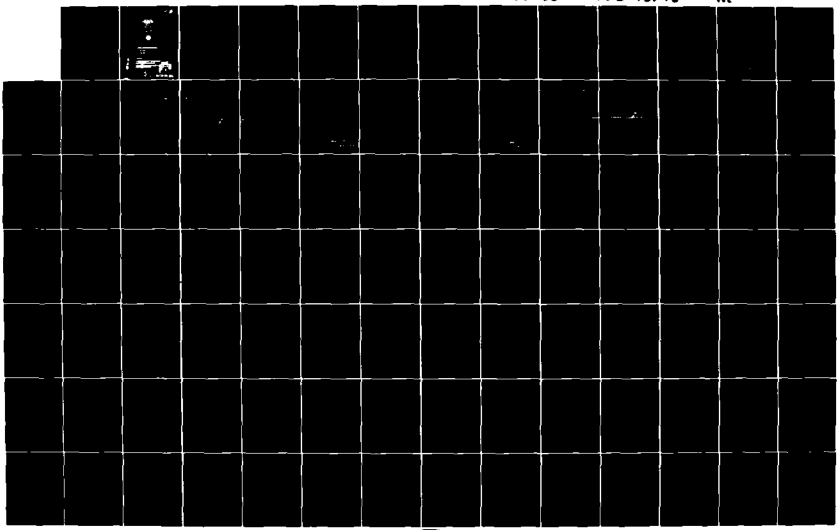
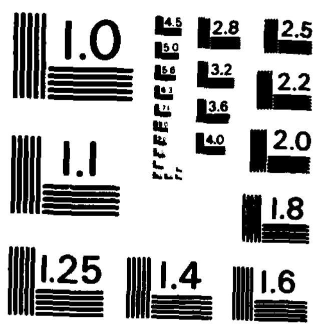
AD-A145 083 FEASIBILITY STUDY FOR THE UNITED STATES COAST GUARD ADVANCED VEHICLE CONC..(U) NAVAL SEA COMBAT SYSTEMS ENGINEERING STATION NORFOLK VA M P JONES ET AL. JUN 83 1/2

UNCLASSIFIED NAVSEACOMBATSYSENGSTA-60-11 USCG-D-33-83 F/G 13/10 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS - 1963 - A

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16. Abstract

This report describes the design of two versions (125' and 110') of high speed planing craft for the USCG.

→ (cont on p 66)

17. Key Words

Planing Craft	Speed/Power
Seakeeping	Accelerations
MTU	CPIC
Double Chine	USCGX
Stability	

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ADMINISTRATIVE INFORMATION

This task was initiated by the United States Coast Guard, Marine Technology Division, G-DMT-2/54, through the David W. Taylor Naval Ship Research and Development Center (DTNSRDC), Code 117, which has been responsible for the overall management of the Advanced Vehicle concept. Reference number for this work request is 1-1170-236-20 (1175).

INTRODUCTION

This feasibility study describes two planing craft as candidates for replacing the current United States Coast Guard fleet of 82' and 95' WPB's under the Advanced Marine Vehicle concept.

The Combatant Craft Engineering Department, Naval Sea Combat Systems Engineering Station, Norfolk, was tasked by DTNSRDC, Code 117, to design these craft for close shore, sea state 3-5, high-speed operation with capability for a 7-day mission. There are two craft designed to these requirements, a 125' version with a length/beam ratio of 6, and a 110' version with a length/beam ratio of 4.6. Both of these craft are constructed of aluminum, can operate in high sea states, and are capable of 30+ knots.

These proposed craft designs are based on information obtained from an extensive full scale test and evaluation of the CPIC-X prototype craft and TECHEVAL/OPEVAL of several other small planing combatants existing in the current U.S. Navy inventory. In addition, other data from past model tests have been used to supplement the full-scale test data.

MISSION REQUIREMENTS AND DESIGN GUIDELINES

The following mission requirements and design guidelines were provided by the Coast Guard for the planing craft concept:

A. MISSION REQUIREMENTS

1. PRIMARY MISSIONS

   a. Enforcement of Laws and Treaties (ELT)
   b. Search and Rescue (SAR)
   c. Military Preparedness (MP)
   d. Port and Environmental Safety (PES)

2. SECONDARY MISSIONS

   a. Short Range Aids to Navigation (SRA)
   b. Marine Environmental Response (MER)

B. DESIGN GUIDELINES

1. ARRANGEMENT AND EQUIPMENT

a. 5.4 Meter RIB and Allied Knuckle Boom Crane
b. (2) 50 cal. Machine Gun Mounts
c. Towing Bitt and Line
d. Small Arms Locker
e. Desalinator
f. Pyro Locker
g. Clear aft deck area for towing and helo drop/lift

2. SPEED/SEA STATE

a. 30 knots in Sea State 2
b. 25 knots in Sea State 3
c. 20 knots in Sea State 4
d. 35 knots dash capability (calm water)
e. Survive in Sea State 6

3. ENDURANCE

a. 5-7 day mission

(1) 24 hrs at 26+ knots (full speed)
(2) 96-144 hrs at 10+ knots (cruise)
(3) 10% reserve fuel

4. OPERATING ENVIRONMENT

a. 90% operation south of 38N within 300 miles of land (no ice capability)

5. COMPLEMENT (PERMANENT)

a. 1 Officer
b. 2 CPO
c. 11 Enlisted

6. MISCELLANEOUS DESIGN FEATURES

a. Roll stabilization
b. Two-compartment intact and damaged stability, USN criteria
c. External firefighting capability
d. Aluminum or steel construction
e. 15-year hull life

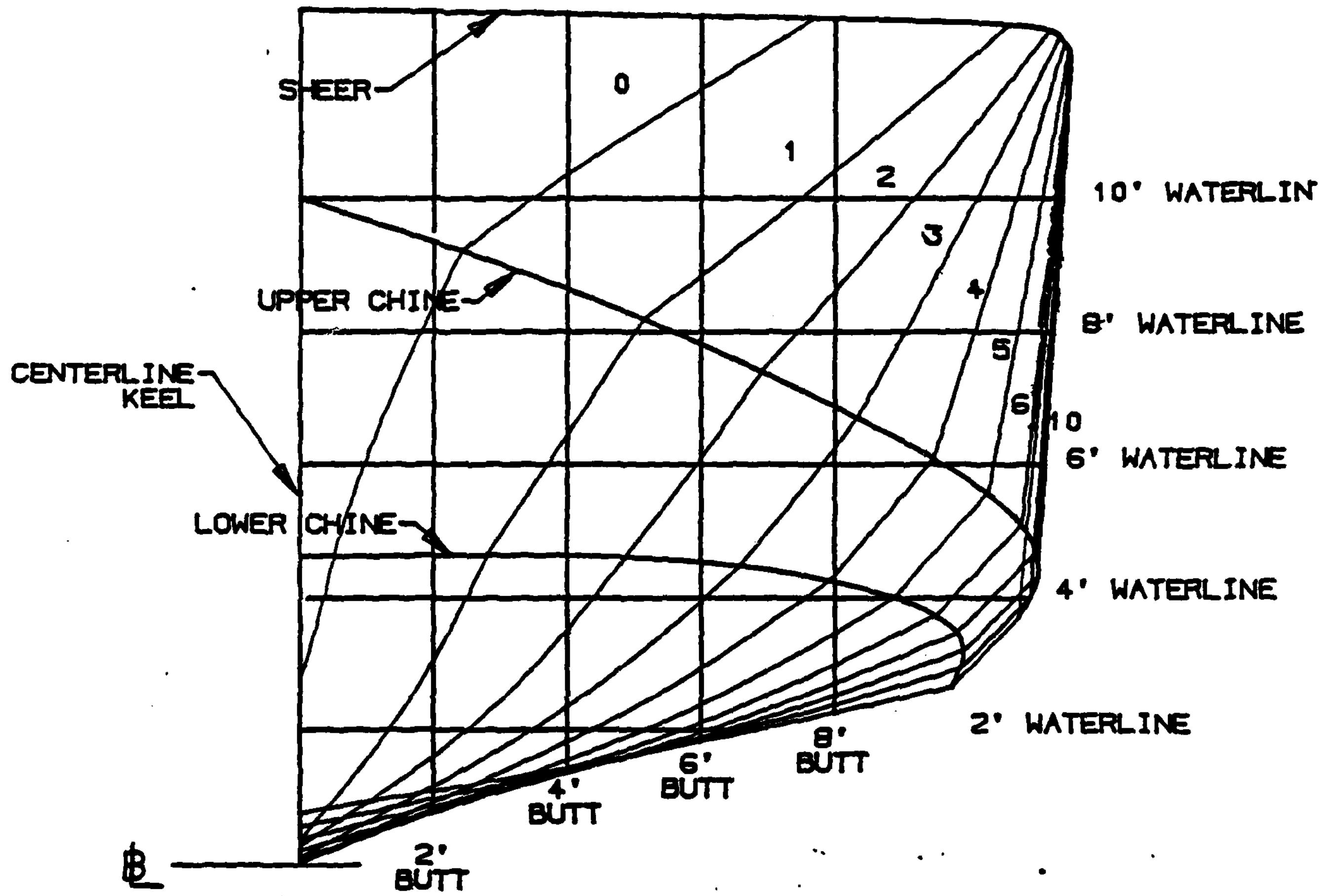
VEHICLE DESCRIPTION AND CHARACTERISTICS

The USCGX planing hull concept has been presented in this feasibility study in two versions. The craft differ in length and beam dimensions, and spacial arrangements. The craft are identical in hull design, which is deep-vee, double-chine, longitudinally framed and constructed of aluminum. These craft are high-speed platforms capable of carrying presently available small warship weapon systems (such as the 25mm EMERLEC shown), and are provided with several 50 cal. machine gun stations to be used as required.

Propulsion for each craft is accomplished with twin MTU 16V538T92 high-performance diesel engines providing a maximum total of 8160 BHP. Each diesel drives a fixed-pitch propeller through a primary reverse reduction gear provided with the engine.

Both craft are entirely capable of being controlled from the pilot house, including the propulsion system, weapons system, and communications system. A flybridge with essential controls is provided for maneuvering and observation procedures. In addition, each craft includes an Engineer's Operating Station (EOS) equipped for monitoring all mechanical systems, and is located below decks just forward of the engine room. Habitability for the crew is enhanced by air conditioning units and heaters located throughout the living spaces, and a hull design exhibiting low slamming accelerations at cruising speeds in rough seas. (See figures 1 through 6.) Tables 1 and 2 list the principal characteristics of the two craft.

Both hulls are based on CPIC-X lines which have been technically and operationally evaluated by virtue of a Comprehensive Technical Evaluation (TECHEVAL).



BODY PLAN

SCALE 1/4"=1'-0"

DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND

135 FT. MPB U S COAST GUARD

LINES PLAN

LINES PLAN

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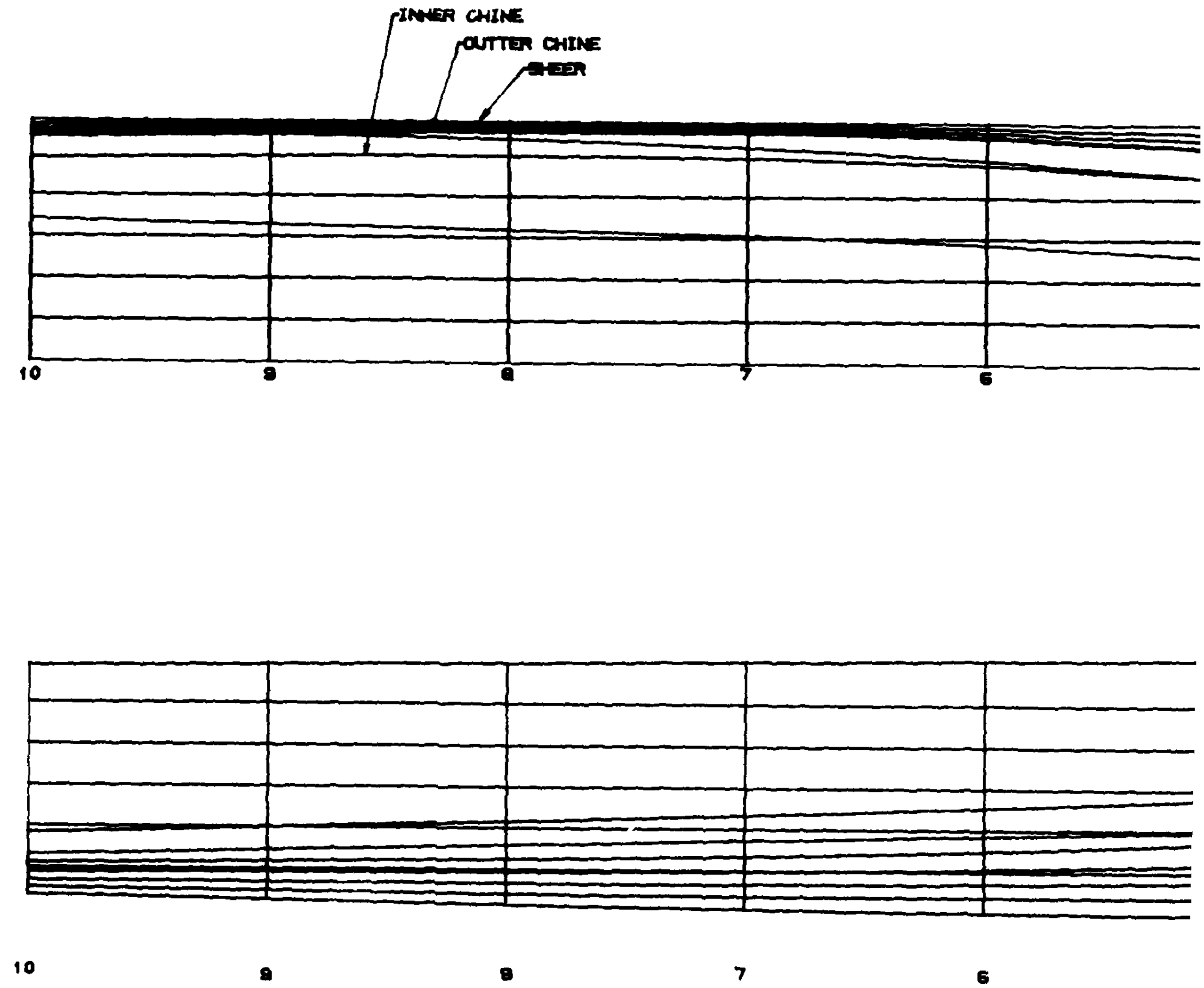
AS NOTED

Figure 1


INNER CHINE
OUTTER CHINE
SHEER
10
9
8
7
6
10
9
8
7
6

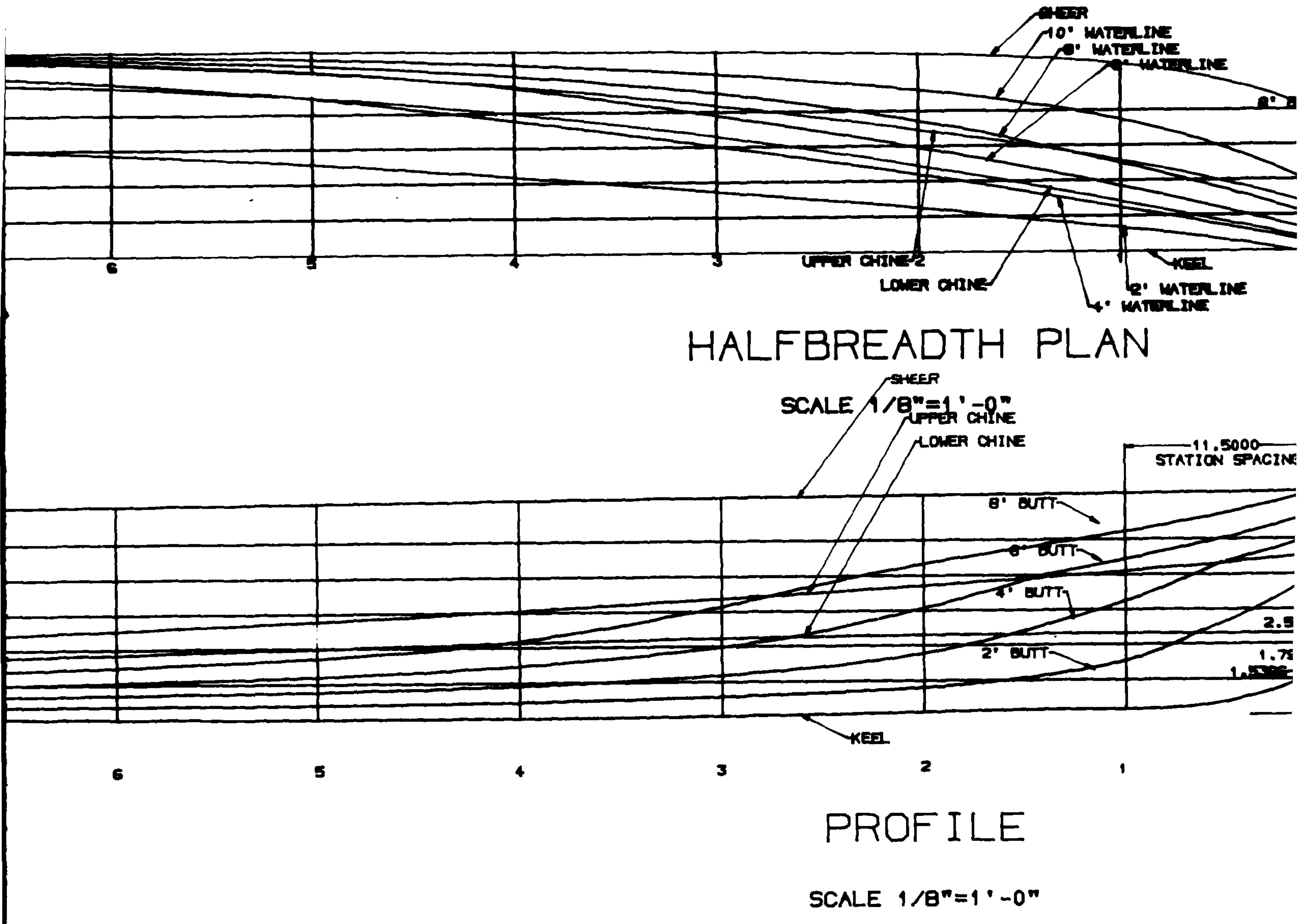
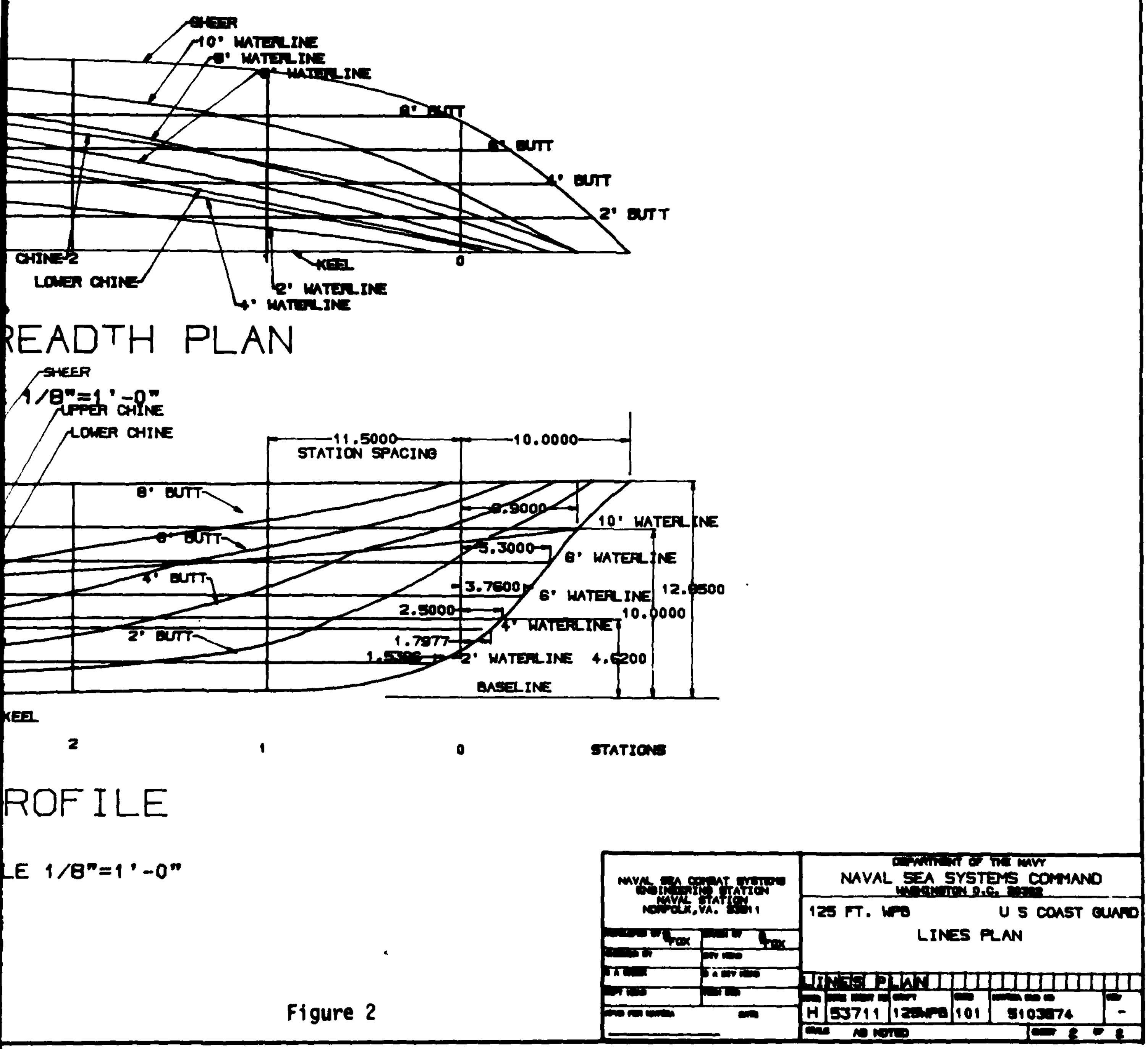

SHEER
10' WATERLINE
8' WATERLINE
6' WATERLINE
UPPER CHINE
LOWER CHINE
KEEL
2' WATERLINE
4' WATERLINE
6
5
4
3
2
1
HALFBREADTH PLAN
SCALE 1/8"=1'-0"
SHEER
UPPER CHINE
LOWER CHINE
11.5000
8' BUTT
6' BUTT
4' BUTT
2' BUTT
KEEL
6
5
4
3
2
1
PROFILE
SCALE 1/8"=1'-0"

Figure 2


SHEER
10' WATERLINE
8' WATERLINE
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8' BUTT
6' BUTT
4' BUTT
2' BUTT
CHINE 2
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KEEL
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LOWER CHINE
2' WATERLINE
4' WATERLINE
READTH PLAN
SHEER
1/8"=1'-0"
UPPER CHINE
LOWER CHINE
11.5000
STATION SPACING
10.0000
8' BUTT
6' BUTT
4' BUTT
2' BUTT
8.9000
5.3000
3.7600
2.5000
1.7977
1.5300
10' WATERLINE
8' WATERLINE
6' WATERLINE
4' WATERLINE
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12.8500
10.0000
4.6200
BASELINE
KEEL
2
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STATIONS
ROFILE
LE 1/8"=1'-0"
NAVAL SEA COMBAT SYSTEMS ENGINEERING STATION NAVAL STATION NORFOLK, VA.
DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
125 FT. WPB
U S COAST GUARD
LINES PLAN
LINES PLAN
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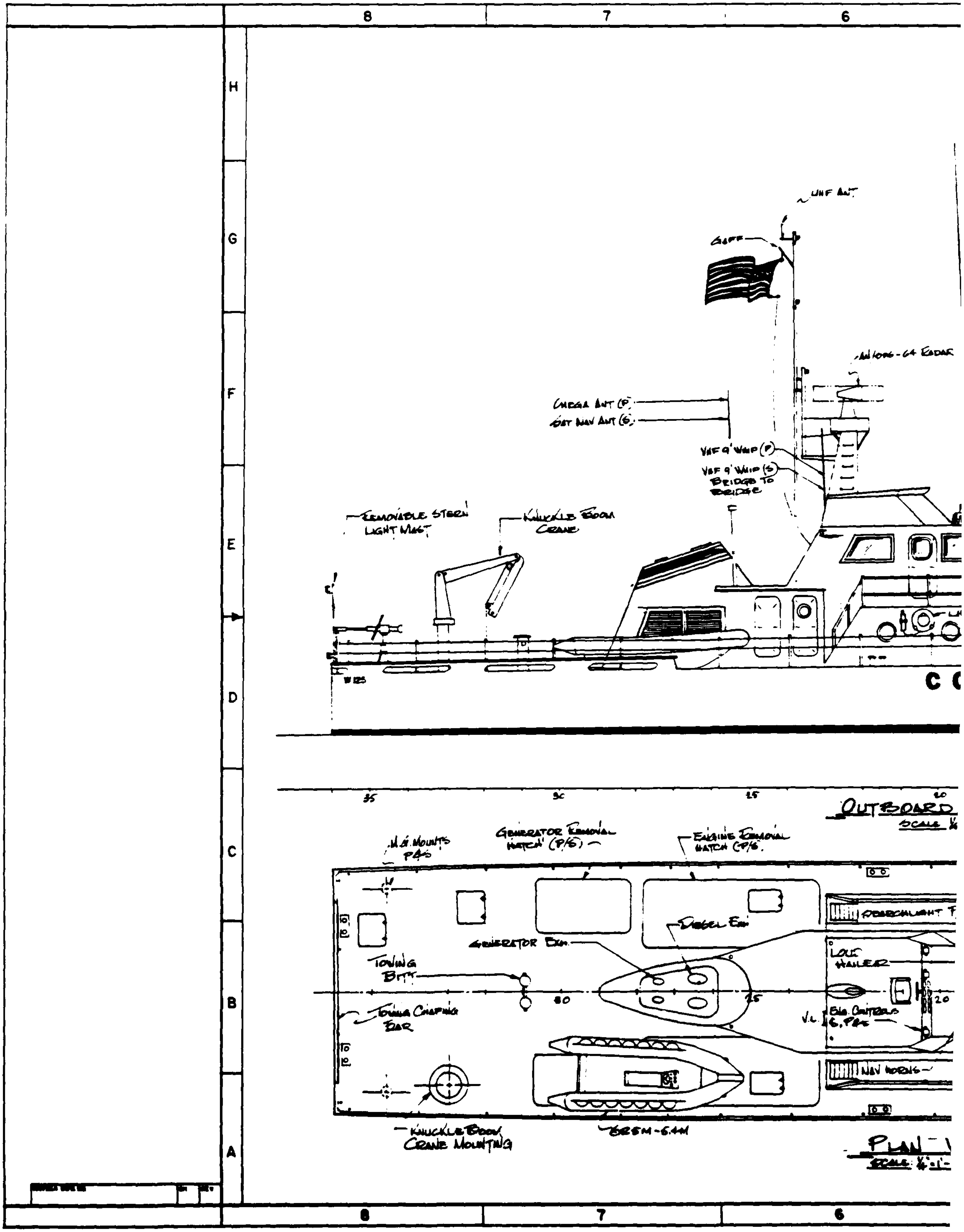
Figure 2



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E
D
C
B
A
UHF ANT
GAFF
OMEGA ANT (P)
SAT NAV ANT (S)
VHF 9' WHIP (P)
VHF 9' WHIP (S)
BRIDGE TO BRIDGE
REMOVABLE STERN LIGHT MAST
KNUCKLE BOOM CRANE
OUTBOARD
M.G. MOUNTS P&S
GENERATOR REMOVAL HATCH (P/S)
ENGINE REMOVAL HATCH (P/S)
DIESEL EXH
GENERATOR EXH
TOWING BITT
TOWING CHAFING BAR
LOUD HAILER
NAV HORNS
KNUCKLE BOOM CRANE MOUNTING
PLAN

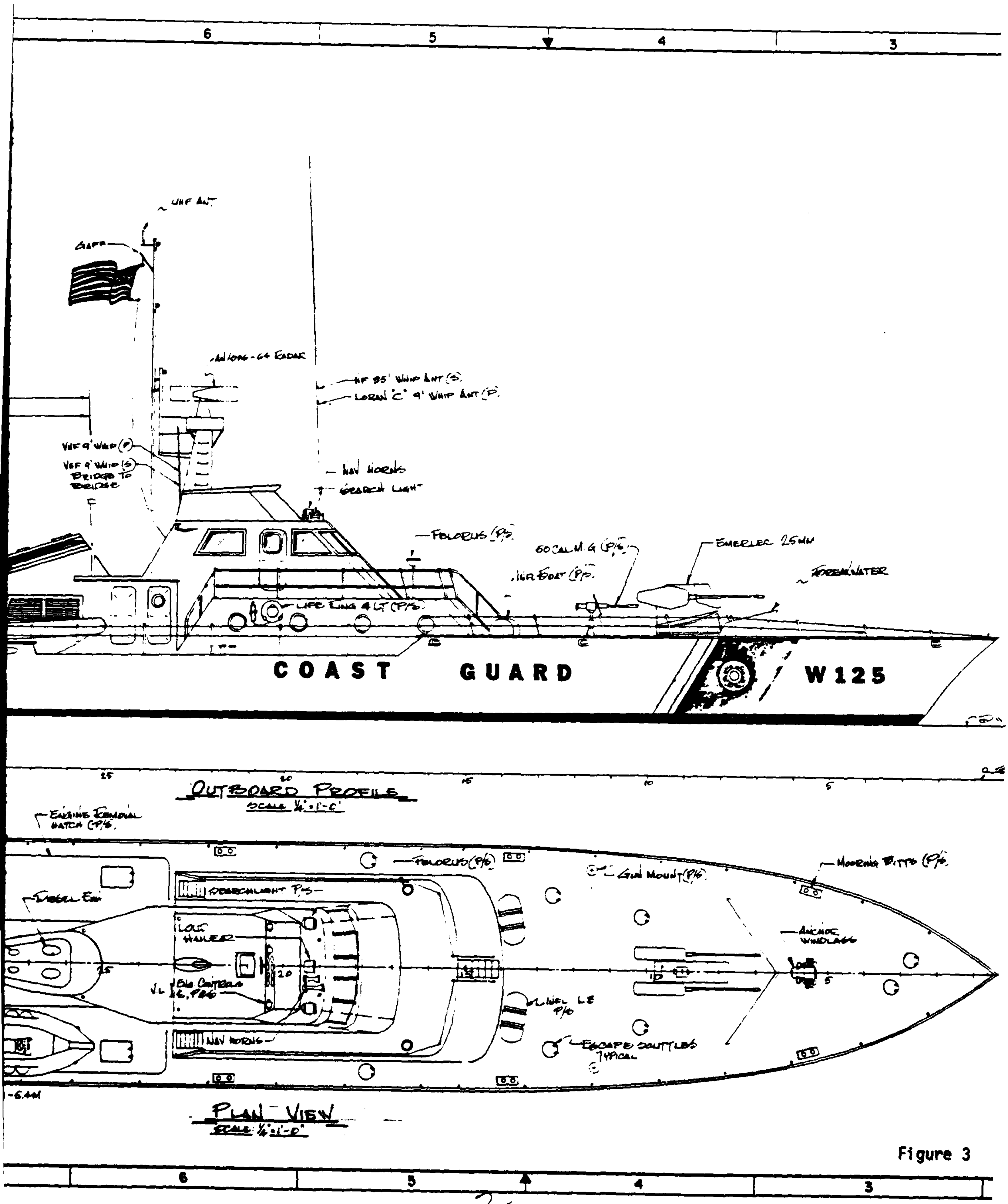
UHF ANT
GAFF
VHF 9' WHIP (P)
VHF 9' WHIP (S)
BRIDGE TO BRIDGE
NAV HORNS
SEARCH LIGHT
LORAN 'C' 9' WHIP ANT (P)
FELORUS (P/S)
LIFE RING & LT (P/S)
EMERLEC 25MM
BREAKWATER
COAST GUARD
W125
OUTBOARD PROFILE
SCALE 1/4"=1'-0"
ENGINE REMOVAL HATCH (P/S)
DIESEL ENG
LOUD HAILER
NAV HORNS
GUN MOUNT (P/S)
MOORING BITTS (P/S)
ANCHOR WINDLASS
ESCAPE SCUTTLES TYPICAL
PLAN VIEW
SCALE 1/4"=1'-0"

Figure 3

REVISIONS

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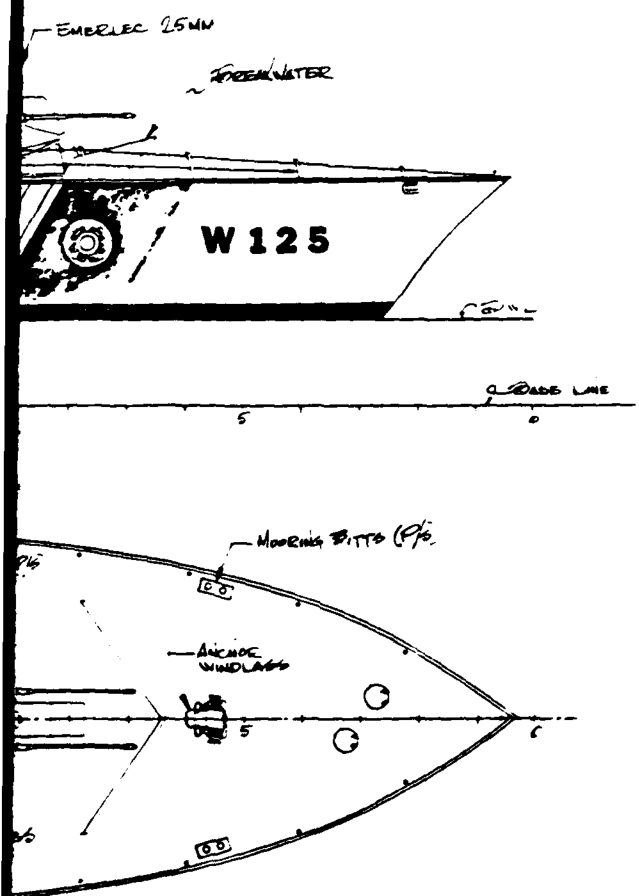

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1	LINES AND OFFSETS	101-5103574

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FEASIBILITY DRAWING

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NAVAL SEA COMBAT SYSTEMS
ENGINEERING STATION
NAVAL STATION
NORFOLK, VA 23511

DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
WASHINGTON D.C. 20362

125 FT. WPB U S COAST GUARD
OUTBOARD PROFILE AND
DECK ARRANGEMENT

DRAWN BY V.E. Davis

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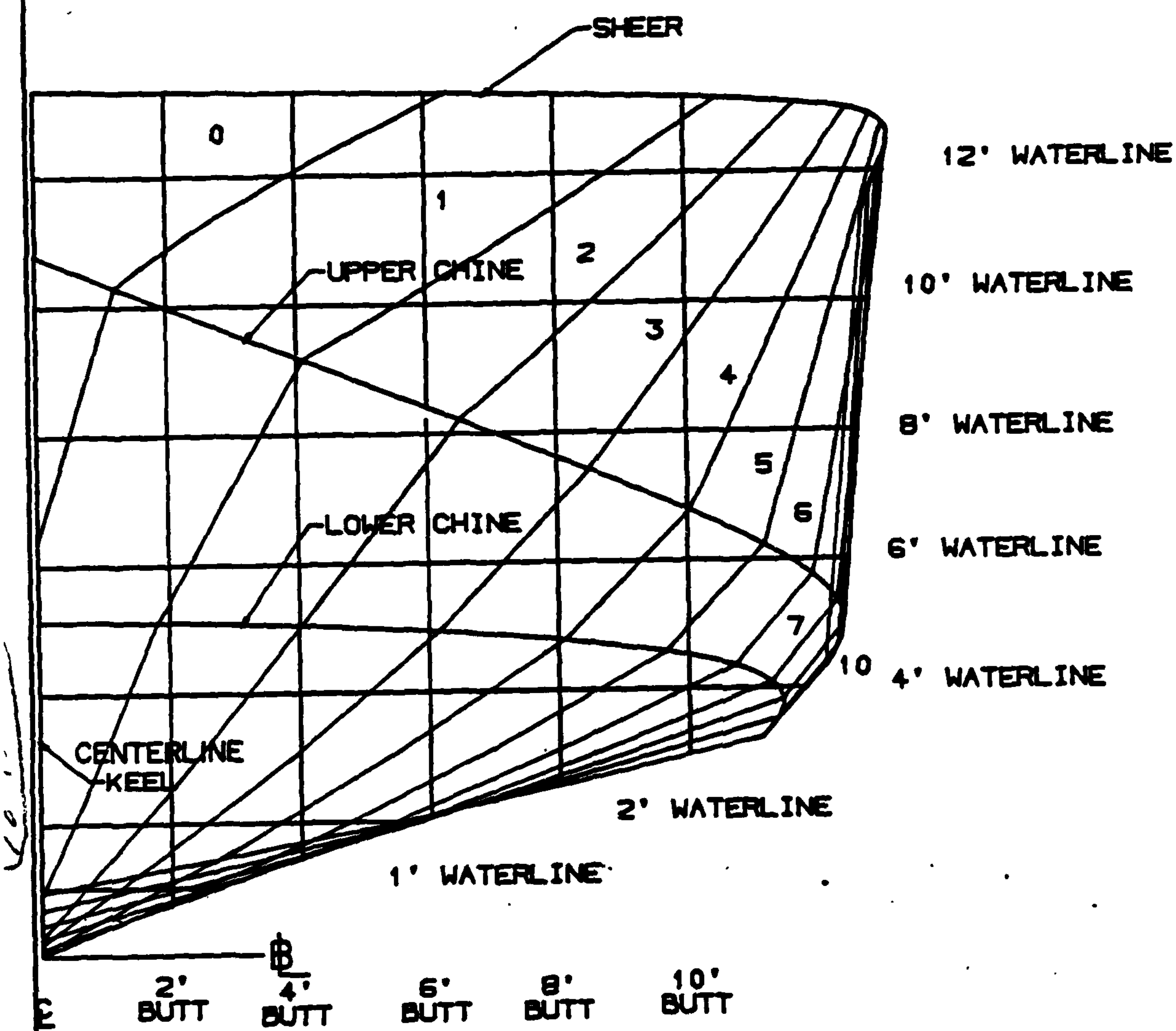
SHEET 1 OF 1

Figure 3



BODY PLAN

SCALE 3/8"=1'-0"

NAVAL SEA SYSTEMS COMMAND

110'WPB U.S.C.G.

LINES PLAN

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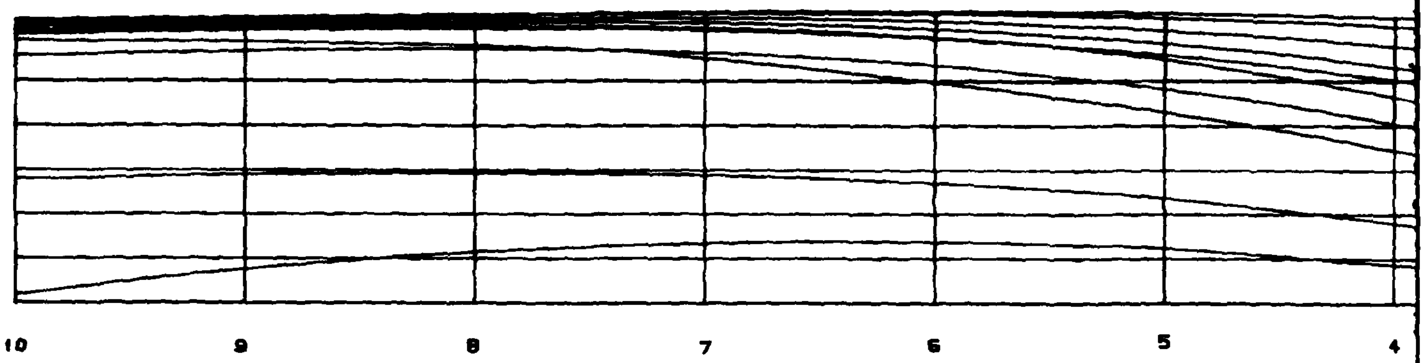
Figure 4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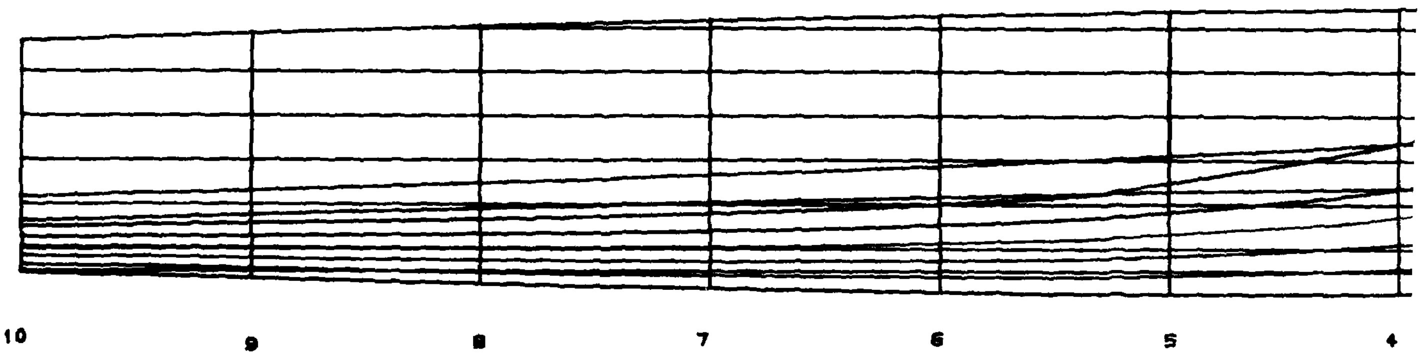
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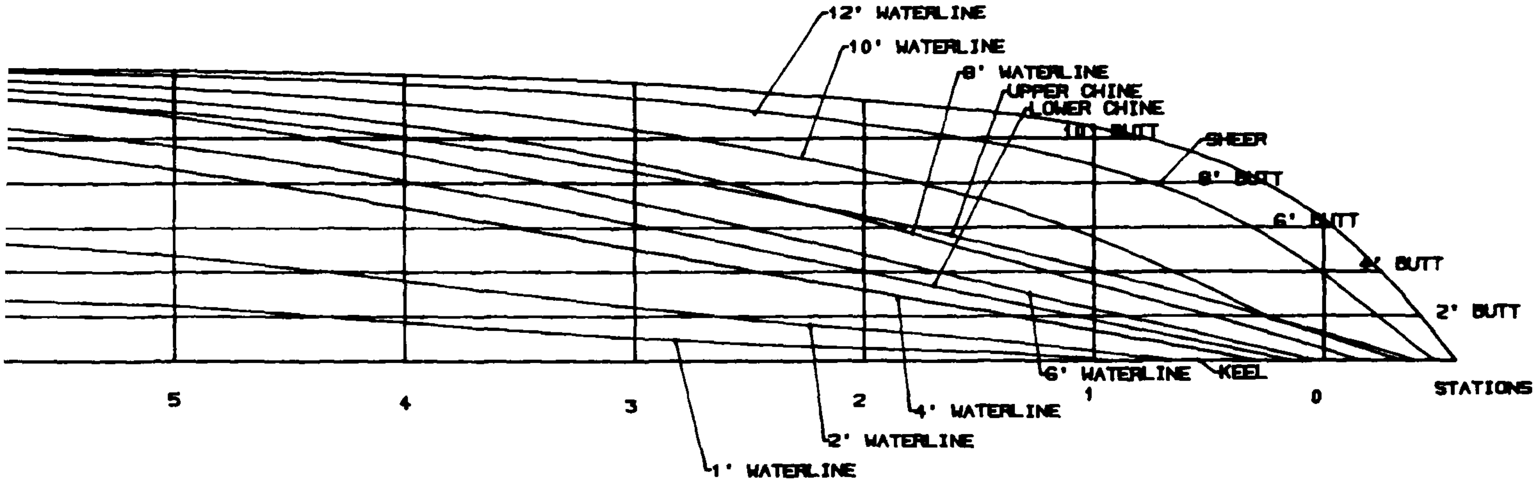
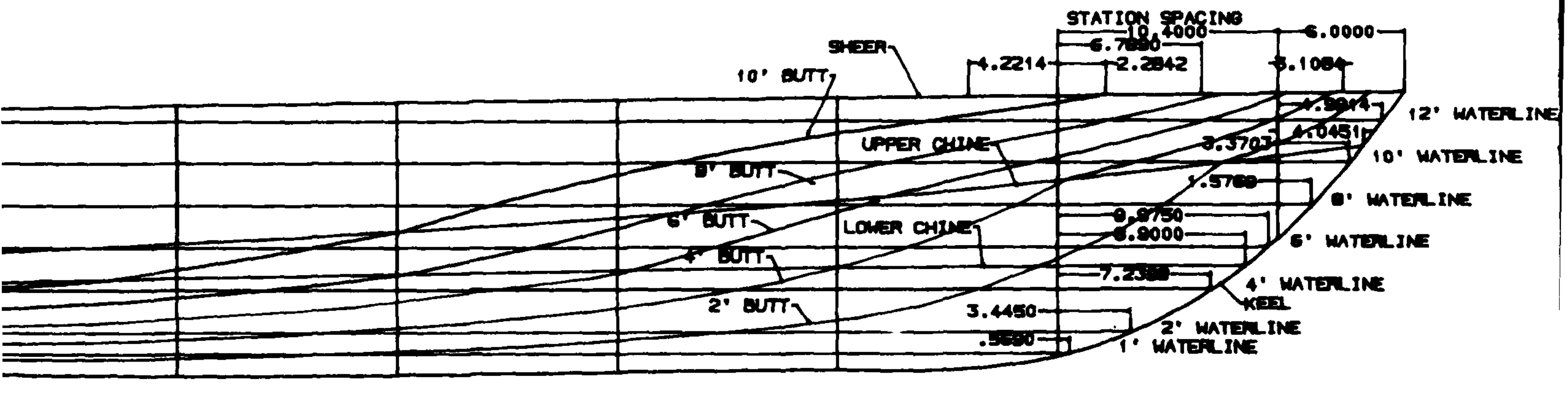


HALFBREADTH PLAN

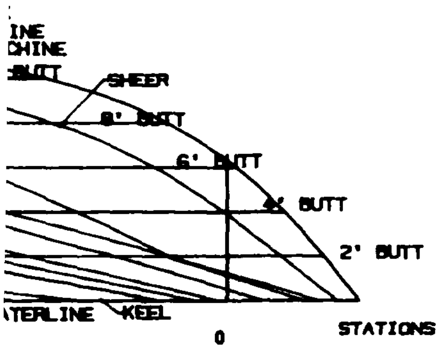
SCALE 1/8"=1'-0"



PROFILE

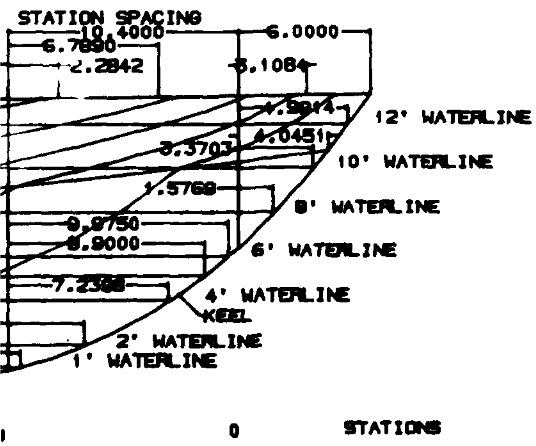
SCALE 1/8"=1'-0"

Figure 5



)TH PLAN

3"=1'-0"



FILE

8"=1'-0"

Figure 5

NAVAL SEA SYSTEMS COMMAND

110'WPB U.S.C.G.

LINES PLAN

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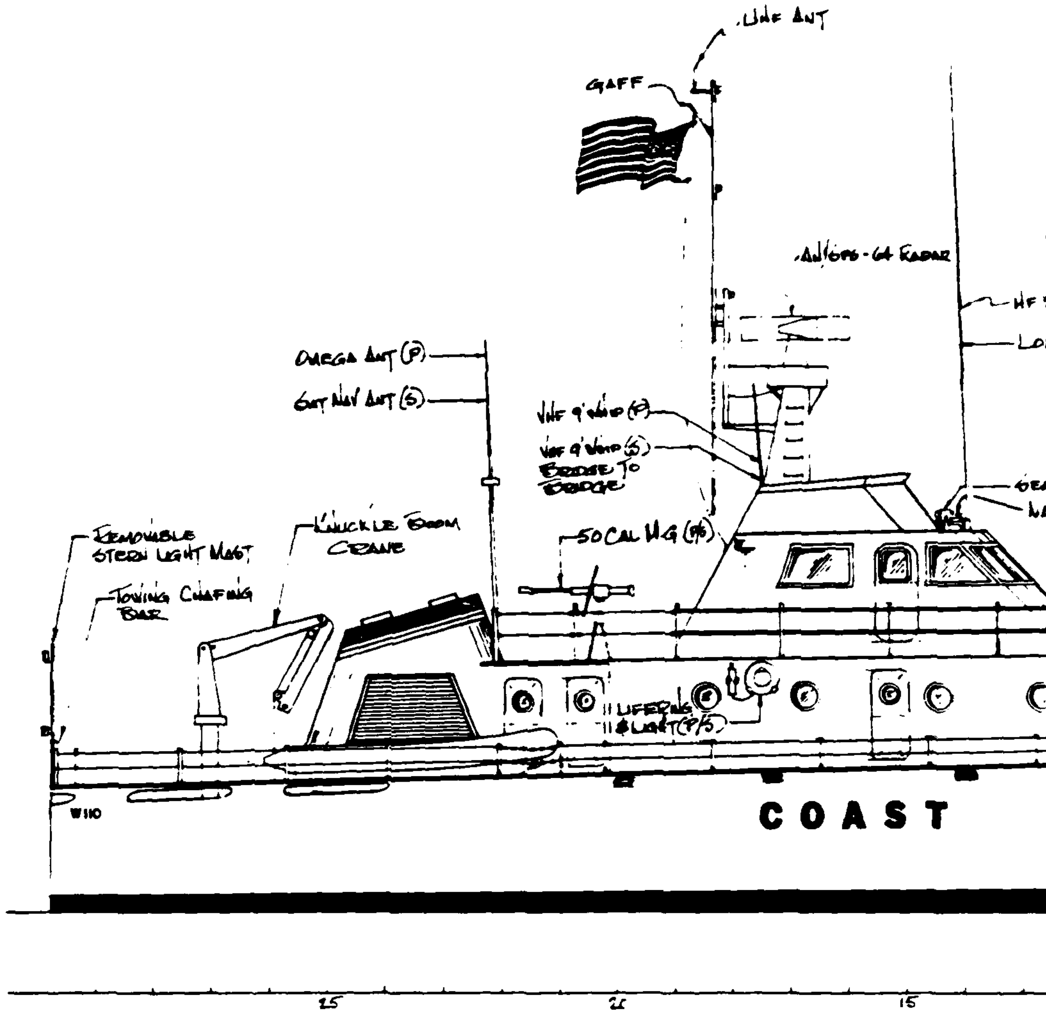
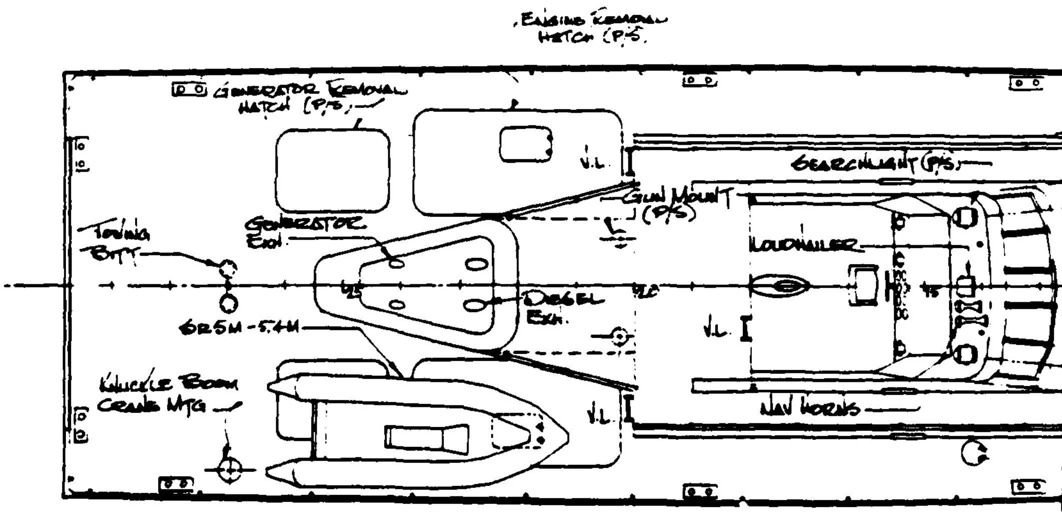


OUTBOARD PROFI

SCALE: 1/4"=1'-0"

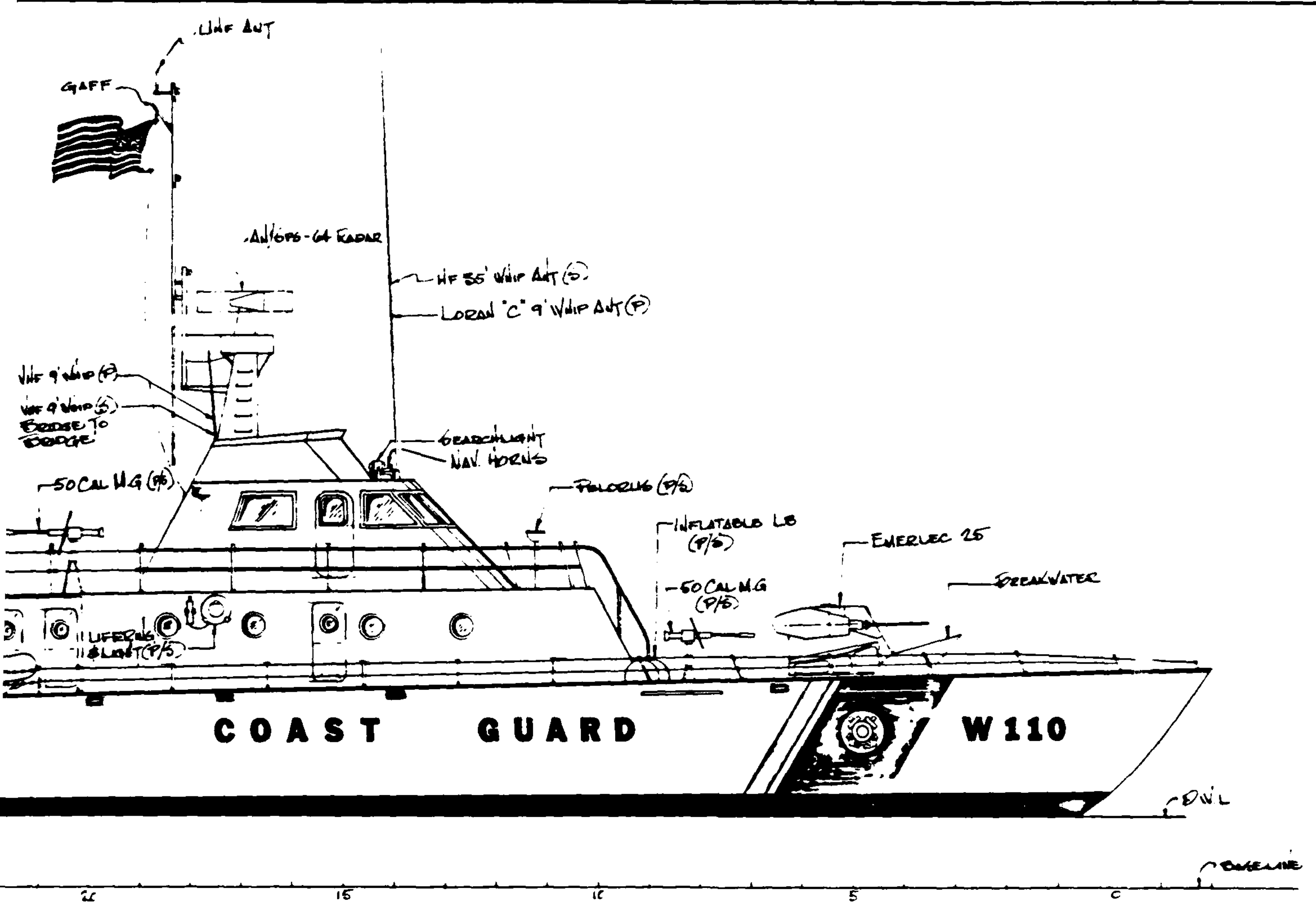


PLAN VIEW

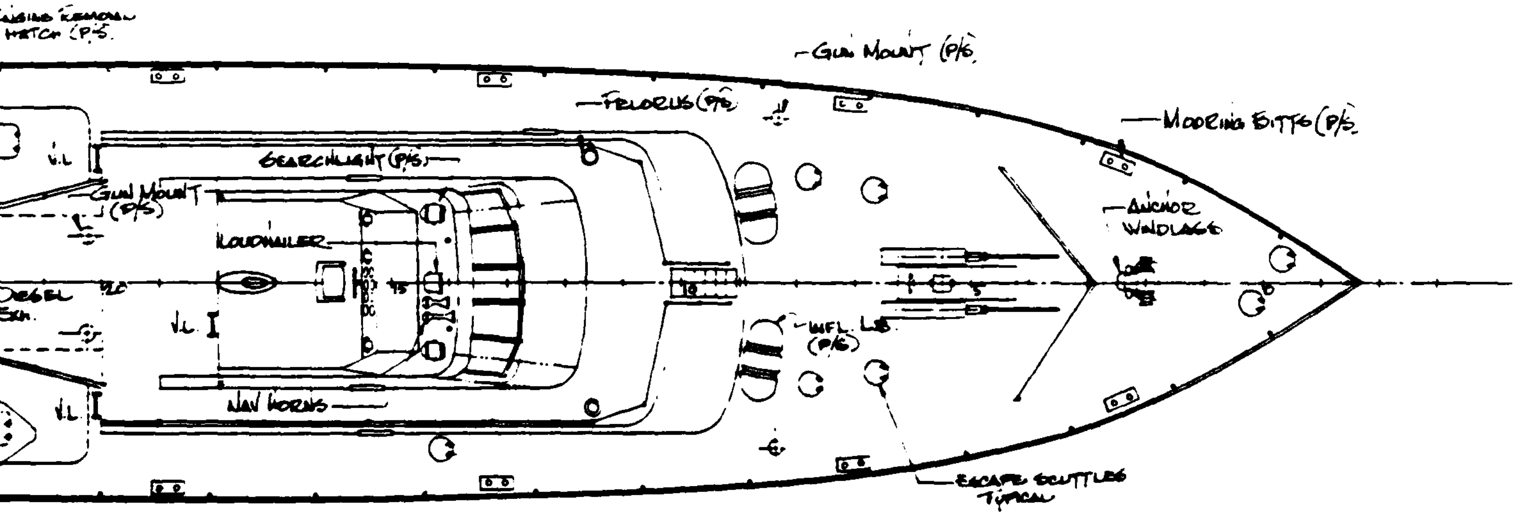
SCALE: 1/4"=1'-0"

8	7	6

6	5	4	3



OUTBOARD PROFILE
SCALE ¼"=1'-0"



PLAN VIEW
SCALE ¼"=1'-0"

Figure

6	5	4	3

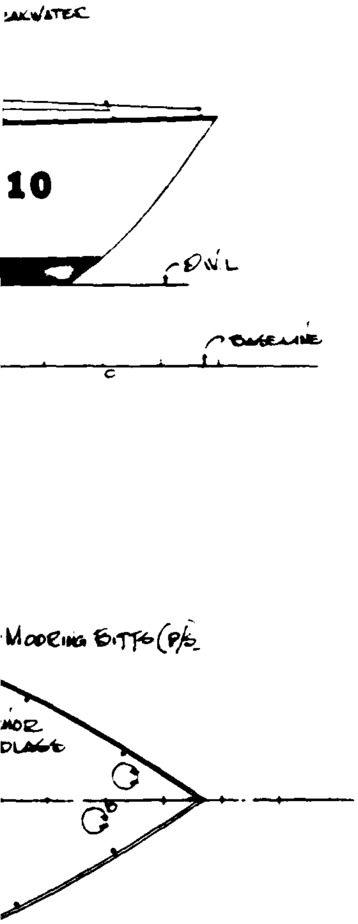


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Figure 6

NAVAL SEA COMBAT SYSTEMS ENGINEERING STATION
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DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
WASHINGTON D.C. 20362

110 FT. WPB U S COAST GUARD
OUTBOARD PROFILE AND DECK ARRANGEMENT

H 53711 101 5103562

SCALE 1/4" = 1'-0" SHEET 1 OF 1

Table 1. 125' USCGX PRINCIPAL CHARACTERISTICS

Length, overall	125.0 ft.
Length, waterline	117.5 ft.
Beam, maximum	23.0 ft.
Beam, waterline (full load)	22.2 ft.
Beam, chine (lower)	19.5 ft.
Draft, full load	4.7 ft.
Draft, navigation (approx.)	6.9 ft.
Displacement - full load	142.2 l.t.
- light condition	98.2 l.t.
Payload, maximum	10.0 l.t.
Maximum Speed (full load) - calm water	35.1 kts
Range (full load) - 10.0 knots	2760 NM
- 32.6 knots	850 NM
Endurance	168 hrs.
Fuel Capacity - main tanks (2)	9655 gal.
- day tanks	2000 gal.
- generator tanks (2)	1000 gal.
- total fuel	12655 gal.
Potable Water Capacity	1500 gal.
Crew - Officers	1
- CPO	2
- Enlisted	12
- Total crew	15

Propulsion Machinery - Twin MTU 16V538T92 Marine diesels (3410 BHP each at 1710 RPM continuous, 4080 BHP each at 1790 RPM overload), KSS60 Marine gearbox, twin screws.

Generators ---------- two DDAD 4-71 @ 100 kW each (parallel operation for standby)

Weapon System: EMERLEC 25 mm
6-50 cal. Pintle Mounts

Electronics: UHF, VHF, HF Radios
NAV Receiver
NAV Radar

Table 2. 110' USCGX PRINCIPAL CHARACTERISTICS

Length, overall	110.0 ft.
Length, waterline	104.0 ft.
Beam, maximum	26.3 ft.
Beam, waterline (full load)	24.7 ft.
Beam, chine (lower)	22.3 ft.
Draft, full load	5.1 ft.
Draft, navigation (approx.)	7.0 ft.
Displacement - full load	140.3 l.t.
- light condition	96.3 l.t.
Payload, maximum	10.0 l.t.
Maximum Speed (full load) - calm water	32.0 kts
Range (full load) - 10.0 knots	2400 NM
- 29.4 knots	800 NM
Endurance	108 hrs.
Fuel Capacity - main tanks (2)	9655 gal.
- day tanks	2000 gal.
- generator tanks (2)	1000 gal.
- total fuel	12655 gal.
Potable Water Capacity	1500 gal.
Crew - Officers	1
- CPO	2
- Enlisted	12
- Total crew	15
Propulsion Machinery	Twin MTU 16V538T92 Marine diesels (3410 BHP each at 1710 RPM continuous, 4080 BHP each at 1790 RPM overload), KSS60 Marine gearbox, twin screws.
Generators	two DDAD 4-71 @ 100 kW each (parallel operation for standby)
Weapon system:	EMERLEC 25 mm 4-50 cal. Pintle Mounts
Electronics:	UHF, VHF, HF Radios NAV Receiver NAV Radar

ated and modeled to arrive at an are presented as tables 3 and 4. spect to weights are slight. ion has a displacement nearly as in displacement is due to differences r systems and functions are identical.

Table 3. 125' USCGX

SWBS	GROUP
100	Structure
200	Propulsion
300	Electric
400	Command and Su
500	Auxiliary
600	Outfit and Fu
700	Combat Systems
	Ligh
Variable Loads	
Fuel	
Potable Water	
Sanitation Holding Tank	
Crew Effects	
	Va
Margin - 5%	
Full Load Displacement	

Table 4. 110' USCGX SHIP WEIGHT BREAKDOWN

SWBS	GROUP	LBS	
100	Structure	77,880	
200	Propulsion	59,820	
300	Electric	16,190	
400	Command and Surveillance	2,720	
500	Auxiliary	15,750	
600	Outfit and Furnishings	15,060	
700	Combat Systems (Payload)	22,400	
	Light Condition		209,826
Variable Loads			
Fuel		67,200	
Potable Water		12,480	
Sanitation Holding Tank		760	
Crew Effects		9,050	
	Variable Loads		89,480
	Sub-Total		299,300
Margin - 5%		14,970	
Full Load Displacement	Total		314,270

SPEED/POWER PREDICTION

The speed/power prediction method used for both the 125' and 110' USCGX is based on reference (1). Reference (1) has been used as a math model for planing craft by the Combatant Craft Engineering Department for the last several years. It is continually updated and has proven its accuracy when compared with full scale production craft such as CPIC, 65'PB, Couger Catamaran, etc. and is used here with confidence. Various performance data charts are presented in Appendix A for reference.

Originally, the Coast Guard requested two craft designs of different Length/Beam (L/B) ratios with completely different hull forms for comparison. Examples given were for a "Nasty" type hull with a Length/Beam ratio of 4.6 and a deadrise of 12°, and a CPIC type hull with a Length/Beam ratio of 6, a double chine and 20° deadrise. Preliminary comparisons of these two hull forms using the math model program revealed that the lower L/B version with lower deadrise required less power to achieve the same speed as the higher L/B, higher deadrise hull. However, the lower L/B ride quality would be poor in comparison. Higher acceleration levels as well as frequent slamming would be experienced in the lower L/B design, leading to reduced crew effectiveness and a higher incidence of motion sickness. Therefore, it was jointly decided that the hull configuration would remain equal (i.e., deadrise and double chine), but the L/B ratio would be varied to approximate the "Nasty" and CPIC hulls.

Both versions were input with the same payload carrying capability, fixed hull depth, and several length and beam combinations for the chosen Length/Beam ratios.

After several iterations, it was found that there were many Length/Beam combinations that met the requirments, but that additional limiting factors would reduce the number of choices. The most evident factor was the required horsepower. Several power plants were available however, many required a high volume of fuel. Gas turbines provided the necessary horsepower, but have a high specific fuel consumption (SFC). American diesels did not provide enough horsepower and have a high weight/power ratio. European diesels provide enough horsepower and meet the necessary fuel requirements, but are costly. Based on these catagories it was determined that in order to meet the operational requirements of both speed and endurance a European diesel would have to be used. Since little is known about the French SACM and other European names except for the MTU with regard to maintainability and reliability, the MTU was considered the best choice. The 538 series was settled upon because it provided the necessary horsepower and SFC to meet the requirements. An engine comparison curve is presented in figures 7 and 8. Further refinement with the selected power plant indicated that the optimum craft has a chine beam of 19.5' and a design waterline of 117.5' for a length to beam ratio of 6.0. Choosing an optimum hull using the same power and considering a Length/Beam ratio of 4.6, yielded the 110' craft.

Resistance and brakehorsepower requirements are presented in figures 9 through 12 for both craft. Power and fuel consumption curves for the MTU 538 series may be found in Appendix B.

DISPLACEMENT/BHP vs. SPEED

125' USCGX
142 TON DISPLACEMENT
CALM WATER

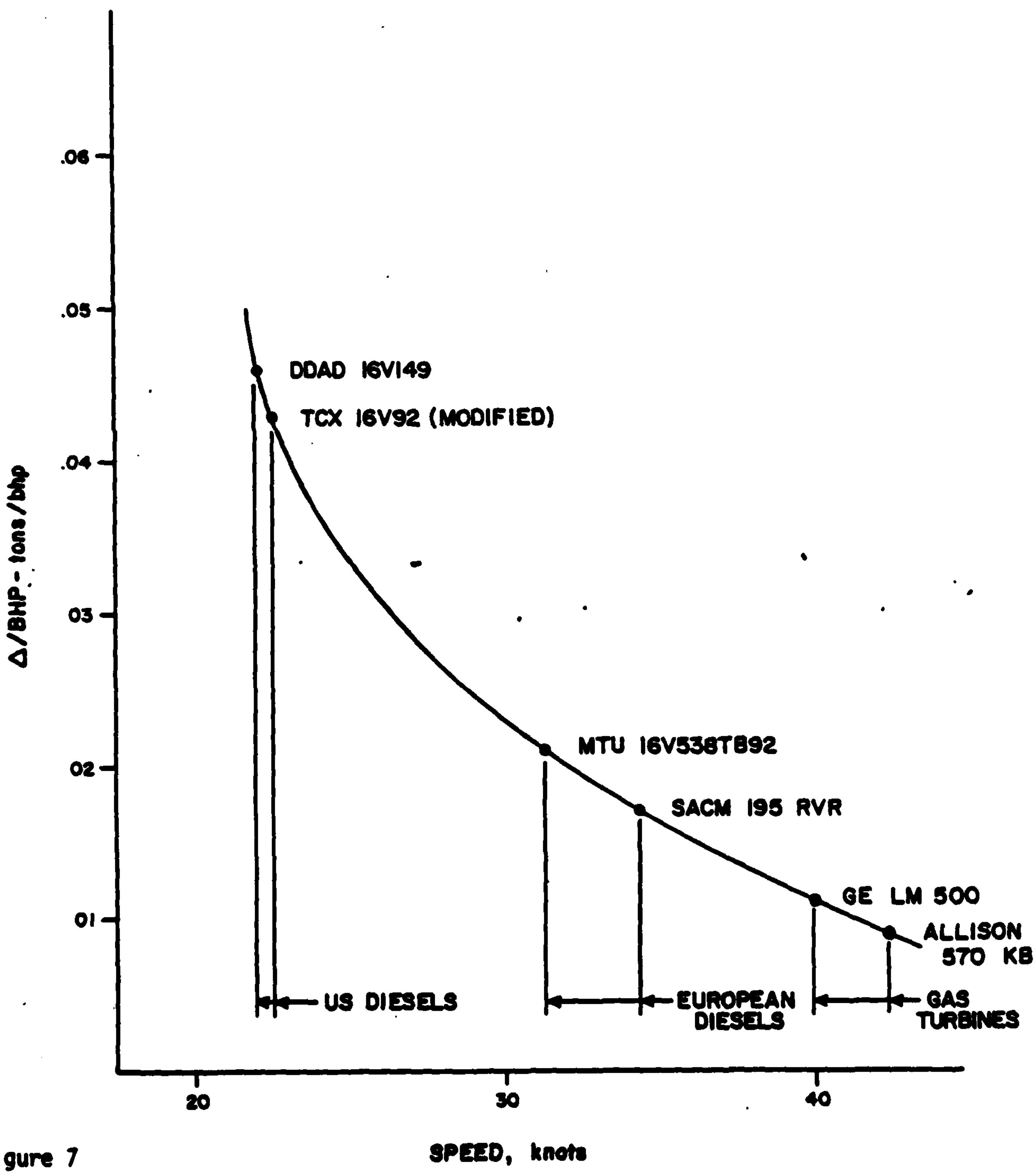


Figure 7

DISPLACEMENT/BHP vs. SPEED
110' USCGX
140 TON DISPLACEMENT
CALM WATER

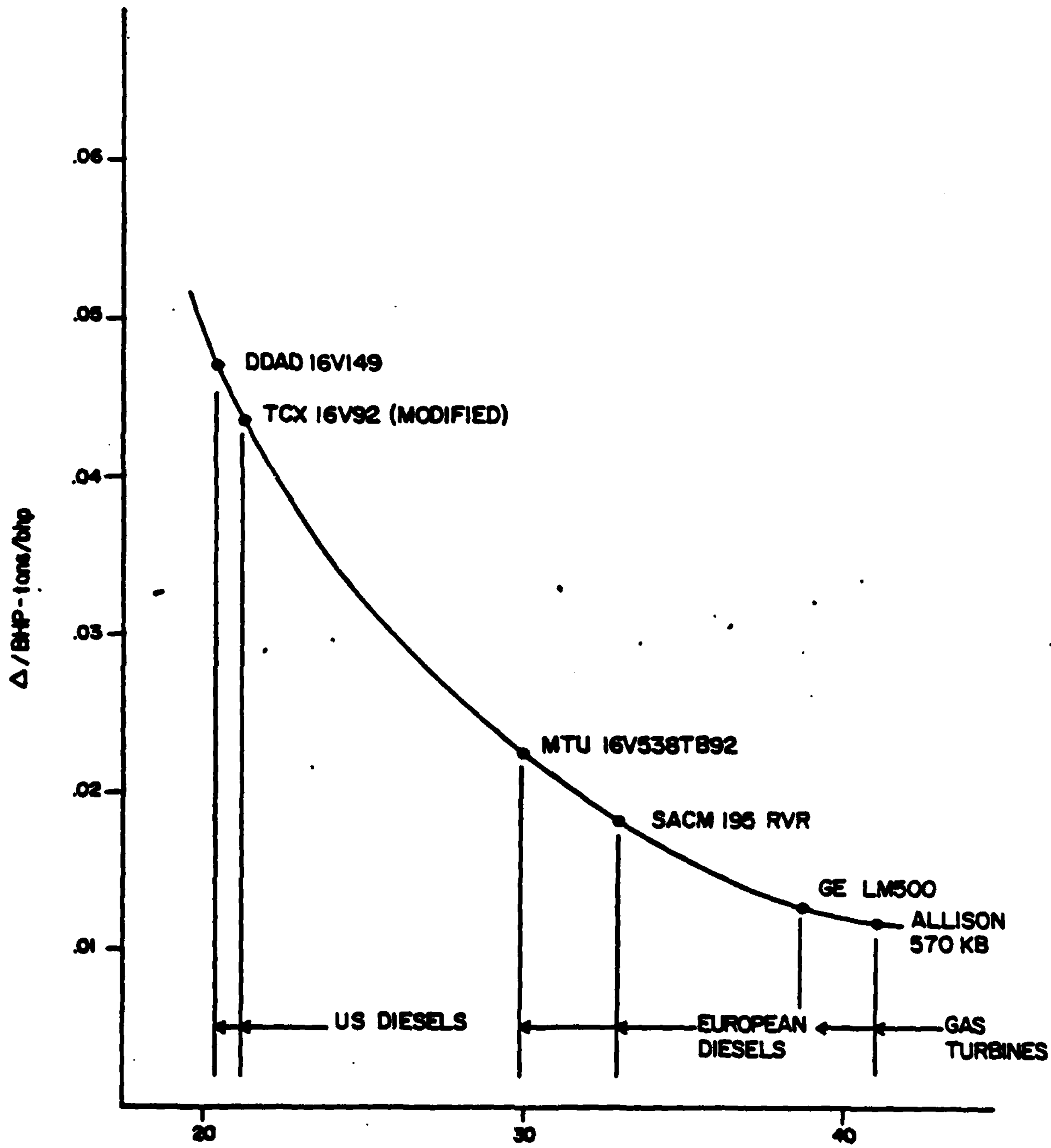


Figure 8

SPEED, knots

RESISTANCE vs. SPEED

125' USCGX

142 TON DISPLACEMENT

CALM WATER THRU SS6

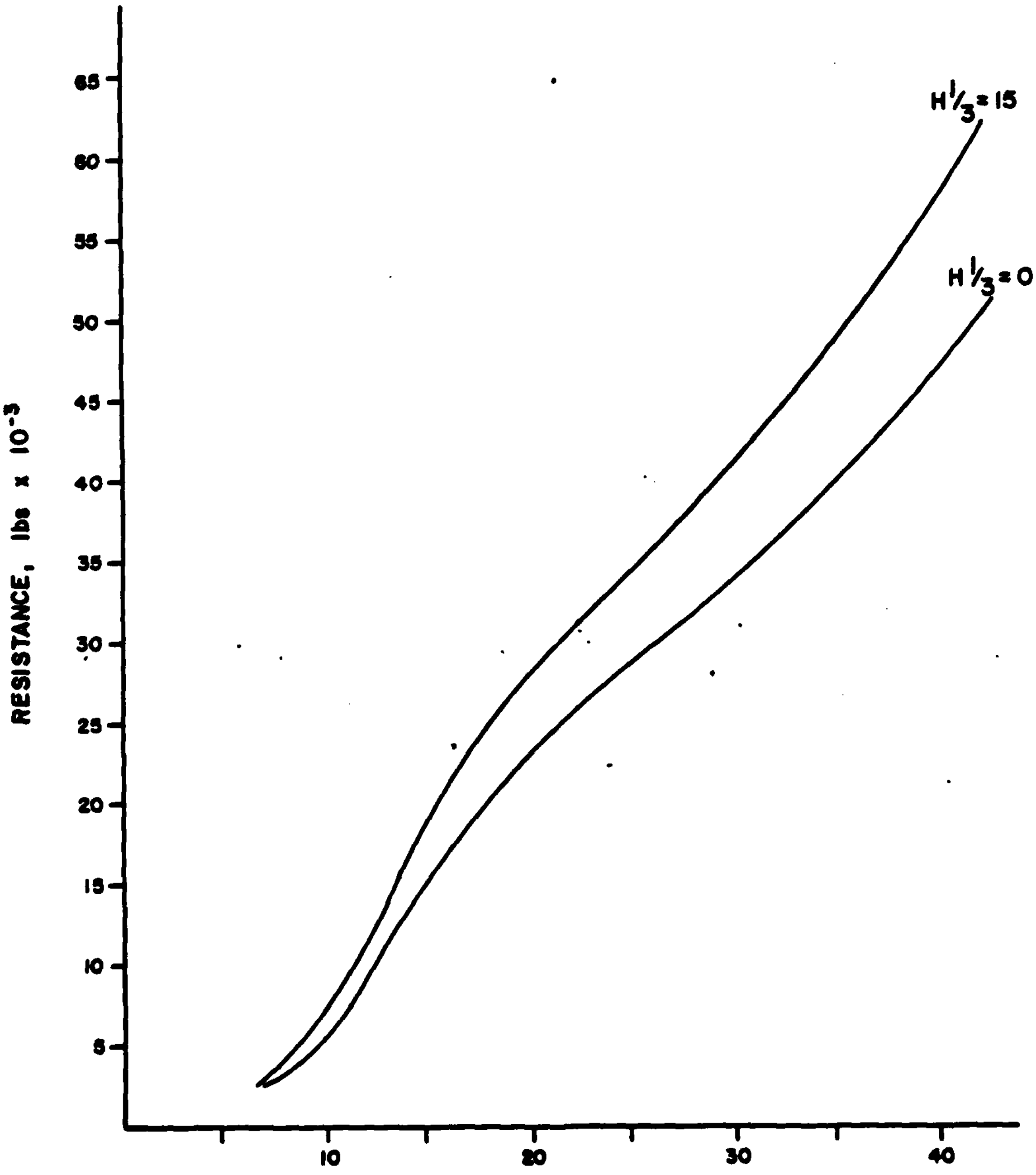


Figure 9

RESISTANCE vs. SPEED

110' USCGX
140 TON DISPLACEMENT
CALM WATER THRU SS6

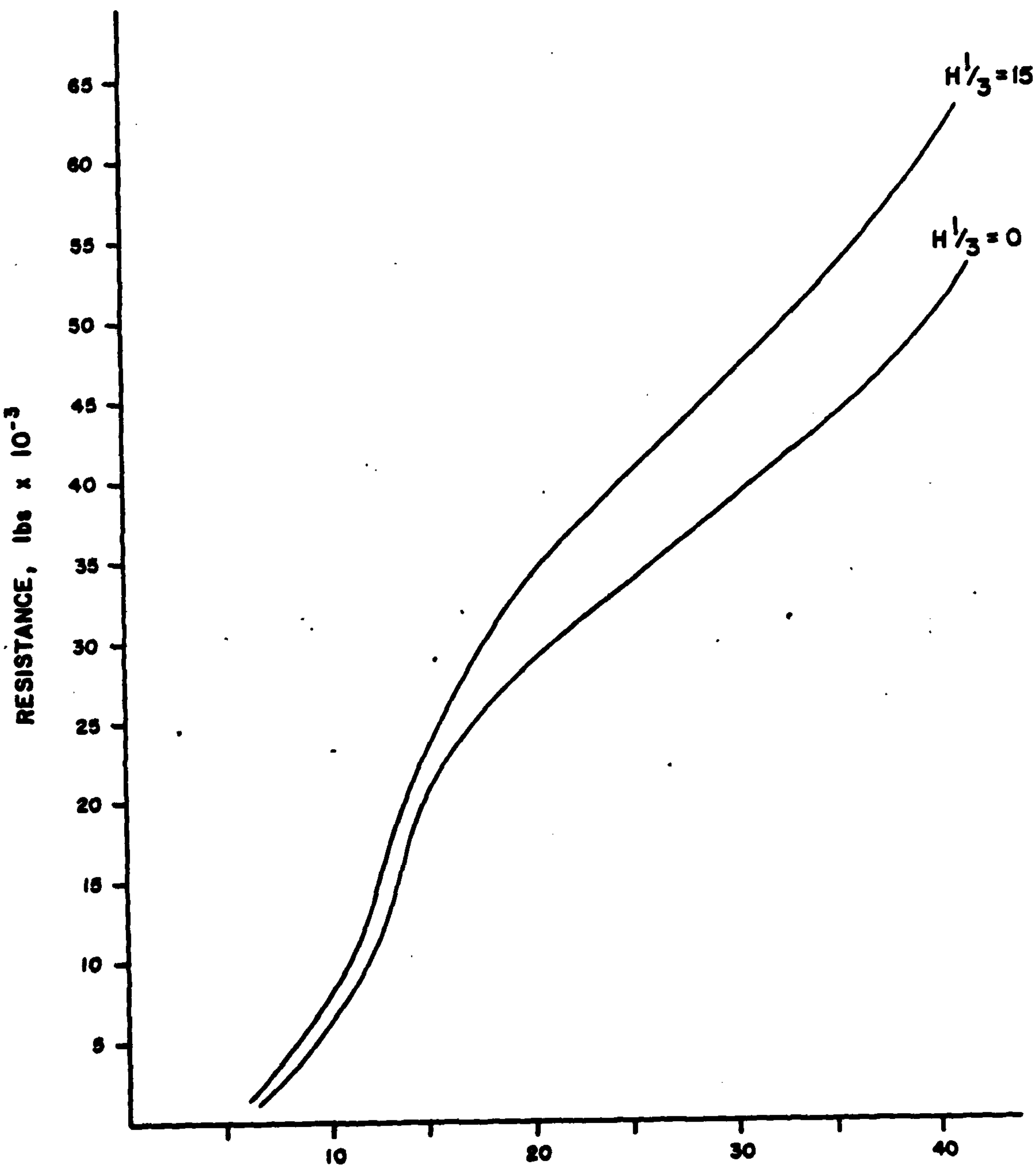


Figure 10

BRAKEHORSEPOWER vs. SPEED

125' USCGX
142 TON DISPLACEMENT
CALM WATER THRU SS6

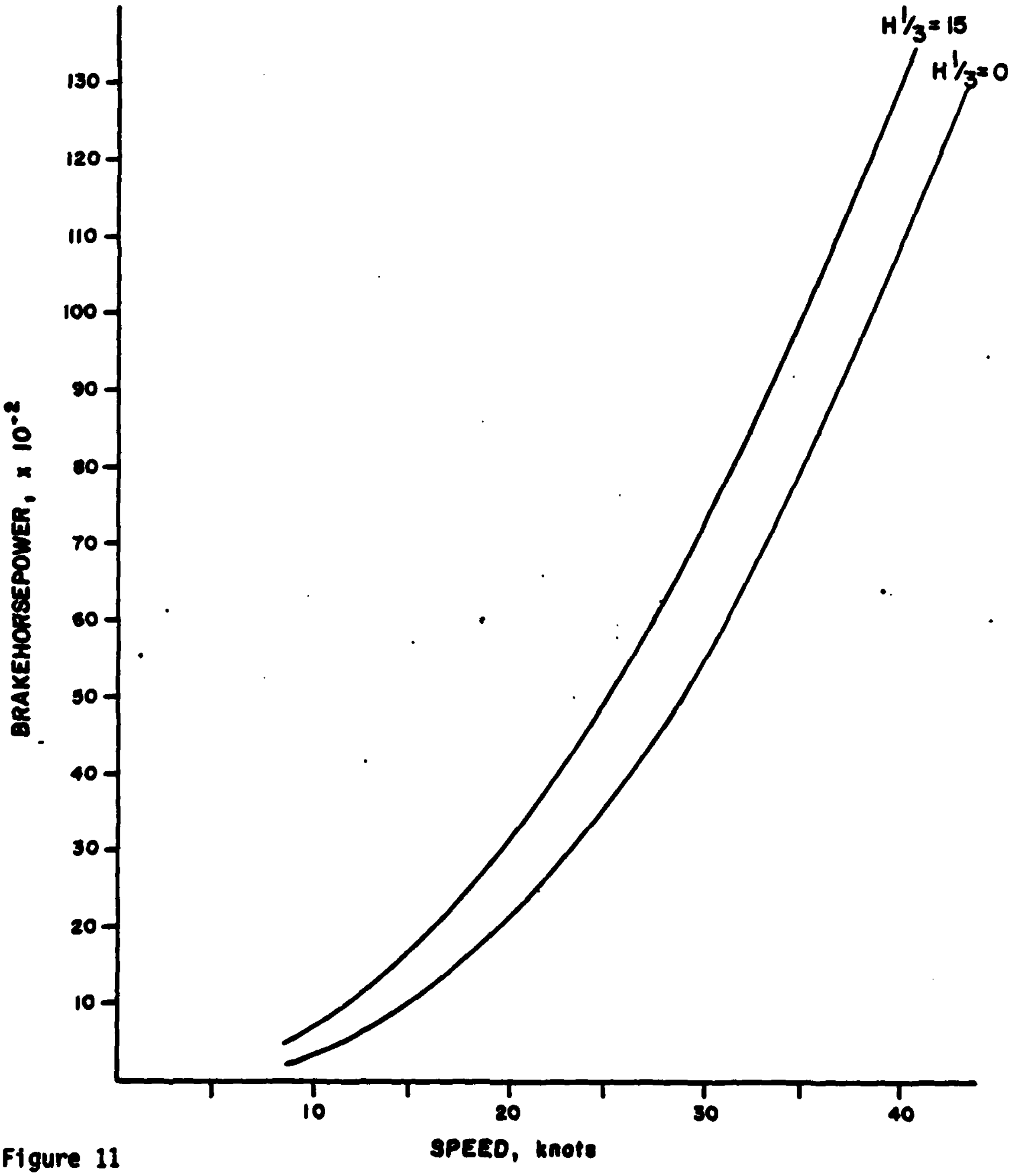


Figure 11

BRAKEHORSEPOWER vs. SPEED

110' USCGX
140 TON DISPLACEMENT
CALM WATER THRU -SS6

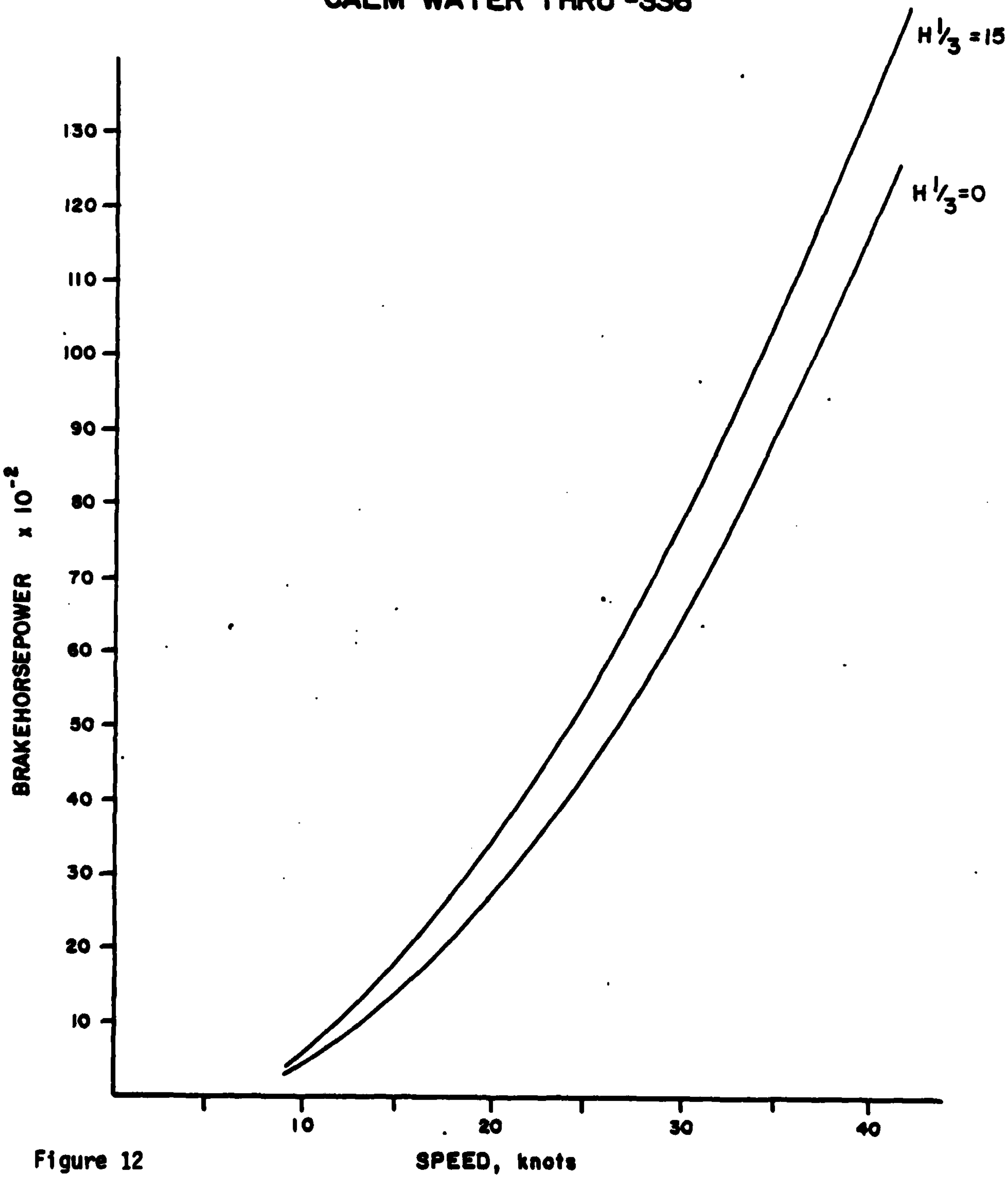


Figure 12

ACCELERATION AND RIDE QUALITY

Accelerations for both craft were calculated using reference (1). These accelerations were plotted and are presented as figures 13 through 16. The 110' version has slightly higher acceleration levels for the same condition (displacement and speed) as the 125' version. This is due to the greater beam loading that would be experienced by the craft with the wider beam. Both craft would experience relatively low accelerations for a planing hull, but these accelerations would still be higher than those expected by similar displacement craft, reference (2). It should be kept in mind that the crew may not be able to function fully from a military standpoint in rough seas, however, pursuit and transit times are greatly reduced in comparison to a smoother-riding slower hull. A close examination of the data will show a convergence between reduced transit time and accelerations experienced, and no matter which hull type (planing or displacement) is used crew sickness and reduced effectiveness will occur during long transit times.

There exist two criteria for predicting ride quality, reference (2). The first, presented as figures 17 and 18, is a rule-of-thumb method which can be used for comparison between craft. The second criterion requires the calculation of the maximum value of the 1/3-octave band RMS center of gravity acceleration of those center of gravity accelerations previously calculated. These values are then plotted against the center frequency as shown in figures 19 and 20. As can be seen, the 125' craft offers reduced likelihood of crew discomfort and the advantage of longer working periods.

Figures 21 and 22 are an indication of the roll and pitch that can be expected from the double-chine hull form. These figures are from actual CPIC full scale trial data, and it is expected that both the 125' and 110' versions would experience less motion due to their added mass being greater than that of CPIC.

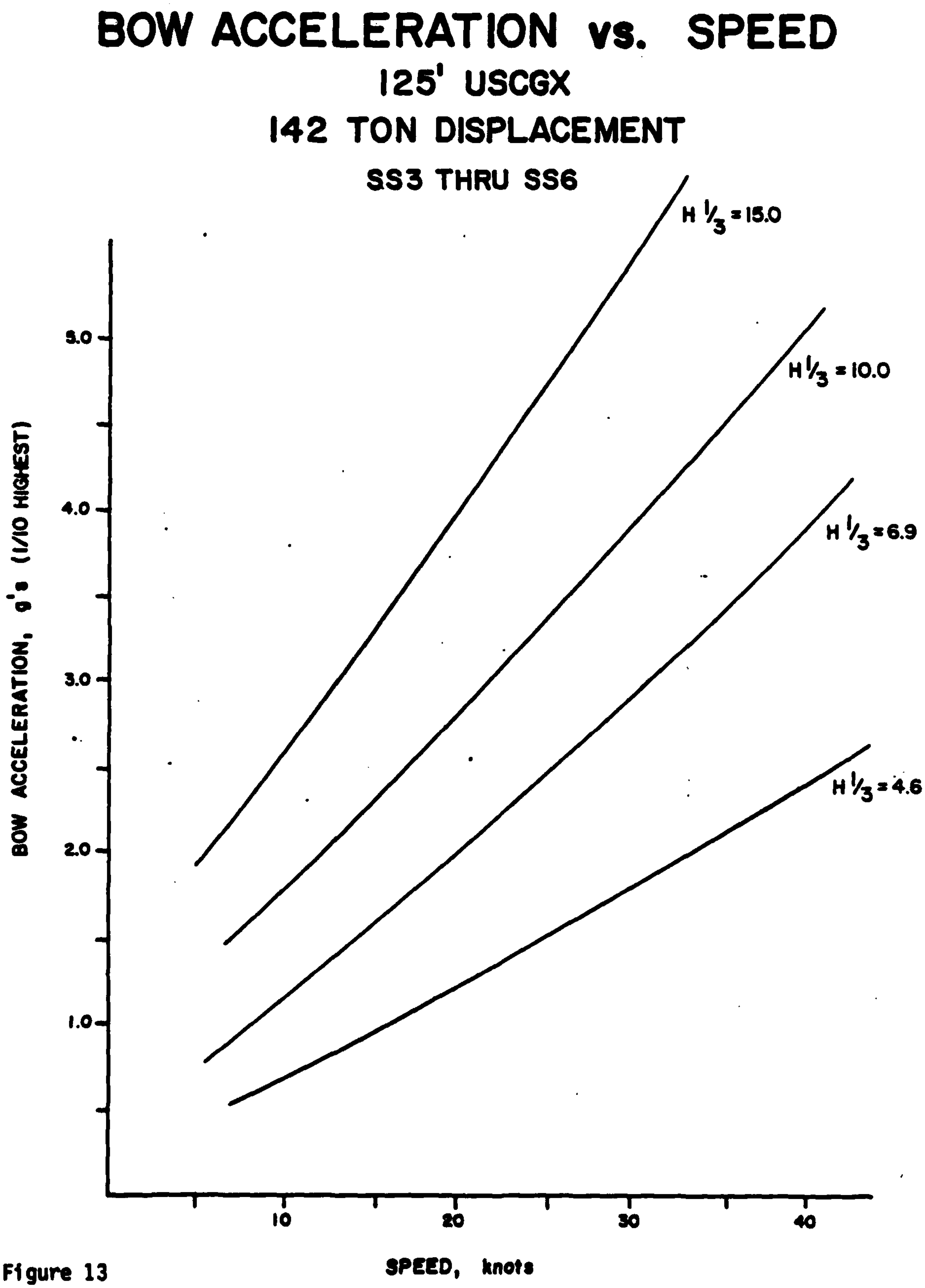

BOW ACCELERATION vs. SPEED
125' USCGX
142 TON DISPLACEMENT
SS3 THRU SS6
H 1/3 = 15.0
H 1/3 = 10.0
H 1/3 = 6.9
H 1/3 = 4.6
5.0
4.0
3.0
2.0
1.0
BOW ACCELERATION, g's (1/10 HIGHEST)
10
20
30
40
SPEED, knots

Figure 13

CG ACCELERATION vs. SPEED

125' USCGX
142 TON DISPLACEMENT
SS3 THRU SS6

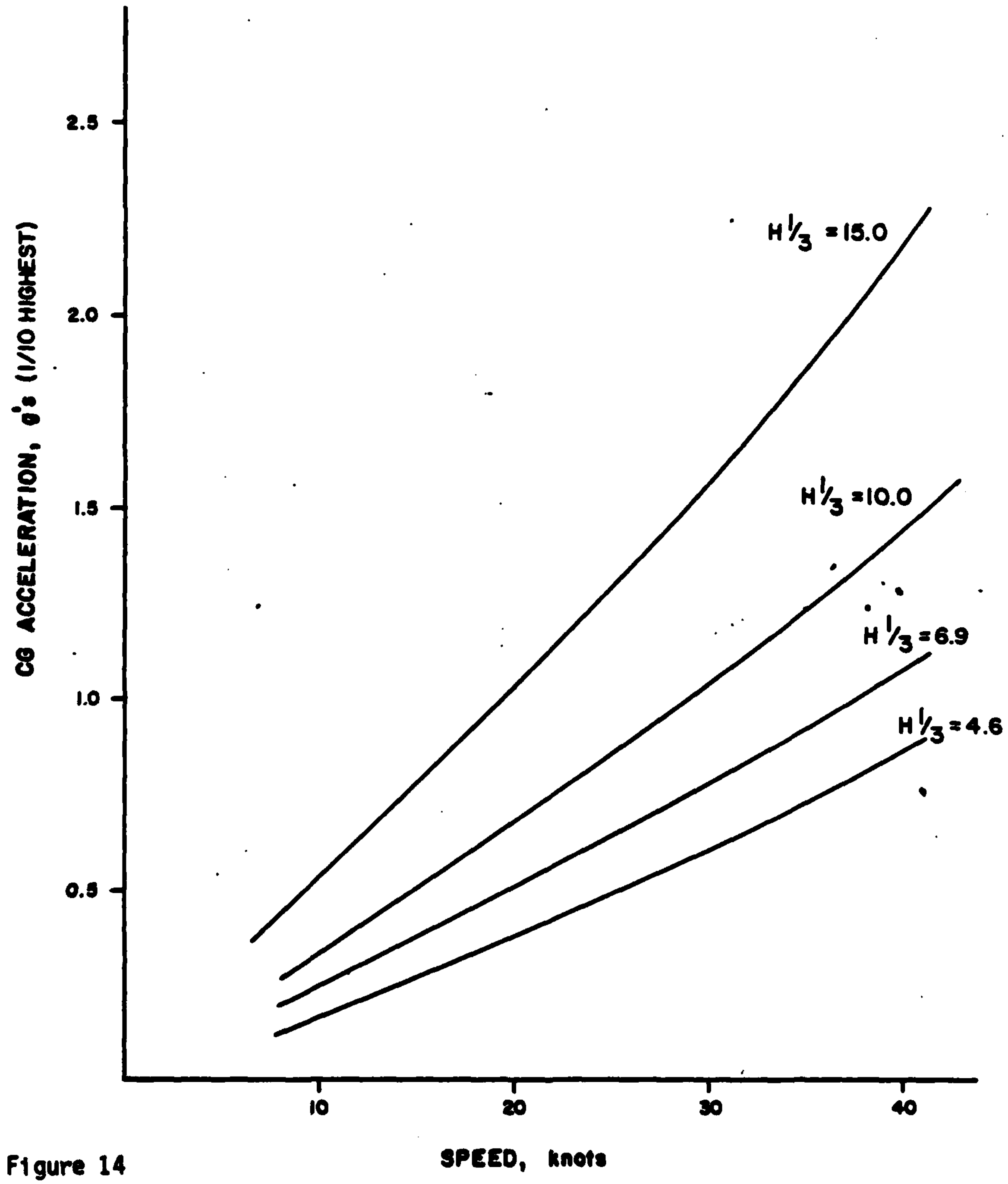


Figure 14

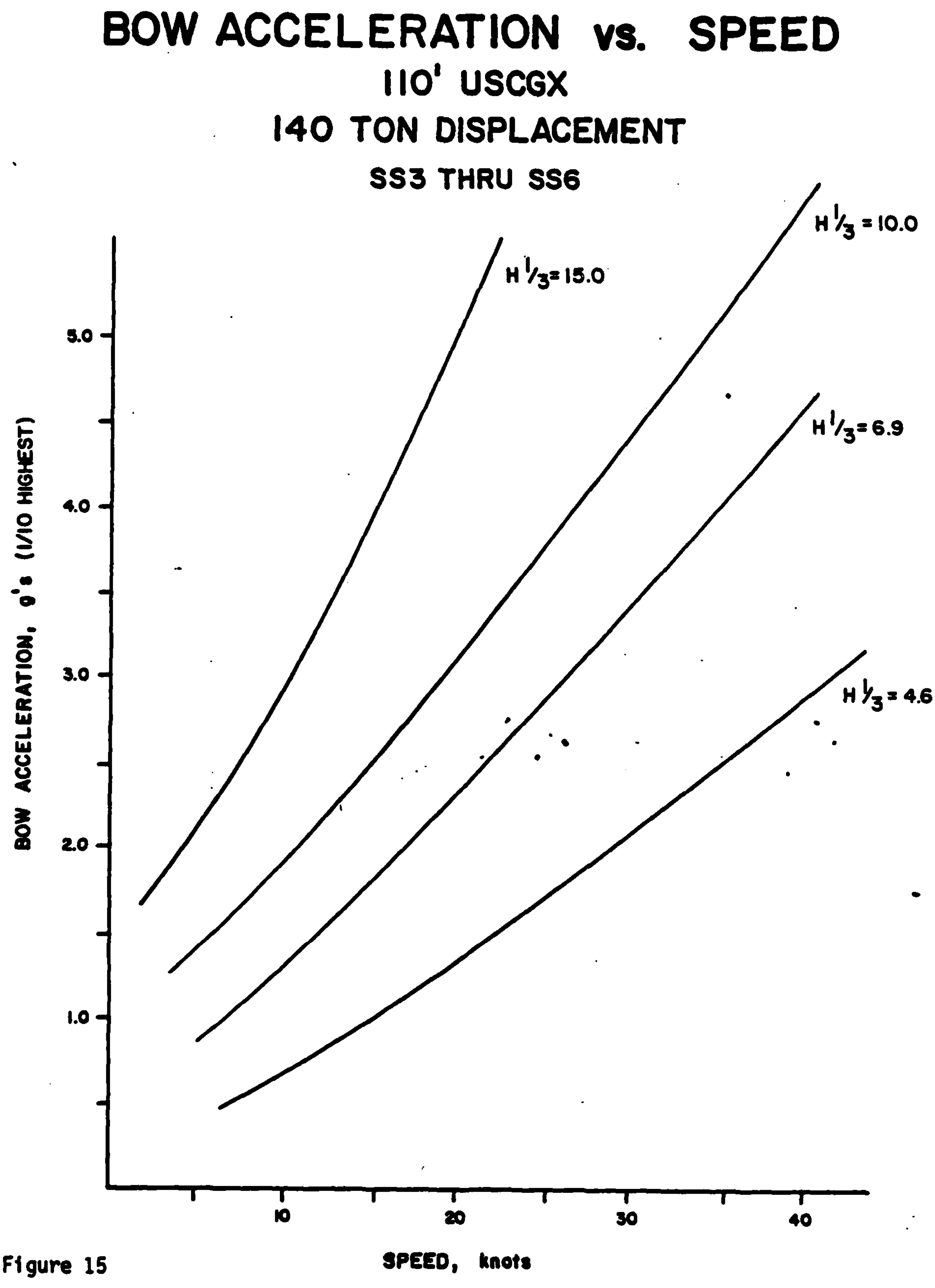

BOW ACCELERATION vs. SPEED
110' USCGX
140 TON DISPLACEMENT
SS3 THRU SS6
H 1/3 = 15.0
H 1/3 = 10.0
H 1/3 = 6.9
H 1/3 = 4.6
BOW ACCELERATION, g's (1/10 HIGHEST)
5.0
4.0
3.0
2.0
1.0
10
20
30
40
SPEED, knots

Figure 15

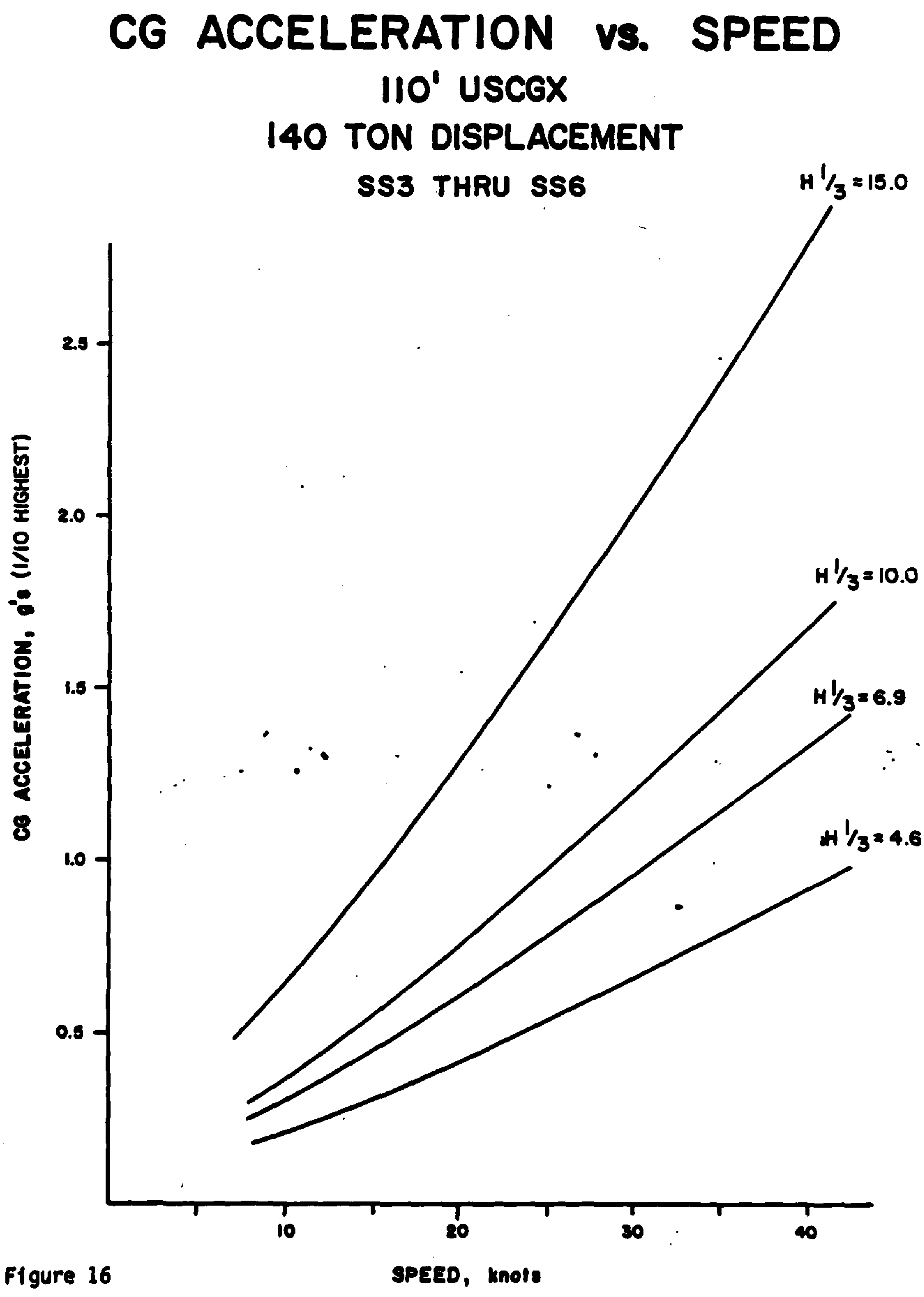

CG ACCELERATION vs. SPEED
110' USCGX
140 TON DISPLACEMENT
SS3 THRU SS6
H 1/3 = 15.0
H 1/3 = 10.0
H 1/3 = 6.9
H 1/3 = 4.6
CG ACCELERATION, g's (1/10 HIGHEST)
2.5
2.0
1.5
1.0
0.5
10
20
30
40
SPEED, knots

Figure 16

OPERATIONAL LIMITS
SIGNIFICANT WAVE HEIGHT vs. SPEED
125' USCGX
142 TON DISPLACEMENT

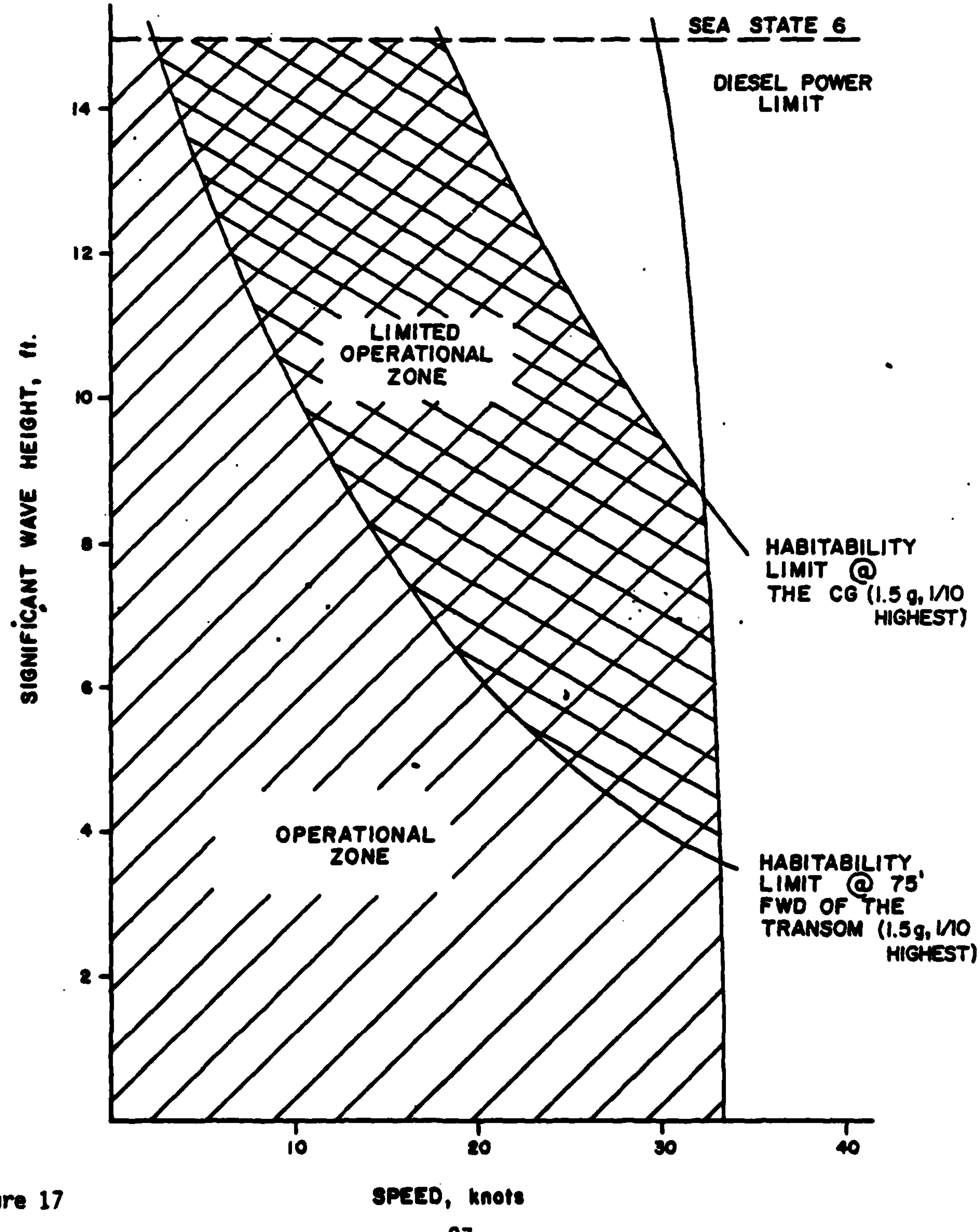


Figure 17

OPERATIONAL LIMITS
SIGNIFICANT WAVE HEIGHT vs. SPEED
110' USCGX
140 TON DISPLACEMENT

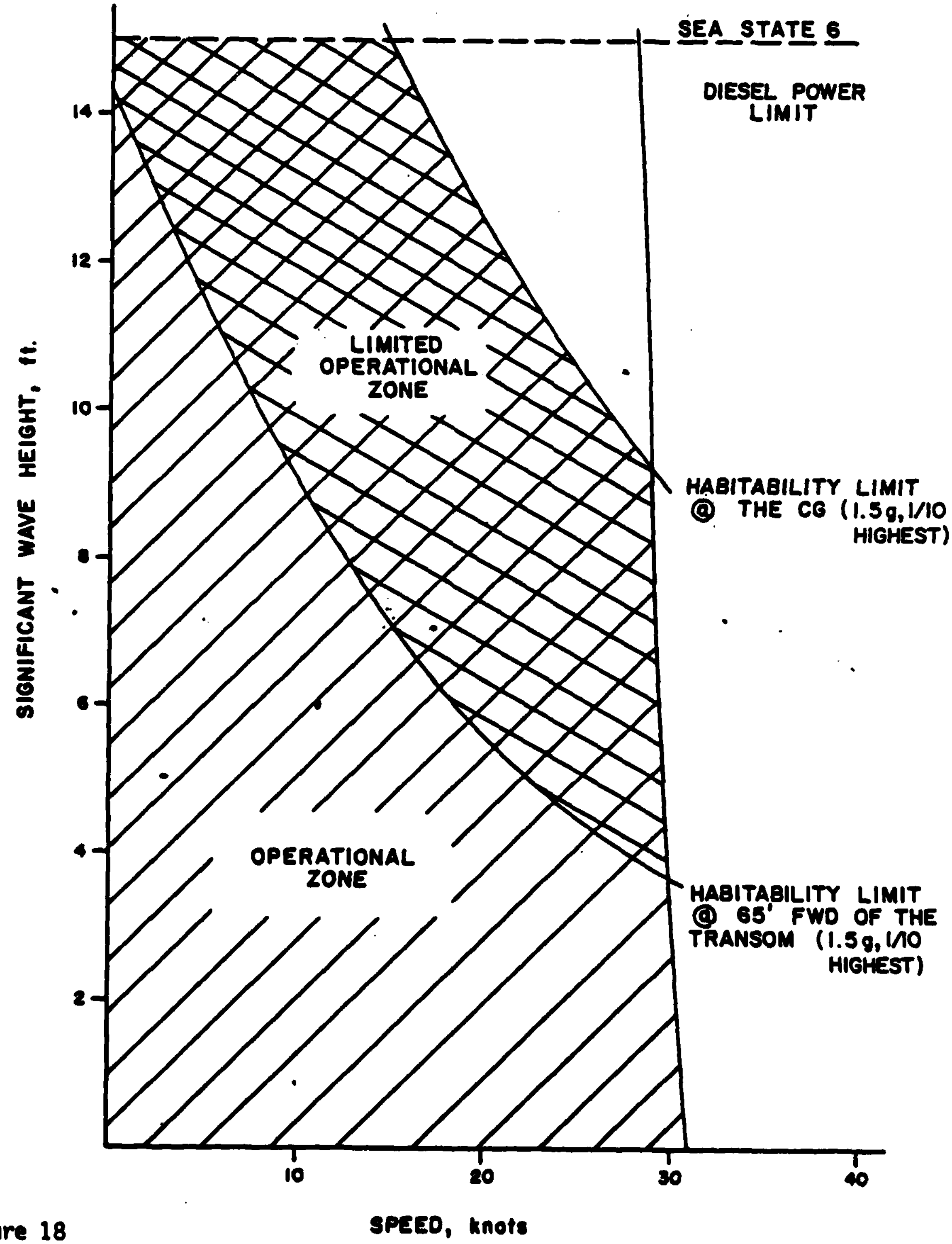
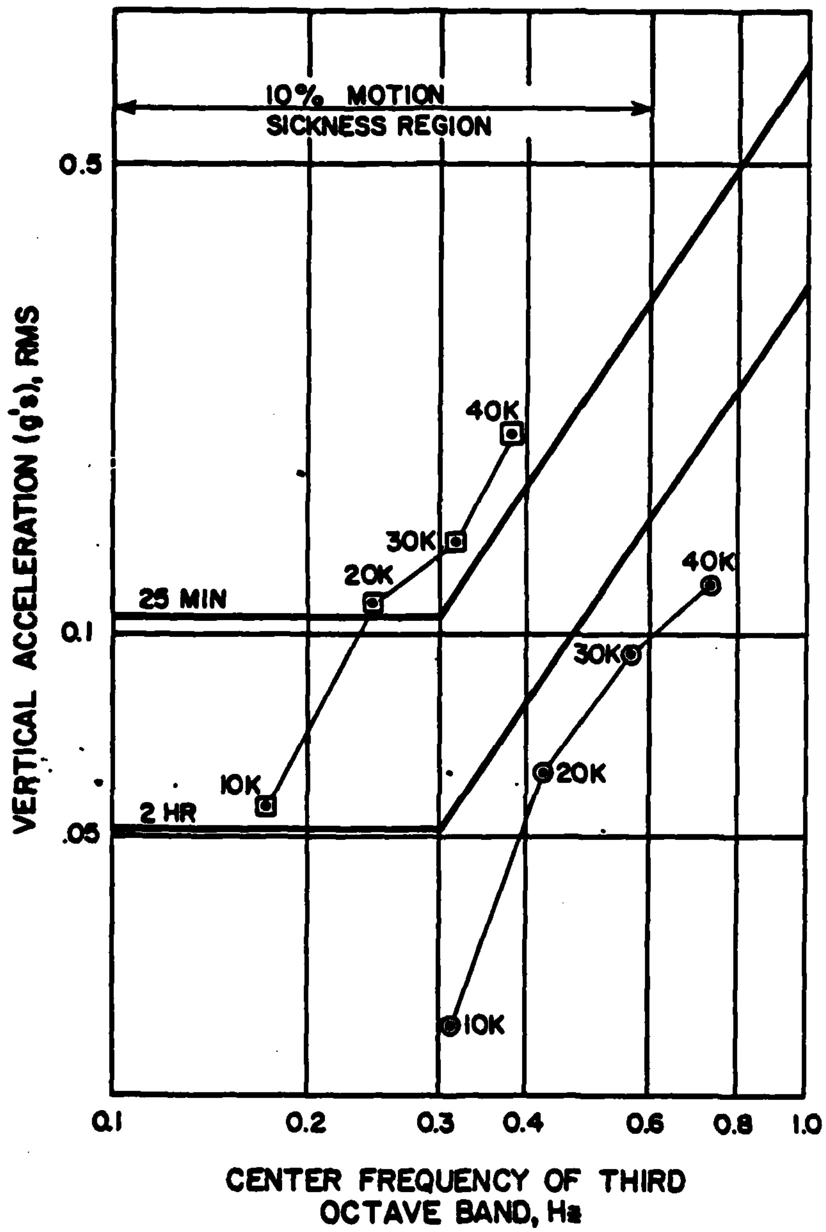


Figure 18

MOTION SICKNESS PREDICTION
FOR 125' USCGX
142 TON DISPLACEMENT



Sea State 3, H 1/3 = 4.6'

Sea State 5, H 1/3 = 12.0'

K = Knots

Figure 19

MOTION SICKNESS PREDICTION
FOR 110' USCGX
140 TON DISPLACEMENT

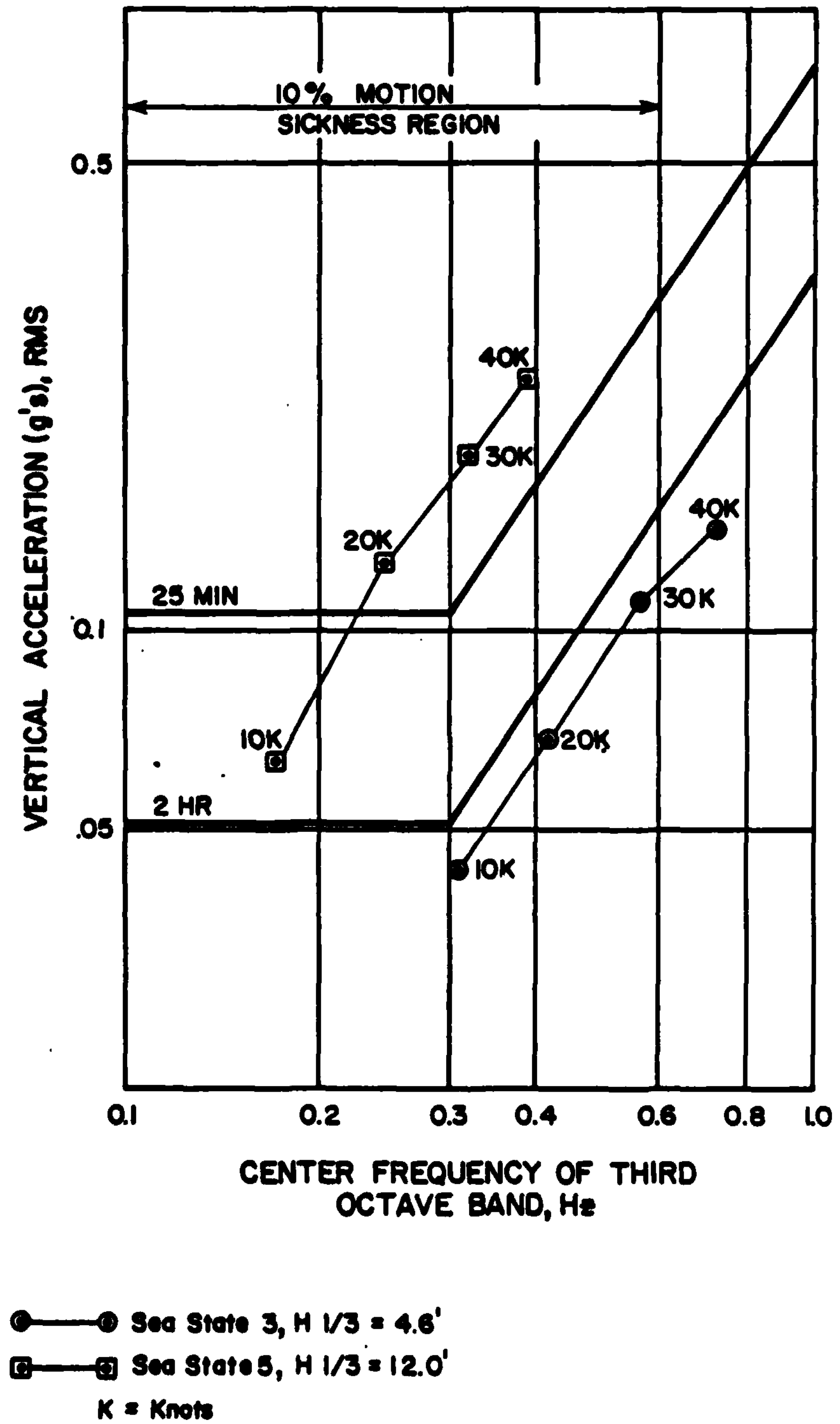


Figure 20

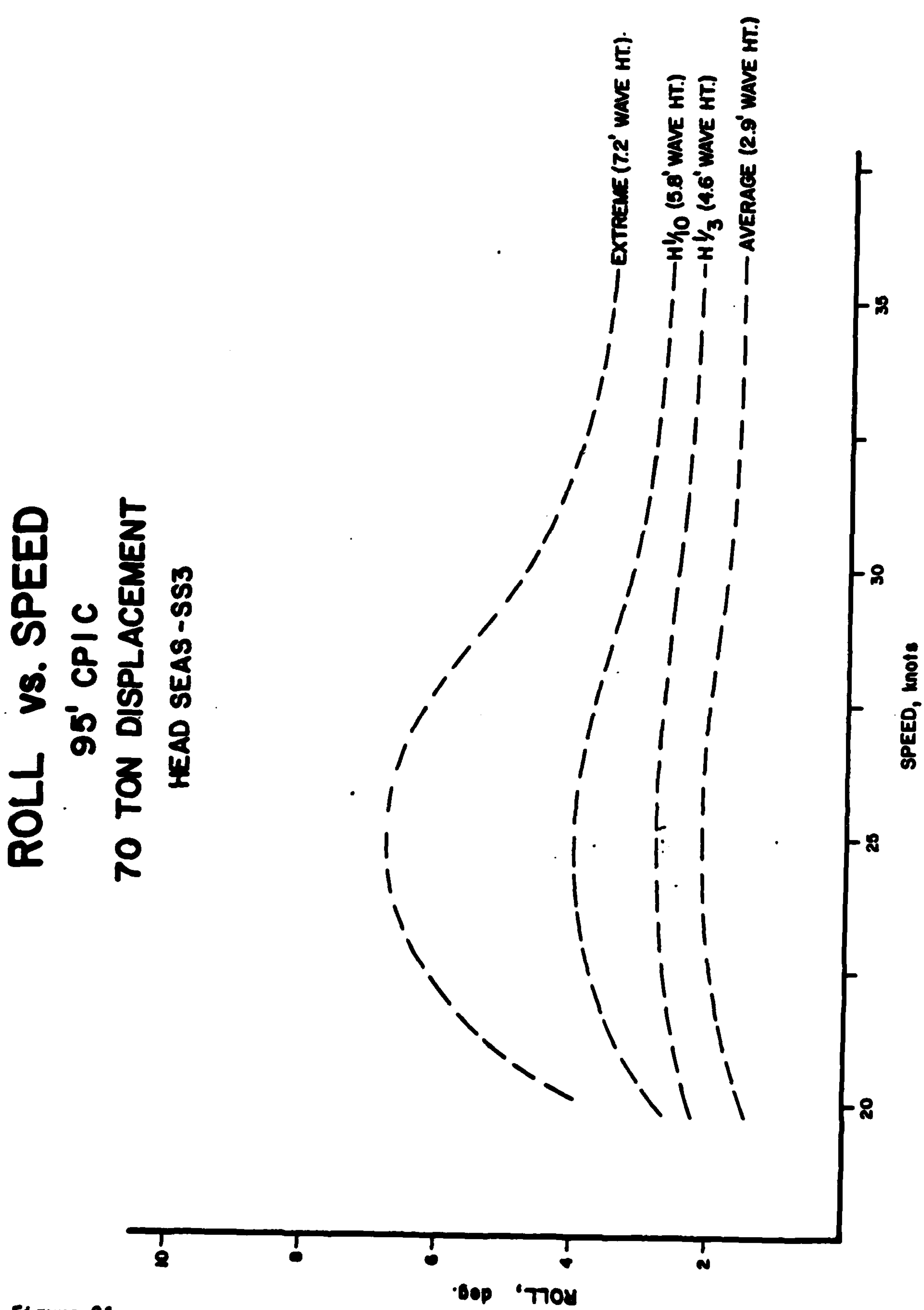
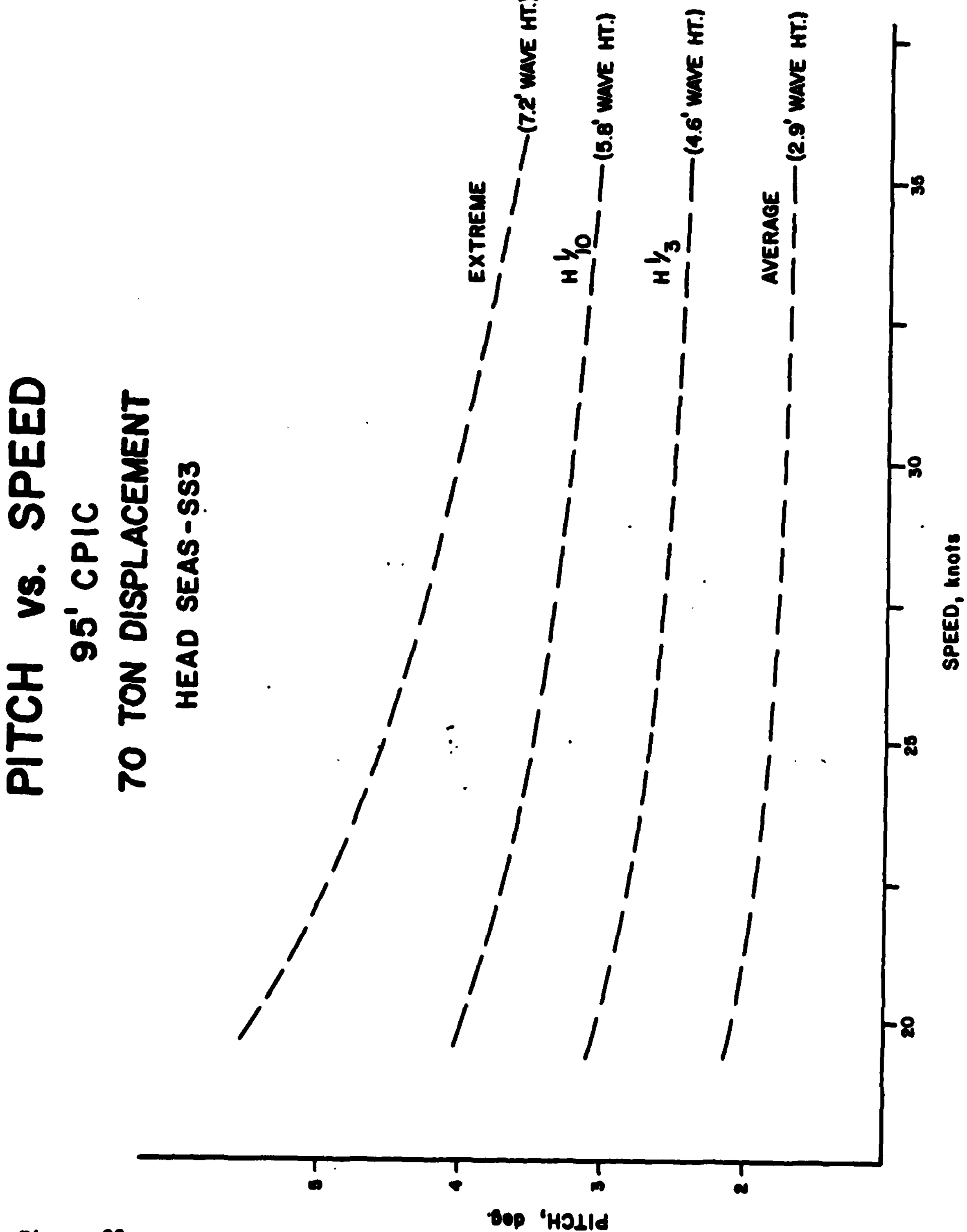

ROLL vs. SPEED
95' CPIC
70 TON DISPLACEMENT
HEAD SEAS-SS3
EXTREME (7.2' WAVE HT.)
H1/10 (5.8' WAVE HT.)
H1/3 (4.6' WAVE HT.)
AVERAGE (2.9' WAVE HT.)
ROLL, deg.
2
4
6
8
10
SPEED, knots
20
25
30
35

Figure 21



PITCH vs. SPEED
95' CPIC
70 TON DISPLACEMENT
HEAD SEAS-SS3
EXTREME
(7.2' WAVE HT.)
H 1/10
(5.8' WAVE HT.)
H 1/3
(4.6' WAVE HT.)
AVERAGE
(2.9' WAVE HT.)
20
25
30
35
SPEED, knots
5
4
3
2
PITCH, deg.

Figure 22

RANGE, ENDURANCE, AND FUEL CONSUMPTION

Range, endurance, and fuel consumption characteristics are given for both craft in figures 23 through 30. Range calculations are based on the Brequet Formula, which takes fuel burnoff into account. The 125' version will meet the minimum range requirements of 5 days at 26 knots for 24 hours and 10 knots for 96 hours. At these speeds and endurance a total of 8650 gallons of fuel is required with 865 gallons of reserve capacity (90% usable +10% reserve). A total of 9655 gallons of fuel has been provided in the design considering no overload tanks or fuel in the day tanks. For a seven day mission with 26 knots for 24 hours and 10 knots for 144 hours, 10320 gallons of usable fuel is required with an additional 1030 gallons required for a 10% reserve. This 11050 gallons can be carried by this craft by simply filling the day tanks along with the main tanks built into the craft. A slight reduction of approximately 1 - 2 knots in speed would result at the top end (burst speed capability) until this 2000 gallon additional day tank fuel is consumed to bring the craft to its design displacement. Further modification could easily be made to this craft if a higher high speed (26+ knots) capability were required, i.e. 30 knots for 24 hours plus 10 knots cruise at 96 or 144 hours. This could be accomplished by the addition of overload tanks built into the inner bottom. The 110' USCGX can only meet the minimum requirements of 5 days by loading additional fuel, approximately 1300 gallons, into the day tanks at initial fueling. This would degrade top end performance slightly until the additional fuel is consumed. A seven day mission would require the addition of an overload tank to meet the minimum of 26+ knots and 10 knots. This craft would approximately equal the 125' version if the cruise speed were lowered from 10 knots to 8 knots.

RANGE vs. SPEED

125' USCGX

30 TONS FUEL

CALM WATER

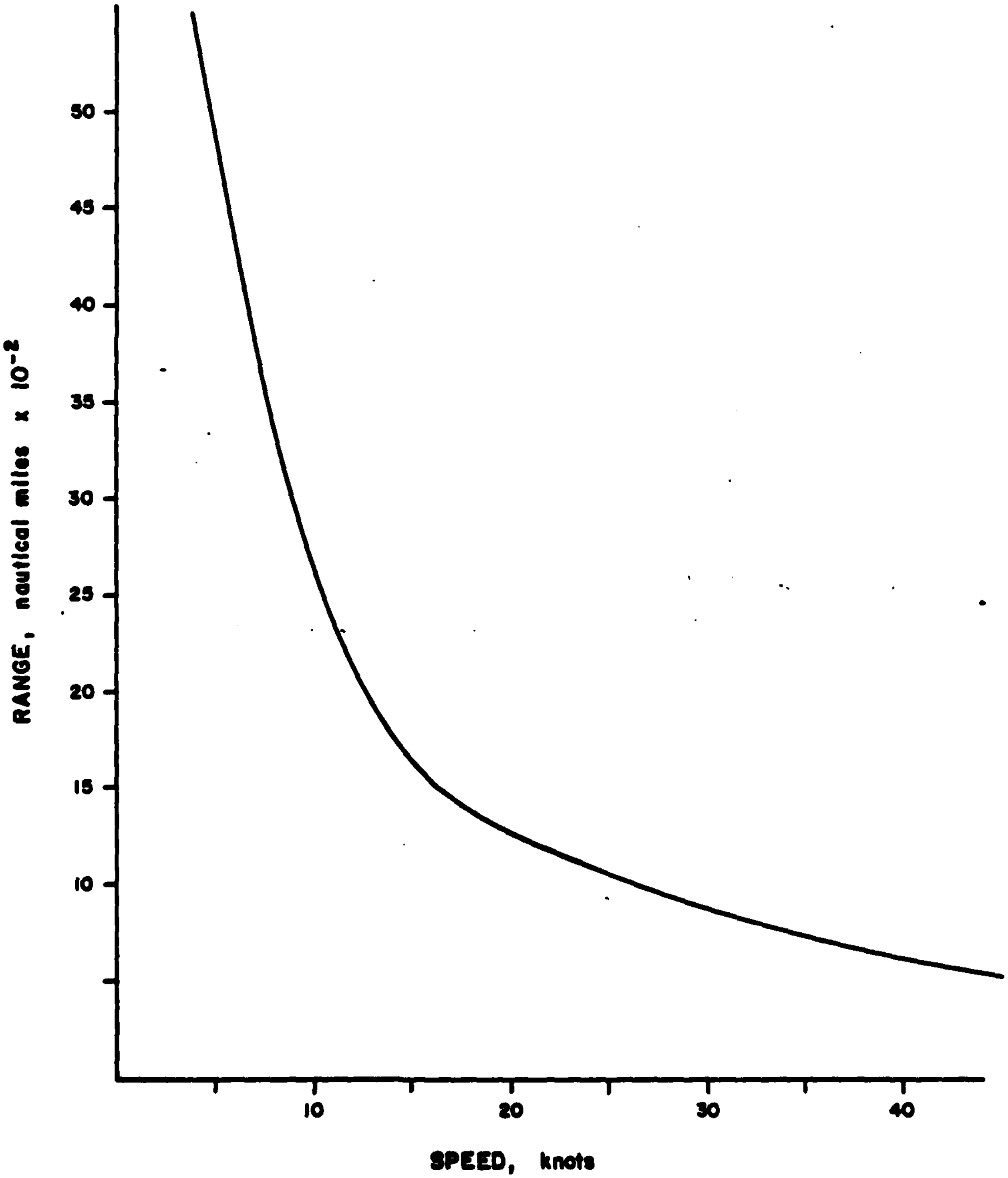


Figure 23

RANGE vs. SPEED
110' USCGX
30 TONS FUEL
CALM WATER

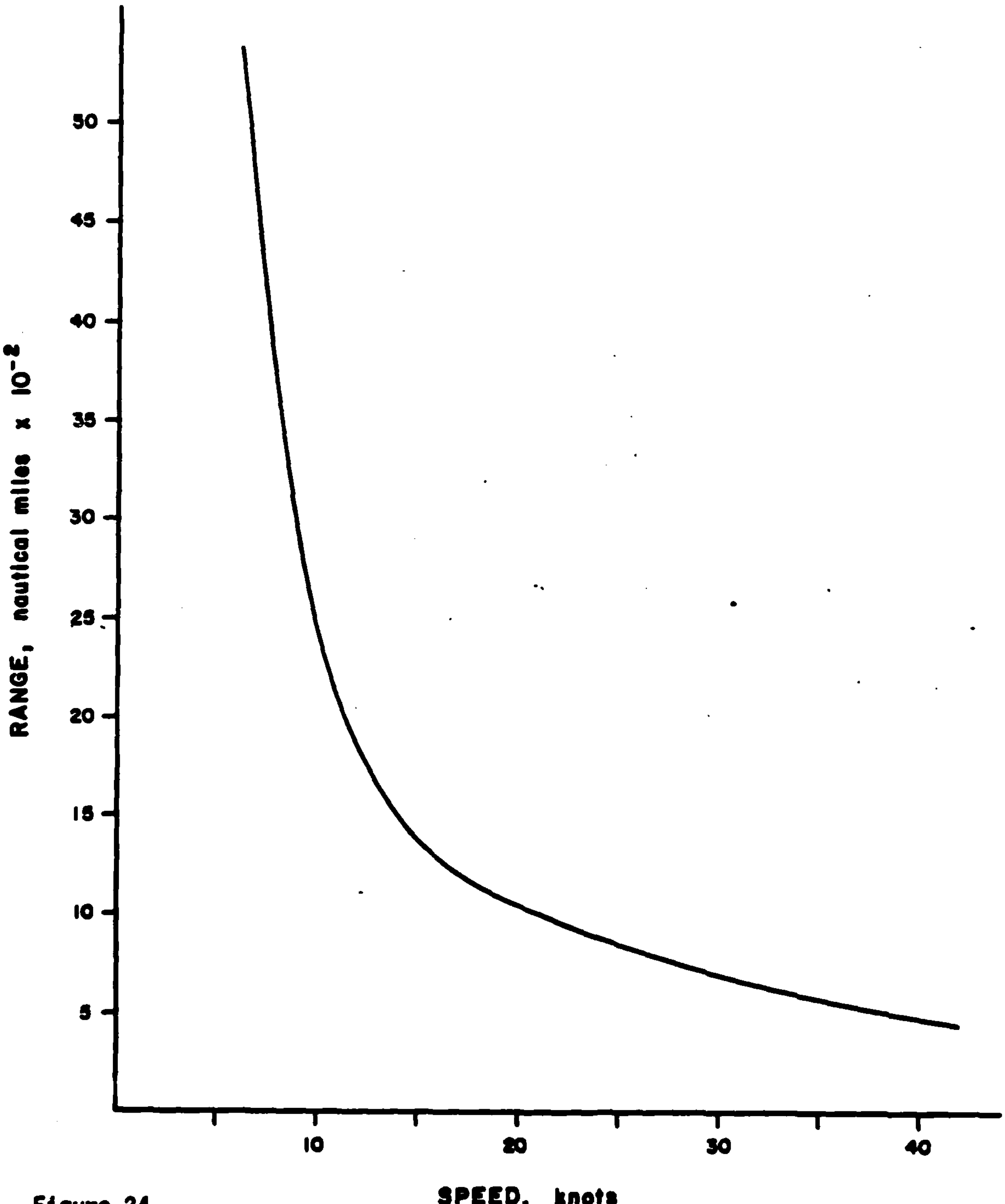


Figure 24

FUEL CONSUMPTION vs. SPEED

125' USCGX
30 TONS FUEL
CALM WATER

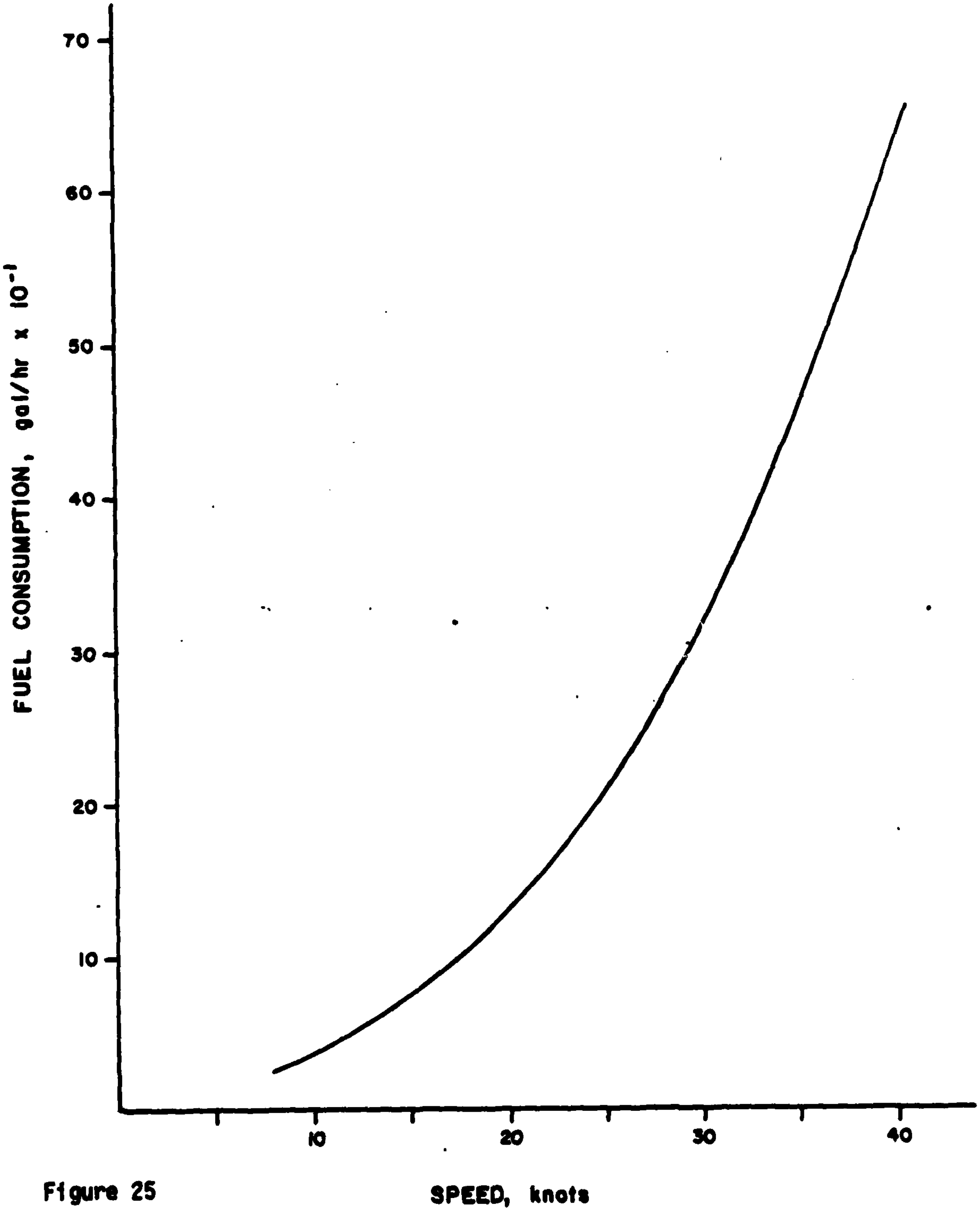


Figure 25

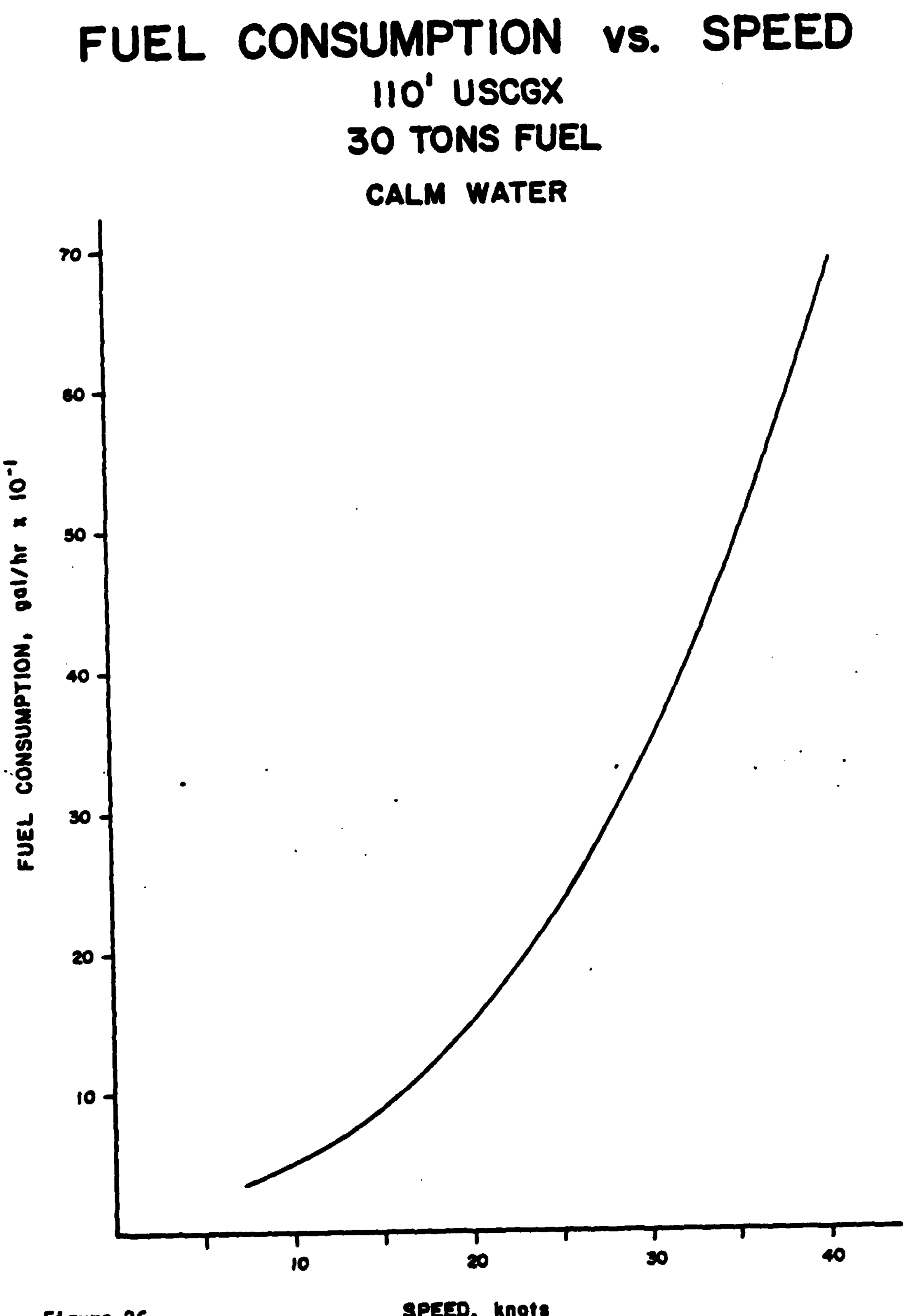

FUEL CONSUMPTION vs. SPEED
110' USCGX
30 TONS FUEL
CALM WATER
FUEL CONSUMPTION, gal/hr x 10⁻¹
70
60
50
40
30
20
10
10
20
30
40
SPEED, knots

Figure 26

FUEL CONSUMPTION vs. TIME

125' USCGX

30 TONS FUEL

CALM WATER

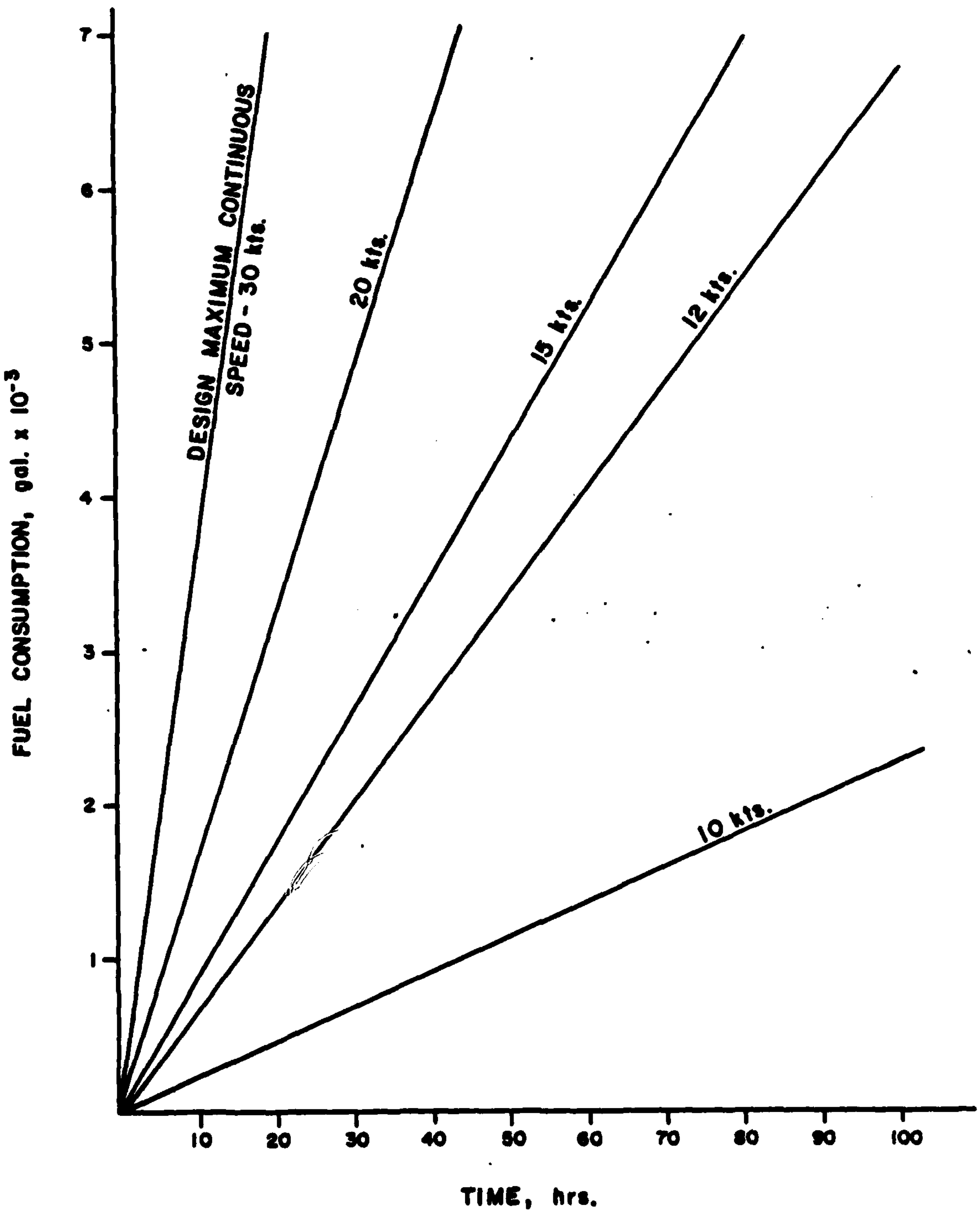


Figure 27

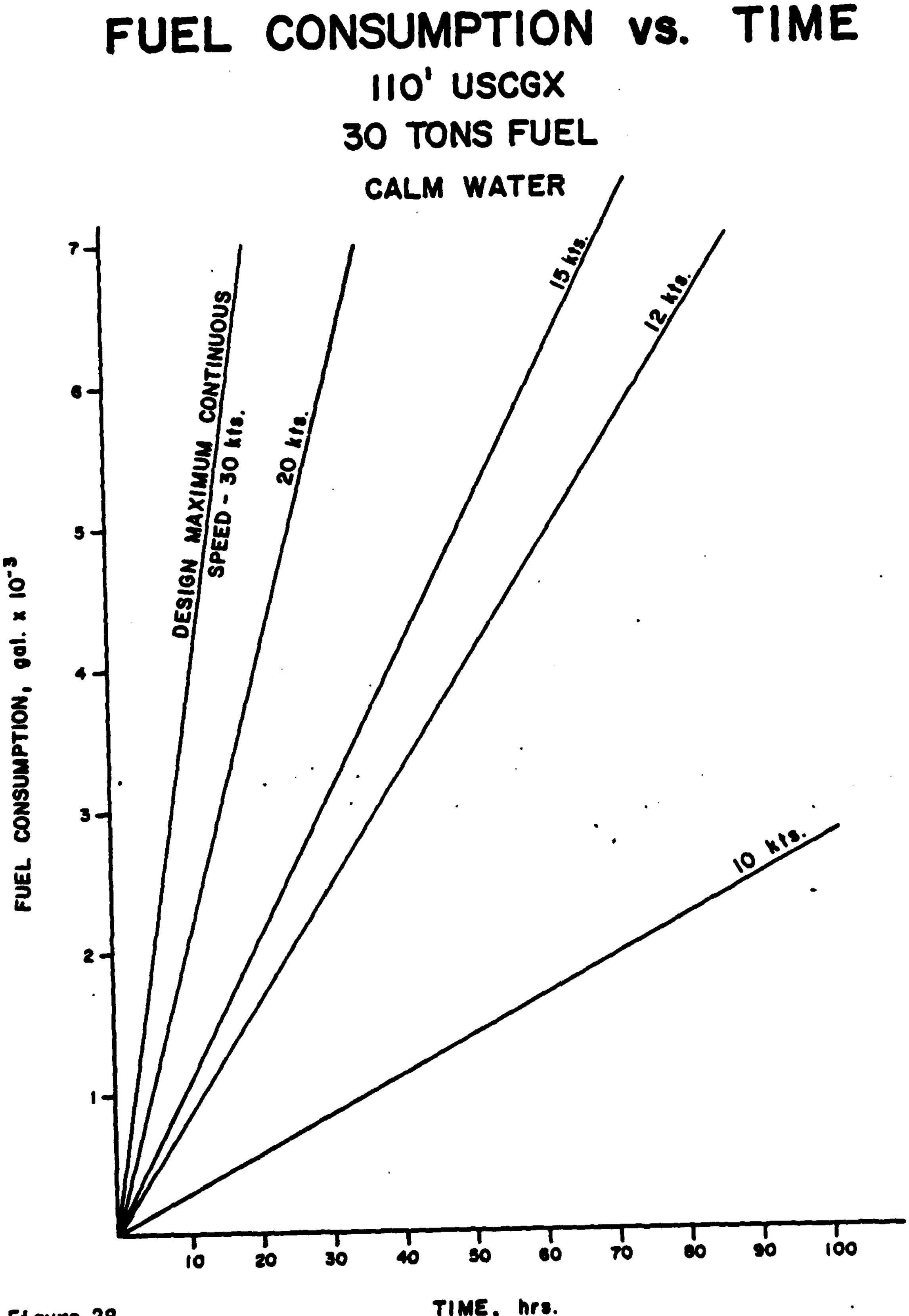

FUEL CONSUMPTION vs. TIME
110' USCGX
30 TONS FUEL
CALM WATER
FUEL CONSUMPTION, gal. x 10⁻³
DESIGN MAXIMUM CONTINUOUS
SPEED - 30 kts.
20 kts.
15 kts.
12 kts.
10 kts.
TIME, hrs.
1
2
3
4
5
6
7
10
20
30
40
50
60
70
80
90
100

Figure 28

ENDURANCE vs. SPEED

125' USCGX

30 TONS FUEL

CALM WATER

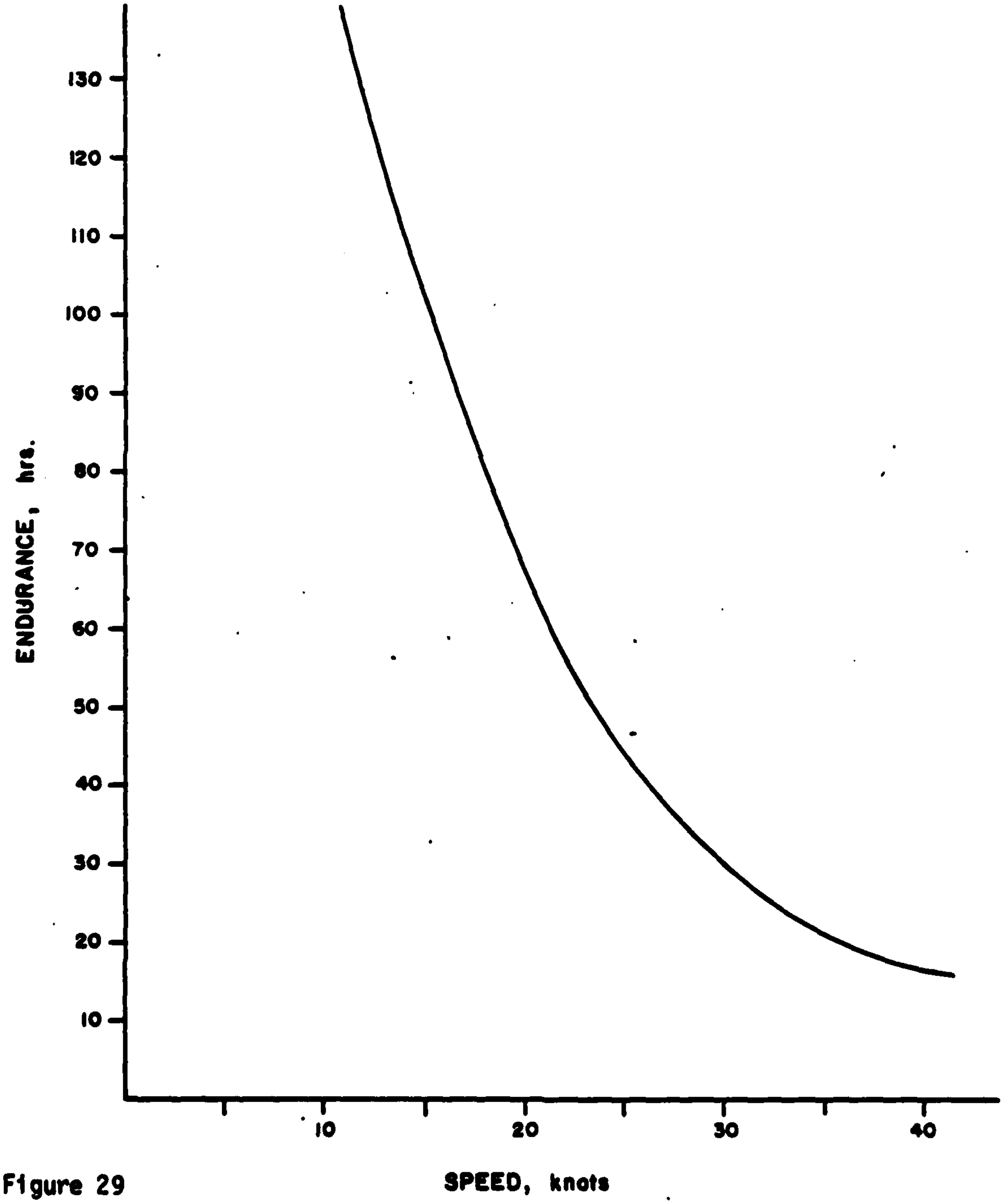


Figure 29

ENDURANCE vs. SPEED
110' USCGX
30 TONS FUEL
CALM WATER

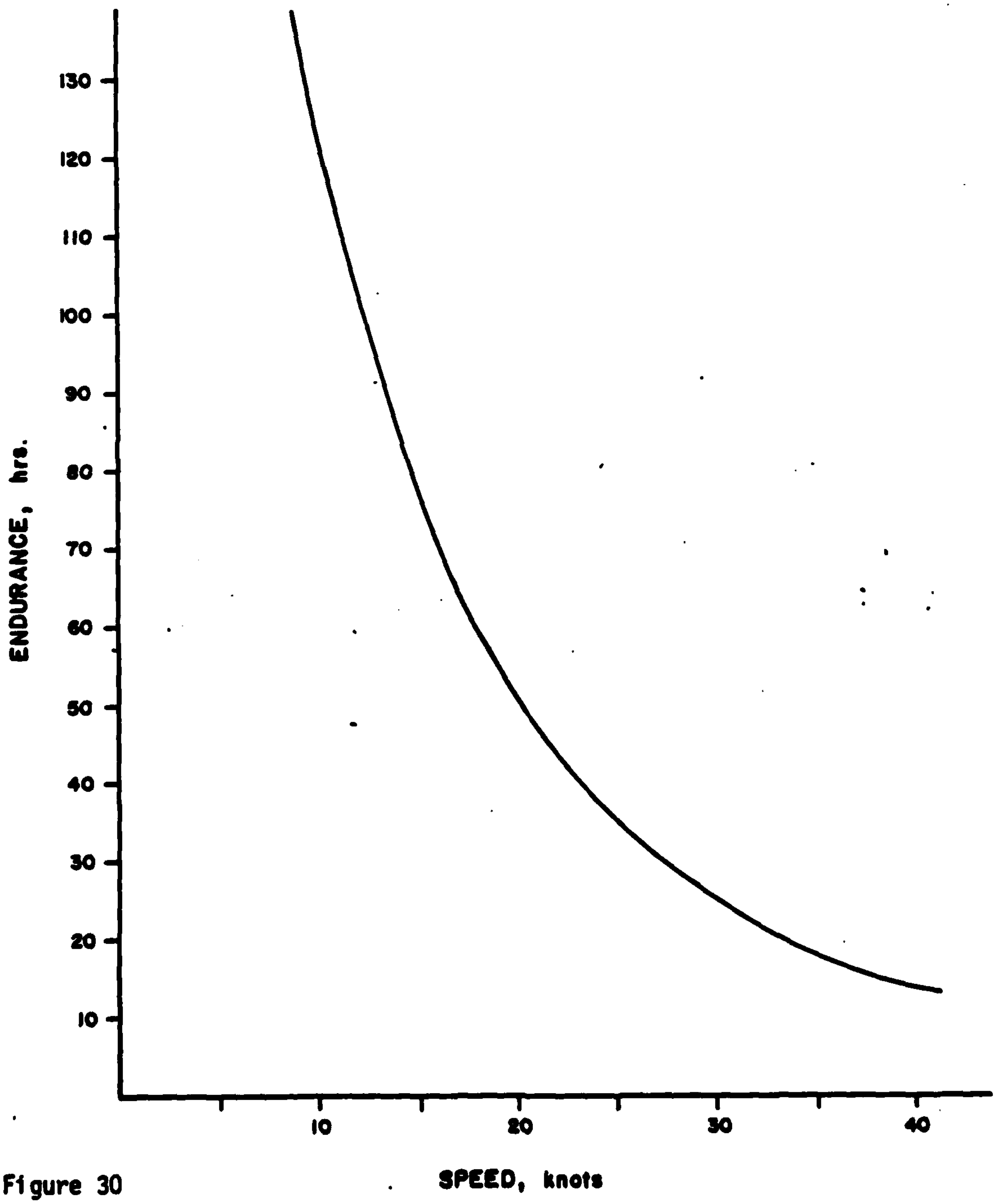


Figure 30

HULL STRUCTURE (BOTH CRAFT)

The hull structure as defined in this section is based on a material selection of 5086 aluminum. This material choice was based on weight, ease of fabrication, maintainability, availability, and corrosion resistance. The 5086 aluminum is readily available and is specified for marine environments.

Watertight bulkheads are located to suit floodable length compartmentation requirements, which is the US Navy criteria of flooding two adjacent compartments with the craft remaining afloat.

Major girders are provided in both the bottom and main decks for longitudinal bending strength. The principal scantlings are shown in figure 31, as a typical midship section. This section serves as an average section for either size hull. It is anticipated that the scantling sizes would change slightly depending on the final hull dimensions chosen.

The typical midship section was designed to a midship bending moment of 16,000 ft long tons, which was calculated using Heller-Jasper, reference (3), with a 60% midship moment reduction as recommended by Allen-Jones, reference (4), and an assumed 1.5g impact acceleration at the center of gravity and a 6g impact acceleration at the bow. These accelerations are considered the maximum that might be expected in the life of this craft.

PROPULSION SYSTEM (BOTH CRAFT)

Main propulsion for these craft is to be provided by twin MTU16V538-92 series diesel engines driving twin screws through a KSS reduction gear. These engines are rated at 3410 BHP each at 1710 RPM continuous, 3770 BHP each at 1750 RPM (maximum 2-hour duration within 12 hours), and 4080 BHP at 1790 RPM overload (maximum 1/2-hour duration within 24 hours), and will provide the following speeds (calm water):

TOTAL BHP	110' USCGX	125' USCGX
6820	29.4 knots	32.6 knots
7540	31.0 knots	34.2 knots
8160	32.0 knots	35.1 knots

It is expected that the propellers will be fixed pitch. However, if it is found in the preliminary design stage that controllable pitch propellers would significantly increase operational effectiveness, they would be recommended.

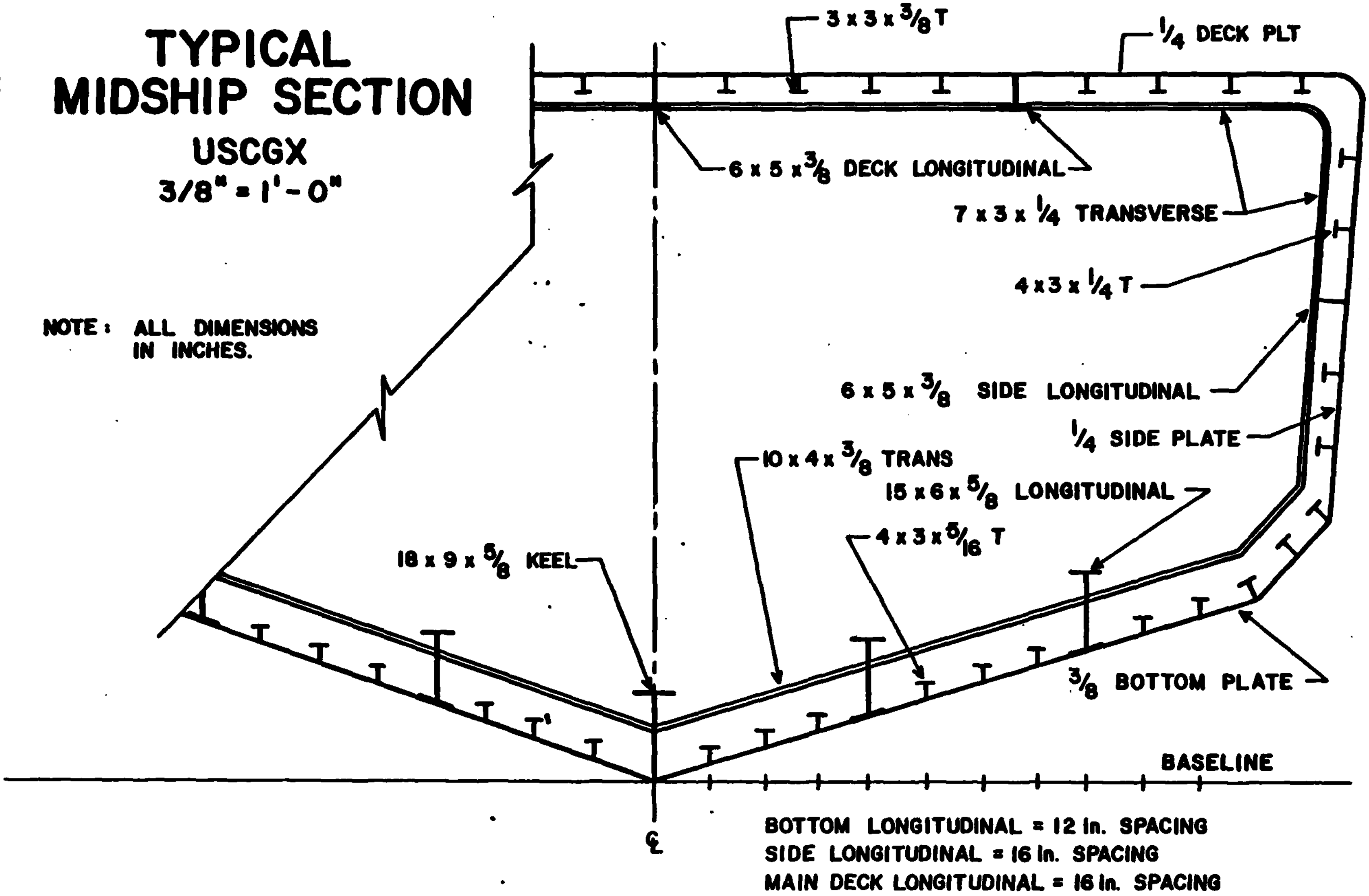

TYPICAL
MIDSHIP SECTION
USCGX
3/8" = 1'-0"
NOTE: ALL DIMENSIONS IN INCHES.
3 x 3 x 3/8 T
1/4 DECK PLT
6 x 5 x 3/8 DECK LONGITUDINAL
7 x 3 x 1/4 TRANSVERSE
4 x 3 x 1/4 T
6 x 5 x 3/8 SIDE LONGITUDINAL
1/4 SIDE PLATE
10 x 4 x 3/8 TRANS
15 x 6 x 5/8 LONGITUDINAL
4 x 3 x 5/16 T
18 x 9 x 5/8 KEEL
3/8 BOTTOM PLATE
BASELINE
℄
BOTTOM LONGITUDINAL = 12 In. SPACING
SIDE LONGITUDINAL = 16 In. SPACING
MAIN DECK LONGITUDINAL = 16 In. SPACING

Figure 31

STABILITY

Studies for both the 110' and 125' USCGX craft were accomplished in full load and minimum operating conditions. A brief discussion of the various calculations follows:

Floodable Length -

A floodable length study of both craft was completed for full load condition at both a 0.0 foot trim and an exaggerated 1 0 foot trim by the stern. The floodable length curves are presented with "Curves of Form and Other Curves" drawings for the applicable craft (Figures 32 and 33). These curves reflect that the two craft in both conditions meet the two-compartment floodable length criteria. The margin line assumed was a line parallel to and three inches below the sheer line.

Intact Dynamic Stability -

A study of intact stability for each craft in both full load and minimum operating conditions, was accomplished. Resulting curves are presented in Figures 34, 35, 36, and 37. As can be seen, the minimum operating condition is the most critical for both craft. However, each craft in both loading conditions met the intact stability criteria of a 70-knot beam wind.

Damaged Stability -

A study of damaged stability was conducted for both craft at full load and minimum operating conditions. Figures 38 and 39 show a plot of righting arms and ranges of stability for each applicable condition and flooding of various adjacent compartments.

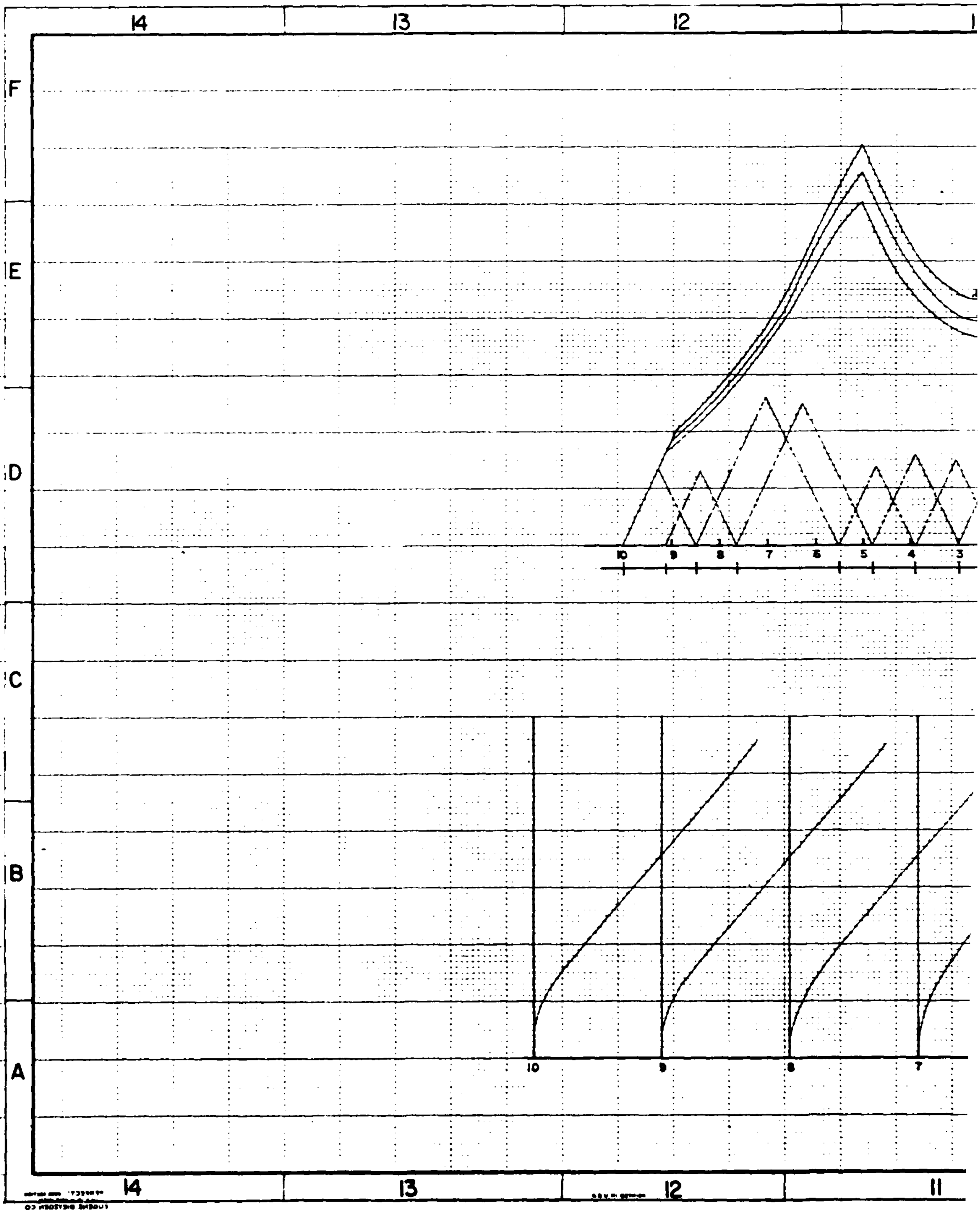
Intact Static Stability -

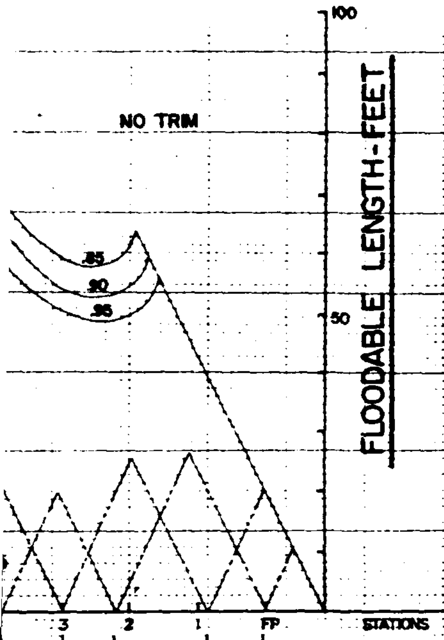
A study of both crafts' intact static stability was conducted in full load and min-op conditions. The craft were analyzed with the craft supported on waves at station 0, midships, the longitudinal center of bouyancy, and station 10.

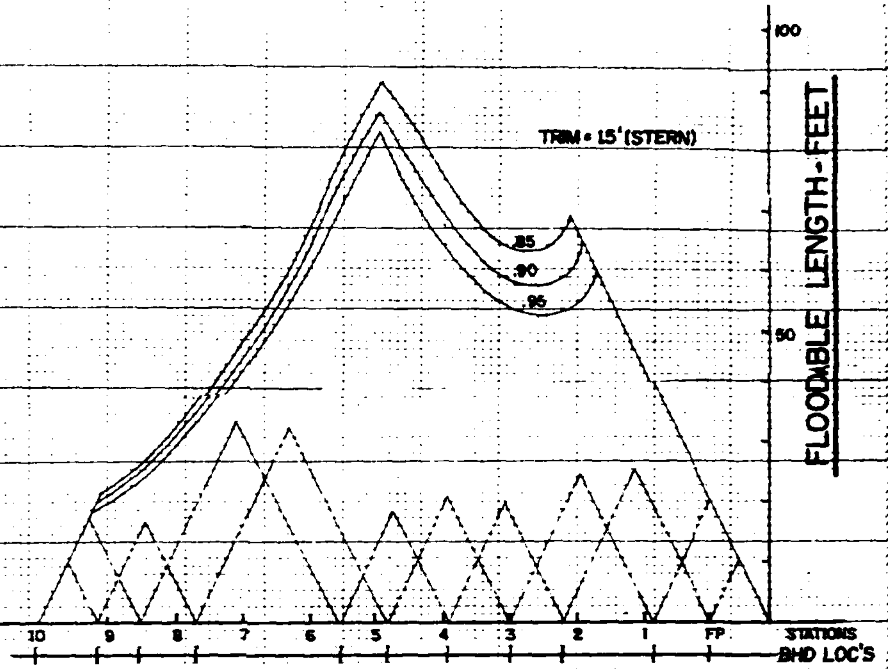
The Longitudinal Center of Buoyancy (LCB) was considered to be the most critical. Figures 40 and 41 present a plot of righting arm curves for each craft at the applicable loading condition and LCB location.

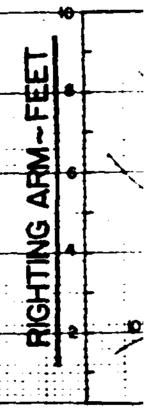
The following wave heights and wave lengths were considered:

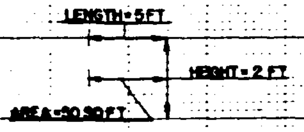
	Wave Height	Wave Length	Sea State
1)	4.6	71.0	3
2)	6.9	99.0	4
3)	10.0	134.0	5
4)	15.0	188.0	6


14
13
12
F
E
D
C
B
A
10 9 8 7 6 5 4 3
10 9 8 7
11

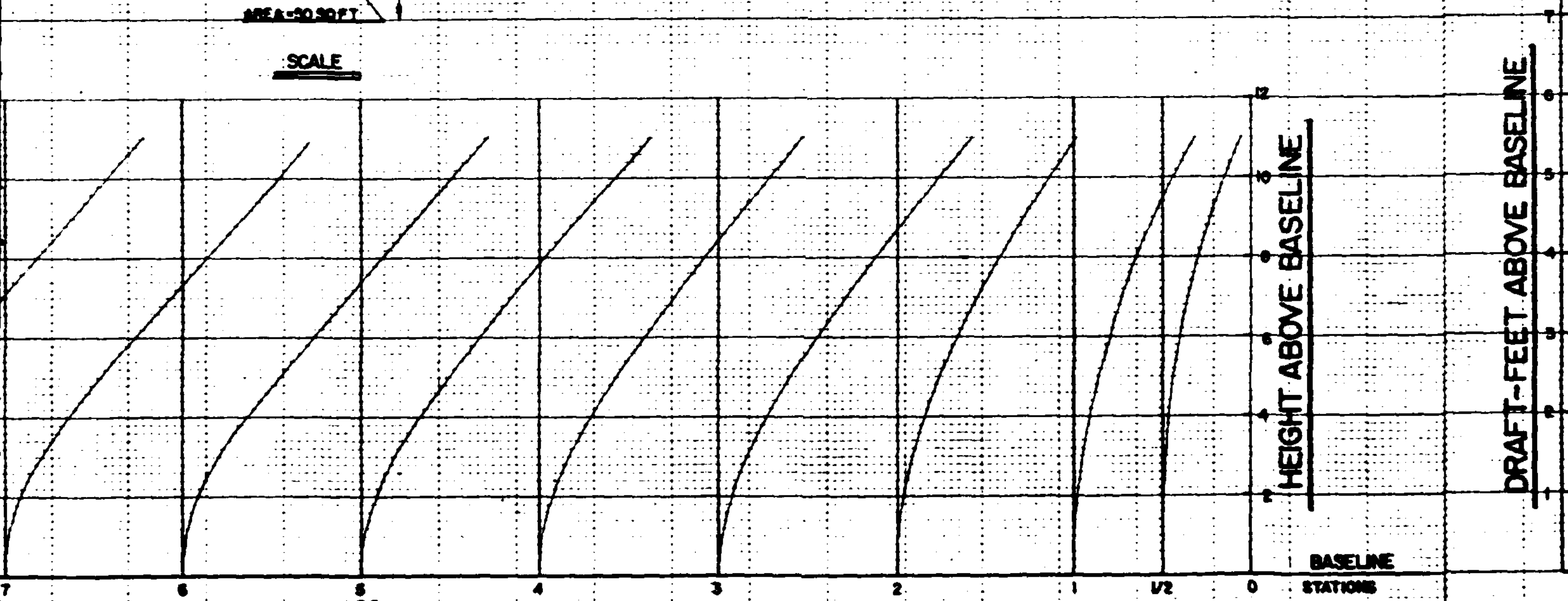








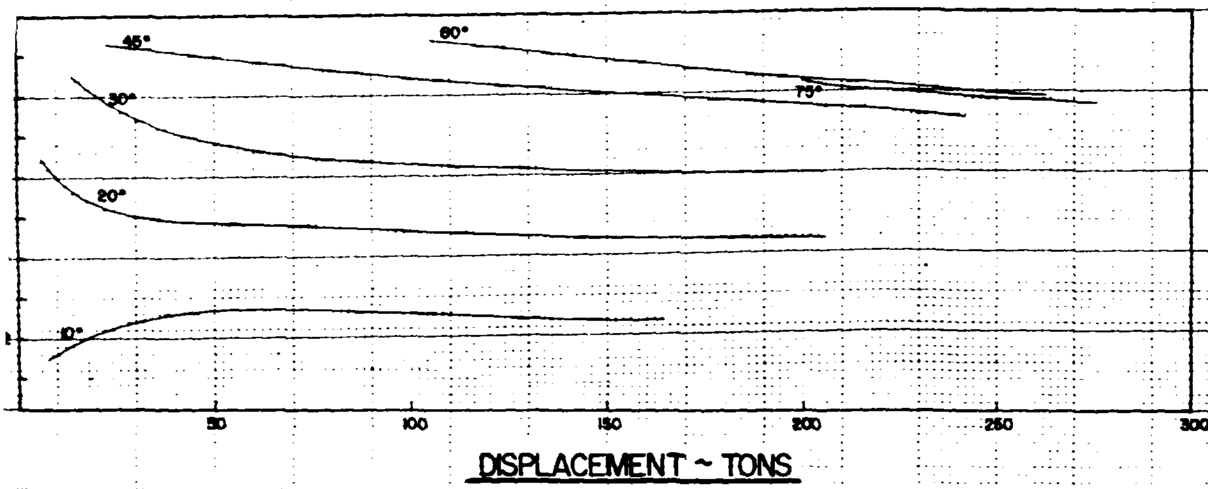
SCALE

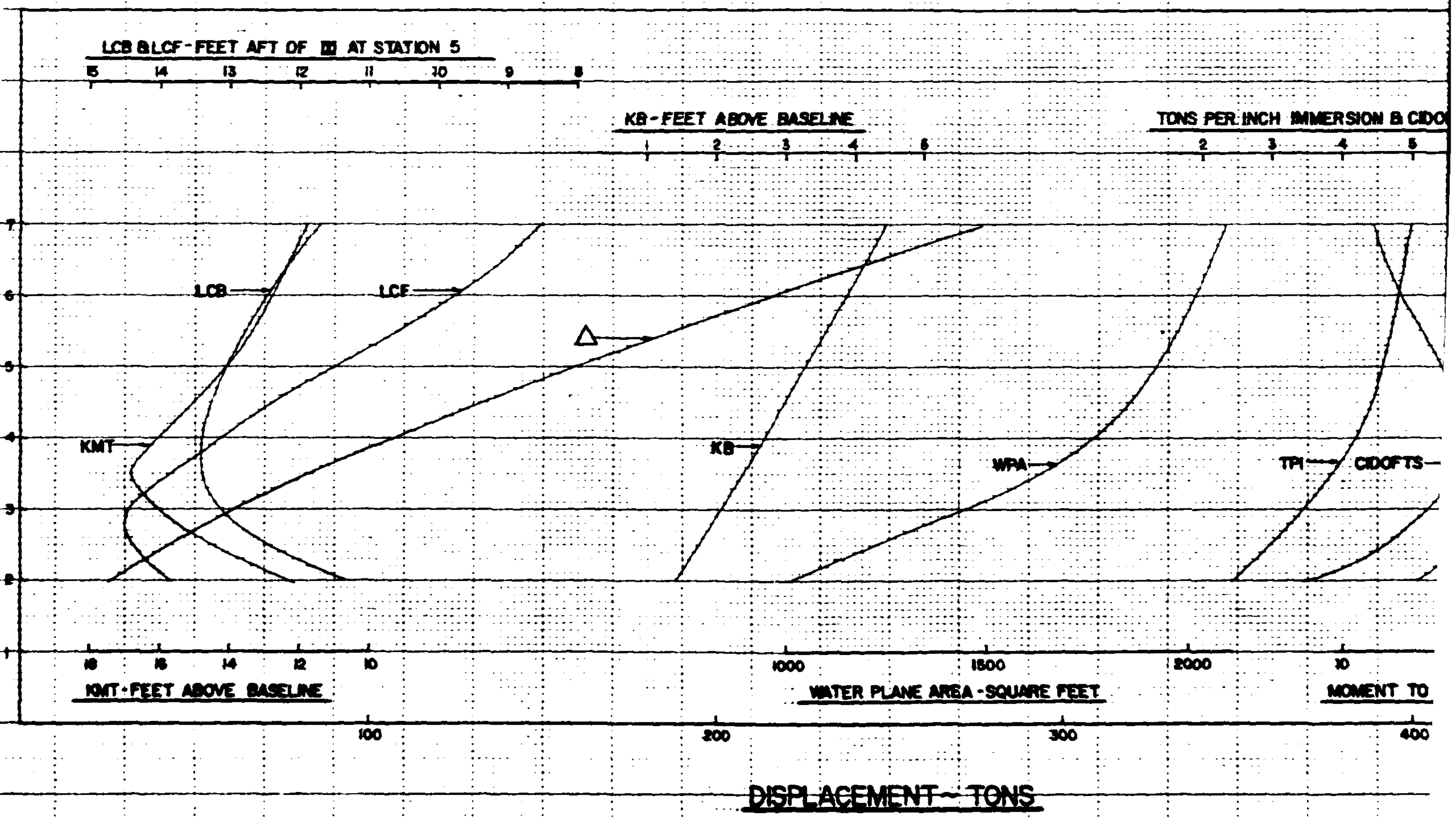


BONJEAN CURVES

2

7	6	5	4


45°
60°
30°
75°
20°
10°
50
100
150
200
250
300
DISPLACEMENT ~ TONS


LCB & LCF - FEET AFT OF ⊠ AT STATION 5
15 14 13 12 11 10 9 8
KB - FEET ABOVE BASELINE
1 2 3 4 5
TONS PER INCH IMMERSION & CIDO
2 3 4 5
LCB
LCF
Δ
KMT
KB
WPA
TPI
CIDOFTS
18 16 14 12 10
KMT - FEET ABOVE BASELINE
1000 1500 2000
WATER PLANE AREA - SQUARE FEET
10
MOMENT TO
100
200
300
400
DISPLACEMENT ~ TONS

7	6	5	4

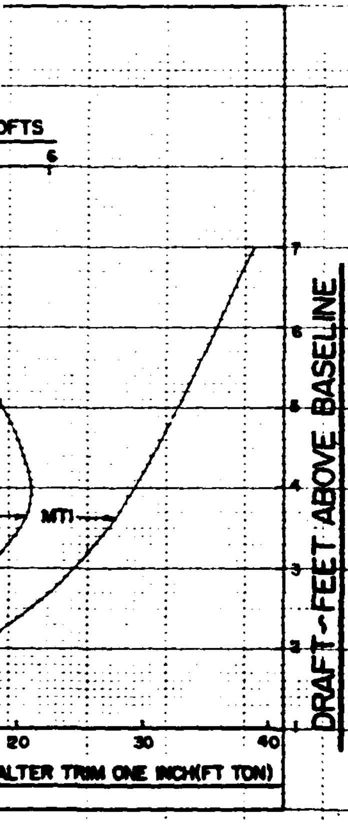
3

REVISIONS			
REV.	DESCRIPTION	DATE	APP'D

L.O.A. = 125'-0"
L.B.P. = 115'-0"
STATION SPACING = 11.5'
D.W.L. = 4'-8"

LEGEND

△ -DISPLACEMENT IN LONG TONS
MTI-MOMENT TO ALTER TRIM ONE INCH
TPI-TONS PER INCH IMMERSION
KM -MEGACENTRIC RADIUS (TRANSVERSE)
KB -CENTER OF BUOYANCY ABOVE BASELINE
LCF-CENTER OF FLOTATION FROM ⊠
WPA-WATER PLANE AREA
LCB-CENTER OF BUOYANCY FROM ⊠
CIDOFTS-CHANGE IN DISPLACEMENT FOR ONE FOOT TRIM BY STERN
GZ -RIGHTING ARMS (ACTUAL)
⊠ -MIDSHIPS @ STATION 5



1	LINES & OFFSETS 125' USCG-101-5103574	
REF NO	DOCUMENT TITLE	DOCUMENT NO.

DATA LIST

FEASIBILITY DRAWING

THIS DWG WAS DEVELOPED IN CONJUNCTION WITH NAVSEACOMBATSYSENGSTA REPORT NO. 80-111

NAVAL SEA COMBAT SYSTEMS ENGINEERING STATION
NAVAL STATION
NORFOLK VA 23511

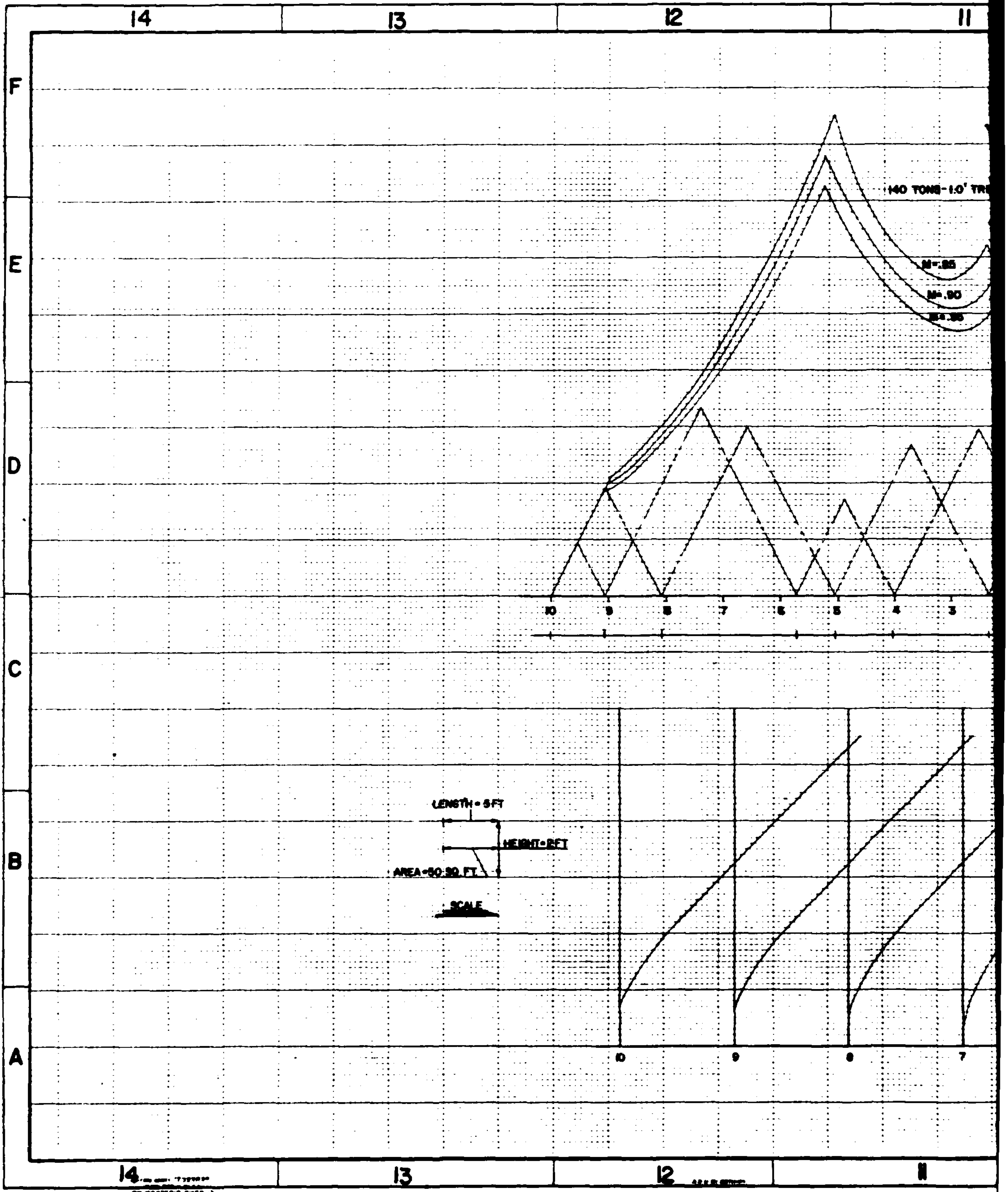
DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
WASHINGTON D.C. 20362

125 FT. WPB US COAST GUARD
CURVES OF FORM
AND OTHER CURVES

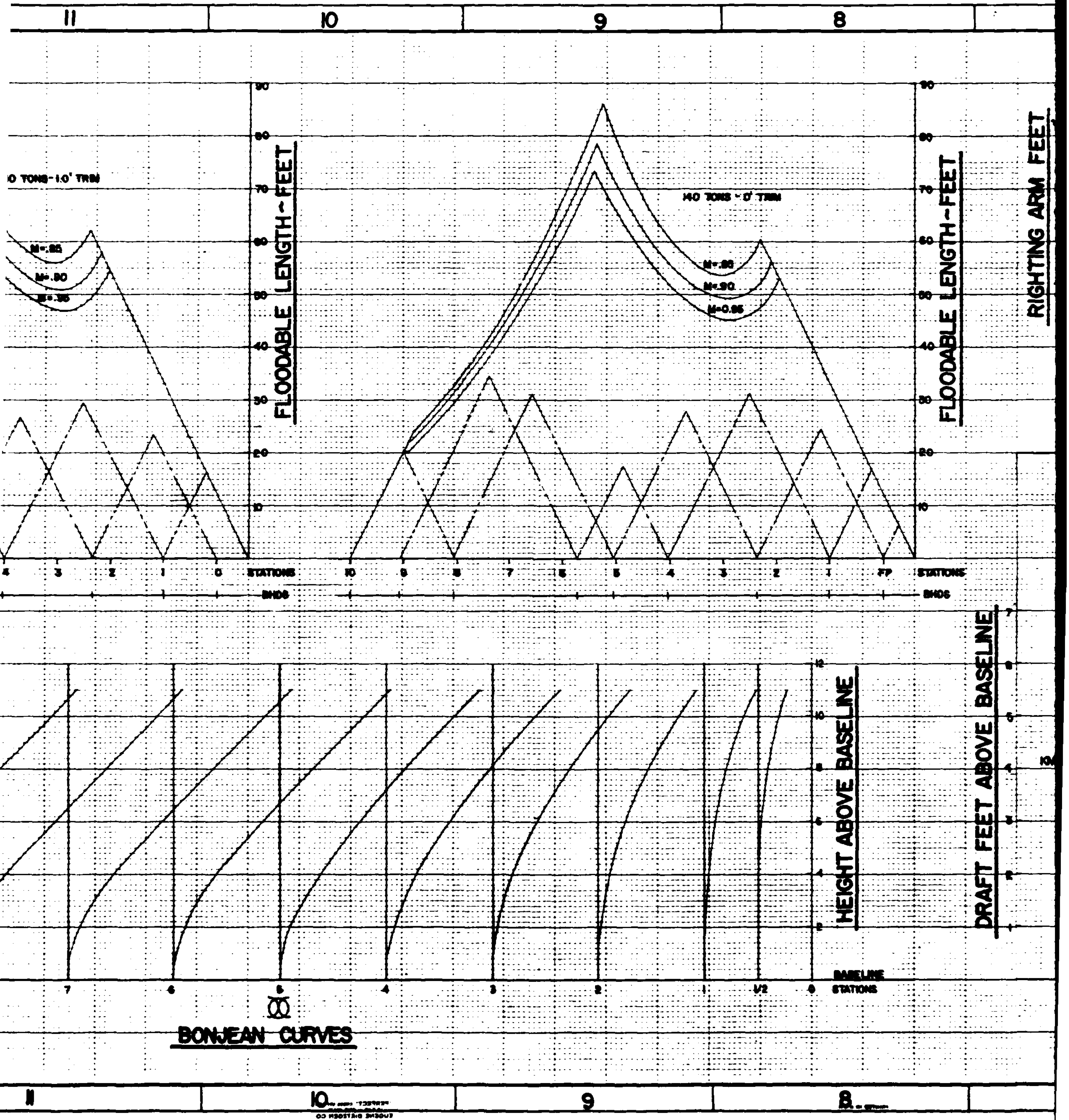
SIZE	CODE IDENT NO.	CRAFT	SWBS	NAVSEA DWG NO.	REV.
H	53711	125' USCG	101	5103584	

SCALE: AS NOTED — SHEET 1 OF 1

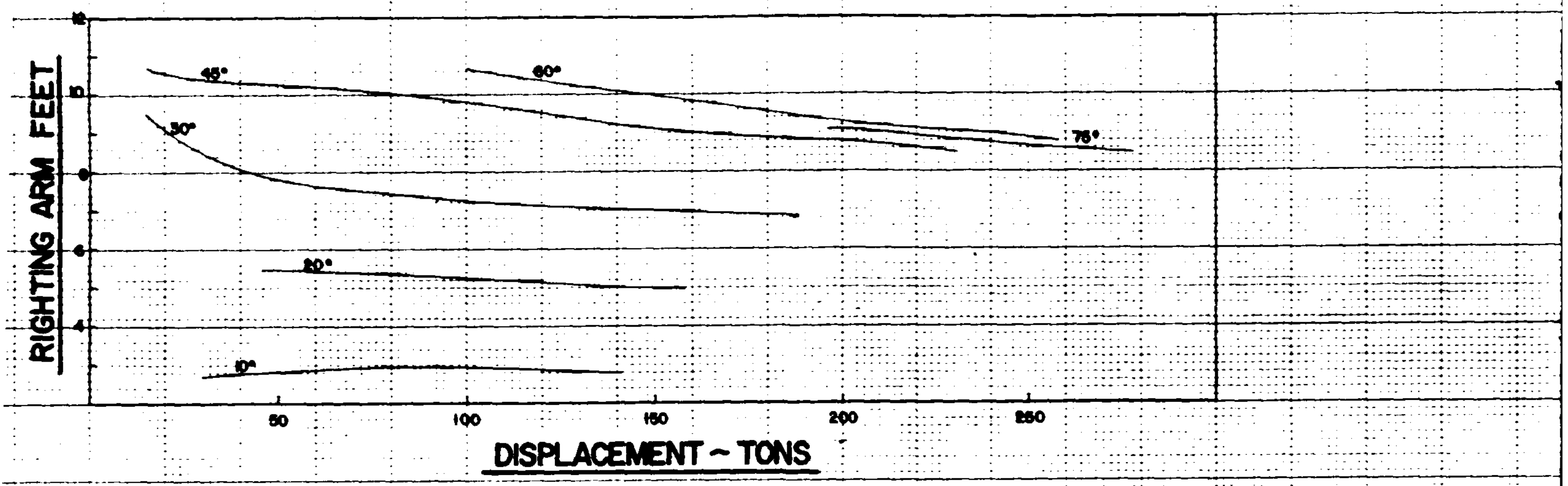
Figure 32

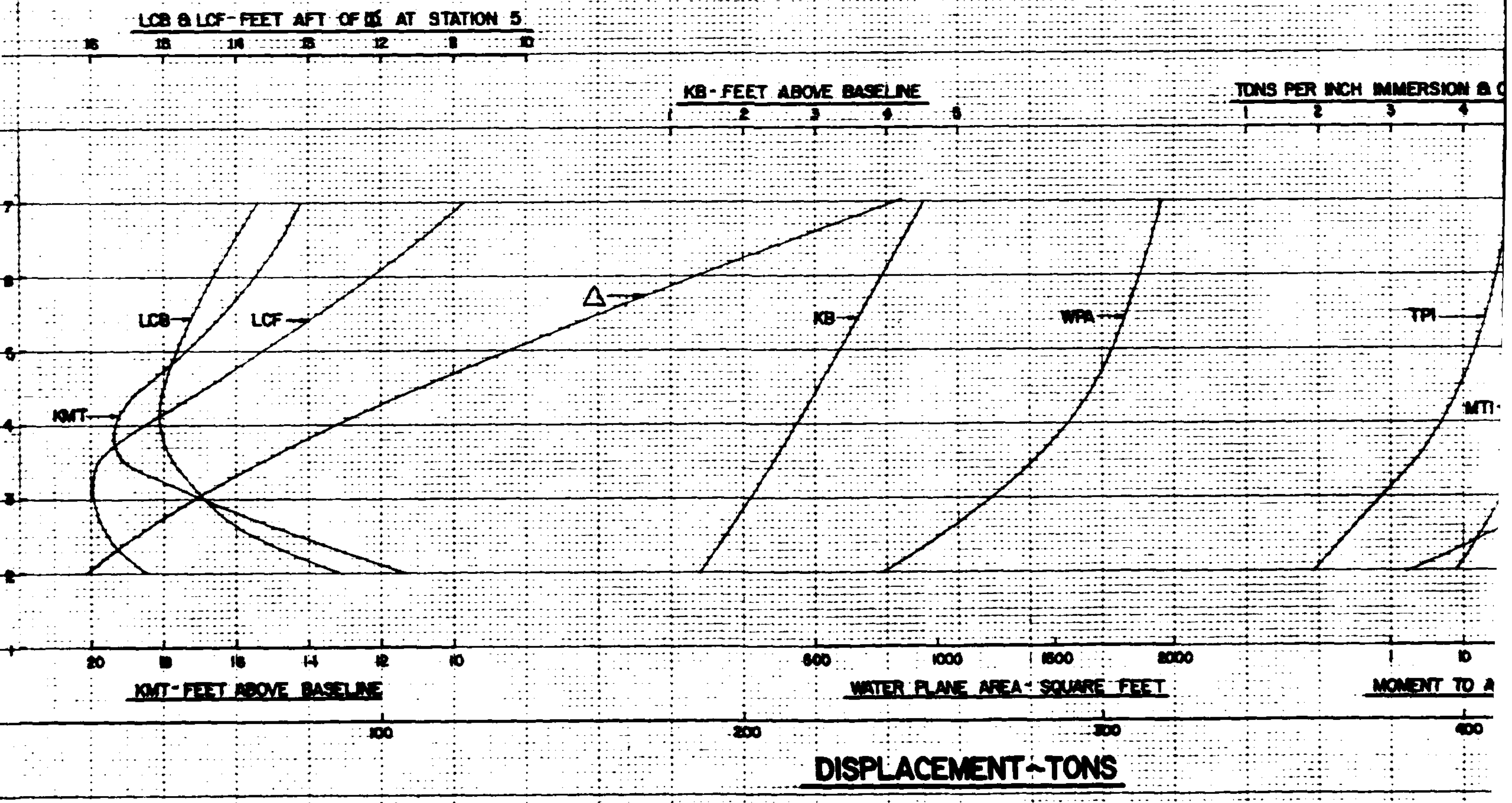


14
13
12
11
F
E
D
C
B
A
140 TONS - 1.0' TR
M=.85
M=.90
10
9
8
7
6
5
4
3
LENGTH = 5 FT
HEIGHT = 2FT
AREA = 50 SQ. FT.
SCALE



11
10
9
8
FLOODABLE LENGTH - FEET
RIGHTING ARM FEET
140 TONS - 0' TRIM
M=.85
M=.90
M=0.95
STATIONS
BHDS
HEIGHT ABOVE BASELINE
DRAFT FEET ABOVE BASELINE
BASELINE
STATIONS
BONJEAN CURVES


RIGHTING ARM FEET
45°
60°
30°
75°
20°
10°
50
100
150
200
250
DISPLACEMENT ~ TONS


LCB & LCF - FEET AFT OF ⊠ AT STATION 5
KB - FEET ABOVE BASELINE
TONS PER INCH IMMERSION
LCB
LCF
Δ
KB
WPA
TPI
KMT
MTI
KMT - FEET ABOVE BASELINE
WATER PLANE AREA - SQUARE FEET
MOMENT TO
DISPLACEMENT ~ TONS

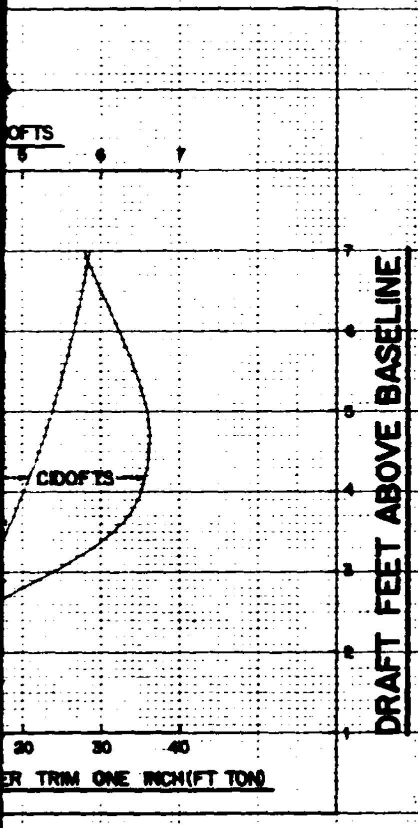
3

REVISIONS			
REV.	DESCRIPTION	DATE	APP'D

L.O.A. = 110'-0"
L.B.P. = 104'-0"
STATION SPACING = 10.4'
D.W.L. = 5.1'

LEGEND

Δ -DISPLACEMENT IN LONG TONS
MTI-MOMENT TO ALTER TRIM ONE INCH
TPI-TONS PER INCH IMMERSION
KM -MEGACENTRIC RADIUS (TRANSVERSE)
KB -CENTER OF BUOYANCY ABOVE BASELINE
LCF-CENTER OF FLOTATION FROM ⊠
WPA-WATER PLANE AREA
LCB-CENTER OF BUOYANCY FROM ⊠
CIDOFTS-CHANGE IN DISPLACEMENT FOR ONE FOOT TRIM BY STERN
GZ -RIGHTING ARMS (ACTUAL)
⊠ -MIDSHIPS @ STATION 5



REF NO	DOCUMENT TITLE		DOCUMENT NO.
1	LINES & OFFSETS	110'	USCG-101-5103580

DATA LIST

FEASIBILITY DRAWING

THIS DWG. WAS DEVELOPED IN CONJUNCTION WITH: NAVSEACOMBATSYSENGSTA REPORT NO. 602-J11

NAVAL SEA COMBAT SYSTEMS ENGINEERING STATION
NAVAL STATION
NORFOLK VA. 23511

DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
WASHINGTON D.C. 20362

110 FT. WPB COAST GUARD
CURVES OF FORM
AND OTHER CURVES

DEVELOPED BY L. WILLIAMS
DRAWN BY L. WILLIAMS
CHECKED BY | DIV. HEAD
DEPT. HEAD | TECH DIR
APPD. FOR NAVSEA
FOR COMMANDER | DATE
Q.A. CHECK | Q.A. DIV HEAD

SIZE	CODE IDENT NO.	CRAFT	SWBS	NAVSEA DWG. NO.	REV.
M	53711		101	5103581	

SCALE: AS NOTED | SHEET 1 OF 1

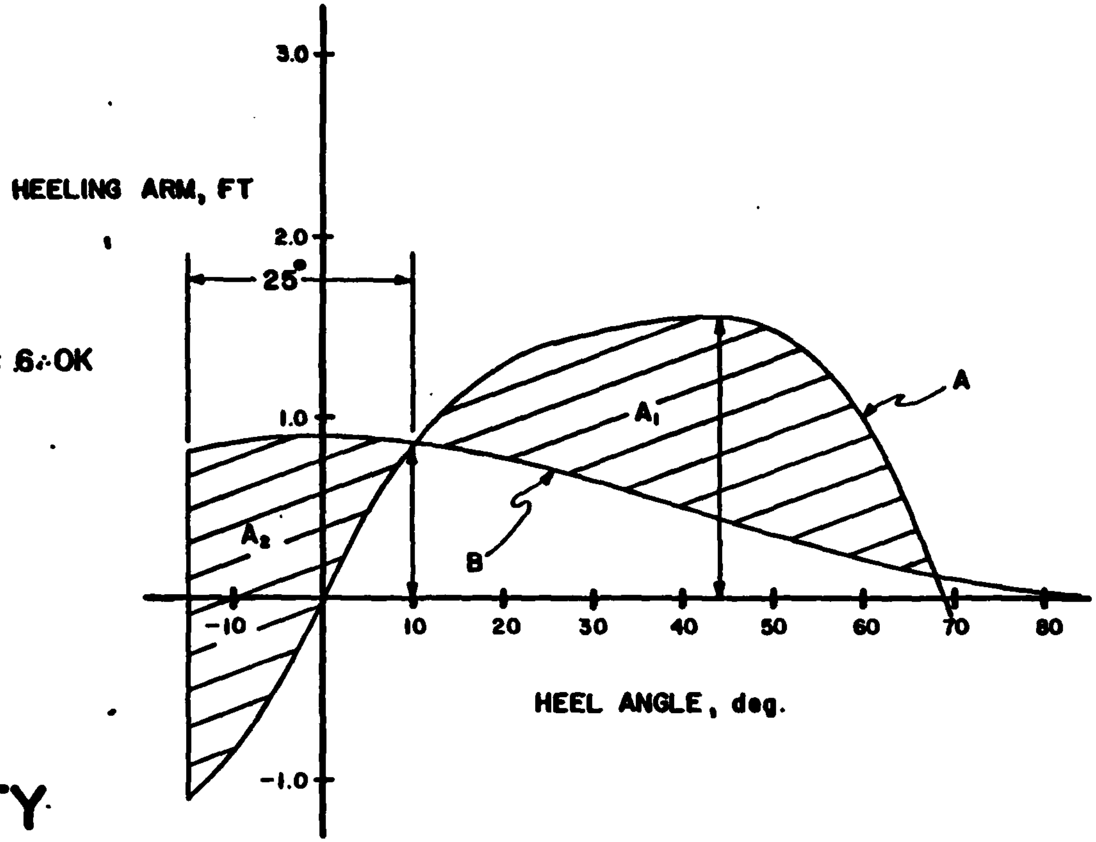
Figure 33

4

MINIMUM OPERATING CONDITION
119 TON DISPLACEMENT
9.50 FT KG

$\frac{\text{CURRENT INTERSECTION}}{\text{MAX. RIGHTING ARM}} = \frac{.86}{1.56} = .55 < .6 \therefore OK$

$\frac{\text{AREA } A_1}{\text{AREA } A_2} = \frac{218.3}{135.3} = 1.61 > 1.4 \therefore OK$



DYNAMIC STABILITY ANALYSIS

(70 KNOT BEAM WIND)
125 FT USCGX

A = RIGHTING ARM CURVE

B = WIND HEEL ARM CURVE

Figure 34

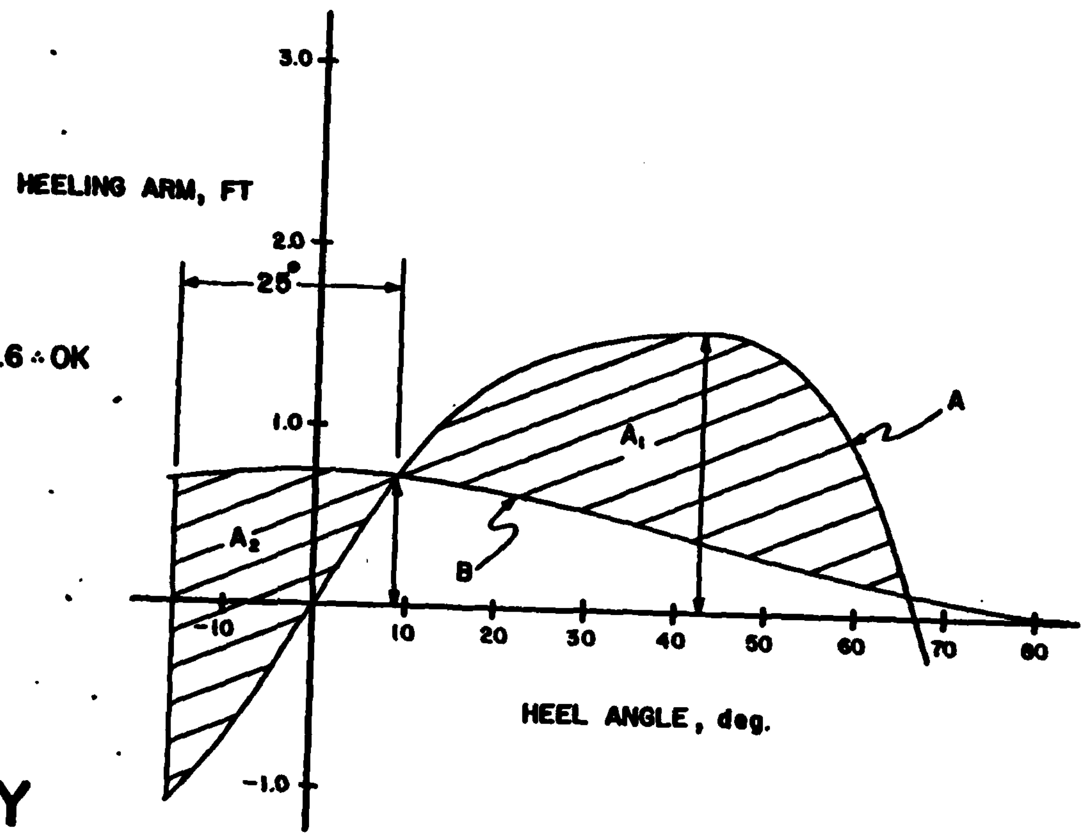
FULL LOAD CONDITION
142 TON DISPLACEMENT
9.28 FT KG

$\frac{\text{CURRENT INTERSECTION}}{\text{MAX. RIGHTING ARM}} = \frac{.72}{1.54} = .47 < .6 \therefore OK$

$\frac{\text{AREA } A_1}{\text{AREA } A_2} = \frac{230}{121.3} = 1.90 > 1.4 \therefore OK$

DYNAMIC STABILITY ANALYSIS

(70 KNOT BEAM WIND)
125 FT USCGX



A = RIGHTING ARM CURVE

B = WIND HEEL ARM CURVE

Figure 35

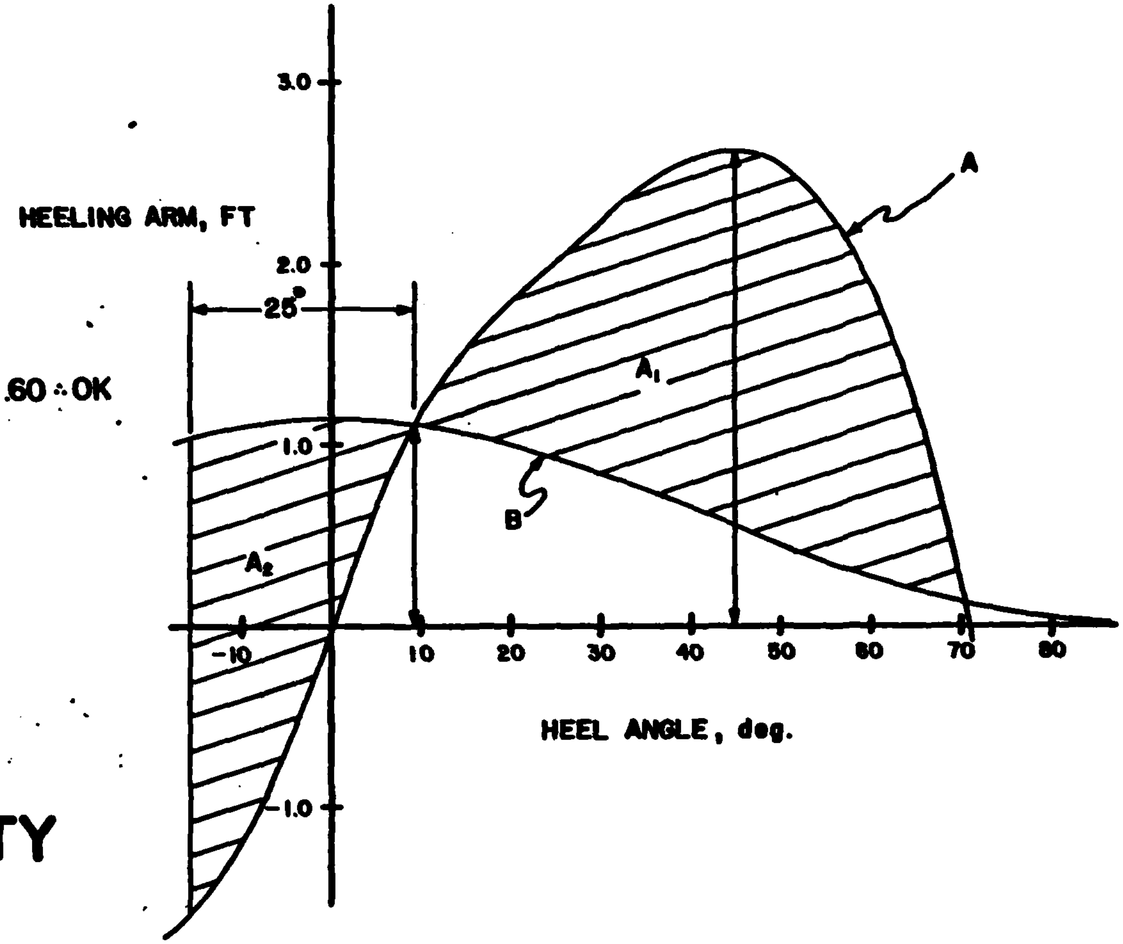
MINIMUM OPERATING CONDITION
117 TON DISPLACEMENT
9.83 FT KG

$\frac{\text{CURRENT INTERSECTION}}{\text{MAX. RIGHTING ARM}} = \frac{1.11}{2.63} = .42 < .60 \therefore \text{OK}$

$\frac{\text{AREA } A_1}{\text{AREA } A_2} = \frac{410}{186} = 2.2 > 1.4 \therefore \text{OK}$

DYNAMIC STABILITY ANALYSIS

(70 KNOT BEAM WIND)
110 FT USCGX



A = RIGHTING ARM CURVE

B = WIND HEEL ARM CURVE

Figure 36

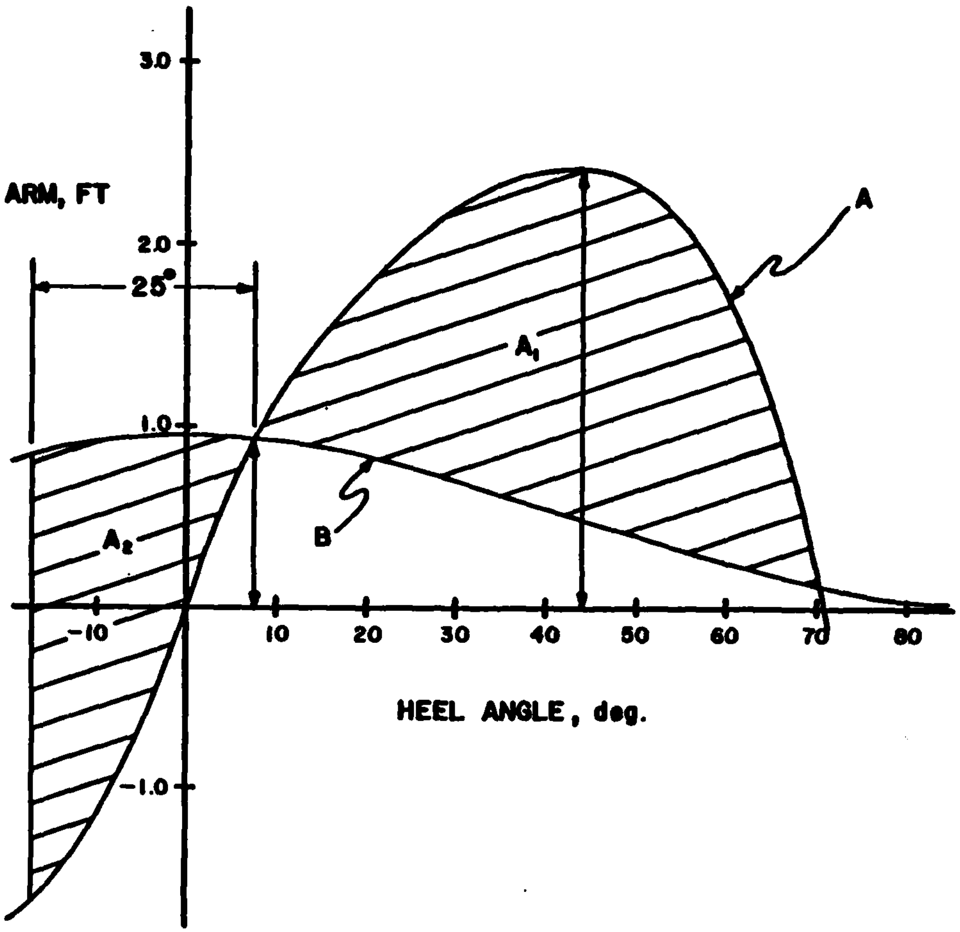
FULL LOAD CONDITION
140 TON DISPLACEMENT
9.64 FT KG

$\frac{\text{CURRENT INTERSECTION}}{\text{MAX. RIGHTING ARM}} = \frac{.94}{2.43} = .39 < .60 \therefore \text{OK}$

$\frac{\text{AREA } A_1}{\text{AREA } A_2} \frac{414}{177} = 2.34 > 1.4 \therefore \text{OK}$

DYNAMIC STABILITY ANALYSIS

(70 KNOT BEAM WIND)
110 FT USCGX



A = RIGHTING ARM CURVE

B = WIND HEEL ARM CURVE

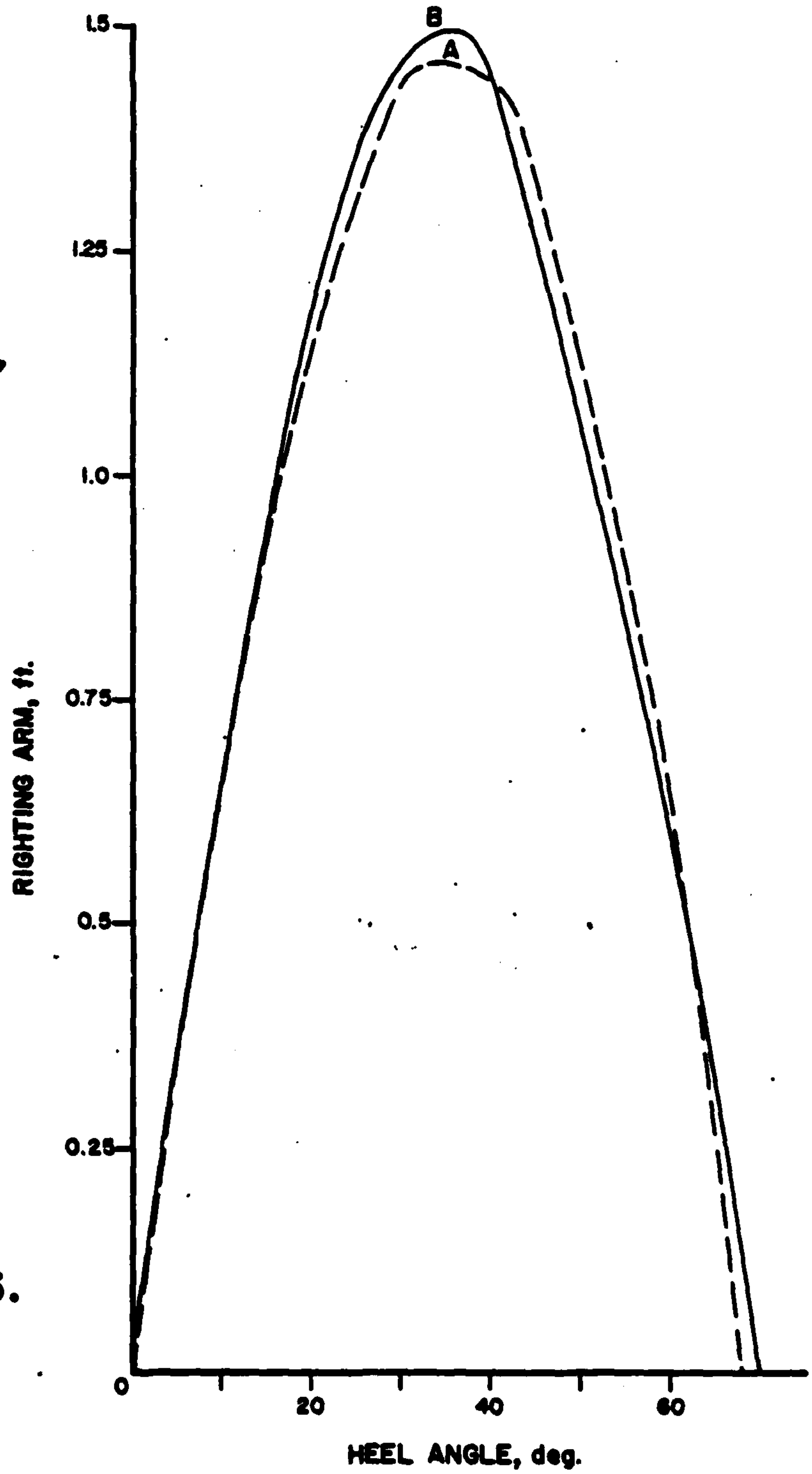
Figure 37

DAMAGED STABILITY

FULL LOAD CONDITION
144.4 TON DISPLACEMENT
KG=9.00'

A. — — — — — — — —
901 GENERATOR RM
910 STORES

B. ————————
910 STORES
920 LAZZARETTE



RIGHTING ARM vs. ANGLE OF HEEL

125' USCGX

Figure 38

DAMAGED STABILITY

140 TON DISPLACEMENT
FULL LOAD CONDITION
KG=9.27 (W/MARGINS)

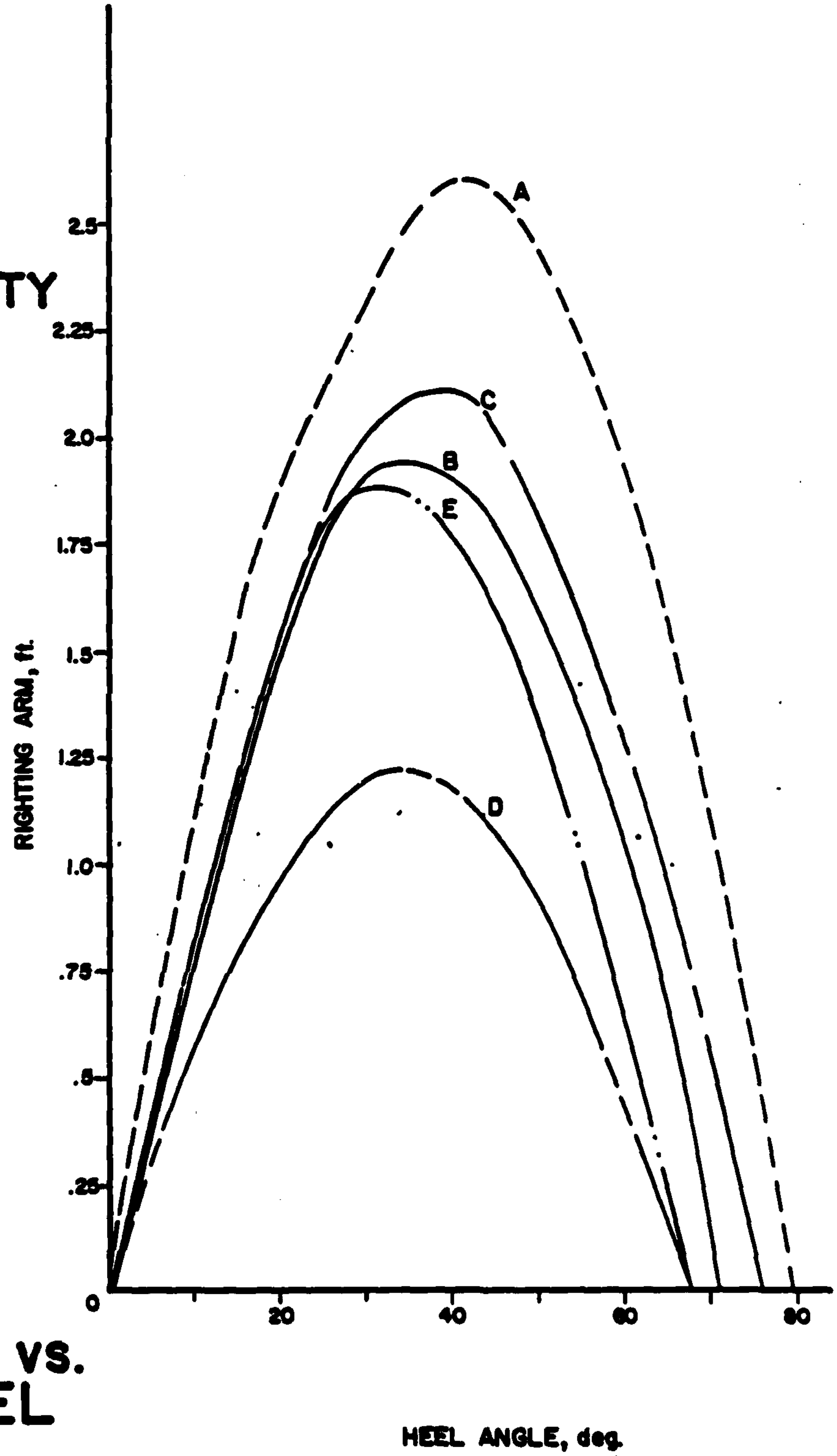
A. — — — — — — — —
501 CREW QTRS/WC
602 FUEL/PORT

B. ————————
601 FUEL/PASS
701 MACHINERY

C. ——— ——— ———
602 FUEL/PORT
701 MACHINERY

D. ———— — — ——
701 MACHINERY
801 AUX MACHINERY

E. ——— .. ———
801 AUX MACHINERY
901 LAZZERETTE



RIGHTING ARM vs. ANGLE OF HEEL

110' USCGX

Figure 39

INTACT STABILITY ON WAVES

142 TON DISPLACEMENT
FULL LOAD CONDITION
KG=9.00

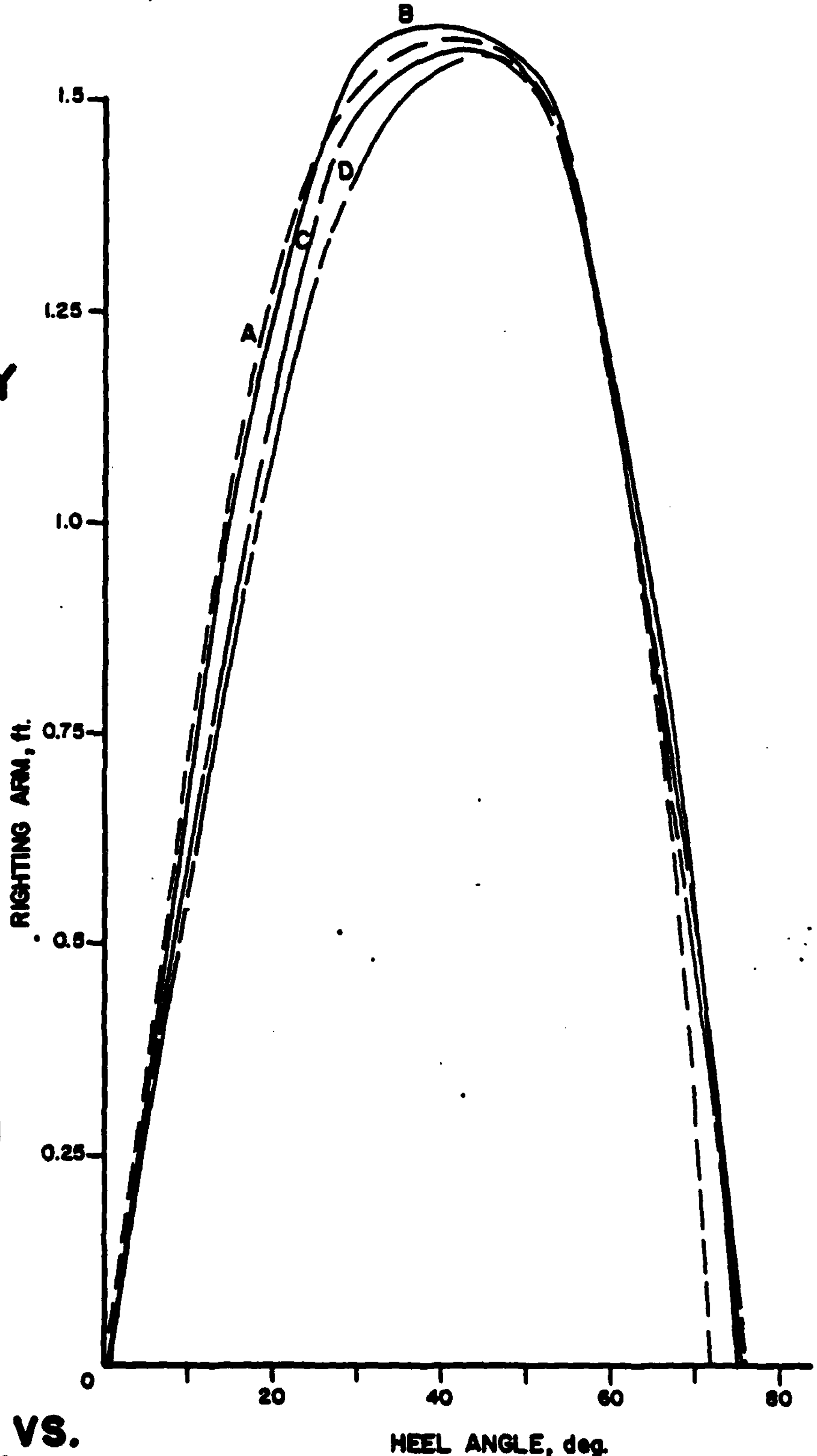
A. — — — — — — — —
WAVE 1-SS3
HEIGHT 4.6
LENGTH 71

B. ————————
WAVE 2-SS4
HEIGHT 6.9
LENGTH 99

C. ———— — ————
WAVE 3-SS5
HEIGHT 10
LENGTH 134

D. ———— — — ————
WAVE 4-SS6
HEIGHT 15
LENGTH 188

WAVE CENTERED @ STATION
13.2' AFT MIDSHIPS



RIGHTING ARM vs. ANGLE OF HEEL
125' USCGX

Figure 40

INTACT STABILITY ON WAVES

140 TON DISPLACEMENT
FULL LOAD CONDITION
KG=9.27

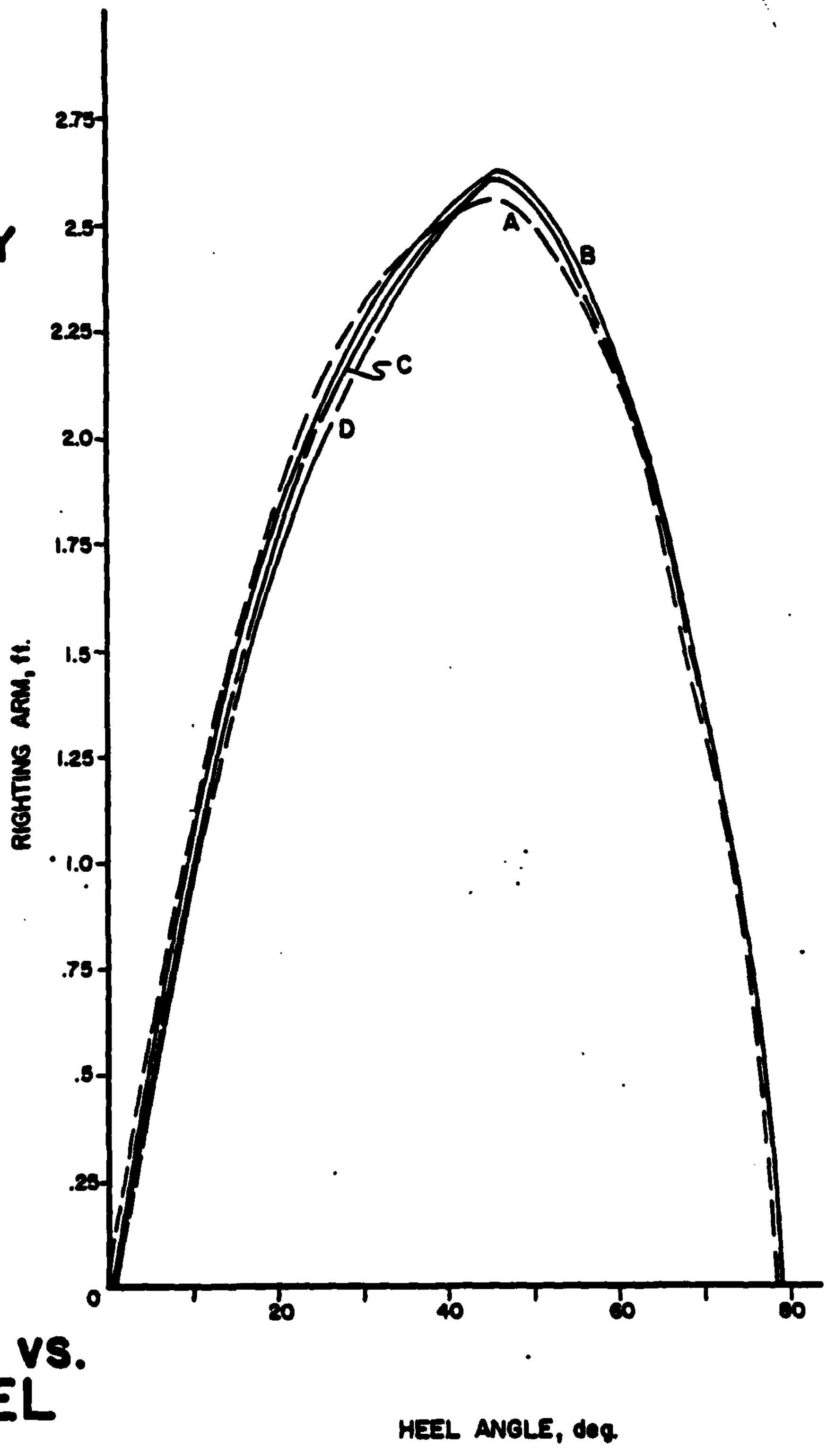
A. — — — — — — — —
WAVE 1-SS3
HEIGHT 4.6
LENGTH 71

B. ————————
WAVE 2-SS4
HEIGHT 6.9
LENGTH 98

C. ———— — ————
WAVE 3-SS5
HEIGHT 10
LENGTH 134

D. ———— — — ————
WAVE 4-SS6
HEIGHT 15
LENGTH 188

WAVE CENTERED @
14.9' AFT MIDSHIPS



RIGHTING ARM vs. ANGLE OF HEEL

110' USCGX

Figure 41

ELECTRIC PLANT (BOTH CRAFT)

The electrical system consists of two 100 kW, 450 V, 60 Hz, AC, DDAD 4-71T diesel-driven generator sets with transformers to provide the 120 V, 60 Hz, AC power, two battery-charging rectifiers to supply 28 Vdc, and two 400 Hz inverters to supply 400 Hz power.

The estimated total electrical load is 60 VA for cruising, 75 VA for battle loading, 50 VA at anchor, pierside while cruising and not preparing meals. The 60 AMP battery-charging rectifier was selected over engine-driven alternators because of reduced maintenance requirements. The 400 Hz static inverter was selected over a MG set because of its small size, light weight, and mean time between failures.

The electric plant is configured to allow for three modes of operation:

- Single generator operation with one generator in standby.

- Parallel operation, (primarily used for transfer of load from one generator to the other).

- Split-plant operation, during which both generators run with each carrying a portion of the total load. This mode is primarily used when increased reliabilty is required, such as in battle conditions or during overload conditions.

The electric plant will be designed to be controlled and monitored primarily from the Engineering Operation Station (EOS). However, the plant can also be monitored from the pilot house.

The distribution system consists of an electric plant control panel (EPCP) located in the EOS, Navy type circuit breaker distribution panels fed from the vital and non-vital bus of the EPCP, transformer banks for 120 V power, and isolated receptacle circuits.

The control system will be designed for unattended automatic operation, although non-automatic control is provided for from the EPCP.

In automatic operation, upon loss of voltage from a generating unit, a standby unit will automatically start paralleling or replacing the unit on the bus. Provisions are made for dropping non-essential loads at any time the load exceeds available generating capacity. Failure of the automatic and remote control will not prevent local starting of a generating unit and connecting it to the bus. The EPCP will contain automatic test and fault isolation for all generating plant units.

All vital auxiliaries for the propulsion plant and navigation are supplied from the 24 Vdc system via the emergency supply battery bank.

AUXILIARY SYSTEMS

The following is a summary of the proposed auxiliary systems:

- Heating, Air-Conditioning, and Ventilation
- Roll Stabilization
- Environmental Control and Sanitation System
- Potable Water
- Fuel System
- Steering System
- Fire Protection

Heating, Air-Conditioning, and Ventilation -

The following criteria govern the design of the heating, air conditioning and ventilation:

Space	Cooling (Maximum temperature)	Heating (Minimum temperature)
Auxiliary machinery space		40° F
Pilot House (enclosed)	80° Fdb 68.2° Fwb	65° F
Living areas (berthing,	80° Fdb 68.2° Fwb	65° F
Galley	105° F	50° F
Main Machinery space		40° F

Design Temperature	Cooling	Heating
Raw Water	85° F	28° F
Weather Air	90° Fdb 81° Fwb	10° F

The heating/cooling system is a reverse cycle system with heating/cooling units designed for mounting in recessed or remote enclosures (e.g., cabinets, voids, or beneath bunks) and ducted to provide the entering air at the optimum location. The quantity of replenishment air for air-conditioned spaces is 5 cfm per man.

The ventilation system has a mechanical air supply and natural exhaust for all machinery spaces and all other spaces requiring removal of a internal heat gain. The ventilation system for the galley has both mechanical supply and exhaust.

A defroster system is provided for the pilot house windows. The system is designed to remove moisture or frost from the windows. There is a heater, blower, ducting, controllable louvers, and dampers to distribute the heated air.

Roll Stabilization -

Roll stabilization will be provided by four (4) hydraulically operated trim tabs located just outboard of the propellers, and approximately 10' forward of the transom, port and starboard. Hydraulic power will be provided by either of four self-contained power packs, actuating hydraulic cylinders. In addition to roll stabilization, tabs will provide a means for controlling running trim and port or starboard list that may be encountered during unusual loading conditions.

Environmental Control and Sanitation System -

The environmental control system would consist of a vacuum collection system, such as Mansfield or EVAK Products, that collects the waste during flush action and forces it into a holding tank with the use of air in lieu of water. This allows a smaller holding tank than is necessary with other systems. Sanitation drainage piping and an additional holding tank storage would be needed for the waste water generated during bathing, cooking, etc.

Potable water System -

The potable water system will consist of a fresh water tank, distribution piping, pumps, heaters, and a desalinization system. The tank will be supplied with fresh water from shoreside facilities by a main deck connection and fill and vent piping, and by the desalinator when required. The tank will store 1500 gallons of fresh water. Distribution of potable water will be accomplished by a main and branch piping. Pressure will be provided by either one or two pumps, located in the outboard diesel generator rooms, taking suction from the fresh water tank.

Hot water will be supplied by two 100-gallon quick recovery heaters, while additional or extremely hot water requirements will be met by local boost heaters.

Fuel System -

The crafts' fuel system will be capable of receiving up to 30 tons of fuel from dockside, storing the fuel, transferring the fuel between tanks, and supplying fuel to the day tanks which will in turn supply the diesel engines.

Fuel receipt will be accomplished by a 5-inch main on each side of the craft feeding risers to each tank. A 2 1/2-inch tank vent will be provided on each side to allow venting on the opposite side from receiving.

A settling tank with a stripping and filter system to remove impurities from the fuel prior to transfer to the day tank will be supplied between the main fuel tanks and the day tanks.

A transfer system consisting of pumps, piping, and manifold system will be installed between all tanks to allow ready transfer of fuel as required under all circumstances.

Steering System -

The steering consists of an electrical-hydraulic steering system, controlled from the pilot house. The system will also be controllable from an auxiliary steering station on the flybridge using duplicate electrical controls, and by using a manually operated standby hydraulic pump. In addition, provisions will be made for a walk-around, hand-held steering control plug-in on the flybridge.

Fire Protection -

Active fire protection is provided by an extinguishing system installed throughout the craft, using HALON, CO_2, Purple-K and water as required, and shown in Table 5.

Portable 15-pound CO_2 and 20-pound Purple-K extinguishers will be located throughout the ship for extinguishing small localized fires.

CO_2 is used in areas of probable electrical/electronic fires, and Purple-K in areas for oil, grease, or petroleum-based fires.

Passive fire protection will be accomplished by treatment of selected bulkhead/deck structure with fire-resistant insulation material.

An engine-driven firemain pump will be provided for the sprinkler system, with a flexible coupling connecting a P250 pump as a back-up. In addition, a portable P250 pump will be located in the designated space above the main deck.

Table 5. FIRE PROTECTION SYSTEM

TYPE OF SPACE	AGENT	TYPE OF SYSTEM
Machinery (Main Propulsion)	Halon*	Automatic-Optical and Thermal Sensors
Machinery (Diesel Generators)	Halon*	Automatic-Optical Sensors
Flammable Liquid Storeroom (or Deck Gear Locker as designated)	Halon*	Automatic-Optical
Electronic and Electrical	CO_2	Manual-Hand Held
Crew Living	CO_2 and Water	Hand Held CO_2 and Firemain
Main Deck	Water	Firemain
Galley	PKP/CO^2	Hand Held
Ammo Stowage	Halon and Water	Automatic-Optical, and Thermal Sensors Sprinkler-Firemain
Misc Stowage	PKP/CO_2	Hand Held
Fuel Line Trunks	Halon	Automatic-Optical

*Will also contain necessary type of hand-held extinguisher.

OUTFIT FURNISHINGS AND ARRANGEMENT

Optimum Arrangement -

From an optimum use point of view, the 110' USCGX offers a slightly improved space arrangement because of the increased beam. Figure 42 gives an indication of the optimum hull dimensions based strictly on volume requirements. The optimum volume for the L/B = 4.6 hull would be obtained by a 106.5' LWL with a 22.8" Bpx, while the optimum L/B = 6.0 would be a 121.5' LWL with a 20.1' Bpx. This volume has been obtained based on 20 $ft.^2$ habitability minimum for each man, fuel requirements, and machinery arrangement. A minimum may be found for the machinery arrangement in figure which is a Bpx of 19.5'. Other considerations must be made that effect a compromise of hull dimension such as power requirements, ride quality, economy, etc. However, even with taking this into consideration, the final dimensions arrived at for both the 110' and 125' versions fall within the acceptable volume limits as indicated. The 125' USCGX offers 18 $ft.^2$ per man in the berthing areas, while the 110' USCGX allows the prescribed 20 $ft.^2$ limit per man.

125' USCGX Outfit -

This craft will accommodate standard Navy or Coast Guard furnishings and provide 18 square feet per man in the berthing areas. The general arrangement of spaces for the 125' USCGX is shown in figure 43. The description of these spaces is as follows:

Commissary Spaces -

The commissary spaces consist of the galley and messroom located between frames 15 and 19, port to starboard on the maindeck. Access to these spaces is either from the crew's berthing area on C deck below, or down from the pilot house.

Equipment and furnishings to be provided are:

- Range
- Oven
- Microwave Oven
- Refrigerator/Freezer
- Coffee Maker
- Sink
- Rangehood w/Blower
- Cabinets
- Dishwasher
- Seats and Mess Tables

Berthing -

The berthing spaces in the craft are located as follows:

Crew - located on the first platform between frames 10 and 19 with:

- B-2 locker per man
- Full height locker per man

- Berth with locker under per man

CPO - located on the maindeck between frames 19 and 23 starboard side with:

- Secretary/Bureau per man
- Berth with locker under per man

Officer - located between frames 19 and 23, maindeck, port side directly across from the CPO quarters with:

- Berth with locker under
- Secretary/Bureau
- Clothes Closet
- Security Safe

Washrooms -

The washrooms spaces are located as follows:

Crew - located on the first platform between frames 13 and 16 with:

- Separate facilities for male and female
- Water Closet
- Lavatory
- Shower
- Accessories

CPO - located on the maindeck forward of the CPO berthing with:

- Water Closet
- Shower
- Lavatory
- Accessories

Officer - located on the maindeck forward of the officers, berthing with:

- Water Closet
- Shower
- Lavatory
- Accessories

Miscellaneous -

Miscellaneous compartments located throughout the craft consist of small arms locker, stores, Bosun's locker, ammo, deck gear lockers, and an anchor chain locker.

110' USCGX Outfit -

This craft will also accommodate standard Navy or Coast Guard furnishings, but will provide 20 $ft.^2$ per man in the berthing areas. The general arrangement of spaces for the 110' USCGX is shown in figure 44.

The descriptions of these spaces are identical to the 125' version except for differences in location.

Illumination -

Illumination in the living and working spaces for both craft is provided by overhead and bulkhead mounted watertight fluorescent fixtures and overhead-mounted watertight incandescent red light fixtures for darkened ship conditions.

OPTIMUM HULL CHOICE FOR ARRANGEMENTS

BEAM vs. LENGTH

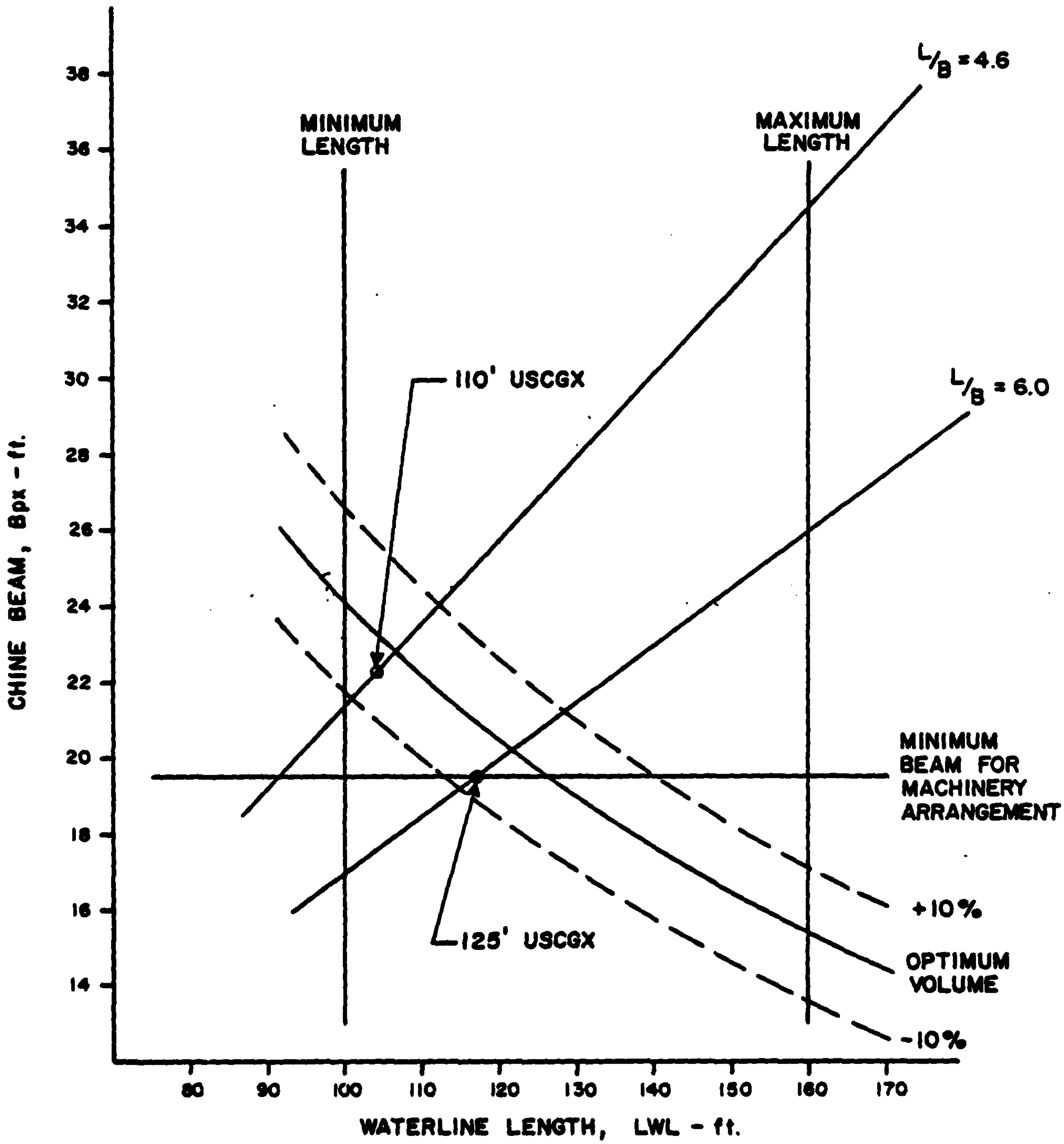
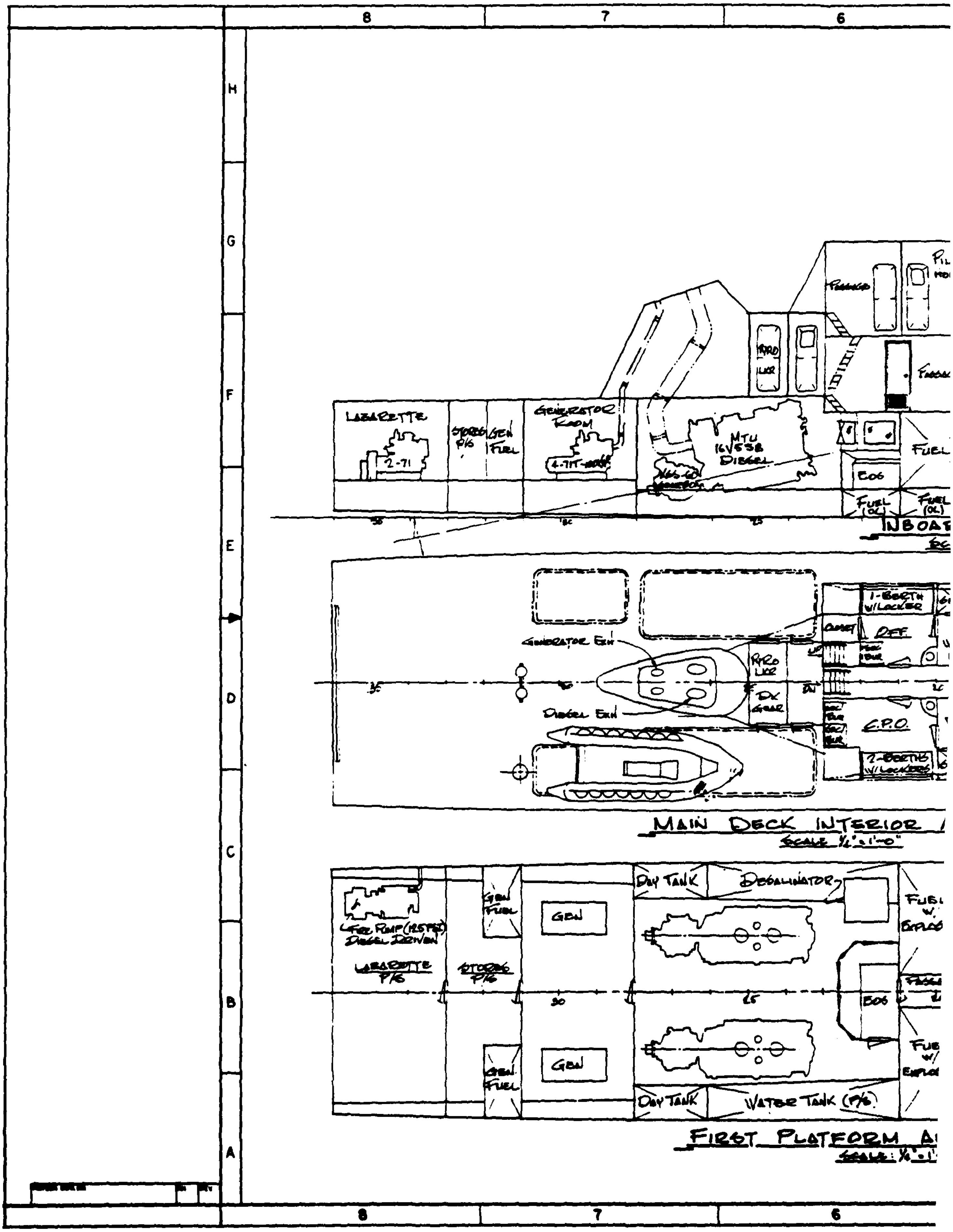
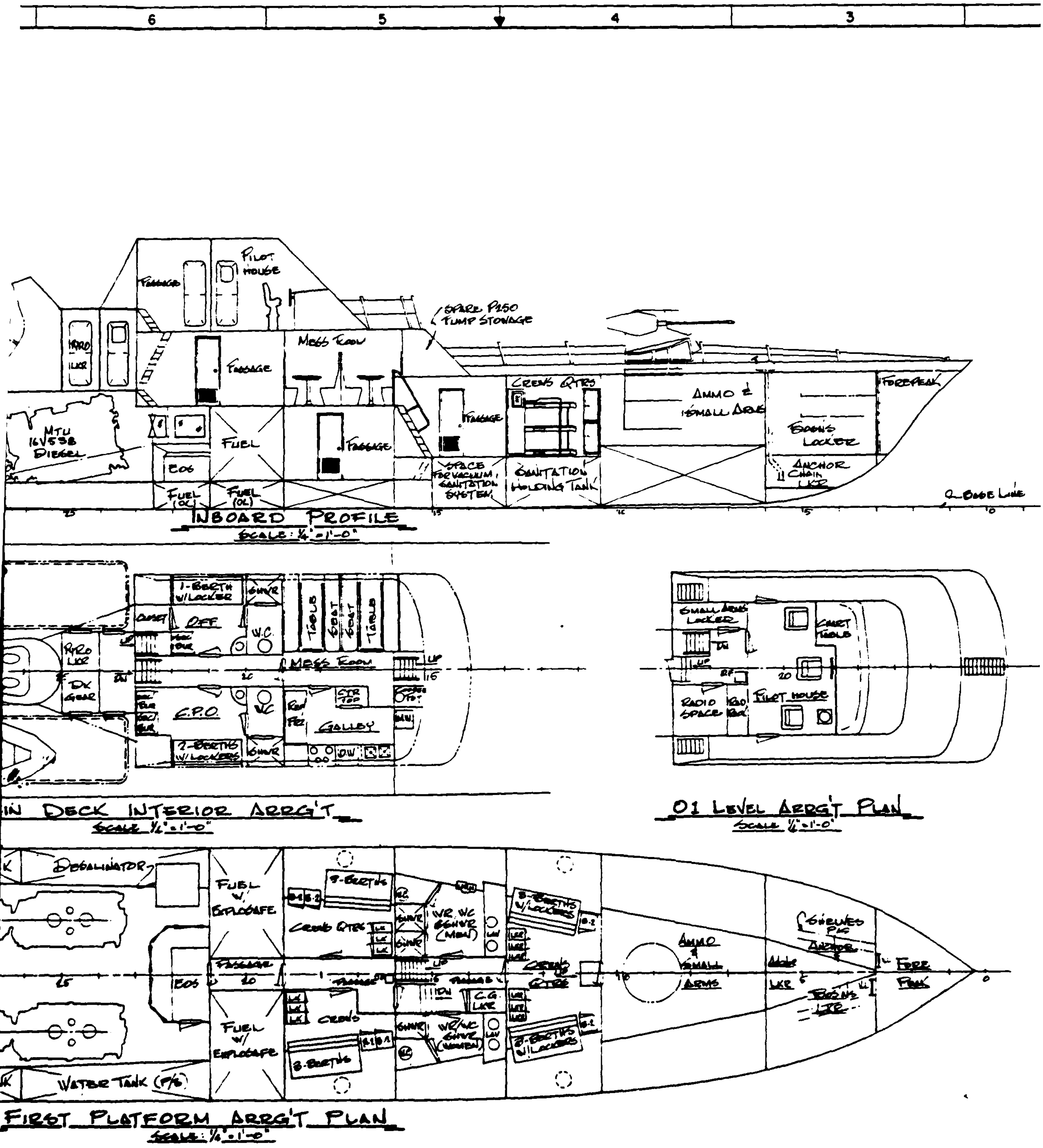


Figure 42



LAZARETTE
2-71
STORES P/S
GEN FUEL
GENERATOR ROOM
MTU 16V538 DIESEL
EOS
FUEL (OL)
INBOAR
GENERATOR EXH
DIESEL EXH
1-BERTH W/LOCKER
OFF.
C.P.O.
2-BERTHS W/LOCKERS
MAIN DECK INTERIOR
SCALE ½"=1'-0"
DAY TANK
DESALINATOR
FIRE PUMP (125PSI) DIESEL DRIVEN
LAZARETTE P/S
STORES P/S
GEN
WATER TANK (P/S)
FIRST PLATFORM A

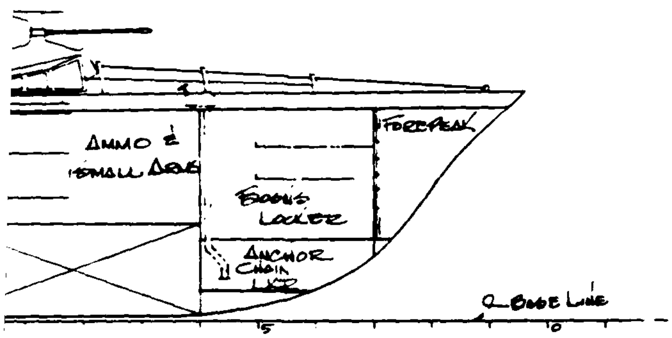


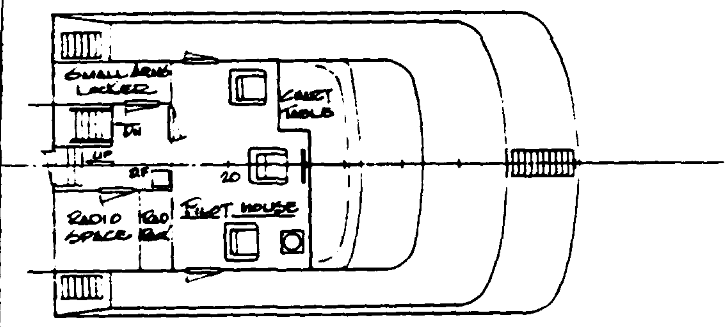
6
5
4
3
PILOT HOUSE
PASSAGE
HARD LKR
MESS ROOM
SPARE P250 PUMP STOWAGE
CREWS QTRS
AMMO & SMALL ARMS
FOREPEAK
BOSN'S LOCKER
ANCHOR CHAIN LKR
MTU 16V538 DIESEL
FUEL
EOS
FUEL (OL)
SPACE FOR VACUUM SANITATION SYSTEM
SANITATION HOLDING TANK
BASE LINE
INBOARD PROFILE
SCALE: 1/4"=1'-0"
1-BERTH W/LOCKER
SHWR
CLOSET
OFF
W.C.
PYRO LKR
DK GEAR
MESS ROOM
C.P.O.
2-BERTHS W/LOCKERS
GALLEY
CTR TOP
DW
IN DECK INTERIOR ARRG'T
SCALE 1/4"=1'-0"
SMALL ARMS LOCKER
CHART TABLE
RADIO SPACE
PILOT HOUSE
01 LEVEL ARRG'T PLAN
SCALE 1/4"=1'-0"
DESALINATOR
FUEL W/ EXPLOSAFE
3-BERTHS
CREWS QTRS
WR WC SHWR (MEN)
3-BERTHS W/LOCKERS
PASSAGE
C.G. LKR
WR/WC SHWR (WOMEN)
AMMO & SMALL ARMS
SHELVES P/S
ANCHOR
FORE PEAK
BOSNS LKR
WATER TANK (P/S)
FIRST PLATFORM ARRG'T PLAN
SCALE: 1/4"=1'-0"

Figure 43

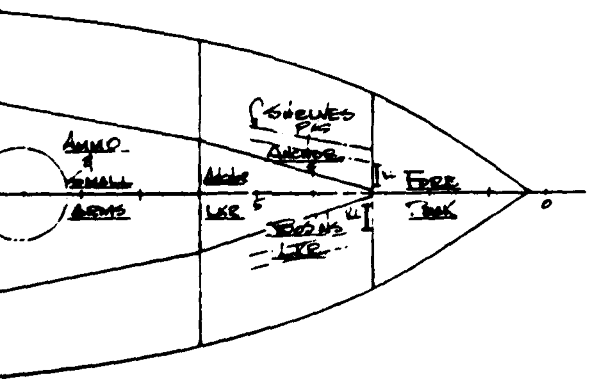
ZONE	REV	DESCRIPTION	DATE	APPROVED

REVISIONS





01 LEVEL ARRG'T PLAN
Scale 1/4"=1'-0"



REF NO	DOCUMENT TITLE	DOCUMENT NO
3	OUTBOARD PROFILE AND DECK ARRANGEMENT	101-5103585
2	CURVES OF FORM	101-5103584
1	LINES AND OFFSETS	101-5103574

DATA LIST

FEASIBILITY DRAWING

THIS DWG DEVELOPED IN CONJUNCTION WITH NAVSEACOMBATSYSENGSTA REPORT NO 80-111

NAVAL SEA COMBAT SYSTEMS ENGINEERING STATION
NAVAL STATION
NORFOLK, VA.

DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND

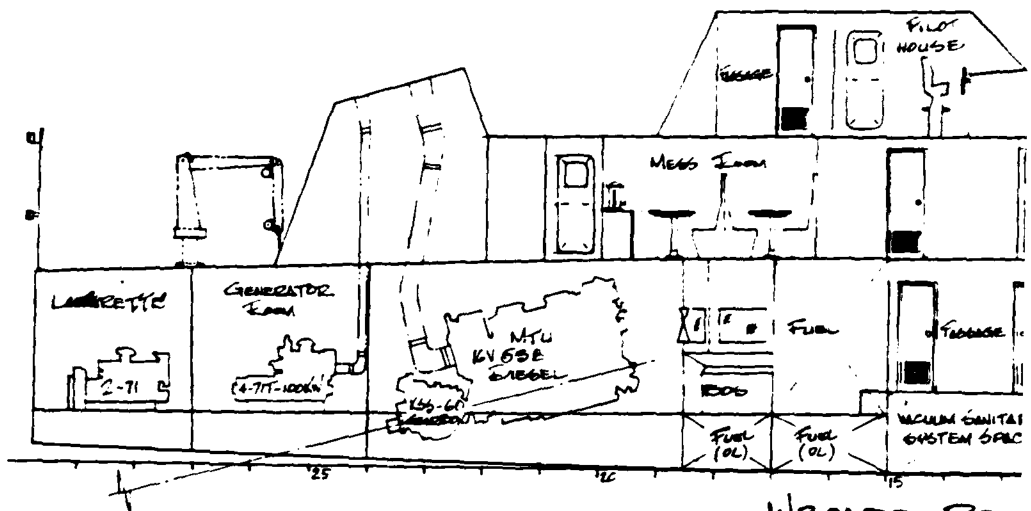
125 FT WPB U S COAST GUARD
INBOARD PROFILE AND DECK ARRANGEMENT

H	53711		101	5103586

SCALE 1/4" = 1'-0" SHEET 1 OF 1

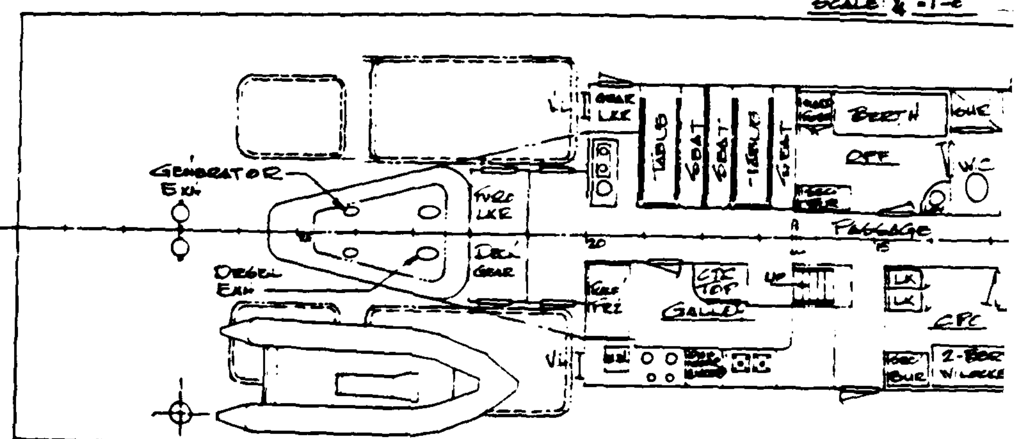
Figure 43

9	8	7	6



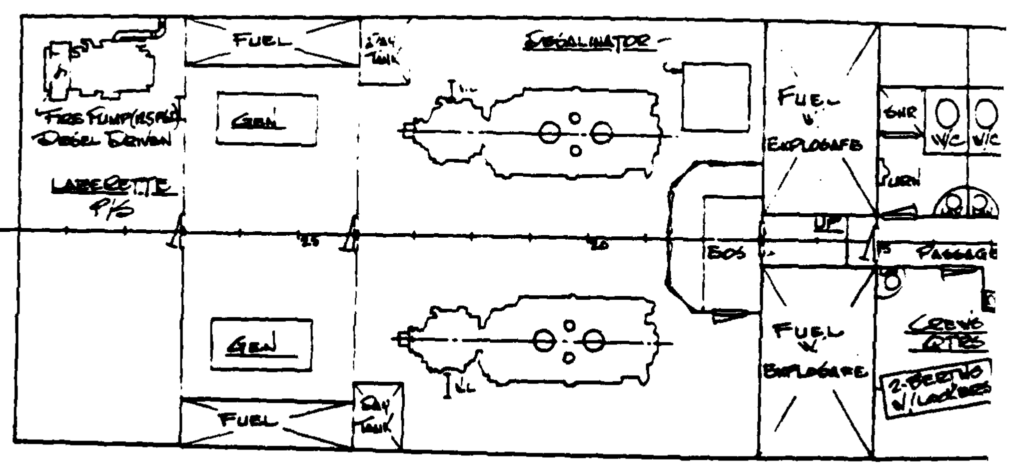
INBOARD PRO

SCALE: ¼"=1'-0"



MAIN DECK INTERIOR ARRG'T

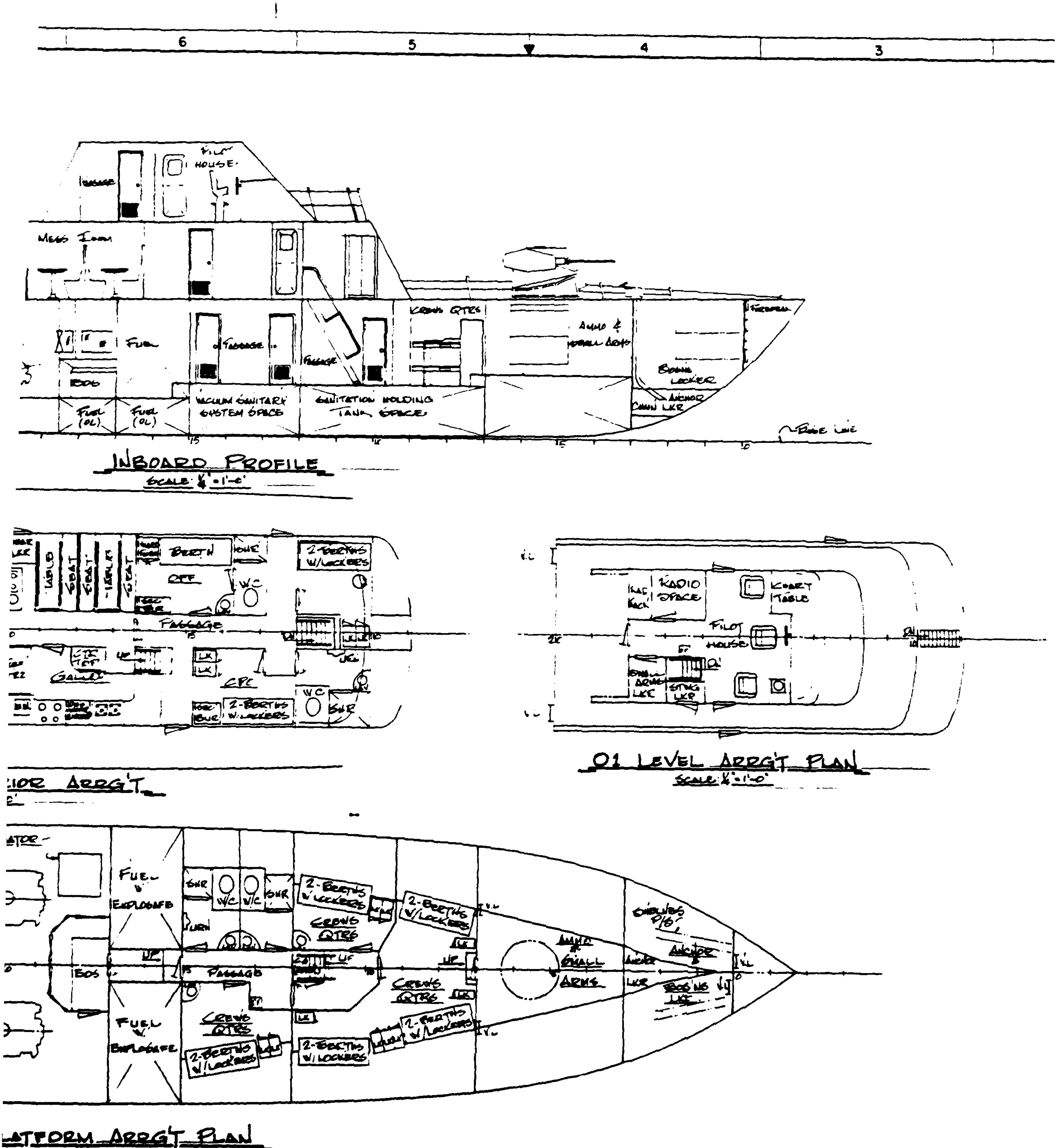
SCALE: ¼"=1'-0"



FIRST PLATFORM ARRG'T PLAN

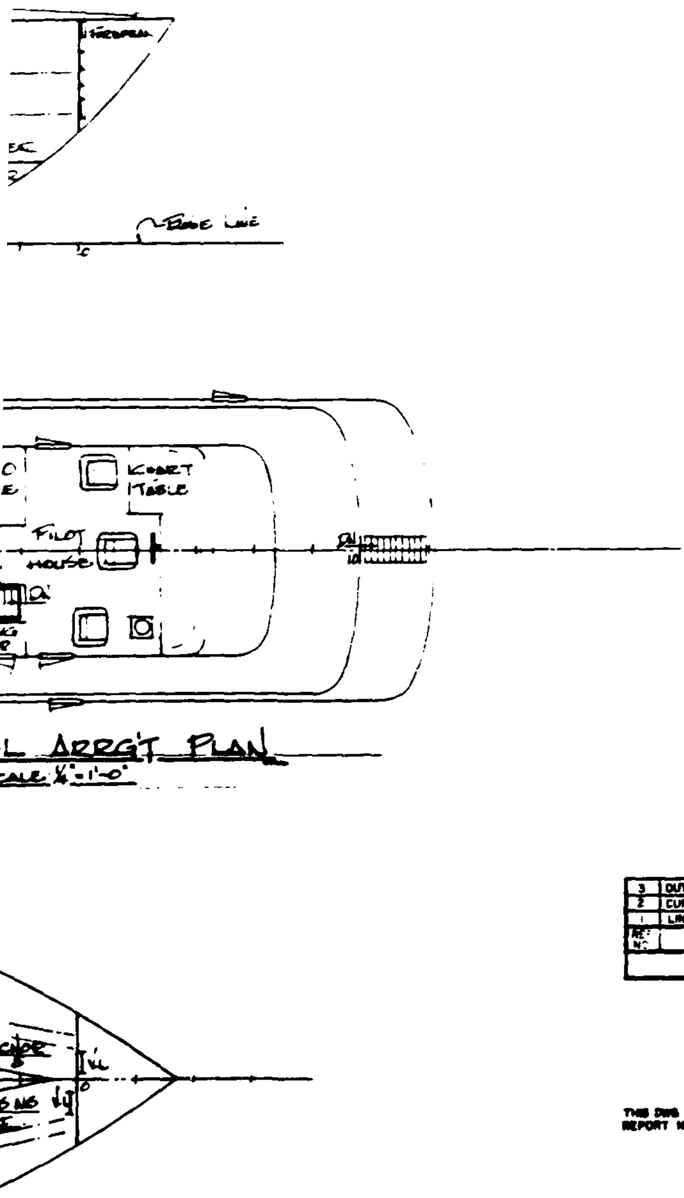
SCALE ¼"=1'-0"

8	7	6



PILOT HOUSE
MESS ROOM
FUEL
PASSAGE
CREWS QTRS
AMMO & SMALL ARMS
BOSNS LOCKER
ANCHOR CHAIN LKR
VACUUM SANITARY SYSTEM SPACE
SANITATION HOLDING TANK SPACE
FUEL (OL)
BASE LINE
INBOARD PROFILE
SCALE ¼"=1'-0"
BERTH
OFF
W.C.
2-BERTHS W/LOCKERS
GALLEY
CIC
SHR
RADIO SPACE
CHART TABLE
PILOT HOUSE
01 LEVEL ARRG'T PLAN
SCALE ¼"=1'-0"
FUEL & EXPLOSAFE
CREWS QTRS
UP
PASSAGE
AMMO & SMALL ARMS
ANCHOR
BOS'NS LKR
ATFORM ARRG'T PLAN
SCALE ¼"=1'-0"

Figure 44



REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED

REF NO	DOCUMENT TITLE	DOCUMENT NO
3	OUTBOARD PROFILE AND DECK ARRANGEMENT	101-5103582
2	CURVES OF FORM	101-510358
1	LINES AND OFFSETS	101-510358

DATA LIST

FEASIBILITY DRAWING

THIS DWG WAS DEVELOPED IN CONJUNCTION WITH NAVSEACOMBATSYSENGSTA REPORT NO 60-111

Figure 44

NAVAL SEA COMBAT SYSTEMS ENGINEERING STATION
NAVAL STATION
NORFOLK, VA 23511

DEVELOPED BY [illegible]
DRAWN BY W.S. DAVIS

DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
WASHINGTON DC 20362

110 FT. WPB U S COAST GUARD
INBOARD PROFILE AND
DECK ARRANGEMENT

H | 53711 | | 101 | 5103583

SCALE 1/8" = 1'-0" SHEET 1 OF 1

CONCLUSIONS

1. Either craft ~~presented in the feasibility study~~ is capable of performing both the primary and secondary missions. These craft have the speed for interception, good ride quality and low acceleration characteristics in high sea states, the necessary load-carrying capability for navigation aids or weapons, and the proper equipment for law enforcement (RIB, crane and weapon system).

2. The 125' USCGX meets all of the design guidelines as presented in this study. The 110' version meets all of the requirements with the exception that it only meets the minimal requirements of endurance and cannot meet the 35 knot burst speed.

3. A synopsis of comparison between the 125' and 110' USCGX and the design guidelines follows:

	DESIGN GUIDELINE	125' USCGX	110' USCGX
C.1.a.	5.4 m RIB w/Crane	Supplied	Supplied
b.	2-50 cal. Machine Gun Mounts	6 Pintle mounts	4 Pintle mounts
c.	Towing Bitt	Supplied	Supplied
d.	Small Arms Locker	2 1/2'x7' supplied	3 1/2'x4' supplied
e.	Desalinator	Supplied	Supplied
f.	Pyro Locker	3 1/2'x3 1/2' supplied	3 1/2'x3 1/2'supplied
g.	Clear Deck Area Aft	390 ft supplied	225 supplied
C.2.a.	30 knots-Sea State 2	30.4 knots	29.0 knots
b.	25 knots-Sea State 3	30.0 knots	28.7 knots
c.	20 knots-Sea State 4	29.9 knots	28.5 knots
d.	35 knot Dash (calm wtr.)	35.2 knots (30 tons fuel)	32.5 knots (30 tons fuel)
e.	Survive Sea St. 6	Survive Sea St. 6	Survive Sea St.6
C.3.a.	5-7 Day Mission		
	24 hrs @ 26K	24 hrs @ 26K	24 hrs @ 26K
	144 hrs @ 10K	144 hrs @ 10K	96 hrs @ 10K
	10% reserve fuel	Supplied	Supplied
C.4.a.	90% Operation South of 38N - 300 MI Radius	Yes	Yes
C.5.a.	1 Officer	Arrangements Provided	Arrangements Provided
b.	2 CPO	Arrangements Provided	Arrangements Provided
c.	11 Enlisted	Arrangements Provided	Arrangements Provided

	DESIGN GUIDELINE	125' USCGX	110' USCGX
C.6.a.	Roll Stabilization	Provided	Provided
b.	2-Compartment Stability	Provided	Provided
c.	External Fire Fighting	Provided	Provided
d.	Aluminum Construction	Provided	Provided
e.	15 Year Hull Life	Provided	Provided

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2. Savitsky, D., and Koeblel, J. G., Jr., "Seakeeping Considerations in Design and Operation of Hard Chine Planing Hulls," Prepared for Combatant Craft Engineering Department, NAVSECNORDIV, May 1983.

3. Heller, S. R., and Jasper, N. H., "On the Structural Design of Planing Craft," Quarterly Transactions of RINA, Jul 1960.

4. Allen, R. G., and Jones, R. R., "Considerations on the Structural Design of High Performance Marine Vehicles," SNAME, NY Metropolitan Section, Jan 1977.

5. "Procedures Manual - Dynamic Stability Analysis for U.S. Navy Small Craft," NAVSEADETNORFOLK Report No. 6660-99, Sept 1982.

APPENIDIX A

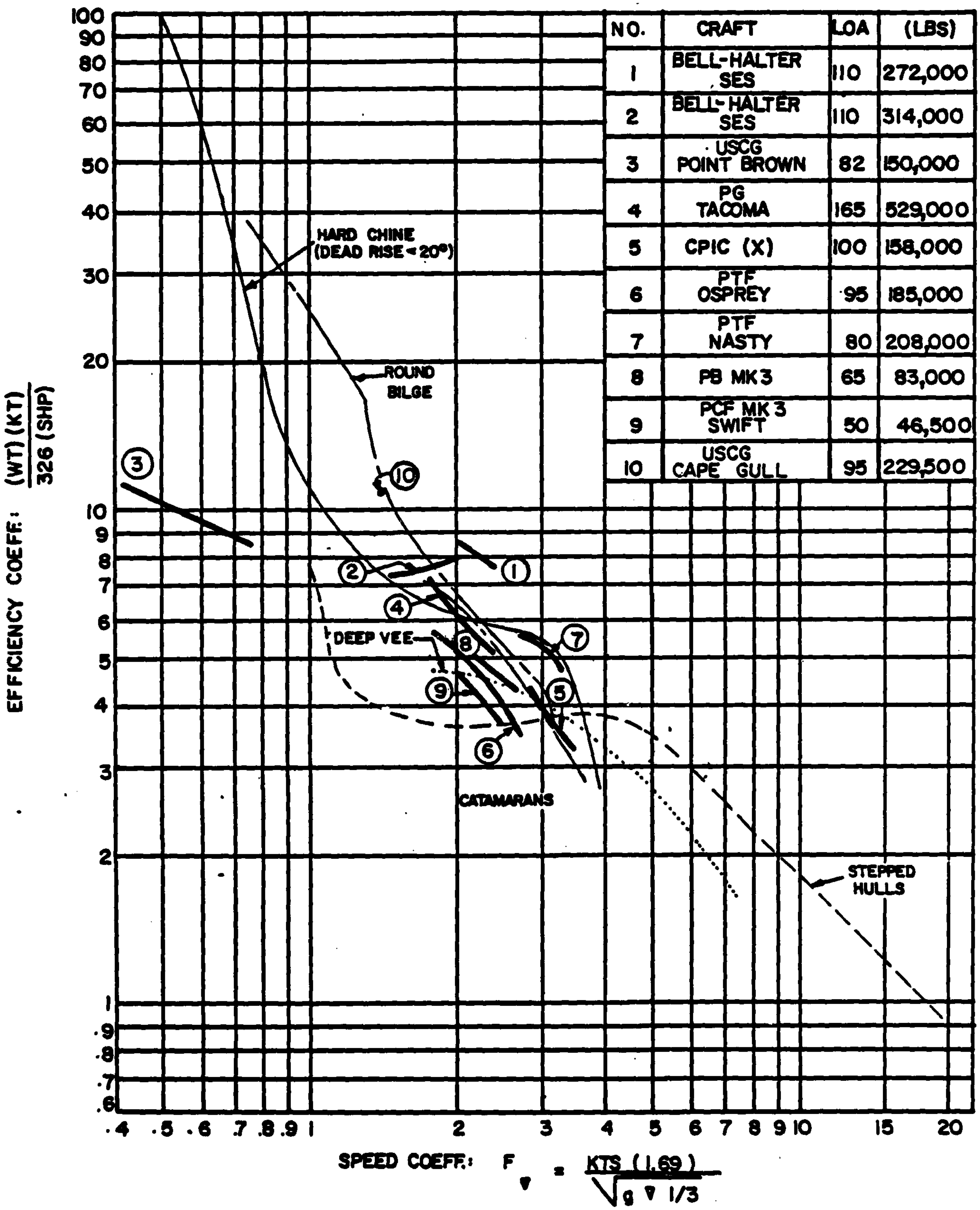
PERFORMANCE INFORMATION
ON VARIOUS PLANING HULLS

PERFORMANCE INFORMATION ON VARIOUS PLANING HULLS

Comparative smooth water performance (Figure A-1) shows the non-dimensional speed-power results for similar type craft ranging in size and type from a 50-foot PCF to a 165-foot patrol gunboat with a displacement hull. The format is a transportation efficiency coefficient versus speed coefficient (volume Froude number :F_∇) computed from displacement, speed, and power factors. The several lines in Figure A-1 labeled for different hull types, that together form an approximate diagonal on the figure, represent an indication of current state-of-the-art performance. The craft presented in Figure A-1 are generally open water patrol craft.

Useful load as a percentage of design displacement (load fraction) is presented as a function of F_∇ for the comparison with craft in Figure A-2. Results for some of the craft are presented for several different loads. Useful load in Figure A-2 includes fuel, potable water, ship's complement and effects, stores, and military payload, if any.

Ride quality in a marine vehicle is always a difficult parameter to quantify because so many factors such as vessel size, speed, weight, sea state, and motion interact to affect ride. The ride quality criteria presented in Figure A-3 is based on an assumption that has evolved from varied combatant craft experience that the upper limit of acceptable c.g. acceleration is an average of the 1/10 highest accelerations equal to 1 g. In figure A-3, if a vessel's top speed in the seaway is less than its position on the plot with respect to the "design speed", the vessel under those conditions is within the criteria. The PTF OSPREY is within the criteria but is known to be a "hard rider". The KNOX class FF-1052, a displacement ship, is included to demonstrate the extreme; it would react to a sea state 3 or 4 as a small craft would to a near calm. This criteria is based on accelerations only and does not allow for pitching and rolling motions per se. Therefore, the 82-foot WPB ranks well within the ride criteria which are not affected by the large WPM roll motions. The displacement sea state chart at the top of Figure A-3 gives the approximate sea state condition associated with the vessel points below.



NO.	CRAFT	LOA	(LBS)
1	BELL-HALTER SES	110	272,000
2	BELL-HALTER SES	110	314,000
3	USCG POINT BROWN	82	150,000
4	PG TACOMA	165	529,000
5	CPIC (X)	100	158,000
6	PTF OSPREY	95	185,000
7	PTF NASTY	80	208,000
8	PB MK3	65	83,000
9	PCF MK3 SWIFT	50	46,500
10	USCG CAPE GULL	95	229,500

Figure A-1. Comparative Smooth Water Performance

AD-A145 083 FEASIBILITY STUDY FOR THE UNITED STATES COAST GUARD ADVANCED VEHICLE CONC..(U) NAVAL SEA COMBAT SYSTEMS ENGINEERING STATION NORFOLK VA M P JONES ET AL. JUN 83 1/2

UNCLASSIFIED NAVSEACOMBATSYSENGSTA-60-11 USCG-D-33-83 F/G 13/10 NL

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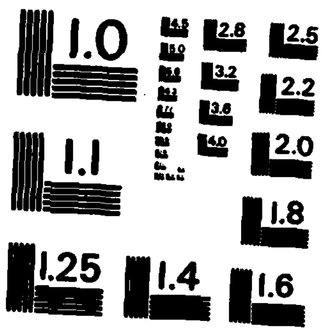


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

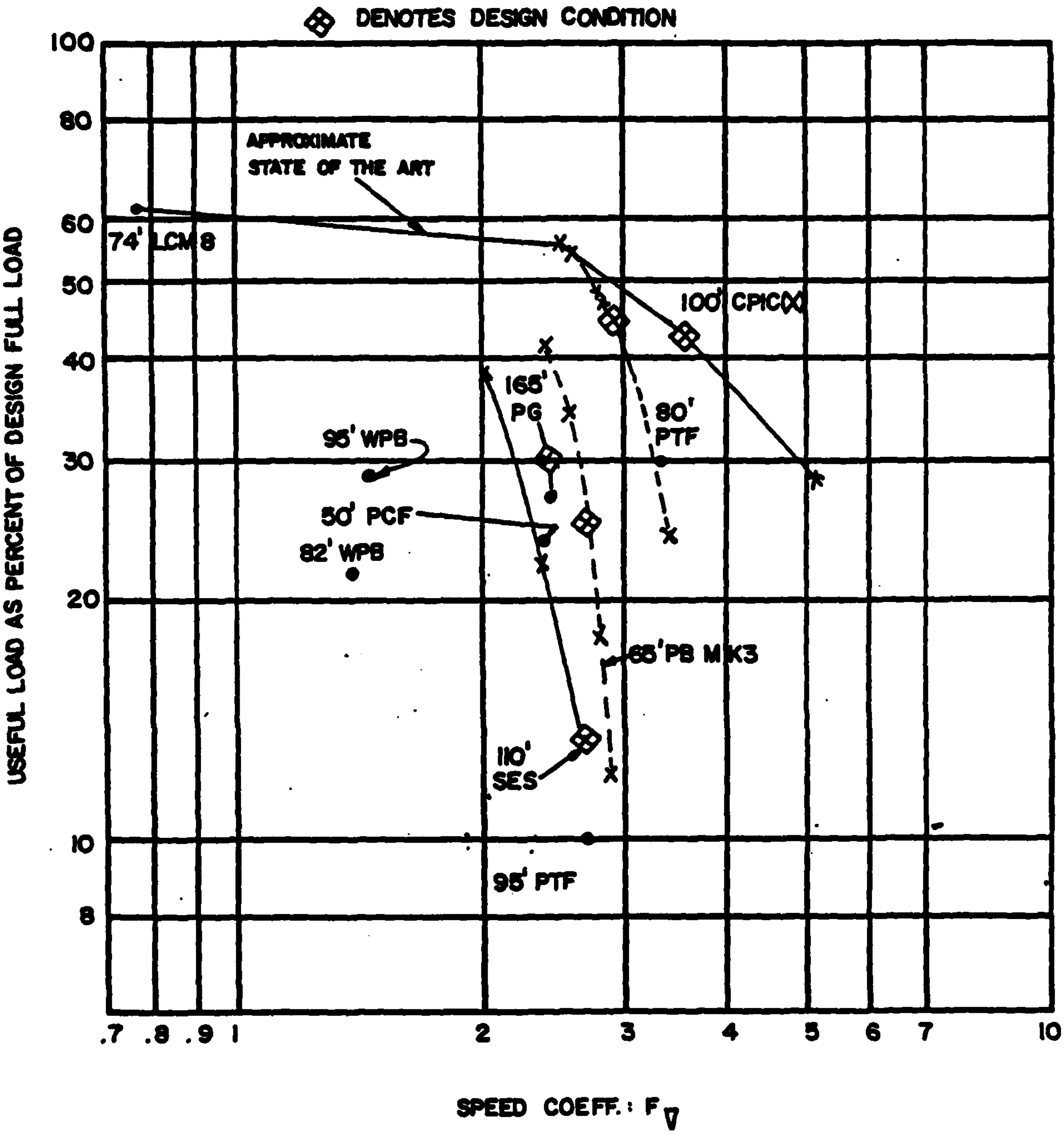


Figure A-2. Useful Load Fraction, State-of-the-Art

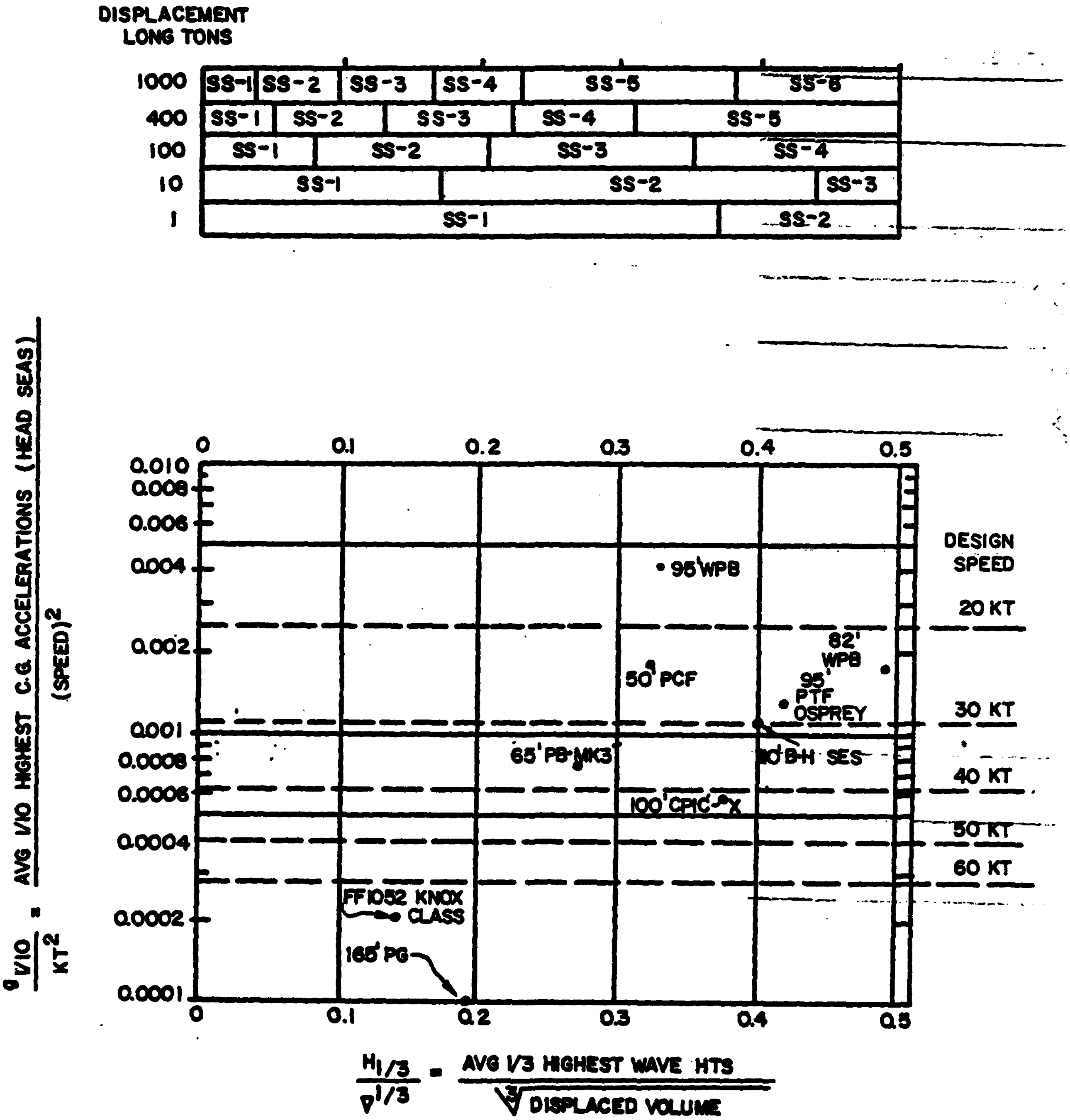


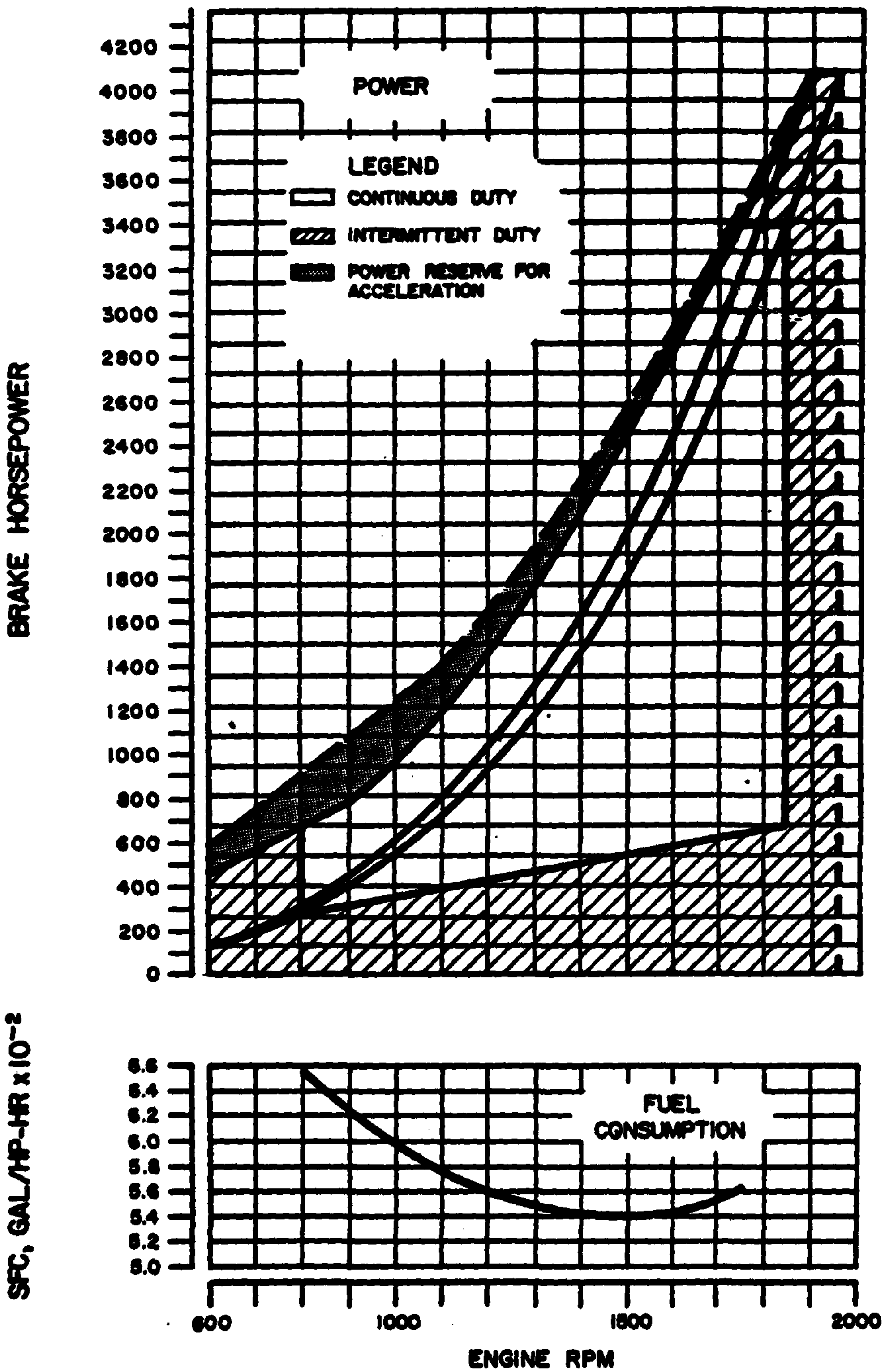
Figure A-3. Ride Quality Criteria

APPENDIX B

POWER/FUEL CONSUMPTION CURVE

POWER/FUEL CONSUMPTION CURVES

16V538TB92



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