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USS OLIVER HAZARD PERRY (FFG-7) STANDARDIZATION TRIALS.(U)
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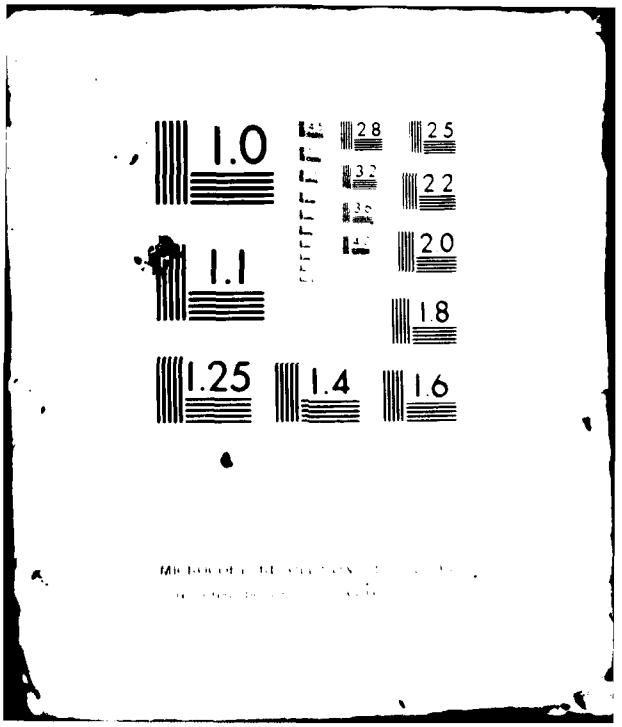
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DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER

Bethesda, Maryland 20084

USS OLIVER HAZARD PERRY (FFG-7) STANDARDIZATION TRIALS (U)

by

Everett L. Woo

SHIP PERFORMANCE DEPARTMENT
RESEARCH AND DEVELOPMENT REPORT

February 1979 DTNSRDC-79/022

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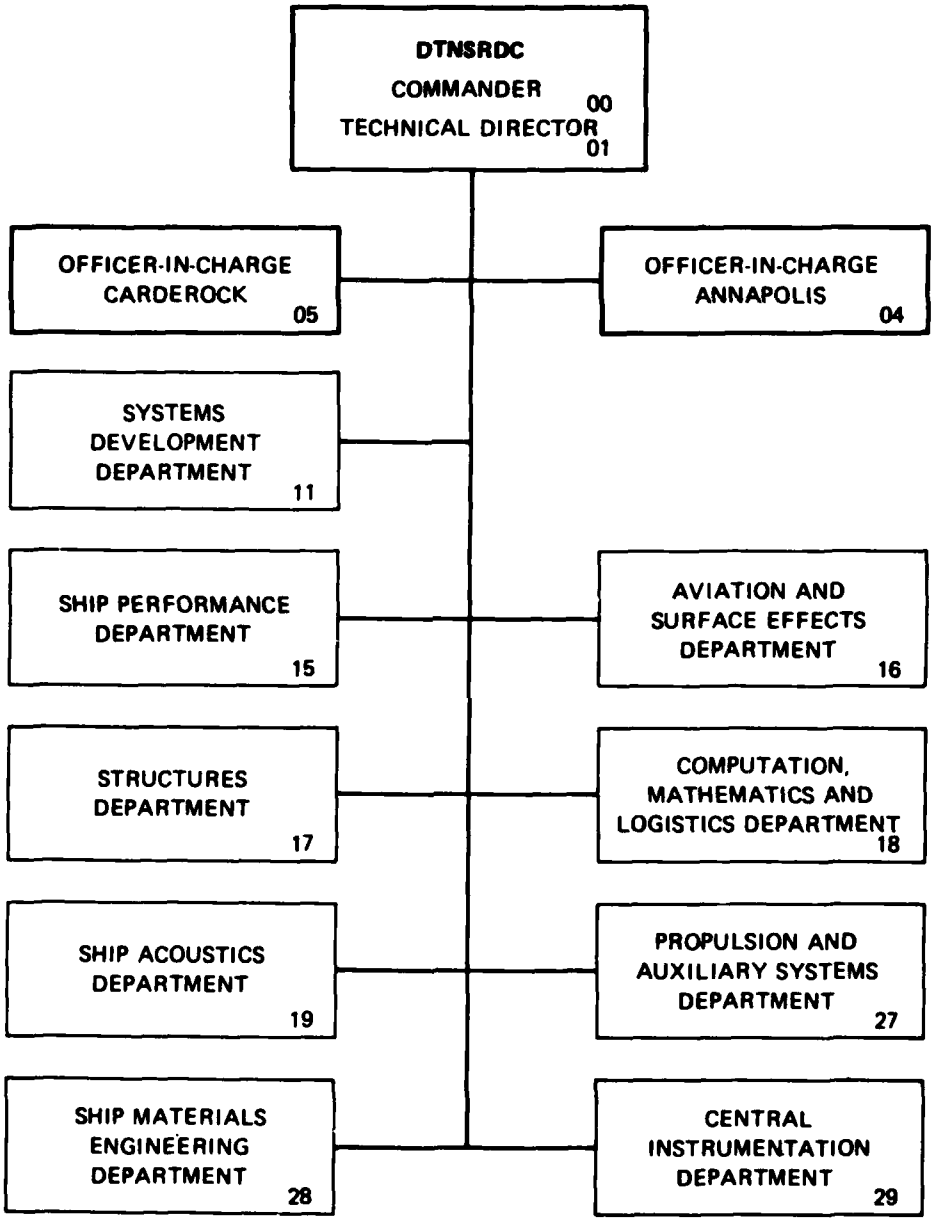

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DEPARTMENT OF THE NAVY
DAVID W. TAYLOR NAVAL SHIP
RESEARCH AND DEVELOPMENT CENTER
BETHESDA, MARYLAND 20084

USS OLIVER HAZARD PERRY (FFG-7) STANDARDIZATION TRIALS (U)

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Everett L. Woo

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February 1979

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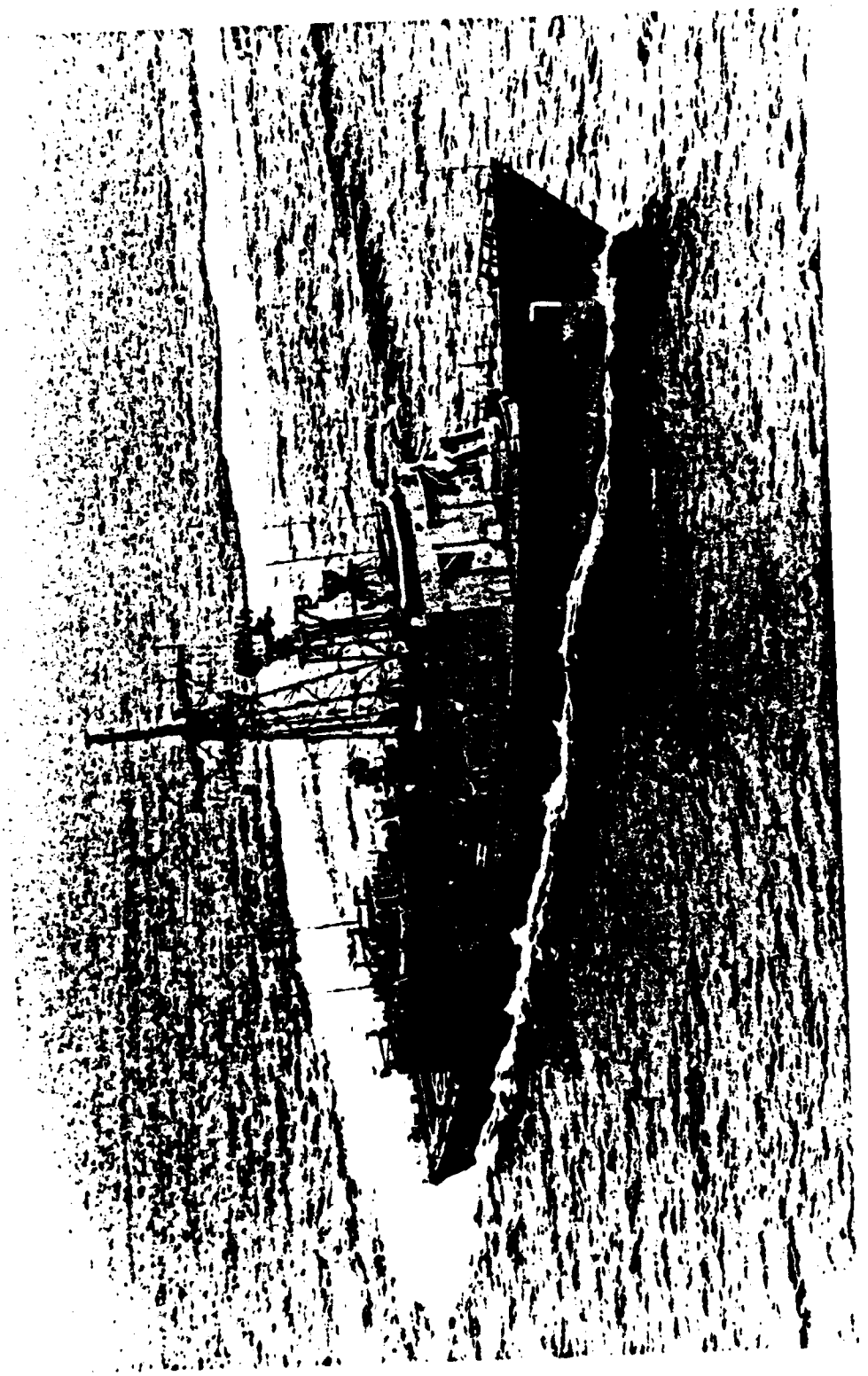

USS OLIVER HAZARD PERRY (FFG-7) (U)

ABSTRACT

(U) This report contains the results of heavy and light displacement standardization trials conducted on USS OLIVER HAZARD PERRY (FFG-7). Measurements of shaft rpm, shaft horsepower, shaft torque, thrust, propeller pitch, ship speed, ship's heading, and relative wind velocity and direction were made throughout the speed range of 6 knots to full power. Heavy and light displacement standardization trials were conducted in the program control power mode utilizing single and twin engine modes of operation with single engine powering performance data comparing favorably with that of twin-engine. Heavy displacement twin-engine standardization trials were undertaken comparing design, over-design, and under-design pitch. Speed attainable at rated power for single and twin auxiliary propulsion units was determined. Very poor directional controllability was experienced with auxiliary propulsion units in operation.

ADMINISTRATIVE INFORMATION

(U) The standardization trials on USS OLIVER HAZARD PERRY (FFG-7) were performed in accordance with Naval Sea Systems Command (NAVSEA) letter PMS-399/GMcN, Serial 1625 of 19 August 1977. This project was carried out under David W. Taylor Naval Ship Research and Development Center (DTNSRDC) Work Unit Number 1-1536-180.

INTRODUCTION

(U) USS OLIVER HAZARD PERRY (FFG-7) is the first of a new class of guided missile frigates displacing 3720 tons (3780 tonnes) in the heavy displacement configuration. PERRY was built by Bath Iron Works, Bath, Maine, and commissioned on 17 December 1977. PERRY is powered by two General Electric LM 2500 gas turbines; a double reduction, double helical, locked-train reduction gear; single shaft; and a five-bladed controllable-reversible pitch (CRP) propeller. The propulsion system is capable of automated control (in a power or speed mode) of the gas turbines as well as remote manual control. Two electric auxiliary propulsion units provide emergency "take-home" power. PERRY is also equipped with the Prairie Masker system to ensure quiet operation and to mask acoustic signature characteristics.
(U) Standardization trials were conducted on PERRY at the three-dimensional tracking range at the Atlantic Fleet Weapons Training Facility (AFWTF),

[redacted]

St. Croix, Virgin Islands during 12-13 and 19-20 May 1978. These trials were carried out by representatives of the David W. Taylor Naval Ship Research and Development Center and AFWTF tracking range personnel with assistance from the ship's force.

TRIAL CONDITIONS

(U) Ship and propeller characteristics and trial conditions are listed in Tables 1 and 2. The last complete painting of the ship's underwater hull area prior to these trials was accomplished during a docking at Boston Marine Industrial Park, Drydock Number 1, between 24 February 1978 and 10 March 1978. Before paint application, the hull and struts were water washed and the top layer of paint sandblasted. It was then recoated. The rudder was sandblasted down to white metal and then repainted. The following paint was applied:

1. Bottom - Existing paint, 4400 (4 mils) and 4413 (4 mils), recoated with 1 coat 4413 primer (4 mils), 2 coats red 121 antifouling (2 mils).
2. Boot Topping - Two coats black 129 antifouling (2 mils).
3. Rudder - Two coats 4413 primer (4 mils), 2 coats 121 antifouling (2 mils).
4. Strut - Existing paint, 4400 (4 mils), and 4413 (4 mils), recoated with 1 coat 4413 primer (4 mils) 2 coats red 121 antifouling (2 mils).
5. Shafting - Two coats 121 antifouling (4 mils).

(U) Figure 1 shows a view of the port side of the hull and the bilge keel. Figure 2 is a view of the propeller and rudder. A pitch calibration was conducted under hot and cold hydraulic oil conditions and the propeller hub was scribed for easy diver inspection during the trials. This calibration indicated that actual propeller pitch would vary from indicated pitch by a maximum of 6 inches (152.4 milimeters). Later pitch checks at Mayport, Florida and at St. Croix also verified that indicated pitch readings would be in error by no more than 6 inches (152.4 milimeters).

(U) Sea conditions were acceptable throughout the trial period (State 1 to a high State 2 sea). The average true wind velocity for the standardization trials was 17 knots. Table 2 gives a more in-depth look at the trial conditions.

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TABLE 1 - SHIP AND PROPELLER CHARACTERISTICS (U)

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SHIP CHARACTERISTICS	
Length Overall (LOA), feet (meters)	445.0 (135.6)
Length between Perpendiculars (LBP), feet (meters)	408.0 (124.4)
Breadth, Extreme, feet (meters)	47.0 (14.3)
Number of Rudders	1
Rudder Area, square feet (square meters)	193.7 (18.4)
PROPELLER CHARACTERISTICS	
Type of Propeller	Controllable-Reversible Pitch (CRP)
Number of Propellers	1
Number of Blades	5
Diameter, feet (meters)	16.5 (5.0)
Design Pitch at 0.7 Radius, feet (meters)	23.5 (7.2)
Projected Area, square feet (square meters)	129.8 (12.1)
Disc Area, square feet (square meters)	213.8 (19.9)
Projected Area Divided by Disc Area	0.607
Expanded Area, square feet (square meters)	157.9 (14.7)
Mean Width Ratio	0.336
Blade Thickness Fraction	0.083
Pitch Ratio at 0.7 Radius	1.42
Propeller Serial Number	28220D
Propeller Drawing Number	Bird Johnson 11565-1011
Propeller Hub Number	28227
Propeller Composition	Nickel-Aluminum-Bronze

UNCLASSIFIED

TABLE 2 - TRIAL CONDITIONS (U)

UNCLASSIFIED

Displacement		Average True Wind Direction	Average True Wind Velocity	Trim		Water Temperature		Air Temperature		Water Specific Gravity
ton	tonne	deg	knot	ft	m	deg F	deg C	deg F	deg C	
12 May 1978, 63 Days Out of Dock, State 1-2 Sea										
3720	3780	96	16	0.50*	0.15*	83	28.3	83	28.3	1.025
13 May 1978, 64 Days Out of Dock, State 1 Sea										
3680	3739	107	15	0.83*	0.25*	82	27.8	83	28.3	1.025
19 May 1978, 70 Days Out of Dock, State 2 Sea										
3400	3454	61	20	1.08**	0.33**	82	27.8	83	28.3	1.025
20 May 1978, 71 Days Out of Dock, State 2 Sea										
3320	3373	107	20	1.50**	0.46**	82	27.8	84	28.9	1.025

*Trim by bow.
**Trim by stern.

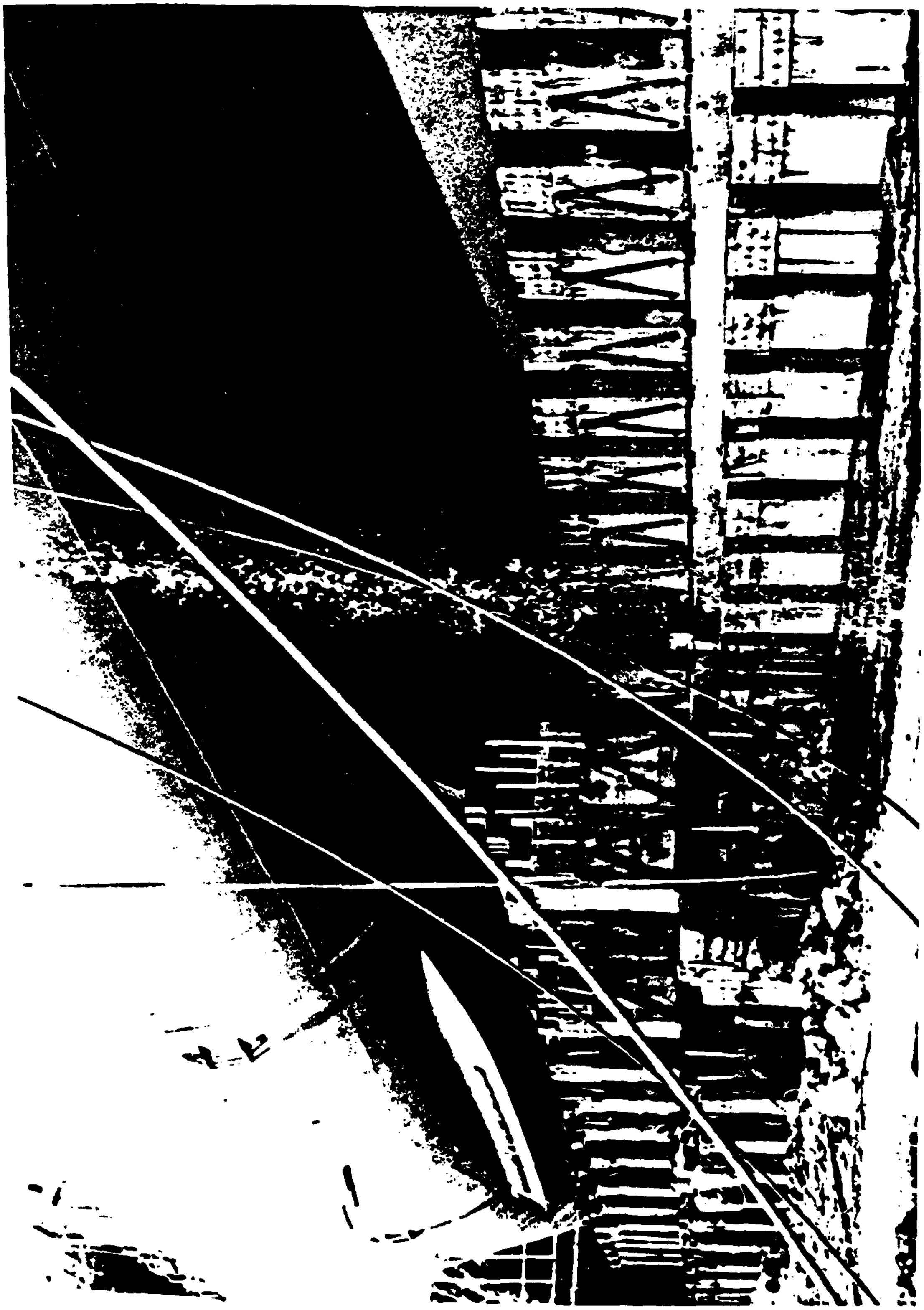

Figure 1 - View of Hull and Bilge Keel (U)

TRIAL PROCEDURES AND INSTRUMENTATION

(C) The trials were conducted in accordance with Chapter 094 of the Naval Ship's Technical Manual. Data were obtained over a 6-knot to full power speed range at the displacements listed in Table 2. Two to three passes were made over the three-dimensional range at selected speeds. The propulsion system can be operated in a program control mode or in a manual mode. When in the program control mode of operation, the propeller pitch can be controlled by turbine power or turbine speed. In the manual control mode of operation, shaft revolutions per minute (rpm) and propeller pitch are controlled independently. All program control mode runs were made in the power mode. Twin and single engine standardization trials were conducted in the program control power mode at heavy and light displacements. The effect of under- and over-design pitch was investigated and compared to the design pitch runs which were conducted in the program control, twin-engine mode. The off-design pitch runs were made in the remote manual, twin-engine mode at the heavy displacement. Single and twin auxiliary propulsion unit powering capabilities were also investigated. The effect of Prairie Masker on maximum speed was determined. These runs were conducted in the twin-engine, remote manual mode and at light displacement.

(U) The measurements taken during each run were shaft rpm, shaft horsepower (shp), shaft torque, shaft thrust, propeller pitch, EM log speed, AFWTF range coordinates, Mini-Ranger coordinates, ship's heading, and relative wind velocity and direction. Speed was calculated using AFWTF range coordinates and DTNSRDC Mini-Ranger coordinates. Both the DTNSRDC Mini-Ranger and AFWTF calculated speeds are listed in Tables 3 and 4. As can be seen, they compared very well; generally within 0.05 knot. AFWTF range data were not available on 19 May 1978, therefore, Mini-Ranger speed data are presented throughout the report for consistency. A DTNSRDC 60-tooth magnetic pick-up was used to measure rpm. From the shaft rpm and torque, the shaft horsepower was calculated. A strain gage type thrustmeter with 10 instrumented leveling plates (5 forward and 5 astern) was used to obtain thrust. Thrust data will not be available until a later date when a laboratory post-calibration can be accomplished on the thrust leveling plates. Relative wind velocity and direction were recorded from the ship's anemometer and true wind velocity and direction were calculated.

TABLE 3 - USS OLIVER HAZARD PERRY (FFG-7) STANDARDIZATION TRIAL RESULTS, ENGLISH UNITS (U)

CONFIDENTIAL

Displacement ton	Pitch ft	Mini-Ranger Speed knot	AFWTF Speed knot	Shaft rpm	Torque lb-ft	SHP
12 MAY 1978, TWIN ENGINE MODE, PROGRAM CONTROL MODE, DESIGN PITCH						
3720	13.3	6.38	6.14	49.4	34,550	330
↓	23.5	9.06	9.16	47.6	77,600	710
	23.5	11.71	11.76	61.1	121,000	1,410
	23.6	15.38	15.37	82.7	222,200	3,500
	23.6	18.44	18.50	100.6	327,050	6,270
	23.6	20.36	20.38	112.1	399,200	8,520
	23.6	23.70	23.70	131.0	539,200	13,450
	23.7	26.80	26.75	154.1	790,950	23,200
3720	23.7	29.20	29.36	178.1	1,075,500	36,480
12 MAY 1978, SINGLE ENGINE MODE, PROGRAM CONTROL MODE, DESIGN PITCH						
3720	23.8	25.26	25.31	142.0	649,550	17,560
3720	23.8	7.94	8.00	42.1	63,550	510
3720	23.1	5.70	5.75	31.2	35,700	210
12 MAY 1978, TWIN ENGINE MODE, MANUAL CONTROL MODE, UNDER-DESIGN PITCH						
3720	19.0	9.66	9.63	59.0	77,850	880
↓	19.0	14.18	14.24	89.2	167,050	2,840
	19.0	18.47	18.48	118.7	292,950	6,630
	19.0	23.02	23.05	148.7	458,800	12,990
3720	19.0	26.26	26.24	178.2	674,850	22,900

TABLE 3 (Continued) (U)

CONFIDENTIAL

Displacement ton	Pitch ft	Mini-Ranger Speed knot	AFWTF Speed knot	Shaft rpm	Torque lb-ft	SHP
13 MAY 1978, TWIN ENGINE MODE, MANUAL CONTROL MODE, OVER-DESIGN PITCH						
3680	28.4	28.58	28.63	148.7	1,165,700	33,020
3680	28.4	24.52	24.53	119.0	678,050	15,370
3680	28.4	18.62	18.65	88.8	363,200	6,140
3680	28.4	13.04	12.98	59.9	164,400	1,880
13 MAY 1978, TWIN ENGINE MODE, MANUAL CONTROL MODE, DESIGN PITCH						
3680	23.7	11.12	11.11	59.4	104,000	1,180
13 MAY 1978, SINGLE AUXILIARY ENGINE MODE						
3680	28.4	1.85	2.38	--	--	--
13 MAY 1978, TWIN AUXILIARY ENGINE MODE						
3680	28.4	2.60	3.40	--	--	--
19 MAY 1978, TWIN ENGINE MODE, PROGRAM CONTROL MODE, DESIGN PITCH						
3400	19.6	6.78	--	40.7	44,950	350
↓	24.6	8.49	--	43.5	73,450	610
	24.6	11.38	--	58.7	122,800	1,370
	24.6	14.57	--	75.1	199,200	2,850
	24.6	17.76	--	93.1	301,150	5,340
	24.6	20.45	--	108.4	402,100	8,300
	24.6	23.76	--	126.2	535,650	12,870
	24.6	26.88	--	148.8	784,500	22,240
3400	24.6	30.20	--	178.7	1,135,700	38,640

TABLE 3 (Continued) (U)

CONFIDENTIAL

Displacement ton	Pitch ft	Mini-Ranger Speed knot	AFWTF Speed knot	Shaft rpm	Torque lb-ft	SHP
20 MAY 1978, SINGLE ENGINE MODE, PROGRAM CONTROL MODE, DESIGN PITCH						
3320	25.3	25.65	25.58	135.7	683,200	17,660
20 MAY 1978, TWIN ENGINE MODE, MANUAL CONTROL MODE, DESIGN PITCH*						
3320	25.0	30.30	30.29	180.1	1,183,850	40,600
20 MAY 1978, TWIN ENGINE MODE, MANUAL CONTROL MODE, DESIGN PITCH**						
3320	24.8	30.57	30.57	182.5	1,190,400	41,360

*With Prairie Masker System in operation.
**Without Prairie Masker System in operation.

TABLE 4 - USS OLIVER HAZARD PERRY (FFG-7) STANDARDIZATION
TRIAL RESULTS, METRIC UNITS (U)

CONFIDENTIAL

Displacement tonne	Pitch m	Mini-Ranger Speed knot	AFWTF Speed knot	Shaft rpm	Torque n-m	Power kw
12 MAY 1978, TWIN ENGINE MODE, PROGRAM CONTROL MODE, DESIGN PITCH						
3780	4.0	6.38	6.14	49.4	46,800	240
↓	7.2	9.06	9.16	47.6	105,200	530
	7.2	11.71	11.76	61.1	164,100	1,050
	7.2	15.38	15.37	82.7	301,250	2,610
	7.2	18.44	18.50	100.6	443,400	4,670
	7.2	20.36	20.38	112.1	541,250	6,360
	7.2	23.70	23.70	131.0	731,100	10,030
	7.2	26.80	26.75	154.1	1,072,400	17,300
3780	7.2	29.20	29.36	178.1	1,458,200	27,210
12 MAY 1978, SINGLE ENGINE MODE, PROGRAM CONTROL MODE, DESIGN PITCH						
3780	7.2	25.26	25.31	142.0	880,700	13,100
3780	7.2	7.94	8.00	42.1	86,150	380
3780	7.0	5.70	5.75	31.2	48,400	160
12 MAY 1978, TWIN ENGINE MODE, MANUAL CONTROL MODE, UNDER-DESIGN PITCH						
3780	5.8	9.66	9.63	59.0	105,550	660
↓	5.8	14.18	14.24	89.2	226,500	2,120
	5.8	18.47	18.48	118.7	397,200	4,940
	5.8	23.02	23.05	148.7	622,050	9,690
3780	5.8	26.26	26.24	178.2	915,000	17,080

TABLE 4 (Continued) (U)

CONFIDENTIAL

Displacement tonne	Pitch m	Mini-Ranger Speed knot	AFWTF Speed knot	Shaft rpm	Torque n-m	Power kw
13 MAY 1978, TWIN ENGINE MODE, MANUAL CONTROL MODE, OVER-DESIGN PITCH						
3739	8.6	28.58	28.63	148.7	1,580,500	24,620
3739	8.6	24.52	24.53	119.0	919,350	11,460
3739	8.6	18.62	18.65	88.8	492,450	4,580
3739	8.6	13.04	12.98	59.9	222,850	1,400
13 MAY 1978, TWIN ENGINE MODE, MANUAL CONTROL MODE, DESIGN PITCH						
3739	7.2	11.12	11.11	59.4	141,050	880
13 MAY 1978, SINGLE AUXILIARY ENGINE MODE						
3739	8.7	1.85	2.38	--	--	--
13 MAY 1978, TWIN AUXILIARY ENGINE MODE						
3739	8.7	2.60	3.40	--	--	--
19 MAY 1978, TWIN ENGINE MODE, PROGRAM CONTROL MODE, DESIGN PITCH						
3454	6.0	6.78	--	40.7	60,950	260
↓	7.5	8.49	--	43.5	99,600	460
	7.5	11.38	--	58.7	166,500	1,020
	7.5	14.57	--	75.1	270,050	2,130
	7.5	17.76	--	93.1	408,300	3,980
	7.5	20.45	--	108.4	545,150	6,190
	7.5	23.76	--	126.2	726,250	9,600
	7.5	26.88	--	148.8	1,063,650	16,580
3454	7.5	30.20	--	178.7	1,539,750	28,810

TABLE 4 (Continued) (U)

CONFIDENTIAL

Displacement tonne	Pitch m	Mini-Ranger Speed knot	AFWTF Speed knot	Shaft rpm	Torque n-m	Power kw
20 MAY 1978, SINGLE ENGINE MODE, PROGRAM CONTROL MODE, DESIGN PITCH						
3373	7.7	25.65	25.58	135.7	926,300	13,170
20 MAY 1978, TWIN ENGINE MODE, MANUAL CONTROL MODE, DESIGN PITCH*						
3373	7.6	30.30	30.29	180.1	1,605,050	30,280
20 MAY 1978, TWIN ENGINE MODE, MANUAL CONTROL MODE, DESIGN PITCH**						
3373	7.6	30.57	30.57	182.5	1,613,950	30,840

*With Prairie Masker System in operation
**Without Prairie Masker System in operation.

[redacted]

PRESENTATION AND DISCUSSION OF TRIAL RESULTS

(U) The maximum steady-state values as denoted in the trial agenda were:

1. Full power shaft torque (twin engine) - 1,167,111 pound-feet (1,582,390 newton-meters).

2. Full power shaft thrust (twin engine) - 281,850 pounds (1,253,725 newtons).

3. Maximum shaft torque (single engine) - 715,315 pound-feet (969, 839 newton-meters).

4. Auxiliary propulsion motor (full load current) - 500 amperes.

(U) The results of the standardization trials conducted on USS OLIVER HAZARD PERRY (FFG-7) are tabulated in Tables 3 and 4 and are presented in Figures 3 through 6. Figures 3 and 4 are a comparison of the heavy and light displacement results run with the plant in the program control power mode and at the design pitch. It should be noted that the pitch was slightly different between heavy and light displacements. If the pitch at heavy displacement and the pitch at light displacement were the same, then a greater "spread" between the curves shown in Figures 3 and 4 would be apparent. Twin and single engine data are shown on these same curves with single engine data falling right on the twin engine curve as expected. In the twin engine propulsion mode, PERRY attained a speed of 29.3 knots at 178.1 rpm, 1,075,500 pound-feet (1,458,200 newton-meters) of shaft torque, and developed 36,480 shaft horsepower (27,200 kilowatts) for the heavy displacement of 3,720 tons (3,780 tonnes). At the twin engine light displacement of 3,400 tons (3,454 tonnes), the maximum speed attained was 30.2 knots at 178.2 rpm, 1,135,700 pound-feet (1,539,800 newton-meters) of shaft torque and 38,640 shaft horsepower (28,800 kilowatts).

(U) In the heavy displacement condition of 3,720 tons (3,780 tonnes), maximum single engine performance speed was 25.3 knots at 142 rpm, 649,560 pound-feet (880,700 newton-meters) of shaft torque and 17,560 shaft horsepower (13,100 kilowatts). For a light displacement of 3,320 tons (3,373 tonnes) the maximum single engine performance was found to be 25.6 knots at 136 rpm, 683,190 pound-feet (926,300 newton-meters) of shaft torque and 17,660 shaft horsepower (13,170 kilowatts).

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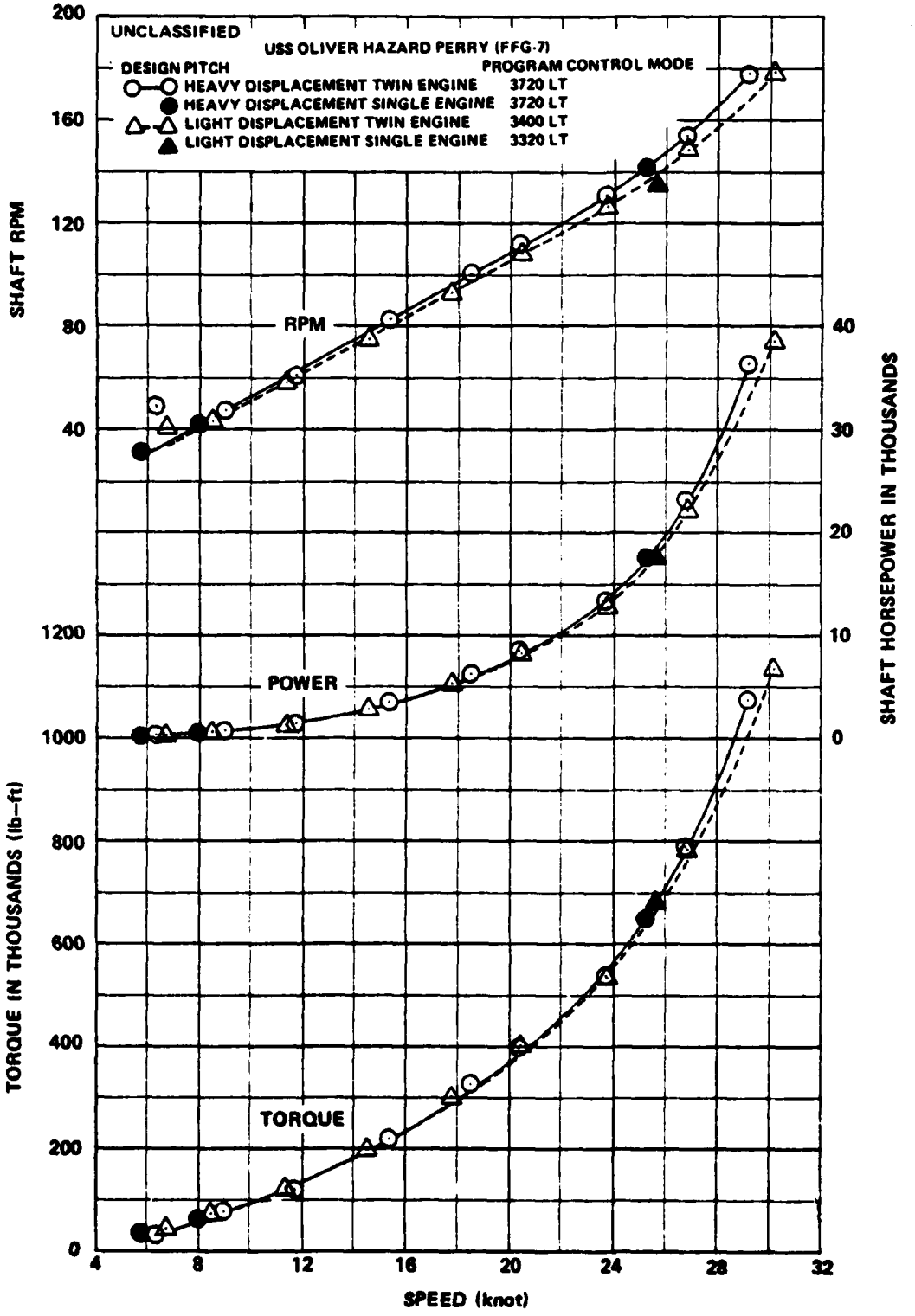

Figure 3 - Comparison of Heavy and Light Displacement Standardization Trial Results, English Units (U)

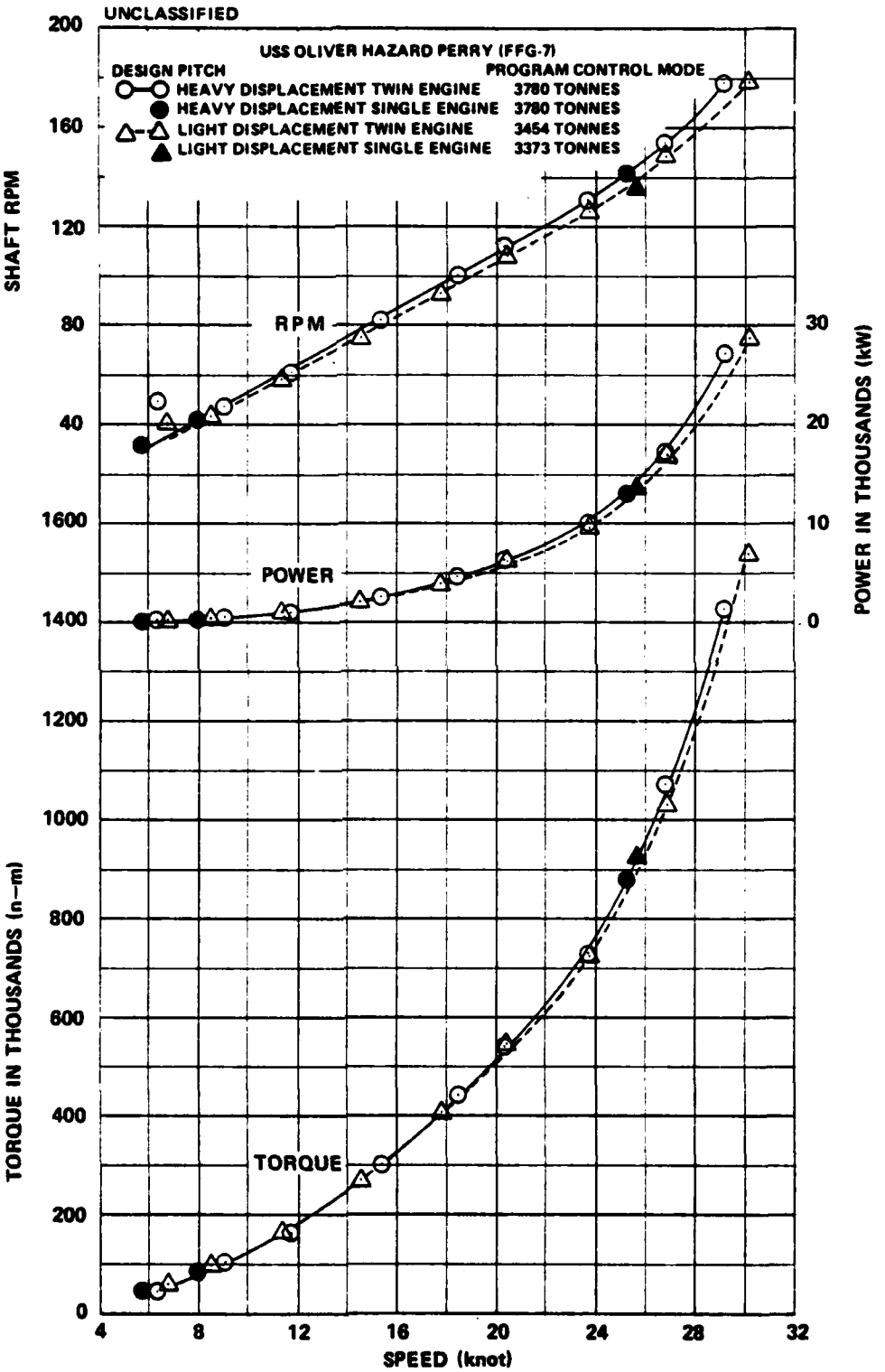

Figure 4 - Comparison of Heavy and Light Displacement Standardization Trial Results, Metric Units (U)

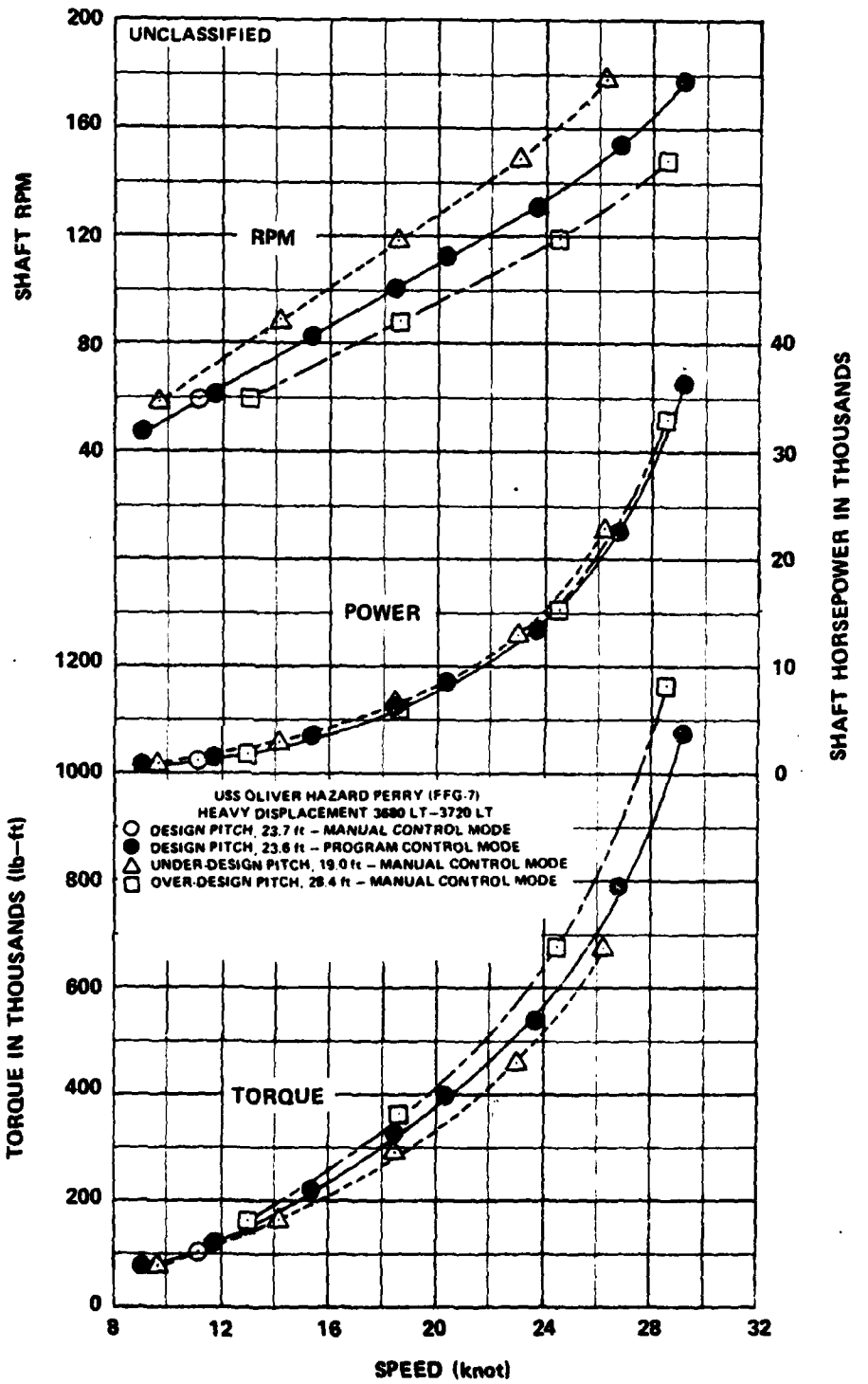

Figure 5 - Comparison of Heavy Displacement Standardization Trial Results Utilizing Different Propeller Pitch Settings, English Units (U)

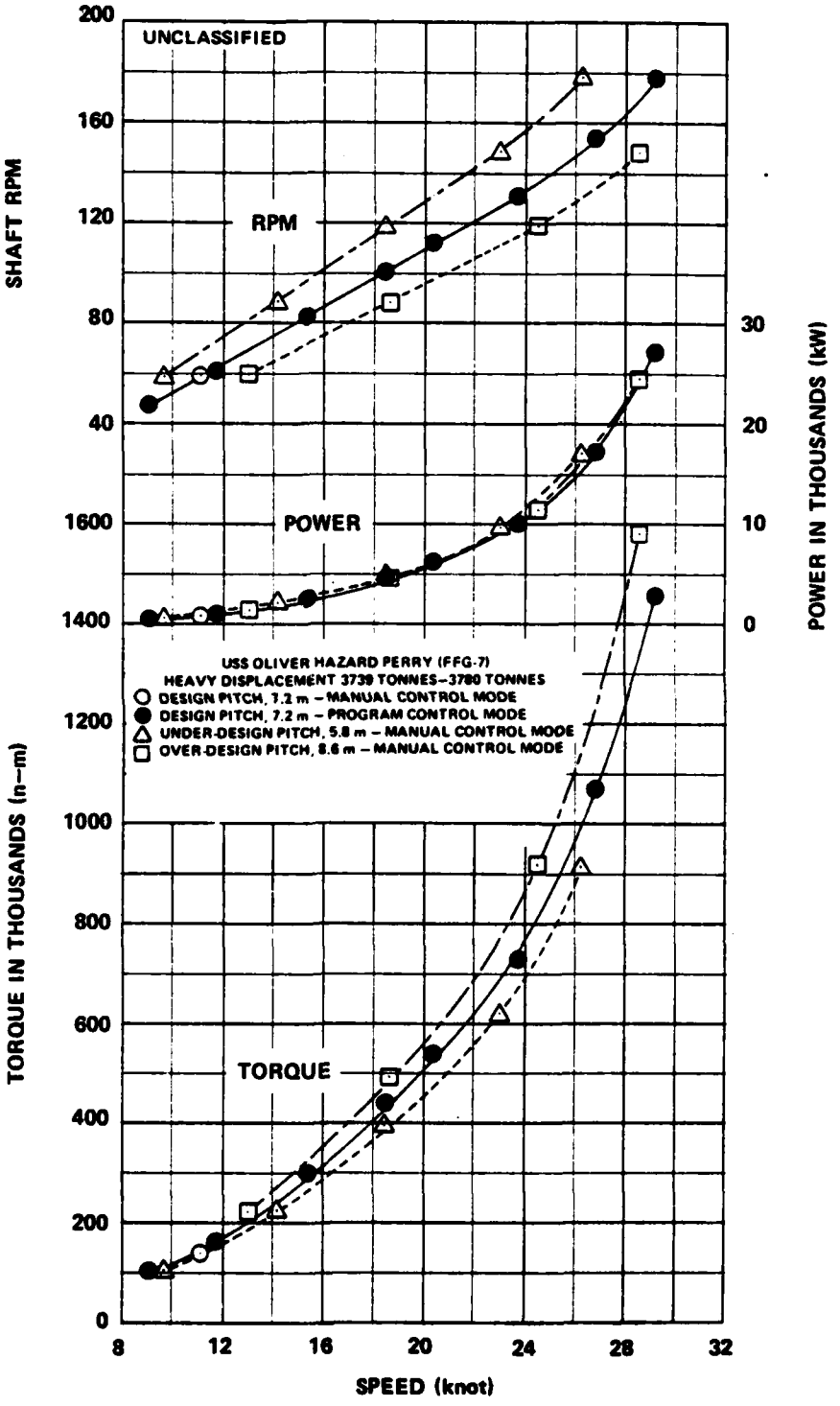

Figure 6 - Comparison of Heavy Displacement Standardization Trial Results Utilizing Different Propeller Pitch Settings, Metric Units (U)

[redacted]

(U) For both the heavy and light displacements in the twin engine mode, at speeds less than 8 knots, it can be observed that rpm does not fair along the respective curves. At these low speeds, the propeller is not programmed to operate at design pitch. This accounts for the "misaligned" data points.

(U) The effects of under- and over-design pitch on PERRY's propulsion characteristics are presented in Figures 5 and 6 and are tabulated in Tables 3 and 4. The over- and under-design pitch conditions were run at heavy displacement using the twin engine manual control mode. These data are compared with the design pitch data obtained in the program control mode. A single design pitch data point was taken using the manual control, twin engine mode as a check on the program control data. This data point, at a speed of 11.1 knots, compared quite favorably with the program control data. The under-design pitch condition (1.15 P/D, 19.0 feet (5.79 meters)), which was rpm limited, proved to be less effecient from a power-speed aspect than the design pitch throughout the speed range. A maximum speed of 26.3 knots was attained at 178 rpm, 22,900 shaft horsepower (17,075 kilowatts) and 674,860 pound-feet (914,990 newton-meters) of shaft torque. For speeds less than 24 knots in the over-design pitch condition (1.72 P/D, 28.4 feet (8.66 meters)), the over-design pitch proved to be just as efficient as design pitch while at speeds above 24 knots, it was not as efficient. However, it should be noted that this pitch condition was conducted with the ship at a slightly lighter displacement of 3,680 tons (3,739 tonnes). This pitch condition was found to be torque limited with a maximum speed of 28.6 knots attained at 149 rpm, 33,000 shaft horsepower (24,600 kilowatts), and 1,165,700 pound-feet (1,580,500 newton-meters) of shaft torque. Design pitch, as expected, proved to be the better of the three pitches from a power versus speed standpoint.

(U) Tests of the ship's auxiliary propulsion units at heavy displacement were also conducted. Speeds of 1.9 and 2.6 knots were obtained for the single and twin auxiliary propulsion tests, respectively. The displacement of the ship during these tests was 3,680 tons (3,739 tonnes). While attaining these speeds, the ship experienced difficulty in maintaining headway and direction in a State 2 sea.

[redacted]

(C) With the plant in the twin engine manual control mode and design pitch, tests were run with and without the Prairie Masker system in operation to determine the effect on maximum speed. These runs were conducted by increasing the shaft rpm until either the torque or rpm reached its maximum steady state operation limit. A speed of 30.3 knots at 180 rpm, 1,183,800 pound-feet (1,605,000 newton-meters) of shaft torque and 40,600 shaft horsepower (30,280 kilowatts) was obtained with the Prairie Masker system in operation. Without the Prairie Masker system in operation, a speed of 30.6 knots at 182 rpm, 1,190,380 pound-feet (1,613,930 newton-meters) of shaft torque, and 41,360 shaft horsepower (30,840 kilowatts) was obtained. The ship's displacement at this time was 3,320 tons (3,373 tonnes) which was the lightest displacement tested. As can be seen, only one percent difference in speed and two percent difference in shaft horsepower were observed.

CONCLUSIONS

(U) The results of the standardization trials of USS OLIVER HAZARD PERRY (FFG-7) are considered to be good and the data applicable to, and representative of, the FFG-7 Class at the same displacements with a clean hull and propeller. The following conclusions can be drawn from the standardization trials.

(U) 1. The maximum speed attained in the heavy displacement program control mode for twin engine was 29.2 knots. The maximum speed attained for the single engine configuration was 25.3 knots.

(U) 2. The maximum speed attained in the light displacement program control mode for twin engine was 30.2 knots. The maximum speed attained for the single engine configuration was 25.7 knots.

(U) 3. Heavy and light displacement powering data for the program control power mode utilizing single and twin engine modes of operation compared favorably.

(U) 4. As expected, design pitch is the most efficient of the three pitch conditions from a power versus speed standpoint. It was also noted that the under-design pitch condition was rpm limited and the over-design pitch was torque limited.

[redacted]

(U) 5. Ship speeds of 1.9 and 2.6 knots were achieved using one auxiliary propulsion engine and then both auxiliary propulsion engines, respectively. These electric propulsion units provided poor steering capability and the ship had trouble maintaining headway in a State 2 sea.

(C) 6. Comparison of powering data with and without Prairie Masker in operation shows there is little difference in the powering characteristics of PERRY.

[redacted]

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