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SPECIAL REPORT NO. 1

APPROACH FOR DEVELOPMENT OF MAINTENANCE-HISTORY ANALYSES FOR DDG-2 CLASS PROPULSION EQUIPMENT

February 1973

Prepared for
PLANNING AND ENGINEERING FOR REPAIRS AND ALTERATIONS
(ANTI-AIRCRAFT WARFARE)
PERA (AAW)
PHILADELPHIA NAVAL SHIPYARD
under Contract N00140-73-C-0074
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This report is one of the four selected as being respresentative of the equipment maintenance-history analyses being preformed under contract N00140-73-D-0074.

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February 1973

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Planning and Engineering for Repairs and Alterations
(Anti-Aircraft Warfare)
PERA (AAW)
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FOREWORD

This report is one of four selected as being representative of the equipment maintenance-history analyses being performed under Contract N00140-73-D-0074.

Approximately 50 reports, covering 75 equipments in the 1200-psi steam propulsion plant for DLG and DDG class ships, were prepared during the performance of the contract work.

SUMMARY

This report describes the method employed by ARINC Research Corporation to analyze data for use in development of a maintenance history of selected equipments in the 1200-psi propulsion plant of the DDG-2 class ships. The maintenance histories are to be used to determine whether the selected equipments aboard the USS TOWERS (DDG-9) should be overhauled during the next scheduled overhaul.

The approach consists of combining and analyzing MDCS data, shipyard data, Casualty Reports (CASREPTs), technical manuals, ship's steaming hours, and information obtained from ship visits. There are four major areas of analysis, from which the conclusions and recommendations for each equipment are derived:

- Corrective-Maintenance Event and Maintenance Man-Hour History
- Parts Usage
- Malfunction History
- Trend Analysis

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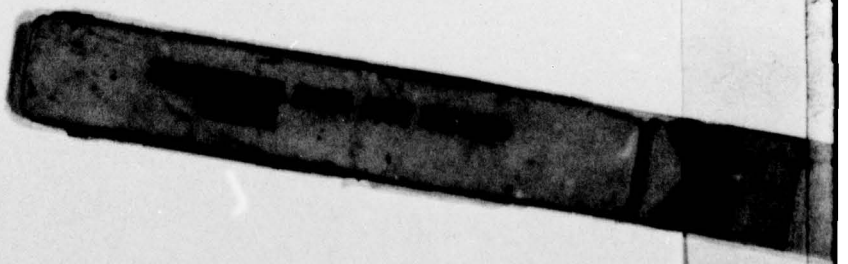

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

The Navy has embarked on a pilot program to increase operational readiness and reduce equipment maintenance time and cost of the 1200-psi steam propulsion plant for the DDG-2 class ships. The USS TOWERS (DDG-9) is being used as the vehicle for the program. Part of the effort is directed toward reducing the cost of overhaul of equipment comprising the steam propulsion plant. Toward this end, the Navy has authorized ARINC Research (under Contract N00140-73-D-0074, Order No. T0002) to perform a systematic compilation and analysis of available data related to selected high-priority equipments.

The seven DDG-2 class ships are listed in Table 1, with their commission dates, builders, and other pertinent information.

Table 1. DDG-2 CLASS SHIPS

Fleet Assignment	Ship Name (USS)	Hull Number	Ship Unit ID Code	Builder	Launch Date	Commissioning Date
Atlantic	LAWRENCE	DDG-4	04670	N.Y. Shipbuilding Corp.	2-60	1-62
Atlantic	RICKETTS	DDG-5	04671	N.Y. Shipbuilding Corp.	6-60	1-62
Atlantic	BARNEY	DDG-6	04672	N.Y. Shipbuilding Corp.	12-60	8-62
Pacific	TOWERS	DDG-9	04675	Todd Shipyards, Inc.	4-59	6-61
Pacific	BUCHANAN	DDG-14	04680	Todd Shipyards, Inc.	5-60	2-12
Atlantic	BYRD	DDG-23	04690	Todd Shipyards, Inc.	2-62	2-64
Pacific	WADDELL	DDG-24	04691	Todd Shipyards, Inc.	2-63	8-64

Table 2. MAINTENANCE-HISTORY DATA TYPES*

Data Type	Remarks
Generation I MDCS Records (Magnetic Tape)	Adequate and complete - period July 1966 through December 1969
Generation III MDCS Records (Magnetic Tape and Printed Format)	Adequate and complete - period January 1970 through June 1972
Material History Reports (Printed Format)	Adequate and complete for Generation III period (January 1970 - June 1972). Provide narrative back-up to Generation III data.
CASREPT and CASCOR Reports (Printed Format)	Reports collected cover recent three-year period, approximately January 1969 through July 1972. Reports provide additional background data on significant failures. Adequate content.
Mechanized Departure Reports (Printed Format)	Complete for recent overhauls; 43% complete for early overhauls; 24% complete for restricted availabilities. Provides marginally adequate overhaul data for applicable availabilities.
Work Booklets	Complete for 43% of recent overhauls. Augmented by Job Orders on remaining 57% of recent overhauls. Not available on previous overhauls. Adequate for applicable overhauls.
Job Orders	Complete for 57% of recent overhauls. Not available for previous overhauls. Adequate for applicable overhauls.
Shipboard Machinery Operating Records	Complete for recent period (generally two years). Adequate content and detailed scope for determining utilization factors.

*This table is extracted from Final Letter Report "Data Summary and Results on Candidate Equipments for Maintenance History Analysis", February 1973.

1.2 PURPOSE

The basic purpose of the ARINC Research work is to provide quantitative information to aid in decision-making during the overhaul planning required for the 1200-psi steam propulsion system of DDG-2 class ships, particularly the USS TOWERS. This report, one in a series, describes the approach used to analyze available data related to the maintenance history of the 1200-psi steam propulsion system. The analysis was conducted to determine whether the selected equipments aboard the USS TOWERS (DDG-9) should be overhauled during the next scheduled yard period.

1.3 DATA SOURCES

The types of data used for the development of the maintenance-history analyses for the selected 1200-psi propulsion equipments are presented in Table 2. This table also assesses the data and time period of coverage. The data generally cover the period July 1966 through June 1972. The primary data used during the analyses are from the Navy's 3M Maintenance Data Collection Subsystem (MDCS), supplemented with the other types of data.

CHAPTER TWO

APPROACH

The approach used to establish a maintenance history for the selected 1200-psi steam propulsion equipments consisted of combining and analyzing MDCS data, shipyard data, and information obtained from ship visits. The MDCS data relevant to the equipment were segregated to reflect only corrective-maintenance events, and the corresponding parts used, during the period July 1966 through June 1972. The shipyard data were summarized to reflect work performed during Regular Overhauls (ROHs) and Restricted Availabilities (RAVs) within the period of interest. The information obtained from ship visits was used to develop utilization factors (Table 3), which were applied to under-way and in-port steaming hours (Table 4) to calculate equipment operating hours. Table 5 presents an average steaming-hour profile for the seven ships for the interval between overhauls.

The approach comprised four major areas of analysis from which indicators were obtained to derive the conclusions:

- Corrective-Maintenance Event and Maintenance Man-Hour History
- Repeated Parts Usage
- Malfunction History
- Trend Analysis

2.1 CORRECTIVE-MAINTENANCE EVENT AND MAINTENANCE MAN-HOUR HISTORY

The number of corrective-maintenance events and maintenance man-hours were first compiled from the MDCS data by year for each of the ships within the DDG-2 class. A corrective-maintenance event, as used in this approach, was considered to encompass any or all labor and part cards contained within a Maintenance Control Number (MCN) or Job Control Number (JCN). The number of events and maintenance man-hours were then compared between ships and time periods to determine consistency of the data. These data were then used to calculate average values of Times Between Corrective-Maintenance Events, Maintenance Man-Hours, and Man-Hours Per Maintenance Action for individual ships and for the entire class. From these values conclusions could be made concerning the frequency and significance of corrective maintenance. If the maintenance was infrequent and the number of maintenance man-hours was small, the analyses did not continue beyond this step.

Table 3. KEY UTILIZATION RATES FOR PROPULSION EQUIPMENT (DDG-2 CLASS)

Equipment	Under-Way K_u	In-Port K_u	Remarks
SSTG Set	0.75	0.50	
Main Circulating Pump	0.27	0.52	Under-way rate calculated from log-book time at 10 knots or less while steaming.
Main Circulating Pump Turbine	0.27	0.52	
HP/LP Turbines	1.00	0.0	
Distillers	1.00	0.50	
LO Purifier and Motor	0.62	0.10	
Boilers	0.50	0.25	
Forced Draft Blower	0.50	0.25	
Auxiliary Feed Booster Pump and Turbine	N/A	N/A	This pump is generally one of the Main Feed Booster Pumps rolling over in standby at half pressure and no load.
Main Feed Pump	0.33	0.17	
Main Feed Booster Pump	0.33	0.17	Four motor-driven; two turbine-driven.
Fuel Oil Service Pump (Turbine Driven)	0.50	0.25	
Main Condensate Pump and Turbine or Motor	0.52	0.27	Two turbine-driven; two motor-driven.
Pressure Regulator, Fuel Oil Service	0.50	0.25	
Motor, AC Auxiliary Condensate Pump, SSTG Set	0.75	0.50	
Piping, Main Steam (ZP07/P701)	1.00	0.50	
Piping, SSTG Set	0.75	0.50	
Motor Gland Exhauster	1.00	0.58	Two exhausters; one each Main Condenser. Continuous operation steaming and during jacking; standby and warmup in port.
Bearing, Line Shaft	1.00	0.0	Derived from previous ships' visits and reports.
Motor, Main Feed Booster Pump	0.33	0.17	
Motor, Main Condensate Pump	0.52	0.27	
Cooler, Main Lube Oil	1.00	0.50	
Piping, Fuel Oil	1.00	0.50	Derived from previous ships' visits and reports.
Motor, Auxiliary Circulating Pump, SSTG Set	0.75	0.50	
Motor, Port and Cruising Fuel Oil Pump	0.0	0.05	
Piping, Main Feed	1.00	0.50	
Main Lube Oil Pump:			
Turbine Drive - ZU/FD01	0.55 (FD01)	0.00 (FD01)	Turbine driven (15 knots or less)
Motor Driven - ZU01/FD03	0.02 (FD03)	0.55 (FD03)	Motor driven (standby) -- used while jacking in port.
Compressor, Reciprocating High Pressure Air Service	0.15		
Auxiliary Circulating Pump, SSTG Set	0.75	0.50	
Auxiliary Condensate Pump, SSTG Set	0.75	0.50	
Reducing Station	1.0	0.50	
Main Condenser	1.0	0.50	
Pressure Regulator, LO Pump, Steaming	0.55	0.10	

Table 4. SHIP STEAMING HOURS (BY CALENDAR QUARTER)

Year	Quarter	DDG-4			DDG-5			DDG-6			DDG-9			DDG-14			DDG-23			DDG-24		
		Hours Under Way	Hours In Port	Total Steaming Hours	Hours Under Way	Hours In Port	Total Steaming Hours	Hours Under Way	Hours In Port	Total Steaming Hours	Hours Under Way	Hours In Port	Total Steaming Hours	Hours Under Way	Hours In Port	Total Steaming Hours	Hours Under Way	Hours In Port	Total Steaming Hours	Hours Under Way	Hours In Port	Total Steaming Hours
1966	3	792	555	1,347	854	1,116	1,970	154	803	957	1,681	321	2,002	1,142	829	1,971	724	725	1,449	23	235	258
	4	1,410	587	1,997	888	723	1,611	816	1,094	1,910	1,186	346	1,532	1,506	466	1,972	651	1,006	1,657	714	920	1,634
1967	1	841	436	1,277	1,034	982	2,016	733	499	1,232	453	952	1,405	159	1,155	1,314	609	747	1,356	746	904	1,650
	2	810	343	1,153	950	817	1,767	1,152	604	1,756	29	92	121	9	392	401	1,138	581	1,719	984	487	1,471
	3	648	818	1,466	643	711	1,354	1,388	553	1,941	33	382	415	658	1,209	1,867	1,096	692	1,788	91	603	694
	4	356	160	516	204	783	987	168	471	639	316	1,458	1,774	489	875	1,364	142	301	443	19	130	149
1968	1	1,248	770	2,018	717	1,035	1,752	628	1,117	1,745	747	904	1,651	1,541	212	1,753	0	34	34	525	1,317	1,842
	2	741	386	1,127	960	768	1,728	1,254	929	2,183	204	341	545	1,534	330	1,864	390	592	982	864	1,319	2,183
	3	0	0	0	456	312	768	788	329	1,117	1,010	781	1,791	1,022	519	1,541	1,018	887	1,905	1,286	806	2,092
	4	121	211	332	462	657	1,119	379	306	685	1,595	166	1,761	503	862	1,365	1,009	897	1,906	1,256	746	2,002
1969	1	751	1,270	2,021	720	552	1,272	764	620	1,384	1,172	294	1,466	511	1,041	1,552	880	940	1,820	1,379	674	2,053
	2	648	750	1,398	1,432	745	2,177	1,521	656	2,177	39	1,000	1,039	1,534	383	1,917	884	481	1,365	1,534	213	1,747
	3	704	603	1,307	860	967	1,827	988	1,066	2,054	573	1,373	1,946	1,181	563	1,744	707	619	1,326	1,152	901	2,053
	4	702	911	1,613	230	167	397	236	83	319	0	268	268	0	0	0	320	703	1,023	885	507	1,392
1970	1	920	1,179	2,099	66	689	755	0	0	0	26	233	259	401	1,336	1,737	656	609	1,265	1,245	849	2,094
	2	630	696	1,326	0	0	0	228	647	875	24	680	704	460	1,024	1,484	623	862	1,485	1,411	542	1,953
	3	684	475	1,159	134	299	433	951	1,123	2,074	768	1,157	1,925	1,286	619	1,905	1,368	840	2,208	973	369	1,342
	4	523	301	824	772	1,060	1,832	948	880	1,828	341	648	989	1,269	427	1,696	798	462	1,260	412	1,142	1,554
1971	1	691	607	1,298	577	999	1,576	457	216	673	1,314	467	1,781	569	446	1,015	164	508	672	34	54	88
	2	1,189	902	2,091	1,026	949	1,975	615	621	1,236	1,085	706	1,791	0	0	0	0	0	0	302	489	791
	3	384	360	744	142	165	307	701	386	1,087	425	384	809	123	836	959	316	733	1,049	666	603	1,269
	4	0	84	84	255	616	871	855	395	1,250	322	584	906	586	801	1,387	898	1,047	1,945	1,102	128	1,230
1972	1	552	1,105	1,657	463	422	885	971	1,213	2,184	336	323	659	857	292	1,149	1,063	1,121	2,184	683	482	1,165
	2	462	771	1,233	379	264	643	1,214	951	2,165	521	234	755	1,590	201	1,791	1,146	836	1,982	1,958	61	2,019

Table 5. PROFILE OF OPERATING HOURS DURING INTERVAL BETWEEN OVERHAULS (AVERAGE HOURS PER MONTH)

Ship	Under Way	Not Under Way	Cold Iron
DDG-4	244.3	246.4	238.6
DDG-5	239.8	247.2	243.1
DDG-6	288.3	230.1	211.6
DDG-9	205.3	238.6	287.7
DDG-14	289.6	211.3	228.8
DDG-23	273.0	242.6	213.9
DDG-24	370.3	253.5	107.1
Mean All Ships	274.3	237.8	217.3

2.2 REPEATED PARTS USAGE

The parts used by the seven ships during the six-year period were reviewed and analyzed. The initial review was performed to identify those parts which were frequently used to repair the equipment by the ship's force. All miscellaneous parts, i.e., nuts, studs, gaskets, etc., and infrequently used parts were excluded, and a list was developed from which the estimated replacement interval could be calculated. Thus it was possible to project the average frequency of part replacement that could be anticipated during Fleet operation. This can be presented in equation form as follows:

$$F = \frac{N_{E/S} \cdot N_S \cdot N_M \cdot N_{P/O}}{N_P}$$

where

F = Frequency of occurrence in equipment months

$N_{E/S}$ = Number of equipments per ship

N_S = Number of ships

N_M = Number of months in time period

$N_{P/O}$ = Number of parts used per occurrence

N_P = Number of total parts used during time period

The frequency of occurrence was used to determine the number of overhaul cycles for the individual parts, an overhaul cycle (operating interval between overhauls) being 36 calendar months. This analysis, in addition to providing an anticipated replacement interval for parts, indicated the seriousness of repeated maintenance and information to aid in determining stocking levels.

2.3 MALFUNCTION HISTORY

The MDCS malfunction coding was categorized to aid in determining the type of equipment malfunctions that were recurring. Since the MDCS reporting system and coding were changed significantly in January 1970, separate categories for each of the two reporting systems were required. The reporting system used prior to January 1970 is referred to here as Generation I, and that beginning in January 1970 as Generation III. A Generation II system did exist, but these data have been converted to make them compatible with the Generation III coding.

In order to combine Generation I and Generation III malfunction data, it was necessary to develop a method for correlating the two types of coding procedures. The method used was to define general categories of types of malfunctions and then assign malfunction codes from each data-reporting system to an appropriate category. The general categories selected and their corresponding definitions are as follows:

Category	Definition
1. Wearout	Any malfunction that appears to be the result of normal usage stress or deterioration.
2. Operation or Environmental	Any malfunction that appears to be the result of external conditions associated with mission or sea environments or to be caused by system operation.
3. Maintenance	Any malfunction that appears to be the result of maintenance or personnel error, logistics support, defective material, or inadequate operating or maintenance instructions.
4. Other	Malfunctions that cannot be classified because the data are insufficient or inappropriate to the equipment being analyzed.

Some judgment is required, of course, in assigning specific maintenance events to these categories, and in many cases there is no precise means of obtaining a positive division between categories. However, for comparison purposes, the relationship between the number of events in one category and those of other categories should be reasonably accurate.

The distribution and categorization of the malfunction codes reported in the Generation I data reporting system are presented in Table 6. The code descriptions are taken from the 3M instruction manuals (43P2).

The criteria for categorizing malfunctions for Generation III data are based on four types of codes:

1. First Indication of Trouble (FIT) Code
2. Cause Code
3. Failed Part Condition Code
4. Narrative Remarks

These were used to assign the malfunction (corrective action) event to one of the four major categories. Of the four types of coded data, the cause code is the primary indicator; on occasion, the FIT code can be the only indication, or this code combined with narrative remarks may be used. The Failed Part Condition Code is not used in this analysis because of its infrequent use.

The Cause Code is used in this analysis to determine the malfunction category unless the cause code is "O". In the case of a "O" cause code, the FIT code is used. If the FIT code of "O" is used, then the narrative accompanying the corrective-maintenance event is used to determine the category. Tables 7 and 8 show the categorization of the Cause Codes and FIT Codes, respectively. The results obtained by using this method will reflect some differences in the percentages of the total number of labor events assigned to each category. These can be attributed to a number of causes, such as the following:

- There are judgment factors in assigning events to the proper category.
- There is sufficient ambiguity in the selection of malfunction codes in the older (Generation I) data system to result in inaccurate category assignment.
- The new (Generation III) data system is not mature, which results in a high percentage of undefined events.
- The new system (Generation III) actually provides a more accurate picture of the relationship of the first three categories.

Table 6. CATEGORIZATION OF MALFUNCTION CODES, GENERATION I DATA (MECHANICAL EQUIPMENT ONLY)

Wearout (Category 1)	Operational/Environmental (Category 2)	Maintenance (Category 3)	Other (Category 4)
008-Noisy	015-Broken Glass	054-Faulty Part, Material	000-No Malfunction
020-Worn Excessively	021-Overloaded	068-Inoperative	004-Low GM or Emission
070-Broken	023-Blown	093-Missing Part	007-Arcing, Arced
116-Cut	050-Blistered	127-Adjustment, Improper	051-Failed to Tune
117-Deteriorated	080-Burned Out	225-Manufacturer's Defect	088-Low Gain
135-Binding	120-Chafed	233-Erratic	091-Low Sensitivity
175-Clearance Over Max	148-Eroded	235-Dry	099-Other
190-Cracked	170-Corroded	239-Improper Fit	160-Contacts Connection Defective
214-Grooved	180-Clogged	259-Oversize	161-Output Incorrect
226-Excessive Play	185-Contaminated	275-Undersize	169-Voltage Incorrect
231-Elongated	230-Dirty	315-RPM Fluctuation	196-Shorted or Grounded
270-Frozen	242-Failed to Operate	346-Misaligned	276-Weak
370-Jammed	255-No Output	660-Stripped	300-Grounded
374-Internal Failure	360-Intermittent Operation	730-Loose	450-Open
381-Leaking	428-Incorrect Reading	750-Missing	472-Fuze Blown
440-Old Age	439-Plugged	780-Bent	649-Sweep Malfunction
458-Out of Balance	464-Overspeed	984-Low Specific Gravity	665-Terminals Reversed
462-Output Too Low	585-Sheared		692-Video Faulty
512-Split	680-Unstable		693-Audio Faulty
524-Pressure Too Low	701-Warped		700-Weak Electrically
576-Ruptured	722-Weld Cracked or Broken		720-Brush Failure
690-Vibration Excessive	771-Scale Excessive		748-Frequently Erratic
710-Bearing Failure	910-Chipped		819-Contacts Do Not Open/Close Properly
928-Pelling	935-Scored		884-Lead or Terminal Broken
978-Wall Thickness Not to Specification	947-Torn		900-Burned
	991-Salinity Too High		962-Low Power
			992-Lost at Sea

Table 7. CAUSE-CODE CATEGORIES (GENERATION III DATA)

Cause Code	Description	Malfunction Category
1	Fire/Collision/Battle/Storm Damage	Environment
2	Foreign Object Damage	Environment
3	Other Abnormal Environment	Environment
4	Manufacturer/Installation Defects	Maintenance
5	Personnel-Related Maintenance Accident	Maintenance
6	Personnel-Related Operational Accident	Maintenance
7	Improper/Inadequate Maintenance Instruction or Periodicity	Maintenance
8	Improper/Inadequate Operating Instruction	Maintenance
9	Design-Related - Normal Stress or Deterioration	Wearout
0	Not Applicable (No Malfunction)	Other

Table 8. FIT CODE CATEGORY (GENERATION III DATA)

FIT Code	Description	Malfunction Category
1	Arcing/Smoking/Fire/Heat	Environment
2	Leaking	Wearout
3	Vibration/Noise/Audio	Environment
4	Alarm	Other
5	Meter/Gauge Reading	Other
6	Frequency/Speed Rotation	Other
7	Video/Sweep/Printout	Other
8	Suction/Vacuum/Flow	Other
9	Fails to: Tune/Adjust/Align/Calibrate/Radiate/Start	Maintenance
0	None of Above	Check Narrative

These differences, however, do not prevent the data from providing trends or indicators of the types of malfunctions that occur repeatedly. If it is noted, in either reporting system, that the predominant cause of corrective maintenance is wearout rather than operational or maintenance-related causes, this supports the conclusion that the equipment will require overhaul, at some prescribed period, but not necessarily during each regularly scheduled ship overhaul.

2.4 TREND ANALYSIS

Trend curves were developed for the equipments on each of the seven ships included in the analysis. The data from all similar equipments on each ship were first compiled by quarter, beginning with the third quarter of 1966. These data consisted of the number of corrective-maintenance actions, the number of man-hours, and parts cost if significant. In addition, operating hours were determined for each quarter by multiplying the utilization factors by the under-way hours and in-port steaming hours. Then the rates of events per operating hour, man-hours per operating hour, and parts cost per operating hour (if significant) were calculated. These are plotted as four-point moving averages (four quarters) for the entire time period, with each point plotted at the mid-point of the interval. Each restricted-availability and overhaul period is also marked on each plot. These DDG availability periods are presented in Table 9.

The events-per-operating-hour and man-hours-per-operating-hour rates were chosen as indicators because they will reflect changes in the maintenance requirements of the ship's force. For example, if the event and man-hour rates remain parallel, even if increasing, it indicates that the equipment problems are not becoming more serious -- only that the frequency is increasing. However, if the event rate stays constant while the man-hour rate increases, then the seriousness of the equipment problems is increasing. On the other hand, if the man-hour rate stays constant but the event rate is increasing, the seriousness of the problems is decreasing or the maintenance is probably occurring because of minor or nuisance items.

Any unusual or abnormal situation can readily be detected by reviewing the plots. These situations are analyzed carefully, with supplementary analysis of other data (such as CASREPT summaries) as appropriate, to determine if any significant trends are present.

Table 9. DDG AVAILABILITY PERIODS*

Availabilities		Launch Date	Commissioning Date
Assigned to Atlantic Fleet			
USS LAWRENCE DDG-4			
ROH	7 Sept. 1971 to 6 Feb. 1972	2/27/60	1/6/62
Restricted	12 Dec. 1970 to 15 Jan. 1971		
ROH	1 July 1968 to 10 Jan. 1969		
USS CV RICKETTS DDG-5			
Restricted	21 Jan. 1972 to 11 Feb. 1972	6/4/70	1/6/62
Restricted	1 Sept. 1971 to 22 Dec. 1971		
Restricted	2 July 1971 to 19 Sept. 1971		
ROH	5 March 1970 to 18 Sept. 1970		
Restricted	12 Aug. 1968 to 9 Nov. 1968		
ROH	14 Dec. 1965 to 12 July 1966		
USS BARNEY DDG-6			
ROH	1 March 1966 to 15 Aug. 1966		
ROH	1 Dec. 1969 to 29 May 1970		
USS BYRD DDG-23			
ROH	26 March 1971 to 5 Sept. 1971	2/6/62	3/7/64
ROH	16 Nov. 1967 to 22 May 1968		
Assigned to Pacific Fleet			
USS TOWERS DDG-9			
Restricted	8 Dec. 1970 to 24 Dec. 1970	4/23/59	6/6/61
ROH	2 Feb. 1970 to 10 July 1970		
Restricted	6 Oct. 1969 to 5 Dec. 1969	Habitability Work	
Restricted	2 June 1969 to 27 June 1969	No Propulsion Work	
Restricted	14 Apr. 1969 to 26 May 1969		
Restricted	6 May 1969 to 26 June 1968		
Restricted	5 Feb. 1968 to 12 Feb. 1968		
ROH	14 Apr. 1967 to 18 Oct. 1967		
Restricted	1 March 1966 to 8 Apr. 1966		
USS BUCHANAN DDG-14			
Restricted	13 Dec. 1971 to 14 Jan. 1972		
ROH	22 Apr. 1971 to 3 Sept. 1971		
Restricted	30 Sept. 1969 to 8 June 1970		
Restricted	26 Feb. 1969 to 14 March 1969		
Restricted	6 Nov. 1967 to 15 Dec. 1967		
ROH	17 Mar. 1967 to 4 Aug. 1967		
USS WADDEL DDG-24		2/26/63	8/28/64
Restricted	22 Nov. 1971 to 27 Nov. 1971		
ROH	5 Feb. 1971 to 20 May 1971		
ROH	4 Aug. 1967 to 19 Feb. 1968		
Restricted	8 July 1966 to 30 Sept. 1966		

*This table was extracted from Final Letter Report, "Data Summary and Results on Candidate Equipments for Maintenance History Analysis" February 1973.