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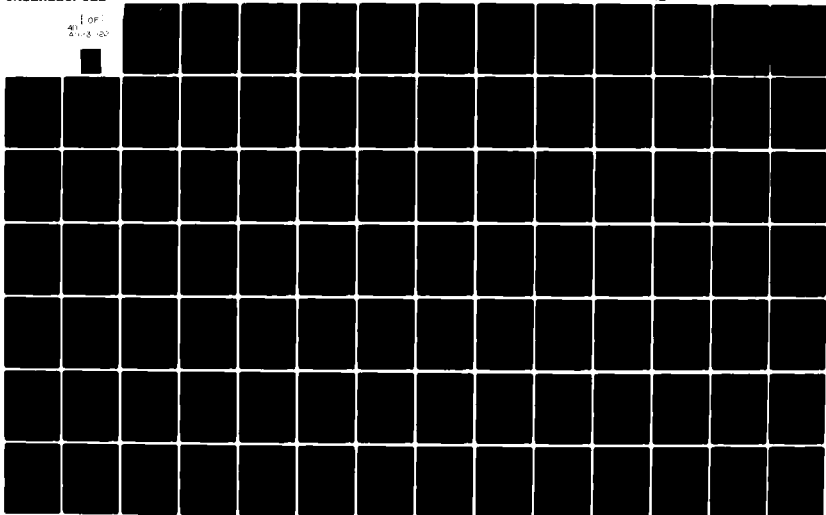
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VOLUME 2B

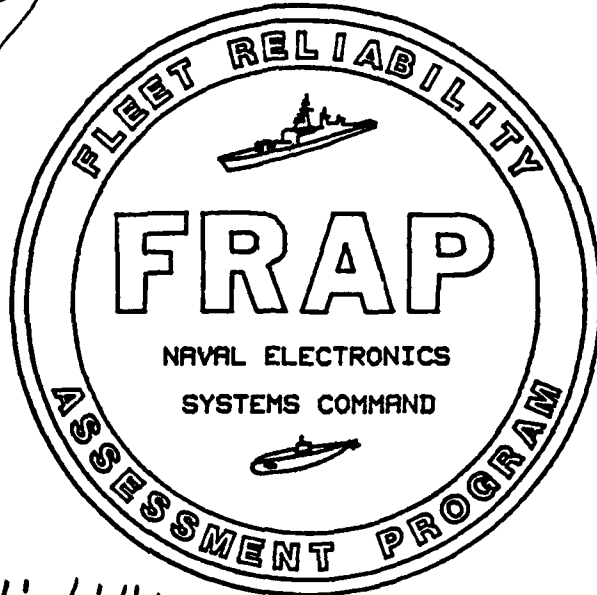
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6 Fleet Reliability Assessment Program
Volume 2B

EQUIPMENT REPORT

NAVMACS A+

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JAN 10 1978

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CRANE, INDIANA

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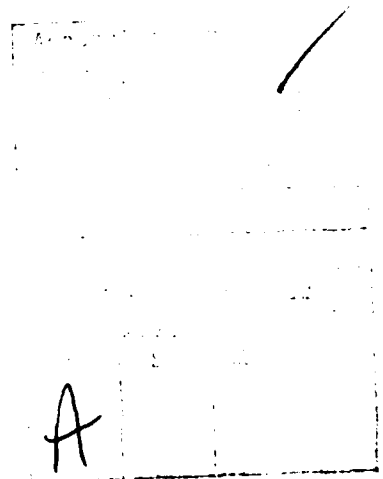
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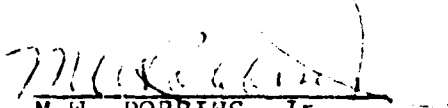
DEPARTMENT OF THE NAVY
NAVAL ELECTRONICS SYSTEMS COMMAND

A093921


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CHANGE NO.	DATE	TITLE OR BRIEF DESCRIPTION	ENTERED BY

VOLUME 2B NAVMACS A+

EQUIPMENT REPORT

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VOLUME 2B NAVMACS A+ EQUIPMENT REPORT

SECTION I - RESULTS

1-1 RESULTS SUMMARY

During the period 1 June 1978 and 30 April 1979 the AN/SYQ-7(V)2 NAVMACS A+ System was monitored by FRAP under operational conditions in a heavy ship-to-shore traffic environment on deployed platforms. A total of 19 selected platforms participated in the study during which 53,272 hours of operating time was accumulated. A total of 26 equipment failures were reported, which places the observed equipment MTBF at 2049 hours. At the 90% confidence limits, the actual equipment MTBF is not greater than 2827 nor less than 1629 hours. The observed duty cycle for this system (operating hours/calender hours) was 0.556. See Table 1-1 for a summary of RMA results and Table 1-2 for a summary of the WRA's and O-levels failing.

1-1.1 HARDWARE PROBLEMS

In general, NAVMACS A+ has performed very well and the few hardware problems reported have been primarily mechanical ones. The paper feed rollers were an early problem, although this appears to have been successfully dealt with. Under certain circumstances the current design of the ribbon reverse mechanism can fail. An ECP has been proposed. Neither problem has dampened the universal praise Fleet users have expressed for this system.

1-1.2 SOFTWARE PROBLEMS

No software related problems were reported for NAVMACS A+. FRAP discovered several of the platforms lacked documentation on the RD-396 unit. These were supplied with photocopies of the manual until proper manuals could be obtained.

SECTION II - SYSTEM DESCRIPTION

2-1 GENERAL

NAVMACS A+ is an automated message handling telecommunications system capable of operating ship-to-shore via High Frequency (2-30 MHz) independent sideband radio receivers and a two way SATCOM link via the AN/WSC-3 transceiver. A digital minicomputer, the AN/UYK-20(V), handles the address decoding, storage, retrieval, and printing of incoming traffic. It also accepts, schedules, and transmits outbound traffic. To a large degree, NAVMACS automates the formerly manual ship's message center and both decreases the operator's workload and increases the efficiency and effectiveness of the Naval telecommunications network.

2-2 MISSION

The NAVMACS A+ is intended to provide the primary ship-to-shore communications link between a deployed surface platform and the world-wide Naval telecommunications network. It handles clear text (red) message

LEGEND

1. OPER. - OPERATIONAL *
2. EQUIP. - EQUIPMENT *
3. PARTS - PARTS REPLACEMENT *

TABLE 1-1. DATA SUMMARY FOR NAVMACS A+.			
PARAMETER	OPER	EQUIP	PARTS
OPERATIONAL			
Calendar Hours	95,736	95,736	95,736
Operating Hours	53,272	53,272	53,272
Duty Cycle	0.556	0.556	0.556
Sample Size	19	19	19
RELIABILITY			
Number of Failures	21	26	23
Time Between Failures-Mean	2421.5	4048.9	2219.7
Time Between Failures-Median	1678.4	1420.2	1538.6
Distribution	EXP	EXP	EXP
MAINTAINABILITY			
Total Repair Time	44	41	110
Number of Repairs	13	11	20
Time to Repair-Mean	3.38	3.7	5.5
Time to Repair-Median	2.35	2.6	3.81
Distribution	EXP	EXP	EXP
Total Down Time	5141	5307	4901
Repairs (or Maint. Act.)	13	11	20
Down Time-Mean	395.5	482.5	245.0
Down Time-Median	35.8	43.6	20.5
Distribution	LN	LN	LN
AVAILABILITY			
Inherent	0.9986	0.9982	0.9975
Observed-Mean	0.8505	0.8194	----
Observed-Median	0.9732	0.9632	----
Effective	0.9119	0.9094	0.9158

* Reference Volume 1, Paragraph 3-4
 NOTE: All Time Units Are In Hours

TABLE 1-2. SUMMARY OF WRA AND O-LEVEL ASSEMBLIES FAILING

WRA	O-LEVEL	DESCRIPTION (NAME)	OPER	EQUIP	PARTS
14		AN/UYK-20(V) DATA PROC SET			
	021	ARITHMETIC LOGIC UNIT	1	1	1
20		ON-143(V)4 INTERCONNECT GRP			
	022	POWER SUPPLY	1	1	1
	010	TRANSMIT DELAY	1	1	1
	014	INTERFACE	1	1	1
	039	----	1	----	----
21		RD-396 CASSETTE PAPER TAPE			
	034	WRITE ELECTRONICS	1	1	1
	013	CONTROL PANEL ASSEMBLY	----	1	1
22		RD-397 PAPER TAPE READER			
	012	READ ASSEMBLY	----	1	1
25		CV-3022 PATCH PANEL			
	099	----	2	----	2
30		TTY-624 LINE PRINTER			
	099	----	16	19	17
		TOTAL	24	26	26

traffic inbound from the link crypto machines and outbound prior to link encryption. Incoming traffic is scanned and only those messages addressed to the ship are stored and printed in full. A log of all incoming message traffic is maintained by printing the address headers and time/date group on the logging printer. During periods of heavy inbound traffic, the logging printer is automatically converted to print out message traffic. Outbound messages are fed into the system which then flags the computer managing the SATCOM system that the ship has traffic to send. When authorized to do so, the system transmits the outbound message and receives an acknowledgement that the message has been successfully picked up by the shore based system. This acknowledgement is printed out by the logging printer. Users report that NAVMACS compresses the old manual time frame for message transmission/acknowledgement from over an hour to typically under ten minutes for routine (the lowest level) priority traffic. Higher priority messages move even faster.

2-3 EQUIPMENT

The Naval Modular Automated Communications System (NAVMACS) A+ consists of ten modules, nine of which are unique:

a. Data Processing Set AN/UJK-20(V). This minicomputer is configured with 64K of core memory and bootstrap loaders in ROM (Read Only Memory) for program loading from the cassette magnetic tape unit or the paper tape reader. The computer serves as the heart of the system as most of the operational features of NAVMACS A+ are contained in software.

b. Interconnecting Group ON-143(V)/USQ. Serves as an interface between the AN/UJK-20(V) and the CUDIX AN/WSC-3 transceiver during high speed SATCOM telecommunications.

c. Converter/Patch Panel CV-3022/UG. Used primarily for digital signal level conversion. On platforms already configured for low level digital operation in the message center, the CV-3022 is omitted.

d. Medium Speed Line. Printer TT-624(V)/UG. Two units are used. One prints messages addressed to the ship. The second serves as a logging printer and prints only headers of incoming messages and acknowledgements of outbound traffic. In times of peak traffic, the second printer picks up the overflow to prevent system saturation and message loss.

e. Cassette Magnetic Tape Unit RD-396(V)/U. Used to load programs into the AN/UJK-20(V).

f. High Speed Paper Tape Reader/Punch PD-397/U. The optical tape reader section is used as the primary entry port for outbound traffic. It is also used for loading the guard list (list of message addresses to be captured and printed in full) and as a back-up program loading device for AN/UJK-20(V) programs. The high speed paper punch section serves as an output device for message retrievals and for off-line encrypted messages.

g. Teletype Reperforator TT-192C. A low speed paper tape punch used as a back-up for the high speed punch in the RD-397.

h. Teletype Transmit Distributor (TD) TT-187/UG. A low speed mechanical reader for punched paper tape which serves as a back-up for the high speed optical reader in the FD-397.

i. Teletypewriter Set AN/UGC-20A (or B). Used by the operator for system control.

SECTION III - SPECIFICATIONS

No system level specifications for the NAVMACS A+ system exist. Those used in the FPAP automated analysis (see SECTION IV below) are estimates compiled from individual equipment specifications, from MIL-HNBK-2173 calculations and from engineering estimates. They are intended to serve as a guide for determining system weaknesses. By using them, the problem identification modules of the FRAP automated analysis program can be used on NAVMACS data.

SECTION IV - PROBLEMS

4-1 HARDWARE PROBLEMS

Although few were reported on 2 Kilo forms, TT-624 paper rollers were an early problem for NAVMACS A+ users. The pressure roller which pinches the paper so as to allow paper feeding wore a groove in the main paper roller (platten). The paper then slipped and did not feed properly. A number of factors appear to be involved. First, there may have been a batch of substandard rollers in the first units. In any case, roller replacement is not straight forward as alignment shims must be used or the pinch roller will cause the paper to "scrub" against the main roller accelerating wearout.

The higher than expected demand rate for rollers led to some shortages which were countered with commendable ingenuity by Fleet technicians. Since the TT-624 is regularly serviced under PMS schedules, technicians found that they could successfully "retread" worn rollers with common electrical friction tape provided they replaced the tape during PMS servicing. The USS RANGER, on the other hand, switched to edge perforated paper and installed a pin drive tractor feed, which permanently solves the problem.

Verbal reports were also received about the ribbon reverse mechanism on the TT-624 which can be "fooled" by certain manual operator sequences. This causes in a failure to reverse the ribbon and lost message traffic can result. Another verbal report mentioned that ribbons "billow" as they grow old and can rub or catch on the rotating print drum. It is understood that an ECP has been proposed to address both problems.

One ship reported that the air filter of the RD-397 is picking up chaff from the paper tape. Unless the air filter is cleaned daily, the unit overheats.

4-2 SOFTWARE PROBLEMS

No software problems were reported. However, when asked about desired improvements, several were forth coming. Fleet users wanted a larger guard list, especially on the larger platforms which have many organizations on board. Also mentioned was a need for a header of more than 192 character or 5 lines. Some platforms desired that net messages be retained in memory for a short time after printing so that the operator could exercise a retrieval option. Others said that the network is seldom busy so they simply send a service request for a repeat transmission.

SECTION V - CORRECTIVE ACTIONS

5-1 HARDWARE

FRAP alerted participating platforms about the critical roller shims in the February 1979 Fleet Feedback Report, which may explain why few FRAP platforms reported roller trouble at the end of the study. Pinch roller feeding on a printer as fast as the TT-624 requires careful roller adjustment, hence the shims. Most medium to high speed printers in commercial use are pin feed tractor fed when high message throughput is expected. It is recommended that consideration be given to equipping all TT-624 units with tractors as the USS RANGER did. The pinch rollers should be retained to allow the use of regular paper as a backup measure.

The ECP for the ribbon reverse mechanism appears to have merit and is reported to provide improved safety for the operator in the form of a finger shield. That alone may well be justification for its serious consideration.

5-2 SOFTWARE CORRECTIVE ACTIONS

None required.

SECTION VI - EQUIPMENT RELIABILITY MODEL

System reliability is defined as the probability of performing a specified function or mission under specified conditions for a specified time. Reliability models are word statements or block diagrams which represent the requirements for mission success. The FRAP equipment models are used to determine the achieved operational reliability and to assess the effect of ECPs and other corrective action upon system reliability. Maintenance Action Reports are compared against the model to determine if a reported failure results in a system failure, or if not a failure, then the degree of system degradation. In addition, the model is used in determining logistic support requirements.

Maintenance of Naval shipboard equipment is accomplished by replacement or repair of components at Organizational (O), Intermediate (I), or Depot (D) repair levels. Ships Maintenance and Material Management (3-M) normally collects organizational level repair data but not intermediate or depot level repair data. Using 3-M field data requires that the lowest components of the model be the lowest level reported by 3-M, i.e., the O-level replaceable component. This O-level component can be a piece-part, printed circuit board, major assembly, or whatever is

planned for the O-level maintenance concept.

Figure 6-1 illustrates the reliability model block diagram of the NAVMACS A+ system. Figures 6-2 and 6-3 are the models for the RD-396/U Paper Tape Reader/Punch and the RD-396(V)/U Cassette Magnetic Tape Unit, respectively.

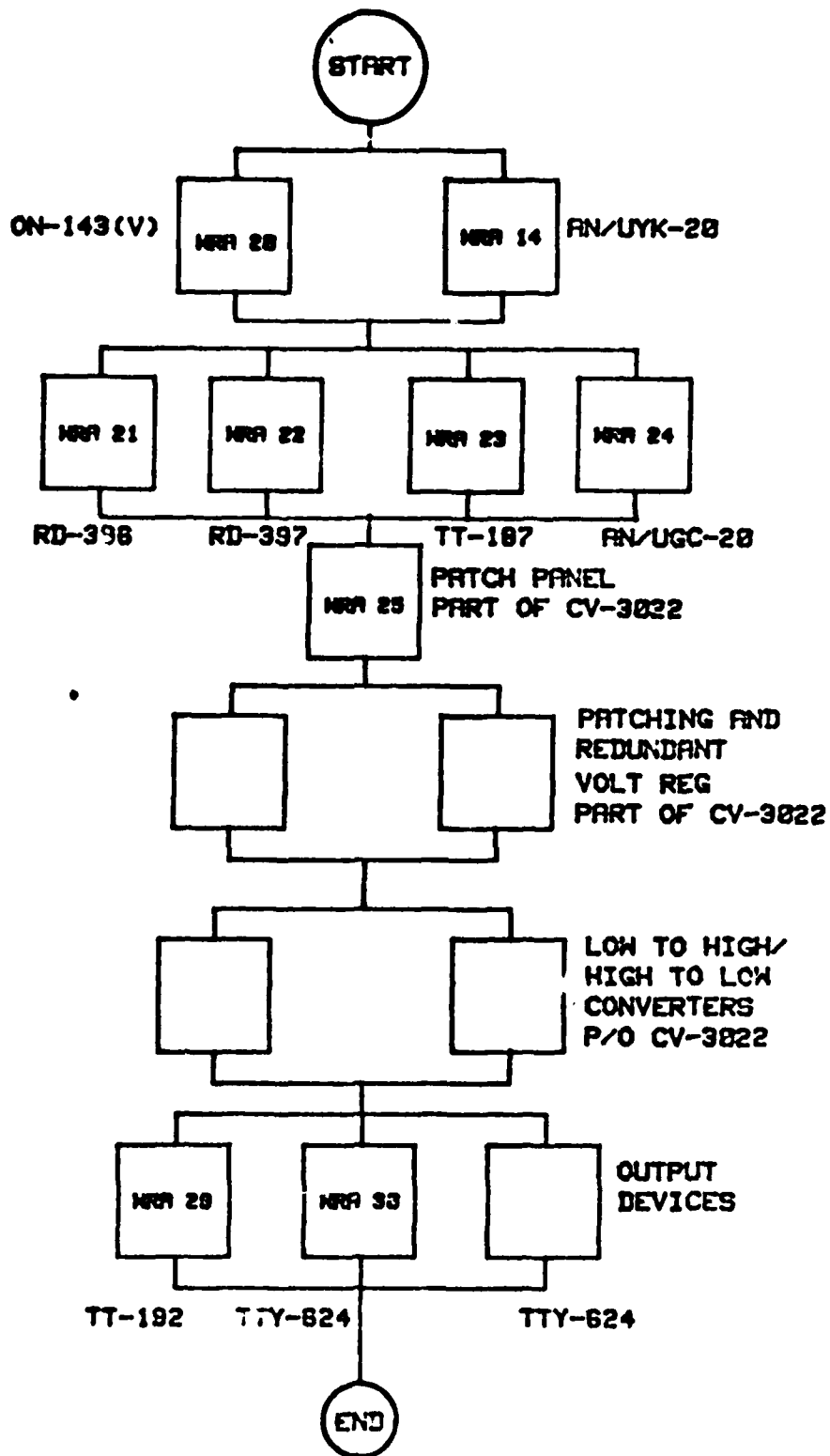


FIGURE 6-1
SYSTEM/WRA-Level Block Diagram
for NRVNACS A+ (AN/SYQ-7(V)2)

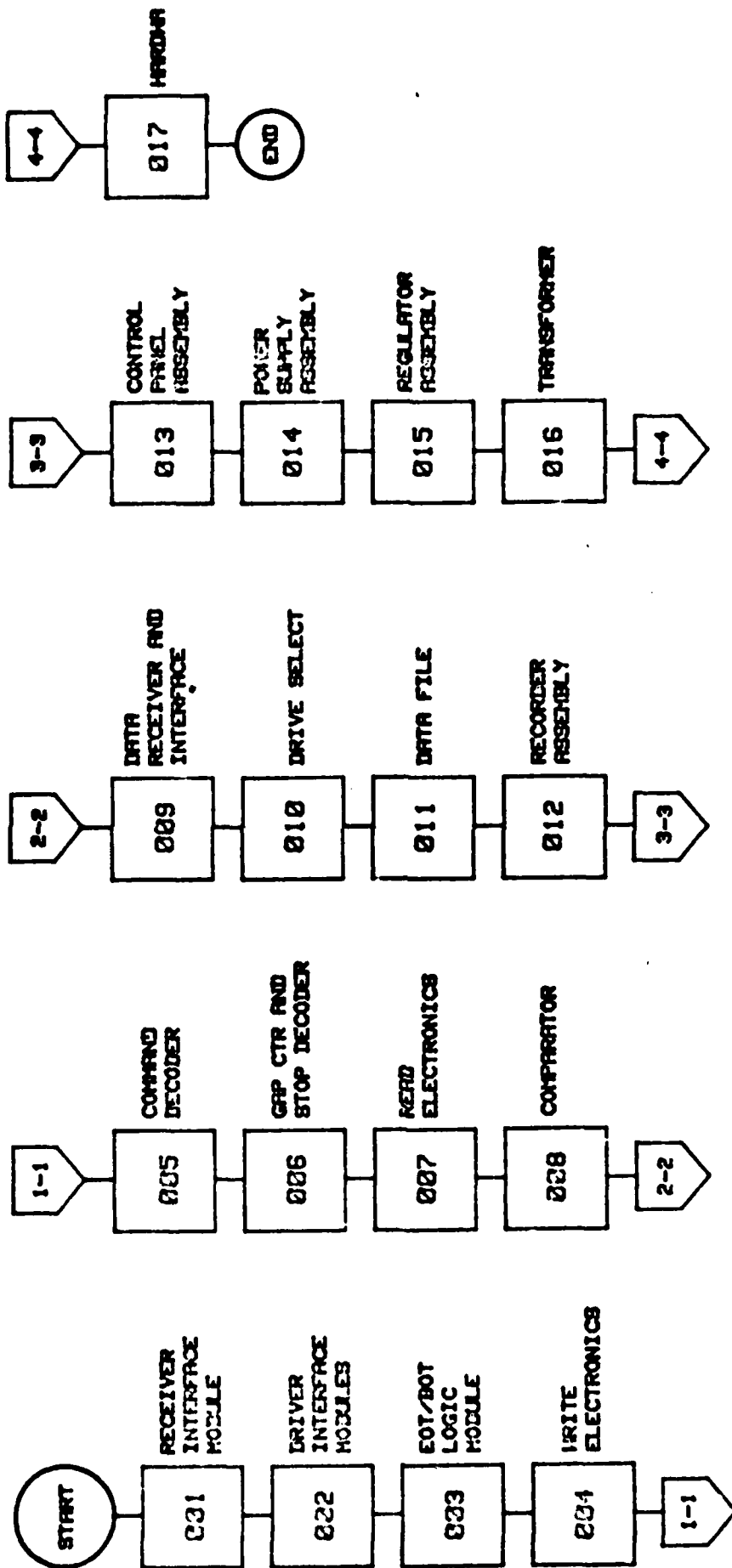


FIGURE 6-2

EQUIPMENT/O-Level Reliability Block Diagram for RD-396(V)/U CMTU (MRA 21)

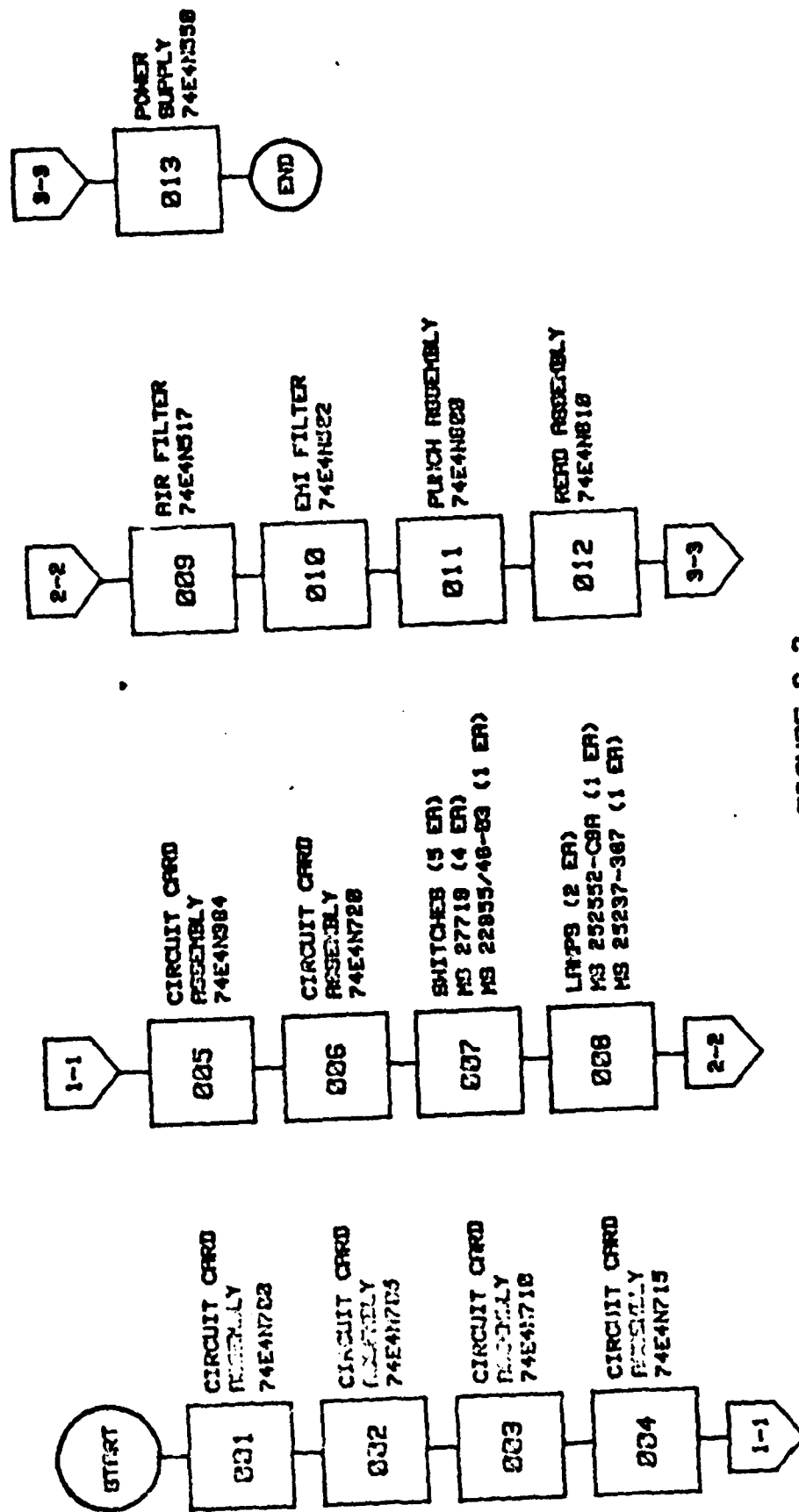


FIGURE 6-3
EQUIPMENT/O-Level Reliability Block Diagram for RD-397/U [MRA 22]

SECTION VII - ANALYSES

The data analysis for NAVMACS is presented in 3 sub-sections, as follows:

- (1) Operational Failures. Failures causing a 10% or greater capability loss are submitted to analysis.
- (2) Equipment Failures. Equipment failures are submitted to analysis.
- (3) Parts Replacement. Those failures requiring the replacement of parts are submitted to analysis.

NAVMACS
OPERATIONAL
RELIABILITY

SYSTEM	SHIPNAME	DATE	ETH	FAILURE TYPE	ASSESSMENT DATA	FAILURE TIME	DUTY	WRA	OL1	OL2	OL3
NAVMACS	ALBANY	8215	8820.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	ALBANY	8241	9422.	CENSORED	602.	602.	.965	0	0	0	0
NAVMACS	ALBANY	9002	10707.	CENSORED	1887.	1887.	.517	0	0	0	0
NO	INITIAL RECORD-FIRST RECORD USED										
NAVMACS	BLUE RIDGE	9047	647.	FINAL	0.	0.	0.000	0	0	0	0
NAVMACS	BOWEN	8184	8421.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	BOWEN	8212	8976.	CENSORED	555.	555.	0.000	0	0	0	0
NAVMACS	BOWEN	8243	9718.	CENSORED	1297.	1297.	.826	0	0	0	0
NAVMACS	BOWEN	8362	11577.	CENSORED	3156.	3156.	.916	0	0	0	0
NAVMACS	CONSTELLATION	8164	3783.	INITIAL	0.	0.	.739	0	0	0	0
NAVMACS	CONSTELLATION	8263	5635.	CENSORED	1852.	1852.	0.000	0	0	0	0
NAVMACS	CONSTELLATION	8264	5635.	FAILURE	1852.	1852.	.779	0	0	0	0
NAVMACS	CONSTELLATION	8279	6020.	CENSORED	2237.	2237.	.772	30	99	0	0
NAVMACS	CONSTELLATION	8324	7179.	FAILURE	3396.	3396.	.811	0	0	0	0
NAVMACS	CONSTELLATION	8340	7517.	FAILURE	1544.	1544.	.884	30	99	0	0
NAVMACS	CONSTELLATION	9032	8047.	CENSORED	3734.	3734.	.884	0	0	0	0
NAVMACS	CONSTELLATION	9096	9093.	CENSORED	4264.	4264.	.763	0	0	0	0
NAVMACS	CONSTELLATION	9105	9180.	FAILURE	5310.	1914.	.745	30	99	0	0
NAVMACS	CONSTELLATION	9114	9338.	CENSORED	5397.	87.	.735	0	0	0	0
NAVMACS	CONSTELLATION	9169	10397.	FAILURE	5555.	245.	.735	30	99	0	0
NAVMACS	DALE	8217	7995.	FINAL	6614.	1059.	.745	0	0	0	0
NAVMACS	DALE	8305	9982.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	DALE	8305	9982.	CENSORED	1987.	1987.	.941	0	0	0	0
NO	INITIAL RECORD-FIRST RECORD USED										
NAVMACS	GUAM	8276	5971.	CENSORED	0.	0.	0.000	0	0	0	0
NAVMACS	GUAM	8300	6445.	FAILURE	474.	474.	.823	20	2	99	0
NAVMACS	INCHON	8205	4843.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	INCHON	9071	9247.	CENSORED	4404.	4404.	.794	0	0	0	0
NAVMACS	INDEPENDENCE	8206	4692.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	INDEPENDENCE	8335	5759.	FAILURE	1067.	1067.	.345	25	99	0	0
NAVMACS	INDEPENDENCE	8345	5931.	FAILURE	1239.	172.	.371	30	99	0	0
NAVMACS	INDEPENDENCE	9031	6246.	CENSORED	1554.	315.	.341	0	0	0	0
NAVMACS	INDEPENDENCE	9044	6536.	DEFERRED	1844.	605.	.378	25	99	0	0
NAVMACS	INDEPENDENCE	9090	6691.	CENSORED	1999.	155.	.335	0	0	0	0
NAVMACS	INDEPENDENCE	9120	7307.	CENSORED	2615.	771.	.391	0	0	0	0
NAVMACS	KINKAID	8222	5800.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	KINKAID	9102	11676.	FINAL	5876.	5876.	.999	0	0	0	0
NAVMACS	KITTY HAWK	8321	2431.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	KITTY HAWK	9008	3718.	FAILURE	1287.	1287.	1.031	30	99	0	0
NAVMACS	KITTY HAWK	9135	4520.	FINAL	2089.	802.	.486	0	0	0	0
NAVMACS	LEAHY	8145	6373.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	LEAHY	8355	7870.	FAILURE	1497.	1497.	.297	21	4	0	0
NAVMACS	LEAHY	9066	9131.	FINAL	2758.	1261.	.402	0	0	0	0
NAVMACS	LUCE	8200	2508.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	LUCE	8230	2979.	CENSORED	471.	471.	.654	0	0	0	0
NAVMACS	LUCE	8247	3335.	FAILURE	827.	827.	.733	30	99	0	0
NAVMACS	LUCE	8321	5063.	CENSORED	2555.	1728.	.880	0	0	0	0
NAVMACS	LUCE	9137	8540.	CENSORED	6032.	5205.	.832	0	0	0	0
NAVMACS	NEW ORLEANS	8146	5814.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	NEW ORLEANS	9066	5957.	FINAL	143.	143.	.021	0	0	0	0

FLEET RELIABILITY ASSESSMENT DATA											
SYSTEM	SHIPNAME	DATE	ETM	FAILURE TYPE	OPERATE	FAILURE TIME	DUTY	MRA	OL1	OL2	OL3
NAVMACS	OKINAWA	8165	1881.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	OKINAWA	8207	2914.	DEFERRED	1033.	1033.	1.025	20	10	0	0
NAVMACS	OKINAWA	8266	4204.	FAILURE	2323.	1290.	.958	30	99	0	0
NAVMACS	OKINAWA	8290	4756.	FAILURE	2875.	552.	.958	20	99	0	0
NAVMACS	OKINAWA	9102	8720.	FINAL	6839.	3964.	.944	0	0	0	0
NAVMACS	RANGER	8164	2377.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	RANGER	8256	3200.	CENSORED	823.	823.	.373	0	0	0	0
NAVMACS	RANGER	8303	3276.	CENSORED	899.	899.	.269	0	0	0	0
NAVMACS	RANGER	8334	4034.	CENSORED	1657.	1657.	.406	0	0	0	0
NAVMACS	RANGER	9037	5910.	FAILURE	3533.	3533.	.619	30	99	0	0
NAVMACS	RANGER	9045	6090.	CENSORED	3713.	180.	.629	0	0	0	0
NAVMACS	SANTA BARBARA	8187	7007.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	SANTA BARBARA	8219	7069.	CENSORED	62.	62.	.081	0	0	0	0
NAVMACS	SANTA BARBARA	8286	7069.	CENSORED	62.	62.	.026	0	0	0	0
NAVMACS	SANTA BARBARA	8323	7419.	FAILURE	412.	412.	.126	30	99	0	0
NAVMACS	SANTA BARBARA	9004	7873.	FAILURE	866.	454.	.198	30	99	0	0
NAVMACS	SARATOGA	8201	7037.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	SARATOGA	8213	7037.	CENSORED	0.	0.	0.000	0	0	0	0
NAVMACS	SARATOGA	8233	7565.	FAILURE	528.	528.	.688	30	99	99	0
NAVMACS	SARATOGA	8236	7613.	DEFERRED	576.	48.	.686	20	14	0	0
NAVMACS	SARATOGA	8274	7973.	CENSORED	936.	360.	.534	0	0	0	0
NAVMACS	SARATOGA	8286	8190.	FAILURE	1153.	577.	.565	30	99	0	0
NAVMACS	SARATOGA	9002	8962.	CENSORED	1925.	772.	.483	0	0	0	0
NAVMACS	SARATOGA	9029	9175.	FAILURE	2138.	985.	.462	30	99	0	0
NAVMACS	VULCAN	8205	5373.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	VULCAN	8235	5444.	CENSORED	71.	71.	.099	0	0	0	0
NAVMACS	VULCAN	8265	5552.	CENSORED	179.	179.	.124	0	0	0	0
NAVMACS	VULCAN	8268	5552.	CENSORED	179.	179.	.118	0	0	0	0
NAVMACS	VULCAN	8275	5553.	DEFERRED	180.	180.	.107	14	21	0	0
NAVMACS	VULCAN	8328	5676.	CENSORED	303.	123.	.103	0	0	0	0
NAVMACS	VULCAN	8356	5771.	CENSORED	398.	218.	.110	0	0	0	0
NAVMACS	VULCAN	9113	6140.	CENSORED	767.	587.	.117	0	0	0	0
NAVMACS	YOSEMITE	8200	246.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	YOSEMITE	8226	740.	CENSORED	494.	494.	.792	0	0	0	0
NAVMACS	YOSEMITE	8255	790.	CENSORED	544.	544.	.412	0	0	0	0
NAVMACS	YOSEMITE	8286	790.	CENSORED	544.	544.	.264	0	0	0	0
NAVMACS	YOSEMITE	8318	810.	CENSORED	564.	564.	.199	0	0	0	0
NAVMACS	YOSEMITE	9009	1160.	CENSORED	914.	914.	.219	0	0	0	0

CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
 EXPONENTIAL PROBABILITY DISTRIBUTION FOR TIME TO FAILURE



NAVMACS

MTBF 2421.5

MEDIAN 1678.4

OPERATING HOURS

R E L I A B I L I T Y
NAVMACS SYSTEM LEVEL

REMAINING SYS. CAP.	TIME TO FAIL HOURS	NO. FAILURES	NO. CENSORED	SURVIVORS	NPD	EXPONENTIAL	WEIBULL
15.	48.0	1.	1.	37.	.026	.019	.014
75.	143.0	1.	1.	35.	.053	.066	.054
0.	180.0	1.	1.	33.	.081	.068	.056
75.	245.0	1.	1.	32.	.109	.092	.077
75.	412.0	1.	1.	31.	.137	.150	.132
75.	454.0	1.	1.	30.	.165	.164	.145
75.	474.0	1.	1.	29.	.193	.170	.152
60.	528.0	1.	1.	28.	.220	.188	.169
50.	552.0	1.	1.	27.	.248	.196	.176
50.	577.0	1.	1.	26.	.276	.203	.184
50.	587.0	1.	1.	24.	.305	.212	.193
50.	605.0	1.	1.				
75.	771.0	1.	1.	21.	.337	.278	.260
75.	802.0	1.	1.	19.	.370	.322	.305
75.	827.0	1.	1.	18.	.403	.334	.318
50.	914.0	1.	1.	16.	.438	.343	.327
50.	985.0	1.	1.	14.	.476	.398	.384
50.	1033.0	1.	1.	13.	.513	.399	.385
50.	1059.0	1.	1.	12.	.550	.446	.435
50.	1067.0	1.	1.	11.	.588	.456	.446
75.	1261.0	1.	1.	10.	.625	.518	.513
75.	1287.0	1.	1.	8.	.667	.530	.525
75.	1290.0	1.	1.				
75.	1497.0	1.	1.	5.	.723	.752	.764
75.	1544.0	1.	1.				
50.	1852.0	1.	1.				
75.	1887.0	1.	1.				
75.	1914.0	1.	1.				
75.	1987.0	1.	1.				
75.	3156.0	1.	1.				
75.	3533.0	1.	1.				
75.	3964.0	1.	1.				
75.	4404.0	1.	1.				
75.	5205.0	1.	1.				
75.	5876.0	1.	1.				

R E L I A B I L I T Y

NAVMACS SYSTEM LEVEL

EQUIPMENT OPERATING HOURS (O.H.) = 53272.0 CALENDAR HOURS(C.H.) = 95736.0 DUTY CYCLE (O.H./C.H.) = .556

NUMBER OF FAILURES = 21. OBSERVED FAILURE RATE/O.H. = .39420E-03

RATIO OF 1.062 IS NOT BEYOND CRITICAL VALUES THEREFORE THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 3421.455, EST. MEDIAN = 1678.424, 90 PER CENT LCL FOR MEAN = 1890.8, 90 PER CENT UCL FOR MEAN = 3461.690

90 PERCENT UCL 3461.68 IS GREATER THAN 285.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

RELIABILITY

NAVMACS WRA 14 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
25.	143.0	1.	1.
	180.0		
	474.0		
	587.0		
	866.0		
	914.0		
	1887.0		
	1987.0		
	2089.0		
	2138.0		
	2615.0		
	2758.0		
	3156.0		
	3713.0		
	4404.0		
	5876.0		
	6032.0		
	6614.0		
	6839.0		

EQUIPMENT OPERATING HOURS (O.H.) = 53272.0 CALENDAR HOURS(C.H.) = 95736.0 DUTY CYCLE (O.H./C.H.) = .556

NUMBER OF FAILURES = 1. OBSERVED FAILURE RATE/O.H. = .18772E-04

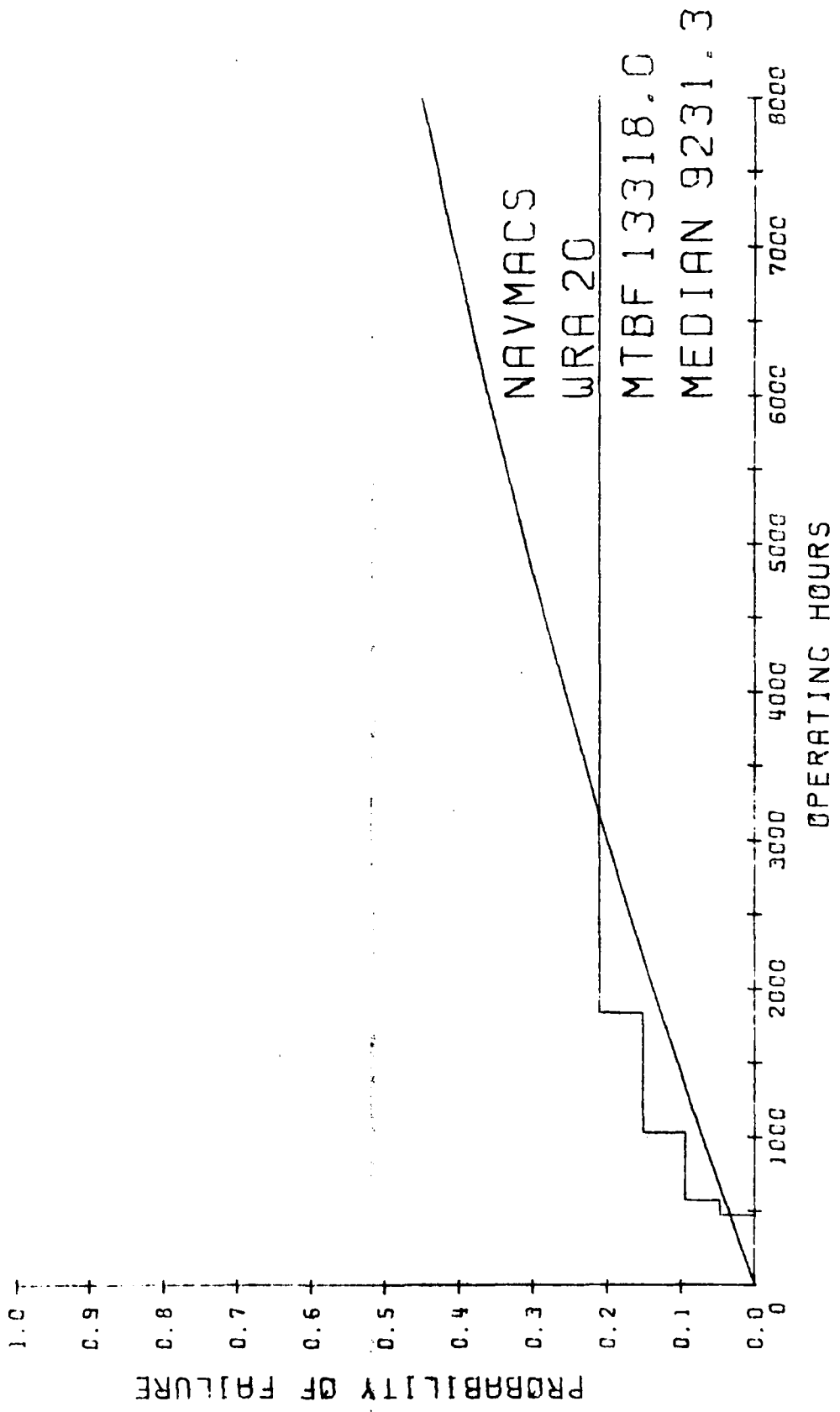
LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 53272.000, EST. MEDIAN = 36925.337, 90 PER CENT LCL FOR MEAN = 13695.6, 90 PER CENT UCL FOR MEAN = 505618.831

90 PERCENT UCL 505618.83 IS GREATER THAN 2000.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
EXPONENTIAL PROBABILITY DISTRIBUTION FOR TIME TO FAILURE



RELIABILITY

NAVMACS WRA 20 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED	SURVIVORS	NPD	EXPONENTIAL	WEIBULL
50.	143.0	1.	1.				
15.	474.0	1.		20.	.048	.035	.052
	576.0	1.		19.	.095	.042	.060
	767.0		1.				
	866.0		1.				
	914.0		1.				
50.	1033.0	1.		15.	.152	.075	.094
	1562.0		1.				
50.	1842.0	1.		13.	.212	.129	.144
	1887.0		1.				
	1987.0		1.				
	2089.0		1.				
	2615.0		1.				
	2758.0		1.				
	3156.0		1.				
	3713.0		1.				
	3964.0		1.				
	4404.0		1.				
	5876.0		1.				
	6032.0		1.				
	6614.0		1.				

EQUIPMENT OPERATING HOURS (O.H.) = 53272.0 CALENDAR HOURS(C.H.) =, 95736.0 DUTY CYCLE (O.H./C.H.) = .556

NUMBER OF FAILURES = 4. OBSERVED FAILURE RATE/0.H. = .75086E-04

ORATIO OF .662 IS NOT BEYOND CRITICAL VALUES THEREFORE THE EXPONENTIAL DISTRIBUTION IS ASSUMED FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 13318.000, EST. MEDIAN = 9231.334, 90 PER CENT LCL FOR MEAN = 6664.4, 90 PER CENT UCL FOR MEAN = 30532.391
 90 PERCENT UCL 30532.39 IS GREATER THAN 1499.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

RELIABILITY
NAVMACS WRA 21 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
	143.0		1.
	474.0		1.
	767.0		1.
	866.0		1.
	914.0		1.
	1261.0		1.
75.	1497.0	1.	
	1887.0		1.
	1987.0		1.
	2089.0		1.
	2138.0		1.
	2615.0		1.
	3156.0		1.
	3713.0		1.
	4404.0		1.
	5876.0		1.
	6032.0		1.
	6614.0		1.
	6839.0		1.

EQUIPMENT OPERATING HOURS (O.H.) = 53272.0 CALENDAR HOURS(C.H.) = 95736.0 DUTY CYCLE (O.H./C.H.) = .556

NUMBER OF FAILURES = 1. OBSERVED FAILURE RATE/O.H. = .18772E-04

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 53272.000, EST. MEDIAN = 36925.337, 90 PER CENT LCL FOR MEAN = 13695.6, 90 PER CENT UCL FOR MEAN = 505618.831

90 PERCENT UCL 505618.83 IS GREATER THAN 1499.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

R E L I A B I L I T Y

NAVMACS WRA 25 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
	143.0		1.
	474.0		1.
	767.0		1.
	771.0		1.
50.	777.0	1.	
	866.0		1.
	914.0		1.
50.	1067.0	1.	
	1887.0		1.
	1987.0		1.
	2089.0		1.
	2138.0		1.
	2758.0		1.
	3156.0		1.
	3713.0		1.
	4404.0		1.
	5876.0		1.
	6032.0		1.
	6614.0		1.
	6839.0		1.

EQUIPMENT OPERATING HOURS (O.H.) = 53272.0 CALENDAR HOURS(C.H.) =, 95736.0 DUTY CYCLE (O.H./C.H.) = .556

NUMBER OF FAILURES = 2. OBSERVED FAILURE RATE/O.H. = .37543E-04

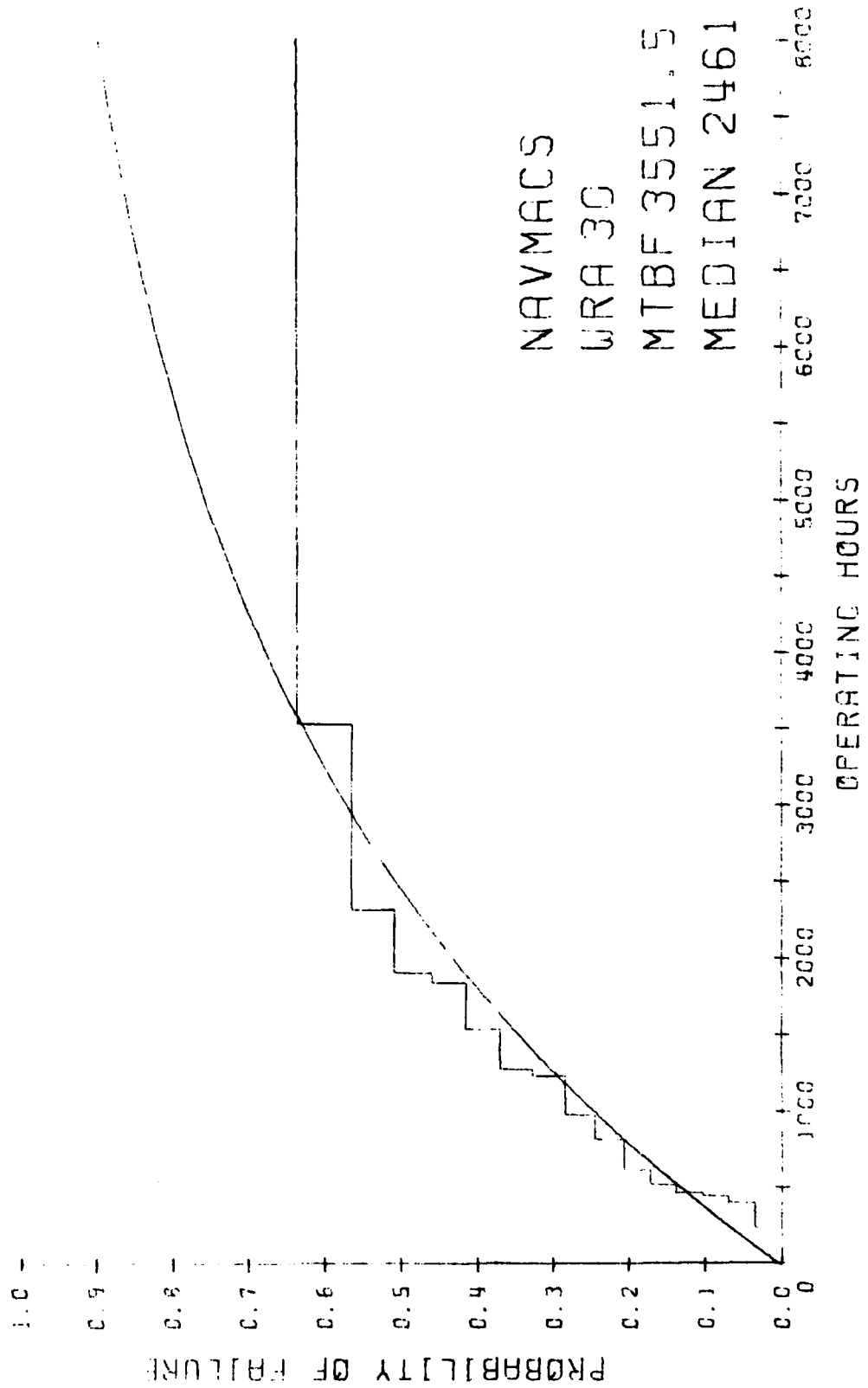
LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 26636.000. EST. MEDIAN = 18462.668, 90 PER CENT LCL FOR MEAN = 10009.2, 90 PER CENT UCL FOR MEAN = 100170.831

90 PERCENT UCL 100170.83 IS GREATER THAN 4000.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
 EXPONENTIAL PROBABILITY DISTRIBUTION FOR TIME TO FAILURE



RELIABILITY

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED	WRA 30 LEVEL SURVIVORS	NPD	EXPONENTIAL	WEIBULL
	.0		1.				
	143.0		1.				
	180.0		1.				
75.	245.0	1.		28.	.034	.067	.064
75.	412.0	1.		27.	.069	.110	.106
75.	454.0	1.		26.	.103	.120	.116
75.	474.0	1.		25.	.138	.125	.121
60.	528.0	1.		24.	.172	.138	.134
50.	625.0	1.		23.	.207	.161	.157
	767.0		1.				
	802.0		1.				
75.	827.0	1.		20.	.245	.208	.204
	914.0		1.				
75.	985.0	1.		18.	.284	.242	.238
	1059.0		1.				
75.	1239.0	1.		16.	.327	.295	.291
75.	1287.0	1.		15.	.369	.304	.301
	1376.0		1.				
75.	1544.0	1.		13.	.414	.353	.350
50.	1852.0	1.		12.	.459	.406	.405
	1887.0		1.				
75.	1914.0	1.		10.	.508	.417	.415
	1987.0		1.				
75.	2323.0	1.		8.	.563	.480	.480
	2758.0		1.				
	3156.0		1.				
75.	3533.0	1.		5.	.636	.630	.633
	4404.0		1.				
	4516.0		1.				
	5205.0		1.				
	5876.0		1.				

EQUIPMENT OPERATING HOURS (O.H.) = 53272.0 CALENDAR HOURS (C.H.) = 95736.0 DUTY CYCLE (O.H./C.H.) = .556

NUMBER OF FAILURES = 15. OBSERVED FAILURE RATE/O.H. = .28157E-03

RATIO OF 1.032 IS NOT BEYOND CRITICAL VALUES THEREFORE THE EXPONENTIAL DISTRIBUTION IS ASSUMED FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 3551.467, EST. MEDIAN = 2461.689, 90 PER CENT LCL FOR MEAN = 2503.0, 90 PER CENT UCL FOR MEAN = 5172.240
 90 PERCENT UCL 5172.24 IS GREATER THAN 500.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

R E L I A B I L I T Y

NAVMACS O-LEVEL SUMMARY

WRA	O-LEVEL BLOCK NO.	O-LEVEL NOMENCLATURE	NUMBER FAILURES	LOWER 90 CONF LIM	MEAN	UPPER 90 CONF LIM	SPEC MTBF	OBSERVED FAILURE TIMES		RELIAB PROBLEM
								LOW	HIGH	
14	21	ARITHMETIC LOGIC UNIT	1.	13695.59	53272.00	505618.83	261440.00	180.00	180.00	NO
20	2	POWER SUPPLY	1.	13695.59	53272.00	505618.83	19268.00	474.00	474.00	NO
20	10	TRANSMIT DELAY	1.	13695.59	53272.00	505618.83	78431.00	1033.00	1033.00	NO
20	14	INTERFACE	1.	13695.59	53272.00	505618.83	142248.00	576.00	576.00	NO
20	99		1.	13695.59	53272.00	505618.83	1000000.00	2875.00	2875.00	YES
21	4	WRITE ELECTRONICS	1.	13695.59	53272.00	505618.83	15748.00	1497.00	1497.00	NO
25	99		2.	10009.21	26636.00	100170.83	1000000.00	1067.00	1844.00	YES
30	99		16.	2374.21	3329.50	4780.02	1000000.00	245.00	3533.00	YES

R E L I A B I L I T Y

2K SUMMARY FOR NAWMACS PROBLEM AREAS

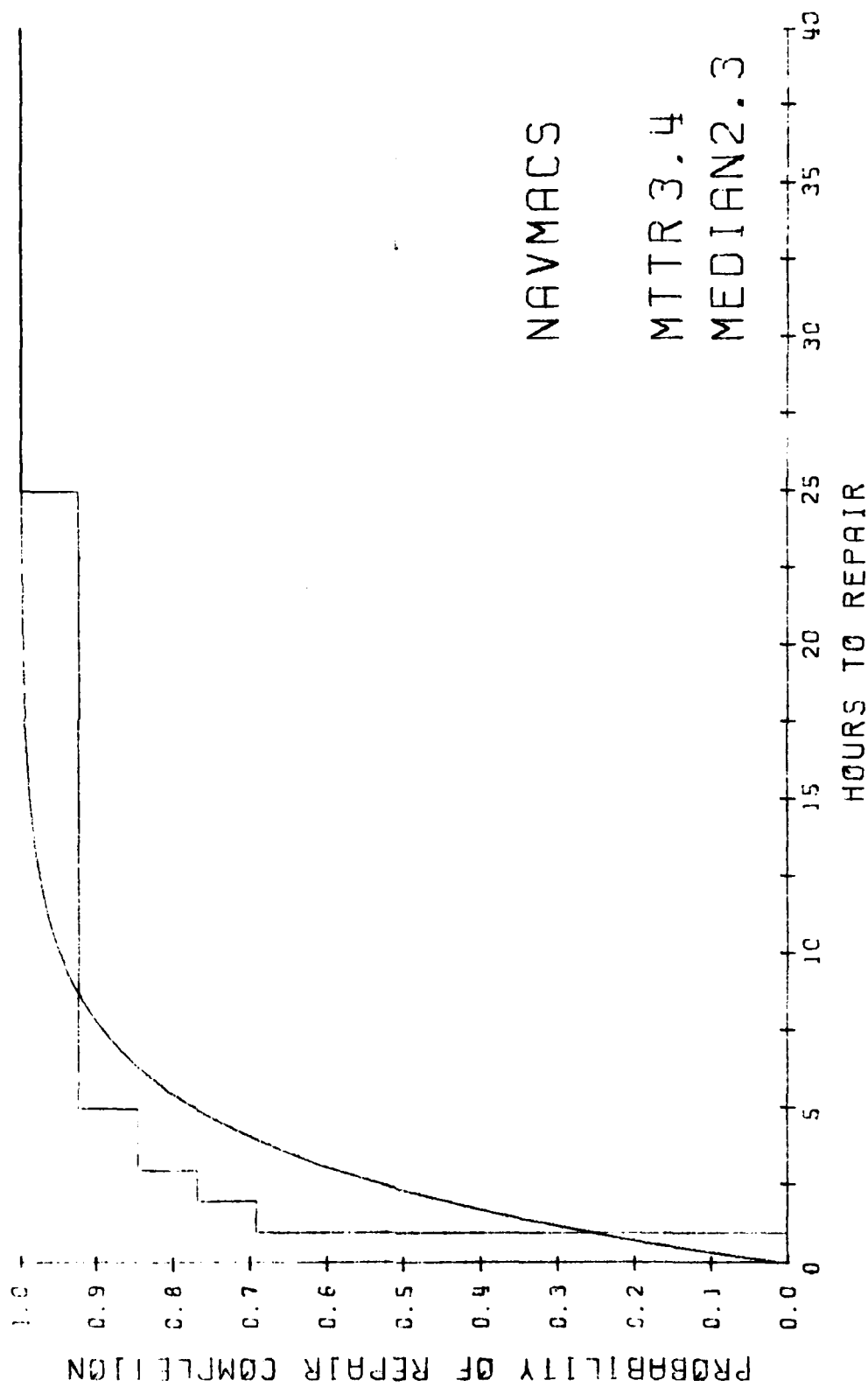
MRA	0-L	0-L	0-L	WHAT HAPPENED
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JCN

FLEET MAINTAINABILITY ASSESSMENT DATA

SYSTEM	SHIPNAME	DISCOVERED	COMPL	REPAIR TIME	DOWN TIME
NAVMACS	CONSTELLATION	8264	8264	0.	0.
NAVMACS	CONSTELLATION	NO REPAIR TIME FOR THE ABOVE RECORD		0.	
NAVMACS	CONSTELLATION	8324	8324	0.	0.
NAVMACS	CONSTELLATION	NO REPAIR TIME FOR THE ABOVE RECORD		0.	
NAVMACS	CONSTELLATION	9096	9096	0.	0.
NAVMACS	CONSTELLATION	NO REPAIR TIME FOR THE ABOVE RECORD		0.	
NAVMACS	CONSTELLATION	9114	9114	0.	0.
NAVMACS	CONSTELLATION	NO REPAIR TIME FOR THE ABOVE RECORD		0.	
NAVMACS	GUAM	8300	8331	25.	744.
NAVMACS	INDEPENDENCE	8335	8335	1.	1.
NAVMACS	INDEPENDENCE	8345	8345	0.	0.
NAVMACS	INDEPENDENCE	NO REPAIR TIME FOR THE ABOVE RECORD		0.	
NAVMACS	KITTY HAWK	9044	9045	1.	24.
NAVMACS	LEAHY	9008	9009	5.	24.
NAVMACS	LUCE	8355	8355	0.	0.
NAVMACS	OKINAWA	NO REPAIR TIME FOR THE ABOVE RECORD		0.	
NAVMACS	OKINAWA	8247	8247	2.	2.
NAVMACS	OKINAWA	8207	8270	1.	1512.
NAVMACS	OKINAWA	8266	8307	0.	984.
NAVMACS	OKINAWA	NO REPAIR TIME FOR THE ABOVE RECORD		0.	
NAVMACS	RANGER	8290	8293	1.	72.
NAVMACS	SANTA BARBARA	9037	9039	1.	48.
NAVMACS	SANTA BARBARA	8323	8323	0.	0.
NAVMACS	SANTA BARBARA	NO REPAIR TIME FOR THE ABOVE RECORD		0.	
NAVMACS	SANTA BARBARA	9004	9004	0.	0.
NAVMACS	SARATOGA	NO REPAIR TIME FOR THE ABOVE RECORD		0.	
NAVMACS	SARATOGA	8233	8233	1.	1.
NAVMACS	SARATOGA	8236	8289	1.	1272.
NAVMACS	SARATOGA	8286	8302	3.	384.
NAVMACS	SARATOGA	9029	9029	1.	1.
NAVMACS	VULCAN	8275	8278	1.	72.

CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
 EXPONENTIAL PROBABILITY DISTRIBUTION FOR TIME TO REPAIR

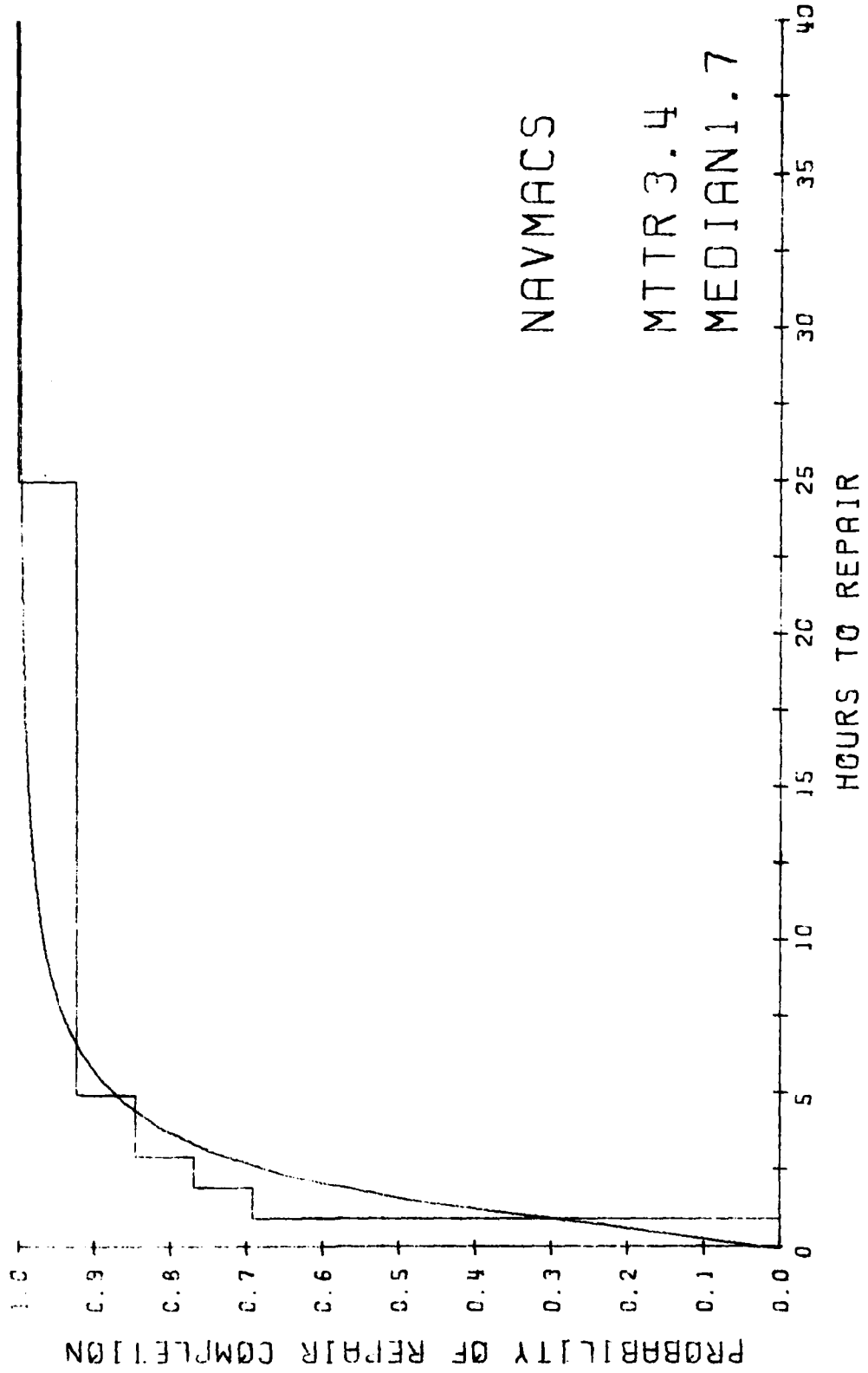


NAVMACS

MTTR 3.4

MEDIAN 2.3

CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
 LOGNORMAL PROBABILITY DISTRIBUTION FOR TIME TO REPAIR



MAINTAINABILITY (REPAIR TIME)

REPAIR TIME		NAVMACS SYSTEM LEVEL					
REPAIR TIME	FREQUENCY	CUM FREQUENCY	NPF	LOGNORMAL	EXPONENTIAL	WEIBULL	
1.0	9	9.0	.643	.300	.256	.349	
2.0	1	10.0	.714	.575	.446	.529	
3.0	1	11.0	.786	.728	.588	.647	
5.0	1	12.0	.857	.872	.772	.793	
25.0	1	13.0	.929	.997	.999	.997	

TOTAL REPAIR HOURS = 44.0 NUMBER OF REPAIRS = 13. OBSERVED REPAIR RATE/HR = .2955E+00

DISTRIBUTION DETERMINATION

MEAN OF LN#S = .51 STD DEV OF LN#S = .97

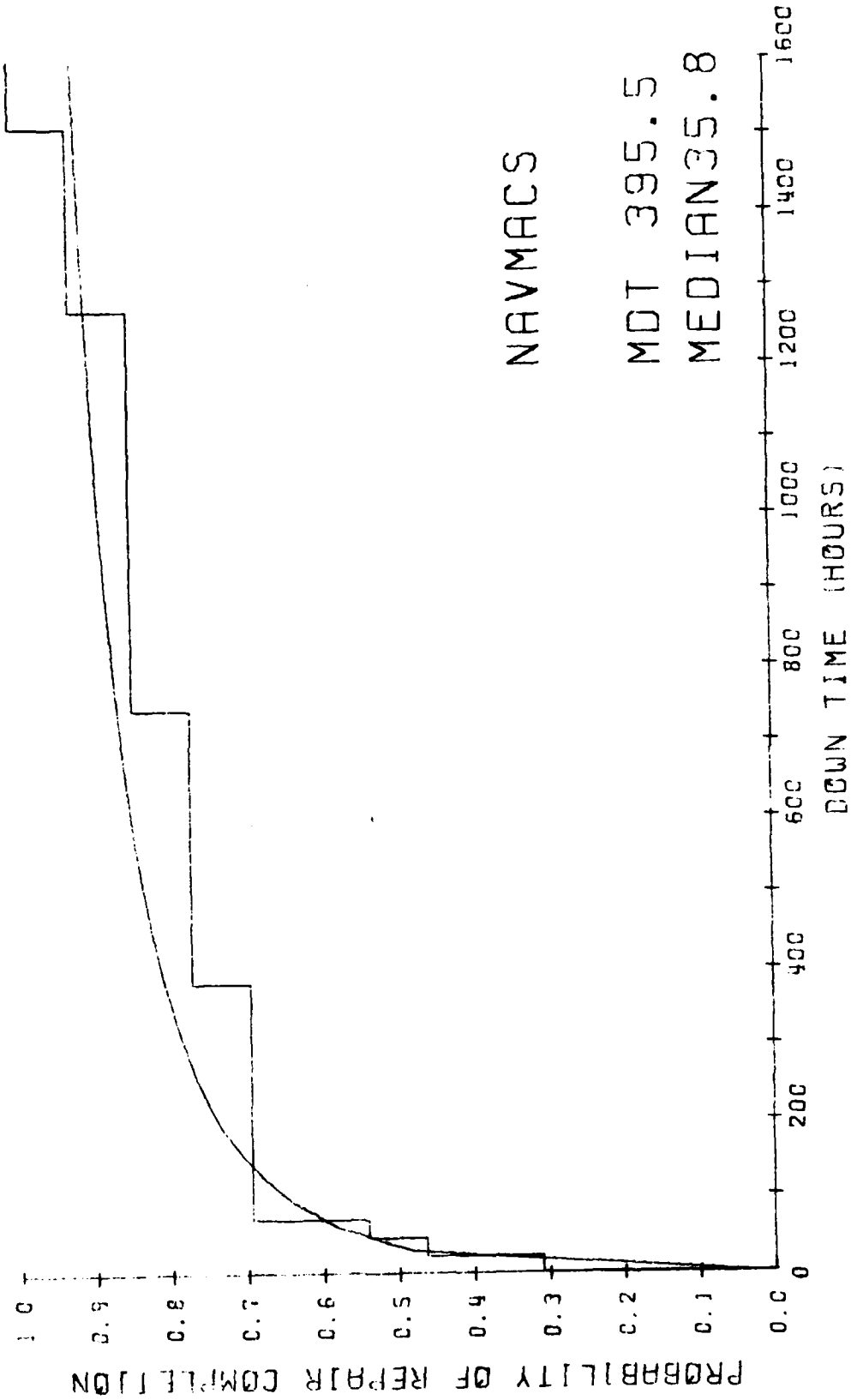
K-S CRITICAL VALUE (.10, 13.) = .214 MAX DIFF CALC = .343 IS GREATER THAN THE CRITICAL VALUE
 THEREFORE THE LOGNORMAL DISTRIBUTION CANNOT BE ASSUMED

QRATIO OF 2.000 DOES NOT EXCEED THE CRITICAL VALUE FOR TEST OF EXPONENTIAL
 THEREFORE THE EXPONENTIAL DISTRIBUTION IS ASSUMED

EST MEAN = 3.38 EST MEDIAN = 2.35 90 PER CENT LCL ON MEAN = 2.47 90 PER CENT UCL ON MEAN = 5.09

SPECIFIED MTTR = 2.00 HOURS LOWER CONF LIM 2.47 IS GREATER THAN MTTR, THUS A MAINTAINABILITY PROBLEM EXISTS

CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
 LOGNORMAL PROBABILITY DISTRIBUTION FOR DOWN TIME



MAINTAINABILITY (DOWN TIME)

NAVMACS SYSTEM LEVEL

DOWN TIME	FREQUENCY	CUM FREQUENCY	NPF	LOGNORMAL	EXPONENTIAL	WEIBULL
1.0	3.	3.0	.214	.095	.003	.113
2.0	1.	4.0	.286	.146	.005	.150
24.0	2.	6.0	.429	.442	.059	.380
48.0	1.	7.0	.500	.543	.114	.477
72.0	2.	9.0	.643	.601	.166	.538
384.0	1.	10.0	.714	.807	.621	.798
744.0	1.	11.0	.786	.866	.848	.881
1272.0	1.	12.0	.857	.904	.960	.932
1512.0	1.	13.0	.929	.915	.978	.945

TOTAL DOWN TIME (TDT) = 5141.0 NUMBER OF REPAIRS (NR) = 13. OBSERVED DOWN TIME/REPAIR (TDT/NR) = 395.46

DISTRIBUTION DETERMINATION

MEAN OF LN#S = 3.58 STD DEV OF LN#S = 2.73

K-S CRITICAL VALUE (.10, 13.) = .214 MAX DIFF CALC = .164 IS LESS THAN THE CRITICAL VALUE
 THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

EST MEAN = 395.46 EST MEDIAN = 35.78 90 PER CENT LCL ON MEDIAN = 12.80 90 PER CENT UCL ON MEDIAN = 100.05

MAINTAINABILITY (REPAIR TIME)
NAVMACS WRA 14 LEVEL

LESS THAN FOUR DISTINCT REPAIR TIMES
THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED
ONLY ONE DISTINCT REPAIR TIME -- NO CONFIDENCE LIMITS

MAINTAINABILITY (REPAIR TIME)

NAVMACS WRA 20 LEVEL

LESS THAN FOUR DISTINCT REPAIR TIMES

THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

ONLY ONE DISTINCT REPAIR TIME -- NO CONFIDENCE LIMITS

MAINTAINABILITY (REPAIR TIME)

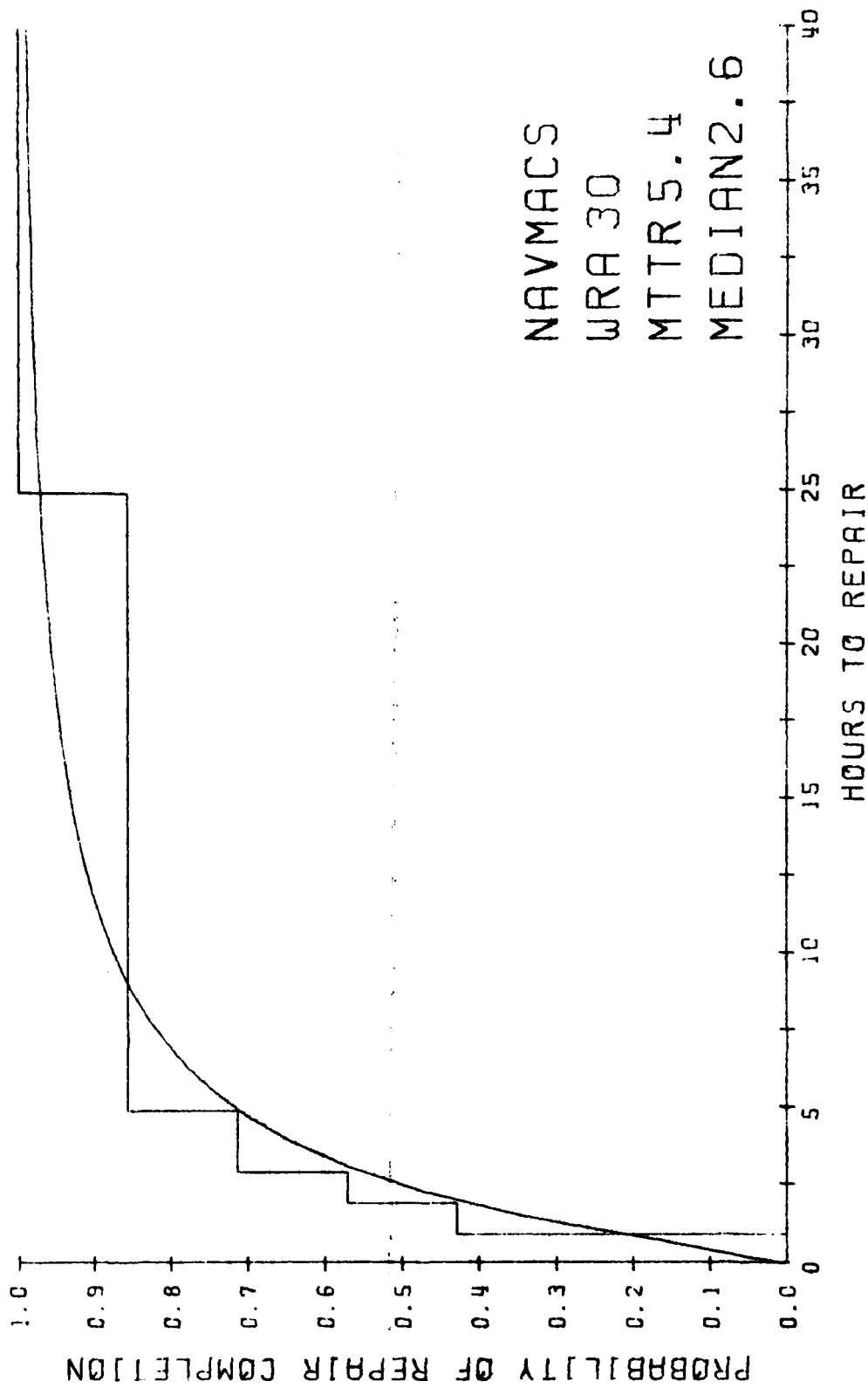
NAVMACS WRA 25 LEVEL

LESS THAN FOUR DISTINCT REPAIR TIMES

THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

ONLY ONE DISTINCT REPAIR TIME -- NO CONFIDENCE LIMITS

CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
 LOGNORMAL PROBABILITY DISTRIBUTION FOR TIME TO REPAIR



MAINTAINABILITY (REPAIR TIME)

NAVMACS WRA 30 LEVEL

REPAIR TIME.	FREQUENCY	CUM FREQUENCY	NPF	LOGNORMAL	EXPONENTIAL	WEIBULL
1.0	3.	3.0	.375	.212	.168	.250
2.0	1.	4.0	.500	.415	.308	.396
3.0	1.	5.0	.625	.551	.45	.503
5.0	1.	6.0	.750	.713	.602	.652
25.0	1.	7.0	.875	.973	.990	.979

TOTAL REPAIR HOURS = 38.0 NUMBER OF REPAIRS = 7. OBSERVED REPAIR RATE/HR = .1842E+00

DISTRIBUTION DETERMINATION

MEAN OF LNBS = .95 STO DEV OF LNBS = 1.18

K-S CRITICAL VALUE (.10, 7.) = .276 MAX DIFF CALC = .223 IS LESS THAN THE CRITICAL VALUE

THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

EST MEAN = 5.43 EST MEDIAN = 2.57 90 PER CENT LCL ON MEDIAN = 1.35 90 PER CENT UCL ON MEDIAN = 4.90
 SPECIFIED MTRR = 2.00 HOURS LOWER CONF LIM 1.35 IS LESS THAN MTRR, THUS THE EQUIPMENT MEETS THE SPECIFICATIONS

MAINTAINABILITY (REPAIR TIME)

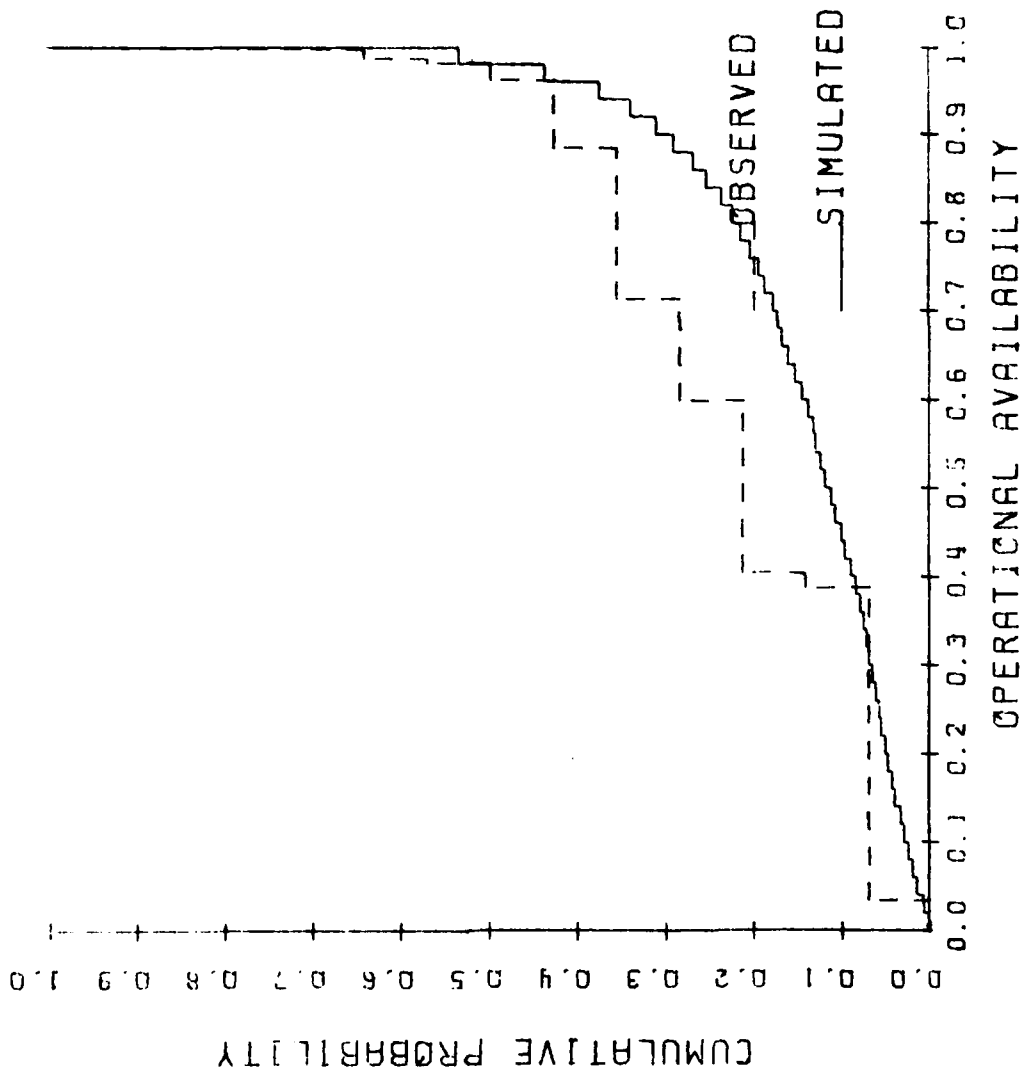
NAVMACS O-LEVEL SUMMARY

MRA	O-LEVEL BLOCK NO.	O-LEVEL NOMENCLATURE	NUMBER REPAIRS	LOWER 90 CONF LIM	UPPER 90 CONF LIM	SPEC MTR	OBSERVED REPAIR TIMES			MAINT PROBLEM
							LOW	MEAN	HIGH	
14	21	ARITHMETIC LOGIC UNIT	1.	NO CONF LIMITS		2.0	1.0	1.00	1.0	
20	10	TRANSMIT DELAY	1.	NO CONF LIMITS		2.0	1.0	1.00	1.0	
20	14	INTERFACE	1.	NO CONF LIMITS		2.0	1.0	1.00	1.0	
20	99		1.	NO CONF LIMITS		2.0	1.0	1.00	1.0	
25	99		2.	NO CONF LIMITS		2.0	1.0	1.00	1.0	
30	99		8.	1.29	4.05	2.0	1.0	4.88	25.0	NO

MAINTAINABILITY (REPAIR TIME)
2K SUMMARY FOR NAVMACS PROBLEM AREAS
WRA 0-L 0-L 0-L WHAT HAPPENED

JCN

NAVMACS OPERATIONAL RELIAB.
CUMULATIVE OBSERVED DISTRIBUTION VERSUS SIMULATED
OPERATIONAL AVAILABILITY PROBABILITY DISTRIBUTION



OWA SUMMARY NAVMACS OPERATIONAL RELIAR. SYSTEM LEVEL

TTF DISTRIBUTION IS EXPONENTIAL WITH MEAN = 2421.50
DT DISTRIBUTION IS LOGNORMAL WITH MEAN OF LNS = 3.58000 AND STANDARD DEVIATION OF LNS = 2.73000
WT DISTRIBUTION IS EXPONENTIAL WITH MEAN = 3.34

INHERENT AVAILABILITY = MTRF/(MTRF+MTTR)

MEAN TIME TO FAILURE = 2421.50
MEAN REPAIR TIME = 3.34
INHERENT AVAILABILITY = .9986

OBSERVED AVAILABILITY (SIMULATION OF RATIOS TTF/(TTF+DT))

50 PERCENT UCL ON INDIVIDUALS = .4400
90 PERCENT UCL ON INDIVIDUALS = .9957
MEAN = .8505
MEDIAN = .9732

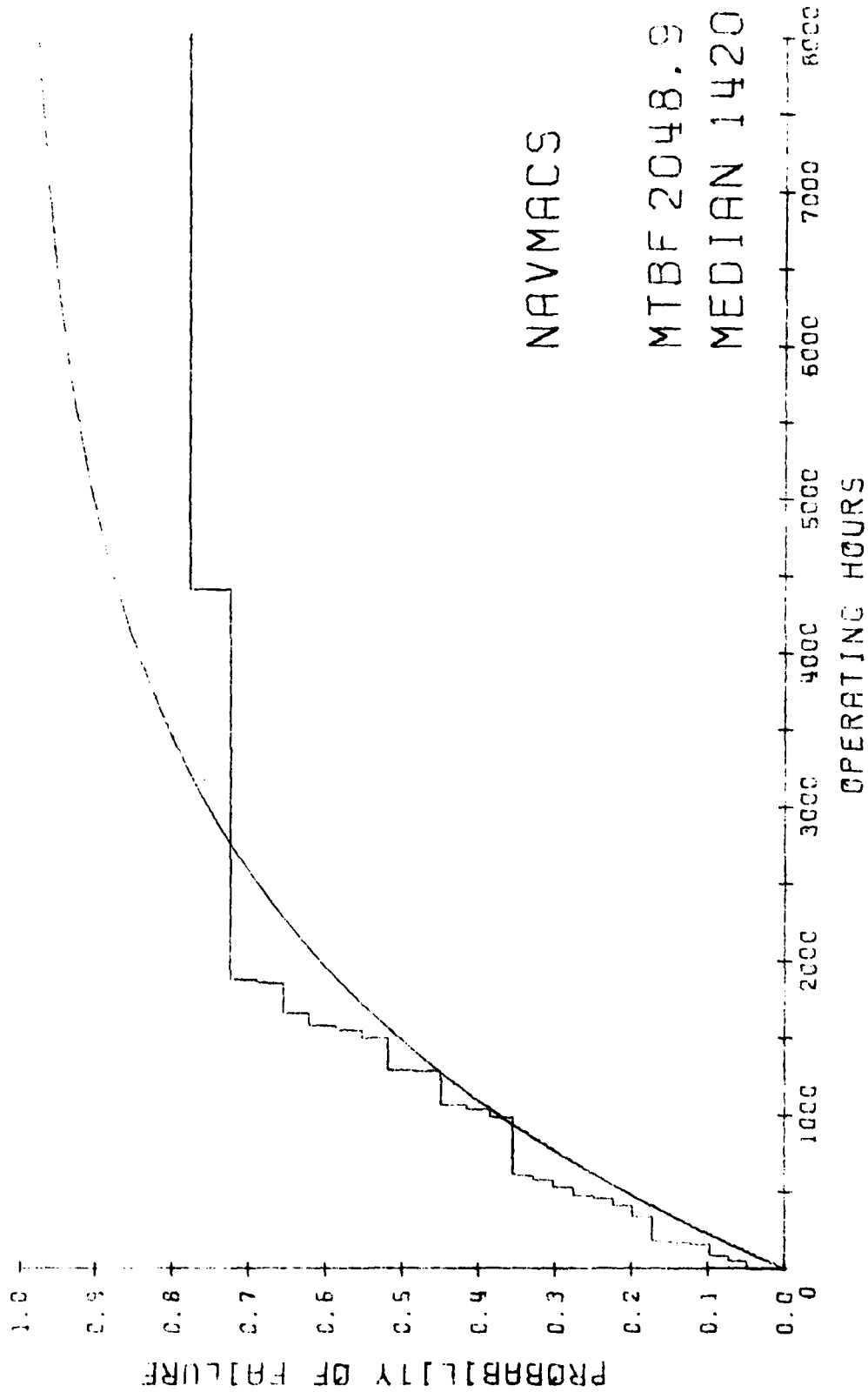
NAVMACS
EQUIPMENT
RELIABILITY

SYSTEM	SHIPNAME	DATE	ETM	FLEET RELIABILITY ASSESSMENT DATA		DUTY	WRA	OL1	OL2	OL3
				FAILURE TYPE	FAILURE TIME					
NAVMACS	ALBANY	8215	8820.	INITIAL	0.	0.000	0	0	0	0
NAVMACS	ALBANY	8241	9422.	CENSORED	602.	.965	0	0	0	0
NAVMACS	ALBANY	9002	10707.	CENSORED	1887.	.517	0	0	0	0
	NO INITIAL RECORD-FIRST RECORD USED									
NAVMACS	BLUE RIDGE	9047	647.	FINAL	0.	0.000	0	0	0	0
NAVMACS	BOWEN	8184	8421.	INITIAL	0.	0.000	0	0	0	0
NAVMACS	BOWEN	8212	8976.	CENSORED	555.	.826	0	0	0	0
NAVMACS	BOWEN	8243	9718.	CENSORED	1297.	.916	0	0	0	0
NAVMACS	BOWEN	8362	11577.	CENSORED	3156.	.739	0	0	0	0
NAVMACS	CONSTELLATION	8164	3783.	INITIAL	0.	0.000	0	0	0	0
NAVMACS	CONSTELLATION	8263	5635.	CENSORED	1852.	.779	0	0	0	0
NAVMACS	CONSTELLATION	8264	5635.	FAILURE	1852.	.772	30	99	0	0
NAVMACS	CONSTELLATION	8279	6020.	CENSORED	2237.	.811	0	0	0	0
NAVMACS	CONSTELLATION	8324	7179.	FAILURE	1544.	.884	30	99	0	0
NAVMACS	CONSTELLATION	8340	7517.	FAILURE	338.	.884	30	99	0	0
NAVMACS	CONSTELLATION	9032	8047.	CENSORED	4264.	.763	0	0	0	0
NAVMACS	CONSTELLATION	9096	9093.	FAILURE	530.	.745	30	99	0	0
NAVMACS	CONSTELLATION	9105	9180.	FAILURE	1576.	.735	30	99	0	0
NAVMACS	CONSTELLATION	9114	9338.	FAILURE	87.	.735	30	99	0	0
NAVMACS	CONSTELLATION	9169	10397.	FINAL	158.	.735	30	99	0	0
NAVMACS	DALE	8217	7995.	INITIAL	1059.	.745	0	0	0	0
NAVMACS	DALE	8305	9982.	CENSORED	1987.	0.000	0	0	0	0
	NO INITIAL RECORD-FIRST RECORD USED									
NAVMACS	GUAM	8276	5971.	CENSORED	0.	0.000	0	0	0	0
NAVMACS	GUAM	8300	6445.	FAILURE	474.	.823	20	2	99	0
NAVMACS	INCHON	8205	4843.	INITIAL	0.	0.000	0	0	0	0
NAVMACS	INCHON	9071	9247.	FAILURE	4404.	.794	30	99	0	0
NAVMACS	INDEPENDENCE	8206	4692.	INITIAL	0.	0.000	0	0	0	0
NAVMACS	INDEPENDENCE	8335	5759.	FAILURE	1067.	.345	25	99	0	0
NAVMACS	INDEPENDENCE	8345	5931.	FAILURE	172.	.371	30	99	0	0
NAVMACS	INDEPENDENCE	9031	6246.	CENSORED	315.	.341	0	0	0	0
NAVMACS	INDEPENDENCE	9044	6536.	DEFERED	605.	.378	25	99	0	0
NAVMACS	INDEPENDENCE	9090	6691.	CENSORED	155.	.335	0	0	0	0
NAVMACS	INDEPENDENCE	9120	7307.	CENSORED	771.	.391	0	0	0	0
NAVMACS	KINKAID	8222	5800.	INITIAL	0.	0.000	0	0	0	0
NAVMACS	KINKAID	9102	11676.	FINAL	5876.	.999	0	0	0	0
NAVMACS	KITTY HAWK	8321	2431.	INITIAL	0.	0.000	0	0	0	0
NAVMACS	KITTY HAWK	9008	3718.	FAILURE	1287.	1.031	30	99	0	0
NAVMACS	KITTY HAWK	9135	4520.	FINAL	2089.	.486	0	0	0	0
NAVMACS	LEAHY	8145	6373.	INITIAL	0.	0.000	0	0	0	0
NAVMACS	LEAHY	8355	7870.	FAILURE	1497.	.297	21	4	0	0
NAVMACS	LEAHY	9066	9131.	FINAL	2758.	.402	0	0	0	0
NAVMACS	LUCE	8200	2508.	INITIAL	0.	0.000	0	0	0	0
NAVMACS	LUCE	8200	2508.	CENSORED	471.	.654	0	0	0	0
NAVMACS	LUCE	8247	2979.	CENSORED	827.	.733	0	0	0	0
NAVMACS	LUCE	8321	3335.	CENSORED	2555.	.880	0	0	0	0
NAVMACS	LUCE	8321	5063.	CENSORED	6032.	.832	0	0	0	0
NAVMACS	LUCE	9137	8540.	CENSORED	6032.	.832	0	0	0	0
NAVMACS	NEW ORLEANS	8146	5814.	INITIAL	0.	0.000	0	0	0	0
NAVMACS	NEW ORLEANS	9066	5957.	FINAL	143.	.021	0	0	0	0

FLEET RELIABILITY ASSESSMENT DATA

SYSTEM	SHIPNAME	DATE	ETM	FAILURE TYPE	OPERATE	FAILURE TIME	DUTY	WRA	OL1	OL2	OL3
NAVMACS	OKINAWA	8165	1881.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	OKINAWA	8207	2914.	DEFERRED	1033.	1033.	1.025	20	10	0	0
NAVMACS	OKINAWA	8266	4204.	FAILURE	2323.	1290.	.958	30	99	0	0
NAVMACS	OKINAWA	8290	4756.	CENSORED	2875.	552.	.958	0	0	0	0
NAVMACS	OKINAWA	9102	8720.	FINAL	6839.	4516.	.944	0	0	0	0
NAVMACS	RANGER	8164	2377.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	RANGER	8256	3200.	CENSORED	823.	823.	.373	0	0	0	0
NAVMACS	RANGER	8303	3276.	CENSORED	899.	899.	.269	0	0	0	0
NAVMACS	RANGER	8334	4034.	FAILURE	1657.	1657.	.406	22	12	0	0
NAVMACS	RANGER	9037	5910.	FAILURE	3533.	1876.	.619	30	99	0	0
NAVMACS	RANGER	9045	6090.	CENSORED	3713.	180.	.629	0	0	0	0
NAVMACS	SANTA BARBARA	8187	7007.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	SANTA BARBARA	8219	7069.	CENSORED	62.	62.	.081	0	0	0	0
NAVMACS	SANTA BARBARA	8286	7069.	CENSORED	62.	62.	.026	0	0	0	0
NAVMACS	SANTA BARBARA	8323	7419.	FAILURE	412.	412.	.126	30	99	0	0
NAVMACS	SANTA BARBARA	9004	7873.	FAILURE	866.	454.	.198	30	99	0	0
NAVMACS	SARATOGA	8201	7037.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	SARATOGA	8213	7037.	CENSORED	0.	0.	0.000	0	0	0	0
NAVMACS	SARATOGA	8233	7565.	FAILURE	528.	528.	.688	30	99	99	0
NAVMACS	SARATOGA	8236	7613.	DEFERRED	576.	48.	.686	20	14	0	0
NAVMACS	SARATOGA	8274	7973.	CENSORED	936.	360.	.534	0	0	0	0
NAVMACS	SARATOGA	8286	8190.	FAILURE	1153.	577.	.565	30	99	0	0
NAVMACS	SARATOGA	9002	8962.	CENSORED	1925.	772.	.463	0	0	0	0
NAVMACS	SARATOGA	9029	9175.	FAILURE	2138.	985.	.462	30	99	0	0
NAVMACS	VULCAN	8205	5373.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	VULCAN	8235	5444.	CENSORED	71.	71.	.099	0	0	0	0
NAVMACS	VULCAN	8265	5552.	DEFERRED	179.	179.	.124	30	99	0	0
NAVMACS	VULCAN	8268	5552.	DEFERRED	179.	0.	.118	21	13	0	0
NAVMACS	VULCAN	8275	5553.	DEFERRED	180.	1.	.107	14	21	0	0
NAVMACS	VULCAN	8328	5676.	CENSORED	303.	123.	.103	0	0	0	0
NAVMACS	VULCAN	8356	5771.	CENSORED	398.	218.	.110	0	0	0	0
NAVMACS	VULCAN	9113	6140.	CENSORED	767.	587.	.117	0	0	0	0
NAVMACS	YOSEMITE	8200	246.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	YOSEMITE	8226	740.	CENSORED	494.	494.	.792	0	0	0	0
NAVMACS	YOSEMITE	8255	790.	CENSORED	544.	544.	.412	0	0	0	0
NAVMACS	YOSEMITE	8286	790.	CENSORED	544.	544.	.264	0	0	0	0
NAVMACS	YOSEMITE	8318	810.	CENSORED	564.	564.	.199	0	0	0	0
NAVMACS	YOSEMITE	9009	1160.	CENSORED	914.	914.	.219	0	0	0	0

CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
 EXPONENTIAL PROBABILITY DISTRIBUTION FOR TIME TO FAILURE



R E L I A B I L I T Y

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED	NAVHACS SYSTEM LEVEL	SURVIVORS	NPD	EXPONENTIAL	WEIBULL
0.	.0	1.	1.		40.	.024	.000	.000
25.	1.0	1.	1.		39.	.049	.000	.006
15.	48.0	1.	1.		38.	.073	.022	.075
95.	87.0	1.	1.		37.	.098	.040	.109
75.	143.0	1.	1.		35.	.123	.071	.157
75.	158.0	1.	1.		34.	.148	.078	.166
100.	172.0	1.	1.		33.	.173	.081	.170
95.	179.0	1.	1.		31.	.199	.147	.247
75.	338.0	1.	1.		30.	.224	.176	.277
75.	412.0	1.	1.		29.	.250	.192	.292
75.	454.0	1.	1.		28.	.276	.199	.299
60.	474.0	1.	1.		27.	.302	.219	.318
50.	528.0	1.	1.		26.	.328	.237	.333
50.	577.0	1.	1.		24.	.355	.247	.342
46	605.0	1.	1.					
	711.0	1.	1.					
	802.0	1.	1.					
	914.0	1.	1.					
75.	985.0	1.	1.		20.	.385	.370	.439
50.	1033.0	1.	1.		19.	.416	.384	.450
	1059.0	1.	1.					
50.	1067.0	1.	1.		17.	.449	.394	.457
	1261.0	1.	1.					
75.	1287.0	1.	1.		15.	.483	.453	.499
75.	1290.0	1.	1.		14.	.518	.454	.500
75.	1497.0	1.	1.		13.	.552	.505	.534
75.	1544.0	1.	1.		12.	.586	.515	.542
75.	1576.0	1.	1.		11.	.621	.523	.547
100.	1657.0	1.	1.		10.	.655	.540	.559
50.	1852.0	1.	1.		9.	.690	.581	.586
75.	1876.0	1.	1.		8.	.724	.585	.589
	1887.0	1.	1.					
	1987.0	1.	1.					
	3156.0	1.	1.					
95.	4404.0	1.	1.		4.	.779	.873	.791
	4516.0	1.	1.					
	5876.0	1.	1.					
	6032.0	1.	1.					

R E L I A B I L I T Y

NAYMACS SYSTEM LEVEL

EQUIPMENT OPERATING HOURS (O.H.) = 53272.0 CALENDAR HOURS(C.H.) = 95736.0 DUTY CYCLE (O.H./C.H.) = .556
NUMBER OF FAILURES = 26. OBSERVED FAILURE RATE/O.H. = .46929E-03

RATIO OF 1.220 IS NOT BEYOND CRITICAL VALUES THEREFORE THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 2048.923, EST. MEDIAN = 1420.205, 90 PER CENT LCL FOR MEAN = 1628.8, 90 PER CENT UCL FOR MEAN = 2826.956
90 PERCENT UCL 2826.96 IS GREATER THAN 285.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

RELIABILITY

NAVMACS WRA 14 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
25.	143.0	1.	1.
	180.0		1.
	474.0		1.
	587.0		1.
	866.0		1.
	914.0		1.
	1687.0		1.
	1987.0		1.
	2089.0		1.
	2138.0		1.
	2615.0		1.
	2758.0		1.
	3156.0		1.
	3713.0		1.
	4404.0		1.
	5876.0		1.
	6032.0		1.
	6614.0		1.
	6839.0		1.

EQUIPMENT OPERATING HOURS (O.H.) = 53272.0 CALENDAR HOURS (C.H.) = 95736.0 DUTY CYCLE (O.H./C.H.) = .556

NUMBER OF FAILURES = 1. OBSERVED FAILURE RATE/O.H. = .18772E-04

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 53272.000, EST. MEDIAN = 36925.337, 90 PER CENT LCL FOR MEAN = 13695.6, 90 PER CENT UCL FOR MEAN = 505618.831
 90 PERCENT UCL 505618.83 IS GREATER THAN 2000.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

RELIABILITY
NAVMACS WRA 20 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
50.	143.0	1.	1.
15.	474.0	1.	
	576.0	1.	
	767.0		1.
	866.0		1.
	914.0		1.
50.	1033.0	1.	
	1562.0		1.
	1887.0		1.
	1987.0		1.
	2089.0		1.
	2615.0		1.
	2758.0		1.
	3156.0		1.
	3713.0		1.
	4404.0		1.
	5806.0		1.
	5876.0		1.
	6032.0		1.
	6614.0		1.

EQUIPMENT OPERATING HOURS (O.H.) = 53272.0 CALENDAR HOURS(C.H.) =, 95736.0 DUTY CYCLE (O.H./C.H.) = .556

NUMBER OF FAILURES = 3. OBSERVED FAILURE RATE/O.H. = .56315E-04

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED
FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 17757.333, EST. MEDIAN = 12308.446, 90 PER CENT LCL FOR MEAN = 7973.9, 90 PER CENT UCL FOR MEAN = 48338.347
90 PERCENT UCL 48338.35 IS GREATER THAN 1499.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

RELIABILITY

NAVMACS WRA 21 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
90.	143.0	1.	1.
	179.0		
	474.0		1.
	588.0		1.
	866.0		1.
	914.0		1.
	1261.0		1.
75.	1497.0	1.	
	1887.0		1.
	1987.0		1.
	2089.0		1.
	2138.0		1.
	2615.0		1.
	3156.0		1.
	3713.0		1.
	4404.0		1.
	5876.0		1.
	6032.0		1.
	6614.0		1.
	6839.0		1.

EQUIPMENT OPERATING HOURS (O.H.) = 53272.0 CALENDAR HOURS(C.H.) =, 95736.0 DUTY CYCLE (O.H./C.H.) = .556

NUMBER OF FAILURES = 2. OBSERVED FAILURE RATE/O.H. = .37543E-04

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED
FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 26636.000, EST. MEDIAN = 18462.668, 90 PER CENT LCL FOR MEAN = 10009.2, 90 PER CENT UCL FOR MEAN = 100170.831
90 PERCENT UCL 100170.83 IS GREATER THAN 1499.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

R E L I A B I L I T Y
NAVMACS WRA 22 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
	143.0		1.
	474.0		1.
	767.0		1.
	866.0		1.
	914.0		1.
100.	1657.0	1.	
	1887.0		1.
	1987.0		1.
	2056.0		1.
	2089.0		1.
	2138.0		1.
	2615.0		1.
	2758.0		1.
	3156.0		1.
	4404.0		1.
	5876.0		1.
	6032.0		1.
	6614.0		1.
	6839.0		1.

EQUIPMENT OPERATING HOURS (O.H.) = 53272.0 CALENDAR HOURS(C.H.) = 95736.0 DUTY CYCLE (O.H./C.H.) = .556

NUMBER OF FAILURES = 1. OBSERVED FAILURE RATE/O.H. = .18772E-04

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 53272.000, EST. MEDIAN = 36925.337, 90 PER CENT LCL FOR MEAN = 13695.6, 90 PER CENT UCL FOR MEAN = 505618.831
 90 PERCENT UCL 505618.83 IS GREATER THAN 1499.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

RELIABILITY

NAVMACS WRA 25 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
	143.0		1.
	474.0		1.
	767.0		1.
	771.0		1.
50.	777.0	1.	
	866.0		1.
	914.0		1.
50.	1067.0	1.	
	1887.0		1.
	1987.0		1.
	2089.0		1.
	2138.0		1.
	2758.0		1.
	3156.0		1.
	3713.0		1.
	4404.0		1.
	5876.0		1.
	6032.0		1.
	6614.0		1.
	6839.0		1.

EQUIPMENT OPERATING HOURS (O.H.) = 53272.0 CALENDAR HOURS(C.H.) = 95736.0 DUTY CYCLE (O.H./C.H.) = .556

NUMBER OF FAILURES = 2. OBSERVED FAILURE RATE/O.H. = .37543E-04

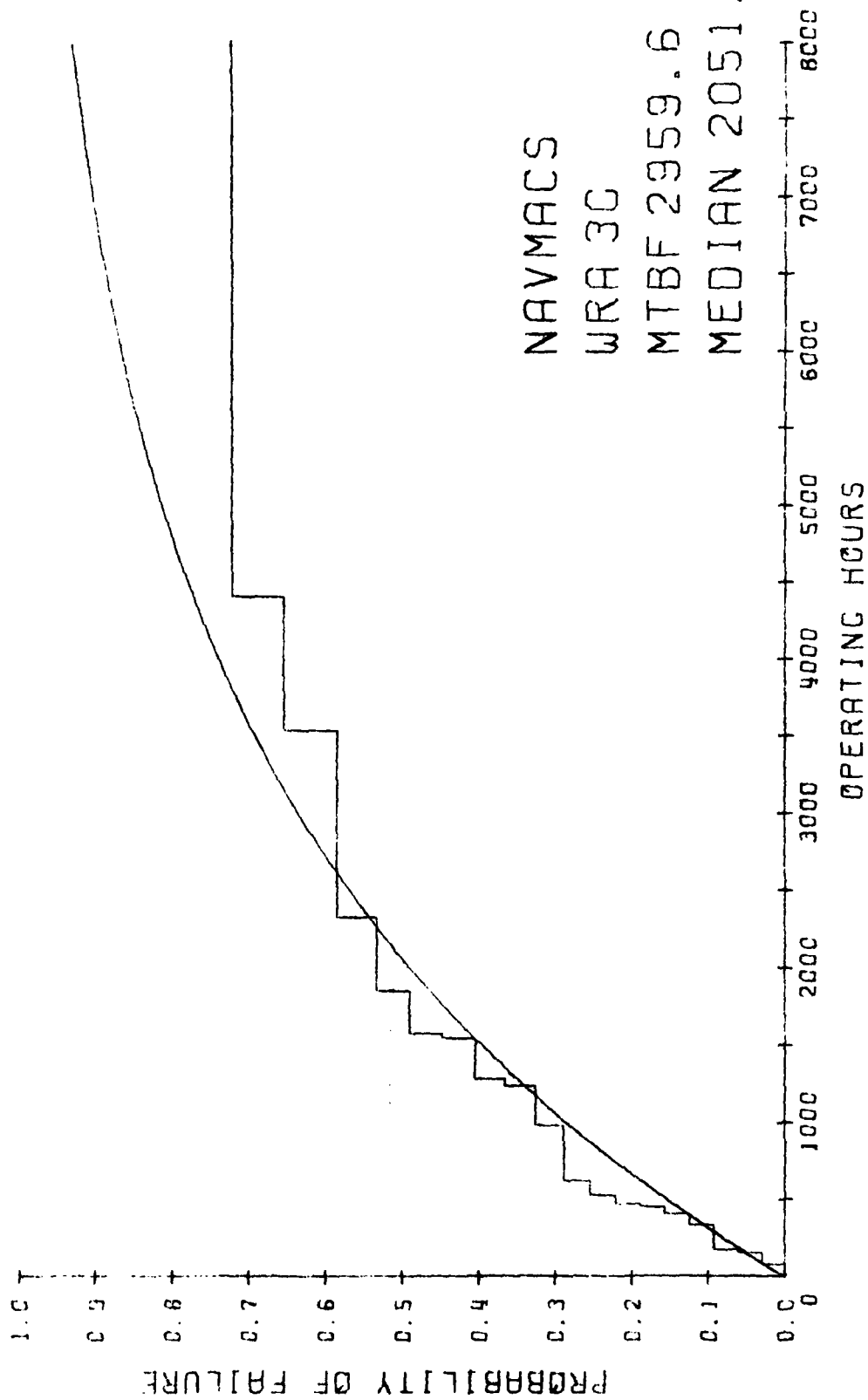
LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 26636.000. EST. MEDIAN = 18462.668, 90 PER CENT LCL FOR MEAN = 10009.2, 90 PER CENT UCL FOR MEAN = 100170.831

90 PERCENT UCL 100170.83 IS GREATER THAN 4000.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
EXPONENTIAL PROBABILITY DISTRIBUTION FOR TIME TO FAILURE



R E L I A B I L I T Y
NAVMACS WRA 30 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED	SURVIVORS	MPD	EXPONENTIAL	WEIBULL
95.	87.0	1.	1.	32.	.030	.029	.043
75.	143.0	1.	1.	30.	.062	.052	.071
100.	179.0	1.	1.	29.	.093	.059	.079
95.	180.0	1.	1.	27.	.125	.108	.134
75.	338.0	1.	1.	26.	.158	.130	.158
75.	412.0	1.	1.	25.	.190	.142	.171
75.	454.0	1.	1.	24.	.222	.148	.177
60.	474.0	1.	1.	23.	.255	.163	.192
50.	528.0	1.	1.	21.	.289	.190	.220
	625.0	1.	1.				
	802.0	1.	1.				
	914.0	1.	1.				
75.	985.0	1.	1.	18.	.326	.283	.309
75.	1059.0	1.	1.	16.	.366	.342	.365
75.	1239.0	1.	1.	15.	.405	.353	.374
75.	1287.0	1.	1.				
75.	1376.0	1.	1.	13.	.448	.406	.423
75.	1544.0	1.	1.	12.	.490	.413	.429
50.	1576.0	1.	1.	11.	.533	.465	.476
	1852.0	1.	1.				
	1887.0	1.	1.				
	1987.0	1.	1.	8.	.585	.544	.546
75.	2323.0	1.	1.				
	2758.0	1.	1.				
75.	3156.0	1.	1.	5.	.654	.697	.681
95.	3533.0	1.	1.	4.	.723	.774	.750
	4404.0						
	4516.0						
	5876.0						
	6032.0						

EQUIPMENT OPERATING HOURS (O.H.) = 53272.0 CALENDAR HOURS(C.H.) = 95736.0 DUTY CYCLE (O.H./C.H.) = .556

NUMBER OF FAILURES = 18. OBSERVED FAILURE RATE/O.H. = .33789E-03

ORATIO OF 1.182 IS NOT BEYOND CRITICAL VALUES THEREFORE THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 2959.556. EST. MEDIAN = 2051.408. 90 PER CENT LCL FOR MEAN = 2152.6. 90 PER CENT UCL FOR MEAN = 4150.529

90 PERCENT UCL 4150.53 IS GREATER THAN 500.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

R E L I A B I L I T Y

NAVMACS O-LEVEL SUMMARY

MRA BLOCK NO.	O-LEVEL BLOCK NO.	O-LEVEL NOMENCLATURE	NUMBER FAILURES	LOWER 90 CONF LIM	MEAN	UPPER 90 CONF LIM	SPEC MTBF	OBSERVED FAILURE TIMES		RELIAB PROBLEM
								LOW	HIGH	
14	21	ARITHMETIC LOGIC UNIT	1.	13695.59	53272.00	505618.83	261440.00	180.00	180.00	NO
20	2	POWER SUPPLY	1.	13695.59	53272.00	505618.83	19268.00	474.00	474.00	NO
20	10	TRANSMIT DELAY	1.	13695.59	53272.00	505618.83	78431.00	1033.00	1033.00	NO
20	14	INTERFACE	1.	13695.59	53272.00	505618.83	142248.00	576.00	576.00	NO
21	4	WRITE ELECTRONICS	1.	13695.59	53272.00	505618.83	15748.00	1497.00	1497.00	NO
21	13	CONTROL PANEL ASSY	1.	13695.59	53272.00	505618.83	23641.00	179.00	179.00	NO
22	12	READ ASSY	1.	13695.59	53272.00	505618.83	3268.00	1657.00	1657.00	NO
25	99		2.	10009.21	26636.00	100170.83	1000000.00	1067.00	1844.00	YES
30	99		19.	2056.64	2803.79	3894.12	1000000.00	87.00	4404.00	YES

RELIABILITY

2K SUMMARY FOR NAVMACS PROBLEM AREAS

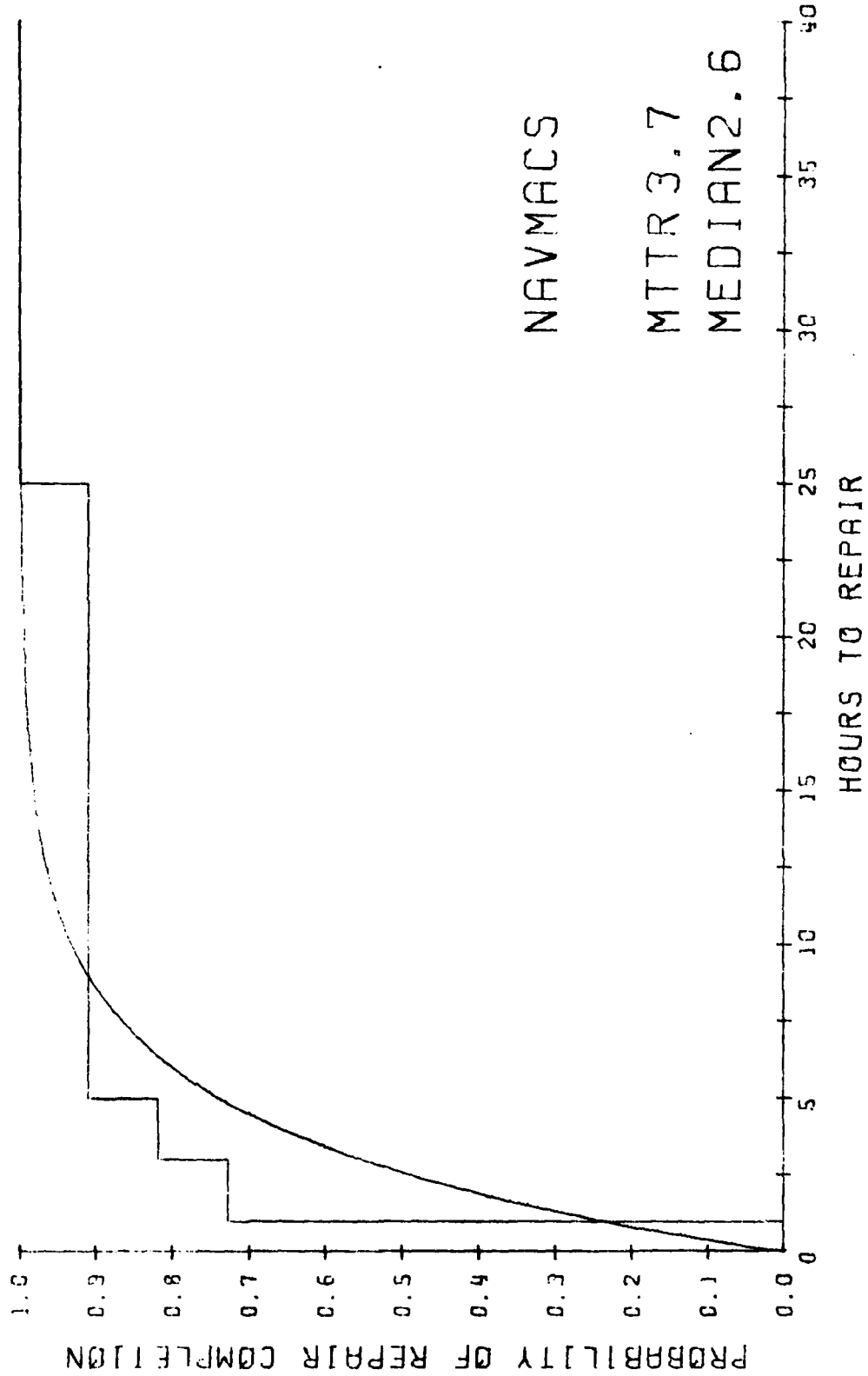
WRA O-L O-L O-L O-L WHAT HAPPENED

JCN

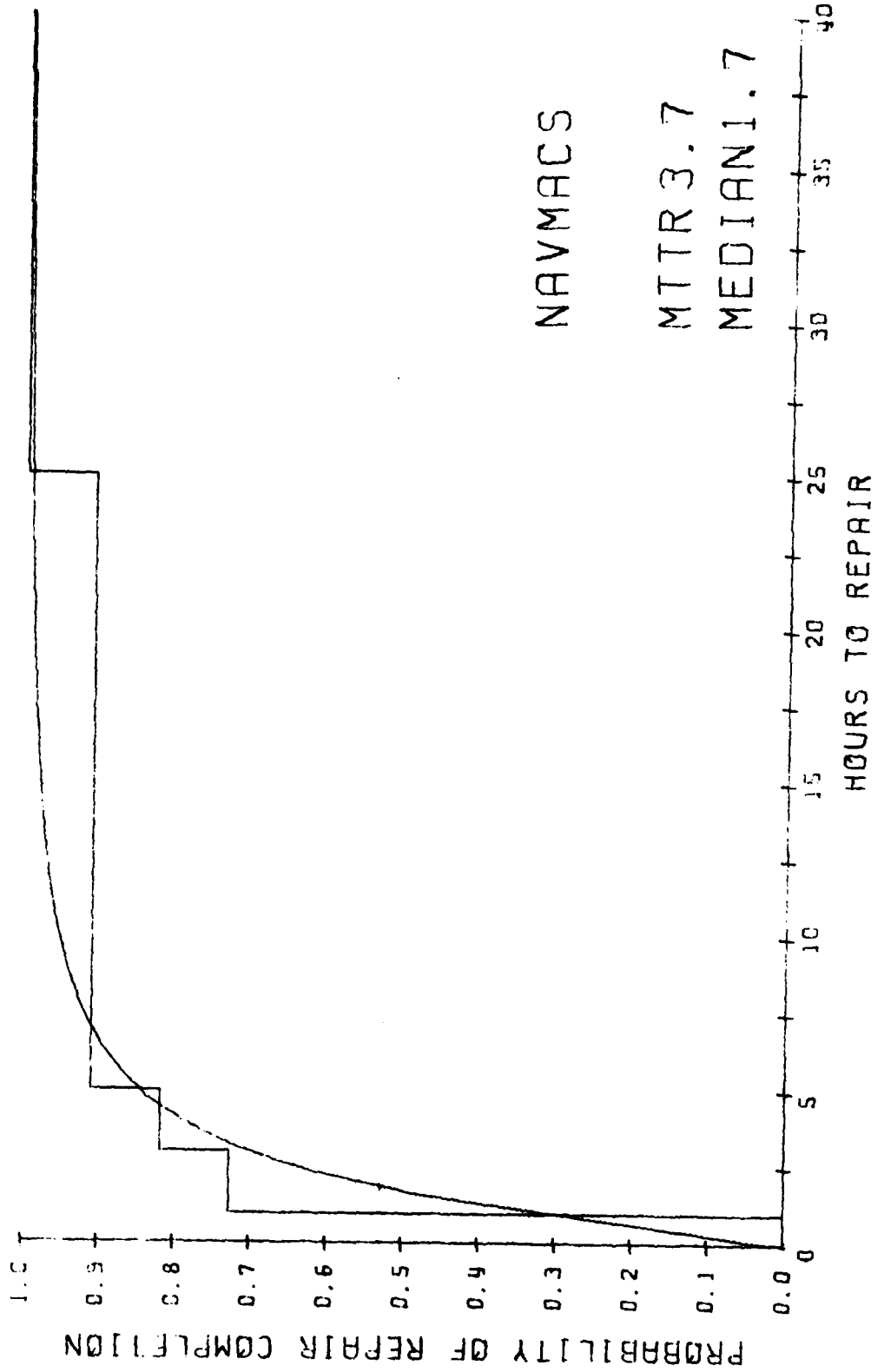
FLEET MAINTAINABILITY ASSESSMENT DATA

SYSTEM	SHIPNAME	DISCOVERED	COMPL	REPAIR TIME	DOWN TIME
NAVMACS	CONSTELLATION	8264	8264	0.	0.
NAVMACS	CONSTELLATION	NO REPAIR TIME FOR THE ABOVE RECORD	8324	0.	0.
NAVMACS	CONSTELLATION	NO REPAIR TIME FOR THE ABOVE RECORD	8340	0.	0.
NAVMACS	CONSTELLATION	NO REPAIR TIME FOR THE ABOVE RECORD	9096	0.	0.
NAVMACS	CONSTELLATION	NO REPAIR TIME FOR THE ABOVE RECORD	9105	0.	96.
NAVMACS	CONSTELLATION	NO REPAIR TIME FOR THE ABOVE RECORD	9114	0.	0.
NAVMACS	GUAM	NO REPAIR TIME FOR THE ABOVE RECORD	8300	25.	744.
NAVMACS	INCHON	NO REPAIR TIME FOR THE ABOVE RECORD	9071	0.	0.
NAVMACS	INDEPENDENCE	NO REPAIR TIME FOR THE ABOVE RECORD	8335	1.	1.
NAVMACS	INDEPENDENCE	NO REPAIR TIME FOR THE ABOVE RECORD	8345	0.	0.
NAVMACS	INDEPENDENCE	NO REPAIR TIME FOR THE ABOVE RECORD	9044	1.	24.
NAVMACS	KITTY HAWK	NO REPAIR TIME FOR THE ABOVE RECORD	9008	5.	24.
NAVMACS	LEAHY	NO REPAIR TIME FOR THE ABOVE RECORD	8355	0.	0.
NAVMACS	OKINAWA	NO REPAIR TIME FOR THE ABOVE RECORD	8207	1.	1512.
NAVMACS	OKINAWA	NO REPAIR TIME FOR THE ABOVE RECORD	8266	0.	984.
NAVMACS	RANGER	NO REPAIR TIME FOR THE ABOVE RECORD	8334	0.	0.
NAVMACS	RANGER	NO REPAIR TIME FOR THE ABOVE RECORD	9037	1.	48.
NAVMACS	SANTA BARBARA	NO REPAIR TIME FOR THE ABOVE RECORD	8323	0.	0.
NAVMACS	SANTA BARBARA	NO REPAIR TIME FOR THE ABOVE RECORD	9004	0.	0.
NAVMACS	SARATOGA	NO REPAIR TIME FOR THE ABOVE RECORD	8233	1.	1.
NAVMACS	SARATOGA	NO REPAIR TIME FOR THE ABOVE RECORD	8236	1.	1272.
NAVMACS	SARATOGA	NO REPAIR TIME FOR THE ABOVE RECORD	8286	3.	384.
NAVMACS	SARATOGA	NO REPAIR TIME FOR THE ABOVE RECORD	9029	1.	1.
NAVMACS	VULCAN	NO REPAIR TIME FOR THE ABOVE RECORD	8265	0.	72.
NAVMACS	VULCAN	NO REPAIR TIME FOR THE ABOVE RECORD	8268	0.	72.
NAVMACS	VULCAN	NO REPAIR TIME FOR THE ABOVE RECORD	8271	0.	72.
NAVMACS	VULCAN	NO REPAIR TIME FOR THE ABOVE RECORD	8275	1.	72.

CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
 EXPONENTIAL PROBABILITY DISTRIBUTION FOR TIME TO REPAIR



CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
 LOGNORMAL PROBABILITY DISTRIBUTION FOR TIME TO REPAIR



MAINTAINABILITY (REPAIR TIME)

REPAIR TIME.	FREQUENCY	CUM FREQUENCY	MPF	LOGNORMAL	EXPONENTIAL	WEIBULL
1.0	8.	8.0	.667	.303	.235	.344
3.0	1.	9.0	.750	.704	.553	.629
5.0	1.	10.0	.833	.847	.739	.771
25.0	1.	11.0	.917	.995	.999	.994

TOTAL REPAIR HOURS = 41.0 NUMBER OF REPAIRS = 11. OBSERVED REPAIR RATE/HR = .2683E+00

DISTRIBUTION DETERMINATION

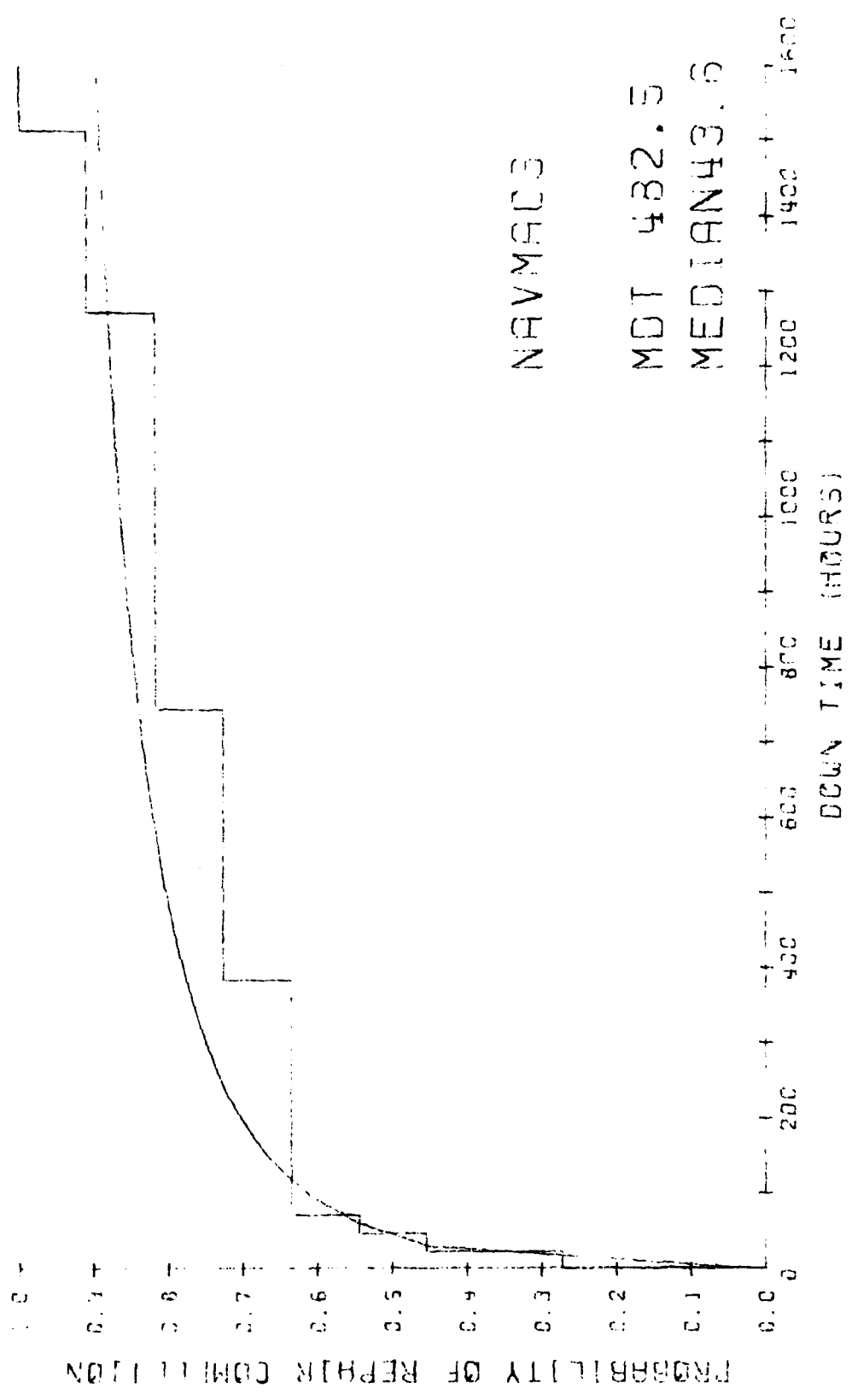
MEAN OF LN'S = .54 STD DEV OF LN'S = 1.05

K-S CRITICAL VALUE (.10, 11.) = .230 MAX DIFF CALC = .363 IS GREATER THAN THE CRITICAL VALUE
 THEREFORE THE LOGNORMAL DISTRIBUTION CANNOT BE ASSUMED

ORATIO OF 2.400 DOES NOT EXCEED THE CRITICAL VALUE FOR TEST OF EXPONENTIAL
 THEREFORE THE EXPONENTIAL DISTRIBUTION IS ASSUMED

EST MEAN = 3.73 EST MEDIAN = 2.58 90 PER CENT LCL ON MEAN = 2.66 90 PER CENT UCL ON MEAN = 5.84
 SPECIFIED MTR = 2.00 HOURS LOWER CONF LIM 2.66 IS GREATER THAN MTR, THUS A MAINTAINABILITY PROBLEM EXISTS

CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL LOGNORMAL PROBABILITY DISTRIBUTION FOR DOWN TIME



MAINTAINABILITY (DOWN TIME)

DOWN TIME	FREQUENCY	CUM FREQUENCY	NPF	LOGNORMAL	EXPONENTIAL	WEIBULL
1.0	3.	3.0	.250	.092	.002	.102
24.0	2.	5.0	.417	.416	.049	.351
48.0	1.	6.0	.500	.513	.095	.443
72.0	1.	7.0	.583	.570	.139	.503
384.0	1.	8.0	.667	.778	.549	.767
744.0	1.	9.0	.750	.841	.786	.857
1272.0	1.	10.0	.833	.883	.928	.915
1512.0	1.	11.0	.917	.894	.956	.930

TOTAL DOWN TIME (TDT) = 5307.0 NUMBER OF REPAIRS (NR) = 11. OBSERVED DOWN TIME/REPAIR (TDT/NR) = 482.45

DISTRIBUTION DETERMINATION

MEAN OF LN#S = 3.78 STD DEV OF LN#S = 2.84

K-S CRITICAL VALUE (.10, 11.) = .230 MAX DIFF CALC = .195 IS LESS THAN THE CRITICAL VALUE

THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

EST MEAN = 462.45 EST MEDIAN = 43.64 90 PER CENT LCL ON MEDIAN = 13.50 90 PER CENT UCL ON MEDIAN = 141.10

MAINTAINABILITY (REPAIR TIME)

NAVMACS WRA 14 LEVEL

LESS THAN FOUR DISTINCT REPAIR TIMES

THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

ONLY ONE DISTINCT REPAIR TIME -- NO CONFIDENCE LIMITS

MAINTAINABILITY (REPAIR TIME)

NAVMACS WRA 20 LEVEL

LESS THAN FOUR DISTINCT REPAIR TIMES

THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

ONLY ONE DISTINCT REPAIR TIME -- NO CONFIDENCE LIMITS

MAINTAINABILITY (REPAIR TIME)

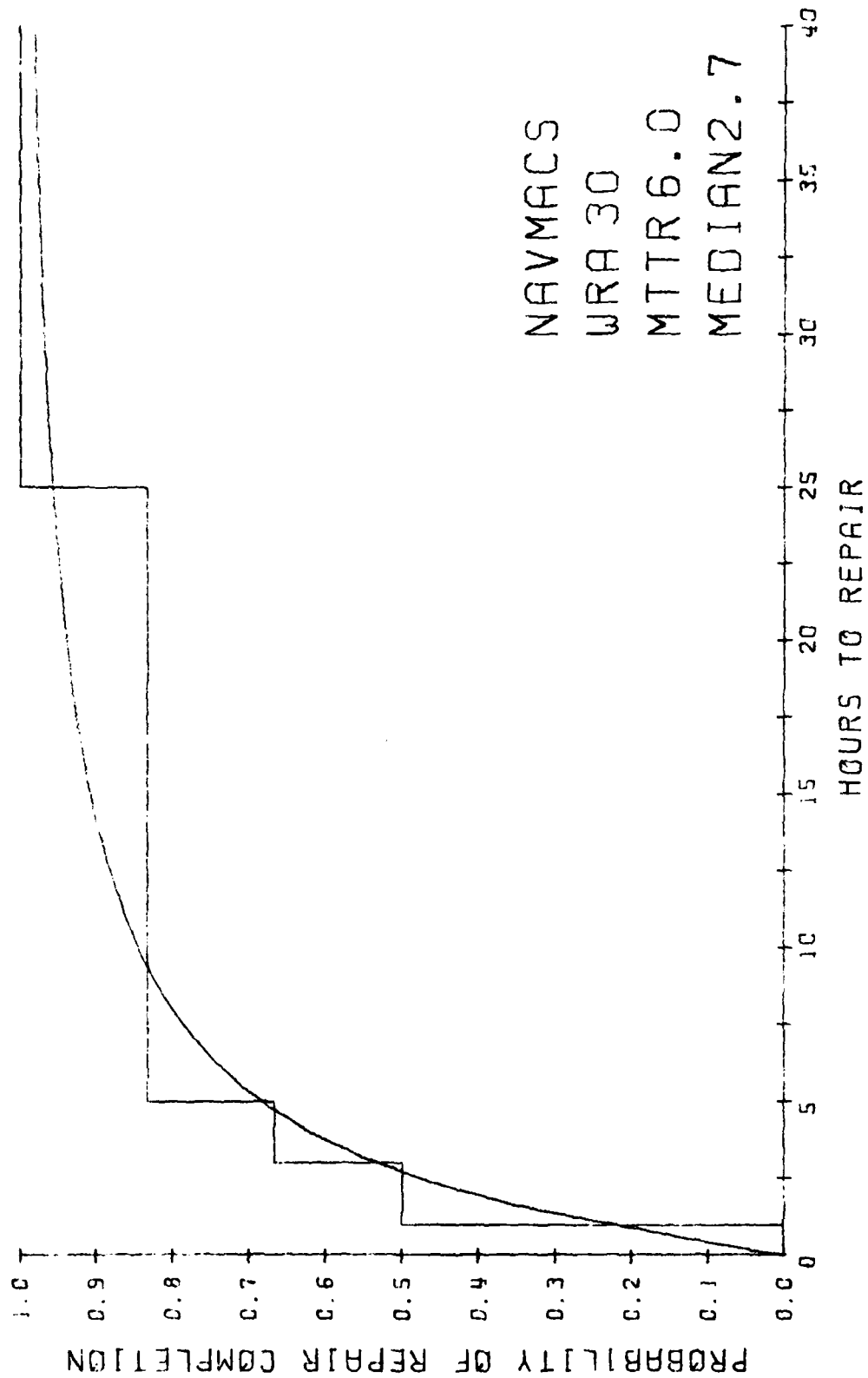
NAVMACS MRA 25 LEVEL

LESS THAN FOUR DISTINCT REPAIR TIMES

THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

ONLY ONE DISTINCT REPAIR TIME -- NO CONFIDENCE LIMITS

CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
 LOGNORMAL PROBABILITY DISTRIBUTION FOR TIME TO REPAIR



MAINTAINABILITY (REPAIR TIME)

NAVMACS WRA 30 LEVEL

REPAIR TIME	FREQUENCY	CUM FREQUENCY	NPF	LOGNORMAL	EXPONENTIAL	WEIBULL
1.0	3.	3.0	.429	.222	.154	.245
3.0	1.	4.0	.571	.534	.393	.486
5.0	1.	5.0	.714	.685	.565	.629
25.0	1.	6.0	.857	.958	.984	.970

TOTAL REPAIR HOURS = 36.0 NUMBER OF REPAIRS = 6. OBSERVED REPAIR RATE/HR = .1667E+00

DISTRIBUTION DETERMINATION

MEAN OF LNFS = .99 STD DEV OF LNFS = 1.29

K-S CRITICAL VALUE (.10, 6.) = .294 MAX DIFF CALC = .244 IS LESS THAN THE CRITICAL VALUE

THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

EST MEAN = 6.00 EST MEDIAN = 2.69 90 PER CENT LCL ON MEDIAN = 1.24 90 PER CENT UCL ON MEDIAN = 5.84

SPECIFIED MTR = 2.00 HOURS LOWER CONF LIM 1.24 IS LESS THAN MTR, THUS THE EQUIPMENT MEETS THE SPECIFICATIONS

MAINTAINABILITY (REPAIR TIME)

NAVMACS O-LEVEL SUMMARY

WPA BLOCK NO.	O-LEVEL NOMENCLATURE	NUMBER REPAIRS	LOWER 90 CONF LIM	UPPER 90 CONF LIM	SPEC MTR	OBSERVED REPAIR TIMES			MAINT PROBLEM
						LOW	MEAN	HIGH	
14	21 ARITHMETIC LOGIC UNIT	1.	NO CONF LIMITS	2.0	2.0	1.0	1.00	1.0	
20	10 TRANSMIT DELAY	1.	NO CONF LIMITS	2.0	2.0	1.0	1.00	1.0	
20	14 INTERFACE	1.	NO CONF LIMITS	2.0	2.0	1.0	1.00	1.0	
25	99	2.	NO CONF LIMITS	2.0	2.0	1.0	1.00	1.0	
30	99	7.	1.19	4.57	2.0	1.0	5.29	25.0	NO

MAINTAINABILITY (REPAIR TIME)

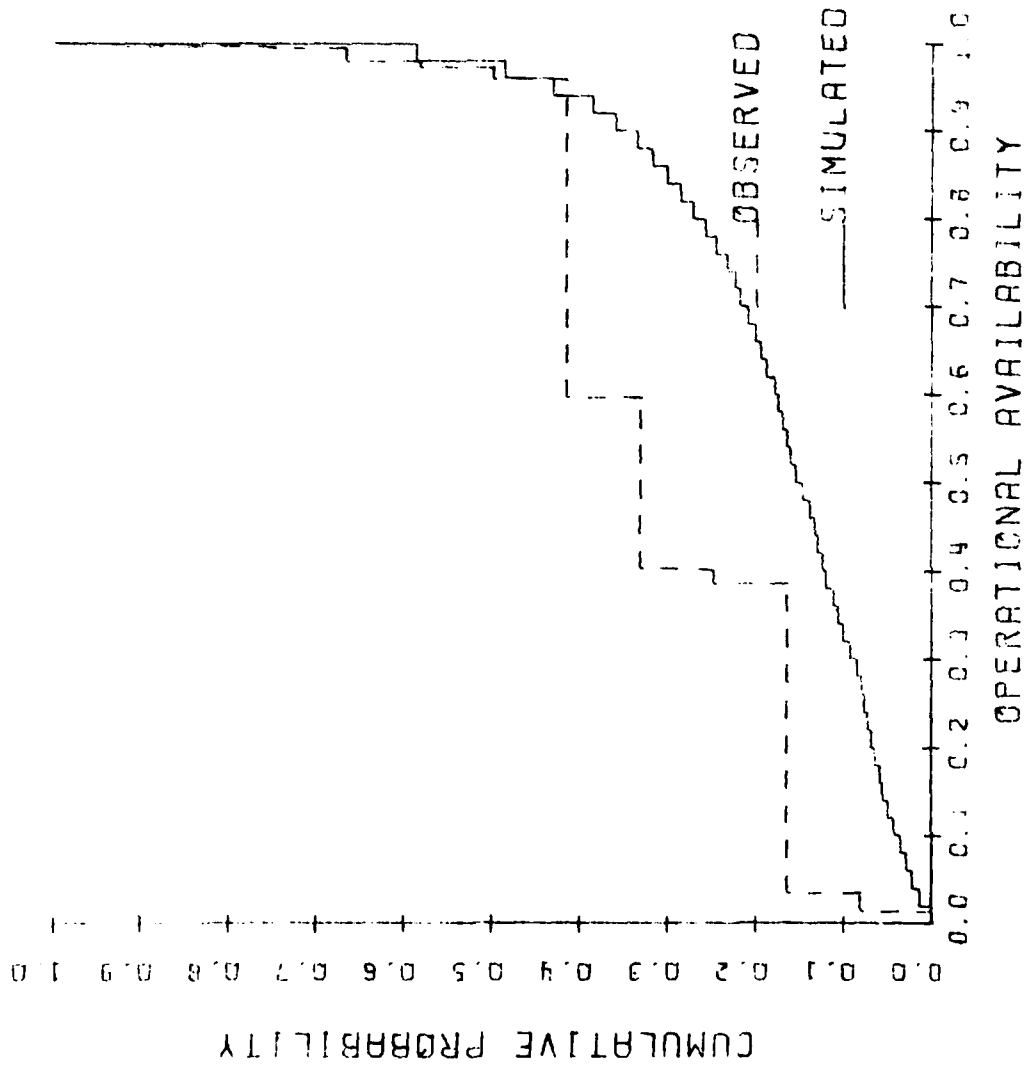
2K SUMMARY FOR NAVMACS PROBLEM AREAS

WRA 0-L 0-L 0-L WHAT HAPPENED

JCN

NAVMACS EQUIP. RELIABILITY

CUMULATIVE OBSERVED DISTRIBUTION VERSUS SIMULATED OPERATIONAL AVAILABILITY PROBABILITY DISTRIBUTION



RMA SUMMARY NAVMACS EQUIP. RELIABILITY SYSTEM LEVEL

TTF DISTRIBUTION IS EXPONENTIAL WITH MEAN = 2048.90
DT DISTRIBUTION IS LOGNORMAL WITH MEAN OF LNS = 3.78000 AND STANDARD DEVIATION OF LNS = 2.84000
MT DISTRIBUTION IS EXPONENTIAL WITH MEAN = 3.73

INHERENT AVAILABILITY = $MTBF / (MTBF + MTTR)$

MEAN TIME TO FAILURE = 2048.90
MEAN REPAIR TIME = 3.73
INHERENT AVAILABILITY = .9982

OBSERVED AVAILABILITY (SIMULATION OF RATIOS $TTF / (TTF + DT)$)

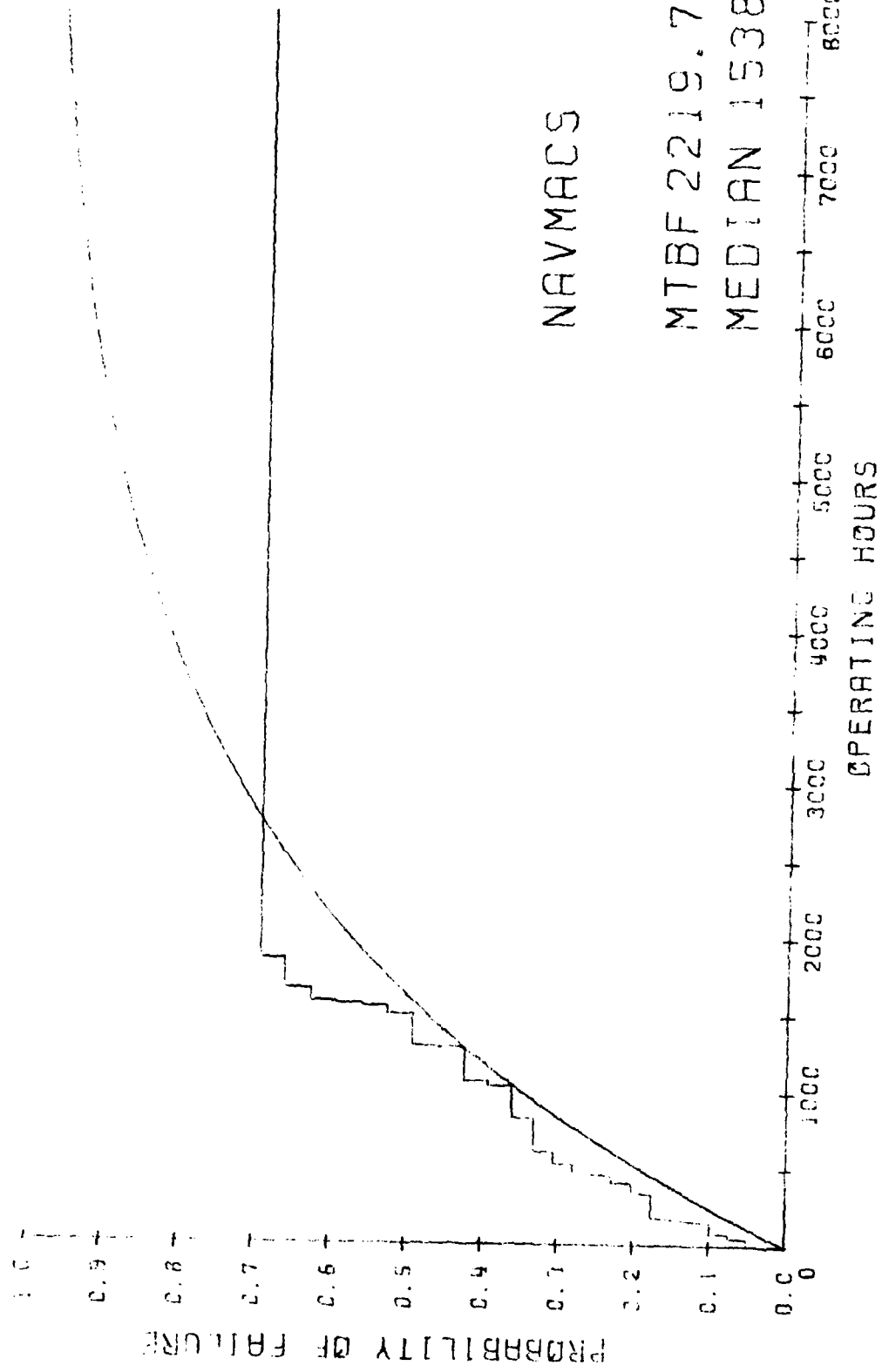
90 PERCENT LCL ON INDIVIDUALS = .3215
90 PERCENT UCL ON INDIVIDUALS = .9952
MEAN = .8194
MEDIAN = .9632

NAVMACS
PARTS
REPLACEMENT

FLEET RELIABILITY ASSESSMENT DATA											
SYSTEM	SHIPNAME	DATE	ETM	FAILURE TYPE	OPERATE	FAILURE TIME	DUTY	WRA	OL1	OL2	OL3
NAVMACS	ALBANY	8215	8820.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	ALBANY	8241	9422.	CENSORED	602.	602.	.965	0	0	0	0
NAVMACS	ALBANY	9002	10707.	CENSORED	1887.	1887.	.517	0	0	0	0
NAVMACS	NO INITIAL RECORD-FIRST RECORD USED										
NAVMACS	BLUE RIDGE	9047	647.	FINAL	0.	0.	0.000	0	0	0	0
NAVMACS	BOWEN	8184	8421.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	BOWEN	8212	8976.	CENSORED	555.	555.	.826	0	0	0	0
NAVMACS	BOWEN	8243	9718.	CENSORED	1297.	1297.	.916	0	0	0	0
NAVMACS	BOWEN	8362	11577.	CENSORED	3156.	3156.	.739	0	0	0	0
NAVMACS	CONSTELLATION	8164	3783.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	CONSTELLATION	8263	5635.	CENSORED	1852.	1852.	.779	0	0	0	0
NAVMACS	CONSTELLATION	8264	5635.	FAILURE	1852.	1852.	.772	30	99	0	0
NAVMACS	CONSTELLATION	8279	6020.	CENSORED	2237.	385.	.811	0	0	0	0
NAVMACS	CONSTELLATION	8324	7179.	FAILURE	3396.	1544.	.884	30	99	0	0
NAVMACS	CONSTELLATION	8340	7517.	FAILURE	3734.	338.	.884	30	99	0	0
NAVMACS	CONSTELLATION	9032	8047.	CENSORED	4264.	530.	.763	0	0	0	0
NAVMACS	CONSTELLATION	9096	9093.	FAILURE	5310.	1576.	.745	30	99	0	0
NAVMACS	CONSTELLATION	9105	9180.	FAILURE	87.	158.	.735	30	99	0	0
NAVMACS	CONSTELLATION	9114	9338.	FAILURE	5555.	158.	.735	30	99	0	0
NAVMACS	CONSTELLATION	9169	10397.	FINAL	6614.	1059.	.745	0	0	0	0
NAVMACS	DALE	8217	7995.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	DALE	8305	9982.	CENSORED	1987.	1987.	.941	0	0	0	0
NAVMACS	NO INITIAL RECORD-FIRST RECORD USED										
NAVMACS	GUAM	8276	5971.	CENSORED	0.	0.	0.000	0	0	0	0
NAVMACS	GUAM	8300	6445.	FAILURE	474.	474.	.823	20	2	99	0
NAVMACS	INCHON	8205	4843.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	INCHON	9071	9247.	CENSORED	4404.	4404.	.794	0	0	0	0
NAVMACS	INDEPENDENCE	8206	4692.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	INDEPENDENCE	8335	5759.	FAILURE	1067.	1067.	.345	25	99	0	0
NAVMACS	INDEPENDENCE	8345	5931.	FAILURE	1239.	172.	.371	30	99	0	0
NAVMACS	INDEPENDENCE	9031	6246.	CENSORED	1554.	315.	.341	0	0	0	0
NAVMACS	INDEPENDENCE	9044	6536.	DEFERRED	1844.	605.	.378	25	99	0	0
NAVMACS	INDEPENDENCE	9090	6691.	CENSORED	1999.	155.	.335	0	0	0	0
NAVMACS	INDEPENDENCE	9120	7307.	CENSORED	2615.	771.	.391	0	0	0	0
NAVMACS	KINKAID	8222	5800.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	KINKAID	9102	11676.	FINAL	5876.	5876.	.999	0	0	0	0
NAVMACS	KITTY HAWK	8321	2431.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	KITTY HAWK	9008	3718.	FAILURE	1287.	1287.	1.031	30	99	0	0
NAVMACS	KITTY HAWK	9135	4520.	FINAL	2089.	802.	.486	0	0	0	0
NAVMACS	LEAHY	8145	6373.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	LEAHY	8355	7870.	FAILURE	1497.	1497.	.297	21	4	0	0
NAVMACS	LEAHY	9066	9131.	FINAL	2758.	1261.	.402	0	0	0	0
NAVMACS	LUCE	8200	2508.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	LUCE	8230	2979.	CENSORED	471.	471.	.654	0	0	0	0
NAVMACS	LUCE	8247	3335.	FAILURE	827.	827.	.733	30	99	0	0
NAVMACS	LUCE	8321	5063.	CENSORED	2555.	1728.	.860	0	0	0	0
NAVMACS	LUCE	9137	8540.	CENSORED	6032.	5205.	.832	0	0	0	0
NAVMACS	NEW ORLEANS	8146	5814.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	NEW ORLEANS	9066	5957.	FINAL	143.	143.	.021	0	0	0	0

		FLEET RELIABILITY ASSESSMENT DATA									
SYSTEM	SHIPNAME	DATE	ETM	FAILURE TYPE	OPERATE	FAILURE TIME	DUTY	MRA	OL1	OL2	OL3
NAVMACS	OKINAWA	8165	1881.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	OKINAWA	8207	2914.	DEFERRED	1033.	1033.	1.025	20	10	0	0
NAVMACS	OKINAWA	8266	4204.	FAILURE	2323.	1290.	.958	30	99	0	0
NAVMACS	OKINAWA	8290	4756.	CENSORED	2875.	552.	.958	0	0	0	0
NAVMACS	OKINAWA	9102	8720.	FINAL	6839.	4516.	.944	0	0	0	0
NAVMACS	RANGER	8164	2377.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	RANGER	8256	3200.	CENSORED	823.	823.	.373	0	0	0	0
NAVMACS	RANGER	8303	3276.	CENSORED	899.	899.	.269	0	0	0	0
NAVMACS	RANGER	8334	4034.	FAILURE	1657.	1657.	.406	22	12	0	0
NAVMACS	RANGER	9037	5910.	CENSORED	3533.	1876.	.619	0	0	0	0
NAVMACS	RANGER	9045	6090.	CENSORED	3713.	2056.	.629	0	0	0	0
NAVMACS	SANTA BARBARA	8187	7007.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	SANTA BARBARA	8219	7069.	CENSORED	62.	62.	.081	0	0	0	0
NAVMACS	SANTA BARBARA	8286	7069.	CENSORED	62.	62.	.026	0	0	0	0
NAVMACS	SANTA BARBARA	8323	7419.	FAILURE	412.	412.	.126	30	99	0	0
NAVMACS	SANTA BARBARA	9004	7873.	FAILURE	866.	454.	.198	30	99	0	0
NAVMACS	SARATOGA	8201	7037.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	SARATOGA	8233	7565.	FAILURE	528.	528.	.688	30	99	99	0
NAVMACS	SARATOGA	8236	7613.	DEFERRED	576.	48.	.686	20	14	0	0
NAVMACS	SARATOGA	8274	7973.	CENSORED	936.	360.	.534	0	0	0	0
NAVMACS	SARATOGA	8286	8190.	CENSORED	1153.	577.	.565	0	0	0	0
NAVMACS	SARATOGA	9002	8962.	CENSORED	1925.	1349.	.483	0	0	0	0
NAVMACS	SARATOGA	9029	9175.	FAILURE	2138.	1562.	.462	30	99	0	0
NAVMACS	VULCAN	8205	5373.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	VULCAN	8235	5444.	CENSORED	71.	71.	.099	0	0	0	0
NAVMACS	VULCAN	8265	5552.	DEFERRED	179.	179.	.124	30	99	0	0
NAVMACS	VULCAN	8268	5552.	DEFERRED	179.	0.	.118	21	13	0	0
NAVMACS	VULCAN	8275	5553.	DEFERRED	180.	1.	.107	14	21	0	0
NAVMACS	VULCAN	8328	5676.	CENSORED	303.	123.	.103	0	0	0	0
NAVMACS	VULCAN	8356	5771.	CENSORED	398.	218.	.110	0	0	0	0
NAVMACS	VULCAN	9113	6140.	CENSORED	767.	587.	.117	0	0	0	0
NAVMACS	YOSEMITE	8200	246.	INITIAL	0.	0.	0.000	0	0	0	0
NAVMACS	YOSEMITE	8226	740.	CENSORED	494.	494.	.792	0	0	0	0
NAVMACS	YOSEMITE	8255	790.	CENSORED	544.	544.	.412	0	0	0	0
NAVMACS	YOSEMITE	8286	790.	CENSORED	544.	544.	.264	0	0	0	0
NAVMACS	YOSEMITE	8318	810.	CENSORED	564.	564.	.199	0	0	0	0
NAVMACS	YOSEMITE	9009	1160.	CENSORED	914.	914.	.219	0	0	0	0

CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
EXPONENTIAL PROBABILITY DISTRIBUTION FOR TIME TO FAILURE



R E L I A B I L I T Y

REMAINING SYS. CAP.	TIME TO FAIL .0	NO. FAILURES	NO. CENSORED	NAVMACS	SYSTEM LEVEL	SURVIVORS	NPD	EXPONENTIAL	WEIBULL
0.	.0	1.	1.			39.	.025	.000	.000
25.	1.0	1.	1.			38.	.050	.000	.008
15.	48.0	1.	1.			37.	.075	.021	.081
95.	87.0	1.	1.			36.	.100	.037	.115
	143.0			1.					
75.	158.0	1.	1.			34.	.126	.066	.161
75.	172.0	1.	1.			33.	.151	.072	.169
100.	179.0	1.	1.			32.	.177	.074	.173
95.	338.0	1.	1.			31.	.203	.136	.246
75.	412.0	1.	1.			30.	.229	.163	.273
75.	454.0	1.	1.			29.	.254	.178	.287
75.	474.0	1.	1.			28.	.280	.185	.293
60.	528.0	1.	1.			27.	.306	.204	.310
	587.0			1.					
50.	605.0	1.	1.			25.	.332	.230	.332
	771.0			1.					
	802.0			1.					
75.	827.0	1.	1.			22.	.361	.300	.387
	914.0			1.					
50.	1033.0	1.	1.			20.	.392	.360	.430
	1059.0			1.					
50.	1067.0	1.	1.			18.	.424	.369	.436
	1261.0			1.					
75.	1287.0	1.	1.			16.	.458	.426	.475
75.	1290.0	1.	1.			15.	.492	.427	.475
75.	1497.0	1.	1.			14.	.526	.476	.507
75.	1544.0	1.	1.			13.	.559	.487	.513
75.	1562.0	1.	1.			12.	.593	.491	.516
75.	1576.0	1.	1.			11.	.627	.494	.518
100.	1657.0	1.	1.			10.	.661	.511	.529
50.	1852.0	1.	1.			9.	.695	.550	.553
	1887.0			1.					
	1987.0			1.					
	2056.0			1.					
	3156.0			1.					
	4404.0			1.					
	4516.0			1.					
	5205.0			1.					
	5876.0			1.					

R E L I A B I L I T Y

NAVMACS SYSTEM LEVEL

ESTIMATED OPERATING HOURS (O.H.) = 53272.0 CALENDAR HOURS(C.H.) = 95736.0 DUTY CYCLE (O.H./C.H.) = .556

NUMBER OF FAILURES = 23. OBSERVED FAILURE RATE/O.H. = .43175E-03

RATIO OF 1.066 IS NOT BEYOND CRITICAL VALUES THEREFORE THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 2219.667, EST. MEDIAN = 1538.556, 90 PER CENT LCL FOR MEAN = 1749.6, 90 PER CENT UCL FOR MEAN = 3112.286

90 PERCENT UCL 3112.29 IS GREATER THAN 285.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

RELIABILITY

NAVMACS WRA 14 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED	DUTY CYCLE (O.H./C.H.) =
25.	143.0	1.	1.	95736.0
	180.0			
	474.0			
	587.0			
	866.0			
	914.0			
	1887.0			
	1987.0			
	2089.0			
	2138.0			
	2615.0			
	2758.0			
	3156.0			
	3713.0			
	4404.0			
	5876.0			
	6032.0			
	6614.0			
	6839.0			

EQUIPMENT OPERATING HOURS (O.H.) = 53272.0 CALENDAR HOURS (C.H.) = 95736.0 DUTY CYCLE (O.H./C.H.) = .556

NUMBER OF FAILURES = 1. OBSERVED FAILURE RATE/O.H. = .18772E-04

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 53272.000, EST. MEDIAN = 36925.337, 90 PER CENT LCL FOR MEAN = 13695.6, 90 PER CENT UCL FOR MEAN = 505618.831
 90 PERCENT UCL 505618.83 IS GREATER THAN 2000.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

RELIABILITY
NAVMACS WRA 20 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED	DUTY CYCLE (O.H./C.H.) =
50.	143.0	1.	1.	.556
15.	474.0	1.		
	576.0			
	767.0			
	866.0			
	914.0			
50.	1033.0	1.		
	1562.0			
	1887.0			
	1987.0			
	2089.0			
	2615.0			
	2758.0			
	3156.0			
	3713.0			
	4404.0			
	5806.0			
	5876.0			
	6032.0			
	6614.0			

EQUIPMENT OPERATING HOURS (O.H.) = 53272.0 CALENDAR HOURS(C.H.) = 95736.0 DUTY CYCLE (O.H./C.H.) = .556

NUMBER OF FAILURES = 3. OBSERVED FAILURE RATE/O.H. = .56315E-04

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 17757.333, EST. MEDIAN = 12308.446, 90 PER CENT LCL FOR MEAN = 7973.9, 90 PER CENT UCL FOR MEAN = 48338.347

90 PERCENT UCL 48338.35 IS GREATER THAN 1499.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

R E L I A B I L I T Y

NAVMACS WRA 21 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
90.	143.0		1.
	179.0	1.	
	474.0		1.
	588.0		1.
	866.0		1.
	914.0		1.
	1261.0		1.
75.	1497.0	1.	
	1887.0		1.
	1987.0		1.
	2089.0		1.
	2138.0		1.
	2615.0		1.
	3156.0		1.
	3713.0		1.
	4404.0		1.
	5876.0		1.
	6032.0		1.
	6614.0		1.
	6839.0		1.

EQUIPMENT OPERATING HOURS (O.H.) = 53272.0 CALENDAR HOURS(C.H.) = 95736.0 DUTY CYCLE (O.H./C.H.) = .556

NUMBER OF FAILURES = 2. OBSERVED FAILURE RATE/O.H. = .37543E-04

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 26636.000. EST. MEDIAN = 18462.668. 90 PER CENT LCL FOR MEAN = 10009.2. 90 PER CENT UCL FOR MEAN = 100170.831

90 PERCENT UCL 100170.83 IS GREATER THAN 1499.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

R E L I A B I L I T Y

NAVMACS WRA 22 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
	143.0		1.
	474.0		1.
	767.0		1.
	866.0		1.
	914.0		1.
100.	1657.0	1.	
	1887.0		1.
	1987.0		1.
	2056.0		1.
	2089.0		1.
	2138.0		1.
	2615.0		1.
	2758.0		1.
	3156.0		1.
	4404.0		1.
	5876.0		1.
	6032.0		1.
	6614.0		1.
	6839.0		1.

EQUIPMENT OPERATING HOURS (O.H.) = 53272.0 CALENDAR HOURS(C.H.) = 95736.0 DUTY CYCLE (O.H./C.H.) = .556

NUMBER OF FAILURES = 1. OBSERVED FAILURE RATE/O.H. = .18772E-04

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 53272.000; EST. MEDIAN = 36925.337; 90 PER CENT LCL FOR MEAN = 13695.6; 90 PER CENT UCL FOR MEAN = 505618.831

90 PERCENT UCL 505618.83 IS GREATER THAN 1499.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

RELIABILITY

NAVMACS WRA 25 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
	143.0		1.
	474.0		1.
	767.0		1.
	771.0		1.
50.	777.0	1.	
	866.0		1.
	914.0		1.
50.	1067.0	1.	
	1887.0		1.
	1987.0		1.
	2089.0		1.
	2138.0		1.
	2758.0		1.
	3156.0		1.
	3713.0		1.
	4404.0		1.
	5876.0		1.
	6032.0		1.
	6614.0		1.
	6839.0		1.

EQUIPMENT OPERATING HOURS (O.H.) = 53272.0 CALENDAR HOURS(C.H.) =, 95736.0 DUTY CYCLE (O.H./C.H.) = .556

NUMBER OF FAILURES = 2. OBSERVED FAILURE RATE/O.H. = .37543E-04

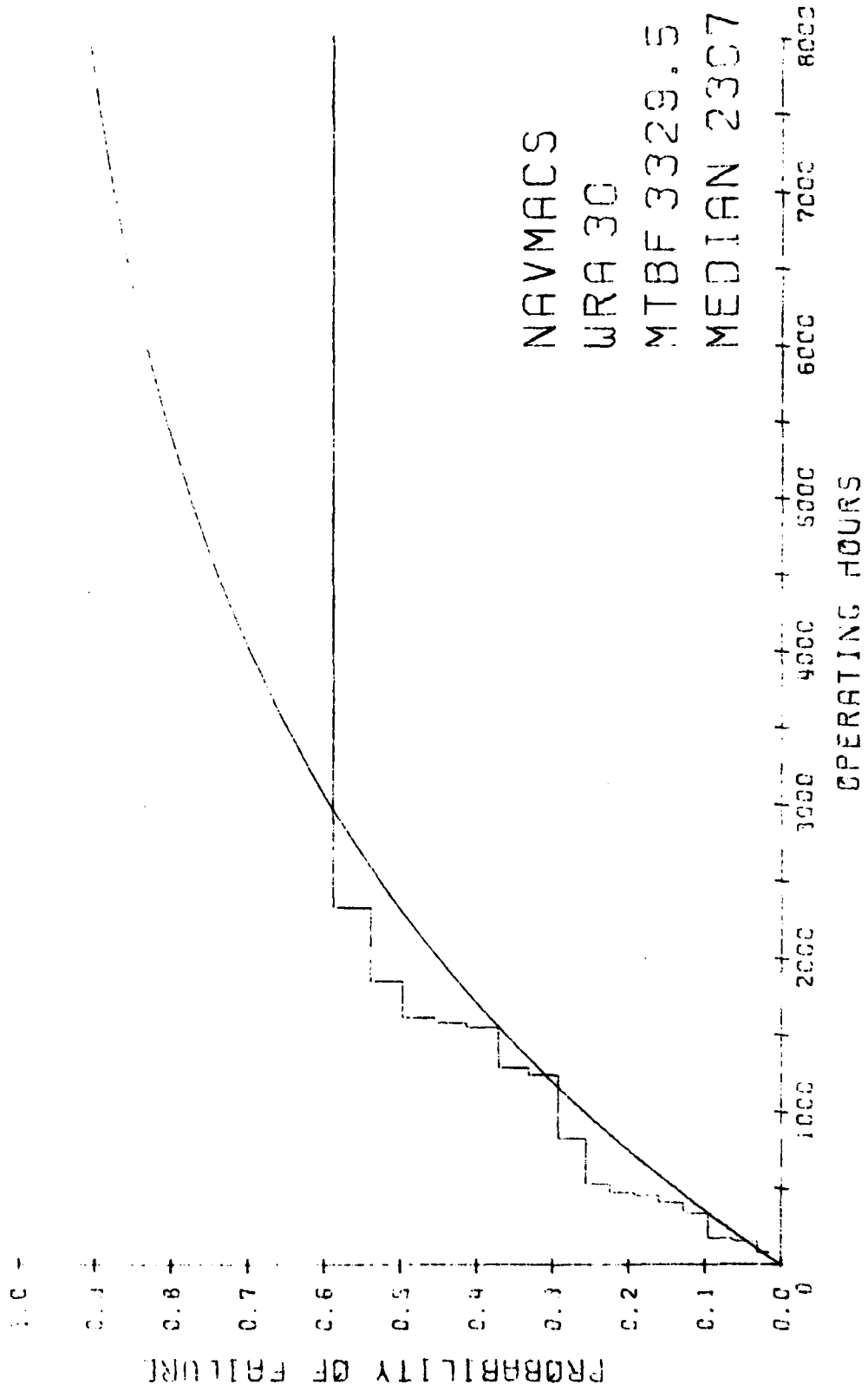
LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 26636.000, EST. MEDIAN = 18462.668, 90 PER CENT LCL FOR MEAN = 10009.2, 90 PER CENT UCL FOR MEAN = 100170.831

90 PERCENT UCL 100170.83 IS GREATER THAN 4000.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
EXPONENTIAL PROBABILITY DISTRIBUTION FOR TIME TO FAILURE



RELIABILITY

NAVMACS WRA 30 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED	SURVIVORS	NPD	EXPONENTIAL	WEIBULL
95.	87.0	1.	1.	31.	.031	.026	.048
	143.0						
75.	158.0	1.	1.	29.	.064	.046	.077
100.	179.0	1.		28.	.096	.052	.085
95.	338.0	1.		27.	.128	.097	.138
75.	412.0	1.		26.	.160	.116	.159
75.	454.0	1.		25.	.193	.127	.171
75.	474.0	1.		24.	.225	.133	.177
60.	528.0	1.		23.	.257	.147	.191
	588.0		1.				
	802.0		1.				
75.	827.0	1.		20.	.293	.220	.262
	914.0						
	1059.0						
75.	1239.0	1.		17.	.332	.311	.344
75.	1287.0	1.		16.	.371	.321	.353
	1376.0						
75.	1544.0	1.		14.	.413	.371	.396
75.	1576.0	1.		13.	.455	.377	.401
75.	1610.0	1.		12.	.497	.383	.406
50.	1852.0	1.		11.	.539	.427	.442
	1887.0		1.				
	1987.0		1.				
75.	2323.0	1.		8.	.590	.502	.503
	2758.0						
	3156.0		1.				
	3713.0		1.				
	4404.0		1.				
	4516.0		1.				
	5205.0		1.				
	5876.0		1.				

EQUIPMENT OPERATING HOURS (O.H.) = 53272.0 CALENDAR HOURS (C.H.) = 95736.0 DUTY CYCLE (O.H./C.H.) = .556

NUMBER OF FAILURES = 16. OBSERVED FAILURE RATE/O.H. = .30035E-03

ORATIO OF .901 IS NOT BEYOND CRITICAL VALUES THEREFORE THE EXPONENTIAL DISTRIBUTION IS ASSUMED FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 3329.500. EST. MEDIAN = 2307.834. 90 PER CENT LCL FOR MEAN = 2374.2. 90 PER CENT UCL FOR MEAN = 4780.017

90 PERCENT UCL 4780.02 IS GREATER THAN 500.00 HOURS. THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

R E L I A B I L I T Y

NAVMACS O-LEVEL SUMMARY

WRA	O-LEVEL BLOCK NO.	O-LEVEL NOMENCLATURE	NUMBER FAILURES	LOWER 90 CONF LIM	MEAN	UPPER 90 CONF LIM	SPEC MTBF	OBSERVED FAILURE TIMES LOW	HIGH	RELIAB PROBLEM
14	21	ARITHMETIC LOGIC UNIT	1.	13695.59	53272.00	505618.83	261440.00	180.00	180.00	NO
20	2	POWER SUPPLY	1.	13695.59	53272.00	505618.83	19268.00	474.00	474.00	NO
20	10	TRANSMIT DELAY	1.	13695.59	53272.00	505618.83	78431.00	1033.00	1033.00	NO
20	14	INTERFACE	1.	13695.59	53272.00	505618.83	142248.00	576.00	576.00	NO
21	4	WRITE ELECTRONICS	1.	13695.59	53272.00	505618.83	15748.00	1497.00	1497.00	NO
21	13	CONTROL PANEL ASSY	1.	13695.59	53272.00	505618.83	23641.00	179.00	179.00	NO
22	12	READ ASSY	1.	13695.59	53272.00	505618.83	3268.00	1657.00	1657.00	NO
25	99		2.	10009.21	26636.00	100170.83	1000000.00	1067.00	1844.00	YES
30	99		17.	2257.99	3133.65	4443.09	1000000.00	87.00	2323.00	YES

R E L I A B I L I T Y

2K SUMMARY FOR NAVMACS PROBLEM AREAS

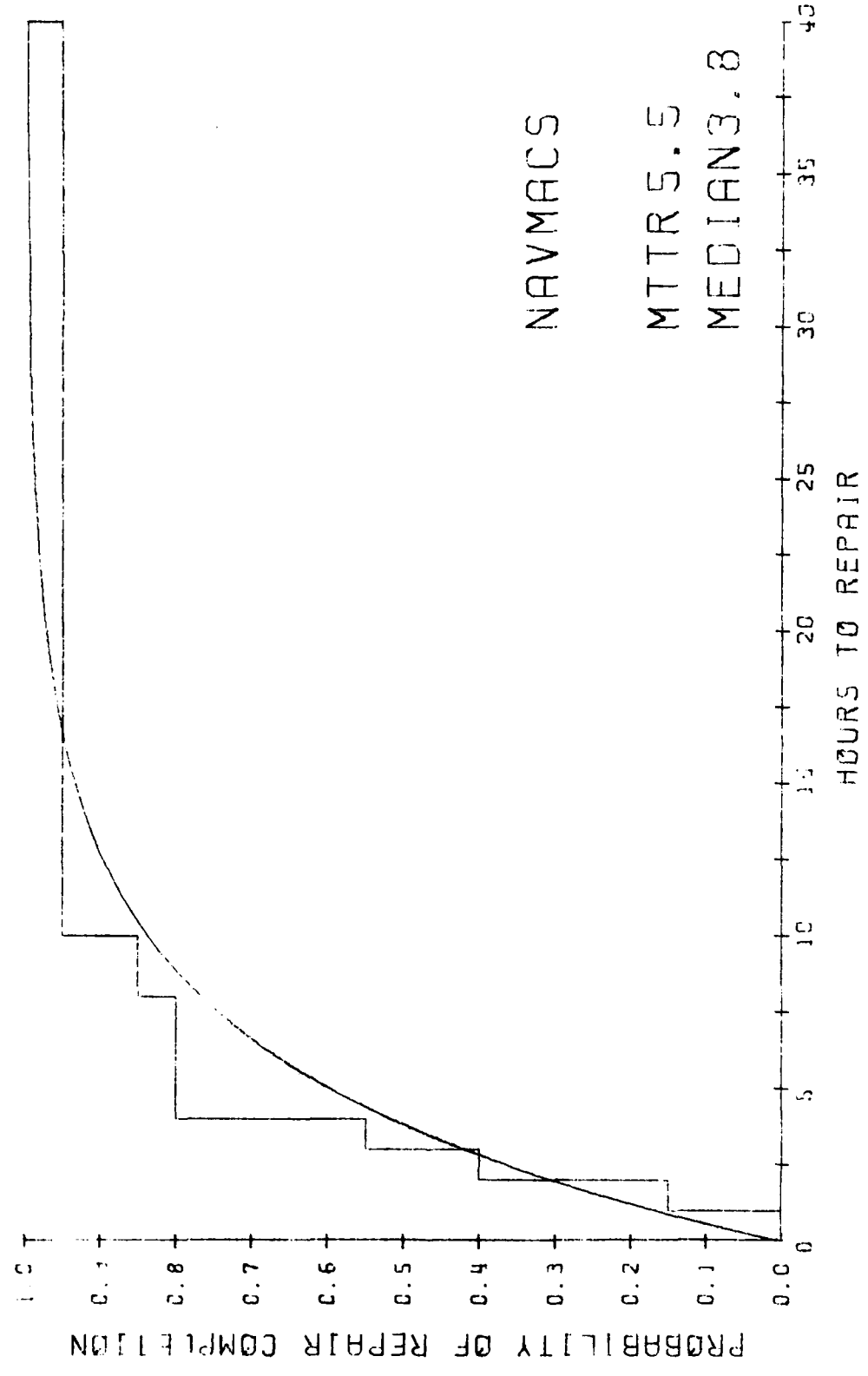
WRA	0-L	0-L	0-L	WHAT HAPPENED
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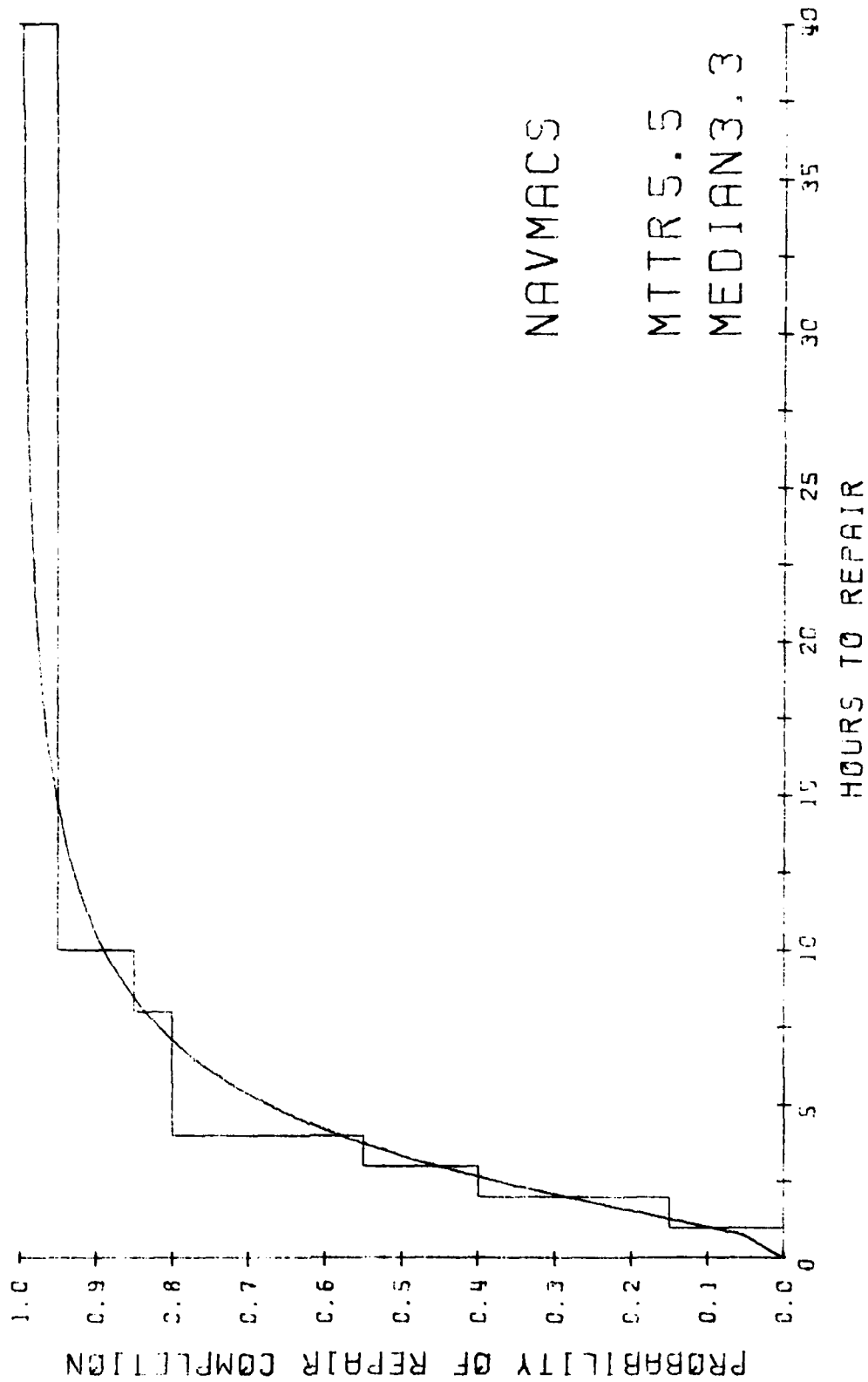
FLEET MAINTAINABILITY ASSESSMENT DATA

SYSTEM	SHIPNAME	DISCOVERED	COMPL	REPAIR TIME	DOWN TIME
NAVMACS	CONSTELLATION	8264	8264	4.	4.
NAVMACS	CONSTELLATION	8324	8324	4.	4.
NAVMACS	CONSTELLATION	8340	8340	2.	2.
NAVMACS	CONSTELLATION	9096	9096	1.	1.
NAVMACS	CONSTELLATION	9105	9109	2.	96.
NAVMACS	CONSTELLATION	9114	9114	2.	2.
NAVMACS	GUAM	8300	8331	40.	744.
NAVMACS	INDEPENDENCE	8335	8335	8.	8.
NAVMACS	INDEPENDENCE	8345	8345	2.	2.
NAVMACS	INDEPENDENCE	9044	9045	3.	24.
NAVMACS	KITTY HAWK	9008	9009	10.	24.
NAVMACS	LEAHY	8355	8355	0.	0.
NO REPAIR TIME FOR THE ABOVE RECORD					
NAVMACS	LUCE	8247	8247	2.	2.
NAVMACS	OKINAWA	8207	8270	10.	1512.
NAVMACS	OKINAWA	8266	8307	3.	984.
NAVMACS	RANGER	8334	8334	0.	0.
NO REPAIR TIME FOR THE ABOVE RECORD					
NAVMACS	SANTA BARBARA	8323	8323	0.	0.
NO REPAIR TIME FOR THE ABOVE RECORD					
NAVMACS	SANTA BARBARA	9004	9004	0.	0.
NO REPAIR TIME FOR THE ABOVE RECORD					
NAVMACS	SARATOGA	8233	8233	1.	1.
NAVMACS	SARATOGA	8236	8289	1.	1272.
NAVMACS	SARATOGA	9029	9029	3.	3.
NAVMACS	VULCAN	8265	8268	4.	72.
NAVMACS	VULCAN	8268	8271	4.	72.
NAVMACS	VULCAN	8275	8278	4.	72.

CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
 EXPONENTIAL PROBABILITY DISTRIBUTION FOR TIME TO REPAIR



CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL LOGNORMAL PROBABILITY DISTRIBUTION FOR TIME TO REPAIR



MAINTAINABILITY (REPAIR TIME)

REPAIR TIME	FREQUENCY	CUM FREQUENCY	NPF	LOGNORMAL	EXPONENTIAL	WEIBULL
1.0	3.	3.0	.143	.089	.166	.183
2.0	5.	8.0	.381	.284	.305	.324
3.0	3.	11.0	.524	.453	.420	.438
4.0	5.	16.0	.762	.581	.517	.532
8.0	1.	17.0	.810	.836	.766	.770
10.0	2.	19.0	.905	.890	.838	.837
40.0	1.	20.0	.952	.997	.999	.999

TOTAL REPAIR HOURS = 110.0 NUMBER OF REPAIRS = 20. OBSERVED REPAIR RATE/HR = .1818E+00

DISTRIBUTION DETERMINATION

MEAN OF LN#S = 1.20 STD DEV OF LN#S = .89

K-S CRITICAL VALUE (.10, 20.) = .174 MAX DIFF CALC = .181 IS GREATER THAN THE CRITICAL VALUE

THEREFORE THE LOGNORMAL DISTRIBUTION CANNOT BE ASSUMED

ORATIO OF 2.083 DOES NOT EXCEED THE CRITICAL VALUE FOR TEST OF EXPONENTIAL

THEREFORE THE EXPONENTIAL DISTRIBUTION IS ASSUMED

EST MEAN = 5.50 EST MEDIAN = 3.81 90 PER CENT LCL ON MEAN = 4.25 90 PER CENT UCL ON MEAN = 7.57
 SPECIFIED MTR = 2.00 HOURS LOWER CONF LIM 4.25 IS GREATER THAN MTR. THUS A MAINTAINABILITY PROBLEM EXISTS

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NAVAL WEAPONS SUPPORT CENTER CRANE IN
FLEET RELIABILITY ASSESSMENT PROGRAM. VOLUME 2B. EQUIPMENT REPO--ETC(U)
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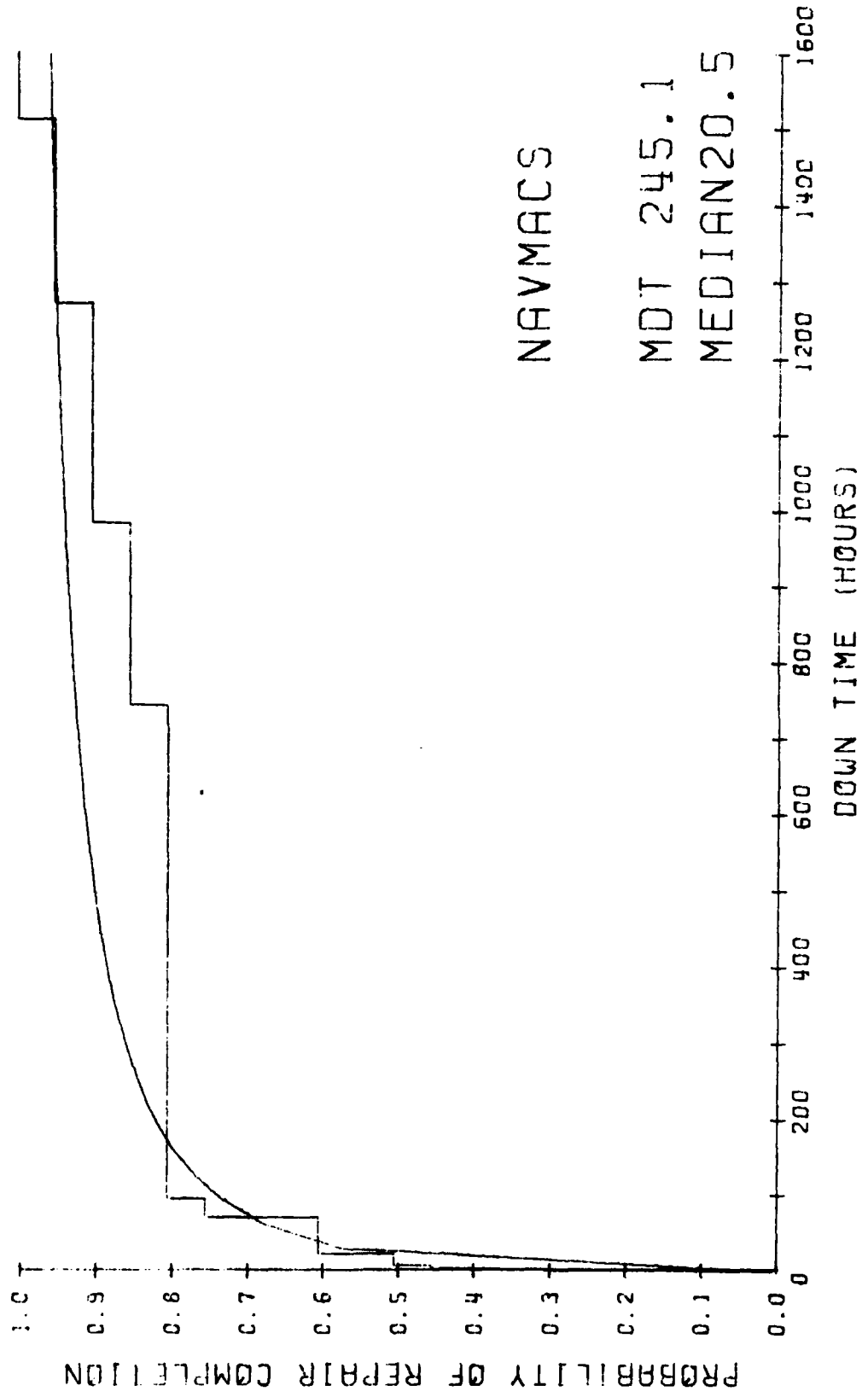
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CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL LOGNORMAL PROBABILITY DISTRIBUTION FOR DOWN TIME



NAVMACS

MDT 245.1

MEDIAN 20.5

MAINTAINABILITY (DOWN TIME)

DOWN TIME.	FREQUENCY	CUM FREQUENCY	NPF	LOGNORMAL	EXPONENTIAL	WEIBULL
1.0	2.	2.0	.095	.115	.004	.159
2.0	4.	6.0	.286	.177	.008	.205
3.0	1.	7.0	.333	.222	.012	.237
4.0	2.	9.0	.629	.258	.016	.262
8.0	1.	10.0	.476	.354	.032	.332
24.0	2.	12.0	.571	.525	.093	.469
72.0	3.	15.0	.714	.691	.255	.629
96.0	1.	16.0	.762	.730	.324	.672
744.0	1.	17.0	.810	.923	.952	.924
984.0	1.	18.0	.857	.938	.982	.944
1272.0	1.	19.0	.905	.949	.994	.959
1512.0	1.	20.0	.952	.956	.998	.968

TOTAL DOWN TIME (TDT) = 4901.0 NUMBER OF REPAIRS (NR) = 20. OBSERVED DOWN TIME/REPAIR (TDT/NR) = 245.05

DISTRIBUTION DETERMINATION

MEAN OF LN'S = 3.02 STD DEV OF LN'S = 2.52

K-S CRITICAL VALUE (.10, 20.) = .174 MAX DIFF CALC = .171 IS LESS THAN THE CRITICAL VALUE

THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

EST MEAN = 245.05 EST MEDIAN = 20.54 90 PER CENT LCL ON MEDIAN = 9.73 90 PER CENT UCL ON MEDIAN = 43.38

MAINTAINABILITY (REPAIR TIME)

NAVMACS WRA 14 LEVEL

LESS THAN FOUR DISTINCT REPAIR TIMES

THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

ONLY ONE DISTINCT REPAIR TIME -- NO CONFIDENCE LIMITS

MAINTAINABILITY (REPAIR TIME)

NAVMACS WRA 20 LEVEL

REPAIR TIME,	FREQUENCY	CUM FREQUENCY	NPF	LOGNORMAL	EXPONENTIAL	WEIBULL
1.0	1.	1.0	.333	.240	.166	.153
10.0	1.	2.0	.667	.760	.838	.840

TOTAL REPAIR HOURS = 11.0 NUMBER OF REPAIRS = 2. OBSERVED REPAIR RATE/HR = .1818E+00

DISTRIBUTION DETERMINATION

MEAN OF LNFS = 1.15 STD DEV OF LNFS = 1.63

LESS THAN FOUR DISTINCT REPAIR TIMES

THEFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

EST MEAN = 5.50 EST MEDIAN = 3.16 90 PER CENT LCL ON MEDIAN = .09 90 PER CENT UCL ON MEDIAN = 109.40

SPECIFIED MTTR = 2.00 HOURS LOWER CONF LIM .09 IS LESS THAN MTTR, THUS THE EQUIPMENT MEETS THE SPECIFICATIONS

MAINTAINABILITY (REPAIR TIME)

NAVMACS WRA 21 LEVEL

LESS THAN FOUR DISTINCT REPAIR TIMES

THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

ONLY ONE DISTINCT REPAIR TIME -- NO CONFIDENCE LIMITS

MAINTAINABILITY (REPAIR TIME)

REPAIR TIME,	FREQUENCY	CUM FREQUENCY	NPF	LOGNORMAL	EXPONENTIAL	WEIBULL
9.0	1.	1.0	.333	.240	.420	.153
8.0	1.	2.0	.667	.760	.766	.840

TOTAL REPAIR HOURS = 11.0 NUMBER OF REPAIRS = 2. OBSERVED REPAIR RATE/HR = .1818E+00

DISTRIBUTION DETERMINATION

MEAN OF LN'S = 1.59 STD DEV OF LN'S = .69

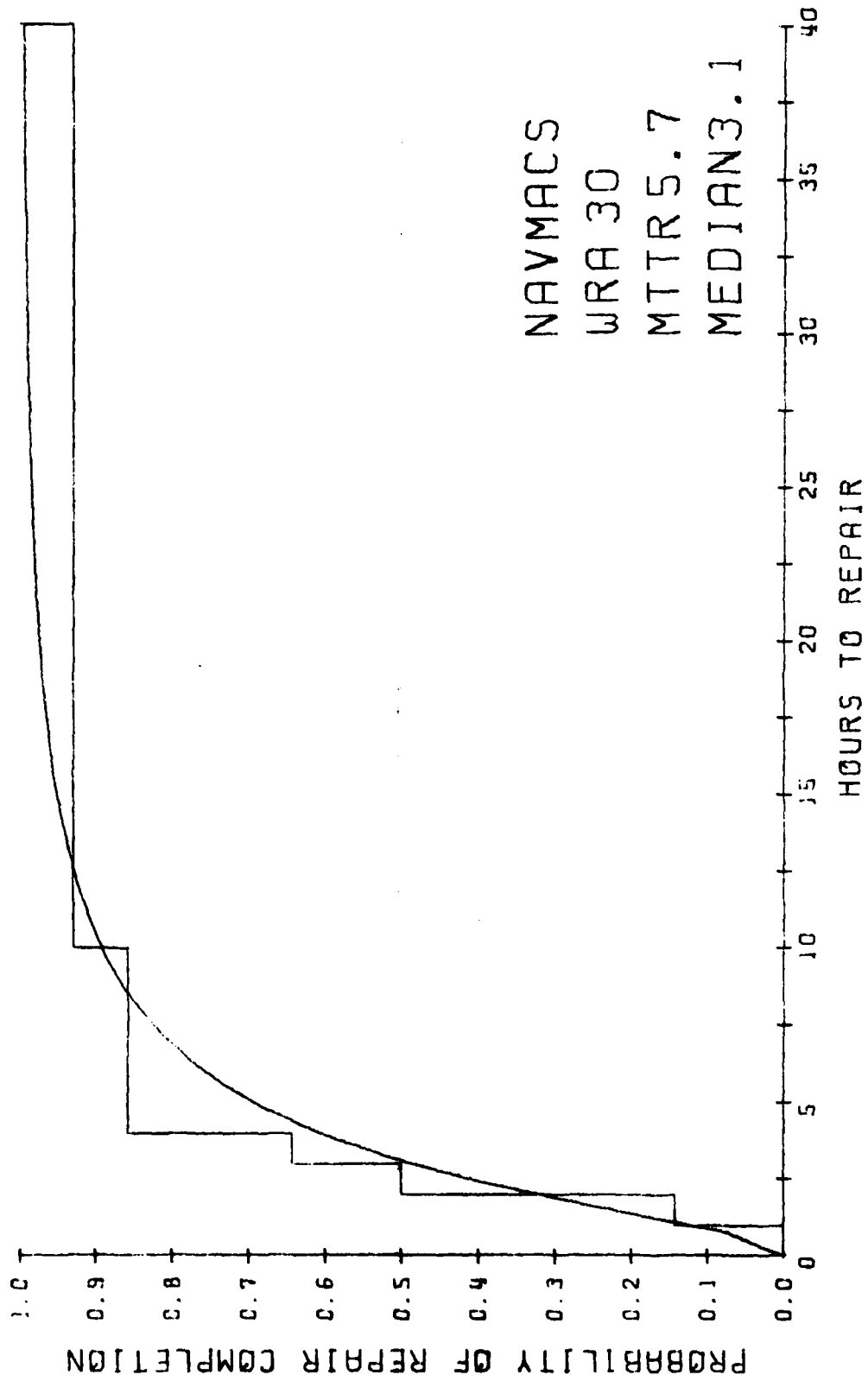
LESS THAN FOUR DISTINCT REPAIR TIMES

THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

EST MEAN = 5.50 EST MEDIAN = 4.90 90 PER CENT LCL ON MEDIAN = 1.08 90 PER CENT UCL ON MEDIAN = 22.17

SPECIFIED MTR = 2.00 HOURS LOWER CONF LIM 1.08 IS LESS THAN MTR. THUS THE EQUIPMENT MEETS THE SPECIFICATIONS

CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
 LOGNORMAL PROBABILITY DISTRIBUTION FOR TIME TO REPAIR



MAINTAINABILITY (REPAIR TIME)

NAVMACS WRA 30 LEVEL

REPAIR TIME	FREQUENCY	CUM FREQUENCY	NPF	LOGNORMAL	EXPONENTIAL	WEIBULL
1.0	2.	2.0	.133	.116	.161	.215
2.0	5.	7.0	.467	.322	.295	.357
3.0	2.	9.0	.600	.487	.408	.465
4.0	3.	12.0	.800	.607	.503	.552
10.0	1.	13.0	.867	.893	.826	.830
40.0	1.	14.0	.933	.997	.999	.997

TOTAL REPAIR HOURS = 80.0 NUMBER OF REPAIRS = 14. OBSERVED REPAIR RATE/HR = .1750E+00

DISTRIBUTION DETERMINATION

MEAN OF LN#S = 1.13 STD DEV OF LN#S = .95

K-S CRITICAL VALUE (.10, 14.) = .207 MAX DIFF CALC = .193 IS LESS THAN THE CRITICAL VALUE

THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

EST MEAN = 5.71 EST MEDIAN = 3.09 90 PER CENT LCL ON MEDIAN = 2.20 90 PER CENT UCL ON MEDIAN = 4.35

SPECIFIED MTR = 2.00 HOURS LOWER CONF LIM 2.20 IS GREATER THAN MTR, THUS A MAINTAINABILITY PROBLEM EXISTS

MAINTAINABILITY (REPAIR TIME)

NAVMACS O-LEVEL SUMMARY

WRA	O-LEVEL BLOCK NO.	O-LEVEL NOMENCLATURE	NUMBER REPAIRS	LOWER 90 CONF LIM	UPPER 90 CONF LIM	SPEC MTR	OBSERVED REPAIR TIMES LOW MEAN HIGH	MAINT PROBLEM
14	21	ARITHMETIC LOGIC UNIT	1.	NO CONF LIMITS		2.0	4.0 4.00 4.0	
20	10	TRANSMIT DELAY	1.	NO CONF LIMITS		2.0	10.0 10.00 10.0	
20	14	INTERFACE	1.	NO CONF LIMITS		2.0	1.0 1.00 1.0	
21	13	CONTROL PANEL ASSY	1.	NO CONF LIMITS		2.0	4.0 4.00 4.0	
25	99		2.	1.08	22.17	2.0	3.0 5.50 8.0	NO
30	99		15.	2.06	4.00	2.0	1.0 5.40 40.0	YES

MAINTAINABILITY (REPAIR TIME)

2K SUMMARY FOR NAVMACS		PROBLEM AREAS		
JCN	WRA	O-L	O-L	WHAT HAPPENED
33640E01M309	30	999	0	ETM LIFTED FM SN 5186/EK
33640E01M385	30	999	0	ETM EST BASED ON SN 1031/1099/EK
33640E01M387	30	999	0	ESTIMATED ETM
33640E012894	30	999	0	CORRECTED ETM
33640E012900	30	999	0	CHG. WDD
33640E012907	30	999	0	EST. ETM
71780E014072	30	999	0	MECHANICAL TBLs TT-624
200090E021823	30	999	0	EST ETM; TEMP. FIX
33620E018694	30	999	0	ONE PRINTER FAILED
33630E01M596	30	999	0	CHG 1161 ETM
522320E011231	30	999	0	CORRECTED BLK 115
73510E015572	30	999	0	ETM CALC ON SN 5164/1047/EK
33610E021636	30	999	0	PAPER TYPE CHANGED
201110E012237	30	999	0	ESTIMATED ETM
201110E012566	30	999	0	REPLACED PCC
33600E02E699	30	999	0	PART BROKE
33600E02	30	999	0	BROKEN WIRE IN CABLE CAUSED FAILURE
33600E02E782	30	999	0	///CHECK BLK 17 vvvvvv///EK//3/12/79
880867A 0721	30	999	0	/EK

