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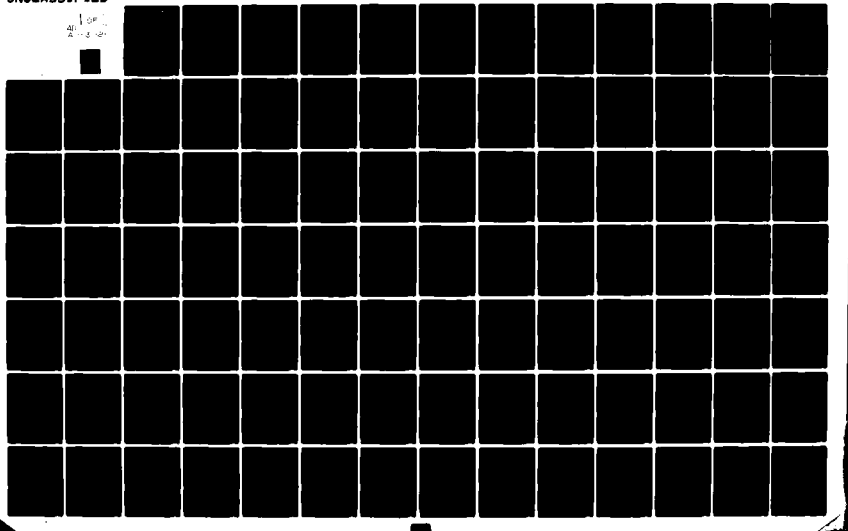

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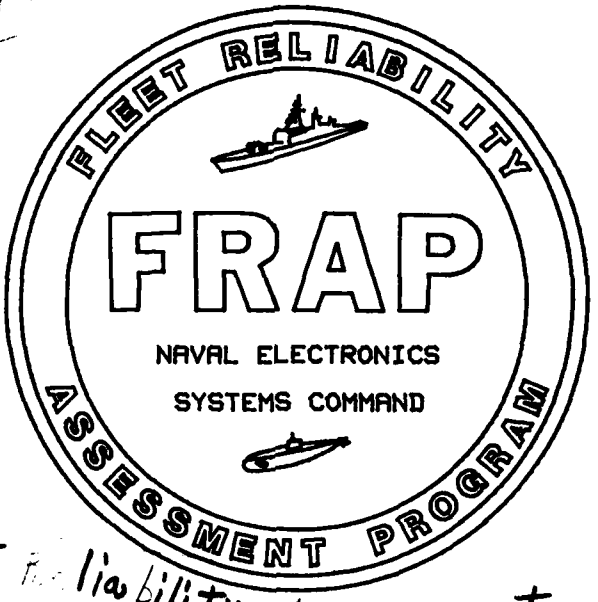

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EQUIPMENT REPORT

CATCC-DAIR.

NAVAL WEAPONS SUPPORT CENTER
CRANE, INDIANA

Published by the direction of Commander Naval Electronics Syeteme Command

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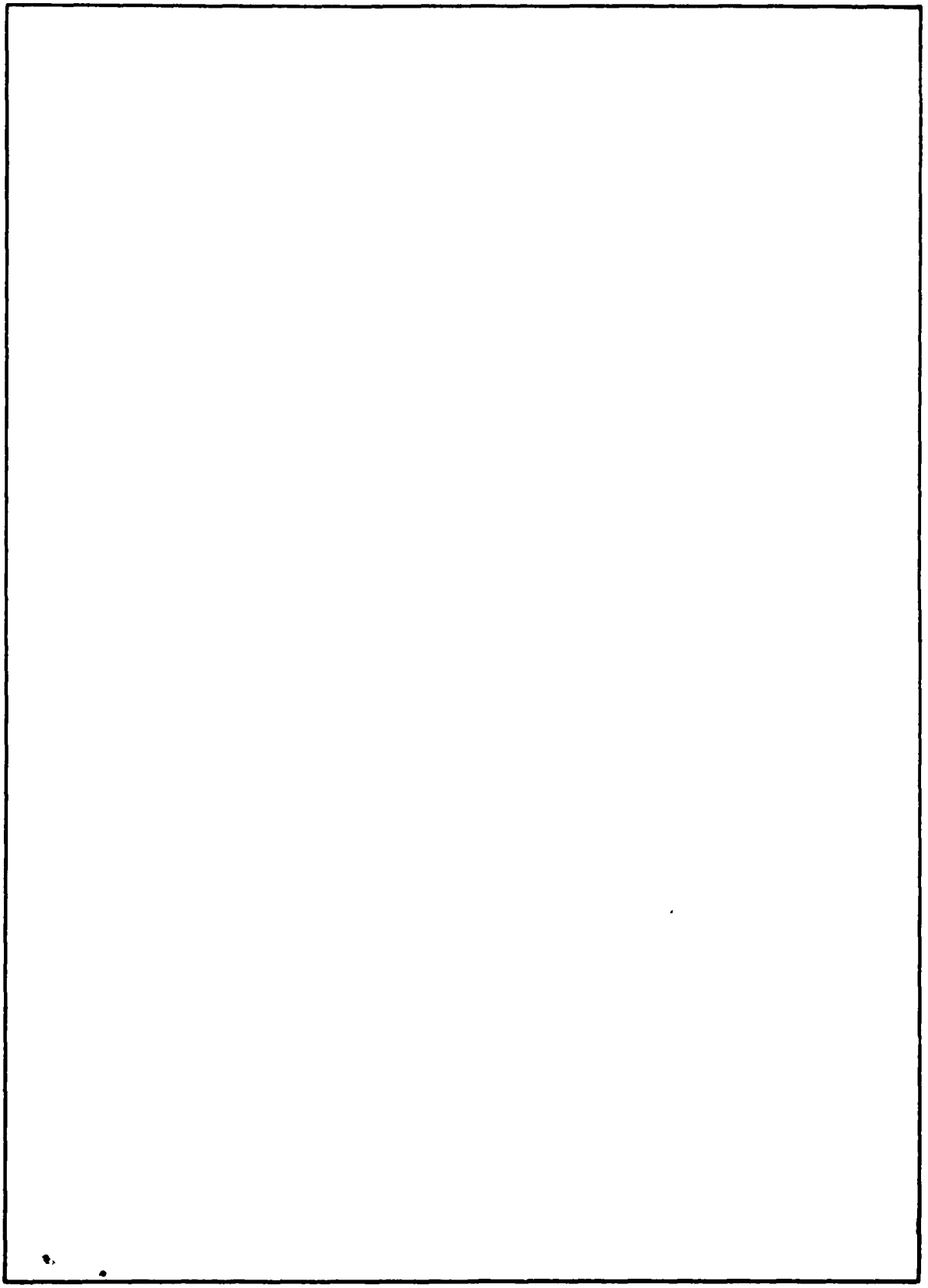

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A	0
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DEPARTMENT OF THE NAVY

NAVAL ELECTRONICS SYSTEMS COMMAND

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RECORD OF CHANGES

CHANGE NO.	DATE	TITLE OR BRIEF DESCRIPTION	ENTERED BY

VOLUME 2A CATCC-DAIR

EQUIPMENT REPORT

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VOLUME 2 CATCC-DAIR EQUIPMENT REPORT

SECTION I - RESULTS

1-1 RESULTS SUMMARY

Between August 1978 and May 1979 FRAP collected data on the AN/TPX-42A(V)8 CATCC-DAIR systems installed aboard the USS INDEPENDENCE, USS KITTY HAWK, and the USS RANGER. The results of the analysis of the data are summarized in Table 1-1.

1-1.1 SUMMARY OF HARDWARE PROBLEMS

Most of the failures (7 out of 11) occurred in WRA 19, the Control Group PPI Console, OD-146, of which 5 are used in the CATCC-DAIR system. Most of these failures (3 out of 7) were O-level 19002, the Deflection Amplifier. Table 1-2 summarizes the WRA and O-levels reported as failed. Identification WRA and O-levels are as follows:

WRA 11	Signal Processor CN-1506
WRA 13	A-D Converter CV-3477
WRA 16	Cartridge Mag Tape Unit AN/USH-26(v)
WRA 18	Alphanumeric Digital Display AN/USQ-69
WRA 19	Indicator Control Group OD-146
19002	Deflection Amplifier
19008	Interface and Logic
19009	Video Amplifier
19016	Panel (Right Side)

(O-level 099 indicates the O-level failed could not be identified from the available information)

1-1.2 SOFTWARE PROBLEMS

CATCC-DAIR is currently recovering from very severe problems with the software used in the Tracking and Display computer. The software in use during the FRAP study period is an interim release which will be replaced by a "fourth generation" software package currently under development.

1-1.3 RECOMMENDATIONS

a. It is recommended that ECPs and retrofits be developed to improve the reliability performance of the Control Group Console, OD-146, with emphasis on the Deflection Amplifier and Power Supply.

b. It is recommended that the "Human Engineered" keyboards be replaced with standard typewriter or teletype style keyboards.

c. It is also recommended that consideration be given to converting the AN/UYK-20(V) to use Concurrent Pascal, a new high-level programming language.

d. It is recommended that the feasibility of converting CATCC-DAIR software to Pascal be investigated.

LEGEND

1. All Data = All Collected Data (Failures/Maintenance Actions)**
2. EQUIP = EQUIPMENT **
3. PARTS = PARTS REPLACEMENT **
4. EXP = EXPONENTIAL
5. LN = LOGNORMAL

TABLE 1-1. DATA SUMMARY FOR CATCC-DAIR.

PARAMETER	All Data	EQUIP	PARTS
OPERATIONAL			
Calendar Hours	11,616	11,616	11,616
Operating Hours	5073	5073	5073
Duty Cycle	0.437	0.437	0.437
Sample Size	2*	2*	2*
RELIABILITY			
Number of Failures	12	10	9
Time Between Failures-Mean	661	971	1304
Time Between Failures-Median	111	126	111
Distribution	WEIBULL	WEIBULL	WEIBULL
MAINTAINABILITY			
Total Repair Time	126	110	110
Number of Repairs	7	6	8
Time to Repair-Mean	18	18.3	17.5
Time to Repair-Median	5.3	4.4	4.6
Distribution	LN	LN	LN
Total Down Time	1132	772	783
Repairs (or Maint. Act.)	7	6	8
Down Time-Mean	162	129	102
Down Time-Median	112	89	46
Distribution	EXP	EXP	WEIBULL
AVAILABILITY			
Inherent	0.9734	0.9815	0.9868
Observed-Mean	---	0.525	---
Observed-Median	---	0.577	---
Effective	0.9996	---	---

*CATCC-DAIR SUMMARY Does Not Include USS INDEPENDENCE Data.

** Reference Volume 1, Paragraph 3-4, and Volume 2A, Paragraph 7-2

NOTE: All Time Units Are in Hours

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

			NUMBER OF FAILURES REPORTED			
WRA	O-LEVEL	DESCRIPTION (NAME)	by 4790/2K	by CASREPT	in WRA	in O-LEVEL
11		SIG. PROC. CN-1506/TPX				
	099	---	1		1	1
13		A/D CONVTR CV-4377/TPX				
	007	POWER SUPPLY		/1	1	1
16		MAG TAPE DRV AN/USH-26				
	099	---	1		1	1
18		DISPLAY AN/USQ-69				
	003	CRT DRIVER ELECTRONICS	1		1	1
19		CONTROL GROUP OD-146	6	1/	7	
	002	DEFLECTION AMPLIFIER	/3			3
	008	INTERFACE AND LOGIC	/1			1
	009	VIDEO AMPLIFIER	/1			1
	016	PANEL (RIGHT SIDE)	/1			1
	099	---		/1		1
TOTAL			9	/2	11	11

SECTION II - SYSTEM DESCRIPTION

2-1 GENERAL

The Carrier Air Traffic Control Center Direct Altitude and Identity Readout (CATCC-DAIR) System consists of a programmable Interrogator Set AN/TPX-42A(V)8 in which the hardwired Indicator Data Processor of the AN/TPX-42A(V)5 has been replaced by an electronic digital mini-computer, the AN/UYK-20(V). To enhance reliability, a second AN/UYK-20(V) may be installed in a parallel redundant scheme. All systems in the FRAP study were so configured.

CATCC-DAIR provides five consoles consisting of OD-58/T Plan Position Indicators (PPI) modified to display alphanumeric information. To each of these has been added a keyboard to allow control of the AN/UYK-20(V) Tracking and Display Processor (TDP) Computer, and an Indicator Control box. One console, designated the supervisory position, has an additional System Control box attached. The TDP Computer(s) are normally located remotely from the consoles and are rack mounted with the radar video processor and other such ancillary and interface equipment as required to interface to the NTDS and ACLS systems and the shipboard radars.

The older AN/TPX-42A(V)5 is installed at Navy and Marine Corps air stations. The (V)8 version, CATCC-DAIR, is essentially the (V)5 system hardware with minor changes (primarily to the power supplies) to allow operation from ship's power and to provide interface into existing ship's radar and data system. The TDP computer with its software provides the operational features that distinguish the (V)8 version from the less capable (V)5 system.

2-2 MISSION

CATCC-DAIR is used to identify and coordinate aircraft operating within a fifty mile radius of the aircraft carrier on which it is installed. In addition to a conventional radar display, CATCC-DAIR provides altitude and identity readouts on all transponder equipped aircraft, both civilian and military, in that 50 mile radius. In addition a number of software features are provided to support flight operations. CATCC-DAIR is normally operational at all times while the ship is underway. This system is essential to the safety and combat readiness of the ship on which it is installed.

2-3 EQUIPMENT DESCRIPTION

The CATCC-DAIR system is a shipboard configuration of the AN/TPX-42A(V)5 currently used at all Naval and Marine Air Station RATCCs (Radar Air Traffic Control Centers). Though similar in appearance, CATCC-DAIR uses a programmable TDP(Tracking and Display Processor), which replaces the hardwired indicator data processor in the AN/TPX-42A(V)5. The TDP consists of (a) two AN/UYK-20 data processing sets, (b) a keyboard for communications with the computers, (c) an OD-58/T indicator modified for display of alphanumeric data, (d) a radar video processor, (e)

various ancillary computer equipment, and (f) the required interface hardware that will permit the system to function and be compatible with shipboard radars, and interface with NTDS (Naval Tactical Data System) and ACLS (Automatic Carrier Landing System).

The system is designed for dual-channel processing (one channel active and the other in hot standby), and has the capability to switch channels, if a failure occurs, without loss of data or interruption to operations. The CATCC-DAIR system consists of the following major units:

a. Data Processing Group OL-201

(1) [WRA 10] Interference Blanker MX-8757/UPX. Eliminates non-synchronous signals, sometimes referred to as "fruit", and sends "defruited" video to the signal processor.

(2) [WRA 13] Analog-to-Digital Converter CV-3477. Accepts single speed synchro (antenna shaft) inputs and outputs two signals, the ARP (Azimuth Reference Pulse) and the ACP (Azimuth Change Pulse). Three units provide ACP/ARPs for two radars, with the extra unit on standby.

(3) [WRA 11] Signal Processor CN-1506. Re-formats the video and mode tags received from either the AN/UPX-233 or the AN/UPX-27 into video and mode sensitive triggers.

(4) Video Signal Processor CP-1310. Generates a signal report message, one per antenna scan, for each transponder equipped aircraft within a selected range. After it is properly formatted, the output message is transmitted to the data processor shortly after the beam of the antenna has passed the position of the aircraft. An extra CP-1310 is provided for dual-channel capability.

(5) Radar Target Data Processor CP-1319. Detects the primary radar normal video, triggers, and azimuth data and develops a signal digital report for each aircraft on each antenna scan. The radar target data processor transfers the messages to the tracking display processor.

b. Conversion-Switching Group OU-131

(1) [WRA 15] Signal Data Converter CV-3476. Has dual channels "A" and "B", one active and one in hot standby, which transfer data between the AN/UYK-20(V) data processing set, keyset control, ACLS, NTDS, CP-1319 and ADD (Alphanumeric Digital Display) utilizing the relay switching assembly. Acts as the AN/UYK-20(V) device controller for video signal processors data, the analog-to-digital converter ACP data and PEM (Position Encoding Module) lines.

(2) [WRA 14] Data Processing Set AN/UYK-20(V). A programmable mini-computer used as the display processor. Two AN/UYK-20(V)s are installed for dual channel capability.

(3) [WRA 17] Data Signal Switching Unit SA-2164. Interconnects the Keyset Central, ACLS, NTDS, Operator Consoles, CP-1319, and AN/UYK-20(V) data processing sets when switching to the standby channel.

(4) [WRA 16] CMTU (Cartridge Magnetic Tape Unit) AN/USH-26(V). Provides for data storage and program loading. Interfaces with the AN/UYK-20(V) data processing sets. It is a self-contained tape storage system consisting of tape drives, power supplies, and a built-in maintenance test panel.

c. [WRA 19] Indicator Control Group OD-146 (5 used in CATCC-DAIR). A modified AN/TPX-42A(V)5 OD-58/T Indicator Group with the following additions:

(1) Keyboard Controller KY-844. Accepts user inputs from a "Human Engineered" keyboard or a joystick style analog positioner and formats them for the AN/UYK-20(V) data processing sets.

(2) Indicator Control C-10330. Provides for selection of interrogation modes, visual system status indication, and display of symbology and alphanumerics. Audio and visual alarms are provided for detected emergency, lost communication, and hijack beacon returns.

(4) Indicator Set Control C-10329 (One only, placed on the console designated as the Supervisor's Console). Provides for range selection of radar and gives visual indication of the type of radar in use, alarm conditions, and channel in use.

(5) Interrogator Set AN/UPX-23 or AN/UPX-27. Challenges Mark XII IFF/SIF (Identification Friend or Foe/Selective Identification Feature) transponder sets and re-structures the replies into video signals for decoders and indicators.

d. Ancillary Equipment

(1) [WRA 18] Alphanumeric Digital Display (ADD) AN/USQ-69. A computer terminal located in the equipment spaces (near the TDP) to assist technicians in maintenance actions.

SECTION III - SPECIFICATIONS

The specification for the AN/TPX-42A(V)8 is ELEX-I-198 dated 21 October 1974. The following specification requirements were taken from this document.

3-1 RELIABILITY

CATCC-DAIR is specified to have a greater than 700 hour equipment MTBF ($Theta_0$ as defined by MIL-STD-781) per paragraph 3.5.11.1 of ELEX-I-198.

3-2 MAINTAINABILITY

CATCC-DAIR is specified to have an average repair time of not more than 0.75 hours and shall have a maximum repair time not greater than 1.5 hours at the 90% confidence limit per paragraph 3.5.12.1 of ELEX-I-198. The AN/UYK-20(V) is maintained by replacement of printed circuit cards,

most of which are throw-aways (the memory arrays being an exception). The TDP computer has its own diagnostic routines to aid fault isolation. The remainder of the system is maintained by piece-part replacement on-site. Since the users have access to a sophisticated electronics repair shop on board, no intermediate level or depot level maintenance is defined.

SECTION IV - PROBLEMS

4-1 ADDITIONAL HARDWARE PROBLEMS

An operational problem has been identified concerning the modified OD-58 console. Strong negative comment has been received from the Fleet about the "Human Engineered" keyboard used. This keyboard starts with "A" in the upper left corner and proceeds across in "ABC" order. The keys are so placed that touch typing is impossible. Whereas any teletype machine or typewriter can serve as a training aid for a typewriter style keyboard (in fact, many people can already touch type), the CATCC DAIR operators can practice only on a system keyboard.

There is also the safety aspect to be considered. The Federal Aviation Administration has standardized on the "ABC" style keyboards for use in civilian air traffic control centers. The situation there bears little resemblance to the operational profile of a Fleet carrier air traffic control center (CATCC). For one thing, civilians do not have to deal with hostile intruders into their air space. For another, civilian air traffic is required to have both an alternate destination and sufficient fuel on board to get there. CATCC traffic has no alternative to carrier landing except ditching at sea. Plus, CATCC aircraft may arrive back from a mission with battle damage and be very low on fuel. These factors make it manditory that the human-machine interface on CATCC DAIR be as natural, rapid and error free as possible. Fleet users feel the "ABC" style keyboard obstructs this rapid interchange because operators must "hunt and peck" to use it.

A related problem outside the FRAP study scope is reported here without comment or recommendation: Several reports have been received from Fleet users concerning the intercom system used with CATCC DAIR. The additional coordination necessary to compensate for the interim software's problems reportedly has overloaded the intercom system. One report also observed that the system did not withstand shipboard wear and tear well.

4-2 SOFTWARE PROBLEMS

CATCC DAIR has been roundly criticized for its software problems. Practically everything new in the AN/TPX-42A(V)8 is software or software related (like the AN/UYK-20(V)) so software problems should have been expected. To be sure, the Fleet did not like the marginally acceptable interim software. It is an unpleasant fact of life that, at this stage in the software art, a hardware design is more likely to shakedown and work correctly quicker than a software design of similar complexity. After comparison with similar software efforts, one must conclude that CATCC DAIR's software development is noteable neither for its success

nor its lack of success. In short, it reflects the common industrial experience with software.

This is not to indicate that such experiences are not frustrating, costly and thoroughly unpleasant. Both Industry and the Department of Defense (DOD) are painfully aware of the cost of software problems in terms of dollars lost and schedules slipped. Even with the contractual muscle of DOD and a three billion dollar yearly volume, DOD has not succeeded in lowering the average error rate for delivered and tested software below one error in every 300 statements. In other words, a computer running unlooped code would run less than one second without encountering a mistake.

The situation is so serious that both DOD and Industrial software developers are actively seeking solutions. DOD has announced a "Software Quality Initiative" to be launched this summer from the Under Secretary of Defense level. Both Industry and DOD are preparing to alter the way the software art is practiced in America.

SECTION V - CORRECTIVE ACTIONS

5-1 HARDWARE CORRECTIVE ACTIONS

It is recommended that the "Human Engineered" keyboard used on CATCC DAIR be replaced by a standard typewriter or teletype style keyboard. The joystick function has been successfully replaced in many microcomputer applications by the arrowed keys on a standard ASCII keyboard. However, Fleet comments on the joystick have been mixed and retaining it may have some merit.

5-2 SOFTWARE CORRECTIVE ACTIONS

Followup discussions with the USS KITTY HAWK indicate that effective solutions to CATCC DAIR's software problems are being found. It is reported that these are being integrated into the Release IV software package, which should solve most Release III problems.

It is recommended that consideration be given to converting the AN/UYK-20(V) to run Pascal, either by obtaining a Pascal compiler or altering the microprogramming or both. It is further recommended that the feasibility of converting CATCC DAIR software to Pascal be investigated. Published industrial cost comparisons indicate that the cost savings in maintainability will be significant. Further, a DOD wide shift to Pascal appears to be certain. Being among the first to shift to Pascal could well counter some of the criticism leveled at this developmental effort.

It is noted that AIL has enlisted the aid of Boeing Computer Services in the CATCC DAIR effort. Boeing is a licensee of UCSD Pascal. It is likely that Pascal is being used in developing Release IV and source code in that language may be obtainable via a contractual modification at modest cost. In any case, Sperry Univac has also shifted its minicomputer operations to Pascal as a cost control measure. It is likely that their inhouse support tools for the AN/UYK-20(V) will be

likewise converted to Pascal and that a Pascal compiler for the AN/UYK-20(V) already exists at Sperry.

It is recommended that NAVELEX assume the initiative in the creation of a software problem reporting system comparable to that already in existence for hardware. It is probable that the most effective way to do this would be as an extension of the existing 3-M system. Since NAVELEX has a vital need for software problem information, an active role in creating the mechanism to obtain that information does not seem inapproriate.

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.

The CATCC-DAIR system reliability model is represented in Figure 6-1a through Figure 6-1c. The model illustrates the redundant features of the system and the alternate modes of operation.

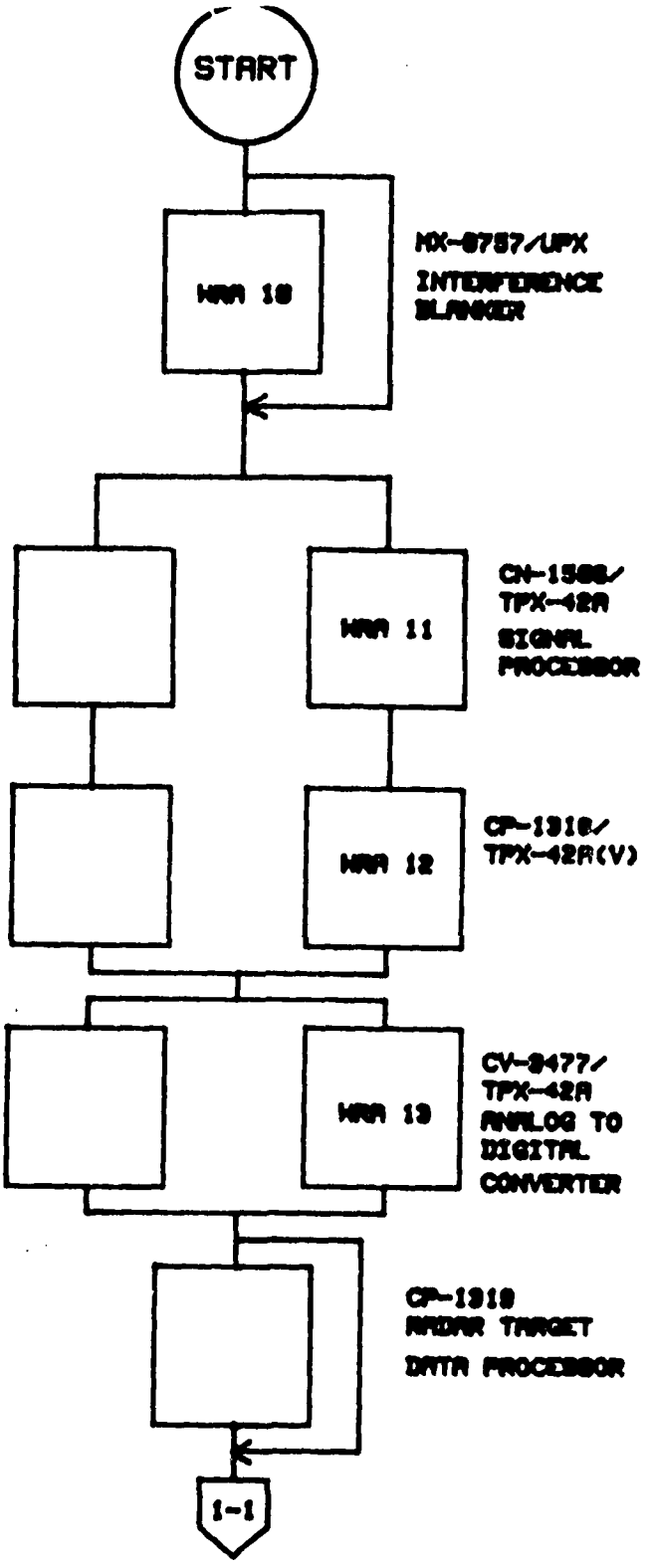


FIGURE 6-1a
SYSTEM/WRA-Level Block Diagram
for CATCC-DAIR (AN/TPX-42A(V)8)

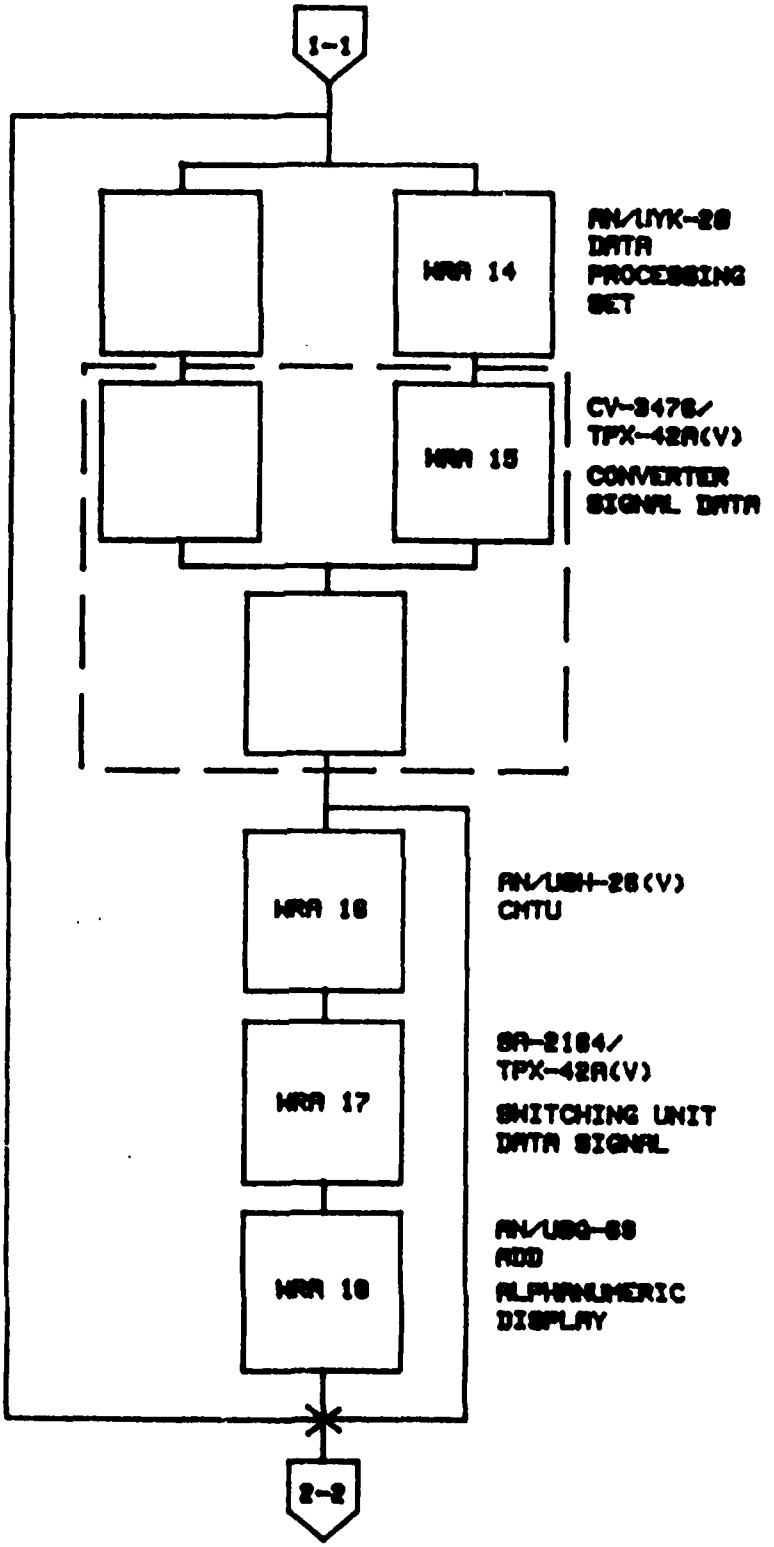


FIGURE 6-1b

CATCC-DAIR SYSTEM Block Diagram (Continued)

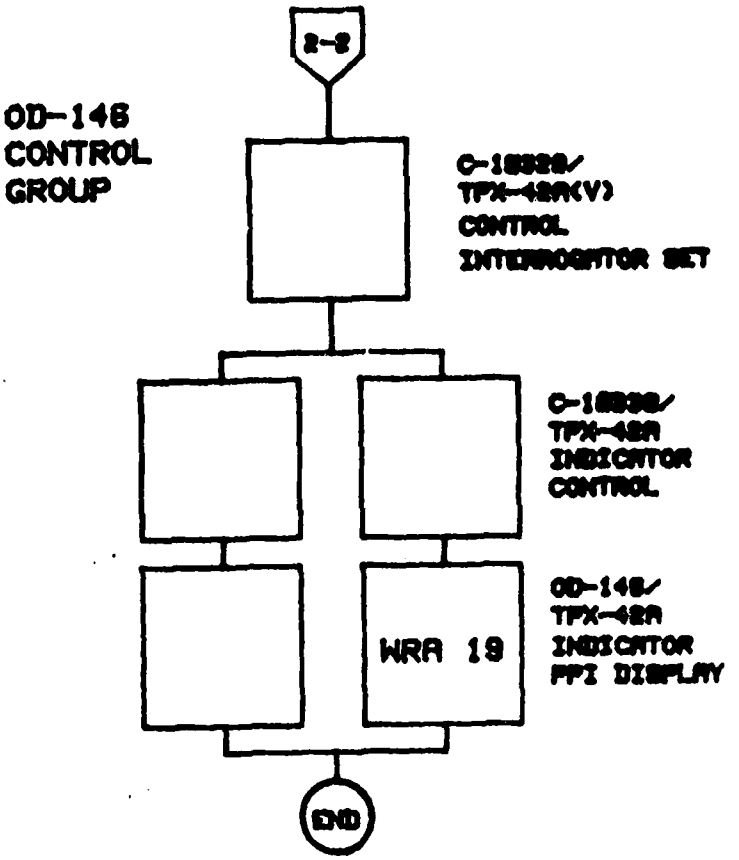


FIGURE 6-1c
CATCC-DAIR SYSTEM Block Diagram (Continued)

SECTION VII - ANALYSIS

7-1 SOFTWARE ANALYSIS

No mechanism exists for the collection of software reliability information. The existing 2 Kilo mechanism does not cover software and despite specifically asking for software problem data, no 2K forms on software were received. This necessitated visits by FRAP personnel to Fleet platforms during the study period, something FRAP would like to avoid since it compromises FRAP's commitment to minimal intrusion into Fleet operations. Even so, the information obtained is subjective in nature and does not lend itself to numerical analysis.

Only a few general observations are possible. At the beginning of the FRAP study, software problems were very severe. As the study progressed, the situation improved. The last contact with the USS KITTYHAWK was in marked contrast to earlier discussions. It was clear that they were pleased with the capabilities CATCC DAIR gave them and that they were eagerly awaiting the delivery of the "Vector Map" upgrade to the TDP software package.

7-2 HARDWARE ANALYSIS

The data analysis for CATCC-DAIR is presented in 4 sub-sections, as follows:

(1) All Data. All of the collected data from the participating platforms is selected for analysis. The reliability analysis is conducted on all failures or maintenance actions without consideration of system capability loss. No maintainability or availability analysis is performed.

(2) All Data, except USS INDEPENDENCE. All of the collected data from the USS RANGER and the USS KITTYHAWK is selected for analysis. A maintainability analysis is performed using active repair time as reported on the 2K form.

(3) Equipment Analysis. Data from the USS RANGER and the USS KITTYHAWK is selected to meet the condition of a hardware or a software failure. The reliability analysis is conducted on this data set. The maintainability analysis uses repair time as reported on the 2K form. The availability analysis uses equipment reliability and repair time in hours.

(4) Parts Replacement. Data from the USS RANGER and the USS KITTYHAWK is selected to meet the condition of requiring a parts replacement. The reliability analysis is performed on this data set. A maintainability analysis is performed using ships force repair man-hours from the 2K form.

SUB-SECTION (1)

CATCC-DAIR

ALL DATA

FLEET RELIABILITY ASSESSMENT DATA

SYSTEM	SHIPNAME	DATE	ETM	FAILURE TYPE	OPERATE	FAILURE TIME	DUTY	WRA	OL1	OL2	OL3
CATCC DAIR	INDEPENDENCE	8206	1458.	INITIAL	0.	0.	0.000	0	0	0	0
CATCC DAIR	INDEPENDENCE	8303	3840.	CENSORED	2382.	2382.	1.023	0	0	0	0
CATCC DAIR	INDEPENDENCE	8334	3858.	CENSORED	2400.	2400.	.781	0	0	0	0
CATCC DAIR	INDEPENDENCE	9001	3902.	CENSORED	2444.	2444.	.636	0	0	0	0
CATCC DAIR	INDEPENDENCE	9031	3902.	CENSORED	2444.	2444.	.536	0	0	0	0
CATCC DAIR	INDEPENDENCE	9062	4366.	CENSORED	2908.	2908.	.548	0	0	0	0
CATCC DAIR	INDEPENDENCE	9091	4778.	FAILURE	3320.	3320.	.553	0	0	0	0
NO INITIAL RECORD-FIRST RECORD USED											
CATCC DAIR	KITTY HAWK	8288	2650.	FAILURE	0.	0.	0.000	14	39	0	0
CATCC DAIR	KITTY HAWK	8321	2658.	INITIAL	0.	0.	0.000	0	0	0	0
CATCC DAIR	KITTY HAWK	8321	2686.	FAILURE	28.	28.	0.000	19	0	0	0
CATCC DAIR	KITTY HAWK	8321	2688.	FAILURE	30.	2.	0.000	11	99	0	0
CATCC DAIR	KITTY HAWK	8348	2794.	FAILURE	136.	106.	.210	18	3	0	0
CATCC DAIR	KITTY HAWK	9010	3104.	FAILURE	446.	310.	.344	0	0	0	0
CATCC DAIR	KITTY HAWK	9011	3125.	FAILURE	467.	21.	.354	0	0	0	0
CATCC DAIR	KITTY HAWK	9029	3293.	FAILURE	635.	168.	.362	16	99	0	0
CATCC DAIR	KITTY HAWK	9135	4085.	FINAL	1427.	792.	.332	0	0	0	0
CATCC DAIR	RANGER	8164	1904.	INITIAL	0.	0.	0.000	0	0	0	0
CATCC DAIR	RANGER	8256	2455.	CENSORED	551.	551.	.250	0	0	0	0
CATCC DAIR	RANGER	8278	2702.	CENSORED	798.	798.	.292	0	0	0	0
CATCC DAIR	RANGER	8307	3386.	FAILURE	1482.	1482.	.432	19	2	0	0
CATCC DAIR	RANGER	8334	4163.	CENSORED	2259.	777.	.554	0	0	0	0
CATCC DAIR	RANGER	8363	4519.	CENSORED	2615.	1133.	.548	0	0	0	0
CATCC DAIR	RANGER	9049	5035.	FAILURE	3131.	1649.	.522	19	9	0	0
CATCC DAIR	RANGER	9058	5230.	FAILURE	3326.	195.	.535	19	16	0	0
CATCC DAIR	RANGER	9074	5514.	FAILURE	3610.	284.	.547	19	2	0	0
CATCC DAIR	RANGER	9080	5514.	FAILURE	3610.	0.	.535	19	8	0	0
CATCC DAIR	RANGER	9104	5550.	FAILURE	3646.	36.	.498	19	2	0	0

R E L I A B I L I T Y

CATCC DAIRSYSTEM LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED	SURVIVORS	NPD	EXPONENTIAL	WEIBULL
100.	.0	1.		14.	.067	.000	.004
100.	2.0	1.		13.	.133	.003	.106
100.	21.0	1.		12.	.200	.032	.263
100.	28.0	1.		11.	.267	.042	.291
98.	36.0	1.		10.	.333	.054	.318
100.	106.0	1.		9.	.400	.151	.455
100.	168.0	1.		8.	.467	.229	.523
100.	195.0	1.		7.	.533	.261	.544
100.	284.0	1.		6.	.600	.356	.602
100.	310.0	1.		5.	.667	.381	.616
	792.0		1.				
100.	1482.0	1.		3.	.750	.899	.844
100.	1649.0	1.		2.	.833	.922	.857
100.	3320.0	1.		1.	.917	.994	.927

EQUIPMENT OPERATING HOURS (O.H.) = 8393.0 CALENDAR HOURS(C.H.) = 17616.0 DUTY CYCLE (O.H./C.H.) = .476

NUMBER OF FAILURES = 13. OBSERVED FAILURE RATE/O.H. = .15489E-02

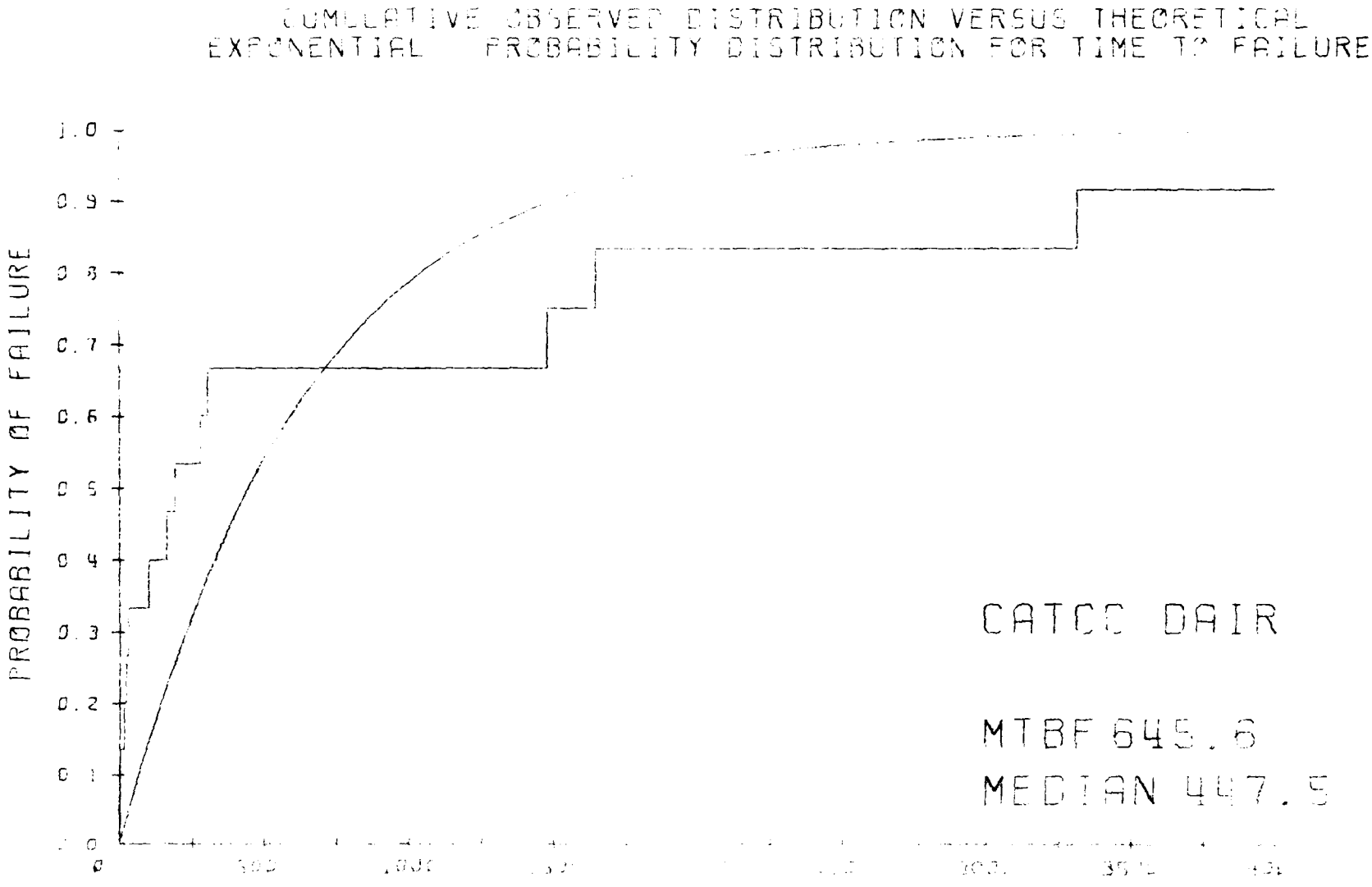
QRATIO OF 4.461 EXCEEDS THE CRITICAL VALUE FOR TEST OF EXPONENTIAL

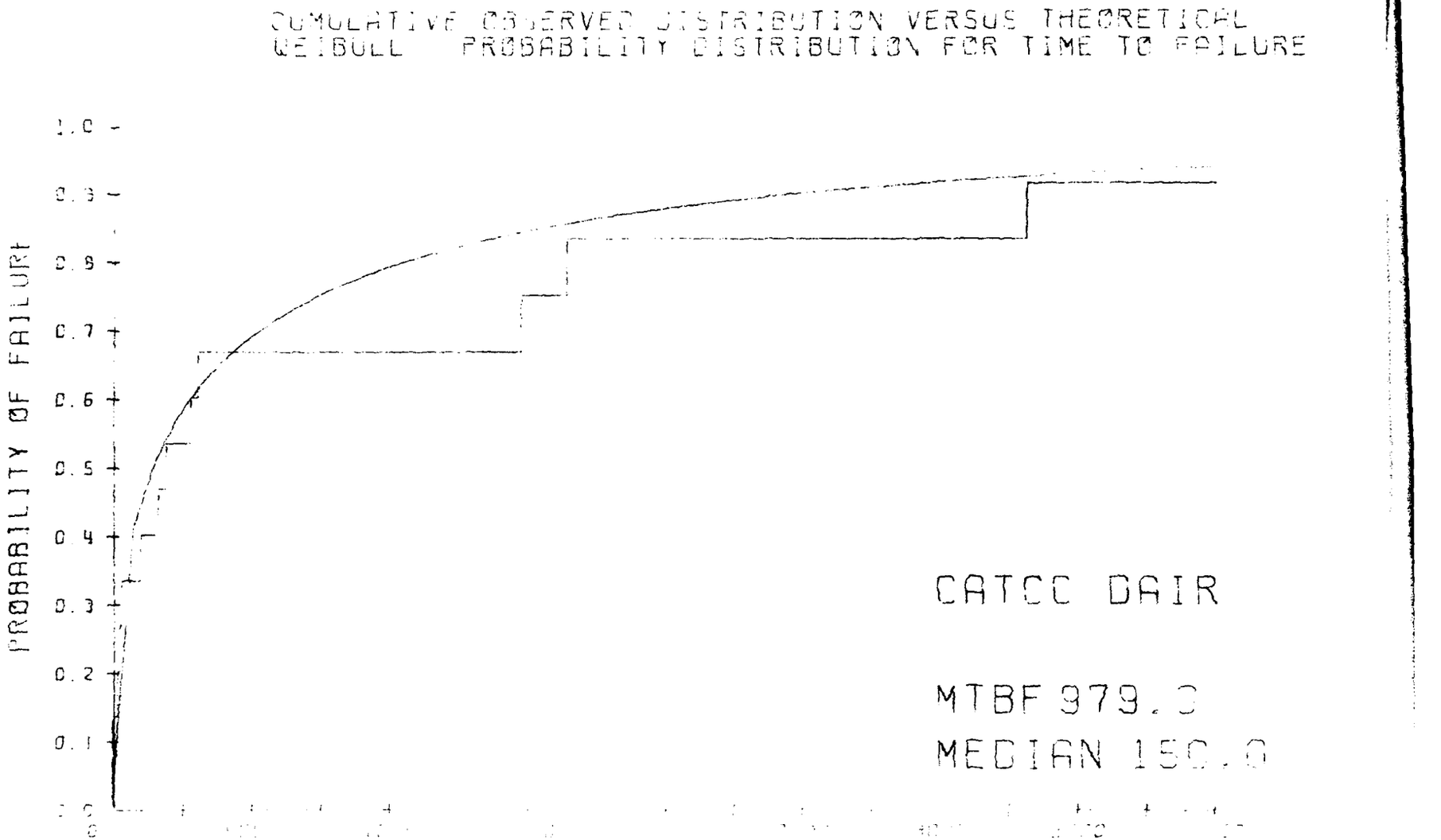
THE WEIBULL PARAMETERS ARE ALPHA = .837230E-01 BETA = .424563E+00

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 979.263, EST. MEDIAN = 150.000, 90 PER CENT LCL FOR MEAN = 0.000, 90 PER CENT UCL FOR MEAN = 2034.941

90 PER CENT LCL FOR BETA = .345781E+00 90 PER CENT UCL FOR BETA = .503345E+00


CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
EXPONENTIAL PROBABILITY DISTRIBUTION FOR TIME TO FAILURE
PROBABILITY OF FAILURE
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
CATCC DAIR
MTBF 645.6
MEDIAN 447.5


CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
WEIBULL PROBABILITY DISTRIBUTION FOR TIME TO FAILURE
PROBABILITY OF FAILURE
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
CATCC DAIR
MTBF 979.0
MEDIAN 150.0

R E L I A B I L I T Y

CATCC DAIR WRA 11 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
100.	30.0	1.	
	1397.0		1.
	3320.0		1.
	3646.0		1.

EQUIPMENT OPERATING HOURS (O.H.) = 8393.0 CALENDAR HOURS(C.H.) =. 17616.0 DUTY CYCLE (O.H./C.H.) = .476

NUMBER OF FAILURES = 1. OBSERVED FAILURE RATE/O.H. = .11915E-03

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 8393.000. EST. MEDIAN = 5817.584. 90 PER CENT LCL FOR MEAN = 2157.7. 90 PER CENT UCL FOR MEAN = 79660.213

90 PERCENT UCL 79660.21 IS GREATER THAN 11655.00 HOURS. THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

R E L I A B I L I T Y

CATCC DAIR WRA 16 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
100.	635.0	1.	
	792.0		1.
	3320.0		1.
	3646.0		1.

EQUIPMENT OPERATING HOURS (O.H.) = 8393.0 CALENDAR HOURS(C.H.) =. 17616.0 DUTY CYCLE (O.H./C.H.) = .476

NUMBER OF FAILURES = 1. OBSERVED FAILURE RATE/O.H. = .11915E-03

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 8393.000. EST. MEDIAN = 5817.584. 90 PER CENT LCL FOR MEAN = 2157.7. 90 PER CENT UCL FOR MEAN = 79660.213

90 PERCENT UCL 79660.21 IS GREATER THAN 2880.00 HOURS. THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

R E L I A B I L I T Y

CATCC DAIR WRA 18 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
100.	136.0	1.	
	1291.0		1.
	3320.0		1.
	3646.0		1.

EQUIPMENT OPERATING HOURS (O.H.) = 8393.0 CALENDAR HOURS(C.H.) =, 17616.0 DUTY CYCLE (O.H./C.H.) = .476

NUMBER OF FAILURES = 1. OBSERVED FAILURE RATE/O.H. = .11915E-03

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 8393.000, EST. MEDIAN = 5817.584, 90 PER CENT LCL FOR MEAN = 2157.7, 90 PER CENT UCL FOR MEAN = 79660.213

90 PERCENT UCL 79660.21 IS GREATER THAN 5000.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

RELIABILITY

CATCC DAIR WRA 19 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED	SURVIVORS	NPD	EXPONENTIAL	WEIBULL
100.	.0	1.		9.	.100	.000	.012
100.	28.0	1.		8.	.200	.023	.276
98.	36.0	1.		7.	.300	.030	.295
100.	195.0	1.		6.	.400	.150	.454
100.	284.0	1.		5.	.500	.211	.495
	1399.0		1.				
100.	1482.0	1.		3.	.625	.709	.688
100.	1649.0	1.		2.	.750	.747	.701
	3320.0		1.				

EQUIPMENT OPERATING HOURS (O.H.) = 8393.0 CALENDAR HOURS(C.H.) = 17616.0 DUTY CYCLE (O.H./C.H.) = .476

NUMBER OF FAILURES = 7. OBSERVED FAILURE RATE/O.H. = .83403E-03

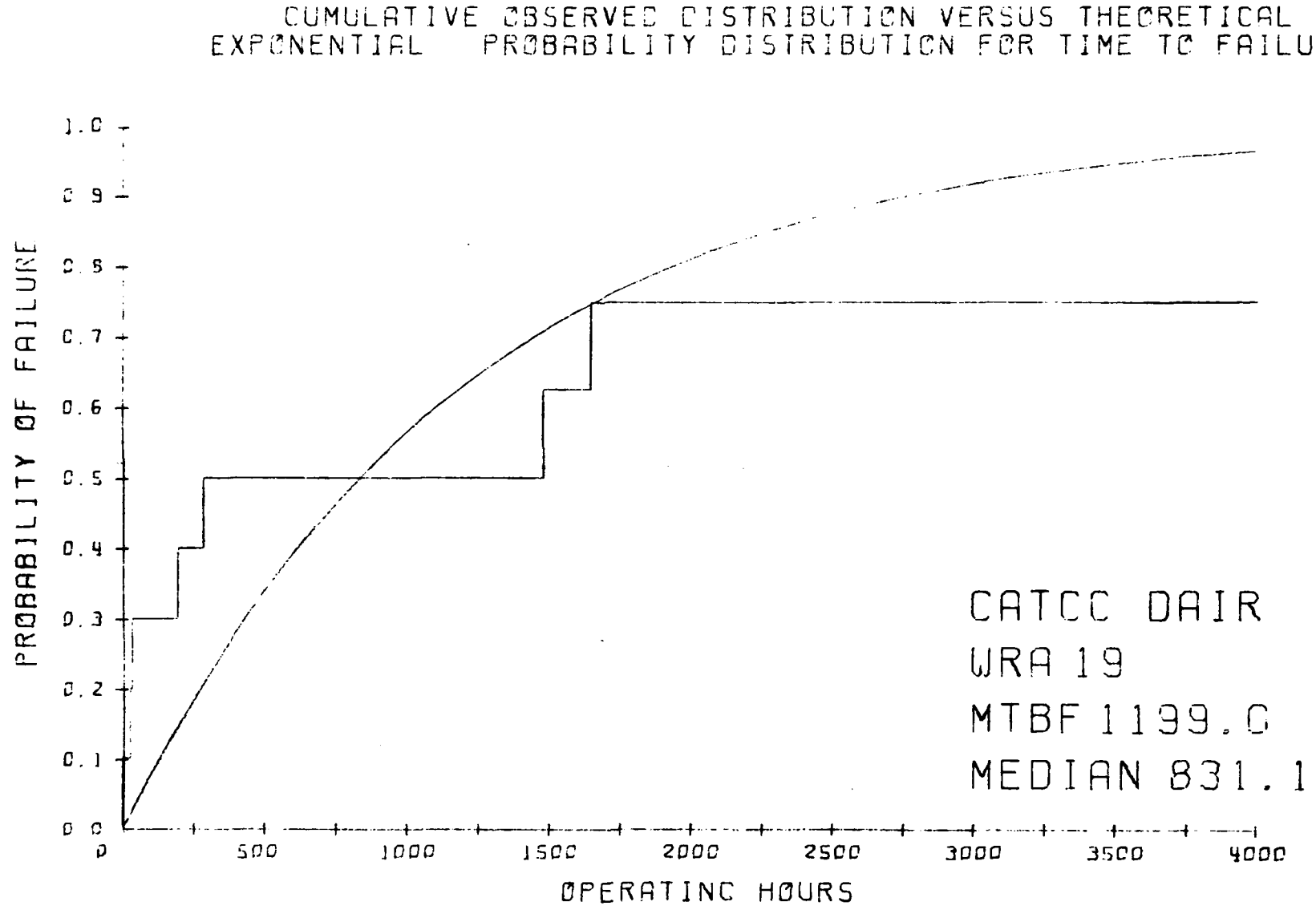
QRATIO OF 4.641 EXCEEDS THE CRITICAL VALUE FOR TEST OF EXPONENTIAL

THE WEIBULL PARAMETERS ARE ALPHA = .109899E+00 BETA = .323382E+00

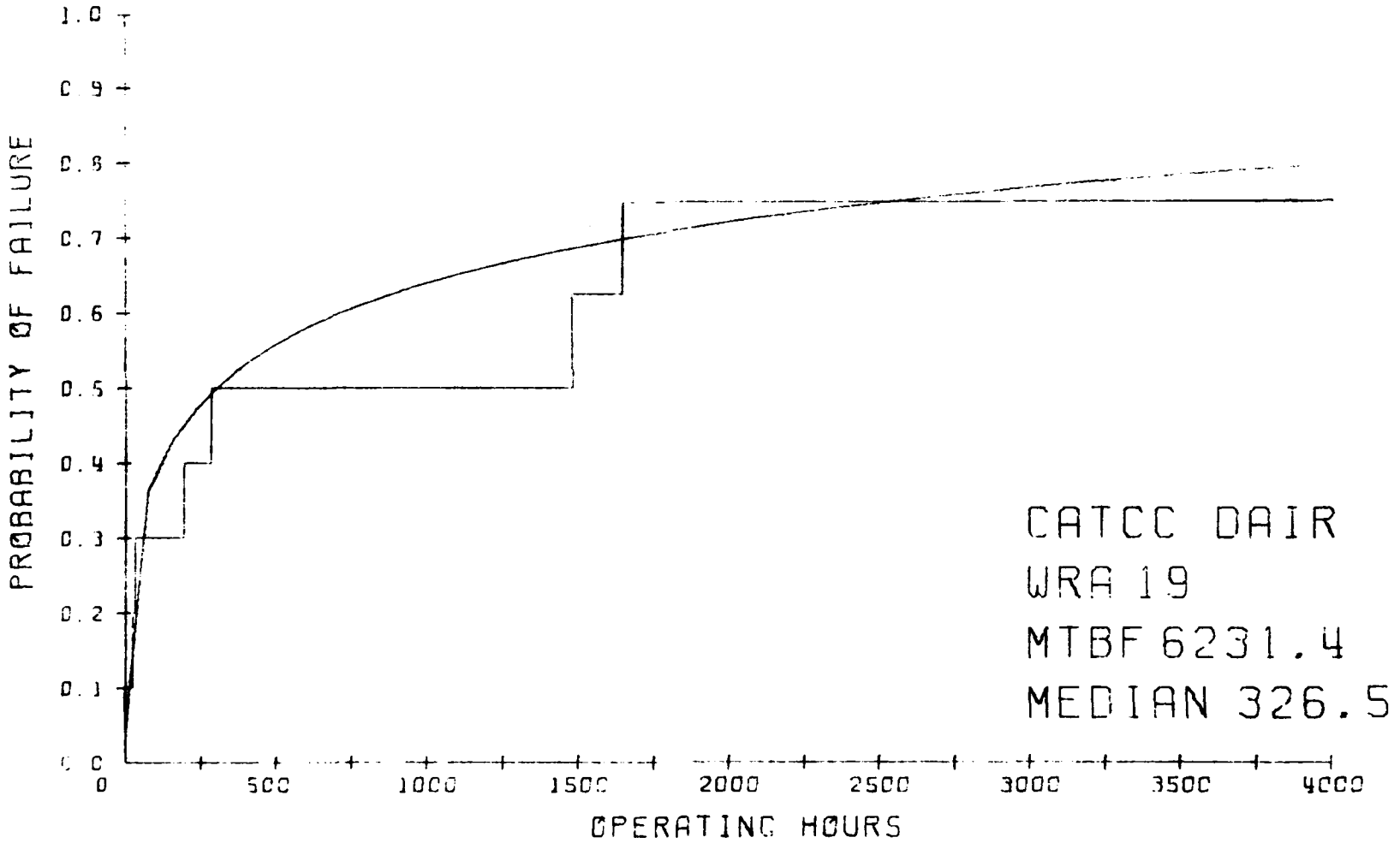
FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 6231.390, EST. MEDIAN = 326.471, 90 PER CENT LCL FOR MEAN = 0.000, 90 PER CENT UCL FOR MEAN = 22319.055

90 PER CENT LCL FOR BETA = .211893E+00 90 PER CENT UCL FOR BETA = .434872E+00


CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
EXPONENTIAL PROBABILITY DISTRIBUTION FOR TIME TO FAILURE
PROBABILITY OF FAILURE
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
500
1000
1500
2000
2500
3000
3500
4000
OPERATING HOURS
CATCC DAIR
WRA 19
MTBF 1199.0
MEDIAN 831.1

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



R E L I A B I L I T Y

CATCC DAIR 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	OBSERVED FAILURE TIMES HIGH	RELIAB PROBLEM
11	99		1.	2157.74	8393.00	79660.21	1000000.00	30.00	30.00	YES
16	99		1.	2157.74	8393.00	79660.21	1000000.00	635.00	635.00	YES
18	3	CRT DRIVER ELECTRONICS	1.	2157.74	8393.00	79660.21	22769.00	136.00	136.00	NO
19	2	DEFLECTION AMPLIFIER	3.	1256.29	2797.67	7615.70	92808.00	1482.00	3646.00	YES
19	8	INTERFACE AND LOGIC	1.	2157.74	8393.00	79660.21	23702.00	3610.00	3610.00	NO
19	9	VIDEO AMPLIFIER	1.	2157.74	8393.00	79660.21	54885.00	3131.00	3131.00	NO
19	16	PANEL (RIGHT SIDE)	1.	2157.74	8393.00	79660.21	24499.00	3326.00	3326.00	NO

RELIABILITY

2K SUMMARY FOR CATCC DAIRPROBLEM AREAS

JCN	WRA	O-L	O-L	O-L	*	WHAT HAPPENED
33610E010740	19	2	0	0		
33610E100780	19	2	0	0		ANOTHER AMP FAILURE/SEE 1131/EK
33610E100789	19	2	0	0		EMT REPORTED AS 55054/EK

SUB-SECTION (2)

CATCC-DAIR

ALL DATA

EXCEPT INDEPENDENCE

FLEET RELIABILITY ASSESSMENT DATA

SYSTEM	SHIPNAME	DATE	ETM	FAILURE TYPE	OPERATE	FAILURE TIME	DUTY	WRA	OL1	OL2	OL3
CATCC DAIR	KITTY HAWK	8288	2650.	FAILURE	0.	0.	0.000	14	39	0	0
CATCC DAIR	KITTY HAWK	8321	2658.	INITIAL	0.	0.	0.000	0	0	0	0
CATCC DAIR	KITTY HAWK	8321	2686.	FAILURE	28.	28.	0.000	19	0	0	0
CATCC DAIR	KITTY HAWK	8321	2688.	FAILURE	30.	2.	0.000	11	99	0	0
CATCC DAIR	KITTY HAWK	8348	2794.	FAILURE	136.	106.	.210	18	3	0	0
CATCC DAIR	KITTY HAWK	9010	3104.	FAILURE	446.	310.	.344	0	0	0	0
CATCC DAIR	KITTY HAWK	9011	3125.	FAILURE	467.	21.	.354	0	0	0	0
CATCC DAIR	KITTY HAWK	9029	3293.	FAILURE	635.	168.	.362	16	99	0	0
CATCC DAIR	KITTY HAWK	9135	4085.	FINAL	1427.	792.	.332	0	0	0	0
CATCC DAIR	RANGER	8164	1904.	INITIAL	0.	0.	0.000	0	0	0	0
CATCC DAIR	RANGER	8256	2455.	CENSORED	551.	551.	.250	0	0	0	0
CATCC DAIR	RANGER	8278	2702.	CENSORED	798.	798.	.292	0	0	0	0
CATCC DAIR	RANGER	8307	3386.	FAILURE	1482.	1482.	.432	19	2	0	0
CATCC DAIR	RANGER	8334	4163.	CENSORED	2259.	777.	.554	0	0	0	0
CATCC DAIR	RANGER	8363	4519.	CENSORED	2615.	1133.	.548	0	0	0	0
CATCC DAIR	RANGER	9049	5035.	FAILURE	3131.	1649.	.522	19	9	0	0
CATCC DAIR	RANGER	9056	5230.	FAILURE	3326.	195.	.535	19	16	0	0
CATCC DAIR	RANGER	9074	5514.	FAILURE	3610.	284.	.547	19	2	0	0
CATCC DAIR	RANGER	9080	5514.	FAILURE	3610.	0.	.535	19	8	0	0
CATCC DAIR	RANGER	9104	5550.	FAILURE	3646.	36.	.498	19	2	0	0

R E L I A B I L I T Y

CATCC DAIRSYSTEM LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED	SURVIVORS	NPD	EXPONENTIAL	WEIBULL
100.	.0	1.		13.	.071	.000	.004
100.	2.0	1.		12.	.143	.005	.115
100.	21.0	1.		11.	.214	.048	.289
100.	24.0	1.		10.	.286	.064	.320
98.	36.0	1.		9.	.357	.082	.350
100.	106.0	1.		8.	.429	.222	.498
100.	148.0	1.		7.	.500	.328	.570
100.	195.0	1.		6.	.571	.370	.593
100.	234.0	1.		5.	.643	.489	.654
100.	310.0	1.		4.	.714	.520	.668
	792.0		1.				
100.	1442.0	1.		2.	.810	.970	.887
100.	1649.0	1.		1.	.905	.980	.898

EQUIPMENT OPERATING HOURS (O.H.) = 5073.0 CALENDAR HOURS(C.H.) = 11616.0 DUTY CYCLE (O.H./C.H.) = .437

NUMBER OF FAILURES = 12. OBSERVED FAILURE RATE/O.H. = .23655E-02

QRATIO OF 3.793 EXCEEDS THE CRITICAL VALUE FOR TEST OF EXPONENTIAL

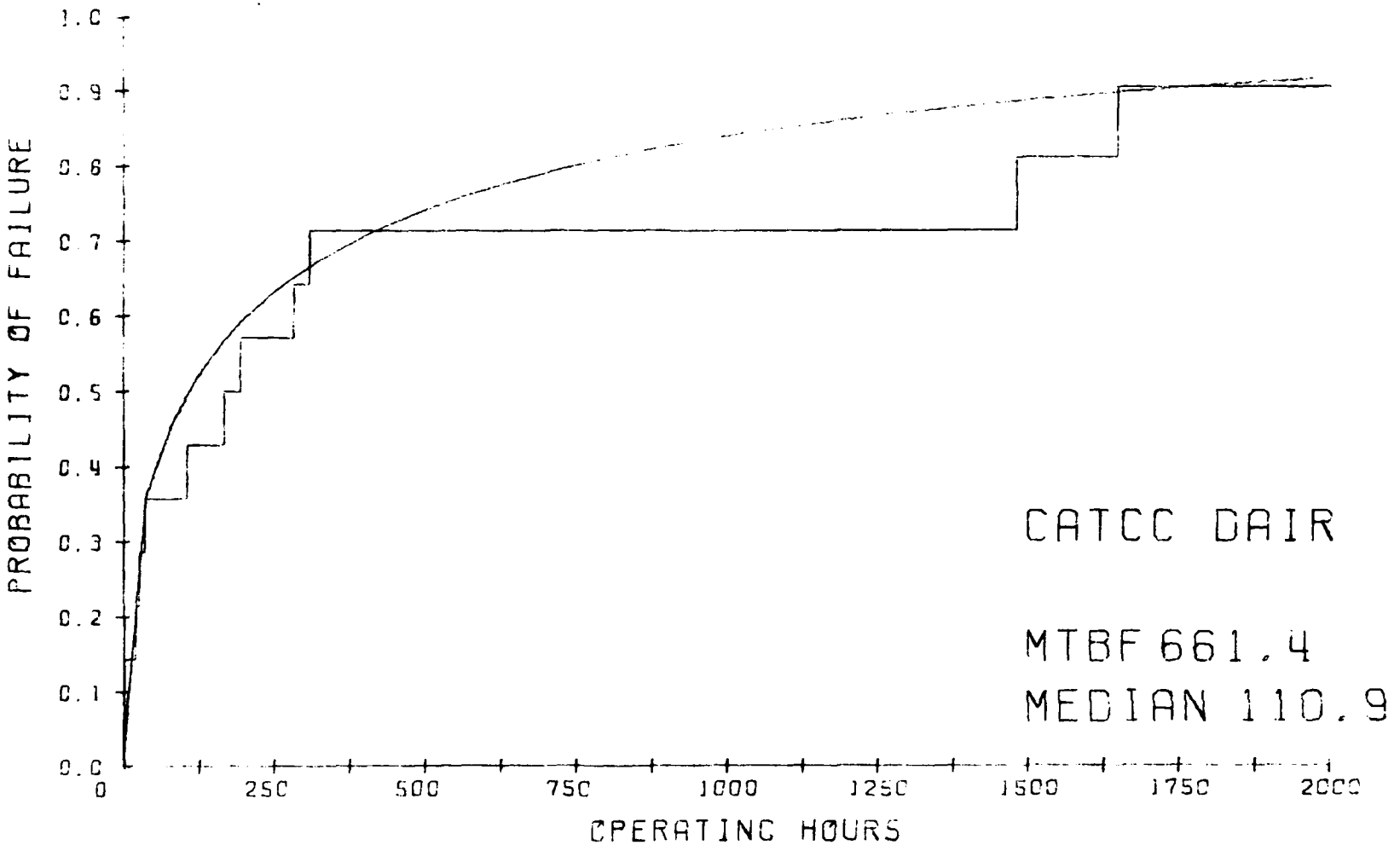
THE WEIBULL PARAMETERS ARE ALPHA = .902120E-01 BETA = .436198E+00

FOR THE ASSUMED DISTRIBUTION

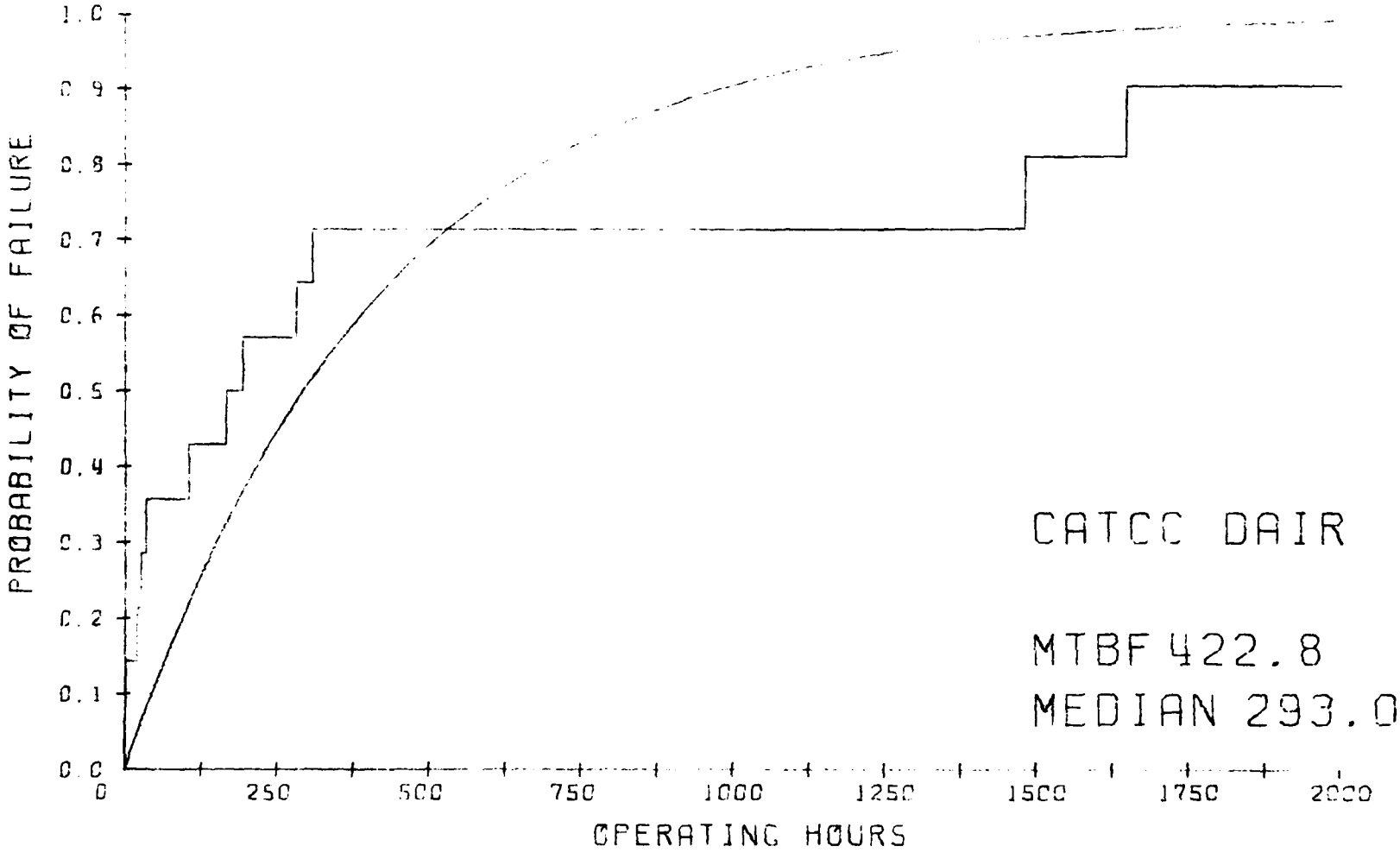
EST. MEAN = 461.361. EST. MEDIAN = 110.870. 90 PER CENT LCL FOR MEAN = 0.000. 90 PER CENT UCL FOR MEAN = 1377.394

90 PER CENT LCL FOR BETA = .348075E+00 90 PER CENT UCL FOR BETA = .524321E+00

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



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



R E L I A B I L I T Y

CATCC DAIR WPA 11 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
100.	30.0	1.	
	1397.0		1.
	[illegible]		1.

EQUIPMENT OPERATING HOURS (O.H.) = 5073.0 CALENDAR HOURS(C.H.) = 11616.0 DUTY CYCLE (O.H./C.H.) = .437

NUMBER OF FAILURES = 1. OBSERVED FAILURE RATE/O.H. = .19712E-03

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 5073.000 EST. MEDIAN = 3516.336 90 PER CENT LCL FOR MEAN = 1304.2, 90 PER CENT UCL FOR MEAN = 48149.203

90 PERCENT UCL 48149.20 IS GREATER THAN 11655.00 HOURS. THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

R E L I A B I L I T Y

CATCC DATA WRA 1A LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
100.	535.0	1.	
	792.0		1.
	3564.		1.

EQUIPMENT OPERATING HOURS (O.H.) = 5073.0 CALENDAR HOURS(C.H.) = 11616.0 DUTY CYCLE (O.H./C.H.) = .437

NUMBER OF FAILURES = 1. OBSERVED FAILURE RATE/O.H. = .19712E-03

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 5073.000. EST. MEDIAN = 3516.336. 90 PER CENT LCL FOR MEAN = 1304.2. 90 PER CENT UCL FOR MEAN = 48149.203

90 PERCENT UCL 48149.20 IS GREATER THAN 2480.00 HOURS. THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

R E L I A B I L I T Y

CATCC DAIR WRA 1A LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
100.	135.0	1.	
	1291.0		1.
	3548.0		1.

EQUIPMENT OPERATING HOURS (O.H.) = 5073.0 CALENDAR HOURS(C.H.) = 11616.0 DUTY CYCLE (O.H./C.H.) = .437

NUMBER OF FAILURES = 1. OBSERVED FAILURE RATE/O.H. = .19712E-03

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 5073.000. EST. MEDIAN = 3516.336. 90 PER CENT LCL FOR MEAN = 1304.2. 90 PER CENT UCL FOR MEAN = 48149.203

90 PERCENT UCL 48149.20 IS GREATER THAN 5000.00 HOURS. THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

R E L I A B I L I T Y

CATCC DAIR WRA 19 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED	SURVIVORS	NPD	EXPONENTIAL	WEIBULL
100.	.0	1.		8.	.111	.000	.009
100.	2[illegible].0	1.		7.	.222	.038	.309
94.	3[illegible].1	1.		6.	.333	.048	.333
100.	1[illegible].0	1.		5.	.444	.236	.523
100.	284.[illegible]	1.		4.	.556	.324	.572
	1339.0		1.				
100.	1452.0	1.		2.	.704	.871	.784
100.	1644.0	1.		1.	.852	.897	.797

EQUIPMENT OPERATING HOURS (O.H.) = 5073.0 CALENDAR HOURS(C.H.) = 11616.0 DUTY CYCLE (O.H./C.H.) = .437

NUMBER OF FAILURES = 7. OBSERVED FAILURE RATE/O.H. = .13794E-02

ORATIO OF 3.883 EXCEEDS THE CRITICAL VALUE FOR TEST OF EXPONENTIAL

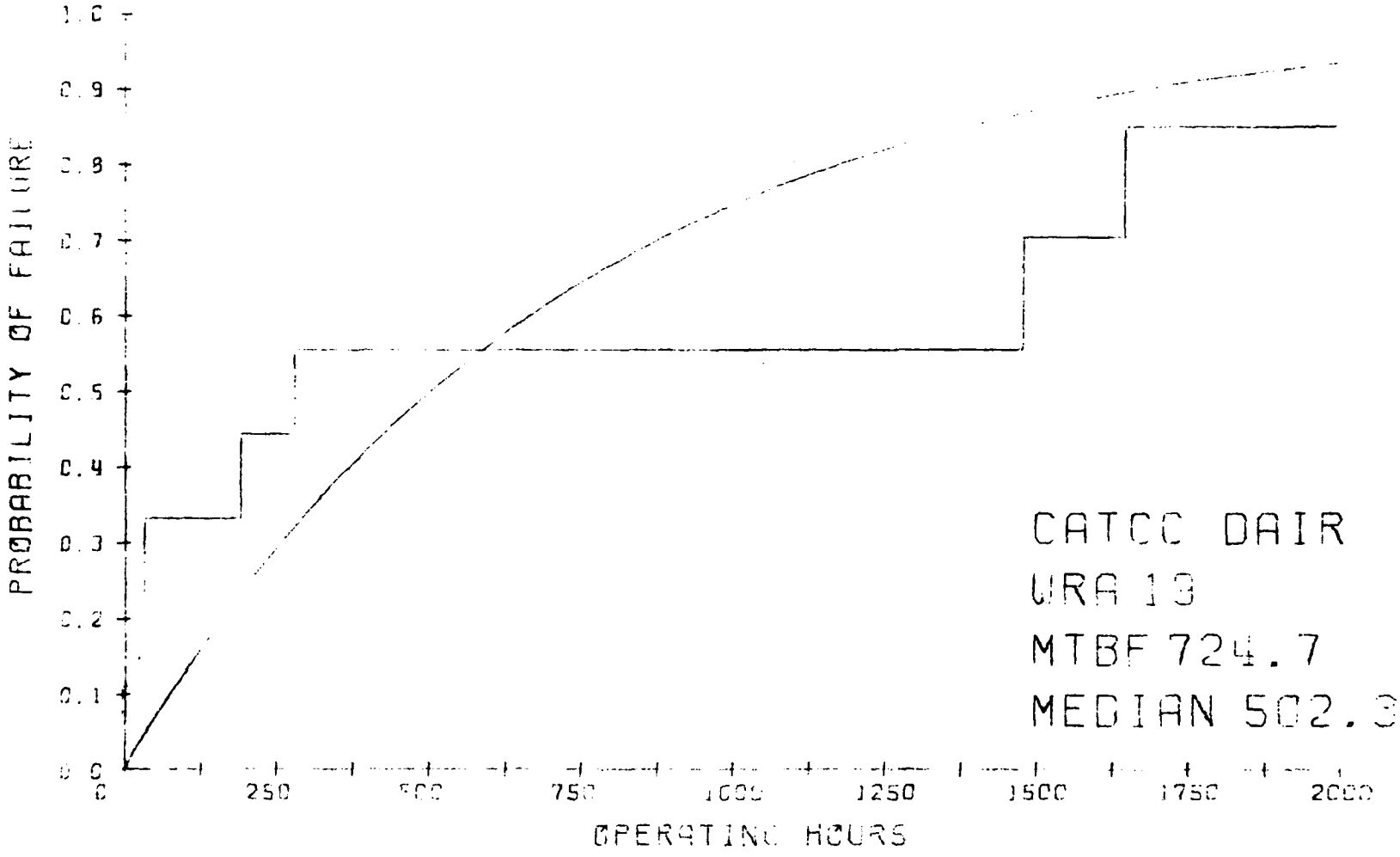
THE WEIBULL PARAMETERS ARE ALPHA = .112102E+00 BETA = .358215E+00

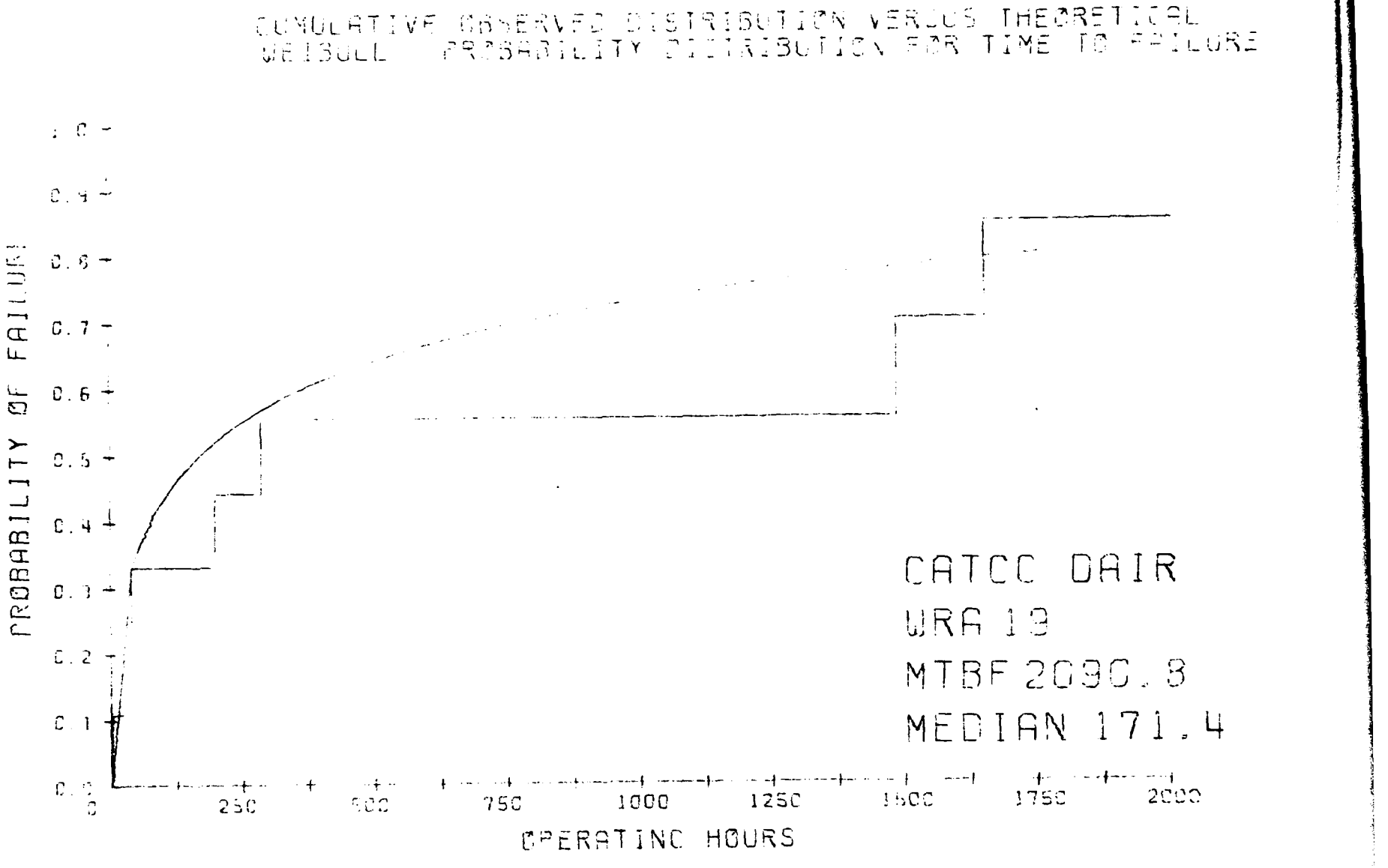
FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 2090.829. EST. MEDIAN = 171.429. 90 PER CENT LCL FOR MEAN = 0.000. 90 PER CENT UCL FOR MEAN = 6529.923

90 PER CENT LCL FOR BETA = .241342E+00 90 PER CENT UCL FOR BETA = .475088E+00

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




CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
WEIBULL PROBABILITY DISTRIBUTION FOR TIME TO FAILURE
PROBABILITY OF FAILURE
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
250
500
750
1000
1250
1500
1750
2000
OPERATING HOURS
CATCC OAIR
WRA 19
MTBF 2090.8
MEDIAN 171.4

R E L I A B I L I T Y

CATCC DATA 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	OBSERVED FAILURE TIMES HIGH	RELIAB PROBLEM
11	99		1.	1304.21	5073.00	48149.20	1000000.00	30.00	30.00	YES
16	99		1.	1304.21	5073.00	48149.20	1000000.00	635.00	635.00	YES
18	3	CRT DRIVER ELECTRONICS	1.	1304.21	5073.00	48149.20	22769.00	136.00	136.00	NO
19	2	DEFLECTION AMPLIFIER	3.	759.34	1691.00	4603.18	92808.00	1482.00	3646.00	YES
19	8	INTERFACE & LOGIC	1.	1304.21	5073.00	48149.20	23702.00	3610.00	3610.00	NO
19	9	VIDEO AMPLIFIER	1.	1304.21	5073.00	48149.20	54885.00	3131.00	3131.00	YES
19	14	PANEL (RIGHT SIDE)	1.	1304.21	5073.00	48149.20	24499.00	3326.00	3326.00	NO

R E L I A B I L I T Y

PR SUMMARY FOR CATCC DATAPROBLEM AREAS

JCA	WHA	O-L	O-L	O-L	WHAT HAPPENED
335105E01[illegible]740	19	[illegible]	0	0	*
335105E010743	19	9	0	0	
335105E010740	19	2	0	0	ANOTHER AMP FAILURE/SEE 1131/EK
335105E[illegible]0744	19	2	0	0	EMT REPORTED AS 55054/EK

FLEET MAINTAINABILITY ASSESSMENT DATA

SYSTEM	SHIPNAME	DISCOVERD	COMPL	REPAIR TIME	DOWN TIME
CATCC DAIR	KITTY HAWK	8288	8288	0.	0.
CATCC DAIR	KITTY HAWK	8321	8321	0.	0.
		NO REPAIR TIME FOR THE ABOVE RECORD			
CATCC DAIR	KITTY HAWK	8321	8321	0.	0.
		NO REPAIR TIME FOR THE ABOVE RECORD			
CATCC DAIR	KITTY HAWK	8348	8348	0.	0.
		NO REPAIR TIME FOR THE ABOVE RECORD			
CATCC DAIR	KITTY HAWK	9010	9010	0.	0.
		NO REPAIR TIME FOR THE ABOVE RECORD			
CATCC DAIR	KITTY HAWK	9011	9026	16.	360.
CATCC DAIR	KITTY HAWK	9029	9029	0.	0.
		NO REPAIR TIME FOR THE ABOVE RECORD			
CATCC DAIR	RANGER	8307	8314	96.	168.
CATCC DAIR	RANGER	9049	9053	5.	96.
CATCC DAIR	RANGER	9058	9058	4.	4.
CATCC DAIR	RANGER	9074	9075	1.	24.
CATCC DAIR	RANGER	9080	9087	2.	168.
CATCC DAIR	RANGER	9104	9117	2.	312.

MAINTAINABILITY (REPAIR TIME)

CATCC DAIR SYSTEM LEVEL

REPAIR TIME.	FREQUENCY	CUM FREQUENCY	NPF	LOGNORMAL	EXPONENTIAL	WEIBULL
1.0	1.	1.0	.125	.140	.054	.193
2.0	2.	3.0	.375	.263	.105	.282
4.0	1.	4.0	.500	.426	.199	.401
5.0	1.	5.0	.625	.483	.243	.446
16.0	1.	6.0	.750	.761	.589	.707
96.0	1.	7.0	.875	.969	.995	.977

TOTAL REPAIR HOURS = 126.0 NUMBER OF REPAIRS = 7. OBSERVED REPAIR RATE/HR = .5556E-01

DISTRIBUTION DETERMINATION

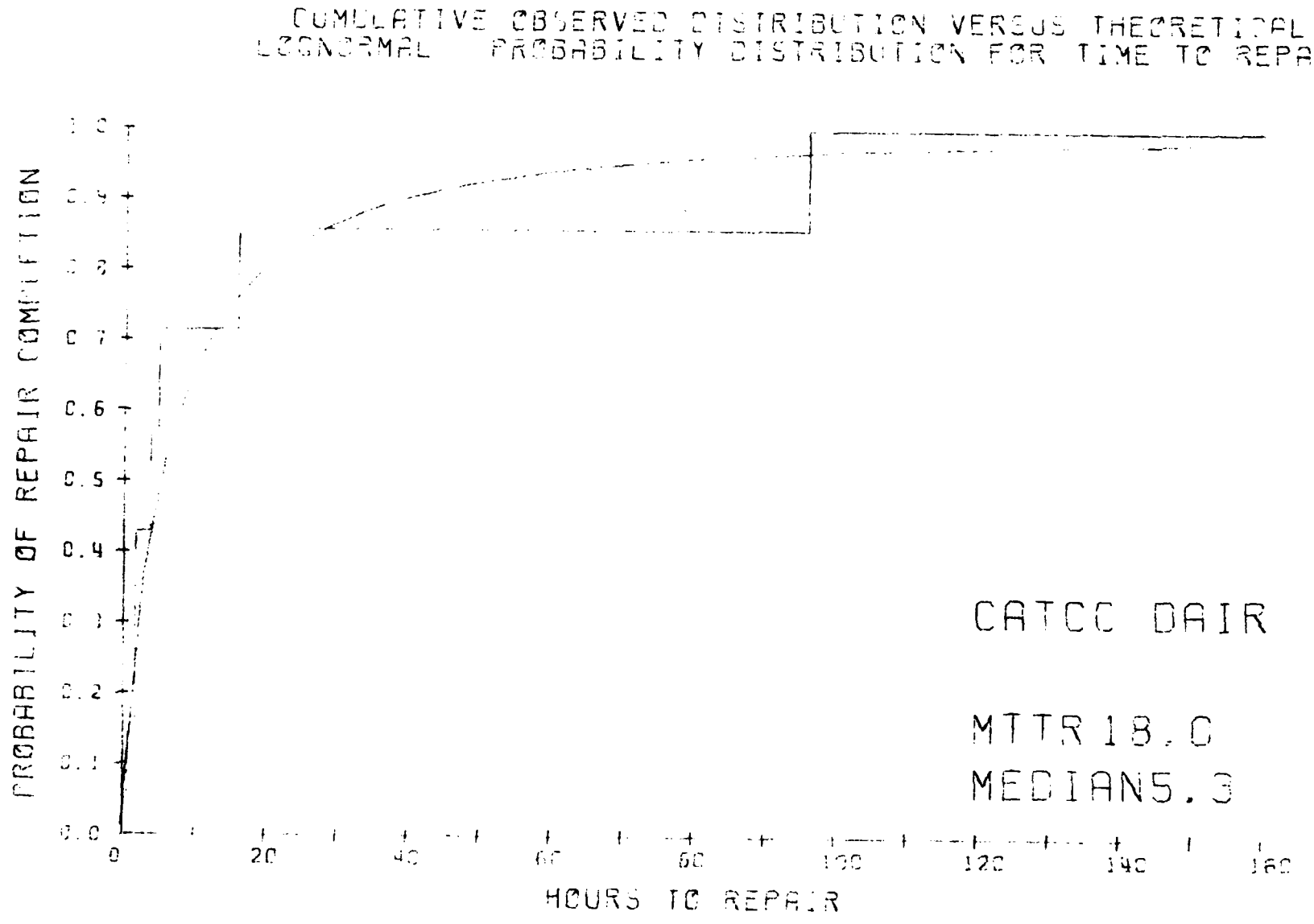
MEAN OF LN*S = 1.67 STD DEV OF LN*S = 1.55

K-S CRITICAL VALUE (.10, 7.) = .276 MAX DIFF CALC = .219 IS LESS THAN THE CRITICAL VALUE

THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

EST MEAN = 18.00 EST MEDIAN = 5.33 90 PER CENT LCL ON MEDIAN = 2.30 90 PER CENT UCL ON MEDIAN = 12.39

SPECIFIED MTTR = 2.00 HOURS LOWER CONF LIM 2.30 IS GREATER THAN MTTR, THUS A MAINTAINABILITY PROBLEM EXISTS


CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
LOGNORMAL PROBABILITY DISTRIBUTION FOR TIME TO REPAIR
PROBABILITY OF REPAIR COMPLETION
0.6
0.5
0.4
0.0
0
20
HOURS TO REPAIR
CATCC DAIR
MTTR 18.0
MEDIAN5.3

MAINTAINABILITY (DOWN TIME)

CATCC DAIR SYSTEM LEVEL

DOWN TIME.	FREQUENCY	CUM FREQUENCY	NPF	LOGNORMAL	EXPONENTIAL	WEIBULL
4.0	1.	1.0	.125	.030	.024	.025
24.0	1.	2.0	.250	.219	.138	.139
96.0	1.	3.0	.375	.533	.448	.449
168.0	2.	5.0	.625	.666	.646	.647
312.0	1.	6.0	.750	.792	.855	.854
360.0	1.	7.0	.875	.816	.892	.892

TOTAL DOWN TIME (TDT) = 1132.0 NUMBER OF REPAIRS (NR) = 7. OBSERVED DOWN TIME/REPAIR (TDT/NR) = 161.71

DISTRIBUTION DETERMINATION

MEAN OF LN≠S = 4.43 STD DEV OF LN≠S = 1.62

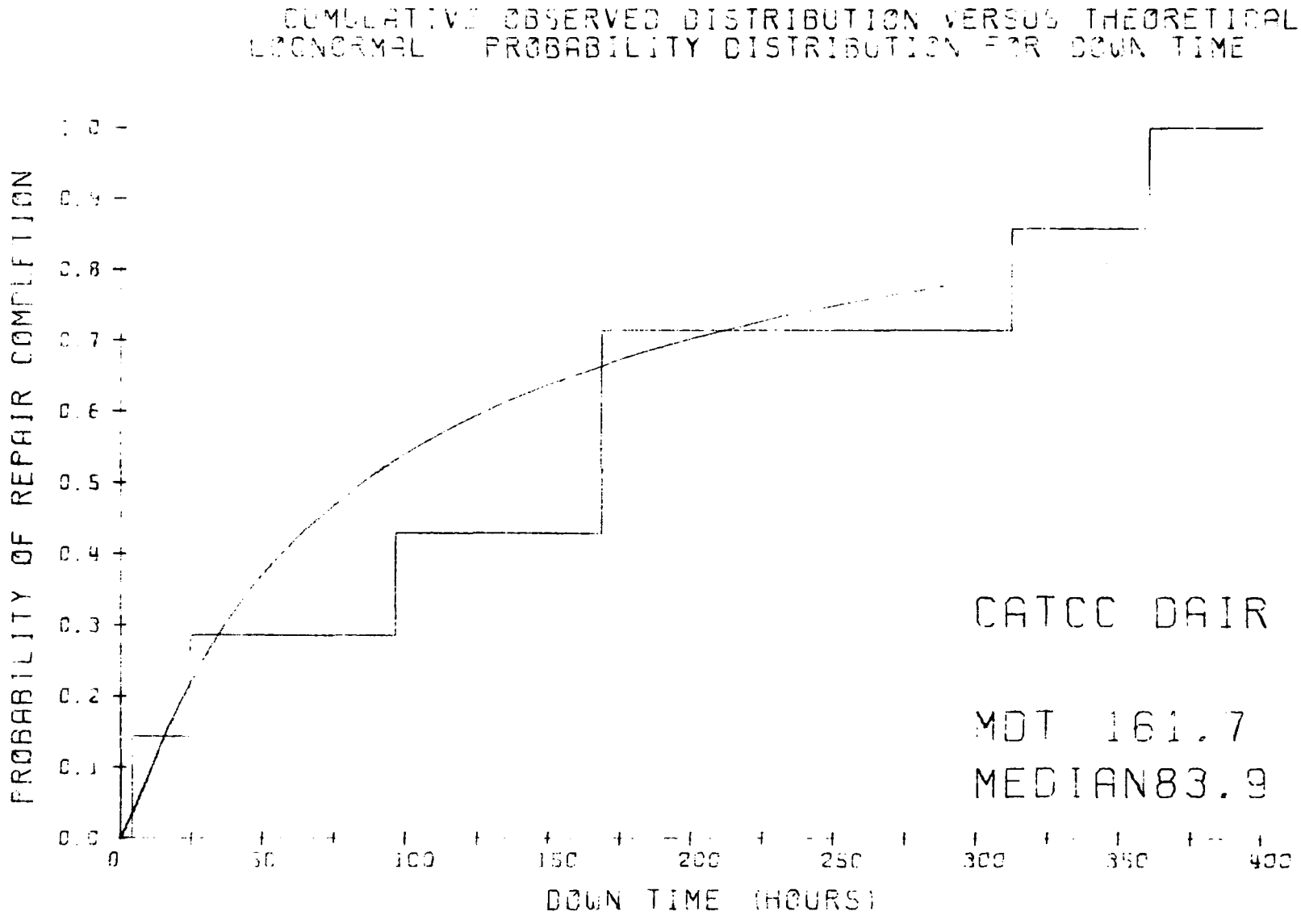
K-S CRITICAL VALUE (.10, 7.) = .276 MAX DIFF CALC = .291 IS GREATER THAN THE CRITICAL VALUE

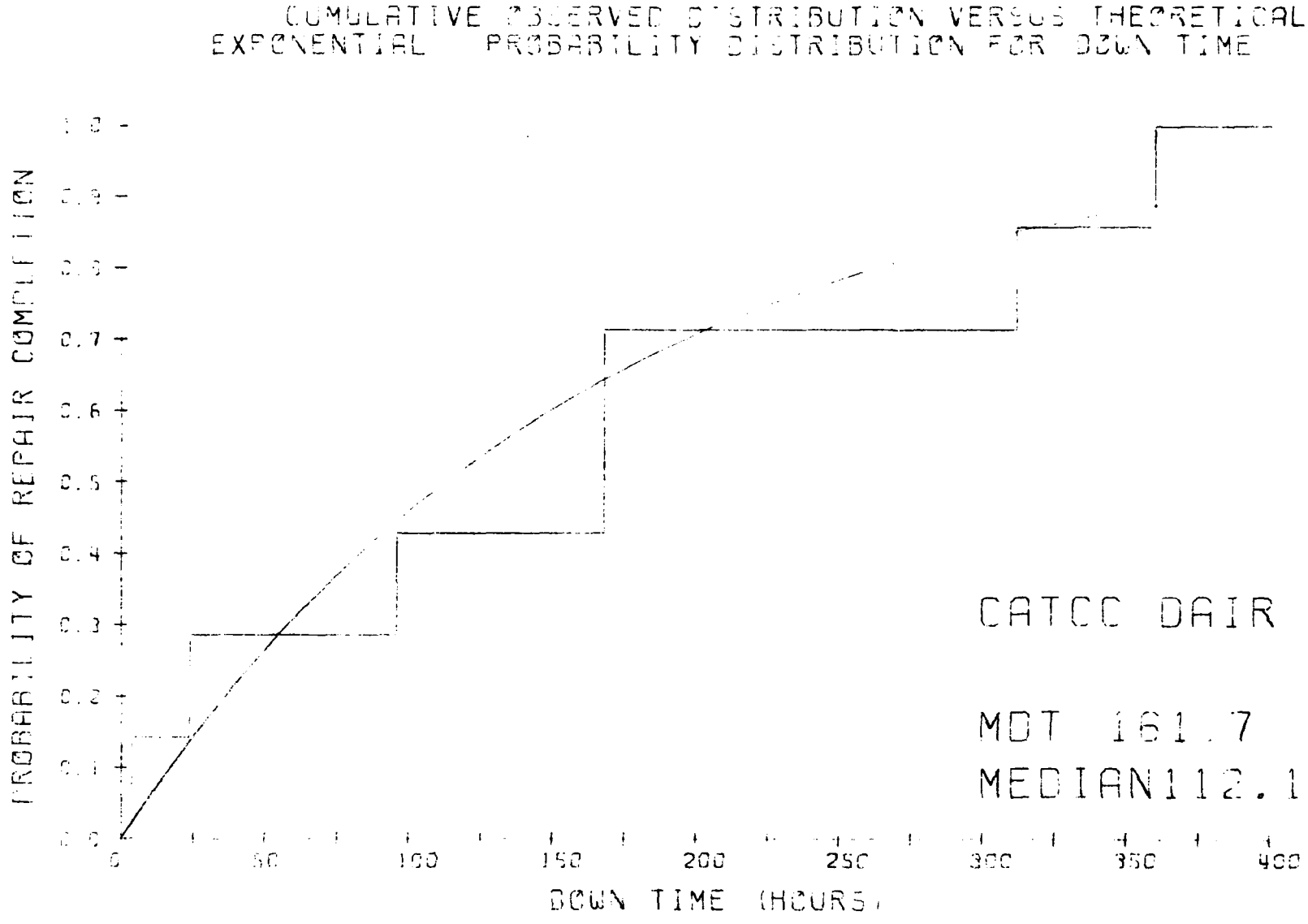
THEREFORE THE LOGNORMAL DISTRIBUTION CANNOT BE ASSUMED

QRATIO OF 1.340 DOES NOT EXCEED THE CRITICAL VALUE FOR TEST OF EXPONENTIAL

THEREFORE THE EXPONENTIAL DISTRIBUTION IS ASSUMED

EST MEAN = 161.71 EST MEDIAN = 112.09 90 PER CENT LCL ON MEAN = 107.48 90 PER CENT UCL ON MEAN = 290.65


CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
LOGNORMAL PROBABILITY DISTRIBUTION FOR DOWN TIME
PROBABILITY OF REPAIR COMPLETION
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
50
100
150
200
250
300
350
400
DOWN TIME (HOURS)
CATCC DAIR
MDT 161.7
MEDIAN83.9


CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
EXPONENTIAL PROBABILITY DISTRIBUTION FOR DOWN TIME
PROBABILITY OF REPAIR COMPLETION
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
50
100
150
200
250
300
350
400
DOWN TIME (HOURS)
CATCC DAIR
MDT 161.7
MEDIAN112.1

MAINTAINABILITY (REPAIR TIME)

CATCC DATA WRA 19 LEVEL

REPAIR TIME.	FREQUENCY	CUM FREQUENCY	NPF	LOGNORMAL	EXPONENTIAL	WEIBULL
1.0	1.	1.0	.143	.177	.053	.231
2.0	2.	3.0	.429	.310	.103	.325
4.0	1.	4.0	.571	.474	.196	.444
5.0	1.	5.0	.714	.529	.239	.487
96.0	1.	6.0	.857	.972	.995	.975

TOTAL REPAIR HOURS = 110.0 NUMBER OF REPAIRS = 6. OBSERVED REPAIR RATE/HR = .5455E-01

DISTRIBUTION DETERMINATION

MEAN OF LN*S = 1.49 STD DEV OF LN*S = 1.61

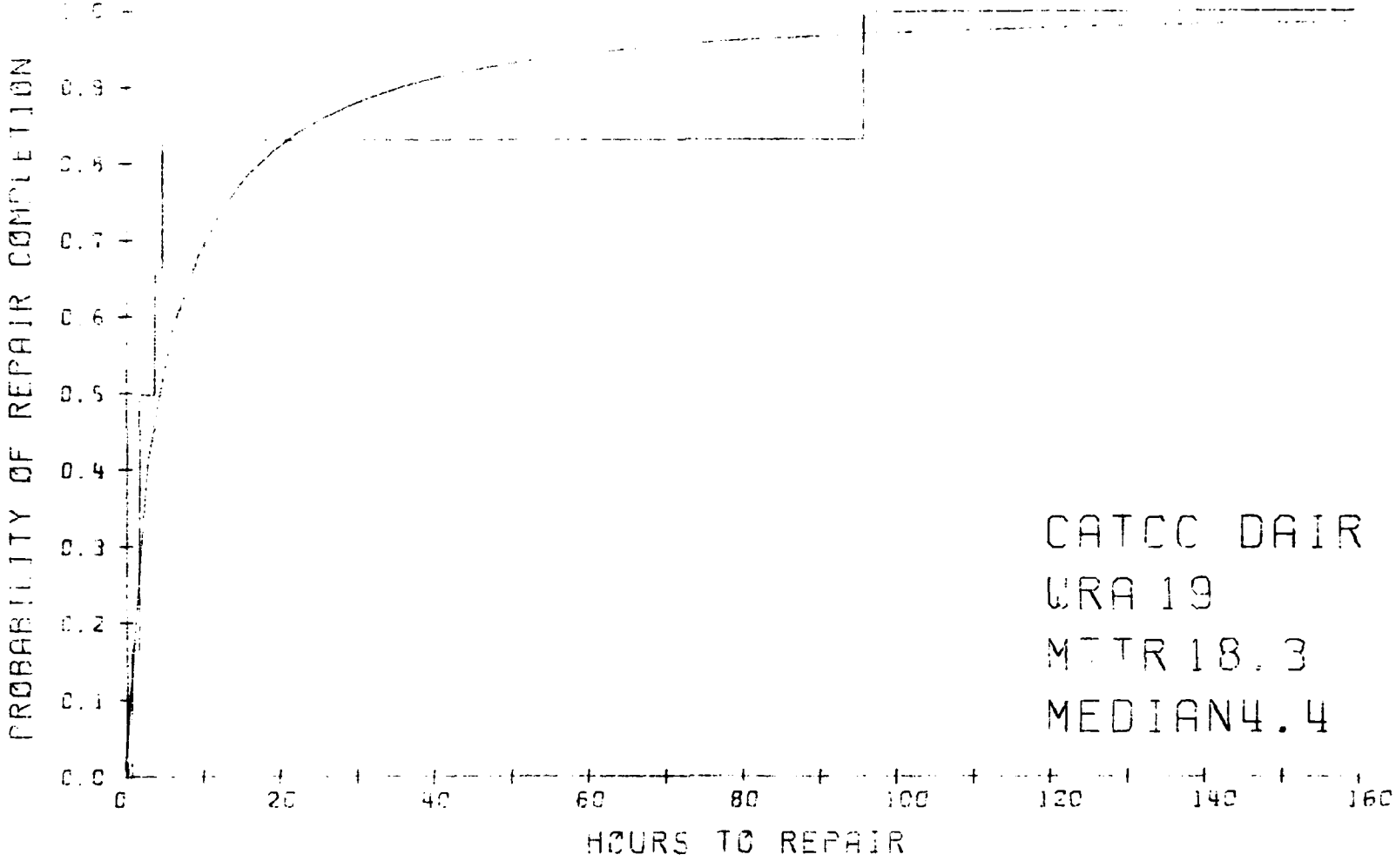
K-S CRITICAL VALUE (.10. 6.) = .294 MAX DIFF CALC = .258 IS LESS THAN THE CRITICAL VALUE

THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

EST MEAN = 19.33 EST MEDIAN = 4.44 90 PER CENT LCL ON MEDIAN = 1.68 90 PER CENT UCL ON MEDIAN = 11.72

SPECIFIED MTTR = 2.00 HOURS LOWER CONF LIM 1.68 IS LESS THAN MTTR. THUS THE EQUIPMENT MEETS THE SPECIFICATIONS

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



MAINTAINABILITY (REPAIR TIME)

CATCC DAIR O-LEVEL SUMMARY

WRA	O-LEVEL BLOCK NO.	O-LEVEL NOMENCLATURE	NUMBER REPAIRS	LOWER 90 CONF LIM	UPPER 90 CONF LIM	SPEC MTTR	OBSERVED REPAIR TIMES LOW	MEAN	HIGH	MAINT PROBLEM
19	2	DEFLECTION AMPLIFIER	3.	.40	84.00	2.0	1.0	33.00	96.0	NO
19	8	INTERFACE AND LOGIC	1.	NO CONF LIMITS		2.0	2.0	2.00	2.0	
19	9	VIDEO AMPLIFIER	1.	NO CONF LIMITS		2.0	5.0	5.00	5.0	
19	16	PANEL (RIGHT SIDE)	1.	NO CONF LIMITS		2.0	4.0	0.00	4.0	

MAINTAINABILITY (REPAIR TIME)

2K SUMMARY FOR CATCC DAIR PROBLEM AREAS

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

SUB-SECTION (3)

CATCC-DAIR

EQUIPMENT

RELIABILITY

DATA

FLEET RELIABILITY ASSESSMENT DATA

SYSTEM	SHIPNAME	DATE	FTM	FAILURE TYPE	OPERATE	FAILURE TIME	DUTY	WRA	OL1	OL2	OL3
CATCC DAIR	KITTY HAWK	8288	2650.	FAILURE	0.	0.	0.000	14	39	0	0
CATCC DAIR	KITTY HAWK	8321	2658.	INITIAL	0.	0.	0.000	0	0	0	0
CATCC DAIR	KITTY HAWK	8321	2686.	FAILURE	28.	28.	0.000	19	0	0	0
CATCC DAIR	KITTY HAWK	8321	2688.	FAILURE	30.	2.	0.000	11	99	0	0
CATCC DAIR	KITTY HAWK	8348	2794.	FAILURE	136.	106.	.210	18	3	0	0
CATCC DAIR	KITTY HAWK	9010	3104.	CENSORED	446.	310.	.344	0	0	0	0
CATCC DAIR	KITTY HAWK	9011	3125.	CENSORED	467.	331.	.354	0	0	0	0
CATCC DAIR	KITTY HAWK	9029	3293.	FAILURE	635.	499.	.362	16	99	0	0
CATCC DAIR	KITTY HAWK	9135	4085.	FINAL	1427.	792.	.332	0	0	0	0
CATCC DAIR	RANGER	8164	1904.	INITIAL	0.	0.	0.000	0	0	0	0
CATCC DAIR	RANGER	8256	2455.	CENSORED	551.	551.	.250	0	0	0	0
CATCC DAIR	RANGER	8278	2702.	CENSORED	798.	798.	.292	0	0	0	0
CATCC DAIR	RANGER	8307	3386.	FAILURE	1482.	1482.	.432	19	2	0	0
CATCC DAIR	RANGER	8334	4163.	CENSORED	2259.	777.	.554	0	0	0	0
CATCC DAIR	RANGER	8363	4519.	CENSORED	2615.	1133.	.548	0	0	0	0
CATCC DAIR	RANGER	9049	5035.	FAILURE	3131.	1649.	.522	19	9	0	0
CATCC DAIR	RANGER	9058	5230.	FAILURE	3326.	195.	.535	19	16	0	0
CATCC DAIR	RANGER	9074	5514.	FAILURE	3610.	284.	.547	19	2	0	0
CATCC DAIR	RANGER	9080	5514.	FAILURE	3610.	0.	.535	19	8	0	0
CATCC DAIR	RANGER	9104	5550.	FAILURE	3646.	36.	.498	19	2	0	0

R E L I A B I L I T Y

CATCC DAIRSYSTEM LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED	SURVIVORS	NPD	EXPONENTIAL	WEIBULL
100.	.0	1.		11.	.083	.000	.006
100.	2.0	1.		10.	.167	.004	.123
100.	28.0	1.		9.	.250	.054	.317
98.	36.0	1.		8.	.333	.069	.344
100.	106.0	1.		7.	.417	.189	.480
100.	195.0	1.		6.	.500	.319	.567
100.	284.0	1.		5.	.583	.429	.623
100.	499.0	1.		4.	.667	.626	.706
	792.0		1.				
100.	1482.0	1.		2.	.778	.946	.851
100.	1649.0	1.		1.	.889	.961	.863

EQUIPMENT OPERATING HOURS (O.H.) = 5073.0 CALENDAR HOURS(C.H.) =. 11616.0 DUTY CYCLE (O.H./C.H.) = .437

NUMBER OF FAILURES = 10. OBSERVED FAILURE RATE/O.H. = .19712E-02

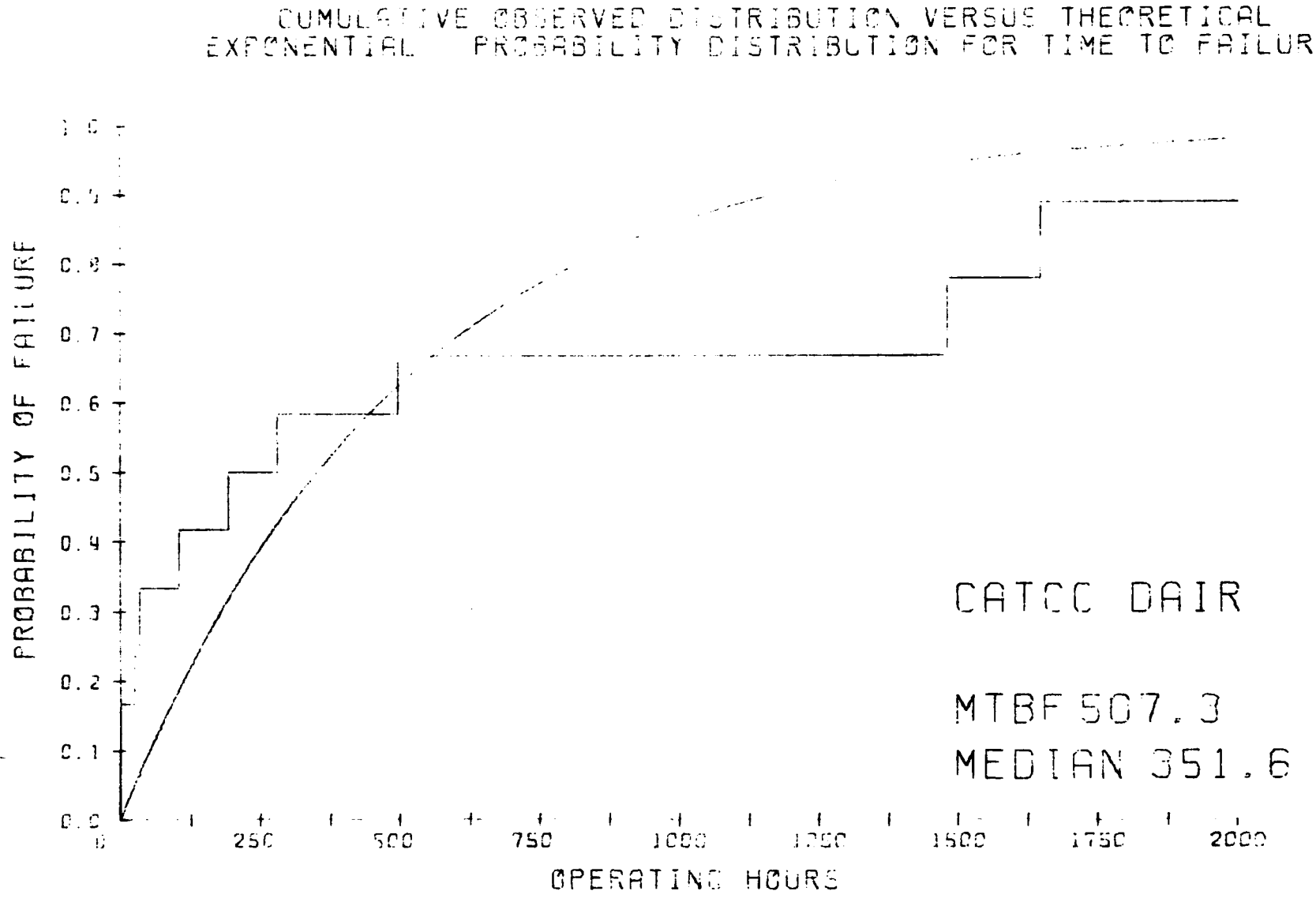
QRATIO OF 4.399 EXCEEDS THE CRITICAL VALUE FOR TEST OF EXPONENTIAL

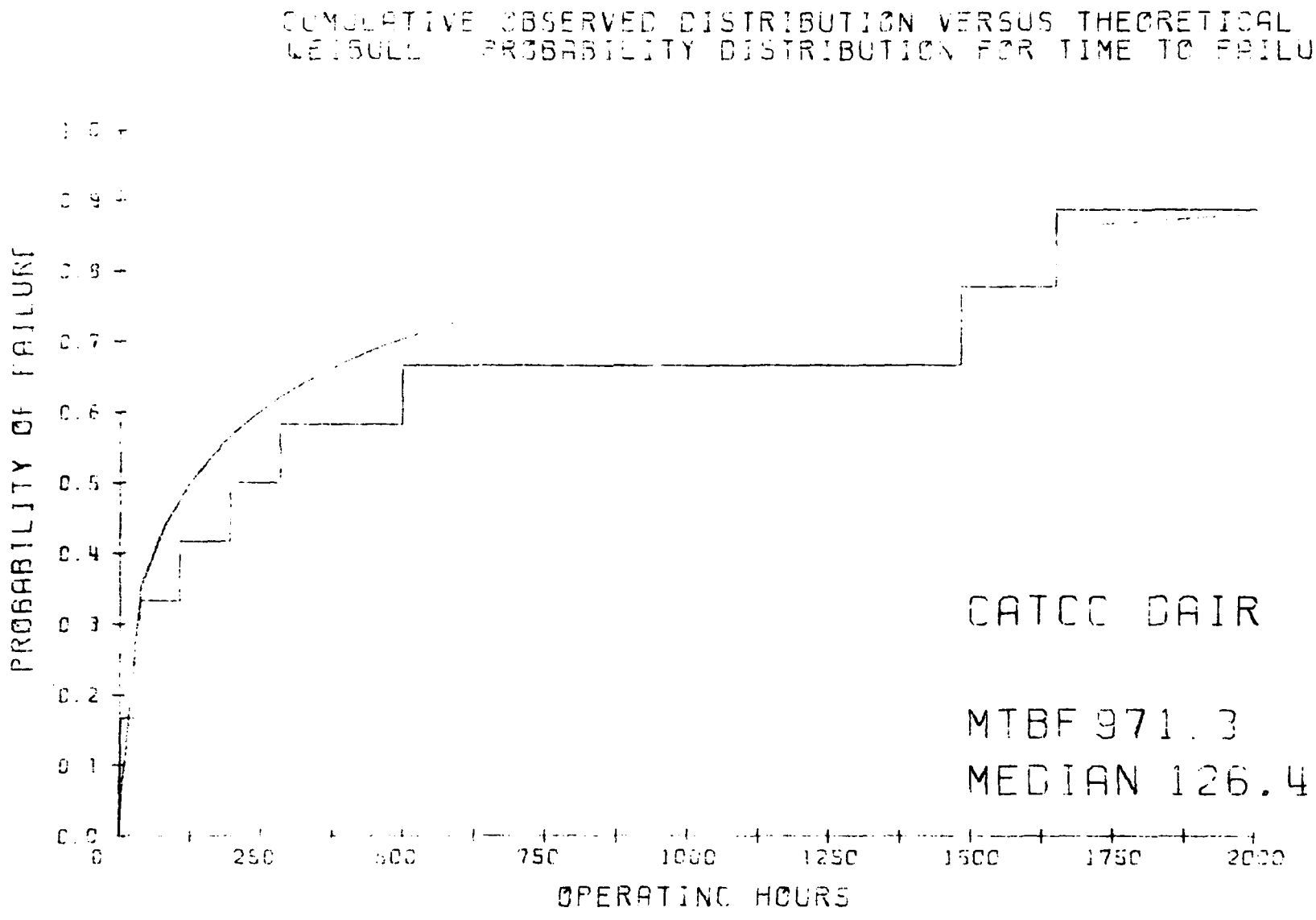
THE WEIBULL PARAMETERS ARE ALPHA = .989034E-01 BETA = .405053E+00

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 971.268, EST. MEDIAN = 126.364, 90 PER CENT LCL FOR MEAN = 0.000, 90 PER CENT UCL FOR MEAN = 2291.286

90 PER CENT LCL FOR BETA = .308808E+00 90 PER CENT UCL FOR BETA = .501298E+00


CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
EXPONENTIAL PROBABILITY DISTRIBUTION FOR TIME TO FAILURE
PROBABILITY OF FAILURE
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
250
500
750
1000
1250
1500
1750
2000
OPERATING HOURS
CATCC DAIR
MTBF 507.3
MEDIAN 351.6


CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
WEIBULL PROBABILITY DISTRIBUTION FOR TIME TO FAILURE
PROBABILITY OF FAILURE
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0
250
500
750
1000
1250
1500
1750
2000
OPERATING HOURS
CATCC DAIR
MTBF 971.3
MEDIAN 126.4

R E L I A B I L I T Y

CATCC DAIR WRA 11 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
100.	30.0	1.	
	1397.0		1.
	3645.0		1.

EQUIPMENT OPERATING HOURS (O.H.) = 5073.0 CALENDAR HOURS(C.H.) =, 11616.0 DUTY CYCLE (O.H./C.H.) = .437

NUMBER OF FAILURES = 1. OBSERVED FAILURE RATE/O.H. = .19712E-03

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 5073.000, EST. MEDIAN = 3516.336, 90 PER CENT LCL FOR MEAN = 1304.2, 90 PER CENT UCL FOR MEAN = 48149.203

90 PERCENT UCL 48149.20 IS GREATER THAN 11655.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

R E L I A B I L I T Y

CATCC DAIR WRA 16 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
100.	635.0	1.	
	792.0		1.
	3646.0		1.

EQUIPMENT OPERATING HOURS (O.H.) = 5073.0 CALENDAR HOURS(C.H.) =. 11616.0 DUTY CYCLE (O.H./C.H.) = .437

NUMBER OF FAILURES = 1. OBSERVED FAILURE RATE/O.H. = .19712E-03

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 5073.000. EST. MEDIAN = 3516.336. 90 PER CENT LCL FOR MEAN = 1304.2. 90 PER CENT UCL FOR MEAN = 48149.203

90 PERCENT UCL 48149.20 IS GREATER THAN 2880.00 HOURS. THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

R E L I A B I L I T Y

CATCC DAIR WRA 18 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
100.	136.0	1.	
	1291.0		1.
	3646.0		1.

EQUIPMENT OPERATING HOURS (O.H.) = 5073.0 CALENDAR HOURS(C.H.) =, 11616.0 DUTY CYCLE (O.H./C.H.) = .437

NUMBER OF FAILURES = 1. OBSERVED FAILURE RATE/O.H. = .19712E-03

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 5073.000, EST. MEDIAN = 3516.336, 90 PER CENT LCL FOR MEAN = 1304.2, 90 PER CENT UCL FOR MEAN = 48149.203

90 PERCENT UCL 48149.20 IS GREATER THAN 5000.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

R E L I A B I L I T Y

CATCC DAIR WRA 19 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED	SURVIVORS	NPD	EXPONENTIAL	WEIBULL
100.	.0	1.		8.	.111	.000	.009
100.	28.0	1.		7.	.222	.038	.309
98.	36.0	1.		6.	.333	.048	.333
100.	195.0	1.		5.	.444	.236	.523
100.	284.0	1.		4.	.556	.324	.572
	1399.0		1.				
100.	1482.0	1.		2.	.704	.871	.784
100.	1649.0	1.		1.	.852	.897	.797

EQUIPMENT OPERATING HOURS (O.H.) = 5073.0 CALENDAR HOURS(C.H.) =. 11616.0 DUTY CYCLE (O.H./C.H.) = .437

NUMBER OF FAILURES = 7. OBSERVED FAILURE RATE/O.H. = .13799E-02

QRATIO OF 3.883 EXCEEDS THE CRITICAL VALUE FOR TEST OF EXPONENTIAL

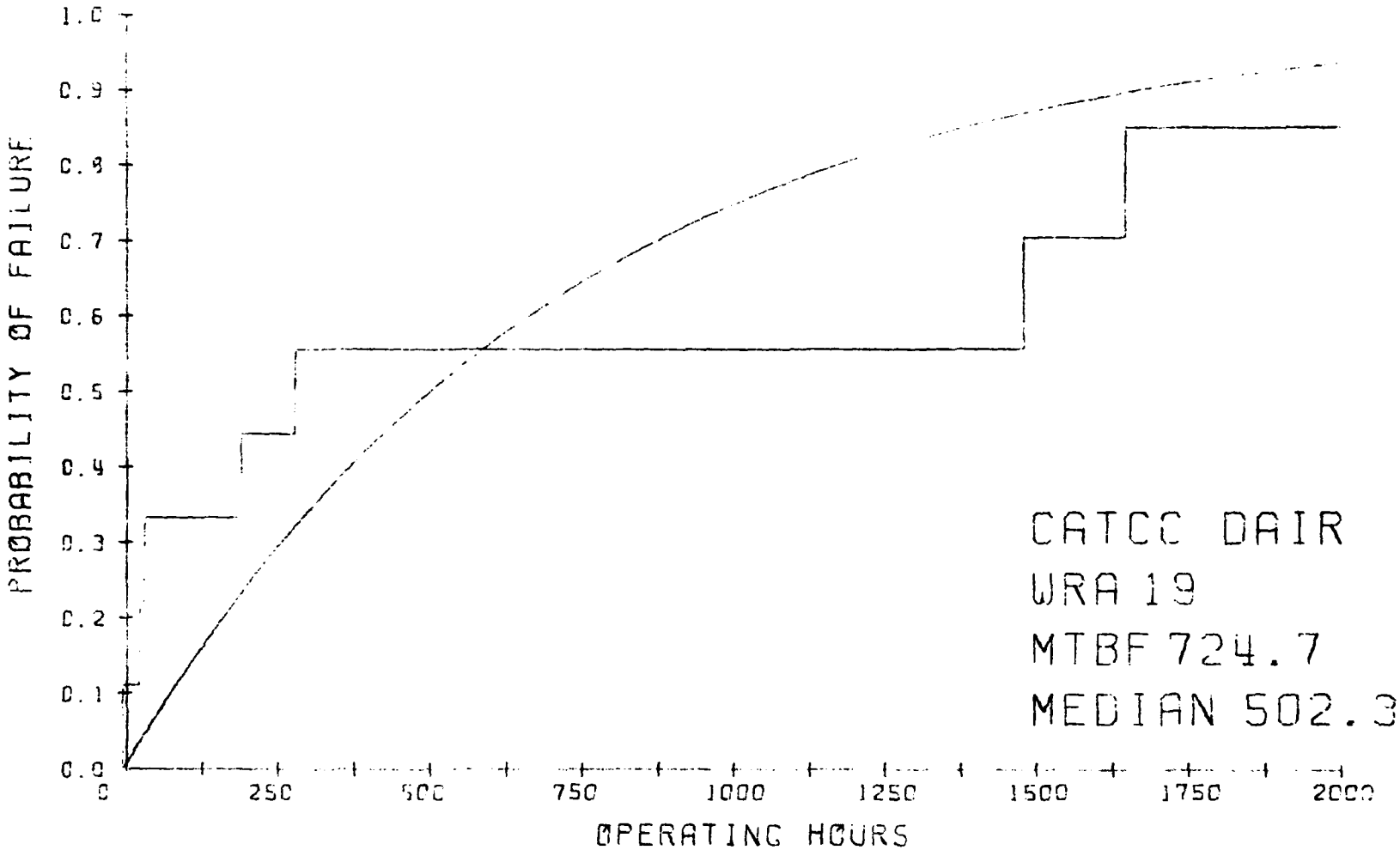
THE WEIBULL PARAMETERS ARE ALPHA = .112102E+00 BETA = .358215E+00

FOR THE ASSUMED DISTRIBUTION

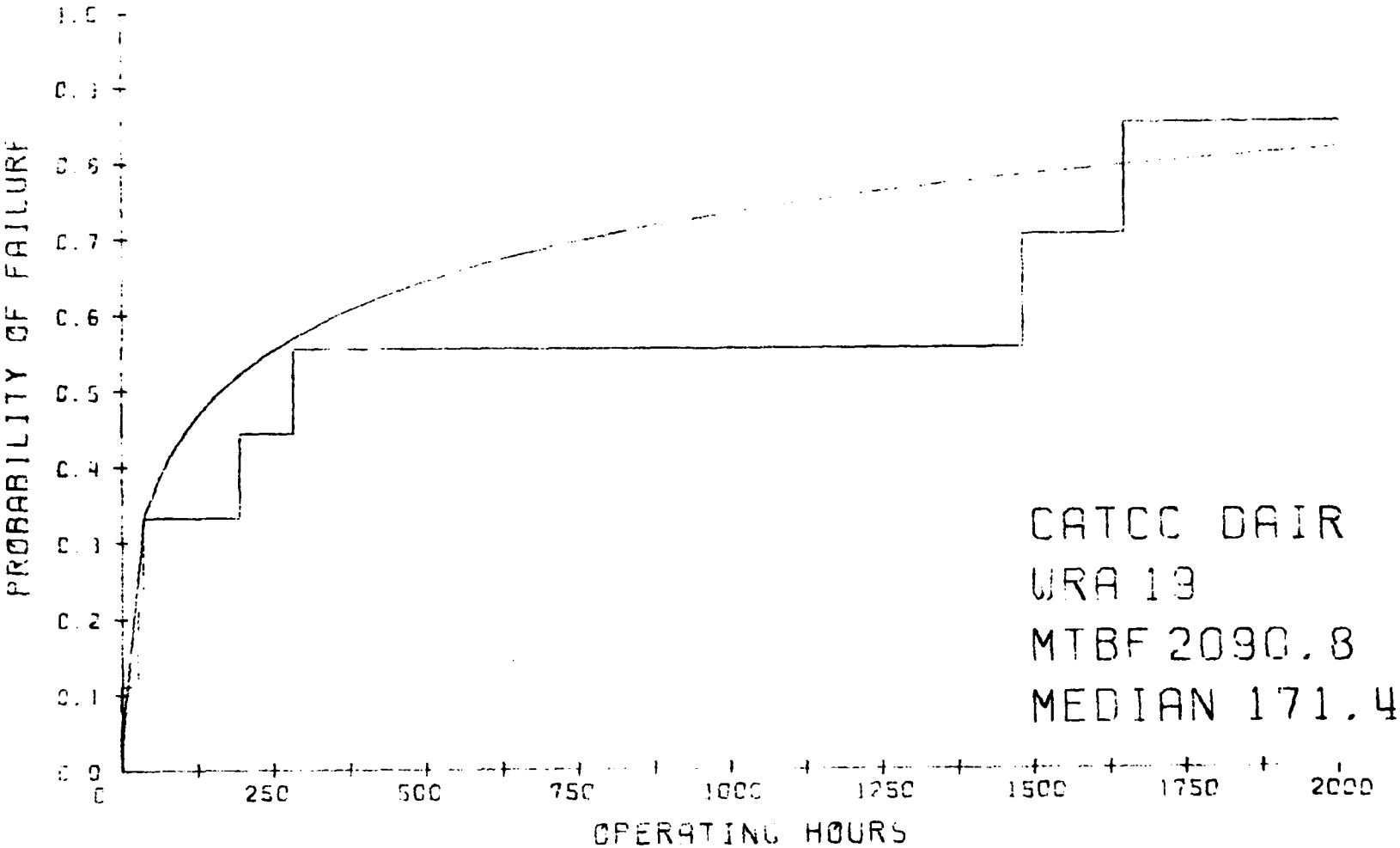
EST. MEAN = 2090.828. EST. MEDIAN = 171.429. 90 PER CENT LCL FOR MEAN = 0.000. 90 PER CENT UCL FOR MEAN = 6529.923

90 PER CENT LCL FOR BETA = .241342E+00 90 PER CENT UCL FOR BETA = .475088E+00

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



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



R E L I A B I L I T Y

CATCC DAIR O-LEVEL SUMMARY

WRA	O-LEVEL BLOCK	O-LEVEL NO.	O-LEVEL NOMENCLATURE	NUMBER FAILURES	LOWER 90 CONF LIM	MEAN	UPPER 90 CONF LIM	SPEC MTBF	OBSERVED FAILURE TIMES LOW	OBSERVED FAILURE TIMES HIGH	RELIAB PROBLEM
11	99			1.	1304.21	5073.00	48149.20	1000000.00	30.00	30.00	YES
16	99			1.	1304.21	5073.00	48149.20	1000000.00	635.00	635.00	YES
18	3		CRT DRIVER ELECTRONICS	1.	1304.21	5073.00	48149.20	22769.00	136.00	136.00	NO
19	2		DEFLECTION AMPLIFIER	3.	759.34	1691.00	4603.18	92808.00	1482.00	3646.00	YES
19	8		INTERFACE AND LOGIC	1.	1304.21	5073.00	48149.20	23702.00	3610.00	3610.00	NO
19	9		VIDEO AMPLIFIER	1.	1304.21	5073.00	48149.20	54885.00	3131.00	3131.00	YES
19	16		PANEL (RIGHT SIDE)	1.	1304.21	5073.00	48149.20	24499.00	3326.00	3326.00	NO

R E L I A B I L I T Y

2K SUMMARY FOR CATCC DAIRPROBLEM AREAS

JCN	WRA	O-L	O-L	O-L	WHAT HAPPENED
33610F010740	19	2	0	0	*
33610E010763	19	9	0	0	
33610E100780	19	2	0	0	ANOTHER AMP FAILURE/SEE 1131/EK
33610E100789	19	2	0	0	EMT REPORTED AS 55054/EK

FLEET MAINTAINABILITY ASSESSMENT DATA

SYSTEM	SHIPNAME	DISCOVERD	COMPL	REPAIR TIME	DOWN TIME
CATCC DAIR	KITTY HAWK	8288	8288	0.	0.
CATCC DAIR	KITTY HAWK	8321	8321	0.	0.
	NO REPAIR TIME FOR THE ABOVE RECORD				
CATCC DAIR	KITTY HAWK	8321	8321	0.	0.
	NO REPAIR TIME FOR THE ABOVE RECORD				
CATCC DAIR	KITTY HAWK	8348	8348	0.	0.
	NO REPAIR TIME FOR THE ABOVE RECORD				
CATCC DAIR	KITTY HAWK	9029	9029	0.	0.
	NO REPAIR TIME FOR THE ABOVE RECORD				
CATCC DAIR	RANGER	8307	8314	96.	168.
CATCC DAIR	RANGER	9049	9053	5.	96.
CATCC DAIR	RANGER	9058	9058	4.	4.
CATCC DAIR	RANGER	9074	9075	1.	24.
CATCC DAIR	RANGER	9080	9087	2.	168.
CATCC DAIR	RANGER	9104	9117	2.	312.

MAINTAINABILITY (REPAIR TIME)

CATCC DAIR SYSTEM LEVEL

REPAIR TIME.	FREQUENCY	CUM FREQUENCY	NPF	LOGNORMAL	EXPONENTIAL	WEIBULL
1.0	1.	1.0	.143	.177	.053	.231
2.0	2.	3.0	.429	.310	.103	.325
4.0	1.	4.0	.571	.474	.196	.444
5.0	1.	5.0	.714	.529	.239	.487
96.0	1.	6.0	.857	.972	.995	.975

TOTAL REPAIR HOURS = 110.0 NUMBER OF REPAIRS = 6. OBSERVED REPAIR RATE/HR = .5455E-01

DISTRIBUTION DETERMINATION

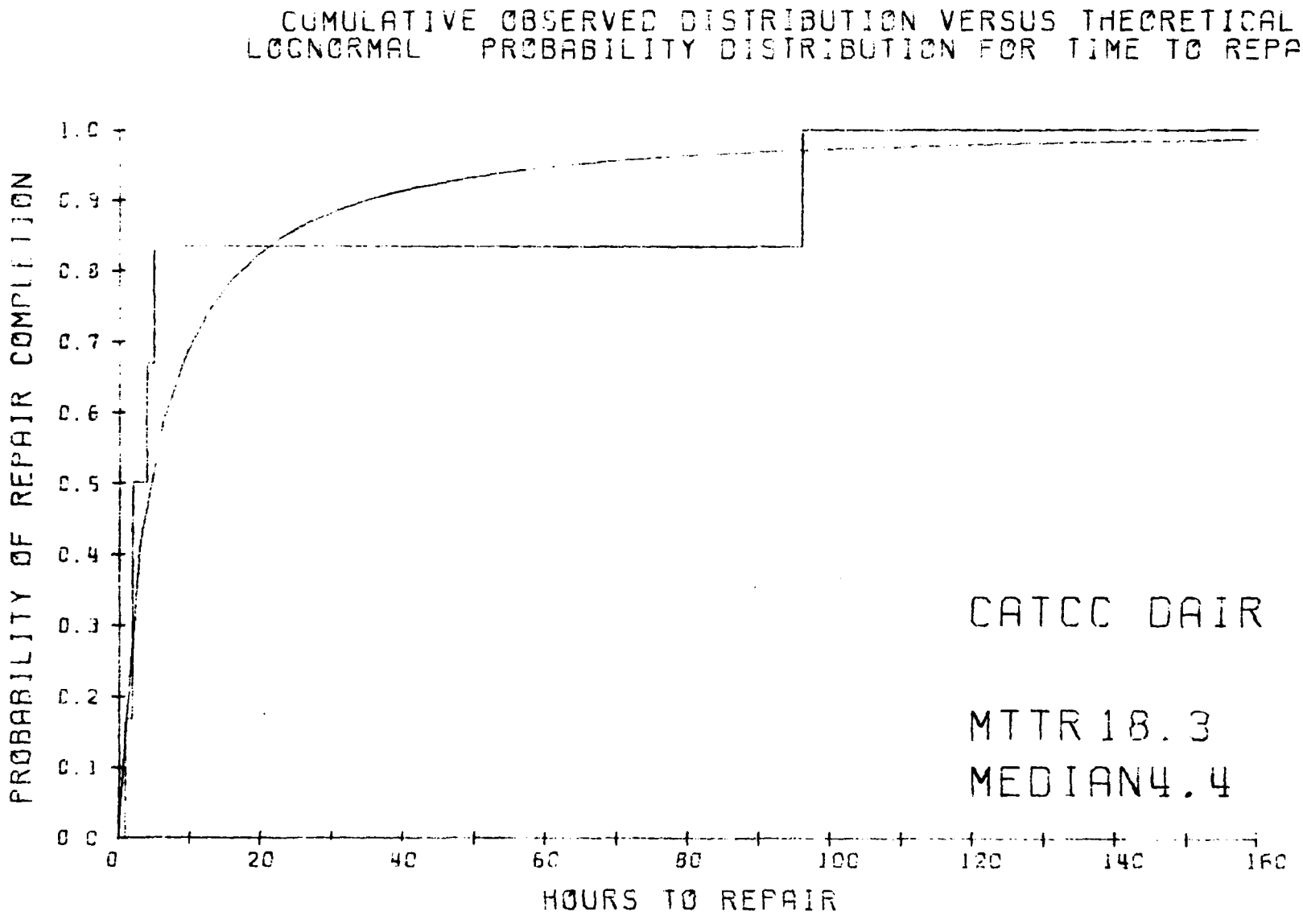
MEAN OF LN≠S = 1.49 STD DEV OF LN≠S = 1.61

K-S CRITICAL VALUE (.10, 6.) = .294 MAX DIFF CALC = .258 IS LESS THAN THE CRITICAL VALUE

THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

EST MEAN = 18.33 EST MEDIAN = 4.44 90 PER CENT LCL ON MEDIAN = 1.68 90 PER CENT UCL ON MEDIAN = 11.72

SPECIFIED MTTR = 2.00 HOURS LOWER CONF LIM 1.68 IS LESS THAN MTTR. THUS THE EQUIPMENT MEETS THE SPECIFICATIONS


CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
LOGNORMAL PROBABILITY DISTRIBUTION FOR TIME TO REPAIR
PROBABILITY OF REPAIR COMPLETION
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
20
40
60
80
100
120
140
160
HOURS TO REPAIR
CATCC DAIR
MTTR 18.3
MEDIAN 4.4

MAINTAINABILITY (DOWN TIME)

CATCC DAIR SYSTEM LEVEL

DOWN TIME.	FREQUENCY	CUM FREQUENCY	NPF	LOGNORMAL	EXPONENTIAL	WEIBULL
4.0	1.	1.0	.143	.042	.031	.034
24.0	1.	2.0	.286	.267	.170	.179
96.0	1.	3.0	.429	.592	.526	.532
168.0	2.	5.0	.714	.718	.729	.730
312.0	1.	6.0	.857	.831	.912	.908

TOTAL DOWN TIME (TDT) = 772.0 NUMBER OF REPAIRS (NR) = 6. OBSERVED DOWN TIME/REPAIR (TDT/NR) = 128.67

DISTRIBUTION DETERMINATION

MEAN OF LN≠S = 4.19 STD DEV OF LN≠S = 1.62

K-S CRITICAL VALUE (.10, 6.) = .294 MAX DIFF CALC = .306 IS GREATER THAN THE CRITICAL VALUE

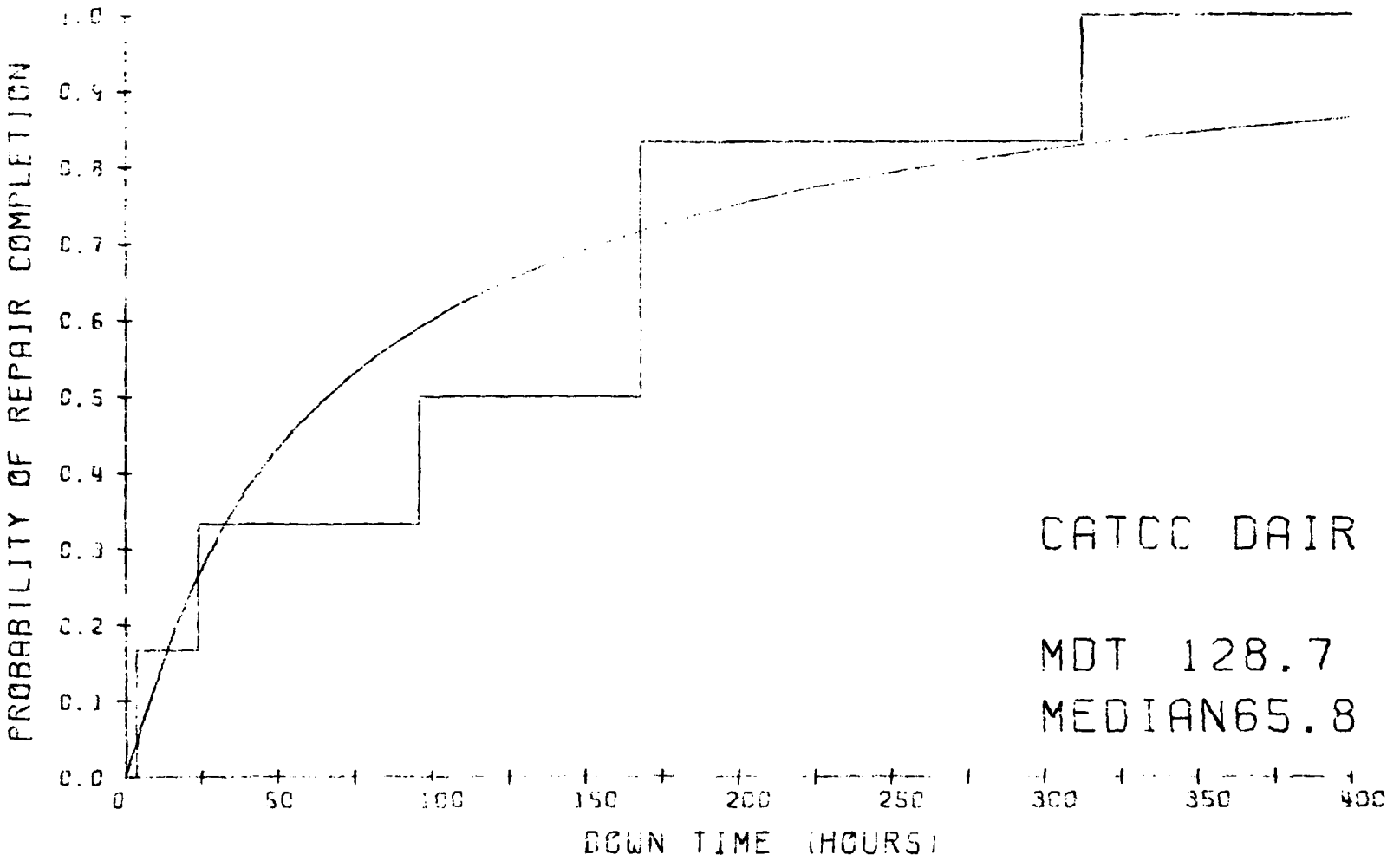
THEREFORE THE LOGNORMAL DISTRIBUTION CANNOT BE ASSUMED

ORATIO OF 3.360 DOES NOT EXCEED THE CRITICAL VALUE FOR TEST OF EXPONENTIAL

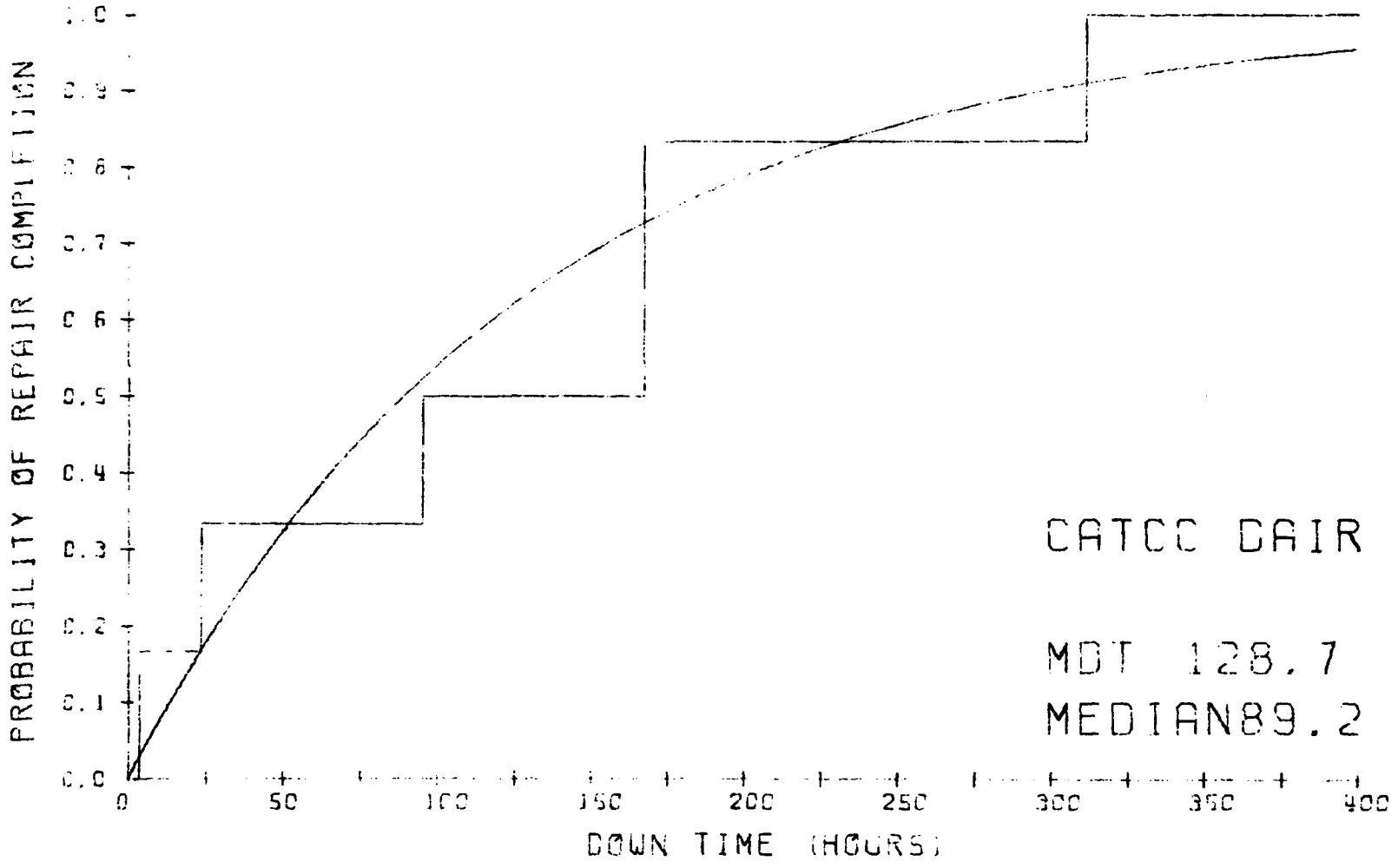
THEREFORE THE EXPONENTIAL DISTRIBUTION IS ASSUMED

EST MEAN = 128.67 EST MEDIAN = 89.18 90 PER CENT LCL ON MEAN = 83.24 90 PER CENT UCL ON MEAN = 244.93

CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL LOGNORMAL PROBABILITY DISTRIBUTION FOR DOWN TIME



CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL EXPONENTIAL PROBABILITY DISTRIBUTION FOR DOWN TIME



MAINTAINABILITY (REPAIR TIME)

CATCC DAIR WRA 19 LEVEL

REPAIR TIME.	FREQUENCY	CUM FREQUENCY	NPF	LOGNORMAL	EXPONENTIAL	WEIBULL
1.0	1.	1.0	.143	.177	.053	.231
2.0	2.	3.0	.429	.310	.103	.325
4.0	1.	4.0	.571	.474	.196	.444
5.0	1.	5.0	.714	.529	.239	.487
96.0	1.	6.0	.857	.972	.995	.975

TOTAL REPAIR HOURS = 110.0 NUMBER OF REPAIRS = 6. OBSERVED REPAIR RATE/HR = .5455E-01

DISTRIBUTION DETERMINATION

MEAN OF LN#S = 1.49 STD DEV OF LN#S = 1.61

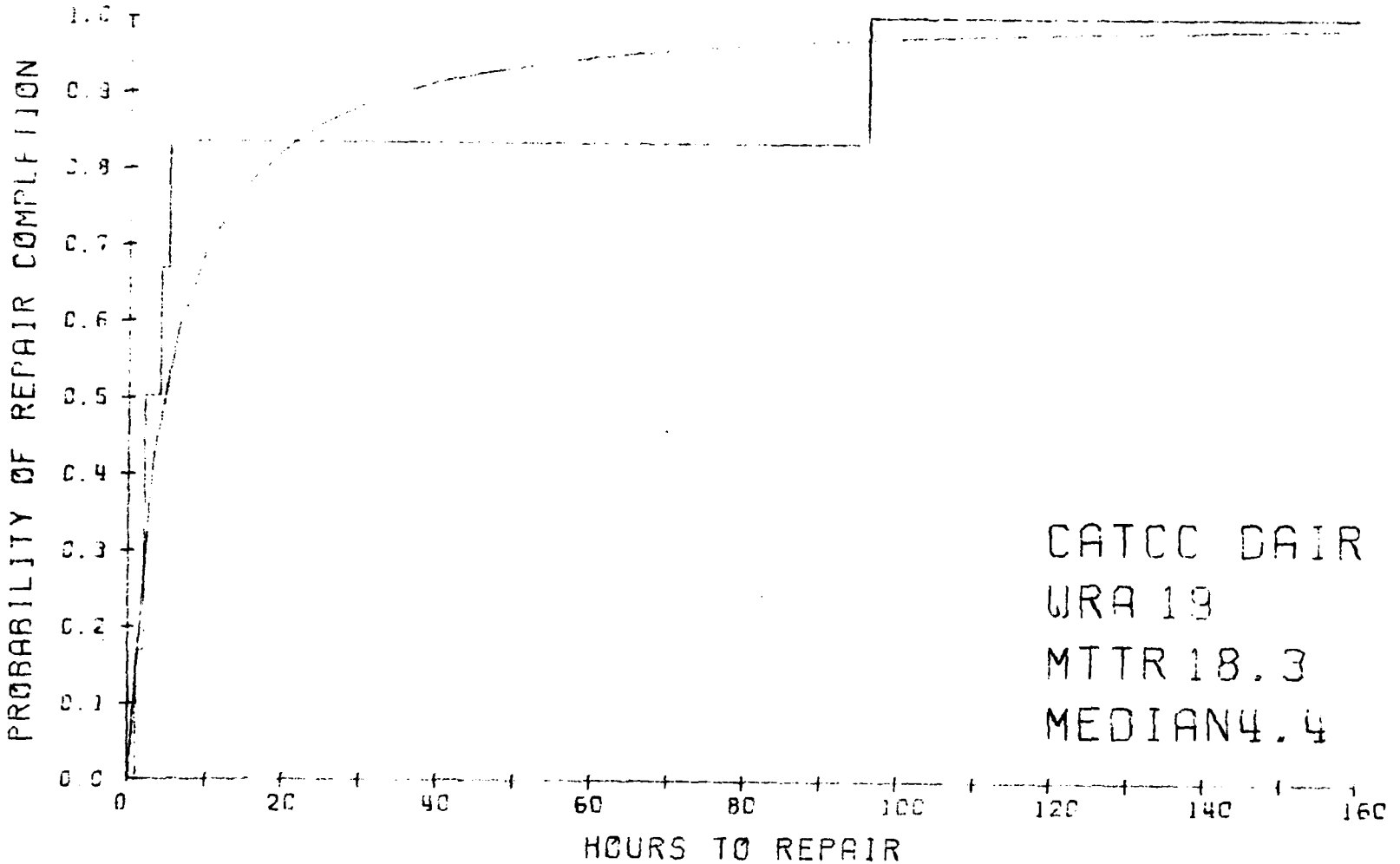
K-S CRITICAL VALUE (.10, 6.) = .294 MAX DIFF CALC = .258 IS LESS THAN THE CRITICAL VALUE

THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

EST MEAN = 18.33 EST MEDIAN = 4.44 90 PER CENT LCL ON MEDIAN = 1.68 90 PER CENT UCL ON MEDIAN = 11.72

SPECIFIED MTTR = 2.00 HOURS LOWER CONF LIM 1.68 IS LESS THAN MTTR, THUS THE EQUIPMENT MEETS THE SPECIFICATIONS

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



MAINTAINABILITY (REPAIR TIME)

CATCC OAIR O-LEVEL SUMMARY

WRA	O-LEVEL BLOCK NO.	O-LEVEL NOMENCLATURE	NUMBER REPAIRS	LOWER 90 CONF LIM	UPPER 90 CONF LIM	SPEC MTTR	OBSERVED REPAIR TIMES LOW	MEAN	HIGH	MAINT PROBLEM
19	2	DEFLECTION AMPLIFIER	3.	.40	84.00	2.0	1.0	33.00	96.0	NO
19	8	INTERFACE AND LOGIC	1.	NO CONF LIMITS		2.0	2.0	2.00	2.0	
19	9	VIDEO AMPLIFIER	1.	NO CONF LIMITS		2.0	5.0	5.00	5.0	
19	16	PANEL (RIGHT SIDE)	1.	NO CONF LIMITS		2.0	4.0	0.00	4.0	

MAINTAINABILITY (REPAIR TIME)

2K SUMMARY FOR CATCC DAIR PROBLEM AREAS

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

RMA SUMMARY CATCC DAIR EQUIP. RELIABILITYSYSTEM LEVEL

TTF DISTRIBUTION IS WEIBULL WITH ALPHA = .09890 AND BETA = .40500 MEAN = 971.27

DT DISTRIBUTION IS EXPONENTIAL WITH MEAN = 128.67

RT DISTRIBUTION IS LOGNORMAL WITH MEAN OF LNS = 1.49000 AND STANDARD DEVIATION OF LNS = 1.61000

INHERENT AVAILABILITY = MTBF/(MTBF+MTTR)

MEAN TIME TO FAILURE = 971.27

MEAN REPAIR TIME = 14.08

INHERENT AVAILABILITY = .9857

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

90 PERCENT LCL ON INDIVIDUALS = .0017

90 PERCENT UCL ON INDIVIDUALS = .9793

MEAN = .5245

MEDIAN = .5773

SUB-SECTION (4)

CATCC-DAIR

PARTS

REPLACEMENT

FLEET RELIABILITY ASSESSMENT DATA

SYSTEM	SHIPNAME	DATE	FTM	FAILURE TYPE	OPERATE	FAILURE TIME	DUTY	WRA	OL1	OL2	OL3
CATCC DAIR	KITTY HAWK	8248	2650.	FAILURE	0.	0.	0.000	14	39	0	0
CATCC DAIR	KITTY HAWK	8321	2658.	INITIAL	0.	0.	0.000	0	0	0	0
CATCC DAIR	KITTY HAWK	8321	2686.	FAILURE	28.	28.	0.000	19	0	0	0
CATCC DAIR	KITTY HAWK	8321	2688.	FAILURE	30.	2.	0.000	11	99	0	0
CATCC DAIR	KITTY HAWK	8348	2794.	FAILURE	136.	106.	.210	18	3	0	0
CATCC DAIR	KITTY HAWK	9010	3104.	CENSORED	446.	310.	.344	0	0	0	0
CATCC DAIR	KITTY HAWK	9011	3125.	CENSORED	467.	331.	.354	0	0	0	0
CATCC DAIR	KITTY HAWK	9029	3293.	CENSORED	635.	499.	.362	16	99	0	0
CATCC DAIR	KITTY HAWK	9135	4085.	FINAL	1427.	1291.	.332	0	0	0	0
CATCC DAIR	RANGER	8164	1904.	INITIAL	0.	0.	0.000	0	0	0	0
CATCC DAIR	RANGER	8256	2435.	CENSORED	551.	551.	.250	0	0	0	0
CATCC DAIR	RANGER	8278	2702.	CENSORED	798.	798.	.292	0	0	0	0
CATCC DAIR	RANGER	8307	3386.	FAILURE	1482.	1482.	.432	19	2	0	0
CATCC DAIR	RANGER	8334	4163.	CENSORED	2259.	777.	.554	0	0	0	0
CATCC DAIR	RANGER	8363	4519.	CENSORED	2615.	1133.	.548	0	0	0	0
CATCC DAIR	RANGER	9049	5035.	FAILURE	3131.	1649.	.522	19	9	0	0
CATCC DAIR	RANGER	9056	5230.	FAILURE	3326.	195.	.535	19	16	0	0
CATCC DAIR	RANGER	9074	5514.	FAILURE	3610.	284.	.547	19	2	0	0
CATCC DAIR	RANGER	9080	5514.	FAILURE	3610.	0.	.535	19	8	0	0
CATCC DAIR	RANGER	9104	5550.	FAILURE	3646.	36.	.498	19	2	0	0

R E L I A B I L I T Y

CATCC DAIRSYSTEM LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED	SURVIVORS	NPD	EXPONENTIAL	WEIBULL
100.	.6	1.		10.	.091	.000	.010
100.	2.0	1.		9.	.182	.004	.151
100.	28.0	1.		8.	.273	.048	.347
98.	36.0	1.		7.	.364	.062	.373
100.	106.0	1.		6.	.455	.171	.499
100.	195.0	1.		5.	.545	.292	.578
100.	284.0	1.		4.	.636	.396	.628
	1291.0		1.				
100.	1442.0	1.		2.	.758	.928	.835
100.	1649.0	1.		1.	.879	.946	.846

EQUIPMENT OPERATING HOURS (O.H.) = 5073.0 CALENDAR HOURS(C.H.) = 11616.0 DUTY CYCLE (O.H./C.H.) = .437

NUMBER OF FAILURES = 9. OBSERVED FAILURE RATE/O.H. = .17741E-02

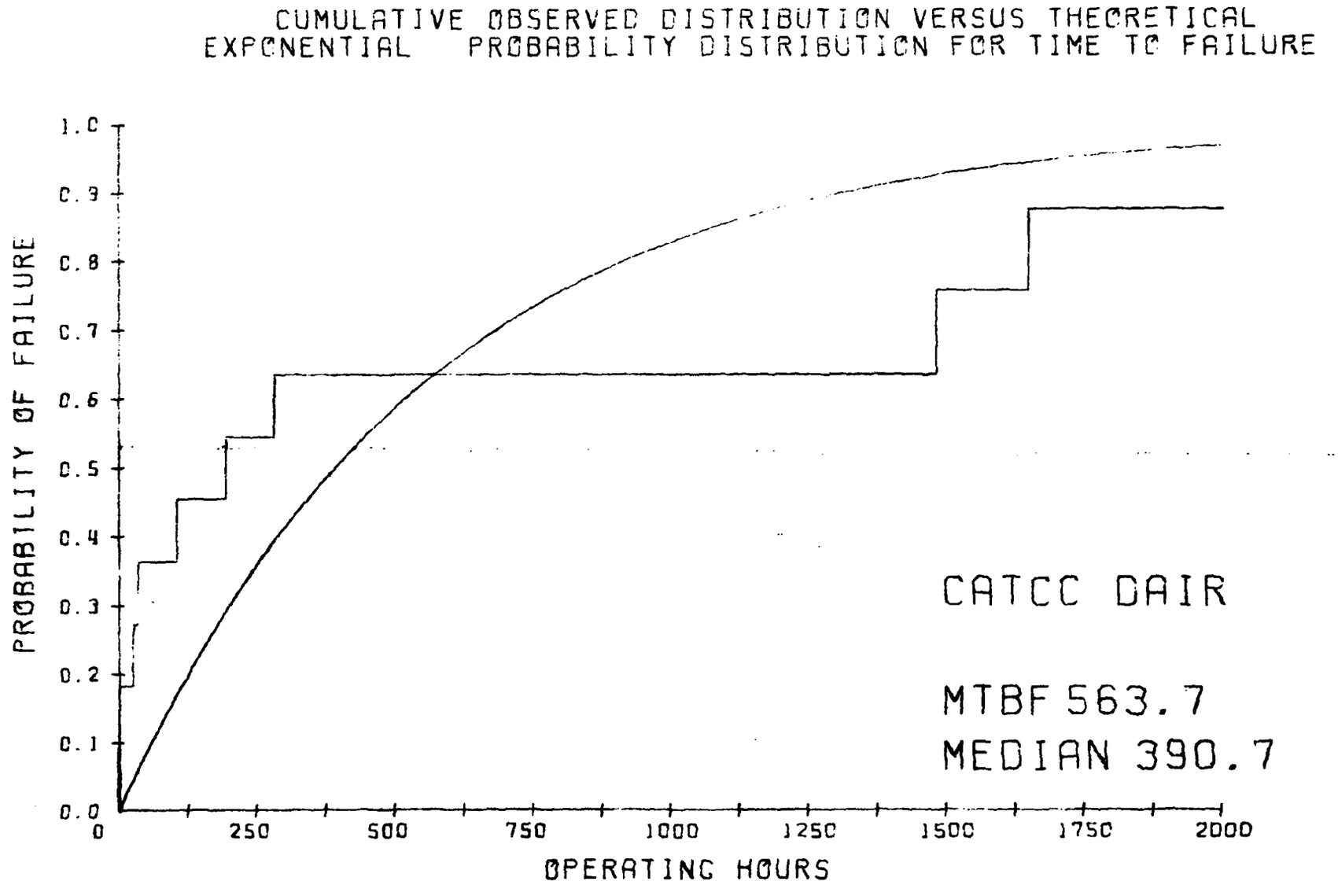
GRATIO OF 6.226 EXCEEDS THE CRITICAL VALUE FOR TEST OF EXPONENTIAL

THE WEIBULL PARAMETERS ARE ALPHA = .127400E+00 BETA = .362814E+00

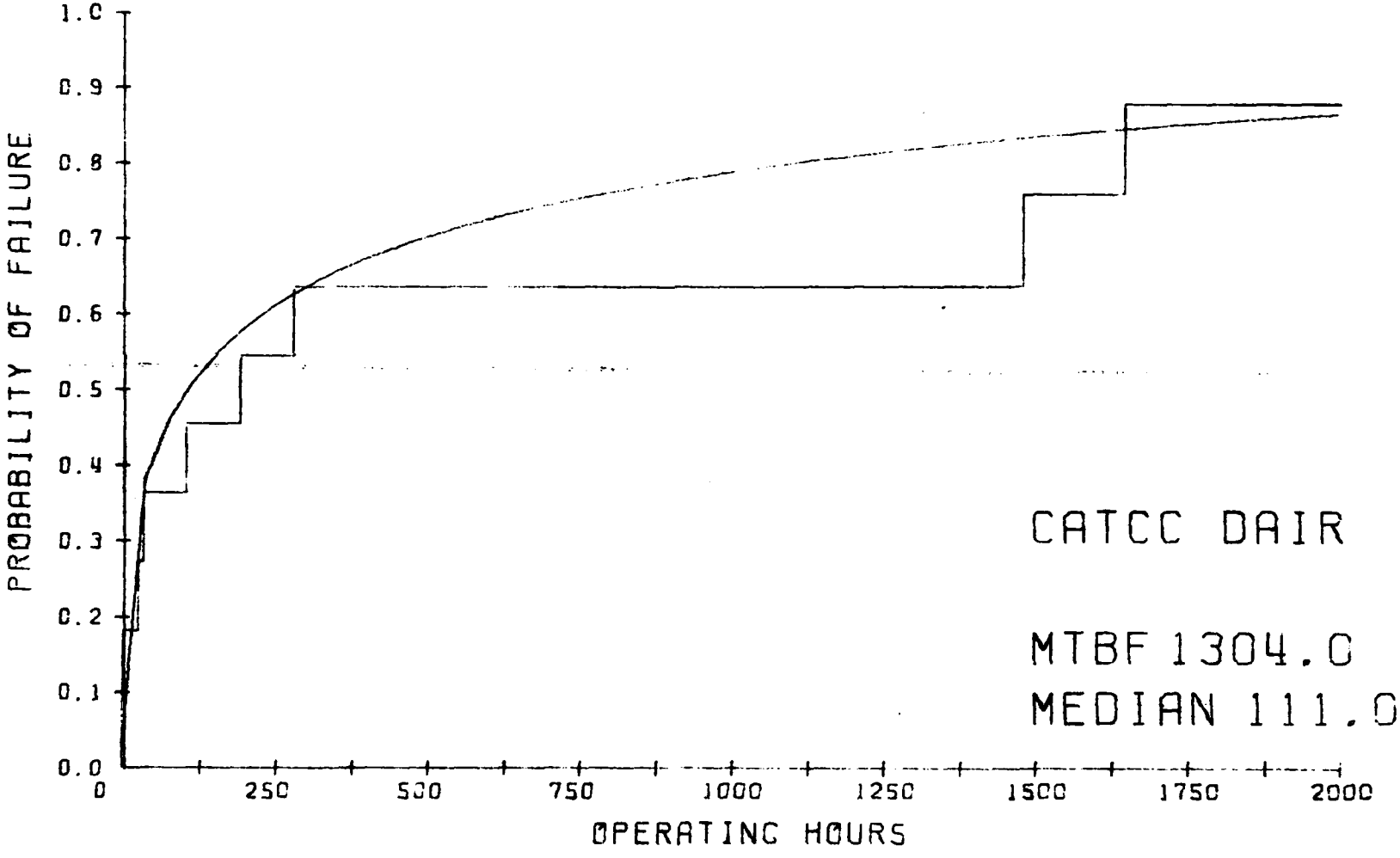
FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 1304.031. EST. MEDIAN = 111.000. 90 PER CENT LCL FOR MEAN = 0.000. 90 PER CENT UCL FOR MEAN = 3591.256

90 PER CENT LCL FOR BETA = .261647E+00 90 PER CENT UCL FOR BETA = .463980E+00


CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
EXPONENTIAL PROBABILITY DISTRIBUTION FOR TIME TO FAILURE
PROBABILITY OF FAILURE
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
250
500
750
1000
1250
1500
1750
2000
OPERATING HOURS
CATCC DAIR
MTBF 563.7
MEDIAN 390.7

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



R E L I A B I L I T Y

CATCC UAIR WRA 11 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
100.	30.0	1.	
	1397.0		1.
	3646.0		1.

EQUIPMENT OPERATING HOURS (O.H.) = 5073.0 CALENDAR HOURS(C.H.) = 11616.0 DUTY CYCLE (O.H./C.H.) = .437

NUMBER OF FAILURES = 1. OBSERVED FAILURE RATE/O.H. = .19712E-03

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 5073.000. EST. MEDIAN = 3516.336. 90 PER CENT LCL FOR MEAN = 1304.2. 90 PER CENT UCL FOR MEAN = 48149.203

90 PERCENT UCL 48149.20 IS GREATER THAN 11655.00 HOURS. THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

R E L I A B I L I T Y

CATCC DAIR WRA 18 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED
100.	136.0	1.	
	1241.0		1.
	3646.0		1.

EQUIPMENT OPERATING HOURS (O.H.) = 5073.0 CALENDAR HOURS(C.H.) =, 11616.0 DUTY CYCLE (O.H./C.H.) = .437

NUMBER OF FAILURES = 1. OBSERVED FAILURE RATE/O.H. = .19712E-03

LESS THAN FOUR FAILURES THE EXPONENTIAL DISTRIBUTION IS ASSUMED

FOR THE ASSUMED DISTRIBUTION

EST. MEAN = 5073.000, EST. MEDIAN = 3516.336, 90 PER CENT LCL FOR MEAN = 1304.2, 90 PER CENT UCL FOR MEAN = 48149.203

90 PERCENT UCL 48149.20 IS GREATER THAN 5000.00 HOURS, THEREFORE THE EQUIPMENT MEETS THE SPECIFICATIONS

R E L I A B I L I T Y

CATCC DAIR WRA 19 LEVEL

REMAINING SYS. CAP.	TIME TO FAIL	NO. FAILURES	NO. CENSORED	SURVIVORS	NPD	EXPONENTIAL	WEIBULL
100.	.0	1.		8.	.111	.000	.009
100.	28.0	1.		7.	.222	.038	.309
98.	36.0	1.		6.	.333	.048	.333
100.	195.0	1.		5.	.444	.236	.523
100.	284.0	1.		4.	.556	.324	.572
	1399.0		1.				
100.	1482.0	1.		2.	.704	.871	.784
100.	1649.0	1.		1.	.852	.897	.797

EQUIPMENT OPERATING HOURS (O.H.) = 5073.0 CALENDAR HOURS(C.H.) = 11616.0 DUTY CYCLE (O.H./C.H.) = .437

NUMBER OF FAILURES = 7. OBSERVED FAILURE RATE/O.H. = .13799E-02

QRATIO OF 3.883 EXCEEDS THE CRITICAL VALUE FOR TEST OF EXPONENTIAL

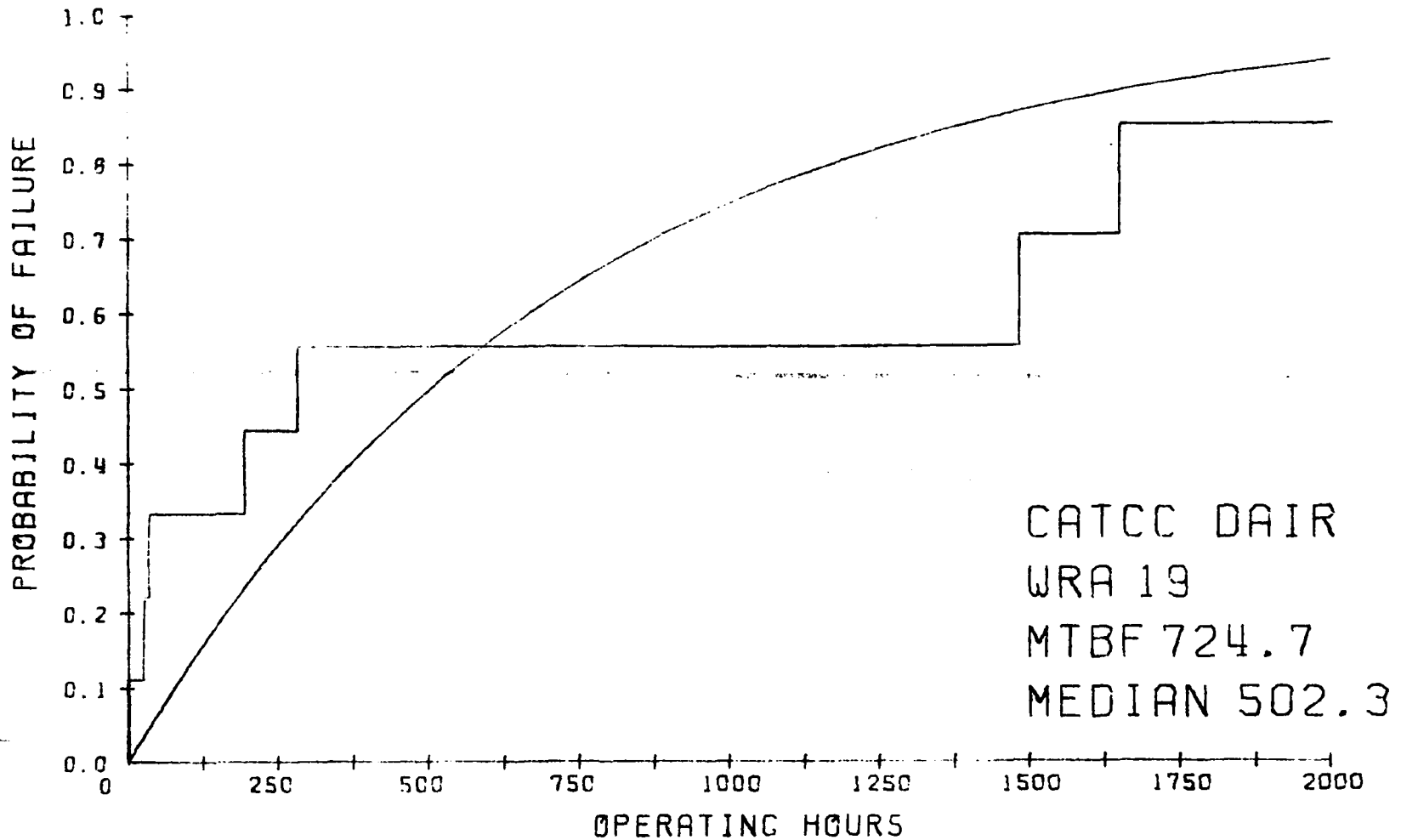
THE WEIBULL PARAMETERS ARE ALPHA = .112102E+00 BETA = .358215E+00

FOR THE ASSUMED DISTRIBUTION

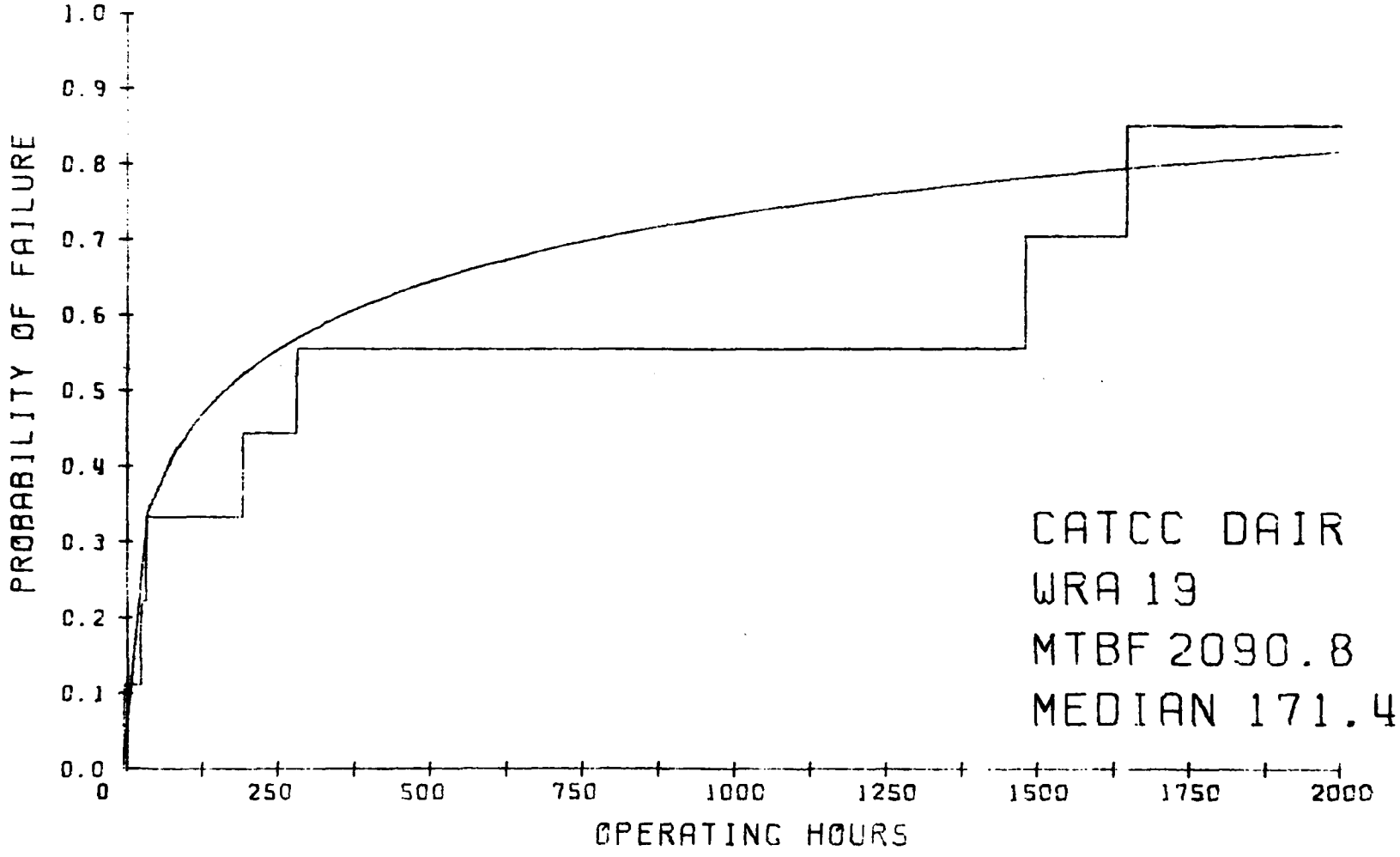
EST. MEAN = 2090.828, EST. MEDIAN = 171.429, 90 PER CENT LCL FOR MEAN = 0.000, 90 PER CENT UCL FOR MEAN = 6529.923

90 PER CENT LCL FOR BETA = .241342E+00 90 PER CENT UCL FOR BETA = .475088E+00

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



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



R E L I A B I L I T Y

CATCC DAIR O-LEVEL SUMMARY

WRA	O-LEVEL BLOCK	O-LEVEL NO.	O-LEVEL NOMENCLATURE	NUMBER FAILURES	LOWER 90 CONF LIM	MEAN	UPPER 90 CONF LIM	SPEC MTBF	OBSERVED FAILURE TIMES LOW	OBSERVED FAILURE TIMES HIGH	RELIAB PROBLEM
11	99			1.	1304.21	5073.00	48149.20	1000000.00	30.00	30.00	YES
18	3		CRT DRIVER ELECTRONICS	1.	1304.21	5073.00	48149.20	22769.00	136.00	136.00	NO
19	2		DEFLECTION AMPLIFIER	3.	759.34	1691.00	4603.18	92808.00	1482.00	3646.00	YES
19	8		INTERFACE AND LOGIC	1.	1304.21	5073.00	48149.20	23702.00	3610.00	3610.00	NO
19	9		VIDEO AMPLIFIER	1.	1304.21	5073.00	48149.20	54885.00	3131.00	3131.00	YES
19	16		PANEL (RIGHT SIDE)	1.	1304.21	5073.00	48149.20	24499.00	3326.00	3326.00	NO

R E L I A B I L I T Y

2K SUMMARY FOR CATCC DAIRPROBLEM AREAS

JCN	*RA	O-L	O-L	O-L	WHAT HAPPENED

FLEET MAINTAINABILITY ASSESSMENT DATA

SYSTEM	SHIPNAME	DISCOVERD	COMPL	REPAIR TIME	DOWN TIME
CATCC DAIR	KITTY HAWK	8288	8288	0.	0.
CATCC DAIR	KITTY HAWK	8321	8321	6.	6.
CATCC DAIR	KITTY HAWK	8321	8321	1.	1.
CATCC DAIR	KITTY HAWK	8348	8348	0.	0.
		NO REPAIR TIME FOR THE ABOVE RECORD			
CATCC DAIR	RANGER	8307	8314	110.	168.
CATCC DAIR	RANGER	9049	9053	10.	96.
CATCC DAIR	RANGER	9058	9058	8.	8.
CATCC DAIR	RANGER	9074	9075	1.	24.
CATCC DAIR	RANGER	9080	9087	2.	168.
CATCC DAIR	RANGER	9104	9117	2.	312.

MAINTAINABILITY (REPAIR TIME)

CATCC DAIR SYSTEM LEVEL

REPAIR TIME.	FREQUENCY	CUM FREQUENCY	NPF	LOGNORMAL	EXPONENTIAL	WEIBULL
1.0	2.	2.0	.222	.163	.056	.219
2.0	2.	4.0	.444	.296	.108	.312
6.0	1.	5.0	.556	.566	.290	.516
8.0	1.	6.0	.667	.637	.367	.578
10.0	1.	7.0	.778	.689	.435	.627
110.0	1.	8.0	.889	.979	.998	.985

TOTAL REPAIR HOURS = 140.0 NUMBER OF REPAIRS = 8. OBSERVED REPAIR RATE/HR = .5714E-01

DISTRIBUTION DETERMINATION

MEAN OF LN#S = 1.53 STD DEV OF LN#S = 1.56

K-S CRITICAL VALUE (.10, 8.) = .261 MAX DIFF CALC = .201 IS LESS THAN THE CRITICAL VALUE

THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

EST MEAN = 17.50 EST MEDIAN = 4.63 90 PER CENT LCL ON MEDIAN = 2.12 90 PER CENT UCL ON MEDIAN = 10.12

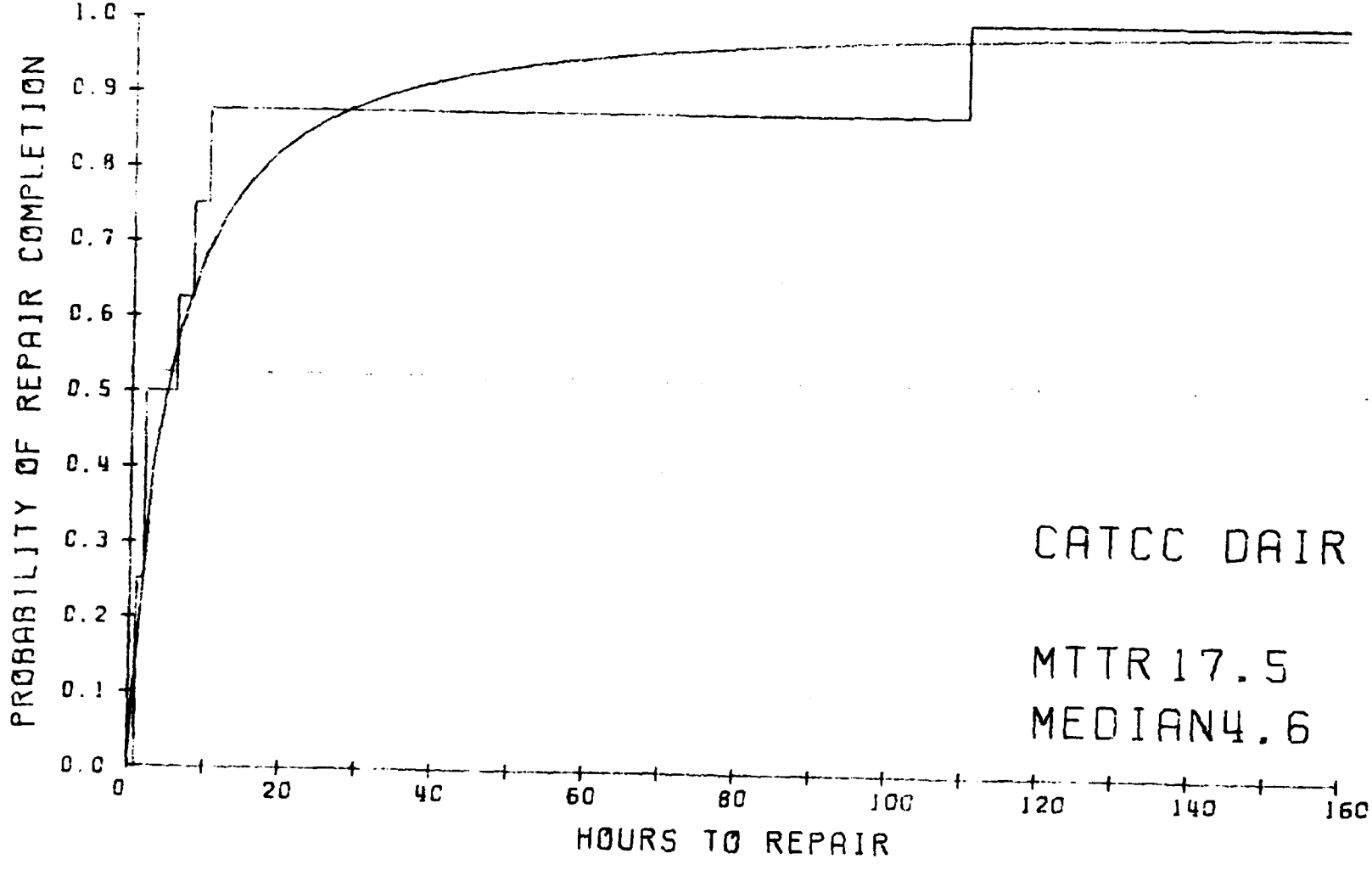
SPECIFIED MTTR = 2.00 HOURS LOWER CONF LIM 2.12 IS GREATER THAN MTTR, THUS A MAINTAINABILITY PROBLEM EXISTS

AD-A093 921 NAVAL WEAPONS SUPPORT CENTER CRANE IN F/G 17/7
FLEET RELIABILITY ASSESSMENT PROGRAM. VOLUME 2A. EQUIPMENT REPO--ETC(U)
SEP 79

UNCLASSIFIED NL

END
DATE FILMED
2-84
DTIC

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



MAINTAINABILITY (DOWN TIME)

CALCC DAIR SYSTEM LEVEL

DOWN TIME.	FREQUENCY	CUM FREQUENCY	NPF	LOGNORMAL	EXPONENTIAL	WEIBULL
1.0	1.	1.0	.111	.044	.010	.052
6.0	1.	2.0	.222	.206	.059	.164
8.0	1.	3.0	.333	.249	.078	.196
24.0	1.	4.0	.444	.446	.217	.366
96.0	1.	5.0	.556	.709	.625	.686
168.0	2.	7.0	.778	.796	.820	.815
312.0	1.	8.0	.889	.871	.959	.923

TOTAL DOWN TIME (TDT) = 783.0 NUMBER OF REPAIRS (NR) = 8. OBSERVED DOWN TIME/REPAIR (TDT/NR) = 97.88

DISTRIBUTION DETERMINATION

MEAN OF LN*S = 3.45 STD DEV OF LN*S = 2.03

K-S CRITICAL VALUE (.10, 8.) = .261 MAX DIFF CALC = .264 IS GREATER THAN THE CRITICAL VALUE

THEREFORE THE LOGNORMAL DISTRIBUTION CANNOT BE ASSUMED

QRATIO OF 9.064 EXCEEDS THE CRITICAL VALUE FOR TEST OF EXPONENTIAL

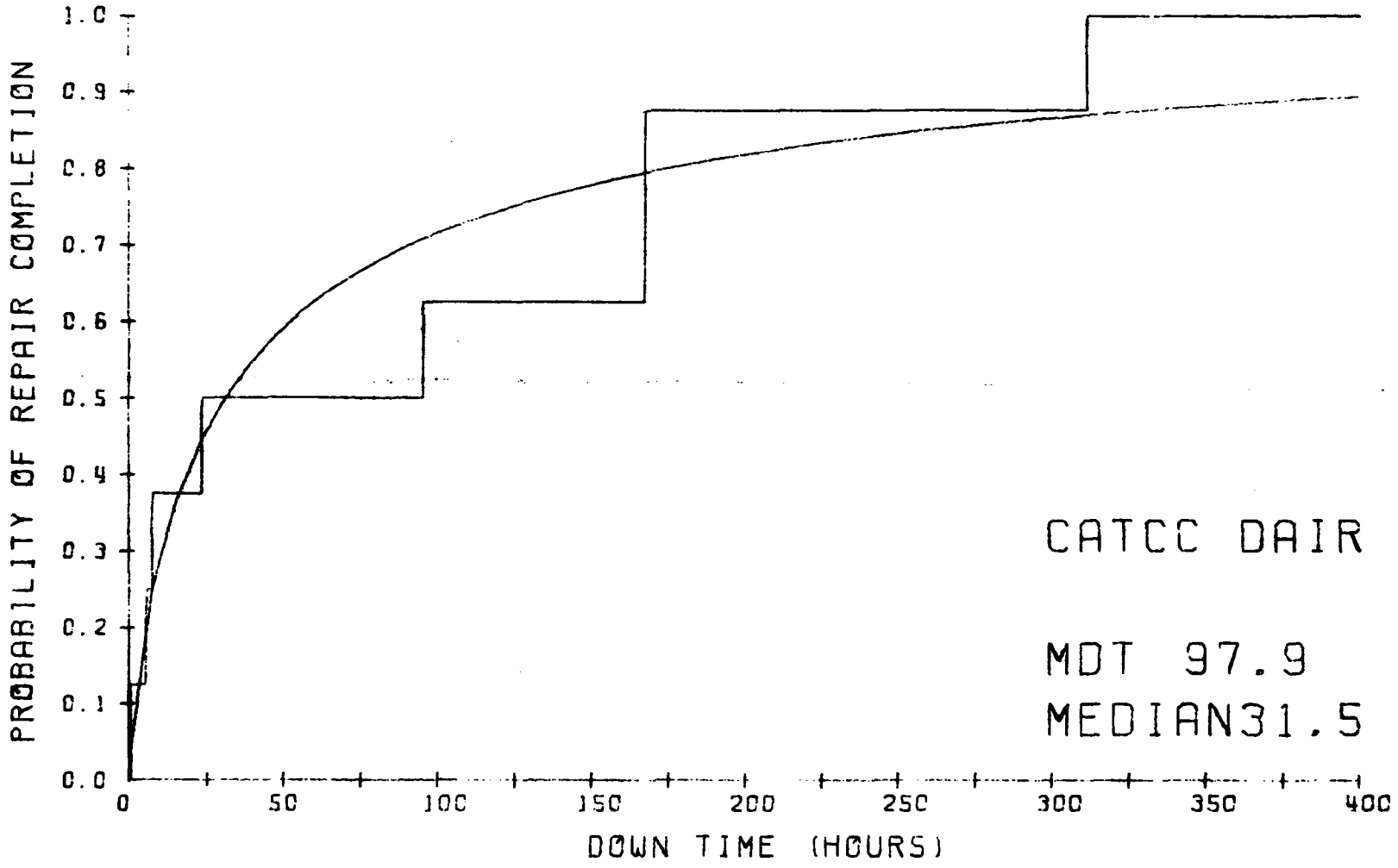
THEREFORE THE EXPONENTIAL DISTRIBUTION CANNOT BE ASSUMED

WEIBULL DISTRIBUTION ASSUMED, ESTIMATED PARAMETERS ARE ALPHA = .53828E-01 BETA = .67239E+00

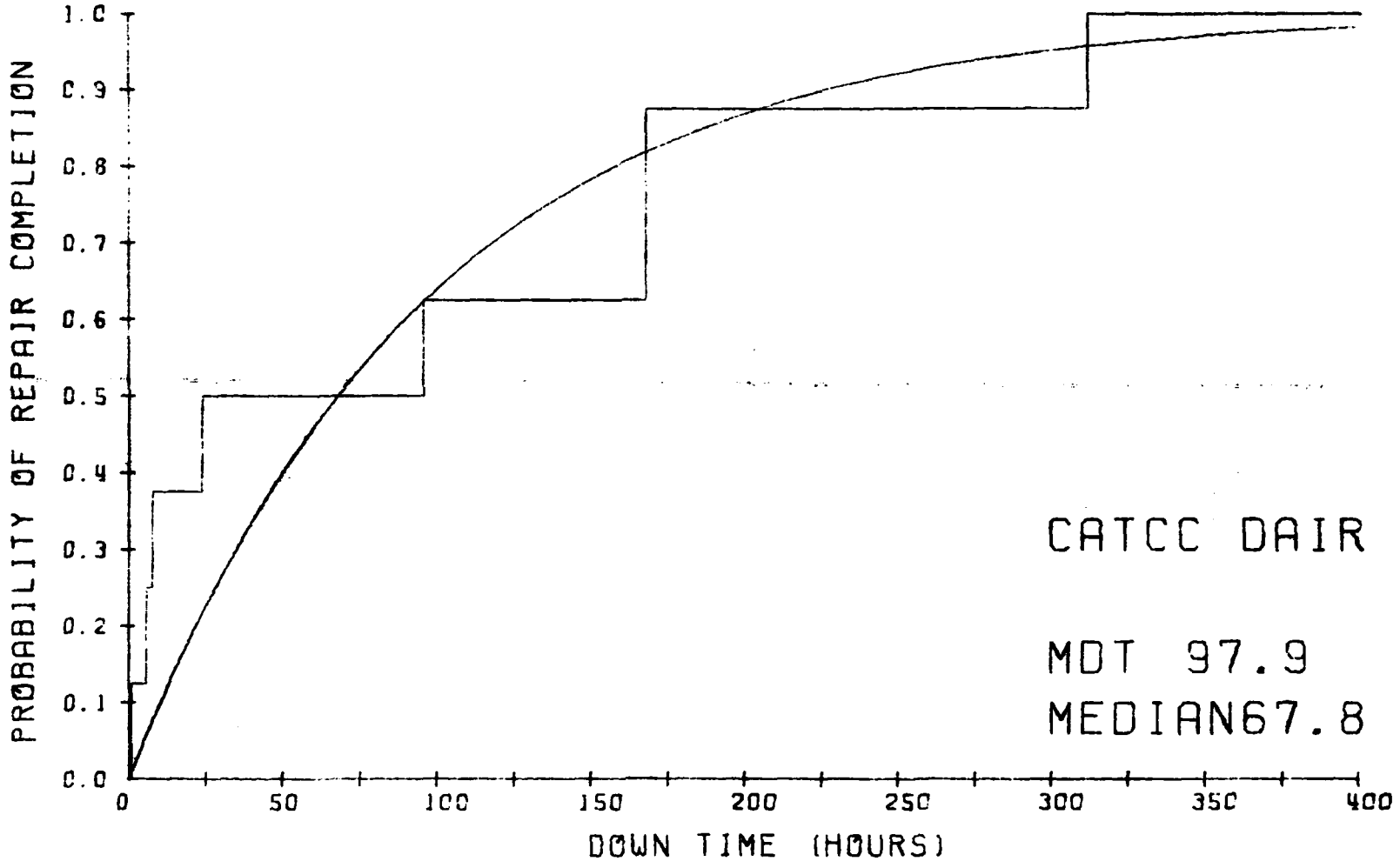
EST MEDIAN = 46.066 EST MEAN = 101.636 90 PER CENT LCL ON MEAN = 23.727 90 PER CENT UCL ON MEAN = 179.545

90 PER CENT LCL FOR BETA = .462323E+00 90 PER CENT UCL FOR BETA = .88245441E+00

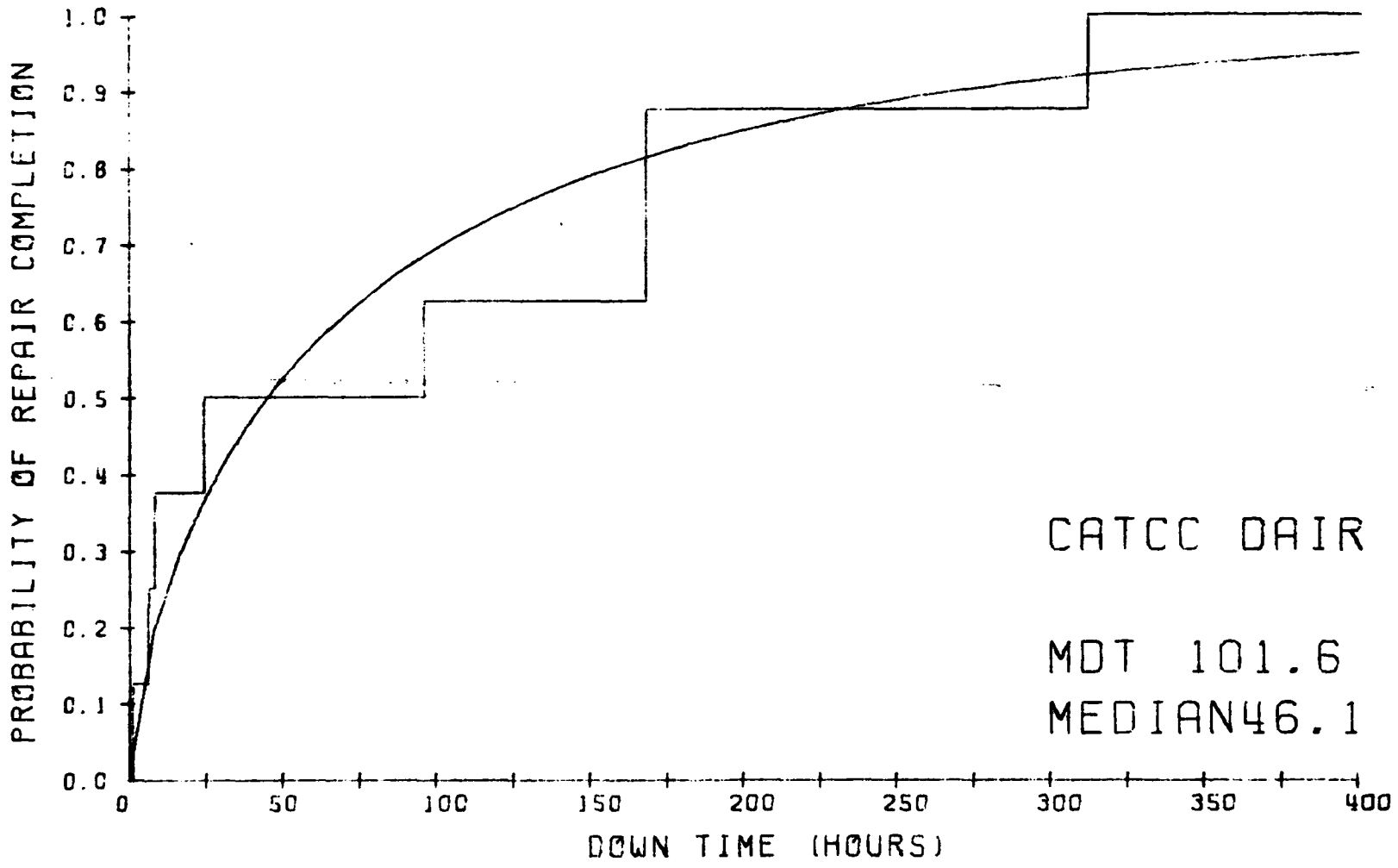
CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL LOGNORMAL PROBABILITY DISTRIBUTION FOR DOWN TIME



CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL EXPONENTIAL PROBABILITY DISTRIBUTION FOR DOWN TIME



CUMULATIVE OBSERVED DISTRIBUTION VERSUS THEORETICAL
WEIBULL PROBABILITY DISTRIBUTION FOR DOWN TIME



MAINTAINABILITY (REPAIR TIME)

CATCC DAIR WRA 11 LEVEL

LESS THAN FOUR DISTINCT REPAIR TIMES

THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

ONLY ONE DISTINCT REPAIR TIME -- NO CONFIDENCE LIMITS

MAINTAINABILITY (REPAIR TIME)

CATCC DAIR WRA 19 LEVEL

REPAIR TIME,	FREQUENCY	CUM FREQUENCY	NPF	LOGNORMAL	EXPONENTIAL	WEIBULL
1.0	1.	1.0	.125	.129	.049	.187
2.0	2.	3.0	.375	.247	.096	.273
6.0	1.	4.0	.500	.510	.261	.469
8.0	1.	5.0	.625	.584	.332	.531
10.0	1.	6.0	.750	.639	.396	.581
110.0	1.	7.0	.875	.971	.996	.980

TOTAL REPAIR HOURS = 139.0 NUMBER OF REPAIRS = 7. OBSERVED REPAIR RATE/HR = .5036E-01

DISTRIBUTION DETERMINATION

MEAN OF LN≠S = 1.75 STD DEV OF LN≠S = 1.55

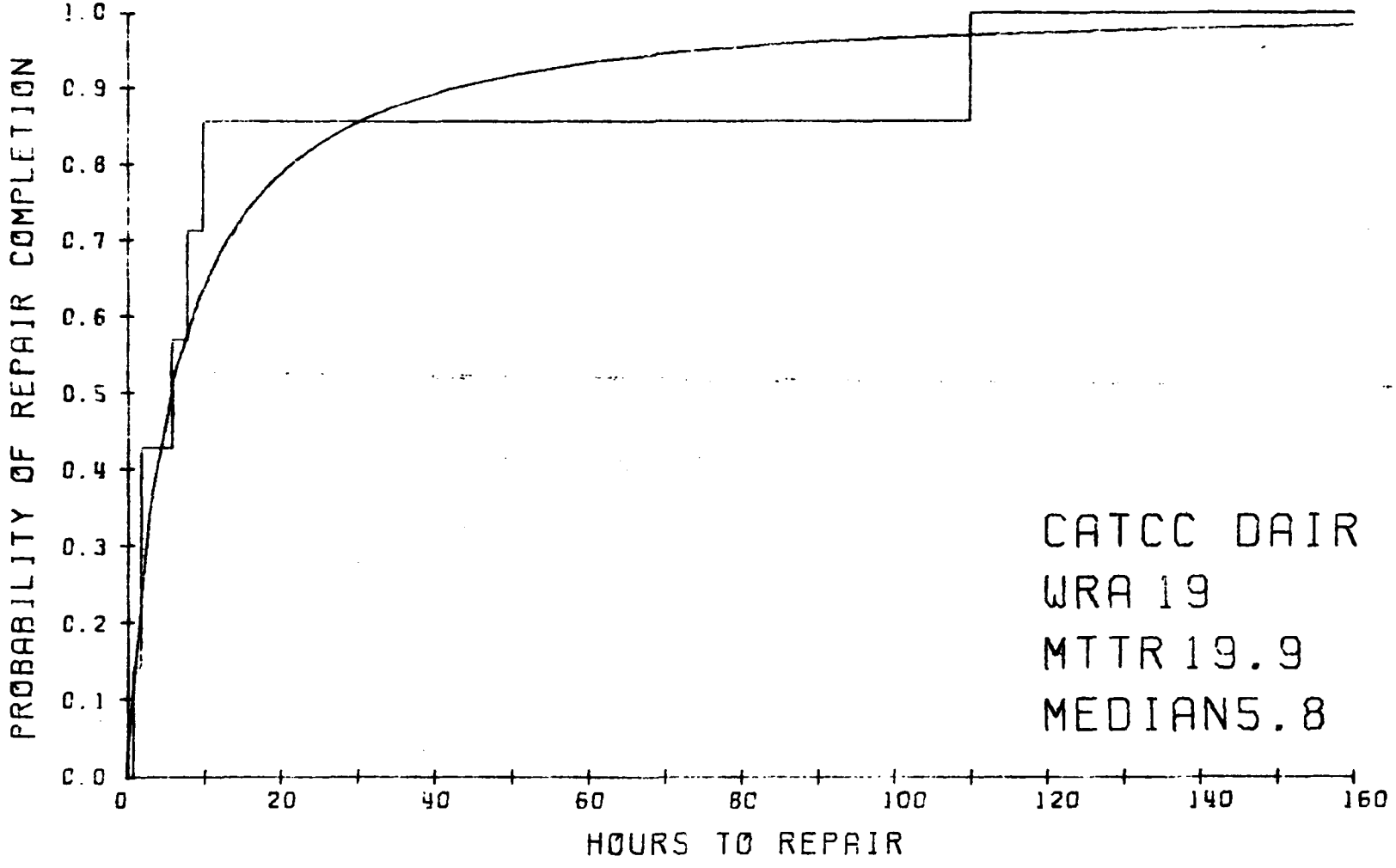
K-S CRITICAL VALUE (.10, 7.) = .276 MAX DIFF CALC = .221 IS LESS THAN THE CRITICAL VALUE

THEREFORE THE LOGNORMAL DISTRIBUTION IS ASSUMED

EST MEAN = 19.86 EST MEDIAN = 5.76 90 PER CENT LCL ON MEDIAN = 2.48 90 PER CENT UCL ON MEDIAN = 13.40

SPECIFIED MTTR = 2.00 HOURS LOWER CONF LIM 2.48 IS GREATER THAN MTTR, THUS A MAINTAINABILITY PROBLEM EXISTS

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



MAINTAINABILITY (REPAIR TIME)

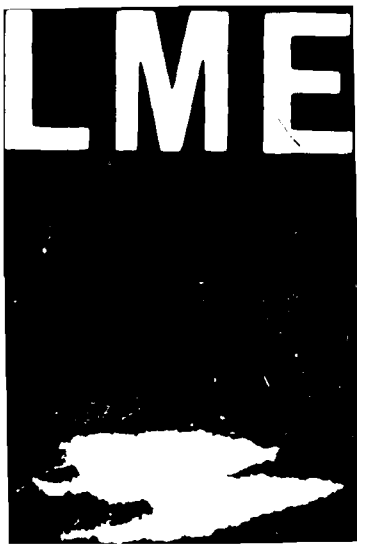
CAICC DAIH O-LEVEL SUMMARY

WRA	O-LEVEL BLOCK NO.	O-LEVEL NOMENCLATURE	NUMBER REPAIRS	LOWER 90 CONF LIM	UPPER 90 CONF LIM	SPEC MTTR	OBSERVED REPAIR TIMES LOW	MEAN	HIGH	MAINT PROBLEM
11	99		1.	NO CONF LIMITS		2.0	1.0	1.00	1.0	
19	2	DEFLECTION AMPLIFIER	3.	.38	95.67	2.0	1.0	37.67	110.0	NO
19	8	INTERFACE AND LOGIC	1.	NO CONF LIMITS		2.0	2.0	2.00	2.0	
19	9	VIDEO AMPLIFIER	1.	NO CONF LIMITS		2.0	10.0	10.00	10.0	
19	16	PANEL (RIGHT SIDE)	1.	NO CONF LIMITS		2.0	8.0	0.00	8.0	

MAINTAINABILITY (REPAIR TIME)

2K SUMMARY FOR CATCC DAIR PROBLEM AREAS

JCN	WRA	0-L	0-L	0-L	WHAT HAPPENED
33630E02M125	19	0	0	0	/EK
33610E010740	19	2	0	0	*
33610E010763	19	9	0	0	
33610E010777	19	16	0	0	/EK
33610E100780	19	2	0	0	ANOTHER AMP FAILURE/SEE 1131/EK
33610E100780	19	8	0	0	ETM REPORTED AS 45014/CORRECTED/EK
33610E100784	19	2	0	0	EMT REPORTED AS 55054/EK


LME