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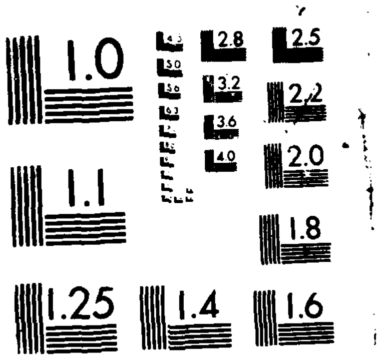

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VALIDATION OF A STOCHASTIC MODEL TO DETERMINE FAILURE RATES FOR COMMUNICATION-ELECTRONIC SYSTEMS

THESIS

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AFIT/GLM/LSMA/87S-84

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Wright-Patterson Air Force Base, Ohio

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VALIDATION OF A STOCHASTIC MODEL TO DETERMINE FAILURE RATES FOR COMMUNICATION-ELECTRONIC SYSTEMS

THESIS

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Logistics Management

Dennis G. Willeck

Major, USAF

September 1987

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Dennis G. Willeck

Table of Contents

List of Figures

List of Tables

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Abstract

Currently mobile C-E War Readiness Spares Kit (WRSK) computations are not automated. They are determined during an annual meeting attended by system users and suppliers. However, the Air Force continues to study several methods and models to automate the process. This thesis reports validation results of one model. The model combines the operating and non-operating failure rates to predict C-E system failures for a specified period of time. This model uses operating failures distributed over operating hours and non-operating failures distributed over system power-up attempts. Validation results showed this model predicted C-E failures as good as current methods during periods of steady-state, *long* operating hours; however, it more accurately predicted failures during periods where operating and non-operating failures occurred. Therefore, the model can be applied to Air Force C-E WRSK computations. HQ USAF/LEYS should develop a policy to ensure C-E system users document the necessary data for application of this model.

VALIDATION OF A STOCHASTIC MODEL TO DETERMINE FAILURE RATES FOR COMMUNICATION-ELECTRONIC SYSTEMS

I. Introduction

Background

This thesis attempts to validate a stochastic model for determining the failure rates of communication-electronic (C-E) systems. The validation will be done on a model proposed by Captain Thomas M. Skowronek, in his 1986 thesis, "Analysis of a Stochastic Model to Determine Failure Rates for Communication-Electronic Systems." This effort will complete his research and validate the model for accuracy. If the model proves valid, then an attempt will be made to apply this model to resolve a long standing Air Force problem of computing Communication-Electronic (C-E) war readiness spares kit (WRSK) requirements.

A WRSK is defined as the spare parts and system components required to repair and maintain the mission capability of mobile C-E systems during the early days of war (3:14-34). Mobile communications-electronic WRSK levels are presently determined during an annual meeting attended by system users and system component suppliers. They analyze past data and input personal experience to determine future WRSK levels (3:14-34). All computations are done by hand with little automation (see Appendix A). Without a true understanding of why and how the C-E systems fail and a close approximation of their failure rate distributions, improvements to this manual method of determining WRSK levels appear unlikely.

Capt Skowronek tested and described a model proposed by Capt R. D. Mabe, Air Force Institute of Technology (AFIT), that predicted C-E system failures which occurred during periods of both on-time and off-time as a result of their operational environment (1; 7; 10). The definitions from Skowronek's thesis for on- and off-time apply.

> Operating failures are straight forward; however, the non-operating failures are detected during equipment power-up. These failures are a combination of three specific types. First there are dormant failures, or failures occurring when the equipment is not operating, which include failures occurring while the unit is moving from one location to another. Secondly, there are those failures which occur during a power-down phase. Finally, there are power-up failures caused by electrical surges in the equipment. Any of these three categories, will only be discovered when the system is going through a power-up cycle (1:Sec IV, 12). Therefore, although non-operating failures could include three separate failure rates, for simplicity, they are all combined into one rate based on power-up cycles [13:5-6].

Capt Skowronek described Mabe's three-dimensional solution which accommodated both on- and off-time failure distributions. He showed that failures would occur on a plane and include both on- and off-time rates. The plane is described by the formula:

$$Z = (Za/Xa)(X) + (Zb/Yb)(Y) \tag{1}$$

where: Za = Expected on-time failures

Xa = On-time hours in current period

X = Transition time in next period

Zb = Expected off-time failures

Yb = Off-time cycles in current period and

Y = Transition off-time cycles in next period.

Figure 1 illustrates the three-dimensional model. This formula for calculating 'Z' forecasts the expected total failures in a future time period based on observations for time and cycles in the current operating period (13:24-30).

The model, as described by Skowronek, appears to accurately characterize the C-E environment. Figure 2, page 8, depicts a three-dimensional Poisson distribution, and pictorially describes what is occurring in the dynamic mobile C-E environment. Past research has indicated that failures do occur in relation to either cycles, time or a combination of the two (1; 4; 9; 13; 14). This research is discussed in greater detail in Chapter 2. The histogram in Figure 2 describes the probability density function (pdf) as it relates to both time and cycles (13:69-70).

Justification for Thesis

The specific task of this thesis is to validate the stochastic model for determining failures for communications-electronic (C-E) systems described by Skowronek. If the model can be validated as a good predictor of C-E system failures (i.e., reliability), it could then provide a more accurate method for determining C-E WRSK requirements (11; 12). Skowronek only verified the accuracy and logic of the model. He lacked empirical data to validate the model.

Specific Problem

The proposed stochastic model has not been validated against empirical data. Before the Air Force Communications Command (AFCC) or Air Force Logistics Command (AFLC) can use the model, it must be proven valid. The model appears to accurately portray the C-E systems operational environment, therefore it should increase the accuracy of predicting failures for C-E systems. By using actual "on-time" and "off-time" data from a specified period of time, an accurate prediction of future failures should be obtained if the model is valid.

Research Questions

Three important questions must be answered to ensure the validation results are not flawed.

1. Does the concept of operating, ("on-time") and non-operating, ("off-time") failures apply to C-E systems?

2. What is the true relationship of C-E system reliability and subsequent spare parts requirements?

3. Does the Skowronek model accurately portray these relationships and predict failure rates?

Scope and Limitations of Research

This research is limited to focus solely on the failure rate distributions of mobile C-E system components. Power-up cycling effects are more pronounced in mobile systems, and should provide a stronger validation.

In the interest of a strict model validation, the conditions developed by Skowronek will be duplicated as closely as possible. The data will be in the two categories that were proposed by Skowronek: operating and nonoperating failures. The terms "off-time", "non-operating", and "off-failures" are all interchangeable and will generally be referred to as *off-time* failures. The terms "on-time", "operating", and "on-failures" are also interchangeable and will generally be referred to as on-time failures (13:6).

II. Literature Review

Overview

This chapter includes a discussion of Skowronek's research which is the basis for the validation process of this thesis. Other topics addressed are: system failures that are corrected by reseating components, reliability issues, and using current field maintenance information for validation.

Stochastic Models

Stochastic models emulate processes which are concerned with a sequence of events ruled by probabilistic laws using probabilistic distributions (8:v). Examples of simple stochastic processes are the outcomes of successive trials of flipping a coin, the results of a learning experiment, or successive observations of some particular characteristic of a population. Stochastic models may be one-dimensional, or multidimensional; for example, the Brownian Motion Process and the Poisson Process, respectively (8:11-21).

Stochastic models are concerned with the distribution of random variables over a suitable parameter. This study's parameter, failure density, has two components; failures distributed over power-up cycles and failures distributed over operating hours. Skowronek's model uses the poisson process and assumes all failures are identically distributed, but lie in independent off-time and on-time distributions.

Skowronek's Model

Skowronek concluded that "to calculate failure rates based on operating time only, will underestimate the true failure rate." His literature review supported the concept that failures do occur both during on-time and off-time. Therefore, a stochastic model which includes on-time and off-time failures, distributed over on-hours and power-up cycles respectively, should emulate the C-E systems environment quite accurately. Skowronek supported his position with documentation from a Martin-Marietta study which provided strong evidence that failures occur during both on-time and off-time (13:12-14; 1:Sec IV, 5-7,15,17; 1:Sec VI,5).

Skowronek described a three-dimensional model which treated both on-time and off-time failures. He concluded that these combined failures occurred on a plane described by the formula:

$$Z = (Za/Xa)(X) + (Zb/Yb)(Y) \quad \text{(Refer to Figure 1)} \qquad (1)$$

where:

Za = Expected on-time failures

Xa = On-time hours in current period

X = Transition time in next period

Zb = Expected off-time failures

Yb = Off-time cycles in current period, and

Y = Transition off-time cycles in next period.

The value of 'Z', is the expected total failures in the next time period based on observations for time and cycles.

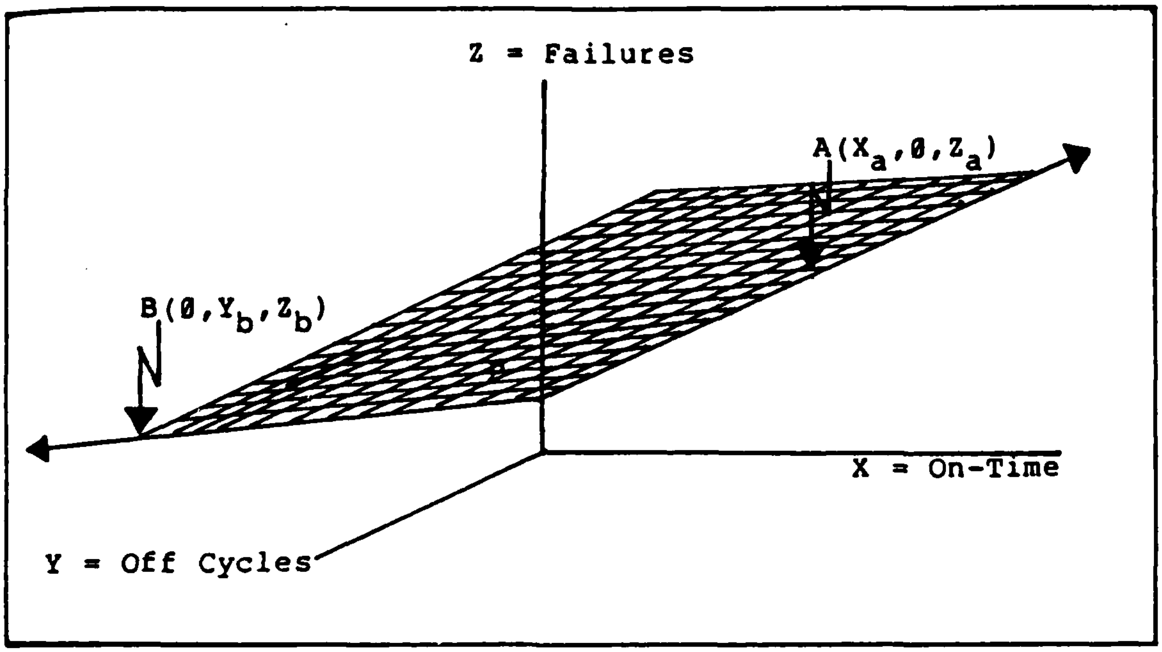


Figure 1. Structural Diagram of the Failure Plane (13:24)

The histogram in Figure 2, depicts the probability for values other than 'Z' given that the location of 'Z' on the plane is the expected value (Lambda) of a Poisson distribution solved for time and cycles. Figure 2, on the following page represents a probability density function (pdf) as it relates to both time and cycles for the plane (13:68-70). This model, as described by Skowronek, appears to accurately characterize the C-E systems environment.

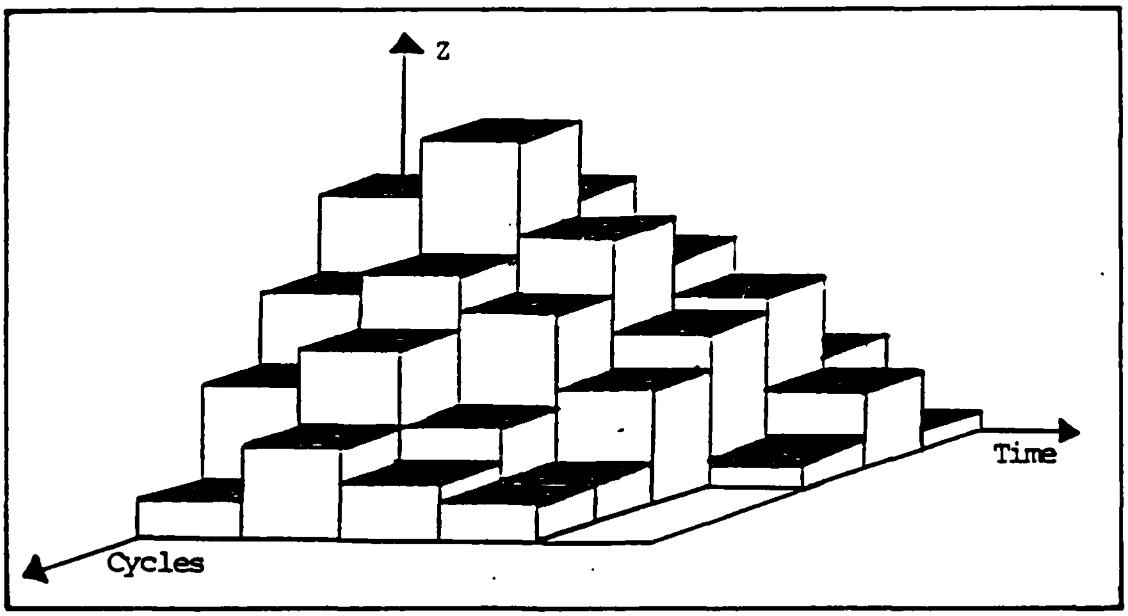


Figure 2. Three-Dimensional Poisson Distribution (13:69)

Skowronek verified his model using hypothetical data; however, he was unable to a validate his model using actual maintenance data. His model performed as predicted, producing results that appeared capable of representing the C-E systems environment more accurately than previous methods of predicting C-E system failure rates. Skowronek also concluded that the failure rate distributions of on-time failures over on-hours and off-time failures over cycles were not identically and independently distributed (13:70-71).

The lack of validation using actual maintenance data led the author to conduct the follow-up process of validating the Skowronek model. The author used actual maintenance data that was available to AFLC through the maintenance data collection (MDC) system (2). This data was collected from the 2d Combat Control Group (2 CCG), Patrick AFB, Florida. Other factors which could affect the accuracy of actual maintenance data were investigated.

Component Reseating

An article written by Claude F. Veraa, Vitro Corporation, published in the 1985 Proceedings Annual Reliability and Maintainability Symposium, discussed an analysis of failures on major computerized systems. Veraa focuses on the concept of "reseating" components. In reseating, a "failed" circuit card is pulled out of the system and pushed back-in to reestablish the contacts. The circuit card is not replaced if reseating fixes the "failed" condition. Reseating represented a very high percentage of failures during new system testing. Up to 80% of the failures were corrected by "reseating" one or more components during the early phase of testing. However, this figure diminished to zero during the latter phases of testing. Veraa suggested numerous potential hardware and software causes for the reseating problems; however, all too often the results of cycling on/off or reseating a particular component corrected the failure and masked the real underlying cause for the failure (14:150-151).

Veraa suggested that since this recycle or reseat action was often the "standard operating procedure," frequently much information concerning system failures was ignored and lost. Veraa's reseating concept is very similar to the environment found in many Air Force units today. The association is that if recycling the system brings it "up" (i.e., turning it off and restarting it), often very little else is done as a corrective action, to include documenting the temporary failure. This becomes of particular importance when the result of recycling increases the stress on the system. This increase in stress as pointed out by Skowronek (13:14), was another significant factor contributing to the failure rate of the C-E system (14:151).

Dormant and Cyclical Failure Rates

In work done by Edward Demko, Singer Kearfott Division, the effect of dormant and cyclic failure rates on reliability growth was considered. He developed a simple expression to incorporate operating, dormant and cyclic failure rates (4:92).

Demko concluded that the failures included in a measurement of the mean time between failure (MTBF) are proportional to operation, dormancy and the number of on/off cycles. He computed the failure rates using regression techniques to observed data. The inputs Demko used were: failures, operating time, dormant time, and on/off cycles. Much of the data Demko's work required could be lost as a result of the reseating conditions described by Veraa. His method is dependent on the documented usage profile or the imputed failures. But, it supports the opinion that cycling of electronic systems has a significant effect upon the system failure rate (4:96). This effect may be difficult to precisely identify if data collection accuracy does not improve.

Field Data

The use of field maintenance data to assess the reliability and maintainability of electronic systems was addressed by Eugene Fiorentino, Rome Air Development Center, April 1979. In his report, 'The Use of Air Force Field Maintenance Data for R & M Assessments of Ground Electronic Systems,' he discussed details of the field maintenance data collection system, data compilation procedures and analysis of the data. Fiorentino pointed out that R & M data from Air Force field operations provides a very large sample for R & M analysis. He investigated areas where the great potential of this data source may be weakened due to poor quality or inaccuracies (5:v-vi).

Fiorentino concluded that most of the data necessary for R & M assessments was available from associated MDC systems. His recommendations, while not all within the scope of field maintenance data system procedures, were designed to improve the quality and usability of field R & M data (5: vi-vii).

Improvements to the MDC system since Fiorentino's study have not eliminated all difficulties in extracting data for computing component failure rates (2). There still exists the problems of interpreting or recreating the activities that occurred in association with a particular maintenance action. For example, areas requiring interpretation were: determining the number of cycles preceding a failure; was a failure cyclical (off-time) or operating (on-time); if more than one part was found faulty, which caused the initial failure and which was an associated failure? Shortcomings in the MDC system will be discussed in greater detail in Chapter 3.

Since Skowronek did not have actual maintenance data with which to validate the model, he proposed the use of:

$$Za = [pN_o(pu)t] \tag{2}$$

as the number of imputed on-time failures in [0,t],

where:

$$p = \frac{\text{Expected (on-failures in [0,t])}}{\text{Expected (off-failures in [0,t])}}$$

$$N_o = \frac{\text{Expected (off-failures in [0,t])}}{\text{Average Number of power-ups}}$$

$$(pu) = \text{Expected (power-up cycles in [0,t])}$$

$$t = \text{time in the program period.}$$

This formula is based on cycles and time, where (p) and (N_o) are constant and (pu)t varies over [0,t]. Skowronek proved summing on-failures (equal to Formula 2) over hours with expected off-time failures over cycles to yield a single failure "rate" was incorrect (13:47). Since the author obtained actual maintenance data in which gross on- and off-failures were relatively discernable, computing an imputed on-failure rate was not necessary for the validation. Therefore 'Za' will be actual operating failures experienced in the validation experiment and not computed according to Skowronek's formula.

III. Methodology

Overview

This chapter discusses the data collection process, criteria for selecting parts to report, and sorting the data. How this information was used to answer Research Question #1 (Does the concept of operating, ("on-time") and non-operating, ("off-time") failures apply to C-E systems?), and Research Question #2 (What is the true relationship of C-E systems reliability and subsequent spare parts requirements?), are discussed in detail. The Lotus 123 spreadsheet formulas used for model computations are found in Appendix B. This chapter concludes with a discussion of Mean Absolute Deviation (MAD), the measure which was used to check model accuracy and answer Research Question #3 (Does the Skowronek model accurately portray these relationships and predict failure rate?).

Data Collection

Data collection to validate the model was a two-fold process, using data on system failures collected by the 2nd Combat Control Group (2 CCG), Patrick AFB. Initially, data was collected using a form developed by Skowronek to ensure cycles per day and operating hours were accurately recorded (see Appendix C). Also recorded was any system or subcomponent causing failures during on-time or off-time. Personnel from the 2 CCG recommended changes to the original data collection form. These changes provided them with a better understanding of the desired information and its intended use in the validation process (see Appendix D).

Next, an experiment to observe data collection and understand the operational environment of the 2 CCG was conducted. The experiment included data collection by the unit and by the author. Two radar systems at the 2 CCG, the MPN-14 and the TPN-19, were selected to conduct the validation of the Skowronek model. These are generally unreliable systems which could generate many failures in a relatively short time span. The unit collected data over a two-month period by observing the performance of each end item. Since only two months of current data were documented on the forms shown in Appendices C and D, the author further retrieved historical validation data from records in the maintenance data collection (MDC) system. Tables 1 and 2 summarize the complete validation database for both end items.

Table 1

MPN-14 Data Summary

		TYPE OF FAILURE	
		On	Off
More Than 2 Failures	7	4	3
2 Failures Or Less	49	36	13
TOTAL NSNs FAILED	56	40	16

Table 2

TPN-19 Data Summary

		TYPE OF FAILURE	
		On	Off
More Than 2 Failures	2	2	0
2 Failures Or Less	6[illegible]	62	2
TOTAL NSNs FAILED	66	64	2

Nearly six months of failure data for the MPN-14 and the TPN-19 were extracted and used as the initial database for the validation process. The total NSNs evaluated represent approximately 10% of the possible end items that could fail. It should be noted here that this failure data was the same data that AFLC would use to predict failure rates or compute WRSK requirements for these C-E systems.

Research Question #1 was answered during discussions with 2 CCG personnel and by information found during the literature review. After speaking with several technicians and the two shop chiefs, the author felt confident that this maintenance data would be usable data. However, the problem of interpreting the data in regard to system cycling arose. This subject is discussed further in Chapter 4.

Data Sorting

Five specific elements were needed to solve the formula for 'Z': on-time failures, off-time failures, total number of cycles, total operating hours and total possessed hours. These data points were sorted into periods of time called "epochs," where each epoch included 30 operating-days.

Using a 30 operating-day epoch created four epochs to forecast and evaluate for the six-month data base. Four epochs allowed the forecasting of expected failures over equal periods of operating and possessed hours. A 30-operating-day epoch better simulates the wartime environment where a 30-day WRSK would be deployed. A step-wise forecast method was used. For example, a forecast was made for epoch 1, and then the actual data for epoch 1 was used to evaluate the forecast accuracy. Further validation occurred by adding another epoch as new data became available.

Validating the Model

This phase of research parallels Skowronek's work, but differs in method. The calculations for manipulating the model were done on the Lotus 123 spreadsheet versus the MultiPlan software used by Skowronek. The data base of actual "on-time" and "off-time" failures, for the period, September 1986 through March 1987 replaces Skowronek's original test data (see Appendices E and F). Finally, the data was organized into epochs.

The validation process required the forecasting of the expected number of failures for each epoch using the database provided. These forecasts were then compared to the actual number of failures experienced in each respective epoch. The model's accuracy was based on how closely the predicted failures per epoch compared to the actual failures. Once the initial data base was manipulated through the model, further validation and sensitivity analysis was possible using follow-on data received from the test unit. The formulas used on the Lotus 123 spreadsheet are found in Appendix B.

Comparing the forecast failures to actual failures documented in the data base validated the model's accuracy. The Mean Absolute Deviation (MAD) between forecast and actual values was selected to evaluate the model's prediction accuracy. The MAD is an effective measure for a short range forecasting model's accuracy (6:93-94).

Forecasts

Three types of forecast were made for each epoch. Forecast 1 was based on all failures over possessed hours, Forecast 2 was based on failures over on-hours, and Forecast 3 was the Skowronek model which treated both on-failures over on-hours and off-failures over cycles.

Skowronek pointed out that when all failures were distributed over operating hours, the resultant failure rate was significantly lower than the rate computed by all failures distributed over cycle-up attempts (13:68). These two methods should represent the lower and upper limits, respectively of a computed failure rate. However, for this experiment all failures over cycle-ups was not computed, because it represents an impractical rate. AFCC currently uses all failures over possessed time. Its most likely replacement would be all failures over on-hours. Therefore, these two forecast methods form the basis for the validation process. The desired MAD will be the lowest value for Forecast 1 (all failures over possessed time), 2 (all failures over operating time), or 3 (as computed by Formula 2).

Comparing MADs for the results should indicate the significance of how on-time and off-time failures apply to C-E systems thereby answering Research Questions #1 and #3. If the model's accuracy is indeed increased over current methods of determining failures, then an attempt to answer Research Question #2 could be made by calculating a 30-day WRSK requirement using the new failure rates.

There were no unusual aspects or steps to this methodology. The method completes validation of the proposed model that Skowronek was unable to accomplish due to a lack of time and field data. If proven effective, this model will be important by bringing the Air Force one step closer to computerizing its system for computing WRSK requirements. Further, it could be used for improving reliability and maintainability of C-E systems.

There was one potential hurdle to validating the Skowronek model. If the C-E failure data collected for this validation does not conform to the distributions assumed for the model, then additional experimentation will be required to test other distributions with a better accuracy potential.

Summary

Data was collected by 2 CCG maintenance technicians and the author. The data covered a six month period, and was divided into 30 operating-day epochs for analysis. Data was used to establish failure rates, which were then put into the model to forecast failures for each epoch. The differences between forecast and actual values were expressed as Mean Absolute Deviations (MAD) to study the accuracy of the model.

IV. Results and Analysis

Overview

This chapter discusses the results obtained during the course of this research effort. In this chapter, trends and relationships are analyzed. The specific environments in which system failures occurred were defined and percentages of the failure data occurring in those environments were determined. The model "fit" to each failure environment was analyzed by comparing the Mean Absolute Deviations (MADs) for the three forecasting methods. This chapter concludes with plausible reasons for the trends and results. Only MPN-14 data will be presented in this analysis. Results from the TPN-19 were not conclusive enough to support validation.

Validation Results

Appendices E and F provide the spreadsheet calculations used in the model validation for the MPN-14 and TPN-19 data, respectively. Three forecasts were computed: Forecast 1 was based on possessed hours; Forecast 2 was based on on-hours; and Forecast 3 used the Skowronek model. Each system data base was fitted to a set of 32 specific failure environments to identify where failures occurred. Figures 3 and 4 represent the decision logic for determining failure environments.

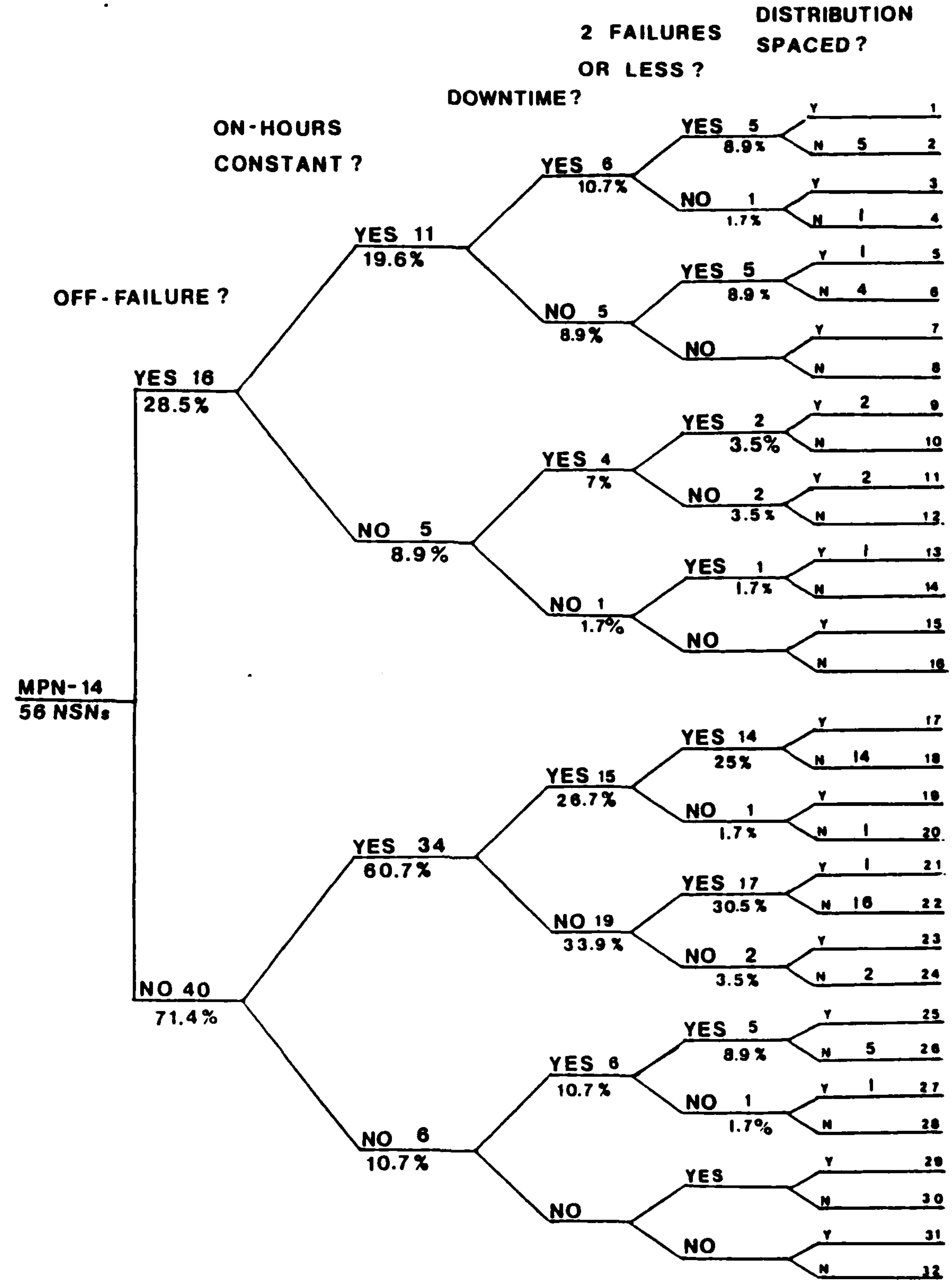


Figure 3. MPN-14 Failure Environment Logic Tree

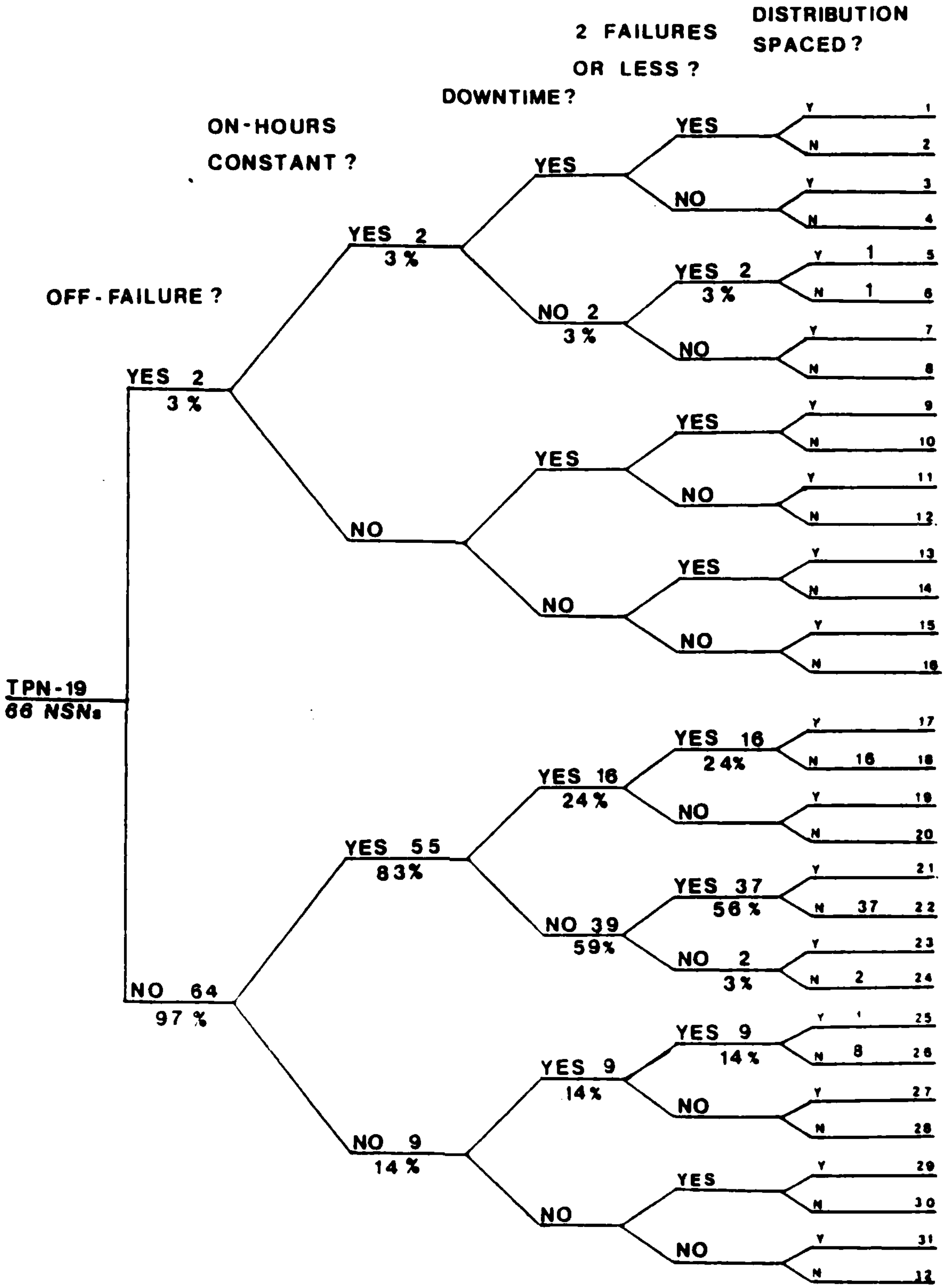


Figure 4. TPN-19 Failure Environment Logic Tree

MPN-14 Failure Environment

Figure 3 shows the possible frequency of MPN-14 failures. The failure environments are identified by number. Terms used to describe the failure environments include: "bunched" if the failures occurred in only one epoch and "spaced" if in more than one epoch; "downtime" if more than 2% of the operating time was lost due to failures, "no downtime" if less than 2%; "constant" if the hours varied in only one epoch, "variable" if more than one epoch varied; and "greater than 2" or "2 or less" whichever corresponded to the actual total number of failures. Table 3 summarizes the characteristics of each off-time failure environment in which failures occurred. The number

Table 3

MPN-14 Off-Time Failure Environment Characteristics

Environment	Characteristics	Frequency / %
2	Bunched, downtime, Constant, 2 or less	5 / 8.9
4	Bunched, downtime, Constant, Greater than 2	1 / 1.7
5	Spaced, no downtime, Constant, 2 or less	1 / 1.7
6	Bunched, no downtime, Constant, 2 or less	4 / 7.1
10	Bunched, downtime, Variable, 2 or less	2 / 3.5
11	Spaced, downtime, Variable, Greater than 2	2 / 3.5
13	Spaced, no downtime, Variable, 2 or less	1 / 1.7

of National Stock Numbered (NSN) items and percentage of occurrence are shown.

Table 4 identifies the characteristics of the <u>on-time</u> failure environments in which failures occurred. The number of NSN items and relative percentage of occurrence are also shown in Table 4.

Table 4

MPN-14 On-time Failure Environments

Environment	Characteristics	Frequency / %
18	Bunched, downtime, Constant, 2 or less	15 / 26.7
20	Bunched, downtime, Constant, greater than 2	1 / 1/7
21	Spaced, no downtime, Constant, 2 or less	1 / 1.7
22	Bunched, no downtime, Constant, 2 or less	16 / 28.5
24	Bunched, no downtime, Constant, greater than 2	2 / 3.5
26	Bunched, downtime, Variable, 2 or less	5 / 8.9
27	Spaced, downtime, Variable, greater than 2	1 / 1.7

There were 32 possible failure environments in which the MPN-14 failures might have occurred. Of the 56 failure data points, 28.5% were off-time failures. Fourteen of the 32 potential failure environments accommodated all of the 56 failure data points. These failure environments were described in Tables 3 and 4.

Model Fit (MPN-14)

Model fit was evaluated by measuring the accuracy of the forecasts of all NSNs within each failure environment. The applicable failure environments (FE), where failures occurred, were defined in Tables 3 and 4. Tables 5 and 6 show the specific NSNs of failed items within each FE for off-time and on-time, respectively. Also shown in Tables 5 and 6 are the sum of the forecast deviations for each NSN and the MAD for the entire FE.

Table 5

MPN-14 Off-time Failure Environment Model Fit

	NSN	Deviations Forecast 1	Forecast 2	Forecast 3
FE 2	5840005571588	2.976744	3.135647	3.128571
	5840006962047	1.5	1.518732	1.517241
	5840005051313	1.5	1.52755	1.526316
	5961004218956	1.5	1.529101	1.521739
	5960002620160	1.5	1.521739	1.512821
	MAD	.448837	.461639	.460334
FE 4	5835004790461	4.465116	4.754386	4.735628
	MAD	1.116279	1.188596	1.183907
FE 5	5960005427181	2.000000	2.000000	2.000000
	MAD	.5	.5	.5
FE 6	5820004943621	1.5	1.502578	1.495868
	5895004844743	1.5	1.502232	1.495868
	5840010902036	3.0	3.220339	3.212121
	5945002499813	3.0	3.005587	2.998661
	MAD	.5625	.576921	.575157
FE 10	5895001055204	1.488372	1.588235	1.576923
	5895002285267	1.511628	1.616016	1.681818
	MAD	.375	.400531	.407343
FE 11	5895011091624	4.0	4.181818	4.110672
	5945004661346	1.75	1.627249	1.584832
	MAD	.375	.406812	.396218
FE [illegible]	[illegible]	[illegible]	2.0	2.0
	MAD	[illegible]	[illegible]	[illegible]

Table 6

MPN-14 On-time Failure Environment Model Fit

		Deviations		
	NSN	Forecast 1	Forecast 2	Forecast 3
FE 18	5935008396719	1.511628	1.527550	1.527550
	5910007587777	1.5	1.553506	1.553506
	5945003038222	1.488372	1.506472	1.506472
	4140010542185	1.5	1.531601	1.531601
	5835000196977	1.5	1.509338	1.509338
	6145000804383	1.511628	1.527550	1.527550
	5950006452476	1.5	1.517539	1.517539
	5840006433820	1.5	1.517539	1.517539
	5905009590725	1.5	1.515759	1.515759
	5945002596399	3.0	3.001112	3.001112
	5900008069629	1.5	1.536033	1.536033
	5910001126794	1.5	1.5	1.528169
	5840008446217	1.5	1.540541	1.540541
	5960004259740	1.511628	1.522952	1.522952
	5840010900139	1.5	1.553506	1.553506
	MAD	.400389	.406016	.406486
FE 20	5950008724383	4.5	4.819407	4.819407
	MAD	1.125	1.204852	1.204852
FE 21	5915009535410	3.0	3.005025	3.005025
	MAD	.75	.751256	.751256
FE 22	5990006364151	3.0	3.001112	3.001112
	5840004836149	1.5	1.500278	1.500278
	5840004835887	1.488372	1.500278	1.500278
	5840004836110	1.5	1.500278	1.500278
	5840010227534	1.5	1.500278	1.500278
	5820011061794	1.5	1.500278	1.500278
	5895002177019	1.5	1.502513	1.502513
	5960002359107	1.5	1.500835	1.500835
	5945006657444	1.5	1.503074	1.503074
	5895002285226	1.5	1.505902	1.505902
	5960008939402	3.0	3.008403	3.008403
	5905009599603	3.0	2.504202	2.504202
	5905006656356	3.0	2.504202	2.504202
	5945000274107	1.5	1.502793	1.502793
	5945002015182	1.5	2.001112	2.001112
	5910008251637	3.0	3.005025	3.005025
	MAD	.492006	.485009	.485009
FE 24	5950008724383	4.5	4.819407	4.819407
	5905001100991	4.465116	4.604596	4.604596
	MAD	1.120640	1.178	1.178
FE 26	5950011307663	1.511628	1.578406	1.578406
	5945001985499	1.488372	2.196809	2.196809
	5820011549046	1.511628	1.648415	1.648415
	5950001025136	1.511268	1.564972	1.564972
	5840008508824	1.5	1.592495	1.592495
	MAD	.376234	.429055	.429155
FE 27	5945002017822	1.5	1.500556	1.500556
	MAD	.375	.375139	.375139

Expected Outcome

Forecast 3 was expected to be the most accurate because it treats all of the C-E system environments. Forecast 3 should equal Forecast 2 in environments of on-time failures only, because the cyclical term of Forecast 3 goes to zero when cycle failures are not present (compare Formulas 4 and 5). Forecast 2 should nearly equal Forecast 1 when long, steady-state hours of operation are experienced. That is when on-hours approach the same amount as possessed hours. (Compare Formulas 3 and 4).

$$\text{Forecast 1} = \left(\frac{\text{Total Failures}}{\text{Possessed Hours}}\right) \times \left(\begin{array}{c}\text{Expected Number}\\ \text{of}\\ \text{Possessed Hours}\end{array}\right) \qquad (3)$$

$$\text{Forecast 2} = \left(\frac{\text{Total Failures}}{\text{On-Hours}}\right) \times \left(\begin{array}{c}\text{Expected Number}\\ \text{of}\\ \text{On-Hours}\end{array}\right) \qquad (4)$$

$$\text{Forecast 3} = \left(\frac{\text{On-Fails}}{\text{On-Hours}}\right)\left(\begin{array}{c}\text{Expected}\\ \text{On-Hours}\end{array}\right) + \left(\frac{\text{Cycle Fails}}{\text{Cycles}}\right)\left(\begin{array}{c}\text{Expected}\\ \text{Cycles}\end{array}\right) \qquad (5)$$

Analysis of Results

From the tables, the following trends occur:

1. Forecast 1 was the most acceptable. This was not expected. It occurred because the MPN-14 experienced nearly steady-state operations during the experiment. If a more dynamic environment existed then Forecast 1 would not have been best.

2. Forecast 3 was equal or better than Forecast 2. This was a desireable expected outcome. It reflects that Forecast 3 describes the operating environment and cycling quite well for steady-state and dynamic conditions.

3. Forecast 3 was better than Forecast 1 where there was no maintenance downtime and where failure events were spaced out over more than one epoch. Again, this reflects the ability of Forecast 3 to capture the dynamic operating conditions.

4. When bunching occurred, none of the forecasts was a good predictor. This supports the theory; the Poisson may not be the best distribution for failure analysis. Bunching indicates that the Negative Binomial may be better.

TPN-19 Results

The TPN-19 results were not shown in Chapter 4 because the data set was not usable. Only three percent of TPN-19 failures were off-time failures. The *off-time failure environment is the focus of this* research and therefore, no realistic analysis could be performed on those results. However, Appendix F contains the model computations and Appendix G contains the failure environment characteristics. In Chapter 5 some discussion focuses on the TPN-19 results.

Summary

The Skowronek model was an accurate method of forecasting C-E system failure rates. The Skowronek model reacted as expected and the MAD of its forecasts was equal or lower than the MAD of Forecast 2 which was based on total failures over on-hours. The results described in this chapter were particularly important because a large data set was not available. Additionally, the data set was sorted according to normal peacetime operations and did not contain specific information regarding the number of cycles that a component experienced or whether it was an actual on-time failure or an off-time failure. This was not primary source data, but it was the same data used by AFLC. To fill in the gaps, certain assumptions were made. The operating period used was the home station operating hours for the 2 CCG. Off-time failures were assumed if the failure occurred within 30 minutes of the start of the normal operating period. At other times an off-time failure was readily identified through the MDC data. The model appeared to be valid by the results of the computations.

V. Conclusions and Recommendations

Overview

This chapter contains conclusions and recommendations reached during the course of this research effort. Research Question #1 was answered by findings from the experiment conducted to obtain data on the MPN-14 and TPN-19 radar systems. These findings are discussed in detail. Also included in this chapter is an analysis of the Skowronek model computations using actual field data, which answered Research Question #3. The Skowronek model was examined using the Mean Absolute Deviation (MAD) as a measure of accuracy for comparing the results of the computations, which attempts to answer Research Question #2.

Research Summary

The Skowronek model was verified with theoretical data. It appeared as a more accurate measure of predicting C-E failure rates than the currently used AFLC method. If this condition held true using actual maintenance data then the C-E WRSK computation process could be automated versus the current manual methods. The current WRSK computation process requires annual meetings by system users and component suppliers to review past data and evaluate inputs from past experience.

The Skowronek model was tested using actual maintenance data. An adequate amount of primary source data was not available, therefore, existing data from the maintenance data collection (MDC) system was used for the validation process. The data was sorted into epochs. Failure rates were computed from the total data set as described in Appendix B. Forecasts were made for each epoch. Three forecasting methods were used. Forecast 1 represented the currently used method. Forecast 2 represented a best alternative method and Forecast 3 was the Skowronek model. The absolute value of deviations from the actual failures were then calculated, and the resultant MAD was used to evaluate the model's accuracy.

The results were tabulated in Chapter 4, and the Skowronek model met the expected results. These expectations were that the Skowronek model would predict as accurate or even more accurately than Forecast 2. Finally, in all failure environments the Skowronek model was nearly as accurate as Forecast 1 when there was little downtime.

General Findings

The validation process was hampered by the fact that actual data was reported on the forms in appendices C and D, for a total of only two months. This meant there was insufficient data available to conduct a validation. However, the author examined historical maintenance records and found that six months of standard maintenance data was also available to use in validation. Difficulties arose in extracting a valid data set from the six-month data base.

Four conditions occurred which might have affected the historical data base. First, there may have been cycle-ups of the system that were not related to a failed item. This data was lost in the collection process, because routine cycle-up events were not tracked. Cycling may have also taken place during maintenance (i.e. reseating); however, these cycles were not documented through the standard MDC process either. Second, when a failure occurred, documentation could not reveal whether the system was operating normally or in a power-up cycle at the moment of failure. Third, after a part was replaced, the replacement could have failed immediately, before the system resumed normal operation, or a very short time after the system returned to operations. These could constitute either a cyclical, (off-time) failure or an on-time failure. To clarify which failure occurred, the author assumed the cyclical failure would occur if a replacement spare was received in a non-operational condition, which could not be determined until a power-up was attempted. On the other hand, if the replacement spare began to operate normally, but failed a short time after the system was operational, the failure would be an on-time failure. Again, MDC documentation did not reflect the correct failure. Finally, technicians stated that they might cycle the system up to 60 times or more during troubleshooting in an attempt to find a faulty sub-component. This loss of an accurate count on cycle events constitutes a very significant potential loss of data.

However, these conditions were allowable with the following assumptions. Since the available data was the same data submitted to AFLC via the MDC system, it would be best to use the MDC data for the validation. Second, the author assumed that normal home station conditions occurred throughout the period covered by the data base (29 September 1986 through 25 March 1987).

The normal hours of operation for the MPN-14 were from 0730 to 1500 Monday through Friday, and for the TPN-19 from 0730 Monday through 1500 Friday. As a result, normal operations yielded five cycles with 37.5 total on-hours per week for the MPN-14, and one cycle with 103.5 total on-hours per week for the TPN-19. If failures occurred, then on-hours were reduced, and cycles might be increased or decreased. The data was sorted as outlined in chapter 3, page 16 using the above parameters. In addition, if a failure occurred within the first 30 minutes following the expected power-up, it was considered a cyclical failure.

Data Collection Experiment

The results from the data collection experiment and discussions with 2 CCG personnel answered Research Question #1. The mobile radar system operational environment does require frequent cycling-on and -off of the system. The peacetime environment can present long periods of time in which the system is not shut down. Additionally, the 2 CCG operated under commercial power at their home station, so the equipment did not experience frequent cycling caused by powering on and off generators. However, during wartime and contingencies, the 2 CCG operates from portable generators which create a significantly different environment of power fluctuations and uncontrollable losses of generator power.

Other factors that dictate the potential for frequent system on and off cycling include the natural threats of the wartime environment. These threats come from enemy radar-seeking weapons that may be directed toward the radar emitters used by the MPN-14 and the TPN-19 radar systems. If threats of this nature are detected, the mobile radar system must be shut down quickly to avoid damage or destruction.

It is highly likely that on and off cycling will be a significant part of survivability and operational procedures for the mobile C-E units. The systems therefore, will be affected by on and off cycling.

C-E Relationships

Research Question #2 was not readily answered. The true relationships between C-E system reliability and WRSK requirements can best be resolved through actually computing a WRSK requirement. Comparing WRSK levels determined by this computerized method and by the current method (9) could then be the basis for answering Research Question #2. Generally, as the accuracy of failure rate predictions increase then the WRSK requirements will meet the system's actual spare parts requirements. However, this can only be proven by calculating a 30-day WRSK requirement using the inputs from the Skowronek model. The author did not have time to accomplish this objective and recommends a follow-on to this thesis to accomplish the required research.

Model Accuracy

The answer to Research Question #3 is directly related to the acceptance of the failure environment concept and the need for better data collection. The results indicate that the model was a good predictor for dynamic operating environments. Further, the model was as accurate as Forecast 2, which was based on total failures over on-hours. The MPN-14 data set exhibited 28.5% off-time failures. It must be remembered that this figure represents only peacetime operating conditions and could be significantly higher during contingencies or wartime environments. Although Forecast 1 is acceptable for the peacetime environment, it appears to drive requirements levels lower than needed during contingencies or wartime conditions. Therefore, the Skowronek model should be used for WRSK computations because it is more sensitive to the dynamics of the C-E environment.

It was further noted that as downtime decreased, that is on-hours approached the maximum for the epoch, the model's accuracy became better in nearly all environments.

Some NSN items will experience predominantly on-time failures and others may experience predominantly off-time failures. A forecast method that essentially uses a weighted value for each type of failure during the prediction process would be beneficial to the Air Force. An immediate benefit would be a reduction in stockage of NSNs that are not likely to fail and an increase in stockage of those NSNs that are more likely to fail because of the anticipated environment. A second and major benefit would be the automation of the WRSK computation process and eliminate the need for manual computations.

TPN-19 Conclusions

As stated in Chapter 4 the results of the TPN-19 were not shown because there was no significant off-time failure data. The author believes this condition can be explained by three factors: use of commercial power, long continuous hours of operation between cycles, and data collection inaccuracies discussed in Chapter 2, pages 9-12.

First, commercial power provides a constant supply of electrical power characterized by little fluctuation in cycles or voltage, as compared to gas or diesel generators. Personnel from the 2 CCG agreed that commercial power was not used during deployments and was not considered available during contingencies. The use of commercial power, coupled with the steady-state, normal operating hours used for data sorting criteria, may have significantly contributed to the low 3% of off-failures in the TPN-19 data.

Second, normal operations for the TPN-19 provided only 6-8 cycles per 30 operating-days. This small number drastically reduces the opportunities for the system to experience cycle fails. Also, the majority of the failures were two or less. The possibility exists that more cycling took place; however, there was no way to determine that from the MDC data.

Data collection difficulties were also another factor. Presently, codes do not exist for tracking the number of cycles and off-failures. If this information was readily retrievable the results may have been significantly different than those presented.

Recommendations

The author has three recommendations. First, the Air Force should establish a policy and a program to collect the failure data necessary to compute failure rates considering cycle-up events. As Eugene Fiorentino stated in 1979, the Air Force field data system, the maintenance data collection (MDC) system, provides most of the data required to calculate reliability; however, the MDC system did not contain all the required data. The Air Force could benefit greatly if the MDC system provided accurate data for computing realistic reliability figures. The immediate benefits would reduce provisioning of lesser required parts and increase the provisioning of more urgently needed parts. Ultimately, higher mission capable rates and readiness levels would be achieved with fewer dollars spent.

Second, it is strongly recommended that a follow on thesis test the actual failure rate distributions of the C-E systems. If the true distributions become known, some of the assumptions to failure rate calculations can be discarded. Once the actual distributions are known model adjustments could provide even better compensation for the dynamic C-E system environment.

Finally, computerized WRSK computations using data from the Skowronek model could prove that the entire system can be automated. Automating the system for WRSK computation could save a sizeable sum of money for the Air Force. Once automated, better preplanning of mobility and contingency requirements are possible. The most important benefit is the ability to reliably predict usage rates based on the expected number of on-hours and cycles the C-E systems would operate.

This research should be continued and expanded to benefit not only the Air Force, but also the other services. The 2 CCG has a full understanding of what was needed and were instrumental in providing the needed data to complete this research. With that kind of support, the primary source data needed could be obtained and further study on this subject continued. Benefits from further study appear to strongly interface with recent Reliability and Maintainability issues.

Appendix A: Standard Supply Computation

<u>Steps</u> <u>Explanation</u>

1. Determine the number of demands per part over an operating interval.

2. Determine the total number of operating hours over which the above demands were generated. This is subjective, based on:

   [Total days - down days (weekends and holidays)] *
   [average number of operating hours per unit per day] *
   [average number of units operational each day] = total operational hours.

3. Compute the meantime between demands (MTBD) for each part:

$$MTBF= \frac{\left(\begin{array}{r}\text{total operational}\\ \text{hours (step 2)}\end{array}\right) * \left(\begin{array}{l}\text{quantity per item}\\ \text{of the part (QPA)}\end{array}\right)}{\text{total demands for the part (step 1)}}$$

4. Compute the demands per flying hour (operational hour) for each part:

$$D/FH= \frac{1}{MTBD}$$

Appendix B: Lotus 123 Spreadsheet Formulas

Column Letter	Definition
A.	National Stock Number: Alpha Numeric
B.	Epoch Number: Numeric
C.	Number of On-Hours (t) per epoch: Value
D.	Number of On-Fails (Xt) per epoch: Value
E.	Number of Cycles (c) per epoch: Value
F.	Number of Off-Fails (Yc) per epoch: Value
G.	Number of Possessed Hours per epoch: Value
H.	Expected On-Hours E(t) per epoch: Value
I.	Expected Cycles E(c) per epoch: Value
J.	Possessed Fail Rate: Formula $\left(\frac{\text{Total Failures}}{\text{Total Possessed Hours}}\right)$
K.	Time Only Fail Rate: Formula $\left(\frac{\text{Total Failures}}{\text{Total On-Hours}}\right)$
L.	Cycle Fail Rate: Formula $\left(\frac{\text{Cycle Fails Only}}{\text{Total Number of Cycles}}\right)$
M.	Time W/Cyc Fail Rate: Formula $\left(\frac{\text{On-Fails}}{\text{On-Hours}}\right)$
N.	Actual Number of Fails: Value
O.	Forecast 1 (Possessed): Formula $(\text{Possessed Fail Rate}) \cdot (\text{Expected Possessed Hours})$

P. Delta 1: $|(\text{column O}) - (\text{column N})|$

Q. Forecast 2 (Time Only): Formula

$$\left(\frac{\text{Time Only}}{\text{Fail Rate}}\right) \cdot \left(\frac{\text{Expected}}{\text{On-Hours}}\right)$$

R. Delta 2: $|(\text{column Q}) - (\text{column N})|$

S. Forecast 3 (Skowronek model): Formula

$$\begin{pmatrix}\text{On-time}\\ \text{Fail}\\ \text{Rate}\end{pmatrix} \cdot \begin{pmatrix}\text{Expected}\\ \text{On-Hours}\\ \text{E(h)}\end{pmatrix} + \begin{pmatrix}\text{Cycle}\\ \text{Fail}\\ \text{Rate}\end{pmatrix} \cdot \begin{pmatrix}\text{Expected}\\ \text{Cycles}\\ \text{E(c)}\end{pmatrix}$$

T. Delta 3: $|(\text{column Q}) - (\text{column N})|$

U. MAD I: Formula

$$(\text{Summation of Forecast 1 deviations}) \div 4$$

V. MAD II: Formula

$$(\text{Summation of Forecast 2 deviations}) \div 4$$

W MAD III: Formula

$$(\text{Summation of Forecast 2 deviations}) \div 4$$

Appendix C: Data Form

Data Form

DATE:____________________.

1. NOMENCLATURE OF END ITEM:______________________________.

2. NUMBER OF CYCLE ATTEMPTS PER DAY: (Cross-out a number after each attempt is made. If more than 10, add in numbers).

1 2 3 4 5 6 7 8 9 10

3. RESULT OF EACH ATTEMPT: (Record any failure, i.e., critical or non-critical. Circle SUCCESS or FAILURE. Add more if required).

1. SUCCESS or FAILURE	2. SUCCESS or FAILURE
3. SUCCESS or FAILURE	4. SUCCESS or FAILURE
5. SUCCESS or FAILURE	6. SUCCESS or FAILURE
7. SUCCESS or FAILURE	8. SUCCESS or FAILURE
9. SUCCESS or FAILURE	10. SUCCESS or FAILURE

4. NSN CAUSING FAILED ATTEMPT (OR NONE): 1.____________.

2. ____________ 3. ____________ 4.____________.

5. ____________ 6. ____________ 7.____________.

8. ____________ 9. ____________ 10.____________.

NOTE: 2, 3, and 4 above refer to non-operating failures only.

FOR OPERATING FAILURES:

1. TOTAL NUMBER OF OPERATING FAILURES FOR TODAY:____________.

2. NSN OF PART (SUBASSY OR LRU) THAT FAILED (FOR EACH OPERATING FAILURE): ______________________________.

3. TOTAL "ON-HOURS" FOR EACH DAY (I.E., HOURS OPERATED AFTER SUCCESSFUL POWER-UP TODAY):______________________________.

When determining NSN's use the NSN for the assembly or subassembly (LRU) containing the failed component. Examples: Governor, SF-6 tank, RT-1168, or item that would normally be in WRSK.

Appendix D: Data Collection Form (Revised)

SYSTEM:

I.D.#:________________ IN-GARRISON:________________ DEPLOYED:________________

DATE/TIME POWER APPLIED:________________________________

DATE/TIME POWER REMOVED:________________________________

WUC	NSN OF FAILED ITEM	STATUS	JCN	COMMENTS

USAGE: 1 Sheet will be used for each power application.
For each item failure enter WUC.

Failure Codes for Status Column

C= Cold start Failure: Use this code when the failure happens within approximately 30 minutes of applying power or when failure can be attributed to the application of power.

H= Hot Start Failure: Use this code when the failure happens within approximately 15 minutes of applying full power from a preheat status.

O= Operational Failure: All others.

TO SYSTEM CHIEFS: This work sheet was devised to collect data for research efforts dealing with system failure rates. It is important to try to collect data as accurately as possible to make determination of cycle failures. operating failures and number of cycles during the period covered by this report.

Appendix E: MPN-14 Data Calculations

Spreadsheet Layout

44	45	46	47
48	49	50	51
52	53	54	55
56	57	58	59
60	61	62	63
64	65	66	67
68	69	70	71

A NSN (MPN-14)	B EPOCH	C ON-HOURS (t)	D ON-FAILS (Xt)	E CYCLES (c)	F CYCLE FAIL (Yc)
5990006364151	1	225	0	30	0
	2	225	0	30	0
	3	225	0	30	0
	4	224	2	32	0
	TOTAL	899	2	122	0
5840005571588	1	117.5	1	17	1
	2	225	0	30	0
	3	225	0	30	0
	4	225	0	30	0
	TOTAL	792.5	1	107	1
5945004661346	1	97.5	1	13	0
	2	141	0	20	1
	3	120	1	17	0
	4	225	0	30	0
	TOTAL	583.5	2	80	1
5835004790461	1	94.5	2	16	1
	2	225	0	30	0
	3	225	0	30	0
	4	225	0	30	0
	TOTAL	769.5	2	106	1
5840004836149	1	225	0	30	0
	2	225	0	30	0
	3	224.5	1	31	0
	4	225	0	30	0
	TOTAL	899.5	1	121	0
5935008396719	1	225	0	30	0
	2	178	1	25	0
	3	225	0	30	0
	4	225	0	30	0
	TOTAL	853	1	115	0
5910007587777	1	225	0	30	0
	2	225	0	30	0
	3	225	0	30	0
	4	138	1	19	0
	TOTAL	813	1	109	0
5960005427181	1	225	0	30	0
	2	225	0	30	0
	3	219	1	29	0
	4	223	0	31	1
	TOTAL	892	1	120	1

G POSSESSED HOURS	H LONG RUN E[t]	I LONG RUN E[c]	J POSSESS FAIL RATE	K TIME ONLY FAIL RATE	L CYCLE FAIL RATE
1056	225	30	0.000484	0.002225	0.000000
1008	225	30	0.000484	0.002225	0.000000
1032	225	30	0.000484	0.002225	0.000000
1032	225	30	0.000484	0.002225	0.000000
4128			0.000484	0.002225	0.000000
1056	225	30	0.000484	0.002524	0.009346
1008	225	30	0.000484	0.002524	0.009346
1032	225	30	0.000484	0.002524	0.009346
1032	225	30	0.000484	0.002524	0.009346
4128			0.000484	0.002524	0.009346
1056	225	30	0.000727	0.005141	0.012500
1008	225	30	0.000727	0.005141	0.012500
1032	225	30	0.000727	0.005141	0.012500
1032	225	30	0.000727	0.005141	0.012500
4128	900		0.000727	0.005141	0.012500
1056	225	30	0.000727	0.003899	0.009434
1008	225	30	0.000727	0.003899	0.009434
1032	225	30	0.000727	0.003899	0.009434
1032	225	30	0.000727	0.003899	0.009434
4128			0.000727	0.003899	0.009434
1056	225	30	0.000242	0.001112	0.000000
1008	225	30	0.000242	0.001112	0.000000
1032	225	30	0.000242	0.001112	0.000000
1032	225	30	0.000242	0.001112	0.000000
4128			0.000242	0.001112	0.000000
1056	225	30	0.000242	0.001172	0.000000
1008	225	30	0.000242	0.001172	0.000000
1032	225	30	0.000242	0.001172	0.000000
1032	225	30	0.000242	0.001172	0.000000
4128			0.000242	0.001172	0.000000
1056	225	30	0.000242	0.001230	0.000000
1008	225	30	0.000242	0.001230	0.000000
1032	225	30	0.000242	0.001230	0.000000
1032	225	30	0.000242	0.001230	0.000000
4128			0.000242	0.001230	0.000000
1056	225	30	0.000484	0.002242	0.008333
1008	225	30	0.000484	0.002242	0.008333
1032	225	30	0.000484	0.002242	0.008333
1032	225	30	0.000484	0.002242	0.008333
4128	900	120	0.000484	0.002242	0.008333

M TIME W/CYC FAIL RATE	N ACTUAL FAIL	O FORECAST 1 (POSSESS)	P DELTA 1 (ABSOLUTE)	Q FORECAST 2 TIME ONLY	R DELTA 2 (ABSOLUTE)
0.002225	0	0.511628	0.511628	0.500556	0.500556
0.002225	0	0.488372	0.488372	0.500556	0.500556
0.002225	0	0.500000	0.500000	0.500556	0.500556
0.002225	2	0.500000	1.500000	0.500556	1.499444
0.002225			3.000000		3.001112
0.001262	2	0.511628	1.488372	0.567823	1.432177
0.001262	0	0.488372	0.488372	0.567823	0.567823
0.001262	0	0.500000	0.500000	0.567823	0.567823
0.001262	0	0.500000	0.500000	0.567823	0.567823
0.001262			2.976744		3.135647
0.003428	1	0.767442	0.232558	1.156812	0.156812
0.003428	1	0.732558	0.267442	1.156812	0.156812
0.003428	1	0.750000	0.250000	1.156812	0.156812
0.003428	0	0.750000	0.750000	1.156812	1.156812
0.003428	3		1.500000		3.000000
0.002599	3	0.767442	2.232558	0.877193	2.122807
0.002599	0	0.732558	0.732558	0.877193	0.877193
0.002599	0	0.750000	0.750000	0.877193	0.877193
0.002599	0	0.750000	0.750000	0.877193	0.877193
0.002599			4.465116		4.754386
0.001112	0	0.255814	0.255814	0.250139	0.250139
0.001112	0	0.244186	0.244186	0.250139	0.250139
0.001112	1	0.250000	0.750000	0.250139	0.749861
0.001112	0	0.250000	0.250000	0.250139	0.250139
0.001112			1.500000		1.500278
0.001172	0	0.255814	0.255814	0.263775	0.263775
0.001172	1	0.244186	0.755814	0.263775	[illegible]
0.001172	0	0.250000	0.250000	0.263775	0.263775
0.001172	0	0.250000	0.250000	0.263775	0.263775
0.001172			[illegible]		[illegible]
0.001230	0	0.255814	0.255814	0.276753	0.276753
0.001230	0	0.244186	0.244186	0.276753	0.276753
0.001230	0	0.250000	0.250000	0.276753	0.276753
0.001230	1	0.250000	0.750000	0.276753	0.723247
0.001230			1.500000		1.553506
0.001121	0	0.511628	0.511628	0.504484	0.504484
0.001121	0	0.488372	0.488372	0.504484	0.504484
0.001121	1	0.500000	0.500000	0.504484	0.495516
0.001121	1	0.500000	0.500000	0.504484	0.495516
0.001121	2		2.000000		2.000000

S FORECAST 3 LAMBDA t,c	T DELTA 3 (ABSOLUTE)	U MAD I EACH NSN	V MAD II EACH NSN	W MAD III EACH NSN
0.500556	0.500556	0.75	0.750278	0.750278
0.500556	0.500556			
0.500556	0.500556			
0.500556	1.499444			
	3.001112			
0.564286	1.435714	0.744186	0.783911	0.782142
0.564286	0.564286			
0.564286	0.564286			
0.564286	0.564286			
	3.128571			
1.146208	0.146208	0.375	0.75	0.396208
1.146208	0.146208			
1.146208	0.146208			
1.146208	1.146208			
	1.584833			
0.867814	2.132186	1.116279	1.188596	1.183907
0.867814	0.867814			
0.867814	0.867814			
0.867814	0.867814			
	4.735628			
0.250139	0.250139	0.375	0.375069	0.375069
0.250139	0.250139			
0.250139	0.749861			
0.250139	0.250139			
	1.500278			
0.263775	0.263775	0.377906	0.381887	0.381887
0.263775	0.736225			
0.263775	0.263775			
0.263775	0.263775			
	1.527550			
0.276753	0.276753	0.375	0.388376	0.388376
0.276753	0.276753			
0.276753	0.276753			
0.276753	0.723247			
	1.553506			
0.502242	0.502242	0.5	0.5	0.5
0.502242	0.502242			
0.502242	0.497758			
0.502242	0.497758			
	2.000000			

NSN (MPN-14)	EPOCH	ON-HOURS (t)	ON-FAILS (Xt)	CYCLES (c)	CYCLE FAIL (Yc)
5895011091624	1	225	0	30	0
	2	225	0	30	0
	3	172.5	0	24	1
	4	202.5	1	31	2
	TOTAL	825	1	115	3
5840004835887	1	224.5	1	31	0
	2	225	0	30	0
	3	225	0	30	0
	4	225	0	30	0
	TOTAL	899.5	1	121	0
5840004836110	1	225	0	30	0
	2	225	0	30	[illegible]
	3	224.5	1	31	0
	4	225	0	30	0
	TOTAL	899.5	1	121	0
5950011307663	1	225	0	30	0
	2	189.5	1	26	0
	3	138.5	0	19	0
	4	225	0	30	0
	TOTAL	778	1	105	0
5840010227534	1	225	0	30	0
	2	225	0	30	0
	3	225	0	30	0
	4	224.5	1	31	0
	TOTAL	899.5	1	121	0
5945003038222	1	213.5	1	29	0
	2	225	0	30	0
	3	225	0	30	[illegible]
	4	225	0	30	0
	TOTAL	888.5	1	119	0
4140010542135	1	225	0	30	[illegible]
	2	225	0	30	0
	3	225	0	30	0
	4	171.5	1	24	0
	TOTAL	846.5	1	114	0
5945001985499	1	218.5	1	30	0
	2	157.5	0	22	0
	3	0	0	30	0
	4	0	0	30	[illegible]
	TOTAL	376	1	112	0

POSSESSED HOURS	LONG RUN E[t]	LONG RUN E[c]	POSSESS FAIL RATE	TIME ONLY FAIL RATE	CYCLE FAIL RATE
1056	225	30	0.000969	0.004848	0.026087
1008	225	30	0.000969	0.004848	0.026087
1032	225	30	0.000969	0.004848	0.026087
1032	225	30	0.000969	0.004848	0.026087
4128			0.000969	0.004848	0.026087
1056	225	30	0.000242	0.001112	0.000000
1008	225	30	0.000242	0.001112	0.000000
1032	225	30	0.000242	0.001112	0.000000
1032	225	30	0.000242	0.001112	0.000000
4128			0.000242	0.001112	0.000000
1056	225	30	0.000242	0.001112	0.000000
1008	225	30	0.000242	0.001112	0.000000
1032	225	30	0.000242	0.001112	0.000000
1032	225	30	0.000242	0.001112	0.000000
4128			0.000242	0.001112	0.000000
1056	225	30	0.000242	0.001285	0.000000
1008	225	30	0.000242	0.001285	0.000000
1032	225	30	0.000242	0.001285	0.000000
1032	225	30	0.000242	0.001285	0.000000
4128			0.000242	0.001285	0.000000
1056	225	30	0.000242	0.001112	0.000000
1008	225	30	0.000242	0.001112	0.000000
1032	225	30	0.000242	0.001112	0.000000
1032	225	30	0.000242	0.001112	0.000000
4128			0.000242	0.001112	0.000000
1056	225	30	0.000242	0.001125	0.000000
1008	225	30	0.000242	0.001125	0.000000
1032	225	30	0.000242	0.001125	0.000000
1032	225	30	0.000242	0.001125	0.000000
4128			0.000242	0.001125	0.000000
1056	225	30	0.000242	0.001181	[illegible]
1008	225	30	0.000242	0.001181	[illegible]
1032	225	30	0.000242	0.001181	0.000000
1032	225	30	0.000242	0.001181	0.000000
4128			0.000242	0.001181	0.000000
1056	225	30	0.000242	0.002660	0.000000
1008	225	30	0.000242	0.002660	0.000000
1032	225	30	0.000242	0.002660	0.000000
1032	225	30	0.000242	0.002660	0.000000
4128			0.000242	0.002660	0.000000

TIME W/CYC FAIL RATE	ACTUAL FAIL	FORECAST 1 (POSSESS)	DELTA 1 (ABSOLUTE)	FORECAST 2 TIME ONLY	DELTA 2 (ABSOLUTE)
0.001212	0	1.023256	1.023256	1.090909	1.090909
0.001212	0	0.976744	0.976744	1.090909	1.090909
0.001212	1	1.000000	0.000000	1.090909	0.090909
0.001212	3	1.000000	2.000000	1.090909	1.909091
0.001212			4.000000		4.181818
0.001112	1	0.255814	0.744186	0.250139	0.749861
0.001112	0	0.244186	0.244186	0.250139	0.250139
0.001112	0	0.250000	0.250000	0.250139	0.250139
0.001112	0	0.250000	0.250000	0.250139	0.250139
0.001112			1.488372		1.500278
0.001112	0	0.255814	0.255814	0.250139	0.250139
0.001112	0	0.244186	0.244186	0.250139	0.250139
0.001112	1	0.250000	0.750000	0.250139	0.749861
0.001112	0	0.250000	0.250000	0.250139	0.250139
0.001112			1.500000		1.500278
0.001285	0	0.255814	0.255814	0.289203	0.289203
0.001285	1	0.244186	0.755814	0.289203	0.710797
0.001285	0	0.250000	0.250000	0.289203	0.289203
0.001285	0	0.250000	0.250000	0.289203	0.289203
0.001285			1.511628		[illegible]
0.001112	0	0.255814	0.255814	0.250139	0.250139
0.001112	0	0.244186	0.244186	0.250139	0.250139
0.001112	0	0.250000	0.250000	0.250139	0.250139
0.001112	1	0.250000	0.750000	0.250139	0.749861
0.001112			1.500000		1.500278
0.001125	1	0.255814	0.744186	0.253236	0.746764
0.001125	0	0.244186	0.244186	0.253236	0.253236
0.001125	0	0.250000	0.250000	0.253236	[illegible]
0.001125	0	0.250000	0.250000	0.253236	[illegible]
0.001125			1.488372		[illegible]
[illegible]	[illegible]	0.255814	0.255814	0.265800	[illegible]
0.001181	0	0.244186	0.244186	0.265800	[illegible]
0.001181	0	0.250000	0.250000	0.265800	0.265800
0.001181	1	0.250000	0.750000	0.265800	0.734200
0.001181			1.500000		[illegible]
0.002660	1	0.255814	0.744186	0.598404	[illegible]
0.002660	0	0.244186	0.244186	0.598404	[illegible]
0.002660	0	0.250000	0.250000	0.598404	0.598404
0.002660	[illegible]	0.250000	0.250000	0.598404	[illegible]
0.002660			1.488372		[illegible]

FORECAST 3 LAMBDA t,3	DELTA 3 (ABSOLUTE)	MAD I EACH NON	MAD II EACH NON	MAD III EACH NON
1.055336	1.055336	1.000000	1.045455	1.027668
1.055336	1.055336			
1.055336	0.055336			
1.055336	1.944664			
	4.110672			
0.250139	0.749861	0.372093	0.375069	0.375069
0.250139	0.250139			
0.250139	0.250139			
0.250139	0.250139			
	1.500278			
0.250139	0.250139	0.375000	0.375069	0.375069
0.250139	0.250139			
0.250139	0.749861			
0.250139	0.250139			
	1.500278			
0.289203	0.289203	0.377907	0.394602	0.394602
0.289203	0.710797			
0.289203	0.289203			
0.289203	0.289203			
	1.578406			
0.250139	0.250139	0.375000	0.375069	0.375069
0.250139	0.250139			
0.250139	0.250139			
0.250139	0.749861			
	1.500278			
0.253236	0.746764	0.372093	0.376618	0.376618
0.253236	0.253236			
0.253236	0.253236			
0.253236	0.253236			
	1.506472			
0.265800	0.265800	[illegible]	[illegible]	[illegible]
0.265800	0.265800			
0.265800	0.265800			
0.265800	0.734200			
	1.531601			
0.598404	0.401596	0.372093	0.549202	0.549202
0.598404	0.598404			
0.598404	0.598404			
0.598404	0.598404			
	2.196809			

(MPN-14)	EPOCH	ON HOURS (t)	ON-FAILS (Xt)	CYCLES (c)	CYCLE FAIL (Xc)
5835000196977	1	225	0	30	0
	2	225	0	30	0
	3	208.5	1	29	0
	4	225	0	30	0
	TOTAL	883.5	1	119	0
6145000804383	1	225	0	30	0
	2	178	1	25	0
	3	225	0	30	0
	4	225	0	30	0
	TOTAL	853	1	115	0
5820011549046	1	225	0	30	0
	2	99.5	1	14	0
	3	144.5	0	20	0
	4	225	0	30	0
	TOTAL	694	1	94	0
5820011061794	1	225	0	30	0
	2	225	0	30	0
	3	224.5	1	31	0
	4	225	0	30	0
	TOTAL	899.5	1	121	0
5820004943621	1	225	0	30	0
	2	225	0	30	0
	3	224.5	0	31	1
	4	225	0	30	0
	TOTAL	899.5	0	121	1
5895002177019	1	225	0	30	0
	2	225	0	30	0
	3	220.5	1	31	0
	4	225	0	30	0
	TOTAL	895.5	1	121	0
5960002259107	1	225	0	30	0
	2	225	0	30	0
	3	223.5	1	31	0
	4	225	0	30	0
	TOTAL	898.5	1	121	0
5840006962047	1	225	0	30	0
	2	225	0	30	0
	3	192.5	0	26	1
	4	225	0	30	0
	TOTAL	867.5	0	116	1

PROCESSED HOURS	LONG RUN E[t]	LONG RUN E[c]	PROCESSED FAIL RATE	TIME ONLY FAIL RATE	CYCLE FAIL RATE
1056	225	30	0.000242	0.001132	0.000000
1008	225	30	0.000242	0.001132	0.000000
1032	225	30	0.000242	0.001132	0.000000
1032	225	30	0.000242	0.001132	0.000000
4128			0.000242	0.001132	0.000000
1056	225	30	0.000242	0.001172	0.000000
1008	225	30	0.000242	0.001172	0.000000
1032	225	30	0.000242	0.001172	0.000000
1032	225	30	0.000242	0.001172	0.000000
4128			0.000242	0.001172	0.000000
1056	225	30	0.000242	0.001441	0.000000
1008	225	30	0.000242	0.001441	[illegible]
1032	225	30	0.000242	0.001441	0.000000
1032	225	30	0.000242	0.001441	0.000000
4128			0.000242	0.001441	0.000000
1056	225	30	0.000242	0.001112	0.000000
1008	225	30	0.000242	0.001112	0.000000
1032	225	30	0.000242	0.001112	0.000000
1032	225	30	0.000242	0.001112	0.000000
4128			0.000242	0.001112	0.000000
1056	225	30	0.000242	0.001112	0.008264
1008	225	30	0.000242	0.001112	0.008264
1032	225	30	0.000242	0.001112	0.008264
1032	225	30	0.000242	0.001112	0.008264
4128			0.000242	0.001112	0.008264
1056	225	30	0.000242	0.001117	0.000000
1008	225	30	0.000242	0.001117	0.000000
1032	225	30	0.000242	0.001117	[illegible]
1032	225	30	0.000242	0.001117	[illegible]
4128			0.000242	0.001117	[illegible]
1056	225	30	[illegible]	[illegible]	[illegible]
1008	225	30	0.000242	[illegible]	[illegible]
1032	225	30	0.000242	0.001113	[illegible]
1032	225	30	0.000242	0.001113	0.000000
4128			0.000242	0.001113	0.000000
1056	225	30	0.000242	0.001153	[illegible]
1008	225	30	0.000242	0.001153	0.008621
1032	225	30	0.000242	0.001153	0.008621
1032	225	30	0.000242	0.001153	0.008621
4128			0.000242	0.001153	0.008621

TIME W/CYC FAIL RATE	ACTUAL FAIL	FORECAST TOSSED	[illegible]	FORECAST [illegible] TIME ONLY	[illegible]
0.001102	1	0.255814	0.255814	0.254003	[illegible]
0.001102	1	0.244186	1.244186	0.254660	[illegible]
0.001102	1	0.250000	0.750000	0.254000	0.745[illegible]
0.001102	0	0.250000	0.250000	0.251000	0.251000
0.001102			1.500000		1.509238
0.001172	0	0.255814	0.255814	0.263775	0.263775
0.001172	1	0.244186	0.755814	0.263775	0.736225
0.001172	0	0.250000	0.250000	0.263775	0.263775
0.001172	0	0.250000	0.250000	0.260775	0.260775
0.001172			1.511626		1.527551
0.001441	0	0.255814	0.255814	0.324207	0.324207
0.001441	1	0.244186	0.755814	0.324207	0.675793
0.001441	0	0.250000	0.250000	0.324207	0.324207
0.001441	0	0.250000	0.250000	0.324207	0.324207
0.001441			1.511626		1.648[illegible]
0.001112	0	0.255814	0.255814	0.250139	0.250139
0.001112	0	0.244186	0.244186	0.250139	0.250139
0.001112	1	0.250000	0.750000	0.250139	0.749861
0.001112	0	0.250000	0.250000	0.250139	0.250139
0.001112			1.500000		[illegible]
0.000000	0	0.255814	0.255814	0.250139	0.250139
0.000000	0	0.244186	0.244186	0.250139	0.250139
0.000000	1	0.250000	0.750000	0.250139	0.749861
0.000000	0	0.250000	0.250000	0.250139	0.250139
0.000000			[illegible]		1.5[illegible]278
0.001117	0	0.255814	0.255814	0.251250	0.251250
0.001117	0	0.244186	0.244186	0.251250	0.251250
0.001117	1	[illegible]	[illegible]	[illegible]	[illegible]
0.001117	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0.001117			[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0.001113	1	0.250000	0.750000	[illegible]	[illegible]
0.001113	0	0.250000	0.250000	0.250417	[illegible]
0.001113			1.500000		[illegible]
0.000000	[illegible]	0.255814	[illegible]	[illegible]	[illegible]
0.000000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0.000000	1	0.250000	0.750000	0.259066	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]		[illegible]

FORECAST D LAMBDA t,j	DELTA D ABSOLUTE	MAD 1 EACH NON	MAD 2 EACH NON	MAD 3 EACH NON
0.254669	0.254669	0.375	0.377334	0.377334
0.254669	0.254669			
0.254669	0.745331			
0.254669	0.254669			
	1.509338			
0.263775	0.263775	0.377906	0.381887	0.381887
0.263775	0.736225			
0.263775	0.263775			
0.263775	0.263775			
	1.527550			
0.324207	0.324207	0.377906	0.412103	0.412103
0.324207	0.675793			
0.324207	0.324207			
0.324207	0.324207			
	1.648415			
0.250139	0.250139	0.375	0.375069	0.375069
0.250139	0.250139			
0.250139	0.749861			
0.250139	0.250139			
	1.500278			
0.247934	0.247934	0.375	0.375069	0.373966
0.247934	0.247934			
0.247934	0.752066			
0.247934	0.247934			
	1.495868			
0.251256	0.251256	0.375	0.375628	0.375628
0.251256	0.251256			
0.251256	0.748744			
0.251256	0.251256			
	1.502513			
0.250417	0.250417	0.375	[illegible]	[illegible]
0.250417	0.250417			
0.250417	0.749583			
0.250417	0.250417			
	1.500835			
0.258621	0.258621	0.375	0.379632	0.379310
0.258621	0.258621			
0.258621	0.741379			
0.258621	0.258621			
	1.517241			

NSN MFN 14	EPOCH	ON HOURS (E)	ON FAILS (X)	CYCLES (C)	CYCLE FAIL (Y)
5945006657444	1	225	0	30	0
	2	225	0	30	0
	3	219.5	1	31	0
	4	225	0	30	0
	TOTAL	894.5	1	121	0
5930008724383	1	675	0	90	0
	2	675	0	90	0
	3	201	3	30	1
	4	675	0	90	0
	TOTAL	2226	3	300	0
5925004844740	1	225	0	30	0
	2	225	0	30	0
	3	221	0	31	1
	4	225	0	30	0
	TOTAL	896	0	121	1
5925002285226	1	225	0	30	0
	2	225	0	30	0
	3	214.5	1	31	0
	4	225	0	30	0
	TOTAL	889.5	1	121	0
5945002015144	1	224.5	0	31	1
	2	225	0	30	0
	3	220.5	1	31	0
	4	225	0	30	0
	TOTAL	895	1	122	1
5960008930402	1	450	0	60	0
	2	450	0	60	0
	3	405	2	60	0
	4	450	0	60	0
	TOTAL	1755	2	240	0
[illegible]	1	450	0	60	
	2	450	0	60	
	3	405	2	60	0
	4	450	0	60	0
	TOTAL	1755	2	240	0
5905006656256	1	450	0	60	0
	2	450	0	60	0
	3	435	2	60	0
	4	450	0	60	0
	TOTAL	1785	2	240	0

PROCESSED HOURS	LONG RUN E[t]	LONG RUN E[c]	PROCESS FAIL RATE	TIME ONLY FAIL RATE	CYCLE FAIL RATE
1056	225	30	0.000242	0.001118	0.000000
1008	225	30	0.000242	0.001118	0.000000
1032	225	30	0.000242	0.001118	0.000000
1032	225	30	0.000242	0.001118	0.000000
4128			0.000242	0.001118	0.000000
1056	675	90	0.000727	0.001348	0.000000
1008	675	90	0.000727	0.001348	0.000000
1032	675	90	0.000727	0.001348	0.000000
1032	675	90	0.000727	0.001348	[illegible]
4128			0.000727	[illegible]	[illegible]
1056	225	30	0.000242	0.001118	0.000224
1008	225	30	0.000242	0.001118	[illegible]
1032	225	30	0.000242	[illegible]	0.008264
1032	225	30	0.000242	[illegible]	0.008264
4128			0.000242	[illegible]	0.008264
1056	225	30	0.000242	0.001124	[illegible]
1008	225	30	0.000242	0.001124	[illegible]
1032	225	30	0.000242	0.001124	[illegible]
1032	225	30	0.000242	0.001124	[illegible]
4128			[illegible]	[illegible]	[illegible]
1056	225	30	0.000484	0.002227	0.002197
1008	225	30	0.000484	0.002227	0.002197
1032	225	30	0.000484	0.002227	0.002197
1032	225	30	0.000484	0.002227	0.002197
4128			0.000484	0.002227	0.002197
1056	450	60	0.000484	0.001120	0.000000
1008	450	60	0.000484	0.001120	0.000000
[illegible]	450	[illegible]	0.000484	[illegible]	[illegible]
[illegible]	450	[illegible]	0.000484	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]
[illegible]	225	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	225	[illegible]	[illegible]	[illegible]	[illegible]
1032	225	30	0.000484	[illegible]	[illegible]
1032	225	30	0.000484	0.001120	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]
[illegible]	225	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	225	[illegible]	0.000484	[illegible]	[illegible]
1032	225	30	0.000484	[illegible]	0.000000
[illegible]	225	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]

TIME W/CYC FAIL RATE	ACTUAL FAIL	FORECAST 1 (POISSON)	DELTA 1 (ABSOLUTE)	FORECAST 2 TIME ONLY	DELTA 2 (ABSOLUTE)
0.001118	0	0.255814	0.255814	0.251537	0.251537
0.001118	0	0.244186	0.244186	0.251537	0.251537
0.001118	1	0.250000	0.750000	0.251537	0.748463
0.001118	0	0.250000	0.250000	0.251537	0.251537
0.001118			1.500000		1.503074
0.001348	0	0.767442	0.767442	0.909704	0.909704
0.001348	0	0.732558	0.732558	0.909704	0.909704
0.001348	3	0.750000	2.250000	0.909704	2.090296
0.001348	0	0.750000	0.750000	0.909704	0.909704
0.001348			4.500000		[illegible]
0.000000	0	0.255814	0.255814	0.251110	0.251110
0.000000	0	0.244186	0.244186	0.251110	0.251110
0.000000	1	0.250000	0.750000	0.251110	[illegible]
0.000000	0	0.250000	0.250000	0.251110	0.251110
0.000000			1.500000		[illegible]
0.001124	0	0.255814	0.255814	0.252951	0.252951
0.001124	0	0.244186	0.244186	0.252951	0.252951
0.001124	1	0.250000	0.750000	0.252951	[illegible]
0.001124	0	0.250000	0.250000	0.252951	0.252951
0.001124			1.500000		[illegible]
0.001114	1	0.511628	0.488372	0.501114	0.498886
0.001114	0	0.488372	0.488372	0.501114	0.501114
0.001114	1	0.500000	0.500000	0.501114	0.498886
0.001114	0	0.500000	0.500000	0.501114	0.501114
0.001114			1.976744		2.000000
0.001120	0	0.511628	0.511628	0.504202	0.504202
0.001120	0	0.488372	0.488372	0.504202	0.504202
0.001120	[illegible]	[illegible]	1.500000	0.504202	[illegible]
0.001120	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0.001120			3.000000		[illegible]
[illegible]	[illegible]	0.511628	[illegible]	0.252101	[illegible]
[illegible]	[illegible]	0.488372	0.488372	0.252101	[illegible]
0.001120	2	0.500000	1.500000	0.252101	1.747899
0.001120	0	0.500000	0.500000	0.252101	0.252101
0.001120			3.000000		[illegible]
[illegible]	[illegible]	0.511628	0.511628	0.252101	0.252101
0.001120	[illegible]	0.488372	0.488372	0.252101	[illegible]
0.001120	2	0.500000	1.500000	0.252101	1.747899
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]		[illegible]

FORECAST 3 LAMBDA t,c	DELTA 3 (ABSOLUTE)	MAD 1 EACH NSN	MAD 2 EACH NSN	MAD 3 EACH NSN
0.251537	0.251537	0.375000	0.375769	0.375769
0.251537	0.251537			
0.251537	0.748463			
0.251537	0.251537			
	1.503074			
0.909704	0.909704	1.125000	1.204852	1.204852
0.909704	0.909704			
0.909704	2.090296			
0.909704	0.909704			
	4.819407			
0.247934	0.247934	0.375000	0.375550	0.373967
0.247934	0.247934			
0.247934	0.752066			
0.247934	0.247934			
	1.495868			
0.252951	0.252951	0.375000	0.376476	0.376476
0.252951	0.252951			
0.252951	0.747049			
0.252951	0.252951			
	1.505902			
0.496458	0.503542	0.494186	0.500000	0.500000
0.496458	0.496458			
0.496458	0.503542			
0.496458	0.496458			
	2.000000			
0.504202	0.504202	0.750000	0.752101	0.752101
0.504202	0.504202			
0.504202	1.495798			
0.504202	0.504202			
	3.008402			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0.252101	0.252101			
0.252101	1.747899			
0.252101	0.252101			
	2.504202			
0.252101	0.252101	0.750000	0.626050	0.626050
0.252101	0.252101			
0.252101	1.747899			
0.252101	0.252101			
	2.504202			

NSN (MFN-14)	EPOCH	ON-HOURS (t)	ON-FAILS (Xt)	CYCLES (c)	CYCLE FAIL (Yc)
5950006452476	1	225	0	30	0
	2	225	0	30	0
	3	194.5	1	27	0
	4	225	0	30	0
	TOTAL	869.5	1	117	0
5840006433820	1	225	0	30	0
	2	225	0	30	0
	3	194.5	1	27	0
	4	225	0	30	0
	TOTAL	869.5	1	117	0
5945002499813	1	225	0	30	0
	2	225	0	30	0
	3	220	1	31	1
	4	225	0	30	0
	TOTAL	895	1	121	1
5945000274107	1	225	0	30	0
	2	225	0	30	0
	3	220	1	31	0
	4	225	0	30	[illegible]
	TOTAL	895	1	121	[illegible]
5945002017822	1	864	6	126	0
	2	1350	0	180	0
	3	1212.5	2	78	0
	4	1350	0	180	0
	TOTAL	4776.5	8	564	[illegible]
5945002015102	1	225	0	30	0
	2	225	0	30	0
	3	224	1	31	
	4	225	0	30	[illegible]
	TOTAL	[illegible]	1	121	[illegible]
[illegible]	1	225	[illegible]	[illegible]	
	2	[illegible]	[illegible]	[illegible]	[illegible]
	3	224	1	31	[illegible]
	4	220.5	1	31	[illegible]
	TOTAL	894.5	2	122	[illegible]
5910008251037	1	450	0	[illegible]	[illegible]
	2	450	0	60	0
	3	450	0	60	0
	4	441	2	62	[illegible]
	TOTAL	1791	2	242	[illegible]

POSSESSED HOURS	LONG RUN C[S]	LONG RUN E[c]	POSSESSED FAIL RATE	TIME ONLY FAIL RATE	CYCLE FAIL RATE
1056	225	30	0.000242	0.001150	0.000000
1008	225	30	0.000242	0.001150	0.000000
1032	225	30	0.000242	0.001150	0.000000
1032	225	30	0.000242	0.001150	0.000000
4128			0.000242	0.001150	0.000000
1056	225	30	0.000242	0.001150	0.000000
1008	225	30	0.000242	0.001150	0.000000
1032	225	30	0.000242	0.001150	0.000000
1032	225	30	0.000242	0.001150	0.000000
4128			0.000242	0.001150	0.000000
1056	225	30	0.000484	0.002235	[illegible]
1008	225	30	0.000484	0.002235	[illegible]
1032	225	30	0.000484	0.002235	0.002224
1032	225	30	0.000484	0.002235	[illegible]
4128			0.000484	0.002235	0.002224
1056	225	30	0.000242	0.001117	[illegible]
1008	225	30	0.000242	0.001117	[illegible]
1032	225	30	0.000242	0.001117	[illegible]
1032	225	30	0.000242	0.001117	[illegible]
4128			0.000242	0.001117	[illegible]
1056	1350	180	0.001938	0.001675	[illegible]
1008	1350	180	0.001938	0.001675	0.000000
1032	1350	180	0.001938	0.001675	[illegible]
1032	1350	180	0.001938	0.001675	[illegible]
4128			0.001938	0.001675	[illegible]
1056	450	30	0.000242	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	0.000242	0.001112	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1032	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1032	225	30	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]
1056	450	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	450	[illegible]	[illegible]	0.001117	[illegible]
[illegible]	[illegible]	60	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]

TIME W/CYC FAIL RATE	ACTUAL FAILS	FORECAST 1 (POISSON)	DELTA 1 (ABSOLUTE)	FORECAST 2 TIME ONLY	DELTA 2 ABSOLUTE
0.001150	0	0.255814	0.255814	0.258769	0.258769
0.001150	0	0.244186	0.244186	0.258769	0.258769
0.001150	1	0.250000	0.750000	0.258769	0.741231
0.001150	0	0.250000	0.250000	0.258769	0.258769
0.001150			1.500000		1.517539
0.001150	0	0.255814	0.255814	0.258769	0.258769
0.001150	0	0.244186	0.244186	0.258769	0.258769
0.001150	1	0.250000	0.750000	0.258769	0.741231
0.001150	0	0.250000	0.250000	0.258769	0.258769
0.001150			1.500000		1.517539
0.001117	0	0.511628	0.511628	0.502793	0.502793
0.001117	0	0.488372	0.488372	0.502793	0.502793
0.001117	2	0.500000	1.500000	0.502793	1.497207
0.001117	0	0.500000	0.500000	0.502793	0.502793
0.001117			3.000000		3.005587
0.001117	0	0.255814	0.255814	0.251397	0.251397
0.001117	0	0.244186	0.244186	0.251397	0.251397
0.001117	1	0.250000	0.750000	0.251397	[illegible]
0.001117	0	0.250000	0.250000	0.251397	[illegible]
0.001117			1.500000		[illegible]
0.001675	6	2.046512	3.953488	2.261070	[illegible]
0.001675	0	1.953488	1.953488	2.261070	[illegible]
0.001675	2	2.000000	0.000000	2.261070	[illegible]
0.001675	0	2.000000	2.000000	2.261070	2.261070
0.001675			7.906977		8.522141
0.001112	0	0.255814	0.255814	0.500556	0.500556
0.001112	0	0.244186	0.244186	0.500556	0.500556
[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0.002236	1	0.500000	0.500000	[illegible]	[illegible]
0.002236	1	0.500000	0.500000	[illegible]	[illegible]
0.002236			[illegible]		[illegible]
[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]
0.001117	0	[illegible]	[illegible]	[illegible]	[illegible]
0.001117	0	0.500000	0.500000	0.502513	0.502513
[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]		[illegible]

FORECAST D LAMBDA t,d	DELTA D (ABSOLUTE)	MAD 1 EACH NSN	MAD 2 EACH NSN	MAD 3 EACH NSN
0.258769	0.258769	0.375000	0.379385	0.379385
0.258769	0.258769			
0.258769	0.741231			
0.258769	0.258769			
	1.517539			
0.258769	0.258769	0.375000	0.379385	0.379385
0.258769	0.258769			
0.258769	0.741231			
0.258769	0.258769			
	1.517539			
0.499331	0.499331	0.750000	0.751007	0.749665
0.499331	0.499331			
0.499331	1.500669			
0.499331	0.499331			
	2.998661			
0.251397	0.251397	0.375000	0.375698	0.375000
0.251397	0.251397			
0.251397	0.748603			
0.251397	0.251397			
	1.502793			
2.261070	3.738930	1.375744	2.130535	2.130535
2.261070	2.261070			
2.261070	0.261070			
2.261070	2.261070			
	8.522140			
0.500556	0.500556	0.375000	0.500278	0.500278
0.500556	0.500556			
0.500556	0.499444			
0.500556	0.500556			
	2.001112			
0.500074	0.500074	[illegible]	[illegible]	[illegible]
0.500074	0.500074			
0.500074	0.499926			
0.500074	0.499926			
	2.000000			
0.502513	0.502513	0.750000	0.751256	0.751256
0.502513	0.502513			
0.502513	0.502513			
0.502513	1.497487			
	3.005025			

NSN (NSN-14)	EPOCH	ON-HOURS (S)	ON-FAILS (XS)	CYCLES (C)	CYCLE FAIL (YC)
5905009590725	1	225	0	30	0
	2	225	0	30	0
	3	225	0	30	0
	4	197.5	1	28	0
	TOTAL	872.5	1	118	0
5945002596299	1	450	0	60	0
	2	450	0	60	[illegible]
	3	450	0	60	0
	4	448	2	62	0
	TOTAL	1798	2	242	0
5840010902036	1	450	0	60	[illegible]
	2	450	[illegible]	60	[illegible]
	3	450	[illegible]	60	0
	4	125	0	10	2
	TOTAL	1475	0	[illegible]	2
5905001100991	1	499	0	72	[illegible]
	2	675	0	90	[illegible]
	3	675	0	90	[illegible]
	4	675	0	90	[illegible]
	TOTAL	252[illegible]	0	342	[illegible]
5840010900139	1	225	0	30	0
	2	225	0	30	0
	3	225	0	30	0
	4	138	1	19	[illegible]
	TOTAL	813	1	[illegible]	[illegible]
5960002620160	1	225	0	30	[illegible]
	2	225	0	30	[illegible]
	3	225	[illegible]	30	[illegible]
	4	[illegible]	0	27	1
	TOTAL	[illegible]	[illegible]	117	[illegible]
[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]
	2	[illegible]	[illegible]	14	
	3	225	0	30	0
	4	225	0	30	0
	TOTAL	[illegible]	0	[illegible]	1
5805002295267	1	225	0	[illegible]	[illegible]
	2	127.5	0	18	1
	3	150	0	10	0
	4	[illegible]	[illegible]	[illegible]	[illegible]
	TOTAL	730.5	[illegible]	[illegible]	1

PROCESSED HOURS	LONG RUN [illegible]	LONG RUN [illegible]	PROCESSED FAIL RATE	TIME ONLY FAIL RATE	CYCLE FAIL RATE
1056	225	30	0.000242	0.001146	0.000000
1008	225	30	0.000242	0.001146	0.000000
1032	225	30	0.000242	0.001146	0.000000
1032	225	30	0.000242	0.001146	0.000000
4128			0.000242	0.001146	0.000000
2112	450	60	0.000242	0.001112	0.000000
2016	450	60	0.000242	0.001112	0.000000
2064	450	60	0.000242	0.001112	0.000000
2064	450	60	0.000242	0.001112	[illegible]
8256			0.000242	0.001112	[illegible]
2112	450	60	0.000242	[illegible]	[illegible]
2016	450	60	0.000242	0.001356	[illegible]
2064	450	60	0.000242	0.001356	0.010101
2064	450	60	0.000242	0.001356	0.010101
8256			0.000242	0.001351	0.010101
3168	675	90	0.000242	0.001180	[illegible]
3024	675	90	0.000242	0.001180	[illegible]
3096	675	90	0.000242	0.001180	[illegible]
3096	675	90	0.000242	[illegible]	[illegible]
12384			[illegible]	[illegible]	[illegible]
6336	225	30	0.000040	0.001230	[illegible]
6048	225	30	0.000040	0.001230	0.000000
6192	225	30	0.000040	0.001230	[illegible]
6192	225	30	0.000040	0.001231	[illegible]
24768			0.000040	0.001230	[illegible]
1056	225	30	0.000242	0.001159	0.008547
1008	225	30	0.000242	0.001159	0.008547
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]
[illegible]	225	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	225	[illegible]	0.000242	[illegible]	[illegible]
1032	225	30	0.000242	0.001207	[illegible]
1032	225	30	0.000242	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]
[illegible]	225	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	225	30	[illegible]	[illegible]	[illegible]
1032	225	30	0.000242	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]

TIME W/CYC FAIL RATE	ACTUAL FAIL	FORECAST 1 (POSSECS)	DELTA 1 (ABSOLUTE)	FORECAST 2 TIME ONLY	DELTA 2 (ABSOLUTE)
0.001146	0	0.255814	0.255814	0.257880	0.257880
0.001146	0	0.244186	0.244186	0.257880	0.257880
0.001146	0	0.250000	0.250000	0.257880	0.257880
0.001146	1	0.250000	0.750000	0.257880	0.742120
0.001146			1.500000		1.515760
0.001112	0	0.511628	0.511628	0.500556	0.500556
0.001112	0	0.488372	0.488372	0.500556	0.500556
0.001112	0	0.500000	0.500000	0.500556	0.500556
0.001112	2	0.500000	1.500000	0.500556	[illegible]
0.001112			3.000000		3.001112
0.000000	0	0.511628	0.511628	0.610169	[illegible]
0.000000	0	0.488372	0.488372	0.610169	[illegible]
0.000000	0	0.500000	0.500000	0.610169	0.610169
0.000000	2	0.500000	1.500000	0.610169	1.389831
0.000000			3.000000		[illegible]
0.001189	3	0.767442	2.232558	0.802298	[illegible]
0.001189	0	0.732558	0.732558	0.802298	[illegible]
0.001189	0	0.750000	0.750000	0.802298	[illegible]
0.001189	1	0.750000	1.750000	0.802298	[illegible]
0.001189			4.465116		[illegible]
0.001200	0	0.255814	0.255814	0.276753	0.276753
0.001200	0	0.244186	0.244186	0.276753	0.276753
0.001200	0	0.250000	0.250000	0.276753	0.276753
0.001200	1	0.250000	0.750000	0.276753	0.723247
0.001200			1.500000		[illegible]
0.000000	0	0.255814	0.255814	0.260871	0.260871
0.000000	0	0.244186	0.244186	0.260871	0.260871
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	0	0.250000	0.250000	0.294110	[illegible]
[illegible]	0	0.250000	0.250000	0.294110	0.294110
[illegible]			[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.244186	0.755814	[illegible]	[illegible]
[illegible]	0	0.250000	0.250000	0.308008	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]		[illegible]

FORECAST 3 LAMBDA t,3	DELTA 3 (ABSOLUTE)	MAD 1 EACH NON	MAD 2 EACH NON	MAD 3 EACH NON
0.257880	0.257880	0.375000	0.378940	0.378940
0.257880	0.257880			
0.257880	0.257880			
0.257880	0.742120			
	1.515759			
0.500556	0.500556	0.750000	0.750278	0.750278
0.500556	0.500556			
0.500556	0.500556			
0.500556	1.499444			
	3.001112			
0.606061	0.606061	0.750000	0.805085	[illegible]
0.606061	0.606061			
0.606061	0.606061			
0.606061	1.393939			
	3.212121			
0.802298	2.197702	1.116279	1.151149	1.151149
0.802298	0.802298			
0.802298	0.802298			
0.802298	0.802298			
	4.604596			
0.276753	0.276753	0.375000	0.388376	0.388376
0.276753	0.276753			
0.276753	0.276753			
0.276753	0.723247			
	1.553506			
0.256410	0.256410	0.375000	0.380405	0.378205
0.256410	0.256410			
0.256410	0.256410			
0.256410	0.743590			
	1.512821			
0.288462	0.711538	[illegible]	0.397151	[illegible]
0.288462	0.288462			
0.288462	0.288462			
0.288462	0.288462			
	1.576923			
0.340909	0.340909	[illegible]	0.404004	0.42[illegible]
0.340909	0.659091			
0.340909	0.340909			
0.340909	0.340909			
	1.681818			

NSN MFR ID	EPOCH	ON HOURS	ON FAILS	CYCLES	OFF FAILS
5000010060020	1	225	0	30	[illegible]
	2	225	[illegible]	30	[illegible]
	3	164.5	1	20	[illegible]
	4	225	[illegible]	30	[illegible]
	TOTAL	839.5	1	110	[illegible]
5840005051010	1	225	0	30	
	2	225	0	30	[illegible]
	3	175	[illegible]	24	[illegible]
	4	225	[illegible]	30	
	TOTAL	850	0	114	[illegible]
591[illegible]1126794	1	225	[illegible]	30	[illegible]
	2	225	[illegible]	30	
	3	177	1	25	[illegible]
	4	225	[illegible]	30	
	TOTAL	852	1	115	
5010000440217	1	225	0	30	[illegible]
	2	225	[illegible]	30	
	3	225	[illegible]	30	[illegible]
	4	157.5	1	22	[illegible]
	TOTAL	832.5	1	112	[illegible]
5960004250740	1	225	[illegible]	30	[illegible]
	2	105.5	1	16	
	3	225	0	30	
	4	225	[illegible]	30	
	TOTAL	780.5	[illegible]	106	[illegible]
5150001025136	1	225	[illegible]	30	[illegible]
	2	171	1	24	[illegible]
	3	172.5	[illegible]	[illegible]	[illegible]
	4	225	[illegible]	[illegible]	
	TOTAL	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1	225	[illegible]	[illegible]	
	2	225	[illegible]	[illegible]	
	3	175.5	[illegible]	[illegible]	[illegible]
	4	225	[illegible]	30	[illegible]
	TOTAL	851.5	[illegible]	115	[illegible]
5841005300021	1	225		[illegible]	
	2	225	[illegible]	[illegible]	[illegible]
	3	107	1	15	[illegible]
	4	212.5	[illegible]	28	
	TOTAL	769.5	[illegible]	[illegible]	

PROCESSED HOURS	LONG RUN E(t)	LONG RUN E(c)	PROCESSED FAIL RATE	TIME ONLY FAIL RATE	CYCLE FAIL RATE
1056	225	30	0.000242	[illegible]	[illegible]
1000	225	30	0.000242	0.001191	0.000000
1002	225	30	0.000242	0.001191	[illegible]
1002	225	30	0.000242	0.001191	0.000000
4120			0.000242	0.001191	[illegible]
1056	225	30	0.000242	0.001172	0.008772
1000	225	30	0.000242	0.001172	0.008772
1002	225	30	0.000242	0.001172	0.008772
1002	225	30	0.000242	0.001172	[illegible]
4120			0.000242	0.001172	[illegible]
[illegible]	225	30	[illegible]	[illegible]	[illegible]
1000	225	30	0.000242	[illegible]	[illegible]
1002	225	30	0.000242	[illegible]	[illegible]
1002	225	30	[illegible]	0.001174	[illegible]
4120			0.000242	[illegible]	[illegible]
1056	225	30	0.000242	[illegible]	[illegible]
1000	225	30	0.000242	[illegible]	[illegible]
1002	225	30	0.000242	0.001201	[illegible]
1002	225	30	0.000242	[illegible]	[illegible]
4120			[illegible]	[illegible]	[illegible]
1056	225	30	0.000242	0.001182	[illegible]
1000	225	30	0.000242	[illegible]	[illegible]
1002	225	30	0.000242	0.001182	[illegible]
1002	225	30	0.000242	[illegible]	[illegible]
4120			0.000242	[illegible]	[illegible]
[illegible]	225	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1002	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	225	30	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1002	225	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	[illegible]	[illegible]

TIME W 1:1 FAIL RATE	ACTUAL FAIL	FORECAST 1 (POSSESS)	DELTA 1 (ABSOLUTE)	FORECAST 2 TIME ONLY	DELTA 2 (ABSOLUTE)
0.001191	1	0.255814	0.255814	0.268017	0.268017
0.001191	0	0.244186	0.244186	0.268017	0.268017
0.001191	1	0.250000	0.750000	0.268017	0.731983
0.001191	0	0.250000	0.250000	0.268017	0.268017
0.001191			1.500000		1.536034
0.000000	0	0.255814	0.255814	0.260775	0.260775
0.000000	0	0.244186	0.244186	0.260775	0.260775
0.000000	1	0.250000	0.750000	0.260775	0.739225
0.000000	0	0.250000	0.250000	0.260775	0.260775
0.000000			1.500000		1.521551
0.001174	0	0.255814	0.255814	0.264005	[illegible]
0.001174	0	0.244186	0.244186	0.264005	[illegible]
0.001174	1	0.250000	0.750000	0.264005	0.735995
0.001174	0	0.250000	0.250000	0.264005	[illegible]
0.001174			1.500000		[illegible]
0.001201	1	0.255814	[illegible]	[illegible]	[illegible]
0.001201	0	0.244186	[illegible]	[illegible]	[illegible]
0.001201	0	0.250000	[illegible]	0.271271	[illegible]
[illegible]	1	0.250000	0.750000	0.271271	[illegible]
[illegible]			[illegible]		[illegible]
[illegible]	0	0.255814	0.255814	[illegible]	[illegible]
[illegible]	1	0.244186	0.755814	[illegible]	[illegible]
[illegible]	0	0.250000	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	0.250000	[illegible]	[illegible]
[illegible]			[illegible]		[illegible]
[illegible]	1	0.255814	0.255814	0.262408	[illegible]
[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.250000	[illegible]	0.264550	[illegible]
[illegible]			[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]		[illegible]

FORECAST D	DELTA D	MAD 1	MAD 2	MAD 3
LAMBDA [illegible]	(ABSOLUTE)	EACH NON	EACH NON	EACH NON
0.200017	0.200017	0.075000	0.001000	0.001000
0.200017	0.200017			
0.200017	0.701000			
0.200017	0.200017			
	1.500000			
0.200150	0.200150	0.075000	0.001087	0.00157[illegible]
0.200150	0.200150			
0.200150	0.700842			
0.200150	0.200150			
	1.5[illegible]			
0.204005	0.204005	0.075[illegible]	0.00[illegible]	0.00[illegible]
0.204005	0.204005			
0.204005	0.700[illegible]			
0.204005	0.204005			
	1.528100			
0.270270	0.270270	0.075000	0.005105	0.005[illegible]
0.27[illegible]	0.27[illegible]			
0.27[illegible]	0.270270			
0.27[illegible]	0.72[illegible]			
	[illegible]			
0.201470	0.201470	0.077[illegible]	0.00[illegible]	0.00[illegible]
0.201470	0.700524			
0.201470	0.201470			
0.201470	0.201470			
	1.5[illegible]			
0.20[illegible]	0.20[illegible]	0.077[illegible]	0.0[illegible]	0.0[illegible]
[illegible]	0.7[illegible]			
[illegible]	[illegible]			
[illegible]	[illegible]			
	[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0.20[illegible]	0.20[illegible]			
0.20[illegible]	0.7[illegible]			
0.20[illegible]	0.20[illegible]			
	1.5[illegible]			
[illegible]	0.206240	[illegible]	[illegible]	[illegible]
0.206240	0.206240			
0.206240	0.7[illegible]			
[illegible]	0.20[illegible]			
	[illegible]			

Appendix F: TPN-19 Data Calculations

Spreadsheet Layout

73	74	75	76
77	78	79	80
81	82	83	84
85	86	87	88
89	90	91	92
93	94	95	96
97	98	99	100
101	102	103	104
105	106	107	108

A NSN (ITEM ID)	B EPOCH	C ON HOURS (t)	D ON-FAILS (Xt)	E CYCLES (c)	F CYCLE FAIL (Yc)
5995008325302	1	621	0	7	0
	2	564	0	8	0
	3	530	2	8	0
	4	621	0	6	0
	TOTAL	2336	2	29	0
4810009195209	1	621	0	7	0
	2	514	1	7	0
	3	340	1	5	0
	4	621	0	6	0
	TOTAL	2096	2	25	0
5995001308707	1	621	0	7	0
	2	564	0	8	0
	3	267.5	1	8	0
	4	621	0	6	0
	TOTAL	2073.5	1	29	0
5820004279429	1	621	0	7	0
	2	564	0	8	0
	3	589	1	9	1
	4	621	0	6	0
	TOTAL	2395	1	30	1
5995001130352	1	621	0	7	0
	2	564	0	8	0
	3	304	1	8	0
	4	621	0	6	0
	TOTAL	2110	1	29	0
5961004958607	1	621	0	7	0
	2	302	1	11	[illegible]
	3	[illegible]	[illegible]	7	0
	4	621	[illegible]	6	[illegible]
	TOTAL	[illegible]	[illegible]	[illegible]	[illegible]
5905001500716	1	621	[illegible]	7	[illegible]
	2	564	[illegible]	8	0
	3	304	1	8	[illegible]
	4	621	[illegible]	6	[illegible]
	TOTAL	2110	1	29	0
5905005008086	1	621	0	7	0
	2	564	0	8	0
	3	320.5	[illegible]	8	[illegible]
	4	621	0	6	0
	TOTAL	2126.5	1	29	[illegible]

G POSSESSED HOURS	H LONG RUN [C6]	I LONG RUN [C4]	J POSSESSED FAIL RATE	K TIME ONLY FAIL RATE	L CYCLE FAIL RATE
1056	621	7	0.000484	0.000856	0.000000
1008	564	8	0.000484	0.000856	0.000000
1032	604.5	7	0.000484	0.000856	0.000000
1032	621	6	0.000484	0.000856	0.000000
4128			0.000484	0.000856	0.000000
1056	621	7	0.000484	0.000954	0.000000
1008	564	8	0.000484	0.000954	0.000000
1032	604.5	7	0.000484	0.000954	0.000000
1032	621	6	0.000484	0.000954	0.000000
4128			0.000484	0.000954	0.000000
1056	621	7	0.000242	0.000421	0.000000
1008	564	8	0.000242	0.000421	0.000000
1032	604.5	7	0.000242	0.000421	0.000000
1032	621	6	0.000242	0.000421	0.000000
4128			0.000242	0.000421	0.000000
1056	621	7	0.000484	0.000835	0.000000
1008	564	8	0.000484	0.000835	0.000000
1032	604.5	7	0.000484	0.000835	0.000000
1032	621	6	0.000484	0.000835	0.000000
4128			0.000484	0.000835	0.000000
1056	621	7	0.000242	0.000415	0.000000
1008	564	8	0.000242	0.000415	0.000000
1032	604.5	7	0.000242	0.000415	0.000000
1032	621	6	0.000242	0.000415	0.000000
4128			0.000242	0.000415	0.000000
1056	621	7	0.000484	0.000897	0.000000
1008	564	8	0.000484	0.000897	0.000000
1032	604.5	7	0.000484	0.000897	0.000000
1032	621	6	0.000484	0.000897	0.000000
4128			0.000484	0.000897	0.000000
1056	621	7	0.000242	0.000415	0.000000
1008	564	8	0.000242	0.000415	0.000000
1032	604.5	7	0.000242	0.000415	0.000000
1032	621	6	0.000242	0.000415	0.000000
4128			0.000242	0.000415	0.000000
1056	621	7	0.000242	0.000429	0.000000
1008	564	8	0.000242	0.000429	0.000000
1032	604.5	7	0.000242	0.000429	0.000000
1032	621	6	0.000242	0.000429	0.000000
4128			0.000242	0.000429	0.000000

M	N	O	P	Q	R
TIME W/I.C FAIL RATE	ACTUAL FAIL	FORECAST 1 (POSSESS)	DELTA 1 (ABSOLUTE)	FORECAST 2 TIME ONLY	DELTA 2 (ABSOLUTE)
0.000856	0	0.511628	0.511628	0.531678	0.531678
0.000856	0	0.488372	0.488372	0.482877	0.482877
0.000856	2	0.500000	1.500000	0.517551	1.482449
0.000856	0	0.500000	0.500000	0.531678	0.531678
0.000856			3.000000		3.028682
0.000954	0	0.511628	0.511628	0.592557	0.592557
0.000954	1	0.488372	0.511628	0.538168	0.461832
0.000954	1	0.500000	0.500000	0.579813	0.420187
0.000954	0	0.500000	0.500000	0.592557	0.592557
0.000954			2.023256		2.067133
0.000421	0	0.255814	0.255814	0.261633	0.261633
0.000421	0	0.244186	0.244186	0.237624	0.237624
0.000421	1	0.250000	0.750000	0.254687	0.745313
0.000421	0	0.250000	0.250000	0.261633	0.261633
0.000421			1.500000		1.506214
0.000418	0	0.511628	0.511628	0.518580	0.518580
0.000418	0	0.488372	0.488372	0.470981	0.470981
0.000418	2	0.500000	1.500000	0.504802	1.495198
0.000418	0	0.500000	0.500000	0.518580	0.518580
0.000418			3.000000		3.003340
0.000415	0	0.255814	0.255814	0.257676	0.257676
0.000415	0	0.244186	0.244186	0.234025	0.234025
0.000415	1	0.250000	0.750000	0.250830	0.749170
0.000415	0	0.250000	0.250000	0.257676	0.257676
0.000415			1.500000		1.498546
0.000597	0	0.511628	0.511628	0.557026	0.557026
[illegible]	1	0.488372	0.511628	0.531171	[illegible]
[illegible]	1	0.500000	[illegible]	0.542517	[illegible]
[illegible]	1	0.500000	[illegible]	0.557026	[illegible]
[illegible]			[illegible]		[illegible]
0.000415	0	0.255814	0.255814	0.257676	0.257676
0.000415	0	0.244186	0.244186	0.234025	0.234025
0.000415	1	0.250000	0.750000	0.250830	0.749170
0.000415	0	0.250000	0.250000	0.257676	0.257676
0.000415			1.500000		1.498546
0.000429	0	0.255814	0.255814	0.266581	0.266581
0.000429	0	0.244186	0.244186	0.242112	0.242112
[illegible]	1	0.250000	0.750000	0.250400	[illegible]
0.000429	0	0.250000	0.250000	0.266581	0.266581
0.000429			1.500000		[illegible]

C FORECAST 3 LAMBDA .5,.[illegible]	T DELTA 3 (ABSOLUTE)	U MAD 1 EACH NSN	V MAD 2 EACH NSN	W MAD 3 EACH NSN
0.531678	0.531678	0.750000	0.757170	0.757170
1.482877	0.482877			
0.517551	1.482449			
0.531678	0.531678			
	3.028082			
0.592557	0.592557	0.505814	0.517533	0.517533
0.538168	0.461832			
0.579813	0.420187			
0.592557	0.592557			
	2.070134			
0.261000	0.261000	0.375000	0.378554	0.378554
0.207624	0.207624			
0.251687	0.745313			
0.261000	0.261000			
	1.506214			
0.492221	1.492221	0.750000	0.750005	0.742084
0.502157	0.502157			
0.485731	1.514268			
0.450220	1.450220			
	2.968837			
0.257676	0.257676	0.375000	0.374637	0.374637
0.234025	0.234025			
0.250000	0.749170			
0.257676	0.257676			
	1.[illegible]98540			
0.557026	0.557026	0.755811	0.737750	0.737750
0.506171	1.[illegible]			
0.542517	0.542517			
0.557026	0.557026			
	[illegible]			
0.257676	0.257676	0.375000	0.374637	0.374637
0.234025	0.234025			
0.250000	0.749170			
0.257676	0.257676			
	1.498540			
0.266581	0.266581	0.375000	0.378944	0.378944
0.242112	0.242112			
0.259498	0.740502			
0.266581	1.266581			
	1.515776			

A NSN (TPN-19)	B EPOCH	C ON-HOURS (t)	D ON-FAILS (Xt)	E CYCLES (c)	F CYCLE FAIL (Yc)
5985004027457	1	621	0	7	0
	2	564	0	8	0
	3	602	1	8	0
	4	621	0	6	0
	TOTAL	2408	1	29	0
5895005067003	1	621	0	7	0
	2	564	0	8	0
	3	526.5	1	8	0
	4	621	0	6	0
	TOTAL	2332.5	1	29	0
5895005010100	1	621	0	7	0
	2	564	0	8	0
	3	501	1	5	0
	4	370	0	4	0
	TOTAL	2056	1	24	0
5985005008473	1	621	0	7	0
	2	564	0	8	0
	3	604	1	8	0
	4	621	0	6	0
	TOTAL	2410	1	29	0
5985004174164	1	621	0	7	0
	2	564	0	8	0
	3	604.5	0	7	0
	4	620	1	7	0
	TOTAL	2409.5	1	29	0
5985004300704	1	621	0	7	0
	2	564	0	8	0
	3	604.5	0	7	0
	4	564.5	1	6	0
	TOTAL	2354	1	28	[illegible]
5985005570008	1	621	0	7	0
	2	564	0	8	0
	3	604.5	0	7	0
	4	584	1	6	0
	TOTAL	2373.5	1	28	0
5985005885285	1	621	0	7	0
	2	564	0	8	0
	3	469.5	1	6	0
	4	621	0	6	0
	TOTAL	2275.5	1	27	0

G POSSESSED HOURS	H LONG RUN E[t]	I LONG RUN E[c]	J POSSESSED FAIL RATE	K TIME ONLY FAIL RATE	L CYCLE FAIL RATE
1056	621	7	0.000242	0.000415	0.000000
1008	564	8	0.000242	0.000415	0.000000
1032	604.5	7	0.000242	0.000415	0.000000
1032	621	6	0.000242	0.000415	0.000000
4128			0.000242	0.000415	0.000000
1056	621	7	0.000242	0.000429	0.000000
1008	564	8	0.000242	0.000429	0.000000
1032	604.5	7	0.000242	0.000429	0.000000
1032	621	6	0.000242	0.000429	0.000000
4128			0.000242	0.000429	0.000000
1056	621	7	0.000242	0.000436	0.000000
1008	564	8	0.000242	0.000436	0.000000
1032	604.5	7	0.000242	0.000436	0.000000
1032	621	6	0.000242	0.000436	0.000000
4128			0.000242	0.000436	0.000000
1056	621	7	0.000242	0.000415	0.000000
1008	564	8	0.000242	0.000415	0.000000
1032	604.5	7	0.000242	0.000415	0.000000
1032	621	6	0.000242	0.000415	0.000000
4128			0.000242	0.000415	0.000000
1056	621	7	0.000242	0.000415	0.000000
1008	564	8	0.000242	0.000415	0.000000
1032	604.5	7	0.000242	0.000415	0.000000
1032	621	6	0.000242	0.000415	0.000000
4128			0.000242	0.000415	0.000000
1056	621	7	0.000242	0.000425	0.000000
1008	564	8	0.000242	0.000425	0.000000
1032	604.5	7	0.000242	0.000425	0.000000
1032	621	6	0.000242	0.000425	0.000000
4128			0.000242	0.000425	0.000000
1056	621	7	0.000242	0.000421	0.000000
1008	564	8	0.000242	0.000421	0.000000
1032	604.5	7	0.000242	0.000421	0.000000
1032	621	6	0.000242	0.000421	0.000000
4128			0.000242	0.000421	0.000000
1056	621	7	0.000242	0.000439	0.000000
1008	564	8	0.000242	0.000439	0.000000
1032	604.5	7	0.000242	0.000439	0.000000
1032	621	6	0.000242	0.000439	0.000000
4128			0.000242	0.000439	0.000000

M	.	J	P	I	.
TIME W/O I FAIL RATE	ACTUAL FAILS	FORECAST 1 (POSSESS)	DELTA 1 (ABSOLUTE)	FORECAST 2 TIME ONLY	DELTA 2 (ABSOLUTE)
0.000415	0	0.255814	0.255814	0.257090	0.257090
0.000415	0	0.244186	0.244186	[illegible]	[illegible]
0.000415	1	0.250000	0.750000	0.251000	[illegible]
0.000415	0	0.250000	0.250000	0.257090	[illegible]
0.000415			1.500000		[illegible]
0.000429	0	0.255814	0.255814	0.260208	0.260208
0.000429	0	0.244186	0.244186	[illegible]	[illegible]
0.000429	1	0.250000	0.750000	[illegible]	[illegible]
0.000429	0	0.250000	0.250000	[illegible]	[illegible]
0.000429			[illegible]		[illegible]
0.000486	0	0.255814	0.255814	[illegible]	[illegible]
0.000486	0	0.244186	0.244186	[illegible]	[illegible]
0.000486	1	0.250000	0.750000	[illegible]	[illegible]
0.000486	0	0.250000	0.250000	[illegible]	[illegible]
0.000486			1.500000		[illegible]
0.000415	0	0.255814	0.255814	[illegible]	[illegible]
0.000415	0	0.244186	0.244186	[illegible]	[illegible]
0.000415	1	0.250000	0.750000	[illegible]	[illegible]
[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]
0.000415			1.500000		1.498540
0.000415	0	0.255814	0.255814	0.257730	0.257730
0.000415	0	0.244186	0.244186	0.234078	0.234078
0.000415	0	0.250000	0.250000	[illegible]	[illegible]
0.000415	1	0.250000	0.750000	0.257730	0.742271
0.000415			1.500000		[illegible]
0.000425	0	0.255814	0.255814	[illegible]	[illegible]
[illegible]	[illegible]	0.244186	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.250000	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	0.750000	[illegible]	[illegible]
[illegible]			[illegible]		[illegible]
0.000421	0	0.255814	0.255814	[illegible]	[illegible]
0.000421	0	0.244186	[illegible]	[illegible]	[illegible]
0.000421	0	0.250000	0.250000	0.254687	[illegible]
0.000421	1	0.250000	0.750000	[illegible]	[illegible]
[illegible]			1.500000		[illegible]
0.000433	0	0.255814	0.255814	0.272207	0.272207
0.000433	0	0.244186	0.244186	0.247858	0.247858
0.000433	1	0.250000	0.750000	[illegible]	[illegible]
0.000433	0	0.250000	[illegible]	[illegible]	[illegible]
0.000433			1.500000		[illegible]

S	T	U	V	W
FORECAST 3 LAMBDA 0.2	DELTA 3 (ABSOLUTE)	MAD 1 EACH NSN	MAD 2 EACH NSN	MAD 3 EACH NSN
0.257000	0.257000	0.375000	0.374740	0.374740
0.234219	0.234219			
0.251038	0.748962			
0.257890	0.257890			
	1.498962			
0.266238	0.266238	0.375000	0.378770	0.378770
0.241801	0.241801			
0.259164	0.740836			
0.266238	0.266238			
	1.515113			
0.301603	0.301603	0.375000	0.395304	0.395304
0.273919	0.273919			
0.293589	0.706411			
0.301603	0.301603			
	1.583536			
0.257676	0.257676	0.375000	0.374607	0.374607
0.234025	0.234025			
0.250830	0.749170			
0.257676	0.257676			
	1.498540			
0.257730	0.257730	0.375000	0.371209	0.371209
0.234073	0.234073			
0.250882	0.250882			
0.257730	0.742270			
	1.484955			
0.263806	0.263806	0.375000	0.374207	0.374207
0.229532	0.229532			
0.256727	0.256727			
0.263806	0.736194			
	[illegible]			
0.261639	0.261639	0.375000	0.373676	0.373676
0.237624	0.237624			
0.254607	0.254607			
0.261639	0.738361			
	1.492311			
0.272907	0.272907	0.375000	0.382004	0.382004
0.247858	0.247858			
0.265956	0.734044			
0.272907	0.272907			
	1.528016			

A	B	C	D	E	F
NSN	EPOCH	ON HOURS	ON FAILS	CYCLES	OFF FAILS
(TRM-10)		[illegible]	(NO.)	[illegible]	[illegible]
5820004208419	1	621	0	7	[illegible]
	2	564	[illegible]	8	[illegible]
	3	[illegible]1.5	[illegible]	7	[illegible]
	4	620.5	1	7	0
	TOTAL	2410	1	29	[illegible]
5895008710025	1	621	0	7	[illegible]
	2	564	[illegible]	[illegible]	[illegible]
	3	604	1	8	[illegible]
	4	621	[illegible]	[illegible]	[illegible]
	TOTAL	2410	1	2[illegible]	[illegible]
5[illegible]95[illegible]7[illegible]02[illegible]	1	[illegible]21	[illegible]	7	[illegible]
	2	564	0	8	[illegible]
	3	604	1	8	[illegible]
	4	621	0	[illegible]	[illegible]
	TOTAL	2410	1	29	[illegible]
[illegible]1[illegible]5[illegible]1[illegible]910605	1	[illegible]21	0	7	0
	2	564	0	8	[illegible]
	3	604.5	0	7	[illegible]
	4	550.5	1	7	[illegible]
	TOTAL	2340	1	29	[illegible]
4100003505438	1	621	0	7	[illegible]
	2	564	0	8	[illegible]
	3	604.5	0	7	[illegible]
	4	390.5	1	4	[illegible]
	TOTAL	2180	1	26	[illegible]
5985[illegible]11215024	1	621	[illegible]	7	[illegible]
	2	[illegible]3.5	1	[illegible]	[illegible]
	3	[illegible]4.5	[illegible]	7	[illegible]
	4	[illegible]21	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5[illegible]1[illegible]0100[illegible]0[illegible]45	1	[illegible]21	[illegible]	7	[illegible]
	2	564	[illegible]	8	[illegible]
	3	[illegible]01.5	1	8	[illegible]
	4	621	[illegible]	[illegible]	[illegible]
	TOTAL	2407.5	1	29	[illegible]
5895012065570	1	[illegible]21	0	7	[illegible]
	2	564	0	8	0
	3	561	1	[illegible]	[illegible]
	[illegible]	[illegible]21	[illegible]	[illegible]	[illegible]
	TOTAL	[illegible]367	1	29	[illegible]

G	H	I	J	K	L
PROCESSED HOURS	LONG RUN [illegible]	LONG RUN [illegible]	PROCESSED FAIL RATE	TIME ONLY FAIL RATE	CYCLE FAIL RATE
1056	621	7	0.000242	0.000415	0.000000
1008	564	8	0.000242	0.000415	0.000000
1032	604.5	7	0.000242	0.000415	0.000000
1032	621	6	0.000242	0.000415	0.000000
4128			0.000242	0.000415	0.000000
1056	621	7	0.000242	0.000415	0.000000
1008	564	8	0.000242	0.000415	0.000000
1032	604.5	7	0.000242	0.000415	0.000000
1032	621	6	0.000242	0.000415	0.000000
4128			0.000242	0.000415	0.000000
1056	621	7	0.000242	0.000415	0.000000
1008	564	8	0.000242	0.000415	0.000000
1032	604.5	7	0.000242	0.000415	0.000000
1032	621	6	0.000242	0.000415	0.000000
4128			0.000242	0.000415	0.000000
1056	621	7	0.000242	0.000427	0.000000
1008	564	8	0.000242	0.000427	0.000000
1032	604.5	7	0.000242	0.000427	0.000000
1032	621	6	0.000242	0.000427	0.000000
4128			0.000242	0.000427	0.000000
1056	621	7	0.000242	0.000459	0.000000
1008	564	8	0.000242	0.000459	0.000000
1032	604.5	7	0.000242	0.000459	0.000000
1032	621	6	0.000242	0.000459	0.000000
4128			0.000242	0.000459	0.000000
1056	621	7	0.000242	0.000500	0.000000
1008	564	8	0.000242	0.000500	0.000000
1032	604.5	7	0.000242	0.000500	0.000000
1032	621	6	0.000242	0.000500	0.000000
4128			0.000242	0.000500	0.000000
1056	621	7	0.000242	0.000415	0.000000
1008	564	8	0.000242	0.000415	0.000000
1032	604.5	7	0.000242	0.000415	0.000000
1032	621	6	0.000242	0.000415	0.000000
4128			0.000242	0.000415	0.000000
1056	621	7	0.000242	0.000422	0.000000
1008	564	8	0.000242	0.000422	0.000000
1032	604.5	7	0.000242	0.000422	0.000000
1032	621	6	0.000242	0.000422	0.000000
4128			0.000242	0.000422	0.000000

TIME W/CYC FAIL RATE	ACTUAL FAILS	FORECAST 1 (DDDDDD)	DELTA 1 (ABSOLUTE)	FORECAST 2 TIME ONLY	DELTA 2 (ABSOLUTE)
0.000415	1	0.255014	0.255014	[illegible]	[illegible]
0.000415	1	0.244186	0.244186	[illegible]	[illegible]
0.000415	0	0.250000	0.250000	[illegible]	[illegible]
0.000415	1	0.250000	0.750000	[illegible]	[illegible]
0.000415			1.500000		[illegible]
0.000415	1	0.255014	0.255014	0.257070	[illegible]
0.000415	0	0.244186	0.244186	[illegible]	[illegible]
0.000415	1	0.250000	0.750000	0.251001	[illegible]
0.000415	0	0.250000	0.250000	[illegible]	[illegible]
0.000415			[illegible]		[illegible]
0.000415	1	0.255014	0.255014	[illegible]	[illegible]
0.000415	0	0.244186	0.244186	[illegible]	[illegible]
0.000415	1	0.250000	0.750000	0.251001	[illegible]
0.000415	0	0.250000	0.250000	[illegible]	[illegible]
0.000415			1.500000		[illegible]
0.000427	1	0.255014	0.255014	[illegible]	[illegible]
0.000427	0	0.244186	0.244186	[illegible]	[illegible]
0.000427	1	0.250000	0.250000	[illegible]	[illegible]
0.000427	1	0.250000	0.750000	[illegible]	[illegible]
0.000427			1.500000		[illegible]
0.000459	1	0.255014	0.255014	[illegible]	[illegible]
0.000459	0	0.244186	0.244186	[illegible]	[illegible]
0.000459	1	0.250000	0.250000	[illegible]	[illegible]
0.000459	1	0.250000	0.750000	[illegible]	[illegible]
0.000459			1.500000		[illegible]
0.000500	0	0.255014	0.255014	[illegible]	[illegible]
0.000500	1	[illegible]	[illegible]	[illegible]	[illegible]
0.000500	1	0.250000	0.250000	[illegible]	[illegible]
0.000500	1	0.250000	0.250000	[illegible]	[illegible]
0.000500			[illegible]		[illegible]
0.000415	1	0.255014	[illegible]	[illegible]	[illegible]
0.000415	1	0.244186	0.244186	[illegible]	[illegible]
0.000415	1	0.250000	0.750000	[illegible]	[illegible]
0.000415	0	0.250000	0.250000	[illegible]	[illegible]
0.000415			1.500000		[illegible]
0.000422	0	0.255014	0.255014	[illegible]	[illegible]
0.000422	0	0.244186	0.244186	[illegible]	[illegible]
0.000422	1	0.250000	0.750000	[illegible]	[illegible]
0.000422	1	0.250000	0.250000	[illegible]	[illegible]
0.000422			1.500000		[illegible]

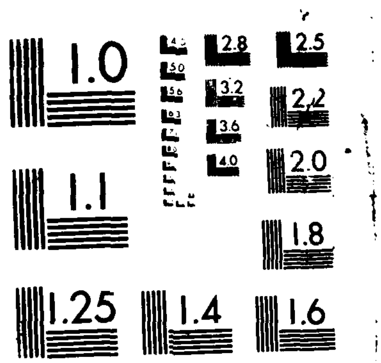
[illegible] D LAMBDA 0,1	DELTA D (ABSOLUTE)	MAX D EACH ROW	AD D EACH ROW	AVE D EACH ROW
0.257676	0.257676	0.375000	0.371211	0.371211
0.234125	0.234125			
0.250000	0.250000			
0.257676	0.742024			
	1.484055			
0.257676	0.257676	0.375000	0.374607	0.374607
0.234025	0.234025			
0.250000	0.740171			
0.257676	0.257676			
	1.490540			
0.257676	0.257676	0.375000	0.374607	0.374607
0.234025	0.234025			
0.251000	0.740171			
0.257676	0.257676			
	1.490540			
0.265000	0.265000	0.375000	0.374640	0.374640
0.241026	0.241026			
0.258000	0.258000			
0.265000	0.734010			
	1.499050			
0.284862	0.284862	0.375000	0.384002	0.384002
0.250716	0.250716			
0.277294	0.277294			
0.284862	0.715100			
	1.533[illegible]			
0.331200	0.331200	0.377907	0.421000	0.421000
[illegible]	[illegible]			
[illegible]	[illegible]			
0.3312[illegible]	0.331200			
	[illegible]			
0.257944	0.257944	0.375000	0.374730	0.374730
0.234200	0.234200			
0.251000	0.740910			
0.257944	0.257944			
	1.[illegible]99035			
0.262057	0.262057	0.375000	0.370301	0.370301
0.238276	0.238276			
0.255057	[illegible]			
0.262057	0.262057			
	1.537005			

[illegible]	[illegible]	[illegible]	[illegible] FAILS	FAILED	[illegible]
5930010027110	1	621	0	7	[illegible]
	2	561	0	[illegible]	[illegible]
	3	[illegible]	[illegible]	7	[illegible]
	4	620.5	1	7	[illegible]
	TOTAL	2[illegible]	[illegible]	20	[illegible]
5910000020098	1	621	0	7	[illegible]
	2	561	0	0	[illegible]
	3	[illegible].5	[illegible]	7	[illegible]
	4	561	1	7	[illegible]
	TOTAL	2000.5	1	2[illegible]	[illegible]
[illegible]	1	621	[illegible]	[illegible]	[illegible]
	2	561	0	3	[illegible]
	3	600.5	1	3	[illegible]
	4	621	0	[illegible]	[illegible]
	TOTAL	2109.5	1	2[illegible]	[illegible]
5910010127045	1	[illegible]	[illegible]	[illegible]	[illegible]
	2	564	[illegible]	0	[illegible]
	3	54[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	TOTAL	200[illegible].5	1	20	[illegible]
5820004940616	1	621	0	7	[illegible]
	2	564	0	0	[illegible]
	3	[illegible]	1	8	[illegible]
	4	621	[illegible]	[illegible]	[illegible]
	TOTAL	2[illegible]	1	2[illegible]	[illegible]
58200049[illegible]0621	1	621	0	7	[illegible]
	2	[illegible]	[illegible]	[illegible]	[illegible]
	3	[illegible]	1	[illegible]	[illegible]
	[illegible]	621	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]
	2	564	[illegible]	[illegible]	[illegible]
	3	600.5	1	0	[illegible]
	4	621	[illegible]	[illegible]	[illegible]
	TOTAL	2[illegible].5	1	2[illegible]	[illegible]
[illegible]07710040	1	621	[illegible]	7	[illegible]
	2	564	[illegible]	0	[illegible]
	3	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	621	[illegible]	[illegible]	[illegible]
	TOTAL	2002.5	1	20	[illegible]

[illegible] UNIT	[illegible]	[illegible]	[illegible] FAIL RATE	[illegible] FAIL RATE	[illegible] FAIL RATE
1056	021	7	0.000242	0.000415	0.000000
1000	564	0	0.000242	0.000415	0.000000
1002	604.5	7	0.000242	0.000415	0.000000
1002	021	6	0.000242	0.000415	0.000000
4120			0.000242	0.000415	0.000000
1056	021	7	0.000242	0.000425	0.000000
1000	564	0	0.000242	0.000425	0.000000
1002	604.5	7	0.000242	0.000425	0.000000
1002	021	6	0.000242	0.000425	0.000000
4120			0.000242	0.000425	0.000000
1056	021	7	0.000242	0.000415	0.000000
1000	564	0	0.000242	0.000415	0.000000
1002	604.5	7	0.000242	0.000415	0.000000
1002	021	6	0.000242	0.000415	0.000000
4120			0.000242	0.000415	0.000000
1056	021	7	0.000242	0.000425	0.000000
1000	564	0	0.000242	0.000425	0.000000
1002	604.5	7	0.000242	0.000425	0.000000
1002	021	6	0.000242	0.000425	0.000000
4120			0.000242	0.000425	0.000000
1056	021	7	0.000242	0.000415	[illegible]
1000	564	0	0.000242	0.000415	[illegible]
1002	604.5	7	0.000242	0.000415	[illegible]
1002	021	6	0.000242	0.000415	[illegible]
4120			0.000242	0.000415	[illegible]
1056	021	7	0.000242	0.000415	[illegible]
1000	[illegible]	0	[illegible]	[illegible]	
1002	[illegible]	7	[illegible]	[illegible]	
1002	021	[illegible]	[illegible]	[illegible]	
[illegible]			[illegible]		
1056	[illegible]	7	[illegible]		
1000	564	0	[illegible]		
1002	604.5	7	[illegible]		
1002	[illegible]	[illegible]	[illegible]		
4120			[illegible]		
1056	021	[illegible]			
1000	[illegible]	[illegible]			
[illegible]	[illegible]				
[illegible]	[illegible]				
[illegible]					

AD-A186 536 VALIDATION OF A STOCHASTIC MODEL TO DETERMINE FAILURE RATES FOR COMMUNICA (U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL OF SYST D G WILLECK 2/2

UNCLASSIFIED SEP 87 AFIT/GLM/LSMA/87S-84 F/G 15/5 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963

M TIME W/CYC FAIL RATE	N ACTUAL FAILS	O FORECAST 1 (POSSESS)	P DELTA 1 (ABSOLUTE)	Q FORECAST 2 TIME ONLY	R DELTA 2 (ABSOLUTE)
0.000415	0	0.255814	0.255814	0.257676	0.257676
0.000415	0	0.244186	0.244186	0.234025	0.234025
0.000415	2	0.250000	1.750000	0.250830	1.749170
0.000415	0	0.250000	0.250000	0.257676	0.257676
0.000415			2.500000		2.498548
0.000425	0	0.255814	0.255814	0.264199	0.264199
0.000425	1	0.244186	0.755814	0.209949	[illegible]
0.000425	1	0.250000	0.750000	0.257170	0.742821
0.000425	0	0.250000	0.250000	[illegible]	[illegible]
0.000425			2.011628		[illegible]
0.000415	0	0.255814	0.255814	0.257700	0.257700
0.000415	1	0.244186	0.755814	0.234070	0.765327
0.000415	1	0.250000	0.750000	0.250882	0.749118
0.000415	0	0.250000	0.250000	0.257700	0.257700
0.000415			2.011628		2.030504
0.000425	0	0.255814	0.255814	0.264199	0.264199
0.000425	0	0.244186	0.244186	0.209949	0.209949
0.000425	2	0.250000	1.750000	0.257170	[illegible]
0.000425	0	0.250000	0.250000	0.264199	[illegible]
0.000425			2.500000		2.511160
0.000415	0	0.255814	0.255814	0.257676	0.257676
0.000415	1	0.244186	0.755814	0.234025	0.765975
0.000415	1	0.250000	0.750000	0.250830	[illegible]
0.000415	0	0.250000	0.250000	0.257676	0.257676
0.000415			2.011628		[illegible]
0.000415	0	0.255814	0.255814	0.257676	0.257676
0.000415	1	0.244186	[illegible]	[illegible]	[illegible]
0.000415	0	0.250000	0.250000	[illegible]	[illegible]
0.000415	1	0.250000	0.250000	[illegible]	[illegible]
[illegible]			[illegible]		[illegible]
0.000415	0	0.255814	[illegible]	0.257700	[illegible]
0.000415	0	0.244186	0.244186	0.234070	0.234070
0.000415	1	0.250000	0.750000	0.250882	[illegible]
0.000415	0	0.250000	0.250000	[illegible]	[illegible]
0.000415			1.500000		[illegible]
0.000429	0	0.255814	[illegible]	0.266208	0.266208
0.000429	0	0.244186	0.244186	0.241001	0.241001
0.000429	1	0.250000	[illegible]	[illegible]	[illegible]
0.000429	0	0.250000	[illegible]	[illegible]	[illegible]
0.000429			1.500000		[illegible]

S	T	U	V	W
FORECAST 3 LAMBDA t,c	DELTA 3 (ABSOLUTE)	MAD 1 EACH NSN	MAD 2 EACH NSN	MAD 3 EACH NSN
0.257676	0.257676	0.625000	0.624637	0.624637
0.234025	0.234025			
0.250830	1.749170			
0.257676	0.257676			
	2.498548			
0.264199	0.264199	0.502907	0.507817	0.507817
0.239949	0.760051			
0.257179	0.742821			
0.264199	0.264199			
	2.031270			
0.257730	0.257730	0.502907	0.507626	0.507626
0.234073	0.765927			
0.250882	0.749118			
0.257730	0.257730			
	2.030504			
0.264199	0.264199	0.625000	0.627792	0.627792
0.239949	0.239949			
0.257179	1.742821			
0.264199	0.264199			
	2.511168			
0.257676	0.257676	0.502907	0.507624	0.507624
0.234025	0.765975			
0.250830	0.749170			
0.257676	0.257676			
	2.030498			
0.257676	0.257676	0.377907	0.380009	[illegible]
0.234025	0.765975			
0.250830	0.250830			
0.257676	0.257676			
	[illegible]			
0.257730	0.257730	0.375000	0.374660	0.374660
0.234073	0.234073			
0.250882	0.749118			
0.257730	0.257730			
	1.498651			
0.266238	0.266238	0.375000	0.378770	0.378778
0.241801	0.241801			
0.259134	0.740866			
0.266238	0.266238			
	1.515110			

A NSN (TPN-19)	B EPOCH	C ON HOURS (t)	D ON-FAILS (Xt)	E CYCLES (c)	F CYCLE FAIL (Yc)
5930007585030	1	621	0	7	0
	2	564	0	8	0
	3	574.5	1	7	0
	4	621	0	6	0
	TOTAL	2380.5	1	28	0
5935003907811	1	621	0	7	0
	2	564	0	8	0
	3	604.5	0	7	0
	4	620	1	7	0
	TOTAL	2409.5	1	29	0
5930006684220	1	621	0	7	0
	2	564	0	8	0
	3	604.5	0	7	0
	4	572	1	6	0
	TOTAL	2361.5	1	28	0
5840010506250	1	621	0	7	0
	2	336	1	5	0
	3	596.5	0	7	0
	4	621	0	6	0
	TOTAL	2174.5	1	25	0
5895011736109	1	621	0	7	0
	2	336.5	1	5	0
	3	437.5	0	5	0
	4	621	0	6	0
	TOTAL	2016	1	23	0
5895011680428	1	621	0	7	0
	2	336.5	1	5	0
	3	565	0	7	0
	4	621	0	6	0
	TOTAL	2143.5	1	25	
5961007648177	1	621	0	7	0
	2	336.5	1	5	0
	3	363.5	0	5	0
	4	621	0	6	0
	TOTAL	1942	1	23	0
5895000000010	1	621	0	7	0
	2	564	0	8	0
	3	600.5	1	[illegible]	0
	4	621	0	[illegible]	0
	TOTAL	2406.5	1	[illegible]	0

G POSSESSED HOURS	H LONG RUN E[t]	I LONG RUN E[c]	J POSSESSED FAIL RATE	K TIME ONLY FAIL RATE	L CYCLE FAIL RATE
1056	621	7	0.000242	0.000420	0.000000
1008	564	8	0.000242	0.000420	0.000000
1032	604.5	7	0.000242	0.000420	0.000000
1032	621	6	0.000242	0.000420	0.000000
4128			0.000242	0.000420	0.000000
1056	621	7	0.000242	0.000415	0.000000
1008	564	8	0.000242	0.000415	0.000000
1032	604.5	7	0.000242	0.000415	0.000000
1032	621	6	0.000242	0.000415	0.000000
4128			0.000242	0.000415	0.000000
1056	621	7	0.000242	0.000428	0.000000
1008	564	8	0.000242	0.000428	0.000000
1032	604.5	7	0.000242	0.000428	0.000000
1032	621	6	0.000242	0.000428	0.000000
4128			0.000242	0.000428	0.000000
1056	621	7	0.000242	0.000460	0.000000
1008	564	8	0.000242	0.000460	0.000000
1032	604.5	7	0.000242	0.000460	0.000000
1032	621	6	0.000242	0.000460	0.000000
4128			0.000242	0.000460	0.000000
1056	621	7	0.000242	0.000496	0.000000
1008	564	8	0.000242	0.000496	0.000000
1032	604.5	7	0.000242	0.000496	0.000000
1032	621	6	0.000242	0.000496	0.000000
4128			0.000242	0.000496	0.000000
1056	621	7	0.000242	0.000467	0.000000
1008	564	8	0.000242	0.000467	0.000000
1032	604.5	7	0.000242	0.000467	0.000000
1032	621	6	0.000242	0.000467	0.000000
4128			0.000242	0.000467	0.000000
1056	621	7	0.000242	0.000515	0.000000
1008	564	8	0.000242	0.000515	0.000000
1032	604.5	7	0.000242	0.000515	0.000000
1032	621	6	0.000242	0.000515	0.000000
4128			0.000242	0.000515	0.000000
1056	621	7	0.000484	0.000830	0.000000
1008	564	8	0.000484	0.000830	0.000000
1032	604.5	7	0.000484	0.000830	0.000000
1032	621	6	0.000484	0.000830	0.000000
4128			0.000484	0.000830	0.000000

M TIME W/CYC FAIL RATE	N ACTUAL FAILS	O FORECAST 1 (POSSESS)	P DELTA 1 (ABSOLUTE)	Q FORECAST 2 TIME ONLY	R DELTA 2 (ABSOLUTE)
0.000420	0	0.255814	0.255814	0.260870	0.260870
0.000420	0	0.244186	0.244186	0.236925	[illegible]
0.000420	2	0.250000	1.750000	0.253938	1.746062
0.000420	0	0.250000	0.250000	0.260870	0.260870
0.000420			2.500000		[illegible]
0.000415	0	0.255814	0.255814	0.257730	0.257730
0.000415	1	0.244186	0.755814	[illegible]	[illegible]
0.000415	1	0.250000	0.750000	[illegible]	0.749110
0.000415	0	0.250000	0.250000	0.257730	[illegible]
0.000415			2.011628		[illegible]
0.000423	0	0.255814	0.255814	0.262968	[illegible]
0.000423	1	0.244186	0.755814	[illegible]	[illegible]
0.000423	1	0.250000	0.750000	[illegible]	[illegible]
0.000423	0	0.250000	[illegible]	0.262968	[illegible]
0.000423			2.011628		[illegible]
0.000460	0	0.255814	0.255814	[illegible]	[illegible]
0.000460	0	0.244186	0.244186	[illegible]	[illegible]
0.000460	2	0.250000	1.750000	0.277095	[illegible]
0.000460	0	[illegible]	0.250000	[illegible]	[illegible]
0.000460			2.500000		[illegible]
0.000496	0	0.255814	0.255814	[illegible]	[illegible]
0.000496	1	0.244186	0.755814	0.279762	[illegible]
0.000496	1	0.250000	0.750000	[illegible]	[illegible]
0.000496	0	0.250000	[illegible]	[illegible]	[illegible]
0.000496			[illegible]		[illegible]
0.000467	0	0.255814	0.255814	[illegible]	[illegible]
0.000467	1	[illegible]	[illegible]	[illegible]	[illegible]
0.000467	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0.000467	0	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]		[illegible]
[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]
0.000515	[illegible]	0.244186	[illegible]	[illegible]	[illegible]
0.000515	1	0.250000	0.750000	[illegible]	[illegible]
0.000515	0	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]		[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0.000830	0	0.488372	0.488372	[illegible]	[illegible]
[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]		[illegible]

S	T	U	V	W
FORECAST S LAMBDA t,z	DELTA S (ABSOLUTE)	MAD 1 EACH NSN	MAD 2 EACH NSN	MAD 3 EACH NSN
0.260870	0.260870	0.625000	0.626181	0.626181
0.236025	0.236025			
0.253938	1.746062			
0.260870	0.260870			
	2.504726			
0.257730	0.257730	0.502907	0.507626	0.507626
0.234070	0.765927			
0.250882	0.749110			
0.257730	0.257730			
	2.030504			
0.262960	0.262960	0.502907	0.507701	0.507701
0.238831	0.761100			
0.255081	0.744010			
0.262960	0.262960			
	2.031124			
0.285500	0.285500	0.625[illegible]	0.638135	[illegible]
0.259070	0.159370			
0.277995	1.722005			
0.285500	0.285500			
	2.552541			
0.308036	0.308036	0.502907	0.509115	0.509115
0.279762	0.720238			
0.299051	0.700149			
0.308036	0.308036			
	2.[illegible]			
0.289710	0.289710	0.677907	1.399580	1.399580
[illegible]	[illegible]			
[illegible]	[illegible]			
[illegible]	[illegible]			
	[illegible]			
0.310770	0.310770	0.675000	1.414078	[illegible]
0.290422	[illegible]			
0.311277	[illegible]			
0.310770	0.310770			
	[illegible]			
0.515400	0.515400	[illegible]	0.401325	0.499026
0.460147	0.460147			
0.501761	[illegible]			
0.515401	0.515401			
	1.[illegible]			

A NSN (TPN-19)	B EPOCH	C ON-HOURS (t)	D ON-FAILS (Xt)	E CYCLES (c)	F CYCLE FAIL (Yc)
5840011759514	1	621	0	7	0
	2	564	0	8	0
	3	603.5	2	9	0
	4	621	0	6	0
	TOTAL	2409.5	2	30	0
5840010583156	1	621	0	7	0
	2	564	0	8	0
	3	602.5	1	8	0
	4	621	0	6	0
	TOTAL	2406.5	1	29	0
5895007743176	1	621	0	7	0
	2	564	0	8	0
	3	552	1	8	0
	4	621	0	6	0
	TOTAL	2358	1	29	0
5895009260001	1	621	0	7	0
	2	564	0	8	0
	3	604.5	0	7	1
	4	620.5	1	7	1
	TOTAL	2410	1	29	1
5895004953697	1	621	0	7	0
	2	564	0	8	0
	3	604.5	0	7	0
	4	620.5	1	7	0
	TOTAL	2410	1	29	[illegible]
[illegible]010005294697	1	621	0	7	0
	2	564	0	8	0
	3	604.5	0	7	[illegible]
	4	560.5	1	7	[illegible]
	TOTAL	235[illegible]	1	[illegible]	[illegible]
6105010068445	1	621	0	7	[illegible]
	2	564	0	8	0
	3	604.5	0	7	0
	4	614	1	7	0
	TOTAL	2403.5	1	29	0
5930010508436	1	4347	0	49	0
	2	3948	0	56	0
	3	4231.5	0	49	0
	4	4236.5	7	48	[illegible]
	TOTAL	16763	7	202	0

G POSSESSED HOURS	H LONG RUN [b]	I LONG RUN [c]	J POSSESSED FAIL RATE	K TIME ONLY FAIL RATE	L CYCLE FAIL RATE
1056	621	7	0.000484	0.000830	0.000000
1008	564	8	0.000484	0.000830	0.000000
1032	604.5	7	0.000484	0.000830	0.000000
1032	621	6	0.000484	0.000830	0.000000
4128			0.000484	0.000830	0.000000
1056	621	7	0.000242	0.000415	0.000000
1008	564	8	0.000242	0.000415	0.000000
1032	604.5	7	0.000242	0.000415	0.000000
1032	621	6	0.000242	0.000415	0.000000
4128			0.000242	0.000415	0.000000
1056	621	7	0.000242	0.000424	0.000000
1008	564	8	0.000242	0.000424	0.000000
1032	604.5	7	0.000242	0.000424	0.000000
1032	621	6	0.000242	0.000424	0.000000
4128			0.000242	0.000424	0.000000
1056	621	7	0.000484	0.000830	0.034483
1008	564	8	0.000484	0.000830	0.034483
1032	604.5	7	0.000484	0.000830	0.034483
1032	621	6	0.000484	0.000830	0.034483
4128			0.000484	0.000830	0.034483
1056	621	7	0.000242	0.000415	0.000000
1008	564	8	0.000242	0.000415	0.000000
1032	604.5	7	0.000242	0.000415	0.000000
1032	621	6	0.000242	0.000415	0.000000
4128			0.000242	0.000415	0.000000
1056	621	7	0.000242	0.000426	0.000000
1008	564	8	0.000242	0.000426	0.000000
1032	604.5	7	0.000242	0.000426	0.000000
1032	621	6	0.000242	0.000426	0.000000
4128			0.000242	0.000426	0.000000
1056	621	7	0.000242	0.000416	0.000000
1008	564	8	0.000242	0.000416	0.000000
1032	604.5	7	0.000242	0.000416	0.000000
1032	621	6	0.000242	0.000416	0.000000
4128			0.000242	0.000416	0.000000
1056	4347	49	0.001696	0.000418	0.000000
1008	3948	56	0.001696	0.000418	0.000000
1032	4231.5	49	0.001696	0.000418	0.000000
1032	4347	42	0.001696	0.000418	0.000000
4128			0.001696	0.000418	0.000000

M TIME W/CYC FAIL RATE	N ACTUAL FAILS	O FORECAST 1 (POSSESS)	P DELTA 1 (ABSOLUTE)	Q FORECAST 2 TIME ONLY	R DELTA 2 (ABSOLUTE)
0.000830	0	0.511628	0.511628	0.515460	0.515460
0.000830	0	0.488372	0.488372	0.468147	0.468147
0.000830	2	0.500000	1.500000	0.501764	1.498236
0.000830	0	0.500000	0.500000	0.515460	0.515460
0.000830			3.000000		2.997302
0.000415	0	0.255814	0.255814	0.257837	0.257837
0.000415	1	0.244186	0.755814	0.234171	0.765829
0.000415	1	0.250000	0.750000	0.250986	0.749014
0.000415	0	0.250000	0.250000	0.257837	0.257837
0.000415			2.011628		2.000517
0.000424	0	0.255814	0.255814	0.263059	0.263059
0.000424	1	0.244186	0.755814	0.239186	0.760814
0.000424	1	0.250000	0.750000	0.256361	0.743639
0.000424	0	0.250000	0.250000	0.263059	0.263059
0.000424			2.011628		2.031170
0.000415	0	0.511628	0.511628	0.515050	0.515050
0.000415	0	0.488372	0.488372	0.468050	0.468050
0.000415	2	0.500000	1.500000	0.501060	1.498940
0.000415	0	0.500000	0.500000	0.515050	0.515050
0.000415			3.000000		2.997095
0.000415	0	0.255814	0.255814	0.257676	0.257676
0.000415	1	0.244186	0.755814	0.234025	0.765975
0.000415	1	0.250000	0.750000	0.250830	0.749170
0.000415	0	0.250000	0.250000	0.257676	0.257676
0.000415			2.011628		[illegible]
0.000426	0	0.255814	0.255814	0.264255	[illegible]
0.000426	1	0.244186	0.755814	[illegible]	[illegible]
0.000426	0	0.250000	0.250000	0.257204	[illegible]
0.000426	0	0.250000	0.250000	0.264255	[illegible]
[illegible]			1.511628		[illegible]
0.000416	0	0.255814	0.255814	[illegible]	[illegible]
0.000416	0	0.244186	0.244186	[illegible]	[illegible]
0.000416	1	0.250000	0.750000	0.251508	0.748492
0.000416	0	0.250000	0.250000	[illegible]	[illegible]
0.000416			1.500000		[illegible]
0.000418	0	1.790698	1.790698	1.815248	1.815248
0.000418	0	1.709302	1.709302	1.648631	1.648631
0.000418	1	1.750000	0.750000	1.757117	[illegible]
0.000418	[illegible]	1.750000	1.750000	1.815248	[illegible]
0.000418			6.000000		[illegible]

S FORECAST 3 LAMBDA t,c	T DELTA 3 (ABSOLUTE)	U MAD 1 EACH NSN	V MAD 2 EACH NSN	W MAD 3 EACH NSN
0.515460	0.515460	0.750000	0.749326	0.749326
0.468147	0.468147			
0.501764	1.498236			
0.515460	0.515460			
	2.997302			
0.257837	0.257837	0.502907	0.507629	0.507629
0.234171	0.765829			
0.250986	0.749014			
0.257837	0.257837			
	2.030517			
0.263359	0.263359	0.502907	0.507733	0.50773[illegible]
0.239186	0.760814			
0.256361	0.743639			
0.263359	0.263359			
	2.031170			
0.499056	0.499056	0.750000	0.749274	0.745327
0.509887	0.509887			
0.492209	1.507791			
0.464570	0.464570			
	2.981306			
0.257676	0.257676	0.502907	0.507624	0.507624
0.234025	0.765975			
0.250830	0.749170			
0.257676	0.257676			
	2.030496			
0.264255	0.264255	0.377907	0.386436	0.3864[illegible]
[illegible]	0.760000			
0.257234	0.257234			
0.264255	0.264255			
	1.545743			
0.250070	0.250070	0.375000	0.374974	0.374974
0.234650	0.234638			
0.251508	0.748492			
0.250070	0.250070			
	1.499896			
1.815248	1.815248	1.500000	1.511536	1.51153[illegible]
1.648631	1.648631			
1.767017	[illegible]			
1.815248	1.815248			
	6.0461[illegible]			

A NSN (TPN-19)	B EPOCH	C ON-HOURS (t)	D ON-FAILS (Xt)	E CYCLES (c)	F CYCLE FAIL (Yc)
5930010502436	1	1863	0	21	0
	2	1692	0	24	0
	3	1813.5	0	21	0
	4	1754	0	9	0
	TOTAL	7122.5	0	75	0
5895008325851	1	621	0	7	0
	2	564	0	8	0
	3	604.5	0	7	0
	4	588.5	1	7	0
	TOTAL	2378	1	29	0
5820010271806	1	621	0	7	0
	2	564	0	8	0
	3	603	1	8	0
	4	621	0	6	0
	TOTAL	2409	1	29	0
5985000046205	1	621	0	7	0
	2	479	1	6	0
	3	462	0	6	0
	4	621	0	6	0
	TOTAL	2183	1	25	0
5935009885470	1	621	0	7	0
	2	497.5	1	6	0
	3	604.5	0	7	0
	4	621	0	6	0
	TOTAL	2344	1	26	0
5935002472120	1	621	0	7	0
	2	478	1	6	0
	3	538.5	0	6	0
	4	621	0	6	0
	TOTAL	2258.5	1	25	[illegible]
5960000275806	1	621	0	7	0
	2	564	0	8	0
	3	604	1	8	0
	4	621	0	6	0
	TOTAL	2410	1	29	0
5895000839475	1	621	0	7	0
	2	564	0	8	0
	3	604	1	8	0
	4	621	0	6	0
	TOTAL	2410	1	29	0

G POSSESSED HOURS	H LONG RUN E[t]	I LONG RUN E[c]	J POSSESSED FAIL RATE	K TIME ONLY FAIL RATE	L CYCLE FAIL RATE
1056	1863	21	0.000727	0.000421	0.000000
1008	1692	24	0.000727	0.000421	0.000000
1032	1813.5	21	0.000727	0.000421	0.000000
1032	1863	18	0.000727	0.000421	0.000000
4128			0.000727	0.000421	0.000000
1056	621	7	0.000242	0.000421	0.000000
1008	564	8	0.000242	0.000421	0.000000
1032	604.5	7	0.000242	0.000421	0.000000
1032	621	6	0.000242	0.000421	0.000000
4128			0.000242	0.000421	0.000000
1056	621	7	0.000242	0.000415	0.000000
1008	564	8	0.000242	0.000415	0.000000
1032	604.5	7	0.000242	0.000415	0.000000
1032	621	6	0.000242	0.000415	0.000000
4128			0.000242	0.000415	0.000000
1056	621	7	0.000242	0.000458	0.000000
1008	564	8	0.000242	0.000458	0.000000
1032	604.5	7	0.000242	0.000458	0.000000
1032	621	6	0.000242	0.000458	0.000000
4128			0.000242	0.000458	0.000000
1056	621	7	0.000242	0.000427	0.000000
1008	564	8	0.000242	0.000427	0.000000
1032	604.5	7	0.000242	0.000427	0.000000
1032	621	6	0.000242	0.000427	0.000000
4128			0.000242	0.000427	0.000000
1056	621	7	0.000242	0.000443	0.000000
1008	564	8	0.000242	0.000443	0.000000
1032	604.5	7	0.000242	0.000443	0.000000
1032	621	6	0.000242	0.000443	0.000000
4128			0.000242	0.000443	0.000000
1056	621	7	0.000242	0.000415	0.000000
1008	564	8	0.000242	0.000415	0.000000
1032	604.5	7	0.000242	0.000415	0.000000
1032	621	6	0.000242	0.000415	0.000000
4128			0.000242	0.000415	0.000000
1056	621	7	0.000242	0.000415	0.000000
1008	564	8	0.000242	0.000415	0.000000
1032	604.5	7	0.000242	0.000415	0.000000
1032	621	6	0.000242	0.000415	0.000000
4128			0.000242	0.000415	0.000000

M TIME W/CYC FAIL RATE	N ACTUAL FAILS	O FORECAST 1 (POSSESS)	P DELTA 1 (ABSOLUTE)	Q FORECAST 2 TIME ONLY	R DELTA 2 (ABSOLUTE)
0.000421	0	0.767442	0.767442	0.784696	0.784696
0.000421	0	0.732558	0.732558	0.712671	0.712671
0.000421	2	0.750000	1.250000	0.763847	1.236153
0.000421	0	0.750000	0.750000	0.784696	0.784696
0.000421			3.500000		3.518217
0.000421	0	0.255814	0.255814	0.261144	0.261144
0.000421	1	0.244186	0.755814	0.237174	0.762826
0.000421	1	0.250000	0.750000	0.254205	0.745795
0.000421	0	0.250000	0.250000	0.261144	0.261144
0.000421			2.011628		2.030909
0.000415	0	0.255814	0.255814	0.257706	0.257706
0.000415	1	0.244186	0.755814	0.234122	0.765878
0.000415	1	0.250000	0.750000	0.250934	0.749066
0.000415	0	0.250000	0.250000	0.257706	0.257706
0.000415			2.011628		2.030511
0.000458	0	0.255814	0.255814	0.284471	0.284471
0.000458	0	0.244186	0.244186	0.250860	0.250860
0.000458	2	0.250000	1.750000	0.276913	1.723087
0.000458	0	0.250000	0.250000	0.284471	0.284471
0.000458			2.500000		2.550089
0.000427	0	0.255814	0.255814	0.264902	0.264902
0.000427	1	0.244186	0.755814	0.240614	0.759386
0.000427	1	0.250000	0.750000	0.257892	0.742108
0.000427	0	0.250000	0.250000	0.264902	0.264902
0.000427			2.011628		2.031357
0.000440	[illegible]	0.255814	0.255814	0.274961	0.274961
[illegible]	1	[illegible]	[illegible]	0.240722	[illegible]
[illegible]	[illegible]	[illegible]	0.250000	0.257036	[illegible]
[illegible]	[illegible]	[illegible]	0.250000	0.274961	0.274961
[illegible]			[illegible]		[illegible]
0.000415	[illegible]	0.255814	0.255814	0.257676	[illegible]
0.000415	[illegible]	0.244186	0.244186	0.234025	0.234025
0.000415	1	0.250000	0.750000	0.250829	0.749171
[illegible]	[illegible]	[illegible]	0.250000	0.257676	0.257676
[illegible]			[illegible]		[illegible]
0.000415	0	0.255814	0.255814	0.257676	0.257676
0.000415	0	0.244186	0.244186	0.234025	0.234025
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	0.257676	[illegible]
[illegible]			1.500000		[illegible]

S FORECAST 3 LAMBDA t,c	T DELTA 3 (ABSOLUTE)	U MAD 1 EACH NSN	V MAD 2 EACH NSN	W MAD 3 EACH NSN
0.784696	0.784696	0.875000	0.879554	0.879554
0.712671	0.712671			
0.763847	1.236153			
0.784696	0.784696			
	3.518217			
0.261144	0.261144	0.502907	0.507727	0.507727
0.237174	0.762826			
0.254205	0.745795			
0.261144	0.261144			
	2.030908			
0.257783	0.257783	0.502907	0.507626	0.507626
0.234122	0.765878			
0.250934	0.749066			
0.257783	0.257783			
	2.030511			
0.284471	0.284471	0.625000	0.637597	0.637597
0.258360	0.258360			
0.276913	1.723087			
0.284471	0.284471			
	2.550389			
0.264932	0.264932	0.502907	0.507839	0.507839
0.240614	0.759386			
0.257892	0.742108			
0.264932	0.264932			
	2.031357			
0.274961	0.274961	0.377907	0.391964	0.391964
0.240723	0.759277			
0.267656	[illegible]			
0.274961	0.274961			
	[illegible]			
0.257676	0.257676	0.375000	0.374637	0.374637
0.234025	0.234025			
0.250830	0.749170			
0.257676	0.257676			
	1.498548			
0.257676	0.257676	0.375000	0.374637	0.374637
0.234025	0.234025			
0.250830	0.749170			
0.257676	0.257676			
	1.498548			

A NSN (TPN-19)	B EPOCH	C ON-HOURS (t)	D ON-FAILS (Xt)	E CYCLES (c)	F CYCLE FAIL (Yc)
5895003718022	1	621	0	7	0
	2	564	0	8	0
	3	604.25	1	8	0
	4	621	0	6	0
	TOTAL	2410.25	1	29	0
5895010550466	1	621	0	7	0
	2	564	0	8	0
	3	604.25	1	8	0
	4	621	0	6	0
	TOTAL	2410.25	1	29	0
5895009203391	1	621	0	7	0
	2	564	0	8	0
	3	603.25	1	8	0
	4	621	0	6	0
	TOTAL	2409.25	1	29	0
5895000032201	1	621	0	7	0
	2	564	0	8	0
	3	546	1	7	0
	4	621	0	6	0
	TOTAL	2352	1	28	0
5835001957512	1	621	0	7	0
	2	564	0	8	0
	3	604.5	1	7	0
	4	621	0	6	0
	TOTAL	2410.5	1	28	0
5895001470040	1	621	0	7	0
	2	564	0	8	0
	3	572	1	8	0
	4	621	0	6	0
	TOTAL	2378	1	29	0
5895000071848	1	621	0	7	0
	2	564	0	8	0
	3	604.5	0	8	0
	4	619.5	1	7	0
	TOTAL	2409	1	30	0
5935001345528	1	621	0	7	0
	2	564	0	8	0
	3	506	1	8	0
	4	621	0	6	0
	TOTAL	2312	1	29	0

G POSSESSED HOURS	H LONG RUN E[t]	I LONG RUN E[c]	J POSSESSED FAIL RATE	K TIME ONLY FAIL RATE	L CYCLE FAIL RATE
1056	621	7	0.000242	0.000415	0.000000
1008	564	8	0.000242	0.000415	0.000000
1032	604.5	7	0.000242	0.000415	0.000000
1032	621	6	0.000242	0.000415	0.000000
4128			0.000242	0.000415	0.000000
1056	621	7	0.000242	0.000415	0.000000
1008	564	8	0.000242	0.000415	0.000000
1032	604.5	7	0.000242	0.000415	0.000000
1032	621	6	0.000242	0.000415	0.000000
4128			0.000242	0.000415	0.000000
1056	621	7	0.000242	0.000415	0.000000
1008	564	8	0.000242	0.000415	0.000000
1032	604.5	7	0.000242	0.000415	0.000000
1032	621	6	0.000242	0.000415	0.000000
4128			0.000242	0.000415	0.000000
1056	621	7	0.000242	0.000425	0.000000
1008	564	8	0.000242	0.000425	0.000000
1032	604.5	7	0.000242	0.000425	0.000000
1032	621	6	0.000242	0.000425	0.000000
4128			0.000242	0.000425	0.000000
1056	621	7	0.000242	0.000415	0.000000
1008	564	8	0.000242	0.000415	0.000000
1032	604.5	7	0.000242	0.000415	0.000000
1032	621	6	0.000242	0.000415	0.000000
4128			0.000242	0.000415	0.000000
1056	621	7	0.000242	0.000421	0.000000
1008	564	8	0.000242	0.000421	0.000000
1032	604.5	7	0.000242	0.000421	0.000000
1032	621	6	0.000242	0.000421	0.000000
4128			0.000242	0.000421	0.000000
1056	621	7	0.000242	0.000415	0.000000
1008	564	8	0.000242	0.000415	0.000000
1032	604.5	7	0.000242	0.000415	0.000000
1032	621	6	0.000242	0.000415	0.000000
4128			0.000242	0.000415	0.000000
1056	621	7	0.000242	0.000433	0.000000
1008	564	8	0.000242	0.000433	0.000000
1032	604.5	7	0.000242	0.000433	0.000000
1032	621	6	0.000242	0.000433	0.000000
4128			0.000242	0.000433	0.000000

M TIME W/CYC FAIL RATE	N ACTUAL FAILS	O FORECAST 1 (POSSESS)	P DELTA 1 (ABSOLUTE)	Q FORECAST 2 TIME ONLY	R DELTA 2 (ABSOLUTE)
0.000415	0	0.255814	0.255814	0.257650	0.257650
0.000415	0	0.244186	0.244186	0.234001	0.234001
0.000415	2	0.250000	1.750000	0.250804	1.749196
0.000415	0	0.250000	0.250000	0.257650	0.257650
0.000415			2.500000		2.49[illegible]
0.000415	0	0.255814	0.255814	0.257650	0.257650
0.000415	1	0.244186	0.755814	0.234001	0.765999
0.000415	1	0.250000	0.750000	0.250004	0.7[illegible]
0.000415	0	0.250000	0.250000	0.257650	0.257650
0.000415			2.[illegible]		[illegible]
0.000415	0	0.255814	0.255814	0.257757	0.257757
0.000415	1	0.244186	0.755814	0.234000	0.765[illegible]
0.000415	1	0.250000	0.750000	0.250508	0.749[illegible]
0.000415	0	0.250000	0.250000	0.257757	0.257757
0.000415			2.011628		2.030507
0.000425	0	0.255814	0.255814	0.26[illegible]	[illegible]
0.000425	0	0.244186	0.244186	0.239790	[illegible]
0.000425	2	0.250000	1.750000	0.257[illegible]	1.7[illegible]
0.000425	0	0.250000	0.250000	0.234[illegible]	[illegible]
0.000425			2.500000		2.51[illegible]
0.000415	0	0.255814	0.255814	0.257620	0.257620
0.000415	1	0.244186	0.755814	0.233976	0.766024
0.000415	1	0.250000	0.750000	0.250770	0.749222
0.000415	0	0.250000	0.250000	0.257620	0.257620
0.000415			2.011628		[illegible]
0.000421	0	0.255814	0.255814	0.261144	0.261[illegible]
0.000421	[illegible]	[illegible]	0.755814	0.237[illegible]	[illegible]
0.000421	0	0.250000	0.250000	[illegible]	[illegible]
0.000421	0	0.250000	0.250000	0.261144	0.261[illegible]
[illegible]			[illegible]		[illegible]
0.000415	0	0.255814	0.255814	[illegible]	[illegible]
0.000415	0	0.244186	0.244186	0.234122	[illegible]
0.000415	1	0.250000	0.750000	0.250934	[illegible]
0.000415	0	0.250000	0.250000	[illegible]	[illegible]
0.000415			1.500000		[illegible]
0.000433	0	0.255814	0.255814	0.268599	[illegible]
0.000433	0	0.244186	0.244186	0.240945	0.240945
[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]
0.000433	0	0.250000	0.250000	[illegible]	[illegible]
0.000433			1.500000		1.51[illegible]

S	T	U	V	W
FORECAST 3 LAMBDA 0,2	DELTA 3 (ABSOLUTE)	MAD 1 EACH NSN	MAD 2 EACH NSN	MAD 3 EACH NSN
0.257650	0.257650	0.625000	0.624624	0.624624
0.234001	0.234001			
0.250804	1.749196			
0.257650	0.257650			
	2.498496			
0.257650	0.257650	0.502907	0.507624	0.507624
0.234001	0.765999			
0.250804	0.749196			
0.257650	0.257650			
	2.030495			
0.257757	0.257757	0.502907	0.507627	0.507627
0.234090	0.765902			
0.250900	0.749092			
0.257757	0.257757			
	2.030507			
0.264001	0.264001	0.625000	0.627710	0.627710
0.239796	0.239796			
0.257013	1.742985			
0.264001	0.264001			
	2.510842			
0.257620	0.257620	0.502907	0.507620	0.507620
0.233976	0.766024			
0.250775	0.749222			
0.257620	0.257620			
	2.030492			
0.261144	0.261144	0.377907	0.384030	0.384030
[illegible]	[illegible]			
[illegible]	[illegible]			
0.261144	0.261144			
	[illegible]			
0.257700	0.257700	0.375000	0.374000	0.374000
0.234122	0.234122			
0.250934	0.749066			
0.257700	0.257700			
	1.490755			
0.268599	0.268599	0.375000	0.379920	0.379920
0.240945	0.240945			
0.261401	0.738500			
0.268599	0.268599			
	1.519000			

A NSN (TPN-19)	B EPOCH	C ON-HOURS (t)	D ON FAILS (Xt)	E CYCLES (c)	F CYCLE FAIL (Yc)
6645010058152	1	621	0	7	0
	2	563.5	1	9	0
	3	604.5	0	7	0
	4	621	0	6	0
	TOTAL	2410	1	29	0
5910010127845	1	621	0	7	0
	2	564	0	8	0
	3	544.5	1	7	0
	4	621	0	6	0
	TOTAL	2350.5	1	28	0

G	H	I	J	K	L
POSSESSED HOURS	LONG RUN [illegible]	LONG RUN [illegible]	POSSESSED FAIL RATE	TIME ONLY FAIL RATE	CYCLE FAIL RATE
1056	621	7	0.000242	0.000415	0.000000
1008	504	8	0.000242	0.000415	0.000000
1032	604.5	7	0.000242	0.000415	0.000000
1032	621	6	0.000242	0.000415	0.000000
4128			0.000242	0.000415	0.000000
1056	621	7	0.000242	0.000425	0.000000
1008	504	8	0.000242	0.000425	0.000000
1032	604.5	7	0.000242	0.000425	0.000000
1032	621	6	0.000242	0.000425	0.000000
4128			0.000242	0.000425	0.000000

M	N	O	P	Q	R
TIME W/CYC FAIL RATE	ACTUAL FAILS	FORECAST 1 (POSSESS)	DELTA 1 (ABSOLUTE)	FORECAST 2 TIME ONLY	DELTA 2 (ABSOLUTE)
0.000415	0	0.255814	0.255814	0.257676	0.257676
0.000415	0	0.244186	0.244186	0.234025	0.234025
0.000415	2	0.250000	1.750000	0.250830	1.749170
0.000415	0	0.250000	0.250000	0.257676	0.257676
0.000415			2.500000		2.490540
0.000425	0	0.255814	0.255814	0.264199	0.264199
0.000425	1	0.244186	0.755814	0.209949	0.79[illegible]51
0.000425	1	0.250000	0.750000	0.257179	0.742821
0.000425	0	0.250000	0.250000	0.264199	0.264[illegible]
0.000425			2.011628		2.[illegible]01273

S	T	U	V	W
FORECAST 3 LAMBDA t,i	DELTA 3 (ABSOLUTE)	MAD 1 EACH NSN	MAD 2 EACH NSN	MAD 3 EACH NSN
0.257676	0.257676	0.625000	0.624637	0.624637
0.234025	0.234025			
0.250830	1.749170			
0.257676	0.257676			
	2.498548			
0.264199	0.264199	0.502907	0.507817	0.507817
0.239949	0.760051			
0.257179	0.742821			
0.264199	0.264199			
	2.031270			

Appendix G: TPN-19 Failure Environments (FE)

Off-Time Failure Environment Characteristics

FE	Characterized by	Frequency	%
5	Spaced, No Downtime, Constant, 2 or less	1	1.5
6	Bunched, No Downtime, Constant, 2 or less	1	1.5

On-Time Failure Environment Characteristics

FE	Characterized by	Frequency	%
18	Bunched, Downtime, Constant, 2 or less	16	24
22	Bunched, No Downtime, Constant, 2 or less	37	56
24	Bunched, No Downtime, Constant, Greater than 2	2	3
25	Spaced, Downtime, Variable, 2 or less	1	1.5
26	Bunched, Downtime, Variable, 2 or less	8	12

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BLOCK 19. ABSTRACT

Currently mobile C-E War Readiness Spares Kit (WRSK) computations are not automated. They are determined during an annual meeting attended by system users and suppliers. However, the Air Force continues to study several methods and models to automate the process. This thesis reports validation results of one model. The model combines the operating and non-operating failure rates to predict C-E system failures for a specified period of time. This model uses operating failures distributed over operating hours and non-operating failures distributed over system power-up attempts. Validation results showed this model predicted C-E failures as good as current methods during periods of steady-state, long operating hours; however, it more accurately predicted failures during periods where operating and non-operating failures occurred. Therefore, the model can be applied to Air Force C-E WRSK computations. HQ USAF/LEYS should develop a policy to ensure C-E system users document the necessary data for application of this model.

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