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System Mean-Time-Between-Failure Versus Life-Cycle Logistics Cost Subject To The Introduction Of Line-Replaceable-Unit Redundancy

18 March 1988

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U.S. ARMY MISSILE COMMAND

Redstone Arsenal, Alabama 35898-5000

Systems Analysis Division
Systems Analysis & Evaluation Office
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System Mean-Time-Between-Failure Versus Life-Cycle Logistics Cost Subject To The Introduction Of Line-Replaceable-Unit Redundancy

18 MARCH 1988

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Abstract

This document presents an examination of ten alternate system designs in which redundancy is employed to achieve various values of system mean-time-between-failure (MTBF). In serial system designs where line-replaceable-units (LRU's) possess exponentially distributed times to failure, life-cycle logistics cost is inversely proportional to system MTBF. In this analysis, this phenomena was found to be contradicted. Life-cycle logistics cost is directly proportional to system MTBF, in the presents of LRU redundancy and no preventive or scheduled maintenance.

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CHAPTER 1

INTRODUCTION

On July 14, 1987, the Reliability, Availability & Maintainability Division of the US Army Materiel Systems Analysis Activity provided a Briefing Chart Report [No. BR-R-6], see the attached bibliography, which addressed reliability versus cost. Within this report, the M65 Airborne TOW System was analyzed. To summarize the report's findings for this system, which is composed of eight serially connected line-replaceable-units (LRU's), the life-cycle logistics cost was found to be inversely proportional to system mean-time-between-failure (MTBF). Simply stated, the system's life-cycle logistics cost rise in direct proportion to increases in the LRU failure rates. This finding can be generalized to all systems composed of n serially connected LRU's, as long as each LRU's time-to-failure is exponentially distributed. A pictorial representation of this generalization is found in Figure 1.

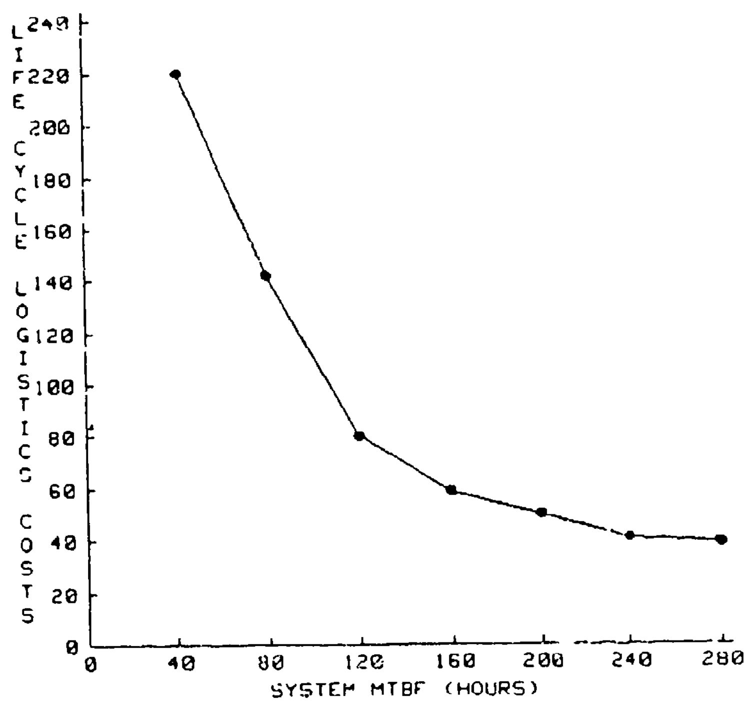


Figure 1 - General Relationship Between Life-Cycle Logistics Cost and System MTBF for Serially Connected LRU's

The purpose of this presentation is to expand the scope of the findings stated in the report referenced above. Specifically, this discussion deals with a system composed of n serially connected LRU configurations rather than n serially connected LRU's. The assumption is made, herein, that the LRU's possess exponentially distributed times-to-failure, but the LRU configurations do not possess exponentially distributed times-to-failure. Appendix 1 provides illustrations of the sixty LRU configurations that a system design can take possess. To illustrate the fact that the LRU's can possess exponentially distributed times-to-failure and that the configuration does not, consider the case illustrated in Figure 2. The configuration is composed of two different LRU's, either of the LRU's can perform the configuration's function. Neither LRU is to

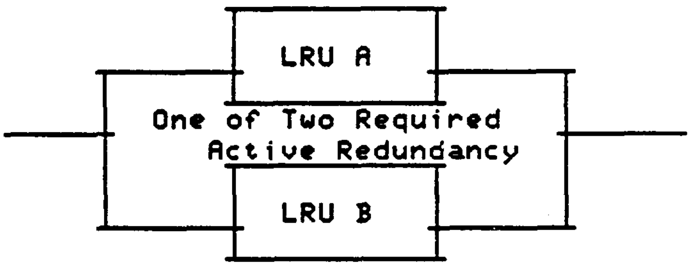


Figure 2 - Simplest LRU Active Redundant Case

be replaced prior to the failure of both. If LRU A's failure rate is equal to A and LRU B's failure rate is equal to B, then the reliability of the configuration can be shown to be equal to

$$R(t) = e^{-UAt} + e^{-UBt} - e^{-U(A+B)t} \qquad [1]$$

where U is the utilization fraction of the configuration. Since the reliability is the complement of the cumulative probability of failure, the density function for time-to-failure can be shown to be

$$f(t) = U\left(Ae^{-UAt} + Be^{-UBt} - (A+B)e^{-U(A+B)t} \right), \qquad [2]$$

which is clearly not a simple exponential relationship. If it were an exponential distribution, the failure rate would be constant. The failure rate of the configuration can be found by dividing equation 2 by equation 1. The resulting ratio is not constant, in fact it is an increasing function as time increases. Therefore, the time-to-failure of the configuration is absolutely not exponentially distributed.

The illustration discussed above is subject to the constraint that no corrective maintenance is performed on the LRU's until the configuration fails. This constaint is currently imposed on the application of any of the sixty configurations shown in Appendix 1 and is an underlying assumption carried forward thoughout this report. Efforts are currently under way to evaluate the effect of periodic, scheduled maintenance on the configurations' performance and logistics parameters. Reporting on the effect will be the subject of a subsequent report.

This report presents a discussion of the relationship between life cycle logistics costs and system MTBF subject to the introduction of non-maintained LRU redundancy at the configuration level. The discussion will be limited to a single, hypothetical system whose functions can be effectively performed by any of ten alternate designs. The only difference between the designs is the amount and degree of redundancy contained in the designs. This discussion is stratified into specific sections designated by chapter. Chapter 2 provides a presentation of the alternate designs, a discussion of the models to be employed, and an enumeration of data required for the analysis. Briefly stated, the Logistics Analysis Model, LOGAM, was used to predict life-cycle logistics cost and a newly developed model; entitled System, Configuration, Replaceable Assembly Prediction and Integration for Reliability Of New Systems [SCRAPIRONS]; was used to predict system MTBF. Chapter 3 contains a summary of the results obtained in this exercise along with a comparison of the derived MTBF versus life-cycle logistics cost relationship with that form shown in Figure 1. Chapter 4 addresses the conclusions, inferences and extensions derived from this analysis application. The attached appendices contain supporting data and information pertinent to the analysis.

CHAPTER 2

THE PROBLEM DEFINITION

I. General

To preclude discussion and/or debate pertaining to the feasibility or appropriateness of the methodology employed to increase redundancy within configurations, a decision was made to begin with a design containing a relatively high degree of redundancy. Subsequent designs were then generated by simply reducing the level of redundancy in selected configurations by eliminating identified LRU's. Accomplishment of each function was retained by satisfying the minimum requirements specified for each configuration as stated in the labeling of Design Configuration #1, see Figure 3. The function associated with each configuration was given a generic name and was assumed to be mission essential. The loss of any function constitutes system failure. The ten designs are specified below along with the input data associated with each design. It should be pointed out that the LRU failure rates are constant between designs, and only the density of LRU application varies. Each design configuration is composed of a discrete number of LRU applications. Summarized in Table 1 is an exhaustive listing of the types of LRU's of which each design is composed. It will be noted that except for Design Configuration #1, not all types of LRU's are present in every design. Once an LRU application was dropped, it was not replaced in subsequent designs. In fact, the intent of the LRU dropping scenario was to reduce the system's MTBF. The column headers contained in Table 1 are self explanatory, hence a detailed enumeration of Table 1's data content will not be given here. Instead attention will be focused on additional LRU data which remained constant for all ten design configurations. Namely, the LRU common data inputted to LOGAM to predict life-cycle logistics cost. Each LRU type present in a particular design is required to have three-hundred twenty -eight data elements supplied in a file referred to as NAMELIST. Appendix 2 contains a NAMELIST form which defines these data elements, identifies which are LRU unique and which are LRU common, and provides the values used in this analysis. The ten design configurations follow.

Table 1 - LRU/Module Data Constant Across All Designs

LRU Type	Average Module Cost in Dollars	Average Module Shipping /Storage Volume (Cu.Ft.)	Average Module Shipping /Storage Weight (lbs.)	Number Of Modules Per LRU	LRU Shipping /Storage Volume (Cu.Ft.)	LRU Shipping /Storage Weight (lbs.)	LRU Unit Cost Dollars
LRUa	100.00	.100	1.200	16	2.000	20.000	2400.00
LRUb	50.00	.500	.600	36	20.000	25.000	1000.00
LRUc	75.00	.080	.800	24	2.000	31.000	1800.00
LRUd	25.00	.020	.300	48	1.500	18.000	750.00
LRUe	60.00	.060	.600	32	2.000	24.000	1500.00
LRUf	50.00	.050	.500	30	1.750	20.000	1200.00
LRUg	80.00	.080	.750	21	11.750	18.000	1900.00
LRUh	20.00	.020	.250	49	1.200	15.000	500.00
LRUi	60.00	.060	.500	26	1.800	15.000	1500.00
LRUj	22.00	.022	.200	60	1.500	20.000	550.00
LRUk	78.00	.078	.800	34	5.100	32.500	1900.00
LRUl	10.00	.010	.100	87	2.100	8.700	250.00
LRUm	50.00	.050	.500	37	3.440	25.000	1250.00
LRUn	40.00	.010	.400	45	1.260	25.000	1100.00
LRUo	80.00	.080	1.000	19	2.300	28.000	2000.00
LRUp	30.00	.030	.250	50	2.880	15.000	750.00
LRUq	50.00	.050	.500	31	1.620	26.000	1275.00
LRUr	40.00	.040	.500	39	1.850	29.000	1160.00
LRUs	16.00	.016	.200	77	2.600	21.000	400.00
LRUt	12.00	.012	.100	100	2.400	22.000	300.00
LRUu	22.00	.022	.200	82	2.600	48.000	580.00
LRUv	35.00	.035	.500	21	1.000	16.000	960.00
LRUw	109.00	.110	1.000	20	4.100	52.000	1500.00
LRUx	110.00	.100	1.000	18	2.200	25.000	1900.00
LRUy	225.00	1.005	3.000	40	95.000	150.000	2950.00
LRUz	10.00	.100	.500	45	6.000	36.000	500.00

II. Design Configuration #1 Specification

Figure 3 provides a reliability block diagram of the first system design. Basically, the system is to perform thirteen functions. Function #1 is required continuously, hence its utilization fraction is one-hundred percent. The ten LRU's shown are considered to be actively redundant,

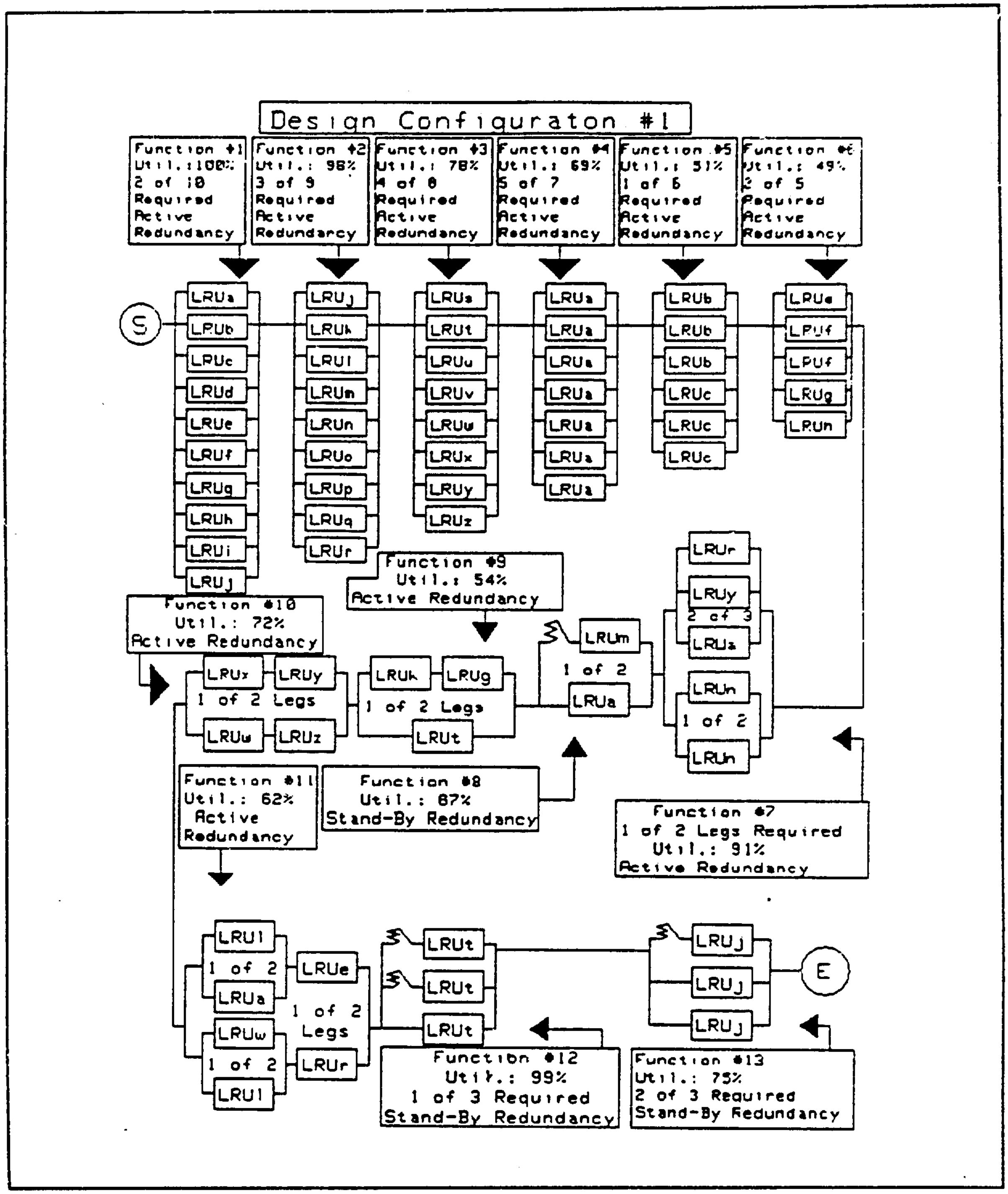


Figure 3 - Design Configuration #1's Reliability Block Diagram

hence there is no consideration for switching or re-initialization. The remaining twelve functions are labeled and are similarly defined. Functions #8, #12, and #13 require further clarification, however. These three configurations are referred to as stand-by redundant configurations. The stand-by LRU's possess an operate failure rate and a stand-by failure rate. While in the stand-by mode(i.e., not performing the function but capable of doing so), the LRU's failure rate is equal to the stand-by value which is usually numerically less than the operate failure rate. When the primary LRU fails, the stand-by LRU assumes full operation if it has not failed in the stand-by mode. Upon assuming the operate mode, the stand-by LRU's failure rate takes on its operate value. Perfect switching is assumed. Table 2 contains the reliability and maintainability input data associated with the configurations comprising this design.

Table 2 - Design Configuration #1's Reliability & Maintainability Data

Reliability Configuration I.D. Design Number	Reliability Configuration I.D. Std. Form Number	Configuration's Identification Name	Usage Ratio (%)	LRU Composition ID [LRU Name]	Operate Failure Rate Per Million Hours	Stand-by Failure Rate Per Million Hours	Average Time-To Remove/ Replace In Minutes
1	53	Function 1	100				
				LRUa	217	0	60
				LRUb	172	0	00
				LRUc	213	0	95
				LRUd	179	0	20
				LRUe	230	0	49
				LRUf	212	0	53
				LRUg	210	0	41
				LRUh	205	0	65
				LRUi	210	0	63
				LRUj	221	0	60
2	46	Function 2	90				
				LRUj	199	0	61
				LRUk	195	0	55
				LRUl	105	0	63
				LRUm	202	0	35
				LRUn	100	0	52
				LRUo	193	0	66
				LRUp	170	0	35
				LRUq	210	0	39
				LRUr	206	0	71
3	40	Function 3	70				
				LRUs	102	0	91
				LRUt	195	0	55
				LRUu	100	0	75
				LRUv	205	0	30
				LRUw	160	0	33
				LRUx	204	0	44
				LRUy	106	0	35
				LRUz	194	0	09
4	35	Function 4	69				
				LRUa	201	0	39
				LRUa	190	0	47
				LRUa	202	0	34
				LRUa	109	0	61
				LRUa	194	0	71
				LPUa	100	0	50
				LRUa	100	0	35

Table 2 - Design Configuration #1's Reliability & Maintainability Data Continued

Reliability Configuration I.D. Design Number	Std. Form Number	Configuration's Identification Name	Usage Ratio (%)	LRU Composition ID [LRU Name]	Operate Failure Rate Per Million Hours	Stand-by Failure Rate Per Million Hours	Average Time-To Remove/ Replace In Minutes
5	26	Function 5	51				
				LRUb	174	0	84
				LRUb	204	0	63
				LRUb	215	0	75
				LRUc	182	0	35
				LRUc	186	0	42
				LRUc	195	0	68
6	10	Function 6	49				
				LRUe	185	0	45
				LRUf	205	0	61
				LRUf	209	0	94
				LRUg	239	0	65
				LRUh	205	0	62
7	25	Function 7	91				
				LRUr	183	0	72
				LRUy	189	0	68
				LRUa	191	0	55
				LRUn	228	0	88
				LRUn	218	0	51
8	14	Function 8	87				
				LRUm	201	21	61
				LRUa	198	0	64
9	13	Function 9	54				
				LRUg	197	0	48
				LRUt	195	0	85
				LRUk	171	0	45
10	8	Function 10	72				
				LRUx	225	0	85
				LRUw	203	0	53
				LRUy	204	0	41
				LRUz	196	0	59
11	24	Function 11	62				
				LRUl	200	0	53
				LRUa	213	0	87
				LRUw	191	0	65
				LRUl	205	0	55
				LRUe	201	0	82
				LRUr	180	0	51
12	19	Function 12	99				
				LRUt	178	20	47
				LRUt	178	20	47
				LRUt	178	0	47
13	18	Function 13	75				
				LRUj	188	25	69
				LRUj	188	0	51
				LRUj	185	0	45

The data content of Table 2 requires a detailed description. The column with the header entitled Design Number is simply a counter of the number of configurations present in the design being analyzed. The second column, entitled Std. Form Number, cross references the configuration to the appropriate standard form shown in Appendix 1. The Configuration's Identification Name column is simply an identifier while the Use Ratio column contains the utilization fraction, stated in percent form, of the configuration. The last four columns of Table 2 are devoted to the data associated with the LRU's comprising the configurations. It will be noted that a configuration can be composed of different LRU's and that in the case of multiple applications of the same LRU within a configuration the failure rates and times-to-remove/replace do not necessarily have to be equal. They can be equal but are not constrained to be equal. The remaining column headers of Table 2 are self explanatory. Table 2 is an optional output of the reliability model referred to as SCRAPIRONS.

III. Design Configuration #2 Specification

Figure 4 provides a reliability block diagram for Design Configuration #2. This design was derived from the first one by three steps. First, two LRU's, LRUb and LRUe, were removed from Function #1, thereby reducing the level of redundancy from two of ten to two of eight. Secondly, the three LRUb's in Function #5 were removed which lowered the function's redundancy to one of three. The final modification was to remove LRUe from Function #6. The result of this removal reduced the redundancy level to two of four. Table 3 provides the LRU make-up for Design Configuration #2. The aforementioned reductions' net effect will be to reduce the probability of system survival for any specified time period and the system mathematical mean-time-between-failure in a logistics environment that specifies no corrective action prior to loss of function(i.e., system failure).

IV. Design Configuration #3 Specification

Design Configuration #3 was derived by three more function modifications. The first modification was to remove LRUy from Function #3,

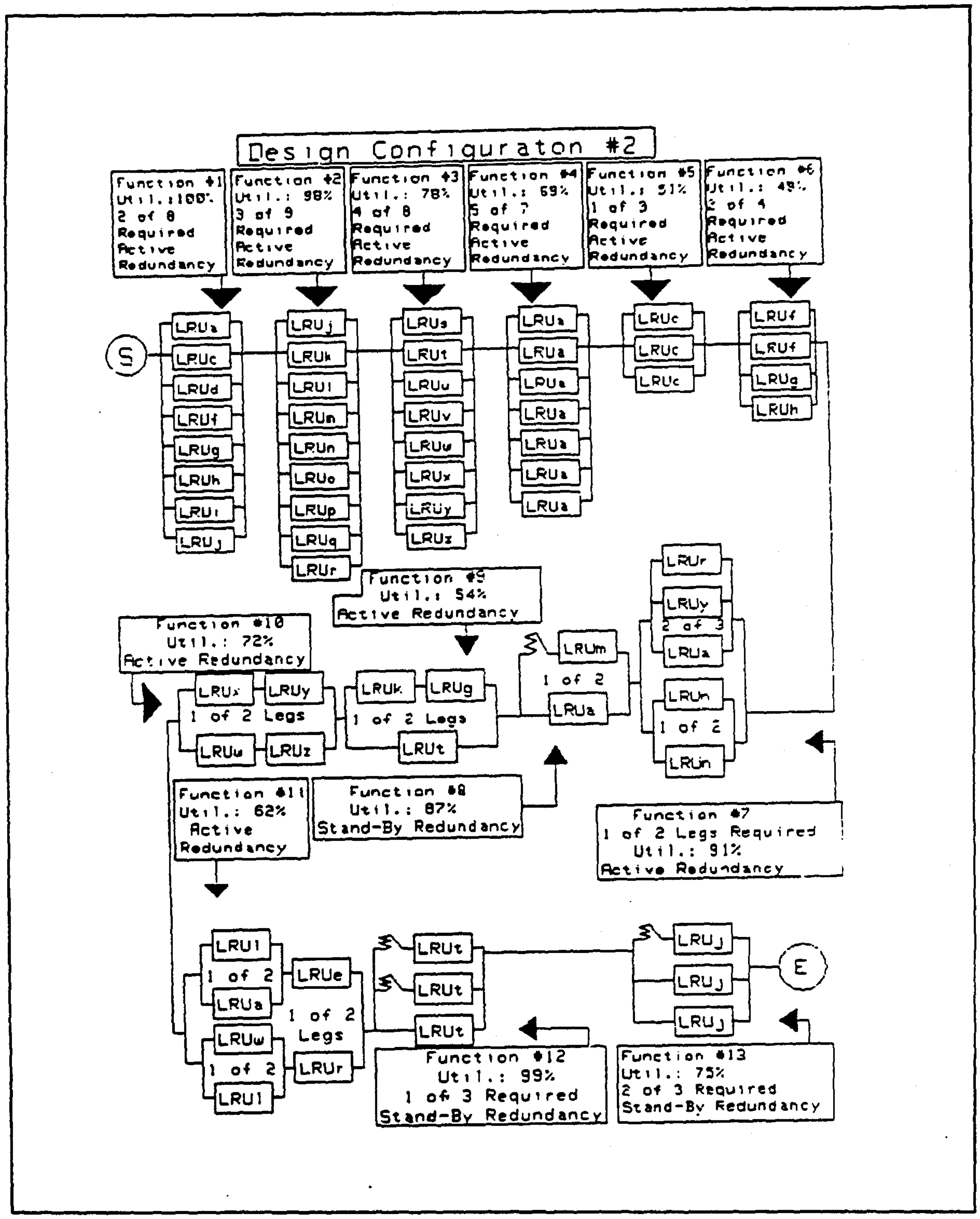


Figure 4 - Design Configuration #2's Reliability Block Diagram

reducing the redundancy level further to four of seven. Secondly, LRUy and one of the LRUn's were removed from Function #7's Configuration. This later removal results in a redudancy requirement of either LRUr and LRUa or LRUn. The last modification to Design Configuration #2 was to

Table 3 - Design Configuration #2's Reliability & Maintainability Data

Reliability Configuration I.D. Design Number	Reliability Configuration I.D. Std. Form Number	Configuration's Identification Name	Usage (%)	LRU Composition ID [LRU Name]	Operate Failure Rate Per Million Hours	Stand-by Failure Rate Per Million Hours	Average Time-To Remove/Replace In Minutes
1	30	Function 1	100	LRUa	217	0	60
				LRUc	213	0	95
				LRUd	179	0	20
				LRUf	212	0	53
				LRUg	210	0	41
				LRUh	205	0	65
				LRUi	210	0	63
				LRUj	221	0	60
2	46	Function 2	90	LRUj	199	0	61
				LRUk	195	0	55
				LRUl	105	0	63
				LRUm	202	0	35
				LRUn	100	0	52
				LRUo	193	0	66
				LRUp	170	0	35
				LRUq	210	0	39
				LRUr	206	0	71
3	40	Function 3	70	LRUs	102	0	91
				LRUt	195	0	55
				LRUu	100	0	75
				LRUv	205	0	30
				LRUw	160	0	33
				LRUx	204	0	44
				LRUy	106	0	35
				LRUz	194	0	89
4	35	Function 4	69	LRUa	201	0	39
				LRUa	190	0	47
				LRUa	202	0	34
				LRUa	189	0	61
				LRUa	194	0	71
				LRUa	188	0	50
				LRUa	100	0	35
5	3	Function 5	51	LRUc	102	0	35
				LRUc	106	0	42
				LRUc	195	0	60
6	6	Function 6	49	LRUf	205	0	61
				LRUf	209	0	94
				LRUg	239	0	65
				LRUh	205	0	62
7	25	Function 7	91	LRUr	183	0	72
				LRUy	189	0	60
				LRUa	191	0	55
				LRUn	220	0	80
				LRUn	210	0	51
8	14	Function 8	87	LRUm	201	21	61
				LRUa	190	0	64

Table 3 - Design Configuration #2's Reliability & Maintainability Data (Continued)

Reliability Configuration I.D.		Configuration's Identification Name	Usage Ratio (%)	LRU Composition ID (LRU Name)	Operate Failure Rate Per Million Hours	Stand-by Failure Rate Per Million Hours	Average Time-To Remove-Replace In Minutes
Design Number	Std. Form Number						
9	13	Function 9	54	LRUg	197	0	40
				LRUt	195	0	05
				LRUk	171	0	45
10	0	Function 10	72	LRUx	225	0	05
				LRUw	203	0	53
				LRUy	204	0	41
				LRUz	196	0	59
11	24	Function 11	62	LRUl	200	0	53
				LRUa	213	0	07
				LRUw	191	0	65
				LRUl	205	0	55
				LRUe	201	0	02
				LRUr	100	0	51
12	19	Function 12	99	LRUt	170	20	47
				LRUt	170	20	47
				LRUt	170	0	47
13	10	Function 13	75	LRUj	100	25	69
				LRUj	100	0	51
				LRUj	105	0	45

remove LRUx and LRUy from Function #10. By so doing, Function #10 is accomplished by the combination of two serially connected LRU's. In order to conform to the standard forms shown in Appendix 1, Function #10 was split into two subfunctions, Function #10a and Function #10b. The result of these three modifications is shown in Figure 5 and is reflected in the data content of Table 4.

V. Design Configuration #4 Specification

To obtain Design Configuration #4, the redundancy of three more configurations was reduced. The least reliable LRUc was dropped from Function #5, and the stand-by unit, LRUm, was dropped from Function #8. Finally, a stand-by unit was dropped from Function #12. The results of these modifications are reflected in the reliability block diagram, shown in Figure 6, and the associated data contained in Table 5.

Table 4 - Design Configuration #3's Reliability & Maintainability Data

Reliability Configuration I.D. Design Number	Reliability Configuration I.D. Std. Form Number	Configuration's Identification Name	Use Ratio (%)	LRU Composition ID (LRU Name)	Operate Failure Rate Per Million Hours	Stand-by Failure Rate Per Million Hours	Average Time-To Remove/Replace In Minutes
1	30	Function 1	100	LRUa	217	0	60
				LRUc	213	0	95
				LRUd	179	0	20
				LRUf	212	0	83
				LRUg	210	0	41
				LRUh	205	0	65
				LRUi	210	0	63
				LRUj	221	0	60
2	46	Function 2	98	LRUj	199	0	61
				LRUk	195	0	55
				LRUl	185	0	63
				LRUm	202	0	35
				LRUn	180	0	52
				LRUo	193	0	66
				LRUp	170	0	35
				LRUq	210	0	39
				LRUr	206	0	71
3	34	Function 3	78	LRUs	182	0	91
				LRUt	195	0	85
				LRUu	180	0	75
				LRUv	205	0	38
				LRUw	160	0	33
				LRUx	204	0	44
				LRUz	194	0	89
4	35	Function 4	69	LRUa	201	0	39
				LRUa	198	0	47
				LRUa	202	0	34
				LRUa	189	0	61
				LRUa	194	0	71
				LRUa	188	0	50
				LRUa	180	0	35
5	3	Function 5	51	LRUc	182	0	35
				LRUc	186	0	42
				LRUc	195	0	68
6	6	Function 6	49	LRUf	205	0	61
				LRUf	209	0	94
				LRUg	239	0	65
				LRUh	205	0	62
7	13	Function 7	91	LRUr	183	0	72
				LRUn	210	0	51
				LRUa	191	0	55
8	14	Function 8	87	LRUm	201	21	61
				LRUa	198	0	64
9	13	Function 9	54	LRUk	171	0	45
				LRUt	195	0	85
				LRUg	197	0	40

Table 4 - Design Configuration #3's Reliability & Maintainabilty Data (Continued)

Reliability Configuration I.D. Design Number	Reliability Configuration I.D. Std. Form Number	Configuration's Identification Name	Use Ratio (%)	LRU Composition ID [LRU Name]	Operate Failure Rate Per Million Hours	Stand-by Failure Rate Per Million Hours	Average Time-To Remove/Replace In Minutes
10	1	Function 10a	72	LRUw	203	0	83
11	1	Function 10b	72	LRUz	196	0	59
12	24	Function 11	62	LRUl	200	0	53
				LRUa	213	0	87
				LRUw	191	0	65
				LRUl	205	0	55
				LRUe	201	0	82
				LRUr	188	0	51
13	19	Function 12	99	LRUt	178	20	47
				LRUt	178	20	47
				LRUt	178	0	47
14	18	Function 13	75	LRUj	188	25	69
				LRUj	188	0	51
				LRUj	185	0	45

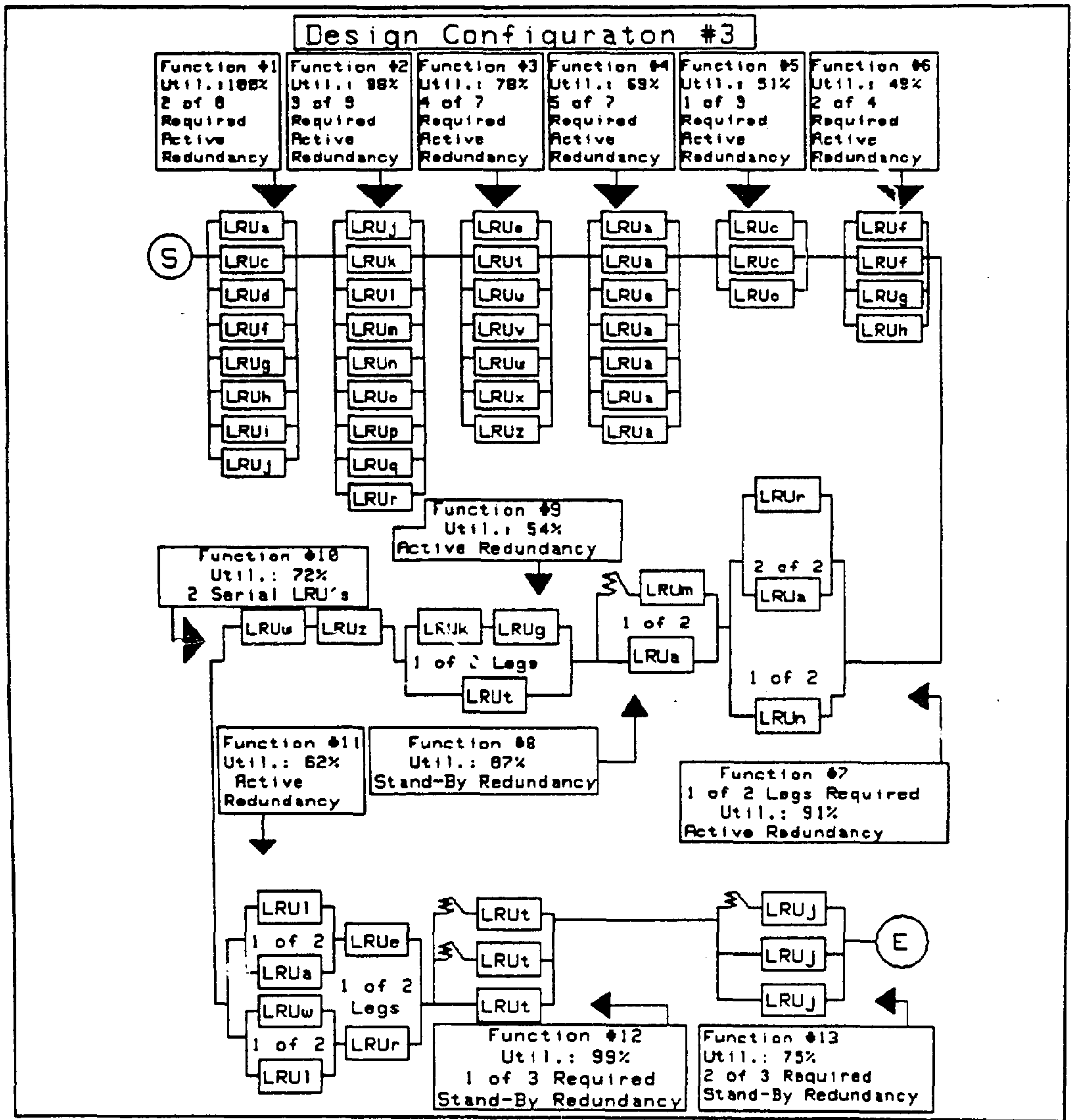


Figure 5 - Design Configuration #3's Reliability Block Diagram

Table 5 - Design Configuration #4's Reliability & Maintainability Data

Reliability Configuration I.D.		Configuration's Identification Name	Use Rate (%)	LRU Composition ID (LRU Name)	Operate Failure Rate Per Million Hours	Stand-by Failure Rate Per Million Hours	Average Time-To Remove/Replace In Minutes
Design Number	Std. Form Number						
1	30	Function 1	100				
				LRUa	217	0	60
				LRUc	213	0	95
				LRUd	179	0	20
				LRUf	212	0	83
				LRUg	210	0	41
				LRUh	205	0	65
				LRUi	210	0	63
				LRUj	221	0	60
2	46	Function 2	90				
				LRUj	199	0	61
				LRUk	195	0	55
				LRUl	185	0	63
				LRUm	202	0	35
				LRUn	180	0	82
				LRUo	193	0	66
				LRUp	170	0	35
				LRUq	210	0	39
				LRUr	206	0	71
3	34	Function 3	70				
				LRUs	182	0	91
				LRUt	195	0	55
				LRUu	186	0	75
				LRUv	205	0	30
				LRUw	168	0	33
				LRUx	204	0	44
				LRUz	194	0	89
4	35	Function 4	69				
				LRUa	201	0	39
				LRUa	198	0	47
				LRUa	202	0	34
				LRUa	189	0	61
				LRUa	194	0	71
				LRUa	188	0	50
				LRUa	168	0	35
5	2	Function 5	51				
				LRUc	182	0	35
				LRUc	186	0	42
6	6	Function 6	49				
				LRUf	205	0	61
				LRUf	209	0	94
				LRUg	239	0	65
				LRUh	205	0	62
7	13	Function 7	91				
				LRUr	183	0	72
				LRUn	210	0	51
				LRUa	191	0	55
8	1	Function 8	87				
				LRUa	198	0	64
9	13	Function 9	54				
				LRUk	171	0	45
				LRUt	195	0	85
				LRUg	197	0	40
10	1	Function 10a	72				
				LRUw	203	0	53
11	1	Function 10b	72				
				LRUz	196	0	59
12	24	Function 11	62				
				LRUl	200	0	53
				LRUa	213	0	87
				LRUw	191	0	65
				LRUl	205	0	55
				LRUe	201	0	82
				LRUr	180	0	51

Table 5 - Design Configuration #4's Reliability & Maintainability Data (Continued)

Reliability Configuration I.D. Design Number	Reliability Configuration I.D. Std. Form Number	Configuration's Identification Name	Usage Ratio (%)	LRU Composition ID [LRU Name]	Operate Failure Rate Per Million Hours	Stand-by Failure Rate Per Million Hours	Average Time-To Remove/Replace In Minutes
13	14	Function 12	99				
				LRUt	170	20	47
				LRUt	170	0	47
14	10	Function 13	70				
				LRUj	100	25	69
				LRUj	100	0	51
				LRUj	105	0	45

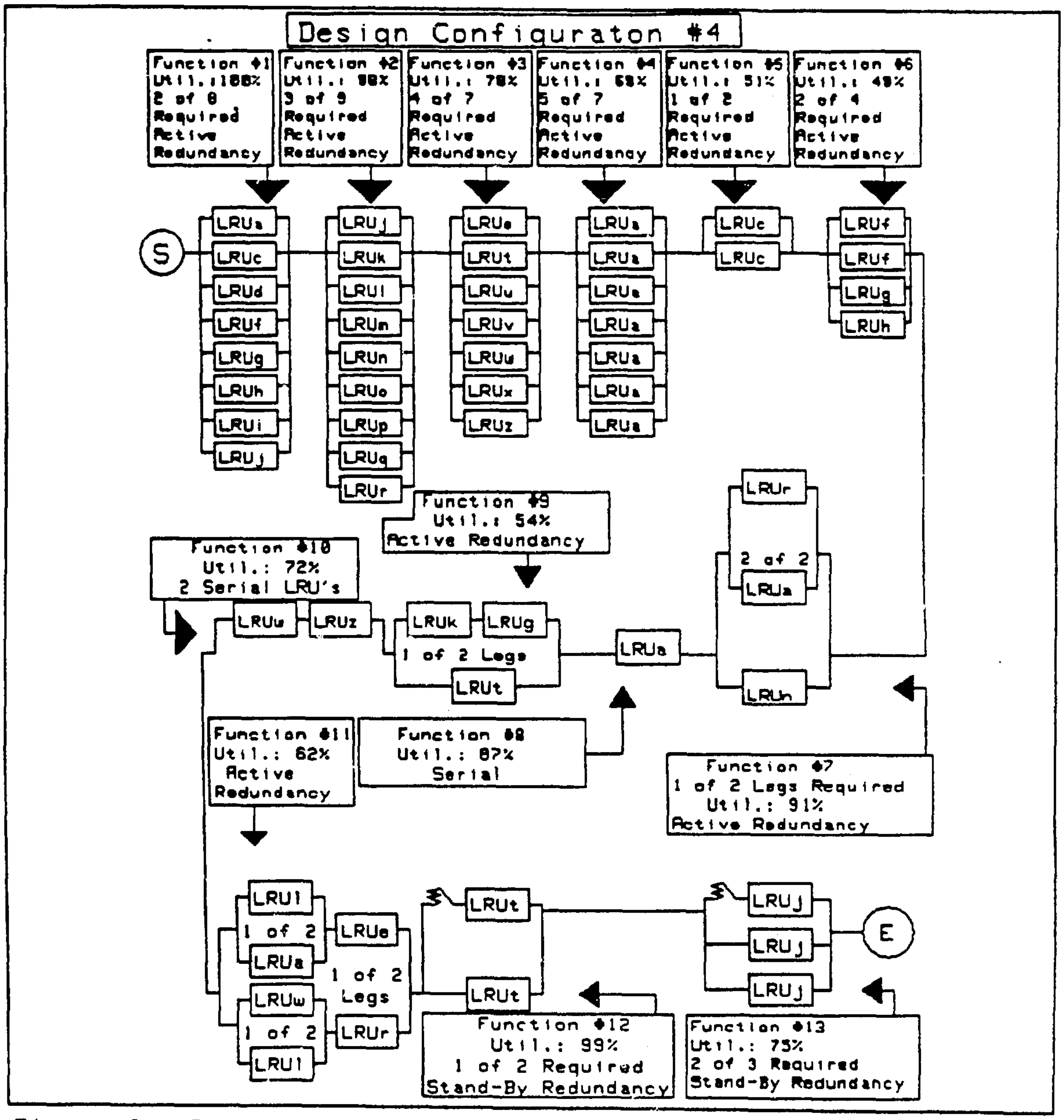


Figure 6 - Design Configuration #4's Reliability Block Diagram

VI. Design Configuration #5 Specification

Figure 7 provides a schematic of the reliability block diagram for Design Configuration #5. This design was derived from the previous design by the methodology described below. LRUg was dropped from Function #5, and

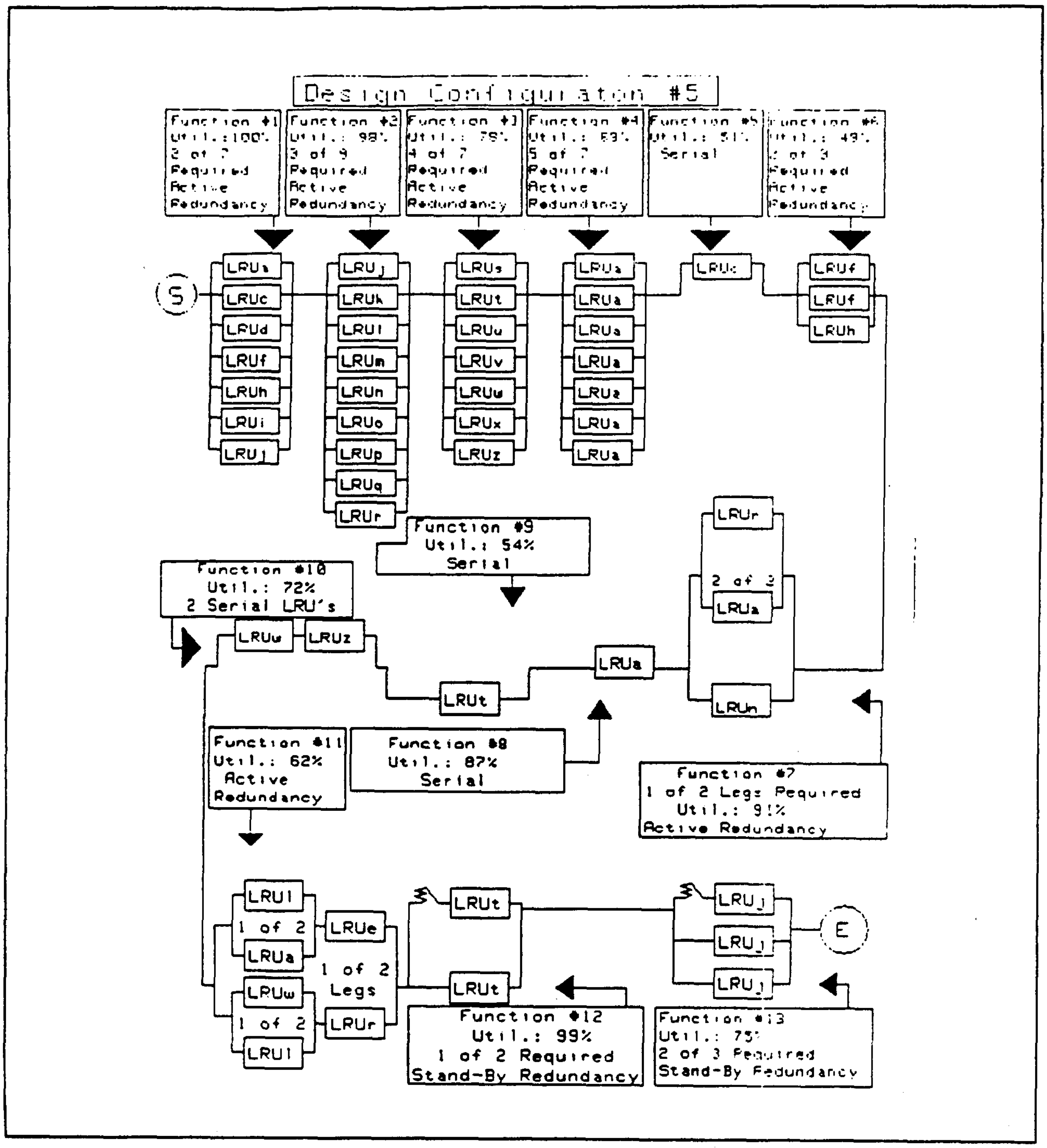


Figure 7 - Design Configuration #5's Reliability Block Diagram

LRUg was dropped from Function #6. Additionally, LRUk and LRUg were dropped from Function #9. Table 6 contains the data associated with this design configuration.

Table 6 - Design Configuration #5's Reliability & Maintainability Data

Reliability Configuration I.D.		Configuration's Identification Name	Use Ratio (%)	LRU Composition ID (LRU Name)	Operate Failure Rate Per Million Hours	Stand-by Failure Rate Per Million Hours	Average Time-To Remove Replace In Minutes
Design Number	Std. Form Number						
1	32	Function 1	100				
				LRUa	217	0	68
				LRUc	213	0	95
				LRUd	179	0	20
				LRUf	212	0	53
				LRUh	205	0	65
				LRUi	210	0	63
				LRUj	221	0	60
2	46	Function 2	98				
				LRUj	199	0	61
				LRUk	195	0	55
				LRUl	185	0	63
				LRUm	202	0	35
				LRUn	188	0	52
				LRUo	193	0	66
				LRUp	178	0	35
				LRUq	218	0	39
				LRUr	206	0	71
3	34	Function 3	78				
				LRUs	182	0	91
				LRUt	195	0	55
				LRUu	188	0	75
				LRUv	205	0	38
				LRUw	168	0	33
				LRUx	204	0	44
				LRUz	194	0	89
4	35	Function 4	69				
				LRUa	201	0	39
				LRUa	198	0	47
				LRUa	202	0	34
				LRUa	189	0	61
				LRUa	194	0	71
				LRUa	188	0	50
				LRUa	180	0	35
5	1	Function 5	51				
				LRUc	182	0	35
6	4	Function 6	49				
				LRUf	205	0	61
				LRUf	209	0	94
				LRUh	205	0	62
7	13	Function 7	91				
				LRUr	183	0	72
				LRUn	210	0	51
				LRUa	191	0	55
8	1	Function 8	87				
				LRUa	198	0	64
9	1	Function 9	54				
				LRUt	195	0	85
10	1	Function 10a	72				
				LRUw	203	0	53
11	1	Function 10b	72				
				LRUz	196	0	59
12	24	Function 11	62				
				LRUl	200	0	53
				LRUa	213	0	87
				LRUw	191	0	65
				LRUl	205	0	55
				LRUe	201	0	82
				LRUr	180	0	51
13	14	Function 12	99				
				LRUt	178	20	47
				LRUt	178	0	47
14	18	Function 13	75				
				LRUj	188	25	69
				LRUj	188	0	51
				LRUj	185	0	45

VII. Design Configuration #6 Specification

Design Configuration #6's derivation from Design Configuration #5 was accomplished by dropping LRUi from Function #1, LRUq from Function #2, and the stand-by LRUt from Function #12. The resulting reliability block diagram is shown in Figure 8 while the data pertinent to this design is itemized in Table 7.

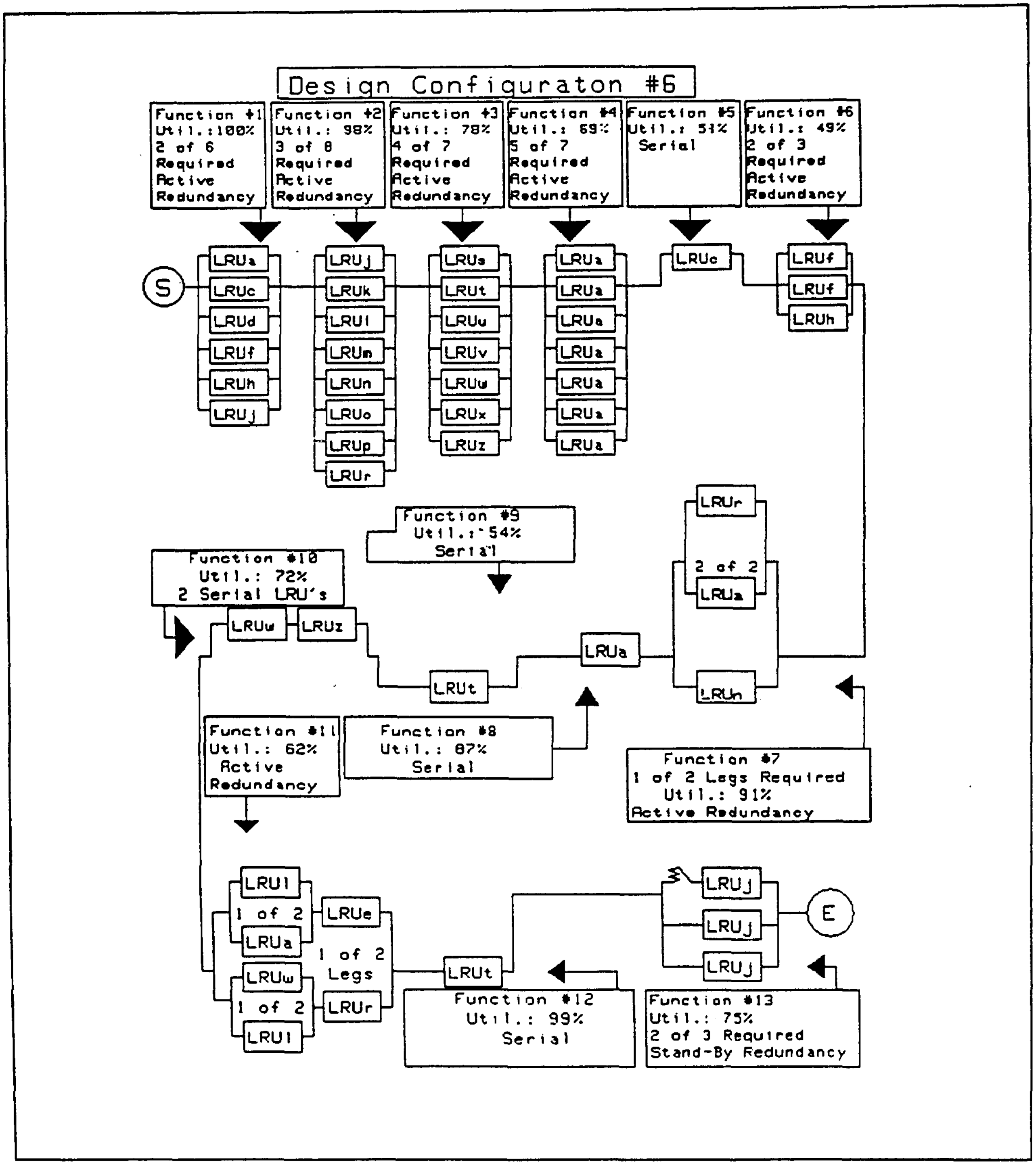


Figure 8 - Design Configuration #6's Reliability Block Diagram

Table 7 - Design Configuration #6's Reliability & Maintainability Data

Reliability Configuration I.D.		Configuration's Identification Name	Use Ratio (%)	LRU Composition ID (LRU Name)	Operate Failure Rate Per Million Hours	Stand-by Failure Rate Per Million Hours	Average Time-To Remove/ Replace In Minutes
Design Number	Std. Form Number						
1	27	Function 1	100	LRUa	217	0	68
				LRUc	213	0	95
				LRUd	179	0	20
				LRUf	212	0	53
				LRUh	205	0	65
				LRUj	221	0	60
2	39	Function 2	98	LRUj	199	0	61
				LRUk	195	0	55
				LRUl	185	0	63
				LRUm	202	0	35
				LRUn	188	0	52
				LRUo	193	0	66
				LRUp	178	0	35
				LRUr	206	0	71
3	34	Function 3	78	LRUs	182	0	91
				LRUt	195	0	55
				LRUu	188	0	75
				LRUv	205	0	38
				LRUw	168	0	33
				LRUx	204	0	44
				LRUz	194	0	89
4	35	Function 4	69	LRUa	201	0	39
				LRUa	198	0	47
				LRUa	202	0	34
				LRUa	189	0	61
				LRUa	194	0	71
				LRUa	188	0	50
				LRUa	180	0	35
5	1	Function 5	51	LRUc	182	0	35
6	4	Function 6	49	LRUf	205	0	61
				LRUf	209	0	94
				LRUh	205	0	62
7	13	Function 7	91	LRUr	183	0	72
				LRUn	210	0	51
				LRUa	191	0	55
8	1	Function 8	87	LRUa	198	0	64
9	1	Function 9	54	LRUt	195	0	85
10	1	Function 10a	72	LRUw	203	0	53
11	1	Function 10b	72	LRUz	196	0	59
12	24	Function 11	62	LRUl	200	0	53
				LRUa	213	0	87
				LRUw	191	0	65
				LRUl	205	0	55
				LRUe	201	0	82
				LRUr	180	0	51
13	1	Function 12	99	LRUt	178	0	47
14	18	Function 13	75	LRUj	188	25	69
				LRUj	188	0	51
				LRUj	185	0	43

VIII. Design Configuration #7 Specification

Design Configuration #7's derivation from Design Configuration #6 was accomplished by dropping LRUh from Function #1, LRUp from Function #2, LRUh from Function #6, and the stand-by LRUj from Function #13. The resulting reliability block diagram is shown in Figure 9 while the data pertinent to this design is itemized in Table 8.

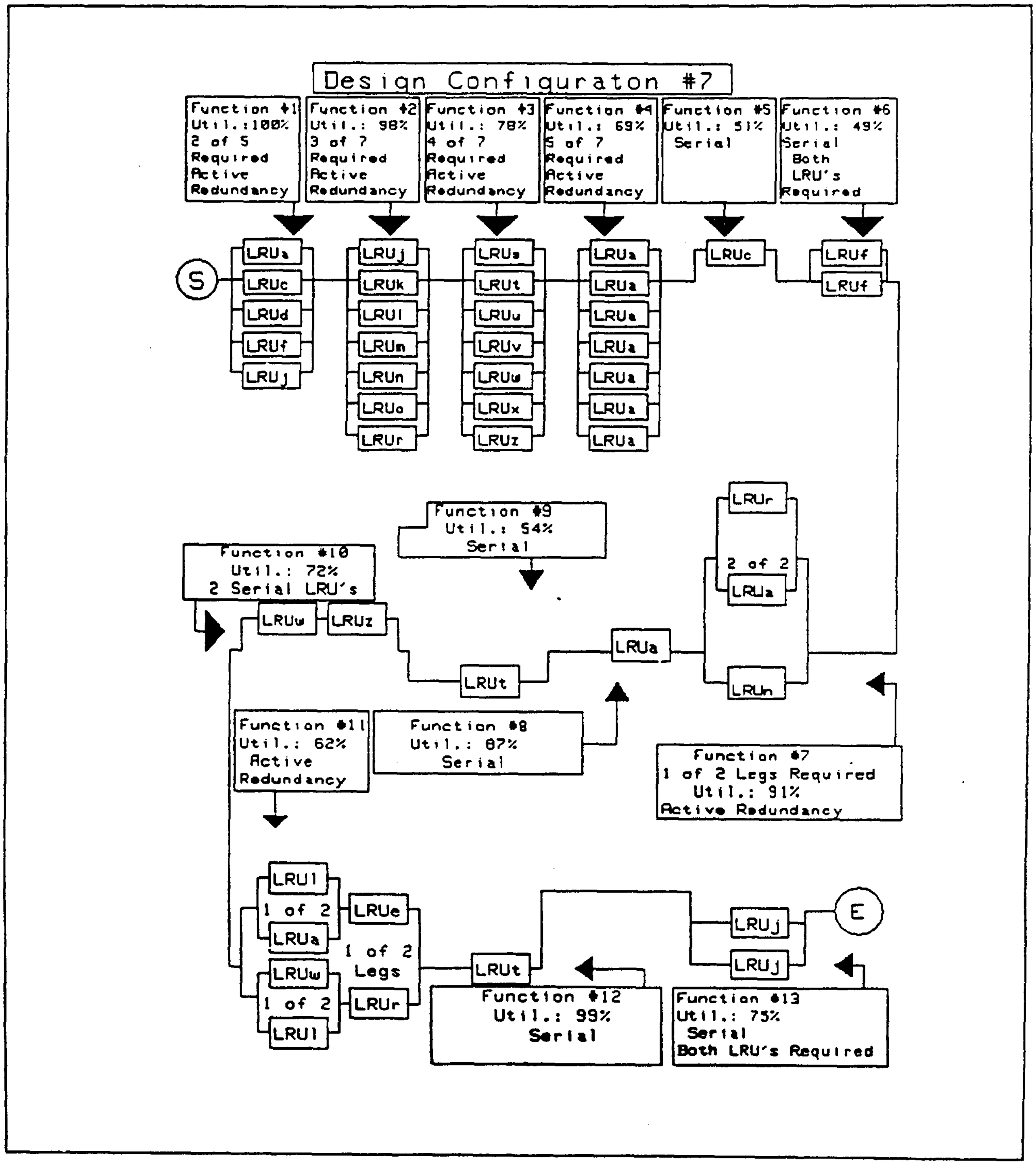


Figure 9 - Design Configuration #7's Reliability Block Diagram

Table 8 - Design Configuration #7's Reliability & Maintainability Data

Reliability Configuration I.D. Design Number	Reliability Configuration I.D. Std. Form Number	Configuration's Identification Name	Use Ratio (%)	LRU Composition ID [LRU Name]	Operate Failure Rate Per Million Hours	Stand-by Failure Rate Per Million Hours	Average Time-To Remove/ Replace In Minutes
1	10	Function 1	100				
				LRUa	217	0	69
				LRUc	213	0	95
				LRUd	179	0	20
				LRUf	212	0	53
				LRUj	221	0	60
2	33	Function 2	98				
				LRUj	199	0	61
				LRUk	195	0	55
				LRUl	185	0	63
				LRUm	202	0	35
				LRUn	188	0	52
				LRUo	193	0	66
				LRUr	206	0	71
3	34	Function 3	78				
				LRUs	182	0	91
				LRUt	195	0	55
				LRUu	188	0	75
				LRUv	205	0	38
				LRUw	168	0	33
				LRUx	204	0	44
				LRUz	194	0	89
4	35	Function 4	69				
				LRUa	201	0	39
				LRUa	198	0	47
				LRUa	202	0	34
				LRUa	189	0	61
				LRUa	194	0	71
				LRUa	188	0	50
				LRUa	180	0	35
5	1	Function 5	51	LRUc	182	0	35
6	1	Function 6a	49	LRUf	205	0	61
7	1	Function 6b	49	LRUf	209	0	94
8	13	Function 7	91				
				LRUr	183	0	72
				LRUn	210	0	51
				LRUa	191	0	55
9	1	Function 8	87	LRUa	198	0	64
10	1	Function 9	54	LRUt	195	0	85
11	1	Function 10a	72	LRUw	203	0	53
12	1	Function 10b	72	LRUz	196	0	59
13	24	Function 11	62				
				LRUl	200	0	53
				LRUa	213	0	87
				LRUw	191	0	65
				LRUl	205	0	55
				LRUe	201	0	82
				LRUr	180	0	51
14	1	Function 12	99	LRUt	178	0	47
15	1	Function 13a	75	LRUj	188	0	51
16	1	Function 13b	75	LRUj	185	0	45

III. Design Configuration #8 Specification

Design Configuration #8's derivation from Design Configuration #7 was accomplished by dropping LRUd from Function #1, LRUo from Function #2, LRUr and LRUs from Function #7, and LRUw, LRUl and LRUr from Function #11. The resulting reliability block diagram is shown in Figure 10 while the data pertinent to this design is itemized in Table 9.

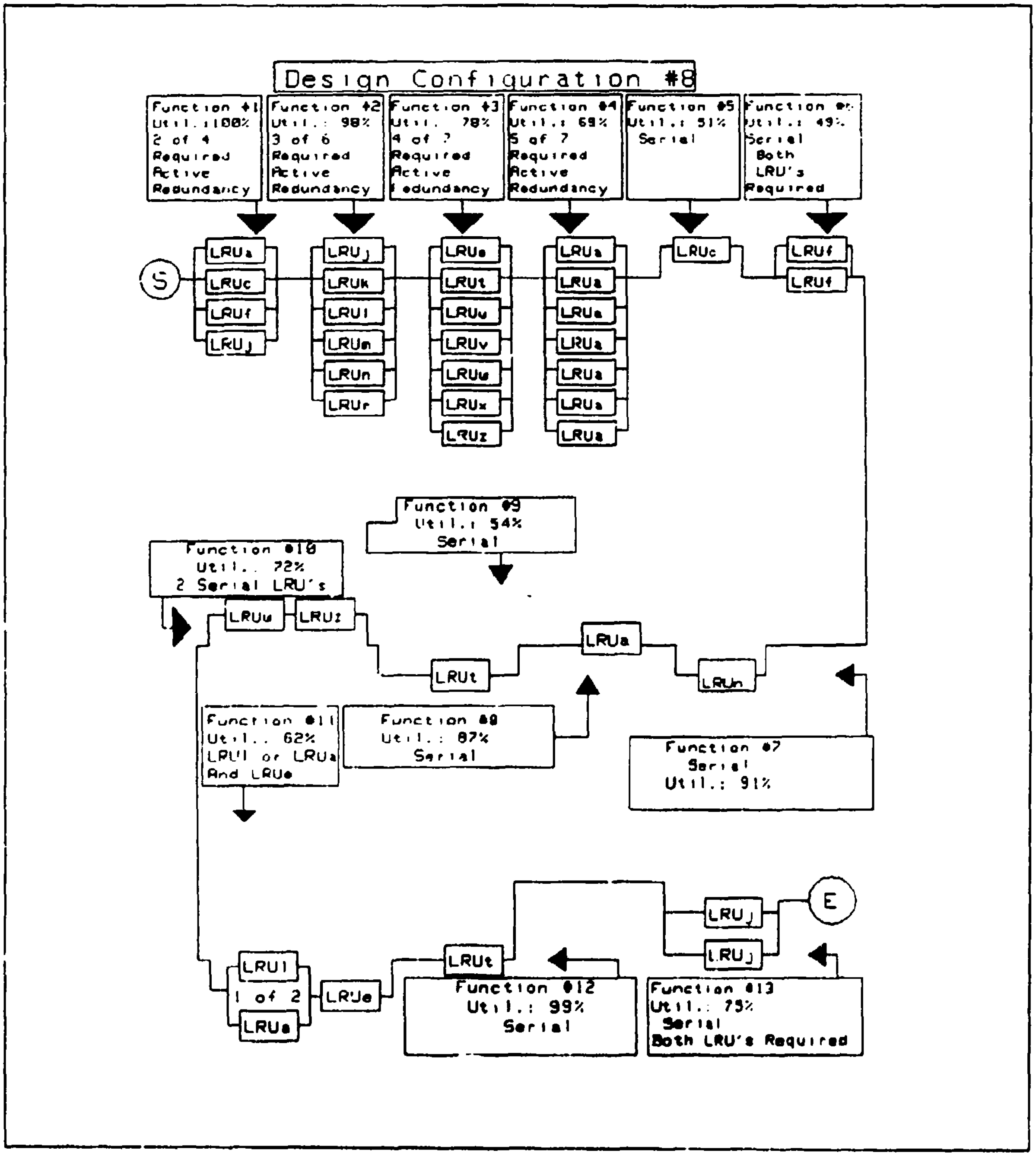


Figure 10 - Design Configuration #8's Reliability Block Diagram

Table 9 - Design Configuration #8 : Reliability & Maintainability Data

Reliability Configuration I.D. Design Number	Reliability Configuration I.D. Std. Form Number	Configuration's Identification Name	Usage Ratio (%)	LRU Composition ID (LRU Name)	Operate Failure Rate Per Million Hours	Stand-by Failure Rate Per Million Hours	Average Time-To Remove/ Replace In Minutes
1	6	Function 1	100				
				LRUa	217	0	68
				LRUc	213	0	95
				LRUf	212	0	53
				LRUj	221	0	68
2	28	Function 2	98				
				LRUj	199	0	61
				LRUk	195	0	55
				LRUl	185	0	63
				LRUa	202	0	35
				LRUn	188	0	52
				LRUr	206	0	71
3	34	Function 3	78				
				LRUs	182	0	91
				LRUt	195	0	55
				LRUu	188	0	75
				LRUv	205	0	38
				LRUw	168	0	33
				LRUx	204	0	44
				LRUz	194	0	89
4	35	Function 4	69				
				LRUa	201	0	39
				LRUa	198	0	47
				LRUa	202	0	34
				LRUa	189	0	61
				LRUa	194	0	71
				LRUa	188	0	58
				LRUa	188	0	35
5	1	Function 5	51				
				LRUc	182	0	35
6	1	Function 6a	49				
				LRUf	205	0	61
7	1	Function 6b	49				
				LRUf	209	0	94
8	1	Function 7	91				
				LRUn	210	0	51
9	1	Function 8	87				
				LRUa	198	0	64
10	1	Function 9	54				
				LRUt	195	0	85
11	1	Function 10a	72				
				LRUw	203	0	53
12	1	Function 10b	72				
				LRUz	196	0	59
13	2	Function 11a	62				
				LRUl	208	0	53
				LRUa	213	0	87
14	1	Function 11b	62				
				LRUe	201	0	82
15	1	Function 12	99				
				LRUt	178	0	47
16	1	Function 13a	75				
				LRUj	188	0	51
17	1	Function 13b	75				
				LRUj	185	0	45

X. Design Configuration #9 Specification

Figure 11 provides a schematic of the reliability block diagram for Design Configuration #9. This design was derived from the previous design by the methodology described below. LRUc was dropped from Function #1, and

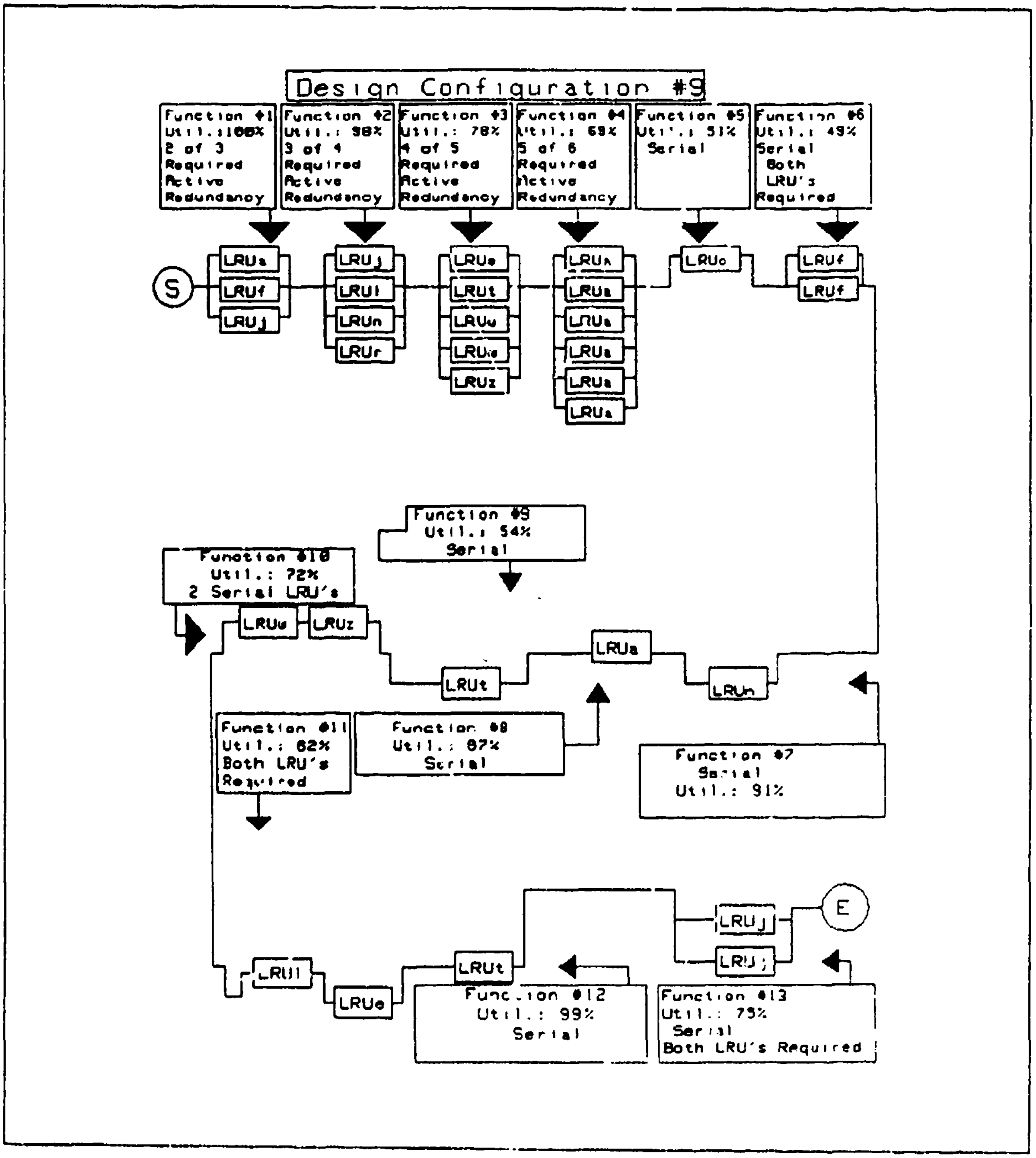


Figure 11 - Design Configuration #9's Reliability Block Diagram

LRUk and LRUm were dropped from Function #2. Additionally, LRU[illegible] and LRU[illegible] were dropped from Function #3. An LRUa was dropped from Function #4, and

LRUa was dropped from Function #11.

Table 10 - Design Configuration #9's Reliability & Maintainability Data

Reliability Configuration I.D. Design Number	Reliability Configuration I.D. Std. Form Number	Configuration's Identification Name	Usage Ratio (%)	LRU Composition ID [LRU Name]	Operate Failure Rate Per Million Hours	Stand-by Failure Rate Per Million Hours	Average Time-To Remove/Replace In Minutes
1	4	Function 1	100	LRUa	217	0	68
				LRUf	212	0	53
				LRUj	221	0	60
2	7	Function 2	90	LRUj	199	0	61
				LRUl	185	0	63
				LRUn	188	0	52
				LRUr	206	0	71
3	12	Function 3	70	LRUs	182	0	91
				LRUt	195	0	55
				LRUu	188	0	75
				LRUv	160	0	33
				LRUz	194	0	89
4	30	Function 4	69	LRUa	201	0	39
				LRUa	190	0	47
				LRUa	189	0	61
				LRUa	194	0	71
				LRUa	180	0	59
				LRUa	180	0	35
5	1	Function 5	51	LRUc	182	0	35
6	1	Function 6a	49	LRUf	205	0	61
7	1	Function 6b	49	LRUf	209	0	94
8	1	Function 7	91	LRUn	210	0	51
9	1	Function 8	87	LRUa	198	0	64
10	1	Function 9	54	LRUt	195	0	85
11	1	Function 10a	72	LRUw	203	0	53
12	1	Function 10b	72	LRUz	196	0	59
13	1	Function 11a	62	LRUl	200	0	53
14	1	Function 11b	62	LRUe	201	0	82
15	1	Function 12	99	LRUt	178	0	47
16	1	Function 13a	75	LRUj	188	0	51
17	1	Function 13b	75	LRUj	185	0	45

XI. <u>Design Configuration #10 Specification</u>

Figure 12 provides a schematic of the reliability block diagram for Design Configuration #10. This design is unique in that it is totally void of redundancy(i.e., it is totally serial). Its LRU composition was derived

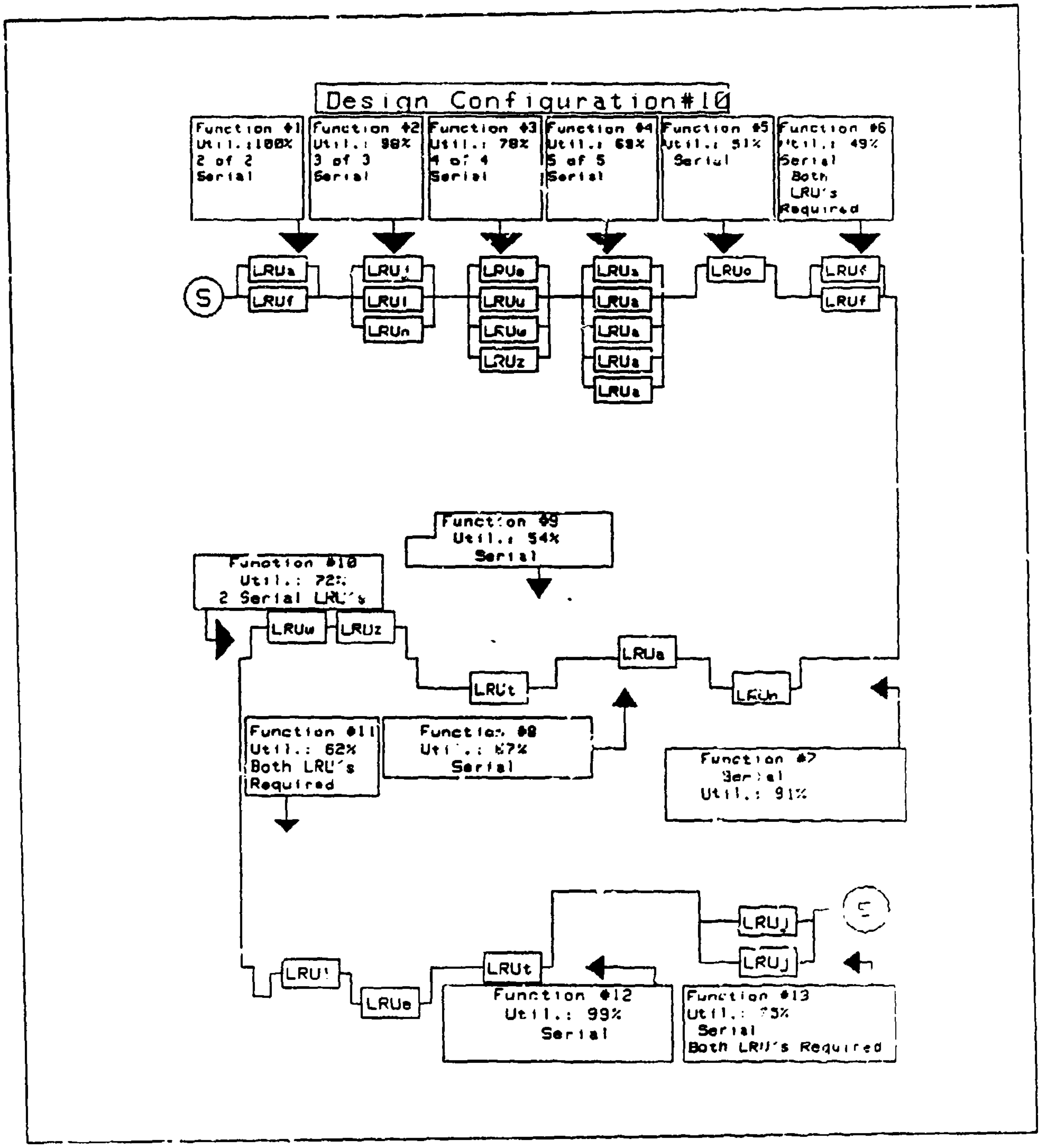


Figure 12 - Design Configuration #10's Reliability Block Diagram

from the previous design by dropping selected LRU's, yet satisfying the functional requirements levied on the configuration.

Table 11 - Design Configuration #10's Reliability & Maintainability Data

Reliability Configuration I.D. Design Number	Reliability Configuration I.D. Std. Form Number	Configuration's Identification Name	Usage Ratio (%)	LRU Composition ID (LRU Name)	Operate Failure Rate Per Million Hours	Stand-by Failure Rate Per Million Hours	Average Time-To Remove/Replace In Minutes
1	1	Function 1a	100	LRUa	217	0	68
2	1	Function 1b	100	LRUf	212	0	53
3	1	Function 2a	90	LRUj	199	0	61
4	1	Function 2b	90	LRUl	185	6	63
5	1	Function 2c	90	LRUn	188	0	52
6	1	Funct.on 3a	70	LRUs	182	0	91
7	1	Function 3b	70	LRUu	180	0	75
8	1	Function 3c	70	LRUw	160	0	33
9	1	Function 3d	70	LRUz	194	0	89
10	1	Function 4a	69	LRUa	198	0	47
11	1	Function 4b	69	LRUa	189	0	61
12	1	Function 4c	69	LRUa	194	0	71
13	1	Function 4d	69	LRUa	188	0	50
14	1	Function 4e	69	LRUa	180	0	35
15	1	Function 5	51	LRUc	182	0	35
16	1	Function 6a	49	LRUf	205	0	61
17	1	Function 6b	49	LRUf	209	0	94
18	1	Function 7	91	LRUn	210	0	51
19	1	Function 8	87	LRUa	198	0	64
20	1	Function 9	54	LRUt	195	0	85
21	1	Function 10a	72	LRUw	203	0	53
22	1	Function 10b	72	LRUz	196	0	59

Table 11 - Design Configuration #10's Reliability & Maintainability Data (Continued)

Reliability Configuration I.D.		Configuration's Identification Name	Usage Ratio (%)	LRU Composition ID [LRU Name]	Operate Failure Rate Per Million Hours	Stand-by Failure Rate Per Million Hours	Average Time-To Remove/Replace In Minutes
Design Number	Std. Form Number						
23	1	Function 11a	62	LRUl	200	0	53
24	1	Function 11b	62	LRUe	201	0	82
25	1	Function 12	99	LRUt	170	0	47
26	1	Function 13a	75	LRUj	188	0	51
27	1	Function 13b	75	LRUk	185	0	45

XI. Problem Approach

The information and data presented in this chapter forms the data base used in the reliability predictions obtained via the application of SCRAPIRONS and the logistics life-cycle cost forecasts obtained via the application of LOGAM. One additional input requires further clarification. Namely, the logistics system should be described. Simply stated, failed LRU's are removed and replaced at the system level. The failed LRU's are returned to the depot for repair. LRU repair is accomplished by modular replacement with defective modules being discarded. This logistics system is provided, as input, to LOGAM by setting the variable, GG, equal to one and the remaining G-Factors equal to zero. The selection of this logistics system was made for two reasons, first, for its widespread use in support of missile systems and for its relative brievity.

The initial step in this analysis focused on predicting system MTBF for each of the ten designs. Once this was accomplished, attention was then focused on inputting the LRU consumption rates and mean-time-to-repair to LOGAM to predict life-cycle logistics cost. The results of these applications are summarized in Chapter 3 of this report.

CHAPTER 3

RESULTS

I. SCRAPIRONS' Output Summary

The initial step in the analysis dealt with inputting the data required, for each design configuration, into the SCRAPIRONS model and forecasting the resulting system MTBF's. Table 12 contains a summary of the results obtained. These MTBF point estimates forecast the average number of hours between system failure, subject to the constraint that no corrective maintenance actions are initiated until system failure occurs. At system failure, the complete LRU configuration is restored to a fully operational state. The SCRAPIRONS output obtained for each design configuration is provided in Appendices 3 through 12.

Table 12 - MTBF Point Estimates

Design Number	System MTBF (Hours)
#1	2,133.91
#2	2,091.78
#3	1,499.37
#4	1,234.64
#5	1,043.19
#6	915.60
#7	670.31
#8	568.47
#9	450.68
#10	251.79

II. LOGAM'S Output Summary

Once the design configurations' MTBF's were predicted, attention was then focused on forecasting the logistics life-cycle cost, via LOGAM applications. The resulting life-cycle logistics cost estimates for the ten designs are summarized in Table 13. Abbreviated LOGAM outputs, in P92 Formats, are provided in Appendix 13.

Table 13 - Life-Cycle Logistics Cost

Design Number	Life-Cycle Log Cost
#1	$22,546,710
#2	$22,097,920
#3	$19,565,330
#4	$19,540,390
#5	$18,844,570
#6	$17,813,100
#7	$16,260,390
#8	$14,832,[illegible]30
#9	$12,535,950
#10	$11,746,750

III. Relationship Discussion

Figure 13 provides a bar chart illustration of the relationship implied herein between system MTBF, predicted via SCRAPIRONS, and life-cycle logistics cost, forecasted via LOGAM. The costs shown in Figure 13 are stated in millions of dollars while the MTBF values are stated in hours. It is pertinent to point out at this time that each of the cost

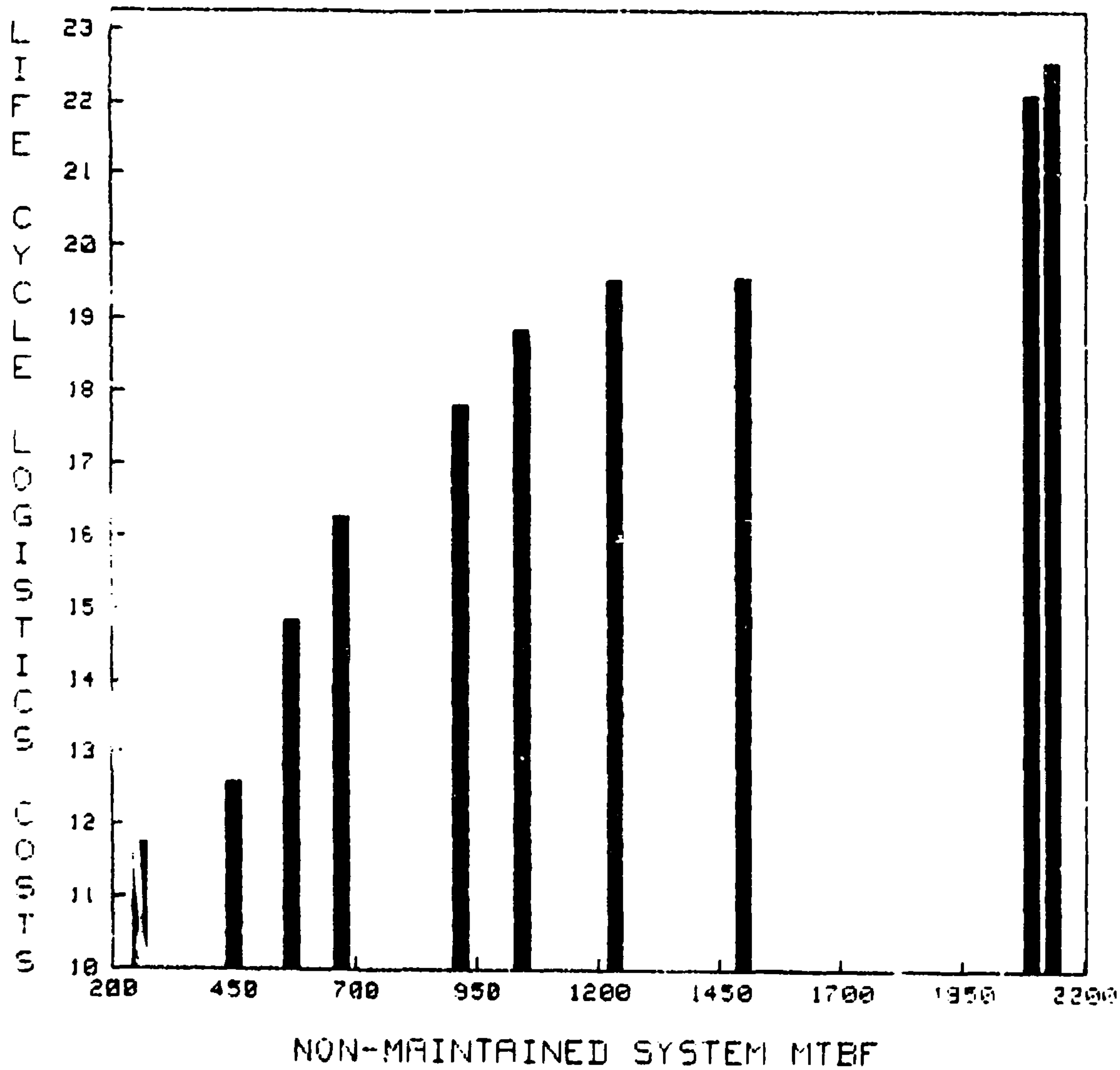


Figure 13 - System MTBF Versus Life-Cycle Logistics Cost

forecasts and MTBF estimates are directly tied to a finite, unique design and as such do not form a continuum of points. Moreover, they constitute a sample of the feasible, obtainable system designs which possess their own system-effectiveness and logistics parameters. The ten designs analyzed herein do not constitute an exhaustive itemization of all possible designs this hypothetical system could take on. This fact is evidenced by the arbitrary method employed to develop the alternate designs.

It will be noted that the overall trend of life-cycle logistic cost versus system MTBF, illustrated in Figure 13, is completely opposite to that portrayed in Figure 1. This phenomena can be explained. In serially connected, exponentially distributed LRU system designs, the LRU consumption rate per operational hour numerically equals the LRU's composite failure rate per operational hour. When the system fails, one LRU failure caused the system failure. Under the assumption of perfect diagnostic capability, one LRU replacement occurs per system failure. When redundancy is introduced into the design, multiple LRU replacements can occur per system failure, even if no LRU replacements are made prior to system failure. If a periodic, scheduled maintenance interval is introduced, where failed LRU's are replaced in redundant configurations prior to system failure, the LRU consumption rate would further diverge from the composite LRU failure rates. In reality, logistics costs can and do increase when system MTBF increases as a result of redundancy or scheduled maintenance cycles. This possibility precludes one from concluding that in all cases, increases in system MTBF results in decreases in system life-cycle costs. In summary, increases in system MTBF can result in either decreases or increases in life-cycle logistics cost, hence system MTBF is not an accurate driver of life-cycle logistics cost. If fact, in the presence of design redundancy and/or scheduled maintenance actions, the system MTBF is not an accurate driver for the frequency of maintenance. Consequently, other design parameters such as mean-time-between-corrective-maintenance or mean-time-between-maintenance must be explored as cost drivers since they more accurately reflect the average time between system demands for logistical resources.

CHAPTER 4

CONCLUSIONS AND EXTENSIONS

The hypothesis that logistics life-cycle costs decrease as system MTBF increases is not true in all cases. Specifically, this analysis has examined ten design alternatives for a hypothetical system and illustrated that logistics life-cycle cost can increase as system MTBF increases. This phenomena occurred under the imposed constraints of both stand-by and active redundancy at the LRU level, a fixed logistics concept, fixed LRU descriptions, and no scheduled maintenance policy. It is hypothesized that if a scheduled maintenance interval is imposed that the system MTBF would increase further for Designs 1 through 9 but that the logistics life-cycle cost would also increase for these designs. This inference is based on the conclusions that a scheduled maintenance interval would allow for replacing failed LRU's in redundant configurations prior to configuration failure thereby increasing the configurations' MTBF but also increasing the consumption rate of selected LRU's and increasing the personnel requirements. The net effect of a scheduled maintenance policy is an increase in the logistics resources consumed by the system. This consumption of resources is offset, from a trade-off sense, by the increase in system reliability and MTBF.

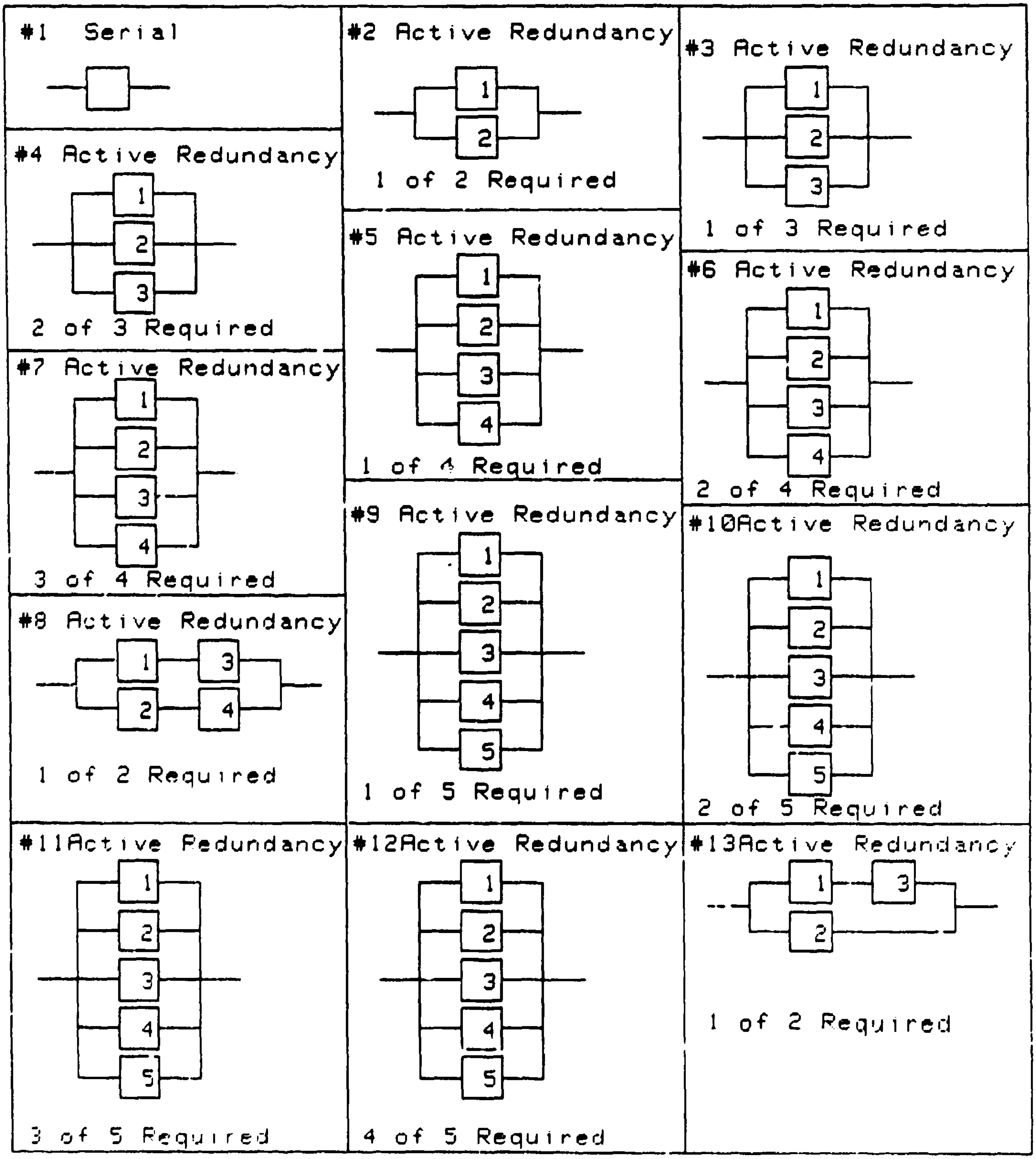
In conclusion, it is erroneous to assume that higher system MTBF's result in reduced logistics life-cycle costs. In fact, higher logistics costs are often required to achieved higher system MTBF's. The quantity and quality of logistics resources consumed by a given system is related to the failure characteristics of the equipment comprising it, however other factors must be considered. The mean-time-between-maintenance, MTBM, of a system appears to be a more meaningful index of logistics cost than the MTBF. Both parameters are functions of the failure characteristics of a system's components, but the MTBM is inclusive of more pertinent considerations pertaining to function and modes of operation. The MTBM and MTBF of a system can be equal if, and only if, specific conditions exist. The incorporation of a single redundant entity in a design violates these conditions. Finally, the utilization of equipment and the degree of functional redundancy designed into systems, often result in both higher system MTBF's and higher life-cyrle logistics costs.

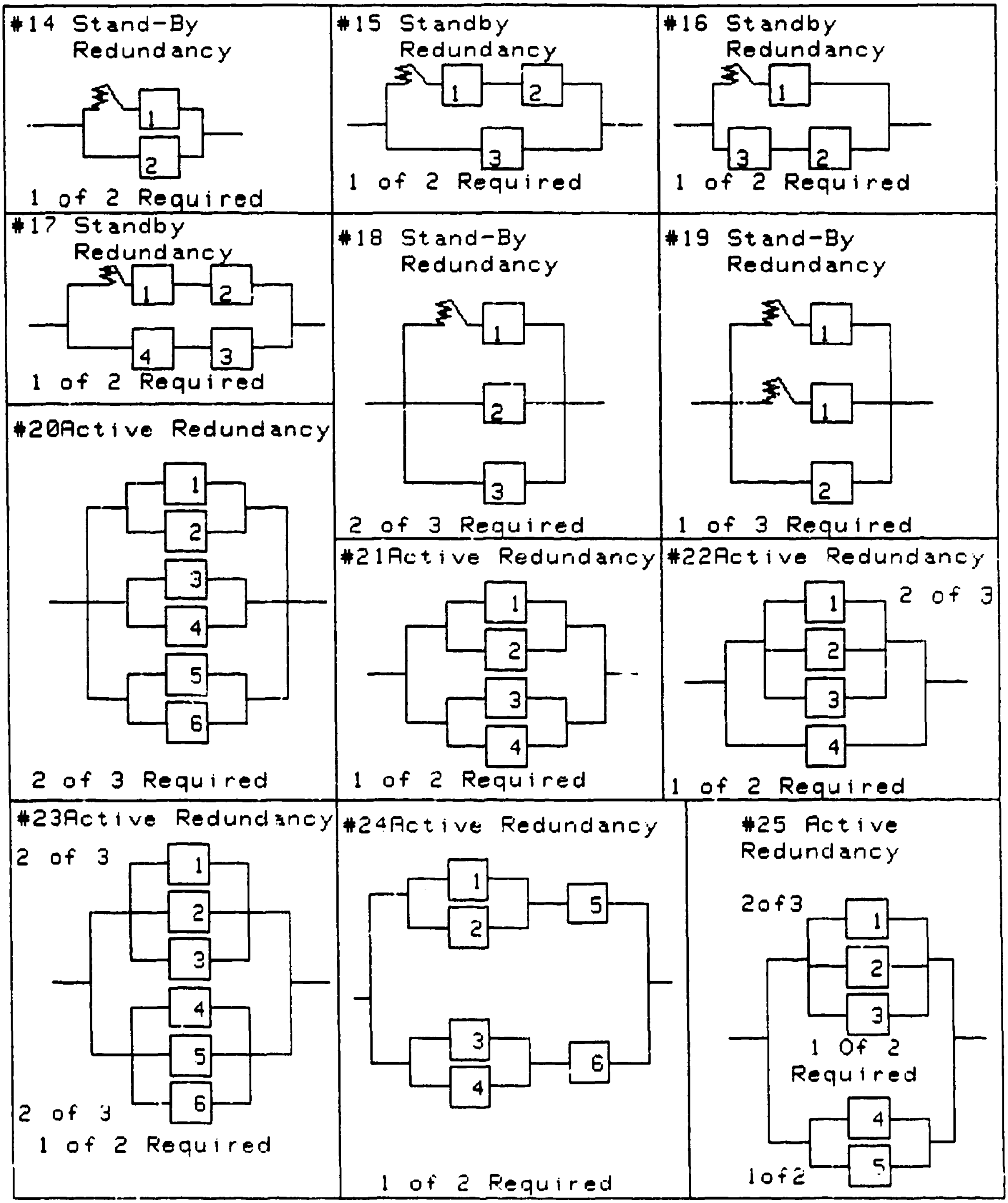
Appendix 1

Line-Replaceable-Unit (LRU) Configurations

Allowable LRU Reliability Configurations

Each Block Shown, Among and Between Configurations, Is Assumed To Be A Unique LRU Application(i.e., they may be different LRU's according to the numbering scheme shown for each LRU configuration).

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2
1 of 2 Required
#15 Standby Redundancy
1
2
3
1 of 2 Required
#16 Standby Redundancy
1
3
2
1 of 2 Required
#17 Standby Redundancy
1
2
4
3
1 of 2 Required
#18 Stand-By Redundancy
1
2
3
2 of 3 Required
#19 Stand-By Redundancy
1
1
2
1 of 3 Required
#20Active Redundancy
1
2
3
4
5
6
2 of 3 Required
#21Active Redundancy
1
2
3
4
1 of 2 Required
#22Active Redundancy
2 of 3
1
2
3
4
1 of 2 Required
#23Active Redundancy
2 of 3
1
2
3
4
5
6
2 of 3
1 of 2 Required
#24Active Redundancy
1
2
5
3
4
6
1 of 2 Required
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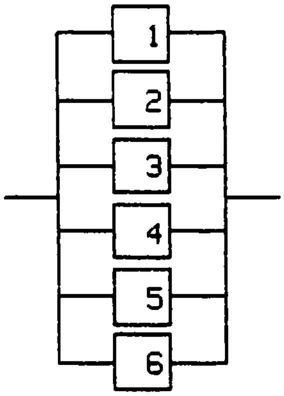
2of3
1
2
3
1 Of 2 Required
4
5
1of2

#26Active Redundancy



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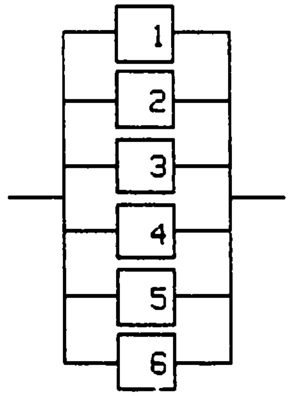

2 of 6 Required

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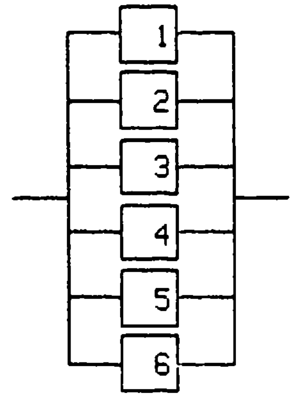

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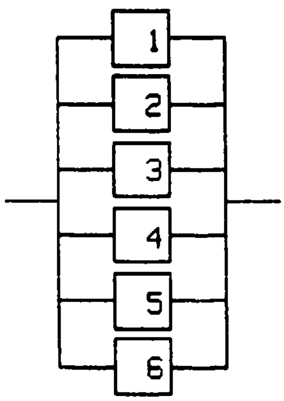

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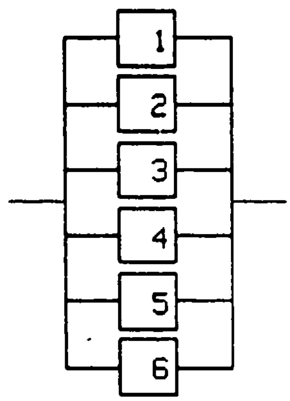

5 of 6 Required

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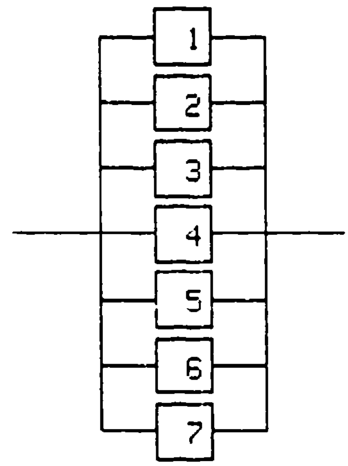

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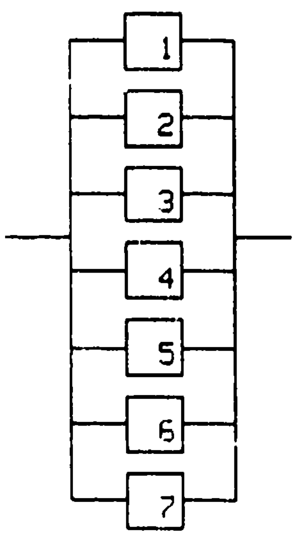

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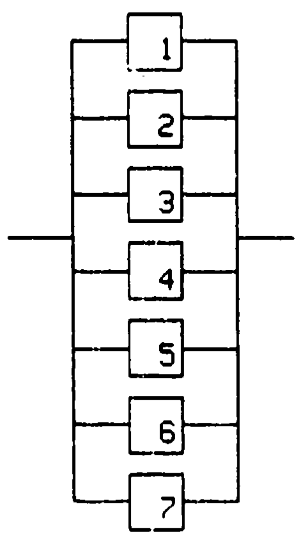

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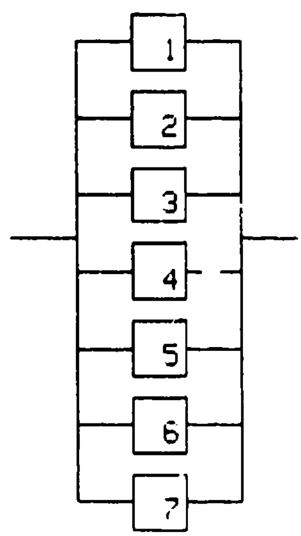

4of7 Required

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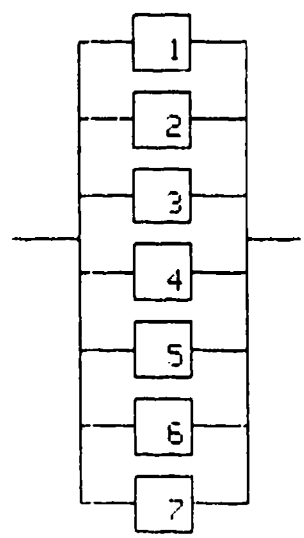

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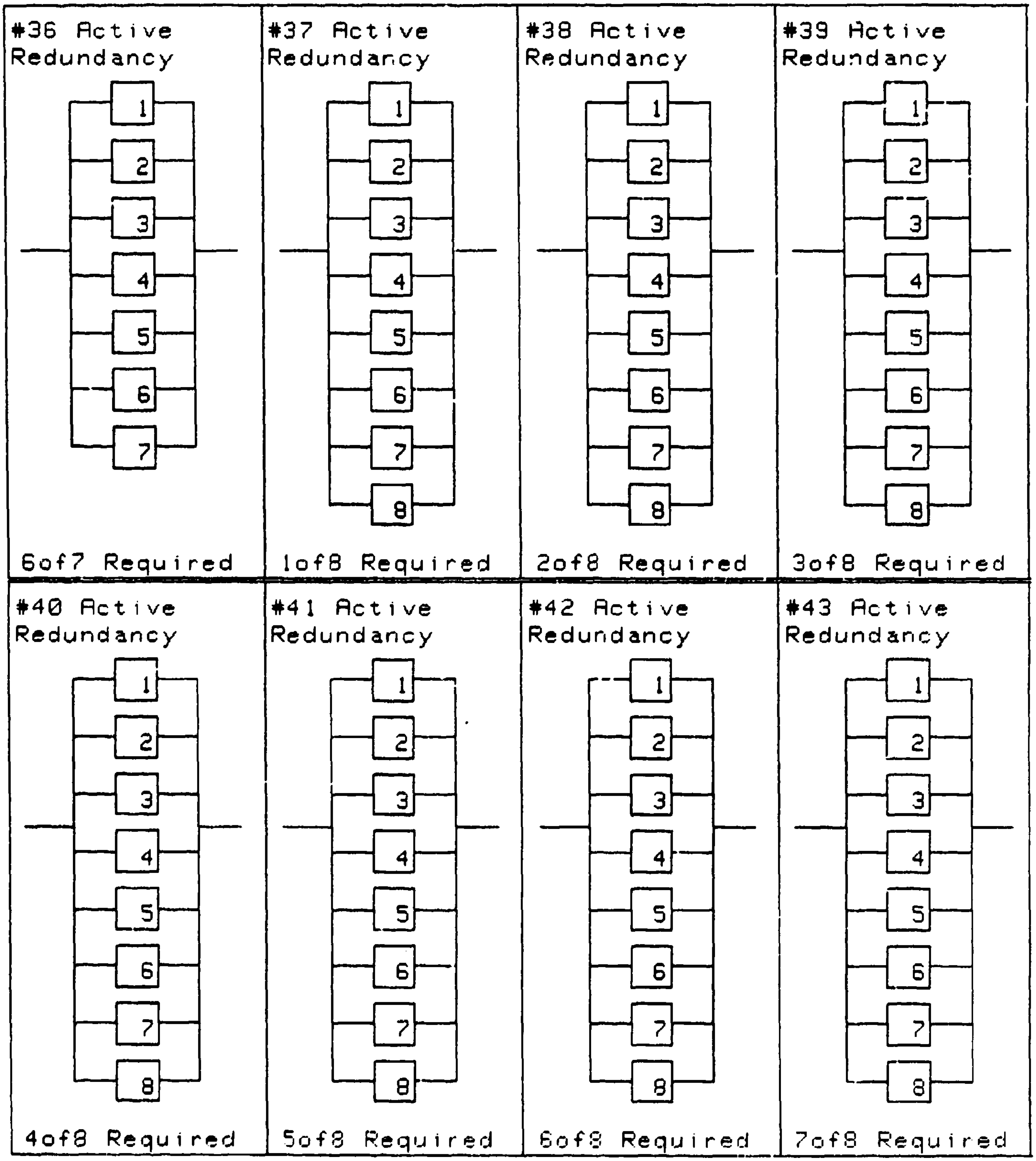
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6of7 Required
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7
8
1of8 Required
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2of8 Required
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3of8 Required
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4of8 Required
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5of8 Required
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6of8 Required
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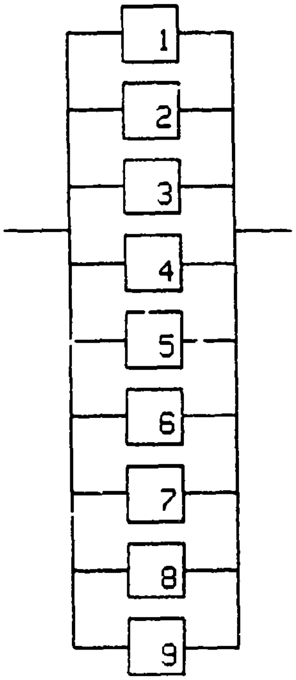
8
7of8 Required

#44 Active Redundancy



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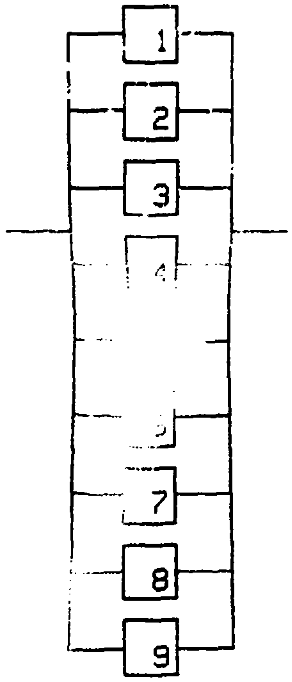

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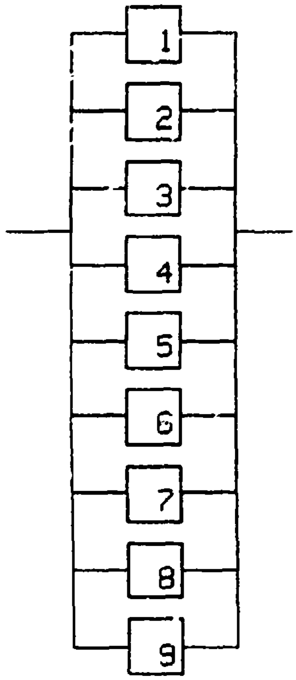

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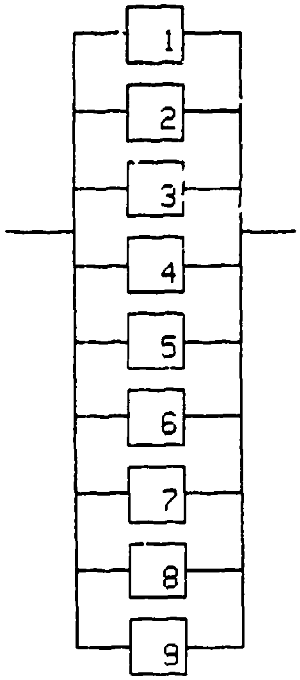

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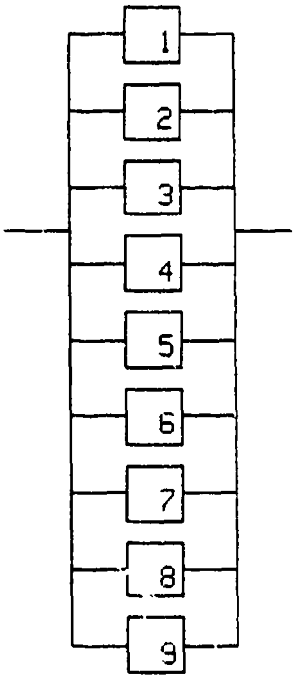

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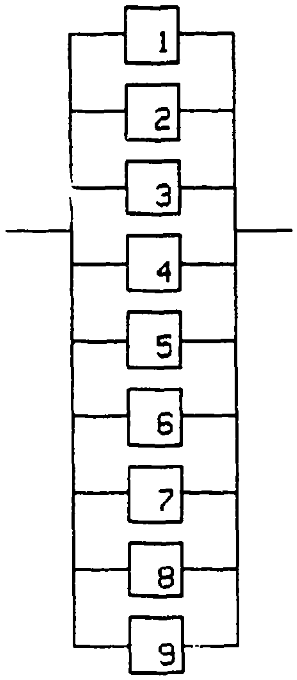

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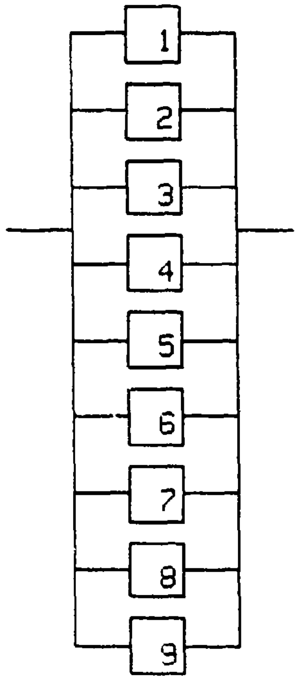

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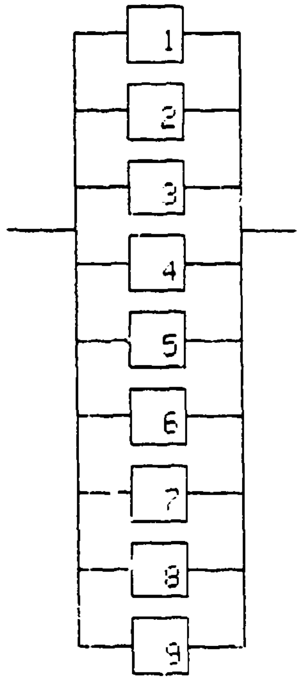

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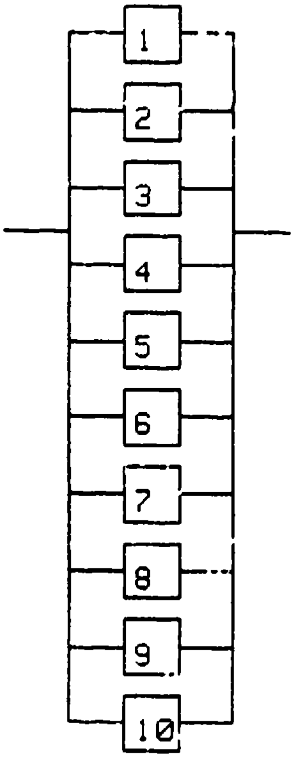

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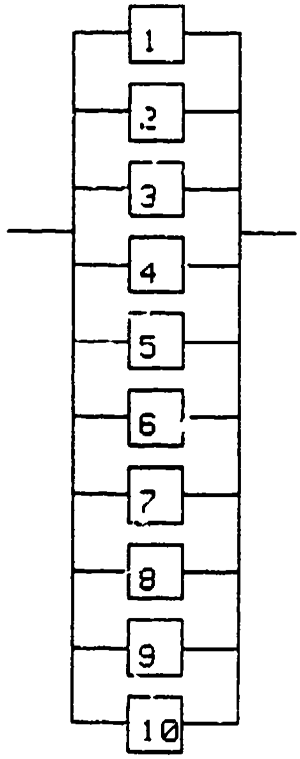

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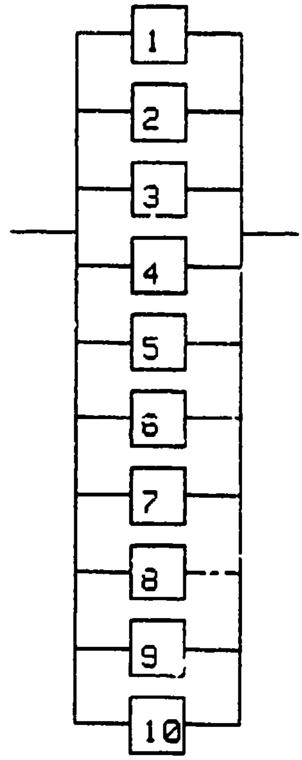

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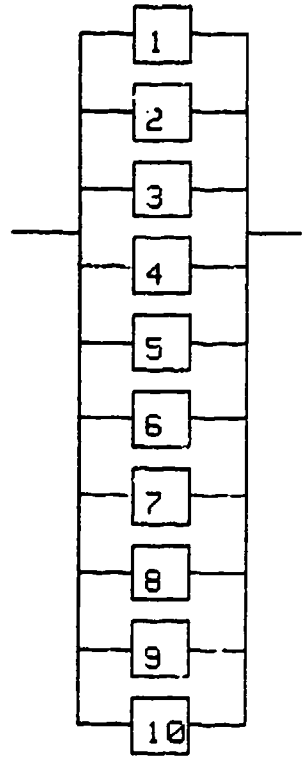

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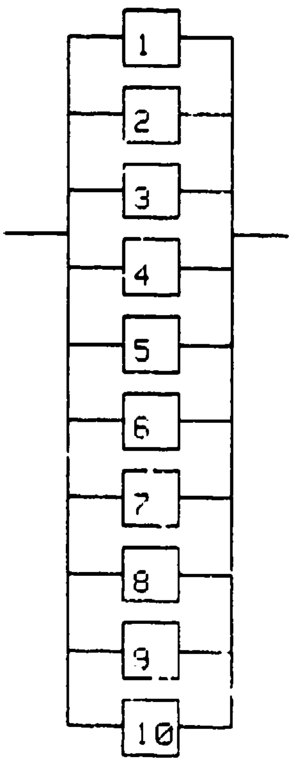

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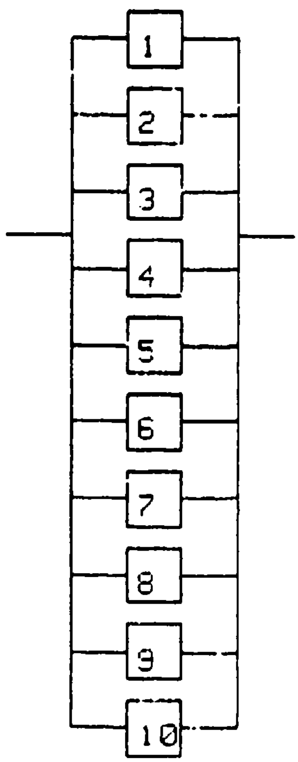

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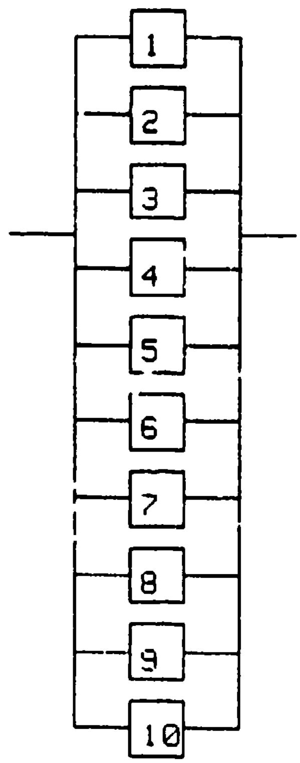

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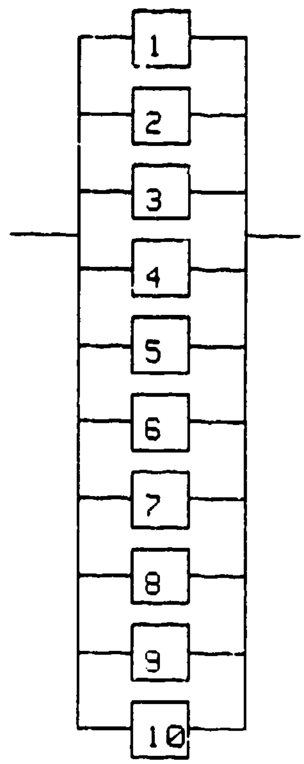

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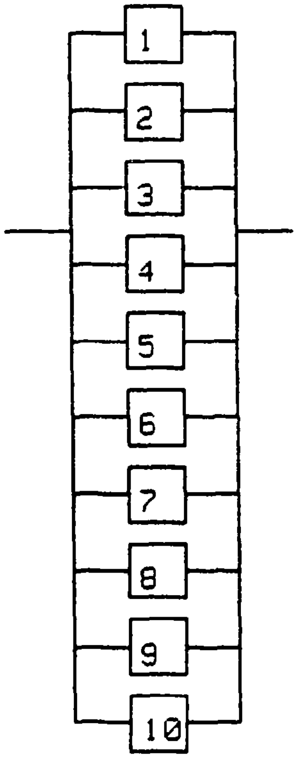
#60 Active Redundancy  9of10 Required	TO BE DEVELOPED	TO BE DEVELOPED	TO BE DEVELOPED

Appendix 2

LOGAM LRU Data

Each Line-Replaceable-Unit (LRU) contained in an identified design must be described by three-hundred twenty-eight data elements to be accepted by the LOGAM computational algorithms. For the exercise associated with the ten designs, these data elements can be classified into three categories(i.e., those that are constant between the design configurations and are common among the LRU's; those that are constant between the design configurations but are LRU peculiar; and those that vary between design configurations and are LRU peculiar). Those data elements that are common to all LRU's and are constant between design configurations describe the logistics concept envisioned to support the system, identify the number of systems to be deployed, specify the number and types of logistics echelons and so on. These data elements, along with the numeric values chosen for this exercise, are summarized in Table 10 of this appendix.

Those data elements that are constant between design configurations but are LRU peculiar are CMP, CUBEM, CUBEU, CUP, P, WM and WU. These variables are defined in Table 10. The values used in this exercise, per LRU, are shown in Table 1. The final data element classification, those data elements which vary between design configurations and LRU type, contain only two elements, E and TRC. A summary of the values taken on by these two data elements versus the ten designs is provided in Table 14 Table 15.

Table 14 - System Mean-Time-To-Repair Summary For The Ten Design Configurations (SCRAPIRONS's Output)

Configuration Number	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
TRC in Min.	223.88	208.24	189.97	182.13	162.31	148.27	129.27	111.57	85.68	57.54

Table 15 - LRU Consumption Rates Versus Design Configurations
(SCRAPIRONS's Output/E Entry in LOGAM)

LRU	Design Configuration Number									
	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
LRUa	1103.2	1103.2	1142.5	1229.7	1235.2	1242.9	1253.7	1191.5	1067.0	1044.1
LRUb	226.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LRUc	226.1	263.0	263.0	231.7	204.9	212.5	223.1	241.5	92.8	92.8
LRUd	106.8	103.7	103.7	103.7	108.6	115.3	124.3	9.0	0.0	0.0
LRUe	251.0	82.8	82.8	82.8	82.8	82.8	82.8	124.6	124.6	124.6
LRUf	233.5	250.1	250.1	250.1	274.0	281.6	333.0	351.3	374.3	414.9
LRUg	219.9	229.7	229.7	229.7	0.0	0.0	0.0	0.0	0.0	0.0
LRUh	170.0	177.5	177.5	177.5	192.0	199.4	0.0	0.0	0.0	0.0
LRUi	106.8	106.3	106.3	106.3	111.8	0.0	0.0	0.0	0.0	0.0
LRUj	361.9	469.0	469.0	469.0	474.6	487.2	537.0	565.8	620.7	474.8
LRUk	153.4	153.4	153.4	153.4	112.1	116.8	125.0	134.4	0.0	0.0
LRUl	279.0	279.0	279.0	279.0	279.0	283.5	291.2	216.8	282.0	305.3
LRUm	198.2	198.2	198.2	113.1	113.1	118.0	126.5	136.3	0.0	0.0
LRUn	235.7	235.7	270.0	270.0	270.0	274.6	282.5	323.5	350.8	375.3
LRUo	111.8	111.8	111.8	111.8	111.8	116.5	124.6	0.0	0.0	0.0
LRUp	109.4	109.4	109.4	109.4	109.4	113.7	0.0	0.0	0.0	0.0
LRUq	115.1	115.1	115.1	115.1	115.1	0.0	0.0	0.0	0.0	0.0
LRUr	235.5	235.5	272.2	272.2	272.2	277.3	285.9	137.3	169.7	0.0
LRUs	102.8	102.8	109.3	109.3	109.3	109.3	109.3	109.3	126.8	142.0
LRUt	323.5	323.5	330.7	386.8	403.2	394.7	394.7	394.7	415.0	231.5
LRUu	104.3	104.3	111.1	111.1	111.1	111.1	111.1	111.1	129.9	146.6
LRUv	108.1	108.1	115.9	115.9	115.9	115.9	115.9	115.9	0.0	0.0
LRUw	283.2	380.7	334.1	334.1	334.1	334.1	334.1	250.9	265.4	277.2
LRUx	211.9	107.9	115.7	115.7	115.7	115.7	115.7	115.7	0.0	0.0
LRUy	239.8	343.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LRUz	203.1	105.7	254.0	254.0	254.0	254.0	254.0	254.0	274.1	292.4

Table 16's content is extensive, twenty 8.5 by 11 inch pages, hence the reduction shown was performed to reduce the size of this report. Each LRU present in a given design must be described by such an array. It is pertinent to point out that heretofore the data element, E, is customarily approximated by various means for designs containing redundant configurations. In this application, the data element is computed, exactly, via SCRAPIRONS and can be interpreted as the number of LRU's consumed, by type, by the system during a one-million hour operating interval.

Table 10 - NAMELIST Data Content Definition and Standard Values

SENSY NO.	Basic Name	FORTRAN Name	Description	Input Value
1	Name(1)	ARA	Annual Military manpower turnover fraction for field test and repair.	.4000
2	Name(2)	ARAD	Annual civilian manpower turnover fraction for depot test and repair.	.2000
3	Name(3)	AYZP	Control to specify the method for computing the initial provision quantities. It generally is input as a whole number as follows: 1, if LOGAM Maintenance Rule is to be used. 0, if LOGAM Supply Rule is to be used. -1, if provision quantities are to be input.	1.0000
4	Name(4)	CAD	Cost in dollars per year to retain an item (LRU, module, non-standard part) in the supply system.	1142.0
5	Name(5)	CALMAN	Cost in dollars per year for a calibration person.	25315
6	Name(6)	CALPUD	Cost in dollars for technical data for calibration/Type III test equipment.	0.0000
7	Name(7)	CALSET	The number of calibration/Type III test sets and teams.	0.0000
8	Name(8)	CCAL	Cost in dollars to develop calibration/Type III test equipment.	0.0000
9	Name(9)	CCALP	Cost in dollars to procure a calibration/Type III test set.	0.0000
10	Name(10)	CCALR	Cost in dollars per year to support a calibration/Type III test set.	0.0000
11	Name(11)	CCSP	Cost in dollars to develop contact support/Type IV test sets.	0.0000
12	Name(12)	CCSPP	Cost in dollars to procure a contact support/Type IV test set.	0.0000
13	Name(13)	CCSPR	Cost in dollars per year to support a contact support/Type IV test set.	0.0000
14	Name(14)	CDDI	Shipping cost in dollars per pound per trip from the Depot to General Support Unit.	.3000
15	Name(15)	CDEO	Shipping cost in dollars per pound per trip from the Installation to the Direct Support Activity.	.0600
16	Name(16)	CDFD	Shipping cost in dollars per pound per one-way trip from a contractor to the government depot. (Applied to shipment of reprocured material.	.0600
17	Name(17)	CDID	Shipping cost in dollars per pound per trip from the General Support to Depot.	.3000
18	Name(18)	CDIO	Shipping cost in dollars per pound per trip from the General to the Direct Support.	.0600
19	Name(19)	CDIST	Cost in dollars per item per pounu to distribute initial provision of LRU's, modules and parts.	.0600
20	Name(20)	CDMAN	Cost in dollars per year for a test person at Direct Support.	23760
21	Name(21)	CDOE	Shipping cost in dollars per pound per trip from Direct Support to installation.	.0600
22	Name(22)	CDOI	Shipping cost in dollars per pound per trip from Direct to General Support.	.0600
23	Name(23)	CDPMAN	Cost in dollars per year for a test person at Depot.	74610
24	Name(24)	CDPRMN	Cost in dollars per year for a repairman at Depot.	74610
25	Name(25)	CDRMAN	Cost in dollars per year for a repairman at Direct Support.	25315
26	Name(26)	CEMAN	Cost in dollars per year for a test person at the Equipment level.	25315
27	Name(27)	CEN	Cost in dollars to enter a line item into the supply system.	1072.0
28	Name(28)	CEHD	Cost in dollars to develop an LRU.	0.0000
29	Name(29)	CERMAN	Cost in dollars per year for a repairman at the Equipment level.	25315
30	Name(30)	CFTD	Cost in dollars per square foot/month for floor space at Depot for test equipment.	2.0000
31	Name(31)	CGMAN	Cost in dollars per year for a test person at General Support.	25315
32	Name(32)	CGRMAN	Cost in dollars per year for a repairman at General Support.	25315
33	Name(33)	CI	Cost in dollars to develop Type I test equipment.	0.0000

Table 10 - NAMELIST Data Content Definition and Standard Values (Continued)

SENSY NO.	Basic Name	FORTRAN Name	Description	Input Value
34	Name(34)	CII	Cost in dollars to develop Type II test equipment.	0.0000
35	Name(35)	CKIT	Cost in dollars for a modification kit.	0.0000
36	Name(36)	CKMD	Safety stock coefficient for module stock at Depot.	.9000
37	Name(37)	CKME	Safety stock coefficient for module stock at equipment level.	.9000
38	Name(38)	CKMI	Safety stock coefficient for module stock at General Support.	.9000
39	Name(39)	CKMO	Safety stock coefficient for module stock at Direct Support.	.9000
40	Name(40)	CKPD	Safety stock coefficient for part stock at Depot.	.9000
41	Name(41)	CKPI	Safety stock coefficient for part stock at General Support.	.9000
42	Name(42)	CKPO	Safety stock coefficient for part stock at Direct Support.	.9000
43	Name(43)	CKUD	Safety stock coefficient for LRU stock at Depot.	.9000
44	Name(44)	CKUE	Safety stock coefficient for LRU stock at equipment level.	.9000
45	Name(45)	CKUI	Safety stock coefficient for LRU stock at General Support.	.9000
46	Name(46)	CKUO	Safety stock coefficient for LRU stock at Direct Support.	.9000
47	Name(47)	CLRUPG	Cost in dollars to program and provide technical data for Type I test equipment for LRU repair.	1200.0
48	Name(48)	CMODPG	Cost in dollars to program and provide technical data for Type I test equipment for module repair for each module type.	0.0000
49	Name(49)	CMP	Cost in dollars for spare or replacement module.	[redacted]
50	Name(50)	CONMAN	Cost in dollars per year/per person for the contact support team.	25315
51	Name(51)	CONTCT	Number of contact support sets and teams.	0.0000
52	Name(52)	CPE	Nonrecurring production cost in dollars for an LRU.	0.0000
53	Name(53)	CPI	Cost in dollars to procure a Type I test set.	250000
54	Name(54)	CPII	Cost in dollars to procure a Type II test equipment.	0.0000
55	Name(55)	CPP	Average cost in dollars for a spare or replacement part.	0.0000
56	Name(56)	CPUBII	Cost in dollars to program and provide technical data for Type II test equipment.	0.0000
57	Name(57)	CPUBV	Cost in dollars for technical data for Type V test equipment.	0.0000
58	Name(58)	CPV	Procurement cost in dollars for Type V test equipment.	0.0000
59	Name(59)	CRI	Cost in dollars per year for materials to support a Type I test station.	600.00
60	Name(60)	CRII	Cost in dollars per year for material to support a Type II test station.	0.0000
61	Name(61)	CRM	Cost in dollars per module reorder action.	909.00
62	Name(62)	CRP	Cost in dollars per part reorder action.	909.00
63	Name(63)	CRU	Cost in dollars per LRU reorder action.	909.00
64	Name(64)	CRV	Yearly cost in dollars to set up training programs for Type V test set.	0.0000
65	Name(65)	CSDKP	Cost in dollars per cubic foot per month for material storage at Depot.	2.0900
66	Name(66)	CSDSU	Cost in dollars per cubic foot per month for material storage at Direct Support.	.2500
67	Name(67)	CSFSU	Cost in dollars per cubic foot per month for material storage at Equipment level.	4.0000
68	Name(68)	CSGSU	Cost in dollars per cubic foot per month for material storage at General Support.	.2500
69	Name(69)	CTCPUB	Cost in dollars to program and provide technical data for contract support/Type IV test equipment.	0.0000
70	Name(70)	CTRA	Cost in dollars to train one person for field maintenance.	[illegible]
71	Name(71)	CTRAD	Cost in dollars to train one person for Depot maintenance.	[illegible]
72	Name(72)	CTRCAL	Nonrecurring cost in dollars to set up training program for calibration Type III test equipment teams.	0.0000

Table 10 - NAMELIST Data Content Definition and Standard Values (Continued)

SENSY NO.	Basic Name	FORTRAN Name	Description	Input Value
73	Name(73)	CTRI	Nonrecurring cost in dollars to set up training program for Type I test equipment.	0.0000
74	Name(74)	CTRII	Nonrecurring cost in dollars to set up training program for Type II test equipment.	0.0000
75	Name(75)	CTRSPT	Nonrecurring cost in dollars to set up training program for contact support in Type IV test equipment.	0.0000
76	Name(76)	CTRV	Nonrecurring cost in dollars to set up training pronram for Type V test equipment.	0.0000
77	Name(77)	CUBEM	Storage volume in cubic feet for a module.	[redacted]
78	Name(78)	CUBEP	Storage volume in cubic feet for a part.	0.1000
79	Name(79)	CUBEU	Storage volume in cubic feet for a LRU.	[redacted]
80	Name(80)	CUCE	Cost in dollars per year for equipment level manpower to provide preventive/ scheduled maintenance.	43736
81	Name(81)	CUP	Cost in dollars for the LRU under analysis (deployment, replacement, and provision LRUs).	[redacted]
82	Name(82)	CV	Development cost in dollars for Type V test equipment.	0.0000
83	Name(83)	DAOOL	Fraction of Depot workload that is good when delivered to the field stockage point. 1 - DAOOL is recycled.	.9500
84	Name(84)	DD	Number of Depot level maintenance locations.	1.0000
85	Name(85)	DDS	Number of Depot level support points.	1.0000
86	Name(86)	DI	Number of General Support maintenance locations.	1.0000
87	Name(87)	DIS	Number of General Support supply points.	1.0000
88	Name(88)	DTE	Pipeline in days for delays in handling repairable LRUs or modules being shipped rearward from the equipment level.	14.00
89	Name(89)	DTI	Pipeline in days for delays in handling repairable LRUs or modules being shipped rearward from the General Support.	0.0000
90	Name(90)	DTO	Pipeline in days for delays in handling repairable LRUs or modules being shipped rearward from Direct Support.	14.00
91	Name(91)	E	Failure rate per operational hour.	[redacted]
92	Name(92)	EACAL	Controls posting out one time costs for calibration/Type III test channels including manpower. If NO posting is desired, EACAL = 0. If posting is desired, EACAL = 1.	0.0000
93	Name(93)	EACSP	Controls posting out one time costs for contact support/Type IV test equipment and manpower. If NO posting is desired, EACSP = 0. If posting is desired, EACSP = 1.	0.0000
94	Name(94)	ED	Number of deployment installations.	64.00
95	Name(95)	EDS	Number of equipment level supply points.	3.0000
96	Name(96)	EE	The number of material systems (LRUs) at each deployment installation.	1.0000
97	Name(97)	EREI	Expected value flag for tests and repair men on major items at the equipment level.	1.0000
98	Name(98)	ETE	Controls posting out of accumulated work demands for men and Type V test equipment. If NO posting is desired, ETE = 0. If posting is desired, ETE = 1.	1.0000
99	Name(99)	ETEI	Expected value flag for Type V test equipment on major items at equipment level.	1.0000
100	Name(100)	ETI	Controls posting out of accumulated work demands at service channels of TYPE I test equipment & their associated repair positions. If NO posting is desired, ETI = 0. If posting is desired, ETI = 1.	1.0000
101	Name(101)	ETII	Controls posting out of accumulated work demand, at service channels at Depot of Type II test equipment. If NO posting is desired, ETII = 0. If posting is desired, ETII = 1.	1.0000

Table 10 - NAMELIST Data Content Definition and Standard Values (Continued)

SENSY NO.	Basic Name	FORTRAN Name	Description	Input Value
102	Name(102)	EVDM	Expected value flag for test manpower at Depot	1.0000
103	Name(103)	EVDR	Expected value flag for repair manpower at Depot	1.0000
104	Name(104)	EVDT	Expected value flag for test equipment at Depot	1.0000
105	Name(105)	EVEM	Expected value flag for test manpower at equipment level.	1.0000
106	Name(106)	EVER	Expected value flag for repair manpower at equipment level.	1.0000
107	Name(107)	EVET	Expected value flag for test equipment at equipment level.	1.0000
108	Name(108)	EVIM	Expected value flag for test manpower at General Support.	1.0000
109	Name(109)	EVIR	Expected value flag for repair manpower at General Support.	1.0000
110	Name(110)	EVIT	Expected value flag for test equipment at General Support.	1.0000
111	Name(111)	EVOM	Expected value flag for test manpower at Direct Support.	1.0000
112	Name(112)	EVOR	Expected value flag for repair manpower at Direct Support.	1.0000
113	Name(113)	EVOT	Expected value flag for test equipment at Direct Support.	1.0000
114	Name(114)	FE	The fraction of Type V test equipment manpower added for self support.	0.0000
115	Name(115)	FI	The fraction of Type I test equipment manpower demand that is added for self-support.	.0000
116	Name(116)	FII	Fraction of Type II test equipment manpower demand that is added for self-support.	.0000
117	Name(117)	FINT	Yearly interest rate. Used in the computation of present worth. It is the net rate between discount rate & inflation rate. If inflation exceeds discount FINTS < 0. Zero input gives net cost without discount.	0.0000
118	Name(118)	FLM	Factor of the calibration and contact support test equipment maintenance support costs for civilian maintenance labor.	1.0000
119	Name(119)	FMD	Fraction of modules that arrive at Depot that are repaired. Modules not repaired are scrapped.	1.0000
120	Name(120)	FMI	Module repair fraction at General Support.	1.0000
121	Name(121)	FMO	Module repair fraction at Direct Support.	1.0000
122	Name(122)	FN	Number of identical LRU's within a system whose failure does not detract from system availability. Used to model effects of equipment redundancy within the system.	0.0000
123	Name(123)	FNGF	Number to specify the ratio of false 'no go' LRU demands to true failures.	1.5000
124	Name(124)	FNSP	Nonstandard part fraction related to the cost for supply administration.	.2000
125	Name(125)	FSA	Field supply administration cost. Dollars per year per line item type per field supply location.	160.00
126	Name(126)	FTI	Number of square feet of space required at Depot for Type I test equipment.	150.00
127	Name(127)	FTII	Number of square feet of space required at Depot for Type II test equipment.	0.0000
128	Name(128)	FTM	Time factor in weeks used in the computation of Module stock at Depot. FTM is the fixed time cycle associated with module reprocurement. Typically, this is the factory start-up time between placement of an order and delivery of the first module.	10.00
129	Name(129)	FTP	Time factor in weeks used in the computation of parts stock at Depot. FTP is the fixed time cycle associated with parts reprocurement. Typically, this is the factory start-up time between placement of an order and delivery of the first part.	0.0000

Table 10 - NAMELIST Data Content Definition and Standard Values (Continued)

SENSY NO.	Basic Name	FORTRAN Name	Description	Input Value
130	Name(130)	FTU	Time factor in weeks used in the computation of LRU stock at Depot. FTP is the fixed time cycle associated with parts reprocurement. Typically, this is the factory start-up time between placement of an order and delivery of the first LFU.	10.00
131	Name(131)	FUD	LRU repair fraction at Depot.	1.0000
132	Name(132)	FUE	LRU repair fraction at equipment level.	1.0000
133	Name(133)	FUI	LRU repair fraction at General Support.	1.0000
134	Name(134)	FUO	LRU repair fraction at Direct Support.	1.0000
135	Name(135)	G(1)	GA-Specifies a policy of discard at failure. There are no maintenance support activities. All failures, false 'no go' indications, and attrition rate inputs result in LRU discard. Only LRU's are stocked in the supply system. There is no demand for modules or parts.	0.0000
136	Name(136)	G(2)	GB-Similar to GA but here is a provision to detect false 'no go's' at Direct Support and only failed and attrited LRU's are discarded. There is no demand for module or part stock. There is a demand for checkout service at Direct Support and the algebra uses Type I test equipment input data for this.	0.0000
137	Name(137)	G(3)	GC-Specifies LRU repair at equipment level by removing & replacing a defective module. The defective module is discarded.	0.0000
138	Name(138)	G(4)	GD-Specifies LRU repair at Direct Support by removing & replacing a defective module. The defective module is discarded.	0.0000
139	Name(139)	G(5)	GE-Specifies LRU repair at General Support by removing & replacing a defective module. The defective module is discarded.	0.0000
140	Name(140)	G(6)	GF-Specifies LRU repair at General Support with checkout performed at Direct Support to remove false 'no go' LRU's before sending the work to General Support. LRU repair is by removal & replacement of a defective module & the defective module is discarded.	0.0000
141	Name(141)	G(7)	GG-Specifies LRU repair at Depot. Defective modules are discarded.	1.0000
142	Name(142)	G(8)	GH-Specifies LRU repair at Depot preceded by a checkout at Direct Support to screen false 'no go's '. Defective modules are discarded.	0.[illegible]
143	Name(143)	G(9)	GI-Specifies LRU repair at equipment level & module repair at Direct Support.	0.0000
144	Name(144)	G(10)	GJ-Specifies LRU repair at equipment level & module repair at General Support.	0.0000
145	Name(145)	G(11)	GK-Specifies LRU repair at equipment level & module repair at Depot.	0.0000
146	Name(146)	G(12)	GL-Specifies LRU and module repair at Direct Support.	0.0000
147	Name(147)	G(13)	GM-Specifies LRU repair at Direct Support & module repair at General Support.	0.0000
148	Name(148)	G(14)	GN-Specifies LRU repair at Direct Support & module repair at Depot.	[illegible]
149	Name(149)	G(15)	GO-Specifies checkout to catch false 'no go's' at Direct Support followed by LRU and module repair at General Support.	0.0000
150	Name(150)	G(16)	GP-Specifies checkout to catch false 'no go's' at Direct Support followed by LRU repair at General Support & module repair at Depot.	0.0000
151	Name(151)	G(17)	GQ-Specifies LRU checkout at catch false 'no go's' at Direct Support followed followed by LRU & module repair at Depot.	0.0000
152	Name(152)	G(18)	GK-Specifies LRU & module repair at General Support.	0.0000
153	Name(153)	G(19)	GS-Specifies LRU repair at General Support & module repair at Depot.	0.0000
154	Name(154)	G(20)	GT-Specifies LRU & module repair at Depot.	0.0000

Table 16 - NAMELIST Data Content Definition and Standard Values (Continued)

SENSY NO.	Basic Name	FORTRAN Name	Description	Input Value
155	Name(155)	H(1)	Stock authorization flag at organization.	1.0000
156	Name(156)	H(2)	Stock authorization flag at Direct Support.	0.0000
157	Name(157)	H(3)	Stock authorization flag at General Support.	0.0000
158	Name(158)	H(4)	Stock authorization flag at Depot.	1.0000
159	Name(159)	HPM	Discretionary procurement holding time in days for modules.	1.0000
160	Name(160)	HPP	Discretionary procurement holding time in days for parts.	1.0000
161	Name(161)	HPU	Discretionary procurement holding time in days for LRU's.	1.0000
162	Name(162)	IBG	A debuggung FLAG, which when set to 1, causes the printout of the current values of internal variables.	0.0000
163	Name(163)	IFLAG	Flag for summarizing individual LRU cases between distinct groups of LRU cases. Used generally for summing outputs of identical LRU cases that are common in two or more theaters. 1 - Suppresses the summarization. 0 - Summarizes & prints the results.	1.0000
164	Name(164)	IMF	Selects the file number on tape or disc that contains data sorted by MOS for maintenance support positions. The data read by selecting IMF is sorted from the AR570-2 MACRIT data base. IMF is used in conjunction with OPER to build the TOE tables for personnel related costs.	0.0000
165	Name(165)	INHIB	An integer to control the printout of individual LRU output. Only the numbers 0 & 1 are permitted. INHIB = 0 prints the LRU output page. INHIB = 1 inhibits the printout of LRU output.	0.0000
166	Name(166)	IO	An integer to control the printout of the input NAMELIST data. IO = 0 Inhibits NAMELIST printout. IO > 0 Entire sequence of input data for all LRU's printed out in alphabetical order.	0.0000
167	Name(167)	IOPER	Selects the option to add TOE operational costs to the LOGAM output. IOPER = 1 Initiates the subroutine to compute the Operation and Support costs derived from a typical TOE structure. The O&S costs computed conform to DA PAM 11-4.	0.0000
168	Name(168)	IS	An integer to control reset functions for maintenance concept fractions, case total accumulators, availability accumulators, workload accumulators, and recall of saved input values. IS = 0 This is the default value and should be the value used on the first pass through LOGAM. With this value the accumulator arrays are initialized without going through the recall logic to store the input data array (SAV). If the recall array is used on the first pass the default values from BLKDAT will be erased. IS = 1 Anticipatory control for the next LRU. All inputs used for an LRU case where NB=0 are recalled for use with the next LRU. Any values input for the next case will modify the recalled values. Availability and workload accumulators and case total accumulators are also reset. IS is automatically reset to 1 by the program if the user requests grand total outputs with NU<-1.	0.0000

Table 1[illegible] - NAMELIST Data Content Definition and Standard Values (Continued)

SENSY NO.	Basic Name	FORTRAN Name	Description	Input Value
			IS<> 2 Resets maintenance concept (G) fractions to zero. IS = 2 Retains maintenance concept (G) fraction from one LRU to the next. IS = 3 Neutralizes all reset actions. It is automatically set to 3 after a pass through the initialization section of LOGAM. This assures that the accumulators will not be reset until the user inputs IS=1 or HU<-1	
169	Name(169)	JTED	An integer control used to designate the type and location of test equipment. JTED = 1 Permits location of Type I test equipment at the Direct Support, General Support, and Depot sites. JTED = 2 Permits location of type I test equipment as in JTED = 1 except only Type II test equipment is at the Depot.	1.0000
170	Name(170)	HA	An integer to control the number of system availability modes to be tallied for the case being run.	1.0000
171	Name(171)	HB	An integer to control initialization of default values.	0.0000
172	Name(172)	HU	An integer to control printout of case totals and grand totals pages, reset the grand total accumulators and provide the means for a positive porogram stop. HU=or> 0 Suppresses print of totals page. HU = -1 Prints the case totals page. This value may be used at any time to examine the contents of the total accumulators. The printout of the case totals page is not accompanied by any change in the accumulators or any other program variable. HU = -2 Prints the case totals page as for HU = -1 and also prints a grand totals page following the case totals page. Reset of the case total accumulators is accomplished by the control IS. IS=1 is automatically set when HU<-1 to reset the case total accumulators after printout of the case totals pages. HU = -3 Provides the same function as HU = -2, i.e., it prints out both the case total and the grand total pages. Additionally, it resets the grand total accumulators. HU = -4 Provides a positive program stop; used in combination with a dummy REMARK card and a dummy UNITS card followed by a NAMELIST card with HU = -4.	0.0000
173	Name(173)	OD	Number of Direct Support maintenance locations.	3.0000
174	Name(174)	ODS	Number of Direct Support supply or stock transfer points.	3.0000
175	Name(175)	OL(1)	The operating level of supply in days for consumables at Organization supply points.	0.0000
176	Name(176)	OL(2)	The operating level of supply in days for consumables at Direct supply points.	30.00
177	Name(177)	OL(3)	The operating level of supply in days for consumables at General supply points.	30.00
178	Name(178)	OL(4)	The operating level of supply in days for consumables at Depot supply points.	90.00

Table 10 - NAMELIST Data Content Definition and Standard Values (Continued)

SENSY NO.	Basic Name	FORTRAN Name	Description	Input Value
179	Name(179)	OST(1)	The order & ship time in days for Organization supply points.	30.00
180	Name(180)	OST(2)	The order & ship time in days for Direct supply points.	0.0000
181	Name(181)	OST(3)	The order & ship time in days for General supply points.	0.0000
182	Name(182)	OST(4)	The order & ship time in days for Depot supply points.	180.00
183	Name(183)	OTF	The fraction of real time that deployed equipment operates.	.2373
184	Name(184)	P	Number of module types per LRU used to cost supply administration.	[redacted]
185	Name(185)	PMR	Production rate for modules. This input, PRU and PPR are overridden by the program if the rates are insufficient to meet the demand.	0.0000
186	Name(186)	PP	Number of part types per LRU used to cost supply administration.	0.0000
187	Name(187)	PPR	Production rate for parts. Refer to PMR description.	0.0000
188	Name(188)	PUR	Production rate for LRUs. Refer to PMR description.	0.0000
189	Name(189)	QMM	The minimum reorder quantity for modules.	1.0000
190	Name(190)	QMP	The minimum reorder quantity for parts.	1.0000
191	Name(191)	QMU	The minimum reorder quantity for LRUs.	1.0000
192	Name(192)	QTD	Total Depot level LRU stock quantity for all DDS locations.	0.0000
193	Name(193)	QTE	Total organization level LRU stock quantity for all EDS locations.	0.0000
194	Name(194)	QTI	Total General Support level LRU stock quantity for all DIS locations.	0.0000
195	Name(195)	QTMD	Total Depot level module stock quantity for all DDS locations.	0.0000
196	Name(196)	QTME	Total Organizational level module stock quantity for all EDS stock locations.	0.0000
197	Name(197)	QTMI	Total General Support level module stock quantity for all DIS locations	0.0000
198	Name(198)	QTMO	Total Direct Support level module stock quantity for all ODS locations.	0.0000
199	Name(199)	QTO	Total Direct Support level LRU stock quantity for all CDS locations.	0.0000
200	Name(200)	QTPD	Total Depot level part stock quantity for all DDS locations	0.0000
201	Name(201)	QTPI	Total General Support level part stock quantity for all DIS locations	0.0000
202	Name(202)	QTPO	Total Direct Support level part stock quantity for all ODS locations.	0.0000
203	Name(203)	RDD	Delay time in days between request for an LRU at a maintenance Depot and handling of the request by the supply point. Used in the computation of availability in reckoning down-time at the Depot.	5.0000
204	Name(204)	REO	REO is similar to ROI but in this instance, it sets the days of supply at the equipment level for condemned modules.	1.0000
205	Name(205)	REPEAT	Number of LRU types in a material system (EE). These are LRUs that are similar in their failure rates and maintenance concepts but because of their type difference they impact the cost of supply administration.	1.0000
206	Name(206)	RF	The fraction of TRC that is devoted to LRU remove and replace time excluding fault isolate and retest time.	.9000
207	Name(207)	RID	When using LOGAM supply rules, RID is input in days and is a specification use to distinguish between the supply allowance for condemned modules and parts and the number of days of supply for LRUs and for repaired modules at the General Support level. Within the program, RID is summed with the input TDI to form the term RIDT which sets the days of supply at	0.0000

Table 1[illegible] - NAMELIST Data Content Definition and Standard Values (Continued)

SENSY NO.	Basic Name	FORTRAN Name	Description	Input Value
			General Support for condemned modules and parts.	
208	Name(208)	ROI	Like RID, ROI is a specification used to distinguish between the supply allowance for condemned module and parts and the number of days of supply for LRUs and for repaired modules at the Direct Support level. Within the program, ROI is summed with the input TIO to form the term ROIT. ROIT sets the days of supply at Direct Support for condemned modules and parts.	0.0000
209	Name(209)	SL(1)	The safety level days of supply for consumables at Organization supply points.	0.0000
210	Name(210)	SL(2)	The safety level days of supply for consumables at Direct supply points.	15.00
211	Name(211)	SL(3)	The safety level days of supply for consumables at General supply points.	15.00
212	Name(212)	SL(4)	The safety level days of supply for consumables at Depot supply points.	30.00
213	Name(213)	SMD	Module scrap fraction at Depot.	1.0000
214	Name(214)	SME	Module scrap fraction at Organization level	0.0000
215	Name(215)	SMF	Scheduled maintenance fraction (CUCE definition).	0.0000
216	Name(216)	SMI	Module scrap fraction at General Support.	0.0000
217	Name(217)	SMO	Module scrap fraction at Direct Support.	0.0000
218	Name(218)	SPE	Fraction for controlling the sunk portion of the prime equipment cost. Any fraction may be used for SPE, SPEV, & SPEVR. SPE = 0 charges zero (sinks) the cost of the deployed prime equipment. SPE = 1 charges full cost for deployed equipment.	0.0000
219	Name(219)	SPEV	Factor to control sinking of cost of the initial provision. SPEV = 0 no cost for the initial allowance. SPEV = 1 charges full cost.	1.0000
220	Name(220)	SPEVR	Factor to sink costs for reordered material SPEVR = 0 charges zero cost. SPEVR = 1 charges full cost.	1.0000
221	Name(221)	STAT	The depot pipe in days between the depot and the rear-most facility shipping LRUs and modules to the depot.	45.00
222	Name(222)	SUD	LRU scrap fraction at Depot.	.0500
223	Name(223)	SUE	LRU scrap fraction at equipment level.	0.0000
224	Name(224)	SUI	LRU scrap fraction at General Support level.	0.0000
225	Name(225)	SUO	LRU scrap fraction at the Direct Support level.	0.0000
226	Name(226)	SVE	Salvage fraction for cost of installed LRUs at the end of the life of the program.	0.0000
227	Name(227)	SVR	Salvage fraction of the cost for consumed material.	0.0000
228	Name(228)	SVT	Salvage fraction of the cost for test equipment.	0.0000
229	Name(229)	SVV	Salvage fraction of the cost for residual inventory.	0.0000
230	Name(230)	TALMAN	Number of test men per calibration crew.	2.0000
231	Name(231)	TAT(1)	Maintenance turn-around time in days at the Organization maintenance support level.	1.0000
232	Name(232)	TAT(2)	Maintenance turn-around time in days at the Direct maintenance support level.	4.0000
233	Name(233)	TAT(3)	Maintenance turn-around time in days at the General maintenance support level.	0.0000
234	Name(234)	TAT(4)	Maintenance turn-around time in days at the Depot support level.	90.00
235	Name(235)	TATE	The number of days required for stock to be obtained at the equipment level.	4.0000

Table 10 - NAMELIST Data Content Definition and Standard Values (Continued)

SENSY NO.	Basic Name	FORTRAN Name	Description	Input Value
236	Name(236)	TAYZ(1)	The availability accumulator for the aggregate number of LRU's. Enter a one to output this availability. If the output is not desired, enter a zero.	1.0000
237	Name(237)	TAYZ(2)	The availability accumulator for the first subsystem grouping of LRU's. If the output is desired enter a one, otherwise enter a zero.	1.0000
238	Name(238)	TAYZ(3)	The availability accumulator for the second subsystem grouping of LRU's. If the output is desired enter a one, otherwise enter a zero.	1.0000
239	Name(239)	TAYZ(4)	The availability accumulator for the third subsystem grouping of LRU's. If the output is desired enter a one, otherwise enter a zero.	1.0000
240	Name(240)	TAYZ(5)	The availability accumulator for the fourth subsystem grouping of LRU's. If the output is desired enter a one, otherwise enter a zero.	1.0000
241	Name(241)	TAYZ(6)	The availability accumulator for the fifth subsystem grouping of LRU's. If the output is desired enter a one, otherwise enter a zero.	1.0000
242	Name(242)	TAYZ(7)	The availability accumulator for the sixth subsystem grouping of LRU's. If the output is desired enter a one, otherwise enter a zero.	1.0000
243	Name(243)	TAYZ(8)	The availability accumulator for the seventh subsystem grouping of LRU's. If the output is desired enter a one, otherwise enter a zero.	1.0000
244	Name(244)	TAYZ(9)	The availability accumulator for the eighth subsystem grouping of LRU's. If the output is desired enter a one, otherwise enter a zero.	1.0000
245	Name(245)	TAYZ(10	The availability accumulator for the nineth subsystem grouping of LRU's. If the output is desired enter a one, otherwise enter a zero.	1.0000
246	Name(246)	TC	Mean test time in hours to checkout an LRU at any level for detection of false no go LRUs. Used to compute demand for test manpower.	.5000
247	Name(247)	TD	Mean test time in hours to checkout an LRU at any level for detection of false 'no go' LRU's. Used to compute demand for test manpower.	.5000
248	Name(248)	TDI	Sums with TID to form variable TIDT which sets the number of days of supply for LRUs and for repaired modules at the General Support level. If [illegible] f LRUs is not designated at General Support, then TIDT sums with TEOT and TOIT in computing down-time in the availability calculations (RID).	15.00
249	Name(249)	TDMAN	Manpower productivity factor or number of men per test crew at Direct Support.	0.0000
250	Name(250)	TDMW	The mean time in hours spent in the test position at Depot per test sequence. The program assumes that this time will be spent twice. Once before modification is made and once after the modification. This is also true for TIMW and TOMW.	.5000

SENSY NO.	Basic Name	FORTRAN Name	Description	Input Value
251	Name(251)	TDPMI	Manpower productivity factor or number of men per test equipment crew at Depot (for Type I test equipment.	.9000
252	Name(252)	TDPMII	Manpower productivity factor or number of men per repair crew at Depot (for Type II test equipment.)	0.0000
253	Name(253)	TDPRI	Manpower productivity factor or the number of men per repair crew at Depot for Type I test equipment.	.9000
254	Name(254)	TDPRII	Manpower productivity factor or the number of men per repair crew at Depot for Type II test equipment.	0.0000
255	Name(255)	TDR	Repair time in hours to repair an LRU. Used to compute demand at Depot.	1.5000
256	Name(256)	TDRMAN	Manpower productivity factor or number of men per repair crew at Direct Support.	0.0000
257	Name(257)	TE	Test time in hours for an LRU at equipment level. Used to compute the demand for test manpower.	.5000
258	Name(258)	TEMAN	Manpower productivity factor or number of men per test crew at equipment level.	1.0000
259	Name(259)	TENMAN	The men applied to MTTR effort at equipment level. This is a multiplier of the number of eight hour shifts needed to perform the work	1.0000
260	Name(260)	TEO	Pipelength in hours between equipment level and Direct Support when using LOGAM Supply Rules or expedited time for obtaining a spare when using LOGAM Maintenance Rules (definition of OL).	0.0000
261	Name(261)	TER	Repair time in manhours for an LRU at equipment level. Used to compute the demand for repair manpower.	0.0000
262	Name(262)	TERMAN	manpower productivity factor or number of repairman per repair crew at equipment level.	2.0000
263	Name(263)	TF	mean time in hours to test and LRU at Direct Support. It is the total time per service action in the test position and it is used to set the demand for test equipment and for test equipment men.	0.0000
264	Name(264)	TFR	Repair time in hours for an LRU at Direct Support. Used to compute demand for reapir manpower.	0.0000
265	Name(265)	TGMAN	Manpower productivity factor or number of men per test crew at General Support.	2.0000
266	Name(266)	TGRMAN	Manpower productivity factor or number of repairmen per repair crew at General Support	2.0000
267	Name(267)	TI	Test time in hours for an LRU at General Support. Used to compute demand for test manpower	0.0000
268	Name(268)	TID	Sums with TDI to form variable TIDT which sets the number of days of supply for LRUs and for repaired modules at the General Support level. If stock or LRUs is not designated at General Support, then TIDT sums with TEOT and TOIT in computing down-time in the availability calculations (RID).	0.0000
269	Name(269)	TIMW	The mean time in hours spent in the test position at General Support per test sequence. The program assumes that this time will be spent twice: once before a modification and ance after the modification.	0.0000
270	Name(270)	TIO	Sums with TOI to make the variable TOIT. TOIT states the number of days of supply at Direct Support for LRUs (repaired or condemned) and modules which will be repaired. If LRU stock is not designated at Direct, then TOIT also adds additional down-time to TEOT in the computation of availability (ROI).	0.0000

Table 18 - NAMELIST Data Content Definition and Standard Values (Continued)

SENSY NO.	Basic Name	FORTRAN Name	Description	Input Value
271	Name(271)	TIR	Repair time in hours of an LRU at General Support. Used to compute demand for repair manpower.	0.0000
272	Name(272)	TMD	Test time in hours for module checkout at Depot. Used to compute demand for test manpower.	.2500
273	Name(273)	TMDD	The time in hours for modification kit installation per repair crew at Depot.	0.0000
274	Name(274)	TMDR	Repair time in hours for a module at Depot. Used to compute demand for repair manpower.	0.0000
275	Name(275)	TMI	Mean test in hours for module checkout at General Support. Used to compute demand for test manpower.	0.0000
276	Name(276)	TMID	The time in hours for modification kit installation per repair crew at General Support.	0.0000
277	Name(277)	TMIR	Repair time in hours for a module at General Support. Used to compute demand for repair manpower.	0.0000
278	Name(278)	TMO	Mean test time in hours for module checkout at Direct Support. Used to compute demand for test manpower.	0.0000
279	Name(279)	TMOD	The time in hours for modification kit installation per repair crew at Direct Support.	0.0000
280	Name(280)	TMOR	Repair time in hours for a module at Direct Support. Used to compute demand for repair manpower.	0.0000
281	Name(281)	TOE	Pipelength in hours between Direct Support and equipment level when using LOGAM Supply Rules used with TOE.	0.0000
282	Name(282)	TOI	Sums with TIO to make the variable TOIT, TOIT states the number of days of supply at Direct Support for LRUs (repaired or condemned) and modules which will be repaired. If LRU stock is not designated at Direct, then TOIT also adds down-time to TECT in the computation of availability (ROI).	0.0000
283	Name(283)	TOMH	The mean time in hours spent in the test position at Direct Support per test sequence. The program assumes that this time will be spent twice: once before the modification is installed and once after the modification is installed.	0.0000
284	Name(284)	TONMAN	Number of men per contact support crew (Type IV test equipment).	2.0000
285	Name(285)	TRC	Down-time in hours per service demand at equipment level (equivalent to MTTR).	[redacted]
286	Name(286)	TUMD	Used in concepts GN, GP, GQ, GS, and GT which call for LRU and module repair at Depot. TUMD sets the supply allowance in hours for moduels at Depot to cover the time between removal of a module from an LRU until the module is repaired and returned to service for servicing further LRUs.	84.00
287	Name(287)	TUMI	used in concepts GM, GO, and GR which call for LRU and module repair at General Support. TUMI sets the supply allowance in hours for modules at General Support to cover the time between removal of a module from an LRU until the module is repaired and returned to service for servicing further LRUs.	84.00
288	Name(288)	TUMO	Used for maintenance concepts LG where both LRU and module repairs are performed at Direct Support. TUMO sets the supply allowance in hours for modules at Direct Support to cover the time between removal of a module from an LRU until the module is repaired and returned to service for servicing further LRUs.	84.00
289	Name(289)	WD	The scheduled work week in hours for test equipment at Depot.	40.00

Table 18 - NAMELIST Data Content Definition and Standard Values (Continued)

SENSY NO.	Basic Name	FORTRAN Name	Description	Input Value
290	Name(290)	WDM	The scheduled work week in hours for test crews at Depot.	40.00
291	Name(291)	WDR	The scheduled work week in hours for repair crews at Depot.	40.00
292	Name(292)	WE	Scheduled work week in hours for test equipment at Organization.	44.00
293	Name(293)	WEM	Scheduled work week in hours for test crews at Organization.	44.00
294	Name(294)	WER	Scheduled work week in hours for repair crews at Organization.	44.00
295	Name(295)	WI	The scheduled work week in hours for test equipment at General Support.	44.00
296	Name(296)	WIM	The scheduled work week in hours for test crews at General Support.	44.00
297	Name(297)	WIR	The scheduled work week in hours for repair crews at General Support.	44.00
298	Name(298)	WM	The shipping weight in pounds of a module.	[redacted]
299	Name(299)	WMR	The work week in hours for repair men performing TRC work on major items.	44.00
300	Name(300)	WMT	The work week in hours for Type V test equipment.	44.00
301	Name(301)	WO	The scheduled work week in hours for test equipment at Direct Support.	44.00
302	Name(302)	WOM	The scheduled work week in hours for test crews at Direct Support.	44.00
303	Name(303)	WOR	The scheduled work week in hours for repair crews at Direct Support.	44.00
304	Name(304)	WP	The shipping weight in pounds of a part.	0.0000
305	Name(305)	WTKIT	The shipping weight in pounds of mod kit.	0.0000
306	Name(306)	WU	The shipping weight in pounds of an LRU.	[redacted]
307	Name(307)	YAT	The annual attrition fraction for LRUs. It represents an annual demand for reissue and reprocurement to replace attrited LRUs. It operates on the population of installed LRUs to determine the number to be replaced each year. Within the program YAT is converted to 'A', an hourly attrition rate. 'A', in turn, is multiplied by OTF to get the real time rate.	0.0000
308	Name(308)	YD	The length of the development phase of the program in years. It is only used in computing present value of costs incurred during a development phase (definition for FINT).	0.0000
309	Name(309)	YMWO	The number of MWOs per year per LRU. YMWO is input as a percent per year of MWOs expected to be performed in the life cycle, i.e., if two MWOs are expected in a life cycle of 10 years, YMWO = 0.2.	0.0000
310	Name(310)	YP	The length of the production or acquisition phase in years. It is used in computing the present value of costs incurred during the production phase. It is also used in estimating the initial production rate which is used as a reference rate in the main program in the computation of reorder buy quantities.	1.0000
311	Name(311)	YR	The duration of the operation and maintenance portion of the program in years. Many of the cost computations for support are directly proportional to this input. It is also used in computing present value of operation and maintenance expenditures.	10.00
312	Name(312)	YZ	Input in the dimension of years and may be positive or negative. It is used in the computation of present value of costs to change the zero point of reference at which present value is started. The program treats YD, YP, and YR as consecutive non-overlapping time intervals. Nominally, present value is computed for the end of the production phase and the start of the operation and maintenance phase. YZ shifts this point by as many years ahead of or after it.	0.0000

Table 10 - NAMELIST Data Content Definition and Standard Values (Continued)

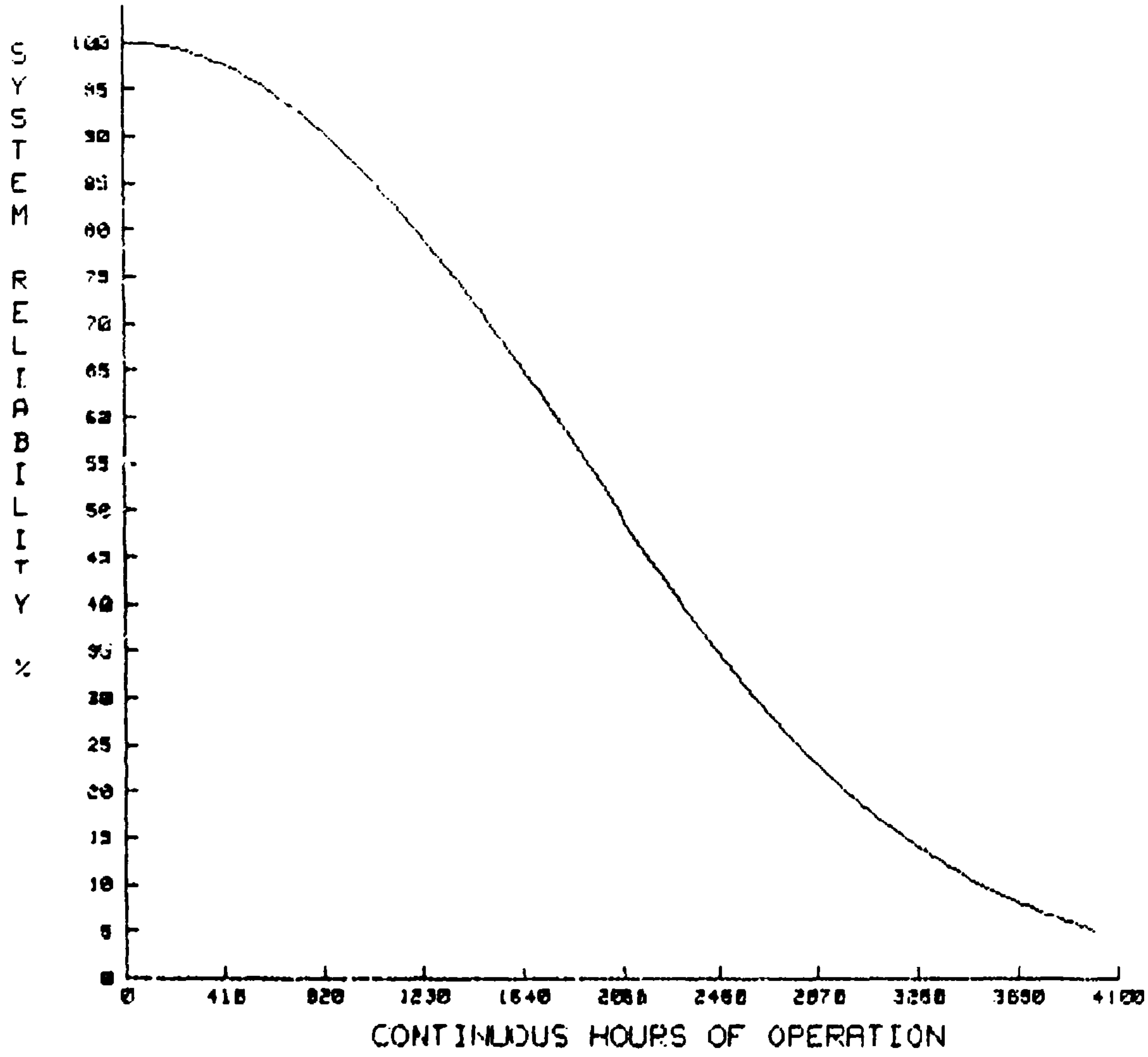
SENSY NO.	Basic Name	FORTRAN Name	Description	Input Value
			Thus, if YZ equals the negative of YP, then present value is stated at the start of the production phase. If YZ is positive, it moves the point so many years into the O&M period from it start. Shifting YZ from LRU to LRU in the input sequence of LRUs being analyzed and using sunk cost input controls can accomplish, at present value, a time phasing of program cost totals.	
313	Name(313)	ZFL	Round-off rule used in computing service channel quantities when integer round-off is invoked.	1.0000
314	Name(314)	ZI	Fraction of MWOs installed at General Support.	.9999
315	Name(315)	ZM(1)	The round-off fractions for modules at Equipment supply points.[ZFL].	.9999
316	Name(316)	ZM(2)	The round-off fractions for modules at Direct supply points.[ZFL].	.9999
317	Name(317)	ZM(3)	The round-off fractions for modules at General supply points.[ZFL].	.9999
318	Name(318)	ZM(4)	The round-off fractions for modules at Depot supply points.[ZFL].	.9999
319	Name(319)	ZO	Fraction of MWOs installed at Direct Support.	0.0000
320	Name(320)	ZP(1)	The round-off fractions for parts at at Direct supply points.[ZFL].	.9999
321	Name(321)	ZP(2)	The round-off fractions for parts at at General supply points.[ZFL].	.9999
322	Name(322)	ZP(3)	The round-off fractions for parts at at Depot supply points.[ZFL].	.9999
323	Name(323)	ZU(1)	The round-off fractions for LRU's at at Equipment supply points.[ZFL].	.9999
324	Name(324)	ZU(2)	The round-off fractions for LRU's at at Direct supply points.[ZFL].	.9999
325	Name(325)	ZU(3)	The round-off fractions for LRU's at at General supply points.[ZFL].	.9999
326	Name(326)	ZU(4)	The round-off fractions for LRU's at at Depot supply points.[ZFL].	.9999
327	Name(327)	SENSY	An array dimensioned by 266 orgainzed in the NAMELIST/L/ format to conduct sensitivity runs. Refer to section 3.3 for a description of sensitivity analysis.	0.0000
328	Name(328)	T	Table of Organization and Equipment (TOE) dimensioned by 2000. The contents of this array are not used unless IOPER=1 is input and case totals are selected with NU<-1.	0.0000

Appendix 3

SCRAPIRONS's Output For Design Configuration # 1

System Reliability Predictions

Hours Of Continous Operation	R (%)	Hours Of Continous Operation	P (%)	Hours Of Continous Operation	P (%)	Hours Of Continous Operation	P (%)
20	100.0	1020	85.4	2020	50.7	3020	19.3
40	100.0	1040	84.8	2040	49.9	3040	18.8
60	100.0	1060	84.3	2060	49.1	3060	18.4
80	99.9	1080	83.7	2080	48.4	3080	17.9
100	99.9	1100	83.1	2100	47.6	3100	17.5
120	99.8	1120	82.5	2120	46.8	3120	17.1
140	99.7	1140	81.9	2140	46.1	3140	16.7
160	99.7	1160	81.3	2160	45.3	3160	16.3
180	99.6	1180	80.7	2180	44.6	3180	15.9
200	99.5	1200	80.1	2200	43.8	3200	15.5
220	99.4	1220	79.5	2220	43.1	3220	15.1
240	99.2	1240	78.9	2240	42.4	3240	14.8
260	99.1	1260	78.3	2260	41.7	3260	14.4
280	98.9	1280	77.6	2280	40.9	3280	14.0
300	98.8	1300	77.0	2300	40.2	3300	13.7
320	98.6	1320	76.3	2320	39.5	3320	13.4
340	98.4	1340	75.7	2340	38.8	3340	13.0
360	98.2	1360	75.0	2360	38.1	3360	12.7
380	98.0	1380	74.4	2380	37.4	3380	12.4
400	97.8	1400	73.7	2400	36.8	3400	12.0
420	97.5	1420	73.0	2420	36.1	3420	11.7
440	97.3	1440	72.3	2440	35.4	3440	11.4
460	97.0	1460	71.6	2460	34.7	3460	11.1
480	96.8	1480	70.9	2480	34.1	3480	10.8
500	96.5	1500	70.2	2500	33.4	3500	10.6
520	96.2	1520	69.5	2520	32.8	3520	10.3
540	95.9	1540	68.8	2540	32.2	3540	10.0
560	95.6	1560	68.0	2560	31.6	3560	9.7
580	95.2	1580	67.3	2580	30.9	3580	9.5
600	94.9	1600	66.6	2600	30.3	3600	9.2
620	94.6	1620	65.9	2620	29.7	3620	9.0
640	94.2	1640	65.1	2640	29.1	3640	8.7
660	93.8	1660	64.4	2660	28.5	3660	8.5
680	93.4	1680	63.7	2680	28.0	3680	8.2
700	93.0	1700	62.9	2700	27.4	3700	8.0
720	92.6	1720	62.2	2720	26.8	3720	7.8
740	92.2	1740	61.5	2740	26.3	3740	7.6
760	91.8	1760	60.7	2760	25.7	3760	7.4
780	91.3	1780	60.0	2780	25.2	3780	[illegible].1
800	90.9	1800	59.3	2800	24.6	3800	6.9
820	90.4	1820	58.6	2820	24.1	3820	6.7
840	90.0	1840	57.8	2840	23.6	3840	6.5
860	89.5	1860	57.0	2860	23.1	3860	6.4
880	89.0	1880	56.2	2880	22.6	3880	6.2
900	88.5	1900	55.4	2900	22.1	3900	6.0
920	88.0	1920	54.6	2920	21.6	3920	5.8
940	87.5	1940	53.8	2940	21.1	3940	5.6
960	87.0	1960	53.0	2960	20.6	3960	5.5
980	86.5	1980	52.3	2980	20.2	3980	5.3
1000	85.9	2000	51.5	3000	19.7	4000	5.2


SYSTEM RELIABILITY %
CONTINUOUS HOURS OF OPERATION

System Design Parameter Estimate Summary

System Parameter	Point Estimate
Mean-Time-Between-Failure	2133.91 hours
Mean-Time-To-Repair	223.88 Minutes
Line Replaceable Unit Consumption Rate Per Thousand Hours of Operation	6.08 LRU's
Inherent Availability	99.83 %
Average Number of LRU's Replaced, Upon System Failure	3.77

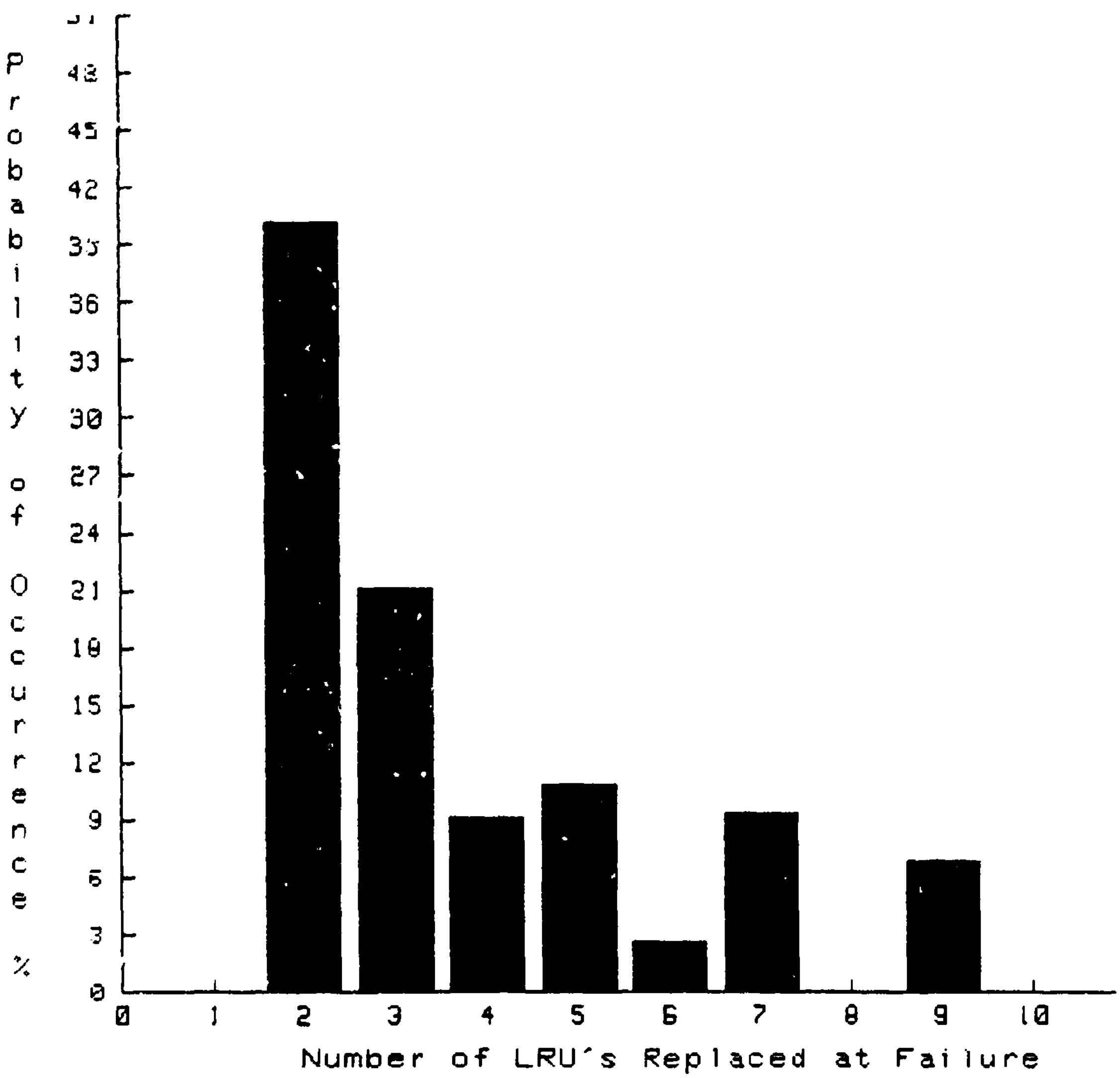
Configuration Analysis Output Summary

The Mean-Time-Between-Failure Predictions Itemized Below Are Based On The Assumption That No Repair Actions Are Initiated Prior To Configuration Failure. Upon Failure, The Configuration Is Totally Restored.

Configuration Name	MTBF (Hours)	MTTR (Minutes)	Inherent Availability (Percent)
Function 1	9366	534.73	99.90494
Function 2	6936	371.01	99.91093
Function 3	5971	287.53	99.91980
Function 4	3825	144.33	99.93714
Function 5	25139	367.00	99.97567
Function 6	12622	262.14	99.96540
Function 7	16041	260.89	99.97290
Function 8	11748	125.00	99.98227
Function 9	11240	127.32	99.98112
Function 10	5041	120.02	99.96033
Function 11	7990	262.15	99.94535
Function 12	15551	94.00	99.98993
Function 13	8024	110.62	99.97703

Probabilistic Line-Replaceable-Unit Consumption at Failure

The average number of LRU's replaced when the system fails is 3.77. The standard deviation of this random variable is 2.13. The distribution of this random variable is illustrated in the below figure.



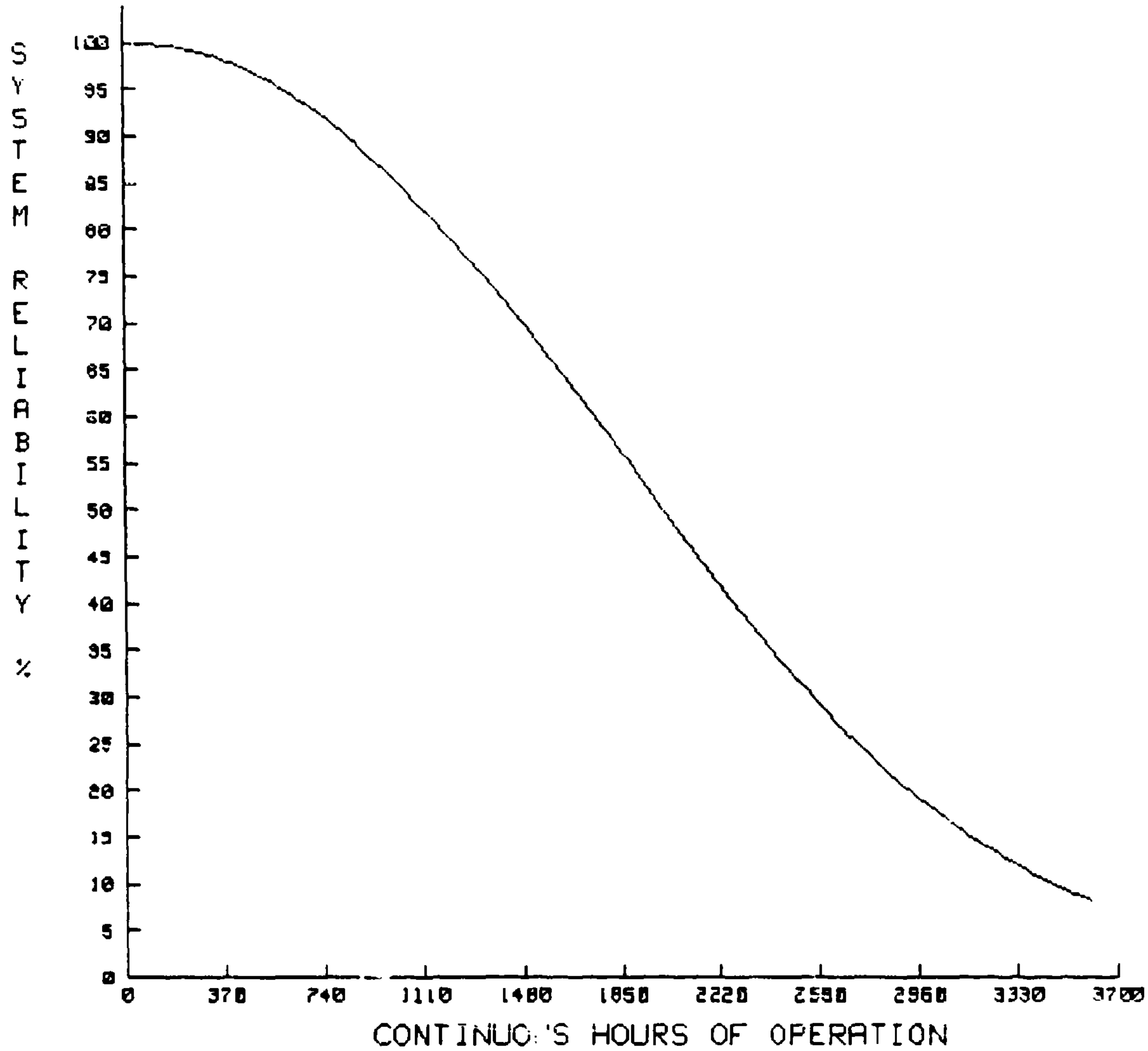
Number Of LRU's Replaced	1	2	3	4	5	6	7	8	9	10
Probability Of Occurrence (%)	0	40	21	9	11	3	9	0	7	0
Probability Of % or Less (%)	0	40	61	70	81	84	93	93	100	100

Appendix 4

SCRAPIRONS's Output For Design Configuration # 2

System Reliability Predictions

Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)
18	100.0	918	87.8	1818	57.4	2718	25.3
36	100.0	936	87.3	1836	56.8	2736	24.8
54	100.0	954	86.8	1854	56.1	2754	24.3
72	99.9	972	86.3	1872	55.3	2772	23.8
90	99.9	990	85.8	1890	54.6	2790	23.3
108	99.8	1008	85.3	1908	53.8	2808	22.9
126	99.8	1026	84.8	1926	53.1	2826	22.4
144	99.7	1044	84.3	1944	52.4	2844	21.9
162	99.7	1062	83.8	1962	51.7	2862	21.5
180	99.6	1080	83.3	1980	50.9	2880	21.0
198	99.5	1098	82.7	1998	50.2	2898	20.6
216	99.4	1116	82.2	2016	49.5	2916	20.2
234	99.3	1134	81.6	2034	48.8	2934	19.7
252	99.1	1152	81.1	2052	48.1	2952	19.3
270	99.0	1170	80.5	2070	47.4	2970	18.9
288	98.9	1188	80.0	2088	46.7	2988	18.5
306	98.7	1206	79.4	2106	46.0	3006	18.1
324	98.5	1224	78.8	2124	45.3	3024	17.7
342	98.4	1242	78.2	2142	44.6	3042	17.3
360	98.2	1260	77.7	2160	43.9	3060	16.9
378	98.0	1278	77.1	2178	43.2	3078	16.5
396	97.8	1296	76.5	2196	42.5	3096	16.2
414	97.6	1314	75.9	2214	41.8	3114	15.8
432	97.4	1332	75.3	2232	41.2	3132	15.4
450	97.1	1350	74.7	2250	40.5	3150	15.1
468	96.9	1368	74.1	2268	39.9	3168	14.8
486	96.6	1386	73.5	2286	39.2	3186	14.4
504	96.4	1404	72.8	2304	38.6	3204	14.1
522	96.1	1422	72.2	2322	37.9	3222	13.7
540	95.8	1440	71.5	2340	37.3	3240	13.4
558	95.5	1458	70.9	2358	36.6	3258	13.1
576	95.2	1476	70.2	2376	36.0	3276	12.8
594	94.9	1494	69.6	2394	35.4	3294	12.5
612	94.6	1512	68.9	2412	34.8	3312	12.2
630	94.3	1530	68.2	2430	34.2	3330	11.9
648	93.9	1548	67.6	2448	33.6	3348	11.6
666	93.6	1566	66.9	2466	33.0	3366	11.3
684	93.2	1584	66.2	2484	32.4	3384	11.1
702	92.9	1602	65.6	2502	31.8	3402	10.8
720	92.5	1620	64.9	2520	31.2	3420	10.5
738	92.1	1638	64.2	2538	30.7	3438	10.3
756	91.7	1656	63.5	2556	30.1	3456	10.0
774	91.3	1674	62.9	2574	29.5	3474	9.7
792	90.9	1692	62.2	2592	29.0	3492	9.5
810	90.5	1710	61.5	2610	28.4	3510	9.3
828	90.0	1728	60.8	2628	27.9	3528	9.0
846	89.6	1746	60.1	2646	27.4	3546	8.8
864	89.2	1764	59.5	2664	26.8	3564	8.6
882	88.7	1782	58.8	2682	26.3	3582	8.3
900	88.2	1800	58.1	2700	25.8	3600	8.1


SYSTEM RELIABILITY %
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
370
740
1110
1480
1850
2220
2590
2960
3330
3700
CONTINUOUS HOURS OF OPERATION

System Design Parameter Estimate Summary

System Parameter	Point Estimate
Mean-Time-Between-Failure	2091.78 hours
Mean-Time-To-Repair	208.24 Minutes
Line Replaceable Unit Consumption Rate Per Thousand Hours of Operation	5.86 LRU's
Inherent Availability	99.83 %
Average Number of LRU's Replaced, Upon System Failure	3.53

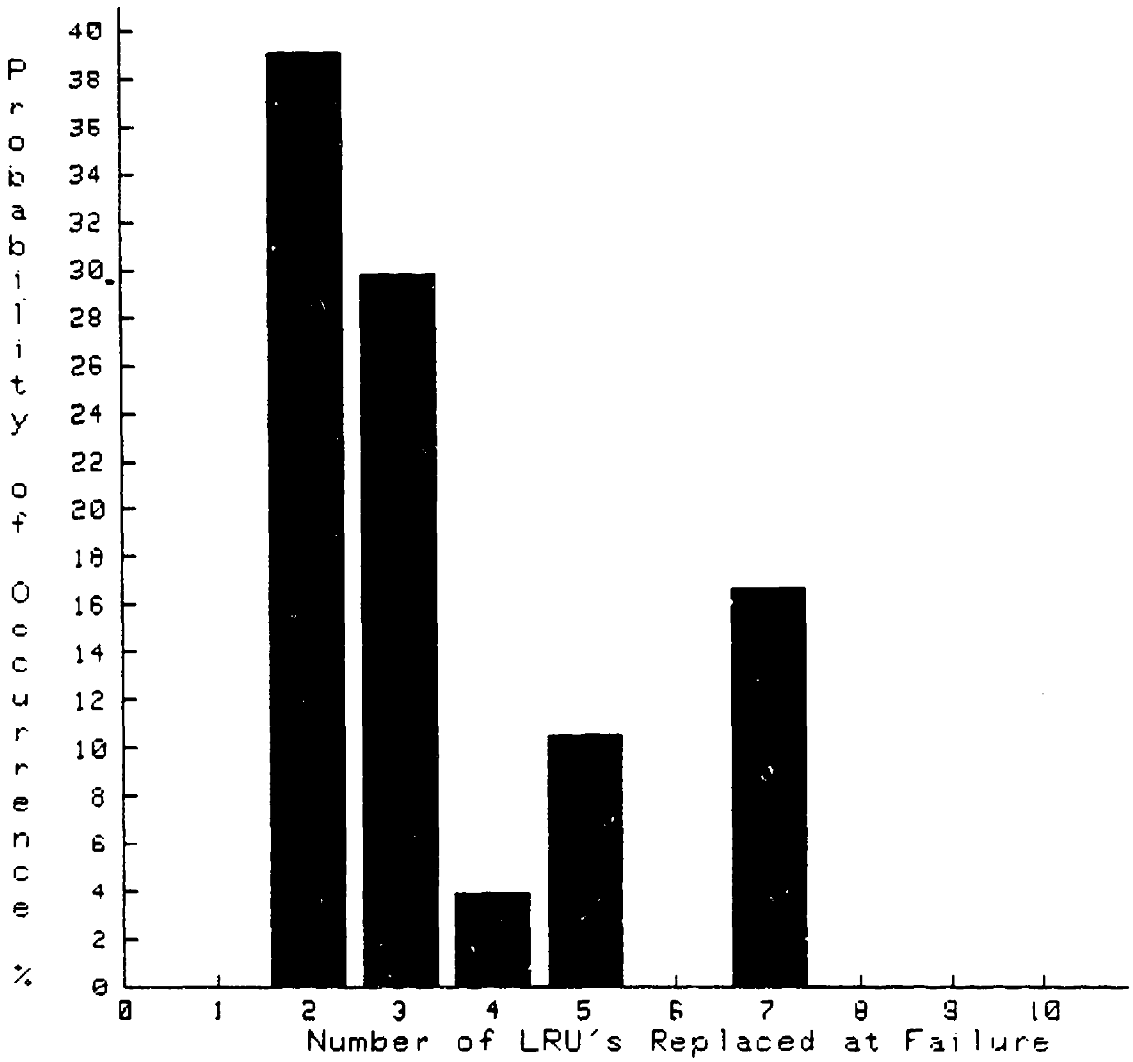
Configuration Analysis Output Summary

The Mean-Time-Between-Failure Predictions Itemized Below Are Based On The Assumption That No Repair Actions Are Initiated Prior To Configuration Failure. Upon Failure, The Configuration Is Totally Restored.

Configuration Name	MTBF (Hours)	MTTR (Minutes)	Inherent Availability (Percent)
Function 1	8236	407.71	99.91756
Function 2	6936	371.01	99.91093
Function 3	5971	287.53	99.91980
Function 4	3825	144.33	99.93714
Function 5	19178	145.00	99.98740
Function 6	10336	211.41	99.96592
Function 7	16041	260.89	99.97290
Function 8	11748	125.00	99.98227
Function 9	11240	127.32	99.98112
Function 10	5041	120.02	99.96033
Function 11	7990	262.15	99.94535
Function 12	15551	94.00	99.98993
Function 13	8024	110.62	99.97703

Probabilistic Line-Replaceable-Unit Consumption at Failure

The average number of LRU's replaced when the system fails is 3.53. The standard deviation of this random variable is 1.80. The distribution of this random variable is illustrated in the below figure.



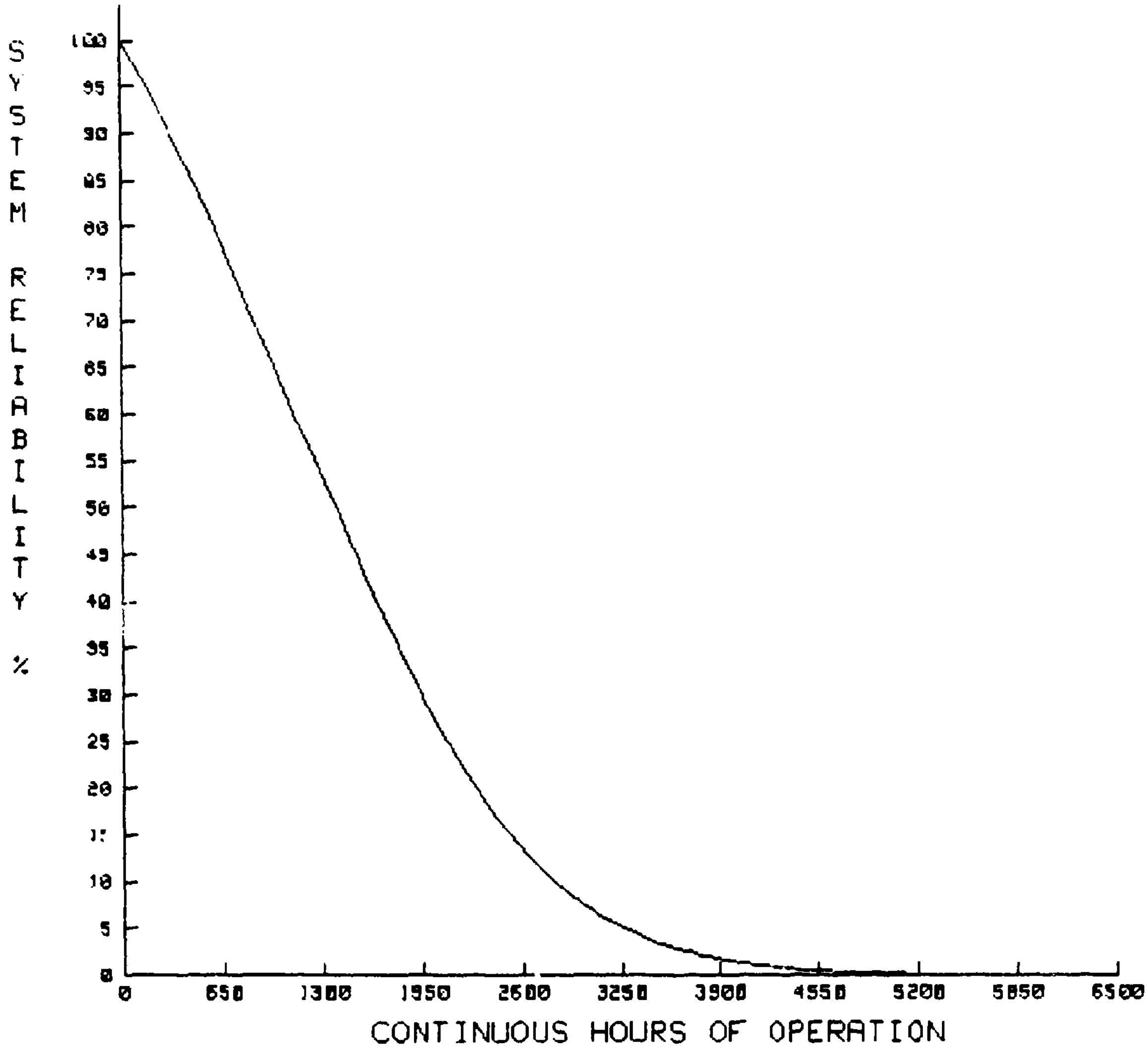
Number Of LRU's Replaced	1	2	3	4	5	6	7	8	9	10
Probability Of Occurrence (%)	0	39	30	4	11	0	17	0	0	0
Probability Of % or Less (%)	0	39	69	73	83	83	100	100	100	100

Appendix 5

SCRAPIRONS's Output For Design Configuration # 3

System Reliability Predictions

Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)
32	99.1	1632	40.7	3232	5.2	4832	.2
64	98.1	1664	39.6	3264	5.0	4864	.2
96	97.2	1696	38.4	3296	4.7	4896	.2
128	96.2	1728	37.3	3328	4.5	4928	.2
160	95.2	1760	36.3	3360	4.2	4960	.2
192	94.2	1792	35.2	3392	4.0	4992	.2
224	93.2	1824	34.1	3424	3.8	5024	.2
256	92.2	1856	33.1	3456	3.6	5056	.1
288	91.2	1888	32.0	3488	3.4	5088	.1
320	90.1	1920	30.9	3520	3.2	5120	.1
352	89.0	1952	29.9	3552	3.0	5152	.1
384	87.9	1984	28.9	3584	2.9	5184	.1
416	86.8	2016	27.9	3616	2.7	5216	.1
448	85.7	2048	26.9	3648	2.6	5248	.1
480	84.6	2080	25.9	3680	2.4	5280	.1
512	83.5	2112	25.0	3712	2.3	5312	.1
544	82.3	2144	24.1	3744	2.2	5344	.1
576	81.1	2176	23.2	3776	2.0	5376	.1
608	80.0	2208	22.3	3808	1.9	5408	.1
640	78.8	2240	21.5	3840	1.8	5440	.1
672	77.6	2272	20.7	3872	1.7	5472	.1
704	76.3	2304	19.9	3904	1.6	5504	.1
736	75.1	2336	19.1	3936	1.5	5536	.0
768	73.9	2368	18.3	3968	1.4	5568	.0
800	72.7	2400	17.6	4000	1.3	5600	.0
832	71.4	2432	16.9	4032	1.3	5632	.0
864	70.2	2464	16.2	4064	1.2	5664	.0
896	68.9	2496	15.5	4096	1.1	5696	.0
928	67.7	2528	14.9	4128	1.0	5728	.0
960	66.4	2560	14.3	4160	1.0	5760	.0
992	65.2	2592	13.7	4192	.9	5792	.0
1024	63.9	2624	13.1	4224	.9	5824	.0
1056	62.6	2656	12.5	4256	.8	5856	.0
1088	61.4	2688	12.0	4288	.8	5888	.0
1120	60.1	2720	11.4	4320	.7	5920	.0
1152	58.9	2752	10.9	4352	.7	5952	.0
1184	57.6	2784	10.4	4384	.6	5984	.0
1216	56.4	2816	10.0	4416	.6	6016	.0
1248	55.1	2848	9.5	4448	.5	6048	.0
1280	53.9	2880	9.1	4480	.5	6080	.0
1312	52.7	2912	8.6	4512	.5	6112	.0
1344	51.5	2944	8.2	4544	.4	6144	.0
1376	50.2	2976	7.8	4576	.4	6176	.0
1408	49.0	3008	7.5	4608	.4	6208	.0
1440	47.8	3040	7.1	4640	.4	6240	.0
1472	46.6	3072	6.8	4672	.3	6272	.0
1504	45.4	3104	6.4	4704	.3	6304	.0
1536	44.2	3136	6.1	4736	.3	6336	.0
1568	43.0	3168	5.8	4768	.3	6368	.0
1600	41.9	3200	5.5	4800	.3	6400	.0


SYSTEM RELIABILITY %
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
650
1300
1950
2600
3250
3900
4550
5200
5850
6500
CONTINUOUS HOURS OF OPERATION

System Design Parameter Estimate Summary

System Parameter	Point Estimate
Mean-Time-Between-Failure	1499.37 hours
Mean-Time-To-Repair	180.00 Minutes
Line Replaceable Unit Consumption Rate Per Thousand Hours of Operation	5.77 LRU's
Inherent Availability	99.80 %
Average Number of LRU's Replaced, Upon System Failure	3.06

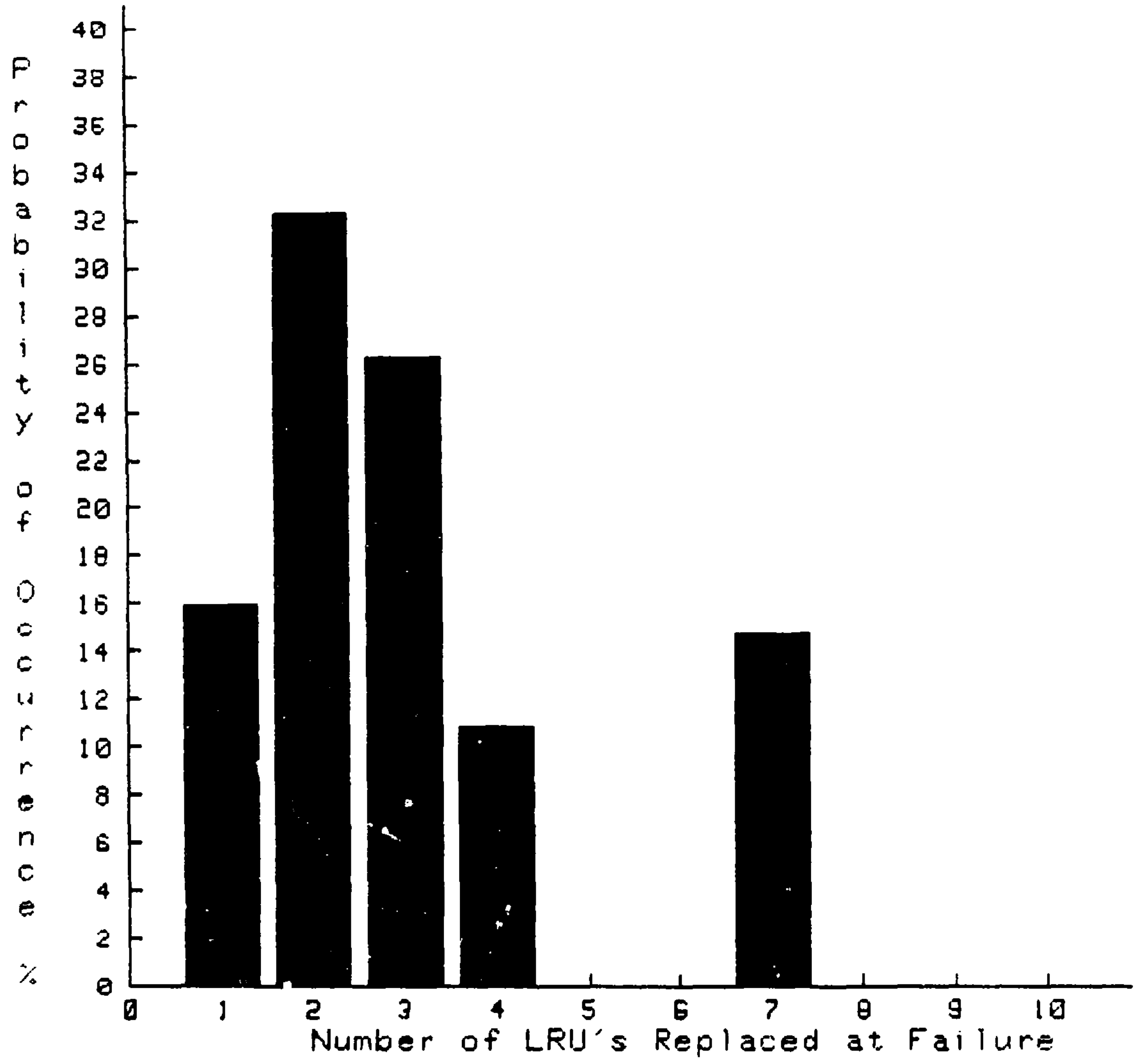
Configuration Analysis Output Summary

The Mean-Time-Between-Failure Predictions Itemized Below Are Based On The Assumption That No Repair Actions Are Initiated Prior To Configuration Failure. Upon Failure, The Configuration Is Totally Restored.

Configuration Name	MTBF (Hours)	MTTR (Minutes)	Inherent Availability (Percent)
Function 1	8236	407.71	99.91756
Function 2	6936	371.01	99.91093
Function 3	5110	242.72	99.92090
Function 4	3825	144.33	99.93714
Function 5	19178	145.00	99.98740
Function 6	10336	211.41	99.96592
Function 7	6289	114.32	99.96972
Function 8	11748	125.00	99.98227
Function 9	11240	127.32	99.98112
Function 10a	6842	53.00	99.98709
Function 10b	7086	59.00	99.98613
Function 11	7990	262.15	99.94533
Function 12	15551	94.00	99.98993
Function 13	8024	110.62	99.97703

Probabilistic Line-Replaceable-Unit Consumption at Failure

The average number of LRU's replaced when the system fails is 3.06. The standard deviation of this random variable is 1.85. The distribution of this random variable is illustrated in the below figure.



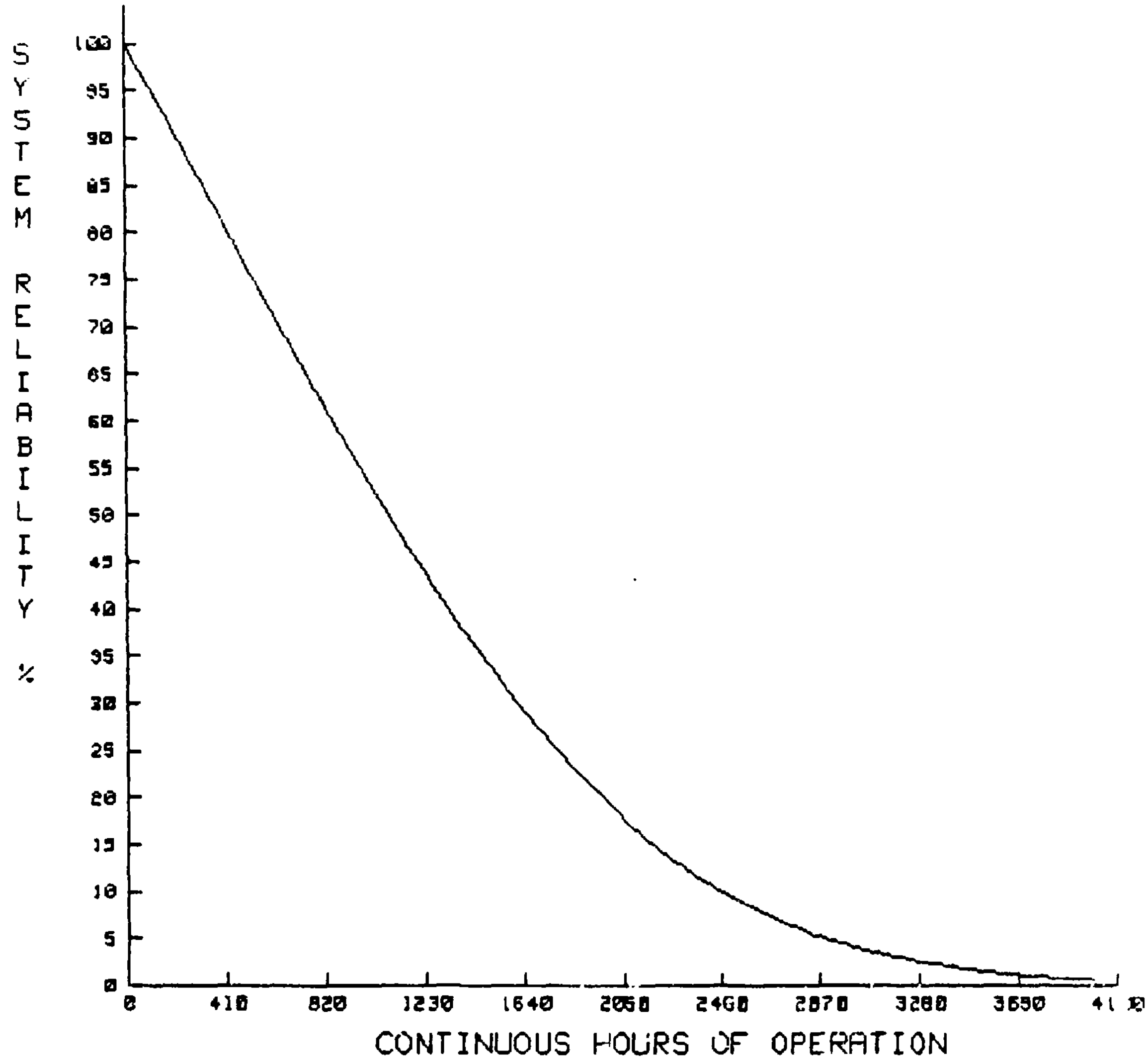
Number Of LRU's Replaced	1	2	3	4	5	6	7	8	9	10
Probability Of Occurrence (%)	16	32	26	11	0	0	15	0	0	0
Probability Of X or Less (%)	16	48	74	85	85	85	100	100	100	100

Appendix 6

SCRAPIRONS's Output For Design Configuration # 4

System Reliability Predictions

Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)	Hours Of Contincus Operation	R (%)
20	99.1	1020	52.6	2020	18.5	3020	4.0
40	98.2	1040	51.7	2040	18.0	3040	3.9
60	97.2	1060	50.8	2060	17.5	3060	3.8
80	96.3	1080	50.0	2080	17.1	3080	3.6
100	95.4	1100	49.1	2100	16.6	3100	3.5
120	94.5	1120	48.3	2120	16.2	3120	3.4
140	93.5	1140	47.5	2140	15.8	3140	3.3
160	92.6	1160	46.6	2160	15.3	3160	3.1
180	91.7	1180	45.8	2180	14.9	3180	3.0
200	90.7	1200	45.0	2200	14.5	3200	2.9
220	89.8	1220	44.2	2220	14.1	3220	2.8
240	88.9	1240	43.4	2240	13.7	3240	2.7
260	87.9	1260	42.6	2260	13.3	3260	2.6
280	87.0	1280	41.8	2280	13.0	3280	2.5
300	86.0	1300	41.0	2300	12.6	3300	2.4
320	85.1	1320	40.3	2320	12.2	3320	2.4
340	84.2	1340	39.5	2340	11.9	3340	2.3
360	83.2	1360	38.7	2360	11.6	3360	2.2
380	82.3	1380	38.0	2380	11.2	3380	2.1
400	81.3	1400	37.3	2400	10.9	3400	2.0
420	80.4	1420	36.5	2420	10.6	3420	2.0
440	79.4	1440	35.8	2440	10.3	3440	1.9
460	78.5	1460	35.1	2460	10.0	3460	1.8
480	77.5	1480	34.4	2480	9.7	3480	1.7
500	76.6	1500	33.7	2500	9.4	3500	1.7
520	75.6	1520	33.0	2520	9.1	3520	1.6
540	74.7	1540	32.3	2540	8.8	3540	1.6
560	73.7	1560	31.7	2560	8.6	3560	1.5
580	72.8	1580	31.0	2580	8.3	3580	1.4
600	71.8	1600	30.3	2600	8.0	3600	1.4
620	70.9	1620	29.7	2620	7.8	3620	1.3
640	69.9	1640	29.1	2640	7.6	3640	1.3
660	69.0	1660	28.4	2660	7.3	3660	1.2
680	68.0	1680	27.8	2680	7.1	3680	1.2
700	67.1	1700	27.2	2700	6.9	3700	1.1
720	66.2	1720	26.6	2720	6.7	3720	1.1
740	65.2	1740	26.0	2740	6.4	3740	1.0
760	64.3	1760	25.5	2760	6.2	3760	1.0
780	63.4	1780	24.9	2780	6.0	3780	1.0
800	62.5	1800	24.3	2800	5.8	3800	.9
820	61.5	1820	23.8	2820	5.7	3820	.9
840	60.6	1840	23.2	2840	5.5	3840	.9
860	59.7	1860	22.7	2860	5.3	3860	.8
880	58.8	1880	22.1	2880	5.1	3880	.8
900	57.9	1900	21.6	2900	4.9	3900	.8
920	57.0	1920	21.0	2920	4.8	3920	.7
940	56.1	1940	20.5	2940	4.6	3940	.7
960	55.2	1960	20.0	2960	4.5	3960	.7
980	54.3	1980	19.5	2980	4.3	3980	.6
1000	53.4	2000	19.0	3000	4.2	4000	.6


SYSTEM RELIABILITY %
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
410
820
1230
1640
2050
2460
2870
3280
3690
CONTINUOUS HOURS OF OPERATION

System Design Parameter Estimate Summary

System Parameter	Point Estimate
Mean-Time-Between-Failure	1234.64 hours
Mean-Time-To-Repair	168.44 Minutes
Line Replaceable Unit Consumption Rate Per Thousand Hours of Operation	5.73 LRU's
Inherent Availability	99.77 %
Average Number of LRU's Replaced, Upon System Failure	2.84

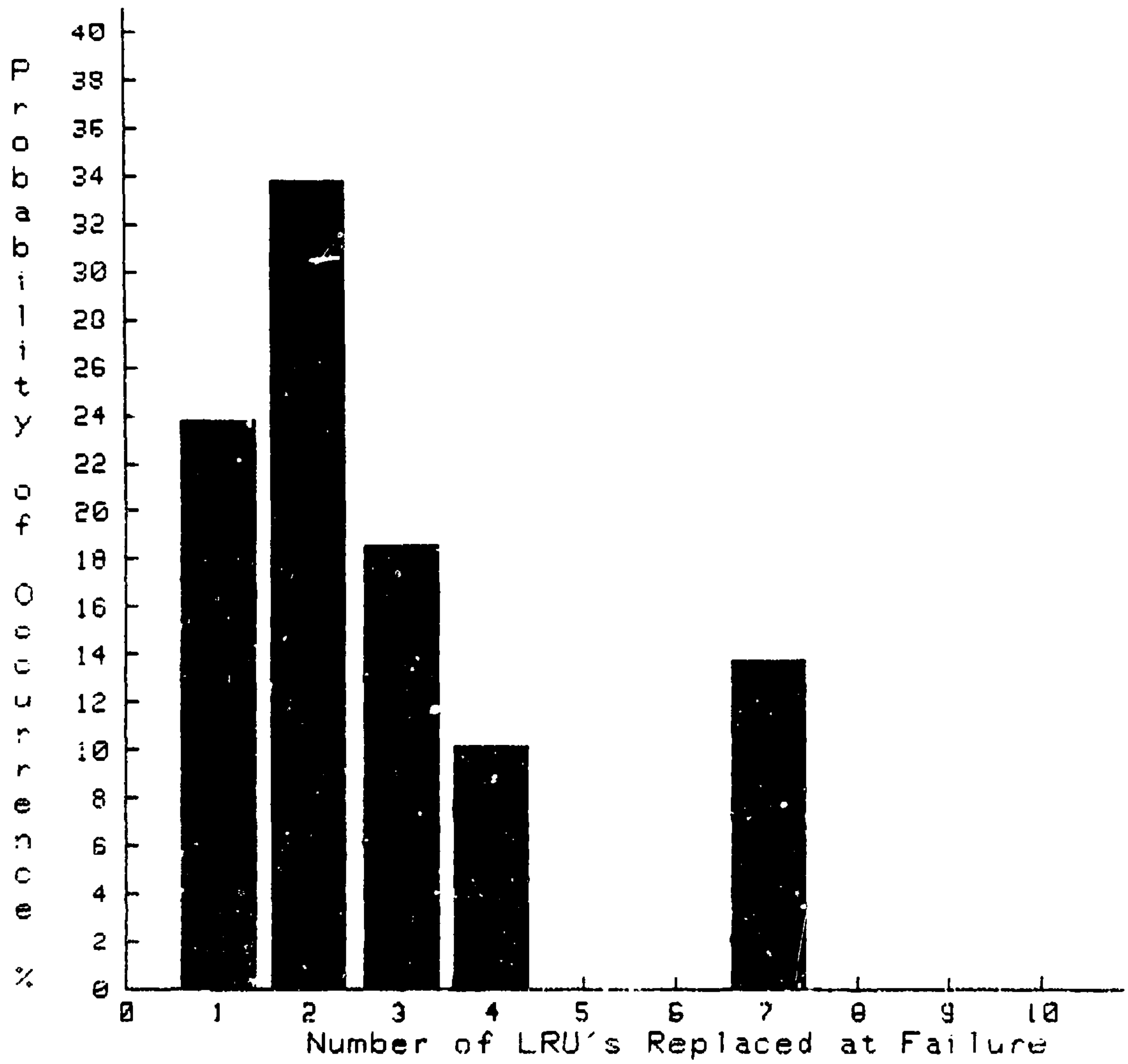
Configuration Analysis Output Summary

The Mean-Time-Between-Failure Predictions Itemized Below Are Based On The Assumption That No Repair Actions Are Initiated Prior To Configuration Failure. Upon Failure, The Configuration Is Totally Restored.

Configuration Name	MTBF (Hours)	MTTR (Minutes)	Inherent Availability (Percent)
Function 1	8236	407.71	99.91756
Function 2	6936	371.01	99.91093
Function 3	5110	242.72	99.92090
Function 4	3825	144.33	99.93714
Function 5	15987	77.00	99.99197
Function 6	10336	211.41	99.96592
Function 7	6289	114.32	99.96972
Function 8	5805	64.00	99.98163
Function 9	11240	127.32	99.98112
Function 10a	6842	53.00	99.98709
Function 10b	7086	59.00	99.98613
Function 11	7990	262.15	99.94535
Function 12	10828	94.00	99.98553
Function 13	8024	110.62	99.97703

Probabilistic Line-Replaceable-Unit Consumption at Failure

The average number of LRU's replaced when the system fails is 2.84. The standard deviation of this random variable is 1.89. The distribution of this random variable is illustrated in the below figure.



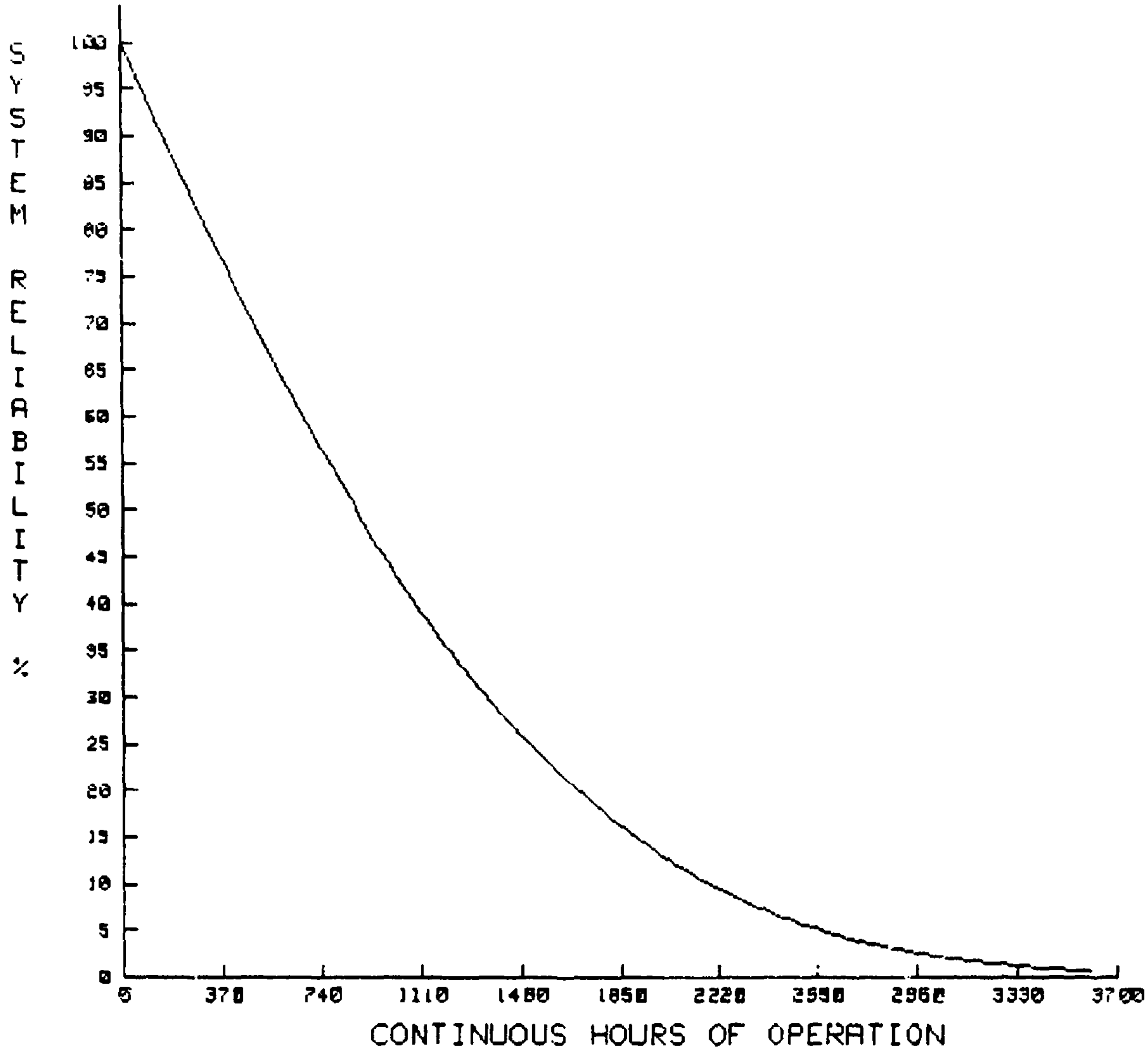
Number Of LRU's Replaced	1	2	3	4	5	6	7	8	9	10
Probability Of Occurrence (%)	24	34	19	10	0	0	14	0	0	0
Probability Of X or Less (%)	24	58	76	86	86	86	100	100	100	100

Appendix 7

SCRAPIRONS's Output For Design Configuration # 5

System Reliability Predictions

Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)
18	98.8	918	47.7	1818	16.9	2718	4.1
36	97.6	936	46.9	1836	16.5	2736	3.9
54	96.5	954	46.1	1854	16.1	2754	3.8
72	95.3	972	45.2	1872	15.7	2772	3.7
90	94.2	990	44.4	1890	15.3	2790	3.6
108	93.0	1008	43.6	1908	14.9	2808	3.5
126	91.9	1026	42.8	1926	14.5	2826	3.3
144	90.7	1044	42.1	1944	14.1	2844	3.2
162	89.6	1062	41.3	1962	13.8	2862	3.1
180	88.5	1080	40.5	1980	13.4	2880	3.0
198	87.3	1098	39.8	1998	13.1	2898	2.9
216	86.2	1116	39.0	2016	12.7	2916	2.8
234	85.1	1134	38.3	2034	12.4	2934	2.7
252	84.0	1152	37.6	2052	12.1	2952	2.6
270	82.9	1170	36.8	2070	11.7	2970	2.6
288	81.8	1188	36.1	2088	11.4	2988	2.5
306	80.7	1206	35.4	2106	11.1	3006	2.4
324	79.6	1224	34.7	2124	10.8	3024	2.3
342	78.6	1242	34.1	2142	10.5	3042	2.2
360	77.5	1260	33.4	2160	10.2	3060	2.2
378	76.4	1278	32.7	2178	10.0	3078	2.1
396	75.4	1296	32.1	2196	9.7	3096	2.0
414	74.3	1314	31.4	2214	9.4	3114	1.9
432	73.3	1332	30.8	2232	9.2	3132	1.9
450	72.2	1350	30.2	2250	8.9	3150	1.8
468	71.2	1368	29.5	2268	8.6	3168	1.8
486	70.2	1386	28.9	2286	8.4	3186	1.7
504	69.1	1404	28.3	2304	8.2	3204	1.6
522	68.1	1422	27.7	2322	7.9	3222	1.6
540	67.1	1440	27.2	2340	7.7	3240	1.5
558	66.1	1458	26.6	2358	7.5	3258	1.5
576	65.1	1476	26.0	2376	7.3	3276	1.4
594	64.1	1494	25.5	2394	7.1	3294	1.4
612	63.2	1512	24.9	2412	6.9	3312	1.3
630	62.2	1530	24.4	2430	6.6	3330	1.3
648	61.2	1548	23.9	2448	6.5	3348	1.2
666	60.3	1566	23.3	2466	6.3	3366	1.2
684	59.3	1584	22.8	2484	6.1	3384	1.1
702	58.4	1602	22.3	2502	5.9	3402	1.1
720	57.4	1620	21.8	2520	5.7	3420	1.1
738	56.5	1638	21.3	2538	5.5	3438	1.0
756	55.6	1656	20.9	2556	5.4	3456	1.0
774	54.7	1674	20.4	2574	5.2	3474	.9
792	53.8	1692	19.9	2592	5.1	3492	.9
810	52.9	1710	19.5	2610	4.9	3510	.9
828	52.0	1728	19.0	2628	4.8	3528	.8
846	51.1	1746	18.6	2646	4.6	3546	.8
864	50.3	1764	18.1	2664	4.5	3564	.8
882	49.4	1782	17.7	2682	4.3	3582	.8
900	48.6	1800	17.3	2700	4.2	3600	.7


SYSTEM RELIABILITY %
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
370
740
1110
1480
1850
2220
2590
2960
3330
3700
CONTINUOUS HOURS OF OPERATION

System Design Parameter Estimate Summary

System Parameter	Point Estimate
Mean-Time-Between-Failure	1043.19 hours
Mean-Time-To-Repair	157.33 Minutes
Line Replaceable Unit Consumption Rate Per Thousand Hours of Operation	5.51 LRU's
Inherent Availability	99.75 %
Average Number of LRU's Replaced, Upon System Failure	2.61

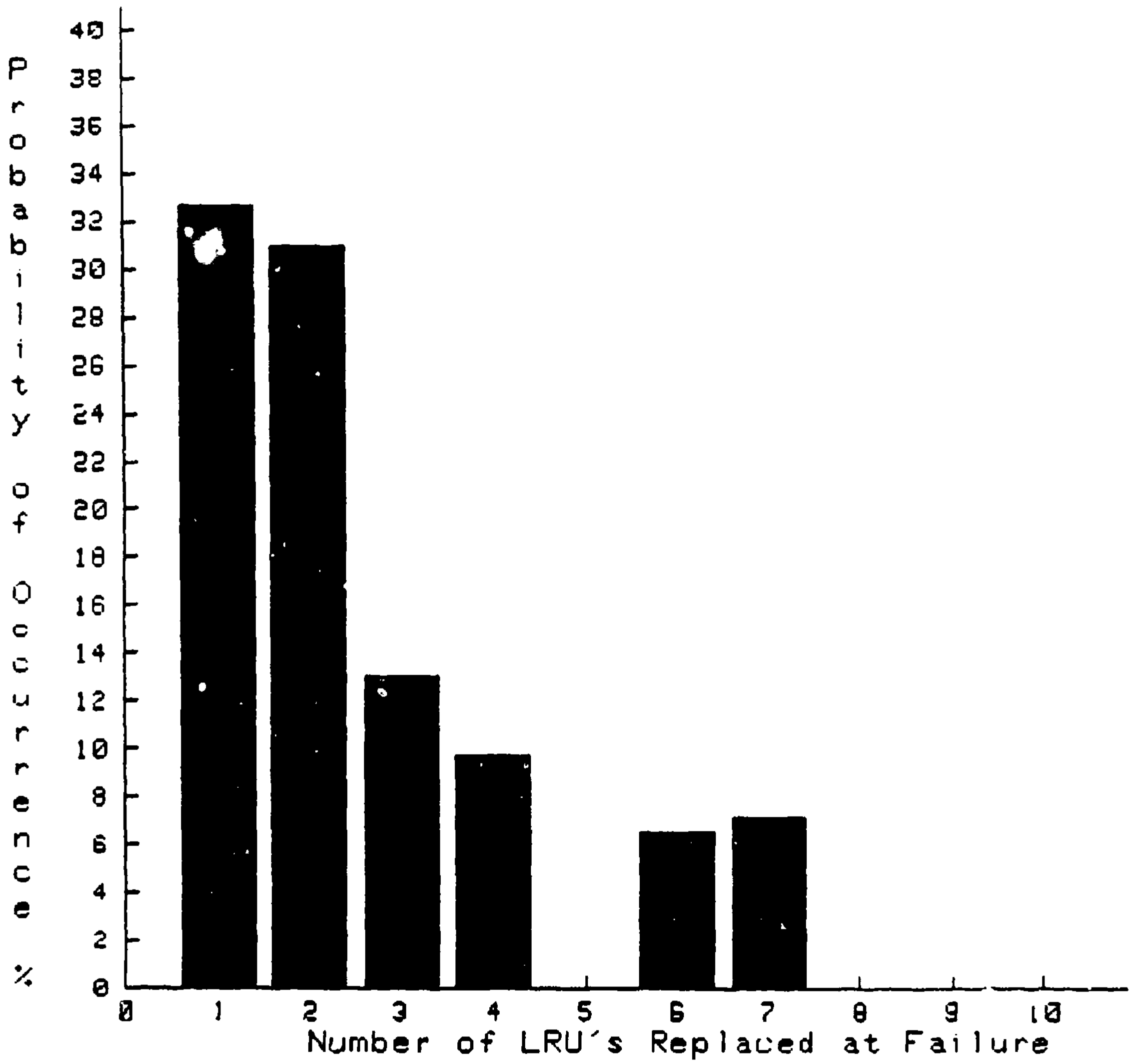
Configuration Analysis Output Summary

The Mean-Time-Between-Failure Predictions Itemized Below Are Based On The Assumption That No Repair Actions Are Initiated Prior To Configuration Failure. Upon Failure, The Configuration Is Totally Restored.

Configuration Name	MTBF (Hours)	MTTR (Minutes)	Inherent Availability (Percent)
Function 1	7682	364.49	99.92098
Function 2	6936	371.01	99.91093
Function 3	5110	242.72	99.92090
Function 4	3825	144.33	99.93714
Function 5	10774	35.00	99.99459
Function 6	8243	144.81	99.97073
Function 7	6289	114.32	99.96972
Function 8	5805	64.00	99.98163
Function 9	9497	85.00	99.98508
Function 10a	6842	53.00	99.98709
Function 10b	7086	59.00	99.98613
Function 11	7990	262.15	99.94535
Function 12	10828	94.00	99.98553
Function 13	8024	110.62	99.97703

Probabilistic Line-Replaceable-Unit Consumption at Failure

The average number of LRU's replaced when the system fails is 2.61. The standard deviation of this random variable is 1.82. The distribution of this random variable is illustrated in the below figure.



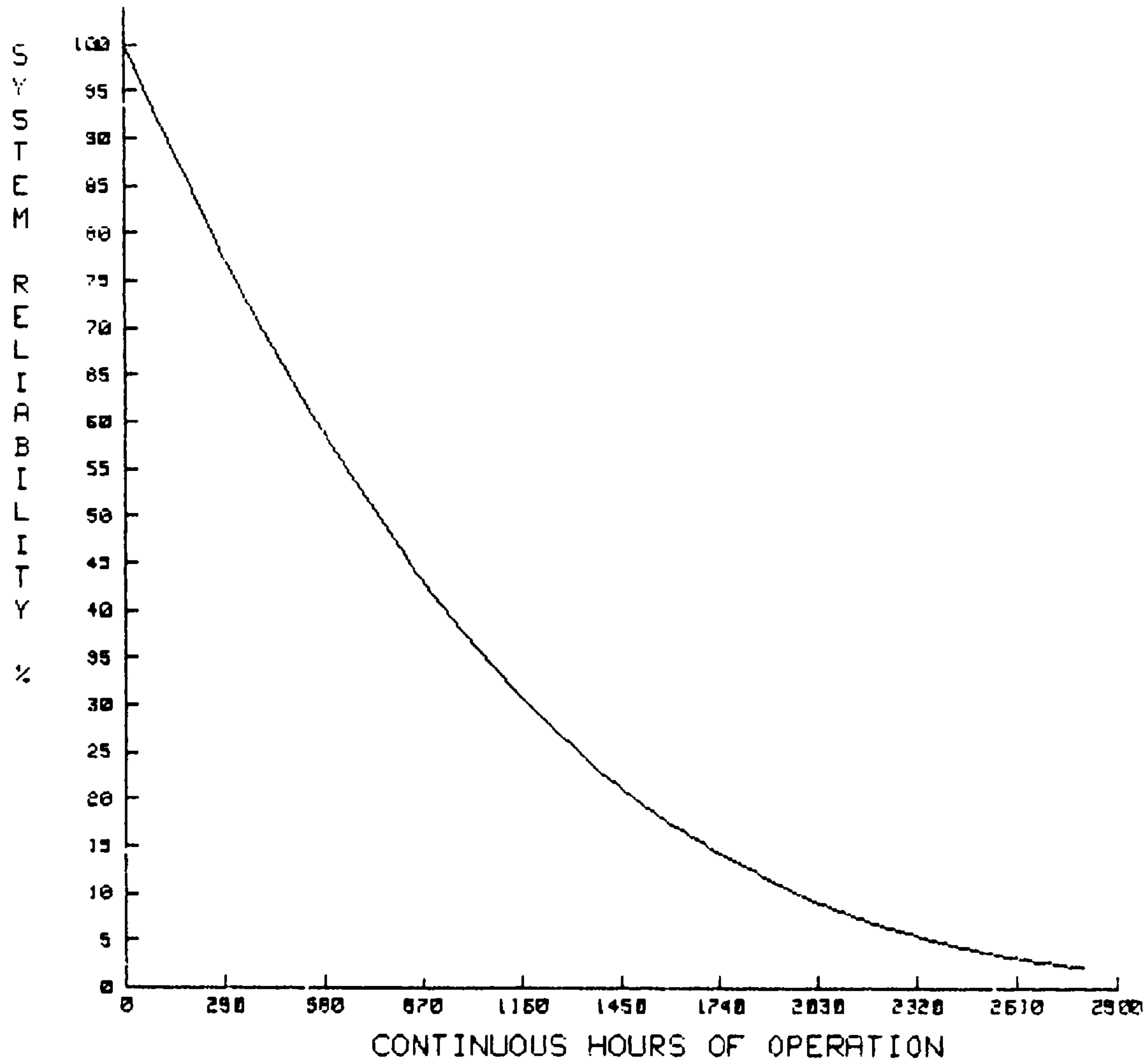
Number Of LRU's Replaced	1	2	3	4	5	6	7	8	9	10
Probability Of Occurrence (%)	33	31	13	10	0	6	7	0	0	0
Probability Of % or Less (%)	33	64	77	86	86	93	100	100	100	100

Appendix 3

SCRAPIRONS's Output For Design Configuration # 6

System Reliability Predictions

Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)
14	98.8	714	51.3	1414	22.3	2114	7.8
28	97.7	728	50.5	1428	21.9	2128	7.7
42	96.5	742	49.8	1442	21.5	2142	7.5
56	95.4	756	49.0	1456	21.1	2156	7.3
70	94.3	770	48.3	1470	20.7	2170	7.1
84	93.2	784	47.6	1484	20.3	2184	7.0
98	92.1	798	46.9	1498	19.9	2198	6.8
112	91.0	812	46.2	1512	19.6	2212	6.6
126	89.9	826	45.5	1526	19.2	2226	6.5
140	88.8	840	44.8	1540	18.8	2240	6.3
154	87.7	854	44.1	1554	18.5	2254	6.2
168	86.6	868	43.4	1568	18.1	2268	6.0
182	85.6	882	42.7	1582	17.8	2282	5.9
196	84.5	896	42.1	1596	17.4	2296	5.7
210	83.5	910	41.4	1610	.1	2310	5.6
224	82.5	924	40.8	1624	16.7	2324	5.4
238	81.4	938	40.1	1638	16.4	2338	5.3
252	80.4	952	39.5	1652	16.1	2352	5.2
266	79.4	966	38.8	1666	15.8	2366	5.1
280	78.4	980	38.2	1680	15.5	2380	4.9
294	77.4	994	37.6	1694	15.2	2394	4.8
308	76.4	1008	37.0	1708	14.8	2408	4.7
322	75.5	1022	36.4	1722	14.5	2422	4.6
336	74.5	1036	35.8	1736	14.3	2436	4.4
350	73.5	1050	35.2	1750	14.0	2450	4.3
364	72.6	1064	34.6	1764	13.7	2464	4.2
378	71.6	1078	34.1	1778	13.4	2478	4.1
392	70.7	1092	33.5	1792	13.1	2492	4.0
406	69.8	1106	32.9	1806	12.9	2506	3.9
420	68.8	1120	32.4	1820	12.6	2520	3.8
434	67.9	1134	31.8	1834	12.3	2534	3.7
448	67.0	1148	31.3	1848	12.1	2548	3.6
462	66.1	1162	30.8	1862	11.8	2562	3.5
476	65.2	1176	30.3	1876	11.6	2576	3.4
490	64.3	1190	29.7	1890	11.3	2590	3.3
504	63.5	1204	29.2	1904	11.1	2604	3.3
518	62.6	1218	28.7	1918	10.8	2618	3.2
532	61.7	1232	28.2	1932	10.6	2632	3.1
546	60.9	1246	27.7	1946	10.3	2646	3.0
560	60.1	1260	27.2	1960	10.1	2660	2.9
574	59.2	1274	26.8	1974	9.9	2674	2.8
588	58.4	1288	26.3	1988	9.7	2688	2.8
602	57.6	1302	25.8	2002	9.4	2702	2.7
616	56.8	1316	25.4	2016	9.2	2716	2.6
630	55.9	1330	24.9	2030	9.0	2730	2.6
644	55.1	1344	24.5	2044	8.8	2744	2.5
658	54.4	1358	24.0	2058	8.6	2758	2.4
672	53.6	1372	23.6	2072	8.4	2772	2.3
686	52.8	1386	23.2	2086	8.2	2786	2.3
700	52.0	1400	22.7	2100	8.0	2800	2.2


SYSTEM RELIABILITY %
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
290
580
870
1160
1450
1740
2030
2320
2610
2900
CONTINUOUS HOURS OF OPERATION

System Design Parameter Estimate Summary

System Parameter	Point Estimate
Mean-Time-Between-Failure	915.60 hours
Mean-Time-To-Repair	145.98 Minutes
Line Replaceable Unit Consumption Rate Per Thousand Hours of Operation	5.36 LRU's
Inherent Availability	99.73 %
Average Number of LRU's Replaced, Upon System Failure	2.41

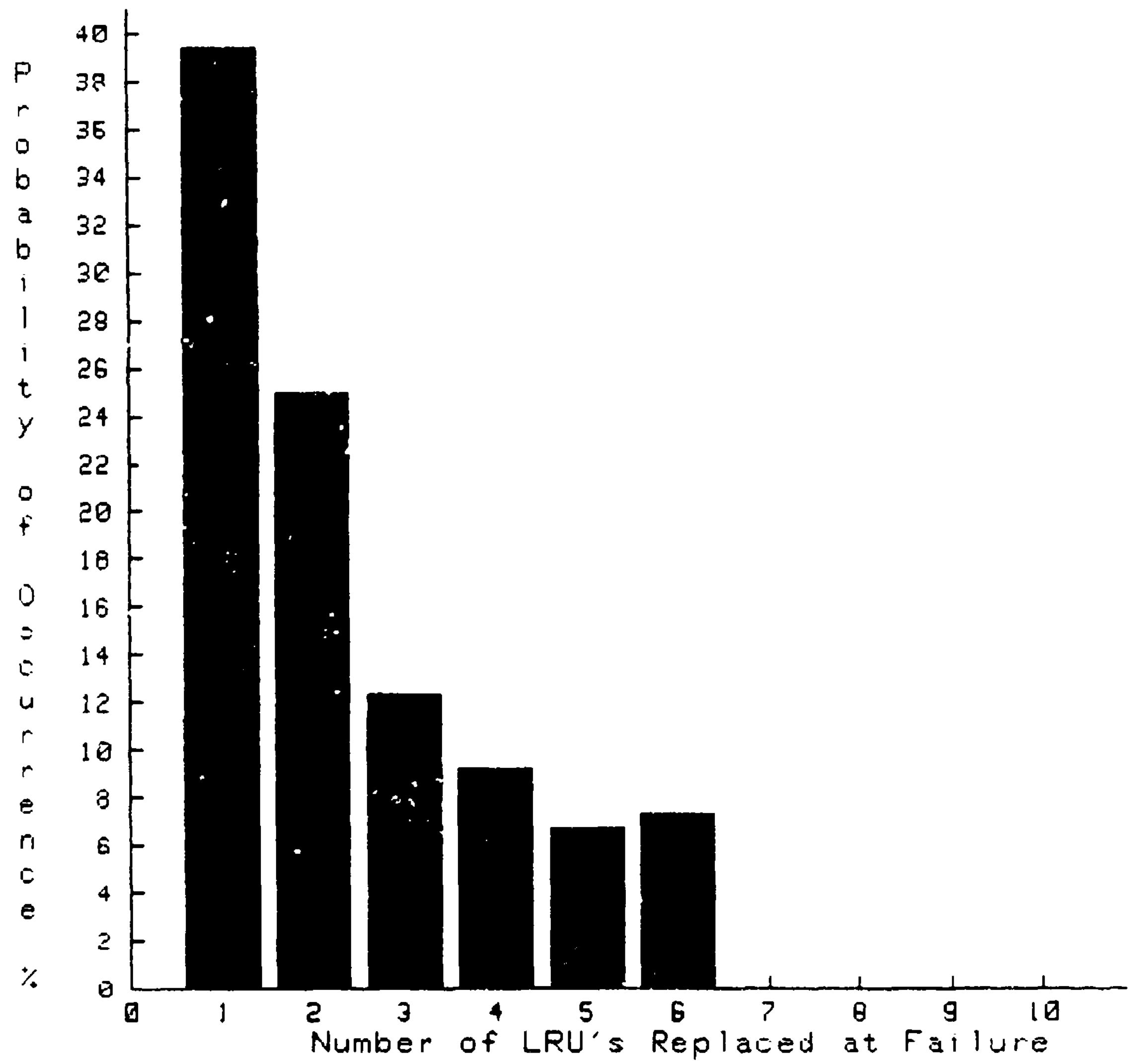
Configuration Analysis Output Summary

The Mean-Time-Between-Failure Predictions Itemized Below Are Based On The Assumption That No Repair Actions Are Initiated Prior To Configuration Failure. Upon Failure, The Configuration Is Totally Restored.

Configuration Name	MTBF (Hours)	MTTR (Minutes)	Inherent Availability (Percent)
Function 1	7005	302.07	99.92318
Function 2	6440	328.86	99.91496
Function 3	5110	242.72	99.92090
Function 4	3825	144.33	99.93714
Function 5	10774	35.00	99.99459
Function 6	8243	144.91	99.97073
Function 7	6289	114.32	99.96972
Function 8	5805	64.00	99.98163
Function 9	9497	85.00	99.98508
Function 10a	6842	53.00	99.98709
Function 10b	7086	59.00	99.98613
Function 11	7990	262.15	99.94535
Function 12	5675	47.00	99.98620
Function 13	8024	110.62	99.97703

Probabilistic Line-Replaceable-Unit Consumption at Failure

The average number of LRU's replaced when the system fails is 2.41. The standard deviation of this random variable is 1.58. The distribution of this random variable is illustrated in the below figure.



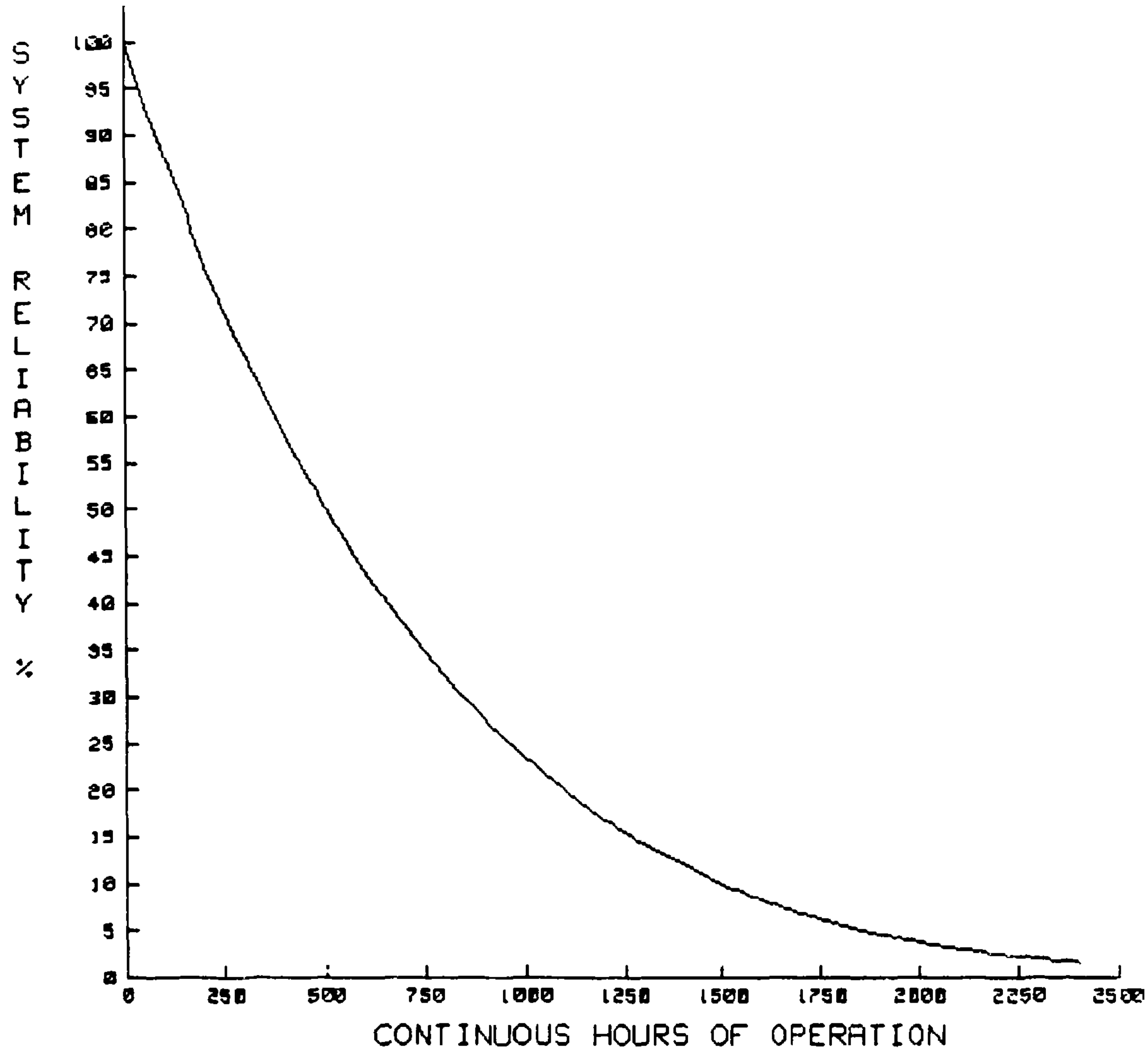
Number Of LRU's Replaced	1	2	3	4	5	6	7	8	9	10
Probability Of Occurrence (%)	39	25	12	9	7	7	0	0	0	0
Probability Of X or Less (%)	39	64	77	86	93	100	100	100	100	100

Appendix 9

SCRAPIRONS's Output For Design Configuration # 7

System Reliability Predictions

Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)
12	98.4	612	42.8	1212	16.5	1812	5.5
24	96.9	624	42.1	1224	16.2	1824	5.4
36	95.4	636	41.3	1236	15.9	1836	5.3
48	93.9	648	40.6	1248	15.6	1848	5.1
60	92.4	660	39.9	1260	15.2	1860	5.0
72	90.9	672	39.2	1272	14.9	1872	4.9
84	89.5	684	38.5	1284	14.6	1884	4.8
96	88.1	696	37.8	1296	14.3	1896	4.7
108	86.7	708	37.1	1308	14.0	1908	4.6
120	85.3	720	36.4	1320	13.7	1920	4.5
132	83.9	732	35.8	1332	13.4	1932	4.3
144	82.6	744	35.1	1344	13.2	1944	4.2
156	81.3	756	34.5	1356	12.9	1956	4.1
168	80.0	768	33.9	1368	12.6	1968	4.0
180	78.7	780	33.3	1380	12.4	1980	3.9
192	77.4	792	32.6	1392	12.1	1992	3.9
204	76.2	804	32.1	1404	11.8	2004	3.8
216	74.9	816	31.5	1416	11.6	2016	3.7
228	73.7	828	30.9	1428	11.3	2028	3.6
240	72.5	840	30.3	1440	11.1	2040	3.5
252	71.3	852	29.8	1452	10.9	2052	3.4
264	70.2	864	29.2	1464	10.6	2064	3.3
276	69.0	876	28.7	1476	10.4	2076	3.2
288	67.9	888	28.1	1488	10.2	2088	3.2
300	66.8	900	27.6	1500	10.0	2100	3.1
312	65.7	912	27.1	1512	9.7	2112	3.0
324	64.6	924	26.6	1524	9.5	2124	2.9
336	63.5	936	26.1	1536	9.3	2136	2.9
348	62.5	948	25.6	1548	9.1	2148	2.8
360	61.4	960	25.1	1560	8.9	2160	2.7
372	60.4	972	24.6	1572	8.7	2172	2.7
384	59.4	984	24.1	1584	8.5	2184	2.6
396	58.4	996	23.7	1596	8.3	2196	2.5
408	57.4	1008	23.2	1608	8.2	2208	2.5
420	56.5	1020	22.8	1620	8.0	2220	2.4
432	55.5	1032	22.3	1632	7.8	2232	2.3
444	54.6	1044	21.9	1644	7.6	2244	2.3
456	53.7	1056	21.5	1656	7.5	2256	2.2
468	52.8	1068	21.1	1668	7.3	2268	2.2
480	51.9	1080	20.6	1680	7.1	2280	2.1
492	51.0	1092	20.2	1692	7.0	2292	2.1
504	50.1	1104	19.8	1704	6.8	2304	2.0
516	49.2	1116	19.4	1716	6.6	2316	1.9
528	48.4	1128	19.1	1728	6.5	2328	1.9
540	47.6	1140	18.7	1740	6.3	2340	1.8
552	46.7	1152	18.3	1752	6.2	2352	1.8
564	45.9	1164	17.9	1764	6.1	2364	1.8
576	45.1	1176	17.6	1776	5.9	2376	1.7
588	44.3	1188	17.2	1788	5.8	2388	1.7
600	43.6	1200	16.9	1800	5.6	2400	1.6


SYSTEM RELIABILITY %
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95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
250
500
750
1000
1250
1500
1750
2000
2250
2500
CONTINUOUS HOURS OF OPERATION

System Design Parameter Estimate Summary

System Parameter	Point Estimate
Mean-Time-Between-Failure	670.31 hours
Mean-Time-To-Repair	126.08 Minutes
Line Replaceable Unit Consumption Rate Per Thousand Hours of Operation	5.22 LRU's
Inherent Availability	99.69 %
Average Number of LRU's Replaced, Upon System Failure	2.08

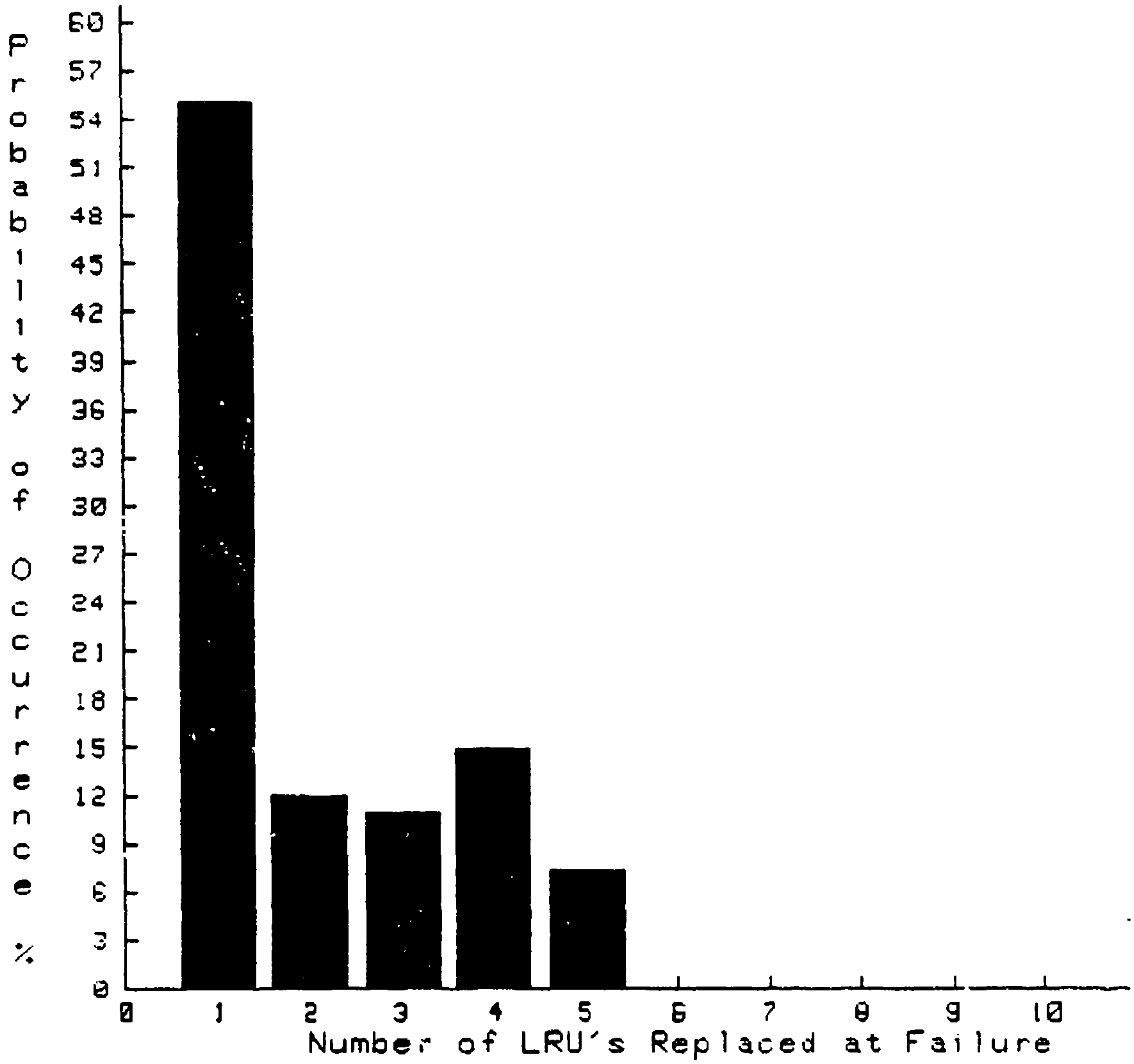
Configuration Analysis Output Summary

The Mean-Time-Between-Failure Predictions Itemized Below Are Based On The Assumption That No Repair Actions Are Initiated Prior To Configuration Failure. Upon Failure, The Configuration Is Totally Restored.

Configuration Name	MTBF (Hours)	MTTR (Minutes)	Inherent Availability (Percent)
Function 1	6184	238.29	99.93582
Function 2	5711	287.82	99.91607
Function 3	5110	242.72	99.92090
Function 4	3825	144.33	99.93714
Function 5	10774	35.00	99.99459
Function 6a	9955	61.00	99.98979
Function 6b	9765	94.00	99.98396
Function 7	6289	114.32	99.96972
Function 8	5805	64.00	99.98163
Function 9	9497	85.00	99.98508
Function 10a	6842	53.00	99.98709
Function 10b	7086	59.00	99.98613
Function 11	7990	262.15	99.94535
Function 12	5675	47.00	99.98620
Function 13a	7092	51.00	99.98802
Function 13b	7207	45.00	99.98959

Probabilistic Line-Replaceable-Unit Consumption at Failure

The average number of LRU's replaced when the system fails is 2.08. The standard deviation of this random variable is 1.38. The distribution of this random variable is illustrated in the below figure.



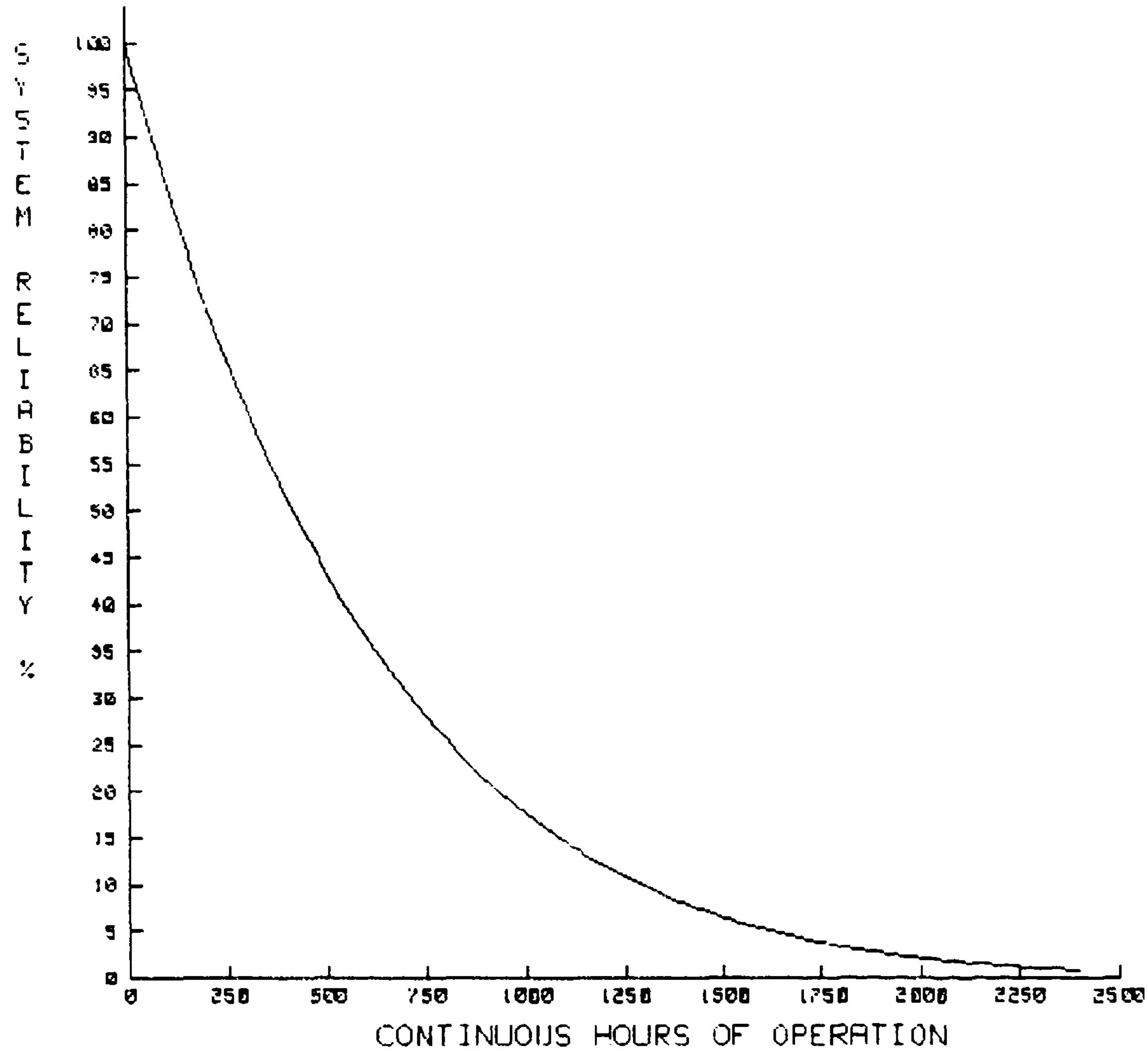
Number Of LRU's Replaced	1	2	3	4	5	6	7	8	9	10
Probability Of Occurrence (%)	55	12	11	15	7	0	0	0	0	0
Probability Of X or Less (%)	55	67	78	93	100	100	100	100	100	100

Appendix 10

SCRAPIRONS's Output For Design Configuration # 8

System Reliability Predictions

Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)
12	98.1	612	35.8	1212	11.6	1812	3.2
24	96.2	624	35.0	1224	11.3	1824	3.2
36	94.3	636	34.3	1236	11.1	1836	3.1
48	92.5	648	33.6	1248	10.8	1848	3.0
60	90.7	660	32.9	1260	10.6	1860	2.9
72	88.9	672	32.2	1272	10.3	1872	2.8
84	87.2	684	31.5	1284	10.1	1884	2.8
96	85.5	696	30.8	1296	9.8	1896	2.7
108	83.8	708	30.2	1308	9.6	1908	2.6
120	82.2	720	29.5	1320	9.3	1920	2.5
132	80.6	732	28.9	1332	9.1	1932	2.5
144	79.0	744	28.3	1344	8.9	1944	2.4
156	77.5	756	27.7	1356	8.7	1956	2.3
168	75.9	768	27.1	1368	8.5	1968	2.3
180	74.5	780	26.5	1380	8.3	1980	2.2
192	73.0	792	25.9	1392	8.1	1992	2.1
204	71.6	804	25.3	1404	7.9	2004	2.1
216	70.2	816	24.8	1416	7.7	2016	2.0
228	68.8	828	24.3	1428	7.5	2028	2.0
240	67.4	840	23.7	1440	7.3	2040	1.9
252	66.1	852	23.2	1452	7.1	2052	1.9
264	64.8	864	22.7	1464	6.9	2064	1.8
276	63.5	876	22.2	1476	6.8	2076	1.8
288	62.2	888	21.7	1488	6.6	2088	1.7
300	61.0	900	21.2	1500	6.4	2100	1.7
312	59.8	912	20.8	1512	6.3	2112	1.6
324	58.6	924	20.3	1524	6.1	2124	1.6
336	57.4	936	19.8	1536	5.9	2136	1.5
348	56.3	948	19.4	1548	5.8	2148	1.5
360	55.2	960	19.0	1560	5.6	2160	1.4
372	54.1	972	18.5	1572	5.5	2172	1.4
384	53.0	984	18.1	1584	5.4	2184	1.4
396	51.9	996	17.7	1596	5.2	2196	1.3
408	50.9	1008	17.3	1608	5.1	2208	1.3
420	49.8	1020	16.9	1620	5.0	2220	1.2
432	48.8	1032	16.5	1632	4.8	2232	1.2
444	47.8	1044	16.2	1644	4.7	2244	1.2
456	46.9	1056	15.8	1656	4.6	2256	1.1
468	45.9	1068	15.4	1668	4.5	2268	1.1
480	45.0	1080	15.1	1680	4.4	2280	1.1
492	44.1	1092	14.7	1692	4.2	2292	1.0
504	43.2	1104	14.4	1704	4.1	2304	1.0
516	42.3	1116	14.0	1716	4.0	2316	1.0
528	41.4	1128	13.7	1728	3.9	2328	1.0
540	40.6	1140	13.4	1740	3.8	2340	.9
552	39.7	1152	13.1	1752	3.7	2352	.9
564	38.9	1164	12.8	1764	3.6	2364	.9
576	38.1	1176	12.5	1776	3.5	2376	.9
588	37.3	1188	12.2	1788	3.4	2388	.8
600	36.5	1200	11.9	1800	3.3	2400	.8


SYSTEM RELIABILITY %
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95
90
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80
75
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30
25
20
15
10
5
0
0
250
500
750
1000
1250
1500
1750
2000
2250
2500
CONTINUOUS HOURS OF OPERATION

System Design Parameter Estimate Summary

System Parameter	Point Estimate
Mean-Time-Between-Failure	568.47 hours
Mean-Time-To-Repair	108.89 Minutes
Line Replaceable Unit Consumption Rate Per Thousand Hours of Operation	4.77 LRU's
Inherent Availability	99.68 %
Average Number of LRU's Replaced, Upon System Failure	1.85

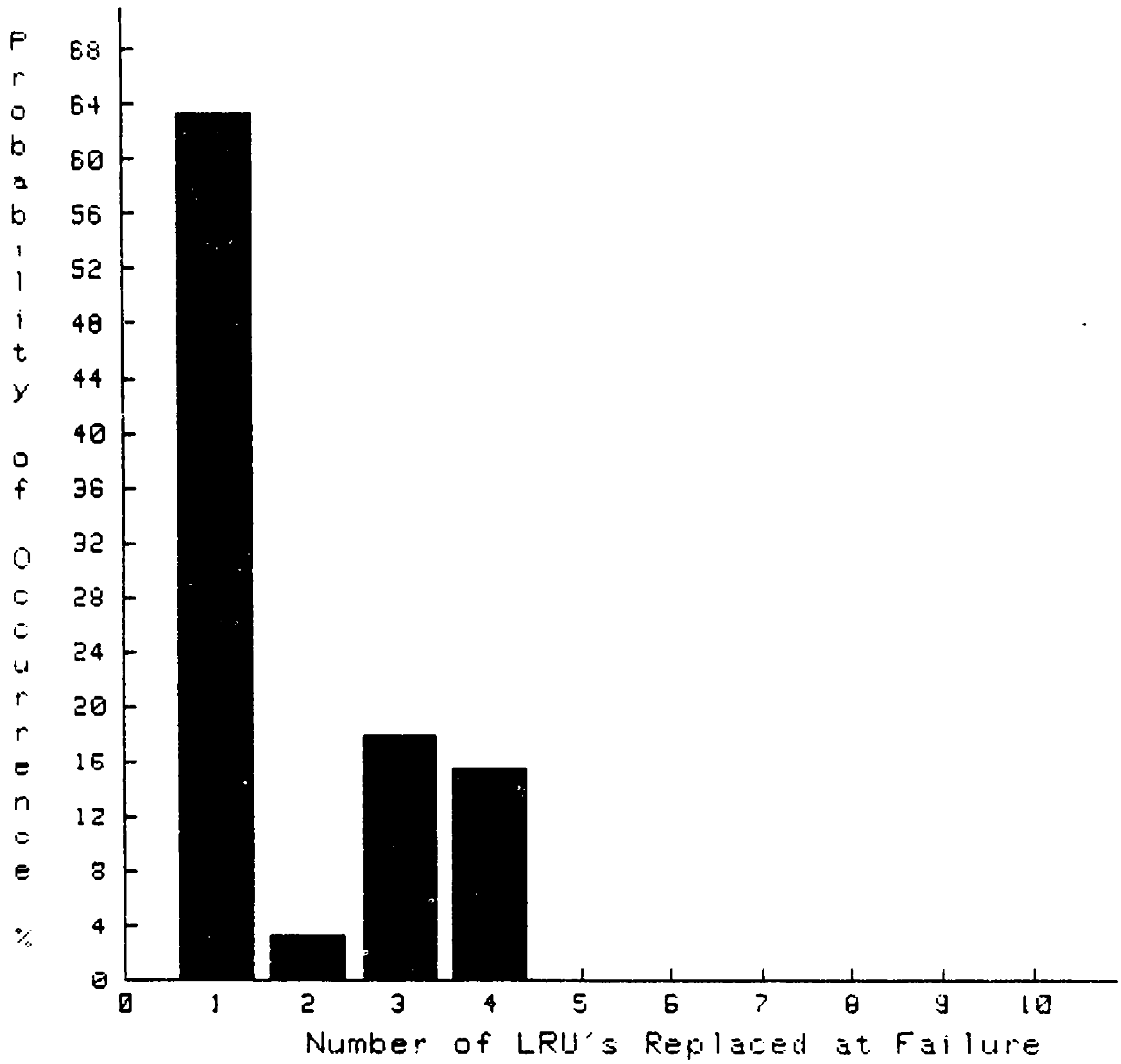
Configuration Analysis Output Summary

The Mean-Time-Between-Failure Predictions Itemized Below Are Based On The Assumption That No Repair Actions Are Initiated Prior To Configuration Failure. Upon Failure, The Configuration Is Totally Restored.

Configuration Name	MTBF (Hours)	MTTR (Minutes)	Inherent Availability (Percent)
Function 1	5022	206.93	99.93137
Function 2	4954	224.65	99.92447
Function 3	5110	242.72	99.92090
Function 4	3825	144.33	99.93714
Function 5	10774	35.00	99.99459
Function 6a	9955	61.00	99.98979
Function 6b	9765	94.00	99.98396
Function 7	5233	51.00	99.98376
Function 8	5805	64.00	99.98163
Function 9	9497	85.00	99.98508
Function 10a	6842	53.00	99.98709
Function 10b	7086	59.00	99.98613
Function 11a	11731	140.00	99.98011
Function 11b	8024	82.00	99.98297
Function 12	5675	47.00	99.98620
Function 13a	7092	51.00	99.98802
Function 13b	7207	45.00	99.98959

Probabilistic Line-Replaceable-Unit Consumption at Failure

The average number of LRU's replaced when the system fails is 1.85. The standard deviation of this random variable is 1.19. The distribution of this random variable is illustrated in the below figure.



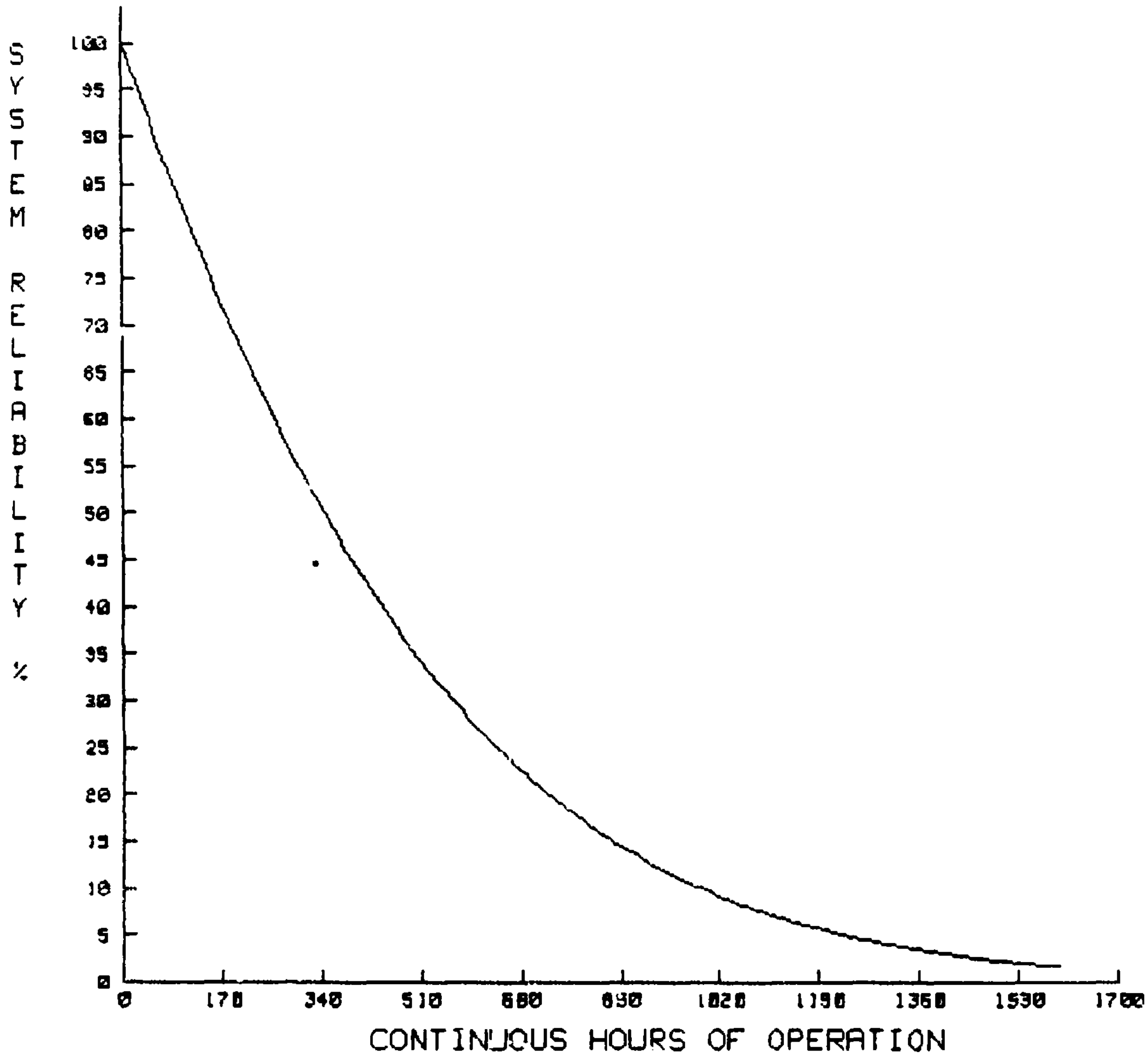
Number Of LRU's Replaced	1	2	3	4	5	6	7	8	9	10
Probability Of Occurrence (%)	63	3	18	15	0	0	0	0	0	0
Probability Of X or Less (%)	63	67	85	100	100	100	100	100	100	100

Appendix 11

SCRAPIRONS's Output For Design Configuration # 9

System Reliability Predictions

Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)
8	98.6	408	43.4	808	16.2	1208	5.4
16	97.2	416	42.6	816	15.8	1216	5.2
24	95.8	424	41.9	824	15.5	1224	5.1
32	94.5	432	41.1	832	15.2	1232	5.0
40	93.1	440	40.3	840	14.9	1240	4.9
48	91.7	448	39.6	848	14.5	1248	4.8
56	90.4	456	38.9	856	14.2	1256	4.7
64	89.1	464	38.1	864	13.9	1264	4.6
72	87.8	472	37.4	872	13.6	1272	4.5
80	86.4	480	36.7	880	13.4	1280	4.4
88	85.2	488	36.0	888	13.1	1288	4.3
96	83.9	496	35.4	896	12.8	1296	4.2
104	82.6	504	34.7	904	12.5	1304	4.1
112	81.3	512	34.0	912	12.2	1312	4.0
120	80.1	520	33.4	920	12.0	1320	3.9
128	78.8	528	32.8	928	11.7	1328	3.8
136	77.6	536	32.1	936	11.5	1336	3.7
144	76.4	544	31.5	944	11.2	1344	3.6
152	75.2	552	30.9	952	11.0	1352	3.5
160	74.0	560	30.3	960	10.8	1360	3.4
168	72.8	568	29.7	968	10.5	1368	3.4
176	71.7	576	29.2	976	10.3	1376	3.3
184	70.5	584	28.6	984	10.1	1384	3.2
192	69.4	592	28.0	992	9.8	1392	3.1
200	68.3	600	27.5	1000	9.6	1400	3.1
208	67.2	608	26.9	1008	9.4	1408	3.0
216	66.1	616	26.4	1016	9.2	1416	2.9
224	65.0	624	25.9	1024	9.0	1424	2.9
232	63.9	632	25.4	1032	8.8	1432	2.8
240	62.8	640	24.9	1040	8.6	1440	2.7
248	61.8	648	24.4	1048	8.4	1448	2.7
256	60.7	656	23.9	1056	8.2	1456	2.6
264	59.7	664	23.4	1064	8.1	1464	2.5
272	58.7	672	23.0	1072	7.9	1472	2.5
280	57.7	680	22.5	1080	7.7	1480	2.4
288	56.7	688	22.0	1088	7.5	1488	2.4
296	55.8	696	21.6	1096	7.4	1496	2.3
304	54.8	704	21.2	1104	7.2	1504	2.2
312	53.8	712	20.7	1112	7.1	1512	2.2
320	52.9	720	20.3	1120	6.9	1520	2.1
328	52.0	728	19.9	1128	6.7	1528	2.1
336	51.1	736	19.5	1136	6.6	1536	2.0
344	50.2	744	19.1	1144	6.4	1544	2.0
352	49.3	752	18.7	1152	6.3	1552	1.9
360	48.4	760	18.3	1160	6.2	1560	1.9
368	47.6	768	17.9	1168	6.0	1568	1.9
376	46.7	776	17.6	1176	5.9	1576	1.8
384	45.9	784	17.2	1184	5.7	1584	1.8
392	45.0	792	16.9	1192	5.6	1592	1.7
400	44.2	800	16.5	1200	5.5	1600	1.7


SYSTEM RELIABILITY %
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25
20
15
10
5
0
0
170
340
510
680
850
1020
1190
1360
1530
1700
CONTINUOUS HOURS OF OPERATION

System Design Parameter Estimate Summary

System Parameter	Point Estimate
Mean-Time-Between-Failure	450.68 hours
Mean-Time-To-Repair	84.63 Minutes
Line Replaceable Unit Consumption Rate Per Thousand Hours of Operation	4.29 LRU's
Inherent Availability	99.69 %
Average Number of LRU's Replaced, Upon System Failure	1.42

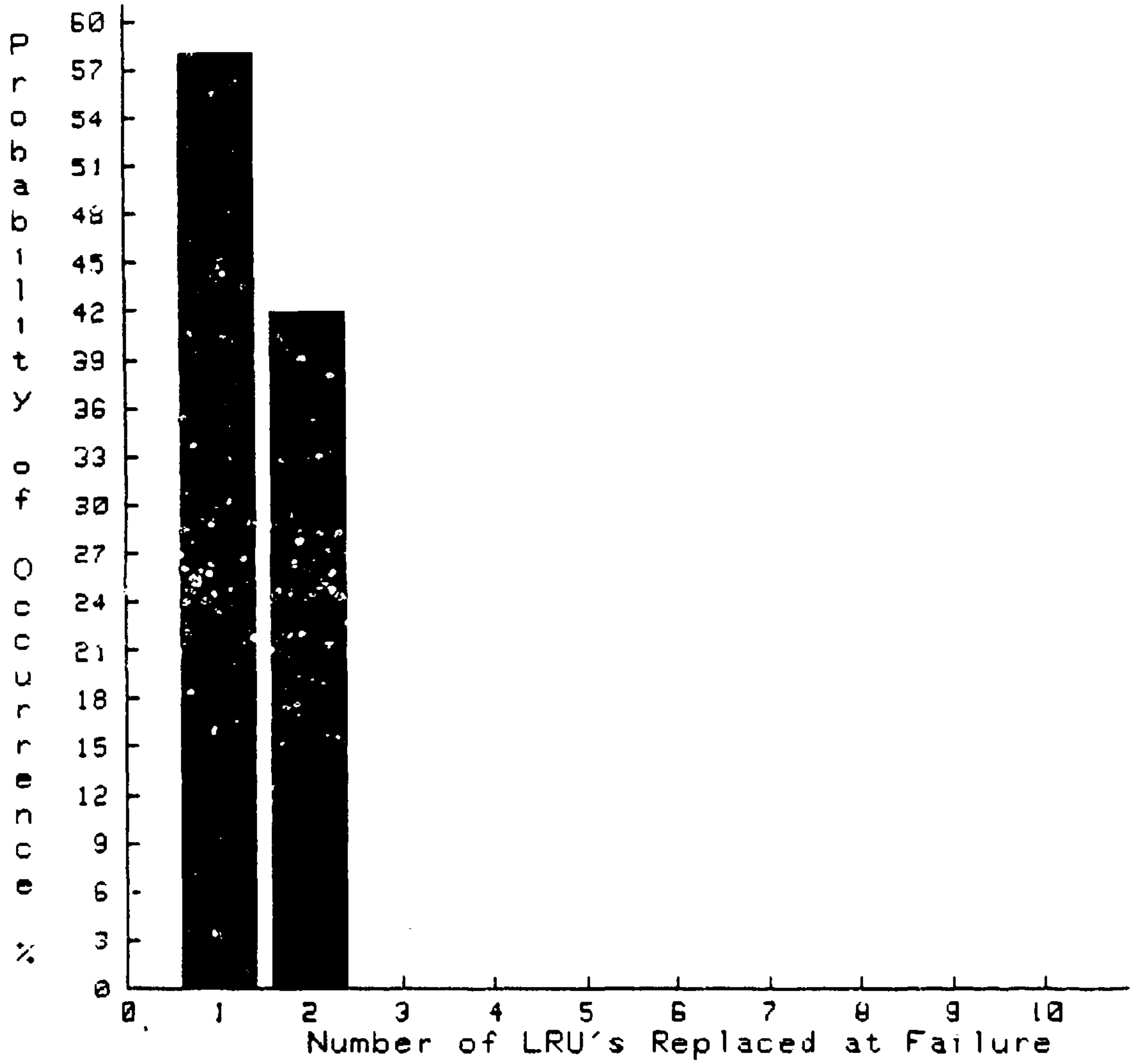
Configuration Analysis Output Summary

The Mean-Time-Between-Failure Predictions Itemized Below Are Based On The Assumption That No Repair Actions Are Initiated Prior To Configuration Failure. Upon Failure, The Configuration Is Totally Restored.

Configuration Name	MTBF (Hours)	MTTR (Minutes)	Inherent Availability (Percent)
Function 1	3847	120.72	99.94772
Function 2	3062	123.76	99.93268
Function 3	3113	138.21	99.92607
Function 4	2773	101.11	99.93927
Function 5	10774	35.00	99.99459
Function 6a	9955	61.00	99.98979
Function 6b	5765	94.00	99.98396
Function 7	5233	51.00	99.98376
Function 8	5805	64.00	99.98163
Function 9	9497	85.00	99.98508
Function 10a	6842	53.00	99.98709
Function 10b	7086	59.00	99.98612
Function 11a	8065	53.00	99.98905
Function 11b	8024	82.00	99.98297
Function 12	5675	47.00	99.98620
Function 13a	7092	51.00	99.98802
Function 13b	7207	45.00	99.98959

Probabilistic Line-Replaceable-Unit Consumption at Failure

The average number of LRU's replaced when the system fails is 1.42. The standard deviation of this random variable is .49. The distribution of this random variable is illustrated in the below figure.



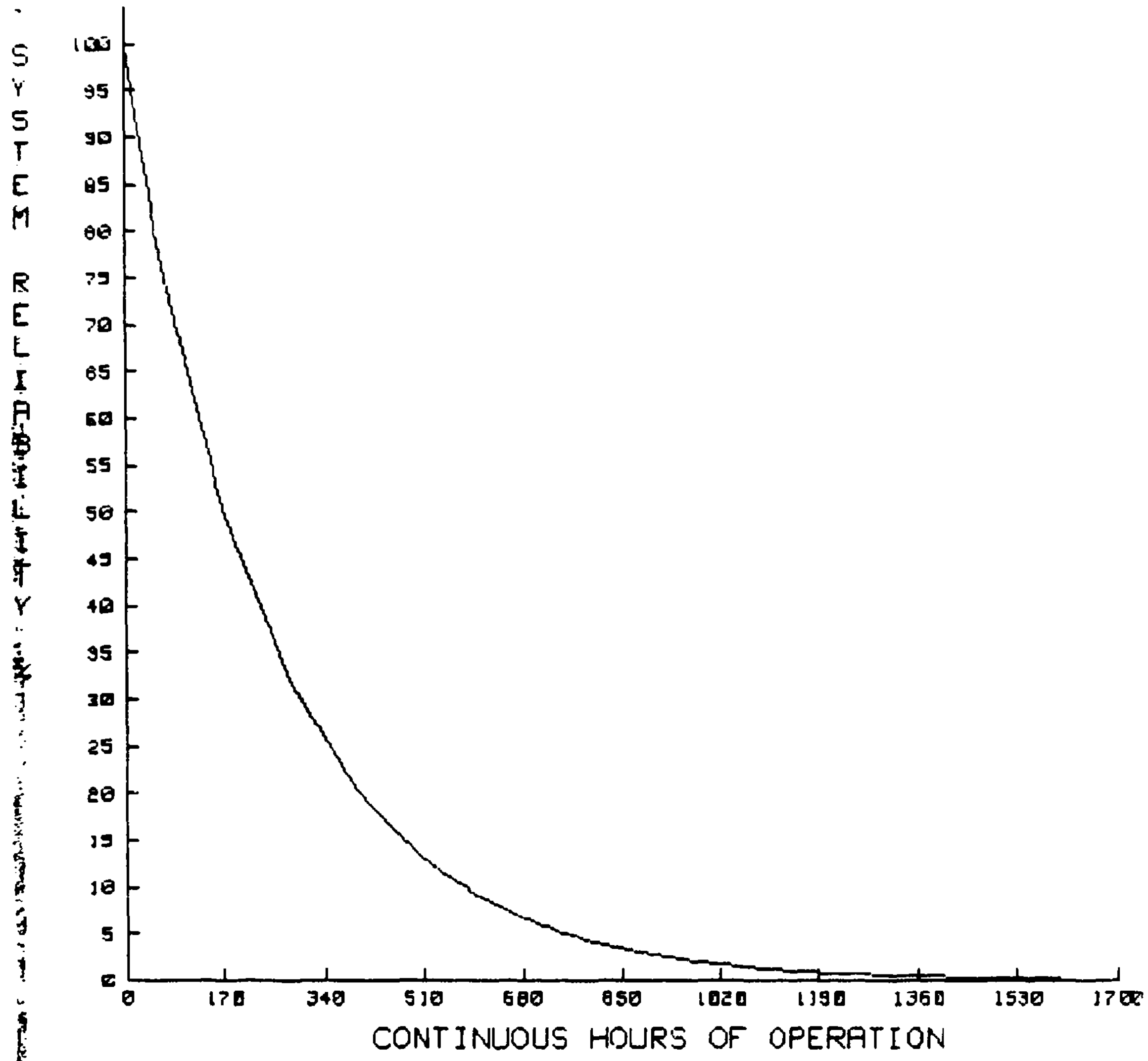
Number Of LRU's Replaced	1	2	3	4	5	6	7	8	9	10
Probability Of Occurrence (%)	58	42	0	0	0	0	0	0	0	0
Probability Of X or Less (%)	58	100	100	100	100	100	100	100	100	100

Appendix 12

SCRAPIRONS's Output For Design Configuration #10

System Reliability Predictions

Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)	Hours Of Continous Operation	R (%)
8	96.9	408	19.8	808	4.0	1208	.8
16	93.8	416	19.2	816	3.9	1216	.8
24	90.9	424	18.6	824	3.8	1224	.8
32	88.1	432	18.0	832	3.7	1232	.7
40	85.3	440	17.4	840	3.6	1240	.7
48	82.6	448	16.9	848	3.4	1248	.7
56	80.1	456	16.3	856	3.3	1256	.7
64	77.6	464	15.8	864	3.2	1264	.7
72	75.1	472	15.3	872	3.1	1272	.6
80	72.8	480	14.9	880	3.0	1280	.6
88	70.5	488	14.4	888	2.9	1288	.6
96	68.3	496	13.9	896	2.8	1296	.6
104	66.2	504	13.5	904	2.8	1304	.6
112	64.1	512	13.1	912	2.7	1312	.5
120	62.1	520	12.7	920	2.6	1320	.5
128	60.1	528	12.3	928	2.5	1328	.5
136	58.3	536	11.9	936	2.4	1336	.5
144	56.4	544	11.5	944	2.4	1344	.5
152	54.7	552	11.2	952	2.3	1352	.5
160	53.0	560	10.8	960	2.2	1360	.5
168	51.3	568	10.5	968	2.1	1368	.4
176	49.7	576	10.2	976	2.1	1376	.4
184	48.2	584	9.8	984	2.0	1384	.4
192	46.6	592	9.5	992	1.9	1392	.4
200	45.2	600	9.2	1000	1.9	1400	.4
208	43.8	608	8.9	1008	1.8	1408	.4
216	42.4	616	8.7	1016	1.8	1416	.4
224	41.1	624	8.4	1024	1.7	1424	.3
232	39.8	632	8.1	1032	1.7	1432	.3
240	38.6	640	7.9	1040	1.6	1440	.3
248	37.3	648	7.6	1048	1.6	1448	.3
256	36.2	656	7.4	1056	1.5	1456	.3
264	35.0	664	7.2	1064	1.5	1464	.3
272	34.0	672	6.9	1072	1.4	1472	.3
280	32.9	680	6.7	1080	1.4	1480	.3
288	31.9	688	6.5	1088	1.3	1488	.3
296	30.9	696	6.3	1096	1.3	1496	.3
304	29.9	704	6.1	1104	1.2	1504	.3
312	29.0	712	5.9	1112	1.2	1512	.2
320	28.1	720	5.7	1120	1.2	1520	.2
328	27.2	728	5.6	1128	1.1	1528	.2
336	26.3	736	5.4	1136	1.1	1536	.2
344	25.5	744	5.2	1144	1.1	1544	.2
352	24.7	752	5.0	1152	1.0	1552	.2
360	23.9	760	4.9	1160	1.0	1560	.2
368	23.2	768	4.7	1168	1.0	1568	.2
376	22.5	776	4.6	1176	.9	1576	.2
384	21.8	784	4.4	1184	.9	1584	.2
392	21.1	792	4.3	1192	.9	1592	.2
400	20.4	800	4.2	1200	.9	1600	.2


SYSTEM RELIABILITY
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
170
340
510
680
850
1020
1190
1360
1530
1700
CONTINUOUS HOURS OF OPERATION

System Design Parameter Estimate Summary

System Parameter	Point Estimate
Mean-Time-Between-Failure	251.79 hours
Mean-Time-To-Repair	60.08 Minutes
Line Replaceable Unit Consumption Rate Per Thousand Hours of Operation	3.97 LRU's
Inherent Availability	99.60 %
Average Number of LRU's Replaced, Upon System Failure	1.00

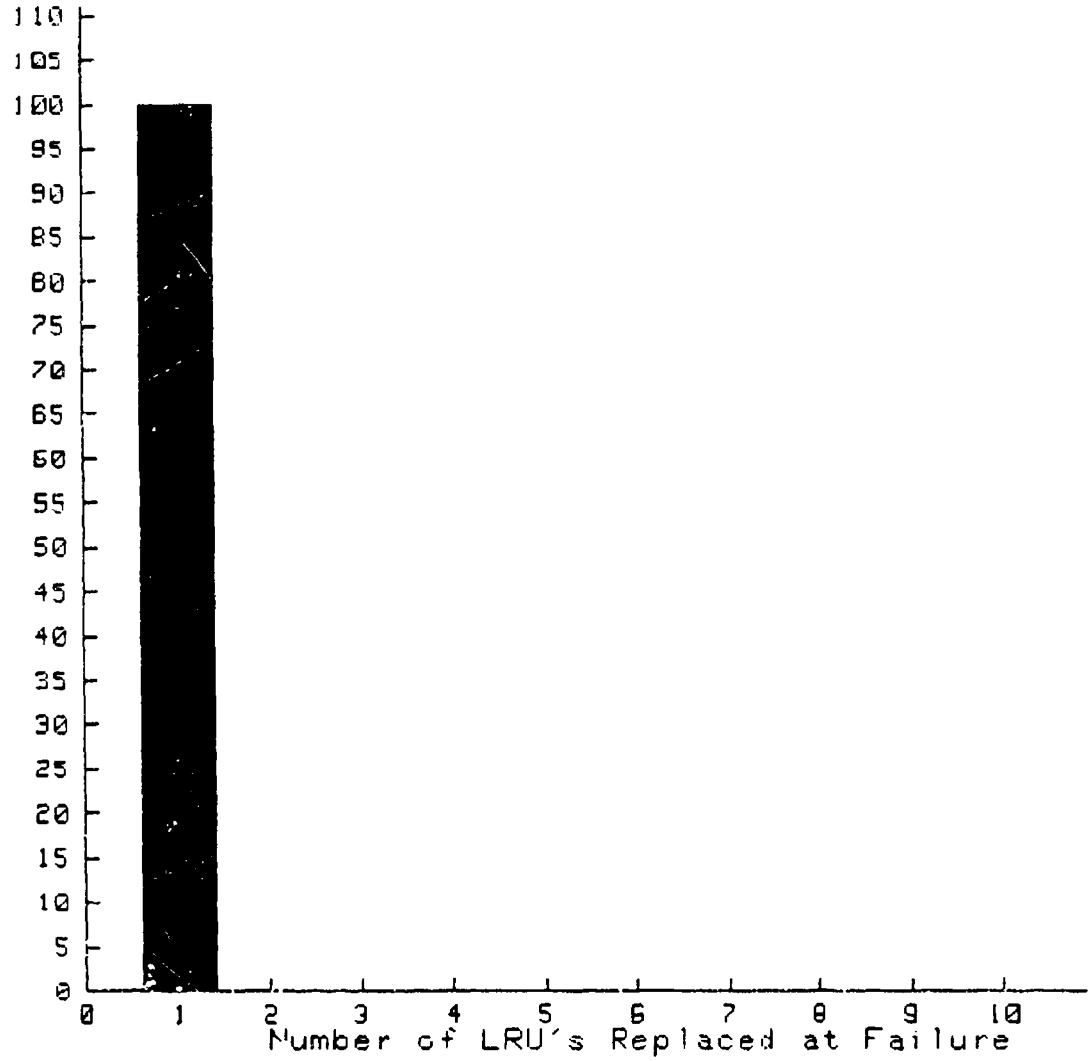
Configuration Analysis Output Summary

The Mean-Time-Between-Failure Predictions Itemized Below Are Based On The Assumption That No Repair Actions Are Initiated Prior To Configuration Failure. Upon Failure, The Configuration Is Totally Restored.

Configuration Name	MTBF (Hours)	MTTR (Minutes)	Inherent Availability (Percent)
Function 1a	4608	68.00	99.97541
Function 1b	4717	53.00	99.98128
Function 2a	5128	61.00	99.98018
Function 2b	5516	63.00	99.98097
Function 2c	5428	52.00	99.98404
Function 3a	7044	91.00	99.97847
Function 3b	6819	75.00	99.98167
Function 3c	7631	33.00	99.99279
Function 3d	6609	89.00	99.97756
Function 4a	7320	47.00	99.98930
Function 4b	7668	61.00	99.98674
Function 4c	7470	71.00	99.98416
Function 4d	7709	50.00	99.98919
Function 4e	8052	35.00	99.99275
Function 5	10774	35.00	99.99459
Function 6a	9955	61.00	99.98979
Function 6b	9765	94.00	99.98396
Function 7	5233	51.00	99.98376
Function 8	5805	64.00	99.98163
Function 9	9497	85.00	99.98508
Function 10a	6842	53.00	99.98709
Function 10b	7086	59.00	99.98613
Function 11a	8065	53.00	99.98905
Function 11b	8024	82.00	99.98297
Function 12	5675	47.00	99.98620
Function 13a	7092	51.00	99.98802
Function 13b	7207	45.00	99.98959

Probabilistic Line-Replaceable-Unit Consumption at Failure

The average number of LRU's replaced when the system fails is 1.00. The standard deviation of this random variable is 0.00. The distribution of this random variable is illustrated in the below figure.



Number Of LRU's Replaced	1	2	3	4	5	6	7	8	9	10
Probability Of Occurrence (%)	100	0	0	0	0	0	0	0	0	0
Probability Of X or Less (%)	100	100	100	100	100	100	100	100	100	100

Appendix 13

Summary LOGAM Output For The Ten Designs

System Maintenance Support Costs Specified In DCA-P-92(R) Format
Design #1 Case Totals - Costs Are Stated in Thousands of Dollars

Element Number	Cost Element Description	Estimated Cost	Percentage
1.0	DEVELOPMENT	XXXXXXXXXX	XXXXXXXXXX
1.011	ENGINEERING	0.00	100.00
>TOTAL<	....	0.00	100.00
2.0	PRODUCTION	XXXXXXXXXX	XXXXXXXXXX
2.011	INITIAL PRODUCTION FACILITIES (IPF)	30.78	1.83
2.021	MANUFACTURING	215.47	12.78
2.022	RECURRING ENGINEERING	61.56	3.65
2.04	DATA	31.20	1.85
2.07	INITIAL SPARES	1347.48	79.90
>TOTAL<	....	1686.50	100.00
3.0	MILITARY CONSTRUCTION	XXXXXXXXXX	XXXXXXXXXX
>TOTAL<	....	0.00	0.00
4.0	FIELDING	XXXXXXXXXX	XXXXXXXXXX
4.01	SYSTEM TESTING AND EVALUATION	0.00	0.00
4.02	TRAINING SERVICES AND EQUIPMENT	0.00	0.00
4.03	TRANSPORTATION	2.73	100.00
4.04	INITIAL REPAIR PARTS	0.00	0.00
4.05	SYSTEM SPECIFIC BASE OPERATING SUPPORT	0.00	0.00
4.06	OTHER O&M FUNDED FIELDING	0.00	0.00
>TOTAL<	....	2.73	100.00
5.0	SUSTAINMENT	XXXXXXXXXX	XXXXXXXXXX
5.01	REPLENISHMENT	XXXXXXXXXX	XXXXXXXXXX
5.011	REPLENISHMENT REPAIR PARTS	0.00	0.00
5.012	REPLENISHMENT SPARES	469.16	2.25
5.013	WAR RESERVE REPAIR PARTS	0.00	0.00
5.014	WAR RESERVE SPARES	0.00	0.00
5.02	PETROLEUM, OILS AND LUBRICANTS (POL)	0.00	0.00
5.03	AMMUNITION	XXXXXXXXXX	XXXXXXXXXX
5.031	TRAINING AMMUNITION/MISSILES	0.00	0.00
5.032	WAR RESERVE AMMUNITION/MISSILES	0.00	0.00
5.04	DEPOT MAINTENANCE	XXXXXXXXXX	XXXXXXXXXX
5.041	CIVILIAN LABOR	889.79	4.27
5.042	MATERIEL (OM)	45	.00
5.043	MATERIEL (PROC)	4.05	.02
5.044	SUPPORT ACTIVITY	0.00	0.00
5.05	FIELD MAINTENANCE CIVILIAN LABOR	0.00	0.00
5.06	TRANSPORTATION	674.51	3.23
5.07	SYSTEM SPECIFIC REPLACEMENT TRAINING SERVICES	XXXXXXXXXX	XXXXXXXXXX
5.071	AMMUNITION/MISSILES/EQUIPMENT	278.47	1.34
5.072	SERVICES	30.94	.15
5.08	MILITARY PERSONNEL	XXXXXXXXXX	XXXXXXXXXX
5.081	CREW PAY AND ALLOWANCES	0.00	0.00
5.082	MAINTENANCE PAY AND ALLOWANCES	945.61	4.53
5.083	SYSTEM SPECIFIC SUPPORT PAY AND ALLOWANCES	0.00	0.00
5.084	TRAINEE/TRAINER PAY AND ALLOWANCES	0.00	0.00
5.085	SYSTEM PROJECT MANAGEMENT PAY AND ALLOWANCES	0.00	0.00
5.086	PERMANENT CHANGE OF STATION (PCS)	0.00	0.00
5.087	OTHER MPA FUNDED SUSTAINMENT	0.00	0.00
5.09	SYSTEM PROJECT MANAGEMENT CIVILIANS	0.00	0.00
5.10	MODIFICATION/KITS	0.00	0.00
5.11	OTHER SUSTAINMENT	XXXXXXXXXX	XXXXXXXXXX
5.111	OTHER O&M SUSTAINING FUNDED	27.03	.13
5.112	OTHER PROCUREMENT FUNDED SUSTAINING	17537.47	84.08
>TOTAL<	....	20857.47	100.00
*******	> TOTAL LIFE CYCLE COST	22546.71	**********

System Maintenance Support Costs Specified In DCA-P-92(R) Format
Design 2 Case Totals - Costs Are Stated in Thousands of Dollars

Element Number	Cost Element Description	Estimated Cost	Percentage
1.0	DEVELOPMENT	XXXXXXXXXX	XXXXXXXXXX
1.011	ENGINEERING	0.00	100.00
>TOTAL<	....	0.00	100.00
2.0	PRODUCTION	XXXXXXXXXX	XXXXXXXXXX
2.011	INITIAL PRODUCTION FACILITIES (IPF)	29.66	1.79
2.021	MANUFACTURING	207.65	12.53
2.022	RECURRING ENGINEERING	59.33	3.58
2.04	DATA	30.00	1.81
2.07	INITIAL SPARES	1331.15	80.30
>TOTAL<	....	1657.79	100.00
3.0	MILITARY CONSTRUCTION	XXXXXXXXXX	XXXXXXXXXX
>TOTAL<	....	0.00	0.00
4.0	FIELDING	XXXXXXXXXX	XXXXXXXXXX
4.01	SYSTEM TESTING AND EVALUATION	0.00	0.00
4.02	TRAINING SERVICES AND EQUIPMENT	0.00	0.00
4.03	TRANSPORTATION	2.86	100.00
4.04	INITIAL REPAIR PARTS	0.00	0.00
4.05	SYSTEM SPECIFIC BASE OPERATING SUPPORT	0.00	0.00
4.06	OTHER O&M FUNDED FIELDING	0.00	0.00
>TOTAL<	....	2.86	100.00
5.0	SUSTAINMENT	XXXXXXXXXX	XXXXXXXXXX
5.01	REPLENISHMENT	XXXXXXXXXX	XXXXXXXXXX
5.011	REPLENISHMENT REPAIR PARTS	0.00	0.00
5.012	REPLENISHMENT SPARES	477.78	2.34
5.013	WAR RESERVE REPAIR PARTS	0.00	0.00
5.014	WAR RESERVE SPARES	0.00	0.00
5.02	PETROLEUM, OILS AND LUBRICANTS (POL)	0.00	0.00
5.03	AMMUNITION	XXXXXXXXXX	XXXXXXXXXX
5.031	TRAINING AMMUNITION/MISSILES	0.00	0.00
5.032	WAR RESERVE AMMUNITION/MISSILES	0.00	0.00
5.04	DEPOT MAINTENANCE	XXXXXXXXXX	XXXXXXXXXX
5.041	CIVILIAN LABOR	857.48	4.20
5.042	MATERIEL (OM)	.43	.00
5.043	MATERIEL (PROC)	3.91	.02
5.044	SUPPORT ACTIVITY	0.00	0.00
5.05	FIELD MAINTENANCE CIVILIAN LABOR	0.00	0.00
5.06	TRANSPORTATION	708.30	3.47
5.07	SYSTEM SPECIFIC REPLACEMENT TRAINING SERVICES	XXXXXXXXXX	XXXXXXXXXX
5.071	AMMUNITION/MISSILES/EQUIPMENT	254.38	1.24
5.072	SERVICES	28.26	.14
5.08	MILITARY PERSONNEL	XXXXXXXXXX	XXXXXXXXXX
5.081	CREW PAY AND ALLOWANCES	0.00	0.00
5.082	MAINTENANCE PAY AND ALLOWANCES	855.80	4.19
5.083	SYSTEM SPECIFIC SUPPORT PAY AND ALLOWANCES	0.00	0.00
5.084	TRAINEE/TRAINER PAY AND ALLOWANCES	0.00	0.00
5.085	SYSTEM PROJECT MANAGEMENT PAY AND ALLOWANCES	0.00	0.00
5.086	PERMANENT CHANGE OF STATION (PCS)	0.00	0.00
5.087	OTHER MPA FUNDED SUSTAINMENT	0.00	0.00
5.09	SYSTEM PROJECT MANAGEMENT CIVILIANS	0.00	0.00
5.10	MODIFICATION/KITS	0.00	0.00
5.11	OTHER SUSTAINMENT	XXXXXXXXXX	XXXXXXXXXX
5.111	OTHER O&M SUSTAINING FUNDED	26.95	.13
5.112	OTHER PROCUREMENT FUNDED SUSTAINING	17224.87	84.28
>TOTAL<	....	20437.28	100.00
*******	> TOTAL LIFE CYCLE COST	22097.92	**********

System Maintenance Support Costs Specified In DCA-P-92(R) Format			
Design 3	Case Totals - Costs Are Stated in Thousands of Dollars		
Element Number	Cost Element Description	Estimated Cost	Percentage
1.0	DEVELOPMENT	XXXXXXXXXX	XXXXXXXXXX
1.011	ENGINEERING	0.00	100.00
>TOTAL<	....	0.00	100.00
2.0	PRODUCTION	XXXXXXXXXX	XXXXXXXXXX
2.011	INITIAL PRODUCTION FACILITIES (IPF)	29.17	1.93
2.021	MANUFACTURING	204.18	13.49
2.022	RECURRING ENGINEERING	58.34	3.85
2.04	DATA	28.80	1.90
2.07	INITIAL SPARES	1193.53	78.83
>TOTAL<	....	1514.03	100.00
3.0	MILITARY CONSTRUCTION	XXXXXXXXXX	XXXXXXXXXX
>TOTAL<	....	0.00	0.00
4.0	FIELDING	XXXXXXXXXX	XXXXXXXXXX
4.01	SYSTEM TESTING AND EVALUATION	0.00	0.00
4.02	TRAINING SERVICES AND EQUIPMENT	0.00	0.00
4.03	TRANSPORTATION	2.17	100.00
4.04	INITIAL REPAIR PARTS	0.00	0.00
4.05	SYSTEM SPECIFIC BASE OPERATING SUPPORT	0.00	0.00
4.06	OTHER O&M FUNDED FIELDING	0.00	0.00
>TOTAL<	....	2.17	100.00
5.0	SUSTAINMENT	XXXXXXXXXX	XXXXXXXXXX
5.01	REPLENISHMENT	XXXXXXXXXX	XXXXXXXXXX
5.011	REPLENISHMENT REPAIR PARTS	0.00	0.00
5.012	REPLENISHMENT SPARES	386.60	2.14
5.013	WAR RESERVE REPAIR PARTS	0.00	0.00
5.014	WAR RESERVE SPARES	0.00	0.00
5.02	PETROLEUM, OILS AND LUBRICANTS (POL)	0.00	0.00
5.03	AMMUNITION	XXXXXXXXXX	XXXXXXXXXX
5.031	TRAINING AMMUNITION/MISSILES	0.00	0.00
5.032	WAR RESERVE AMMUNITION/MISSILES	0.00	0.00
5.04	DEPOT MAINTENANCE	XXXXXXXXXX	XXXXXXXXXX
5.041	CIVILIAN LABOR	843.17	4.67
5.042	MATERIEL (OM)	.43	.00
5.043	MATERIEL (PROC)	3.84	.02
5.044	SUPPORT ACTIVITY	0.00	0.00
5.05	FIELD MAINTENANCE CIVILIAN LABOR	0.00	0.00
5.06	TRANSPORTATION	534.54	2.96
5.07	SYSTEM SPECIFIC REPLACEMENT TRAINING SERVICES	XXXXXXXXXX	XXXXXXXXXX
5.071	AMMUNITION/MISSILES/EQUIPMENT	225.33	1.25
5.072	SERVICES	25.04	.14
5.08	MILITARY PERSONNEL	XXXXXXXXXX	XXXXXXXXXX
5.081	CREW PAY AND ALLOWANCES	0.00	0.00
5.082	MAINTENANCE PAY AND ALLOWANCES	743.03	4.12
5.083	SYSTEM SPECIFIC SUPPORT PAY AND ALLOWANCES	0.00	0.00
5.084	TRAINEE/TRAINER PAY AND ALLOWANCES	0.00	0.00
5.085	SYSTEM PROJECT MANAGEMENT PAY AND ALLOWANCES	0.00	0.00
5.086	PERMANENT CHANGE OF STATION (PCS)	0.00	0.00
5.087	OTHER MPA FUNDED SUSTAINMENT	0.00	0.00
5.09	SYSTEM PROJECT MANAGEMENT CIVILIANS	0.00	0.00
5.10	MODIFICATION/KITS	0.00	0.00
5.11	OTHER SUSTAINMENT	XXXXXXXXXX	XXXXXXXXXX
5.111	OTHER O&M SUSTAINING FUNDED	25.61	.14
5.112	OTHER PROCUREMENT FUNDED SUSTAINING	15261.54	84.56
>TOTAL<	....	18049.13	100.00
*******	TOTAL LIFE CYCLE COST	19565.33	**********

System Maintenance Support Costs Specified In DCA-P-92(R) Format			
Design 4	Case Totals - Costs Are Stated in Thousands of Dollars		
Element Number	Cost Element Description	Estimated Cost	Percentage
1.0	DEVELOPMENT	XXXXXXXXXX	XXXXXXXXXX
1.011	ENGINEERING	0.00	100.00
>TOTAL<	....	0.00	100.00
2.0	PRODUCTION	XXXXXXXXXX	XXXXXXXXXX
2.011	INITIAL PRODUCTION FACILITIES (IPF)	29.31	1.92
2.021	MANUFACTURING	205.15	13.42
2.022	RECURRING ENGINEERING	58.61	3.84
2.04	DATA	28.80	1.88
2.07	INITIAL SPARES	1206.51	78.94
>TOTAL<	....	1528.38	100.00
3.0	MILITARY CONSTRUCTION	XXXXXXXXXX	XXXXXXXXXX
>TOTAL<	....	0.00	0.00
4.9	FIELDING	XXXXXXXXXX	XXXXXXXXXX
4.01	SYSTEM TESTING AND EVALUATION	0.00	0.00
4.02	TRAINING SERVICES AND EQUIPMENT	0.00	0.00
4.03	TRANSPORTATION	2.17	100.00
4.04	INITIAL REPAIR PARTS	0.00	0.00
4.05	SYSTEM SPECIFIC BASE OPERATING SUPPORT	0.00	0.00
4.06	OTHER O&M FUNDED FIELDING	0.00	0.00
>TOTAL<	....	2.17	100.00
5.0	SUSTAINMENT	XXXXXXXXXX	XXXXXXXXXX
5.01	REPLENISHMENT	XXXXXXXXXX	XXXXXXXXXX
5.011	REPLENISHMENT REPAIR PARTS	0.00	0.00
5.012	REPLENISHMENT SPARES	388.60	2.16
5.013	WAR RESERVE REPAIR PARTS	0.00	0.00
5.014	WAR RESERVE SPARES	0.00	0.00
5.02	PETROLEUM, OILS AND LUBRICANTS (POL)	0.00	0.00
5.03	AMMUNITION	XXXXXXXXXX	XXXXXXXXXX
5.031	TRAINING AMMUNITION/MISSILES	0.00	0.00
5.032	WAR RESERVE AMMUNITION/MISSILES	0.00	0.00
5.04	DEPOT MAINTENANCE	XXXXXXXXXX	XXXXXXXXXX
5.041	CIVILIAN LABOR	847.15	4.70
5.042	MATERIEL (OM)	.43	.00
5.043	MATERIEL (PROC)	3.86	.02
5.044	SUPPORT ACTIVITY	0.00	0.00
5.05	FIELD MAINTENANCE CIVILIAN LABOR	0.00	0.00
5.06	TRANSPORTATION	534.08	2.97
5.07	SYSTEM SPECIFIC REPLACEMENT TRAINING SERVICES	XXXXXXXXXX	XXXXXXXXXX
5.071	AMMUNITION/MISSILES/EQUIPMENT	216.19	1.20
5.072	SERVICES	24.02	.13
5.08	MILITARY PERSONNEL	XXXXXXXXXX	XXXXXXXXXX
5.081	CREW PAY AND ALLOWANCES	0.00	0.00
5.082	MAINTENANCE PAY AND ALLOWANCES	706.03	3.92
5.083	SYSTEM SPECIFIC SUPPORT PAY AND ALLOWANCES	0.00	0.00
5.084	TRAINEE/TRAINER PAY AND ALLOWANCES	0.00	0.00
5.085	SYSTEM PROJECT MANAGEMENT PAY AND ALLOWANCES	0.00	0.00
5.086	PERMANENT CHANGE OF STATION (PCS)	0.00	0.00
5.087	OTHER MPA FUNDED SUSTAINMENT	0.00	0.00
5.09	SYSTEM PROJECT MANAGEMENT CIVILIANS	0.00	0.00
5.10	MODIFICATION/KITS	0.00	0.00
5.11	OTHER SUSTAINMENT	XXXXXXXXXX	XXXXXXXXXX
5.111	OTHER O&M SUSTAINING FUNDED	25.73	.14
5.112	OTHER PROCUREMENT FUNDED SUSTAINING	15263.73	84.75
>TOTAL<	....	18009.84	100.00
*******	> TOTAL LIFE CYCLE COST	19540.39	**********

System Maintenance Support Costs Specified In DCA-P-92(R) Format Design 5 Case Totals - Costs Are Stated in Thousands of Dollars			
Element Number	Cost Element Description	Estimated Cost	Percentage
1.0	DEVELOPMENT	XXXXXXXXXX	XXXXXXXXXX
1.011	ENGINEERING	0.00	100.00
>TOTAL<	....	0.00	100.00
2.0	PRODUCTION	XXXXXXXXXX	XXXXXXXXXX
2.011	INITIAL PRODUCTION FACILITIES (IPF)	28.18	1.96
2.021	MANUFACTURING	197.23	13.72
2.022	RECURRING ENGINEERING	56.35	3.92
2.04	DATA	27.60	1.92
2.07	INITIAL SPARES	1128.70	78.49
>TOTAL<	....	1438.05	100.00
3.0	MILITARY CONSTRUCTION	XXXXXXXXXX	XXXXXXXXXX
>TOTAL<	....	0.00	0.00
4.0	FIELDING	XXXXXXXXXX	XXXXXXXXXX
4.01	SYSTEM TESTING AND EVALUATION	0.00	0.00
4.02	TRAINING SERVICES AND EQUIPMENT	0.00	0.00
4.03	TRANSPORTATION	2.09	100.00
4.04	INITIAL REPAIR PARTS	0.00	0.00
4.05	SYSTEM SPECIFIC BASE OPERATING SUPPORT	0.00	0.00
4.06	OTHER O&M FUNDED FIELDING	0.00	0.00
>TOTAL<	....	2.09	100.00
5.0	SUSTAINMENT	XXXXXXXXXX	XXXXXXXXXX
5.01	REPLENISHMENT	XXXXXXXXXX	XXXXXXXXXX
5.011	REPLENISHMENT REPAIR PARTS	0.00	0.00
5.012	REPLENISHMENT SPARES	368.35	2.12
5.013	WAR RESERVE REPAIR PARTS	0.00	0.00
5.014	WAR RESERVE SPARES	0.00	0.00
5.02	PETROLEUM, OILS AND LUBRICANTS (POL)	0.00	0.00
5.03	AMMUNITION	XXXXXXXXXX	XXXXXXXXXX
5.031	TRAINING AMMUNITION/MISSILES	0.00	0.00
5.032	WAR RESERVE AMMUNITION/MISSILES	0.00	0.00
5.04	DEPOT MAINTENANCE	XXXXXXXXXX	XXXXXXXXXX
5.041	CIVILIAN LABOR	814.45	4.68
5.042	MATERIEL (OM)	.41	.00
5.043	MATERIEL (PROC)	3.71	.02
5.044	SUPPORT ACTIVITY	0.00	0.00
5.05	FIELD MAINTENANCE CIVILIAN LABOR	0.00	0.00
5.06	TRANSPORTATION	515.37	2.96
5.07	SYSTEM SPECIFIC REPLACEMENT TRAINING SERVICES	XXXXXXXXXX	XXXXXXXXXX
5.071	AMMUNITION/MISSILES/EQUIPMENT	198.42	1.14
5.072	SERVICES	22.05	.13
5.08	MILITARY PERSONNEL	XXXXXXXXXX	XXXXXXXXXX
5.081	CREW PAY AND ALLOWANCES	0.00	0.00
5.082	MAINTENANCE PAY AND ALLOWANCES	641.35	3.68
5.083	SYSTEM SPECIFIC SUPPORT PAY AND ALLOWANCES	0.00	0.00
5.084	TRAINEE/TRAINER PAY AND ALLOWANCES	0.00	0.00
5.085	SYSTEM PROJECT MANAGEMENT PAY AND ALLOWANCES	0.00	0.00
5.086	PERMANENT CHANGE OF STATION (PCS)	0.00	0.00
5.087	OTHER MPA FUNDED SUSTAINMENT	0.00	0.00
5.09	SYSTEM PROJECT MANAGEMENT CIVILIANS	0.00	0.00
5.10	MODIFICATION/KITS	0.00	0.00
5.11	OTHER SUSTAINMENT	XXXXXXXXXX	XXXXXXXXXX
5.111	OTHER O&M SUSTAINING FUNDED	24.74	.14
5.112	OTHER PROCUREMENT FUNDED SUSTAINING	14815.57	85.13
>TOTAL<	....	17404.43	100.00
*******	> TOTAL LIFE CYCLE COST	18844.57	**********

System Maintenance Support Costs Specified In DCA-P-92(R) Format
Design 6 Case Totals - Costs Are Stated in Thousands of Dollars

Element Number	Cost Element Description	Estimated Cost	Percentage
1.0	DEVELOPMENT	XXXXXXXXXX	XXXXXXXXXX
1.011	ENGINEERING	0.00	100.00
>TOTAL<	....	0.00	100.00
2.0	PRODUCTION	XXXXXXXXXX	XXXXXXXXXX
2.011	INITIAL PRODUCTION FACILITIES (IPF)	27.39	1.97
2.021	MANUFACTURING	191.75	13.79
2.022	RECURRING ENGINEERING	54.79	3.94
2.04	DATA	25.20	1.81
2.07	INITIAL SPARES	1091.22	78.49
>TOTAL<	....	1390.35	100.00
3.0	MILITARY CONSTRUCTION	XXXXXXXXXX	XXXXXXXXXX
>TOTAL<	....	0.00	0.00
4.0	FIELDING	XXXXXXXXXX	XXXXXXXXXX
4.01	SYSTEM TESTING AND EVALUATION	0.00	0.00
4.02	TRAINING SERVICES AND EQUIPMENT	0.00	0.00
4.03	TRANSPORTATION	2.04	100.00
4.04	INITIAL REPAIR PARTS	0.00	0.00
4.05	SYSTEM SPECIFIC BASE OPERATING SUPPORT	0.00	0.00
4.06	OTHER O&M FUNDED FIELDING	0.00	0.00
>TOTAL<	....	2.04	100.00
5.0	SUSTAINMENT	XXXXXXXXXX	XXXXXXXXXX
5.01	REPLENISHMENT	XXXXXXXXXX	XXXXXXXXXX
5.011	REPLENISHMENT REPAIR PARTS	0.00	0.00
5.012	REPLENISHMENT SPARES	355.03	2.16
5.013	WAR RESERVE REPAIR PARTS	0.00	0.00
5.014	WAR RESERVE SPARES	0.00	0.00
5.02	PETROLEUM, OILS AND LUBRICANTS (POL)	0.00	0.00
5.03	AMMUNITION	XXXXXXXXXX	XXXXXXXXXX
5.031	TRAINING AMMUNITION/MISSILES	0.00	0.00
5.032	WAR RESERVE AMMUNITION/MISSILES	0.00	0.00
5.04	DEPOT MAINTENANCE	XXXXXXXXXX	XXXXXXXXXX
5.041	CIVILIAN LABOR	791.82	4.82
5.042	MATERIEL (OM)	.40	.00
5.043	MATERIEL (PROC)	3.61	.02
5.044	SUPPORT ACTIVITY	0.00	0.00
5.05	FIELD MAINTENANCE CIVILIAN LABOR	0.00	0.00
5.06	TRANSPORTATION	503.56	3.07
5.07	SYSTEM SPECIFIC REPLACEMENT TRAINING SERVICES	XXXXXXXXXX	XXXXXXXXXX
5.071	AMMUNITION/MISSILES/EQUIPMENT	183.54	1.12
5.072	SERVICES	20.39	.12
5.08	MILITARY PERSONNEL	XXXXXXXXXX	XXXXXXXXXX
5.081	CREW PAY AND ALLOWANCES	0.00	0.00
5.082	MAINTENANCE PAY AND ALLOWANCES	586.36	3.57
5.083	SYSTEM SPECIFIC SUPPORT PAY AND ALLOWANCES	0.00	0.00
5.084	TRAINEE/TRAINER PAY AND ALLOWANCES	0.00	0.00
5.085	SYSTEM PROJECT MANAGEMENT PAY AND ALLOWANCES	0.00	0.00
5.086	PERMANENT CHANGE OF STATION (PCS)	0.00	0.00
5.087	OTHER MPA FUNDED SUSTAINMENT	0.00	0.00
5.09	SYSTEM PROJECT MANAGEMENT CIVILIANS	0.00	0.00
5.10	MODIFICATION/KITS	0.00	0.00
5.11	OTHER SUSTAINMENT	XXXXXXXXXX	XXXXXXXXXX
5.111	OTHER O&M SUSTAINING FUNDED	24.05	.15
5.112	OTHER PROCUREMENT FUNDED SUSTAINING	13951.93	84.97
>TOTAL<	....	16420.71	100.00
*******	TOTAL LIFE CYCLE COST	17813.10	**********

System Maintenance Support Costs Specified In DCA-F-92(R) Format			
Design 7	Case Totals - Costs Are Stated in Thousands of Dollars		
Element Number	Cost Element Description	Estimated Cost	Percentage
1.0	DEVELOPMENT	XXXXXXXXXX	XXXXXXXXXX
1.011	ENGINEERING	0.00	100.00
>TOTAL<	....	0.00	100.00
2.0	PRODUCTION	XXXXXXXXXX	XXXXXXXXXX
2.011	INITIAL PRODUCTION FACILITIES (IPF)	26.72	1.94
2.021	MANUFACTURING	187.02	13.55
2.022	RECURRING ENGINEERING	53.43	3.87
2.04	DATA	22.80	1.65
2.07	INITIAL SPARES	1090.34	78.99
>TOTAL<	....	1380.30	100.00
3.0	MILITARY CONSTRUCTION	XXXXXXXXXX	XXXXXXXXXX
>TOTAL<	....	0.00	0.00
4.0	FIELDING	XXXXXXXXXX	XXXXXXXXXX
4.01	SYSTEM TESTING AND EVALUATION	0.00	0.00
4.02	TRAINING SERVICES AND EQUIPMENT	0.00	0.00
4.03	TRANSPORTATION	2.03	100.00
4.04	INITIAL REPAIR PARTS	0.00	0.00
4.05	SYSTEM SPECIFIC BASE OPERATING SUPPORT	0.00	0.00
4.06	OTHER O&M FUNDED FIELDING	0.00	0.00
>TOTAL<	....	2.03	100.00
5.0	SUSTAINMENT	XXXXXXXXXX	XXXXXXXXXX
5.01	REPLENISHMENT	XXXXXXXXXX	XXXXXXXXXX
5.011	REPLENISHMENT REPAIR PARTS	0.00	0.00
5.012	REPLENISHMENT SPARES	354.27	2.38
5.013	WAR RESERVE REPAIR PARTS	0.00	0.00
5.014	WAR RESERVE SPARES	0.00	0.00
5.02	PETROLEUM, OILS AND LUBRICANTS (POL)	0.00	0.00
5.03	AMMUNITION	XXXXXXXXXX	XXXXXXXXXX
5.031	TRAINING AMMUNITION/MISSILES	0.00	0.00
5.032	WAR RESERVE AMMUNITION/MISSILES	0.00	0.00
5.04	DEPOT MAINTENANCE	XXXXXXXXXX	XXXXXXXXXX
5.041	CIVILIAN LABOR	772.28	5.19
5.042	MATERIEL (OM)	.39	.00
5.043	MATERIEL (PROC)	3.52	.02
5.044	SUPPORT ACTIVITY	0.00	0.00
5.05	FIELD MAINTENANCE CIVILIAN LABOR	0.00	0.00
5.06	TRANSPORTATION	500.72	3.37
5.07	SYSTEM SPECIFIC REPLACEMENT TRAINING SERVICES	XXXXXXXXXX	XXXXXXXXXX
5.071	AMMUNITION/MISSILES/EQUIPMENT	163.00	1.10
5.072	SERVICES	18.11	.12
5.08	MILITARY PERSONNEL	XXXXXXXXXX	XXXXXXXXXX
5.081	CREW PAY AND ALLOWANCES	0.00	0.00
5.082	MAINTENANCE PAY AND ALLOWANCES	508.32	3.42
5.083	SYSTEM SPECIFIC SUPPORT PAY AND ALLOWANCES	0.00	0.00
5.084	TRAINEE/TRAINER PAY AND ALLOWANCES	0.00	0.00
5.085	SYSTEM PROJECT MANAGEMENT PAY AND ALLOWANCES	0.00	0.00
5.086	PERMANENT CHANGE OF STATION (PCS)	0.00	0.00
5.087	OTHER MPA FUNDED SUSTAINMENT	0.00	0.00
5.09	SYSTEM PROJECT MANAGEMENT CIVILIANS	0.00	0.00
5.10	MODIFICATION/KITS	0.00	0.00
5.11	OTHER SUSTAINMENT	XXXXXXXXXX	XXXXXXXXXX
5.111	OTHER O&M SUSTAINING FUNDED	23.46	.16
5.112	OTHER PROCUREMENT FUNDED SUSTAINING	12533.99	84.24
>TOTAL<	....	14878.06	100.00
*******	> TOTAL LIFE CYCLE COST <	16260.39	**********

System Maintenance Support Costs Specified In DCA-P-92(R) Format			
Design 8	Case Totals - Costs Are Stated in Thousands of Dollars		
Element Number	Cost Element Description	Estimated Cost	Percentage
1.0	DEVELOPMENT	XXXXXXXXXX	XXXXXXXXXX
1.011	ENGINEERING	0.00	100.00
>TOTAL<	....	0.00	100.00
2.0	PRODUCTION	XXXXXXXXXX	XXXXXXXXXX
2.011	INITIAL PRODUCTION FACILITIES (IPF)	24.42	1.93
2.021	MANUFACTURING	170.93	13.54
2.022	RECURRING ENGINEERING	48.84	3.87
2.04	DATA	20.40	1.62
2.07	INITIAL SPARES	997.94	79.04
>TOTAL<	....	1262.52	100.00
3.0	MILITARY CONSTRUCTION	XXXXXXXXXX	XXXXXXXXXX
>TOTAL<	....	0.00	0.00
4.0	FIELDING	XXXXXXXXXX	XXXXXXXXXX
4.01	SYSTEM TESTING AND EVALUATION	0.00	0.00
4.02	TRAINING SERVICES AND EQUIPMENT	0.00	0.00
4.03	TRANSPORTATION	1.84	100.00
4.04	INITIAL REPAIR PARTS	0.00	0.00
4.05	SYSTEM SPECIFIC BASE OPERATING SUPPORT	0.00	0.00
4.06	OTHER O&M FUNDED FIELDING	0.00	0.00
>TOTAL<	....	1.84	100.00
5.0	SUSTAINMENT	XXXXXXXXXX	XXXXXXXXXX
5.01	REPLENISHMENT	XXXXXXXXXX	XXXXXXXXXX
5.011	REPLENISHMENT REPAIR PARTS	0.00	0.00
5.012	REPLENISHMENT SPARES	324.42	2.39
5.013	WAR RESERVE REPAIR PARTS	0.00	0.00
5.014	WAR RESERVE SPARES	0.00	0.00
5.02	PETROLEUM, OILS AND LUBRICANTS (POL)	0.00	0.00
5.03	AMMUNITION	XXXXXXXXXX	XXXXXXXXXX
5.031	TRAINING AMMUNITION/MISSILES	0.00	0.00
5.032	WAR RESERVE AMMUNITION/MISSILES	0.00	0.00
5.04	DEPOT MAINTENANCE	XXXXXXXXXX	XXXXXXXXXX
5.041	CIVILIAN LABOR	705.85	5.20
5.042	MATERIEL (OM)	.36	.00
5.043	MATERIEL (PROC)	3.22	.02
5.044	SUPPORT ACTIVITY	0.00	0.00
5.05	FIELD MAINTENANCE CIVILIAN LABOR	0.00	0.00
5.06	TRANSPORTATION	453.84	3.34
5.07	SYSTEM SPECIFIC REPLACEMENT TRAINING SERVICES	XXXXXXXXXX	XXXXXXXXXX
5.071	AMMUNITION/MISSILES/EQUIPMENT	136.34	1.00
5.072	SERVICES	15.15	.11
5.08	MILITARY PERSONNEL	XXXXXXXXXX	XXXXXXXXXX
5.081	CREW PAY AND ALLOWANCES	0.00	0.00
5.082	MAINTENANCE PAY AND ALLOWANCES	414.41	3.05
5.083	SYSTEM SPECIFIC SUPPORT PAY AND ALLOWANCES	0.00	0.00
5.084	TRAINEE/TRAINER PAY AND ALLOWANCES	0.00	0.00
5.085	SYSTEM PROJECT MANAGEMENT PAY AND ALLOWANCES	0.00	0.00
5.086	PERMANENT CHANGE OF STATION (PCS)	0.00	0.00
5.087	OTHER MPA FUNDED SUSTAINMENT	0.00	0.00
5.09	SYSTEM PROJECT MANAGEMENT CIVILIANS	0.00	0.00
5.10	MODIFICATION/KITS	0.00	0.00
5.11	OTHER SUSTAINMENT	XXXXXXXXXX	XXXXXXXXXX
5.111	OTHER O&M SUSTAINING FUNDED	21.44	.16
5.112	OTHER PROCUREMENT FUNDED SUSTAINING	11493.00	84.71
>TOTAL<	....	13568.02	100.00
*******	> TOTAL LIFE CYCLE COST	14832.38	**********

System Maintenance Support Costs Specified In DCA-P-92(R) Format Design 9 Case Totals - Costs Are Stated in Thousands of Dollars			
Element Number	Cost Element Description	Estimated Cost	Percentage
1.0	DEVELOPMENT	XXXXXXXXXX	XXXXXXXXXX
1.011	ENGINEERING	0.00	100.00
>TOTAL<	....	0.00	100.00
2.0	PRODUCTION	XXXXXXXXXX	XXXXXXXXXX
2.011	INITIAL PRODUCTION FACILITIES (IPF)	21.96	2.09
2.021	MANUFACTURING	153.69	14.60
2.022	RECURRING ENGINEERING	43.91	4.17
2.04	DATA	15.60	1.48
2.07	INITIAL SPARES	817.59	77.66
>TOTAL<	....	1052.76	100.00
3.0	MILITARY CONSTRUCTION	XXXXXXXXXX	XXXXXXXXXX
>TOTAL<	....	0.00	0.00
4.0	FIELDING	XXXXXXXXXX	XXXXXXXXXX
4.01	SYSTEM TESTING AND EVALUATION	0.00	0.00
4.02	TRAINING SERVICES AND EQUIPMENT	0.00	0.00
4.03	TRANSPORTATION	1.63	100.00
4.04	INITIAL REPAIR PARTS	0.00	0.00
4.05	SYSTEM SPECIFIC BASE OPERATING SUPPORT	0.00	0.00
4.06	OTHER O&M FUNDED FIELDING	0.00	0.00
>TOTAL<	....	1.63	100.00
5.0	SUSTAINMENT	XXXXXXXXXX	XXXXXXXXXX
5.01	REPLENISHMENT	XXXXXXXXXX	XXXXXXXXXX
5.011	REPLENISHMENT REPAIR PARTS	0.00	0.00
5.012	REPLENISHMENT SPARES	263.30	2.28
5.013	WAR RESERVE REPAIR PARTS	0.00	0.00
5.014	WAR RESERVE SPARES	0.00	0.00
5.02	PETROLEUM, OILS AND LUBRICANTS (POL)	0.00	0.00
5.03	AMMUNITION	XXXXXXXXXX	XXXXXXXXXX
5.031	TRAINING AMMUNITION/MISSILES	0.00	0.00
5.032	WAR RESERVE AMMUNITION/MISSILES	0.00	0.00
5.04	DEPOT MAINTENANCE	XXXXXXXXXX	XXXXXXXXXX
5.041	CIVILIAN LABOR	634.67	5.50
5.042	MATERIEL (OM)	.32	.00
5.043	MATERIEL (PROC)	2.89	.03
5.044	SUPPORT ACTIVITY	0.00	0.00
5.05	FIELD MAINTENANCE CIVILIAN LABOR	0.00	0.00
5.06	TRANSPORTATION	404.91	3.51
5.07	SYSTEM SPECIFIC REPLACEMENT TRAINING SERVICES	XXXXXXXXXX	XXXXXXXXXX
5.071	AMMUNITION/MISSILES/EQUIPMENT	106.55	.92
5.072	SERVICES	11.84	.10
5.08	MILITARY PERSONNEL	XXXXXXXXXX	XXXXXXXXXX
5.081	CREW PAY AND ALLOWANCES	0.00	0.00
5.082	MAINTENANCE PAY AND ALLOWANCES	308.93	2.68
5.083	SYSTEM SPECIFIC SUPPORT PAY AND ALLOWANCES	0.00	0.00
5.084	TRAINEE/TRAINER PAY AND ALLOWANCES	0.00	0.00
5.085	SYSTEM PROJECT MANAGEMENT PAY AND ALLOWANCES	0.00	0.00
5.086	PERMANENT CHANGE OF STATION (PCS)	0.00	0.00
5.087	OTHER MPA FUNDED SUSTAINMENT	0.00	0.00
5.09	SYSTEM PROJECT MANAGEMENT CIVILIANS	0.00	0.00
5.10	MODIFICATION/KITS	0.00	0.00
5.11	OTHER SUSTAINMENT	XXXXXXXXXX	XXXXXXXXXX
5.111	OTHER O&M SUSTAINING FUNDED	19.28	.17
5.112	OTHER PROCUREMENT FUNDED SUSTAINING	9778.87	84.80
>TOTAL<	....	11531.57	100.00
*******	> TOTAL LIFE CYCLE COST	12585.95	**********

System Maintenance Support Costs Specified In DCA-P-92(R) Format			
Design 10	Case Totals - Costs Are Stated in Thousands of Dollars		
Element Number	Cost Element Description	Estimated Cost	Percentage
1.0	DEVELOPMENT	XXXXXXXXXX	XXXXXXXXXX
1.011	ENGINEERING	0.00	100.00
>TOTAL<	....	0.00	100.00
2.0	PRODUCTION	XXXXXXXXXX	XXXXXXXXXX
2.011	INITIAL PRODUCTION FACILITIES (IPF)	20.31	2.04
2.021	MANUFACTURING	142.19	14.26
2.022	RECURRING ENGINEERING	40.63	4.07
2.04	DATA	14.40	1.44
2.07	INITIAL SPARES	779.47	78.18
>TOTAL<	....	997.01	100.00
3.0	MILITARY CONSTRUCTION	XXXXXXXXXX	XXXXXXXXXX
>TOTAL<	....	0.00	0.00
4.0	FIELDING	XXXXXXXXXX	XXXXXXXXXX
4.01	SYSTEM TESTING AND EVALUATION	0.00	0.00
4.02	TRAINING SERVICES AND EQUIPMENT	0.00	0.00
4.03	TRANSPORTATION	1.52	100.00
4.04	INITIAL REPAIR PARTS	0.00	0.00
4.05	SYSTEM SPECIFIC BASE OPERATING SUPPORT	0.00	0.00
4.06	OTHER O&M FUNDED FIELDING	0.00	0.00
>TOTAL<	....	1.52	100.00
5.0	SUSTAINMENT	XXXXXXXXXX	XXXXXXXXXX
5.01	REPLENISHMENT	XXXXXXXXXX	XXXXXXXXXX
5.011	REPLENISHMENT REPAIR PARTS	0.00	0.00
5.012	REPLENISHMENT SPARES	252.27	2.35
5.013	WAR RESERVE REPAIR PARTS	0.00	0.00
5.014	WAR RESERVE SPARES	0.00	0.00
5.02	PETROLEUM, OILS AND LUBRICANTS (POL)	0.00	0.00
5.03	AMMUNITION	XXXXXXXXXX	XXXXXXXXXX
5.031	TRAINING AMMUNITION/MISSILES	0.00	0.00
5.032	WAR RESERVE AMMUNITION/MISSILES	0.00	0.00
5.04	DEPOT MAINTENANCE	XXXXXXXXXX	XXXXXXXXXX
5.041	CIVILIAN LABOR	587.18	5.46
5.042	MATERIEL (OM)	.30	.00
5.043	MATERIEL (PROC)	2.68	.02
5.044	SUPPORT ACTIVITY	0.00	0.00
5.05	FIELD MAINTENANCE CIVILIAN LABOR	0.00	0.00
5.06	TRANSPORTATION	377.12	3.51
5.07	SYSTEM SPECIFIC REPLACEMENT TRAINING SERVICES	XXXXXXXXXX	XXXXXXXXXX
5.071	AMMUNITION/MISSILES/EQUIPMENT	83.56	.78
5.072	SERVICES	9.28	.09
5.08	MILITARY PERSONNEL	XXXXXXXXXX	XXXXXXXXXX
5.081	CREW PAY AND ALLOWANCES	0.00	0.00
5.082	MAINTENANCE PAY AND ALLOWANCES	226.19	2.10
5.083	SYSTEM SPECIFIC SUPPORT PAY AND ALLOWANCES	0.00	0.00
5.084	TRAINEE/TRAINER PAY AND ALLOWANCES	0.00	0.00
5.085	SYSTEM PROJECT MANAGEMENT PAY AND ALLOWANCES	0.00	0.00
5.086	PERMANENT CHANGE OF STATION (PCS)	0.00	0.00
5.087	OTHER MPA FUNDED SUSTAINMENT	0.00	0.00
5.09	SYSTEM PROJECT MANAGEMENT CIVILIANS	0.00	0.00
5.10	MODIFICATION/KITS	0.00	0.00
5.11	OTHER SUSTAINMENT	XXXXXXXXXX	XXXXXXXXXX
5.111	OTHER O&M SUSTAINING FUNDED	17.84	.17
5.112	OTHER PROCUREMENT FUNDED SUSTAINING	9191.82	85.52
>TOTAL<	....	10748.22	100.00
*******	> TOTAL LIFE CYCLE COST	11746.75	**********

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