MASTER

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MASTER

LOFT SECONDARY COOLANT SYSTEM SPARE
PARTS REQUIREMENTS STUDY

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DEPARTMENT OF ENERGY

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PARTS REQUIREMENTS STUDY**

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LOFT TECHNICAL REPORT LOFT PROGRAM

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ABSTRACT

This report documents a methodology, employing the concept of risk, created to aid in building an efficient spare parts inventory for the LOFT Secondary Cooling System.

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This report documents a methodology, employing the concept of risk, created to aid in building an efficient spare parts inventory for the LOFT secondary coolant system.

ACKNOWLEDGMENT

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I. INTRODUCTION

Herein is described a methodology for optimizing spare parts inventories based on the concept of risk. The method has been applied to the LOFT secondary coolant system (SCS) but can be applied to almost any system in which it is desirable to reduce the risk of extended periods of down time due to a dearth of replacement parts or components.

Each component in a system represents a risk to the system by virtue of its potential for failure. The failure of a critical SCS component would cause an interruption of LOFT operations until the offending component was replaced or repaired. An adequate inventory of spare parts and/or spare components, particularly those with long procurement lead times, could serve to mitigate the effects of a component failure on LOFT operations.

The objective of this analysis is to present an orderly ranking of SCS components with consideration being given to component failure rates, procurement lead times, usage, and the component's relative importance to the system's integrity.

II. ANALYSIS PROCEDURE

2.1 Sources of Component Data

A list of the component parts of the LOFT SCS was obtained from S.D.D.1.1.5. The subcontract number under which each component was purchased was obtained from this list. Using the subcontract number as a reference it was possible to find the vendor package containing a drawing of the component and in many cases a recommended spare parts list in Configuration Document Control and Services (CDCS) files. The vendor drawings and recommended spares lists were used to formulate the input data required to build the computer file.

Not all components were purchased from commercial sources; some were obtained as government furnished equipment (GFE). For most GFE equipment, only a minimum of documentation was available in CDCS files. For these components it was recommended the entire assembly be carried in the spares inventory. As most components in this category are small valves, it is the more efficient method of building an inventory particularly when many components can be substituted one for the other.

2.2 Sources of Component Failure Rate Data

Two sources were consulted to obtain component failure rate data: Table III-1 of WASH-1400 (Reference 1) and Table D-1 of Reference 2.

2.3 Determination of Probability of Component Failure

Probability is a pure number (it has no units) and is usually expressed as the product of the component's chance failure rate (λ) and the time interval over which the component is required to operate (t). The assumption is made that the operating time interval is less than the useful life of the component so the chance failure rate for the component may be assumed invariant with time.

Two time intervals were used in evaluating component risk. If the failure of a particular component would jeopardize plant operations during an experiment, the number of experiment hours in a year (800) was used as the component's operating interval. It was assumed that four 200 hour experiments would be run per year. If the failure of a particular component would be a problem any time it happened during the year whether the plant was operating or not, the number of hours in a year (8760) was used as the component's operating interval.

If more than one mode of failure was possible, the sum of the products of the individual failure rates and operating interval was used to evaluate it's probability of failure. This value was input for each component or part thereof and is printed under the column headed "probability of failure" in the printout; see Section 3.1.

2.4 Determination of Procurement Lead Time

The consequence of a component failure is the lead time required to either obtain a replacement or spare parts to repair the existing component. It was assumed for the purpose of this analysis that no spares are currently stocked. Obviously some are, but performing an inventory of current spares was not considered within the scope of this study.

The time intervals necessary to obtain replacement components or spare parts was estimated based on experience gained while performing a similar study for another INEL test facility. Admittedly, the determination of these time intervals is subjective in nature and therefore will vary considerably. To obtain exact current lead times would be enormously time consuming and

involve additional expense as vendors would undoubtedly request compensation for providing delivery estimates. Other inponderables include the age and therefore the obsolescence of many components. An estimate of procurement lead time for each component and spare part was made and entered in the computer code. This value is printed as part of the output under the column entitled "downtime if no spare (hr)". The numerical values are expressed in hours.

2.5 Determination of Component Criticality

The components that are vital to plant operation are delineated by a "C" in the column of the output headed "CRITICAL". The determination as to whether a component was critical or not was based on a failure mode effects and criticality analysis of LOFT experiment L1-5 (Reference 3). This will be a further aid in deciding which spares are to be carried in inventory.

III. RESULTS

The following pages contain the results of using the input data described in Section II in conjunction with the computer code documented in the Appendix. The component spares are listed in descending order of importance as to their risk, where risk connotes the time LOFT would be down for lack of a spare for that component.

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	LTR-115-44 RISK	CRITICAL
CV-P4-8 BODY 1 SPINDLE	.111E+00	.336E+04	372.960000	C
CV-P4-8 BODY 1 TEC RING	.111E+00	.252E+04	279.720000	C
CV-P4-8 BODY 1 SEAT RING	.444E-01	.286E+04	126.806400	C
CV-P4-8 BODY 1 SEAT	.444E-01	.286E+04	126.806400	C
RV-153 3 IN. 300# 1 DISC INSERT	.170E-01	.655E+04	111.384000	
RV-153 3 IN. 300# 1 SPNDL. LOCKCLIP	.170E-01	.655E+04	111.384000	
RV-153 3 IN. 300# 1 SPRING	.800E-02	.655E+04	52.416000	
RV-153 3 IN. 300# 1 SPRING LIFT STOP	.800E-02	.655E+04	52.416000	
RV-153 3 IN. 300# 1 SPRING WASHER	.800E-02	.655E+04	52.416000	
RV-120 1/2 1150# 1 DISC	.170E-01	.218E+04	37.128000	
RV-130A 1/2-1100# 1 DISC	.170E-01	.218E+04	37.128000	
RV-120 1/2 1150# 1 GASKET SET	.170E-01	.218E+04	37.128000	
RV-130B 1/2-1100# 1 DISC	.170E-01	.218E+04	37.128000	
RV-130A 1/2-1100# 1 GASKET SET	.170E-01	.218E+04	37.128000	
RV-130B 1/2-1100# 1 NOZZLE	.170E-01	.218E+04	37.128000	
RV-130B 1/2-1100# 1 GASKET ASSY	.170E-01	.218E+04	37.128000	
RV-336 3/4 IN. ENTIRE ASSEMBLY	.255E-01	.134E+04	34.272000	

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	LTR-115-44 RISK	CRITICAL
RV-93 (SC-H-16) ENTIRE ASSEMBLY	.255E-01	.134E+04	34.272000	
RV-136 3 IN. 900# 1 DOG SF BR GASKET	.170E-01	.168E+04	28.560000	C
RV-136 3 IN. 900# 1 BONN. ADP. GASKET	.170E-01	.168E+04	28.560000	C
RV-137 3 IN. 900# 1 DOG SF BR GASKET	.170E-01	.168E+04	28.560000	C
RV-136 3 IN. 900# 1 CAP GASKET	.170E-01	.168E+04	28.560000	C
RV-137 3 IN. 900# 1 BONN. ADP. GASKET	.170E-01	.168E+04	28.560000	C
RV-136 3 IN. 900# 1 CAP PLUG GASKET	.170E-01	.168E+04	28.560000	C
RV-137 3 IN. 900# 1 EDUCTOR GASKET	.170E-01	.168E+04	28.560000	C
RV-136 3 IN. 900# 1 EDUCTOR GASKET	.170E-01	.168E+04	28.560000	C
RV-137 3 IN. 900# 1 DOG SHAFT O-RING	.170E-01	.168E+04	28.560000	C
RV-137 3 IN. 900# 1 CAP GASKET	.170E-01	.168E+04	28.560000	C
RV-137 3 IN. 900# 1 SET SCREW GASKET	.170E-01	.168E+04	28.560000	C
RV-136 3 IN. 900# 1 DOG SHAFT O-RING	.170E-01	.168E+04	28.560000	C
RV-137 3 IN. 900# 1 CAP PLUG GASKET	.170E-01	.168E+04	28.560000	C
RV-136 3 IN. 900# 1 SETSCREW GASKET	.170E-01	.168E+04	28.560000	C
RV-136 3 IN. 900# 1 DISC HOLDER	.800E-02	.336E+04	26.880000	C
RV-137 3 IN. 900# 1 DISC HOLDER	.800E-02	.336E+04	26.880000	C

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	LTR-115-44 RISK	CRITICAL
RV-136 3 IN. 900# 1 BELLOWS	.800E-02	.336E+04	26.880000	C
RV-137 3 IN. 900# 1 BELLOWS	.800E-02	.336E+04	26.880000	C
RV-136 3 IN. 900# 1 DISC INSERT	.800E-02	.336E+04	26.880000	C
RV-137 3 IN. 900# 1 DISC INSERT	.800E-02	.336E+04	26.880000	C
CV-P4-8 BODY 1 RETAINER	.876E-02	.252E+04	22.075200	C
CV-P4-8 BODY 1 SEAT HOUSING	.876E-02	.252E+04	22.075200	C
RV-303 1 IN. 150# 1 SPRING LIFT STOP	.800E-02	.218E+04	17.472000	
RV-120 1/2 1150# 1 SPRING ASSY	.800E-02	.218E+04	17.472000	
RV-303 1 IN. 150# 2 SPRING WASHFR	.800E-02	.218E+04	17.472000	
RV-130B 1/2-1100# 1 SPRING ASSY	.800E-02	.218E+04	17.472000	
RV-303 1 IN. 150# 1 SPRING	.800E-02	.218E+04	17.472000	
RV-130A 1/2-1100# 1 SPRING ASSY	.800E-02	.218E+04	17.472000	
CV-P4-10 BODY 1 METAL SEAL	.876E-02	.168E+04	14.716800	C
CV-P4-8 BODY 1 SET CHEVRONS	.876E-02	.168E+04	14.716800	C
CV-P4-8 BODY 1 METAL SEAL	.876E-02	.168E+04	14.716800	C
CV-P4-8 BODY 1 PARKER O-RING	.876E-02	.168E+04	14.716800	C
SC-H-4 1 COUPLING	.400E-02	.336E+04	13.440000	

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	LTR-115-44 RISK	CRITICAL
RV-22 1 1/4 IN. SPRING	.800E-02	.168E+04	13.440000	C
RV-63 6 IN. 150# 1 SPINDLE LOCKCLIP	.800E-02	.168E+04	13.440000	
RV-136 3 IN. 900# 1 DISC RING	.800E-02	.168E+04	13.440000	C
RV-63 6 IN. 150# SPRING	.800E-02	.168E+04	13.440000	
RV-137 3 IN. 900# 1 DISC RING	.800E-02	.168E+04	13.440000	C
RV-63 6 IN. 150# 1 SPRING WASHER	.800E-02	.168E+04	13.440000	
CV-P4-10 BODY 2 FLEXITAL GASKETS	.444E-02	.168E+04	7.459200	C
CV-P4-10 BODY 2 SEALS	.444E-02	.168E+04	7.459200	C
SC-P-62A AUX.F.W. 6 117-7493 SEAL	.330E-02	.218E+04	7.207200	
SC-P-5 FEEDWATER 1 SET GASKETS	.300E-02	.218E+04	6.552000	C
SC-P-62B AUX.F.W. 6 117-7493 SEAL	.300E-02	.218E+04	6.552000	
SC-P-62A AUX.F.W. 18 125-1829 GASKT	.300E-02	.218E+04	6.552000	
SC-P-62B AUX.F.W. 2 A-94237 GASKET	.300E-02	.218E+04	6.552000	
SC-P-62A AUX.F.W. 2 A-94237 GASKET	.300E-02	.218E+04	6.552000	
SC-P-79 S.G.R.P. O-RING(748)	.300E-02	.218E+04	6.552000	
SC-P-62A AUX.F.W. 2 COVER GASKET	.300E-02	.218E+04	6.552000	
SC-P-62B AUX.F.W. 18 125-1829 GASKT	.300E-02	.218E+04	6.552000	

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	LTR-115-44 RISK	CRITICAL
SC-P-62A AUX.F.W. 2 BR. COV. GASKET	.300E-02	.218E+04	6.552000	
SC-P-79 S.G.R.P. COVER GASKET(744)	.300E-02	.218E+04	6.552000	
SC-P-62A AUX.F.W. 3 SET PACKING	.300E-02	.218E+04	6.552000	
SC-P-62B AUX.F.W. 2 COVER GASKET	.300E-02	.218E+04	6.552000	
SC-P-79 S.G.R.P. PACKING(742)	.300E-02	.218E+04	6.552000	
SC-P-62B AUX.F.W. 2 BR. COV. GASKET	.300E-02	.218E+04	6.552000	
SC-P-62B AUX.F.W. 3 SET PACKING	.300E-02	.218E+04	6.552000	
SC-H-4 1 GEAR REDUCER	.174E-02	.336E+04	5.846400	
SC-H-4 1 LOUV.ACT.656-30	.160E-02	.336E+04	5.376000	
SC-H-4 1 LOUV.ACT.656-40	.160E-02	.336E+04	5.376000	
SC-H-16 2 GASKET(DETAIL C)	.302E-02	.134E+04	4.058880	
CV-P4-10 OPERATOR TORQUE SWITCH	.210E-02	.168E+04	3.528000	C
RV-303 1 IN. 150# 1 CAP GASKET	.160E-02	.168E+04	2.688000	
RV-303 1 IN. 150# 1 GUIDE GASKET	.160E-02	.168E+04	2.688000	
RV-303 1 IN. 150# DOG CAM BRG.GASKET	.160E-02	.168E+04	2.688000	
RV-303 1 IN. 150# 1 CAP PLUG GASKET	.160E-02	.168E+04	2.688000	
RV-303 1 IN. 150# 1 BASE GASKET	.160E-02	.168E+04	2.688000	

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	LTR-115-44 RISK	CRITICAL
CV-P4-70 1/2-1500 1 161423 CAGE	.110E-02	.218E+04	2.402400	
SC-H-27 AIR HEAT. 1 8215B21 SOL.VAL	.110E-02	.218E+04	2.402400	
CV-P4-74 2-1500# 1 CAGE(161423)	.110E-02	.218E+04	2.402400	
SC-H-27 AIR HEAT. 2 17555 SOL. KIT	.110E-02	.218E+04	2.402400	
CV-P4-71 1/2 IN. 1 161423 CAGE	.110E-02	.218E+04	2.402400	
SC-H-27 AIR HEAT. 1 821534 SOL.VALV	.110E-02	.218E+04	2.402400	
CV-P4-74 2-1500# 1 PLUG/STEM	.110E-02	.218E+04	2.402400	
CV-P4-70 1/2-1500 1 161424 PLUG/STEM	.110E-02	.218E+04	2.402400	
CV-P4-71 1/2 IN. 1 161424 PLUG/STEM	.110E-02	.218E+04	2.402400	
SC-H-27 AIR HEAT. SCANNER SENS.TUBE	.100E-02	.218E+04	2.184000	
SC-H-27 AIR HEAT. SCANNER 2033 TUBE	.100E-02	.218E+04	2.184000	
SC-H-27 AIR HEAT. SCANNER 668A TUBE	.100E-02	.218E+04	2.184000	
DWL-L-17 (H2NNH2) ENTIRE ASSEMBLY	.158E-02	.134E+04	2.123520	C
DW-L-15 DEMIN. ENTIRE ASSEMBLY	.158E-02	.134E+04	2.123520	C
DW-L-16 DEMIN. ENTIRE ASSEMBLY	.158E-02	.134E+04	2.123520	C
SC-P-5 F.EDWATER 1 SET SLEEVE REAR	.640E-03	.286E+04	1.827840	C
V-410-CB (GFF) CK ENTIRE ASSEMBLY	.438E-03	.336E+04	1.471680	C

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	LTR-115-44 RISK	CRITICAL
CV-P4-10 BODY 13 PACKING RINGS	.876E-03	.168E+04	1.471680	C
RV-137 3 IN. 900# 1 DISC INSERT PIN	.800E-02	.168E+03	1.344000	C
RV-136 3 IN. 900# 1 DISC INSERT PIN	.800E-02	.168E+03	1.344000	C
CV-P4-91 ACTUATOR 1 BELLAWS	.330E-03	.330E+04	1.087350	
CV-P4-91 ACTUATOR 1 STEM BELLAWS	.330E-03	.330E+04	1.087350	
V-5009-CZ 1/2 IN. 1 GASKET	.440E-03	.218E+04	.960960	
CV-P4-91 VALVE 1 PLUG CV8	.440E-03	.218E+04	.960960	
CV-P4-74 2-1500# 1 GASKET(81063)	.440E-03	.218E+04	.960960	
CV-P4-91 VALVE 1 SEAT RING CV8	.440E-03	.218E+04	.960960	
CV-P4-90 BODY PLUG	.440E-03	.218E+04	.960960	
CV-P4-71 1/2 IN. 1 81063 GASKET	.440E-03	.218E+04	.960960	
CV-P4-90 BODY SEAT RING	.440E-03	.218E+04	.960960	
CV-P4-70 1/2-1500 1 81063 GASKET	.440E-03	.218E+04	.960960	
CV-P4-77 (GFE) ENTIRE ASSEMBLY	.531E-03	.168E+04	.892080	C
CV-P4-87 NO DATA ENTIRE ASSEMBLY	.531E-03	.168E+04	.892080	
V-5000-CZ 6 IN. CK 1 DISC 8207-3-139	.240E-03	.336E+04	.806400	C
SC-H-4 1 ELECTRIC MOTOR	.240E-03	.336E+04	.806400	

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	LTR-115-44 RISK	CRITICAL
V-5000-CZ 6 IN. CK 1 HANGER 8217-2-36	.240E-03	.336E+04	.806400	C
V-5000-CZ 6 IN. CK 1 GASKET 9147-5-97	.240E-03	.336E+04	.806400	C
CV-P4-91 VALVE 1 SPIRAL GASKET 48	.440E-03	.168E+04	.739200	
CV-P4-91 VALVE 1 SPIRAL GASKET 45	.440E-03	.168E+04	.739200	
V-1401-CA NO DATA ENTIRE ASSEMBLY	.438E-03	.168E+04	.735840	
V-5698-3/4 IN. CK ENTIRE ASSEMBLY	.438E-03	.168E+04	.735840	
V-2072-CS (GFF) ENTIRE ASSEMBLY	.438E-03	.168E+04	.735840	
V-5699-1 IN. CK ENTIRE ASSEMBLY	.438E-03	.168E+04	.735840	
V-1615-CA (GFE) CK ENTIRE ASSEMBLY	.438E-03	.168E+04	.735840	
V-5159-1.25 IN. CK ENTIRE ASSEMBLY	.438E-03	.168E+04	.735840	
V-2368-CR NO DATA ENTIRE ASSEMBLY	.438E-03	.168E+04	.735840	
V-5163-1/2 IN. CK ENTIRE ASSEMBLY	.438E-03	.168E+04	.735840	
V-5160-1.25 IN CK ENTIRE ASSEMBLY	.438E-03	.168E+04	.735840	
V-5164-1/2 IN. CK ENTIRE ASSEMBLY	.438E-03	.168E+04	.735840	
CV-P4-90 ACTUATOR 1 STEM BELLOWS	.330E-03	.218E+04	.720720	
CV-P4-90 ACTUATOR 1 BELLOWS	.330E-03	.218E+04	.720720	
CV-P4-133 (GFE) ENTIRE ASSEMBLY	.531E-03	.134E+04	.713664	

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	LTR-115-44 RISK	CRITICAL
CV-P4-131 (GFF) ENTIRE ASSEMBLY	.531E-03	.134E+04	.713664	
CV-P4-59 (GFF) ENTIRE ASSEMBLY	.531E-03	.134E+04	.713664	
CV-P4-132 (GFF) ENTIRE ASSEMBLY	.531E-03	.134E+04	.713664	
CV-P4-46 (GFF) ENTIRE ASSEMBLY	.531E-03	.134E+04	.713664	
V-2467-LS (GFE) ENTIRE ASSEMBLY	.210E-03	.336E+04	.705600	
V-358-GS (GFE) ENTIRE ASSEMBLY	.210E-03	.336E+04	.705600	
V-2268-LS (GFE) ENTIRE ASSEMBLY	.210E-03	.336E+04	.705600	
V-2473-LS NO DATA ENTIRE ASSEMBLY	.210E-03	.336E+04	.705600	
V-2269-GS NO DATA ENTIRE ASSEMBLY	.210E-03	.336E+04	.705600	
V-2068-LS (GFF) ENTIRE ASSEMBLY	.210E-03	.336E+04	.705600	
V-2271-GS (GFE) ENTIRE ASSEMBLY	.210E-03	.336E+04	.705600	
V-2270-LS (GFF) ENTIRE ASSEMBLY	.210E-03	.336E+04	.705600	
DW-S-78A STRAINER GASKET	.400E-03	.168E+04	.672000	
DW-S-78B STRAINER GASKET	.400E-03	.168E+04	.672000	
SC-H-4 1 CHECO FAN A-11-8	.180E-03	.336E+04	.604800	
RV-63 6 IN. 50# 1 NOZZLE	.170E-03	.336E+04	.571200	
RV-63 6 IN. 150# 1 DISC INSERT	.170E-03	.336E+04	.571200	

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	RISK	CRITICAL
CV-P4-91 ACTUATOR 1 O-RING (251)	.330E-03	.168E+04	.554400	
CV-P4-90 ACTUATOR 1 GASKET ADJ. SCW.	.330E-03	.168E+04	.554400	
CV-P4-90 ACTUATOR 1 O-RING (255)	.330E-03	.168E+04	.554400	
CV-P4-90 ACTUATOR 1 O-RING (252)	.330E-03	.168E+04	.554400	
CV-P4-91 ACTUATOR 1 O-RING (254)	.330E-03	.168E+04	.554400	
CV-P4-90 ACTUATOR 1 O-RING (251)	.330E-03	.168E+04	.554400	
CV-P4-91 ACTUATOR 1 GASKET ADJ. SCW.	.330E-03	.168E+04	.554400	
CV-P4-90 ACTUATOR 1 O-RING (254)	.330E-03	.168E+04	.554400	
CV-P4-91 ACTUATOR 1 O-RING (255)	.330E-03	.168E+04	.554400	
CV-P4-91 ACTUATOR 1 O-RING (252)	.330E-03	.168E+04	.554400	
SC-S-69 STRAINER GASKET	.400E-03	.134E+04	.537600	
SC-H-4 1 VIBRATION SWITCH	.160E-03	.336E+04	.537600	
V-3050-CZ 2 IN. CK DISC	.240E-03	.218E+04	.524160	C
V-3050-CZ 2 IN. CK CARRIER	.240E-03	.218E+04	.524160	C
V-3050-CZ 2 IN. CK SEAT	.240E-03	.218E+04	.524160	C
CV-P4-70 1/2-1500 1 SOLENOID ACC KIT	.210E-03	.218E+04	.458640	
CV-P4-74 2-1500# SOLENOID ACC. KIT	.210E-03	.218E+04	.458640	

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	LTR-115-44 RISK	CRITICAL
V-3050-CZ 2 IN. CK GASKET	.240E-03	.168E+04	.403200	C
CV-P4-10 BODY 1 SPINDLE ASSY	.111E-03	.336E+04	.372960	C
CV-P4-10 BODY 1 DISC STACK ASSY	.111E-03	.336E+04	.372960	C
SC-P-62A AUX.F.W. 3 124-7204 VALVE	.130E-03	.286E+04	.371280	
RV-22 1 1/4 IN. DISC RETAINER	.170E-03	.218E+04	.371280	C
SC-P-62B AUX.F.W. 6 THROAT RING	.130E-03	.286E+04	.371280	
SC-P-5 FEEDWATER 4 INTERCOVER RUSH	.130E-03	.286E+04	.371280	C
SC-P-62B AUX.F.W. 3 124-7204 VALVE	.130E-03	.286E+04	.371280	
RV-22 1 1/4 IN. NOZZLE	.170E-03	.218E+04	.371280	C
SC-P-79 S.G.R.P. RADIAL BALL BRG.	.130E-03	.286E+04	.371280	
SC-P-5 FEEDWATER 1 PRESS. RED. SLEEV	.130E-03	.286E+04	.371280	C
SC-P-62A AUX.F.W. 6 THROAT RING	.130E-03	.286E+04	.371280	
RV-22 1 1/4 IN. DISC HOLDER	.170E-03	.218E+04	.371280	C
SC-P-79 S.G.R.P. IMPELLER (176)	.130E-03	.286E+04	.371280	
SC-P-5 FEEDWATER 1 WEAR RING (SUCTION)	.130E-03	.286E+04	.371280	C
SC-P-62B AUX.F.W. 3 124-7330 SPRING	.130E-03	.286E+04	.371280	
RV-22 1 1/4 IN. DISC	.170E-03	.218E+04	.371280	C

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	LTR-115-44 RISK	CRITICAL
SC-P-79 S.G.R.P. THRUST BALL BRG.	.130E-03	.286E+04	.371280	
SC-P-5 FEEDWATER 1 PRESS.RUD.BUSH.	.130E-03	.286E+04	.371280	C
SC-P-62A AUX.F.W. 3 124-7330 SPRING	.130E-03	.286E+04	.371280	
SC-P-5 FEEDWATER 4 WEAR RING(INTC)	.130E-03	.286E+04	.371280	C
SC-P-62B AUX.F.W. 6 120-3201 SEAT	.130E-03	.286E+04	.371280	
SC-P-5 FEEDWATER 1 THRUST COLLAR	.130E-03	.286E+04	.371280	C
SC-P-62B AUX.F.W. 3 124-7205 VALVE	.130E-03	.286E+04	.371280	
SC-P-5 FEEDWATER 4 SPACER SLEEVES	.130E-03	.286E+04	.371280	C
SC-P-79 S.G.R.P. SHAFT SLEEVE(217)	.130E-03	.286E+04	.371280	
SC-P-5 FEEDWATER 2 PACK. BOX BUSH	.130E-03	.286E+04	.371280	C
SC-P-62A AUX.F.W. 6 120-3201 SEAT	.130E-03	.286E+04	.371280	
SC-R-79 S.G.R.P. IMPELLER KEY(676)	.130E-03	.286E+04	.371280	
SC-P-62B AUX.F.W. 3 124-9819 SPRING	.130E-03	.286E+04	.371280	
SC-P-79 S.G.R.P. WEAR RING(205)	.130E-03	.286E+04	.371280	
SC-P-62A AUX.F.W. 3 124-7205 VALVE	.130E-03	.286E+04	.371280	
SC-P-79 S.G.R.P. SHAFT RET.RING	.130E-03	.286E+04	.371280	
SC-P-62A AUX.F.W. 3 124-9819 SPRING	.130E-03	.286E+04	.371280	

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	LTR-115-44 RISK	CRITICAL
SC-P-79 S.G.R.P. THRST.BR.RET.RING	.130E-03	.286E+04	.371280	
V-2073-GE (GFE) ENTIRE ASSEMBLY	.210E-03	.168E+04	.352800	
V-1694-LS NO DATA ENTIRE ASSEMBLY	.210E-03	.168E+04	.352800	
V-1356-GA NO DATA ENTIRE ASSEMBLY	.210E-03	.168E+04	.352800	
V-1767-LE (GFE) ENTIRE ASSEMBLY	.210E-03	.168E+04	.352800	
V-1359-GA NO DATA ENTIRE ASSEMBLY	.210E-03	.168E+04	.352800	
V-1357-GA NO DATA ENTIRE ASSEMBLY	.210E-03	.168E+04	.352800	
V-5184-GE (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5082-LE 2 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5697- 3/4 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-1935-LE (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5221- ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-2468-LS (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5700- 1 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-1688-LB (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5198-LZ 1 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5003-IZ 1/2 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	LTR-115-44 RISK	CRITICAL
V-5489-LS (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-1692-LS (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5186 (GFE) 1 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-2298-LB (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5342- ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-1423-LR NO DATA ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5200-LZ 1 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5091-LE 1/2 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5695-1.5 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-2000-LE (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5185 (GFE) 1 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-2498-LH (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5341- ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-1616-LB (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5199-LZ 1 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-433-GP NO DATA ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5694- 1.5 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	LTR-115-44 RISK	CRITICAL
V-1771-LB (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5197-LZ 1 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-2071-LH (GFF) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5488-IB (GFF) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-1207-GR NO DATA ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5201-LT 1 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5007-IZ 1/2 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5696- 3/4 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-1998-LE (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-2496-LB (GFF) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-1690-LB (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5005-IZ 1/2 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-1766-LE NO DATA ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-2297-LB (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-1589-LB (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5162 1/2 I . ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-2063-LS (GFF) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	RISK	CRITICAL
V-3040-LR NO DATA ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-1590-LB (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-359-LB (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-1770-GB (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-2075-LB (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-1358-GA NO DATA ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5083-GE 1.5 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-1936-LE (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-2450-LR NO DATA ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-1689-LB (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5004-IZ 1/2 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-1693-LS NO DATA ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-2359-LS (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-1687-LB (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5092-LE 1/2 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-2062-L' (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-2549-LB (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	LTR-115-44 RISK	CRITICAL
V-1691-LB (GFF) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-436-GR NO DATA ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-1773-BD (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-2067-LS (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-1999-LB (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5008-IZ 1/2 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-2064-LS (GFF) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-2495-LB (GFF) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5006-IZ 1/2 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-2358 (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5165-GR 1/2 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-3041-LH NO DATA ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-5084-GE 1.5 IN. ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-2074-LB (GFF) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-2469-LS (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-2548-LB (GFE) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
V-2497-LB (GFF) ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	LTR-115-44 RISK	CRITICAL
V-3002-LR NO DATA ENTIRE ASSEMBLY	.210E-03	.134E+04	.282240	
CV-P4-10 BODY 1 SEAT RING	.111E-03	.252E+04	.279720	C
SC-H-27 AIR HEAT. 1 FLAME RELAY	.110E-03	.218E+04	.240240	
SC-H-27 AIR HEAT. FLAME RELAY PUL.R	.110E-03	.218E+04	.240240	
SC-H-27 AIR HEAT. FLAME RELAY TUBE	.110E-03	.218E+04	.240240	
SC-H-27 AIR HEAT. FLAME RELAY RECT.	.110E-03	.218E+04	.240240	
V-5009-CZ 1/2 IN. 1 DISC	.876E-04	.218E+04	.191318	
CV-P4-71 1/2 IN. 1 131318 GASKET	.876E-04	.218E+04	.191318	
V-5009-CZ 1/2 IN. 1 SPRING	.876E-04	.218E+04	.191318	
CV-P4-91 VALVE 1 GUIDE LINER (66)	.876E-04	.218E+04	.191318	
CV-P4-70 1/2-1500 1 PACKING SET	.876E-04	.218E+04	.191318	
CV-P4-91 VALVE 1 GUIDE LINER (80)	.876E-04	.218E+04	.191318	
CV-P4-74 2-1500# 1 PACKING SET	.876E-04	.218E+04	.191318	
CV-P4-70 1/2-1500 1 131318 GASKET	.876E-04	.218E+04	.191318	
CV-P4-71 1/2 IN. 1 PACKING SET	.876E-04	.218E+04	.191318	
CV-P4-74 OPERATOR 1 DIAPHRAM	.876E-04	.218E+04	.191318	
CV-P4-74 2-1500# 1 GASKET(131318)	.876E-04	.218E+04	.191318	

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	LTR-115-44 RISK	CRITICAL
CV-P4-10 BODY 12 HEX NUTS	.111E-03	.168E+04	.186480	C
CV-P4-10 DRAG EMT LIMIT SWITCH	.110E-03	.168E+04	.184800	C
SC-H-16 6 1 X 8 1/2 STUDS	.101E-02	.168E+03	.169680	
CV-P4-90 BODY SEAT GASKET	.876E-04	.168E+04	.147168	
CV-P4-91 VALVE GRAFOIL PACKING	.876E-04	.168E+04	.147168	
CV-P4-11 (GFE) BONNET GASKET	.876E-04	.168E+04	.147168	C
CV-P4-73 6-1500# 1 GASKET (810P3)	.876E-04	.168E+04	.147168	C
CV-P4-11 (GFE) PACKING	.876E-04	.168E+04	.147168	C
CV-P4-90 BODY BONNET GASKET	.876E-04	.168E+04	.147168	
CV-P4-73 6-1500# 2 GASKET (161748)	.876E-04	.168E+04	.147168	C
CV-P4-90 BODY UPPER PACKING	.876E-04	.168E+04	.147168	
CV-P4-73 6-1500# 6 PACKING RINGS	.876E-04	.168E+04	.147168	C
CV-P4-90 BODY LOWER PACKING	.876E-04	.168E+04	.147168	
CV-P4-11 (GFE) SEAT RING	.376E-04	.336E+04	.126336	C
CV-P4-11 (GFE) WEDGE	.376E-04	.336E+04	.126336	C
CV-P4-73 OPERATOR 1 DIAPHRAM (80815)	.370E-04	.336E+04	.124320	C
CV-P4-73 6-1500# 1 PLUG	.370E-04	.336E+04	.124320	C

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	LTR-115-44 RISK	CRITICAL
CV-P4-73 6-1500# BALANCING CYLINDER	.370E-04	.336E+04	.124320	C
CV-P4-73 6-1500# 1 SPRING	.370E-04	.336E+04	.124320	C
CV-P4-73 6-1500 2 PISTON RINGS	.370E-04	.336E+04	.124320	C
CV-P4-73 6-1500# 1 SPRING GUIDE	.370E-04	.336E+04	.124320	C
CV-P4-73 6-1500# 1 CAGE	.370E-04	.336E+04	.124320	C
CV-P4-73 6-1500# 1 STEM	.370E-04	.336E+04	.124320	C
CV-P4-73 6-1500# 1 ROLL PIN	.370E-04	.336E+04	.124320	C
CV-P4-73 6-1500# 1 SOLENOID	.630E-04	.168E+04	.105840	C
SC-P-5 FEEDWATER 1 GEAR PUMP ASSY	.300E-04	.286E+04	.085680	
SC-P-5 FEEDWATER 1 SET KINGBURY SH	.300E-04	.286E+04	.085680	
SC-P-5 FEEDWATER 2 SEAL PLATES	.300E-04	.286E+04	.085680	
SC-P-5 FEEDWATER 2 SEAL PLATE BUSH	.300E-04	.286E+04	.085680	
CV-P4-70 OPERATOR 1 75514 DIAPHRAM	.370E-04	.218E+04	.080808	
CV-P4-71 1/2 IN. 1 75514 DIAPHRAM	.370E-04	.218E+04	.080808	
CV-P4-91 ACTUATOR 1 POSITIONER 74501	.330E-04	.218E+04	.072072	
SC-H-4 140 HEADER GASKET	.175E-04	.336E+04	.058800	
SC-H-4 140 HEADER PLUGS	.160E-04	.336E+04	.053760	

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	LTR-115-44 RISK	CRITICAL
V-3050-CZ 2 IN.CK CARRIER PIN	.240E-03	.168E+03	.040320	C
V-5000-CZ 6 IN.CK 1 PIN 8237-5-72	.240E-03	.168E+03	.040320	C
PC-H-1 STM. GEN. 1 MANHOLE GASKET	.175E-04	.168E+04	.029400	
SC-T-6 CON.REC.TK MANHOLE COV.GSKT.	.175E-04	.168E+04	.029400	C
SC-H-6 1 HEADER GASKET	.175E-04	.168E+04	.029400	
PC-H-1 STM. GEN. 12 COVER BOLTS	.160E-04	.168E+04	.026880	
SC-H-6 12 END CAP BOLTS	.160E-04	.168E+04	.026880	
CV-P4-70 1/2-1500 1 LIMITSWITCH KIT	.110E-04	.218E+04	.024024	
RV-303 1 IN. 150# 1 BASE	.110E-04	.218E+04	.024024	
CV-P4-74 2-1500# LIMITSWITCH KIT	.110E-04	.218E+04	.024024	
RV-303 1 IN. 150# 1 DISC	.110E-04	.218E+04	.024024	
CV-P4-71 1/2 IN. 1 SOLENOID ACC KIT	.110E-04	.218E+04	.024024	
RV-303 1 IN. 150# 1 VITON-A O-RING	.110E-04	.168E+04	.018480	
CV-P4-73 6-1500# 1 LIMIT SWITCH	.110E-04	.168E+04	.018480	C
SC-H-27 AIR HEAT. 1 IGNITN TRANSF.	.330E-05	.218E+04	.007207	
SC-H-27 AIR HEAT. 1 FLAME DETECTOR	.330E-05	.218E+04	.007207	
SC-H-27 AIR HEAT. 1 THMCPL ASSY	.300E-05	.218E+04	.006552	

COMPONENT AND PART	PROBABILITY OF FAILURE	DOWN TIME IF NO SPARE (HRS.)	LTR-115-44 RISK	CRITICAL
SC-H-27 AIR HEAT. S437 PURGE TIMER	.140E-05	.218E+04	.003058	
SC-H-27 AIR HEAT. 3 P500-5502 GAUGE	.140E-05	.218E+04	.003058	
SC-H-27 AIR HEAT. 1 S437D TIMER	.140E-05	.218E+04	.003058	
SC-H-29 ENTIRE ASSEMBLY	.120E-05	.218E+04	.002621	
SC-H-28 ENTIRE ASSEMBLY	.120E-05	.218E+04	.002621	
SC-H-30 ENTIRE ASSEMBLY	.120E-05	.218E+04	.002621	
SC-H-27 AIR HEAT. 2 SPARK PLUG (FFG)	.100E-05	.218E+04	.002184	

IV. REFERENCES

1. Reactor Safety Study, An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants, WASH-1400, U.S. Nuclear Regulatory Commission, October, 1975.
2. Reliability Analysis of Nuclear Power Plant Protective Systems, Holmes and Narver Inc., Nuclear Division, HN-190, AEC Research and Development Report US-80, Reactors - General TID-4500, May, 1967.
3. Memo: "L1-5 Failure Mode Effects and Criticality Analysis", RJC-2-78 from R. J. Crump to G. A. Dinneen, dated March 27, 1978.

APPENDIX A

DOCUMENTATION OF RISKSORT:
A SPARE PARTS PROCESSING PROGRAM

RISKSORT

A SPARE PARTS PROCESSING PROGRAM

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ABSTRACT

The Risksort Program utilizes the CYBER 173 to process piece part failure rate data. The risk is calculated as the product of the probability of failure of a part and the procurement lead time if no spare parts are available. The risk provides a basis for deciding which spare parts or spare components to keep in inventory in order to reduce down time due to the unavailability of same in the event of a failure.

RISKSORT

I. Program Description

The Risksort program, on the Cyber 173, processes either card input or terminal input in conjunction with old parts data from disc. It produces a list of all parts in decreasing order of risk and a new master file.

The risk is calculated as: $\text{risk} = \text{probability of failure} * \text{downtime}$.

II. Data InputA. Master Input File

Except for the initial create run, the master file of parts is entered into the program via tape 15. It is a binary file containing records with component, part, probability of failure, downtime, risk, and the critical code. The file is sorted by component and by part.

B. Input Data Cards

The first card of the data is a card specifying the action to be taken by this run. The action may be to create a master file, update the master, or to delete records from the master. Only one action may be taken per run. The format of this first card is:

"CREATE" - to create a master file.

"UPDATE" - to add records to or modify existing records in the master file.

"DELETE" - to delete records from the master file.

The action card is followed by the data cards containing the necessary information for each part. The parts data is input in free format with the data fields in the below order (unless otherwise stated)*. The format for each part's data is:

*For "Delete" only component name and part name are used.

RV-130B 1/2-1100# "1 GASKET ASSY " 0.017 2184. U

[illegible]

Sample Input Data Card

"component name" - a maximum of 20 characters (including blanks) enclosed in double quote marks. (i.e., "component A" has 11 characters).

"part name" - a maximum of 20 characters (including blanks) enclosed in double quotes.

probability of failure - a maximum of 10 characters in exponential** or floating point form (i.e. 125 E-02 has 8 characters or 1.25 has 4 characters). It is not needed if the action is to "DELETE".

down-time - a maximum of 10 characters in exponential or floating point (real) form. It is not needed if the action is to "DELETE".

critical-code - either a C or a U indicating respectively if the component is critical or not.

C. Input by Terminal

The input setup is identical to that of a batch run with data cards except that the information is typed in at the terminal keyboard instead of on cards. For interactive input, the program will also give the above instructions so to the form for the input data. An = sign will also be used to prompt the user.

III. Data Output

The output consists of printed and disk file output.

A. Output File

The output file consists of old and/or new spare parts data sorted by both component name and part name in ascending order. It contains binary data in the following sequence: component name, part name, probability of failure, down time, risk, and the critical code. The file is used as the master file during the subsequent run. The old master file is not destroyed.

**aE $\pm$ n where a is a real number and n is the integer exponent.

B. Printed Output

The print-out consists of two parts. The first section is the printed image of all input data for that run. The second part is an inventory of all parts sorted in descending order by risk. For each component and part, the part's probability of failure, downtime if no spare parts are available, risk and whether or not it is a critical component is printed.

IV. Control Card SetupA. Create Master File - Batch

Job Card...STMFA.,NT1.

ACCOUNT,3460,89505-353-100,I05.

ATTACH,RISK,RISK LGO,ID=DJS.

REQUEST,TAPE15,*PF.

RISK.

REWIND,TAPE15.

CATELOG,TAPE15,MASTER,ID=DJS*,RP=999.

REWIND,TAPE15.

REQUEST,MASTER,N,RINK,VSU=0

COPY,TAPE15,MASTER.

7/8/9

Data Cards

:
:
:
:
eoi.

B. Update or Delete - Batch

Job Card...STMFA,NT1.

ACCOUNT,3460,89505-353-100,I05.

ATTACH,RISK,RISKLGO,ID=DJS.

*User's ID.

ATTACH,TAPE15,MASTER,ID=DJS.*
 BKSP,TAPE15.
 EXIT,U.
 REQUEST,TAPE15,*PF.
 REQUEST,TEMP,E,VSN=T9_____.
 COPY,TEMP,TAPE15.
 CATALOG,TAPE15,MASTER,ID=DJS*,RP=999.
 EXIT,U.
 REWIND,TAPE15.
 REQUEST,TAPE12,*PF.
 RISK.
 REWIND,TAPE12.
 CATALOG,TAPE12,MASTER,ID=DJS*,RP=999.
 REWIND,TAPE12.
 REQUEST,MASTER,N,RING,VSN=0.
 COPY,TAPE12,MASTER.
 PURGE,Z,MASTER,ID=DJS*,LC=1.
 RETURN,Z.

7/8/9

Data Card

eoil.

C. Create New Master - Interactively

REQUEST,TAPE15,*PF
 ATTACH,RISK,RISKLG0,ID=DJS.

*User's ID.

RISK

.
.
type in data at prompt of program
.
.

REWIND,TAPE15,OUTPUT

CATALOG,TAPE15,MASTER,RP=999,ID=DJS*

BATCH,OUTPUT,PRINT,DJS*

D. Update or Delete - Interactively

REQUEST,TAPE12,*PF

ATTACH,RISK,RISKLG0,ID=DJS

ATTACH,TAPE15,MASTER,ID=DJS*

RISK

.
.
type in data at prompt of program
.
.

REWIND, TAPE12,OUTPUT

CATALOG,TAPE12,MASTER,ID=DJS*,RP=999

BATCH,OUTPUT,PRINT,DJS*

*User's ID.

LISTING OF COMPUTER CODE RISKSORT

[illegible]

CCC

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READ IN TYPE OF RUN: CREATE, UPDATE, OR DELETE.


```

      READ(5,20)BCD
      IF(EOF(5))GO,1
1     CALL CVIC(BCD,BIN,IC,NUM,IERR)
      KEY = IBIN(1)
      WRITE(6,30)BCD
      IF(KEY.NE.CREATE .AND. KEY.NE.UPDATE .AND. KEY.NE.DELETE)
1     GO TO 55
      IF(KEY.EQ.DELETE) NFIELD = 2
      IFLAG = .FALSE.
5     ICOUNT = 0
10    CONTINUE
      READ(5,20)BCD
20    FORMAT(8A10)
      IF(EOF(5))GO,25
25    WRITE(6,30)BCD
30    FORMAT(1H,8A10)
      CALL CVIC(BCD,BIN(ICOUNT+1),IC(ICOUNT + 1),NUM , IERR)
      IF(IERR.EQ. 0)GO TO 33
      WRITE(6,32)
32    FORMAT(33H THE ABOVE CARD WILL NOT BE USED, /
1     49H BECAUSE CVIC WOULD NOT ACCEPT IT AS VALID INPUT.)
      GO TO 10
33    ICOUNT = ICOUNT + NUM
      IF(ICOUNT.LT. NFIELD) GO TO 10

C
C
C     STORE DATA
      K1 = (IABS(IC(1)) - 1)/10 + 1
      K2 = (IABS(IC(K1 + 1)) - 1)/10 + 1
      DO 35 I = 1,K1
      COMP(I) = IBIN(I)
35    CONTINUE
      DO 40 I = 1,K2
      PART(I) = IBIN(K1 + I)
40    CONTINUE
      L1 = IABS(IC(1))
      L2 = IABS(IC(K1+1))
      CALL BLNKCK(COMP,L1)
      CALL BLNKCK(PART,L2)
      IF(KEY.EQ.DELETE)GO TO 50

C
C
C     MAKE POF AND DT REALS
      IF(IC(NUM-2).EQ. 1)POF = FLOAT(IBIN(NUM-2))
      IF(IC(NUM-2).NE. 1)POF = BIN(NUM-2)
      IF(IC(NUM-1).EQ. 1)DT = FLOAT(IBIN(NUM-1))
      IF(IC(NUM-1).NE. 1)DT = BIN(NUM-1)
      CODE = IBIN(NUM)

C
C
C     COMPUTE RISK
      RISK = POF * DT

C
C
C     WRITE TO TRANSACTION FILE
      WRITE(10)COMP , PART , POF , DT , RISK , CODE
      GO TO 5
50    WRITE(20)COMP , PART
      GO TO 5
55    CONTINUE
      WRITE(6,65)
65    FORMAT( 38H KEYWORD WAS NOT FOUND. JOB ABORTED.)

```


STOP

```

C
C
C  IF I = 1 CONTINUE WITH INTERACTIVE JOB.
    IF I = 0 NO DATA - STOP JOB.

```

```

70  I = INTRACT(DUMMY)
    IF(I.EQ.1)GO TO 60
    WRITE(6,75)

```

```

75  FORMAT(1H,"NO DATA CARDS FOUND, AND TERMINAL NOT LOGGED IN.)/
    1H,"JOB ABORTED.")

```

```

    STOP
60  RETURN
    END

```

```

SUBROUTINE TERMIN( KEY )

```

```

C
C
C  INPUTS DATA FROM TERMINAL, COMPUTES RISK, AND WRITES TO TAPE10

```

```

COMMON /UNITS/ ISCP, JSCP
COMMON /CVIINF/ BIN(200), IC(40), BCD(8)
COMMON /KEYS/ CREATE, UPDATE, DELETE
DIMENSION IBIN(200)
INTEGER COMP(2), PART(2), END, CREATE, UPDATE, DELETE, CODE
EQUIVALENCE (BIN(1), IBIN(1))
DATA END /3HEND/
CALL CONNEC (ISCP)
CALL CONNEC (JSCP)
NFIELD = 5
WRITE(JSCP,1)

```

```

1  FORMAT(1H,"20HINPUT FILE IS EMPTY./

```

```

2  1H,"42HDATA MUST BE ENTERED THROUGH THE TERMINAL./
3  1H,"43HAN = SIGN WILL BE USED TO PROMPT FOR INPUT.)

```

```

4  WRITE(JSCP,5)

```

```

5  FORMAT(1H,"14HINPUT KEYWORD:/

```

```

1  1H,"44HTYPE: "DELETE" - TO DELETE LINES FROM MASTER/

```

```

2  1H,"38H      : "CREATE" - TO CREATE MASTER FILE/

```

```

3  1H,"50H      : "UPDATE" - TO ADD &/OR CHANGE EXISTING LINES)

```

```

WRITE(JSCP,40)

```

```

READ(ISCP,50)BCD

```

```

WRITE(JSCP,60)BCD

```

```

CALL CVIC(BCD,BIN,IC,NUM,IERR)

```

```

KEY = IBIN(1)

```

```

IF(KEY.EQ.UPDATE .OR. KEY.EQ.CREATE .OR. KEY.EQ.DELETE)

```

```

1  GO TO 9

```

```

WRITE(JSCP,8)

```

```

8  FORMAT(19H"UNRECOGNIZABLE KEY)

```

```

GO TO 4

```

```

9  IF(KEY.EQ.DELETE) NFIELD = 2

```

```

WRITE(JSCP,10)

```

```

10  FORMAT(1H,"21HTO ENTER DATA TYPE : / 15H

```

```

1  54H COMPONENT NAME, PROBABILITY OF FAILURE, AND DOWNTIME. /

```

```

2  1H,"42HNOTE : THEY SHOULD BE SEPARATED BY BLANKS /

```

```

3  1H,"45HOR COMMAS. THE PART AND COMPONENT SHOULD BE /

```

```

4  1H,"50HIN DOUBLE QUOTES OR HOLLERITH, AND EACH A MAXIMUM /

```

```

5  1H,"50HOF 20 CHARACTERS. THE POF AND DT SHOULD BE REALS./

```

```

6  1H,"44HTYPE : END - WHEN ALL DATA HAS BEEN ENTERED.)

```

```

20  ICOUNT = 0

```

```

30  CONTINUE

```

```

WRITE(JSCP,40)

```

```

40  FORMAT(2H =)

```

```

READ(ISCP,50)BCD

```

```

50  FORMAT(8A10)

```

```

WRITE(JSCP,60)BCD

```

```

60  FORMAT(1H,"8A10)

```

```

CALL CVIC(BCD,BIN(ICOUNT+1),IC(ICOUNT+1),NUM,IERR)

```

```

IF(IBIN(1).EQ.END)RETURN

```

```

IF(IERR.EQ.0) GO TO 65

```

```

WRITE(JSCP,62)

```

```

62  FORMAT(33H"THE ABOVE CARD WILL NOT BE USED, /

```

```

48H"BECAUSE AUTO WILL NOT ACCEPT IT AS VALID INPUT")

```



```

      1 4 1000 BECAUSE CIVIC WILL NOT ACCEPT IT AS VALID INPUT.
65 GO TO 30
   ICOUNT = ICOUNT + NUM
   IF(ICOUNT .LT. NFIELD)GO TO 30
C
C
C   STORE DATA
   K1 = (IABS(IC(1))-1)/10 + 1
   K2 = (IABS(IC(K1+1))-1)/10 + 1
   DO 70 I=1,K1
   COMP(I) = IBIN(I)
70 CONTINUE
   DO 80 I=1,K2
   PART(I) = IBIN(K1+I)
80 CONTINUE
   L1 = IABS(IC(1))
   L2 = IABS(IC(K1+1))
C
C
C   CHECK NAMES FOR EXTRA BLANKS
   CALL BLNKCK(COMP,L1)
   CALL BLNKCK(PART,L2)
   IF(KEY .EQ. DELETE)GO TO 90
C
C
C   MAKE POF AND DT REALS
   IF(IC(NUM-2) .EQ. 1)POF = FLOAT(IBIN(NUM-2))
   IF(IC(NUM-2) .NE. 1)POF = BIN(NUM-2)
   IF(IC(NUM-1) .EQ. 1)DT = FLOAT(IBIN(NUM-1))
   IF(IC(NUM-1) .NE. 1)DT = BIN(NUM-1)
   CODE = IBIN(NUM)
C
C
C   COMPUTE RISK
   RISK = POF * DT
C
C
C   WRITE RECORD TO TRANSACTION FILE
   WRITE(10) COMP,PART,POF,DT,RISK,CODE
   GO TO 20
90 WRITE(20)COMP,PART
   GO TO 20
   END
   SUBROUTINE BLNKCK(ISTRNG,NUM)
C
C
C   SUBROUTINE TO REMOVE EXTRA BLANKS FROM THE STRING OF LENGTH NUM.
   LOGICAL BOOLN , SEARCH
   DIMENSION ITEMP(2)
   INTEGER ISTRNG(2)
   DATA ITEMP /2*10H
   L1 = 1
C
C
C   SCAN FOR 2 BLANKS TOGETHER
   CONTINUE
   BOOLN = SEARCH(ISTRNG,L1,NUM,2H ,1,2,LOC1)
C
C
C   LOC1 IS POSITION OF BLANK
   IF(.NOT. BOOLN)GO TO 10
   CALL SKBLNK(ISTRNG,LOC1,NUM,LOC)
C
C
C   LOC IS POSTION OF FIRST NONBLANK CHARACTER.
   HAVE BLANKS FROM LOC1 THRU LOC - 1.
   DELETE EXTRA BLANKS.
C
C
C   CALL STRMOV(ISTRNG,LOC,NUM,ISTRNG,LOC1+1)

```

NUM = NUM - (LOC - LOC1) + 1
 L1 = LOC + 1
 GO TO 5

DO BLANK FILL OF ORIGINAL STRING
 CALL STRMOV(ITEMP, NUM + 1, 20, ISTRNG, NUM + 1)
 RETURN
 END
 SUBROUTINE MASTER(MRL)

CREATE MASTER FILE

REWIND 10

SORT TAPE10 ALPHA-NUMERICALLY AND WRITE TO MASTER FILE

CALL ALPHST(MRL, 10, 15)

SORT MASTER ON RISK AND WRITE TO NEW MASTER FILE

REWIND 12
 CALL RSKSRT(MRL, 15, 12)
 CALL OUTPUT(12)
 RETURN
 END
 SUBROUTINE MERGEN(MRL)

TO CREATE NEW MASTER FROM MASTER AND TRANSACTION FILE

INTEGER PART1(2), COMP1(2), PART2(2), COMP2(2), CODE1, CODE2

REWIND 15

REWIND 10

SORT TRANSACTION FILE

CALL ALPHST(MRL, 10, 10)

READ TRANSACTION FILE

5 READ(10) COMP1, PART1, POF1, DT1, RISK1, CODE1
 IF(EOF(10)) 60, 10

READ OLD MASTER FILE

10 READ(15) COMP2, PART2, POF2, DT2, RISK2, CODE2
 IF(EOF(15)) 70, 20

COMPARE COMP AND PART OF MASTER WITH THOSE OF TRANS. FILE

20 CALL CMPRWD(COMP2, COMP1, 2, ICOMP)
 IF(ICOMP.EQ.0) CALL CMPRWD(PART2, PART1, 2, ICOMP)

TRANS. GT. MASTER

IF(ICOMP.NE.1) GO TO 25
 WRITE(12) COMP2, PART2, POF2, DT2, RISK2, CODE2
 GO TO 10

TRANS. LT. MASTER

25 IF(ICOMP.EQ.0) GO TO 30
 WRITE(12) COMP1, PART1, POF1, DT1, RISK1, CODE1
 READ(10) COMP1, PART1, POF1, DT1, RISK1, CODE1
 IF(EOF(10)) 60, 20

TRANS. EQ. MASTER

WRITE TRANSACTION TO NEW MASTER

```

30 WRITE(12)COMP1,PART1,POF1,DT1,RISK1,CODE1
GO TO 5
C
C
C   IF REACH EOF ON TRANSACTION FILE FIRST
60 CONTINUE
READ(15) COMP2,PART2,POF2,DT2,RISK2,CODE2
IF(EOF(15))100,65
65 WRITE(12)COMP2,PART2,POF2,DT2,RISK2,CODE2
GO TO 60
C
C
C   IF REACH EOF ON MASTER FILE FIRST
70 READ(10) COMP1,PART1,POF1,DT1,RISK1,CODE1
IF(EOF(10))100,75
75 WRITE(12)COMP1,PART1,POF1,DT1,RISK1,CODE1
GO TO 70
100 CONTINUE
REWIND 12
REWIND 10
CALL RSKSRT(MRL,12,10)
CALL OUTPUT(10)
RETURN
END
SUBROUTINE SHORTN(MRL)
C
C
C   TO DELETE CARDS FROM MASTER FILE
INTEGER PART(2),COMP(2),PARTM(2),COMPM(2),CODEN
REWIND 20
REWIND 15
C
C
C   SORT TRANSACTION FILE ALPHA-NUMERICALLY
CALL ALPHST(MRL,20,10)
C
C
C   READ WHICH CARD IS TO BE DELETED
10 READ(10)COMP,PART
IF(EOF(10))90,15
C
C
C   READ MASTER FILE
15 READ(15)COMPM,PARTM,POFM,DTM,RISKM,CODEN
IF(EOF(15))100,20
C
C
C   IF CARD IS TO BE DELETED, DO NOT WRITE TO NEW MASTER
20 CALL CMPRWD(COMPM,COMP,2,ICOMP)
IF(ICOMP .EQ. 0)CALL CMPRWD(PARTM,PART,2,ICOMP)
C
C
C   TRANS GT MASTER
IF(ICOMP .NE. 1)GO TO 25
WRITE(12)COMPM,PARTM,POFM,DTM,RISKM,CODEN
GO TO 15
C
C
C   TRANS EQ MASTER
25 IF(ICOMP .EQ. 0) GO TO 10
C
C
C   TRANS LT MASTER
READ(10)COMP,PART
IF(EOF(10)) 90, 20
LOOP IF NO MORE DELETIONS
20 READ(15) COMPM,PARTM,POFM,DTM,RISKM,CODEN

```

```

70 READ(12) COMP, PART, POF, DT, RISK, CODE
IF (EOF(12)) 100, 95
95 WRITE(12) COMP, PART, POF, DT, RISK, CODE
GO TO 90
100 CONTINUE

C
C
C   SORT NEW MASTER ON RISK IN DESCENDING ORDER
REWIND 10
REWIND 12
CALL RSKSRT(MRL, 12, 10)

C
C
C   OUTPUT NEW MASTER
CALL OUTPUT(10)
RETURN
END
SUBROUTINE ALPHST(MRL, IN, IOUT)
C
C
C   SORT TRANSACTION FILE ALPHABETICALLY ON PART AND COMPONENT
CALL SMSORT(MRL)
CALL SMFILE("SORT", "BINARY", IN, "REWIND")
CALL SMFILE("OUTPUT", "BINARY", IOUT, "REWIND")
CALL SMKEY(1, 1, 20, 0, "DISPLAY", "DISPLAY", "A")
CALL SMKEY(21, 1, 20, 0, "DISPLAY", "DISPLAY", "A")
CALL SMEND
RETURN
END
SUBROUTINE RSKSRT(MRL, I, N)
C
C
C   SORT NEW MASTER ON RISK IN DESCENDING ORDER
CALL SMSORT(MRL)
CALL SMFILE("SORT", "BINARY", I, "REWIND")
CALL SMFILE("OUTPUT", "BINARY", N, "REWIND")
CALL SMKEY(61, 1, 10, 0, "FLOAT", "D")
CALL SMEND
RETURN
END
SUBROUTINE OUTPUT(IFILE)
C
C
C   TO OUTPUT NEW MASTER
INTEGER COMP(2), PART(2), CODE, C
DATA C /"C"/, IBLNK /1H
1 ICOUNT = 0
WRITE(6, 5)
5 FORMAT(1H1, 7X, "COMPONENT", 8X, "PROBABILITY", 4X, "DOWN TIME",
1 9X, "RISK", 8X, "CRITICAL", /, 8X, "AND PART", 9X, "OF FAILURE",
2 4X, "IF NO SPARE", /, 40X, "(HRS.)", /)
40 CONTINUE
READ(IFILE) COMP, PART, POF, DT, RISK, CODE
IF (EOF(IFILE)) 50, 20
20 IF (CODE .NE. C) CODE = IBLNK
WRITE(6, 30) COMP, PART, POF, DT, RISK, CODE
30 FORMAT(1H, 2A10, /, 1H, 2A10, 3X, E10.3, 3X, E10.3, 3X, E14.6, 11X, A1, /)
ICOUNT = ICOUNT + 1
IF (ICOUNT .GT. 16) GO TO 1
GO TO 40
50 CONTINUE
RETURN
END
SUBROUTINE CHPRWD(STR1, STR2, N, ICOMP)
INTEGER STR1(N), STR2(N)
DATA MASK /777777777777B/
C
C
C   SUBROUTINE COMPARES THE STRINGS OF LENGTH N WORDS TO DETERMINE

```

```

C      WHICH IS THE SMALLER OR IF THEY ARE EQUAL.
C      LOOP ONCE FOR EACH WORD IN STRING.
C      DO 20 I=1,N
C      SHIFT UPPER 30 BITS OF WORD I TO LOWER 30, MASK OFF , AND SUBTRACT
C      STRINGS.
C      IF( AND ( SHIFT (STR2(I),30) ,MASK) -
1      AND ( SHIFT (STR1(I),30) ,MASK)) 30,10,40
C      IF TOP 30 BITS ARE = CONTINUE BY CHECKING LOWER 30 BITS.
C      10 IF( AND (STR2(I) , MASK) - ( AND (STR1(I) , MASK))) 30,20,40
C      20 CONTINUE
C      IF BOTH ARE EQUAL
C      ICOMP = 0
C      GO TO 50
C      IF STR2 LT STR1
C      30 ICOMP = -1
C      GO TO 50
C      IF STR2 GT STR1
C      40 ICOMP = 1
C      50 RETURN
C      END
      IDENT INTRACT
      ENTRY INTRACT
      SPACE 3

```

```

***
*
*
*
*
*
*
*
*
***

```

```

CODED BY DAVE STOKLAS --SYSTEM PROGRAMMING
FUNCTION INTRACT - IS THIS JOB INTERACTIVE
CALL IS - I = INTRACT(DUMMY)

```

```

RETURNS - ZERO IF JOB IS NOT INTERACTIVE
          ONE IF JOB IS INTERACTIVE

```

```

INTRACT  SPACE 3
          BSS 1
          SYSTEM RWE,RCL,REPLY
          SX6 0
          SA1 REPLY
          MX2 59
          BX3 X1*X2
          ZR X3,INTRACT
          SX6 1
          EQ INTRACT
          SPACE 3
          BSSZ 1
          SPACE 1
          END

          CALL RWE
          PRESET TO NOT INTERACTIVE
          GET RWE REPLY WORD

          NOT INTERACTIVE-RETURN
          SET INTERACTIVE
          RETURN

REPLY    AREA FOR REPLY FROM RWE

```

```

***** IDJSOAV //// END OF LIST ////
***** IDJSOAV //// END OF LIST ////

```