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**Prepared for the U.S. Department of Energy
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Verified By: [redacted] 1-14-94

May 11, 1962

REACTOR STAFFING MODEL

The primary effort to date in connection with this study has been directed toward obtaining source data which indicates

- (1) the functions performed during reactor outages and the distribution of time required to accomplish these corrective functions,
- (2) the groups of crafts associated with each of the recovery functions performed, and
- (3) the radiation exposures experienced during these activities.

The first phase of preliminary analysis has been based on the "time accountability" report data originated by the various reactor analysts. The attached computer tabulation is one of the analyses performed considering the time and date a reactor was shut down, the "cause" for which it went down and the time and date the reactor was considered back on-line.

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The coding used here is as follows:

Cause 1	Scheduled charge-discharge	Reactor 1 = B
" 2	Rupture	Reactor 2 = C
" 3	Tube replacement	Reactor 3 = D
" 4	Water leaks	Reactor 4 = DR
" 5	Control trips (Panellit, Beckman, etc.)	Reactor 5 = F
" 6	Front face leaks	Reactor 6 = H
" 7	Rear face leaks	Reactor 7 = KE
" 8	Production test	Reactor 8 = KW
" 9	Electrical power failure	
" 10	Orifice failure	
" 11	Control rod failure	
" 12	Scheduled overbore	
" 13	Water supply failure	
" 14	Ball drop - loss of reactivity	
" 15	Plugged rear nozzles	
" 16	Faulty thermocouples	

The report summarizes these accountability data into the following summaries in the order presented below:

1. Total hours down per reactor per cause. (April, 1961 to April, 1962)
2. Number of records indicating experience of outages per reactor per cause.
3. The average and standard deviation; same relationship. (Note: The lack of observations nullifies the value of the standard deviation calculated ... except Reactor 7 and 8 - Cause 1, where the standard deviation is within the acceptable range, less than or equal to one third the average.)
4. Outage summary; total hours down, percentage contribution to the department total outage, and time operating efficiency.
5. Department summary (self explanatory). (Note: The comment following item 3 above applies here.)
6. through 21. Interval between like outages by cause.

(These reports illustrate which reactor was hit by the various problems during the year, how many times it was involved, and the number of hours lapsed between each like shutdown cause. Cause 1 is the only positive section of the report. Here it will be noted that Reactor 1 was so involved with problem outages, it did not have a scheduled charge-discharge shut down. The inverse situation applies to Reactors 7 and 8.)

22. Department summary of outage interval report; (This again is a preliminary analysis to determine whether there is sufficient data to make sound statistical conclusions regarding outage time-cause relationships. It must be noted that the standard deviations are, for all practical purposes, valueless until such time an adequate number of observations are available.)

This analytical output report has been sent to you to illustrate the types of summaries that can be had now that the basic source data is on magnetic tape. In that we are using the data to eventually establish the types of outages, their frequencies, and their duration, there is no reason why you cannot have similar reports generated for your own purposes. If you have such a need, please do not hesitate to give us a call indicating the period of time to be covered (since April of 1961) and the manner in which these data are to be assembled to provide you with the required information.

R. C. Burke
R. C. Burke

OPERATIONS RESEARCH & SYNTHESIS

	REACTOR1	REACTOR2	REACTOR3	REACTOR4	REACTOR5	REACTOR6	REACTOR7	REACTOR8
			TOTAL HOURS DOWN					
CAUSE 1	0.	448.5	225.9	173.2	43.1	0.	451.8	655.1
CAUSE 2	472.4	775.0	491.8	587.1	373.3	606.7	334.0	249.8
CAUSE 3	383.0	192.1	538.8	794.8	606.4	818.4	0.	0.
CAUSE 4	1656.3	470.1	985.4	901.7	827.6	870.3	0.	33.4
CAUSE 5	1.3	8.5	50.6	173.2	121.3	127.5	547.9	324.7
CAUSE 6	31.1	72.4	146.4	35.3	1.8	4.7	0.	0.
CAUSE 7	0.	55.4	5.4	0.	134.6	116.5	1.1	0.
CAUSE 8	0.	3.6	0.	0.	6.3	0.	0.	0.
CAUSE 9	42.3	0.5	87.2	237.8	41.8	0.	0.6	0.
CAUSE10	0.	0.	0.	0.	0.	0.	0.	1.1
CAUSE11	0.	0.	0.	0.	0.	0.	117.5	0.
CAUSE12	0.	200.6	0.	0.	0.	0.	0.	0.
CAUSE13	102.8	43.4	0.	0.	188.9	0.	0.	0.
CAUSE14	0.	0.	0.	89.2	27.1	0.	0.	0.
CAUSE15	37.7	0.	0.	0.	0.	0.	0.	0.
CAUSE16	7.5	10.9	0.	2.6	0.	0.	0.	0.

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	REACTOR1	REACTOR2	**TOTAL DOWN INCIDENTS**			REACTOR6	REACTOR7	REACTOR8	REACTOR9
			REACTOR3	REACTOR4	REACTOR5				
CAUSE 1	0	4	2	2	1	0	6	9	
CAUSE 2	8	11	10	14	9	20	8	6	
CAUSE 3	1	1	2	2	3	5	0	0	
CAUSE 4	28	10	20	14	15	23	0	1	
CAUSE 5	3	12	10	10	5	23	17	18	
CAUSE 6	1	2	4	1	1	3	0	0	
CAUSE 7	0	2	2	0	4	4	1	0	
CAUSE 8	0	1	0	0	1	0	0	0	
CAUSE 9	1	1	4	1	1	0	1	0	
CAUSE10	0	0	0	0	0	0	0	1	
CAUSE11	0	0	0	0	0	0	2	0	
CAUSE12	0	2	0	0	0	0	0	0	
CAUSE13	2	1	0	0	3	0	0	0	
CAUSE14	0	0	0	2	2	0	0	0	
CAUSE15	2	0	0	0	0	0	0	0	
CAUSE16	2	1	0	1	0	0	0	0	

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	REACTOR1		REACTOR2		**DOWN INCIDENT AVERAGE AND STANDARD DEVIATION*		REACTOR3		REACTOR4		REACTOR5		REACTOR6		REACTOR7		REACTOR8	
CAUSE 1	0.	0.	112.1	38.3	113.0	7.4	86.6	68.5	43.1	0.	0.	0.	72.0	9.7	72.8	8.8		
CAUSE 2	59.0	29.9	70.5	82.0	49.2	19.3	41.9	5.3	41.5	21.7	30.3	14.1	41.8	35.6	41.6	26.8		
CAUSE 3	383.0	0.	192.1	0.	269.4	168.8	397.4	75.6	202.1	161.0	163.7	147.7	0.	0.	0.	0.		
CAUSE 4	59.2	36.6	47.0	31.8	49.3	12.2	64.4	24.6	55.2	16.8	37.8	26.2	0.	0.	33.4	0.		
CAUSE 5	0.4	0.2	0.7	0.6	5.1	12.6	17.3	21.9	24.3	26.4	5.5	10.7	32.2	23.7	18.0	18.9		
CAUSE 6	31.1	0.	36.2	0.5	36.6	29.3	35.3	0.	1.8	0.	1.6	0.6	0.	0.	0.	0.		
CAUSE 7	0.	0.	27.7	37.3	2.7	3.1	0.	0.	33.6	37.3	29.1	57.7	1.1	0.	0.	0.		
CAUSE 8	0.	0.	3.6	0.	0.	0.	0.	0.	6.3	0.	0.	0.	0.	0.	0.	0.		
CAUSE 9	42.3	0.	0.5	0.	21.8	25.1	237.8	0.	41.8	0.	0.	0.	0.6	0.	0.	0.		
CAUSE10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.1	0.		
CAUSE11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	58.7	3.2	0.	0.		
CAUSE12	0.	0.	100.3	84.1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.		
CAUSE13	51.4	70.4	43.4	0.	0.	0.	0.	0.	63.0	25.4	0.	0.	0.	0.	0.	0.		
CAUSE14	0.	0.	0.	0.	0.	0.	44.6	23.9	13.5	5.5	0.	0.	0.	0.	0.	0.		
CAUSE15	18.8	25.9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.		
CAUSE16	3.8	3.1	10.9	0.	0.	0.	2.6	0.	0.	0.	0.	0.	0.	0.	0.	0.		

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DOWN INCIDENT SUMMARY- TOTAL HOURS, PERCENTAGE OF TOTAL DEPARTMENT HOURS AND TIME OPERATING EFFICIENCY
 REACTOR1 REACTOR2 REACTOR3 REACTOR4 REACTOR5 REACTOR6 REACTOR7 REACTOR8

TOTAL	2734.5	2281.0	2531.6	2995.0	2372.1	2544.2	1433.1	1264.1
PERCENT	15.062	12.564	13.944	16.496	13.066	14.013	7.893	6.963
EFFNCY	0.688	0.740	0.711	0.658	0.729	0.710	0.836	0.856

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	TOTAL HOURS	**DEPARTMENT SUMMARY** TIMES DOWN	AVERAGE	STANDARD DEVIATION
CAUSE 1	1977.6	24.0	82.4	28.5
CAUSE 2	3890.1	86.0	45.2	36.1
CAUSE 3	3333.7	14.0	238.1	147.0
CAUSE 4	5745.0	111.0	51.8	27.6
CAUSE 5	1355.1	98.0	13.8	19.7
CAUSE 6	291.8	12.0	24.3	22.7
CAUSE 7	313.0	13.0	24.1	38.2
CAUSE 8	9.8	2.0	4.9	1.9
CAUSE 9	410.3	9.0	45.6	75.1
CAUSE10	1.1	1.0	1.1	0.
CAUSE11	117.5	2.0	58.7	3.2
CAUSE12	200.6	2.0	100.3	84.1
CAUSE13	335.1	6.0	55.8	36.3
CAUSE14	116.3	4.0	29.1	22.9
CAUSE15	37.7	2.0	18.8	25.9
CAUSE16	21.1	4.0	5.3	4.2

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INTERVAL BETWEEN LIKE OUTAGES BY CAUSE
CAUSE 1

REACTOR1	REACTOR2	REACTOR3	REACTOR4	REACTOR5	REACTOR6	REACTOR7	REACTOR8
	1040.3	749.9	486.6			977.6	857.7
	1147.4					1069.4	747.8
	2299.6					760.5	1055.8
						826.8	1591.4
						1552.7	473.2
							400.3
							642.9
							917.2

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****INTERVAL BETWEEN LIKE OUTAGES BY CAUSE****
CAUSE 2

REACTOR1	REACTOR2	REACTOR3	REACTOR4	REACTOR5	REACTOR6	REACTOR7	REACTOR8
334.6	170.0	444.1	502.2	189.2	418.9	1.8	2864.7
138.2	834.2	2898.2	1965.7	136.1	2.4	186.8	594.3
3.3	34.7	36.2	395.5	1528.8	1274.2	538.6	2882.6
1067.0	2970.2	253.5	142.1	207.0	1165.6	395.0	16.1
4788.8	251.7	545.9	203.7	62.9	519.5	5722.4	1138.6
1136.8	1007.9	1085.8	41.3	2.0	26.6	1439.6	
193.3	360.6	978.1	93.7	900.2	74.9	96.4	
	224.7	494.8	74.2	12.7	660.8		
	375.9	395.8	28.1		1625.4		
	1415.7		38.0		198.3		
			1120.8		129.8		
			270.4		45.6		
			1720.8		127.2		
					12.2		
					183.4		
					79.0		
					64.1		
					1083.4		
					337.1		

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••INTERVAL BETWEEN LIKE OUTAGES BY CAUSE••
CAUSE 3

REACTOR1	REACTOR2	REACTOR3	REACTOR4	REACTOR5	REACTOR6	REACTOR7	REACTOR8
		1515.0	1445.1	1934.1	1050.3		
				3004.4	2841.2		
					1117.1		
					1675.2		

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****INTERVAL BETWEEN LIKE OUTAGES BY CAUSE****

REACTOR1	REACTOR2	REACTOR3	REACTOR4	CAUSE 4 REACTOR5	REACTOR6	REACTOR7	REACTOR8
81.4	2.7	1426.1	61.3	6.6	2.9		
1472.5	666.8	506.1	425.8	2107.1	538.4		
430.9	69.0	335.7	103.0	16.2	453.2		
49.7	99.5	623.9	522.0	105.8	188.9		
111.1	184.4	776.9	162.5	579.0	580.9		
229.2	3507.2	31.2	529.8	399.6	203.4		
255.5	1255.8	81.8	69.1	278.4	584.7		
89.1	76.1	519.0	711.2	1461.8	356.5		
12.0	1360.7	195.8	2286.0	6.7	314.1		
99.5		132.5	281.9	105.0	182.5		
109.2		139.8	1082.6	352.5	92.5		
124.4		43.1	458.2	326.2	73.4		
156.2		385.6	506.7	139.8	92.3		
2.3		266.2		959.0	448.3		
148.4		119.0			160.7		
49.4		76.2			70.7		
121.0		145.6			140.6		
75.6		197.4			113.6		
62.5		270.0			304.5		
347.6					136.8		
137.6					1457.5		
903.5					69.2		
36.2							
152.3							
365.8							
150.1							
249.0							

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INTERVAL BETWEEN LIKE OUTAGES BY CAUSE
CAUSE 5

REACTOR1	REACTOR2	REACTOR3	REACTOR4	REACTOR5	REACTOR6	REACTOR7	REACTOR8
631.1	1203.3	1393.1	2782.2	73.3	305.1	353.6	15.6
1645.3	3.3	2963.8	293.5	4878.6	308.2	323.1	574.4
	2368.3	529.6	622.6	210.8	205.6	628.3	322.8
	968.9	786.1	286.9	1453.6	357.5	1252.5	712.5
	36.1	358.8	326.6		1094.9	148.0	41.6
	136.6	1045.7	117.7		1.1	585.2	2438.0
	1183.7	0.1	69.6		1044.4	296.2	1008.4
	63.1	492.5	925.7		0.3	130.9	714.7
	1050.3	66.3	1139.2		1.4	558.4	51.5
	987.1				0.6	214.4	331.2
	411.6				1407.1	792.9	0.2
					11.7	208.3	1.1
					3.3	357.8	0.7
					15.5	646.0	70.2
					5.3	483.7	457.1
					65.6	4.1	179.2
					110.9		447.9
					0.9		
					1063.7		
					742.6		
					702.6		
					0.6		

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INTERVAL BETWEEN LIKE OUTAGES BY CAUSE
 REACTOR1 REACTOR2 REACTOR3 REACTOR4 REACTOR5 REACTOR6 REACTOR7 REACTOR8
 6044.2 1214.6 3074.2 1649.0 657.6 660.1

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REACTOR1
 REACTOR2 4389.9
 REACTOR3 3551.9
 REACTOR4
 CAUSE 7
 REACTOR5 529.7
 753.4
 6536.2
 REACTOR6 704.3
 1000.8
 2965.5
 REACTOR7
 REACTOR8

INTERVAL BETWEEN LIKE OUTAGES BY CAUSE

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****INTERVAL BETWEEN LIKE OUTAGES BY CAUSE****

REACTOR1

REACTOR2

REACTOR3

REACTOR4

CAUSE 8

REACTOR5

REACTOR6

REACTOR7

REACTOR9

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REACTOR1 REACTOR2 REACTOR3 REACTOR4 REACTOR5 REACTOR6 REACTOR7 REACTOR8

••INTERVAL BETWEEN LIKE OUTAGES BY CAUSE••

CAUSE 9

1373.5
17.8
3146.1

••INTERVAL BETWEEN LIKE OUTAGES BY CAUSE••
CAUSE10

REACTOR1

REACTOR2

REACTOR3

REACTOR4

REACTOR5

REACTOR6

REACTOR7

REACTOR8

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****INTERVAL BETWEEN LIKE OUTAGES BY CAUSE****

REACTOR1	REACTOR2	REACTOR3	REACTOR4	CAUSE11 REACTOR5	REACTOR6	REACTOR7 540.7	REACTOR8
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****INTERVAL BETWEEN LIKE OUTAGES BY CAUSE****

REACTOR1

REACTOR2
3112.7

REACTOR3

REACTOR4

REACTOR5

REACTOR6

REACTOR7

REACTOR8

CAUSE12

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••INTERVAL BETWEEN LIKE OUTAGES BY CAUSE••
CAUSE13

REACTOR1
272.6

REACTOR2

REACTOR3

REACTOR4

REACTOR5
517.8
28.6

REACTOR6

REACTOR7

REACTOR8

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••INTERVAL BETWEEN LIKE OUTAGES BY CAUSE••

REACTOR1	REACTOR2	REACTOR3	REACTOR4	CAUSE14 REACTOR5	REACTOR6	REACTOR7	REACTOR8
			115.3	10.1			

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••INTERVAL BETWEEN LIKE OUTAGES BY CAUSE••
CAUSE15

REACTOR1
5512.3

REACTOR2

REACTOR3

REACTOR4

REACTOR5

REACTOR6

REACTOR7

REACTOR8

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••INTERVAL BETWEEN LIKE OUTAGES BY CAUSE••
CAUSE16

REACTOR1
3936.5

REACTOR2

REACTOR3

REACTOR4

REACTOR5

REACTOR6

REACTOR7

REACTOR8

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	SUMMARY OF INTERVALS--AVERAGES AND STANDARD DEVIATIONS															
	REACTOR1		REACTOR2		REACTOR3		REACTOR4		REACTOR5		REACTOR6		REACTOR7		REACTOR8	
CAUSE 1	0.	0.	1495.8	698.2	749.9	0.	486.6	0.	0.	0.	0.	0.	1037.4	312.7	835.8	376.6
CAUSE 2	1094.6	1690.4	764.6	888.7	792.5	854.8	507.4	664.3	379.9	547.0	422.6	501.4	1197.3	2052.4	1499.3	1315.9
CAUSE 3	0.	0.	0.	0.	1515.0	0.	1445.1	0.	2469.3	756.8	1671.0	828.9	0.	0.	0.	0.
CAUSE 4	223.0	308.1	802.5	1142.0	330.1	337.6	553.9	594.6	488.8	619.9	298.4	314.6	0.	0.	0.	0.
CAUSE 5	1138.2	717.1	764.8	723.5	848.5	909.2	729.3	850.7	1654.1	2237.5	338.6	452.5	436.5	308.0	433.4	601.1
CAUSE 6	0.	0.	6044.2	0.	1979.3	972.8	0.	0.	0.	0.	658.9	1.7	0.	0.	0.	0.
CAUSE 7	0.	0.	4389.9	0.	3551.9	0.	0.	0.	266.5	3405.1	1556.9	1228.9	0.	0.	0.	0.
CAUSE 8	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CAUSE 9	0.	0.	0.	0.	1512.5	1568.8	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CAUSE 10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CAUSE 11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	540.7	0.	0.	0.
CAUSE 12	0.	0.	3112.7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CAUSE 13	272.6	0.	0.	0.	0.	0.	0.	0.	273.2	345.9	0.	0.	0.	0.	0.	0.
CAUSE 14	0.	0.	0.	0.	0.	0.	115.3	0.	10.1	0.	0.	0.	0.	0.	0.	0.
CAUSE 15	5512.3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CAUSE 16	3936.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

DECLASSIFIED

DATE

FILMED

6/29/94

END