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TITLE

Summary of Adequacy of Coolant Supply Backup

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April 4, 1960

SUMMARY OF ADEQUACY OF COOLANT SUPPLY BACKUP

INTRODUCTION

A preliminary analysis of the adequacy of the "Secondary" and "Last Ditch" cooling systems at the Hanford reactors indicates that action will be required prior to the summer months if power level limitations are to be avoided. This analysis is based upon preliminary data from recently completed trip-out tests combined with cooling water requirements at present and CY-60 power levels. More complete data will be presented shortly in HW-64417, and final evaluation of test data will be expedited.

The "Secondary" cooling system was found to have a high degree of reliability and to be of quite adequate capacity.

The "Last Ditch" systems will be generally inadequate for the coming summer months, but may be significantly improved by relatively simple changes.

RECOMMENDATIONS

1. The process objective of maintaining backup cooling protection in accordance with the Reactor Cooling System Reliability Criteria should be adhered to insofar as is possible.
2. Where minor modifications will secure conformance with the criteria at the desired reactor power level then every effort should be made to achieve this conformance at the earliest possible date.

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3. Should the calculated risk be assumed of operating a reactor above this "Last Ditch" adequacy limit this operation must be restricted both as to degree and duration in order to maintain this risk within reasonable limits.
4. Whenever abnormal process conditions decrease the reliability of the primary or secondary coolant systems then full compliance with the reactor "Last Ditch" system adequacy limit shall be achieved by limiting power levels.

DISCUSSION

At the old reactors (B, C, D, DR, F and H) the first component of the "Last Ditch" system, the hi-tanks, supply coolant flow by gravity to the reactor after the flywheel decay of the process pumps. The hi-tank adequacy depends upon the ability of this system to take over the reactor flow from the decay of the flywheels to satisfy the following conditions:

- a. Take over flow from the flywheel decay and deliver a high enough flow rate over the critical 2 to 10 minutes after shutdown to prevent excessive coolant temperatures.
- b. To deliver an adequate flow long enough that the lower flow of the export system will be adequate when the hi-tanks have emptied.

The adequacy of these hi-tanks is presented in Table I of this summary. This shows the C and DR tanks to be adequate. The other reactor's hi-tanks are adequate in winter but means must be established for cooling the water in these tanks during the summer months. This can be done by flushing or bleeding. The frequency of flushing or the amount of bleeding will have to be determined. A method that will increase both the critical flow rate from the hi-tanks and their effective total capacity is to open the export groves valve at the same time the hi-tanks system opens to the reactor. This combined with temperature monitoring would assure us of hi-tanks adequacy during FY-60 and 61.

The export system adequacy depends upon several different factors. The sooner the hi-tanks empty the greater the flow-rate demanded from the export system. For the case of the total loss of pumping power to any single reactor the export system has ample capacity to maintain adequate reactor cooling after the hi-tanks have emptied. In the case of the B-C and D-DR dual reactor areas with a full area loss of electrical and steam power the export system will provide adequate cooling to both reactors. If for any reason, however, the surge suppressors opened at an area while on export flow then the reactor flow would decrease from about 6000 gpm to about 3000 gpm at a single reactor area and to about 1000 gpm at a dual reactor area with the possibility of severe reactor damage. A study by experts of this surge suppression system is recommended.

The K-Reactor "Last Ditch" system adequacy is presented as Table II in this summary. In this table methods are suggested for considerably increasing the K-Reactor "Last Ditch" system capacity by relatively minor modifications. The first method, when both reactors are operating, considerably improves the last

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ditch adequacy but does not meet the proposed operating levels. The second method, probably only feasible when the aiding reactor is down, achieves full adequacy for 5-pump-set operation and a considerable increase in protection for 6-pump-set operation. Accurate measurement of the flow and temperatures of this "Last Ditch" coolant should increase the allowable power level with full "Last Ditch" protection by 5 to 10 percent.

The following general statements summarize the current status of the backup cooling adequacy of the Hanford reactors:

1. The secondary cooling system at the Hanford reactors is quite adequate although the lo-lift pumps at the C and K reactors do not satisfy the criteria of the separation of secondary and primary pumps.
2. The hi-tank capacity is adequate at all the old reactors during the winter months. During the summer the hi-tank temperatures should be monitored and cooling provided when necessary by bleeding or flushing.
3. The export system will provide adequate reactor cooling after the emptying of the hi-tanks provided the surge-suppressors do not open.
4. The K-Reactor last-ditch system (the HPCT plus the LPCT) is not adequate under present operating conditions for either 5 or 6 pump-set operation. However, with relatively minor modifications it can be made nearly adequate for 5 pump-set operation and greatly improved adequacy for six. This can be done by removing the HPCT orifices, operating 3 service water pumps as back-up and valving #3 and #4 lo-lift pumps directly to the HPCT through the HPC and V-70 valves, whenever the aiding reactor is shut down.

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TABLE I
HI-TANK COOLING ADEQUACY

SOURCE OF LAST DITCH COOLING	REACTOR	SEASON OF YEAR	OPERATING CONDITIONS		POWER LEVEL		PROPOSED SYSTEM CHANGES	POWER LEV
			FLOW	BULK OUTLET TEMP.	AT BULK LIMIT	MAX. WITH PRESENT LAST DITCH PROTECTION (% OF BULK LIMIT)		MAX. FOR RE LAST DITCH PI (% OF BULK
<u>Hi-Tanks</u>	B	Winter	84	93.5	1950	112	1. Monitor hi-tank temp. 2. Flush or bleed tanks to keep temp. within 5°C of process water.	126
		Spring-Fall	"	"	1750	102		109
		Summer	"	"	1650	92		107
" "	C	Winter	97	93.5	2200	144	No modifications required	-
		Spring-Fall	"	"	2000	123		-
		Summer	"	"	1900	110		-
" "	D	Winter	82	93.5	1900	103	1. Monitor hi-tank temp. 2. Flush or bleed tanks to keep temp. within 5°C of process water.	120
		Spring-Fall	"	"	1700	96		102
		Summer	"	"	1600	84		100
" "	DR	Winter	84	93.5	1950	122	1. Monitor hi-tank temp.	-
		Spring-Fall	"	"	1750	113		-
		Summer	"	"	1650	100		-
" "	F or H	Winter	85	93.5	2000	98	1. Monitor hi-tank temp. 2. Flush or bleed tanks to keep temp. within 5°C of process water. 3. Revise export groves valve setting so that it opens at the same time as the hi-tanks.*	112 148
		Spring-Fall	"	"	1800	89		96 123
		Summer	"	"	1700	80		97 101

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TABLE II

K CROSSTIES COOLING ADEQUACY

OPERATING CONDITIONS			POWER LEVEL		PROPOSED SYSTEM CHANGES	POWER LEVEL
GENERAL	FLOW	BULK OUTLET TEMP	AT BULK LIMIT	MAX. WITH PRESENT LAST DITCH PROTECTION (% OF BULK LIMIT)		MAX. FOR REVISED LAST DITCH PROTECTION (% OF BULK LIMIT)
Both reactors operating on 6-pump sets.	183	86*	3900*	77**	A. Both reactors operating. 1. Remove HPCT orifices. 2. Measure reactor low flow accurately. 3. Monitor crosstie temperature 4. Flush or bleed crossties as necessary to maintain low temperature. 5. Operate 3 S.W. pumps or be able to bring third S.W. pump up to full flow 100 seconds after power loss at other reactor.	
	"	95	4300	69		100
	"	95	3800	68		92
	"	95	3600	67		92
Both reactors operating on 5-pump sets.	156	85*	3300*	81**		91
	"	95	3700	73		107
	"	95	3300	72		98
	"	95	3100	71		97
Aiding reactor down, stricken reactor on 6-pump sets.	183	86*	3900*	75**	B. Aiding reactor down. 1. Isolate both #3 and #4 L.L. pumps directly to HPCT through HPC valve. 2. Measure reactor low flow accurately. 3. Monitor crosstie temperature. 4. Flush or bleed crossties as necessary to maintain low temperature. 5. Operate 3 S.W. pumps or be able to bring third S.W. pump up to full flow in 100 seconds after power loss at other reactor.	96
	"	95	4300	68		110
	"	95	3800	66		98
	"	95	3600	64		97
Aiding reactor down, stricken reactor on 5- pump sets.	156	85*	3300*	87**		96
	"	95	3700	78		122
	"	95	3300	76		111
	"	95	3100	75		110
Inter-time operation, reactor is not then on bulk limits. * value.						109

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