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by

J. A. Ayres

This document consists
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By Authority of CG-PR-2

R. M. Dulin, 1-25-94

By J. A. Ayres, 4-20-94

Verified By W. K. Hanson, 4-20-94

1. W. K. Kratzer
2. J. A. Ayres
3. D. R. Dickinson
4. J. E. Hanson
5. M. E. Jackson
6. C. G. Lewis
7. J. L. Poe
8. F. W. Woodfield
9. Record Center
10. 300 File

June 28, 1960

W. K. Kratzer
Reactor Fuels Unit
Research and Engineering Section

KER-1 THERMAL CYCLE

In accordance with your verbal request we are enclosing the data that were collected during the recent thermal cycle of KER-1. These data include the RTD readings and information taken from the thermocouple fuel element.

The cycle test was authorized by a letter to R. V. Dulin from W. K. Kratzer, "Request for Thermal Cycle on Thermocouple Element in KER-1, PT IP-314-A", dated May 27, 1960.

In conjunction with obtaining data on film build-up, as stated in the above letter, the test provided an excellent opportunity to study the effect of temperature on measured tube power. It has been noticed that the KER reactor tubes appear to produce more power (greater ΔT) at lower operating temperatures, but the reason for this power increase is not known. With the additional thermocouples to measure water temperatures at the center of the tube, it should be possible to determine if this increase is from the graphite or from the fuel elements.

During the cycle test, however, the ΔT between the inlet and mid-tube thermocouples (adjacent to TC element) showed almost no relationship to the over-all tube ΔT . The same results were found to be true when the ΔT between the outlet and the coolant channel thermocouples were compared with the tube ΔT . However, this does not point out a fault of the system but merely the method

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that was used in lowering temperatures. If the temperature had been decreased (and increased) in larger steps with an equilibrium period between each step, a relationship could have been established between the readings that might have been helpful in determining the source of the power increase. I would like to suggest that for future tests of this nature that the step-equilibrium system be used.

It should be noted that in Table I, no reading below 100 C is listed. The scale on the Resistance Temperature Detector (RTD) start at 100 C and they cannot be used at lower temperatures. Table I also shows that the cycle began at 0930 on 6-1-60 and ended at 1330 on 6-2-60.

The thermocouple element contains one thermocouple at the center (core temperature), and two more couples just under the zirconium jacket (sub-jacket temperature). The sub-jacket temperature in Table II shows the average of these two. The two couples adjacent to the element are averaged as "H₂O temperature" in the table. (Refer to PT IP-314-A for TC positions in element.)

The ΔT between the sub-jacket and the water temperature indicate the changing conditions across the water film. It can be seen (Table IIO that the ΔT varies inversely with temperature and that the ΔT returned to normal when the operating temperature was raised to normal. This shows that increase in ΔT was not caused by any film build up during the cycle but was caused by the change in heat transfer characteristics at the lower temperature.

The thermal cycle did not have any long-term effects that could be detected on the existing equipment. The final readings before reactor shutdown at midnight on 6-5-60 were essentially the same as those taken when the loop returned to normal temperature after the cycle test.

The reactor power level remained constant during the test and none of the adjacent control rods were moved.

Coolant Systems Development
HANFORD LABORATORIES OPERATION

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TABLE I

RTD READINGS

<u>Decreasing Temperature</u> (6-1-60) (°C)				<u>Increasing Temperature</u> (6-2-60) (°C)			
<u>Time</u>	<u>Inlet</u>	<u>Outlet</u>	<u>ΔT</u>	<u>Time</u>	<u>Inlet</u>	<u>Outlet</u>	<u>ΔT</u>
0930	238	271	33	0945	100	100	
0945	238	271	33	1000	100	128	
1000	235	268	33	1015	108	148	40
1015	233	266	33	1030	122	162	40
1030	230	263	33	1045	142	175	33*
1045	228	261	33	1100	164	201	37
1100	225	259	34	1115	178	215	37
1115	223	259	36*	1130	199	234	35
1130	222	256	34	1145	210	245	35
1145	220	254	34	1200	225	258	33
1200	211	246	35	1215	233	265	32
1215	204	240	36	1230	239	271	32
1230	192	223	31*	1245	241	273	32
1245	182	219	37	1300	245	276	31
1300	171	212	41	1315	254	285	31
1315	163	201	38	1330	257	288	31
1330	156	194	38				
1345	151	189	38				
1400	145	183	38				
1415	141	180	39				
1430	131	171	40				
1445	119	160	41				
1500	113	153	40				
1515	104	145	41				
1530	100	141	41				
1545	100	135					
1600	100	132					
1615	100	129					
1630	100	120					
1700	100	104					
1715	100	103					
1730	100	103					

* Questionable reading.

TABLE II
THERMOCOUPLE READINGS

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(6-1-60) Decreasing
(°C)

<u>Time</u>	<u>H₂O</u> <u>Temperature</u>	<u>Sub-Jacket</u> <u>Temperature</u>	<u>Core</u> <u>Temperature</u>
0937	243	364	565
1200	216	339	548
1252	185	309	520
1330	171	296	510
1400	154	282	498
1435	132	264	482
1510	115	247	470
1530	102	235	465
1840	66	205	461

(6-2-60) Increasing
(°C)

<u>Time</u>	<u>H₂O</u> <u>Temperature</u>	<u>Sub-Jacket</u> <u>Temperature</u>	<u>Core</u> <u>Temperature</u>
1000	87	219	442
1030	138	264	485
1100	171	296	510
1130	205	328	540
1215	235	356	565
1350	261	381	583

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