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TITLE

REAR FACE PIPING STUDY AT ELEVATED BULK OUTLET TEMPERATURES KE REACTOR

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REAR FACE PIPING STUDY AT ELEVATED BULK OUTLET TEMPERATURES
KE REACTOR

By:

D. H. Frieling
P. H. Hutton
Reactor, Plant Engineering Operation
Facilities Engineering Operation
IRRADIATION PROCESSING DEPARTMENT

November 9, 1961

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November 9, 1961

M. H. Schack
Reactor Modification Design Operation

REAR FACE PIPING STUDY AT ELEVATED BULK OUTLET TEMPERATURES KE REACTOR

- Ref: 1) Letter, 105-KE Downcomer Testing, Project CGI-883, PH Hutton from MH Schack, dated 8-26-60.
- 2) Letter, same subject as Ref. 1, MH Schack from PH Hutton, dated 9-9-60.
- 3) Letter, same subject as Ref. 1, MH Schack from PH Hutton, dated 12-2-60.
- 4) Letter, same subject as Ref. 1, MH Schack from PH Hutton, dated 1-4-61.
- 5) Document HW-68101, 100-K Area Downcomer Test Data, Project CGI-883, by PH Hutton, dated 1-10-61.
- 6) Letter, Supplemental Testing, 100-K Area Downcomer, Project CGI-883, MH Schack from PH Hutton, dated 3-23-61.
- 7) Document HW-70825, 105-KE Downcomer Testing, Project CGI-883, by PH Hutton and DH Frieling, dated 1-10-61.
- 8) Development Test IP-419-E, 105-KE Rear Face Piping Test During Operation at Maximum Bulk Outlet Temperature, by DH Frieling, dated 6-26-61.

Accumulation of data on rear face piping strain, piping vibration, water pressures, and water temperatures at KE Reactor as outlined in Ref. 8 was recently completed. A preliminary review of this data indicates that much of the pressure and temperature data could be significant to your study regarding the capability of the KE Reactor rear face piping to accommodate the proposed increased water flow. (Project CGI-883.) In view of this, a copy of the pressure-temperature data is attached. This will supplement earlier data obtained at your request and transmitted to you in Ref's 5 and 7. Please note that a drawing indicating the instrument locations is included in Ref's 7 and 8.

The purpose of the test as described in Ref. 8 was two-fold:

1. To establish mechanical and hydraulic conditions in the rear face piping accompanying operation at current flows and maximum bulk outlet temperatures.

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M. H. Schack

November 9, 1961

2. To use this information to assess the feasibility of continued operation at these conditions.

A preliminary review of the data brings forth the following observations:

1. A downcomer flow transition begins to occur at about the 85°C bulk outlet temperature.
2. The current flow conditions at the top of the downcomer appear to be slightly different from the original design concept.
3. The pressure recorded on the near side of the downcomer just above the orifice (P-10) appears doubtful, and instrumentation will be checked.
4. Flow characteristics of the multiple parallel orifices in a single channel does not appear to be as initially anticipated; additional information regarding this phenomena is needed.

As an extension of this test, we wish to explore the feasibility of operating this system in excess of the limiting 95°C bulk outlet temperature through model tests. Consequently, we would like to discuss with you the arrangements needed to utilize the model at Washington State University for tests at increased bulk outlet temperature.

Since the instrumentation at KE will be removed soon, please notify me of any further questions as soon as possible.

P. H. Hutton
Reactor, Plant Engineering Operation
FACILITIES ENGINEERING OPERATION

D. H. Frieling
Reactor, Plant Engineering Operation
FACILITIES ENGINEERING OPERATION

PHH-DHF:lw

Development Test No. IP-419-E
Project No. CGI-883

D. H. Frieling
P. H. Hutton

REAR FACE PIPING STUDY AT ELEVATED BULK OUTLET TEMPERATURE
KE REACTOR

GENERAL	POINT NO.	MAX. ⁽¹⁾ PRESS. (psig)	MIN. ⁽¹⁾ PRESS. (psig)	AVE. ⁽¹⁾ PRESS. (psig)	CYCLIC CONDITION ⁽¹⁾ AND DOUBLE AMPLITUDE	POINT NO.	TEMPERATURE ⁽²⁾ RECORDINGS TAKEN DURING TEST (°C)
TEST DATE: 9-1-61 TOTAL FLOW: 175,000 gal/min. POWER LEVEL: 3 MW BULK OUTLET TEMP: 21°C TORP: 360 TIME: 3:25 p.m.	P-1	Out of Service				T-1	20.42
	P-2	2.5	1.3	1.7	0.8 cps 0.5 to 1.2 psig 34 cps 0.2 to 1.0 psig	T-2	21.79
	P-3	17.9	13.7	16.4	175 cps 0.6 to 4.2 psig	T-3	20.56
	P-4	Out of Service				T-4	20.06
	P-5	10.0	8.9	9.5	55 cps 0.2 to 0.7 psig		
	P-7	4.0	2.3	3.2	0.5 cps 1.5 to 1.9 psig 40 cps 0.3 to 1.7 psig		
	P-8	4.6	4.4	4.6	120 cps 0.2 to 0.3 psig		
	P-9	5.2	4.3	4.6	9 cps 0.3 to 0.5 psig		
	* P-10	Negl. Variation		-0.1	Negligible Variation		
	P-11	-2.0	-7.0	-4.5	27 cps 1.0 to 3.0 psig		
	P-13	-1.4	-3.2	-2.3	31 cps 0.2 to 1.4 psig		
	P-14	5.7	4.6	5.2	3.8 cps 0.5 to 1.0 psig 41 cps 0.3 to 0.4 psig		
	P-15	-2.3	-6.2	-4.3	26 cps 1.5 to 3.5 psig		
	P-16	8.6	7.8	8.2	0.6 cps 0.5 to 1.0 psig 6 cps 0.2 to 0.3 psig		

(1) Unless otherwise noted, accuracy of + 10% is assumed.

(2) Unless otherwise noted, accuracy of + 1% is assumed.

* Sensing element port may have been plugged; pressure will be checked.

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Development Test No. IP-419-E
Project No. CGI-883

D. H. Frieling
P. H. Hutton

REAR FACE PIPING STUDY AT ELEVATED BULK OUTLET TEMPERATURE
KE REACTOR

GENERAL	POINT NO.	MAX. ⁽¹⁾ PRESS. (psig)	MIN. ⁽¹⁾ PRESS. (psig)	AVE. ⁽¹⁾ PRESS. (psig)	CYCLIC CONDITION ⁽¹⁾ AND DOUBLE AMPLITUDE	POINT NO.	TEMPERATURE ⁽²⁾ RECORDINGS TAKEN DURING TEST (°C)
TEST DATE: 9-1-61 TOTAL FLOW: 175,000 gal/min. POWER LEVEL: 750 MW BULK OUTLET TEMP: 36.0°C TORP: 364 psig TIME: 7:40 p.m.	P-1	Out of Service				T-1	35.27
	P-2	2.3	1.0	1.7	23 cps 0.6 to 1.3 psig	T-2	37.71
	P-3	18.0	15.0	16.5	No Reading		
	P-4	Out of Service					
	P-5	10.4	9.2	9.6	19 cps 0.2 to 0.6 psig	T-3	36.48
	P-7	5.0	3.0	4.0	6 cps 1.0 to 1.6 psig 48 cps 0.5 to 1.4 psig	T-4	36.95
	P-8	6.0	4.8	5.4	19 cps 0.4 to 0.7 psig		
	P-9	5.4	4.8	5.1	10 cps 0.2 to 0.6 psig		
	* P-10	Neg. Variation		0.0	Negligible Variation		
	P-11	-2.0	-6.0	-4.0	18 cps 0.8 to 3 psig		
	P-13	-1.6	-3.8	-2.5	19 cps 0.8 to 2.2 psig		
	P-14	5.7	4.7	5.2	5 cps 0.4 to 0.7 psig		
	P-15	-3.8	-6.8	-4.8	12 cps 2.0 to 3.0 psig		
	P-16	8.3	7.2	7.8	4 cps 0.1 to 0.2 psig		
(1) Unless otherwise noted, accuracy of + 10% is assumed. (2) Unless otherwise noted, accuracy of + 1% is assumed. * Sensing element port may have been plugged; pressure will be checked.							

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Development Test No. IP-419-E
Project No. CGI-883

D. H. Frieling
P. H. Hutton

REAR FACE PIPING STUDY AT ELEVATED BULK OUTLET TEMPERATURE
KE REACTOR

GENERAL	POINT NO.	MAX ⁽¹⁾ PRESS. (psig)	MIN ⁽¹⁾ PRESS. (psig)	AVE ⁽¹⁾ PRESS. (psig)	CYCLIC CONDITION ⁽¹⁾ AND DOUBLE AMPLITUDE	POINT NO.	TEMPERATURE ⁽²⁾ RECORDINGS TAKEN DURING TEST (°C)
TEST DATE: 9-1-61 TOTAL FLOW: 176,000 gpm POWER LEVEL: 1010 MW BULK OUTLET TEMP: 42.0°C TORP: 375 psig TIME: 8:35 p.m.	P-1	Out of Service				T-1	39.06
	P-2	3.9	1.5	2.4	29 cps 0.3 to 1.2 psig		
	P-3	18.7	14.3	16.5	98 cps 2.0 to 3.8 psig	T-2	43.83
	P-4	Out of Service					
	P-5	10.2	8.7	9.5	20-1/2 cps 0.1 to 0.8 psig	T-3	42.68
	P-7	5.2	2.5	3.9	1 cps 1.0 to 2.1 psig 38 cps 0.4 to 1.4 psig	T-4	43.22
	P-8	6.1	4.8	5.5	27 cps 0.3 to 0.8 psig		
	P-9	5.1	4.0	4.5	8-1/2 cps 0.3 to 0.7 psig		
	* P-10	Neg. Variation		+0.05	Negligible Variation		
	P-11	-1.0	-7.0	-4.0	20 cps constant 0.1 psig		
	P-13	0.0	-3.8	-1.9	26 cps 0.3 to 2.3 psig		
	P-14	6.0	4.8	5.3	49 cps 0.2 to 0.6 psig		
	P-15	-1.0	-7.0	-4.0	19 cps 2.0 to 5.5 psig		
	P-16	7.8	6.6	7.2	8 cps 0.2 to 0.4 psig		
(1) Unless otherwise noted, accuracy of $\pm 10\%$ is assumed. (2) Unless otherwise noted, accuracy of $\pm 1\%$ is assumed. * Sensing element port may have been plugged; pressure will be checked.							

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REAR FACE PIPING STUDY AT ELEVATED BULK OUTLET TEMPERATURE
KE REACTOR

GENERAL	POINT NO.	MAX. ⁽¹⁾ PRESS. (psig)	MIN. ⁽¹⁾ PRESS. (psig)	AVE. ⁽¹⁾ PRESS. (psig)	CYCLIC CONDITION ⁽¹⁾ AND DOUBLE AMPLITUDE	POINT NO.	TEMPERATURE ⁽²⁾ RECORDINGS TAKEN DURING TEST (°C)
TEST DATE: 9-2-61 TOTAL FLOW: 184,000 gpm POWER LEVEL: 3140 MW BULK OUTLET TEMP: 82.4°C TORP: 390 psig TIME: 12:10 p.m.	P-1	Out of	Service			T-1	79.73
	P-2	3.0	0.7	1.9	19 cps 0.1 to 1.7 psig	T-2	87.10
	P-3	18.0	15.2	16.6	11 cps 0.5 to 2.0 psig	T-3	86.12
	P-4	Out of	Service			T-4	87.40
	P-5	Out of	Service				
	P-7	5.2	2.3	3.8	31 cps 0.3 to 2.6 psig		
	P-8	6.5	2.9	4.7	59 cps 0.5 to 3.1 psig		
	P-9	6.7	4.9	5.8	7 cps 0.4 to 1.0 psig		
	* P-10	Neg. Variation		+0.1	Negligible Variation		
	P-11	0.0	-6.0	-3.0	18 cps 1.0 to 3.0 psig		
	P-13	0.0	-3.75	-1.9	13 cps 0.5 to 3.5 psig		
	P-14	6.0	4.5	5.3	2-3/4 cps 0.6 to 1.3 psig 58 cps 0.1 to 0.8 psig		
	P-15	-5.5	-7.1	-6.3	17 cps 0.3 to 1.5 psig		
	P-16	9.4	8.1	8.8	29 cps 0.1 to 0.5 psig		
(1) Unless otherwise noted, accuracy of $\pm 10\%$ is assumed. (2) Unless otherwise noted, accuracy of $\pm 1\%$ is assumed. * Sensing element port may have been plugged; pressure will be checked.							

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P. H. Hutton

REAR FACE PIPING STUDY AT ELEVATED BULK OUTLET TEMPERATURE
KE REACTOR

GENERAL	POINT NO..	MAX. ⁽¹⁾ PRESS. (psig)	MIN. ⁽¹⁾ PRESS. (psig)	AVE. ⁽¹⁾ PRESS. (psig)	CYCLIC CONDITION ⁽¹⁾ AND DOUBLE AMPLITUDE	POINT NO.	TEMPERATURE ⁽²⁾ RECORDINGS TAKEN DURING TEST (°C)
TEST DATE: 9-6-61 TOTAL FLOW: 184,000 gpm POWER LEVEL: 3300 MW BULK OUTLET TEMP: 86.2°C TORP: 389 psig TIME: 9:30 a.m.	P-1	Out of Service				T-1	87.40
	P-2	2.5	0.7	1.6	19 cps 0.2 to 1.5 psig		
	P-3	18.0	14.8	16.4	6 cps 0.5 to 2.0 psig	T-2	87.19
	P-4	Out of Service					
	P-5	11.2	9.2	10.2	21 cps 0.5 to 1.9 psig	T-3	85.86
	P-7	5.3	2.4	3.9	32 cps 0.3 to 1.5 psig		
	P-8	8.3	5.0	6.7	55 cps 0.3 to 3.3 psig Slight Modulation	T-4	86.33
	P-9	6.1	4.3	5.2	8 cps 0.5 to 1.6 psig		
	*P-10	Neg. Variation		+0.04	Negligible Variation		
	P-11	-0.5	-6.0	-2.5	19 cps 1.0 to 3.0 psig		
	P-13	2.0	-4.5	-2.0	7 cps 0.7 to 5.5 psig		
	P-14	5.6	4.3	4.9	31 cps 0.2 to 0.7 psig		
	P-15	-5.2	-6.3	-5.8	16 cps 0.2 to 1.0 psig		
	P-16	9.2	8.2	8.7	26 cps 0.1 to 0.4 psig		
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REAR FACE PIPING STUDY AT ELEVATED BULK OUTLET TEMPERATURE
KE REACTOR

GENERAL	POINT NO.	MAX. PRESS. (1) (psig)	MIN. PRESS. (1) (psig)	AVE. PRESS. (1) (psig)	CYCLIC CONDITION (1) AND DOUBLE AMPLITUDE	POINT TEMPERATURE (2) NO. RECORDINGS TAKEN DURING TEST (°C)
TEST DATE: 9-6-61 TOTAL FLOW: 184,000 gpm POWER LEVEL: 3400 MW BULK OUTLET TEMP: 90°C TORP: 389 psig TIME: 11:15 p.m.	P-1	Out of Service				T-1 90.92
	P-2	2.4	1.1	1.8	19 cps 0.1 to 1.2 psig	
	P-3	17.0	13.9	15.5	4 cps 0.8 to 2.8 psig	T-2 91.63
	P-4	Out of Service				T-3 90.40
	P-5	12.8	7.8	10.3	48 cps 1.0 to 4.0 psig	
	P-7	5.4	2.7	4.1	1-3/8 cps 1.2 to 2.5 psig	T-4 89.99
	P-8	10.2	4.4	7.3	33 cps 0.2 to 1.4 psig	
	P-9	4.9	3.9	4.5	75 cps 0.4 to 2.0 psig	
	* P-10	Neg. Variation		+0.1	8-1/2 cps 0.4 to 0.7 psig	
	P-11	-1.0	-3.0	-2.0	Negligible Variation	
	P-13	0.0	-4.0	-2.0	19 cps 0.3 to 1.5 psig	
	P-14	5.9	4.7	5.3	14 cps 0.1 to 0.6 psig	
					2 cps 0.4 to 0.8 psig	
					38-3/4 cps 0.1 to 0.3 psig	
	P-15	-3.8	-4.3	-4.2	20-1/2 cps 0.2 to 0.4 psig	
	P-16	9.0	7.7	8.4	2-1/4 cps 0.2 to 0.7 psig	
						25 cps 0.1 to 0.3 psig

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KE REACTOR

GENERAL	POINT NO.	MAX. ⁽¹⁾ PRESS. (psig)	MIN. ⁽¹⁾ PRESS. (psig)	AVE. ⁽¹⁾ PRESS. (psig)	CYCLIC CONDITION ⁽¹⁾ AND DOUBLE AMPLITUDE	POINT NO.	TEMPERATURE ⁽²⁾ RECORDINGS TAKEN DURING TEST (°C)
TEST DATE: 9-8-61 TOTAL FLOW: 184,000 gpm POWER LEVEL: 3650 MW BULK OUTLET TEMP: 93.6°C TORP: 389 psig TIME: 10:40 a.m.	P-1	Out of Service				T-1	93.94
	P-2	3.0	1.0	2.0	18 cps 0.1 to 1.4 psig	T-2	95.73
	P-3	17.2	12.5	14.9	3 cps 1.8 to 3.1 psig		
	P-4	Out of Service					
	P-5	12.6	9.5	11.5	51 cps 0.4 to 2.4 psig	T-3	94.57
	P-7	4.2	1.5	3.0	32 cps 0.4 to 1.6 psig		
	P-8	18.0	10.0	14.0	1-1/3 cps 2.5 to 10 psig	T-4	94.62
	P-9	7.3	4.6	5.9	10 cps 0.5 to 1 psig		
	* P-10	Neg. Variation		+0.05	Negligible Variation		
	P-11	-0.5	-3.0	-1.8	26 cps 0.5 to 2 psig		
	P-13	-2.8	-3.3	-3.1	16 cps 0.05 to 0.3 psig		
	P-14	5.8	4.8	5.3	48 cps 0.1 to 0.5 psig		
	P-15	-0.7	-2.3	-1.5	16 cps 0.2 to 0.8 psig		
	P-16	9.3	8.7	9.0	21 cps 0.1 to 0.5 psig		
(1) Unless otherwise noted, accuracy of + 10% is assumed. (2) Unless otherwise noted, accuracy of 1% is assumed. * Sensing element port may have been plugged; pressure will be checked.							

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Project No. CGI-883

D. H. Frieling
P. H. Hutton

REAR FACE PIPING STUDY AT ELEVATED BULK OUTLET TEMPERATURE
KE REACTOR

GENERAL	POINT NO.	(1)		AVE. PRESS. (psig)	CYCLIC CONDITION (1) AND DOUBLE AMPLITUDE	POINT NO.	TEMPERATURE RECORDINGS TAKEN DURING TEST (°C) (2)
		MAX. PRESS. (psig)	MIN. PRESS. (psig)				
TEST DATE: 9-11-61 TOTAL FLOW: 184,000 gpm POWER LEVEL: 3670 MW BULK OUTLET TEMP: 94.4°C TORP: 189 psig TIME: 10:00 a.m.	P-1	Out of	Service			T-1	95.83
	P-2	2.9	0.7	2.1	36 cps 0.1 to 1.0 psig	T-2	95.92
	P-3	18.0	10.8	14.4	2 cps 2.0 to 6.5 psig 450 cps 0.2 to 1.1 psig (Extensive Modulation)	T-3	94.97
	P-4	Out of	Service			T-4	95.79
	P-5	12.2	9.0	10.5	28 cps 0.3 to 2.0 psig		
	P-7	5.0	2.2	3.6	31 cps 0.2 to 1.6 psig		
	P-8	18.4	10.0	14.0	1-3/4 cps 3.4 to 6.6 psig 420 cps 0.4 to 6.6 psig (Extensive Modulation)		
	P-9	10.0	4.8	7.0	1-1/2 cps 1.5 to 2.8 psig		
	* P-10	Neg. Variation		+0.02	Negligible Variation		
	P-11	-0.5	-2.5	-1.4	26 cps 0.5 to 1.5 psig		
	P-13	-2.4	-3.0	-2.7	19 cps 0.05 to 0.3 psig		
	P-14	5.9	4.7	5.6	41 cps 0.2 to 0.6 psig		
	P-15	-0.4	-2.1	-1.3	15 cps 0.3 to 0.8 psig		
	P-16	9.0	7.8	8.6	15 cps 0.1 to 0.7 psig		

(1) Unless otherwise noted, accuracy of $\pm 10\%$ is assumed.
 (2) Unless otherwise noted, accuracy of $\pm 1\%$ is assumed.
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KE REACTOR

GENERAL	POINT NO.	MAX. ⁽¹⁾ PRESS. (psig)	MIN. ⁽¹⁾ PRESS. (psig)	AVE. ⁽¹⁾ PRESS. (psig)	CYCLIC CONDITION ⁽¹⁾ AND DOUBLE AMPLITUDE	POINT NO.	TEMPERATURE ⁽²⁾ RECORDINGS TAKEN DURING TEST (°C)
TEST DATE: 9-8-61 TOTAL FLOW: 184,000 gpm POWER LEVE: 3670 MW BULK OUTLET TEMP: 94.6°C TORP: 389 psig TIME: 5:45 p.m.	P-1	Out of Service				T-1	95.48
	P-2	3.0	1.2	2.1	22 cps 0.2 to 1.3 psig	T-2	96.36
	P-3	17.0	11.5	14.3	High Noise Level 2-3/4 cps 2.0 to 5.0 psig 500 cps 0.3 to 1.8 psig	T-3	95.16
	P-4	Out of Service				T-4	95.35
	P-5	11.7	9.3	10.5	37 cps 0.4 to 2.1 psig		
	P-7	5.0	2.5	3.7	1 cps 1.0 to 2.0 psig 26 cps 0.5 to 1.5 psig		
	P-8	16.0	10.8	14.0	2 cps 1.8 to 4.0 psig 600 cps 0.3 to 2.0 psig		
	P-9	10.5	6.5	8.5	12 cps 0.8 to 2.5 psig 180 cps 1.5 psig (Constant)		
	* P-10	Neg. Variation		+0.1	Negligible Variation		
	P-11	-0.05	-2.5	-1.3	31 cps 0.5 to 1.5 psig		
	P-13	-2.6	-2.9	-2.8	18 cps 0.1 to 0.3 psig		
	P-14	6.3	5.3	5.8	3/4 cps 0.3 to 0.9 psig 38 cps 0.1 to 0.4 psig		
	P-15	-0.3	-1.7	-1.0	17 cps 0.1 to 0.7 psig		
	P-16	9.7	8.2	8.9	19 cps 0.1 to 0.7 psig		

(1) Unless otherwise noted, accuracy of $\pm 10\%$ is assumed.

(2) Unless otherwise noted, accuracy of $\pm 1\%$ is assumed.

* Sensing element port may have been plugged; pressure will be checked.

DECLASSIFIED

**DATE
FILMED**

8/24/94

END