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BOILING BURNOUT NEWSLETTER NO. 1

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BROOKHAVEN NATIONAL LABORATORY

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Boiling Burnout Newsletter

WAPD

1. Summary of New Data Available

   Preliminary data* are enclosed in Tables I, II, III, IV, V, and VI. Tables I to V are data for round nickel tubes in a vertical and inclined (45°) position. Table VI contains some preliminary data for nickel rectangular channels (0.060" and 0.050" spacings) in a vertical position.

2. Problems Encountered in Test Program

   Problems unique to operation with a rectangular channel were eliminated with a minimum of development effort. The channel was designed with thin metal sections in the corners of the channel which prevented any tendency for burnout to occur in the corners.

3. Required Burnout Information

   The effect of channel L/D, local quality and any other significant parameters affecting quality burnout are required.

4. Remarks

   The subcooled burnout data obtained at WAPD are in close agreement with the ANL correlation. This agreement is noticed for both vertical and inclined channels. In other words, inclining the channel at 45° seems to have very little effect on the burnout point in the subcooled and the quality range tested.

   The future burnout testing program consists essentially of the following:

   a. Burnout data will be obtained on 0.050", 0.060" and 0.087" rectangular channels. These data will be obtained under the condition of zero quality and zero subcooling at the channel exit.

   b. The effect of materials on the burnout point will also be investigated.

- J. E. Zerbe

* Some of these data have been included in WAPD Monthly Progress Reports.

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Table I

SUBCOOLED LOCAL BOILING BURNOUT D.T.
VERTICAL NICKEL TUBE

I.D. = 0.187 in. O.D. = 0.227 in.
L = 12.5 in. Exit Pressure = 2000 psia

Exit Subcooling (°F)	Mass Flow Rate (10^6 lb/hr.ft.^{2})	Burnout Flux (10^6 Btu/hr.ft.^{2})
161	7.76	4.09
111	7.28	3.36
61	6.94	2.71
36	6.58	2.24
161	6.38	3.75
111	6.2	3.11
5	6.15	1.64
61	5.88	2.52
36	5.45	2.12
161	5.43	4.68
161	5.24	3.16
5	5.18	1.56
111	4.81	2.73
61	4.74	2.28
22	4.58	2.01
36	4.57	1.89
12	4.44	1.725
3	4.27	1.33
161	4.11	4.02
121	3.98	3.24
110	3.85	3.01
27	3.66	2.14
57	3.66	2.14
11	3.53	1.71
161	2.79	3.16
111	2.69	2.59
67	2.66	1.97
23	2.66	1.97
91	2.65	2.20
44	2.65	2.20
52	2.51	1.85
14	2.51	1.85
41	2.50	1.68
7	2.50	1.68
25	2.40	1.30
25	1.40	1.23
108	1.38	1.69
43	1.38	1.49
31	1.35	1.25
24	1.33	1.02
93	0.897	1.46
121	0.895	1.46
31	0.80	0.77
25	0.752	0.66
58	0.577	1.02

Table II

SUBCOOLED LOCAL BOILING BURNOUT DATA
INCLINED (45°) NICKEL TUBE

I.D. = 0.187 in. O.D. = 0.227 in.
L = 12.5 in. Exit Pressure = 2000 psia

Exit Subcooling (°F)	Mass Flow Rate (10^6 lb/hr.ft.^{2})	Burnout Flux (10^6 Btu/hr.ft.^{2})
112	5.17	3.4
110	5.15	3.41
36	4.60	2.32
13	4.35	1.86
111	3.92	3.02
36	3.60	2.12
15	3.45	1.69
109	2.69	2.52
37	2.56	1.82
17	2.55	1.51
111	1.51	2.02
34	1.45	1.34
16	1.25	0.945
39	0.96	1.04

Table III

QUALITY BURNOUT DATA
VERTICAL NICKEL TUBE

I.D. = 0.187 in. O.D. = 0.227 in.
L = 12.5 in. Exit Pressure = 2000 psia

Inlet Subcooling ΔT(°F)	G (10^6 lb/hr.ft.^{2})	Heat Flux (10^6 B/hr.ft.^{2})	Exit Steam Quality (%)
8.5	5.51	1.100	8.51
9.8	4.53	0.952	8.60
59.0	4.12	1.480	1.54
34.5	3.97	1.190	5.10
10.5	3.66	0.904	10.5
12.9	3.66	0.890	9.56
87.6	3.22	1.525	4.47
60.0	3.14	1.270	4.05
36.0	2.93	0.992	6.27
10.5	2.73	0.795	13.0
111.8	2.24	1.362	2.0
59.0	2.11	0.992	7.9
85.8	2.11	1.170	5.9
36.0	2.03	0.845	11.2
10.0	1.83	0.709	18.6
108.8	1.26	0.903	9.1
37.0	1.14	0.692	22.8
138.0	1.13	1.150	19.0
59.5	1.08	0.752	21.0
87.4	1.03	0.733	14.4
186.5	0.795	0.713	0.0
131.0	0.795	0.940	30.9
288.8	0.784	1.02	0.0
127.0	0.783	0.607	8.0
36.0	0.77	0.533	28.1
85.8	0.718	0.510	14.8
59.5	0.692	0.575	28.9
112.8	0.666	0.523	12.2
108.8	0.628	0.492	13.1
108.0	0.550	0.385	7.7
127.0	0.475	0.349	5.75
284.3	0.415	0.686	21.0
123.0	0.384	0.270	4.75

Table IV

QUALITY BURNOUT DATA
INCLINED (45°) NICKEL TUBE

I.D. = 0.187 in. O.D. = 0.227 in.
L = 12.5 in. Exit Pressure = 2000 psia

Inlet Subcooling T(°F)	Mass Flow Rate (10^6 lb/hr.ft.^{2})	Burnout Flux (10^6 Btu/hr.ft.^{2})	Exit Steam Quality (%)
58	4.08	1.57	3.4
35	3.87	1.30	8.0
11	3.62	0.956	11.4
135	3.52	2.02	7.6
61	3.17	1.365	5.6
36	2.88	1.06	9.4
12	2.78	0.836	13.2
136	2.39	1.59	5.9
60	2.11	1.03	9.0
36	1.99	0.85	12.8
11	1.88	0.743	18.9
61	1.13	0.823	22.8
37	1.07	0.743	27.8
11	1.03	0.658	33.0
60	0.656	0.636	37.0
35	0.616	0.573	42.2

Table V

QUALITY BURNOUT DATA
VERTICAL NICKEL TUBE - P_{exit} 1000 (approx.)

Tube I.D. = 0.187 in. Tube O.D. = 0.227 in. Tube Length = 12.5 in.

Inlet Subcooling (°F)	Mass Velocity (10^6 lb/hr.ft.^{2})	Burnout Flux (10^6 Btu/hr.ft.^{2})	Exit Steam Quality (%)
69.0	4.71	1.87	3.7
64.0	4.63	1.85	4.7
103.5	4.54	2.12	0.55
100.0	4.54	2.10	0.37
44.6	4.4	1.60	6.54
135.0	3.72	2.185	0.17
133.5	3.66	2.17	0.56
104.0	3.56	1.83	2.54
66.5	3.38	1.63	7.4
44.0	3.28	1.51	10.6
68.6	2.42	1.54	13.6
131.0	2.36	1.[illegible]7	10.7
45.6	2.26	1.[illegible]6	18.0
43.6	1.53	1.3[illegible]	28.6
131.5	1.23	1.57	28.3

Table VI

SUBCOOLED LOCAL BOILING BURNOUT DATA
VERTICAL NICKEL CHANNEL
EXIT PRESSURE - 2000 psia

Channel Flow Dimension - 1 inch x 0.060 inch
Channel Length - 12 1/16 inch

Exit Subcooling (°F)	Mass Flow Rate (10^6 lb/hr.ft.^{2})	Burnout Flux (10^6 Btu/hr.ft.^{2})
110.5	1.97	2.25
5.0	1.56	1.20
15.0	0.825	0.591

Channel Flow Dimension - 1 inch x 0.050 inch
Channel Length - 12 1/16 inch

Exit Subcooling (°F)	Mass Flow Rate (10^6 lb/hr.ft.^{2})	Burnout Flux (10^6 Btu/hr.ft.^{2})
42.0	1.5	0.940
4.5	1.45	0.902

END