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FINAL REPORT: PRODUCTION TEST IP-543-A
EFFLUENT SAMPLING - OVERBORE TUBE

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FINAL REPORT: PRODUCTION TEST IP-543-A
EFFLUENT SAMPLING - OVERBORE TUBES

By

R. G. Geier

January 9, 1964

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FINAL REPORT: PRODUCTION TEST IP-543-A
EFFLUENT SAMPLING - OVERBORE TUBE

By

R. G. Geier

INTRODUCTION

It had been postulated that the increased film area of a charged overbore tube would be counterbalanced by the lower temperature fuel surface and decreased flux so that the radioisotope content of the effluent would be the same as that from a normal tube. In order to confirm or deny the postulate, Tube 3267-C was equipped with an effluent sample line under the provisions of PT-IP-543-A.⁽¹⁾ Sampling and analytical work began in mid-April and continued through November, 1963.

SUMMARY

Effluent samples obtained from an overbore tube at C Reactor over a nine-month period were analyzed for P^{32} , As^{76} , Np^{239} and Cr^{51} . Based on the results obtained for these isotopes, it can be concluded that the radioisotope content of the effluent from an overbore tube will be the same as the radioisotope content of the effluent from a normal size tube operating under similar conditions.

DISCUSSION

A. Tube

Tube 3267-C, a Zircaloy overbore size tube at C Reactor, was equipped to permit effluent sampling.

B. Fuel Charge

During the test, Tube 3267-C contained a charge of nineteen CVIN fuel elements. The charge was centered within the length normally occupied by thirty-two CIIN fuel elements. Considering the tube and fuel dimensions, the surface area in the reactor flux zone was 15 per cent greater than it would have been had a C-size tube been charged with thirty-two CIIN fuel elements.

C. Operating Conditions

Sampling of the effluent from Tube 3267-C began in mid-April and continued through November. During this period the tube was discharged and charged three times. Irradiation conditions for the exposure periods are given in the following table.

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Charge Date	1/14/63	6/01/63	9/21/63	10/29/63
Discharge Date	6/01/63	9/21/63	10/29/63	(1)
Tube Power, kw	1253	1219	1107	1149
Outlet Temperature, °C	88	93	88	88
Inlet Temperature, °C	8	17	18	12
Flow, gpm	58.5	60.2	60.2	57.1

(1) Conditions from charge to 12/1/63.

D. Water Treatment

During the sampling period the C-Reactor coolant was treated in accordance with Production Test IP-560-A.⁽²⁾ Test conditions were:

	Test Side (Far)	Control Side (Near)
pH	6.6	6.6
Dichromate, ppm	1.0	1.8
Alum, ppm	18.0	18.0

In as much as Tube 3267-C is a near side tube it was receiving coolant containing 1.8 ppm sodium dichromate.

E. Effluent Analyses

The effluent from Tube 3267-C was sampled each weekday that the reactor was operating. Analyses for P³², Cr⁵¹, As⁷⁶ and Np²³⁹ were obtained on each sample. Individual sample analyses are shown in Table I. Monthly average results from the overbore tube are compared with the monthly average results obtained from a composite of the two effluent risers in the table below. The daily riser analyses can be found in the sequential reports issued on the subject.^(3,4)

	<u>Tube 3267-C</u>				<u>C-Reactor Riser</u>			
	pg/ml				pg/ml			
	P ³²	As ⁷⁶	Np ²³⁹	Cr ⁵¹	P ³²	As ⁷⁶	Np ²³⁹	Cr ⁵¹
4/63	12.1	160	135	550	6.4	80	75	330
5/63	12.8	145	155	610	9.9	105	125	510
6/63	4.2	65	60	310	8.2	115	115	490
7/63	5.4	155	145	570	7.2	110	125	500
8/63	9.1	250	325	1260	8.3	190	240	1030
9/63	9.0	190	220	840	6.7	150	180	610
10/63	6.6	130	125	770	9.3	140	205	850
11/63	7.2	80	80	850	13.4	120	185	780
Average	8.3	150	160	720	8.7	130	160	650

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The results from Tube 3267-C are typical of those expected from sampling a single tube. After recharging (June 1) the results are lower than the riser. They increase as exposure progresses and after about two months exceed the riser values. It can be noted, however, that superimposed upon the above pattern is a reflection of unusual water conditions. In August when the riser showed inordinately high Cr^{51} , Np^{239} and As^{76} results, similarly high results were obtained from the tube samples.

The ratios of the overbore tube analyses to the riser analyses, both averaged over the entire sampling period, are:

	<u>Conc. in Overbore Effluent</u> <u>Conc. in Riser</u>
P32	0.95
As ⁷⁶	1.15
Np ²³⁹	1.00
Cr ⁵¹	1.11

Considering the accuracy of the analyses and the influence of sampling equipment and technique, it can be concluded that the radioisotope content of the effluent from an overbore tube will not be different from the radioisotope content of a normal tube operating under similar conditions.

Inspection of Table I shows several instances of high Cr^{51} and Np^{239} values which were not included in the monthly averages. In almost all cases the high values occurred immediately following a purge. This is in contrast to riser Cr^{51} values which show a sharp drop following a purge. It is believed that the phenomenon is due to the sampling take-off location, lines, etc., rather than to some peculiarity of the overbore tube.

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T A B L E I
EFFLUENT ANALYSES - TUBE 3267-C

All Values - pc/ml

Date	P32	As ⁷⁶	Np ²³⁹	Cr ⁵¹	Date	P32	As ⁷⁶	Np ²³⁹	Cr ⁵¹
4/15/63	11.3	200	78	380	6/05/63	2.7	30	35	108
16	7.9	140	140	440	6	3.6	44	69	88
17	11.0	--	--	--	7	3.6	62	55	222
18	13.1	--	--	--	10	4.1	43	50	217
22	11.5	25	--	--	11	4.0	79	52	212
23	10.1	31	220	530	12	4.5	100	63	298
24	11.1	38	130	730	13	3.3	85	69	315
25	14.1	160	170	720	14	3.7	56	66	265
26	11.9	180	150	750	17	4.7	42	62	297
29	15.4	91	100	370	18	4.7	70	--	--
30	15.8	180	90	470	24	5.1	37	73	533
5/01/63	12.5	240	73	317	25	4.7	86	74	519
2	11.9	200	120	508	26	5.1	96	69	545
3	12.8	130	177	712	27	3.9	64	46	313
6	16.4	180	219	1170	28	4.6	100	44	344
7	13.0	100	87	583	7/01/63	4.2	80	(6)	(12)
10	7.2	130	--	--	5	4.3	120	--	--
13	9.2	70	137	507	8	5.3	125	52	494
14	11.9	140	--	--	9	5.9	135	--	--
15	13.2	150	184	682	10	6.2	215	37	(120)
16	14.1	150	73	552	11	5.3	155	105	574
17	15.2	90	180	694	12	4.5	145	74	348
20	13.4	140	90	323	15	4.4	100	63	345
21	15.4	140	--	--	16	5.7	95	106	452
22	14.8	220	202	703	17	3.2	85	128	538
23	13.6	170	172	557	18	5.7	125	129	556
24	12.5	120	165	543	19	5.4	110	132	544
27	11.4	130	129	430	22	6.6	215	272	555
28	15.9	170	224	706	23	5.2	105	--	--
29	10.6	180	222	766	24	6.5	290	189	965
31	12.8	50	183	586	25	6.8	--	272	837
					26	6.1	130	203	612
					29	5.1	290	146	385
					30	6.2	135	172	640
					31	4.4	310	220	728

() Not included in monthly averages.

TABLE I (Continued)

All Values - pc/ml

Date	P ³²	As ⁷⁶	Nd ²³⁹	Cr ⁵¹	Date	P ³²	As ⁷⁶	Nd ²³⁹	Cr ⁵¹
8/01/63	7.5	240	--	--	10/01/63	2.6	44	31	418
2	9.0	326	--	--	2	3.6	85	41	1010
5	8.8	155	286	959	3	4.8	69	71	1550
6	6.8	250	316	1110	4	5.0	60	(262)	915
7	7.4	307	302	1080	7	7.5	74	80	(2580)
8	9.7	388	293	1130	8	4.5	57	121	(4)
9	9.5	--	311	1170	9	5.9	77	102	639
16	6.4	182	174	(4640)	10	8.5	130	102	588
19	9.1	146	319	900	11	6.9	154	136	589
20	11.8	211	331	(5420)	14	5.1	80	128	(3590)
21	7.8	87	216	779	15	4.1	81	90	594
22	7.0	435	354	1050	16	5.5	103	90	409
23	12.0	313	379	1450	17	6.2	150	98	507
28	10.8	168	375	1730	18	6.6	189	108	553
29	10.1	202	428	1690	21	6.0	137	190	448
30	12.1	353	451	2020	22	8.2	233	171	904
9/03/63	(0.3)	(4)	148	1520	23	6.7	191	155	653
4	7.3	193	168	527	24	8.7	125	240	1280
5	6.7	193	184	705	25	10.4	236	225	839
6	6.7	99	247	805	28	10.0	256	224	1160
9	12.6	327	284	967	29	11.2	147	(590)	(15200)
10	7.8	312	287	1050	11/04/63	5.3	69	52	1260
11	12.0	202	(905)	(27800)	5	5.9	38	63	1690
12	12.1	138	235	(3880)	6	8.9	74	(390)	(8200)
16	7.9	147	190	602	7	6.8	57	(221)	(5670)
17	6.9	261	248	812	8	4.9	77	53	470
18	10.4	153	220	(2290)	13	4.4	140	59	267
19	9.2	92	170	562	14	8.2	57	82	694
					15	8.9	73	99	744
					18	9.5	137	52	300
					26	9.9	68	98	1720
					27	7.1	68	65	378
					12/02/63	--	--	122	697
					3	--	--	131	1150

() Not included in monthly averages.

**DATE
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