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DOCUMENT NO.

W-60820

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GENERAL ELECTRIC

HANFORD ATOMIC PRODUCTS OPERATION - RICHLAND, WASHINGTON

TITLE

SUPPLEMENT A TO PT IP-227-A, IRRADIATION OF URANIUM SWELLING CAPSULES (HAPO-221)

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Series 1.

June 22, 1959

SUPPLEMENT A TO PT IP-227-A,
IRRADIATION OF URANIUM SWELLING CAPSULES

OBJECTIVE

The objective of this Supplement to PT-IP-227-A⁽¹⁾ is to authorize a change in capsule design, to include swelling samples of different operating conditions, and to increase the number of tubes in the initial phase of the test from four to five.

(1) Kratzer, W.K., "PT-IP-227-A, Irradiation of Uranium Swelling Capsules," HW-59191, February 10, 1959 (Secret).

SUMMARY

The swelling capsule design is changed to provide an expansion chamber at one end only to prevent NaK being retained in the expansion chamber. Swelling samples are provided to operate at a cladding surface temperature of 350°C rather than 300°C, and the maximum sample exposure is increased from 3500 MWD/T to 5000 MWD/T. The number of swelling capsule charges in the initial phase of the test is increased from four to five tubes.

BASIS AND JUSTIFICATION

PT IP-227-A authorizes the irradiation of seventy-two Zircaloy-2 jacketed uranium high temperature swelling samples in NaK filled aluminum capsules. A total of 12 tubes of swelling capsules are to be irradiated. The original test provided for the initial irradiation of four tubes of capsules, not necessarily concurrently. If the results from the first four tubes were satisfactory, the balance of the tubes would be irradiated.

Since the original test was issued, it has become apparent that the range of exposures and temperatures provided by the samples would not adequately cover the desired region of high temperature uranium swelling. Consequently the sample operating conditions have been modified to increase the maximum sample cladding temperature from 300 to 350°C and the maximum sample exposure from 3500 MWD/T to 5000 MWD/T.

The number of tubes in the initial phase of the test have been increased from four to five to provide a greater variety of sample conditions for evaluation before continuing with the balance of the test. Again, simultaneous irradiation of the five tubes, although desirable, is not mandatory.

The original swelling capsule design provided two expansion chambers for the NaK, one at either end of the capsule. During final inspection of the capsules it was found that the NaK had a tendency to hang up in the expansion chamber when the capsule was tilted, and that emptying one chamber immediately filled the one at the opposite end. The capsules have been redesigned with the expansion chamber at one end only to obviate this difficulty.

TEST DETAILS

The contents and designed operating conditions for the initial five tubes of swelling capsules are given in Table I. The designation and operating conditions for individual samples are given in Table II. The modified capsule design is shown in drawings H-3-13150 and H-3-13151.

OTHER CHANGES TO THE PRODUCTION TEST

All requirements of the original production test not specifically modified by this Supplement will remain unchanged.

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TABLE I
CONTENTS AND OPERATING CONDITIONS FOR INITIAL FIVE TUBES

<u>TUBE</u>	1	2	3	4	5*
Sample	A 313	A 312	A 321	A 223	B 231
	A 231	A 311	A 221	A 322	B 232
	A 232	A 213	A 222	A 323	B 233
	A 333	A 332	A 241	A 243	B 331
	A 211	A 331	A 242	A 342	B 332
	A 212	A 233	A 341	A 343	B 333
Adjacent Tube Power KW/tube	700	700	960	960	700
Exposure Time, days	68	68	50	50	136
Preferred order of irradiation	1	1	3	3	2

* May include one extra element as thermocouple element.

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TABLE II
SAMPLE DESIGNATION AND OPERATING CONDITIONS

<u>Samples</u>	<u>Zircaloy Cladding, inches</u>	<u>Sample Power Required, KW/ft</u>	<u>Cladding Temp., °C</u>		<u>Axial Temp., °C</u>		<u>Sample Exposure MWD/T</u>
			<u>Desired</u>	<u>Calculated</u>	<u>Desired</u>	<u>Calculated</u>	
— A 21(1-3)	0.020	24	250	264	500	514	1500
— A 22(1-3)	0.020	33	250	273	600	603	1500
— A 23(1-3)	0.020	24	350	354	600	604	1500
A 24(1-3)	0.020	33	350	378	700	722	1500
— A 31(1-3)	0.030	24	250	249	500	526	1500
— A 32(1-3)	0.030	33	250	257	600	624	1500
— A 33(1-3)	0.030	24	350	354	600	621	1500
A 34(1-3)	0.030	33	350	359	700	726	1500
B 23(1-3)	0.020	24	350	354	600	604	3000
B 33(1-3)	0.030	24	350	354	600	621	3000
C 22(1-3)	0.020	33	250	273	600	603	5000
C 23(1-3)	0.020	24	350	354	600	604	5000
C 32(1-3)	0.030	33	250	257	600	624	5000
C 33(1-3)	0.030	24	350	354	600	621	5000

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HAZARDS

Increasing the sample cladding temperature from 300 to 350°C and the sample exposure from 3500 to 5000 MWD/T should not significantly affect the capsule failure probability, since the greater sample distortion is accommodated by the capsule design. The discussion of hazards in the original production test is equally applicable to the modified conditions provided by this Supplement.

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