Attachment 5

Summary of Shipping Records to RWMC Related to Irradiated Shippingport Fuel Material

This Page Intentionally Left Blank

Summary of Shipping Records to RWMC Related to Irradiated Shippingport Fuel Material

Date	Disposition Number	Description (as given on shipping record)	Fuel Mat'l (Y/N)	Container	Vol. (yd^3)	Wt. (lbs)	Radiation Levels[(a)]	Curies	Isotopes	Disposal Location	Hard Copy of Shipping Record?	Other
11/22/60	155	Dissolved PWR rods from Bdl. #0551 absorbed in vermiculite inside metal container	Y	NL	1	NL	NL	80	Zr^{95} Pu^{239} (2.48 gms) U^{235} (5.4 gms) U^{238} (1034 gms) Co^{60}	Trench #20	Yes	
1/17/61	167	Dissolved PWR Rods from Bdl #0551 absorbed in vermiculite for disposal.	Y	Galvanize Metal	1	NL	17 mr/hr	30	Pu^{239} (0.5 gms)	Trench #20	Yes	Signed for S.S. accountability
4/5/61	193	Dissolved PWR rods from Blds 3H0109 & 6E0551 absorbed in vermiculite for disposal	Y	Galvanize Metal Insert	1	100	70 mr/hr	10	U^{235} (1.24 gms) Pu^{239} (2.5 gms) U^{238} (520 gms)	Trench #20	Yes	Signed for S.S. accountability
4/5/61	193	Dissolved PWR rods from blds 3H0109 & 6E0551 absorbed in vermiculite for disposal	Y	Galvanize Metal Insert	1	100	70 mr/hr	30	U^{235} (1.24 gms) Pu^{239} (2.5 gms) U^{238} (520 gms)	Trench #20	Yes	Signed for S.S. accountability
5/4/62	302	Solid Zr^{95} pieces (15) PWR Fuel Rods (depleted U^{238})	Y	Lead Cask	0.6	26,000	10 R/hr 250 mr/hr	2.8	U^{238} (2 Kg) Pu^{239} (5 gms) U^{235} (10.13 gms)	Trench #26	Yes	Signed for S.S. accountability, 300 gal. of water
5/4/62	303	Dissolved (3) PWR Fuel rods absorbed in vermiculite filled bottles	Y	Lead Cask	0.5	26,000	100 mr/hr	384	U^{238} (0.4 Kg) Pu^{239} (1.8 gms) U^{235} (2.2 gms)	Trench #26	Yes	Signed for S.S. accountability
6/29/62	320	(5) PWR rods dissolved contained in vermiculite filled bottles	Y	Lead Cask	0.5	26,000	250 mr/hr 25 mr/hr	150	U^{238} (668 gms) Pu^{239} (2.98 gms) U^{235} (2.21 gms)	Trench #26	Yes	Signed for S.S. accountability, states that it meets approved letter #NRFE-O-327
8/2/62	330	Dissolved PWR (4) Fuel rods absorbed in vermiculate filled bottles	Y	Lead Cask	0.5	NL	120 mr/hr	120	U^{238} (532 gms) Pu^{239} (2.38 gms) U^{235} (1.77 gms)	Trench #26	Yes	Signed for S.S. accountability
8/3/62	331	(12) Solid PWR fuel rods contained in burial insert	Y	Lead Cask	0.5	NL	125 mr/hr	36	U^{238} (1596 gms) Pu^{239} (7.2 gms) U^{235} (5.3 gms)	Trench #26	Yes	Signed for S.S. accountability
10/24/62	365	Dissolved (5) PWR rod (Fuel) absorbed in Vermiculite filled bottles.	Y	Lead Cask	0.5	NL	150 mr/hr 50 mr/hr	150	U^{238} (665 gms) Pu^{239} (2.85 gms) U^{235} (2.2 gms)	Trench #27	Yes	Signed for S.S. accountability
11/29/62	382	Dissolved PWR Fuel Rods (5) absorbed in vermiculite filled poly bottles	Y	Lead Cask	0.5	NL	150 mr/hr 50 mr/hr	150	U^{238} (665 gms) Pu^{239} (2.85 gms) U^{235} (2.2 gms)	Trench #27	Yes	Signed for S.S. accountability
5/28/64	653	One 15 gallon drum spec. ICC-5c 304 containing 2.5 gallon dissolved SS material absorbed in vermiculite. PWR rod cooled > 120 days	Y		15 Gal. 3 ft^3	NL	100 mr/hr 5 mr/hr	60	U^{238} (268 gms) Pu^{239} (1.25 gms) U^{235} (0.18 gms)	Trench #34	Yes	Signed for S.S. accountability.
6/4/65	810	Irradiated core components, wear strips, end boxes, 12 PWR rods	Y	Cask	16 ft^3	NL	3 R/hr 400 mr/hr	13	U^{238} (1.59 Kg) Pu (0.5 gm)	Trench #36	Yes	Signed for S.S. accountability
6/26/67	67EWD150	20 Each Expended PWR Fuel Rods in a banded stainless Steel container	Y	Cask	16 cf	125	100 mr/hr 1 mr/hr	10	U^{238} (2,680 gm) Pu (15 gm)	Trench #45	Yes	Signed for S.S. Accountability

Date	Disposition Number	Description (as given on shipping record)	Fuel Mat'l (Y/N)	Container	Vol. (yd^3)	Wt. (lbs)	Radiation Levels[(a)]	Curies	Isotopes	Disposal Location	Hard Copy of Shipping Record?	Other
6/10/68	68EWD105	Scrap Insert #83 containing PWR Bundles #0291, and 0381 and misc. core hardware	Y	Cask	16 cf	26,000	125 mr/hr 15 mr/hr	900	U^{238} (31.68 Kg) U^{235} (80 gms) Pu (164 gm)	Trench #47	Yes	Signed for S.S. accountability
6/19/68	68EWD108	Scrap Insert #55 containing PWR Bundles #0750 and 0495 and misc core and loop hardware	Y	Cask	16 cf	26,000	150 mr/hr 40 mr/hr	110 (fuel)	U^{238} (31.68 Kg) U^{235} (80 gms) Pu (164 gm)	Trench #47	Yes	Signed for S.S. accountability
6/20/68	68EWD110	Scrap Insert #72 containing PWR Bundles #0044 and #0468 and S5W Misc. Hardware	Y	Cask	16 cf	26,000	5 R/hr 450 mr/hr	140 (fuel)	U^{238} (31.68 Kg) U^{235} (80 gms) Pu (164 gm)	Trench #47	Yes	Signed for S.S. accountability
6/24/68	68EWD117	Scrap Insert #88 containing 2 PWR bundles #0065 and 0504 and misc S5W hardware	Y	Cask	16 cf	26,000	4 R/hr 250 mr/hr	6,000 (total)	U^{238} (31.68 Kg) U^{235} (80 gms) Pu (164 gm)	Trench #47	Yes	Signed for S.S. accountability
6/25/68	68EWD118	Misc Hardware from S5W Disposal effort. Also two PWR rod bundles 0116 and 0144. Insert 74.	Y	Cask	16 cf	26,000	2 R/hr 200 mr/hr	85 (fuel)	U^{238} (31.68 Kg) U^{235} (80 gms) Pu (164 gm)	Trench #47	Yes	Signed for S.S. accountability
8/12/68	68EWD144	Scrap insert #75 containing 2 PWR bundles #0320 and #0450	Y	Cask	16 cf	26,000	250 mr/hr 20 mr/hr	335	U^{238} (31.45 Kg) U^{235} (80 gms) Pu (160 gm)	Trench #48	Yes	Signed for S.S. accountability
8/14/68	68EWD147	72 each, PWR fuel rods and core hardware. Scrap insert #66	Y	Cask	16 cf	26,000	50 mr/hr 1 mr/hr	24 (fuel)	U^{238} (10.33 Kg) U^{235} (10 gms) Pu (54 gm)	Trench #48	Yes	Signed for S.S. accountability

(a) The first reading is on contact while the second reading is at 1 meter.

Notes:

The following assumptions were made to sum the total isotopes disposed to the RWMC

- The 1/17/61 shipment did not include totals for U-238 and U-235. Using the same ratios of isotopes for a similar shipment on 11/22/60, 208 grams of U-238 and 0.92 grams of U-235 would have been disposed in this shipment.
- There are two separate burial records for 4/5/61. Both of them had 520 grams of "S.S." typed on the forms. Handwritten corrections to these forms appear to have assumed that there was a total of 520 grams between the two shipments and allocated 390 grams to one shipment and 130 grams to the other. Since the accountability "writeoff" letter indicates that 1.04 kg of uranium was written off for these shipments, the original higher typed values in the disposal records are considered to be correct. This table includes 520 grams for each of the two shipments.
- The 6/4/65 shipment did not have a total for U-235. Using the same ratios of isotopes as later shipments (6/67 through 8/68), approximately 4 grams of U-235 would have been disposed.
- The 6/26/67 shipment did not have a total for U-235. Using the same ratios of isotopes for later shipments (6/67 through 8/68), approximately 6.8 grams of U-235 would have been disposed.

Totals = 214 Kg U-238
639 grams U-235
1083 grams Pu-239

Total (Dissolved) = 5.48 Kg U-238
16.4 g U-235
22.1 g Pu-239

Total (Solid) = 208 Kg U-238
623 g U-235
1061 g Pu-239

Attachment 6

Shippingport Core 1 Seed Fuel and Soap Assemblies Transferred to Off-Site Locations or in ECF Storage

This Page Intentionally Left Blank

SHIPPINGPORT CORE 1 SEED FUEL AND SOAP ASSEMBLIES TRANSFERRED TO OFF-SITE LOCATIONS OR IN ECF STORAGE

Shippingport Core 1 (PWR-1) seed fuel was primarily sent to the Idaho Chemical Processing Plant (ICPP) for reprocessing although small quantities were also sent to other facilities. Each seed assembly contained four subassemblies (S/A). Each subassembly contained 15 fuel elements. "Element" quantities refer to the total mass of uranium. "Isotope" quantities refer to total mass of Uranium-235. The serialized fuel accountability transfer transactions are referenced.

Date	Fuel Transferred	Quantity	Reference
6/3/60	Transfer of 15 element samples from PWR-1 Seed Assembly 1 to Bettis.	54g Element 44g Isotope	WEI-WEB-22
9/11/61	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1733g Element 1416g Isotope	WEI-CPI-78
9/18/61	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1733g Element 1416g Isotope	WEI-CPI-79
9/20/61	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1733g Element 1416g Isotope	WEI-CPI-80
9/25/61	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1733g Element 1416g Isotope	WEI-CPI-81
9/28/61	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1733g Element 1416g Isotope	WEI-CPI-82
9/11/61	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1733g Element 1416g Isotope	WEI-CPI-83
10/4/61	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1733g Element 1416g Isotope	WEI-CPI-84
10/5/61	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1733g Element 1416g Isotope	WEI-CPI-85
10/11/61	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1733g Element 1416g Isotope	WEI-CPI-86
10/20/61	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1733g Element 1416g Isotope	WEI-CPI-87
10/25/61	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1733g Element 1416g Isotope	WEI-CPI-88
10/26/61	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1733g Element 1416g Isotope	WEI-CPI-89
11/1/61	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1733g Element 1416g Isotope	WEI-CPI-90
11/2/61	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1733g Element 1416g Isotope	WEI-CPI-91
11/3/61	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1733g Element 1416g Isotope	WEI-CPI-92
11/7/61	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1733g Element 1416g Isotope	WEI-CPI-93
11/8/61	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1733g Element 1416g Isotope	WEI-CPI-94
11/9/61	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1733g Element 1416g Isotope	WEI-CPI-95
2/23/62	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1733g Element 1416g Isotope	WEI-CPI-100
2/23/62	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1733g Element 1416g Isotope	WEI-CPI-101

2/26/62	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP 1733g Element 1416g Isotope	WEI-CPI-102
2/27/62	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP. 1733g Element 1416g Isotope	WEI-CPI-103
3/1/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-104
3/2/62	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP. 1733g Element 1416g Isotope	WEI-CPI-105
3/6/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-106
3/7/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-108
3/12/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-110
3/19/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-111
3/22/62	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP. 1733g Element 1416g Isotope	WEI-CPI-113
5/29/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-116
5/31/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-117
6/4/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-118
6/5/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-119
6/7/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-120
6/8/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-121
7/3/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-122
7/5/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-123
7/5/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-124
7/9/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-125
7/11/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-126
7/13/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-127
7/26/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-128
7/26/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-129
8/1/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-130
8/3/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-131
8/7/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-132
8/9/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-133
8/10/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP. 1946g Element 1539g Isotope	WEI-CPI-134

8/17/62	Transfer of 1 PWR-1 Seed 2 Assembly to ICPP.	1936g Element 1532g Isotope	WEI-CPI-138
1/30/63	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1732g Element 1416g Isotope	WEI-CPI-151
1/31/63	Transfer of 1 PWR-1 Seed 1 Assembly to ICPP.	1733g Element 1416g Isotope	WEI-CPI-154
2/4/63	Transfer of 4 PWR-1 Seed 1 S/As to ICPP.	1733g Element 1416g Isotope	WEI-CPI-158
2/8/63	Transfer of 4 PWR-1 Seed 1 S/As to ICPP.	1732g Element 1416g Isotope	WEI-CPI-161
2/11/63	Transfer of 3 PWR-1 Seed 1 S/As to ICPP.	1299g Element 1062g Isotope	WEI-CPI-165
3/25/63	Transfer of 4 PWR-1 Seed 2 S/As to ICPP.	1946g Element 1539g Isotope	WEI-CPI-188
3/26/63	Transfer of 4 PWR-1 Seed 2 S/As to ICPP.	1946g Element 1539g Isotope	WEI-CPI-191
3/26/63	Transfer of 2 PWR-1 Seed 2 S/As and 16 fuel elements to ICPP.	1431g Element 1131g Isotope	WEI-CPI-195
3/28/63	Transfer of 3 PWR-1 Seed 2 S/As to ICPP.	1459g Element 1154g Isotope	WEI-CPI-197
3/28/63	Transfer of 4 PWR-1 Seed 2 S/As to ICPP.	1946g Element 1539g Isotope	WEI-CPI-199
3/29/63	Transfer of 15 PWR-1 Seed 1 fuel elements and 1 PWR-1 Seed 2 fuel element to ICPP.	460g Element 376g Isotope	WEI-CPI-201
4/3/63	Transfer of 15 PWR-1 Seed 1 fuel elements to ICPP.	433g Element 354g Isotope	WEI-CPI-206
4/3/63	Transfer of 14 PWR-1 Seed 1 fuel elements to ICPP.	402g Element 330g Isotope	WEI-CPI-207
4/4/63	Transfer of 4 PWR-1 Seed 2 S/As to ICPP.	1946g Element 1539g Isotope	WEI-CPI-210
5/29/63	Transfer of 1 PWR-1 Seed 2 S/A to ICPP.	486g Element 385g Isotope	WEI-CPI-232
5/31/63	Transfer of 1 PWR-1 Seed 2 S/A to ICPP.	486g Element 385g Isotope	WEI-CPI-233
6/3/63	Transfer of 16 PWR-1 Seed 1 fuel elements to ICPP.	462g Element 378g Isotope	WEI-CPI-236
6/4/63	Transfer of 1 PWR-1 Seed 1 S/A and 12 fuel elements to ICPP.	780g Element 637g Isotope	WEI-CPI-237
6/10/63	Transfer of PWR-1 Seed section & fuel element to ICPP.	385g Element 314g Isotope	WEI-CPI-240
6/11/63	Transfer of 15 PWR-1 Seed 1 fuel elements to ICPP.	452g Element 372g Isotope	WEI-CPI-241
6/12/63	Transfer of 14 PWR-1 Seed 1 fuel elements to ICPP.	402g Element 330g Isotope	WEI-CPI-242

6/13/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP	1988g Element 1482g Isotope	WEI-CPI-243
6/17/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1482g Isotope	WEI-CPI-244
6/18/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1482g Isotope	WEI-CPI-245
6/20/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1482g Isotope	WEI-CPI-247
6/21/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1482g Isotope	WEI-CPI-248
6/25/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1482g Isotope	WEI-CPI-249
6/27/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1482g Isotope	WEI-CPI-250
6/28/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1482g Isotope	WEI-CPI-252
7/1/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1482g Isotope	WEI-CPI-254
7/2/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1482g Isotope	WEI-CPI-255
7/3/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1482g Isotope	WEI-CPI-257
7/8/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1482g Isotope	WEI-CPI-259
7/8/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1482g Isotope	WEI-CPI-261
7/9/63	Transfer of PWR-1 Seed 1 elements to ICPP	95.86g Element 77.91g Isotope	WEI-CPI-251
7/9/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1482g Isotope	WEI-CPI-264
7/10/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1483g Isotope	WEI-CPI-265
7/12/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1483g Isotope	WEI-CPI-266
7/16/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1483g Isotope	WEI-CPI-267
7/19/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1483g Isotope	WEI-CPI-268
7/22/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1483g Isotope	WEI-CPI-269
7/23/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1483g Isotope	WEI-CPI-270
7/23/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1483g Isotope	WEI-CPI-271
8/8/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1482g Isotope	WEI-CPI-274
8/9/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1482g Isotope	WEI-CPI-275
8/12/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1482g Isotope	WEI-CPI-276
8/14/63	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1482g Isotope	WEI-CPI-277
2/3/64	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1482g Isotope	WEI-CPI-284
2/4/64	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1482g Isotope	WEI-CPI-285

2/5/64	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1482g Isotope	WEI-CPI-286
2/6/64	Transfer of 1 PWR-1 Seed 3 Assembly to ICPP.	1988g Element 1482g Isotope	WEI-CPI-288
2/7/64	Transfer of 1 PWR-1 Seed 3 S/A to ICPP.	497g Element 370g Isotope	WEI-CPI-289
8/28/64	Transfer of 3 PWR-1 Seed 3 S/As and 8 fuel elements to ICPP.	1725g Element 1286g Isotope	PZB-JZA-7
8/31/64	Transfer of 15 PWR-1 Seed 3 fuel elements to ICPP.	438g Element 327g Isotope	PZB-JZA-8
9/1/64	Transfer of 15 PWR-1 Seed 3 fuel elements to ICPP.	439g Element 326g Isotope	PZB-JZA-9
9/2/64	Transfer of 11 PWR-1 Seed 3 fuel elements to ICPP.	322g Element 239g Isotope	PZB-JZA-10
9/2/64	Transfer of 13 PWR-1 Seed 3 fuel elements to ICPP.	380g Element 283g Isotope	PZB-JZA-11
4/26/65	Transfer of 3 PWR-1 Seed 4 assemblies to ICPP.	6069g Element 4878g Isotope	PZB-JZA-39
4/30/65	Transfer of 4 PWR-1 Seed 4 S/As to ICPP	2023g Element 1626g Isotope	PZB-JZA-41
5/5/65	Transfer of 3 PWR-1 Seed 4 assemblies to ICPP.	6069g Element 4878g Isotope	PZB-JZA-42
5/20/65	Transfer of 3 PWR-1 Seed 4 assemblies to ICPP.	6069g Element 4878g Isotope	PZB-JZA-46
5/27/65	Transfer of 2 PWR-1 Seed 4 assemblies to ICPP.	4046g Element 3252g Isotope	PZB-JZA-49
6/14/65	Transfer of 2 PWR-1 Seed 4 assemblies to ICPP.	4046g Element 3252g Isotope	PZB-JZA-51
7/30/65	Transfer of PWR-1 Seed 3 elements to ICPP.	175g Element 131g Isotope	PZB-JZA-58
1/21/66	Transfer of PWR-1 SOAP element to ICPP.	0.114g Element 0.103g Isotope	PZB-JZA-79
1/27/66	Transfer of PWR-1 SOAP II fuel to ICPP.	.097g Element .082g Isotope	PZB-JZA-79
12/2/66	Transfer of 2 PWR-1 Seed 4 assemblies to ICPP.	4046g Element 3250g Isotope	PZB-JWA-13
12/9/66	Transfer of 4 PWR-1 Seed 4 assemblies to ICPP.	8092g Element 6500g Isotope	PZB-JWA-14
12/16/66	Transfer of 4 PWR-1 Seed 4 assemblies to ICPP.	8092g Element 6500g Isotope	PZB-JWA-15
12/30/66	Transfer of 3 PWR-1 Seed 4 assemblies	6069g Element 4875g Isotope	PZB-JWA-16

	to ICPP.		
1/6/67	Transfer of 2 PWR-1 Seed 4 assemblies to ICPP.	4046g Element 3250g Isotope	PZB-JWA-17
6/9/67	Transfer of PWR-1 Seed 4 fuel to ICPP.	10g Element 8g Isotope	PZB-JWA-34
11/17/67	Transfer of PWR-1 Seed 4 fuel to ICPP.	19g Element 16g Isotope	PZB-JWA-56
7/31/69	Transfer of PWR-1 SOAP II Assy. To ICPP	486g Element 358g Isotope	PZB-JWA-91
10/31/69	Transfer of PWR-1 SOAP II Assy. To ICPP	487g Element 333g Isotope	PZB-JWA-94
11/30/69	Transfer of PWR-1 SOAP II To ICPP Transfer of PWR-1 SOAP I To ICPP	61g Element 52g Isotope 171g Element 103g Isotope	PZB-JWA-95
2/27/70	Transfer of PWR-1 SOAP To ICPP	320g Element 274g Isotope	PZB-JWA-99
5/28/71	Transfer of PWR-1 Seed 4 To ICPP	1g Element 1 g Isotope	PZB-JWA-116
7/6/71	Transfer of PWR-1 Seed 4 To ICPP	1g Element 1 g Isotope	PZB-JSA-1
7/13/71	Transfer of PWR-1 Seed 4 To ICPP	146g Element 117 g Isotope	PZB-JSA-1
1/24/72	Transfer of PWR-1 Seed 4 To ICPP	832.98g Element 669.50g Isotope	PZB-JSA-51
1/25/72	Transfer of PWR-1 Seed 1 S/A to ICPP	433g Element 354g Isotope	PZB-JSA-52
1/26/72	Transfer of PWR-1 Seed 1 S/A to ICPP Transfer of 2 PWR-1 Seed 4 S/As to ICPP	433g Element 354g Isotope 1011g Element 812.5g Isotope	PZB-JSA-53
1/27/72	Transfer of 2 PWR-1 Seed 4 S/As to ICPP	1011.5g Element 812.5g Isotope	PZB-JSA-54
1/31/72	Transfer of 2 PWR-1 Seed 4 S/As to ICPP	1011.5g Element 812.5g Isotope	PZB-JSA-56
2/1/72	Transfer of PWR-1 Seed 3 Assembly to ICPP	1988g Element 1482g Isotope	PZB-JSA-58
2/1/72	Transfer of PWR-1 Seed 2 Assembly to ICPP	1946g Element 1539g Isotope	PZB-JSA-59
8/17/90	Transfer of PWR-1 Seed 4 Assembly to ICPP	2023g Element 1626g Isotope	PZB-JXI-601
N/A	PWR-1 SOAP-I fuel in storage at ECF (from inventory reports): Enriched Uranium from PWR-1 SOAP-I	45g Element	27g Isotope
N/A	PWR-1 SOAP-2 fuel in storage at ECF (from inventory reports): Enriched Uranium from PWR-1 SOAP-II	52g Element	44g Isotope

Summary PWR-1 (Irradiated) Seed Fuel Transferred from NRF or in ECF Storage

Seed 1	26 Assemblies 13 S/As 74 Elements misc. elements	52,988 g Element 43,304 g Isotope
Seed 2	26 Assemblies 21 S/A	60,801 g Element 48,087 g Isotope
Seed 3	30 Assemblies 1 S/A 54 Elements misc. elements	61,891 g Element 46,143 g Isotope
Seed 4	29 Assemblies 10 S/As misc. elements	64,734 g Element 52,015 g Isotope
Combined Seed or Unspecified Seed	Misc. assemblies and elements	4,781 g Element 3,744 g Isotope
SOAP-I	Misc. fuel	216 g Element 130 g Isotope
SOAP-II	Misc. assemblies and fuel	1,086 g Element 787 g Isotope
Unspecified SOAP	Misc. fuel	320 g Element 274 g Isotope
Total		246,817 g Element 194,484 g Isotope

This Page Intentionally Left Blank

Attachment 7

Shippingport Core 1 Blanket Fuel (Natural Uranium) Transferred to Off-Site Locations (Other than RWMC) or in ECF Storage

This Page Intentionally Left Blank

SHIPPINGPORT CORE 1 BLANKET FUEL (NATURAL URANIUM) TRANSFERRED TO OFF-SITE LOCATIONS (OTHER THAN RWMC) OR IN ECF STORAGE

Shippingport Core 1 (PWR-1) blanket fuel (natural uranium) was primarily sent to the Hanford site for reprocessing. Some blanket fuel was sent to ECF for testing purposes or prior to being shipped to Hanford. In addition to the majority that was sent to Hanford, smaller quantities were sent to the Bettis-Pittsburgh and Oak Ridge National Laboratory. The PWR-1 contained 113 blanket subassemblies. Each subassembly contained 7 fuel bundles (total of 791). Each fuel bundle contained 120 fuel rods (total of 94,920). "Depleted" or "Normal U" typically refers to natural uranium. Serialized transfer transactions are given.

Date	Fuel Transferred	Quantity	Reference
2/19/60	Transfer of 2 rods from PWR blanket bundle #0551 to Bettis. (Values per DUQ-WEI-1)	.62 g Pu .24 Kg U .001 Kg U 235	WEI-WEB-16
4/15/60	Transfer of 2 rods from PWR blanket bundle #0551 to Bettis. (Values per DUQ-WEI-1)	.62 g Pu .26 Kg U .001 Kg U 235	WEI-WEB-19
5/22/61	Transfer of 3 rods from PWR fuel bundles to Knolls Atomic Power Laboratory.	1 g Pu .390 Kg U 2 g U 235	WEI-SGE-11
9/27/61	Transfer of rod #110 from PWR blanket bundle #035 to Bettis. (Values per DUQ-WEI-8)	.133 Kg U .0004 Kg U 235 .597g Pu	WEI-WEB-48
11/2/61	Transfer of rod #111 from PWR blanket bundle #0545 to Bettis. (Values per DUQ-WEI-8)	.133 Kg U .0004 Kg U 235 .597g Pu	WEI-WEB-52
12/8/61	Transfer of 2 rods from PWR blanket bundle #0485 Assy #035 to Bettis. (Values per DUQ-WEI-8)	.266 Kg U .0008 U 2351 .192 g Pu	WEI-WEB-55
5/25/62	Transfer of rod #23 from PWR blanket bundle #0671 Assy #047 to Bettis. (Values per DUQ-WEI-9)	.133 Kg U .442 g U 235 .596 g Pu	WEI-WEB-62
8/27/62	Transfer of 1 fuel rod from PWR blanket bundle 0558 to Bettis. (Values per DUQ-WEI-8)	.133 Kg U .442 g U 235 .596 g Pu	WEI-WEB-68
8/31/62	Transfer of 1 fuel rod from PWR blanket bundle 0558 to Bettis. (Values per DUQ-WEI-8)	.133 Kg U .442 g U 235 .596 g Pu	WEI-WEB-70
3/22/63	Transfer of 3 fuel rods from irradiated PWR blanket Assy. 041. (Per DUQ-WEI-14 values) to Bettis.	.3975 Kg U 1.2 g U 235 1.9 g Pu	WEI-WEB-83

10/25/63	Transfer of 4 fuel rods from PWR Blanket Assy 041, Bundle 0079 to Bettis (As per values from DUQ-WEI-14).	.530 Kg U .0016 Kg U 235 2.5 g Pu	WEI-WEB-107CC2
11/19/63	Transfer of 6 PWR Rods from Assembly 50 (Shippers values per DUQ-WEI-17 and WEB-WEI- 114, 170, & 172) to Bettis.	.8 Kg U 2.4 g Pu	WEI-WEB-111CC1
3/20/64	Transfer of 2 PWR Rods containing depleted U and Pu (Rods 2,5 from Bundle 0386)	.3 Kg U U 235 (listed as negligible) 1 g Pu	WEI-WEB-118
5/25/64	Transfer of 2 fuel rods from LCSR "SABRE" Assembly to Bettis. (Rods 239 & 304) (Values as per DUQ-WEI-19CC)	3.632 Kg Depleted U .02 Kg U 235 8.6 g Pu	WEI-WEB-124
2/11/66	Transfer of 8 irradiated PWR-1 Blanket Subassembly Fuel Rods to Oak Ridge National Laboratory.	5 g Pu 1 Kg Depleted U .003 Kg U 235	PZB-FZC-1
2/18/66	Transfer of 2 PWR-1 Blanket Subassembly Rods to Bettis-Pgh.	1 g Pu .264 Kg U .001 Kg U235	PZB-PZA-49
3/11/66	Transfer of 2 PWR-1 Blanket Subassembly Rods to Bettis-Pgh.	1 g Pu .264 Kg U .001 Kg U235	PZB-PZA-5
4/22/66	Transfer of 54 irradiated PWR-1 Blanket Subassembly Rods to Bettis-Pgh.	37 g Pu 7 Kg U .02 Kg U235	PZB-PZA-54
6/22/66	Transfer of 14 irradiated PWR-1 Blanket Fuel Subassemblies to Isochem., Inc. in Richland, Wash. In container, M-130 #10.	8218 g Pu 1558 Kg Normal U 5 Kg U 235	PZB-HWA-1
8/1/66	Transfer of 16,288 irradiated PWR Core 1 Blanket Subassembly Fuel Rods to Isochem in M-130 #10.	10,382 g Pu 2,139 Kg Depleted U 7 Kg U 235	PZB-HWA-2
7/7/67	Transfer of 10 irradiated PWR-1 Blanket Subassembly Rods to Bettis-Pgh.	7 g Pu 1 Kg U U 235 (Listed as negligible)	PZB-PZA-76
10/27/67	Transfer of 8 irradiated PWR-1 Blanket Subassembly Rods to Bettis-Pgh.	6 g Pu 1 Kg U U 235 (Listed as negligible)	PZB-PZA-83
7/3/68	Transfer of 2 irradiated rods from the Sabre Test Assembly to Bettis-Pgh.	9 g Pu 3.64 Kg U U 235 (Listed as negligible)	PZB-PZA-101
10/3/69	Transfer of 29 irradiated PWR-1 Blanket Subassembly Rods to Bettis-Pgh.	9 g Pu 4 Kg U .02 Kg U235	PZB-PZA-83

2/14/74	Transfer of 47 PWR-1 Fuel Elements to Battelle, Pacific NW Laboratories.	32 g Pu 6 Kg U U 235 (Listed as negligible)	PZB-YDZ-1
7/7/78	Transfer of one PWR-1 blanket rod to Bettis-Pgh.	1 g Pu .13 Kg U U 235 (Listed as negligible)	PZB-PZA-216
7/7/80	Transfer of one 8-rod bundle section and one 7-rod bundle section of PWR-1 blanket fuel to Battelle Memorial, Columbus, Ohio	4 g Pu 2 Kg U U 235 (Listed as negligible)	PZB-CAF-74
9/16/87	Transfer of 1 PWR-1 rod and 44 rods from SABRE test assembly to ICPP	178 g Pu 80.06 Kg U	PZB-JXI-517

In Storage at ECF

Depleted Uranium Blanket Fuel	304Kg Element
Plutonium from PWR-1 Blanket Fuel	1,227g Plutonium

Summary Core 1 Blanket Fuel Transferred from NRF or in ECF Storage

Total PWR-1 blanket fuel transferred and in ECF Storage	4,114.8 Kg U 20.139 Kg Plutonium 12.1 Kg U-235[(a)]

(a) The total for U-235 is not likely to be accurate due to rounding and some transfers not including U-235 amounts. The reporting quantity for U-235 in Depleted Uranium is 1 Kg. As a result, values less than 0.5 Kg were not required to be listed.

This Page Intentionally Left Blank

Attachment 8

Curie Content of PWR-1 Blanket Fuel

This Page Intentionally Left Blank

Curie Content of PWR-1 Blanket Fuel

Bettis-Pittsburgh personnel performed a detailed evaluation of existing information on the calculated and measured burnup and radionuclide content for PWR-1 blanket fuel. This core was designed by Bettis-Pittsburgh and analyzed analytically before operation. A key objective of the core examination program at ECF was to obtain data for comparison to calculations in order to assess the capability of analytical tools.

The parameters of most interest in the 1960's were burnup as well as uranium and plutonium concentrations. Therefore, the reports of the day deal almost exclusively with these parameters. In core examination programs, burnup was typically determined based on Cs-137 gamma measurements. Plutonium and uranium were determined based on dissolution of a relatively small number of blanket fuel rods. The large number of fission product and actinide radionuclides typically calculated today for environmental analyses were neither calculated nor measured by Bettis-Pittsburgh and ECF in the 1960's. Therefore, Bettis-Pittsburgh has performed new calculations using the Oak Ridge National Laboratory ORIGEN-S computer code.

Nearly all of the PWR-1 blanket fuel disposed of at RWMC was fuel that had been irradiated throughout all four seed lives. Therefore, Bettis-Pittsburgh focused on four seed life calculations. Thermal and fast neutron flux values from reference (a) were used as input along with time information for each seed operation. Each seed was treated as one time interval in a four time step calculation. ORIGEN-S provides output in both burnup (in MwD/Kg U) and radionuclide concentrations (in Ci/Kg U).

For the ORIGEN-S average burnup calculations, Bettis-Pittsburgh compared the calculated burnup with the average burnup reported in references (b) and (c). These results agreed within ten percent. In order to compare plutonium concentrations with plutonium measurements that were made for rods with only one and two seed lives, Bettis-Pittsburgh performed some ORIGEN-S calculations for one and two seed lives. The ORIGEN-S calculated values were higher than the measured plutonium isotope values by a factor of approximately three. Adjusting the flux information to force the ORIGEN-S calculated plutonium to match the measured plutonium resulted in burnup values that did not match the measured burnup information. Thus, it was not possible to get the ORIGEN-S program to adequately duplicate both the burnup and the plutonium. For these calculations, Bettis-Pittsburgh elected to slightly adjust the ORIGEN-S input parameters so that the calculated burnup closely matched the measured burnup. Since the burnup information is based on number of fissions, this would indicate that other fission product concentrations should be reasonably accurate. Other actinide concentrations are likely to be high similar to the plutonium. Therefore, a factor of three reduction was applied to the ORIGEN-S results for plutonium and other actinides based on the measured plutonium values from the 1960s.

Interestingly, the 1960's Bettis-Pittsburgh reports generally reported good agreement between calculation and measurement, usually within 10 percent, for both burnup and plutonium concentrations. These calculations used detailed core modeling and Bettis-Pittsburgh computational methods of that era. A primary reason for the difference in results is due to the fact that ORIGEN-S treats the fast neutron spectrum with two energy groups rather than a large number of groups, as is usually done for core physics calculations. Even though new ORIGEN-S do not appear to be as accurate as the detailed core model burnup and plutonium calculations of the 1960's, it is necessary to use the new calculations to obtain the full range of radionuclides.

Bettis-Pittsburgh reports from the 1960's indicate that neutron fluxes, and therefore burnup, varied widely within the PWR-1 core blanket. Blanket fuel closest to the seed assemblies had higher neutron flux and higher burnup. The individual rods with the highest measured burnup were approximately 3 times higher than the blanket average burnup. Individual rod bundles could also have burnup approximately 2.5 times the blanket average. In addition to radial variation within the core, the burnup of blanket bundles would vary axially over the seven bundle heights in each blanket assembly.

Most of the fuel disposed of at RWMC consisted of intact bundles. The disposal records have bundle numbers for these intact bundles. Specific subassembly locations have been found for the 12 intact bundles. Most of the subassembly locations (11) were adjacent to seed assemblies, and one was from the outer ring of the blanket. Thus, radially, the bundles disposed of at RWMC would have had greater than average fluxes. The 12 bundles had a variety of height locations within the reactor. Thus, axially, the bundles were not as biased toward higher flux locations as they were radially. The best estimate was obtained by multiplying the average depletion calculations (adjusted for the actinide overprediction) by a factor of 1.5. The upper bound estimate was then obtained by multiplying by another factor of 1.5, or a combined factor of 2.25. Given the reported factor from the 1960s that individual rod bundles could have burnup 2.5 times the blanket average and the fact that the 12 disposed of bundles were biased toward higher fluxes radially, but not axially, this worst case estimate is considered to be reasonable and conservative.

ORIGEN-S calculated radionuclide concentrations for various isotopes are presented in the following table. These values are for the average four seed burnup of 10.86 MwD/kg of natural uranium. Values for one year and five years after shutdown are provided. For fission product radionuclides, the best estimate concentrations used in this report are 1.5 times these average burnup concentrations, and the upper bound estimate concentrations are 2.25 times the average burnup concentrations. Due to the known overcalculation of plutonium and actinides by a factor of approximately three, the actinide concentrations used in this report are reduced by a factor of three from the concentrations in this table and then multiplied by 1.5 and 2.25 to obtain the best estimate and upper bound estimate respectively. For the uranium isotopes and their decay chain radionuclides, the curie content has little uncertainty based on the known amount of uranium disposed to the RWMC, therefore the best estimate and upper bound estimates use the average burnup concentrations listed in this table.

Table 1. ORIGEN-S calculated activity concentrations for decayed fission products, actinides, and daughter products in the Shippingport natural uranium blanket elements based on 10.86 MwD/kg natural U.

Isotope	1 Years Decay Ci/kg	5 Years Decay Ci/kg
Ac-227	1.67E-10	4.47E-10
Am-241	1.04E-01	2.73E-01
Am-243	2.24E-04	2.24E-04
C-14	9.07E-05	9.07E-05
Cm-244	3.35E-03	2.87E-03
Cs-137	3.40E+01	3.08E+01
Eu-152	7.32E-03	5.94E-03
Eu-154	8.16E-01	5.92E-01
H-3	1.48E-01	1.18E-01
I-129	1.25E-05	1.25E-05
Nb-94	4.39E-08	4.39E-08
Np-237	2.55E-05	2.59E-05
Pa-231	2.32E-09	2.71E-09
Pb-210	1.65E-12	6.51E-12
Pu-238	1.14E-01	1.15E-01
Pu-239	4.25E-01	4.25E-01
Pu-240	3.71E-01	3.71E-01
Pu-241	2.91E+01	2.40E+01
Pu-242	2.45E-04	2.45E-04
Ra-226	2.49E-11	6.39E-11
Ra-228	2.10E-15	6.84E-15
Sr-90	1.99E+01	1.81E+01
Tc-99	4.78E-03	4.78E-03
Th-228	3.52E-07	8.68E-07
Th-229	6.03E-12	8.54E-12
Th-230	1.74E-08	2.77E-08
Th-232	9.36E-15	1.88E-14
U-232	7.56E-07	1.14E-06
U-233	6.90E-09	7.34E-09
U-234	2.79E-04	2.80E-04
U-235	4.53E-06	4.53E-06
U-236	4.81E-05	4.83E-05
U-238	3.29E-04	3.29E-04

References

a. WAPD-TM-265, Isotopic Analysis of Irradiated Natural Uranium Dioxide Fuel Rods from PWR Core 1, February 1962

b. WAPD-T-1608, Isotopic Composition of PWR Core 1 Blanket Irradiated to 16,000 MWD/Metric Ton U: Theory Vs Experiment, September 1963

c. WAPD-PWR-RD-1557, PWR-1 Component Examination Program, May 1963