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Monthly Progress Report
Heat Source Technology Programs
January 1994

Compiled by
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MONTHLY PROGRESS REPORT
HEAT SOURCE TECHNOLOGY PROGRAMS

JANUARY 1994

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MONTHLY PROGRESS REPORT

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T. G. George

ABSTRACT

This monthly report describes activities performed in support of Cassini fueled-clad production and studies related to the use of $^{238}\text{PuO}_2$ in radioisotope power systems carried out for the Office of Special Applications of the U.S. Department of Energy (DOE) by Los Alamos National Laboratory (LANL). Most of the activities described are ongoing; the results and conclusions described may change as the work progresses.

I. HEAT SOURCE AND FEED POWDER SHIPMENTS

The first delivery of fuel for Cassini flight-quality applications, designated as shipment 469, was received from the Westinghouse Savannah River Company (WSRC) in mid-December. Calorimetry of the shipment was completed by 22 December. In mid-January, thirteen of the fourteen fuel containers received in shipment 469 were released to the Heat Source Technology group (NMT-9), and were introduced into the fuel processing glovebox line. A shipper/receiver difference associated with the fourteenth container (SN-1434) prevented its release to NMT-9 personnel.

By the end of the month, samples of fuel from five containers received in shipment 468, and five 5320 shipping containers loaded with high-quality returns required for the Cassini blend plan, were shipped to WSRC.

Two fuel samples for chemical analysis were received from WSRC by 31 January.

II. IRIDIUM HARDWARE SHIPMENTS AND INVENTORY

No new shipments of GPHS iridium components were received in January. However, on 12 January, a shipment of 39 post-impact containment shells (PICS) received in December was inspected in the presence of an engineer from Martin Marietta energy

Systems/Y-12 (MMES/Y-12). The LANL inventory of GPHS hardware, as of 31 January, is shown in Table I.

Table I. LANL Inventory of GPHS Iridium Hardware

<u>Type of Hardware</u>	<u>Category</u>	<u>Number of Items in Inventory</u>
PICS*	Prime	151
PICS	Restricted Use	54
Type II Weld Shields	Prime	213

*PICS = post-impact containment shell

III. FACILITIES

A. General

During January progress on the installation of equipment and gloveboxes required to support Cassini production continued to be delayed by the slow response of organizations responsible for work approval, scheduling, and performance.

B. Launcher Relocation

Work continued in January on construction of an addition to PF-4 to house the relocated launcher and on a number of related procurements.

1. Construction Activities

Painting of the interior of the launcher addition began in mid-January. By the end of the month a Placite primer had been applied to the ceiling of the addition and to the top 8 feet of the interior walls. At this rate of progress the painting job will require several months.

Servicing and testing of the launcher addition's bridge crane were delayed by the interior painting operation.

Installation of a gas system required for operation of the launcher began in early January. JCI personnel worked throughout the month to install gas piping in the basement of building PF-4.

In mid-January JCI personnel began work on fabricating the ceiling armor that will be installed in the launcher addition. JCI also began fabrication of a launcher base plate and a top support plate.

At the beginning of the month, the ductwork tubing required for the launcher addition's heating, ventilation, and air conditioning (HVAC) system was received, inspected, and accepted. Fabrication of ductwork hangers for the HVAC system was also completed, and installation of the ductwork began. However, ductwork installation activities were

suspended at the end of the month to avoid potential problems in connecting the ductwork to the HVAC system filter trains.

Information and documents necessary to remove vacuum pumps located in the basement of building PF-4, in an area where the supply filter train for the launcher addition's HVAC system will be installed, were collected by the TA-55 Facilities Engineering group (NMT-8).

2. Design Activities

Shop drawings for the launcher addition's blast doors were approved by the architecture and engineering (A&E) contractor, and were returned to the vendor for use in fabrication.

Shop drawings for the filter trains used in the launcher addition's HVAC system were also completed and reviewed. Seismic calculations for the filter trains were completed, and the calculations were submitted to the A&E contractor for review. When the seismic calculations have been approved the drawings will be released to the vendor for use in fabrication.

3. Procurements

JCI personnel began to prepare technical specifications to define a housing that will hold the high-efficiency particulate air (HEPA) filter used to exhaust air from inside the launcher room. These specifications will be used for procurement of the filter housing.

JCI personnel also proceeded with the purchase of various electrical components required for operation of the launcher's gas system.

4. Administrative Activities

A secretary was assigned to reformat the safe operating procedures (SOPs) written for operation of the relocated launcher.

C. Metallography and Ceramography Glovebox Lines

All of the gloveboxes in the metallography and ceramography lines have been installed and wired for electric power. A bench-top metallographic facility for "cold" (uncontaminated) specimens was activated previously and has been used to support fueled-clad weld-process development.

On 9 November, NMT-9 requested a facility-required Safety and Technical Assessment for Readiness of Technology (START) review of the glovebox line and metallography operation. A review committee was selected, and convened on 23 November. Twenty-five committee findings and a number of additional comments were provided to NMT-9 on 15 December. No operations may be conducted in the glovebox line until after all of the "A" findings identified by the START committee have been closed, and action plans have been developed to close the "B" findings.

Work orders to address findings and comments received from the START review committee were initiated in early January. A target date for the completion of all required work was established as 7 February. By 31 January, work to close 11 of the 25 findings received from the START committee had been completed.

IV. GENERAL-PURPOSE HEAT SOURCE (GPHS) PROGRAM

A. Preproduction Activities

1. Operational Readiness Evaluation (ORE)

A Cassini production ORE was conducted at LANL on 16–20 November 1992. Also present was a DOE Environment and Health (EH) audit/review team that acted in an oversight capacity. The ORE was closed out on 20 November, with six findings to be resolved before the start of Cassini heat source production. The work required to close all six findings was completed by the end of May. Packages on five findings were then forwarded to the DOE's Los Alamos Area Office (DOE/LAAO) and Albuquerque Operations Office (DOE/AL) for formal closure. A package for the sixth finding was submitted in August.

On 9 December, the manager of DOE's Albuquerque Field Office (ALO) approved the startup of Cassini production operations at TA-55. Authorization to begin Cassini production operations at TA-55 was received from DOE's Los Alamos Area Office (LAAO) on 4 January. This notification officially closed the ORE.

2. GPHS Fuel Powder, Pellet, and Fueled-Clad Specifications

The $^{238}\text{PuO}_2$ fuel powder acceptance specification, the GPHS fuel pellet specification, and the GPHS fueled-clad specification had previously been distributed to the Office of Special Applications (OSA), EG&G Mound Applied Technologies (EG&G MAT), MMES/Valley Forge (MMES/VF), Oak Ridge National Laboratory (ORNL), and WSRC for review, as required by the Interface Working Agreement (IWA). Seven organizations/individuals provided comments on the draft specifications by the deadline of 7 May. These comments will be addressed in subsequent specification revisions.

3. Fueled-Clad Weld Development

During November, four plutonia pellets were encapsulated within clad/vent-sets. The welds on all four capsules appeared to be exemplary, and each capsule easily passed through the ring gauge. Metallographic examination of the capsule welds was postponed, pending the startup of the hot metallography line.

4. Fueled-Clad Ultrasonic Test (UT) Development

There was no activity during December.

In mid-January, LANL completed ultrasonic testing of 11 empty capsules used for a "round-robin" study between LANL, WSRC, and MMES/Y-12. The welds in 8 of the 11 capsules examined were rated as acceptable. A meeting was planned for early February to compare the results obtained by each study participant.

5. Cold Process Verification (CPV) Tests

The CPV test series was designed to verify that the welding process for simulant-fueled ("cold") capsules had been optimized and to quantify the impact responses of the hot-pressed, and cold-pressed and sintered, uranium fuel-simulants.

Most of the simulant-fueled clads required for the CPV test series were welded previously. Eight capsules were loaded with hot-pressed urania (^{235}U -depleted) fuel-simulant and seven capsules were loaded with cold-pressed urania. UT examination performed with the existing Panametrics system indicated that the welds in nearly three-quarters of the capsules (11 of 15) contained indications that exceeded the proposed UT acceptance criterion.

The postmortem examinations of capsules tested in CPV-1 and CPV-2 were completed previously. The status of ongoing postmortem examinations are given in the following sections.

a. CPV-3. On 26 February 1993, capsule SC0004, which had been loaded with cold-pressed and sintered urania fuel-simulant, was impacted against a steel plate at 55.0 ± 0.1 m/s and 1090°C . The iridium hardware used for this capsule was designated as "Prime" and was from the D2 batch. Postimpact examination revealed that although the capsule contained two small transverse cracks on the cup radii at the edges of the impact face, no urania had been released. Details of this initial examination were documented in previous monthly reports.

In this month we completed the metallographic examination of selected clad sections and performed a sieve analysis (Table II) of the urania fuel simulant.

Table II. Sieve Analysis of Urania Fuel-Simulant in Capsule SC0004*

Particle Size (mm)	Weight Fraction
+5600	0.4189
+2000 to 5600	0.3054
+ 350 to 2000	0.1687
+ 425 to 850	0.0417
+ 180 to 425	0.0257
+ 125 to 180	0.0033
+ 75 to 125	0.0046
+ 45 to 75	0.0020
≤ 45	<u>0.0297</u>
Total:	1.0000

* Weight fractions are calculated on the basis of the recovered pellet weight.

Metallographic examination of an axial section cut from the vent cup revealed penetrating intergranular cracks on both sides (top and impact face) of the cup radius. The crack on the vent side of the SC0004 cup radius appeared nearly identical to the impact face crack, and apart from location, was similar to cracks observed on the impact faces of other CPV capsules.

An axial section of the SC0004 weld-shield cup contained a deep crack on the impact face of the cup radius. The crack was exclusively intergranular, and penetrated 92% of the wall thickness.

Examination of sections cut from the single-pass and overlap regions of the SC0004 girth weld revealed that the weld had an acceptable microstructure in both regions. Although the overlap weld contained a number of large grains oriented along the weld centerline, none of the grains extended through more than 40% of the weld thickness. The microstructure in the single-pass region was exemplary.

During macroscopic examination of the defueled capsule three small axial weld cracks were observed on the interior surface of the impact face. All of the cracks appeared to have originated at or near the weld centerline, and then propagated along grain boundaries into the vent or weld-shield cups. Metallographic examination of a transverse section containing the three weld cracks revealed that the single crack visible in the polished section was exclusively intergranular, and extended through 85% of the weld thickness. Because no significant reflectors were detected during a pre-impact UT examination of the weld, it is apparent that this crack resulted from a mechanical interaction with the fragmenting fuel pellet.

b. CPV-4. On 5 March, capsule SC0020, which had been loaded with cold-pressed and sintered urania fuel-simulant, was impacted against a steel plate at 55.3 ± 0.2 m/s and 1090°C . The iridium hardware used for this capsule was X- and YR-batch material (vent cup ID, X342-2; shield cup ID, YR421-1) produced for the Galileo and Ulysses missions. Postimpact examination revealed that capsule SC0020 had been breached by several cracks and that a small amount of urania had been released into the tantalum containment vessel. Details of this initial examination were documented in previous monthly reports.

In this month we sectioned capsule SC0020 to provide specimens for metallography and initiated a sieve analysis of the retained and released urania fuel simulant.

c. CPV-5. On 15 June, capsule SC0017, which had been loaded with cold-pressed and sintered urania, was impacted against a steel plate at 55.3 ± 0.1 m/s and 1090°C . The iridium hardware for this capsule was designated as "Prime" and was from the D2 batch. Postimpact examination revealed that capsule SC0017 had breached, and that a small quantity of urania had been released. Details of this initial examination were documented in previous monthly reports.

In this month we made no progress on the CPV-5 postmortem examination.

d. CPV-6. On 29 June, capsule SC0018, which had been loaded with cold-pressed and sintered urania, was impacted against a steel plate at 55.0 ± 1.0 m/s and 1090°C . The iridium hardware used for this capsule was designated as "Prime" and was from the CR3 batch. Postimpact examination of the impacted capsule revealed that although a network of hairline axial cracks was visible on the impact face, no urania had been released. Details of this initial examination were documented in previous monthly reports.

In this month we made no progress on the CPV-6 postmortem examination.

e. CPV-7. On 13 July, capsule SC0019, which had been loaded with cold-pressed and sintered urania, was impacted against a steel plate at 55.3 ± 0.1 m/s and 1090°C . The iridium hardware used for this capsule was X- and YR-batch material (vent cup ID, X340-4; shield cup ID, YR427-6) produced for the Galileo and Ulysses missions. Postimpact examination revealed that the capsule exhibited a centerline weld failure on the trailing face; however, no urania was released into the tantalum containment vessel. Details of this initial examination were documented in previous monthly reports.

In this month we made no progress on the CPV-7 postmortem examination.

f. CPV-8. On 17 November, capsule SC0006, which had been loaded with a cold-pressed and sintered urania pellet, was impacted against a steel plate at 55.3 ± 0.1 m/s and 1090°C. The iridium hardware used for this capsule was designated as "Prime" and was from the CR3 batch.

In this month we made no progress on the CPV-8 postmortem examination.

g. CPV-9. On 24 November, capsule SC0015, which had been loaded with a hot-pressed and sintered urania pellet, was impacted against a steel plate at 54.5 ± 0.1 m/s and 1090°C. The iridium hardware used for this capsule was designated as "Prime" and was from the CR3 batch.

In this month we made no progress on the CPV-9 postmortem examination.

h. CPV-10. On 10 December, capsule SC0009, which had been loaded with a hot-pressed and sintered urania pellet, was impacted against a steel plate at 55.5 ± 0.2 m/s and 1090°C. The iridium hardware used for this capsule was designated as "Prime" and was from the CR3 batch.

In this month, we made no progress on the CPV-10 postmortem examination.

i. CPV-11. On 19 January, capsule SC0016, which had been loaded with a hot-pressed and sintered urania pellet, was impacted against a steel plate at 54.8 ± 0.1 m/s and 1090°C. The iridium hardware used for this capsule was X- and XR-batch material (vent cup ID, X312-2; shield cup ID, XR367-2) produced for the Galileo and Ulysses missions.

6. Production Qualification

Previously, all process operations involving fuel received in shipments 467 and 468 were suspended pending the outcome of impurity analyses. In early January, the results of these analyses were received from LANL's chemical analysis group (CST-1); these results, along with comparative analyses of an archive fuel sample from the milliwatt heat source program, are listed in Tables III and IV. As a result of these analyses, the program office directed that all processing of fuel designated for the production qualification effort be suspended.

The analytical results listed in Tables III and IV indicate that the silicon content of the fuel in shipments 467 and 468, while still undesirable, was significantly less than that of fuel received in shipment 466. In addition, there were significant differences in the WSRC and LANL analytical results, particularly with respect to the levels of silicon, calcium, and magnesium. Finally, the data listed in Tables III and IV suggest that one or more of the LANL fuel processing operations were modestly effective in reducing the levels of calcium and magnesium.

Because of questions raised by the significant differences between the WSRC and LANL impurity analyses, LANL personnel devoted a significant amount of time to preparing duplicate analytical samples for shipment to WSRC, and to receiving and processing analytical samples from future WSRC shipments. At the beginning of the month, LANL personnel prepared two duplicate 2.5 g samples from shipment 468, and a sample of milliwatt granules, for shipment to WSRC. LANL personnel also packaged five additional samples of shipment 468 fuel for transport. However, when it was discovered that WSRC would be unable to open the thin-wall tantalum sample containers, all five samples were

Table III. Nonactinide Cation Impurities Detected in Shipment 467 Fuel

WSRC SN No. ^a	LANL Lot No.	Impurity Amounts (ppm/sample of plutonia fuel)																				
		<u>Ag</u>	<u>Al</u>	<u>B</u>	<u>Be</u>	<u>Bi</u>	<u>Ca</u>	<u>Cd</u>	<u>Cr</u>	<u>Cu</u>	<u>F</u>	<u>Fe</u>	<u>Mg</u>	<u>Mn</u>	<u>Mo</u>	<u>Na</u>	<u>Ni</u>	<u>P</u>	<u>Pb</u>	<u>Si</u>	<u>Sn</u>	<u>Zn</u>
1612	272																					
as-received		5	<DL ^b	<DL	<DL	<DL	250-2500	<DL	55	30	<10	110	70	20	30	<DL	70	<22	15	390	<DL	<DL
		1	<DL	<DL	<DL	<DL	250-2500	<DL	60	20	NS ^c	140	70	20	20	<DL	80	NS	5	410	<DL	<DL
granules ^d		<DL	160	<DL	<DL	<DL	250	<DL	110	50	NS	270	25	10	<DL	<DL	80	NS	25	140	5	20
		<DL	460	<DL	<DL	<DL	250	<DL	170	50	NS	370	25	10	<DL	<DL	130	NS	25	160	5	20
1614	273																					
WSRC Analysis		NS	<DL	<DL	<DL	NS	<DL	<DL	29	18	NS	98	7	3	<DL	5	77	3	5	<DL	<DL	<DL
LANL:																						
as-received		10	<DL	<DL	<DL	<DL	250	<DL	75	10	<10	260	50	10	20	<DL	140	<23	20	550	<DL	10
		10	<DL	<DL	<DL	<DL	250-2500	<DL	45	5	NS	140	40	10	50	<DL	120	NS	15	290	<DL	5
granules		<DL	130	<DL	<DL	<DL	150	<DL	130	20	NS	540	15	10	<DL	<DL	150	NS	100	550	<DL	<DL
		<DL	120	<DL	<DL	<DL	150	<DL	96	20	NS	420	15	10	<DL	<DL	130	NS	100	410	<DL	<DL
1613	274																					
WSRC Analysis		NS	15	<DL	<DL	NS	<DL	<DL	31	3	NS	251	8	3	<DL	9	33	<8	45	<DL	<DL	<DL
LANL:																						
as-received		3	7	<DL	<DL	<DL	250-2500	<DL	65	5	<10	290	70	5	<DL	<DL	75	<24	100	360	<DL	5
		3	60	<DL	<DL	<DL	250-2500	<DL	45	5	NS	170	50	5	<DL	<DL	50	NS	80	170	<DL	20
granules		<DL	<DL	<DL	<DL	<DL	100	<DL	<DL	5	NS	100	10	5	<DL	<DL	<DL	NS	<DL	230	<DL	<DL
		<DL	<DL	<DL	<DL	<DL	100	<DL	15	10	NS	130	10	5	<DL	<DL	<DL	NS	<DL	210	<DL	<DL
1615	275																					
as-received		<DL	9	<DL	<DL	<DL	250-2500	<DL	35	10	<10	160	70	10	20	<DL	65	<24	25	120	<DL	<DL
granules		<DL	70	<DL	<DL	<DL	75	<DL	110	3	NS	360	25	7	<DL	<DL	30	NS	<DL	190	10	<DL
		<DL	30	<DL	<DL	<DL	75	<DL	90	3	NS	300	25	7	<DL	<DL	35	NS	<DL	180	10	<DL
1618	276	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1619	277	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1622	278																					
WSRC Analysis		NS	<DL	<DL	<DL	NS	<DL	<DL	23	<DL	NS	59	<DL	2	<DL	<DL	21	<12	8	<DL	10	<DL
LANL:																						
as-received		<DL	30	<DL	<DL	<DL	250-2500	<DL	60	2	<10	200	100	5	<DL	<DL	25	<23	10	370	<DL	<DL
		10	10	<DL	<DL	<DL	250-2500	<DL	55	2	NS	180	100	5	<DL	<DL	35	NS	15	340	<DL	<DL
granules		<DL	30	<DL	<DL	<DL	250	<DL	85	25-50	NS	285	25	35	<DL	<DL	15	NS	<DL	610	<DL	5
		<DL	25	<DL	<DL	<DL	250	<DL	100	25	NS	290	25	35	<DL	<DL	15	NS	<DL	680	<DL	<DL
1621	279	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

^a The WSRC SN number indicates the ID number of the shipping container used to transport the fuel to Los Alamos.

^b Below the detection limit.

^c Not submitted for this analysis.

^d Analyses were performed on samples of fuel that had been processed to seasoned granules at LANL.

Table III. Nonactinide Cation Impurities Detected in Shipment 467 Fuel
(Continued)

WSRC SN No.	LANL Lot No.	Impurity Amounts (ppm/sample of plutonia fuel)																				
		Ag	Al	B	Be	Bi	Ca	Cd	Cr	Cu	F	Fe	Mg	Mn	Mo	Na	Ni	P	Pb	Si	Sn	Zn
1623	280	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1625	281	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1624	282	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
1628	283	as-received granules	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	<DL		80	<DL	<DL	<DL	250-2500	<DL	95	25	NS	250	35	20	<DL	<DL	120	NS	50	400	<DL	5
	<DL		35	<DL	<DL	<DL	250-2500	<DL	110	25	NS	250	35	10	<DL	<DL	140	NS	50	400	<DL	5
	<DL		70	<DL	<DL	<DL	250-2500	<DL	90	30	NS	280	35	10	<DL	<DL	70	NS	50	310	20	20
	<DL		15	<DL	<DL	<DL	250	<DL	95	25	NS	330	30	40	20	<DL	85	NS	10	590	15	5
	<DL		60	<DL	<DL	<DL	125-1250	<DL	90	25	NS	310	30	50	30	<DL	80	NS	50	450	15	15

Table IV. Nonactinide Cation Impurities Detected In Shipment 468 Fuel And A Milliwatt Archive Sample

WSRC SN No. ^a	LANL Lot No.	Impurity Amounts (ppm/sample of plutonia fuel)																			
		Ag	Al	B	Be	Bi	Ca	Cd	Cr	Cu	Fe	Mg	Mn	Mo	Na	Ni	P	Pb	Si	Sn	Zn
1632	285																				
WSRC analysis		NS ^b	21	<DL ^c	<DL	NS	30	<DL	42	<DL	195	11	4	<DL	39	38	<18	<6	<47	<DL	<DL
LANL: as-rec.		<DL	5	<DL	<DL	<DL	250	<DL	35	10	130	50	10	<DL	<DL	40	<24	5	300	<DL	<DL
		<DL	7	<DL	<DL	<DL	250	<DL	35	10	130	50	20	<DL	<DL	35	NS	5	270	<DL	<DL
granules ^d																					
S3		<DL	<DL	<DL	<DL	<DL	30	<DL	55	50-500	200	50	10	<DL	<DL	55	NS	10	400	<DL	7
		<DL	<DL	<DL	<DL	<DL	30	<DL	50	50-500	180	50	10	<DL	<DL	45	NS	10	380	<DL	5
S4		<DL	<DL	<DL	<DL	<DL	20	<DL	60	50-500	210	40	15	<DL	<DL	55	NS	10	360	<DL	5
		<DL	<DL	<DL	<DL	<DL	25	<DL	80	50-500	270	40	15	<DL	<DL	70	NS	10	280	<DL	5
S5		<DL	30	<DL	<DL	<DL	250	<DL	85	25-250	330	20	20	20	<DL	75	NS	<DL	430	<DL	5
		<DL	20	<DL	<DL	<DL	200	<DL	67	25-250	260	20	20	20	<DL	70	NS	5	370	<DL	5
1631	286																				
WSRC Analysis		NS	29	<DL	<DL	NS	55	<DL	58	2	201	14	38	<DL	18	55	10	34	<35	<DL	<DL
LANL: as-rec.		<DL	<DL	<DL	<DL	<DL	250-2500	<DL	70	10	200	100	100	<DL	<DL	70	NS	25	450	<DL	<DL
		<DL	5	<DL	<DL	<DL	250-2500	<DL	50	10	180	100	100	<DL	<DL	150	NS	15	350	<DL	<DL
1398	290																				
WSRC Analysis		NS	123	<DL	<DL	NS	91	<DL	40	5	199	28	9	<DL	36	18	<12	<DL	<27	<DL	9
LANL: as-rec.		<DL	6	<DL	<DL	<DL	250-2500	<DL	50	10	200	75	20	<DL	<DL	55	NS	25	450	<DL	<DL
1362	297																				
WSRC Analysis		NS	14	<DL	<DL	NS	<55	<DL	38	<DL	168	4	5	<DL	7	16	<13	<DL	<29	<DL	<DL
LANL: as-rec.		<DL	10	<DL	<DL	<DL	250-2500	<DL	80	50	270	75	30	<DL	<DL	85	NS	20	830	<DL	<DL
		<DL	10	<DL	<DL	<DL	250-2500	<DL	75	50	260	75	30	<DL	<DL	80	NS	20	720	<DL	<DL
1359	299																				
WSRC Analysis		NS	<33	<DL	<DL	NS	74	<DL	40	8	214	19	3	<DL	<16	33	<8	<DL	<26	<DL	<DL
LANL: as-rec.		<DL	10	<DL	<DL	<DL	250-2500	<DL	45	15	340	150	40	<DL	<DL	35	NS	20	450	<DL	<DL
Milliwatt Archive Sample (Received 1989, processed 1990) Analyses																					
1989 SRS		NS	15	1	<DL	NS	10	<DL	25	<DL	40	<DL	<DL	50	30	<DL	NS	<DL	15	<DL	<DL
1990 LANL:																					
as rec.		<7	<50	<DL	<DL	<DL	91	<DL	28	50	59	15	<DL	<DL	20	<DL	NS	<DL	30	<DL	<DL
		<7	<50	<DL	<DL	<DL	82	<DL	26	50	64	15	<DL	<DL	20	<DL	NS	<DL	30	<DL	<DL
granules		4	52	<DL	<DL	<DL	51	<DL	25	<DL	121	<DL	<DL	<DL	<DL	5	NS	<DL	47	<DL	<DL
		10	78	<DL	<DL	<DL	97	<DL	27	<DL	132	<DL	<DL	<DL	<DL	6	NS	<DL	75	<DL	<DL
1993 LANL:																					
granules		1	<5	<DL	<DL	<DL	5	<DL	<DL	2	16	10	<DL	<DL	<DL	<DL	NS	<DL	35	<DL	20
		<1	65	<DL	<DL	<DL	100	<DL	<DL	20	50	25	10	<DL	<DL	<DL	NS	25	190	<DL	<DL

^a The WSRC SN number indicates the ID number of the shipping container used to transport the fuel to Los Alamos.^b Not submitted for this analysis.^c Below the detection limit.^d Analyses were performed on samples of fuel that had been processed to seasoned granules at LANL.

reintroduced into the glovebox line, reopened, and repackaged into screwtop containers subsequently obtained from WSRC.

On the basis of verbal direction from the program office, work was initiated on 12 January to remove several early-shipment fuel lots from the glovebox line. These included fuel lots 290, 297, and 299 (from shipment 468), which had been sampled only and were still in the original EP60s; lots 273 and 282 (from shipment 467), which had been processed to granules; and remaining granules and powder from LANL fuel lots 262, 263, 264, 265, 266, 268, and 269 (from shipment 466).

In response to an additional request from the program office, and to resolve questions concerning the behavior of fuel with a high silicon content, we identified a high vacuum furnace that could be temporarily modified to duplicate EG&G Mound Applied Technologies' module reduction and monitoring facility (MRMF). A residual gas analyzer system that can be used to analyze gas within the vacuum furnace or to fill gas sampling bottles was also located, and a pressure gage that operates in the relevant range (10^{-3} to 1000 torr) was ordered.

B. Cassini Fueled-Clad Production

1. Fuel Processing

The first delivery of fuel for Cassini flight-quality applications, designated as shipment 469, was received from the Westinghouse Savannah River Company (WSRC) in mid-December.

Because of the anomalous impurity levels detected in the production qualification fuel received in shipments 466, 467, and 468, the program office directed that priority be given to obtaining analyses of flight fuel received in shipment 469. Accordingly, four EP61s from shipment 469 were introduced into the glovebox line and sampled for chemical analysis; the samples were sent to the analytical chemistry facility on 12 January. The LANL lots and corresponding WSRC IDs were lots 302, 303, 307, and 309; SN-1634, -1314, -1300, and -1400, respectively.

At a meeting at LANL on 11 January, WSRC personnel requested, and LANL agreed, that samples from WSRC shipping containers SN-1405, -1401, -1409, -1465, and -1314 (LANL fuel lots 304, 313, 310, 301, and 303), would be submitted for analysis as soon as possible. These containers were selected because WSRC had analyzed samples from each container before shipment. However, because of uncertainties associated with the original WSRC fuel analyses, and because WSRC revised their analytical procedures in mid-January, LANL agreed to again take duplicate samples and arrange for shipment to Savannah River.

By 19 January, the five additional WSRC shipping containers had been introduced into the glovebox line. However, a shipper/receiver difference regarding the contents of container SN-1465 prevented any sampling of this container. In addition to the samples normally required for LANL fuel analyses, duplicate 2.5 gram samples were obtained from each of the four containers that could be sampled. One sample from each container will be returned to WSRC for analysis and one sample will be stored at LANL pending the identification of a third analytical laboratory that can perform impurity analyses on $^{238}\text{PuO}_2$.

2. Administrative Activities

Six fabrication procedure and data form revisions had been forwarded to DOE/NE-53 for review and approval by 19 January.

C. Safety Test Program

There was no activity during January.

D. Research and Development

There was no activity during January.

E. Project Management

All required weekly status reports were delivered on schedule. The program Project Management System (PMS) monthly status report (which included a data disk) was also delivered to FSC (the operator of the program PMS) on schedule.

V. LIGHT-WEIGHT RADIOISOTOPE HEATER UNIT (LWRHU) PROGRAM

A. LWRHU Fuel Powder, Pellet, and Fueled Capsule Specifications

Revisions to the LWRHU fuel powder, pellet, and fueled capsule specifications were completed in early January, and final versions of these documents were distributed for review and approval on 12 January.

B. LWRHU Weld Development

There was no activity during January.

C. LWRHU Production

In early January, the vacuum oven for curing the cement used to seal the LWRHU aeroshell was installed in building PF-4.

Vacuum outgassing of LWRHU primary shipping containers began on 12 January. By 26 January, one quarter of the containers had been outgassed.

LANL fuel lots 272, 274, 275, 278, 283, and 285 were identified by the program office for potential use in the LWRHU program. By 26 January, work had been initiated to process lot 285 fuel into low-fired granules.

Three LWRHU procedure and data form revisions were submitted to DOE/NE-53 for review and approval. Two additional procedures were distributed for internal review.

D. LWRHU Performance/Safety Testing

Fabrication of two urania (^{235}U -depleted) fuel-simulant pellets for LWRHU vibration tests was completed in mid-July. Encapsulation of the urania pellets will occur after the development of "cold" weld process parameters.

Graphite components for the two simulant-fueled LWRHUs required for vibration testing were received from EG&G MAT at the end of November.

VI. 60-WATT HEAT SOURCE PROGRAM

A. Preproduction Activities

1. Equipment and Facilities

In this month, installation of the hot isostatic press (HIP) continued to be delayed by other facility priorities. However, in early January a gas bottle rack for the unit's argon supply was installed on a wall adjacent to the HIP. Although a target date for completing the HIP unit installation was previously established at 3 February, and although the major installation work has been completed, without a reprioritization of facility activities it is unlikely that the installation process will be complete by 1 May.

When the HIP unit has been connected to all building services, a factory representative will be scheduled to start up the unit and install a gas reclaim feature. After the unit has been demonstrated as operational, a facility START review will be requested. The START review must be closed out before any programmatic activities can be performed. In the interim, arrangements have been made with another LANL group for HIPing simulant-fueled clads.

2. Hardware

Personnel from the Heat Source Technology group (NMT-9) collaborated with personnel from Teledyne Brown Engineering (TBE) to outline a plan for the use of simulant pellets and previously received PICS designated for 60-watt development activities.

In mid-January, an inventory of urania pellets available for testing and the dimensions of six plutonia pellets fabricated as part of the Cassini production qualification effort, were provided to TBE.

B. Technical Support

A preliminary safety test program for the 60-watt heat source was received in mid-January. The plan was reviewed and comments were forwarded to TBE.

VII. 1-KW SHIPPING CONTAINER

A. Container Opening Facility

Design work required to install equipment necessary for opening the 1-kW container continued.

B. Container Welding Facility

A glovebox designed to house the 1-kW welding fixture, as well as the weld fixture, power supply, and controller were delivered to LANL. Design work required for installation of the glovebox and welding equipment was initiated by 31 December. LANL personnel also continued to work on a transport/manipulation system for the secondary container used in the 1-kW cask.

VIII. PROGRAMMATIC MEETINGS AND VISITORS

Members of a mentor team selected by DOE/HQ were present on site throughout the month.

Two members of the Heat Source Technology group (NMT-9) and a representative from LANL's Analytical Chemistry group (CST-1) attended a meeting on 5 January at DOE headquarters in Germantown, Maryland, to discuss fuel impurity levels.

On 6 January, two NMT-9 staff members attended a 60-watt heat source meeting at FSC in Germantown, Maryland.

E. C. Brolin toured the Cassini production areas in building PF-4 on 10 January.

On 10 January, two MMES/Y-12 personnel visited LANL to witness the inspection of a shipment of iridium components designated for the Cassini program.

On 11 January, two WSRC personnel visited LANL to discuss resolution of issues associated with differences in WSRC and LANL analytical results.

DATE

FILMED

8/3 /94

END