2048

ORNL-TM-4035

ISOTOPIC POWER FUELS
MONTHLY STATUS REPORT FOR
OCTOBER 1972

Eugene Lamb

RECEIVED BY TIC NOV 17 1972

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

MASTER

OAK RIDGE NATIONAL LABORATORY

OPERATED BY UNION CARBIDE CORPORATION • FOR THE U.S. ATOMIC ENERGY COMMISSION

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Atomic Energy Commission, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

Contract No. W-7405-eng-26

ISOTOPES DEVELOPMENT CENTER

ISOTOPIC POWER FUELS MONTHLY
STATUS REPORT FOR OCTOBER 1972

Eugene Lamb

Isotopes Division

NOVEMBER 1972

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Atomic Energy Commission, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

NOTICE This document contains information of a preliminary nature and was prepared primarily for internal use at the Oak Ridge National Laboratory. It is subject to revision or correction and therefore does not represent a final report.

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37830
operated by
UNION CARBIDE CORPORATION
for the
U.S. ATOMIC ENERGY COMMISSION

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

204

CONTENTS

	<u>Page</u>
CURIUM-244 FUEL DEVELOPMENT	1
Curium Oxide Fuel Development and Properties	1
²⁴⁴ Cm ₂ O ₃ Compatibility Program	1
Vapor Transport of ²⁴⁴ Cm ₂ O ₃	2
APPENDIX, Curium-244 Inventory	2

ISOTOPIC POWER FUELS MONTHLY
STATUS REPORT FOR OCTOBER 1972

Eugene Lamb

CURIUM-244 FUEL DEVELOPMENT

(Division of Space Nuclear Systems Program 04 30 05 03)

Curium Oxide Fuel Development and Properties

$^{244}\text{Cm}_2\text{O}_3$ Compatibility Program

Procurement of materials and other test-system components is continuing. Precious-metal melting stock was obtained for all metals and alloys except those involving iridium, and machining of test components is now under way.

The two ceramic materials selected for inclusion in this program are ThO_2 and ZrO_2 . Rods of ThO_2 were prepared and are being machined into modified inner-capsule test-system components. An order has recently been placed to commercially obtain ZrO_2 inner-capsule components. We expect that procurement of all test-system components, except those involving iridium, will be completed by December 15, 1972.

A short-term compatibility experiment was performed between SiC and CmO_2 . The objective of the test was to determine if SiC could be used in our compatibility matrix as a high-temperature containment form for Cm_2O_3 . Curium dioxide and SiC were weighed out to mole ratios of 1:2, respectively. The powders were mixed by mortar and pestle and then cold-pressed into a pellet. The pellet was loaded into a tungsten crucible, which was put into a high-temperature vacuum furnace. The pellet was observed as temperature of the furnace was slowly increased. A noticeable increase in gas pressure occurred above 1200°C ; at 1560°C , the pellet appeared to be melting. After the pellet was removed from the furnace, it was observed that approximately one-half had melted. The mass fraction lost by the crucible and pellet was 0.345. The melted substance appeared to have a shiny, silvery metallic luster. Part of the unmelted substance was submitted for x-ray diffraction analysis.

Two of the possible reactions which could have occurred are:

The mass fractions lost in reactions (1) and (2) are 0.247 and 0.157, respectively. In the present case more mass was lost than either of the two above reactions could account for. Part of the sample had either volatilized or escaped the crucible. From the increase in gas

pressure and from the melting point of the product, it appears as if a curium silicide product was formed. The x-ray diffraction analysis, which has not been received, should identify the product. This experiment clearly showed that the material SiC should not be used for containment of Cm_2O_3 at high temperatures.

An examination of the $\text{BeO}-^{244}\text{Cm}_2\text{O}_3$ system showed the formation of low-melting eutectics ($\sim 1650^\circ\text{C}$), which was cause for elimination of BeO ceramic from the test matrix.¹

Vapor Transport of $^{244}\text{Cm}_2\text{O}_3$

Mass spectra have been obtained with the mass spectrometer unit. A calibrated gas mixture has been prepared and used to tune the system. We are presently testing the unit with Nd_2O_3 to determine the lowest temperature at which NdO or Nd is first observed. Neodymium oxide is being used as a stand-in for $^{244}\text{Cm}_2\text{O}_3$ because it has been previously studied and probably has a vapor pressure similar to Cm_2O_3 . The NdO and Nd peaks have been observed at 1650°C .

APPENDIX

Curium-244 Inventory

<u>Cumulative Receipts and Usage</u>	<u>Curium-244 (g)</u>	<u>Less Decay 4-30-72</u>
Cumulative Receipts from SRL	2488	
Allocated to 04 Heat Source Program	2148	
Current Use in ORNL Test Program	(379)	
Analytical Samples from Test Program	(1)	
Shipped to Lovelace Foundation	(10)	
Shipped to SRL for Analysis	(2)	
Test Program Residues for Recycle	(83)	
Discarded to ORNL Tank Farm	(6)	
Raw Material Inventory, 04 Heat Source Program	1667	1544
Allocated to 05 Transuranium Program	340	
Transferred to TRU	(109)	
Shipments to Other Sites	(27)	
Transferred to Target Fabrication Group	(5)	
Raw Material Inventory, 05 Transuranium Program	<u>199</u>	<u>184</u>
Total Raw Material Inventory on October 31, 1972	1866	1728

¹Eugene Lamb, *Isotopic Power Fuels Monthly Status Report for August 1972*, ORNL-TM-3982, Oak Ridge National Laboratory.

INTERNAL DISTRIBUTION

1. A. F. Rupp	11. M. E. Ramsey
2. T. A. Butler	12-13. R. A. Robinson
3. W. R. Casto	14. A. H. Snell
4. R. G. Donnelly	15. R. W. Schaich
5. D. E. Ferguson	16. D. B. Trauger
6. Lynda Kern	17. Laboratory Records - RC
7. E. Lamb	18-20. Laboratory Records Department
8. R. E. Leuze	21-23. Central Research Library
9. H. C. McCurdy	24. Document Reference Section
10. R. E. McHenry	25. ORNL Patent Office

EXTERNAL DISTRIBUTION

- 26-27. R. D. Baker, Los Alamos Scientific Laboratory
- 28. W. Brooksbank, G. C. Marshall Space Flight Center, NASA
- 29. R. T. Carpenter, AEC-SNS, Washington, D.C.
- 30. W. T. Cave, Mound Laboratory
- 31. J. Coleman, Nuclear Utilities Services Corporation
- 32. G. R. Crane, Andrews Air Force Base
- 33. D. D. Davis, Dayton Area Office, AEC
- 34. G. P. Dix, AEC-SNS, Washington, D.C.
- 35. H. C. Donnelly, Albuquerque Area Office, AEC
- 36. J. Epstein, Goddard Space Flight Center, NASA
- 37. R. K. Flitcraft, Monsanto Research Corporation
- 38-39. E. E. Fowler, AEC-DAT, Washington, D.C.
- 40. L. Frank, Weiner Associates, Inc.
- 41. D. S. Gabriel, AEC-SNS, Washington, D.C.
- 42. N. Goldenberg, AEC-SNS, Washington, D.C.
- 43. A. Hoffman, TRW Systems
- 44. R. G. Ivanoff, Jet Propulsion Laboratory
- 45. H. Jaffe, AEC-SNS, Washington, D.C.
- 46. J. H. Jarrett, Pacific Northwest Laboratory
- 47. E. Katzen, Ames Research Center
- 48. T. B. Kerr, NASA Headquarters
- 49. F. E. Kruesi, Savannah River Laboratory
- 50. G. Linkous, Isotopes, Inc.
- 51. S. V. Manson, NASA Headquarters
- 52. T. A. Nemzek, AEC-ROO
- 53. G. A. Newby, AEC-SNS, Washington, D.C.
- 54. W. Pardue, Battelle Memorial Institute
- 55. J. A. Powers, AEC-SNS, Washington, D.C.
- 56. T. E. Redding, NASA
- 57. W. Remini, NASA
- 58. C. R. Richmond, AEC-BM, Washington, D.C.
- 59. R. Schafer, General Electric Company
- 60. E. H. Schneider, AEC-SNS, Washington, D.C.
- 61. F. Schulman, AEC-SNS, Washington, D.C.
- 62. M. Shaw, AEC-RDT, Washington, D.C.
- 63. H. C. Slone, Lewis Research Center
- 64. M. D. Starr, Naval Facilities Engineering Command

- 65. N. Stetson, AEC-SROO
- 66. V. Truscello, Jet Propulsion Laboratory
- 67. D. Watrous, Donald W. Douglas Laboratories
- 68. A. Wilber, Ames Research Center
- 69. H. H. Youngblood, Langley Research Center
- 70. Research and Technical Support Division, AEC-ORO
- 71-72. Technical Information Center