SEP 1 2 1962

NUMEC

Nuclear Materials and Equipment Corporation Apollo, Pennsylvania Telephone GRover 2-8411 Cable NUMEC

NUMEC P-44

August 5, 1962

Mr. Morris Goldberg, Director
Contracts Division
New York Operations Office
U. S. Atomic Energy Commission
376 Hudson Street
New York 14, New York

MASTER

Attention: Mr. Seymour Zirin, Contracts Administrator

Subject: CONTRACT AT(30-1)-2389
"DEVELOPMENT OF PLUTONIUM-BEARING FUEL MATERIALS"
MONTHLY PROGRESS LETTER FOR MONTH OF JULY 1962

Gentlemen:

NUMEC herewith transmits the Monthly Progress Letter for July 1962 covering work performed under Contract AT(30-1)-2389.

Major effort during this month was expended on the preparation and characterization of samples scheduled for in-pile screening tests. Also, calculations were completed on the determination of the amounts of boron steel required to reduce General Electric Testing Reactor (GETR) Trail Cable Facility fluxes to the levels desired for the various test specimens. Final capsule assembly will be performed as soon as the boron steel is received and the final capsule design is approved by GETR.

Installation of hot cell and hot metallographic cell alpha box equipment is continuing in order to have these facilities in operation when the irradiated specimens are returned for post-irradiation examination. A second-hand Bausch and Lomb metallograph has been procured and is being modified to permit examination of the irradiated specimens.

Effort is continuing on the preparation and evaluation of UO_2-PuO_2 coprecipitated by relatively long, continuous processing. Three additional preparation runs were completed this month under the conditions set forth in Table I. To evaluate the effect of Pu/U ratio over a broader range, one run was made with UO_2-35 w/o PuO_2.

DISCLAIMER

Table I

Preparation Data for Continuous Coprecipitation of UO_2-PuO_2

Run Identification	297 Pu-18	297 Pu-19	297 Pu-20
End Product	UO_2-0.5 w/o PuO_2	UO_2-35 w/o PuO_2	UO_2-12.5 w/o PuO_2
Feed Composition:			
g U/1	109.4	73.5	87.5
g Pu/1	0.6	36.3	12.5
H^+, molarity	1.0	1.0	1.0
Feed Flow Rate, l/hr	1.2	1.2	1.1
Ammonia Concentration, molarity	14.5	14.5	14.5
Ammonia Flow Rate l/hr	0.3	0.3	0.3
Holdup Time, minutes	32.4	30.0	32
Total Number Throughputs	20	10	16
Drying Temperature, °C	110	180	180

Precipitates produced during the startup and shutdown portions of the runs were segregated from the steady-state material. Further, to allow assessment of the effects of conversion conditions, the steady-state portions of the runs were divided into portions of 180 g each and then converted to mixed oxide under different conditions. To allow product comparison with steady-state materials, the startup and shutdown portions were also converted. Characterization of these samples is expected to be completed next month. Preliminary results indicate that PuO_2-UO_2 powder derived from the ADU-$Pu(OH)_4$ precipitate obtained at the beginning or middle of a run has a significantly lower surface area than powder derived from the precipitate obtained at the end of 8 to 10 hours of continuous operation. The available data also indicate that at least part of this difference may be attributed to minor variations in precipitate treatment prior to reduction.

Steady-state intermediate production run 297 Pu-18 was used to study the contribution of possible reduction of ADU by the ammonia evolved during the initial stages of mixed oxide precursor conversion. Wet filter cakes were dried at a relatively low temperature of 110°C for three days to avoid premature thermal decomposition during the drying step. To determine whether or not self-reduction occurred, large and small charges of the precursor were thermally decomposed in N_2 using a rapid temperature rise from ambient to operating conditions. Separate but similar size charges were thermally decomposed in commercially-purified N_2 using a slow temperature rise from ambient to operating temperature according to conditions summarized in Table II. Weighed samples were calcined in air at 900°C and then reweighed to determine the oxygen to metal ratio.

Table II

Conditions for Thermal Decomposition of UO_2-0.5 w/o PuO_2 Precursor

Charge size (g)	Rate of Temp. Rise (Ambient to Conversion) (°C/min)	Conversion Temperature (°C)	Hold Time * (min)	Oxygen to Metal Ratio
64	12	740	80	2.66
70	2	740	80	2.66
429	12	740	80	2.66
438	2	740	80	2.66

* gas atmosphere - nitrogen (4.5 SCFH)

The value of the oxygen to metal ratio was 2.66 in every case, indicating that the product of the conversion was U_3O_8 and that no significant amount of self-reduction had occurred under the conditions used.

Sintering studies on PuO_2 and mixed oxide UO_2-PuO_2 are also continuing to allow assessment of the effect of the various process variables that enter into the precipitation operation. Standardization of pellet fabrication techniques are being contemplated to allow more meaningful interpretation of the data. Pure PuO_2 pellets that were sintered in vacuum at a high temperature (1800-2000°C) reacted considerably with the pellet supports, tantalum and magnesium. No evaluation of the sinterability at these temperatures could be made because of these reactions. Metallographic examination of the PuO_2, the support metal, and the reaction products is under way.

Effort is also continuing on the development of techniques for producing spherical particles by mechanical agglomeration and sintering, and by plasma torch fusion. Wet agglomeration methods have been attempted during this period. Initial trials indicate that green agglomerates having densities as high as 5.1 g/cc can thereby be obtained; in comparison dry agglomeration yielded green densities in the range 3.5 to 3.8 g/cc. Subsequent sintering of these agglomerates at 1550-1600°C for 2 hours in air resulted in densification to 10.4 g/cc. The primary purpose of the plasma torch fusion studies performed during this month was to obtain complete fusion of mixed oxide particles. While pure PuO_2 or UO_2 can be readily fused to high density, mixed crystal particles are generally only surface polished when run through the torch under similar conditions. Trial runs with a plasma nozzle designed to gain longer residence time within the high temperature torch zone have indicated promise in this direction.

Due to the release of the new uranium price schedule, all previously performed fuel cycle economics analyses have been revised. The results show that no major conclusions need be altered due to the revision in uranium prices.

Very truly yours,

Karl H. Puechl

Karl H. Puechl
Acting Director
Advanced Materials Center

KHP/emk

EXTERNAL DISTRIBUTION

U. S. Atomic Energy Commission, New York Operations Office
- M. Goldberg, Contracts Division
- S. Zirin, Contracts Division
- V. Siuta, Research and Development Division
- H. S. Potter, Patent Group

U. S. Atomic Energy Commission, National Laboratories
- R. Grube - Washington
- J. M. Simmons, Division of Reactor Development - Washington (2)
- G. W. Wensch - Washington
- Reports and Statistics Branch - Washington
- F. Foote, Argonne National Laboratory
- H. Young, Argonne National Laboratory (4)
- E. J. Kreh, Westinghouse-Bettis Atomic Power Laboratory
- E. A. Eschbach, Hanford Atomic Products Operations
- E. A. Evans, Hanford Atomic Products Operations
- J. Musser, Hanford Atomic Products Operations
- I. D. Thomas, Hanford Atomic Products Operations
- O. J. Wick, Hanford Atomic Products Operations
- W. Cashin, Knolls Atomic Power Laboratory
- H. Rizzo, Lawrence Radiation Laboratory
- R. D. Baker, Los Alamos Scientific Laboratory
- L. B. Jones, Mound Laboratory
- Office of Technical Information Extension, ORNL

U. S. Atomic Energy Commission, Contractors
- R. W. Dayton, Battelle Memorial Institute
- R. F. Dickerson, Battelle Memorial Institute
- K. Taylor, Carborundum Company
- C. Cohen, General Electric Company-San Jose
- A. Strasser, Nuclear Development Corporation of America
- R. W. Hartwell, Power Reactor Development Company

NUMEC DISTRIBUTION LIST

R. J. Atkins
E. M. Benson
A. Biancheria
F. M. Cain
C. S. Caldwell
J. D. Clement
J. Eck
G. G. Ehrlich
F. Forscher
H. J. Garber
E. E. Garcia
R. W. Gerrish
J. Goodman
B. O. Grable
O. S. Gray
E. K. Halteman
S. A. Haram
R. M. Horgos
M. D. Houston
R. A. Jaroszeski
L. J. Jones
W. C. Judd
A. Kasberg
H. W. Krake
J. C. Limpert
D. C. McKissick
J. Marley
O. Menis
J. F. Miles
L. P. Pepkowitz
K. H. Puechl
P. Rey
W. J. Ross
J Roth
J. Ruzbacki
A. T. Sabo
J. Scott
Z. M. Shapiro
F. Shipko
J. Stoner
R. S. Swain
J. M. Toman
M. M. Turkanis
B. Vondra
L. Weber
A. M. Weis
M. Zambernard
Library