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**LIGHT WATER REACTOR FUEL RECYCLE PROGRAM
PLUTONIUM NITRATE-TO-OXIDE CONVERSION PROJECT
INITIAL REPORT, APRIL 1976**

Edward D. Erickson

Chemistry Research and Development
PROCESS CHEMISTRY AND ENGINEERING GROUP

Work performed under 189 No. F-AL-10-001
for the
Savannah River Operations Office
U. S. Energy Research and Development Administration

Rockwell International

Atomics International Division
Rocky Flats Plant
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U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
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SUBJECT DESCRIPTORS

Plutonium Processing
Plutonium Nitrates
Plutonium Oxides

ROCKWELL INTERNATIONAL
ATOMICS INTERNATIONAL DIVISION
ROCKY FLATS PLANT
P.O. BOX 464
GOLDEN, COLORADO 80401

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for the
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Abstract. Rocky Flats Plant has received a contract from the Savannah River Operations Office of the U.S. Energy Research and Development Administration (ERDA) to critically analyze and evaluate existing technology for converting plutonium nitrate to plutonium oxide, and to recommend improved flow sheets and equipment for this process. Information will be provided to produce a conceptual design and cost study for a plutonium nitrate conversion facility usable in a Light Water Reactor (LWR) fuel recycle plant. A program plan has been written detailing the technical approach, the expected results, and personnel utilization. During the fourth quarter of FY 1976 the basis for comparison and selection of existing conversion processes will be defined, a literature search will be made for conversion processes, and contacts will be made with ERDA contractors and those in private industry who have knowledge of conversion processes.

INTRODUCTION

During the years since Rocky Flats Plant began operations in 1952, valuable experience has been developed in the operation of precipitation, calcination, hydrofluorination, and fluid bed fluorination processes for converting plutonium nitrate to various compounds such as oxides and fluorides, and in producing pure metal. These processes have been operated on a continuous basis for the purpose of recovering and purifying plutonium for use in weapons production. The experience in equipment design and operation of the basic unit operations is readily adaptable to the development of a suitable production process for converting plutonium nitrate to plutonium oxide in the recycle process for Light Water Reactor (LWR) fuel.

The conversion of plutonium nitrate to plutonium oxide has been accomplished at Rocky Flats Plant by the precipitation of plutonium from nitrate solutions by the addition of hydrogen peroxide, followed by calcination of the peroxide precipitate to an oxide. A proposal was made to the Savannah River Operations Office (SROO) for work to be performed at Rocky Flats Plant to identify the most viable plutonium nitrate-to-oxide conversion process for LWR fuel recycle, to provide engineering criteria for the design of a conversion facility, and to identify the areas in the technology requiring further research and development. Savannah River Laboratory (SRL) serves as coordinator for the technical portion of the ERDA program for LWR fuel recycle.¹

This proposal was accepted and funding has been assigned to Rocky Flats Plant under Cost Category KK-60-01-000, Project Number 189 No. F-AL-10-001.

DISCUSSION

The scope of the Rocky Flats project consists of a critical analysis and evaluation of existing technology for the conversion of plutonium nitrate to plutonium oxide, and the recommendation, as needed or desirable, of improved flow sheets or equipment (or both) for the conversion process.

Large scale conversion of plutonium nitrate to plutonium oxide has been accomplished by precipitation of plutonium as the oxalate or peroxide and subsequent calcination. Laboratory and pilot

¹Program Plan for Research and Development in Support of LWR Fuel Recycle; DPST-75-517, E.I. duPont deNemours & Company, Savannah River Laboratory. December 17, 1975.

scale methods of conversion include direct calcination using screw conveyor calciners and various types of fluid bed calciners. Sol-Gel processes are being investigated as a conversion process based on plutonium precipitation, peptization, and extraction of nitric acid to form the sol. Rocky Flats Plant will perform a literature search and contact the users and researchers working with these processes in order to gather information and data needed to make a critical analysis and evaluation of existing technology. The intent of the project is to provide engineering criteria and a design for a commercial process with a minimum of additional research and development work.

The goals for accomplishing this project are as follows.

FY 1976:

Define the basis for comparison and selection of existing processes for conversion of plutonium nitrate to plutonium oxide.

Complete a literature search of candidate conversion processes.

Contact ERDA contractors having knowledge and experience with the operation of existing candidate conversion processes and inspect their facilities.

FY 1976A:

Begin development of information packages on candidate processes and select a primary conversion process using the selection criteria developed in FY 1976.

Complete the preliminary flow sheets of the candidate conversion processes.

FY 1977:

Assemble data for process engineering criteria, prepare complete process design criteria for the primary process selected in FY 1976A. Complete the information packages on the secondary (candidate) processes. Perform R and D investigations as necessary to develop the process criteria, and as needed by SRL for the fuel recycle facility.

FY 1978:

Identify problems associated with the conversion process and determine solutions. Provide methods to contain and dispose of conversion process wastes. Provide R and D investigations as identified by the engineering design organization. Review the primary and alternative process designs and assure that they effectively interface with upstream and downstream processes and requirements.

CONCLUSIONS

Information will be provided SRL to produce a conceptual design and cost study for a plutonium nitrate conversion facility for use in a LWR fuel recycle plant. This information will be provided by the Plutonium Nitrate-to-Oxide (PNO) Conversion Project Team at the Rocky Flats Plant from the results of an analysis and evaluation of existing technology for converting plutonium nitrate to plutonium oxide.