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TITLE

CPD REQUIREMENTS IN SUPPORT OF MULTI-PRODUCT OPERATION - N-REACTOR

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P. H. Reinker

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R. L. Dickeman, General Manager
 N-Reactor Department

CPD REQUIREMENTS IN SUPPORT OF
MULTI-PRODUCT OPERATION - N-REACTOR

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By Authority of RM Iten
PR-24, 3-29-94

By DK Hanson, 4-11-94

Verified By Q2 Savely 4-15-94

References: (1) Letter, P. H. Reinker from R. L. Dickeman, "Capital Requirements for Chemical Processing of 1.34% and 2.05% Enriched Uranium", dated September 25, 1963.

(2) HW-78864, "A Program for Multi-Product Operation of the N-Reactor", by N-Reactor Department - Research and Engineering Staff, dated September 9, 1963.

The following information, covering CPD capital cost requirements in support of two N-Reactor multi-product operation cases, is submitted in answer to Reference 1. These capital costs are reported in reference to a base production case which could be handled, in total, by Purex once the current program, to modify that plant for dissolution of zirconium-clad fuel and processing of 1.0 percent enrichment level material, is completed. Purex production capability, in the base case, with suitable allowances for PRTR fuel processing, production of 1000 kg/year of non-representative plutonium, shipment of 125 tons/year of N-Reactor material offsite, and plant turnaround time, would amount to about 5900 tons per year of combined E-Metal and

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normal uranium from the older reactors and 810 tons per year of 0.95% U-235 from N-Reactor. This approach is consistent with the intent of Reference 1 and should show, most clearly, the effects of changing N-Reactor conditions upon Chemical Processing Department.

The following tabulation shows our preliminary estimates of additional capital cost requirements within CPD in going from the base case to either the proposed Case II or the alternate Case III, as defined in Reference 2.

CPD ADDITIONAL CAPITAL COSTS, \$

	<u>Case II</u>	<u>Case III</u>
Irradiated Fuel Shipping	160,000	100,000
Dissolving	60,000	60,000
Separations	---	---
Denitration	400,000	1,000,000
UO ₃ Shipping	750,000	270,000
Total	<u>1,370,000</u>	<u>1,430,000</u>

Costs for separating the fuel-target assembly, canistering, and handling of fuel in the N-Reactor basin are not included in the above CPD summary. Of particular significance to NRD is the fact that the canister cross-sectional dimensions will be reduced to suit the nuclear safety requirements of the fuel shipping casks and the dissolvers for the higher enrichment levels of Case II and Case III. The costs for modifying the six N-Reactor casks, currently approved for appropriation and in design status, are included under both Case II and Case III. These changes are required to partition the casks into geometrically-favorable slabs by addition of inserts containing a fixed neutron poison and moderator into the cask wells. In neither case are additional new casks needed to match the dissolving rate at the Purex Plant assuming two round-trip transfers per day. In Case II, one new well-car is needed.

We plan to provide new dissolvers for the Purex Plant capable of supporting an instantaneous plant capacity of 33 tons per day on normal or E-Metal material and capable, with other plant changes, of processing base case N-Reactor fuel at an instantaneous rate of 20 - 25 tons per day. This dissolver system will be capable, with the addition of an insert to reduce the dissolver annulus to a geometrically-favorable configuration, of handling either the 1.34 or the 2.05 enrichment level. However, due to the reduced zirconium-uranium ratio in the co-product fuel material, dissolving rates are increased despite reduced uranium charges in the dissolver. We have estimated instantaneous rates of about 30 tons per day for the 1.34 enrichment level co-product material and about 20 tons per day for the 2.05 material. It can be seen that, the net Purex production time available for E-Metal and normal uranium processing would not be reduced in either case

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below that in the base case. The capital costs shown reflect only the Purex dissolver changes.

Nuclear safety control in Purex will be sufficiently dependable that no capital costs are involved for chemical separations beyond those already planned, even in the 2.05 enrichment level case.

The calciners in the UO_3 Plant are geometrically-favorable for the denitration step involving the 1.34 enrichment level material of Case II. Two modes of UO_3 Plant operation are apparent for this case: equipping the entire UO_3 Plant to run in step with Purex and campaigning normal, E-Metal, and N-Reactor material through the six calciners accordingly; or segregating E-Metal and N-Reactor uranium through two calciners and running normal uranium through the other four. The first alternative would require extensive changeout of UO_3 powder handling and storage facilities in the plant to meet the nuclear safety requirements of the 1.34 enrichment level. The second alternative would require fewer modifications to UO_3 powder equipment but would necessitate storage of substantial quantities of 2 M UNH between the Purex and UO_3 Plants. The latter alternative was selected since a total of 600,000 gallons (1200 tons of uranium equivalent) UNH storage capacity, a bare minimum for this type of operation, already exists at Purex and Redox. Purex campaigns would be limited to about 1300 tons of normal and 650 tons of E-Metal or N-Reactor material by this interplant storage. Should some other program, committing the Redox Plant, materialize, the Redox UNH storage system, total capacity of 200,000 gallons, might become unavailable for lag storage between Purex and UO_3 Plant. Additional capital expenditures of about \$300,000 needed to replace Redox tankage, in this event, are not included in the cost summary. Also, at the higher enrichment level and quantity of enriched material involved in Case II, segregation of the off-gas scrubber acid from the two enriched uranium calciners and provisions to recycle it directly back to the calciners would be justified. The capital cost for these improvements is included.

For the Case III enrichment level, a new calciner of favorable geometry must be provided for N-Reactor uranium processing. In addition, the UNH concentration in the plant must be maintained below 3 M for nuclear safety control. The enriched calciner capacity, when taking these factors into consideration, is reduced to about 2.4 tons per day; one complete calciner system is needed to support Case III production requirements of N-Reactor. In addition, a UNH storage tank of about 150,000 gallons (300 tons of uranium equivalent) is needed to provide interplant lag storage needed, on a two campaign basis through Purex, because of the large difference in processing rates between separation and calcination of N-Reactor material, 20 versus 2.4 tons per day.

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Capital costs for UO_3 shipping systems cover a sufficient number of new bird-cage type containers, designed for geometrically-favorable array in an infinite one-tier arrangement, and rail flatcars for a 25 day round-trip to Paducah assuming the material is shipped as rapidly as it is processed. These costs do not reflect any costs at Paducah which may be needed incidental to handling of the new shipping containers.

Z-Plant button-line and reclamation facilities will have capability to handle either of the two N-Reactor cases in this study without additional capital outlay.

We understand that IPD is also considering increases in enrichment level to the range of 1.3 - 1.5 percent. Mutual benefit to IPD and NRD programs may develop if CPD capital expenditures, particularly in the dissolving, denitration, and UO_3 shipping areas, can be managed to satisfy both requirements. In Case II, particularly, this would be of advantage to NRD, because the expenditures would appear to be needed for either program.

While Reference 1 did not request operating cost data from CPD, we note that your proposal to the Commission, Reference 2, did include this information. Presumably this was taken from earlier CPD cost studies transmitted to NRD; however, substantial error may arise in translating such information from study to study. I would appreciate CPD Financial's being given an opportunity to review the separations cost data with your people before you submit your final report on multi-product operation of N-Reactor to the Commission. If further assistance is needed, please advise.

General Manager
Chemical Processing Department

PH Reinker:ch

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