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FROM: R. G. Post *R.G.P.*

ECONOMIC EVALUATION OF CONTINUOUS UNH CALCINATION

INTRODUCTION

Recovered uranium from the Redox and TBP Plants is concentrated to 100 per cent UNH by boiling off water and nitric acid in 224-U Building, and the UNH solution is then calcined or denitrated to UO_3 powder in 18 batch-operated calcination pots, also in 224-U Building. Plans are proceeding now to add to the above denitration capacity by installing two additional batch calcination pots of larger diameter than the present 18 pots (6 ft. rather than 2.5 ft.). At the time of design scoping of the existing batch calcination facilities several years ago it was recognized that potential savings in direct labor and maintenance costs, and other operational advantages, would undoubtedly result from the development of a continuous calcination process. However, no continuous UNH calcination process existed at that time, and the 18 batch pots were installed modeled after similar-sized pots in use by the Mallinckrodt Chemical Company at St. Louis.

A program to develop a suitable continuous UNH calcination process and equipment is now in progress with the objective of augmenting or replacing the existing batch process in 224-U Building. This document sets forth the savings calculated for complete replacement of the batch pots with a new continuous process. Although subject to later firming-up, for the basis of this savings calculation it is assumed that two parallel continuous calcination units would be installed with a combined nominal design capacity of 15 tons of uranium/day

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average (18.5 tons/day instantaneous rate). However, in the event of a forced shutdown of one line for repairs, it is expected that the other line would be capable of carrying well over half of the above capacity in order to minimize lost production.

SUMMARY

The production costs and estimated installation costs presented in the table below are for an average production rate of 15 tons U per day. The costs are for one year of operation.

<u>Item</u>	<u>Present Process</u>	<u>Continuous Process</u>	<u>Difference</u>
Direct Labor	\$258,000.	\$124,000.	\$134,000.
Supervision	-----	-----	48,000.
Electric Power	25,000.	11,000.	14,000.
Maintenance	65,000.	33,000.	32,000.
Sub-total			\$228,000.
IME	651,000.	469,000.	183,000.
Total - Annual savings for continuous calcination			\$411,000.

Since the cost of installing a continuous calciner is estimated to be approximately \$350,000. (including project overhead and contingencies) such an installation would be paid off in approximately 1.5 years based on the \$228,000. annual direct saving, or in approximately 0.85 year based on the total \$412,000. annual saving which includes IME costs.

DISCUSSION

Operating Costs

The data for the cost of operating the present equipment and the reductions in manpower which may be realized by using continuous operation, were obtained by consultation with members of the U facility Manufacturing Department staff.

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Direct Labor

The present manpower requirements for the 224-U Building depend upon production rates as shown in the following table:

<u>Present Process</u>						
<u>Production Rate</u>	<u>On each of 4 shifts</u>			<u>On days</u>		
<u>Tons U/day, instant.</u>	<u>Chief Op.</u>	<u>Process Op.</u>	<u>Train.</u>	<u>Chief Op.</u>	<u>Proc. Op.</u>	<u>Train.</u>
8.4 to 11.8	1	2	6	0	1	3
11.8 to 15.2	1	2	7	0	1	3
15.2 to 18.6	1	2	8	0	1	3
15 tons average:	1	2	8	0	1	3
Total	4	8	32	0	1	3
Total Chief Operators - - 4 - - \$49.32 per week						
Total Process Operators - 9 - - 972.27						
Total Trainees - - 35 - - 3538.85						

\$4960.44 per week or \$257,942.88 per year

The distribution of manpower for a continuous calciner will provide one operator and one trainee for the graphic panel, and one operator and two trainees for the calciner and drum loading room. This results in the following manpower requirements:

<u>Continuous Process</u>						
<u>Production Rate</u>	<u>On each of 4 shifts</u>			<u>On days</u>		
	<u>Chief Op.</u>	<u>Process Op.</u>	<u>Train.</u>	<u>Chief Op.</u>	<u>Proc. Op.</u>	<u>Train.</u>
15 tons/day average	0	2	3	0	1	2
Total Chief Operators	0	\$ 0.00				
Total Process Operators	9	927.27				
Total Trainees	14	1415.54				

Total Cost (incl. shift differential and isolation pay) \$2,387.81 per week

\$124,166.12 per year

Savings- \$133,776.76 per year

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Since there is such a large reduction in the direct labor, it is felt that a shift supervisor can be released. This is a savings of \$12,000. per year per shift or a total of \$48,000. per year.

Electric Power

Building 224-U is equipped with peak load watt meters and the present load is about 1000 KW of which 750 KW can be charged to the pot room. This load will increase with production rates and for 15 tons per day, the load will be 1125 KW. Two continuous calciners should operate without exceeding 750 KW. This results in a decrease of 375 KW at \$22. per KW year for a total saving of \$8,250. per year.

Indirect Manufacturing Expense

The IME for a continuous calciner was estimated for each item and presented in the following table. Some items were calculated separately and these are omitted from the IME part of this table. Those items for which no saving is predicted are assumed to be independent of method of operation and the number of personnel charged to direct labor. Analytical charges are based on predicted sampling schedules. All other items are taken to be directly proportional to direct labor.

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UO₃ PRODUCTION COSTS

Rate: 15 tons of uranium per day

Costs figures: Dollars per year

<u>Item</u>	<u>*Present Process</u>	<u>Continuous Process</u>	<u>Save</u>
Material direct - - - - -	0.00	0.00	
Labor direct - - - - -	257,942.88	124,166.12	133,776.76
Supervision - - - - -			48,000.00
Electrical - - - - -	24,750.00	16,500.00	8,250.00
Maintenance - - - - -	65,124.00	33,000.00	32,000.00
I.M.E.(not already accounted for)			
Engineers, Clerical & Other - - -	5,516.00	1,758.00	1,758.00
Job training - - - - -	6,564.00	3,282.00	3,282.00
Other salaries - - - - -	4,200.00	2,100.00	2,100.00
Shop tools & supplies - - - - -	46,440.00	23,220.00	23,220.00
Office supplies - - - - -	192.00	192.00	0.00
Continuity of service - - - - -	28,240.00	14,120.00	14,120.00
Other operating expenses - - - -	204,300.00	102,150.00	102,150.00
Rent, light and heat - - - - -	12,000.00	12,000.00	0.00
Water, steam, air and sewage - - -	206,400.00	206,400.00	0.00
Radiation monitoring - - - - -	38,400.00	38,400.00	0.00
Plant Eng. Service - - - - -	15,800.00	15,800.00	0.00
Process Unit - Process - - - - -	3,700.00	3,700.00	0.00
" " - Anal. - - - - -	12,000.00**	8,000.00	4,000.00
Operations Unit General - - - - -	19,200.00	9,600.00	9,600.00
Manufacturing General - - - - -	11,100.00	5,550.00	5,550.00
Auto Equip. Rental - - - - -	1,900.00	1,900.00	0.00
Freight, H.W. Railroad - - - - -	3,800.00	3,800.00	0.00
Area Bus Service - - - - -	12,600.00	6,300.00	6,300.00
Area Road Maint. - - - - -	1,080.00	540.00	540.00
Laundry - - - - -	18,000.00	9,000.00	9,000.00
Other Services - - - - -	2,000.00	1,000.00	1,000.00
Totals			
Direct Costs - - - - -	347,817.00	173,666.00	174,027.00
Supervision - - - - -	- - - ***	- - - ***	48,000.00
IME - - - - -	651,432.00	468,812.00	182,620.00
			\$ 404,647.00

* Cost figures from November and December operation.

** Corrected to revised sampling schedule.

*** Figures not available.

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Cost of Installation of Continuous Calciner

Capacity Basis: 400 tons per month

15 tons per day, sustained

18.5 tons per day, maximum instantaneous rate

<u>Item</u>	<u>Cost</u>
2 Calcining units	\$75,000.
Piping	20,000.
Instrumentation	20,000.
Installation and building changes	<u>50,000.</u>
Sub-total - - - - -	\$ 165,000.
Contingency (25%)	<u>41,000.</u>
Sub-total - - - - -	\$ 206,000.
Contract Plus Fixed Fee	<u>103,000.</u>
Sub-total - - - - -	\$ 309,000.
Design charges	<u>31,000.</u>
Total Cost - - - - -	\$ 340,000.

The advantages of a continuous calciner may be considerably greater than those arising from the reduction in operating costs. These advantages include:

1. Releasing additional manpower for program "X". This amounts to 25 operators and 4 shift supervisors.
2. Improvement in product quality. This can be realized by better control and greater uniformity.
3. Hydration of UO_3 could be readily introduced.
4. Reduction of dust hazard. This would result from a sealed system and the elimination of the pneumatic unloading system.

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5. Greater assurance against "crash" shutdowns which would stop Purex and Redox plants. This arises from a large margin of extra capacity provided by two continuous units.
6. Material of higher radiation level can be processed since contact operation will not be required except for the drum loading which can be shielded.
7. It is expected that the continuous units, if properly designed, may be insensitive to the foaming which occurs in the batch pots, caused by traces of tributyl and dibutyl phosphates. Hence less interference with calcination capacity would be expected during periods when traces of TBP and/or DBP are inadvertently present in the UNH feed to the calcination step - and it may even develop that steam stripping of RCU would no longer be required.

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