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HW-33282 RD
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RICHLAND, WASHINGTON HANFORD ATOM^R PRODUCTS OPERATION

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Rough Draft

PRELIMINARY BPX FLOWSHEET

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INTRODUCTION

Current H.A.P.O. planning has scheduled significant increases in low-NGS irradiated fuel production for the near future. This action, coupled with the imminent activation of the K-Reactor areas, will result in a uranium production rate which exceeds the anticipated capacities of the Purex, Redox and T Plant separations facilities. Additional separations capacity is scheduled to be provided by reactivating B Plant.

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However, a number of other separations processing schemes - which will provide additional capacity - are being evaluated for their economic and operating attractiveness as compared to combined BiPO_4 -TBP plant operation. The BPX process described in this memorandum is one such process. It is a modification of the TBX Scheme III of HW-32691. BPX was first proposed by the Manufacturing Department in HW-32908.

A study is currently being made by the Design Section to determine the capital investment and engineering effort required for BPX. Although the attached flowsheet (previously transmitted informally to the Design Section) has not been demonstrated in pilot-plant studies, most of the operating conditions depicted are quite similar to demonstrated Purex conditions and the flowsheet is considered sufficiently "firm" for these preliminary design studies.

SUMMARY

Basically, the BPX process employs a Purex-type flowsheet utilizing a uranium-plutonium partition cycle followed by two uranium cycles and two plutonium cycles. The dissolvers, partition cycle, two plutonium cycles, plutonium load-out, and a uranium concentrator plus waste treatment and solvent recovery for the afore-mentioned operations would be located either in 221-B or in a remotely-maintained extension to 221-B. The partially decontaminated and concentrated uranium would then be shipped to 221-U for two additional cycles of uranium decontamination. The final uranium concentrate from the solvent-extraction battery would be processed through a silica gel bed to insure adequate decontamination of the uranium.

Equipment now available in 221-B, 221-U, and 224-U would be used to the fullest extent to minimize capital expenditures and reduce construction time. A comparative economic appraisal of the BPX process has been documented in HW-33394-RD.

DISCUSSION

The pertinent flowsheet details of the BPX process are shown on the attached figures. The following discussion elaborates on the novel features of the flowsheet and also lists process items of general technical interest.

Dissolution

Dissolution facilities for a 150 tons of uranium per month processing rate are already provided in 221-B. Increasing dissolution capacity to 1,00 tons U/month (equivalent to both B and T Plants operating on BiPO_4 flowsheets) would require the installation of additional dissolvers. These could be provided either by installing new dissolvers in the 221-B canyon or in an extension (221-BX) to the building.

Partition Cycle

The partition cycle specified is identical to Purex-type partition cycles. It employs four pulse columns (1A, 1BS, 1BX, and 1C).

Plutonium Cycles

Likewise, the plutonium cycles are analogous but not identical to the Purex plutonium cycles. Two plutonium cycles are used in order to provide a total of three decontamination cycles for the plutonium product.

The final plutonium cycle is of the reflux type, producing a final product containing 55 grams per liter of plutonium. In this manner, the need for installing plutonium concentrators is eliminated. It is anticipated that the plutonium concentrate would be sampled and "loaded-out" into PR cans by equipment very similar to that designed for the Purex Plant.

Uranium Cycles

The partially concentrated uranium product from 221-B and 221-BX would be further concentrated and then subjected to two uranium decontamination cycles in the 221-U Building. Although the uranium is thus processed through a total of three decontamination cycles, it is believed that the backcycle techniques to be employed in 221-U, combined with the short scrub sections on these columns, will make uranium decontamination marginal. A silica gel treatment of the final uranium concentrate is provided to give the additional Zr-Nb decontamination deemed necessary to produce a product containing a low radioactivity level.

Uranium Concentration

A total of four uranium concentrators is shown in the attached flowsheet. All of these units should be provided with stripping towers to remove organic material from the feed stream. The first concentrator, 1UC, should be located in the 221-B extension. In this location it will permit the 1CU to be concentrated for rework through the partition cycle, whenever necessary, and will also reduce the volume of the stream to be pumped cross-country to the 221-U Building.

The second uranium concentrator (in 221-U) will complete concentration of the 1CU and also provide the necessary concentration of the backcycled RDW. Sodium nitrite is added to the concentrator for ruthenium control.

The third uranium concentrator (in 221-U) provides intercycle steam stripping and the necessary concentration between the RC and RD Columns.

The fourth uranium concentrator (in 224-U) will strip and concentrate the final uranium stream. After this operation, the concentrate will be processed through a silica gel bed for additional Zr-Nb decontamination.

Waste Treatment

The separation of the BPX process into two physical locations and semi-independent plants requires the use of two waste treatment systems (one at each location). Because of this fact, the use of acid recovery-type waste treatment facilities is not considered attractive. In lieu of acid recovery facilities, backcycling techniques are used to minimize the plant waste volumes and decrease chemical consumption.

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In the 221-B (and extension) Buildings, the 2AW and 3AW streams are backcycled. The remaining solvent-extraction battery waste (LAW) is neutralized, concentrated and discharged to underground storage. This waste will boil during storage. The coating waste should be provided with alternate routings to either underground storage or cribs.

In the 221-U Building, the RDW stream is partially backcycled to provide acid for the RAIS and RAF streams. The remainder of the RDW plus the RAW waste streams is neutralized. The activity level of this composite neutralized stream is low enough to be satisfactory for in-line waste scavenging. The details of this step are shown on the attached figures.

Solvent Recovery

The physical separation of the two portions of the BPX process also requires independent solvent treatment facilities. A total of three solvent recovery systems are shown. The 221-B system consists of a Purex "O"-type column and a centrifuge for the organic effluent. This system will treat the solvent for the partition and two plutonium cycles. Two "RO"-type contactors will be used in 221-U to handle the solvent requirements; one system for each of the two uranium cycles. This mode of operation will result in minimum cross-contamination between cycles and should result in maximum uranium decontamination. All three cycles use 0.25 M sodium carbonate as a scrubbing agent for the solvent.

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Figure 1
PRELIMINARY BPX CHEMICAL FLOWSHEET
FEED PREPARATION
CHEMICAL DEVELOPMENT UNIT
SEPARATIONS TECHNOLOGY SUB-SECTION
TECHNICAL SECTION, ENGINEERING DEPARTMENT
HAMFORD ATOMIC PRODUCTS OPERATION
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Figure 4
PRELIMINARY BPX CHEMICAL FLOWSHEET
TAIL-END TREATMENT AND WASTE SCAVENGING

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NOTES:

- (1) All flows are relative to IAF flow equals 100 (747 gallons per ton of U).
- (2) Radioactivity estimates are based on one ton equivalent of uranium irradiated to 200 MW/T at 5.6 MW/T and cooled 90 days.

CHEMICAL DEVELOPMENT UNIT
SEPARATIONS TECHNOLOGY SUB-SECTION
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