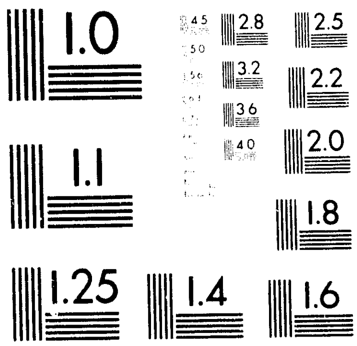
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by

L. D. Gustafson
Process Supervisor
Purex Processing Operation
CHEMICAL PROCESSING DEPARTMENT

February 5, 1957

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1.01 Introduction

This document is a supplementary operating guide to document HW-44064, "Process Specifications for Critical Mass Control - Purex Plant". It is primarily intended that this document illustrate the actual operational means of conforming to the limits of critical mass control as presented in HW-44064.

For the sake of brevity, frequent reference is made to specific paragraphs from document HW-44064. It is therefore necessary to refer to document HW-44064 while reading this guide.

1.02 Methods of Conforming to HW-44064 Document on Critical Mass Control

1.02.01 Reference Paragraphs 1.03.01 and 1.03.02 of HW-44064

Prior to the 1B column, control is essentially dependent upon HAF Pu concentration per ton of uranium. This is checked by sample analysis on each batch as the HAF is prepared in the TK-E5 and TK-E6 vessels. Recycle or rework plutonium is added to the TK-E3 and TK-E6 vessels on a semiroutine basis. Control of this recycle or rework material is well defined in standard operating procedures with supervisory approval required for transfer. Transfers referred to here are the E-3-A to TK-E3 and the TK-L11 to TK-E6.

The TK-J5 vessel contents are occasionally jetted to the TK-J1 vessel. This transfer is made infrequently and must be controlled through knowledge of TK-J1 and TK-J5 contents. Under normal conditions the TK-J5 plutonium holdup is less than 500 grams, and at 600 to 800 MWD processing levels the TK-J1 vessel may receive a minimum of 700 grams per ton of uranium before exceeding the 1500 grams per ton control limit. Holdup in TK-J1 is normally greater than three tons of uranium.

The TK-J1 vessel may also receive condensate from L Package and 2A column pulse leakage. Excessive plutonium loss to these two streams would be detectable in L Cell operation or routine TK-J1 sample analysis.

1.02.02 1BX Column - Reference Paragraph 1.03.03 of HW-44064

To prevent exceeding control limits in the 1BX column, maximum Pu concentration must be limited to less than 7 g./l. and stagnant stripping prevented. The following safeguards are present:

(1) Batchwise maximum Fe^{++} concentration in 1BX limited to .035 M. (Sampled each batch)

[redacted]

(2) Stagnant stripping would be indicated by:

(a) Drop or loss of 1BX flow (rotometer)
(b) Drop or loss of 1BP flow to J-5 (valve loading pressure, 1BXP rotometer)
(c) 2AF Pu analysis (routinely sampled each shift)
(d) 2BP Pu analysis (routinely sampled each shift)
(e) Lowering of plutonium concentrator production.

Precipitation is most likely when the column is shut down. To be of concern the precipitation would have to be preceded by an undetected concentration buildup. This would be indicated by unusual operation or sample analysis.

1.02.03 1BS Column - Reference Paragraph 1.03.04 of HW-44064

The two possibilities for exceeding critical mass specifications in the 1B Scrub Column are exceeding a concentration of 11 g./l. of plutonium and precipitation.

Concentration is dependent upon 1BXP concentration. The controls, as outlined in paragraph 1.02.02, show the means of limiting 1BXP concentration.

Precipitation as mentioned in HW-44064 would be noted by operating difficulties such as flooding or loss of flow.

1.02.04 2AF Tank - Reference Paragraph 1.03.05 of HW-44064

Exceeding control limits in the 2AF Tank TK-J5 is unlikely for the following reasons:

(1) Normal process flow and two agitators keep the flow pattern uniform. Failure of both agitators is unlikely, and as a more positive safeguard these agitators are on the emergency power circuit.

(2) Increase in concentration is checked by TK-J5 sample analysis, 2BP (L-3) sample analysis, and control of 1BXP concentration as outlined in preceding paragraph 1.02.02.

Should agitators fail and concentration become high, the 2AF tank contents may be jetted to the 1AF Tank TK-J1 where uranium content would alleviate the criticality problem.

1.02.05 Reference Paragraph 1.03.06 of HW-44064

The L Cell equipment pieces, including the 2A and 2B columns, are constructed to critically safe dimensions except for the water jacket on the TK-L6 (Product Receiver). By adhering to well defined L Cell personnel entry regulations, this basic design of the cell equipment provides critical mass control.

1.02.06 <u>Reference Paragraph 1.03.07 of HW-44064</u>

Presence of plutonium in the TK-L6 Product Receiver jacket may be prevented by constant water pressure to the jacket. Presence of water flow, due to elevation of cooling water discharge, provides a positive pressure, preventing flow from vessel into the jacket. Constant water flow is provided by an open by-pass valve in the TK-L6 jacket water line. Loss of water flow would also be noted by temperature increase in TK-L6.

1.02.07 <u>L Cell Floor and Sump - Reference Paragraph 1.03.08 of HW-44064</u>

During all normal operation the sump volume is maintained at a minimum, keeping liquid in the "critically safe" sump. Sump is sampled routinely and emptied as required. As a double check on the sump weight factor, a conductivity probe has been installed with warning light to detect presence of liquid before sump is overflowed to floor.

Should large volumes be collected in the sump, the plutonium cycle operation would reveal the extent of the loss of plutonium. Plant shutdown would stop this excessive collection and, as mentioned in HW-44064, overflow of uniform plutonium solution from approximately five days of production at maximum rates would be necessary to exceed minimum critical mass. The material from L Cell floor and sump can be transferred directly to the TK-L11 vessel which is critically safe by construction. Material can then be routed to TK-E6 (HAF Makeup) and mixed with high concentration uranium solution.

1.02.08 <u>PR Room Vessels - Reference Paragraph 1.03.09 of HW-44064</u>

All work in the PR room is controlled by regulations conforming to the SPECIFICATIONS paragraph - 1.07.01 of HW-44064. Maintenance work is performed through glove ports, and no personnel entry other than the arms through glove ports is necessary.

1.02.09 <u>PR Room Sumps - Reference Paragraph 1.03.10 of HW-44064</u>

Critical mass control of these sumps is considered satisfactory due to construction and volume limits. Routine operation practices keep the normal sump volumes low, and material in sumps is sampled as necessary. To reach critical mass control limits, a vessel would have to be filled with process solution, emptied to the sump, and then refilled at least once more with process solution and emptied to the sump. Loss of this much plutonium would be readily detected by process plutonium accountability. Sumps may be transferred to the "critically safe" Tank TK-L11.

[redacted]

1.02.10 FR Cans - Reference Paragraph 1.03.11 of HW-44064

Loaded cans are handled in jackets at all times except during "loadout" operation. Procedures and posted instructions regulate handling of PR Cans. Cans are not stacked at Purex, and less than 60 cans are normally available for use in the building.

1.02.11 Recycle Cans and E-3-A Recycle Vessel - Reference Paragraph 1.03.12 of HW-44064

Recycle Can handling procedures and controls correspond to those used for the PR Cans.

The use of a standard form requiring Supervisor's approval for batch makeup in the E-3-A vessel provides satisfactory control. This procedure also requires Supervisor's approval for transfer to TK-E3 and confirmation of plutonium analysis.

1.02.12 Reference Paragraph 1.03.13 of HW-44064

Control of potential criticality problems caused by Purex-Plant streams are handled by many methods. In this paragraph only the prime sources of control are mentioned. The combined experiences of the Operating and Process groups provides many safeguards which would be impossible to cover here.

The S-LA sump transfer is controlled by Supervisor's approval and is routinely sampled. Unusual collections of high plutonium content are now routed to TK-L11, a "critically safe" vessel, instead of TK-F18.

Unusual collection in the Acid Accumulator, TK-F10, of high plutonium content streams from the L Cell vessels is subject to the following safeguards:

(1) Routine analysis of TK-F10 plutonium content each eight-hour shift.

(2) Large immediate losses of plutonium from L Cell would be noted by operational indications such as unusual weight factor and differential pressure instrument readings, dropsin specific gravity instrument readings, drop in TK-L6 collection rate, and steam flow changes to concentrator.

(3) Positive pressure is maintained on the steam bundles of the Plutonium Concentrator E-L4 and the Plutonium Stripper T-L3 by a continuous air supply system.

Control of plutonium content to less than 1200 grams in F Cell vessels is largely dependent upon routine sample analysis of all active vessels. Sampling schedules and control limits are rigidly maintained and closely followed by the Processing Supervisor, Process Engineer, and Dispatcher. Control limits are posted in the Dispatcher's office for ready reference.

Since the problem is greatest in the Acid Concentrators, the control limits are focused on prevention of plutonium buildup in these locations. TK-F7 and TK-F10 are the Concentrator feed tanks. At the assigned control limits to TK-F7 and TK-F10 at 1.44 C.F. the E-F11 and E-F6 Concentrators would have to be operated a minimum of two and four days respectively, without overflow, before the 1200 gram limit would be reached.

Detection of overflow from E-F6 is not as easily checked as E-F11. Among the overflow checkpoints are:

(1) TK-F7 specific gravity.

(2) TK-F7 temperature.

(3) E-F6 Beckmann - A rise may be noted when overflow stops due to retention of fission products.

(4) E-F6 weight factor.

None of these checkpoints are as positive as the direct overflow indication for E-F11; however, a combination of two or more of the above checkpoints should positively indicate loss of overflow from E-F6.

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