SRO-344-4

REPROCESSING OF NPR FUEL
AT
NUCLEAR FUEL SERVICES, INC.
WEST VALLEY FACILITY

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Prepared by:
Fuels Reprocessing Branch
U. S. Atomic Energy Commission
Savannah River Operations Office

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ADDITIONAL REPORTS

While this report deals primarily with operations at the NFS facility during NPR fuel reprocessing, the following reports and documents would be useful.

NFS Safety Analysis

Available from:

Public Documents Room
U. S. Atomic Energy Commission
Washington, D. C.

Reprocessing of Dresden Reactor Fuel - Number SRO-123

Reprocessing of Yankee Reactor Fuel - Number SRO-124

NFS Quarterly Reports to Regulatory - Numbers SRO-125-1 through
SRO-125-10

Numbers SRO-344-1 through
SRO-344-3

Available from:

Division of Technical Information Extension
U. S. Atomic Energy Commission
Oak Ridge, Tennessee

INTRODUCTION

The first reprocessing operation on spent reactor fuel at Nuclear Fuel Services, Inc., (NFS) began April 19, 1966, the day that NFS was granted a provisional operating license. Fuel from the New Production Reactor (NPR) located near Richland, Washington, supplied under baseload Contract AT(38-1)-344, was transferred from the fuel storage pool into the process mechanical cell. Shearing of this fuel began on April 20 and dissolution of the first batch was completed on April 21, 1966. Hot feed (HAF) to the partition cycle began on April 25 and the first tank-trailer of recovered uranium product was delivered to the AEC at West Valley on May 2, 1966. Reprocessing of the 95 tonnes of uranium in Lots AEC-I, II, and III was completed on November 24, 1966.

Preliminary to "hot" startup in April, NFS performed equipment and process flowsheet checks on unirradiated or simulated reactor fuels. Shearing and/or sawing of Dresden (SS and Zr clad), Yankee, NPR, and Indian Point fuel was done to check equipment and operating procedures and to provide actual experience for personnel. Modification and replacement of some Process Mechanical Cell equipment was necessary after initial checkout.

Throughout the processing period covered in this report, the AEC-West Valley staff consisted of 10 personnel. This report summarizes the first five months of reprocessing experience and includes specific data relating to processing operations, analytical laboratory operations, and nuclear materials accountability.

This report is divided into the following four sections.

Section I - Run Plan

This was prepared by NFS and sets forth the parameters by which the various mechanical and chemical operations would be run. Included are sampling schedules and stream composition tables. The run plan is prepared prior to the commencement of processing, with revisions based on processing experience.

Section II - Process Summary

This was prepared by the AEC staff maintaining surveillance over NFS operations in connection with rights granted under the contract. Included are tables summarizing operations for Fuel Shearing and Dissolution. This data was compiled from NFS records and charts.

Section III - Analytical Comparisons

AEC-West Valley analytical surveillance and methods of analysis are discussed. AEC and NFS Quality Control data are compared. Input and product SNM solution concentrations are tabulated and compared. The uranium product concentration measured at the receiving site by the National Lead Co. at Fernald, Ohio, has been included.

Introduction (Cont'd)

Readers interested in the overall NFS accountability measurement system should refer to Reports No. SRO-123 and SRO-124 referenced on the preceding page.

Section IV - Nuclear Material Management Reports

Reports for Lots AEC-I, II, and III are included in this report. These reports are prepared by NFS for each process lot or campaign. It provides the customer with an SNM Material Balance covering the period during which their fuel was reprocessed.

SECTION I

NPR RUN PLAN

Prepared by M. E. Weech
NUCLEAR FUEL SERVICES, INC.

April 14, 1966

The proposed flowsheets and operating conditions for the hot run No. 1 of NPR fuel to be started during April, 1966 are attached.

A summary of the run is as follows:

1. Two consecutive runs of hot NPR fuel will be made. The first lot will contain approximately 24.2 tonnes uranium and 2150 grams plutonium. A plant cleanout is to be performed before the second lot of NPR fuel containing approximately 24.2 tonnes uranium and 2150 grams plutonium will be processed. The total operating time including turn around is estimated at 64 days from initial startup.
2. Column raffinates and other wastes below throw-away limits are to be concentrated in the waste evaporators. One batch of H. L. waste and two batches of L. L. waste concentrates per lot of fuel processed will be sent to permanent waste storage. It may be desirable to recycle these concentrates for recovery prior to final disposal.
3. Raffinates and other wastes above throw-away limits are to be sent to rework and recycled for recovery near the end of each run if practical.
4. A table listing the recommended maximum permissible throw-away limits is included in the run plan. Adherence to the attached run plan should result in recoveries of 99.7% U and 99.5% Pu of that charged to the system.
5. A mercurous-mercuric nitrate scrub solution will be used in the dissolver off-gas scrubber to absorb the very small amounts of radio-iodine.

6. No criticality problems exist with the uranium downstream of the dissolvers. Plutonium criticality will be a problem only by a gross accident.

Specific points that may be in question and additional information are discussed in the following sections:

1. General

Instrument settings and rates not specified in this run plan should be obtained from the SOP's.

The instrument controller and pump stroke settings given in this run plan are approximate. The settings specified are to be throttled as necessary to obtain the flow rate specified. In all cases where only one stream is being withdrawn from a vessel, the actual vessel depletion rate in liters per hour is the controlling factor. Approximate instrument depletion rates for these vessels are shown as an aide to quickly establish that rate required. For vessels where multiple streams are being withdrawn, the calibration of the applicable FRC or pump stroke is to be used for setting the rate specified.

Some minor changes of pulser settings, particularly for 4C-7 and 4C-8 may be required to reduce column losses.

The calibration tables for the XCR vessels recalibrated during January are not completed. Temporary calibration curves based upon those recalibrations were given to the Production Department during the last run.

All charts, data sheets, and logs for these two lot runs must be saved for future reference and segregated from other run data.

Accountability of all waste solutions and products must be performed as outlined in SOP 15-10.

It may be necessary to make small changes in some of the stream rates should decontamination factors of processing steps not be adequate to meet product specifications.

The U and Pu losses in raffinates and other streams as shown in the run plan are typical. The maximum permissible throw-away losses are summarized in a table for convenience.

To: W. H. Lewis

April 14, 1966

Page 3

Hot NPR Run No. 1

The entire process must be operating at chemical equilibrium and required temperatures before feed is started to 4C-1.

The inter-cycle feed adjustment tanks should be operated at as low a volume as practical to provide surge in the event of difficulties downstream.

2. Fuel Cutting in PMC

The first run will be AEC-NPR Lot 2, and the second run will be AEC-NPR Lot 1 as identified in N. Stetson's letter to you dated March 10, 1966.

The NPR fuel must be cut into 5/8-inch pieces to reduce the dissolution time and to provide the shortest element end piece practical. The first dissolver batches should be cut into six baskets with liners until an accurate 5/8-inch cut fuel packing density has been determined. If the cut fuel packing density is more than 10.48 twenty-four inch cut elements/ft³ (194 KG U/ft³) the fuel can be cut into five baskets with liners without fear of overfilling the baskets.

The maximum amount of cut fuel that is compatible with dissolver operation should be cut for each dissolver charge. The maximum dissolver charge is listed below in various units:

MAXIMUM DISSOLVER FUEL CHARGE

<u>KG U</u>	<u>24" Elements Only</u>		<u>18" Elements Only</u>		<u>Inches of Cut Fuel as Measured by Feed Position Indicator - Either 18" or 24" Elements or a Mixture of the Two Sizes</u>
	<u>Number of Elements</u>	<u>Number of Full Shear Magazines</u>	<u>Number of Elements</u>	<u>Number of Full Shear Magazines</u>	
1689	88	11	117	11.7	2112

The maximum fuel charge is to be measured by the shear feed position indicator and must not exceed a total of 2112 inches cut fuel for each dissolver charge as measured by the indicator.

The liners must not be capped. If they are capped it is probable the dissolver reflux line will be flooded with the dissolvent with a possible

dissolver pressurization resulting. Should liner caps be required the maximum fuel charge must be reduced.

The last dissolution of each lot must be planned to provide complete fuel submergence in the dissolvent. Consultation with Technical Services is recommended when the approximate size of this last dissolver charge is first known.

3. Dissolution

The following alarms and controllers must be set as shown before fuel is charged to the dissolvers.

<u>Alarm or Instrument No.</u>	<u>For</u>	<u>To Be Set At</u>
3PCH-3	3C-2 Dissolver	5" W. C. Vacuum
3PCH-6	3C-1 "	5" " "
3PAH-1	3C-2 "	7" " "
3PAH-6	3C-1 "	7" " "
3LCL-2	3C-2 "	54% 3LR-1 Chart
3LCL-4	3C-1 "	54% 3LR-3 Chart

The cut fuel will not require cooling in the dissolver prior to dissolvent addition. The first dissolutions are to be done without air sparge. Air sparge will be reconsidered after data on the first dissolution are in.

Undiluted recovered acid is to be used for dissolvent. SOP 3-4 contains a nomograph which can be used to determine the quantity of dissolvent and hull rinse. The hull rinse volume is ratioed with the fuel charge on the nomograph such that when combined with the dissolver product in 3D-1 no or very little adjustment in 3D-1 will be required.

The first NPR fuel charge should be dissolved at boiling for at least 32 hours. The following special procedure is suggested to determine the quality of the first hull rinse and dissolution:

1. Dissolve the first fuel batch at least 32 hours.
2. Jet the dissolver product to 3D-1 and perform the hull rinse with the volume as determined on SOP 3-4 nomograph.

3. Add the same amount of dissolvent originally used, sparge without heat for 1 hour and sample. This test will determine the efficiency of the hull rinse.
4. Make a second dissolution of the same hulls for at least 6 hours and sample the dissolver. This test will determine the quality of the first fuel dissolution.
5. If the dissolver product of the second dissolution of the same fuel contains less than 3 grams U/liter this same dissolvent can be used for the subsequent fuel dissolution.

The dissolution time for subsequent fuel charges can then be roughly estimated from evaluation of instrument charts and the results of the first dissolution.

The uranium concentration will be high in the dissolver product from each dissolution. No U freezing is expected; however, to prevent a possible freezing due to an unusual variance of U and HNO_3 concentrations, the dissolvers should not be cooled below 110 F as long as the dissolvers contain dissolver product. A temperature higher than this will produce additional jet dilution which may require needless 3D-1 solution adjustment.

The hull rinse water must be slightly acidified ($.1 \text{ M } \text{HNO}_3$) to prevent possible plutonium polymer formation. If boiling of 3D-1 is necessary, sufficient HNO_3 will be in 3D-2. If water must be added to 3D-2 it must be made up in 14D-22 as outlined in SOP 14-2.

The dissolver off-gas scrubber 6C-6 must be sampled for H^+ analysis after each dissolution. If the H^+ is more than $1.6 \text{ M } \text{HNO}_3$, a batch of mercuric-mercurous nitrate must be made up in 14D-30 to replace the solution discarded from the scrubber 6C-6 as per SOP 14-2.

The hull sample must not be less than 0.6 gallons and must contain at least three element end caps. SOP 15-10 defines the method of sampling the hulls.

See Section 21 for comments affecting dissolver operation when using 7D-11 acid for dissolution.

6. Feed Adjustment in and Recycle to 3D-1

The first dissolver batches will probably require some adjustment since unusual dissolver tests will be done. Routine batches thereafter should not require adjustment if the proper volumes of dissolvent and hull rinse are used, and jet dilutions are normal.

Recycled material from rework should be adjusted to 3D-1 solution specifications unless the rework solution contains large amounts of Fe, NaNO_3 or Pu. It may be desirable to submit a sample of rework solution to the lab. for a boil-up test prior to the final adjustment in 7C-4 and jetting to 3D-1.

If fluid must be added to 3LI-7 or 3DI-3 at any time, a sample of that fluid added must be submitted for specific gravity analysis and a copy of the results and date added sent to Technical Services.

7. Partition Cycle

Raffinates more than 0.10 g/l U and/or 9.0×10^{-6} g/l Pu should be sent to 7D-8 for future recycling.

The 4C-1 feed rate is to be controlled by the two-stage air lift. The primary air lift setting should be adequate to keep 4Y-13 full to overflowing. The actual feed rate as measured in 4D-1 is to be controlled by throttling the air rotometer in the southeast corner of UXA to give the HAF rate specified.

The solvent rate is 5% higher than used during most of the cold runs. The higher rate will reduce the U and Pu losses to 4D-2H but might cause slightly higher losses in 4C-4-S. The 4C-4-S losses can be reduced if necessary by either increasing 4C-4 strip rate 5% or reducing the HAX rate 5%.

8. Butt for 4D-9 and 4D-12

The FRC settings specified are based upon a butt molarity of 12.0 HNO_3 and must be throttled to maintain 4D-9 and 4D-12 at $1.0 \pm 0.2 \text{ M } \text{HNO}_3$.

9. I and II Uranium Extraction Systems

The solvent rates are 5% more than used during most of the cold runs. If slightly higher U losses in 4C-10-S and 4C-12-S are experienced either a 5% reduction in the solvent rates or a 5% increase in the strip rates will reduce the losses.

10. Uranium Product Concentration

Care must be exercised during the 5C-4 startup to prevent dilute product or water from entering into 5D-9. If the evaporator liquid level gets too high during the initial concentration, uranium could be carried overhead to 5D-8 resulting in possible uranium losses in 4C-10 lean solvent. The volume in 5C-4 should not be more than 200 liters during startup or regular operation. To prevent exceeding 200 liters 5C-4 volume the startup and initial concentration to the run plan density, it is recommended the evaporator be started as follows:

- a) The SOP 5-1 should be followed for startup except the initial 5LRC-27 auto setting should be 56% chart, 5DRC-20 on manual with zero instrument output, and 5TRC-5 set on 130 F on auto.
- b) After 5C-4 has been filled to 49-56% level on 5LRC-27, the 5FIC-7 should be throttled on manual control to maintain 5LRC-27 between 42 and 56% chart with feed coming to 5C-4 from 5D-7.
- c) When 5DRC-20 has reached 36% chart the 5LRC-27 set point should be increased to 62% chart.
- d) When 5DRC-20 has reached 60% chart, 5LRC-27 should be placed on automatic control with the set point at 95% chart.
- e) When 5DRC-20 has reached 60% chart, 5DRC-20 should be placed on auto control with the set point at 78% chart.
- f) The 5FIC-7 controller should then be placed on auto control with the set point at 7.1. The 5FIC-7 setting is to be throttled in small increments until the 5DRC-20 output signal is between 4 to 8 psig. After this 5FIC-7 setting is found 5FIC-7 should not require additional throttling during the run.

The run plan specifies rather tight uranium specifications for 5C-4 in relation to the product in 5D-12A/B. This tighter 5C-4 specification is desirable to insure 5D-12A/B product specification.

The temperature of 5D-8 must not be less than 130 F; otherwise, uranium losses can be expected via 4C-10-S, and a potential plugging of 13C-2 aqueous outlet line could result.

11. Silica Gel Bed 5C-6A

The valving around 5C-6A and 5C-6B is to be set to pass product through 5C-6A bed.

No regeneration of 5C-6A is anticipated during these two runs. However, should this be necessary, the destruction of the oxalic acid in 7C-5 by HNO_3 is slow and will require approximately 20 hours at boiling. The destruction reaction rate can be increased by the addition of KMnO_4 to give a 7C-5 KMnO_4 concentration of .0025 M. The oxalic acid must be all destroyed to prevent corrosion of stainless steel.

12. Product Quality Evaluation in 5D-12A/B

Each batch collected must be sampled for quality and the results received before jetting. The sampling schedule lists the maximum permissible gross beta, gross gamma and Pu specifications. Product batches exceeding these specifications should be sent to 5D-15A-2 for future recycling.

13. Uranium Product Loadout

The 5PCV-14 has been set and sealed to provide not more than 15 psig air pressure to pressurize the product to the product trailer tank. The 5V-1 air sparge must not be used to assist this transfer; otherwise, it would be possible to pressurize 5V-1 sufficiently to cause 5PSV-1 to relieve a large volume of 30 psig air to the VOG system. Not only would this probably pressurize the VOG system and disrupt the entire process, but could result in serious contamination out through the stack. When the trailer tank has been filled, care must be exercised to slowly bleed off the 5V-1 pressure to the VOG system before completely opening the 3-inch block valve.

14. Plutonium Cycle

The 4D-6 acid concentration should be operated at not less than 3.3 M HNO_3 . If possible the HNO_3 M should be $3.9 \pm .2$ during the periods when an ion exchange bed is not being washed. See Section 15 of this letter for 4D-6 special procedure during an ion exchange bed washing. Fresh concentrated acid must be used for 4D-6 butt to prevent excessive 4C-7 feed rates and possible product contamination. The 4D-6 4LRC-1 should be operated at 40.0% chart at all times.

Should plutonium concentrations become high in 4C-8-S the 4C-7 solvent rate should be decreased 5%.

15. Pu Ion Exchange

Exchanger 5C-1A should be used for the first loading. Tentative plans are to continue loading the bed with Pu until significant losses are detected in 5C-1A-R. Due to the very low Pu concentration in the XAF it is difficult to predict how many grams Pu the bed is capable of efficiently absorbing. Hopefully only one ion exchange bed will be required for each lot run. Instructions will be issued when to switch beds and elute 5D-1A.

When an ion exchange bed is taken off the line and washed as per SOP 5-7 the following procedure is recommended to produce the least disruption of 4D-6 and no change in the IIAF rate:

- a) Maintain 4LRC-1 setting at 40.0% chart at all times.
- b) 4LRC-2 (4Y-32 feed metering pot for 4C-7) is throttled to maintain 5D-2 at a level of 10-15% chart when not recycling ion exchange wash (XCX).
- c) The NaNO_2 rate to 4D-6 is maintained constant during the time the 5D-2 bed wash is recycled.
- d) Perform the ion exchanger wash (XCX) as outlined in SOP 5-7. During the wash the 5D-2 liquid level will build up but not overflow if the prescribed 90 L wash volume is used.
- e) Do not change the 4LRC-2 set point until item h below is completed.

- f) After the wash cycle is completed, shut off the butt to 4D-6 (14G-63).
- g) The 5D-2 liquid level will now work down slowly.
- h) When the 5D-2 5LR-1 reading has reached 10-15% chart, start up the 4D-6 butt pump 14G-63.
- i) Revert to routine throttling of 4LRC-2 as necessary to maintain 5D-2 at 10-15% chart.

The 4D-6 acid concentration will slowly drop down to 3.3 during the above special procedure, and will slowly return to 3.9 after 14G-63 has been turned back on.

16. Pu Product Quality Evaluation in 5D-4

After an ion exchange bed is eluted the quality of the product must be determined prior to concentration in 5C-2. If the analysis results exceed the specifications listed for 5D-4 in the sampling schedule, the elutriant should be recycled for decontamination and not concentrated in 5C-2.

17. Pu Product Concentration in 5C-2

The elutriant is concentrated as per SOP 5-8. All of the 5D-4 elutriant is concentrated in 5C-2 until a TI-2-31 temperature of 235 F or a density at boiling of 65.7 % chart on 5DR-17, whichever occurs first, is reached.

18. H. L. Waste Evaporator 7C-1

All the 4C-1 raffinate for each lot run will be concentrated for one batch of waste per lot run unless more uranium than specified in the permissible throw-away limits is added or more dissolver liners for the entire run are used than predicted.

¹⁸⁰⁰
~~4000~~ The operating volume of the evaporator should be maintained at or near 1800 liters. The neutralized waste concentrate will be sent to 8D-2 permanent storage.

It may prove desirable to recycle the waste concentrate for Pu and U recovery prior to final concentration and disposal.

19. L. L. Waste Evaporator 7C-2

Tentative plans are for two batches of waste concentrate for each of the two lot runs. If reliable corrosion rates of H_2SO_4 (ferrous sulfamate degradation product) on stainless steel is obtained soon enough it may be possible to make only one waste concentrate batch for each of the two lot runs.

The operating volume should be maintained at or near ⁴³⁰⁰~~2500~~ liters.

The evaporator must be operated as smoothly as possible to prevent surges. Surges could cause significant fission product carryover to 7D-3 which could result in excessively contaminated recovered acid.

It may prove desirable to recycle the waste concentrate for Pu and U recovery prior to final concentration and disposal.

20. Rework Evaporator 7C-4

No criticality problems are expected from any uranium concentration in 7C-4. However, the plutonium concentration must be maintained less than 2 grams per liter. A severe upset in the operation of the plutonium cycle or ion exchange system is the only source of significant quantities of plutonium being recycled to the rework system.

Raffinates sent to rework for recycling are to be concentrated and held for recycling near the end of the run. Should an excessive number of raffinate batches require concentration and subsequent recycle to provide rework room the following equation can be used to determine the boil down required for solution adjustment in 7C-4 to meet the 3D-1 solution specification:

$$HNO_3 \text{ M} = \frac{(\text{Density at Boiling}) - 0.3104 (\text{UM}) - 0.96}{0.031}$$

Determine density at boiling from 7DR-4

Determine UM by dividing the total grams of U added to 7C-4 into the volume in 7C-4. Solve for the HNO_3 M.

Refer to Section 6 for additional comments.

21. Acid Recovery System

Uranium was found in 7D-3 and 7D-5 during all the cold runs. The uranium source was 7C-2 and was caused by surges in 7C-2. Being uranium was carried over to 7D-3 during the cold runs, fission products will be carried over should 7C-2 surge to 7D-3. Large and frequent surges could result in excessively contaminated recovered acid. Consequently, the recovered acid should be routinely analyzed for gross gamma.

The vaporizer bottoms pump 7G-10 must be operated preferably at a constant, low, rate to reduce the fission products in the recovered acid. If a constant, low, rate is not possible, daily and preferably shiftly pumpings should be made.

After a large volume of 7D-11 acid (approx. 7.5 M HNO_3) has been accumulated, a planned dissolution will be required to use this acid. If the 7D-11 acid is at least 6.5 M HNO_3 , equal volumes of 7D-11 acid and fresh concentrated acid can be used for the dissolver for a maximum dissolver charge. If the 7D-11 acid is less than 6.5 M HNO_3 Technical Services should be consulted to establish the dissolver charge for this special handling.

Weak acid from 7D-6 to the interceptor containing fission products exceeding the maximum permissible should be routed to 7C-1 or to 7C-2. The composite sampler pump 7G-14 should be operated continuously to provide an accurate record of the contamination sent to the interceptor.

22. VOG System

Caustic solution (1.32 M NaOH) from 14D-25B is to be used for 6C-3 scrub when the 6C-3 scrub has reached 3.9 M HNO_3 , the solution should be replaced with fresh 1.32 M caustic.

23. DOG System

A mixture of mercurous-mercuric nitrate is to be used for 6C-6 scrub. The scrubber 6C-6 must be sampled after each dissolution. SOP 14-2 contains a procedure for making up this solution in 14D-30. When the 6C-6 scrub has

reached 1.5 M HNO_3 , a fresh batch of mercurous-mercuric nitrate solution is to be made up in 14D-30 and added to 6C-6 after accountability sampling 6C-6 and pumping one-half the 6C-6 volume to 7D-2.

24. Sampling Requirements

The sampling load has been considerably reduced from that used during cold runs and may prove inadequate for normal process surveillance. There will be rather frequent special samples requested especially during processing troubles.

ORIGINAL SIGNED BY

M. E. WEECH

MEW/CEB/sk

M. E. Weech

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L. J. Friedman w/attachments
M. Ross w/attachments

NPR 1 TONNE U/DAY RUN PLAN

Hot Run No. 1
April, 1966
NPR Run

STREAM	RATE, L/HR	FLOW CONTROL		APPROX. VESSEL DEPLETION RATE, % CHARGE/4 HRS.	STREAM COMPOSITION
		INSTRUMENT	SETTING		
<u>Dissolution</u>					
Dissolvent	99.7 Ave.	----	----	----	Undiluted Recovered Acid not less than 10.0 M HNO ₃
Dissolver Product (when using 5 basket liners)	----	----	----	----	406 g/l U 0.036 g/l Pu 0.054 M Fe 2.63 M HNO ₃
Hull Rinse from 3D-2	Approx. 1266 1/batch	----	----	----	0.1 ± .05 M HNO ₃
Hulls	Approximately 143 KG/batch (8.6 ft ³ hulls/batch)				5 x 10 ⁻³ Weight % U 5 x 10 ⁻⁸ Weight % Pu
3D-1	----	----	----	----	325 ± 16 g/l U 0.0289 g/l Pu ave. 0.043 M Fe 2.1 ± 0.2 M HNO ₃
<u>Partition Cycle</u>					
4C-1 Feed (HAF)	136 ± 6	4LR-27	----	8.1	308 ± 15 g/l U
		4FI-17	40	----	0.0275 g/l Pu ave.
		4FI-18 Rotometer	17.5 ± as needed	----	0.041 M Fe 2.0 ± 0.2 M HNO ₃
4C-1 Scrub (HAS)	86 ± 4	14FRC-1	34	15.1	3.0 ± 0.1 M HNO ₃
4C-1 Solvent (HAX)	526 ± 5	4FRC-22	31.0	----	30 ± 1.0 Volume % TBP

NPR 1 TONNE U/DAY RUN PLAN

Hot Run No. 1
April, 1966
NPR Run

STREAM	RATE, L/HR.	FLOW CONTROL		APPROX. VESSEL DEPLETION RATE, % CHARGE/4 HRS.	STREAM COMPOSITION
		INSTRUMENT	SETTING		
Partition Cycle Cont.					
4C-1-R (HAW)	222 ± 10	----	----	----	0.01 g/l U 1.7 x 10 ⁻⁶ g/l Pu 0.025 M Fe 1.9 ± 0.2 M HNO ₃
4D-2-H (HAWC)	234 ± 12	----	----	----	0.0095 g/l U 1.6 x 10 ⁻⁶ g/l Pu 0.024 M Fe 1.8 ± 0.2 M HNO ₃
4C-2 Strip (HBX)	59 ± 3	14FRC-2	33.6	9.7	0.10 ± .02 M HNO ₃ 0.03 ± .01 Red. N.
4C-3 Scrub (HBS)	69 ± 3	14FRC-25	40.5	----	30 ± 1.0 Vol. % TED
4C-3 Product (HBP)	59 ± 3	----	----	----	0.0632 g/l Pu 5.0 x 10 ⁻⁵ g/l U 0.03 M Fe 1.8 ± 0.3 M HNO ₃
4C-4 Strip (HCX)	543 ⁺²⁷ ₋₀	14FRC-3	35.5	----	0.01 ± 0.005 M HNO ₃
First Uranium Cycle					
4D-9 Butt	49 ⁺¹¹ ₋₈	14FRC-13	24 ⁺⁶ ₋₄	----	12.0 ± 2.0 M HNO ₃

NPR 1 TONNE U/DAY RUN PLAN

Hot Run No. 1
April, 1966
NPR Run

STREAM	RATE, L/HR.	FLOW CONTROL		APPROX. VESSEL DEPLETION RATE, % CHART/4 HRS.	STREAM COMPOSITION
		INSTRUMENT	SETTING		
First Uranium Cycle Cont.					
4C-9 Feed (IAF)	592 ± 38 8	----	----	-----	70 ± 1/4 g/l U 6.3 x 10 ⁻⁷ g/l Pu 1.0 ± 0.2 M HNO ₃
4C-9 Scrub Total (IAS)	49 ± 3	----	----	-----	0.01 ± .005 M HNO ₃ 0.04 ± .002 Red. N.
Acid from 14D-11	43.4 ± 2.6	14FRC-14	53.6	9.9	0.01 ± .005 M HNO ₃
Ferrous Sulfamate from 14D-12	5.6 ± 0.4	14FrIC-15	0.23	18.5% 14LI-18 drop in 15 minutes	0.35 ± .05 Red.N.
4C-9 Inter. Scrub (IAS')	49 ± 3	14FRC-16	38.6	----	4.0 ± 0.2 M HNO ₃
4C-9 Solvent (IAX)	570 ± 6	4FRC-7	30.8	----	30 ± 1.0 Vol. % TBP
4C-9-R (IAW)	690 ± 44 14	----	----	----	0.001 g/l U 5.5 x 10 ⁻⁷ g/l Pu 0.0028 M Fe 1.2 ± 0.2 M HNO ₃
4D-10H (IAWC)	726 ± 46 14	----	----	----	0.001 g/l U 5.2 x 10 ⁻⁷ g/l Pu 0.0027 M Fe 1.1 ± .2 M HNO ₃
4C-10 Strip from 5D-8 (ICX)	543 ± 27 0	5FRC-9	45.7	----	0.003 ± .002 M HNO ₃

NPR 1 TONNE U/DAY RUN PLAN

1st Run No. 1
April, 1966
NPR Run

STREAM	RATE, L/HR.	FLOW CONTROL		APPROX. VESSEL DEPLETION RATE, % CHART/4 HRS.	STREAM COMPOSITION
		INSTRUMENT	SETTING		
<u>Second Uranium Cycle</u>					
4D-12 Butt	44 $\begin{smallmatrix} + 10 \\ - 6 \end{smallmatrix}$	14FRC-18	21 $\begin{smallmatrix} + 5 \\ - 3 \end{smallmatrix}$	----	12.0 $\pm$ 2.0 M HNO ₃
4C-11 Feed (IDF)	587 $\begin{smallmatrix} + 37 \\ - 6 \end{smallmatrix}$	----	----	----	71 $\begin{smallmatrix} + 1 \\ - 5 \end{smallmatrix}$ g/1 U 1.0 $\pm$ 0.2 M HNO ₃
4C-11 Scrub (IDS)	49 $\pm$ 3	14FRC-19	38.0	11.0	0.01 $\pm$.005 M HNO ₃
4C-11 Inter. Scrub (IDS')	49 $\pm$ 3	14FRC-17	34.6	----	4.0 $\pm$ 0.2 M HNO ₃
4C-11 Solvent (IDX)	570 $\pm$ 6	4FRC-12	32.6	----	30 $\pm$ 1.0 Vol. % TPP
4C-11 Raffinate (IDW)	685 $\begin{smallmatrix} + 43 \\ - 12 \end{smallmatrix}$	----	----	----	0.001 g/1 U 1.2 $\pm$ 0.2 M HNO ₃
4D-13 H (IDWC)	721 $\begin{smallmatrix} + 45 \\ - 13 \end{smallmatrix}$	----	----	----	0.001 g/1 U 1.1 $\pm$ 0.2 M HNO ₃
4C-12 Strip (IEX)	543 $\begin{smallmatrix} + 27 \\ - 0 \end{smallmatrix}$	14FRC-20	36.7	----	0.01 $\pm$ 0.005 M HNO ₃
<u>Diluent Wash System</u>					
4C-12A Feed (IGF)	543 $\begin{smallmatrix} + 27 \\ - 0 \end{smallmatrix}$	----	----	----	76 $\begin{smallmatrix} + 0 \\ - 4 \end{smallmatrix}$ g/1 U 0.1 M HNO ₃
4C-12A Diluent Scrub (IGS)	25 $\pm$ 3	13G-16	48.3	3 minutes and 20 seconds for 12" burette drop	100% Amsco (1BP must not exceed 2.0 Vol. %)

NPR 1 TONNE U/DAY RUN PLAN

Hot Run No. 1
April, 1966
NPR Run

STREAM	RATE, L/HR.	FLOW CONTROL		APPROX. VESSEL DEPLETION RATE, % CHART/4 HRS.	STREAM COMPOSITION
		INSTRUMENT	SETTING		
<u>Diluent Wash System Cont.</u>					
4C-12A Aqueous Scrub (IGSA)	25 ± 3	4FRC-101	55.1	----	0.01 ± 0.005 M HNO ₃
4C-12A Product Air Lift (IGU)	0.6 ± 0.2 CFM	4FI-101	0.6 ± 0.2 CFM	----	----
13C-7 Reflux	25 ± 3	13G-17	36.7	3 minutes and 20 seconds for 12" burette drop.	100% Amsco
13C-7 Steam	25 ± 3 lbs/hr. (Steam rate should be .5 lb/hr for each liter/hr of combined IGS + 13C-7 Reflux)				
<u>Uranium Product Concentration</u>					
5C-4 Product	122 ± 2	5DRC-20	68.0	----	340 ± 10 g/l U 0.41 M HNO ₃
5C-4 Condensate to 5D-8	446 ± 10	5TRC-5	130 F	----	0.001 M HNO ₃
14D-9 Strip to 5D-8	97 ^{+ 27} - 0	5LRC-29	65.0	----	0.01 ± 0.005 M HNO ₃
5D-12A and 5D-12B	122 ± 2	The specifications listed to the right are maximum for shippable product. Batches exceeding these specifications must be sent to 5D-15A2 for ultimate recycle.			340 ± 50 g/l U Not > 1 x 10 ⁻⁸ gr. Pu/gr U Not > 2250 c/m/mg U Gross Bet Not > 600 c/m/mg U Gross Gam
5V-1 Product	128 ± 2	----	----	----	320 ± 50 g/l U 0.32 M HNO ₃

NPR 1 TONNE U/DAY RUN PLAN

Hot Run No. 1
April, 1966
NPR Run

STREAM	RATE, L/HR.	FLOW CONTROL		APPROX. VESSEL DEPLETION RATE, % CHART/4 HRS.	STREAM COMPOSITION
		INSTRUMENT	SETTING		
<u>Plutonium Cycle</u>					
4D-6 Butt Total	13.0 $\pm$.6	----	-----	-----	8.52 <u>M</u> HNO ₃ 0.30 <u>M</u> NaNO ₂
14D-45 Acid	8.5 $\pm$.4	14FR-7	7.2 $\pm$ 1.0	-----	13.5 $\pm$.5 <u>M</u> HNO ₃
		14G-63	6.95		
14D-15 NaNO ₂	4.8 $\pm$.2	14FR-5	4.2 $\pm$ 1.0	10.0	0.8 $\pm$.04 <u>M</u> NaNO ₂
		14G-27	4.05		
4D-6 (IIAF)	93.3 $\pm$ 4	4LRC-2	13.1 $\pm$.5	Throttle 4LPC-2 to maintain 5D-2 at 5-10% on 5LR-1 when not recycling 5C-1A/ B/C wash.	0.04 g/l Pu 6 x 10 ⁻⁵ g/l U 3.9 $\pm$.2 <u>M</u> HNO ₃ 0.05 <u>M</u> NaNO ₂ 0.022 <u>M</u> Fe
4C-7 Scrub (IIAS)	11.7 $\pm$.6	14G-36	70.0	11.5	1.0 $\pm$ 0.2 <u>M</u> HNO ₃
4C-7 Solvent (IIAX)	58 $\pm$ 3	4FRC-2	36.5	-----	30 $\pm$ 1.0 Vol. % TBP
4C-7 Raffinate (IIAW)	105 $\pm$ 5	-----	-----	-----	2.1 x 10 ⁻⁶ g/l Pu 0 g/l U 3.57 $\pm$.5 <u>M</u> HNO ₃ 0.044 <u>M</u> NaNO ₂ 0.020 <u>M</u> Fe

STREAM	RATE, L/HR.	FLOW CONTROL		APPROX. VESSEL DILUTION RATE, % CHART/4 HRS.	STREAM COMPOSITION
		INSTRUMENT	SETTING		
<u>Plutonium Cycle Cont.</u>					
4D-8H (IIAWC)	110 $\pm$ 5	----	----	----	2.0 x 10 ⁻⁶ g/l Pu 0 g/l U 3.4 $\pm$.5 M HNO ₃ 0.043 M NaNO ₂ 0.019 M Fe
4C-8 Scrub (IIBS)	5.2 $\pm$.3	4FRC-5	42.0	----	30 $\pm$ 1.0 Vol. % 1BP
4C-8 Strip (IIBX)	10.4 $\pm$.5	14G-14	82.0	9.1	0.05 $\pm$.01 M HNO ₃ 0.03 $\pm$.01 Red. N.
4C-8 Lean Solvent (IIBW)	63 $\pm$ 4	----	----	----	5.0 x 10 ⁻⁵ g/l U
<u>Pu Ion Exchange Cycle</u>					
5D-1 Butt Total	10.9 $\pm$.5	----	----	----	12.1 M HNO ₃ 0.081 M NaNO ₃
14D-45 Acid	9.8 $\pm$.4	14FR-9	2.88 $\pm$.5	----	13.5 $\pm$.5 M HNO ₃
		14G-28	42.0 $\pm$ 2.0		
14D-43 NaNO ₂	1.1 $\pm$.1	14G-61	4.63 $\pm$.5	3.9	0.8 $\pm$.04 M NaNO ₂
5D-1 (XAF)	21.3 $\pm$.5	----	----	----	0.175 g/l Pu 0.04 M NaNO ₂ 0.015 M Fe 6.9 $\pm$.4 M HNO ₃

STREAM	RATE, L/HR.	FLOW CONTROL		APPROX. VESSEL DEPLETION RATE, % CHART/4 HRS.	STREAM COMPOSITION
		INSTRUMENT	SETTING		
<u>Pu Ion Exchange Cycle Cont.</u>					
Ion Exchanger Pre and Past Elution Washes (XCX)	223.2	14G-40A	194	----	6.9 ± 0.4 M HNO ₃
Ion Exchanger Elutriant	16.8	14G-40B	133	13.0% 14LI-27 drop in 5-minutes	90 liter batch of 0.62 ± .02 M HNO ₃
5D-4 (Pu Product Evap. Feed)	90 l/batch	The specification listed to the right are maximum for shippable product. Batches exceeding these specifications must be sent to 5D-1 for recycle.			Not > 50 μ curies Gross Beta + Gross Gamma, gram Pu
5C-2 Pu Product	Approx. 8.8 l/batch	The evaporator is operated until either a temperature of 235°F or a 5DR-17 reading of 65.7 % chart is reached whichever occurs first.			250 ± 20 g/l Pu 4.1 ± 1.0 M HNO ₃
5D-6 Condensate	Approx. 81.2 l/batch	----	----	----	1 x 10 ⁻³ g/l Pu 0.24 M HNO ₃
<u>Solvent Wash System</u>					
13D-1 Scrub	41 ± 3	14FRC-27	60.3	----	0.2 ± 0.01 M Na ₂ CO ₃
13D-2 Scrub	33 ± 3	14FRC-28	48.5	----	0.2 ± 0.01 M Na ₂ CO ₃
13D-3 Scrub	33 ± 3	14FRC-29	48.5	----	0.2 ± 0.01 M Na ₂ CO ₃
13D-4 Scrub	41 ± 3	14FRC-24	60.3	----	0.4 ± 0.1 M HNO ₃
13D-5 Scrub	33 ± 3	14FRC-25	48.5	----	0.4 ± 0.1 M HNO ₃
13D-6 Scrub	33 ± 3	14FRC-26	48.5	----	0.4 ± 0.1 M HNO ₃

STREAM	RATE, L/HR.	FLOW CONTROL		APPROX. VESSEL DEPLETION RATE, % CHART/4 HRS.	STREAM COMPOSITION
		INSTRUMENT	SETTING		
<u>Solvent System</u>					
13D-4 (First Cycle Solvent)	----	-----	----	-----	30 ± 1.0 Vol. % TBP
13D-5 (Second Cycle Solvent)	----	-----	----	-----	30 ± 1.0 Vol. % TBP
13D-6 (Third Cycle Solvent)	----	-----	----	-----	30 ± 1.0 Vol. % TBP
<u>Waste Evaporators</u>					
7C-1 Feed (High Level Waste)	246 ± 12	7LRC-6	Variable to maintain 1800 liters in 7C-1	-----	0.009 g/l U 9 x 10 ⁻⁶ g/l Pu 0.26 M Fe 1.7 ± 0.2 M HNO ₃
7D-4 Pre-neutralized Waste	One batch of approximately 1800 l each for entire lot run.		-----	-----	2.45 M HNO ₃ 1.45 g/l U 2.4 x 10 ⁻³ g/l Pu 1.83 M Fe
7C-2 Feed (Low Level Waste)	1876 ± 95	7LRC-7	Variable to maintain approximately 4300 liters in 7C-2	-----	0.0055 g/l U 5.2 x 10 ⁻⁶ g/l Pu 0.0023 M Fe 0.0045 M SO ₄ ⁼ 0.0026 M Na ⁺ 1.14 M HNO ₃

NPR 1 TONNE U/DAY RUN PLAN

Hot Run No. 1
April, 1966
NPR Run

STREAM	RATE, L/HR.	FLOW CONTROL		APPROX. VESSEL DEPLETION RATE, % CHART/4 HRS.	STREAM COMPOSITION
		INSTRUMENT	SETTING		
<u>Waste Evaporator's Cont.</u>					
7D-10 Pre-neutralized Waste	Two batches of approximately 4300 l each for entire lot run.	----	----	----	0.67 g/l U ⁺ 0.0063 g/l Pu 0.28 M Fe 0.55 M SO ₄ ⁼ 0.055 M Na ⁺ 6.4 M HNO ₃
<u>Acid Recovery System</u>					
7C-3 Feed	2232	7FRC-5	6.6	----	1.10 M HNO ₃ Ave.
7E-1 Steam Supply	----	7FRC-11	6.9 (% Chart Control Point = (1.05)(7FRC-5 Chart Reading))		
7E-1 Bottoms to 7D-11	22	7HIC-34	9.0 ± 2.0	----	7.9 ± 1.0 M HNO ₃
7C-3 Liquid Level	----	7LRC-19	55-60	----	-----
7C-3 Reflux	755	7FRC-8	95	----	Demineralized H ₂ O
7C-3 Temperature	----	7TRC-13	154-158 F	----	----
7C-3 Recovered Acid	234 ± 10	----	----	----	10.5 ± .5 M HNO ₃
7D-6 Weak Acid	2100 ± 100	----	----	----	.005 M HNO ₃
<u>Off-Gas Systems</u>					
6C-3	-----	6LI-3	77	----	1.32 ± .07 M NaOH
6C-6	-----	6LI-1	32.5	----	.001 ± .0002 M Hg Not > 1.6 M HNO ₃

PROCESS CONTROLLERS

NPR 1 TONNE U/DAY RUI PLAN

Hot Run No. 1
April, 1966
NPR Run

<u>COLUMN</u>	<u>INSTRUMENT EQUIPMENTS</u>	<u>CONTROLLER SETTING</u>
4C-1	4LRC-29	52 % Chart
4C-2	4LRC-33	60 % "
4C-3	4LRC-37	60 % "
4C-4	4LRC-38	46 % "
4C-7	4LRC-3	62 % "
4C-8	4LRC-4	42 % "
4C-9	4LRC-7	55 % "
4C-10	4LRC-11	40 % "
4C-11	4LRC-14	70 % "
4C-12	4LRC-15	40 % "
4C-12A	4LRC-101	55 % "
13D-1 Washer	13LIC-3	70 % "
13D-1 Washer	13LIC-4	70 % "
13D-2 Washer	13LIC-6	70 % "
13D-2 Washer	13LIC-7	70 % "
13D-3 Washer	13LIC-9	70 % "
13D-3 Washer	13LIC-10	70 % "

<u>COLUMN PULSERS</u>	<u>FOR COLUMN</u>	<u>APPROXIMATE VERIFIER SETTING</u>	<u>AIR PRESSURE, PSIG</u>	<u>TO GIVE</u>
4V-1	4C-1	53.3	13.4	60 cycles/min and .75" amplitude
4V-2	4C-2	53.3	13.0	60 cycles/min and .75" amplitude
4V-3	4C-3	53.3	10.3	60 cycles/min and .75" amplitude
4V-4	4C-4	66.6	17.0	75 cycles/min and .60" amplitude
4V-5	4C-7	53.3	14.8	60 cycles/min and .75" amplitude
4V-6	4C-8	53.3	11.8	60 cycles/min and .75" amplitude

PROCESS CONTROLLERS

Hot Run No. 1
April, 1966
NPR Run

NPR 1 TONNE U/DAY RUN PLAN

<u>COLUMN PULSERS</u>	<u>FOR COLUMN</u>	<u>APPROXIMATE VERNII SITTING</u>	<u>AIR PRESSURE, PSIG</u>	<u>TO GIVE</u>
4V-7	4C-9	75.5	16.0	85 cycles/min and 1.0" amplitude
4V-8	4C-10	66.6	18.5	75 cycles/min and 0.6" amplitude
4V-9	4C-11	75.5	16.0	85 cycles/min and 1.0" amplitude
4V-10	4C-12	66.6	18.5	75 cycles/min and 0.6" amplitude
4V-12A	4C-12A	53.3	11.5	60 cycles/min and 0.75" amplitude

<u>TEMPERATURE CONTROLLERS</u>	<u>FOR</u>	<u>SETTING</u>
4TRC-1	Rich Solvent to 4C-10	165 F to Give 150 F on TI-2-8
4TRC-2	Rich Solvent to 4C-12	165 F to Give 150 F on TI-2-10
4TRC-3	Rich Solvent to 4C-4	165 F to Give 150 F on TI-2-20
5TIC-3	Pu Ion Exchanger Feed	140 F
5TRC-5	U Product Evaporator Condensate for 4C-10 Strip	130 F
5TRC-11	5D-9 U Product Surge Tank	140 F
6TRC-4	VOG Condenser 6E-3 Outlet Gas	100 F
6TRC-5	VOG Heater 6E-4 Outlet Gas	150 F
13TIC-1	13D-1 Washer Temperature Control	122 F
13TIC-2	13D-1 Washer Temperature Control	122 F
13TIC-4	13D-2 Washer Temperature Control	122 F
13TIC-5	13D-2 Washer Temperature Control	122 F
13TIC-7	13D-3 Washer Temperature Control	122 F
13TIC-8	13D-3 Washer Temperature Control	122 F
14TIC-2	HCX, ICX, and IDX Heater Outlet	165 F
TI-2-6	4D-6 Solution	60 - 100 F

PROCESS CONTROLLERS

Hot Run No. 1

April, 1966

LPR Run

NPR 1 TONNE U/DAY RUN PLANTEMPERATURE CONTROLLERSFORSETTING

TR-1-15

13D-4 Solvent Run Tank

Not More than 90 F

TR-1-16

13D-5 Solvent Run Tank

Not More than 90 F

TR-1-17

13D-6 Solvent Run Tank

Not More than 90 F

PRESSURE CONTROLLERSFORSETTING

6PRC-1

Extraction Process VOG Header

5 Inches Vacuum

6PRC-2

Chemical Process Cell VOG Header

5 Inches Vacuum

DENSITY CONTROLLERSFOR% CHART SETTING

5DRC-23

To prevent excessive U Product density in
5D-9

78.0

LEVEL CONTROLLERSFOR% CHART SETTING

4LRC-1

Control of 5D-2 recycle rate to 4D-6

40.0

5LRC-26

5D-7 Liquid Level Control

50.0

5LRC-27 (Startup)

Low U Product Evaporator 5C-4 startup level
control before 5DRC-20 reads 36.0%

56.0

5LRC-27 (Startup)

Low U Product Evaporator 5C-4 level control
after 5DRC-20 reads 36.0%

61.0

5LRC-27 (Operation)

Low U Product Evaporator 5C-4 level control
after 5DRC-20 reads 78% and for routine
operation.

95.0

5LRC-29

5D-8 liquid level control

70.0

5LRC-30

5D-9 product surge tank level control

50.0

FLOW CONTROLLERSFOR% SETTING

5FIC-7

Steam rate to 5C-4 reboiler 5E-3

7.1 $\pm$ 2.0 to give a 5DRC-20 output
signal of 4 to 8 psig for 1 ton/day.

SAMPLING REQUIREMENTS

Hot Run No. 1
April, 1966
NPR Run

NPR 1 TONNE U/DAY RUN PLAN

<u>SIDING OR VESSEL</u>	<u>SAMPLING FREQUENCY</u>	<u>NUMBER OF BOTTLES</u>	<u>TO BE ANALYZED FOR</u>	<u>SPECIFICATION</u>
Hulls	After Each Dissolution	Not <.6 gallon of hulls. This sample must contain at least three element end pieces.	Rinse in 0.1 M HNO ₃ . Leach in Conc. HNO ₃ . Total dissolution. U Iso. Dilution and Pu Iso. Dilution on each analysis.	Not > 0.11 Wt. % U Not > 1.5 x 10 ⁻⁴ wt. % Pu <u>Total</u> in hulls.
3D-1 (Feed Adjustment)	Before Adjustment	8	U color, U Iso. Dil., U Coulometric, U Isotopic dist., Pu Iso. Dilution, Pu Isotopic, Pu Alpha Count, H ⁺ , Sp. Gr., U-232, U-233 and Gross Gamma	325 ± 16 g/l U 2.10 ± .2 M HNO ₃
3D-2	Each batch before hull-rinsing and before sending to 7D-2	3	U Fluorimetric, Pu Alpha Count	Not > .026 g/l U and 2.3 x 10 ⁻⁶ g/l Pu when sending to 7D-2.
4C-1-R (HAW)	1000 and 2000 each day.	2	U Fluorimetric, Pu Alpha Count, H ⁺	-----
4C-3-P (HBP)	1000 and 2000 each day.	2	U Fluorimetric, H ⁺ , Gross Gamma	-----
4C-4-S (HCW)	1000 and 2000 each day	2	U Fluorimetric	-----
4C-7-R (IIAW)	2000 and 0400 each day	2	U Fluorimetric, H ⁺ Pu Alpha Count	-----
4C-8-S (IIEN)	2000 and 0400 each day	2	U Fluorimetric, Pu Alpha Count,	-----

SAMPLING REQUIREMENTS

Not Run No. 1

April, 1966

KPR Run

NPR 1 TONNE U/DAY RUN PLAN

<u>STREAM OR VESSEL</u>	<u>SAMPLING FREQUENCY</u>	<u>NUMBER OF BOTTLES</u>	<u>TO BE ANALYZED FOR</u>	<u>SPECIFICATION</u>
4C-8-P (IIBP)	2000 and 0400 each day	2	U Fluorimetric, Pu Alpha Count, H ⁺ , Gross Gamma	-----
4C-9-R (IAW)	0400 and 1000 each day	2	U Fluorimetric, H ⁺	-----
4C-10-S (ICW)	0400 and 1000 each day	2	U Fluorimetric	-----
4C-11-R (IDW)	0400 and 1000 each day	2	U Fluorimetric, H ⁺	-----
4C-12-S (IEW)	0400 and 1000 each day	2	U Fluorimetric	-----
4D-1 (HAF)	As Requested by Supervision	4	U Color, H ⁺ , Sp. Gr.	303 ± 15 g/l U 2.0 ± 0.2 M HNO ₃
4D-2H (HAWC)	Each Batch Collected	6	U Fluorimetric, H ⁺ , Pu Alpha Count	< 0.10 g/l U < 9.6 x 10 ⁻⁵ g/l Pu
4D-6 (IIAF)	Once Per Shift	2	H ⁺	3.9 ± .2 M HNO ₃ - .6
4D-8H (IIAWC)	Each Batch Collected	6	Pu Alpha Count, U Fluorimetric, H ⁺	Not > 0.10 g/l U Not > 2.0 x 10 ⁻⁵ g/l Pu
4D-9 (IAF)	at 1000 and 2200	2	U Color, Pu Alpha Count, H ⁺ , Gross Gamma	1.0 ± 0.2 M HNO ₃
4D-10H (IAWC)	Each Batch Collected	6	U Fluorimetric, Pu Alpha Count, H ⁺	Not > 0.034 g/l U Not > 3.1 x 10 ⁻⁶ g/l Pu
4D-12 (IDF)	At 1000 and 2200	2	U Color, H ⁺ , Gross Gamma	1.0 ± 0.2 M HNO ₃

SAMPLING REQUIREMENTS

NPR 1 TONNE U/DAY RUN PLAN

Hot Run No. 1
April, 1966
NPR Run

<u>STREAM OR VESSEL</u>	<u>SAMPLING FREQUENCY</u>	<u>NUMBER OF BOTTLERS</u>	<u>TO BE ANALYZED FOR</u>	<u>SPECIFICATION</u>
4D-13H (IDWC)	Each Batch Collected	6	U Fluorimetric, Pu Alpha Count, H ⁺	Not > 0.034 g/l U
5C-1A-R (No. 1 Pu Ion Exch.)	Once Per Day at 1800 While Loading	2	Pu Alpha Count, H ⁺	6.9 ± 0.4 M HNO ₃
5C-1B-R (No. 2 Pu Ion Exch.)	Once Per Day at 1800 While Loading	2	Pu Alpha Count, H ⁺	6.9 ± 0.4 M HNO ₃
5C-1C-R (No. 3 Pu Ion Exch.)	Once Per Day at 1800 While Loading	2	Pu Alpha Count, H ⁺	6.9 ± 0.4 M HNO ₃
5D-4 (Pu Evap. Feed)	Each Batch Collected	2	Pu Alpha Count, U Fluorimetric Gross Beta, Gross Gamma	Not > 50 µc Gross Beta + Gross Gamma/gram Pu
5D-5A & 5D-5B (Pu Prod.)	Each Batch Collected	6	Pu Iso. Dilution, Pu Isotopic, Pu Amper- omatic, Sp. Gr., Sulfates and Chlorides, Emission Spec. Impurities, Entrained Organic, H ⁺ , U.	Not > 50 µc F.P. Beta + Gamma/gram Pu Not > 5000 ppm U + other metal impurities Not > 0.5 Vol. % Organic Cl ⁻ ± SO ₄ ⁼ must be low 250 ± 20 g/l Pu Not < 2.0 M HNO ₃ Not > 5000 p U + other metals pmp Pu
5D-6 (Pu Evap. Cond.)	Each Batch Collected	2	Pu Alpha Count	Not > 4.0 x 10 ⁻³ g/l Pu
5D-7 (U Evap. Feed)	As Requested by Supervision	2	U Color, Gross Gamma	-----
5D-8 (ICX)	Only when 5C-4 is upset.	2	U Fluorimetric, H ⁺	-----

SAMPLING REQUIREMENTS

NPR 1 TONNE U/DAY RUN PLAN

Hot Run No. 1

April, 1966

Run NPR

<u>STREAM OR VESSEL</u>	<u>SAMPLING FREQUENCY</u>	<u>NUMBER OF BOTTLES</u>	<u>TO BE ANALYZED FOR</u>	<u>SPECIFICATION</u>
5D-9 (U Evap. Prod)	As Requested by Supervision	2	U Color, Sp. Gr. H ⁺	340 ± 10 g/l U
5D-11 (Silica Gel Regn. Solution)	Each Batch Collected	3	U Fluorimetric	Not > 0.2 g/l U
5D-12A/B (U Product)	Each Batch Collected	2 (125 ml bottles)	U Color Pu Alpha Count Gross Beta Gross Gamma	Not > 1.0 x 10 ⁻⁸ gr. Pu/gr. U Not > 2250 c/m/mg U Gross Beta Not > 600 c/m/mg U Gross Gamma
5D-15A-1 and 5D-15B	Each Batch Collected	4 (125 ml bottles)	U Color U-232 U-233 Pu Alpha Count plus Transuranics Halides Sulfur Carbon Phosphorus Emission Spec. Impurities Gross Beta Gross Gamma Purity upon Ignition	Not > 11 pU-232 pmp U-235 Not > 90 pU-233 pmp U-235 Not > 1 x 10 ⁻⁸ gr. Pu/gr. U Not > 25 pHalides pmp U Not > 500 pS pmp U Not > 200 pC pmp U Not > 150 pP pmp U Not > 2250 c/m/mg U Gross Beta Not > 600 c/m/mg U Gross Gamma Not < 98.5% Pure
5D-15A-2 (Product to Recycle)	Each Batch Prior to Recycling	2	U Color, H ⁺	
5V-1 (U Product)	Each Batch Collected	4 (125 ml bottles)	U Iso. Dilution U Isotopic U Titrimetric Sp. Gr.	320 ± 50 g/l U
6C-3 (VOG Scrubber)	Once Every Other Day at 0300	3	U Fluorimetric, Pu Alpha Count, H ⁺	Not > 4.0 M HNO ₃

SAMPLING REQUIREMENTS

NPR 1 TONNE U/DAY RUN PLAN

Hot Run No. 1

April, 1966

NPR Run

<u>STREAM OR VESSEL</u>	<u>SAMPLING FREQUENCY</u>	<u>NUMBER OF BOTTLES</u>	<u>TO BE ANALYZED FOR</u>	<u>SPECIFICATION</u>
6C-6 (DOG Scrubber)	After Each Dissolution	3	U Fluorimetric, Pu Alpha Count, H ⁺	Not > 1.6 <u>M</u> HNO ₃
6D-3 (VOG Condensate)	Each Batch Collected	4 (125 ml bottles)	U Fluorimetric Pu Alpha Count H ⁺	-----
7C-3 (Acid Fractionator Trays)	As Requested by Supervision	2 (125 ml bottles)	Total Halides	-----
7C-4 (Rework Evaporator)	Before Recycling to 3D-1 or to 7D-10	2	U Fluorimetric Pu Alpha Count	-----
7C-5 (General Purpose Evap.)	Each Batch Before Neutralization	4 (125 ml bottles)	Neut. Equivalent U Fluorimetric Pu Alpha Count Sp. Gr.	-----
7C-5 (General Purpose Evap.)	Each Batch After Neutralization	2	pH	Not < 8.0 pH
7D-3 (Acid Fractionator Feed Tank)	Once Per Day at 0300	2	U Fluorimetric, H ⁺ Gross Gamma	-----
7D-4 (H.L. Waste Neut. Tank)	Each Batch before Neutralization	4 (125 ml bottles)	Neut. Equivalent U Fluorimetric Pu Alpha Count Sp. Gr.	-----
7D-4 (H. L. Waste Neut. Tank)	Each Batch After Neutralization	2	pH	Not < 8.0 pH
7D-5 (Recovered Acid)	Once Per Day at 2000 or more often if needed.	2 (125 ml bottles)	H ⁺ Gross Gamma	Not < 10.0 <u>M</u> HNO ₃

SAMPLING REQUIREMENTS

NPR 1 TONNE. U/DAY RUN PLAN

Hot Run No. 1

April, 1966

NPR Run

<u>STREAM OR VESSEL</u>	<u>SAMPLING FREQUENCY</u>	<u>NUMBER OF BOTTLES</u>	<u>TO BE ANALYZED FOR</u>	<u>SPECIFICATION</u>
7D-6 (24 Hour Composite From 7G-14)	Once Per Day at 0030	2 for Analytical (125 ml bottles) 1 for H & S (125 ml bottles)	Gross Beta and Gross Gamma by Lab. Tritium by Health & Safety	
7D-6 (Neutralized Effluent to Interceptor)	Once Per Shift	2 (125 ml bottles)	Litmus Paper Test by Operator Gross Beta and Gross Alpha by Health & Safety	Basic Not > 1.0×10^{-1} $\mu\text{C}/\text{ml}$ Gross Beta Not > 1.0×10^{-2} $\mu\text{C}/\text{ml}$ Gross Alpha
7D-10 (L. L. Waste Neut. Tank)	Each Batch Before Neutralization	4 (125 ml bottles)	Neut. Equivalent U Fluorimetric Pu Alpha Count Sp. Gr.	-----
7D-10 (L. L. Waste Neut. Tank)	Each Batch After Neutralization	2	pH	Not < 8.0 pH
7D-13 (Laundry-Analytical Drain)	Each Batch Collected	4 (125 ml bottles) 1 (125 ml bottle)	U Fluorimetric and Pu Alpha Count by Lab. Gross Alpha and Beta by Health & Safety	Not > 0.1 g/l U Not > 1.6×10^{-4} g/l Pu Not > 1×10^{-1} $\mu\text{C}/\text{ml}$ Gross Beta Not > 1×10^{-1} $\mu\text{C}/\text{ml}$ Gross Alpha
7D-14(Hot Analytical Cell Drain)	Each Batch Collected (Jet to and Sample in 7D-4)	4 (125 ml bottles)	U Fluorimetric Pu Alpha Count H^+ Sp. Gr.	Not > 0.6 g/l U Not > 1.2×10^{-2} g/l Pu
13D-4 (1st. Cycle Solvent)	Every other day at 0600	2 (125 ml bottles)	TBP, Gross Gamma	30 ± 1.0 Vol. % TBP

SAMPLING REQUIREMENTS

Hot Run No. 1
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NPR Run

NPR 1 TONNE U/DAY RUN PLAN

<u>STREAM OR VESSEL</u>	<u>SAMPLING FREQUENCY</u>	<u>NUMBER OF BOTTLES</u>	<u>TO BE ANALYZED FOR</u>	<u>SPECIFICATION</u>
13D-5 (2nd. Cycle Solvent)	Every Other Day at 0600	2 (125 ml bottles)	TBP, Gross Gamma	30 ± 1.0 Vol. % TBP
13D-6 (3rd. Cycle Solvent)	Every Other Day at 0600	2 (125 ml bottles)	TBP, Gross Gamma	30 ± 1.0 Vol. % TBP
13D-8 (Solvent Wash Waste)	Each Batch Collected	6 (125 ml bottles)	U Fluorimetric Pu Alpha Count H^+ or OH^- Sp. Gr.	Not > 0.11 g/1 U Not > 1.0×10^{-5} g/1 Pu
13D-19 (Diluent Wash)	Once Per Day at 0600	2 (125 ml bottles)	TBP	Not > 2 vol. % TBP
14D-3 (Fresh HNO_3)	At least once per Week	1	H^+	Not < 11.0 M HNO_3
14D-4 (Solvent Wash & Strip)	Once Per Shift	1	H^+	$0.4 \pm .1$ M HNO_3 Sp. Gr. 1.012
14D-5 (HEX)	Each Batch Prepared	1	H^+ , Red. N.	$0.10 \pm .02$ M HNO_3 $0.03 \pm .01$ Red. N. 1.002
14D-7 (IIBX)	Each Batch Prepared	1	H^+ , Red. N.	$0.05 \pm .01$ M HNO_3 $0.03 \pm .01$ Red. N. 1.002
14D-9 (HCX, ICX Makeup, and IEX)	Once Per Shift at 2000	1	H^+	$0.01 \pm .005$ M HNO_3 1.000
14D-10 (IAS Acid)	Each Batch Prepared	1	H^+	$0.01 \pm .005$ M HNO_3 1.000

SAMPLING REQUIREMENTS

NPR 1 TONNE U/DAY RUN PLAN

Hot Run No. 1
April, 1966
NPR Run

<u>STREAM OR VESSEL</u>	<u>SAMPLING FREQUENCY</u>	<u>NUMBER OF BOTTLES</u>	<u>TO BE ANALYZED FOR</u>	<u>SPECIFICATION</u>	<u>Sp. Gr.</u>
14D-12 (IAS Ferrous Sulfamate)	Each Batch Prepared	1	Red. N.	$0.35 \pm .05$ Red. N.	1.061
14D-13 (IAF & IDF Butl)	When Requested by Supervision	1	H ⁺	12.0 ± 2.0 M HNO ₃	1.316
14D-14 (NaNO ₂ Mix Tank)	Each Batch Prepared	1	NO ₂ ⁻	$0.8 \pm .04$ M NaNO ₂	1.035
14D-16 (HAS)	Each Batch Prepared	1	H ⁺	$3.0 \pm .10$ M HNO ₃	1.097
14D-18 (IIAS)	Each Batch Prepared	1	H ⁺	$1.0 \pm .2$ M HNO ₃	1.032
14D-22 (Hull Rinse Water)	Each Batch Prepared	1	H ⁺	$0.1 \pm .05$ M HNO ₃	1.002
14D-23 (Pu IX Wash)	Each Batch Prepared	1	H ⁺	$6.9 \pm .4$ M HNO ₃	1.219
14D-25B (Caustic for 7D-6 and 6C-3)	Each Batch Prepared	1	OH ⁻	$1.32 \pm .07$ M NaOH	1.055
14D-26A (Carbonate Wash Makeup)	Each Batch Prepared	1	CO ₃ ⁼	$0.2 \pm .01$ M NaCO ₃	1.020
14D-30 (6C-6 Scrub Makeup)	Each Batch Prepared	1	Hg	$0.00224 \pm .0001$ M Hg as per the makeup procedure	1.000
14D-32 (Neutron Poison Solution)	Each Batch Prepared	1	H ₃ BO ₄	Not < 22 g/l H ₃ BO ₄	1.020
14D-33 (IDS)	Each Batch Prepared	1	H ⁺	$0.01 \pm .005$ M HNO ₃	1.000

SAMPLING REQUIREMENTSHot Run No. 1
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NPR RunNPR 1 TONNE U/DAY RUN PLAN

<u>SIRIAM OR VESSEL</u>	<u>SAMPLING FREQUENCY</u>	<u>NUMBER OF BOTTLFS</u>	<u>TO BE ANALYZED FOR</u>	<u>SPECIFICATION</u>	<u>Sp. Gr.</u>
14D-40 (IAS' and IDS')	Each Batch Prepared	1	H ⁺	4.0 $\pm$.2 <u>M</u> HNO ₃	1.130
14D-45 (IIAF and XAF Butt)	Once Every Other Day	1	H ⁺	13.0 $\pm$.5 <u>M</u> HNO ₃	1.377
14D-46 (Pu IX Elutriant)	Each Batch Prepared	1	H ⁺	0.62 $\pm$.02 <u>M</u> HNO ₃	1.019

URANIUM AND PLUTONIUM ITS FOR DISPOSAL

Hot Run No. 1
April, 1966
NPR Run

NPR 1 TONNAGE U RUN PLAN

The Shift Supervisor may approve the disposal of hulls or solutions that do not exceed the process limits listed below. Any hulls or solutions over the process limit should be recovered when practical. If the operation of the plant is such that disposal of hulls or solutions exceeding the process limit is desirable, prior approval from the Production Manager or his alternate is required.

PERMISSIBLE FISSILE MATERIAL AND ACTIVITY LIMITS FOR DISPOSAL

<u>VESSEL</u>	<u>FOR TRANSFER TO</u>	<u>URANIUM, g/l</u>	<u>PLUTONIUM, g/l</u>	<u>GROSS BEHA</u>	<u>GROSS GAMA</u>
NPR Hulls	Burial	0.11 weight %	0.00015 weight %	-----	-----
3D-2	7D-2	0.026	2.3×10^{-6}	-----	-----
4D-2H (HAWC)	7D-1	0.10	9.6×10^{-5}	-----	-----
4D-8H (IIAWC)	7D-2	0.10	2.0×10^{-5}	-----	-----
4D-10H (IAWC)	7D-2	0.034	3.1×10^{-6}	-----	-----
4D-13H (IDWC)	7D-2	0.034	-----	-----	-----
5D-6	4D-8C	-----	4.0×10^{-3}	-----	-----
5D-11	7C-5	0.20	-----	-----	-----
6C-3	7D-2	0.40	1.0×10^{-2}	-----	-----
6C-6	7D-2	0.30	1.0×10^{-2}	-----	-----
6D-3	7D-2	0.1	7.0×10^{-3}	-----	-----
7C-4	7D-10	0.10	1.0×10^{-3}	-----	-----
7C-5	8D-1	0.30	3.0×10^{-3}	-----	-----
7D-13	Interceptor	0.10	1.6×10^{-4}	1×10^{-1}	1×10^{-2}
7D-14 (Sample in 7D-4)	8D-1	0.6	1.2×10^{-2}	-----	-----
13D-8	7D-2	0.11	1.0×10^{-5}	-----	-----
7D-6	Interceptor	-----	-----	1×10^{-1}	1×10^{-2}

Section II - Processing Summary

General

The first spent reactor fuel processed at NFS was discharged from the New Production Reactor (NPR) located at Richland, Washington. This initial load of fuel was supplied by the U. S. Atomic Energy Commission under its contract with NFS. It consisted of about 95 metric tons of uranium, containing 54.9 kg plutonium, that was delivered to NFS in the NFSX-1 rail cask during the period 10/30/65 to 6/6/66. This material was processed in three separate lots as shown below with a plant clean-out between each lot.

	<u>Processing Dates</u>		<u>MTU</u>	<u>Kg Pu</u>	<u>Average Burnup</u>
	<u>From</u>	<u>To</u>			
Lot AEC-II (1)	4/20/66	5/24/66	19.7	1.7	100 MWD/T
Lot AEC-I	5/24/66	6/27/66	28.8	2.3	100 MWD/T
Lot AEC-III	6/12/66	11/24/66	46.7	50.9	1700 MWD/T

(1) At the beginning of the processing year the AEC designated three processing lots of fuel and the content of each lot was identified with respect to position in the fuel storage pool. However, due to problems encountered in moving fuel within the pool, NFS elected to process the fuel designated in Lot AEC-II prior to the fuel designated in Lot AEC-I.

Lot AEC-II was originally designated as a 24 metric ton uranium batch. Prior to completing this lot, a malfunction in the 250 ton fuel shear occurred. NFS elected to terminate the lot (with AEC concurrence) to complete repairs.

Following completion of Lot AEC-I, a scheduled shutdown of 19 days was taken to make some modifications in the Low Activity Waste - Acid Recovery System. This system continued to malfunction throughout the processing of Lot AEC-III, and in September the plant was shut down for almost two months to modify the system further. This shutdown occurred just after operations had been restarted following repair of damages caused by a runaway truck. Damage to the Utility Room wall resulted in a temporary loss of several building services.

Other major problems were encountered in the following areas:

- (1) Process Mechanical Cell Mechanical Handling Systems.
- (2) Solvent Extraction Column Pulsing Systems.
- (3) Plutonium Anion Exchange System.
- (4) Vessel Off-Gas System.

Details of these problems and actions taken are described in the discussion portion of this section.

Process Mechanical Cell (PMC)

Initial operations in the PMC were satisfactory. Shearing of assemblies began with the shear set to cut 5/8-inch fuel pieces. Because of the brittleness of the metal, excessive quantities of metal fines were generated. This problem was solved by increasing the length of cut to two inches. The lengths of NPR assemblies were 17 inches or 23 inches.

Initially it was believed that the fuel shearing operation might be one of the limiting factors in process throughput. After experience was gained in handling NPR fuel and in PMC operations, an instantaneous throughput rate of 2 MTU per day was attained. This was considerably in excess of the maximum 1.2 MTU per day throughput achieved in solvent extraction. There were, nevertheless, major equipment problems in the PMC which contributed to downtime. These were in the 250 Ton Shear, the Master Slave Manipulators (MSM) and the Power Manipulator (PAR).

250 Ton Shear

After 19.7 MTU of Lot AEC-II fuel had been sheared, the 250 Ton Shear went out of service. A pin in the outer gag operating mechanism worked loose and caused failure of the connecting links to the mechanical drive of the outer gag. This failure caused jamming of the inner gag mechanism and fractured the throughwall operating shaft and several bolts which support a bearing on the main gear shaft. The original installation consisted only of a pressure fit of the pin to the shaft. Although repairs were completed in seven days, NFS elected to terminate the processing lot to utilize the downtime for process cleanout and turnaround.

During the processing of Lot AEC-I, the feed ram which pushes fuel into the shear began jamming at irregular intervals. Processing of fuel was completed without hindering throughput. During the turnaround period, the shear was disassembled. It appeared that the rubber shoe on the outer gag probably impeded the ram operation. During the disassembly the outer gag rod was found to be fractured where it connects to a drive mechanism. This should have hampered shearing operations, but no difficulty was experienced that could be attributed to the broken linkage.

The connecting rod break was satisfactorily welded. An inspection of the shear traveling knife revealed significant wear. The knife was removed, reversed, and reinstalled. (Each knife has two cutting edges). Approximately 200,000 cuts were made with this first edge.

There was a failure of a lubrication hose to the traveling knife ram, but no plant downtime resulted.

Master-Slave Manipulators

The major share of fuel handling in the PMC is done with Master Slave Manipulators (MSM's). The nature of the work is such that MSM's are

put to very heavy duty. Frequent breakdown of equipment was experienced from the start. The MSM's were not rugged enough to withstand the heavy work required. In addition, repairs were difficult because the boot which protects the in-cell mechanism from exposure to liquids and radioactive contamination tore continually. Decontamination of the MSM's prior to actual repair became a major part of repair time. Eventually NFS had to replace most of the original MSM's with one of a sturdier design to withstand the heavy useage. The new manipulators had a substantial boot, but ruptures continued to occur and decontamination was still a significant part of repair time.

Power Manipulator

Along with the Master Slave Manipulators, the Power Manipulator (PAR) is one of the most important service tools in the PMC. There were many mechanical and electrical problems which immobilized the PAR for significant intervals throughout the processing of the first 95 MTU of NPR fuel.

In one instance, the tube hoist cable broke allowing all tubes with the exception of the large base tube to drop past their mechanical stops. This caused extensive damage to the wrist extension and the rotating section. With the help of the vendor, several modifications were made to strengthen this unit. In addition to this major outage, there were frequent outages caused by electrical failures of the DC motor, of insulation wire due to tensions applied directly to the wire, and of hand and wrist motions.

It is estimated that the PAR was out of service for repairs at least 35% of the effective operating time. NFS and the vendor investigated the PAR problems to improve the design and extend the useage time of the equipment.

General Purpose Cell

During the processing of fuel in the first three lots, a sampling technique was used to determine the residual quantities of uranium remaining in the fuel hulls following leaching. This technique was unsatisfactory because a representative sample could not be taken. Each dissolver batch contained about 150 kg of hulls, and a good statistical sample would have required 10% of this quantity. Since the analytical laboratory could not handle a quantity that large, sampling consisted of removing only a few pieces from each batch. As can be seen from the data in Tables I, II, and III, the residue in the leached hulls varied significantly from batch to batch without correlation with any other aspect of the dissolution step. Alternate methods for measurement of nuclear material in the hulls are being developed. One method involves a comparison of the fuel fabricator's cladding weight with the weight of the hulls discharged from the dissolver.

TABLE I

SUMMARY OF LOT AEC-II DISSOLUTION DATA

Date	Batch/ Vessel	No. of Bas- kets	No. of Assm.	U Kgs ^{1/} Charged	Acid ^{2/} Charge Liters	Acid ^{2/} M	Boil Time Hrs.	Rinse Acid Liters	Hull Leach Liters	Heel Acid M	Boil Time Hrs.	U in Hulls Kgs	3D-1 ^{3/} U g/l	3D-1 Kgs U	3D-1 ^{3/} Acid M	
4/21	1 (3C-2)	4	60	1110	2760	10.4	24	423	None	-	-	1.2	302	1070	3.1	
4/23	2 (3C-1)	5	75	1389	3693	9.2	32	*	None	-	-	7.5	303	1394	2.9	
4/24	3 (3C-2)	5	75	1389	2622	11.2	37	820	None	-	-	2.2	318	1367	2.5	
4/26	4 (3C-1)	5	90	1665	3231	8.9	53	800	None	-	-	7.1	333	1671	2.5	
4/27	5 (3C-2)	5	90	1665	4107	8.3	48	820	None	-	-	6.2	323	1667	2.0	
4/30	6 (3C-1)	5	90	1665	4107	8.3	43	837	None	-	-	5.6	319	1640	2.1	
5/1	7 (3C-2)	5	90	1665	4112	8.3	50	701	1496	12	19	5.2	327	1650	2.4	
5/2	8 (3C-1)	5	90	1665	4113	8.3	40	*	1558	11	17	13.5	349	1648	*	
5/4	9 (3C-2)	5	90	1665	4872	6.5	37	*	*	*	14	0.0	356	1664	2.0	
5/5	10 (3C-1)	5	90	1665	*	*	*	*	*	*	12	0.3	394	1616	2.0	
5/7	11 (3C-2)	5	90	1665	3727	7.1	14	*	3174	12	9	0.0	568	1695	2.1	
5/9	12 (3C-1)	5	90	1665	3894	8.3	24	1125	1485	12	12	0.1	322	1678	2.5	
5/11	13 (3C-2)	5	75	833	2320	7.1	23	*	3178	12	10	0.0	337	810	2.1	
		1095												48.9	19570	

*Information not available.

^{1/} Reactor Estimates.

^{2/} Estimates from makeup tank records.

^{3/} Lab analysis.

These notes also apply to Tables II and III.

TABLE II

SUMMARY OF LOT AEC-I DISSOLUTION DATA

Date	Batch/ Vessel	No. of Bas- kets	No. of Assm.	U Kgs ^{1/} Charged	Acid ^{2/} Charge Liters	Acid ^{2/} M	Boil Time Hrs.	Rinse Acid Liters	Hull Leached Liters	Heel Acid M	Boil Time Hrs.	U in Hulls Kgs	3D-1 ^{3/} U g/l	3D-1 Kgs U	3D-1 ^{3/} Acid M
5/20	(3C-2)	5	90	1665	4670	7.3	21	500	3173	11.5	10	0.0	328	1711	2.5
5/21	(3C-1)	5	90	1665	4112	8.3	21	820	3473	11.0	9	0.0	329	1679	2.9
5/25	(3C-2)	5	90	1665	4112	8.2	21	820	3040	12.0	10	1.4	341	1669	2.3
5/27	(3C-1)	5	90	1665	4402	7.6	21	820	3040	12.0	9	0.0	335	1661	2.6
5/29	(3C-2)	5	120	1665	4200	8.1	21	820	3040	12.0	9	0.0	328	1638	2.6
5/30	(3C-1)	5	120	1665	4200	8.1	21	820	3040	11.7	9	0.0	357	1670	2.2
5/31	(3C-2)	5	120	1665	4112	7.4	23	830	3040	16.7	9	7.9	306	1546	2.1
6/2	(3C-1)	5	120	1665	4005	*	22	834	1269	11.5	13	0.0	362	1772	2.0
6/2	(3C-2)	5	120	1665	4200	*	21	*	3490	*	13	3.9	291	1650	3.1
6/4	(3C-1)	5	118	1628	4110	*	22	830	3181	11.5	11	0.0	340	1640	1.8
6/6	(3C-2)	5	108	1669	4212	8.1	21	830	3933	11.5	9	0.4	327	1697	2.3
6/7	(3C-1)	5	90	1665	4376	10.0	21	830	3023	11.9	9	0.1	317	1722	3.0
6/8	(3C-2)	5	90	1665	4122	8.1	23	819	3040	11.9	9	0.1	342	1669	2.3
6/11	(3C-1)	5	90	1665	4100	8.1	21	830	3033	11.9	9	0.3	333	1653	2.3
6/12	(3C-2)	5	90	1665	4100	8.1	22	830	3048	11.9	10	0.0	336	1672	2.2
6/14	(3C-1)	5	90	1665	4120	8.1	21	834	1796	11.6	9	0.0	353	1654	2.1
6/15	(3C-2)	3	54	998	2000	*	21	492	1838	11.6	9	0.0	354	1021	2.6
6/17	(3C-1)	4	65	1100	2100	*	21	517	3320	11.9	9	0.1	339	1081	2.0

1755

14.2

28805

SUMMARY OF LOT AEC-III DISSOLUTION DATA

Date 1966	Batch No.	No. of Bas- kets	No. of Assm.	U Kgs ^{1/} Charged	Acid ^{2/} Charge Liters	Acid ^{2/} M	Boil Time Hrs.	Rinse Acid Liters	Hull Leached Liters	Heel Acid M	Boil Time Hrs.	U in Hulls Kgs	3D-1 ^{3/} U g/l	3D-1 Kgs U	3D-1 ^{3/} Acid M
7/15	1	5	90	1665	4115	7.1	21	*	3088	11.4	10	9.9	332	1654	0.3
7/15	2	5	90	1665	4382	7.9	23	*	3980	7.8	12	0.0	310	1640	2.0
7/18	3	5	90	1665	4180	6.3	33	*	3016	11.4	10	0.0	324	1656	2.1
7/20	4	5	90	1665	4060	7.7	22	*	3040	11.4	12	0.0	312	1606	2.1
7/21	5	5	90	1665	4120	7.7	21	*	3188	11.4	10	9.4	310	1540	1.9
7/23	6	5	90	1665	4100	7.6	22	*	3003	10.5	10	0.0	313	1672	1.9
7/24	7	5	90	1665	4100	7.6	24	823	3400	11.4	9	0.0	352	1704	2.1
7/25	8	5	90	1665	4129	7.4	23	309	3400	9.4	10	28.7	311	1438	2.7
7/27	9	5	90	1665	4158	6.7	20	747	3336	11.2	10	0.0	362	1818	1.0
7/28	10	5	90	1676	4175	8.1	20	*	3470	10.9	10	0.0	348	1690	2.4
7/29	11	5	90	1665	4119	8.3	15	720	3311	10.7	9	0.0	333	1666	1.6
7/31	12	5	90	1665	4126	7.8	20	*	3325	10.7	22	0.0	345	1674	2.1
8/1	13	5	90	1665	3980	8.3	21	830	4083	7.9	27	0.0	322	1574	1.5
8/3	14	5	90	1665	5008	5.8	18	208	3795	10.7	10	9.9	285	1588	3.0
8/3	15	5	90	1665	4100	6.4	21	208	4116	9.0	10	0.0	314	1596	2.5
8/5	16	5	90	1665	4448	7.4	20	716	3330	10.4	9	18.2	364	1912	2.0
8/6	17	5	90	1665	4168	7.6	19	743	3323	10.5	14	6.4	296	1514	2.2

Continued

TABLE III (CONT'D)

Page 2

SUMMARY OF LOT AEC-III DISSOLUTION DATA

Date 1966	Batch No.	No. of Bas- kets	No. of Assm.	U Kgs ^{1/} Charged	Acid ^{2/} Charge Liters	Acid ^{2/} M	Boil Time Hrs.	Rinse Acid Liters	Hull Heel Leached Acid Liters M	Boil Time Hrs.	U in Hulls Kgs	3D-1 ^{3/} U g/l	3D-1 Kgs U	3D-1 ^{3/} Acid M
8/8	18	5	117	1657	4154	7.6	20	726	3474 10.5	10	12.4	325	1709	1.6
8/10	19	5	120	1656	4043	*	20	815	3462 *	12	0.0	372	1778	1.5
8/11	20	5	120	1656	4011	*	23	733	3763 *	14	0.0	332	1638	1.8
8/13	21	5	120	1656	4314	*	19	719	3824 *	13	0.0	312	1626	2.2
8/14	22	5	120	1656	4390	*	19	705	3178 *	13	0.0	340	1729	2.0
8/15	23	5	92	1669	3707	*	17	407	3460 *	13	0.0	301	1520	2.2
8/17	24	5	90	1665	3633	*	23	125	3569 *	15	0.0	345	1850	2.0
8/19	25	3	53	981	4176	*	19	*	3447 *	17	0.0	322	933	2.8
8/20	26	5	90	1665	3447	*	18	*	3600 *	13	13.1	312	1509	2.1
8/22	27	5	90	1656	*	*	20	743	3030 *	13	0.0	311	1815	1.3
8/25	28	4	72	1325	*	*	20	*	2314 *	17	0.0	324	1381	2.5
8/28	29	3	63	810	2855	*	20	*	1195 *	53	0.0	*	*	1.4
2677											108.0	45430		

There were many mechanical and electrical problems with the Master Slave and Power Manipulators in the General Purpose Cell. These were similar to those described for the same equipment in the Process Mechanical Cell and were attributed to the heavy duty work that was performed.

Dissolving

At the start of NPR processing, the standard dissolver charge was 1.1 tonnes uranium. The charge was gradually increased to 1.7 tonnes uranium. This became a standard dissolving batch for NPR fuel. The dissolving time cycle was also varied until an optimum total time cycle of 30 hours was established. The steps in the cycle were: twenty-one hours initial dissolution; transfer dissolver solution to 3D-1; end with a nine-hour hull leach using fresh acid. Tables I, II, and III are summaries of the dissolving operations over the first three NPR processing lots.

There were several pressurizations experienced during the dissolving operations. These appeared to be caused by erratic operation of the air-operated control valves on the off-gas system. On several occasions the valves were removed, cleaned, and reset. This did not solve the pressurization problem. On one occasion liquid burped into the off-gas system creating a seal which had to be blown out with high pressure air.

Solvent Extraction

The solvent extraction system performance throughout the processing of the NPR fuel was adequate. However, it was evident from the beginning that alterations to the pulsing system would be required to gain an efficient operation. There were frequent failures of the pulser pumps which led to the conclusion that the pumps were not suitable for this type operation. Eventually, NFS replaced all of the original pulser pumps. The original design of the system placed globe valves in the pulsing lines. These valves caused an excessive pressure drop in the system requiring more work for the pumps. During Lot AEC-III processing, ball valves were placed in the first and second cycles to determine their effect on the pressure drop. As a result of this test, all of the globe valves were replaced with ball valves.

The average throughput rate was 1.1 tonnes U per day with a maximum attained throughput of 1.4 tonnes U per day. With all systems operating satisfactorily a sustained throughput of 1.25 tonnes U per day could be obtained.

Product losses were generally within the flow sheet limits. However, there were several instances of large losses which required recycle of waste solutions via the rework system. During the first recycle of solution, recovery of plutonium was poor (about 50%) and the partition cycle solvent showed excessive degradation. It was concluded that the losses and degradation were caused by the presence of excessive fission products

and solids in the rework solution. Nearly 30% of rework was found to be from partition cycle waste which contains 95% of the fission products and most of the solids generated from the dissolver. Recycling through rework concentrated these undesirables, and they caused degradation of solvent when fed back into solvent extraction. The addition of solvent wash waste to the rework was also a problem. Since this solution was acid deficient, it could have caused precipitation or polymerization of plutonium. As a result of the degradation, NFS had to replace the partition cycle solvent following the completion of processing of Lot AEC-II. It was also decided that recycle of partition cycle waste and solvent wash waste would be minimized to prevent recurrence of solvent degradation. Table IV is a summary of product losses from solvent extraction for the three initial NPR fuel processing campaigns.

Useful decontamination data on the solvent extraction system was not available because of the low burnup of the NPR fuel processed in the first three lots. (This is now available from Dresden and Yankee reactor fuel reprocessing summaries which can be obtained from DTIE, Documents SRO-123 and SRO-124.) Upon initial startup of the solvent extraction system it was found that the uranium from the first 2-3 days of processing was out of specification with regard to fission product content. This was apparently the time interval required for the system to reach equilibrium. The material was stored for recycle at the end of the campaign just prior to system cleanout.

Intermittent pluggage in the feed lines to the partition cycle was attributed to the metal fines generated during shearing and dissolving. Eventually a filter was installed in the transfer line from the dissolver to the accountability and feed adjustment tank (3D-1) to remove the solids.

Solvent Recovery

Operation of this system using 0.2M Na_2CO_3 solution was satisfactory. However, excessive U or Pu in the solvent could have caused precipitated or polymerized products in the acid deficient wash waste.

Since the solvent wash waste was evaporated prior to discard, the presence of small quantities of solvent in addition to the carbonate could have contributed to maloperation in the waste evaporators. (NFS later discovered that these solvent wash waste solutions were undesirables in any evaporator, and provisions were made for discard directly to underground waste storage.)

Plutonium Purification

This system includes three ion exchange resin columns operated in parallel to provide an additional decontamination step for plutonium and a concentration of plutonium from about 2 grams per liter of solution as received from solvent extraction to 65 grams per liter of solution. This concentrated plutonium is then evaporated to 250 grams per liter for packaging for shipment.

TABLE IV
PRODUCT LOSSES FROM SOLVENT EXTRACTION

<u>Lot AEC-</u>		<u>Partition Cycle</u>	<u>Pu Cycle</u>	<u>1st U Cycle</u>	<u>2nd Cycle</u>	<u>Solvent Wash Waste</u>
II	Kg U Lost	1.7	0.0	5.9	6.1	18.8
	% of Input	0.009	0.0	0.03	0.03	0.10
I	Kg U Lost	0.8	0.1	6.0	1.3	12.2
	% of Input	0.003	0.0	0.02	0.00	0.04
III	Kg U Lost	13.0	0.4	31.7	42.3	41.2
	% of Input	0.028	<0.1	0.07	0.09	0.09
II	Gm Pu Lost	4.6	0.2	3.4	0.9	16.8
	% of Input	0.3	<0.1	0.2	0.1	1.0
I	Gm Pu Lost	2.3	1.6	2.9	0.4	9.9
	% of Input	0.1	0.1	0.1	<0.1	0.4
III	Gm Pu Lost	52.3	48.6	18.0	1.0	45.4
	% of Input	0.1	0.1	<0.1	<0.1	<0.1

Operation of the anion exchange system with Permutit -- SK resin was for the most part satisfactory with a maximum load established at about 4.5 kg plutonium per resin column.

During the processing of the last 20-30 kg of plutonium in Lot AEC-III, NFS began to experience decontamination difficulties with the plutonium. Although the solution was successfully decontaminated to meet specifications, the system did not function as expected. NFS suspected that the isolation valves for each of the three resin columns were leaking, causing cross contamination of the product streams. Replacement of the valves was scheduled prior to the next processing lot. In addition, to enhance decontamination, a column wash consisting of about 300 liters of 7.0M HNO_3 - 0.05M HF was put in just after the column was loaded with the Pu Product.

Operation of the plutonium product evaporator was satisfactory as it was able to keep up with the throughput rate for the low burnup NPR fuel. It was evident, however, that it would limit plant throughput with higher burnup fuels. The discharge piping from the evaporator continually plugged. The unplugging operation required entry of maintenance personnel into the Pu Purification Cell. This was unsatisfactory and NFS planned several modifications to the system.

Uranium Purification

This system consists of silica gel columns for final decontamination of uranium. It functioned satisfactorily in removing the last traces of fission product zirconium. As related above, during startup of each campaign, solvent extraction decontamination was insufficient and the silica gel could not remove the excess fission products; therefore, this material was recycled. During subsequent solvent extraction operation, this system performed well.

Low Activity Waste - Acid Recovery

This was the most serious problem area in the plant and was the major cause of plant outage throughout the initial period of processing. During the processing of Lots AEC-II and I, waste evaporator 7C-2 burped intermittently causing carryover of fission products into the acid recovery system. Shielding of the acid recovery equipment was not adequate for this carryover, and radiation levels in occupied areas of the plant consequently increased up to 50 mr/hr. NFS had to shut down operations on several occasions to decontaminate the Acid Recovery System. A nineteen-day shutdown was taken prior to starting Lot AEC-III in order to correct some of the problems. Included in the revisions was the installation of a de-entrainment vessel between 7C-2 and its condenser 7E-7 to take out any entrained liquid carried in the overheads. The system was functioning satisfactorily until it was shut down on August 30 because of a non-related accident involving the crash of a truck into the process utility building. Upon starting up the system, there was a sudden surge of pressure and a burp of evaporator

bottoms into the overheads. This contaminated the entire Acid Recovery System and caused the shutdown of processing operations until October 27. Radiation levels in the occupied areas of the plant were as high as 100 mr/hr.

During the long shutdown period, most of the effort was spent on cleaning up the Acid Recovery System. The 7E-7 condenser was especially troublesome to clean up because of the design. The coolant is passed through the tubes while the condensate is passed through the shell. The shell contains many crevices and corners where radioactive solids and solutions lodge and become difficult to remove.

NFS generated 30,000 gallons of waste in cleaning up the Acid Recovery System and a variety of chemicals were used including:

- (1) Concentrated Nitric Acid
- (2) Nitric Acid - HF Mixture
- (3) Caustic - Permanganate Mixture
- (4) Oxalic Acid
- (5) Turco Solution

It was not possible to determine which chemical was the most effective.

Following the cleanup, some piping changes were made so that the 7C-2 overheads were fed to the general purpose evaporator (7C-5) prior to entering Acid Recovery. This provided another decontamination stage, but was done at the expense of throughput rate because 7C-5 has a smaller capacity. As a result, the solvent extraction throughput rate was reduced to 0.6 tonnes U per day. New controls for controlling steam to the 7C-1 and 7C-2 evaporators were installed.

These consisted of:

- (1) Installation of a trap in the steam condensate-out line.
- (2) Installation of a plenum chamber and pump on the steam condensate-out line to help overcome the excessive head between the evaporator and the main condensate header (not tied in).
- (3) Installation of controls for steam input to the evaporator by moving the control point from the condensate-out to the steam inlet.

NFS planned to operate this system until the completion of Dresden fuel processing when a shutdown was planned for installation of a new 7C-2 vessel so that the throughput rate can be returned to the normal one tonne U per day.

Waste Handling

The design of the plant specified storage of radioactive liquid waste in 750,000 gallon underground vessels. These are uncooled vessels designed

for self boiling wastes that evaporate to maximum solids concentration. Included in the design were provisions for using air circulators. However, the air circulator would not function until 400,000 gallons of solution were in the vessel. Therefore, NFS had to initially charge this amount of water to assure operation of the circulator. In addition, the initial fuel processed did not contain sufficient fission products to promote the self boiling. Consequently, NFS had about a 200,000 gallon capacity for waste storage to the nominal fill point of 600,000 gallons. This might have been sufficient had not the severe problems in the Acid Recovery System developed which required storage of large quantities of decontamination solutions. It was apparent that NFS would have to provide for boil-off of the solution with an external heat source.

From available data, it was estimated that the waste volume generated, exclusive of the extra solutions from decontamination, was about 400 gallons per tonne uranium. This was close to the flow sheet calculation of 411 gallons per tonne.

Miscellaneous Systems

Vessel Off Gas System (VOG)

Frequent pluggage of the VOG filters was experienced throughout the NPR processing campaigns. Installation of a cyclone separator on the system was completed just prior to processing of Lot AEC-III. The separator did not alleviate the problem even though entrained moisture was suspected as the cause of the pluggage.

Sampling of the vessel off-gases just prior to entry into the filters confirmed that high concentrations of radioactive particulates were present in the off-gas stream. The particulates bypassed the scrubber and cyclone and eventually plugged the filters. The filters cost \$1,300 each. In addition to this cost, many personnel received their allowable quarterly radiation dose during changeout of filters. Table V is a summary of the VOG filter failures during the Lot AEC-III processing period.

On one particular occasion both VOG filters were plugged at the same time, and no spare filters were available. A partial vacuum was kept on the system by opening vessel 3D-1 to dissolver 3C-2 via the 3C-1 transfer line. This tied the VOG system to the dissolver off-gas system exhausters.

During the shutdown period while acid recovery system was being cleaned out, an adapter was installed in the filter housing. This permitted use of off-the-shelf filters that cost \$100. At the same time, a stainless steel roughing filter was placed in front of the absolute filter. This latter modification alleviated the problem and reduced the frequency of filter changes.

TABLE V
VESSEL OFF-GAS FILTERS

<u>VOG</u>	<u>Date Put On Line</u>	<u>Date Off Line</u>	<u>P in inches at Time of Replacement</u>
6T2	7/15/66	7/23/66	1.5"
6T2A	7/23/66	8/9/66	>15"
6T2	8/9/66	8/13/66	>15"
6T2A	8/13/66	8/13/66	> 2" (Fail DOP)
6T2	8/13/66	8/20/66	>15"
6T2A	8/20/66	8/29/66	>15"
6T2	8/29/66	9/3/66	>15"
6T2A	9/15/66	11/8/66	2.1" (Hole in filter)
6T2	11/8/66	After AEC-III	--

Vessel Sampling System

During the processing of NPR fuel, pluggage in sample and process lines due to presence of metal fines was a continuing problem although with respect to sampling it was not a serious contributor to downtime. However, the 1-C sampler located in the Chemical Operating Aisle was plagued with several mechanical failures during the campaign. The service manipulator broke down on several occasions and required extensive maintenance time for repair. The elevator between the sampler and the Analytical Laboratory was out of service for long periods of time. Of the two problems, the most serious was that concerned with the elevator. It was a cable type lift that makes two right-angle turns on the way to the laboratory. The cable would slip off of its drive drum and jam the system. Correcting this was very tedious and time consuming. On one occasion the cable kinked and had to be replaced. This job alone took one week to complete. It appeared that the elevator would be a continuing problem. While repairs were being made, NFS hand carried samples to the lab in lead pigs. While this is an expedient, it is unsatisfactory for long term use because of the high radiation generated by 3D-1 and High Activity Waste (4D-2) samples.

General Building Ventilation Reversals

On several occasions there were air reversals in the building ventilation system which resulted in a general spread of low level contamination throughout the process building. The three ventilation systems (Building Ventilation, Vessel Off-Gas and Dissolver Off-Gas) were so delicately balanced that the opening of too many doors could cause an upset, especially in the GPC and PMC areas. An attempt was made to administratively control the opening of the various doors.

Recovered Product

Contractual requirements provided for delivery of recovered product to the AEC in properly packaged and approved containers FOB West Valley. Shipping arrangements and notifications were handled by the AEC. The shipments were made to AEC receiving sites: Uranium - Fernald, Ohio, and Plutonium - Richland, Washington.

A total of 24 shipments of uranyl nitrate were made using an NFS tank trailer as authorized under DOT SP 5059. Two shipments containing a total of 31 containers delivered the plutonium product under DOT SP 5061. The above shipments delivered about 95 tonnes of uranium and 54 kilograms of plutonium recovered during processing of Lots AEC-I, -II, and -III.

Section III - Analytical Comparisons

The terms of the contract between AEC and NFS granted AEC the right to observe any measurements made by NFS in their laboratory and to make any measurements desired for the purpose of verifying NFS analyses. The contract specified that these analyses should be made using NFS laboratory equipment and analytical procedures approved by the AEC Contracting Officer.

For verification purposes, AEC elected to analyze only those NFS samples that were most important from an accountability standpoint, i.e., the samples representing large quantities of uranium and/or plutonium. These were the input accountability samples (3D-1), and the uranium and plutonium product samples. Analytical results and comparisons between AEC and NFS for input and among AEC, NFS, and National Lead (NL - uranium only) for product are found in Tables VI through XI at the end of this report. No effort was made to analyze the large numbers of waste, hull, or inventory samples since these were too numerous for the available two-man AEC analytical team and these types of samples individually represented only small quantities of special nuclear materials.

For the purpose of making the analyses, AEC obtained the temporary services of a chemist and a technician from the Savannah River Plant. These two people made analytical measurements for the AEC during the processing of Lots AEC-II and AEC-I after which they were replaced by two permanent AEC chemists who were trained in the appropriate analytical methods at the Savannah River Plant prior to assuming their functions at NFS. The AEC chemists performed the analyses of Lot AEC-III samples.

There were some difficulties involved in making analytical measurements in the contractor's laboratory and using only his equipment and his procedures as specified by the contract. Most of these problems were associated with working space and equipment limitations, equipment maintenance, and the unfamiliarity of the AEC analysts with the particular equipment in use at NFS. For example, use of the hot cells by AEC was not practical, although such use is necessary if a completely independent analysis of an input accountability sample is to be made. The contract afforded AEC access to the cells at all times, but NFS found it necessary to use the cell space almost continuously, leaving little time for AEC analysts to learn the operation of the NFS manipulators, let alone prepare samples. To solve this problem, AEC chose to observe NFS hot cell work, and to analyze aliquots of these samples outside the cells. The same types of problems were encountered in connection with the use of hood space, bench top space, and counting equipment. Many of the difficulties related to equipment and space-sharing could be attributed to the problems associated with the startup of a new facility. As time passed and both NFS and AEC became more efficient in their use of equipment and space, some of the early problems disappeared. Others persisted, notably the need to rely on the contractor for maintenance of equipment and chemical and operating supplies. These imposed continuing limitations on the quantity, quality, and methods of analyses that could be performed.

Both NFS and AEC adopted the same system of analysis for all types of accountability samples. Single concentration determinations on the contents of each of two duplicate sample vials were made. The average of the two determinations was deemed to be the concentration. Both parties began development of quality control programs consisting of analyzing quality control standards in conjunction with each sample or group of samples analyzed. When the difference between duplicates exceeded the limits established by quality control, analyses were repeated until satisfactory results were obtained.

During the processing of the first three lots of fuel, it was necessary for AEC and NFS to reanalyze many samples to obtain satisfactory results. Agreement between AEC and NFS proved satisfactory for uranium input, uranium product, and plutonium product concentrations. There was open exchange of information between the parties and major differences were resolved through reanalyses by AEC or NFS. Obtaining good agreement on the plutonium concentration in input samples was a continuing problem. AEC concentrations were higher than those of NFS by about 3% on the average and by as much as 8% for individual batches. The AEC method of analysis was TTA-alpha counting. This was the only method available for the determination of plutonium in the presence of large quantities of uranium because AEC did not have the capability for mass spectrometric analysis. Although this method does not have satisfactory precision or accuracy for accountability purposes, it provided a means of detecting errors in NFS' analyses. NFS employed the isotope dilution - mass spectrometer technique which is both accurate and precise. It was concluded that AEC results were high, probably because of the activity of ^{238}Pu in the plutonium. Alpha pulse height equipment was not available for determining the percentage of activity from 238 and applying an appropriate correction. Measurements made by TTA-alpha counting were thus not suitable for detecting NFS errors of normal magnitude but did serve to detect a major NFS bias of several percent in Lot AEC-II, caused by incorrect interpretation of their ^{242}Pu spike data.

Tabulated below are the analytical methods used by AEC and NFS along with the precisions and biases established for the methods:

<u>Sample</u>	<u>Method of Analysis</u>	
	<u>AEC</u>	<u>NFS</u>
Input Uranium	Coulometry P=0.38%, B=Nil	Amperometry P=0.98%, B=Nil
Input Plutonium	TTA - Alpha Count P=2.88%, B=+1.3%	Iso Dil - Mass Spec. P=2.5%, B=Nil
Product Uranium	Coulometry P=0.37%, B=Nil	Potentiometry P=0.48%, B=Nil
Product Plutonium	Amperometry P=0.5%, B=Unknown	Amperometry P=0.8%, B=Nil

(P is precision expressed in terms of relative standard deviation.)

Summarized below are the average percent differences that were found between AEC and NFS analyses for the samples analyzed in each of the three campaigns:

<u>Sample</u>	<u>Lot AEC-II</u>	<u>Lot AEC-I</u>	<u>Lot AEC-III</u>
Input Uranium			
No. Batches	13	18	29
*% Diff.	-1.2	-1.0	+0.3
Input Plutonium			
No. Batches	13	18	29
% Diff.	+2.3	+3.4	+2.2
Product Uranium			
No. Batches	5	7	11
% Diff.	-0.6	-0.2	+0.2
Product Plutonium			
No. Batches	2	1	5
% Diff.	+0.3	+0.4	-0.1

*% Diff. = AEC average relative to NFS. Plus indicates AEC measurements relatively high.

TABLE VI

ANALYTICAL BALANCE - PROCESSING LOT II - URANIUMInput

<u>Batch</u>	<u>NFS</u> <u>g/l</u>	<u>AEC</u> <u>g/l</u>	<u>g/l</u> <u>Diff.</u>	<u>%</u> <u>Diff.</u>	<u>w/o</u> <u>235</u>
1	300.1	300.4	+0.3	+0.1	.942
2	300.5	298.9	-1.6	-0.5	.969
3	315.2	312.7	-2.5	-0.8	.959
4	328.7	330.7	+2.0	+0.6	.931
5	319.5	315.3	-4.2	-1.3	.946
6	315.5	306.6	-8.9	-2.8	.949
7	323.9	322.7	-1.2	-0.4	.926
8	343.9	334.5	-8.4	-2.4	.933
9	352.2	348.8	-3.4	-1.0	.931
10	390.1	384.4	-5.7	-1.5	.935
11	366.6	364.7	-1.9	-0.5	.932
12	None				
13	317.1	307.3	-9.8	-3.1	.913
14	<u>332.4</u>	<u>325.0</u>	<u>-7.4</u>	<u>-2.2</u>	<u>.913</u>
Av.	331.2	327.1	-4.1	-1.2	.937

Fernald

<u>Product</u>					<u>w/o</u>	<u>g/l</u>
1	350.6	350.1	-0.5	-0.1	.941	351.7
2	350.1	347.4	-2.7	-0.8	.948	349.8
3	355.4	350.6	-4.8	-1.3	.944	354.3
4	334.4	333.0	-1.4	-0.4	.934	334.4
5	<u>329.3</u>	<u>329.4</u>	<u>+0.1</u>	<u>+0.0</u>	<u>.924</u>	<u>331.6</u>
Av.	344.0	342.1	-1.9	-0.6	.938	344.4

TABLE VII

ANALYTICAL BALANCE - PROCESSING LOT II - PLUTONIUMInput

<u>Batch</u>	<u>NFS g/l</u>	<u>AEC g/l</u>	<u>g/l Diff.</u>	<u>% Diff.</u>	<u>w/o 240</u>
1	0.0164	0.0150	-0.0014	-8.5	0.30
2	0.0126	0.0126	0.0000	0	0.19
3	0.0154	0.0150	-0.0004	-2.6	0.21
4	0.0146	0.0146	0.0000	0	0.27
5	0.0121	0.0121	0.0000	0	0.21
6	0.0126	0.0122	-0.0004	-3.2	0.27
7	0.0350	0.0355	+0.0005	+1.4	0.78
8	0.0251	0.0262	+0.0009	+4.4	0.51
9	0.0307	0.0322	+0.0015	+4.9	0.52
10	0.0363	0.0369	+0.0006	+1.7	0.60
11	0.0380	0.0392	+0.0012	+1.0	0.70
12	None				
13	0.0667	0.0686	+0.0019	+1.0	1.75
14	0.0878	0.0920	+0.0042	+4.8	2.73
Av.	0.0310	0.0317	+0.0007	+2.3	1.19*

Product

1	61.33	61.42	+0.09	+0.14	0.91
2	<u>72.03</u>	<u>72.30</u>	<u>+0.27</u>	<u>+0.37</u>	<u>0.92</u>
Av.	66.68	66.86	+0.18	+0.27	0.92

*Average is weighted by the Pu concentration of each batch.

TABLE VIII

ANALYTICAL BALANCE-PROCESSING LOT I-URANIUMInput

<u>Batch</u>	<u>NFS</u> <u>g/l</u>	<u>AEC</u> <u>g/l</u>	<u>g/l</u> <u>Diff.</u>	<u>%</u> <u>Diff.</u>	<u>w/o</u> <u>235</u>
1	324.5	317.5	- 7.0	- 2.2	.933
2	324.5	320.3	- 4.2	- 1.3	.925
3	336.3	334.4	- 1.9	- 0.6	.920
4	330.7	332.9	+ 2.2	+ 0.7	.975
5	323.6	320.0	- 3.6	- 1.1	.925
6	352.4	347.6	- 4.8	- 1.4	.927
7	302.1	296.8	- 5.3	- 1.8	.937
8	356.0	352.3	- 3.7	- 1.0	.938
9	285.9	279.2	- 6.7	- 2.3	.920
10	33.47	329.2	- 5.5	- 1.6	.931
11	322.3	318.8	- 3.5	- 1.1	.935
12	312.5	314.5	+ 2.0	+ 0.6	.935
13	337.9	335.3	- 2.6	- 0.8	.934
14	328.5	326.9	- 1.6	- 0.5	.937
15	331.4	329.4	- 2.0	- 0.6	.939
16	350.3	342.7	- 7.6	- 2.2	.943
17	349.0	347.9	- 1.1	- 0.3	.940
18	<u>335.0</u>	<u>334.3</u>	- <u>0.7</u>	- <u>0.2</u>	<u>.932</u>
Average	329.9	326.6	- 3.3	- 1.0	.935

FernaldProduct

					<u>w/o</u>	<u>g/l</u>
1	318.9	316.5	- 2.4	- 0.8	.923	.930 319.0
2	325.0	323.3	- 1.7	- 0.5	.935	.935 324.4
3	328.0	324.2	- 3.8	- 1.2	.939	.940 327.2
4	338.7	337.5	- 1.2	- 0.4	.938	.933 338.9
5	335.0	337.1	+ 2.1	+ 0.6	.935	.939 336.2
6	333.4	336.5	+ 3.1	+ 0.9	.937	.941 334.9
7	<u>318.3</u>	<u>318.2</u>	- <u>0.1</u>	- <u>0.0</u>	<u>.932</u>	<u>.935</u> 320.4
Average	328.2	327.6	- 0.6	- 0.2	.934	.936 328.7

TABLE IXANALYTICAL BALANCE-PROCESSING LOT I-PLUTONIUMInput

<u>Batch</u>	<u>NFS g/l</u>	<u>AEC g/l</u>	<u>g/l diff.</u>	<u>% diff.</u>
1	0.0339	0.0335	- 0.0004	- 1.18
2	0.0464	0.0493	+ 0.0029	+ 6.25
3	0.0469	0.0491	+ 0.0022	+ 4.69
4	0.0455	0.0469	+ 0.0014	+ 3.08
5	0.0235	0.0238	+ 0.0003	+ 1.28
6	0.0291	0.0280	- 0.0011	- 3.78
7	0.0163	0.0167	+ 0.0004	+ 2.95
8	0.0119	0.0126	+ 0.0007	+ 5.88
9	0.0073	0.0073	+ 0.0000	+ 0.00
10	0.0100	0.0108	+ 0.0008	+ 8.00
11	0.0380	0.0400	+ 0.0020	+ 7.14
12	0.0298	0.0307	+ 0.0009	+ 3.02
13	0.0266	0.0279	+ 0.0013	+ 4.89
14	0.0138	0.0147	+ 0.0009	+ 6.52
15	0.0163	0.0172	+ 0.0009	+ 5.52
16	0.0148	0.0152	+ 0.0004	+ 2.70
17	0.0369	0.0382	+ 0.0013	+ 3.52
18	<u>0.0320</u>	<u>0.0330</u>	+ <u>0.0010</u>	+ <u>3.12</u>
Average	0.0266	0.0275	+ 0.0009	+ 3.38

Product

106.30	105.83	- 0.47	- 0.45
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TABLE X

ANALYTICAL BALANCE - PROCESSING LOT III - URANIUMInput

<u>Batch</u>	<u>NFS</u> <u>(g/l)</u>	<u>AEC</u> <u>(g/l)</u>	<u>g/l</u> <u>Diff.</u>	<u>%</u> <u>Diff.</u>	<u>w/o</u> <u>235</u>
1	328.4	325.6	- 2.8	- 0.8	0.861
2	306.6	302.5	- 4.1	- 1.3	0.857
3	319.8	319.5	- 0.3	- 0.1	0.854
4	309.3	305.3	- 4.0	- 1.3	0.858
5	305.9	310.0	+ 4.1	+ 1.3	0.864
6	309.0	311.6	+ 2.6	+ 0.8	0.855
7	346.5	341.4	- 5.1	- 1.5	0.853
8	306.8	301.3	- 5.5	- 1.8	0.862
9	356.4	353.4	- 3.0	- 0.8	0.863
10	343.6	342.8	+ 0.8	+ 0.2	0.851
11	328.6	333.2	+ 5.4	+ 1.6	0.855
12	341.2	346.4	+ 5.2	+ 1.5	0.859
13	318.3	321.7	+ 3.4	+ 1.1	0.859
14	281.7	282.6	+ 0.9	+ 0.3	0.853
15	309.8	312.2	+ 2.4	+ 0.8	0.855
16	358.7	361.1	+ 2.4	+ 0.7	0.855
17	291.4	295.2	+ 3.8	+ 1.3	0.850
18	319.8	320.8	+ 1.0	+ 0.3	0.876
19	366.8	368.8	+ 2.0	+ 0.5	0.894
20	327.9	331.3	+ 3.4	+ 1.0	0.833
21	307.5	308.2	+ 0.7	+ 0.2	0.785
22	334.8	334.8	0.0	0.0	0.782
23	296.4	299.8	+ 3.4	+ 1.2	0.729
24	339.5	342.9	+ 3.4	+ 1.0	0.707
25	314.5	317.1	+ 2.6	+ 0.8	0.700
26	305.5	307.4	+ 1.9	+ 0.6	0.710
27	306.0	306.8	+ 0.8	+ 0.3	0.700
28	318.0	319.4	+ 1.4	+ 0.4	0.723
29	None				
30	<u>230.1</u>	<u>229.4</u>	<u>- 0.7</u>	<u>- 0.3</u>	<u>0.724</u>
Av.	318.2	319.1	+ 0.9	+ 0.3	0.821*

* w/o 235 average is weighted by the U concentration and volume of each batch so that a comparison between input and product 235 can be made.

Table X (Cont'd)

Product

<u>Batch</u>	<u>NFS</u> <u>(g/l)</u>	<u>AEC</u> <u>(g/l)</u>	<u>g/l</u> <u>Diff.</u>	<u>%</u> <u>Diff.</u>	<u>w/o</u> <u>235</u>	<u>Fernald</u>	
						<u>w/o</u> <u>235</u>	<u>g/l</u>
1	337.6	338.4	+ 0.8	+ 0.2	0.857	0.858	341.0
2	331.2	331.6	+ 0.4	+ 0.1	0.856	0.857	334.3
3	343.6	341.8	- 1.8	- 0.5	0.859	Not Available	
4	341.8	345.2	+ 3.4	+ 1.0	0.859	0.854	342.2
5	342.0	343.1	+ 1.1	+ 0.3	0.858	0.853	341.4
6	342.5	345.4	+ 2.9	+ 0.8	0.840	0.842	343.3
7	342.5	342.8	+ 0.3	+ 0.1	0.842	0.843	342.2
8	342.7	343.8	+ 1.1	+ 0.3	0.786	0.792	344.9
9	343.1	343.7	+ 0.6	+ 0.2	0.786	0.791	344.6
10	314.4	312.6	- 1.8	+ 0.6	0.727	0.730	313.0
11	<u>302.7</u>	<u>302.2</u>	<u>- 0.5</u>	<u>+ 0.2</u>	<u>0.723</u>	<u>0.731</u>	<u>304.6</u>
Av.	334.9	335.5	+ 0.6	+ 0.2	0.818*	0.819	335.9

* w/o 235 average is weighted by the U concentration and volume of each batch so that a comparison between input and product 235 can be made.

TABLE XI

ANALYTICAL BALANCE - PROCESSING LOT III - PLUTONIUM

<u>Input</u>					
<u>Batch</u>	<u>NFS</u> <u>(g/l)</u>	<u>AEC</u> <u>(g/l)</u>	<u>g/l</u> <u>Diff.</u>	<u>%</u> <u>Diff.</u>	<u>w/o</u> <u>240</u>
1	0.259	0.268	+ 0.009	+ 3.4	5.577
2	0.250	0.254	+ 0.004	+ 1.6	5.751
3	0.249	0.253	+ 0.004	+ 1.6	5.522
4	0.226	0.228	+ 0.002	+ 0.8	5.338
5	0.238	0.247	+ 0.009	+ 3.6	5.471
6	0.242	0.221	- 0.021	- 8.7	5.405
7	0.276	0.269	- 0.007	- 2.5	5.569
8	0.238	0.240	+ 0.002	+ 0.8	5.526
9	0.274	0.273	- 0.001	- 0.4	5.199
10	0.289	0.296	+ 0.007	+ 2.4	5.629
11	0.274	0.280	+ 0.006	+ 2.2	5.777
12	0.278	0.279	+ 0.001	+ 0.4	5.579
13	0.249	0.251	+ 0.002	+ 0.8	5.450
14	0.226	0.234	+ 0.008	+ 3.5	5.450
15	0.239	0.252	+ 0.013	+ 5.4	5.349
16	0.277	0.284	+ 0.007	+ 2.5	5.276
17	0.241	0.246	+ 0.005	+ 2.1	5.879
18	0.191	0.198	+ 0.007	+ 3.7	4.445
19	0.155	0.157	+ 0.002	+ 1.3	3.298
20	0.336	0.352	+ 0.016	+ 4.8	8.238
21	0.445	0.453	+ 0.008	+ 1.8	9.603
22	0.470	0.489	+ 0.019	+ 4.0	9.544
23	0.572	0.595	+ 0.023	+ 4.0	12.103
24	0.680	0.703	+ 0.023	+ 3.4	12.403
25	0.674	0.700	+ 0.026	+ 3.9	13.006
26	0.615	0.639	+ 0.024	+ 3.9	12.836
27	0.639	0.657	+ 0.018	+ 2.8	12.591
28	0.610	0.648	+ 0.038	+ 6.2	12.198
29	None				
30	<u>0.688</u>	<u>0.701</u>	<u>+ 0.013</u>	<u>+ 1.9</u>	<u>12.117</u>
Av.	0.359	0.367	+ 0.008	+ 2.2	8.715*

* w/o 240 is weighted by the Pu concentration and volume of each batch so that a comparison between input and product 240 can be made.

Table XI (Cont'd)

Product

	<u>Batch</u>	<u>NFS</u> <u>(g/l)</u>	<u>AEC</u> <u>(g/l)</u>	<u>g/l</u> <u>Diff.</u>	<u>%</u> <u>Diff.</u>	<u>w/o</u> <u>240</u>
1	(Bottles 6-9)	237.6	235.9	- 1.7	- 0.7	6.550
2	(Bottles 10-14)	246.4	246.6	+ 0.2	+ 0.1	6.542
3	(Bottles 16-17)	232.3	230.9	- 1.4	- 0.6	10.290
4	(Bottles 18-21)	234.1	233.3	- 0.8	- 0.3	10.254
5	(Bottles 22-25)	181.8	183.5	+ 1.7	+ 0.9	10.245
6	(Bottles 26-31)	<u>154.4</u>	<u>154.4</u>	<u>0.0</u>	<u>0.0</u>	<u>10.227</u>
Av.		214.4	214.1	- 0.3	- 0.1	8.652*

* w/o 240 is weighted by the Pu concentration and volume of each batch so that a comparison between input and product 240 can be made.

SECTION IV

NFS NUCLEAR MATERIALS MANAGEMENT REPORTS NO. 1, 2, AND 3

FOR

LOTS AEC-II, -I, AND -III

NUCLEAR FUEL SERVICES, INC.

West Valley, New York

NUCLEAR MATERIALS MANAGEMENT

Report #1

June 1966

Revision 4

I. CUSTOMER AND SOURCE

a) CUSTOMER	ATOMIC ENERGY COMMISSION
b) FUEL DESCRIPTION	MATERIAL CATEGORY #9
c) PROCESSING LOT	LOT NO. AEC-II
d) REACTOR NAME AND LOCATION	NEW PRODUCTION REACTOR RICHLAND, WASHINGTON

II. <u>MATERIAL BALANCE</u>	URANIUM (Grams)	PLUTONIUM (Grams)	Pu-239+241 (Grams)	Value
a) Beginning Inventory	0	0	0	0
b) Input	19,715,777	1,739	1,721	\$848,427
c) Product	19,251,863	1,199	1,188	823,079
d) Input-Product Difference	463,914	540	533	
e) Measured Loss (ML)				
1) Hulls & Lab. Scrap	54,559	4	4	
2) Liquid Waste	33,487	27	26	
3) Total ML	88,046	31	30	4,012
f) Ending Inventory	246,170	194	192	
g) Material Unaccounted for (MUF)	129,698	315	311	

MUF = (Beginning Inventory + Input) - (Product + Measured Loss + Ending Inventory)

III. RECOVERY

a) R = 100 P/1 %	97.6	68.9	97.2
b) L = 100 ML/I %	0.45	1.78	0.47

IV. GUARANTEED RECOVERY

a) (P - 0.985 I) Value	(\$10,622)
b) (0.01 I - ML) Value	\$ 4,472

V. CREDIT TO CUSTOMER'S ACCOUNT

\$10,622

NUCLEAR MATERIALS MANAGEMENT

Report #1 (Rev. 4)

June 1966

Page 2

VI. URANIUM AND PLUTONIUM BASE CHARGES

<u>URANIUM</u>	<u>Total U</u> <u>(Grams)</u>	<u>U-235</u> <u>(Grams)</u>	<u>Average</u> <u>Assay</u> <u>(Wt. Fraction)</u>	<u>Base</u> <u>Charge</u> <u>Per Kg U</u>
Input	19,715,777	184,714	.00937	\$42.16
Product	19,251,863	180,611	.00938	42.24

<u>PLUTONIUM</u>	<u>Total Pu</u> <u>(Grams)</u>	<u>Pu-239 + 241</u> <u>(Grams)</u>	<u>Average</u> <u>Assay</u> <u>(Wt. Fraction)</u>
Input	1,739	1,721	.990
Product	1,199	1,183	.991

The base charge is
\$10 per gram of the
contained isotopes
Pu-239 + Pu-241.

VII. BIAS AND LIMITS OF ERROR

Because of the limited amount of quality control data available, no estimates of bias and precision could be calculated for this process lot.

NUCLEAR MATERIALS MANAGEMENT

Report #1 (Rev. 4)

Page 3

- Attachments:
1. FRS to PMC Fuel Transfer
 2. Measured Input
 3. Product Loadout
 4. Measured Losses (Leached Hulls)
 5. Measured Losses (Liquid Waste)
 6. Ending Inventory

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MEASURED URANIUM
CAMPAIGN #1
Lot No. AEC-2

ITEM	DATE	URANIUM (Gross)	U-235 (Gross)	PLUTONIUM (Gross)	Pu-239 + Pu-241 (Gross)
1	4-23-66	1,059,550	10,219.0	59.527	59.510
2	4-28-66	1,391,710	13,526.2	57.903	57.703
3	4-28-66	1,300,744	13,101.8	66.703	66.609
4	4-29-66	1,071,159	15,540.6	73.610	73.464
5	4-30-66	1,600,093	15,763.1	63.214	63.032
6	5-2-66	1,640,439	15,563.7	64.564	64.413
7	5-3-66	1,650,334	15,270.9	101.092	100.232
8	5-6-66	1,640,534	15,334.4	110.221	117.638
9	5-6-66	1,663,975	15,400.5	146.146	145.384
10	5-8-66	1,615,771	15,109.4	150.671	149.764
11	5-10-66	1,703,179	15,919.1	177.482	176.236
12	5-12-66	1,677,743	15,311.9	354.379	348.157
13	5-13-66	809,948	7,394.8	210.276	204.527
3C-2 Flush	5-17-66	243	2.2	.193	.190
	SUBTOTAL	19,603,306	183,660.6	1,724.970	1,707.203
Shells and Lab. Scrap		54,559	511.2	3.031	3.022
GC-6		83	0.8	.001	.001
Scraps		1,564	14.7	3.630	3.812
3C-1 Inventory		56,265	527.2	6.498	6.433
	TOTAL	19,715,777	184,714.5	1,739.160	1,721.273

Attachment 3

PRODUCT LOADOUT

CAMPAIGN #1

Lot No. AEC-II

URANIUM

<u>SHIPMENT NUMBER</u>	<u>DATE</u>	<u>TRANSFER SERIES</u>	(Grams) <u>SHIPPING WT. URANIUM</u>	(Grams) <u>U-235</u>
1	5-2-66	DAA-DAX-1	3,927,386	36,957
2	5-9-66	DAA-DAX-2	3,954,350	37,487
3	5-11-66	DAA-DAX-3	4,014,135	37,893
4	5-17-66	DAA-DAX-4	3,803,855	35,452
5	5-20-66	DAA-DAX-5	3,552,137	32,822
		TOTAL	19,251,863	180,611

PLUTONIUM

<u>BOTTLE NUMBER</u>	<u>DATE</u>	<u>BIRD CAGE</u>	(Grams) <u>SHIPPING WT. PLUTONIUM</u>	(Grams) <u>Pu-239+241</u>
1	6-4-66	P-22	551	546
2	6-4-66	P-21	648	642
		TOTAL	1,199	1,188

ANALYTICAL DATA (GROSS WEIGHTS)

CARGO #1

LOT NO. SEC-2

ITEM	DATE	UTANIUM (Gross)	PLUTONIUM (Gross)
1	4-21-55	1215	.007
2	4-23-55	7536	.315
3	4-27-55	2230	.103
4	4-29-55	7074	.312
5	5-1-55	6163	.235
6	5-2-55	5591	.215
7	5-3-55	5205	.532
8	5-3-55	13535	.935
9	5-3-55	36	.033
10	5-13-55	2925	.272
11	5-12-55	0	0
12	5-14-55	64	.013
13	5-14-55	363	.095

SUBTOTAL

51,919

3.182

Lab. Sample

4-27-55

2,640

.579

TOTAL

54,559

3.661

ISOTOPE	AVERAGE ENRICHMENT	ISOTOPE WT (Gross)
U-235	00037	511.2
235-239 + 239-241	.9990	3.822

ALL INFORMATION CONTAINED
HEREIN IS UNCLASSIFIED
DATE 11-11-2001 BY 60322 UCBAW/STP
LOT N. AEC-2

<u>VESSEL</u> <u>NUMBER</u>	<u>URANIUM</u> <u>(GMS)</u>	<u>PLUTONIUM</u> <u>(GMS)</u>
3D-2	13	.013
4D-2H	1699	4.660
4D-6H	37	.212
4D-10H	5932	3.411
4D-13H	6079	.934
5D-11	-0-	-0-
6C-3	90	.014
6C-6	83	.001
6D-3	334	.016
7C-4	-0-	-0-
7C-5	-0-	-0-
7D-13	303	.005
7D-14	102	.437
1SD-8	10804	16.319
	<hr/>	<hr/>
TOTAL	33,407	26.675

<u>ISOTOPE</u>	<u>AVERAGE</u> <u>ENRICHMENT</u>	<u>ISOTOPE WT.</u> <u>(GMS)</u>
U-235	.00937	313.0
Pu-239 + Pu-241	.990	26.403

I. MATERIALS AVAILABLE NOW:

LBS

CONSUMER	PROD	DATE	QTY	UNIT	VALUE
WATER	GRID	DATE	QTY	UNIT	VALUE
330	21-3	50-24	330,000	1200	

II. MATERIAL IN PROCESS

WATER	PROD	DATE	QTY	UNIT	VALUE
WATER	PROD	DATE	QTY	UNIT	VALUE
30-1			50,000	1200	
50-1			10,000	1200	
50-2A			-----	10,400	
50-3B			-----	-----	
5V-1			10,150	-----	
50-15A2			154,000	-----	
70-4			233	.519	
150-6			120	2.020	
TOTAL			210,170	104.402	

ISOTOPE	AVERAGE ENRICHMENT	ISOTOPE WT. (G)
U-233	.00137	2303.6
Pu-239 + Pu-241	.998	192.547

NUCLEAR FUEL SERVICES, INC.

West Valley, New York

NUCLEAR MATERIALS MANAGEMENT

Report #2 (Rev. 3)

July 1966

I. CUSTOMER AND SOURCE

a) CUSTOMER	ATOMIC ENERGY COMMISSION
b) FUEL DESCRIPTION	MATERIAL CATEGORY #9
c) PROCESSING LOT	LOT NO. AEC-I
d) REACTOR NAME AND LOCATION	NEW PRODUCTION REACTOR RICHLAND, WASHINGTON

II. <u>MATERIAL BALANCE</u>	<u>URANIUM</u> <u>(Grams)</u>	<u>PLUTONIUM</u> <u>(Grams)</u>	<u>Pu-239 + 241</u> <u>(Grams)</u>	<u>Value</u>
a) Beginning Inventory	246,170	194	192	
b) Input	28,814,488	2,297	2,274	\$1,222,287
c) Product	28,713,838	2,455	2,430	1,227,123
d) Input-Product Difference	100,650	- 158	- 156	
e) Measured Loss (ML)				
1) Hulls	14,253	1	1	
2) Liquid Waste	23,795	24	24	
3) Total ML	38,048	25	25	1,834
f) Ending Inventory	150,108	129	128	
g) Material Unaccounted For (MUF)	158,664	- 118	- 117	
MUF = (Input + Beginning Inventory) - (Product + Measured Losses + Ending Inventory)				

III. RECOVERY

a) R = 100 P/I %	99.7	106.9	100.4
b) L = 100 ML/I %	.13	1.09	.15

IV. GUARANTEED RECOVERY

a) (P - 0.990 I) Value	\$17,059
b) (0.01 I - ML) Value	\$10,389

V. DEBIT TO CUSTOMER'S ACCOUNT

\$17,059

NUCLEAR MATERIALS MANAGEMENT

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VI. URANIUM AND PLUTONIUM BASE CHARGES

<u>URANIUM</u>	<u>Total U (Grams)</u>	<u>U-235 (Grams)</u>	<u>Average Assay (Wt. Fraction)</u>	<u>Base Charge Per Kg U</u>
Input	28,814,488	268,387	.00931	\$41.63
Product	28,713,838	268,244	.00934	41.89

<u>PLUTONIUM</u>	<u>Total Pu (Grams)</u>	<u>Pu-239 + 241 (Grams)</u>	<u>Average Assay (Wt. Fraction)</u>
Input	2,297	2,274	.990
Product	2,455	2,430	.990

The base charge is
\$10 per gram of the
contained isotopes
Pu-239 + Pu-241

VII. BIAS AND LIMITS OR ERROR

Estimates of bias and precision are not available at this time.

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Attachments:

1. FRS to PMC Fuel Transfer
2. Measured Input
3. Product Loadout
4. Measured Losses (Leached Hulls)
5. Measured Losses (Liquid Waste)
6. Ending Inventory

REPORT OF INVENTORY
COMPARISON #2
FOR NO. AEC-1

DATE	POOL G.D.	CONTAINER NUMBER	NO. & LENGTH OF ASSEMBLIES	UFANTHIN (Gross)	U-233 (Gross)	PLUTONIUM (Gross)
5-9	7-6 INVENTORY		30-24"	555,094	5101	49
5-16	21-A	329	30-24"	555,094	5101	49
5-18	21-B	329	30-24"	555,094	5101	49
	21-C	329	30-24"	555,094	5101	49
5-20	21-D	329	30-24"	555,094	5101	49
	21-E	329	30-24"	555,094	5101	49
	21-F	329	30-24"	555,094	5101	49
5-21	21-G	329	30-24"	555,094	5101	49
	21-H	329	30-24"	555,094	5101	49
5-24	21-I	329	30-24"	555,094	5101	49
	21-J	329	30-24"	555,094	5101	49
	21-K	329	30-24"	555,094	5101	49
5-25	21-L	329	30-24"	555,094	5101	49
5-26	21-M	329	30-24"	555,094	5101	49
	21-N	329	30-24"	555,094	5101	49
5-27	21-O	329	30-24"	555,094	5101	49
5-28	21-P	329	30-24"	555,094	5101	49
	21-Q	329	30-24"	555,094	5101	49
5-29	21-R	329	30-24"	555,094	5101	49
	21-S	329	30-24"	555,094	5101	49
5-30	21-T	329	30-24"	555,094	5101	49
	21-U	329	30-24"	555,094	5101	49
5-31	21-V	329	30-24"	555,094	5101	49
	21-W	329	30-24"	555,094	5101	49
6-1	21-X	329	30-24"	555,094	5101	49
	21-Y	329	30-24"	555,094	5101	49
6-2	21-Z	329	30-24"	555,094	5101	49
	21-AA	329	30-24"	555,094	5101	49
6-3	21-AB	329	30-24"	555,094	5101	49
	21-AC	329	30-24"	555,094	5101	49
	21-AD	329	30-24"	555,094	5101	49
	21-AE	329	30-24"	555,094	5101	49
6-4	21-AF	329	30-24"	555,094	5101	49
	21-AG	329	30-24"	555,094	5101	49
6-5	21-AH	329	30-24"	555,094	5101	49
6-6	21-AI	329	30-24"	555,094	5101	49
	21-AJ	329	30-24"	555,094	5101	49
6-7	21-AK	329	30-24"	555,094	5101	49
	21-AL	329	30-24"	555,094	5101	49
6-8	21-AM	329	30-24"	555,094	5101	49
	21-AN	329	30-24"	555,094	5101	49
6-9	21-AO	329	30-24"	555,094	5101	49
	21-AP	329	30-24"	555,094	5101	49
	21-AQ	329	30-24"	555,094	5101	49
	21-AR	329	30-24"	555,094	5101	49

WISCONSIN FUEL TRANSFER

CONTAINER

CONTAINER

LOT No. ABC-1

DATE	FOIL CAND	CONTAINER NUMBER	NO. & LENGTH OF ASSEMBLIES	URANIUM (Gms.)	U-235 (Gms.)	PLUTONIUM (Gms.)
6-10	19-D	238	30-27"	533,091	5231	49
	19-C	239	30-27"	533,094	5231	49
6-11	19-B	243	30-27"	533,074	5231	49
6-12	19-A	257	30-27"	533,091	5201	47
	17-B	248	30-27"	533,094	5201	49
	17-A	263	30-27"	533,094	5201	49
6-13	13-E	40	20-16", 15-27"	533,403	5199	37
TOTAL			945-24" 810-16"	28,650,943	259,090	2037
ADJUSTMENT (For Round Off)				- 13	- 2	- 4
TOTAL				28,650,930	259,088	2033

INVENTORY
COMPARISON #2
NOT No. REC-1

ATCH	DATE	SENTINEL (GAL)	U-200 (GAL)	FLUSH (GAL)	INVENTORY (GAL)
3C-1 Inventory	5-17-66	55,235	527.2	6.413	55,768
1	5-23-66	1,711,193	15,903.5	176.160	1,727,256
2	5-24-66	1,679,016	15,526.7	220.543	1,694,785
3	5-26-66	1,607,633	15,349.4	220.652	1,623,034
4	5-28-66	1,601,014	15,293.3	223.553	1,616,860
5	5-30-66	1,633,150	15,154.3	116.360	1,648,664
6	5-31-66	1,639,974	15,431.3	132.122	1,655,527
7	6-1-66	1,343,643	14,409.7	62.393	1,358,445
8	6-3-66	1,772,366	16,023.1	58.502	1,788,891
9	6-4-66	1,649,693	13,070.9	37.744	1,662,507
10	6-5-66	1,640,823	15,325.0	51.271	1,656,419
11	6-7-66	1,697,866	15,031.3	713.350	1,713,249
12	6-8-66	1,721,533	16,003.5	100.523	1,737,661
13	6-10-66	1,633,623	13,534.6	131.761	1,647,319
14	6-12-66	1,652,833	13,437.4	67.217	1,666,487
15	6-13-66	1,671,743	13,643.3	62.201	1,685,587
16	6-13-66	1,633,733	13,597.1	67.014	1,647,344
17	6-16-66	1,020,353	9,592.6	103.153	1,029,099
18	6-13-66	1,031,337	10,073.4	103.213	1,041,623
19	6-13-66	5,473	52.9	.372	5,526
3C-1 Flush		611	5.7		
3C-1 Flush		43	0.4		
	SUBTOTAL	23,732,639	237,311.2	2,271.217	2,273,867
Wells		14,193	132.7	.609	.609
CG-6		33	0.3	.010	.010
Stumps		13,610	145.3	.664	.664
3C-2 Inventory		31,933	297.3	4.593	4,594
TOTAL		23,814,408	237,887.0	2,276.719	2,279,144

PRODUCT LOADOUT

CAMPAIGN #2

Lot No. AEC-I

URANIUM

<u>SHIPMENT NUMBER</u>	<u>DATE</u>	<u>TRANSFER SERIES</u>	<u>SHIPPING WT. URANIUM</u>	<u>(Grams) U-235</u>
6	6-2-66	DAA-DAX-6	4,158,631	38,384
7	6-7-66	DAA-DAX-7	4,142,851	38,736
8	6-9-66	DAA-DAX-8	4,147,937	38,948
9	6-15-66	DAA-DAX-9	4,232,498	39,701
10	6-19-66	DAA-DAX-10	4,200,859	39,278
11	6-21-66	DAA-DAX-11	4,199,109	39,346
12	6-27-66	DAA-DAX-12	3,632,053	33,351
		TOTAL	28,713,838	268,244

PLUTONIUM

<u>BOTTLE NUMBER</u>	<u>DATE</u>	<u>BIRD CAGE</u>	<u>SHIPPING WT. PLUTONIUM</u>	<u>(Grams) Pu-239+241</u>
3	6-30-66	P-23	1,067	1,056
4	6-30-66	#4	851	843
5	6-30-66	#5	537	531
		TOTAL	2,455	2,430

DEPARTMENT OF DEFENSE
 CONTRACT
 LOT No. A7C-1

<u>PAGE</u>	<u>DATE</u>	<u>UNIT</u> <u>(G-1)</u>	<u>PRICE</u> <u>(G-1)</u>
1	5-25-65	1	1.000
2	5-26-65	1	1.000
3	5-28-65	1372	.109
4	5-29-65	1	1.000
5	5-31-65	1	1.000
6	6-1-65	1	1.000
7	6-3-65	7031	.073
8	6-4-65	1	1.000
9	6-5-65	3593	.100
10	6-7-65	1	1.000
11	6-8-65	403	.010
12	6-10-65	53	.073
13	6-11-65	132	.020
14	6-14-65	313	.073
15	6-15-65	9	1.000
16	6-16-65	1	1.000
17	6-17-65	1	1.000
18	6-18-65	174	.027
TOTAL		14,233	.009

<u>PRICE</u>	<u>AVERAGE</u> <u>PERCENT</u>	<u>PERCENT</u> <u>(G-1)</u>
U-203	.00051	102.1
U-203 + U-204	.000	.001

[illegible]

0-2500-22

701 No. 120-2

DESCRIPTION	AMOUNT	TOTAL
3D-2	---	---
4D-2H	611.4	2.000
4D-CH	62.6	2.000
4D-ICH	6517.5	2.000
4D-ISH	1021.3	.272
5D-11	---	---
6D-3	343.9	.199
6D-6	33.0	.010
6D-3	417.9	.157
7C-4	---	---
7C-5	---	---
7D-13	544.4	.000
7D-14	1919.3	6.669
13D-8	12226.2	9.000
TOTAL	23,794.7	24.216

<u>ISOTOPE</u>	<u>AVERAGE ENRICHMENT</u>	<u>ISOTOPE WT. (Gauss)</u>
U-235	.00931	221.5
Pu-239 + Pu-241	.990	23.974

REPORT OF THE
COMMISSIONER
NOT No. AEC-1

I. INITIAL PROCESS

<u>WEIGHT</u> <u>(Grams)</u>	<u>QUANTITY</u> <u>(Grams)</u>	<u>PLACENT WT</u> <u>(Grams)</u>
3G-2	31,953.4	4.500
3D-2	0.7	----
3D-3A	----	34.200
3D-3H	----	34.000
3D-8	0.4	----
3D-15A1	110,149.0	----
3V-1	7,942.1	----
13D-4	1.1	.002
13D-5	1.3	----
13D-5	1.2	.002
13D-6	59.1	6.100
 TOTAL	 100,103.3	 125.979

<u>ISOTOPE</u>	<u>AVERAGE</u> <u>ENRICHMENT</u>	<u>ISOTOPE WT.</u> <u>(Grams)</u>
U-235	.00931	1.377.5
Pu-239 -- Pu-241	.950	127.639

NUCLEAR FUEL SERVICES, INC.

West Valley, New York

NUCLEAR MATERIALS MANAGEMENT

Report #3, Rev. 2

January, 1967

I. CUSTOMER AND SOURCE

a) CUSTOMER	ATOMIC ENERGY COMMISSION
b) FUEL DESCRIPTION	MATERIAL CATEGORY #9
c) PROCESSING LOT	LOT NO. AEC-III
d) REACTOR NAME AND LOCATION	NEW PRODUCTION REACTOR RICHLAND, WASHINGTON

II. <u>MATERIAL BALANCE</u>	<u>URANIUM (Grams)</u>	<u>PLUTONIUM (Grams)</u>	<u>Pu-239 + 241 (Grams)</u>	<u>Value</u>
a) Beginning Inventory	150,108	129	128	
b) Input	46,681,213	50,881	46,384	\$ 1,969,776
c) Product	46,322,112	50,235	45,818	1,945,120
d) Measured Losses (ML)				
1) Hulls	108,001	118	107	
2) Liquid Waste	136,356	191	174	
3) Total ML	244,357	309	281	10,693
e) Ending Inventory	9,031	356	325	
f) Material Unaccounted For (MUF)	255,771	110	87	

MUF = (Beginning Inventory + Input) - (Product + Measured Loss + Ending Inventory)

III. RECOVERY

a) R = 100 P/I %	99.2	98.7	93.7
b) L = 100 ML/I %	0.52	0.61	0.54

IV. GUARANTEED RECOVERY

a) (P - 0.935) Value	\$ 4,891
b) (0.01 I - ML) Value	\$ 9,005

V. DEBIT TO CUSTOMER'S ACCOUNT

\$ 4,891

NUCLEAR MATERIALS MANAGEMENT

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VI. URANIUM AND PLUTONIUM BASE CHARGES

<u>URANIUM</u>	<u>Total U</u> <u>(Grams)</u>	<u>U-235</u> <u>(Grams)</u>	<u>Average</u> <u>Assay</u> <u>(Wt. Fraction)</u>	<u>Base</u> <u>Charge</u> <u>Per Kg U</u>
Input	46,631,213	333,260	.00821	\$32.26
Product	46,322,112	379,563	.00819	32.10

<u>PLUTONIUM</u>	<u>Total Pu</u> <u>(Grams)</u>	<u>Pu-239 + 241</u> <u>(Grams)</u>	<u>Average</u> <u>Assay</u> <u>(Wt. Fraction)</u>
Input	50,881	46,384	.9116
Product	50,235	45,818	.9121

The base charge is
\$10 per gram of the
contained isotopes
Pu-239 and Pu-241.

Input Pu-U Ratio = 1.090 Kg per tonne

NUCLEAR MATERIALS MANAGEMENT

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VII. LIMITS OF ERROR

The following are 95% precision limits for the campaign. The figures are plus or minus ($\pm$) quantities and represent upper and lower boundaries for the measurement errors.

<u>COMPONENT</u>	<u>URANIUM</u>		<u>PLUTONIUM</u>	
	Grams	Percent	Grams	Percent
1. Beginning Inventory	11,081	7.38	19	14.7
2. Input	130,740	0.39	777	1.68
3. Product	146,373	0.32	275	0.60
4. Measured Losses				
a) Hulls	51,390	47.6	56	47.6
b) Liquid Waste	7,291	5.67	17	7.91
c) Other	259	20.0	1	20.0
d) Total ML	51,909	20.2	59	20.5
5. Ending Inventory	407	4.49	23	6.46
6. Material Unaccounted For	238,555		827	

<u>RECOVERY</u>	<u>ERROR</u>	<u>ERROR</u>
1. R% = 100 P/I	0.50	1.76
2. L% = 100 ML/I	0.10	0.13

NUCLEAR MATERIALS MANAGEMENT

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ATTACHMENTS:

1. FRS to PMC Fuel Transfer
2. Measured Input
- 3.. Product Loadout (Uranium and Plutonium)
4. Measured Losses (Leached Hulls)
5. Measured Losses (Liquid Waste)
6. Ending Inventory
7. Accidental Losses

FRS 10 PNC FUEL TRANSFER

CAMPAIGN #3

LOT No. ARC-3
(FEWSTON 1)

<u>DATE</u>	<u>POOL GRID</u>	<u>CANISTER NUMBER</u>	<u>No. & LENGTH OF ASST. TUBES</u>	<u>URANIUM (Grams)</u>	<u>U-235 (Grams)</u>	<u>PLUTONIUM (Grams)</u>
7-11-66	24-T	257	30-24"	554,273	4,753	429
7-12-66	24-S	256	30-24"	554,273	4,753	429
	24-R	271	30-24"	554,274	4,753	429
7-13-66	24-P	290	30-24"	554,274	4,753	429
	24-N	289	30-24"	554,274	4,753	429
7-14-66	24-M	268	30-24"	554,274	4,753	429
	24-L	344	30-24"	554,274	4,753	429
	24-K	256	30-24"	554,274	4,753	429
7-15-66	24-J	255	30-24"	554,274	4,753	429
7-16-66	24-H	254	30-24"	554,274	4,753	429
	24-G	253	30-24"	554,274	4,753	429
	24-F	252	30-24"	554,274	4,753	429
7-17-66	24-E	251	30-24"	554,274	4,753	429
7-18-66	24-D	50	30-24"	554,274	4,753	429
	24-C	49	30-24"	554,274	4,753	429
7-19-66	24-B	48	30-24"	554,274	4,753	429
	24-A	47	30-24"	554,274	4,753	429
7-20-66	23-X	46	30-24"	554,255	4,753	429
	23-W	45	30-24"	554,255	4,753	429
	23-V	44	30-24"	554,255	4,753	429
7-21-66	23-U	43	30-24"	554,255	4,753	429
	23-T	42	30-24"	554,255	4,753	429
	23-S	41	30-24"	554,255	4,753	429
7-22-66	23-R	347	30-24"	554,255	4,753	429
	23-P	276	30-24"	554,255	4,753	429
7-24-66	23-N	275	30-24"	554,255	4,753	429
	23-M	274	30-24"	554,255	4,753	429
	23-L	437	30-24"	554,255	4,753	429
7-25-66	23-K	436	30-24"	554,255	4,753	429
	23-J	435	30-24"	554,255	4,753	429
7-26-66	23-H	434	30-24"	554,255	4,753	429
7-27-66	23-G	433	30-24"	554,255	4,753	429
	23-F	397	30-24"	554,255	4,753	429
7-28-66	23-E	396	30-24"	554,255	4,753	429
	23-D	395	30-24"	554,255	4,753	429
	23-C	394	30-24"	554,255	4,753	429
7-29-66	23-B	393	30-24"	554,255	4,753	429
7-30-66	23-A	392	30-24"	554,255	4,753	429
	22-X	391	30-24"	554,255	4,753	429
7-31-66	22-V	390	30-24"	554,255	4,753	429
	22-U	389	30-24"	554,255	4,753	429
	22-T	388	30-24"	554,255	4,753	429
8-1-66	22-S	387	30-24"	554,255	4,753	429
	22-R	386	30-24"	554,255	4,753	429
	22-P	385	30-24"	554,255	4,753	429
8-2-66	22-N	384	30-24"	554,255	4,753	429
	22-M	383	30-24"	554,255	4,753	429

FRS 1210 5871 1000000

COMPUTED
 COMPARISON
 1000000000
 (ATTACHMENT)

DATE	MODEL (C-1)	CANISTER NUMBER	INITIAL SERIAL	UNIT (C-1)	U-200 (C-1)	RECEIPT (C-1)
8-2-66	21-K	353	30-100	551,500	4,700	100
	22-K	353	30-100	551,500	2,017	200
8-4-66	22-J	353	30-100	551,500	4,700	100
	22-H	354	30-100	551,500	4,700	100
8-5-66	21-G	352	30-100	551,500	4,700	100
	22-F	352	30-100	551,500	4,700	100
8-6-66	22-E	353	30-100	551,500	4,700	100
	22-D	349	30-100	551,500	4,700	100
8-7-66	22-C	353	30-100	551,500	4,700	100
	22-B	352	30-100	551,500	4,700	100
	22-A	331	30-100	551,500	4,700	100
8-8-66	25-K	238	30-100	410,074	3,020	100
	25-J	255	10-100	107,077	1,020	100
	25-I	355	30-100	550,000	4,000	100
8-9-66	25-G	345	30-100	550,000	4,000	100
	25-F	334	30-100	550,000	4,000	100
8-10-66	25-E	40	30-100	550,000	4,000	100
8-11-66	25-D	255	30-100	550,000	4,000	100
	25-C	237	30-100	550,000	4,000	100
8-12-66	25-B	318	30-100	550,000	4,000	100
8-12-66	25-A	319	30-100	550,000	4,000	100
8-14-66	25-X	277	30-200	554,210	4,000	1,000
	25-W	263	30-200	554,210	4,000	1,000
8-15-66	25-V	262	30-200	554,210	4,000	1,000
	25-U	261	30-200	554,210	4,000	1,000
	25-T	250	30-200	554,210	4,000	1,000
	25-S	239	30-200	554,210	4,000	1,000
8-16-66	25-R	233	30-200	554,210	4,000	1,000
	25-P	237	30-200	554,210	4,000	1,000
8-17-66	25-N	270	30-200	554,210	4,000	1,000
	25-M	271	30-200	554,210	4,000	1,000
8-18-66	25-L	264	30-200	554,210	4,000	1,000
8-19-66	25-K	320	30-200	552,701	4,000	1,000
8-20-66	25-J	321	30-200	552,701	4,000	1,000
	25-H	322	30-200	552,701	4,000	1,000
	25-G	323	30-200	552,701	4,000	1,000
	25-F	324	30-200	552,701	4,000	1,000
8-21-66	25-E	325	30-200	552,701	4,000	1,000
	25-D	326	30-200	552,701	4,000	1,000
SUBTOTAL			2003-200 600-100	46,772,000	333,000	46,111
Less Ruptured Assembly				-	-	-
Material Returned to FRS				7,300	57	11
Adjustment (For Round Off)				00	22	00
TOTAL				46,765,000	333,079	46,122

APPENDIX II
CONTINUED
FOR THE 1960S
(DIVISION 1)

DATE	DATE	1960	1961	1962	1963
3C-2 Inventory	7-13-65	- 37,900	- 37,900	- 37,900	- 37,900
1	7-13-65	1,000,000	1,000,000	1,000,000	1,000,000
2	7-17-65	1,000,000	1,000,000	1,000,000	1,000,000
3	7-19-65	1,000,000	1,000,000	1,000,000	1,000,000
4	7-21-65	1,000,000	1,000,000	1,000,000	1,000,000
5	7-22-65	1,000,000	1,000,000	1,000,000	1,000,000
6	7-24-65	1,000,000	1,000,000	1,000,000	1,000,000
7	7-25-65	1,000,000	1,000,000	1,000,000	1,000,000
8	7-26-65	1,000,000	1,000,000	1,000,000	1,000,000
9	7-27-65	1,000,000	1,000,000	1,000,000	1,000,000
10	7-29-65	1,000,000	1,000,000	1,000,000	1,000,000
11	7-31-65	1,000,000	1,000,000	1,000,000	1,000,000
12	8-1-65	1,000,000	1,000,000	1,000,000	1,000,000
13	8-2-65	1,000,000	1,000,000	1,000,000	1,000,000
14	8-4-65	1,000,000	1,000,000	1,000,000	1,000,000
15	8-4-65	1,000,000	1,000,000	1,000,000	1,000,000
16	8-6-65	1,000,000	1,000,000	1,000,000	1,000,000
17	8-6-65	1,000,000	1,000,000	1,000,000	1,000,000
18	8-9-65	1,000,000	1,000,000	1,000,000	1,000,000
19	8-11-65	1,000,000	1,000,000	1,000,000	1,000,000
20	8-12-65	1,000,000	1,000,000	1,000,000	1,000,000
21	8-14-65	1,000,000	1,000,000	1,000,000	1,000,000
22	8-14-65	1,000,000	1,000,000	1,000,000	1,000,000
23	8-16-65	1,000,000	1,000,000	1,000,000	1,000,000
24	8-18-65	1,000,000	1,000,000	1,000,000	1,000,000
25	8-19-65	1,000,000	1,000,000	1,000,000	1,000,000
26	8-21-65	1,000,000	1,000,000	1,000,000	1,000,000
27	8-23-65	1,000,000	1,000,000	1,000,000	1,000,000
28	8-26-65	1,000,000	1,000,000	1,000,000	1,000,000
29*	9-23-65	1,000,000	1,000,000	1,000,000	1,000,000
3C-1 Flush		46,833	332.0	67.407	31.044
SUBTOTAL		46,572,794	332,370.1	50,762,104	46,275,502
Nulls		100,000	636.7	117.720	107.314
GC-6		157	1.3	.446	.407
Sumps		243	2.0	.831	.700
3C-1,2 Inventory		10	.1	.000	.010
PMC Filter		1	----	.001	.001
SUBTOTAL		102,419	640.1	119.016	103.432
TOTAL INPUT		46,681,213	333,010.2	50,881,122	46,378,934

* Included 3C-2 Flush

PRODUCT LOADOUT

CAMPAIGN #3

Lot No. AEC-III

<u>URANIUM</u>	<u>SHIPMENT NUMBER</u>	<u>DATE</u>	<u>TRANSFER SERIES</u>	<u>SHIPPING WEIGHTS (Grams)</u>	
				<u>URANIUM</u>	<u>U-235</u>
	1	7-26-66	DAX-DAA-13	4,276,957	36,654
	2	7-28-66	DAX-DAA-14	4,230,476	36,213
	3	8-2-66	DAX-DAA-15	4,239,103	36,414
	4	8-9-66	DAX-DAA-16	4,324,305	37,146
	5	8-11-66	DAX-DAA-17	4,329,227	37,145
	6	8-18-66	DAX-DAA-18	4,321,505	36,302
	7	8-21-66	DAX-DAA-19	4,320,447	36,378
	8	8-29-66	DAX-DAA-20	4,324,328	33,989
	9	8-31-66	DAX-DAA-21	4,320,013	33,955
	10	11-21-66	DAX-DAA-23	4,034,982	29,334
	11	11-24-66	DAX-DAA-24	3,600,759	26,033
			TOTAL	46,322,112	379,563

PLUTONIUM

<u>BIRD CAGE</u>	<u>BOTTLE NUMBER</u>	<u>DATE</u>	<u>TRANSFER SERIES</u>	<u>LOADOUT WEIGHTS (Grams)</u>	
				<u>PLUTONIUM</u>	<u>Pu-239 + 241</u>
P69	6	9-14-66	DAX-DAA-25	2,358	2,202
P88	7	9-15-66		2,377	2,220
P90	8	9-15-66		2,397	2,238
P70	9	9-15-66		2,305	2,153
P53	10	10-2-66		2,452	2,300
P51	11	10-2-66		2,456	2,294
P6	12	10-2-66		2,454	2,292
P62	13	10-2-66		2,465	2,302
P81	14	10-2-66		2,401	2,243
P49	16	11-22-66		2,381	2,132
P77	17	11-23-66		2,234	2,001
P89	18	11-26-66		2,375	2,126
P64	19	11-27-66		2,342	2,097
P29	20	11-27-66		2,341	2,096
P26	21	11-27-66		2,346	2,100
P48	22	12-1-66		1,829	1,638
P55	23	12-4-66		1,834	1,642
P28	24	12-4-66		1,844	1,651
P27	25	12-4-66		852	763
P31	26	12-5-66		1,540	1,379
P33	27	12-5-66		1,541	1,380
P73	28	12-5-66		1,543	1,382
P30	29	12-8-66		1,545	1,384
P35	30	12-8-66		1,536	1,376
P32	31	12-8-66		477	427
			TOTAL	50,235	45,818

DESIGNED FOR USE (IN GED H3773)

COMPARISON TO

LOT NO. AEG-8

(REVISION 1)

<u>DISSOLVER</u> <u>ATCH</u>	<u>DATE</u>	<u>UNWEIGHT</u> <u>(Gm)</u>	<u>PLUTONIUM</u> <u>(Gm)</u>
1	9-1-66	9,500	10.751
2	8-4-66	-----	-----
3	8-4-66	-----	-----
4	9-1-66	-----	-----
5	7-23-66	9,400	10.246
6	7-23-66	-----	-----
7	7-27-66	-----	-----
8	9-9-66	28,700	31.200
9	7-27-66	-----	-----
10	7-30-66	-----	-----
11	7-31-66	-----	-----
12	8-2-66	-----	-----
13	8-3-66	-----	-----
14	8-3-66	9,900	10.751
15	8-6-66	-----	-----
16	8-7-66	18,200	19.033
17	8-9-66	6,400	6.573
18	8-10-66	12,400	13.816
19	8-12-66	-----	-----
20	8-14-66	-----	-----
21	8-15-66	-----	-----
22	8-17-66	-----	-----
23	8-17-66	-----	-----
24	8-20-66	-----	-----
25	8-21-66	-----	-----
26	8-22-66	13,100	14.279
27	9-4-66	-----	-----
28	9-4-66	-----	-----
29	11-0-66	-----	-----
KMC Filter	10-10-66	1	0.001
TOTAL		109,001	117.721

ISOTOPE

U-235

Pu-239 + Pu-241

AVERAGE
ENERGY UNIT

.00021

.9116

ISOTOPE WT.
(Gm)

833.7

107.314

CONFIDENTIAL - SECURITY INFORMATION

C. 1. 1. 1.
C. 1. 1. 1.
(SECTION 1)

<u>Item</u>	<u>Quantity</u>	<u>Value</u>
1-1	1	1.00
1-2	1	1.00
1-3	1	1.00
1-4	1	1.00
1-5	1	1.00
1-6	1	1.00
1-7	1	1.00
1-8	1	1.00
1-9	1	1.00
1-10	1	1.00
1-11	1	1.00
1-12	1	1.00
1-13	1	1.00
1-14	1	1.00
1-15	1	1.00
1-16	1	1.00
1-17	1	1.00
1-18	1	1.00
1-19	1	1.00
1-20	1	1.00
1-21	1	1.00
1-22	1	1.00
1-23	1	1.00
1-24	1	1.00
1-25	1	1.00
1-26	1	1.00
1-27	1	1.00
1-28	1	1.00
1-29	1	1.00
1-30	1	1.00
1-31	1	1.00
1-32	1	1.00
1-33	1	1.00
1-34	1	1.00
1-35	1	1.00
1-36	1	1.00
1-37	1	1.00
1-38	1	1.00
1-39	1	1.00
1-40	1	1.00
1-41	1	1.00
1-42	1	1.00
1-43	1	1.00
1-44	1	1.00
1-45	1	1.00
1-46	1	1.00
1-47	1	1.00
1-48	1	1.00
1-49	1	1.00
1-50	1	1.00
1-51	1	1.00
1-52	1	1.00
1-53	1	1.00
1-54	1	1.00
1-55	1	1.00
1-56	1	1.00
1-57	1	1.00
1-58	1	1.00
1-59	1	1.00
1-60	1	1.00
1-61	1	1.00
1-62	1	1.00
1-63	1	1.00
1-64	1	1.00
1-65	1	1.00
1-66	1	1.00
1-67	1	1.00
1-68	1	1.00
1-69	1	1.00
1-70	1	1.00
1-71	1	1.00
1-72	1	1.00
1-73	1	1.00
1-74	1	1.00
1-75	1	1.00
1-76	1	1.00
1-77	1	1.00
1-78	1	1.00
1-79	1	1.00
1-80	1	1.00
1-81	1	1.00
1-82	1	1.00
1-83	1	1.00
1-84	1	1.00
1-85	1	1.00
1-86	1	1.00
1-87	1	1.00
1-88	1	1.00
1-89	1	1.00
1-90	1	1.00
1-91	1	1.00
1-92	1	1.00
1-93	1	1.00
1-94	1	1.00
1-95	1	1.00
1-96	1	1.00
1-97	1	1.00
1-98	1	1.00
1-99	1	1.00
1-100	1	1.00
TOTAL	100	100.00

<u>Item</u>	<u>Quantity</u>	<u>Value</u>
U-100	1	1.00
P-100	1	1.00

PLANT INVENTORY

CHURCH #3

LOT NO. REC-3

(REVISION 1)

I. MATERIAL IN PROCESS

<u>VESSEL</u> <u>NUMBER</u>	<u>URANIUM</u> <u>(Gm.)</u>	<u>PLOUTONIUM</u> <u>(Gm.)</u>
3C-1	1.8	.069
3C-2	13.8	.163
6C-6	4.8	.057
3D-1	18.1	.188
3D-2	21.0	.059
4D-2C	7.3	.033
4D-2H	7.3	.035
4D-9	197.9	.012
4D-10C	6.9	.002
4D-12	1022.4	.002
4D-13C	3.9	-----
13D-4	1.9	.030
13D-6	1.3	.104
5D-7	48.0	.001
5D-9	1074.7	-----
5D-15A-2	78.4	.001
5V-1	5570.4	-----
4D-6	0.1	.419
4D-7C	0.1	.001
13D-5	1.5	.002
5D-5A	-----	200.107
5D-5B	-----	125.534
5D-11	0.3	-----
6C-8	0.2	.900
6D-3	2.2	.351
7C-4	610.8	13.004
7C-5	117.8	.024
7D-8	171.7	3.650
7D-14	92.4	.204
13D-3	1.2	.333
5D-8	0.2	-----
TOTAL	9300.9	353.820

Adjustment (Pu Specific Activity Correction
= 0.9921)

353.986

<u>ISOTOPE</u>	<u>AVERAGE</u> <u>ENRICHMENT</u>	<u>ISOTOPE WT.</u> <u>(Gm.)</u>
U-235	.00021	75
Pu-239 + Pu-241	.0003	325

100-100-100
 100-100-100
 100-100-100
 100-100-100

The following quantities are reported for inventory purposes. The financial responsibility for the items under Contract No. AT (10-1)-124 remains to be resolved.

	QUANTITY (Gross)	REPORTED (Gross)
Ruptured Assembly	3,188	3,476
CPC Spill Material	9,503	8,100
	<hr/>	<hr/>
TOTAL	12,691	11,576

ISOTOPE	AVG. AGE IN MONTHS	ISOTOPE AT (Gross)
U-235	.00021	10.12
Pu-239 + Pu-241	.9116	10.520

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