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STUDY (IV)
UTILIZATION OF Z PLANT
FOR PLOWSHARE PROGRAM

L. E. Bruns

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STUDY (IV)

UTILIZATION OF Z PLANT
FOR PLOWSHARE PROGRAM

L. E. Bruns

Plutonium Process Engineering Section
Operations Support Engineering Department

ATLANTIC RICHFIELD HANFORD COMPANY
Richland, Washington

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August 23, 1972

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~~ATOMIC WEAPON DATA - U.S. S2~~

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STUDY (IV)UTILIZATION OF Z PLANT
FOR PLOWSHARE PROGRAMINTRODUCTION

The conversion of plutonium nitrate to metal, the fabrication and assembly of plutonium devices and the recovery of scrap by Atlantic Richfield Hanford Company (ARHCO) has been studied previously in support of the Plowshare Program. Previous studies (references 1, 2 and 3) and Plowshare Task Force meetings (references 4 and 5) along with a teletype directive (reference 6) form the bases for Study IV. The major changes and additions in Study IV as compared to Study III are (1) a complete new building is considered as an alternate to the use of existing facilities, (2) waste storage tankage is added to capital costs, (3) operating costs are divided into labor, material and overheads, and are based on 1976 dollars, (4) depreciation on capital costing is excluded from unit costs, and (5) features of the existing ARHCO plant coupled with comments on actual operating experience and further explanation of the flowsheets are added to the appendix.

CASES

The following table shows the type and weight of material in the four study cases:

TABLE I

<u>Case</u>	<u>Metal Phase</u>	<u>kg Plutonium per Unit</u>	<u>Type of Plutonium</u>
1			
2			
3			
4			

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Tables II and III show the outputs (amount shipped) and the throughputs (capacity of each facility to attain the required output) starting with 1978. Table II covers lower production rates; Table III covers higher rates. Not included in the tables is the total amount of plutonium that should be made available as plutonium nitrate from the fuel reprocessor to assure that shipping requirements can be met. The total amount is dependent upon storage requirements of nitrate for blending, necessary in-process inventories, and final device storage.

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TABLE II

LOWER RATE OUTPUT AND THROUGHPUT REQUIREMENTS

Cases	Unit Weight (kg)	Kg Plutonium per year (1)			
		1978	1979	1980	1981 Through 1985
1					
2					
3					
4					

NOTES: (1) Numbers in parentheses are units/year output.

(2) PRF & BL capacity means the required throughputs through the Plutonium Reclamation Facility and the Button Line (plutonium nitrate to metal).*

(3) Fab. capacity is the required throughput through fabrication.*

* Does not include additional plutonium required for lag storage.

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TABLE III

HIGHER RATE OUTPUT AND THROUGHPUT REQUIREMENTS

Cases	Unit Weight (Kg)	Kg Plutonium per Year (1)				
		1978	1979	1980	1981	1982 Through 1985
1	[					
2						
3.						
4						

NOTES: (1) Numbers in parentheses are units/year output.

(2) PRF & BL Cap. means the required throughputs through the Plutonium Reclamation Facility and the Button Line (plutonium nitrate to metal).*

(3) Fab. cap. is the required throughput through fabrication.*

* Does not include additional plutonium required for lag storage.

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ATOMIC ENERGY DATA

FACILITIES REQUIRED

Facilities considered for this study were 1) existing building with renovations, and 2) a complete new building with new equipment. All new buildings and equipment will meet the tornado, earthquake, radiation exposure and criticality prevention criteria.

EXISTING BUILDINGS

The existing building is a multimillion dollar complex complete with a highly efficient ventilation system. It has passed a Factory Mutual inspection for fire safety. These features and others are discussed in Appendix A.

The change and additions to existing facilities will be based on striving to attain a 1 rem per man year goal limit at the working face of processing hoods. Such a goal may not be entirely practicable for all existing equipment, but additional shielding will lower the overall exposure to personnel. In any case, the overall radiation dosage to personnel will be less than 5 rem/man year (body) and less than 30 rem/man year (hand). Shielding and equipment requirements are noted below.

Case 1 and 2 Requirements (Weapon Grade Composition)

Plutonium Reclamation Facility (PRF)

To attain a reduce exposure, additional shielding is required in the Miscellaneous Treatment hoods, access hoods, penthouse hoods, and charging hoods.

Waste Treatment Facility

Additional shielding is required in all americium processing areas.

Plutonium Nitrate to Metal Process (Button Line)

Additional shielding is required in all hoods.

Fabrication

Existing hoods must be renovated and provided with better shielding. Equipment, [] and assembly hoods must be added.

General

All plutonium storage areas within the process buildings should be further shielded.

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Case 3 and 4 Requirements

Plutonium Reclamation Facility (PRF)

use existing PRF facilities with added shielding for Miscellaneous Treatment, access hoods, penthouse hoods, and the incinerator. Also, some equipment is required to guarantee capacities such as a product concentrator, a few higher capacity pumps and columns inventory control instrumentation. need compact rich feed facility (see figure VII in the appendix).

Waste Treatment

purification shielding is required. } only added americium
the americium purification existing equipment must be replaced with higher capacity, semiremote hoods (manipulator on one side, gloves on the other).

Plutonium Nitrate to Metal Process (Button Line)

Both cases require new blending, oxalate precipitation, calcination, fluorination, and metal reduction hoods and equipment which can be operated semiremotely.

Fabrication and Assembly

Existing hoods and equipment must be replaced by those which can be operated semiremotely (either manipulator on one side, gloves on the other, or other means to minimize handling). A new semiremote hood will be required for assembly.

NEW BUILDING

The new building would house all facilities for plutonium nitrate purification and scrap recovery, waste treatment and americium recovery, incineration of scrap, conversion of nitrate to metal, fabrication, final inspection, assembly and some storage. Also, the new building will contain supporting services such as laboratories and maintenance shops. The size of the building for cases 1 and 2 is 50,000 square feet and for cases 3 and 4 is 60,000 square feet. The design bases are as follows:

Cases 1 and 2

Reclamation	200 kg Pu/Mo
Button Line	1 kg Pu/hr
Waste Treatment	4000 liters neutralized waste/day
Am Purification	10 g Am/Mo
Waste Storage Tanks	One, 1,000,000 gallon tank
Incinerator	2 drums/day
Fabrication	
Inspection & Assembly	

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*In building, firewall protected -- alternate, separate building.

Cases 3 and 4

Reclamation	1200 kg Pu/Mo (800 rich, 400 lean)
Button Line	2 kg Pu/hr
Waste Treatment	8000 liters neutralized waste/day
Am Purification	20 g Am/Day
Waste Storage Tank	Three, 1,000,000 gallon tanks
Incinerator	4 drums/day
Fabrication	
Inspection & Assembly	

COSTS

Bases and Assumptions

1. Cost figures are based on 1973 dollars for capital and 1976 dollars for operating.
2. Flowsheets shown in the appendix or multiples of these (see discussion on flowsheets) are used as a basis.
3. Past experience with design and construction of similar type facilities is used for capital costing (escalated to 1973 dollars).
4. Current and past (fabrication) operating experience forms a basis for operating costs.
5. All operating costs will include full costs, i.e., manufacturing costs plus ARHCO and AEC overheads.
6. All new construction will be such that the exposure at the working face of the hood will be less than 1 rem/man year. Shielding will be added to existing hoods and plutonium storage areas even though the 1 rem/man year is difficult to attain. In all cases, the body exposure will be less than 5 rems/man year, and the hand exposure will be less than 30 rems/man year.
7. The following average isotopic abundance [] is assumed:

238Pu	[]
239Pu	
240Pu	
241Pu	
242Pu	
8. Weapons grade nitrate should not require americium removal. For this study, all [] nitrates will be processed to remove americium.

ATOMIC WEAPON DESIGN NO. 59

9. The flowsheets will have all fabrication scrap routed back through recovery to reduce exposure levels in the nitrate to final unit processing. With weapons grade, the bulk of the fabrication metal scrap will go back to ingotting.
10. It is assumed that the existing PRF can handle [Beyond that, a compact recovery unit (see Figure VII appendix) for processing the nitrate (americium removal) and the metal rework will be added.
11. Fabrication recycle is assumed to be [Plutonium nitrate to metal (button) is 5 percent. Plutonium losses to in-tank solidification (ITS) are less than 0.2 percent of the nitrate feed plutonium. Approximately 75 percent of the americium will be recovered; the remainder is safely stored in ITS.
12. The starting material will be about a 200 gram plutonium/liter plutonium nitrate solution in all cases.
13. Development work is assumed that will result in a minimum of rework for the plutonium metal balls [It is also assumed that gallium can be added in the ingotting step.
14. Neither shipping costs for delivery of plutonium nitrate and or alloy to Hanford or the delivery of metal, shapes, or final units off-site are included in the costing.
15. Special tooling for fabrication is added into operating costs.
16. Assembly costs consider the primary but not the secondary assembly.
17. The possibility of cost sharing with servicing components of other programs and attendant savings was considered but not reflected in operating costs. The savings would be approximately 10% - 25% depending on production levels and facilities employed.

Capital Costs

The capital expenditures required for the various cases shown in tables IV, V, and VI, on the following pages. Each table is followed with a timing schedule. For the new Building, design is based on the maximum capacity.

Operating Costs

Total operating costs based on 1976 dollars are given in tables VII and VIII. costs are divided into labor, material and overheads. An important factor in assuring that these costs can be met is the experience that is available at ARHCO (see Appendix B).

Unit Costs

Table IX gives the unit costs for the various rates.

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TABLE IV
CAPITAL COST ESTIMATE - EXISTING BUILDING BY PROCESS STEPS
(ESTIMATES INCLUDE DESIGN, CONSTRUCTION & CONTINGENCY)
FY 1973 \$(IN MILLIONS)

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TABLE V

CAPITAL COST ESTIMATES FOR NEW FACILITY

CASES 1 & 2

\$=000's
FY 1973

BUILDING (CONCRETE, LIGHTING, PLUMBING, SUPPLY VENT, 50,000 SF)
EXHAUST AIR SYSTEM (EQUIPMENT, FILTERS, STACK, ETC.)
CHEMICAL MAKEUP SYSTEM
ELECTRICAL (500 KVA)
SAFEGUARDS (INTRUSION ALARMS, LOCKS, ETC.)
BUTTON LINE
FABRICATION LINE
INSPECTION
ASSEMBLY
Pu RECLAMATION FACILITY
INCINERATOR
WASTE TREATMENT
WASTE STORAGE TANKS

TOTAL PROJECT COSTS \$10⁶

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TABLE VI

CAPITAL COST ESTIMATES FOR NEW FACILITY

CASES 3 & 4

BUILDING - (CONCRETE, LIGHTING, PLUMBING & SUPPLY VENT, 60,000 SF)
 EXHAUST AIR SYSTEM (EQUIPMENT, FILTERS & STACK)
 CHEMICAL MAKEUP SYSTEM
 ELECTRICAL (500 KVA)
 SAFEGUARDS - (INTRUSION ALARMS, LOCKS, ETC.)
 BUTTON LINE
 FABRICATION LINE
 INSPECTION
 ASSEMBLY
 P_u RECLAMATION
 INCINERATOR
 WASTE TREATMENT - (INCLUDING AM FACILITIES)
 WASTE STORAGE TANKS

TOTAL PROJECT COSTS \$10⁶

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TABLE VII

OPERATING COSTS (1) LOWER RATES

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TABLE VII - Continued
OPERATING COSTS (1) LOWER RATES

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TABLE VIII
OPERATING COSTS (1) HIGHER RATES

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TABLE VIII Continued

OPERATING COSTS ⁽¹⁾ HIGHER RATES

~~HEADON DATA~~ W2. S2

AWD W2 S2

TABLE IX

UNIT COST IN DOLLARS

NOTES: (1) PRF is nitrate purification and scrap recovery to pure plutonium nitrate; BL is nitrate to metal (add 15% to BL costs to go to ingot); FAB includes final inspection and primary assembly.

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FLWSHEETS

Flowsheets are shown in the Appendix C for case 4, [One of the rates used was [The flowsheets are further explained in Appendix C. The flowsheets in the appendix are as follows:

- Figure I: Overall Z Plant Flowsheet, []
- Figure II: Americium Purification and Scrap Processing, []
- Figure III: Waste Treatment for Plowshare, []
- Figure IV: Plutonium Nitrate to Metal for Plowshare, []
- Figure V: Fabrication Flowsheet, []

The existing FRF can handle up to []

a high capacity, rich feed (plutonium nitrate and dissolved metal) facility is added, the existing PRF handling all other plutonium scrap. The Waste Treatment Facility would require replacement of americium hoods and equipment to handle the larger americium output.

- Figure VI: Overall Z Plant Flowsheet, []
- Figure VII: New Rich Feed Reclamation Facility Flowsheet, []
- Figure VIII: Plutonium Reclamation Facility Scrap Processing Flowsheet
- Figure IX: Waste Treatment, []
- Figure X: Plutonium Nitrate to Metal []
- Figure XI: Fabrication Flowsheet, []

Flowsheets for cases 1 and 2 can be handled in existing reclamation and plutonium nitrate to metal equipment; fabrication requires renovation of almost all the hoods. The fabrication flowsheets are shown for [] weapons grade plutonium.

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They are shown in the appendix as follows:

Figure XII: Fabrication Flowsheet Case 1,

Figure XIII: Fabrication Flowsheet Case 2,

Flowsheets for other capacities can use multiples of these. Flowsheets for the new building are multiples of existing flowsheets for Cases 1 and 2 and multiples of the [] flowsheet for Cases 3 and 4.

RADIATION

Design of new equipment will be such that the exposure at the working face of a hood is 1 rem/man year. Absolute exposure for personnel will be less than 5 rem/man year and less than 30 rem/man year for hand exposure. The average isotopic value of [] plutonium is as follows:

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ATOMIC [REDACTED]

- NOTES: (1) 0.1" represents attenuation for 0.1 inch of stainless steel.
- (2) 0.25" Pb represents attenuation for 0.25 inch of lead.
- (3) Relative neutron exposures given here do not consider the variation in average neutron energies or americium growth or multiplication. These effects will be small, with minor attenuation -- a few percent. These effects will need to be considered for shielding.

The values on page 19 shows that an operator working with the fluoride powder, for example, can receive 8 times the neutron and 5 times the gamma dose (10 days since americium and ^{237}U removal).

If the operator received 1.5 rem/man-year gamma and 2.0 rem per man-year neutron with weapons grade, he could work only a little more than a month in that area with [REDACTED] and no further shielding. Hence, semiremote operation is recommended, manipulators on one side and a shielded glove panel on the other.

The processes will be highly instrumented and television cameras would be used wherever practical. Since some amount of manual handling is necessary during glovebox cleanup, maintenance, and assembly, the americium and ^{237}U should be kept as low as possible. By putting all virgin nitrate through an americium removal step and processing all recycle through the Plutonium Reclamation Facility, a less than 20-day ^{241}Am - ^{237}U buildup can be attained.

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APPENDIX A

DESCRIPTION OF EXISTING FACILITY AND EQUIPMENT

The plant currently in operation has the facilities for conversion of plutonium nitrate to the metal and the recovery of plutonium from scraps and metallurgical residues. Fabrication facilities are present but are in stand-by condition. The plant is known as Z Plant and is shown on the sketch titled "Z Plant Floor Plans," page 24.

The 234-5 Building is a 3-story steel frame structure. The plutonium metal reduction and fabrication operating bays are enclosed in 6 - 12 inches of reinforced concrete in rooms running through the center. Processing is performed in stainless steel gloved boxes. Maintenance, laboratory, and other supporting facilities are provided within the building. An elaborate ventilation system is installed. Vacuum, compressed air, and exhaust fan equipment are housed in the adjoining 291-Z Building.

Other major processing steps are housed in adjoining buildings. The 232-Z Building is employed for scrap incineration. The 236-Z Building houses the solvent extraction process for the recovery of plutonium from scrap behind 2 feet of concrete. The 242-Z Building houses the waste treatment and americium recovery processes. Not shown is a new plutonium storage facility which meets all AEC criteria including that for tornado and earthquake resistance. Analysis of the 234-5, 236-Z, 242-Z, and 232-Z Buildings for tornado and earthquake resistance has not yet been made, but experience has shown their ability to withstand winds up to 80 mph.

There are areas within the 234-5 Building where new equipment can be installed without disturbing any current operations. For example, a new shielded, semi-remote button line could be installed in empty room 221, along with a new compact remote rich feed reclamation facility (see flowsheet, figure VII). The fabrication area is available for hood renovation.

Throughout the entire Z Plant complex, all equipment has been constructed of geometrically favorable design wherever possible to enhance nuclear safety.

The Z Plant was recently analyzed for fire safety by the Factory Mutual Research Corporation of Norwood, Massachusetts (H-S-13 [secret], January 29, 1971, "Fire Protection Review -- Atlantic Richfield Hanford Company 200-West Area, Building 234-5Z Area, Richland, Washington"). The conclusions drawn gave a high fire safety rating to the Z Plant. Their major recommendation was to increase the sprinkler system coverage, and this is being provided. This facility may then be classed in the "preferred" risk category.

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It can be concluded that the existing Z Plant facility and equipment therein offer a powerful system to the Plowshare Program. At today's dollars, this complex, with its usable equipment, is estimated at \$65,000,000. All systems throughout are well known and well understood. Some of the existing equipment is relatively new; and analytical laboratories, development laboratories, maintenance shops, nondestructive counting areas are unique and well equipped. A completely integrated facility is then available for processing plutonium from the nitrate to final device form, including associated scrap recovery work.

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291-2 - STACK

234.5 BLDG - FIRST F

DECLAI

237-2 BLDG.
(INCINERATOR)

WASTE
MATERIAL
STORAGE
NUT
236 20

SK-2-2869

OOR PLAN

[illegible]

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APPENDIX B

OPERATING EXPERIENCE

The Atlantic Richfield Hanford Company has professional and operating personnel with up to 25 years experience in plutonium processing, including extractive metallurgy, scrap recovery, metal fabrication, and nondestructive testing. ARHCO is currently engaged in processing feeds for both defense and civilian application and the recovery of scrap. ARHCO serves as a central scrap management operation for the Atomic Energy Commission, and has been designated as the national plutonium site.

At the Hanford site, the expertise of many scientific disciplines is available. For example, Pacific Northwest Laboratory (Battelle Memorial Institute) personnel have dealt with all phases of plutonium fabrication. Wastes, which must be disposed of, will be treated by ARHCO waste management experts and, thus, will not have to be shipped off-site for treatment.

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APPENDIX C

FLWSHEETS

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The flowsheets on the ensuing pages are brief plutonium path flowsheets. Since volume can be limiting in all systems, volume and plutonium paths are shown. In some cases, key chemicals are also shown.

Figure I through Figure XI

The first series of flowsheets Fig. I through Fig. V, selected have
All similar flowsheets
can use multiples

the maximum expected.

Assumptions made for these flowsheets are as follows:

1. All virgin feed enters the system at about 200 g/l plutonium nitrate solution.
2. All plutonium nitrate goes through the PRF to remove americium and uranium-237.
3. All recycle from the button line and fabrication immediately goes back through PRF. The object of this and item 2 are to keep the hand exposure from Am-241, and U-237 gamma at a minimum. The flowsheets are aimed at providing less than 20-day old plutonium since Am and U separation, thus allowing some selective manual handling, such as during the intricate task of final assembly.
4. Sufficient nitrate blending capacity is available. Additional blending equipment will be part of the new rich feed reclamation facility, see Fig. VII.
5. For all processing of capacity button line is assumed using the proven fluoride process. Development work will stress the pyrochemical process patented by ARHCO's Dr. R. E. Felt (ARH-1198, R. E. Felt, "A Pyrochemical Process For The Reduction Of PuO₂ To Metal", July 1969) for this process could reduce both capital and operating costs and radiation exposure rates.
6. The gallium addition to attain the delta phase will be added in the ingotting step.

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Flowsheets I and VI are the overall flowsheets respectively, showing the path of plutonium from original nitrate to the final assembly, with plutonium wastes safely stored in underground tanks in solid form. These flowsheets show the major recycle streams that go back through reclamation to keep the gamma exposure from U-237 10-50% below maximum and Am exposure tolerable for necessary hood glove manual handling (maintenance, scrap cleanup, loadout, loadin, sorting, part measurements, final assembly). The major recycle streams are the supernates from the oxalate precipitation process, plutonium oxalate, oxide and fluoride sweeps (hood cleanouts), slag and crucible, reject metal, ingotting and casting crucibles, ingotting skulls, sprues, briquetted turnings, samples, miscellaneous (rags, containers, gloves, plastic bags, fabrication oil, etc) and reject parts.

Flowsheet II is the flowsheet for the existing PRF (Plutonium Reclamation Facility). The PRF has successfully processed 200 kg Pu/month on a 15 shift per week (XYZ shift) as scrap into the solvent extraction system and 30-40 kg Pu/day via the solvent extraction recycle system. Since high concentrations of relatively pure solutions can blend into the recycle system, feeds like 200 g Pu/l plutonium nitrate can be added in the recycle stream without seriously affecting the scrap feed capacity. In Flowsheet II the virgin Pu nitrate is added to the recycle stream. More product concentrator capacity and improved solvent extraction instrumentation will be required and these are incorporated in capital costs. The estimated capacity for the existing PRF is 300 kg Pu/month on a 21 shift per week basis (ABCD shift) from scraps and 400 kg Pu/month (ABCD shift) as recycle. The recycle feed must be such that the nitric acid scrub section in the extraction column will remove the bulk of the impurities; in the case of the major impurity is americium. Greater than 90% of the americium can be separated from the plutonium by this technique.

Figure III, does not seriously tax the waste cleanup columns. However, the americium purification is taxed and at this point the facility requires replacement with a higher capacity system. The losses of Pu and Am to ITS (in-tank-solidification) may be overstated since recovery from the newly installed centrifuges was not considered. Also, recent improvements in the Am purification process indicate the losses shown in Fig. III may be overstated.

All liquid wastes will be piped to waste evaporators for concentration and then go to the ITS (in-tank-solidification) tanks for safe storage as a salt cake. Liquid wastes include the high salt, acidic wastes shown as final effluents in Fig. III plus sump wastes which are mostly water (e.g. steam condensates, cooling water, scrubber solutions, lab wastes). Solid wastes like centrifuge residues that no longer have economically recoverable Pu are dried, placed in steel 55 gallon drums and stored underground. Figure IX, Waste Treatment Flowsheet. In this case, new Am purification equipment is required to meet the capacities shown.

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Fig. IV and X are the button line (nitrate to metal) flowsheets

The difference will be in the number of shifts and the number of people per shift. The estimated capacity for a 1-shift/day operation is 8 kg Pu/day, 2-shift is 19 kg Pu/day and 3-shift is 32 kg Pu/day, all average rates. The new button line will consist of receiving, blending and storage tankage, oxalate precipitation tankage; drum filters and supernate treatment facilities; calciner, fluorinator and reduction furnaces; button breakout and slag and crucible handling facilities.

Fig. V and XI show the main metal to assembly steps for delta metal fabrication. The gallium will be added at the ingotting step. Silicon nitride (SiN) crucibles will be used in the ingotting step; carbon and SiN crucibles will be used in casting. After sprue removal, the plutonium balls may require a contour adjustment such as coining or electropolishing. The primary part will be formed to its required shape by a power-roll system.

Turnings will be briquetted and sent back to recovery along with reject metal, fabrication oil, and other miscellaneous scrap. The assembly costing considered only that for primary component.

Fig. VII and VIII are the new Rich Feed Reclamation Facility and the existing PRF flowsheets, respectively. The new plant would be a high capacity compact facility having nitrate blending capabilities, electrolytic dissolvers, necessary solvent extraction tankage and compact centrifugal contactors, for an extraction and stripping system. The facility would be installed in the existing 221 area of the 234-5 Building along with the new button line. It would be a completely shielded remotely operated facility.

The new reclamation plant would handle only rich and relatively pure feed. The plutonium nitrate being recycled would be added at the fourth stage giving 4 stages of nitric acid scrub to remove the americium (98% removal). Electrolytically dissolved metal would be added at the 7th stage along with necessary salts to insure complete gallium and other impurity removal. Iron nitrate is added as one of the salts to minimize breakdown of the organic solvent tributyl phosphate.

Centrifugal contactors were planned for use in the new facility to lower the residence time of high exposure plutonium in contact with the organic, the object being to reduce the radiolysis effect on the organic. The extraction waste from the new facility would go to waste treatment. Any spent solutions (e.g. floor spills) would go to the currently existing facility for recovery. The product handling system would include necessary tankage and a falling-film evaporator capable of concentrating 50 kg Pu/day from 60 to 200 Pu/liters.

The currently existing PRF would handle all other scrap, such as slag and crucible, incinerator ash, supernates, Pu sweeps, floor spills from both plants and other miscellaneous scraps. Organic cleanup columns are available to handle spent organic from the new facility.

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Weapon Grade Flowsheets

The WG (weapons grade) plutonium has been processed many years at Z Plant hence flowsheets for all phases of the planned Plowshare programs with the exception of assembly are covered by existing flowsheets and know-how. Two flowsheets are shown in Fig. XII and XIII.

Some shielding is required to assure present day exposure criteria. Beyond the button line existing hoods would require renovation. New assembly hoods are required.

Flowsheets for New Building

Flowsheets for the new building will be similar to those shown in Fig. I through V. The values in these flowsheets would be multiplied by the units/year desired. All facilities, including the reclamation and waste treatment facilities will originally be large enough to handle.

For the weapons grade systems the reclamation, waste treatment and button line facilities will be compact units, approximately half the size of the existing units. Plutonium fabrication will be similar to that handled in the past and planned for the Plowshare program within the 234-5 Building. Existing flowsheets will handle all cases for weapons grade.

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FIGURE 1
OVERALL Z-PLANT FLOWSHEET FOR PLOWSHARE

FIGURE II

AMERICIUM PURIFICATION & SCRAP PROCESSING

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FIGURE III
WASTE TREATMENT FOR PLOWSHARE

FIGURE IV
PLUTONIUM NITRATE TO METAL FOR PLOWSHARE

NOTES:

- (1) BLENDING NITRATE WILL BE LOW 240 Pu PER CENT MATERIAL.
- (2) 400 KG Pu/MO BASIS COMMENSURATE WITH 200 UNITS/YEAR,
55/12 OVERALL FLOWSHEET

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FIGURE V
FABRICATION FLOWSHEET

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FIGURE VI
OVERALL Z - PLANT FLOWSHEET

NOTES:

(2) ONE NEW BUTTON LINE
FITS ANY PROJECTED RATE.

(3) CAN SHIP AT A,B,C, OR D.

FIGURE VII
NEW RICHFEED RECLAMATION FACILITY FLOWSHEET

* CCX, CCXF₁, CCXF₂ ARE STRIPPING AGENTS USING NITRIC ACID AND HYDROXYLAMINE NITRATE, THE TOTAL FLOW IS 500 LITERS/DAY
+ BL IS BUTTON LINE

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FIGURE VIII
PLUTONIUM RECLAMATION FACILITY
SCRAP PROCESSING FLOWSHEET

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FIGURE IX
WASTE TREATMENT

FIGURE X
PLUTONIUM NITRATE TO METAL

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BASIS:

NEW BUTTON LINE: 1000 KG/Mo
XYZ SHIFT

FAB: PQ SHIFT

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FIGURE XII
FABRICATION FLOWSHEET CASE 1

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FIGURE XIII

FABRICATION FLOWSHEET CASE 2

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