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Hanford Engineering Development Laboratory

Westinghouse Hanford Company
A subsidiary of Westinghouse Electric Corporation
P. O. Box 1970 Richland, Wa. 99352

TITLE AND AUTHOR

INITIAL DIVERSION ASSESSMENT QUESTIONNAIRE

D. D. SCOTT

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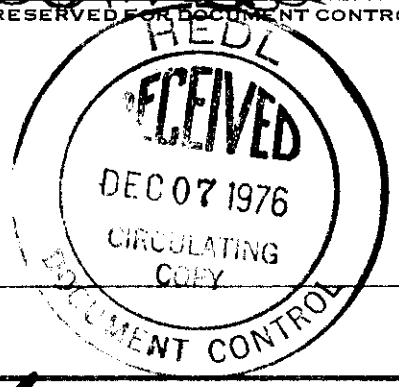

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CLASSIFICATION

INITIAL DIVERSION ASSESSMENT QUESTIONNAIRE

D. D. SCOTT

DECEMBER 6, 1976

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TC-674-2

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DIVERSION PATH ANALYSIS OF THE IRRADIATION TEST PIN FUEL FABRICATION LINE

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HEDL Classification Officer

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Prepared for the U.S. Energy Research and Development Administration under Contract No. E(45-1)-2170

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PRELIMINARY DOCUMENT

This document contains information of a preliminary nature prepared in the course of work under U.S. ERDA Contract E(45-1)2170. This information is subject to correction or modification upon the collection and evaluation of additional data.

DIVERSION PATH ANALYSIS OF THE IRRADIATION TEST PIN FUEL FABRICATION LINE

WORKPAPER DOCUMENTATION

(For Methodology See TC-674-1)

D. D. Scott
F. M. Smith

June 1976

Hanford Engineering Development Laboratory

Operated by the Westinghouse Hanford Company

A Subsidiary of Westinghouse Electric Corporation

for the United States Energy Research and Development Administration Contract No. E(45-1)2170

DIVERSION PATH ANALYSIS

PROCESS: IRRADIATION TEST PIN FUEL FABRICATION LINE
Title

LOCATION: 203
MBA(s)

WORKPAPER DOCUMENTATION

DATE PREPARED: June, 1976

PREPARED BY: DD Scott, Bldg. 325, Rm 943
Name and Address

2-3971
Phone

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Name, Address and Phone

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Rm 25, 2-3597
Name, Address and Phone

DATE REVIEWED: 7/2/76

REVIEWED BY: [signature]

APPROVAL (IF REQUIRED): [signature]

4.1 Bounds of Analysis

DIVERSION PATH ANALYSIS

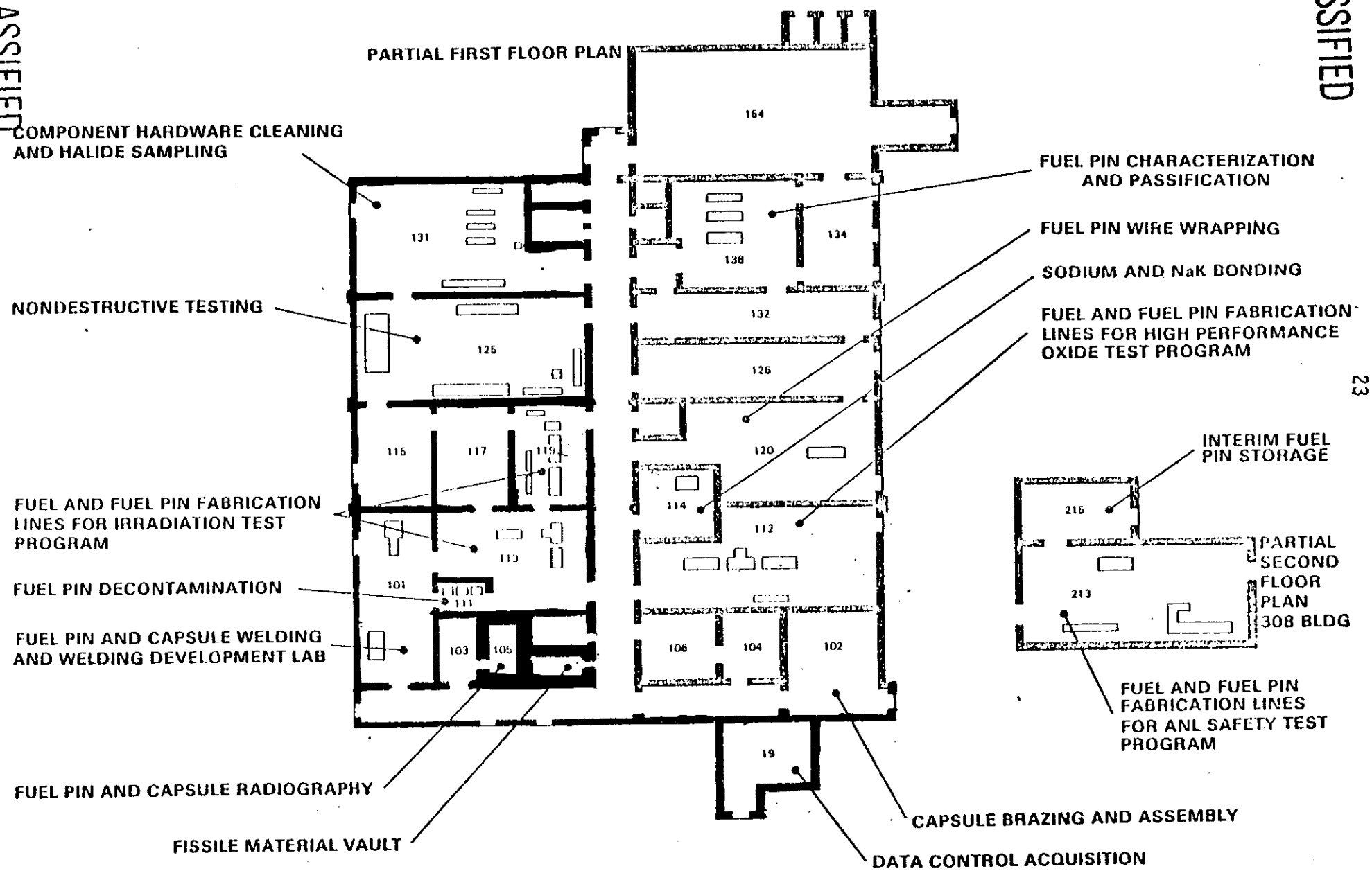
PROCESS: IRRADIATION TEST PIN FUEL FABRICATION

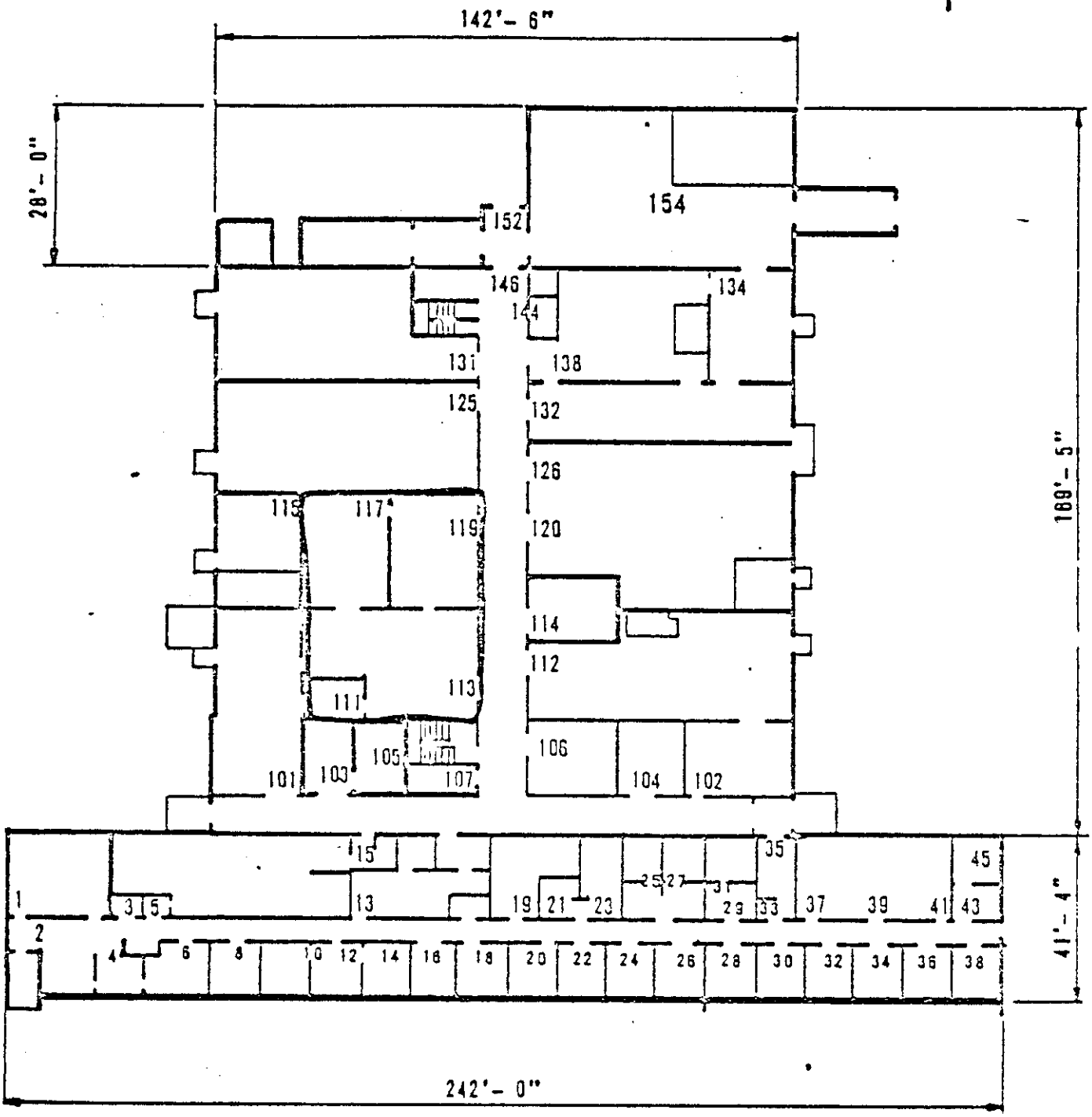
BOUNDS OF THE ANALYSIS

1. Description of the Process
Only the first six steps of the mixed oxide fuel fabrication line are covered in this analysis. They are: (1) Receiving and Storage of Feed Materials, (2) Calcining, (3) Screen and V-blend, (4) Ball Mill and Cross Blend, (5) Binder Addition, and (6) Preslug and Granulate. Each step has been designated as a unit process. This analysis considers only removal modes from the process line and does not include removal modes from the building or area.
2. MBA(s) or Parts of MBA(s) Included in the Analysis
MBA 203 (308 Building) MBA 203 (308 In-Process and Storage Vault)
3. Personnel Considered as Potential Diverters
1. All personnel assigned to the laboratory area who handle SNM. 2. Authorized personnel granted access to the laboratory area, but are not assigned to specific work areas in the laboratory. 3. Authorized personnel granted access to the 308 Building, but not the laboratory. 4. Authorized visitors.
4. Personnel Excluded as Potential Diverters
1. Process Engineers. 2. Process Foreman. 3. Production Control Personnel (Q.A., Safeguards, Criticality Safety, Health Physics). 4. Management levels above engineers.

4.2 Process, Equipment, Building Layout

FTR FUEL, FUEL PIN AND CAPSULE FABRICATION LINES

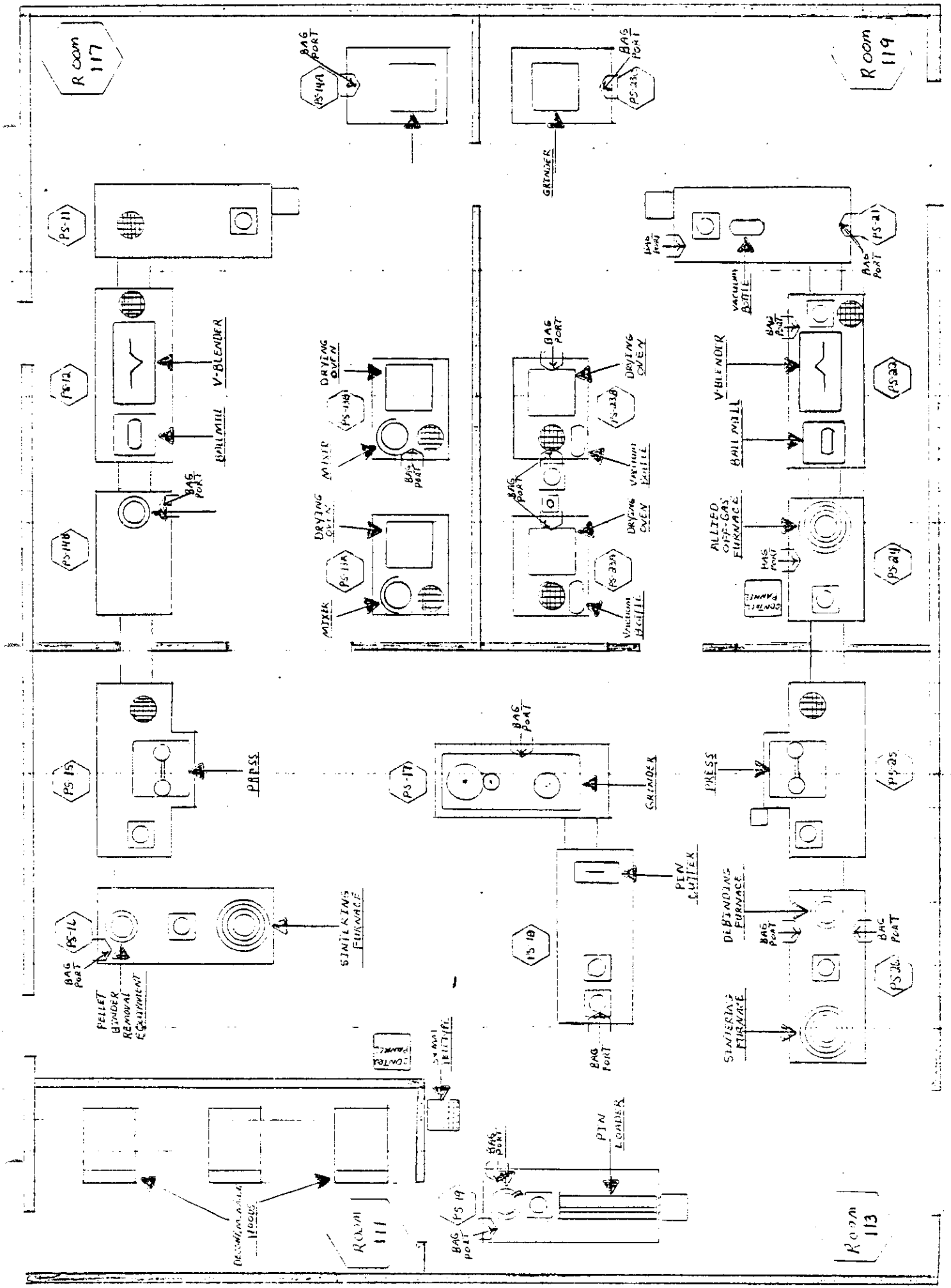




FIRST FLOOR PLAN

0 20 40FT

308 Building


Room 117
Room 119
Room 111
Room 113
PS-11
PS-12
PS-14A
PS-14B
PS-15
PS-16
PS-17
PS-18
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PS-31
PS-32
PS-33A
PS-33B
PS-34
PS-35
PS-36
V-BLENDER
BALL MILL
BAG PORT
DRYING OVEN
MIXER
PRESS
SINTERING FURNACE
PELLET BINDER REMOVAL EQUIPMENT
GRINDER
PIN CUTTER
PIN LOADER
VACUUM BOTTLE
ALLIED OFF-GAS FURNACE
DEBINDING FURNACE
CONTROL PANEL
DESICCANT HOODS

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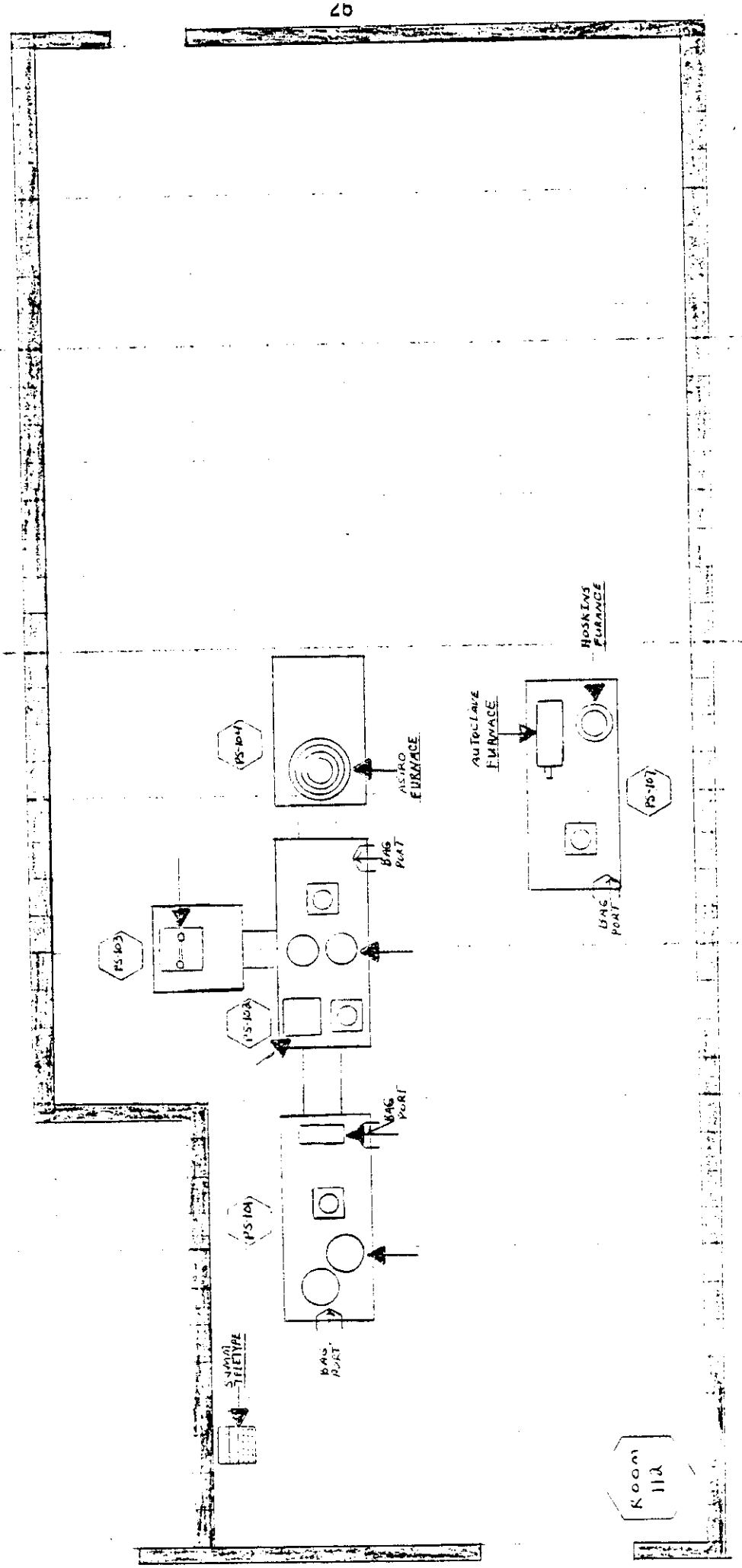

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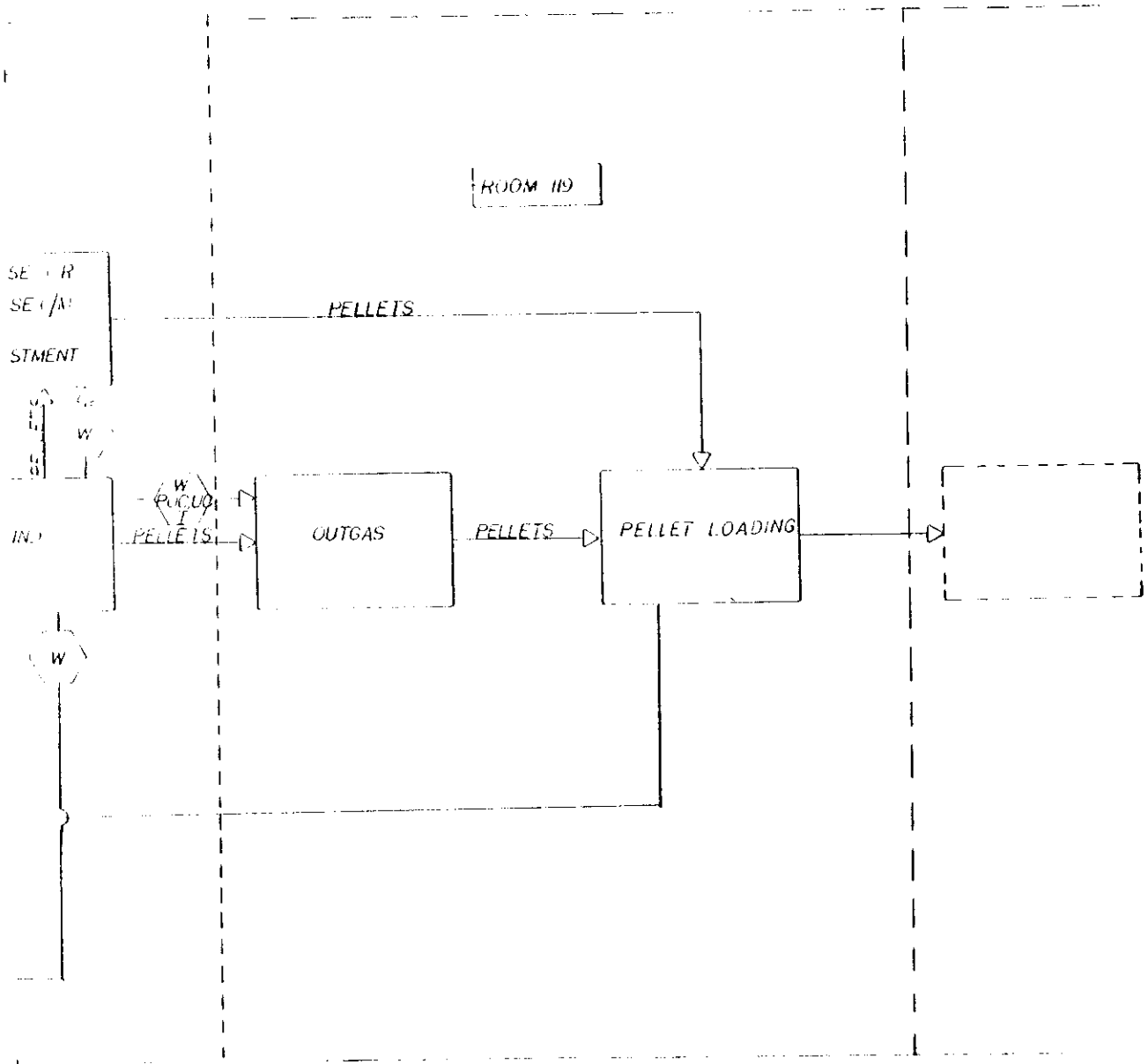
4.3 Process Block Flow Diagram



W	WEIGHING
PUC	PU ASSAY CHEM
UC	U ASSAY CHEM
I	ISOTOPIC
WDN	WASTE DRUM NEUTRON
WDG	WASTE DRUM GAMMA
NWCC	NEUTRON WELL COINCIDENCE COUNTER

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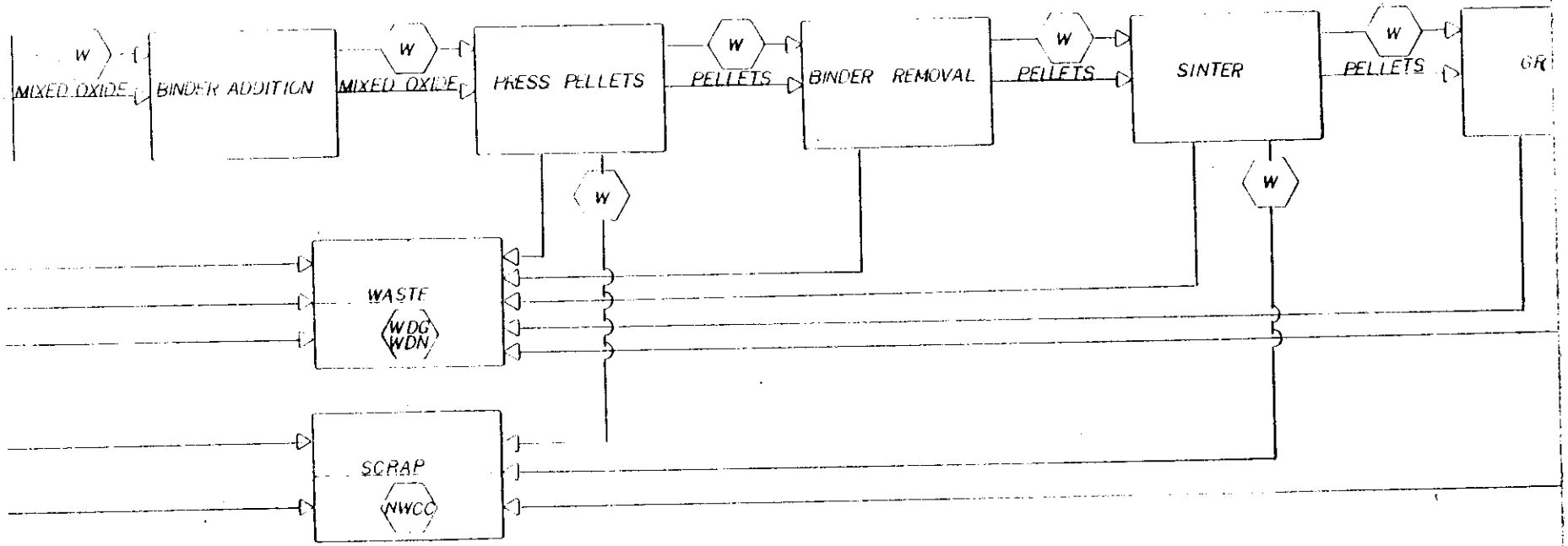
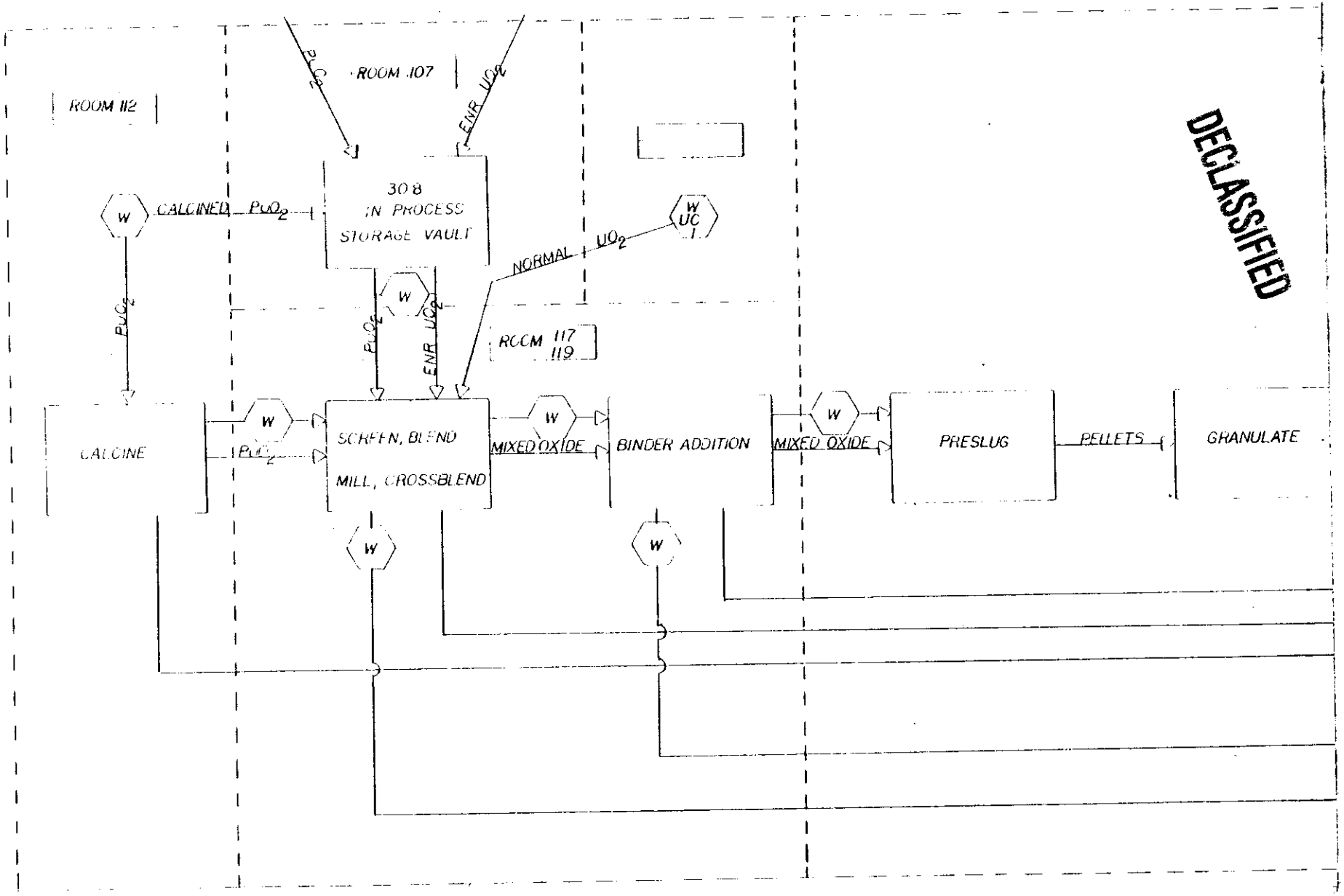
ROOM 113

INCREA
DECREA
ADJU





4.4 Data Checklist

INFORMATION AND DATA CHECK LIST

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Check-off	Item Number	
	1.0	DESCRIPTION OF THE PROCESSING EQUIPMENT
✓	1.1	Floor plans showing equipment placement; measurement points; physical bounds such as walls, ceilings, etc.
✓	1.2	Access and egress to equipment (e.g. glove-box ports, bag-out points, control gates in process line, etc.)
✓	1.3	Access and egress to subject areas (e.g. doorways, etc.)
	2.0	DESCRIPTION OF MATERIAL STORAGE AREAS - VAULTS AND IN-PROCESS STORAGE AREAS FOR MATERIAL USED IN THE PROCESS
✓	2.1	Location (included on the floor plan, if within the process area)
✓	2.2	Persons having access, keys or combinations to locks
✓	2.3	Documentation of procedures for receipts and removals of material
N/A	2.4	Control of keys when not in use is
✓	2.5	How material/physically moved between vault and process area
✓	2.6	Personnel involved in movement of material from vault to process area
	3.0	MATERIAL FLOWS IN THE PROCESS - IDENTIFICATION OF PRODUCT, SCRAP, RECYCLE, SAMPLE, CHANGES IN CHEMICAL OR PHYSICAL FORM, BATCH MAKEUP, PROCESSING OF REJECTS, MUF, ASSIGNMENT TO MEASURED DISCARD, PROCESS HOLDUP
✓	3.1	Establish origination of materials when entering process
✓	3.2	Establish locations of material when in the process
✓	3.3	Establish destinations of materials upon leaving the process
✓	3.4	Utilize process transfer information such as MTR Flow Characterization to assist in validating material flows (13)

INFORMATION AND DATA CHECK LIST

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Check-off	Item Number	
	4.0	DESCRIPTION OF PROCESSING STEPS (Material and Information) - MUST REFLECT THE OPERATIONS OVER THE PERIOD OF TIME FOR WHICH THE DATA WAS COLLECTED
✓	4.1	Source - procedure manuals, if available, up to date and accurate
✓	4.2	Source - interviews with process operators, engineers and foremen and other personnel with an intimate knowledge of the process to determine actual practice
✓	4.3	Document actual practice deviations from procedures in 4.1.
✓	4.4	Where each process step takes place in relation to the equipment placement as shown on floor plan. See 1.1 and 1.2.
✓	4.5	Operators involved in each step (note the different steps performed by a single operator); and operator responsible for each step
✓	4.6	Details of the operations performed at each step, as noted from 4.1 and 4.2 above
✓	4.7	Any breaks or discontinuities in process line (e.g. where material is bagged-out and bagged-in for transfer to another part or received from another part of the process)
?	4.8	Processing and handling of item kills, if applicable to the process
✓	4.9	Other Process Documentation - Specifications
N/A	4.10	Part Drawings (engineering drawings)
N/A	4.11	If Chemical process, chemistry and chemical engineering
N/A	4.12	Engineering Calculations - including personnel responsible for the calculations and documentation of any judgements and decisions based on the calculations

INFORMATION AND DATA CHECK LIST

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Check-off	Item - Number	
	5.0	DESCRIPTION OF MATERIAL
✓	5.1	Type at each step in the process - product, samples, feed, etc., include changes in chemical and physical form
✓	5.2	How identified - items, batches, etc.
✓	5.3	Quantity on hand at each step
✓	5.4	Residence times at each step - see Timing information below.
✓	5.5	Measurements made on material - see Measurements below.
✓	5.6	Information recorded on measurements and transfer of material - see Records below.
	5.7	See Process and Accountability forms below
	6.0	DESCRIPTION OF SCRAP AND RECYCLE
✓	6.1	Type generated at each step
✓	6.2	How identified - item, batches, etc.
✓	6.3	Quantity generated at each step
✓	6.4	Residence times at each step - see Timing information below
N/A	6.5	Measurements made on material for recycle into this process; for record keeping; see Measurements below.
✓	6.6	Information recorded on measurement and transfer of material; see Records below
	6.7	See Process and Accountability forms below
	7.0	DESCRIPTION OF MATERIAL IN STORAGE AREAS OR VAULTS, IF PART OF THE PROCESS
✓	7.1	Type of material
✓	7.2	How identified
✓	7.3	Quantities
✓	7.4	Residence times

INFORMATION AND DATA CHECK LIST

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Check-off	Item - Number	
✓	7.5	Information recorded on measurements (if made) and transfer of material; see Records and Measurements, below.
	7.6	See Accountability forms below.
	8.0	MEASUREMENTS
✓	8.1	Location of measurement points
✓	8.2	Types of measurements - and type at each point
✓	8.3	Precision and accuracy (if determined)
✓	8.4	Calibration data
✓	8.5	Person(s) responsible for measurement and recording of data
✓	8.6	Form used for recording data-see Process and Accountability forms below.
?	8.7	Comparisons made on measurement data-see Process Controls below.
	9.0	PROCESS AND ACCOUNTABILITY FORMS
✓	9.1	Copy of each form used to include: an explanation of data to be entered in each field on forms and the sources of data recorded on each form
✓	9.2	Personnel responsible for entries on the forms and their location in the process when making the entries.
✓	9.3	Routing of forms
?	9.4	If forms control is applied, a description of exactly how
✓	9.5	Personnel with access to partially completed and blank forms
	10.0	RECORDS - AS DISTINGUISHED FROM PROCESS AND ACCOUNTABILITY FORMS, ABOVE.
✓	10.1	Records maintained on the process, formal
✓	10.2	Records maintained on the process, informal
✓	10.3	Personnel with access to records

Check-off	Item - Number	
✓	10.4	Routing
?	10.5	How item kills are accomplished
?	10.6	Documentation of batch makeup - what records are kept
?	10.7	Prior period adjustments, if applicable, and how are they accomplished
	11.0	PERSONNEL - OPERATORS AND SUPERVISORS
✓	11.1	Locations in the process (compare with 4.5)
✓	11.2	Activities associated with each location - if keyed to the location (compare with 4.5)
✓	11.3	Instructions given and received
?	11.4	Known deviations from the instructions (compare with 4.3)
	11.5	See Measurements; Process and Accountability forms and locations in the process when recording data.
	12.0	PROCESS RESULTS
✓	12.1	Expected (theoretical and experimental)
?	12.2	Experienced (analysis of process data) - e.g., yields
✓	12.3	S-R differences
?	12.4	Sources for 12.2, 12.3 - measurement data; transfer information
N/A	12.5	MUF-calculated result for the process; components of the calculation; MUF control, if applicable.
N/A	12.6	Trend in Analysis of Process Data
?	12.7	PROCESS DATA used to calculate items 12.2, 12.3, 12.4, 12.5, 12.6
	13.0	PROCESS CONTROLS
?	13.1	Checks and verifications of process completion-for each step
?	13.2	Quality controls

INFORMATION AND DATA CHECK LIST

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Check-off	Item - Number	
?	13.3	Process controls used for comparison purposes: • Yields - acceptable level • Shipper/Receiver Difference-acceptable level • Trends in analysis of process data • Reject-failed specifications • Other reject criteria
?	13.4	Physical appearances - documentation, if deviation from normal could indicate an abnormal situation
	14.0	PROCESSING PROBLEMS
✓	14.1	Typical problems encountered - important to the decision of assessing an abnormal situation
?	14.2	Frequency
?	14.3	Causes
	15.0	TIMING INFORMATION
✓	15.1	Length of time for completion of each process step
✓	15.2	Time between processing steps
✓	15.3	Time between taking measurements and incorporation of these data into production and/or accountability data
✓	15.4	Time between completion of form and analysis of data on form
?	15.5	Time between notice of abnormal situation and response (and personnel responsible for the response)
✓	15.6	Time between sending samples to lab and return of analysis data
	16.0	MATERIAL ACCOUNTING ACTIVITIES - DESCRIPTION OF, AS THEY PERTAIN TO THE PROCESS. SEE 9.0. PROCESS AND ACCOUNTABILITY FORMS.
	17.0	INVENTORY ACTIVITIES - DESCRIPTION OF
✓	17.1	BPID
✓	17.2	Frequency of inventory

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4.5 UNIT PROCESS

1. Receiving

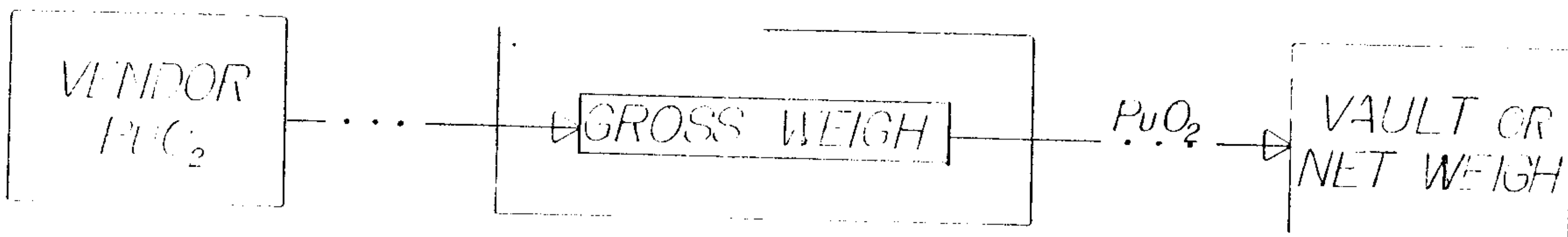
Receiving

The receiving operation is composed of ten steps. They are:

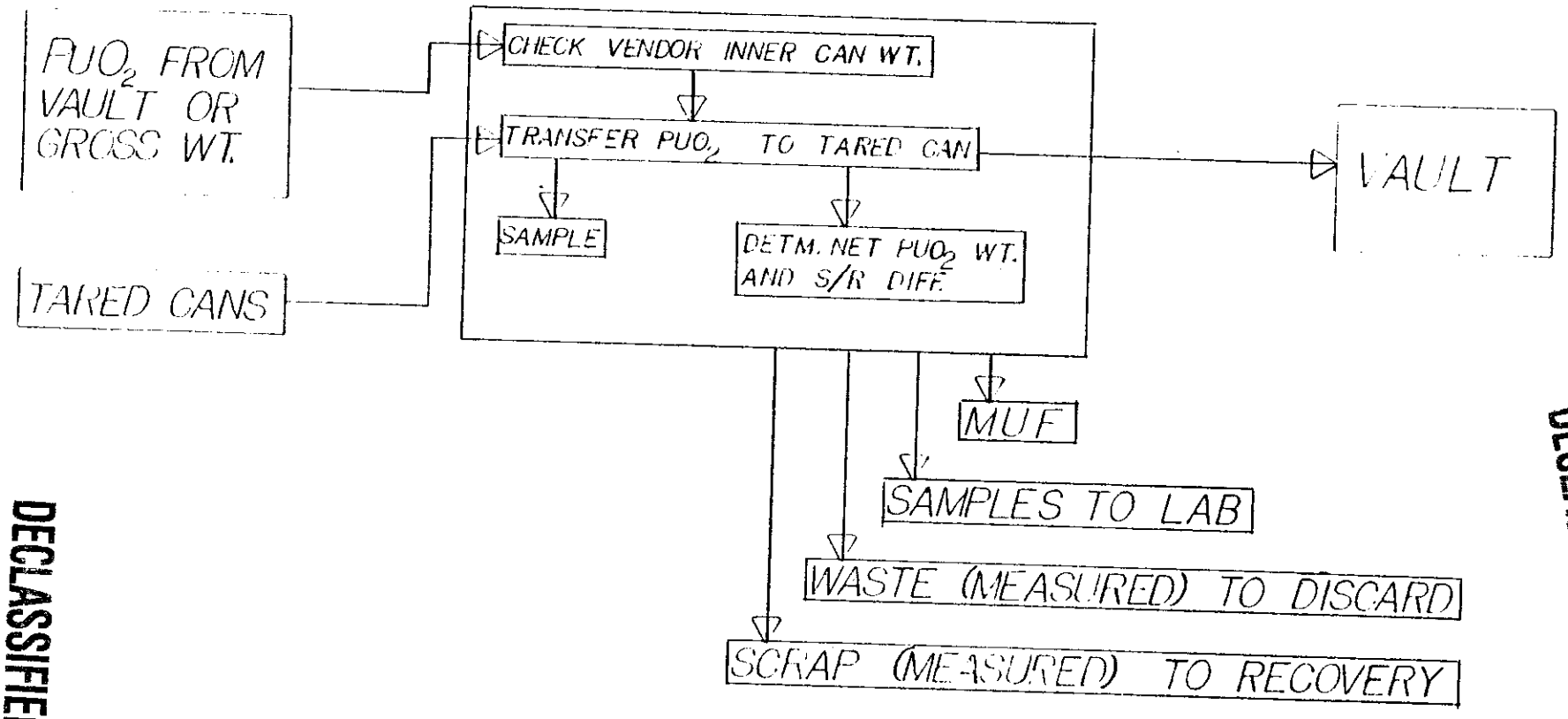
- Obtaining gross weight of PuO_2 container.
- Making up temporary acceptance records.
- Storage in vault (on hold).
- Transfer of PuO_2 container to assay and sampling room.
- Opening and net weighing contents.
- Sampling.
- Repackaging and labeling.
- Turn to vault for storage (on hold).
- Determining S/R difference.
- Acceptance and release for processing.

When a shipment is received, each container is inspected for damage, checked for contamination, the inside containers unloaded, gross weighed, the weight compared to the shipping documents, and the container put into a storage cubicle. Temporary storage and control records are made up on each container at this point and a "hold" from processing is initiated. After all containers have undergone the initial inspection and storage process, each container is then sent to a sampling lab for more detailed analysis. The contents of the container are put into a tared weighing container and a net weight obtained on the powder. The powder is then sampled for chemical analysis to determine Pu content, isotope, etc., and the sample sent to the analytical laboratory. The powder is reweighed, packaged, a temporary label applied to the container, returned to the vault on a "hold" from processing status, and temporary storage and control records made up. After the chemical analysis has been completed, comparison of the shippers and receivers data is made to determine if any S/R differences exist. If there are significant differences in the data, resolution must be made before the material can be released for processing. If there are no significant differences final acceptance records are made up, permanent container labels are applied, and the material is released for processing.

I-A. RECEIVING OF PuO_2 FEED



1B NET WEIGH AND SAMPLE PUO_2



UNIT PROCESS RECEIVING MEASUREMENT ON BULK FISSILE OXIDE MATERIAL #1

I. Incoming Material from Offsite Vendor

A. Bulk PuO_2

B. Fully enriched UO_2

II. Incoming Information

A. ERDA-741 Nuclear Material Transaction Report

B. ERDA-741 Back Up and Analytical Data

C. Vendor Container Label

D. HEDL Measurement and Disposition Agreement

E. QA Sampling Plan

F. S&MM Sampling Plan

III. Receiving Activities and Associated Data Generation

Procedure - Receiving Measurements on Bulk Fissile Oxide Material

A. General

This procedure governs the receiving measurements on bulk fissile oxide material. Requirements for weighing, sampling, and analysis of feed material are not applicable to all SS material receipts.

S&MM receiving measurements are concerned only with SS material content. Other determinations are made by technical groups working with the material.

S&MM shall not assume that all containers are received, that shipper's weights and assay values are correct, or that samples accompanying shipments are representative.

B. Procedure

1. Container Count

a. Verify each container physically against shipper's record.

b. If a discrepancy is observed, suspend further acceptance tests and work on the shipment until the discrepancy is resolved.

2. Gross Weighing

a. Check with the shipper to determine if gross weights include the weight of the lid and sealing tape.

b. In case of a gross weight discrepancy, contact the shipper and decide further action to be taken. During net weighing particular attention should be given to containers where gross weights differ significantly.

3. Sampling

All samples must be labeled with shipper's lot number and container number; a shipment composite sample must be labeled with the shipper's lot number.

a. Prior to net weighing obtain a representative sample of about 20 grams from the container by means of a metal cylindrical sample thief. The sample should be taken at five (5) or more random locations along vertical traverses through the container contents. Transfer the sample to a tared sample bottle coded to the container. Weigh the sample content and cap the bottle immediately to minimize moisture absorption. Net weighing of the container can proceed at this point (see 4 below).

b. Transfer about half the sample obtained in (a) above to a tared shipment composite sample bottle noting the weight of sample transferred. Subtract the weight of composite sample from the initial sample weight.

c. Repeat steps (a) and (b) for each container in the shipment so that approximately 10-gram individual samples and 10-gram composite samples are obtained from all of the containers in the shipment.

d. After thorough blending of the shipment composite sample, remove approximately 5 grams as an analytical composite sample. The balance of composite sample is retained as a shipment archive sample composite.

e. Prepare duplicate 1-gram samples from the analytical composite sample for submission to analytical chemistry. Maintain the balance of analtyical composite.

f. Prepare duplicate 2-gram samples from each container analytical sample obtained as a result of (a) and (b) above for submission to analytical chemistry. Maintain the balance of container analytical samples.

4. Net Weighing

a. When a container has been sampled, transfer contents to a tared metal container.

b. Record net weight of the container contents as the sum of the tared contents and the sample weight.

c. Obtain the shipment net weight as the sum of all tared contents and sample net weights. Include all weighed sweeps, etc, in arriving at the shipment net weight.

d. In case of a net weight discrepancy, notify the shipper immediately. Postpone any technical operations with the material until the discrepancy is resolved.

5. Summary Report

a. Tabulate all receiving measurement data in a comparison with shipper's data. Include weights, chemical assay, isotopic assay, and limits of error.

b. Show observed shipper-receiver difference from comparative values.

c. Show route-mean-square limit of error calculation for shipper-receiver difference.

d. In those cases where the shipper does not supply his limits of error, then the limit of error calculation for shipper-receiver difference is equal to the square root of 2 (1.414) times the receiving measurement limit of error.

e. Describe acceptance or rejection of SS material content of the shipment in accordance with (a) and (b) above.

IV. Records Maintained

A. ERDA-741 Nuclear Material Transaction Report
Completed by both Shipper and Receiver.

B. ERDA-741 Back Up and Analytical Data
Completed by both Shipper and Receiver.

C. New HEDL Fissile Material Container Label

D. Loan Slip

E. Computer Glovebox Transaction Report

F. Glovebox Log

G. HEDL Measurement and Disposition Agreement

H. QA and S&MM Sampling Plans

List of Personnel Per Unit Process

1. Receiving

A. At preceding unit process

a. From vendor

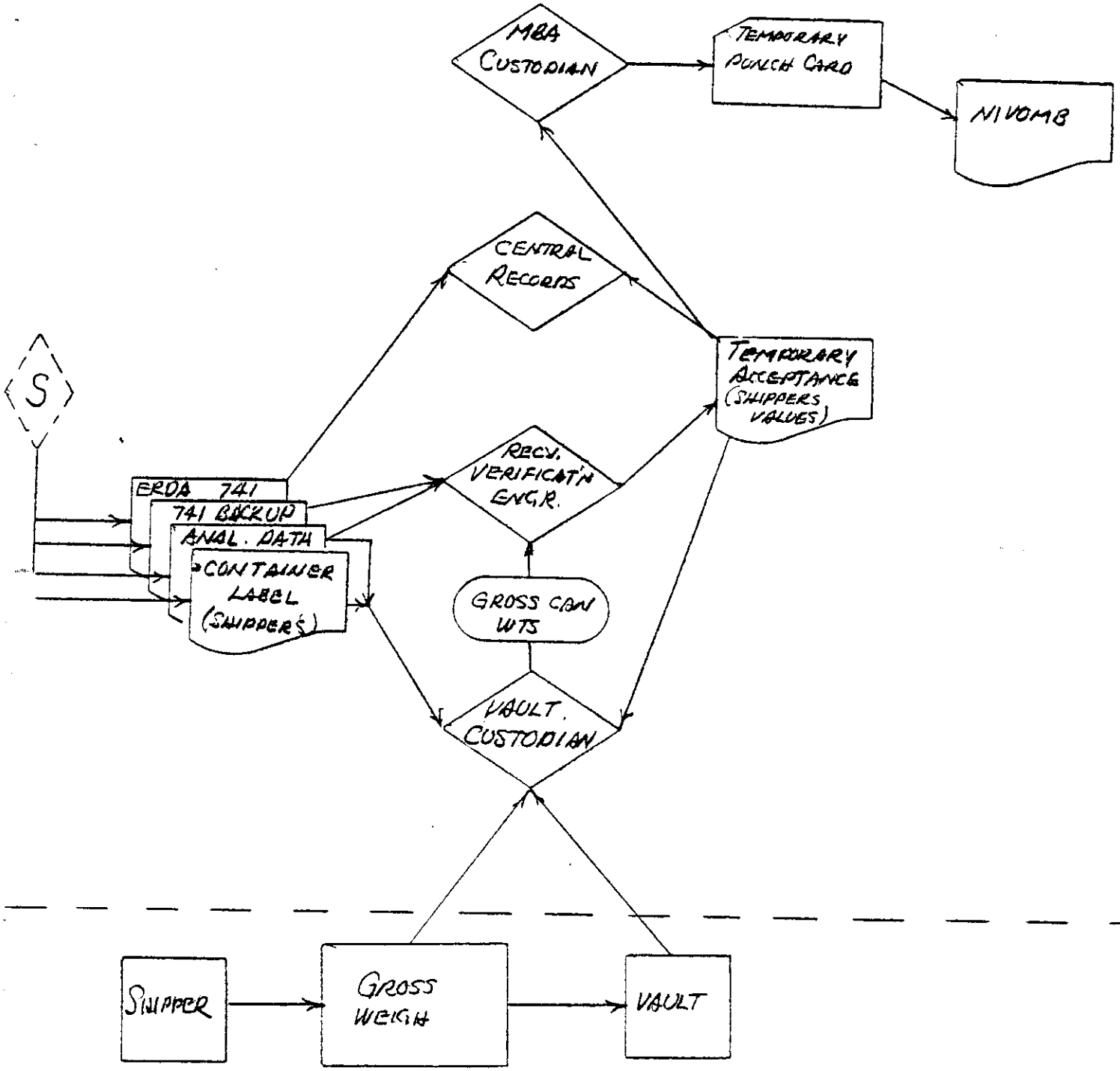
B. At following unit process (calcine)

1. Process operators A and B

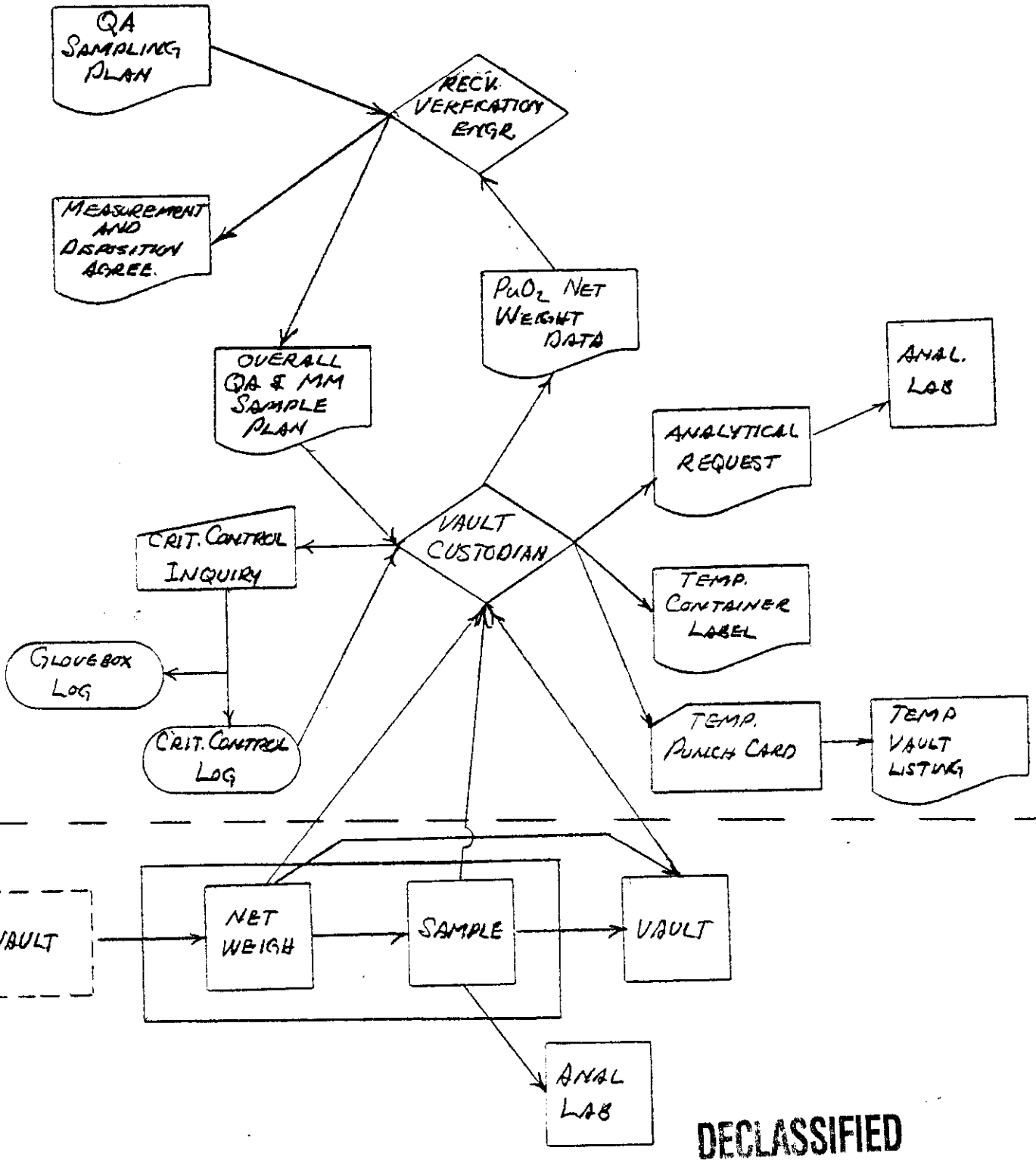
2. Vault custodian

3. Process Engineer (Foreman)

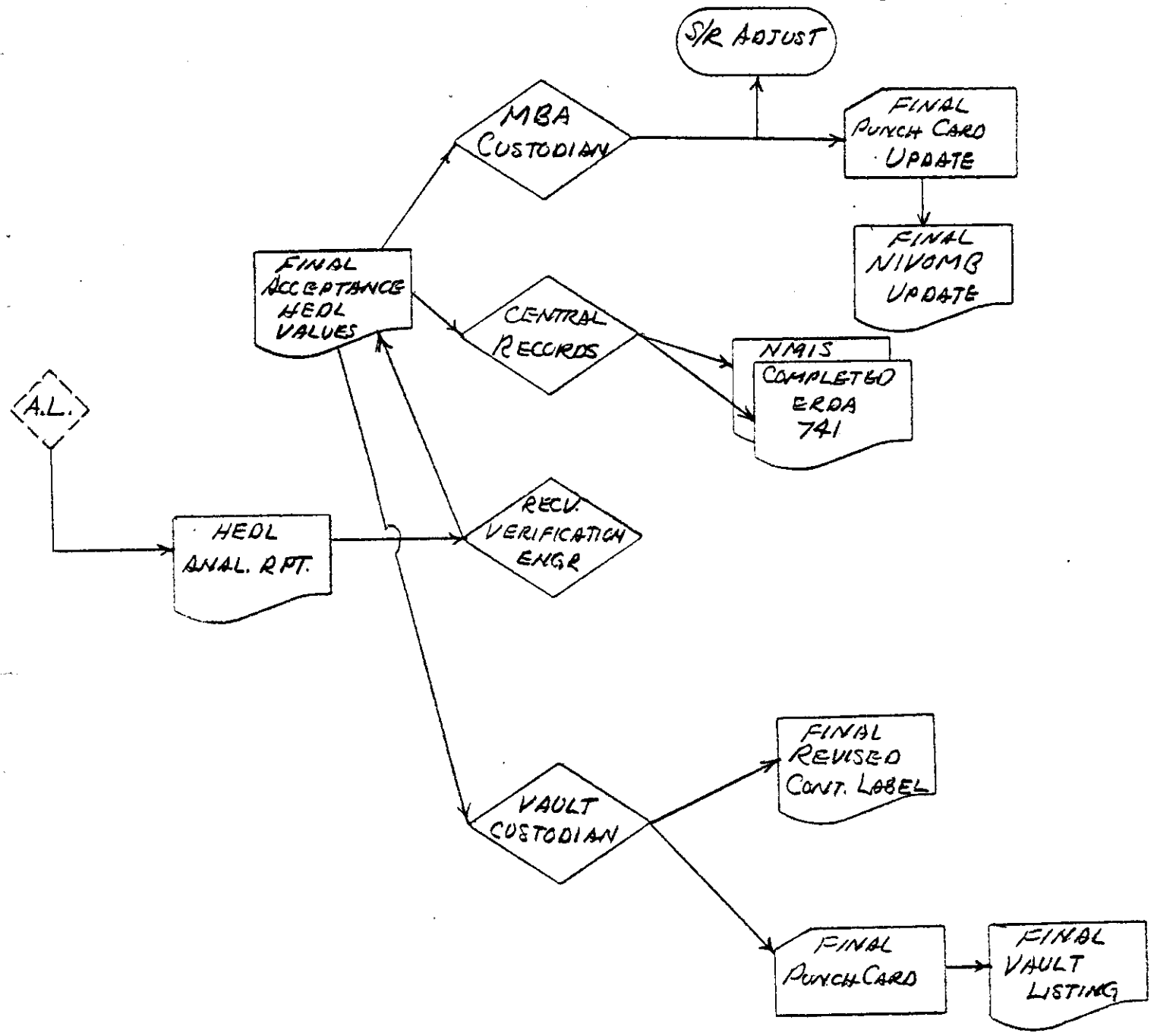
1A. Receiving PuO_2 Shipments



7B. Net Weighing and Sampling of PuO_2



1C. FINAL ACCEPTANCE OR PuO$_2$ SHIPMENT



Vault Custodian: Receiving

1.0 Task

The vault custodian is a technician who performs all operations involving the handling, measurement, data recording, and packaging of SNM for the unit process.

2.0 Safeguards Activities

The vault custodian is responsible for performing and recording input/output measurement data, observing and reporting abnormal situations relating to possible theft or sabotage, and preparing records of transfer for purposes of accountability. The vault custodian is not responsible for making decisions involving safeguards related matters.

3.0 Information Needs

The following information is needed by the vault custodian:

- 741 and backup information.
- Criticality listing for amount of SNM in each storage area.
- Inventory listing for entire vault.
- Fissile content of each container in the unit process.
- Gross, tare, and net weight of each container in the unit process.
- Analytical measurement data for each newly received container of feed material.
- QA and S&MM sampling plans.
- Vendor container label.

RECEIVING

INCOMING INFO

 FEED, PRODUCT, SCRAP WASTE, SAMPLES

I

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC.	PERS	PROC.	PERS
Feed PuO_2 UO_2	1. 741	Vendor			Vault	Cust.
	2. 741 Backup Info	Vendor			"	"
	3. Vendor Label	Vendor			"	"
	4. QA Sampling Plan	QA			"	"
	5. S&MM Sampling Plan	S&MM			"	"

RECEIVING

INFO AND DATA GENERATED

FEED, PRODUCT, SCRAP WASTE, SAMPLES

II

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC.	PERS	PROC.	PERS
	1. Container Label	Vault Custodian				
	2. Loan Slip	" "				
	3. Cubicle Log	" "				
	4. Criticality Log	" "				
	5. Inventory Card	" "				

[redacted]

RECEIVING

RECORDS AND REPORTS PREPARED

FEED, PRODUCT, SCRAP WASTE, SAMPLES

III

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC.	PERS	PROC.	PERS
	1. Container Label					
	2. Loan Slip					
	3. Cubicle Log					
	4. Cirticality Log					
	5. Inventory Card					

[redacted]

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RECEIVING

RECORDS AND REPORTS MAINTAINED

FEED, PRODUCT, SCRAP WASTE, SAMPLES

IV

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC	PERS	PROC	PERS
	1. 741					
	2. 741 Backup Info					
	3. Loan Slip					
	4. QA Sampling Plan					
	5. S&MM Sampling Plan					
	6. Cubicle Log					
	7. Criticality Log					

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RECEIVING

OUTGOING INFO

FEED, PRODUCT, SCRAP WASTE, SAMPLES

V

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC.	PERS	PROC.	PERS
Feed PuO_2 UO_2	1. Container Label 2. Loan Slip	Vault Custodian " "	Vault "	Cust. "	Calc. or Blend	Oper.

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4.6 UNIT PROCESS

2. Calcining

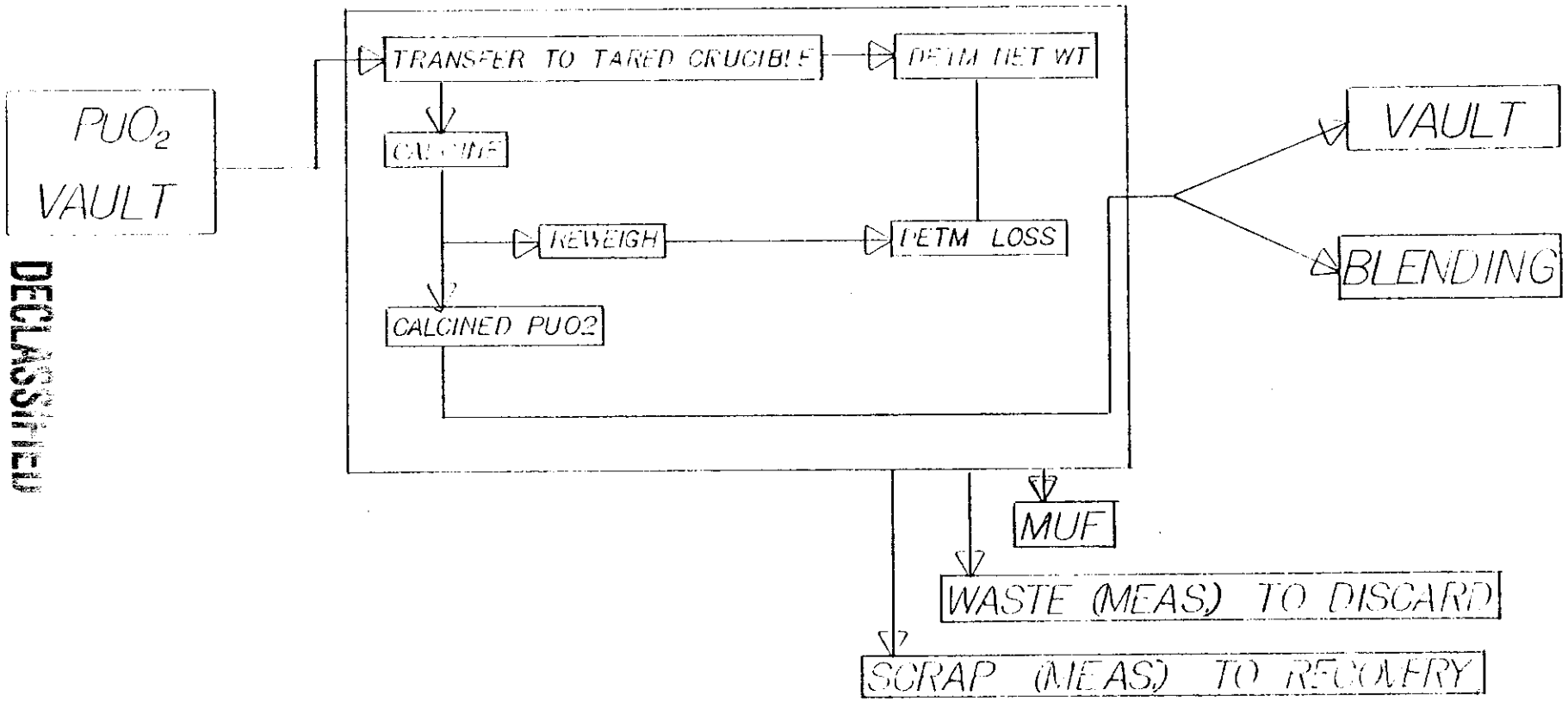
PuO_2 Calcining

The calcining operation consists of the following four steps:

- Weighting to obtain net weight.
- Calcining furnace.
- Weighting to determine weight loss.
- Transfer to storage or process line.

Four, one kilogram canisters of PuO_2 feed material are transferred to the calcining glovebox from either the 324, 308 storage vault. Each container is taken one at a time and the gross weight obtained, the contents placed in a stainless basket, and the tare weight determined on the empty canister. The stainless basket is then placed in the furnace and heated to about 750° C for 20 hours. The calcined PuO_2 is removed from the furnace, placed in a clean tared canister, gross weighted and labeled for transfer to either the in-process storage vault or the next unit process.

2. CALCINING



UNIT PROCESS CALCINE #2

I. Incoming Material from Preceding Unit Process

A. Receiver verified and released PuO_2

B. From 308 or 324 Buildings in-process storage vault

II. Incoming Information

A. Loan Slip

B. Container Label

C. Computer Glovebox Transaction Report

D. Glovebox Log

E. Process information given to operator via DSI

F. Follower card FM

III. Receiving Activities and Associated Data Generation

Procedure for Hoskins

A. Obtain PuO_2 powder designated by Fabrication Engineer from storage vault, gross weigh and transfer to calcining glovebox. Concurrently loan slip is generated.

B. Add material to inventory sheet using the vault fissile material factor.

Record these values in the lab notebook.

C. Confirm balance calibration with standard mass.

D. Weigh can of PuO_2 and record in notebook and on FM card as the weight before calcining.

E. Place contents of can into crucible quantitatively and place into furnace.

F. Calcine according to the program described by Fabrication Engineer.

G. Cool and dump the calcined PuO_2 from the crucible into the stainless steel trough.

H. Return calcined PuO_2 to a clean tared pint metal can and label with standard fissile material label and date.

I. Weigh the powder in the can and record weight in the notebook and on the FM card as the after calcining weight.

J. Tape seal the can, bagout and place into a second can.

K. Tape seal the outer can, affix fissile material label and gross weigh.

L. Prepare loan slip for transfer out of the account (use new factor of .88 for Pu content).

M. Removed to storage or blending hood as specified by engineer, after verifying transfer on computer.

IV. Records Maintained

A. Loan Slip

B. Fissile Material Container Label

C. Computer Glovebox Transaction Report

D. Glovebox Log

E. Process information given to operator via DSI

F. Follower Card FM

List of Personnel Per Unit Process

2. Calcine

A. At preceding unit process (Receiving)

1. Vault custodian 308 vault

2. Technician during sampling and repackaging operations

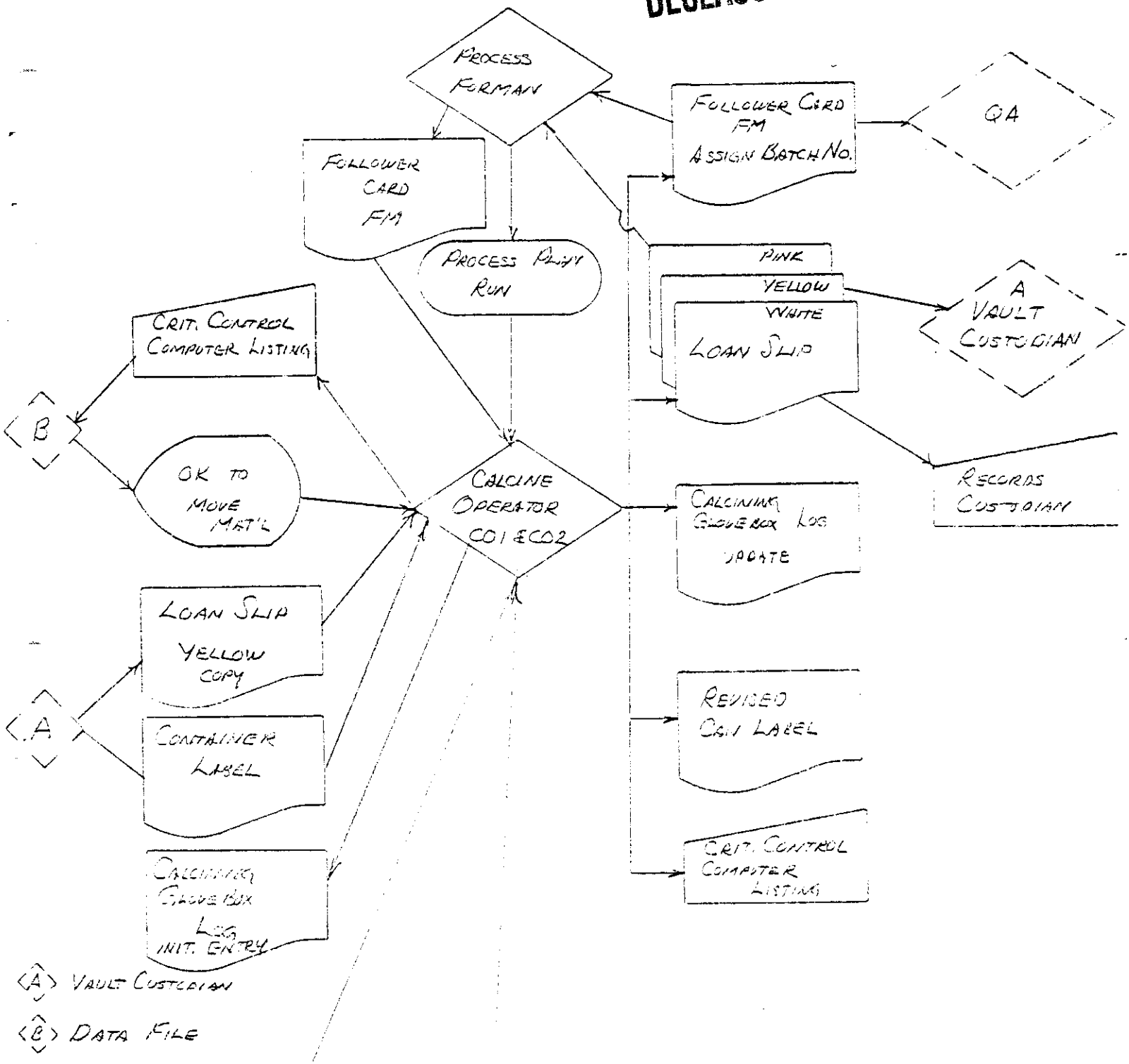
B. At the following unit process (Screen and V-Blend)

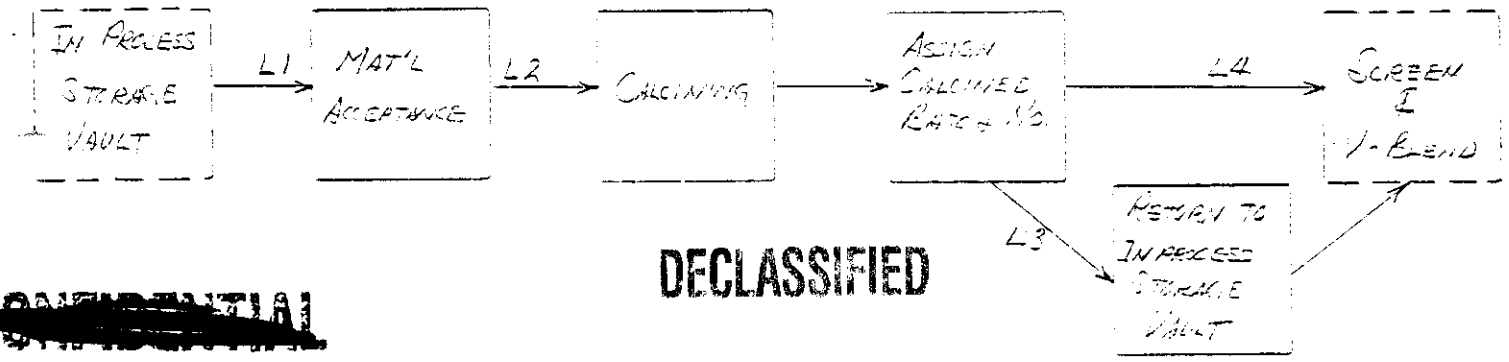
1. Process operators A and B (Usually same two process operators for the calcining operation)

2. Vault custodian 308 vault

3. Process Engineer (Foreman)

2 CALCINING





Process Operator: Calcine

1.0 Task

The Calcine operator is a process technician who performs all operations involving the handling, measurement, processing, data recording, and packaging of SNM for the unit process.

2.0 Safeguards Activities

The process operator is responsible for performing and recording input/output measurement data, observing and reporting abnormal situations relating to possible theft or sabotage, and preparing records of transfer for purposes of accountability. The process operator is not responsible for making decisions involving safeguards related matters.

3.0 Information Needs

The following information is needed by the process operator:

- List of transfers into and out of unit process.
- Criticality listing for amount of SNM in the unit process.
- Fissile content of each container in the unit process.
- Gross, tare, and net weight of each container in the unit process.
- Quality assurance follower card for calcining data.
- Process instructions from the Process Engineer.
- Knowledge of process operations.

TIMING INFORMATION

Calcining

4 kgs

1. Weigh - 5 minutes/kg
2. Calcine - 2-20 hours/kg
3. Package - 30 minutes/kg
4. Weigh - 5 minutes/kg

CALCINE

INCOMING INFO

FEED, PRODUCT, SCRAP WASTE, SAMPLES

I

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC	PERS	PROC	PERS
Feed PuO_2	1. Loan Slip (Yellow)	308 Vault Cust.	308 Vault	Cust.	Calc.	Oper.
	2. Container Label		308 Vault	Cust.	Calc.	Oper.
	3. DSIWI	Process Eng.	Proc.	Form	Calc.	Oper.
	4. Follower Card (FMB)	QA Dept.	Proc.	Form	Calc.	Oper.

CALCINE

INFO AND DATA GENERATED

DECLASSIFIED

II

FEED, PRODUCT, SCRAP WASTE, SAMPLES

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC	PERS	PROC	PERS
Feed PuO_2	1. Glovebox Log	Calc. Oper.				
	2. Engineering Lab Notebook	Calc. Oper.				
	3. Criticality Log	Calc. Oper.				

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CALCINE

RECORDS AND REPORTS PREPARED

FEED, PRODUCT, SCRAP WASTE, SAMPLES

III

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC.	PERS	PROC.	PERS
	1. Follower Card (FMB) 2. Engineering Lab Notebook 3. Criticality Log 4. Glovebox Log 5. Loan Slip					

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CALCINE

RECORDS AND REPORTS MAINTAINED

FEED, PRODUCT, SCRAP WASTE, SAMPLES

IV

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC.	PERS	PROC.	PERS
	1. Follower Card (FMB)					
	2. Engineering Lab Notebook					
	3. Criticality Log					
	4. Glovebox Log					
	5. Loan Slip					

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC.	PERS	PROC.	PERS
Product Calc. PuO_2	1. Container Label	Calc. Oper.	Calc.	Oper.	308 Vault or Blend	Cust. Oper.
	" "	" "	"	"		
	2. Loan Slip (Yellow)	Calc. Oper.	Calc.	Oper.	308 Vault	Cust.
	" " (White)	" "	"	"	Record	Cust.
	" " (Pink)	" "	"	"	Proc.	Foreman
	3. Criticality Log	Calc. Oper.	Calc.	Oper.	Safg.	Computer
	4. Glovebox Log	Calc. Oper.				
	5. Follower Card (FMB)	Calc. Oper.	Calc.	Oper.	Proc.	Foreman

4.7 UNIT PROCESS

3. Screen and V-Blend

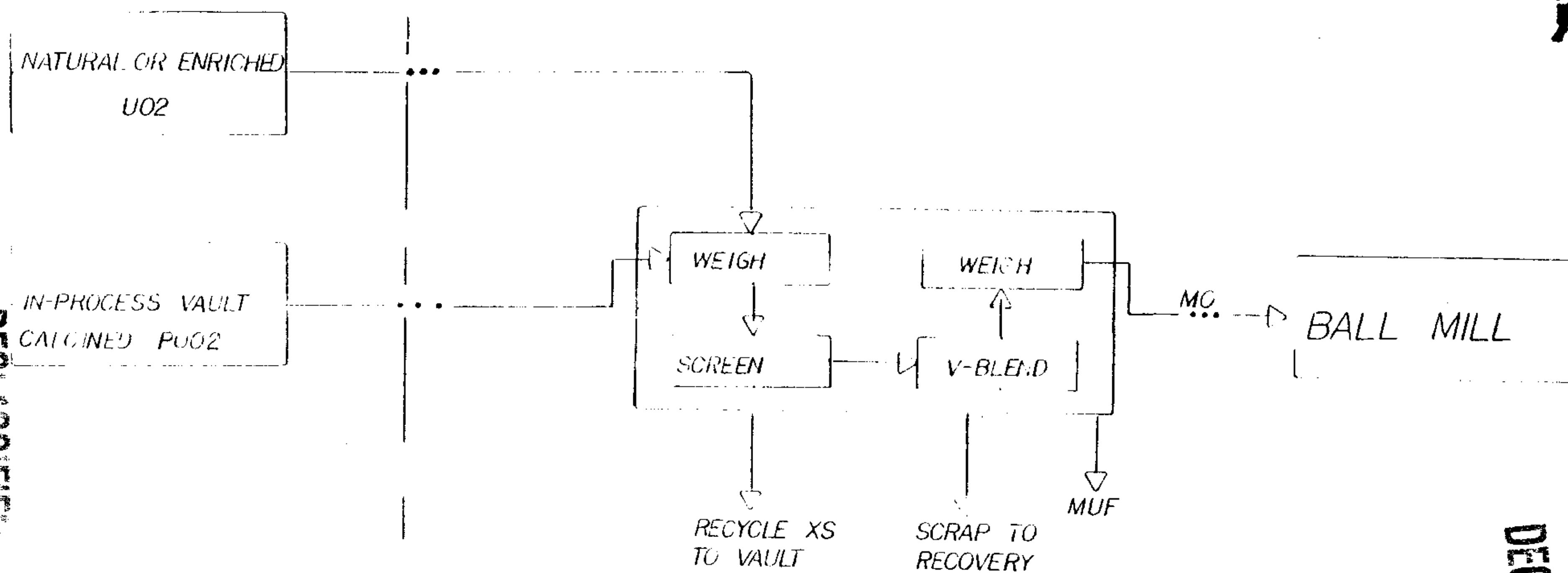
Screen and V-Blend

The screen and V-blend operation has four steps:

- Weighting out required quantities of PuO_2 and UO_2.
- Screening and hand blending the two quantities of oxides together.
- V-blending the mixed oxide.
- Getting the material ready for the next unit process.

A batch quantity of mixed oxide is usually either one or four kilograms, however, smaller batch quantities may be made. Enough containers of PuO_2 are transferred into the glovebox to make up the batch quantity specified by the process engineer. The PuO_2 is screened onto a weighing pan and weighted. The UO_2 is placed directly on a separate weighing pan and weighted to the required quantity. Both quantities of oxide are then manually blended six times by layering on a screen. In this step batches are limited to 1,000 grams each. After manually blending, the 1,000 gram batch is placed in the V-blender and blended an additional ten minutes using the intensifier. The batch is then discharged into a rubber lined ballmill jar for the next stage of the process.

3. SCREEN V-BLEND



UNIT PROCESS SCREEN AND V-BLEND #3

I. Incoming Material from Preceding Unit Process

A. PuO_2 from vault or calcining process

B. UO_2 from vault or storage

II. Incoming Information

A. Loan Slip

B. Glovebox Log (GBL)

C. Computer Glovebox Transaction Report

D. Container Label

E. Process Run Plan

F. Follower Card FB

III. Receiving Activities and Associated Data Generation

Procedure Screen and Blend

A. Enter PuO_2 and UO_2 into hood.

B. Confirm weight of all PuO_2 and UO_2 brought into hood. Enter confirmed weight of PuO_2 on data follower card.

C. Use separate weighing pans for UO_2 and PuO_2. Check tare weight of weighing pan and weigh required amount of PuO_2 or UO_2 that is specified by fabrication engineer. If the fuel ^{235}U enrichment is not normal (0.7%) or fully enriched (>92%) follow Alternate Procedure below.

D. Check weigh original PuO_2 or UO_2 can and calculate difference to insure correct amount has been used. Mark new weights of unused PuO_2 and UO_2 on cans.

E. Manually blend the UO_2 and PuO_2 powders by layering on a 20 mesh screen. Limit batches to 1000 grams. Pass this material through the screen six times.

F. Clean two quart Patterson-Kelly twin shell blender with a nylon brush between batches and wipe out with damp cloths between enrichment changes.

G. Blend batch in blender using intensifier for ten minutes.

H. Place large tared pan under blender, unload and clean blender into pan. Any material spilled outside of pan becomes sweeps and is not returned to blend.

I. Weigh pan and contents for recovery calculation.

IV. Alternate Procedure: Enriched UO_2

A. All weights shall be verified and initialed by another person.

B. Confirm balance calibration per Operating Procedure.

C. Weigh >92% enriched UO_2 in receiving container.

D. Tare weigh the weighing container and weigh amount 93% enriched UO_2 specified by Fabrication Engineer.

E. Weigh remaining >92% enriched UO_2 in receiving container and calculate difference in weight to insure correct weight was used.

F. Place >92% enriched UO_2 weighed in Step IV-C into blend holding container.

G. Confirm balance calibration per Operating Procedure.

H. Weigh normal or depleted UO_2 in receiving container.

I. Tare weigh the weighing container and weigh amount of normal or depleted UO_2 specified by Fabrication Engineer.

J. Weigh remaining normal or depleted UO_2 in receiving container and calculate difference in weight to insure correct weight was used.

K. Place normal or depleted UO_2 weighed in step IV-I into blend holding container.

L. Return to step III-C and weigh amount of PuO_2 specified by Fabrication Engineer.

V. Records Maintained

A. Loan Slip

B. Glovebox Log

C. Computer Glovebox Transaction Report

D. Container Label

E. Process Run Plan

F. Follower Card FB

List of Personnel Per Unit Process

3. Screen and V-Blend

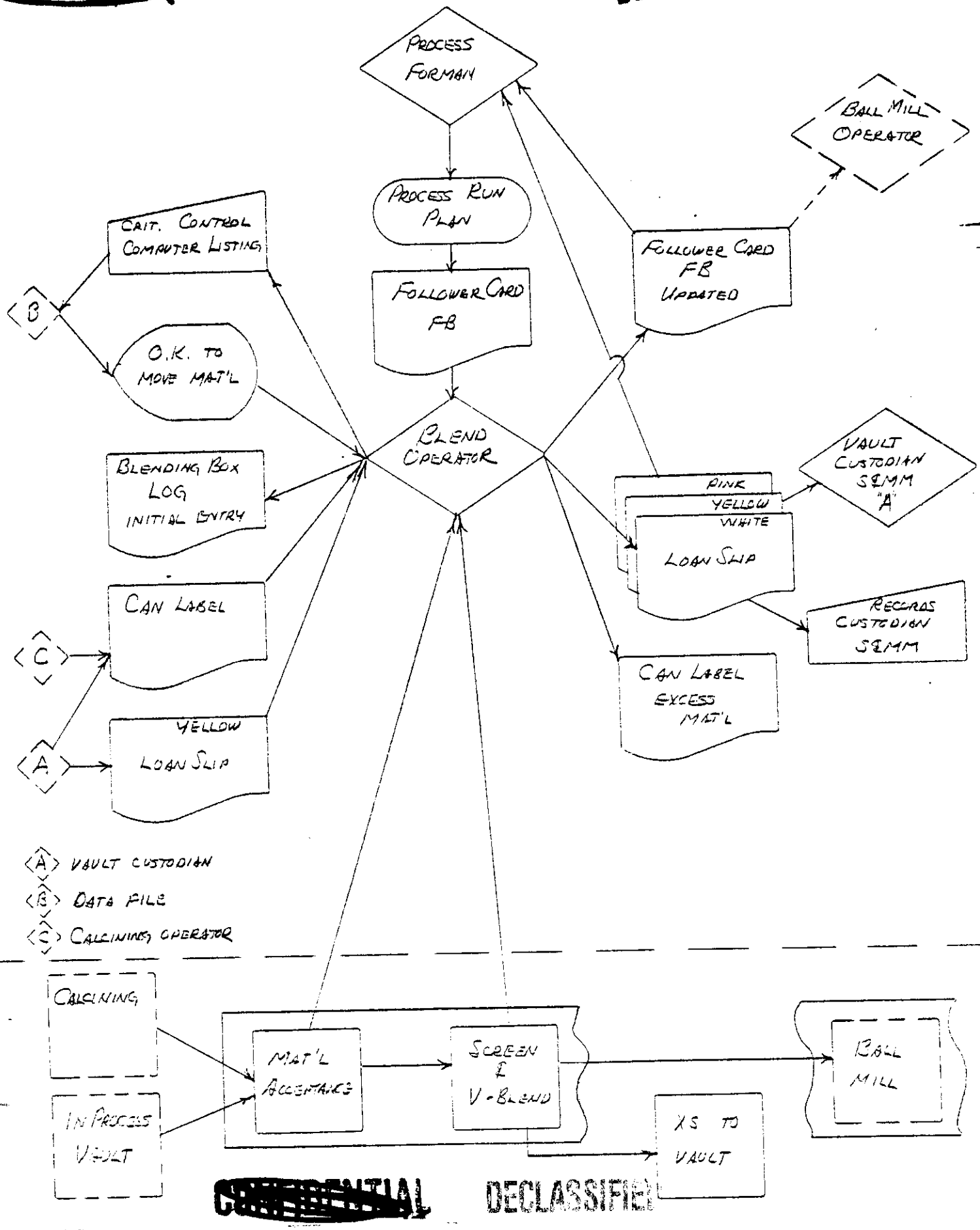
A. At preceding unit process (calcine)

1. Process operators A and B
2. Vault custodian
3. Process Engineer (Foreman)

B. At the following unit process (Ball Mill and Crossblend)

1. Process operators A and B (Same two operators in Screen and V-Blend)
2. Process Engineer (Foreman)

3 SCREEN & V-BLEND



Process Operator: Screen and V-Blend

1.0 Task

The Screen and V-Blend operator is a process technician who performs all operations involving the handling, measurement, processing, data recording, and packaging of SNM for the unit process.

2.0 Safeguards Activities

The process operator is responsible for performing and recording input/output measurement data, observing and reporting abnormal situations relating to possible theft or sabotage, and preparing records of transfer for purposes of accountability. The process operator is not responsible for making decisions involving safeguards related matters.

3.0 Information Needs

The following information is needed by the process operator:

- List of transfers into and out of the unit process.
- Criticality listing for amount of SNM in the unit process.
- Gross, tare, and net weight of each container in the unit process.
- Quality Assurance follower cards for screen and V-blending.
- Process instructions from Process Engineers.
- Knowledge of process operations.

TIMING INFORMATION

Screen and V-Blend

4 kg Batch

1. Weigh - 5 minutes/kg
2. Screen - 10 minutes/kg
3. V-Blend - 10 minutes/kg
4. Transfer to Ball Mill jar - 5 minutes/kg

SCREEN AND V-BLEND

INCOMING INFO

FEED, PRODUCT, SCRAP, WASTE, SAMPLES

I

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC.	PERS	PROC.	PERS
Calcined PuO_2 Nat. or Enr. UO_2	1. Loan Slip	308 Vault Cust.	308 Vault	Cust.	S & V-B	Oper.
	2. Container Label		308 Vault	Cust.	S & V-B	Oper.
	3. Follower Cards					
	a. Fuel Powder (FB)	S & V-B Oper.	QA Dept.		S & V-B	Oper.
	b. PuO_2 Powder (FA)	" "	"		"	"
	c. UO_2 Powder (XN)	" "	"		"	"
	4. Criticality Log	" "		Computer	S & V-B	Oper.

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SCREEN AND V-BLEND

INFO AND DATA GENERATED

FEED, PRODUCT, SCRAP WASTE, SAMPLES

II

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM PROC	FROM PERS	TO PROC	TO PERS
	1. Glovebox Log	S & V-B Oper.				
	2. Engineering Lab Notebook	" "				
	3. Criticality Log	" "				
	4. Follower Cards					
	a. Fuel Powder (FB)	" "				
	b. PuO_2 Powder (FA)	" "				
	c. UO_2 Powder (XN)	" "				

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SCREEN AND V-BLEND

RECORDS AND REPORTS PREPARED

FEED, PRODUCT, SCRAP WASTE, SAMPLES

III

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC.	PERS	PROC.	PERS
	1. Follower Cards	S & V-B Oper.				
	a. Fuel Powder (FB)	" "				
	b. PuO_2 Powder (FA)	" "				
	c. UO_2 Powder (XN)	" "				
	2. Engineering Lab Notebook	" "				
	3. Criticality Log	" "				
	4. Glovebox Log	" "				

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SCREEN AND V-BLEND

RECORDS AND REPORTS MAINTAINED

FEED, PRODUCT, SCRAP WASTE, SAMPLES

IV

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC	PERS	PROC.	PERS
	1. Follower Cards	S & V-B Oper.				
	a. Fuel Powder (FB)	" "				
	b. PuO_2 Powder (FA)	" "				
	c. UO_2 Powder (XN)	" "				
	2. Engineering Lab Notebook	" "				
	3. Criticality Log	" "				
	4. Glovebox Log	" "				

SCREEN AND V-BLEND

OUTGOING INFO

FEED, PRODUCT, SCRAP WASTE, SAMPLES

V

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM PROC.	FROM PERS	TO PROC.	TO PERS
Mixed Oxide	1. Container Label	S & V-B Oper.	S & V-B	Oper.	BM & C	Oper.
	2. Criticality Log	" "	"	"	"	"
	3. Glovebox Log	" "	"	"	"	"
	4. Follower Cards					
	a. Fuel Powder (FB)	" "	"	"	"	"
	b. PuO_2 Powder (FA)	" "	"	"	"	"
	c. UO_2 Powder (XN)	" "	"	"	"	"

4.8 UNIT PROCESS

4. Ball Mill and Crossblend

Ball Mill and Cross Blend

The ball mill and cross blend operation consist of six steps:

- Ball milling.
- Screening.
- V-blending.
- Sampling for screen analysis.
- V-blending.
- Determining process loss.

After the mixed oxide has been discharged into the ball mill jar, eight pounds of tungsten carbide balls are introduced. Milling time is 20 hours. One to four jars may be milled at one time. The milled oxide is passed through a screen and visually checked for mill fragments. If a four kilogram batch is processed, the four kilograms are hand blended together for five minutes and placed in the V-blender for 15 minutes using the intensifier. The mixed oxide is then removed from the V-blender, and split into two, two-kilogram containers. If it is a one kilogram batch, it is put directly in the V-blender for ten minutes, using the intensifier. After V-blending, a 100 gram sample is obtained from the batch and a screen analysis performed. After the analysis the sample is returned to the batch and reblended in the V-blender for five minutes. The total powder weight is determined and the process loss calculated.

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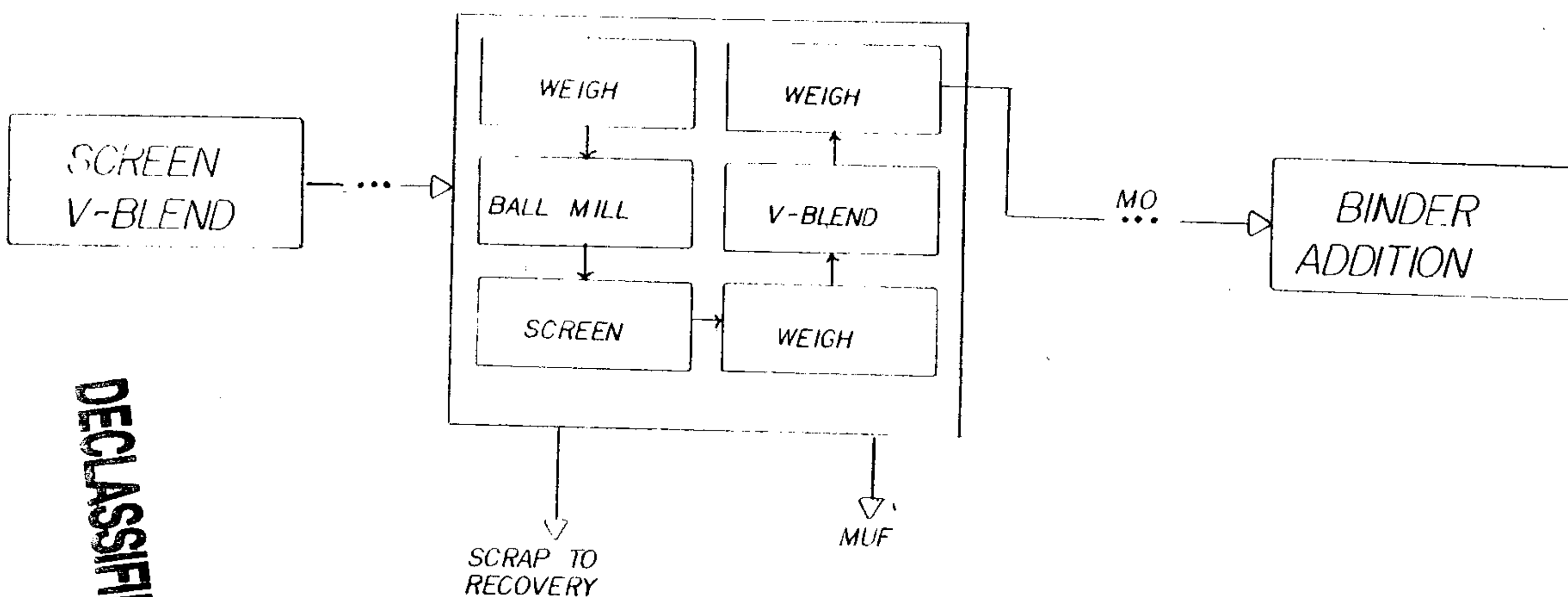
4. BALL MILL AND CROSSBLEND



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UNIT PROCESS BALL MILL AND CROSS BLENDING #4

I. Incoming Material from Preceding Unit Process

A. Mixed Oxide

II. Incoming Information

A. Glovebox Log (GBL)

B. Computer Glovebox Transaction Report

C. Follower Card FB

D. Process Run Plan

III. Receiving Activities and Associated Data Generation

Ball Milling and Cross Blending

A. Charge each mill with 1000 grams of mixed oxide and mill for 20 hrs.

B. Remove milled material from ball jar and pass through a 20 mesh screen to break up any agglomerates.

C. Place the four kilograms of milled powder in a stainless steel pan and hand blend powder for five minutes.

D. Place the four kilograms of hand blended powder in V-blender. V-blend with intensifier fifteen minutes.

E. Remove blended powder from V-blender and divide blended powder into two, 2-kilogram containers.

F. Weigh powder to determine process loss and record in lab notebook.

G. After sweeping or vacuuming work area, wipe down equipment and floor with wet rags of kn own tare. Dried rag will contain X amount of material recovered. Identify sweeps and rags as to percent of enrichment and weight and send to vault for recovery and record in notebook.

H. Record all weight, powder identification numbers, time, any variations from the specified procedure and any other irregularities in the lab notebook and on data follower cards.

IV. Records Maintained

A. Glovebox Log (BGL)

B. Computer Glovebox Transaction Report

C. Follower Card FB

D. Process Run Plan

E. Container Label

List of Personnel Per Unit Process

4. Ball Mill and Crossblend

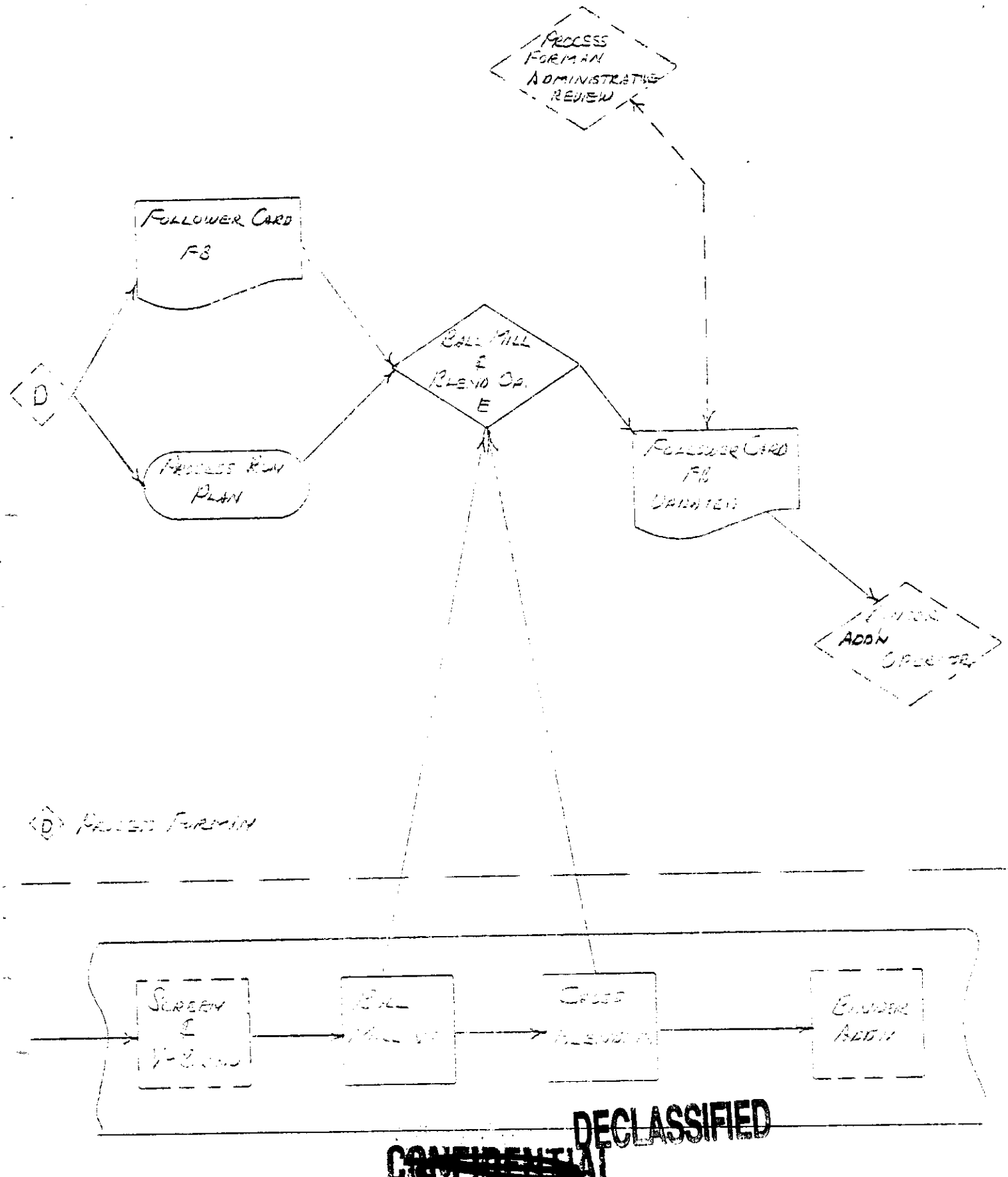
A. At preceding unit process (Screen and V-Blend)

1. Process operator A and B (Same two operators in calcining)
2. Vault custodian
3. Process Engineer (Foreman)

B. At the following unit process (Binder Addition)

1. Process operators A and B (Same two operators in Ball Mill and Crossblend)
2. Process Engineer (Foreman)

4 Ball Milling & Cross Blending



Process Operator: Ball Mill and Crossblend

1.0 Task

The Ball Mill and Crossblend operator is a process technician who performs all operations involving the handling, measurement, processing, data recording, and packaging of SNM for the unit process.

2.0 Safeguards Activities

The process operator is responsible for performing and recording input/output measurement data, observing and reporting abnormal situations relating to possible theft or sabotage, and preparing records of transfer for purposes of accountability. The process operator is not responsible for making decisions involving safeguards related matters.

3.0 Information Needs

The following information is needed by the process operator:

- List of transfers into and out of the unit process.
- Criticality listing for amount of SNM in the unit process.
- Gross, tare, and net weight of each container in the unit process.
- Quality Assurance follower cards for Ball Mill and Crossblend.
- Process instructions from Process Engineer.
- Knowledge of process operations.

TIMING INFORMATION

Ball Mill and Crossblend

4 kg Batch

1. Ball Mill - 20 hours/kg (4 kg done at same time)
2. Screen - 15 minutes/kg
3. Hand Blend - 5 minutes/4 kg
4. V-Blend - 15 minutes/4 kg
5. Package in 2 kg quantities - 10 minutes/2 kg
6. Sample (100 gm) and screen test - 20 minutes/2 kg
7. Screen sample in batch - 5 minutes/2 kg
8. V-Blend - 5 minutes/2 kg
9. Package in 2 kg quantities - 5 minutes
10. Weigh - 5 minutes/2 kg

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BALL MILL AND CROSSBLEND

INCOMING INFO

FEED, PRODUCT, SCRAP WASTE, SAMPLES

I

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC	PERS	PROC	PERS
Mixed Oxide	1. Follower Cards	BM & C Oper.	S & V-B	P.O.	BM & C	P.O.
	a. Fuel Powder (FB)	"	" "	"	"	"
	b. PuO_2 Powder (FA)	"	" "	"	"	"
	c. UO_2 Powder (XN)	"	" "	"	"	"

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BALL MILL AND CROSSBLEND
INFO AND DATA GENERATI

FEED, PRODUCT, SCRAP
WASTE, SAMPLES

II

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC.	PERS	PROC.	PERS
	1. Engineering Lab Notebook	BM & C Oper.				
	2. Follower Cards					
	a. Fuel Powder (FB)	" "				
	b. PuO_2 Powder (FA)	" "				
	c. UO_2 Powder (XN)	" "				

BALL MILL AND CROSSBLEND

RECORDS AND REPORTS PREPARED

FEED, PRODUCT, SCRAP WASTE, SAMPLES

III

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC	PERS	PROC	PERS
	1. Follower Cards	BM & C Oper.				
	a. Fuel Powder (FB)	" "				
	b. PuO_2 Powder (FA)	" "				
	c. UO_2 Powder (XN)	" "				
	2. Engineering Lab Notebook	" "				

BALL MILL AND CROSSBLEND

RECORDS AND REPORTS MAINTAINED

FEED, PRODUCT, SCRAP WASTE, SAMPLES

IV

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC	PERS	PROC	PERS
	1. Follower Cards	BM & C Oper.				
	a. Fuel Powder (FB)	" "				
	b. PuO_2 Powder (FA)	" "				
	c. UO_2 Powder (XN)	" "				
	2. Engineering Lab Notebook	" "				

CONFIDENTIAL

BALL MILL AND CROSSBLEND
OUTGOING INFO

FEED, PRODUCT, SCRAP
WASTE, SAMPLES

V

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC.	PERS	PROC.	PERS
Mixed Oxide	1. Follower Cards	BM & C Oper.	BM & C	Oper.	B. A.	Oper.
	a. Fuel Powder (FB)	" "	"	"	"	"
	b. PuO_2 Powder (FA)	" "	"	"	"	"
	c. UO_2 Powder (XN)	" "	"	"	"	"

4.9 UNIT PROCESS

5. Binder Addition

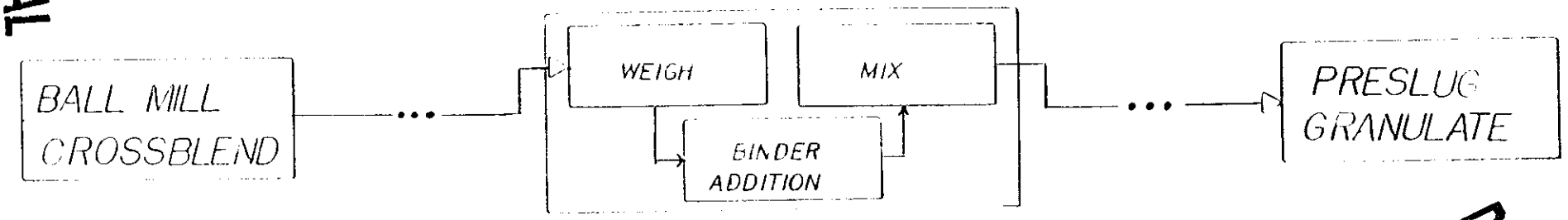
Binder Addition

The binder addition operation has three steps:

- Dividing and weighting the mixed oxide.
- Binder addition.
- Mixing.

The mixed oxide is divided and weighted into 1,000 gram batches and put in a stainless pan. A weighted amount of dry binder is added to the mixed oxide and hand blended in. The batch is placed in a polyethylene jar and roll mixed for 15 minutes. It is then ready for transfer to the next unit process.

5. BINDER ADDITION



UNIT PROCESS BINDER ADDITION #5

I. Incoming Material from Preceding Unit Process

A. Mixed Oxide

II. Incoming Information

A. Glovebox Log (GBL)

B. Computer Glovebox Transaction Report

C. Follower Report Card FB

D. Process Run Plan

E. Container Label

III. Receiving Activities and Associated Data Generation

Note: Two separate methods are used for binder addition. One is a wet carbowax binder and the other is a dry sterotex binder.

Carbowax Addition (Wet Method)

A. Weigh mixed oxide. Do not exceed 500 grams net weight in each stainless steel pan.

B. Add Carbowax and demineralized H_2O to mixed oxide.

C. Spread the binder-powder mix uniformly in a drying pan and dry the powder for two to eight hours. Record drying time and temperature in lab notebook and on data follower card.

D. Force the dried material through a screen into screening pan using a stainless steel pusher and shaker.

E. Repeat steps C and D for second two kilograms of a 4-kilogram lot.

F. Transfer material to preslug process.

Dry Binder Addition

A. Weigh mixed oxide. Do not exceed 1000 grams net weight in each stainless steel pan.

B. Add dry binder (-100 mesh) to powder in pan by hand stirring with spatula until homogeneous from visual inspection. Amount of binder determined by engineer.

C. Place mix in a quart size polyethylene jar and roll mix for 15 minutes to improve the homogeneity of the binder and mixed oxide blend.

D. Transfer material to preslug process.

[redacted]

IV. Records Maintained

A. Glovebox Log (GBL)

B. Computer Glovebox Transaction Report

C. Follower Card FB

D. Process Run Plan

E. Container Label

[redacted]

List of Personnel Per Unit Process

5. Binder Addition

A. At preceding unit process (Ball Mill and Crossblend)

1. Process operator A and B (Same two operators in Screen and V-Blend)

2. Process Engineer (Foreman)

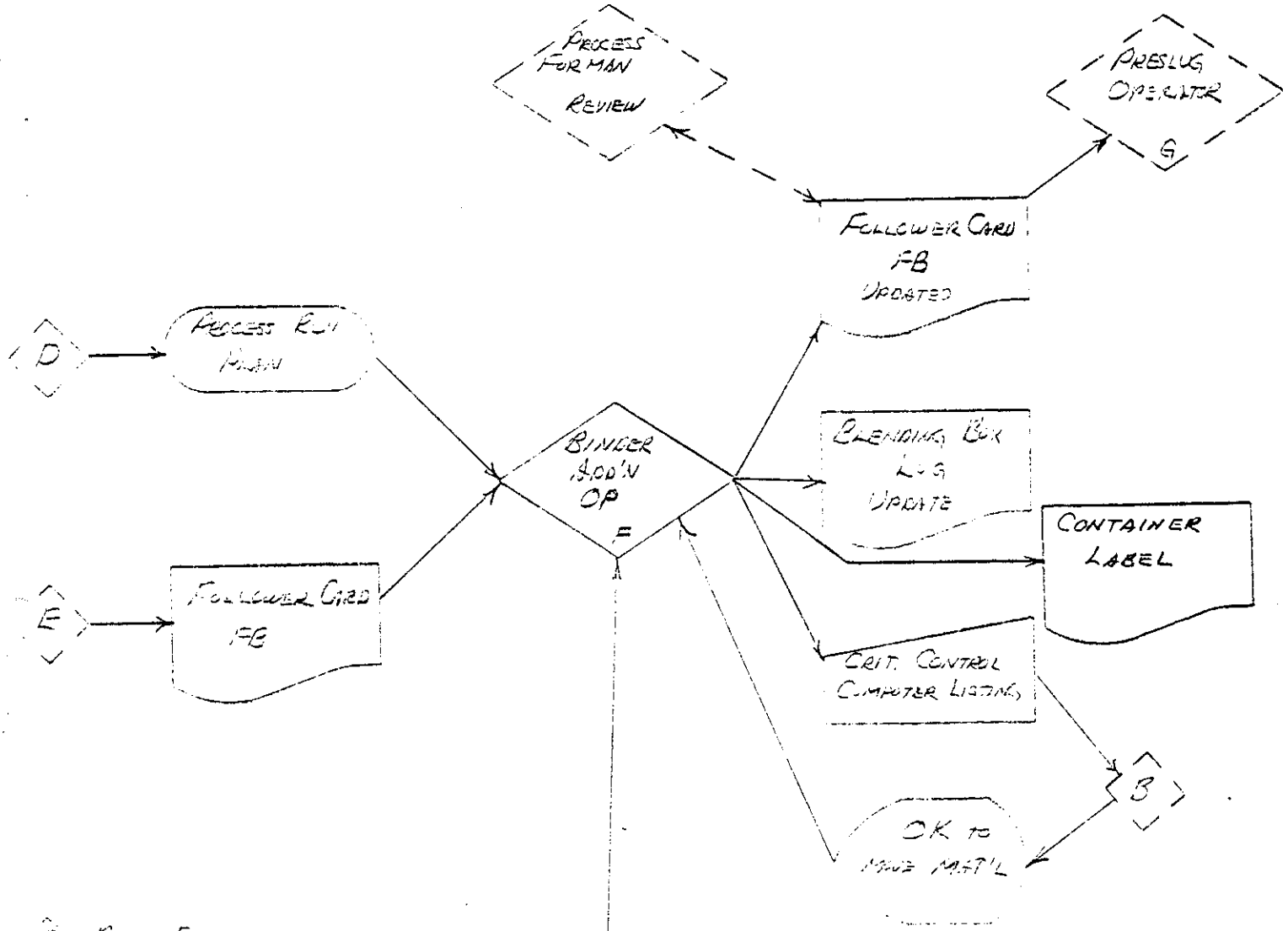
B. At the following unit process (Preslug and Granulate)

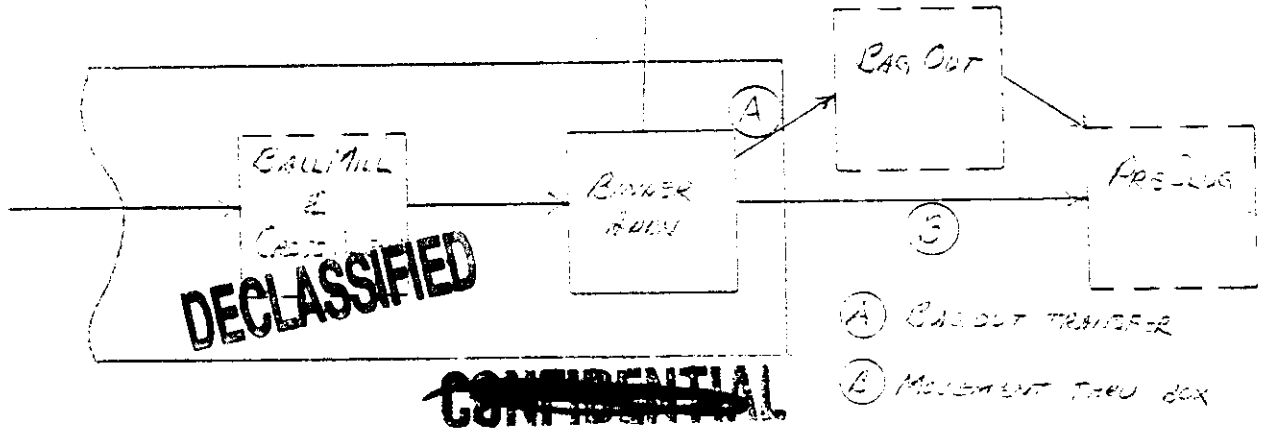
1. Process operator A (Press operator)

2. Process operators A and B (Screen and V-Blend)

3. Process Engineer (Foreman)

5 WET OR DRY BINDER ADD'N





Process Operator: Binder Addition

1.0 Task

The Binder Addition operator is a process technician who performs all operations involving the handling, measurement, processing, data recording, and packaging of SNM for the unit process.

2.0 Safeguards Activities

The process operator is responsible for performing and recording input/output measurement data, observing and reporting abnormal situations relating to possible theft or sabotage, and preparing records of transfer for purposes of accountability. The process operator is not responsible for making decisions involving safeguards related matters.

3.0 Information Needs

The following information is needed by the process operator:

- List of transfers into and out of the unit process.
- Criticality listing for amounts of SNM in the unit process.
- Gross, tare, and net weight of each container in the unit process.
- Quality Assurance follower cards for Binder Addition.
- Process instructions from Process Engineer.
- Knowledge of process operations.

TIMING INFORMATION

Binder Addition

4 kg Batch

1. Weigh (1 kg batch) - 5 minutes/kg
2. Add binder and hand blend - 5 minutes/kg
3. Roll mix - 15 minutes/kg

I

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC.	PERS	PROC.	PERS
Mixed Oxide	1. Follower Cards	B.A. Oper.	BM & C	P.O.	B.A.	P.O.
	a. Fuel Powder (FB)	"	"	"	"	"
	b. PuO_2 Powder (FA)	"	"	"	"	"
	c. UO_2 Powder (XN)	"	"	"	"	"

BINDER ADDITION

INFO AND DATA GENERATION

FEED, PRODUCT, SCRAP WASTE, SAMPLES

II

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC	PERS	PROC	PERS
	1. Engineering Lab Notebook 2. Follower Cards a. Fuel Powder (FB) b. PuO_2 Powder (FA) c. UO_2 Powder (XN)	B.A. Oper.				

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BINDER ADDITION

RECORDS AND REPORTS PREPARED

FEED, PRODUCT, SCRAP
WASTE, SAMPLES

III

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC.	PERS	PROC.	PERS
	1. Follower Cards a. Fuel Powder (FB) b. PuO_2 Powder (FA) c. UO_2 Powder (XN)	B.A. Oper. " " "				
	2. Engineering Lab Notebook	"				

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC.	PERS	PROC.	PERS
	1. Follower Cards	B.A. Oper.				
	a. Fuel Powder (FB)	" "				
	b. PuO_2 Powder (FA)	" "				
	c. UO_2 Powder (XN)	" "				
	2. Engineering Lab Notebook	" "				

FEED, PRODUCT, SCRAP WASTE, SAMPLES

V

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC.	PERS.	PROC.	PERS.
Mixed Oxide	1. Container Label	B.A. Oper.	B.A.	Oper.	Preslug	Oper.
	2. Criticality Log	" "	"	"	"	"
	3. Glovebox Log	" "	"	"	"	"
	4. Follower Cards					
	a. Fuel Powder (FB)	" "	"	"	"	"
	b. PuO_2 Powder (FA)	" "	"	"	"	"
	c. UO_2 Powder (XN)	" "	"	"	"	"

4.10 UNIT PROCESS

6. Preslug and Granulate

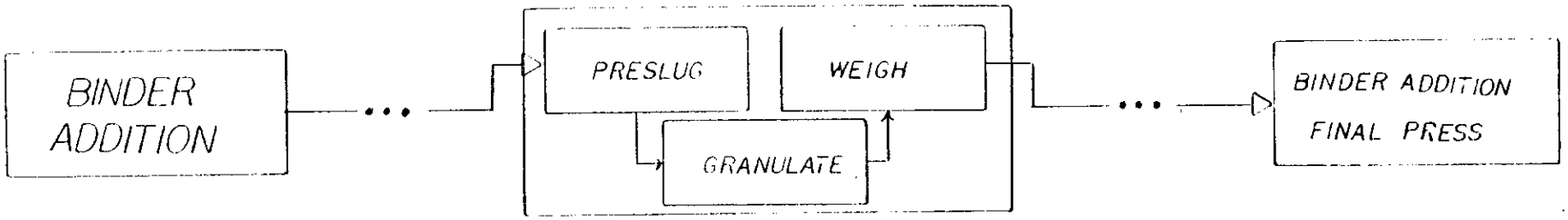
Preslug and Granulate

The preslug and granulation operation has two steps:

- Pressing mixed oxide powder into pellets.
- Grinding the pellets back into powder.

The mixed oxide powder is put in a 200 gram hopper on the pellet press and pellets are continuously pressed until all of the powder has been run through the process. The pellets are then ground up in the granular for additional binder addition and final press.

C. PRESLUG GRANULATE



UNIT PROCESS PRESLUG AND GRANULATE #6

I. Incoming Material from Preceding Unit Process

A. Mixed Oxide with Binder

II. Incoming Information

A. Glovebox Log

B. Follower Card FB

C. Computer Glovebox Transaction Report

D. Container Label

III. Receiving Activities and Associated Data Generation

Preslug and Granulate

A. Preslug the four kilograms of feed material.

B. Granulate all preslugged material to pass through a 20 mesh screen onto a 100 mesh screen, then into a screening pan.

C. All (+) 20 mesh granules are regranulated.
All (-) 100 mesh granules are recycled through preslug.

D. All (-) 20 (+) 100 mesh material is ready for pellet pressing.

E. Record any nontypical or unusual aspects in laboratory notebook and data follower cards.

IV. Records Maintained

A. Glovebox Log

B. Follower Card FB

C. Computer Glovebox Transaction Report

D. Container Label

List of Personnel Per Unit Process

6. Preslug and Granulate

A. At preceding unit process (Binder Addition)

1. Process operators A and B (Same two operators in Ball Mill and Crossblend)
2. Process Engineer (Foreman)

B. At the following unit process (Binder Addition and Final Press)

1. Process operator A (Press operator)
2. Process operators A and B (Binder Addition)
3. Process Engineer (Foreman)

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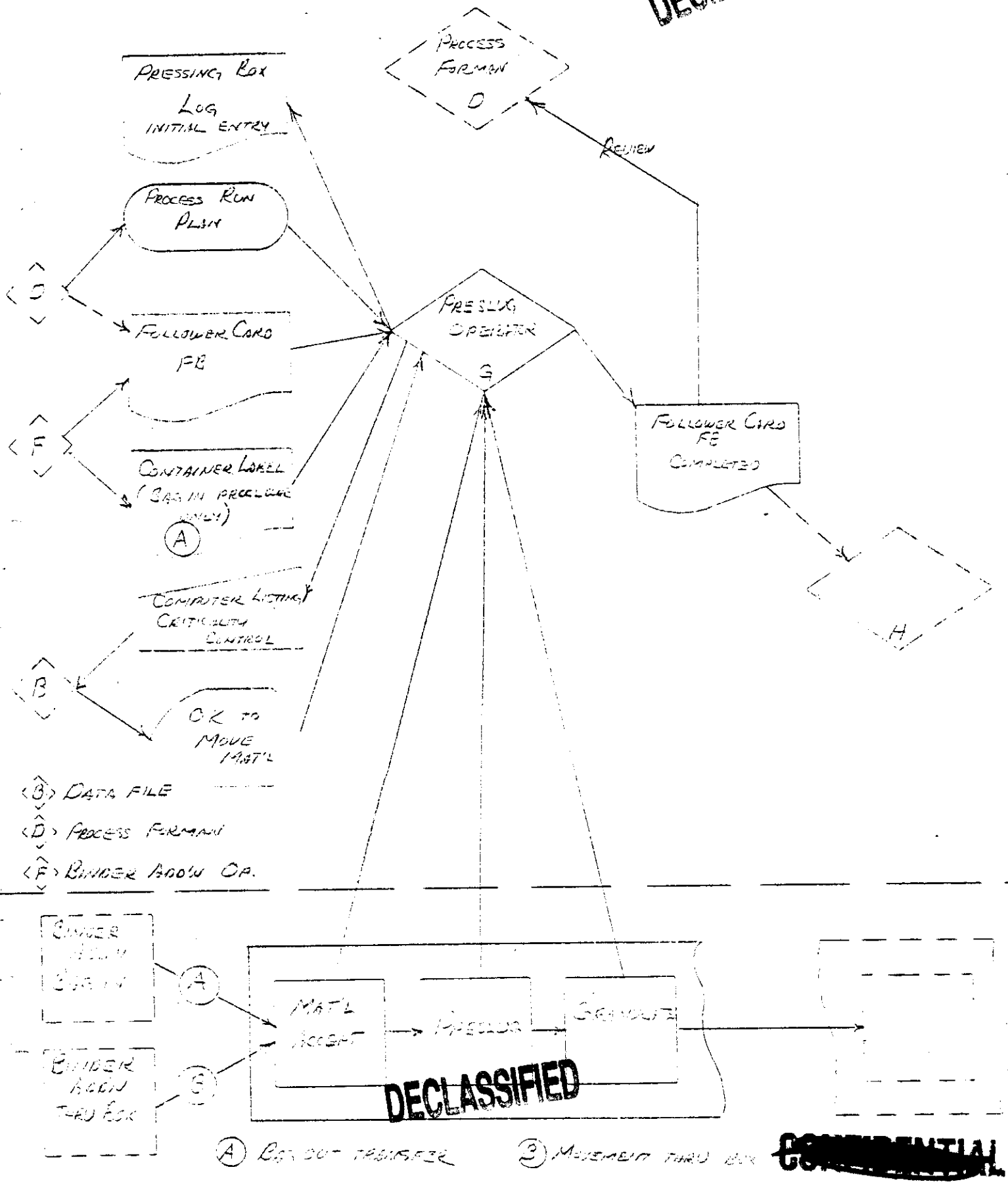
6 PRESSING & GRANULATION



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Process Operator: Preslug and Granulate

1.0 Task

The Preslug, Granulate operator is a process technician who performs all operations involving the handling, measurement, processing, data recording, and packaging of SNM for the unit process.

2.0 Safeguards Activities

The process operator is responsible for performing and recording input/output measurement data, observing and reporting abnormal situations relating to possible theft or sabotage, and preparing records of transfer for purposes of accountability. The process operator is not responsible for making decisions involving safeguards related matters.

3.0 Information Needs

The following information is needed by the process operator:

- List of transfers into and out of the unit process.
- Criticality listing for amounts of SNM in the unit process.
- Gross, tare, and net weight of each container in the unit process.
- Quality Assurance follower cards for Preslug and Granulate.
- Process instructions from Process Engineer.
- Knowledge of process operations.

TIMING INFORMATION

Preslug and Granulate

4 kg Batch

1. Preslug - 4 hours/4 kg
2. Granulate - 4 hours/4 kg

CONFIDENTIAL

PRESLUG AND GRANULATE

INCOMING INFO

FEED, PRODUCT, SCRAP WASTE, SAMPLES

I

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC.	PERS	PROC.	PERS
Mixed Oxide	1. Container Label	P & G Oper.	B.A.	P.O.	P & G	P.O.
	2. Follower Cards					
	a. Fuel Powder (FB)	" "	"	"	"	"
	b. PuO_2 Powder (FA)	" "	"	"	"	"
	c. UO_2 Powder (XN)	" "	"	"	"	"
	3. Criticality Log	" "	"	"	"	"

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PRESLUG AND GRANULATE
INFO AND DATA GENERATION

FEED, PRODUCT, SCRAP
WASTE, SAMPLES

II

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC.	PERS	PROC.	PERS
	1. Glovebox Log	P&G Oper.				
	2. Criticality Log	" "				
	3. Engineering Lab Notebook	" "				
	4. Follower Cards					
	a. Fuel Powder (FB)	" "				
	b. PuO_2 Powder (FA)	" "				
	c. UO_2 Powder (XN)	" "				

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PRESLUG AND GRANULATE

RECORDS AND REPORTS PREPARED

FEED, PRODUCT, SCRAP WASTE, SAMPLES

III

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM PROC.	FROM PERS	TO PROC.	TO PERS
	1. Follower Cards a. Fuel Powder (FB) b. PuO_2 Powder (FA) c. UO_2 Powder (XN)	P & G Oper. " " "				
	2. Engineering Lab Notebook	"				
	3. Criticality Log	"				
	4. Glovebox Log	"				

CONFIDENTIAL

PRESLUG AND GRANULATE
RECORDS AND REPORTS MAINTAINED

FEED, PRODUCT, SCRAP
WASTE, SAMPLES

IV

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC	PERS	PROC	PERS
	1. Follower Cards	P & G Oper.				
	a. Fuel Powder (FB)	" "				
	b. PuO_2 Powder (FA)	" "				
	c. UO_2 Powder (XN)	" "				
	2. Engineering Lab Notebook	" "				
	3. Criticality Log	" "				
	4. Glovebox Log	" "				

PRESLUG AND GRANULATE

OUTGOING INFO

FEED, PRODUCT, SCRAP WASTE, SAMPLES

V

MATERIAL FORM	INFO FORMAT	PERSON WHO ENTERS DATA	FROM		TO	
			PROC.	PERS	PROC.	PERS
Mixed Oxide	1. Container Label	P & G Oper.	P & G	Oper.	BA & FP	Oper.
	2. Criticality Log	" "	"	"	"	"
	3. Glovebox Log	" "	"	"	"	"
	4. Follower Cards					
	a. Fuel Powder (FB)	" "	"	"	"	"
	b. PuO_2 Powder (FA)	" "	"	"	"	"
	c. UO_2 Powder (XN)	" "	"	"	"	"

4.11 ARPW Summary Sheet

DPA Number HEDL-SNM-001
Area Analyzed Irradiation Test Pin Line

Material PuO_2
Date of Completion June 30, 1976

COVERAGE / DETECTION TIME (DAYS)	ADJUSTED RELATIVE PATH WEIGHT																	
	1.0-0.9		0.89-0.8		0.79-0.7		0.69-0.6		0.59-0.5		0.49-0.4		0.39-0.3		0.29-0.2		0.19-0.1	
	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future
Not Possible	X	3	X	2	X	1	X	-	X	-	X	1	X	2	X	1	X	14
1 Or Less	11	13	1	2	1	3	-	2	2	2	3	11	2	8	1	2	7	8
2 To 7	1	-	-	-	-	-	-	-	-	-	2	-	1	3	1	-	2	1
8 To 30	1	-	2	-	-	-	-	-	-	-	2	-	4	-	-	2	3	-
More Than 30	3	-	1	-	3	-	2	-	-	-	5	-	6	-	3	-	11	-
Total Paths	16		4		4		2		2		12		13		5		23	

DPA Number HEDL-SNM-001
Area Analyzed Irradiation Test Pin Line

Material Mixed Oxide
Date of Completion June 30, 1976

	ADJUSTED RELATIVE PATH WEIGHT																	
	1.0-0.9		0.89-0.8		0.79-0.7		0.69-0.6		0.59-0.5		0.49-0.4		0.39-0.3		0.29-0.2		0.19-0.1	
COVERAGE / DETECTION TIME (DAYS)	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future
Not Possible	X	-	X	-	X	1	X	-	X	-	X	1	X	2	X	2	X	-
1 Or Less	3	6	2	2	1	3	-	-	-	-	2	1	5	7	1	2	5	8
2 To 7	3	-	-	-	2	-	-	-	-	-	-	-	2	-	1	-	3	-
8 To 30	-	-	-	-	1	-	-	-	-	-	-	-	2	-	2	-	-	-
More Than 30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Paths	6		2		4		0		0		2		9		4		8	

DPA Number HEDL-SNM-001
Area Analyzed Irradiation Test Pin Line

Material 93% Uranium
Date of Completion June 30, 1976

	ADJUSTED RELATIVE PATH WEIGHT																	
	1.0-0.9		0.89-0.8		0.79-0.7		0.69-0.6		0.59-0.5		0.49-0.4		0.39-0.3		0.29-0.2		0.19-0.1	
COVERAGE / DETECTION TIME (DAYS)	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future
Not Possible	X	-	X	-	X	1	X	-	X	-	X	-	X	2	X	1	X	2
1 Or Less	4	4	-	-	1	-	-	-	-	-	1	1	2	3	-	-	4	2
2 To 7	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
8 To 30	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
More Than 30	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Total Paths	4		0		1		0		0		1		5		1		4	

4.12 Worst Case Situation

WORST CASE SITUATIONS

Summaries of the worst case situations are listed below. These summaries represent situations in which detection is minimal and future coverage was not ascertained.

1.0 Brief Description: Theft of a container of PuO_2 from the vault by an inside employe performing a maintenance function. Theft would not be discovered until the material was requested for processing or a physical inventory was performed.

1.1 Diversion Path: SDP 1-2

1.2 Adjusted Relative Path Weight: 1.0-0.9

1.3 Time Sensitivity: Greater than 30 days

2.0 Brief Description: During receiving operations vault custodian puts full container of PuO_2 from shelf into an empty shipping container and removes from vault. Theft would not be detected until material was requested for processing or a physical inventory was performed.

2.1 Diversion Path: SDP 1-3

2.2 Adjusted Relative Path Weight: 1.0-0.9

2.3 Time Sensitivity: Greater than 30 days

3.0 Brief Description: Vault custodian removes container of PuO_2 from vault. Places container in waste drum in room 106 for later removal. Container missing when requested for processing or a physical inventory was performed.

3.1 Diversion Path: SDP 1-1

3.2 Adjusted Relative Path Weight: 1.0-0.9

3.3 Time Sensitivity: Greater than 30 days

4.0 Brief Description: Process operator bags out excess PuO_2 from screen and V-blend operations for return to vault. Conceals container and removes at a later time. Theft would not be detected until a mass balance was made at the end of the month.

4.1 Diversion Path: SDP 3-2

4.2 Adjusted Relative Path Weight: 1.0-0.9

4.3 Time Sensitivity: Less than 30 days

5.0 Brief Description: Vault custodian removes container of PuO_2 from vault, pulls punch card on container and has new vault listing run. Also changes cubicle log to reflect removal. Theft would be detected when the MBA custodian noted a discrepancy between vault custodian records and vault listing.

5.1 Diversion Path: SDP 1-4

5.2 Adjusted Relative Path Weight: 0.9-0.8

5.3 Time Sensitivity: Greater than 30 days

6.0 Brief Description: Vault custodian makes out paperwork for transfer of material to 324 Building. On way to 324 Building conceals material and forges loan slip signatures. Theft would be discovered when mass balance records were checked at end of month.

6.1 Diversion Path: SDP 1-5

6.2 Adjusted Relative Path Weight: 0.9-0.8

6.3 Time Sensitivity: Less than 30 days

7.0 Brief Description: Process operator removes 550 grams of calcined PuO_2 from container in the calcining hood. Falsifies all paperwork to show the 550 grams went to processing and returns remaining amount to vault. Theft would not be discovered until MBA records were reconciled at end of month.

7.1 Diversion Path: SDP 2-7

7.2 Adjusted Relative Path Weight: 0.9-0.8

7.3 Time Sensitivity: Less than 30 days

8.0 Brief Description: Vault custodian substitutes dummy can of inert PuO_2 in vault, conceals container and removes at a later time. Theft would be noted when material was sent to processing.

8.1 Diversion Path: SDP 1-6

8.2 Adjusted Relative Path Weight: 0.8-0.7

8.3 Time Sensitivity: Greater than 30 days

9.0 Brief Description: Process operator substitutes dummy container of inert material for calcined container of PuO_2 in the calcining hood and returns inert material to vault. Theft would be discovered when container was requested for processing.

9.1 Diversion Path: SDP 2-8

9.2 Adjusted Relative Path Weight: 0.8-0.7

9.3 Time Sensitivity: Greater than 30 days

10.0 Brief Description: Process operator removes 550 grams of calcined PuO_2 from container in calcining glovebox, replaces PuO_2 taken out with inert material. Bags out PuO_2 and conceals. Returns container to vault. Theft would not be discovered until container was requested for processing.

10.1 Diversion Path: SDP 2-9

10.2 Adjusted Relative Path Weight: 0.8-0.7

10.3 Time Sensitivity: Greater than 30 days

4.13 Forms

Hanford Engineering Development Laboratory

PROCEDURE TITLE: LOAN SLIP - SS MATERIAL
Form No. BD-7200-047 (4-73)

PROCEDURE NO.
APPENDIX A - Part G

UNCLASSIFIED

Hanford Engineering Development Laboratory	LOAN SLIP-SS MATERIAL			No. 15902
LENDER	BLDG.	CONTROL CUSTODIAN		DATE
ALLOTMENT	NET WEIGHT	FACTOR USED	SS VALUE	ENRICHMENT
		U	U	235 U %
		PU	PU	240 PU %
MATERIAL DESCRIPTION AND IDENTIFICATION ☐ PIN ☐ PELLET ☐ POWDER ☐ OTHER				
REMARKS				
ASSIGNED TO	BLDG.	RECEIVED BY		

BD-7200-047 (4-73) COPIES:
WHITE-CONTROL CUSTODIAN YELLOW-ASSIGNED TO PINK - LENDER

UNCLASSIFIED

UNCLASSIFIED EXAMPLE

F _____ FUEL PELLET CARD

PRODUCT SPEC. _____ REV. ____ CARD NO. F-_____

PROCESS SPEC. _____ REV. ____ M O POWDER LOT NO. _____

DRAWING NO. _____ REV. ____ PROCESS LINE NO. _____

		30	40	50	60	70	REMARKS
AA							
A	PRESSING						
A1	FB CARD NO.						
A2	POWDER BATCH NO.						
A3	PELLET BATCH NO.						
A4	LINE PRESSURE/psig						
A5	FORMING PRESSURE/psi						
A6	DIE IN. DIA./in.						
A7	BATCH WEIGHT/g						
A8	MEAN GREEN DENSITY						
A9	FC CARD NO.						
A10	PERFORMED BY						
A11	DATE						

						REMARKS
B	BINDER REMOVAL					
B1	PELLET BATCH NO.					
B2	WT. GREEN PELLETS/g					
B3	WT. DEBOUND PELLETS/g					
B4	WT. LOST/g					
B5	WT. PERCENT LOST					
B6	ATMOSPHERE					
B7	FLOW RATE SCFH					
B8	RATE RISE,°C/HR					
B9	SOAK TEMP.°C					
B10	SOAK TIME HR					
B11	COOLING RATE °C/HR					
B12	PERFORMED BY					
B13	DATE					

EXAMPLE

(1) CC	(5) (7)	(30)	(40)	(50)	(60)	(70) (72) REMARKS
C	SINTERING					
	PELLET BATCH NO.					
C2	WT. DEBOUND PELLETS/g					
C3	WT. SINTERED PELLETS/g					
C4	WT. LOST/g					
C5	TOTAL WT. % LOST					
C6	LOCATION IN FURNACE					
C7	ATMOSPHERE					
C8	MOISTURE CONTENT/ppm					
C9	FLOW RATE SCFH					
C10	RATE RISE, °C/HR					
C11	SOAK TEMP. °C					
C12	SOAK TIME/HR					
C13	COOLING RATE °C/HR					
C14	COOLING SOAK TIME/HR					
C15	TEMP. °C					
C16	VACUUM OUTGASSED					
C17	TEMP. AT EVACUATION °C					
	VACUUM PRESSURE TORR					
C19	COOLING RATE °C/HR					
C20	FJ CARD NO.					
C21	FB CARD NO.					
C22	FL CARD NO.					
C23	FN CARD NO.					
C24	FH CARD NO.					
C25	PERFORMED BY					
C26	DATE					

DD D	CENTERLESS GRINDING	REMARKS
D1	PELLET BATCH NO.	
D2	WT. UNGROUND/g	
D3	WT. GROUND/g	
D4	WT. LOST/g	
D5	FJ CARD NO.	
D6	PERFORMED BY	
	DATE	

UNCLASSIFIED EXAMPLE

(1) FA _____ (24) PuO_2 POWDER CARD (48) CARD NO. FA-(60) _____

(48) PuO_2 POWDER LOT NO. (67) _____

(5) PRODUCT SPEC. NO. (23) _____ (36) REV. (41) _____ PuO_2 ANALYTICAL REPORT NO. (74) _____

ANALYTICAL CHEM. PROCEDURE (32) _____ REV. _____ PuO_2 CALCINING CARD NO. FM-(75) _____

SAMPLED AT RECEIVING (26) ☐ SAMPLED AFTER WADCO CALCINING (36) (67) ☐

		(31)	(41)	(51)	(61)	(71)
A1	VENDOR SOURCE (19)					
A2	(7) VENDOR BATCH NO(S)					
A3	NET WT.					
A4	FABRICATOR'S LOT NO(S)					

(1) B	(5) SIEVE ANALYSIS (7)	(32) % PuO_2 Powder Passed (31)	(41) No. of Samples (41)	(51) Accept (53)	(61) Reject (63)
B1	170-MESH				
B2	200-MESH				
B3	325-MESH				

C	(5) PARTICLE DISTRIBUTION	(32) % of Particles (32)	(42) Size Less Than Microns (42)	(53) Number of Samples (53)	(63) Accept (63)	(73) Reject (75)
C1						

(1) D	(5) CHEMICAL PROPERTIES	(33) Sample 1	(43) Sample 2	(53) Mean	(63) Accept	(73) Reject	
D1	SURFACE AREA, m^2g						
E	ISOTOPIC CONTENT BY WT.						
E1	(7) $^{239}Pu + ^{241}Pu$						
E2	^{241}Pu						
E3	^{238}Pu						
E4	ALL OTHER EXCLUDING ^{240}Pu						
E5	^{240}Pu						
E6	AMERICIUM CONTENT(ANALYSIS)						
E	OXYGEN-TO-Pu RATIO						
E8	Pu CONTENT						
E9	LOSS ON IGNITION						
E10	SINTERABILITY TEST						

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Form FAD

E X A M P L E

UNCLASSIFIED

(1) F	(5) IMPURITY LEVELS (7)	(23) C ppm	(33) Sample 1	(43) Sample 2	Mean	(45) Accept (55)	(73) Reject (75)
F1	CARBON	C					
F2	FLUORINE	F					
F3	CHLORINE	Cl					
F4	NITRIDE NITROGEN	N					
F5	SULFATE	S					
F6	ALUMINUM	Al					
F7	BORON	B					
F8	BERYLLIUM	Be					
F9	CALCIUM	Ca					
F10	CADMIUM	Cd					
F11	CHROMIUM	Cr					
F12	COBALT	Co					
F13	IRON	Fe					
F14	POTASSIUM	K					
F15	LITHIUM	Li					
F16	MAGNESIUM	Mg					
F17	SODIUM	Na					
F18	NICKEL	Ni					
F19	PHOSPHORUS	P					
F20	TANTALUM	Ta					
F21	TUNGSTEN	W					
F22	VANADIUM	V					
F23	SUM OF Cu,Zn,Si,Ti						
F24	SUM OF Ag,Mn,Mo,Pb,Sn						
F25	SUM OF Sm,Eu,Gd,Dy						
F26	TOTAL IMPURITIES						
F27	OTHER						

(5) WAIVER NUMBERS (IF APPLICABLE) (36) _____

(14) SIGNED (21) _____ (53) DATE (52) _____

REMARKS:

UNCLASSIFIED

Form FAD

EXAMPLE

UNCLASSIFIED

(1) FB _____ (25) FUEL POWDER CARD

(5) PRODUCT SPEC. NO. (23) _____ (49) CARD NO. FB- (61) _____

PROCESS SPEC. NO. _____ (43) M.O.POWDER LOT NO. (61) _____

(43) LINE NO. (52) _____

A STARTING MATERIALS

A1 (7) PuO_2 POWDER CARD NO. FA- (31) _____ (51) QA ACCEPT (61) ☐ (66) QA REJECT (76) ☐

A2 PuO_2 POWDER LOT NO. (27) _____

A3 UO_2 POWDER CARD NO. XN- (30) _____ QA ACCEPT ☐ QA REJECT ☐

A4 UO_2 POWDER LOT NO. (26) _____

A5 (ENRICHED)UO_2 POWDER CARD NO. XN- (40) _____ QA ACCEPT ☐ QA REJECT ☐

A6 UO_2 POWDER LOT NO. _____

B (5) SCREEN BLENDING

(7) WEIGHTS	PuO_2	Normal UO_2	Enriched UO_2	PuO_2	Normal UO_2	Enriched UO_2
	(11)	(21)	(31)	(41)	(51)	(61)
1						
B2 2						
B3 3						
B4 4						
B5 Total						

B6 M.O. POWDER LOT NO. (28) _____

B7 PERFORMED BY (20) _____

B8 DATE (12) _____

C BALLMILLING

C1 Type of Milling (23) _____ (22)

	(21) RUN NO. 1 Wt.of Media/Jar	Wt.of M.O.	(51) RUN NO. 2 Wt.of Media/Jar	Wt.of M.O.
(13) 1	(25)	(38)	(55)	(68)
C3 2				
3				
C5 4				

C6 PERFORMED BY (20) _____ (51) DATE (56) _____

Form FBD

UNCLASSIFIED

E X A M P L E

UNCLASSIFIED

(19) SPLIT AND CROSS BLEND RUN NO. 1 AND RUN NO. 2

	(5) CROSS-BLENDING (7)	(21)	(41)
D1	WEIGHT		
D2	MINUTES		
D3	PERFORMED BY		
D4	DATE		

	BINDER ADDITION, DRYING, AND GRANULATION	(30)	(40)	(50)	(60)	(70)
E1	HOOD NO.					
E2	TYPE OF BINDER					
E3	WT. % BINDER					
E4	WT. OF POWDER					
E5	WT. OF BINDER SOLUTION					
E6	WT. OF WATER ADDED					
E7	DRIER TEMPERATURE					
E8	HOURS					
E9	REDRY HOURS					
E10	WORK PERFORMED BY					
.1	DATE					
E12	M.O. POWDER BATCH NO.					

	PRE-SLUG					
F1	LINE PRESSURE					
F2	FORMING PRESSURE					
F3	DIE I. DIA.					
F4	BATCH NO.					
F5	PERFORMED BY					
F6	DATE					
F7	MEAN GREEN DENSITY (PRESLUG PELLET)					
F8	FL CARD NO.					

G OTHER PROCESSING AND REMARKS

EXPLAIN: (15)

EXAMPLE UNCLASSIFIED

(1) FC _____

(24) GREEN PELLET DATA

(49) CARD NO. FC- (61) _____

(47) PELLET BATCH NO. (43) _____

(38) GREEN PELLET BATCH WEIGHT (63) _____

(32) FUEL POWDER FOLLOWER CARD NO. FB- (23) _____

(1) A

	(14) DIA. (12)	(22) LENGTH (22)	(32) LENGTH BETWEEN DISHES (32)	(42) TOTAL DISH DEPTH (42)	(52) WEIGHT (52)	(62) DENSITY g/cc (62)	
A1							
A2							
A3							
A4							
A5							
A6							
A7							
A8							
A9							
A10							
A11							
A12							
A13							
A14							
A15							
A16							
A17							
A18							
A19							
A20							
A21							
A22							
A23							
A24							
A25							
A26							

P

(41) WORK PERFORMED BY: (59)

SIGNED (48) _____ DATE (62) (67) _____

FORM FCC

UNCLASSIFIED

EXAMPLE

UNCLASSIFIED

(1) FH _____

(9) SINTERED FUEL PELLET CHEMICAL DATA

(5) PRODUCT SPEC. (19) _____ (36) REV. (41) ____

ANAL.CHEM.METHODS (23) _____ REV. ____

SAMPLING PLAN (19) _____ REV. ____

(49) CARD NO. FH- (61) _____

(47) PELLET BATCH NO. (64) _____

(1) A	IMPURITY LEVELS (7)	(24)	(35) SAMPLE 1	(42) SAMPLE 2	(50) SAMPLE 3	(58) SAMPLE 4	(66) SAMPLE 5	(74) ACC	(78) REJ
A1	CARBON	C							
A2	NITRIDE NITROGEN	N							
A3	FLUORINE	F							
A4	CHLORINE	Cl							
A5	SULFUR	S							
A6	ALUMINUM	Al							
A7	BORON	B							
A8	BERYLLIUM	Be							
A9	CALCIUM	Ca							
A10	CADMIUM	Cd							
A11	CHROMIUM	Cr							
A12	COBALT	Co							
A13	IRON	Fe							
A14	POTASSIUM	K							
A15	LITHIUM	Li							
A16	MAGNESIUM	Mg							
A17	SODIUM	Na							
A18	NICKEL	Ni							
A19	PHOSPHORUS	P							
A20	VANADIUM	V							
A21	TANTALUM	Ta							
A22	TUNGSTEN	W							
A23	SUM OF Cu,Zn,Si,Ti								
A24	SUM OF Ag,Mn,Mo,Pb,Sn								
A25	SUM OF Sm,Eu,Gd,Dy								
A26	TOTAL IMPURITIES								
A27	OTHER								

EXAMPLE

UNCLASSIFIED

(1) B	(7)	(41) Mean	(54) Range (49) High	(60) Low	(66) No. of Samples	(75) QA (74) Acc	(28) Rej
B1	GAS CONTENT						
B2	MOISTURE CONTENT						
B3	FUEL FISSILE CONTENT						
B4	Pu CONTENT						
B5	U CONTENT						
B6	OXYGEN-TO-METAL RATIO						
B7	^{235}U ISOTOPIC(IF APPLICABLE)						
B8	PLUTONIUM CONCENTRATION REGIONS						
B9	FIGURE OF MERIT(HOMOGENEITY)						
B10	GRAIN SIZE						
B11	POROSITY						
B12	SECONDARY PHASE						

C (11) NONCON. NUMBERS (27) _____

LOT EVAL. & DISPOSITION: (36) (42) QA ACCEPT ☐ (52) (55) QA REJECT ☐ (65)

FUEL PELLET FOLLOWER CARD NO. F- (43) _____

PELLET ANALYTICAL REPORT NO. (40) _____

SINTERED FUEL PELLET DIMENSIONS, DENSITY AND CHARACTERISTICS CARD NO. FJ- (36) (43) _____

(28) SIGNED (35) _____ (56) DATE (61) _____

UNCLASSIFIED

EXAMPLE

UNCLASSIFIED

FJ _____

SINTERED FUEL PELLET DIMENSIONS, DENSITY, AND CHARACTERISTICS

PRODUCT SPEC. NO. _____ REV. ____ CARD NO. FJ- _____

PROCESS SPEC. NO. _____ REV. ____

DRAWING NO. _____ REV. ____ PELLET BATCH NO. _____

SAMPLING PLAN _____ REV. ____

AS SINTERED ☐ AS SINTERED BATCH WEIGHT _____ g

GROUND ☐

		First End Diameter	Center Diameter	Second End Diameter	Length	Dish Depth	Weight	Density g/cc	Density T.D.
A1	Mean								
A2	Sigma								
A3	Min.								
A4	Max.								
A5	Acc.								
A6	Rej.								

B

% FIRED LENGTH SHRINKAGE _____ %

% FIRED DIAMETER SHRINKAGE _____ %

WEIGHT OF BROKEN, CRACKED AND CHIPPED PELLETS _____

WEIGHT PERCENT DEFECTIVE PELLETS _____ %

C

REFERENCE CARDS:

FUEL PELLET FOLLOWER CARD F- _____

GREEN PELLET DATA CARD FC- _____

FUEL PELLET DISH DIAMETER, CHAMFER, AND PERPENDICULARITY CARD FN- _____

SINTERED FUEL PELLET CHEMICAL DATA FH- _____

QA EVALUATION OF BATCH DISPOSITION:

ACCEPT ☐ REJECT ☐

SIGNED _____ DATE _____

Form FJD

UNCLASSIFIED

EXAMPLE

NUMBER SAMPLED _____ UNCLASSIFIED DISH DIAMETER _____

B	FIRST END DIAM.	CENTER DIAM.	SECOND END DIAM.	PELLET LENGTH	LENGTH BETWEEN DISHES	1ST END DISH LENGTH	2ND END DISH LENGTH	WEIGHT	DENSITY
B1	.19	.19	.19						
B2	.19	.19	.19						
B3	.19	.19	.19						
B4	.19	.19	.19						
B5	.19	.19	.19						
B6	.19	.19	.19						
B7	.19	.19	.19						
B8	.19	.19	.19						
B9	.19	.19	.19						
B10	.19	.19	.19						
B11	.19	.19	.19						
B12	.19	.19	.19						
B13	.19	.19	.19						
B14	.19	.19	.19						
B15	.19	.19	.19						
B16	.19	.19	.19						
B17	.19	.19	.19						
B18	.19	.19	.19						
B19	.19	.19	.19						
B20	.19	.19	.19						
B21	.19	.19	.19						
B22	.19	.19	.19						
B23	.19	.19	.19						
B24	.19	.19	.19						
B25	.19	.19	.19						
B26	.19	.19	.19						
B27	.19	.19	.19						
B28	.19	.19	.19						
B29	.19	.19	.19						
B30	.19	.19	.19						
C1 Mean									
C2 Sigma									

D MEASURED BY: SIGNATURE _____ DATE _____

Form FJC

UNCLASSIFIED

EXAMPLE

UNCLASSIFIED

(1) FLT _____ (24) FUEL PELLET HEAT TREAT CARD

(5) PRODUCT SPEC. (21) _____ (36) REV. (37) ____ (49) CARD NO. FL- (62) _____

PROCESS SPEC. _____ REV. ____ (47) PELLET BATCH NO. _____

WEIGHT OF BATCH _____ (28) FUEL PELLET FOLLOWER CARD NO. F- _____

(1) A (7)

A1	PELLET BATCH NO.
A2	WT. OF PELLETS
A3	LOCATION IN FURNACE
A4	WT. AFTER OFF-GAS/gm
A5	RUN NO.
A6	TORR BEFORE HEAT
A7	GAS TYPE
A8	RATE OF RISE °C/HR.
A9	SOAK TEMP. °C
A10	SOAK TIME HR.
A11	VACUUM TORR @ SOAK
A12	GAS FLOW RATE
A13	COOLING RATE °C/HR.
A14	TORR AT CYCLE END
A15	TEMP. AT UNLOADING/°C
A16	PERFORMED BY
A17	DATE

(41)	(51)	(61)	(71)

B VACUUM STORAGE

B1	PELLET BATCH NO.
B2	WT. OF PELLET BATCH
B3	VACUUM TORR
B4	TEMPERATURE °C
B5	DATE IN
B6	TIME IN
B7	DATE OUT (AFTER FINAL SAMPLING)
B8	TIME OUT (AFTER FINAL SAMPLING)
B9	PERFORMED BY

(1) C (5) REMARKS: (14)

Form FLT

UNCLASSIFIED

EXAMPLE

UNCLASSIFIED

(1) FM _____ (24) PuO_2 CALCINING CARD

(5) PRODUCT SPEC. NO. (23) _____ (36) (41) REV. ____ (49) CARD NO. FM-(61) _____

PROCESS SPEC. NO. _____ REV. ____ PuO_2 POWDER LOT NO. (69) _____

(32) PuO_2 POWDER CARD NO. FA-(61) _____

(1)	(7)	(30)	(40)	(50)	(60)	(70)
A1	VENDOR BATCH NO.					
A2	NET WT. FROM STORAGE/gm					
A3	WEIGHT CHECK BEFORE CALCINING/gm					
A4	WEIGHT AFTER CALCINING/gm					
B	CALCINING CONDITIONS					
B1	RATE OF RISE					
B2	SOAK TEMPERATURE °C					
B3	SOAK TIME/hours					
B4	ATMOSPHERE					
B5	PERFORMED BY					
B6	DATE					
C	PuO_2 BLENDING					
C1	WEIGHT UTILIZED FOR WADCO LOT/gm					

C2 WADCO LOT NO. (19) _____

C3 WADCO LOT WEIGHT BEFORE SAMPLING (40) _____

C4 PERFORMED BY (20) _____ (61) (66) DATE _____

D WAIVER NUMBERS (IF APPLICABLE) (38) _____

(11) QA (21) ACCEPT (28) ☐ (35) REJECT (40) ☐

(35) (42) SIGNED _____ (64) (69) DATE _____

E (7) REMARKS: (15)

UNCLASSIFIED

Form FMB

E X A M P L E

UNCLASSIFIED

(1)	(11) DIAMETER	(21) PELLET % TD	(31) PLANAR SMEAR DENSITY	(47) ACC	(56) REJ
A 31					
A 32					
A 33					
A 34					
A 35					
A 36					
A 37					
A 38					
A 39					
A 40					
A 41					
A 42					
A 43					
A 44					
A 45					
A 46					
A 47					
A 48					
A 49					
A 50					
A 51					
A 52					
A 53					
A 54					
A 55					
A 56					
A 57					
A 58					
A 59					
A 60					

(1) B

(49) VARIABLES

(7)		(47) ACC	(56) REJ
B1 Mean			
B Sigma			

C

(26) WORK PERFORMED BY (44) _____ (61) DATE (66) _____

QA REVIEW (56) _____ DATE _____

Form FOA

EXAMPLE

UNCLASSIFIED

FO _____ FUEL PLANAR SMEAR DENSITY

CARD NO: FO- _____

PRODUCT SPEC. _____ REV. _____ SINTERED FUEL CARDS:

PROCESS SPEC. _____ REV. _____ PELLET DENSITY FJ- _____

DRAWING NO. _____ REV. _____ PELLET FOLLOWER F- _____

SAMPLING PLAN _____ REV. _____ PELLET OFFGAS FL- _____

A	DIAMETER	PELLET % TD	PLANAR SMEAR DENSITY	ACC	REJ
A 1					
A 2					
A 3					
A 4					
A 5					
A 6					
A 7					
A 8					
A 9					
A 10					
A 11					
A 12					
A 13					
A 14					
A 15					
A 16					
A 17					
A 18					
A 19					
A 20					
A 21					
A 22					
A 23					
A 24					
A 25					
A 26					
A 27					
A 28					
A 29					
A 30					

Form FOA

UNCLASSIFIED

UNCLASSIFIED

(1) G _____ (24) INSULATOR PELLET CARD

(5) PRODUCT SPEC. (19) _____ (45) CARD NO. G- (60) _____

PROCESS SPEC. _____ PELLET LOT NO. (63) _____

WEIGHT OF BATCH (21) _____

(1)	(5) BINDER REMOVAL	(30)	(41) REMARKS
A			
	(7) RUN NO.		
A1	WT. GREEN PELLETSg		
A2	WT. DEBOUND PELLETSg		
A3	ATMOSPHERE		
A4	FLOW RATE SCFH		
A5	RATE RISE,°C/Hr		
A6	SOAK TEMP.°C		
A7	SOAK TIME Hr		
A8	COOLING RATE °C/Hr		
A9	PERFORMED BY		
A10	DATE		

(1)	(5) SINTERING		(41) REMARKS
	(7)		
B1	WT. DEBOUND PELLETS		
B2	LOCATION IN FURNACE		
B3	WT. SINTERED PELLETS		
B4	RUN NO.		
B5	ATMOSPHERE		
B6	MOISTURE CONTENTppm		
B7	FLOW RATE SCFH		
B8	RATE RISE,°C/Hr		
B9	SOAK TEMP.°C		
B10	SOAK TIME Hr		
B11	COOLING RATE °C/Hr		
	OTHER		
B12	VACUUM OUTGASSED	(31) YES (35) ☐ (37) NO (40) ☐	
B13	TEMP.AT EVACUATION,°C	(20)	
B14	VACUUM PRESSURE Torr		
B15	PERFORMED BY		
B16	DATE		

Form GC

UNCLASSIFIED

E X A M P L E

UNCLASSIFIED

(5) CENTERLESS GRINDING (31) YES ☐ (37) NO ☐ (43) SIGNED _____ (50) DATE _____

	(32) No.	(42) Acc.	(48) Rej.	(52) Signed	(72) Date
INSULATOR POWDER FOLLOWER CARD	GA				
GREEN PELLET DATA CARD	GC				
SINTERED INSULATOR PELLET DENSITY CARD	GD				
SINTERED INSULATOR PELLET CHEM.DATA CARD	GF				

UNCLASSIFIED

EXAMPLE

UNCLASSIFIED

(1) GA _____ (24) INSULATOR POWDER CARD

(5) PRODUCT SPEC. NO. _____ (23) (49) CARD NO. GA- _____ (61)

PROCESS SPEC. NO. _____ (36) REV. _____ (41)

(41) INSULATOR POWDER LOT NO. _____ (65)

(9) UO_2 POWDER CARD NO. XN- _____ (32) (53) QA ACCEPT ☐ (63) (66) REJECT ☐ (73)

UO_2 POWDER LOT NO. _____ (28)

BATCH WT. _____

(1) A		(26)	(45) REMARKS (46)
	PRESLUGGING		
A1	(7) LINE PRESSURE		
A2	FORMING PRESSURE		
A3	DIE I.D.		
A4	WORK PERFORMED BY		
A5	DATE		
B	GRANULATE		
B1	SCREEN SIZE		
B2	TIME SCREEN		
C	BINDER ADDITION		
C1	TYPE BINDER		
C2	WT% BINDER		
C3	WT POWDER		
C4	WT BINDER		
C5	WORK PERFORMED BY		
C6	DATE		
D	PRESSING		
D1	LINE PRESSURE		
D2	FORMING PRESSURE		
D3	DIE I.D.		
D4	MEAN GREEN DENSITY		
D5	GREEN DENSITY CARD NO.		
D6	PERFORMED BY		
D7	DATE		

UNCLASSIFIED

Form GAC

EXAMPLE

UNCLASSIFIED

GC _____

(24) INSULATOR GREEN PELLET DENSITY

(5) PRODUCT SPEC. (19) _____ (36) REV. (41) ____

PROCESS SPEC. _____ REV. ____

(49) CARD NO. GC- (61) _____

INSULATOR PELLET LOT NO. (30) _____

INSULATOR POWER FOLLOWER CARD NO. (34) _____

(1) A	(20) DIAM.	(30) LENGTH	(40) WEIGHT	(50) T.D.			
A1							
A2							
A3							
A4							
A5							
A6							
A7							
A8							
A9							
A10							
A11							
A12							
A13							
A14							
A15							
A16							
A17							
A18							
A19							
A20							
A21							
A22							
A23							
A24							
A25							
A26							
A27							
A28							
A29							
A30							
A31							
A32							
A33							

(41) Signed (48) _____ (52) Date (67) _____

Form GCC

UNCLASSIFIED

(1) GD _____ (14) SINTERED INSULATOR PELLET DENSITY

(5) PRODUCT SPEC. (19) _____ (36) REV. (41) ____ UNCLASSIFIED (58) CARD NO. GD- (70) _____

PROCESS SPEC. _____ REV. _____

SINTERED INSULATOR PELLET CHEM. DATA GF (45) _____

INSULATOR PELLET FOLLOWER CARD NO. (40) _____

PELLET LOT NO. (22) _____

SAMPLING PLAN (19) _____ (40) REV. (45) ____

(1) A	(5) DIAM	(13) DIAM	(21) DIAM	(29) LENGTH	(37) WIDTH	(45) % T.D.	(54) CHAMFER	(63) PERPENDICU-LARITY	(74) ACC	(78) REJ
A1										
A2										
A3										
A4										
A5										
A6										
A7										
A8										
A9										
A10										
A11										
A12										
A13										
A14										
A15										
A16										
A17										
A18										
A19										
A20										
A21										
A22										
A23										
A24										
A25										
A26										
A27										
A28										
A29										
A30										

Form GDC

UNCLASSIFIED

UNCLASSIFIED EXAMPLE

(1)	(5) DIAM	(13) DIAM	(21) DIAM	(29) LENGTH	(37) WIDTH	(45) % T.D.	(54) CHAMFER	(63) PERPENDICU-LARITY	(74) ACC	(78) REJ
A31										
A										
A33										
A34										
A35										
A36										
A37										
A38										
A39										
A40										
A41										
A42										
A43										
A44										
A45										
A46										
A47										
A48										
A										
A50										
A51										
A52										
A53										
A54										
A55										
A56										
A57										
A58										
A59										
A60										
A61										
A62										
A63										
A64										
A65										
A										
A67										
A68										

Form GDC

UNCLASSIFIED (26) SIGNED (53) _____ (27) DATE (55) _____

(1) GF _____ UNCLASSIFIED EXAMPLE

(9) SINTERED INSULATOR PELLET CHEM. DATA

(5) PRODUCT SPEC. (19) _____ (36) REV. (41) ____ (49) CARD NO. GF (61) _____

ANAL. CHEM. METHODS (23) _____ REV. ____ (49) PELLET LOT NO. (64) _____

INSULATOR PELLET FOLLOWER CARD NO. (39) _____

SAMPLING PLAN (19) _____ REV. ____ (40) PELLET ANAL. REPORT NO. (63) _____

(1) A (76) Q A (73) REJ

	IMPURITY LEVELS (7)	(24)	(29) SAMPLE-1	(38) SAMPLE-2	(47) SAMPLE-3	(56) SAMPLE-4	(65) SAMPLE-5	(74) ACC (78)
A1	CARBON	C						
A2	NITRIDE NITROGEN	N						
A3	FLUORINE	F						
A4	CHLORINE	Cl						
A5	SULFUR	S						
A6	ALUMINUM	Al						
A7	BORON	B						
A8	BERYLLIUM	Be						
A9	CALCIUM	Ca						
	CADMIUM	Cd						
A11	CHROMIUM	Cr						
A12	COBALT	Co						
A13	IRON	Fe						
A14	POTASSIUM	K						
A15	LITHIUM	Li						
A16	MAGNESIUM	Mg						
A17	SODIUM	Na						
A18	NICKEL	Ni						
A19	PHOSPHORUS	P						
A20	VANADIUM	V						
A21	TANTALUM	Ta						
A22	TUNGSTEN	W						
A23	SUM OF Cu,Zn,Si,Ti							
A24	SUM OF Ag,Mn,Mo,Pb,Sn							
A25	SUM OF Sm,Eu,Gd,Dy							
A26	TOTAL IMPURITIES							
	OTHER							

Form GFD

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E X A M P L E

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(7)	(41) MEAN	(54) RANGE (49) HIGH	(60) LOW	(66) NO. OF SAMPLES	(75) Q A (74) ACC	(78) REJ
B1 GAS CONTENT					(76)	
B2 MOISTURE CONTENT						
B3 OXYGEN-TO-METAL RATIO						
B4 DENSITY						

B5 DENSITY FOLLOWER CARD NO. GD (36) _____

WAIVER NUMBERS (22) _____

(27) SIGNED (34) _____ (56) DATE (61) _____

Form GFD

UNCLASSIFIED

UNCLASSIFIED EXAMPLE

(1) XN _____ (24) UO_2 POWDER INSPECTION (42) CARD NO. XN- (61) _____

(5) PRODUCT SPEC. (19) _____ (36) REV. (41) ____ (49) UO_2 ANALYTICAL REPORT NO. (71) _____

ANAL. CHEM. METHODS (22) _____ REV. ____ UO_2 POWDER LOT NO. (68) _____

VENDOR SOURCE (19) _____ VENDOR LOT NO. (64) _____

(1) A				(32) SAMPLE 1	(42) SAMPLE 2	(52) ACCEPT (55)	(62) REJECT (65)
A1	TOTAL LOT WEIGHT						
A2	MAXIMUM PARTICLE SIZE						
A3	PARTICLES DIST.						
A4	SURFACE AREA						
A5	CARBON	(24) C	ppm				
A6	FLUORINE	F					
A7	CHLORINE	Cl					
A8	NITRIDE NITROGEN	N					
A9	SULFUR	S					
A10	ALUMINUM	Al					
A11	BORON	B					
A12	BERYLLIUM	Be					
A13	CALCIUM	Ca					
A14	CADMIUM	Cd					
A15	CHROMIUM	Cr					
A16	COBALT	Co					
A17	IRON	Fe					
A18	POTASSIUM	K					
A19	LITHIUM	Li					
A20	MAGNESIUM	Mg					
A21	SODIUM	Na					
A22	NICKEL	Ni					
A23	PHOSPHORUS	P					
A24	VANADIUM	V					
A25	TANTALUM	Ta					
A26	TUNGSTEN	W					
A27	SUM OF Cu,Zn,Si,Ti						
A28	SUM OF Ag,Mn,Mo,Pb,Sn						
A29	SUM OF Sm,Eu,Gd,Dy						
A30	TOTAL IMPURITIES						

Form XND

UNCLASSIFIED

EXAMPLE

UNCLASSIFIED

		(32) SAMPLE 1	(42) SAMPLE 2	(52) ACCEPT	(62) REJECT		
	(5)			(55)	(65)		
A31	O/U RATIO						
A32	U CONTENT						
A33	MOISTURE CONTENT						
B	ISOTOPIC CONTENT BY WEIGHT						
B1	(7) 234_U						
B2	235_U						
B3	236_U						
B4	238_U						
C1	SINTERABILITY TEST						

D (5) NONCON. NO.(S) (21) _____

(25) QUALITY ASSURANCE (32) ACCEPT ☐ (36) REJECT (43) ☐

(34) SIGNED (41) _____ (63) DATE (68) _____

UNCLASSIFIED

Form XND

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