UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JUL 11 1988

Michael J. Lawrence, Manager
U.S. Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

Dear Mr. Lawrence:

As you are aware, NRC and DOE staffs met on June 9, 1988 to discuss DOE's plans to dispose of double-shell tank wastes and NRC concerns with respect to the classification of waste in these tanks. I have enclosed the signed meeting minutes for your information.

As a result of this meeting, NRC gained a better understanding of the classification of wastes in the twenty-eight double-shell tanks. First, DOE and NRC staff agreed that the phosphate-sulfate waste (PSW), presently stored in two tanks at Hanford, is clearly low-level waste since it does not arise from reprocessing of spent fuel. Second, it was established that two double-shell tanks contain neutralized current acid waste (NCAW) from reprocessing, and these wastes are high-level waste. Third, it was agreed that additional meetings would be necessary to reach a consensus on the classification of wastes in the remaining twenty-four double-shell tanks.

I think it may be difficult to proceed without NRC and DOE agreement on the definition for high-level waste. As you know, the NRC position is that the definition in 10 CFR Part 50, Appendix F is the applicable definition for determining whether or not a particular waste stream is high-level waste. I believe DOE and NRC consensus on this point is necessary to provide an adequate foundation for future discussion on this matter. Recently, I also had the opportunity to discuss my concerns with Tom Hindman, Director of DOE's Defense Programs.

I have instructed my staff to arrange for a second meeting with your staff and DOE Headquarters staff in order to resolve the outstanding issues relating to the disposal of radioactive wastes at Hanford. If you have any questions concerning this letter, please do not hesitate to contact me.

Sincerely,

Hugh L. Thompson, Jr.

Hugh L. Thompson, Jr., Director
Office of Nuclear Material Safety
and Safeguards

Enclosure:
As stated

cc: T. Hindman, DOE

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PDR WASTE
WM-10 PDC

101
NL01 1/1
WM-10

NRC - DOE MEETING

ON DISPOSAL OF HANFORD DEFENSE WASTES

Date: June 9, 1988

Time: 2:00-5:00 PM

Location: 4B11-NRC White Flint Bldg., Rockville, MD

List of Attendees: See Attachment 1

Summary: NRC and DOE staff met to discuss disposal plans for the Hanford double-shell tank wastes. The meeting objectives were as follows:

1. To provide an opportunity for DOE to present information on their plans to dispose of double-shell tank wastes within the scope of the Hanford Defense Waste-Environmental Impact Statement (HDW-EIS).

2. To provide an opportunity for the DOE to present information on their plans to dispose of Hanford phosphate-sulfate wastes (PSW) from N-Reactor decontamination.

3. To provide an opportunity for NRC to discuss their views and concerns with DOE.

4. To identify possible future interactions between NRC and DOE.

DOE's presentation (Attachment 2) identified six different waste streams that it intends to process at Hanford for disposal. These include: (1) phosphate-sulfate waste (PSW); (2) plutonium finishing plant waste; (3) cladding removal waste; (4) neutralized current acid waste; (5) double-shell slurry feed; and (6) double-shell slurry.

DOE indicated that it intends to initiate processing of the PSW in July 1988 by grouting and disposing of the grout in a shallow land burial facility at Hanford. The PSW wastes are a result of primary loop decontamination of N-Reactor and ion-exchange wastes. DOE indicated that these wastes have been segregated from other Hanford wastes and are clearly low-level wastes. NRC agrees with DOE that these wastes are low-level wastes. NRC staff indicated that it sees no reason why DOE could not proceed to dispose of these wastes as scheduled.

DOE intends to treat the neutralized current acid wastes (NCAW) as high-level waste. Cesium would be removed from the supernate and combined with sludge containing strontium and other precipitated radionuclides and then vitrified into borosilicate glass for eventual disposal in a geologic repository. DOE

indicated that the treated supernate would be mixed with grout and disposed of as low-level waste.

DOE indicated that it intends to treat the remaining four categories of wastes as non-high-level waste and to pretreat as necessary and dispose of them via the grout facility. Both NRC and DOE staff concluded that more discussions are needed to clarify the classification of wastes in the remaining four categories. DOE extended an invitation to the NRC staff to visit the Hanford site and view the project facilities that are currently in place. Additional discussions on waste classification could take place at that time.

The NRC reiterated that the source-based definition set forth in 10 CFR Part 50, Appendix F is the applicable definition for determining whether or not a particular radioactive waste stream is high-level waste.

D. M. Smith 7/5/88.
for Ronald E. Gerton
U. S. Department of Energy

Regis R. Boyle 6/28/88
Regis R. Boyle
U. S. Nuclear Regulatory Commission

ATTACHMENT 1

Attachment 1

List of Attendees

Attendee	Organizational Affiliation	Phone
Chad Glenn	NRC / NMSS	FTS 492-0567
REGIS BOYLE	NRC / NMSS / LOW-LEVEL WASTE	FTS 492-0559
James A Wolf	NRC / OGC / R & FC	FTS 492-1641
Cherri DeFigh-Price	Westinghouse Hanford	FTS 444-1804
PAULA CLARK	US DOE - Richland Operations	FTS 444-4718
Edward Regnier	DOE / OCRWM	586 4590
DAN FEHRINGER	NRC (HLWM)	492-0426
Ray Pelletier	DOE / HQ Environmental Guidance	586-8505
W.T. (SONNY) GOLDSTON	DOE / Savannah River	239-5532
RONALD E. GERTON	DOE Richland	FTS 444-5557
Robert M Carosino	DOE Richland	FTS 444-2024
DON WODRICH	WHC RICHLAND	FTS 490-2038
Martha Crosland	DOE / OGC	586-6947
GERALD H. DALY	DOE HQ DP-123	353-4187
Mike Bell	NRC / LLWM / RB	FTS 492-3435
John T. Greeves	NRC / LLW /	301 492-3344

ATTACHMENT 2

DISPOSAL OF N-REACTOR LOW-LEVEL LIQUID WASTE

BY

GROUTING IN SUBSURFACE VAULTS

PRESENTED TO THE

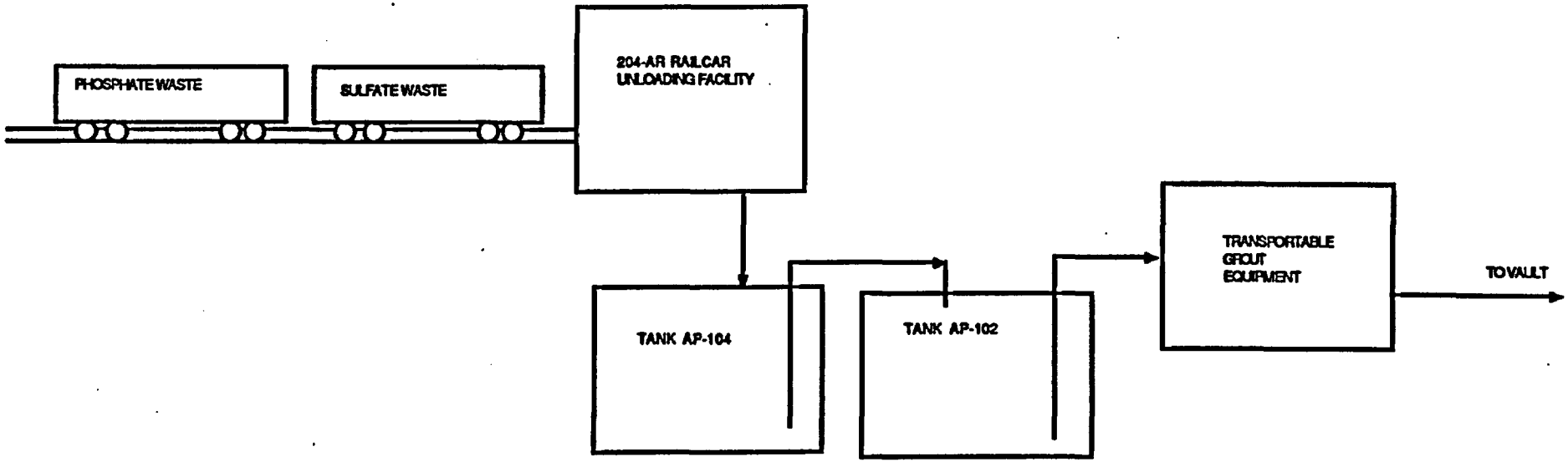
NUCLEAR REGULATORY COMMISSION

JUNE 9, 1988

N-REACTOR LOW-LEVEL LIQUID WASTE IS CALLED PHOSPHATE/SULFATE WASTE (PSW)

- IT IS N-REACTOR PRIMARY LOOP DECONTAMINATION SOLUTIONS, AND ION EXCHANGE ELUENT FROM THE WATER TREATMENT SYSTEM.
- VOLUME: 1 MILLION GALLONS.
- SCHEDULE FOR GROUTING: START JUNE 1988, COMPLETE 1989.
- HDW-EIS CALLS OUT PSW AS LLW NOT IN SCOPE OF EIS (PAGE D8).

PSW RECEIPT AND STORAGE



AP TANK FARM CONSTRUCTED 1986
PSW FIRST AND ONLY WASTE IN TANKS 102 AND 104

PSW GROUT FEED

	VOLUME	TRU	Cs-137	Sr-90	I-129	Tc-99	C-14
CONCENTRATION (Ci/M^3)	-	1.7E-03[1]	4.7E-04	1.7E-05	2.1E-08	4.2E-05	-
TOTAL (Ci UNLESS OTHERWISE INDICATED)	3.8E+03M^3	6.6E-03	1.8E+00	7.0E-02	7.8E-05	1.7E-01	-
BASIS: SAMPLING							
10 CFR 61 CLASS A LIMITS (Ci/M^3)	-	10[1].	1.0E+00	4.0E-02	6.0E-03	3.0E-01	8.0E-01

1. UNITS ARE NANOCURIES PER GRAM.

DISPOSAL OF HANFORD LOW-LEVEL TANK WASTE

BY

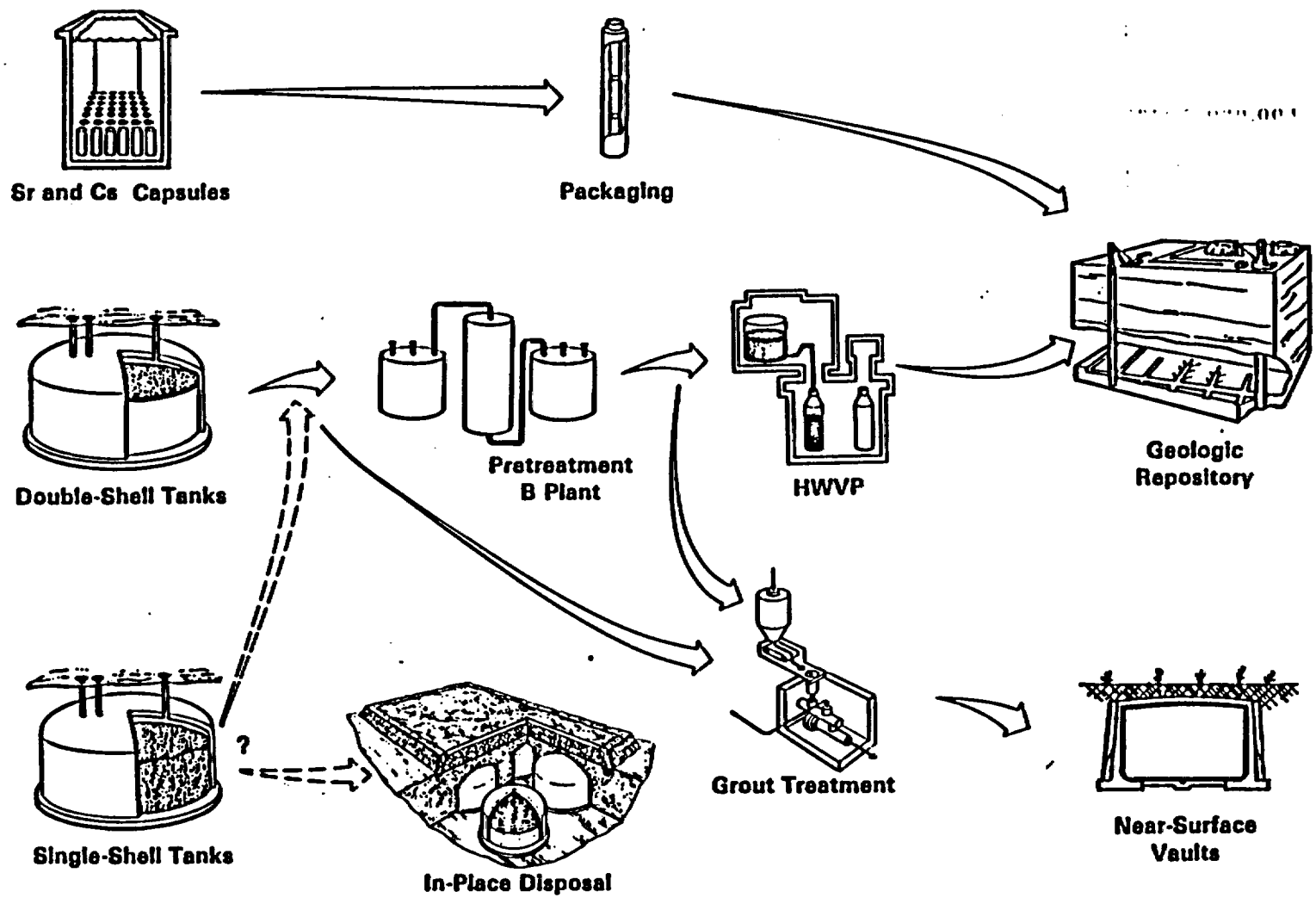
GROUTING IN SUBSURFACE VAULTS

PRESENTED TO THE

NUCLEAR REGULATORY COMMISSION

JUNE 9, 1988

Hanford Waste Management Program



28804-068.001

GROUT DISPOSAL PROGRAM

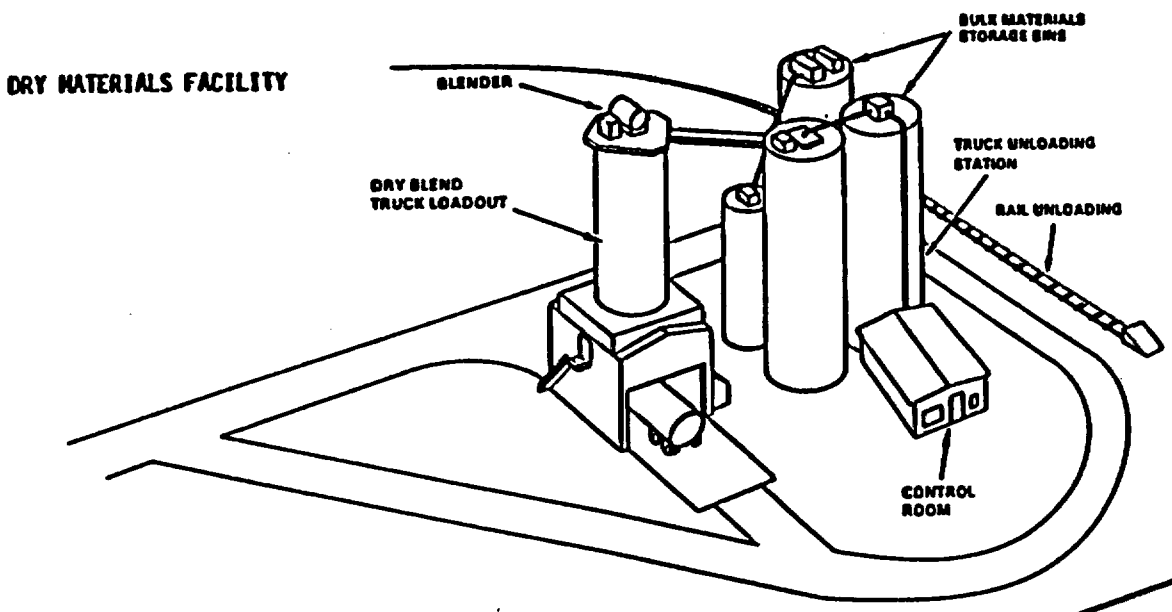
OBJECTIVE

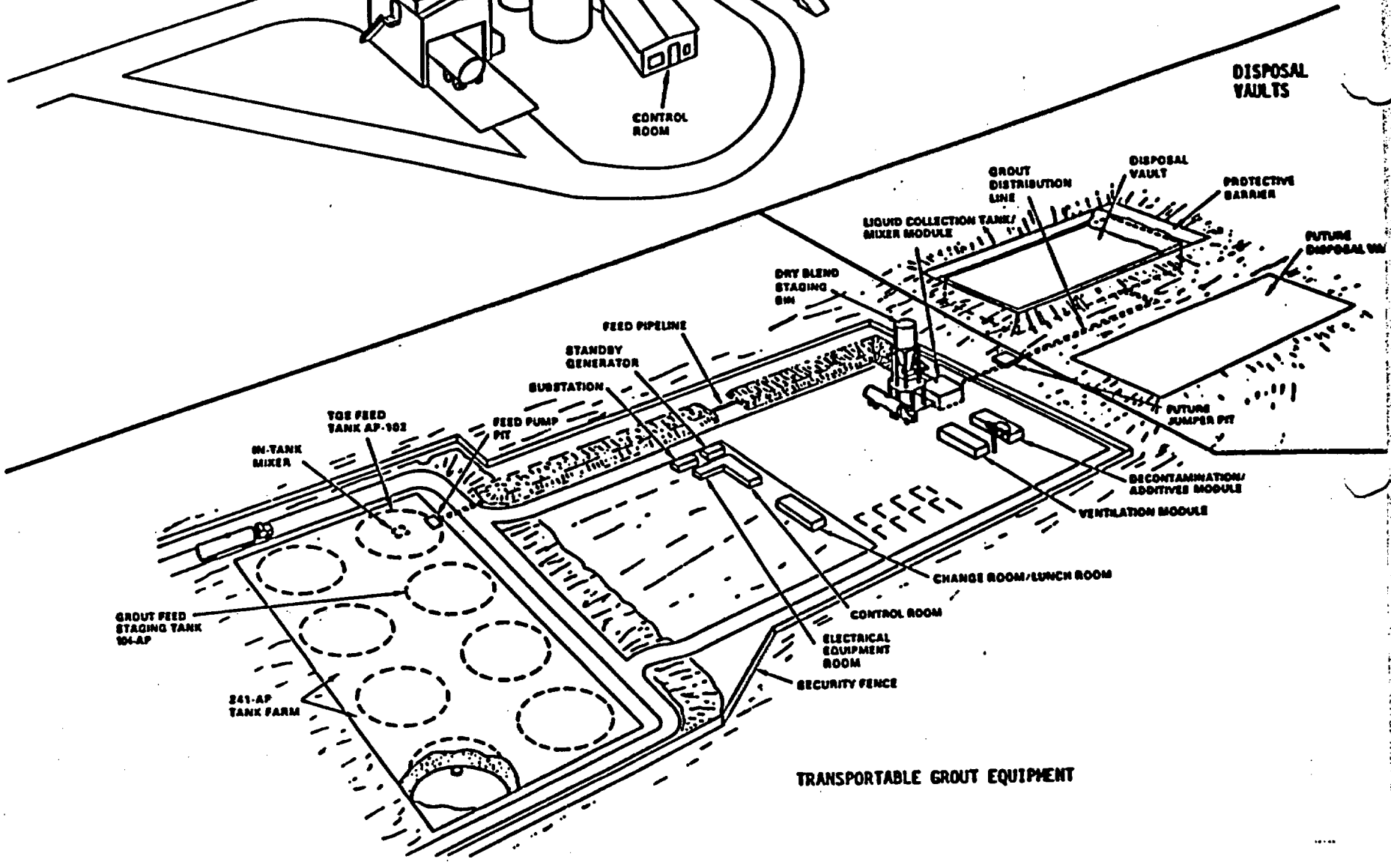
- o PERMANENT DISPOSAL OF LOW-LEVEL DOUBLE-SHELL TANK WASTE
  - IMPLEMENTS PUBLIC, STATE, AND CONGRESSIONAL DIRECTION TO PERMANENTLY DISPOSE OF DOUBLE-SHELL TANK WASTE (HDW-EIS)
  - SUPPORTS INTERIM STABILIZATION AND ISOLATION OF SINGLE-SHELL TANKS

SCOPE

- o DEVELOP TECHNOLOGY
- o DESIGN AND CONSTRUCT TREATMENT AND DISPOSAL FACILITIES
- o OPERATE HANFORD'S FIRST TREATMENT AND DISPOSAL FACILITY FOR TANK WASTE

GROUT TREATMENT FACILITY

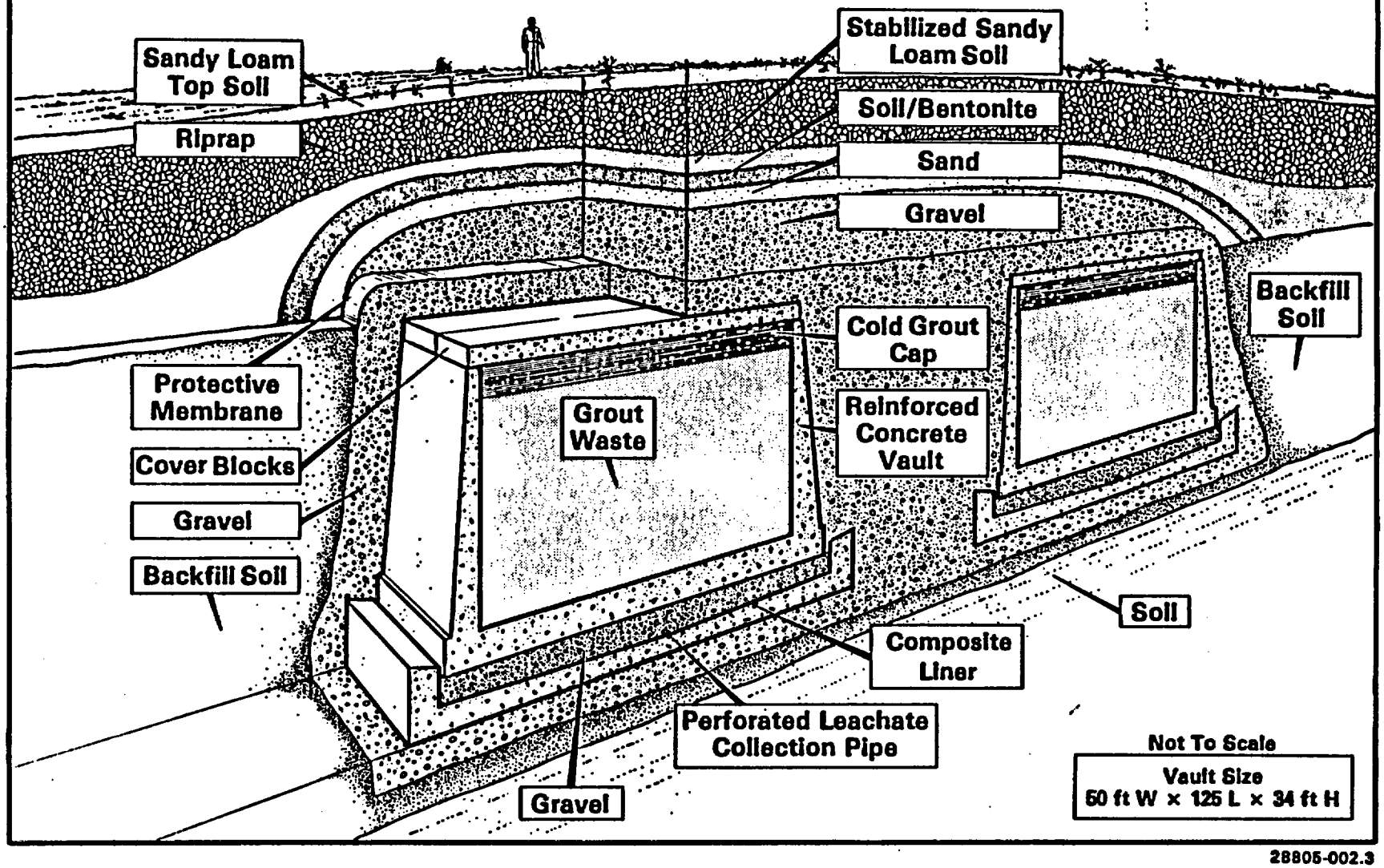




FACILITIES

PHOTOS

Grouted Waste Disposal Vaults
(With Hanford Protective Barrier)



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GROUT DISPOSAL PROGRAM CRITERIA

- DISPOSAL SYSTEM CRITERIA
- GROUT PRODUCT CRITERIA
- GROUT FEED CRITERIA

DISPOSAL SYSTEM CRITERIA

DISPOSAL SYSTEM IS BEING DESIGNED TO MEET:

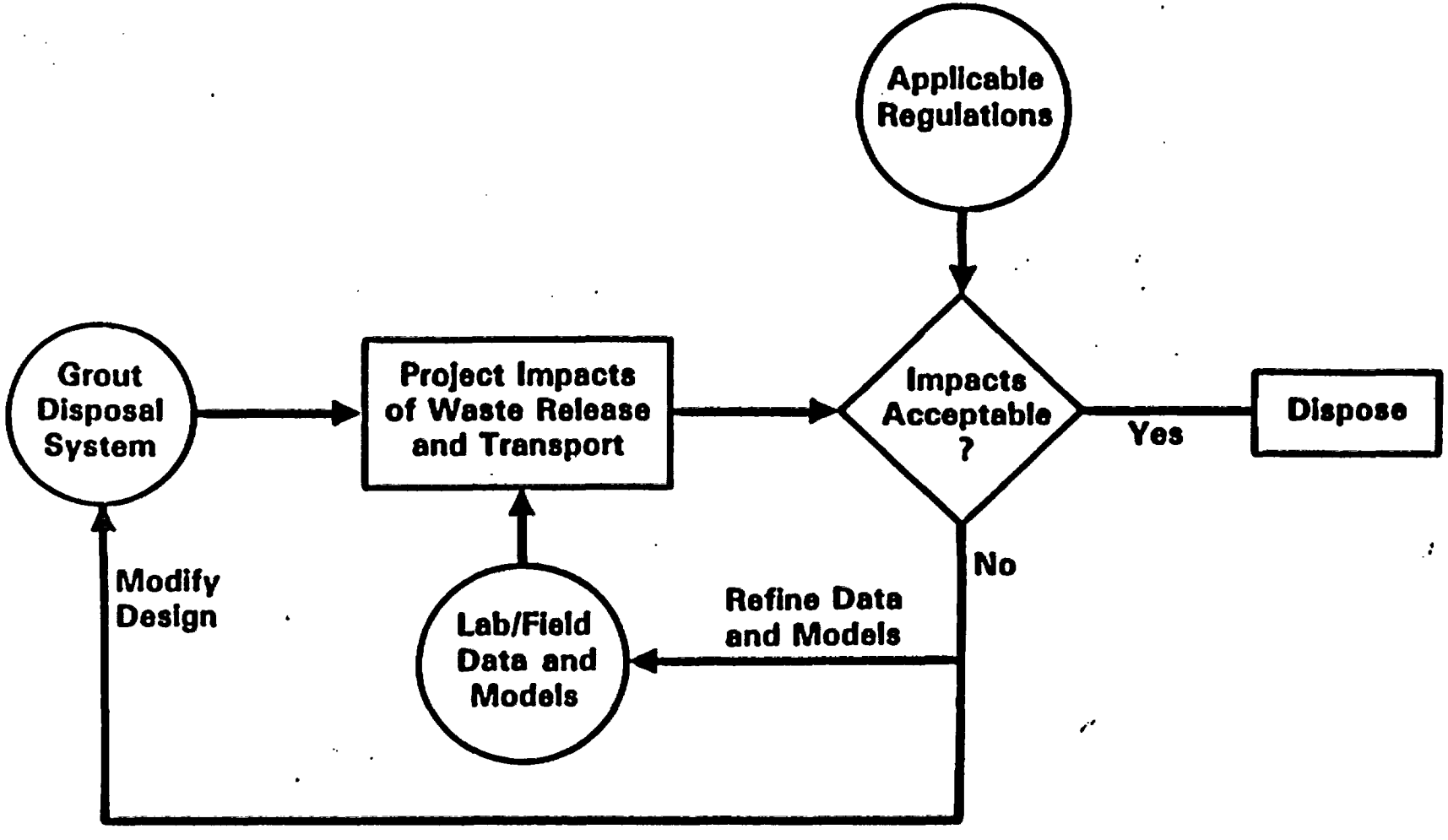
- o RCRA REQUIREMENTS
  - DOUBLE LINER AND LEACHATE COLLECTION AND REMOVAL SYSTEM
  - MULTI-LAYER, LOW-PERMEABILITY PROTECTIVE COVER
- o LONG-TERM PERFORMANCE REQUIREMENTS

PERFORMANCE ASSESSMENT

- o DEMONSTRATE TO OURSELVES AND OTHERS THAT PROJECTED PERFORMANCE OF DISPOSAL SYSTEM WILL BE ACCEPTABLE FOR 10,000 YEARS

- o STANDARDS BEING USED AS GUIDELINES
  - INTERIM PRIMARY DRINKING WATER STANDARDS (40 CFR 141)
  - DRAFT EPA LOW-LEVEL WASTE REGULATIONS (40 CFR 193)
  - DOE ORDERS (DRAFT DOE ORDER 5820.2A)
  - NRC LOW-LEVEL WASTE REGULATIONS (10 CFR 61)

Performance Assessment Methodology



PERFORMANCE ASSESSMENT

- PERFORMANCE ASSESSMENT INPUT WAS USED TO GUIDE THE DESIGN OF THE DISPOSAL SYSTEM

- MODEL DEVELOPMENT AND DATA ACQUISITION ARE ONGOING TO REFINE PERFORMANCE EVALUATION

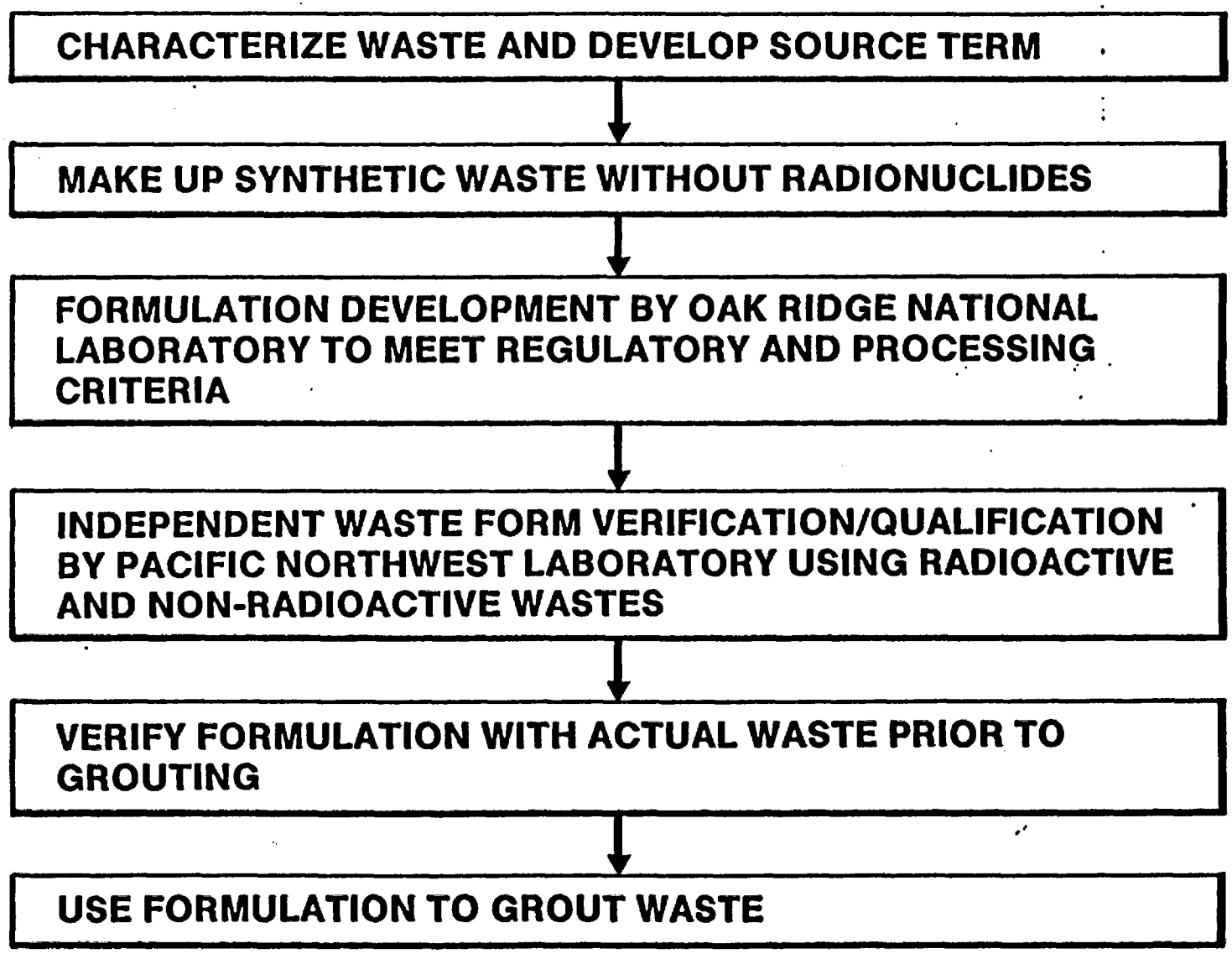
GROUT PRODUCT CRITERIA

- o VOLUMETRIC CHANGE -- NO VOLUME INCREASE WHILE GROUT IS IN THE NON-PLASTIC STATE
- o HEAT GENERATION -- TOTAL HEAT GENERATION MUST RESULT IN A TEMPERATURE LESS THAN 100°C
- o FREE LIQUIDS
  - MUST BE $\leq$ 3% AFTER 28 DAYS OF CURING
- o LEACHABILITY
  - MUST PASS EP TOXICITY TEST
  - ANS 16.1 LEACHABILITY INDEX FOR KEY CONTAMINANTS
- o COMPRESSIVE STRENGTH
  - $\geq$ 50 PSI USING ASTM TEST #C-39

GROUT FEED CRITERIA

- LOW-LEVEL WASTE
- LESS THAN NRC CLASS C LIMITS
- CESIUM-137 CONCENTRATION LESS THAN 330 CURIES PER CUBIC METER

Product Development and Assurance Approach



DST WASTE CLASSIFICATION

DOE DEFINITION OF HIGH-LEVEL WASTE:

- "THE HIGHLY RADIOACTIVE MATERIAL THAT RESULTS FROM THE REPROCESSING OF SPENT NUCLEAR FUEL, INCLUDING LIQUID WASTE PRODUCED DIRECTLY IN REPROCESSING AND ANY SOLID WASTE DERIVED FROM THE LIQUID, THAT CONTAINS A COMBINATION OF TRU WASTE AND FISSION PRODUCTS IN CONCENTRATIONS AS TO REQUIRE PERMANENT ISOLATION." (DOE ORDER 5820.2A)

10 CFR PART 50, APPENDIX F, DEFINITION OF HIGH-LEVEL WASTE:

- "THOSE AQUEOUS WASTES RESULTING FROM THE OPERATION OF THE FIRST CYCLE SOLVENT EXTRACTION SYSTEM, OR EQUIVALENT, AND THE CONCENTRATED WASTES FROM SUBSEQUENT EXTRACTION CYCLES, OR EQUIVALENT, IN A FACILITY FOR REPROCESSING IRRADIATED REACTOR FUELS."

DST WASTE CLASSIFICATION (Cont'd)

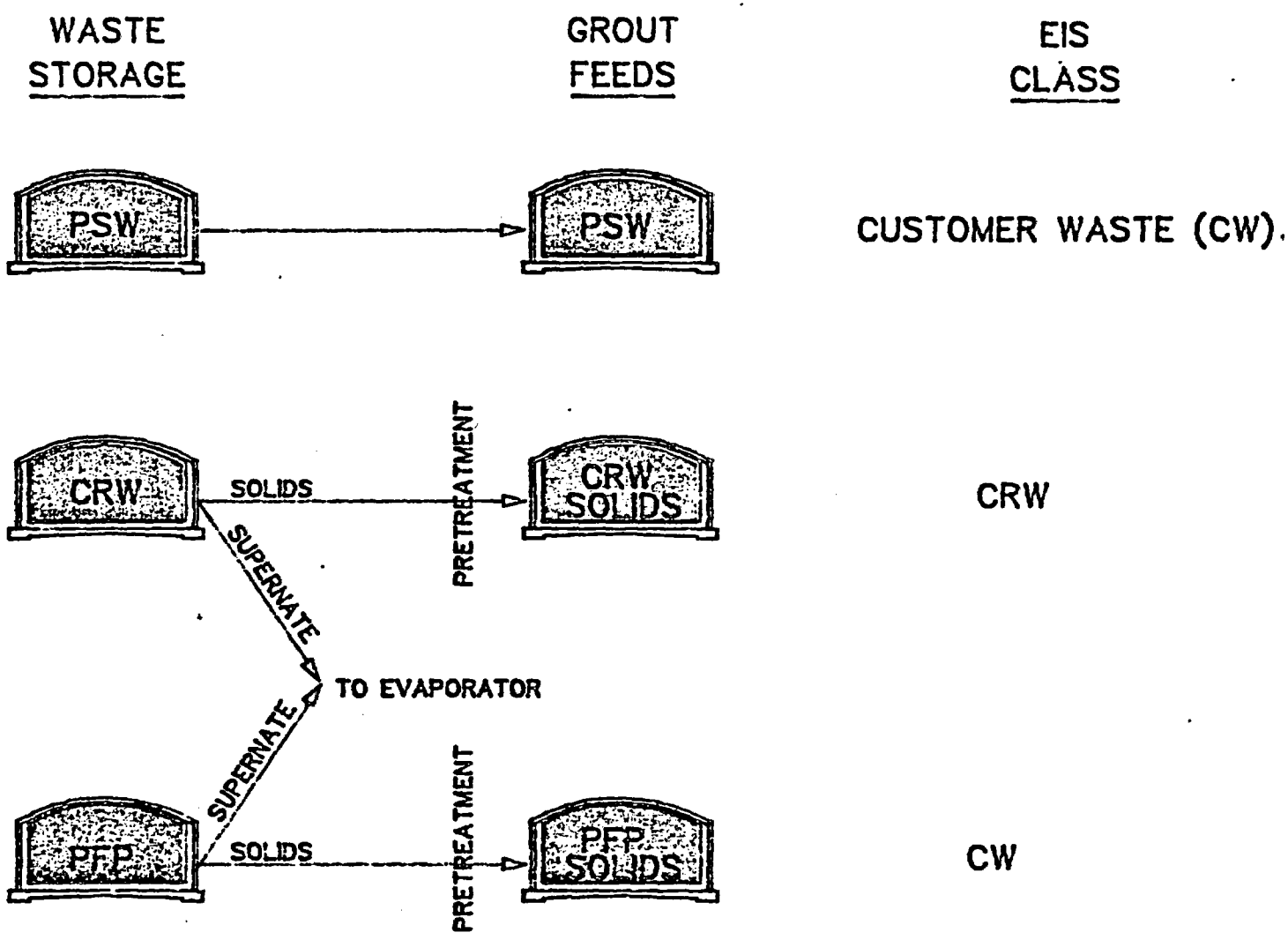
NRC DEFINITION OF HIGH-LEVEL WASTE:

- "(1) IRRADIATED REACTOR FUEL, (2) LIQUID WASTES RESULTING FROM THE OPERATION OF THE FIRST CYCLE SOLVENT EXTRACTION SYSTEM, OR EQUIVALENT, AND THE CONCENTRATED WASTES FROM SUBSEQUENT EXTRACTION CYCLES, OR EQUIVALENT, IN A FACILITY FOR REPROCESSING IRRADIATED REACTOR FUEL, AND (3) SOLIDS INTO WHICH SUCH LIQUID WASTES HAVE BEEN CONVERTED." (10CFR60)

CONGRESSIONAL DEFINITION OF HIGH-LEVEL WASTE

- "(A) THE HIGHLY RADIOACTIVE MATERIAL RESULTING FROM THE REPROCESSING OF SPENT NUCLEAR FUEL, INCLUDING LIQUID WASTE PRODUCED DIRECTLY IN REPROCESSING AND ANY SOLID WASTE DERIVED FROM SUCH LIQUID THAT CONTAINS FISSION PRODUCTS IN SUFFICIENT CONCENTRATIONS; AND (B) OTHER HIGHLY RADIOACTIVE MATERIAL THAT THE COMMISSION, CONSISTENT WITH EXISTING LAW, DETERMINES BY RULE REQUIRES PERMANENT ISOLATION." (NUCLEAR WASTE POLICY ACT OF 1982)

GROUT FEEDS: NON–HIGH LEVEL BY SOURCE



DST WASTE CLASSIFICATION

WASTES THAT ARE NOT HIGH-LEVEL WASTE BECAUSE OF SOURCE:

WASTE STORAGE	SOURCE	GROUT FEED
PSW	N-REACTOR DECONTAMINATION SOLUTION AND WATER TREATMENT WASTE.	PSW
PFP	PLUTONIUM FINISHING PLANT AND MISCELLANEOUS DECONTAMINATION AND LABORATORY SOLUTIONS.	PFP SOLIDS
CRW	DISSOLVED SPENT FUEL CLADDING GENERATED BEFORE FIRST SOLVENT EXTRACTION CYCLE AND ARE NOT EQUIVALENT TO FIRST CYCLE SOLVENT EXTRACTION WASTES.	CRW SOLIDS

DESCRIPTION OF GROUT FEED WHICH IS NON-HIGH LEVEL BY SOURCE

	CURRENT STORED VOLUME	CURRENT + FUTURE GROUT FEED VOLUME	
PSW	1.0 MILLION GAL	1.0 MILLION GAL	PHOSPHATE/SULFATE WASTE - WASTE FROM N REACTOR DECONTAMINATION OPERATIONS AND WATER TREATMENT.
PFP	0.15 MILLION GAL	1.0 MILLION GAL	PLUTONIUM FINISHING PLANT SOLIDS FROM Pu PURIFICATION AND RECOVERY PROCESS. PRETREATED FOR TRU REMOVAL.
CRW	0.6 MILLION GAL	3.7 MILLION GAL	NEUTRALIZED CLADDING REMOVAL WASTE SOLIDS FROM PUREX FUEL DECLADDING PROCESS. PRETREATED FOR TRU REMOVAL.

CRW SOLIDS AS GROUT FEED (ESTIMATED)

	VOLUME	TRU	Cs-137	Sr-90	I-129	Tc-99	C-14
CONCENTRATION (Ci/M^3)	-	68[1].	2.6E+01	7.0E+00	-	-	-
TOTAL (Ci UNLESS OTHERWISE INDICATED)	1.4E+04M^3	9.5E+02	3.7E+05	9.8E+04	-	-	-

BASIS: SAMPLE RESULTS AND COMPUTER SIMULATION

10 CFR 61 CLASS B LIMITS (Ci/M^3)	-	10[1].	4.4E+01	1.5E+02	6.0E-03	3.0E-01	8.0E-01
10 CFR 61 CLASS C LIMITS (Ci/M^3)	-	100[1].	4.6E+03	7.0E+03	6.0E-02	3.0E+00	8.0E+00

1. UNITS ARE NANOCURIES PER GRAM

PFP SOLIDS AS GROUT FEED (ESTIMATED)

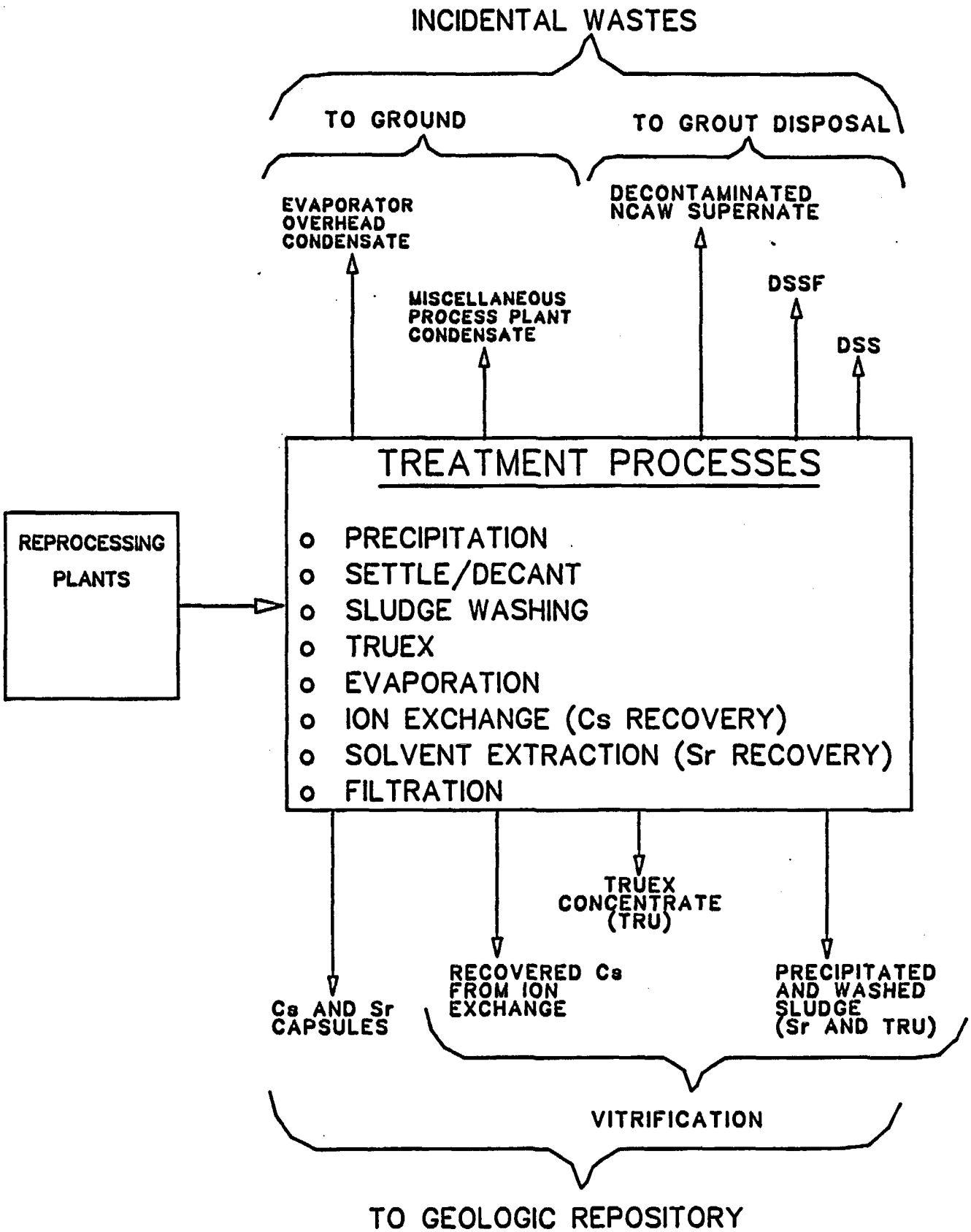
	VOLUME	TRU	Cs-137	Sr-90	I-129	Tc-99	C-14
CONCENTRATION (Ci/M^3)	-	50[1].	8.0E-02	1.2E-01	-	-	-
TOTAL (Ci UNLESS OTHERWISE INDICATED)	3.6E+03M^3	1.8E+02	2.9E+02	4.3E+02	-	-	-

BASIS: SAMPLE RESULTS AND PRETREATMENT FLOWSHEET

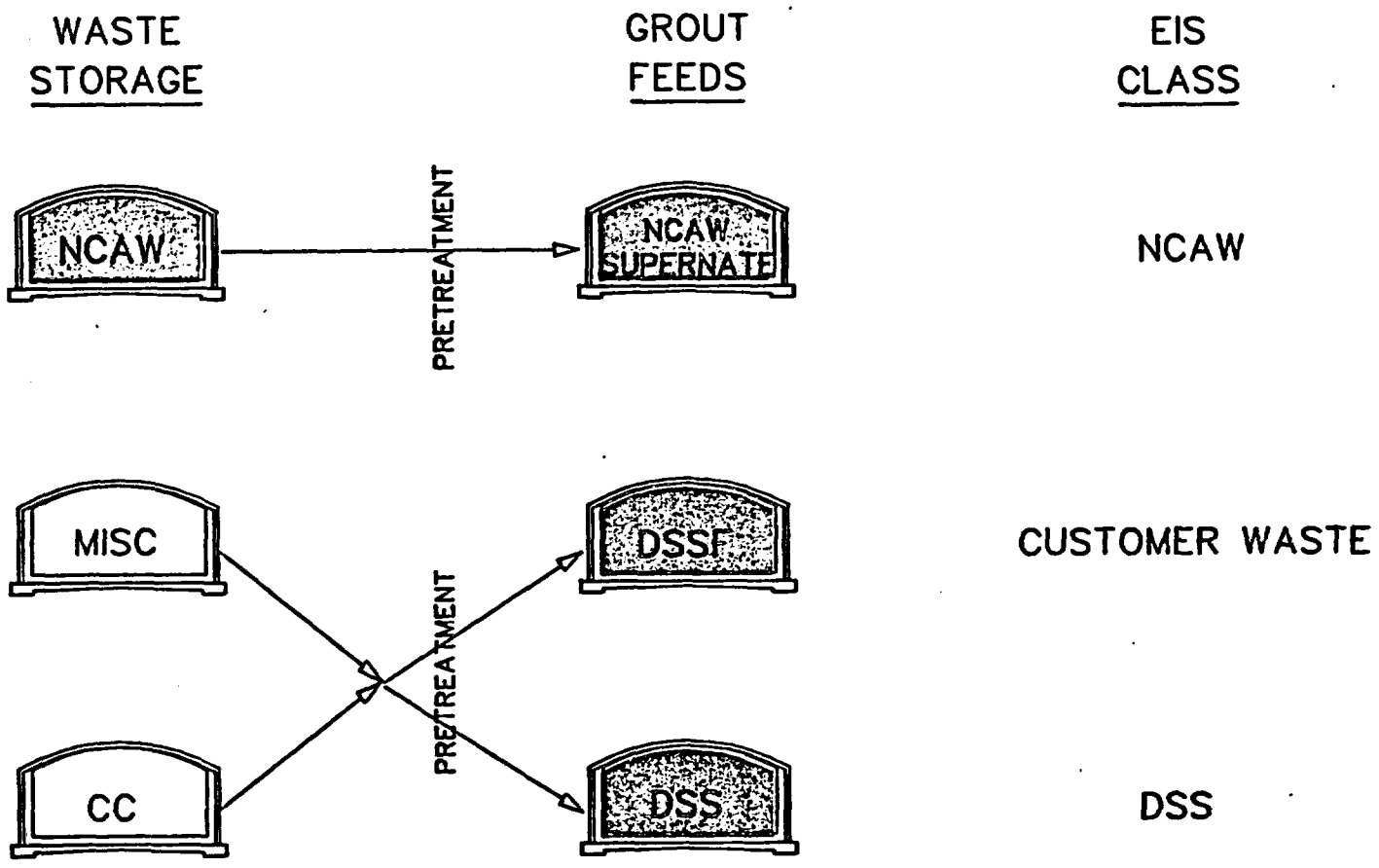
10 CFR 61 CLASS B LIMITS (Ci/M^3)	-	10[1].	4.4E+01	1.5E+02	6.0E-03	3.0E-01	8.0E-01
10 CFR 61 CLASS C LIMITS (Ci/M^3)	-	100[1].	4.6E+03	7.0E+03	6.0E-02	3.0E+00	8.0E+00

1. UNITS ARE NANOCURIES PER GRAM.

WASTE TREATMENT



GROUT FEEDS: INCIDENTAL WASTES



DST WASTE CLASSIFICATION

GROUT FEEDS THAT WILL NOT BE HIGH-LEVEL WASTE BECAUSE THEY ARE INCIDENTAL WASTES (DUE TO TREATMENT AND RESULTING LOW RADIOACTIVITY):

WASTE STORAGE	TREATMENT PROCESS	GROUT FEED
NCAW	- PRECIPITATION BY NEUTRALIZATION - ^{137}Cs REMOVAL BY ION EXCHANGE	NCAW SUPERNATE
MISC. WASTES	- PRECIPITATION BY NEUTRALIZATION - PREVIOUS ^{90}Sr REMOVAL - PREVIOUS ^{137}Cs REMOVAL - INCLUDES OTHER LOW-LEVEL WASTE	DSSF & DSS
COMPLEXED CONCENTRATE	- PRECIPITATION BY NEUTRALIZATION - PREVIOUS ^{90}Sr REMOVAL - PREVIOUS ^{137}Cs REMOVAL - TRU REMOVAL BY TRUEX	DSSF

DESCRIPTION OF INCIDENTAL WASTE GROUT FEEDS

	CURRENT STORED VOLUME	CURRENT + FUTURE GROUT FEED VOLUME	
NCAW SUPERNATE	1.5 MILLION GAL	2.7 MILLION GAL	NEUTRALIZED CURRENT ACID WASTE SUPERNATE FROM PUREX HIGH-LEVEL WASTE. AGED AND PRETREATED TO REMOVE SOLIDS (TRU + Sr) AND ^{137}Cs.
DSSF	10 MILLION GAL	41 MILLION GAL	DOUBLE-SHELL SLURRY FEED - PARTIALLY CONCENTRATED BY EVAPORATION, RETRIEVABLE, INCLUDES LOW-LEVEL WASTES FROM ALL GENERATION POINTS PLUS SUPERNATE FROM SST.
DSS	1.0 MILLION GAL	3.2 MILLION GAL	DOUBLE-SHELL SLURRY - DSSF WITH ADDITIONAL CONCENTRATION BY EVAPORATION. RETRIEVAL WILL REQUIRE DILUTION.

COMPARISON OF INCIDENTAL WASTE GROUT FEEDS AND TYPICAL HIGH-LEVEL WASTES

	INCIDENTAL WASTE GROUT FEEDS (Ci/m^3)			TYPICAL HIGH-LEVEL WASTES (Ci/m^3)	
RADIONUCLIDE	DSSF	DSS	NCAW SUPERNATE	HANFORD NCAW (5 YRS OLD)	COMMERCIAL HIGH-LEVEL WASTE (10 YEARS OLD)
Sr-90	50	0.48	1.4	3,800	87,000
Cs-137	55	250	120	4,600	120,000
Tc-99	0.08	0.078	0.44	0.81	22
C-14	0.019	0.0000004	0.07	0.13	--
I-129	0.000004	0.0003	0.00006	0.0001	0.0003
TRU[1]	8	1.3	15	49000	610,000

1. UNITS ARE NANOCURIES PER GRAM.

COMPARISON OF INCIDENTAL WASTE GROUT FEEDS AND 10 CFR PART 61 LIMITS

	INCIDENTAL WASTE GROUT FEEDS			TYPICAL LOW-LEVEL WASTES	
RADIONUCLIDE	DSSF (Ci/m^3)	DSS (Ci/m^3)	NCAW SUPERNATE (Ci/m^3)	CLASS B (Ci/m^3)	CLASS C (Ci/m^3)
Sr-90	50	0.48	1.4	150	7000
Cs-137	55	250	120	44	4600
Tc-99	0.08	0.078	0.44	0.3	3
C-14	0.019	0.0000004	0.07	0.8	8
I-129	0.000004	0.0003	0.00006	0.006	0.06
TRU[1]	8	1.3	15	10	100

1. Units are nanocuries per gram.

NCAW SUPERNATE AS GROUT FEED (ESTIMATED)

	VOLUME	TRU	Cs-137	Sr-90	I-129	Tc-99	C-14
CONCENTRATION (Ci/M^3)	-	15[1].	1.2E+02	1.4E+00	6.2E-05	4.4E-01	6.9E-02
TOTAL (Ci UNLESS OTHERWISE INDICATED)	1.0E+04M	1.5E+02	1.2E+06	1.4E+04	6.3E-01	4.4E+03	7E+02

BASIS: SPENT FUEL COMPUTER CODES PLUS COMPUTER SIMULATION OF PROCESS STEPS AND PRETREATMENT FLOWSHEET

1. UNITS ARE NANOCURIES PER GRAM.

DOUBLE-SHELL SLURRY FEED AS GROUT FEED (ESTIMATED)

	VOLUME	TRU	Cs-137	Sr-90	I-129	Tc-99	C-14
CONCENTRATION (Ci/M^3)	-	8[1]	5.5E+01	5.0E+01	4.1E-06	8.1E-02	1.9E-02
TOTAL (Ci UNLESS OTHERWISE INDICATED)	1.6E+05M^3	1.3E+03	8.8E+06	8.0E+06	6.6E-01	1.3E+04	3.0E+03

BASIS: COMPUTER MODELING AND PROCESS FLOWSHEETS

1. UNITS ARE NANOCURIES PER GRAM.

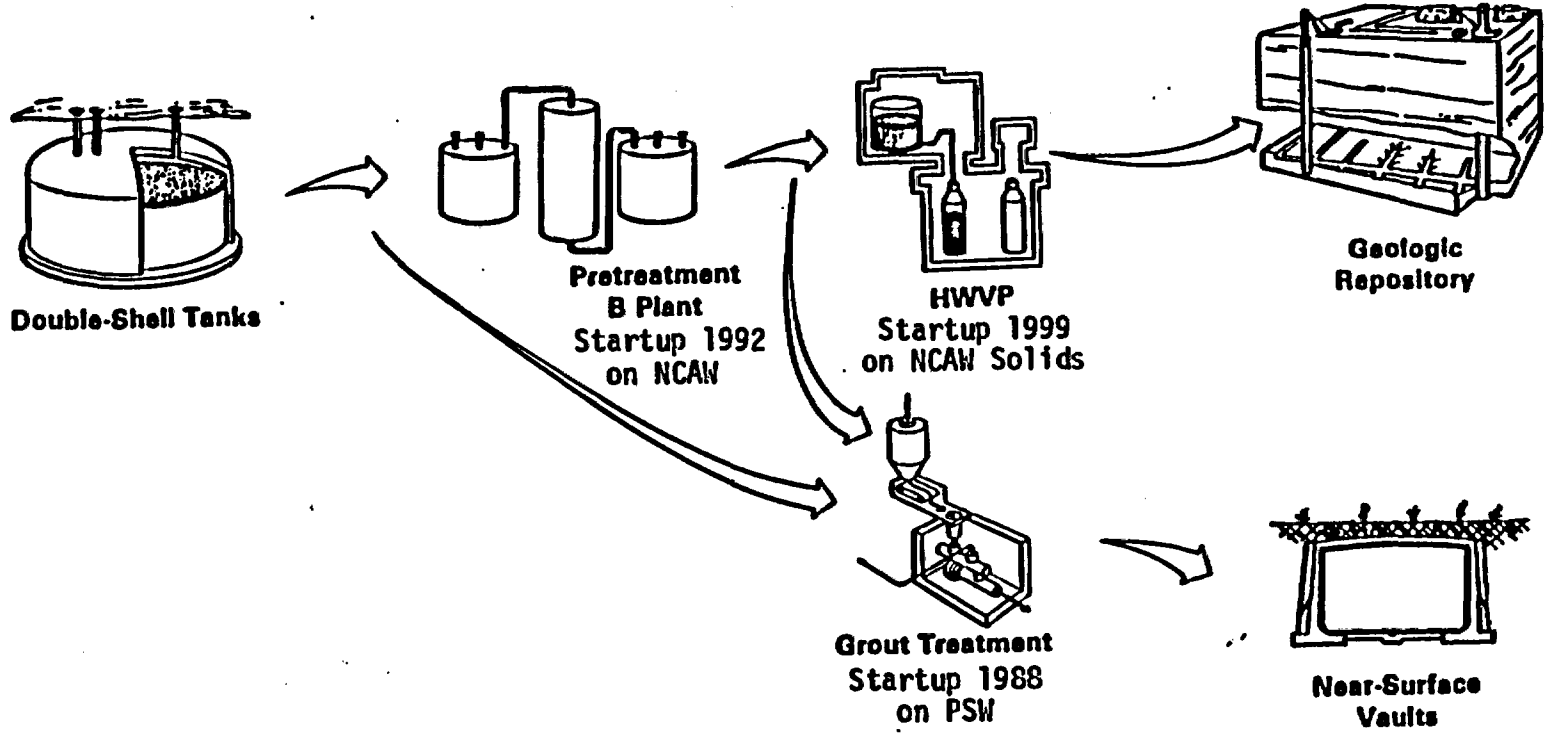
DOUBLE-SHELL SLURRY AS GROUT FEED

	VOLUME	TRU	Cs-137	Sr-90	I-129	Tc-99	C-14
CONCENTRATION (Ci/M^3)	-	1.3[1]	2.5E+02	4.8E-01	3.0E-04	7.8E-02	4.0E-07
TOTAL (Ci UNLESS OTHERWISE INDICATED	1.0E+04M^3	1.3E+01	2.6E+06	5.0E+03	3.1E+00	8.1E+02	4.2E-03

BASIS: SAMPLING

1. UNITS ARE NANOCURIES PER GRAM.

DST DISPOSAL PLAN AND SCHEDULE



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INITIAL CANDIDATE WASTE FEEDS

1988

- o PHOSPHATE/SULFATE WASTE
  - DILUTE PHOSPHATE WASTE FROM 1987 REACTOR DECON
  - SULFATE WASTE FROM WATER TREATMENT ION EXCHANGE

1989

- o PHOSPHATE/SULFATE WASTE
  - DILUTE PHOSPHATE WASTE FROM REACTOR DECON
  - SULFATE WASTE FROM WATER TREATMENT ION EXCHANGE

1990

- o DOUBLE-SHELL SLURRY FEED (DSSF)(106AN)
  - PHOSPHATE WASTE FROM REACTOR DECON (88%)
  - FLUSH WATER (7%)
  - CESIUM PROCESSING WASTE (5%)

INITIAL CANDIDATE WASTE FEEDS (Cont'd)

1991

0 DOUBLE-SHELL SLURRY FEED (101AW)

- PUREX MISCELLANEOUS WASTE STREAMS (26%)
- FLUSH WATER (22%)
- PUREX DECLADDING WASTE (13%)
- CESIUM/STRONTIUM PROCESSING WASTE (10%)
- SALT WELL LIQUID (7%)
- S, T, Z PLANT WASTES (5%)
- 100, 300, 400 AREA WASTES (8%)
- EVAPORATOR FLUSH (2%)
- MISCELLANEOUS (7%)

RADIONUCLIDE CONCENTRATIONS INITIAL DOUBLE-SHELL TANK WASTE FEEDS (CURIES PER CUBIC METER)

	PSW	106-AN	101-AW
CESIUM 137	4.7×10^{-4}	$3 \times 10^{+2}$	$3 \times 10^{+2}$
STRONTIUM 90	1.7×10^{-5}	$4 \times 10^{+0}$	$2 \times 10^{+1}$
CARBON 14	-	7×10^{-4}	3×10^{-3}
TECHNICIUM 99	4.2×10^{-5}	8×10^{-2}	5×10^{-3}
IODINE 129	2.1×10^{-8}	$<2 \times 10^{-4}$	1×10^{-4}
TRU	<2 pCi/G	2 nCi/G	1 nCi/G

* BASED ON SAMPLING