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June 28, 1991
Contract No. NRC-02-88-005
Project No. 20-3706-001

U.S. NUCLEAR REGULATORY COMMISSION
ATTN: Mr. R. Davis Hurt
Office of Nuclear Material Safety & Safeguards
Fuel Cycle Safety Branch
WF1
Mail Stop 6-H-3
Washington, D.C. 20555

Subject: Waste Solidification Systems, Intermediate Milestone No. 20-3706-001-005, Off-Gas Constituents

Dear Mr. Hurt:

Attached is a review of the off-gas constituents that may be available in the waste solidification system for potential release to the stacks at the West Valley plant. The data presented in this submittal will be used to develop the necessary understanding of potential surges and failures of the off-gas systems. This transmittal completes the activities associated with the subject Intermediate Milestone.

Please call me at (512) 522-5150 if you need any additional information on the subject.

Sincerely,

Prasad K. Nair
Program Element Manager
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Off-Gas Constituents for Waste Solidification Systems
Intermediate Milestone 20-3706-001-005
for Task 1 (Draft Safety Evaluation Report on
Vitrification Off-Gas System), Subtask A
June 28, 1991

The Center for Nuclear Waste Regulatory Analyses (CNWRA) has initiated a program element for providing assistance to NRC in evaluating the Department of Energy's West Valley Demonstration Project (WVDP) high-level waste vitrification-related activities. The foremost processing activity of the WVDP will be vitrification of high-level radioactive wastes into borosilicate glass logs. The high-level radioactive wastes to be processed at the WVDP currently are stored on-site, and these wastes have been inventoried by the WVDP staff. A simplified flowsheet showing the various waste tanks in the process is given as Figure 1. This figure represents the pathways for the waste and the various steps of the processes which must be understood before off-gas constituents can be estimated.

This letter report presents the high-level waste analytical data obtained from the WVDP and updates the previously reported data in the NRC staff paper of March 18, 1990 (Reference 1). The most recent data were provided by West Valley Nuclear Services Co, Inc., on June 14, 1991, in the document titled "Vitrification Mass Balance" (Reference 2). The data in this document are based on a 1987 inventory updated to 1990 by calculations for radioactive decay and resultant radionuclide daughters.

Data from References 1 and 2 are presented in Table I and II, respectively. Table II includes calculated values for average concentrations of various radioactive materials in stack gases along with melter inventory concentration. Values for average stack concentration were based on dilution of the total current inventory of radiation for each element in the total air throughput (50,000 SCFM designed air flow x 11,000 hours estimated processing duration). The average volume is calculated to be 9.35×10^{14} mL. This technique is the same as that used in Reference 1. It is important to note that the concentration values are averages, and they do not take into account variations in those values due to fluctuations in air flow and distribution of each element in the off-gases with time. Also, these calculated values are concentrations in the stack discharge, which would be expected to be diluted by the time the stack discharge mixes with ambient air to reach the controlled area boundary. For comparison, values are also given in both Table I and Table II for limits for concentrations of effluents in unrestricted areas, per 10 CFR Part 20, Appendix B, Table II, dated January 1, 1991.

Further updated data from vitrification mass balance studies are expected to be available in Rev. 8 of Reference 2, currently scheduled for release in December 1991. This report will include the latest sludge sampling and can provide the most extensive analytical data to date. The data transmitted in this report will be checked for any changes in the off-gas constituents. All the data and analyses received to date and incorporated in this report have been from WV's measurement and sampling.

This report represents the Intermediate Milestone for Task 1, Subtask A, as identified in the Center's Program Element Plan for the Waste Solidification Systems Program Element.

List of References

1. Hurt, R. Davis, "Preliminary Report of West Valley Vitrification Off-Gases," 3/18/90.

2. Crocker, Robert L., Vitrification Mass Balance, Rev. 7, transmitted to the CNWRA on 6/14/91.

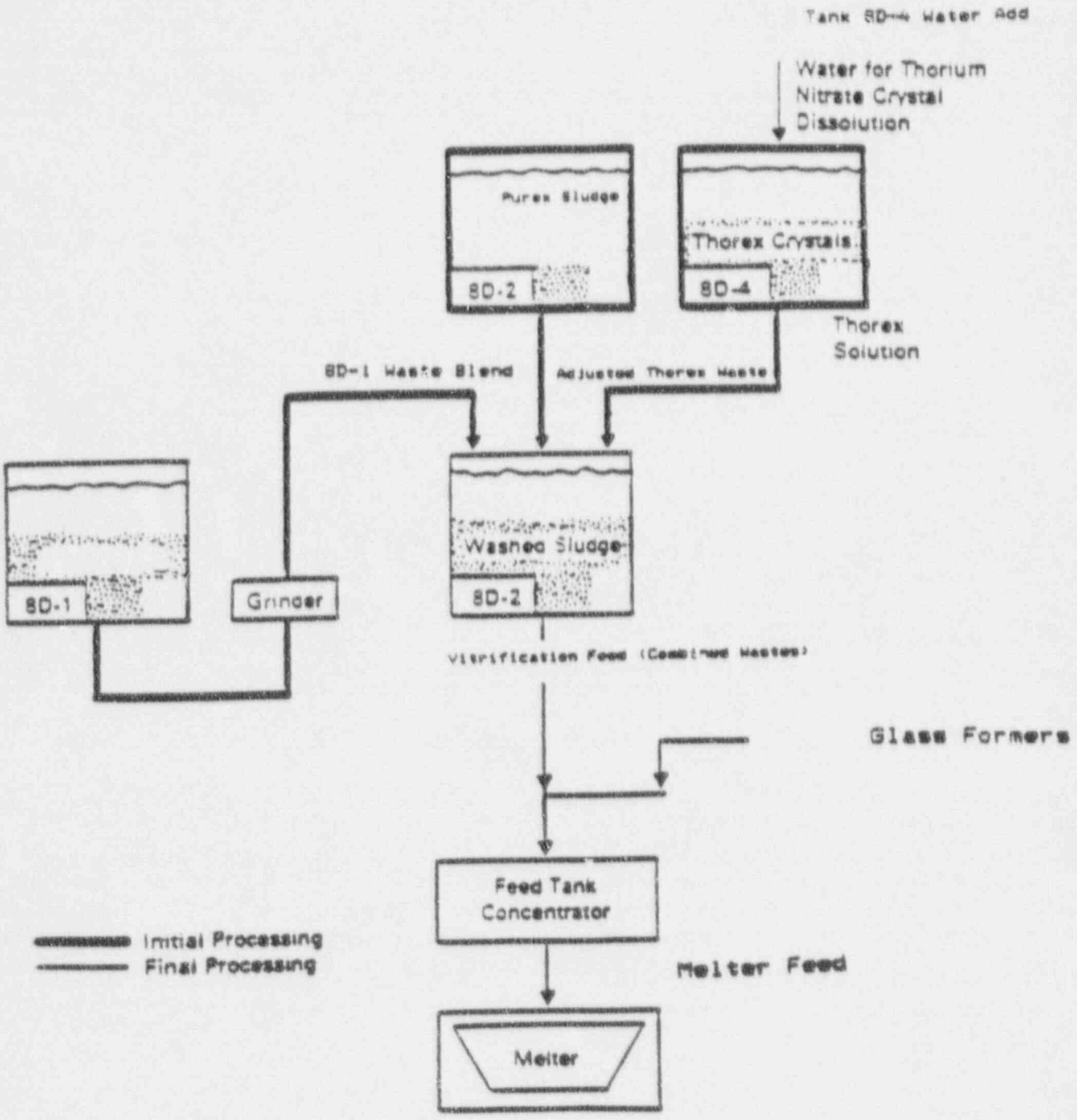

Fig. 1 Simplified Waste Tank Process Flowsheet

Table I

Estimated Inventory to Melter* (Ref. 1)

ISOTOPE	*TOTAL INVENTORY (Ci)	Airborne Release Rate (μCi/ml)	10 CFR Part 20 ** Airborne Release Limit (μCi/ml)
H-3	0.65	7.0×10^{-5}	2×10^{-7} - S,I
C-14	1.3	1.4×10^{-6}	1×10^{-7} - S
Sr-90/Y-90	13.1×10^{6}	1.4×10^{-2}	2×10^{-10} - I (Sr) 3×10^{-11} - S (Sr)
Tc-99	14.0	1.5×10^{-6}	7×10^{-8} - S 2×10^{-9} - I
Ru-106/Rh-106	8.4	9.0×10^{-7}	3×10^{-9} - S (Ru) 2×10^{-10} - I (Ru)
I-129	0.19	2.0×10^{-10}	2×10^{-11} - S 2×10^{-9} - I
Cs-137/Ba-137m	13.5×10^{6}	1.5×10^{-2}	2×10^{-8} - S (Cs) 5×10^{-10} - I (Cs)
Pu-238	6.7×10^{3}	7.2×10^{-6}	7×10^{-11} - S 1×10^{-12} - I
Pu-239	1.7×10^{3}	1.8×10^{-6}	6×10^{-11} - S 1×10^{-12} - I
Pu-240	1.3×10^{3}	1.4×10^{-6}	6×10^{-11} - S 1×10^{-12} - I
Pu-241	6.8×10^{4}	7.3×10^{-5}	3×10^{-12} - S 1×10^{-8} - I
Am-241	7.1×10^{4}	7.6×10^{-5}	2×10^{-13} - S 4×10^{-12} - I

* Estimated Inventory to melter is from NRC staff paper on WVDP vitrification off-gas system dated March 18, 1990.

** Dated Jan. 1, 1991

S - Soluble

I - Insoluble

Table II

Current Estimated Inventory to Melter *(Ref. 2)

ISOTOPE	Melter Feed* (Ci)	Off Gases* (Ci)	Airborne Release Rate** (μCi/ml)	10 CFR Part 20 Airborne Release Limit*** (μCi/ml)
H-3	2.32×10^{-1}	2.32×10^{-1}	2.50×10^{-10}	2×10^{-7} - S,I
C-14	5.49×10^{-1}	5.49×10^{-1}	5.87×10^{-10}	1×10^{-7} - S
Sr-90	6.72×10^{4}	2.24×10^{4}	2.40×10^{-5}	2×10^{-10} - I 3×10^{-11} - S
Y-90	6.72×10^{4}	2.24×10^{4}	2.40×10^{-5}	4×10^{-9} - S 3×10^{-9} - I
Tc-99	1.21×10^{2}	1.21×10^{1}	1.30×10^{-6}	7×10^{-8} - S 2×10^{-9} - I
Ru-106	1.57×10^{1}	1.57	1.68×10^{-6}	3×10^{-9} - S 2×10^{-10} - I
Rh-106	1.42×10^{1}	4.42×10^{-2}	4.73×10^{-11}	See Ru-106
I-129	1.81×10^{-1}	1.81×10^{-1}	1.94×10^{-10}	2×10^{-11} - S 2×10^{-9} - I
Cs-137	7.36×10^{5}	1.47×10^{3}	1.57×10^{-4}	2×10^{-9} - S 5×10^{-10} - I
Ba-137m	6.96×10^{4}	1.39×10^{3}	1.49×10^{-4}	2×10^{-9} - S 5×10^{-10} - I
Pu-238	8.32×10^{3}	2.77×10	2.96×10^{-6}	7×10^{-11} - S 2×10^{-12} - I

Table II (Cont'd)

Current Estimated Inventory to Melter (Ref. 2)

ISOTOPE	Melter Feed* (Ci)	Off Gases* (Ci)	Airborne Release Rate** (μCi/ml)	10 CFR Part 20 Airborne Release Limit*** (μCi/ml)
Pu-239	1.63×10^{3}	5.44	5.82×10^{-4}	6×10^{-11} - S 1×10^{-12} - I
Pu-240	1.19×10^{3}	3.98	4.25×10^{-4}	6×10^{-11} - S 1×10^{-12} - I
Pu-241	8.09×10^{4}	2.70×10^{2}	2.90×10^{-2}	3×10^{-12} - S 1×10^{-10} - I
Am-241	5.36×10^{4}	1.79×10^{2}	1.90×10^{-2}	2×10^{-13} - S 4×10^{-12} - I

* Estimated Inventory to melter is from WV Letter EK:89:0232 on Vitrification Mass Balance Revision Number 7 dated October 10, 1989

** Airborne Release Rate is calculated based on 9.35×10^{5}mL total flow volume

*** Dated Jan. 1, 1991

S - Soluble

I - Insoluble