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Changes from previous version and reason for the changes (attach pages as necessary)

DOCUMENT TITLE: ***HANFORD COMPLEXANT CONCENTRATE CESIUM REMOVAL USING CRYSTALLINE SILICOTITANATE***

Document No.: SESC-EN-RPT-005 **Revision No.:** *0*

Key Words: Hanford, Tank Waste, Complexant Concentrate, DST, 241-AN-107, Cesium, Ion Exchange, Radioactive, IE-911, Crystalline Silicotitanate

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Hanford Complexant Concentrate Cesium Removal Using Crystalline Silicotitanate

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Key Words: Hanford, Tank Waste, Complexant Concentrate, DST, 241-AN-107, Cesium, Ion Exchange, Radioactive, IE-911, Crystalline Silicotitanate

Abstract: This document provides a report of test conduct in the demonstration testing of ion exchange material IE-911 (a Crystalline Silicotitanate) in a bench-scale flow test with Hanford Complexant Concentrate supernatant liquor from tank 241-AN-107. Treatment of this five molar sodium solution was conducted at six column volumes per hour. Breakthrough detection (0.1%) and 50 percent breakthrough (λ_{50}) of ^{137}Cs were at 100 and 1,044 column volumes of treatment, respectively.

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ABBREVIATIONS

ALARA	As low as reasonably achievable
Bq	Becquerel, one disintegration per second
CC	Complexant Concentrate
Ci	Curie, 3.7 x 10^{10} Becquerel
CST	Crystalline Silicotitanate
CV	Column Volumes
DF	Decontamination Factor
DOE	United States Department of Energy
DSSF	Double-Shell Slurry Feed
FDH	Fluor Daniel Hanford, Inc.
IX	Ion Exchange
LIMS	Laboratory information management system
LLW	Low-Level Waste
LMHC	Lockheed Martin Hanford Corporation
NHC	Numatec Hanford Corporation
NRC	Nuclear Regulatory Commission
OST	Office of Science and Technology
PNNL	Battelle Pacific Northwest National Laboratory
SESC	SGN Eurisys Services Corporation
TFA	Tank Focus Area
TOC	Total Organic Carbon
TRU	Transuranic, atomic number greater than 92
TWRS	Tank Waste Remediation System
WHC	Westinghouse Hanford Company
^{137}mBa	Barium, metastable isotope 137
^{137}Cs	Cesium, isotope 137

ACKNOWLEDGMENTS

It is with sincere gratitude that the author wishes to acknowledge the valued contribution of the many personnel who were integral to the successful completion of this effort. To this end, I wish to thank:

Numatec Hanford Corporation, Process Chemistry
Mark A. Beck for test conduct, gamma probe operation and data acquisition, sample preparation, and data handling.
Jeff W. Chenault for test apparatus installation, test conduct, sample load out, and waste management
D. Wayne Edmonson for waste transfer work plan creation and conduct, test apparatus installation, test conduct, sample load out, and waste management.
Lino A. Guerra for test apparatus installation, test conduct, sample load out, and waste management.
John R. Smith for sample load out.

Rust Federal Services Hanford Company, 222-S Operations
For provision of facilities for the conduct of test operations, test surveillance, quality assurance, and radiological safety support.

Lockheed Martin Hanford Corporation
George Stanton for providing the support, scheduling, and personnel required to acquire the large volume of tank waste required for this work.

SGN Eurisys Services Corporation
Rabindra K. Biyani, P.E., for test plan, and procedure development and execution,
Theodore M. Hohl for test execution engineering support,
Dr. James B. Duncan for test plan, and procedure development and execution, and
George T. McDonald for test apparatus component procurement, assembly, and leak testing.

Battelle Pacific Northwest National Laboratory
Dean E. Kurath for program management and funding assistance.

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Hanford Complexant Concentrate Cesium Removal Using Crystalline Silicotitanate

1.0 INTRODUCTION

Cesium-137 (^{137}Cs) is a primary radiation source in the dissolved tank waste at the Hanford Site. Removal of ^{137}Cs from the waste can reduce the hazard and waste classification (NRC 1989) of the low-level waste, and reduce treatment and disposal costs.

Several cesium removal sorbents have been developed by private industry and the U.S. Department of Energy's (DOE) Office of Science and Technology (OST) [EM-50] for the removal of cesium from the radioactive tank wastes located at various DOE facilities. In mid-1996, ion exchange column tests were conducted for evaluating cesium removal from Hanford's DSSF waste in tank 241-AW-101 (Hendrickson *et al.* 1996). There have also been a number of batch tests using Hanford tank wastes and several other column tests using simulated Hanford tank wastes or actual wastes from other DOE sites.

The Hanford Tank Waste Remediation System (TWRS) organization has indicated that further column-flow tests using sorbents with *actual* waste need to be performed to verify the applicability of the simulant data. These tests may also identify potential problems or interferences when processing actual wastes under full-scale conditions.

This document is a report of cesium removal testing at the Hanford Site with supernatant liquor from Hanford waste tank 241-AN-107 in contact with crystalline silicotitanate (CST) produced by UOP as *IONSIV*, IE-911[1]. The waste contained within Hanford Double-Shell Tank (DST) 241-AN-107 is termed Complexant Concentrate (CC) waste due to the high concentration of organic complexant agents and their degradation products.

This work is funded by the DOE OST Tanks Focus Area under Technology Task Plan RL37WT42 *Cesium Flow Studies at Hanford* through Pacific Northwest National Laboratory (PNNL) previously identified as RL07WT42.

This work has been performed under the program management of Battelle PNNL and the technical direction of the SGN Eurisys Services Corporation (SESC)/Process Engineering organization in coordination with and by the staff of Numatec Hanford Corporation (NHC)/Process Chemistry. Additional support has been provided by Lockheed Martin Hanford Corporation (LHMC) in the acquisition of waste material samples and Rust Federal Services Hanford Company in facility, analytical, and radiological support. The radiological test work

[1] *IONSIV* and IE-911 are trademarks of the UOP, Des Plains, IL.

was conducted within the facilities and hot cells of the 222-S Analytical laboratories.

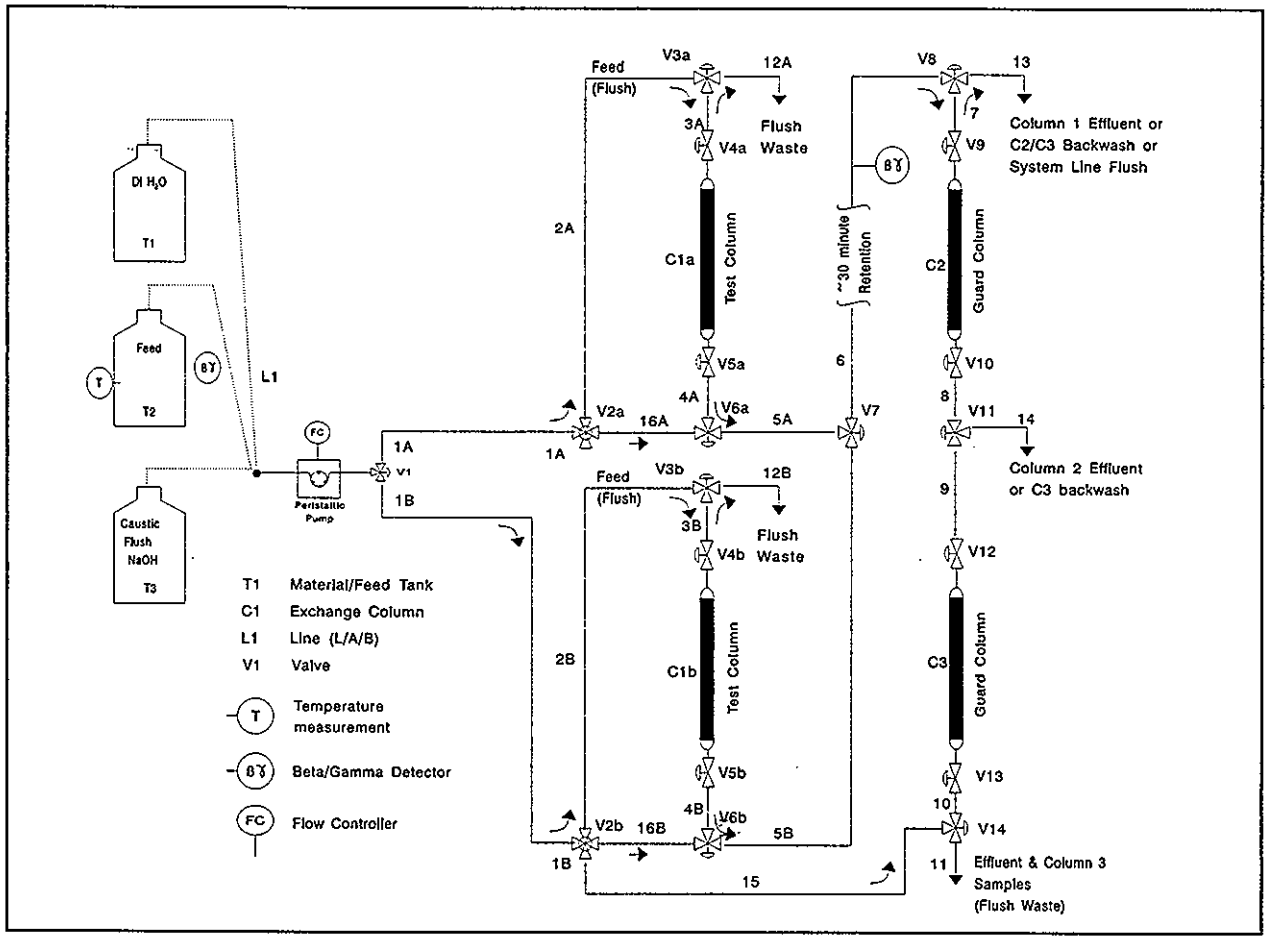
The overall goal of the task was to evaluate a CST sorbent performance upon a CC supernatant solution with specific objectives to provide samples and operational data to determine the column distribution ratio (λ) of the sorbent when used with Hanford CC supernatant liquor in a bench-scale, column system. An analytical objective was to determine whether the sorbent was able to reduce the ^{137}Cs concentration to allow subsequent manufacture of a vitrified waste form below the average concentration of 1.11×10^{11} Bq $^{137}Cs/m^3$ (<3 Ci/m^3). Compliance with this concentration would require effluents of less than 2.75×10^{10} Bq/mL [0.744 μCi/mL] (Hendrickson *et al.* 1996, DOE 1996).

The task was completed by successfully demonstrating the performance of the CST material in the bench-scale system installed within a hot cell. Analytical samples demonstrated 50 percent breakthrough at 1,044 CV of treatment and primary column compliance with treatment targets (0.744 μCi/mL) to approximately 117 CV while all secondary column and final column effluents met the treatment target throughout the test. The final 270 CV treated demonstrated a mean decontamination factor of 4,430 at the final effluent condition compared to the target performance of a decontamination factor of 224.

2.0 DESCRIPTION OF TEST

For this cesium ion exchange test, a test apparatus was constructed (**Figure 1**), functionally tested, and placed into the 1F hot cell within the 222-S Laboratory in the 200W Area of the Hanford Site. Approximately 5,440 milliliters of Complexant Concentrate (CC) waste supernatant liquor from Hanford DST 241-AN-107 were received through the sampling efforts of the TWRS Characterization Project at Hanford (Hohl 1996).

Figure 1: Bench-scale Cesium Exchange Flows and Instrumentation



Waste tank liquor was diluted with 0.53 M sodium hydroxide (NaOH) to the target concentration of five molar sodium and 0.24 M hydroxide and was processed through the test assembly (see **Figure 1**), thus contacting the waste material with the CST in the primary column (C1a) and the two guard columns (C2 and C3, respectively). A total of six batches of the tank waste were prepared to the target concentrations yielding 7,660 g of prepared waste feed.

Data from on-line gamma detection is provided in Appendix A for this CST test. Mass flow rate data and calculations are provided in Appendix B. Sample chemical and radiochemical data, associated with sample times relative to treatment (Column volumes processed), are provided in Appendix C. The sample data is subject to some error as a result of funding restrictions and the inability to complete some supplementary quality assurance assessments and sample reruns. In particular, the feed liquor ^{137}Cs analytical results are evidently 26.7% higher than the actual concentration.

Test conduct complied with applicable quality assurance requirements (Meznarich 1995, 1996).

2.1 TEST ITEMS

The test apparatus, detection equipment, the sorbent, and tank waste material are described herein.

2.1.1 Test Apparatus

The test apparatus consisted of a Plexiglas[2] basin and upright back piece to retain the various valves, and columns and the peristaltic pump. The physical configuration is detailed in **Figure 2**, with valves designated by V#s. In scale, the test assembly back piece was designed and fabricated as 31.75 cm high by 63 cm wide, and separable from the basin. Basins fabricated for FY 1997 test work were not installed into the hot cell; reuse of the basin within the hot cell from FY 1996 work allowed this waste minimization.

The assembly pieces were fabricated to be directly installed into the target hot cell through the airlock, allowing full bed preparation under nonradiological conditions. Test apparatus equipment and sources are listed in Appendix D. It should be noted that during the last several days prior to hot cell entry, the pump and feed line were replaced to provide a greater probability of continuous flow; ongoing tests with saltcake wastes had yielded periodic feed line closure within the peristaltic pump head.

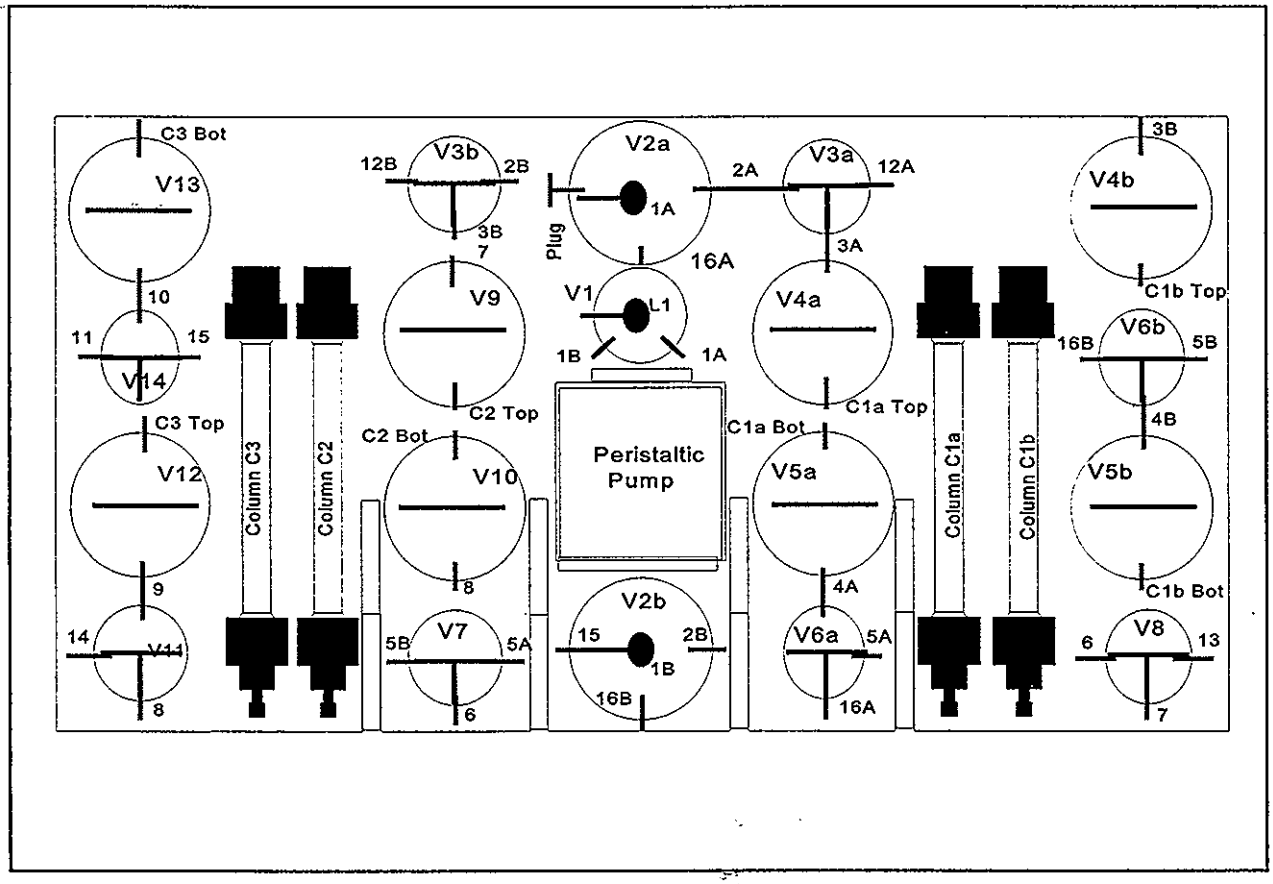
The test columns were glass with a circular cross-section. Lead columns were refabricated to have internal diameters (ID) of 0.7 cm while guard columns had IDs of 1 cm as received from the manufacturer. Each column was equipped with a bed retainer and down stream filter (bed support) of 10 μm.

[2] Plexiglas is a trademark of the Rohm and Haas Company, Philadelphia, PA.

The valves were of aluminum body construction with Teflon[3] cores and barbs. Valves and their handles were selected for frequency of use and hot cell manipulator operation.

During operation, the on-line gamma detector was used to observe the primary column effluent line (line 6, **Figure 1**). Columns were run in the down-flow configuration.

Figure 2: Physical Test Assembly Valve and Column Arrangement



2.1.2 Crystalline Silicotitanate Exchange Material

The CST material was provided by UOP, from their Des Plaines, Illinois, molecular sieve plant. The material is produced by UOP as *IONSIV*, IE-911, and is now commercially available. The material was from Lot No. 999096810002, and was received by SESC in November 1996.

[3] Teflon is a trademark of E. I. duPont de Nemours, Co. Wilmington, DE.

Crystalline silicotitanates (CST) are a new class of inorganic ion exchangers invented and developed by Sandia National Laboratories (SNL) and Texas A&M University in 1992. It was determined that CSTs have a high affinity for Cs and Sr ion exchange in highly alkaline solutions. Based upon this finding, an extensive program funded by Laboratory Directed Research and Development at SNL, the Efficient Separations Program, and the TWRS was established. As the development proceeded, a Cooperative Research and Development Agreement was executed with UOP (Des Plaines, Illinois) to scale up CST production to commercial quantities and to develop an engineered form for use in ion exchange columns. Extensive input was obtained from WHC, PNNL, and DOE on the required properties of the engineered form for use at Hanford. Based upon this guidance, a 30/60 mesh ion exchanger called *IONSIV*® IE-911 was developed by UOP, tested at Sandia, and made available to WHC, SESC, and other DOE facilities. During FY 1996, the IE-911 material was contacted with 241-AW-101 Double-Shell Slurry Feed waste (Hendrickson, Biyani, and Beck 1996) and demonstrated high-loading and selectivity for cesium. FY 1997 work focused on further demonstration of waste treatments with this CST material.

The *IONSIV* IE-911 was prepared in batch mode by wetting the ion exchanger and removing the fines. A pretreatment step to adjust the pH of the ion exchanger to be in equilibrium with the waste solution was completed in flow with sodium hydroxide after the material was slurried into the test columns by calibrated micropipette and allowed to settle to predetermined bed heights of seven or ten centimeters for the lead and guard columns, respectively.

2.1.3 On-Line Gamma Detector

The beta-gamma detector was prepared for continuous monitoring of the effluent during each phase of the test. The detector acquired gamma energy data from the test apparatus and flows, recording the data on an IBM[4]-compatible computer using the GammaVision[5] program. In addition to breakthrough monitoring, the detector was applicable for purge and rinse observation following the conduct. It was used to observe the test columns for relative activity following test completion to assure a resin digest sample dilution sufficient to allow sample egress from the hot cell.

Placement of the detector was nominally 30 minutes (3 CV) downstream from the primary column and 36.6 minutes upstream from the first guard column of the assembly.

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[4] IBM is a trademark of International Business Machines, Inc., White Plains, NY.

[5] GammaVision is a trademark of EG&G Ortec, Inc., Oak Ridge, TN.

2.2 TEST CONDUCT

Waste feed materials were retrieved from the 200E Area Tank Farms immediately after safety clearance to enter the tank. Initial tank sampling was January 22, 1997. The 45 125-mL bottles were directly received and loaded into cubicle 1F in three operations. The last samples were received and loaded into cubicle 1F on January 28, 1997. The column tests were conducted between February 26, 1997 and March 11, 1997. Prior to this period, the test equipment was assembled, leak checked, loaded with exchange material, calibrated for flow, conditioned, and installed into the hot cell.

Waste batch preparation began February 17, 1997, and on February 26, 1997, testing began with verification of flow and final preparation of the gamma detector. Flow was initiated at 3:17 p.m. with waste feed material at a target of six column volumes per hour.

Sampling was initiated per the procedures (Biyani *et al.* 1997) of the first and increments of 100 CV. Later test conduct sampling frequency planned at 50 CV increments through completion was restricted to two samples daily in order to restrict analytical cost mortgages in the range beyond 50 percent breakthrough.

Gamma data acquisition was halted for nine hours during the first night of operation due to an error of computer handling during surveillance. The ease of program recovery was demonstrated with reinitiation of gamma data acquisition by the on-duty nuclear process operator. This period of data loss during early operation is not considered significant over the 333 hours of test conduct and decontamination. Placement of in-cell lead shielding bricks between the test apparatus and the gamma detector proved to be highly effective in eradicating growth of background gamma radiation at the detector.

The test equipment performed without failure and without a need to reset the pump flow rate. All sampling occurred without error. The fifth and sixth batches of waste feed were each loaded into the feed vessel with minor pump stoppages late in the test.

Discontinuation of waste feed occurred at approximately 98 percent breakthrough at 11:04 a.m. on March 11, 1997. The columns were purged of residual waste feed material with the flow of NaOH through the system. Final pump shutdown occurred at 11:08 a.m. on March 12, 1997. The exchange apparatus was disassembled and prepared for disposal, and the exchange columns were digested in preparation of disposal.

Samples of the tank waste material (2), prepared feed material (2), feed material solids (1), primary column effluents (21), first guard column effluents (10), and secondary guard effluent composites (6) were loaded out on March 13, 1997 and submitted for analysis. Following submission, sample analyses were restricted due to funding constraints.

Formal record of test conduct is contained within laboratory notebooks WHC-N-1361, Vol. 2, (WHC 1996b) for nonradiological work, and WHC-N-1361, Vol. 3 (WHC 1996c), and HNF-N-13, Vol. 1 (HNF 1997) for radiological work. Additional documentation on gamma probe operation is contained within laboratory notebook WHC-N-1115, Vol. 1 (Beck, 1996). This documentation and all test conduct was guided by the applicable quality assurance standards (WHC 1996a, Meznarich 1995 and 1996, DOE 1994a and 1994b).

2.3 WASTE MANAGEMENT

Waste management has proceeded in accordance with the test plan and procedures (Hendrickson, Biyani, and Duncan 1997, and Biyani *et al.* 1997). The test complied with treatment test notification requirements (EPA 1986, WDOE 1994, and Izatt 1988). Further discussion of material disposition is provided in Section 6.0.

3.0 TEST METHOD AND TEST EQUIPMENT

All activities associated with the test were anticipated with provision in the procedures (Biyani *et al.* 1997).

3.1 SORBENT BED DENSITY, CONDITIONING, AND LOADING

As provided, the cesium sorbent material was prepared per the manufacturer specifications and the wetted bed densities measured. The dry bulk density of the CST was 0.954 g/mL and the bed density under 0.53 M NaOH was 0.972 g/mL (WHC 1996b). Lead columns were filled to a settled bed height of seven centimeters. Guard columns were filled to a settled bed height of ten centimeters. The lead columns and guard columns had internal diameters of 0.7 and 1.0 cm, respectively. Calibrated micropipettes and scales used in these activities are identified in the data sheets and test logbook (WHC 1996b).

3.2 TEST APPARATUS CALIBRATION

Figure 3: CST Primary Subassembly Calibration

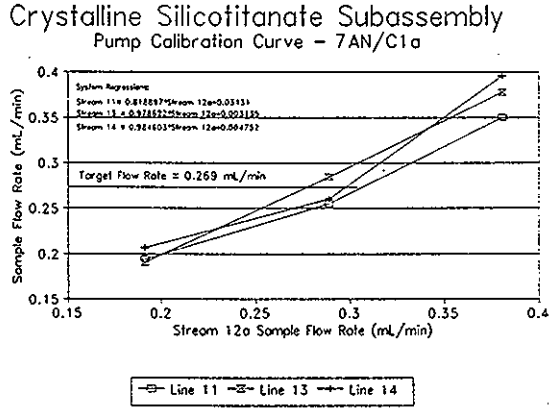

Table 1: Pump Curve Calibration

CST- 107-AN Test Assembly				
Pump °	12a	11	13	14
90	0.191	0.194	0.191	0.207
150	0.289	0.255	0.284	0.26
200	0.381	0.35	0.377	0.395

After column loading, the pump was calibrated for flow on each subassembly with sodium hydroxide. Calibration curves for the test assembly were established for each lead column with the guard columns. The calibration curves for the primary column assembly are provided in **Table 1** and depicted in **Figure 3**. Calibration data for the backup column assembly (C1b and the guards) is not provided herein as it was not called upon during test conduct.

These curves were deemed necessary to interpret sample mass flow rates as system flows to confirm that the system was operating within specifications of 6 CV/hr ± 10%.

3.3 WASTE FEED PREPARATION

Waste feed preparations were conducted by pouring tank sample bottle contents into one of two one-liter polyethylene bottles transferred into the hot cell for that purpose. Little solids were observed in the sample bottles; what was noted was crystalline and plate-like in nature and expected to be either sodium nitrate or sodium carbonate. The in-cell scale was checked with various standards and observed to be reading 0.23% high; the scale could not be recalibrated due to its placement within the hot cell. Based upon the weight of tank waste material (contents from at least five sample bottles) added to the one-liter bottle, a mass of 0.53 M NaOH was added to bring the material to target concentrations of 5 M Na and 0.24 M OH^-. The batches were agitated and allowed to stand prior to decanting into the four-liter feed tank. Following all feed transfers into the feed tank, the accumulated solids were placed into sample vial FS-1. Neither feed centrifugation nor filtration were required to provide a clear, but dark red liquor. As anticipated in the test plan (Hendrickson, Biyani, and Duncan 1997) no precipitates formed during dilution, and the crystals observed in the tank liquor bottles went into solution. Masses of tank waste materials received and waste batches prepared are provided in Appendix E.

The specific density of prepared feed was measured in cell in a centrifuge cone as 1.239 g/mL. No confirmatory specific density sample analyses were available due to analytical funding restriction.

3.4 TEST INITIATION

The test was initiated with background and standards counts with the gamma detector, records of these backgrounds are contained in the hot cell gamma probe laboratory notebook (Beck 1996). Concurrent with such counts system pump set, flush, and conditioning with 0.24 M NaOH proceeded with the final conditioning period of 100 minutes.

The test flow was begun with simultaneous initiation of the runtime clock, gamma data acquisition, and feed pump power. No difficulties in test startup occurred. Test initiation of flow occurred at 3:17 p.m. on February 26, 1997.

3.5 SAMPLING

Sampling occurred as detailed in the test procedures with the exception that the interval between the first and second samples was reduced by approximately two hours to minimize personnel schedule impacts with absolute slip of startup by this period (two hours and two minutes later than planned). Samples were loaded out with the observation that significant doses remained present due to beta radiation. It was evident that the strontium contained within the waste was not removed by contact with the exchange material.

3.6 OVERALL EQUIPMENT PERFORMANCE

The equipment performed successfully and without failure. It should be noted that as final preparations for the test were underway, the test procedures and plan were modified to account for evidence of pump flow failure in the smaller bore tubing used in parallel saltcake liquor test work. In remediation, the feed line internal diameter was increased (0.51 mm to 1.42 mm) and the pump replaced (10-60 rpm to 1-6 rpm). Materials of construction are detailed in Appendix D with costs of less than $4,000. Check sheets of assembly are contained within the logbook (WHC 1996b).

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4.0 TEST RESULTS

Test conduct relied heavily upon the on-line gamma data acquisition immediately available during test conduct. Periodic target changes of the gamma probe to provide background and 100 percent (feed liquor) standards allowed in-cell standards and drift analysis for the gamma probe. The merit of on-line data acquisition is increasingly apparent in light of the time required for physical sample load out, storage, and eventual analysis.

4.1 TANK SAMPLE AND LIQUID FEED ANALYSES

Sample identification and detailed lab results are provided in Appendix C.

4.1.1 Comparison of 241-AN-107 Estimate to Tank Sample Analysis

Two samples (Core-1 and Core-2) were submitted for analysis. The analysis of the tank liquors is provided in **Table 2.** Estimates of composition of the tank material was provided in the test plan (Hendrickson, Biyani, and Duncan 1997) and is provided in **Table 3.** ^{137}Cs analyses of the feed were at no more than 1 percent variance from expectations. Inasmuch as these samples were acquired at the same riser and depth as the samples from which expectations were developed, the remainder of the analytical expectations are reasonably accepted.

Table 2: Tank 241-AN-107 Liquor Analyses

Analyte	CORE-1	CORE-2
^{60}Co, µCi/mL	0.175	0.201
^{137}Cs, µCi/mL	316	337
^{154}Eu, µCi/mL	0.674	0.836
^{155}Eu, µCi/mL	<0.6020	<0.6446
^{241}Am, µCi/mL	<1.2390	<1.2760
SpG	1.3994	

Table 3: August 1996 Characterization of 241-AN-107 Supernatant Liquor

Tank 241-AN-107 CC Composition							
Units: Molarity; µCi/mL for radionuclides							
Analyte	Result	Analyte	Result	Analyte	Result	Analyte	Result
Al	1.43E-02	K	4.62E-02	F^-	6.99E-03	TIC	1.4E+00
Ba	1.52E-04	La	2.45E-04	SO_4^{-2}	8.58E-02	^{90}Sr	9.66E+01
Ca	1.48E-02	Na	8.47E+00	NO_3^-	3.70E+00	^{99}Tc	5.88E-02
Cd	5.70E-04	Ni	9.02E-03	NO_2^-	1.33E+00	^{137}Cs	3.23E+02
Cr	3.38E-03	Pb	1.87E-03	PO_4^{-3}	1.22E-02	$^{239/240}Pu$	4.64E-02
Fe	3.03E-02	U	5.35E-04	OH^-	1.50E-02	^{241}Am	5.25E-01
Hg	2.49E-06	Cl^-	5.15E-02	TOC	3.3E+00	SpG	1.43

4.1.2 Feed Batch Preparation

Feed materials received and batch preparations are detailed in Appendix E. Feed material was prepared by sample jar aggregation and dilution with 0.53 M NaOH. The typical batch was approximately 1,250 grams after caustic dilution with one batch being approximately 1,500 grams.

Two prepared feed liquor samples and one solids sample were withdrawn for analysis. Alpha energy analyses of 2.54 E-01 μCi/mL[6] ± 4.42% and 3.19 E-01 μCi/mL ± 3.88%, for samples F-1 and F-2, respectively, were yielded as early results. These results are 1,760 times greater than anticipated from prior sampling of the tank and are highly suspect.

Anticipated composition was provided in the test plan and is provided in **Table 4**.

Table 4: Feed Preparation Estimates

241-AN-107	Current	Caustic Add.	Postdilution
	M or Ci/L		
Density (g/mL)	1.43	1.019	1.251
OH	0.015	0.53	0.240
Na	8.47	0.53	5.001
Al	0.0143		0.008
Cr	0.0034		0.002
K	0.0462		0.026
NO_3	3.7		2.331
NO_2	1.33		0.749
PO_4	0.0122		0.007
SO_4	0.0858		0.048
Cs-137	0.323		0.1821
Sr-90	0.0966		0.054
Volume (l)	1	0.776	1.776
Na/Cs-137	310,755		325,448
Na/K	183		192

4.1.3 Feed Solids

One sample of feed solids (FS1) was withdrawn for analysis. It was taken in a bottle labeled 'SC1E-42' as the prepared bottle for the sample was not found within the hot cell. Analysis was stopped due to funding and no results are available.

4.2 TREATMENT TEST RESULTS

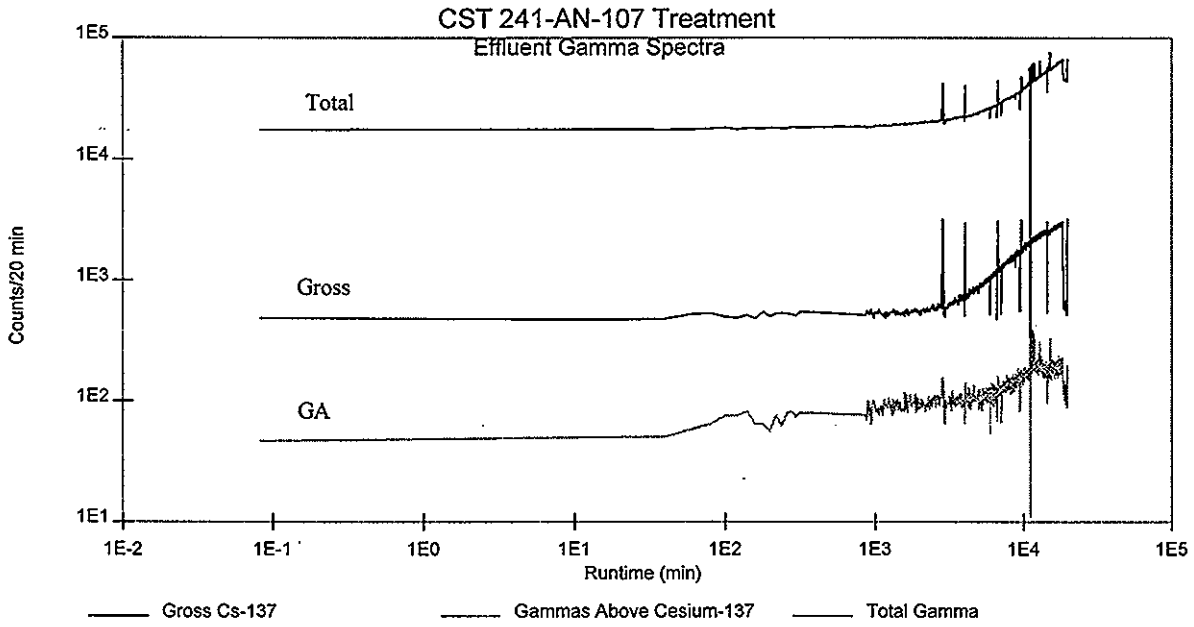
Upon completion of testing, samples identified by the test plan were submitted for analyses. Subsequent to submittal, analytical regimes were constrained due to funding and many planned analyses were deleted. This section describes the results of the on-line gamma results, and the chemical and radiochemical results of physical samples.

[6] The internationally accepted standard of measurement of radioactivity is the Becquerel (Bq). One Curie (Ci) is equal to 3.7×10^{10} Bq.

4.2.1 On-Line Gamma Results

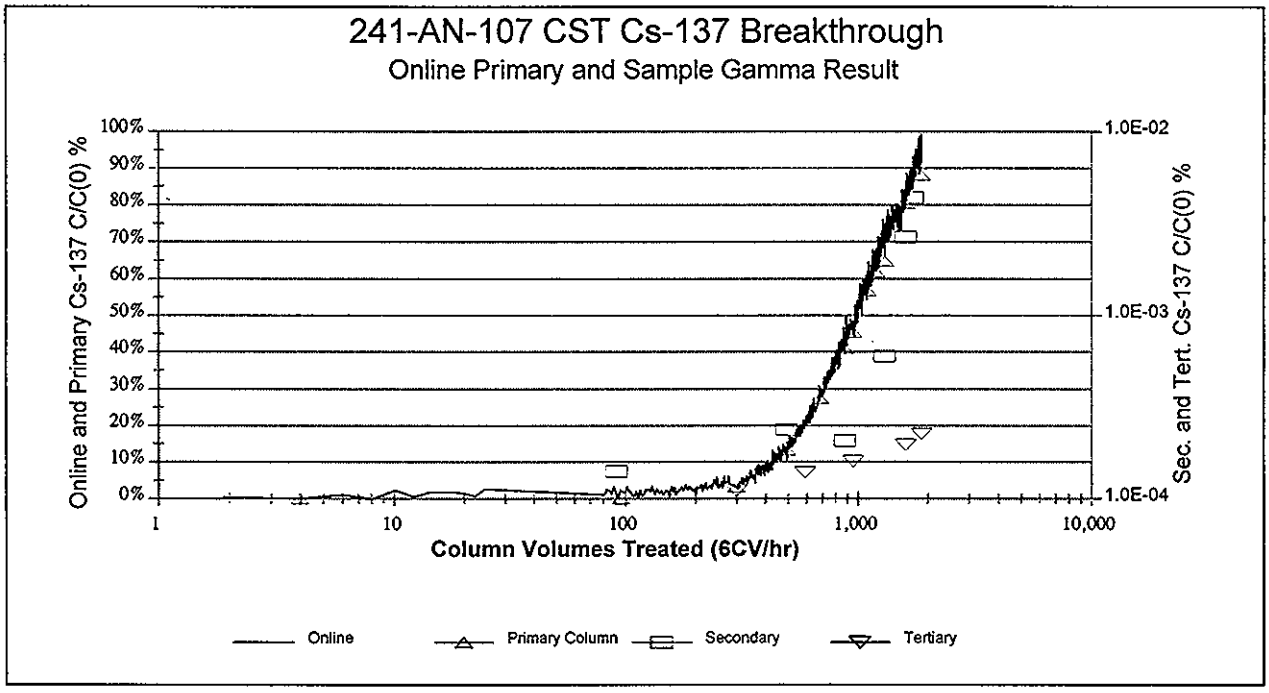
Gamma data proceeded from test initiation on February 26, 1997 through column load, system flush, and background and feed standard analysis at the test end. Each of these activities, with intermittent background and feed standard measurements, is depicted in the accumulated gamma data of **Figure 4**. Gamma data includes total gamma, gross Cs-137, and gamma above cesium (energy greater than that range specified to identify ^{137}Cs).

Figure 4: 241-AN-107 CST Effluent Treatment Gamma Results with Standards



Following analyses for mass balance, treatment volumes may be provided as the treatment axis and standard counts removed to simplify the display of exchange material performance. This curve is provided in **Figure 5**. This figure also contains sample results for the primary, secondary and tertiary columns which are discussed below. Evident 50 percent breakthrough from these analyses is at 985.5 CV, with detection of breakthrough at approximately 200 CV.

Figure 5: 241-AN-107 ^{137}Cs Breakthrough over IE-911 CST (6CV/hr)



4.2.2 Mass Rate Data

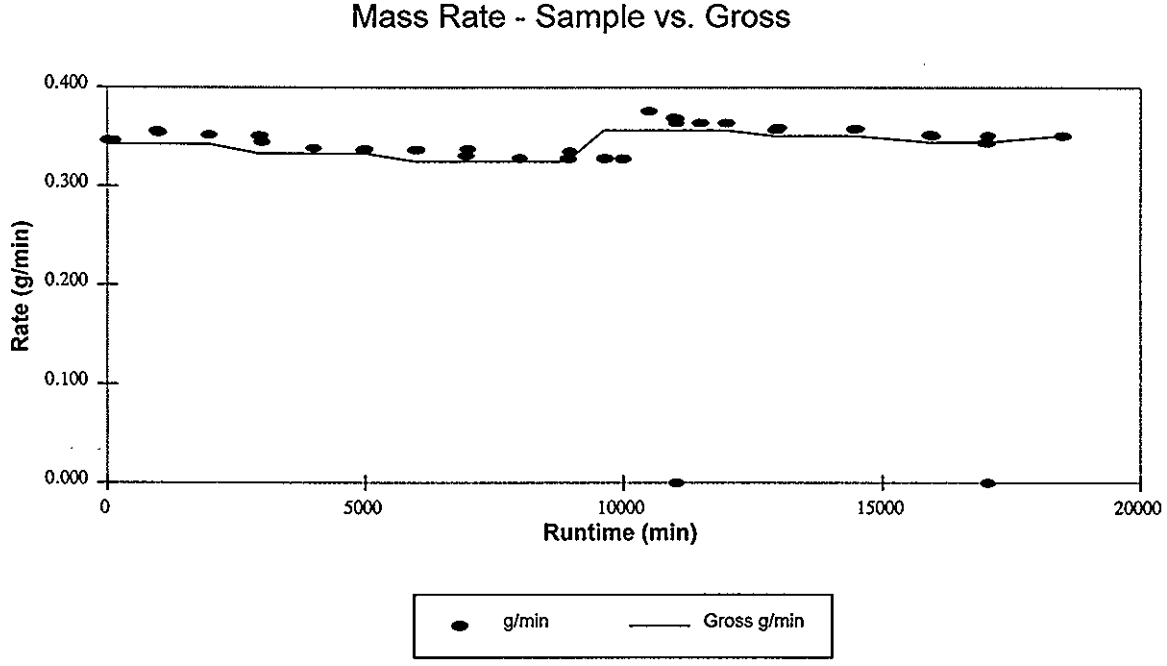
Mass rate data was accumulated via sampling efforts and by effluents collected. Mass rate data and calculations are provided in Appendix B. These calculations allow direct interpretation of runtime or clock time (as in the gamma data) to masses of waste feed (and through density to column volumes) through the test column to the gamma probe or the sample point. In this manner, the abscissa of **Figure 5** is that of column volumes of treatment and all samples or data are referenced to actual volumes treated at the reference sample point (samples downstream of the gamma detector at the same run time would represent material passed through the column when the column had treated a lower volume).

Mass rates, as determined by samples (without pump calibration correction) and by the absolute collected masses from the system, the defining variable of treatment volumes, are depicted in **Figure 6**.

4.2.3 Chemical and Radiochemical Sample Results

Chemical and radiochemical results are provided in Appendix C as Tables C-3a, C-3b, and C-3c for primary column effluents, and as Tables C-4 and C-5 for secondary and tertiary column effluents, respectively.

Figure 6: Mass Rates for Samples and Test System



4.2.3.1 Chemical Data

The sample analyses that have been conducted are discussed in this section. Many analyses were subject to funding-based constraints

.

4.2.3.1.1 Inductively Coupled Plasma Analysis

Inductively coupled plasma analyses were curtailed from conduct as a result of funding constraints. As a result, no ICP-MS or ICP-AES data are available from this test.

4.2.3.1.2 Ion Chromatography and Hydroxide

Hydroxide and ion chromatography (IC) data acquired from the test are provided in **Table 5**.

Hydroxide data were acquired for the feed materials and for five samples from the primary column effluent. The analysis of feed sample F2 was consistent with the effluent analyses at an average concentration of approximately 0.126M. This concentration is half of the target composition and may have significant bearing upon sorbtion.

Table 5: Treatment Effluent Anion Analyses

Analyte	Average Concentration (M)	Expected Feed (M)	Actual/Expected Feed
OH	1.26E-01	2.40E-01	53%
F	9.48E-02	3.94E-03	2408%
Cl	2.64E-02	2.90E-02	91%
NO_2	6.55E-01	7.49E-01	87%
NO_3	1.95E+00	2.08E+00	93%
PO_4	8.06E-03	6.87E-03	117%
SO_4	4.86E-02	4.83E-02	101%

IC data were acquired for five samples from the primary column effluent. The analyses were generally consistent and, with the exception of fluoride, in the region of expected waste composition.

4.2.3.1.3 Total Organic and Inorganic Carbon

No Total Organic Carbon (TOC) or Total Inorganic Carbon (TIC) results were acquired due to analytical regime truncation. Concentrations are reasonably those expected in **Table 4**.

4.2.3.1.4 Density

The density of the feed solution was acquired within the test hot cell as 1.239 g/mL. This was 99 percent of anticipated density. No supportive laboratory density analyses were performed due to analytical regime truncation.

4.2.3.2 Radiochemical Data

Gamma energy analyses have been performed for nearly all samples that proceeded through analysis. Alpha analyses were conducted on feeds and have been discussed above.

4.2.3.2.1 Gamma Energy Analysis

GEA analyses are tabulated in Appendix C and segregated by the amount of treatment incurred.

These GEA results are depicted in **Figure 7**, **Figure 8**, and **Figure 9**, respectively. **Figure 7** clearly shows the growth of the ^{137}Cs concentration in the effluent stream while the remaining

GEA analytes remain essentially constant throughout the test. One sample point is observed to be an outlier. As all analytes show that outlying characteristic for this sample it is concluded that analytical dilution error exists with that point. In addition, the first sample is observed to be suppressed. The first sample occurred at 1.02 CV; it is expected that this sample (as observed with IC data as well) suffered from dilution with the sodium hydroxide present in the system at test start. It had been observed in larger diameter tubes that the waste feed did not displace the entire cross section of liquor simultaneously, presumably an effect of the surface tension of the liquors and the 25%+ difference in specific densities.

4.2.3.2.1.1 ^{137}Cesium

Peak decontamination factors (DF) from primary column samples occurred with the first sample at a DF of 21,300. As observed above on sample dilution, this value may be twice that actually acquired. The next sample from the primary column was after 92 CV of treatment and demonstrated a DF of only 1,270. The test was run until the primary effluent concentration was approximately 98 percent of feed concentration, the last available primary column sample occurred at 88.3 percent breakthrough. The effluent sample data are consistent with in-cell standards in expressing performance following correction of feed cesium values (by the ratio of tank liquor cesium and nitrate, nitrite, and chloride average concentrations relative to expected concentrations).

Figure 7: Primary Column GEA Results

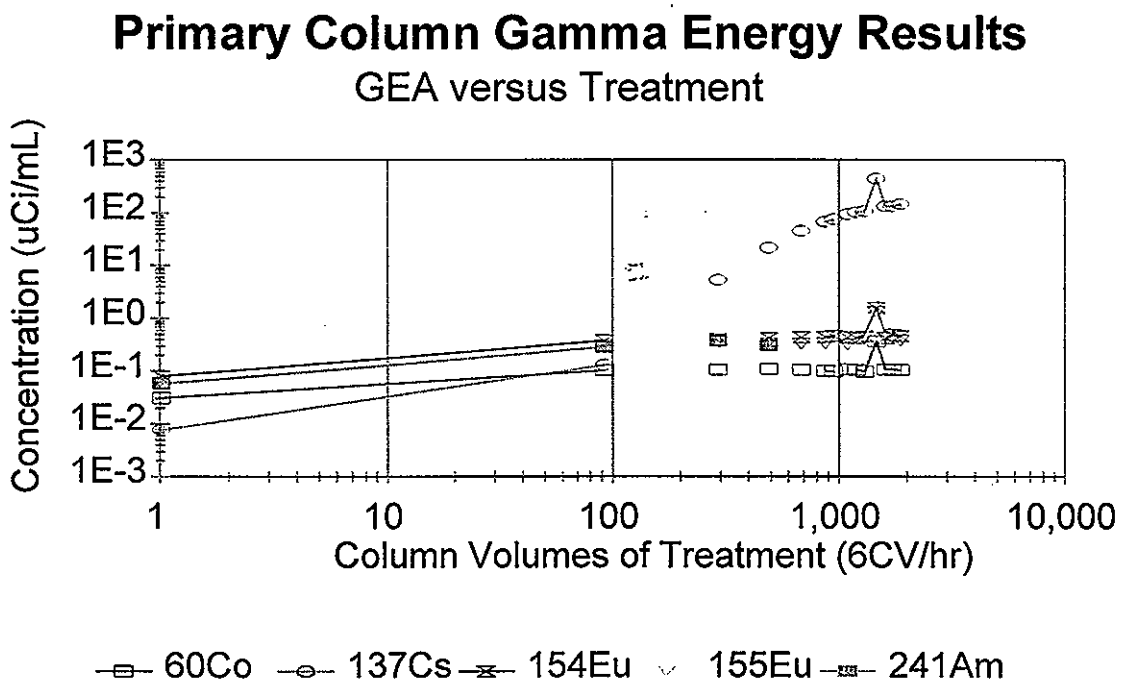


Figure 8: Secondary Column GEA Results

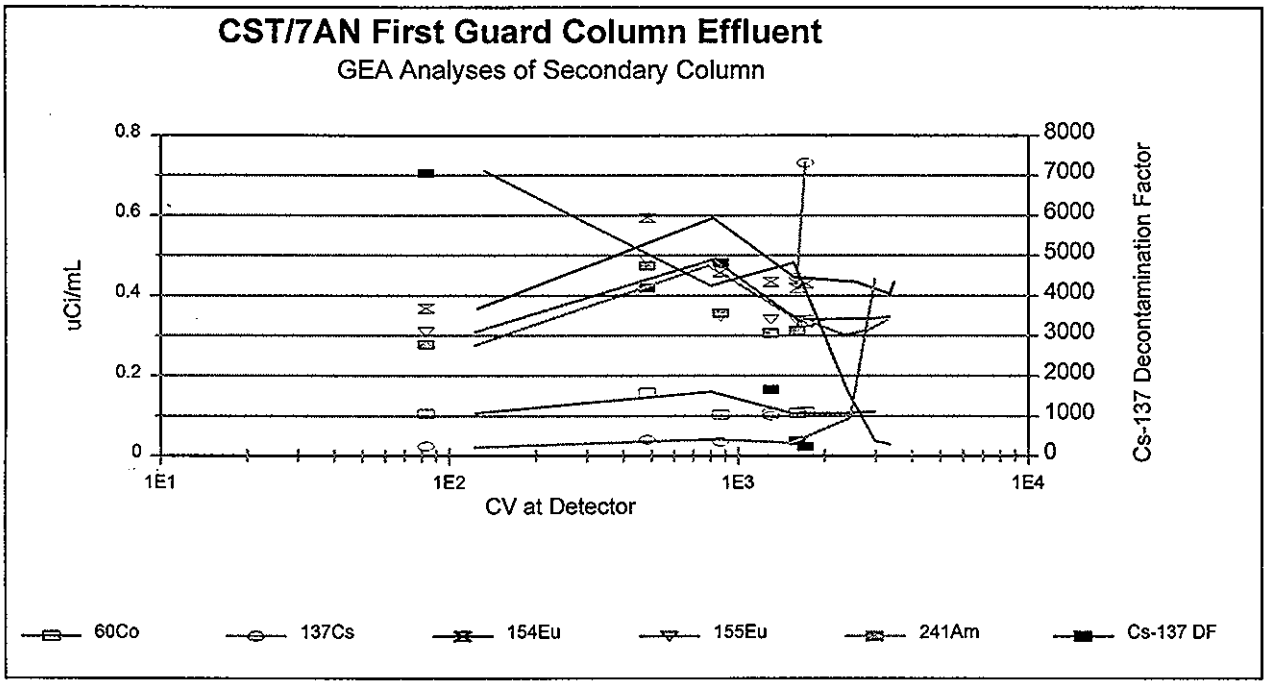
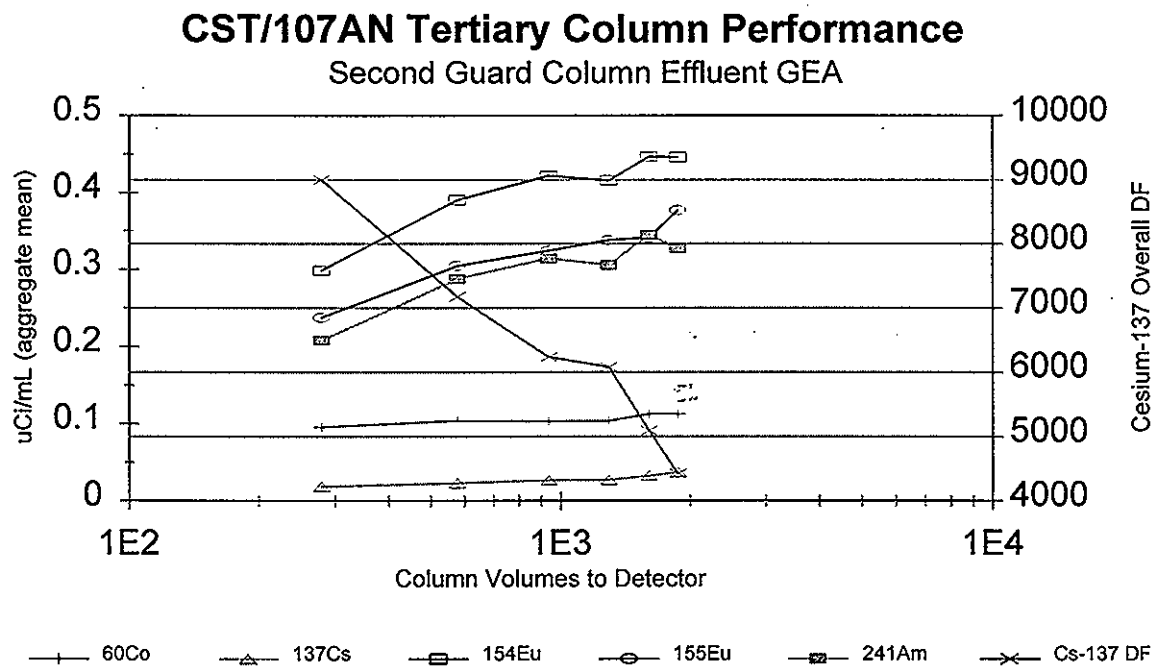


Figure 9: Tertiary Column GEA Results



4.2.3.2.1.2 Other Radionuclides

GEA analyses for ^{60}Co, ^{154}Eu, ^{155}Eu, and ^{241}Am were performed. Given the noise in the data, no conclusion of sorbtion can be made. The results are contained in Appendix C and depicted in **Figure 7**, **Figure 8**, and **Figure 9**.

4.2.3.2.2 Alpha Energy Analysis

Alpha energy analyses of the feed were conducted and are considered to be highly suspect, as described above. No effluent analyses were conducted due to funding constraints. No conclusions of uptake may be made regarding alpha-emitting isotopes.

4.2.3.2.3 Other Radionuclides

No beta energy analysis was conducted as a result of analytical regime reduction. Strontium has been considered a key issue in the treatment of this waste. Anecdotally, when the final treatment effluents (followed three columns of cesium decontamination) were loaded out of the hot cell for transport, the liter bottles did exhibit very high high-energy beta fields. Such fields would be consistent with the lack of treatment of the ^{90}Sr due to complexation.

4.2.3.2.4 Isotopic Analyses

No cesium, strontium or other isotopic analyses were conducted within the context of this test due to analytical reductions. Sample analyses conducted by mass spectroscopy on 241-AN-107 liquor for the Hanford Privitization effort yielded mole fractions and other analyses as detailed in **Table 6**.

Table 6: 241-AN-107 Complexant Concentrate Tank Liquor Isotopic Analyses

Isotopic Composition Estimates				
	µCi/mL	µg/mL	Mol/L	Mol Fraction
^{133}Cs		6.34E+00	4.77E-05	57.653%
^{134}Cs	2.36E-01	1.83E-04	1.36E-09	0.002%
^{135}Cs	1.21E-03	1.05E+00	7.78E-06	9.406%
^{137}Cs	3.23E+02	3.73E+00	2.73E-05	32.940%
Total Cs	3.23E+02	1.11E+01	8.28E-05	100.000%
^{99}Tc	6.82E-02	4.02E+00	4.06E-05	

4.2.4 Comparison and Evaluation of ^{137}Cs λ_{50} Analytical Paths

On-line gamma data yielded expectations of 50 percent breakthrough at 985.5 CV while sample analysis yielded an expectation of 50 percent breakthrough at 1,044 CV. This variance is less

than six percent. The preference of this investigator is to rely upon the on-line gamma energy data in determining relative breakthrough due to the in-cell presence of a feed standard created from the 241-AN-107 waste feed. Sample analyses are suspect. In fact one effluent sample reported as 268 percent of feed concentration.

Again, as with other reports, it is expected that near total correlation exists as investigators were able to demonstrate lack of background drift and obvious background and 100% standard counting period matches. Background and standard activities were identified within the logbooks.

4.2.5 Secondary Column Analyses and Final Effluents

The secondary and tertiary column effluents have been tabulated and depicted above. Recognizing that the tertiary effluents were aggregates over an average of greater than 300 CV each, the peak overall DF exhibited was that of the first batch at 9,000, decreasing to 4,430 during the last batch. A total of 1,870 CV were treated and received in the tertiary column jugs. No other chemical or radiochemical sample results for these effluents are available unless conducted to support technetium removal studies which used these cesium depleted liquors.

4.3 COMPARISON OF 241-AN-107 AND 241-AW-101 IE-911 ION EXCHANGE RESULTS

Performance of the IE-911 exchange material with DSSF material during FY 1996 yielded approximately 700 CV to 50 percent breakthrough. Modeling of those results with the sole dependency as cesium content yielded anticipation that IE-911 performance with the CC waste used herein would be 809 CV. Sandia Laboratory investigators anticipated 1,500 CV to 50% breakthrough with CC waste. Sample-based 50 percent breakthrough occurred at 1,044 CV; modestly in excess of that predicted by Hanford personnel, but significantly lower than that anticipated by Sandia. It appears that although high loading and selectivity for cesium is observed with CST materials, the Sandia model remains highly optimistic.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The test was successfully completed, demonstrating the performance of the CST material in a bench-scale column flow system installed in a hot cell. Analytical objectives for sample identification of column performance were met with extensive gamma energy analyses of liquors. The performance of the material in the removal of cesium from the waste was superb, but no final data exists which allows interpretation of the sources (counter-ion and co-ion) of deviation from model estimates. Without a substantial portion of the chemical data to report, few recommendations on model variance may be made at this time. The general reliability of the on-line gamma detection and data acquisition has proven to be extremely valuable and has provided essentially all results necessary to determine the cesium removal performance of the ion exchange substrate with this waste.

5.1 CONCLUSIONS

Complexant Concentrate waste from Hanford Double-Shell Tank 241-AN-107 was successfully sampled from the tank, prepared, treated, and sampled for cesium removal in a bench-scale radioactive flow test. On-line gamma energy analyses of treatment effluents yielded high selectivities and load of cesium upon IE-911 crystalline silicotitanate exchange material. Beta radiation detected upon sample load out indicated that strontium was not significantly removed from the waste.

- On-line gamma energy analyses yielded λ_{50} of 977 CV when regression was conducted on the direct performance curve and 985.5 CV when regression was conducted on the negative natural log of the ^{137}Cs removal performance.

- Primary column sample analytical results yielded λ_{50} of 1,044 CV.

- On-Line gamma energy analyses yielded an initial detection of breakthrough (consistently increasing over 2%) at 200 CV.

- Primary column sample analyses indicated compliance with a 0.744 µCi/mL (DF = 224) product through 117 CV while all secondary and tertiary column effluents met this standard through the 1,870 CV tested.

- The highest primary column sample decontamination observed and considered valid was 1,272. The observed decontamination factor after two columns of treatment decreased from 7,040 to 228 over the test while the ternary effluents demonstrated a DF falling from 9,000 to 4,425. The ternary effluents contained an average of 310 CV.

- The designed test equipment, prepared procedures, and on-line gamma detection

capability proved to be highly successful, durable, and reliable for process control, record keeping, and data acquisition.

- The strontium present in this waste was apparently complexed and not significantly sorbed by this exchange material. If it is determined necessary to remove strontium from this waste in subsequent treatment and disposal, oxidation of the organic components would be required to release the strontium for exchange with this sorbent.

- Gamma energy analysis data for guard column samples indicated that some sorbtion of americium and europium may have occurred. Quantification of absolute sorbtion are not presently available as the feed activity of these isotopes suffered interference by ^{137}Cs. At present no data present conclusively indicates treatment and variation of these analyte concentrations over the test duration except that due to sample preparation and analysis.

5.2 RECOMMENDATIONS

This material has demonstrated significant loading and selectivity for cesium in this waste and should be considered for process implementation if determined efficacious. As many sample analyses were curtailed, further analysis of ICP analytes may provide verification of the estimated composition and further substantiation of all breakthrough analyses. Some limited analysis conducted to support ion exchange tests of this complexant concentrate waste with another exchange material did, for example, indicate that the sodium content of the effluent was within one percent of the target composition. Such analyses may further exchange performance model development in high carbonate fields such as the waste tested.

The on-line gamma probe development and application should be supported with activities of this nature due to its high reliability, resilience, and live response characteristics.

6.0 DISPOSITION OF TEST ITEMS

- The test equipment containing the pump, columns, and tubing has been disassembled, packaged and disposed.
- All waste cans have been removed containing spent crushed sample jars (45 loaded in) and melted plastic components.
- Approximately 5,890 g of decontaminated 241-AN-107 waste liquor was prepared and removed from the hot cell for shipment to follow-on technetium removal demonstrations for EM-50.
- Waste flushes have been disposed through the hot cell drain.
- Unspent sorbent materials are retained by SESC.
- Residual prepared feed, supplemented, was used in follow on cesium removal demonstration with another sorbent.
- Unspent tank liquors are were disposed through the hot cell drain as they were found to have no further economic application.

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APPENDIX A: On-Line Gamma Detector Raw Data

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Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
26	2	97	15:17:05	1200.4	1200	488	274	26	651.25	15.07	37.28				
26	2	97	15:37:06	1200.4	1200	475	209	27	658.78	12.25	42.64	Cs-137	661.66	7.9005	1.020643
26	2	97	15:57:07	1200.4	1200	482	303	25	653.78	14.96	33.32	Cs-137	661.66	11.4539	0.94504
26	2	97	16:17:08	1200.4	1200	525	315	27	653.49	14.58	35.56	Cs-137	661.66	11.9075	1.020643
26	2	97	16:37:08	1200.4	1200	537	321	27	653.46	15.61	40.34	Cs-137	661.66	12.1343	1.020643
26	2	97	16:57:09	1200.4	1200	500	307	26	654.7	18.24	38.45	Cs-137	661.66	11.6051	0.982841
26	2	97	17:17:10	1200.4	1200	489	312	25	653.37	12.4	39.19	Cs-137	661.66	11.7941	0.94504
26	2	97	17:37:11	1200.4	1200	516	294	27	654.69	21.26	44.9	Cs-137	661.66	11.1137	1.020643
26	2	97	17:57:12	1200.4	1200	486	280	26	655.8	10.31	35.03	Cs-137	661.66	10.5844	0.982841
26	2	97	18:17:13	1200.4	1200	548	320	27	653.53	15.93	37.36	Cs-137	661.66	12.0965	1.020643
26	2	97	18:37:14	1200.4	1200	503	263	27	655.24	20	39.27	Cs-137	661.66	9.9418	1.020643
26	2	97	18:57:15	1200.4	1200	533	288	27	653.78	14.03	43.13	Cs-137	661.66	10.8869	1.020643
26	2	97	19:17:16	1200.4	1200	536	279	28	655.43	9.1	38.3	Cs-137	661.66	10.5466	1.058445
26	2	97	19:37:17	1200.4	1200	533	237	28	653.61	15.1	30.72	Cs-137	661.66	8.959	1.058445
26	2	97	19:57:18	1200.4	1200	523	271	27	654.94	19.24	35.82	Cs-137	661.66	10.2442	1.020643
26	2	97	20:17:19	1200.4	1200	508	256	27	653.65	13.69	35.47	Cs-137	661.66	9.6772	1.020643
26	2	97	20:37:20	1200.4	1200	554	341	27	653.92	12.64	37.74	Cs-137	661.66	12.8903	1.020643
27	2	97	5:47:28	1200.4	1200	516	280	27	653.91	20.74	39.24	Cs-137	661.66	10.5844	1.020643
27	2	97	6:07:29	1200.4	1200	555	285	28	654.48	13.55	35.8	Cs-137	661.66	10.7735	1.058445
27	2	97	6:27:30	1200.4	1200	545	262	28	651.3	21.48	38.22				
27	2	97	6:47:31	1200.4	1200	523	280	27	653.67	16.65	46.58	Cs-137	661.66	10.5844	1.020643
27	2	97	7:07:32	1200.4	1200	571	307	28	654.18	19.73	34.95	Cs-137	661.66	11.6051	1.058445
27	2	97	7:27:33	1200.4	1200	522	288	27	651.82	21.39	38				
27	2	97	7:47:34	1200.4	1200	492	274	26	655.58	11.76	33.29	Cs-137	661.66	10.3576	0.982841
27	2	97	8:07:34	1200.4	1200	549	324	27	651.58	16.1	38.75				
27	2	97	8:27:35	1200.4	1200	539	326	27	653.93	11.63	41.08	Cs-137	661.66	12.3233	1.020643
27	2	97	8:47:36	1200.4	1200	532	301	27	653.94	14.18	42.66	Cs-137	661.66	11.3783	1.020643
27	2	97	9:07:37	1200.4	1200	572	285	29	653.5	11.19	37.6	Cs-137	661.66	10.7735	1.096246
27	2	97	9:27:38	1200.4	1200	544	313	27	652.45	18	36.31	Cs-137	661.66	11.8319	1.020643
27	2	97	9:47:39	1200.4	1200	538	313	27	651.39	15.77	41.48				
27	2	97	10:07:40	1200.4	1200	511	256	27	651.84	18.44	44.61	Cs-137	661.66	9.6772	1.020643
27	2	97	10:27:41	1200.4	1200	507	277	27	653.69	13.06	38.24	Cs-137	661.66	10.471	1.020643
27	2	97	10:47:42	1200.4	1200	541	326	27	653.73	14.35	37.6	Cs-137	661.66	12.3233	1.020643
27	2	97	11:07:43	1200.4	1200	493	271	26	650.8	25.62	39.96				
27	2	97	11:27:44	1200.4	1200	548	296	28	653.93	15.19	37.62	Cs-137	661.66	11.1893	1.058445
27	2	97	11:47:45	1200.4	1200	508	274	27	655.62	19.84	35.33	Cs-137	661.66	10.3576	1.020643
27	2	97	12:07:46	1200.4	1200	514	313	26	651.65	14.48	35.4				
27	2	97	12:27:47	1200.4	1200	550	262	28	655.89	14.04	36.92	Cs-137	661.66	9.904	1.058445

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
27	2	97	12:47:48	1200.4	1200	547	313	27	653.97	13.94	49.25	Cs-137	661.66	11.8319	1.020643
27	2	97	13:07:49	1200.4	1200	553	262	29	651.78	18.27	30.76				
27	2	97	13:27:50	1200.4	1200	541	307	27	651.29	20.85	35.71				
27	2	97	13:47:51	1200.4	1200	574	268	29	653.62	13.68	42.2	Cs-137	661.66	10.1308	1.096246
27	2	97	14:07:52	1200.4	1200	537	318	27	652.18	13.98	38.89	Cs-137	661.66	12.0209	1.020643
27	2	97	14:27:53	1200.4	1200	517	294	27	655.92	13.99	34.59	Cs-137	661.66	11.1137	1.020643
27	2	97	14:47:54	1200.4	1200	555	278	28	652.89	24.49	42.39	Cs-137	661.66	10.5088	1.058445
27	2	97	15:07:55	1200.4	1200	542	315	27	655.86	14.67	39.73	Cs-137	661.66	11.9075	1.020643
27	2	97	15:27:56	1200.4	1200	526	294	27	655.81	10.47	37.85	Cs-137	661.66	11.1137	1.020643
27	2	97	15:47:57	1200.4	1200	543	308	27	653.66	11.2	31.61	Cs-137	661.66	11.6429	1.020643
27	2	97	16:07:57	1200.4	1200	521	314	26	651.89	15.61	39.37	Cs-137	661.66	11.8697	0.982841
27	2	97	16:27:58	1200.4	1200	518	272	27	653.58	15.1	31.36	Cs-137	661.66	10.282	1.020643
27	2	97	16:47:59	1200.4	1200	542	323	27	655.26	23.29	40.03	Cs-137	661.66	12.2099	1.020643
27	2	97	17:08:00	1200.4	1200	546	270	28	653.48	8.82	40.41	Cs-137	661.66	10.2064	1.058445
27	2	97	17:28:01	1200.4	1200	538	310	27	651.96	17.06	39.21	Cs-137	661.66	11.7185	1.020643
27	2	97	17:48:02	1200.4	1200	504	307	26	655.64	11.11	31.62	Cs-137	661.66	11.6051	0.982841
27	2	97	18:08:03	1200.4	1200	553	311	28	655.32	17.61	38.67	Cs-137	661.66	11.7563	1.058445
27	2	97	18:28:04	1200.4	1200	572	383	27	653.36	10.94	37.61	Cs-137	661.66	14.478	1.020643
27	2	97	18:48:05	1200.4	1200	537	288	28	651.94	20.69	41.62	Cs-137	661.66	10.8869	1.058445
27	2	97	19:08:06	1200.4	1200	567	291	29	653.68	12.18	34.93	Cs-137	661.66	11.0003	1.096246
27	2	97	19:28:07	1200.4	1200	515	266	27	654.09	14.87	37.09	Cs-137	661.66	10.0552	1.020643
27	2	97	19:48:08	1200.4	1200	534	288	27	653.28	16.13	33.66	Cs-137	661.66	10.8869	1.020643
27	2	97	20:08:09	1200.4	1200	546	315	27	653.83	11.71	31.83	Cs-137	661.66	11.9075	1.020643
27	2	97	20:28:10	1200.4	1200	553	316	28	655.76	10.31	40.83	Cs-137	661.66	11.9453	1.058445
27	2	97	20:48:11	1200.4	1200	554	304	28	654.57	19.71	42.05	Cs-137	661.66	11.4917	1.058445
27	2	97	21:08:12	1200.4	1200	568	293	29	652.14	16.38	39.1	Cs-137	661.66	11.0759	1.096246
27	2	97	21:28:13	1200.4	1200	547	289	28	653.94	15.95	35.12	Cs-137	661.66	10.9247	1.058445
27	2	97	21:48:14	1200.4	1200	558	318	28	651.64	18.74	38.12				
27	2	97	22:08:15	1200.4	1200	584	347	28	653.87	14.4	42.01	Cs-137	661.66	13.1172	1.058445
27	2	97	22:28:16	1200.4	1200	562	301	28	651.81	18.82	38.63				
27	2	97	22:48:17	1200.4	1200	551	261	29	651.94	15.44	35.37	Cs-137	661.66	9.8662	1.096246
27	2	97	23:08:18	1200.4	1200	575	324	28	652.1	18.18	35.09	Cs-137	661.66	12.2477	1.058445
27	2	97	23:28:19	1200.4	1200	553	325	27	652.01	15.15	44.86	Cs-137	661.66	12.2855	1.020643
27	2	97	23:48:20	1200.4	1200	566	290	29	653.52	15.01	37.3	Cs-137	661.66	10.9625	1.096246
28	2	97	0:08:21	1200.4	1200	545	331	27	651.43	13.98	41.53				
28	2	97	0:28:21	1200.4	1200	548	314	27	653.77	13.23	38.88	Cs-137	661.66	11.8697	1.020643
28	2	97	0:48:22	1200.4	1200	559	313	28	651.94	18.78	32.89	Cs-137	661.66	11.8319	1.058445
28	2	97	1:08:23	1200.4	1200	520	298	27	651.55	16.49	43.54				

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
28	2	97	1:28:24	1200.4	1200	521	290	27	651.06	20.07	38.66				
28	2	97	1:48:25	1200.4	1200	571	334	28	651.55	18.47	37.76				
28	2	97	2:08:26	1200.4	1200	565	305	28	653.74	13.29	32.87	Cs-137	661.66	11.5295	1.058445
28	2	97	2:28:27	1200.4	1200	562	340	28	653.45	11.55	37.42	Cs-137	661.66	12.8525	1.058445
28	2	97	2:48:28	1200.4	1200	579	339	28	655.69	20.41	42.34	Cs-137	661.66	12.8147	1.058445
28	2	97	3:08:29	1200.4	1200	584	355	28	653.57	14.88	36.25	Cs-137	661.66	13.4196	1.058445
28	2	97	3:28:30	1200.4	1200	544	289	28	655.69	13.04	37.82	Cs-137	661.66	10.9247	1.058445
28	2	97	3:48:31	1200.4	1200	578	329	28	651.44	15.62	38.26				
28	2	97	4:08:32	1200.4	1200	559	352	27	653.34	14.73	41.16	Cs-137	661.66	13.3062	1.020643
28	2	97	4:28:33	1200.4	1200	583	328	28	655.07	16.53	37.77	Cs-137	661.66	12.3989	1.058445
28	2	97	4:48:34	1200.4	1200	595	313	29	653.84	12.15	39.07	Cs-137	661.66	11.8319	1.096246
28	2	97	5:08:35	1200.4	1200	552	271	28	653.74	19.23	37.54	Cs-137	661.66	10.2442	1.058445
28	2	97	5:28:36	1200.4	1200	561	283	28	655.76	10.78	30.78	Cs-137	661.66	10.6978	1.058445
28	2	97	5:48:37	1200.4	1200	568	354	27	655.62	9.24	39.86	Cs-137	661.66	13.3818	1.020643
28	2	97	6:08:38	1200.4	1200	581	359	28	654.41	22.36	42.53	Cs-137	661.66	13.5708	1.058445
28	2	97	6:28:39	1200.4	1200	563	323	28	653.8	14.31	35.66	Cs-137	661.66	12.2099	1.058445
28	2	97	6:48:40	1200.4	1200	556	299	28	653.48	14.95	38.06	Cs-137	661.66	11.3027	1.058445
28	2	97	7:08:41	1200.4	1200	582	381	27	652.48	13.91	39.36	Cs-137	661.66	14.4024	1.020643
28	2	97	7:28:42	1200.4	1200	601	340	29	653.44	15.82	38.7	Cs-137	661.66	12.8525	1.096246
28	2	97	7:48:43	1200.4	1200	617	351	29	652.9	12.26	27.68	Cs-137	661.66	13.2684	1.096246
28	2	97	8:08:44	1200.4	1200	598	337	29	655.87	9	36.11	Cs-137	661.66	12.7391	1.096246
28	2	97	8:28:45	1200.4	1200	586	346	28	652.39	17.15	36.76	Cs-137	661.66	13.0794	1.058445
28	2	97	8:48:46	1200.4	1200	635	332	30	653.72	12.41	33.99	Cs-137	661.66	12.5501	1.134048
28	2	97	9:08:47	1200.4	1200	571	316	28	653.6	12.7	35.57	Cs-137	661.66	11.9453	1.058445
28	2	97	9:28:48	1200.4	1200	587	338	28	651.9	15.36	34.36	Cs-137	661.66	12.7769	1.058445
28	2	97	9:48:49	1200.4	1200	565	286	29	652	14.21	36.34	Cs-137	661.66	10.8113	1.096246
28	2	97	10:08:50	1200.4	1200	577	328	28	654.03	15.04	38.31	Cs-137	661.66	12.3989	1.058445
28	2	97	10:28:51	1200.4	1200	597	323	29	653.46	12.15	35.2	Cs-137	661.66	12.2099	1.096246
28	2	97	10:48:52	1200.4	1200	606	333	29	655.83	10.1	30.32	Cs-137	661.66	12.5879	1.096246
28	2	97	11:08:53	1200.4	1200	565	321	28	653.35	14.62	43.98	Cs-137	661.66	12.1343	1.058445
28	2	97	11:28:54	1200.4	1200	598	301	29	651.86	15.12	34.68	Cs-137	661.66	11.3783	1.096246
28	2	97	11:48:55	1200.4	1200	642	387	29	653.6	12.92	39.96	Cs-137	661.66	14.6292	1.096246
28	2	97	12:08:56	1200.4	1200	601	335	29	651.62	13.56	40				
28	2	97	12:28:57	1200.4	1200	595	339	29	654.15	22.32	34.59	Cs-137	661.66	12.8147	1.096246
28	2	97	12:48:58	1200.4	1200	601	329	29	655.61	10.58	39.57	Cs-137	661.66	12.4367	1.096246
28	2	97	13:08:59	1200.4	1200	605	362	29	653.42	11.64	39.59	Cs-137	661.66	13.6842	1.096246
28	2	97	13:29:00	1200.4	1200	609	333	29	653.91	11.88	34.59	Cs-137	661.66	12.5879	1.096246
28	2	97	13:49:01	1200.4	1200	641	378	30	653.69	12.49	30.97	Cs-137	661.66	14.289	1.134048

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
28	2	97	14:09:02	1200.4	1200	591	378	28	656.05	9.46	39.13	Cs-137	661.66	14.289	1.058445
28	2	97	14:29:03	1200.5	1200	1421	846	44	655.57	7.24	33.49	Cs-137	661.66	31.9801	1.66327
28	2	97	14:49:04	1200.7	1200	3182	1877	66	651.81	10.05	36.07				
28	2	97	15:09:05	1200.7	1200	3116	1950	65	653.18	4.5	34.09	Cs-137	661.66	73.7131	2.457103
28	2	97	15:29:06	1200.7	1200	3194	1914	66	653.24	0.14	32.08	Cs-137	661.66	72.3522	2.494905
28	2	97	15:49:08	1200.4	1200	534	309	27	652.39	18.76	44.84	Cs-137	661.66	11.6807	1.020643
28	2	97	16:09:09	1200.4	1200	555	292	28	653.72	14.79	41.31	Cs-137	661.66	11.0381	1.058445
28	2	97	16:29:10	1200.4	1200	508	286	27	656.13	12.84	37.66	Cs-137	661.66	10.8113	1.020643
28	2	97	16:49:11	1200.4	1200	498	297	26	653.28	11.78	40.97	Cs-137	661.66	11.2271	0.982841
28	2	97	17:09:11	1200.4	1200	568	292	29	655.29	17.75	36.03	Cs-137	661.66	11.0381	1.096246
28	2	97	17:29:12	1200.4	1200	600	354	29	654.33	18.25	35.2	Cs-137	661.66	13.3818	1.096246
28	2	97	17:49:13	1200.4	1200	601	349	29	654.38	16.18	45.41	Cs-137	661.66	13.1928	1.096246
28	2	97	18:09:15	1200.4	1200	593	344	29	655.98	16.42	43.83	Cs-137	661.66	13.0037	1.096246
28	2	97	18:29:16	1200.4	1200	600	369	28	653.68	20.91	37.51	Cs-137	661.66	13.9488	1.058445
28	2	97	18:49:17	1200.4	1200	613	314	30	654.52	21.45	42.59	Cs-137	661.66	11.8697	1.134048
28	2	97	19:09:18	1200.4	1200	592	308	29	655.77	14.52	45.47	Cs-137	661.66	11.6429	1.096246
28	2	97	19:29:19	1200.4	1200	638	338	30	655.85	15.2	41.85	Cs-137	661.66	12.7769	1.134048
28	2	97	19:49:20	1200.4	1200	639	367	30	651.72	15.32	38.22				
28	2	97	20:09:21	1200.4	1200	634	334	30	653.62	23.06	32.22	Cs-137	661.66	12.6257	1.134048
28	2	97	20:29:22	1200.4	1200	662	392	30	656.22	8.08	35.6	Cs-137	661.66	14.8182	1.134048
28	2	97	20:49:23	1200.4	1200	646	328	31	651.55	12.33	38.25				
28	2	97	21:09:24	1200.4	1200	621	347	29	650.36	20.04	40.33				
28	2	97	21:29:25	1200.4	1200	659	386	30	651.84	18.29	38.32	Cs-137	661.66	14.5914	1.134048
28	2	97	21:49:26	1200.4	1200	636	338	30	654.65	15.88	41.95	Cs-137	661.66	12.7769	1.134048
28	2	97	22:09:27	1200.4	1200	653	313	31	652.79	22.62	38.81	Cs-137	661.66	11.8319	1.171849
28	2	97	22:29:28	1200.4	1200	648	348	30	655.91	10.29	40.92	Cs-137	661.66	13.155	1.134048
28	2	97	22:49:29	1200.4	1200	646	364	30	652.02	16.59	37.56	Cs-137	661.66	13.7598	1.134048
28	2	97	23:09:30	1200.4	1200	674	407	30	651.14	12.36	35.36				
28	2	97	23:29:31	1200.4	1200	679	388	31	653.57	11.6	38.4	Cs-137	661.66	14.667	1.171849
28	2	97	23:49:32	1200.4	1200	631	385	29	653.01	20.22	48.11	Cs-137	661.66	14.5536	1.096246
1	3	97	0:09:33	1200.4	1200	665	347	31	653.76	12.65	36.1	Cs-137	661.66	13.1172	1.171849
1	3	97	0:29:34	1200.4	1200	658	355	31	653.54	13.53	38.35	Cs-137	661.66	13.4196	1.171849
1	3	97	0:49:35	1200.4	1200	663	365	30	652.08	18.12	47.71	Cs-137	661.66	13.7976	1.134048
1	3	97	1:09:36	1200.4	1200	703	448	30	652.1	13.67	38.47	Cs-137	661.66	16.9351	1.134048
1	3	97	1:29:37	1200.4	1200	718	395	32	653.47	21.89	37.64	Cs-137	661.66	14.9316	1.209651
1	3	97	1:49:38	1200.4	1200	685	355	31	655.3	18.06	38.51	Cs-137	661.66	13.4196	1.171849
1	3	97	2:09:39	1200.4	1200	663	363	31	653.44	13.62	39.2	Cs-137	661.66	13.722	1.171849
1	3	97	2:29:40	1200.4	1200	678	381	31	653.41	11.05	38.13	Cs-137	661.66	14.4024	1.171849

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
1	3	97	2:49:41	1200.4	1200	689	365	31	653.79	13.85	34.02	Cs-137	661.66	13.7976	1.171849
1	3	97	3:09:42	1200.4	1200	661	358	31	653.87	11.97	32.89	Cs-137	661.66	13.533	1.171849
1	3	97	3:29:43	1200.4	1200	688	397	31	657.92	17.96	49.65	Cs-137	661.66	15.0072	1.171849
1	3	97	3:49:44	1200.4	1200	689	395	31	652.36	13.91	30.07	Cs-137	661.66	14.9316	1.171849
1	3	97	4:09:45	1200.4	1200	628	356	30	651.92	15.01	35.75	Cs-137	661.66	13.4574	1.134048
1	3	97	4:29:46	1200.4	1200	722	412	32	655.8	10.07	32.93	Cs-137	661.66	15.5743	1.209651
1	3	97	4:49:47	1200.4	1200	737	407	32	654.46	19.79	37.19	Cs-137	661.66	15.3852	1.209651
1	3	97	5:09:48	1200.4	1200	701	407	31	652.15	15.1	41.1	Cs-137	661.66	15.3852	1.171849
1	3	97	5:29:49	1200.4	1200	752	414	33	653.48	8.94	34.6	Cs-137	661.66	15.6499	1.247452
1	3	97	5:49:50	1200.4	1200	689	359	31	655.52	10.17	34.62	Cs-137	661.66	13.5708	1.171849
1	3	97	6:09:51	1200.4	1200	702	385	31	652.22	13.9	34.76	Cs-137	661.66	14.5536	1.171849
1	3	97	6:29:52	1200.4	1200	759	451	32	651.5	15.75	42.19				
1	3	97	6:49:53	1200.4	1200	724	402	32	653.61	13.13	34.19	Cs-137	661.66	15.1962	1.209651
1	3	97	7:09:54	1200.4	1200	686	386	31	655.47	9.53	34.21	Cs-137	661.66	14.5914	1.171849
1	3	97	7:29:55	1200.4	1200	745	471	31	655.01	22.1	39.15	Cs-137	661.66	17.8045	1.171849
1	3	97	7:49:56	1200.4	1200	686	407	31	653.48	15.22	35.3	Cs-137	661.66	15.3852	1.171849
1	3	97	8:09:57	1200.4	1200	735	399	32	655.23	19.99	42.55	Cs-137	661.66	15.0828	1.209651
1	3	97	8:29:58	1200.4	1200	758	428	32	657.1	14.11	35.96	Cs-137	661.66	16.1791	1.209651
1	3	97	8:49:59	1200.4	1200	746	437	32	655.99	17.04	41.91	Cs-137	661.66	16.5193	1.209651
1	3	97	9:10:01	1200.4	1200	739	380	33	654.62	18.97	37.26	Cs-137	661.66	14.3646	1.247452
1	3	97	9:30:02	1200.4	1200	750	447	32	653.57	13.47	42.32	Cs-137	661.66	16.8973	1.209651
1	3	97	9:50:04	1200.4	1200	688	415	31	653.85	11.71	37.26	Cs-137	661.66	15.6877	1.171849
1	3	97	10:10:05	1200.4	1200	774	445	33	655.02	20.44	37.71	Cs-137	661.66	16.8217	1.247452
1	3	97	10:30:06	1200.4	1200	504	244	27	653.9	14.95	34.62	Cs-137	661.66	9.2236	1.020643
1	3	97	10:50:07	1200.7	1200	3010	1852	64	651.55	11.01	34.5				
1	3	97	11:10:08	1200.4	1200	767	434	33	653.57	12.79	37.95	Cs-137	661.66	16.4059	1.247452
1	3	97	11:30:09	1200.4	1200	708	408	31	653.44	8.65	37.4	Cs-137	661.66	15.423	1.171849
1	3	97	11:50:10	1200.4	1200	781	385	34	654.5	19.89	40.15	Cs-137	661.66	14.5536	1.285254
1	3	97	12:10:11	1200.4	1200	727	355	33	655.24	19.22	32	Cs-137	661.66	13.4196	1.247452
1	3	97	12:30:12	1200.4	1200	702	381	31	653.85	10.58	35.65	Cs-137	661.66	14.4024	1.171849
1	3	97	12:50:13	1200.4	1200	745	418	32	653.7	14.64	37.51	Cs-137	661.66	15.8011	1.209651
1	3	97	13:10:14	1200.4	1200	727	427	32	653.46	13.93	35.43	Cs-137	661.66	16.1413	1.209651
1	3	97	13:30:15	1200.5	1200	718	403	32	652.05	17.44	35.67	Cs-137	661.66	15.234	1.209651
1	3	97	13:50:16	1200.4	1200	767	423	33	654.12	10.71	31.58	Cs-137	661.66	15.9901	1.247452
1	3	97	14:10:17	1200.5	1200	765	426	33	653.9	12.87	36.31	Cs-137	661.66	16.1035	1.247452
1	3	97	14:30:18	1200.5	1200	734	401	32	651.96	14.35	34.76	Cs-137	661.66	15.1584	1.209651
1	3	97	14:50:20	1200.5	1200	797	425	34	651.79	13.75	34.48				
1	3	97	15:10:21	1200.5	1200	721	326	33	656.64	14.29	34.47	Cs-137	661.66	12.3233	1.247452

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
1	3	97	15:30:22	1200.5	1200	854	507	34	653.56	12.33	37.27	Cs-137	661.66	19.1654	1.285254
1	3	97	15:50:23	1200.5	1200	760	388	33	655.2	18.05	37.45	Cs-137	661.66	14.667	1.247452
1	3	97	16:10:24	1200.5	1200	789	412	34	651.47	18.2	31.82				
1	3	97	16:30:25	1200.5	1200	833	448	34	653.41	14.87	31.64	Cs-137	661.66	16.9351	1.285254
1	3	97	16:50:26	1200.5	1200	795	477	33	651.27	14.58	35.04				
1	3	97	17:10:27	1200.5	1200	796	488	33	653.5	12.04	39.92	Cs-137	661.66	18.4472	1.247452
1	3	97	17:30:28	1200.5	1200	838	471	34	653.94	14.29	38.27	Cs-137	661.66	17.8045	1.285254
1	3	97	17:50:29	1200.5	1200	772	418	33	653.36	12.99	35.38	Cs-137	661.66	15.8011	1.247452
1	3	97	18:10:30	1200.5	1200	796	433	34	653.5	22.7	41.84	Cs-137	661.66	16.3681	1.285254
1	3	97	18:30:31	1200.5	1200	787	443	33	653.81	12.34	33.27	Cs-137	661.66	16.7461	1.247452
1	3	97	18:50:32	1200.5	1200	830	449	34	653.32	11.17	38.93	Cs-137	661.66	16.9729	1.285254
1	3	97	19:10:33	1200.5	1200	800	464	33	653.82	14.83	42.48	Cs-137	661.66	17.5399	1.247452
1	3	97	19:30:34	1200.5	1200	822	449	34	655.98	13.78	37.66	Cs-137	661.66	16.9729	1.285254
1	3	97	19:50:35	1200.5	1200	878	506	35	654	10.62	37.07	Cs-137	661.66	19.1276	1.323056
1	3	97	20:10:36	1200.5	1200	877	457	36	653.6	10.51	38.46	Cs-137	661.66	17.2753	1.360857
1	3	97	20:30:38	1200.5	1200	791	475	33	653.65	11.67	37.15	Cs-137	661.66	17.9558	1.247452
1	3	97	20:50:39	1200.5	1200	779	461	33	650.22	17.12	41.19				
1	3	97	21:10:40	1200.5	1200	813	445	34	653.66	13.64	36.98	Cs-137	661.66	16.8217	1.285254
1	3	97	21:30:41	1200.5	1200	840	459	34	653.79	10.78	35.66	Cs-137	661.66	17.3509	1.285254
1	3	97	21:50:42	1200.5	1200	795	402	34	653.96	10.86	35.53	Cs-137	661.66	15.1962	1.285254
1	3	97	22:10:43	1200.5	1200	859	488	35	651.81	17.11	38.67				
1	3	97	22:30:44	1200.5	1200	829	469	34	653.43	12.47	34.6	Cs-137	661.66	17.7289	1.285254
1	3	97	22:50:45	1200.5	1200	853	398	36	654.54	20.85	38.63	Cs-137	661.66	15.045	1.360857
1	3	97	23:10:46	1200.5	1200	827	476	34	655.58	9.69	35.01	Cs-137	661.66	17.9936	1.285254
1	3	97	23:30:47	1200.5	1200	896	477	36	653.63	12.82	38.44	Cs-137	661.66	18.0314	1.360857
1	3	97	23:50:48	1200.5	1200	856	457	35	653.86	8.29	34.06	Cs-137	661.66	17.2753	1.323056
2	3	97	0:10:49	1200.5	1200	865	487	35	651.82	12.78	37.04				
2	3	97	0:30:50	1200.5	1200	881	470	35	655.63	8.01	29.12	Cs-137	661.66	17.7667	1.323056
2	3	97	0:50:51	1200.5	1200	833	501	34	651.83	16.8	40.18				
2	3	97	1:10:52	1200.5	1200	862	487	35	653.59	10	37.47	Cs-137	661.66	18.4094	1.323056
2	3	97	1:30:53	1200.5	1200	881	428	36	655.78	9.83	33.31	Cs-137	661.66	16.1791	1.360857
2	3	97	1:50:54	1200.5	1200	826	487	34	651.62	13.74	38.16				
2	3	97	2:10:55	1200.5	1200	861	480	35	653.72	11	36.65	Cs-137	661.66	18.1448	1.323056
2	3	97	2:30:56	1200.5	1200	786	423	33	651.82	16.49	38.59				
2	3	97	2:50:57	1200.5	1200	870	456	35	653.88	11.51	32.95	Cs-137	661.66	17.2375	1.323056
2	3	97	3:10:58	1200.5	1200	915	502	36	653.64	12.53	34.77	Cs-137	661.66	18.9764	1.360857
2	3	97	3:30:59	1200.5	1200	883	490	35	654.88	18.09	34.42	Cs-137	661.66	18.5228	1.323056
2	3	97	3:51:01	1200.5	1200	904	535	35	651.55	15.33	42.69				

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
2	3	97	4:11:02	1200.5	1200	872	482	35	653.24	15.45	39.26	Cs-137	661.66	18.2204	1.323056
2	3	97	4:31:03	1200.5	1200	952	532	37	653.79	11.23	31.78	Cs-137	661.66	20.1104	1.398659
2	3	97	4:51:04	1200.5	1200	926	482	37	653.79	11.17	30.49	Cs-137	661.66	18.2204	1.398659
2	3	97	5:11:05	1200.5	1200	924	517	36	655.49	18.61	39.39	Cs-137	661.66	19.5434	1.360857
2	3	97	5:31:06	1200.5	1200	911	500	36	655.15	20.09	40.11	Cs-137	661.66	18.9008	1.360857
2	3	97	5:51:07	1200.5	1200	882	468	36	653.48	11.54	37.04	Cs-137	661.66	17.6911	1.360857
2	3	97	6:11:08	1200.5	1200	928	542	36	651.6	13.66	35.17				
2	3	97	6:31:09	1200.5	1200	884	534	35	655.62	9.96	31.55	Cs-137	661.66	20.186	1.323056
2	3	97	6:51:10	1200.5	1200	947	504	37	655.75	7.13	33.94	Cs-137	661.66	19.052	1.398659
2	3	97	7:11:11	1200.5	1200	897	502	35	653.87	12.14	37.82	Cs-137	661.66	18.9764	1.323056
2	3	97	7:31:12	1200.5	1200	901	497	36	656.54	16.02	39.06	Cs-137	661.66	18.7874	1.360857
2	3	97	7:51:14	1200.5	1200	894	544	35	653.57	12.69	31.28	Cs-137	661.66	20.5641	1.323056
2	3	97	8:11:15	1200.5	1200	901	469	36	653.64	11.06	27.54	Cs-137	661.66	17.7289	1.360857
2	3	97	8:31:16	1200.5	1200	934	527	36	653.41	11.62	33.97	Cs-137	661.66	19.9214	1.360857
2	3	97	8:51:17	1200.5	1200	910	569	35	653.58	11.85	37.36	Cs-137	661.66	21.5091	1.323056
2	3	97	9:11:18	1200.5	1200	933	507	36	653.66	12.28	35.13	Cs-137	661.66	19.1654	1.360857
2	3	97	9:31:19	1200.5	1200	936	532	36	655.67	8.46	33.52	Cs-137	661.66	20.1104	1.360857
2	3	97	9:51:20	1200.5	1200	918	525	36	652.2	15.53	42.36	Cs-137	661.66	19.8458	1.360857
2	3	97	10:11:21	1200.5	1200	964	511	37	651.44	17.92	39.67				
2	3	97	10:31:22	1200.5	1200	985	580	37	653.69	11.69	37.49	Cs-137	661.66	21.9249	1.398659
2	3	97	10:51:23	1200.5	1200	980	517	37	651.63	14.44	36.98				
2	3	97	11:11:24	1200.5	1200	1004	533	38	651.57	12.19	34.55				
2	3	97	11:31:26	1200.5	1200	952	472	37	654.19	10.91	33.77	Cs-137	661.66	17.8424	1.398659
2	3	97	11:51:27	1200.5	1200	970	565	37	654.09	17.48	41.46	Cs-137	661.66	21.3579	1.398659
2	3	97	12:11:28	1200.5	1200	983	575	37	653.62	11.63	34.18	Cs-137	661.66	21.7359	1.398659
2	3	97	12:31:29	1200.5	1200	1026	558	38	653.69	12.61	34.69	Cs-137	661.66	21.0933	1.43646
2	3	97	12:51:30	1200.5	1200	1005	576	37	653.8	10.36	37.93	Cs-137	661.66	21.7737	1.398659
2	3	97	13:11:31	1200.5	1200	1028	560	38	652.17	12.95	34.14	Cs-137	661.66	21.1689	1.43646
2	3	97	13:31:32	1200.5	1200	989	518	38	654.15	10.15	37.56	Cs-137	661.66	19.5812	1.43646
2	3	97	13:51:33	1200.5	1200	956	544	36	655.62	7.93	35.83	Cs-137	661.66	20.5641	1.360857
2	3	97	14:11:34	1200.5	1200	1001	548	38	652.28	12.44	41.77	Cs-137	661.66	20.7153	1.43646
2	3	97	14:31:35	1200.5	1200	1023	549	38	653.96	12.89	36.74	Cs-137	661.66	20.7531	1.43646
2	3	97	14:51:36	1200.5	1200	979	588	37	654.72	20.48	42.41	Cs-137	661.66	22.2273	1.398659
2	3	97	15:11:37	1200.5	1200	1018	583	38	653.72	11.08	36.36	Cs-137	661.66	22.0383	1.43646
2	3	97	15:31:38	1200.5	1200	1039	574	38	656.05	17.61	34.81	Cs-137	661.66	21.6981	1.43646
2	3	97	15:51:40	1200.5	1200	978	573	37	655.35	19.91	39.06	Cs-137	661.66	21.6603	1.398659
2	3	97	16:11:41	1200.5	1200	999	514	38	652.13	14.73	35.54	Cs-137	661.66	19.43	1.43646
2	3	97	16:31:42	1200.5	1200	1015	535	38	654.98	18.97	35.52	Cs-137	661.66	20.2239	1.43646

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
2	3	97	16:51:43	1200.5	1200	1031	570	38	655.64	8.65	31.6	Cs-137	661.66	21.5469	1.43646
2	3	97	17:11:44	1200.5	1200	1073	575	39	655.68	21.16	39.72	Cs-137	661.66	21.7359	1.474262
2	3	97	17:31:45	1200.5	1200	1015	561	38	656.1	19.93	37.07	Cs-137	661.66	21.2067	1.43646
2	3	97	17:51:46	1200.5	1200	1036	600	38	655.68	8.78	30.77	Cs-137	661.66	22.681	1.43646
2	3	97	18:11:47	1200.5	1200	1070	617	39	653.59	11.77	34.51	Cs-137	661.66	23.3236	1.474262
2	3	97	18:31:48	1200.5	1200	1056	640	38	653.32	12.45	42.79	Cs-137	661.66	24.193	1.43646
2	3	97	18:51:49	1200.5	1200	524	268	27	654.18	21.32	38.36	Cs-137	661.66	10.1308	1.020643
2	3	97	19:11:50	1200.5	1200	1032	587	38	653.42	9.91	32.13	Cs-137	661.66	22.1895	1.43646
2	3	97	19:31:51	1200.5	1200	1056	645	38	652.08	13.06	35.26	Cs-137	661.66	24.382	1.43646
2	3	97	19:51:52	1200.5	1200	1050	621	38	651.8	13.41	35.4				
2	3	97	20:11:54	1200.5	1200	1060	571	39	653.42	10.85	35.63	Cs-137	661.66	21.5847	1.474262
2	3	97	20:31:55	1200.5	1200	1097	648	39	653.34	12.27	39.94	Cs-137	661.66	24.4954	1.474262
2	3	97	20:51:56	1200.5	1200	1036	664	37	651.47	15.39	39.47				
2	3	97	21:11:57	1200.5	1200	1110	618	40	655.4	7.15	35.46	Cs-137	661.66	23.3614	1.512064
2	3	97	21:31:58	1200.5	1200	1052	662	37	651.73	15.37	34.94				
2	3	97	21:51:59	1200.5	1200	1081	600	39	651.79	15.01	31.52				
2	3	97	22:12:00	1200.5	1200	1076	608	39	652.14	15.12	37.9	Cs-137	661.66	22.9834	1.474262
2	3	97	22:32:01	1200.5	1200	1058	633	38	653.53	11.52	34.59	Cs-137	661.66	23.9284	1.43646
2	3	97	22:52:02	1200.5	1200	1127	620	40	653.42	8.97	35.63	Cs-137	661.66	23.437	1.512064
2	3	97	23:12:04	1200.5	1200	1116	619	40	651.31	12.85	36.59				
2	3	97	23:32:05	1200.5	1200	1113	639	39	653.37	9.1	33.28	Cs-137	661.66	24.1552	1.474262
2	3	97	23:52:06	1200.5	1200	1087	627	39	653.55	10.07	31.77	Cs-137	661.66	23.7016	1.474262
3	3	97	0:12:07	1200.5	1200	1055	616	38	651.89	14.52	38.51	Cs-137	661.66	23.2858	1.43646
3	3	97	0:32:08	1200.5	1200	1173	726	40	653.72	9.59	34.83	Cs-137	661.66	27.444	1.512064
3	3	97	0:52:09	1200.5	1200	1131	616	40	651.94	14.25	33.55	Cs-137	661.66	23.2858	1.512064
3	3	97	1:12:10	1200.5	1200	1136	698	39	653.5	11.87	38.52	Cs-137	661.66	26.3855	1.474262
3	3	97	1:32:11	1200.5	1200	1113	583	40	653.89	11.23	32.33	Cs-137	661.66	22.0383	1.512064
3	3	97	1:52:12	1200.5	1200	1087	682	38	655.29	19.38	38.78	Cs-137	661.66	25.7807	1.43646
3	3	97	2:12:13	1200.5	1200	1159	692	40	653.47	11.21	34.7	Cs-137	661.66	26.1587	1.512064
3	3	97	2:32:15	1200.5	1200	1180	656	41	652.46	14.4	36.71	Cs-137	661.66	24.7978	1.549865
3	3	97	2:52:16	1200.5	1200	1097	680	38	653.48	11.58	37.03	Cs-137	661.66	25.7051	1.43646
3	3	97	3:12:17	1200.5	1200	1151	676	40	655.42	8.5	37.04	Cs-137	661.66	25.5539	1.512064
3	3	97	3:32:18	1200.5	1200	1167	688	40	653.28	9.34	34.35	Cs-137	661.66	26.0075	1.512064
3	3	97	3:52:19	1200.5	1200	1157	663	40	655.57	8.7	29.05	Cs-137	661.66	25.0625	1.512064
3	3	97	4:12:20	1200.5	1200	1182	699	40	651.72	14.88	33.26				
3	3	97	4:32:21	1200.5	1200	1225	697	41	654.72	19.3	42.4	Cs-137	661.66	26.3477	1.549865
3	3	97	4:52:22	1200.5	1200	1180	690	40	651.63	13.67	35.01				
3	3	97	5:12:23	1200.5	1200	1175	677	40	653.31	10.41	32.88	Cs-137	661.66	25.5917	1.512064

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
3	3	97	5:32:25	1200.6	1200	1137	672	40	654.72	17.18	42.43	Cs-137	661.66	25.4027	1.512064
3	3	97	5:52:26	1200.5	1200	1133	666	40	653.57	11.41	34.16	Cs-137	661.66	25.1759	1.512064
3	3	97	6:12:27	1200.5	1200	513	285	27	653.78	13.32	37.21	Cs-137	661.66	10.7735	1.020643
3	3	97	6:32:28	1200.5	1200	480	300	25	653.37	24.77	46.16	Cs-137	661.66	11.3405	0.94504
3	3	97	6:52:29	1200.5	1200	578	348	28	653.87	13.34	35.89	Cs-137	661.66	13.155	1.058445
3	3	97	7:12:30	1200.5	1200	531	303	27	653.33	11.17	34.61	Cs-137	661.66	11.4539	1.020643
3	3	97	7:32:31	1200.5	1200	522	267	27	652.77	19.87	27.65	Cs-137	661.66	10.093	1.020643
3	3	97	7:52:32	1200.8	1200	3099	1854	65	653.23	4.05	34.22	Cs-137	661.66	70.0841	2.457103
3	3	97	8:12:33	1200.8	1200	3018	1694	65	653.38	6.7	31.6	Cs-137	661.66	64.0359	2.457103
3	3	97	8:32:35	1200.8	1200	3111	1907	65	653.2	2.77	34.36	Cs-137	661.66	72.0876	2.457103
3	3	97	8:52:36	1200.6	1200	1184	683	41	651.18	13.47	41.28				
3	3	97	9:12:37	1200.6	1200	1218	687	41	654.07	23.01	41.88	Cs-137	661.66	25.9697	1.549865
3	3	97	9:32:39	1200.6	1200	1238	726	41	651.93	10.41	39.8	Cs-137	661.66	27.444	1.549865
3	3	97	9:52:40	1200.6	1200	1211	734	41	653.67	11.28	41.72	Cs-137	661.66	27.7464	1.549865
3	3	97	10:12:41	1200.6	1200	1250	783	41	653.54	9.56	36.77	Cs-137	661.66	29.5986	1.549865
3	3	97	10:32:42	1200.6	1200	1255	721	42	655.46	7.53	34.53	Cs-137	661.66	27.2549	1.587667
3	3	97	10:52:45	1200.6	1200	1212	708	41	653.22	9.14	35.06	Cs-137	661.66	26.7635	1.549865
3	3	97	11:12:46	1200.6	1200	1314	780	42	653.49	10.71	39.76	Cs-137	661.66	29.4852	1.587667
3	3	97	11:32:47	1200.6	1200	1274	709	42	653.58	11.05	35.11	Cs-137	661.66	26.8013	1.587667
3	3	97	11:52:48	1200.6	1200	1255	733	42	655.71	18.76	41.48	Cs-137	661.66	27.7086	1.587667
3	3	97	12:12:50	1200.6	1200	1263	783	41	653.43	7.21	34.24	Cs-137	661.66	29.5986	1.549865
3	3	97	12:32:51	1200.6	1200	1242	762	41	653.26	9.81	37.42	Cs-137	661.66	28.8048	1.549865
3	3	97	12:52:52	1200.6	1200	1291	748	42	653.5	10.27	34.35	Cs-137	661.66	28.2756	1.587667
3	3	97	13:12:53	1200.6	1200	1238	746	41	653.58	10.19	31.28	Cs-137	661.66	28.2	1.549865
3	3	97	13:32:54	1200.6	1200	1166	678	40	654.45	20.83	39.67	Cs-137	661.66	25.6295	1.512064
3	3	97	13:52:55	1200.5	1200	535	322	27	653.44	10.23	34.48	Cs-137	661.66	12.1721	1.020643
3	3	97	14:12:56	1200.5	1200	533	333	27	653.66	12.7	38.9	Cs-137	661.66	12.5879	1.020643
3	3	97	14:32:57	1200.6	1200	1343	782	43	653.4	9.82	33.48	Cs-137	661.66	29.5608	1.625468
3	3	97	14:52:58	1200.6	1200	1353	780	43	653.49	11.34	34.73	Cs-137	661.66	29.4852	1.625468
3	3	97	15:13:00	1200.6	1200	1308	780	42	651.66	13.72	34.61				
3	3	97	15:33:01	1200.6	1200	1265	776	41	653.26	8.86	37.65	Cs-137	661.66	29.334	1.549865
3	3	97	15:53:02	1200.6	1200	1274	761	42	653.47	11.02	40.08	Cs-137	661.66	28.767	1.587667
3	3	97	16:13:03	1200.6	1200	1315	832	42	653.3	8.59	34.94	Cs-137	661.66	31.4509	1.587667
3	3	97	16:33:04	1200.6	1200	1376	764	44	651.94	13.83	35.74	Cs-137	661.66	28.8804	1.66327
3	3	97	16:53:05	1200.6	1200	1347	829	43	649.5	15.11	35.85				
3	3	97	17:13:07	1200.6	1200	1274	704	42	653.47	9.9	36.1	Cs-137	661.66	26.6123	1.587667
3	3	97	17:33:08	1200.6	1200	1307	774	42	653.36	9.19	36.63	Cs-137	661.66	29.2584	1.587667
3	3	97	17:53:09	1200.6	1200	1352	839	43	653.32	10.44	38.59	Cs-137	661.66	31.7155	1.625468

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
3	3	97	18:13:10	1200.6	1200	1352	836	43	651.33	12.54	43.31				
3	3	97	18:33:11	1200.6	1200	1355	800	43	653.56	8.53	33.91	Cs-137	661.66	30.2413	1.625468
3	3	97	18:53:12	1200.6	1200	1346	812	43	651.58	12.93	35.19				
3	3	97	19:13:14	1200.6	1200	1322	758	43	653.38	9.35	37.79	Cs-137	661.66	28.6536	1.625468
3	3	97	19:33:15	1200.6	1200	1306	832	42	653.49	9.07	33.15	Cs-137	661.66	31.4509	1.587667
3	3	97	19:53:16	1200.6	1200	1385	857	43	653.85	22.13	45.66	Cs-137	661.66	32.396	1.625468
3	3	97	20:13:17	1200.6	1200	1402	805	44	653.43	10.91	37.06	Cs-137	661.66	30.4303	1.66327
3	3	97	20:33:19	1200.6	1200	1408	853	44	651.6	12.69	37.86				
3	3	97	20:53:20	1200.6	1200	1358	761	44	653.83	10.81	35.06	Cs-137	661.66	28.767	1.66327
3	3	97	21:13:21	1200.6	1200	1365	861	43	651.52	13.45	42.07				
3	3	97	21:33:22	1200.6	1200	1341	810	43	653.35	9.22	39.75	Cs-137	661.66	30.6193	1.625468
3	3	97	21:53:23	1200.6	1200	1403	797	44	653.35	10.72	31.24	Cs-137	661.66	30.1279	1.66327
3	3	97	22:13:24	1200.6	1200	1426	781	45	653.38	8.29	33.84	Cs-137	661.66	29.523	1.701072
3	3	97	22:33:26	1200.6	1200	1383	870	43	653.58	8.88	40.44	Cs-137	661.66	32.8874	1.625468
3	3	97	22:53:27	1200.6	1200	1411	844	44	653.68	11.33	35.99	Cs-137	661.66	31.9045	1.66327
3	3	97	23:13:28	1200.6	1200	1389	844	43	653.53	9.89	33.51	Cs-137	661.66	31.9045	1.625468
3	3	97	23:33:29	1200.6	1200	1362	711	44	653.26	8.35	34.12	Cs-137	661.66	26.8769	1.66327
3	3	97	23:53:31	1200.6	1200	1379	752	44	651.8	12.36	34.58				
4	3	97	0:13:32	1200.6	1200	1382	822	44	653.39	10.54	34.43	Cs-137	661.66	31.0729	1.66327
4	3	97	0:33:33	1200.6	1200	1398	816	44	651.71	12.79	33.64				
4	3	97	0:53:34	1200.6	1200	1424	785	45	653.55	10.78	35.12	Cs-137	661.66	29.6742	1.701072
4	3	97	1:13:35	1200.6	1200	1382	884	43	651.24	12.14	36.6				
4	3	97	1:33:36	1200.6	1200	1441	850	45	653.42	10.63	36.74	Cs-137	661.66	32.1314	1.701072
4	3	97	1:53:38	1200.6	1200	1415	869	44	653.36	10.28	37.31	Cs-137	661.66	32.8496	1.66327
4	3	97	2:13:39	1200.6	1200	1472	859	45	655.05	20.44	43.51	Cs-137	661.66	32.4716	1.701072
4	3	97	2:33:40	1200.6	1200	1437	815	45	651.79	12.62	37.24				
4	3	97	2:53:42	1200.6	1200	1509	957	45	653.41	10.08	36.05	Cs-137	661.66	36.1761	1.701072
4	3	97	3:13:43	1200.6	1200	1468	829	45	654.18	22.44	41.98	Cs-137	661.66	31.3375	1.701072
4	3	97	3:33:44	1200.6	1200	1387	732	45	654.3	22.75	38.3	Cs-137	661.66	27.6708	1.701072
4	3	97	3:53:47	1200.6	1200	1436	812	45	651.31	12.69	31.66				
4	3	97	4:13:49	1200.6	1200	1403	867	44	653.41	9.88	33.55	Cs-137	661.66	32.774	1.66327
4	3	97	4:33:50	1200.6	1200	1420	892	44	653.34	9.27	39.07	Cs-137	661.66	33.719	1.66327
4	3	97	4:53:51	1200.6	1200	1451	854	45	653.27	9.67	34.66	Cs-137	661.66	32.2826	1.701072
4	3	97	5:13:52	1200.6	1200	1427	833	44	653.39	8.13	35.82	Cs-137	661.66	31.4887	1.66327
4	3	97	5:33:53	1200.6	1200	1507	918	45	653.29	9.99	34.63	Cs-137	661.66	34.7019	1.701072
4	3	97	5:53:55	1200.6	1200	1508	905	45	651.78	12.23	41.73				
4	3	97	6:13:56	1200.6	1200	1508	938	45	653.36	9.8	35.48	Cs-137	661.66	35.4579	1.701072
4	3	97	6:33:57	1200.6	1200	1424	836	44	653.16	9.82	37	Cs-137	661.66	31.6021	1.66327

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
4	3	97	6:53:58	1200.6	1200	1408	713	45	654.78	17.57	35.77	Cs-137	661.66	26.9525	1.701072
4	3	97	7:14:00	1200.6	1200	1558	925	46	653.62	8.97	37.43	Cs-137	661.66	34.9665	1.738873
4	3	97	7:34:01	1200.6	1200	1465	850	45	653.48	9.63	34.71	Cs-137	661.66	32.1314	1.701072
4	3	97	7:54:02	1200.6	1200	1517	906	46	651.66	12.17	34.34				
4	3	97	8:14:03	1200.6	1200	1516	942	45	653.44	8.47	35.54	Cs-137	661.66	35.6091	1.701072
4	3	97	8:34:05	1200.6	1200	1510	835	46	653.41	10.86	32.96	Cs-137	661.66	31.5643	1.738873
4	3	97	8:54:06	1200.6	1200	1560	891	47	653.44	9.36	36.51	Cs-137	661.66	33.6812	1.776675
4	3	97	9:14:07	1200.6	1200	1508	875	46	653.39	8.46	35.86	Cs-137	661.66	33.0764	1.738873
4	3	97	9:34:08	1200.6	1200	1489	907	45	653.08	6.99	34.97	Cs-137	661.66	34.286	1.701072
4	3	97	9:54:09	1200.6	1200	1525	811	47	653.82	9.92	34.12	Cs-137	661.66	30.6571	1.776675
4	3	97	10:14:11	1200.6	1200	1519	863	46	651.41	13.18	33.48				
4	3	97	10:34:12	1200.6	1200	1518	880	46	655.37	17.64	40.44	Cs-137	661.66	33.2654	1.738873
4	3	97	10:54:13	1200.6	1200	1523	887	46	653.34	8.68	33.1	Cs-137	661.66	33.53	1.738873
4	3	97	11:14:14	1200.6	1200	1432	838	45	653.27	8.55	37.85	Cs-137	661.66	31.6777	1.701072
4	3	97	11:34:15	1200.6	1200	1618	952	47	651.64	12.26	34.08				
4	3	97	11:54:17	1200.6	1200	1472	903	45	651.23	12.51	36.92				
4	3	97	12:14:18	1200.6	1200	1464	816	45	653.2	9.73	31.52	Cs-137	661.66	30.8461	1.701072
4	3	97	12:34:19	1200.6	1200	1514	850	46	653.45	10.11	36.72	Cs-137	661.66	32.1314	1.738873
4	3	97	12:54:20	1200.6	1200	1519	928	45	651.42	12.65	35.02				
4	3	97	13:14:21	1200.6	1200	1593	900	47	653.41	10.6	36.78	Cs-137	661.66	34.0214	1.776675
4	3	97	13:34:23	1200.6	1200	1454	875	45	651.52	14.51	38.22				
4	3	97	13:54:24	1200.6	1200	1546	950	46	651.6	13.15	41.27				
4	3	97	14:14:25	1200.6	1200	1548	1005	45	651.25	12.43	36.87				
4	3	97	14:34:26	1200.6	1200	1591	970	47	653.83	20.54	42.79	Cs-137	661.66	36.6675	1.776675
4	3	97	14:54:30	1200.6	1200	1636	986	47	653.32	7.95	37	Cs-137	661.66	37.2724	1.776675
4	3	97	15:14:33	1200.6	1200	1598	908	47	653.36	8.31	33.14	Cs-137	661.66	34.3238	1.776675
4	3	97	15:34:34	1200.6	1200	1556	956	46	651.77	11.92	35.21				
4	3	97	15:54:35	1200.6	1200	1560	949	46	653.41	9.47	37.39	Cs-137	661.66	35.8737	1.738873
4	3	97	16:14:36	1200.7	1200	1573	937	47	653.49	10.59	36.93	Cs-137	661.66	35.4201	1.776675
4	3	97	16:34:38	1200.7	1200	1582	957	46	654.59	21.19	40.15	Cs-137	661.66	36.1761	1.738873
4	3	97	16:54:39	1200.6	1200	1570	950	46	651.67	12.57	35.29				
4	3	97	17:14:40	1200.7	1200	1566	891	47	653.42	8.52	32.67	Cs-137	661.66	33.6812	1.776675
4	3	97	17:34:41	1200.7	1200	1578	927	47	651.44	11.22	38.04				
4	3	97	17:54:43	1200.7	1200	1588	942	47	654.87	22	42.48	Cs-137	661.66	35.6091	1.776675
4	3	97	18:14:44	1200.7	1200	1624	963	47	653.51	8.41	31.51	Cs-137	661.66	36.4029	1.776675
4	3	97	18:34:45	1200.7	1200	1621	892	48	653.48	9.91	35.79	Cs-137	661.66	33.719	1.814476
4	3	97	18:54:46	1200.7	1200	1722	1035	49	653.52	6.93	34.16	Cs-137	661.66	39.1246	1.852278
4	3	97	19:14:48	1200.7	1200	1627	996	47	653.25	10.04	34.12	Cs-137	661.66	37.6504	1.776675

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
4	3	97	19:34:49	1200.7	1200	1608	985	47	651.59	12.34	37.65				
4	3	97	19:54:50	1200.6	1200	1307	735	43	653.42	11.05	34.61	Cs-137	661.66	27.7842	1.625468
4	3	97	20:14:51	1200.7	1200	1615	943	47	651.69	11.67	34.41				
4	3	97	20:34:52	1200.7	1200	1539	918	46	653.12	7.85	34.92	Cs-137	661.66	34.7019	1.738873
4	3	97	20:54:54	1200.7	1200	1592	915	47	651.34	11.75	34.02				
4	3	97	21:14:55	1200.7	1200	1682	1028	48	653.27	7.58	33.29	Cs-137	661.66	38.86	1.814476
4	3	97	21:34:56	1200.7	1200	1637	1000	47	655.36	18.92	41.96	Cs-137	661.66	37.8016	1.776675
4	3	97	21:54:57	1200.7	1200	1675	984	48	653.22	8.69	36.47	Cs-137	661.66	37.1968	1.814476
4	3	97	22:14:59	1200.7	1200	1687	1002	48	655.03	20.64	39.07	Cs-137	661.66	37.8772	1.814476
4	3	97	22:35:00	1200.7	1200	1674	1042	48	651.49	13.32	33.96				
4	3	97	22:55:01	1200.7	1200	1622	977	47	653.41	9.36	34.23	Cs-137	661.66	36.9322	1.776675
4	3	97	23:15:02	1200.7	1200	1796	1109	49	651.42	12.14	40.71				
4	3	97	23:35:04	1200.7	1200	1600	928	47	653.24	9.14	34.05	Cs-137	661.66	35.0799	1.776675
4	3	97	23:55:05	1200.7	1200	1728	1043	49	653.43	8.8	33.84	Cs-137	661.66	39.4271	1.852278
5	3	97	0:15:06	1200.7	1200	1641	1034	47	653.17	8.29	37.78	Cs-137	661.66	39.0868	1.776675
5	3	97	0:35:07	1200.7	1200	1709	962	49	653.68	10.97	36.28	Cs-137	661.66	36.3651	1.852278
5	3	97	0:55:08	1200.7	1200	1695	1007	48	653.83	6.99	34.88	Cs-137	661.66	38.0662	1.814476
5	3	97	1:15:10	1200.7	1200	1661	978	48	651.16	13.75	38.33				
5	3	97	1:35:11	1200.7	1200	1645	961	48	653.47	8.14	35.14	Cs-137	661.66	36.3273	1.814476
5	3	97	1:55:12	1200.7	1200	1704	1041	48	653.39	8.56	35.19	Cs-137	661.66	39.3515	1.814476
5	3	97	2:15:14	1200.7	1200	1668	1030	48	653.81	8.72	34.85	Cs-137	661.66	38.9356	1.814476
5	3	97	2:35:15	1200.7	1200	1745	1073	49	653.35	8.24	34.29	Cs-137	661.66	40.5611	1.852278
5	3	97	2:55:16	1200.7	1200	1673	953	48	653.52	8.15	31.47	Cs-137	661.66	36.0249	1.814476
5	3	97	3:15:17	1200.7	1200	1678	975	48	653.65	9.15	34.41	Cs-137	661.66	36.8566	1.814476
5	3	97	3:35:19	1200.7	1200	1693	985	49	653.27	8.44	37.89	Cs-137	661.66	37.2346	1.852278
5	3	97	3:55:20	1200.7	1200	1689	939	49	653.38	8.15	34.51	Cs-137	661.66	35.4957	1.852278
5	3	97	4:15:21	1200.7	1200	1711	994	49	653.5	10.46	36.86	Cs-137	661.66	37.5748	1.852278
5	3	97	4:35:22	1200.7	1200	1707	1086	48	653.36	8.16	34.69	Cs-137	661.66	41.0525	1.814476
5	3	97	4:55:24	1200.7	1200	1741	1054	49	653.42	8.41	31.71	Cs-137	661.66	39.8429	1.852278
5	3	97	5:15:25	1200.7	1200	1720	933	50	653.37	8.73	37.46	Cs-137	661.66	35.2689	1.890079
5	3	97	5:35:26	1200.7	1200	1778	978	50	651.43	11.56	34.77				
5	3	97	5:55:28	1200.5	1200	557	282	28	654.31	17.11	33.73	Cs-137	661.66	10.66	1.058445
5	3	97	6:15:29	1200.5	1200	569	291	29	653.86	13.2	31.18	Cs-137	661.66	11.0003	1.096246
5	3	97	6:35:30	1200.5	1200	560	315	28	652.9	21.55	42.14	Cs-137	661.66	11.9075	1.058445
5	3	97	6:55:31	1200.7	1200	1567	934	46	653.38	9.36	34.83	Cs-137	661.66	35.3067	1.738873
5	3	97	7:15:32	1200.7	1200	1757	999	50	653.33	10.41	36.01	Cs-137	661.66	37.7638	1.890079
5	3	97	7:35:33	1200.7	1200	1740	951	50	651.71	12.44	34.31				
5	3	97	7:55:35	1200.7	1200	1681	1048	48	653.46	8.33	36.33	Cs-137	661.66	39.6161	1.814476

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
5	3	97	8:15:36	1200.7	1200	1772	1098	49	651.64	11.62	36.17				
5	3	97	8:35:37	1200.7	1200	1768	1045	49	653.45	10.2	34.93	Cs-137	661.66	39.5027	1.852278
5	3	97	8:55:39	1200.7	1200	1724	966	49	651.46	12.56	35.13				
5	3	97	9:15:40	1200.9	1200	3163	1915	66	653.36	2.81	33.87	Cs-137	661.66	72.39	2.494905
5	3	97	9:35:41	1200.9	1200	3181	1859	67	653.28	3.74	30.82	Cs-137	661.66	70.2732	2.532707
5	3	97	9:55:43	1200.9	1200	3087	1782	66	653.27	5.18	33.6	Cs-137	661.66	67.3624	2.494905
5	3	97	10:15:44	1200.7	1200	1667	1003	48	653.37	9.07	35.59	Cs-137	661.66	37.915	1.814476
5	3	97	10:35:46	1200.7	1200	1773	1020	50	653.44	11	37	Cs-137	661.66	38.5576	1.890079
5	3	97	10:55:47	1200.7	1200	1815	1102	50	653.54	10.01	32.86	Cs-137	661.66	41.6574	1.890079
5	3	97	11:15:48	1200.8	1200	1845	1177	50	651.67	11.99	37.73				
5	3	97	11:35:49	1200.8	1200	1890	1158	51	651.4	11.9	34.94				
5	3	97	11:55:51	1200.7	1200	1746	1015	49	655.25	19.87	41.72	Cs-137	661.66	38.3686	1.852278
5	3	97	12:15:52	1200.7	1200	1799	1076	50	653.24	7.96	36.98	Cs-137	661.66	40.6745	1.890079
5	3	97	12:35:53	1200.7	1200	1757	1109	49	651.33	11.58	44.97				
5	3	97	12:55:55	1200.7	1200	1834	1141	50	653.47	7.88	34.86	Cs-137	661.66	43.1316	1.890079
5	3	97	13:15:56	1200.7	1200	1798	1114	49	653.17	8.65	33.6	Cs-137	661.66	42.111	1.852278
5	3	97	13:35:57	1200.7	1200	1764	1047	49	651.64	12.02	34.57				
5	3	97	13:55:59	1200.7	1200	1851	1172	50	651.45	11.86	36.14				
5	3	97	14:16:00	1200.7	1200	1808	1087	50	653.3	8.27	33.68	Cs-137	661.66	41.0903	1.890079
5	3	97	14:36:01	1200.7	1200	1850	1139	50	653.46	9.59	34.73	Cs-137	661.66	43.056	1.890079
5	3	97	14:56:03	1200.7	1200	1925	1200	51	653.51	6.73	37.91	Cs-137	661.66	45.3619	1.927881
5	3	97	15:16:04	1200.7	1200	1767	1053	49	651.22	12.42	36				
5	3	97	15:36:05	1200.7	1200	1817	1076	50	653.38	10.17	35.2	Cs-137	661.66	40.6745	1.890079
5	3	97	15:56:06	1200.7	1200	1887	1147	51	653.23	9.76	33.77	Cs-137	661.66	43.3584	1.927881
5	3	97	16:16:08	1200.7	1200	1863	1071	51	653.31	9.37	34.57	Cs-137	661.66	40.4855	1.927881
5	3	97	16:36:09	1200.7	1200	1915	1137	51	653.28	5.84	36.99	Cs-137	661.66	42.9804	1.927881
5	3	97	16:56:10	1200.7	1200	1916	1052	52	653.3	8.42	33.91	Cs-137	661.66	39.7673	1.965683
5	3	97	17:16:12	1200.7	1200	1907	1151	51	653.35	7.87	30.55	Cs-137	661.66	43.5096	1.927881
5	3	97	17:36:13	1200.7	1200	1868	1164	50	654.86	19.2	42.71	Cs-137	661.66	44.0011	1.890079
5	3	97	17:56:14	1200.7	1200	1890	1059	52	653.86	18.73	38.64	Cs-137	661.66	40.0319	1.965683
5	3	97	18:16:16	1200.7	1200	1971	1124	53	655.91	15.93	37.87	Cs-137	661.66	42.489	2.003484
5	3	97	18:36:17	1200.7	1200	1915	1084	52	653.37	8.35	37.46	Cs-137	661.66	40.9769	1.965683
5	3	97	18:56:18	1200.7	1200	1930	1244	51	651.38	10.85	35				
5	3	97	19:16:20	1200.8	1200	2039	1205	53	651.46	12.08	37.15				
5	3	97	19:36:21	1200.7	1200	1928	1148	52	653.37	8.13	33.36	Cs-137	661.66	43.3962	1.965683
5	3	97	19:56:22	1200.8	1200	1913	1100	52	654.94	17.68	35.45	Cs-137	661.66	41.5817	1.965683
5	3	97	20:16:24	1200.8	1200	1965	1131	52	651.26	14.38	36.73				
5	3	97	20:36:25	1200.8	1200	1878	1105	51	653.41	7.6	31.31	Cs-137	661.66	41.7708	1.927881

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
5	3	97	20:56:26	1200.8	1200	2033	1238	53	653.11	6.26	35.34	Cs-137	661.66	46.7984	2.003484
5	3	97	21:16:28	1200.8	1200	1932	1190	51	653.34	7.34	39.4	Cs-137	661.66	44.9839	1.927881
5	3	97	21:36:29	1200.8	1200	1957	1102	53	653.3	7.27	33.32	Cs-137	661.66	41.6574	2.003484
5	3	97	21:56:30	1200.8	1200	1820	1053	50	654.8	19.88	40.87	Cs-137	661.66	39.8051	1.890079
5	3	97	22:16:32	1200.8	1200	1945	1183	52	651.59	11.46	38.03				
5	3	97	22:36:33	1200.8	1200	1974	1108	53	651.24	11.88	38.66				
5	3	97	22:56:34	1200.8	1200	1953	1152	52	653.4	8.3	34.76	Cs-137	661.66	43.5474	1.965683
5	3	97	23:16:36	1200.8	1200	1964	1241	51	653.44	7.17	33.87	Cs-137	661.66	46.9118	1.927881
5	3	97	23:36:37	1200.8	1200	1920	1145	51	653.26	7.58	34.75	Cs-137	661.66	43.2828	1.927881
5	3	97	23:56:38	1200.8	1200	1961	1196	52	651.59	13.15	37.25				
6	3	97	0:16:40	1200.8	1200	2065	1196	54	653.4	8.77	33.68	Cs-137	661.66	45.2107	2.041286
6	3	97	0:36:41	1200.8	1200	1998	1194	52	653.26	8.29	34.05	Cs-137	661.66	45.1351	1.965683
6	3	97	0:56:43	1200.8	1200	2059	1132	54	655.49	4.75	33.76	Cs-137	661.66	42.7914	2.041286
6	3	97	1:16:44	1200.8	1200	1962	1075	53	653.17	6.3	33.9	Cs-137	661.66	40.6367	2.003484
6	3	97	1:36:45	1200.8	1200	1990	1156	53	653.28	7.43	35.84	Cs-137	661.66	43.6986	2.003484
6	3	97	1:56:47	1200.8	1200	2050	1183	54	653.42	7.61	34.99	Cs-137	661.66	44.7193	2.041286
6	3	97	2:16:48	1200.8	1200	2070	1272	53	653.31	5.31	37.14	Cs-137	661.66	48.0836	2.003484
6	3	97	2:36:49	1200.8	1200	2061	1125	54	653.53	9.4	34.52	Cs-137	661.66	42.5268	2.041286
6	3	97	2:56:51	1200.8	1200	2056	1243	53	653.55	5.45	35.7	Cs-137	661.66	46.9874	2.003484
6	3	97	3:16:52	1200.8	1200	1987	1195	52	653.47	6.62	31.34	Cs-137	661.66	45.1729	1.965683
6	3	97	3:36:54	1200.8	1200	2054	1193	53	655.48	5.97	35.68	Cs-137	661.66	45.0973	2.003484
6	3	97	3:56:55	1200.8	1200	2076	1215	54	653.43	7.98	36.28	Cs-137	661.66	45.9289	2.041286
6	3	97	4:16:56	1200.8	1200	2049	1191	53	653.51	9.51	34.57	Cs-137	661.66	45.0217	2.003484
6	3	97	4:36:58	1200.8	1200	1968	1077	53	653.4	9.92	32.27	Cs-137	661.66	40.7123	2.003484
6	3	97	4:56:59	1200.8	1200	2103	1179	55	653.56	7.68	32.9	Cs-137	661.66	44.5681	2.079087
6	3	97	5:17:01	1200.8	1200	2053	1153	54	653.4	7.95	33.36	Cs-137	661.66	43.5852	2.041286
6	3	97	5:37:04	1200.8	1200	2046	1128	54	653.62	8.32	36.17	Cs-137	661.66	42.6402	2.041286
6	3	97	5:57:06	1200.8	1200	2043	1072	54	653.37	7.37	33.82	Cs-137	661.66	40.5233	2.041286
6	3	97	6:17:07	1200.8	1200	2063	1181	54	653.4	7.36	36.67	Cs-137	661.66	44.6437	2.041286
6	3	97	6:37:08	1200.8	1200	1929	1137	52	651.47	9.76	36.39				
6	3	97	6:57:10	1200.8	1200	2086	1117	55	653.42	8.78	34.35	Cs-137	661.66	42.2244	2.079087
6	3	97	7:17:11	1200.8	1200	2031	1131	54	653.31	8.36	33.15	Cs-137	661.66	42.7536	2.041286
6	3	97	7:37:12	1200.9	1200	2039	1229	53	653.42	7.7	38.29	Cs-137	661.66	46.4582	2.003484
6	3	97	7:57:14	1201	1200	2087	1136	55	653.38	8.59	33.61	Cs-137	661.66	42.9426	2.079087
6	3	97	8:17:15	1200.9	1200	2002	1100	53	653.18	6.77	31.22	Cs-137	661.66	41.5817	2.003484
6	3	97	8:37:17	1201.1	1200	2107	1153	55	653.46	8.53	35.68	Cs-137	661.66	43.5852	2.079087
6	3	97	8:57:19	1201.1	1200	2131	1210	55	651.79	12.21	33.66				
6	3	97	9:17:20	1201.1	1200	2010	1236	52	653.57	9.47	36.34	Cs-137	661.66	46.7228	1.965683

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
6	3	97	9:37:22	1201.1	1200	2194	1297	55	653.4	7.67	33.23	Cs-137	661.66	49.0287	2.079087
6	3	97	9:57:23	1201.1	1200	2009	1062	54	653.46	7.87	34.66	Cs-137	661.66	40.1453	2.041286
6	3	97	10:17:25	1201	1200	2087	1196	54	653.41	7.81	36.57	Cs-137	661.66	45.2107	2.041286
6	3	97	10:37:27	1200.8	1200	1086	658	38	653.65	8.54	36.8	Cs-137	661.66	24.8734	1.43646
6	3	97	10:57:28	1200.5	1200	74	50	9	651.65	18.26	31.93				
6	3	97	11:17:29	1201	1200	1982	1172	52	651.49	10.7	35.28				
6	3	97	11:37:31	1201	1200	2074	1174	54	653.41	8.52	35.94	Cs-137	661.66	44.3791	2.041286
6	3	97	11:57:32	1201	1200	2123	1151	55	653.44	9.35	31.18	Cs-137	661.66	43.5096	2.079087
6	3	97	12:17:34	1201.1	1200	2037	1188	53	653.46	6.78	34.77	Cs-137	661.66	44.9083	2.003484
6	3	97	12:37:35	1201.1	1200	2025	1158	53	655.34	22.21	39.96	Cs-137	661.66	43.7742	2.003484
6	3	97	12:57:37	1201	1200	2070	1251	53	651.51	10.41	34.82				
6	3	97	13:17:38	1201	1200	2124	1253	54	651.52	10.7	35.27				
6	3	97	13:37:40	1201.1	1200	2035	1186	53	653.48	7.75	32.01	Cs-137	661.66	44.8327	2.003484
6	3	97	13:57:42	1201.2	1200	2173	1222	55	651.72	12.07	33.92				
6	3	97	14:17:44	1201	1200	2148	1278	54	651.43	11.33	34.12				
6	3	97	14:37:45	1200.8	1200	2131	1210	55	652.06	11.86	34.26	Cs-137	661.66	45.7399	2.079087
6	3	97	14:57:47	1200.8	1200	2070	1222	54	653.34	5.95	36.18	Cs-137	661.66	46.1935	2.041286
6	3	97	15:17:48	1200.8	1200	2125	1220	55	653.37	7.88	34.11	Cs-137	661.66	46.1179	2.079087
6	3	97	15:37:50	1200.8	1200	2161	1352	54	653.26	7.05	32.25	Cs-137	661.66	51.1077	2.041286
6	3	97	15:57:51	1200.8	1200	2227	1234	56	653.27	7.66	33.44	Cs-137	661.66	46.6472	2.116889
6	3	97	16:17:52	1200.8	1200	2062	1214	53	653.39	6.84	31.53	Cs-137	661.66	45.8911	2.003484
6	3	97	16:37:54	1200.8	1200	2115	1200	55	653.34	8.05	35.28	Cs-137	661.66	45.3619	2.079087
6	3	97	16:57:55	1200.8	1200	2276	1374	56	653.35	3.7	35.51	Cs-137	661.66	51.9394	2.116889
6	3	97	17:17:57	1200.8	1200	2190	1278	55	651.23	8.4	34.62				
6	3	97	17:37:58	1201.1	1200	2188	1277	55	653.46	7.12	31.42	Cs-137	661.66	48.2726	2.079087
6	3	97	17:58:00	1201.1	1200	2105	1331	53	653.28	6.93	34.52	Cs-137	661.66	50.3139	2.003484
6	3	97	18:18:01	1201.2	1200	2264	1322	56	653.25	7.34	31.43	Cs-137	661.66	49.9737	2.116889
6	3	97	18:38:03	1201.2	1200	2260	1258	57	651.18	9.63	33.52				
6	3	97	18:58:05	1201	1200	2223	1260	56	653.14	6.23	37.43	Cs-137	661.66	47.63	2.116889
6	3	97	19:18:06	1201.1	1200	2204	1247	56	653.4	6.72	34.07	Cs-137	661.66	47.1386	2.116889
6	3	97	19:38:08	1201.2	1200	2138	1304	54	653.34	7.6	30.54	Cs-137	661.66	49.2933	2.041286
6	3	97	19:58:10	1201.2	1200	2247	1368	55	654.37	19.51	38.29	Cs-137	661.66	51.7126	2.079087
6	3	97	20:18:11	1201.1	1200	2260	1383	56	651.48	10.97	37.75				
6	3	97	20:38:13	1201.1	1200	2185	1324	55	655.57	2.43	33.61	Cs-137	661.66	50.0493	2.079087
6	3	97	20:58:15	1201.1	1200	2178	1326	55	653.25	7.47	34.47	Cs-137	661.66	50.1249	2.079087
6	3	97	21:18:16	1201.1	1200	2277	1383	56	651.47	11.2	35.72				
6	3	97	21:38:18	1201	1200	2212	1281	56	653.53	7.82	35.53	Cs-137	661.66	48.4238	2.116889
6	3	97	21:58:20	1201	1200	2273	1307	56	653.36	9.89	34.63	Cs-137	661.66	49.4067	2.116889

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
6	3	97	22:18:21	1201.1	1200	2244	1314	56	653.22	6.3	33.6	Cs-137	661.66	49.6713	2.116889
6	3	97	22:38:23	1201.1	1200	2220	1296	56	653.41	6.74	31.48	Cs-137	661.66	48.9909	2.116889
6	3	97	22:58:25	1201	1200	2133	1346	54	655.02	20.39	38.38	Cs-137	661.66	50.8809	2.041286
6	3	97	23:18:26	1200.8	1200	2227	1287	56	651.51	11.96	34.91				
6	3	97	23:38:28	1200.9	1200	2203	1232	56	653.45	6.54	31.06	Cs-137	661.66	46.5716	2.116889
6	3	97	23:58:29	1200.9	1200	2253	1264	56	653.41	9.07	32.67	Cs-137	661.66	47.7812	2.116889
7	3	97	0:18:31	1200.9	1200	2289	1329	57	653.19	6	35.67	Cs-137	661.66	50.2383	2.154691
7	3	97	0:38:32	1200.9	1200	2224	1258	56	653.35	7.19	32.74	Cs-137	661.66	47.5544	2.116889
7	3	97	0:58:34	1200.9	1200	2238	1341	55	653.26	7.96	34.01	Cs-137	661.66	50.6919	2.079087
7	3	97	1:18:35	1200.9	1200	2230	1267	56	653.39	7.98	35.22	Cs-137	661.66	47.8946	2.116889
7	3	97	1:38:36	1200.9	1200	2266	1348	56	653.42	7.99	33.76	Cs-137	661.66	50.9565	2.116889
7	3	97	1:58:38	1200.9	1200	2266	1279	57	655.64	17.99	41.41	Cs-137	661.66	48.3482	2.154691
7	3	97	2:18:39	1200.9	1200	2294	1307	57	653.4	7.12	33.02	Cs-137	661.66	49.4067	2.154691
7	3	97	2:38:41	1200.9	1200	2369	1424	57	651.63	9.97	35.17				
7	3	97	2:58:42	1200.9	1200	2237	1298	56	653.37	7.51	34.06	Cs-137	661.66	49.0665	2.116889
7	3	97	3:18:44	1200.9	1200	2247	1319	56	653.5	9.4	35.52	Cs-137	661.66	49.8603	2.116889
7	3	97	3:38:45	1200.9	1200	2325	1386	57	653.29	6.95	37.32	Cs-137	661.66	52.393	2.154691
7	3	97	3:58:47	1200.9	1200	2219	1325	55	651.49	10.76	37.1				
7	3	97	4:18:48	1200.9	1200	2156	1253	55	655.46	3.47	33.54	Cs-137	661.66	47.3654	2.079087
7	3	97	4:38:50	1200.9	1200	2298	1208	58	653.47	8.33	31.93	Cs-137	661.66	45.6643	2.192492
7	3	97	4:58:51	1200.9	1200	2338	1426	57	653.36	7.1	35.63	Cs-137	661.66	53.9051	2.154691
7	3	97	5:18:53	1200.9	1200	2234	1349	55	653.59	7.13	31.53	Cs-137	661.66	50.9943	2.079087
7	3	97	5:38:54	1200.9	1200	2244	1359	55	653.51	6.54	34.42	Cs-137	661.66	51.3724	2.079087
7	3	97	5:58:56	1200.9	1200	2235	1371	55	653.37	7.34	35	Cs-137	661.66	51.826	2.079087
7	3	97	6:18:57	1200.9	1200	2287	1303	57	653.37	7.13	36.47	Cs-137	661.66	49.2555	2.154691
7	3	97	6:38:59	1200.9	1200	2366	1337	58	653.4	6.28	36.54	Cs-137	661.66	50.5407	2.192492
7	3	97	6:59:00	1200.9	1200	2280	1338	56	653.35	7.53	32.16	Cs-137	661.66	50.5785	2.116889
7	3	97	7:19:02	1200.9	1200	2297	1425	56	653.52	8.18	36.1	Cs-137	661.66	53.8673	2.116889
7	3	97	7:39:03	1200.9	1200	2277	1348	56	653.22	6.77	33.84	Cs-137	661.66	50.9565	2.116889
7	3	97	7:59:05	1200.9	1200	2301	1419	56	653.49	6.67	36.97	Cs-137	661.66	53.6405	2.116889
7	3	97	8:19:06	1200.9	1200	2293	1262	57	654.94	18.57	38.36	Cs-137	661.66	47.7056	2.154691
7	3	97	8:39:08	1200.9	1200	2300	1320	57	653.59	9.38	36.81	Cs-137	661.66	49.8981	2.154691
7	3	97	8:59:10	1200.9	1200	2237	1322	56	653.2	7.3	30.34	Cs-137	661.66	49.9737	2.116889
7	3	97	9:19:11	1200.9	1200	2336	1406	57	651.66	11.54	35.64				
7	3	97	9:39:13	1200.9	1200	2392	1418	58	653.39	7.83	34.62	Cs-137	661.66	53.6027	2.192492
7	3	97	9:59:14	1200.9	1200	2311	1317	57	653.37	7.3	33.37	Cs-137	661.66	49.7847	2.154691
7	3	97	10:19:16	1200.9	1200	2365	1395	57	651.4	11.3	35.52				
7	3	97	10:39:17	1200.9	1200	2297	1214	58	653.75	5.99	30.83	Cs-137	661.66	45.8911	2.192492

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
7	3	97	10:59:19	1200.9	1200	2411	1305	59	653.36	7.99	31.04	Cs-137	661.66	49.3311	2.230294
7	3	97	11:19:20	1200.9	1200	2392	1474	57	653.63	5.9	33.48	Cs-137	661.66	55.7195	2.154691
7	3	97	11:39:21	1200.9	1200	2385	1458	57	653.32	7.06	36.02	Cs-137	661.66	55.1147	2.154691
7	3	97	11:59:23	1200.9	1200	2370	1388	57	653.17	5.16	34.65	Cs-137	661.66	52.4686	2.154691
7	3	97	12:19:24	1200.9	1200	2341	1295	58	651.56	11.14	34.66				
7	3	97	12:39:26	1200.9	1200	2490	1566	58	653.33	8.26	31.91	Cs-137	661.66	59.1973	2.192492
7	3	97	12:59:27	1200.9	1200	2342	1376	57	651.37	9.75	33.89				
7	3	97	13:19:29	1200.9	1200	2435	1433	58	653.29	6.76	35.78	Cs-137	661.66	54.1697	2.192492
7	3	97	13:39:30	1200.9	1200	2388	1359	58	653.38	8.82	32.51	Cs-137	661.66	51.3724	2.192492
7	3	97	13:59:32	1201	1200	2399	1424	58	653.45	5.82	32.17	Cs-137	661.66	53.8295	2.192492
7	3	97	14:19:33	1200.9	1200	2290	1396	56	653.09	4.89	36.93	Cs-137	661.66	52.771	2.116889
7	3	97	14:39:35	1201.1	1200	2351	1517	56	651.42	11.06	34.57				
7	3	97	14:59:37	1201.2	1200	2320	1432	56	653.86	21.38	41.04	Cs-137	661.66	54.1319	2.116889
7	3	97	15:19:38	1201.1	1200	2298	1344	57	653.22	6.4	31.41	Cs-137	661.66	50.8053	2.154691
7	3	97	15:39:40	1201	1200	2316	1349	57	653.22	6.69	29.17	Cs-137	661.66	50.9943	2.154691
7	3	97	15:59:42	1200.9	1200	2297	1449	56	651.16	11.4	35.54				
7	3	97	16:19:43	1201.1	1200	2309	1433	56	653.2	6.96	33.15	Cs-137	661.66	54.1697	2.116889
7	3	97	16:39:45	1201	1200	2245	1456	55	653.38	6.01	37.24	Cs-137	661.66	55.0391	2.079087
7	3	97	16:59:46	1200.9	1200	2360	1472	56	653.34	6.19	34.15	Cs-137	661.66	55.6439	2.116889
7	3	97	17:19:48	1200.9	1200	2466	1517	58	654.04	23.28	40.12	Cs-137	661.66	57.345	2.192492
7	3	97	17:39:49	1200.9	1200	2385	1488	57	653.08	6.01	35.72	Cs-137	661.66	56.2488	2.154691
7	3	97	17:59:51	1200.9	1200	2335	1456	56	653.52	7.37	36.5	Cs-137	661.66	55.0391	2.116889
7	3	97	18:19:52	1200.9	1200	2420	1536	57	651.53	10.68	34.02				
7	3	97	18:39:54	1200.9	1200	2357	1511	56	653.29	5.42	36.53	Cs-137	661.66	57.1182	2.116889
7	3	97	18:59:55	1200.9	1200	2363	1418	57	653.32	7.12	34.34	Cs-137	661.66	53.6027	2.154691
7	3	97	19:19:57	1200.9	1200	2348	1439	57	653.25	6.66	32.66	Cs-137	661.66	54.3965	2.154691
7	3	97	19:39:58	1200.9	1200	2331	1392	57	655.55	22.8	35.83	Cs-137	661.66	52.6198	2.154691
7	3	97	20:00:00	1200.9	1200	2488	1520	58	651.33	11.51	32.93				
7	3	97	20:20:02	1200.9	1200	2506	1458	59	653.4	3.67	32.45	Cs-137	661.66	55.1147	2.230294
7	3	97	20:40:03	1200.9	1200	2512	1531	59	653.34	8.44	35.58	Cs-137	661.66	57.8742	2.230294
7	3	97	21:00:05	1200.9	1200	2426	1478	58	653.57	3.45	36.14	Cs-137	661.66	55.8707	2.192492
7	3	97	21:20:06	1200.9	1200	2375	1425	57	653.49	7.78	34.35	Cs-137	661.66	53.8673	2.154691
7	3	97	21:40:08	1201	1200	2425	1397	58	651.5	11.89	34.4				
7	3	97	22:00:09	1201	1200	2495	1457	59	653.43	8.57	33.37	Cs-137	661.66	55.0769	2.230294
7	3	97	22:20:11	1201	1200	2429	1467	58	651.39	10.58	36.07				
7	3	97	22:40:12	1200.9	1200	2387	1293	59	653.51	6.67	32.45	Cs-137	661.66	48.8775	2.230294
7	3	97	23:00:14	1201	1200	2433	1387	58	653.37	7.56	32.63	Cs-137	661.66	52.4308	2.192492
7	3	97	23:20:15	1201	1200	2558	1481	60	655.28	19.23	41.39	Cs-137	661.66	55.9842	2.268095

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
7	3	97	23:40:17	1201	1200	2466	1452	58	653.23	6.57	31.51	Cs-137	661.66	54.8879	2.192492
8	3	97	0:00:18	1201	1200	2438	1474	58	653.34	7.78	36.98	Cs-137	661.66	55.7195	2.192492
8	3	97	0:20:20	1201	1200	2349	1296	58	655.49	4.22	30.33	Cs-137	661.66	48.9909	2.192492
8	3	97	0:40:21	1201	1200	2443	1411	58	653.34	9.45	33.65	Cs-137	661.66	53.338	2.192492
8	3	97	1:00:23	1201	1200	2450	1469	58	654.86	22.31	41.22	Cs-137	661.66	55.5305	2.192492
8	3	97	1:20:25	1201	1200	2518	1516	59	653.3	5.99	32.89	Cs-137	661.66	57.3072	2.230294
8	3	97	1:40:26	1201	1200	2364	1456	57	653.5	6.88	33.94	Cs-137	661.66	55.0391	2.154691
8	3	97	2:00:28	1201	1200	2368	1423	57	651.65	11.09	35.53				
8	3	97	2:20:29	1201	1200	2402	1403	58	653.42	9.48	31.54	Cs-137	661.66	53.0356	2.192492
8	3	97	2:40:31	1201	1200	2446	1456	58	654.82	19.98	37.97	Cs-137	661.66	55.0391	2.192492
8	3	97	3:00:32	1201	1200	2400	1320	58	655.38	18.41	35.38	Cs-137	661.66	49.8981	2.192492
8	3	97	3:20:34	1201	1200	2396	1348	58	653.3	6.18	33.31	Cs-137	661.66	50.9565	2.192492
8	3	97	3:40:35	1201	1200	2496	1398	59	653.3	7.12	33.57	Cs-137	661.66	52.8466	2.230294
8	3	97	4:00:37	1201	1200	2403	1530	57	653.27	6.65	36.76	Cs-137	661.66	57.8364	2.154691
8	3	97	4:20:39	1201	1200	2412	1357	58	653.33	7.52	33.29	Cs-137	661.66	51.2968	2.192492
8	3	97	4:40:40	1201	1200	2381	1326	58	653.43	6.69	33.39	Cs-137	661.66	50.1249	2.192492
8	3	97	5:00:42	1201	1200	2474	1370	59	653.34	8.37	30.11	Cs-137	661.66	51.7882	2.230294
8	3	97	5:20:43	1201	1200	2428	1369	59	653.4	7.48	35.96	Cs-137	661.66	51.7504	2.230294
8	3	97	5:40:45	1201	1200	2465	1523	58	653.34	7.35	36.17	Cs-137	661.66	57.5718	2.192492
8	3	97	6:00:46	1201	1200	2489	1611	58	653.32	7.14	33.62	Cs-137	661.66	60.8984	2.192492
8	3	97	6:20:48	1201	1200	2504	1424	59	654.96	20.3	34.82	Cs-137	661.66	53.8295	2.230294
8	3	97	6:40:50	1201	1200	2481	1467	59	653.4	6.37	31.23	Cs-137	661.66	55.4549	2.230294
8	3	97	7:00:51	1201	1200	2433	1476	58	653.57	5.62	35.85	Cs-137	661.66	55.7951	2.192492
8	3	97	7:20:53	1201	1200	2592	1401	61	653.56	8.99	31.59	Cs-137	661.66	52.96	2.305897
8	3	97	7:40:54	1201	1200	2575	1501	60	653.4	6.77	32.33	Cs-137	661.66	56.7402	2.268095
8	3	97	8:00:56	1201	1200	2514	1441	59	653.49	7.99	30.95	Cs-137	661.66	54.4721	2.230294
8	3	97	8:20:58	1201	1200	2465	1365	59	653.53	6.73	36.73	Cs-137	661.66	51.5992	2.230294
8	3	97	8:40:59	1201	1200	2515	1429	60	655.47	13.39	33.23	Cs-137	661.66	54.0185	2.268095
8	3	97	9:01:01	1201	1200	2551	1501	60	653.43	8.52	34.49	Cs-137	661.66	56.7402	2.268095
8	3	97	9:21:02	1201	1200	2452	1399	59	653.47	6.61	35.05	Cs-137	661.66	52.8844	2.230294
8	3	97	9:41:04	1201	1200	2589	1497	60	653.41	6.81	33.69	Cs-137	661.66	56.589	2.268095
8	3	97	10:01:06	1201	1200	2428	1453	58	653.58	7.29	34.47	Cs-137	661.66	54.9257	2.192492
8	3	97	10:21:07	1201	1200	2469	1428	59	651.42	9.12	34.79				
8	3	97	10:41:09	1201	1200	2481	1392	59	653.31	7.77	34.13	Cs-137	661.66	52.6198	2.230294
8	3	97	11:01:11	1201	1200	2487	1453	59	653.62	6.95	36.72	Cs-137	661.66	54.9257	2.230294
8	3	97	11:21:12	1201	1200	2530	1390	60	653.28	7.52	29.56	Cs-137	661.66	52.5442	2.268095
8	3	97	11:41:14	1201	1200	2419	1409	58	653.52	5.84	35.99	Cs-137	661.66	53.2624	2.192492
8	3	97	12:01:15	1201	1200	2501	1418	59	651.8	9.85	33.56				

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
8	3	97	12:21:17	1201	1200	2485	1459	59	653.52	7.07	33.97	Cs-137	661.66	55.1525	2.230294
8	3	97	12:41:18	1201	1200	2474	1484	58	653.53	7.04	31.57	Cs-137	661.66	56.0976	2.192492
8	3	97	13:01:20	1201	1200	2487	1481	59	653.45	8.03	35.35	Cs-137	661.66	55.9842	2.230294
8	3	97	13:21:22	1201	1200	2500	1550	58	653.65	7.23	33.04	Cs-137	661.66	58.5925	2.192492
8	3	97	13:41:24	1201	1200	2536	1495	59	653.53	8.99	32.45	Cs-137	661.66	56.5134	2.230294
8	3	97	14:01:25	1201	1200	2512	1448	59	653.34	6.6	31.38	Cs-137	661.66	54.7367	2.230294
8	3	97	14:21:27	1201	1200	2488	1496	58	653.45	6.85	34.25	Cs-137	661.66	56.5512	2.192492
8	3	97	14:41:28	1201	1200	2533	1462	60	655.36	20.19	39.59	Cs-137	661.66	55.2659	2.268095
8	3	97	15:01:30	1201	1200	2565	1508	60	653.38	4.87	33.17	Cs-137	661.66	57.0048	2.268095
8	3	97	15:21:32	1201	1200	2528	1544	59	653.28	5.82	31.47	Cs-137	661.66	58.3657	2.230294
8	3	97	15:41:33	1201	1200	2500	1447	59	653.32	7.19	30.7	Cs-137	661.66	54.6989	2.230294
8	3	97	16:01:35	1201	1200	2596	1507	60	651.48	10.87	34.88				
8	3	97	16:21:37	1201	1200	2518	1495	59	653.32	7.04	32.83	Cs-137	661.66	56.5134	2.230294
8	3	97	16:41:38	1201	1200	2477	1406	59	653.32	3.71	33.63	Cs-137	661.66	53.149	2.230294
8	3	97	17:01:40	1201	1200	1955	1107	52	653.36	10.17	36.55	Cs-137	661.66	41.8464	1.965683
8	3	97	17:21:41	1200.8	1200	623	323	30	654.24	11.27	30.81	Cs-137	661.66	12.2099	1.134048
8	3	97	17:41:43	1201.1	1200	3064	1786	65	653.36	6.51	31.16	Cs-137	661.66	67.5136	2.457103
8	3	97	18:01:44	1200.8	1200	543	310	27	653.69	14.82	33.93	Cs-137	661.66	11.7185	1.020643
8	3	97	18:21:46	1200.8	1200	583	338	28	653.98	18.16	31.62	Cs-137	661.66	12.7769	1.058445
8	3	97	18:41:47	1201	1200	2380	1473	57	651.46	11.53	35.02				
8	3	97	19:01:49	1201	1200	2488	1519	58	653.35	5.82	31.57	Cs-137	661.66	57.4206	2.192492
8	3	97	19:21:50	1201	1200	2438	1403	58	653.22	6.93	34.9	Cs-137	661.66	53.0356	2.192492
8	3	97	19:41:52	1201	1200	2597	1544	60	653.42	5.93	32.76	Cs-137	661.66	58.3657	2.268095
8	3	97	20:01:54	1201	1200	2503	1486	59	653.41	6.61	33.44	Cs-137	661.66	56.1732	2.230294
8	3	97	20:21:55	1201	1200	2562	1434	60	653.39	6.24	30.1	Cs-137	661.66	54.2075	2.268095
8	3	97	20:41:57	1201.1	1200	2535	1473	59	653.34	7.73	36.23	Cs-137	661.66	55.6817	2.230294
8	3	97	21:01:58	1201.1	1200	2441	1418	58	653.42	7.16	35.14	Cs-137	661.66	53.6027	2.192492
8	3	97	21:22:00	1201	1200	2506	1377	60	653.6	7.6	33.61	Cs-137	661.66	52.0528	2.268095
8	3	97	21:42:02	1201	1200	2486	1404	59	653.51	7.36	31.31	Cs-137	661.66	53.0734	2.230294
8	3	97	22:02:03	1201	1200	2588	1506	60	653.45	6.81	30.85	Cs-137	661.66	56.9292	2.268095
8	3	97	22:22:05	1201.1	1200	2410	1402	58	653.43	7.61	30.86	Cs-137	661.66	52.9978	2.192492
8	3	97	22:42:07	1201.1	1200	2505	1593	58	651.61	10.53	36.92				
8	3	97	23:02:08	1201.1	1200	2580	1518	60	653.38	5.71	30.49	Cs-137	661.66	57.3828	2.268095
8	3	97	23:22:10	1201.1	1200	2465	1415	59	653.42	8.57	31.33	Cs-137	661.66	53.4892	2.230294
8	3	97	23:42:12	1201.1	1200	2469	1444	59	653.38	7.58	32.82	Cs-137	661.66	54.5855	2.230294
9	3	97	0:02:14	1201.1	1200	2492	1460	59	653.62	8.04	32.66	Cs-137	661.66	55.1903	2.230294
9	3	97	0:22:15	1201.1	1200	2481	1341	60	651.77	12.31	32.7				
9	3	97	0:42:17	1201.1	1200	2544	1551	59	653.57	7.02	34.67	Cs-137	661.66	58.6303	2.230294

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
9	3	97	1:02:19	1201.1	1200	2531	1370	60	653.47	8.08	31.12	Cs-137	661.66	51.7882	2.268095
9	3	97	1:22:20	1201.1	1200	2501	1437	59	653.51	8.74	33.65	Cs-137	661.66	54.3209	2.230294
9	3	97	1:42:22	1201.1	1200	2456	1373	59	653.59	6.83	35.05	Cs-137	661.66	51.9016	2.230294
9	3	97	2:02:24	1201.1	1200	2520	1515	59	653.49	7.6	32.38	Cs-137	661.66	57.2694	2.230294
9	3	97	2:22:25	1201.1	1200	2526	1389	60	653.43	9.14	32.15	Cs-137	661.66	52.5064	2.268095
9	3	97	2:42:27	1201.1	1200	2485	1444	59	653.72	7.44	34.42	Cs-137	661.66	54.5855	2.230294
9	3	97	3:02:29	1201.1	1200	2486	1344	60	653.51	7.35	30.73	Cs-137	661.66	50.8053	2.268095
9	3	97	3:22:30	1201.4	1200	2576	1349	61	653.32	7.19	29.74	Cs-137	661.66	50.9943	2.305897
9	3	97	3:42:32	1201.5	1200	2506	1373	60	655.46	2.99	31.27	Cs-137	661.66	51.9016	2.268095
9	3	97	4:02:34	1201.4	1200	2445	1272	60	653.71	9.68	31.69	Cs-137	661.66	48.0836	2.268095
9	3	97	4:22:36	1201.3	1200	2499	1433	59	653.43	8.73	32.92	Cs-137	661.66	54.1697	2.230294
9	3	97	4:42:38	1201.3	1200	2417	1352	59	653.74	4.49	28.71	Cs-137	661.66	51.1077	2.230294
9	3	97	5:02:40	1201.5	1200	2525	1404	60	653.46	7.11	30.19	Cs-137	661.66	53.0734	2.268095
9	3	97	5:22:42	1201.2	1200	2564	1424	60	653.39	6.67	32.12	Cs-137	661.66	53.8295	2.268095
9	3	97	5:42:44	1201.1	1200	2540	1382	60	653.76	8.62	30.9	Cs-137	661.66	52.2418	2.268095
9	3	97	6:02:46	1201.1	1200	2649	1477	61	653.42	7.78	32.51	Cs-137	661.66	55.8329	2.305897
9	3	97	6:22:47	1201.1	1200	2550	1446	60	653.72	7.02	30.88	Cs-137	661.66	54.6611	2.268095
9	3	97	6:42:49	1201.1	1200	2598	1476	60	653.51	7.23	33.54	Cs-137	661.66	55.7951	2.268095
9	3	97	7:02:51	1201.1	1200	2697	1440	62	653.44	6.8	31.93	Cs-137	661.66	54.4343	2.343699
9	3	97	7:22:52	1201.1	1200	2540	1399	60	653.67	7.34	30.51	Cs-137	661.66	52.8844	2.268095
9	3	97	7:42:54	1201.1	1200	2578	1348	61	653.59	8.25	29.83	Cs-137	661.66	50.9565	2.305897
9	3	97	8:02:56	1201.1	1200	2570	1376	61	655.48	2.17	29.64	Cs-137	661.66	52.015	2.305897
9	3	97	8:22:57	1201.1	1200	2623	1405	61	653.51	7.28	32.48	Cs-137	661.66	53.1112	2.305897
9	3	97	8:42:59	1201.1	1200	2603	1385	61	655.57	1.58	29.57	Cs-137	661.66	52.3552	2.305897
9	3	97	9:03:01	1201.1	1200	2632	1370	62	653.58	8.95	30.62	Cs-137	661.66	51.7882	2.343699
9	3	97	9:23:02	1201.1	1200	2617	1384	62	655.65	0.25	31.64	Cs-137	661.66	52.3174	2.343699
9	3	97	9:43:04	1201.1	1200	2538	1240	61	653.5	8.05	29.21	Cs-137	661.66	46.874	2.305897
9	3	97	10:03:06	1201.1	1200	2622	1352	62	653.84	7.57	33.23	Cs-137	661.66	51.1077	2.343699
9	3	97	10:23:08	1201.1	1200	2587	1353	61	655.57	2.14	29.99	Cs-137	661.66	51.1456	2.305897
9	3	97	10:43:09	1201.1	1200	2615	1307	62	655.47	3.14	28.86	Cs-137	661.66	49.4067	2.343699
9	3	97	11:03:11	1201.1	1200	2559	1272	62	653.73	8.53	31.59	Cs-137	661.66	48.0836	2.343699
9	3	97	11:23:13	1201.1	1200	2649	1441	62	655.48	2.6	30.93	Cs-137	661.66	54.4721	2.343699
9	3	97	11:43:14	1201.1	1200	2671	1517	61	653.5	7.45	33.74	Cs-137	661.66	57.345	2.305897
9	3	97	12:03:16	1201.1	1200	2664	1359	63	653.65	7.26	30.4	Cs-137	661.66	51.3724	2.3815
9	3	97	12:23:18	1201.1	1200	2568	1494	60	653.6	7.34	30.62	Cs-137	661.66	56.4756	2.268095
9	3	97	12:43:19	1201.1	1200	2696	1401	63	653.54	6.84	31.65	Cs-137	661.66	52.96	2.3815
9	3	97	13:03:21	1201.1	1200	2627	1466	61	653.56	7.85	33.53	Cs-137	661.66	55.4171	2.305897
9	3	97	13:23:23	1201.1	1200	2651	1433	62	653.42	8.82	32.43	Cs-137	661.66	54.1697	2.343699

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
9	3	97	13:43:24	1201.1	1200	2651	1520	61	653.76	7.68	33.8	Cs-137	661.66	57.4584	2.305897
9	3	97	14:03:26	1201.1	1200	2572	1433	60	653.53	6.2	35.32	Cs-137	661.66	54.1697	2.268095
9	3	97	14:23:28	1201.1	1200	2605	1528	60	653.44	6.81	34.28	Cs-137	661.66	57.7608	2.268095
9	3	97	14:43:30	1201.1	1200	2649	1557	61	653.36	7.15	31.95	Cs-137	661.66	58.8571	2.305897
9	3	97	15:03:31	1201.1	1200	2673	1480	62	653.4	8.1	32.63	Cs-137	661.66	55.9464	2.343699
9	3	97	15:23:33	1201.1	1200	2642	1502	61	653.5	7	36.36	Cs-137	661.66	56.778	2.305897
9	3	97	15:43:35	1201.1	1200	2693	1504	62	653.44	7.43	29.67	Cs-137	661.66	56.8536	2.343699
9	3	97	16:03:36	1201.1	1200	2684	1493	62	653.42	7.61	33.27	Cs-137	661.66	56.4378	2.343699
9	3	97	16:23:38	1201.1	1200	2632	1557	60	655.57	1.77	32.97	Cs-137	661.66	58.8571	2.268095
9	3	97	16:43:43	1201.1	1200	2608	1421	61	653.42	7.17	32.45	Cs-137	661.66	53.7161	2.305897
9	3	97	17:03:45	1201.1	1200	2710	1609	61	653.42	5.52	35.15	Cs-137	661.66	60.8228	2.305897
9	3	97	17:23:47	1201.1	1200	2624	1544	60	653.53	8.18	33.67	Cs-137	661.66	58.3657	2.268095
9	3	97	17:43:49	1201.1	1200	2686	1579	61	653.24	6.41	33.6	Cs-137	661.66	59.6887	2.305897
9	3	97	18:03:51	1201.1	1200	2763	1593	62	653.19	5.29	32.97	Cs-137	661.66	60.2179	2.343699
9	3	97	18:23:52	1201.1	1200	2664	1707	60	651.2	11.63	38.21				
9	3	97	18:43:54	1201.1	1200	2729	1641	61	653.38	4.18	35.27	Cs-137	661.66	62.0324	2.305897
9	3	97	19:03:56	1201.1	1200	2654	1646	60	653.46	6.97	36.68	Cs-137	661.66	62.2214	2.268095
9	3	97	19:23:57	1201.1	1200	2813	1558	63	651.51	9.69	33.42				
9	3	97	19:43:59	1201.1	1200	2755	1615	62	653.38	3.47	36.63	Cs-137	661.66	61.0496	2.343699
9	3	97	20:04:01	1201.1	1200	2734	1696	61	653.41	5.76	34.06	Cs-137	661.66	64.1115	2.305897
9	3	97	20:24:02	1201.1	1200	2744	1601	62	653.43	6.78	31.69	Cs-137	661.66	60.5203	2.343699
9	3	97	20:44:04	1201.1	1200	2724	1602	62	653.42	6.27	35.81	Cs-137	661.66	60.5581	2.343699
9	3	97	21:04:06	1201.1	1200	2709	1554	62	653.57	7.95	31.21	Cs-137	661.66	58.7437	2.343699
9	3	97	21:24:08	1201.1	1200	2655	1497	61	653.54	8.15	35.8	Cs-137	661.66	56.589	2.305897
9	3	97	21:44:09	1201.1	1200	2694	1609	61	653.31	5.45	31.41	Cs-137	661.66	60.8228	2.305897
9	3	97	22:04:11	1201.1	1200	2725	1606	62	653.34	7.3	35.51	Cs-137	661.66	60.7094	2.343699
9	3	97	22:24:13	1201.1	1200	2698	1492	62	653.6	6.61	30.18	Cs-137	661.66	56.4	2.343699
9	3	97	22:44:15	1201.1	1200	2772	1621	62	653.62	5.84	31.84	Cs-137	661.66	61.2764	2.343699
9	3	97	23:04:16	1201.1	1200	2719	1590	62	653.52	7.2	31.61	Cs-137	661.66	60.1045	2.343699
9	3	97	23:24:18	1201.1	1200	2786	1526	63	653.45	6.92	33.37	Cs-137	661.66	57.6852	2.3815
9	3	97	23:44:20	1201.1	1200	2755	1498	63	653.28	6.46	30.81	Cs-137	661.66	56.6268	2.3815
10	3	97	0:04:21	1201.1	1200	2673	1410	62	653.34	5.73	32.54	Cs-137	661.66	53.3002	2.343699
10	3	97	0:24:23	1201.1	1200	2738	1562	62	653.23	5.93	33.68	Cs-137	661.66	59.0461	2.343699
10	3	97	0:44:25	1201.1	1200	2696	1524	62	653.91	7.81	33.03	Cs-137	661.66	57.6096	2.343699
10	3	97	1:04:27	1201.1	1200	2792	1541	63	653.65	7.06	31.52	Cs-137	661.66	58.2523	2.3815
10	3	97	1:24:28	1201.1	1200	2665	1493	61	653.53	9.24	31.61	Cs-137	661.66	56.4378	2.305897
10	3	97	1:44:30	1201.2	1200	2739	1554	62	653.7	7.2	32.81	Cs-137	661.66	58.7437	2.343699
10	3	97	2:04:32	1201.2	1200	2695	1600	61	653.44	7.2	37.17	Cs-137	661.66	60.4825	2.305897

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
10	3	97	2:24:34	1201.1	1200	2787	1596	63	653.34	6.51	33.52	Cs-137	661.66	60.3313	2.3815
10	3	97	2:44:35	1201.1	1200	2697	1493	62	653.78	6.69	33.39	Cs-137	661.66	56.4378	2.343699
10	3	97	3:04:37	1201.2	1200	2693	1583	61	653.39	7.51	31.72	Cs-137	661.66	59.8399	2.305897
10	3	97	3:24:39	1201.2	1200	2829	1606	63	653.39	6.76	30.6	Cs-137	661.66	60.7094	2.3815
10	3	97	3:44:41	1201.2	1200	2737	1635	61	653.39	7.38	32.45	Cs-137	661.66	61.8056	2.305897
10	3	97	4:04:42	1201.2	1200	2739	1605	62	653.6	6.73	29.94	Cs-137	661.66	60.6716	2.343699
10	3	97	4:24:44	1201.2	1200	2812	1563	63	653.58	6.56	30.13	Cs-137	661.66	59.0839	2.3815
10	3	97	4:44:46	1201.2	1200	2776	1549	63	653.53	8.27	32.86	Cs-137	661.66	58.5547	2.3815
10	3	97	5:04:48	1201.2	1200	2813	1460	64	653.28	6.63	30.9	Cs-137	661.66	55.1903	2.419302
10	3	97	5:24:49	1201.2	1200	2764	1608	62	653.42	5.56	30.83	Cs-137	661.66	60.785	2.343699
10	3	97	5:44:51	1201.2	1200	2852	1706	63	653.34	6.42	31.59	Cs-137	661.66	64.4895	2.3815
10	3	97	6:04:53	1201.2	1200	2718	1437	63	653.46	7.48	29.77	Cs-137	661.66	54.3209	2.3815
10	3	97	6:24:55	1201.2	1200	2695	1545	62	653.45	7.7	33.91	Cs-137	661.66	58.4035	2.343699
10	3	97	6:44:56	1201.2	1200	2816	1630	63	653.55	5.75	33.57	Cs-137	661.66	61.6166	2.3815
10	3	97	7:04:58	1201.2	1200	2844	1650	63	653.42	5.7	32.45	Cs-137	661.66	62.3726	2.3815
10	3	97	7:25:00	1201.2	1200	2734	1529	62	653.51	5.32	32.29	Cs-137	661.66	57.7986	2.343699
10	3	97	7:45:02	1201.2	1200	2823	1574	63	653.62	6.58	33.26	Cs-137	661.66	59.4997	2.3815
10	3	97	8:05:03	1201.2	1200	2769	1376	64	653.47	3.53	31.13	Cs-137	661.66	52.015	2.419302
10	3	97	8:25:05	1201.2	1200	2788	1574	63	653.63	7.05	32.47	Cs-137	661.66	59.4997	2.3815
10	3	97	8:45:07	1201.2	1200	2819	1565	63	653.25	4.26	28.99	Cs-137	661.66	59.1595	2.3815
10	3	97	9:05:09	1201.2	1200	2753	1587	62	653.49	5.28	29.87	Cs-137	661.66	59.9911	2.343699
10	3	97	9:25:11	1201.2	1200	2764	1588	62	653.4	6.32	34.32	Cs-137	661.66	60.0289	2.343699
10	3	97	9:45:12	1201.2	1200	2749	1519	63	653.45	4.39	33.29	Cs-137	661.66	57.4206	2.3815
10	3	97	10:05:14	1201.2	1200	2712	1668	61	653.21	3.76	35.24	Cs-137	661.66	63.0531	2.305897
10	3	97	10:25:16	1201.2	1200	2722	1566	62	653.59	7.89	32.28	Cs-137	661.66	59.1973	2.343699
10	3	97	10:45:18	1201.2	1200	2803	1657	62	653.45	7.13	33.56	Cs-137	661.66	62.6372	2.343699
10	3	97	11:05:20	1201.2	1200	2856	1716	63	653.37	7.51	32.52	Cs-137	661.66	64.8675	2.3815
10	3	97	11:25:22	1201.2	1200	2703	1655	61	653.24	8.35	33.34	Cs-137	661.66	62.5616	2.305897
10	3	97	11:45:23	1201.2	1200	2827	1576	63	653.54	6.71	32.73	Cs-137	661.66	59.5753	2.3815
10	3	97	12:05:25	1201.2	1200	2824	1581	63	653.43	6.55	30.48	Cs-137	661.66	59.7643	2.3815
10	3	97	12:25:27	1201.2	1200	2925	1695	64	653.43	3.41	32.36	Cs-137	661.66	64.0737	2.419302
10	3	97	12:45:29	1201.2	1200	2843	1713	63	653.37	6.03	29.97	Cs-137	661.66	64.7541	2.3815
10	3	97	13:05:31	1201.2	1200	2791	1538	63	653.39	6.99	36.29	Cs-137	661.66	58.1388	2.3815
10	3	97	13:25:32	1201.2	1200	2790	1572	63	653.59	7.59	30.58	Cs-137	661.66	59.4241	2.3815
10	3	97	13:45:34	1201.2	1200	2762	1540	63	653.75	7.6	30.44	Cs-137	661.66	58.2144	2.3815
10	3	97	14:05:36	1201.2	1200	2756	1634	62	653.62	6.46	31.13	Cs-137	661.66	61.7678	2.343699
10	3	97	14:25:38	1201.2	1200	2877	1623	64	653.57	5.37	30.81	Cs-137	661.66	61.352	2.419302
10	3	97	14:45:40	1201.2	1200	2848	1648	63	653.45	4.63	33.23	Cs-137	661.66	62.297	2.3815

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
10	3	97	15:05:41	1201.2	1200	2863	1627	64	653.4	6.08	31.37	Cs-137	661.66	61.5032	2.419302
10	3	97	15:25:43	1201.2	1200	2916	1614	64	653.37	5.53	32.61	Cs-137	661.66	61.0118	2.419302
10	3	97	15:45:45	1201.2	1200	2780	1615	62	653.31	7.03	31.97	Cs-137	661.66	61.0496	2.343699
10	3	97	16:05:47	1201.2	1200	2856	1581	64	653.55	6.58	31.97	Cs-137	661.66	59.7643	2.419302
10	3	97	16:25:49	1201.2	1200	2910	1767	63	653.37	6.64	32.72	Cs-137	661.66	66.7954	2.3815
10	3	97	16:45:50	1201.2	1200	2915	1648	64	653.38	2.83	31.51	Cs-137	661.66	62.297	2.419302
10	3	97	17:05:52	1201.2	1200	2933	1649	64	653.54	6.31	34.64	Cs-137	661.66	62.3348	2.419302
10	3	97	17:25:54	1201.2	1200	2829	1650	63	653.5	6.62	34.04	Cs-137	661.66	62.3726	2.3815
10	3	97	17:45:56	1201.2	1200	2931	1815	63	653.4	5.61	31.44	Cs-137	661.66	68.6099	2.3815
10	3	97	18:05:58	1201.2	1200	2947	1710	64	651.71	10.57	35.17				
10	3	97	18:26:00	1201.2	1200	2893	1591	64	653.57	6.58	30.51	Cs-137	661.66	60.1423	2.419302
10	3	97	18:46:01	1201.2	1200	2941	1676	64	653.47	6.71	31.76	Cs-137	661.66	63.3555	2.419302
10	3	97	19:06:03	1201.2	1200	2902	1704	64	655.55	2.28	32.07	Cs-137	661.66	64.4139	2.419302
10	3	97	19:26:05	1201.2	1200	2802	1696	62	653.33	6.84	36.55	Cs-137	661.66	64.1115	2.343699
10	3	97	19:46:07	1201.2	1200	2984	1652	65	653.63	2.88	31.81	Cs-137	661.66	62.4482	2.457103
10	3	97	20:06:09	1201.2	1200	2819	1589	63	653.85	7.61	33.09	Cs-137	661.66	60.0667	2.3815
10	3	97	20:26:10	1201.2	1200	2868	1611	64	653.38	7.01	32.16	Cs-137	661.66	60.8984	2.419302
10	3	97	20:46:12	1201.2	1200	2880	1590	64	655.43	2.93	29.74	Cs-137	661.66	60.1045	2.419302
10	3	97	21:06:14	1201.3	1200	2948	1706	64	653.52	5.45	35.25	Cs-137	661.66	64.4895	2.419302
10	3	97	21:26:16	1201.2	1200	2923	1656	64	653.36	6.83	32.73	Cs-137	661.66	62.5994	2.419302
10	3	97	21:46:18	1201.2	1200	2878	1579	64	653.61	5.97	31.11	Cs-137	661.66	59.6887	2.419302
10	3	97	22:06:20	1201.3	1200	2977	1713	65	653.55	3.95	31.22	Cs-137	661.66	64.7541	2.457103
10	3	97	22:26:21	1201.3	1200	2903	1659	64	653.48	7.54	34.8	Cs-137	661.66	62.7128	2.419302
10	3	97	22:46:23	1201.3	1200	2945	1724	64	653.44	6.59	33.72	Cs-137	661.66	65.1699	2.419302
10	3	97	23:06:25	1201.2	1200	2883	1548	64	655.61	19.88	35.5	Cs-137	661.66	58.5169	2.419302
10	3	97	23:26:27	1201.3	1200	2942	1577	65	653.43	7.02	32.23	Cs-137	661.66	59.6131	2.457103
10	3	97	23:46:29	1201.2	1200	2861	1538	64	653.59	7.66	30.5	Cs-137	661.66	58.1388	2.419302
11	3	97	0:06:31	1201.3	1200	2853	1608	64	653.5	7.13	35.52	Cs-137	661.66	60.785	2.419302
11	3	97	0:26:33	1201.3	1200	2912	1613	64	653.58	6.87	27.25	Cs-137	661.66	60.974	2.419302
11	3	97	0:46:34	1201.3	1200	2884	1569	64	653.6	6.67	30.93	Cs-137	661.66	59.3107	2.419302
11	3	97	1:06:36	1201.3	1200	2846	1625	63	653.49	7.14	31.19	Cs-137	661.66	61.4276	2.3815
11	3	97	1:26:38	1201.3	1200	2972	1609	65	653.49	6.21	30.59	Cs-137	661.66	60.8228	2.457103
11	3	97	1:46:40	1201.3	1200	2966	1569	66	653.58	7.24	33.38	Cs-137	661.66	59.3107	2.494905
11	3	97	2:06:42	1201.3	1200	2938	1510	66	653.71	7.94	33.06	Cs-137	661.66	57.0804	2.494905
11	3	97	2:26:44	1201.3	1200	2941	1615	65	653.48	8.01	34.1	Cs-137	661.66	61.0496	2.457103
11	3	97	2:46:46	1201.3	1200	2870	1643	64	655.6	1.88	29.98	Cs-137	661.66	62.108	2.419302
11	3	97	3:06:47	1201.3	1200	3006	1614	66	653.74	6.58	31.39	Cs-137	661.66	61.0118	2.494905
11	3	97	3:26:49	1201.3	1200	2980	1702	65	653.61	6.86	31.29	Cs-137	661.66	64.3383	2.457103

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
11	3	97	3:46:51	1201.3	1200	2972	1502	66	653.55	6.88	30.85	Cs-137	661.66	56.778	2.494905
11	3	97	4:06:53	1201.3	1200	2965	1690	65	653.59	6.57	30.57	Cs-137	661.66	63.8847	2.457103
11	3	97	4:26:55	1201.3	1200	2988	1692	65	653.56	7.06	33.43	Cs-137	661.66	63.9603	2.457103
11	3	97	4:46:57	1201.3	1200	2971	1666	65	653.47	5.21	32.14	Cs-137	661.66	62.9774	2.457103
11	3	97	5:06:59	1201.3	1200	2978	1548	66	653.61	7.9	31.42	Cs-137	661.66	58.5169	2.494905
11	3	97	5:27:01	1201.3	1200	3051	1636	66	655.5	0.76	30.27	Cs-137	661.66	61.8434	2.494905
11	3	97	5:47:03	1201.3	1200	2807	1604	63	653.57	7.56	31.6	Cs-137	661.66	60.6338	2.3815
11	3	97	6:07:04	1201.3	1200	2894	1532	65	655.56	2.89	28.89	Cs-137	661.66	57.912	2.457103
11	3	97	6:27:06	1201.3	1200	2971	1647	65	653.67	6.59	33.97	Cs-137	661.66	62.2592	2.457103
11	3	97	6:47:08	1201.3	1200	2915	1613	64	653.43	6.27	31.16	Cs-137	661.66	60.974	2.419302
11	3	97	7:07:10	1201.3	1200	2903	1574	65	653.6	6.51	30.8	Cs-137	661.66	59.4997	2.457103
11	3	97	7:27:12	1201.3	1200	2919	1563	65	653.31	5.6	33.99	Cs-137	661.66	59.0839	2.457103
11	3	97	7:47:14	1201.3	1200	2820	1417	64	655.57	5.09	29.23	Cs-137	661.66	53.5649	2.419302
11	3	97	8:07:16	1201.3	1200	2902	1522	65	653.53	6.62	31.37	Cs-137	661.66	57.534	2.457103
11	3	97	8:27:18	1201.3	1200	2963	1523	66	653.69	9.31	32.07	Cs-137	661.66	57.5718	2.494905
11	3	97	8:47:20	1201.3	1200	3066	1642	67	655.61	3.1	29.08	Cs-137	661.66	62.0702	2.532707
11	3	97	9:07:22	1201.3	1200	2936	1637	65	653.65	6.77	33.01	Cs-137	661.66	61.8812	2.457103
11	3	97	9:27:23	1201.3	1200	2927	1529	65	653.61	6.98	31.86	Cs-137	661.66	57.7986	2.457103
11	3	97	9:47:25	1201.3	1200	2969	1589	65	653.77	7.16	33.07	Cs-137	661.66	60.0667	2.457103
11	3	97	10:07:27	1201.3	1200	2952	1512	66	653.37	8.19	30.65	Cs-137	661.66	57.156	2.494905
11	3	97	10:27:29	1201.3	1200	2954	1637	65	653.37	6.92	30.75	Cs-137	661.66	61.8812	2.457103
11	3	97	10:47:31	1201.3	1200	2950	1689	64	653.59	6.88	31.17	Cs-137	661.66	63.8469	2.419302
11	3	97	11:07:33	1201.3	1200	2935	1754	64	653.35	5.81	32.78	Cs-137	661.66	66.304	2.419302
11	3	97	11:27:34	1201.3	1200	2886	1605	64	653.54	6.34	30.69	Cs-137	661.66	60.6716	2.419302
11	3	97	11:47:36	1201.3	1200	3006	1779	65	653.45	6.47	29.73	Cs-137	661.66	67.249	2.457103
11	3	97	12:07:38	1201.3	1200	3083	1578	67	653.5	7.06	30.79	Cs-137	661.66	59.6509	2.532707
11	3	97	12:27:40	1201.3	1200	2930	1677	64	653.44	5.91	31.07	Cs-137	661.66	63.3933	2.419302
11	3	97	12:47:42	1201.2	1200	2301	1251	57	653.52	5.03	31.34	Cs-137	661.66	47.2898	2.154691
11	3	97	13:07:44	1201.1	1200	1724	970	49	653.51	8.11	35.24	Cs-137	661.66	36.6675	1.852278
11	3	97	13:27:45	1201.1	1200	1375	794	44	655.78	6.67	33.51	Cs-137	661.66	30.0145	1.66327
11	3	97	13:47:47	1201	1200	1161	641	41	653.48	11.01	30.59	Cs-137	661.66	24.2308	1.549865
11	3	97	14:07:49	1201	1200	963	537	37	653.7	9.95	34.07	Cs-137	661.66	20.2995	1.398659
11	3	97	14:27:50	1201	1200	803	488	33	653.68	10.41	40.37	Cs-137	661.66	18.4472	1.247452
11	3	97	14:47:52	1201	1200	691	403	31	654.64	22.12	42.26	Cs-137	661.66	15.234	1.171849
11	3	97	15:07:53	1201	1200	726	403	32	653.42	11.94	38.07	Cs-137	661.66	15.234	1.209651
11	3	97	15:27:55	1201	1200	652	338	31	651.84	18.03	39.75	Cs-137	661.66	12.7769	1.171849
11	3	97	15:47:57	1201	1200	659	324	31	655.21	17.79	42.11	Cs-137	661.66	12.2477	1.171849
11	3	97	16:07:58	1201	1200	609	348	29	653.55	16.98	38.07	Cs-137	661.66	13.155	1.096246

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
11	3	97	16:28:00	1201	1200	655	350	30	653.19	9.54	37.7	Cs-137	661.66	13.2306	1.134048
11	3	97	16:48:01	1201	1200	578	359	28	654.97	18.47	39.84	Cs-137	661.66	13.5708	1.058445
11	3	97	17:08:03	1201	1200	619	383	29	651.75	14.23	40.57				
11	3	97	17:28:05	1201	1200	637	374	30	653.62	14.73	41.58	Cs-137	661.66	14.1378	1.134048
11	3	97	17:48:06	1201	1200	616	342	29	651.58	15.03	40.99				
11	3	97	18:08:08	1201	1200	664	356	31	652.05	17.18	31.55	Cs-137	661.66	13.4574	1.171849
11	3	97	18:28:09	1201	1200	627	329	30	655.8	10.95	39.22	Cs-137	661.66	12.4367	1.134048
11	3	97	18:48:11	1201	1200	653	315	31	655.2	17.86	40.47	Cs-137	661.66	11.9075	1.171849
11	3	97	19:08:12	1201	1200	653	378	30	652.35	15.8	34.01	Cs-137	661.66	14.289	1.134048
11	3	97	19:28:14	1201	1200	653	379	30	653.64	11.86	38.51	Cs-137	661.66	14.3268	1.134048
11	3	97	19:48:15	1201	1200	620	284	30	655.87	17.92	37.62	Cs-137	661.66	10.7357	1.134048
11	3	97	20:08:17	1201	1200	628	342	30	653.89	12.08	34.27	Cs-137	661.66	12.9281	1.134048
11	3	97	20:28:18	1201	1200	593	337	29	656.85	21.61	31.86	Cs-137	661.66	12.7391	1.096246
11	3	97	20:48:20	1201	1200	674	365	31	654	12.98	36.66	Cs-137	661.66	13.7976	1.171849
11	3	97	21:08:22	1201	1200	640	353	30	653.99	13.13	38.04	Cs-137	661.66	13.344	1.134048
11	3	97	21:28:23	1201	1200	633	342	30	655.96	12.59	34.56	Cs-137	661.66	12.9281	1.134048
11	3	97	21:48:25	1201	1200	633	369	29	653.83	13.58	30.41	Cs-137	661.66	13.9488	1.096246
11	3	97	22:08:26	1201	1200	600	354	29	653.7	13.79	35	Cs-137	661.66	13.3818	1.096246
11	3	97	22:28:28	1201	1200	640	370	30	654.35	19.5	31.41	Cs-137	661.66	13.9866	1.134048
11	3	97	22:48:30	1201	1200	626	341	30	655.69	10.98	32.75	Cs-137	661.66	12.8903	1.134048
11	3	97	23:08:31	1201	1200	646	388	30	651.94	15.83	41.17	Cs-137	661.66	14.667	1.134048
11	3	97	23:28:33	1201	1200	664	392	30	653.7	12.24	36.32	Cs-137	661.66	14.8182	1.134048
11	3	97	23:48:34	1201	1200	636	394	29	652.54	14.42	34.83	Cs-137	661.66	14.8938	1.096246
12	3	97	0:08:36	1201	1200	637	355	30	654.38	19.17	41.63	Cs-137	661.66	13.4196	1.134048
12	3	97	0:28:37	1201	1200	672	349	31	653.65	12.12	34.34	Cs-137	661.66	13.1928	1.171849
12	3	97	0:48:39	1201	1200	639	318	30	655.79	10.87	31.84	Cs-137	661.66	12.0209	1.134048
12	3	97	1:08:40	1201	1200	621	366	29	655.7	9.82	29.31	Cs-137	661.66	13.8354	1.096246
12	3	97	1:28:42	1201	1200	574	274	29	653.83	19.4	31.19	Cs-137	661.66	10.3576	1.096246
12	3	97	1:48:43	1201	1200	613	373	29	652.13	17.05	31.22	Cs-137	661.66	14.1	1.096246
12	3	97	2:08:45	1201	1200	635	403	29	655.77	18.64	39.27	Cs-137	661.66	15.234	1.096246
12	3	97	2:28:47	1201	1200	619	363	29	651.91	17.65	39.89	Cs-137	661.66	13.722	1.096246
12	3	97	2:48:48	1201	1200	611	316	30	653.8	15.18	35.58	Cs-137	661.66	11.9453	1.134048
12	3	97	3:08:50	1201	1200	633	415	29	653.51	10.26	38.29	Cs-137	661.66	15.6877	1.096246
12	3	97	3:28:51	1201	1200	614	312	30	653.61	12.08	36.2	Cs-137	661.66	11.7941	1.134048
12	3	97	3:48:53	1201	1200	644	363	30	653.77	13.99	34.88	Cs-137	661.66	13.722	1.134048
12	3	97	4:08:54	1201	1200	621	306	30	655.81	10.61	38.17	Cs-137	661.66	11.5673	1.134048
12	3	97	4:28:56	1201	1200	617	368	29	651.39	13.64	36.2				
12	3	97	4:48:57	1201	1200	642	353	30	655.62	18.03	31.98	Cs-137	661.66	13.344	1.134048

Table A-1: 241-AN-107 CST Test Raw Cesium Gamma Data

Date D/M/Y			Time	RT	LT	Gross	Net	+/-	Centroid	FWHM	FW(1/10)	Library	(keV)	uCi	+/-
12	3	97	5:08:59	1201	1200	656	344	31	655.75	9.57	29.64	Cs-137	661.66	13.0037	1.171849
12	3	97	5:29:00	1201	1200	635	318	30	655.58	8.91	36.25	Cs-137	661.66	12.0209	1.134048
12	3	97	5:49:02	1201	1200	608	332	29	654.24	13.67	37.64	Cs-137	661.66	12.5501	1.096246
12	3	97	6:09:04	1201	1200	589	337	29	653.63	22.18	42.9	Cs-137	661.66	12.7391	1.096246
12	3	97	6:29:05	1201	1200	611	308	30	654.16	16.1	34.94	Cs-137	661.66	11.6429	1.134048
12	3	97	6:49:07	1201	1200	625	313	30	655.85	11.92	31.74	Cs-137	661.66	11.8319	1.134048
12	3	97	7:09:08	1201	1200	631	348	30	653.79	14.77	33.74	Cs-137	661.66	13.155	1.134048
12	3	97	7:29:10	1201	1200	589	370	28	656.98	16.34	39.43	Cs-137	661.66	13.9866	1.058445
12	3	97	7:49:11	1201	1200	563	290	28	651.6	18.89	40.51				
12	3	97	8:09:13	1201	1200	533	302	27	651.54	14.74	33.2				
12	3	97	8:29:14	1200.9	1200	557	317	28	651.84	18.33	31.97	Cs-137	661.66	11.9831	1.058445
12	3	97	8:49:16	1201	1200	552	288	28	655.99	15.05	38.33	Cs-137	661.66	10.8869	1.058445
12	3	97	9:09:18	1201	1200	552	303	28	654.17	14.13	35	Cs-137	661.66	11.4539	1.058445
12	3	97	9:29:20	1201	1200	577	331	28	652.02	13.66	34.65	Cs-137	661.66	12.5123	1.058445
12	3	97	9:49:21	1200.9	1200	518	308	26	655.81	11.18	34.14	Cs-137	661.66	11.6429	0.982841
12	3	97	10:09:23	1201	1200	526	289	27	656.5	16.47	38.93	Cs-137	661.66	10.9247	1.020643
12	3	97	10:29:24	1201	1200	574	295	29	655.85	17.62	43.6	Cs-137	661.66	11.1515	1.096246
12	3	97	10:49:26	1201	1200	559	331	28	654.04	10.11	29.58	Cs-137	661.66	12.5123	1.058445
12	3	97	11:09:27	1201.1	1200	1965	1161	52	651.62	10.66	35.84				
12	3	97	11:29:30	1201.3	1200	3121	1813	66	653.46	6.53	30.76	Cs-137	661.66	68.5343	2.494905
12	3	97	11:49:32	1201.3	1200	3190	1892	66	653.57	6.62	33.82	Cs-137	661.66	71.5206	2.494905
12	3	97	12:09:34	1201.3	1200	3253	1994	67	653.51	5.49	30.07	Cs-137	661.66	75.3764	2.532707
12	3	97	12:29:35	1201.3	1200	3216	1783	68	653.27	5.99	30.17	Cs-137	661.66	67.4002	2.570508
12	3	97	12:49:37	1201.3	1200	3129	1851	66	653.24	5.32	30.71	Cs-137	661.66	69.9707	2.494905

Definitions:

Date and Time: Date and clock time of the initiation of the counting period with these results.
RT: Program run time for the counting period [seconds].
LT: Gamma probe live counting time for the counting period [seconds].
Gross: Gross Cs-137 gamma counts detected during counting period.
Net: Net, non-attenuated gamma counts.
+/-: One σ error analysis on gamma counts.
Centroid: Center of gamma counts [keV].
FWHM: [F]ull [W]idth of the peak energy distribution at one [H]alf of the the peak [M]aximum [keV].
FW(1/10): Full Width of the peak energy distribution at one-tenth of the peak maximum [keV].
Library: Isotope of interest.
keV: gamma decay energy of interest.
μCi: calculated activity of detected gamma counts based upon internal standards.
+/-: One σ error analysis on activity calculation, μCi.

Table A-2: Gamma Probe Backgrounds and Standards				
Runtime	Background	Avg bkg	C(0)	Avg C(0)
0	488	488	3021	3021
2852.001		488	3182	3101.5
2892.032		488	3116	3106.333
2892.032		488	3194	3128.25
2912.048	534	511		3128.25
2932.063	555	525.6667		3128.25
2972.094	498	518.75		3128.25
4032.916	504	515.8		3128.25
4052.931		515.8	3010	3104.6
5974.419	524	517.1667		3104.6
6654.946	513	516.5714		3104.6
6674.962	480	512		3104.6
6694.977	578	519.3333		3104.6
6714.993	531	520.5		3104.6
6735.008	522	520.6364		3104.6
6755.024		520.6364	3099	3103.667
6775.039		520.6364	3018	3091.429
6795.055		520.6364	3111	3093.875
9517.163	557	523.6667		3093.875
9537.178	569	527.1538		3093.875
9557.194	560	529.5		3093.875
9717.318		529.5	3163	3101.556
9737.333		529.5	3181	3109.5
9757.349		529.5	3087	3107.455
14541.05		529.5	3064	3103.833
14561.07	543	530.4		3103.833
14581.08	583	533.6875		3103.833
19705.05	563	535.4118		3103.833
19725.07	533	535.2778		3103.833
19745.08	557	536.4211		3103.833
19765.1	552	537.2		3103.833
19785.11	552	537.9048		3103.833

Table A-2: Gamma Probe Backgrounds and Standards				
Runtime	Background	Avg bkg	C(0)	Avg C(0)
19805.13	577	539.6818		3103.833
19825.15	518	538.7391		3103.833
19845.16	526	538.2083		3103.833
19865.18	574	539.64		3103.833
19885.19	559	540.3846		3103.833
19925.22		540.3846	3121	3105.154
19945.24		540.3846	3190	3111.214
19965.25		540.3846	3253	3120.667
19985.27		540.3846	3216	3126.625
20005.28		540.3846	3129	3126.765

APPENDIX B: Mass Flow Rate Measurements and Analyses

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Table B-1: Final Column Effluents					
Jug	Tare	Gross	Delta	RT Start	RT Finish
C3E-1	104.1	1072.8	968.7	0	2954.7
C3E-2	101.45	1052.6	951.15	3018.7	5968.4
C3E-3	100.15	1223.3	1123.15	6015.6	9631.65
C3E-4	99.91	1199.4	1099.49	9663.4	12938.4
C3E-5	101.66	1099.2	997.54	12938.4	15918.5
C3E-6	99.7	933.1	833.4	15982.6	18467.4

Table B-2: Primary and Secondary Column Sample Data										
Sample Vial	Tare	Gross	Delta	RT Start	RT Finish	Flush st	Flush fin	end flush	Jug	min
C1E-01	27.7	34.86	7.16	105.9	126.6	95.4	105.9	128.6		20.67
C1E-02	27.76	34.66	6.9	998.55	1018	988.5	998.55			19.48
C1E-03	27.85	34.84	6.99	1979.8	1999.7	1967.8	1979.8		746.9	19.85
C1E-04	27.81	35.02	7.21	2997.9	3018.7	2984.3	2997.8			20.90
C1E-05	27.67	34.78	7.11	3995.5	4016.4	3982.1	3995.2			21.00
C1E-06	27.65	34.16	6.51	4992.8	5012.1	4985.2	4992.8			19.30
C1E-07	27.64	34.84	7.2	5994.2	6015.6	5968.4	5994.1			21.38
C1E-08	27.59	34.31	6.72	6981.15	7001.1	6967.6	6981.15			19.93
C1E-09	27.76	34.48	6.72	7988.4	8008.9	7978.9	7988.4			20.48
C1E-10	27.6	34.5	6.9	8971.7	8922.4	8962.8	8971.5			20.60
C1E-11	27.61	34.14	6.53	9985	10004.7	9972.4	9985	10005.6	198.78	19.92
C1E-12	27.45	34.64	7.19	10484.5	10503.6	10475.3	10484.4			19.10
C1E-13	27.67	35.1	7.43	11003.6	11023.7	10993.6	11003.4			20.15
C1E-14	27.88	37.07	9.19	11487.1	11512.3	11479.2	11487.1	11513.1		25.22
C1E-15	27.69	35.34	7.65	11986.6	12007.6	11975.6	11986.6			20.98
C1E-19	27.78	35.24	7.46	12987	13007.5	12970.8	12986.9			20.75
C1E-23	27.7	34.8	7.1	14493.7	14513.6	14481.1	14493.7	14517.7	610.4	19.82
C1E-27	27.44	34.5	7.06	15962.3	15982.4	15953.6	15962.2	15982.6		20.13
C1E-29	27.66	34.84	7.18	18478.1	18498.5	18467.4	18478.1			20.45
C1E-30	27.73	34.4	6.67	9641.6	9661.9	9631.65	9641.6	9663.4		20.32
C1E-31	27.34	34.4	7.06	17016.8	17037.3	17002.5	17016.8			20.53
C2E-01	27.17	34.25	7.08	967.15	987	957.1	967.15			19.87

Table B-2: Primary and Secondary Column Sample Data

Sample Vial	Tare	Gross	Delta	RT Start	RT Finish	Flush st	Flush fin	end flush	Jug	min
C2E-02	26.8	33.6	6.8	2962.8	2982.3	2954.7	2962.7			19.37
C2E-03	26.8	33.19	6.39	4959.4	4978.4	4950.1	4959			19.02
C2E-04	26.79	33.82	7.03	6943.6	6964.8	6932.3	6943.6			21.27
C2E-05	26.72	33.3	6.58	8938.8	8958.8	8928.2	8938			20.07
C2E-06	27.02	34.57	7.55	10971.6	10991.9	10959.2	10971.5		537.9	20.42
C2E-07	27.27	34.45	7.18	12948.9	12969	12938.4	12948.6		1199.4	20.10
C2E-08	26.75	33.56	6.81	14460	14479.1	14450	14460			19.02
C2E-09	27.15	34.36	7.21	15931.3	15951.8	15918.5	15931.1		1099.2	20.47
C2E-10	27.26	34.36	7.1	16981.4	17002	16972	16981.4		442.34	20.62

Table B-3: Sample Masses of Final Column Effluents, Tank Waste, and Feed Solids

Sample Vial	Tare	Gross	Delta
C3E-1	27.78	38.66	10.88
C3E-2	27.55	35.3	7.75
C3E-3	28.03	35.12	7.09
C3E-4	27.77	48.1	20.33
C3E-5	27.43	47.09	19.66
C3E-6	27.83	43.93	16.1
Core-1	27.96	35.92	7.96
Core-2	27.84	34.77	6.93
FS1 (SC1E-42)	26.65	29.92	3.27

Table B-4: Mass contributions

Runtime	Flush	Sample	Jug	Contrib	Accumulated g	g/min	Gross g/min		Column Volumes To Detector	dCV/min	Gross CV	Net CV
0	0.00	0.00	C3E-1	0	0.0	0.347		0.343	-9.4	0.103	0.0	-9.4
105.9	3.64	0.00	C3E-1		3.6	0.346		0.343	-8.3	0.103	10.9	1.5
126.6	0.00	7.16	C3E-1		10.8	0.346		0.343	-6.2	0.103	13.0	3.6
128.6	0.69	0.00	C3E-1		11.5	0.346		0.343	-6.0	0.103	13.2	3.8
967.15	3.58	0.00	C3E-1		15.1	0.356		0.343	-4.9	0.103	99.3	89.9
987	0.00	7.08	C3E-1		22.2	0.356		0.343	-2.8	0.103	101.3	91.9
998.55	3.56	0.00	C3E-1		25.7	0.354		0.343	-1.7	0.103	102.5	93.1
1018	0.00	6.90	C3E-1		32.6	0.354		0.343	0.4	0.103	104.5	95.1
1979.8	4.23	0.00	C3E-1		36.8	0.352		0.343	1.6	0.103	203.3	193.9
1999.7	0.00	6.99	C3E-1		43.8	0.352		0.343	3.7	0.103	205.3	195.9
2954.7	0.00	0.00	C3E-1	968.7	1012.5	0.351	0.343	0.333	294.0	0.100	300.5	291.1
2962.7	2.81	0.00			1015.3	0.351		0.333	294.8	0.100	301.3	291.9
2982.3	0.00	6.80			1022.1	0.351		0.333	296.8	0.100	303.3	293.8
2997.8	4.66	0.00			1026.8	0.345		0.333	298.2	0.100	304.8	295.4
3018.7	0.00	7.21			1034.0	0.345		0.333	300.4	0.100	306.9	297.5
3995.2	4.44	0.00	C3E-2		1038.4	0.339		0.333	301.7	0.100	404.2	394.8
4016.4	0.00	7.11	C3E-2		1045.5	0.339		0.333	303.8	0.100	406.3	396.9
4959	2.99	0.00	C3E-2		1048.5	0.336		0.333	304.7	0.100	500.3	490.9
4978.4	0.00	6.39	C3E-2		1054.9	0.336		0.333	306.7	0.100	502.2	492.8
4992.8	2.56	0.00	C3E-2		1057.5	0.337		0.333	307.4	0.100	503.7	494.2
5012.1	0.00	6.51	C3E-2		1064.0	0.337		0.333	309.4	0.100	505.6	496.2
5968.4	0.00	0.00	C3E-2	951.15	2015.2	0.337	0.333	0.325	594.4	0.097	598.7	589.3
5994.1	8.65	0.00			2023.8	0.337		0.325	596.9	0.097	601.2	591.8
6015.6	0.00	7.20	C3E-3	0	2031.0	0.337		0.325	599.1	0.097	603.3	593.9
6943.6	3.73	0.00	C3E-3		2034.7	0.331		0.325	600.2	0.097	693.7	684.2
6964.8	0.00	7.03	C3E-3		2041.8	0.331		0.325	602.3	0.097	695.7	686.3
6981.15	4.57	0.00	C3E-3		2046.3	0.337		0.325	603.7	0.097	697.3	687.9
7001.1	0.00	6.72	C3E-3		2053.1	0.337		0.325	605.7	0.097	699.3	689.8
7988.4	3.12	0.00	C3E-3		2056.2	0.328		0.325	606.6	0.097	795.4	786.0
8008.9	0.00	6.72	C3E-3		2062.9	0.328		0.325	608.7	0.097	797.4	788.0
8938	3.21	0.00	C3E-3		2066.1	0.328		0.325	609.6	0.097	887.8	878.4

Table B-4: Mass contributions

Runtime	Flush	Sample	Jug	Contrib	Accumulated g	g/min	Gross g/min		Column Volumes To Detector	dCV/min	Gross CV	Net CV
8958.8	0.00	6.58	C3E-3		2072.7	0.328		0.325	611.6	0.097	889.9	880.5
8971.5	2.91	0.00	C3E-3		2075.6	0.335		0.325	612.5	0.097	891.1	881.7
8922.4	0.00	6.90	C3E-3		2082.5	0.328		0.325	614.5	0.097	886.3	876.9
9631.65	0.00	0.00	C3E-3	1123.15	3205.7	0.328	0.325	0.356	951.0	0.107	962.1	952.7
9641.6	3.27	0.00			3208.9	0.328		0.356	952.0	0.107	963.1	953.7
9661.9	0.00	6.67			3215.6	0.328		0.356	954.0	0.107	965.3	955.9
9663.4	0.49	0.00		0	3216.1	0.328		0.356	954.2	0.107	965.5	956.1
9985	4.13	0.00	C3E-4		3220.2	0.328		0.356	955.4	0.107	999.8	990.4
10004.7	0.00	6.53	C3E-4		3226.7	0.328		0.356	957.4	0.107	1001.9	992.5
10005.6	0.30	0.00	C3E-4		3227.0	0.328		0.356	957.5	0.107	1002.0	992.6
10484.4	3.43	0.00	C3E-4		3230.5	0.376		0.356	958.5	0.107	1053.1	1043.7
10503.6	0.00	7.19	C3E-4		3237.7	0.376		0.356	960.6	0.107	1055.2	1045.8
10971.5	4.55	0.00	C3E-4		3242.2	0.370		0.356	962.0	0.107	1105.2	1095.8
10991.9	0.00	7.55	C3E-4		3249.8	0.370		0.356	964.3	0.107	1107.3	1097.9
11003.4	3.61	0.00	C3E-4		3253.4	0.369		0.356	965.3	0.107	1108.6	1099.2
11023.7	0.00	7.43	C3E-4		3260.8	0.369		0.356	967.6	0.107	1110.7	1101.3
11027	0.00	0.00	C3E-4		3260.8	0.369		0.356	967.6	0.107	1111.1	1101.7
11028.7	0.00	0.00	C3E-4		3260.8	0.000		0.356	967.6	0.107	1111.3	1101.9
11028.7	0.00	0.00	C3E-4		3260.8	0.364		0.356	967.6	0.107	1111.3	1101.9
11487.1	2.90	0.00	C3E-4		3263.7	0.364		0.356	968.4	0.107	1160.2	1150.8
11512.3	0.00	9.19	C3E-4		3272.9	0.364		0.356	971.2	0.107	1162.9	1153.5
11513.1	0.29	0.00	C3E-4		3273.2	0.364		0.356	971.3	0.107	1163.0	1153.6
11986.6	4.01	0.00	C3E-4		3277.2	0.365		0.356	972.5	0.107	1213.6	1204.2
12007.6	0.00	7.65	C3E-4		3284.8	0.365		0.356	974.8	0.107	1215.8	1206.4
12938.4	0.00	0.00	C3E-4	1099.49	4384.3	0.357	0.356	0.351	1304.2	0.105	1313.6	1304.2
12948.6	3.64	0.00	C3E-5	0	4388.0	0.357		0.351	1305.3	0.105	1314.7	1305.3
12969	0.00	7.18	C3E-5		4395.1	0.357		0.351	1307.4	0.105	1316.8	1307.4
12986.9	5.79	0.00	C3E-5		4400.9	0.360		0.351	1309.2	0.105	1318.7	1309.3
13007.5	0.00	7.46	C3E-5		4408.4	0.360		0.351	1311.4	0.105	1320.9	1311.5
14460	3.58	0.00	C3E-5		4412.0	0.358		0.351	1312.5	0.105	1473.5	1464.1
14479.1	0.00	6.81	C3E-5		4418.8	0.358		0.351	1314.5	0.105	1475.5	1466.1

Table B-4: Mass contributions

Runtime	Flush	Sample	Jug	Contrib	Accumulated g	g/min	Gross g/min		Column Volumes To Detector	dCV/min	Gross CV	Net CV
14493.7	4.51	0.00	C3E-5		4423.3	0.358		0.351	1315.9	0.105	1477.0	1467.6
14513.6	0.00	7.10	C3E-5		4430.4	0.358		0.351	1318.0	0.105	1479.1	1469.7
14517.7	1.47	0.00	C3E-5		4431.9	0.358		0.351	1318.4	0.105	1479.5	1470.1
15918.5	0.00	0.00	C3E-5	997.54	5429.4	0.352	0.351	0.344	1617.3	0.103	1624.0	1614.6
15931.1	4.44	0.00	C3E-5		5433.8	0.352		0.344	1618.6	0.103	1625.3	1615.9
15951.8	0.00	7.21			5441.1	0.352		0.344	1620.8	0.103	1627.5	1618.0
15962.2	3.02	0.00			5444.1	0.351		0.344	1621.7	0.103	1628.5	1619.1
15982.4	0.00	7.06	C3E-6		5451.1	0.351		0.344	1623.8	0.103	1630.6	1621.2
15982.6	0.07	0.00	C3E-6		5451.2	0.351		0.344	1623.8	0.103	1630.6	1621.2
16981.4	3.22	0.00	C3E-6		5454.4	0.344		0.344	1624.8	0.103	1733.6	1724.2
17002	0.00	7.10	C3E-6	0	5461.5	0.344		0.344	1626.9	0.103	1735.8	1726.4
17016.8	4.90	0.00	C3E-6		5466.4	0.344		0.344	1628.4	0.103	1737.3	1727.9
17037.3	0.00	7.06	C3E-6		5473.5	0.344		0.344	1630.5	0.103	1739.4	1730.0
17041.5	0.00	0.00	C3E-6		5473.5	0.344		0.344	1630.5	0.103	1739.8	1730.4
17044	0.00	0.00	C3E-6		5473.5	0.000		0.344	1630.5	0.103	1740.1	1730.7
17044.1	0.00	0.00	C3E-6		5473.5	0.351		0.344	1630.5	0.103	1740.1	1730.7
18467.4	0.00	0.00	C3E-6	833.4	6306.9	0.351	0.344	0.351	1880.2	0.105	1889.8	1880.4
18478.1	3.76	0.00			6310.6	0.351		0.351	1881.3	0.105	1891.0	1881.6
18498.5	0.00	7.18			6317.8	0.351		0.351	1883.5	0.105	1893.1	1883.7

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APPENDIX C: Test Sample Chemical and Radiological Analysis Data

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Table C-1: Core Sample Analyses				
Sample		CORE-1	CORE-2	Core Average
Laboratory ID:		S97R000114	S97R000115	
PARAMETER	UNITS			
GEA:Cs137,Co60,Eu154-155,Am241				
Cobalt-60 by GEA	µCi/mL	0.175	0.201	0.188
Co-60 GEA Rel. % Count Error	% Ct. Error	12.7	11.2	11.95
Cesium-137 by GEA	µCi/mL	316	337	326.5
Cs-137 GEA Rel. % Count Error	% Ct. Error	0.27	0.26	0.265
Europium-154 by GEA	µCi/mL	0.674	0.836	0.755
Eu-154 GEA Rel % Counting Err	% Ct. Error	12.4	11.9	12.15
Europium-155 by GEA	µCi/mL	<0.6020	<0.6446	<0.6233
Eu-155 GEA Rel % Counting Err	% Ct. Error			
Americium-241 by GEA	µCi/mL	<1.2390	<1.2760	<1.2575
Am-241 GEA Rel. % Count Error	% Ct. Error			
OTHER ANALYSIS				
Dose Rate in mrad/hour	mrad/hour	1250	1250	
Alpha				
Alpha in Liquid Samples	µCi/mL			
Alpha Liq.- Rel. % Count Error	% Ct. Error			

Table C-2: Feed Sample Analyses				
Sample		F1	F2	Feed Average
Laboratory ID:		S97R000116	S97R000117	µCi/mL or M
PARAMETER	UNITS			
GEA:Cs137,Co60,Eu154-155,Am241				
Cobalt-60 by GEA	µCi/mL	0.128	0.113	0.1205
Co-60 GEA Rel. % Count Error	% Ct. Error	11.4	14.5	12.95
Cesium-137 by GEA	µCi/mL	220	202	211#
Cs-137 GEA Rel. % Count Error	% Ct. Error	0.23	0.3	0.265
Europium-154 by GEA	µCi/mL	0.473	0.439	0.456
Eu-154 GEA Rel % Counting Err	% Ct. Error	12.6	13.5	13.05
Europium-155 by GEA	µCi/mL	<0.3130	<0.4190	<0.3660
Eu-155 GEA Rel % Counting Err	% Ct. Error			
Americium-241 by GEA	µCi/mL	<0.6146	<0.8861	<0.7504
Am-241 GEA Rel. % Count Error	% Ct. Error			
OTHER ANALYSIS				
Dose Rate in mrad/hour	mrad/hour	1500	1000	1250
OH- by Pot. Titration	µg/mL	17600	2090	0.5789
Alpha				
Alpha in Liquid Samples	µCi/mL	0.254	0.319	0.2865
Alpha Liq.- Rel. % Count Error	% Ct. Error	4.42	3.88	4.15

Replacement of this value for C(0) with (166.57) the average concentration of measured versus expected major analytes (NO_2, NO_3) from feed multiplied by the expected ^{137}Cs yields near perfect tracking with gamma probe (except with one sample at 200%). Conclusion, the two GEAs for the feed ^{137}Cs are biased 26.7% high.

Table C-3a: Primary Column Effluent Sample Analyses						
Customer ID:		C1E-1	C1E-2	C1E-4	C1E-6	C1E-8
Lab Sample#:		S97R000142	S97R000143	S97R000130	S97R000132	S97R000133
PARAMETER	UNITS					
GEA:Cs137,Co60,Eu154-155,Am241						
Cobalt-60 by GEA	µCi/mL	0.0306	0.104	0.107	0.11	0.107
Co-60 GEA Rel. % Count Error	% Ct. Error	3.74	2.88	4.58	4.21	4.65
Cesium-137 by GEA	µCi/mL	0.00781	0.131	5.24	21.9	45.6
Cs-137 GEA Rel. % Count Error	% Ct. Error	12.8	3.52	0.68	0.3	0.23
Europium-154 by GEA	µCi/mL	0.0805	0.38	0.401	0.424	0.433
Eu-154 GEA Rel % Counting Err	% Ct. Error	3.4	2.19	3.58	3.27	4
Europium-155 by GEA	µCi/mL	0.0597	0.308	0.345	0.33	0.329
Eu-155 GEA Rel % Counting Err	% Ct. Error	6.78	4.76	8.7	10.7	14.5
Americium-241 by GEA	µCi/mL	0.0563	0.286	0.372	0.303	<0.9114
Am-241 GEA Rel. % Count Error	% Ct. Error	15	11.9	17.5	24.9	
OTHER ANALYSIS						
Dose Rate in mrad/hour	mrad/hour	150	200	500	400	600
Received Sample Yet?						
OH- by Pot. Titration	µg/mL					
Anions by IC-Dionex 4000i/4500						
Fluoride-IC-Dionex 4000/4500	µg/mL					
Chloride-IC-Dionex 4000/4500	µg/mL					
Nitrite-IC - Dionex 4000/4500	µg/mL					
Bromide by Ion Chromatograph	µg/mL					
Nitrate by IC-Dionex 4000/4500	µg/mL					
Phosphate-IC-Dionex 4000/4500	µg/mL					
Sulfate by IC-Dionex 4000/4500	µg/mL					
Oxalate by IC-Dionex 4000/4500	µg/mL					
Mean Runtime	min	116.25	1008.275	3008.3	5002.45	6991.125
CV Treated		1.02e+00	9.26e+01	2.95e+02	4.94e+02	6.87e+02
Cs-137 C/C(0)		4.69e-05	7.86e-04	3.15e-02	1.31e-01	2.74e-01

Table C-3b: Primary Column Effluent Sample Analyses						
Customer ID:		C1E-10	C1E-30	C1E-13	C1E-15	C1E-19
Lab Sample#:		S97R000135	S97R000151	S97R000145	S97R000125	S97R000126
PARAMETER	UNITS					
GEA:Cs137,Co60,Eu154-155,Am241						
Cobalt-60 by GEA	µCi/mL	0.102	0.0991	0.108	0.106	0.097
Co-60 GEA Rel. % Count Error	% Ct. Error	9.44	9.83	8.21	8.91	14.6
Cesium-137 by GEA	µCi/mL	68.2	75.7	94.5	103	108
Cs-137 GEA Rel. % Count Error	% Ct. Error	0.37	0.35	0.28	0.3	0.32
Europium-154 by GEA	µCi/mL	0.443	0.462	0.436	0.418	0.452
Eu-154 GEA Rel % Counting Err	% Ct. Error	7.35	7.42	7.49	8.46	9.05
Europium-155 by GEA	µCi/mL	0.332	<0.1930	0.32	<0.2750	0.436
Eu-155 GEA Rel % Counting Err	% Ct. Error	37.4		35.9		44.5
Americium-241 by GEA	µCi/mL	<0.3402	<0.3400	<0.2605	<0.4555	<0.5224
Am-241 GEA Rel. % Count Error	% Ct. Error					
OTHER ANALYSIS						
Dose Rate in mrad/hour	mrad/hour	600	600	500	500	600
Received Sample Yet?						
OH- by Pot. Titration	µg/mL				2180	2060
Anions by IC-Dionex 4000i/4500						
Fluoride-IC-Dionex 4000/4500	µg/mL					1888
Chloride-IC-Dionex 4000/4500	µg/mL					951
Nitrite-IC - Dionex 4000/4500	µg/mL					36060
Bromide by Ion Chromatograph	µg/mL					<643.9
Nitrate by IC-Dionex 4000/4500	µg/mL					139600
Phosphate-IC-Dionex 4000/4500	µg/mL					813
Sulfate by IC-Dionex 4000/4500	µg/mL					4960
Oxalate by IC-Dionex 4000/4500	µg/mL					876.3
Mean Runtime	min	8947.05	9651.75	11013.65	11997.1	12997.25
CV Treated		8.78e+02	9.53e+02	1.10e+03	1.20e+03	1.31e+03
Cs-137 C/C(0)		4.09e-01	4.54e-01	5.67e-01	6.18e-01	6.48e-01

Table C-3c: Primary Column Effluent Sample Analyses					
Customer ID:		C1E-23	C1E-27	C1E-31	C1E-29
Lab Sample#:		S97R000127	S97R000128	S97R000129	S97R000150
PARAMETER	UNITS				
GEA:Cs137,Co60,Eu154-155,Am241					
Cobalt-60 by GEA	µCi/mL	0.363	0.107	0.108	0.105
Co-60 GEA Rel. % Count Error	% Ct. Error	8.29	9.95	11.7	10.1
Cesium-137 by GEA	µCi/mL	446	134	134	147
Cs-137 GEA Rel. % Count Error	% Ct. Error	0.2	0.26	0.37	0.25
Europium-154 by GEA	µCi/mL	1.59	0.422	0.484	0.455
Eu-154 GEA Rel % Counting Err	% Ct. Error	7.4	9.76	11	8.82
Europium-155 by GEA	µCi/mL	1.31	0.433	<0.3700	0.376
Eu-155 GEA Rel % Counting Err	% Ct. Error	31.8	39		41.9
Americium-241 by GEA	µCi/mL	<1.2990	<0.5188	<0.7287	<0.4807
Am-241 GEA Rel. % Count Error	% Ct. Error				
OTHER ANALYSIS					
Dose Rate in mrad/hour	mrad/hour	750	550	750	700
Received Sample Yet?					
OH- by Pot. Titration	µg/mL	2180	2220	2100	
Anions by IC-Dionex 4000i/4500					
Fluoride-IC-Dionex 4000/4500	µg/mL	1741	1845	1729	
Chloride-IC-Dionex 4000/4500	µg/mL	863.5	935.1	987.8	
Nitrite-IC - Dionex 4000/4500	µg/mL	35020	35530	37420	
Bromide by Ion Chromatograph	µg/mL	<643.9	<643.9	<643.9	
Nitrate by IC-Dionex 4000/4500	µg/mL	136300	137100	140100	
Phosphate-IC-Dionex 4000/4500	µg/mL	634.8	847.2	<618.1	
Sulfate by IC-Dionex 4000/4500	µg/mL	4646	4580	4669	
Oxalate by IC-Dionex 4000/4500	µg/mL	1012	911.5	833.8	
Mean Runtime	min	14503.65	15972.35	17027.05	18488.3
CV Treated		1.47e+03	1.62e+03	1.73e+03	1.88e+03
Cs-137 C/C(0)		2.68e+00	8.04e-01	8.04e-01	8.83e-01

Table C-4: Secondary Column Effluent Sample Analyses							
Customer ID:		C2E-1	C2E-3	C2E-5	C2E-7	C2E-9	C2E-10
Lab Sample#:		S97R000152	S97R000154	S97R000156	S97R000158	S97R000160	S97R000161
PARAMETER	UNITS						
GEA:Cs137,Co60,Eu154-155,Am241							
Cobalt-60 by GEA	µCi/mL	0.106	0.159	0.104	0.106	0.107	0.11
Co-60 GEA Rel. % Count Error	% Ct. Error	2.82	3.26	8.67	4.51	4.59	4.54
Cesium-137 by GEA	µCi/mL	0.0236	0.0397	0.0345	0.1	0.446	0.732
Cs-137 GEA Rel. % Count Error	% Ct. Error	11.7	12.3	30.7	6.67	2.49	1.84
Europium-154 by GEA	µCi/mL	0.368	0.596	0.459	0.434	0.419	0.43
Eu-154 GEA Rel % Counting Err	% Ct. Error	2.25	3.25	8.22	3.39	4.1	3.17
Europium-155 by GEA	µCi/mL	0.309	0.489	0.347	0.34	0.338	0.339
Eu-155 GEA Rel % Counting Err	% Ct. Error	5.32	4.94	11.8	5.09	5.64	5.24
Americium-241 by GEA	µCi/mL	0.278	0.475	0.356	0.307	0.312	0.333
Am-241 GEA Rel. % Count Error	% Ct. Error	9.79	10.6	9.67	4.75	4.4	4.79
OTHER ANALYSIS							
Dose Rate in mrad/hour	mrad/hour	250	400	450	450	500	500
Mean Runtime	min	977.075	4968.9	8948.8	12958.95	15941.55	16991.675
CV Treated		8.33e+01	4.84e+02	8.72e+02	1.30e+03	1.61e+03	1.72e+03
Cs-137 C/C(0)		1.42e-04	2.38e-04	2.07e-04	6.00e-04	2.68e-03	4.39e-03
Cs-137 DF		7.06e+03	4.20e+03	4.83e+03	1.67e+03	3.73e+02	2.28e+02

Table C-5: Tertiary Column Effluent Sample Analyses							
Customer ID:		C3E-1	C3E-2	C3E-3	C3E-4	C3E-5	C3E-6
Lab Sample#:		S97R000162	S97R000165	S97R000163	S97R000166	S97R000164	S97R000167
PARAMETER	UNITS						
GEA:Cs137,Co60,Eu154-155,Am241							
Cobalt-60 by GEA	µCi/mL	0.096	0.104	0.103	0.104	0.113	0.113
Co-60 GEA Rel. % Count Error	% Ct. Error	3.26	4.53	4.71	6.63	6.21	6.25
Cesium-137 by GEA	µCi/mL	0.0185	0.0232	0.0267	0.0274	0.0327	0.0376
Cs-137 GEA Rel. % Count Error	% Ct. Error	16.6	19.2	17.4	28.5	24.2	20.6
Europium-154 by GEA	µCi/mL	0.299	0.391	0.422	0.416	0.447	0.446
Eu-154 GEA Rel % Counting Err	% Ct. Error	2.82	3.34	3.66	4.86	4.42	4.63
Europium-155 by GEA	µCi/mL	0.238	0.305	0.324	0.338	0.341	0.377
Eu-155 GEA Rel % Counting Err	% Ct. Error	4.09	5.02	5.36	7.92	7.67	6.75
Americium-241 by GEA	µCi/mL	0.208	0.288	0.314	0.306	0.345	0.327
Am-241 GEA Rel. % Count Error	% Ct. Error	3.75	5.15	5.31	7.34	6.64	6.97
OTHER ANALYSIS							
Dose Rate in mrad/hour	mrad/hour	300	400	500	750	800	800
Mean Runtime	min	2954.7	5968.4	9631.65	12938.4	15918.5	18467.4
CV Treated		2.80e+02	5.78e+02	9.41e+02	1.29e+03	1.60e+03	1.87e+03
Cs-137 C/C(0)		1.11e-04	1.39e-04	1.60e-04	1.64e-04	1.96e-04	2.26e-04
Cs-137 DF		9.00e+03	7.18e+03	6.24e+03	6.08e+03	5.09e+03	4.43e+03

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APPENDIX D: Test Equipment and Sources

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Table D-1: Cesium Removal Test Assembly Material List[7]

1 sht.	3/8 inch Plexiglas. Central stores 40-5450-100
1 pkg.	Cable ties. Central stores 17160255
1 ea.	Pump system. Cole Parmer FE-77120-10
1 set	Pump brackets. Cole Parmer FE-77120-03
1 pk.	Barbed connectors. 1/16 x 1/8. Cole Parmer H-06365-44
1 pk.	Barbed connectors. 3/16 x 1/8. Cole Parmer H-30703-48
1 pk.	Barbed connectors. 4-6 mm. Cole Parmer H-06288-10
1 ea.	Tygon tubing. 0.89 mm ID. Cole Parmer FE-95609-26
1 pkg.	Cable ties. 3 1/4 inch. Cole Parmer H-06830-08
8 ea.	On/off valve. Hamilton/Fisher 86901
2 ea.	3 port distribution valve. Hamilton/Fisher 86912
9 ea.	T flow, 3 way valve. Hamilton/Fisher 86777
10 ea.	Valve mounting nuts. Hamilton/Fisher 35121
60 ea.	1/4 - 28 barbed fitting, Teflon. Hamilton/Fisher 35032
1 pkg.	Valve plugs. Hamilton/Fisher 88802
1 box	Tygon tubing. 1/16 ID. Fisher 14-169-1B
1 box	Tygon tubing. 1/8 ID. Fisher 14-169-1E
1 box	Tygon tubing. 3/16 ID. Fisher 14-169-1G
4 ea.	Column assy. Kontes/Fisher 420830-1500
8 ea.	10 micron bed support. Kontes/Fisher 420809-1010
1 ea.	Column only. Kontes/Fisher 420831-1500
8 ea.	Column spring clips. Misc. hardware
1 lot	Misc. fasteners

[7] Plexiglas is a trademark of Rohm and Haas Company, Philadelphia, PA
Cole-Parmer is a tradename of Cole-Parmer Instruments, Niles, IL
Tygon is a trademark of Norton Performance Plastics, Akron, OH
Hamilton is a tradename of the Hamilton, Co., Reno. NV
Fisher is a tradename of Fisher Scientific, Pittsburgh, PA
Kontes is a tradename of The Kontes Glass Company, Vineland, NJ

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APPENDIX E: Test Waste Sample and Feed Batch Data

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Table E-1: Waste Feed Bottles Received					
Bottle	Gross (g)	Net (g)	Bottle	Gross (g)	Net (g)
7AN-97-01	277.15	177.809	7AN-97-24	277.2	177.859
7AN-97-02	279.19	179.849	7AN-97-25	280.03	180.689
7AN-97-03	280.22	180.879	7AN-97-26	279.53	180.189
7AN-97-04	277.74	178.399	7AN-97-27	279.51	180.169
7AN-97-05	277.4	178.059	7AN-97-28	277.41	178.069
7AN-97-06	279.52	180.179	7AN-97-29	276.17	176.829
7AN-97-07	278.36	179.019	7AN-97-30	275.84	176.499
7AN-97-08	277.65	178.309	7AN-97-31	280.09	180.749
7AN-97-09	279.58	180.239	7AN-97-32	278.99	179.649
7AN-97-10	277.94	178.599	7AN-97-33	279.23	179.889
7AN-97-11	280	180.659	7AN-97-34	197.12	97.779
7AN-97-12	279.31	179.969	7AN-97-35	171.09	71.749
7AN-97-13	279.81	180.469	7AN-97-36	277.35	178.009
7AN-97-14	279.8	180.459	7AN-97-37	144.61	45.269
7AN-97-15	279.8	180.459	7AN-97-38	278.6	179.259
7AN-97-16	277.64	178.299	7AN-97-39	278.85	179.509
7AN-97-17	278.31	178.969	7AN-97-40	154.09	54.749
7AN-97-18	277.45	178.109	7AN-97-41	278.13	178.789
7AN-97-19	276.19	176.849	7AN-97-42	279.13	179.789
7AN-97-20	280.03	180.689	7AN-97-43	277.91	178.569
7AN-97-21	279.54	180.199	7AN-97-44	278.28	178.939
7AN-97-22	279.13	179.789	7AN-97-45	277.27	177.929
7AN-97-23	276.38	177.039	Total (g)	12084.57	7614.225
Typical Tare	99.341		Volume (mL)		5440.891

Table E-2: Waste Feed Batch Preparation			
Batch	Tank Waste Bottle	Waste (g)	NaOH (g) 0.53M
1 7Pp2	7AN-97- 01	175.16	
	7AN-97- 02	178.76	
	7AN-97- 03	176.62	
	7AN-97- 04	173.8	
	7AN-97- 05	101.3	
	SubTotal	805.64	446.3
1 Pp1	7AN-97- 06	178.54	
	7AN-97- 07	187.19	
	7AN-97- 08	166.27	
	7AN-97- 09	178.3	
	7AN-97- 05	77.9	
	7AN-97- 10	18.1	
	SubTotal	806.3	446.7
2 7Pp2	7AN-97- 10	157.42	
	7AN-97- 11	175.22	
	7AN-97- 12	177.79	
	7AN-97- 14	179.1	
	7AN-97- 13	113.7	
	7AN-97- 19	115.68	
	SubTotal	918.91	507.72
2 7Pp1	7AN-97- 13	63.95	
	7AN-97- 15	178.81	
	7AN-97- 16	175.38	
	7AN-97- 17	176.17	
	7AN-97- 18	196.4	
	7AN-97- 19	9.7	
	SubTotal	800.41	443.2
3 "9/3"	7AN-97- 19	20.66	
	7AN-97- 20	178.2	
	7AN-97- 26	171.54	
	7AN-97- 32	177.86	
	7AN-97- 33	178.3	
	7AN-97- 27	78	

Table E-2: Waste Feed Batch Preparation			
Batch	Tank Waste Bottle	Waste (g)	NaOH (g) 0.53M
	SubTotal	804.56	444.6
4 "9/3"	7AN-97- 27	99.5	
	7AN-97- 21	176.72	
	7AN-97- 22	178.53	
	7AN-97- 23	175.74	
	7AN-97- 24	176.6	
	SubTotal	807.09	432.2
Total Feed Components (g)		4942.91	2720.72
Total Prepared Feed (g)		7663.63	

Document Checked - Number: SESC-EN-RPT-005 Revision: 0

Title: Hanford Complexant Concentrate Cesium Removal Using Crystalline Silicotitanate

Yes	No	N/A	
[X]	[ ]	[ ]	Problem completely defined.
[X]	[ ]	[ ]	Appropriate analytical method used.
[X]	[ ]	[ ]	Necessary assumptions are appropriate, explicitly stated, and supported.
[X]	[ ]	[ ]	Computer codes and data files documented.
[X]	[ ]	[ ]	Data used in calculations explicitly stated in document.
[ ]	[ ]	[X]	Sources of non-standard formulae/data are referenced and the correctness of the reference verified.
[X]	[ ]	[ ]	Data checked for consistency with original source information as applicable.
[X]	[ ]	[ ]	Mathematical derivations checked including dimensional consistency of results.
[X]	[ ]	[ ]	Models appropriate and used within range of validity or use outside range of established validity justified.
[X]	[ ]	[ ]	Hand calculations checked for errors.
[ ]	[ ]	[X]	Code run streams correct and consistent with analysis documentation.
[ ]	[ ]	[X]	Code output consistent with input and with results reported in analysis documentation.
[X]	[ ]	[ ]	Acceptability limits on analytical results applicable and supported. Limits checked against sources.
[X]	[ ]	[ ]	Safety margins consistent with good engineering practices.
[X]	[ ]	[ ]	Conclusion consistent with analytical results and applicable limits.
[X]	[ ]	[ ]	Results and conclusions address all points required in the problem statement.

I have checked the analysis/calculation and it is complete and accurate to the best of my knowledge.

RK Bijani 9/15/97

Engineer/Checker Date

Note: Any hand calculations, notes, or summaries generated as part of this check should be signed, dated, and attached to this checklist. Material should be labeled and recorded so that it is intelligible to a technically qualified third party