DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

PACIFIC NORTHWEST LABORATORY
operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC06-76RLO 1830

EFFECTS OF TUFF WASTE PACKAGE COMPONENTS ON
RELEASE FROM 76-68 SIMULATED WASTE GLASS

Final Report

G. L. McVay
G. R. Robinson

April 1984

Prepared for
Lawrence Livermore National Laboratory
under a Related Services Agreement
with the U. S. Department of Energy
under Contract DE-AC06-76RLO 1830

Pacific Northwest Laboratory
Richland, Washington 99352

SUMMARY

An experimental matrix has been conducted that will allow evaluation of the effects of waste package constituents on the waste form release behavior in a tuff repository environment. Tuff rock and groundwater were used along with 304L, 316, and 1020M ferrous metals to evaluate release from uranium-doped MCC 76-68 simulated waste glass. One of the major findings was that in the absence of 1020M mild steel, tuff rock powder dominates the system. However, when 1020M mild steel is present, it appears to dominate the system. The rock-dominated system results in suppressed glass-water reaction and leaching while the 1020M-dominated system results in enhanced leaching--but the metal effectively scavenges uranium from solution. The 300-series stainless steels play no significant role in affecting glass leaching characteristics.

CONTENTS

SUMMARY	iii
INTRODUCTION	1
EXPERIMENTAL	3
DOPED GLASS PREPARATION	3
GLASS SAMPLE PREPARATION	4
ROCK SAMPLE PREPARATION	5
METALLIC SAMPLE PREPARATION	6
EXPERIMENTAL PROCEDURES	6
RESULTS AND DISCUSSION	7
CONCLUSIONS	17
REFERENCES	18
APPENDIX A - EXPERIMENTAL PROCEDURES	A.1
APPENDIX B - SAMPLE DIMENSIONS	B.1
APPENDIX C - LEACH DATA	C.1

TABLES

1	Component Composition	19
2	Composition of Metallic Samples (in wt%)	20
3	Glass Powder Surface Area Calculations	21
4	Test Matrix	22
5	ICP Acid Strip Data	23

FIGURES

1	Boron release from 76-68 simulated waste glass in tuff groundwater at 40, 70, 90, and 150°C for 3 to 182 days at an SA/V of 10 m ⁻¹	24
2	Silicon release from 76-68 simulated waste glass in tuff groundwater at 40, 70, 90, and 150°C for 3 to 182 days at an SA/V of 10 m ⁻¹	25
3	Time-dependent uranium concentrations in tuff groundwater contacting 76-68 simulated waste glass at 40, 70, 90, and 150°C for times from 3 to 182 days at an SA/V of 10 m ⁻¹	26
4	Elemental compositions of 76-68 glass, tuff rock, and tuff groundwater	27
5	Effect of preleaching tuff rock monoliths at 90°C for one day on elemental removal in 90°C tuff groundwater.	28
6	Effect of preleaching tuff rock powder at 90°C for one day on elemental removal in 90°C tuff groundwater	29
7	The change in time-dependent Si solution concentration in 90°C tuff groundwater as glass and rock monolithic samples are added. Glass sample surface area/tuff groundwater volume (SA/V) = 10 m ⁻¹ . Rock monolithic samples had same geometric surface area as glass	30

8	The change in time-dependent B solution concentration in 90 ⁰ C tuff groundwater as glass and rock monolithic samples are added. Glass sample surface area/tuff groundwater volume (SA/V) = 10 m ⁻¹ . Rock monolithic sample had same geometric surface area as glass	31
9	Time-dependent silicon solution concentrations in 90 ⁰ C tuff groundwater comparing the effects of tuff rock monolithic and powdered samples	32
10	Time-dependent B solution concentrations in 90 ⁰ C tuff groundwater comparing the effects of tuff rock monolithic and powdered samples	33
11	Time-dependent Si concentrations in 90 ⁰ C tuff groundwater comparing the effects of increasing the relative glass surface area	34
12	Time-dependent B concentrations in 90 ⁰ C tuff groundwater comparing the effects of increasing the relative glass surface area	35
13	Time-dependent B concentrations in 90 ⁰ C tuff groundwater with various tuff rock quantities and SA/V ratios	36
14	Time-dependent Si concentrations in 90 ⁰ C tuff groundwater comparing rock surface areas	37
15	Time-dependent B concentrations in 90 ⁰ C tuff groundwater comparing the ratio of rock to glass	38
16	Time-dependent uranium concentrations in 90 ⁰ C tuff groundwater as a function of tuff rock surface area	39

17.	Comparison of component contribution to pH in 90°C tuff groundwater. All samples were monolithic with an SA/V = 10 m ⁻¹	40
18	Effects of metals on pH in 90°C tuff groundwater. All samples were monolithic with an SA/V = 10 m ⁻¹	41
19	Effect of metals on B solution concentration in 90°C tuff groundwater. All samples were monolithic and of the same surface area	42
20	Effect of metals on the time-dependent B solution concentration in 90°C tuff groundwater comparing SA/V and rock surface area effects	43
21	Effect of metal type on uranium solution concentration in 90°C tuff groundwater. All samples were monolithic and the SA/V = 10 m ⁻¹	44
22	The effects of various conditions on reaction layer thickness for a 91-day exposure to 90°C tuff groundwater. All samples were monoliths and SA/V = 10 m ⁻¹	45
23	SEM cross-sections of reaction layer thicknesses under various conditions	46
24	SEM cross-section of 76-68 glass exposed for 91 days to 150°C tuff groundwater	47
25	Effect of filtering on a monolithic glass and rock interactive experiment in 90°C tuff groundwater with an SA/V = 10 m ⁻¹	48

26	The same as for Figure 25 except for the presence of a 304L sample	49
27	Illustration of replication of experiments containing glass and rock powder at an $SA/V = 100 \text{ m}^{-1}$ in 90°C tuff groundwater	50
28	Illustration of replication of experiments containing glass, rock powder, and 304L SS at an $SA/V = 100 \text{ m}^{-1}$ in 90°C tuff groundwater	51

EFFECTS OF TUFF WASTE PACKAGE COMPONENTS ON RELEASE FROM 76-68 SIMULATED WASTE GLASS

INTRODUCTION

Deep geologic disposal of radioactive nuclear waste has received international attention in recent years. It has become the method of choice for nuclear waste disposal and, because of this, a very significant research activity is being funded by the Department of Energy to evaluate various geologies for potential repository sites. The geologies currently being considered in the United States are salt, basalt, tuff, and very recently, granite.

The most generally accepted concept for disposal of high-level radioactive waste is to incorporate it into a solid waste form that is placed into a deep geologic repository. The waste form is normally considered to be part of a multiple barrier system (called a waste package) which gives redundant safeguards against the removal of radioactive elements from the repository. This waste package can consist of a waste form, hard barriers, and backfill materials.

In every repository design, the radioactive waste is contained within a waste form. The waste form that is currently favored and the one that has received the largest amount of research is borosilicate glass for reprocessed waste and possibly spent fuel if reprocessing does not become a reality for commercial waste. Hard barriers include both canister and overpack materials. The canister is commonly a 300-series stainless steel, such as 304L, whereas the overpack material depends on the waste-package design and repository selection. In some designs the overpack is a relatively thin layer of highly corrosion-resistant material, such as a titanium alloy, placed over the canister. In other designs the overpack is

a thick layer of less corrosion-resistant metal such as cast iron or ductile iron. The backfill materials can be clays (which act as a water barrier), other materials which have special water-restrictive or sorptive characteristics, or crushed rock of the same type as the repository media. In general, the waste-package designs have not been finalized and could vary with changing Nuclear Regulatory Commission regulations and repository media type.

Waste forms have typically been investigated in aqueous solutions with none of the other waste-package component materials present. This approach leads to an understanding of waste-form behavior in "normal" water environments only. However, except for rather severe accident scenarios, the waste form will not be exposed directly to the unaltered groundwater. Under expected repository conditions, the groundwater will progressively move through the barriers of the waste package by diffusion, corrosion, or other barrier-failure modes. Therefore, the waste form will be exposed to altered groundwater as well as the remains of the other waste-package constituents. Since reliable long-time prediction of elemental release characteristics from the waste package and the repository is required for licensing, it is necessary to understand the effects of other waste-package constituents on elemental release from the waste form.

The current concept for a waste package to be used in a tuff repository is to incorporate the waste form in 304L stainless steel with no additional hard barriers or backfill material other than the tuff rock. Additionally, it is possible that the borehole will be lined with a soft iron such as 1020M and, therefore, this material should be considered as available for interactive effects.

In an effort to understand release from a waste package system in a tuff repository, a series of interactive experiments were conducted in tuff groundwater using 76-68 glass, tuff rock, and ferrous metals. The 76-68 glass was chosen because of the large existing data base and because it represents, in a generic sense, a commercial waste glass. The metals used were both 304L and 316 stainless steels as well as 1020M mild steel. Interactive effects between metals and 76-68 glass have been reported

previously,⁽¹⁻³⁾ but not for the metals used in these experiments and not in a realistic tuff repository environment.

All tests conducted were static in nature and designed to evaluate the effects of rock and of candidate metals on release of constituents from the glass. The glass was doped with uranium but did not contain other actinides or Tc. Therefore, release of many relevant radionuclides can only be inferred. Additionally, the effects of radiation, radiolysis, and the determination of solubility limits along with appropriate alteration products were not addressed in this reported research.

EXPERIMENTAL

The purpose of the experimental program was to evaluate interactive effects of candidate waste package constituents on release characteristics from the waste form in a tuffaceous environment. Materials used in this investigation were:

- Tuff groundwater obtained from well J-13 near the Yucca Mountain site
- Topopah Spring tuff rock
- 76-68 simulated waste glass (UO_2 doped) as prepared by PNL
- Candidate metals: 304L SS, 316 SS, and 1020M

The compositions of the waste glass, tuff rock, and tuff groundwater used are given in Table 1. The metallic sample compositions are given in Table 2.

DOPED GLASS PREPARATION

The UO_2 doped glass was prepared as follows:

Bars of previously melted and cast 76-68 glass (MCC No.'s 309, 307, 281, 276, and 265) were prepared for doping by crushing and sieving to -100 mesh size fraction. The dopant solution was prepared by

dissolving UO_2 powder in nitric acid solution and diluting this with D.I. water to the desired concentration level. The dopant solution was added to the powdered glass, mechanically mixed, and then heated on a hot plate until dry. The doped glass powder was then melted in a platinum crucible at 1100°C for 30 minutes prior to casting. The glass bars were cast into a steel bar mold assembly preheated on a hot plate. When the bars were sufficiently solidified, they were transferred to the auxiliary furnace where they were held at 500°C for 2 hours and furnace-cooled to room temperature. The resultant material had the composition as shown in Table 1. This analysis was obtained from center cuts of two different bars from which specimens were selected.

GLASS SAMPLE PREPARATION

Glass samples were used in both monolithic and powdered forms depending upon the surface area desired.

Monoliths: Specimens were cut from cast bars with a low-speed diamond saw using deionized water as the cutting medium. The outside surfaces of the cast bars were completely removed by sawing, and samples were cut from the inner core. After cutting, the samples were ultrasonically cleaned in deionized water and absolute ethanol to remove adherent fines.

Powders: Cast glass bars, after surface removal by sawing, were crushed in a steel mortar and pestle. The powders were then sieved across magnets and separated into size fractions of -40 +80 mesh and -100 +200 mesh. Reduction by more conventional methods resulted in powders that were too fine in particle size. Surface areas were calculated from average particle sizes as illustrated in Table 3. It was necessary to calculate surface areas rather than measure them because BET techniques are not useful for powders with surface areas this small. Compositional analysis of the two size fractions were both the same as that obtained from monolithic samples, Table 1. Therefore, the glass is homogeneous on the scale evaluated. Prior to utilization, the glass powders were ultrasonically cleaned in deionized water and absolute ethanol to remove adherent ultrafines.

ROCK SAMPLE PREPARATION

Rock samples used were supplied by Lawrence Livermore National Laboratory. Analysis of the rock composition is given in Table 1. As can be seen, the total of elements only sum to 92.2 wt% and, therefore, the analysis is not adequate and can only be used as a rough guide. The rock was highly porous in nature and N_2 BET analysis of the monolithic rock yielded a measured surface area of $0.823 \text{ m}^2/\text{g}$. This is much higher than the glass powders used in this study, Table 3. Therefore, if the porosity is accessible to water, then the tests containing both rock and water should be rock dominated. Crushing of the rock to -60 mesh powder resulted in an increase in the N_2 BET measured surface area to $1.40 \text{ m}^2/\text{g}$. It was considered necessary to include all of the rock powder, rather than separate out a size fraction, due to apparent inhomogeneities and the unknown effect of trace elements.

Monoliths: Rock monolithic samples were cut from the as-received Topopah Spring tuff rock with a low-speed diamond saw using deionized water as the cutting medium. The cut rock specimens were ultrasonically cleaned in deionized water and absolute ethanol to remove adherent fines. In interactive experiments involving both monolithic rock and glass samples, the rock specimen was cut to achieve the same geometric surface area as the glass.

Powders: As-received tuff rock was covered with plastic bags and broken with a hammer until all the pieces were small enough to fit into a steel mortar and pestle. These pieces were crushed until all passed through a 10-mesh screen. Some metal contamination from the steel of the mortar was noticed and removed from the rock by sieving it across magnets. The -10 mesh powder was then transferred to a ball mill and processed until all material passed through a -60 mesh screen. The -60 mesh powder was used unwashed for interactive testing. It was felt that the fines might be enriched in certain elements (due to the heterogeneous appearance of the rock), which could be preferentially removed by washing.

METALLIC SAMPLE PREPARATION

Metallic samples were only used in monolithic form and were prepared in a similar manner regardless of whether 304L, 316SS or 1020M metal was used. The metallic specimens were cut to the same geometric surface area as the monolithic glass samples. The compositions of metals used are given in Table 2.

300 Series Stainless Steel Monoliths: The samples were sawed to the appropriate size and ultrasonically cleaned in acetone, absolute ethanol, and deionized water prior to use.

1020M Mild Steel Monoliths: The procedure used for 1020M samples was identical to that used for stainless steels except that the samples were acid etched in 1:1 HCl and rinsed in deionized water prior to ultrasonic cleaning. The purpose for the acid etch was to remove corrosion layers that existed on the unsawed surfaces of the samples.

EXPERIMENTAL PROCEDURES

The detailed experimental procedure is given in Appendix A and, therefore, will only be summarized here. All of the tests were static, conducted in Teflon containers, and included tuff groundwater. The tests were divided into four categories as can be seen from the test matrix shown in Table 4. These four categories are as follows:

- Test I - Glass + tuff groundwater
- Test II - Glass + tuff rock + tuff groundwater
- Test III - Glass + tuff rock + metal + tuff groundwater
- Test IV - Tuff water blanks, tuff groundwater blanks, replicates, and rock preleach effects

Experimental variables were temperature (40 to 150°C), time (3 to 182 days), and surface area ratios of components as listed in Table 4.

The procedures used closely follow the Materials Characterization Center MCC-1 and MCC-3 procedures.⁽⁴⁾ For Test I, the glass samples were

leached on teflon supports. In Test II, glass powders and rock samples were placed on the floor of the teflon container. Glass monoliths were placed on teflon supports. In Test III, both the rock and metal were placed on the container floor, while the monolithic glass samples resided on a teflon support. Glass powders were placed on the container floor. In many of the experiments containing glass powder, a small glass coupon was added for solid state analysis.

After the designated time period, the solutions were cooled and the pH measured. All solutions containing powders or precipitates were filtered using a 0.45 μm filter. If the solution was clear, an unfiltered aliquote was also taken. Additionally, as the solution volume permitted, aliquotes were taken and filtered through 50 and 18 Angstrom filters. Solutions were analyzed initially for elemental concentrations by use of the induction coupled plasma spectrometer (ICP), and more recently analyses were also made for anions. All solutions submitted for ICP analyses were acidified to 1% V/V with ultrex nitric acid. The leach containers were acid stripped with a 1% V/V nitric acid solution which was also submitted for ICP analysis. The acid strip analysis is meaningless for experiments that contained powders due to the inability to reliably rinse all of the powder from the container prior to acid stripping.

Solid state analyses of selected leached glass samples were performed by secondary ion mass spectrometry (SIMS) and scanning electron microscopy (SEM) with dispersive X-ray analysis (EDAX). X-ray fluorescence (XRF) analyses were also conducted on selected filter papers.

RESULTS AND DISCUSSION

The experimental matrix, Table 4, was designed to evaluate the interactive effects of potential waste package constituents on release characteristics of the waste form. The tests were divided into four major categories to progressively increase the complexity of the system being evaluated and, thereby, to hopefully better understand the processes occurring.

In Tests 1 and 4, baselines were established. Test 1 was designed to evaluate waste form release characteristics in tuff groundwater without interactive effects from other waste package constituents. These results should be the basis from which interactive effects are measured. Test 2 was designed to evaluate the effects of tuff rock on waste form release characteristics. The rock and glass samples were either in monolithic or in powdered form depending upon component surface area ratios desired. The test marked "II-90D" was duplicated, i.e., the same experiment was rerun with fresh samples at a different time to evaluate the reproducibility of experimental and analytical techniques.

Test 3 was intended to simultaneously evaluate the effects of both tuff rock and ferrous metal on waste form release characteristics. The metals evaluated were the relatively inert 300 series stainless steels, 304L and 316, and the more reactive 1020M mild steel. As in Test 2, both powdered and monolithic glass and rock samples were used to vary the component surface area ratios and the glass surface-area-to-groundwater volume ratios. Test III-90B was run in duplicate and contained ten times the normal metallic surface area to be consistent with the ten-fold increase in glass surface area, i.e., the metal and glass surface area ratios remained the same.

In all other tests the metallic surface area was equivalent to monolithic glass sample surface areas. Therefore, if the glass surface areas were increased by using powders, the metallic surface area remained constant (except for Test III-90B), resulting in a surface area ratio change.

The experiments conducted in Test 4 were for the purpose of establishing baseline data for the tuff rock/tuff groundwater system, the time dependence of tuff groundwater composition alone, and various effects of washing and/or preleaching the rock constituents of interactive tests. Tests IV-90A and IV-90B were to evaluate the time dependent release from tuff rock monolithic and powdered samples, respectively, in tuff groundwater.

The series of tests IV-CM and IV-CP illustrate temperature-dependent release from one-day preleaching of tuff rock monoliths and powders,

respectively, in tuff groundwater. Tests IV-90D and IV-90E are repeats of tests IV-90A and IV-90B with the exception that the rock samples were preleached prior to initiation of the experiment. The tests labeled IV-23-P0 and IV-M0 give solution analyses for the elements removed from the rock samples during the cleaning procedure. Tests IV-90F and IV-90G are repeats of II-90A and II-90B with the rock samples being preleached in tuff groundwater. If preleaching makes no difference, then the two series of tests should yield the same results.

Finally, Test IV-90 is an evaluation of the time-dependent stability of the tuff groundwater at 90°C. The majority of experiments were conducted at 90°C; comparisons were made and effects evaluated from the 90°C results.

There is a large amount of data that has been generated by the experiments outlined in Table 4 and described above. This data is all included in tabular form in Appendix C. Only certain facets and aspects of the data, which appeared most relevant to the authors, have been plotted and will be discussed. Along this line, only B, Si, and uranium release results will be considered in the text. Other elemental release values can be obtained from Appendix C. The release values for B are particularly important from an understanding point of view since B does not readily sorb on the waste package constituents or on the container walls, nor is it normally associated with precipitates. Therefore, B represents the amount of glass reaction that has occurred.

The concentration of Si in solution is important because the release characteristics of the waste glass have been shown to be directly related to Si solution concentrations.⁽⁵⁾ Since Si is a major constituent in both the glass and the tuff rock, only general effects information can be obtained. The release values for uranium are important as an indicator of actinide behavior.

Release characteristics of 76-68 glass in tuff groundwater alone, Test 1, are illustrated in Figures 1, 2, and 3 for B, Si, and uranium, respectively. Other elements of interest can be gleaned from Appendix C. The data shown in Figures 1 and 2 are illustrated in three-dimensional

plots. This allows the most information to be illustrated in the least amount of space and gives a better overall picture of the elemental release characteristics. Figure 1 for B and Figure 2 for Si show identical trends, i.e., that elemental release is enhanced with both temperature and time and that the temperature increase from 90 to 150°C results in the largest increase in elemental release. The activation energy for B release from 76-68 glass into tuff groundwater was determined to be 16 Kcal/mole, which agrees reasonably well with the previously determined⁽⁶⁾ 18 Kcal/mole for 76-68 glass in D.I. water. This indicates that glass-water interactions are similar in tuff groundwater and in deionized water.

Uranium release results from 76-68 glass into tuff groundwater are shown in Figure 3. This figure illustrates that there is somewhat more scatter in the uranium data than for other elements evaluated. This is due in part to the relatively lower concentrations in solution. However, it can be seen from Figure 3 that relatively little uranium was released at 40°C. At higher temperatures, the uranium release data appear to be independent of temperature within the data scatter. In fact, there appears to be very little time dependence within the data scatter at any temperature evaluated. Initial pH values for the tuff groundwater averaged 7.3 and, after 91 days of leaching, the pH value rose to 8.5 at 40°C, 9.0 at 70°C, 9.3 at 90 and 150°C. The pH value is an indicator of glass reaction which has occurred and has a large effect on the solubility limit of uranium. In general, over a pH range of 7 to 9.5 (which spans the leaching results), the solubility of uranium decreases with increasing pH. Therefore, the lower solution concentrations of uranium observed at 40°C is not the result of solubility limits but rather of lower glass reaction rates. It cannot be inferred from the data shown in Figure 3 whether solubility limits control the solution concentrations at higher temperatures. However, from the B release data of Figure 1, it can be seen that the glass reaction increases with both temperature and time, and thus, the fact that uranium concentrations do not increase indicates that alteration products and corresponding solubility limits may be controlling the solution concentration of uranium. Assuming the average solution concentration of uranium is about one ppm, then this converts to

4×10^{-6} M, which is not an unreasonable solubility limit for anhydrous uranium oxide at pH values of 9 in air saturated solutions.

When constituents of the waste package (other than the glass) are added to the test, interactive effects can become important. In addition, analyses become more complicated due to the same elements being present in more than one component of the test. This is illustrated in Figure 4 where the elemental compositions of the glass, tuff rock, and tuff groundwater are simultaneously displayed. As can be seen, there are many common elements such as Na, Si, and Ca.

No matter what waste package design is finally selected, tuff rock will be present. Therefore, it is important to evaluate the effects of tuff rock on waste form release characteristics. This is done in test series 2 (see Table 4). Both tuff rock monoliths (of the same geometric surface area as the glass monolithic samples) and tuff rock powders were used to conduct the interactive tests. The rock monoliths were ultrasonically cleaned after cutting. The rock powder was not normally cleaned due to the apparent inhomogeneity of the rock which, it was feared, would result in heterogeneous compositional variations between powder particle sizes. Since the fine powder particles preferentially dissolve due to their relatively large surface areas, exposure to water in cleaning or preleaching procedures could result in undesirably altered rock powder samples. The entire rock sample preparation is described under the previous experimental section. Since it is the author's understanding that rock samples are preleached at LLNL, a comparison of elemental release into 90°C tuff groundwater from rock samples prepared in the manner used in this test matrix to preleached rock samples are given in Figures 5 and 6 for monoliths and powders, respectively. As can be seen from the figures, there is essentially no difference in release characteristics between cleaned and preleached monolithic rock samples. However, there is a larger difference observed (Figure 6) in the case of powders. Uncleaned powders result in more elemental release when exposed to water than preleached powders. The effect of preleaching rock samples prior to interactive testing, however, is small when waste form release characteristics are being evaluated, see Appendix C.

An evaluation of the effect of tuff rock on Si, B, and uranium elemental release from 76-68 glass has been conducted as a function of the surface area ratios of rock/glass samples and as a function of glass sample surface area to tuff groundwater ratios (see Table 4). These results are illustrated in Figures 7 through 16.

The time-dependent effect on Si solution concentration of adding tuff rock monoliths and waste glass monoliths to tuff groundwater are illustrated in Figure 7. The glass sample surface area to tuff groundwater volume ratio (SA/V) is 10 m^{-1} with rock and glass monolithic samples being equal in surface area. It can be seen from Figure 7 that the tuff groundwater alone changes insignificantly while addition of either rock or glass or both causes enhanced silicon solution concentrations. The presence of Si in solution has a strong retardation on glass leaching⁽⁵⁾ due to reduction of the silicate matrix dissolution as silicon saturation is approached. That this is happening can be seen in Figure 8, which illustrates the time-dependent B solution concentration as glass and rock are added to tuff groundwater.

Again, glass and rock monoliths were added which were of the same surface area and the $\text{SA/V} = 10 \text{ m}^{-1}$. Boron is an indicator of glass reaction which has occurred because it does not normally form precipitates nor sorb on the container wall to any extent. As can be seen from Figure 8, there is a small amount of B released from the rock monoliths which should not affect interpretation of the results. Glass alone in tuff groundwater releases the most amount of B. When a monolithic rock sample is added, the B in solution decreases somewhat, indicating that less glass reaction has occurred. This seems reasonable since silicon has been added to the solution from the tuff rock which will somewhat retard glass-water interaction.

When rock powder is added to the system, the concentration of Si in solution increases significantly above that achieved with either rock or glass monoliths alone, particularly at longer times (Figure 9). This increased Si in solution should result in reduced glass reaction with the tuff groundwater. That this is the case is illustrated in Figure 10 where

time-dependent B solution concentrations are shown as a function of rock sample type. It is obvious that tuff rock powder is much more effective at reducing glass-water reactions (and thus release) than the rock monolith.

This is a particularly interesting point because the surface areas as determined by N_2 BET are not consistent with this result. The average N_2 -BET surface area of the rock monoliths is 0.28 m^2 . This is because of the high degree of porosity of the rock samples evaluated. The N_2 -BET surface area of the 0.1 gm rock powder sample was 0.13 m^2 . This is approximately half of the monolithic rock sample surface area. Obviously, the N_2 -BET surface area measured on the monolithic rock sample is not as effective as the rock powder surface area. It could be that not all of the porosity contributing to the monolithic rock surface area is accessible by the liquid or that there is a large difference in reactivity of the powdered surface area compared to the monolithic porosity surfaces or that both effects are operative. Whether rock monoliths or powder are used, the system should be rock dominated (based on N_2 -BET surface areas) because the glass surface area, in a $SA/V = 10$ experiment, is approximately 10^{-4} m^2 , which is 3 orders of magnitude less glass surface area than rock.

Even in cases where one order of magnitude more glass surface area is used, i.e., $SA/V = 100$ instead of 10, the effects of tuff rock powder on release from the glass are the same, Figures 11 and 12. The addition of ten times more glass surface area has little effect on silicon solution concentrations, indicating that the system is already rock-dominated with only 0.1 gm rock powder, Figure 11. This is substantiated by Figure 12, which illustrates that B release, i.e., glass-water interaction, is significantly reduced by 0.1 gm rock powder and does not increase to any extent with time. Increasing the glass surface area present by one order of magnitude does not significantly increase boron release, i.e., glass-water reaction.

The results illustrated in Figure 13 summarizes the findings discussed so far, i.e., glass-tuff groundwater reactions are drastically reduced by the addition of rock powder but not nearly as much by the addition of rock monolithic samples. Additionally, Figure 13 also illustrates that

increasing the glass and rock powder surface area by one order of magnitude has no significant effect on B release. Increases in the quantity of rock powder above 0.1 gram cause increased Si solution concentrations but have small additional effects on B release from the glass as is illustrated in Figures 14 and 15. The small increase in boron observed when $SA/V = 400 \text{ m}^{-1}$ with 4 gm rock powder could come either from the glass or from impurities in the rock. Glass reaction layer thicknesses were undetectably small with rock powder present, indicating that the boron probably came from the additional rock powder.

Although increases in rock powder above 0.1 gm made little difference in B solution concentrations, it makes a large difference in uranium solution concentrations, Figure 16. With 0.1 gm rock powder present, the amount of uranium in solution is about one order of magnitude less than with no rock present, Figure 3. Increasing the amount of rock present lowers the uranium solution concentration even though the amount of glass increases, Figure 16. These results can probably be explained by uranium sorption on the rock surfaces.

The last waste package constituent to be considered in regard to interactive effects is ferrous metal. The metals considered in this investigation are 304L and 316 stainless steel as well as 1020M mild steel. The 300-series stainless steels form a protective chrome oxide layer and are not expected to be reactive. However, the 1020M mild steel is more reactive and is expected to have a larger interactive effect.

The effect of waste package constituents on pH is shown in Figure 17 for glass and tuff rock monolithic samples in tuff groundwater at an SA/V of 10 m^{-1} . Additionally, 304L stainless steel samples of the same geometric surface area as the glass are included with the rock and glass in Figure 17. There is no effect on pH of the rock or 304L SS over what is observed for glass alone. This is consistent with the fact that rock monoliths caused relatively little effect on glass-water interactions. The 304L SS also seems to be inert as far as pH alteration is concerned.

This is not the case, however, for 1020M steel as can be seen from Figure 18. This figure shows pH changes for glass and tuff rock monolithic

samples with metal present in 90°C tuff groundwater. The rock and metal samples are of the same surface area as the glass sample and the $SA/V = 10 \text{ m}^{-1}$. As can be seen, the 300-series stainless steels are similar and have essentially no effect, while 1020M mild steel increases the pH level significantly higher than the glass alone does. This indicates a large amount of reaction occurring between metal and water. Therefore, the 1020M metal should have an effect on glass reaction and release characteristics.

That this occurs is illustrated in Figure 19, which it can be seen that 304L and 316 stainless steel have little effect on B release, while 1020M has a large effect. These experiments were conducted with monolithic rock samples and, therefore, may not be expected to be rock dominated from previous discussions. Nevertheless, the 1020M steel has a large effect under these experimental conditions.

The inclusion of rock powder in the test matrix shows interesting results as can be seen in Figure 20. In this series of tests, when the SA/V was increased from 10 to 100, the metal sample surface area was increased by ten to keep the surface area ratio constant. Additionally, rock powder was used instead of a rock monolith. This system should still be rock dominated since the rock surface area is still two orders of magnitude greater than either the glass or metal. However, as can be seen from Figure 20, the 1020M metal is dominating the system and causing very large glass reactions (as determined by B release) to occur. The 304L SS has essentially no effect even when its surface area has been increased by a factor of 10. More research needs to be conducted to determine how much rock is needed to overcome the 1020M steel.

The effect of metal on uranium solution concentrations is shown in Figure 21. These tests were conducted with glass and rock monolithic samples and show less uranium in solution than was observed for glass alone, Figure 3, but much more than was observed for rock powder, Figure 16. Rock powder reduces glass reaction with water and offers possible sorption sites for the uranium. Acid stripping of the metal samples, Table 5, shows that 1020M is much more effective at removing

uranium from solution than the stainless steels. This could be due to the fact that 1020M samples cause more glass reaction and thus have more uranium in solution to sorb or also because iron hydroxide is forming, which is a very good scavenger for actinides.

The fact that B has been used as an indicator of glass reaction throughout requires some verification. With this intention, reaction layer thicknesses were measured with an SEM on cross-sections of reacted samples. The results are shown in Figure 22 for comparison to B results. As can be seen from the figure, tuff rock monoliths and 300-series stainless steels cause little effect on reaction layer thicknesses. However, 1020M steel causes a large increase in reaction layer thickness. Additionally, 150°C temperatures cause large reaction layers. Figures 23 and 24 show the SEM photographs of sample cross-sections. In addition to observations made from Figure 22, the effect of 0.1 gm rock powder should be noted on Figure 23. The rock powder results in no detectable reaction layer on the glass and on adherent layer of rock powder fines.

Almost all of the experiments were filtered. Figures 25 and 26 show some of these results. In these figures, it can be seen that filtration has removed only a small amount of Si from solution. Since Si is tied up in most colloids and/or precipitates, then it appears that these were not present in large quantities in the experiments plotted. The experiments shown in Figure 25 are with monolithic glass and rock samples and in Figure 26 with monolithic glass, rock, and 304L SS samples. Other experiments, which were conducted with glass and/or rock powder, as well as those incorporating 1020M steel show more effect of filtration due to the formation of precipitates and/or colloids. These data can be gleaned from Appendix C.

The reproducibility of the data is illustrated in Figures 27 and 28. Duplicate experiments were conducted at separate times to evaluate the experimental and analytical aspects of the program. The replicate experiments are marked on the test matrix in Table 4. One experiment (Figure 27) was Test 2 with rock and glass powder, and the other experiment (Figure 28) was Test 3 which was identical with the exception of the

inclusion of a piece of 304L SS. The Si release data from both experiments are essentially the same because of the relative inertness of 304L SS. Replication of the data is good.

CONCLUSIONS

The major conclusions that can be drawn from the completion of this test matrix are as follows:

- In the absence of 1020M mild steel, tuff rock powder dominates the system.
- Tuff rock monolithic samples do not have a large effect on 76-68 glass release characteristics even though the rock monolith has a large N_2 -BET surface area.
- Increasing amounts of rock powder do not detectably decrease B release (it is already very low) but has a significant effect on reducing uranium solution concentrations.
- When 1020M mild steel is present, it appears to dominate the system, significantly increasing glass reaction. However, the 1020M steel also scavenges uranium from solution, probably as a result of iron hydroxide formation, increased pH, and reduced Eh.

REFERENCES

1. Buckwalter, C. Q. and L. R. Pederson. 1982. "Inhibition of Nuclear Waste Glass Leaching by Chemisorption." J. Am. Ceram. Soc. 65(9):431-436.
2. McVay, G. L. and C. Q. Buckwalter. 1983. "Effect of Iron on Waste-Glass Leaching." J. Am. Ceram. Soc. 66(3):170-174.
3. Shade, J. W., L. R. Pederson and G. L. McVay. 1983. Waste Glass/Metal Interactions in Brines. PNL-SA-10913, Pacific Northwest Laboratory, Richland, Washington.
4. The Nuclear Waste Materials Handbook, Test Methods. DOE/TIC-11400. Prepared by Materials Characterization Center, J. E. Mendel, ed.
5. Pederson, L. R., C. Q. Buckwalter, G. L. McVay and B. L. Riddle. 1982. "Glass Surface Area to Solution Volume Ratio and Its Implications to Accelerated Leach Testing." Scientific Basis for Nuclear Waste Management, Vol. 6, pp. 47-54.
6. Bradley, D. J., D. G. Coles, F. N. Hodges, G. L. McVay and R. E. Westerman. 1983. Nuclear Waste Package Materials Testing Report: Basaltic and Tuffaceous Environments. PNL-4452, Pacific Northwest Laboratory, Richland, Washington.

TABLE 1. Component Composition

OXIDES	UO ₂ SPIKED (76-68) wt%	TUFF ROCK wt%	ELEMENTS	TUFF WATER ppm
SiO ₂	42.00	70.000	Si	30.100
Na ₂ O	12.70	3.720	Na	47.500
Fe ₂ O ₃	9.56	0.860	Fe	
B ₂ O ₃	9.00		B	
ZnO	5.10		Zr	
UO ₂	3.98		U	
TiO ₂	3.08	0.100	Ti	
CaO	2.37	0.610	Ca	12.400
La ₂ O ₃	4.10		La	
MoO ₃	1.97		Mo	
Nd ₂ O ₃	1.40		Nd	
Ce ₂ O ₃	0.90		Ce	
Cs ₂ O	1.10		Cs	
P ₂ O ₅	0.80		P	
BaO	0.55	0.007	Ba	
Al ₂ O ₃	0.59	12.000	Al	
K ₂ O		4.510	K	4.600
SrO	0.40	0.005	Sr	0.042
Cr ₂ O ₃	0.47		Cr	
NiO	0.23		Ni	
MnO ₂		0.060	Sm	
CuO		0.010	Mn	
Li ₂ O			Cu	
MgO		0.070	Li	0.047
ZrO ₂	1.89	0.030	Mg	1.900
			Zr	

TABLE 2. Composition of Metallic Samples
(in wt%)

TYPE NO.	C	Mn MAX	Si MAX	P MAX	S MAX	Cr	Ni
304L*	0.03	2.00	1.00	0.045	0.03	18-20	8-12
316SS*	0.08	2.00	1.00	0.045	0.03	16-18	10-14
1020M**	0.19	0.36	0.29	0.430			

Remainder Fe

*American Iron and Steel Institute, standard type numbers

**Lusk Metals Test Report, Speci. AISI, Source Pitt Steel
heat No. B27625

TABLE 3. Glass Powder Surface Area Calculations

	SA/V = 100	SA/V = 400
Mesh size	-40 + 80	-100 + 200
Ave. particle size (cm)	.0299	.0112
Particle surface area (cm ²)	.005364	.000753
Volume particle (cm ³)	2.673 E-5	1.405 E-6
SA/G (cm ² /g)	66.890	178.635

TABLE 4. TEST MATRIX

Test	Temp., °C	Time, Days	Waste Form Morphology	Metal ⁺⁺⁺	SA/V ⁺	Rock ⁺ Morphology
TEST 1						
I-40	40	3- 182	MONO		10	N.A.
I-70	70	"	"		"	"
I-90	90	"	"		"	"
I-150	150	3- 91	"		"	"
TEST 2						
II-40	40	3-182	MONO		10	MONO
II-70	70	3-182	"		"	"
II-90A	90	"	"		"	"
II-90B	90	"	"		"	0.1 g ROCK POWDER
II-90C	90	"	POWDER -40+80		100	1 g ROCK POWDER
II-90D**	90	"	"		100	0.1 g ROCK POWDER
II-90E	90	3- 56	POWDER -100+200		400	4 g ROCK POWDER
II-150	150	3- 91	MONO		10	MONO
TEST 3						
III-40	40	3 -182	MONO	304 L	10	MONO
III-70	70	"	"	"	"	"
III-90A	90	3 - 91	"	"	"	"
III-90B**	90	"	POWDER -40+80	++	100	0.1 g ROCK POWDER
III-90C	90	3 - 182	MONO	1020 M	10	MONO
III-90D	90	"	"	316 SS	"	"
III-90E	90	3 - 28	POWDER -40+80	1020 M	100	0.1 g ROCK POWDER
III-150	150	3 - 91	MONO	304 L	10	MONO
TEST 4						
IV-90A	90	7 - 91	NONE	NONE	N.A.	MONO
IV-90B	90	3 - 91	"	"	"	0.1 g ROCK POWDER
IV-CM	40	1	"	"	"	MONO
IV-CM	70	"	"	"	"	"
IV-CM	90	"	"	"	"	"
IV-CM	150	"	"	"	"	"
IV-CP	40	1	NONE	NONE	"	0.1 g ROCK POWDER
IV-CP	70	"	"	"	"	"
IV-CP	90	"	"	"	"	"
IV-CP	150	"	"	"	"	"
IV-90D	90	3 - 91	"	"	"	MONO
(Tuff monolith preleached for 1 day at 90°C)						
IV-90E	90	3 - 91	"	"	"	0.1 g ROCK POWDER
(a) Prewashed in sonic cleaner (in tuff water)						
(b) preleached for 1 day at 90°C (in tuff water)						
IV-23-P0	23	-	"	"	"	0.1 g ROCK POWDER
(a) Prewashed in sonic cleaner for 5 minutes.						
(b) Solution filtered 0.45 µm.						
IV-M0	23	-	"	"	"	MONO
(a) Sonic cleaned for 5 minutes.						
IV-90F	90	3 - 91	MONO	"	10	MONO
(a) Tuff rock monoliths preleached for 1 day at 90°C in tuff water.						
IV-90G	90	3 - 91	MONO	"	10	0.1 g ROCK POWDER
(a) Tuff rock powder sonic-cleaned.						
(b) Tuff rock powder preleached for 1 day at 90°C in tuff water.						
IV-90	90	3 - 91	NONE	NONE	N.A.	NONE
(a) Tuff water only.						

* Glass sample surface area/leachate volume.

** Duplicate experiments made to 28 days.

+ Rock monoliths had the same geometric surface area as the glass sample.
Rock powder was -60 mesh.

++ Metallic surface area is ten times glass monolith surface area to be consistent with higher SA/V.

+++Metallic surface area was equal to glass surface area.

TABLE 5. ICP ACID STRIP DATA
METALS IN 3 N HNO3 + .5 N HF

ELEMENTS DET. LIM	Blank	1020M Blank	90C-56 1020 M	90C-91 1020 M	316SS Blank	90D-56 316 SS	90D-91 316 SS	304L blank	90A-56 304L	90A-91 304L
AL (.03)*	100									100
B (.01)										130
Ca (.02)										
Cr (.02)					130	240	160	100	240	088
Fe (.005)	67	6000	78,600	29,800	520	970	590	400	940	310
Na (.16)										
Ni (.02)	20				089	180	120	057	140	067
Si (.02)	350	450	440	730	640	470	320	1,100	500	1,500
U (.0005)				1.063			0.083			0.077

*mg/l (ppm)

Boron
Concentration
mg/liter

Temperature
°C

Time
(days)

FIGURE 1.

FIGURE 2.

URANIUM ANALYSIS

FIGURE 3.

WT % OXIDES SPDXED (78-88) GLASS

WT % OXIDES TUFF ROCK

COMPOSITION OF TUFF WATER

FIGURE 4.

FIGURE 5.

FIGURE 6.

COMPARISON OF COMPONENT CONTRIBUTION SILICON , 90C

FIGURE 7.

COMPARISON OF COMPONENT CONTRIBUTION BORON, 90 C

FIGURE 8.

BORON NOT PRESENT IN WATER ANALYSIS

EFFECTS OF GLASS/ROCK
SILICON 90C

EFFECTS OF GLASS/ROCK
BORON, 90C

FIGURE 10.

EFFECTS OF SA/V SILICON 90C

FIGURE 11.

EFFECTS OF SA/V BORON '90C

FIGURE 12.

EFFECTS OF GLASS/ROCK BORON, 90C

FIGURE 13.

EFFECTS OF GLASS/ROCK SILICON 90C

FIGURE 14.

EFFECTS OF GLASS/ROCK
BORON, 90C

FIGURE 15.

URANIUM ANALYSIS
GLASS+ROCK

FIGURE 16.

COMPARISON OF COMPONENT CONTRIBUTION TO PH
LLNL WASTE PACKAGE TESTS, 90C

FIGURE 17.

EFFECT OF METALS ON PH
LLNL WASTE PACKAGE TEST 3 (GLASS + ROCK + METAL)
90 C, pH

FIGURE 18.

INTERACTIVE EFFECTS BORON 90C

FIGURE 19.

EFFECT OF INCREASED METAL SURFACE AREA

FIGURE 20.

METALS AND URANIUM

FIGURE 21.

GEL LAYER THICKNESS 90 C , 91 DAYS

GEL LAYER THICKNESS FOR TESTS 1, 2, & 3

FIGURE 22.

EFFECTS OF WASTE PACKAGE
COMPONENTS ON GLASS REACTIONS

GLASS
ALONE

GLASS
ROCK
MONOLITH
304 L

90°C
TUFF
WATER
91 DAYS

GLASS
ROCK
MONOLITH
1020 M

GLASS
ROCK
POWDER

5 μ

FIGURE 23.

10 μ

(76-68) WASTE GLASS
150°C TUFF WATER 91 DAYS

FIGURE 24.

EFFECT OF FILTERING SILICON 90 C

*TEST II (GLASS + ROCK) *

FIGURE 25.

EFFECTS OF FILTERING
SILICON TEST3 90C

TEST RUN WITH 304 L

FIGURE 26.

REPLICATE DATA SETS
TEST 2 - D , 90 C

FIGURE 27.

REPLICATE DATA SETS
TEST 3 - B 90 C

FIGURE 28.

APPENDIX A

EXPERIMENTAL PROCEDURES

INDEX FOR EXPERIMENTAL PROCEDURES
for
INVESTIGATION OF THE BEHAVIOR AND INTERACTIONS
OF TUFF WASTE PACKAGE COMPONENTS

<u>Title</u>	<u>Date</u>	<u>Author</u>	<u>Identification Number</u>
° Procedures for Determination of the Leach Rate and Inter- active Reaction of LLNL Waste Package Materials	10-83	G.R. Robinson	LLNL-TP-1

PROCEDURES FOR DETERMINATION OF
THE LEACH RATE AND INTERACTIVE
REACTION OF LLNL WASTE
PACKAGE MATERIALS

GR Robinson

October, 1983

- I. Material Preparation
- II. Specimen Preparation
 - A. Tuff Rock Monoliths
 - B. Tuff Rock Powders
 - C. UO_2 Spiked (76-68) Glass Monoliths
 - D. UO_2 Spiked MCC (76-68) Glass Powders
 - E. 1020 Mild Steel
 - F. 316 SS
 - G. 304 L Steel
- III. Experimental Procedure
 - A. Leaching Procedure
 - B. Specimen Handling
 - C. Sampling Procedure for Monolith Leachates
 - D. Sampling Procedure for Powdered Specimen Leachates

For Approval Of

Name	Approved	Date
<i>Ray L. Mc Gay</i>	✓	10-26-83
<i>Griffin Robinson</i>	✓	10-26-83

TEST CONDITIONS, SAMPLE PREPARATION AND DESCRIPTION

I. MATERIAL PREPARATION

The material tested was MCC (76-68) borosilicate glass spiked with 3.7 wt% UO_2 . This material was prepared by John Wald, Pacific Northwest Laboratory, 308 Building, on December 22, 1982, as follows:

Bars of previously melted and cast 76-68 glass were prepared for doping by crushing and sieving to -100 mesh size fraction. The dopant solution was prepared by dissolving UO_2 powder in nitric acid solution and diluting this with D.I. water to the desired concentration level. The dopant solution was added to the powdered glass, mechanically mixed, and then heated on a hot plate until dry. The doped glass powder was then melted in a platinum crucible at 1100°C for 30 minutes prior to casting. The glass bars were cast into a steel bar mold assembly preheated on a hot plate. When the bars were sufficiently solidified, they were transferred to the auxiliary furnace where they were held at 500°C for 2 hours and furnace cooled to room temperature. The resultant material had the composition as shown in Table 1.1 found in the final report. This analysis was obtained from center cuts of two different bars from which specimens were selected.

II. SPECIMEN PREPARATION

II.A. Tuff Rock Monoliths

Sections of as-received Topopah Spring Tuff rock were cut to give surface areas of 150, 200, and 250 mm^2 . Specimen dimensions and calculated surface areas were recorded. These specimens were cut on a low-speed Buehler Isomet saw using a 200-grit (low density) diamond saw blade using D.I. water as a collant. Geometric surface areas of glass and rock were kept the same for tests in which sample/rock ratio equals one.

II.B. Tuff Rock Powders

One complete section of as-received tuff rock was covered with plastic bags and broken with a hammer until all the pieces were small enough to fit into a steel mortar and pestle. These pieces were crushed until all passed through a 10-mesh screen. Some metal contamination from the steel of the mortar was noticed and removed from the rock by sieving it across magnets. The -10 mesh powder was then transferred to a ball mill, and the entire section was processed until all material passed through a -60 mesh screen. The -60 mesh powder was used unwashed for Tests 1, 2, and 3 and as described in Table 1 on Test 4. Samples were prepared by weighing and the weights recorded.

II.C. UO₂ Spiked MCC (76-68) Glass Monoliths

Six 1/2 by 1/2 by 3-inch bars were used as received from John Wald of Battelle, Pacific Northwest Laboratories, Richland, Washington. Specimens were cut with a Buehler low-speed saw using a low-density (200-grit) diamond saw blade. D.I. water was used as the cutting medium and crystal bond as the adhesive. The outside surface of the as-formed bars was completely removed; and then from the remaining sections, specimens of 150, 200 and 250 mm² surface area were cut as needed and used at random. Only specimens within ± 10 percent of the needed surface area were used.

II.D. UO₂ Spiked MCC (76-68) Glass Powders

Defective (chipped), or specimens that failed to meet the $\pm 10\%$ surface area requirements were used for the powdered specimens. These were placed in a steel mortar and pestle and crushed. The crushed glass was then sifted through -40 +80 mesh sieves, a second set -100 +200, and still a third, -200. Surface areas were calculated, summarized and recorded.

II.E. 1020 Mild Steel

Steel sheets were used as received from Stan Pittman of Battelle, Pacific Northwest Laboratory, Richland, Washington. Specimens were cut by stamping from a .06" thick sheet. These were sonic cleaned in

acetone, an absolute alcohol. These specimens were then acid etched in 1:1 HCl very quickly and then sonic cleaned in D.I. water to clean off an initial corroded layer on the surface of the metal. Bulk analysis is given in Table 2 and specimen dimensions, surface areas, and weights were recorded.

II.F. 316 SS

316 SS was used as received from E. S. Churman of the Battelle, Pacific Northwest Laboratory machine shop. The specimens were machined to the proper size from a 3-inch diameter cylinder labeled: CPTF, 316SST, HT No. 10536. Bulk analysis is presented by X-ray diffraction diagrams in Figure 1. Specimens were sonic cleaned in acetone, absolute alcohol, and D.I. water.

II.F. 304 L Steel

304 L specimens were used as received from E. S. Churman of the PNL machine shop. These were machined to the proper size from a bar labeled CF 304L ANN 008 763 COND "01" SO H.T. AL1855 Mill Crucible 12-8. Bulk analysis is presented by X-ray profiles in Figure 1 and nominal compositions as listed in Table 2.

III. EXPERIMENTAL PROCEDURE

Samples were prepared according to MCC-1 and 3 as needed, SA/V values were calculated using Table 3 for glass powders.

III.A. Leaching Procedure

The leaching procedure used was as given in MCC-1 for LLNL Test 1 and MCC-1 and MCC-3 where applicable in the other LLNL tests with the following exceptions:

1. Glass powders were used in all tests with $SA/V = 100 \text{ m}^{-1}$ and 400 m^{-1} . These specimens were static leached and not agitated.
2. Powdered rock and rock monoliths were used in Tests 3 and 4, along with the glass specimens being tested.
3. Metals were also added in Test III along with glass and rock specimens.

III.B. Specimen Handling

All handling of specimens was done with tweezers and dust-free plastic gloves.

III.C Sampling Procedure for Monolith Leachates

1. An aliquot of tuff water was taken, the pH determined, and the aliquot discarded.
2. The volume of leachant was determined based on the geometric surface area of the specimen.
3. The calculated volume of leachant was placed in clean leach containers. The specimens were added and completely submersed. The leach container with contents was weighed and placed in a preheated environmental chamber at the test temperature. The date and time were recorded.
4. After 24 hours, the leach containers were retightened. The testing period was controlled to within 2%. At the appropriate time, the containers were removed, and the date and time recorded. The containers were allowed to cool, then weighed, and the final weight recorded.
5. The specimens were removed from the leach containers and rinsed with high-purity water, H_2O and $ETOH$ 1:1, and $ETOH$. They were dried to constant weight, then weighed and stored in sealed, labeled containers.
6. An aliquot of the cooled leachate was taken and the pH measured.
7. An aliquot was removed for anion analysis.
8. If no material was observed as precipitated or sloughed from the specimen, another aliquot was taken and labeled unfiltered.
9. The solution was acidified to 1%, V/V, with conc. HNO_3 , allowed to stand at room temperature overnight, and submitted for ICP and Cs analysis. (If solids were observed in the leachate, the solution was filtered using a .45 μm filter and then acidified.)

10. Another aliquot was taken and filtered through an 18 A filter. This aliquot was acidified to 1%, V/V, with conc. HNO_3 . The solution was allowed to stand at room temperature overnight and submitted for ICP and Cs analysis.
11. Another aliquot was taken and filtered through an 50 A filter. This aliquot was acidified to 1%, V/V, with conc. HNO_3 . The solution was allowed to stand at room temperature overnight and submitted for ICP and Cs analysis.
12. All filters were dried, labeled, and saved. A few were submitted for x-ray fluorescent analysis.
13. A very small aliquot was taken from the 18 A filtered solution for uranium analysis.
14. A 1% HNO_3 solution was added to the empty jars, to the level of the original leachant. These were placed in the test oven overnight. This acid strip solution was then submitted for ICP and CS analysis.

III.C Sampling Procedure for Powdered Specimen Leachates

1. The required glass powder weight was calculated by using the needed SA/V ratio and the surface area per unit weight of the powder. Nominal rock power weights of .1 g, 1 g and 4 grams were used.
2. Very small glass coupons were added (and included in SA/V calculations) for surface analysis.
3. The powdered specimen procedure was identical to the monolith procedure except that the leachate solution was always filtered using a .45 μ millipore filter after pH determination. The powder was collected, dried, and stored in sealed containers; then steps 7 to 14 of monolith procedure followed.

Samples for surface analysis were selected at the end of the test.

Gel layer thickness determinations were made; ESCA scans and Sims depth profiles were made.

Calibrations and Standards

- . Moore and Wright (Sheffield) Ltd. Micro 2000 standard foil supplied by the manufacturer. HEDL 364-47-01-004
- . Calibrated with a micrometer calibration device at the 3717-B Building Standard Laboratory, Hanford Engineering Development Laboratory, Richland, Wa. (a)
- . 6-mo. frequency.

Thermocouples:

- . Type K (chromel-alumel).
- . Calibrated against a platinum resistance thermometer over the temperature range of 25^o to 200^o C. HEDL 364-47-01-002
- . as requested

Thermocouple Probe:

- . John M. Fluke, co. Model 2190A-600
- . Certified by the manufacturer against NBS standards.
- . Calibrated against a platinum resistance thermometer over the range of 25^o to 200^o C. HEDL 364-7906-002
- . 6-mo. frequency

Balance:

Mettler P1 1200 HEDL 364-06-01-002
Mettler A3 HEDL 364-06-01-003
Mettler PC 4400 HEDL 364-06-01-001
Mettler PC H20t HEDL 364-06-01-001

- . Calibrated against standard weights
- . 1-mo. frequency

Volume:

- . High precision pipettes calibrated, using the weight of distilled water contained HEDL 364-28-04-001
HEDL 364-28-04-

TABLE A.1. STANDARD WATER LEACH ANALYSES

ELEMENTS	OBSERVATIONS					MEAN	STDEV
	8-3-83	12-16-82	1-11-83	3-25-83	5-16-83		
NA	86.100	88.700	86.800	91.500	88.300	88.2800	2.090933
B	48.800	50.700	50.400	50.200	49.800	49.9800	0.736206
SI	19.900	20.600	20.400	20.800	20.100	20.3600	0.364692
SR	5.070	5.100	5.200	5.280	5.190	5.1680	0.084083
CS	5.200	5.200	5.100	5.490	4.800	5.1580	0.247629
ND	2.070	2.110	2.140	2.160	2.160	2.1280	0.038341
MO	2.000	2.020	2.020	2.080	2.000	2.0240	0.032863
CE	1.860	1.910	1.920	1.970	2.000	1.9320	0.054498
SH	0.016	0.066	0.034	0.050	0.022	0.0376	0.020513
AL	0.014	0.053	0.029	0.034	0.026	0.0312	0.014237
CA	0.024	0.041	0.020	0.026	0.021	0.0264	0.008503
FE	0.011	0.022	0.002	0.003	0.044	0.0164	0.017387
CR	0.008	0.041	0.004	0.006	0.019	0.0156	0.015339
AS	0.006	0.030	0.007	0.010	0.017	0.0140	0.009925
BA	0.008	0.009	0.008	0.009	0.008	0.0084	0.000548
LI	0.002	0.011	0.000	0.002	0.007	0.0044	0.004506
ZN	0.004	0.005	0.005	0.003	0.005	0.0044	0.000894
CU	0.004	0.005	0.002	0.003	0.005	0.0038	0.001304
MN	0.000	0.007	0.000	0.001	0.004	0.0024	0.003050

Note: Blind standard samples from a stable and homogeneous solution are submitted for analysis twice a week. Table 6 is a random sampling of analyses over a nine-month period and is presented as a demonstration of accuracy to be expected from PNL ICP analysis.

LEACH CONTAINERS

Three different styles of leach containers were used in the LLNL waste package tests.

1. No. 0102 Jar, 2 fl. oz/ 60 ml PFA labware from Savillex.
(40, 70, 90°C short-term 3 to 28-day tests)
2. No. 561 PFA labware jar from Savillex.
(40, 70, 90°C long-term 56 to 182-day tests)
3. No. 4745 Teflon-lined acid digestion bombs from Parr
Instrument Company for 150°C tests.

Glass specimens were held near the centroid of the leach volume by a PFA Teflon support screen in all previously listed leach vessels. Metal and rock samples were placed on the floor of the containers--always separated from the glass specimens. All powders were placed on the floor of the containers.

Leach containers and sample bottles were cleaned according to MCC-1 procedures.

APPENDIX B

SAMPLE DIMENSIONS

LLNL WASTE PACKAGE TESTS
LABELING FORMAT

[Test] [Year] [Set] [Temp] [Subset] [Time] [Solution]/[or Material]

Test - TU (tuff) LLNL Waste Package Tests
Year - 1983
Set - I (glass only), II (glass + rock), III (glass + rock + metal),
IV (rock only)
Temp. - 40, 70, 90 or 150°C
Subset - Subset with SA/V or sample/rock varied (See Table 4)
Time - Test matrix 3, 7, 14, 28, 56, 91, 182 days

Solution: UN - unfiltered
AS - acid strip
18A - 18A filter
50A - 50A filter
10X - 10X dilution
DUP - duplicate
.45 μ m - .45 μ m filter
N.D. - not detected

Material - G (glass), R (rock), M (metal)

Example: TU83-II90-C14AS represents a tuff waste package interactive test conducted in 1983 containing glass + tuff rock at 90°C. Sample conditions and ratios are described in Table 4 under II-90C. The tests were conducted for 14 days, and these particular results are for the container acid strip solutions.

SPECIMEN DEMINSIONS FOR LLNL MATRIX

TEST NO. I GLASS SPECIMENS	X AVE. (mm)	Y AVE. (mm)	Z AVE. (mm)	SURFACE AREA (mm) ²	SPECIMEN WT. (gm)
TU83-I40-3G	4.1715	10.4030	3.6930	194.440	0.4828
TU83-I40-7G	5.5785	9.9755	2.4585	187.800	0.3969
TU83-I40-14G					
TU83-I40-28G	4.9080	9.9775	3.5145	202.600	0.4615
TU83-I40-56G	7.2585	6.4020	5.5600	244.840	0.6982
TU83-I40-91G	4.8640	5.0530	10.0110	247.710	0.6907
TU83-I40-182G	1.8255	9.5280	9.1435	242.408	0.4261
TU83-I70-3G	4.1975	3.6845	10.5185	196.740	0.4603
TU83-I70-7G	4.9240	9.8800	3.2645	194.000	0.4729
TU83-I70-14G					
TU83-I70-28G	5.3785	9.7655	3.3725	207.200	0.5287
TU83-I70-56G	6.8830	4.3270	8.9360	259.910	0.7635
TU83-I70-91G	4.2120	5.1830	9.9980	231.520	0.6225
TU83-I70-182G	9.5030	9.1100	1.7720	239.100	0.4478
TU83-I90-3G					0.4609
TU83-I90-7G	4.9000	9.9540	3.2755	194.900	0.4677
TU83-I90-14G	5.2340	9.7800	3.4175	205.200	0.5024
TU83-I90-28G	6.0700	9.4040	2.2925	185.100	0.3797
TU83-I90-56G	9.1285	9.4961	1.7850	239.870	0.4445
TU83-I90-91G	4.9650	5.2040	10.0540	256.160	0.6798
TU83-I90-182G	6.8820	4.3650	8.4670	250.530	0.7050
TU83-I150-3G	9.1050	3.9610	2.5960	139.980	0.2803
TU83-I150-7G	9.0980	2.6390	3.9600	140.976	0.2843
TU83-I150-14G	9.0910	3.9640	2.7360	143.520	0.2919
TU83-I150-28G	9.4980	3.9500	2.5630	143.940	0.2731
TU83-I150-56G	8.8730	4.6045	2.7110	154.786	0.2948
TU83-I150-91G	8.7795	4.6210	2.5370	149.119	0.2764
TU83-I150-182G	8.8295	4.5800	2.4995	147.912	0.2927

SPECIMEN DEMINSIONS FOR LLNL MATRIX

TEST NO. II GLASS SPECIMENS	X AVE. (mm)	Y AVE (mm)	Z AVE (mm)	SURFACE AREA (mm) ²	SPECIMEN WT. (gm)

TU83-II40-3G	10.3885	3.8720	4.1125	197.740	0.4741
TU83-II40-7G	5.4860	9.9200	2.3600	181.600	0.3851
TU83-II40-28G	5.0385	9.7790	3.3830	198.800	0.4914
TU83-II40-56G	9.1490	9.4890	1.8220	241.520	0.4716
TU83-II40-91G	8.3450	6.8740	4.2090	242.840	0.7104
TU83-II40-182G	9.4850	9.1060	1.7690	238.730	0.4570
TU83-II70-3G	10.4770	4.1995	3.8540	201.123	0.4553
TU83-II70-7G	8.9050	5.3460	3.3645	191.110	0.4715
TU83-II70-28G	9.9905	5.6950	2.3830	188.560	0.3932
TU83-II70-56G	9.0850	9.4910	1.7420	233.570	0.4443
TU83-II70-91G	9.9980	6.0830	3.4150	231.480	0.5980
TU83-II70-182	9.4815	9.0980	1.7420	237.250	0.4370
TU83-II90-A3G	5.4460	2.5725	10.0695	189.504	
TU83-II90-A7G	4.9135	9.9230	3.2115	192.800	0.4647
TU83-II90-A14G	4.9095	9.8635	3.1710	190.500	0.4605
TU83-II90-A28G	5.4045	8.8720	3.4460	194.300	0.4758
TU83-II90-A56G	9.1040	9.5120	1.7670	238.983	0.4503
TU83-II90-A91G	9.9800	5.7300	4.0300	240.990	0.6905
TU83-II90-A182G	10.0845	5.2630	4.3920	240.970	0.7017
TU83-II90-B3G	4.3090	3.6845	10.4550	198.897	
TU83-II90-B7G	6.0860	3.4050	9.3600	219.117	0.5326
TU83-II90-B14G	5.4700	3.2100	9.2000	194.800	0.4830
TU83-II90-B28G	5.3900	3.3265	9.4390	200.411	0.4626
TU83-II90-B56G	9.3555	3.5945	6.0670	224.390	0.5939
TU83-II90-B182G	10.1515	4.2095	5.4635	242.388	0.6950
TU83-II90-C3G					0.2867
TU83-II90-C7G					0.2889
TU83-II90-C14G					0.2904
TU83-II90-C28G		(Glass Powder -40 +80 mesh)			0.2818
TU83-II90-C56G					0.2833
TU83-II90-C91G					0.2806
TU83-II90-C182G					0.2891
TU83-II90-D3G					0.2847
TU83-II90-D7G					0.2844
TU83-II90-D14G					0.2866
TU83-II90-D28G		(Glass Powder -40 +80 mesh)			0.2867
TU83-II90-D56G					0.2879
TU83-II90-D91G					0.2894
TU83-II90-D182G					0.2850
TU83-II90-E3G					0.4478
TU83-II90-E7G					0.4480
TU83-II90-E14G					0.4478
TU83-II90-E28G		(Glass Powder -100 +200 mesh)			0.4478
TU83-II90-E56G					0.4478
TU83-II90-E91G					0.4476
TU83-II90-E182G					0.4478
TU83-II150-3G	10.0120	5.8550	1.5090	165.120	0.2327
TU83-II150-7G	9.0950	3.9560	2.6245	140.470	0.2816
TU83-II150-14G	9.0960	3.9560	2.6820	141.978	0.2800
TU83-II150-28G	9.5790	3.4260	3.3830	153.627	0.3096
TU83-II150-56	9.4880	4.1910	2.2695	141.617	0.2613
TU83-II150-91	8.9130	4.6090	2.6000	152.474	0.3032
TU83-II150-182	9.4995	4.1175	2.7340	152.686	0.3005

SPECIMEN DIMENSIONS USED IN LLNL STUDY

TEST NO. II TUFF ROCK	X AVE. (mm)	Y AVE. (mm)	Z AVE. (mm)	SURFACE AREA (mm) ²	SPECIMEN WT. (gm)
<hr/>					
TU83-II40-3R	10.9540	5.8485	2.0490	196.9850	0.2976
TU83-II40-7R	5.5055	4.9690	2.1405	206.6000	0.3091
TU83-II40-14R					
TU83-II40-28R	5.4515	11.9630	2.2340	208.2000	0.2934
TU83-II40-56R	14.5470	5.4790	2.7420	269.2300	0.4984
TU83-II40-91R	14.4000	5.3940	2.8240	267.3100	0.5049
TU83-II40-182R	13.4610	5.4680	3.0400	262.2900	0.4967
TU83-II70-3R	12.1070	6.0275	2.8575	249.5885	0.4622
TU83-II70-7R	5.8170	2.0940	11.0295	198.9000	0.2703
TU83-II70-14R					
TU83-II70-28R	5.7075	1.9360	10.9000	188.7000	0.2612
TU83-II70-56R	13.1780	5.6210	2.5320	246.3400	0.4265
TU83-II70-91R	14.5730	5.5130	2.7440	270.9100	0.5011
TU83-II70-182R	13.1720	5.5750	3.1600	265.3480	0.5278
TU83-II90-A3R	10.8415	5.3470	1.9170	178.0057	0.2508
TU83-II90-A7R	5.3675	2.6170	10.8970	202.0000	0.3110
TU83-II90-A14R	5.2920	2.0875	11.9610	198.6000	0.2913
TU83-II90-A28R	5.3730	1.8430	11.4905	185.6000	0.2386
TU83-II90-A56R	13.2120	5.4850	3.2160	265.1940	0.5315
TU83-II90-A91R	13.4040	5.5660	2.5140	244.5900	0.4328
TU83-II90-A182R	13.2120	5.4850	3.2160	265.1940	0.4827
TU83-II90-B3R					—
TU83-II90-B7R					0.1012
TU83-II90-B14R					0.1006
TU83-II90-B28R		(Rock Powder < -60 mesh)			0.1015
TU83-II90-B56R					0.1007
TU83-II90-B91R					0.1005
TU83-II90-B182R					0.1017
TU83-II90-C3R					0.9996
TU83-II90-C7R					0.9987
TU83-II90-C14R					1.0007
TU83-II90-C28R		(Rock Powder < -60 mesh)			1.0006
TU83-II90-C56R					0.9979
TU83-II90-C91R					1.0015
TU83-II90-C182R					1.0007
TU83-II90-D3R					0.1004
TU83-II90-D7R					0.1005
TU83-II90-D14R					0.1001
TU83-II90-D28R		(Rock Powder < -60 mesh)			0.1002
TU83-II90-D56R					0.1010
TU83-II90-D91R					0.1017
TU83-II90-D182R					0.1095
TU83-II90-E3R					4.0010
TU83-II90-E7R					4.000
TU83-II90-E14R					4.000
TU83-II90-E28R		(Rock Powder < -60 mesh)			4.002
TU83-II90-E56R					4.000
TU83-II90-E91R					4.000
TU83-II90-E182R					4.0010
TU83-II150-3R	6.0450	5.4380	3.9190	155.7500	0.2627
TU83-II150-7R	5.6980	5.5960	3.3980	140.5260	0.2290
TU83-II150-14R	6.0650	5.8450	3.0650	143.9080	0.2248
TU83-II150-28R	6.0960	5.8050	3.2170	147.3450	0.2394
TU83-II150-56R	5.8330	6.021	3.221	146.60	
TU83-II150-91R	5.580	6.200	3.544	152.688	
TU83-II150-182R	6.069	5.836	2.980	141.791	

DIMENSIONS OF SPECIMENS USED FOR LLNL STUDY

TEST NO. III GLASS SPECIMENS	X AVE. (mm)	Y AVE. (mm)	Z AVE. (mm)	SURFACE AREA (mm) ²	SPECIMEN WT. (gm)
<hr/>					
TU83-III40-3G	4.1650	3.4990	10.48100	189.7990	
TU83-III40-7G	9.5040	6.0760	2.25100	185.6000	0.3743
TU83-III40-14G	9.3995	6.0795	2.47700	191.0000	0.4050
TU83-III40-28G	9.3815	6.0790	2.50100	191.4000	0.4247
TU83-III40-56G	10.0005	5.2865	4.41100	240.5900	0.6946
TU83-III40-91G	10.0165	5.2460	4.44300	240.7100	0.6866
TU83-III40-182G	9.5020	9.0640	1.76600	237.8100	0.4553
TU83-III70-3G	4.1605	3.5860	10.49000	192.3610	
TU83-III70-7G	9.9725	5.5775	2.45000	187.4000	0.3886
TU83-III70-14G	10.0045	5.6900	2.39600	189.1000	0.4025
TU83-III70-28G	9.2045	5.4705	3.13200	192.6300	0.4684
TU83-III70-56G	10.1020	5.1810	4.38800	238.9000	0.6876
TU83-III70-91G	10.0025	5.2400	4.37000	238.0400	0.6933
TU83-III70-182G	10.0385	6.0560	4.01400	250.7900	0.7257
TU83-III90-A3G	6.4375	9.1500	2.58350	198.3469	0.4515
TU83-III90-A7G	9.9980	5.7440	2.43050	191.4000	0.4073
TU83-III90-A14G	9.3845	6.0540	2.58200	193.4000	0.4204
TU83-III90-A28G	9.4700	4.8690	3.39750	189.6500	0.4670
TU83-III90-A56G	10.1460	6.5360	4.02266	266.7500	0.7788
TU83-III90-A91G	10.3350	5.3570	4.41400	245.3200	0.7135
TU83-III90-A182G	10.0215	5.2260	4.40400	239.0000	0.6915
TU83-III90-B3G					0.2852
TU83-III90-B7G					0.2868
TU83-III90-B14G					0.2857
TU83-III90-B28G		(Glass Powder -40 +80 mesh)			0.2870
TU83-III90-B56G					0.2863
TU83-III90-B91G					0.2871
TU83-III90-B182G					0.2883
TU83-III90-C3G	8.5000	4.9020	4.13200	194.0880	0.5023
TU83-III90-C7G	10.1650	5.4765	2.55100	191.0670	
TU83-III90-C14G	9.4390	5.3900	3.32650	200.4000	0.4626
TU83-III90-C28G	9.9950	5.8190	2.65900	200.4360	0.3737
TU83-III90-C56G	10.5750	5.3720	4.39200	243.6000	0.7158
TU83-III90-C91G	6.3185	5.5120	7.11650	238.0000	0.7062
TU83-III90-C182G	7.2360	6.4635	5.40800	241.7200	0.6936
TU83-III90-D3G	9.1825	6.5460	2.70600	205.3390	0.4877
TU83-III90-D7G	3.9670	9.2040	5.43850	216.2800	0.5859
TU83-III90-D14G	4.4995	10.3705	3.69000	205.1775	
TU83-III90-D28G	5.4520	9.3830	3.30700	200.4400	0.4928
TU83-III90-D56G	4.1425	10.1170	5.45350	239.6560	0.6806
TU83-III90-D91G	4.2205	10.1345	5.44150	241.7710	0.6942
TU83-III90-182G	4.1685	10.1465	5.46100	204.9400	0.6889
TU83-III90-E3G					0.2892
TU83-III90-E7G					0.2892
TU83-III90-E14G		(Glass Powder -40 +80 mesh)			0.2905
TU83-III90-E28G					0.2899
TU83-III150-3G	9.6130	3.1245	3.22850	142.3170	0.2789
TU83-III150-7G	9.4920	3.1295	3.21000	140.4500	0.2656
TU83-III150-14G	10.2665	3.7300	3.17400	163.9000	0.3268
TU83-III150-28G	3.1470	3.3815	9.30150	142.7400	0.2795
TU83-III150-56G	9.4890	4.1180	2.72700	152.3640	0.2927
TU83-III150-91G	8.8600	4.6070	2.70750	154.5590	0.3018
TU83-III150-182G	8.7566	4.6760	2.62300	152.3690	0.3176

DIMENSIONS OF SPECIMENS USED IN LLNL MATRIX

TEST NO. III ROCK SPECIMENS	X AVE. (mm)	Y AVE. (mm)	Z AVE. (mm)	SURFACE AREA (mm) ²	SPECIMEN WT. (gm)
<hr/>					
TU83-III40-3R	11.934	5.3155	1.8960	192.28046	0.2612
TU83-III40-7R	11.871	5.9640	2.0810	215.82150	0.3383
TU83-III40-14R	11.575	5.5600	2.0160	197.82950	0.2632
TU83-III40-28R	12.008	5.2290	2.1998	201.36300	0.3204
TU83-III40-56R	14.481	5.3410	2.7690	264.46000	0.4870
TU83-III40-91R	12.044	5.4900	2.9070	234.18500	0.4448
TU83-III40-182R	13.192	5.5530	3.0480	260.77000	0.5189
TU83-III70-3R	11.467	5.9660	2.0500	208.29900	0.3121
TU83-III70-7R	11.948	5.5115	1.9970	201.43600	0.3031
TU83-III70-14R	10.855	5.3360	1.9520	179.05400	0.2574
TU83-III70-28R	10.900	5.7510	1.9250	189.47800	0.2367
TU83-III70-56R	12.011	5.5270	2.9460	236.10300	0.4432
TU83-III70-91R	13.185	5.5546	3.0390	260.09000	0.5108
TU83-III70-182R	14.660	5.5020	2.7340	273.58000	0.5014
TU83-III90-A3R	11.066	5.4380	2.0570	188.25000	0.2716
TU83-III90-A7R	11.529	5.5440	1.9015	192.76000	0.2743
TU83-III90-A14R	11.504	5.4200	2.0170	192.97470	0.2791
TU83-III90-A28R	11.471	5.3610	1.7580	182.17330	0.2408
TU83-III90-A56R	11.892	6.1470	2.9390	252.23000	0.4710
TU83-III90-A91R	14.362	5.4110	2.7630	264.69000	0.4675
TU83-III90-A182R	11.486	5.9640	2.8910	237.90000	0.4487
TU83-III90-B3R					0.1103
TU83-III90-B7R					0.1109
TU83-III90-B14R					0.1180
TU83-III90-B28R					0.0916
TU83-III90-B56R					0.1176
TU83-III90-B91R					0.0884
TU83-III90-B182R					0.0808
TU83-III90-C3R	11.935	6.024	1.730	205.931	
TU83-III90-C7R	12.088	6.004	2.0005	217.5388	
TU83-III90-C14R	11.4805	5.3125	2.0385	190.4454	
TU83-III90-C28R	12.0065	5.5625	1.8965	200.2115	
TU83-III90-C56R	14.752	5.415	1.756	230.59	
TU83-III90-C91R	11.932	5.522	2.873	232.06	
TU83-III90-C182R	12.065	6.040	2.864	249.45	
TU83-III90-D3R	14.572	5.274	1.765	223.76	0.3126
TU83-III90-D7R	14.384	5.419	2.772	265.68	0.4827
TU83-III90-D14R	11.9645	5.451	1.949	198.3226	0.2999
TU83-III90-D28R	11.9365	5.5205	2.7335	227.2283	0.3951
TU83-III90-D56R	12.011	5.532	2.949	236.358	0.4567
TU83-III90-D91R	13.185	5.572	3.201	267.19	0.5453
TU83-III90-D182R					
TU83-III90-E3R					0.1002
TU83-III90-E7R					0.1007
TU83-III90-E14R					0.1000
TU83-III90-E28R					0.1007
TU83-III150-3R	5.359	5.9950	3.5970	145.93000	0.2300
TU83-III150-7R	5.650	5.8100	3.8310	153.45000	0.2570
TU83-III150-14R	5.687	5.8090	3.3810	143.80700	0.2590
TU83-III150-28R	5.666	5.8190	3.8110	153.47900	0.2458
TU83-III150-56R	5.596	6.7230	3.5520	162.75000	0.2870
TU83-III150-91R	5.789	5.6280	3.7550	150.90200	0.2446
TU83-III150-182R	5.763	6.0590	3.3240	148.42800	0.2425

DIMENSIONS OF SPECIMENS FOR LLNL MATRIX

TEST NO. III METAL SPECIMENS	X AVE. (mm)	Y AVE. (mm)	Z AVE. (mm)	SURFACE AREA (mm) ²	METAL TYPE	SPECIMEN WT. (gm)
TU83-III40-3M	7.243	5.107	5.069	199.1840	304L	1.4630
TU83-III40-7M	7.221	4.701	5.149	190.4070	304L	1.3336
TU83-III40-14M	7.275	5.132	4.809	194.0010	304L	1.3898
TU83-III40-28M	7.202	5.017	4.883	191.5950	304L	1.3730
TU83-III40-56M	10.159	4.400	5.115	238.3370	304L	1.7833
TU83-III40-91M	10.138	5.123	4.775	249.6160	304L	1.9296
TU83-III40-182M	10.173	5.105	5.096	259.6800	304L	2.0827
TU83-III70-3M	7.228	5.090	4.879	193.7800	304L	1.3924
TU83-III70-7M	7.248	4.943	5.109	196.2213	304L	1.3893
TU83-III70-14M	7.270	5.104	4.846	194.1400	304L	1.3883
TU83-III70-28M	7.267	5.099	4.999	197.7440	304L	1.3820
TU83-III70-56M	10.277	5.017	5.082	258.5600	304L	2.0516
TU83-III70-91M	10.290	5.045	5.048	258.6480	304L	2.0399
TU83-III70-182M	10.157	5.037	5.115	257.7500	304L	2.0487
TU83-III90-A3M	7.279	4.879	5.107	195.2100	304L	1.4070
TU83-III90-A7M	7.161	5.085	5.034	196.1200	304L	1.4234
TU83-III90-A14M	7.286	5.124	4.580	188.3425	304L	1.3299
TU83-III90-A28M	7.338	5.082	4.729	192.0520	304L	1.3876
TU83-III90-A56M	10.258	4.947	4.908	250.7400	304L	1.9379
TU83-III90-A91M	4.605	5.105	10.203	245.1780	304L	1.8384
TU83-III90-A182M	4.808	5.126	10.202	251.9800	304L	1.9548
TU83-III90-B3M	25.374	5.166	4.058	509.9570	304L	4.1406
	25.352	5.128	4.016	504.7560	304L	4.0812
	25.380	5.142	3.988	504.4500	304L	4.0727
	25.360	5.158	4.374	528.6157	304L	4.4527
TU83-III90-B7M	25.494	5.363	4.746	566.4130	304L	4.6726
	25.517	5.165	4.294	527.1180	304L	4.3750
	25.406	5.157	4.147	515.5270	304L	4.2082
	25.365	5.162	4.073	510.5890	304L	4.1556
TU83-III90-B14M	25.472	5.247	4.117	520.2430	304L	4.1092
	25.381	5.158	4.110	512.8900	304L	4.2151
	25.342	5.149	4.000	504.9300	304L	4.0718
	25.396	5.120	4.040	506.6230	304L	4.0775
TU83-III90-B28M	25.363	5.161	4.142	514.6577	304L	4.2327
	25.381	5.143	4.396	529.4450	304L	4.4734
	25.502	5.384	3.686	502.3263	304L	3.7726
	25.386	5.145	3.953	502.9140	304L	4.0255
TU83-III90-B56M	25.391	5.258	3.952	509.2921	304L	4.0195
	25.401	5.164	4.169	517.2220	304L	4.2598
	25.399	5.201	4.670	550.0440	304L	4.6535
	25.368	5.160	4.089	511.4860	304L	4.1716
TU83-III90-B91M	25.366	5.108	3.931	498.7560	304L	3.9261
	25.375	5.156	4.262	521.9440	304L	4.3238
	25.466	5.159	4.011	508.4610	304L	4.0668
	25.362	5.170	4.669	547.2600	304L	4.7879
TU83-III90-B182M	25.386	5.157	4.163	516.1617	304L	4.2499
	25.370	5.154	4.114	512.6740	304L	4.1933
	25.404	5.153	4.001	507.1410	304L	4.0926
	25.378	5.152	4.339	526.4340	304L	4.4216
TU83-III90-C3M	8.500	4.902	4.132	194.0880	1020M SS	0.7948
TU83-III90-C7M	10.056	7.578	1.482	204.6700	1020M SS	0.8368
TU83-III90-C14M	10.077	7.515	1.476	204.4600	1020M SS	0.8271
TU83-III90-C28M	9.381	7.415	1.463	197.1430	1020M SS	0.7975
TU83-III90-C56M	9.859	10.151	1.483	259.5000	1020M SS	1.0913
TU83-III90-C91M	9.841	9.823	1.471	251.1870	1020M SS	1.0606
TU83-III90-C182M	10.439	10.164	1.464	272.5200	1020M SS	1.1473
TU83-III90-D3M	7.545	5.003	5.110	205.7584	316 SS	
TU83-III90-D7M	5.098	5.157	7.580	208.0466	316 SS	1.5550
TU83-III90-D14M	5.112	5.102	7.672	208.3974	316 SS	1.5520
TU83-III90-D28M	5.101	5.146	7.607	208.3974	316 SS	1.5540
TU83-III90-D56M	5.029	5.157	10.235	260.3765	316 SS	2.0594
TU83-III90-D91M	5.048	5.102	10.143	257.4127	316 SS	2.0214
TU83-III90-D182M	5.036	5.072	10.119	255.6509	316 SS	2.0089
TU83-III90-E3M	10.010	10.263	1.471	265.1080	1020 SS	
	9.851	10.400	1.479	264.8000	1020 SS	
	7.579	9.906	1.471	201.5960	1020 SS	
	10.258	10.074	1.454	263.8040	1020 SS	
	10.576	9.951	1.468	270.7500	1020 SS	
	10.035	10.116	1.438	260.9820	1020 SS	
	10.017	10.282	1.461	265.3030	1020 SS	
	10.072	7.477	1.468	202.1405	1020 SS	

8.7572

DIMENSIONS OF SPECIMENS FOR LLNL MATRIX

TEST NO. III METAL SPECIMENS	X AVE. (mm)	Y AVE. (mm)	Z AVE. (mm)	SURFACE AREA (mm) ²	METAL TYPE	SPECIMEN WT. (gm)
TU83-III190-E7M	10.229	10.025	1.433	265.1650	1020 SS	8.2618
	9.946	7.425	1.458	198.3360	1020 SS	
	10.078	10.029	1.483	251.7800	1020 SS	
	10.213	10.141	1.468	266.8990	1020 SS	
	10.122	10.135	1.454	254.0800	1020 SS	
	10.000	10.325	1.436	264.8700	1020 SS	
	10.017	5.023	1.425	143.4940	1020 SS	
	10.079	5.082	1.448	146.5790	1020 SS	
TU83-III190-E14M	9.872	7.298	1.459	194.1937	1020 SS	
	10.197	10.081	1.464	264.9660	1020 SS	8.1580
	10.149	10.361	1.456	270.0320	1020 SS	
	10.217	10.056	1.466	264.9250	1020 SS	
	10.058	10.293	1.432	265.3390	1020 SS	
	10.216	10.009	1.464	263.7230	1020 SS	
	10.070	7.508	1.560	206.0500	1020 SS	
	7.542	9.935	1.485	201.7660	1020 SS	
TU83-III190-E23M	9.995	10.229	1.441	252.7630	1020 SS	
	10.040	5.056	1.460	145.6040	1020 SS	0.9348
	10.157	10.351	1.469	270.5227	1020 SS	
	9.842	7.553	1.468	199.7450	1020 SS	
	10.019	10.205	1.475	264.1480	1020 SS	
	9.996	7.360	1.444	197.2650	1020 SS	
	10.044	7.328	1.470	198.2780	1020 SS	
	9.954	7.440	1.466	199.1150	1020 SS	
TU83-III150-3M	9.899	7.543	1.469	200.5809	1020 SS	0.9934
	9.887	7.354	1.448	195.3480	1020 SS	
	10.042	4.964	1.465	143.6640	1020 SS	
	5.080	5.063	5.080	154.4930	304L	
	5.027	5.090	5.004	152.4460	304L	
	5.023	4.813	5.024	147.1840	304L	
	5.151	5.029	5.007	155.0000	304L	
	5.018	5.026	5.103	152.9500	304L	
TU83-III150-91M	4.854	4.951	5.127	148.6050	304L	0.9508
	4.819	5.101	5.142	151.1820	304L	

TABLE B.1. DIMENSIONS OF SPECIMENS FOR LLNL TEST MATRIX

TEST NO. IVA(a) TUFF ROCK MONOLITHS	X AVE. (mm)	Y AVE. (mm)	Z AVE. (mm)	SA (mm) ²	WT. (gm)	VOL. ml
TU83-IV90-A3	5.971	5.478	3.554	146.798		14.67
TU83-IV90-A7	5.822	6.028	3.360	149.822		14.98
TU83-IV90-A14	10.893	5.659	3.033	223.691		22.40
TU83-IV90-A28	11.480	6.025	2.804	236.650		23.61
TU83-IV90-A56	6.006	5.823	2.769	135.455		13.47
TU83-IV90-A91	10.953	5.768	2.813	220.426		22.01
TU83-IV90-A182	11.037	5.794	2.927	226.425		22.64

(a) Tuff rock monoliths, leached in tuff water at 90°C

TABLE B.2. SPECIMENS FOR LLNL TEST MATRIX

TEST NO. IVB(a) TUFF ROCK POWDERS	WT. (gm)	VOL. ml
TU83-IV90-B3	.10043	20.00
TU83-IV90-B7	.10063	20.02
TU83-IV90-B14	.10027	20.01
TU83-IV90-B28	.10069	20.00
TU83-IV90-B56	.10062	20.00
TU83-IV90-B91	.10020	20.02
TU83-IV90-B182	.10015	20.01

(a) Tuff Rock powder, <60 mesh, leached at 90°C in tuff water.

TABLE B.3. SPECIMEN DIMENSIONS FOR LLNL TEST MATRIX

TEST NO. IVCM(a) TUFF ROCK MONOLITHS	X AVE. (mm)	Y AVE. (mm)	Z AVE. (mm)	SA (mm) ²	WT. (gm)	VOL. ml
TU83-IV40-CM	6.053	5.624	3.640	153.092		15.20
TU83-IV90-CM	5.674	5.803	3.842	154.042		15.40
TU83-IV90-CM	6.074	6.104	3.617	162.247		16.23
TU83-IV150-CM	5.978	7.644	2.302	154.597		15.23

(a) Tuff rock monoliths leached in tuff water for one day at 40, 70, 90, and 150°C.

TABLE B.4. SPECIMENS FOR LLNL TEST MATRIX

TEST NO. IV-CP(a) TUFF ROCK POWDERS	WT. (gm)	VOL. ml
TU83-IV40-CP	.1000	20.05
TU83-IV70-CP	.1005	20.02
TU83-IV90-CP	.1001	2.05
TU83-IV150-CP	.1002	15.00

(a) Tuff Rock powders, <60 mesh, leached in tuff water at 40, 70, 90, and 150°C for one day.

TABLE B.5. SPECIMEN DIMENSIONS FOR LLNL TEST MATRIX

TEST NO. IV90-D(a) TUFF ROCK MONOLITHS	X AVE. (mm)	Y AVE. (mm)	Z AVE. (mm)	SA (mm) ²	WT. (gm)	VOL. ml
TU83-IV90-D3 ^(b)				196.548		19.61
TU83-IV90-D7				212.643		20.74
TU83-IV90-D14				194.033		19.65
TU83-IV90-D28				200.010		19.64
TU83-IV90-D56				183.425		19.61
TU83-IV90-D91				191.683		19.62
TU83-IV90-D182				195.119		19.62

(a) Tuff rock monoliths preleached for one day in 137.34 ml tuff water.

(b) Then leached at 90°C for the specified time period.

TABLE B.6. SPECIMENS FOR LLNL TEST MATRIX

TEST NO. IV90-E(a) TUFF ROCK POWDERS	WT. (gm)	VOL. ml
TU83-IV90-E3 ^(b)	.10004	20.04
TU83-IV90-E7	.10040	20.00
TU83-IV90-E14	.10010	20.02
TU83-IV90-E28	.10061	20.01
TU83-IV90-E56	.10019	20.01
TU83-IV90-E91	.10030	20.00
TU83-IV90-E182	.10040	20.04

(a) Tuff rock powders, <60 mesh, preleached for one day in tuff water at 90°C.

(b) Then leached at 90°C for the specified time period.

TABLE B.7. SPECIMENS FOR LLNL TEST MATRIX

TEST NO. IV90-F	X AVE. (mm)	Y AVE. (mm)	Z AVE. (mm)	SA (mm) ²	WT. (gm)	VOL. ml
MCC (76-68) GLASS MONOLITHS ^(a)						
TU83-IV90-F3	9.370	6.672	2.283	198.265	.2224	19.80
TU83-IV90-F7	9.333	6.797	2.349	202.658	.3080	20.29
TU83-IV90-F14	5.70	6.996	4.429	192.422	.4192	19.22
TU83-IV90-F28	9.342	6.733	2.368	201.909	.3053	20.18
TU83-IV90-F56	9.349	6.699	2.067	191.611	.4880	19.17
TU83-IV90-F91	9.382	6.667	2.707	211.742	.2985	21.16
TU83-IV90-F182	9.375	6.695	2.248	197.77	.3760	19.77
TUFF ROCK MONOLITHS ^(b)						
TU83-IV90-F3 ^(c)	5.504	1.576	12.011	187.424		
TU83-IV90-F7	5.479	2.291	11.509	203.814		
TU83-IV90-F14	5.423	3.204	11.502	233.172		
TU83-IV90-F28	5.441	2.295	10.886	193.402		
TU83-IV90-F56	6.112	2.878	12.169	253.979		
TU83-IV90-F91	5.489	2.044	11.972	202.869		
TU83-IV90-F182	5.491	2.550	11.998	220.956		

(a) MCC (76-68) GLASS MONOLITHS: Leached with the following tuff rock specimens.

(b) Tuff rock monoliths preleached for one day in tuff water at 90°C.

(c) Then leached for the specified periods with MCC (76-68) waste glass in tuff water at 90°C.

TABLE B.8. SPECIMENS FOR LLNL TEST MATRIX

TEST NO. IV-G	X AVE. (mm)	Y AVE. (mm)	Z AVE. (mm)	SA (mm) ²	WT. (gm)	VOL. ml
MCC (76-68) GLASS MONOLITHS ^(a)						
TU83-IV90-G3	9.170	6.480	2.642	201.522	.4660	20.15
TU83-IV90-G7	8.254	5.357	3.590	186.16	.4631	18.61
TU83-IV90-G14	9.366	6.978	2.311	206.25	.3984	20.62
TU83-IV90-G28	8.195	5.345	3.715	188.20	.4536	18.83
TU83-IV90-G56	8.358	5.435	2.331	155.15	.2964	15.51
TU83-IV90-G91	8.251	5.337	3.148	173.62	.3790	17.35
TU83-IV90-G182	8.043	5.363	2.990	166.43	.3615	16.64
TUFF ROCK MONOLITHS ^(b)						
TU83-IV90-G3 ^(c)					.10063	
TU83-IV90-G7					.10053	
TU83-IV90-G14					.10013	
TU83-IV90-G28					.10003	
TU83-IV90-G56					.10042	
TU83-IV90-G91					.10055	
TU83-IV90-G182					.10051	

(a) MCC (76-68) glass monoliths leached with tuff rock powder.

(b) Tuff rock powder, <60 mesh, preleached for one day in tuff water at 90°C.

(c) Then leached for the specified periods with MCC (76-68) waste glass in tuff water at 90°C.

APPENDIX C

LEACH DATA

LLNL WASTE PACKAGE TESTS
LEACH TEST 1 DATA (GLASS ONLY), TUFF WATER

TEST PARAMETERS	TU83-I40-3		TU83-I40-7			TU83-I40-28	
DATE RUN BEGAN	15-JAN-83		21-JAN-83			21-JAN-83	
DATE RUN ENDED	18-FEB-83		28-JAN-83			18-FEB-83	
SPECIMEN SA mm2	194.440		187.800			202.600	
SPECIMEN INI'L WT.(gm)	0.483		0.397			0.462	
SPECIMEN FIN'L WT.(gm)	0.483		0.396			0.461	
WEIGHT CHANGE(gm)	0.000		0.000			0.000	
LEACHANT INI'L VOL.	19.420		18.560			20.260	
LEACHANT FIN'L VOL.	19.400		18.560			20.220	
VOLUME CHANGE	0.020		0.000			0.040	
INI'L pH AT 23 C	7.310		7.310			7.310	
FIN'L pH AT 23 C	7.480		8.030			7.490	
SA/V	10.012		10.119			10.000	
ELEMENTAL ANALYSIS ^(a)	TU83-I40-3		TU83-I40-7			TU-I40-28	
(DET. LIM.)	18A	AS	18A	UN	AS	18A	AS
Al (.03)						0.035	0.056
As (.08)							
B (.01)	0.170	0.014	0.180	0.189	0.013	0.190	0.029
Ba (.002)	0.006	0.003	0.006	0.008	0.002	0.004	0.002
Ca (.01)	12.000	0.443	11.000	12.600	0.119	12.000	0.472
Cd (.004)							
Ce (.04)							
Co (.01)							
Cr (.02)		0.014		0.002	0.000	0.005	0.013
Cu (.004)		0.022		0.024	0.029		0.076
Dy (.004)							
Eu (.002)							
Fe (.005)	0.022	0.085	0.015	0.031	0.031	0.031	0.238
Gd (.01)							
K (.3)	5.800	0.062	5.700	5.550	0.215	5.900	0.103
La (.008)			0.080	0.105	0.012		
Li (.004)	0.058	0.003	0.050	0.053	0.001	0.059	0.003
Mg (.06)	2.000	0.067	1.810	1.980	0.045	2.000	0.077
Mn (.002)		0.002				0.014	0.004
Mo (.01)	0.013	0.004	0.022	0.024	0.007	0.016	0.005
Na (.01)	59.000	1.510	45.800	50.000	0.306	52.000	1.150
Nd (.02)							
Ni (.02)		0.011		0.004	0.005	0.006	0.017
P (.1)							
Pb (.06)							
Ru (.05)							
Sb (.05)							
Si (.02)	29.000	0.818	28.000	28.000	0.271	29.000	0.787
Sr (.002)	0.040	0.002	0.037	0.045	0.001	0.041	0.002
Te (.06)							
Ti (.002)				0.007	0.012		
Zn (.02)	0.610	0.028	1.630	0.046	0.019	0.480	0.058
Zr (.008)					0.002		
Cs (.005)			0.013	0.016		0.006	
F (.130)							
CL (.015)	*	*	*	*	*	*	*
N03(.040)							
S04(.300)							

18A - 18 Angstrom Filtered Solution
 AS - Acid Strip
 UN - Unfiltered
 0.45μ - 45 microns Filtered Solution
 50A - 50 Angstrom Filtered Solution
 * - No Anion Analysis
 (a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST I DATA (GLASS ONLY), TUFF WATER

TEST PARAMETERS	TU83-I40-56		TU83-I40-91			TU83-I40-182	
DATE RUN BEGAN	26-JAN-83		26-JAN-83			26-JAN-83	
DATE RUN ENDED	23-MAR-83		27-APR-83			27-JUL-83	
SPECIMEN SA mm2	244.840		247.710			242.408	
SPECIMEN INI'L WT.(gm)	0.698		0.691			0.426	
SPECIMEN FIN'L WT.(gm)	0.700		0.690			--	
WEIGHT CHANGE(gm)	-0.002		0.000			--	
LEACHANT INI'L VOL.	24.480		24.770			24.240	
LEACHANT FIN'L VOL.	24.160		24.720			24.200	
VOLUME CHANGE	0.320		0.050			0.040	
INI'L pH AT 23 C	7.310		7.310			7.310	
FIN'L pH AT 23 C	8.340		8.540			8.340	
SA/V	10.002		10.000			10.000	
ELEMENTAL ANALYSIS ^(a)	TU83-I40-56		TU83-I40-91			TU83-I40-182	
(DET. LIM.) mg/liter	18A	AS	18A	50A	UN	18A	UN
Al (.03)		0.025	0.007	0.001	0.009	0.060	
As (.08)			0.009	0.016	0.002		
B (.01)	0.250	0.020	0.284	0.286	0.286	0.360	0.340
Ba (.002)	0.013		0.019	0.017	0.001	0.020	0.022
Ca (.01)	12.000	0.108	11.600	12.500	12.300	11.000	13.000
Cd (.004)							
Ce (.04)							
Co (.01)							
Cr (.02)		0.004	0.006	0.043	0.009		
Cu (.004)		0.017	0.005	0.097	0.039	0.004	
Dy (.004)							
Eu (.002)							
Fe (.005)		0.090	0.017	0.147	0.090	0.013	0.037
Gd (.01)							
K (.3)	5.900	0.049	4.970	4.820	6.050	5.500	5.100
La (.008)			0.013	0.024	0.027		
Li (.004)	0.051	0.003	0.050	0.044	0.064	0.047	0.045
Mg (.06)	1.980	0.038	1.840	1.940	1.970	1.800	2.000
Mn (.002)		0.003	0.001	0.003	0.001		
Mo (.01)	0.050	0.008	0.062	0.067	0.017	0.090	0.087
Na (.01)	52.000	0.093	46.300	45.300	51.600	46.000	48.000
Nd (.02)							
Ni (.02)		0.187	0.012	0.035	0.011		
P (.1)			0.003	0.037	0.017		
Pb (.06)							
Ru (.05)							
Sb (.05)				0.003			
Si (.02)	31.000	0.139	28.300	30.500	30.300	29.000	29.000
Sr (.002)	0.049		0.053	0.055	0.041	0.053	0.060
Te (.06)				0.002			
Ti (.002)		0.004					
Zn (.02)	0.380	0.042	0.260	0.052	0.032	1.200	
Zr (.008)		0.004					
Cs (.005)	0.042		0.050	0.052	0.005	0.084	0.094
F (1.30)			2.300			2.800	
CL (.015)			4.600			7.900	
NO3(.040)	*	*	12.000	*	*	9.500	*
SO4(.300)			18.000			19.000	

18A - 18 Angstrom Filtered Solution
 AS - Acid Strip
 UN - Unfiltered
 0.45 - 45 microns Filtered Solution
 50A - 50 Angstrom Filtered Solution
 * - No Anion Analysis
 (a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST I DATA (GLASS ONLY), TUFF WATER

TEST PARAMETERS	TU83-I40-182		TU83-I70-3		TU83-I70-7		
DATE RUN BEGAN	26-JAN-83		15-FEB-83		21-JAN-83		
DATE RUN ENDED	27-JUL-83		18-FEB-83		28-JAN-83		
SPECIMEN SA mm2	242.408		196.740		194.000		
SPECIMEN INI'L WT.(gm)	0.426		0.460		0.473		
SPECIMEN FIN'L WT.(gm)	--		0.460		0.473		
WEIGHT CHANGE(gm)							
LEACHANT INI'L VOL.	24.240		19.680		19.400		
LEACHANT FIN'L VOL.	24.200		19.640		19.330		
VOLUME CHANGE	0.040		0.040		0.070		
INI'L pH AT 23°C	7.310		7.310		7.310		
FIN'L pH AT 23°C	8.340		8.480		8.680		
SA/V	10.000		9.997		10.000		
ELEMENTAL ANALYSIS (DET. LIM.) mg/liter	TU83-I40-182		TU83-I70-3		TU83-I70-7		
	50A	AS	18A	AS	18A	UN	AS
Al (.03)			0.089	0.057	0.030	0.028	0.028
As (.08)							
B (.01)	0.350		0.407	0.022	0.730	0.740	0.019
Ba (.002)	0.026		0.027	0.003	0.039	0.053	0.001
Ca (.01)	12.280	0.045	11.700	0.299	11.000	12.800	0.332
Cd (.004)							
Ce (.04)							
Co (.01)							
Cr (.02)							
Cu (.004)				0.013		0.029	0.051
Dy (.004)							
Eu (.002)							
Fe (.005)	0.024	0.130	0.026	0.363	0.012	0.030	0.054
Gd (.01)							
K (.3)	5.020		5.500	0.104	5.800	5.650	0.308
La (.008)							
Li (.004)	0.050		0.055	0.001	0.050	0.054	0.002
Mg (.06)	2.000		1.940	0.062	1.760	1.980	0.074
Mn (.002)			0.002	0.003			0.002
Mo (.01)	0.080		0.116	0.007	0.270	0.269	
Na (.01)	48.600	0.060	52.600	0.567	52.000	52.300	0.633
Nd (.02)							
Ni (.02)				0.103			
P (.1)							
Pb (.06)							
Ru (.05)							
Sb (.05)							
Si (.02)	29.000	0.440	29.900	0.485	30.000	30.000	0.569
Sr (.002)	0.056		.063	0.002	0.084	0.103	0.002
Te (.06)							
Ti (.002)				0.003		0.007	0.011
Zn (.02)	0.572	0.021	0.463	0.044	0.500	0.041	0.023
Zr (.008)		0.015	0.102	0.002		0.009	
Cs (.005)	0.096				0.170	0.170	
F (1.30)							
Cl (0.15)	*	*	*	*	*	*	*
N03(.040)							
S04(.300)							

18A - 18 Angstrom Filtered Solution
 AS - Acid Strip
 UN - Unfiltered
 0.45 - 45 microns Filtered Solution
 50A - 50 Angstrom Filtered Solution
 * - No Anion Analysis
 (a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS
LEACH TEST 1 DATA (GLASS ONLY), TUFF WATER

TEST PARAMETERS	TU83-I70-28	TU83-I70-56	TU83-I70-91
DATE RUN BEGAN	21-JAN-83	26-JAN-83	26-JAN-83
DATE RUN ENDED	18-FEB-83	23-MAR-83	02-APR-83
SPECIMEN SA mm2	207.200	259.910	231.520
SPECIMEN INI'L WT.(gm)	0.529	0.764	0.623
SPECIMEN FIN'L WT.(gm)	0.528	0.763	0.622
WEIGHT CHANGE(gm)	0.000	0.000	0.000
LEACHANT INI'L VOL.	20.720	25.990	23.150
LEACHANT FIN'L VOL.	20.540	25.830	22.900
VOLUME CHANGE	0.180	0.160	0.250
INI'L pH AT 23 C	7.310	7.310	7.310
FIN'L pH AT 23 C	8.660	8.860	8.970
SA/V	10.000	10.000	10.001
ELEMENTAL ANALYSIS	TU83-I70-28	TU83-I70-56	TU83-I70-91
(DET. LIM.) mg/liter	18A AS	18A AS	18A UN

Al (.03)	0.050	0.050	0.044	0.060	0.045	
As (.08)					0.002	
B (.01)	1.550	0.071	2.450	0.014	3.260	3.220
Ba (.002)	0.058	0.006	0.064	0.005	0.048	0.054
Ca (.01)	10.000	1.370	8.800	1.600	5.970	6.590
Cd (.004)					0.007	
Ce (.04)						
Co (.01)						
Cr (.02)	0.025	0.024	0.042		0.054	0.068
Cu (.004)		0.049		0.019	0.008	0.006
Dy (.004)						
Eu (.002)						
Fe (.005)	0.026	0.176	0.014	0.140	0.058	0.047
Gd (.01)						
K (.3)	5.300	0.136	5.600		4.670	5.170
La (.008)						0.012
Li (.004)	0.054		0.047		0.050	0.044
Mg (.06)	0.550	1.110	0.360	1.100	0.125	0.110
Mn (.002)		0.005		0.004		
Mo (.01)	0.620	0.027	1.000	0.017	1.350	1.370
Na (.01)	55.000	2.090	57.000	0.220	52.100	56.700
Nd (.02)						
Ni (.02)		0.039		0.040	0.128	
P (.1)						
Pb (.06)						
Ru (.05)						
Sb (.05)						
Si (.02)	31.000	2.690	34.000	1.300	32.900	33.300
Sr (.002)	0.150	0.010	0.200	0.009	0.197	0.220
Te (.06)						
Ti (.002)		0.003		0.006		
Zn (.02)	0.140	0.180	0.140	0.320	0.108	
Zr (.008)				0.025		
Cs (.005)	0.550	0.024	0.920		0.800	0.920
F (.130)					3.900	
CL (.015)					7.700	
NO3(.040)	*	*	*	*	9.100	*
SO4(.300)					18.000	

18A - 18 ANSTROM FILTERED SOLUTION

AS - ACID STRIP SOLUTION

UN - UNFILTERED

* - NO ANION ANALYSIS

(a) - BLANKS INDICATE ELEMENTS BELOW DETECTION LIMITS

LLNL WASTE PACKAGE TESTS
LEACH TEST 1 DATA (GLASS ONLY), TUFF WATER

TEST PARAMETERS	TU83-I70-182				TU83-I90-3		TU83-I90-7
DATE RUN BEGAN	26-JAN-83				15-FEB-83		21-JAN-83
DATE RUN ENDED	27-JLY-83				18-FEB-83		28-JAN-83
SPECIMEN SA mm2	239.100				192.880		194.900
SPECIMEN INI'L WT.(gm)	0.448				0.461		0.468
SPECIMEN FIN'L WT.(gm)	-				0.459		0.467
WEIGHT CHANGE(gm)	-				0.002		0.000
LEACHANT INI'L VOL.	23.910				19.280		19.490
LEACHANT FIN'L VOL.	23.390				19.190		19.300
VOLUME CHANGE	0.520				0.090		0.190
INI'L pH AT 23 C	7.310				7.310		7.310
FIN'L pH AT 23 C	9.130				8.420		8.780
SA/V	10.000				10.004		10.000
ELEMENTAL ANALYSIS	TU83-I70-182				TU83-I90-3		TU83-I90-7
(DET. LIM.) mg/liter	UN	18A	50A	AS	18A	AS	18A
Al (.03)		0.070		0.050	0.060	0.152	0.030
As (.08)							
B (.01)	4.200	3.900	4.100		1.100	0.523	1.750
Ba (.002)	0.042	0.027	0.039	0.004	0.058	0.088	0.046
Ca (.01)	6.000	4.600	5.700	4.150	11.000	1.360	5.890
Cd (.004)							
Ce (.04)							
Co (.01)							
Cr (.02)	0.075	0.072	0.093		0.024	0.157	0.029
Cu (.004)				0.009		0.017	
Dy (.004)							
Eu (.002)							
Fe (.005)	0.029	0.008	0.111	0.290	0.110	1.680	0.018
Gd (.01)							
K (.3)	5.600	4.800	5.700		5.700	0.113	5.700
La (.008)							
Li (.004)	0.051	0.047	0.054		0.056	0.003	0.051
Mg (.06)	0.028	0.050		1.300	0.780	0.761	0.190
Mn (.002)				0.005		0.024	
Mo (.01)	1.700	1.700	1.680		0.410	0.225	0.720
Na (.01)	66.000	60.000	60.000	0.060	54.000	2.800	55.000
Nd (.02)							
Ni (.02)				0.072		0.098	
P (.1)							
Pb (.06)							
Ru (.05)							
Sb (.05)							
Si (.02)	37.000	36.000	36.000	2.780	31.000	4.870	32.000
Sr (.002)	0.220	0.150	0.195	0.017	0.120	0.063	0.120
Te (.06)							
Ti (.002)						0.329	
Zn (.02)		0.280	0.162	0.800	0.400	0.765	0.270
Zr (.008)			0.051			0.086	
Cs (.005)	1.400	1.300	1.050	0.006	0.350	0.190	0.500
F (.130)							
Cg (.015)							
NO3(.040)							
SO4(.300)	*	*	*	*	*	*	*

18A - 18 Angstrom Filtered Solution
AS - Acid Strip
UN - Unfiltered
0.45μ - 45 microns Filtered Solution
50A - 50 Angstrom Filtered Solution
* - No Anion Analysis
(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST I DATA (GLASS), TUFF WATER

TEST PARAMETERS	TU83-I90-7		TU83-I90-14		TU83-I90-28		TU83-I90-56
DATE RUN BEGAN	21-JAN-83		21-JAN-83		21-JAN-83		26-JAN-83
DATE RUN ENDED	28-JAN-83		4-FEB-83		18-FEB-83		23-MAR-83
SPECIMEN SA mm2	194.900		205.200		185.100		239.870
SPECIMEN INI'L WT.(gm)	0.468		0.502		0.380		0.445
SPECIMEN FIN'L WT.(gm)	0.467		0.502		0.379		0.444
WEIGHT CHANGE(gm)	0.000		0.000		0.000		0.001
LEACHANT INI'L VOL.	19.490		20.520		18.510		23.990
LEACHANT FIN'L VOL.	19.300		20.260		17.890		23.480
VOLUME CHANGE	0.190		0.260		0.620		0.510
INI'L pH AT 23 C	7.310		7.310		7.310		7.310
FIN'L pH AT 23 C	8.780		8.960		9.110		9.170
SA/V	10.000		10.000		10.000		9.999
ELEMENTAL ANALYSIS(a) (DET. LI) mg/liter	TU83-I90-7		TU83-I90-14		TU83-I90-28		TU83-I90-56
	UN	AS	18A	AS	18A	AS	18A
Al (.03)	0.054	0.048	0.045	0.004	0.130	0.095	0.073
As (.08)							0.031
B (.01)	1.770	0.029	2.770	0.059	3.600	0.117	6.070
Ba (.002)	0.077	0.002	0.039	0.004	0.030	0.011	0.032
Ca (.01)	13.300	1.200	8.220	0.934	5.200	4.420	4.290
Cd (.004)							0.001
Ce (.04)							
Co (.01)							
Cr (.02)	0.031	0.002	0.038	0.007	0.065	0.006	0.232
Cu (.004)	0.017	0.008				0.031	0.005
Dy (.004)							
Eu (.002)							
Fe (.005)	0.051	0.070	0.020	0.018	0.079	0.148	0.554
Gd (.01)							
K (.3)	5.480	0.278	5.500	0.092	5.700	0.148	5.920
La (.008)							0.005
Li (.004)	0.054	0.001	0.055	0.002	0.056	0.003	0.051
Mg (.06)	0.613	0.918	0.110	0.260	0.070	1.230	0.027
Mn (.002)		0.001		0.001		0.004	0.006
Mo (.01)	0.733	0.015	1.200	0.023	1.500	0.053	2.610
Na (.01)	56.000	0.657	55.000	1.170	60.000	1.660	63.300
Nd (.02)							
Ni (.02)	0.010	0.011				0.128	0.013
P (.1)							0.171
Pb (.06)							
Ru (.05)							
Sb (.05)							0.034
Si (.02)	32.400	1.790	33.900	1.220	37.000	2.840	44.100
Sr (.002)	0.183	0.005	0.190	0.011	0.170	0.027	0.186
Te (.06)							
Ti (.002)	0.011	0.010		0.001		0.021	
Zn (.02)	0.090	0.124	0.150	0.008	0.380	0.452	0.155
Zr (.008)	0.007	0.002		0.001		0.031	
Cs (.005)	0.500		1.100	0.018	1.200		2.200
F (.130)							
Cl (.015)							
NO3(.040)	*	*	*	*	*	*	*
SO4(.300)							

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

0.45 μ - 45 microns Filtered Solution

50A - 50 Angstrom Filtered Solution

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST I DATA (GLASS ONLY), TUFF WATER

TEST PARAMETERS	TU83-190-56	TU83-190-91	TU83-190-182
DATE RUN BEGAN	26-JAN-83	26-JAN-83	26-JAN-83
DATE RUN ENDED	23-MAR-83	27-APR-83	27-JULY-83
SPECIMEN SA mm2	239.870	256.160	250.530
SPECIMEN INI'L WT.(gm)	0.445	0.680	0.705
SPECIMEN FIN'L WT.(gm)	0.444	0.679	--
WEIGHT CHANGE(gm)	0.001	0.001	
LEACHANT INI'L VOL.	23.990	25.610	25.540
LEACHANT FIN'L VOL.	23.480	24.760	23.95
VOLUME CHANGE	0.510	0.850	1.59
INI'L pH AT 23 C	7.310	7.310	7.310
FIN'L pH AT 23 C	9.170	9.280	9.410
SA/V	9.999	10.002	9.809
ELEMENTAL ANALYSIS (DET. LIM.) mg/liter	TU83-190-56	TU83-190-91	TU83-190-182
	AS	18A UN	UN 18A 50A
Al (.03)	0.110	0.036 0.059	0.040 0.090
As (.08)		0.009	
B (.01)	0.027	6.930 7.090	6.800 6.500 6.500
Ba (.002)	0.005	0.030 0.025	0.035 0.019 0.028
Ca (.01)	2.600	3.380 2.930	4.700 3.300 4.200
Cd (.004)		0.001	
Ce (.04)			
Co (.01)			
Cr (.02)		0.123 0.120	0.130 0.130 0.130
Cu (.004)	0.014	0.003 0.001	0.007 0.008
Dy (.004)			
Eu (.002)			
Fe (.005)	0.240	0.007 0.029	0.016 0.025 0.022
Gd (.01)			
K (.3)		5.060 5.460	5.700 5.500 5.400
La (.008)		0.002	
Li (.004)		0.044 0.050	0.063 0.062 0.060
Mg (.06)	1.200		
Mn (.002)	0.004		
Mo (.01)	0.018	3.030 2.970	2.900 2.800 2.800
Na (.01)	0.280	65.400 71.600	65.000 63.000 64.000
Nd (.02)			
Ni (.02)	0.050	0.004 0.028	
P (.1)		0.049	
Pb (.06)			
Ru (.05)			
Sb (.05)		0.034 0.010	
Si (.02)	2.100	44.500 44.200	46.000 44.000 45.000
Sr (.002)	0.018	0.180 0.154	0.210 0.130 0.168
Te (.06)		0.002	
Ti (.002)	0.002		
Zn (.02)	0.590	0.007 0.146	0.330 0.027 0.078
Zr (.008)			
Cs (.005)	0.008	1.700 1.800	2.200 2.000 2.000
F (1.30)			
Cl (.015)		8.000	8.800
NO3 (.040)	*	8.800	* 10.400 *
SO4 (.300)		18.000	19.000

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

50A - 50 Angstrom Filtered Solution

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST I DATA (GLASS ONLY), TUFF WATER

TEST PARAMETERS	TU83-I90-182	TU83-I150-3		TU83-I150-7		TU83-I150-14	
DATE RUN BEGAN	26-JAN-83	31-JAN-83		31-JAN-83		31-JAN-83	
DATE RUN ENDED	27-JUL-83	3-FEB-83		7-FEB-83		14-FEB-83	
SPECIMEN SA mm2	250.530	139.980		140.946		143.520	
SPECIMEN INI'L WT.(gm)	0.705	0.280		0.284		0.292	
SPECIMEN FIN'L WT.(gm)	--	0.278		0.283		0.287	
WEIGHT CHANGE(gm)	--	0.002		0.002		0.005	
LEACHANT INI'L VOL.	25.540	14.010		14.120		14.350	
LEACHANT FIN'L VOL.	25.540	13.970		13.990		14.300	
VOLUME CHANGE		0.040		0.130		0.050	
INI'L pH AT 23 C	7.310	7.310		7.310		7.310	
FIN'L pH AT 23 C	9.410	8.870		9.070		9.130	
SA/V	9.809	9.991		9.982		10.001	
ELEMENTAL ANALYSIS (DET. LIM.) mg/liter	<u>TU83-I90-182</u> AS	<u>TU83-I150-3</u> 18A AS		<u>TU83-I150-7</u> 18A AS		<u>TU83-I150-14</u> 18A AS	
Al (.03)	1.290	0.190	0.102	0.150	0.016	0.240	0.233
As (.08)							
B (.01)		7.700	0.097	8.600	0.415	20.000	0.400
Ba (.002)		0.014	0.007	0.004	0.004	0.005	0.007
Ca (.01)	8.200	1.070	5.290	0.450	2.830	0.380	4.190
Cd (.004)							
Ce (.04)							
Co (.01)							
Cr (.02)		0.170	0.005	0.220	0.010	0.460	0.015
Cu (.004)			0.064		0.002		0.214
Dy (.004)							
Eu (.002)							
Fe (.005)	0.055	0.081	0.147	0.057	0.002	0.045	0.230
Gd (.01)							
K (.3)	0.510	3.600	0.070	5.200	0.244	5.700	0.007
La (.008)							
Li (.004)		0.051	0.002	0.034	0.005	0.057	0.002
Mg (.06)		0.070	1.010	0.060	0.082		1.430
Mn (.002)	0.008		0.002		0.000		0.004
Mo (.01)		3.400	0.042	3.800	0.181	7.200	0.141
Na (.01)	0.500	55.000	0.990	68.000	2.660	130.000	2.510
Nd (.02)							
Ni (.02)			0.009				0.011
P (.1)							
Pb (.06)							
Ru (.05)							
Sb (.05)							
Si (.02)	3.300	49.000	1.810	55.100	2.570	95.000	4.090
Sr (.002)	0.012	0.070	0.029	0.015	0.023	0.018	0.030
Te (.06)							
Ti (.002)			0.002		0.002		0.001
Zn (.02)		0.180	0.243	0.650	0.017	0.380	0.928
Zr (.008)			0.004		0.002		0.004
Cs (.005)		2.600	0.046	2.800	0.132	6.100	0.162
F (1.30)							
Cl (.015)							
NO3(.040)	*	*	*	*	*	*	*
SO4(.300)							

18A - 18 Angstrom Filtered Solution
 AS - Acid Strip
 UN - Unfiltered
 0.45μ - 45 microns Filtered Solution
 50A - 50 Angstrom Filtered Solution
 * - No Anion Analysis
 (a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS
LEACH TEST 1 DATA (GLASS ONLY), TUFF WATER

TEST PARAMETERS	TU83-150-28		TU83-150-56			
DATE RUN BEGAN	31-JAN-83		6-APR-83			
DATE RUN ENDED	28-FEB-83		1-Jan-83			
SPECIMEN SA mm2	143.940		154.786			
SPECIMEN INI'L WT.(gm)	0.273		0.295			
SPECIMEN FIN'L WT.(gm)	0.267					
WEIGHT CHANGE(gm)	0.006		0.295			
LEACHANT INI'L VOL.	14.410		15.480			
LEACHANT FIN'L VOL.	14.350		15.480			
VOLUME CHANGE	0.060					
INI'L pH AT 23 C	7.310		7.310			
FIN'L pH AT 23 C	9.280		9.410			
SA/V	9.989		9.999			
(a)						
ELEMENTAL ANALYSIS	TU83-I150-28		TU83-I150-56			
(DET. LIM.) mg/liter	18A	AS	18A	UN	50A	AS
Al (.03)	0.299	0.258	0.460	0.340	0.340	0.230
As (.08)	0.061	0.004				
B (.01)	28.200	0.984	33.400	33.600	33.600	0.510
Ba (.002)	0.006	0.009	0.030			0.015
Ca (.01)	0.623	3.130	0.600	0.500	0.500	1.920
Cd (.004)	0.004	0.001				
Ce (.04)	0.003					
Co (.01)	0.005	0.001				
Cr (.02)	2.000	0.027	0.920	0.860	0.860	0.031
Cu (.004)	0.026	0.540	0.184	0.026	0.026	0.041
Dy (.004)						
Eu (.002)	0.001					
Fe (.005)	0.047	0.844	2.000	0.042	0.042	0.940
Gd (.01)	0.112		0.060			
K (.3)	5.540	0.104	5.200	5.600	5.600	
La (.008)	0.003	0.041	0.120			0.028
Li (.004)	0.050	0.003	0.052	0.052	0.052	
Mg (.06)	0.095	1.290	0.380			1.290
Mn (.002)	0.155	0.005	0.008			0.007
Mo (.01)	10.100	0.349	13.000	12.400	12.400	0.180
Na (.01)	152	4.830	148	161.8	161.8	2.480
Nd (.02)	0.004					
Ni (.02)	0.822	0.108	0.300			0.080
P (.1)	3.960	0.254	0.480			0.340
Pb (.06)		0.042				
Ru (.05)	0.032					
Sb (.05)	0.145	0.004				
Si (.02)	114	7.330	135	138	136	5.700
Sr (.002)	0.028	0.030	0.066	0.008	0.008	0.032
Te (.06)	0.024					
Ti (.002)	0.026	0.014	0.072			0.023
Zn (.02)	0.583	2.410	0.980	0.700	0.404	2.790
Zr (.008)		0.006	0.018			
Cs (.005)	7.930	0.380	6.800	7.200	6.800	0.021
F (.130)			1.800			
CL (.015)			4.700			
NO3 (.040)	*	*	5.300	*	*	*
S04 (.300)			12.000			

18A - 18 Angstrom Filtered Solution
AS - Acid Strip
UN - Unfiltered
50A - 50 Angstrom Filtered Solution
* - No anion Analysis

LLNL WASTE PACKAGE TESTS LEACH TEST I DATA
(GLASS , , TUFF WATER

TEST PARAMETERS

TU83-II50-91

DATE RUN BEGAN 6-APR-83
DATE RUN ENDED 6-JUL-83
SPECIMEN SA mm2 149.119
SPECIMEN INI'L WT.(gm 0.276
SPECIMEN FIN'L WT.(gm .270
WEIGHT CHANGE(gm) 0.006
LEACHANT INI'L VOL. 14.910
LEACHANT FIN'L VOL. 14.910
VOLUME CHANGE
INI'L pH AT 23 C 7.310
FIN'L pH AT 23 C 9.290
SA/V 10.001

ELEMENTAL ANALYSIS(a)
(DET. LIM.) mg/liter

TU83-II50-91
UN 18A 50A AS

Al (.03)	0.340	0.400	0.320	0.140
As (.08)			0.080	
B (.01)	39.400	38.800	39.000	0.036
Ba (.002)	0.012			0.005
Ca (.01)	0.540	0.420	0.412	0.410
Cd (.004)				
Ce (.04)				
Co (.01)				
Cr (.02)	1.060	1.000	1.020	
Cu (.004)	0.028	0.014		0.160
Dy (.004)				
Eu (.002)				
Fe (.005)	0.610	0.082	0.074	0.357
Gd (.01)				
K (.3)	5.600	5.000	5.400	
La (.008)				
Li (.004)	0.050	0.050	0.050	
Mg (.06)	0.320	0.130		0.770
Mn (.002)				0.003
Mo (.01)	13.640	13.200	13.240	0.017
Na (.01)	178	176	178	0.310
Nd (.02)				
Ni (.02)	0.098			0.024
P (.1)	0.340		0.240	
Pb (.06)				
Ru (.05)				
Sb (.05)				
Si (.02)	146.000	144	144	2.170
Sr (.002)	0.034	0.006	0.014	0.013
Te (.06)				
Ti (.002)	0.026		0.008	0.006
Zn (.02)	1.840	0.880	0.420	2.360
Zr (.008)				0.021
Cs (.005)	9.800	9.800	9.200	0.076
F (1.30)	2.200			
CL (.015)	4.300			
NO3(.040)	5.100			
SO4(.300)	10.000	*	*	*

18A - 18 Angstrom Filtered Solution
AS - Acid Strip
UN - Unfiltered
0.45 μ - 45 microns Filtered Solution
50A - 50 Angstrom Filtered Solution
* - No Anion Analysis
(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST II DATA (GLASS AND ROCK),TUFF WATER

TEST PARAMETERS	TU83-II40-3		TU83-II40-7			TU83-II40-28	
DATE RUN BEGAN	22-FEB-83		21-JAN-83			21-JAN-83	
DATE RUN ENDED	25-FEB-83		28-JAN-83			18-FEB-83	
SPECIMEN SA mm2	197.740		181.600			198.800	
PARTICLE SIZE	MONOLITH		MONOLITH			MONOLITH	
SPECIMEN INI'L WT.(gm)	0.474		0.385			0.491	
SPECIMEN FIN'L WT.(gm)	0.474		0.3845			---	
WEIGHT CHANGE(gm)	---		---			---	
LEACHANT INI'L VOL.	19.770		18.160			19.880	
LEACHANT FIN'L VOL.	19.770		18.140			---	
VOLUME CHANGE	---		0.020			---	
INI'L pH AT 23 C	7.310		7.310			7.310	
FIN'L pH AT 23 C	7.980		8.140			8.230	
SA/V	10.002		10.000			10.000	
ELEMENTAL ANALYSIS ^(a) (DET.LIM)MG/LITER	TU83-II40-3		TU83-II40-7			TU83-II40-28	
	18A	AS	18A	UN	AS	18A	AS
Al (.03)		0.041	0.048	0.028	0.166	0.068	0.018
As (.08)				0.032	0.022	0.000	0.020
B (.01)	0.170	0.010	0.170	0.175	0.016	0.201	0.014
Ba (.002)	0.004		0.006	0.005	0.002	0.005	0.002
Ca (.01)	11.500	0.410	11.000	12.700	0.323	12.100	0.585
Cd (.004)				0.001	0.001	0.001	
Ce (.04)				0.002	0.017		
Co (.01)				0.002	0.003		0.002
Cr (.02)				0.002	0.003	0.007	0.009
Cu (.004)	0.006	0.018	0.017	0.056	0.057	0.002	0.023
Dy (.004)					0.001		
Eu (.002)				0.001	0.001		
Fe (.005)		0.056	0.020	0.032	0.036	0.032	0.078
Gd (.01)		0.040			0.040		0.012
K (.3)	6.200		7.400	7.270	0.325	7.970	0.173
La (.008)	0.014		0.090	0.110	0.012	0.003	0.006
Li (.004)	0.047		0.050	0.054	0.001	0.057	0.002
Mg (.06)	1.800	0.080	1.800	1.930	0.076	1.840	0.077
Mn (.002)	0.005		0.005	0.005	0.001	0.005	0.002
Mo (.01)	0.011		0.020	0.020	0.008	0.028	0.006
Na (.01)	46.000	1.200	47.500	49.000	0.934	50.300	1.510
Nd (.02)				0.010	0.014		
Ni (.02)				0.018	0.009	0.011	0.012
P (.1)			0.100	0.121	0.022	0.022	0.009
Pb (.06)					0.013		0.003
Ru (.05)				0.004	0.013		
Sb (.05)				0.012	0.019		0.008
Si (.02)	28.000	0.830	28.000	28.200	0.712	29.500	0.992
Sr (.002)	0.043	0.003	0.042	0.046	0.002	0.049	0.003
Te (.06)					0.009		0.006
Ti (.002)		0.006	0.008	0.009	0.013		
Zn (.02)	0.620	0.020	1.700	0.044	0.021	0.616	0.018
Zr (.008)			0.029	0.004			0.009
Cs (.005)	0.009			0.006		0.013	
F (.130)							
Cl (.015)							
NO ₂	*	*	*	*	*	*	*
NO ₃ (.040)							
SO ₄ (.300)							

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST II DATA (GLASS AND ROCK), TUFF WATER

TEST PARAMETERS	TU83-II40-56			TU83-II40-91		TU83-II40-182		
DATE RUN BEGAN	27-JAN-83			27-JAN-83		27-JAN-83		
DATE RUN ENDED	24-FEB-83			28-FEB-83		28-JULY-83		
SPECIMEN SA mm2	241.520			242.840		238.730		
PARTICLE SIZE	MONOLITH			MONOLITH		MONOLITH		
SPECIMEN INI'L WT.(gm)	0.472			0.710		0.457		
SPECIMEN FIN'L WT.(gm)	0.495			0.710		---		
WEIGHT CHANGE(gm)	0.023			---		---		
LEACHANT INI'L VOL.	24.150			24.290		23.870		
LEACHANT FIN'L VOL.	23.780			23.890		23.840		
VOLUME CHANGE	0.370			0.400		0.030		
INI'L pH AT 23 C	7.310			7.310		7.310		
FIN'L pH AT 23 C	8.330			8.420		8.550		
SA/V	10.001			9.998		10.001		
ELEMENTAL ANALYSIS ^(a)	TU83-II40-56			TU83-II40-91		TU83-II40-182		
(DET.LIM)MG/LITER	18A	UN	AS	18A	UN	UN	AS	18A
Al (.03)	0.034	0.021	0.018	0.024	0.004			
As (.08)					0.037			
B (.01)	0.290	0.300	0.012	0.315	0.308	0.280		0.270
Ba (.002)	0.010	0.009		0.011	0.009	0.006		0.006
Ca (.01)	13.000	14.000	0.440	14.500	15.100	14.000	0.035	12.000
Cd (.004)								
Ce (.04)								
Co (.01)								
Cr (.02)				0.011	0.004			
Cu (.004)			0.008	0.005	0.003	0.008	0.005	
Dy (.004)								
Eu (.002)								
Fe (.005)	0.006	0.008	0.041	0.009	0.004	0.016	0.041	
Gd (.01)								
K (.3)	6.800	7.700		7.290	7.290	6.800		6.700
La (.008)	0.040	0.030		0.018	0.033			
Li (.004)	0.050	0.051		0.050	0.044	0.045		0.042
Mg (.06)	2.100	1.900	0.078	1.910	2.040	1.900		1.700
Mn (.002)				0.003				
Mo (.01)	0.075	0.067	0.010	0.072	0.082	0.057		0.051
Na (.01)	48.000	51.000	1.100	47.000	47.100	49.000	0.023	48.000
Nd (.02)								
Ni (.02)				0.006	0.007			
P (.1)				0.063	0.014			
Pb (.06)								
Ru (.05)								
Sb (.05)					0.011			
Si (.02)	30.000	30.000	0.840	28.300	29.700	29.000	0.220	29.000
Sr (.002)	0.081	0.077		0.125	0.131	0.079		0.065
Te (.06)								
Ti (.002)								
Zn (.02)		0.560		0.445	0.007			1.300
Zr (.008)							0.013	
Cs (.005)	0.015	0.036		0.029	0.014	0.030		0.023
F (.130)				2.400				2.700
Cl (.015)				9.000				8.300
NO ₂								
NO ₃ (.040)	*	*		7.900	*	*	*	11.300
SO ₄ (.300)				18.000				19.000

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST II DATA (GLASS AND ROCK), TUFF WATER

TEST PARAMETERS	TU83-II70-3			TU83-II70-7		
DATE RUN BEGAN	22-FEB-83			21-JAN-83		
DATE RUN ENDED	25-FEB-83			28-JAN-83		
SPECIMEN SA mm2	201.125			198.900		
PARTICLE SIZE	MONOLITH			MONOLITH		
SPECIMEN INI'L WT.(gm)	0.455			0.4715		
SPECIMEN FIN'L WT.(gm)	0.455			0.4715		
WEIGHT CHANGE(gm)	--			--		
LEACHANT INI'L VOL.	20.110			19.110		
LEACHANT FIN'L VOL.	20.080			19.050		
VOLUME CHANGE	0.030			0.060		
INI'L pH AT 23 C	7.310			7.310		
FIN'L pH AT 23 C	8.000			8.410		
SA/V	10.001			10.408		
ELEMENTAL ANALYSIS ^(a)	TU83-II70-3			TU83-II70-7		
(DET.LIM)MG/LITER	18A	50A	AS	UN	50A	AS
Al (.03)		0.053	0.017	0.049	0.075	0.020
As (.08)				0.023	0.026	0.016
B (.01)	0.270	0.230	0.010	0.218	0.232	0.013
Ba (.002)	0.006	0.004		0.007	0.010	0.001
Ca (.01)	11.000	12.000	0.340	12.400	11.300	0.197
Cd (.004)				0.001	0.002	
Ce (.04)						
Co (.01)						0.001
Cr (.02)				0.002	0.004	0.025
Cu (.004)		0.005	0.018	0.008	0.028	0.036
Dy (.004)						
Eu (.002)						
Fe (.005)			0.100	0.116	0.056	0.157
Gd (.01)						0.004
K (.3)	6.700	8.400		8.100	7.750	0.181
La (.008)				0.082	0.106	0.007
Li (.004)	0.042	0.048		0.055	0.052	
Mg (.06)	1.700	1.600		1.750	1.860	0.046
Mn (.002)				0.001	0.001	0.004
Mo (.01)	0.051	0.023		0.035	0.042	0.007
Na (.01)	49.000	55.000	0.960	50.700	49.000	0.560
Nd (.02)						
Ni (.02)				0.005	0.006	0.023
P (.1)				0.060	0.055	0.017
Pb (.06)						
Ru (.05)						
Sb (.05)						
Si (.02)	29.000	30.000	0.710	29.500	29.200	0.486
Sr (.002)	0.065	0.044		0.045	0.051	0.002
Te (.06)						
Ti (.002)					0.016	0.013
Zn (.02)	1.300	0.460	0.026	0.685	0.043	0.020
Zr (.008)					0.005	
Cs (.005)	0.023	0.024		0.022	0.013	
F (1.30)	2.700					
Cl (.015)	8.300					
N02						
N03 (.040)	11.300	*	*	*	*	*
S04 (.300)	19.000					

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

0.45μ - 45 microns Filtered Solution

50A - 50 Angstrom Filtered Solution

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST II DATA (GLASS AND ROCK), TUFF WATER

TEST PARAMETERS	TU83-II70-28		TU83-II70-56			TU83-II70-91	
DATE RUN BEGAN	21-JAN-83		27-JAN-83			27-JAN-83	
DATE RUN ENDED	18-FEB-83		24-MAR-83			28-APR-83	
SPECIMEN SA mm2	188.700		243.340			270.910	
PARTICLE SIZE	MONOLITH		MONOLITH			MONOLITH	
SPECIMEN INI'L WT.(gm)	.3932		.4443			.5980	
SPECIMEN FIN'L WT.(gm)	.3932		.4439			.5972	
WEIGHT CHANGE(gm)	--		0.0004			0.0008	
LEACHANT INI'L VOL.	18.860		23.720			23.150	
LEACHANT FIN'L VOL.	18.730		23.560			22.860	
VOLUME CHANGE	0.130		0.160			0.290	
INI'L pH AT 23 C	7.310		7.310			7.310	
FIN'L pH AT 23 C	8.620		8.840			8.960	
SA/V							
ELEMENTAL ANALYSIS ^(a) (DET.LIM)MG/LITER	TU83-II70-28		TU83-II70-56			TU83-II70-91	
	18A	AS	18A	UN	AS	18A	UN
Al (.03)	0.120	0.056	0.041	0.026	0.039	0.037	0.007
As (.08)	0.000	0.008		0.046		0.011	0.064
B (.01)	0.310	0.016	1.650	1.660	0.032	2.230	2.200
Ba (.002)	0.009	0.001	0.029	0.034		0.023	0.024
Ca (.01)	11.000	0.582	7.000	8.000	0.220	5.330	5.740
Cd (.004)							
Ce (.04)							
Co (.01)		0.002		0.001			
Cr (.02)		0.005	0.028	0.030		0.040	0.038
Cu (.004)	0.008	0.097		0.003	0.011	0.033	0.001
Dy (.004)		0.001					
Eu (.002)							
Fe (.005)	0.032	0.074	0.009		0.110	0.047	
Gd (.01)		0.006		0.016			
K (.3)	7.400	0.061	7.900	7.790		7.160	7.090
La (.008)		0.007	0.010	0.020			0.007
Li (.004)	0.059	0.001	0.051	0.053		0.050	0.044
Mg (.06)	0.890	0.096	0.500	0.578	0.220	0.144	0.156
Mn (.002)		0.002				0.001	
Mo (.01)	0.064	0.007	0.660	0.717	0.017	0.900	0.962
Na (.01)	58.000	0.848	53.700	56.000	0.800	53.200	53.000
Nd (.02)		0.002					
Ni (.02)		0.019					0.001
P (.1)		0.008		0.099			0.004
Pb (.06)		0.003					
Ru (.05)				0.002			
Sb (.05)		0.010		0.016			0.012
Si (.02)	31.000	0.779	34.000	35.500	0.820	34.100	36.000
Sr (.002)	0.053	0.003	0.120	0.148		0.127	0.148
Te (.06)		0.008					
Ti (.002)		0.007			0.004		
Zn (.02)	0.380	0.066	0.140	0.001	0.150	0.150	0.002
Zr (.008)		0.002					
Cs (.005)	0.039		0.480	0.490	0.008	0.400	0.300
F (1.30)						6.600	
Cl (.015)						8.200	
N02							
N03 (.040)	*	*	*	*	*	10.300	*
S04 (.300)						18.000	

18A - 18 Angstrom Filtered Solution
 AS - Acid Strip
 UN - Unfiltered
 0.45μ - 45 microns Filtered Solution
 50A - 50 Angstrom Filtered Solution
 * - No Anion Analysis
 (a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST II DATA (GLASS AND ROCK),TUFF WATER

TEST PARAMETERS	TU83-II70-182			TU83-II90-A3
DATE RUN BEGAN	27-JAN-83			22-FEB-83
DATE RUN ENDED	4-MAY-83			7-JULY-83
SPECIMEN SA mm2	240.970			189.504
PARTICLE SIZE	MONOLITH			MONOLITH
SPECIMEN INI'L WT.(gm)	0.528			---
SPECIMEN FIN'L WT.(gm)				0.415
WEIGHT CHANGE(gm)	---			---
LEACHANT INI'L VOL.	23.730			18.950
LEACHANT FIN'L VOL.	23.220			18.850
VOLUME CHANGE	0.510			0.100
INI'L pH AT 23 C	7.310			7.310
FIN'L pH AT 23 C	9.080			8.600
SA/V	10.155			10.000
ELEMENTAL ANALYSIS ^(a)	TU83-II70-182			TU83-II90-A3
(DET.LIM)MG/LITER	UN	AS	18A	18A
Al (.03)	0.030	0.090	0.020	0.034
As (.08)				0.045
B (.01)	3.400		3.300	0.532
Ba (.002)	0.019		0.014	0.027
Ca (.01)	4.600	0.170	3.600	11.100
Cd (.004)				0.001
Ce (.04)				
Co (.01)				
Cr (.02)	0.063	0.031	0.063	0.011
Cu (.004)		0.008		0.017
Dy (.004)				
Eu (.002)				
Fe (.005)	0.096	0.410	0.015	0.008
Gd (.01)				
K (.3)	7.800		6.900	7.210
La (.008)				0.019
Li (.004)	0.047		0.042	0.052
Mg (.06)		0.730	0.062	0.846
Mn (.002)				0.001
Mo (.01)	1.400		1.400	0.178
Na (.01)	55.000	0.010	56.000	46.600
Nd (.01)				
Ni (.02)		0.078		0.013
P (.1)				
Pb (.06)				
Ru (.05)				0.003
Sb (.05)				0.006
Si (.02)	39.000	2.100	38.000	30.400
Sr (.002)	0.130	0.004	0.093	0.075
Te (.06)				0.005
Ti (.002)				0.004
Zn (.02)	0.027	0.740	0.190	0.241
Zr (.008)	0.016			0.011
Cs (.005)	0.740		0.580	0.172
F (.130)			4.300	
Cl (.015)			8.800	
NO ₂				
NO ₃ (.040)			10.300	
SO ₄ (.300)	*	*	19.000	*

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST II DATA (GLASS AND ROCK), TUFF WATER

TEST PARAMETERS	TU83-II90-A7			TU83-II90-A14		TU83-II90-A28	
DATE RUN BEGAN	21-JAN-83			21-JAN-83		21-JAN-83	
DATE RUN ENDED	28-JAN-83			4-FEB-83		18-FEB-83	
SPECIMEN SA mm2	192.800			190.500		194.300	
PARTICLE SIZE	MONOLITH			MONOLITH		MONOLITH	
SPECIMEN INI'L WT.(gm)	0.465			0.461		0.476	
SPECIMEN FIN'L WT.(gm)	0.464			0.459		0.415	
WEIGHT CHANGE(gm)	0.001			0.002		0.001	
LEACHANT INI'L VOL.	19.280			19.050		19.430	
LEACHANT FIN'L VOL.	17.780			18.650		19.390	
VOLUME CHANGE	1.500			0.400		0.040	
INI'L pH AT 23°C	7.310			7.310		7.310	
FIN'L pH AT 23°C	8.830			8.980		9.040	
SA/V	10.000			10.000		10.000	
ELEMENTAL ANALYSIS (DET.LIM)MG/LITER	TU83-II90-A7			TU83-II90-A14		TU83-II90-A28	
	18A	UN	AS	18A	AS	18A	AS
Al (.03)	0.226	0.455	0.018	0.065	0.003	0.074	0.171
As (.08)	0.024	0.037	0.029	0.044	0.014		0.005
B (.01)	0.316	0.320	0.010	1.780	0.032	3.500	0.067
Ba (.002)	0.007	0.009	0.001	0.021	0.001	0.018	0.018
Ca (.01)	10.000	11.500	0.012	5.810	0.188	4.800	0.272
Cd (.004)				0.001	0.002		0.003
Ce (.04)							0.003
Co (.01)			0.001				0.010
Cr (.02)	0.004	0.007		0.034	0.005	0.057	0.160
Cu (.004)	0.004	0.053	0.020	0.004			0.021
Dy (.004)					0.001		
Eu (.002)							
Fe (.005)	0.006	0.056	0.042	0.008	0.005	0.013	0.002
Gd (.01)			0.005	0.009			0.005
K (.3)	7.770	7.690	0.142	7.690	0.067	7.800	0.055
La (.008)	0.074	0.088	0.002	0.011	0.002		0.013
Li (.004)	0.051	0.052		0.050	0.008	0.054	0.003
Mg (.06)	0.360	0.419	0.073	0.073	0.049		0.688
Mn (.002)			0.001	0.002	0.003		0.051
Mo (.01)	0.075	0.081	0.004	0.727	0.009	1.500	0.035
Na (.01)	49.100	49.000	0.235	51.100	0.661	65.000	1.150
Nd (.01)							0.003
Ni (.02)	0.003	0.007	0.003	0.005	0.001		0.360
P (.1)	0.046	0.126	0.030	0.095	0.040		0.088
Pb (.06)			0.020				0.025
Ru (.05)			0.001	0.002	0.001		0.005
Sb (.05)	0.000	0.002	0.001	0.014			0.003
Si (.02)	30.000	30.300	0.331	38.400	0.657	44.000	0.313
Sr (.002)	0.047	0.057	0.001	0.101	0.002	0.120	0.021
Te (.06)			0.005				0.016
Ti (.002)		0.013	0.008	0.001	0.001		0.013
Zn (.02)	0.374	0.045	0.107	0.137	0.010	0.130	0.328
Zr (.008)		0.029		0.001	0.001	0.013	0.002
Cs (.005)	0.055	0.055		0.440		0.960	
F (.130)							
Cl (.015)	*	*	*	*	*	*	*
N02							
N03(.040)							
S04(.300)							

18A - 18 Angstrom Filtered Solution
 AS - Acid Strip
 UN - Unfiltered
 0.45 μ - 45 microns Filtered Solution
 50A - 50 Angstrom Filtered Solution
 * - No Anion Analysis
 (a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST II DATA (GLASS AND ROCK), TUFF WATER

TEST PARAMETERS	TU83-II90-A56			TU83-II90-A91		TU83-II90-A182
DATE RUN BEGAN	27-JAN-83			27-JAN-83		27-JAN-83
DATE RUN ENDED	24-FEB-83			28-APR-83		28-JUL-83
SPECIMEN SA mm2	238.983			240.990		240.970
PARTICLE SIZE	MONOLITH			MONOLITH		MONOLITH
SPECIMEN INI'L WT.(gm)	0.450			0.691		0.702
SPECIMEN FIN'L WT.(gm)	0.449			0.690		--
WEIGHT CHANGE(gm)	0.001			0.001		--
LEACHANT INI'L VOL.	23.900			24.110		24.080
LEACHANT FIN'L VOL.	23.900			23.650		22.410
VOLUME CHANGE	--			0.46		1.670
INI'L pH AT 23°C	7.310			7.310		7.310
FIN'L pH AT 23°C	9.080			9.230		9.290
SA/V	9.999			9.995		10.007
ELEMENTAL ANALYSIS (DET.LIM.)MG/LITER	TU83-II90-A56			TU83-II90-A91		TU83-II90-A182
	18A	UN	AS	18A	UN	18A
Al (.03)	0.081	0.063	0.104	0.084	0.044	0.066
As (.08)					0.017	
B (.01)	4.500	4.600	0.021	6.260	6.190	4.600
Ba (.002)	0.014	0.018		0.010	0.011	0.014
Ca (.01)	3.100	3.500	0.160	1.800	1.890	3.000
Cd (.004)					0.002	
Ce (.04)						
Co (.01)						
Cr (.02)	0.077	0.089		0.121	0.132	0.090
Cu (.004)			0.012	0.001	0.001	
Dy (.004)						
Eu (.002)						
Fe (.005)	0.200		0.150	0.005	0.001	0.024
Gd (.01)						
K (.3)	9.300	9.200		7.290	7.150	7.800
La (.008)						
Li (.004)	0.047	0.053		0.050	0.044	0.048
Mg (.06)			0.450			
Mn (.002)			0.003	0.001		
Mo (.01)	1.900	2.100	0.012	2.610	2.790	2.000
Na (.01)	63.000	67.000	0.230	67.400	69.200	66.000
Nd (.02)						
Ni (.02)			0.030		0.004	
P (.1)				0.057	0.053	
Pb (.06)						
Ru (.05)						
Sb (.05)				0.014	0.024	
Si (.02)	51.000	53.000	0.950	52.800	55.100	64.000
Sr (.002)	0.110	0.140		0.079	0.103	0.046
Te (.06)						
Ti (.002)						
Zn (.02)	0.160		0.350	0.254	0.002	0.280
Zr (.008)						
Cs (.005)	1.260	1.340	0.005	0.820	1.200	0.920
F (.130)				5.500		6.300
Cl (.015)				8.300		9.400
N02						
N03(.040)				11.800		18.500
S04(.300)				18.000		21.000

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

0.45μ - 45 microns Filtered Solution

50A - 50 Angstrom Filtered Solution

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST II DATA (GLASS AND ROCK), TUFF WATER

TEST PARAMETERS	TU83-II90-A182			TU83-II90-B3	TU83-II90-B7	
DATE RUN BEGAN	27-JAN-83			22-FEB-83	26-JAN-83	
DATE RUN ENDED	28-JULY-83			25-FEB-83	2-FEB-83	
SPECIMEN SA mm2	240.970			198.897	219.117	
PARTICLE SIZE	MONOLITH			MONOLITH	MONOLITH	
SPECIMEN INI'L WT.(gm)	0.702			--	0.533	
SPECIMEN FIN'L WT.(gm)	--			.4153	0.464	
WEIGHT CHANGE(gm)	--			--	0.069	
LEACHANT INI'L VOL.	24.080			19.950	21.910	
LEACHANT FIN'L VOL.	22.410			19.830	20.410	
VOLUME CHANGE	1.670			0.120	1.500	
INI'L pH AT 23 C	7.310			7.310	7.310	
FIN'L pH AT 23 C	9.290			8.650	9.200	
SA/V	10.007			10.030	10.736	
ELEMENTAL ANALYSIS(a) (DET.LIM)MG/LITER)	TU83-II90-A182			TU83-II90-B3	TU83-II90-B7	
	UN	50A	AS	18A	18A	UN
Al (.03)	0.050	0.120	0.070	0.507	0.747	0.686
As (.08)						0.028
B (.01)	4.600	4.500		0.200	0.178	0.195
Ba (.002)	0.017	0.015			0.002	0.001
Ca (.01)	3.300	2.820	0.110	13.000	4.720	5.960
Cd (.004)						
Ce (.04)						
Co (.01)						
Cr (.02)	0.086	0.075				0.004
Cu (.004)						0.009
Dy (.004)						
Eu (.002)						
Fe (.005)	0.041	0.060	0.280		0.081	0.040
Gd (.01)						
K (.3)	9.500	8.700		10.000	8.400	9.520
La (.008)				0.029	0.009	0.007
Li (.004)	0.056	0.060		0.056	0.048	0.056
Mg (.06)			0.410	0.420	0.170	0.104
Mn (.002)					0.004	0.002
Mo (.01)	1.900	1.830		0.010	0.020	0.017
Na (.01)	72.000	65.000	0.026	55.000	43.000	51.100
Nd (.02)						
Ni (.02)			0.031		0.020	0.007
P (.1)	0.100					0.132
Pb (.06)						
Ru (.05)						
Sb (.05)						0.003
Si (.02)	66.000	63.000	1.500	33.000	31.000	35.300
Sr (.002)	0.130	0.087	0.003	0.091	0.044	0.060
Te (.06)						
Ti (.002)						
Zn (.02)	0.055	0.255	0.530	0.400	0.450	0.219
Zr (.008)						
Cs (.005)	1.200	1.020		0.010	0.008	0.008
F (1.30)						
Cl (.015)						
N02						
N03(.040)	*	*	*	*	*	*
S04(.300)						

18A - 18 Angstrom Filtered Solution
 AS - Acid Strip
 UN - Unfiltered
 0.45μ - 45 microns Filtered Solution
 50A - 50 Angstrom Filtered Solution
 * - No Anion Analysis
 (a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST II DATA (GLASS AND ROCK),TUFF WATER

TEST PARAMETERS	TU83-II90-B14	TU83-II90-B28	TU83-II90-B56
DATE RUN BEGAN	26-JAN-83	26-JAN-83	26-JAN-83
DATE RUN ENDED	9-FEB-83	23-FEB-83	23-MAR-83
SPECIMEN SA mm2	194.800	200.410	224.390
PARTICLE SIZE	MONOLITH	MONOLITH	MONOLITH
SPECIMEN INI'L WT.(gm)	0.483	0.463	0.594
SPECIMEN FIN'L WT.(gm)	0.483	0.533	0.695
WEIGHT CHANGE(gm)	--	0.070	0.101
LEACHANT INI'L VOL.	19.490	19.490	22.470
LEACHANT FIN'L VOL.	19.090	19.450	21.080
VOLUME CHANGE	0.400	0.040	1.390
INI'L pH AT 23 C	7.310	7.310	7.310
FIN'L pH AT 23 C	9.100	9.100	9.140
SA/V	9.995	10.283	9.986
ELEMENTAL ANALYSIS	TU83-II90-B14	TU83-II90-B28	TU83-II90-B56
(DET.LIM)MG/LITER	18A	18A	18A
Al (.03)	1.620	0.664	0.442
As (.08)			
B (.01)	0.240	0.260	0.300
Ba (.002)	0.009		
Ca (.01)	7.500	4.800	7.500
Cd (.004)			
Ce (.04)			
Co (.01)			
Cr (.02)	0.025		
Cu (.004)	0.840	0.011	
Dy (.004)			
Eu (.002)			
Fe (.005)	0.500	0.013	0.018
Gd (.01)			
K (.3)	9.200	9.900	9.900
La (.008)		0.008	0.010
Li (.004)	0.057	0.056	0.059
Mg (.06)	0.200		0.080
Mn (.002)	0.130	0.005	
Mo (.01)	0.018	0.018	0.056
Na (.01)	53.000	58.000	58.800
Nd (.02)			
Ni (.02)	0.070		
P (.1)	0.200		0.100
Pb (.06)			
Ru (.05)			
Sb (.05)			
Si (.002)	35.000	39.000	39.000
Sr (.002)	0.096	0.046	0.071
Te (.06)			
Ti (.002)			
Zn (.02)	0.820	0.240	0.160
Zr (.008)			
Cs (.005)	0.053	0.007	0.019
F (1.30)			
Cl (.015)	*	*	*
NO2			
NO3(.040)			
SO4(.300)			

18A - 18 Angstrom Filtered Solution
AS - Acid Strip
UN - Unfiltered
0.45 μ - 45 microns Filtered Solution
50A - 50 Angstrom Filtered Solution
* - No Anion Analysis
(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST II DATA (GLASS AND ROCK), TUFF WATER

TEST PARAMETERS	TU83-II90-B56		TU83-II90-B91		TU83-II90-B182	
DATE RUN BEGAN	26-JAN-83		26-JAN-83		26-JAN-83	
DATE RUN ENDED	23-MAR-83		27-APR-83		28-JULY-83	
SPECIMEN SA mm2	224.390		242.367		242.388	
PARTICLE SIZE	MONOLITH		MONOLITH		MONOLITH	
SPECIMEN INI'L WT.(gm)	0.594		0.685		0.695	
SPECIMEN FIN'L WT.(gm)	0.695		0.687		--	
WEIGHT CHANGE(gm)	0.101		0.002		--	
LEACHANT INI'L VOL.	22.470		24.250		24.260	
LEACHANT FIN'L VOL.	21.430		23.030		22.590	
VOLUME CHANGE	1.040		1.220		1.670	
INI'L pH AT 23 C	7.310		7.310		7.310	
FIN'L pH AT 23 C	9.140		9.230		9.290	
SA/V	9.986		9.994		9.991	
ELEMENTAL ANALYSIS ^(a)	TU83-II90-B56		TU83-II90-B91		TU83-II90-B182	
(DET.LIM)MG/LITER	UN	AS	18A	UN	.45μ	18A
Al (.03)	0.422	2.580	0.388	0.375	0.200	0.230
As (.08)						
B (.01)	0.292		0.296	0.304	0.440	0.430
Ba (.002)		0.003	0.002			
Ca (.01)	7.680	1.640	6.810	7.720	8.300	6.700
Cd (.004)						
Ce (.04)						
Co (.01)						
Cr (.02)						
Cu (.004)	0.006	0.010	0.010	0.010		
Dy (.004)						
Eu (.002)						
Fe (.005)	0.002	0.323	0.012	0.040	0.012	0.014
Gd (.01)		0.005				
K (.3)	9.520	1.440	8.590	8.410	8.500	7.200
La (.008)	0.017	0.006		0.012		
Li (.004)	0.051		0.050	0.044	0.047	0.055
Mg (.06)						
Mn (.002)		0.016				
Mo (.01)	0.064	0.008	0.051	0.058	0.120	0.120
Na (.01)	61.000	1.110	51.800	52.600	51.000	51.000
Nd (.02)						
Ni (.02)						
P (.1)	0.06	0.058	0.095	0.081		
Pb (.06)		0.024				
Ru (.05)						
Sb (.05)						
Si (.02)	39.400	6.240	38.300	39.000	46.000	42.000
Sr (.002)	0.079		0.068	0.077	0.083	0.061
Te (.06)						
Ti (.002)						
Zn (.02)	0.009	0.033	0.119	0.058		0.440
Zr (.008)						
Cs (.005)	0.048		0.042	0.062	0.106	0.094
F (1.30)			5.100			6.100
Cl (.015)			9.300			9.700
N02						
N03 (.040)	*	*	26.000	*	*	23.000
S04 (.300)			22.000			23.000

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

0.45μ - 45 microns Filtered Solution

50A - 50 Angstrom Filtered Solution

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST II DATA (GLASS AND ROCK), TUFF WATER

TEST PARAMETERS	TU83-II90-B182		TU83-II90-C3	TU83-II90-C7	
DATE RUN BEGAN	26-JAN-83		22-FEB-83	22-FEB-83	
DATE RUN ENDED	27-JULY-83		25-FEB-83	1-MAR-83	
SPECIMEN SA mm2	242.388		2006.22	2000.26	
PARTICLE SIZE	MONOLITH		-40+80	-40+80	
SPECIMEN INI'L WT.(gm)	0.695		1.000	0.999	
SPECIMEN FIN'L WT.(gm)	--		--	--	
WEIGHT CHANGE(gm)	--		--	--	
LEACHANT INI'L VOL.	24.260		20.060	20.830	
LEACHANT FIN'L VOL.	22.710		19.940	20.600	
VOLUME CHANGE	1.550		0.120	0.230	
INI'L pH AT 23 C	7.310		7.310	7.310	
FIN'L pH AT 23 C	9.350		8.650	8.890	
SA/V	9.991		100.01	96.028	
ELEMENTAL ANALYSIS ^(a)	TU83-II90-B182		TU83-II90-C3	TU83-II90-C7	
(DET.LIM.)MG/LITER	50A	AS	18A	18A	AS
Al (.03)		0.120	0.086	0.138	1.300
As (.08)					
B (.01)	0.430	0.010	0.350	0.370	0.078
Ba (.002)		0.006			0.012
Ca (.01)	7.400	3.400	43.000	34.000	1.200
Cd (.004)					
Ce (.04)					
Co (.01)					
Cr (.02)					
Cu (.004)		0.016		0.010	
Dy (.004)					
Eu (.002)					
Fe (.005)	0.024	0.500			0.260
Gd (.01)					
K (.3)	8.500		33.000	34.000	0.700
La (.008)			0.090	0.080	0.080
Li (.004)	0.050	.006	0.074	0.079	
Mg (.06)		1.400	0.350	0.250	0.060
Mn (.002)		0.012	0.004		0.016
Mo (.01)	0.114		0.030	0.038	0.038
Na (.01)	51.000	0.100	58.000	76.000	0.850
Nd (.02)					0.027
Ni (.02)		0.066			
P (.1)				0.120	
Pb (.06)					
Ru (.05)					
Sb (.05)					
Si (.02)	45.000	3.290	40.000	45.000	3.600
Sr (.002)	0.072	0.024	0.430	0.380	0.012
Te (.06)					
Ti (.002)					0.050
Zn (.02)	0.200	1.200	0.410	.340	0.100
Zr (.008)					0.008
Cs (.005)	0.090	0.006	0.012	0.010	0.033
F (1.30)					
Cl (.015)					
NO2	*	*	*	*	*
NO3 (.040)					
SO4 (.300)					

18A - 18 Angstrom Filtered Solution
 AS - Acid Strip
 UN - Unfiltered
 0.45μ - 45 microns Filtered Solution
 50A - 50 Angstrom Filtered Solution
 * - No Anion Analysis
 (a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST II DATA (GLASS AND ROCK), TUFF WATER

TEST PARAMETERS	TU83-II90-C14		TU83-II90-C28			TU83-II90-C56	
DATE RUN BEGAN	22-FEB-83		22-FEB-83			22-FEB-83	
DATE RUN ENDED	8-MAR-83		22-MAR-83			19-APR-83	
SPECIMEN SA mm2	2039.63		1991.82			1996.92	
PARTICLE SIZE	-40+80		-40+80			-40+80	
SPECIMEN INI'L WT.(gm)	1.001		1.001			0.998	
SPECIMEN FIN'L WT.(gm)	--		--			--	
WEIGHT CHANGE(gm)	--		--			--	
LEACHANT INI'L VOL.	20.390		19.970			19.970	
LEACHANT FIN'L VOL.	20.240		19.700			19.440	
VOLUME CHANGE	0.150		0.270			0.530	
INI'L pH AT 23 C	7.310		7.310			7.310	
FIN'L pH AT 23 C	8.900		8.990			9.070	
SA/V	100.031		99.741			99.996	
ELEMENTAL ANALYSIS ^(a)	TU83-II90-C14		TU83-II90-C28			TU83-II90-C56	
(DET.LIM.)MG/LITER	18A	AS	18A	.45μ	AS	18A	.45μ
Al (.03)	0.180	1.630	0.090	0.136	3.680	0.136	0.817
As (.08)				0.086		0.017	0.035
B (.002)	0.410	0.027	0.420	0.416	0.018	0.441	0.447
Ba (.01)		0.005		0.001	0.003	0.003	0.001
Ca (.01)	42.000	0.790	39.000	40.300	1.600	33.500	36.000
Cd (.004)	0.005						0.001
Ce (.04)							
Co (.01)				0.001	0.010		0.007
Cr (.02)				0.004		0.006	0.007
Cu (.004)	0.024		0.010	0.009	0.008	0.012	0.013
Dy (.004)							
Eu (.002)							
Fe (.005)	0.007	0.130	0.012	0.007	0.220	0.052	0.072
Gd (.01)		0.020					
K (.3)	35.000	1.100	35.000	35.400	2.600	30.500	31.600
La (.008)	0.090	0.037	0.090	0.095		0.050	0.065
Li (.004)	0.079		0.082	0.084		0.082	0.074
Mg (.06)	0.330		0.150	0.114	0.130	0.118	0.131
Mn (.002)	0.003	0.011			0.027	0.001	0.010
Mo (.01)	0.046	0.013	0.040	0.047	0.010	0.041	0.045
Na (.01)	79.000	1.400	81.000	86.500	2.700	78.100	80.400
Nd (.02)							
Ni (.02)				0.004		0.004	0.004
P (.1)	0.180		0.200	0.197	0.100	0.239	0.180
Pb (.06)							
Ru (.05)							
Sb (.05)				0.021		0.005	0.005
Si (.02)	44.000	4.400	48.000	50.900	11.000	50.900	53.500
Sr (.002)	0.380	0.008	0.390	0.411	0.015	0.356	0.381
Te (.06)						0.002	0.007
Ti (.002)		0.023			0.021		0.002
Zn (.02)	0.290	0.040	0.390	0.007		0.350	0.022
Zr (.008)							
Cs (.005)	0.028	0.013	0.023	0.010		0.024	0.038
F (1.30)							
Cl (.015)							
N02	*	*	*	*	*	*	*
N03 (.040)							
S04 (.300)							

18A - 18 Angstrom Filtered Solution
 AS - Acid Strip
 UN - Unfiltered
 0.45μ - 45 microns Filtered Solution
 50A - 50 Angstrom Filtered Solution
 * - No Anion Analysis
 (a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST II DATA (GLASS AND ROCK),TUFF WATER

TEST PARAMETERS	TU83-II90-C56	TU83-II90-C91			TU83-II90-C182		
DATE RUN BEGAN	22-FEB-83	22-FEB-83			22-FEB-83		
DATE RUN ENDED	19-APR-83	24-MAY-83			9-AUG-83		
SPECIMEN SA mm2	1996.92	1987.50			2030.20		
PARTICLE SIZE	-40+80	-40+80			-40+80		
SPECIMEN INI'L WT.(gm)	0.998	1.002			1.001		
SPECIMEN FIN'L WT.(gm)	--	--			--		
WEIGHT CHANGE(gm)	--	--			--		
LEACHANT INI'L VOL.	19.970	21.080			21.000		
LEACHANT FIN'L VOL.	19.440	20.240			20.840		
VOLUME CHANGE	0.53	0.840			0.160		
INI'L pH AT 23 C	7.310	7.310			7.310		
FIN'L pH AT 23 C	9.070	9.210			9.210		
SA/V	99.996	94.284			96.676		
ELEMENTAL ANALYSIS ^(a)	TU83-II90-C56	TU83-II90-C91			TU83-II90-C182		
(DET.LIM)MG/LITER	AS	0.45 μ	18A	AS	0.45 μ	18A	50A
Al (.03)	1.110	0.234	0.143	0.879	0.09	0.130	
As (.08)	0.003	0.042	0.034				
B (.01)	0.008	0.492	0.466	0.024	0.493	0.480	0.500
Ba (.002)	0.002	0.012	0.001	0.004		0.006	
Ca (.01)	5.700	32.800	33.000	3.810	34.000	28.200	31.900
Cd (.004)	0.000	0.012	0.002				
Ce (.04)							
Co (.01)	0.001	0.002	0.005				
Cr (.02)	0.002	0.014	0.007	0.001			
Cu (.004)	0.001	0.008	0.016	0.005		0.014	
Dy (.004)							
Eu (.002)							
Fe (.005)	0.067	0.020	0.014	0.094	0.165	0.054	0.046
Gd (.01)							
K (.3)	0.602	30.800	30.600	0.413	32.000	28.000	30.700
La (.008)	0.020	0.044	0.039	0.029			
Li (.004)	0.001	0.076	0.072	0.001	0.820	0.070	0.084
Mg (.06)	0.023	0.166	0.065	0.005			
Mn (.002)	0.008	0.004	0.002	0.006			
Mo (.01)	0.011	0.050	0.049	0.002	0.450	0.038	0.040
Na (.01)	0.517	88.400	79.400	0.521	92.000	84.700	86.000
Nd (.02)							
Ni (.02)	0.001	0.010	0.006	0.001			
P (.1)		0.170	0.204		0.109		
Pb (.06)							
Ru (.05)			0.003				
SL (.05)		0.016	0.023				
Si (.02)	3.070	56.800	53.000	2.220	62.000	58.600	60.400
Sr (.002)	0.012	0.346	0.363	0.011	0.354	0.300	0.360
Te (.06)							
Ti (.002)	0.005			0.012			
Zn (.02)	0.017	2.180	0.025	0.036	0.005	0.800	0.240
Zr (.008)	0.001		0.001	0.001			
Cs (.005)	0.014	0.030	0.032	0.010	0.024	0.020	0.030
F (1.30)							
Cl (.015)							
NO2	*	*	*	*	*	*	*
NO3 (.040)							
SO4 (.300)							

18A - 18 Angstrom Filtered Solution
AS - Acid Strip
UN - Unfiltered
0.45 μ - 45 microns Filtered Solution
50A - 50 Angstrom Filtered Solution
* - No Anion Analysis
(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS
LEACH TEST II DATA (GLASS AND ROCK), TUFF WATER

TEST PARAMETERS	TU83-II90-D3	TU83-II90-D7	TU83-II90-D14	TU83-II90-D28
DATE RUN BEGAN	22-FEB-83	22-FEB-83	22-FEB-83	22-FEB-83
DATE RUN ENDED	25-FEB-83	1-MAR-83	3-MAR-83	22-MAR-83
SPECIMEN SA mm2	2018.58	1983.39	2005.68	2014.18
PARTICLE SIZE	-40+80	-40+80	-40+80	-40+80
SPECIMEN INI'L WT.(gm)	0.285	0.284	0.287	0.287
SPECIMEN FIN'L WT.(gm)	-	-	-	-
WEIGHT CHANGE(gm)	-	-	-	-
LEACHANT INI'L VOL.	20.190	19.860	20.190	20.150
LEACHANT FIN'L VOL.	20.130	19.780	20.040	19.87
VOLUME CHANGE	0.060	0.080	0.150	0.280
INI'L pH AT 23 C	7.310	7.310	7.310	7.310
FIN'L pH AT 23 C	8.60	8.90	9.150	9.220
SA/V	99.979	99.869	99.340	99.959
ELEMENTAL ANALYSIS(a)	TU83-II90-D3	TU83-II90-D7	TU83-II90-D14	TU83-II90-D28
(DET.LIM.)MG/LITER	18A	18A AS	18A AS	18A
Al (.03)	0.483	0.532 2.860	0.534 10.100	0.651
As (.08)			0.090	
B (.01)	0.280	0.300 0.220	0.320 0.330	0.490
Ba (.002)		0.035	0.071	
Ca (.01)	17.000	15.000 0.600	14.000 2.300	9.100
Cd (.004)				
Ce (.04)		0.054	0.094	
Co (.01)			0.014	
Cr (.02)		0.027	0.031	
Cu (.004)		0.010 0.007	0.011 0.005	0.017
Dy (.004)				
Eu (.002)				
Fe (.005)	0.007	0.580	1.100	0.012
Gd (.01)			0.042	
K (.3)	9.100	11.000 1.700	11.000 5.900	12.000
La (.008)	0.030	0.030 0.250	0.030 0.400	0.020
Li (.004)	0.049	0.055	0.058	0.060
Mg (.06)	1.300	0.490 0.130	0.350 0.440	
Mn (.002)	0.019	0.020	0.067	
Mo (.01)	0.040	0.045 0.090	0.050 0.140	0.070
Na (.01)	51.000	57.000 2.300	55.000 5.700	60.000
Nd (.02)		0.080	0.140	
Ni (.02)			0.020	
P (.1)	0.170	0.130 0.140	0.140	0.670
Pb (.06)				
Ru (.05)				
SB (.05)				
Si (.02)	33.000	35.000 9.100	34.000 25.000	38.000
Sr (.002)	0.120	0.110 0.027	0.110 0.048	0.099
Te (.06)				
Ti (.002)		0.130	0.240	
Zn (.02)	0.700	0.430 0.270	0.260 0.460	0.330
Zr (.008)		0.024	0.014	
Cs (.005)	0.048	0.051 0.099	0.062 0.170	0.089
F (.130)			3.400	
CL (.015)			15.200	
N02				
N03(.040)			19.000	
S04(.300)	*	*	26.000 *	*

18A - 18 Angstrom Filtered Solution
 AS - Acid Strip
 UN - Unfiltered
 0.45 μ - 45 microns Filtered Solution
 50A - 50 Angstrom Filtered Solution
 * - No Anion Analysis
 (a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS
LEACH TEST II DATA (GLASS AND ROCK), TUFF WATER

TEST PARAMETERS	TU83-II90-D28	TU83-II90-D56			TU83-II90-D91	
DATE RUN BEGAN	22-FEB-83	22-FEB-83			22-FEB-83	
DATE RUN ENDED	22-MAR-83	19-APR-83				
SPECIMEN SA mm2	2014.18	2006.11			2025.27	
PARTICLE SIZE	-40+80	-40+80			-40+80	
SPECIMEN INI'L WT.(gm)	0.287	0.288			0.289	
SPECIMEN FIN'L WT.(gm)	--	--			--	
WEIGHT CHANGE(gm)	--	--			--	
LEACHANT INI'L VOL.	20.150	20.060			20.290	
LEACHANT FIN'L VOL.	19.870	19.520			19.460	
VOLUME CHANGE	0.28	0.540			0.830	
INI'L pH AT 23 C	7.310	7.310			7.310	
FIN'L pH AT 23 C	9.220	9.220			9.300	
SA/V	99.959	100.005			99.816	
ELEMENTAL ANALYSIS	TU83-II90-D28	TU83-II90-056			TU83-II90-091	
(DET.LIM.)MG/LITER	.45 μ	18A	.45 μ	AS	.45 μ	50A
A1 (.03)	0.658	0.422	0.666	0.550	0.476	0.460
As (.08)	0.027		0.015		0.028	0.067
B (.01)	0.498	0.545	0.541	0.249	0.494	0.508
Ba (.002)	0.002	0.001	0.003	0.025	0.012	0.002
Ca (.01)	10.600	7.050	8.140	1.490	6.180	7.250
Cd (.004)	0.002		0.001	0.002	0.006	0.001
Ce (.04)				0.027		
Co (.01)	0.002					0.004
Cr (.02)	0.008	0.010	0.016	0.023	0.014	0.009
Cu (.004)	0.018	0.010	0.013	0.027	0.026	0.016
Dy (.004)						
Eu (.002)						
Fe (.005)	0.044	0.059	0.054	0.520	0.004	0.019
Gd (.01)						0.012
K (.3)	11.700	9.880	9.620	0.267	9.880	9.730
La (.008)	0.041	0.002	0.012	0.193		0.011
Li (.004)	0.053	0.050	0.044	0.001	0.048	0.048
Mg (.06)	0.164	0.115	0.112	0.031	0.088	0.104
Mn (.002)	0.005	0.001	0.005	0.015	0.002	0.002
Mo (.01)	0.078	0.125	0.133	0.073	0.112	0.111
Na (.01)	59.300	56.800	57.900	1.450	61.200	59.400
Nd (.02)	0.007			0.054		0.001
Ni (.02)	0.008		0.009	0.017	0.010	0.007
P (.1)	0.118	0.129	0.096		0.196	0.205
Pb (.06)				0.022		0.004
Ru (.05)						0.009
SB (.05)	0.021	0.001	0.006			0.031
Si (.02)	39.800	38.200	39.700	1.860	41.600	40.600
Sr (.002)	0.115	0.083	0.098	0.024	0.076	0.087
Te (.06)						0.009
Ti (.002)				0.079		0.001
Zn (.02)	0.050	0.182	0.051	0.205	0.184	0.016
Zr (.008)			0.016	0.039	0.026	0.002
Cs (.005)	0.033	0.100	0.148	0.062	0.082	0.125
F (.130)						
CL						
N02	*	*	*	*	*	*
N03(.040)						
S04(.300)						

18A - 18 Angstrom Filtered Solution
AS - Acid Strip
UN - Unfiltered
0.45 μ - 45 microns Filtered Solution
50A - 50 Angstrom Filtered Solution
* - No Anion Analysis
(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST II DATA (GLASS + ROCK), TUFF WATER

TEST PARAMETERS	TU83-II90-D91		TU83-II90-D182		TU83-II90D-3REP		
DATE RUN BEGAN	22-FEB-83		22-FEB-83		27-JUN-83		
DATE RUN ENDED	24-MAY-83		-AUG-83		30-JUN-83		
SPECIMEN SA mm2	1935.80		1906.37		2000.67		
PARTICLE SIZE	-40+80		-40+80		-40+80		
SPECIMEN INI'L WT.(gm)	0.289		0.285		0.299		
SPECIMEN FIN'L WT.(gm)	--		--		--		
WEIGHT CHANGE(gm)	--		--		--		
LEACHANT INI'L VOL.	20.290		20.340		20.000		
LEACHANT FIN'L VOL.	18.840		18.890		19.890		
VOLUME CHANGE	1.450		1.450		0.110		
INI'L pH AT 23 C	7.310		7.310		7.310		
FIN'L pH AT 23 C	9.300		9.400		8.750		
SA/V	99.816		93.725		100.033		
ELEMENTAL ANALYSIS(a)	TU83-II90-D91		TU83-II90-D182		TU83-II90D-3REP		
(DET.LIM)MG/LITER	18A	AS	UN	18A	UN	18A	50A
Al (.03)	0.416	2.520	0.250	0.192	0.200	0.450	0.630
As (.08)	0.040						
B (.01)	0.500	0.057	0.630	0.620	0.580	0.294	0.280
Ba (.002)	0.080	0.012			0.006		0.003
Ca (.01)	5.960	0.558	5.900	5.360	14.130	4.200	15.500
Cd (.004)							
Ce (.04)							
Co (.01)							
Cr (.02)							
Cu (.004)	0.018	0.005			0.012		0.005
Dy (.004)							
Eu (.002)							
Fe (.005)	0.158	0.228	0.074	0.044	0.054	0.045	0.031
Gd (.01)							
K (.3)	9.080	1.320	9.500	8.800	7.800	8.700	9.400
La (.008)	0.004	0.062					0.028
Li (.004)	0.056		0.049	0.058	0.050	0.075	0.084
Mg (.06)	0.142	0.089			0.120	0.480	0.480
Mn (.002)	0.004	0.015					0.005
Mo (.01)	0.186	0.022	0.150	0.132	0.144		0.026
Na (.01)	57.200	1.340	64.000	59.000	66.000	58.000	66.000
Nd (.02)							
Ni (.02)							
P (.1)	0.188						
Pb (.06)							
Ru (.05)							
Sb (.05)							
Si (.02)	38.400	6.460	49.000	48.000	44.000	33.600	33.400
Sr (.002)	0.070	0.010	0.085	0.074	0.054	0.087	0.102
Te (.06)							
Ti (.002)		0.037					
Zn (.02)	0.466	0.093		0.166	0.260	2.040	0.035
Zr (.008)							
Cs (.005)	0.050	0.047	0.098	0.128	0.162	0.057	0.054
F (.130)	5.400						
Cl (.015)	11.400						
NO2(.040)							
NO3(.300)	32.000	*	*	*	*	*	*
SO4	22.000						

18A - 18 Angstrom Filtered Solution
 AS - Acid Strip
 UN - Unfiltered
 0.45μ - 45 microns Filtered Solution
 50A - 50 Angstrom Filtered Solution
 * - No Anion Analysis
 (a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKATE TESTS LEACH TEST II DATA (GLASS + ROCK), TUFF WATER

TEST PARAMETERS	TU83-II90D-3REP	TU83-II90D-7REP	TU83-II90D-14REP
DATE RUN BEGAN	27-JUN-83	25-JUN-83	27-JUN-83
DATE RUN ENDED	30-JUN-83	5-JULY-83	11-JULY-83
SPECIMEN SA mm2	2000.67	2000.67	1993.98
PARTICLE SIZE	-40+80	-40+80	-40+80
SPECIMEN INI'L WT.(gm)	0.299	0.299	0.298
SPECIMEN FIN'L WT.(gm)	--	--	--
WEIGHT CHANGE(gm)	--	--	--
LEACHANT INI'L VOL.	20.000	20.000	20.000
LEACHANT FIN'L VOL.	19.890	19.750	19.66
VOLUME CHANGE	0.110	0.250	0.34
INI'L pH AT 23 C	7.310	7.310	7.310
FIN'L pH AT 23 C	8.750	9.000	9.100
SA/V	100.033	100.033	99.699
ELEMENTAL ANALYSIS ^(a) (DET.LIM.)MG/LITER	TU83-II90D-3REP AS	TU83-II90D-7REP 18A 0.45μ 50A AS	TU83-II90D-14REP 18A
Al (.03)	0.680	0.640 0.730 0.660 1.980	0.820
As (.08)			
B (.01)	0.189	0.440 0.430 0.440 0.670	0.340
Ba (.002)	0.032		0.115
Ca (.01)	0.290	6.940 8.400 7.080 4.970	5.280
Cd (.004)			0.009
Ce (.04)			0.190
Co (.01)			
Cr (0.2)	0.021		0.068
Cu (.004)	0.005	0.008 0.014	
Dy (.004)			
Eu (.002)			
Fe (.005)	0.531	0.030 0.257 0.024 1.600	0.260
Gd (.01)			
K (.3)	0.310	8.600 9.400 8.600 0.960	9.800
La (.008)	0.240		0.890
Li (.004)		0.050 0.050 0.048	0.080
Mg (.06)		0.130 0.104 0.160 0.120	0.156
Mn (.002)	0.008		0.023
Mo (.01)	0.078	0.038 0.047 0.060 0.287	0.048
Na (.01)	0.980	56.000 57.000 56.000 3.270	58.000
Nd (.02)	0.068		0.290
Ni (.02)			0.037
P (.1)			
Pb (.06)			0.140
Ru (.05)			
Sbn (.05)			
Si (.02)	3.260	34.000 34.800 34.600 8.770	36.000
Sr (.002)	0.024	0.062 0.082 0.070 0.088	0.054
Te (.06)			
Ti (.002)	0.115		0.413
Zn (.02)	0.250	0.560 0.027 0.580 0.866	0.090
Zr (.008)	0.054		0.044 0.087
Cs (.005)	0.084	0.220 0.201 0.216 0.230	0.184
F (.130)			
Cl (.015)			
No2 (.040)	*	*	*
No3 (.300)			
So4			

18A - 18 Angstrom Filtered Solution
 AS - Acid Strip
 UN - Unfiltered
 0.45μ - 45 microns Filtered Solution
 50A - 50 Angstrom Filtered Solution
 * - No Anion Analysis
 (a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST II DATA (GLASS + ROCK), TUFF WATER

TEST PARAMETERS	TU83-II90D-14REP			TU83-II90D-28REP			
DATE RUN BEGAN	27-JUN-83			27-JUN-83			
DATE RUN ENDED	11-JULY-83			25-JULY-83			
SPECIMEN SA mm2	1993.98			2000.67			
PARTICLE SIZE	-40+80			-40+80			
SPECIMEN INI'L WT.(gm)	0.298			0.299			
SPECIMEN FIN'L WT.(gm)	--			--			
WEIGHT CHANGE(gm)	--			--			
LEACHANT INI'L VOL.	20.00			20.020			
LEACHANT FIN'L VOL.	19.66			19.450			
VOLUME CHANGE	0.34			0.570			
INI'L pH AT 23 C	7.310			7.310			
FIN'L pH AT 23 C	9.100			9.210			
SA/V	99.699			99.933			
ELEMENTAL ANALYSIS ^(a)	TU83-II90D-14REP			TU83-II90D-28REP			
(DET.LIM)MG/LITER	50A	0.45μ	AS	18A	0.45μ	50A	AS
Al (.03)	0.750	0.880	1.840	0.600	0.520	0.600	9.310
As (.08)							
B (.01)	0.310	0.360	0.470	0.420	0.430	0.420	0.430
Ba (.002)			0.076				0.068
Ca (.01)	6.200	7.000	4.860	3.600	4.500	4.200	3.400
Cd (.004)			0.005				0.006
Ce (.04)			0.040				0.110
Co (.01)							0.010
Cr (0.2)			0.040	0.026			0.040
Cu (.004)							0.021
Dy (.004)							
Eu (.002)							
Fe (.005)	0.258	0.138	1.120	0.026	0.021	0.048	1.300
Gd (.01)							0.020
K (.3)	9.200	11.000	0.800	8.000	9.800	8.200	5.600
La (.008)			0.540				0.460
Li (.004)	0.069	0.078		0.048	0.052	0.054	0.006
Mg (.06)							0.390
Mn (.002)			0.022				0.067
Mo (.01)	0.038	0.038	0.180	0.026	0.042	0.036	0.160
Na (.01)	59.000	70.000	2.300	54.000	54.000	56.000	6.100
Nd (.02)			0.140				0.160
Ni (.02)							0.020
P (.1)	0.140				0.100		0.110
Pb (.06)							
Ru (.05)							
Sb (.05)							
Si (.02)	36.000	44.000	7.300	36.000	41.000	36.000	26.000
Sr (.002)	0.075	0.078	0.060	0.036	0.058	0.046	0.057
Te (.06)							
Ti (.002)			0.270				0.250
Zn (.02)	0.020	0.280	0.580	0.260		0.168	0.500
Zr (.008)			0.053				0.027
Cs (.005)	0.068	0.092	0.188	0.044	0.016	0.048	0.190
F (.130)				2.600			
Cl (.015)				9.400			
No2 (.040)	*	*	*		*	*	*
No3 (.300)				25.000			
So4				22.000			

18A - 18 Angstrom Filtered Solution
AS - Acid Strip
UN - Unfiltered
0.45μ - 45 microns Filtered Solution
50A - 50 Angstrom Filtered Solution
* - No Anion Analysis
(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST II DATA (GLASS AND ROCK), TUFF WATER

TEST PARAMETERS	TU83-II90-E3		TU83-II90-E7		TU83-II90-E14
DATE RUN BEGAN	25-FEB-83		23-FEB-83		23-FEB-83
DATE RUN ENDED	28-FEB-83		2-MAR-83		9-MAR-83
SPECIMEN SA mm2	8002.858		8002.858		8002.858
PARTICLE SIZE	-100+200		-100+200		-100+200
SPECIMEN INI'L WT.(gm)	0.448		0.448		0.448
SPECIMEN FIN'L WT.(gm)	---		---		---
WEIGHT CHANGE(gm)	---		---		---
LEACHANT INI'L VOL.	20.270		20.200		20.200
LEACHANT FIN'L VOL.	20.190		19.430		19.540
VOLUME CHANGE	0.080		0.770		0.660
INI'L pH AT 23 C	7.310		7.310		7.310
FIN'L pH AT 23 C	8.440		8.880		8.820
SA/V	394.813		396.181		396.181
ELEMENTAL ANALYSIS(a)	TU83-II90-E3		TU83-II90-E7		TU83-II90-E14
(DET.LIM.)MG/LITER	18A	AS	18A	AS	18A
Al (.03)		0.183	0.052	3.500	0.065
As (.08)	0.067		0.120	0.011	0.120
B (.01)	0.888	0.120	1.100	0.237	1.000
Ba (.002)	0.012	0.017	0.015	0.039	0.011
Ca (.01)	131.000	1.000	150.500	0.924	
Cd (.004)				0.001	
Ce (.04)				0.064	
Co (.01)			0.010	0.027	
Cr (.02)	0.002	0.024		0.024	
Cu (.004)	0.007		0.027	0.006	0.020
Dy (.004)					
Eu (.002)	0.001				
Fe (.005)		0.340	0.080	0.694	0.010
Gd (.01)				0.025	
K (.3)	80.700		90.000	2.090	90.000
La (.008)	0.234	0.130	0.270	0.270	0.230
Li (.004)	0.135		0.150		0.150
Mg (.06)	0.621		0.210	0.113	0.150
Mn (.002)		0.010		0.044	
Mo (.01)	0.087	0.050	0.140	0.094	0.120
Na (.01)	100.000	0.430	175.000	2.580	170.000
Nd (.02)		0.039	0.075	0.086	0.060
Ni (.02)				0.011	
P (.1)	0.223	0.130	0.320	0.084	0.300
Pb (.06)				0.032	
Ru (.05)				0.004	
Sb (.05)	0.003				
Si (.02)	47.400	0.930	55.000	10.900	60.000
Sr (.002)	1.680	0.016	1.800	0.034	0.700
Te (.06)				0.007	
Ti (.002)		0.067	0.022	0.146	
Zn (.02)	0.717	0.140	0.230	0.298	0.360
Zr (.008)		0.033	0.014	0.055	
Cs (.005)	0.022	0.039	0.032	0.112	0.030
F (.130)					
Cl (.015)					
NO ₂					
NO ₃ (.040)	*	*	*	*	*
SO ₄ (.300)					

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST II DATA (GLAS + ROCK), TUFF WATER

TEST PARAMETERS	TU83-II90-E28			TU83-II90-E56			
DATE RUN BEGAN	23-FEB-83			23-FEB-83			
DATE RUN ENDED	23-MAR-83			20-APR-83			
SPECIMEN SA mm2	8003.57			8003.57			
PARTICLE SIZE	-100+200			-100+200			
SPECIMEN INI'L WT.(gm)	0.448			0.448			
SPECIMEN FIN'L WT.(gm)	--			--			
WEIGHT CHANGE(gm)	--			--			
LEACHANT INI'L VOL.	20.200			20.200			
LEACHANT FIN'L VOL.	18.35			18.69			
VOLUME CHANGE	1.850			1.51			
INI'L pH AT 23°C	7.310			7.310			
FIN'L pH AT 23°C	9.106			9.030			
SA/V	396.216			399.216			
ELEMENTAL ANALYSIS(a) (DET.LIM.)MG/LITER	TU83-II90-E28			TU83-II90-E56			
	.45μ	18A	AS	AS	UN	50A	18A
Al (.03)	0.054	0.084	0.462	0.759	0.087		0.053
As (.08)	0.148		0.003	0.006	0.122	0.119	0.094
B (.01)	1.120	1.110	0.174	0.126	1.700	1.330	1.70
Ba (.002)	0.010	0.010	0.018	0.010	0.010	0.008	0.012
Ca (.01)	138.000	130	0.452	0.550	136.000	127.000	123.000
Cd (.004)	0.004		0.003	0.001	0.002	0.005	0.003
Ce (.04)	0.020		0.025	0.006		0.012	
Co (.01)	0.016	0.010	0.008	0.003	0.012	0.019	0.011
Cr (.02)	0.013	0.030	0.013	0.010	0.013	0.020	0.015
Cu (.004)	0.024	0.028	0.022	0.011	0.022	0.026	0.025
Dy (.004)							
Eu (.002)	0.003				0.002	0.003	
Fe (.005)	0.007	0.110	0.129	0.241	0.024	0.034	0.058
Gd (.01)							
K (.3)	88.600	90.000	0.205	0.330	85.000	77.300	78.000
La (.008)	0.272	0.230	0.161	0.073	0.180	0.051	0.157
Li (.004)	0.149	0.150	0.002		0.154	0.147	0.160
Mg (.06)	0.124	0.190	0.051	0.029	0.055	0.087	0.102
Mn (.002)		0.006	0.024	0.016		0.002	
Mo (.01)	0.153	0.140	0.053	0.031	0.275	0.156	0.277
Na (.01)	195.000	200	0.992	0.703	199.000	189.000	189.000
Nd (.02)	0.045	0.030	0.050	0.018	0.017	0.042	0.006
Ni (.02)	0.007		0.009	0.008	0.006	0.012	0.008
P (.1)	0.447	0.490	0.041		0.392	0.479	0.442
Pb (.06)	0.025		0.035	0.018		0.043	
Ru (.05)	0.021		0.002		0.004	0.019	0.002
Sb (.05)	0.057		.012		0.049	0.060	0.050
Si (.02)	69.800	67.000	1.320	2.21	73.300	65.100	67.000
Sr (.002)	1.780	1.700	0.019	0.011	1.690	1.790	1.69
Te (.06)	0.036				0.019	0.029	0.018
Ti (.002)	0.003		0.062	0.03		0.009	
Zn (.02)	0.062	0.660	0.177	0.09	0.021	0.033	0.453
Zr (.008)			0.017	0.014		0.005	0.014
Cs (.005)	0.022	0.031	0.049		0.110	0.044	
F (.130)							
Cl (.015)							
NO ₂ (.040)							
NO ₃ (.300)							
SO ₄	*	*	*	*	*	*	*

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

.45μ - 45 microns Filtered Solution

50A - 50 Angstrom Filtered Solution

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST II DATA (GLASS AND ROCK), TUFF WATER

TEST PARAMETERS	TU83-II150-3	TU83-II150-7		TU83-II150-14		TU83-II150-28	
DATE RUN BEGAN	31-JAN-83	31-JAN-83		31-JAN-83		31-JAN-83	
DATE RUN ENDED	3-FEB-83	7-FEB-83		14-FEB-83		28-FEB-83	
SPECIMEN SA mm2	165.120	140.470		141.978		153.627	
PARTICLE SIZE	MONOLITH	MONOLITH		MONOLITH		MONOLITH	
SPECIMEN INI'L WT.(gm)	.233 27	0.282		0.280		0.310	
SPECIMEN FIN'L WT.(gm)	---	---		---		---	
WEIGHT CHANGE(gm)	---	---		---		---	
LEACHANT INI'L VOL.	16.510	14.050		14.980		15.360	
LEACHANT FIN'L VOL.	16.500	13.860		14.970		15.320	
VOLUME CHANGE	0.010	0.190		0.010		0.040	
INI'L pH AT 23°C	7.310	7.310		7.310		7.310	
FIN'L pH AT 23°C	8.280	8.830		8.890		9.100	
SA/V	10.007	9.998		9.478		10.002	
ELEMENTAL ANALYSIS(a)	TU83-II150-3		TU83-II150-7		TU83-II150-14		TU83-II150-28
(DET.LIM.)MG/LITER	18A	AS	18A	AS	18A	AS	18A
Al (.03)	0.511	0.244	0.675	0.127	0.389	0.216	0.458
As (.08)	0.018	0.024	0.040	0.022	0.014		
B (.01)	5.390	0.051	5.000	0.213	13.400	0.107	16.000
Ba (.002)	0.036	0.005	0.007	0.002	0.022	0.002	0.018
Ca (.01)	3.160	0.950	1.810	1.590	2.540	0.204	1.800
Cd (.004)	0.003	0.003	0.002		0.002	0.001	
Ce (.04)				0.005			
Co (.01)			0.001		0.006		
Cr (.02)	0.119	0.005	0.057	0.008	0.139	0.041	0.320
Cu (.004)	0.010	0.423	0.018	0.022	0.067	0.502	0.008
Dy (.004)	0.002	0.001		0.002			
Eu (.002)							
Fe (.005)	0.019	0.270	0.021	0.025	1.860	0.382	0.030
Gd (.01)	0.024						0.050
K (.3)	7.880	0.068	5.510	0.514	9.950		9.500
La (.008)	0.008	0.010	0.003	0.005		0.002	
Li (.004)	0.049	0.002	0.038	0.005	0.059		0.056
Mg (.06)	0.090	0.922	0.060	0.159	0.007	0.530	0.060
Mn (.002)		0.003	0.002		0.117	0.008	
Mo (.01)	2.320	0.021	1.000	0.090	4.640	0.038	6.600
Na (.01)	59.000	0.563	85.000	3.870	100.000	1.100	110.000
Nd (.02)							
Ni (.02)	0.007	0.023	0.005		0.768	0.046	
P (.1)	0.034	0.070	0.121	0.021	0.063	0.045	
Pb (.06)		0.027		0.006		0.046	
Ru (.05)	0.006	0.002	0.007	0.008			
Sb (.05)	0.043	0.005	0.032		0.063	0.007	
Si (.02)	66.300	1.700	82.000	6.420	113.000	1.850	150.000
Sr (.002)	0.142	0.010	0.050	0.016	0.138	0.007	
Te (.06)	0.008		0.001				
Ti (.002)	0.002	0.002	0.001	0.002		0.001	0.007
Zn (.02)	0.480	0.438	0.825	0.048	0.489	0.746	0.740
Zr (.008)	0.003	0.002	0.001	0.002			
Cs (.005)	1.800	0.023	1.500	0.071	3.200	0.039	4.280
F (.130)							
Cl (.015)	*	*	*	*	*	*	*
NO ₂							
NO ₃ (.040)							
SO ₄ (.300)							

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST II DATA (GLASS AND ROCK), TUFF WATER

TEST PARAMETERS	TU83-II150-28	TU83-II150-56				TU83-II150-91
DATE RUN BEGAN	31-JAN-83	6-APR-83				6-APR-83
DATE RUN ENDED	28-FEB-83	1-JUN-83				6-JULY-83
SPECIMEN SA mm2	153.627	141.620				152.470
PARTICLE SIZE	MONOLITH	MONOLITH				MONOLITH
SPECIMEN INI'L WT.(gm)	0.310	0.261				0.303
SPECIMEN FIN'L WT.(gm)	--	--				0.3016
WEIGHT CHANGE(gm)		--				0.0014
LEACHANT INI'L VOL.	15.360	14.620				15.250
LEACHANT FIN'L VOL.	15.320	13.920				13.080
VOLUME CHANGE	0.040	0.700				2.170**excess mass loss
INI'L pH AT 23 C	7.310	7.310				7.310
FIN'L pH AT 23 C	9.100	9.270				9.210
SA/V	10.002	9.687				9.998
ELEMENTAL ANALYSIS ^(a)	TU83-II150-28	TU83-II150-56				TU83-II150-91
(DET.LIM.)MG/LIT	AS	0.45 _μ	18A	50A	AS	18A
Al (.03)	0.205	0.480	0.360	0.360	0.150	0.360
As (.08)						
B (.01)	0.013	13.600	12.480	12.600		12.440
Ba (.002)		0.012		0.008		0.008
Ca (.01)	0.180	3.000	0.940	1.480	1.050	1.680
Cd (.004)						
Ce (.04)						
Co (.01)						
Cr (.02)	0.000	0.166	0.142	0.144		0.320
Cu (.004)	0.150	0.078	0.026	0.014	0.046	0.024
Dy (.004)						
Eu (.002)	0.000					
Fe (.005)	0.170	0.260	0.028	0.072	0.210	0.212
Gd (.01)						
K (.3)		8.200	8.200	8.200		8.600
La (.008)						
Li (.004)		0.050	0.048	0.050		0.056
Mg (.06)	0.500	0.560			0.460	
Mn (.002)	0.004					
Mo (.01)		2.900	2.580	2.660		4.940
Na (.01)	0.180	76.000	74.000	74.000	0.050	106.000
Nd (.02)						
Ni (.02)						
P (.01)						
Pb (.06)						
Ru (.05)						
Sb (.05)						
Si (.02)	0.870	158.000	142	144	1.570	148.000
Sr (.002)	0.005	0.082	0.020	0.048	0.006	0.062
Te (.06)						
Ti (.002)						
Zn (.02)	0.720	0.460	0.480	0.340	0.360	0.420
Zr (.008)		0.016				
Cs (.005)	0.012	1.780	1.560	1.560		2.800
F (1.30)		1.800				
Cl (.015)		5.500				
NO2	*	0.200	*	*	*	*
NO3 (.040)		6.700				
SO4 (.300)		9.000				

18A - 18 Angstrom Filtered Solution
 AS - Acid Strip
 UN - Unfiltered
 0.45_μ - 45 microns Filtered Solution
 50A - 50 Angstrom Filtered Solution
 * - No Anion Analysis
 (a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TEST
LEACH TEST DATA FOR TEST III (GLASS, ROCK AND METAL)
40, 70, 90, 150°C, STATIC

TEST PARAMETERS	TU83-III40-3		TU83-III40-7		TU83-III40-14		TU83-III40-28
DATE RUN BEGAN	22-FEB-83		25-JAN-83		25-JAN-83		25-JAN-83
DATE RUN ENDED	25-FEB-83		1-FEB-83		8-FEB-83		22-FEB-83
SPECIMEN SA mm2	189.799		185.600		191.000		191.400
PARTICLE SIZE	MONOLITH		MONOLITH		MONOLITH		MONOLITH
SPECIMEN INI'L WT.(gm)			0.374		0.405		0.425
SPECIMEN FIN'L WT.(gm)	0.459		0.375		0.406		0.468
WEIGHT CHANGE(gm)							-0.043
LEACHANT INI'L VOL.	18.980		18.560		19.100		19.140
LEACHANT FIN'L VOL.	18.980		18.410		19.090		19.120
VOLUME CHANGE			0.150		0.010		0.020
INI'L pH AT 23 C	7.310		7.310		7.310		7.310
FIN'L pH AT 23 C	7.510		7.690		8.200		8.250
SA/V	9.999		10.000		10.000		10.000
ELEMENTAL ANALYSIS(a)	TU83-III40-3		TU83-III40-7		TU83-III40-14		TU83-III40-28
(DET.LIM)MG/L	18A	AS	18A	AS	18A	AS	18A
Al (.03)		0.000		0.035	0.030	0.034	
As (.08)							
B (.01)	0.100	0.012	0.170	0.032	0.180	0.024	0.190
Ba (.002)	0.003			0.002	0.005		0.004
Ca (.01)	11.700	0.400	11.600	0.996	12.000	0.176	11.900
Cd (.004)						0.004	
Ce (.04)							
Co (.01)							
Cr (.02)					0.140		
Cu (.004)		0.026	0.012	0.046	0.008	0.049	0.006
Dy (.004)							
Eu (.0020)							
Fe (.005)		0.087	0.009	0.338	0.530	0.246	0.053
Gd (.01)							
K (.3)	6.400		7.200	0.347	7.300		6.700
La (.008)	0.013		0.087	0.012	0.008		
Li (.004)	0.054		0.053	0.008	0.055		0.049
Mg (.06)	1.800	0.060	1.850	0.161	1.900		1.820
Mn (.002)	0.013		0.023	0.011	0.038	0.003	0.023
Mo (.01)	0.010		0.017	0.019	0.025		0.024
Na (.01)	50.000	1.100	46.000	3.310	46.000	0.029	46.000
Nd (.02)							
Ni (.02)				0.030	0.080	0.263	
P (.1)			0.100				
Pb (.06)							
Ru (.05)							
Sb (.05)							
Si (.02)	28.000	0.720	28.000	0.220	28.500	0.167	28.000
Sr (.002)	0.045		0.043	0.005	0.045		0.047
Te (.06)							
Ti (.002)		0.011		0.002			
Zn (.02)	0.860	0.079	0.850	0.033	0.660	0.044	0.720
Zr (.008)							
Cs (.005)	0.007	0.005					0.010
F (.130)							
CL (.015)							
N02	*	*	*	*	*	*	*
N03(.040)							
S04(.300)							
P04							

18A - 18 Angstrom Filtered Solution
AS - Acid Strip
UN - Unfiltered
0.45μ - 45 microns Filtered Solution
50A - 50 Angstrom Filtered Solution
* - No Anion Analysis
(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA (GLASS, ROCK AND METAL), TUFF WATER
40,70,90,150°C, STATIC

TEST PARAMETERS	TU83-III40-28	TU83-III40-56			TU83-III40-91		
DATE RUN BEGAN	25-JAN-83	28-JAN-83			28-JAN-83		
DATE RUN ENDED	22-FEB-83	25-FEB-83			29-APR-83		
SPECIMEN SA mm2	191.400	240.710			240.710		
PARTICLE SIZE	MONOLITH	MONOLITH			MONOLITH		
SPECIMEN INI'L WT.(gm)	0.425	0.695			0.687		
SPECIMEN FIN'L WT.(gm)	0.468	0.694			0.687		
WEIGHT CHANGE(gm)	-0.043	0.001			-0.000		
LEACHANT INI'L VOL.	19.140	24.590			24.070		
LEACHANT FIN'L VOL.	19.120	24.560			24.070		
VOLUME CHANGE	0.020	0.030			0.000		
INI'L pH AT 23 C	7.310	7.310			7.310		
FIN'L pH AT 23 C	8.250	8.140			8.580		
SA/V	10.010	9.790			10.000		
ELEMENTAL ANALYSIS(a)	TU83-III40-28	5783-III40-56			TU83-III40-91		
(DET.LIM)MG/LITER	AS	18A	UN	AS	18A	UN	AS
Al (.03)		0.036	0.023	0.016	0.030	0.006	0.003
As (.08)		0.021	0.047		0.022	0.051	
B (.01)	0.019	0.310	0.307	0.005	0.270	0.274	0.005
Ba (.002)		0.013	0.014		0.007	0.006	
Ca (.01)	0.500	14.700	16.100	0.092	11.500	12.000	0.068
Cd (.004)		0.001	0.001	0.001	0.001	0.001	
Ce (.04)							
Co (.01)							
Cr (.02)			0.003	0.001	0.004	0.002	
Cu (.004)	0.042	0.010	0.011	0.022	0.006	0.003	0.033
Cy (.004)							
Eu (.002)							
Fe (.005)	0.077	0.006	0.001	0.436	0.037	0.001	0.029
Gd (.01)							
K (.3)		8.120	7.890		6.170	6.500	
La (.008)		0.032	0.041	0.001	0.016	0.021	
Li (.004)		0.047	0.051		0.049	0.044	0.001
Mg (.06)	0.060	2.070	2.260	0.011	1.760	1.860	
Mn (.002)	0.003	0.028	0.030	0.003	0.016	0.014	0.001
Mo (.01)		0.073	0.082		0.056	0.061	
Na (.01)	1.600	51.700	51.600	0.114	44.700	48.000	0.126
Nd (.02)							
Ni (.02)		0.006	0.007	0.022	0.002	0.002	0.045
P (.1)		0.052			0.046	0.022	
Pb (.06)							
Ru (.05)							
Sb (.05)			0.013			0.005	
Si (.02)	0.980	29.900	30.900	0.114	28.000	29.000	0.280
Sr (.002)		0.113	0.125	0.002	0.055	0.058	
Te (.06)							
Ti (.002)	0.011						
Zn (.02)	0.024	0.763	0.008	0.020	0.341	0.013	0.015
Zr (.008)							
Cs (.005)	0.005	0.040	0.017	0.005	0.026	0.012	
F (1.30)						2.500	
Cl (.015)						8.000	
NO3(.040)	*	*	*	*	*	10.000	*
SO4(.300)						18.000	

18A - 18 Angstrom Filtered Solution
AS - Acid Strip
UN - Unfiltered
0.45 μ - 45 microns Filtered Solution
50A - 50 Angstrom Filtered Solution
* - No Anion Analysis
(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA (GLASS, ROCK AND METAL), TUFF WATER
40,70,90,150°C, STATIC

TEST PARAMETERS	TU83-III40-182				TU83-III70-3		TU83-III70-7	
DATE RUN BEGAN	28-JAN-83				22-FEB-83		25-JAN-83	
DATE RUN ENDED	29-JULY-83				25-FEB-83		1-FEB-83	
SPECIMEN SA mm2	237.810				192.361		187.400	
PARTICLE SIZE	MONOLITH				MONOLITH		MONOLITH	
SPECIMEN INI'L WT.(gm)	0.455				---		0.389	
SPECIMEN FIN'L WT.(gm)	---				0.473		0.389	
WEIGHT CHANGE(gm)	---				---		---	
LEACHANT INI'L VOL.	23.780				19.240		18.740	
LEACHANT FIN'L VOL.	---				19.200		18.670	
VOLUME CHANGE	---				0.040		0.070	
INI'L pH AT 23 C	7.310				7.310		7.310	
FIN'L pH AT 23 C	8.580				7.660		8.460	
SA/V	10.000				9.998		10.000	
ELEMENTAL ANALYSIS ^(a)	TU83-III40-182				TU83-III70-3		TU83-III70-7	
(DET.LIM.)MG/LITER	18A	UN	50A	AS	18A	AS	18A	
Al (.03)					0.101	0.059	0.070	
As (.08)	0.110							
B (.01)	0.280	0.280	0.280		0.208	0.030	0.220	
Ba (.002)	0.007	0.120	0.016		0.004	0.004	0.005	
Ca (.01)	13.000	14.000	12.200	0.039	11.300	0.477	11.100	
Cd (.004)								
Ce (.04)								
Co (.01)								
Cr (.02)								
Cu (.004)		0.008		0.018	0.009	0.039	0.016	
Dy (.004)								
Eu (.002)								
Fe (.005)	0.008	0.014	0.020	0.039		0.249	0.016	
Gd (.01)								
K (.3)	6.000	5.900	6.000		6.380		7.400	
La (.008)						0.008	0.080	
Li (.004)	0.042	0.041	0.050		0.051		0.055	
Mg (.06)	1.700	1.800	1.660		1.760		1.650	
Mn (.002)		0.003			0.002	0.007	0.000	
Mo (.01)	0.056	0.063	0.060		0.021		0.035	
Na (.01)	45.000	47.000	50.000	0.047	52.500	1.390	47.000	
Nd (.02)								
Ni (.02)								
P (.1)					0.003			
Pb (.06)								
Ru (.05)								
Sb (.05)								
Si (.02)	28.000	28.000	28.000	0.250	29.500	1.050	28.500	
Sr (.002)	0.063	0.071	0.062		0.046	0.004	0.046	
Te (.06)								
Ti (.002)						0.021		
Zn (.02)	0.610		1.200		0.674	0.063	0.400	
Zr (.008)								
Cs (.005)	0.026	0.032	0.020		0.022	0.009	0.019	
F (.130)		3.500						
Cl (.015)		8.800						
NO ₂								
NO ₃ (.040)	*	6.400	*	*	*	*	*	
SO ₄ (.300)		19.000						
PO ₄								

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

50A - 50 Angstrom Filtered Solution

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA (GLASS, ROCK AND METAL), TUFF WATER
40,70,90,150°C, STATIC

TEST PARAMETERS	TU83-III70-7	TU83-III70-14		TU83-III70-28		TU83-III70-56	
DATE RUN BEGAN	25-JAN-83	25-JAN-83		26-JAN-83		28-JAN-83	
DATE RUN ENDED	1-FEB-83	8-FEB-83		23-FEB-83		25-MAR-83	
SPECIMEN SA mm2	187.400	189.100		192.630		238.800	
PARTICLE SIZE	MONOLITH	MONOLITH		MONOLITH		MONOLITH	
SPECIMEN INI'L WT.(gm)	0.389	0.403		0.468		0.688	
SPECIMEN FIN'L WT.(gm)	0.389	0.403		0.469		0.688	
WEIGHT CHANGE(gm)	---					-0.000	
LEACHANT INI'L VOL.	18.740	18.910		19.260		23.880	
LEACHANT FIN'L VOL.	18.670	18.840		19.230		23.730	
VOLUME CHANGE	0.070	0.070		0.030		0.150	
INI'L pH AT 23 C	7.310	7.310		7.310		7.310	
FIN'L pH AT 23 C	8.460	8.720		8.780		8.840	
SA/V	10.000	10.000		10.002		10.000	
ELEMENTAL ANALYSIS ^(a) (DET.LIM)MG/LITER	TU83-III-70-7 AS	TU83-III70-14 18A AS		TU83-III70-28 18A AS		TU83-III70-56 18A UN	
Al (.03)		0.050				0.043	
As (.08)							
B (.01)	0.022	0.350		0.713	0.016	1.140	1.160
Ba (.002)		0.011		0.016		0.022	0.025
Ca (.01)	0.572	11.000 0.056		8.270	0.320	8.990	10.400
Cd (.004)							
Ce (.04)							
Co (.01)							
Cr (.02)							
Cu (.004)	0.026	0.005 0.012		0.065			
Dy (.004)							
Eu (.002)							
Fe (.005)	0.083	0.024 0.142		0.157			
Gd (.01)						0.018	
K (.3)		7.400		6.480		8.500	
La (.008)	0.009	0.014				0.017	
Li (.004)	0.007	0.050		0.051		0.047	
Mg (.06)	0.096	1.400 0.012		0.342 0.210		0.505	
Mn (.002)	0.007	0.002		0.093 0.013		0.586	
Mo (.01)		0.096		0.229		0.439	
Na (.01)	1.620	46.000 0.027		50.000 0.844		50.500	
Nd (.02)						53.100	
Ni (.02)				0.105 0.023			
P (.1)						0.101	
Pb (.06)	0.016						
Ru (.05)						0.004	
Sb (.05)							
Si (.02)	1.190	30.000 0.084		30.400 0.952		35.200	
Sr (.002)	0.003	0.058		0.073 0.002		0.099	
Te (.06)						0.116	
Ti (.002)	0.002						
Zn (.02)	0.030	0.270 0.025		0.387 0.102		0.234	
Zr (.008)		0.025					
Cs (.005)		0.059		0.076		0.340	
F (.130)						0.350	
Cl (.015)							
NO ₂							
NO ₃ (.040)	*	*	*	*	*	*	*
SO ₄ (.300)							
PO ₄							

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA (GLASS, ROCK AND METAL), TUFF WATER
40,70,90,150°C, STATIC

TEST PARAMETERS	TU83-III70-56	TU83-III70-91	TU83-III70-182
DATE RUN BEGAN	28-JAN-83	28-JAN-83	28-JAN-83
DATE RUN ENDED	25-MAR-83	29-APR-83	29-JUL-83
SPECIMEN SA mm2	238.800	238.040	250.790
PARTICLE SIZE	MONOLITH	MONOLITH	MONOLITH
SPECIMEN INI'L WT.(gm)	0.688	0.693	0.726
SPECIMEN FIN'L WT.(gm)	0.688	0.692	--
WEIGHT CHANGE(gm)	-0.000	0.002	--
LEACHANT INI'L VOL.	23.880	23.800	25.080
LEACHANT FIN'L VOL.	23.730	23.530	24.59
VOLUME CHANGE	0.150	0.270	0.49
INI'L pH AT 23 C	7.310	7.310	7.310
FIN'L pH AT 23 C	8.840	8.930	8.990
SA/V	10.000	10.002	9.996

(A)

ELEMENTAL ANALYSIS (DET. LIM) MG/LITER	TU83-III70-56	TU83-III70-91			TU83-III70-182		
	AS	18A	UN	AS	18A	UN	50A
Al (.03)	0.006	0.037	0.010	0.097	0.026		0.070
As (.08)		0.011	0.039		0.044		
B (.01)	0.002	2.230	2.160	0.145	3.200	3.300	3.300
Ba (.002)	0.001	0.023	0.024	0.001	0.016	0.022	0.022
Ca (.01)	0.064	5.960	6.420	0.251	3.780	4.700	4.100
Cd (.004)			0.001				
Ce (.04)							
Co (.01)							
Cr (.02)	0.001	0.039	0.041		0.065	0.063	0.064
Cu (.004)	0.008	0.004	0.005	0.019			
Dy (.004)							
Eu (.002)							
Fe (.005)	0.062	0.019	0.001	0.206		0.022	0.024
Gd (.01)			0.010				
K (.3)		6.900	7.670	0.019	6.98	7.600	7.600
La (.008)		0.002	0.013				
Li (.004)		0.050	0.044	0.002	0.042	0.050	0.050
Mg (.06)	0.060	0.169	0.188	0.282	0.070	0.070	0.070
Nn (.002)	0.001			0.002			
Mo (.01)	0.009	0.903	0.957	0.018	1.370	1.400	1.400
Na (.01)	0.057	49.700	56.000	1.190	60.000	57.100	60.000
Nd (.02)							
Ni (.02)	0.008	0.002	0.003	0.025			
P (.1)		0.022			0.036		0.100
Pb (.06)							
Ru (.05)							
Sb (.05)			0.020				
Si (.02)	0.200	34.000	34.800	1.430	37.700	39.000	38.000
Sr (.002)	0.002	0.132	0.145	0.005	0.100	0.150	0.120
Te (.06)							
Ti (.002)							
Zn (.02)	0.088	0.121	0.001	0.223	0.188	0.032	0.200
Zr (.008)	0.017						
Cs (.005)		0.400	0.300	0.012	0.68	0.890	0.870
F (.130)		4.300				4.800	
Cl (.015)	*	11.500	*	*	*	8.800	*
NO3(.040)		8.800				12.800	
SO4(.300)		18.000				20.000	

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

50A - 50 Angstrom Filtered Solution

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA (GLASS, ROCK AND METAL), TUFF WATER
40,70,90,150°C, STATIC

TEST PARAMETERS	TU83-III70-182	TU83-III90-A3	TU83-III90-A7			
DATE RUN BEGAN	28-JAN-83	17-JUN-83	25-JAN-83			
DATE RUN ENDED	29-JULY-83	20-JUN-83	1-FEB-83			
SPECIMEN SA mm2	250.790	198.347	191.400			
PARTICLE SIZE	MONOLITH	MONOLITH	MONOLITH			
SPECIMEN INI'L WT.(gm)	0.726	0.4515	0.407			
SPECIMEN FIN'L WT.(gm)	--	--	0.408			
WEIGHT CHANGE(gm)			--			
LEACHANT INI'L VOL.	25.080	19.85	19.140			
LEACHANT FIN'L VOL.	24.59	19.71	18.73			
VOLUME CHANGE	0.49	0.14	0.41			
INI'L pH AT 23 C	7.310	7.310	7.310			
FIN'L pH AT 23 C	8.990	9.090	9.010			
SA/V	9.996	9.992	10.000			
ELEMENTAL ANALYSIS ^(a)	TU83-III70-182	TU83-III90-A3				TU83-III90-A7
(DET.LIM)MG/LITER	AS	18A	UN	.45	50A	AS
						18A
Al (.03)		0.120	0.050	0.074	0.059	
As (.08)						
B (.01)		0.560	0.570	0.575	0.560	0.010
Ba (.002)		0.024	0.029		0.031	
Ca (.01)	0.064	8.400	12.000	10.730	10.700	0.560
Cd (.004)			0.007			
Ce (.04)						
Co (.01)						
Cr (.02)						
Cu (.004)	0.008	0.008	0.011	0.008		0.027
Cy						
Eu (.002)						
Fe (.005)	0.062	0.026	0.075	0.059	0.032	0.170
Gd (.01)						
K (.3)		7.300	8.000	7.600	7.700	
La (.008)						
Li (.004)		0.052	0.046	0.055	0.049	
Mg (.06)	0.060	0.640	0.650	0.624	0.570	0.100
Mn (.002)				0.048		
Mo (.01)		0.162	0.190		0.180	
Na (.01)	0.057	48.000	52.000	50.100	50.000	0.530
Nd (.02)						
Ni (.02)				0.126		
P (.1)						
Pb (.06)						
Ru (.05)						
Sb (.05)						
Si (.02)	0.200	32.000	32.000	30.400	32.000	0.740
Sr (.002)	0.002	0.054	0.081	0.037	0.073	
Te (.06)						
Ti (.002)						
Zn (.02)	0.088	1.160	0.023	0.161	0.230	0.027
Zr (.008)	0.017					
Cs (.005)		0.140	0.148		0.146	
F (1.30)		1.200				
Cl (.015)		4.200				
N02		0.200				
N03 (.040)	*	7.200	*	*	*	*
S04 (.300)		11.000				
P04						

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

0.45μ - 45 microns Filtered Solution

50A - 50 Angstrom Filtered Solution

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA (GLASS, ROCK AND METAL), TUFF WATER
40,70,90,150°C, STATIC

TEST PARAMETERS	TU83-III90-A7	TU83-III90-A14		TU83-III90-A28			
DATE RUN BEGAN	25-JAN-83	25-JAN-83		26-JAN-83			
DATE RUN ENDED	1-FEB-83	8-FEB-83		23-FEB-83			
SPECIMEN SA mm2	191.400	193.400		189.650			
PARTICLE SIZE	MONOLITH	MONOLITH		MONOLITH			
SPECIMEN INI'L WT.(gm)	0.407	0.420		0.467			
SPECIMEN FIN'L WT.(gm)	0.408	0.420		--			
WEIGHT CHANGE(gm)	-0.000	--					
LEACHANT INI'L VOL.	19.140	19.340		18.960			
LEACHANT FIN'L VOL.		18.930		18.940			
VOLUME CHANGE		0.410		0.020			
INI'L pH AT 23 C	7.310	7.310		7.310			
FIN'L pH AT 23 C	9.010	9.220		9.080			
SA/V	10.000	10.000		10.003			
ELEMENTAL ANALYSIS ^(a) (DET.LIM)MG/LITER	TU83-III90-A7 AS	TU83-III90-A14 18A AS		TU83-III90-A28 UN 18A 50A AS			
Al (.03)	0.076	0.070	0.059	0.158	0.085	0.112	0.023
As (.08)	0.016			0.014			
B (.01)	0.038	1.300		2.020	1.980	2.000	
Ba (.002)	0.003	0.016		0.026	0.029	0.032	
Ca (.01)	0.482	5.200	0.136	7.680	9.240	8.720	0.388
Cd (.004)				0.006		0.008	
Ce (.04)							
Co (.01)							
Cr (.02)		0.020		0.048	0.041	0.050	
Cu (.004)	0.049	0.005	0.030	0.012	0.012	0.016	0.008
Cy							
Eu (.002)							
Fe (.005)	0.137	0.025	0.119	0.024	0.040	0.008	0.078
Gd (.01)				0.066	0.052	0.074	
K (.3)		7.500		6.940	6.760	6.880	
La (.008)		0.014		0.016	0.015	0.016	
Li (.004)	0.004	0.055		0.052	0.044	0.052	
Mg (.06)	0.317		0.318	0.142	0.097	0.088	0.200
Mn (.002)	0.007		0.003	0.002			0.002
Mo (.01)	0.011	0.510		0.822	0.808	0.820	0.001
Na (.01)	1.010	49.000	0.026	57.400	53.700	57.000	0.055
Nd (.02)							
Ni (.02)							
P (.1)				0.186	0.098	0.154	
Pb (.06)							
Ru (.05)							
Sb (.05)							
Si (.02)	1.240	40.000	0.584	44.400	43.000	44.600	0.375
Sr (.002)	0.004	0.077	0.001	0.118	0.158	0.142	0.007
Te (.06)							
Ti (.002)	0.030			0.004	0.003	0.002	
Zn (.02)	0.097	0.150	0.132	1.656	0.036	0.202	0.113
Zr (.008)							
Cs (.005)	0.007	0.300		0.270	0.580	0.250	
F (1.30)				1.500			
Cl (.015)				4.600			
NO2				0.600			
NO3 (.040)				31.200			
SO4 (.300)	*	*	*	7.500	*	*	*
PO4							

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

50A - 50 Angstrom Filtered Solution

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TEST
LEACH TEST DATA FOR TEST III (GLASS, ROCK, AND METAL)
40, 70, 90, 150°C, STATIC

TEST PARAMETERS	TU83-III90-A56			TU33-III90-A91		
DATE RUN BEGAN	28-JAN-83			28-JAN-83		
DATE RUN ENDED	25-MAR-83			29-APR-83		
SPECIMEN SA mm2	266.750			245.320		
PARTICLE SIZE	MONOLITH			MONOLITH		
SPECIMEN INI'L WT.(gm)	0.779			0.714		
SPECIMEN FIN'L WT.(gm)	0.777			0.713		
WEIGHT CHANGE(gm)	0.002			0.000		
LEACHANT INI'L VOL.	26.680			24.530		
LEACHANT FIN'L VOL.	26.160			23.730		
VOLUME CHANGE	0.520			0.800		
INI'L pH AT 23 C	7.310			7.310		
FIN'L pH AT 23 C	9.110			9.170		
SA/V	9.998			10.001		
ELEMENTAL ANALYSIS(a)	TU83-III90-A56			TU83-III90-A91		
(DET.LIM)MG/LITER	18A	UN	AS	18A	UN	AS
Ag (.03)	0.076	0.070				
As (.08)	0.020	0.028		0.057	0.086	
B (.01)	4.460	4.630	0.007	4.830	4.790	0.015
Ba (.002)	0.020	0.023		0.016	0.016	
Ca (.01)	4.160	4.660	0.171	2.890	2.540	0.097
Cd (.004)						
Ce (.04)						
Co (.01)						
Cr (.02)	0.088	0.097	0.003	0.083	0.083	
Cu (.004)			0.012			0.015
Dy (.004)						
Eu (.002)						
Fe (.005)	0.018		0.120	0.022		0.191
Gd (.01)						
K (.3)	8.530	9.340		8.040	8.160	
La (.008)	0.007					
Li (.004)	0.047	0.053		0.050	0.048	
Mg (.06)			0.173			0.255
Mn (.002)			0.002			0.002
Mo (.01)	1.890	2.030	0.012	2.010	2.130	
Na (.01)	65.400	70.500	0.134	65.800	66.300	0.133
Nd (.02)						
Ni (.02)			0.016			0.024
P (.1)		0.113				
Pb (.06)						
Ru (.05)						
Sb (.05)						
Si (.02)	49.400	53.800	0.528	53.400	57.000	0.729
Sr (.002)	0.126	0.157	0.003	0.122	0.141	0.003
Te (.06)						
Ti (.002)						
Zn (.02)	0.165		0.195	0.157		0.304
Zr (.008)						
Cs (.005)	1.340	1.340		0.960	0.700	
F (.130)				5.700		
CL (.015)				8.800		
N02						
N03(.040)	*	*	*	18.500	*	*
S04(.300)				19.000		
P04						

18A - 18 Angstrom Filtered Solution
AS - Acid Strip
UN - Unfiltered
0.45 μ - 45 microns Filtered Solution
50A - 50 Angstrom Filtered Solution
* - No Anion Analysis
(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA
(GLASS , ROCK AND METAL) , TUFF WATER

TEST PARAMETERS	TU83-III90-B7		TU83-III90-B14			U83-III90-B28		TU83-III90-B56	
DATE RUN BEGAN	8-MAR-93		8-MAR-83			8-MAR-83		8-MAR-83	
DATE RUN ENDED	15-MAR-83		22-MAR-83			5-APR-83		3-MAY-83	
SPECIMEN SA mm2	84.921		88.958			82.974		85.165	
PARTICLE SIZE	-40 + 80		-40 + 80			-40 + 80		-40 + 80	
SPECIMEN INI'L WT.(gm)	0.111		0.118			0.092		0.118	
SPECIMEN FIN'L WT.(gm)	0.111		0.117						
WEIGHT CHANGE(gm)	-0.000		0.001			0.092		0.118	
LEACHANT INI'L VOL.	20.020		19.980			20.050		20.000	
LEACHANT FIN'L VOL.	19.880		19.690			18.260		18.950	
VOLUME CHANGE	0.140		0.290			1.790		1.050	
INI'L pH AT 23 C	7.310		7.310			7.310		7.310	
FIN'L pH AT 23 C	8.730		9.060			9.130		9.400	
SA/V									
(a)									
ELEMENTAL ANALYSIS	TU83-III90-B7		TU83-III90-B14			TU83-III90-B28		TU83-III90-B56	
(DET.LIM.)MG/LITER	18A	AS	18A	.45μ	AS	18A	AS	18A	
A1 (.03)	0.645	0.930	0.688	0.722	1.750	0.564	2.230	0.462	
As (.08)	0.063		0.017	0.036	0.002	0.013		0.026	
B (.01)	0.325	0.093	0.337	0.341	0.401	0.371	0.257	0.468	
Ba (.002)	0.003	0.017	0.001	0.001	0.065	0.001	0.042	0.003	
Ca (.01)	9.840	0.550	5.720	7.070	0.650	5.270	0.402	5.170	
Cd (.004)	0.002		0.001		0.050	0.002	0.004	0.001	
Ce (.04)	0.024				0.098		0.067		
Co (.01)	0.004				0.004		0.003	0.004	
Cr (.02)	0.011	0.028	0.004	0.010	0.058	0.006	0.029	0.204	
Cu (.004)	0.017	0.027	0.008	0.008	0.012	0.026	0.056	0.040	
Dy (.004)	0.007								
Eu (.002)									
Fe (.005)		0.400	0.008	0.017	1.140	0.048	0.683	0.465	
Gd (.01)	0.039				0.040		0.016		
K (.3)	9.800	0.500	10.300	10.900	0.949	8.510	0.691	9.240	
La (.008)	0.020	0.110	0.007	0.015	0.468	0.004	0.299	0.007	
Li (.004)	0.056		0.051	0.056	0.002	0.043	0.001	0.062	
Mg (.06)	0.376	0.090	0.140	0.135	0.134	0.107	0.105	0.101	
Mn (.002)	0.002	0.012	0.001	0.002	0.024	0.002	0.019	0.012	
Mo (.01)	0.068	0.040	0.063	0.070	0.176	0.037	0.112	0.098	
Na (.01)	52.400	1.400	58.000	62.000	2.380	49.200	1.280	54.800	
Nd (.02)	0.022	0.010			0.161		0.100		
Ni (.02)	0.008	0.020	0.002	0.004	0.031	0.005	0.028	0.085	
P (.1)	0.036		0.159	0.001	0.076	0.076		0.900	
Pb (.06)	0.013				0.088		0.054	0.005	
Ru (.05)	0.017				0.004			0.006	
Sb (.05)	0.020		0.004	0.012	0.004	0.006		0.008	
Si (.02)	33.000	3.300	36.100	38.500	6.580	31.900	5.490	38.700	
Sr (.002)	0.089	0.015	0.066	0.086	0.049	0.055	0.030	0.058	
Te (.06)	0.026							0.007	
Ti (.002)	0.002	0.058			0.247		0.157	0.007	
Zn (.02)	0.321	0.140	0.321	0.017	0.517	0.241	0.342	0.157	
Zr (.02)	0.003	0.024			0.027		0.017	0.006	
Cs (.005)	0.062	0.040	0.059	0.024	0.174	0.090	0.108	0.120	
F (.130)			3.400			4.700		2.400	
Cl (.015)			12.000			10.400		5.800	
NO3(.400)	*	*	36.200	*	*	23.500	*	22.700	
SO4(3.00)			26.000			17.500		10.000	

18A - 18 Angstrom Filtered Solution

As - Acid Strip

UN - Unfiltered

.45 - .45 microns Filtered Solution

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA (GLASS, ROCK AND METAL), TUFF WATER

TEST PARAMETERS	TU83-III90-B3
DATE RUN BEGAN	08-MAR-83
DATE RUN ENDED	11-MAR-83
SPECIMEN SA mm2	1998.4
PARTICLE SIZE	-40+80
SPECIMEN INI'L WT.(gm)	0.110
SPECIMEN FIN'L WT.(gm)	0.117
WEIGHT CHANGE(gm)	0.007
LEACHANT INI'L VOL.	19.960
LEACHANT FIN'L VOL.	19.870
VOLUME CHANGE	0.090
INI'L pH AT 23 C	7.46
FIN'L pH AT 23 C	8.64
SA/V	100.12

ELEMENTAL ANALYSIS^(a)
(DET.LIM.)MG/LITER

	TU83-III90-B3	
	18A	AS
Al (.03)	0.510	1.300
As (.08)	0.110	
B (.01)	0.310	0.510
Ba (.002)	0.004	0.061
Ca (.01)	12.000	0.490
Cd (.004)		
Ce (.04)		0.095
Co (.01)		
Cr (.02)		0.046
Cu (.004)	0.018	0.013
Dy (.004)		
Eu (.002)		
Fe (.005)	0.008	0.940
Gd (.01)		0.040
K (.3)	9.200	0.700
La (.008)	0.030	0.430
Li (.004)	0.053	
Mg (.06)	0.630	0.100
Mn (.002)		0.015
Mo (.01)	0.070	0.140
Na (.01)	52.000	2.200
Nd (.02)		0.140
Ni (.02)		0.030
P (.1)	0.140	
Pb (.06)		
Ru (.05)		
Sb (.05)		
Si (.02)	32.000	6.100
Sr (.002)	0.096	0.045
Te (.06)		
Ti (.002)		0.220
Zn (.02)	0.460	0.500
Zr (.008)	0.033	0.120
Cs (.005)	0.164	0.148
F (.130)		
Cl (.015)		
N02		
N03 (0.40)		
S04 (3.00)		
P04		

18A - 18 Angstrom Filtered Solution
AS - Acid Strip
UN - Unfiltered
0.45 - 45 microns Filtered Solution
50A - 50 Angstrom Filtered Solution
* - No Anion Analysis
(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA (GLASS, ROCK AND METAL), TUFF WATER
40,70,90,150°C, STATIC

TEST PARAMETERS	TU83-III90-B56		TU83-III90-B91			
DATE RUN BEGAN	8-MAR-83		8-MAR-83			
DATE RUN ENDED	3-MAY-83		7-JUN-83			
SPECIMEN SA mm2	2000.85		2000.06			
PARTICLE SIZE	-40 + 80		-40 + 80			
SPECIMEN INI'L WT.(gm)	0.118		0.088			
SPECIMEN FIN'L WT.(gm)	--		--			
WEIGHT CHANGE(gm)						
LEACHANT INI'L VOL.	20.000		19.980			
LEACHANT FIN'L VOL.	18.950		14.040			
VOLUME CHANGE	1.050		5.94** excess mass loss			
INI'L pH AT 23 C	7.310		7.310			
FIN'L pH AT 23 C	9.400		9.610			
SA/V	100.043		100.103			
ELEMENTAL ANALYSIS(a) (DET. LIM.)MG/LITER	TU83-III90-B56		TU83-III90-B91			
	UN	AS	18A	UN	50A	AS
Al (.03)	0.540	0.719	0.450	0.360	0.390	0.420
As (.08)						
B (.01)	0.457	0.202	0.450	0.480	0.480	0.120
Ba (.002)		0.028				0.018
Ca (.01)	5.990	0.387	3.540	6.000	5.250	0.360
Cd (.004)						
Ce (.04)						
Co (.01)						
Cr (.02)						
Cu (.004)	0.019	0.010	0.108			
Cy						
Dy (.004)						
Eu (.002)						
Fe (.005)	0.023	0.476	0.102	0.246	0.330	0.280
Gd (.01)						
K (.3)	8.880		11.400	11.100	11.400	0.130
La (.008)	0.010	0.195				
Li (.004)	0.054		0.069	0.063	0.066	
Mg (.06)	0.066					
Mn (.002)	0.002	0.010				0.004
Mo (.01)	0.098	0.067	0.075	0.075	0.078	0.047
Na (.01)	82.700	1.490	78.000	84.000	81.000	0.530
Nd (.02)		0.035				0.028
Ni (.02)						
P (.1)						
Pb (.06)						
Ru (.05)						
Sb (.05)						
Si (.02)	40.400	2.950	64.000	66.000	66.000	2.100
Sr (.002)	0.072	0.022	0.036	0.069	0.057	0.014
Te (.06)						
Ti (.002)	0.002	0.096				0.066
Zn (.02)		0.236	0.294		0.246	0.140
Zr (.008)		0.017	0.030		0.027	0.029
Cs (.005)	0.055	0.075	0.081	0.072	0.063	0.046
F (1.30)			2.800			
Cl (.015)			4.900			
N02			0.300			
N03(.040)			12.400			
S04(.300)	*	*	10.000	*	*	*
P04						

18A - 18 Angstrom Filtered Solution
AS - Acid Strip
UN - Unfiltered
0.45μ - 45 microns Filtered Solution
50A - 50 Angstrom Filtered Solution
* - No Anion Analysis
(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA (GLASS, ROCK AND METAL), TUFF WATER
40,70,90,150°C, STATIC

TEST PARAMETERS	TU83-III90-B3REP				TU83-III90-B7REP			TU83-III90-B14REP	
DATE RUN BEGAN	5-JUL-83				30-JUN-83			30-JUN-83	
DATE RUN ENDED	8-JUL-83				7-JUL-83			14-JUL-83	
SPECIMEN SA mm2	1993.978				2007.36			2006.69	
PARTICLE SIZE	-40+80				-40+80			-40+80	
SPECIMEN INI'L WT.(gm.)	0.2980				0.3000			0.2990	
SPECIMEN FIN'L WT.(gm.)	--				--			--	
WEIGHT CHANGE (gm.)	--				--			--	
LEACHANT INI'L VOL.	19.94				20.07			20.07	
LEACHANT FIN'L VOL.	19.68				19.00			19.44	
VOLUME CHANGE	0.26				1.07			0.63	
INI'L pH AT 23°C	7.310				7.310			7.310	
FIN'L pH at 23°C	8.710				8.950			9.100	
SA/V	99.999				100.018			99.984	
ELEMENTAL ANALYSIS ^(a)	TU83-III90-B3REP				TU83-III90-B7REP			TU83-III90-B14REP	
(DET.LIM.) MG/LITER	50A	AS	.45μ	18A	18A	50A	AS	18A	AS
Al (.03)	0.660	0.540	0.740	0.620	0.645	0.655	0.728	0.688	0.420
As (.08)					0.307	0.015			
B (.01)	0.300	0.050	0.300	0.310	0.331	0.340	0.100	0.340	0.016
Ba (.002)	0.016	0.100		0.004	0.003	0.003	0.018		0.790
Ca (.01)	8.000		8.000	7.400	8.740	9.000	0.340	4.930	
Cd (.004)									
Ce (.04)									
Co (.01)									
Cr (.02)									
Cu (.004)	0.020	0.004			0.042	0.002	0.004		
Dy (.004)									
Eu (.002)									
Fe (.005)	0.066	0.051	0.080	0.092	0.077	0.011	0.261	0.080	0.054
Gd (.01)									
K (.3)	9.000		9.800	8.000	9.460	9.860		9.500	
La (.008)							0.129		
Li (.004)	0.186	0.011	0.210	0.164	0.030	0.032		0.028	0.005
Mg (.06)	0.260		0.070		0.177	0.055		0.063	
Mn (.002)		0.005							
Mo (.01)	0.078		0.050	0.040	0.041	0.04	0.041	0.028	0.200
Na (.01)	56.000	0.690	59.000	52.000	55.000	58.000	0.520	60.000	
Nd (.02)							0.037		
Ni (.02)					0.015				
P (.1)									
Pb (.06)									
Ru (.05)									
Sb (.05)					0.001				
Si (.02)	36.000	1.760	36.000	34.000	34.000	37.000	1.540	37.800	1.410
Sr (.002)	0.064		0.080	0.072	0.032	0.044	0.012	0.017	
Te (.06)									
Ti (.002)	0.010						0.061		
Zn (.02)	0.860		0.020	0.280	1.570	0.257	0.140	0.479	
Zr (.008)	0.048				0.001		0.025		
Cs (.005)	0.160		0.140	0.146	0.051	0.055	0.034	0.052	
F (1.30)									
Cl (.015)	*	*	*	*	*	*	*	*	*
NO ₂									
NO ₃ (.040)									
SO ₄ (.300)									
PO ₄									

18A - 18 Angstrom Filtered Solution
AS - Acid Strip
UN - Unfiltered
.45μ - 45 microns Filtered Solution
50A - 50 Angstrom Filtered Solution
* - No Anion Analysis
(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA (GLASS, ROCK AND METAL), TUFF WATER
40,70,90,150°C, STATIC

TEST PARAMETERS	TU83-III90-B14REP	TU83-III90-B28REP			
DATE RUN BEGAN	30-JUN-83	30-JUN-83			
DATE RUN ENDED	14-JUL-83	28-JUL-83			
SPECIMEN SA mm2	2006.69	1992.64			
PARTICLE SIZE	-40+80	-40+80			
SPECIMEN INI'L WT.(gm.)	.2900	.2978			
SPECIMIN FIN'L WT.(gm.)	--	--			
WEIGHT CHANGE(gm.)	--	--			
LEACHANT INI'L VOL.	20.07	19.91			
LEACHANT FIN'L VOL.	19.44	19.32			
VOLUME CHANGE	0.63	0.59			
INI'L pH AT 23 C	7.310	7.310			
FIN'L pH AT 23 C	9.100	9.230			
SA/V	99.984	100.082			
ELEMENTAL ANALYSIS (DET.LIM.)MG/LITER	TU83-III90-B14REP	TU83-III90-B28REP			
	50A	AS	.45μ	18A	50A
A1 (.03)	0.740	0.130	0.600	0.550	0.588
As (.08)					
B (.01)	0.350		0.300	0.300	0.220
Ba (.002)	0.008				
Ca (.01)	4.400	0.900	5.000	4.800	5.000
Cd (.004)					
Ce (.04)					
Co (.01)					
Cr (.02)			0.008		
Cu (.004)		0.013			
Dy (.004)					
Eu (.002)					
Fe (.005)	0.300	0.012	0.066	0.046	0.024
Gd (.01)					
K (.3)	8.600		8.400	8.500	8.600
La (.008)					
Li (.004)	0.052		0.060	0.018	0.038
Mg (.06)					
Mn (.002)					
Mo (.01)	0.042		0.057		0.036
Na (.01)	61.000	0.064	52.000	50.000	51.000
Nd (.02)					
Ni (.02)					
P (.1)					
Pb (.06)					
Ru (.05)					
Sb (.05)					
Si (.02)	38.000	0.460	39.000	36.000	37.000
Sr (.002)	0.050		0.058	0.012	0.028
Te (.06)					
Ti (.002)					
Zn (.02)	0.640			0.088	0.280
Zr (.008)					
Cs (.005)	0.166		0.030	0.013	0.018
F (1.30)				2.700	
Cl (.015)				9.700	
N02					
N03(.040)				24.900	
S04(.300)	*	*	*	23.000	*
P04					

18A - 18 Angstrom Filtered Solution
AS - Acid Strip
UN - Unfiltered
0.45μ - 45 microns Filtered Solution
50A - 50 Angstrom Filtered Solution
* - No Anion Analysis
(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA (GLASS, ROCK AND METAL), TUFF WATER
40,70,90,150°C, STATIC

TEST PARAMETERS	TU83-III90-C3				TU83-III90-C7		TU83-III90-C14	
DATE RUN BEGAN	17-JUN-83				2-FEB-83		2-FEB-83	
DATE RUN ENDED	20-JUN-83				9-FEB-83		30-MAR-83	
SPECIMEN SA mm2	194.088				191.0670		200.4000	
PARTICLE SIZE	MONOLITH				MONOLITH		MONOLITH	
SPECIMEN INI'L WT.(gm)	--				--		0.4626	
SPECIMEN FIN'L WT.(gm)	0.418				0.4579		0.3696	
WEIGHT CHANGE(gm)	--				--		0.0930	
LEACHANT INI'L VOL.	19.390				19.1000		20.0300	
LEACHANT FIN'L VOL.	19.110				18.6000		19.1500	
VOLUME CHANGE	0.28				0.5000		0.8800	
INI'L pH AT 23°C	7.310				7.310		7.310	
FIN'L pH AT 23°C	9.05				10.0900		10.0800	
SA/V	10.009				10.0035		10.4698	
ELEMENTAL ANALYSIS(a)	TU83-III90-C3				TU83-III90-C7		TU83-III90-C14	
(DET.LIM.)MG/LITER	18A	UN	50A	AS	18A	AS	18A	UN
Al (.03)	0.140	0.065	0.033		0.218	0.0500	0.1610	0.199
As (.08)					0.095			
B (.01)	1.280	1.310	1.300		8.34	0.1300	13.5000	14.000
Ba (.002)		0.039	0.010	0.150	0.002	0.1500		0.006
Ca (.01)	1.860	3.500	2.800		1.65		0.3860	0.037
Cd (.004)		0.005						
Ce (.04)					0.005			
Co (.01)								
Cr (.02)								
Cu (.004)		0.006		0.006	0.009	0.0070		0.005
Cy								
Dy (.004)								
Eu (.002)								
Fe (.005)	0.064	15.000	1.360	7.000	0.024	7.8000	0.0850	1.210
Gd (.01)					0.042	0.0200		
K (.3)	6.400	6.600	6.600		9.83	0.3000	6.6800	8.060
La (.008)					0.003			
Li (.004)	0.050	0.047	0.046		0.018		0.0080	0.009
Mg (.06)	0.320	0.490	0.410		0.091		0.0150	
Mn (.002)		0.079	0.006	0.018		0.0410		0.016
Mo (.01)	0.300	0.350	0.340	0.010	0.486	0.0300	0.5260	0.565
Na (.01)	51.000	51.000	50.000	0.100	77.7	1.2000	97.0000	111.000
Nd (.02)								
Ni (.02)					0.007		0.0010	0.004
P (.1)					0.239		0.2750	0.194
Pb (.06)					0.004			
Ru (.05)					0.011			
Sb (.05)					0.032			
Si (.02)	26.000	27.000	25.000	1.170	27.4	1.2000	49.2000	54.800
Sr (.002)	0.028	0.085	0.058	0.004	0.023	0.0080	0.0050	0.010
Te (.06)					0.021			
Ti (.002)								
Zn (.02)	1.160	0.088	0.260	0.030	0.140	0.1100	0.3750	0.040
Zr (.008)					0.002			
Cs (.005)	0.336	0.368	0.360		1.66	0.0360	2.1000	2.700
F (1.30)	0.090							
Cl (.015)	4.000	*	*	*	*	*	*	*
NO ₂	2.000							
NO ₃ (.040)	4.300							
SO ₄ (.300)	6.000							
PO ₄								

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

.45u - 45 microns Filtered Solution

50A - 50 Angstrom Filtered Solution

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA (GLASS, ROCK AND METAL), TUFF WATER
40,70,90,150°C, STATIC

TEST PARAMETERS	TU83-III90-C14	TU83-III90-C28		TU83-III90-C56		
DATE RUN BEGAN	2-FEB-83	2-FEB-83		2-FEB-83		
DATE RUN ENDED	30-MAR-83	2-MAR-83		30-MAR-83		
SPECIMEN SA mm2	200.400	200.436		243.600		
PARTICLE SIZE	MONOLITH	MONOLITH		MONOLITH		
SPECIMEN INI'L WT.(gm)	0.463	0.374		0.716		
SPECIMEN FIN'L WT.(gm)	0.370	0.712		0.702		
WEIGHT CHANGE(gm)	0.093	-0.338		0.014		
LEACHANT INI'L VOL.	20.030	20.030		24.350		
LEACHANT FIN'L VOL.	19.150	19.350		23.850		
VOLUME CHANGE	0.880	0.680		0.500		
INI'L pH AT 23 C	7.310	7.310		7.310		
FIN'L pH AT 23 C	10.080	9.850		9.800		
SA/V	10.005	10.007		10.004		
ELEMENTAL ANALYSIS ^(a)	TU83-III-90-C14	TU83-III90-C28		TU83-III90-C56		
(DET.LIM.)MG/LITER	AS	18A	AS	18A	UN	AS
Al (.03)	0.029	0.190	0.030	0.119	0.091	0.056
As (.08)				0.033	0.071	0.018
B (.01)	0.012	9.300		10.600	9.970	0.054
Ba (.002)	0.011		0.010			0.022
Ca (.01)	0.146	0.770	0.140	0.568	0.677	0.159
Cd (.004)						
Ce (.04)						
Co (.01)						
Cr (.02)						
Cu (.004)	0.010		0.021		0.004	0.008
Dy (.004)						
Eu (.002)						
Fe (.005)	6.180	0.008	7.100	0.009	0.796	25.500
Gd (.01)		0.020	0.020		0.008	0.001
K (.3)		8.700		6.930	6.510	
La (.008)						
Li (.004)		0.015		0.016	0.014	
Mg (.06)	0.049	0.090				
Mn (.002)	0.057		0.027		0.022	0.174
Mo (.01)	0.020	0.540	0.021	1.060	1.080	0.094
Na (.01)	0.120	83.000	0.050	85.500	76.800	0.240
Nd (.02)						
Ni (.02)					0.020	
P (.1)		0.300		0.195	0.047	
Pb (.06)						
Ru (.05)						
Sb (.05)						
Si (.02)	0.763	52.000	0.620	61.000	60.400	2.520
Sr (.002)	0.008	0.014	0.007	0.015	0.026	0.014
Te (.06)						
Ti (.002)						
Zn (.02)	0.095	0.140	0.070	0.304	0.042	0.143
Zr (.008)						
Cs (.005)	0.005	1.860	0.005	2.200	2.400	
F (1.30)				4.300		
Cl (.015)				8.500		
NO2						
NO3(.040)						
SO4(.300)	*	*	*	4.200	*	*
PO4						

18A - 18 Angstrom Filtered Solution
AS - Acid Strip
UN - Unfiltered
0.45_μ - 45 microns Filtered Solution
50A - 50 Angstrom Filtered Solution
* - No Anion Analysis
(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA (GLASS, ROCK AND METAL), TUFF WATER
40,70,90,150°C, STATIC

TEST PARAMETERS	TU83-III90-C91			TU83-III90-C182			
DATE RUN BEGAN	2-FEB-83			2-FEB-83			
DATE RUN ENDED	4-MAY-83			3-AUG-83			
SPECIMEN SA mm2	238.0000			241.7200			
PARTICLE SIZE	MONOLITH			MONOLITH			
SPECIMEN INI'L WT.(gm)	0.7062			0.6936			
SPECIMEN FIN'L WT.(gm)	0.7017			0.5843			
WEIGHT CHANGE(gm)	0.0045			0.1093			
LEACHANT INI'L VOL.	23.8100			24.1900			
LEACHANT FIN'L VOL.	22.9500			22.57			
VOLUME CHANGE	0.8600			1.62			
INI'L pH AT 23 C	7.310			7.310			
FIN'L pH AT 23 C	9.9000			9.910			
SA/V	9.9958			9.9926			
ELEMENTAL ANALYSIS ^(a) (DET.LIM)MG/LITER	TU83-III90-C91			TU83-III90-C182			
	18A	.45	AS	18A	UN	50A	AS
Al (.03)	0.1940	0.154	0.035	0.1200	0.080	0.180	
As (.08)	0.0280	0.025					
B (.01)	14.2000	14.400	0.045	16.0000	16.000	14.800	
Ba (.002)	0.0100		0.018				
Ca (.01)	0.6410	0.647	0.150	0.5000	0.730	0.560	.038
Cd (.004)							
Ce (.04)							
Co (.01)							
Cr (.02)	0.0160	0.015	0.006			0.360	
Cu (.004)	0.0250	0.011	0.031				
Cy (.004)							
Dy (.004)							
Eu (.002)							
Fe (.005)	0.1940	1.300	11.100	0.2200	0.380	0.960	6.400
Gd (.01)	0.0300	0.026					
K (.3)	7.5500	7.440		7.4000	8.200	7.200	
La (.008)							
Li (.004)	0.0080	0.007		0.0120	0.015	0.016	
Mg (.06)	0.1110						
Mn (.002)	0.0030	0.039	0.195		0.017	0.064	0.089
Mo (.01)	1.3500	1.360	0.026	1.7000	1.600	1.300	0.024
Na (.01)	94.5000	95.600	0.358	95.0000	110.000	102.000	0.011
Nd (.02)							
Ni (.02)						0.480	
P (.1)	0.4140	0.333		0.2600	17.000	1.120	
Pb (.06)							
Ru (.05)							
Sb (.05)							
Si (.02)	66.0000	66.700	1.120	70.0000	71.000	68.000	0.520
Sr (.002)	0.0120	0.023	0.012	0.0080	0.031	0.008	
Te (.06)							
Ti (.002)	0.0030	0.002				0.008	
Zn (.02)	0.5950	0.064	0.135	1.2000	0.033	1.060	0.028
Zr (.008)							
Cs (.005)	2.2000	3.200	0.012	2.6000	3.600	7.200	
F (1.30)	1.8000						2.100
Cl (.015)	6.0000						2.900
N02	0.7000						
N03(.040)	6.1000						1.000
S04(.300)	5.0000	*	*	*	*	*	*
P04							

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

0.45 - 45 microns Filtered Solution

50A - 50 Angstrom Filtered Solution

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA (GLASS, ROCK AND METAL), TUFF WATER
40,70,90,150°C, STATIC

TEST PARAMETERS	TU83-III90-D3				TU83-III90-D7		TU83-III90-D14	
DATE RUN BEGAN	17-JUN-83				2-FEB-83		16-MAR-83	
DATE RUN ENDED	20-JUN-83				9-FEB-83		30-MAR-83	
SPECIMEN SA mm2	205.758				216.280		205.178	
PARTICLE SIZE	MONOLITH				MONOLITH		MONOLITH	
SPECIMEN INI'L WT.(gm)	0.4877				0.586		--	
SPECIMEN FIN'L WT.(gm)	--				0.584		--	
WEIGHT CHANGE(gm)	--				0.002		--	
LEACHANT INI'L VOL.	20.53				21.670		20.520	
LEACHANT FIN'L VOL.	20.41				21.150		18.900	
VOLUME CHANGE	0.12				0.520		1.620	
INI'L pH AT 23 C	7.310				7.310		7.310	
FIN'L pH AT 23 C	8.92				9.210		9.250	
SA/V	10.022				9.981		9.999	
ELEMENTAL ANALYSIS ^(a) (DET. LIM.)MG/LITER	TU83-III90-D3				TU83-III90-D7		TU83-III90-D14	
	18A	UN	50A	AS	18A	AS	18A	
Al (.03)	0.160	0.040	0.030	0.033	0.120	0.040	0.086	
As (.08)							0.005	
B (.01)	0.500	0.490	0.495		1.550	0.019	1.820	
Ba (.002)	0.020	0.025	0.029		0.020		0.009	
Ca (.01)	8.800	12.000	11.000	0.100	4.100	0.110	3.170	
Cd (.004)		0.004						
Ce (.04)								
Co (.01)								
Cr (.02)					0.060		0.040	
Cu (.004)		0.010		0.008	0.013	0.023		
Dy (.004)								
Eu (.002)								
Fe (.005)	0.034	0.048	0.088	0.110	0.015	0.260	0.039	
Gd (.01)					0.090	0.020		
K (.3)	6.800	7.600	6.900		8.100		8.160	
La (.008)					0.010	0.017		
Li (.004)	0.052	0.048	0.050		0.050		0.050	
Mg (.06)	1.160	1.150	1.100	0.065	0.090	0.180		
Mn (.002)								
Mo (.01)	0.140	0.150	0.150		1.300		0.702	
Na (.01)	48.000	54.000	49.000	0.020	60.000	0.210	54.900	
Nd (.02)					0.027			
Ni (.02)								
P (.1)							0.012	
Pb (.06)								
Ru (.05)								
Sb (.05)								
Si (.02)	31.000	32.000	31.000	0.300	41.000	0.440	42.900	
Sr (.002)	0.060	0.087	0.082		0.110		0.064	
Te (.06)								
Ti (.002)						0.011		
Zn (.02)	0.220	0.022	0.370	0.030	0.090	0.170	0.208	
Zr (.008)								
Cs (.005)	0.112	0.120	0.124		0.800	0.006	0.360	
F (1.30)	1.400							
Cl (.015)	4.900							
NO2	0.600							
NO3(.040)	6.900	*	*	*	*	*	*	
SO4(.300)	11.000							
PO4								

18A - 18 Angstrom Filtered Solution
UN - Unfiltered
0.45μ - 45 microns Filtered Solution
50A - 50 Angstrom Filtered Solution
* - No Anion Analysis
(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA (GLASS, ROCK AND METAL), TUFF WATER
40,70,90,150°C, STATIC

TEST PARAMETERS	TU83-III90-D14		TU83-III90-D28		TU83-III90-D56		
DATE RUN BEGAN	16-MAR-83		2-FEB-83		2-FEB-83		
DATE RUN ENDED	30-MAR-83		2-MAR-83		3-AUG-83		
SPECIMEN SA mm2	205.178		200.440		239.656		
PARTICLE SIZE	MONOLITH		MONOLITH		MONOLITH		
SPECIMEN INI'L WT.(gm)	--		0.493		0.681		
SPECIMEN FIN'L WT.(gm)	.4726		0.493		0.632		
WEIGHT CHANGE(gm)	--		--		-0.001		
LEACHANT INI'L VOL.	20.520		20.010		23.970		
LEACHANT FIN'L VOL.	18.900		19.420		23.490		
VOLUME CHANGE	1.620		0.590		0.480		
INI'L pH AT 23 C	7.310		7.310		7.310		
FIN'L pH AT 23 C	9.250		9.230		9.150		
SA/V	9.999		10.017		9.998		
ELEMENTAL ANALYSIS ^(a)	U83-III90-D14		TU83-III90-D28		TU83-III90-D56		
(DET.LIM) MG/LITER	UN	AS	18A	AS	18A	UN	AS
Al (.03)	0.062	0.064	0.100	0.050	0.067	0.053	0.037
As (.08)					0.003	0.045	
B (.01)	1.820	0.069	1.900		5.180	4.970	0.015
Ba (.002)	0.008	0.002	0.017		0.017	0.019	0.003
Ca (.01)	2.950	0.264	3.000	0.470	2.570	2.950	0.128
Cd (.004)						0.001	
Ce (.04)							
Co (.01)			0.039				
Cr (.02)	0.041				0.091	0.083	
Cu (.004)		0.093		0.017		0.007	0.013
Dy (.004)							
Eu (.002)							
Fe (.005)	0.008	0.352	0.069	0.130	0.005	0.045	0.152
Gd (.01)			0.070	0.030		0.034	
K (.3)	8.430	0.188	8.100		7.790	7.590	
La (.008)			0.020			0.009	
Li (.004)	0.049		0.049		0.050	0.044	
Mg (.06)		0.287	0.095	0.200			0.229
Mn (.002)		0.007					0.006
Mo (.01)	0.764	0.036	0.780		2.180	2.270	0.015
Na (.01)	57.800	1.960	53.000	0.060	61.000	59.000	0.195
Nd (.02)							
Ni (.02)							0.025
P (.1)							
Pb (.06)				0.150			
Ru (.05)							
Sb (.05)							
Si (.02)	47.100	2.710	43.000	0.410	45.700	46.000	0.630
Sr (.002)	0.083	0.005	0.093		0.101	0.122	0.003
Te (.06)							
Ti (.002)						0.003	0.004
Zn (.02)	0.010	0.191	0.130	0.120	0.133	0.013	0.265
Zr (.008)							
Cs (.005)	0.280	0.022	0.450	0.005	1.000	0.740	
F (1.30)							
Cl (.015)							
N02							
N03(.040)	*	*	*	*	*	*	*
S04(.300)							
P04							

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA (GLASS, ROCK AND METAL), TUFF WATER
40,70,90,150°C, STATIC

TEST PARAMETERS	TU83-III90-D91			TU83-III90-D182			
DATE RUN BEGAN	2-FEB-83			2-FEB-83			
DATE RUN ENDED	4-MAY-83			3-AUG-83			
SPECIMEN SA mm2	241.771			240.94			
PARTICLE SIZE	MONOLITH			MONOLITH			
SPECIMEN INI'L WT.(gm)	0.694			0.689			
SPECIMEN FIN'L WT.(gm)	0.693			--			
WEIGHT CHANGE(gm)	0.002						
LEACHANT INI'L VOL.	24.180			24.080			
LEACHANT FIN'L VOL.	23.270						
VOLUME CHANGE	0.910			--			
INI'L pH AT 23 C	7.310			7.310			
FIN'L pH AT 23 C	9.210			9.230			
SA/V	9.999			10.006			
ELEMENTAL ANALYSIS ^(a) (DET.LIM)MG/LITER	TU83-III90-D91			TU83-III90-D182			
	18A	UN	AS	18A	UN	50A	AS
Al (.03)	0.089	0.080	0.030	0.120	0.100	.220	0.070
As (.08)							
B (.01)	5.290	5.370	0.011	6.200	6.300	6.200	
Ba (.002)	0.011	0.016		0.005	0.015	0.012	
Ca (.01)	2.160	2.650	0.056	1.300	2.400	1.800	0.095
Cd (.004)							
Ce (.04)							
Co (.01)							
Cr (.02)	0.101	0.105		0.120	0.300	0.280	
Cu (.004)	0.012	0.011	0.018				
Dy (.004)							
Eu (.002)							
Fe (.005)	0.014	0.023	0.104	0.007	0.500	0.062	0.230
Gd (.01)	0.055	0.044					
K (.3)	7.850	7.810		6.800	7.900	6.800	
La (.008)							
Li (.004)	0.044	0.044		0.042	0.054	0.054	
Mg (.06)	0.038	0.039	0.152				0.310
Mn (.002)			0.003			0.030	0.005
Mo (.01)	2.280	2.320		2.700	2.700	2.600	
Na (.01)	63.100	64.200	0.040	68.000	74.000	74.000	0.034
Nd (.02)							
Ni (.02)						0.200	0.032
P (.1)		0.109				0.580	
Pb (.06)							
Ru (.05)							
Sb (.05)							
Si (.02)	52.100	53.400	0.480	59.000	62.000	60.000	1.300
Sr (.002)	0.080	0.107		0.040	0.110	0.060	0.003
Te (.06)							
Ti (.002)	0.003	0.004					
Zn (.02)	0.206	0.030	0.224	0.440	0.080	0.580	0.590
Zr (.008)							
Cs (.005)	0.860	1.200		1.200	1.800	1.600	
F (1.30)	6.000			6.500			
Cl (.015)	8.000			8.600			
NO2	0.500						
NO3(.040)	11.400	*	*	10.800	*	*	*
SD4(.300)	17.500			20.000			
P04							

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

50A - 50 Angstrom Filtered Solution

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA (GLASS, ROCK AND METAL), TUFF WATER
40,70,90,150°C, STATIC

TEST PARAMETERS		TU83-III90-E3	

DATE RUN BEGAN		5-JUL-83	
DATE RUN ENDED		8-JUL-83	
SPECIMEN SA mm2		1935.095	
PARTICLE SIZE		-40+80	
SPECIMEN INI'L WT.(gm)		.2892	
SPECIMEN FIN'L WT.(gm)		--	
WEIGHT CHANGE(gm)		--	
LEACHANT INI'L VOL.		20.00	
LEACHANT FIN'L VOL.		19.75	
VOLUME CHANGE		0.25	
INI'L pH AT 23 C		7.310	
FIN'L pH AT 23 C		10.03	
SA/V		96.755	
ELEMENTAL ANALYSIS ^(a)		TU83-III90-E3	
(DET.LIM.)MG/LITER		18A	AS

Al (.03)		0.160	1.100
As (.08)			
B (.01)		10.600	0.330
Ba (.002)			0.094
Ca (.01)		0.400	0.470
Cd (.004)			0.009
Ce (.04)			0.086
Co (.01)			
Cr (0.2)			0.038
Cu (.004)			
Dy (.004)			
Eu (.002)			
Fe (.005)		0.054	41.000
Gd (.01)			
K (.3)		9.200	0.400
La (.008)			0.530
Li (.004)		0.056	
Mg (.06)			0.060
Mn (.002)			
Mo (.01)		1.340	0.560
Na (.01)		90.000	1.400
Nd (.02)			0.160
Ni (.02)			0.040
P (.1)			
Pb (.06)			0.120
Ru (.05)			
Sb (.05)			
Si (.02)		20.000	8.500
Sr (.002)		0.010	0.054
Te (.06)			
Ti (.002)			0.180
Zn (.02)		0.136	1.100
Zr (.008)			0.089
Cs (.005)		2.400	0.132
F (.130)		2.600	
Cx (.015)		10.000	
No2 (.040)			
No3 (.300)		9.600	
So4		19.000	

18A - 18 Angstrom Filtered Solution
AS - Acid Strip
UN - Unfiltered
0.45μ - 45 microns Filtered Solution
50A - 50 Angstrom Filtered Solution
* - No Anion Analysis
(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA (GLASS, ROCK AND METAL), TUFF WATER
40,70,90,150°C, STATIC

TEST PARAMETERS	TU83-III90-E3		TU83-III90-E7			TU83-III90-E14	
DATE RUN BEGAN	5-JUL-83		28-JUN-83			28-JUN-83	
DATE RUN ENDED	8-JUL-83		5-JUL-83			12-JUL-83	
SPECIMEN SA mm2	1935.093		1935.09			1943.79	
PARTICLE SIZE	-40+80		-40+80			-40+80	
SPECIMEN INI'L WT (gm.)	.2892		.2892			.2905	
SPECIMEN FIN'L WT (gm.)	--		--			--	
WEIGHT CHANGE (gm.)	--		--			--	
LEACHANT INI'L VOL.	20.00		19.99			19.99	
LEACHANT FIN'L VOL.	19.75		19.64			19.61	
VOLUME CHANGE	0.25		0.35			0.38	
INI'L pH AT 23 C	7.310		7.310			7.310	
FIN'L pH AT 23 C	10.03		10.61			10.53	
SA/V	96.755		96.802			97.238	
ELEMENTAL ANALYSIS	TU83-III90-E3		TU83-III90-E7			TU83-III90-E14	
(DET.LIM) MG/LITER	.45 μ	50A	18A	AS	.45 μ	50A	18A
Al (.03)	0.310	0.160	0.220	1.700	0.370	0.480	0.480
As (.08)							
B (.01)	11.000	11.000	17.660	0.140	19.200	37.000	36.000
Ba (.002)	0.013	0.004		0.098	0.014		
Ca (.01)	0.930	0.760	0.580	0.340	1.180	1.120	0.640
Cd (.004)				0.005	0.006		
Ce (.04)				0.051			
Co (.01)							
Cr (.02)							
Cu (.004)			0.400		0.085	0.076	
Dy (.004)							
Eu (.002)							
Fe (.005)	0.770	0.300	0.056	55.900	1.850	0.368	0.192
Gd (.01)							
K (.3)	10.400	10.000	11.600	0.750	13.000	9.600	8.700
La (.008)				0.300			
Li (.004)	0.062	0.062	0.034		0.034	0.032	0.016
Mg (.06)				0.082	0.126		
Mn (.002)	0.004			0.146	0.019		
Mo (.01)	1.400	1.360	1.180	0.440	1.410	2.400	2.500
Na (.01)	91.000	92.000	118.000	0.880	120.000	190.000	186.000
Nd (.02)				0.077			
Ni (.02)				0.037	0.032		
P (.01)	0.130				0.250		0.600
Pb (.06)							
Ru (.05)							
Sb (.05)							
Si (.02)	23.000	22.000	29.200	9.810	32.000	60.000	56.000
Sr (.002)	0.059	0.030	0.006	0.027	0.030	0.006	
Te (.06)							
Ti (.002)				0.030			
Zn (.02)	0.067	0.132	0.178	0.740	0.210	0.184	0.400
Zr (.008)				0.009			
Cs (.005)	2.500	2.400	3.600	0.049	4.400	6.000	5.900
F (1.30)		2.000					
Cl (.015)	*	9.800	*	*	*	*	*
N02							
N03(.040)							
S04(.300)							
P04							

18A - 18 Angstrom Filtered Solution
AS - Acid Strip
UN - Unfiltered
0.45 μ - 45 microns Filtered Solution
50A - 50 Angstrom Filtered Solution
* - No Anion Analysis
(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA (GLASS, ROCK AND METAL), TUFF WATER
40,70,90,150°C, STATIC

TEST PARAMETERS	TU83-III90-E14	TU83-III90-E28
DATE RUN BEGAN	28-JUN-83	28-JUN-83
DATE RUN ENDED	12-JUL-83	25-JUL-83
SPECIMEN SA mm2	1945.79	1939.78
PARTICLE SIZE	-40+80	-40+80
SPECIMEN INI'L WT.(gm.)	.2905	.2899
SPECIMEN FIN'L WT.(gm.)	-	-
WEIGHT CHANGE (gm.)	-	-
LEACHANT INI'L VOL.	19.99	20.10
LEACHANT FIN'L VOL.	19.61	19.57
VOLUME CHANGE	0.38	0.53
INI'L pH AT 23°C	7.310	7.310
FIN'L pH AT 23°C	10.53	10.33
SA/V	97.238	96.506

ELEMENTAL ANALYSIS ^(a) (DET.LIM.)MG/LITER	TU83-III90E-14		TU83-III90-E28			
	AS	.45μ	18A	AS	50A	.45μ
Al (.03)	0.270	0.350	0.105	0.130	0.100	0.140
As (.08)						
B (.01)	0.099	37.000	45.10	0.220	45.30	47.000
Ba (.002)	0.031	0.008		0.026		0.009
Ca (.01)	0.092	0.280	0.244	0.080	0.198	0.240
Cd (.004)						
Ce (.04)						
Co (.01)						
Cr (.02)			0.006		0.006	0.028
Cu (.004)						
Dy (.004)						
Eu (.002)						
Fe (.005)	16.800	0.730	0.017	2.340	0.154	1.400
Gd (.01)						
K (.3)		11.600	9.00		9.300	
La (.008)	0.200			0.180		8.800
Li (.004)		0.009	0.004		0.004	0.005
Mg (.06)						
Mn (.002)	0.030	0.006		0.009	0.047	0.012
Mo (.01)	0.240	2.500	5.88	0.080	5.88	6.100
Na (.01)	0.350	190.000	222.00	0.850	250.00	320.000
Nd (.02)						
Ni (.02)					0.366	
P (.1)		0.530	0.321		1.03	1.100
Pb (.06)						
Ru (.05)						
Sb (.05)			0.025		0.022	
Si (.02)	3.070	60.000	90.600	1.630	92.000	93.000
Sr (.002)		0.017	0.006	0.019	0.006	0.016
Te (.06)						
Ti (.002)	0.052			0.085	0.026	
Zn (.02)	0.440	0.092	0.277	0.220	0.276	0.100
Zr (.008)	0.023			0.046		
Cs (.005)	0.037	6.200	4.500	0.064	4.800	5.300
F (1.30)	*	*	1.000		*	*
Cl (0.15)			7.200			
NO ₂						
NO ₃ (.040)			1.600			
SO ₄ (.300)						
PO ₄						

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

.45μ - 45 microns Filtered Solution

50A - 50 Angstrom Filtered Solution

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TEST
LEACH TEST DATA FOR TEST III (GLASS, ROCK, AND METAL)
40, 70, 90, 150°C, STATIC

TEST PARAMETERS	TU83-III150-3		TU83-III150-7	
DATE RUN BEGAN	31-JAN-83		31-JAN-83	
DATE RUN ENDED	3-FEB-83		7-FEB-83	
SPECIMEN SA mm2	142.317		140.450	
PARTICLE SIZE	MONOLITH		MONOLITH	
SPECIMEN INI'L WT.(gm)	0.279		0.266	
SPECIMEN FIN'L WT.(gm)	0.278		0.264	
WEIGHT CHANGE(gm)	0.001		0.002	
LEACHANT INI'L VOL.	14.230		14.050	
LEACHANT FIN'L VOL.	14.200		14.000	
VOLUME CHANGE	0.030		0.050	
INI'L pH AT 23 C	7.310		7.310	
FIN'L pH AT 23 C	8.410		8.510	
SA/V	10.001		9.996	
ELEMENTAL ANALYSIS(a)	TU83-III150-3		TU83-III150-7	
(DET. LIM)MG/LITER	18A	AS	18A	AS
Al (.03)	0.350	0.031	0.540	0.297
As (.08)				
B (.002)	4.000	0.162	4.500	0.282
Ba (.01)	0.009	0.003	0.02	0.007
Ca (.01)	1.400	1.470	2.040	2.650
Cd (.004)				
Ce (.04)				
Co (.01)				
Cr (.02)	0.100		0.100	
Cu (.004)	0.018	0.005	0.007	0.704
Dy (.004)				
Eu (.002)				
Fe (.005)	0.048	0.009	0.079	1.320
Gd (.01)				
K (.3)	5.700	0.211	9.300	0.534
La (.008)				0.011
Li (.004)	0.036		0.050	0.007
Mg (.06)	0.060	0.074	0.090	0.984
Mn (.002)	0.004			0.013
Mo (.01)	1.700	0.062	1.910	0.116
Na (.01)	45.000	1.760	56.000	3.690
Nd (.02)				
Ni (.02)				0.087
P (.1)				
Pb (.06)				
Ru (.05)				
Sb (.05)				
Si (.02)	64.000	2.850	68.000	5.630
Sr (.002)	0.054	0.012	0.087	0.020
Te (.06)				
Ti (.002)				0.002
Zn (.02)	0.810	0.022	0.340	0.596
Zr (.008)				
Cs (.005)	1.050	0.055	1.300	0.105
F (.130)				
CL (.015)				
NO2	*	*	*	*
NO3(.040)				
SO4(.300)				
PO4				

18A - 18 Angstrom Filtered Solution
AS - Acid Strip
UN - Unfiltered
0.45μ - 45 microns Filtered Solution
50A - 50 Angstrom Filtered Solution
* - No Anion Analysis
(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA (GLASS, ROCK AND METAL), TUFF WATER
40,70,90,150°C, STATIC

TEST PARAMETERS	TU83-III150-14			TU83-III150-28	
DATE RUN BEGAN	31-JAN-83			31-JAN-83	
DATE RUN ENDED	14-FEB-83			28-FEB-83	
SPECIMEN SA mm2	163.900			142.740	
PARTICLE SIZE	MONOLITH			MONOLITH	
SPECIMEN INI'L WT.(gm)	0.327			0.280	
SPECIMEN FIN'L WT.(gm)	0.325			0.278	
WEIGHT CHANGE(gm)	0.002			0.002	
LEACHANT INI'L VOL.	16.390			14.280	
LEACHANT FIN'L VOL.	16.080			14.160	
VOLUME CHANGE	0.310			0.120	
INI'L pH AT 23 C	7.310			7.310	
FIN'L pH AT 23 C	8.650			8.650	
SA/V	10.000			9.996	
ELEMENTAL ANALYSIS ^(a)					
(DET.LIM)MG/LITER	TU83-III150-14			TU83-III150-28	
	18A	UN	AS	18A	AS
Al (.03)	0.390	0.450	0.157	0.420	0.388
As (.08)					
B (.01)	9.510	9.760	0.011	11.800	0.107
Ba (.002)	0.013	0.020		0.035	0.012
Ca (.01)	1.690	1.860	0.402	4.400	0.388
Cd (.004)					
Ce (.04)					
Co (.01)					
Cr (.02)	0.227	0.230	0.068	0.240	0.056
Cu (.004)	0.005		0.202		0.230
Dy (.004)					
Eu (.002)					
Fe (.005)	0.011		0.479	0.015	0.277
Gd (.01)	0.018	0.032			
K (.3)	8.900	8.900		8.600	0.092
La (.008)					0.011
Li (.004)	0.058	0.060		0.053	
Mg (.06)			0.359		0.351
Mn (.002)				0.040	0.009
Mo (.01)	4.020	4.210		4.200	0.044
Na (.01)	81.000	81.000	0.327	130.000	1.230
Nd (.02)					
Ni (.02)			0.053	0.250	0.020
P (.1)			0.229		
Pb (.06)					
Ru (.05)					
Sb (.05)	0.072				
Si (.02)	122.000	139.000	0.602	130.000	2.310
Sr (.002)	0.083	0.090	0.004	0.220	0.008
Te (.06)					
Ti (.002)	0.002	0.003			0.011
Zn (.02)	0.618	0.700	0.512	0.620	0.437
Zr (.008)					0.018
Cs (.005)	2.590	2.590	0.005	2.900	0.048
F (1.30)					
Cl (.015)					
NO2					
NO3(.040)	*		*	*	*
SO4(.300)					
PO4					

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST III DATA (GLASS, ROCK AND METAL), TUFF WATER
40,70,90,150°C, STATIC

TEST PARAMETERS	TU83-III150-56				TU83-III150-91			
DATE RUN BEGAN	6-APR-83				6-APR-83			
DATE RUN ENDED	1-JUN-83				6-JUL-83			
SPECIMEN SA mm2	152.360				154.559			
PARTICLE SIZE	MONOLITH				MONOLITH			
SPECIMEN INI'L WT.(gm)	0.293				0.302			
SPECIMEN FIN'L WT.(gm)	--				.291			
WEIGHT CHANGE(gm)					0.011			
LEACHANT INI'L VOL.	15.260				15.490			
LEACHANT FIN'L VOL.	15.14				3.97			
VOLUME CHANGE	0.12				11.52**excess mass loss			
INI'L pH AT 23 C	7.310				7.310			
FIN'L pH AT 23 C	8.710				9.260			
SA/V	9.984				9.978			
ELEMENTAL ANALYSIS(a)	TU83-III150-56				TU83-III150-91			
(DET. LIM.)MG/LITER	18A	UN	50A	AS	18A	UN	50A	AS
Al (.03)	0.400	0.500	0.360	0.130	0.400	0.560	0.460	0.091
As (.08)								
B (.01)	12.620	12.780	12.680	0.011	17.040	18.000	17.600	0.011
Ba (.002)		0.012	0.010		0.012	0.032	0.026	
Ca (.01)	0.860	1.720	1.340	0.530	1.560	2.900	2.880	0.072
Cd (.004)					0.010			
Ce (.04)								
Co (.01)								
Cr (.02)	0.320	0.340	0.320		0.400	0.460	0.400	
Cu (.004)		0.018		0.032	0.042	0.182	0.044	0.280
Dy (.004)								
Eu (.002)								
Fe (.005)	0.040	0.260	0.082	0.229	0.048	0.396	0.600	0.076
Gd (.01)								
K (.3)	7.400	8.200	7.800		8.600	8.600	9.600	
La (.008)								
Li (.004)	0.058	0.054	0.058		0.060	0.060	0.060	
Mg (.06)		0.580		0.310		0.380	0.194	0.150
Mn (.002)		0.006		0.003		0.008	0.008	0.003
Mo (.01)	5.180	5.380	5.280		6.860	7.600	7.200	
Na (.01)	96.000	108.000	104	0.086	112.000	114.000	112.000	0.040
Nd (.02)								
Ni (.02)								
P (.1)							0.200	
Pb (.06)								
Ru (.05)								
Sb (.05)								
Si (.02)	156.000	156.000	154.000	0.840	150.000	158.000	152.000	0.460
Sr (.002)	0.026	0.088	0.062	0.006	0.066	0.184	0.130	
Te (.06)								
Ti (.002)		0.006						
Zn (.02)	0.540	0.560	0.340	0.520	0.660	1.114	0.600	0.430
Zr (.008)								
Cs (.005)	2.600	2.800	2.800	0.012	3.900	4.240	4.600	
F (1.30)					1.800			
Cl (.015)					5.000			
N02	*	*	*	*	0.200		*	*
N03(.040)					5.300	*		
S04(.300)					9.000			
P04								

18A - 18 Angstrom Filtered Solution

AS - Acid Strip

UN - Unfiltered

50A - 50 Angstrom Filtered Solution

* - No Anion Analysis

LLNL WASTE PACKAGE LEACH TEST IV DATA (TUFF ROCK MONOLITH) TUFF WATER, 90°C, STATIC

TEST PARAMETERS	TUIV-90-A7	TUIV-90-A14	TUIV-90-A28	TUIV-90-A56	TUIV-90-A91
DATE RUN BEGAN	11-APR-83	11-APR-83	11-APR-83	11-APR-83	11-APR-83
DATE RUN ENDED	18-APR-83	25-APR-83	9-MAY-83	6-JUN-83	11-JULY-83
LEACHANT VOL.	14.98	22.40	23.61	13.47	22.01
INI'L pH AT 23°C	7.310	7.310	7.310	7.310	7.310
FIN'L pH AT 23°C	9.005	9.275	9.389	9.457	9.662

ELEMENTS (DET.LIM)MG/LITER	TUIV-90-A7	TUIV-90-A14	TUIV-90-A28	TUIV-90-A56	TUIV-90-A91
Al (.03)	0.056	0.058	0.084	0.062	0.073
B (.01)	0.164	0.162	0.178	0.148	0.294
Ba (.002)		0.002		0.004	
Ca (.01)	4.795	4.080	4.381	13.199	3.607
Ce (.04)					
Fe (.005)	0.009	0.008	0.011	0.006	0.070
K (.3)	7.752	7.944	6.660	4.981	8.720
Li (.004)	0.044	0.047	0.044	0.050	0.049
Mg (.06)	0.281	0.139	0.090		0.147
Mn (.002)					
Mo (.01)	0.014	0.017	0.013	0.015	0.016
Na (.01)	48.520	49.116	54.430	49.693	56.102
P (.1)					
Pb (.06)					
Si (.02)	37.350	39.328	43.888	52.190	66.424
Sm					
Sr (.002)	0.034	0.032	0.031	0.043	0.029
Ti (.002)					
Zr (.008)					
Cs (.005)					
F (.130)	*	2.700	2.600	1.900	*
Cl (.015)	*	8.500	16.700	15.500	
NO3(.040)	*	11.500	11.000	8.000	
SO4(.300)	*	22.000	19.000	11.500	
NO2					
PO4					

LLNL WASTE PACKAGE LEACH TEST IV DATA (TUFF ROCK POWDER) TUFF WATER, 90°C, STATIC

TEST PARAMETERS	TU83-IV90-B3	TU83-IV90-B7	TU83-IV90-B14	TU83-IV90-B28	TU83-IV90-B56	TU83-IV90-B91
DATE RUN BEGAN	15-APRIL-83	14-APRIL-83	14-APRIL-83	14-APRIL-83	14-APRIL-83	14-APRIL-83
DATE RUN ENDED	18-APRIL-83	21-APRIL-83	28-APRIL-83	12-MAY-83	9-JUNE-83	14-JULY-83
LEACHANT VOL.	20.00	20.02	20.01	20.01	20.00	20.02
INI'L pH AT 23 C	7.310	7.310	7.310	7.310	7.310	7.310
FIN'L pH AT 23 C	8.525	8.737	9.648	9.161	9.435	9.462
ELEMENTAL ANALYSIS (DELT.LIM)MG/LITER	TU83-IV90-B3	TU83-IV90-B7	TU83-IV90-B14	TU83-IV90-B28	TU83-IV90-B56	TU83-IV90-B91
Al (.03)	1.400	1.760		1.200	2.400	2.400
B (.01)	0.184	0.190		0.200	0.280	0.370
Ba (.002)						
Ca (.01)	7.800	6.600		4.600	4.800	5.400
Cr (.02)						
Cu (.004)						
Dy (.004)						
Fe (.005)	0.110	0.110		0.097	0.140	0.200
K (.300)	9.000	9.700		8.400	9.700	9.800
La (.008)						
Li (.004)	0.044	0.050		0.050	0.051	
Mg (.06)	0.720	0.730		0.160	0.340	0.510
Mn (.002)						
Mo (.01)						
Na (.01)	50.700	53.200		53.400	58.000	61.000
Ni (.02)						
P (.100)						
Si (.02)	37.400	39.800		42.200	52.000	54.000
Sr (.002)	0.082	0.074		0.055	0.058	0.060
Ti (.002)						
Zn (.02)						
Zr (.008)						
F (.130)	2.700	3.000		2.700	*	6.600
Cl (.015)	11.600	12.000		10.500	*	11.700
NO3(.040)	23.800	29.000		25.000	*	26.700
SO4(.300)	25.300	25.000		25.000	*	26.700

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST IV DATA (TUFF ROCK POWDER) TUFF WATER

TEST PARAMETERS	TU83-IV40-CP1	TU83-IV70-CP1	TU83-IV90-CP1	TU83-IV150-CP1	TU83-IV23-PO
DATE RUN BEGAN	18-APRIL-83	18-APRIL-83	18-APRIL-83	19-APRIL-83	ELAPSED TIME=
DATE RUN ENDED	19-APRIL-83	19-APRIL-83	19-APRIL-83	20-APRIL-83	5.0 MIN.
LEACHANT VOL.	20.05	20.02	20.05	15.00	20.00
INI'L pH AT 23 C	7.310	7.210	7.310	7.310	7.310
FIN'L pH AT 23 C	8.148	8.315	9.247	7.841	8.129
ELEMENTAL ANALYSIS	TU83-IV40-CP1	TU83-IV70-CP1	TU83-IV90-CP1	TU83-IV150-CP1	TU83-IV23-PO
Al (.03)	0.020	0.200	0.220	1.240	0.224
B (.08)	0.210	0.200	0.200	0.200	0.170
Ca (.01)	12.800	13.000	9.400	7.400	19.534
Fe (.005)	0.010	0.164	0.240	0.096	0.207
K (.3)	66.400	15.900	19.400	9.600	7.861
Li (.004)	0.048	0.054	0.052	0.050	0.044
Mg (.06)	80.000	14.300	16.000	2.140	3.128
Na (.01)	136.700	63.400	69.400	53.000	53.630
Si (.02)	29.900	31.800	32.500	53.900	31.286
Sr (.002)	0.062	0.060	0.052	0.048	0.128
F (.130)	2.200	3.600	2.500	4.800	2.200
Cl (.015)		81.000	105.000	24.000	11.900
NO3 (.040)	11.900	13.100	13.100	14.300	33.300
SO4 (.300)	17.700	17.700	17.700	17.700	27.900

LLNL WASTE PACKAGE TESTS LEACH TEST IV DATA (TUFF ROCK MONOLITH) TUFF WATER

TEST PARAMETERS	TU83-IV40-CM1	TU83-IV70-CM1	TU83-IV90-CM1	TU83-IV150-CM1	TU83-IV23-MO
DATE RUN BEGAN	18-APRIL-83	18-APRIL-83	18-APRIL-83	19-APRIL-83	ELAPSED TIME=
DATE RUN ENDED	19-APRIL-83	19-APRIL-83	19-APRIL-83	20-APRIL-83	5.0 MIN.
LEACHANT VOL.	15.20	15.40	16.23	15.23	20.57
INI'L pH AT 23 C	7.310	7.310	7.310	7.310	7.310
FIN'L pH AT 23 C	8.281	8.476	9.038	7.677	7.899
ELEMENTAL ANALYSIS	TU83-IV40-CM1	TU83-IV70-CM1	TU83-IV90-CM1	TU83-IV150-CM1	TU83-IV23-MO
Al (.03)		0.100	0.250	0.660	0.112
B (.08)	0.160	0.160	0.180	0.160	0.159
Ca (.01)	12.200	12.800	12.000	5.800	12.728
Fe (.005)	0.370	0.020	0.010	0.100	0.037
K (.3)	5.500	5.800	7.400	7.200	5.113
Li (.004)	0.044	0.047	0.055	0.051	0.046
Mg (.06)	2.000	2.000	1.650	0.500	2.064
Na (.01)	47.200	47.900	49.600	48.200	46.218
Si (.02)	29.400	30.500	32.300	39.500	29.386
Sr (.002)	0.044	0.049	0.046	0.036	0.043
F (.130)	1.900	1.900	2.700	3.900	1.900
Cl (.015)	8.100	7.400	8.200	7.800	7.700
NO3 (.040)	9.500	10.700	10.700	11.900	9.500
SO4 (.300)	16.200	17.700	17.700	16.200	16.200

LLNL WASTE PACKAGE LEACH TEST IV DATA (TUFF ROCK MONOLITH) TUFF WATER, 90°C, STATIC

TEST PARAMETERS	TU83-IV90-D3	TU83-IV90-D7	TU83-IV90-D14	TU83-IV90-D28	TU83-IV90-D56	TU83-IV90-D91
DATE RUN BEGAN	19-APRIL-83	3-MAY-83	19-APRIL-83	19-APRIL-83	19-APRIL-83	19-APRIL-83
DATE RUN ENDED	22-APRIL-83	10-MAY-83	3-MAY-83	17-MAY-83	14-JUNE-83	19-JULY-83
LEACHANT VOL.	19.61	20.74	19.65	19.64	19.61	19.62
INIT'L pH AT 23 C	7.310	7.310	7.310	7.310	7.310	7.310
FINAL pH AT 23 C	8.573	9.180	9.145	9.314	9.509	9.649

ELEMENTAL ANALYSIS	TU83-IV90-D3	TU83-IV90-D7	TU83-IV90-D14	TU83-IV90-D28	TU83-IV90-D56	TU83-IV90-D91
Al (.03)		0.040	0.040	0.060	0.110	0.070
B (.01)	0.150	0.180	0.160	0.170	0.357	0.260
Ba (.002)						
Ca (.01)	9.500	7.200	3.700	3.900	2.670	2.800
Cr (.02)						
Cs (.005)						
Cu (.004)						
Fe (.005)	0.010	0.010	0.010	0.160	0.050	0.251
K (.300)	5.200	7.700	5.600	6.000	5.702	6.300
La (.008)						
Li (.004)	0.043	0.044	0.046	0.050	0.043	
Mg (.06)	1.027	0.100	0.100	1.000		
Mn (.002)						
Mo (.01)			0.012		0.018	
Na (.01)	47.500	50.000	49.000	48.000	50.877	61.000
Ni (.02)			0.003			
P (.100)						
Si (.100)	31.000	35.200	41.300	41.400	48.300	61.000
Sr (.02)	0.040	0.036	0.029	0.033	0.022	0.023
Ti (.002)						
Zn (.002)						
Zr (.02)						
F (.008)	2.500	2.800	1.500	1.100	*	*
Cl (.130)	8.000	5.000	4.300	4.200		
NO3 (.040)	12.500	14.000		7.000		
SO4 (.300)	20.000	19.000		14.000		

* - No Anion Analysis

LLNL WASTE PACKAGE LEACH TEST IV DATA (TUFF ROCK POWDER) TUFF WATER, 90°C, STATIC

TEST PARAMETERS	TU83-IV90-E3	TU83-IV90-E7	TU83-IV90-E14	TU83-IV90-E28	TU83-IV90-E56	TU83-IV90-E91
DATE RUN BEGAN	22-APRIL-83	21-APRIL-83	21-APRIL-83	21-APRIL-83	21-APRIL-83	21-APRIL-83
DATE RUN ENDED	25-APRIL-83	28-APRIL-83	4-MAY-83	19-MAY-83	16-JUNE-83	21-JULY-83
LEACHANT VOL.	20.04	20.00	20.02	20.01	20.01	20.00
INIT'L pH AT 23 C	7.310	7.310	7.310	7.310	7.310	7.310
FINAL pH AT 23 C	9.628	8.728	9.232	9.250	9.466	9.282

ELEMENTAL ANALYSIS	TU83-IV90-E3	TU83-IV90-E7	TU83-IV90-E14	TU83-IV90-E28	TU83-IV90-E56	TU83-IV90-E91
Al (.03)	0.120	0.200	0.250	0.210	0.190	0.180
B (.01)	0.150	0.150	0.160	0.180	0.436	0.250
Ba (.002)						
Ca (.01)	8.100	3.400	4.000	3.200	3.100	5.000
Cr (.02)						
Cs (.005)						
Cu (.004)						
Fe (.005)	0.010	0.020	0.010	0.007	0.056	0.051
K (.300)	5.100	5.300	5.700	5.200	5.100	5.100
La (.008)						
Li (.004)	0.045	0.047	0.053	0.050	0.045	
Mg (.06)	0.380	0.170	0.500	0.040	0.060	
Mn (.002)						
Mo (.01)					0.010	
Na (.01)	49.800	50.200	52.000	51.000	52.000	51.000
Ni (.02)					0.002	
P (.100)						
S (.100)				8.500	8.609	8.600
Si (.02)	31.000	35.000	39.000	42.000	48.000	49.000
Sr (.002)	0.041	0.031	0.033	0.027	0.031	0.037
Ti (.002)						
Zn (.02)						
Zr (.008)						
F (.130)	2.500	2.500	2.600	2.900		
Cl (.015)	10.000	9.500	6.600	6.500		
NO3 (.040)	12.500	15.000	19.000	11.000	*	*
SO4 (.300)	22.000	22.000		19.000		

* - No Anion Analysis

LLNL WASTE PACKAGE LEACH TEST IV DATA (GLASS AND ROCK), TUFF WATER, 90°C, STATIC

TEST PARAMETERS	TU83-IV90-F3	TU83-IV90-F7	TU83-IV90-F14
DATE RUN BEGAN	9-MAY-83	9-MAY-83	9-MAY-83
DATE RUN ENDED	12-MAY-83	16-MAY-83	23-MAY-83
LEACHANT VOL.	19.80	20.29	19.22
INIT'L pH AT 23 C	7.310	7.310	7.310
INIT'L pH AT 90 C	8.770	9.190	9.330

ELEMENTAL ANALYSIS	TU83-IV90-F3			TU83-IV90-F7			TU83-IV90-F14
	18A	UN	AS	18A	UN	AS	18A
Al (.03)	0.075	0.057	0.216	0.056	0.116	0.049	0.090
As (.08)							
B (.002)	0.859	0.866	0.013	1.520	1.530	0.018	2.030
Ba (.002)	0.031	0.037	0.003	0.022	0.028		0.021
Ca (.01)	7.220	8.380	2.290	5.070	5.900	0.405	4.940
Cd (.004)							
Ce (.04)							
Co (.01)							
Cr (.02)							
Cu (.004)							
Dy (.004)							
Eu (.002)							
Fe (.005)	0.054	0.069	0.287	0.064	0.023	0.151	0.015
Gd (.01)	0.072	0.064		0.058	0.062		0.043
K (.3)	5.990	5.940		6.500	5.940		6.720
La (.008)	0.015	0.014		0.010	0.012		0.009
Li (.004)	0.044	0.048	0.004	0.048	0.044		0.044
Mg (.06)	0.624	0.700	0.857	0.222	0.171	0.354	0.083
Mn (.002)			0.006			0.003	
Mo (.01)	0.319	0.324		0.603	0.609		0.833
Na (.01)	49.000	49.000	0.375	52.300	49.100	0.084	53.800
Nd (.02)							
Ni (.02)							
P (.1)							
Pb (.06)							
Ru (.05)							
Sb (.05)							
Si (.02)	30.600	31.600	1.080	35.300	35.100	0.536	38.400
Sr (.002)	0.081	0.097	0.005	0.086	0.109	0.002	0.088
Te (.06)							
Ti (.002)							
Zn (.02)	0.266		0.109	0.190	0.019	0.101	0.167
Zr (.008)				0.016	0.004		0.001
Cs (.005)	0.225	0.220		0.370	0.370		0.500
F (1.30)	2.300			3.100			2.500
Cl (.015)	8.200			7.800			8.400
NO2		*	*	1.500	*	*	0.400
NO3(.040)	8.800			9.600			16.200
SO4(.300)	20.700			20.300			17.500
PO4							

18A - 18 Angstrom Filtered Solution
AS - Acid Strip
UN - Unfiltered
0.45μ - 45 microns Filtered Solution
50A - 50 Angstrom Filtered Solution
* - No Anion Analysis
(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE LEACH TEST IV DATA (GLASS AND ROCK), TUFF WATER, 90°C, STATIC

TEST PARAMETERS	TU83-IV90-F56		TU83-IV90-F91			
DATE RUN BEGAN	10-MAY-83		9-MAY-83			
DATE RUN ENDED	5-JULY-83		8-AUGUST-83			
LEACHANT VOL.	19.71		21.16			
INIT'L pH AT 23 C	7.310		7.310			
FIN'L pH AT 23 C	9.310		9.305			

ELEMENTAL ANALYSIS	TU83-IV90-F56		TU83-IV90-F91			
	50A	AS	18A	UN	50A	AS
Al (.03)	0.110	0.050	0.040	0.120	0.084	0.010
As (.08)						
B (.01)	4.160	0.043	5.030	5.060	5.000	
Ba (.002)	0.006	0.005	0.006	0.008	0.005	
Ca (.01)	2.500	0.188	1.640	2.860	1.826	0.105
Cd (.004)						
Ce (.04)						
Co (.01)						
Cr (.02)			0.088	0.090	0.080	
Cu (.004)						
Dy (.004)						
Eu (.002)						
Fe (.005)	0.018	0.187	0.040	0.129	0.020	0.087
Gd (.01)						
K (.3)	7.140		6.640	6.140	6.200	
La (.008)						
Li (.004)	0.060	0.004	0.055	0.054	0.054	
Mg (.06)	0.050	0.334	0.006			0.155
Mn (.002)		0.004				
Mo (.01)	1.718	0.020	2.080	2.140	2.000	
Na (.01)	70.600	0.587	69.500	69.000	70.000	0.073
Nd (.02)						
Ni (.02)						
P (.1)						
Pb (.06)						
Ru (.05)						
Sb (.05)						
Si (.02)	51.400	1.220	55.000	56.600	55.000	0.585
Sr (.002)	0.056	0.007	0.050	0.112	0.042	
Te (.06)						
Ti (.002)						
Zn (.02)	0.200	0.363	0.279			0.299
Zr (.008)						
Cs (.005)	0.980	0.010	0.960	1.000	0.960	
F (1.30)			5.400			
Cl (.015)			7.600			
N02						
N03(.040)			10.400			
S04(.300)	*	*	19.000	*	*	*
P04						

18A - 18 Angstrom Filtered Solution
AS - Acid Strip
UN - Unfiltered
0.45u - 45 microns Filtered Solution
50A - 50 Angstrom Filtered Solution
* - No Anion Analysis
(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE LEACH TEST IV DATA (GLASS AND ROCK), TUFF WATER, 90°C, STATIC

TEST PARAMETERS	TU83-IV90-G3	TU83-IV90-G7	TU83-IV90-G14
DATE RUN BEGAN	14-JUNE-83	18-MAY-83	18-MAY-83
DATE RUN ENDED	17-JUNE-83	25-MAY-83	1-JUNE-83
LEACHANT VOL.	20.15	18.61	20.62
INI'L pH AT 23 C	7.310	7.310	7.310
FIN'L pH AT 23 C	9.820	9.520	9.870

ELEMENTAL ANALYSIS	TU83-IV90-G3			TU83-IV90-G7			TU83-IV90-G14
	18A	UN	AS	18A	UN	AS	18A
Al (.03)	0.270	0.260	7.300	0.146	0.149	6.620	0.176
As (.08)							
B (.01)	0.380	0.386	0.023	0.882	0.881	0.010	1.120
Ba (.002)							
Ca (.01)	2.640	3.400	2.330	17.640	18.700	2.350	2.180
Cd (.004)							
Ce (.04)							
Co (.01)							
Cr (.02)							
Cu (.004)							
Dy (.004)							
Eu (.002)							
Fe (.005)	0.045	0.020	0.459	0.026	0.012	0.383	
Gd (.01)				0.010	0.018		
K (.3)	6.600	6.520	4.580	15.140	14.900	3.700	6.600
La (.008)							
Li (.004)	0.058	0.056	0.003	0.064	0.065	0.003	0.060
Mg (.06)							
Mn (.002)			0.033	0.002	0.002	0.036	
Mo (.01)	0.094	0.097	0.005	0.298	0.289		0.392
Na (.01)	54.000	57.600	4.870	69.800	65.300	3.330	60.000
Nd (.02)							
Ni (.02)							
P (.1)							
Pb (.06)							
Ru (.05)							
Sb (.05)							
Si (.02)	37.000	37.600	22.900	38.600	38.000	17.200	51.000
Sr (.002)	0.030	0.042	0.007	0.224	0.241	0.006	0.038
Te (.06)							
Ti (.002)				0.004			
Zn (.02)	0.140	0.021	0.038	0.316	0.026	0.020	0.184
Zr (.008)				0.040			
Cs (.005)	0.082	0.072		0.200	0.200		0.288
F (1.30)	0.300			1.500			1.600
Cl (.015)	0.900			8.000			5.800
NO2	0.200			0.700			0.100
NO3(.040)	10.800	*	*	37.700	*	*	8.200
SO4(.300)	20.000			14.500			10.000
PO4							

18A - 18 Angstrom Filtered Solution
 AS - Acid Strip
 UN - Unfiltered
 0.45u - 45 microns Filtered Solution
 50A - 50 Angstrom Filtered Solution
 * - No Anion Analysis
 (a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE LEACH TEST IV DATA (GLASS AND ROCK), TUFF WATER, 90°C, STATIC

TEST PARAMETERS	TU83-IV90-G56		TU83-IV90-G91			
DATE RUN BEGAN	18-MAY-83		18-MAY-83			
DATE RUN ENDED	13-JULY-83		17-AUGUST-83			
LEACHANT VOL.	15.51		17.35			
INI'L pH AT 23 C	7.310		7.310			
FIN'L pH AT 23 C	9.200		9.370			
ELEMENTAL ANALYSIS	TU83-IV90-G56		TU83-IV90-G91			
	50A	AS	UN	18A	50A	AS
Al (.03)	0.120	1.900				3.100
As (.08)						
B (.01)	1.900	0.033	3.400	3.200	3.200	0.050
Ba (.002)						
Ca (.01)	3.200	1.240	4.800	2.600	3.800	0.440
Cd (.004)						
Ce (.04)						
Co (.01)						
Cr (.02)						
Cu (.004)						
Dy (.004)						
Eu (.002)						
Fe (.005)	0.396	0.112	0.060	0.084	0.190	0.190
Gd (.01)						
K (.3)	6.000	0.897	5.800	5.800	5.400	0.300
La (.008)						
Li (.004)	0.052		0.058	0.055	0.050	
Mg (.06)						
Mn (.002)						
Mo (.01)	1.208		1.400	1.300	1.300	
Na (.01)	62.600	1.470	62.000	58.000	60.000	2.000
Nd (.02)						
Ni (.02)						
P (.1)						
Pb (.06)						
Ru (.05)						
Sb (.05)						
Si (.02)	50.200	5.840	61.200	54.800	59.200	10.400
Sr (.002)	0.138	0.005	0.148	0.070	0.104	0.005
Te (.06)						
Ti (.002)						
Zn (.02)	0.729	0.029	0.030	0.095	0.081	0.045
Zr (.008)						
Cs (.015)	1.030	0.015				
F (1.30)						
Cl (.015)						
N02						
N03(.040)	*	*	*	*	*	*
S04(.300)						
P04						

18A - 18 Angstrom Filtered Solution
 AS - Acid Strip
 UN - Unfiltered
 0.45µ - 45 microns Filtered Solution
 50A - 50 Angstrom Filtered Solution
 * - No Anion Analysis
 (a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE LEACH TEST IV DATA (TUFF WATER ONLY), 90°C, STATIC

TEST PARAMETERS	TU83-IV90-3	TU83-IV90-7	TU83-IV90-14	TU83-IV90-28	TU83-IV90-56	TU83-IV90-91
DATE RUN BEGAN	20-MAY-83	19-MAY-83	19-MAY-83	19-MAY-83	19-MAY-83	19-MAY-83
DATE RUN ENDED	23-MAY-83	26-MAY-83	2-JUNE-83	16-JUNE-83	7-JULY-83	8-AUGUST-83
LEACHANT VOL.	40.00	40.02	40.01	40.01	40.00	40.00
INI'L pH AT 23 C	7.310	7.310	7.310	7.310	7.310	7.310
FIN'L pH AT 23 C	9.015	9.084	9.267	9.065	9.185	8.980

ELEMENTAL ANALYSIS ^(a) (DET.LIM.)mg/LITER	TUFF WATER	TU83-IV90-3	TU83-IV90-7	TU83-IV90-14	TU83-IV90-28	TU83-IV90-56	TU83-IV90-91
Al (.03)							
As (.08)							
B (.01)	0.130	0.142	0.180	0.165	0.148	0.148	0.199
Ba (.002)			0.004	0.003		0.004	
Ca (.01)	13.300	12.419	12.426	13.460	12.210	13.199	13.365
Ce (.04)						0.052	
Fe (.005)			0.052	0.022	0.029	0.006	
Gd (.01)		0.004	0.003			0.006	
K (.30)	4.900	4.642	4.764	4.716	4.705	4.981	4.759
Li (.004)	0.046	0.047	0.048	0.047	0.043	0.050	0.048
Mg (.06)	1.91	1.920	1.027	0.140	0.044	2.111	0.032
Mn (.002)						0.412	
Mo (.01)							
Na (.01)	42.5	47.480	47.745	48.011	49.566	49.693	48.630
Pb (.06)							
Se (.1)							
Si (.02)	27.7	30.142	29.589	28.379	28.884	32.190	28.570
Sr (.002)	0.040	0.042	0.041	0.035	0.033	0.043	0.036
Te (.06)							
Ti (.002)	*						
V (.005)							
F (.130)		2.300	1.800	1.600	*	*	*
Cl (.015)		6.500	4.000	4.200			
NO ₃ (.015)		12.000	6.500	6.500			
SO ₄ (.040)		22.000	11.500	10.500			

* - No Anion Analysis

(a) - Blanks Indicate Elements Below Detection Limits

LLNL WASTE PACKAGE TESTS LEACH TEST I DATA
GLASS ONLY), TUFF WATER

SAMPLE NO.	Uranium	PPM
TU83-40-3		0.026
TU83-40-7		0.066
TU83-40-28		0.100
TU83-40-56		0.104
TU83-140-91		0.122
TU83-140-182		0.118
TU83-170-3		0.414
TU83-170-7		0.727
TU83-170-28		---
TU83-170-56		1.625
TU83-170-91		2.171
TU83-170-182		0.627
TU83-190-3		0.517
TU83-190-7		0.496
TU83-190-14		0.582
TU83-190-28		0.652
TU83-190-56		0.650
TU83-190-91		0.520
TU83-190-182		0.274
TU83-1150-3		0.344
TU83-1150-7		0.357
TU83-1150-14		0.933
TU83-1150-28		1.333
TU83-1150-96		1.360

LLNL WASTE PACKAGE TESTS LEACH TEST II DATA (GLASS AND ROCK), TUFF WATER

SAMPLE NO.	Uranium	PPM	SAMPLE NO.	Uranium	PPM
TU83-1140-3		0.016	TU83-1190-C7		0.015
TU83-1140-7		0.026	TU83-1190-C14		0.012
TU83-1140-28		0.046	TU83-1190-C28		0.018
TU83-1140-56		0.069	TU83-1190-C56		0.014
TU83-1140-91		0.102	TU83-1190-C91		0.028
TU83-1140-182		0.055	TU83-1190-C182		0.049
TU83-1170-3		0.026	TU83-1190-D3		0.066
TU83-1170-7		0.221	TU83-1190-D7		0.058
TU83-1170-28		0.118	TU83-1190-D14		0.072
TU83-1170-56		0.886	TU83-1190-D28		0.105
TU83-1170-91		0.713	TU83-1190-D56		0.190
TU83-1170-182		0.420	TU83-1190-D91		0.100
TU83-1190-A3		0.244	TU83-1190-D182		0.104
TU83-1190-A7		0.212	TU83-1190-E3		0.015
TU83-1190-A14		0.410	TU83-1190-E7		0.005
TU83-1190-A28		0.345	TU83-1190-E14		0.002
TU83-1190-A56		0.500	TU83-1190-E28		0.001
TU83-1190-A91		0.455	TU83-1190-E56		0.002
TU83-1190-A182		0.418	TU83-1190-E91		0.004
TU83-1190-B3		0.015	TU83-1190-E182		0.008
TU83-1190-B7		0.015	TU83-11150-3		0.344
TU83-1190-B14		0.021	TU83-11150-7		0.467
TU83-1190-B28		0.027	TU83-11150-14		0.530
TU83-1190-B56		0.083	TU83-11150-28		0.903
TU83-1190-B91		0.055	TU83-11150-56		
TU83-1190-B182		0.031	TU83-11150-91		0.576
TU83-1190-C3		0.021			

LLNL WASTE PACKAGE TEST LEACH TEST DATA FOR TEST III (GLASS + TUFF
ROCK + METAL) 40,70,90,& 150 C, STATIC, URANIUM

SAMPLES	PPM
TU83-III40-3	0.017
TU83-III40-7	0.020
TU83-III40-14	0.026
TU83-III40-28	0.027
TU83-III40-91	0.066
TU83-III40-182	0.053
TU83-III70-3	0.040
TU83-III70-7	0.070
TU83-III70-14	0.168
TU83-III70-28	0.525
TU83-III70-56	1.350
TU83-III70-182	0.600
TU83-III90-A3	0.291
TU83-III90-A7	0.138
TU83-III90-A14	0.312
TU83-III90-A56	0.535
TU83-III90A-91	0.477
TU83-III90-A182	0.175
TU83-III90-B3	0.085
TU83-III90-B7	0.097
TU83-III90-B14	0.094
TU83-III90-B28	0.089
TU83-III90-B56	0.079
TU83-III90-B91	0.040
TU83-III90-B182	0.066
TU83-III90-C3	0.167
TU83-III90-C7	0.307
TU83-III90-C14	0.457
TU83-III90-C28	0.710
TU83-III90-C56	0.469
TU83-III90-C182	0.372
TU83-III90-D3	0.144
TU83-III90-D7	0.383
TU83-III90-D14	0.360
TU83-III90-D28	0.542
TU83-III90-D56	0.500
TU83-III90-D91	0.429
TU83-III90-D182	0.246
TU83-III150-3	0.400
TU83-III150-7	0.263
TU83-III150-14	0.240
TU83-III150-28	0.639
TU83-III150-56	0.354
TU83-III150-91	0.533

DISTRIBUTION

No. of
Copies

OFFSITE

3 Dr. V. M. Oversby
Lawrence Livermore National Laboratory
P. O. Box 808
Livermore, California 94550

2 DOE Technical Information Center

ONSITE

DOE Richland Operations Office

H. E. Ransom

8 Pacific Northwest Laboratory

G. L. McVay (2)
G. R. Robinson
R. P. Turcotte
M. R. Kreiter
Technical Information (2)
Publishing Coordination