This document was prepared in conjunction with work accomplished under Contract No. DE-AC09-96SR18500 with the U. S. Department of Energy.

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Revision 0

THE IMPACTS OF URANIUM AND THORIUM ON THE DEFENSE WASTE PROCESSING FACILITY (DWPF) VISCOSITY MODEL (U)

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February 2005

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Key Words: *DWPF, glass viscosity, process control*

Retention: Permanent

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EXECUTIVE SUMMARY

The Defense Waste Processing Facility (DWPF) at the Savannah River Site (SRS) vitrifies high level liquid waste (HLLW) into borosilicate glass for stabilization and permanent disposal. The viscosity of the borosilicate glass melt as a function of temperature is the single most important variable affecting the melt rate and pour ability of the glass. The viscosity determines the rate of melting of the raw feed, the rate of glass bubble release (foaming and fining), the rate of homogenization, the adequacy of heat transfer, the devitrification rate, and thus, the quality (in terms of glass homogeneity) of the final glass product. If the viscosity is too low, excessive convection currents can occur during melting, increasing corrosion/erosion of the melter materials of construction (refractory and electrodes) and making control of the melter more difficult. The lowest glass viscosities allowed in the DWPF melter have, therefore, been determined to be ~20 poise. DWPF glasses must pour continuously into a large steel canister for ultimate storage in a geologic repository, but glasses with a viscosity ≥500 poise do not readily pour. Moreover, too high a viscosity can reduce product quality by causing voids in the final glass. A conservative range of 20-110 poise at a melt temperature, T_{melt} or T_m, of 1150°C was, therefore, established for DWPF production.

Since measurement of glass viscosity is difficult and lengthy, routine measurement of this parameter on radioactive waste glasses during DWPF glass production is unachievable. A glass viscosity model was developed for the DWPF in 1991 in order to relate parameters that could easily be measured, e.g. glass composition and melt temperature, to both the glass viscosity and glass resistivity. The current DWPF viscosity model was developed based on the as-batched compositions of 41 glasses including pure frits because the glasses had not yet been analyzed. The viscosities used to develop the model were measured by two commercial laboratories, Owens Corning Fiberglass (OCF) and the Corning Engineering Laboratory Services (CELS). Large batches of glass were fabricated at Savannah River National Laboratory (SRNL) and the same glass was sent to each laboratory. The OCF laboratory used the ASTM C965A procedure and CELS laboratory used the ASTM C965B procedure. The model was developed using the OCF measurements and validated using the CELS measurements.

The DWPF viscosity modeling approach used in 1991 was based on glass structural considerations, expressed as a calculated non-bridging oxygen (NBO) term. The DWPF viscosity model assumes that if DWPF glass were a pure SiO_2 glass that it would be fully polymerized, e.g. there would be no NBO bonds. In the DWPF viscosity model it is assumed that each mole of alkali oxide added creates two NBO, thus depolymerizing the glass. The DWPF viscosity model further assumes that each mole of Al_2O_3 creates two bridging oxygen (BO) bonds (polymerizes the glass structure), that each mole of Fe_2O_3 creates two NBO, and that each mole of B_2O_3 creates one NBO.

Radioactive glasses were not included in the development of the 1991 DWPF viscosity model because OCF and CELS could not handle radioactive glasses. Moreover, the open literature indicated that U^{+6} in silicate glasses is present as the uranyl ion, UO_2^{2+} which

simultaneously acts as a network former and a network modifier, e.g. of the six existing U-O bonds, two are short and four are long. The two short U-O_{axial} bonds cannot polymerize with Si in the glass network and thus act as network modifiers while the four longer U-$O_{equatorial}$ bonds bond with Si and act as bridging oxygens. Thus, the U^{+6} forms $(UO_2)O_4$ polyhedra in the glass and may slightly polymerize the glass at a ratio of 4:2 or 0.66:0.33. Since the polymerization ratio is close to 0.5:0.5, the effect on viscosity was predicted to be very small unless the concentration of U^{+6} in the glass is large. However, U^{+4} is bonded to at least one network modifier and to one network former. Therefore, the overall net effect is that U^{+4} neither polymerizes nor depolymerizes the glass network. There is some ambiguity about how Th^{+4} is connected to a silicate glass network. However, the literature suggests that Th^{+4} may likely act as a weak network modifier which could make high Th^{+4} containing glasses more fluid.

The SRNL developed radioactive viscosity measurement capability in 1998. Multiple viscosity measurements indicated an accuracy of the measurements to within 10% of the values obtained by OCF and CELS in the 1000-1200°C range and a relative standard deviation of ~2% at the DWPF melt temperature of 1150°C. During a multi-laboratory round robin of the DWPF startup frit, the SRNL viscosity values were determined to be biased ~ 9% higher than those generated by OCF and CELS.

During the investigation of the impact of Crystalline Silicotitanate (CST) resin on DWPF glass properties, the viscosities of uranium bearing glasses and non-uranium bearing glasses were measured at SRNL. These studies concluded that the DWPF viscosity model slightly under predicted the viscosities measured at 1150ºC when uranium was present in the glass. Two other studies, indicated that the DWPF viscosity model slightly over predicted the viscosities measured at SRNL on glasses containing uranium. These assessments were made by measuring the glass viscosities at various temperatures, fitting a Fulcher equation to the data, and assessing the viscosity at one temperature, the nominal DWPF melt temperature of 1150°C. One of the SRNL studies also indicated that the presence of thorium in a glass appeared to have minimal impact and was not of a practical concern but that there was some indication that thorium slightly increased viscosity.

The role of oxidized uranium (U^{+6}) and thorium (Th^{+4}) on DWPF glass viscosity is, therefore, investigated in this study for the glasses used in the original 1991 model and the subsequent data generated by SRNL on radioactive and non-radioactive glasses. This included an analysis of the DWPF startup frit being used as a viscosity standard since this glass is known to crystallize and show non-Newtonian behavior below 1050°C which can cause bias in the viscosity measurement and subsequently in the viscosity-temperature curve fitting.

It is the focus of this study to determine if an additional NBO term is needed to account for potential impacts of (U^{+6}) and thorium (Th^{+4}) in the glass. The role of U^{+4} cannot be assessed in the current study as none of the glasses containing uranium were sufficiently reduced to contain any U^{+4}. The approach taken in this study to assess the current DWPF viscosity model and the need for a U^{+6} and/or a Th^{+4} term included the following:

- determined that the 1991 DWPF PCCS viscosity model is biased due to six as-batched glass compositions that were found to be misbatched when the glasses were analyzed and two glasses that were determined to be phase separated in 1995: phase separated glasses can give anomalous viscosity response

- determined that the magnitude of the bias in the 1991 DWPF viscosity model based on as-batched glass compositions over the 7-1000 poise range relative to the non-radioactive as-measured glasses was the same as the bias observed between the as-batched model and radioactive glasses

- revised the coefficients of the 1991 DWPF viscosity model using the as-measured glass compositions by eliminating the data for the eight glasses that exhibited disparate glass compositions and/or inhomogeneity

- determined that once the bias in the 1991 DWPF viscosity model was corrected a U^{+6} term was not needed as long as the Th^{+4} concentrations in the glass were < 1wt%, e.g. those expected in the next few DWPF sludge batches

- determined that once the bias in the 1991 DWPF viscosity model was corrected that a Th^{+4} term would be necessary for glasses containing Th^{+4} >1 wt%.

The revised non-radioactive viscosity model based on the as-measured glass compositions should be implemented in DWPF because of the bias in the 1991 model caused by using the as-batched compositions and the phase separated glasses. The revised DWPF viscosity model is:

$$\log \eta(poise) = -0.519571 + \left(\frac{4453.87}{T(^oC)}\right) - \left(1.690326 * NBO_{asmeasured}\right)$$

with an R^2 of 0.966 and a RMSE of 0.0832.

The revised DWPF viscosity model above was developed based on 33 of the original 41 non-radioactive glasses. The revised DWPF viscosity model was validated with 1004 non-radioactive glass viscosity-temperature measurements. The validation data included ~200 replicate measurements on the DWPF startup frit by six different laboratories, ~130 measurements on the Waste Compliance Plan (WCP) glasses by OCF, ~10 measurements of the Environmental Assessment (EA) glass by OCF, ~140 glasses from West Valley measured at Alfred University, ~125 measurements from SRNL testing in the early 1980's, ~700 measurements from Pacific Northwest National Laboratory (PNNL) on two different statistically designed matrices of simulated waste glasses (Composition Variability Study I and II), and ~530 measurements made by OCF on glasses made in the SRNL Integrated DWPF Melter System (IDMS) and the Scale Glass Melter (SGM). This validation data had become available after the as-batched viscosity model had been developed for DWPF in 1991.

A data set of 192 radioactive viscosity-temperature pairs containing only U^{+6} was assessed against the revised non-radioactive DWPF viscosity model. The comparison indicated that $\log(Visc)_{measured\ radioactive\ (poise)} = 0.0203269 + 0.9988938\ \log(Visc)_{calc\ revised\ radioactive\ (poise)}$ with an R^2 of 0.97. This indicates that a calculated viscosity of 20 poise might actually be 20.9 poise and that a calculated viscosity of 110 poise might actually be 114.7 poise. All the uranium containing glasses lie within the 95% individual confidence intervals of the revised DWPF viscosity model. An additional comparison was demonstrated with recent data on the Frit 418/SB3 uranium containing glasses. In both of these comparisons it was shown that a U^{+6} term is not needed if the bias in the 1991 "as-batched" is replaced with the revised model coefficients determined in this study.

The revised DWPF viscosity model presented in this study eliminates the 15 poise bias that existed with the WP-17 WQR glasses calculated with the 1991 as-batched PCCS model. It also eliminated the ~16 poise bias determined in the Frit 418/SB3 study. The revised model fits all of the WQR data in addition to an additional 1004 validation points. Since the DWPF viscosity model is also related to sulfate solubility and melt rate, it would be of additional benefit for DWPF to implement the revised model presented in this study.

In summary, a uranium term is not needed in the DWPF viscosity model as long as the U_3O_8 concentrations of the glasses being melted are ≤5.76 wt%, the maximum value examined in this study. The fact that a U^{+6} term is not needed in the DWPF viscosity model is consistent with the fact that U^{+6} has four bridging and two non-bridging oxygen bonds. Therefore, the impact of the number of bridging and non-bridging oxygen's is approximately equal at U_3O_8 concentrations of ≤5.76 wt%. Uranium may not have an impact at higher U_3O_8 concentrations but this would have to be demonstrated since the effects of the 0.66:0.33 BO to NBO ratio may become more significant as the U_3O_8 content increases.

While U^{+6} appears to have little to no impact on glass viscosity, this may or may not be true for U^{+4} and U^{+5} in glass since these species were not examined in this study. This is of especial note since the DWPF is currently operating at a REDOX target of 0.2 where 45% of the uranium is U^{+6}, 45% is U^{+5}, and 10% is U^{+4}.

An additional 26 glasses for which 98 viscosity-temperature measurements were available indicate disparate roles for ThO_2 depending on the U_3O_8 concentration and the Al_2O_3 concentration of the glasses measured. For the data generated on three DWPF glasses at SRNL where the ThO_2 content and U_3O_8 content were each in the 2.5-3.0 wt% range, the presence of ThO_2 made the melts more fluid. This is consistent with what is known from the literature about the coordination chemistry of Th^{+4} in glass, e.g. that it may act as a weak network modifier. However, twenty two West Valley mixed uranium-thorium glasses with U_3O_8 ~0.6-0.7 wt% and ThO_2 of 3.5-3.6 wt%, demonstrate a trend toward more polymerized melts (higher viscosities). The West Valley glasses are much higher in Al_2O_3 than the glasses measured at SRNL although they are in the range of the DWPF viscosity model. This indicates that there may be a synergistic interaction between ThO_2, U_3O_8, and Al_2O_3 that needs further investigation.

Data for one glass containing ThO_2 only were available from West Valley. It contained only 1.79 wt% ThO_2 and the data fit the revised DWPF viscosity model indicating no impact of ThO_2 on glass viscosity. Since the ThO_2 only glass contains only 1.79 wt% ThO_2 instead of the 2.76-3.6 wt% used in the mixed ThO_2-U_3O_8 studies, there may be a threshold below which ThO_2 does not have any impact on glass viscosity. The ThO_2 threshold needs further investigation.

The following recommendations are made:

- implement the revised DWPF viscosity model presented in this study because
  - the 1991 DWPF viscosity model is biased due to the presence of incorrect and anomalous data
  - the revised model will aid in glass formulation efforts to improve melt rate by increasing alkali and/or boron content because the new model eliminates the biases noted for high alkali glasses when compared to the 1991 DWPF viscosity model
  - the revised model is more accurate and will give improved performance if used to model sulfate solubility and/or melt rate in DWPF
  - the revised non-radioactive DWPF viscosity model has been validated with >1000 glasses produced after the 1991 DWPF non-radioactive model was developed

- investigate the viscosity of a few uranium containing glasses at the DWPF target REDOX of 0.2 to assess the impact, if any, of U^{+5} and U^{+4}: note that this will entail running the viscometer in an inert atmosphere to prevent the reduced glass from oxidizing during remelting in the viscometer

- investigate the impact of ThO_2 and uranium in high alumina glasses to determine if there is a threshold below which ThO_2 does not impact glass viscosity

- investigate the impact of ThO_2 and uranium in high alumina glasses to determine if there is are synergistic effects between U_3O_8 and ThO_2 and/or between U_3O_8 and Al_2O_3

- investigate the threshold values of other glass components that could significantly impact glass viscosity on the adequacy of the DWPF viscosity model, e.g. glasses with $\geq$ 3.5 wt% CaO or $\geq$ 2.0 wt% ZrO_2, if melter feeds containing these components are expected to be processed in the DWPF melter in the future.

- investigate the use of a different SRNL viscosity standard because the current standard, the DWPF startup frit, exhibits low temperature non-Newtonian behavior or investigate the use of the DWPF startup frit standard viscosity curves at temperatures $\geq$950° where the temperature-viscosity relationship is Newtonian

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ADS	Analytic Development Section
BO	Bridging Oxygen
CELS	Corning Engineering Laboratory Services
CST	Cesium SilicoTitanate
CVS	Composition Variability Study
DWPF	Defense Waste Processing Facility
EA	Environmental Assessment
EXAFS	Extended X-Ray Absorption Fine Structure
HLLW	High Level Liquid Waste
IDMS	Integrated DWPF Melter System
NBO	Non-Bridging Oxygen
OCF	Owens Corning Fiberglass
OLS	Ordinary Least Squares
PNNL	Pacific Northwest National Laboratory
REDOX	REDuction/OXidation
RMSE	Root Mean Square Error
SGM	Scale Glass Melter
SRNL	Savannah River National Laboratory
SRS	Savannah River Site
SS	Sharp Shurtz
WCP	Waste Compliance Plan
WQR	Waste Qualification Runs
XAS	X-ray Absorption Structure
XAFS	X-ray Absorption Fine Structure

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1.0 INTRODUCTION

The Defense Waste Processing Facility (DWPF) at the Savannah River Site (SRS) vitrifies high level liquid waste (HLLW) into borosilicate glass for stabilization and permanent disposal. The viscosity (η) of the borosilicate glass melt as a function of temperature is the single most important variable affecting the melt rate [1, 2] and pour ability of the glass. The viscosity determines the rate of melting of the raw feed, the rate of glass bubble release (foaming and fining), the rate of homogenization, the adequacy of heat transfer, the devitrification rate, and thus, the quality (in terms of glass homogeneity) of the final glass product [1, 2, 3, 4]. If the viscosity is too low, excessive convection currents can occur, increasing corrosion/erosion of the melter materials of construction (refractory and electrodes) and making control of the melter more difficult [3, 4]. The lowest glass viscosities allowed in the DWPF melter have, therefore, been determined to be 20 poise [3, 4]. DWPF glasses must pour continuously into a large steel canister for ultimate storage in a geologic repository, but glasses with viscosities above 500 poise do not readily pour [3]. Moreover, too high a viscosity can reduce product quality by causing voids in the final glass [3]. A conservative range of 20-110 poise at a melt temperature, T_{melt} or T_m, of 1150°C was, therefore, chosen for DWPF production [3, 5].

Likewise, an optimum range of electrical resistivity (ρ) between 1 and 10 Ω-cm was recommended [4]. In this range, the glass is conductive enough to pass appreciable amounts of electric currents without requiring high voltages. However, it is not so conductive that excessive current densities are required at the electrodes to produce heat. Excessive current densities would reduce electrode life [4]. Since η and ρ are inversely related [6, 7, 8] the range of 1-10 Ω-cm corresponds to 3-266 poise based on $\eta(poise) = 2.66\rho(\Omega cm)$ [7] . Therefore, the DWPF viscosity constraints of 20-110 poise keeps the DWPF melter well within the recommended electrical resistivity constraints.

Since measurement of glass viscosity is difficult and lengthy, routine measurement of this parameter during DWPF glass production is unachievable. A glass viscosity model was developed for the DWPF in 1991 [8, 9] in order to relate parameters that could easily be measured, e.g. glass composition and melt temperature, to both the glass viscosity and glass resistivity. The current DWPF viscosity model was developed based on the as-batched compositions of 41 glasses including pure frits. The glass compositions were subsequently measured but the viscosity model was never reevaluated.

The glass viscosities on which the current DWPF viscosity model is based were measured by the analytic division of Owens Corning Fiberglass (OCF) who was then known as Sharp-Shurtz (SS) and by Corning Engineering Laboratory Services (CELS). Both laboratories performed standard spinning bob viscosity measurements (ASTM 965). The glasses were made at the Savannah River National Laboratory (SRNL) from reagent grade chemicals and melted at 1150°C for 4 hours. CELS used the method of Reibling [10] to measure viscosity and resistivity simultaneously (ASTM C965B) over the viscosity range of approximately 100-10,000,000 poise. The corresponding temperature range (400-1200°C) includes the temperature of maximum devitrification for DWPF glass, i.e. 700-800°C [11, 12, 13]. The CELS viscosity data were, therefore, suspected to be non-Newtonian below 800°C due to the presence of crystalline material at the higher viscosities [14], i.e. lower temperatures. In addition, glasses in the 1,000,000-10,000,000 poise range (the viscosities that define the "forming" range of many glasses) are known to exhibit non-Newtonian viscous flow rather than Newtonian viscous flow [15].

Sharp Shurtz measured the viscosity (ASTM C965A) over the range of approximately 30-800 poise which corresponds to a temperature range of 850-1250°C for DWPF type glasses and a Newtonian viscosity range. An assessment of the viscosities measured by each laboratory for the same glasses was made [7] and the CELS data were shown to exhibit non-ideal (non-Newtonian) behavior. Therefore, the SS viscosity data were determined to be more accurate and the SS data were preferentially used to develop the DWPF viscosity model. The DWPF viscosity model was validated with the CELS viscosity data truncated at a lower melt temperature of 800°C to avoid potential bias due to non-Newtonian behavior. In addition, the raw data from SS were used for modeling rather than individual Fulcher fits (see Section 2.0) to the viscosity data to ensure that any non-Newtonian bias was eliminated. Blind standards were sent to each laboratory over a period of ~5 years and the reproducibility of the viscosity measurements was excellent [9] in the DWPF viscosity range of 20-110 poise.

Samples of glasses from DWPF Waste Qualification Runs (WQR) WP-14, WP-15, and WP-17 were taken from DWPF canisters S00009, S00179, and S00310, respectively [16] The viscosities were measured at the SRNL in 1997 during non-radioactive startup testing of the SRNL viscometer discussed below. For the WP-14 glass the as-batched viscosity model predicted a viscosity of 83.7 poise at 1150°C and the glass measurement based on a Fulcher fit equation was 78.7 poise. Likewise for WP-15, the model viscosity was 62.5 vs. a measured-Fulcher fit value of 58.2 poise. For WP-17 the model viscosity was calculated as 80.7 poise while the measured-Fulcher fit value was only 64.4 poise. Except for WP-17, which had a ~16 poise bias, the DWPF as-batched viscosity model appeared to be predicting within ±5 poise of the as-measured values.[‡]

Since neither SS nor CELS could handle radioactive glasses, SRNL developed radioactive viscosity measurement capability in 1998 with a Harrop viscometer [17, 18]. The ASTM C965A procedure was modified to use only 6-7 grams of glass compared to the 200-700 grams required by the commercial laboratories. Multiple viscosity measurements on the DWPF startup frit were made on the SRNL viscometer. The data indicated an accuracy of the SRNL

[‡] Section 5.3 will demonstrate that the revised non-radioactive DWPF viscosity model (Equation 4) validates all of the WQR runs with greater precision than the as-batched DWPF viscosity model (Equation 3).

measurements to with 10% of the values obtained by SS and CELS [19] in the 1000-1200°C range and a relative standard deviation of ~2 % at the DWPF melt temperature of 1150°C. While this assessment acknowledged that the viscosity data fit better in the high temperature range than in the low temperature range (the SRNL values were biased high in the low temperature range) and that crystallization of the DWPF startup frit might be the cause of this discrepancy, no attempt was made to refit the Fulcher equations by eliminating the <800°C non-Newtonian (lower temperature) data which may have biased the Fulcher fits.

During a second assessment [18] of viscosities of DWPF Sludge Batch 2 (SB2) type glasses, several of the standards run by CELS and SS were also run in the SRNL viscometer and measured by the Pacific Northwest National Laboratory (PNNL). Comparisons were made on the individual glasses by first fitting Fulcher fits (see Section 2.0) to the data derived by various laboratories and then assessing an individual calculated viscosity at only one temperature, the DWPF melt temperature of 1150°C. These data indicated that the SRNL viscosity values were ~ 9% higher than those of CELS and SS and within 0.02% of viscosity values measured at PNNL. The PNNL and SRNL data suggested that the DWPF viscosity model may under predict the viscosity for uranium containing glasses in the "sludge only flowsheet" SB2 composition range. A similar result was obtained during an assessment of glass viscosities with and without uranium while investigating the impact of Crystalline Silicotitanate (CST) resin on DWPF glass properties [20, 21, 22, 23, 24]. In these studies, the DWPF viscosity model under predicted the viscosities measured whether the glasses contained uranium or not.

However, additional assessments on glasses formulated from a DWPF "coupled flowsheet" and Purex and HM sludges indicated that the DWPF viscosity model over predicted the viscosities measured [25, 26, 27, 28, 29] whether the glasses contained uranium or not. Again this assessment was made at one temperature, the nominal DWPF melt temperature of 1150°C.

The two most recent assessments of glass viscosity measurements on simulated radioactive glasses were performed by Peeler and Edwards [30, 31]. The 2003 study [30] evaluated the impact of higher uranium and thorium in DWPF glasses as waste loading is increased. The findings indicated the following:

- the presence of uranium lowered the viscosity
- the presence of thorium appeared to have a minimal impact and was not considered to be of practical concern
- there was some indication that thorium slightly increased viscosity.

The 2004 study [31] evaluated the viscosity of DWPF SB3 with Frit 418 for glasses containing U^{+6}.. In this study the measured viscosity values at the DWPF melt temperature of 1150°C were biased compared to the calculated viscosity values by ~16 poise. The 16 poise bias is the same as that noted in the WP-17 non-radioactive waste glass measurement at the DWPF melt temperature of 1150°C. However, the similarity of the bias in the radioactive SB3 glasses to the bias in the WP-17 non-radioactive glasses suggests that the non-radioactive DWPF model may be biased and that the bias may not be a function of the presence of the U^{+6}.

Since the SB2 [18], CST [20,21,22,23,24], coupled flowsheet [25,26,27,28,29], higher waste loading [30], and SB3 [31] studies all covered statistically designed but narrow composition regions and since some of the studies indicated an over-prediction of the viscosity while other studies indicated an under-prediction of the viscosity in the presence of U^{+6}, a more global look at the pooled U^{+6} containing glasses was deemed necessary. At the same time, the bias in the non-radioactive WQR glasses versus the non-radioacitve 1991 DWPF viscosity model was needed.

2.0 BACKGROUND

2.1 HISTORICAL DEVELOPMENT OF THE DWPF VISCOSITY MODEL

The DWPF viscosity modeling approach used in 1991 was based on glass structural considerations, expressed as a calculated non-bridging oxygen (NBO) term (Equation 1). Oxide species were expressed in mole fraction and related to the viscosity-temperature dependence of the Fulcher equation [32,33], also known as the Vogel-Fulcher-Tammann (VFT)[‡] equation. The VFT relates the viscosity (η) of a glass to temperature (Equation 2) for Newtonian fluids.

Equation 1 $$NBO \equiv \frac{2\,(Na_2O + K_2O + Cs_2O + Li_2O + Fe_2O_3 - Al_2O_3) + B_2O_3}{SiO_2}$$

Equation 2 $$\log_{10}\eta = A + \frac{B}{T - T_o}$$

In Equation 2, η is viscosity (poise or d•Pa[*]), T is temperature in °C, and A, B, and T_o are fitted constants. It is well documented that the overall fit of the Fulcher equation is excellent for glasses but that it also overestimates viscosity at lower temperatures in the range of viscosities $>10^{10}$ Pa.s [34].

Calculation of the NBO term from molar composition was combined with quantitative statistical analyses of response surfaces to express glass viscosity and resistivity as a function of melt temperature and glass composition (see the spline fit in Figure 1). The DWPF glass viscosity model is given by

Equation 3 $$\log\eta(poise) = -0.61 + \left(\frac{4472.45}{T(^oC)}\right) - (1.534 * NBO).$$

‡ Fulcher derived this expression to model viscosity of inorganic glasses in 1925. In 1921 Vogel (Phys. Zeit., 22, 645-646) derived a similar expression for the viscosity of water, mercury, and oils and Tammann and Hesse generated a similar equation for organic liquids in 1926 (Z. Anorg. Allg. Chem. 156, 245-257). So all three are credited with the derivation of the mathematical expression and it is often referred to as the VFT equation.

* The unit of viscosity is the dyne second per square centimeter which is called the poise. The SI unit for viscosity is the Newton second per square meter, or pascal second; one of these units equals 10 poise [2].

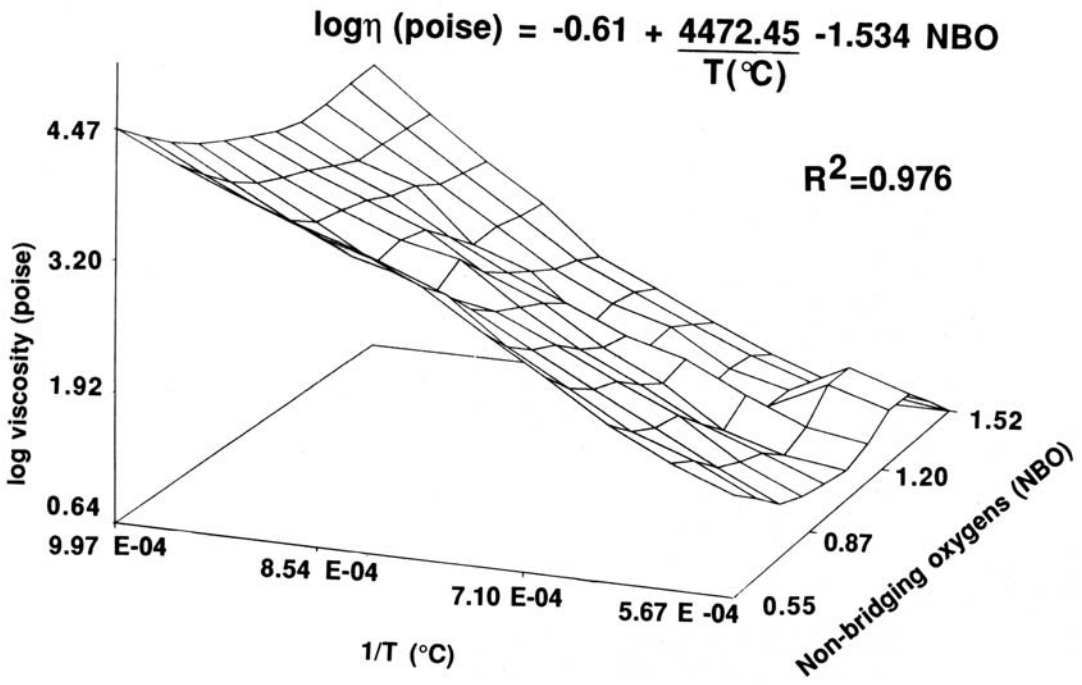

Figure 1. Three dimensional spline function of the data used to fit the DWPF viscosity model showing the relationship between glass viscosity, inverse temperature, and the compositionally dependent non-bridging (NBO) term.

The DWPF viscosity model assumes that a pure SiO_2 glass is fully polymerized as shown in Table I; i.e. there are no NBO and 4 BO bonds. Addition of other species known as network modifiers depolymerizes the glass while network formers polymerize the glass. This approach was a simplification of an NBO term developed by White and Minser [35] to describe the structural features observed in Raman spectroscopy data of complex natural glasses (obsidians and tektites) which had no B_2O_3 and almost all FeO instead of Fe_2O_3,

$$\text{i.e. } \frac{NBO}{T} = \frac{2\{[Na_2O]+[K_2O]+[CaO]+[MgO]+[FeO]-[Al_2O_3]-[Fe_2O_3]\}}{[SiO_2]+2[Al_2O_3]+[Fe_2O_3]}.$$

Equation 1 is also consistent with the usage of a viscosity ratio (V_r) to model the viscosity of slags [36]. The V_r is defined as the sum of the Z/r (charge/radius) of the network formers times the atomic % of the network formers divided by the sum of the Z/r (charge/radius) of the network modifiers times the atomic % of the network modifiers.

In the DWPF viscosity model it is assumed that each mole of alkali oxide added creates two non-bridging oxygen bonds by forming metasilicate (Na_2SiO_3) structural units, thus depolymerizing the glass (see Table I). While the exact number of non-bridging oxygen atoms depends on the molar ratio of all of the species in a waste glass to SiO_2, most DWPF glasses have a O^{2-}/ Si^{4+} ratio of 2.6 to 3.3 which implies that disilicate and metasilicate NBO structural units predominate for the alkali species (Table I) in the waste glasses. Calculation of the O^{2-}/

Si^{4+} ratio for DWPF glasses included contributions from Na, K, Li, and Cs alkali species and a Si^{4+} concentration that was depleted by the amount associated with B_2O_3 structural units.

The DWPF viscosity model further assumes that each mole of Al_2O_3 creates two bridging oxygen bonds (polymerizes the glass structure) by creating tetrahedral alumina groups that bond as $NaAlO_2$ structural groups. In Al_2O_3 and/or SiO_2 deficient glasses, Fe_2O_3 can take on a tetrahedral coordination and polymerize a glass by forming $NaFeO_2$ structural groups. However, if sufficient Al_2O_3 and SiO_2 are present in a glass such as DWPF waste glasses that typically contain >3 wt% Al_2O_3 and >40 wt% SiO_2, then Fe_2O_3 is octahedral and creates two non-bridging oxygen bonds, i.e. it depolymerizes the glass matrix as assumed in the DWPF viscosity model (Equation 1). This is consistent with the work of Mysen [37] who demonstrated that high iron magmas (iron silicate glasses) that contained levels of 10 wt% Fe_2O_3 decreased the melt viscosity. He concluded that $NaFeO_2$ structural groups were not incorporated into the silicate network to the same degree as $NaAlO_2$ structural groups [37]. Therefore, Fe_2O_3 is considered a network modifier and depolymerizer in the DWPF viscosity model. Since FeO is also known to act as a glass network depolymerizer, there is no need for a separate FeO term and all the iron in a given glass is calculated as if it were Fe_2O_3.

Lastly, the DWPF viscosity model assumes that each mole of B_2O_3 creates one non-bridging oxygen bond. This is based on data by Smets and Krol [38], and Konijnendijk [39] who demonstrated that for sodium silicate glasses with low B_2O_3 content the B_2O_3 enters the glass network as BO_4^- tetrahedral. At higher B_2O_3 concentrations these tetrahedra are converted into planar BO_3^- groups. Tetrahedral BO_4^- contributes no NBO while planar BO_3^- groups contribute one non-bridging oxygen atom [40].

Table I. Distribution of Non-Bridging and Bridging Oxygen Bonds in the Alkali-Silica System [adapted from reference 41].

	$Na_2O:SiO_2$	Predominant Q Species‡	O^{2-}/Si^{4+}	O_{NBO}^{2-}/Si^{4+}	O_{BR}^{2-}/Si^{4+}
Silica	0:1	Q^4 [42]	2.00	0	4.00
Tetrasilicate	1:4	Q^3+Q^4 [43]	2.25	0.5	3.50
Trisilicate	1:3	Q^3+Q^4 [42]	2.33	0.66	3.33
Disilicate	1:2	Q^3 [44]	2.5	1.00	3.00
Metasilicate	1:1	Q^2 [44]	3.00	2.00	2.00
Pyrosilicate	3:2	Q^1 [46]	3.5	3.00	1.00
Orthosilicate	2:1	Q^0 [42]	4.00	4.00	0

‡ The polymerization or extent of medium-range order of a melt can thus be expressed by calculating [45] or measuring [46] a Q distribution, e.g. the number of Q^4, Q^3, Q^2, Q^1, and Q^0 species in a simple two or three component melt. The Q^n is the number of bridging (BO) atoms linked to a given Si atom (where n=0, 1, 2, 3, or 4) [43]. The number of Q^4 units in a melt, e.g. silica tetrahedra that have not reacted with a metal cation to form a non-bridging oxygen, can be correlated to the thermodynamic activity of SiO_2 in the melt [47]. The Q distribution in a glass has been shown to also influence freezing point depression of a glass, i.e. the liquidus, as well as crystallization rate and phase separation [47]. In particular, a bimodal Q distribution will promote phase separation while systems which have larger concentrations of Q^0 and Q^1 species (more modifier rich) will crystallize more rapidly than melts with oxides that produce primarily Q^3.

2.2 THE STRUCTURAL ROLE OF URANIUM AND THORIUM IN GLASS

In glass, uranium only occurs in tetravalent and hexavalent forms [48]. Uranium used to be commonly found in decorative glasses at concentrations up to 4 wt% as UO_2 and/or UO_3. U^{+4} occurs as UO_2 and U^{+6} as the uranyl ion, i.e. UO_2^{2+}, in commercial and decorative glasses [48].

Karraker [49] performed Mossbauer spectroscopy of various actinide ions known to be in SRS HLW borosilicate glass. His study indicated that U was present in HLW glasses in the +4, +5, and +6 state and was a function of glass REDuction/OXidation (REDOX). Carbon was used to reduce the U^{+6} to U^{+5} and U^{+4} during analysis. It was also determined that U^{+6} was present as the uranyl ion, UO_2^{2+}, as in commercial and decorative glasses. Because of the +2 charge on the uranyl ion, it was hypothesized that the uranyl ion probably acts as a network-modifier like Ca^{+2} in glass.

Various studies by Schreiber [50, 51, 52, 53, 54] also indicated that uranium existed in SRS HLW borosilicate type glasses in the +4, +5, and +6 oxidation states. His works indicated that U^{+6} was much more soluble in SRS Frit 131 type borosilicate glasses than U^{+4} and that under reducing conditions (high temperatures and/or low oxygen fugacity), where Ti^{+3} is stabilized instead of Ti^{+4}, the presence of Ti in a waste glass can enhance the solubility of U^{+4}. Schreiber determined that U^{+4} had the lowest solubility in SRS type borosilicate waste glasses, ~9 elemental wt% in a pure frit, and that U^{+6} was over four times more soluble (~40 elemental wt% in a pure frit) than U^{+4} [50].

Schreiber, et al., also determined that the relative stability of U^{+4} vs. U^{+5} vs. U^{+6} was dependent on the relative Fe^{+2} and Fe^{+3} content of an SRS waste glass. In addition, the Fe^{+2}/Fe^{+3} REDOX couple was found to buffer the uranium REDOX from reduction by Cr^{+2} and or oxidation by species such as Mn^{+3} and Ce^{+4} [53,54]. The stability of U^{+4} and U^{+6} in the glass is also dependent on the relative concentrations of Cr^{+2} vs. Cr^{+6} in the glass and Mn^{+4} vs. Mn^{+2} [55].

Schreiber [50] also used absorption spectroscopy to determine that the U^{+6} was present as the uranyl ion UO_2^{2+} in the SRS Frit 131 type borosilicate glasses and that the UO_2^{2+} uranyl ion is the stable form within the borosilicate network. Likewise, he determined that the U^{+5} was present in an octahedral site with some tetragonal distortion and may form a linear $O\text{-}U\text{-}O^{+}$ complex which is also observed in some silicate glasses [56]. It was determined that U^{+4} was present in eight-fold coordination and closely associated with borate groups in glasses with high B_2O_3 content and with silicate groups in low B_2O_3 containing glasses. By comparing work he performed on uranium speciation in the SRS borosilicate glasses with previous work he performed on aluminosilicate and aluminophosphate glasses, he concluded that the general coordination sites of the individual uranium REDOX species are independent of the glass composition [50].

Simulated borosilicate waste glasses produced in France were investigated [57] by X-ray Absorption Spectroscopy (XAS) and the uranium was determined to be primarily present as U^{+6} with a coordination number of 6 and a structural similarity to crystalline UO_3. Data confirming that the uranium was structurally bonded to the borosilicate glass network were inconclusive. However, a 1995 review of all XAS studies of highly charged cations in silicate melts at the melt temperature was performed by Brown, Farges and Calas [58]. In this review, U^{+6} and Th^{+4} are classified as glass network modifiers. However, X-ray Absorption Fine Structure (XAFS) spectroscopy of U^{+6} suggests that it occurs as uranyl moieties (structural parts); i.e. two U^{+6}-O_{axial} bond distances are shorter than the other 4 to 5 U^{+6}-$O_{equatorial}$ bond distances. Thus, U^{+6} acts simultaneously as a network former and a network modifier, e.g., the two short U-O_{axial} bonds cannot form bonds with silica or low field strength cations and thus act as network modifiers while the longer U-$O_{equatorial}$ bonds bond with Si and act as bridging oxygens [59] as shown in Figure 2.[‡] Thus, the U^{+6} forms $(UO_2)O_4$ polyhedra in the glass and may slightly polymerize the glass. Depending on the concentration of uranium in the glass, this effect may be difficult to discern.

The XAS work of Farges and others [58,59] indicates that U^{+4} forms $U^{+4}O_6$ and $U^{+4}O_8$ polyhedra in silicate melts and that the U^{+4} is either six-fold or eight-fold coordinated. Tetravalent uranium in six-fold coordination is thought to bond to five NBO's and to one or more oxygens that are not bonded to Si (designated as non-framework oxygens) as shown in Figure 3. As used in this context, the NBO itself is 3 or 4 coordinated; i.e., bonded to U^{+4}, to at least one network modifier and to one network former. Therefore, the overall net effect is that U^{+4} neither polymerizes nor depolymerizes the glass network although determination of medium range order (second nearest neighbors) for Th^{+4} glasses indicates that +4 cations in silicate glasses can act as weak network modifiers (see discussion in next paragraph).

Farges [60] and Brown [58] studied the structural environment of Th^{+4} in several silicate glasses containing between 1-3 wt% Th^{+4} using Extended X-ray Absorption Fine Structure (EXAFS) spectroscopy. The EXAFS studies suggest ThO_6 polyhedra and ThO_8 polyhedra occur in glass similar to the $U^{+4}O_6$ and $U^{+4}O_8$ polyhedra. A larger fraction of ThO_8 polyhedra was determined in glasses with only 100 ppm Th^{+4} versus those with higher concentrations. There is only weak evidence for second nearest neighbors in XAFS studies of most thorium containing glasses. Therefore, there is some ambiguity about how the ThO_6 and ThO_8 polyhedra are connected to the silicate framework [58]. However, Farges concludes that Th^{+4} may likely acts as a weak network modifier [60].

[‡] Note that Ti^{+5} has the same structural behavior, acting as both a network former and a network modifier.

3.0 OBJECTIVES AND APPROACH

The role of oxidized uranium (U^{+6}) and thorium (Th^{+4}) on DWPF glass viscosity is investigated in this modeling study. The basic form of the DWPF viscosity model is a three-dimensional relationship between $\log_{10}\eta = \text{constant} + \frac{\text{constant}}{\text{Temperature}}$, similar to the Fulcher relationship, and glass composition expressed as a non-bridging oxygen (NBO) term. It will be the focus of this study to determine if the bias observed in many DWPF related viscosity studies performed since DWPF non-radioactive startup in 1994 appear to be biased because there is bias in the data originally used to develop the model or whether the bias is due to the need for an additional NBO term to account for potential impacts of (U^{+6}) and thorium (Th^{+4}) in the glass. The role of U^{+4} cannot be assessed in the current report as none of the glasses containing uranium are sufficiently reduced to contain any U^{+4}, i.e. at the lower (more oxidized) DWPF REDOX limit of 0.09, U^{+6} dominates, while at the upper (more reduced) DWPF REDOX limit of 0.33 the predominant uranium species is U^{+5} [61].

The approach taken to assess the current DWPF viscosity model included the following:

- assess whether the DWPF glass viscosity model is biased due to the fact that it was developed on as-batched rather than as-measured glass compositions or whether it is biased because it does not have a U^{+6} and/or a Th^{+4} term

- assess whether the radioactive glass data generated at SRNL are biased compared to the non-radioactive OCF and CELS measurements because SRNL is using the DWPF startup frit as a viscosity standard and it exhibits low temperature non-Newtonian behavior

- if the DWPF glass viscosity model is biased due to the fact that it was developed on as-batched rather than as-measured glass compositions then refit the model with the as-measured data and then evaluate whether a U^{+6} term and/or a Th^{+4} term are needed.

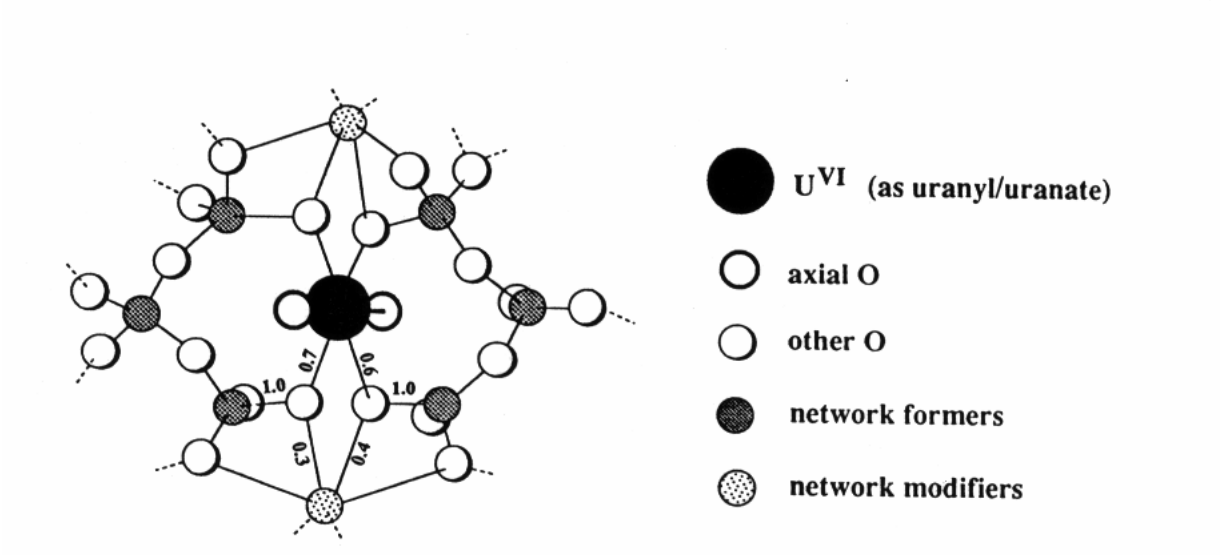

Figure 2. Structural model for U^{+6} in silicate glass demonstrating that U^{+6} in a melt has six nearest oxygen neighbors. The two axial oxygen atoms are NBO's and the four other oxygen atoms bridge to other network modifiers in the glass (from 59).

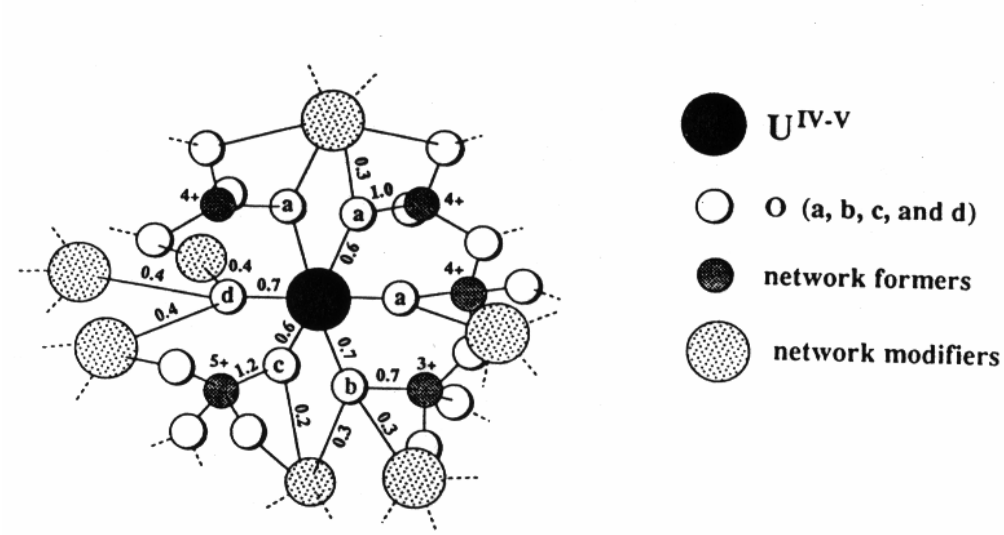

Figure 3. Structural model for U^{+4} in silicate glasses. Oxygen atoms labeled as a, b, and c are 3 and 4 coordinated depending on what network formers and modifiers are present in a given glass. These oxygens are bonded to one Si, to one U^{+4}, and at least one network modifier acting as both a network former and a network breaker. The oxygen atom labeled as d is a non-framework oxygen and may act as a network modifier (from 59).

4.0 EXPERIMENTAL

Forty one glasses of varying, expected extreme DWPF compositions were fabricated between 1984 and 1996. The range of the individual oxides is given in Table II. During this time, viscosity, liquidus temperature (T_L), and replicate chemical analyses were performed on these glasses. Often duplicate glass compositions were rebatched and sent to the various laboratories for replicate measurements. Thus, there are two Frit 131 average sludge only glasses that were made in 1985 (designated AH131AV-1985 and 1985-2) and another Frit 131 average sludge only glass made in 1988 (designated AH131AV-1988). The laboratory performing >90% of the chemical analyses was CELS as indicated in Table III. The viscosity was measured by both Sharp Shurtz and CELS but the data that were used in modeling were the data generated by Sharp Shurtz using ASTM C965A which eliminated bias due to unwanted crystallization at the lower temperatures used by CELS during viscosity measurement using ASTM 965B.

CELS analyzed the AH glasses in quadruplicate[†] so that any effects of short term instrument bias on the whole element chemistry would be observable. CELS analyzed the various black frits six to ten times as indicated in Table III. All CELS composition analyses are traceable to the NBS777 standard glass. These data indicate little random or systematic variation for these analyses. The white frits were dissolved and analyzed by SRNL's Analytic Development Section (ADS) in duplicate.

Validation data glasses and radioactive glasses were measured in the references indicated in Appendices A, B, C, and D. Many of the glasses in Appendix A (DWPF startup frit data) were from the PNNL and SRNL viscosity round robins. Other than the discussion of these round robins in Section 1.0, no further discussion of these analyses will be given in this study. Appendix B gives the validation data used in this study. Appendix C gives the uranium only glass data used in this study. Appendix D gives the uranium-thorium glass data used in this study. Each appendix gives the source of the glass data, the analytic laboratory that performed the chemical analysis and the analytic laboratory that performed the viscosity analysis.

5.0 RESULTS

5.1 DETERMINATION OF THE SOURCE OF THE DWPF VISCOSITY MODEL BIAS

The 1991 DWPF viscosity model given in Equation 3 was developed on the 220 viscosity measurements for the 41 non-radioactive glasses tabulated in Table III. As-batched compositions which gave the calculated as-batched NBO values shown in Table III were used because the as-measured compositions from CELS were not completed at the time the model was developed. These as-measured compositions are now tabulated in Table III and Table IV.

[†] That is, two dissolutions were performed—one on each day—with each dissolution being analyzed in duplicate.

A comparison of the as-batched to as-measured NBO values for the model glasses shows that there were significant differences in the compositions (Figure 4) of five glasses based on Frit 131 and it is suspected that a container of frit may have been incorrectly labeled which led to these compositional differences. In addition two glasses based on Frit 168 were determined to be phase separated [62] which can give anomalous viscosity measurements [63]. Figure 5 (left) shows how the as-batched PCCS model appears to give an excellent fit to the as-batched data upon which it is based but that the PCCS model does not give an excellent fit to the as-measured glass composition data (Figure 5-right). If the ordinary least squares (OLS) regressions from the two figures shown in Figure 5 are overlain as shown in Figure 6, it can easily be seen that the as-batched PCCS model is biased high compared to the same model calculated with all 41 as-measured compositions, e.g. including the eight glasses that have disparate compositions and/or disparate homogeneity. While this bias appears small in the DWPF range of log η = 1.3 to log η = 2.04 (20-110 poise) this bias translates to the following: a PCCS calculated viscosity of 20 poise is 17.3 poise, a PCCS calculated viscosity of 50 poise is 39.6 poise, and a PCCS calculated viscosity of 110 poise is 80.74 poise. The bias translates to viscosity differences of -2.7 poise at ~20 poise to -29 poise at ~110 poise.

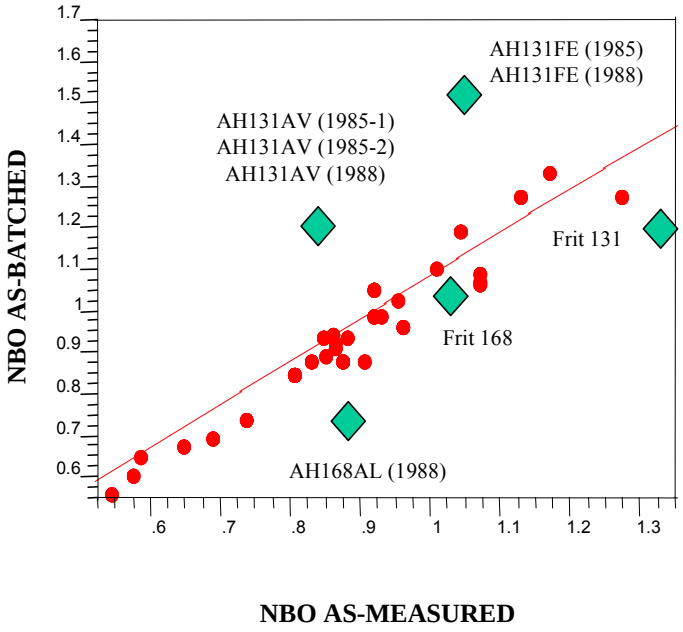

Figure 4. Comparison of as-batched and as-measured non-bridging oxygen terms from Equation 3. The eight glasses shown as solid diamonds are the Frit 131 glasses that were made with an incorrect frit and the two glasses that were phase separated (AH168AL and Frit 168).

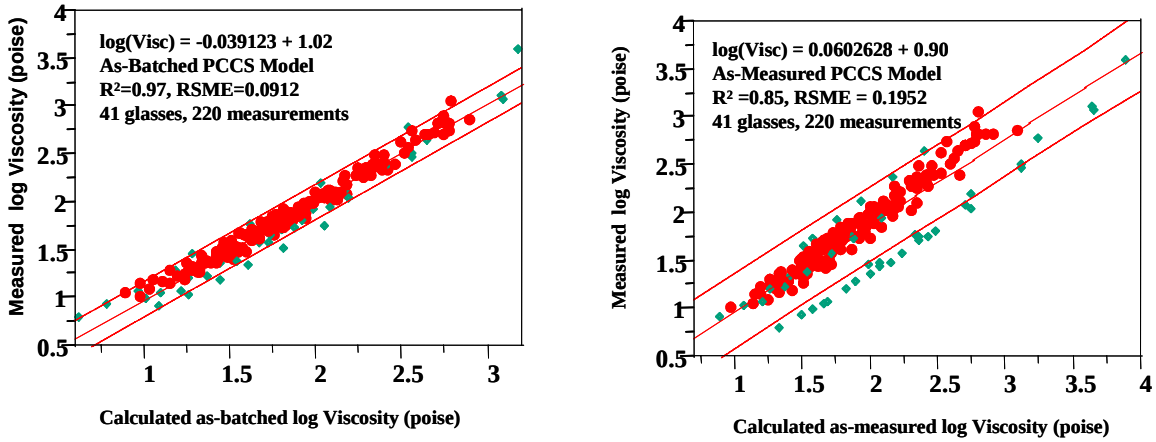

Figure 5. Comparison of the measured viscosities for the 41 glasses in the DWPF PCCS viscosity model to the viscosities calculated using the as-batched and the as-measured compositions. The diamonds indicate the eight glasses shown in Figure 4 to have incorrect as-batched compositions or to be phase separated.

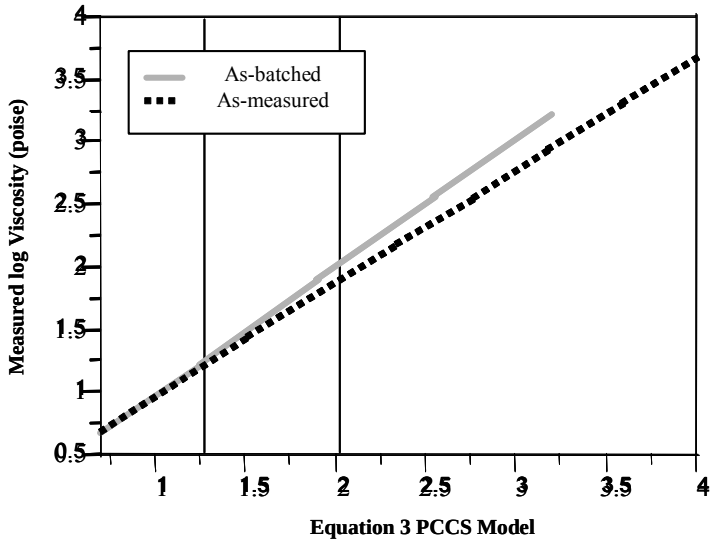

Figure 6. Overlay of the ordinary least square regressions of the PCCS viscosity model calculated from the as-batched and the as-measured glass compositions.

To evaluate whether the as-batched vs. as-measured bias is similar to that observed when the PCCS viscosity model based on as-batched compositions is compared to the as-measured radioactive data, the latter is plotted in

Figure 7. The measured uranium viscosity data are biased low compared to the as-batched viscosity data just as the 41 as-measured non-radioactive glasses were biased low compared to the as-batched viscosity data (Figure 6). While this bias appears small in the DWPF range of log $\eta = 1.3$ to log $\eta = 2.04$ (20-110 poise) this bias translates to the following: a PCCS calculated viscosity of 20 poise is 15.6 poise, a PCCS calculated viscosity of 50 poise is 41.5 poise, and a PCCS calculated viscosity of 110 poise is 96.3 poise. The bias translates to viscosity differences of -4.4 poise at ~20 poise to -14 poise at ~110 poise which are smaller than the differences of -2.7 to -29.3 between the non-radioactive as-batched vs. the non-radioactive as-measured correlations shown in Figure 5 and Figure 6. Therefore, it is likely that the DWPF PCCS as-batched model is biased high and that the bias is caused by the disparate non-radioactive data and not due to the need for a U^{+6} term in the viscosity model. Therefore, the 33 original non-radioactive as-measured PCCS model glasses, those not exhibiting disparate compositions or homogeneity, were used to fit new coefficients to the DWPF PCCS model. This was then compared to the as-measured uranium data to determine if the PCCS viscosity model needed a U^{+6} or other radioactive term.

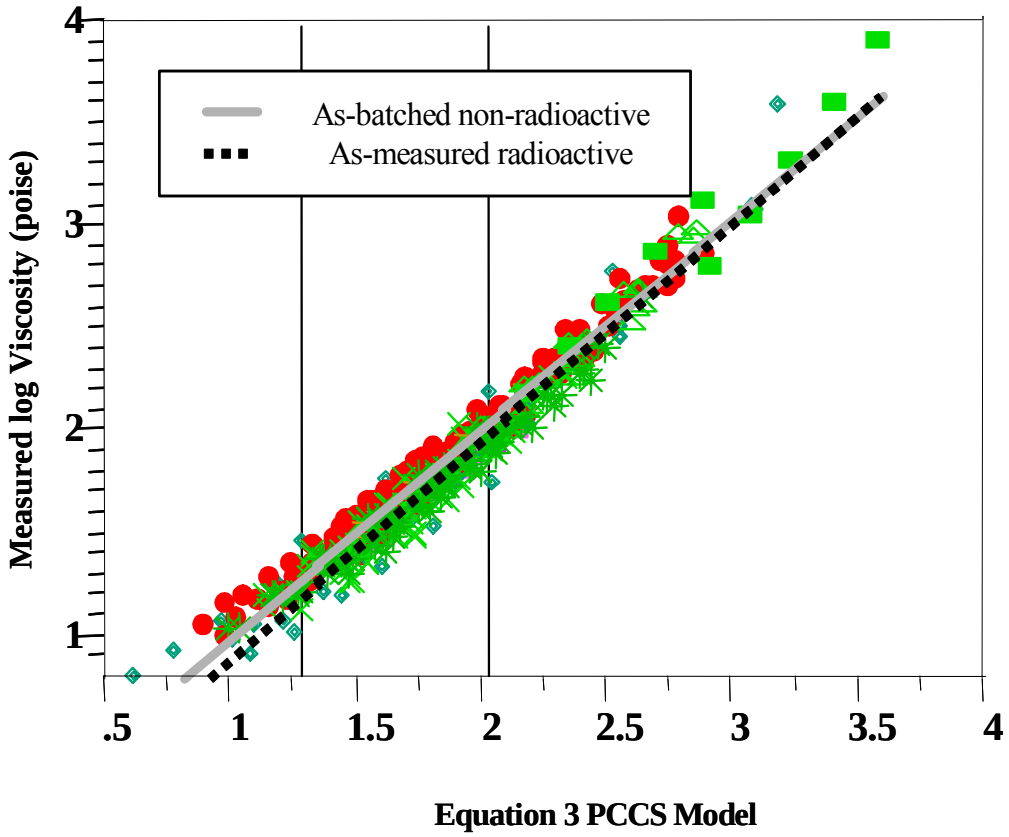

Figure 7. Overlay of the ordinary least square regressions of the PCCS viscosity model calculated from the as-batched and the as-measured uranium containing glasses.

5.2 REVISION OF THE DWPF VISCOSITY MODEL COEFFICIENTS

A reassessment of the DWPF viscosity model (Equation 3) based on the remaining 33 glasses (175 of the 220 viscosity measurements given in Table III and Table IV) was performed. Regression of 1/T(°C), $NBO_{as\text{-}measured}$, and viscosity for these 175 viscosity-temperature pairs gives the following revised coefficients for the DWPF viscosity model :

Equation 4 $$\log\eta(poise) = -0.519571 + \left(\frac{4453.87}{T(^oC)}\right) - (1.690326 * NBO_{asmeasured})$$

with an R^2 of 0.966 and a RMSE of 0.0832. Regression of Equation 4 against the as-measured viscosities for the 33 model glasses is shown in Figure 8.

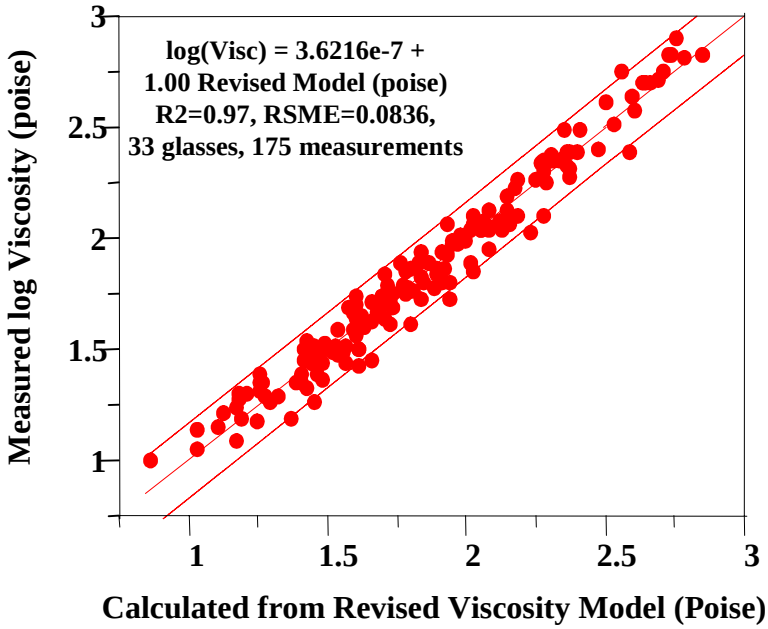

Figure 8. Fit of the calculated viscosity from Equation 4 to the measured viscosities for the 175 viscosity-temperature pairs on the 33 model glasses

The range of compositions over which the revised DWPF viscosity model was developed is given in Table II. Most of the components span well beyond any compositions run in the DWPF including the REDOX ratio of $Fe^{+2}/\Sigma Fe$. Note that the upper limits modeled for CaO and ZrO_2 were 1.5 and 1 wt%, respectively, although the model was validated over twice that range (see Section 5.3 and Table V). At the concentrations of CaO and ZrO_2 given in Table II there is no need for a CaO or ZrO_2 term in the viscosity model. However, if glasses with >3.5 wt% CaO or 2 wt% ZrO_2 are ever processed in the DWPF then the viscosity model may need to be supplemented with a CaO and/or a ZrO_2 term as these elements are known to have a significant

impact on glass viscosity when present in high concentrations [48]. Alternatively, studies can be initiated to determine the threshold values for the CaO and ZrO_2 impacts on glass viscosity.

5.3 EVALUATION OF POTENTIAL BIAS FROM SRNL VISCOSITY STANDARD

In order to ascertain whether the over and under predictions of the DWPF viscosity model as described in references 17-29 were possibly related to bias in the measurement of the SRNL viscosity standard at temperatures below 1025°C [64]the known liquidus temperature for this glass, the revised DWPF viscosity model (Equation 4) was compared to the measured viscosities for the standard over various temperature ranges. During development of the 1991 DWPF viscosity model the viscosity data from OCF was preferentially used [7, 8, 9] over the data from CELS because it covered the temperature range between 873-1491°C (Table II) and thus avoided temperatures below 850°C where DWPF glasses were known to undergo maximum devitrification. The higher temperature viscosity measurements in the 1991 model were associated with the high silica containing frits which did not melt until ≥ 1250ºC.

About 199 viscosity-temperature measurements had been made on the DWPF startup frit during the setup of the SRNL viscometer [17, 18, 19] and during a PNNL sponsored viscosity round robin [65]. Data from the laboratories A, B, D, E, F and G that used one of the two versions of ASTM 965 were compiled in a DWPF startup frit validation database (see Appendix A). Laboratories A, B, E, and G used ASTM C965A and laboratories D and F used ASTM C965B. The other laboratories used experimentally non-validated viscosity measurements that were not ASTM procedures of any type. Thus, 199 viscosity-temperature pairs were generated by six different laboratories including SRNL, PNNL and CELS and compared to the data generated by SS, i.e., the data on which the DWPF viscosity models were developed (Equation 3 and Equation 4). Only the 24 chemical replicates completed by CELS were used for the composition of the DWPF startup frit [65] since this composition had been verified by SRNL.

In order to ascertain if the SRNL viscosity standard exhibits bias at low temperatures due to non-Newtonian behavior below 1050°C, the standard data were regressed against (1) all the data measured regardless of the measurement temperature, (2) against the data measured only at ≥800°C, and (3) against the data measured only at ≥950°C. These comparisons should demonstrate whether the fit of the SRNL standard is sensitive to the temperature range over which it is measured.

When the measured viscosity data generated at all temperatures for the DWPF startup frit is regressed against Equation 4, the regression indicates ~23% bias in the fit, e.g., $\log (Visc)_{meas} = -0.30764 + 1.2302025 \log(Visc)_{calc}$ as evidenced by a non-zero intercept and a slope greater than 1.00 for the 199 data points. The correlation has an R^2 of 0.99 and a root mean square error (RMSE) of 0.096575. The 95% confidence intervals for the intercept were -0.3458 to -0.2695 and the confidence intervals for the slope were 1.2127 to 1.2477 indicating that this is a bias and not merely scatter in the data. When the 20 viscosity-temperature pairs measured at temperatures of ≤800°C are removed from the DWPF startup frit database and the remaining 179 data points are regressed the fit is $\log(Visc)_{meas} = -0.020761 + 1.0670453 \log(Visc)_{calc}$ with an R^2

= 1.00 and a RMS of 0.032547. This fit indicates only a 6% bias. If the temperature of the viscosity-temperature pairs are further constrained to temperatures of 950°C, as was done in the viscosity round robin [65], then the equation of fit to Equation 4 is $\log(\text{Visc})_{meas} = 0.0450796 + 1.0270176 \log(\text{Visc})_{calc.}$ This is only a bias of ~2.7% and has an intercept of ~0.05 with an R^2 of 0.99 and a RMSE of 0.024104 for the remaining 155 data pairs. This indicates that the DWPF startup frit may not be a good viscosity standard due to its tendency to crystallize at temperatures below 1050°C and exhibit non-Newtonian behavior. Conversely, this standard can be used but the viscosity should be measured at temperatures ≥950°C. If viscosity measurements are made at lower temperatures these should not be used during the Fulcher fit of the standard glasses as it can cause bias in the Fulcher fit. This will avoid any potential problems with viscometer calibration that might bias the measurement of other glasses.

5.4 VALIDATION OF THE REVISED DWPF VISCOSITY MODEL

As-measured viscosity-temperature data and measured compositions are available for ~1800 waste glasses of similar composition to DWPF waste glasses. Additional as-batched data and data for natural magmas and soda-lime-silica glasses have also been tabulated in the database (over 13,000 observations). The natural magma and soda-lime-silica glass data were not used in the validation of the DWPF viscosity model because only borosilicate glass data were considered and only as-measured compositions were considered.

The 1805 waste glass viscosity-temperature pairs and measured glass compositions considered for use as validation data are given in Appendices A and B. The validation data considered includes 184 of the 199 DWPF Startup Frit measurements from Appendix A (the remaining 15 measurements are model data), 129 measurements on the seven Waste Compliance Plan (WCP) glasses by SS and SRNL, 7 measurements on the Environmental Assessment (EA) glass, 136 measurements from West Valley performed at Alfred University in three separate studies, 124 measurements performed at SRNL in 1982 on a different viscometer than the one currently used at SRNL, 72 measurements by PNNL during their (Composition Variability Study) CVS-1 study on 23 different glasses, 627 by PNNL during their CVS-2 study on 101 different glasses,[‡] 195 measurements by SS on glasses from the SRNL Integrated DWPF Melter System (IDMS) and 331 measurements by SS on glasses from full-sized canisters poured during SRNL Scale Glass Melter (SGM) campaigns.

[‡] As-measured data was only available for 98 of the 101 glasses (see Appendix B).

Table II. Temperature, Viscosity and Composition Ranges for the DWPF Viscosity Model

Parameter	Maximum Value	Minimum Value
Temperature (°C)	1491	873
Viscosity (poise)	1122.02	10.23
$Fe^{+2}/\Sigma Fe$	0.47	0.00
Al_2O_3(wt%)	13.90	0.00
B_2O_3(wt%)	12.20	6.41
BaO(wt%)	0.20	0.00
CaO(wt%)	1.47	0.00
Cr_2O_3(wt%)	0.09	0.00
Cs_2O(wt%)	0.15	0.00
CuO(wt%)	0.33	0.00
Cu_2O(wt%)	0.30	0.00
FeO(wt%)	7.14	0.00
Fe_2O_3(wt%)	14.20	0.00
K_2O(wt%)	5.73	0.00
La_2O_3(wt%)	0.36	0.00
Li_2O(wt%)	6.96	2.59
MgO(wt%)	2.92	0.49
MnO(wt%)	3.26	0.00
Na_2O(wt%)	15.80	5.80
NiO(wt%)	2.97	0.00
SiO_2(wt%)	77.04	45.60
SrO(wt%)	0.07	0.00
TiO_2(wt%)	1.78	0.00
ZnO(wt%)	0.00	0.00
ZrO_2(wt%)	0.99	0.00
Sum Oxides	100.28	98.23

Of the 1805 non-radioactive glass viscosity-temperature-compositions available for validation of the DWPF model about 801 were eliminated on the following basis:

- if the measured composition was <95 wt% or >105 wt% on an oxide basis the analysis was considered inadequate for validation
- if the measured temperature was ≤ 800°C the data were excluded to avoid bias due to potential non-Newtonian viscosity behavior

In order to constrain the validation data to a composition range that overlapped the DWPF composition range but was, in general broader, while not having to develop new composition terms for ZrO_2, CaO, and MgO which are all known to impact glass viscosity strongly, the following boundary conditions were set:

- if the ZrO_2 was ≥ 2.00 wt%, which was twice the ZrO_2 content of the data on which the DWPF model is based (see Table II), the data were excluded
- if the CaO was ≥ 3.5 wt%, which was more than twice the CaO content of the data on which the DWPF model is based (see Table II), the data were excluded
- if the MgO was ≥ 6.00 wt%, which was twice the MgO content of the data on which the DWPF model is based (see Table II), the data were excluded
- if the B_2O_3 was ≥ 14.00 wt%, which was over the B_2O_3 content of the data on which the DWPF model is based (see Table II) by 2 wt% but clearly in the range of phase separated glasses as defined by Tovena [66], the data were excluded.

Table III. Analysis Details, Measured Viscosity-Temperature Data, and Calculated Non-Bridging Oxygen Terms (NBO) for the DWPF As-Batched and the As-Measured Compositions Given in Table IV.

Sample ID	Chemical Reps	Chem Lab	Vis Lab	Temp (°C)	log(Visc)	Visc (poise)	Calc log Vis As-batched	Calc log Vis As Meas	1/T(°C)	NBO (As-batched)	NBO (As Meas)
AH131AL(1985)	4	CELS	SS	944	2.75	562.34	2.78	2.71	1.0593	0.88	0.88
AH131AL(1985)	4	CELS	SS	1021	2.37	234.42	2.42	2.36	0.9794	0.88	0.88
AH131AL(1985)	4	CELS	SS	1098	2.05	112.20	2.11	2.05	0.9107	0.88	0.88
AH131AL(1985)	4	CELS	SS	1178	1.77	58.88	1.84	1.78	0.8489	0.88	0.88
AH131AL(1985)	4	CELS	SS	1264	1.50	31.62	1.58	1.52	0.7911	0.88	0.88
AH131AL(1988)	4	CELS	SS	1020	2.33	213.80	2.42	2.36	0.9804	0.88	0.88
AH131AL(1988)	4	CELS	SS	1079	2.08	120.23	2.19	2.12	0.9268	0.88	0.88
AH131AL(1988)	4	CELS	SS	1143	1.84	69.18	1.95	1.89	0.8749	0.88	0.88
AH131AL(1988)	4	CELS	SS	1200	1.65	44.67	1.77	1.71	0.8333	0.88	0.88
AH131AL(1988)	4	CELS	SS	1255	1.48	30.20	1.60	1.55	0.7968	0.88	0.88
AH131AL(1985)	4	CELS	SS	1283	1.40	25.12	1.53	1.47	0.7794	0.88	0.88
AH131AV(1985)	4	CELS	SS	803	3.08	1202.26	3.10	3.60	1.2453	1.214	0.85
AH131AV(1985)	4	CELS	SS	887	2.47	295.12	2.57	3.07	1.1274	1.214	0.85
AH131AV(1985)	4	CELS	SS	958	2.04	109.65	2.20	2.70	1.0438	1.214	0.85
AH131AV(1985)	4	CELS	SS	1045	1.71	51.29	1.81	2.31	0.9569	1.214	0.85
AH131AV(1985)	4	CELS	SS	1119	1.45	28.18	1.52	2.03	0.8937	1.214	0.85
AH131AV(1985-2)	4	CELS	SS	805	3.11	1288.25	3.08	3.58	1.2422	1.214	0.85
AH131AV(1985-2)	4	CELS	SS	888	2.52	331.13	2.56	3.06	1.1261	1.214	0.85
AH131AV(1985-2)	4	CELS	SS	968	2.08	120.23	2.15	2.65	1.0331	1.214	0.85
AH131AV(1985-2)	4	CELS	SS	1045	1.75	56.23	1.81	2.31	0.9569	1.214	0.85
AH131AV(1985-2)	4	CELS	SS	1121	1.48	30.20	1.52	2.02	0.8921	1.214	0.85
AH131AV(1988)	4	CELS	SS	1016	1.81	64.57	1.93	2.43	0.9843	1.214	0.85
AH131AV(1988)	4	CELS	SS	1077	1.58	38.02	1.68	2.19	0.9285	1.214	0.85
AH131AV(1988)	4	CELS	SS	1141	1.37	23.44	1.45	1.95	0.8764	1.214	0.85
AH131AV(1988)	4	CELS	SS	1197	1.21	16.22	1.26	1.77	0.8354	1.214	0.85
AH131AV(1988)	4	CELS	SS	1252	1.06	11.48	1.10	1.61	0.7987	1.214	0.85
AH131AV(1988)	4	CELS	SS	1281	0.99	9.77	1.02	1.53	0.7806	1.214	0.85
AH131FE(1985)	4	CELS	SS	730	3.60	3981.07	3.18	3.79	1.3699	1.52	1.06
AH131FE(1985)	4	CELS	SS	816	2.78	602.56	2.54	3.15	1.2255	1.52	1.06
AH131FE(1985)	4	CELS	SS	898	2.20	158.49	2.04	2.65	1.1136	1.52	1.06
AH131FE(1985)	4	CELS	SS	979	1.77	58.88	1.63	2.24	1.0215	1.52	1.06
AH131FE(1985)	4	CELS	SS	1057	1.47	29.51	1.29	1.91	0.9461	1.52	1.06

Sample ID	Chemical Reps	Chem Lab	Vis Lab	Temp (°C)	log(Visc)	Visc (poise)	Calc log Vis As-batched	Calc log Vis As Meas	1/T(°C)	NBO (As-batched)	NBO (As Meas)
AH131FE(1988)	4	CELS	SS	958	1.75	56.23	1.73	2.34	1.0438	1.52	1.06
AH131FE(1988)	4	CELS	SS	1019	1.49	30.90	1.45	2.07	0.9814	1.52	1.06
AH131FE(1988)	4	CELS	SS	1081	1.28	19.05	1.20	1.81	0.9251	1.52	1.06
AH131FE(1988)	4	CELS	SS	1141	1.08	12.02	0.98	1.60	0.8764	1.52	1.06
AH131FE(1988)	4	CELS	SS	1200	0.93	8.51	0.79	1.41	0.8333	1.52	1.06
AH131FE(1988)	4	CELS	SS	1253	0.81	6.46	0.63	1.25	0.7981	1.52	1.06
AH165AL(1988)	4	CELS	SS	1079	2.58	380.19	2.54	2.61	0.9268	0.647	0.59
AH165AL(1988)	4	CELS	SS	1145	2.32	208.93	2.30	2.38	0.8734	0.647	0.59
AH165AL(1988)	4	CELS	SS	1202	2.10	125.89	2.12	2.19	0.8319	0.647	0.59
AH165AL(1988)	4	CELS	SS	1259	1.90	79.43	1.95	2.02	0.7943	0.647	0.59
AH165AL(1988)	4	CELS	SS	1288	1.81	64.57	1.87	1.94	0.7764	0.647	0.59
AH165AV(1988)	4	CELS	SS	1022	2.28	190.55	2.32	2.38	0.9785	0.94	0.86
AH165AV(1988)	4	CELS	SS	1082	2.04	109.65	2.08	2.14	0.9242	0.94	0.86
AH165AV(1988)	4	CELS	SS	1143	1.81	64.57	1.86	1.92	0.8749	0.94	0.86
AH165AV(1988)	4	CELS	SS	1199	1.62	41.69	1.68	1.73	0.8340	0.94	0.86
AH165AV(1988)	4	CELS	SS	1255	1.45	28.18	1.51	1.57	0.7968	0.94	0.86
AH165AV(1988)	4	CELS	SS	1285	1.37	23.44	1.43	1.49	0.7782	0.94	0.86
AH165FE(1988)	4	CELS	SS	1017	1.96	91.20	1.95	2.09	0.9833	1.195	1.05
AH165FE(1988)	4	CELS	SS	1079	1.73	53.70	1.70	1.84	0.9268	1.195	1.05
AH165FE(1988)	4	CELS	SS	1141	1.51	32.36	1.48	1.61	0.8764	1.195	1.05
AH165FE(1988)	4	CELS	SS	1199	1.33	21.38	1.29	1.42	0.8340	1.195	1.05
AH165FE(1988)	4	CELS	SS	1257	1.18	15.14	1.11	1.25	0.7955	1.195	1.05
AH165FE(1988)	4	CELS	SS	1286	1.10	12.59	1.03	1.17	0.7776	1.195	1.05
AH168AL(1988)	4	CELS	SS	1019	2.65	446.68	2.65	2.35	0.9814	0.736	0.89
AH168AL(1988)	4	CELS	SS	1078	2.38	239.88	2.41	2.11	0.9276	0.736	0.89
AH168AL(1988)	4	CELS	SS	1142	2.12	131.83	2.18	1.88	0.8757	0.736	0.89
AH168AL(1988)	4	CELS	SS	1197	1.92	83.18	2.00	1.70	0.8354	0.736	0.89
AH168AL(1988)	4	CELS	SS	1254	1.74	54.95	1.83	1.53	0.7974	0.736	0.89
AH168AL(1988)	4	CELS	SS	1283	1.65	44.67	1.75	1.45	0.7794	0.736	0.89
AH168AV(1985)	4	CELS	SS	873	2.87	741.31	2.90	3.02	1.1455	1.053	0.92
AH168AV(1985)	4	CELS	SS	953	2.39	245.47	2.47	2.59	1.0493	1.053	0.92
AH168AV(1985)	4	CELS	SS	1031	2.03	107.15	2.11	2.24	0.9699	1.053	0.92
AH168AV(1985)	4	CELS	SS	1107	1.73	53.70	1.81	1.94	0.9033	1.053	0.92
AH168AV(1985)	4	CELS	SS	1191	1.46	28.84	1.53	1.66	0.8396	1.053	0.92
AH168AV(1988)	4	CELS	SS	1022	2.10	125.89	2.15	2.28	0.9785	1.053	0.92
AH168AV(1988)	4	CELS	SS	1084	1.85	70.79	1.90	2.03	0.9225	1.053	0.92
AH168AV(1988)	4	CELS	SS	1147	1.62	41.69	1.67	1.80	0.8718	1.053	0.92

Sample ID	Chemical Reps	Chem Lab	Vis Lab	Temp (°C)	log(Visc)	Visc (poise)	Calc log Vis As-batched	Calc log Vis As Meas	1/T(°C)	NBO (As-batched)	NBO (As Meas)
AH168AV(1988)	4	CELS	SS	1204	1.43	26.92	1.49	1.62	0.8306	1.053	0.92
AH168AV(1988)	4	CELS	SS	1260	1.27	18.62	1.32	1.45	0.7937	1.053	0.92
AH168AV(1988)	4	CELS	SS	1290	1.19	15.49	1.24	1.37	0.7752	1.053	0.92
AH168FE(1988)	4	CELS	SS	1022	1.80	63.10	1.72	1.85	0.9785	1.335	1.17
AH168FE(1988)	4	CELS	SS	1082	1.57	37.15	1.48	1.61	0.9242	1.335	1.17
AH168FE(1988)	4	CELS	SS	1144	1.36	22.91	1.25	1.39	0.8741	1.335	1.17
AH168FE(1988)	4	CELS	SS	1203	1.20	15.85	1.06	1.19	0.8313	1.335	1.17
AH168FE(1988)	4	CELS	SS	1259	1.06	11.48	0.89	1.03	0.7943	1.335	1.17
AH200AL(1988)	4	CELS	SS	1017	2.91	812.83	2.75	2.76	0.9833	0.677	0.65
AH200AL(1988)	4	CELS	SS	1079	2.62	416.87	2.50	2.51	0.9268	0.677	0.65
AH200AL(1988)	4	CELS	SS	1143	2.34	218.78	2.26	2.28	0.8749	0.677	0.65
AH200AL(1988)	4	CELS	SS	1201	2.13	134.90	2.08	2.09	0.8326	0.677	0.65
AH200AL(1988)	4	CELS	SS	1257	1.94	87.10	1.91	1.92	0.7955	0.677	0.65
AH200AL(1988)	4	CELS	SS	1286	1.83	67.61	1.83	1.84	0.7776	0.677	0.65
AH200AV(AH8/1985)	4	CELS	SS	916	2.82	660.69	2.76	2.79	1.0917	0.988	0.92
AH200AV(AH8/1985)	4	CELS	SS	994	2.40	251.19	2.37	2.40	1.0060	0.988	0.92
AH200AV(AH8/1985)	4	CELS	SS	1071	2.06	114.82	2.05	2.08	0.9337	0.988	0.92
AH200AV(AH8/1985)	4	CELS	SS	1148	1.77	58.88	1.77	1.80	0.8711	0.988	0.92
AH200AV(AH8/1985)	4	CELS	SS	1234	1.50	31.62	1.50	1.53	0.8104	0.988	0.92
AH200AV(1988)	4	CELS	SS	1021	2.36	229.09	2.25	2.29	0.9794	0.988	0.92
AH200AV(1988)	4	CELS	SS	1084	2.10	125.89	2.00	2.03	0.9225	0.988	0.92
AH200AV(1988)	4	CELS	SS	1147	1.87	74.13	1.77	1.81	0.8718	0.988	0.92
AH200AV(1988)	4	CELS	SS	1203	1.66	45.71	1.59	1.63	0.8313	0.988	0.92
AH200AV(1988)	4	CELS	SS	1259	1.49	30.90	1.43	1.46	0.7943	0.988	0.92
AH200FE(1988)	4	CELS	SS	1019	1.93	85.11	1.82	1.94	0.9814	1.277	1.13
AH200FE(1988)	4	CELS	SS	1083	1.67	46.77	1.56	1.68	0.9234	1.277	1.13
AH200FE(1988)	4	CELS	SS	1143	1.45	28.18	1.34	1.46	0.8749	1.277	1.13
AH200FE(1988)	4	CELS	SS	1200	1.29	19.50	1.16	1.28	0.8333	1.277	1.13
AH200FE(1988)	4	CELS	SS	1259	1.16	14.45	0.98	1.10	0.7943	1.277	1.13
AH202AL(1988)	4	CELS	SS	1050	3.05	1122.02	2.80	2.80	0.9524	0.557	0.55
AH202AL(1988)	4	CELS	SS	1111	2.75	562.34	2.56	2.57	0.9001	0.557	0.55
AH202AL(1988)	4	CELS	SS	1173	2.50	316.23	2.35	2.36	0.8525	0.557	0.55
AH202AL(1988)	4	CELS	SS	1227	2.27	186.21	2.18	2.19	0.8150	0.557	0.55
AH202AL(1988)	4	CELS	SS	1284	2.07	117.49	2.02	2.03	0.7788	0.557	0.55
AH202AL(1988)	4	CELS	SS	1344	1.89	77.62	1.86	1.88	0.7440	0.557	0.55
AH202AV(AH10/1985)	4	CELS	SS	979	2.71	512.86	2.66	2.67	1.0215	0.844	0.81
AH202AV(AH10/1985)	4	CELS	SS	1054	2.35	223.87	2.34	2.34	0.9488	0.844	0.81

Sample ID	Chemical Reps	Chem Lab	Vis Lab	Temp (°C)	log(Visc)	Visc (poise)	Calc log Vis As-batched	Calc log Vis As Meas	1/T(°C)	NBO (As-batched)	NBO (As Meas)
AH202AV(AH10/1985)	4	CELS	SS	1129	2.05	112.20	2.06	2.06	0.8857	0.844	0.81
AH202AV(AH10/1985)	4	CELS	SS	1215	1.76	57.54	1.78	1.78	0.8230	0.844	0.81
AH202AV(AH10/1985)	4	CELS	SS	1299	1.50	31.62	1.54	1.55	0.7698	0.844	0.81
AH202AV(1988)	4	CELS	SS	1037	2.49	309.03	2.40	2.41	0.9643	0.848	0.81
AH202AV(1988)	4	CELS	SS	1097	2.23	169.82	2.17	2.18	0.9116	0.848	0.81
AH202AV(1988)	4	CELS	SS	1161	1.99	97.72	1.94	1.95	0.8613	0.848	0.81
AH202AV(1988)	4	CELS	SS	1217	1.79	61.66	1.76	1.78	0.8217	0.848	0.81
AH202AV(1988)	4	CELS	SS	1275	1.65	44.67	1.60	1.61	0.7843	0.848	0.81
AH202FE(1988)	4	CELS	SS	1017	2.13	134.90	2.09	2.15	0.9833	1.104	1.01
AH202FE(1988)	4	CELS	SS	1078	1.87	74.13	1.85	1.90	0.9276	1.104	1.01
AH202FE(1988)	4	CELS	SS	1143	1.63	42.66	1.61	1.67	0.8749	1.104	1.01
AH202FE(1988)	4	CELS	SS	1199	1.45	28.18	1.43	1.48	0.8340	1.104	1.01
AH202FE(1988)	4	CELS	SS	1253	1.29	19.50	1.27	1.32	0.7981	1.104	1.01
BLACK FRIT 165-Drain Valve Test Stand-4 (1987)	2	CELS	SS	951	2.02	104.71	2.13	2.00	1.0515	1.278	1.28
BLACK FRIT 165-Drain Valve Test Stand-4 (1987)	2	CELS	SS	1016	1.75	56.23	1.83	1.70	0.9843	1.278	1.28
BLACK FRIT 165-Drain Valve Test Stand-4 (1987)	2	CELS	SS	1077	1.52	33.11	1.58	1.45	0.9285	1.278	1.28
BLACK FRIT 165-Drain Valve Test Stand-4 (1987)	2	CELS	SS	1145	1.31	20.42	1.34	1.21	0.8734	1.278	1.28
BLACK FRIT 165-Drain Valve Test Stand-4 (1987)	2	CELS	SS	1198	1.15	14.13	1.16	1.03	0.8347	1.278	1.28
BLACK FRIT 165-Drain Valve Test Stand-4 (1987)	2	CELS	SS	1257	1.01	10.23	0.99	0.86	0.7955	1.278	1.28
DWPF STARTUP 10-26 (1989)	24	CELS	SS	1100	1.84	69.18	1.82	1.71	0.9091	1.064	1.07
DWPF STARTUP 10-26 (1989)	24	CELS	SS	1130	1.74	54.95	1.72	1.60	0.8850	1.064	1.07
DWPF STARTUP 10-26 (1989)	24	CELS	SS	1183	1.55	35.48	1.54	1.43	0.8453	1.064	1.07
DWPF STARTUP 10-26 (1989)	24	CELS	SS	1238	1.39	24.55	1.37	1.26	0.8078	1.064	1.07
DWPF STARTUP 10-26 (1989)	24	CELS	SS	1266	1.30	19.95	1.29	1.18	0.7899	1.064	1.07
DWPF STARTUP 10-27a(1989)	24	CELS	SS	1066	1.94	87.10	1.94	1.84	0.9381	1.07	1.07

Sample ID	Chemical Reps	Chem Lab	Vis Lab	Temp (°C)	log(Visc)	Visc (poise)	Calc log Vis As-batched	Calc log Vis As Meas	1/T(°C)	NBO (As-batched)	NBO (As Meas)
DWPF STARTUP 10-27a(1989)	24	CELS	SS	1129	1.71	51.29	1.71	1.61	0.8857	1.07	1.07
DWPF STARTUP 10-27a(1989)	24	CELS	SS	1184	1.52	33.11	1.53	1.42	0.8446	1.07	1.07
DWPF STARTUP 10-27a(1989)	24	CELS	SS	1238	1.36	22.91	1.36	1.26	0.8078	1.07	1.07
DWPF STARTUP 10-27a(1989)	24	CELS	SS	1264	1.28	19.05	1.29	1.19	0.7911	1.07	1.07
DWPF STARTUP 10-27b(1989)	24	CELS	SS	1068	1.89	77.62	1.90	1.83	0.9363	1.091	1.07
DWPF STARTUP 10-27b(1989)	24	CELS	SS	1130	1.67	46.77	1.67	1.60	0.8850	1.091	1.07
DWPF STARTUP 10-27b(1989)	24	CELS	SS	1185	1.46	28.84	1.49	1.42	0.8439	1.091	1.07
DWPF STARTUP 10-27b(1989)	24	CELS	SS	1239	1.32	20.89	1.33	1.26	0.8071	1.091	1.07
DWPF STARTUP 10-27b(1989)	24	CELS	SS	1267	1.24	17.38	1.25	1.18	0.7893	1.091	1.07
AH4(1985)	4	CELS	SS	949	2.71	512.86	2.75	2.64	1.0537	0.879	0.91
AH4(1985)	4	CELS	SS	1027	2.33	213.80	2.40	2.28	0.9737	0.879	0.91
AH4(1985)	4	CELS	SS	1104	2.02	104.71	2.09	1.98	0.9058	0.879	0.91
AH4(1985)	4	CELS	SS	1186	1.74	54.95	1.81	1.70	0.8432	0.879	0.91
AH4(1985)	4	CELS	SS	1270	1.48	30.20	1.56	1.45	0.7874	0.879	0.91
AH5(1985)	4	CELS	SS	957	2.72	524.81	2.70	2.69	1.0449	0.889	0.85
AH5(1985)	4	CELS	SS	1044	2.36	229.09	2.31	2.31	0.9579	0.889	0.85
AH5(1985)	4	CELS	SS	1119	2.05	112.20	2.02	2.02	0.8937	0.889	0.85
AH5(1985)	4	CELS	SS	1203	1.76	57.54	1.74	1.74	0.8313	0.889	0.85
AH5(1985)	4	CELS	SS	1288	1.51	32.36	1.50	1.50	0.7764	0.889	0.85
AH7(1985)	4	CELS	SS	940	2.70	501.19	2.64	2.64	1.0638	0.985	0.93
AH7(1985)	4	CELS	SS	1017	2.31	204.17	2.28	2.28	0.9833	0.985	0.93
AH7(1985)	4	CELS	SS	1093	1.99	97.72	1.97	1.98	0.9149	0.985	0.93
AH7(1985)	4	CELS	SS	1173	1.71	51.29	1.69	1.70	0.8525	0.985	0.93
AH7(1985)	4	CELS	SS	1258	1.45	28.18	1.43	1.45	0.7949	0.985	0.93
AH9(1985)	4	CELS	SS	966	2.64	436.52	2.58	2.60	1.0352	0.936	0.88
AH9(1985)	4	CELS	SS	1043	2.27	186.21	2.24	2.26	0.9588	0.936	0.88
AH9(1985)	4	CELS	SS	1117	1.98	95.50	1.96	1.97	0.8953	0.936	0.88
AH9(1985)	4	CELS	SS	1202	1.69	48.98	1.68	1.69	0.8319	0.936	0.88

Sample ID	Chemical Reps	Chem Lab	Vis Lab	Temp (°C)	log(Visc)	Visc (poise)	Calc log Vis As-batched	Calc log Vis As Meas	1/T(°C)	NBO (As-batched)	NBO (As Meas)
AH9(1985)	4	CELS	SS	1288	1.44	27.54	1.43	1.44	0.7764	0.936	0.88
AH11(1985)	4	CELS	SS	926	2.83	676.08	2.78	2.86	1.0799	0.936	0.85
AH11(1985)	4	CELS	SS	1005	2.41	257.04	2.40	2.48	0.9950	0.936	0.85
AH11(1985)	4	CELS	SS	1082	2.07	117.49	2.09	2.16	0.9242	0.936	0.85
AH11(1985)	4	CELS	SS	1160	1.78	60.26	1.81	1.89	0.8621	0.936	0.85
AH11(1985)	4	CELS	SS	1246	1.51	32.36	1.54	1.62	0.8026	0.936	0.85
AH13(1985-HI)	4	CELS	SS	942	2.83	676.08	2.72	2.74	1.0616	0.926	0.87
AH13(1985-HI)	4	CELS	SS	1023	2.40	251.19	2.34	2.37	0.9775	0.926	0.87
AH13(1985-HI)	4	CELS	SS	1098	2.08	120.23	2.04	2.07	0.9107	0.926	0.87
AH13(1985-HI)	4	CELS	SS	1177	1.78	60.26	1.77	1.80	0.8496	0.926	0.87
AH13(1985-HI)	4	CELS	SS	1263	1.51	32.36	1.51	1.54	0.7918	0.926	0.87
AH15(1985-HI)	4	CELS	SS	999	2.36	229.09	2.30	2.32	1.0010	1.024	0.96
AH15(1985-HI)	4	CELS	SS	1077	2.00	100.00	1.97	2.00	0.9285	1.024	0.96
AH15(1985-HI)	4	CELS	SS	1152	1.72	52.48	1.70	1.73	0.8681	1.024	0.96
AH15(1985-HI)	4	CELS	SS	1238	1.43	26.92	1.43	1.46	0.8078	1.024	0.96
AH16(1985-HI)	4	CELS	SS	956	2.83	676.08	2.72	2.73	1.0460	0.881	0.83
AH16(1985-HI)	4	CELS	SS	1035	2.39	245.47	2.36	2.38	0.9662	0.881	0.83
AH16(1985-HI)	4	CELS	SS	1111	2.06	114.82	2.06	2.08	0.9001	0.881	0.83
AH16(1985-HI)	4	CELS	SS	1191	1.77	58.88	1.79	1.82	0.8396	0.881	0.83
AH16(1985-HI)	4	CELS	SS	1277	1.49	30.90	1.54	1.56	0.7831	0.881	0.83
FRIT 131 (1987)	1	SRTC/ADS	SS	989	1.75	56.23	2.06	1.73	1.0111	1.208	1.33
FRIT 131 (1987)	1	SRTC/ADS	SS	1045	1.53	33.88	1.82	1.49	0.9569	1.208	1.33
FRIT 131 (1987)	1	SRTC/ADS	SS	1097	1.34	21.88	1.61	1.28	0.9116	1.208	1.33
FRIT 131 (1987)	1	SRTC/ADS	SS	1142	1.20	15.85	1.45	1.12	0.8757	1.208	1.33
FRIT 131 (1987)	1	SRTC/ADS	SS	1199	1.03	10.72	1.27	0.94	0.8340	1.208	1.33
FRIT 131 (1987)	1	SRTC/ADS	SS	1259	0.91	8.13	1.09	0.76	0.7943	1.208	1.33
FRIT 165(1987)	10	CELS	SS	986	2.52	331.13	2.53	2.53	1.0142	0.912	0.87
FRIT 165(1987)	10	CELS	SS	1041	2.26	181.97	2.29	2.30	0.9606	0.912	0.87
FRIT 165(1987)	10	CELS	SS	1095	2.04	109.65	2.08	2.08	0.9132	0.912	0.87
FRIT 165(1987)	10	CELS	SS	1140	1.87	74.13	1.91	1.92	0.8772	0.912	0.87
FRIT 165(1987)	10	CELS	SS	1197	1.69	48.98	1.73	1.74	0.8354	0.912	0.87
FRIT 165(1987)	10	CELS	SS	1255	1.52	33.11	1.55	1.57	0.7968	0.912	0.87
FRIT 165(1987)	10	CELS	SS	1313	1.36	22.91	1.40	1.41	0.7616	0.912	0.87
FRIT 168(1987)	.	Nominal	SS	1043	1.95	89.13	2.09	2.00	0.9588	1.032	1.03
FRIT 168(1987)	.	Nominal	SS	1096	1.73	53.70	1.89	1.80	0.9124	1.032	1.03
FRIT 168(1987)	.	Nominal	SS	1141	1.57	37.15	1.73	1.64	0.8764	1.032	1.03
FRIT 168(1987)	.	Nominal	SS	1195	1.39	24.55	1.55	1.46	0.8368	1.032	1.03

Sample ID	Chemical Reps	Chem Lab	Vis Lab	Temp (°C)	log(Visc)	Visc (poise)	Calc log Vis As-batched	Calc log Vis As Meas	1/T(°C)	NBO (As-batched)	NBO (As Meas)
FRIT 168(1987)	.	Nominal	SS	1253	1.22	16.60	1.38	1.29	0.7981	1.032	1.03
FRIT 168(1987)	.	Nominal	SS	1310	1.08	12.02	1.22	1.13	0.7634	1.032	1.03
FRIT 200(1987)	.	Nominal	SS	1092	2.38	239.88	2.35	2.31	0.9158	0.74	0.74
FRIT 200(1987)	.	Nominal	SS	1137	2.19	154.88	2.19	2.15	0.8795	0.74	0.74
FRIT 200(1987)	.	Nominal	SS	1195	1.98	95.50	2.00	1.96	0.8368	0.74	0.74
FRIT 200(1987)	.	Nominal	SS	1253	1.78	60.26	1.82	1.79	0.7981	0.74	0.74
FRIT 200(1987)	.	Nominal	SS	1308	1.61	40.74	1.67	1.64	0.7645	0.74	0.74
FRIT 201(1987)	.	Nominal	SS	1353	1.59	38.90	1.63	1.60	0.7391	0.693	0.69
FRIT 201(1987)	.	Nominal	SS	1382	1.52	33.11	1.56	1.53	0.7236	0.693	0.69
FRIT 201(1987)	.	Nominal	SS	1409	1.46	28.84	1.50	1.47	0.7097	0.693	0.69
FRIT 201(1987)	.	Nominal	SS	1436	1.40	25.12	1.44	1.41	0.6964	0.693	0.69
FRIT 201(1987)	.	Nominal	SS	1491	1.27	18.62	1.33	1.30	0.6707	0.693	0.69
FRIT 202(1987)	2	SRTC/ADS	SS	1358	1.86	72.44	1.75	1.79	0.7364	0.606	0.58
FRIT 202(1987)	2	SRTC/ADS	SS	1384	1.79	61.66	1.69	1.73	0.7225	0.606	0.58
FRIT 202(1987)	2	SRTC/ADS	SS	1411	1.72	52.48	1.63	1.67	0.7087	0.606	0.58
FRIT 202(1987)	2	SRTC/ADS	SS	1438	1.67	46.77	1.57	1.61	0.6954	0.606	0.58
FRIT 202(1987)	2	SRTC/ADS	SS	1466	1.60	39.81	1.51	1.55	0.6821	0.606	0.58
FRIT 202(1987)	2	SRTC/ADS	SS	1491	1.53	33.88	1.46	1.50	0.6707	0.606	0.58
FRIT 202PHP(1987)	6	CELS	SS	1091	2.07	117.49	2.01	1.93	0.9166	0.962	0.96
FRIT 202PHP(1987)	6	CELS	SS	1137	1.89	77.62	1.85	1.77	0.8795	0.962	0.96
FRIT 202PHP(1987)	6	CELS	SS	1193	1.69	48.98	1.66	1.58	0.8382	0.962	0.96
FRIT 202PHP(1987)	6	CELS	SS	1249	1.51	32.36	1.50	1.42	0.8006	0.962	0.96
FRIT 202PHP(1987)	6	CELS	SS	1304	1.36	22.91	1.34	1.26	0.7669	0.962	0.96
FRIT 202PHP(1987)	6	CELS	SS	1360	1.22	16.60	1.20	1.12	0.7353	0.962	0.96

Table IV. As-Measured Glass Compositions for the DWPF Viscosity Model.

Sample ID	FeII/SFe	Al2O3(v)	B2O3(v)	BaO(v)	CaO(v)	Cr2O3(v)	Cs2O(v)	CuO(v)	Cu2O(v)	FeO(v)	Fe2O3(v)	K2O(v)	La2O3(v)	Li2O(v)	MgO(v)	MnO(v)	Na2O(v)	NiO(v)	SiO2(v)	SrO(v)	TiO2(v)	ZnO(v)	ZrO2(v)	S Oxides
AH131AL(1985)	0.02	13.50	10.80	0.00	0.38	0.00	0.00	0.00	0.00	0.09	4.57	0.00	0.36	4.09	1.38	2.51	14.10	0.63	46.40	0.00	0.72	0.00	0.34	99.88
AH131AL(1985)	0.02	13.50	10.80	0.00	0.38	0.00	0.00	0.00	0.00	0.09	4.57	0.00	0.36	4.09	1.38	2.51	14.10	0.63	46.40	0.00	0.72	0.00	0.34	99.88
AH131AV(1985)	0.07	4.39	7.60	0.00	0.76	0.00	0.00	0.00	0.00	0.70	11.13	0.00	0.00	4.25	0.67	2.59	9.86	1.04	55.00	0.00	0.06	0.00	0.88	99.01
AH131AV(1985-2)	0.07	4.39	7.60	0.00	0.76	0.00	0.00	0.00	0.00	0.70	11.13	0.00	0.00	4.25	0.67	2.59	9.86	1.04	55.00	0.00	0.06	0.00	0.88	99.01
AH131AV(1988)	0.07	4.39	7.60	0.00	0.76	0.00	0.00	0.00	0.00	0.70	11.13	0.00	0.00	4.25	0.67	2.59	9.86	1.04	55.00	0.00	0.06	0.00	0.88	99.01
AH131FE(1985)	0.56	2.25	7.33	0.00	1.01	0.00	0.00	0.00	0.00	8.81	7.61	0.00	0.00	4.06	0.66	0.93	10.90	2.56	51.40	0.00	0.01	0.00	0.87	99.38
AH131FE(1988)	0.56	2.25	7.33	0.00	1.01	0.00	0.00	0.00	0.00	8.81	7.61	0.00	0.00	4.06	0.66	0.93	10.90	2.56	51.40	0.00	0.01	0.00	0.87	99.38
AH165AL(1988)	0.06	13.40	7.34	0.00	0.51	0.00	0.00	0.00	0.00	0.24	4.57	0.00	0.00	4.20	0.66	2.62	10.60	0.67	53.60	0.00	0.00	0.00	0.79	99.23
AH165AV(1988)	0.05	5.17	6.57	0.00	1.04	0.00	0.00	0.00	0.00	0.47	11.08	0.00	0.00	5.02	0.66	2.57	9.96	1.01	55.30	0.00	0.00	0.00	0.76	99.66
AH165FE(1988)	0.47	1.42	7.28	0.00	1.40	0.00	0.00	0.00	0.00	7.14	9.07	0.00	0.00	4.05	0.65	1.07	10.70	2.97	52.00	0.00	0.00	0.00	0.85	99.39
AH168AL(1988)	0.06	6.72	13.70	0.00	0.14	0.00	0.00	0.00	0.00	0.14	2.31	0.00	0.00	5.34	0.89	1.09	11.80	0.33	56.40	0.00	0.00	0.00	0.87	99.74
AH168AV(1985)	0.06	5.58	10.60	0.00	0.68	0.00	0.00	0.00	0.00	0.61	10.51	0.00	0.00	4.24	0.74	2.64	10.10	1.02	51.60	0.00	0.00	0.00	0.69	99.08
AH168AV(1988)	0.06	5.58	10.60	0.00	0.68	0.00	0.00	0.00	0.00	0.61	10.51	0.00	0.00	4.24	0.74	2.64	10.10	1.02	51.60	0.00	0.00	0.00	0.69	99.08
AH168FE(1988)	0.42	2.47	11.40	0.00	1.35	0.00	0.00	0.00	0.00	6.22	9.39	0.00	0.00	4.12	0.71	0.98	10.80	2.82	48.30	0.00	0.00	0.00	0.67	99.92
AH200AL(1988)	0.02	13.40	10.20	0.00	0.54	0.00	0.00	0.00	0.00	0.07	4.39	3.12	0.00	2.65	1.25	2.49	10.60	0.61	48.40	0.00	1.70	0.00	0.03	99.46
AH200AV(AH8/1985)	0.04	5.14	10.30	0.00	0.63	0.00	0.00	0.00	0.00	0.39	11.47	3.18	0.00	2.68	1.24	2.55	9.77	1.02	49.50	0.00	1.41	0.00	0.02	99.34
AH200AV(1988)	0.04	5.14	10.30	0.00	0.63	0.00	0.00	0.00	0.00	0.39	11.47	3.18	0.00	2.68	1.24	2.55	9.77	1.02	49.50	0.00	1.41	0.00	0.02	99.34
AH200FE(1988)	0.40	2.07	10.10	0.00	0.92	0.00	0.00	0.00	0.00	5.94	9.80	3.15	0.00	2.59	1.21	0.95	10.60	2.57	47.40	0.00	1.78	0.00	0.02	99.76
AH202AL(1988)	0.02	13.90	7.42	0.00	0.41	0.00	0.00	0.00	0.00	0.08	4.31	3.32	0.00	4.18	1.28	2.51	7.34	0.62	52.40	0.00	1.71	0.00	0.03	99.52
AH202AV(AH10/1985)	0.03	4.96	7.44	0.00	0.72	0.00	0.00	0.00	0.00	0.31	11.56	3.33	0.00	4.27	1.30	2.59	6.55	1.00	54.10	0.00	1.37	0.00	0.03	99.56
AH202AV(1988)	0.03	4.96	7.44	0.00	0.72	0.00	0.00	0.00	0.00	0.31	11.56	3.33	0.00	4.27	1.30	2.59	6.55	1.00	54.10	0.00	1.37	0.00	0.03	99.56
AH202FE(1988)	0.42	1.36	7.08	0.00	0.96	0.00	0.00	0.00	0.00	6.28	9.62	3.28	0.00	4.27	1.26	0.95	7.62	2.73	52.55	0.00	1.72	0.00	0.02	100.40
BLACK FRIT 165-Drain Valve Test Stand-4 (1987)	0.00	3.80	12.20	0.00	1.20	0.00	0.00	0.00	0.00	0.00	9.90	0.00	0.00	4.40	0.60	1.79	15.80	0.80	48.39	0.00	0.00	0.00	0.60	99.49
DWPF STARTUP 10-26 (1989)	0.00	4.60	8.51	0.10	1.47	0.09	0.00	0.00	0.00	0.00	14.20	2.70	0.00	3.25	0.84	1.93	11.53	1.11	47.90	0.00	1.18	0.00	0.11	99.52
DWPF STARTUP 10-27a(1989)	0.00	4.60	8.51	0.10	1.47	0.09	0.00	0.00	0.00	0.00	14.20	2.70	0.00	3.25	0.84	1.93	11.53	1.11	47.90	0.00	1.18	0.00	0.11	99.52
DWPF STARTUP 10-27b(1989)	0.00	4.60	8.51	0.10	1.47	0.09	0.00	0.00	0.00	0.00	14.20	2.70	0.00	3.25	0.84	1.93	11.53	1.11	47.90	0.00	1.18	0.00	0.11	99.52
AH4(1985)	0.00	4.69	7.06	0.00	1.00	0.05	0.06	0.00	0.00	0.00	11.00	3.16	0.00	4.10	0.73	2.12	9.89	0.97	53.48	0.05	1.30	0.00	0.01	99.67
AH5(1985)	0.00	5.48	6.95	0.00	0.66	0.00	0.00	0.00	0.00	0.00	11.40	3.16	0.00	3.77	0.60	2.64	9.24	0.96	53.08	0.00	1.31	0.00	0.01	99.26
AH7(1985)	0.00	6.27	11.50	0.00	0.64	0.00	0.00	0.00	0.00	0.00	11.30	3.15	0.00	3.15	0.59	2.62	9.24	0.95	49.00	0.00	1.29	0.00	0.02	99.72
AH9(1985)	0.00	6.04	8.75	0.00	0.69	0.01	0.06	0.00	0.00	0.00	11.60	3.13	0.00	3.47	0.58	2.64	9.20	0.97	50.88	0.05	1.33	0.00	0.01	99.41

Sample ID	FeII/SFe	Al2O3(v)	B2O3(v)	BaO(v)	CaO(v)	Cr2O3(v)	Cs2O(v)	CuO(v)	Cu2O(v)	FeO(v)	Fe2O3(v)	K2O(v)	La2O3(v)	Li2O(v)	MgO(v)	MnO(v)	Na2O(v)	NiO(v)	SiO2(v)	SrO(v)	TiO2(v)	ZnO(v)	ZrO2(v)	S Oxides
AH11(1985)	0.00	5.70	12.00	0.00	0.65	0.01	0.06	0.00	0.00	0.00	11.00	2.99	0.00	3.62	1.11	2.63	6.42	0.93	50.40	0.04	1.29	0.00	0.01	98.86
AH13(1985-HI)	0.00	6.48	6.41	0.00	1.25	0.01	0.05	0.00	0.00	0.00	13.60	3.06	0.00	3.32	0.49	3.25	8.80	1.14	49.00	0.05	1.29	0.00	0.03	98.23
AH15(1985-HI)	0.00	6.87	9.20	0.00	1.27	0.01	0.05	0.00	0.00	0.00	13.60	3.10	0.00	2.80	1.02	3.26	9.41	1.13	45.60	0.06	1.34	0.00	0.01	98.73
AH16(1985-HI)	0.00	6.36	7.20	0.00	1.26	0.08	0.03	0.00	0.00	0.00	13.40	3.06	0.00	4.06	1.00	3.22	6.54	1.10	50.20	0.07	1.30	0.00	0.01	98.89
FRIT 131 (1987)	0.00	0.35	14.37	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.06	0.18	0.50	5.12	1.69	0.13	18.80	0.10	52.06	0.00	0.95	0.27	0.46	95.12
FRIT 165(1987)	0.00	0.00	9.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.96	0.99	0.00	12.16	0.00	68.89	0.00	0.00	0.00	0.99	99.31
FRIT 168(1987)	0.00	0.00	17.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	1.00	0.00	13.00	0.00	62.00	0.00	0.00	0.00	1.00	100.00
FRIT 200(1987)	0.00	0.00	12.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	2.00	0.00	11.00	0.00	70.00	0.00	0.00	0.00	0.00	100.00
FRIT 201(1987)	0.00	0.00	10.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.50	1.00	0.00	10.00	0.00	73.00	0.00	0.00	0.00	0.00	100.00
FRIT 202(1987)	0.00	0.40	7.81	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00	6.60	1.90	0.00	5.80	0.00	77.04	0.00	0.10	0.00	0.00	100.04
FRIT 202PHP(1987)	0.00	4.30	8.60	0.20	1.22	0.07	0.15	0.33	0.30	0.00	10.70	5.73	0.00	3.42	2.92	0.00	9.20	0.70	51.20	0.00	1.24	0.00	0.00	100.28

Table V Temperature, Viscosity and Composition Ranges for the DWPF Viscosity Validation

Parameter	Maximum Value	Minimum Value
Temperature (°C)	1350	803.35
Viscosity (poise)	11,000	8.9
$Fe^{+2}/\Sigma Fe$	0.71	0.00
Al_2O_3(wt%)	17.74	0.81
B_2O_3(wt%)	13.25	4.90
BaO(wt%)	0.5	0.00
CaO(wt%)	3.2	0.02
CdO(wt%)	1.18	0.00
Ce_2O_3(wt%)	0.67	0.00
CoO(wt%)	0.10	0.00
Cr_2O_3(wt%)	0.82	0.00
Cs_2O(wt%)	0.24	0.00
CuO(wt%)	0.23	0.00
Cu_2O(wt%)	0.20	0.00
FeO(wt%)	8.62	0.00
Fe_2O_3(wt%)	17.74	1.90
K_2O(wt%)	3.86	0.00
La_2O_3(wt%)	1.12	0.00
Li_2O(wt%)	6.60	0.87
MgO(wt%)	4.80	0.00
MnO(wt%)	3.31	0.03
MoO_3(wt%)	0.51	0.00
Na_2O(wt%)	16.8	6.41
Nd_2O_3(wt%)	2.01	0.00
NiO(wt%)	3.01	0.00
P_2O_5(wt%)	1.01	0.00
PbO(wt%)	0.19	0.00
Pr_6O_{11}(wt%)	0.02	0.00
Rh_2O_3(wt%)	0.02	0.00
RuO_2(wt%)	0.06	0.00
SO_4(wt%)	0.59	0.00
Sb_2O_3(wt%)	0.01	0.00
SiO_2(wt%)	60.39	40.50
Sm_2O_3(wt%)	0.02	0.00
SrO(wt%)	0.18	0.00
TiO_2(wt%)	1.43	0.00
V_2O_5(wt%)	0.01	0.00
Y_2O_3(wt%)	0.23	0.00
ZnO(wt%)	0.21	0.00
ZrO_2(wt%)	2.00	0.00
SUM Oxides	104.75	95.07

Using these compositional boundary conditions, the validation pool contains 1004 viscosity-temperature pairs. When the validation data viscosities were calculated from Equation 4 and plotted against the measured viscosities for these same data the following relationship was obtained

Equation 5 $\log(\text{Visc})_{\text{measured}} = -0.052113 + 1.0361415 \log(\text{Visc})_{\text{calculated validation data}}$ (poise)

indicating a near zero intercept and a slope of unity. Equation 5 had an R^2 of 0.96 and a RSME of 0.11122 for the 1004 viscosity-temperature pairs which represent ~170 different glasses (see Appendix B). The RSME is larger than that of Model Data because there is more scatter in the data; e.g., some of the data fall outside the 95% individual confidence bands (Figure 9). This is to be expected as the data used for validation were not as rigorously controlled as the data used for modeling; e.g., glasses were measured by many different laboratories and analysts over a 22 year time span and glasses were measured over a composition range wider than that upon which the DWPF model was developed. This is especially true for the one glass from West Valley that contained 17.7 wt% total Fe_2O_3 (indicated by the + marks biased highest above the DWPF viscosity model upper 95% confidence limit). This glass may have crystallized and exhibited non-Newtonian behavior during viscosity measurement due to the high iron content, but the glass was included in the validation data set since it was not known for certain whether or not this glass had crystallized. Likewise, it is not known why two of the glasses measured in 1982 at SRNL (black x's) are biased high compared to the revised DWPF viscosity model because the literature from which they were taken does not indicate the condition of the glass. Lastly, some of the DWPF startup frit glasses (black *'s) appear biased high when compared to the model but they are glasses that were measured at temperatures of ~850°C and the DPWF startup frit is known to crystallize at temperatures <1025°C [64].

A comparison of the composition ranges in Table II for the viscosity model data with the composition range over which the viscosity model was validated (Table V) demonstrates that the model is applicable well outside the composition range for which it was developed (see Table V). Note that glasses with Al_2O_3 content <3 wt% were included in the validation data even though some glasses at these values of Al_2O_3 have been shown to be phase separated [62].

In addition, the data from the DWPF Waste Qualification Runs (WQR) WP-14, WP-15, and WP-17 [16] were reassessed as additional validation data of the revised DWPF viscosity model (Equation 4). The WP-14 glass had a predicted viscosity of 72.2 poise at 1150°C and the glass measurement based on a Fulcher fit equation was 78.7 poise. The WP-15 glass predicted viscosity was 52.4 vs. a measured-Fulcher fit value of 58.2 poise. For the WP-17 glass the model viscosity was calculated as 68.8 poise while the measured Fulcher fit value was 64.4 poise. The revised DWPF as-measured viscosity model was within ±6 poise for all of the WQR glasses instead of being accurate for only the WP-14 and WP-15 glasses when calculated with the 1991 as-batched viscosity model which has been shown to have a bias.

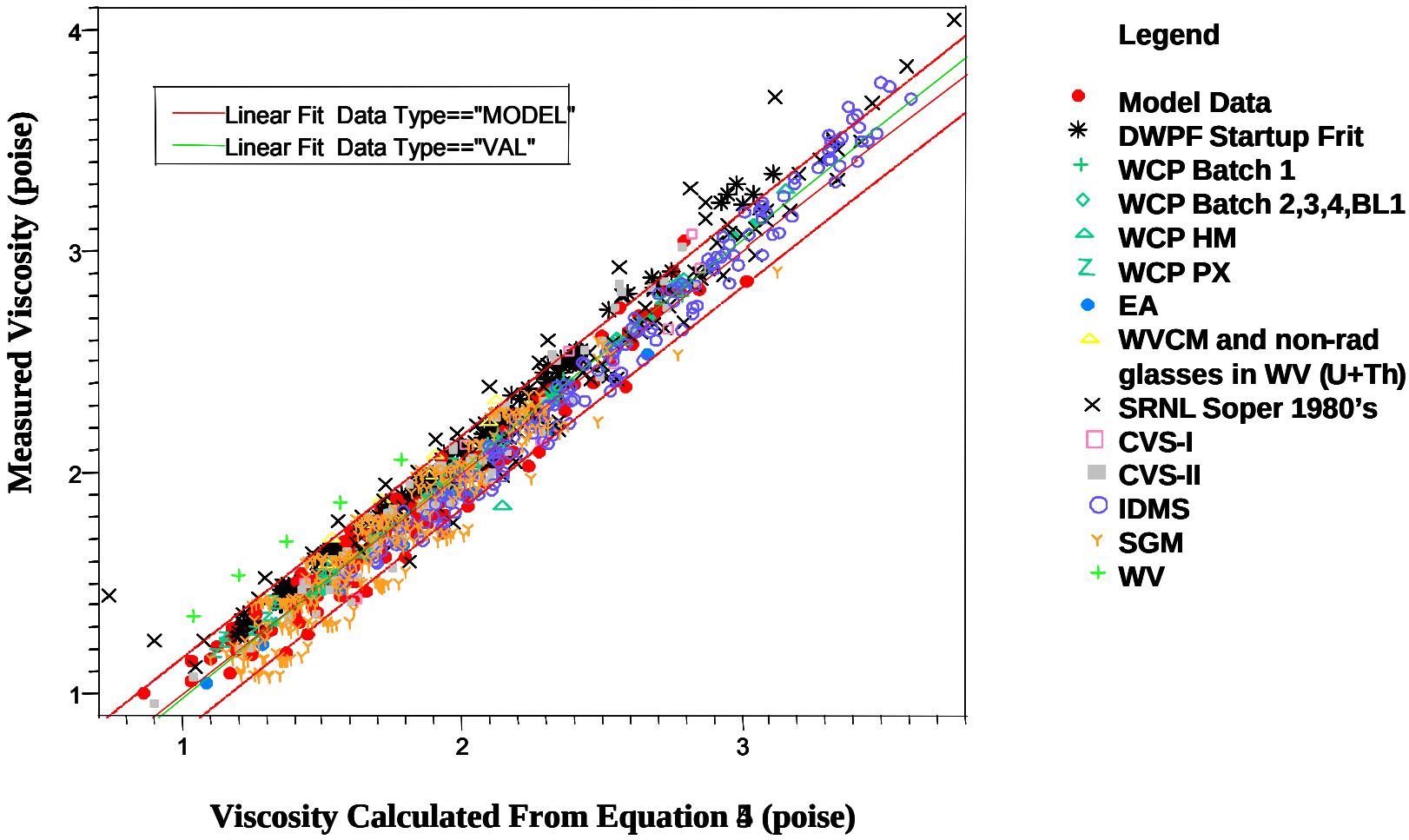

Figure 9. Fit of validation data to the revised DWPF viscosity model showing the individual 95% confidence bands for Equation 4.

5.5 DWPF VISCOSITY MODEL FOR URANIUM CONTAINING GLASSES

A data set of uranium containing glasses only was constructed from the data in references [17-30] and recent viscosity data on M-Area glasses for which chemistries were already available [67]. These studies included the CST study [20-24], the PHA study [26-29], the M-Area study, the results from the radioactive round robin glasses which included a uranium containing standard glass [18], and the recent higher waste loading impacts study [30]. These data formed a "uranium only" viscosity database of 301 viscosity-temperature pairs. All glass chemistries were as-measured. All of the glasses were oxidized and so it is assumed that all of the uranium is present as U^{+6}. The uranium in these glasses ranged from zero to 5.76 wt%. Some glasses had trace amounts of ThO_2 in them, e.g. 0.06 wt%, the typical concentrations experienced in DWPF HLW processing to date. However, the impacts of elevated ThO_2 on viscosity will be discussed in Section 5.5 since DWPF Sludge Batch 8 (SB8) is projected to have elevated concentrations of ThO_2 [30] from some THOREX processing at SRS that produced some high ThO_2 containing wastes that are present in a limited number of waste tanks. It is also of note that some of the glasses had up to 3.1 wt% TiO_2 (Table VI) which appeared to have little or no impact on glass viscosity.

Table VI. Temperature, Viscosity and Composition Ranges for the DWPF Uranium Only Glasses

Parameter	Maximum Value	Minimum Value
Temperature (°C)	1258	974
Viscosity (poise)	7979.51	10.81
$Fe^{+2}/\Sigma Fe$	0.00	0.00
Al_2O_3(wt%)	29.02	2.53
B_2O_3(wt%)	11.89	4.33
CaO(wt%)	1.79	0.29
Cr_2O_3(wt%)	0.30	0.07
CuO(wt%)	0.51	0.00
Cu_2O(wt%)	0.46	0.00
Fe_2O_3(wt%)	16.86	1.74
K_2O(wt%)	5.84	0.00
Li_2O(wt%)	6.82	0.00
MgO(wt%)	2.47	0.06
MnO(wt%)	4.02	0.03
Na_2O(wt%)	12.74	7.27
NiO(wt%)	2.78	0.19
P_2O_5(wt%)	0.76	0.00
SiO_2(wt%)	55.85	34.15
ThO_2(wt%)	0.06	0.00
TiO_2(wt%)	3.10	0.00
U_3O_8(wt%)	5.76	0.00
ZrO_2(wt%)	0.97	0.00
SUM Oxides	103.87	95.14

Of the 301 "uranium only" data points available, 14 did not meet the 100±5 wt% criteria for the oxide composition. The glasses excluded are indicated in Appendix C and are MN-7, MN-11 and CST 12c which was also eliminated because of high ZrO_2 content. Forty data pairs were excluded because they had >1 wt% ZrO_2. The uranium containing glasses were confined to 1 wt% ZrO_2 to be consistent with the range of ZrO_2 on which the revised and 1991 DWPF models were based (Table II). The glasses excluded are indicated in Appendix C and are CST- 06, 08, 09, 11, 12, 12c, 14, and 15.

The data were also constrained to a temperatures of ≥800°C to eliminate potential bias due to non-Newtonian viscosity behavior. Glasses with >14 wt% B_2O_3 were excluded because of phase separation and the known impacts of this phenomena on glass viscosity measurements. The glasses excluded are indicated in Appendix C and are MN-3, MLSi-9, MHSi-6, MLSi-3B, and MN-2.

Sixty four data pairs had CaO values in excess of the 1.5 wt% maximum on which the DWPF model was developed. However, these 64 values were left in the uranium glass database because the CaO contents were 1.51, 1.69, and 1.79 wt% CaO which was only ~15 relative % over the maximum value on which the DWPF model had been developed. This left a uranium glass modeling database of 227 viscosity-temperature pairs compared to the 175 viscosity-temperature pairs that the DWPF model had been developed with.

When the 227 uranium glass viscosity-temperature pairs are modeled using the revised DWPF viscosity model, Equation 4, the following relationship is derived

Equation 6 $$\log(\text{Visc})_{\text{measured(poise)}} = -0.018072 + 1.0348022 \log(\text{Visc})_{\text{calculated from Equation 4(poise)}}$$

with an R^2 of 0.96 and an RSME of 0.104468 as compared to 0.0832 for Equation 4.

Equation 6 has a zero intercept and a slope of ~1.03 indicating a slight bias of the uranium containing glass data to the DWPF model (Equation 4) without a uranium term, ~3% in the data. However, the 3% bias is influenced the most by three radioactive glasses from the radioactive viscosity round robin (glass 1, glass 3, and glass 5) indicated by the pale blue and green z's in Figure 10. During the statistical analysis of the data from the radioactive round robin it was determined that SRNL's data were biased 9% high compared to data from CELS and SS and 2% high compared to data generated by PNNL [18]. Therefore, the 35 viscosity-temperature pairs associated with the uranium containing glasses studied in the radioactive viscosity round robin were excluded from the uranium glass database which left 192 viscosity-temperature pairs to be modeled.

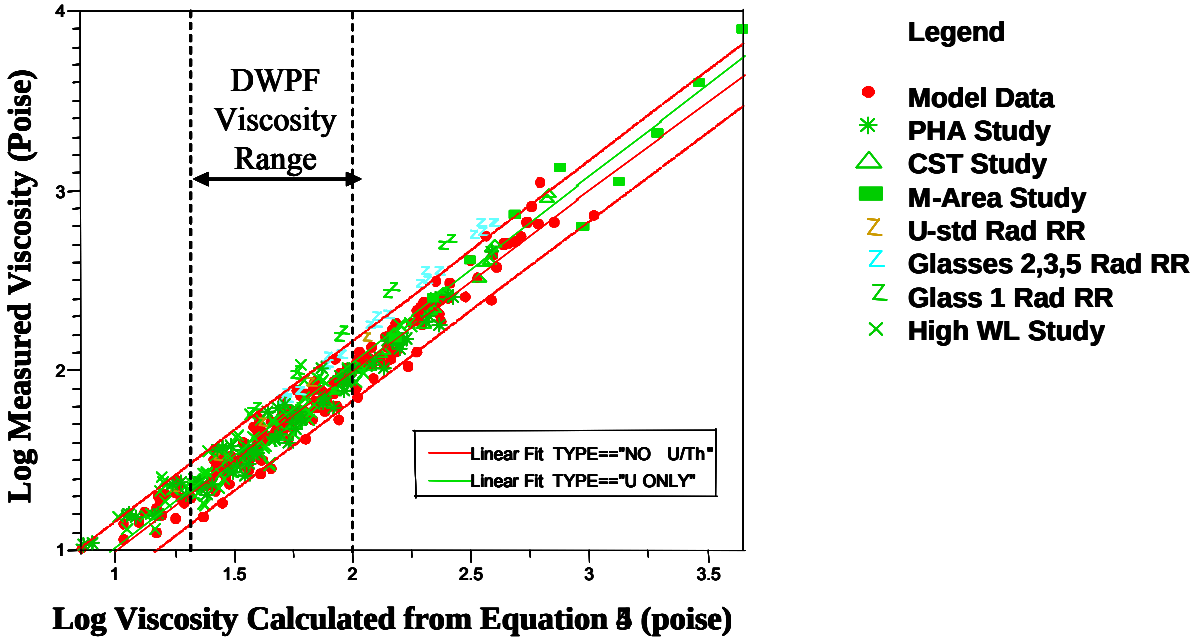

Figure 10. Comparison of the as-measured DWPF viscosity model that contains no uranium term to uranium containing glasses including Glasses 1, 3, and 5 from the radioactive viscosity round robin.

Regression of the uranium glass data without glasses 1, 3, and 5 from the radioactive viscosity round robin gave the following relationship:

Equation 7 $\log(\text{Visc})_{\text{measured}}(\text{poise}) = 0.0203269 + 0.9988938 \log(\text{Visc})_{\text{calculated from Equation 4}}(\text{poise})$

with an R^2 of 0.97 and an RSME of 0.08602 for the 192 data sets being modeled. This indicates that a calculated viscosity of 20 poise might actually be 20.9 poise and that a calculated viscosity of 100 poise might actually be 104 poise.

Figure 11 indicates that all the uranium containing glasses lie within the 95% individual confidence interval of the revised DWPF viscosity model (Equation 4). Likewise, the fit of Equation 4 to model data and to the 192 data points for the uranium containing glasses are coincident (see Figure 11).

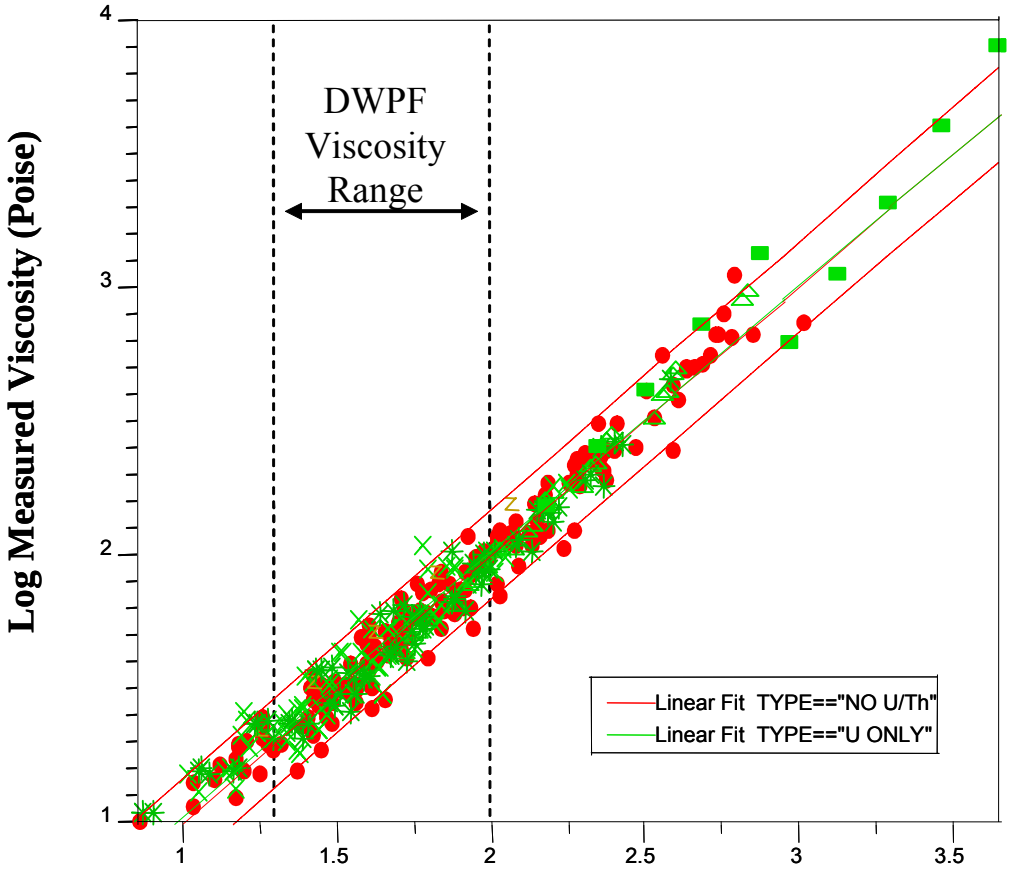

Figure 11. Comparison of the DWPF viscosity model that contains no uranium term to uranium excluding glasses including Glasses 1, 3, and 5 from the radioactive viscosity round robin.

In summary, a uranium term is not needed in the revised as-measured DWPF viscosity model (Equation 4) as long as the U_3O_8 concentrations of the glasses are ≤5.76 wt% as indicated in Table VI.

The fact that a U^{+6} term is not needed in the DWPF viscosity model is consistent with the fact that U^{+6} has four bridging and two non-bridging oxygens (Figure 2). Therefore, the impact of the number of bridging and non-bridging oxygen's is approximately equal, and U_3O_8 at concentrations of ≤5.76 wt% have no discernable impacts on viscosity in this composition range.

While U^{+6} appears to have little to no impact on glass viscosity, this same conclusion should be verified for U^{+4} and U^{+5} in glass since these species were not examined in this study. This is of special note since the DWPF is currently operating at a REDOX target of 0.2. Schreiber's [61] Electromotive Force (EMF) series for DWPF glass indicates the speciation shown in Table VII for uranium as a function of REDOX. At the DWPF target REDOX of 0.2 there are equal contributions from both U^{+6} and U^{+5} and a slight contribution from U^{+4}. At the lower (more

oxidized) DWPF REDOX limit of 0.09, U^{+6} dominates (Table VII) - while at the upper (more reduced) DWPF REDOX limit of 0.33 the predominant uranium species is U^{+5} (Table VII).

Table VII. Uranium Speciation as a Function of Glass REDOX at 1150°C

REDOX as $Fe^{+2}/\Sigma Fe$	**U^{+6} (%)**	**U^{+5} (%)**	**U^{+4} (%)**	**Σ U (%)**
0.09 (oxidizing DWPF limit)	75	24	1	100
0.2 (SB2 and SB3 target)	45	45	10	100
0.33 (reducing DWPF limit)	35	50	15	100

5.6 DWPF Viscosity Model for Uranium and Thorium Containing Glasses

Several glasses contained more than the 0.06 wt% ThO_2 typical of DWPF glasses processed to date. There were three glasses in the higher waste loading study of Peeler and Edwards [30] that substituted ThO_2 for U_3O_8 on an equimolar basis. This provided a set of three glasses with U_3O_8 concentrations between 2.75 and 3.08 wt% and ThO_2 concentrations of 2.66-2.75 wt%. All of these glasses were oxidizing and it is assumed that the uranium was all U^{+6} as were all the glasses discussed in Section 5.4.

Data from two additional studies of uranium and thorium containing glasses were available from West Valley. These data contained 22 glasses containing both U_3O_8 and ThO_2 and one glass containing ThO_2 only (Table VIII).

Table VIII. Concentration Ranges of U_3O_8 and ThO_2 in Mixed Uranium and Thorium Glasses

Glass [Ref]	U_3O_8 (wt%)	ThO_2 (wt%)
RCTH-30 [30]	2.76	2.79
RCTH-40 [30]	3.08	2.66
RCTH-50 [30]	2.77	2.75
22 West Valley Glasses	0.62 - 0.72	3.50 - 3.60
1 West Valley Glass	0	1.79

The 26 glasses had 110 viscosity-temperature pairs of data associated with them. All the compositions summed to 100±5 wt% on an oxide basis and all the viscosity measurements had been made at ≥ 800°C. One glass had ZrO_2 ≥ 1 wt% and the four viscosity-temperature pairs associated with this glass were removed from the modeling data set. Two glasses had B_2O_3 concentrations ≥ 14 wt% indicating that these glasses might be phase separated and exhibit anomalous viscosity measurement. The eight viscosity-temperature pairs associated with these two glasses were removed from the modeling data set. None of the glasses had CaO ≥ 1.5 wt% This left a modeling set, partially constrained to the DWPF composition region (Table I), for an evaluation of the role of Th^{+4} in the presence of U^{+6}. The final database contained 98 viscosity-temperature pairs. All of the data are given in Appendix D.

Table IX. Temperature, Viscosity and Composition Ranges for Mixed Uranium-Thorium Glasses

Parameter	Maximum Value	Minimum Value
Temperature (°C)	1256	996
Visc (poise)	950.00	16.36
Al_2O_3(wt%)	11.90	3.00
B_2O_3(wt%)	12.90	5.05
BaO(wt%)	0.20	0.00
CaO(wt%)	1.00	0.20
Ce_2O_3(wt%)	0.67	0.00
Cr_2O_3(wt%)	0.30	0.10
Cs_2O(wt%)	0.10	0.00
Fe_2O_3(wt%)	15.30	10.94
K_2O(wt%)	3.50	0.00
Li_2O(wt%)	5.16	1.90
MgO(wt%)	2.09	0.00
MnO(wt%)	3.80	0.82
Na_2O(wt%)	13.30	8.20
Nd_2O_3(wt%)	0.30	0.00
NiO(wt%)	2.73	0.20
P_2O_5(wt%)	0.88	0.10
SO_4(wt%)	0.24	0.00
SiO_2(wt%)	47.24	37.80
ThO_2(wt%)	3.90	1.80
TiO_2(wt%)	1.00	0.00
U_3O_8(wt%)	3.08	0.00
ZrO_2(wt%)	0.60	0.05
SUM Oxides	99.31	96.76

For the 18 viscosity-temperature pairs of the three high ThO_2 containing glasses measured at SRNL [30] the following relationship was derived between the DPWF viscosity model (Equation 4) and the measured data:

Equation 8 $\log(Visc)_{measured}$ (poise) = $0.0884762 + 0.8755177_{\log \text{ vis calculated from Equation 4}}$ (poise)

where $R^2 = 0.90$ and RSME = 0.072617.

Figure 12 shows the bias of the SRNL data toward more fluid melt viscosities graphically. Figure 12 indicates that moderate ThO_2 in the presence of U_3O_8 may depolymerize the glass matrix and makes the DWPF melts more fluid. This is consistent with what is known from the literature about the coordination chemistry of Th^{+4} in glass (see Figure 2 and Figure 3); i.e., that is may act as a weak network modifier.

The West Valley mixed uranium-thorium glass database is clearly biased toward more polymerized melts (higher viscosities) as evidenced in Figure 12 and Equation 9.

Equation 9 $\log(Visc)_{measured} = -0.046514 + 1.1382915_{\log \text{ vis calculated from Equation 4}}$ (poise)

with an $R^2 = 0.89$ and a RMSE 0.108248 for the 22 glasses. These data indicate that high ThO_2 (3.5 wt% ThO_2) in the presence of only a small amount of U^{+6} as U_3O_8 (~0.6-0.7 wt%) contracts and polymerizes the glass network as shown in Figure 3. However, these glasses are much higher in Al_2O_3, Nd_2O_3, and Ce_2O_3 than the glasses studied by Peeler and Edwards [30]. The West Valley glasses are, however, in the range of Al_2O_3 modeled during the development of the DWPF viscosity model (compare Table V and Table IX). This indicates that there may be a synergistic interaction between ThO_2 and Al_2O_3 that warrants further investigation.

Interestingly, the ThO_2 only glass (not modeled) is shown on Figure 12 as the green triangles. It appears to fit the DWPF viscosity model and is not biased toward higher or lower viscosities as are the mixed uranium and thorium glasses. Since the ThO_2 only glass contains only 1.79 wt% ThO_2 (Table VIII) instead of the 2.76-3.6 wt% used in the SRNL and West Valley studies, there may be a threshold below which ThO_2 does not impact the glass viscosity. The SRNL data suggest that the presence of more U^{+6} may counterbalance the glass polymerization effects of increased ThO_2. The synergistic effects on viscosity of U^{+6} in the presence of U^{+5} and U^{+4};e.g., at the DWPF target REDOX of 0.2, need to be studied as well as the synergistic effects on viscosity of U^{+6} in the presence of Th^{+4}.

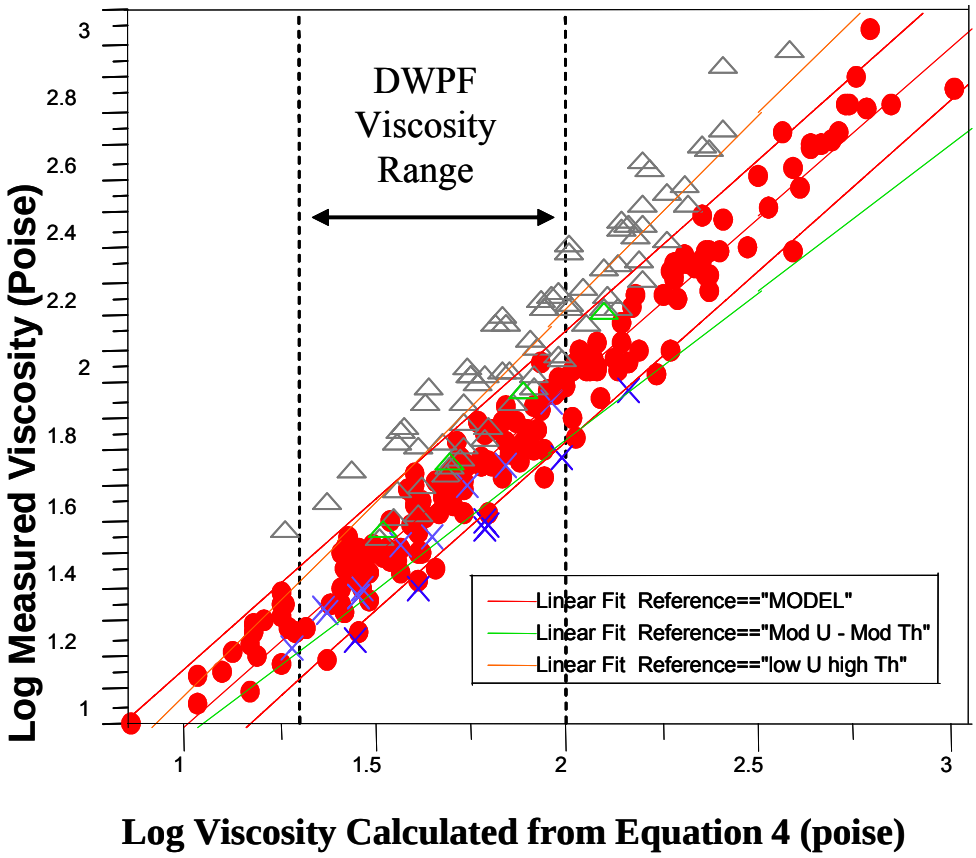

Figure 12. Comparison of the DWPF viscosity model that contains no uranium or thorium term to the measured viscosities for mixed uranium and thorium containing glasses.

5.7 Validation of the Revised Viscosity Model for Frit 418 Sludge Batch 3 (SB3) Glasses Containing Uranium and Thorium

Additional validation that a U^{+6} term is not needed in the revised DWPF viscosity model (Equation 4) is provided by a recent study of the viscosity of uranium containing glasses made with Frit 418 and simulated SB3 waste [31]. In the Frit 418/SB3 study the measured viscosity values at the DWPF melt temperature of 1150°C indicated a bias of ~16 poise when evaluated with the 1991 as-batched viscosity model (Equation 3). Therefore, the Frit 418/SB3 glasses were assessed against the revised "as measured" DPWF model to determine if this bias still existed.

First, the composition range in terms of U_3O_8 (wt%) of the 192 uranium glass viscosity-temperature pairs used to demonstrate that a U^{+6} term is not needed in the revised DWPF viscosity model (Equation 4) were compared to the 32 viscosity-temperature pairs generated in the Frit 418/SB3 study (Figure 13). This figure demonstrates that the composition of the 192 viscosity-temperature pairs discussed in Section 5.5 span the U_3O_8 (wt%) compositions of the Frit 418/SB3 study.

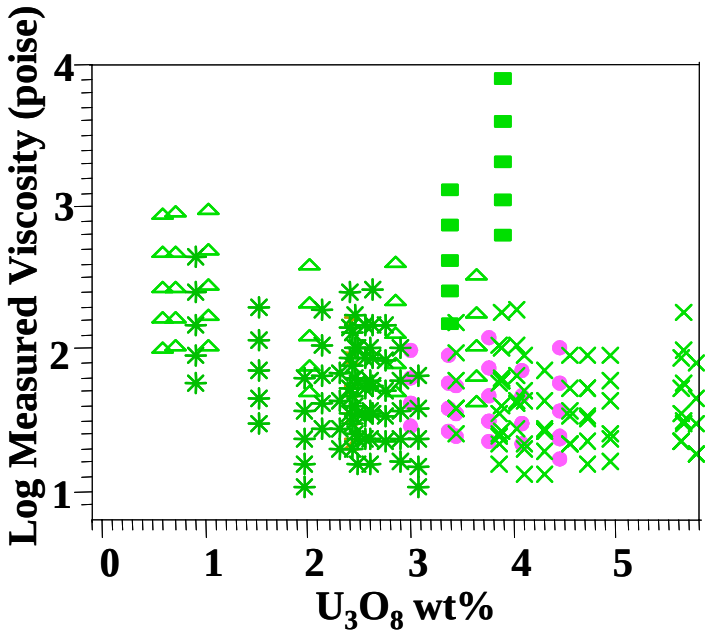

Figure 13. U_3O_8 content of the six Frit 418/SB3 glasses compared to the remaining 35 uranium containing glasses used to determine that a U^{+6} term was not needed in the revised DWPF viscosity model (Equation 4). The solid circles are the Frit 418/SB3 viscosity-temperature data. The other symbols are the same as those given in Figure 10.

Secondly, the 32 Frit 418/SB3 viscosity-temperature pairs were overlain on the revised DWPF viscosity model (Equation 4) as shown in Figure 14. In Figure 14 (left) both the model data and the Frit 418/SB3 data points are shown. Individual OLS regressions are fitted to the revised DWPF model and to the Frit 418/SB3. While the OLS for the Frit 418/SB3 glasses has a slightly different slope (it crosses the OLS for model data) it fits well within the individual 95% confidence intervals shown for the model data over the entire viscosity range but especially well within the DWPF viscosity region of log viscosity of 1.3-2.04 (20 to 110 poise). In addition, a 20 poise model viscosity calculates as 22.5 poise and 110 poise calculates as 109.3 poise using the Frit 418/SB3 OLS data regression shown in Figure 14. For clarity, in Figure 14 (right) the OLS and 95% confidence intervals from Figure 14 (Equation 4) are shown without the model data points so that the position of the Frit 418/SB3 data can more easily be observed. Figure 14 is additional validation that a U^{+6} term is not needed in the revised DWPF viscosity model

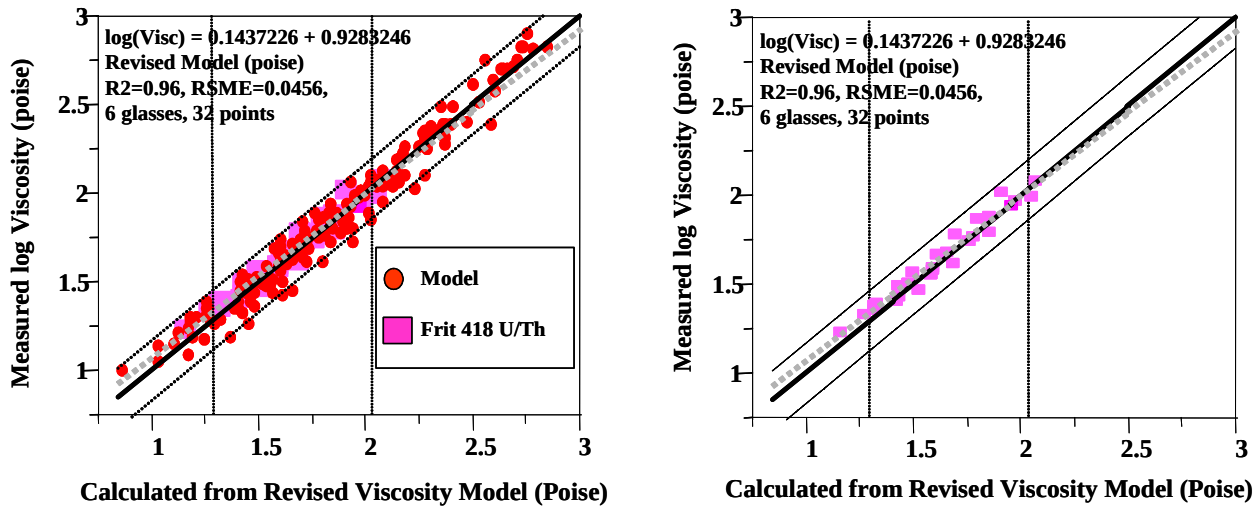

Figure 14. Comparison of the revised DWPF viscosity model (Equation 4) without a U^{+6} term and the Frit 418/SB3 study glasses.

6.0 CONCLUSIONS

An assessment of the DWPF glass viscosity model demonstrated that the as-batched compositions used to develop the 1991 PCCS viscosity model were biased high compared to the same model developed with the as-measured glass compositions because of eight glasses that had anomalous compositions and homogeneity. The range of viscosities covered during this comparison was 7-1000 poise. The bias was -2.7 poise at ~20 poise and ~29 poise at ~110 poise with a bias of ~17 poise at a viscosity of ~50 poise. A similar comparison was performed between the 1991 PCCS viscosity model based on the as-batched compositions and the as-measured radioactive glasses and the bias was in the same direction and about the same order of magnitude; e.g., -4.4 poise at ~20 poise to -14 poise at ~110 poise. The non-radioactive as-batched vs. the radioactive as measured biases are somewhat smaller than the differences between the non-radioactive as-batched vs. the non-radioactive as-measured correlations. Due to the similarity of the bias whether U^{+6} was present in the glasses or not, the 33 original non-

radioactive as-measured PCCS model glasses, those not exhibiting disparate compositions or homogeneity, were used to fit new coefficients to the DWPF PCCS model. This was then compared to the as-measured uranium data to determine if the PCCS viscosity model needed a U^{+6} or other radioactive term.

The revised viscosity model developed with 33 of the original 41 glasses should be implemented in DWPF to eliminate this bias. The revised DWPF viscosity model is:

$$\log \eta(poise) = -0.519571 + \left(\frac{4453.87}{T(^oC)}\right) - (1.690326 * NBO_{asmeasured})$$

with an R^2 of 0.966 and a RMSE of 0.0832.

While the revised DWPF viscosity model was developed based on 33 rather than 41 non-radioactive glasses, it was validated with 1004 non-radioactive glass viscosity-temperature measurements. The validation data included ~200 replicate measurements on the DWPF startup frit by six different laboratories, ~130 measurements on the Waste Compliance Plan (WCP) glasses by OCF, ~10 measurements of the Environmental Assessment (EA) glass by OCF, ~140 glasses from West Valley measured at Alfred University, ~125 measurements from SRNL testing in the early 1980's, ~700 measurements from Pacific Northwest National Laboratory (PNNL) on two different statistically designed matrices of simulated waste glasses (Chemical Variability Study I and II), and ~530 measurements made by OCF on glasses made in the SRNL Integrated DWPF Melter System (IDMS) and the Scale Glass Melter (SGM). This validation data had become available after the as-batched viscosity model had been developed for DWPF in 1991.

A data set of 192 radioactive viscosity-temperature pairs containing only U^{+6} were assessed against the revised as-measured non-radioactive DWPF viscosity model to determine if a U^{+6} term was needed. The comparison indicated that $\log(Visc)_{\text{measured for radioactive glasses (poise)}} = 0.0203269 + 0.9988938 \log(Visc)_{\text{calc from the as-measured DWPF model for same radioactive glasses (poise)}}$ with an R^2 of 0.97. This indicates that a calculated viscosity of 20 poise might actually be 20.9 poise and that a calculated viscosity of 100 poise might actually be 104 poise. All the uranium containing glasses lie within the 95% individual confidence intervals of the revised DWPF viscosity model. An additional comparison was demonstrated with recent data on the Frit 418/SB3 uranium containing glasses. In both of these comparisons it was shown that a U^{+6} is not needed if the bias in the 1991 "as-batched" is replaced with the revised model coefficients determined in this study.

The revised DWPF viscosity model presented in this study eliminates the 15 poise bias that existed with the WP-17 WQR glasses calculated with the 1991 as-batched PCCS model. It is also eliminated the ~16 poise bias determined in the Frit 418/SB3 study. The revised model fits all of the WQR data in addition to an additional 1004 validation points. Since the DWPF viscosity model is also related to sulfate solubility and melt rate, it would be of additional benefit for DWPF to implement the revised model presented in this study.

The fact that a U^{+6} term is not needed in the DWPF viscosity model is consistent with the fact that U^{+6} has four bridging and two non-bridging oxygen bonds. Therefore, the impact of the

number of bridging and non-bridging oxygen's is approximately equal at U_3O_8 concentrations of ≤5.76 wt%. Uranium may not have an impact at higher U_3O_8 concentrations but this would have to be demonstrated since the effects of the 0.66:0.33 BO to NBO ratio may become more significant as the U_3O_8 content increases.

While U^{+6} appears to have little to no impact on glass viscosity, this may or may not be true for U^{+4} and U^{+5} in glass since these species were not examined in this study. This is of especial note since the DWPF is currently operating at a REDOX target of 0.2 where 45% of the uranium is U^{+6}, 45% is U^{+5}, and 10% is U^{+4}.

An additional 26 glasses for which 98 viscosity-temperature measurements were available indicate disparate roles for ThO_2 depending on the U_3O_8 concentration and the Al_2O_3 concentration of the glasses measured. For the data generated on 3 DWPF glasses at SRNL where the ThO_2 content and U_3O_8 content were each in the 2.5-3.0 wt% range, the presence of ThO_2 made the melts more fluid. This is consistent with what is known from the literature about the coordination chemistry of Th^{+4} in glass; e.g., that is may act as a weak network modifier. However, the 22 West Valley mixed uranium-thorium glass glasses with U_3O_8 ~0.6-0.7 wt% and ThO_2 of 3.5-3.6 wt%, demonstrate a trend toward more polymerized melts (higher viscosities). The West Valley glasses are much higher in Al_2O_3 than the glasses measured at SRNL although they are in the range of the DWPF viscosity model. This indicates that there may be a synergistic interaction between ThO_2, U_3O_8, and Al_2O_3 that needs further investigation.

Data for one glass containing ThO_2 only were available from West Valley. It contained only 1.79 wt% ThO_2 and the data fit the revised DWPF viscosity model indicating no impact of ThO_2 on glass viscosity. Since the ThO_2 only glass contains only 1.79 wt% ThO_2 instead of the 2.76-3.6 wt% used in the mixed ThO_2-U_3O_8 studies, there may be a threshold below which ThO_2 does not have any impact on glass viscosity.

7.0 RECOMMENDATIONS/PATH FORWARD

The following recommendations are made:

- implement the revised DWPF viscosity model presented in this study because
  - the 1991 DWPF viscosity model is biased due to the presence of incorrect and anomalous data
  - the revised model will aid in glass formulation efforts to improve melt rate by increasing alkali and/or boron content because the new model eliminates the biases noted for high alkali glasses when compared to the 1991 DWPF viscosity model
  - the revised model is more accurate and will give improved performance if used to model sulfate solubility [68, 69] and/or melt rate* in DWPF

* A preliminary modeling attempt has shown that log viscosity calculated from Equation 3 in this study and wt% solids of a given feed are highly correlated to the melt fluxes measured during pilot scale testing at SRNL and PNNL in the 1980's.

- the revised non-radioactive DWPF viscosity model has been validated with >1000 glasses produced after the 1991 DWPF non-radioactive model was developed

- investigate the viscosity of a few uranium containing glasses at the DWPF target REDOX of 0.2 to assess the impact, if any, of U^{+5} and U^{+4}: note that this will entail running the viscometer in an inert atmosphere to prevent the reduced glass from oxidizing during remelting in the viscometer

- investigate the impact of ThO_2 and uranium in high alumina glasses to determine if there is a threshold below which ThO_2 does not impact glass viscosity

- investigate the impact of ThO_2 and uranium in high alumina glasses to determine if there is are synergistic effects between U_3O_8 and ThO_2 and/or between U_3O_8 and Al_2O_3

- investigate the threshold values of other glass components that could significantly impact glass viscosity on the adequacy of the DWPF viscosity model, e.g. glasses with ≥ 3.5 wt% CaO or ≥ 2.0 wt% ZrO_2, if feeds containing these components are expected to be processed in the DWPF melter in the future.

- investigate the use of a different SRNL viscosity standard because the current standard, the DWPF startup frit, exhibits low temperature non-Newtonian behavior or investigate the use of the DWPF startup frit standard viscosity curves at temperatures ≥950° where the temperature-viscosity relationship is Newtonian.

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APPENDIX A

Table AI. DWPF Startup Frit Viscosity-Temperature Database

Sample ID	Reference	Data Type	Chemical Repeats	Chemistry Lab	Viscosity Lab	Temp (°C)	Visc (poise)
DWPF STARTUP 10-26 (1989)	WSRC-RP-89-18	MODEL	24	CELS	SS	1100	69.18
DWPF STARTUP 10-26 (1989)	WSRC-RP-89-18	MODEL	24	CELS	SS	1130	54.95
DWPF STARTUP 10-26 (1989)	WSRC-RP-89-18	MODEL	24	CELS	SS	1183	35.48
DWPF STARTUP 10-26 (1989)	WSRC-RP-89-18	MODEL	24	CELS	SS	1238	24.55
DWPF STARTUP 10-26 (1989)	WSRC-RP-89-18	MODEL	24	CELS	SS	1266	19.95
DWPF STARTUP 10-27a(1989)	WSRC-RP-89-18	MODEL	24	CELS	SS	1066	87.10
DWPF STARTUP 10-27a(1989)	WSRC-RP-89-18	MODEL	24	CELS	SS	1129	51.29
DWPF STARTUP 10-27a(1989)	WSRC-RP-89-18	MODEL	24	CELS	SS	1184	33.11
DWPF STARTUP 10-27a(1989)	WSRC-RP-89-18	MODEL	24	CELS	SS	1238	22.91
DWPF STARTUP 10-27a(1989)	WSRC-RP-89-18	MODEL	24	CELS	SS	1264	19.05
DWPF STARTUP 10-27b(1989)	WSRC-RP-89-18	MODEL	24	CELS	SS	1068	77.62
DWPF STARTUP 10-27b(1989)	WSRC-RP-89-18	MODEL	24	CELS	SS	1130	46.77
DWPF STARTUP 10-27b(1989)	WSRC-RP-89-18	MODEL	24	CELS	SS	1185	28.84
DWPF STARTUP 10-27b(1989)	WSRC-RP-89-18	MODEL	24	CELS	SS	1239	20.89
DWPF STARTUP 10-27b(1989)	WSRC-RP-89-18	MODEL	24	CELS	SS	1267	17.38
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1138	43.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1093	67.90
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1041	104.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	992	173.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	942	318.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1040	107.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1139	44.70
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1188	30.70
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1238	21.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1140	44.30
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1139	43.70
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1091	67.80
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1041	105.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	992	171.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	942	315.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1040	107.00

Sample ID	Reference	Data Type	Chemical Repeats	Chemistry Lab	Viscosity Lab	Temp (°C)	Visc (poise)
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1138	43.80
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1188	30.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1238	20.40
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1141	43.70
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1139	43.70
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1090	68.70
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1041	107.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	992	176.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	941	325.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1039	109.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1138	44.50
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1187	30.60
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1238	21.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	A	1139	43.80
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1152.1	41.40
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1100.8	63.30
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1050.6	98.80
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1000.1	162.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	950.1	284.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1052.3	97.50
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1152	42.60
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1201.5	30.70
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1251.1	23.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1152.9	44.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1151.7	40.30
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1100.7	61.10
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1051.2	96.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1001.1	157.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	949	283.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1047.7	98.80
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1152.1	41.20
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1203.2	29.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1251.2	21.20
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1153.6	41.20
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1152.6	40.70

Sample ID	Reference	Data Type	Chemical Repeats	Chemistry Lab	Viscosity Lab	Temp (°C)	Visc (poise)
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1101.5	61.30
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1050.7	96.20
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	999.7	160.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	949.9	282.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1051.5	96.10
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1151.6	41.70
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1200	29.70
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1252	20.90
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	B	1149.6	42.80
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	1167.4	40.70
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	1109.9	61.10
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	1054	96.80
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	994.7	174.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	947.3	301.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	881.4	734.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	833.5	1640.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	760.1	7590.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	711	30500.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	662.7	168000.01
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	616.6	1410000.06
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	1152.3	42.60
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	1117.9	56.20
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	1059.8	92.60
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	999.5	167.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	942.8	311.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	874.6	815.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	827.8	1810.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	723.2	20600.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	698.8	45500.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	651.3	268000.01
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	1165.3	39.20
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	1121.2	54.70
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	1056.2	93.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	998.2	162.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	941.9	311.00

Sample ID	Reference	Data Type	Chemical Repeats	Chemistry Lab	Viscosity Lab	Temp (°C)	Visc (poise)
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	885.9	690.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	816.5	2250.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	766.5	6570.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	715.3	26700.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	652.4	241000.01
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	D	621.6	1080000.05
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1155.6	36.20
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1105.3	55.10
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1055.1	87.10
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1005.6	145.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	955.8	258.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1056.5	87.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1155.7	37.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1204.8	25.90
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1254	18.70
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1154.9	37.30
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1160	37.10
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1108.9	56.80
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1058.3	89.90
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1008.3	150.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	958.4	266.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1059.2	89.60
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1158.1	38.40
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1207.1	26.80
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1255.9	19.20
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1156.7	38.80
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1160.1	36.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1108.9	55.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1058.2	87.40
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1008.1	146.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	958.3	258.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1059.1	86.40
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1158.1	36.70
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1206.9	25.70
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1255.9	18.40

Sample ID	Reference	Data Type	Chemical Repeats	Chemistry Lab	Viscosity Lab	Temp (°C)	Visc (poise)
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	E	1156.7	37.30
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	1081	80.90
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	1006	167.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	949	330.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	888	762.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	846	1660.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	785	5610.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	732	28500.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	698	91000.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	1075	78.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	1025	129.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	962	284.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	903	646.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	842	1830.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	787	5370.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	732	26100.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	686	108000.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	1069	86.10
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	1031	126.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	959	308.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	916	553.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	837	2020.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	784	6920.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	752	15800.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	F	707	67900.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	G	1206.5	27.80
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	G	1151	42.10
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	G	1097	65.80
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	G	1044	108.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	G	991	189.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	G	938	357.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	G	1205	28.20
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	G	1152.5	42.30
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	G	1096	66.30
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	G	1042	109.00

Sample ID	Reference	Data Type	Chemical Repeats	Chemistry Lab	Viscosity Lab	Temp (°C)	Visc (poise)
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	G	989	190.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	G	935.5	362.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	G	1204	27.80
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	G	1149.5	41.90
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	G	1095.5	65.50
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	G	1042	108.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	G	989	189.00
DWPF STARTUP 10-27b(1989)	PNNL-2001 Round Robin	VAL	24	CELS	G	936	354.00
DWPF Startup Frit 1-29-03	Tommy Edwards 5-20-04	VAL	24	CELS	SRNL	1201.5	31.31
DWPF Startup Frit 1-29-03	Tommy Edwards 5-20-04	VAL	24	CELS	SRNL	1151	44.91
DWPF Startup Frit 1-29-03	Tommy Edwards 5-20-04	VAL	24	CELS	SRNL	1089.5	73.36
DWPF Startup Frit 1-29-03	Tommy Edwards 5-20-04	VAL	24	CELS	SRNL	1041	114.18
DWPF Startup Frit 1-29-03	Tommy Edwards 5-20-04	VAL	24	CELS	SRNL	998	181.63
DWPF Startup Frit 1-30-03	Tommy Edwards 5-20-04	VAL	24	CELS	SRNL	1201	30.31
DWPF Startup Frit 1-30-03	Tommy Edwards 5-20-04	VAL	24	CELS	SRNL	1143.5	46.13
DWPF Startup Frit 1-30-03	Tommy Edwards 5-20-04	VAL	24	CELS	SRNL	1088.5	72.44
DWPF Startup Frit 1-30-03	Tommy Edwards 5-20-04	VAL	24	CELS	SRNL	1039.5	114.29
DWPF Startup Frit 1-30-03	Tommy Edwards 5-20-04	VAL	24	CELS	SRNL	979.5	217.22
DWPF Startup Frit 7-24-02	Tommy Edwards 5-20-04	VAL	24	CELS	SRNL	1189.5	31.47
DWPF Startup Frit 7-24-02	Tommy Edwards 5-20-04	VAL	24	CELS	SRNL	1139.5	46.61
DWPF Startup Frit 7-24-02	Tommy Edwards 5-20-04	VAL	24	CELS	SRNL	1084.5	75.47
DWPF Startup Frit 7-24-02	Tommy Edwards 5-20-04	VAL	24	CELS	SRNL	1028.5	132.58
DWPF Startup Frit 7-24-02	Tommy Edwards 5-20-04	VAL	24	CELS	SRNL	972	239.90
DWPF Startup Frit 7-31-02	Tommy Edwards 5-20-04	VAL	24	CELS	SRNL	1204.5	30.79
DWPF Startup Frit 7-31-02	Tommy Edwards 5-20-04	VAL	24	CELS	SRNL	1149.5	46.03
DWPF Startup Frit 7-31-02	Tommy Edwards 5-20-04	VAL	24	CELS	SRNL	1094.5	73.65
DWPF Startup Frit 7-31-02	Tommy Edwards 5-20-04	VAL	24	CELS	SRNL	1040.5	123.38
DWPF Startup Frit 7-31-02	Tommy Edwards 5-20-04	VAL	24	CELS	SRNL	986.5	223.79

Table AII. DWPF Startup Frit Composition Database Based on Twenty-Four Replicates by CELS

Sample ID	Al2O3 (wt%)	B2O3 (wt%)	BaO (wt%)	CaO (wt%)	Cr2O3 (wt%)	Fe2O3 (wt%)	K2O (wt%)	Li2O (wt%)	MgO (wt%)	MnO (wt%)	Na2O (wt%)	NiO (wt%)	SiO2 (wt%)	TiO2 (wt%)	ZrO2 (wt%)	Sum Oxides
DWPF STARTUP 10-26 (1989)	4.60	8.51	0.10	1.47	0.09	14.20	2.70	3.25	0.84	1.93	11.53	1.11	47.90	1.18	0.11	99.52

APPENDIX B

Table BI. Validation Viscosity-Temperature Database

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
WCP BATCH 1	SS Report	CELS	SS	1264.72	20.86	OK	0.00
WCP BATCH 1	SS Report	CELS	SS	1207.85	29.40	OK	0.00
WCP BATCH 1	SS Report	CELS	SS	1153.8	42.83	OK	0.00
WCP BATCH 1	SS Report	CELS	SS	1094.46	67.25	OK	0.00
WCP BATCH 1	SS Report	CELS	SS	1050.26	103.01	OK	0.00
WCP BATCH 1	SS Report	CELS	SS	999.91	171.94	OK	0.00
WCP BATCH 1	SS Report	CELS	SS	945.56	312.33	OK	0.00
WCP BATCH 1	SS Report	CELS	SS	892.53	638.91	OK	0.00
WCP BATCH 1	WSRC-TR-99-00245	CELS	SRNL	1199.5	33.63	OK	0.00
WCP BATCH 1	WSRC-TR-99-00245	CELS	SRNL	1143.5	51.49	OK	0.00
WCP BATCH 1	WSRC-TR-99-00245	CELS	SRNL	1089.5	81.33	OK	0.00
WCP BATCH 1	WSRC-TR-99-00245	CELS	SRNL	1037	134.81	OK	0.00
WCP BATCH 1	WSRC-TR-99-00245	CELS	SRNL	984	236.57	OK	0.00
WCP BATCH 1	WSRC-TR-99-00245	CELS	SRNL	1198	33.25	OK	0.00
WCP BATCH 1	WSRC-TR-99-00245	CELS	SRNL	1142	50.06	OK	0.00
WCP BATCH 1	WSRC-TR-99-00245	CELS	SRNL	1089	78.55	OK	0.00
WCP BATCH 1	WSRC-TR-99-00245	CELS	SRNL	1035.5	130.59	OK	0.00
WCP BATCH 1	WSRC-TR-99-00245	CELS	SRNL	982.5	229.71	OK	0.00
WCP BATCH 1	WSRC-TR-99-00245	CELS	SRNL	1199	34.35	OK	0.00
WCP BATCH 1	WSRC-TR-99-00293	CELS	SRNL	1143.5	52.43	OK	0.00
WCP BATCH 1	WSRC-TR-99-00293	CELS	SRNL	1090	83.03	OK	0.00
WCP BATCH 1	WSRC-TR-99-00293	CELS	SRNL	1037	136.80	OK	0.00
WCP BATCH 1	WSRC-TR-99-00293	CELS	SRNL	984	239.97	OK	0.00
WCP BATCH 1	WSRC-TR-99-00293	CELS	SRNL	1200	33.72	OK	0.00
WCP BATCH 1	WSRC-TR-99-00293	CELS	SRNL	1148	50.85	OK	0.00
WCP BATCH 1	WSRC-TR-99-00293	CELS	SRNL	1092	80.37	OK	0.00
WCP BATCH 1	WSRC-TR-99-00293	CELS	SRNL	1040	131.08	OK	0.00
WCP BATCH 1	WSRC-TR-99-00293	CELS	SRNL	986	232.73	OK	0.00
WCP BATCH 1	WSRC-TR-99-00262	CELS	SRNL	1199.5	33.63	OK	0.00
WCP BATCH 1	WSRC-TR-99-00262	CELS	SRNL	1143.5	51.49	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
WCP BATCH 1	WSRC-TR-99-00262	CELS	SRNL	1089.5	81.33	OK	0.00
WCP BATCH 1	WSRC-TR-99-00262	CELS	SRNL	1037	134.81	OK	0.00
WCP BATCH 1	WSRC-TR-99-00262	CELS	SRNL	984	236.57	OK	0.00
WCP BATCH 1	WSRC-TR-99-00262	CELS	SRNL	1198	33.25	OK	0.00
WCP BATCH 1	WSRC-TR-99-00262	CELS	SRNL	1142	50.06	OK	0.00
WCP BATCH 1	WSRC-TR-99-00262	CELS	SRNL	1089	78.55	OK	0.00
WCP BATCH 1	WSRC-TR-99-00262	CELS	SRNL	1035.5	130.59	OK	0.00
WCP BATCH 1	WSRC-TR-99-00262	CELS	SRNL	982.5	229.71	OK	0.00
WCP BATCH 1	WSRC-RP-99-0053	CELS	SRNL	1187	36.31	OK	0.00
WCP BATCH 1	WSRC-RP-99-0053	CELS	SRNL	1133	56.08	OK	0.00
WCP BATCH 1	WSRC-RP-99-0053	CELS	SRNL	1080	88.96	OK	0.00
WCP BATCH 1	WSRC-RP-99-0053	CELS	SRNL	1027	148.11	OK	0.00
WCP BATCH 1	WSRC-RP-99-0053	CELS	SRNL	976	261.34	OK	0.00
WCP BATCH 1	WSRC-RP-99-0053	CELS	SRNL	1188	37.01	OK	0.00
WCP BATCH 1	WSRC-RP-99-0053	CELS	SRNL	1133	57.14	OK	0.00
WCP BATCH 1	WSRC-RP-99-0053	CELS	SRNL	1080	90.69	OK	0.00
WCP BATCH 1	WSRC-RP-99-0053	CELS	SRNL	1028	149.82	OK	0.00
WCP BATCH 1	WSRC-RP-99-0053	CELS	SRNL	976	265.20	OK	0.00
WCP BATCH 1	WSRC-RP-99-01053	CELS	SRNL	1194	33.11	OK	0.00
WCP BATCH 1	WSRC-RP-99-01053	CELS	SRNL	1139	50.45	OK	0.00
WCP BATCH 1	WSRC-RP-99-01053	CELS	SRNL	1086	80.28	OK	0.00
WCP BATCH 1	WSRC-RP-99-01053	CELS	SRNL	1032	133.25	OK	0.00
WCP BATCH 1	WSRC-RP-99-01053	CELS	SRNL	979	234.85	OK	0.00
WCP BATCH 2	SS Report	CELS	SS	1219.11	33.32	OK	0.00
WCP BATCH 2	SS Report	CELS	SS	1163.65	49.19	OK	0.00
WCP BATCH 2	SS Report	CELS	SS	1107.38	77.14	OK	0.00
WCP BATCH 2	SS Report	CELS	SS	1048.55	134.16	OK	0.00
WCP BATCH 2	SS Report	CELS	SS	992.18	243.72	OK	0.00
WCP BATCH 2	SS Report	CELS	SS	931.58	491.90	OK	0.00
WCP BATCH 2	SS Report	CELS	SS	870.86	1198.48	OK	0.00
WCP BATCH 3	SS Report	CELS	SS	1210.43	29.20	OK	0.00
WCP BATCH 3	SS Report	CELS	SS	1153.15	44.26	OK	0.00
WCP BATCH 3	SS Report	CELS	SS	1096.15	70.71	OK	0.00
WCP BATCH 3	SS Report	CELS	SS	1051.75	109.62	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
WCP BATCH 3	SS Report	CELS	SS	1000.36	185.16	OK	0.00
WCP BATCH 3	SS Report	CELS	SS	946.02	343.87	OK	0.00
WCP BATCH 3	SS Report	CELS	SS	892.69	711.15	OK	0.00
WCP BATCH 4	SS Report	CELS	SS	1191.95	27.95	OK	0.00
WCP BATCH 4	SS Report	CELS	SS	1136.15	42.37	OK	0.00
WCP BATCH 4	SS Report	CELS	SS	1078.19	67.64	OK	0.00
WCP BATCH 4	SS Report	CELS	SS	1020.12	118.23	OK	0.00
WCP BATCH 4	SS Report	CELS	SS	960.69	229.19	OK	0.00
WCP BATCH 4	SS Report	CELS	SS	900.29	500.85	OK	0.00
WCP BATCH 4	SS Report	CELS	SS	838	1357.22	OK	0.00
WCP BLEND 1	SS Report	CELS	SS	1270.78	21.24	OK	0.00
WCP BLEND 1	SS Report	CELS	SS	1215.81	30.07	OK	0.00
WCP BLEND 1	SS Report	CELS	SS	1159.02	44.72	OK	0.00
WCP BLEND 1	SS Report	CELS	SS	1103.27	69.31	OK	0.00
WCP BLEND 1	SS Report	CELS	SS	1044.9	118.78	OK	0.00
WCP BLEND 1	SS Report	CELS	SS	989.98	212.98	OK	0.00
WCP BLEND 1	SS Report	CELS	SS	929.57	434.89	OK	0.00
WCP HM	SS Report	CELS	SS	1192.53	81.33	OK	0.00
WCP HM	SS Report	CELS	SS	1136.36	128.57	OK	0.00
WCP HM	SS Report	CELS	SS	1079.07	218.56	OK	0.00
WCP HM	SS Report	CELS	SS	1021.47	389.61	OK	0.00
WCP HM	SS Report	CELS	SS	960.08	816.11	OK	0.00
WCP HM	SS Report	CELS	SS	901.78	1900.55	OK	0.00
WCP HM	WSRC-RP-99-01053	CELS	SRNL	1188	88.98	OK	0.00
WCP HM	WSRC-RP-99-01053	CELS	SRNL	1134	70.81	OK	0.00
WCP HM	WSRC-RP-99-01053	CELS	SRNL	1081	232.35	OK	0.00
WCP HM	WSRC-RP-99-01053	CELS	SRNL	1028	402.84	OK	0.00
WCP HM	WSRC-RP-99-01053	CELS	SRNL	976	741.48	OK	0.00
WCP HM	WSRC-RP-99-01053	CELS	SRNL	1187	89.64	OK	0.00
WCP HM	WSRC-RP-99-01053	CELS	SRNL	1131	143.10	OK	0.00
WCP HM	WSRC-RP-99-01053	CELS	SRNL	1079	235.18	OK	0.00
WCP HM	WSRC-RP-99-01053	CELS	SRNL	1027	406.92	OK	0.00
WCP HM	WSRC-RP-99-01053	CELS	SRNL	974	748.43	OK	0.00
WCP HM	WSRC-RP-99-01053	CELS	SRNL	1191	86.29	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
WCP HM	WSRC-RP-99-01053	CELS	SRNL	1136	137.90	OK	0.00
WCP HM	WSRC-RP-99-01053	CELS	SRNL	1084	225.53	OK	0.00
WCP HM	WSRC-RP-99-01053	CELS	SRNL	1031	390.07	OK	0.00
WCP HM	WSRC-RP-99-01053	CELS	SRNL	978	720.34	OK	0.00
WCP HM	WSRC-RP-99-01053	CELS	SRNL	1193	84.46	OK	0.00
WCP HM	WSRC-RP-99-01053	CELS	SRNL	1138.5	133.83	OK	0.00
WCP HM	WSRC-RP-99-01053	CELS	SRNL	1083.5	220.62	OK	0.00
WCP HM	WSRC-RP-99-01053	CELS	SRNL	1030.5	380.32	OK	0.00
WCP HM	WSRC-RP-99-01053	CELS	SRNL	977.5	701.21	OK	0.00
WCP PUREX	SS Report	CELS	SS	1155.32	19.33	OK	0.00
WCP PUREX	SS Report	CELS	SS	1097.62	29.61	OK	0.00
WCP PUREX	SS Report	CELS	SS	1051.16	43.85	OK	0.00
WCP PUREX	SS Report	CELS	SS	998.24	72.85	OK	0.00
WCP PUREX	SS Report	CELS	SS	946.17	129.97	OK	0.00
WCP PUREX	SS Report	CELS	SS	893	258.42	OK	0.00
WCP PUREX	SS Report	CELS	SS	838	605.34	OK	0.00
WCP PUREX	WSRC-RP-99-01053	CELS	SRNL	1187	18.26	OK	0.00
WCP PUREX	WSRC-RP-99-01053	CELS	SRNL	1134	26.74	OK	0.00
WCP PUREX	WSRC-RP-99-01053	CELS	SRNL	1079	41.15	OK	0.00
WCP PUREX	WSRC-RP-99-01053	CELS	SRNL	1026	66.20	OK	0.00
WCP PUREX	WSRC-RP-99-01053	CELS	SRNL	974	113.15	OK	0.00
WCP PUREX	WSRC-RP-99-01053	CELS	SRNL	1187	17.33	OK	0.00
WCP PUREX	WSRC-RP-99-01053	CELS	SRNL	1133	25.41	OK	0.00
WCP PUREX	WSRC-RP-99-01053	CELS	SRNL	1079	38.98	OK	0.00
WCP PUREX	WSRC-RP-99-01053	CELS	SRNL	1026	62.87	OK	0.00
WCP PUREX	WSRC-RP-99-01053	CELS	SRNL	974	106.25	OK	0.00
WCP PUREX	WSRC-RP-99-01053	CELS	SRNL	1196.5	15.41	OK	0.00
WCP PUREX	WSRC-RP-99-01053	CELS	SRNL	1141.5	22.78	OK	0.00
WCP PUREX	WSRC-RP-99-01053	CELS	SRNL	1088	34.93	OK	0.00
WCP PUREX	WSRC-RP-99-01053	CELS	SRNL	1035	55.74	OK	0.00
WCP PUREX	WSRC-RP-99-01053	CELS	SRNL	982.5	94.45	OK	0.00
EA	WSRC-TR-92-346, Rev. 1	CELS	SS	1185.61	11.19	OK	0.00
EA	WSRC-TR-92-346, Rev. 1	CELS	SS	1124.7	16.89	OK	0.00
EA	WSRC-TR-92-346, Rev. 1	CELS	SS	1050.49	30.01	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
EA	WSRC-TR-92-346, Rev. 1	CELS	SS	998.47	47.31	OK	0.00
EA	WSRC-TR-92-346, Rev. 1	CELS	SS	944.79	81.19	OK	0.00
EA	WSRC-TR-92-346, Rev. 1	CELS	SS	891.27	156.42	OK	0.00
EA	WSRC-TR-92-346, Rev. 1	CELS	SS	835.27	345.91	OK	0.00
Wvcm-30	West Valley	West Valley, 1988	Alfred University	1150	87.00	OK	0.00
Wvcm-30	West Valley	West Valley, 1988	Alfred University	1100	125.00	OK	0.00
Wvcm-30	West Valley	West Valley, 1988	Alfred University	1050	190.00	OK	0.00
Wvcm-30	West Valley	West Valley, 1988	Alfred University	1000	312.00	OK	0.00
Wvcm-32	West Valley	West Valley, 1988	Alfred University	1150	32.00	OK	0.00
Wvcm-32	West Valley	West Valley, 1988	Alfred University	1100	46.00	OK	0.00
Wvcm-32	West Valley	West Valley, 1988	Alfred University	1050	71.00	OK	0.00
Wvcm-32	West Valley	West Valley, 1988	Alfred University	1000	117.00	OK	0.00
Wvcm-34	West Valley	West Valley, 1988	Alfred University	1150	50.00	OK	0.00
Wvcm-34	West Valley	West Valley, 1988	Alfred University	1100	76.00	OK	0.00
Wvcm-34	West Valley	West Valley, 1988	Alfred University	1050	121.00	OK	0.00
Wvcm-34	West Valley	West Valley, 1988	Alfred University	1000	210.00	OK	0.00
Wvuth-39	West Valley	West Valley, 1988	Alfred University	1150	38.00	OK	0.00
Wvuth-39	West Valley	West Valley, 1988	Alfred University	1100	59.00	OK	0.00
Wvuth-39	West Valley	West Valley, 1988	Alfred University	1050	97.00	OK	0.00
Wvuth-39	West Valley	West Valley, 1988	Alfred University	1000	168.00	OK	0.00
165W-Al	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	1169	150.00	OK	0.00
165W-Al	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	1120	240.00	OK	0.00
165W-Al	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	1074	380.00	OK	0.00
165W-Al	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	1024	660.00	OK	0.00
165W-Al	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	976	1200.00	OK	0.00
165W-Al	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	925	2200.00	OK	0.00
165W-Al	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	878	4600.00	OK	0.00
165W-Al	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	830	11000.00	OK	0.00
165W-Fe	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	1166	33.00	OK	0.00
165W-Fe	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	1116	43.00	OK	0.00
165W-Fe	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	1069	62.00	OK	0.00
165W-Fe	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	1020	98.00	OK	0.00
165W-Fe	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	973	160.00	OK	0.00
165W-Fe	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	923	290.00	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
165W-Fe	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	875	620.00	OK	0.00
165W-Fe	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	825	1400.00	OK	0.00
165TDS-3A	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	1164	60.00	OK	0.00
165TDS-3A	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	1115	88.00	OK	0.00
165TDS-3A	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	1067	140.00	OK	0.00
165TDS-3A	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	1020	240.00	OK	0.00
165TDS-3A	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	973	390.00	OK	0.00
165TDS-3A	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	923	830.00	OK	0.00
165TDS-3A	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	876	1900.00	OK	0.00
165TDS-3A	DPST-82-899, SRTC, Plodinec, M.J.	SRNL/ADS	SRNL/1982	827	4900.00	OK	0.00
154W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1200	121.00	OK	0.00
154W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1150	176.00	OK	0.00
154W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1100	300.00	OK	0.00
154W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1050	464.00	OK	0.00
154W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1000	776.00	OK	0.00
154W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	950	1371.00	OK	0.00
154W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	900	2863.00	OK	0.00
155W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1200	59.00	OK	0.00
155W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1150	80.00	OK	0.00
155W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1100	125.00	OK	0.00
155W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1050	183.00	OK	0.00
155W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1000	299.00	OK	0.00
155W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	950	550.00	OK	0.00
155W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	900	1067.00	OK	0.00
156W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1200	108.00	OK	0.00
156W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1150	177.00	OK	0.00
156W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1100	276.00	OK	0.00
156W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1050	456.00	OK	0.00
156W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1000	808.00	OK	0.00
156W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	950	1547.00	OK	0.00
156W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	900	3145.00	OK	0.00
157W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1200	47.00	OK	0.00
157W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1150	61.00	OK	0.00
157W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1100	95.00	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
157W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1050	143.00	OK	0.00
157W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1000	250.00	OK	0.00
157W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	950	404.00	OK	0.00
157W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	900	735.00	OK	0.00
131W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1200	56.33	OK	0.00
131W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1150	84.33	OK	0.00
131W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1100	134.67	OK	0.00
131W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1050	215.00	OK	0.00
131W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1000	341.00	OK	0.00
131W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	950	655.33	OK	0.00
131W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	900	1288.00	OK	0.00
153TDS-3A	Soper Notebook	SRNL/ADS	SRNL/1982	1200	44.40	OK	0.00
153TDS-3A	Soper Notebook	SRNL/ADS	SRNL/1982	1150	61.80	OK	0.00
153TDS-3A	Soper Notebook	SRNL/ADS	SRNL/1982	1100	87.30	OK	0.00
153TDS-3A	Soper Notebook	SRNL/ADS	SRNL/1982	1050	140.80	OK	0.00
153TDS-3A	Soper Notebook	SRNL/ADS	SRNL/1982	1000	225.20	OK	0.00
153TDS-3A	Soper Notebook	SRNL/ADS	SRNL/1982	900	1648.20	OK	0.00
153W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1200	157.00	OK	0.00
153W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1150	263.00	OK	0.00
153W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1100	425.50	OK	0.00
153W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1050	689.00	OK	0.00
153W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1000	1257.00	OK	0.00
153W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	950	2552.00	OK	0.00
21W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1200	243.00	OK	0.00
21W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1150	382.00	OK	0.00
21W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1100	665.00	OK	0.00
21W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1050	1167.00	OK	0.00
21W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1000	2293.00	OK	0.00
21W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	950	4683.00	OK	0.00
165W-ST-1	Soper Notebook	SRNL/ADS	SRNL/1982	1168.4	47.30	OK	0.00
165W-ST-1	Soper Notebook	SRNL/ADS	SRNL/1982	1121.3	69.30	OK	0.00
165W-ST-1	Soper Notebook	SRNL/ADS	SRNL/1982	1073	106.70	OK	0.00
165W-ST-1	Soper Notebook	SRNL/ADS	SRNL/1982	1025	177.00	OK	0.00
165W-ST-1	Soper Notebook	SRNL/ADS	SRNL/1982	977	300.70	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
165W-ST-1	Soper Notebook	SRNL/ADS	SRNL/1982	929	563.00	OK	0.00
165W-ST-1	Soper Notebook	SRNL/ADS	SRNL/1982	881	1162.30	OK	0.00
165W-Al(35%)	Soper Notebook	SRNL/ADS	SRNL/1982	1168.4	168.30	OK	0.00
165W-Al(35%)	Soper Notebook	SRNL/ADS	SRNL/1982	1121.3	275.00	OK	0.00
165W-Al(35%)	Soper Notebook	SRNL/ADS	SRNL/1982	1073	462.30	OK	0.00
165W-Al(35%)	Soper Notebook	SRNL/ADS	SRNL/1982	1025	814.30	OK	0.00
165W-Al(35%)	Soper Notebook	SRNL/ADS	SRNL/1982	977	1495.60	OK	0.00
165W-Al(35%)	Soper Notebook	SRNL/ADS	SRNL/1982	929	3064.60	OK	0.00
165W-Al(35%)	Soper Notebook	SRNL/ADS	SRNL/1982	881	6777.00	OK	0.00
164W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1168.4	109.60	OK	0.00
164W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1121.3	167.60	OK	0.00
164W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1073	267.60	OK	0.00
164W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1025	447.60	OK	0.00
164W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	977	765.30	OK	0.00
164W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	929	1498.00	OK	0.00
164W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	881	3061.60	OK	0.00
131W-Fe	Soper Notebook	SRNL/ADS	SRNL/1982	1168.4	27.50	OK	0.00
131W-Fe	Soper Notebook	SRNL/ADS	SRNL/1982	1121.3	17.00	OK	0.00
131W-Fe	Soper Notebook	SRNL/ADS	SRNL/1982	1073	17.00	OK	0.00
131W-Fe	Soper Notebook	SRNL/ADS	SRNL/1982	1025	27.00	OK	0.00
131W-Fe	Soper Notebook	SRNL/ADS	SRNL/1982	977	41.00	OK	0.00
131W-Fe	Soper Notebook	SRNL/ADS	SRNL/1982	929	74.30	OK	0.00
131W-Fe	Soper Notebook	SRNL/ADS	SRNL/1982	881	147.00	OK	0.00
131W-Fe	Soper Notebook	SRNL/ADS	SRNL/1982	832.8	311.00	OK	0.00
131W-Fe	Soper Notebook	SRNL/ADS	SRNL/1982	784.7	599.00	OK	0.00
131TDS-3A	Soper Notebook	SRNL/ADS	SRNL/1982	1168.4	13.00	OK	0.00
131TDS-3A	Soper Notebook	SRNL/ADS	SRNL/1982	1121.3	18.00	OK	0.00
131TDS-3A	Soper Notebook	SRNL/ADS	SRNL/1982	1073	28.50	OK	0.00
131TDS-3A	Soper Notebook	SRNL/ADS	SRNL/1982	1025	42.00	OK	0.00
131TDS-3A	Soper Notebook	SRNL/ADS	SRNL/1982	977	68.60	OK	0.00
131TDS-3A	Soper Notebook	SRNL/ADS	SRNL/1982	929	118.60	OK	0.00
131TDS-3A	Soper Notebook	SRNL/ADS	SRNL/1982	881	240.30	OK	0.00
131TDS-3A	Soper Notebook	SRNL/ADS	SRNL/1982	832.8	618.60	OK	0.00
131TDS-3A	Soper Notebook	SRNL/ADS	SRNL/1982	784.7	1599.30	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
131W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1168.4	39.50	OK	0.00
131W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1121.3	58.30	OK	0.00
131W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1073	94.30	OK	0.00
131W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	1025	153.00	OK	0.00
131W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	977	261.30	OK	0.00
131W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	929	475.30	OK	0.00
131W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	881	949.30	OK	0.00
131W-Al	Soper Notebook	SRNL/ADS	SRNL/1982	832.8	2079.00	OK	0.00
CVS1-1	PNL-10359	PNNL	PNNL	1250	25.40	OK	0.00
CVS1-1	PNL-10359	PNNL	PNNL	1150	58.10	OK	0.00
CVS1-1	PNL-10359	PNNL	PNNL	1050	166.90	OK	0.00
CVS1-1	PNL-10359	PNNL	PNNL	949	723.80	OK	0.00
CVS1-2	PNL-10359	PNNL	PNNL	1248	58.10	OK	0.00
CVS1-2	PNL-10359	PNNL	PNNL	1149	135.80	OK	0.00
CVS1-2	PNL-10359	PNNL	PNNL	1050	383.20	OK	0.00
CVS1-2	PNL-10359	PNNL	PNNL	951	1564.60	OK	0.00
CVS1-3	PNL-10359	PNNL	PNNL	1149	23.90	OK	0.00
CVS1-3	PNL-10359	PNNL	PNNL	1050	64.80	OK	0.00
CVS1-3	PNL-10359	PNNL	PNNL	951	217.80	OK	0.00
CVS1-4	PNL-10359	PNNL	PNNL	1149	87.90	OK	0.00
CVS1-4	PNL-10359	PNNL	PNNL	1051	289.50	OK	0.00
CVS1-4	PNL-10359	PNNL	PNNL	951	1404.50	OK	0.00
CVS1-5	PNL-10359	PNNL	PNNL	1348	31.90	OK	0.00
CVS1-5	PNL-10359	PNNL	PNNL	1250	60.20	OK	0.00
CVS1-5	PNL-10359	PNNL	PNNL	1150	131.80	OK	0.00
CVS1-5	PNL-10359	PNNL	PNNL	1050	351.10	OK	0.00
CVS1-5	PNL-10359	PNNL	PNNL	950	1188.90	OK	0.00
CVS1-6	PNL-10359	PNNL	PNNL	1052	55.90	OK	0.00
CVS1-6	PNL-10359	PNNL	PNNL	952	227.30	OK	0.00
CVS1-7	PNL-10359	PNNL	PNNL	1348	67.50	OK	0.00
CVS1-7	PNL-10359	PNNL	PNNL	1248	194.70	OK	0.00
CVS1-7	PNL-10359	PNNL	PNNL	1148	751.50	OK	0.00
CVS1-8	PNL-10359	PNNL	PNNL	1350	45.70	OK	0.00
CVS1-8	PNL-10359	PNNL	PNNL	1252	102.10	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
CVS1-9	PNL-10359	PNNL	PNNL	1251	15.80	OK	0.00
CVS1-9	PNL-10359	PNNL	PNNL	1152	39.80	OK	0.00
CVS1-10	PNL-10359	PNNL	PNNL	1350	138.30	OK	0.00
CVS1-10	PNL-10359	PNNL	PNNL	1250	308.00	OK	0.00
CVS1-10	PNL-10359	PNNL	PNNL	1150	834.70	OK	0.00
CVS1-11	PNL-10359	PNNL	PNNL	1251	56.80	OK	0.00
CVS1-11	PNL-10359	PNNL	PNNL	1152	144.80	OK	0.00
CVS1-12	PNL-10359	PNNL	PNNL	1148	4.20	OK	0.00
CVS1-12	PNL-10359	PNNL	PNNL	1049	8.80	OK	0.00
CVS1-12	PNL-10359	PNNL	PNNL	952	23.10	OK	0.00
CVS1-13	PNL-10359	PNNL	PNNL	1247	15.50	OK	0.00
CVS1-13	PNL-10359	PNNL	PNNL	1148	33.60	OK	0.00
CVS1-13	PNL-10359	PNNL	PNNL	1049	98.30	OK	0.00
CVS1-13	PNL-10359	PNNL	PNNL	949	467.50	OK	0.00
CVS1-14	PNL-10359	PNNL	PNNL	1249	14.10	OK	0.00
CVS1-14	PNL-10359	PNNL	PNNL	1150	33.70	OK	0.00
CVS1-14	PNL-10359	PNNL	PNNL	1051	113.80	OK	0.00
CVS1-14	PNL-10359	PNNL	PNNL	950	612.90	OK	0.00
CVS1-15	PNL-10359	PNNL	PNNL	1251	13.00	NOSUM	0.00
CVS1-15	PNL-10359	PNNL	PNNL	1151	25.30	NOSUM	0.00
CVS1-15	PNL-10359	PNNL	PNNL	1051	58.80	NOSUM	0.00
CVS1-15	PNL-10359	PNNL	PNNL	951	178.00	NOSUM	0.00
CVS1-16	PNL-10359	PNNL	PNNL	1348	28.90	OK	0.00
CVS1-16	PNL-10359	PNNL	PNNL	1249	64.80	OK	0.00
CVS1-16	PNL-10359	PNNL	PNNL	1149	180.20	OK	0.00
CVS1-17	PNL-10359	PNNL	PNNL	1252	10.40	OK	0.00
CVS1-17	PNL-10359	PNNL	PNNL	1152	22.20	OK	0.00
CVS1-17	PNL-10359	PNNL	PNNL	1052	58.30	OK	0.00
CVS1-17	PNL-10359	PNNL	PNNL	953	231.00	OK	0.00
CVS1-19	PNL-10359	PNNL	PNNL	1251	24.60	OK	0.00
CVS1-19	PNL-10359	PNNL	PNNL	1151	57.30	OK	0.00
CVS1-19	PNL-10359	PNNL	PNNL	1051	163.50	OK	0.00
CVS1-19	PNL-10359	PNNL	PNNL	951	645.30	OK	0.00
CVS1-20	PNL-10359	PNNL	PNNL	1252	25.20	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
CVS1-20	PNL-10359	PNNL	PNNL	1152	55.10	OK	0.00
CVS1-20	PNL-10359	PNNL	PNNL	1053	153.10	OK	0.00
CVS1-20	PNL-10359	PNNL	PNNL	953	539.00	OK	0.00
CVS1-21	PNL-10359	PNNL	PNNL	1249	41.40	OK	0.00
CVS1-21	PNL-10359	PNNL	PNNL	1150	95.80	OK	0.00
CVS1-21	PNL-10359	PNNL	PNNL	950	1387.50	OK	0.00
CVS1-22	PNL-10359	PNNL	PNNL	1351	44.30	OK	0.00
CVS1-22	PNL-10359	PNNL	PNNL	1252	112.00	OK	0.00
CVS1-23	PNL-10359	PNNL	PNNL	1252	26.60	OK	0.00
CVS1-23	PNL-10359	PNNL	PNNL	1153	55.50	OK	0.00
CVS1-23	PNL-10359	PNNL	PNNL	1053	139.10	OK	0.00
CVS1-23	PNL-10359	PNNL	PNNL	953	447.20	OK	0.00
CVS2-1	PNL-10359	PNNL	PNNL	1199	51.10	OK	0.00
CVS2-1	PNL-10359	PNNL	PNNL	1123	98.10	OK	0.00
CVS2-1	PNL-10359	PNNL	PNNL	1048	212.90	OK	0.00
CVS2-1	PNL-10359	PNNL	PNNL	948	707.70	OK	0.00
CVS2-2	PNL-10359	PNNL	PNNL	1149	62.10	OK	0.00
CVS2-2	PNL-10359	PNNL	PNNL	1097	104.40	OK	0.00
CVS2-2	PNL-10359	PNNL	PNNL	1047	172.20	OK	0.00
CVS2-2	PNL-10359	PNNL	PNNL	1100	97.20	OK	0.00
CVS2-2	PNL-10359	PNNL	PNNL	1150	61.40	OK	0.00
CVS2-2	PNL-10359	PNNL	PNNL	1199	42.40	OK	0.00
CVS2-2	PNL-10359	PNNL	PNNL	1249	29.00	OK	0.00
CVS2-2	PNL-10359	PNNL	PNNL	1147	64.70	OK	0.00
CVS2-2	PNL-10359	PNNL	PNNL	999	306.80	OK	0.00
CVS2-2	PNL-10359	PNNL	PNNL	948	600.60	OK	0.00
CVS2-3	PNL-10359	PNNL	PNNL	1148	56.00	OK	0.00
CVS2-3	PNL-10359	PNNL	PNNL	1096	96.50	OK	0.00
CVS2-3	PNL-10359	PNNL	PNNL	1048	156.70	OK	0.00
CVS2-3	PNL-10359	PNNL	PNNL	1100	88.20	OK	0.00
CVS2-3	PNL-10359	PNNL	PNNL	1150	55.40	OK	0.00
CVS2-3	PNL-10359	PNNL	PNNL	1198	35.80	OK	0.00
CVS2-3	PNL-10359	PNNL	PNNL	1249	25.60	OK	0.00
CVS2-3	PNL-10359	PNNL	PNNL	1147	58.60	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
CVS2-3	PNL-10359	PNNL	PNNL	998	300.90	OK	0.00
CVS2-3	PNL-10359	PNNL	PNNL	949	618.50	OK	0.00
CVS2-4	PNL-10359	PNNL	PNNL	1198	43.70	OK	0.00
CVS2-4	PNL-10359	PNNL	PNNL	1124	78.10	OK	0.00
CVS2-4	PNL-10359	PNNL	PNNL	1048	173.60	OK	0.00
CVS2-4	PNL-10359	PNNL	PNNL	948	594.70	OK	0.00
CVS2-5	PNL-10359	PNNL	PNNL	1149	78.90	OK	0.00
CVS2-5	PNL-10359	PNNL	PNNL	1097	136.00	OK	0.00
CVS2-5	PNL-10359	PNNL	PNNL	1047	238.20	OK	0.00
CVS2-5	PNL-10359	PNNL	PNNL	1100	136.50	OK	0.00
CVS2-5	PNL-10359	PNNL	PNNL	1150	80.70	OK	0.00
CVS2-5	PNL-10359	PNNL	PNNL	1200	54.10	OK	0.00
CVS2-5	PNL-10359	PNNL	PNNL	1250	37.20	OK	0.00
CVS2-5	PNL-10359	PNNL	PNNL	1147	85.30	OK	0.00
CVS2-5	PNL-10359	PNNL	PNNL	999	463.20	OK	0.00
CVS2-5	PNL-10359	PNNL	PNNL	948	984.20	OK	0.00
CVS2-6	PNL-10359	PNNL	PNNL	1149	61.80	OK	0.00
CVS2-6	PNL-10359	PNNL	PNNL	1098	100.10	OK	0.00
CVS2-6	PNL-10359	PNNL	PNNL	1048	172.50	OK	0.00
CVS2-6	PNL-10359	PNNL	PNNL	1100	99.60	OK	0.00
CVS2-6	PNL-10359	PNNL	PNNL	1150	61.60	OK	0.00
CVS2-6	PNL-10359	PNNL	PNNL	1199	41.00	OK	0.00
CVS2-6	PNL-10359	PNNL	PNNL	1250	28.70	OK	0.00
CVS2-6	PNL-10359	PNNL	PNNL	1148	64.40	OK	0.00
CVS2-6	PNL-10359	PNNL	PNNL	999	333.00	OK	0.00
CVS2-6	PNL-10359	PNNL	PNNL	949	683.90	OK	0.00
CVS2-7	PNL-10359	PNNL	PNNL	1148	43.50	OK	0.00
CVS2-7	PNL-10359	PNNL	PNNL	1098	65.70	OK	0.00
CVS2-7	PNL-10359	PNNL	PNNL	1048	106.70	OK	0.00
CVS2-7	PNL-10359	PNNL	PNNL	1099	65.40	OK	0.00
CVS2-7	PNL-10359	PNNL	PNNL	1150	42.30	OK	0.00
CVS2-7	PNL-10359	PNNL	PNNL	1199	28.50	OK	0.00
CVS2-7	PNL-10359	PNNL	PNNL	1250	21.70	OK	0.00
CVS2-7	PNL-10359	PNNL	PNNL	1149	43.70	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
CVS2-7	PNL-10359	PNNL	PNNL	998	190.30	OK	0.00
CVS2-7	PNL-10359	PNNL	PNNL	949	355.00	OK	0.00
CVS2-8	PNL-10359	PNNL	PNNL	1148	43.50	OK	0.00
CVS2-8	PNL-10359	PNNL	PNNL	1097	70.80	OK	0.00
CVS2-8	PNL-10359	PNNL	PNNL	1046	112.20	OK	0.00
CVS2-8	PNL-10359	PNNL	PNNL	1100	65.90	OK	0.00
CVS2-8	PNL-10359	PNNL	PNNL	1150	42.70	OK	0.00
CVS2-8	PNL-10359	PNNL	PNNL	1200	29.30	OK	0.00
CVS2-8	PNL-10359	PNNL	PNNL	1250	21.30	OK	0.00
CVS2-8	PNL-10359	PNNL	PNNL	1299	15.70	OK	0.00
CVS2-8	PNL-10359	PNNL	PNNL	1145	46.40	OK	0.00
CVS2-8	PNL-10359	PNNL	PNNL	995	198.60	OK	0.00
CVS2-8	PNL-10359	PNNL	PNNL	947	354.40	OK	0.00
CVS2-9	PNL-10359	PNNL	PNNL	1198	46.80	OK	0.00
CVS2-9	PNL-10359	PNNL	PNNL	1123	95.70	OK	0.00
CVS2-9	PNL-10359	PNNL	PNNL	1048	230.70	OK	0.00
CVS2-9	PNL-10359	PNNL	PNNL	943	1110.50	OK	0.00
CVS2-9A	PNL-10359	PNNL	PNNL	1149	73.30	OK	0.00
CVS2-9A	PNL-10359	PNNL	PNNL	1099	124.30	OK	0.00
CVS2-9A	PNL-10359	PNNL	PNNL	1048	220.90	OK	0.00
CVS2-9A	PNL-10359	PNNL	PNNL	1100	120.10	OK	0.00
CVS2-9A	PNL-10359	PNNL	PNNL	1150	72.30	OK	0.00
CVS2-9A	PNL-10359	PNNL	PNNL	1200	45.20	OK	0.00
CVS2-9A	PNL-10359	PNNL	PNNL	1250	30.40	OK	0.00
CVS2-9A	PNL-10359	PNNL	PNNL	1148	73.80	OK	0.00
CVS2-9A	PNL-10359	PNNL	PNNL	999	427.60	OK	0.00
CVS2-9A	PNL-10359	PNNL	PNNL	948	930.70	OK	0.00
CVS2-10	PNL-10359	PNNL	PNNL	1149	86.70	OK	0.00
CVS2-10	PNL-10359	PNNL	PNNL	1098	145.40	OK	0.00
CVS2-10	PNL-10359	PNNL	PNNL	1048	241.10	OK	0.00
CVS2-10	PNL-10359	PNNL	PNNL	1100	142.40	OK	0.00
CVS2-10	PNL-10359	PNNL	PNNL	1150	87.00	OK	0.00
CVS2-10	PNL-10359	PNNL	PNNL	1200	60.70	OK	0.00
CVS2-10	PNL-10359	PNNL	PNNL	1250	43.90	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
CVS2-10	PNL-10359	PNNL	PNNL	1147	94.30	OK	0.00
CVS2-10	PNL-10359	PNNL	PNNL	999	447.80	OK	0.00
CVS2-10	PNL-10359	PNNL	PNNL	949	887.50	OK	0.00
CVS2-11	PNL-10359	PNNL	PNNL	1198	20.10	OK	0.00
CVS2-11	PNL-10359	PNNL	PNNL	1123	39.80	OK	0.00
CVS2-11	PNL-10359	PNNL	PNNL	1048	92.20	OK	0.00
CVS2-11	PNL-10359	PNNL	PNNL	948	388.30	OK	0.00
CVS2-12	PNL-10359	PNNL	PNNL	1198	23.70	OK	0.00
CVS2-12	PNL-10359	PNNL	PNNL	1123	41.80	OK	0.00
CVS2-12	PNL-10359	PNNL	PNNL	1048	89.30	OK	0.00
CVS2-12	PNL-10359	PNNL	PNNL	945	356.20	OK	0.00
CVS2-13	PNL-10359	PNNL	PNNL	1148	71.70	OK	0.00
CVS2-13	PNL-10359	PNNL	PNNL	1096	125.00	OK	0.00
CVS2-13	PNL-10359	PNNL	PNNL	1046	205.20	OK	0.00
CVS2-13	PNL-10359	PNNL	PNNL	1099	117.70	OK	0.00
CVS2-13	PNL-10359	PNNL	PNNL	1149	70.20	OK	0.00
CVS2-13	PNL-10359	PNNL	PNNL	1199	48.50	OK	0.00
CVS2-13	PNL-10359	PNNL	PNNL	1248	33.20	OK	0.00
CVS2-13	PNL-10359	PNNL	PNNL	1146	76.70	OK	0.00
CVS2-13	PNL-10359	PNNL	PNNL	997	393.10	OK	0.00
CVS2-13	PNL-10359	PNNL	PNNL	948	724.00	OK	0.00
CVS2-14	PNL-10359	PNNL	PNNL	1149	28.80	OK	0.00
CVS2-14	PNL-10359	PNNL	PNNL	1099	50.30	OK	0.00
CVS2-14	PNL-10359	PNNL	PNNL	1048	88.60	OK	0.00
CVS2-14	PNL-10359	PNNL	PNNL	1100	49.90	OK	0.00
CVS2-14	PNL-10359	PNNL	PNNL	1150	28.80	OK	0.00
CVS2-14	PNL-10359	PNNL	PNNL	1199	20.00	OK	0.00
CVS2-14	PNL-10359	PNNL	PNNL	1249	13.30	OK	0.00
CVS2-14	PNL-10359	PNNL	PNNL	1148	29.90	OK	0.00
CVS2-14	PNL-10359	PNNL	PNNL	998	175.40	OK	0.00
CVS2-14	PNL-10359	PNNL	PNNL	949	383.60	OK	0.00
CVS2-15	PNL-10359	PNNL	PNNL	1149	44.00	OK	0.00
CVS2-15	PNL-10359	PNNL	PNNL	1099	71.80	OK	0.00
CVS2-15	PNL-10359	PNNL	PNNL	1048	117.10	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
CVS2-15	PNL-10359	PNNL	PNNL	1100	69.50	OK	0.00
CVS2-15	PNL-10359	PNNL	PNNL	1150	44.40	OK	0.00
CVS2-15	PNL-10359	PNNL	PNNL	1199	29.40	OK	0.00
CVS2-15	PNL-10359	PNNL	PNNL	1249	21.60	OK	0.00
CVS2-15	PNL-10359	PNNL	PNNL	1148	47.40	OK	0.00
CVS2-15	PNL-10359	PNNL	PNNL	998	226.90	OK	0.00
CVS2-15	PNL-10359	PNNL	PNNL	949	424.00	OK	0.00
CVS2-16	PNL-10359	PNNL	PNNL	1199	42.70	OK	0.00
CVS2-16	PNL-10359	PNNL	PNNL	1123	83.80	OK	0.00
CVS2-16	PNL-10359	PNNL	PNNL	1048	188.80	OK	0.00
CVS2-16	PNL-10359	PNNL	PNNL	948	657.10	OK	0.00
CVS2-16A	PNL-10359	PNNL	PNNL	1148	66.80	OK	0.00
CVS2-16A	PNL-10359	PNNL	PNNL	1097	112.40	OK	0.00
CVS2-16A	PNL-10359	PNNL	PNNL	1047	186.10	OK	0.00
CVS2-16A	PNL-10359	PNNL	PNNL	1099	105.90	OK	0.00
CVS2-16A	PNL-10359	PNNL	PNNL	1149	67.10	OK	0.00
CVS2-16A	PNL-10359	PNNL	PNNL	1198	44.20	OK	0.00
CVS2-16A	PNL-10359	PNNL	PNNL	1248	29.30	OK	0.00
CVS2-16A	PNL-10359	PNNL	PNNL	1147	69.10	OK	0.00
CVS2-16A	PNL-10359	PNNL	PNNL	998	344.90	OK	0.00
CVS2-16A	PNL-10359	PNNL	PNNL	948	706.20	OK	0.00
CVS2-17	PNL-10359	PNNL	PNNL	1149	55.70	OK	0.00
CVS2-17	PNL-10359	PNNL	PNNL	1098	88.50	OK	0.00
CVS2-17	PNL-10359	PNNL	PNNL	1048	149.00	OK	0.00
CVS2-17	PNL-10359	PNNL	PNNL	1100	85.30	OK	0.00
CVS2-17	PNL-10359	PNNL	PNNL	1149	53.70	OK	0.00
CVS2-17	PNL-10359	PNNL	PNNL	1199	34.50	OK	0.00
CVS2-17	PNL-10359	PNNL	PNNL	1250	24.60	OK	0.00
CVS2-17	PNL-10359	PNNL	PNNL	1147	56.90	OK	0.00
CVS2-17	PNL-10359	PNNL	PNNL	999	273.50	OK	0.00
CVS2-17	PNL-10359	PNNL	PNNL	949	576.80	OK	0.00
CVS2-18	PNL-10359	PNNL	PNNL	1148	64.60	OK	0.00
CVS2-18	PNL-10359	PNNL	PNNL	1097	105.30	OK	0.00
CVS2-18	PNL-10359	PNNL	PNNL	1047	177.80	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
CVS2-18	PNL-10359	PNNL	PNNL	1099	105.10	OK	0.00
CVS2-18	PNL-10359	PNNL	PNNL	1150	64.70	OK	0.00
CVS2-18	PNL-10359	PNNL	PNNL	1199	42.00	OK	0.00
CVS2-18	PNL-10359	PNNL	PNNL	1248	28.90	OK	0.00
CVS2-18	PNL-10359	PNNL	PNNL	1145	68.40	OK	0.00
CVS2-18	PNL-10359	PNNL	PNNL	997	339.60	OK	0.00
CVS2-18	PNL-10359	PNNL	PNNL	948	667.50	OK	0.00
CVS2-19	PNL-10359	PNNL	PNNL	1149	67.60	OK	0.00
CVS2-19	PNL-10359	PNNL	PNNL	1097	115.10	OK	0.00
CVS2-19	PNL-10359	PNNL	PNNL	1048	187.30	OK	0.00
CVS2-19	PNL-10359	PNNL	PNNL	1100	110.20	OK	0.00
CVS2-19	PNL-10359	PNNL	PNNL	1150	67.60	OK	0.00
CVS2-19	PNL-10359	PNNL	PNNL	1200	44.40	OK	0.00
CVS2-19	PNL-10359	PNNL	PNNL	1249	29.50	OK	0.00
CVS2-19	PNL-10359	PNNL	PNNL	1148	71.40	OK	0.00
CVS2-19	PNL-10359	PNNL	PNNL	999	369.30	OK	0.00
CVS2-19	PNL-10359	PNNL	PNNL	949	770.10	OK	0.00
CVS2-20	PNL-10359	PNNL	PNNL	1144	127.70	OK	0.00
CVS2-20	PNL-10359	PNNL	PNNL	1094	235.20	OK	0.00
CVS2-20	PNL-10359	PNNL	PNNL	1044	447.20	OK	0.00
CVS2-20	PNL-10359	PNNL	PNNL	1094	234.70	OK	0.00
CVS2-20	PNL-10359	PNNL	PNNL	1144	131.20	OK	0.00
CVS2-20	PNL-10359	PNNL	PNNL	1194	78.00	OK	0.00
CVS2-20	PNL-10359	PNNL	PNNL	1245	50.70	OK	0.00
CVS2-20	PNL-10359	PNNL	PNNL	1144	130.20	OK	0.00
CVS2-20	PNL-10359	PNNL	PNNL	994	949.70	OK	0.00
CVS2-20	PNL-10359	PNNL	PNNL	944	2184.20	OK	0.00
CVS2-21	PNL-10359	PNNL	PNNL	1145	61.70	OK	0.00
CVS2-21	PNL-10359	PNNL	PNNL	1096	98.50	OK	0.00
CVS2-21	PNL-10359	PNNL	PNNL	1046	162.00	OK	0.00
CVS2-21	PNL-10359	PNNL	PNNL	1096	96.60	OK	0.00
CVS2-21	PNL-10359	PNNL	PNNL	1146	62.30	OK	0.00
CVS2-21	PNL-10359	PNNL	PNNL	1195	41.60	OK	0.00
CVS2-21	PNL-10359	PNNL	PNNL	1244	29.30	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
CVS2-21	PNL-10359	PNNL	PNNL	1145	64.00	OK	0.00
CVS2-21	PNL-10359	PNNL	PNNL	995	287.60	OK	0.00
CVS2-21	PNL-10359	PNNL	PNNL	946	556.20	OK	0.00
CVS2-22	PNL-10359	PNNL	PNNL	1148	59.70	OK	0.00
CVS2-22	PNL-10359	PNNL	PNNL	1098	93.60	OK	0.00
CVS2-22	PNL-10359	PNNL	PNNL	1047	156.30	OK	0.00
CVS2-22	PNL-10359	PNNL	PNNL	1098	93.10	OK	0.00
CVS2-22	PNL-10359	PNNL	PNNL	1148	61.70	OK	0.00
CVS2-22	PNL-10359	PNNL	PNNL	1198	41.00	OK	0.00
CVS2-22	PNL-10359	PNNL	PNNL	1248	27.90	OK	0.00
CVS2-22	PNL-10359	PNNL	PNNL	1148	60.50	OK	0.00
CVS2-22	PNL-10359	PNNL	PNNL	997	281.60	OK	0.00
CVS2-22	PNL-10359	PNNL	PNNL	947	542.70	OK	0.00
CVS2-23	PNL-10359	PNNL	PNNL	1145	101.60	OK	0.00
CVS2-23	PNL-10359	PNNL	PNNL	1095	169.60	OK	0.00
CVS2-23	PNL-10359	PNNL	PNNL	1045	294.10	OK	0.00
CVS2-23	PNL-10359	PNNL	PNNL	1096	169.60	OK	0.00
CVS2-23	PNL-10359	PNNL	PNNL	1145	104.50	OK	0.00
CVS2-23	PNL-10359	PNNL	PNNL	1194	67.60	OK	0.00
CVS2-23	PNL-10359	PNNL	PNNL	1243	46.30	OK	0.00
CVS2-23	PNL-10359	PNNL	PNNL	1144	106.40	OK	0.00
CVS2-23	PNL-10359	PNNL	PNNL	995	537.20	OK	0.00
CVS2-23	PNL-10359	PNNL	PNNL	945	1172.20	OK	0.00
CVS2-24	PNL-10359	PNNL	PNNL	1147	21.10	OK	0.00
CVS2-24	PNL-10359	PNNL	PNNL	1097	30.60	OK	0.00
CVS2-24	PNL-10359	PNNL	PNNL	1047	46.60	OK	0.00
CVS2-24	PNL-10359	PNNL	PNNL	1098	29.90	OK	0.00
CVS2-24	PNL-10359	PNNL	PNNL	1148	20.20	OK	0.00
CVS2-24	PNL-10359	PNNL	PNNL	1199	14.10	OK	0.00
CVS2-24	PNL-10359	PNNL	PNNL	1247	10.30	OK	0.00
CVS2-24	PNL-10359	PNNL	PNNL	1144	19.90	OK	0.00
CVS2-24	PNL-10359	PNNL	PNNL	997	73.30	OK	0.00
CVS2-24	PNL-10359	PNNL	PNNL	947	131.10	OK	0.00
CVS2-25	PNL-10359	PNNL	PNNL	1147	13.80	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
CVS2-25	PNL-10359	PNNL	PNNL	1097	20.00	OK	0.00
CVS2-25	PNL-10359	PNNL	PNNL	1048	31.40	OK	0.00
CVS2-25	PNL-10359	PNNL	PNNL	1098	19.80	OK	0.00
CVS2-25	PNL-10359	PNNL	PNNL	1148	13.70	OK	0.00
CVS2-25	PNL-10359	PNNL	PNNL	1197	9.70	OK	0.00
CVS2-25	PNL-10359	PNNL	PNNL	1246	7.20	OK	0.00
CVS2-25	PNL-10359	PNNL	PNNL	1148	14.40	OK	0.00
CVS2-25	PNL-10359	PNNL	PNNL	998	54.50	OK	0.00
CVS2-25	PNL-10359	PNNL	PNNL	947	101.10	OK	0.00
CVS2-26	PNL-10359	PNNL	PNNL	1146	12.70	OK	0.00
CVS2-26	PNL-10359	PNNL	PNNL	1095	21.30	OK	0.00
CVS2-26	PNL-10359	PNNL	PNNL	1046	34.80	OK	0.00
CVS2-26	PNL-10359	PNNL	PNNL	1097	20.90	OK	0.00
CVS2-26	PNL-10359	PNNL	PNNL	1147	13.00	OK	0.00
CVS2-26	PNL-10359	PNNL	PNNL	1194	8.80	OK	0.00
CVS2-26	PNL-10359	PNNL	PNNL	1244	6.30	OK	0.00
CVS2-26	PNL-10359	PNNL	PNNL	1145	13.00	OK	0.00
CVS2-26	PNL-10359	PNNL	PNNL	996	63.40	OK	0.00
CVS2-26	PNL-10359	PNNL	PNNL	946	136.50	OK	0.00
CVS2-27	PNL-10359	PNNL	PNNL	1144	151.10	OK	0.00
CVS2-27	PNL-10359	PNNL	PNNL	1094	251.00	OK	0.00
CVS2-27	PNL-10359	PNNL	PNNL	1045	429.20	OK	0.00
CVS2-27	PNL-10359	PNNL	PNNL	1094	249.40	OK	0.00
CVS2-27	PNL-10359	PNNL	PNNL	1144	150.60	OK	0.00
CVS2-27	PNL-10359	PNNL	PNNL	1194	97.70	OK	0.00
CVS2-27	PNL-10359	PNNL	PNNL	1241	66.10	OK	0.00
CVS2-27	PNL-10359	PNNL	PNNL	1143	158.50	OK	0.00
CVS2-27	PNL-10359	PNNL	PNNL	993	887.30	OK	0.00
CVS2-27	PNL-10359	PNNL	PNNL	943	1731.10	OK	0.00
CVS2-28	PNL-10359	PNNL	PNNL	1147	133.20	NOSUM	0.00
CVS2-28	PNL-10359	PNNL	PNNL	1097	220.10	NOSUM	0.00
CVS2-28	PNL-10359	PNNL	PNNL	1046	375.00	NOSUM	0.00
CVS2-28	PNL-10359	PNNL	PNNL	1097	216.50	NOSUM	0.00
CVS2-28	PNL-10359	PNNL	PNNL	1148	137.30	NOSUM	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
CVS2-28	PNL-10359	PNNL	PNNL	1197	92.10	NOSUM	0.00
CVS2-28	PNL-10359	PNNL	PNNL	1246	62.80	NOSUM	0.00
CVS2-28	PNL-10359	PNNL	PNNL	1146	145.40	NOSUM	0.00
CVS2-28	PNL-10359	PNNL	PNNL	996	757.00	NOSUM	0.00
CVS2-28	PNL-10359	PNNL	PNNL	946	1451.60	NOSUM	0.00
CVS2-29	PNL-10359	PNNL	PNNL	1149	52.20	OK	0.00
CVS2-29	PNL-10359	PNNL	PNNL	1098	98.90	OK	0.00
CVS2-29	PNL-10359	PNNL	PNNL	1048	203.80	OK	0.00
CVS2-29	PNL-10359	PNNL	PNNL	1099	97.50	OK	0.00
CVS2-29	PNL-10359	PNNL	PNNL	1149	54.30	OK	0.00
CVS2-29	PNL-10359	PNNL	PNNL	1199	32.30	OK	0.00
CVS2-29	PNL-10359	PNNL	PNNL	1248	20.60	OK	0.00
CVS2-29	PNL-10359	PNNL	PNNL	1149	54.50	OK	0.00
CVS2-29	PNL-10359	PNNL	PNNL	998	466.20	OK	0.00
CVS2-29	PNL-10359	PNNL	PNNL	949	1248.10	OK	0.00
CVS2-30	PNL-10359	PNNL	PNNL	1147	265.90	OK	0.00
CVS2-30	PNL-10359	PNNL	PNNL	1096	467.80	OK	0.00
CVS2-30	PNL-10359	PNNL	PNNL	1047	785.50	OK	0.00
CVS2-30	PNL-10359	PNNL	PNNL	1098	466.70	OK	0.00
CVS2-30	PNL-10359	PNNL	PNNL	1148	282.20	OK	0.00
CVS2-30	PNL-10359	PNNL	PNNL	1197	186.10	OK	0.00
CVS2-30	PNL-10359	PNNL	PNNL	1247	125.60	OK	0.00
CVS2-30	PNL-10359	PNNL	PNNL	1147	289.20	OK	0.00
CVS2-30	PNL-10359	PNNL	PNNL	998	1557.50	OK	0.00
CVS2-31	PNL-10359	PNNL	PNNL	1146	105.00	OK	0.00
CVS2-31	PNL-10359	PNNL	PNNL	1096	175.80	OK	0.00
CVS2-31	PNL-10359	PNNL	PNNL	1047	299.60	OK	0.00
CVS2-31	PNL-10359	PNNL	PNNL	1096	178.00	OK	0.00
CVS2-31	PNL-10359	PNNL	PNNL	1146	108.00	OK	0.00
CVS2-31	PNL-10359	PNNL	PNNL	1195	68.20	OK	0.00
CVS2-31	PNL-10359	PNNL	PNNL	1245	48.40	OK	0.00
CVS2-31	PNL-10359	PNNL	PNNL	1146	110.80	OK	0.00
CVS2-31	PNL-10359	PNNL	PNNL	996	641.70	OK	0.00
CVS2-31	PNL-10359	PNNL	PNNL	947	1419.10	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
CVS2-32	PNL-10359	PNNL	PNNL	1142	85.90	OK	0.00
CVS2-32	PNL-10359	PNNL	PNNL	1092	157.10	OK	0.00
CVS2-32	PNL-10359	PNNL	PNNL	1043	281.60	OK	0.00
CVS2-32	PNL-10359	PNNL	PNNL	1093	150.90	OK	0.00
CVS2-32	PNL-10359	PNNL	PNNL	1143	86.60	OK	0.00
CVS2-32	PNL-10359	PNNL	PNNL	1193	52.70	OK	0.00
CVS2-32	PNL-10359	PNNL	PNNL	1243	33.50	OK	0.00
CVS2-32	PNL-10359	PNNL	PNNL	1143	87.80	OK	0.00
CVS2-32	PNL-10359	PNNL	PNNL	994	575.20	OK	0.00
CVS2-32	PNL-10359	PNNL	PNNL	943	1286.10	OK	0.00
CVS2-33	PNL-10359	PNNL	PNNL	1148	21.40	OK	0.00
CVS2-33	PNL-10359	PNNL	PNNL	1098	32.60	OK	0.00
CVS2-33	PNL-10359	PNNL	PNNL	1048	52.00	OK	0.00
CVS2-33	PNL-10359	PNNL	PNNL	1099	32.20	OK	0.00
CVS2-33	PNL-10359	PNNL	PNNL	1149	21.70	OK	0.00
CVS2-33	PNL-10359	PNNL	PNNL	1198	15.20	OK	0.00
CVS2-33	PNL-10359	PNNL	PNNL	1247	10.80	OK	0.00
CVS2-33	PNL-10359	PNNL	PNNL	1148	22.40	OK	0.00
CVS2-33	PNL-10359	PNNL	PNNL	999	87.40	OK	0.00
CVS2-33	PNL-10359	PNNL	PNNL	948	155.20	OK	0.00
CVS2-34	PNL-10359	PNNL	PNNL	1145	19.70	OK	0.00
CVS2-34	PNL-10359	PNNL	PNNL	1095	28.00	OK	0.00
CVS2-34	PNL-10359	PNNL	PNNL	1046	41.40	OK	0.00
CVS2-34	PNL-10359	PNNL	PNNL	1097	27.70	OK	0.00
CVS2-34	PNL-10359	PNNL	PNNL	1046	19.60	OK	0.00
CVS2-34	PNL-10359	PNNL	PNNL	1195	14.40	OK	0.00
CVS2-34	PNL-10359	PNNL	PNNL	1244	10.70	OK	0.00
CVS2-34	PNL-10359	PNNL	PNNL	1145	19.80	OK	0.00
CVS2-34	PNL-10359	PNNL	PNNL	996	65.70	OK	0.00
CVS2-34	PNL-10359	PNNL	PNNL	945	112.90	OK	0.00
CVS2-35	PNL-10359	PNNL	PNNL	1144	28.70	OK	0.00
CVS2-35	PNL-10359	PNNL	PNNL	1093	44.50	OK	0.00
CVS2-35	PNL-10359	PNNL	PNNL	1043	71.20	OK	0.00
CVS2-35	PNL-10359	PNNL	PNNL	1094	44.20	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
CVS2-35	PNL-10359	PNNL	PNNL	1144	29.50	OK	0.00
CVS2-35	PNL-10359	PNNL	PNNL	1193	20.40	OK	0.00
CVS2-35	PNL-10359	PNNL	PNNL	1244	15.10	OK	0.00
CVS2-35	PNL-10359	PNNL	PNNL	1143	30.10	OK	0.00
CVS2-35	PNL-10359	PNNL	PNNL	993	120.60	OK	0.00
CVS2-35	PNL-10359	PNNL	PNNL	943	216.50	OK	0.00
CVS2-36	PNL-10359	PNNL	PNNL	1146	19.60	OK	0.00
CVS2-36	PNL-10359	PNNL	PNNL	1095	29.40	OK	0.00
CVS2-36	PNL-10359	PNNL	PNNL	1045	46.70	OK	0.00
CVS2-36	PNL-10359	PNNL	PNNL	1096	29.30	OK	0.00
CVS2-36	PNL-10359	PNNL	PNNL	1145	19.80	OK	0.00
CVS2-36	PNL-10359	PNNL	PNNL	1196	13.80	OK	0.00
CVS2-36	PNL-10359	PNNL	PNNL	1246	10.10	OK	0.00
CVS2-36	PNL-10359	PNNL	PNNL	1145	19.50	OK	0.00
CVS2-36	PNL-10359	PNNL	PNNL	995	75.00	OK	0.00
CVS2-36	PNL-10359	PNNL	PNNL	945	136.50	OK	0.00
CVS2-37	PNL-10359	PNNL	PNNL	1146	124.30	OK	0.00
CVS2-37	PNL-10359	PNNL	PNNL	1095	200.50	OK	0.00
CVS2-37	PNL-10359	PNNL	PNNL	1046	317.50	OK	0.00
CVS2-37	PNL-10359	PNNL	PNNL	1097	194.80	OK	0.00
CVS2-37	PNL-10359	PNNL	PNNL	1146	127.40	OK	0.00
CVS2-37	PNL-10359	PNNL	PNNL	1195	87.00	OK	0.00
CVS2-37	PNL-10359	PNNL	PNNL	1244	62.00	OK	0.00
CVS2-37	PNL-10359	PNNL	PNNL	1146	130.50	OK	0.00
CVS2-37	PNL-10359	PNNL	PNNL	997	546.70	OK	0.00
CVS2-37	PNL-10359	PNNL	PNNL	947	1029.70	OK	0.00
CVS2-38	PNL-10359	PNNL	PNNL	1147	122.10	OK	0.00
CVS2-38	PNL-10359	PNNL	PNNL	1096	211.90	OK	0.00
CVS2-38	PNL-10359	PNNL	PNNL	1047	388.00	OK	0.00
CVS2-38	PNL-10359	PNNL	PNNL	1097	212.70	OK	0.00
CVS2-38	PNL-10359	PNNL	PNNL	1147	124.10	OK	0.00
CVS2-38	PNL-10359	PNNL	PNNL	1197	77.50	OK	0.00
CVS2-38	PNL-10359	PNNL	PNNL	1247	51.40	OK	0.00
CVS2-38	PNL-10359	PNNL	PNNL	1147	124.40	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
CVS2-38	PNL-10359	PNNL	PNNL	998	770.60	OK	0.00
CVS2-39	PNL-10359	PNNL	PNNL	1145	21.40	OK	0.00
CVS2-39	PNL-10359	PNNL	PNNL	1095	33.40	OK	0.00
CVS2-39	PNL-10359	PNNL	PNNL	1047	54.50	OK	0.00
CVS2-39	PNL-10359	PNNL	PNNL	1097	31.50	OK	0.00
CVS2-39	PNL-10359	PNNL	PNNL	1147	20.20	OK	0.00
CVS2-39	PNL-10359	PNNL	PNNL	1196	13.30	OK	0.00
CVS2-39	PNL-10359	PNNL	PNNL	1143	20.80	OK	0.00
CVS2-39	PNL-10359	PNNL	PNNL	994	96.10	OK	0.00
CVS2-39	PNL-10359	PNNL	PNNL	944	200.00	OK	0.00
CVS2-40	PNL-10359	PNNL	PNNL	1147	68.10	OK	0.00
CVS2-40	PNL-10359	PNNL	PNNL	1097	114.20	OK	0.00
CVS2-40	PNL-10359	PNNL	PNNL	1048	188.30	OK	0.00
CVS2-40	PNL-10359	PNNL	PNNL	1098	111.90	OK	0.00
CVS2-40	PNL-10359	PNNL	PNNL	1148	67.80	OK	0.00
CVS2-40	PNL-10359	PNNL	PNNL	1197	47.20	OK	0.00
CVS2-40	PNL-10359	PNNL	PNNL	1247	32.40	OK	0.00
CVS2-40	PNL-10359	PNNL	PNNL	1147	71.60	OK	0.00
CVS2-40	PNL-10359	PNNL	PNNL	998	351.10	OK	0.00
CVS2-40	PNL-10359	PNNL	PNNL	947	681.00	OK	0.00
CVS2-41	PNL-10359	PNNL	PNNL	1147	64.00	OK	0.00
CVS2-41	PNL-10359	PNNL	PNNL	1097	102.30	OK	0.00
CVS2-41	PNL-10359	PNNL	PNNL	1047	168.00	OK	0.00
CVS2-41	PNL-10359	PNNL	PNNL	1098	100.10	OK	0.00
CVS2-41	PNL-10359	PNNL	PNNL	1147	63.00	OK	0.00
CVS2-41	PNL-10359	PNNL	PNNL	1197	41.60	OK	0.00
CVS2-41	PNL-10359	PNNL	PNNL	1246	29.70	OK	0.00
CVS2-41	PNL-10359	PNNL	PNNL	1147	64.60	OK	0.00
CVS2-41	PNL-10359	PNNL	PNNL	998	295.80	OK	0.00
CVS2-41	PNL-10359	PNNL	PNNL	947	617.30	OK	0.00
CVS2-42	PNL-10359	PNNL	PNNL	1147	56.60	OK	0.00
CVS2-42	PNL-10359	PNNL	PNNL	1096	90.50	OK	0.00
CVS2-42	PNL-10359	PNNL	PNNL	1047	149.50	OK	0.00
CVS2-42	PNL-10359	PNNL	PNNL	1098	89.40	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
CVS2-42	PNL-10359	PNNL	PNNL	1148	57.10	OK	0.00
CVS2-42	PNL-10359	PNNL	PNNL	1197	36.80	OK	0.00
CVS2-42	PNL-10359	PNNL	PNNL	1247	25.80	OK	0.00
CVS2-42	PNL-10359	PNNL	PNNL	1147	57.50	OK	0.00
CVS2-42	PNL-10359	PNNL	PNNL	998	267.00	OK	0.00
CVS2-42	PNL-10359	PNNL	PNNL	948	545.40	OK	0.00
CVS2-43	PNL-10359	PNNL	PNNL	1147	45.50	OK	0.00
CVS2-43	PNL-10359	PNNL	PNNL	1097	72.30	OK	0.00
CVS2-43	PNL-10359	PNNL	PNNL	1047	124.30	OK	0.00
CVS2-43	PNL-10359	PNNL	PNNL	1097	72.70	OK	0.00
CVS2-43	PNL-10359	PNNL	PNNL	1148	45.90	OK	0.00
CVS2-43	PNL-10359	PNNL	PNNL	1197	29.40	OK	0.00
CVS2-43	PNL-10359	PNNL	PNNL	1247	20.80	OK	0.00
CVS2-43	PNL-10359	PNNL	PNNL	1147	47.00	OK	0.00
CVS2-43	PNL-10359	PNNL	PNNL	997	252.10	OK	0.00
CVS2-43	PNL-10359	PNNL	PNNL	947	532.90	OK	0.00
CVS2-44	PNL-10359	PNNL	PNNL	1147	61.90	NOSUM	0.00
CVS2-44	PNL-10359	PNNL	PNNL	1097	100.10	NOSUM	0.00
CVS2-44	PNL-10359	PNNL	PNNL	1047	166.30	NOSUM	0.00
CVS2-44	PNL-10359	PNNL	PNNL	1098	98.00	NOSUM	0.00
CVS2-44	PNL-10359	PNNL	PNNL	1148	61.90	NOSUM	0.00
CVS2-44	PNL-10359	PNNL	PNNL	1197	41.20	NOSUM	0.00
CVS2-44	PNL-10359	PNNL	PNNL	1246	28.80	NOSUM	0.00
CVS2-44	PNL-10359	PNNL	PNNL	1147	63.00	NOSUM	0.00
CVS2-44	PNL-10359	PNNL	PNNL	998	303.90	NOSUM	0.00
CVS2-44	PNL-10359	PNNL	PNNL	948	599.60	NOSUM	0.00
CVS2-45	PNL-10359	PNNL	PNNL	1148	60.50	NOSUM	0.00
CVS2-45	PNL-10359	PNNL	PNNL	1098	97.30	NOSUM	0.00
CVS2-45	PNL-10359	PNNL	PNNL	1049	164.40	NOSUM	0.00
CVS2-45	PNL-10359	PNNL	PNNL	1100	95.50	NOSUM	0.00
CVS2-45	PNL-10359	PNNL	PNNL	1149	60.80	NOSUM	0.00
CVS2-45	PNL-10359	PNNL	PNNL	1198	40.90	NOSUM	0.00
CVS2-45	PNL-10359	PNNL	PNNL	1248	27.50	NOSUM	0.00
CVS2-45	PNL-10359	PNNL	PNNL	1149	62.90	NOSUM	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
CVS2-45	PNL-10359	PNNL	PNNL	998	326.10	NOSUM	0.00
CVS2-45	PNL-10359	PNNL	PNNL	948	641.70	NOSUM	0.00
CVS2-46	PNL-10359	PNNL	PNNL	1148	47.90	OK	0.00
CVS2-46	PNL-10359	PNNL	PNNL	1097	73.10	OK	0.00
CVS2-46	PNL-10359	PNNL	PNNL	1048	122.60	OK	0.00
CVS2-46	PNL-10359	PNNL	PNNL	1100	71.60	OK	0.00
CVS2-46	PNL-10359	PNNL	PNNL	1150	48.20	OK	0.00
CVS2-46	PNL-10359	PNNL	PNNL	1199	32.70	OK	0.00
CVS2-46	PNL-10359	PNNL	PNNL	1248	22.50	OK	0.00
CVS2-46	PNL-10359	PNNL	PNNL	1148	49.00	OK	0.00
CVS2-46	PNL-10359	PNNL	PNNL	998	224.10	OK	0.00
CVS2-46	PNL-10359	PNNL	PNNL	948	443.90	OK	0.00
CVS2-47	PNL-10359	PNNL	PNNL	1147	66.00	OK	0.00
CVS2-47	PNL-10359	PNNL	PNNL	1098	109.90	OK	0.00
CVS2-47	PNL-10359	PNNL	PNNL	1048	192.90	OK	0.00
CVS2-47	PNL-10359	PNNL	PNNL	1100	110.30	OK	0.00
CVS2-47	PNL-10359	PNNL	PNNL	1149	70.70	OK	0.00
CVS2-47	PNL-10359	PNNL	PNNL	1198	43.20	OK	0.00
CVS2-47	PNL-10359	PNNL	PNNL	1248	29.00	OK	0.00
CVS2-47	PNL-10359	PNNL	PNNL	1148	68.10	OK	0.00
CVS2-47	PNL-10359	PNNL	PNNL	999	373.40	OK	0.00
CVS2-47	PNL-10359	PNNL	PNNL	948	805.90	OK	0.00
CVS2-48	PNL-10359	PNNL	PNNL	1148	39.40	OK	0.00
CVS2-48	PNL-10359	PNNL	PNNL	1098	63.20	OK	0.00
CVS2-48	PNL-10359	PNNL	PNNL	1048	105.10	OK	0.00
CVS2-48	PNL-10359	PNNL	PNNL	1099	62.30	OK	0.00
CVS2-48	PNL-10359	PNNL	PNNL	1149	40.00	OK	0.00
CVS2-48	PNL-10359	PNNL	PNNL	1198	26.90	OK	0.00
CVS2-48	PNL-10359	PNNL	PNNL	1248	19.00	OK	0.00
CVS2-48	PNL-10359	PNNL	PNNL	1148	40.60	OK	0.00
CVS2-48	PNL-10359	PNNL	PNNL	999	196.40	OK	0.00
CVS2-48	PNL-10359	PNNL	PNNL	948	397.20	OK	0.00
CVS2-49	PNL-10359	PNNL	PNNL	1147	66.50	OK	0.00
CVS2-49	PNL-10359	PNNL	PNNL	1098	104.70	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
CVS2-49	PNL-10359	PNNL	PNNL	1048	175.60	OK	0.00
CVS2-49	PNL-10359	PNNL	PNNL	1098	103.10	OK	0.00
CVS2-49	PNL-10359	PNNL	PNNL	1147	66.30	OK	0.00
CVS2-49	PNL-10359	PNNL	PNNL	1198	43.50	OK	0.00
CVS2-49	PNL-10359	PNNL	PNNL	1247	30.90	OK	0.00
CVS2-49	PNL-10359	PNNL	PNNL	1147	67.20	OK	0.00
CVS2-49	PNL-10359	PNNL	PNNL	998	313.10	OK	0.00
CVS2-49	PNL-10359	PNNL	PNNL	948	648.50	OK	0.00
CVS2-50	PNL-10359	PNNL	PNNL	1147	59.60	NOSUM	0.00
CVS2-50	PNL-10359	PNNL	PNNL	1096	95.70	NOSUM	0.00
CVS2-50	PNL-10359	PNNL	PNNL	1047	164.90	NOSUM	0.00
CVS2-50	PNL-10359	PNNL	PNNL	1098	94.60	NOSUM	0.00
CVS2-50	PNL-10359	PNNL	PNNL	1147	58.70	NOSUM	0.00
CVS2-50	PNL-10359	PNNL	PNNL	1197	37.80	NOSUM	0.00
CVS2-50	PNL-10359	PNNL	PNNL	1247	25.70	NOSUM	0.00
CVS2-50	PNL-10359	PNNL	PNNL	1147	58.50	NOSUM	0.00
CVS2-50	PNL-10359	PNNL	PNNL	998	312.80	NOSUM	0.00
CVS2-50	PNL-10359	PNNL	PNNL	948	635.30	NOSUM	0.00
CVS2-51	PNL-10359	PNNL	PNNL	1149	69.70	NOSUM	0.00
CVS2-51	PNL-10359	PNNL	PNNL	1099	117.30	NOSUM	0.00
CVS2-51	PNL-10359	PNNL	PNNL	1048	199.60	NOSUM	0.00
CVS2-51	PNL-10359	PNNL	PNNL	1099	115.50	NOSUM	0.00
CVS2-51	PNL-10359	PNNL	PNNL	1149	70.30	NOSUM	0.00
CVS2-51	PNL-10359	PNNL	PNNL	1198	47.50	NOSUM	0.00
CVS2-51	PNL-10359	PNNL	PNNL	1248	32.60	NOSUM	0.00
CVS2-51	PNL-10359	PNNL	PNNL	1148	72.80	NOSUM	0.00
CVS2-51	PNL-10359	PNNL	PNNL	999	395.80	NOSUM	0.00
CVS2-51	PNL-10359	PNNL	PNNL	948	821.60	NOSUM	0.00
CVS2-52	PNL-10359	PNNL	PNNL	1148	92.00	OK	0.00
CVS2-52	PNL-10359	PNNL	PNNL	1098	148.20	OK	0.00
CVS2-52	PNL-10359	PNNL	PNNL	1048	259.20	OK	0.00
CVS2-52	PNL-10359	PNNL	PNNL	1099	147.10	OK	0.00
CVS2-52	PNL-10359	PNNL	PNNL	1149	94.30	OK	0.00
CVS2-52	PNL-10359	PNNL	PNNL	1198	62.30	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
CVS2-52	PNL-10359	PNNL	PNNL	1249	42.60	OK	0.00
CVS2-52	PNL-10359	PNNL	PNNL	1149	95.60	OK	0.00
CVS2-52	PNL-10359	PNNL	PNNL	999	485.60	OK	0.00
CVS2-52	PNL-10359	PNNL	PNNL	949	1006.50	OK	0.00
CVS2-55	PNL-10359	PNNL	PNNL	1147	63.50	OK	0.00
CVS2-55	PNL-10359	PNNL	PNNL	1096	105.50	OK	0.00
CVS2-55	PNL-10359	PNNL	PNNL	1046	177.60	OK	0.00
CVS2-55	PNL-10359	PNNL	PNNL	1097	103.60	OK	0.00
CVS2-55	PNL-10359	PNNL	PNNL	1147	64.90	OK	0.00
CVS2-55	PNL-10359	PNNL	PNNL	1197	41.80	OK	0.00
CVS2-55	PNL-10359	PNNL	PNNL	1247	28.90	OK	0.00
CVS2-55	PNL-10359	PNNL	PNNL	1147	65.30	OK	0.00
CVS2-55	PNL-10359	PNNL	PNNL	997	338.80	OK	0.00
CVS2-55	PNL-10359	PNNL	PNNL	946	703.00	OK	0.00
CVS2-56	PNL-10359	PNNL	PNNL	1146	62.20	NOSUM	0.00
CVS2-56	PNL-10359	PNNL	PNNL	1096	100.70	NOSUM	0.00
CVS2-56	PNL-10359	PNNL	PNNL	1047	170.50	NOSUM	0.00
CVS2-56	PNL-10359	PNNL	PNNL	1097	100.50	NOSUM	0.00
CVS2-56	PNL-10359	PNNL	PNNL	1147	63.20	NOSUM	0.00
CVS2-56	PNL-10359	PNNL	PNNL	1197	41.20	NOSUM	0.00
CVS2-56	PNL-10359	PNNL	PNNL	1247	28.90	NOSUM	0.00
CVS2-56	PNL-10359	PNNL	PNNL	1147	64.40	NOSUM	0.00
CVS2-56	PNL-10359	PNNL	PNNL	996	325.20	NOSUM	0.00
CVS2-56	PNL-10359	PNNL	PNNL	946	659.20	NOSUM	0.00
CVS2-57	PNL-10359	PNNL	PNNL	1147	70.00	NOSUM	0.00
CVS2-57	PNL-10359	PNNL	PNNL	1096	113.50	NOSUM	0.00
CVS2-57	PNL-10359	PNNL	PNNL	1046	199.00	NOSUM	0.00
CVS2-57	PNL-10359	PNNL	PNNL	1097	112.90	NOSUM	0.00
CVS2-57	PNL-10359	PNNL	PNNL	1147	69.70	NOSUM	0.00
CVS2-57	PNL-10359	PNNL	PNNL	1197	44.90	NOSUM	0.00
CVS2-57	PNL-10359	PNNL	PNNL	1247	30.40	NOSUM	0.00
CVS2-57	PNL-10359	PNNL	PNNL	1147	69.00	NOSUM	0.00
CVS2-57	PNL-10359	PNNL	PNNL	996	386.20	NOSUM	0.00
CVS2-57	PNL-10359	PNNL	PNNL	945	825.80	NOSUM	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
CVS2-58	PNL-10359	PNNL	PNNL	1146	19.30	OK	0.00
CVS2-58	PNL-10359	PNNL	PNNL	1096	29.60	OK	0.00
CVS2-58	PNL-10359	PNNL	PNNL	1046	47.50	OK	0.00
CVS2-58	PNL-10359	PNNL	PNNL	1097	28.90	OK	0.00
CVS2-58	PNL-10359	PNNL	PNNL	1146	19.20	OK	0.00
CVS2-58	PNL-10359	PNNL	PNNL	1195	13.10	OK	0.00
CVS2-58	PNL-10359	PNNL	PNNL	1245	9.40	OK	0.00
CVS2-58	PNL-10359	PNNL	PNNL	1146	18.80	OK	0.00
CVS2-58	PNL-10359	PNNL	PNNL	997	80.50	OK	0.00
CVS2-58	PNL-10359	PNNL	PNNL	946	152.50	OK	0.00
CVS2-59	PNL-10359	PNNL	PNNL	1147	11.90	NOSUM	0.00
CVS2-59	PNL-10359	PNNL	PNNL	1097	16.70	NOSUM	0.00
CVS2-59	PNL-10359	PNNL	PNNL	1048	24.10	NOSUM	0.00
CVS2-59	PNL-10359	PNNL	PNNL	1098	15.90	NOSUM	0.00
CVS2-59	PNL-10359	PNNL	PNNL	1147	11.90	NOSUM	0.00
CVS2-59	PNL-10359	PNNL	PNNL	1196	8.90	NOSUM	0.00
CVS2-59	PNL-10359	PNNL	PNNL	1246	6.20	NOSUM	0.00
CVS2-59	PNL-10359	PNNL	PNNL	1147	12.30	NOSUM	0.00
CVS2-59	PNL-10359	PNNL	PNNL	998	37.70	NOSUM	0.00
CVS2-59	PNL-10359	PNNL	PNNL	947	68.20	NOSUM	0.00
CVS2-70	PNL-10359	PNNL	PNNL	1154	99.80	NOSUM	0.00
CVS2-70	PNL-10359	PNNL	PNNL	1104	161.90	NOSUM	0.00
CVS2-70	PNL-10359	PNNL	PNNL	1053	271.60	NOSUM	0.00
CVS2-70	PNL-10359	PNNL	PNNL	1105	159.70	NOSUM	0.00
CVS2-70	PNL-10359	PNNL	PNNL	1154	105.20	NOSUM	0.00
CVS2-70	PNL-10359	PNNL	PNNL	1204	73.90	NOSUM	0.00
CVS2-70	PNL-10359	PNNL	PNNL	1253	48.70	NOSUM	0.00
CVS2-70	PNL-10359	PNNL	PNNL	1153	103.00	NOSUM	0.00
CVS2-70	PNL-10359	PNNL	PNNL	1003	434.80	NOSUM	0.00
CVS2-70	PNL-10359	PNNL	PNNL	953	795.50	NOSUM	0.00
CVS2-74	PNL-10359	PNNL	PNNL	1151	92.80	NOSUM	0.00
CVS2-74	PNL-10359	PNNL	PNNL	1101	147.30	NOSUM	0.00
CVS2-74	PNL-10359	PNNL	PNNL	1050	242.60	NOSUM	0.00
CVS2-74	PNL-10359	PNNL	PNNL	1102	147.00	NOSUM	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
CVS2-74	PNL-10359	PNNL	PNNL	1151	95.40	NOSUM	0.00
CVS2-74	PNL-10359	PNNL	PNNL	1201	63.90	NOSUM	0.00
CVS2-74	PNL-10359	PNNL	PNNL	1251	44.20	NOSUM	0.00
CVS2-74	PNL-10359	PNNL	PNNL	1151	96.90	NOSUM	0.00
CVS2-74	PNL-10359	PNNL	PNNL	1001	441.60	NOSUM	0.00
CVS2-74	PNL-10359	PNNL	PNNL	950	849.70	NOSUM	0.00
CVS2-79	PNL-10359	PNNL	PNNL	1151	696.80	NOSUM	0.00
CVS2-79	PNL-10359	PNNL	PNNL	1101	1212.80	NOSUM	0.00
CVS2-79	PNL-10359	PNNL	PNNL	1051	2357.90	NOSUM	0.00
CVS2-79	PNL-10359	PNNL	PNNL	1102	1242.20	NOSUM	0.00
CVS2-79	PNL-10359	PNNL	PNNL	1151	715.90	NOSUM	0.00
CVS2-91	PNL-10359	PNNL	PNNL	1150	139.10	NOSUM	0.00
CVS2-91	PNL-10359	PNNL	PNNL	1100	239.30	NOSUM	0.00
CVS2-91	PNL-10359	PNNL	PNNL	1049	443.40	NOSUM	0.00
CVS2-91	PNL-10359	PNNL	PNNL	1100	238.70	NOSUM	0.00
CVS2-91	PNL-10359	PNNL	PNNL	1150	142.90	NOSUM	0.00
CVS2-91	PNL-10359	PNNL	PNNL	1200	91.40	NOSUM	0.00
CVS2-91	PNL-10359	PNNL	PNNL	1250	60.90	NOSUM	0.00
CVS2-91	PNL-10359	PNNL	PNNL	1150	148.20	NOSUM	0.00
CVS2-91	PNL-10359	PNNL	PNNL	1000	971.70	NOSUM	0.00
CVS2-91	PNL-10359	PNNL	PNNL	949	2199.10	NOSUM	0.00
CVS2-95	PNL-10359	PNNL	PNNL	1152	15.90	OK	0.00
CVS2-95	PNL-10359	PNNL	PNNL	1102	22.60	OK	0.00
CVS2-95	PNL-10359	PNNL	PNNL	1051	34.30	OK	0.00
CVS2-95	PNL-10359	PNNL	PNNL	1102	22.50	OK	0.00
CVS2-95	PNL-10359	PNNL	PNNL	1152	15.50	OK	0.00
CVS2-95	PNL-10359	PNNL	PNNL	1202	11.80	OK	0.00
CVS2-95	PNL-10359	PNNL	PNNL	1251	8.90	OK	0.00
CVS2-95	PNL-10359	PNNL	PNNL	1152	15.50	OK	0.00
CVS2-95	PNL-10359	PNNL	PNNL	1002	55.50	OK	0.00
CVS2-95	PNL-10359	PNNL	PNNL	951	99.50	OK	0.00
CVS2-96	PNL-10359	PNNL	PNNL	1150	55.30	NOSUM	0.00
CVS2-96	PNL-10359	PNNL	PNNL	1099	91.10	NOSUM	0.00
CVS2-96	PNL-10359	PNNL	PNNL	1049	158.80	NOSUM	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
CVS2-96	PNL-10359	PNNL	PNNL	1100	91.70	NOSUM	0.00
CVS2-96	PNL-10359	PNNL	PNNL	1149	55.60	NOSUM	0.00
CVS2-96	PNL-10359	PNNL	PNNL	1199	36.00	NOSUM	0.00
CVS2-96	PNL-10359	PNNL	PNNL	1250	25.10	NOSUM	0.00
CVS2-96	PNL-10359	PNNL	PNNL	1149	55.60	NOSUM	0.00
CVS2-96	PNL-10359	PNNL	PNNL	999	311.60	NOSUM	0.00
CVS2-96	PNL-10359	PNNL	PNNL	948	661.50	NOSUM	0.00
CVS2-97	PNL-10359	PNNL	PNNL	1151	71.40	NOSUM	0.00
CVS2-97	PNL-10359	PNNL	PNNL	1100	116.70	NOSUM	0.00
CVS2-97	PNL-10359	PNNL	PNNL	1051	199.70	NOSUM	0.00
CVS2-97	PNL-10359	PNNL	PNNL	1101	115.30	NOSUM	0.00
CVS2-97	PNL-10359	PNNL	PNNL	1151	72.30	NOSUM	0.00
CVS2-97	PNL-10359	PNNL	PNNL	1200	47.20	NOSUM	0.00
CVS2-97	PNL-10359	PNNL	PNNL	1250	31.60	NOSUM	0.00
CVS2-97	PNL-10359	PNNL	PNNL	1150	74.90	NOSUM	0.00
CVS2-97	PNL-10359	PNNL	PNNL	1001	392.90	NOSUM	0.00
CVS2-97	PNL-10359	PNNL	PNNL	950	805.20	NOSUM	0.00
CVS2-98	PNL-10359	PNNL	PNNL	1147	19.50	NOSUM	0.00
CVS2-98	PNL-10359	PNNL	PNNL	1096	27.50	NOSUM	0.00
CVS2-98	PNL-10359	PNNL	PNNL	1047	41.90	NOSUM	0.00
CVS2-98	PNL-10359	PNNL	PNNL	1098	27.30	NOSUM	0.00
CVS2-98	PNL-10359	PNNL	PNNL	1147	19.50	NOSUM	0.00
CVS2-98	PNL-10359	PNNL	PNNL	1196	14.30	NOSUM	0.00
CVS2-98	PNL-10359	PNNL	PNNL	1246	10.80	NOSUM	0.00
CVS2-98	PNL-10359	PNNL	PNNL	1146	19.30	NOSUM	0.00
CVS2-98	PNL-10359	PNNL	PNNL	997	65.30	NOSUM	0.00
CVS2-98	PNL-10359	PNNL	PNNL	947	112.20	NOSUM	0.00
HANFORD-294	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1137.6	75.18	NOSUM	0.01
HANFORD-294	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1079.22	126.61	NOSUM	0.01
HANFORD-294	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1020.27	230.86	NOSUM	0.01
HANFORD-294	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	961	478.50	NOSUM	0.01
HANFORD-294	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	901.7	1160.46	NOSUM	0.01
HANFORD-294	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	839.36	3577.50	NOSUM	0.01
HANFORD-294	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	808.05	7065.62	NOSUM	0.01

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
HANFORD-353	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1124.19	70.96	OK	0.00
HANFORD-353	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1075.75	111.40	OK	0.00
HANFORD-353	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1023.65	194.07	OK	0.00
HANFORD-353	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	971.02	369.82	OK	0.00
HANFORD-353	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	918	783.38	OK	0.00
HANFORD-353	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	865.16	1958.44	OK	0.00
HANFORD-353	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	808.61	6378.96	OK	0.00
HANFORD-423	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1135.93	69.87	OK	0.00
HANFORD-423	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1080.7	118.23	OK	0.00
HANFORD-423	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1021.99	218.56	OK	0.00
HANFORD-423	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	963.07	458.37	OK	0.00
HANFORD-423	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	902.09	1158.22	OK	0.00
HANFORD-423	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	839.04	3750.77	OK	0.00
HANFORD-423	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	808.86	7378.70	OK	0.00
PX1-1A-4643	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1192.96	29.48	OK	0.00
PX1-1A-4643	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1131.85	46.91	OK	0.00
PX1-1A-4643	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1068.14	80.81	OK	0.00
PX1-1A-4643	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1008.22	151.98	OK	0.00
PX1-1A-4643	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	945.87	321.17	OK	0.00
PX1-1A-4643	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	877.97	832.80	OK	0.00
PX1-1A-4643	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	813.22	2609.22	OK	0.00
PX1-2A-4726	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1149.67	39.95	OK	0.00
PX1-2A-4726	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1100.34	60.04	OK	0.00
PX1-2A-4726	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1050.26	97.70	OK	0.00
PX1-2A-4726	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	997.41	170.01	OK	0.00
PX1-2A-4726	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	943.25	324.74	OK	0.00
PX1-2A-4726	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	888.45	698.60	OK	0.00
PX1-2A-4726	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	835.19	1768.36	OK	0.00
PX1-3A-4778	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1177.24	41.26	OK	0.00
PX1-3A-4778	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1121.35	64.51	OK	0.00
PX1-3A-4778	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1076.86	96.88	OK	0.00
PX1-3A-4778	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1024.85	161.01	OK	0.00
PX1-3A-4778	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	971.41	293.63	OK	0.00
PX1-3A-4778	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	917.38	599.27	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
PX1-3A-4778	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	862.15	1408.12	OK	0.00
PX2-1A-4455	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1151.33	79.14	OK	0.00
PX2-1A-4455	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1103.12	122.26	OK	0.00
PX2-1A-4455	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1050.78	199.21	OK	0.00
PX2-1A-4455	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	998.7	353.13	OK	0.00
PX2-1A-4455	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	944.63	696.42	OK	0.00
PX2-1A-4455	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	889.55	1539.11	OK	0.00
PX2-1A-4455	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	834.79	3984.28	OK	0.00
PX2-2A-4509	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1189.94	39.27	OK	0.00
PX2-2A-4509	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1128.13	64.02	OK	0.00
PX2-2A-4509	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1066.07	112.44	OK	0.00
PX2-2A-4509	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1003.31	213.85	OK	0.00
PX2-2A-4509	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	942.47	451.90	OK	0.00
PX2-2A-4509	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	876.79	1183.56	OK	0.00
PX2-2A-4509	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	813.87	3652.83	OK	0.00
PX2-3-4570	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1125.65	48.07	OK	0.00
PX2-3-4570	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1077.82	73.00	OK	0.00
PX2-3-4570	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1025.22	121.32	OK	0.00
PX2-3-4570	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	972.93	217.72	OK	0.00
PX2-3-4570	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	919.48	433.40	OK	0.00
PX2-3-4570	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	865.72	976.67	OK	0.00
PX2-3-4570	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	810.39	2599.38	OK	0.00
PX2-3A-4565	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1189.36	31.63	OK	0.00
PX2-3A-4565	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1129.96	49.39	OK	0.00
PX2-3A-4565	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1069.25	85.22	OK	0.00
PX2-3A-4565	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1007.77	161.39	OK	0.00
PX2-3A-4565	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	944.63	342.15	OK	0.00
PX2-3A-4565	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	879.16	865.07	OK	0.00
PX2-3A-4565	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	817.75	2423.37	OK	0.00
PX3-1A-5780	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1186.69	48.85	OK	0.00
PX3-1A-5780	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1126.6	79.62	OK	0.00
PX3-1A-5780	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1064.22	138.53	OK	0.00
PX3-1A-5780	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1002.46	265.22	OK	0.00
PX3-1A-5780	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	940.24	567.04	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
PX3-1A-5780	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	876.87	1439.79	OK	0.00
PX3-1A-5780	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	809.26	4960.21	OK	0.00
PX3-2A-5818	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1150.83	66.26	OK	0.00
PX3-2A-5818	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1102.39	100.70	OK	0.00
PX3-2A-5818	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1050.04	165.38	OK	0.00
PX3-2A-5818	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	997.56	285.44	OK	0.00
PX3-2A-5818	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	943.4	554.52	OK	0.00
PX3-2A-5818	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	889.08	1207.29	OK	0.00
PX3-2A-5818	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	833.11	3138.27	OK	0.00
PX3-3A-5880	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1104.3	93.60	NOSUM	0.00
PX3-3A-5880	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1050.41	152.82	NOSUM	0.00
PX3-3A-5880	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	997.18	269.62	NOSUM	0.00
PX3-3A-5880	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	943.48	510.31	NOSUM	0.00
PX3-3A-5880	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	888.92	1113.40	NOSUM	0.00
PX3-3A-5880	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	833.99	2898.14	NOSUM	0.00
PX4-1A-6390	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1125.87	67.57	OK	0.00
PX4-1A-6390	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1074.64	104.79	OK	0.00
PX4-1A-6390	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1022.29	174.65	OK	0.00
PX4-1A-6390	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	968.73	316.56	OK	0.00
PX4-1A-6390	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	915.12	641.84	OK	0.00
PX4-1A-6390	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	860.32	1493.28	OK	0.00
PX4-1A-6390	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	803.35	4497.28	OK	0.00
PX4-2A-6433	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1190.66	35.83	OK	0.00
PX4-2A-6433	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1129.88	56.38	OK	0.00
PX4-2A-6433	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1069.25	97.64	OK	0.00
PX4-2A-6433	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1006.48	180.49	OK	0.00
PX4-2A-6433	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	944.48	376.05	OK	0.00
PX4-2A-6433	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	879.31	957.61	OK	0.00
PX4-2A-6433	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	812.74	3174.10	OK	0.00
PX4-3A-6460	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1190.01	35.83	OK	0.00
PX4-3A-6460	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1129.45	57.03	OK	0.00
PX4-3A-6460	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1070.06	96.84	OK	0.00
PX4-3A-6460	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1006.71	180.76	OK	0.00
PX4-3A-6460	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	943.48	381.43	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
PX4-3A-6460	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	880.26	957.61	OK	0.00
PX4-3A-6460	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	813.22	3141.67	OK	0.00
HM1-2-3829	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1139.86	82.45	OK	0.02
HM1-2-3829	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1081.29	134.44	OK	0.02
HM1-2-3829	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1022.67	238.69	OK	0.02
HM1-2-3829	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	963.53	475.14	OK	0.02
HM1-2-3829	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	902.56	1068.78	OK	0.02
HM1-2-3829	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	840.24	2934.67	OK	0.02
HM1-2-3829	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	808.69	5634.56	OK	0.02
HM1-4-3855	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1124.63	94.11	OK	0.02
HM1-4-3855	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1076.71	145.99	OK	0.02
HM1-4-3855	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1024.17	245.44	OK	0.02
HM1-4-3855	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	972.4	446.63	OK	0.02
HM1-4-3855	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	918.78	893.26	OK	0.02
HM1-4-3855	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	865.48	2034.75	OK	0.02
HM1-4-3855	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	837.76	3316.65	OK	0.02
HM2-1A-3979	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1150.9	79.58	OK	0.00
HM2-1A-3979	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1100.26	124.17	OK	0.00
HM2-1A-3979	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1047.28	201.40	OK	0.00
HM2-1A-3979	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	996.12	356.94	OK	0.00
HM2-1A-3979	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	942.32	693.15	OK	0.00
HM2-1A-3979	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	888.68	1493.28	OK	0.00
HM2-1A-3979	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	832.79	3165.56	OK	0.00
HM2-2A-4099	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1215.53	50.14	OK	0.00
HM2-2A-4099	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1157.43	79.41	OK	0.00
HM2-2A-4099	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1100.26	132.88	OK	0.00
HM2-2A-4099	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1038.33	244.78	OK	0.00
HM2-2A-4099	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	976.06	500.32	OK	0.00
HM2-2A-4099	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	912.78	1164.18	OK	0.00
HM2-2A-4099	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	847.27	3400.01	OK	0.00
HM2-3A-4120	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1175.95	62.22	OK	0.00
HM2-3A-4120	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1119.52	98.24	OK	0.00
HM2-3A-4120	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1074.35	147.64	OK	0.00
HM2-3A-4120	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1022.37	250.52	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
HM2-3A-4120	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	969.34	454.10	OK	0.00
HM2-3A-4120	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	915.51	922.38	OK	0.00
HM2-3A-4120	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	860.88	2155.86	OK	0.00
HM3-1A-4174	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1221.05	44.22	OK	0.00
HM3-1A-4174	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1159.89	71.55	OK	0.00
HM3-1A-4174	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1100.85	118.36	OK	0.00
HM3-1A-4174	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1040.04	211.69	OK	0.00
HM3-1A-4174	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	976.97	433.61	OK	0.00
HM3-1A-4174	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	913.56	998.48	OK	0.00
HM3-1A-4174	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	848.15	2829.76	OK	0.00
HM3-2A-4224	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1189.86	57.67	OK	0.00
HM3-2A-4224	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1129.08	96.84	OK	0.00
HM3-2A-4224	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1069.25	164.62	OK	0.00
HM3-2A-4224	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1009.12	309.34	OK	0.00
HM3-2A-4224	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	944.02	676.78	OK	0.00
HM3-2A-4224	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	882.31	1667.75	OK	0.00
HM3-2A-4224	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	813.87	5799.36	OK	0.00
HM3-3A-4356	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1148.29	80.78	OK	0.00
HM3-3A-4356	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1100.12	126.62	OK	0.00
HM3-3A-4356	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1047.73	204.12	OK	0.00
HM3-3A-4356	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	995.67	363.50	OK	0.00
HM3-3A-4356	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	941.86	725.89	OK	0.00
HM3-3A-4356	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	887.82	1593.71	OK	0.00
HM3-3A-4356	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	830.78	4148.01	OK	0.00
HM4-1A-5258	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1150.03	51.30	OK	0.00
HM4-1A-5258	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1102.02	76.14	OK	0.00
HM4-1A-5258	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1050.49	122.80	OK	0.00
HM4-1A-5258	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	998.02	210.13	OK	0.00
HM4-1A-5258	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	944.09	398.43	OK	0.00
HM4-1A-5258	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	888.92	862.34	OK	0.00
HM4-1A-5258	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	828.37	2428.73	OK	0.00
HM4-1-5260	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1124.92	59.52	OK	0.00
HM4-1-5260	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1077.08	89.02	OK	0.00
HM4-1-5260	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1023.87	147.52	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
HM4-1-5260	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	972.02	261.98	OK	0.00
HM4-1-5260	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	918.47	523.95	OK	0.00
HM4-1-5260	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	864.05	1220.84	OK	0.00
HM4-1-5260	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	808.78	3433.68	OK	0.00
HM4-2A-5641	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1147.71	55.23	OK	0.00
HM4-2A-5641	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1099.46	83.50	OK	0.00
HM4-2A-5641	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1047.35	134.81	OK	0.00
HM4-2A-5641	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	994.83	235.23	OK	0.00
HM4-2A-5641	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	941.55	447.55	OK	0.00
HM4-2A-5641	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	888.37	969.33	OK	0.00
HM4-2A-5641	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	831.51	2570.63	OK	0.00
HM4-3A-5748	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1163.22	57.35	OK	0.00
HM4-3A-5748	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1101.07	96.03	OK	0.00
HM4-3A-5748	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	1039.3	168.39	OK	0.00
HM4-3A-5748	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	979.41	323.33	OK	0.00
HM4-3A-5748	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	916.21	726.27	OK	0.00
HM4-3A-5748	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	851.1	2060.44	OK	0.00
HM4-3A-5748	WSRC-TR-93-672, DWPF Durability	SRNL/ADS	SS	781.02	8693.81	OK	0.00
SGM6-3,1T-1	SS Report	SRNL/ADS	SS	1195	25.70	NOSUM	0.07
SGM6-3,1T-1	SS Report	SRNL/ADS	SS	1137	38.90	NOSUM	0.07
SGM6-3,1T-1	SS Report	SRNL/ADS	SS	1090	58.88	NOSUM	0.07
SGM6-3,1T-1	SS Report	SRNL/ADS	SS	1034	97.72	NOSUM	0.07
SGM6-3,1T-1	SS Report	SRNL/ADS	SS	979	177.83	NOSUM	0.07
SGM6-3,2B-1	SS Report	SRNL/ADS	SS	1193	25.70	OK	0.09
SGM6-3,2B-1	SS Report	SRNL/ADS	SS	1136	39.81	OK	0.09
SGM6-3,2B-1	SS Report	SRNL/ADS	SS	1104	52.48	OK	0.09
SGM6-3,2B-1	SS Report	SRNL/ADS	SS	1048	85.11	OK	0.09
SGM6-3,2B-1	SS Report	SRNL/ADS	SS	993	147.91	OK	0.09
SGM6-3,2T-1	SS Report	SRNL/ADS	SS	1195	25.12	OK	0.11
SGM6-3,2T-1	SS Report	SRNL/ADS	SS	1137	38.90	OK	0.11
SGM6-3,2T-1	SS Report	SRNL/ADS	SS	1088	58.88	OK	0.11
SGM6-3,2T-1	SS Report	SRNL/ADS	SS	1031	97.72	OK	0.11
SGM6-3,2T-1	SS Report	SRNL/ADS	SS	973	177.83	OK	0.11
SGM6-3,2T-2	SS Report	SRNL/ADS	SS	1196	25.70	OK	0.14

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
SGM6-3,2T-2	SS Report	SRNL/ADS	SS	1139	39.81	OK	0.14
SGM6-3,2T-2	SS Report	SRNL/ADS	SS	1091	61.66	OK	0.14
SGM6-3,2T-2	SS Report	SRNL/ADS	SS	1034	100.00	OK	0.14
SGM6-3,2T-2	SS Report	SRNL/ADS	SS	974	186.21	OK	0.14
SGM6-3,2T-3	SS Report	SRNL/ADS	SS	1193	26.30	OK	0.09
SGM6-3,2T-3	SS Report	SRNL/ADS	SS	1136	39.81	OK	0.09
SGM6-3,2T-3	SS Report	SRNL/ADS	SS	1090	58.88	OK	0.09
SGM6-3,2T-3	SS Report	SRNL/ADS	SS	1033	97.72	OK	0.09
SGM6-3,2T-3	SS Report	SRNL/ADS	SS	979	177.83	OK	0.09
SGM6-3,2T-4	SS Report	SRNL/ADS	SS	1192	25.70	OK	0.13
SGM6-3,2T-4	SS Report	SRNL/ADS	SS	1135	39.81	OK	0.13
SGM6-3,2T-4	SS Report	SRNL/ADS	SS	1085	61.66	OK	0.13
SGM6-3,2T-4	SS Report	SRNL/ADS	SS	1029	102.33	OK	0.13
SGM6-3,2T-4	SS Report	SRNL/ADS	SS	972	186.21	OK	0.13
SGM6-3,3B	SS Report	SRNL/ADS	SS	1192	26.30	OK	0.07
SGM6-3,3B	SS Report	SRNL/ADS	SS	1135	40.74	OK	0.07
SGM6-3,3B	SS Report	SRNL/ADS	SS	1087	60.26	OK	0.07
SGM6-3,3B	SS Report	SRNL/ADS	SS	1030	102.33	OK	0.07
SGM6-3,3B	SS Report	SRNL/ADS	SS	972	186.21	OK	0.07
SGM6-3,3T-1	SS Report	SRNL/ADS	SS	1197	25.12	OK	0.09
SGM6-3,3T-1	SS Report	SRNL/ADS	SS	1138	38.90	OK	0.09
SGM6-3,3T-1	SS Report	SRNL/ADS	SS	1089	58.88	OK	0.09
SGM6-3,3T-1	SS Report	SRNL/ADS	SS	1033	97.72	OK	0.09
SGM6-3,3T-1	SS Report	SRNL/ADS	SS	975	177.83	OK	0.09
SGM6-3,4B-1	SS Report	SRNL/ADS	SS	1194	26.30	OK	0.09
SGM6-3,4B-1	SS Report	SRNL/ADS	SS	1136	40.74	OK	0.09
SGM6-3,4B-1	SS Report	SRNL/ADS	SS	1096	56.23	OK	0.09
SGM6-3,4B-1	SS Report	SRNL/ADS	SS	1045	87.10	OK	0.09
SGM6-3,4B-1	SS Report	SRNL/ADS	SS	992	134.90	OK	0.09
SGM6-3,4T-1	SS Report	SRNL/ADS	SS	1193	26.30	NOSUM	0.08
SGM6-3,4T-1	SS Report	SRNL/ADS	SS	1135	39.81	NOSUM	0.08
SGM6-3,4T-1	SS Report	SRNL/ADS	SS	1086	63.10	NOSUM	0.08
SGM6-3,4T-1	SS Report	SRNL/ADS	SS	1029	104.71	NOSUM	0.08
SGM6-3,4T-1	SS Report	SRNL/ADS	SS	974	186.21	NOSUM	0.08

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
SGM6-3,4T-2	SS Report	SRNL/ADS	SS	1187	27.54	OK	0.13
SGM6-3,4T-2	SS Report	SRNL/ADS	SS	1137	39.81	OK	0.13
SGM6-3,4T-2	SS Report	SRNL/ADS	SS	1099	56.23	OK	0.13
SGM6-3,4T-2	SS Report	SRNL/ADS	SS	1042	91.20	OK	0.13
SGM6-3,4T-2	SS Report	SRNL/ADS	SS	985	165.96	OK	0.13
SGM6-3,4T-3	SS Report	SRNL/ADS	SS	1192	26.30	NOSUM	0.16
SGM6-3,4T-3	SS Report	SRNL/ADS	SS	1134	39.81	NOSUM	0.16
SGM6-3,4T-3	SS Report	SRNL/ADS	SS	1090	58.88	NOSUM	0.16
SGM6-3,4T-3	SS Report	SRNL/ADS	SS	1032	97.72	NOSUM	0.16
SGM6-3,4T-3	SS Report	SRNL/ADS	SS	976	181.97	NOSUM	0.16
SGM6-3,4T-4	SS Report	SRNL/ADS	SS	1190	28.18	NOSUM	0.11
SGM6-3,4T-4	SS Report	SRNL/ADS	SS	1133	42.66	NOSUM	0.11
SGM6-3,4T-4	SS Report	SRNL/ADS	SS	1086	64.57	NOSUM	0.11
SGM6-3,4T-4	SS Report	SRNL/ADS	SS	1028	107.15	NOSUM	0.11
SGM6-3,4T-4	SS Report	SRNL/ADS	SS	972	194.98	NOSUM	0.11
SGM6-3,5B-1	SS Report	SRNL/ADS	SS	1191	26.30	OK	0.10
SGM6-3,5B-1	SS Report	SRNL/ADS	SS	1136	40.74	OK	0.10
SGM6-3,5B-1	SS Report	SRNL/ADS	SS	1089	60.26	OK	0.10
SGM6-3,5B-1	SS Report	SRNL/ADS	SS	1033	100.00	OK	0.10
SGM6-3,5B-1	SS Report	SRNL/ADS	SS	975	186.21	OK	0.10
SGM6-6,1T-1	SS Report	SRNL/ADS	SS	1191	26.30	OK	0.11
SGM6-6,1T-1	SS Report	SRNL/ADS	SS	1135	40.74	OK	0.11
SGM6-6,1T-1	SS Report	SRNL/ADS	SS	1089	61.66	OK	0.11
SGM6-6,1T-1	SS Report	SRNL/ADS	SS	1031	102.33	OK	0.11
SGM6-6,1T-1	SS Report	SRNL/ADS	SS	972	186.21	OK	0.11
SGM6-6,2B-1	SS Report	SRNL/ADS	SS	1198	26.30	OK	0.06
SGM6-6,2B-1	SS Report	SRNL/ADS	SS	1138	40.74	OK	0.06
SGM6-6,2B-1	SS Report	SRNL/ADS	SS	1112	50.12	OK	0.06
SGM6-6,2B-1	SS Report	SRNL/ADS	SS	1054	83.18	OK	0.06
SGM6-6,2B-1	SS Report	SRNL/ADS	SS	996	151.36	OK	0.06
SGM6-6,2T-1	SS Report	SRNL/ADS	SS	1107	56.23	OK	0.09
SGM6-6,2T-1	SS Report	SRNL/ADS	SS	1050	95.50	OK	0.09
SGM6-6,2T-1	SS Report	SRNL/ADS	SS	993	169.82	OK	0.09
SGM6-6,2T-1	SS Report	SRNL/ADS	SS	933	346.74	OK	0.09

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
SGM6-6,2T-1	SS Report	SRNL/ADS	SS	869	812.83	OK	0.09
SGM6-6,2T-2	SS Report	SRNL/ADS	SS	1194	27.54	OK	0.11
SGM6-6,2T-2	SS Report	SRNL/ADS	SS	1135	42.66	OK	0.11
SGM6-6,2T-2	SS Report	SRNL/ADS	SS	1087	63.10	OK	0.11
SGM6-6,2T-2	SS Report	SRNL/ADS	SS	1032	107.15	OK	0.11
SGM6-6,2T-2	SS Report	SRNL/ADS	SS	973	199.53	OK	0.11
SGM6-6,2T-3	SS Report	SRNL/ADS	SS	1192	26.92	OK	0.10
SGM6-6,2T-3	SS Report	SRNL/ADS	SS	1135	41.69	OK	0.10
SGM6-6,2T-3	SS Report	SRNL/ADS	SS	1087	63.10	OK	0.10
SGM6-6,2T-3	SS Report	SRNL/ADS	SS	1030	104.71	OK	0.10
SGM6-6,2T-3	SS Report	SRNL/ADS	SS	973	194.98	OK	0.10
SGM6-6,2T-4	SS Report	SRNL/ADS	SS	1192	26.92	OK	0.08
SGM6-6,2T-4	SS Report	SRNL/ADS	SS	1134	41.69	OK	0.08
SGM6-6,2T-4	SS Report	SRNL/ADS	SS	1091	60.26	OK	0.08
SGM6-6,2T-4	SS Report	SRNL/ADS	SS	1035	102.33	OK	0.08
SGM6-6,2T-4	SS Report	SRNL/ADS	SS	978	181.97	OK	0.08
SGM6-6,3B	SS Report	SRNL/ADS	SS	1194	26.30	OK	0.07
SGM6-6,3B	SS Report	SRNL/ADS	SS	1136	40.74	OK	0.07
SGM6-6,3B	SS Report	SRNL/ADS	SS	1091	60.26	OK	0.07
SGM6-6,3B	SS Report	SRNL/ADS	SS	1035	100.00	OK	0.07
SGM6-6,3B	SS Report	SRNL/ADS	SS	979	181.97	OK	0.07
SGM6-6,3T-1	SS Report	SRNL/ADS	SS	1204	24.55	OK	0.09
SGM6-6,3T-1	SS Report	SRNL/ADS	SS	1134	41.69	OK	0.09
SGM6-6,3T-1	SS Report	SRNL/ADS	SS	1087	61.66	OK	0.09
SGM6-6,3T-1	SS Report	SRNL/ADS	SS	1027	104.71	OK	0.09
SGM6-6,3T-1	SS Report	SRNL/ADS	SS	964	194.98	OK	0.09
SGM6-6,4B-1	SS Report	SRNL/ADS	SS	1193	26.92	OK	0.05
SGM6-6,4B-1	SS Report	SRNL/ADS	SS	1136	41.69	OK	0.05
SGM6-6,4B-1	SS Report	SRNL/ADS	SS	1091	61.66	OK	0.05
SGM6-6,4B-1	SS Report	SRNL/ADS	SS	1033	102.33	OK	0.05
SGM6-6,4B-1	SS Report	SRNL/ADS	SS	976	190.55	OK	0.05
SGM6-6,4T-1	SS Report	SRNL/ADS	SS	1194	27.54	OK	0.12
SGM6-6,4T-1	SS Report	SRNL/ADS	SS	1135	43.65	OK	0.12
SGM6-6,4T-1	SS Report	SRNL/ADS	SS	1087	69.18	OK	0.12

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
SGM6-6,4T-1	SS Report	SRNL/ADS	SS	1031	109.65	OK	0.12
SGM6-6,4T-1	SS Report	SRNL/ADS	SS	973	204.17	OK	0.12
SGM6-6,4T-2	SS Report	SRNL/ADS	SS	1194	25.70	OK	0.10
SGM6-6,4T-2	SS Report	SRNL/ADS	SS	1137	39.81	OK	0.10
SGM6-6,4T-2	SS Report	SRNL/ADS	SS	1089	60.26	OK	0.10
SGM6-6,4T-2	SS Report	SRNL/ADS	SS	1032	100.00	OK	0.10
SGM6-6,4T-2	SS Report	SRNL/ADS	SS	973	186.21	OK	0.10
SGM6-6,4T-3	SS Report	SRNL/ADS	SS	1194	26.30	NOSUM	0.06
SGM6-6,4T-3	SS Report	SRNL/ADS	SS	1137	40.74	NOSUM	0.06
SGM6-6,4T-3	SS Report	SRNL/ADS	SS	1088	61.66	NOSUM	0.06
SGM6-6,4T-3	SS Report	SRNL/ADS	SS	1031	102.33	NOSUM	0.06
SGM6-6,4T-4	SS Report	SRNL/ADS	SS	1194	26.30	OK	0.08
SGM6-6,4T-4	SS Report	SRNL/ADS	SS	1137	40.74	OK	0.08
SGM6-6,4T-4	SS Report	SRNL/ADS	SS	1089	61.66	OK	0.08
SGM6-6,4T-4	SS Report	SRNL/ADS	SS	1031	102.33	OK	0.08
SGM6-6,4T-4	SS Report	SRNL/ADS	SS	977	181.97	OK	0.08
SGM6-6,5B-1	SS Report	SRNL/ADS	SS	1192	26.92	OK	0.71
SGM6-6,5B-1	SS Report	SRNL/ADS	SS	1137	41.69	OK	0.71
SGM6-6,5B-1	SS Report	SRNL/ADS	SS	1089	61.66	OK	0.71
SGM6-6,5B-1	SS Report	SRNL/ADS	SS	1035	102.33	OK	0.71
SGM6-6,5B-1	SS Report	SRNL/ADS	SS	975	190.55	OK	0.71
SGM8-A29	SS Report	SRNL/ADS	SS	1223	32.36	OK	0.11
SGM8-A29	SS Report	SRNL/ADS	SS	1167	48.98	OK	0.11
SGM8-A29	SS Report	SRNL/ADS	SS	1111	75.86	OK	0.11
SGM8-A29	SS Report	SRNL/ADS	SS	1066	114.82	OK	0.11
SGM8-A29	SS Report	SRNL/ADS	SS	1013	194.98	OK	0.11
SGM8-A29	SS Report	SRNL/ADS	SS	957	363.08	OK	0.11
SGM8-A38	SS Report	SRNL/ADS	SS	1224	30.90	NOSUM	0.17
SGM8-A38	SS Report	SRNL/ADS	SS	1167	46.77	NOSUM	0.17
SGM8-A38	SS Report	SRNL/ADS	SS	1111	74.13	NOSUM	0.17
SGM8-A38	SS Report	SRNL/ADS	SS	1066	112.20	NOSUM	0.17
SGM8-A38	SS Report	SRNL/ADS	SS	1013	186.21	NOSUM	0.17
SGM8-A38	SS Report	SRNL/ADS	SS	960	338.84	NOSUM	0.17
SGM8-A23	SS Report	SRNL/ADS	SS	1221	32.36	OK	0.14

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
SGM8-A23	SS Report	SRNL/ADS	SS	1166	48.98	OK	0.14
SGM8-A23	SS Report	SRNL/ADS	SS	1110	77.62	OK	0.14
SGM8-A23	SS Report	SRNL/ADS	SS	1065	114.82	OK	0.14
SGM8-A23	SS Report	SRNL/ADS	SS	1012	194.98	OK	0.14
SGM8-A23	SS Report	SRNL/ADS	SS	959	346.74	OK	0.14
SGM8-B55	SS Report	SRNL/ADS	SS	1220	30.90	OK	0.13
SGM8-B55	SS Report	SRNL/ADS	SS	1165	45.71	OK	0.13
SGM8-B55	SS Report	SRNL/ADS	SS	1109	72.44	OK	0.13
SGM8-B55	SS Report	SRNL/ADS	SS	1064	107.15	OK	0.13
SGM8-B55	SS Report	SRNL/ADS	SS	1012	181.97	OK	0.13
SGM8-B55	SS Report	SRNL/ADS	SS	958	331.13	OK	0.13
SGM8-B49	SS Report	SRNL/ADS	SS	1220	35.48	OK	0.18
SGM8-B49	SS Report	SRNL/ADS	SS	1164	53.70	OK	0.18
SGM8-B49	SS Report	SRNL/ADS	SS	1108	85.11	OK	0.18
SGM8-B49	SS Report	SRNL/ADS	SS	1064	131.83	OK	0.18
SGM8-B49	SS Report	SRNL/ADS	SS	1011	223.87	OK	0.18
SGM8-B49	SS Report	SRNL/ADS	SS	957	398.11	OK	0.18
SGM8-B10	SS Report	SRNL/ADS	SS	1222	36.31	OK	0.12
SGM8-B10	SS Report	SRNL/ADS	SS	1167	54.95	OK	0.12
SGM8-B10	SS Report	SRNL/ADS	SS	1110	87.10	OK	0.12
SGM8-B10	SS Report	SRNL/ADS	SS	1066	134.90	OK	0.12
SGM8-B10	SS Report	SRNL/ADS	SS	1013	223.87	OK	0.12
SGM8-B10	SS Report	SRNL/ADS	SS	964	380.19	OK	0.12
SGM7-7, 1	SS Report	SRNL/ADS	SS	1194	21.88	OK	0.34
SGM7-7, 1	SS Report	SRNL/ADS	SS	1137	33.88	OK	0.34
SGM7-7, 1	SS Report	SRNL/ADS	SS	1087	52.48	OK	0.34
SGM7-7, 1	SS Report	SRNL/ADS	SS	1037	81.28	OK	0.34
SGM7-7, 1	SS Report	SRNL/ADS	SS	987	134.90	OK	0.34
SGM7-7,2B	SS Report	SRNL/ADS	SS	1191	20.89	OK	0.41
SGM7-7,2B	SS Report	SRNL/ADS	SS	1133	31.62	OK	0.41
SGM7-7,2B	SS Report	SRNL/ADS	SS	1107	39.81	OK	0.41
SGM7-7,2B	SS Report	SRNL/ADS	SS	1051	61.66	OK	0.41
SGM7-7,2B	SS Report	SRNL/ADS	SS	995	104.71	OK	0.41
SGM7-7,3	SS Report	SRNL/ADS	SS	1196	19.95	OK	0.47

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
SGM7-7,3	SS Report	SRNL/ADS	SS	1137	30.20	OK	0.47
SGM7-7,3	SS Report	SRNL/ADS	SS	1079	47.86	OK	0.47
SGM7-7,3	SS Report	SRNL/ADS	SS	1027	75.86	OK	0.47
SGM7-7,3	SS Report	SRNL/ADS	SS	972	131.83	OK	0.47
SGM7-7,4	SS Report	SRNL/ADS	SS	1192	21.38	OK	0.49
SGM7-7,4	SS Report	SRNL/ADS	SS	1134	32.36	OK	0.49
SGM7-7,4	SS Report	SRNL/ADS	SS	1101	43.65	OK	0.49
SGM7-7,4	SS Report	SRNL/ADS	SS	1052	64.57	OK	0.49
SGM7-7,4	SS Report	SRNL/ADS	SS	1007	100.00	OK	0.49
SGM7-8, 1T-2	SS Report	SRNL/ADS	SS	1226	17.38	OK	0.54
SGM7-8, 1T-2	SS Report	SRNL/ADS	SS	1167	25.12	OK	0.54
SGM7-8, 1T-2	SS Report	SRNL/ADS	SS	1112	38.90	OK	0.54
SGM7-8, 1T-2	SS Report	SRNL/ADS	SS	1066	56.23	OK	0.54
SGM7-8, 1T-2	SS Report	SRNL/ADS	SS	1013	91.20	OK	0.54
SGM7-8, 1T-2	SS Report	SRNL/ADS	SS	958	158.49	OK	0.54
SGM7-8, 1T-3	SS Report	SRNL/ADS	SS	1219	18.62	OK	0.55
SGM7-8, 1T-3	SS Report	SRNL/ADS	SS	1163	26.92	OK	0.55
SGM7-8, 1T-3	SS Report	SRNL/ADS	SS	1106	40.74	OK	0.55
SGM7-8, 1T-3	SS Report	SRNL/ADS	SS	1061	58.88	OK	0.55
SGM7-8, 1T-3	SS Report	SRNL/ADS	SS	1008	97.72	OK	0.55
SGM7-8, 1T-4	SS Report	SRNL/ADS	SS	1223	17.38	OK	0.55
SGM7-8, 1T-4	SS Report	SRNL/ADS	SS	1166	25.12	OK	0.55
SGM7-8, 1T-4	SS Report	SRNL/ADS	SS	1110	38.02	OK	0.55
SGM7-8, 1T-4	SS Report	SRNL/ADS	SS	1064	56.23	OK	0.55
SGM7-8, 1T-4	SS Report	SRNL/ADS	SS	1011	91.20	OK	0.55
SGM7-8, 1T-4	SS Report	SRNL/ADS	SS	958	158.49	OK	0.55
SGM7-8, 1T-5	SS Report	SRNL/ADS	SS	1255	14.13	OK	0.53
SGM7-8, 1T-5	SS Report	SRNL/ADS	SS	1200	19.95	OK	0.53
SGM7-8, 1T-5	SS Report	SRNL/ADS	SS	1144	29.51	OK	0.53
SGM7-8, 1T-5	SS Report	SRNL/ADS	SS	1079	48.98	OK	0.53
SGM7-8, 1T-5	SS Report	SRNL/ADS	SS	1016	85.11	OK	0.53
SGM7-8, 1T-5	SS Report	SRNL/ADS	SS	951	165.96	OK	0.53
SGM7-8, 2B-2	SS Report	SRNL/ADS	SS	1255	14.45	OK	0.50
SGM7-8, 2B-2	SS Report	SRNL/ADS	SS	1198	20.42	OK	0.50

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
SGM7-8, 2B-2	SS Report	SRNL/ADS	SS	1139	30.90	OK	0.50
SGM7-8, 2B-2	SS Report	SRNL/ADS	SS	1079	50.12	OK	0.50
SGM7-8, 2B-2	SS Report	SRNL/ADS	SS	1016	89.13	OK	0.50
SGM7-8, 2B-2	SS Report	SRNL/ADS	SS	953	169.82	OK	0.50
SGM7-8, 2T-1	SS Report	SRNL/ADS	SS	1258	14.13	OK	0.53
SGM7-8, 2T-1	SS Report	SRNL/ADS	SS	1198	19.95	OK	0.53
SGM7-8, 2T-1	SS Report	SRNL/ADS	SS	1143	29.51	OK	0.53
SGM7-8, 2T-1	SS Report	SRNL/ADS	SS	1076	48.98	OK	0.53
SGM7-8, 2T-1	SS Report	SRNL/ADS	SS	1015	87.10	OK	0.53
SGM7-8, 2T-1	SS Report	SRNL/ADS	SS	951	165.96	OK	0.53
SGM7-8, 2T-2	SS Report	SRNL/ADS	SS	1256	14.45	OK	0.55
SGM7-8, 2T-2	SS Report	SRNL/ADS	SS	1197	20.89	OK	0.55
SGM7-8, 2T-2	SS Report	SRNL/ADS	SS	1139	31.62	OK	0.55
SGM7-8, 2T-2	SS Report	SRNL/ADS	SS	1076	51.29	OK	0.55
SGM7-8, 2T-2	SS Report	SRNL/ADS	SS	1013	95.50	OK	0.55
SGM7-8, 2T-2	SS Report	SRNL/ADS	SS	954	169.82	OK	0.55
SGM7-8, 2T-3	SS Report	SRNL/ADS	SS	1222	16.98	OK	0.55
SGM7-8, 2T-3	SS Report	SRNL/ADS	SS	1166	25.12	OK	0.55
SGM7-8, 2T-3	SS Report	SRNL/ADS	SS	1109	38.02	OK	0.55
SGM7-8, 2T-3	SS Report	SRNL/ADS	SS	1064	54.95	OK	0.55
SGM7-8, 2T-3	SS Report	SRNL/ADS	SS	1011	91.20	OK	0.55
SGM7-8, 2T-3	SS Report	SRNL/ADS	SS	956	158.49	OK	0.55
SGM7-8, 3B-2	SS Report	SRNL/ADS	SS	1224	16.60	OK	0.57
SGM7-8, 3B-2	SS Report	SRNL/ADS	SS	1166	24.55	OK	0.57
SGM7-8, 3B-2	SS Report	SRNL/ADS	SS	1111	37.15	OK	0.57
SGM7-8, 3B-2	SS Report	SRNL/ADS	SS	1064	54.95	OK	0.57
SGM7-8, 3B-2	SS Report	SRNL/ADS	SS	1011	91.20	OK	0.57
SGM7-8, 3B-2	SS Report	SRNL/ADS	SS	956	162.18	OK	0.57
SGM7-8, 3B-3	SS Report	SRNL/ADS	SS	1223	16.98	OK	0.53
SGM7-8, 3B-3	SS Report	SRNL/ADS	SS	1167	25.12	OK	0.53
SGM7-8, 3B-3	SS Report	SRNL/ADS	SS	1112	38.02	OK	0.53
SGM7-8, 3B-3	SS Report	SRNL/ADS	SS	1065	56.23	OK	0.53
SGM7-8, 3B-3	SS Report	SRNL/ADS	SS	1012	91.20	OK	0.53
SGM7-8, 3B-3	SS Report	SRNL/ADS	SS	958	162.18	OK	0.53

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
SGM7-8, 3B-5	SS Report	SRNL/ADS	SS	1239	15.49	OK	0.52
SGM7-8, 3B-5	SS Report	SRNL/ADS	SS	1160	26.92	OK	0.52
SGM7-8, 3B-5	SS Report	SRNL/ADS	SS	1104	40.74	OK	0.52
SGM7-8, 3B-5	SS Report	SRNL/ADS	SS	1059	60.26	OK	0.52
SGM7-8, 3B-5	SS Report	SRNL/ADS	SS	1007	97.72	OK	0.52
SGM7-8, 3T-3	SS Report	SRNL/ADS	SS	1227	16.22	OK	0.64
SGM7-8, 3T-3	SS Report	SRNL/ADS	SS	1169	23.44	OK	0.64
SGM7-8, 3T-3	SS Report	SRNL/ADS	SS	1113	35.48	OK	0.64
SGM7-8, 3T-3	SS Report	SRNL/ADS	SS	1067	51.29	OK	0.64
SGM7-8, 3T-3	SS Report	SRNL/ADS	SS	1015	85.11	OK	0.64
SGM7-8, 3T-3	SS Report	SRNL/ADS	SS	959	147.91	OK	0.64
SGM7-8, 3T-4	SS Report	SRNL/ADS	SS	1255	12.88	OK	0.66
SGM7-8, 3T-4	SS Report	SRNL/ADS	SS	1196	19.05	OK	0.66
SGM7-8, 3T-4	SS Report	SRNL/ADS	SS	1143	28.18	OK	0.66
SGM7-8, 3T-4	SS Report	SRNL/ADS	SS	1079	45.71	OK	0.66
SGM7-8, 3T-4	SS Report	SRNL/ADS	SS	1017	81.28	OK	0.66
SGM7-8, 3T-4	SS Report	SRNL/ADS	SS	952	151.36	OK	0.66
SGM7-8, 3T-5	SS Report	SRNL/ADS	SS	1227	15.49	OK	0.50
SGM7-8, 3T-5	SS Report	SRNL/ADS	SS	1170	22.91	OK	0.50
SGM7-8, 3T-5	SS Report	SRNL/ADS	SS	1113	33.88	OK	0.50
SGM7-8, 3T-5	SS Report	SRNL/ADS	SS	1066	50.12	OK	0.50
SGM7-8, 3T-5	SS Report	SRNL/ADS	SS	1013	81.28	OK	0.50
SGM7-8, 3T-5	SS Report	SRNL/ADS	SS	960	141.25	OK	0.50
SGM9-7, 2B-1	SS Report	SRNL/ADS	SS	1264	12.59	OK	0.44
SGM9-7, 2B-1	SS Report	SRNL/ADS	SS	1236	14.45	OK	0.44
SGM9-7, 2B-1	SS Report	SRNL/ADS	SS	1182	21.38	OK	0.44
SGM9-7, 2B-1	SS Report	SRNL/ADS	SS	1127	32.36	OK	0.44
SGM9-7, 2B-1	SS Report	SRNL/ADS	SS	1064	53.70	OK	0.44
SGM9-7, 2T-2	SS Report	SRNL/ADS	SS	1268	12.30	OK	0.40
SGM9-7, 2T-2	SS Report	SRNL/ADS	SS	1239	15.49	OK	0.40
SGM9-7, 2T-2	SS Report	SRNL/ADS	SS	1184	21.88	OK	0.40
SGM9-7, 2T-2	SS Report	SRNL/ADS	SS	1129	32.36	OK	0.40
SGM9-7, 2T-2	SS Report	SRNL/ADS	SS	1067	53.70	OK	0.40
SGM9-7, 2T-3	SS Report	SRNL/ADS	SS	1270	12.02	OK	0.38

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
SGM9-7, 2T-3	SS Report	SRNL/ADS	SS	1240	14.13	OK	0.38
SGM9-7, 2T-3	SS Report	SRNL/ADS	SS	1187	20.42	OK	0.38
SGM9-7, 2T-3	SS Report	SRNL/ADS	SS	1129	30.90	OK	0.38
SGM9-7, 2T-3	SS Report	SRNL/ADS	SS	1067	51.29	OK	0.38
SGM9-7, 3T-1	SS Report	SRNL/ADS	SS	1266	12.59	OK	0.40
SGM9-7, 3T-1	SS Report	SRNL/ADS	SS	1238	14.79	OK	0.40
SGM9-7, 3T-1	SS Report	SRNL/ADS	SS	1183	21.38	OK	0.40
SGM9-7, 3T-1	SS Report	SRNL/ADS	SS	1129	31.62	OK	0.40
SGM9-7, 3T-1	SS Report	SRNL/ADS	SS	1065	53.70	OK	0.40
SGM9-7, 4B-1	SS Report	SRNL/ADS	SS	1267	12.02	OK	0.40
SGM9-7, 4B-1	SS Report	SRNL/ADS	SS	1238	14.13	OK	0.40
SGM9-7, 4B-1	SS Report	SRNL/ADS	SS	1183	20.89	OK	0.40
SGM9-7, 4B-1	SS Report	SRNL/ADS	SS	1128	30.90	OK	0.40
SGM9-7, 4B-1	SS Report	SRNL/ADS	SS	1070	48.98	OK	0.40
SGM9-7, 4T-1	SS Report	SRNL/ADS	SS	1266	12.30	OK	0.43
SGM9-7, 4T-1	SS Report	SRNL/ADS	SS	1238	14.45	OK	0.43
SGM9-7, 4T-1	SS Report	SRNL/ADS	SS	1182	20.89	OK	0.43
SGM9-7, 4T-1	SS Report	SRNL/ADS	SS	1128	31.62	OK	0.43
SGM9-7, 4T-1	SS Report	SRNL/ADS	SS	1065	52.48	OK	0.43
SGM9-7, 4T-2	SS Report	SRNL/ADS	SS	1265	12.30	OK	0.41
SGM9-7, 4T-2	SS Report	SRNL/ADS	SS	1237	14.45	OK	0.41
SGM9-7, 4T-2	SS Report	SRNL/ADS	SS	1184	20.89	OK	0.41
SGM9-7, 4T-2	SS Report	SRNL/ADS	SS	1129	31.62	OK	0.41
SGM9-7, 4T-2	SS Report	SRNL/ADS	SS	1065	53.70	OK	0.41
SGM9-7, 4T-3	SS Report	SRNL/ADS	SS	1271	12.30	OK	0.42
SGM9-7, 4T-3	SS Report	SRNL/ADS	SS	1240	14.13	OK	0.42
SGM9-7, 4T-3	SS Report	SRNL/ADS	SS	1184	20.42	OK	0.42
SGM9-7, 4T-3	SS Report	SRNL/ADS	SS	1129	30.20	OK	0.42
SGM9-7, 4T-3	SS Report	SRNL/ADS	SS	1067	50.12	OK	0.42
SGM9-7, 4T-4	SS Report	SRNL/ADS	SS	1267	12.30	OK	0.41
SGM9-7, 4T-4	SS Report	SRNL/ADS	SS	1239	14.79	OK	0.41
SGM9-7, 4T-4	SS Report	SRNL/ADS	SS	1183	21.38	OK	0.41
SGM9-7, 4T-4	SS Report	SRNL/ADS	SS	1129	31.62	OK	0.41
SGM9-7, 4T-4	SS Report	SRNL/ADS	SS	1067	52.48	OK	0.41

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
SGM9-7, 5B-1	SS Report	SRNL/ADS	SS	1266	12.02	OK	0.44
SGM9-7, 5B-1	SS Report	SRNL/ADS	SS	1238	14.45	OK	0.44
SGM9-7, 5B-1	SS Report	SRNL/ADS	SS	1184	20.89	OK	0.44
SGM9-7, 5B-1	SS Report	SRNL/ADS	SS	1134	30.90	OK	0.44
SGM9-7, 5B-1	SS Report	SRNL/ADS	SS	1068	51.29	OK	0.44
SGM9-7, Dump Start	SS Report	SRNL/ADS	SS	1260	14.13	OK	0.04
SGM9-7, Dump Start	SS Report	SRNL/ADS	SS	1233	16.60	OK	0.04
SGM9-7, Dump Start	SS Report	SRNL/ADS	SS	1180	23.99	OK	0.04
SGM9-7, Dump Start	SS Report	SRNL/ADS	SS	1125	36.31	OK	0.04
AL-001	West Valley	West Valley	Alfred University	1000	112.72	OK	0.00
AL-001	West Valley	West Valley	Alfred University	1050	70.24	OK	0.00
AL-001	West Valley	West Valley	Alfred University	1100	45.29	OK	0.00
AL-001	West Valley	West Valley	Alfred University	1150	30.22	OK	0.00
AL-001	West Valley	West Valley	Alfred University	1200	20.86	OK	0.00
AL-002	West Valley	West Valley	Alfred University	1000	123.03	OK	0.00
AL-002	West Valley	West Valley	Alfred University	1050	75.04	OK	0.00
AL-002	West Valley	West Valley	Alfred University	1100	47.07	OK	0.00
AL-002	West Valley	West Valley	Alfred University	1150	31.80	OK	0.00
AL-002	West Valley	West Valley	Alfred University	1200	24.25	OK	0.00
AL-004	West Valley	West Valley	Alfred University	1000	155.60	OK	0.00
AL-004	West Valley	West Valley	Alfred University	1050	91.77	OK	0.00
AL-004	West Valley	West Valley	Alfred University	1100	57.60	OK	0.00
AL-004	West Valley	West Valley	Alfred University	1150	38.47	OK	0.00
AL-004	West Valley	West Valley	Alfred University	1200	27.35	OK	0.00
AL-005	West Valley	West Valley	Alfred University	1000	181.97	OK	0.00
AL-005	West Valley	West Valley	Alfred University	1050	113.17	OK	0.00
AL-005	West Valley	West Valley	Alfred University	1100	73.19	OK	0.00
AL-005	West Valley	West Valley	Alfred University	1150	46.65	OK	0.00
AL-005	West Valley	West Valley	Alfred University	1200	27.77	OK	0.00
CR-001	West Valley	West Valley	Alfred University	1000	127.06	OK	0.00
CR-001	West Valley	West Valley	Alfred University	1050	78.03	OK	0.00
CR-001	West Valley	West Valley	Alfred University	1100	50.37	OK	0.00
CR-001	West Valley	West Valley	Alfred University	1150	34.18	OK	0.00
CR-001	West Valley	West Valley	Alfred University	1200	24.38	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
CR-002	West Valley	West Valley	Alfred University	1000	109.65	OK	0.00
CR-002	West Valley	West Valley	Alfred University	1050	69.86	OK	0.00
CR-002	West Valley	West Valley	Alfred University	1100	45.56	OK	0.00
CR-002	West Valley	West Valley	Alfred University	1150	31.77	OK	0.00
CR-002	West Valley	West Valley	Alfred University	1200	24.74	OK	0.00
CR-004	West Valley	West Valley	Alfred University	1000	120.23	OK	0.00
CR-004	West Valley	West Valley	Alfred University	1050	74.60	OK	0.00
CR-004	West Valley	West Valley	Alfred University	1100	49.60	OK	0.00
CR-004	West Valley	West Valley	Alfred University	1150	33.72	OK	0.00
CR-004	West Valley	West Valley	Alfred University	1200	22.37	OK	0.00
CR-005	West Valley	West Valley	Alfred University	1000	130.02	OK	0.00
CR-005	West Valley	West Valley	Alfred University	1050	78.97	OK	0.00
CR-005	West Valley	West Valley	Alfred University	1100	50.35	OK	0.00
CR-005	West Valley	West Valley	Alfred University	1150	33.71	OK	0.00
CR-005	West Valley	West Valley	Alfred University	1200	23.69	OK	0.00
FE-001	West Valley	West Valley	Alfred University	1000	147.57	OK	0.00
FE-001	West Valley	West Valley	Alfred University	1050	90.40	OK	0.00
FE-001	West Valley	West Valley	Alfred University	1100	58.05	OK	0.00
FE-001	West Valley	West Valley	Alfred University	1150	39.08	OK	0.00
FE-001	West Valley	West Valley	Alfred University	1200	27.58	OK	0.00
FE-002	West Valley	West Valley	Alfred University	1000	156.31	OK	0.00
FE-002	West Valley	West Valley	Alfred University	1050	92.98	OK	0.00
FE-002	West Valley	West Valley	Alfred University	1100	58.04	OK	0.00
FE-002	West Valley	West Valley	Alfred University	1150	38.02	OK	0.00
FE-002	West Valley	West Valley	Alfred University	1200	26.14	OK	0.00
FE-004	West Valley	West Valley	Alfred University	1000	112.20	OK	0.00
FE-004	West Valley	West Valley	Alfred University	1050	73.41	OK	0.00
FE-004	West Valley	West Valley	Alfred University	1100	48.62	OK	0.00
FE-004	West Valley	West Valley	Alfred University	1150	34.54	OK	0.00
FE-004	West Valley	West Valley	Alfred University	1200	27.88	OK	0.00
FE-005	West Valley	West Valley	Alfred University	1000	114.82	OK	0.00
FE-005	West Valley	West Valley	Alfred University	1050	73.02	OK	0.00
FE-005	West Valley	West Valley	Alfred University	1100	49.70	OK	0.00
FE-005	West Valley	West Valley	Alfred University	1150	34.22	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
FE-005	West Valley	West Valley	Alfred University	1200	22.52	OK	0.00
MN-001	West Valley	West Valley	Alfred University	1000	124.74	OK	0.00
MN-001	West Valley	West Valley	Alfred University	1050	80.81	OK	0.00
MN-001	West Valley	West Valley	Alfred University	1100	53.87	OK	0.00
MN-001	West Valley	West Valley	Alfred University	1150	37.63	OK	0.00
MN-001	West Valley	West Valley	Alfred University	1200	28.06	OK	0.00
MN-002	West Valley	West Valley	Alfred University	1000	133.66	OK	0.00
MN-002	West Valley	West Valley	Alfred University	1050	83.57	OK	0.00
MN-002	West Valley	West Valley	Alfred University	1100	54.57	OK	0.00
MN-002	West Valley	West Valley	Alfred University	1150	37.22	OK	0.00
MN-002	West Valley	West Valley	Alfred University	1200	26.51	OK	0.00
MN-004	West Valley	West Valley	Alfred University	1000	123.03	OK	0.00
MN-004	West Valley	West Valley	Alfred University	1050	77.52	OK	0.00
MN-004	West Valley	West Valley	Alfred University	1100	51.32	OK	0.00
MN-004	West Valley	West Valley	Alfred University	1150	35.03	OK	0.00
MN-004	West Valley	West Valley	Alfred University	1200	24.19	OK	0.00
MN-005	West Valley	West Valley	Alfred University	1000	113.24	OK	0.00
MN-005	West Valley	West Valley	Alfred University	1050	71.66	OK	0.00
MN-005	West Valley	West Valley	Alfred University	1100	47.26	OK	0.00
MN-005	West Valley	West Valley	Alfred University	1150	32.49	OK	0.00
MN-005	West Valley	West Valley	Alfred University	1200	23.28	OK	0.00
NI-001	West Valley	West Valley	Alfred University	1000	107.65	OK	0.00
NI-001	West Valley	West Valley	Alfred University	1050	69.05	OK	0.00
NI-001	West Valley	West Valley	Alfred University	1100	46.82	OK	0.00
NI-001	West Valley	West Valley	Alfred University	1150	33.87	OK	0.00
NI-001	West Valley	West Valley	Alfred University	1200	26.40	OK	0.00
NI-002	West Valley	West Valley	Alfred University	1000	131.83	OK	0.00
NI-002	West Valley	West Valley	Alfred University	1050	86.88	OK	0.00
NI-002	West Valley	West Valley	Alfred University	1100	56.64	OK	0.00
NI-002	West Valley	West Valley	Alfred University	1150	38.53	OK	0.00
NI-002	West Valley	West Valley	Alfred University	1200	28.85	OK	0.00
NI-004	West Valley	West Valley	Alfred University	1000	114.82	OK	0.00
NI-004	West Valley	West Valley	Alfred University	1050	72.71	OK	0.00
NI-004	West Valley	West Valley	Alfred University	1100	46.48	OK	0.00

Sample ID	Reference	Chemical Analysis Laboratory	Viscosity Measurement Laboratory	Temp (°C)	Viscosity (poise)	95<SOx<105	FeII/ΣFe
NI-004	West Valley	West Valley	Alfred University	1150	31.77	OK	0.00
NI-004	West Valley	West Valley	Alfred University	1200	24.62	OK	0.00
NI-005	West Valley	West Valley	Alfred University	1000	102.09	OK	0.00
NI-005	West Valley	West Valley	Alfred University	1050	66.14	OK	0.00
NI-005	West Valley	West Valley	Alfred University	1100	44.26	OK	0.00
NI-005	West Valley	West Valley	Alfred University	1150	30.60	OK	0.00
NI-005	West Valley	West Valley	Alfred University	1200	21.86	OK	0.00
P-001	West Valley	West Valley	Alfred University	1000	138.04	OK	0.00
P-001	West Valley	West Valley	Alfred University	1050	88.50	OK	0.00
P-001	West Valley	West Valley	Alfred University	1100	57.22	OK	0.00
P-001	West Valley	West Valley	Alfred University	1150	40.20	OK	0.00
P-001	West Valley	West Valley	Alfred University	1200	33.08	OK	0.00
P-002	West Valley	West Valley	Alfred University	1000	118.85	OK	0.00
P-002	West Valley	West Valley	Alfred University	1050	73.83	OK	0.00
P-002	West Valley	West Valley	Alfred University	1100	48.40	OK	0.00
P-002	West Valley	West Valley	Alfred University	1150	33.49	OK	0.00
P-002	West Valley	West Valley	Alfred University	1200	24.46	OK	0.00
P-004	West Valley	West Valley	Alfred University	1000	107.40	OK	0.00
P-004	West Valley	West Valley	Alfred University	1050	69.96	OK	0.00
P-004	West Valley	West Valley	Alfred University	1100	47.37	OK	0.00
P-004	West Valley	West Valley	Alfred University	1150	33.35	OK	0.00
P-004	West Valley	West Valley	Alfred University	1200	24.41	OK	0.00
P-005	West Valley	West Valley	Alfred University	1000	132.43	OK	0.00
P-005	West Valley	West Valley	Alfred University	1050	84.15	OK	0.00
P-005	West Valley	West Valley	Alfred University	1100	55.39	OK	0.00
P-005	West Valley	West Valley	Alfred University	1150	37.77	OK	0.00
P-005	West Valley	West Valley	Alfred University	1200	26.68	OK	0.00

Table BII. Validation Glass Composition Database (Oxide Wt%)

Sample ID	Al_2O_3	B_2O_3	BaO	CaO	CdO	Ce_2O_3	CoO	Cr_2O_3	Cs_2O	CuO	Cu_2O	FeO	Fe_2O_3	K_2O	La_2O_3	Li_2O	MgO	MnO	MoO_3	Na_2O	Nd_2O_3	NiO	P_2O_5	PbO	Pr_6O_{11}	Rh_2O_3	RuO_2	SO4	Sb_2O_3	SiO_2	Sm_2O_3	SrO	TiO_2	V_2O_5	Y_2O_3	ZnO	ZrO_2	Oxide Sum
WCP BATCH 1	4.88	7.78	0.15	1.22	0.00	0.00	0.00	0.11	0.06	0.20	0.18	0.00	12.84	3.33	0.00	4.43	1.42	1.72	0.11	9.00	0.15	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.20	0.00	0.00	0.68	0.00	0.00	0.00	0.10	99.31
WCP BATCH 2	4.63	7.88	0.16	1.08	0.00	0.00	0.00	0.13	0.02	0.21	0.19	0.00	11.12	3.38	0.00	4.50	1.42	1.41	0.17	9.21	0.26	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	52.10	0.00	0.00	0.69	0.00	0.00	0.00	0.17	99.63
WCP BATCH 3	3.44	7.69	0.18	0.99	0.00	0.00	0.00	0.14	0.06	0.20	0.18	0.00	11.71	3.40	0.00	4.51	1.42	1.53	0.12	9.01	0.17	1.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	52.60	0.00	0.00	0.68	0.00	0.00	0.00	0.12	99.20
WCP BATCH 4	3.43	8.14	0.25	0.84	0.00	0.00	0.00	0.14	0.09	0.23	0.20	0.00	11.71	3.86	0.00	4.29	1.43	2.54	0.20	9.16	0.39	1.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.10	0.00	0.00	1.03	0.00	0.00	0.00	0.22	99.31
WCP BLEND 1	4.16	8.05	0.18	1.03	0.00	0.00	0.00	0.13	0.08	0.22	0.20	0.00	10.91	3.68	0.00	4.44	1.41	1.67	0.15	9.13	0.22	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	51.90	0.00	0.00	0.89	0.00	0.00	0.00	0.14	99.48
WCP HM	7.15	7.03	0.11	1.01	0.00	0.00	0.00	0.09	0.06	0.13	0.11	0.00	7.78	2.21	0.00	4.62	1.49	1.75	0.22	8.56	0.55	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	55.80	0.00	0.00	0.56	0.00	0.00	0.00	0.33	99.97
WCP PUREX	2.99	10.33	0.20	1.09	0.00	0.00	0.00	0.15	0.06	0.21	0.19	0.00	13.25	3.41	0.00	3.22	1.41	1.69	0.08	12.62	0.06	1.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.50	0.00	0.00	0.68	0.00	0.00	0.00	0.05	99.38
EA	3.70	11.30	0.00	1.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.99	0.04	0.42	4.26	1.72	1.34	0.00	16.80	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.73	0.00	0.00	0.70	0.00	0.00	0.00	0.46	100.15
Wvcm-30	2.90	10.10	0.00	0.60	0.00	0.10	0.00	0.30	0.10	0.00	0.00	0.00	12.40	3.60	0.10	3.10	1.10	1.06	0.00	11.10	0.00	0.90	0.85	0.00	0.00	0.00	0.00	0.36	0.00	45.70	0.00	0.00	0.70	0.00	0.00	0.00	2.70	97.76
Wvcm-32	2.90	14.20	0.00	0.60	0.00	0.10	0.00	0.30	0.10	0.00	0.00	0.00	12.50	3.60	0.10	3.10	0.40	1.06	0.00	11.20	0.10	0.90	0.85	0.00	0.00	0.00	0.00	0.36	0.00	41.70	0.00	0.00	0.00	0.00	0.00	0.00	3.80	97.86
Wvcm-34	4.60	10.10	0.00	3.10	0.00	0.10	0.10	0.20	0.00	0.00	0.00	0.00	9.80	1.90	0.10	3.00	1.40	1.88	0.00	11.50	0.00	1.10	1.01	0.00	0.00	0.00	0.00	0.36	0.00	44.30	0.00	0.00	1.00	0.00	0.00	0.00	1.90	97.44
Wvuth-39	10.10	12.90	0.20	0.80	0.00	0.67	0.00	0.10	0.10	0.00	0.00	0.00	12.20	1.30	0.00	4.40	0.90	0.98	0.00	8.30	0.30	0.20	0.82	0.00	0.00	0.00	0.00	0.24	0.00	40.50	0.00	0.00	0.90	0.00	0.00	0.00	2.00	97.90
165W-Al	14.55	7.13	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.06	0.03	0.00	4.99	0.75	2.65	0.00	10.87	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	51.48	0.00	0.00	0.00	0.00	0.00	0.00	0.71	98.16
165W-Fe	0.81	7.02	0.00	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.71	0.03	0.00	4.91	0.73	0.97	0.00	11.07	0.00	3.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.28	0.00	0.00	0.00	0.00	0.00	0.00	0.70	98.56
165TDS-3A	3.25	7.02	0.00	1.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.19	0.04	0.00	4.91	0.74	3.31	0.00	10.21	0.00	1.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.73	0.00	0.00	0.00	0.00	0.00	0.00	0.70	97.98
154W-Al	14.55	7.77	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.06	0.03	0.00	4.49	0.53	2.65	0.00	11.44	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	51.19	0.00	0.00	0.00	0.00	0.00	0.00	0.50	98.16
155W-Al	14.55	8.06	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.06	0.03	0.57	4.63	1.32	2.65	0.00	15.36	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	98.16
156W-Al	14.55	7.42	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.06	0.03	0.00	2.99	0.53	2.65	0.00	14.37	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.34	0.00	0.00	1.35	0.00	0.00	0.00	0.00	98.23
157W-Al	14.55	9.91	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.06	0.03	0.00	4.49	0.53	2.65	0.00	14.94	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	44.63	0.00	0.00	1.35	0.00	0.00	0.00	0.00	98.09
131W-Al	14.55	10.48	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.06	0.03	0.36	4.06	1.46	2.65	0.00	14.22	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	44.28	0.00	0.00	0.71	0.00	0.00	0.00	0.36	98.16
153TDS-3A	3.25	7.02	0.00	1.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.19	0.04	0.00	3.16	1.44	3.31	0.00	10.56	0.00	1.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.02	0.00	0.00	1.40	0.00	0.00	0.00	0.70	97.98
153W-Al	14.55	7.13	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.06	0.03	0.00	3.21	1.46	2.65	0.00	11.23	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.76	0.00	0.00	1.43	0.00	0.00	0.00	0.71	98.16
21W-Al	14.55	7.13	0.00	3.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.06	0.03	0.00	2.85	0.03	2.65	0.00	14.79	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.43	0.00	0.00	7.13	0.00	0.00	0.00	0.00	98.16
165W-ST-1	4.93	6.94	0.00	1.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.70	0.02	0.00	4.86	0.72	2.87	0.00	9.13	0.00	1.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	51.63	0.00	0.00	0.00	0.00	0.00	0.00	0.69	97.15
165W-Al(35%)	17.75	6.50	0.00	0.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.95	0.04	0.00	4.55	0.69	3.23	0.00	10.41	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	47.85	0.00	0.00	0.00	0.00	0.00	0.00	0.65	97.76
164W-Al	14.55	7.13	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.06	0.03	0.00	4.99	0.75	2.65	0.00	10.87	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.76	0.00	0.00	0.00	0.00	0.00	0.00	1.43	98.16
131W-Fe	0.81	10.32	0.00	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.71	0.03	0.35	4.00	1.44	0.97	0.00	14.37	0.00	3.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43.19	0.00	0.00	0.70	0.00	0.00	0.00	0.35	98.56

Sample ID	Al_2O_3	B_2O_3	BaO	CaO	CdO	Ce_2O_3	CoO	Cr_2O_3	Cs_2O	CuO	Cu_2O	FeO	Fe_2O_3	K_2O	La_2O_3	Li_2O	MgO	MnO	MoO_3	Na_2O	Nd_2O_3	NiO	P_2O_5	PbO	Pr_6O_{11}	Rh_2O_3	RuO_2	SO4	Sb_2O_3	SiO_2	Sm_2O_3	SrO	TiO_2	V_2O_5	Y_2O_3	ZnO	ZrO_2	Oxide Sum
131TDS-3A	3.25	10.32	0.00	1.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.19	0.04	0.35	4.00	1.44	3.31	0.00	13.51	0.00	1.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43.64	0.00	0.00	0.70	0.00	0.00	0.00	0.35	97.98
131W-Al	14.55	10.48	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.06	0.03	0.36	4.06	1.46	2.65	0.00	14.22	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	44.28	0.00	0.00	0.71	0.00	0.00	0.00	0.36	98.16
CVS1-1	6.42	11.60	0.07	2.77	0.55	0.11	0.00	0.10	0.10	0.06	0.05	0.00	5.66	0.80	0.44	3.40	3.59	0.10	0.22	8.91	0.83	0.44	0.02	0.00	0.00	0.00	0.00	0.00	0.00	47.70	0.00	0.08	0.02	0.00	0.04	0.00	4.18	98.26
CVS1-2	15.00	5.11	0.02	10.20	0.00	0.03	0.00	0.02	0.03	0.01	0.01	0.00	2.03	0.40	0.12	6.15	0.00	0.03	0.05	5.04	0.21	0.13	0.01	0.00	0.00	0.00	0.00	0.00	0.00	52.00	0.00	0.02	0.00	0.00	0.01	0.00	0.90	97.52
CVS1-3	13.80	20.10	0.02	0.04	0.00	0.07	0.00	0.03	0.02	0.01	0.01	0.00	2.02	0.90	0.12	6.01	7.76	0.03	0.05	5.11	0.22	0.14	0.01	0.00	0.00	0.00	0.00	0.00	0.00	41.10	0.00	0.02	0.01	0.00	0.01	0.00	0.90	98.50
CVS1-4	0.00	20.00	0.02	2.04	0.00	0.03	0.00	0.03	0.03	0.02	0.01	0.00	2.10	0.50	0.12	0.86	7.91	0.03	0.06	8.93	0.21	0.14	0.01	0.00	0.00	0.00	0.00	0.00	0.00	54.60	0.00	0.02	0.00	0.00	0.01	0.00	0.05	97.70
CVS1-5	8.03	5.17	0.02	0.10	0.00	0.03	0.00	0.00	0.02	0.02	0.01	0.00	14.90	0.90	0.11	6.20	0.00	0.03	0.06	6.41	0.21	0.14	0.01	0.00	0.00	0.00	0.00	0.00	0.00	56.30	0.00	0.02	0.01	0.00	0.01	0.00	0.02	98.72
CVS1-6	0.09	19.20	0.16	0.12	1.30	0.26	0.00	0.22	0.25	0.13	0.11	0.00	1.90	0.70	1.00	6.16	0.00	0.22	0.50	5.37	1.88	0.94	0.06	0.00	0.00	0.00	0.00	0.59	0.00	41.50	0.00	0.17	0.03	0.00	0.09	0.00	11.60	95.09
CVS1-7	0.10	5.07	0.02	10.00	0.00	0.03	0.00	0.02	0.03	0.01	0.01	0.00	3.34	0.70	0.12	0.87	0.00	0.03	0.05	9.46	0.21	0.14	0.01	0.00	0.00	0.00	0.00	0.00	0.00	55.50	0.00	0.02	0.03	0.00	0.01	0.00	12.20	97.98
CVS1-8	0.09	5.27	0.02	0.03	0.00	0.03	0.00	0.03	0.03	0.02	0.01	0.00	15.20	0.60	0.11	0.92	8.07	0.03	0.06	7.80	0.21	0.15	0.01	0.00	0.00	0.00	0.00	0.00	0.00	54.50	0.00	0.02	0.02	0.00	0.01	0.00	6.96	100.20
CVS1-9	0.00	20.20	0.18	0.04	1.41	0.29	0.00	0.22	0.25	0.13	0.12	0.00	14.00	0.00	1.11	0.91	8.16	0.24	0.55	5.62	2.01	1.06	0.06	0.00	0.00	0.00	0.00	0.59	0.00	41.40	0.00	0.18	0.00	0.00	0.10	0.00	0.02	99.37
CVS1-10	12.10	8.48	0.18	0.05	1.18	0.29	0.00	0.24	0.24	0.13	0.12	0.00	2.06	0.50	1.12	0.87	0.00	0.23	0.51	9.24	2.01	1.05	0.06	0.00	0.00	0.00	0.00	0.59	0.00	56.50	0.00	0.18	0.01	0.00	0.10	0.00	0.02	98.59
CVS1-11	14.50	16.00	0.14	10.30	1.10	0.22	0.00	0.19	0.20	0.11	0.10	0.00	2.06	0.00	0.90	0.98	0.00	0.19	0.43	7.30	1.63	0.84	0.05	0.00	0.00	0.00	0.00	0.47	0.00	41.80	0.00	0.15	0.00	0.00	0.08	0.00	0.02	100.20
CVS1-12	0.00	18.10	0.02	10.20	0.00	0.03	0.00	0.03	0.02	0.02	0.01	0.00	14.90	0.00	0.12	7.03	0.00	0.03	0.05	7.61	0.20	0.14	0.01	0.00	0.00	0.00	0.00	0.00	0.00	41.70	0.00	0.03	0.00	0.00	0.01	0.00	0.01	100.28
CVS1-13	0.43	20.30	0.02	0.03	0.00	0.03	0.00	0.02	0.03	0.02	0.01	0.00	2.05	0.00	0.11	0.86	0.00	0.03	0.06	17.40	0.20	0.13	0.01	0.00	0.00	0.00	0.00	0.00	0.00	55.10	0.00	0.02	0.00	0.00	0.01	0.00	0.06	96.91
CVS1-14	2.40	19.60	0.02	0.02	0.00	0.03	0.00	0.02	0.02	0.01	0.01	0.00	1.94	0.60	0.11	0.93	0.00	0.03	0.05	18.50	0.20	0.13	0.01	0.00	0.00	0.00	0.00	0.00	0.00	40.40	0.00	0.02	0.03	0.00	0.01	0.00	12.30	97.37
CVS1-15	0.00	5.07	0.17	0.05	1.36	0.31	0.00	0.23	0.26	0.13	0.11	0.00	2.01	1.00	1.05	5.68	7.60	0.23	0.53	11.20	1.31	1.01	0.06	0.00	0.00	0.00	0.00	0.59	0.00	53.80	0.00	0.17	0.01	0.00	0.09	0.00	0.02	94.59
CVS1-16	14.30	5.09	0.02	0.04	0.00	0.03	0.00	0.02	0.03	0.01	0.01	0.00	8.51	0.70	0.11	0.85	7.71	0.03	0.05	17.40	0.21	0.14	0.01	0.00	0.00	0.00	0.00	0.00	0.00	42.30	0.00	0.02	0.00	0.00	0.01	0.00	0.02	97.61
CVS1-17	0.00	5.13	0.17	9.95	1.36	0.28	0.00	0.23	0.26	0.13	0.12	0.00	13.70	0.40	1.08	0.91	0.00	0.23	0.53	15.40	1.95	1.04	0.06	0.00	0.00	0.00	0.00	0.59	0.00	43.80	0.00	0.18	0.00	0.00	0.09	0.00	0.04	98.16
CVS1-19	6.36	11.50	0.07	2.89	0.56	0.13	0.00	0.10	0.10	0.05	0.05	0.00	5.59	0.80	0.44	3.45	3.55	0.10	0.22	9.64	0.81	0.43	0.02	0.00	0.00	0.00	0.00	0.00	0.00	47.60	0.00	0.07	0.02	0.00	0.04	0.00	4.00	98.60
CVS1-20	6.37	11.60	0.07	2.70	0.55	0.11	0.00	0.10	0.11	0.06	0.05	0.00	5.55	1.40	0.43	3.50	3.44	0.09	0.22	11.00	0.81	0.44	0.02	0.00	0.00	0.00	0.00	0.00	0.00	47.50	0.00	0.07	0.02	0.00	0.04	0.00	4.11	100.36
CVS1-21	0.74	20.10	0.02	2.14	0.00	0.03	0.00	0.04	0.03	0.02	0.01	0.00	2.07	0.00	0.13	0.86	7.95	0.03	0.06	8.55	0.21	0.14	0.01	0.00	0.00	0.00	0.00	0.00	0.00	55.40	0.00	0.02	0.00	0.00	0.01	0.00	0.02	98.56
CVS1-22	0.08	5.12	0.02	0.09	0.00	0.03	0.00	0.02	0.03	0.03	0.03	0.00	14.80	0.70	0.11	0.96	7.54	0.03	0.05	8.36	0.20	0.18	0.01	0.00	0.00	0.00	0.00	0.00	0.00	53.40	0.00	0.02	0.02	0.00	0.01	0.00	7.03	98.85
CVS1-23	4.34	9.45	0.07	2.94	0.52	0.10	0.00	0.09	0.10	0.05	0.05	0.00	11.40	0.90	0.41	2.96	0.78	0.09	0.21	9.43	0.76	0.40	0.02	0.00	0.00	0.00	0.00	0.00	0.00	51.40	0.00	0.07	0.01	0.00	0.04	0.00	0.64	97.23
CVS2-1	7.95	8.80	0.14	0.08	1.10	0.27	0.00	0.21	0.18	0.10	0.09	0.00	4.00	3.30	0.83	5.80	4.65	0.26	0.43	7.00	1.50	0.88	0.05	0.00	0.00	0.00	0.00	0.47	0.00	53.40	0.00	0.14	0.02	0.00	0.07	0.00	1.00	103.14
CVS2-2	10.65	7.05	0.04	6.90	0.00	0.12	0.00	0.07	0.06	0.04	0.03	0.00	4.25	1.50	0.27	5.30	0.00	0.11	0.13	7.80	0.48	0.31	0.01	0.00	0.00	0.00	0.00	0.00	0.00	51.00	0.00	0.05	0.04	0.00	0.02	0.00	2.80	99.02
CVS2-3	9.95	13.05	0.50	6.90	0.00	0.14	0.00	0.09	0.05	0.04	0.03	0.00	4.35	3.40	0.27	4.05	0.97	0.11	0.13	6.50	0.48	0.33	0.01	0.00	0.00	0.00	0.00	0.00	0.00	46.70	0.00	0.05	0.02	0.00	0.03	0.00	3.50	101.63
CVS2-4	5.95	10.90	0.04	7.00	0.00	0.10	0.00	0.08	0.04	0.03	0.03	0.00	3.85	0.67	0.25	4.65	0.00	0.18	0.13	6.30	0.46	0.30	0.01	0.00	0.00	0.00	0.00	0.00	0.00	55.30	0.00	0.05	0.03	0.00	0.02	0.00	1.00	97.38
CVS2-5	6.90	15.45	0.12	2.60	0.59	0.23	0.00	0.19	0.19	0.10	0.09	0.00	3.45	1.70	3.41	1.70	0.00	0.20	0.40	8.90	1.30	0.83	0.05	0.00	0.00	0.00	0.00	0.47	0.00	48.70	0.00	0.12	0.03	0.00	0.06	0.00	0.73	98.93
CVS2-6	1.55	6.90	0.11	6.80	0.82	0.20	0.00	0.16	0.16	0.08	0.07	0.00	11.25	1.00	0.64	3.50	0.47	0.22	0.32	6.30	1.20	0.68	0.04	0.00	0.00	0.00	0.00	0.00	0.00	53.90	0.00	0.11	0.01	0.00	0.06	0.00	0.95	97.48
CVS2-7	8.95	15.70	0.11	1.70	0.86	0.20	0.00	0.17	0.17	0.08	0.07	0.00	3.85	0.83	0.66	4.95	0.00	0.24	0.34	7.70	1.20	0.66	0.04	0.00	0.00	0.00	0.00	0.00	0.00	46.90	0.00	0.12	0.01	0.00	0.06	0.00	1.00	96.56
CVS2-8	5.80	6.95	0.04	0.14	0.00	0.10	0.00	0.08	0.07	0.04	0.03	0.00	10.65	1.90	0.25	5.40	4.45	0.15	0.13	9.00	0.47	0.78	0.01	0.00	0.00	0.00	0.00	0.00	0.00	49.40	0.00	0.05	0.03	0.00	0.02	0.00	0.49	96.42
CVS2-9	1.40	9.50	0.04	0.06	0.00	0.01	0.00	0.08	0.06	0.04	0.03	0.00	7.00	1.50	0.27	5.45	0.00	0.07	0.13	8.60	0.48	0.30	0.01	0.00	0.00	0.00	0.00	0.00	0.00	54.70	0.00	0.05	0.04	0.00	0.02	0.00	9.60	99.42

Sample ID	Al_2O_3	B_2O_3	BaO	CaO	CdO	Ce_2O_3	CoO	Cr_2O_3	Cs_2O	CuO	Cu_2O	FeO	Fe_2O_3	K_2O	La_2O_3	Li_2O	MgO	MnO	MoO_3	Na_2O	Nd_2O_3	NiO	P_2O_5	PbO	Pr_6O_{11}	Rh_2O_3	RuO_2	SO4	Sb_2O_3	SiO_2	Sm_2O_3	SrO	TiO_2	V_2O_5	Y_2O_3	ZnO	ZrO_2	Oxide Sum
CVS2-9A	1.40	9.50	0.04	0.06	0.00	0.01	0.00	0.08	0.06	0.04	0.03	0.00	7.00	1.50	0.27	5.45	0.00	0.07	0.13	8.60	0.48	0.30	0.01	0.00	0.00	0.00	0.00	0.00	0.00	54.70	0.00	0.05	0.04	0.00	0.02	0.00	9.60	99.42
CVS2-10	10.05	16.90	0.05	0.13	0.00	0.11	0.00	0.09	0.07	0.04	0.03	0.00	6.35	1.10	0.30	0.19	0.00	0.15	0.15	11.80	0.55	0.33	0.02	0.00	0.00	0.00	0.00	0.00	0.00	46.80	0.00	0.05	0.03	0.00	0.03	0.00	1.00	96.29
CVS2-11	1.04	7.45	0.11	6.80	0.84	0.22	0.00	0.02	0.18	0.09	0.08	0.00	3.95	0.45	0.66	5.50	1.11	0.25	0.34	9.10	1.20	0.69	0.04	0.00	0.00	0.00	0.00	0.00	0.00	49.10	0.00	0.12	0.03	0.00	0.06	0.00	8.70	98.12
CVS2-12	9.00	17.45	0.05	7.60	0.00	0.10	0.00	0.07	0.06	0.04	0.03	0.00	4.00	1.30	0.27	4.50	1.00	0.14	0.14	6.90	0.49	0.30	0.01	0.00	0.00	0.00	0.00	0.00	0.00	46.40	0.00	0.05	0.02	0.00	0.02	0.00	0.06	99.98
CVS2-13	8.95	7.10	0.05	3.20	0.00	0.12	0.00	0.01	0.05	0.04	0.03	0.00	4.05	3.70	0.28	2.15	4.80	0.18	0.14	16.20	0.49	0.31	0.01	0.00	0.00	0.00	0.00	0.00	0.00	50.50	0.00	0.05	0.03	0.00	0.03	0.00	0.10	102.55
CVS2-14	2.45	13.20	0.08	3.10	0.63	0.18	0.00	0.14	0.11	0.06	0.05	0.00	3.95	1.70	0.48	3.40	4.50	0.18	0.25	7.00	0.85	0.50	0.03	0.00	0.00	0.00	0.00	0.00	0.00	47.40	0.00	0.08	0.06	0.00	0.04	0.00	9.00	99.42
CVS2-15	7.45	7.75	0.13	5.50	0.99	0.24	0.00	0.18	0.17	0.10	0.09	0.00	3.80	0.79	0.79	2.05	0.00	0.29	0.40	14.40	1.50	0.82	0.05	0.00	0.00	0.00	0.00	0.47	0.00	47.40	0.00	0.14	0.03	0.00	0.07	0.00	1.00	97.01
CVS2-16	2.30	10.40	0.10	0.92	0.79	0.22	0.00	0.16	0.15	0.08	0.07	0.00	7.00	3.10	0.61	3.60	0.86	0.20	0.32	10.50	1.10	0.65	0.03	0.00	0.00	0.00	0.00	0.00	0.00	54.00	0.00	0.10	0.02	0.00	0.05	0.00	3.80	101.11
CVS2-16A	2.30	10.40	0.10	0.92	0.79	0.22	0.00	0.16	0.15	0.08	0.07	0.00	7.00	3.10	0.61	3.60	0.86	0.20	0.32	10.50	1.10	0.65	0.03	0.00	0.00	0.00	0.00	0.00	0.00	54.00	0.00	0.10	0.02	0.00	0.05	0.00	3.80	101.11
CVS2-17	6.15	11.35	0.07	3.00	0.56	0.17	0.00	0.13	0.10	0.05	0.04	0.00	5.50	1.80	0.42	3.30	3.30	0.15	0.22	8.90	0.79	0.45	0.02	0.00	0.00	0.00	0.00	0.00	0.00	48.10	0.00	0.07	0.03	0.00	0.04	0.00	4.10	98.81
CVS2-18	2.35	10.60	0.10	0.93	0.80	0.21	0.00	0.17	0.15	0.08	0.07	0.00	7.05	2.80	0.62	3.65	0.86	0.22	0.32	10.90	1.09	0.66	0.03	0.00	0.00	0.00	0.00	0.00	0.00	53.20	0.00	0.10	0.03	0.00	0.06	0.00	4.00	101.03
CVS2-19	3.00	10.10	0.23	1.08	0.64	0.09	0.00	0.10	0.02	0.11	0.10	0.00	6.10	0.00	2.12	3.44	0.81	0.20	0.28	11.60	0.70	0.63	0.03	0.00	0.00	0.00	0.00	0.53	0.00	51.10	0.00	0.00	0.10	0.00	0.00	0.48	3.97	97.75
CVS2-20	0.96	4.86	0.02	0.04	0.00	0.52	0.00	0.03	0.25	0.01	0.01	0.00	5.64	0.00	0.10	6.28	0.04	0.01	0.05	14.55	0.19	0.10	0.02	0.00	0.00	0.00	0.00	0.00	0.00	56.30	0.00	0.02	0.04	0.00	0.01	0.00	11.80	101.84
CVS2-21	6.69	12.90	0.02	0.05	0.00	0.02	0.00	0.03	0.03	0.02	0.01	0.00	1.90	0.00	0.10	6.46	7.05	0.03	0.05	8.47	0.21	0.10	0.01	0.00	0.00	0.00	0.00	0.00	0.00	54.95	0.00	0.02	0.01	0.00	0.01	0.00	0.00	99.13
CVS2-22	3.66	5.02	0.17	0.06	1.23	0.22	0.00	0.21	0.27	0.12	0.11	0.00	2.03	0.20	1.00	7.03	7.31	0.20	0.50	13.55	1.92	0.93	0.07	0.00	0.00	0.00	0.00	0.59	0.00	55.60	0.00	0.17	0.02	0.00	0.08	0.00	0.00	102.77
CVS2-23	5.61	5.08	0.02	7.60	0.00	0.01	0.00	0.03	0.04	0.01	0.01	0.00	1.88	0.00	0.09	0.81	0.04	0.03	0.05	22.65	0.16	0.10	0.01	0.00	0.00	0.00	0.00	0.00	0.00	54.85	0.00	0.02	0.01	0.00	0.01	0.00	0.00	99.10
CVS2-24	9.40	20.08	0.15	0.07	1.15	0.23	0.00	0.20	0.28	0.12	0.10	0.00	1.85	2.00	0.93	6.73	0.02	0.18	0.47	12.90	1.82	0.87	0.07	0.00	0.00	0.00	0.00	0.56	0.00	43.60	0.00	0.15	0.01	0.00	0.08	0.00	0.00	104.50
CVS2-25	0.40	4.96	0.09	7.65	0.72	0.12	0.00	0.12	0.19	0.07	0.06	0.00	14.15	0.00	0.58	6.63	0.07	0.10	0.30	12.95	1.17	0.54	0.03	0.00	0.00	0.00	0.00	0.00	0.00	49.03	0.00	0.10	0.01	0.00	0.05	0.00	0.00	100.07
CVS2-26	2.50	20.00	0.02	7.70	0.00	0.46	0.00	0.02	0.06	0.02	0.01	0.00	1.90	0.00	0.08	6.80	0.10	0.02	0.05	5.20	0.20	0.09	0.01	0.00	0.00	0.00	0.00	0.00	0.00	43.00	0.00	0.02	0.03	0.00	0.01	0.00	8.90	97.18
CVS2-27	7.64	4.92	0.02	0.05	0.00	0.02	0.00	0.03	0.03	0.01	0.01	0.00	1.90	0.00	0.09	1.68	7.15	0.02	0.05	23.35	0.17	0.09	0.01	0.00	0.00	0.00	0.00	0.00	0.00	53.33	0.00	0.02	0.07	0.00	0.01	0.00	0.00	100.65
CVS2-28	4.86	4.43	0.15	0.02	1.08	0.15	0.00	0.12	0.25	0.11	0.10	0.00	1.75	0.00	0.87	1.03	0.01	0.17	0.44	20.30	1.66	0.93	0.07	0.00	0.00	0.00	0.00	0.59	0.00	49.15	0.00	0.14	0.01	0.00	0.07	0.00	0.00	88.98
CVS2-29	0.05	20.18	0.17	7.58	1.31	0.62	0.00	0.21	0.28	0.13	0.11	0.00	1.88	0.00	1.01	0.82	0.07	0.21	0.51	10.80	2.12	0.93	0.07	0.00	0.00	0.00	0.00	0.59	0.00	41.70	0.00	0.17	0.03	0.00	0.09	0.00	7.36	99.50
CVS2-30	4.35	19.60	0.02	0.01	0.00	0.02	0.00	0.03	0.03	0.01	0.01	0.00	12.18	0.00	0.09	0.84	0.01	0.01	0.05	12.50	0.15	0.09	0.01	0.00	0.00	0.00	0.00	0.00	0.00	49.15	0.00	0.02	0.01	0.00	0.01	0.00	0.00	99.17
CVS2-31	5.14	18.95	0.02	7.57	0.00	0.02	0.00	0.01	0.05	0.02	0.01	0.00	1.93	0.00	0.10	2.95	0.07	0.03	0.05	9.01	0.21	0.10	0.01	0.00	0.00	0.00	0.00	0.00	0.00	54.15	0.00	0.02	0.02	0.00	0.01	0.00	0.00	100.44
CVS2-32	0.27	4.91	0.02	0.05	0.00	0.52	0.00	0.02	0.03	0.01	0.01	0.00	1.94	0.00	0.10	4.12	0.04	0.02	0.05	24.45	0.18	0.09	0.03	0.00	0.00	0.00	0.00	0.00	0.00	53.83	0.00	0.02	0.03	0.00	0.01	0.00	12.25	102.97
CVS2-33	8.75	5.40	0.17	0.05	1.25	0.28	0.00	0.21	0.28	0.13	0.11	0.00	1.90	0.00	1.01	3.50	7.10	0.19	0.44	22.00	2.10	0.92	0.03	0.00	0.00	0.00	0.00	0.59	0.00	41.00	0.00	0.17	0.01	0.00	0.08	0.00	0.00	98.21
CVS2-34	13.50	17.00	0.02	0.05	0.00	0.02	0.00	0.02	0.06	0.02	0.01	0.00	1.95	0.00	0.11	3.50	0.02	0.02	0.05	21.00	0.20	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	0.00	0.02	0.01	0.00	0.00	0.00	0.09	97.75
CVS2-35	13.05	4.93	0.02	7.76	0.00	0.02	0.00	0.02	0.02	0.01	0.01	0.00	5.97	0.00	0.09	4.20	0.06	0.01	0.05	24.50	0.19	0.09	0.01	0.00	0.00	0.00	0.00	0.00	0.00	39.78	0.00	0.02	0.01	0.00	0.01	0.00	0.00	100.80
CVS2-36	0.88	4.97	0.02	7.80	0.00	0.02	0.00	0.02	0.02	0.01	0.01	0.00	14.43	0.00	0.09	6.92	0.05	0.02	0.05	13.95	0.20	0.09	0.01	0.00	0.00	0.00	0.00	0.00	0.00	53.38	0.00	0.02	0.02	0.00	0.01	0.00	0.00	102.96
CVS2-37	13.58	8.30	0.02	0.02	0.00	0.01	0.00	0.03	0.03	0.01	0.01	0.00	1.90	0.00	0.09	6.42	0.00	0.03	0.05	14.05	0.17	0.09	0.01	0.00	0.00	0.00	0.00	0.00	0.00	55.08	0.00	0.02	0.01	0.00	0.01	0.00	0.00	99.92
CVS2-38	2.73	11.00	0.02	0.02	0.00	0.02	0.00	0.03	0.03	0.01	0.01	0.00	13.38	0.00	0.10	0.85	7.06	0.02	0.05	14.35	0.19	0.10	0.01	0.00	0.00	0.00	0.00	0.00	0.00	50.05	0.00	0.02	0.02	0.00	0.01	0.00	0.00	100.07
CVS2-39	2.47	4.83	0.02	0.05	0.00	0.31	0.00	0.02	0.04	0.01	0.01	0.00	6.75	0.00	0.08	6.43	6.90	0.01	0.05	17.25	0.17	0.09	0.02	0.00	0.00	0.00	0.00	0.00	0.00	45.51	0.00	0.02	0.02	0.00	0.01	0.00	6.01	97.06
CVS2-40	9.70	6.30	0.05	1.90	0.00	0.18	0.00	0.07	0.10	0.04	0.03	0.00	1.90	0.00	0.29	4.00	4.40	0.06	0.14	16.60	0.63	0.28	0.02	0.00	0.00	0.00	0.00	0.00	0.00	49.00	0.00	0.05	0.01	0.00	0.01	0.00	1.60	97.35

Sample ID	Al_2O_3	B_2O_3	BaO	CaO	CdO	Ce_2O_3	CoO	Cr_2O_3	Cs_2O	CuO	Cu_2O	FeO	Fe_2O_3	K_2O	La_2O_3	Li_2O	MgO	MnO	MoO_3	Na_2O	Nd_2O_3	NiO	P_2O_5	PbO	Pr_6O_{11}	Rh_2O_3	RuO_2	SO4	Sb_2O_3	SiO_2	Sm_2O_3	SrO	TiO_2	V_2O_5	Y_2O_3	ZnO	ZrO_2	Oxide Sum
CVS2-41	9.70	6.80	0.52	4.80	0.00	0.18	0.00	0.06	0.11	0.04	0.04	0.00	2.85	0.00	0.33	6.60	1.80	0.05	0.15	12.00	0.69	0.30	0.02	0.00	0.00	0.00	0.00	0.00	0.00	51.00	0.00	0.06	0.01	0.00	0.02	0.00	1.70	99.83
CVS2-42	2.90	4.90	0.50	3.10	0.00	0.13	0.00	0.06	0.09	0.04	0.03	0.00	9.30	0.00	0.30	6.60	3.35	0.06	0.14	6.60	0.60	0.29	0.02	0.00	0.00	0.00	0.00	0.00	0.00	55.00	0.00	0.05	0.01	0.00	0.02	0.00	1.70	95.79
CVS2-43	4.77	14.18	0.05	2.09	0.00	0.37	0.00	0.07	0.12	0.04	0.04	0.00	2.83	0.00	0.28	5.93	2.66	0.07	0.14	8.09	0.60	0.30	0.03	0.00	0.00	0.00	0.00	0.00	0.00	48.70	0.00	0.05	0.03	0.00	0.03	0.00	6.10	97.53
CVS2-44	6.10	10.50	0.05	4.70	0.00	0.17	0.00	0.06	0.10	0.04	0.03	0.00	1.90	0.00	0.29	6.50	1.75	0.06	0.14	5.30	0.61	0.29	0.02	0.00	0.00	0.00	0.00	0.00	0.00	49.00	0.00	0.05	0.02	0.00	0.02	0.00	1.60	89.30
CVS2-45	5.75	11.00	0.12	1.90	0.87	0.29	0.00	0.14	0.22	0.09	0.08	0.00	2.90	0.00	0.71	5.60	4.45	0.13	0.35	5.20	1.45	0.65	0.03	0.00	0.00	0.00	0.00	0.00	0.00	47.00	0.00	0.12	0.01	0.00	0.06	0.00	1.70	90.82
CVS2-46	7.21	12.25	0.11	1.96	0.81	0.22	0.00	0.14	0.24	0.08	0.07	0.00	1.94	0.00	0.66	6.32	1.81	0.15	0.34	9.27	1.35	0.65	0.03	0.00	0.00	0.00	0.00	0.00	0.00	50.60	0.00	0.11	0.02	0.00	0.06	0.00	1.50	97.89
CVS2-47	3.90	4.95	0.15	4.90	0.88	0.39	0.00	0.17	0.20	0.09	0.08	0.00	1.90	0.00	0.69	4.00	1.75	0.15	0.35	13.00	1.45	0.65	0.05	0.00	0.00	0.00	0.00	0.00	0.00	52.00	0.00	0.12	0.02	0.00	0.06	0.00	4.40	96.28
CVS2-48	8.35	13.00	0.09	4.90	0.69	0.15	0.00	0.11	0.17	0.07	0.06	0.00	1.90	0.00	0.57	3.80	1.75	0.12	0.29	11.00	1.10	0.51	0.03	0.00	0.00	0.00	0.00	0.00	0.00	46.00	0.00	0.09	0.01	0.00	0.03	0.00	1.70	96.49
CVS2-49	7.63	13.25	0.05	1.91	0.00	0.17	0.00	0.01	0.11	0.04	0.04	0.00	4.94	0.00	0.31	3.68	1.76	0.07	0.15	12.80	0.62	0.31	0.02	0.00	0.00	0.00	0.00	0.00	0.00	48.00	0.00	0.05	0.01	0.00	0.03	0.00	1.67	97.62
CVS2-50	6.25	11.50	0.06	2.70	0.51	0.29	0.00	0.08	0.12	0.01	0.00	0.00	5.35	0.00	0.38	3.70	3.17	0.08	0.21	11.00	0.81	0.37	0.02	0.00	0.00	0.00	0.00	0.00	0.00	44.00	0.00	0.07	0.02	0.00	0.04	0.00	3.70	94.41
CVS2-51	2.85	9.75	0.22	0.99	0.59	0.20	0.00	0.10	0.16	0.09	0.08	0.00	5.70	0.00	2.05	3.20	0.72	0.17	0.28	12.00	0.64	0.59	0.05	0.00	0.00	0.00	0.00	0.53	0.00	46.00	0.00	0.00	0.11	0.00	0.00	0.43	3.40	91.08
CVS2-52	2.60	8.75	0.11	0.12	0.74	0.15	0.00	0.13	0.16	0.08	0.07	0.00	7.55	0.00	0.61	8.30	0.01	0.13	0.32	6.80	1.30	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	58.00	0.00	0.11	0.02	0.00	0.05	0.00	3.90	100.04
CVS2-55	2.70	11.50	0.00	0.69	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.00	7.65	0.00	0.00	4.05	0.71	2.04	0.00	11.00	1.70	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	52.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	95.54
CVS2-56	2.60	11.00	0.00	0.66	0.00	0.01	0.00	0.66	0.00	0.33	0.30	0.00	7.60	0.00	0.00	4.05	0.69	3.14	0.00	9.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	50.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	91.12
CVS2-57	2.50	11.00	0.00	0.67	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.00	7.55	0.00	0.00	3.85	0.68	0.00	0.00	10.00	5.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	91.10
CVS2-58	15.00	20.50	0.02	1.90	0.00	0.02	0.00	0.02	0.03	0.01	0.01	0.00	2.10	0.00	0.10	7.15	7.55	0.02	0.05	6.70	0.20	0.07	0.01	0.00	0.00	0.00	0.00	0.00	0.00	36.00	0.00	0.02	0.01	0.00	0.01	0.00	0.86	98.36
CVS2-59	10.55	16.20	0.02	3.31	0.00	0.03	0.00	0.03	0.03	0.01	0.01	0.00	1.73	0.00	0.10	6.58	0.08	0.03	0.06	11.40	0.20	0.29	0.01	0.00	0.00	0.00	0.00	0.00	0.00	39.80	0.00	0.02	0.02	0.00	0.01	0.00	0.64	91.14
CVS2-70	16.70	13.35	0.00	0.08	0.00	0.09	0.00	1.06	0.00	0.08	0.07	0.00	0.64	0.00	0.04	6.23	0.08	0.27	0.00	7.46	0.04	0.08	0.02	0.20	0.00	0.00	0.00	0.00	0.00	44.60	0.00	0.00	0.01	0.00	0.00	0.00	0.06	91.16
CVS2-74	7.40	7.51	0.15	0.70	1.04	0.20	0.00	0.19	0.25	0.11	0.10	0.00	2.93	0.00	0.84	6.38	0.27	0.18	0.44	6.23	1.70	0.81	0.07	0.00	0.00	0.00	0.00	0.54	0.00	51.65	0.00	0.15	0.02	0.00	0.07	0.00	0.08	90.43
CVS2-79	2.00	15.65	0.15	0.46	1.06	0.20	0.00	0.19	0.24	0.11	0.10	0.00	9.99	0.00	0.86	1.15	0.44	0.19	0.45	4.75	1.74	0.85	0.05	0.00	0.00	0.00	0.00	0.53	0.00	52.40	0.00	0.15	0.02	0.00	0.07	0.00	0.48	94.76
CVS2-91	1.85	15.45	0.15	0.44	1.02	0.20	0.00	0.19	0.24	0.11	0.10	0.00	0.36	0.00	0.83	0.91	3.42	0.18	0.43	9.99	1.67	0.81	0.07	0.00	0.00	0.00	0.00	0.53	0.00	48.95	0.00	0.14	0.02	0.00	0.07	0.00	0.50	89.10
CVS2-95	3.39	10.55	0.06	1.07	0.00	0.08	0.00	0.07	0.08	0.04	0.04	0.00	8.33	0.00	0.35	4.07	1.40	1.02	0.17	16.00	0.69	0.55	0.02	0.00	0.00	0.00	0.00	0.00	0.00	46.30	0.00	0.06	0.65	0.00	0.03	0.00	0.36	95.34
CVS2-96	5.97	11.20	0.07	2.47	0.47	0.10	0.00	0.09	0.11	0.05	0.04	0.00	5.27	0.00	0.39	3.47	3.17	0.09	0.20	9.94	0.77	0.36	0.02	0.00	0.00	0.00	0.00	0.00	0.00	44.60	0.00	0.07	0.03	0.00	0.03	0.00	3.98	92.95
CVS2-97	2.87	9.94	0.23	0.98	0.60	0.00	0.00	0.11	0.15	0.10	0.09	0.00	5.90	0.00	1.96	3.28	0.77	0.19	0.29	11.40	0.65	0.60	0.05	0.00	0.00	0.00	0.00	0.53	0.00	48.50	0.00	0.00	0.11	0.00	0.00	0.48	3.67	93.65
CVS2-98	12.75	16.45	0.02	0.08	0.00	0.03	0.00	0.03	0.03	0.02	0.01	0.00	1.72	0.00	0.07	3.33	0.00	0.02	0.05	18.40	0.15	0.08	0.01	0.00	0.00	0.00	0.00	0.00	0.00	38.40	0.00	0.01	0.01	0.00	0.01	0.00	0.01	91.69
HANFORD-294	2.71	11.43	0.07	0.52	0.00	0.00	0.00	0.36	0.00	0.05	0.04	0.05	8.74	0.59	0.25	4.46	0.47	0.93	0.12	7.56	0.00	0.79	0.04	0.16	0.00	0.00	0.00	0.00	0.00	51.68	0.00	0.03	0.16	0.00	0.00	0.26	1.48	92.94
HANFORD-353	2.81	12.65	0.06	0.48	0.00	0.00	0.00	0.38	0.00	0.04	0.03	0.00	8.54	0.39	0.23	4.73	0.36	0.78	0.15	7.61	0.00	0.87	0.03	0.17	0.00	0.00	0.00	0.00	0.00	51.73	0.00	0.03	0.16	0.00	0.00	0.29	3.38	95.90
HANFORD-423	2.82	13.14	0.06	0.41	0.00	0.00	0.00	0.45	0.00	0.04	0.03	0.00	7.94	0.27	0.21	4.83	0.27	0.66	0.16	7.77	0.00	0.81	0.02	0.17	0.00	0.00	0.00	0.00	0.00	52.39	0.00	0.03	0.14	0.00	0.00	0.29	3.66	96.57
PX1-1A-4643	5.23	7.29	0.19	1.46	0.00	0.00	0.00	0.46	0.00	0.09	0.08	0.00	10.51	2.88	0.00	4.28	1.46	3.10	0.00	9.73	0.00	1.59	0.00	0.17	0.00	0.00	0.00	0.00	0.00	49.14	0.00	0.03	0.17	0.00	0.00	0.16	0.08	98.09
PX1-2A-4726	4.96	7.36	0.20	1.50	0.00	0.00	0.00	0.55	0.00	0.17	0.15	0.00	11.17	3.03	0.00	4.34	1.44	3.26	0.00	10.02	0.00	1.71	0.00	0.19	0.00	0.00	0.00	0.00	0.00	50.58	0.00	0.03	0.37	0.00	0.00	0.17	0.07	101.27
PX1-3A-4778	4.34	7.25	0.18	1.33	0.00	0.00	0.00	0.52	0.00	0.15	0.13	0.00	9.96	2.77	0.00	4.49	1.47	2.84	0.00	9.55	0.00	1.57	0.00	0.16	0.00	0.00	0.00	0.00	0.00	52.42	0.00	0.02	0.35	0.00	0.00	0.17	0.08	99.75

Sample ID	Al_2O_3	B_2O_3	BaO	CaO	CdO	Ce_2O_3	CoO	Cr_2O_3	Cs_2O	CuO	Cu_2O	FeO	Fe_2O_3	K_2O	La_2O_3	Li_2O	MgO	MnO	MoO_3	Na_2O	Nd_2O_3	NiO	P_2O_5	PbO	Pr_6O_{11}	Rh_2O_3	RuO_2	SO4	Sb_2O_3	SiO_2	Sm_2O_3	SrO	TiO_2	V_2O_5	Y_2O_3	ZnO	ZrO_2	Oxide Sum
PX2-1A-4455	8.52	6.87	0.09	0.79	0.00	0.00	0.00	0.39	0.00	0.08	0.07	0.00	9.52	2.15	0.00	4.33	1.59	2.84	0.00	10.45	0.00	0.64	0.00	0.03	0.00	0.00	0.00	0.00	0.00	51.86	0.00	0.14	0.10	0.00	0.00	0.10	0.06	100.62
PX2-2A-4509	6.97	7.19	0.14	1.14	0.00	0.00	0.00	0.45	0.00	0.12	0.10	0.00	10.99	2.48	0.00	4.32	1.56	3.04	0.00	9.55	0.00	1.18	0.00	0.11	0.00	0.00	0.00	0.00	0.00	50.20	0.00	0.08	0.17	0.00	0.00	0.13	0.06	99.98
PX2-3-4570	5.99	7.40	0.18	1.45	0.00	0.00	0.00	0.46	0.00	0.14	0.13	0.00	10.90	3.02	0.00	4.29	1.51	3.24	0.00	9.84	0.00	1.51	0.00	0.15	0.00	0.00	0.00	0.00	0.00	48.86	0.00	0.05	0.22	0.00	0.00	0.15	0.07	99.56
PX2-3A-4565	5.99	7.40	0.18	1.45	0.00	0.00	0.00	0.46	0.00	0.14	0.13	0.00	10.90	3.02	0.00	4.29	1.51	3.24	0.00	9.84	0.00	1.51	0.00	0.15	0.00	0.00	0.00	0.00	0.00	48.86	0.00	0.05	0.22	0.00	0.00	0.15	0.07	99.56
PX3-1A-5780	4.23	8.21	0.06	0.68	0.00	0.00	0.00	0.35	0.00	0.08	0.08	0.00	9.08	2.41	0.00	4.80	1.43	1.73	0.01	8.81	0.00	0.74	0.00	0.05	0.00	0.00	0.00	0.00	0.00	59.68	0.00	0.05	0.24	0.00	0.00	0.11	0.73	103.57
PX3-2A-5818	3.92	8.06	0.07	0.74	0.00	0.00	0.00	0.36	0.00	0.11	0.09	0.00	9.99	2.32	0.01	4.86	1.49	1.75	0.01	8.56	0.00	0.81	0.01	0.07	0.00	0.00	0.00	0.00	0.00	60.39	0.00	0.04	0.24	0.00	0.00	0.12	0.72	104.75
PX3-3A-5880	2.94	6.90	0.06	0.69	0.00	0.00	0.00	0.29	0.00	0.10	0.09	0.00	9.38	2.16	0.00	4.49	1.41	1.56	0.01	8.40	0.00	0.80	0.00	0.07	0.00	0.00	0.00	0.00	0.00	54.25	0.00	0.02	0.19	0.00	0.00	0.13	0.85	94.78
PX4-1A-6390	2.81	7.89	0.08	0.81	0.00	0.00	0.00	0.35	0.00	0.15	0.13	0.00	10.26	2.59	0.00	4.83	1.63	1.66	0.01	8.66	0.00	0.92	0.02	0.10	0.00	0.00	0.00	0.00	0.00	52.29	0.00	0.02	0.25	0.00	0.00	0.12	0.82	96.40
PX4-2A-6433	2.57	8.01	0.08	0.90	0.00	0.00	0.00	0.35	0.00	0.17	0.15	0.00	10.55	2.74	0.00	4.78	1.66	1.68	0.01	8.67	0.00	0.97	0.02	0.11	0.00	0.00	0.00	0.00	0.00	53.14	0.00	0.02	0.27	0.00	0.00	0.12	0.81	97.77
PX4-3A-6460	2.56	8.07	0.08	0.88	0.00	0.00	0.00	0.38	0.00	0.18	0.16	0.03	10.57	2.66	0.00	4.83	1.69	1.69	0.01	8.31	0.00	0.99	0.02	0.11	0.00	0.00	0.00	0.00	0.00	53.36	0.00	0.02	0.28	0.00	0.00	0.12	0.77	97.77
HM1-2-3829	6.00	6.62	0.10	0.90	0.00	0.00	0.00	0.23	0.00	0.07	0.06	0.18	10.73	1.66	0.00	4.45	1.60	2.54	0.00	9.29	0.00	0.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	52.13	0.00	0.00	0.10	0.00	0.00	0.00	0.04	97.47
HM1-4-3855	6.50	6.49	0.10	0.84	0.00	0.00	0.00	0.22	0.00	0.07	0.06	0.21	9.71	1.36	0.00	4.52	1.62	2.63	0.00	10.01	0.00	0.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	52.90	0.00	0.00	0.09	0.00	0.00	0.00	0.02	98.03
HM2-1A-3979	7.66	6.77	0.09	0.76	0.00	0.00	0.00	0.51	0.00	0.07	0.06	0.00	10.12	1.62	0.00	4.48	1.57	2.79	0.00	10.38	0.00	0.70	0.00	0.05	0.00	0.00	0.00	0.00	0.00	53.96	0.00	0.15	0.09	0.00	0.00	0.10	0.08	102.01
HM2-2A-4099	7.82	6.78	0.09	0.73	0.00	0.00	0.00	0.47	0.00	0.08	0.07	0.00	10.08	1.85	0.00	4.43	1.54	2.80	0.00	10.56	0.00	0.67	0.00	0.06	0.00	0.00	0.00	0.00	0.00	53.28	0.00	0.16	0.12	0.00	0.00	0.10	0.06	101.75
HM2-3A-4120	7.54	6.80	0.09	0.71	0.00	0.00	0.00	0.39	0.00	0.07	0.06	0.00	9.46	1.95	0.00	4.67	1.55	2.68	0.00	10.60	0.00	0.61	0.00	0.05	0.00	0.00	0.00	0.00	0.00	53.11	0.00	0.15	0.11	0.00	0.00	0.09	0.07	100.76
HM3-1A-4174	7.49	6.25	0.08	0.66	0.00	0.00	0.00	0.38	0.00	0.07	0.06	0.00	9.20	2.11	0.00	4.02	1.44	2.48	0.00	10.48	0.00	0.56	0.00	0.04	0.00	0.00	0.00	0.00	0.00	51.11	0.00	0.14	0.10	0.00	0.00	0.08	0.05	96.80
HM3-2A-4224	8.38	6.53	0.08	0.72	0.00	0.00	0.00	0.38	0.00	0.08	0.07	0.00	9.76	2.17	0.00	4.16	1.51	2.73	0.00	10.32	0.00	0.57	0.00	0.05	0.00	0.00	0.00	0.00	0.00	49.73	0.00	0.15	0.10	0.00	0.00	0.09	0.05	97.63
HM3-3A-4356	8.96	6.61	0.09	0.77	0.00	0.00	0.00	0.41	0.00	0.08	0.07	0.00	10.27	2.23	0.00	4.15	1.55	2.90	0.00	9.95	0.00	0.59	0.00	0.04	0.00	0.00	0.00	0.00	0.00	49.60	0.00	0.15	0.10	0.00	0.00	0.08	0.07	98.67
HM4-1A-5258	5.33	10.05	0.06	0.50	0.00	0.00	0.00	0.45	0.00	0.06	0.05	0.00	8.54	2.37	0.00	4.50	0.90	1.51	0.07	9.55	0.00	0.62	0.00	0.10	0.00	0.00	0.00	0.00	0.00	54.62	0.00	0.08	0.26	0.00	0.00	0.12	1.20	100.94
HM4-1-5260	5.33	10.05	0.06	0.50	0.00	0.00	0.00	0.45	0.00	0.06	0.05	0.00	8.54	2.37	0.00	4.50	0.90	1.51	0.07	9.55	0.00	0.62	0.00	0.10	0.00	0.00	0.00	0.00	0.00	54.62	0.00	0.08	0.26	0.00	0.00	0.12	1.20	100.94
HM4-2A-5641	6.48	9.52	0.05	0.51	0.00	0.00	0.00	0.69	0.00	0.11	0.09	0.00	8.23	2.80	0.02	4.47	1.09	1.72	0.04	9.62	0.00	1.01	0.01	0.07	0.00	0.00	0.00	0.00	0.00	55.94	0.00	0.09	0.27	0.00	0.00	0.11	0.71	103.65
HM4-3A-5748	5.87	9.12	0.05	0.51	0.00	0.00	0.00	0.39	0.00	0.08	0.08	0.00	7.53	2.89	0.00	4.59	1.21	1.72	0.02	9.68	0.00	0.54	0.00	0.03	0.00	0.00	0.00	0.00	0.00	58.35	0.00	0.09	0.27	0.00	0.00	0.11	0.46	103.60
HM4-3A-5748	5.87	9.12	0.05	0.51	0.00	0.00	0.00	0.39	0.00	0.08	0.08	0.00	7.53	2.89	0.00	4.59	1.21	1.72	0.02	9.68	0.00	0.54	0.00	0.03	0.00	0.00	0.00	0.00	0.00	58.35	0.00	0.09	0.27	0.00	0.00	0.11	0.46	103.60
SGM6-3,1T-1	4.27	10.11	0.00	1.59	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.82	11.94	1.83	0.00	3.04	1.12	0.21	0.00	11.61	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.39	0.00	0.03	0.65	0.00	0.00	0.00	0.13	94.65
SGM6-3,2B-1	4.03	9.34	0.00	1.15	0.00	0.00	0.00	0.04	0.00	0.00	0.00	1.05	12.43	2.07	0.00	2.92	1.00	1.89	0.00	12.71	0.00	1.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.07	0.00	0.03	0.55	0.00	0.00	0.00	0.00	98.49
SGM6-	4.29	10.02	0.00	1.51	0.00	0.00	0.00	0.10	0.00	0.00	0.00	1.26	11.61	2.17	0.00	2.95	1.16	0.20	0.00	12.93	0.00	1.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	47.40	0.00	0.03	0.69	0.00	0.00	0.00	0.09	97.50

Sample ID	Al_2O_3	B_2O_3	BaO	CaO	CdO	Ce_2O_3	CoO	Cr_2O_3	Cs_2O	CuO	Cu_2O	FeO	Fe_2O_3	K_2O	La_2O_3	Li_2O	MgO	MnO	MoO_3	Na_2O	Nd_2O_3	NiO	P_2O_5	PbO	Pr_6O_{11}	Rh_2O_3	RuO_2	SO4	Sb_2O_3	SiO_2	Sm_2O_3	SrO	TiO_2	V_2O_5	Y_2O_3	ZnO	ZrO_2	Oxide Sum
3,2T-1																																						
SGM6-3,2T-2	4.25	10.14	0.00	1.50	0.00	0.00	0.00	0.09	0.00	0.00	0.00	1.62	11.43	2.19	0.00	2.97	1.17	0.20	0.00	12.86	0.00	1.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.61	0.00	0.03	0.70	0.00	0.00	0.00	0.08	96.97
SGM6-3,2T-3	4.28	10.03	0.00	1.49	0.00	0.00	0.00	0.11	0.00	0.00	0.00	1.03	11.72	2.25	0.00	2.94	1.18	0.19	0.00	12.85	0.00	1.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.35	0.00	0.03	0.69	0.00	0.00	0.00	0.09	96.33
SGM6-3,2T-4	4.26	10.09	0.00	1.51	0.00	0.00	0.00	0.09	0.00	0.00	0.00	1.48	11.15	2.22	0.00	2.96	1.19	0.20	0.00	12.56	0.00	1.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.54	0.00	0.03	0.70	0.00	0.00	0.00	0.09	96.32
SGM6-3,3B	4.29	9.05	0.00	1.40	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.82	12.43	2.49	0.00	2.78	1.09	1.81	0.00	12.31	0.00	1.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	44.71	0.00	0.04	0.65	0.00	0.00	0.00	0.00	95.07
SGM6-3,3T-1	4.25	10.08	0.00	1.49	0.00	0.00	0.00	0.10	0.00	0.00	0.00	1.10	12.21	2.34	0.00	2.91	1.20	0.19	0.00	12.90	0.00	1.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.40	0.00	0.04	0.72	0.00	0.00	0.00	0.06	97.37
SGM6-3,4B-1	4.25	9.02	0.00	1.37	0.00	0.00	0.00	0.12	0.00	0.00	0.00	1.07	12.17	2.10	0.00	2.73	1.11	1.78	0.00	12.50	0.00	1.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.18	0.00	0.04	0.67	0.00	0.00	0.00	0.00	95.18
SGM6-3,4T-1	4.16	9.58	0.00	1.49	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.91	11.46	2.26	0.00	2.84	1.20	0.19	0.00	12.27	0.00	1.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.31	0.00	0.04	0.72	0.00	0.00	0.00	0.05	93.89
SGM6-3,4T-2	4.19	9.49	0.00	1.19	0.00	0.00	0.00	0.02	0.00	0.00	0.00	1.62	12.20	2.43	0.00	2.84	1.19	1.94	0.00	12.83	0.00	1.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.65	0.00	0.03	0.66	0.00	0.00	0.00	0.00	101.52
SGM6-3,4T-3	4.16	9.80	0.00	1.44	0.00	0.00	0.00	0.10	0.00	0.00	0.00	1.82	10.74	2.28	0.00	2.79	1.18	0.18	0.00	12.06	0.00	1.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.56	0.00	0.04	0.72	0.00	0.00	0.00	0.04	94.03
SGM6-3,4T-4	4.25	9.92	0.00	1.46	0.00	0.00	0.00	0.09	0.00	0.00	0.00	1.27	11.36	2.20	0.00	2.83	1.20	0.19	0.00	11.82	0.00	1.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.73	0.00	0.04	0.73	0.00	0.00	0.00	0.04	94.38
SGM6-3,5B-1	4.40	9.18	0.00	1.40	0.00	0.00	0.00	0.13	0.00	0.00	0.00	1.23	12.47	2.32	0.00	2.71	1.16	1.90	0.00	12.33	0.00	1.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.25	0.00	0.04	0.72	0.00	0.00	0.00	0.00	97.33
SGM6-6,1T-1	4.17	8.78	0.00	1.15	0.00	0.00	0.00	0.04	0.00	0.00	0.00	1.34	11.65	2.84	0.00	2.50	1.18	1.92	0.00	13.18	0.00	1.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	47.25	0.00	0.03	0.71	0.00	0.00	0.00	0.00	97.81
SGM6-6,2B-1	4.08	8.92	0.00	1.20	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.67	12.40	2.58	0.00	2.56	1.19	1.89	0.00	12.48	0.00	1.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.13	0.00	0.04	0.72	0.00	0.00	0.00	0.00	97.92
SGM6-6,2T-1	3.42	7.63	0.00	0.92	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.90	10.45	2.71	0.00	2.17	1.00	1.51	0.00	13.28	0.00	1.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.22	0.00	0.03	0.60	0.00	0.00	0.00	0.00	101.90
SGM6-6,2T-2	4.12	9.09	0.00	1.22	0.00	0.00	0.00	0.25	0.00	0.00	0.00	1.37	11.85	2.69	0.00	2.59	1.21	2.06	0.00	12.51	0.00	1.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.28	0.00	0.03	0.73	0.00	0.00	0.00	0.00	99.11
SGM6-6,2T-3	4.17	9.03	0.00	1.18	0.00	0.00	0.00	0.03	0.00	0.00	0.00	1.23	12.01	2.58	0.00	2.57	1.19	1.84	0.00	12.46	0.00	1.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	47.07	0.00	0.03	0.71	0.00	0.00	0.00	0.00	97.20
SGM6-6,2T-4	4.19	9.01	0.00	1.18	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.95	12.43	2.54	0.00	2.57	1.20	1.84	0.00	11.47	0.00	1.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.98	0.00	0.03	0.71	0.00	0.00	0.00	0.00	96.26
SGM6-6,3B	3.99	8.75	0.00	1.16	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.76	12.07	2.73	0.00	2.50	1.14	1.69	0.00	12.86	0.00	1.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.38	0.00	0.04	0.68	0.00	0.00	0.00	0.00	95.83
SGM6-6,3T-1	4.41	9.44	0.00	0.70	0.00	0.00	0.00	0.03	0.00	0.00	0.00	1.09	12.88	2.69	0.00	2.70	1.25	1.98	0.00	12.77	0.00	1.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.38	0.00	0.03	0.75	0.00	0.00	0.00	0.00	101.21
SGM6-6,4B-1	4.48	8.98	0.00	1.39	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.58	12.98	2.63	0.00	2.52	1.19	1.92	0.00	12.82	0.00	1.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.63	0.00	0.04	0.78	0.00	0.00	0.00	0.00	97.16
SGM6-6,4T-1	4.24	9.20	0.00	1.27	0.00	0.00	0.00	0.03	0.00	0.00	0.00	1.48	12.08	2.64	0.00	2.63	1.20	1.87	0.00	12.94	0.00	1.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.73	0.00	0.03	0.73	0.00	0.00	0.00	0.00	100.27
SGM6-6,4T-2	4.70	8.74	0.00	1.09	0.00	0.00	0.00	0.03	0.00	0.00	0.00	1.15	12.05	2.72	0.00	2.45	1.04	1.80	0.00	12.79	0.00	1.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.32	0.00	0.03	0.69	0.00	0.00	0.00	0.00	96.73
SGM6-6,4T-3	2.74	6.40	0.00	0.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.52	9.20	2.75	0.00	1.90	0.82	1.07	0.00	12.77	0.00	1.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.56	0.00	0.02	0.47	0.00	0.00	0.00	0.00	73.25
SGM6-6,4T-4	4.06	8.71	0.00	1.16	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.93	12.25	2.61	0.00	2.47	1.15	1.79	0.00	12.40	0.00	1.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.97	0.00	0.03	0.69	0.00	0.00	0.00	0.00	95.46
SGM6-6,5B-1	4.46	8.95	0.00	1.37	0.00	0.00	0.00	0.12	0.00	0.00	0.00	8.62	3.97	2.76	0.00	2.52	1.16	1.94	0.00	12.93	0.00	1.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.14	0.00	0.04	0.78	0.00	0.00	0.00	0.00	95.85

Sample ID	Al_2O_3	B_2O_3	BaO	CaO	CdO	Ce_2O_3	CoO	Cr_2O_3	Cs_2O	CuO	Cu_2O	FeO	Fe_2O_3	K_2O	La_2O_3	Li_2O	MgO	MnO	MoO_3	Na_2O	Nd_2O_3	NiO	P_2O_5	PbO	Pr_6O_{11}	Rh_2O_3	RuO_2	SO4	Sb_2O_3	SiO_2	Sm_2O_3	SrO	TiO_2	V_2O_5	Y_2O_3	ZnO	ZrO_2	Oxide Sum
SGM8-A29	3.80	7.78	0.02	1.68	0.00	0.00	0.00	0.02	0.00	0.00	0.00	1.12	10.41	0.40	0.00	4.57	0.75	0.17	0.00	10.82	0.00	1.02	0.04	0.01	0.00	0.00	0.00	0.00	0.00	53.27	0.00	0.01	0.11	0.00	0.00	0.00	0.62	96.62
SGM8-A38	3.75	7.73	0.03	2.13	0.00	0.00	0.00	0.01	0.00	0.00	0.00	1.83	10.19	0.30	0.00	4.46	0.66	0.19	0.00	10.60	0.00	1.03	0.05	0.01	0.00	0.00	0.00	0.00	0.00	50.08	0.00	0.01	0.13	0.00	0.00	0.00	0.72	93.90
SGM8-A23	3.59	7.28	0.02	1.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	10.43	0.23	0.00	4.54	0.65	0.16	0.00	10.57	0.00	0.92	0.05	0.01	0.00	0.00	0.00	0.00	0.00	53.53	0.00	0.01	0.08	0.00	0.00	0.00	0.71	96.09
SGM8-B55	3.93	8.02	0.02	2.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	11.14	0.25	0.00	4.82	0.68	0.18	0.00	10.43	0.00	1.07	0.05	0.01	0.00	0.00	0.00	0.00	0.00	53.46	0.00	0.01	0.12	0.00	0.00	0.00	0.77	98.53
SGM8-B49	4.33	7.50	0.02	1.74	0.00	0.00	0.00	0.01	0.00	0.00	0.00	1.89	9.54	0.13	0.00	4.83	0.76	0.18	0.00	11.22	0.00	1.09	0.03	0.00	0.00	0.00	0.00	0.00	0.00	52.95	0.00	0.01	0.08	0.00	0.00	0.00	0.66	96.97
SGM8-B10	5.08	7.55	0.02	1.75	0.00	0.00	0.00	0.01	0.00	0.00	0.00	1.16	9.89	0.09	0.00	5.00	0.86	0.19	0.00	11.08	0.00	0.87	0.02	0.01	0.00	0.00	0.00	0.00	0.00	53.59	0.00	0.01	0.06	0.00	0.00	0.00	0.65	97.89
SGM7-7, 1	3.97	10.24	0.00	1.34	0.00	0.00	0.00	0.13	0.00	0.00	0.00	3.66	8.06	2.40	0.00	3.04	1.11	1.65	0.00	12.75	0.00	0.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.19	0.00	0.04	0.43	0.00	0.00	0.00	0.05	96.04
SGM7-7,2B	3.65	10.63	0.00	1.30	0.00	0.00	0.00	0.13	0.00	0.00	0.00	4.21	6.63	2.24	0.00	3.16	1.09	1.70	0.00	12.46	0.00	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.87	0.00	0.04	0.32	0.00	0.00	0.00	0.15	95.52
SGM7-7,3	3.74	10.85	0.00	1.25	0.00	0.00	0.00	0.12	0.00	0.00	0.00	4.79	6.10	2.43	0.00	3.27	1.13	1.65	0.00	11.73	0.00	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.13	0.00	0.04	0.30	0.00	0.00	0.00	0.15	96.58
SGM7-7,4	3.28	10.87	0.00	1.05	0.00	0.00	0.00	0.20	0.00	0.00	0.00	5.55	6.29	2.36	0.00	3.25	1.03	1.52	0.00	12.09	0.00	1.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.38	0.00	0.04	0.22	0.00	0.00	0.00	0.55	99.85
SGM7-8, 1T-2	3.91	10.97	0.01	1.51	0.00	0.00	0.00	0.16	0.00	0.05	0.05	5.60	5.28	2.66	0.05	3.36	1.19	2.00	0.00	11.30	0.00	0.89	0.03	0.00	0.00	0.00	0.00	0.00	0.00	46.91	0.00	0.04	0.30	0.00	0.00	0.18	0.28	96.72
SGM7-8, 1T-3	3.94	11.06	0.01	1.31	0.00	0.00	0.00	0.17	0.00	0.05	0.05	5.71	5.20	2.63	0.04	3.38	1.16	2.02	0.00	10.43	0.00	0.90	0.03	0.00	0.00	0.00	0.00	0.00	0.00	46.96	0.00	0.04	0.30	0.00	0.00	0.17	0.27	95.83
SGM7-8, 1T-4	3.94	10.96	0.01	1.33	0.00	0.00	0.00	0.28	0.00	0.05	0.05	5.91	5.29	2.61	0.04	3.34	1.14	2.00	0.01	10.39	0.00	0.91	0.03	0.00	0.00	0.00	0.00	0.00	0.00	47.03	0.00	0.04	0.30	0.00	0.00	0.21	0.27	96.15
SGM7-8, 1T-5	3.74	11.91	0.01	1.42	0.00	0.00	0.00	0.10	0.00	0.02	0.02	5.42	5.43	2.18	0.04	3.50	1.19	0.16	0.00	11.47	0.00	0.93	0.01	0.01	0.00	0.00	0.00	0.00	0.00	50.13	0.00	0.04	0.32	0.00	0.00	0.00	0.22	98.28
SGM7-8, 2B-2	3.91	11.06	0.01	1.32	0.00	0.00	0.00	0.20	0.00	0.05	0.05	5.24	5.71	2.43	0.04	3.39	1.17	2.02	0.00	11.74	0.00	0.91	0.03	0.00	0.00	0.00	0.00	0.00	0.00	46.65	0.00	0.04	0.30	0.00	0.00	0.19	0.28	96.73
SGM7-8, 2T-1	3.84	11.89	0.01	1.42	0.00	0.00	0.00	0.10	0.00	0.02	0.02	5.61	5.46	2.00	0.04	3.46	1.18	0.16	0.00	11.16	0.00	1.13	0.02	0.01	0.00	0.00	0.00	0.00	0.00	49.88	0.00	0.04	0.32	0.00	0.00	0.00	0.22	97.99
SGM7-8, 2T-2	3.68	11.83	0.01	1.42	0.00	0.00	0.00	0.10	0.00	0.03	0.02	5.67	5.08	2.31	0.04	3.42	1.17	0.15	0.00	11.85	0.00	0.88	0.01	0.01	0.00	0.00	0.00	0.00	0.00	49.74	0.00	0.04	0.31	0.00	0.00	0.00	0.22	98.01
SGM7-8, 2T-3	3.59	11.60	0.01	1.38	0.00	0.00	0.00	0.10	0.00	0.02	0.02	5.51	5.02	2.20	0.04	3.35	1.14	0.15	0.00	11.61	0.00	0.94	0.01	0.01	0.00	0.00	0.00	0.00	0.00	48.39	0.00	0.04	0.31	0.00	0.00	0.00	0.21	95.65
SGM7-8, 3B-2	3.90	10.96	0.01	1.32	0.00	0.00	0.00	0.18	0.00	0.05	0.05	5.80	4.92	2.42	0.04	3.33	1.16	2.02	0.00	11.82	0.00	0.91	0.02	0.00	0.00	0.00	0.00	0.00	0.00	46.36	0.00	0.04	0.00	0.00	0.23	0.17	0.26	95.99
SGM7-8, 3B-3	3.99	11.04	0.01	1.47	0.00	0.00	0.00	0.18	0.00	0.05	0.05	5.52	5.33	2.36	0.05	3.37	1.18	2.05	0.00	11.46	0.00	0.92	0.03	0.00	0.00	0.00	0.00	0.00	0.00	47.38	0.00	0.04	0.31	0.00	0.00	0.17	0.27	97.22
SGM7-8, 3B-5	3.94	11.04	0.01	1.34	0.00	0.00	0.00	0.17	0.00	0.05	0.05	5.45	5.61	2.42	0.04	3.37	1.16	2.03	0.00	11.77	0.00	0.90	0.02	0.00	0.00	0.00	0.00	0.00	0.00	46.99	0.00	0.04	0.30	0.00	0.00	0.16	0.27	97.13
SGM7-8, 3T-3	3.78	11.75	0.01	1.47	0.00	0.00	0.00	0.10	0.00	0.03	0.02	6.77	4.30	2.35	0.05	3.34	1.15	0.16	0.00	11.39	0.00	1.18	0.01	0.01	0.00	0.00	0.00	0.00	0.00	47.77	0.00	0.05	0.32	0.00	0.00	0.00	0.21	96.23
SGM7-8, 3T-4	3.80	11.62	0.01	1.61	0.00	0.00	0.00	0.10	0.00	0.03	0.03	6.99	4.07	2.51	0.05	3.32	1.15	0.17	0.00	10.92	0.00	1.16	0.02	0.01	0.00	0.00	0.00	0.00	0.00	48.67	0.00	0.05	0.32	0.00	0.00	0.00	0.22	96.81
SGM7-8, 3T-5	3.72	11.63	0.01	1.41	0.00	0.00	0.00	0.09	0.00	0.02	0.02	5.17	5.81	2.29	0.05	3.33	1.13	0.16	0.00	11.48	0.00	1.04	0.01	0.01	0.00	0.00	0.00	0.00	0.00	47.44	0.00	0.05	0.32	0.00	0.00	0.00	0.21	95.40
SGM9-7, 2B-1	3.88	10.85	0.01	1.67	0.00	0.00	0.00	0.15	0.00	0.14	0.13	5.30	7.55	2.54	0.05	3.04	1.31	0.21	0.00	12.19	0.00	1.32	0.02	0.01	0.00	0.00	0.00	0.00	0.00	50.92	0.00	0.05	0.55	0.00	0.00	0.00	0.06	101.94
SGM9-7, 2T-2	3.87	10.65	0.01	1.64	0.00	0.00	0.00	0.11	0.00	0.15	0.14	4.81	7.87	2.69	0.05	3.03	1.30	0.21	0.00	12.51	0.00	1.31	0.02	0.01	0.00	0.00	0.00	0.00	0.00	53.08	0.00	0.05	0.55	0.00	0.00	0.00	0.07	104.12

Sample ID	Al_2O_3	B_2O_3	BaO	CaO	CdO	Ce_2O_3	CoO	Cr_2O_3	Cs_2O	CuO	Cu_2O	FeO	Fe_2O_3	K_2O	La_2O_3	Li_2O	MgO	MnO	MoO_3	Na_2O	Nd_2O_3	NiO	P_2O_5	PbO	Pr_6O_{11}	Rh_2O_3	RuO_2	SO4	Sb_2O_3	SiO_2	Sm_2O_3	SrO	TiO_2	V_2O_5	Y_2O_3	ZnO	ZrO_2	Oxide Sum
SGM9-7, 2T-3	3.31	9.34	0.00	1.46	0.00	0.00	0.00	0.10	0.00	0.12	0.11	3.95	7.09	2.59	0.05	2.71	1.13	0.17	0.00	12.20	0.00	1.31	0.02	0.01	0.00	0.00	0.00	0.00	0.00	50.10	0.00	0.04	0.47	0.00	0.00	0.00	0.04	96.32
SGM9-7, 3T-1	3.81	10.59	0.01	1.63	0.00	0.00	0.00	0.11	0.00	0.14	0.13	4.78	7.81	2.67	0.06	2.99	1.28	0.20	0.00	12.08	0.00	1.32	0.02	0.01	0.00	0.00	0.00	0.00	0.00	52.37	0.00	0.05	0.55	0.00	0.00	0.00	0.06	102.68
SGM9-7, 4B-1	3.51	10.08	0.01	1.55	0.00	0.00	0.00	0.31	0.00	0.13	0.12	4.76	8.01	2.66	0.05	2.80	1.21	0.19	0.00	12.27	0.00	0.97	0.02	0.01	0.00	0.00	0.00	0.00	0.00	52.03	0.00	0.05	0.50	0.00	0.00	0.00	0.05	101.29
SGM9-7, 4T-1	3.46	10.01	0.01	1.62	0.00	0.00	0.00	0.26	0.00	0.13	0.11	5.01	7.43	2.87	0.05	2.78	1.21	0.19	0.00	12.01	0.00	1.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	49.78	0.00	0.05	0.50	0.00	0.00	0.00	0.05	98.60
SGM9-7, 4T-2	3.46	10.08	0.00	1.50	0.00	0.00	0.00	0.25	0.00	0.13	0.11	4.75	7.66	2.88	0.05	2.78	1.21	0.19	0.00	11.71	0.00	1.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	51.94	0.00	0.05	0.50	0.00	0.00	0.00	0.05	100.36
SGM9-7, 4T-3	3.42	10.05	0.00	1.46	0.00	0.00	0.00	0.25	0.00	0.13	0.12	4.84	7.46	2.89	0.05	2.76	1.21	0.22	0.00	12.42	0.00	0.99	0.03	0.01	0.00	0.00	0.00	0.00	0.00	52.63	0.00	0.05	0.50	0.00	0.00	0.00	0.08	101.55
SGM9-7, 4T-4	3.38	10.05	0.00	1.48	0.00	0.00	0.00	0.20	0.00	0.13	0.11	4.66	7.39	2.89	0.05	2.76	1.21	0.21	0.00	12.13	0.00	0.99	0.04	0.01	0.00	0.00	0.00	0.00	0.00	53.87	0.00	0.05	0.50	0.00	0.00	0.00	0.08	102.18
SGM9-7, 5B-1	3.50	10.11	0.01	1.55	0.00	0.00	0.00	0.28	0.00	0.13	0.11	5.20	7.41	2.66	0.05	2.80	1.21	0.19	0.00	12.15	0.00	0.97	0.02	0.01	0.00	0.00	0.00	0.00	0.00	52.86	0.00	0.05	0.50	0.00	0.00	0.00	0.05	101.81
SGM9-7, Dump Start	3.53	10.40	0.02	1.40	0.00	0.00	0.00	0.35	0.00	0.03	0.02	0.44	12.21	1.17	0.04	3.62	0.76	0.18	0.00	11.78	0.00	1.11	0.04	0.01	0.00	0.00	0.00	0.00	0.00	55.02	0.00	0.04	0.40	0.00	0.00	0.00	0.42	102.99
AL-001	1.68	10.32	0.07	0.57	0.01	0.08	0.00	0.20	0.00	0.01	0.00	0.00	14.88	3.68	0.05	3.14	1.38	0.99	0.01	11.48	0.15	0.40	0.26	0.01	0.04	0.03	0.10	0.47	0.01	45.48	0.04	0.04	1.02	0.01	0.02	0.03	2.68	99.29
AL-002	2.32	10.32	0.07	0.56	0.01	0.08	0.00	0.19	0.00	0.01	0.00	0.00	14.47	3.68	0.04	3.14	1.37	0.96	0.01	11.44	0.14	0.39	0.25	0.01	0.04	0.03	0.10	0.46	0.01	45.47	0.04	0.04	1.02	0.01	0.02	0.03	2.60	99.29
AL-004	3.89	10.31	0.07	0.53	0.01	0.08	0.00	0.18	0.00	0.01	0.00	0.00	13.48	3.67	0.04	3.14	1.37	0.90	0.01	11.36	0.13	0.36	0.24	0.01	0.04	0.03	0.09	0.42	0.01	45.44	0.03	0.04	1.02	0.01	0.02	0.03	2.42	99.35
AL-005	5.18	10.31	0.07	0.50	0.01	0.07	0.00	0.17	0.00	0.01	0.00	0.00	12.67	3.67	0.04	3.14	1.36	0.84	0.01	11.30	0.13	0.34	0.23	0.01	0.03	0.02	0.08	0.40	0.01	45.42	0.03	0.03	1.02	0.01	0.02	0.03	2.27	99.39
CR-001	2.98	10.31	0.07	0.55	0.01	0.08	0.00	0.00	0.00	0.01	0.00	0.00	14.17	3.67	0.04	3.14	1.37	0.94	0.01	11.42	0.14	0.38	0.25	0.01	0.04	0.03	0.09	0.44	0.01	45.46	0.04	0.04	1.02	0.01	0.02	0.03	2.55	99.29
CR-002	2.98	10.31	0.07	0.55	0.01	0.08	0.00	0.10	0.00	0.01	0.00	0.00	14.12	3.67	0.04	3.14	1.37	0.94	0.01	11.42	0.14	0.38	0.25	0.01	0.04	0.03	0.10	0.44	0.01	45.46	0.04	0.04	1.02	0.01	0.02	0.03	2.54	99.33
CR-004	2.95	10.31	0.07	0.54	0.01	0.08	0.00	0.50	0.00	0.01	0.00	0.00	13.88	3.67	0.04	3.14	1.37	0.92	0.01	11.40	0.14	0.38	0.24	0.01	0.04	0.03	0.09	0.43	0.01	45.45	0.03	0.04	1.02	0.01	0.02	0.03	2.49	99.33
CR-005	2.94	10.31	0.07	0.54	0.01	0.08	0.00	0.80	0.00	0.01	0.00	0.00	13.70	3.67	0.04	3.14	1.37	0.91	0.01	11.38	0.14	0.37	0.24	0.01	0.04	0.03	0.09	0.43	0.01	45.45	0.03	0.04	1.02	0.01	0.02	0.03	2.46	99.36
FE-001	3.48	10.34	0.09	0.72	0.01	0.10	0.00	0.26	0.00	0.01	0.00	0.00	10.39	3.70	0.06	3.14	1.41	1.30	0.01	11.85	0.20	0.53	0.34	0.01	0.05	0.04	0.13	0.61	0.01	45.58	0.05	0.05	1.02	0.01	0.03	0.04	3.52	99.04
FE-002	3.22	10.33	0.08	0.63	0.01	0.10	0.00	0.22	0.00	0.01	0.00	0.00	12.23	3.69	0.05	3.14	1.39	1.12	0.01	11.63	0.17	0.45	0.30	0.01	0.04	0.03	0.11	0.53	0.01	45.52	0.04	0.04	1.02	0.01	0.02	0.04	3.02	99.16
FE-004	2.72	10.30	0.06	0.46	0.01	0.06	0.00	0.15	0.00	0.01	0.00	0.00	15.90	3.66	0.04	3.14	1.35	0.75	0.01	11.19	0.11	0.31	0.20	0.01	0.03	0.02	0.07	0.36	0.10	45.39	0.03	0.03	1.02	0.01	0.02	0.03	2.03	99.55
FE-005	2.46	10.28	0.05	0.37	0.01	0.05	0.00	0.12	0.00	0.01	0.00	0.00	17.74	3.64	0.03	3.14	1.33	0.57	0.01	10.97	0.08	0.23	0.15	0.01	0.02	0.02	0.06	0.26	0.01	45.33	0.02	0.02	1.02	0.01	0.01	0.02	1.53	99.56
MN-001	3.04	10.32	0.07	0.57	0.01	0.08	0.00	0.20	0.00	0.01	0.00	0.00	14.78	3.68	0.05	3.14	1.38	0.01	0.01	11.47	0.15	0.40	0.26	0.01	0.04	0.03	0.10	0.47	0.01	45.47	0.04	0.04	1.02	0.01	0.02	0.03	2.66	99.53
MN-002	3.00	10.32	0.07	0.56	0.01	0.08	0.00	0.19	0.00	0.01	0.00	0.00	14.42	3.68	0.04	3.14	1.37	0.47	0.01	11.44	0.14	0.39	0.25	0.01	0.04	0.03	0.09	0.46	0.01	45.46	0.04	0.04	1.02	0.01	0.02	0.03	2.59	99.40
MN-004	2.92	10.31	0.07	0.53	0.01	0.08	0.00	0.18	0.00	0.01	0.00	0.00	13.48	3.67	0.04	3.14	1.37	1.70	0.01	11.36	0.13	0.36	0.24	0.01	0.04	0.03	0.09	0.42	0.01	45.44	0.03	0.04	1.02	0.01	0.02	0.03	2.42	99.18
MN-005	2.86	10.31	0.07	0.51	0.01	0.07	0.00	0.17	0.00	0.01	0.00	0.00	12.90	3.67	0.04	3.14	1.36	2.46	0.01	11.32	0.13	0.35	0.23	0.01	0.03	0.02	0.08	0.41	0.01	45.43	0.03	0.03	1.02	0.01	0.02	0.03	2.31	99.02
NI-001	2.99	10.32	0.07	0.55	0.01	0.08	0.00	0.19	0.00	0.01	0.00	0.00	14.29	3.68	0.04	3.14	1.37	0.95	0.01	11.43	0.14	0.01	0.25	0.01	0.04	0.03	0.09	0.44	0.01	45.46	0.04	0.04	1.02	0.01	0.02	0.03	2.57	99.29
NI-002	2.98	10.31	0.07	0.55	0.01	0.08	0.00	0.19	0.00	0.01	0.00	0.00	14.18	3.67	0.04	3.14	1.37	0.94	0.01	11.42	0.14	0.19	0.25	0.01	0.04	0.03	0.09	0.44	0.01	45.46	0.04	0.04	1.02	0.01	0.02	0.03	2.55	99.30
NI-004	2.95	10.31	0.07	0.54	0.01	0.08	0.00	0.19	0.00	0.01	0.00	0.00	13.87	3.67	0.04	3.14	1.37	0.92	0.01	11.40	0.14	0.70	0.24	0.01	0.04	0.03	0.09	0.43	0.01	45.45	0.03	0.04	1.02	0.01	0.02	0.03	2.49	99.33
NI-005	2.93	10.31	0.07	0.54	0.01	0.08	0.00	0.18	0.00	0.01	0.00	0.00	13.68	3.67	0.04	3.14	1.37	0.91	0.01	11.38	0.14	1.01	0.24	0.01	0.04	0.03	0.09	0.43	0.01	45.45	0.03	0.04	1.02	0.01	0.02	0.03	2.46	99.35
P-001	3.01	10.32	0.07	0.56	0.01	0.08	0.00	0.20	0.00	0.01	0.00	0.00	14.52	3.68	0.04	3.14	1.38	0.96	0.01	11.45	0.14	0.39	0.01	0.01	0.04	0.03	0.10	0.46	0.01	45.47	0.04	0.04	1.02	0.01	0.02	0.03	2.61	99.82

Sample ID	Al_2O_3	B_2O_3	BaO	CaO	CdO	Ce_2O_3	CoO	Cr_2O_3	Cs_2O	CuO	Cu_2O	FeO	Fe_2O_3	K_2O	La_2O_3	Li_2O	MgO	MnO	MoO_3	Na_2O	Nd_2O_3	NiO	P_2O_5	PbO	Pr_6O_{11}	Rh_2O_3	RuO_2	SO4	Sb_2O_3	SiO_2	Sm_2O_3	SrO	TiO_2	V_2O_5	Y_2O_3	ZnO	ZrO_2	Oxide Sum
P-002	2.99	10.32	0.07	0.55	0.01	0.08	0.00	0.19	0.00	0.01	0.00	0.00	14.29	3.68	0.04	3.14	1.37	0.95	0.01	11.43	0.14	0.39	0.13	0.01	0.04	0.03	0.09	0.44	0.01	45.46	0.04	0.04	1.02	0.01	0.02	0.03	2.57	99.55
P-004	2.91	10.31	0.07	0.52	0.01	0.08	0.00	0.18	0.00	0.01	0.00	0.00	13.40	3.67	0.04	3.14	1.37	0.89	0.01	11.36	0.13	0.36	0.60	0.01	0.04	0.03	0.09	0.42	0.01	45.44	0.03	0.04	1.02	0.01	0.02	0.03	2.40	98.61
P-005	2.84	10.31	0.07	0.50	0.01	0.07	0.00	0.17	0.00	0.01	0.00	0.00	12.74	3.67	0.04	3.14	1.36	0.84	0.01	11.30	0.13	0.34	0.96	0.01	0.03	0.02	0.08	0.40	0.01	45.42	0.03	0.03	1.02	0.01	0.02	0.03	2.28	97.86

APPENDIX C

Table CI. Uranium Only ($ThO_2 \leq 0.06$) Glass Viscosity-Temperature Database

Sample ID	COMMENT	Chemistry Laboratory	Viscosity Laboratory	Temperature (°C)	Viscosity (poise)	SUM OXIDES
RC-30 (PHF OL/165Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1099	29.72	OK
RC-30 (PHF OL/165Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1148.5	17.72	OK
RC-30 (PHF OL/165Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1046.5	43.64	OK
RC-30 (PHF OL/165Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1005	76.84	OK
RC-30 (PHF OL/165Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1150.5	18.05	OK
RC-40 (PHF OL/200Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1100.5	56.81	OK
RC-40 (PHF OL/200Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1150	29.97	OK
RC-40 (PHF OL/200Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1043.5	95.64	OK
RC-40 (PHF OL/200Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	996	175.01	OK
RC-40 (PHF OL/200Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1150.5	29.47	OK
RC-50 (PHF OL/320Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1101.5	34.61	OK
RC-50 (PHF OL/320Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1152.5	21.91	OK
RC-50 (PHF OL/320Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1049.5	52.80	OK
RC-50 (PHF OL/320Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1002.5	85.74	OK
RC-50 (PHF OL/320Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1152.5	22.08	OK
Tk 40-03	WSRC-TR-2003-00386	SRTC/ML	SRNL	1146.5	33.42	OK
Tk 40-03	WSRC-TR-2003-00386	SRTC/ML	SRNL	1202.5	22.31	OK
Tk 40-03	WSRC-TR-2003-00386	SRTC/ML	SRNL	1257.5	15.38	OK
Tk 40-03	WSRC-TR-2003-00386	SRTC/ML	SRNL	1147.5	32.22	OK
Tk 40-03	WSRC-TR-2003-00386	SRTC/ML	SRNL	1092.5	51.46	OK
Tk 40-03	WSRC-TR-2003-00386	SRTC/ML	SRNL	1038.5	87.21	OK
Tk 40-03	WSRC-TR-2003-00386	SRTC/ML	SRNL	1092.5	52.68	OK
rchwl 01	WSRC-TR-2003-00386	SRTC/ML	SRNL	1096.5	36.23	OK
rchwl 01	WSRC-TR-2003-00386	SRTC/ML	SRNL	1149	21.50	OK
rchwl 01	WSRC-TR-2003-00386	SRTC/ML	SRNL	1097.5	32.85	OK
rchwl 01	WSRC-TR-2003-00386	SRTC/ML	SRNL	1049.5	51.86	OK
rchwl 01	WSRC-TR-2003-00386	SRTC/ML	SRNL	1005	86.82	OK
rchwl 01	WSRC-TR-2003-00386	SRTC/ML	SRNL	1150	21.49	OK
rchwl 02	WSRC-TR-2003-00386	SRTC/ML	SRNL	1139.5	23.41	OK

Sample ID	COMMENT	Chemistry Laboratory	Viscosity Laboratory	Temperature (°C)	Viscosity (poise)	SUM OXIDES
rchwl 02	WSRC-TR-2003-00386	SRTC/ML	SRNL	1196.5	15.01	OK
rchwl 02	WSRC-TR-2003-00386	SRTC/ML	SRNL	1142.5	21.00	OK
rchwl 02	WSRC-TR-2003-00386	SRTC/ML	SRNL	1086	34.87	OK
rchwl 02	WSRC-TR-2003-00386	SRTC/ML	SRNL	1042	55.82	OK
rchwl 02	WSRC-TR-2003-00386	SRTC/ML	SRNL	992.5	106.27	OK
rchwl 02	WSRC-TR-2003-00386	SRTC/ML	SRNL	1140.5	25.18	OK
rchwl 03	WSRC-TR-2003-00386	SRTC/ML	SRNL	1099.5	63.82	OK
rchwl 03	WSRC-TR-2003-00386	SRTC/ML	SRNL	1148.5	41.90	OK
rchwl 03	WSRC-TR-2003-00386	SRTC/ML	SRNL	1203	27.05	OK
rchwl 03	WSRC-TR-2003-00386	SRTC/ML	SRNL	1151.5	40.21	OK
rchwl 03	WSRC-TR-2003-00386	SRTC/ML	SRNL	1048.5	103.05	OK
rchwl 03	WSRC-TR-2003-00386	SRTC/ML	SRNL	999.5	181.34	OK
rchwl 04	WSRC-TR-2003-00386	SRTC/ML	SRNL	1100	59.09	OK
rchwl 04	WSRC-TR-2003-00386	SRTC/ML	SRNL	1149.5	37.78	OK
rchwl 04	WSRC-TR-2003-00386	SRTC/ML	SRNL	1203.5	24.71	OK
rchwl 04	WSRC-TR-2003-00386	SRTC/ML	SRNL	1151	36.94	OK
rchwl 04	WSRC-TR-2003-00386	SRTC/ML	SRNL	1052.5	90.28	OK
rchwl 04	WSRC-TR-2003-00386	SRTC/ML	SRNL	1008	149.03	OK
rchwl 05	WSRC-TR-2003-00386	SRTC/ML	SRNL	1096	41.97	OK
rchwl 05	WSRC-TR-2003-00386	SRTC/ML	SRNL	1144.5	24.61	OK
rchwl 05	WSRC-TR-2003-00386	SRTC/ML	SRNL	1200.5	15.70	OK
rchwl 05	WSRC-TR-2003-00386	SRTC/ML	SRNL	1147.5	23.01	OK
rchwl 05	WSRC-TR-2003-00386	SRTC/ML	SRNL	1044	57.92	OK
rchwl 05	WSRC-TR-2003-00386	SRTC/ML	SRNL	1010	89.16	OK
rchwl 06	WSRC-TR-2003-00386	SRTC/ML	SRNL	1098	42.64	OK
rchwl 06	WSRC-TR-2003-00386	SRTC/ML	SRNL	1150.5	21.32	OK
rchwl 06	WSRC-TR-2003-00386	SRTC/ML	SRNL	1202.5	13.02	OK
rchwl 06	WSRC-TR-2003-00386	SRTC/ML	SRNL	1151	19.81	OK
rchwl 06	WSRC-TR-2003-00386	SRTC/ML	SRNL	1052.5	49.47	OK
rchwl 06	WSRC-TR-2003-00386	SRTC/ML	SRNL	1009	88.15	OK
Tk 40-01	WSRC-TR-2003-00386	SRTC/ML	SRNL	1152.5	26.34	OK
Tk 40-01	WSRC-TR-2003-00386	SRTC/ML	SRNL	1202.5	18.55	OK
Tk 40-01	WSRC-TR-2003-00386	SRTC/ML	SRNL	1258	12.83	OK
Tk 40-01	WSRC-TR-2003-00386	SRTC/ML	SRNL	1148	26.09	OK

Sample ID	COMMENT	Chemistry Laboratory	Viscosity Laboratory	Temperature (°C)	Viscosity (poise)	SUM OXIDES
Tk 40-01	WSRC-TR-2003-00386	SRTC/ML	SRNL	1093.5	41.94	OK
Tk 40-01	WSRC-TR-2003-00386	SRTC/ML	SRNL	1038.5	70.26	OK
Tk 40-01	WSRC-TR-2003-00386	SRTC/ML	SRNL	1147.5	26.99	OK
Tk 40-02	WSRC-TR-2003-00386	SRTC/ML	SRNL	1142.5	61.22	OK
Tk 40-02	WSRC-TR-2003-00386	SRTC/ML	SRNL	1198.5	39.19	OK
Tk 40-02	WSRC-TR-2003-00386	SRTC/ML	SRNL	1253.5	26.17	OK
Tk 40-02	WSRC-TR-2003-00386	SRTC/ML	SRNL	1144	59.40	OK
Tk 40-02	WSRC-TR-2003-00386	SRTC/ML	SRNL	1089	101.45	OK
Tk 40-02	WSRC-TR-2003-00386	SRTC/ML	SRNL	1034	177.00	OK
Tk 40-02	WSRC-TR-2003-00386	SRTC/ML	SRNL	1144.5	59.38	OK
Glass 1	WSRC-RP-99-01053		SRNL	1188	63.97	OK
Glass 1	WSRC-RP-99-01053		SRNL	1134	102.00	OK
Glass 1	WSRC-RP-99-01053		SRNL	1081	170.05	OK
Glass 1	WSRC-RP-99-01053		SRNL	1028	296.97	OK
Glass 1	WSRC-RP-99-01053		SRNL	975	556.94	OK
Glass 1	WSRC-RP-99-01053		SRNL	1195.5	59.74	OK
Glass 1	WSRC-RP-99-01053		SRNL	1139.5	94.99	OK
Glass 1	WSRC-RP-99-01053		SRNL	1088	156.96	OK
Glass 1	WSRC-RP-99-01053		SRNL	1035	272.09	OK
Glass 1	WSRC-RP-99-01053		SRNL	982.5	504.54	OK
U STD	WSRC-RP-99-01053	CELS	SRNL	1199.5	22.32	OK
U STD	WSRC-RP-99-01053	CELS	SRNL	1145	33.43	OK
U STD	WSRC-RP-99-01053	CELS	SRNL	1091	52.42	OK
U STD	WSRC-RP-99-01053	CELS	SRNL	1038.5	87.01	OK
U STD	WSRC-RP-99-01053	CELS	SRNL	984.5	155.87	OK
Glass 3	WSRC-RP-99-01053		SRNL	1190	76.50	OK
Glass 3	WSRC-RP-99-01053		SRNL	1137	121.94	OK
Glass 3	WSRC-RP-99-01053		SRNL	1080	203.46	OK
Glass 3	WSRC-RP-99-01053		SRNL	1028	358.45	OK
Glass 3	WSRC-RP-99-01053		SRNL	975	668.44	OK
Glass 3	WSRC-RP-99-01053		SRNL	1196.5	69.61	OK
Glass 3	WSRC-RP-99-01053		SRNL	1140.5	109.54	OK
Glass 3	WSRC-RP-99-01053		SRNL	1088	180.46	OK
Glass 3	WSRC-RP-99-01053		SRNL	1034	312.72	OK

Sample ID	COMMENT	Chemistry Laboratory	Viscosity Laboratory	Temperature (°C)	Viscosity (poise)	SUM OXIDES
Glass 3	WSRC-RP-99-01053		SRNL	981.5	578.51	OK
Glass 3	WSRC-RP-99-01053		SRNL	1187	71.28	OK
Glass 3	WSRC-RP-99-01053		SRNL	1137	112.58	OK
Glass 3	WSRC-RP-99-01053		SRNL	1080.5	186.97	OK
Glass 3	WSRC-RP-99-01053		SRNL	1026	326.58	OK
Glass 3	WSRC-RP-99-01053		SRNL	974	607.85	OK
Glass 5	WSRC-RP-99-01053		SRNL	1188	77.50	OK
Glass 5	WSRC-RP-99-01053		SRNL	1135.5	123.61	OK
Glass 5	WSRC-RP-99-01053		SRNL	1080	205.63	OK
Glass 5	WSRC-RP-99-01053		SRNL	1027	363.06	OK
Glass 5	WSRC-RP-99-01053		SRNL	975	675.84	OK
Glass 5	WSRC-RP-99-01053		SRNL	1190.5	77.71	OK
Glass 5	WSRC-RP-99-01053		SRNL	1136.3	124.04	OK
Glass 5	WSRC-RP-99-01053		SRNL	1081.5	206.56	OK
Glass 5	WSRC-RP-99-01053		SRNL	1028	364.33	OK
Glass 5	WSRC-RP-99-01053		SRNL	975.5	678.18	OK
CST 07	WSRC-TR-99-00245	SRTC-ML	SRNL	1195.5	50.34	OK
CST 07	WSRC-TR-99-00245	SRTC-ML	SRNL	1140	78.05	OK
CST 07	WSRC-TR-99-00245	SRTC-ML	SRNL	1087	126.73	OK
CST 07	WSRC-TR-99-00245	SRTC-ML	SRNL	1034	217.55	OK
CST 07	WSRC-TR-99-00245	SRTC-ML	SRNL	980.5	401.17	OK
CST 08	WSRC-TR-99-00245	SRTC-ML	SRNL	1192.5	45.31	OK
CST 08	WSRC-TR-99-00245	SRTC-ML	SRNL	1138.5	70.75	OK
CST 08	WSRC-TR-99-00245	SRTC-ML	SRNL	1085.5	115.38	OK
CST 08	WSRC-TR-99-00245	SRTC-ML	SRNL	1032	200.04	OK
CST 08	WSRC-TR-99-00245	SRTC-ML	SRNL	979.5	370.70	OK
CST 09	WSRC-TR-99-00245	SRTC-ML	SRNL	1197	38.98	OK
CST 09	WSRC-TR-99-00245	SRTC-ML	SRNL	1142.5	60.12	OK
CST 09	WSRC-TR-99-00245	SRTC-ML	SRNL	1088.5	99.37	OK
CST 09	WSRC-TR-99-00245	SRTC-ML	SRNL	1035.5	173.61	OK
CST 09	WSRC-TR-99-00245	SRTC-ML	SRNL	982	324.34	OK
CST 10	WSRC-TR-99-00245	SRTC-ML	SRNL	1199	42.20	OK
CST 10	WSRC-TR-99-00245	SRTC-ML	SRNL	1146	64.62	OK
CST 10	WSRC-TR-99-00245	SRTC-ML	SRNL	1094	103.29	OK

Sample ID	COMMENT	Chemistry Laboratory	Viscosity Laboratory	Temperature (°C)	Viscosity (poise)	SUM OXIDES
CST 10	WSRC-TR-99-00245	SRTC-ML	SRNL	1036.5	177.95	OK
CST 10	WSRC-TR-99-00245	SRTC-ML	SRNL	983	323.51	OK
CST 11	WSRC-TR-99-00245	SRTC-ML	SRNL	1198.5	37.11	OK
CST 11	WSRC-TR-99-00245	SRTC-ML	SRNL	1145	57.32	OK
CST 11	WSRC-TR-99-00245	SRTC-ML	SRNL	1089	92.77	OK
CST 11	WSRC-TR-99-00245	SRTC-ML	SRNL	1035.5	160.56	OK
CST 11	WSRC-TR-99-00245	SRTC-ML	SRNL	982.5	295.24	OK
CST 12	WSRC-TR-99-00245	SRTC-ML	SRNL	1197.5	33.97	OK
CST 12	WSRC-TR-99-00245	SRTC-ML	SRNL	1145	52.92	OK
CST 12	WSRC-TR-99-00245	SRTC-ML	SRNL	1088.5	86.87	OK
CST 12	WSRC-TR-99-00245	SRTC-ML	SRNL	1035.5	150.16	OK
CST 12	WSRC-TR-99-00245	SRTC-ML	SRNL	982.5	283.45	OK
CST 01	WSRC-TR-99-00291	SRTC-ADS	SRNL	1197	48.88	OK
CST 01	WSRC-TR-99-00291	SRTC-ADS	SRNL	1141	75.70	OK
CST 01	WSRC-TR-99-00291	SRTC-ADS	SRNL	1088	121.82	OK
CST 01	WSRC-TR-99-00291	SRTC-ADS	SRNL	1035	211.70	OK
CST 01	WSRC-TR-99-00291	SRTC-ADS	SRNL	982	391.25	OK
CST 06	WSRC-TR-99-00291	SRTC-ADS	SRNL	1199	42.81	OK
CST 06	WSRC-TR-99-00291	SRTC-ADS	SRNL	1143.5	66.59	OK
CST 06	WSRC-TR-99-00291	SRTC-ADS	SRNL	1089	108.50	OK
CST 06	WSRC-TR-99-00291	SRTC-ADS	SRNL	1035.5	188.65	OK
CST 06	WSRC-TR-99-00291	SRTC-ADS	SRNL	983	353.10	OK
CST 14	WSRC-TR-99-00289	SRTC-ADS	SRNL	1197	35.82	OK
CST 14	WSRC-TR-99-00289	SRTC-ADS	SRNL	1142.5	55.08	OK
CST 14	WSRC-TR-99-00289	SRTC-ADS	SRNL	1088.5	90.10	OK
CST 14	WSRC-TR-99-00289	SRTC-ADS	SRNL	1036	156.54	OK
CST 14	WSRC-TR-99-00289	SRTC-ADS	SRNL	983	293.59	OK
CST 15	WSRC-TR-99-00289	SRTC-ADS	SRNL	1198	36.61	OK
CST 15	WSRC-TR-99-00289	SRTC-ADS	SRNL	1142	57.62	OK
CST 15	WSRC-TR-99-00289	SRTC-ADS	SRNL	1088.5	95.92	OK
CST 15	WSRC-TR-99-00289	SRTC-ADS	SRNL	1035.5	169.18	OK
CST 15	WSRC-TR-99-00289	SRTC-ADS	SRNL	983	379.17	OK
CST 12c	WSRC-TR-99-00293	SRTC-ADS	SRNL	1200	34.54	NOSUM
CST 12c	WSRC-TR-99-00293	SRTC-ADS	SRNL	1144	53.57	NOSUM

Sample ID	COMMENT	Chemistry Laboratory	Viscosity Laboratory	Temperature (°C)	Viscosity (poise)	SUM OXIDES
CST 12c	WSRC-TR-99-00293	SRTC-ADS	SRNL	1091	87.94	NOSUM
CST 12c	WSRC-TR-99-00293	SRTC-ADS	SRNL	1037.5	152.89	NOSUM
CST 12c	WSRC-TR-99-00293	SRTC-ADS	SRNL	984	286.43	NOSUM
CST 20	WSRC-TR-99-00293	SRTC-ADS	SRNL	1200	102.49	OK
CST 20	WSRC-TR-99-00293	SRTC-ADS	SRNL	1148	162.38	OK
CST 20	WSRC-TR-99-00293	SRTC-ADS	SRNL	1096	268.02	OK
CST 20	WSRC-TR-99-00293	SRTC-ADS	SRNL	1043	471.58	OK
CST 20	WSRC-TR-99-00293	SRTC-ADS	SRNL	991	894.41	OK
CST 26	WSRC-TR-99-00293	SRTC-ADS	SRNL	1200	100.55	OK
CST 26	WSRC-TR-99-00293	SRTC-ADS	SRNL	1147	161.21	OK
CST 26	WSRC-TR-99-00293	SRTC-ADS	SRNL	1090.5	267.88	OK
CST 26	WSRC-TR-99-00293	SRTC-ADS	SRNL	1037	474.04	OK
CST 26	WSRC-TR-99-00293	SRTC-ADS	SRNL	984	892.81	OK
CST 32	WSRC-TR-99-00293	SRTC-ADS	SRNL	1200.5	104.09	OK
CST 32	WSRC-TR-99-00293	SRTC-ADS	SRNL	1145	166.82	OK
CST 32	WSRC-TR-99-00293	SRTC-ADS	SRNL	1092	279.30	OK
CST 32	WSRC-TR-99-00293	SRTC-ADS	SRNL	1039	498.98	OK
CST 32	WSRC-TR-99-00293	SRTC-ADS	SRNL	986	950.84	OK
PHA-01	WSRC-TR-99-00262	SRTC-ADS	SRNL	1201	30.24	OK
PHA-01	WSRC-TR-99-00262	SRTC-ADS	SRNL	1146	45.25	OK
PHA-01	WSRC-TR-99-00262	SRTC-ADS	SRNL	1092	70.79	OK
PHA-01	WSRC-TR-99-00262	SRTC-ADS	SRNL	1038.5	116.27	OK
PHA-01	WSRC-TR-99-00262	SRTC-ADS	SRNL	985.5	203.80	OK
PHA-03	WSRC-TR-99-00262	SRTC-ADS	SRNL	1202	23.00	OK
PHA-03	WSRC-TR-99-00262	SRTC-ADS	SRNL	1145	34.27	OK
PHA-03	WSRC-TR-99-00262	SRTC-ADS	SRNL	1091	52.64	OK
PHA-03	WSRC-TR-99-00262	SRTC-ADS	SRNL	1037	86.52	OK
PHA-03	WSRC-TR-99-00262	SRTC-ADS	SRNL	984	148.20	OK
PHA-12c	WSRC-TR-99-0294	SRTC-ADS	SRNL	1201	20.57	OK
PHA-12c	WSRC-TR-99-0294	SRTC-ADS	SRNL	1146	27.86	OK
PHA-12c	WSRC-TR-99-0294	SRTC-ADS	SRNL	1091	43.27	OK
PHA-12c	WSRC-TR-99-0294	SRTC-ADS	SRNL	1038	69.80	OK
PHA-15c	WSRC-TR-99-0294	SRTC-ADS	SRNL	1199.5	16.10	OK
PHA-15c	WSRC-TR-99-0294	SRTC-ADS	SRNL	1144	23.59	OK

Sample ID	COMMENT	Chemistry Laboratory	Viscosity Laboratory	Temperature (°C)	Viscosity (poise)	SUM OXIDES
PHA-15c	WSRC-TR-99-0294	SRTC-ADS	SRNL	1090.5	36.93	OK
PHA-15c	WSRC-TR-99-0294	SRTC-ADS	SRNL	1037	60.11	OK
PHA-15c	WSRC-TR-99-0294	SRTC-ADS	SRNL	984	103.67	OK
PHA-32	WSRC-TR-99-0294	SRTC-ADS	SRNL	1200.5	59.48	OK
PHA-32	WSRC-TR-99-0294	SRTC-ADS	SRNL	1147.5	93.04	OK
PHA-32	WSRC-TR-99-0294	SRTC-ADS	SRNL	1091	150.23	OK
PHA-32	WSRC-TR-99-0294	SRTC-ADS	SRNL	1038	253.14	OK
PHA-32	WSRC-TR-99-0294	SRTC-ADS	SRNL	985	458.66	OK
PHA-07	WSRC-TR-99-00262	SRTC-ML	SRNL	1197.5	36.42	OK
PHA-07	WSRC-TR-99-00262	SRTC-ML	SRNL	1142	55.94	OK
PHA-07	WSRC-TR-99-00262	SRTC-ML	SRNL	1089	89.11	OK
PHA-07	WSRC-TR-99-00262	SRTC-ML	SRNL	1035.5	148.95	OK
PHA-07	WSRC-TR-99-00262	SRTC-ML	SRNL	982.5	265.08	OK
PHA-08	WSRC-TR-99-00262	SRTC-ML	SRNL	1196.7	27.72	OK
PHA-08	WSRC-TR-99-00262	SRTC-ML	SRNL	1143	42.27	OK
PHA-08	WSRC-TR-99-00262	SRTC-ML	SRNL	1086.5	66.56	OK
PHA-08	WSRC-TR-99-00262	SRTC-ML	SRNL	1034.5	109.63	OK
PHA-08	WSRC-TR-99-00262	SRTC-ML	SRNL	981.5	191.25	OK
PHA-09	WSRC-TR-99-00262	SRTC-ML	SRNL	1194.5	23.44	OK
PHA-09	WSRC-TR-99-00262	SRTC-ML	SRNL	1139	34.58	OK
PHA-09	WSRC-TR-99-00262	SRTC-ML	SRNL	1085	54.09	OK
PHA-09	WSRC-TR-99-00262	SRTC-ML	SRNL	1032	88.39	OK
PHA-09	WSRC-TR-99-00262	SRTC-ML	SRNL	979	153.31	OK
PHA-10	WSRC-TR-99-00262	SRTC-ML	SRNL	1198.5	35.24	OK
PHA-10	WSRC-TR-99-00262	SRTC-ML	SRNL	1140.5	54.40	OK
PHA-10	WSRC-TR-99-00262	SRTC-ML	SRNL	1088	86.78	OK
PHA-10	WSRC-TR-99-00262	SRTC-ML	SRNL	1034.5	144.93	OK
PHA-10	WSRC-TR-99-00262	SRTC-ML	SRNL	981	258.01	OK
PHA-11	WSRC-TR-99-00262	SRTC-ML	SRNL	1198	26.41	OK
PHA-11	WSRC-TR-99-00262	SRTC-ML	SRNL	1141.5	39.89	OK
PHA-11	WSRC-TR-99-00262	SRTC-ML	SRNL	1088.5	63.04	OK
PHA-11	WSRC-TR-99-00262	SRTC-ML	SRNL	1035	103.97	OK
PHA-11	WSRC-TR-99-00262	SRTC-ML	SRNL	982	180.77	OK
PHA-12	WSRC-TR-99-00262	SRTC-ML	SRNL	1197.5	20.61	OK

Sample ID	COMMENT	Chemistry Laboratory	Viscosity Laboratory	Temperature (°C)	Viscosity (poise)	SUM OXIDES
PHA-12	WSRC-TR-99-00262	SRTC-ML	SRNL	1144	30.72	OK
PHA-12	WSRC-TR-99-00262	SRTC-ML	SRNL	1089.5	47.61	OK
PHA-12	WSRC-TR-99-00262	SRTC-ML	SRNL	1036.5	77.59	OK
PHA-12	WSRC-TR-99-00262	SRTC-ML	SRNL	983	134.21	OK
PHA-14	WSRC-TR-99-00290	SRTC-ADS	SRNL	1197.5	16.22	OK
PHA-14	WSRC-TR-99-00290	SRTC-ADS	SRNL	1144.5	23.90	OK
PHA-14	WSRC-TR-99-00290	SRTC-ADS	SRNL	1086.5	37.33	OK
PHA-14	WSRC-TR-99-00290	SRTC-ADS	SRNL	1033.5	60.43	OK
PHA-14	WSRC-TR-99-00290	SRTC-ADS	SRNL	980	103.64	OK
PHA-15	WSRC-TR-99-00290	SRTC-ADS	SRNL	1197.5	10.81	OK
PHA-15	WSRC-TR-99-00290	SRTC-ADS	SRNL	1142	15.64	OK
PHA-15	WSRC-TR-99-00290	SRTC-ADS	SRNL	1088	23.50	OK
PHA-15	WSRC-TR-99-00290	SRTC-ADS	SRNL	1035	37.49	OK
PHA-15	WSRC-TR-99-00290	SRTC-ADS	SRNL	981.5	62.96	OK
PHA-17	WSRC-TR-99-00290	SRTC-ADS	SRNL	1199	15.70	OK
PHA-17	WSRC-TR-99-00290	SRTC-ADS	SRNL	1142	23.40	OK
PHA-17	WSRC-TR-99-00290	SRTC-ADS	SRNL	1089.5	36.41	OK
PHA-17	WSRC-TR-99-00290	SRTC-ADS	SRNL	1036	59.14	OK
PHA-17	WSRC-TR-99-00290	SRTC-ADS	SRNL	983	102.25	OK
PHA-18	WSRC-TR-99-00290	SRTC-ADS	SRNL	1198.5	11.01	OK
PHA-18	WSRC-TR-99-00290	SRTC-ADS	SRNL	1142	15.43	OK
PHA-18	WSRC-TR-99-00290	SRTC-ADS	SRNL	1089	24.03	OK
PHA-18	WSRC-TR-99-00290	SRTC-ADS	SRNL	1036	38.69	OK
PHA-18	WSRC-TR-99-00290	SRTC-ADS	SRNL	983	65.52	OK
MHSi-6	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1255.5	248.69	OK
MHSi-6	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1199	422.99	OK
MHSi-6	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1151	689.75	OK
MHSi-6	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1099.5	1241.23	OK
MHSi-6	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1048.5	2328.65	OK
MLSi-3B	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1199	125.62	OK
MLSi-3B	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1150	195.27	OK
MLSi-3B	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1099.5	323.69	OK
MLSi-3B	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1049.5	561.82	OK
MLSi-3B	WSRC-TR-2000-00339	SRTC-ADS	SRNL	999.5	1762.67	OK

Sample ID	COMMENT	Chemistry Laboratory	Viscosity Laboratory	Temperature (°C)	Viscosity (poise)	SUM OXIDES
MHSi-11A	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1253	152.78	OK
MHSi-11A	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1198.5	254.06	OK
MHSi-11A	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1150	413.75	OK
MHSi-11A	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1097.5	730.43	OK
MHSi-11A	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1048.5	1326.32	OK
MLSi-9	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1200	50.22	OK
MLSi-9	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1149.5	75.38	OK
MLSi-9	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1099	117.27	OK
MLSi-9	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1050	187.09	OK
MLSi-9	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1001	316.82	OK
MLSi-1	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1299.5	475.76	NOSUM
MLSi-1	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1249	818.24	NOSUM
MLSi-1	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1199	1456.84	NOSUM
MLSi-1	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1148	2757.10	NOSUM
MN-5D	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1249.5	630.74	OK
MN-5D	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1197	1128.37	OK
MN-5D	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1147.5	2077.13	OK
MN-5D	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1098.5	3990.34	OK
MN-5D	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1050	7979.51	OK
MN-3	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1200.5	364.72	OK
MN-3	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1150.5	594.63	OK
MN-3	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1099.5	1027.33	OK
MN-3	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1049.5	1889.03	OK
MN-3	WSRC-TR-2000-00339	SRTC-ADS	SRNL	999.5	3929.08	OK
MN-11	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1200.5	17.91	NOSUM
MN-11	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1151.5	24.55	NOSUM
MN-11	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1100	36.06	NOSUM
MN-11	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1050	54.31	NOSUM
MN-11	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1000	85.78	NOSUM
MN-2	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1293.5	389.18	NOSUM
MN-2	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1247.5	543.59	NOSUM
MN-2	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1198.5	896.69	NOSUM
MN-2	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1152.5	1526.83	NOSUM
MN-2	WSRC-TR-2000-00339	SRTC-ADS	SRNL	1095	3141.84	NOSUM

Sample ID	COMMENT	Chemistry Laboratory	Viscosity Laboratory	Temperature (°C)	Viscosity (poise)	SUM OXIDES
VIS-1 - 30%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL			
VIS-1 - 30%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1149.5	41.78	OK
VIS-1 - 30%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1199.5	29.42	OK
VIS-1 - 30%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1150	41.94	OK
VIS-1 - 30%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1100	62.58	OK
VIS-2 - 33%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1049.5	99.15	OK
VIS-2 - 33%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1150.5	38.55	OK
VIS-2 - 33%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1199	27.13	OK
VIS-2 - 33%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1151.5	38.71	OK
VIS-2 - 33%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1098	59.51	OK
VIS-2 - 33%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1047.5	93.79	OK
VIS-3- 35%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	999.5	75.72	OK
VIS-3- 35%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1149.5	36.42	OK
VIS-3- 35%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1199.5	25.33	OK
VIS-3- 35%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1150	36.41	OK
VIS-3- 35%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1098.5	55.42	OK
VIS-4- 37%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1048	86.61	OK
VIS-4- 37%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1151.5	32.39	OK
VIS-4- 37%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1201	22.46	OK
VIS-4- 37%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1152.5	31.92	OK
VIS-4- 37%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1102	47.88	OK
VIS-4- 37%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1050	75.46	OK
VIS-5- 40%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1000.5	121.96	OK
VIS-5- 40%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1149.5	31.13	OK
VIS-5- 40%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1199.5	21.65	OK
VIS-5- 40%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1151.5	30.95	OK
VIS-5- 40%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1099.5	47.14	OK
VIS 6-45%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1050	73.00	OK
VIS 6-45%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1148.5	24.86	OK
VIS 6-45%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1199.5	17.00	OK
VIS 6-45%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1151	24.35	OK
VIS 6-45%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1100.5	37.07	OK
VIS 6-45%WL	WSRC-TR-2004-00429	SRTC-ML	SRNL	1049.5	59.61	OK

Table CII. Uranium Only ($ThO_2 \leq 0.06$) Glass Composition Database

Sample ID	Al_2O_3 (wt%)	B_2O_3 (wt%)	CaO (wt%)	CdO (wt%)	Ce_2O_3 (wt%)	CoO (wt%)	Cr_2O_3 (wt%)	CuO (wt%)	Cu_2O (wt%)	Fe_2O_3 (wt%)	K_2O (wt%)	La_2O_3 (wt%)	Li_2O (wt%)	MgO (wt%)	MnO (wt%)	MoO_3 (wt%)	Na_2O (wt%)	Nd_2O_3 (wt%)	NiO (wt%)	P_2O_5 (wt%)	PbO (wt%)	SiO_2 (wt%)	SrO (wt%)	ThO_2 (wt%)	TiO_2 (wt%)	U_3O_8 (wt%)	ZnO (wt%)	ZrO_2(wt%)	Sum Oxides (wt%)
RC-30 (PHF OL/165Frit at 35% WL)	3.25	6.29	0.61	0.00	0.00	0.00	0.10	0.00	0.00	11.33	0.00	0.00	4.64	1.55	3.79	0.00	12.62	0.00	2.78	0.05	0.00	45.30	0.00	0.00	0.00	5.76	0.00	0.68	98.76
RC-40 (PHF OL/200Frit at 35% WL)	3.17	7.40	0.66	0.00	0.00	0.00	0.10	0.00	0.00	11.57	0.00	0.00	3.32	2.09	3.74	0.00	11.29	0.00	2.69	0.13	0.00	46.18	0.00	0.00	0.00	5.65	0.00	0.04	98.00
RC-50 (PHF OL/320Frit at 35% WL)	3.20	4.95	0.65	0.00	0.00	0.00	0.11	0.00	0.00	11.25	0.00	0.00	5.28	0.93	3.71	0.00	11.98	0.00	2.72	0.12	0.00	47.24	0.00	0.00	0.00	5.61	0.00	0.04	97.79
Tk 40-03	5.46	4.84	1.60	0.00	0.00	0.00	0.13	0.00	0.00	14.91	0.00	0.00	4.99	1.54	2.09	0.00	11.74	0.00	0.73	0.14	0.00	46.23	0.00	0.06	0.00	4.72	0.00	0.04	99.22
rchwl 01	4.76	5.95	1.64	0.00	0.00	0.00	0.12	0.00	0.00	16.44	0.00	0.00	4.26	1.05	2.10	0.00	12.74	0.00	0.88	0.11	0.00	42.90	0.00	0.06	0.00	4.52	0.00	0.49	98.01
rchwl 02	5.02	5.76	1.69	0.00	0.00	0.00	0.13	0.00	0.00	16.45	0.00	0.00	4.00	1.27	3.81	0.00	12.72	0.00	0.75	0.13	0.00	40.25	0.00	0.06	0.00	3.85	0.00	0.52	96.41
rchwl 03	4.17	7.87	1.45	0.00	0.00	0.00	0.11	0.00	0.00	13.60	0.00	0.00	3.33	1.68	1.86	0.00	11.50	0.00	0.79	0.11	0.00	47.61	0.00	0.06	0.00	4.02	0.00	0.04	98.20
rchwl 04	4.43	7.44	1.49	0.00	0.00	0.00	0.12	0.00	0.00	14.41	0.00	0.00	3.17	1.86	3.44	0.00	11.53	0.00	0.67	0.12	0.00	46.23	0.00	0.06	0.00	3.42	0.00	0.05	98.44
rchwl 05	5.00	4.58	1.74	0.00	0.00	0.00	0.14	0.00	0.00	16.70	0.00	0.00	4.76	0.51	2.29	0.00	12.26	0.00	0.93	0.14	0.00	44.33	0.00	0.06	0.00	4.93	0.00	0.05	98.39
rchwl 06	5.31	4.33	1.79	0.00	0.00	0.00	0.13	0.00	0.00	16.86	0.00	0.00	4.44	0.77	4.02	0.00	12.16	0.00	0.78	0.14	0.00	43.16	0.00	0.06	0.00	4.09	0.00	0.04	98.07
Tk 40-01	5.02	6.11	1.52	0.00	0.00	0.00	0.12	0.00	0.00	14.91	0.00	0.00	4.41	1.96	1.88	0.00	12.14	0.00	0.66	0.12	0.00	44.33	0.00	0.06	0.00	4.28	0.00	0.63	98.12
Tk 40-02	4.54	8.04	1.33	0.00	0.00	0.00	0.10	0.00	0.00	12.31	0.00	0.00	3.41	2.47	1.68	0.00	11.03	0.00	0.60	0.13	0.00	48.77	0.00	0.06	0.00	3.87	0.00	0.04	98.37
Glass 1	6.83	8.92	1.74	0.00	0.00	0.00	0.08	0.02	0.01	13.20	0.00	0.00	3.43	2.07	1.60	0.00	11.90	0.00	0.22	0.00	0.00	48.20	0.00	0.00	0.14	0.00	0.00	0.00	98.36
U STD	4.10	9.21	1.30	0.00	0.00	0.00	0.30	0.00	0.00	13.20	3.00	0.00	3.06	1.21	2.89	0.00	11.80	0.00	1.12	0.00	0.00	45.35	0.00	0.00	1.05	2.41	0.00	0.00	100.00
Glass 3	6.51	8.80	1.58	0.00	0.00	0.00	0.07	0.02	0.02	10.30	0.00	0.00	3.73	1.95	1.39	0.00	11.40	0.00	0.19	0.00	0.00	50.50	0.00	0.00	0.22	1.46	0.00	0.00	98.14
Glass 5	6.65	8.67	1.44	0.00	0.00	0.00	0.08	0.02	0.01	10.10	0.00	0.00	3.43	1.77	1.43	0.00	11.20	0.00	0.19	0.00	0.00	50.00	0.00	0.00	0.12	1.43	0.00	0.00	96.54
CST 07	2.94	7.79	0.98	0.00	0.00	0.00	0.13	0.03	0.03	11.25	0.09	0.00	4.05	0.09	1.93	0.00	8.97	0.00	0.88	0.00	0.00	53.43	0.00	0.00	1.81	2.86	0.00	0.64	97.90
CST 08	2.96	7.24	0.93	0.00	0.00	0.00	0.12	0.04	0.03	11.14	0.09	0.00	4.17	0.09	1.89	0.00	8.45	0.00	0.87	0.00	0.00	52.27	0.00	0.00	2.68	3.04	0.00	1.14	97.15
CST 09	2.83	7.10	0.99	0.00	0.00	0.00	0.13	0.04	0.04	11.98	0.12	0.00	3.72	0.09	1.91	0.00	8.73	0.00	0.89	0.00	0.00	50.40	0.00	0.00	3.81	2.51	0.00	1.66	96.95
CST 10	2.82	7.33	0.97	0.00	0.00	0.00	0.12	0.03	0.03	10.48	0.09	0.00	4.26	0.09	1.96	0.00	9.05	0.00	0.87	0.00	0.00	52.45	0.00	0.00	2.43	3.65	0.00	0.64	97.27
CST 11	2.89	7.71	1.01	0.00	0.00	0.00	0.12	0.03	0.03	11.91	0.09	0.00	3.98	0.09	2.00	0.00	9.05	0.00	0.93	0.00	0.00	52.49	0.00	0.00	3.53	2.50	0.00	1.17	99.53
CST 12	3.00	7.53	1.02	0.00	0.00	0.00	0.14	0.04	0.04	11.70	0.09	0.00	3.91	0.10	1.87	0.00	8.66	0.00	0.92	0.00	0.00	49.47	0.00	0.00	4.50	2.65	0.00	1.64	97.29
CST 01	2.74	8.25	0.91	0.00	0.00	0.00	0.14	0.04	0.04	9.72	0.19	0.00	4.71	0.06	1.83	0.00	8.87	0.00	0.85	0.00	0.00	55.39	0.00	0.00	2.03	2.02	0.00	0.41	98.19
CST 06	2.60	7.53	0.88	0.00	0.00	0.00	0.17	0.05	0.05	10.46	0.21	0.00	4.22	0.07	1.64	0.00	8.67	0.00	0.82	0.00	0.00	51.73	0.00	0.00	5.08	2.16	0.00	1.06	97.40
CST 14	3.90	7.40	1.21	0.00	0.00	0.00	0.15	0.05	0.04	13.87	0.18	0.00	4.01	0.08	2.30	0.00	9.65	0.00	1.08	0.00	0.00	50.58	0.00	0.00	2.91	3.22	0.00	1.26	101.89
CST 15	4.00	6.58	1.22	0.00	0.00	0.00	0.15	0.05	0.04	13.19	0.17	0.00	3.97	0.07	2.49	0.00	9.53	0.00	1.13	0.00	0.00	49.59	0.00	0.00	3.94	2.84	0.00	1.78	100.73
CST 12c	3.01	6.60	0.92	0.00	0.00	0.00	0.17	0.05	0.05	11.23	0.19	0.00	3.89	0.07	2.06	0.00	8.75	0.00	0.96	0.00	0.00	48.19	0.00	0.00	5.05	2.32	0.00	1.33	94.84
CST 20	6.28	8.54	0.54	0.00	0.00	0.00	0.10	0.02	0.02	7.16	0.18	0.00	4.40	0.15	1.95	0.00	8.76	0.00	0.32	0.00	0.00	55.85	0.00	0.00	3.08	0.72	0.00	0.93	99.01

Sample ID	Al_2O_3 (wt%)	B_2O_3 (wt%)	CaO (wt%)	CdO (wt%)	Ce_2O_3 (wt%)	CoO (wt%)	Cr_2O_3 (wt%)	CuO (wt%)	Cu_2O (wt%)	Fe_2O_3 (wt%)	K_2O (wt%)	La_2O_3 (wt%)	Li_2O (wt%)	MgO (wt%)	MnO (wt%)	MoO_3 (wt%)	Na_2O (wt%)	Nd_2O_3 (wt%)	NiO (wt%)	P_2O_5 (wt%)	PbO (wt%)	SiO_2 (wt%)	SrO (wt%)	ThO_2 (wt%)	TiO_2 (wt%)	U_3O_8 (wt%)	ZnO (wt%)	ZrO_2(wt%)	Sum Oxides (wt%)
CST 26	6.82	7.68	0.52	0.00	0.00	0.00	0.12	0.02	0.02	7.84	0.18	0.00	4.19	0.15	2.16	0.00	8.64	0.00	0.35	0.00	0.00	54.76	0.00	0.00	3.03	0.61	0.00	0.94	98.01
CST 32	8.01	6.95	0.54	0.00	0.00	0.00	0.12	0.03	0.03	8.44	0.21	0.00	3.98	0.18	2.63	0.00	8.73	0.00	0.42	0.00	0.00	52.57	0.00	0.00	3.10	1.04	0.00	0.97	97.93
PHA-01	2.86	9.15	1.00	0.00	0.00	0.00	0.17	0.29	0.26	9.55	3.09	0.00	4.66	1.45	2.06	0.00	8.69	0.00	0.90	0.00	0.00	51.83	0.00	0.00	1.11	1.54	0.00	0.10	98.72
PHA-03	2.53	9.34	0.92	0.00	0.00	0.00	0.16	0.50	0.45	9.57	5.84	0.00	4.37	1.35	1.69	0.00	8.01	0.00	0.81	0.00	0.00	49.16	0.00	0.00	1.12	2.76	0.00	0.14	98.74
PHA-12c	2.71	9.30	1.00	0.00	0.00	0.00	0.15	0.49	0.44	10.84	5.66	0.00	4.13	1.22	1.97	0.00	8.29	0.00	0.94	0.00	0.00	47.33	0.00	0.00	2.14	2.33	0.00	0.13	99.06
PHA-15c	3.32	8.52	1.35	0.00	0.00	0.00	0.16	0.51	0.46	13.62	5.39	0.00	3.80	1.21	2.50	0.00	8.69	0.00	1.19	0.00	0.00	41.74	0.00	0.00	1.13	2.61	0.00	0.20	96.40
PHA-32	7.12	8.01	0.60	0.00	0.00	0.00	0.13	0.39	0.35	7.92	4.57	0.00	3.93	1.08	2.72	0.00	7.82	0.00	0.42	0.00	0.00	49.45	0.00	0.00	1.12	0.92	0.00	0.17	96.70
PHA-07	2.76	7.40	1.05	0.00	0.00	0.00	0.13	0.26	0.23	10.85	3.07	0.00	4.47	1.42	1.94	0.00	7.91	0.00	0.90	0.00	0.00	51.04	0.00	0.00	0.69	2.63	0.00	0.14	96.89
PHA-08	2.82	8.44	1.06	0.00	0.00	0.00	0.12	0.36	0.33	11.20	4.33	0.00	4.30	1.36	1.95	0.00	8.22	0.00	0.90	0.00	0.00	50.77	0.00	0.00	0.70	2.16	0.00	0.13	99.17
PHA-09	2.82	9.07	1.03	0.00	0.00	0.00	0.12	0.40	0.36	10.47	5.27	0.00	4.26	1.30	1.98	0.00	8.21	0.00	0.89	0.00	0.00	48.94	0.00	0.00	0.70	2.56	0.00	0.14	98.53
PHA-10	2.74	7.69	1.04	0.00	0.00	0.00	0.12	0.26	0.24	10.20	3.11	0.00	4.53	1.37	1.93	0.00	8.18	0.00	0.87	0.00	0.00	52.18	0.00	0.00	1.36	2.41	0.00	0.13	98.38
PHA-11	2.77	8.65	1.04	0.00	0.00	0.00	0.12	0.35	0.32	10.40	4.24	0.00	4.32	1.32	1.91	0.00	8.27	0.00	0.90	0.00	0.00	52.11	0.00	0.00	1.33	2.46	0.00	0.13	100.64
PHA-12	2.73	9.38	1.05	0.00	0.00	0.00	0.12	0.43	0.38	10.88	5.49	0.00	4.15	1.26	1.91	0.00	8.37	0.00	0.89	0.00	0.00	49.50	0.00	0.00	1.35	2.46	0.00	0.13	100.46
PHA-14	3.58	10.07	1.13	0.00	0.00	0.00	0.14	0.37	0.33	13.47	4.42	0.00	3.96	1.50	2.26	0.00	9.54	0.00	1.06	0.00	0.00	45.91	0.00	0.00	0.74	2.92	0.00	0.18	101.59
PHA-15	3.58	11.66	1.20	0.00	0.00	0.00	0.15	0.48	0.43	14.27	4.90	0.00	3.73	1.40	2.24	0.00	10.35	0.00	1.08	0.00	0.00	42.01	0.00	0.00	0.72	1.99	0.00	0.19	100.39
PHA-17	3.61	9.52	1.20	0.00	0.00	0.00	0.15	0.37	0.33	13.45	4.84	0.00	3.94	1.44	2.43	0.00	9.47	0.00	1.10	0.00	0.00	45.38	0.00	0.00	1.44	2.49	0.00	0.18	101.35
PHA-18	3.51	11.89	1.25	0.00	0.00	0.00	0.15	0.48	0.43	13.94	5.21	0.00	3.79	1.41	2.21	0.00	10.45	0.00	1.05	0.00	0.00	43.35	0.00	0.00	1.46	3.09	0.00	0.22	103.87
MHSi-6	19.43	15.79	0.33	0.00	0.02	0.01	0.08	0.01	0.01	1.67	1.66	0.00	0.02	0.20	0.04	0.01	13.30	0.01	0.40	0.71	0.02	40.51	0.00	0.00	0.07	3.03	0.03	0.09	97.48
MLSi-3B	15.44	32.62	0.25	0.00	0.08	0.01	0.08	0.01	0.01	1.43	0.87	0.01	0.06	0.19	0.03	0.01	9.43	0.04	0.60	0.41	0.04	31.44	0.00	0.00	0.07	4.32	0.02	0.02	97.53
MHSi-11A	24.36	7.15	0.39	0.00	0.00	0.00	0.09	0.01	0.01	2.00	1.74	0.00	6.82	0.21	0.05	0.00	7.27	0.00	0.42	0.76	0.00	44.54	0.00	0.00	0.00	3.36	0.00	0.04	99.21
MLSi-9	22.28	14.47	0.25	0.00	0.02	0.01	0.07	0.01	0.01	1.26	0.70	0.00	0.00	0.18	0.03	0.01	27.09	0.01	0.51	0.22	0.02	28.61	0.00	0.00	0.06	3.88	0.02	0.01	99.75
MLSi-1	20.70	11.16	0.33	0.00	0.07	0.01	0.08	0.02	0.01	1.55	1.13	0.01	0.40	0.24	0.03	0.01	12.26	0.04	0.72	0.51	0.04	38.98	0.00	0.00	0.08	5.66	0.03	0.04	94.14
MN-5D	29.02	11.69	0.29	0.00	0.00	0.00	0.09	0.01	0.01	1.74	1.09	0.00	0.00	0.19	0.03	0.00	11.89	0.00	0.48	0.57	0.00	34.15	0.00	0.00	0.00	3.88	0.00	0.00	95.14
MN-3	14.61	28.26	0.31	0.00	0.02	0.03	0.09	0.01	0.01	1.55	1.28	0.00	0.02	0.21	0.03	0.01	7.96	0.01	0.50	0.37	0.03	35.55	0.00	0.00	0.08	4.20	0.03	0.02	95.21
MN-11	17.77	10.65	0.00	0.27	0.02	0.01	0.08	0.00	0.00	1.59	0.00	0.00	0.00	7.74	0.03	0.01	8.58	0.01	0.52	0.63	0.02	37.97	0.00	0.00	0.06	4.20	0.02	0.02	90.20
MN-2	16.85	21.83	0.01	0.30	0.02	0.01	0.09	0.01	0.01	1.63	0.00	0.00	0.00	0.01	0.03	0.01	8.75	0.01	0.55	0.50	0.04	38.76	0.00	0.00	0.08	4.44	0.03	0.02	94.04
VIS-1 30%WL	4.79	5.52	0.87	0.00	0.06	0.00	0.07	0.02	0.02	9.50	0.08	0.03	5.66	1.09	2.08	0.00	11.99	0.00	0.53	0.00	0.05	52.56	0.00	0.06	0.02	3.01	0.05	0.07	98.17
VIS-2 33%WL	5.26	5.30	0.95	0.00	0.06	0.00	0.07	0.02	0.02	10.06	0.09	0.03	5.47	1.13	2.27	0.00	12.49	0.00	0.54	0.00	0.05	49.89	0.00	0.06	0.02	3.37	0.06	0.08	97.33
VIS-3- 35%WL	5.66	5.66	1.05	0.00	0.06	0.00	0.09	0.02	0.02	10.69	0.09	0.04	5.28	1.24	2.44	0.00	12.89	0.00	0.60	0.00	0.05	49.78	0.00	0.06	0.21	3.45	0.49	0.08	100.02
VIS-4- 37%WL	5.96	5.09	1.07	0.00	0.07	0.00	0.10	0.02	0.02	11.58	0.10	0.04	5.10	1.29	2.57	0.00	13.21	0.00	0.61	0.00	0.05	47.11	0.00	0.06	0.02	3.77	0.06	0.08	98.02
VIS-5- 40%WL	6.51	4.69	1.14	0.00	0.06	0.00	0.10	0.03	0.02	12.42	0.12	0.04	4.92	1.37	2.84	0.00	13.86	0.00	0.65	0.00	0.06	45.95	0.00	0.06	0.02	4.08	0.07	0.09	99.17
VIS 6-45%WL	7.12	4.38	1.30	0.00	0.08	0.00	0.00	0.03	0.03	13.39	0.13	0.04	4.52	1.50	3.08	0.00	14.09	0.00	0.69	0.00	0.06	42.28	0.00	0.06	0.02	4.46	0.09	0.09	97.51

APPENDIX D

Table DI. Uranium-Thorium Glass Viscosity-Temperature Database

Sample ID	COMMENT	Chemistry Laboratory	Viscosity Laboratory	Temperature (°C)	Viscosity (poise)	SUM OXIDES
RCTH-30 (PHF OL/165Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1145.5	20.87	OK
RCTH-30 (PHF OL/165Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1092	32.77	OK
RCTH-30 (PHF OL/165Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1048	49.62	OK
RCTH-30 (PHF OL/165Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	996	87.42	OK
RCTH-30 (PHF OL/165Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1147.5	21.25	OK
RCTH-40 (PHF OL/2005Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1144.5	38.01	OK
RCTH-40 (PHF OL/200Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1200.5	24.75	OK
RCTH-40 (PHF OL/2005Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1256	17.18	OK
RCTH-40 (PHF OL/200Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1146	36.70	OK
RCTH-40 (PHF OL/200Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1090.5	59.10	OK
RCTH-40 (PHF OL/200Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1046	93.75	OK
RCTH-40 (PHF OL/200Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1146.5	38.37	OK
RCTH-50 (PHF OL/320Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1149	23.34	OK
RCTH-50 (PHF OL/320Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1203.5	16.36	OK
RCTH-50 (PHF OL/320Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1150.5	23.34	OK
RCTH-50 (PHF OL/320Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1096	35.22	OK
RCTH-50 (PHF OL/320Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1045	56.22	OK
RCTH-50 (PHF OL/320Frit at 35% WL)	WSRC-TR-2003-00386	SRTC/ML	SRNL	1148.5	24.44	OK
Wvcm-39		West Valley, 1988		1150	37.00	OK
Wvcm-39		West Valley, 1988		1100	55.00	OK
Wvcm-39		West Valley, 1988		1050	88.00	OK
Wvcm-39		West Valley, 1988		1000	149.00	OK
Wvcm-40		West Valley, 1988		1150	45.00	OK
Wvcm-40		West Valley, 1988		1100	67.00	OK
Wvcm-40		West Valley, 1988		1050	106.00	OK
Wvcm-40		West Valley, 1988		1000	181.00	OK
Wvcm-41		West Valley, 1988		1150	73.00	OK
Wvcm-41		West Valley, 1988		1100	110.00	OK
Wvcm-41		West Valley, 1988		1050	175.00	OK

Sample ID	COMMENT	Chemistry Laboratory	Viscosity Laboratory	Temperature (°C)	Viscosity (poise)	SUM OXIDES
Wvcm-41		West Valley, 1988		1000	300.00	OK
Wvcm-42		West Valley, 1988		1150	74.00	OK
Wvcm-42		West Valley, 1988		1100	105.00	OK
Wvcm-42		West Valley, 1988		1050	167.00	OK
Wvcm-42		West Valley, 1988		1000	289.00	OK
Wvcm-44		West Valley, 1988		1150	87.00	OK
Wvcm-44		West Valley, 1988		1100	133.00	OK
Wvcm-44		West Valley, 1988		1050	217.00	OK
Wvcm-44		West Valley, 1988		1000	381.00	OK
Wvcm-45		West Valley, 1988		1150	156.00	OK
Wvcm-45		West Valley, 1988		1100	254.00	OK
Wvcm-45		West Valley, 1988		1050	447.00	OK
Wvcm-45		West Valley, 1988		1000	854.00	OK
Wvcm-46		West Valley, 1988		1150	165.00	OK
Wvcm-46		West Valley, 1988		1100	272.00	OK
Wvcm-46		West Valley, 1988		1050	485.00	OK
Wvcm-46		West Valley, 1988		1000	950.00	OK
Wvcm-47		West Valley, 1988		1150	108.00	OK
Wvcm-47		West Valley, 1988		1100	172.00	OK
Wvcm-47		West Valley, 1988		1050	295.00	OK
Wvcm-47		West Valley, 1988		1000	549.00	OK
Wvcm-48		West Valley, 1988		1150	40.00	OK
Wvcm-48		West Valley, 1988		1100	60.00	OK
Wvcm-48		West Valley, 1988		1050	96.00	OK
Wvcm-48		West Valley, 1988		1000	165.00	OK
Wvcm-50		West Valley, 1988		1150	64.00	OK
Wvcm-50		West Valley, 1988		1100	104.00	OK
Wvcm-50		West Valley, 1988		1050	179.00	OK
Wvcm-50		West Valley, 1988		1000	330.00	OK
Wvcm-53		West Valley, 1988		1150	100.00	OK
Wvcm-53		West Valley, 1988		1100	164.00	OK
Wvcm-53		West Valley, 1988		1050	280.00	OK
Wvcm-53		West Valley, 1988		1000	504.00	OK
Wvcm-56		West Valley, 1988		1150	42.00	OK

Sample ID	COMMENT	Chemistry Laboratory	Viscosity Laboratory	Temperature (°C)	Viscosity (poise)	SUM OXIDES
Wvcm-56		West Valley, 1988		1100	65.00	OK
Wvcm-56		West Valley, 1988		1050	105.00	OK
Wvcm-56		West Valley, 1988		1000	179.00	OK
Wvuth-7		West Valley, 1988		1150	96.00	OK
Wvuth-7		West Valley, 1988		1100	147.00	OK
Wvuth-7		West Valley, 1988		1050	241.00	OK
Wvuth-7		West Valley, 1988		1000	424.00	OK
Wvuth-8		West Valley, 1988		1150	48.00	OK
Wvuth-8		West Valley, 1988		1100	78.00	OK
Wvuth-8		West Valley, 1988		1050	137.00	OK
Wvuth-8		West Valley, 1988		1000	259.00	OK
Wvuth-12		West Valley, 1988		1150	41.00	OK
Wvuth-12		West Valley, 1988		1100	69.00	OK
Wvuth-12		West Valley, 1988		1050	121.00	OK
Wvuth-12		West Valley, 1988		1000	226.00	OK
Wvuth-13		West Valley, 1988		1150	50.00	OK
Wvuth-13		West Valley, 1988		1100	74.00	OK
Wvuth-13		West Valley, 1988		1050	117.00	OK
Wvuth-13		West Valley, 1988		1000	199.00	OK
Wvuth-14		West Valley, 1988		1150	35.00	OK
Wvuth-14		West Valley, 1988		1100	56.00	OK
Wvuth-14		West Valley, 1988		1050	94.00	OK
Wvuth-14		West Valley, 1988		1000	167.00	OK
Wvuth-15		West Valley, 1988		1150	53.00	OK
Wvuth-15		West Valley, 1988		1100	88.00	OK
Wvuth-15		West Valley, 1988		1050	150.00	OK
Wvuth-15		West Valley, 1988		1000	265.00	OK
Wvuth-19		West Valley, 1988		1150	48.00	OK
Wvuth-19		West Valley, 1988		1100	76.00	OK
Wvuth-19		West Valley, 1988		1050	126.00	OK
Wvuth-19		West Valley, 1988		1000	220.00	OK
Wvuth-22		West Valley, 1988		1150	59.00	OK
Wvuth-22		West Valley, 1988		1100	96.00	OK
Wvuth-22		West Valley, 1988		1050	161.00	OK

Sample ID	COMMENT	Chemistry Laboratory	Viscosity Laboratory	Temperature (°C)	Viscosity (poise)	SUM OXIDES
Wvuth-22		West Valley, 1988		1000	279.00	OK
Wvuth-23		West Valley, 1988		1150	64.00	OK
Wvuth-23		West Valley, 1988		1100	105.00	OK
Wvuth-23		West Valley, 1988		1050	182.00	OK
Wvuth-23		West Valley, 1988		1000	332.00	OK
Wvuth-28		West Valley, 1988		1150	66.00	OK
Wvuth-28		West Valley, 1988		1100	109.00	OK
Wvuth-28		West Valley, 1988		1050	191.00	OK
Wvuth-28		West Valley, 1988		1000	357.00	OK
Wvuth-37		West Valley, 1988		1150	37.00	OK
Wvuth-37		West Valley, 1988		1100	58.00	OK
Wvuth-37		West Valley, 1988		1050	94.00	OK
Wvuth-37		West Valley, 1988		1000	162.00	OK

Table DII. Uranium-Thorium Glass Composition Database

Sample ID	Al2O3 (wt%)	B2O3 (wt%)	BaO (wt%)	CaO (wt%)	Ce2O3 (wt%)	Cr2O3 (wt%)	Cs2O (wt%)	CuO (wt%)	Cu2O (wt%)	Fe2O3 (wt%)	K2O (wt%)	Li2O (wt%)	MgO (wt%)	MnO (wt%)	Na2O (wt%)	Nd2O3 (wt%)	NiO (wt%)	P2O5 (wt%)	SO4 (wt%)	SiO2 (wt%)	ThO2 (wt%)	TiO2 (wt%)	U3O8 (wt%)	ZrO2 (wt%)	Sum Oxides (wt%)
RCTH-30 (PHF OL/165Frit at 35% WL)	3.46	6.36	0.00	0.66	0.00	0.10	0.00	0.00	0.00	10.94	0.00	4.61	1.62	3.80	12.92	0.00	2.73	0.10	0.00	45.01	2.80	0.00	2.76	0.57	98.45
RCTH-40 (PHF OL/2005Frit at 35% WL)	3.43	6.82	0.00	0.66	0.00	0.13	0.00	0.00	0.00	10.98	0.00	2.93	2.09	3.70	11.12	0.00	2.59	0.12	0.00	46.39	2.66	0.00	3.08	0.05	96.76
RCTH-50 (PHF OL/320Frit at 35% WL)	3.37	5.05	0.00	0.65	0.00	0.13	0.00	0.00	0.00	11.26	0.00	5.16	0.98	3.77	12.16	0.00	2.65	0.13	0.00	47.24	2.75	0.00	2.77	0.07	98.12
Wvcm-39	3.10	9.80	0.20	1.00	0.10	0.10	0.10	0.05	0.04	12.50	2.00	2.70	1.00	1.22	13.30	0.20	0.40	0.88	0.24	43.30	3.60	1.00	0.62	0.60	98.06
Wvcm-40	3.00	9.80	0.20	1.00	0.10	0.30	0.10	0.00	0.00	12.30	3.50	3.00	1.30	1.14	10.80	0.20	0.40	0.82	0.24	44.30	3.60	1.00	0.62	0.50	98.21
Wvcm-41	3.00	8.90	0.20	0.90	0.10	0.30	0.10	0.00	0.00	12.40	3.50	3.00	1.30	1.06	9.80	0.20	0.30	0.82	0.24	46.40	3.60	1.00	0.62	0.40	98.13
Wvcm-42	5.00	9.80	0.20	1.00	0.10	0.30	0.10	0.00	0.00	12.50	1.90	2.80	1.30	1.14	10.60	0.20	0.30	0.82	0.24	44.10	3.60	1.00	0.62	0.50	98.11
Wvcm-44	6.50	9.00	0.20	0.90	0.10	0.30	0.10	0.00	0.00	11.60	3.20	2.70	1.20	1.06	9.90	0.20	0.30	0.75	0.24	44.80	3.30	0.90	0.52	0.40	98.16
Wvcm-45	8.00	7.40	0.20	0.80	0.10	0.30	0.10	0.00	0.00	12.30	1.60	3.00	1.30	1.06	10.20	0.20	0.30	0.82	0.24	44.70	3.60	1.00	0.62	0.40	98.23
Wvcm-46	8.00	9.90	0.20	0.70	0.10	0.30	0.10	0.00	0.00	12.10	1.60	2.00	1.30	1.06	8.90	0.20	0.30	0.82	0.24	44.70	3.60	1.00	0.62	0.30	98.03
Wvcm-47	8.00	12.40	0.10	0.60	0.10	0.30	0.10	0.00	0.00	12.10	1.30	2.00	1.30	1.06	9.20	0.20	0.30	0.82	0.24	42.30	3.60	1.00	0.62	0.30	97.93
Wvcm-48	8.60	9.60	0.20	1.00	0.10	0.30	0.10	0.00	0.00	13.10	2.50	2.90	0.90	1.14	10.70	0.20	0.30	0.20	0.24	41.00	3.90	1.00	0.62	0.50	99.10
Wvcm-50	9.90	12.30	0.20	0.80	0.67	0.10	0.10	0.00	0.00	11.90	1.60	2.20	0.80	0.98	9.80	0.10	0.30	0.82	0.24	39.60	3.50	0.80	0.62	0.40	97.72
Wvcm-53	10.20	12.60	0.00	0.20	0.67	0.10	0.10	0.00	0.00	12.20	0.90	2.00	0.00	0.82	10.90	0.20	0.30	0.85	0.24	41.10	3.60	0.00	0.62	0.20	97.79
Wvcm-56	8.80	14.00	0.20	0.80	0.76	0.20	0.10	0.00	0.00	10.90	1.60	2.40	0.90	0.98	8.90	0.20	0.30	0.20	0.24	42.00	3.90	0.90	0.73	0.40	99.40
Wvuth-7	8.20	9.30	0.20	0.90	0.10	0.30	0.10	0.00	0.00	11.60	3.30	2.80	1.20	1.14	10.20	0.20	0.30	0.75	0.24	41.90	3.40	0.90	0.62	0.40	98.05
Wvuth-8	2.90	9.30	0.20	0.90	0.10	0.30	0.10	0.00	0.00	11.70	3.30	2.80	1.20	1.14	10.20	0.20	0.30	0.75	0.24	42.00	3.40	0.90	0.62	5.50	98.05
Wvuth-12	10.00	12.30	0.20	0.90	0.10	0.30	0.10	0.00	0.00	12.00	2.50	2.70	1.20	1.06	9.80	0.20	0.30	0.20	0.24	39.80	3.50	0.90	0.62	0.40	99.31
Wvuth-13	11.90	12.30	0.20	0.90	0.10	0.30	0.10	0.00	0.00	12.00	2.50	2.70	1.20	1.06	9.80	0.20	0.30	0.20	0.24	37.80	3.50	0.90	0.62	0.40	99.22
Wvuth-14	9.90	12.40	0.20	0.90	0.10	0.30	0.10	0.00	0.00	12.00	2.50	2.70	1.20	1.06	9.80	0.20	0.30	0.78	0.24	37.90	3.50	0.90	0.62	0.40	98.00
Wvuth-15	10.00	10.40	0.20	0.90	0.10	0.30	0.10	0.00	0.00	12.00	2.50	2.70	1.20	1.06	9.80	0.20	0.30	0.82	0.24	39.90	3.50	0.90	0.62	0.40	98.13
Wvuth-19	9.70	12.00	0.20	0.80	0.67	0.10	0.10	0.00	0.00	11.70	1.60	2.20	0.80	0.98	11.60	0.10	0.30	0.78	0.24	38.80	3.50	0.80	0.62	0.40	97.99
Wvuth-22	9.70	14.10	0.20	0.80	0.67	0.10	0.10	0.00	0.00	11.70	1.60	2.20	0.80	0.98	9.60	0.10	0.30	0.78	0.24	38.80	3.40	0.80	0.62	0.40	97.99
Wvuth-23	9.50	11.80	0.20	0.80	0.67	0.10	0.10	0.00	0.00	15.30	1.50	2.10	0.80	0.98	9.40	0.10	0.30	0.78	0.24	38.10	3.40	0.80	0.62	0.40	97.99
Wvuth-28	9.90	10.30	0.20	0.70	0.67	0.30	0.10	0.00	0.00	11.90	1.90	1.90	1.30	1.06	11.80	0.20	0.30	0.82	0.00	39.60	3.50	0.70	0.62	0.30	98.07
Wvuth-37	10.10	12.90	0.20	0.80	0.67	0.10	0.10	0.00	0.00	12.20	1.30	4.40	0.90	0.98	8.20	0.30	0.20	0.82	0.24	40.40	1.80	0.90	0.00	0.30	97.80