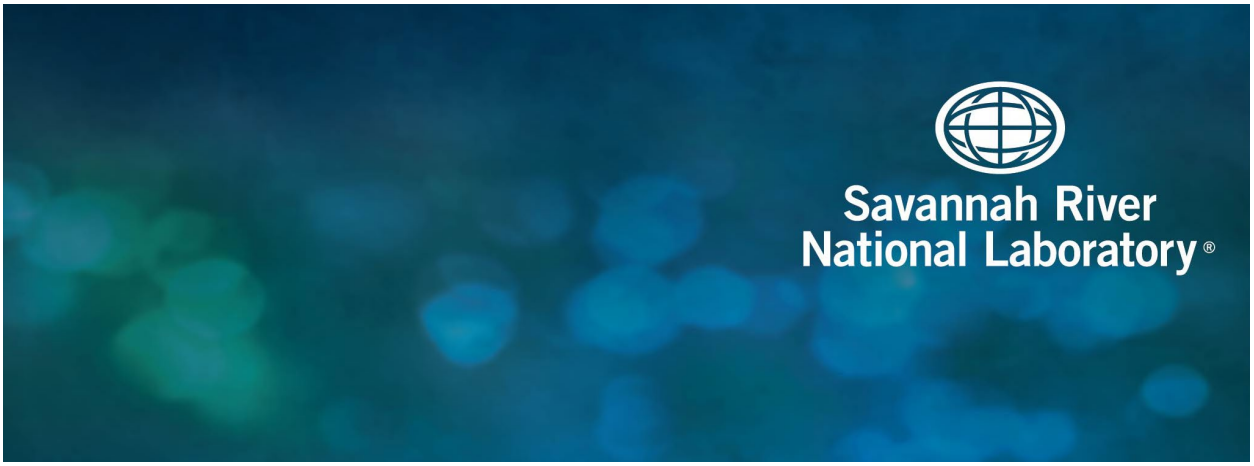
Contract No:

This document was prepared in conjunction with work accomplished under Contract No. 89303321CEM000080 with the U.S. Department of Energy (DOE) Office of Environmental Management (EM).

Disclaimer:



A U.S. DEPARTMENT OF ENERGY NATIONAL LAB • SAVANNAH RIVER SITE • AIKEN, SC • USA

Characterization of the Sulfur-Saturated Melt Versions of the LAW HPVR Glasses

M. C. Hsieh

November 2022

SRNL-STI-2022-00553, Revision 0

DISCLAIMER

Printed in the United States of America

Prepared for
U.S. Department of Energy

SRNL-STI-2022-00553
Revision 0

Keywords: *Hanford, WTP, low-activity waste, waste glass*

Retention: *Lifetime*

Characterization of the Sulfur-Saturated Melt Versions of the LAW HPVR Glasses

M. C. Hsieh

November 2022

Savannah River National Laboratory is operated by Battelle Savannah River Alliance for the U.S. Department of Energy under Contract No. 89303321CEM000080.

REVIEWS AND APPROVALS

AUTHORS:

_____
M. C. Hsieh, Applied Materials Research

TECHNICAL REVIEW:

_____
A. N. Stanfield, Applied Materials Research, Reviewed per E7 2.60

APPROVAL:

_____
J. Manna, Division Director, Environmental and Legacy Management

ACKNOWLEDGEMENTS

The author would like to thank Matthew Alexander, Daniel Jones, and Whitney Riley at Savannah River National Laboratory for their skilled assistance with the sample and data analyses described in this report. The author thanks Viviana Gervasio and Renee Russell at Pacific Northwest National Laboratory for helpful discussions and review of these data and the report. Funding from the U.S. Department of Energy through Inter-Entity Work Order HAN-M0SRV00101 as managed by Albert A. Kruger is gratefully acknowledged.

EXECUTIVE SUMMARY

This report provides the results from the chemical analyses of a sulfur-saturated melt versions of the Low-Activity Waste High PCT and VHT Response study glasses, which are a series of simulated nuclear waste glasses designed and fabricated at Pacific Northwest National Laboratory. These data will be used in the development, validation, and implementation of enhanced property/composition models for waste glass vitrification at Hanford.

Chemical analyses were performed on a representative sample of each of the sulfur-saturated melt versions of the glasses to allow for comparisons with targeted compositions, as well as the measured compositions of the quenched glasses. The relative differences between the targeted and measured concentrations of B_2O_3, K_2O, Li_2O, V_2O_5, and ZrO_2 for several of the glasses were greater than ±10%. The relative difference between the targeted and measured concentrations of SO_3 were greater than 10% for all study glasses.

The wash solutions contained mainly sodium, sulfur, and sulfate ions.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ABBREVIATIONS

BDL	below detection limit
DOE	U. S. Department of Energy
hpstd	High Purity Standards ICP multi-element custom solution SM-744-063
HPVR	High PCT and VHT Response Glass
IC	ion chromatography
ICP-OES	inductively coupled plasma – optical emission spectroscopy
ID	identifier
KH	potassium hydroxide fusion
LAW	low-activity waste
LM	lithium metaborate fusion
LRM	low-activity test reference material
ORP	Office of River Protection
PCT	Product Consistency Test
PF	sodium peroxide fusion
PNNL	Pacific Northwest National Laboratory
Q	quenched
seq	sequence
SRNL	Savannah River National Laboratory
SRS	Savannah River Site
SSM	sulfur-saturated melt
std	High Purity Standards ICP multi-element custom solution SM-744-013
TTQAP	Task Technical and Quality Assurance Plan
VHT	Vapor Hydration Test
wt.%	weight percent
WTP	Hanford Waste Treatment and Immobilization Plant

1.0 Introduction

The U.S. Department of Energy (DOE) is responsible for building the Hanford Tank Waste Treatment and Immobilization Plant (WTP) at the Hanford site in Washington to remediate 56 million gallons of radioactive waste historically stored in 177 underground tanks. The Office of River Protection (ORP) has requested that the Savannah River National Laboratory (SRNL) contribute in areas of recognized capabilities and expertise for glass waste form development to support successful startup of the WTP.

Successful efforts have allowed for demonstration of greatly enhanced treatment efficiencies of those projected from the minimum requirements set forth in the WTP Contract[a]. Additional flexibility and expansion of the qualified glass forming region are the current focus.[1] SRNL support of this work is defined in the Task Technical and Quality Assurance Plan (TTQAP).[2]

This report provides results from the chemical analyses of the sulfur-saturated melt (SSM) versions of the Low-Activity Waste High PCT and VHT Response (LAW HPVR) study glasses, a series of simulated nuclear waste glasses designed and fabricated at Pacific Northwest National Laboratory (PNNL). The glasses were selected as part of a broader study of the influence of glass composition on chemical durability, sulfur retention, and other properties.[3] The resulting data will be used in the development, validation, and implementation of enhanced property/composition models for nuclear waste glasses.[1]

2.0 Experimental Procedure

2.1 Quality Assurance

Requirements for performing reviews of technical reports and the extent of review are established in Savannah River Site (SRS) Manual E7, Procedure 2.60.[4] SRNL documents the extent and type of review using the SRNL Technical Report Design Checklist contained in WSRC-IM-2002-00011.[5] Laboratory data for this study were recorded in the SRNL Electronic Laboratory Notebook system, experiment L6390-00441-05. The glasses provided by PNNL were designed and fabricated following a Task Plan.[1]

2.2 Glasses Selected for Study

The baseline (quenched) glass compositions in this study were designed and fabricated by PNNL. Characterization of the baseline glasses were reported earlier.[6] Samples of each of the SSM versions of the study glasses, along with samples of the wash solutions resulting from the preparation of each of the SSM glasses, were received at SRNL for chemical composition analysis. The PNNL identifiers (IDs) for the glass samples and associated SRNL sample identifiers are listed in Table 2-1. The identifiers for the wash solutions are likewise listed in

[a] Contract DE-AC27-01RV14136, as amended, U.S. Department of Energy, Richland, WA (2000).

Table 2-2.

Table 2-1. Identifiers for the LAW HPVR SSM Study Glasses

PNNL Glass ID	Lab ID
LAW-HPVR-01-1-SSM-S	S-13867
LAW-HPVR-02-1-SSM-S	S-13868
LAW-HPVR-03-1-SSM-S	S-13869
LAW-HPVR-04-1-SSM-S	S-13870
LAW-HPVR-05-SSM-S	S-13871
LAW-HPVR-06-SSM-S	S-13872
LAW-HPVR-07-SSM-S	S-13873
LAW-HPVR-08-SSM-S	S-13874
LAW-HPVR-09-SSM-S	S-13875
LAW-HPVR-10-SSM-S	S-13876
LAW-HPVR-11-SSM-S	S-13877
LAW-HPVR-12-SSM-S	S-13878
LAW-HPVR-13-SSM-S	S-13879
LAW-HPVR-14-SSM-S	S-13880
LAW-HPVR-15-SSM-S	S-13881
LAW-HPVR-16-SSM-S	S-13882
LAW-HPVR-17-SSM-S	S-13883
LAW-HPVR-18-SSM-S	S-13884
LAW-HPVR-19-SSM-S	S-13885
LAW-HPVR-20-SSM-S	S-13886
LAW-HPVR-21-SSM-S	S-13887
LAW-HPVR-22-SSM-S	S-13888
LAW-HPVR-23-SSM-S	S-13889
LAW-HPVR-24-SSM-S	S-13890
LAW-HPVR-25-SSM-S	S-13891
LAW-HPVR-26-SSM-S	S-13892
LAW-HPVR-SSM-S	S-13893

Table 2-2. Identifiers for the LAW HPVR SSM Wash Solutions

PNNL Wash Solution ID	Lab ID
LAW-HPVR-01-1-SSM-W	S-13894
LAW-HPVR-02-1-SSM-W	S-13895
LAW-HPVR-03-1-SSM-W	S-13896
LAW-HPVR-04-1-SSM-W	S-13897
LAW-HPVR-05-SSM-W	S-13898
LAW-HPVR-06-SSM-W	S-13899
LAW-HPVR-07-SSM-W	S-13900
LAW-HPVR-08-SSM-W	S-13901
LAW-HPVR-09-SSM-W	S-13902
LAW-HPVR-10-SSM-W	S-13903
LAW-HPVR-11-SSM-W	S-13904
LAW-HPVR-12-SSM-W	S-13905
LAW-HPVR-13-SSM-W	S-13906
LAW-HPVR-14-SSM-W	S-13907
LAW-HPVR-15-SSM-W	S-13908
LAW-HPVR-16-SSM-W	S-13909
LAW-HPVR-17-SSM-W	S-13910
LAW-HPVR-18-SSM-W	S-13911
LAW-HPVR-19-SSM-W	S-13912
LAW-HPVR-20-SSM-W	S-13913
LAW-HPVR-21-SSM-W	S-13914
LAW-HPVR-22-SSM-W	S-13915
LAW-HPVR-23-SSM-W	S-13916
LAW-HPVR-24-SSM-W	S-13917
LAW-HPVR-25-SSM-W	S-13918
LAW-HPVR-26-SSM-W	S-13919
LAW-HPVR-SSM-W	S-13920

2.3 Glass Composition Analysis

Chemical analyses were performed under the auspices of an analytical plan[7] on a representative sample of each of the glasses listed in Table 2-1 to allow for comparisons with the targeted compositions. Three dissolution techniques were used for preparing each of the glass samples, in duplicate, for analysis (potassium hydroxide fusion (KH), lithium metaborate fusion (LM), and sodium peroxide fusion (PF)).[8-10] Note that for some analytes, the analytical plan specified more than one preparation method for analysis. The results were reviewed and, in general, the method that provided better recovery of the analyte was selected for reporting.

Each of the duplicate samples was analyzed twice for each element of interest by inductively coupled plasma – optical emission spectroscopy (ICP-OES)[11] or ion chromatography (IC),[12] for a total of four measurements per element per glass. Glass standards were also intermittently measured to assess the performance of the ICP-OES and IC instruments over the course of these analyses. Specifically, several samples of the low-activity test reference material (LRM) were included as part of the analytical plans. The LRM composition reported as the "Consensus Average" is used as the reference composition of this glass.[13] The preparation and measurement methods used for each of the reported glass components are listed in Table 2-3.

Table 2-3. Preparation and Measurement Methods Used in Reporting the Analyte Concentrations of the Study Glasses

Analyte	Measurement Method	Preparation Method
Al	ICP-OES	LM
B	ICP-OES	PF
Ca	ICP-OES	LM
Cl	IC	KH
Cr	ICP-OES	LM
F	IC	KH
Fe	ICP-OES	LM
K	ICP-OES	LM
Li	ICP-OES	PF
Mg	ICP-OES	LM
Na	ICP-OES	LM
P	ICP-OES	LM
S	ICP-OES	LM
Si	ICP-OES	PF
Sn	ICP-OES	LM
Ti	ICP-OES	LM
V	ICP-OES	LM
Zn	ICP-OES	LM
Zr	ICP-OES	LM

2.4 Wash Solution Analysis

Chemical analyses were performed under the auspices of an analytical plan[7] on a representative sample of each of the wash solutions resulting from the preparation of the SSM versions of the glasses, as listed in

Table 2-2. The samples were diluted at SRNL based on the expected concentrations of the species in solution in preparation for the analysis.

Each of the samples was analyzed in triplicate for each element of interest by ICP-OES[11] and IC[12]. Solution standards and blanks were also intermittently measured to assess the performance of the ICP-OES and IC instruments over the course of these analyses. The measurement methods used for each of the reported wash solution components are listed in Table 2-4.

Table 2-4. Measurement Methods Used in Reporting the Analyte Concentrations of the Wash Solutions

Analyte	Measurement Method
Al	ICP-OES
B	ICP-OES
Ca	ICP-OES
Cl^-	IC
Cr	ICP-OES
F^-	IC
Fe	ICP-OES
K	ICP-OES
Li	ICP-OES
Mg	ICP-OES
Na	ICP-OES
P	ICP-OES
PO_4^{3-}	IC
S	ICP-OES
SO_4^{2-}	IC
Si	ICP-OES
Sn	ICP-OES
Ti	ICP-OES
V	ICP-OES
Zn	ICP-OES
Zr	ICP-OES

3.0 Results and Discussion

JMP® Version 16.0.0 (SAS Institute, Inc.)[14] was used to support these analyses.

3.1 Review and Evaluation of the SSM Glass Composition Measurements

Table A-1, Table A-2, and Table A-3 in Appendix A provide the elemental concentration measurements in weight percent (wt.%) from glasses prepared using KH, LM, and PF methods, respectively. Elemental measurements for samples of the LRM glass are also included in these tables of Appendix A.

3.1.1 Treatment of Detection Limits

The elemental concentrations in Table A-1, Table A-2, and Table A-3 in Appendix A were converted to oxide concentrations by multiplying the values of each element by the gravimetric factor for the corresponding oxide. A concentration measurement that was reported to be below the detection limit was set to the detection limit for the purposes of data review and calculating a sum of oxides for each glass.

Concentration measurements that were below the detection limit (BDL) are denoted with a less than symbol (<).

3.1.2 Composition Measurements by Glass Identifier

Exhibit A-1 in Appendix A provides plots of the oxide concentration measurements by the PNNL Glass ID (including the LRM glasses) by Lab ID grouped by targeted concentration. Different symbols and colors are used to represent the different glasses. These plots show the individual measurements across the duplicates of each preparation method and the two instrument calibrations for each glass. Plotting the data in this format provides an opportunity to review the values for each individual glass as a function of the duplicate preparations and duplicate measurements. A review of the plots presented in these exhibits reveals the repeatability of the four individual values for each oxide for each glass. There were no indications of errors in preparation or measurement that had to be addressed in treatment of the data.

3.1.3 Results for the LRM Standard Glass

Exhibit A-2 in Appendix A provides a comparison of the LRM results to their acceptability limits utilized by SRNL.[11] The review is in the form of plots of the measurements arranged by preparation method and element, framed by upper and lower acceptability limits for the concentration of each element of interest. The results show that all measurements of the LRM elements of interest were within the acceptability limits during the execution of these analyses.

3.1.4 Measured versus Target Compositions

All measurements for each oxide for each glass (Table A-1, Table A-2, and Table A-3 in Appendix A) were used in calculating oxide values, which were then averaged to determine a representative chemical composition for each glass. A sum of oxides was also computed for each glass based upon the averaged oxide values. Exhibit A-3 in Appendix A provides plots showing the results for each glass for each oxide to allow PNNL to draw comparisons between the measured and targeted values.

Table A-4 in Appendix A provides a summary of the average compositions, targeted compositions and some associated differences and relative differences. The measured sums of oxides for all glasses fall within the interval of 95.6 wt.% to 98.3 wt. %, indicating acceptable recovery of the glass components.[15] Entries in Table A-4 show the relative differences between the measured and targeted values for the analytes with measured and targeted values above 1 wt.%. The relative differences were shaded if they are 10% or more and are summarized below.

- B_2O_3 relative differences were 10% or greater for LAW-HPVR-01-1-SSM-S, LAW-HPVR-04-1-SSM-S, LAW-HPVR-07-SSM-S, LAW-HPVR-09-SSM-S, LAW-HPVR-10-SSM-S, LAW-HPVR-12-SSM-S, LAW-HPVR-14-SSM-S, LAW-HPVR-19-SSM-S, LAW-HPVR-20-SSM-S, LAW-HPVR-24-SSM-S, and LAW-HPVR-25-SSM-S.
- The K_2O relative differences were greater than 10% for LAW-HPVR-01-1-SSM-S, LAW-HPVR-02-1-SSM-S, LAW-HPVR-03-1-SSM-S, LAW-HPVR-04-1-SSM-S, LAW-HPVR-06-SSM-S, LAW-HPVR-07-SSM-S, LAW-HPVR-08-SSM-S, LAW-HPVR-09-SSM-S, LAW-HPVR-10-SSM-S, LAW-HPVR-11-SSM-S, LAW-HPVR-13-SSM-S, LAW-HPVR-15-SSM-S, LAW-HPVR-16-SSM-S, LAW-HPVR-17-SSM-S, LAW-HPVR-18-SSM-S, LAW-HPVR-21-SSM-S, LAW-HPVR-22-SSM-S, LAW-HPVR-23-SSM-S, LAW-HPVR-24-SSM-S, LAW-HPVR-25-SSM-S, and LAW-HPVR-26-SSM-S.
- The Li_2O relative differences were greater than 10% for LAW-HPVR-01-1-SSM-S, LAW-HPVR-03-1-SSM-S, LAW-HPVR-04-1-SSM-S, LAW-HPVR-05-SSM-S, LAW-HPVR-13-SSM-S, LAW-HPVR-16-SSM-S, LAW-HPVR-19-SSM-S, LAW-HPVR-24-SSM-S, and LAW-HPVR-26-SSM-S
- V_2O_5 relative differences were 10% or greater for LAW-HPVR-10-SSM-S, LAW-HPVR-12-SSM-S , LAW-HPVR-20-SSM-S, and LAW-HPVR-23-SSM-S.

- The ZrO_2 relative differences were 10% for LAW-HPVR-19-SSM-S, and LAW-HPVR-20-SSM-S.
- As expected, the measured SO_3 concentrations in the glasses were higher than targeted due to the use of the sulfur saturation method in fabricating these glasses.

3.2 Comparison of Measured Compositions of Baseline and SSM Glasses

Exhibit A-4 in Appendix A provides a comparison of the measured oxide concentrations among the baseline (quenched) and SSM versions of the study glasses. A review of Exhibit A-4 led to the following observation:

- The measured Cl^- concentrations were lower in the SSM versions of the study glasses.
- The measured SO_3 concentrations were higher for SSM versions of the study glasses, as expected, due to the use of the sulfur saturation method in fabricating these glasses.

The discussion of the analyses of the wash solutions, provided in Section 3.3, may provide further insight into the measured compositions of the SSM glasses.

3.3 Review and Evaluation of the Wash Solution Measurements

Table B-1 in Appendix B provides the elemental concentration measurements in mg/L for the wash solutions as measured by ICP-OES. Table B-2 in Appendix B provides the anion concentration measurements in mg/L for the wash solutions as measured by IC. Elemental measurements of the blanks and standard solutions are included in these tables of Appendix B.

3.3.1 Treatment of Detection Limits

The elemental and anion concentrations in Table B-1 and Table B-2 of Appendix B include measurements that were reported to be below the detection limit. These values were set to the detection limit for the purposes of data review and of calculating an average composition for each wash solution.

3.3.2 Composition Measurements by Wash Solution Identifier

Exhibit B-1 in Appendix B provides plots of the elemental and anion concentration measurements grouped by the wash solution identifier (including the blanks and standard solutions). Different symbols and colors are used to represent the different solutions. Plotting the data in this format provides an opportunity to review the values for each individual solution as a function of the triplicate measurements. A review of the plots presented in these exhibits reveals the repeatability of the three individual values for each analyte for each solution. These observations were not considered to indicate an error in preparation or measurement that had to be addressed in treatment of the data. Therefore, the entire set of measurement data was used in determining representative, measured compositions for the wash solutions.

3.3.3 Results for the Standard Solutions

Table B-3 in Appendix B provides comparisons of the standard solution results to their reference values. The results in this table indicate no issues with the performance of the analyses.

3.3.4 Measured Compositions of the Wash Solutions

From the discussion in Section 3.3.2, all the measurements for each analyte for each wash solution (Table B-1 and Table B-2 of Appendix B) were averaged to determine a representative chemical composition for each solution. Table B-4 in Appendix B provides a summary of the average measured compositions of the wash solutions. The following observations are offered from the review of Table B-4:

- The wash solutions contained mainly Na (338-832 mg/L), S (147-507 mg/L), and SO_4^{2-} (467-1610 mg/L), which could be attributed to the excess sodium sulfate added as part of the SSM preparation process.

- The measured concentrations of B, Ca, Cl^-, Cr, K, Li, P, Si, V, and PO_4^{3-} in the wash solutions were generally below 100 mg/L.
- The measured concentrations of K were above 100 for 14 of the glasses.
- The measured concentrations of Al, F^-, Fe, Mg, Sn, Ti, Zn and Zr in the wash solutions were near or below the detection limits.

4.0 Summary

Chemical analyses were performed on a series of SSM versions of simulated nuclear waste glasses and resulting wash solutions with ICP-OES and IC. The glasses were designed and fabricated by PNNL as part of a broader study of the influence of glass composition on chemical durability, sulfur retention, and other properties.

The relative differences between the targeted and measured concentrations of B_2O_3, K_2O, Li_2O, V_2O_5, and ZrO_2 for several of the glasses were greater than ±10%. As expected, the measured concentrations of SO_3 in most of the glasses were higher than targeted due to the use of the sulfur saturation method in fabricating these glasses.

The wash solutions contained mainly sodium, sulfur, and sulfate ions.

5.0 References

1. V. Gervasio, "High PCT and VHT Response Glass Matrix," Pacific Northwest National Laboratory, Richland, WA, EWG-TP-179, Rev 0.0, 2022.

2. K.M. Fox, "Task Technical and Quality Assurance Plan for Hanford Waste Glass Development and Characterization," Savannah River National Laboratory, Aiken, SC, SRNL-RP-2013-00692, Revision 1, 2016.

3. D.K. Peeler, D.S. Kim, J.D. Vienna, M.J. Schweiger, and G.F. Piepel, "Office of River Protection Advanced Low-Activity Waste Glass Research and Development Plan," Pacific Northwest National Laboratory, Richland, WA, PNNL-24883, EWG-RPT-008, Revision 0, 2015.

4. "Technical Reviews," Savannah River Site, Aiken, SC, Manual E7, Procedure 2.60, Rev. 21, 2022.

5. "Savannah River National Laboratory Technical Report Design Check Guidelines," Westinghouse Savannah River Company, Aiken, SC, WSRC-IM-2002-00011, Rev. 2, 2004.

6. M.C. Hsieh, "Composition Measurements of the LAW HPVR Glasses," Savannah River National Laboratory, Aiken, SC, SRNL-STI-2022-00265, Revision 0, 2022.

7. M.C. Hsieh, "An Analytical Plan for Measuring the Chemical Compositions of the Sulfur-Saturated Melt Versions of the LAW HPVR Study Glasses and Wash Solutions," Savannah River National Laboratory, Aiken, SC, SRNL-L3310-2022-00004, Revision 0, 2022.

8. "Sample Dissolution Using Potassium Hydroxide Fusion," Savannah River National Laboratory, Aiken, SC, Manual L29, Procedure ITS-0035, Rev. 3, 2015.

9. "Lithium Metaborate Fusion Preparation," Savannah River National Laboratory, Aiken, SC, Manual L33, Procedure 0071, Rev. 0, 2021.

10. "Dissolution of Glass, Sludge, and Slurry Samples Using Na_2O_2/NaOH/HCl," Savannah River National Laboratory, Aiken, SC, Manual L33, Procedure 0040, Rev. 0, 2022.

11. "Calibration, Verification, and Operation of the Agilent 5110 ICP-OES Inductively Coupled Plasma-Optical Emission Spectrometer," Savannah River National Laboratory, Aiken, SC, Manual L33, Procedure 0242, Rev. 1, 2021.

12. "Anion Analysis Using the Dionex ICS 6000 Ion Chromatograph," Savannah River National Laboratory, Aiken, SC, Manual L33, Procedure 0244, Rev. 1, 2020.

13. W.L. Ebert and S.F. Wolf, "Round-Robin Testing of a Reference Glass for Low-Activity Waste Forms," Argonne National Laboratory, Argonne, IL, ANL-99/22, Revision 0, 1999.

14. JMP(R) Version 16.0.0, SAS Institute Inc., Cary, NC, 2021.

15. C.M. Jantzen, J.B. Pickett, K.G. Brown, T.B. Edwards, and D.C. Beam, "Process/Product Models for the Defense Waste Processing Facility (DWPF): Part I. Predicting Glass Durability from Composition Using a Thermodynamic Hydration Energy Reaction Model (THERMO)," Westinghouse Savannah River Company, Aiken, SC, WSRC-TR-93-672, Rev. 1, 1995.

Appendix A. Tables and Exhibits Supporting the LAW HPVR Glass Composition Measurements

Table A-1. KH Measurements (wt.%) of the SSM Study Glasses

PNNL ID	Block	Sub – Block	Seq	Lab ID	Cl^-	F^-
LRM	1	1	1	LRMKH111	<0.0250	0.889
LAW-HPVR-01-1-SSM-S	1	1	2	S-13867KH21	0.524	0.0430
LAW-HPVR-08-SSM-S	1	1	3	S-13874KH21	0.417	0.0764
LAW-HPVR-SSM-S	1	1	4	S-13893KH11	<0.0250	0.913
LAW-HPVR-19-SSM-S	1	1	5	S-13885KH21	0.277	0.0445
LAW-HPVR-17-SSM-S	1	1	6	S-13883KH11	0.239	0.117
LAW-HPVR-SSM-S	1	1	7	S-13893KH21	<0.0250	0.885
LAW-HPVR-24-SSM-S	1	1	8	S-13890KH21	0.257	0.108
LAW-HPVR-19-SSM-S	1	1	9	S-13885KH11	0.272	0.0436
LAW-HPVR-24-SSM-S	1	1	10	S-13890KH11	0.256	0.108
LRM	1	1	11	LRMKH112	<0.0250	0.888
LAW-HPVR-08-SSM-S	1	1	12	S-13874KH11	0.408	0.0738
LAW-HPVR-04-1-SSM-S	1	1	13	S-13870KH11	0.0592	0.125
LAW-HPVR-02-1-SSM-S	1	1	14	S-13868KH21	0.288	0.0662
LAW-HPVR-04-1-SSM-S	1	1	15	S-13870KH21	0.0588	0.127
LAW-HPVR-17-SSM-S	1	1	16	S-13883KH21	0.236	0.114
LAW-HPVR-23-SSM-S	1	1	17	S-13889KH21	0.418	0.0797
LAW-HPVR-01-1-SSM-S	1	1	18	S-13867KH11	0.500	0.0406
LAW-HPVR-02-1-SSM-S	1	1	19	S-13868KH11	0.284	0.0658
LAW-HPVR-23-SSM-S	1	1	20	S-13889KH11	0.418	0.0810
LRM	1	1	21	LRMKH113	<0.0250	0.880
LRM	1	2	1	LRMKH121	<0.0250	0.863
LAW-HPVR-24-SSM-S	1	2	2	S-13890KH22	0.238	0.107
LAW-HPVR-17-SSM-S	1	2	3	S-13883KH12	0.223	0.115
LAW-HPVR-04-1-SSM-S	1	2	4	S-13870KH12	0.0523	0.125
LAW-HPVR-02-1-SSM-S	1	2	5	S-13868KH22	0.263	0.0650
LAW-HPVR-19-SSM-S	1	2	6	S-13885KH22	0.253	0.0435
LAW-HPVR-24-SSM-S	1	2	7	S-13890KH12	0.234	0.105
LAW-HPVR-23-SSM-S	1	2	8	S-13889KH12	0.384	0.0788
LAW-HPVR-23-SSM-S	1	2	9	S-13889KH22	0.375	0.0775
LAW-HPVR-17-SSM-S	1	2	10	S-13883KH22	0.209	0.111
LRM	1	2	11	LRMKH122	<0.0250	0.850
LAW-HPVR-08-SSM-S	1	2	12	S-13874KH22	0.366	0.0709
LAW-HPVR-SSM-S	1	2	13	S-13893KH12	<0.0250	0.843
LAW-HPVR-02-1-SSM-S	1	2	14	S-13868KH12	0.256	0.0640
LAW-HPVR-08-SSM-S	1	2	15	S-13874KH12	0.370	0.0712
LAW-HPVR-01-1-SSM-S	1	2	16	S-13867KH12	0.477	0.0406
LAW-HPVR-04-1-SSM-S	1	2	17	S-13870KH22	0.0582	0.127
LAW-HPVR-01-1-SSM-S	1	2	18	S-13867KH22	0.520	0.0437
LAW-HPVR-SSM-S	1	2	19	S-13893KH22	<0.0250	0.903
LAW-HPVR-19-SSM-S	1	2	20	S-13885KH12	0.279	0.0471
LRM	1	2	21	LRMKH123	<0.0250	0.891
LRM	2	1	1	LRMKH211	<0.0250	0.891
LAW-HPVR-26-SSM-S	2	1	2	S-13892KH21	0.321	0.0997
LAW-HPVR-07-SSM-S	2	1	3	S-13873KH21	0.267	0.0814
LAW-HPVR-25-SSM-S	2	1	4	S-13891KH21	0.214	0.136
LAW-HPVR-11-SSM-S	2	1	5	S-13877KH21	0.582	0.0467

Table A-1. KH Measurements (wt.%) of the SSM Study Glasses (continued)

PNNL ID	Block	Sub – Block	Seq	Lab ID	Cl^-	F^-
LAW-HPVR-09-SSM-S	2	1	6	S-13875KH21	0.267	0.0585
LAW-HPVR-16-SSM-S	2	1	7	S-13882KH11	0.379	0.0895
LAW-HPVR-16-SSM-S	2	1	8	S-13882KH21	0.377	0.0903
LAW-HPVR-13-SSM-S	2	1	9	S-13879KH21	0.353	0.0830
LAW-HPVR-07-SSM-S	2	1	10	S-13873KH11	0.268	0.0813
LRM	2	1	11	LRMKH212	<0.0250	0.896
LAW-HPVR-10-SSM-S	2	1	12	S-13876KH11	0.296	0.0545
LAW-HPVR-09-SSM-S	2	1	13	S-13875KH11	0.265	0.0591
LAW-HPVR-26-SSM-S	2	1	14	S-13892KH11	0.322	0.100
LAW-HPVR-10-SSM-S	2	1	15	S-13876KH21	0.308	0.0563
LAW-HPVR-18-SSM-S	2	1	16	S-13884KH11	0.373	0.115
LAW-HPVR-25-SSM-S	2	1	17	S-13891KH11	0.217	0.136
LAW-HPVR-18-SSM-S	2	1	18	S-13884KH21	0.374	0.116
LAW-HPVR-11-SSM-S	2	1	19	S-13877KH11	0.582	0.0472
LAW-HPVR-13-SSM-S	2	1	20	S-13879KH11	0.357	0.0831
LRM	2	1	21	LRMKH213	0.0251	0.898
LRM	2	2	1	LRMKH221	<0.0250	0.881
LAW-HPVR-07-SSM-S	2	2	2	S-13873KH12	0.266	0.0802
LAW-HPVR-18-SSM-S	2	2	3	S-13884KH12	0.368	0.113
LAW-HPVR-16-SSM-S	2	2	4	S-13882KH12	0.376	0.0879
LAW-HPVR-11-SSM-S	2	2	5	S-13877KH12	0.567	0.0463
LAW-HPVR-11-SSM-S	2	2	6	S-13877KH22	0.568	0.0455
LAW-HPVR-26-SSM-S	2	2	7	S-13892KH12	0.309	0.0977
LAW-HPVR-25-SSM-S	2	2	8	S-13891KH12	0.212	0.134
LAW-HPVR-09-SSM-S	2	2	9	S-13875KH22	0.256	0.0571
LAW-HPVR-18-SSM-S	2	2	10	S-13884KH22	0.363	0.113
LRM	2	2	11	LRMKH222	<0.0250	0.864
LAW-HPVR-25-SSM-S	2	2	12	S-13891KH22	0.204	0.132
LAW-HPVR-13-SSM-S	2	2	13	S-13879KH22	0.344	0.0802
LAW-HPVR-16-SSM-S	2	2	14	S-13882KH22	0.359	0.0884
LAW-HPVR-13-SSM-S	2	2	15	S-13879KH12	0.339	0.0809
LAW-HPVR-10-SSM-S	2	2	16	S-13876KH12	0.280	0.0530
LAW-HPVR-07-SSM-S	2	2	17	S-13873KH22	0.258	0.0807
LAW-HPVR-26-SSM-S	2	2	18	S-13892KH22	0.314	0.0997
LAW-HPVR-09-SSM-S	2	2	19	S-13875KH12	0.260	0.0596
LAW-HPVR-10-SSM-S	2	2	20	S-13876KH22	0.305	0.0560
LRM	2	2	21	LRMKH223	<0.0250	0.892
LRM	3	1	1	LRMKH311	<0.0250	0.889
LAW-HPVR-15-SSM-S	3	1	2	S-13881KH11	0.292	0.0482
LAW-HPVR-03-1-SSM-S	3	1	3	S-13869KH11	0.0335	0.0621
LAW-HPVR-05-SSM-S	3	1	4	S-13871KH21	0.527	0.127
LAW-HPVR-14-SSM-S	3	1	5	S-13880KH11	0.496	0.0631
LAW-HPVR-20-SSM-S	3	1	6	S-13886KH21	0.393	0.102
LAW-HPVR-22-SSM-S	3	1	7	S-13888KH21	0.238	0.105
LAW-HPVR-21-SSM-S	3	1	8	S-13887KH11	0.269	0.0990
LAW-HPVR-03-1-SSM-S	3	1	9	S-13869KH21	0.0337	0.0624
LAW-HPVR-12-SSM-S	3	1	10	S-13878KH21	0.374	0.0468

Table A-1. KH Measurements (wt.%) of the SSM Study Glasses (continued)

PNNL ID	Block	Sub – Block	Seq	Lab ID	Cl^-	F^-
LRM	3	1	11	LRMKH312	<0.0250	0.888
LAW-HPVR-21-SSM-S	3	1	12	S-13887KH21	0.275	0.0997
LAW-HPVR-22-SSM-S	3	1	13	S-13888KH11	0.242	0.106
LAW-HPVR-20-SSM-S	3	1	14	S-13886KH11	0.396	0.101
LAW-HPVR-14-SSM-S	3	1	15	S-13880KH21	0.496	0.0629
LAW-HPVR-06-SSM-S	3	1	16	S-13872KH11	0.288	0.0523
LAW-HPVR-12-SSM-S	3	1	17	S-13878KH11	0.375	0.0470
LAW-HPVR-05-SSM-S	3	1	18	S-13871KH11	0.523	0.125
LAW-HPVR-06-SSM-S	3	1	19	S-13872KH21	0.290	0.0516
LAW-HPVR-15-SSM-S	3	1	20	S-13881KH21	0.295	0.0482
LRM	3	1	21	LRMKH313	<0.0250	0.873
LRM	3	2	1	LRMKH321	<0.0250	0.898
LAW-HPVR-03-1-SSM-S	3	2	2	S-13869KH12	0.0326	0.0603
LAW-HPVR-03-1-SSM-S	3	2	3	S-13869KH22	0.0321	0.0619
LAW-HPVR-15-SSM-S	3	2	4	S-13881KH22	0.295	0.0481
LAW-HPVR-14-SSM-S	3	2	5	S-13880KH12	0.499	0.0628
LAW-HPVR-06-SSM-S	3	2	6	S-13872KH22	0.287	0.0523
LAW-HPVR-21-SSM-S	3	2	7	S-13887KH12	0.270	0.0988
LAW-HPVR-14-SSM-S	3	2	8	S-13880KH22	0.496	0.0626
LAW-HPVR-22-SSM-S	3	2	9	S-13888KH22	0.235	0.105
LAW-HPVR-21-SSM-S	3	2	10	S-13887KH22	0.266	0.0998
LRM	3	2	11	LRMKH322	<0.0250	0.889
LAW-HPVR-22-SSM-S	3	2	12	S-13888KH12	0.243	0.106
LAW-HPVR-06-SSM-S	3	2	13	S-13872KH12	0.289	0.0517
LAW-HPVR-05-SSM-S	3	2	14	S-13871KH22	0.539	0.128
LAW-HPVR-12-SSM-S	3	2	15	S-13878KH22	0.375	0.0472
LAW-HPVR-05-SSM-S	3	2	16	S-13871KH12	0.525	0.125
LAW-HPVR-20-SSM-S	3	2	17	S-13886KH22	0.393	0.102
LAW-HPVR-20-SSM-S	3	2	18	S-13886KH12	0.398	0.101
LAW-HPVR-12-SSM-S	3	2	19	S-13878KH12	0.371	0.0473
LAW-HPVR-15-SSM-S	3	2	20	S-13881KH12	0.290	0.0482
LRM	3	2	21	LRMKH323	<0.0250	0.893

Table A-2. LM Measurements (wt.%) of the SSM Study Glasses

PNNL ID	Block	Sub – Block	Seq	Lab ID	Al	Ca	Cr	Fe	K	Mg	Na	P	S	Sn	Ti	V	Zn	Zr
LRM	1	1	1	LRMLM111	5.40	0.388	0.127	0.981	1.14	0.0644	15.4	0.211	0.0991	<0.100	0.0614	<0.0500	<0.100	0.712
LAW-HPVR-26-SSM-S	1	1	2	S-13892LM21	6.22	4.64	0.0437	0.132	1.80	0.0426	13.3	0.211	0.666	1.40	0.525	0.156	0.435	2.50
LAW-HPVR-05-SSM-S	1	1	3	S-13871LM11	2.07	4.56	0.0725	0.176	0.454	0.0463	12.8	0.271	0.782	0.671	0.266	0.955	0.545	4.48
LAW-HPVR-14-SSM-S	1	1	4	S-13880LM11	3.04	6.60	<0.0250	0.0861	0.0915	0.0470	18.3	0.121	0.713	3.40	0.823	<0.0500	0.261	3.53
LAW-HPVR-09-SSM-S	1	1	5	S-13875LM21	2.61	4.50	0.0397	0.101	1.14	0.0384	14.7	0.124	0.988	0.283	1.78	0.590	0.270	1.58
LAW-HPVR-09-SSM-S	1	1	6	S-13875LM11	2.63	4.53	0.0514	0.138	1.20	0.0367	15.0	0.126	1.02	0.275	1.79	0.592	0.269	1.57
LAW-HPVR-17-SSM-S	1	1	7	S-13883LM11	4.57	6.47	0.0525	0.162	3.18	0.0542	13.8	0.249	0.727	0.642	0.133	0.370	0.519	1.89
LAW-HPVR-03-1-SSM-S	1	1	8	S-13869LM21	4.17	4.74	<0.0250	0.0881	3.80	0.0399	12.8	0.123	0.639	3.33	0.634	1.77	0.268	4.92
LAW-HPVR-13-SSM-S	1	1	9	S-13879LM11	1.97	4.96	0.0476	0.128	2.21	0.0441	12.8	0.187	0.590	0.485	0.0557	1.24	0.392	4.43
LAW-HPVR-16-SSM-S	1	1	10	S-13882LM11	3.60	4.65	0.0439	0.125	1.60	0.0415	14.9	0.193	0.613	3.32	0.562	0.496	0.401	3.56
LRM	1	1	11	LRMLM112	5.48	0.390	0.124	0.967	1.23	0.0638	15.8	0.211	0.0885	<0.100	0.0607	<0.0500	<0.100	0.725
LAW-HPVR-19-SSM-S	1	1	12	S-13885LM11	2.67	6.11	0.0356	0.0823	0.287	0.0452	16.2	<0.100	1.20	0.306	0.499	2.11	0.219	1.39
LAW-HPVR-17-SSM-S	1	1	13	S-13883LM21	4.41	6.42	0.0535	0.161	3.13	0.0539	13.4	0.247	0.698	0.631	0.133	0.370	0.512	1.84
LAW-HPVR-26-SSM-S	1	1	14	S-13892LM11	6.10	4.55	0.0456	0.134	1.85	0.0430	13.1	0.207	0.680	1.41	0.542	0.159	0.444	2.48
LAW-HPVR-14-SSM-S	1	1	15	S-13880LM21	2.97	6.40	0.0269	0.0897	0.104	0.0483	18.0	0.129	0.743	3.37	0.873	<0.0500	0.274	3.48
LAW-HPVR-05-SSM-S	1	1	16	S-13871LM21	2.03	4.51	0.0758	0.182	0.470	0.0473	12.7	0.278	0.780	0.690	0.277	0.984	0.559	4.44
LAW-HPVR-13-SSM-S	1	1	17	S-13879LM21	1.87	4.80	0.0493	0.131	2.14	0.0452	12.3	0.190	0.611	0.489	0.0565	1.20	0.399	4.28
LAW-HPVR-03-1-SSM-S	1	1	18	S-13869LM11	3.93	4.47	0.0301	0.0900	3.59	0.0395	12.3	0.128	0.645	3.27	0.647	1.70	0.270	4.81
LAW-HPVR-19-SSM-S	1	1	19	S-13885LM21	2.60	5.95	0.0646	0.0828	0.291	0.0465	15.7	<0.100	1.17	0.314	0.514	2.08	0.226	1.38
LAW-HPVR-16-SSM-S	1	1	20	S-13882LM21	3.43	4.46	0.0480	0.129	1.57	0.0431	14.4	0.191	0.615	3.23	0.580	0.505	0.410	3.43
LRM	1	1	21	LRMLM113	5.30	0.378	0.127	0.976	1.18	0.0642	15.4	0.210	0.0964	<0.100	0.0614	<0.0500	<0.100	0.706
LRM	1	2	1	LRMLM121	5.25	0.370	0.125	0.969	1.20	0.0648	15.5	0.206	0.0756	<0.100	0.0611	<0.0500	<0.100	0.718
LAW-HPVR-09-SSM-S	1	2	2	S-13875LM22	2.45	4.19	0.0371	0.101	1.17	0.0390	14.4	0.129	1.06	0.279	1.69	0.577	0.269	1.55
LAW-HPVR-17-SSM-S	1	2	3	S-13883LM22	4.21	6.00	0.0504	0.158	3.02	0.0539	13.1	0.240	0.663	0.624	0.130	0.354	0.506	1.83
LAW-HPVR-14-SSM-S	1	2	4	S-13880LM12	2.85	6.14	0.0270	0.0878	0.0950	0.0489	17.9	0.125	0.689	3.30	0.846	<0.0500	0.265	3.49
LAW-HPVR-14-SSM-S	1	2	5	S-13880LM22	2.91	6.26	<0.0250	0.0884	0.0985	0.0490	18.2	0.124	0.692	3.38	0.854	<0.0500	0.267	3.54
LAW-HPVR-16-SSM-S	1	2	6	S-13882LM12	3.37	4.37	0.0454	0.128	1.54	0.0427	14.4	0.197	0.578	3.22	0.572	0.490	0.405	3.48
LAW-HPVR-16-SSM-S	1	2	7	S-13882LM22	3.37	4.37	0.0476	0.129	1.55	0.0436	14.4	0.194	0.591	3.21	0.579	0.494	0.407	3.50
LAW-HPVR-13-SSM-S	1	2	8	S-13879LM12	1.82	4.59	0.0466	0.129	2.15	0.0454	12.2	0.193	0.578	0.496	0.0568	1.17	0.394	4.30
LAW-HPVR-05-SSM-S	1	2	9	S-13871LM12	1.90	4.23	0.0765	0.179	0.455	0.0478	12.4	0.276	0.754	0.678	0.272	0.949	0.549	4.39
LAW-HPVR-05-SSM-S	1	2	10	S-13871LM22	1.92	4.31	0.0728	0.181	0.455	0.0479	12.5	0.278	0.730	0.681	0.273	0.952	0.551	4.45
LRM	1	2	11	LRMLM122	5.04	0.364	0.129	0.993	1.12	0.0662	15.2	0.212	0.0823	<0.100	0.0627	<0.0500	<0.100	0.709
LAW-HPVR-26-SSM-S	1	2	12	S-13892LM12	5.68	4.32	0.0449	0.133	1.76	0.0434	12.9	0.208	0.639	1.36	0.531	0.154	0.439	2.46
LAW-HPVR-19-SSM-S	1	2	13	S-13885LM22	2.54	5.77	0.0622	0.0822	0.276	0.0467	15.6	0.101	1.21	0.312	0.506	2.04	0.223	1.38
LAW-HPVR-13-SSM-S	1	2	14	S-13879LM22	1.81	4.62	0.0479	0.129	2.07	0.0454	12.1	0.189	0.580	0.488	0.0556	1.16	0.395	4.31
LAW-HPVR-26-SSM-S	1	2	15	S-13892LM22	5.73	4.31	0.0459	0.133	1.70	0.0435	12.9	0.204	0.639	1.36	0.529	0.154	0.436	2.45
LAW-HPVR-17-SSM-S	1	2	16	S-13883LM12	4.09	5.94	0.0527	0.163	3.07	0.0557	13.0	0.249	0.690	0.651	0.135	0.366	0.521	1.81
LAW-HPVR-09-SSM-S	1	2	17	S-13875LM12	2.36	4.07	0.0524	0.141	1.14	0.0380	14.0	0.128	0.985	0.283	1.64	0.591	0.273	1.49
LAW-HPVR-19-SSM-S	1	2	18	S-13885LM12	2.49	5.65	0.0357	0.0826	0.280	0.0466	15.5	<0.100	1.18	0.312	0.506	2.00	0.222	1.36
LAW-HPVR-03-1-SSM-S	1	2	19	S-13869LM12	3.73	4.26	0.0291	0.0893	3.52	0.0399	12.2	0.129	0.626	3.17	0.638	1.64	0.267	4.79
LAW-HPVR-03-1-SSM-S	1	2	20	S-13869LM22	3.74	4.25	<0.0250	0.0891	3.53	0.0409	12.3	0.125	0.619	3.19	0.639	1.65	0.270	4.73
LRM	1	2	21	LRMLM123	4.97	0.361	0.129	0.995	1.11	0.0662	15.2	0.216	0.0857	<0.100	0.0623	<0.0500	<0.100	0.706
LRM	2	1	1	LRMLM211	5.21	0.376	0.124	0.961	1.25	0.0654	15.5	0.205	0.0909	<0.100	0.0601	<0.0500	<0.100	0.720
LAW-HPVR-21-SSM-S	2	1	2	S-13887LM21	4.73	4.36	0.0491	0.145	3.72	0.0447	14.5	0.222	0.671	0.136	1.73	1.80	0.474	1.88
LAW-HPVR-01-1-SSM-S	2	1	3	S-13867LM11	1.97	4.61	<0.0250	0.0753	1.49	0.0380	13.2	<0.100	0.757	1.65	1.05	1.73	0.194	3.94
LAW-HPVR-15-SSM-S	2	1	4	S-13881LM11	2.27	4.25	0.0308	0.0791	3.09	0.0360	11.9	0.107	0.665	2.96	0.0599	0.293	0.225	2.34
LAW-HPVR-25-SSM-S	2	1	5	S-13891LM21	1.89	7.87	0.0602	0.175	0.958	0.0678	17.0	0.279	0.762	1.46	1.18	0.118	0.582	3.32

Table A-2. LM Measurements (wt.%) of the SSM Study Glasses (continued)

PNNL ID	Block	Sub – Block	Seq	Lab ID	Al	Ca	Cr	Fe	K	Mg	Na	P	S	Sn	Ti	V	Zn	Zr
LAW-HPVR-12-SSM-S	2	1	6	S-13878LM11	2.22	5.14	0.0262	0.0677	0.0765	0.0412	16.7	<0.100	0.871	1.66	0.589	0.942	0.198	1.99
LAW-HPVR-22-SSM-S	2	1	7	S-13888LM11	3.08	5.04	0.0460	0.146	1.98	0.0485	14.8	0.224	0.705	3.72	1.89	2.03	0.476	3.17
LAW-HPVR-06-SSM-S	2	1	8	S-13872LM11	1.90	8.42	0.0257	0.0997	3.58	0.0609	12.1	0.118	0.773	0.124	0.565	0.222	0.243	2.05
LAW-HPVR-22-SSM-S	2	1	9	S-13888LM21	2.98	4.90	0.0474	0.143	2.03	0.0484	14.6	0.223	0.711	3.71	1.86	2.00	0.474	3.13
LAW-HPVR-12-SSM-S	2	1	10	S-13878LM21	2.22	5.09	0.0280	0.0684	0.0741	0.0411	16.3	<0.100	0.867	1.67	0.590	0.944	0.198	1.98
LRM	2	1	11	LRMLM212	5.14	0.376	0.123	0.949	1.14	0.0644	15.0	0.207	0.0858	<0.100	0.0588	<0.0500	<0.100	0.720
LAW-HPVR-21-SSM-S	2	1	12	S-13887LM11	4.65	4.31	0.0470	0.141	3.62	0.0436	14.1	0.209	0.656	0.134	1.73	1.80	0.461	1.86
LAW-HPVR-01-1-SSM-S	2	1	13	S-13867LM21	1.93	4.59	<0.0250	0.0694	1.41	0.0377	13.0	<0.100	0.765	1.66	1.06	1.73	0.192	3.92
LAW-HPVR-10-SSM-S	2	1	14	S-13876LM11	1.77	6.09	0.0478	0.0854	1.39	0.0474	16.3	0.116	0.996	2.44	<0.0500	0.895	0.278	1.87
LAW-HPVR-10-SSM-S	2	1	15	S-13876LM21	1.78	6.14	0.0365	0.0845	1.45	0.0482	16.3	0.120	1.05	2.44	<0.0500	0.901	0.267	1.86
LAW-HPVR-06-SSM-S	2	1	16	S-13872LM21	1.94	8.79	0.0256	0.0944	3.66	0.0607	12.1	0.118	0.769	0.124	0.561	0.221	0.242	2.10
LAW-HPVR-07-SSM-S	2	1	17	S-13873LM11	2.27	7.02	0.0312	0.107	2.13	0.0565	14.9	0.165	0.752	1.59	0.149	2.12	0.344	4.74
LAW-HPVR-25-SSM-S	2	1	18	S-13891LM11	1.86	7.93	0.0509	0.171	0.959	0.0674	17.0	0.266	0.757	1.47	1.19	0.119	0.571	3.32
LAW-HPVR-07-SSM-S	2	1	19	S-13873LM21	2.21	6.97	0.0317	0.105	2.11	0.0553	14.8	0.165	0.739	1.55	0.145	2.10	0.340	4.67
LAW-HPVR-15-SSM-S	2	1	20	S-13881LM21	2.25	4.23	0.0281	0.076	3.07	0.0349	11.9	0.101	0.663	3.01	0.0583	0.286	0.217	2.36
LRM	2	1	21	LRMLM213	5.14	0.378	0.122	0.942	1.18	0.0642	15.2	0.202	0.0967	<0.100	0.0584	<0.0500	<0.100	0.719
LRM	2	2	1	LRMLM221	5.14	0.376	0.124	0.947	1.20	0.0637	15.3	0.202	0.0867	<0.100	0.0594	<0.0500	<0.100	0.701
LAW-HPVR-12-SSM-S	2	2	2	S-13878LM22	2.27	5.18	0.0255	0.0681	0.0672	0.0406	16.9	<0.100	0.847	1.65	0.597	0.929	0.196	1.95
LAW-HPVR-25-SSM-S	2	2	3	S-13891LM22	1.88	8.02	0.0628	0.174	0.9493	0.0673	17.4	0.273	0.750	1.44	1.14	0.117	0.577	3.21
LAW-HPVR-01-1-SSM-S	2	2	4	S-13867LM22	1.96	4.57	<0.0250	0.0702	1.52	0.0375	13.5	<0.100	0.750	1.63	1.01	1.70	0.193	3.85
LAW-HPVR-10-SSM-S	2	2	5	S-13876LM12	1.82	6.12	0.0472	0.086	1.47	0.0472	16.9	0.115	0.917	2.40	<0.0500	0.889	0.278	1.82
LAW-HPVR-10-SSM-S	2	2	6	S-13876LM22	1.79	5.99	0.0393	0.0854	1.38	0.0482	16.6	0.117	1.05	2.39	<0.0500	0.898	0.268	1.78
LAW-HPVR-15-SSM-S	2	2	7	S-13881LM22	2.28	4.26	0.0298	0.0784	3.12	0.0355	12.2	0.105	0.658	2.96	0.0618	0.292	0.223	2.27
LAW-HPVR-21-SSM-S	2	2	8	S-13887LM22	4.75	4.32	0.0498	0.146	3.77	0.0449	14.9	0.210	0.682	0.141	1.64	1.76	0.472	1.81
LAW-HPVR-22-SSM-S	2	2	9	S-13888LM12	3.05	4.93	0.0469	0.148	1.98	0.0488	15.0	0.227	0.729	3.66	1.79	1.99	0.480	3.05
LAW-HPVR-07-SSM-S	2	2	10	S-13873LM22	2.24	6.87	0.0311	0.108	2.20	0.0569	15.4	0.166	0.748	1.54	0.154	2.05	0.348	4.53
LRM	2	2	11	LRMLM222	5.24	0.371	0.127	0.971	1.24	0.0656	15.8	0.207	0.0801	<0.100	0.0613	<0.0500	<0.100	0.698
LAW-HPVR-07-SSM-S	2	2	12	S-13873LM12	2.21	6.78	0.0322	0.110	2.17	0.0576	15.3	0.171	0.757	1.53	0.156	2.02	0.354	4.49
LAW-HPVR-01-1-SSM-S	2	2	13	S-13867LM12	1.92	4.39	0.0254	0.0767	1.48	0.0385	13.4	<0.100	0.765	1.61	0.996	1.65	0.198	3.70
LAW-HPVR-06-SSM-S	2	2	14	S-13872LM22	1.90	8.25	0.0285	0.0979	3.67	0.0623	12.4	0.122	0.783	0.123	0.592	0.227	0.250	1.96
LAW-HPVR-21-SSM-S	2	2	15	S-13887LM12	4.74	4.27	0.0475	0.1463	3.81	0.0450	14.9	0.205	0.667	0.136	1.62	1.75	0.475	1.79
LAW-HPVR-15-SSM-S	2	2	16	S-13881LM12	2.29	4.19	0.0326	0.081	3.19	0.0364	12.4	0.108	0.675	2.96	0.0622	0.296	0.228	2.29
LAW-HPVR-12-SSM-S	2	2	17	S-13878LM12	2.22	4.97	0.0254	0.0686	0.0783	0.0418	16.8	<0.100	1.04	1.62	0.6101	0.953	0.202	1.90
LAW-HPVR-22-SSM-S	2	2	18	S-13888LM22	3.06	4.84	0.0475	0.145	2.05	0.0487	15.0	0.228	0.702	3.65	1.73	1.94	0.479	3.02
LAW-HPVR-25-SSM-S	2	2	19	S-13891LM12	1.86	7.66	0.0525	0.179	0.992	0.0696	17.6	0.275	0.769	1.43	1.10	0.123	0.593	3.16
LAW-HPVR-06-SSM-S	2	2	20	S-13872LM12	1.85	8.37	0.0277	0.102	3.42	0.0619	11.9	0.119	0.771	0.124	0.587	0.223	0.248	1.98
LRM	2	2	21	LRMLM223	5.17	0.369	0.129	0.973	1.15	0.0659	15.2	0.208	0.0840	<0.100	0.0612	<0.0500	<0.100	0.706
LRM	3	1	1	LRMLM311	5.02	0.376	0.127	0.986	1.23	0.0669	15.0	0.2174	0.0849	<0.100	0.0613	<0.0500	<0.100	0.698
LAW-HPVR-SSM-S	3	1	2	S-13893LM21	5.09	0.365	0.124	0.977	1.22	0.0664	14.6	0.215	0.0906	<0.100	0.0606	<0.0500	<0.100	0.695
LAW-HPVR-02-1-SSM-S	3	1	3	S-13868LM21	1.95	5.42	0.0527	0.108	2.61	0.0468	12.8	0.170	0.765	2.25	0.670	1.88	0.331	1.41
LAW-HPVR-18-SSM-S	3	1	4	S-13884LM11	2.13	5.87	0.0836	0.160	0.747	0.0558	11.7	0.273	0.889	3.33	0.313	1.96	0.529	2.05
LAW-HPVR-11-SSM-S	3	1	5	S-13877LM11	2.00	4.39	<0.0250	0.0700	2.22	0.0364	15.2	0.101	0.683	2.70	1.68	1.31	0.201	4.42
LAW-HPVR-20-SSM-S	3	1	6	S-13886LM11	1.72	4.42	0.0673	0.142	<0.0500	0.0459	17.0	0.225	0.958	0.240	0.898	0.761	0.476	2.04
LAW-HPVR-24-SSM-S	3	1	7	S-13890LM11	1.93	5.79	0.0528	0.143	3.49	0.0528	11.8	0.226	0.823	1.95	1.75	1.62	0.474	1.76
LAW-HPVR-SSM-S	3	1	8	S-13893LM11	4.91	0.363	0.122	0.965	1.12	0.0657	14.4	0.202	0.0959	<0.100	0.0612	<0.0500	<0.100	0.688
LAW-HPVR-08-SSM-S	3	1	9	S-13874LM21	4.57	4.91	0.0291	0.119	1.93	0.0427	11.3	0.163	0.589	1.21	1.52	0.384	0.326	3.60
LAW-HPVR-04-1-SSM-S	3	1	10	S-13870LM11	1.85	4.64	0.0777	0.169	1.04	0.0501	12.4	0.278	0.966	0.816	1.56	1.95	0.555	1.58

Table A-2. LM Measurements (wt.%) of the SSM Study Glasses (continued)

PNNL ID	Block	Sub – Block	Seq	Lab ID	Al	Ca	Cr	Fe	K	Mg	Na	P	S	Sn	Ti	V	Zn	Zr
LRM	3	1	11	LRMLM312	5.06	0.370	0.123	0.971	1.12	0.0659	14.4	0.212	0.0876	<0.100	0.0606	<0.0500	<0.100	0.687
LAW-HPVR-02-1-SSM-S	3	1	12	S-13868LM11	1.93	5.25	0.0518	0.104	2.56	0.0452	12.6	0.158	0.761	2.24	0.638	1.85	0.321	1.39
LAW-HPVR-08-SSM-S	3	1	13	S-13874LM11	4.58	4.82	0.0301	0.118	1.84	0.0420	11.3	0.159	0.566	1.21	1.51	0.375	0.322	3.61
LAW-HPVR-20-SSM-S	3	1	14	S-13886LM21	1.72	4.32	0.067	0.138	<0.0500	0.0442	16.7	0.215	0.943	0.234	0.871	0.743	0.461	2.00
LAW-HPVR-18-SSM-S	3	1	15	S-13884LM21	2.09	5.77	0.0783	0.154	0.719	0.0544	11.4	0.256	0.856	3.32	0.298	1.95	0.516	2.03
LAW-HPVR-11-SSM-S	3	1	16	S-13877LM21	2.01	4.30	<0.0250	0.0678	2.20	0.0354	15.0	0.0976	0.680	2.66	1.64	1.29	0.194	4.37
LAW-HPVR-23-SSM-S	3	1	17	S-13889LM21	2.71	5.06	0.0342	0.108	0.793	0.0454	15.5	0.168	0.625	2.61	0.803	0.683	0.350	3.59
LAW-HPVR-24-SSM-S	3	1	18	S-13890LM21	1.96	5.67	0.0532	0.139	3.43	0.0514	11.6	0.227	0.801	1.96	1.72	1.59	0.461	1.78
LAW-HPVR-04-1-SSM-S	3	1	19	S-13870LM21	1.91	4.75	0.0753	0.167	1.11	0.0492	12.5	0.275	0.965	0.818	1.58	1.97	0.549	1.60
LAW-HPVR-23-SSM-S	3	1	20	S-13889LM11	2.75	5.13	0.036	0.109	0.804	0.0456	15.6	0.170	0.641	2.61	0.814	0.689	0.356	3.66
LRM	3	1	21	LRMLM313	5.23	0.388	0.122	0.946	1.15	0.0644	14.8	0.208	0.0929	<0.100	0.0584	<0.0500	<0.100	0.714
LRM	3	2	1	LRMLM321	5.34	0.396	0.127	0.964	1.14	0.0655	15.2	0.205	0.0878	<0.100	0.0597	<0.0500	<0.100	0.731
LAW-HPVR-23-SSM-S	3	2	2	S-13889LM22	2.90	5.36	0.0391	0.110	0.791	0.0460	17.0	0.168	0.644	2.70	0.828	0.6967	0.355	3.78
LAW-HPVR-18-SSM-S	3	2	3	S-13884LM22	2.24	6.11	0.0817	0.156	0.715	0.0549	12.3	0.245	0.875	3.46	0.305	2.01	0.518	2.12
LAW-HPVR-11-SSM-S	3	2	4	S-13877LM22	2.12	4.50	<0.0250	0.0684	2.31	0.0352	16.0	<0.100	0.670	2.80	1.69	1.33	0.194	4.56
LAW-HPVR-02-1-SSM-S	3	2	5	S-13868LM22	1.99	5.47	0.0505	0.104	2.65	0.0451	13.4	0.147	0.750	2.31	0.644	1.90	0.320	1.44
LAW-HPVR-24-SSM-S	3	2	6	S-13890LM12	2.02	5.92	0.0546	0.140	3.61	0.0515	12.3	0.208	0.798	2.01	1.77	1.65	0.461	1.81
LAW-HPVR-18-SSM-S	3	2	7	S-13884LM12	2.19	5.99	0.0858	0.157	0.730	0.0546	12.2	0.247	0.874	3.41	0.306	1.97	0.519	2.08
LAW-HPVR-SSM-S	3	2	8	S-13893LM22	5.19	0.359	0.126	0.958	1.18	0.0648	15.4	0.193	0.0933	<0.100	0.0594	<0.0500	<0.100	0.657
LAW-HPVR-20-SSM-S	3	2	9	S-13886LM12	1.83	4.64	0.0676	0.143	<0.0500	0.0456	18.1	0.207	0.940	0.240	0.907	0.766	0.476	2.12
LAW-HPVR-20-SSM-S	3	2	10	S-13886LM22	1.85	4.64	0.0734	0.143	<0.0500	0.0454	18.3	0.214	0.951	0.237	0.917	0.771	0.474	2.14
LRM	3	2	11	LRMLM322	5.31	0.3778	0.131	0.984	1.20	0.0663	15.4	0.209	0.0873	<0.100	0.0613	<0.0500	<0.100	0.703
LAW-HPVR-08-SSM-S	3	2	12	S-13874LM22	4.90	5.13	0.0337	0.121	2.00	0.0427	12.1	0.155	0.578	1.26	1.57	0.384	0.325	3.79
LAW-HPVR-04-1-SSM-S	3	2	13	S-13870LM12	1.96	4.94	0.0795	0.171	1.11	0.0501	13.4	0.255	0.963	0.825	1.62	2.01	0.556	1.66
LAW-HPVR-02-1-SSM-S	3	2	14	S-13868LM12	2.06	5.60	0.0527	0.106	2.62	0.0462	13.4	0.151	0.768	2.35	0.663	1.94	0.327	1.47
LAW-HPVR-24-SSM-S	3	2	15	S-13890LM22	2.06	5.91	0.056	0.142	3.57	0.0524	12.2	0.219	0.811	2.03	1.78	1.66	0.465	1.85
LAW-HPVR-23-SSM-S	3	2	16	S-13889LM12	2.79	5.22	0.0384	0.112	0.798	0.0467	16.4	0.168	0.650	2.66	0.844	0.706	0.360	3.68
LAW-HPVR-11-SSM-S	3	2	17	S-13877LM12	2.13	4.52	<0.0250	0.0709	2.30	0.0365	16.1	<0.100	0.676	2.81	1.69	1.33	0.201	4.57
LAW-HPVR-SSM-S	3	2	18	S-13893LM12	5.23	0.369	0.127	0.971	1.14	0.0660	15.3	0.194	0.0984	<0.100	0.0623	<0.0500	<0.100	0.670
LAW-HPVR-08-SSM-S	3	2	19	S-13874LM12	4.91	5.15	0.0316	0.121	1.93	0.0431	12.1	0.158	0.582	1.27	1.57	0.386	0.327	3.82
LAW-HPVR-04-1-SSM-S	3	2	20	S-13870LM22	1.96	4.94	0.08	0.170	1.14	0.0499	13.7	0.259	0.951	0.828	1.61	2.01	0.558	1.66
LRM	3	2	21	LRMLM323	5.54	0.384	0.128	0.977	1.21	0.0663	15.8	0.207	0.0888	<0.100	0.0611	<0.0500	<0.100	0.715

Table A-3. PF Measurements (wt.%) of the SSM Study Glasses

PNNL ID	Block	Sub – Block	Seq	Lab ID	B	Li	Si
LRM	1	1	1	LRMPF111	2.32	<0.0500	24.2
LAW-HPVR-12-SSM-S	1	1	2	S-13878PF11	1.70	0.751	20.4
LAW-HPVR-02-1-SSM-S	1	1	3	S-13868PF21	3.83	0.0621	18.0
LAW-HPVR-22-SSM-S	1	1	4	S-13888PF11	2.17	0.664	15.8
LAW-HPVR-04-1-SSM-S	1	1	5	S-13870PF21	2.35	1.35	19.3
LAW-HPVR-14-SSM-S	1	1	6	S-13880PF11	3.00	0.0975	15.1
LAW-HPVR-06-SSM-S	1	1	7	S-13872PF21	3.89	0.525	17.7
LAW-HPVR-06-SSM-S	1	1	8	S-13872PF11	3.83	0.515	17.6
LAW-HPVR-14-SSM-S	1	1	9	S-13880PF21	2.98	0.0867	14.8
LAW-HPVR-26-SSM-S	1	1	10	S-13892PF11	3.83	1.43	15.6
LRM	1	1	11	LRMPF112	2.27	<0.0500	23.9
LAW-HPVR-26-SSM-S	1	1	12	S-13892PF21	3.89	1.41	15.8
LAW-HPVR-22-SSM-S	1	1	13	S-13888PF21	2.16	0.651	15.7
LAW-HPVR-12-SSM-S	1	1	14	S-13878PF21	1.68	0.726	20.1
LAW-HPVR-02-1-SSM-S	1	1	15	S-13868PF11	3.72	0.0729	17.5
LAW-HPVR-05-SSM-S	1	1	16	S-13871PF11	2.94	1.63	18.7
LAW-HPVR-04-1-SSM-S	1	1	17	S-13870PF11	2.31	1.33	19.1
LAW-HPVR-01-1-SSM-S	1	1	18	S-13867PF11	3.44	1.05	17.2
LAW-HPVR-05-SSM-S	1	1	19	S-13871PF21	2.92	1.61	18.8
LAW-HPVR-01-1-SSM-S	1	1	20	S-13867PF21	3.33	1.03	16.8
LRM	1	1	21	LRMPF113	2.21	<0.0500	23.7
LRM	1	2	1	LRMPF121	2.40	0.0671	25.1
LAW-HPVR-12-SSM-S	1	2	2	S-13878PF12	1.79	0.788	21.2
LAW-HPVR-02-1-SSM-S	1	2	3	S-13868PF22	3.91	0.104	18.5
LAW-HPVR-05-SSM-S	1	2	4	S-13871PF12	3.16	1.78	20.1
LAW-HPVR-14-SSM-S	1	2	5	S-13880PF12	3.17	0.134	16.0
LAW-HPVR-22-SSM-S	1	2	6	S-13888PF22	2.22	0.695	16.4
LAW-HPVR-06-SSM-S	1	2	7	S-13872PF22	4.01	0.574	18.6
LAW-HPVR-14-SSM-S	1	2	8	S-13880PF22	3.09	0.122	15.8
LAW-HPVR-26-SSM-S	1	2	9	S-13892PF12	4.00	1.54	16.4
LAW-HPVR-06-SSM-S	1	2	10	S-13872PF12	3.94	0.576	18.3
LRM	1	2	11	LRMPF122	2.37	<0.0500	25.3
LAW-HPVR-01-1-SSM-S	1	2	12	S-13867PF12	3.57	1.13	18.1
LAW-HPVR-05-SSM-S	1	2	13	S-13871PF22	3.07	1.76	19.9
LAW-HPVR-12-SSM-S	1	2	14	S-13878PF22	1.70	0.793	21.0
LAW-HPVR-26-SSM-S	1	2	15	S-13892PF22	3.99	1.55	16.5
LAW-HPVR-22-SSM-S	1	2	16	S-13888PF12	2.20	0.712	16.4
LAW-HPVR-04-1-SSM-S	1	2	17	S-13870PF22	2.38	1.42	20.2
LAW-HPVR-04-1-SSM-S	1	2	18	S-13870PF12	2.43	1.45	20.4
LAW-HPVR-01-1-SSM-S	1	2	19	S-13867PF22	3.57	1.12	18.2
LAW-HPVR-02-1-SSM-S	1	2	20	S-13868PF12	3.97	0.100	18.7
LRM	1	2	21	LRMPF123	2.34	0.0749	25.3
LRM	2	1	1	LRMPF211	2.39	0.0817	25.3
LAW-HPVR-08-SSM-S	2	1	2	S-13874PF11	3.88	1.50	16.4
LAW-HPVR-07-SSM-S	2	1	3	S-13873PF11	2.03	0.461	17.7
LAW-HPVR-17-SSM-S	2	1	4	S-13883PF21	3.97	0.695	17.5
LAW-HPVR-15-SSM-S	2	1	5	S-13881PF21	3.03	1.33	20.6

Table A-3. PF Measurements (wt.%) of the SSM Study Glasses (continued)

PNNL ID	Block	Sub – Block	Seq	Lab ID	B	Li	Si
LAW-HPVR-21-SSM-S	2	1	6	S-13887PF21	3.74	0.0717	16.2
LAW-HPVR-08-SSM-S	2	1	7	S-13874PF21	3.83	1.51	16.4
LAW-HPVR-15-SSM-S	2	1	8	S-13881PF11	3.04	1.34	20.7
LAW-HPVR-07-SSM-S	2	1	9	S-13873PF21	2.00	0.472	17.7
LAW-HPVR-09-SSM-S	2	1	10	S-13875PF21	3.86	1.21	19.5
LRM	2	1	11	LRMPF212	2.32	0.0874	25.4
LAW-HPVR-17-SSM-S	2	1	12	S-13883PF11	3.88	0.706	17.3
LAW-HPVR-09-SSM-S	2	1	13	S-13875PF11	3.82	1.20	19.3
LAW-HPVR-SSM-S	2	1	14	S-13893PF21	2.28	0.0883	24.9
LAW-HPVR-20-SSM-S	2	1	15	S-13886PF11	3.33	0.135	19.3
LAW-HPVR-18-SSM-S	2	1	16	S-13884PF21	3.70	1.20	17.8
LAW-HPVR-20-SSM-S	2	1	17	S-13886PF21	3.28	0.146	19.1
LAW-HPVR-SSM-S	2	1	18	S-13893PF11	2.28	0.0766	25.0
LAW-HPVR-21-SSM-S	2	1	19	S-13887PF11	3.87	0.0779	16.8
LAW-HPVR-18-SSM-S	2	1	20	S-13884PF11	3.83	1.13	18.5
LRM	2	1	21	LRMPF213	2.37	0.0877	26.2
LRM	2	2	1	LRMPF221	2.12	0.0764	25.2
LAW-HPVR-15-SSM-S	2	2	2	S-13881PF22	2.88	1.34	20.6
LAW-HPVR-09-SSM-S	2	2	3	S-13875PF22	3.69	1.19	19.3
LAW-HPVR-21-SSM-S	2	2	4	S-13887PF22	3.63	0.0651	16.3
LAW-HPVR-21-SSM-S	2	2	5	S-13887PF12	3.55	0.0795	16.2
LAW-HPVR-18-SSM-S	2	2	6	S-13884PF12	3.56	1.20	17.7
LAW-HPVR-08-SSM-S	2	2	7	S-13874PF12	3.72	1.53	16.5
LAW-HPVR-20-SSM-S	2	2	8	S-13886PF12	3.23	0.135	19.5
LAW-HPVR-08-SSM-S	2	2	9	S-13874PF22	3.78	1.53	16.6
LAW-HPVR-20-SSM-S	2	2	10	S-13886PF22	3.24	0.143	19.3
LRM	2	2	11	LRMPF222	2.20	0.0856	25.5
LAW-HPVR-17-SSM-S	2	2	12	S-13883PF12	3.86	0.714	17.6
LAW-HPVR-SSM-S	2	2	13	S-13893PF22	2.14	0.0881	25.2
LAW-HPVR-SSM-S	2	2	14	S-13893PF12	2.15	0.0837	25.3
LAW-HPVR-07-SSM-S	2	2	15	S-13873PF22	1.82	0.465	17.8
LAW-HPVR-09-SSM-S	2	2	16	S-13875PF12	3.71	1.20	19.4
LAW-HPVR-18-SSM-S	2	2	17	S-13884PF22	3.58	1.19	17.7
LAW-HPVR-17-SSM-S	2	2	18	S-13883PF22	3.89	0.710	17.8
LAW-HPVR-15-SSM-S	2	2	19	S-13881PF12	2.98	1.38	21.3
LAW-HPVR-07-SSM-S	2	2	20	S-13873PF12	1.87	0.487	18.3
LRM	2	2	21	LRMPF223	2.23	0.105	25.9
LRM	3	1	1	LRMPF311	2.40	0.0526	25.2
LAW-HPVR-23-SSM-S	3	1	2	S-13889PF11	2.09	0.408	18.7
LAW-HPVR-13-SSM-S	3	1	3	S-13879PF21	2.02	0.814	22.6
LAW-HPVR-24-SSM-S	3	1	4	S-13890PF21	2.03	1.20	19.1
LAW-HPVR-16-SSM-S	3	1	5	S-13882PF21	3.57	0.516	17.5
LAW-HPVR-25-SSM-S	3	1	6	S-13891PF21	1.89	0.187	17.9
LAW-HPVR-19-SSM-S	3	1	7	S-13885PF21	2.74	0.803	19.3
LAW-HPVR-25-SSM-S	3	1	8	S-13891PF11	1.95	0.182	18.2
LAW-HPVR-11-SSM-S	3	1	9	S-13877PF11	3.19	0.214	16.1
LAW-HPVR-11-SSM-S	3	1	10	S-13877PF21	3.21	0.213	16.2

Table A-3. PF Measurements (wt.%) of the SSM Study Glasses (continued)

PNNL ID	Block	Sub – Block	Seq	Lab ID	B	Li	Si
LRM	3	1	11	LRMPF312	2.36	0.052	25.0
LAW-HPVR-10-SSM-S	3	1	12	S-13876PF21	3.48	0.139	18.0
LAW-HPVR-19-SSM-S	3	1	13	S-13885PF11	2.72	0.807	19.2
LAW-HPVR-03-1-SSM-S	3	1	14	S-13869PF21	2.67	1.22	16.7
LAW-HPVR-03-1-SSM-S	3	1	15	S-13869PF11	2.64	1.21	16.5
LAW-HPVR-24-SSM-S	3	1	16	S-13890PF11	1.99	1.20	18.9
LAW-HPVR-23-SSM-S	3	1	17	S-13889PF21	2.04	0.403	18.6
LAW-HPVR-10-SSM-S	3	1	18	S-13876PF11	3.38	0.141	17.8
LAW-HPVR-16-SSM-S	3	1	19	S-13882PF11	3.49	0.499	17.4
LAW-HPVR-13-SSM-S	3	1	20	S-13879PF11	1.98	0.810	22.5
LRM	3	1	21	LRMPF313	2.32	0.0561	24.9
LRM	3	2	1	LRMPF321	2.33	0.0554	24.6
LAW-HPVR-13-SSM-S	3	2	2	S-13879PF12	1.98	0.793	22.1
LAW-HPVR-19-SSM-S	3	2	3	S-13885PF22	2.71	0.792	19.2
LAW-HPVR-03-1-SSM-S	3	2	4	S-13869PF12	2.57	1.18	16.1
LAW-HPVR-03-1-SSM-S	3	2	5	S-13869PF22	2.62	1.18	16.4
LAW-HPVR-13-SSM-S	3	2	6	S-13879PF22	1.94	0.785	21.9
LAW-HPVR-11-SSM-S	3	2	7	S-13877PF22	3.07	0.225	15.6
LAW-HPVR-25-SSM-S	3	2	8	S-13891PF22	1.84	0.190	17.6
LAW-HPVR-10-SSM-S	3	2	9	S-13876PF22	3.34	0.154	17.4
LAW-HPVR-16-SSM-S	3	2	10	S-13882PF12	3.48	0.510	17.2
LRM	3	2	11	LRMPF322	2.29	0.0573	24.4
LAW-HPVR-23-SSM-S	3	2	12	S-13889PF12	1.99	0.402	18.3
LAW-HPVR-23-SSM-S	3	2	13	S-13889PF22	2.04	0.397	18.6
LAW-HPVR-24-SSM-S	3	2	14	S-13890PF22	1.95	1.17	18.5
LAW-HPVR-11-SSM-S	3	2	15	S-13877PF12	3.07	0.220	15.7
LAW-HPVR-16-SSM-S	3	2	16	S-13882PF22	3.42	0.501	17.1
LAW-HPVR-10-SSM-S	3	2	17	S-13876PF12	3.26	0.150	17.3
LAW-HPVR-25-SSM-S	3	2	18	S-13891PF12	1.81	0.186	17.5
LAW-HPVR-24-SSM-S	3	2	19	S-13890PF12	1.92	1.19	18.6
LAW-HPVR-19-SSM-S	3	2	20	S-13885PF12	2.58	0.762	18.7
LRM	3	2	21	LRMPF323	2.17	0.0557	23.8

Table A-4. Comparison of Measured and Target Compositions

PNNL ID	Oxide	Mean Measurement (wt.%)	Target (wt.%)	Difference of Measured versus Target	% Difference Measured versus Target
LRM	Al_2O_3	9.87	9.51	0.355	4%
LRM	B_2O_3	7.41	7.85	-0.442	-6%
LRM	CaO	0.528	0.54	-0.012	
LRM	Cl^-	<0.0250	0	0.025	
LRM	Cr_2O_3	0.184	0.19	-0.006	
LRM	F^-	0.884	0.86	0.024	
LRM	Fe_2O_3	1.39	1.38	0.006	0%
LRM	K_2O	1.42	1.48	-0.062	-4%
LRM	Li_2O	<0.143	0.11	0.033	
LRM	MgO	0.108	0.1	0.008	
LRM	Na_2O	20.6	20	0.572	3%
LRM	P_2O_5	0.478	0.54	-0.062	
LRM	SiO_2	53.4	54.2	-0.848	-2%
LRM	SnO_2	<0.127	0	0.127	
LRM	SO_3	0.219	0.3	-0.081	
LRM	TiO_2	0.101	0.1	0.001	
LRM	V_2O_5	<0.0893	0	0.089	
LRM	ZnO	<0.124	0	0.124	
LRM	ZrO_2	0.960	0.93	0.03	
LRM	**Sum of Oxides**	**98.0**	**98.1**	**-0.118**	**0%**
LAW-HPVR-01-1-SSM-S	Al_2O_3	3.68	3.79	-0.115	-3%
LAW-HPVR-01-1-SSM-S	B_2O_3	11.2	12.5	-1.303	-10%
LAW-HPVR-01-1-SSM-S	CaO	6.35	6.5	-0.148	-2%
LAW-HPVR-01-1-SSM-S	Cl^-	0.505	0.035	0.47	
LAW-HPVR-01-1-SSM-S	Cr_2O_3	<0.0367	0.06	-0.023	
LAW-HPVR-01-1-SSM-S	F^-	0.0420	0.07	-0.028	
LAW-HPVR-01-1-SSM-S	Fe_2O_3	0.104	0.08	0.024	
LAW-HPVR-01-1-SSM-S	K_2O	1.78	2.56	-0.783	-31%
LAW-HPVR-01-1-SSM-S	Li_2O	2.33	2.62	-0.289	-11%
LAW-HPVR-01-1-SSM-S	MgO	0.0629	0.01	0.053	
LAW-HPVR-01-1-SSM-S	Na_2O	17.9	18.2	-0.305	-2%
LAW-HPVR-01-1-SSM-S	P_2O_5	<0.229	0.26	-0.031	
LAW-HPVR-01-1-SSM-S	SiO_2	37.6	40.1	-2.502	-6%
LAW-HPVR-01-1-SSM-S	SnO_2	2.08	2.02	0.059	3%
LAW-HPVR-01-1-SSM-S	SO_3	1.90	0.346	1.55	448%
LAW-HPVR-01-1-SSM-S	TiO_2	1.72	1.73	-0.014	-1%
LAW-HPVR-01-1-SSM-S	V_2O_5	3.04	3.26	-0.221	-7%
LAW-HPVR-01-1-SSM-S	ZnO	0.242	0.25	-0.008	
LAW-HPVR-01-1-SSM-S	ZrO_2	5.20	5.64	-0.436	-8%
LAW-HPVR-01-1-SSM-S	**Sum of Oxides**	**96.0**	**100**	**-4.05**	**-4%**
LAW-HPVR-02-1-SSM-S	Al_2O_3	3.75	3.86	-0.114	-3%
LAW-HPVR-02-1-SSM-S	B_2O_3	12.4	13.6	-1.179	-9%
LAW-HPVR-02-1-SSM-S	CaO	7.60	7.6	0.005	0%
LAW-HPVR-02-1-SSM-S	Cl^-	0.273	0.06	0.213	
LAW-HPVR-02-1-SSM-S	Cr_2O_3	0.0759	0.102	-0.026	
LAW-HPVR-02-1-SSM-S	F^-	0.0653	0.12	-0.055	

Table A-4. Comparison of Measured and Target Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Target (wt.%)	Difference of Measured versus Target	% Difference Measured versus Target
LAW-HPVR-02-1-SSM-S	Fe_2O_3	0.151	0.137	0.014	
LAW-HPVR-02-1-SSM-S	K_2O	3.14	4.02	-0.876	-22%
LAW-HPVR-02-1-SSM-S	Li_2O	0.182	0.167	0.015	
LAW-HPVR-02-1-SSM-S	MgO	0.076	0.017	0.059	
LAW-HPVR-02-1-SSM-S	Na_2O	17.6	17.7	-0.109	-1%
LAW-HPVR-02-1-SSM-S	P_2O_5	0.359	0.444	-0.085	
LAW-HPVR-02-1-SSM-S	SiO_2	38.9	41.5	-2.618	-6%
LAW-HPVR-02-1-SSM-S	SnO_2	2.90	2.83	0.074	3%
LAW-HPVR-02-1-SSM-S	SO_3	1.90	0.589	1.311	223%
LAW-HPVR-02-1-SSM-S	TiO_2	1.09	1.16	-0.07	-6%
LAW-HPVR-02-1-SSM-S	V_2O_5	3.38	3.57	-0.192	-5%
LAW-HPVR-02-1-SSM-S	ZnO	0.404	0.427	-0.023	
LAW-HPVR-02-1-SSM-S	ZrO_2	1.93	2.12	-0.192	-9%
LAW-HPVR-02-1-SSM-S	**Sum of Oxides**	**96.2**	**100**	**-3.847**	**-4%**
LAW-HPVR-03-1-SSM-S	Al_2O_3	7.35	7.59	-0.235	-3%
LAW-HPVR-03-1-SSM-S	B_2O_3	8.45	9.16	-0.708	-8%
LAW-HPVR-03-1-SSM-S	CaO	6.20	6.3	-0.102	-2%
LAW-HPVR-03-1-SSM-S	Cl^-	0.0330	0.048	-0.015	
LAW-HPVR-03-1-SSM-S	Cr_2O_3	<0.0399	0.082	-0.042	
LAW-HPVR-03-1-SSM-S	F^-	0.0617	0.096	-0.034	
LAW-HPVR-03-1-SSM-S	Fe_2O_3	0.127	0.109	0.018	
LAW-HPVR-03-1-SSM-S	K_2O	4.35	5.63	-1.281	-23%
LAW-HPVR-03-1-SSM-S	Li_2O	2.58	2.86	-0.282	-10%
LAW-HPVR-03-1-SSM-S	MgO	0.0664	0.014	0.052	
LAW-HPVR-03-1-SSM-S	Na_2O	16.7	16.1	0.615	4%
LAW-HPVR-03-1-SSM-S	P_2O_5	0.289	0.355	-0.066	
LAW-HPVR-03-1-SSM-S	SiO_2	35.1	36.2	-1.062	-3%
LAW-HPVR-03-1-SSM-S	SnO_2	4.11	4	0.114	3%
LAW-HPVR-03-1-SSM-S	SO_3	1.58	0.471	1.108	235%
LAW-HPVR-03-1-SSM-S	TiO_2	1.07	1.09	-0.023	-2%
LAW-HPVR-03-1-SSM-S	V_2O_5	3.02	3.31	-0.293	-9%
LAW-HPVR-03-1-SSM-S	ZnO	0.335	0.341	-0.006	
LAW-HPVR-03-1-SSM-S	ZrO_2	6.50	6.29	0.211	3%
LAW-HPVR-03-1-SSM-S	**Sum of Oxides**	**98.0**	**100**	**-2.032**	**-2%**
LAW-HPVR-04-1-SSM-S	Al_2O_3	3.63	3.71	-0.082	-2%
LAW-HPVR-04-1-SSM-S	B_2O_3	7.62	8.56	-0.937	-11%
LAW-HPVR-04-1-SSM-S	CaO	6.74	6.69	0.051	1%
LAW-HPVR-04-1-SSM-S	Cl^-	0.0571	0.104	-0.047	
LAW-HPVR-04-1-SSM-S	Cr_2O_3	0.114	0.178	-0.064	
LAW-HPVR-04-1-SSM-S	F^-	0.126	0.208	-0.082	
LAW-HPVR-04-1-SSM-S	Fe_2O_3	0.242	0.238	0.004	
LAW-HPVR-04-1-SSM-S	K_2O	1.33	1.61	-0.285	-18%
LAW-HPVR-04-1-SSM-S	Li_2O	2.99	3.36	-0.373	-11%
LAW-HPVR-04-1-SSM-S	MgO	0.0826	0.03	0.053	
LAW-HPVR-04-1-SSM-S	Na_2O	17.5	17.2	0.324	2%
LAW-HPVR-04-1-SSM-S	P_2O_5	0.611	0.772	-0.161	
LAW-HPVR-04-1-SSM-S	SiO_2	42.3	45.9	-3.649	-8%

Table A-4. Comparison of Measured and Target Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Target (wt.%)	Difference of Measured versus Target	% Difference Measured versus Target
LAW-HPVR-04-1-SSM-S	SnO_2	1.04	1.08	-0.037	-3%
LAW-HPVR-04-1-SSM-S	SO_3	2.40	1.02	1.38	135%
LAW-HPVR-04-1-SSM-S	TiO_2	2.66	2.7	-0.044	-2%
LAW-HPVR-04-1-SSM-S	V_2O_5	3.54	3.77	-0.226	-6%
LAW-HPVR-04-1-SSM-S	ZnO	0.690	0.742	-0.052	
LAW-HPVR-04-1-SSM-S	ZrO_2	2.20	2.16	0.035	2%
LAW-HPVR-04-1-SSM-S	**Sum of Oxides**	**95.8**	**100**	**-4.191**	**-4%**
LAW-HPVR-05-SSM-S	Al_2O_3	3.74	3.85	-0.109	-3%
LAW-HPVR-05-SSM-S	B_2O_3	9.73	10.7	-0.968	-9%
LAW-HPVR-05-SSM-S	CaO	6.16	6.2	-0.04	-1%
LAW-HPVR-05-SSM-S	Cl^-	0.529	0.098	0.431	
LAW-HPVR-05-SSM-S	Cr_2O_3	0.109	0.169	-0.06	
LAW-HPVR-05-SSM-S	F^-	0.126	0.197	-0.071	
LAW-HPVR-05-SSM-S	Fe_2O_3	0.257	0.225	0.032	
LAW-HPVR-05-SSM-S	K_2O	0.552	0.818	-0.266	
LAW-HPVR-05-SSM-S	Li_2O	3.65	4.14	-0.491	-12%
LAW-HPVR-05-SSM-S	MgO	0.0785	0.028	0.05	
LAW-HPVR-05-SSM-S	Na_2O	17.0	17.7	-0.715	-4%
LAW-HPVR-05-SSM-S	P_2O_5	0.632	0.731	-0.099	
LAW-HPVR-05-SSM-S	SiO_2	41.4	43.9	-2.451	-6%
LAW-HPVR-05-SSM-S	SnO_2	0.863	0.842	0.021	
LAW-HPVR-05-SSM-S	SO_3	1.90	0.97	0.931	96%
LAW-HPVR-05-SSM-S	TiO_2	0.454	0.452	0.002	
LAW-HPVR-05-SSM-S	V_2O_5	1.71	1.82	-0.106	-6%
LAW-HPVR-05-SSM-S	ZnO	0.686	0.703	-0.017	
LAW-HPVR-05-SSM-S	ZrO_2	6.00	6.41	-0.412	-6%
LAW-HPVR-05-SSM-S	**Sum of Oxides**	**95.6**	**100**	**-4.338**	**-4%**
LAW-HPVR-06-SSM-S	Al_2O_3	3.59	3.72	-0.135	-4%
LAW-HPVR-06-SSM-S	B_2O_3	12.6	13.8	-1.186	-9%
LAW-HPVR-06-SSM-S	CaO	11.8	12.6	-0.766	-6%
LAW-HPVR-06-SSM-S	Cl^-	0.289	0.044	0.245	
LAW-HPVR-06-SSM-S	Cr_2O_3	0.0393	0.075	-0.036	
LAW-HPVR-06-SSM-S	F^-	0.0520	0.087	-0.035	
LAW-HPVR-06-SSM-S	Fe_2O_3	0.141	0.1	0.041	
LAW-HPVR-06-SSM-S	K_2O	4.32	5.87	-1.555	-26%
LAW-HPVR-06-SSM-S	Li_2O	1.18	1.27	-0.091	-7%
LAW-HPVR-06-SSM-S	MgO	0.102	0.012	0.09	
LAW-HPVR-06-SSM-S	Na_2O	16.3	15.9	0.445	3%
LAW-HPVR-06-SSM-S	P_2O_5	0.273	0.324	-0.051	
LAW-HPVR-06-SSM-S	SiO_2	38.6	41	-2.386	-6%
LAW-HPVR-06-SSM-S	SnO_2	0.157	0.149	0.008	
LAW-HPVR-06-SSM-S	SO_3	1.93	0.43	1.503	349%
LAW-HPVR-06-SSM-S	TiO_2	0.961	1	-0.039	-4%
LAW-HPVR-06-SSM-S	V_2O_5	0.399	0.421	-0.022	
LAW-HPVR-06-SSM-S	ZnO	0.306	0.311	-0.005	
LAW-HPVR-06-SSM-S	ZrO_2	2.73	2.93	-0.198	-7%
LAW-HPVR-06-SSM-S	**Sum of Oxides**	**95.9**	**100**	**-4.174**	**-4%**

Table A-4. Comparison of Measured and Target Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Target (wt.%)	Difference of Measured versus Target	% Difference Measured versus Target
LAW-HPVR-07-SSM-S	Al_2O_3	4.22	4.26	-0.042	-1%
LAW-HPVR-07-SSM-S	B_2O_3	6.21	7.07	-0.856	-12%
LAW-HPVR-07-SSM-S	CaO	9.67	9.88	-0.212	-2%
LAW-HPVR-07-SSM-S	Cl^-	0.265	0.061	0.204	
LAW-HPVR-07-SSM-S	Cr_2O_3	0.0461	0.105	-0.059	
LAW-HPVR-07-SSM-S	F^-	0.0809	0.123	-0.042	
LAW-HPVR-07-SSM-S	Fe_2O_3	0.154	0.141	0.013	
LAW-HPVR-07-SSM-S	K_2O	2.59	4.31	-1.717	-40%
LAW-HPVR-07-SSM-S	Li_2O	1.01	1	0.015	1%
LAW-HPVR-07-SSM-S	MgO	0.0938	0.018	0.076	
LAW-HPVR-07-SSM-S	Na_2O	20.4	21	-0.645	-3%
LAW-HPVR-07-SSM-S	P_2O_5	0.382	0.457	-0.075	
LAW-HPVR-07-SSM-S	SiO_2	38.2	37.9	0.34	1%
LAW-HPVR-07-SSM-S	SnO_2	1.97	1.83	0.141	8%
LAW-HPVR-07-SSM-S	SO_3	1.87	0.606	1.264	209%
LAW-HPVR-07-SSM-S	TiO_2	0.252	0.247	0.005	
LAW-HPVR-07-SSM-S	V_2O_5	3.7	3.97	-0.27	-7%
LAW-HPVR-07-SSM-S	ZnO	0.431	0.439	-0.008	
LAW-HPVR-07-SSM-S	ZrO_2	6.22	6.59	-0.366	-6%
LAW-HPVR-07-SSM-S	**Sum of Oxides**	**97.8**	**100**	**-2.234**	**-2%**
LAW-HPVR-08-SSM-S	Al_2O_3	8.96	9.3	-0.344	-4%
LAW-HPVR-08-SSM-S	B_2O_3	12.2	13.1	-0.856	-7%
LAW-HPVR-08-SSM-S	CaO	7	6.85	0.149	2%
LAW-HPVR-08-SSM-S	Cl^-	0.39	0.058	0.332	
LAW-HPVR-08-SSM-S	Cr_2O_3	0.0455	0.1	-0.055	
LAW-HPVR-08-SSM-S	F^-	0.0731	0.116	-0.043	
LAW-HPVR-08-SSM-S	Fe_2O_3	0.171	0.133	0.038	
LAW-HPVR-08-SSM-S	K_2O	2.32	3.66	-1.341	-37%
LAW-HPVR-08-SSM-S	Li_2O	3.27	3.5	-0.233	-7%
LAW-HPVR-08-SSM-S	MgO	0.0707	0.017	0.054	
LAW-HPVR-08-SSM-S	Na_2O	15.8	16.4	-0.628	-4%
LAW-HPVR-08-SSM-S	P_2O_5	0.364	0.433	-0.069	
LAW-HPVR-08-SSM-S	SiO_2	35.2	35.2	0.045	0%
LAW-HPVR-08-SSM-S	SnO_2	1.57	1.49	0.081	5%
LAW-HPVR-08-SSM-S	SO_3	1.45	0.574	0.871	152%
LAW-HPVR-08-SSM-S	TiO_2	2.57	2.57	0.003	0%
LAW-HPVR-08-SSM-S	V_2O_5	0.682	0.731	-0.049	
LAW-HPVR-08-SSM-S	ZnO	0.405	0.416	-0.011	
LAW-HPVR-08-SSM-S	ZrO_2	5	5.41	-0.405	-7%
LAW-HPVR-08-SSM-S	**Sum of Oxides**	**97.6**	**100**	**-2.461**	**-2%**
LAW-HPVR-09-SSM-S	Al_2O_3	4.75	4.88	-0.133	-3%
LAW-HPVR-09-SSM-S	B_2O_3	12.1	13.6	-1.461	-11%
LAW-HPVR-09-SSM-S	CaO	6.05	6.12	-0.072	-1%
LAW-HPVR-09-SSM-S	Cl^-	0.262	0.049	0.213	
LAW-HPVR-09-SSM-S	Cr_2O_3	0.0660	0.084	-0.018	
LAW-HPVR-09-SSM-S	F^-	0.0586	0.098	-0.039	
LAW-HPVR-09-SSM-S	Fe_2O_3	0.172	0.112	0.06	

Table A-4. Comparison of Measured and Target Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Target (wt.%)	Difference of Measured versus Target	% Difference Measured versus Target
LAW-HPVR-09-SSM-S	K_2O	1.40	1.77	-0.37	-21%
LAW-HPVR-09-SSM-S	Li_2O	2.58	2.83	-0.247	-9%
LAW-HPVR-09-SSM-S	MgO	0.0631	0.014	0.049	
LAW-HPVR-09-SSM-S	Na_2O	19.6	19.1	0.48	3%
LAW-HPVR-09-SSM-S	P_2O_5	0.290	0.364	-0.074	
LAW-HPVR-09-SSM-S	SiO_2	41.4	43.5	-2.051	-5%
LAW-HPVR-09-SSM-S	SnO_2	0.355	0.352	0.003	
LAW-HPVR-09-SSM-S	SO_3	2.53	0.483	2.047	424%
LAW-HPVR-09-SSM-S	TiO_2	2.88	2.92	-0.043	-1%
LAW-HPVR-09-SSM-S	V_2O_5	1.05	1.13	-0.081	-7%
LAW-HPVR-09-SSM-S	ZnO	0.336	0.35	-0.014	
LAW-HPVR-09-SSM-S	ZrO_2	2.09	2.27	-0.18	-8%
LAW-HPVR-09-SSM-S	**Sum of Oxides**	**98.1**	**100**	**-1.929**	**-2%**
LAW-HPVR-10-SSM-S	Al_2O_3	3.38	3.55	-0.168	-5%
LAW-HPVR-10-SSM-S	B_2O_3	10.8	12.3	-1.465	-12%
LAW-HPVR-10-SSM-S	CaO	8.51	8.88	-0.366	-4%
LAW-HPVR-10-SSM-S	Cl^-	0.297	0.047	0.25	
LAW-HPVR-10-SSM-S	Cr_2O_3	0.0624	0.08	-0.018	
LAW-HPVR-10-SSM-S	F^-	0.0550	0.093	-0.038	
LAW-HPVR-10-SSM-S	Fe_2O_3	0.122	0.106	0.016	
LAW-HPVR-10-SSM-S	K_2O	1.71	2.27	-0.556	-25%
LAW-HPVR-10-SSM-S	Li_2O	0.314	0.338	-0.024	
LAW-HPVR-10-SSM-S	MgO	0.0792	0.013	0.066	
LAW-HPVR-10-SSM-S	Na_2O	22.3	22.8	-0.524	-2%
LAW-HPVR-10-SSM-S	P_2O_5	0.268	0.346	-0.078	
LAW-HPVR-10-SSM-S	SiO_2	37.7	40.8	-3.095	-8%
LAW-HPVR-10-SSM-S	SnO_2	3.07	3	0.069	2%
LAW-HPVR-10-SSM-S	SO_3	2.51	0.459	2.046	446%
LAW-HPVR-10-SSM-S	TiO_2	<0.0834	0.049	0.034	
LAW-HPVR-10-SSM-S	V_2O_5	1.60	1.78	-0.181	-10%
LAW-HPVR-10-SSM-S	ZnO	0.340	0.333	0.007	
LAW-HPVR-10-SSM-S	ZrO_2	2.48	2.7	-0.225	-8%
LAW-HPVR-10-SSM-S	**Sum of Oxides**	**95.7**	**99.9**	**-4.248**	**-4%**
LAW-HPVR-11-SSM-S	Al_2O_3	3.90	4.02	-0.118	-3%
LAW-HPVR-11-SSM-S	B_2O_3	10.1	11	-0.906	-8%
LAW-HPVR-11-SSM-S	CaO	6.19	6.06	0.135	2%
LAW-HPVR-11-SSM-S	Cl^-	0.575	0.036	0.539	
LAW-HPVR-11-SSM-S	Cr_2O_3	<0.0365	0.061	-0.024	
LAW-HPVR-11-SSM-S	F^-	0.0464	0.071	-0.025	
LAW-HPVR-11-SSM-S	Fe_2O_3	0.0990	0.081	0.018	
LAW-HPVR-11-SSM-S	K_2O	2.72	4.23	-1.511	-36%
LAW-HPVR-11-SSM-S	Li_2O	0.469	0.506	-0.037	
LAW-HPVR-11-SSM-S	MgO	0.0595	0.01	0.049	
LAW-HPVR-11-SSM-S	Na_2O	21.0	22.3	-1.305	-6%
LAW-HPVR-11-SSM-S	P_2O_5	<0.228	0.264	-0.036	
LAW-HPVR-11-SSM-S	SiO_2	34.0	35.4	-1.385	-4%
LAW-HPVR-11-SSM-S	SnO_2	3.48	3.39	0.092	3%

Table A-4. Comparison of Measured and Target Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Target (wt.%)	Difference of Measured versus Target	% Difference Measured versus Target
LAW-HPVR-11-SSM-S	SO_3	1.69	0.35	1.341	383%
LAW-HPVR-11-SSM-S	TiO_2	2.79	2.82	-0.026	-1%
LAW-HPVR-11-SSM-S	V_2O_5	2.35	2.53	-0.182	-7%
LAW-HPVR-11-SSM-S	ZnO	0.246	0.254	-0.008	
LAW-HPVR-11-SSM-S	ZrO_2	6.05	6.55	-0.498	-8%
LAW-HPVR-11-SSM-S	**Sum of Oxides**	**96.0**	**99.9**	**-3.887**	**-4%**
LAW-HPVR-12-SSM-S	Al_2O_3	4.22	4.44	-0.222	-5%
LAW-HPVR-12-SSM-S	B_2O_3	5.53	6.16	-0.63	-10%
LAW-HPVR-12-SSM-S	CaO	7.13	7.41	-0.281	-4%
LAW-HPVR-12-SSM-S	Cl^-	0.374	0.036	0.338	
LAW-HPVR-12-SSM-S	Cr_2O_3	0.0384	0.062	-0.024	
LAW-HPVR-12-SSM-S	F^-	0.0471	0.073	-0.026	
LAW-HPVR-12-SSM-S	Fe_2O_3	0.0975	0.083	0.015	
LAW-HPVR-12-SSM-S	K_2O	0.0892	0.09	-0.001	
LAW-HPVR-12-SSM-S	Li_2O	1.65	1.81	-0.164	-9%
LAW-HPVR-12-SSM-S	MgO	0.0683	0.01	0.058	
LAW-HPVR-12-SSM-S	Na_2O	22.5	23.1	-0.622	-3%
LAW-HPVR-12-SSM-S	P_2O_5	<0.229	0.27	-0.041	
LAW-HPVR-12-SSM-S	SiO_2	44.2	48	-3.77	-8%
LAW-HPVR-12-SSM-S	SnO_2	2.09	2.05	0.045	2%
LAW-HPVR-12-SSM-S	SO_3	2.26	0.358	1.905	532%
LAW-HPVR-12-SSM-S	TiO_2	0.995	1.07	-0.075	-7%
LAW-HPVR-12-SSM-S	V_2O_5	1.68	1.86	-0.178	-10%
LAW-HPVR-12-SSM-S	ZnO	0.247	0.26	-0.013	
LAW-HPVR-12-SSM-S	ZrO_2	2.64	2.88	-0.239	-8%
LAW-HPVR-12-SSM-S	**Sum of Oxides**	**96.1**	**100**	**-3.925**	**-4%**
LAW-HPVR-13-SSM-S	Al_2O_3	3.53	3.57	-0.041	-1%
LAW-HPVR-13-SSM-S	B_2O_3	6.38	6.83	-0.455	-7%
LAW-HPVR-13-SSM-S	CaO	6.64	6.6	0.036	1%
LAW-HPVR-13-SSM-S	Cl^-	0.348	0.069	0.279	
LAW-HPVR-13-SSM-S	Cr_2O_3	0.0699	0.118	-0.048	
LAW-HPVR-13-SSM-S	F^-	0.0818	0.137	-0.055	
LAW-HPVR-13-SSM-S	Fe_2O_3	0.185	0.157	0.028	
LAW-HPVR-13-SSM-S	K_2O	2.58	3.91	-1.329	-34%
LAW-HPVR-13-SSM-S	Li_2O	1.72	1.93	-0.207	-11%
LAW-HPVR-13-SSM-S	MgO	0.0747	0.02	0.055	
LAW-HPVR-13-SSM-S	Na_2O	16.6	16.9	-0.252	-1%
LAW-HPVR-13-SSM-S	P_2O_5	0.435	0.509	-0.074	
LAW-HPVR-13-SSM-S	SiO_2	47.7	49	-1.347	-3%
LAW-HPVR-13-SSM-S	SnO_2	0.621	0.591	0.03	
LAW-HPVR-13-SSM-S	SO_3	1.47	0.676	0.797	118%
LAW-HPVR-13-SSM-S	TiO_2	0.0937	0.085	0.009	
LAW-HPVR-13-SSM-S	V_2O_5	2.13	2.23	-0.101	-5%
LAW-HPVR-13-SSM-S	ZnO	0.492	0.49	0.002	
LAW-HPVR-13-SSM-S	ZrO_2	5.85	6.15	-0.301	-5%
LAW-HPVR-13-SSM-S	**Sum of Oxides**	**97.0**	**100**	**-2.976**	**-3%**

Table A-4. Comparison of Measured and Target Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Target (wt.%)	Difference of Measured versus Target	% Difference Measured versus Target
LAW-HPVR-14-SSM-S	Al_2O_3	5.56	5.77	-0.21	-4%
LAW-HPVR-14-SSM-S	B_2O_3	9.85	11	-1.147	-10%
LAW-HPVR-14-SSM-S	CaO	8.88	9.12	-0.235	-3%
LAW-HPVR-14-SSM-S	Cl^-	0.497	0.047	0.45	
LAW-HPVR-14-SSM-S	Cr_2O_3	<0.038	0.081	-0.043	
LAW-HPVR-14-SSM-S	F^-	0.0629	0.094	-0.031	
LAW-HPVR-14-SSM-S	Fe_2O_3	0.126	0.108	0.018	
LAW-HPVR-14-SSM-S	K_2O	0.117	0.138	-0.021	
LAW-HPVR-14-SSM-S	Li_2O	0.237	0.23	0.007	
LAW-HPVR-14-SSM-S	MgO	0.0801	0.013	0.067	
LAW-HPVR-14-SSM-S	Na_2O	24.4	26.3	-1.901	-7%
LAW-HPVR-14-SSM-S	P_2O_5	0.286	0.351	-0.065	
LAW-HPVR-14-SSM-S	SiO_2	33.0	35.1	-2.101	-6%
LAW-HPVR-14-SSM-S	SnO_2	4.27	4.21	0.059	1%
LAW-HPVR-14-SSM-S	SO_3	1.77	0.465	1.306	281%
LAW-HPVR-14-SSM-S	TiO_2	1.42	1.47	-0.054	-4%
LAW-HPVR-14-SSM-S	V_2O_5	<0.0893	0.064	0.025	
LAW-HPVR-14-SSM-S	ZnO	0.332	0.337	-0.005	
LAW-HPVR-14-SSM-S	ZrO_2	4.74	5.16	-0.419	-8%
LAW-HPVR-14-SSM-S	**Sum of Oxides**	**95.8**	**100**	**-4.301**	**-4%**
LAW-HPVR-15-SSM-S	Al_2O_3	4.29	4.44	-0.146	-3%
LAW-HPVR-15-SSM-S	B_2O_3	9.60	10.6	-0.997	-9%
LAW-HPVR-15-SSM-S	CaO	5.92	6.06	-0.138	-2%
LAW-HPVR-15-SSM-S	Cl^-	0.293	0.04	0.253	
LAW-HPVR-15-SSM-S	Cr_2O_3	0.0443	0.069	-0.025	
LAW-HPVR-15-SSM-S	F^-	0.0482	0.08	-0.032	
LAW-HPVR-15-SSM-S	Fe_2O_3	0.112	0.092	0.02	
LAW-HPVR-15-SSM-S	K_2O	3.76	5.06	-1.305	-26%
LAW-HPVR-15-SSM-S	Li_2O	2.90	3.11	-0.209	-7%
LAW-HPVR-15-SSM-S	MgO	0.0592	0.011	0.048	
LAW-HPVR-15-SSM-S	Na_2O	16.3	15.8	0.511	3%
LAW-HPVR-15-SSM-S	P_2O_5	0.241	0.298	-0.057	
LAW-HPVR-15-SSM-S	SiO_2	44.5	46	-1.503	-3%
LAW-HPVR-15-SSM-S	SnO_2	3.77	3.64	0.134	4%
LAW-HPVR-15-SSM-S	SO_3	1.66	0.395	1.266	321%
LAW-HPVR-15-SSM-S	TiO_2	0.101	0.096	0.005	
LAW-HPVR-15-SSM-S	V_2O_5	0.521	0.56	-0.039	
LAW-HPVR-15-SSM-S	ZnO	0.278	0.286	-0.008	
LAW-HPVR-15-SSM-S	ZrO_2	3.13	3.38	-0.253	-7%
LAW-HPVR-15-SSM-S	**Sum of Oxides**	**97.5**	**100**	**-2.473**	**-2%**
LAW-HPVR-16-SSM-S	Al_2O_3	6.50	6.54	-0.035	-1%
LAW-HPVR-16-SSM-S	B_2O_3	11.2	12.2	-0.963	-8%
LAW-HPVR-16-SSM-S	CaO	6.24	6.17	0.074	1%
LAW-HPVR-16-SSM-S	Cl^-	0.373	0.071	0.302	
LAW-HPVR-16-SSM-S	Cr_2O_3	0.0676	0.121	-0.053	
LAW-HPVR-16-SSM-S	F^-	0.0890	0.141	-0.052	
LAW-HPVR-16-SSM-S	Fe_2O_3	0.183	0.162	0.021	

Table A-4. Comparison of Measured and Target Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Target (wt.%)	Difference of Measured versus Target	% Difference Measured versus Target
LAW-HPVR-16-SSM-S	K_2O	1.89	2.77	-0.885	-32%
LAW-HPVR-16-SSM-S	Li_2O	1.09	1.22	-0.13	-11%
LAW-HPVR-16-SSM-S	MgO	0.0709	0.02	0.051	
LAW-HPVR-16-SSM-S	Na_2O	19.6	19.9	-0.32	-2%
LAW-HPVR-16-SSM-S	P_2O_5	0.444	0.525	-0.081	
LAW-HPVR-16-SSM-S	SiO_2	37.0	38.2	-1.19	-3%
LAW-HPVR-16-SSM-S	SnO_2	4.12	3.94	0.18	5%
LAW-HPVR-16-SSM-S	SO_3	1.50	0.697	0.799	115%
LAW-HPVR-16-SSM-S	TiO_2	0.956	0.945	0.011	
LAW-HPVR-16-SSM-S	V_2O_5	0.886	0.925	-0.039	
LAW-HPVR-16-SSM-S	ZnO	0.505	0.505	0	
LAW-HPVR-16-SSM-S	ZrO_2	4.72	4.94	-0.222	-5%
LAW-HPVR-16-SSM-S	**Sum of Oxides**	**97.5**	**100**	**-2.533**	**-3%**
LAW-HPVR-17-SSM-S	Al_2O_3	8.16	8.22	-0.057	-1%
LAW-HPVR-17-SSM-S	B_2O_3	12.6	13.6	-1.042	-8%
LAW-HPVR-17-SSM-S	CaO	8.69	8.74	-0.054	-1%
LAW-HPVR-17-SSM-S	Cl^-	0.227	0.092	0.135	
LAW-HPVR-17-SSM-S	Cr_2O_3	0.0764	0.158	-0.082	
LAW-HPVR-17-SSM-S	F^-	0.114	0.185	-0.071	
LAW-HPVR-17-SSM-S	Fe_2O_3	0.230	0.211	0.019	
LAW-HPVR-17-SSM-S	K_2O	3.73	5.09	-1.356	-27%
LAW-HPVR-17-SSM-S	Li_2O	1.52	1.59	-0.07	-4%
LAW-HPVR-17-SSM-S	MgO	0.0903	0.026	0.064	
LAW-HPVR-17-SSM-S	Na_2O	18.0	17.7	0.262	1%
LAW-HPVR-17-SSM-S	P_2O_5	0.564	0.686	-0.122	
LAW-HPVR-17-SSM-S	SiO_2	37.5	37.8	-0.255	-1%
LAW-HPVR-17-SSM-S	SnO_2	0.809	0.797	0.012	
LAW-HPVR-17-SSM-S	SO_3	1.73	0.911	0.823	90%
LAW-HPVR-17-SSM-S	TiO_2	0.221	0.204	0.017	
LAW-HPVR-17-SSM-S	V_2O_5	0.652	0.693	-0.041	
LAW-HPVR-17-SSM-S	ZnO	0.640	0.66	-0.02	
LAW-HPVR-17-SSM-S	ZrO_2	2.49	2.64	-0.151	-6%
LAW-HPVR-17-SSM-S	**Sum of Oxides**	**98.0**	**100**	**-1.988**	**-2%**
LAW-HPVR-18-SSM-S	Al_2O_3	4.09	4.28	-0.194	-5%
LAW-HPVR-18-SSM-S	B_2O_3	11.8	13	-1.191	-9%
LAW-HPVR-18-SSM-S	CaO	8.30	8.4	-0.096	-1%
LAW-HPVR-18-SSM-S	Cl^-	0.370	0.096	0.274	
LAW-HPVR-18-SSM-S	Cr_2O_3	0.120	0.165	-0.045	
LAW-HPVR-18-SSM-S	F^-	0.114	0.193	-0.079	
LAW-HPVR-18-SSM-S	Fe_2O_3	0.224	0.22	0.004	
LAW-HPVR-18-SSM-S	K_2O	0.877	1.15	-0.273	-24%
LAW-HPVR-18-SSM-S	Li_2O	2.54	2.8	-0.26	-9%
LAW-HPVR-18-SSM-S	MgO	0.0911	0.028	0.063	
LAW-HPVR-18-SSM-S	Na_2O	16.0	16.3	-0.259	-2%
LAW-HPVR-18-SSM-S	P_2O_5	0.585	0.715	-0.13	
LAW-HPVR-18-SSM-S	SiO_2	38.3	39.5	-1.153	-3%
LAW-HPVR-18-SSM-S	SnO_2	4.29	4.28	0.011	0%

Table A-4. Comparison of Measured and Target Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Target (wt.%)	Difference of Measured versus Target	% Difference Measured versus Target
LAW-HPVR-18-SSM-S	SO_3	2.18	0.949	1.232	130%
LAW-HPVR-18-SSM-S	TiO_2	0.510	0.533	-0.023	
LAW-HPVR-18-SSM-S	V_2O_5	3.52	3.73	-0.209	-6%
LAW-HPVR-18-SSM-S	ZnO	0.648	0.688	-0.04	
LAW-HPVR-18-SSM-S	ZrO_2	2.80	3.08	-0.284	-9%
LAW-HPVR-18-SSM-S	**Sum of Oxides**	**97.5**	**100**	**-2.651**	**-3%**
LAW-HPVR-19-SSM-S	Al_2O_3	4.87	5.19	-0.325	-6%
LAW-HPVR-19-SSM-S	B_2O_3	8.65	9.61	-0.957	-10%
LAW-HPVR-19-SSM-S	CaO	8.21	8.7	-0.487	-6%
LAW-HPVR-19-SSM-S	Cl^-	0.270	0.04	0.23	
LAW-HPVR-19-SSM-S	Cr_2O_3	0.0724	0.068	0.004	
LAW-HPVR-19-SSM-S	F^-	0.0447	0.079	-0.034	
LAW-HPVR-19-SSM-S	Fe_2O_3	0.118	0.091	0.027	
LAW-HPVR-19-SSM-S	K_2O	0.342	0.382	-0.04	
LAW-HPVR-19-SSM-S	Li_2O	1.70	1.95	-0.247	-13%
LAW-HPVR-19-SSM-S	MgO	0.0767	0.011	0.066	
LAW-HPVR-19-SSM-S	Na_2O	21.2	21.4	-0.169	-1%
LAW-HPVR-19-SSM-S	P_2O_5	<0.230	0.295	-0.065	
LAW-HPVR-19-SSM-S	SiO_2	40.9	44.1	-3.239	-7%
LAW-HPVR-19-SSM-S	SnO_2	0.395	0.392	0.003	
LAW-HPVR-19-SSM-S	SO_3	2.97	0.391	2.58	660%
LAW-HPVR-19-SSM-S	TiO_2	0.844	0.888	-0.044	
LAW-HPVR-19-SSM-S	V_2O_5	3.67	4	-0.327	-8%
LAW-HPVR-19-SSM-S	ZnO	0.277	0.283	-0.006	
LAW-HPVR-19-SSM-S	ZrO_2	1.86	2.06	-0.199	-10%
LAW-HPVR-19-SSM-S	**Sum of Oxides**	**96.7**	**99.9**	**-3.229**	**-3%**
LAW-HPVR-20-SSM-S	Al_2O_3	3.36	3.51	-0.147	-4%
LAW-HPVR-20-SSM-S	B_2O_3	10.5	11.9	-1.371	-12%
LAW-HPVR-20-SSM-S	CaO	6.30	6.25	0.053	1%
LAW-HPVR-20-SSM-S	Cl^-	0.395	0.087	0.308	
LAW-HPVR-20-SSM-S	Cr_2O_3	0.101	0.15	-0.049	
LAW-HPVR-20-SSM-S	F^-	0.102	0.175	-0.074	
LAW-HPVR-20-SSM-S	Fe_2O_3	0.202	0.2	0.002	
LAW-HPVR-20-SSM-S	K_2O	<0.0602	0.006	0.054	
LAW-HPVR-20-SSM-S	Li_2O	0.301	0.245	0.056	
LAW-HPVR-20-SSM-S	MgO	0.0751	0.025	0.05	
LAW-HPVR-20-SSM-S	Na_2O	23.6	25.4	-1.776	-7%
LAW-HPVR-20-SSM-S	P_2O_5	0.493	0.649	-0.156	
LAW-HPVR-20-SSM-S	SiO_2	41.3	43.4	-2.112	-5%
LAW-HPVR-20-SSM-S	SnO_2	0.302	0.307	-0.005	
LAW-HPVR-20-SSM-S	SO_3	2.37	0.861	1.506	175%
LAW-HPVR-20-SSM-S	TiO_2	1.50	1.63	-0.132	-8%
LAW-HPVR-20-SSM-S	V_2O_5	1.36	1.53	-0.173	-11%
LAW-HPVR-20-SSM-S	ZnO	0.587	0.624	-0.037	
LAW-HPVR-20-SSM-S	ZrO_2	2.80	3.1	-0.297	-10%
LAW-HPVR-20-SSM-S	**Sum of Oxides**	**95.8**	**100**	**-4.298**	**-4%**
LAW-HPVR-21-SSM-S	Al_2O_3	8.91	9.06	-0.146	-2%

Table A-4. Comparison of Measured and Target Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Target (wt.%)	Difference of Measured versus Target	% Difference Measured versus Target
LAW-HPVR-21-SSM-S	B_2O_3	11.9	12.9	-0.994	-8%
LAW-HPVR-21-SSM-S	CaO	6.04	6.03	0.008	0%
LAW-HPVR-21-SSM-S	Cl^-	0.270	0.084	0.186	
LAW-HPVR-21-SSM-S	Cr_2O_3	0.0707	0.143	-0.072	
LAW-HPVR-21-SSM-S	F^-	0.0993	0.167	-0.068	
LAW-HPVR-21-SSM-S	Fe_2O_3	0.207	0.191	0.016	
LAW-HPVR-21-SSM-S	K_2O	4.49	5.83	-1.337	-23%
LAW-HPVR-21-SSM-S	Li_2O	0.158	0.086	0.072	
LAW-HPVR-21-SSM-S	MgO	0.0739	0.024	0.05	
LAW-HPVR-21-SSM-S	Na_2O	19.7	19.8	-0.119	-1%
LAW-HPVR-21-SSM-S	P_2O_5	0.485	0.622	-0.137	
LAW-HPVR-21-SSM-S	SiO_2	35.0	34.7	0.331	1%
LAW-HPVR-21-SSM-S	SnO_2	0.174	0.166	0.008	
LAW-HPVR-21-SSM-S	SO_3	1.67	0.825	0.845	102%
LAW-HPVR-21-SSM-S	TiO_2	2.80	2.74	0.062	2%
LAW-HPVR-21-SSM-S	V_2O_5	3.17	3.42	-0.247	-7%
LAW-HPVR-21-SSM-S	ZnO	0.586	0.598	-0.012	
LAW-HPVR-21-SSM-S	ZrO_2	2.48	2.64	-0.161	-6%
LAW-HPVR-21-SSM-S	**Sum of Oxides**	**98.3**	**100**	**-1.717**	**-2%**
LAW-HPVR-22-SSM-S	Al_2O_3	5.75	5.81	-0.061	-1%
LAW-HPVR-22-SSM-S	B_2O_3	7.04	7.74	-0.696	-9%
LAW-HPVR-22-SSM-S	CaO	6.89	6.95	-0.055	-1%
LAW-HPVR-22-SSM-S	Cl^-	0.240	0.085	0.155	
LAW-HPVR-22-SSM-S	Cr_2O_3	0.0686	0.146	-0.077	
LAW-HPVR-22-SSM-S	F^-	0.106	0.17	-0.065	
LAW-HPVR-22-SSM-S	Fe_2O_3	0.208	0.195	0.013	
LAW-HPVR-22-SSM-S	K_2O	2.42	3.58	-1.159	-32%
LAW-HPVR-22-SSM-S	Li_2O	1.47	1.6	-0.135	-8%
LAW-HPVR-22-SSM-S	MgO	0.0806	0.024	0.057	
LAW-HPVR-22-SSM-S	Na_2O	20.0	20.3	-0.282	-1%
LAW-HPVR-22-SSM-S	P_2O_5	0.517	0.632	-0.115	
LAW-HPVR-22-SSM-S	SiO_2	34.4	35.6	-1.211	-3%
LAW-HPVR-22-SSM-S	SnO_2	4.68	4.45	0.228	5%
LAW-HPVR-22-SSM-S	SO_3	1.78	0.839	0.938	112%
LAW-HPVR-22-SSM-S	TiO_2	3.03	2.99	0.042	1%
LAW-HPVR-22-SSM-S	V_2O_5	3.55	3.83	-0.277	-7%
LAW-HPVR-22-SSM-S	ZnO	0.594	0.608	-0.014	
LAW-HPVR-22-SSM-S	ZrO_2	4.18	4.45	-0.273	-6%
LAW-HPVR-22-SSM-S	**Sum of Oxides**	**97.0**	**100**	**-2.989**	**-3%**
LAW-HPVR-23-SSM-S	Al_2O_3	5.27	5.39	-0.123	-2%
LAW-HPVR-23-SSM-S	B_2O_3	6.57	7.14	-0.571	-8%
LAW-HPVR-23-SSM-S	CaO	7.27	7.14	0.125	2%
LAW-HPVR-23-SSM-S	Cl^-	0.399	0.065	0.334	
LAW-HPVR-23-SSM-S	Cr_2O_3	0.0540	0.111	-0.057	
LAW-HPVR-23-SSM-S	F^-	0.0793	0.13	-0.051	
LAW-HPVR-23-SSM-S	Fe_2O_3	0.157	0.148	0.009	
LAW-HPVR-23-SSM-S	K_2O	0.959	1.48	-0.521	-35%

Table A-4. Comparison of Measured and Target Compositions (continued)

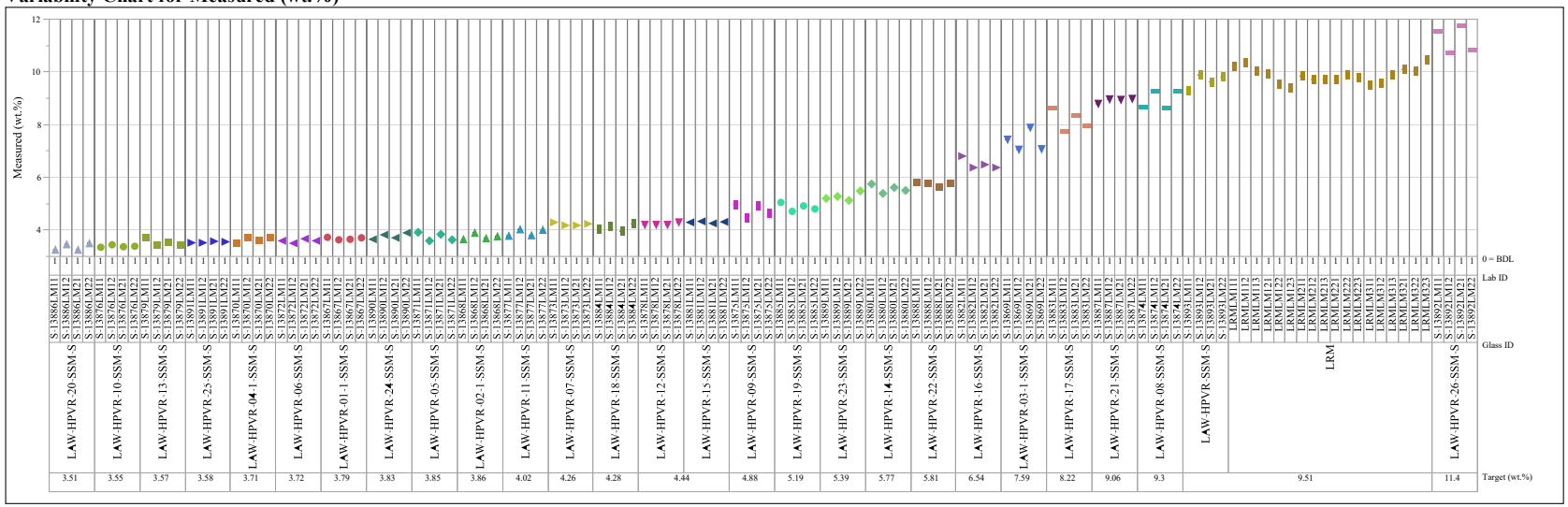
PNNL ID	Oxide	Mean Measurement (wt.%)	Target (wt.%)	Difference of Measured versus Target	% Difference Measured versus Target
LAW-HPVR-23-SSM-S	Li_2O	0.867	0.959	-0.092	
LAW-HPVR-23-SSM-S	MgO	0.0762	0.019	0.057	
LAW-HPVR-23-SSM-S	Na_2O	21.7	23.3	-1.564	-7%
LAW-HPVR-23-SSM-S	P_2O_5	0.386	0.482	-0.096	
LAW-HPVR-23-SSM-S	SiO_2	39.7	41	-1.316	-3%
LAW-HPVR-23-SSM-S	SnO_2	3.36	3.25	0.108	3%
LAW-HPVR-23-SSM-S	SO_3	1.6	0.64	0.958	150%
LAW-HPVR-23-SSM-S	TiO_2	1.37	1.45	-0.078	-5%
LAW-HPVR-23-SSM-S	V_2O_5	1.24	1.37	-0.132	-10%
LAW-HPVR-23-SSM-S	ZnO	0.442	0.463	-0.021	
LAW-HPVR-23-SSM-S	ZrO_2	4.97	5.37	-0.402	-7%
LAW-HPVR-23-SSM-S	**Sum of Oxides**	**96.5**	**99.9**	**-3.433**	**-3%**
LAW-HPVR-24-SSM-S	Al_2O_3	3.76	3.83	-0.065	-2%
LAW-HPVR-24-SSM-S	B_2O_3	6.35	7.04	-0.689	-10%
LAW-HPVR-24-SSM-S	CaO	8.15	8.08	0.067	1%
LAW-HPVR-24-SSM-S	Cl^-	0.246	0.085	0.161	
LAW-HPVR-24-SSM-S	Cr_2O_3	0.0791	0.145	-0.066	
LAW-HPVR-24-SSM-S	F^-	0.107	0.17	-0.063	
LAW-HPVR-24-SSM-S	Fe_2O_3	0.202	0.194	0.008	
LAW-HPVR-24-SSM-S	K_2O	4.25	5.77	-1.524	-26%
LAW-HPVR-24-SSM-S	Li_2O	2.56	2.92	-0.358	-12%
LAW-HPVR-24-SSM-S	MgO	0.0863	0.024	0.062	
LAW-HPVR-24-SSM-S	Na_2O	16.1	15.9	0.242	2%
LAW-HPVR-24-SSM-S	P_2O_5	0.504	0.63	-0.126	
LAW-HPVR-24-SSM-S	SiO_2	40.2	42.6	-2.435	-6%
LAW-HPVR-24-SSM-S	SnO_2	2.52	2.4	0.123	5%
LAW-HPVR-24-SSM-S	SO_3	2.02	0.837	1.181	141%
LAW-HPVR-24-SSM-S	TiO_2	2.93	2.96	-0.033	-1%
LAW-HPVR-24-SSM-S	V_2O_5	2.91	3.06	-0.15	-5%
LAW-HPVR-24-SSM-S	ZnO	0.579	0.606	-0.027	
LAW-HPVR-24-SSM-S	ZrO_2	2.43	2.68	-0.249	-9%
LAW-HPVR-24-SSM-S	**Sum of Oxides**	**96.0**	**99.9**	**-3.939**	**-4%**
LAW-HPVR-25-SSM-S	Al_2O_3	3.54	3.58	-0.042	-1%
LAW-HPVR-25-SSM-S	B_2O_3	6.03	6.68	-0.651	-10%
LAW-HPVR-25-SSM-S	CaO	11.0	11.4	-0.388	-3%
LAW-HPVR-25-SSM-S	Cl^-	0.212	0.105	0.107	
LAW-HPVR-25-SSM-S	Cr_2O_3	0.0827	0.18	-0.097	
LAW-HPVR-25-SSM-S	F^-	0.135	0.21	-0.076	
LAW-HPVR-25-SSM-S	Fe_2O_3	0.250	0.24	0.01	
LAW-HPVR-25-SSM-S	K_2O	1.16	2.01	-0.848	-42%
LAW-HPVR-25-SSM-S	Li_2O	0.401	0.437	-0.036	
LAW-HPVR-25-SSM-S	MgO	0.113	0.03	0.083	
LAW-HPVR-25-SSM-S	Na_2O	23.3	24.7	-1.447	-6%
LAW-HPVR-25-SSM-S	P_2O_5	0.626	0.779	-0.153	
LAW-HPVR-25-SSM-S	SiO_2	38.1	39.3	-1.22	-3%
LAW-HPVR-25-SSM-S	SnO_2	1.84	1.73	0.111	6%
LAW-HPVR-25-SSM-S	SO_3	1.90	1.03	0.866	84%

Table A-4. Comparison of Measured and Target Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Target (wt.%)	Difference of Measured versus Target	% Difference Measured versus Target
LAW-HPVR-25-SSM-S	TiO_2	1.92	1.9	0.022	1%
LAW-HPVR-25-SSM-S	V_2O_5	0.213	0.224	-0.011	
LAW-HPVR-25-SSM-S	ZnO	0.723	0.749	-0.026	
LAW-HPVR-25-SSM-S	ZrO_2	4.39	4.69	-0.297	-6%
LAW-HPVR-25-SSM-S	**Sum of Oxides**	**95.9**	**100**	**-4.093**	**-4%**
LAW-HPVR-26-SSM-S	Al_2O_3	11.2	11.4	-0.191	-2%
LAW-HPVR-26-SSM-S	B_2O_3	12.6	13.7	-1.054	-8%
LAW-HPVR-26-SSM-S	CaO	6.23	6.25	-0.017	0%
LAW-HPVR-26-SSM-S	Cl^-	0.317	0.077	0.24	
LAW-HPVR-26-SSM-S	Cr_2O_3	0.0658	0.132	-0.066	
LAW-HPVR-26-SSM-S	F^-	0.0993	0.155	-0.056	
LAW-HPVR-26-SSM-S	Fe_2O_3	0.190	0.177	0.013	
LAW-HPVR-26-SSM-S	K_2O	2.14	3.1	-0.959	-31%
LAW-HPVR-26-SSM-S	Li_2O	3.19	3.55	-0.358	-10%
LAW-HPVR-26-SSM-S	MgO	0.0715	0.022	0.05	
LAW-HPVR-26-SSM-S	Na_2O	17.6	17.6	-0.009	0%
LAW-HPVR-26-SSM-S	P_2O_5	0.475	0.574	-0.099	
LAW-HPVR-26-SSM-S	SiO_2	34.4	35.5	-1.111	-3%
LAW-HPVR-26-SSM-S	SnO_2	1.76	1.7	0.055	3%
LAW-HPVR-26-SSM-S	SO_3	1.64	0.762	0.876	115%
LAW-HPVR-26-SSM-S	TiO_2	0.887	0.884	0.003	
LAW-HPVR-26-SSM-S	V_2O_5	0.278	0.29	-0.012	
LAW-HPVR-26-SSM-S	ZnO	0.546	0.552	-0.006	
LAW-HPVR-26-SSM-S	ZrO_2	3.34	3.57	-0.23	-6%
LAW-HPVR-26-SSM-S	**Sum of Oxides**	**97.1**	**100**	**-2.93**	**-3%**
LAW-HPVR-SSM-S	Al_2O_3	9.65	9.51	0.136	1%
LAW-HPVR-SSM-S	B_2O_3	7.12	7.85	-0.726	-9%
LAW-HPVR-SSM-S	CaO	0.509	0.54	-0.031	
LAW-HPVR-SSM-S	Cl^-	<0.025	0	0.025	
LAW-HPVR-SSM-S	Cr_2O_3	0.182	0.19	-0.008	
LAW-HPVR-SSM-S	F^-	0.886	0.86	0.026	
LAW-HPVR-SSM-S	Fe_2O_3	1.38	1.38	0.004	0%
LAW-HPVR-SSM-S	K_2O	1.40	1.48	-0.077	-5%
LAW-HPVR-SSM-S	Li_2O	0.181	0.11	0.071	
LAW-HPVR-SSM-S	MgO	0.109	0.1	0.009	
LAW-HPVR-SSM-S	Na_2O	20.1	20	0.089	0%
LAW-HPVR-SSM-S	P_2O_5	0.461	0.54	-0.079	
LAW-HPVR-SSM-S	SiO_2	53.7	54.2	-0.504	-1%
LAW-HPVR-SSM-S	SnO_2	<0.127	0	0.127	
LAW-HPVR-SSM-S	SO_3	0.236	0.3	-0.064	
LAW-HPVR-SSM-S	TiO_2	0.102	0.1	0.002	
LAW-HPVR-SSM-S	V_2O_5	<0.0893	0	0.089	
LAW-HPVR-SSM-S	ZnO	<0.124	0	0.124	
LAW-HPVR-SSM-S	ZrO_2	0.915	0.93	-0.015	
LAW-HPVR-SSM-S	**Sum of Oxides**	**97.3**	**98.1**	**-0.801**	**-1%**

Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Target Concentrations

Oxide=Al_2O_3 (wt%)
Variability Chart for Measured (wt.%)



Oxide=B_2O_3 (wt%)
Variability Chart for Measured (wt.%)

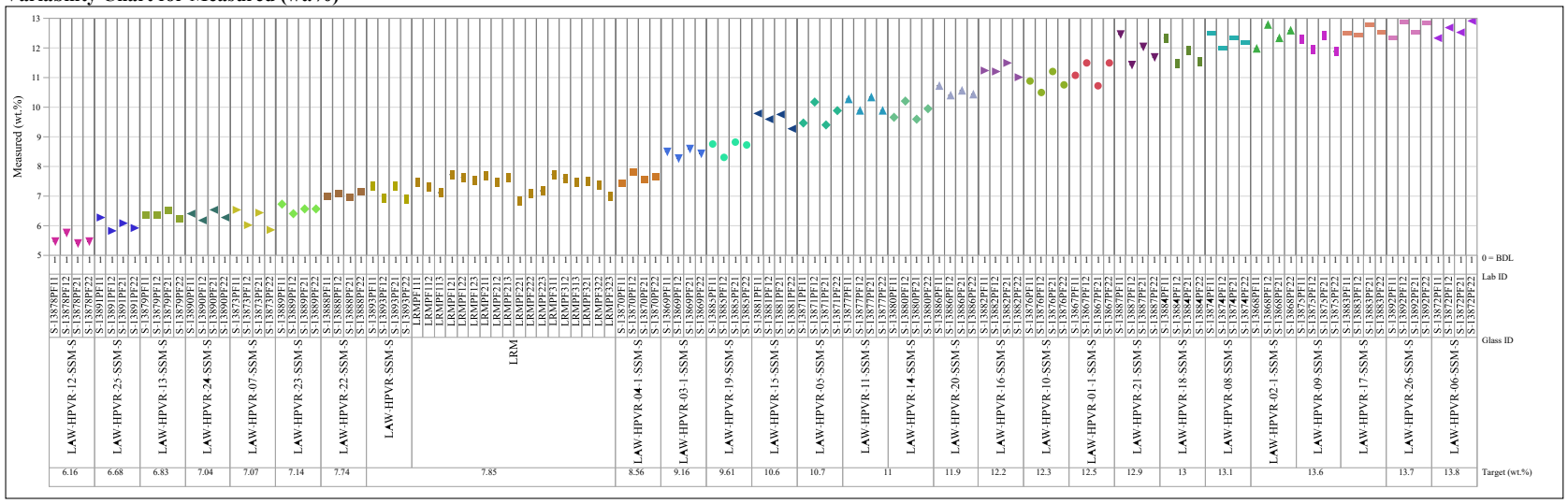
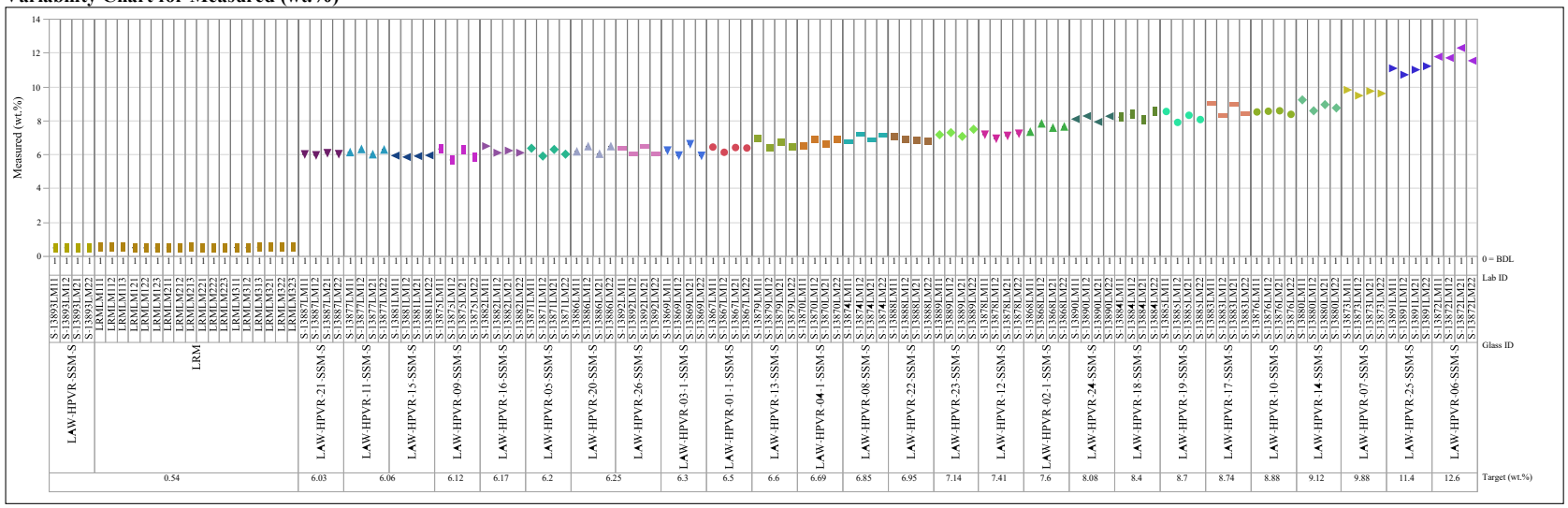


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Target Concentrations (continued)

Oxide=CaO (wt%)
Variability Chart for Measured (wt.%)



Oxide=Cl^- (wt%)
Variability Chart for Measured (wt.%)

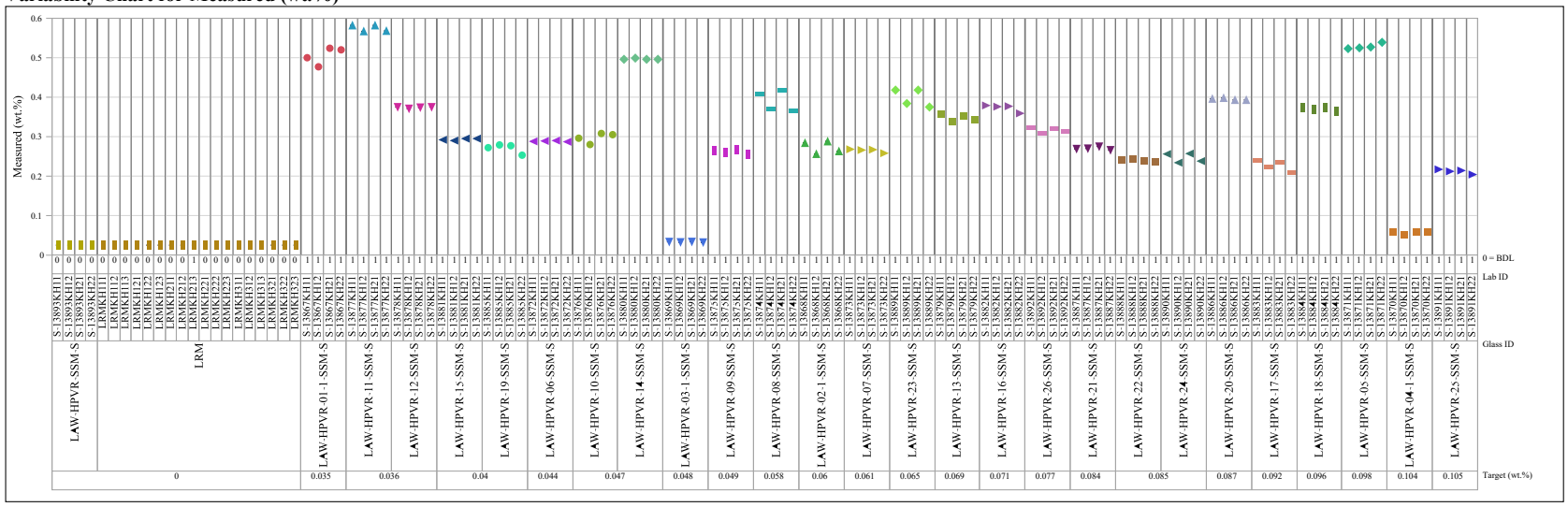
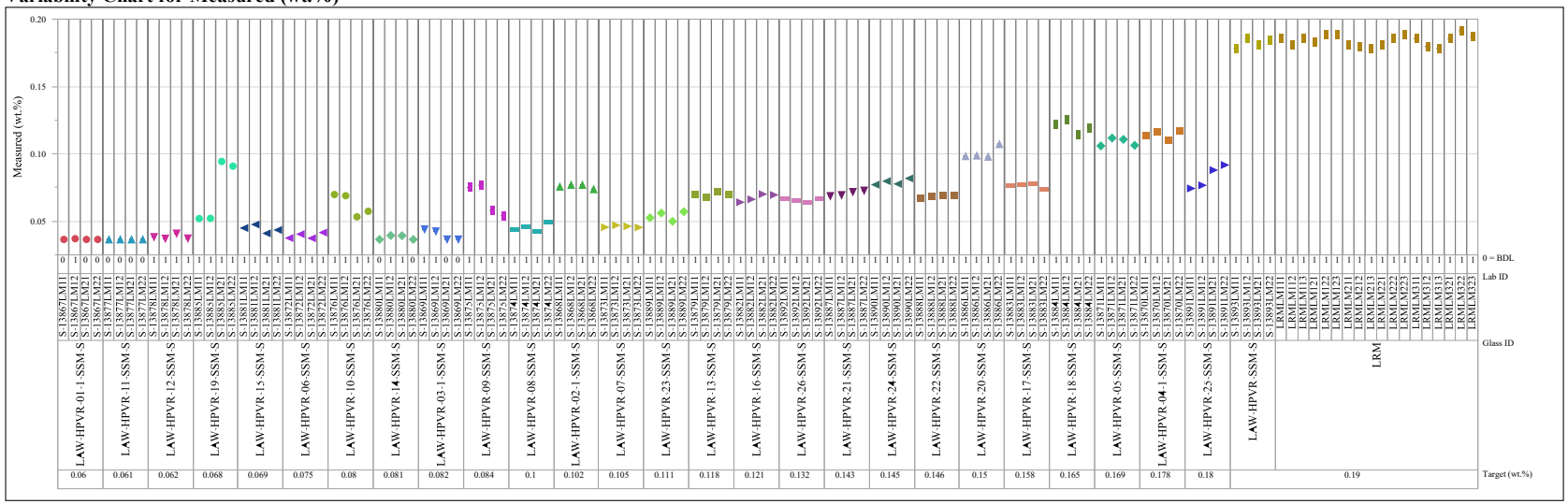


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Target Concentrations (continued)

Oxide=Cr_2O_3 (wt%)
Variability Chart for Measured (wt.%)



Oxide=F^- (wt%)
Variability Chart for Measured (wt.%)

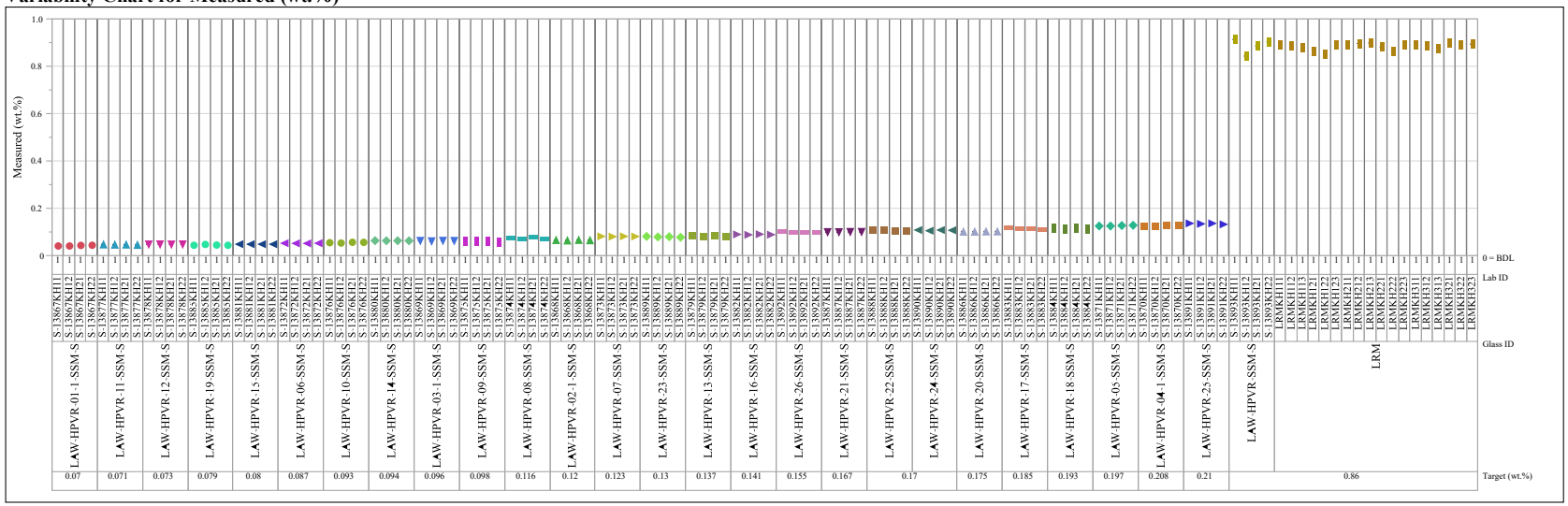
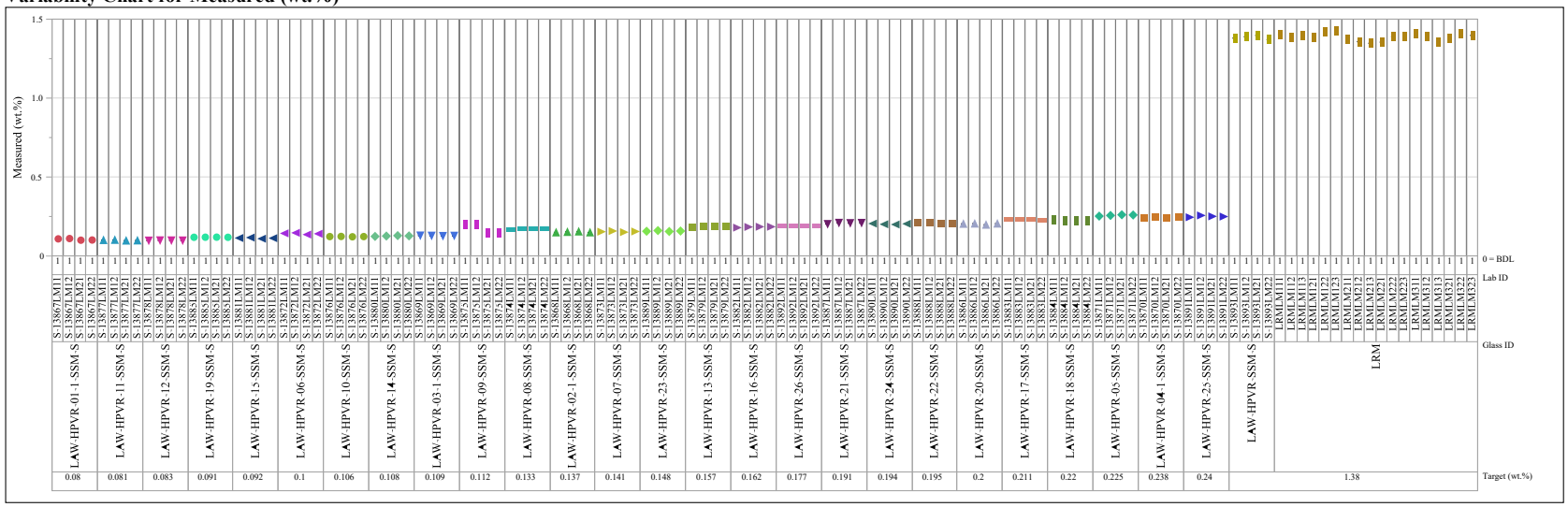


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Target Concentrations (continued)

Oxide=Fe_2O_3 (wt%)
Variability Chart for Measured (wt.%)



Oxide=K_2O (wt%)
Variability Chart for Measured (wt.%)

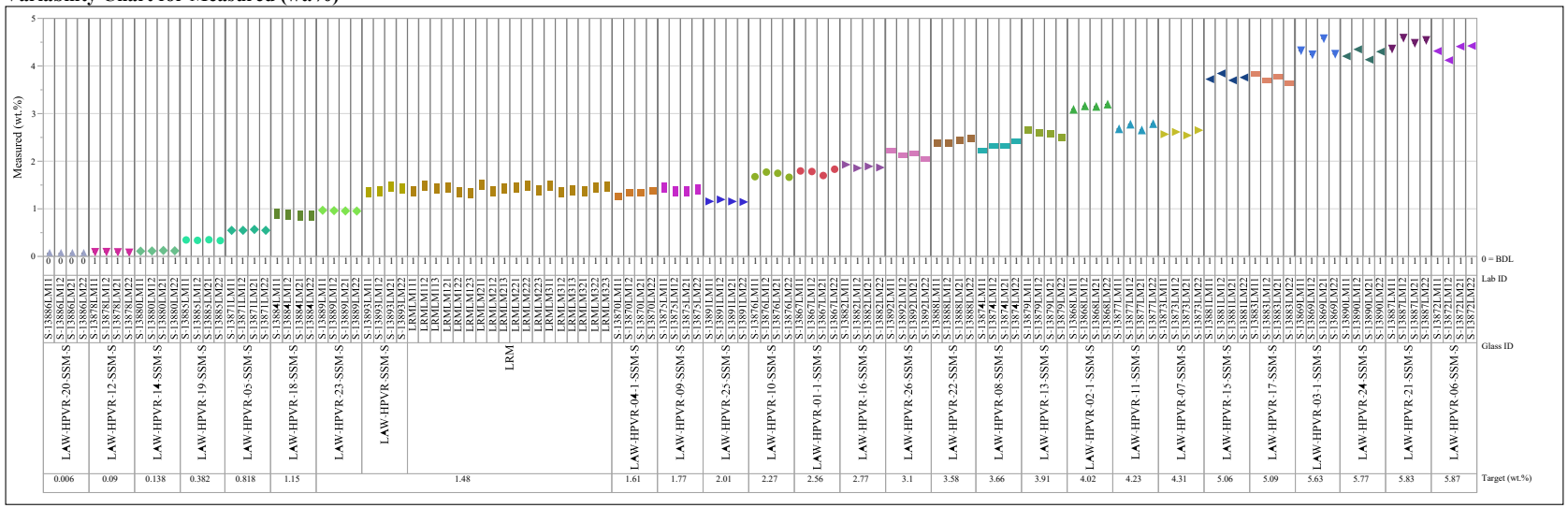
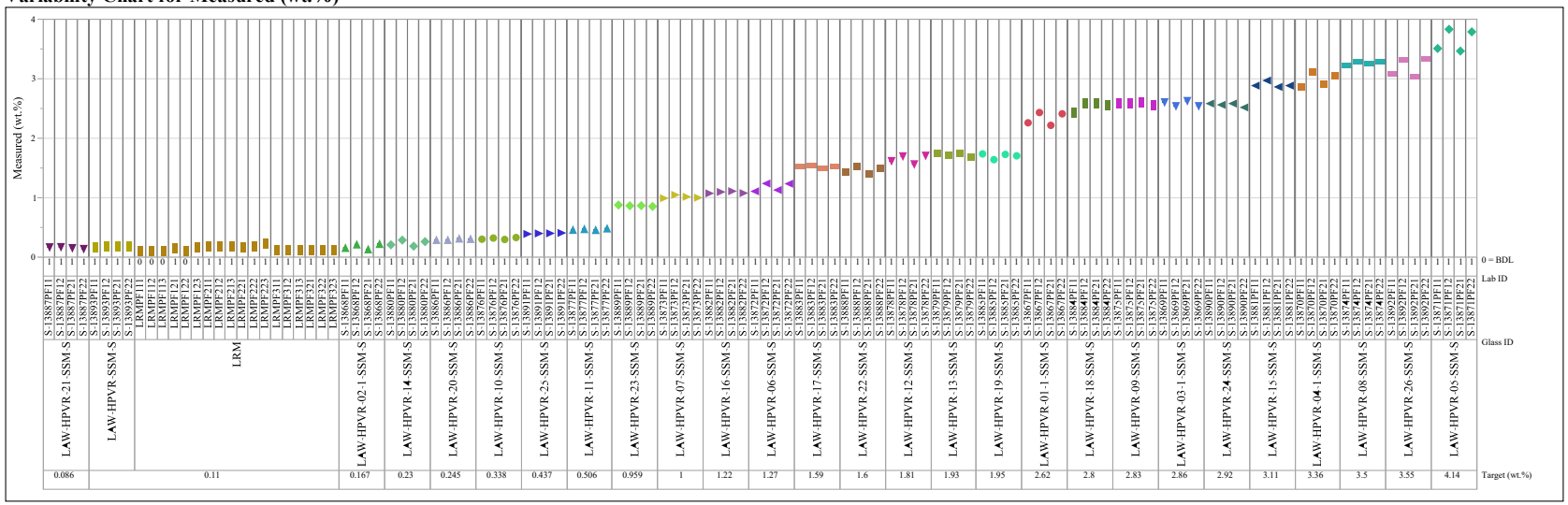


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Target Concentrations (continued)

Oxide=Li_2O (wt%)
Variability Chart for Measured (wt.%)



Oxide=MgO (wt%)
Variability Chart for Measured (wt.%)

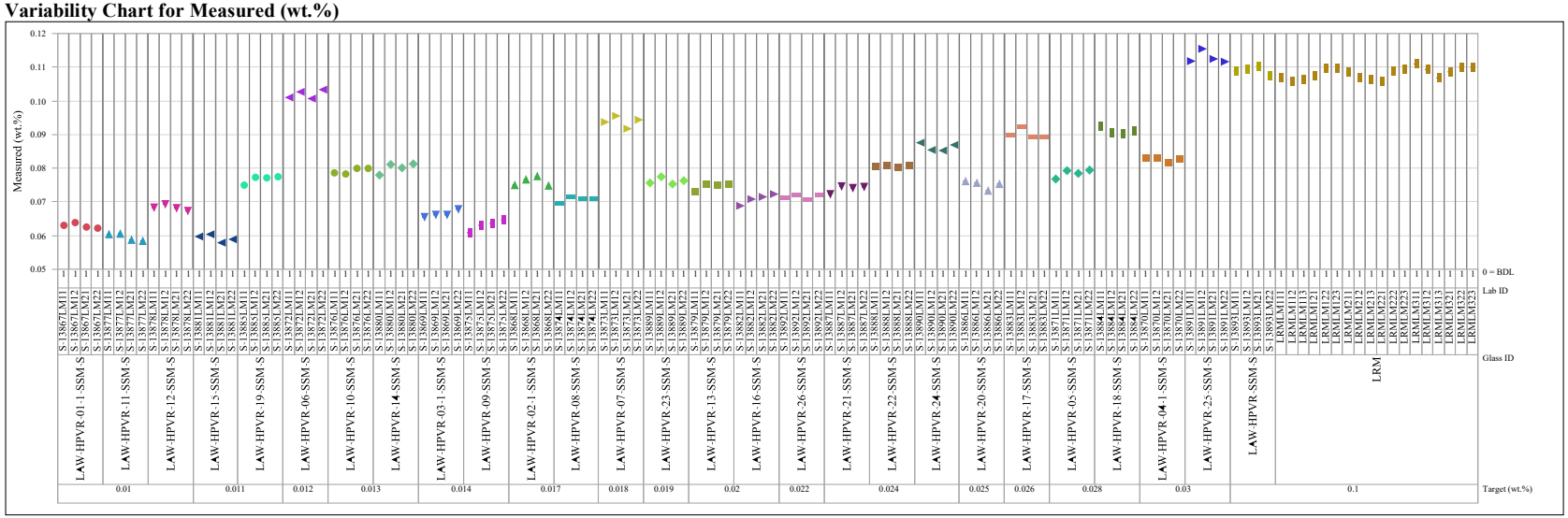
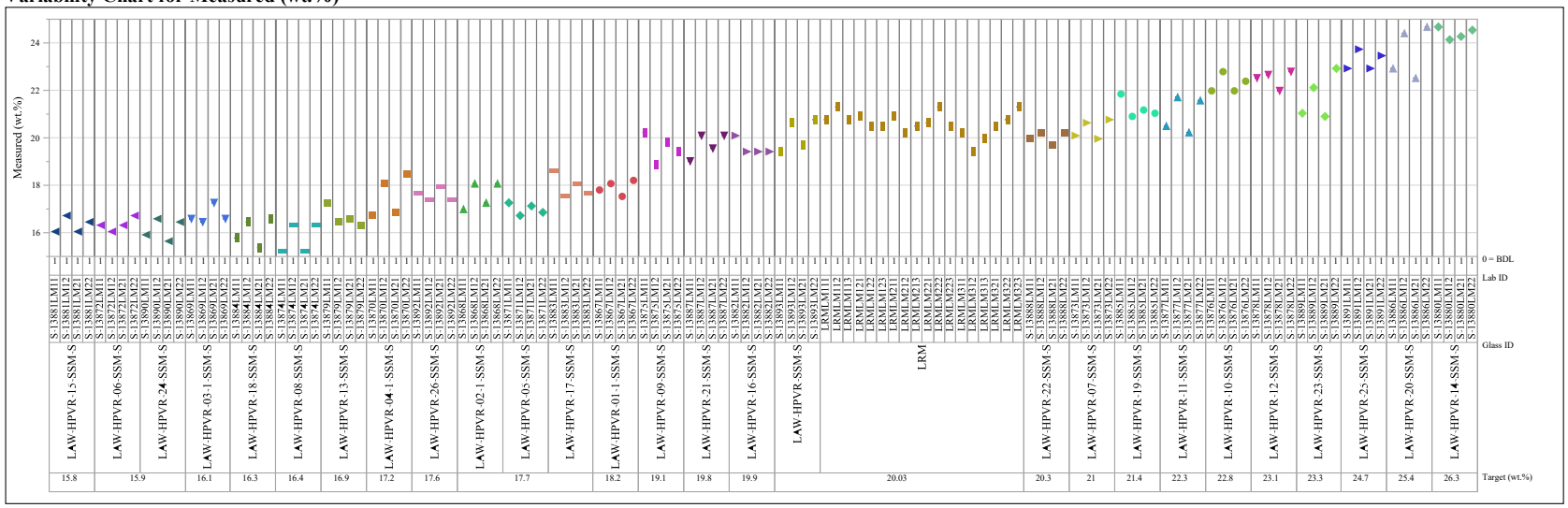


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Target Concentrations (continued)

Oxide=Na_2O (wt%)
Variability Chart for Measured (wt.%)



Oxide=P_2O_5 (wt%)
Variability Chart for Measured (wt.%)

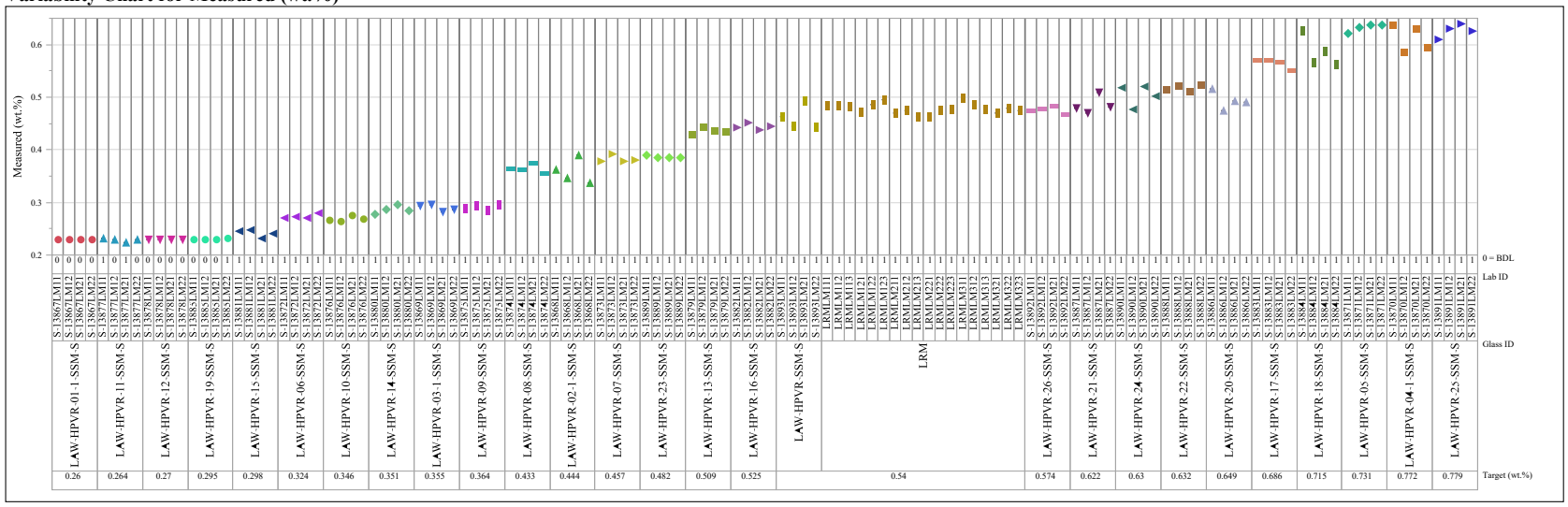
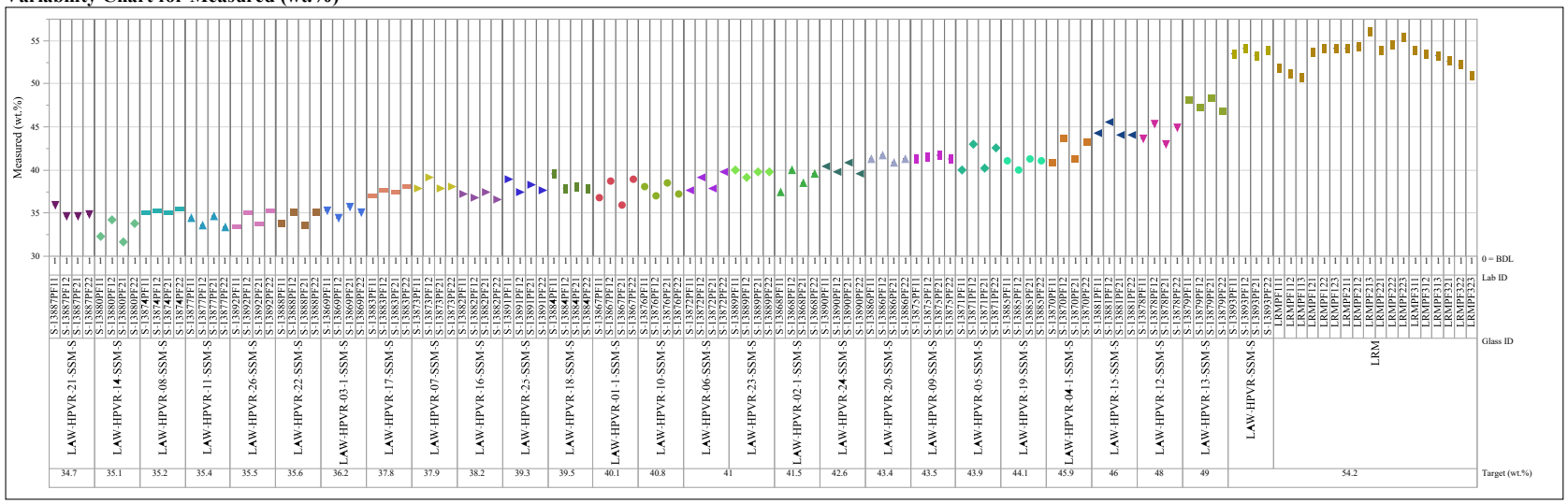


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Target Concentrations (continued)

Oxide=SiO_2 (wt%)
Variability Chart for Measured (wt.%)



Oxide=SnO_2 (wt%)
Variability Chart for Measured (wt.%)

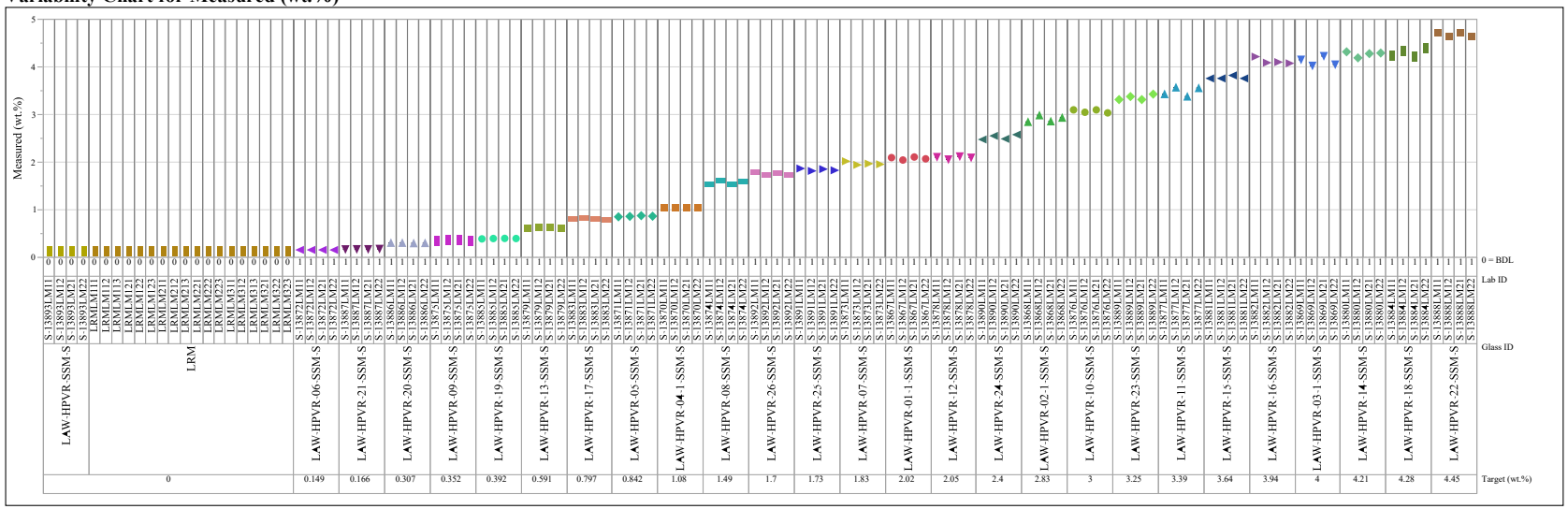
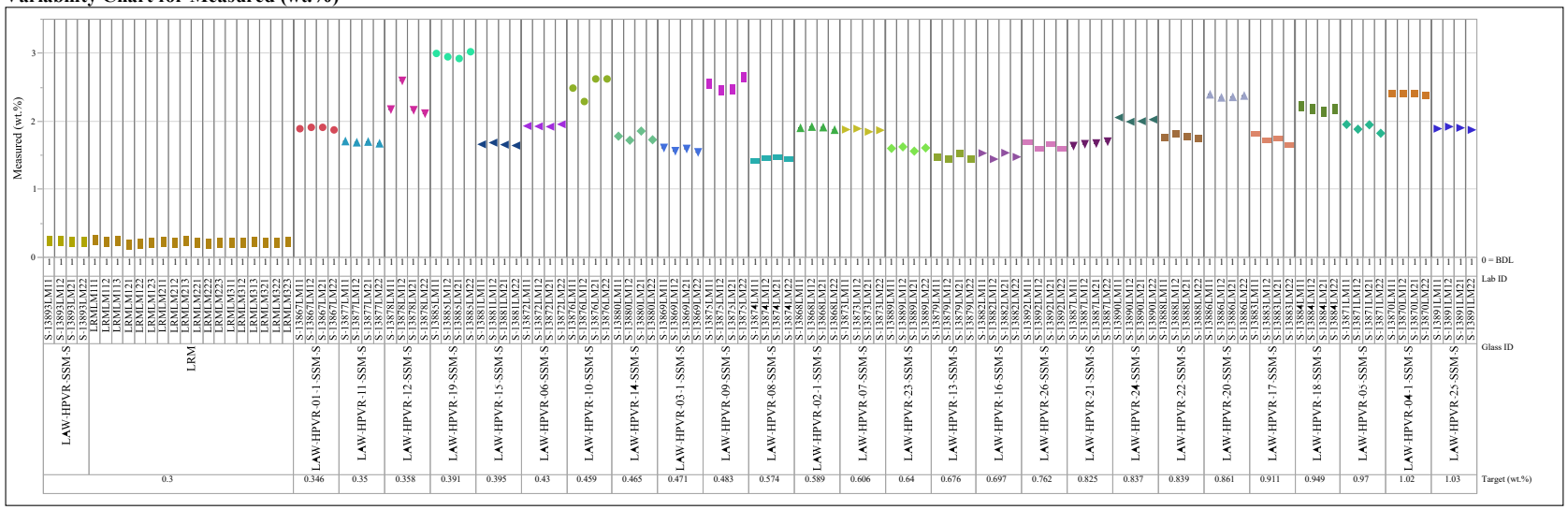


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Target Concentrations (continued)

Oxide=SO_3 (wt%)
Variability Chart for Measured (wt.%)



Oxide=TiO_2 (wt%)
Variability Chart for Measured (wt.%)

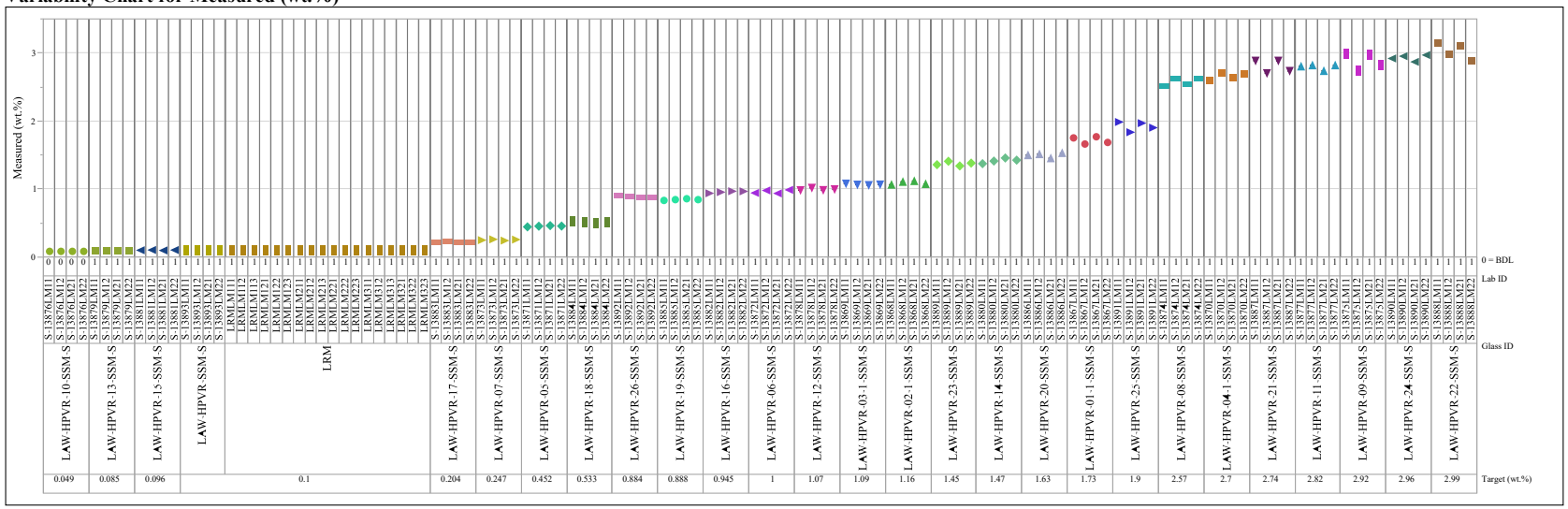
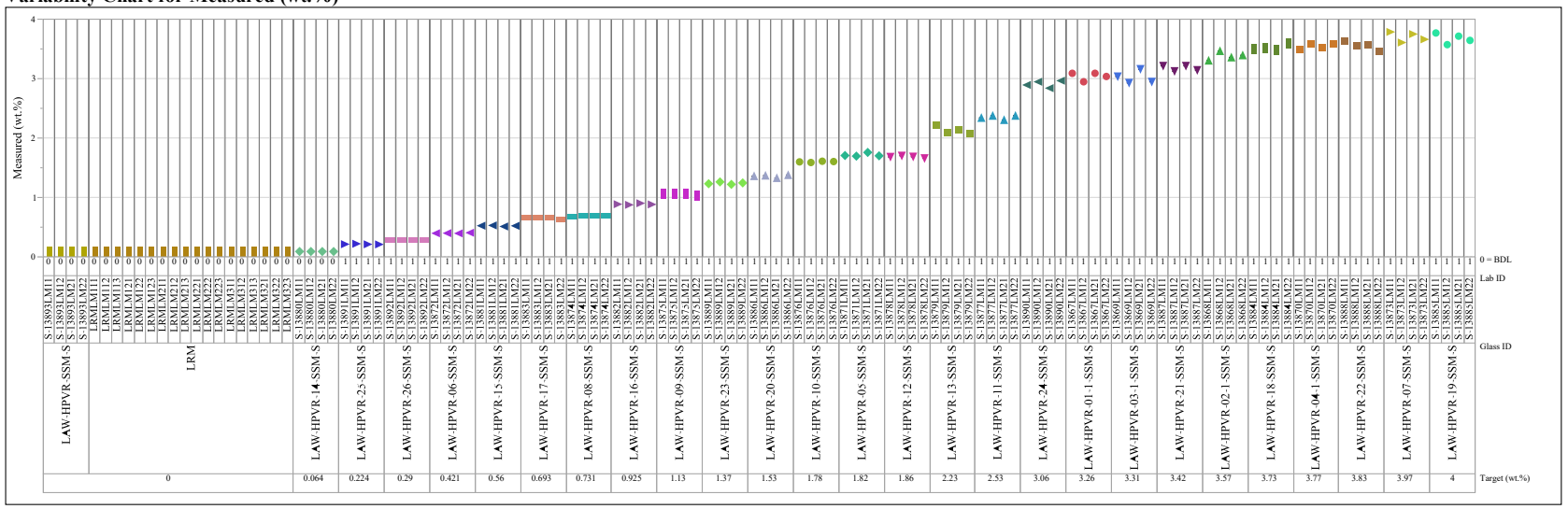


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Target Concentrations (continued)

Oxide=V_2O_5 (wt%)
Variability Chart for Measured (wt.%)



Oxide=ZnO (wt%)
Variability Chart for Measured (wt.%)

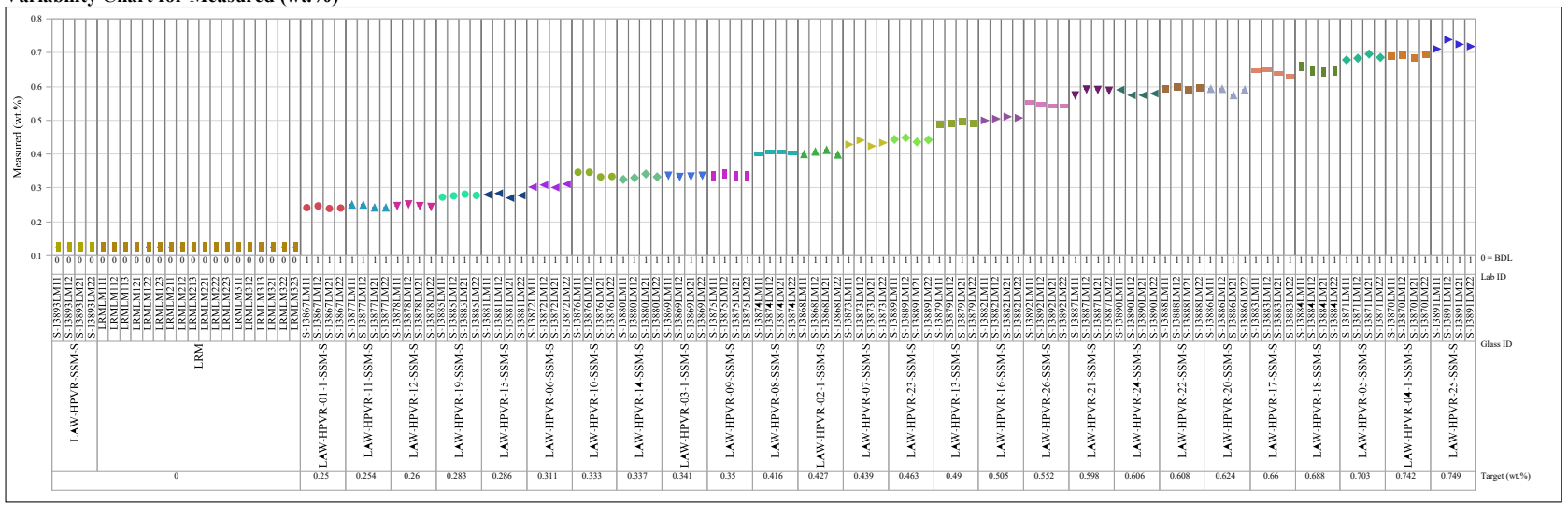


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Target Concentrations (continued)

Oxide=ZrO_2 (wt%)
Variability Chart for Measured (wt.%)

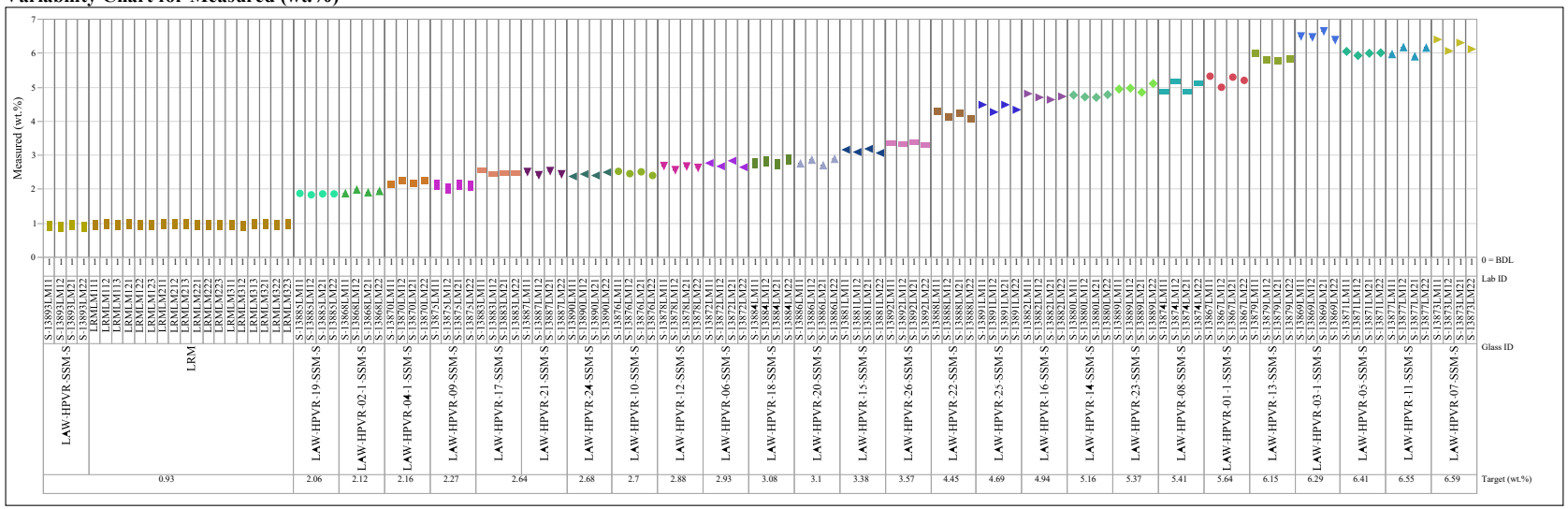
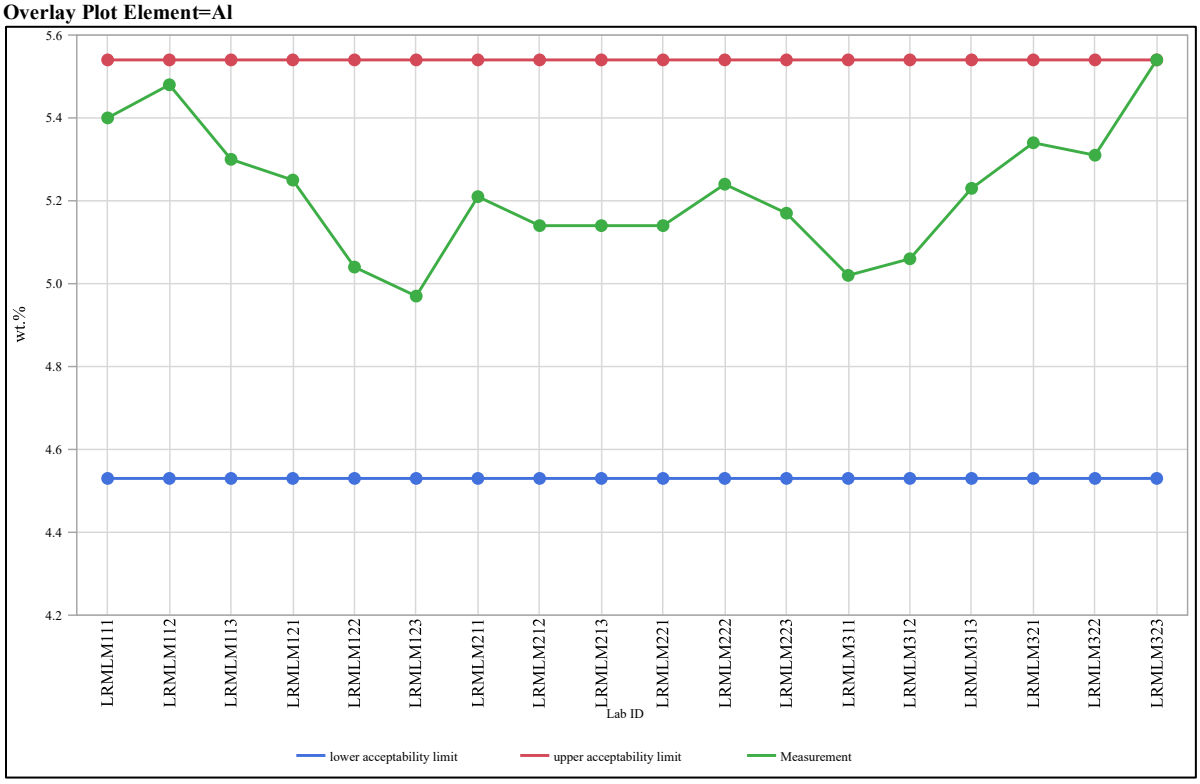


Exhibit A-2. Acceptability Evaluation for Measurements of the LRM Glass

Overlay Plot Element=Al



Overlay Plot Element=B

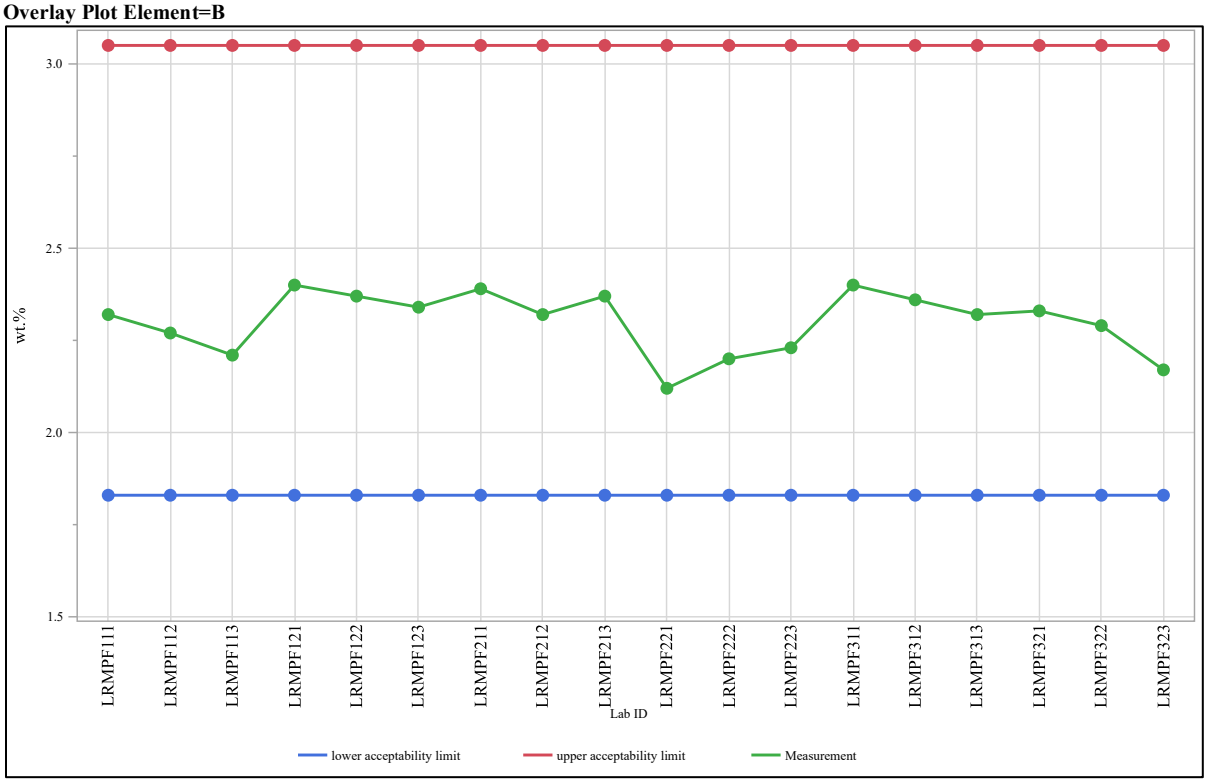
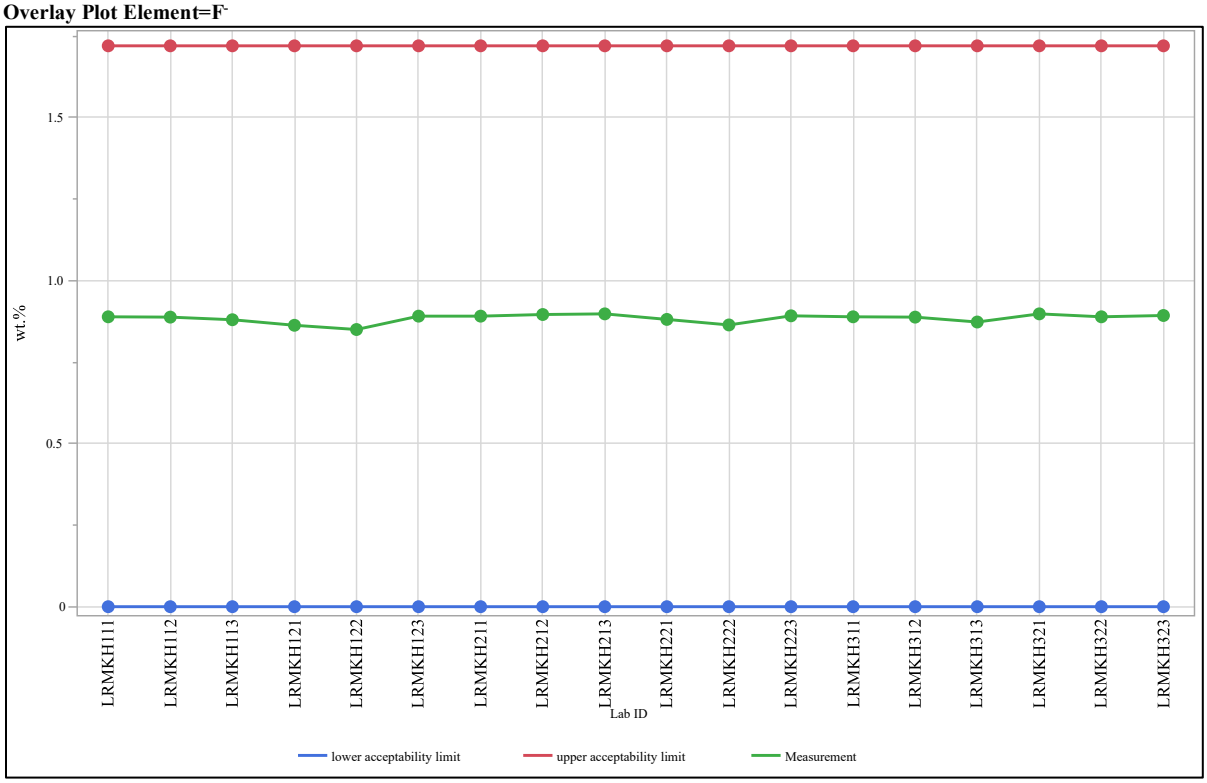


Exhibit A-2. Acceptability Evaluation for Measurements of the LRM Glass (continued)

Overlay Plot Element=F



Overlay Plot Element=Fe

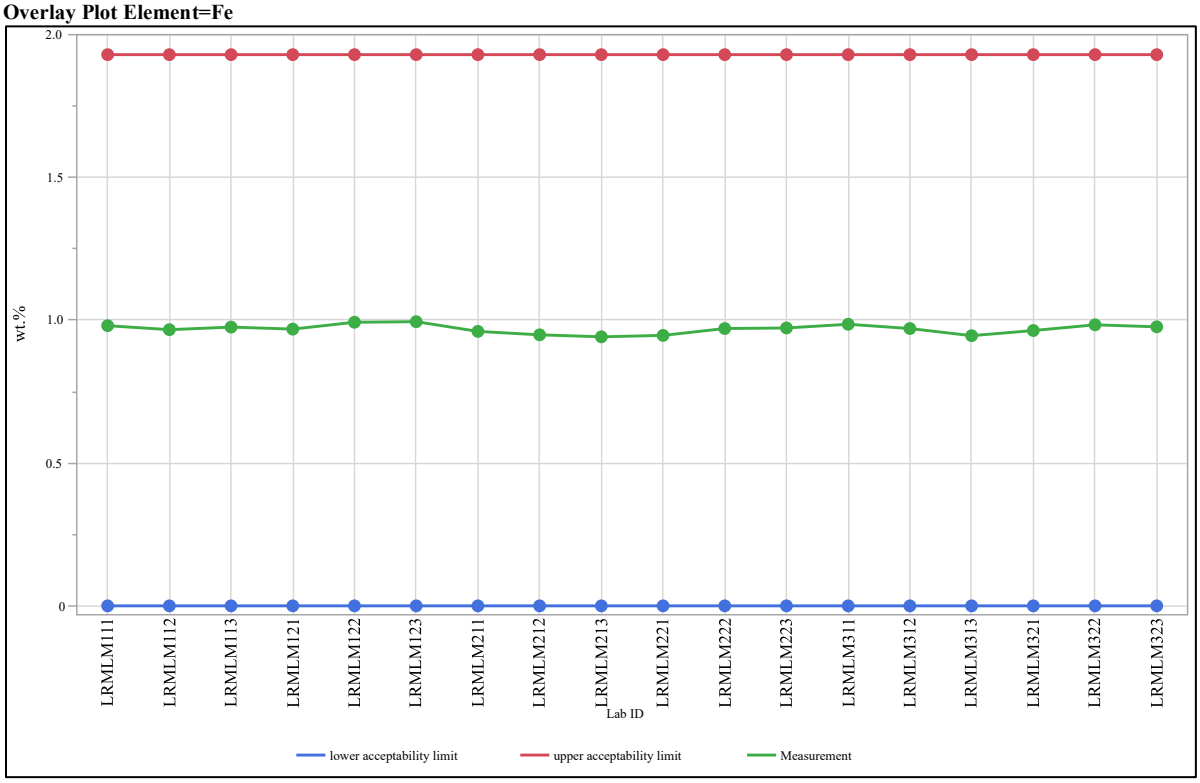
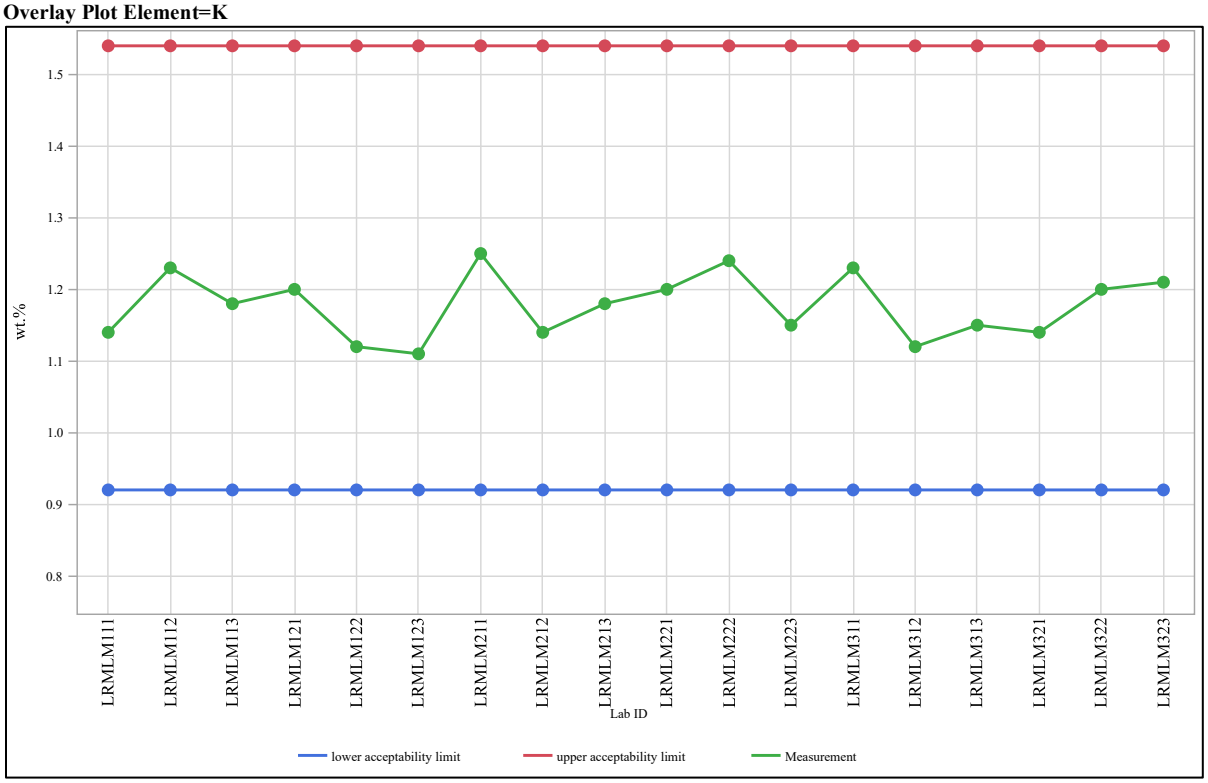


Exhibit A-2. Acceptability Evaluation for Measurements of the LRM Glass (continued)

Overlay Plot Element=K



Overlay Plot Element=Na

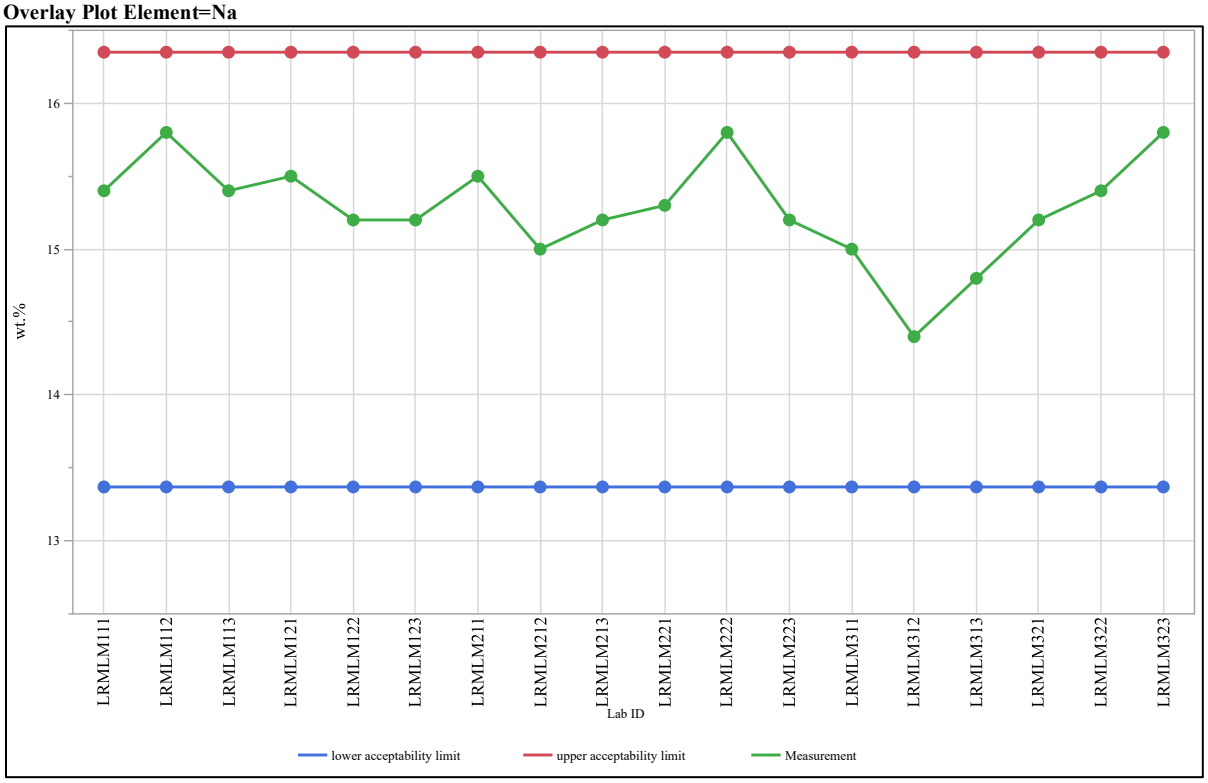
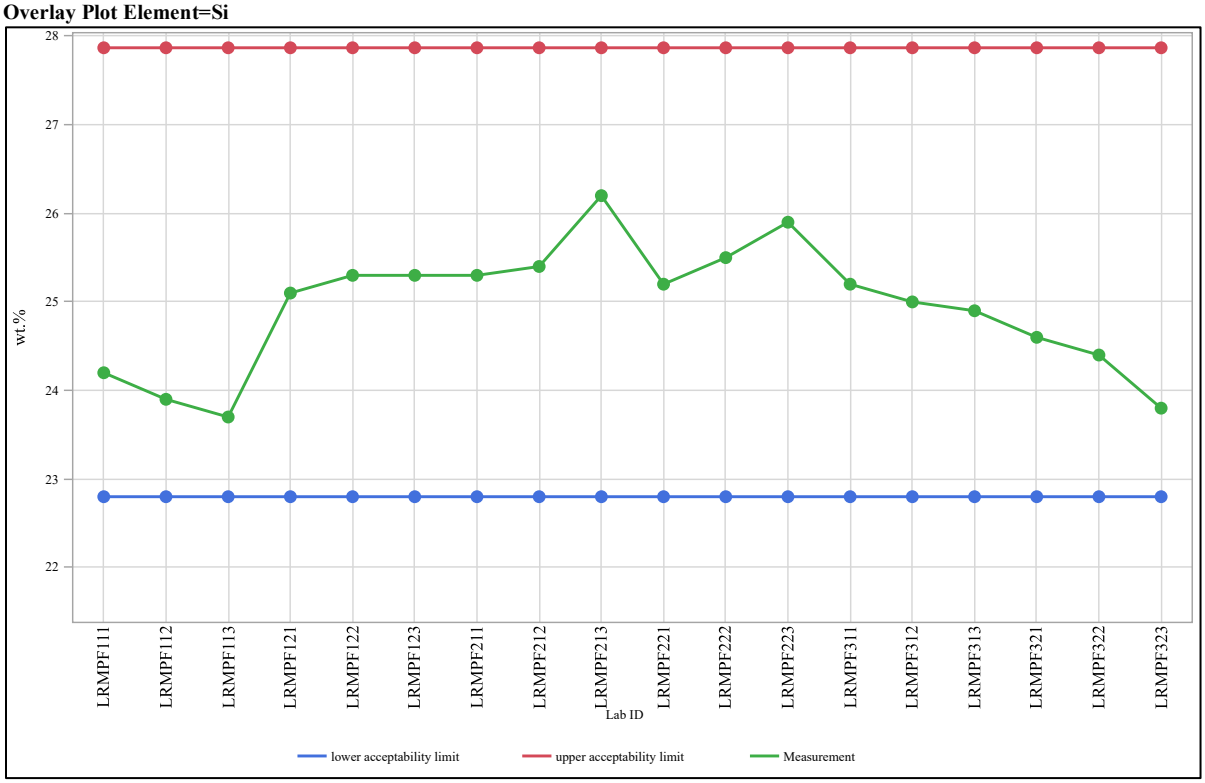


Exhibit A-2. Acceptability Evaluation for Measurements of the LRM Glass (continued)

Overlay Plot Element=Si



Overlay Plot Element=Zr

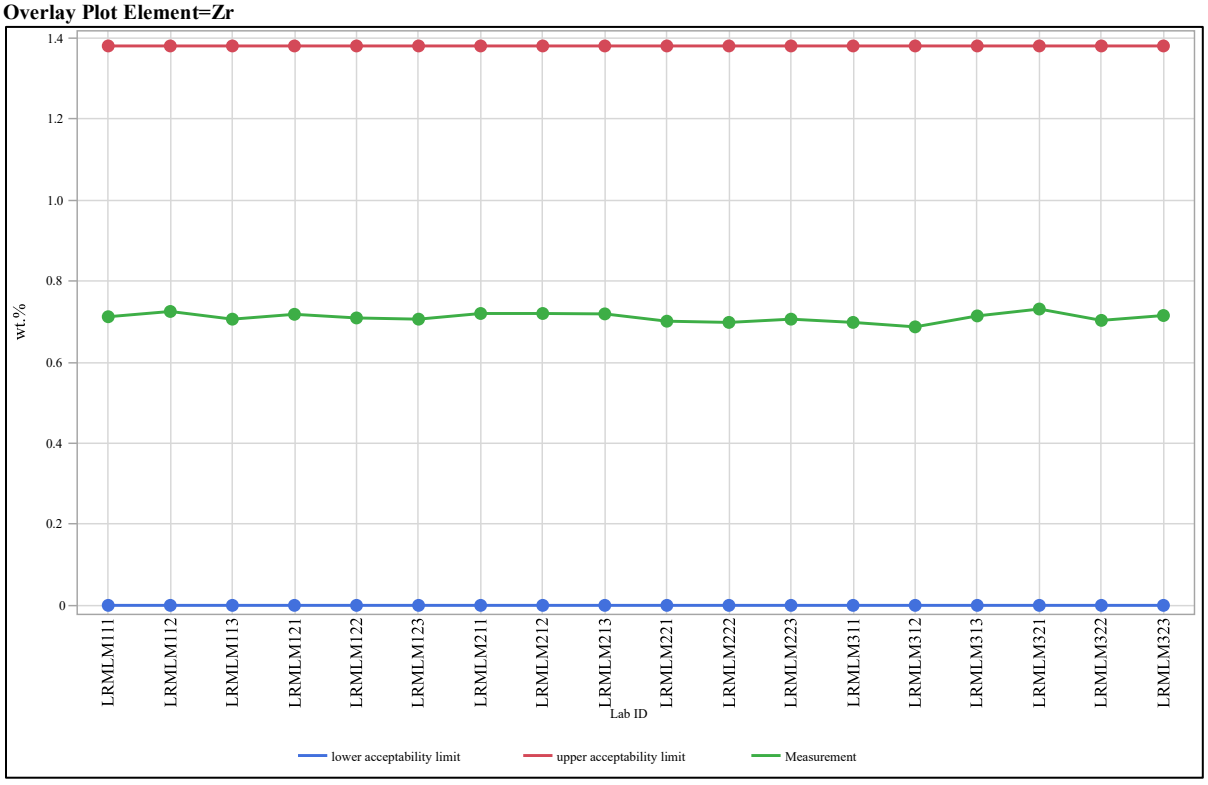
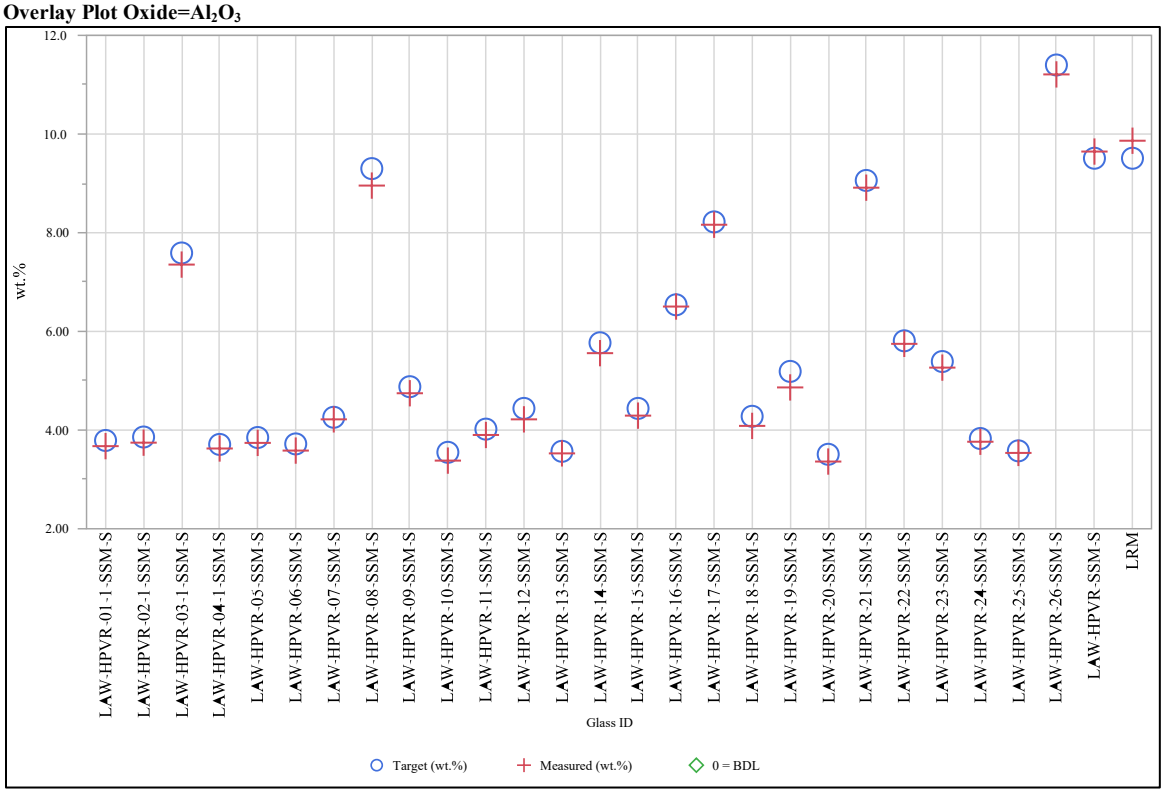


Exhibit A-3. Measured versus Targeted Concentrations by Glass ID by Oxide

Overlay Plot Oxide=Al_2O_3



Overlay Plot Oxide=B_2O_3

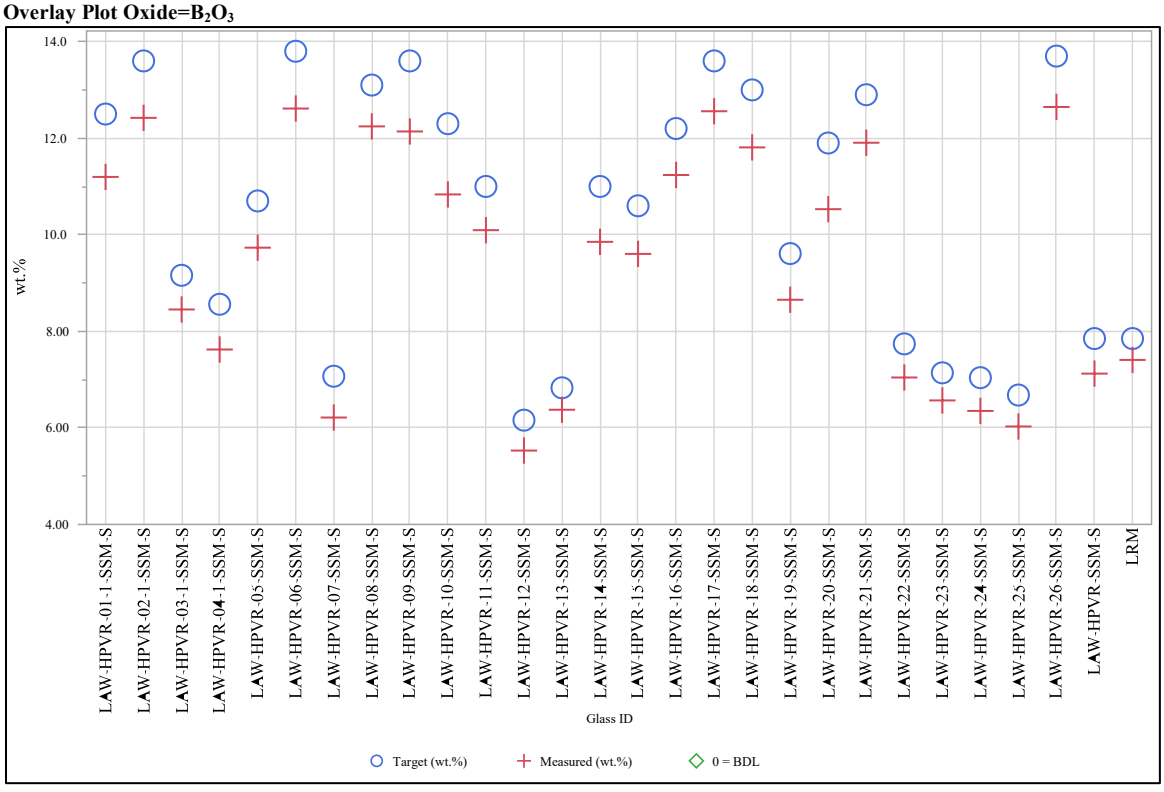
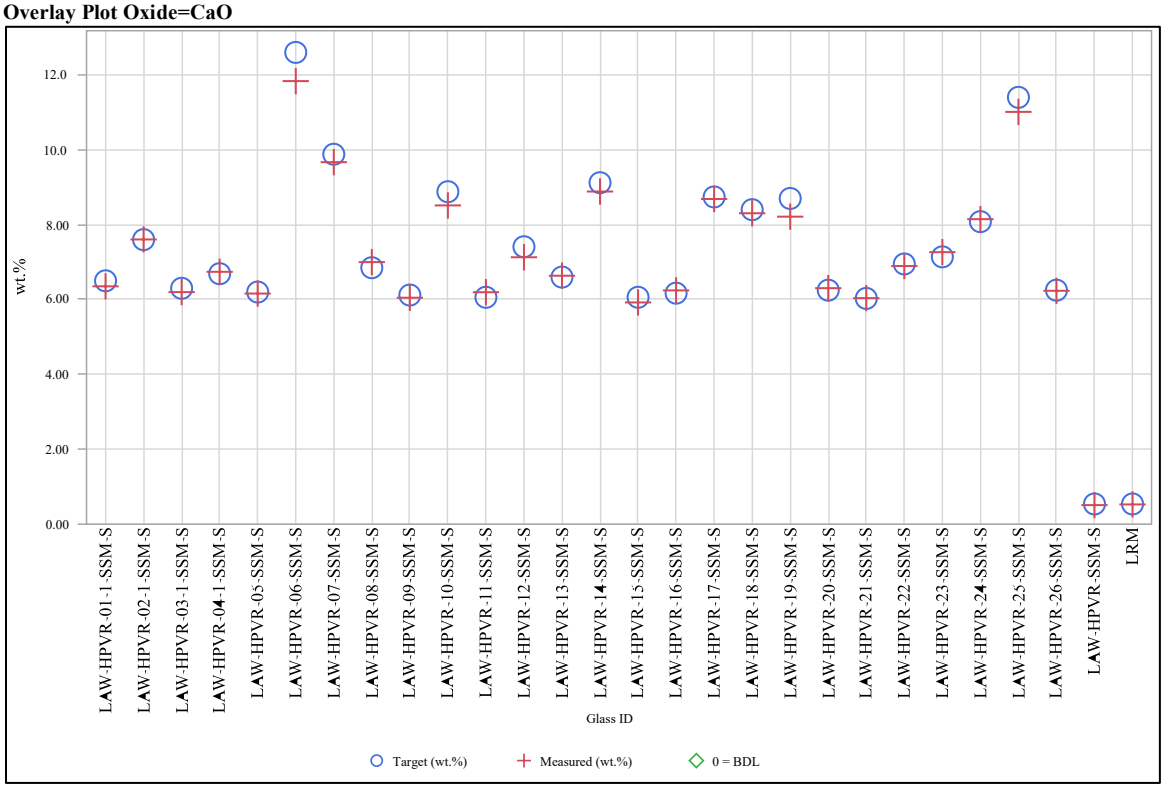


Exhibit A-3. Measured versus Targeted Concentrations by Glass ID by Oxide (continued)

Overlay Plot Oxide=CaO



Overlay Plot Oxide=Cl⁻

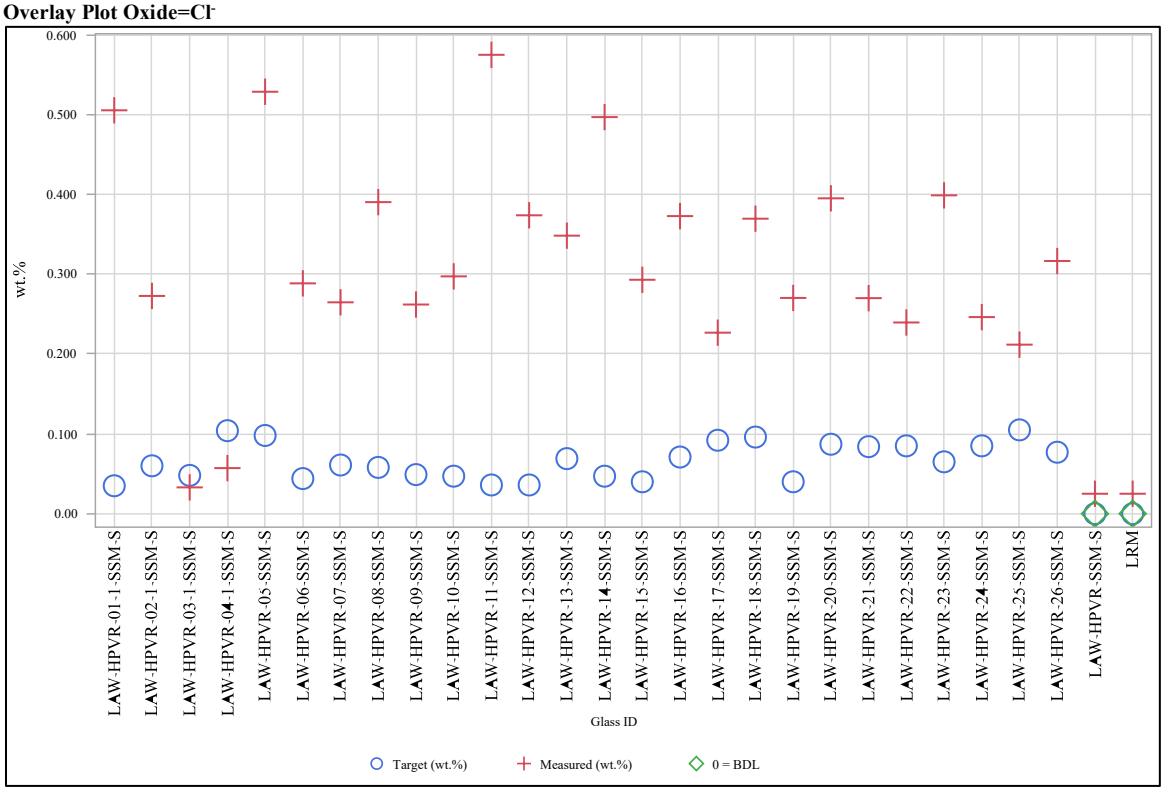
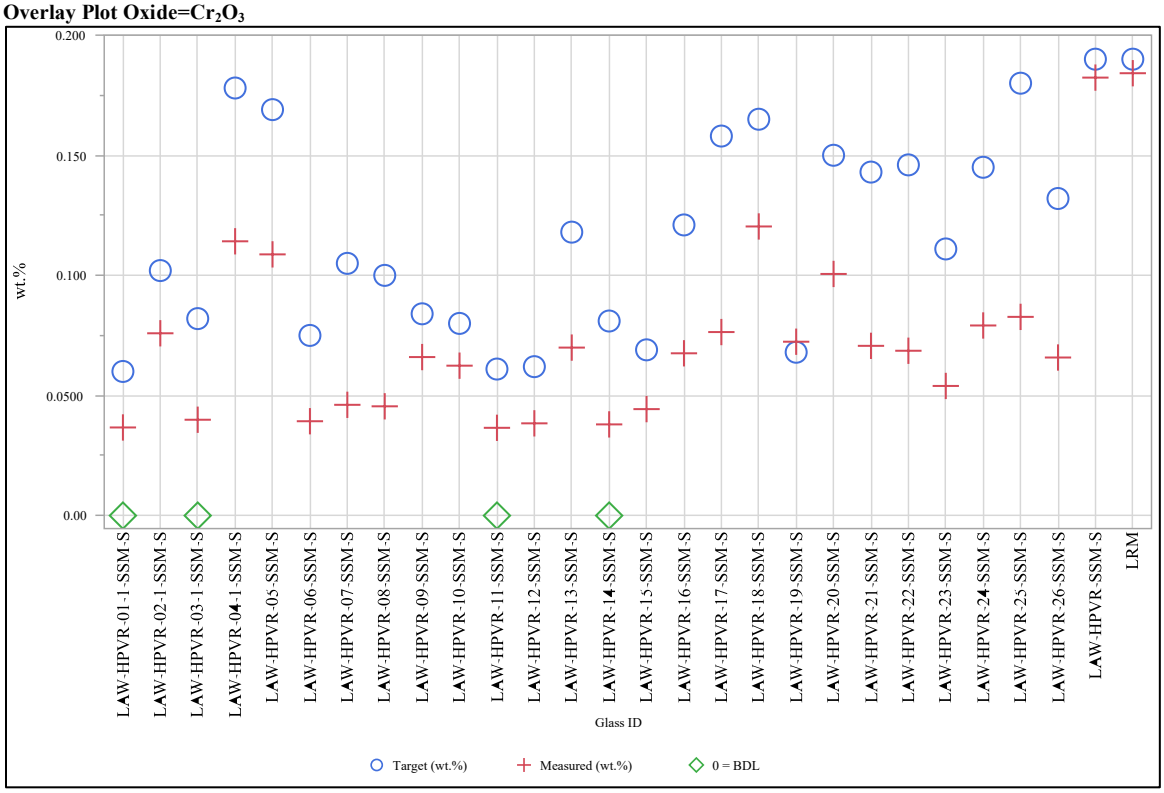


Exhibit A-3. Measured versus Targeted Concentrations by Glass ID by Oxide (continued)

Overlay Plot Oxide=Cr_2O_3



Overlay Plot Oxide=F^-

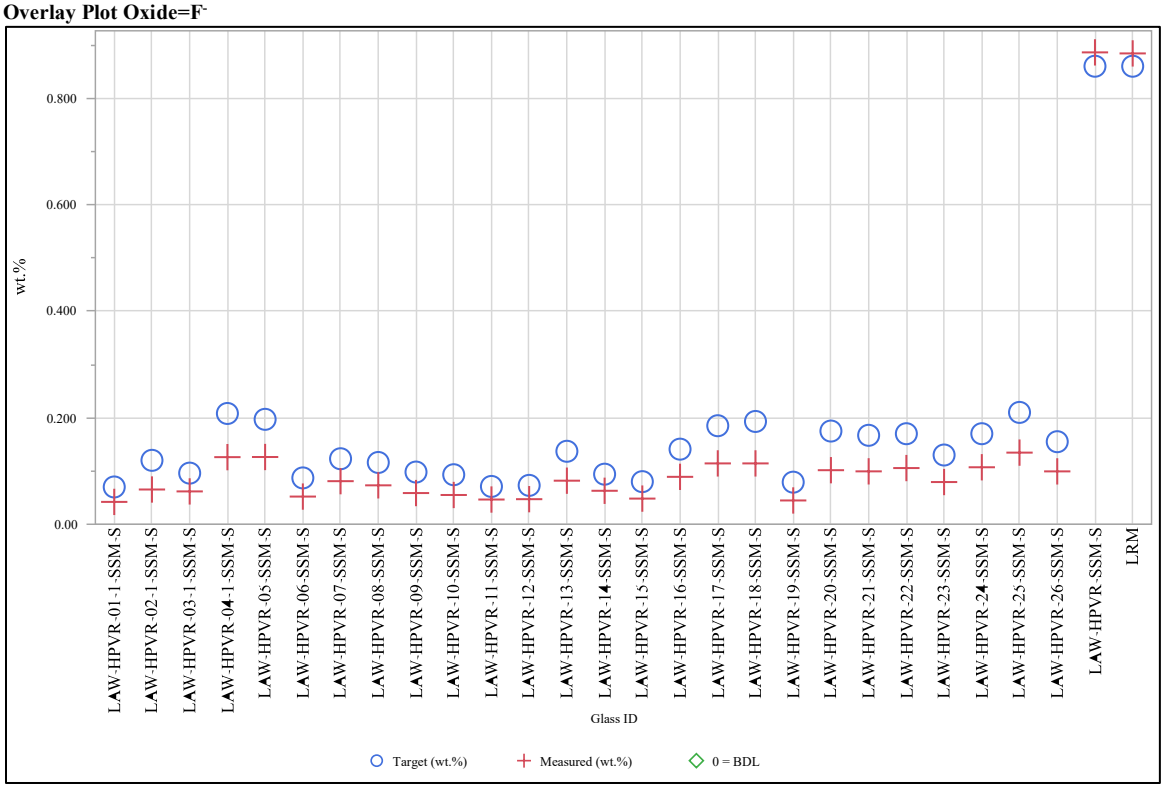
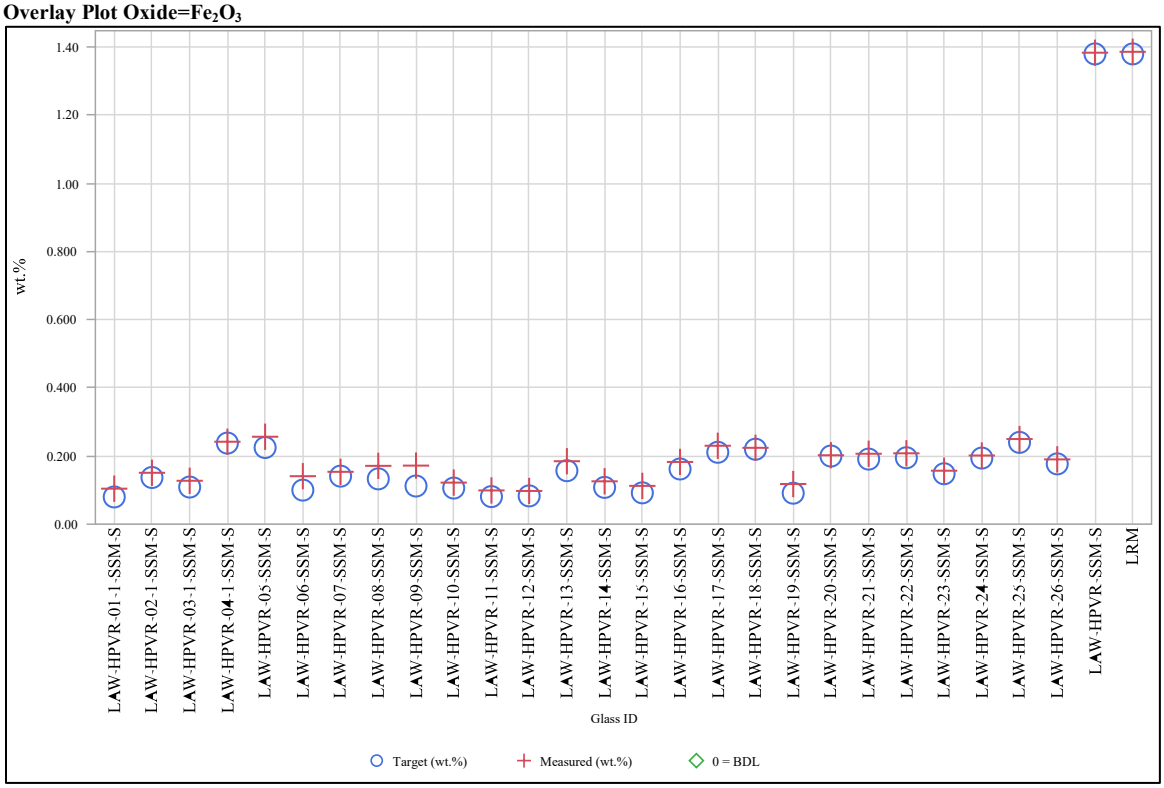


Exhibit A-3. Measured versus Targeted Concentrations by Glass ID by Oxide (continued)

Overlay Plot Oxide=Fe_2O_3



Overlay Plot Oxide=K_2O

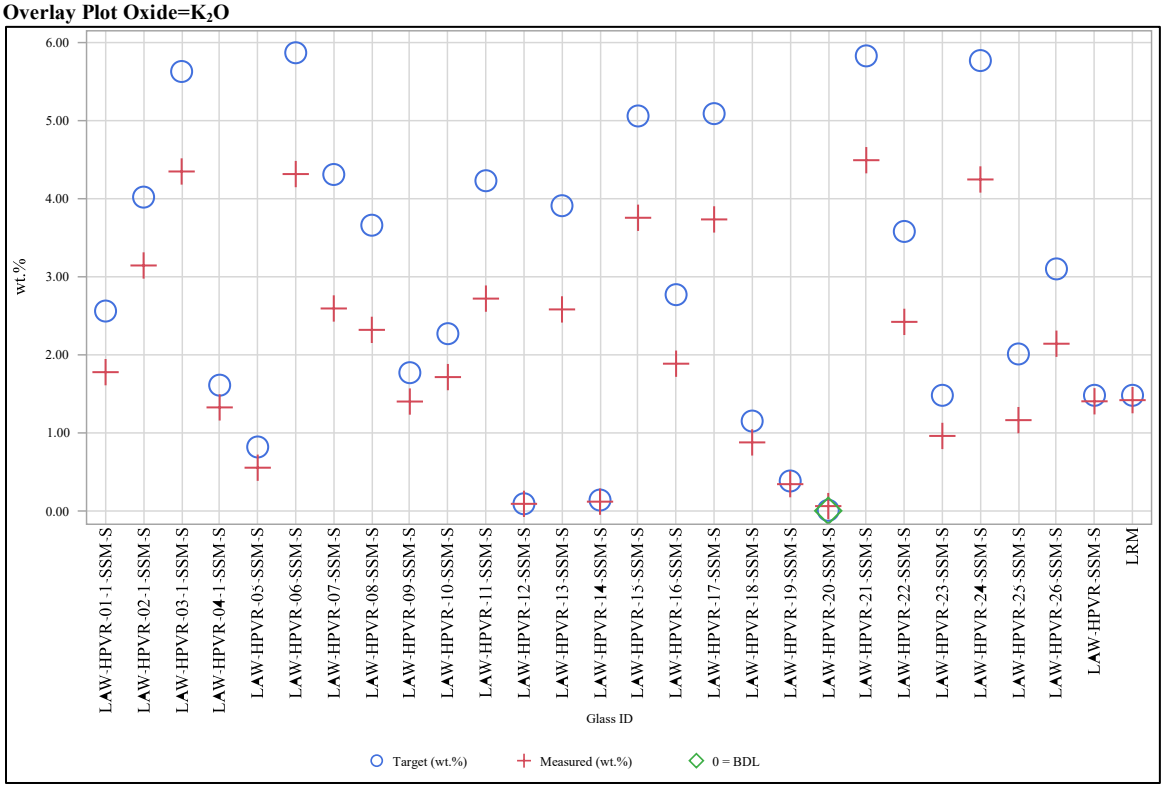
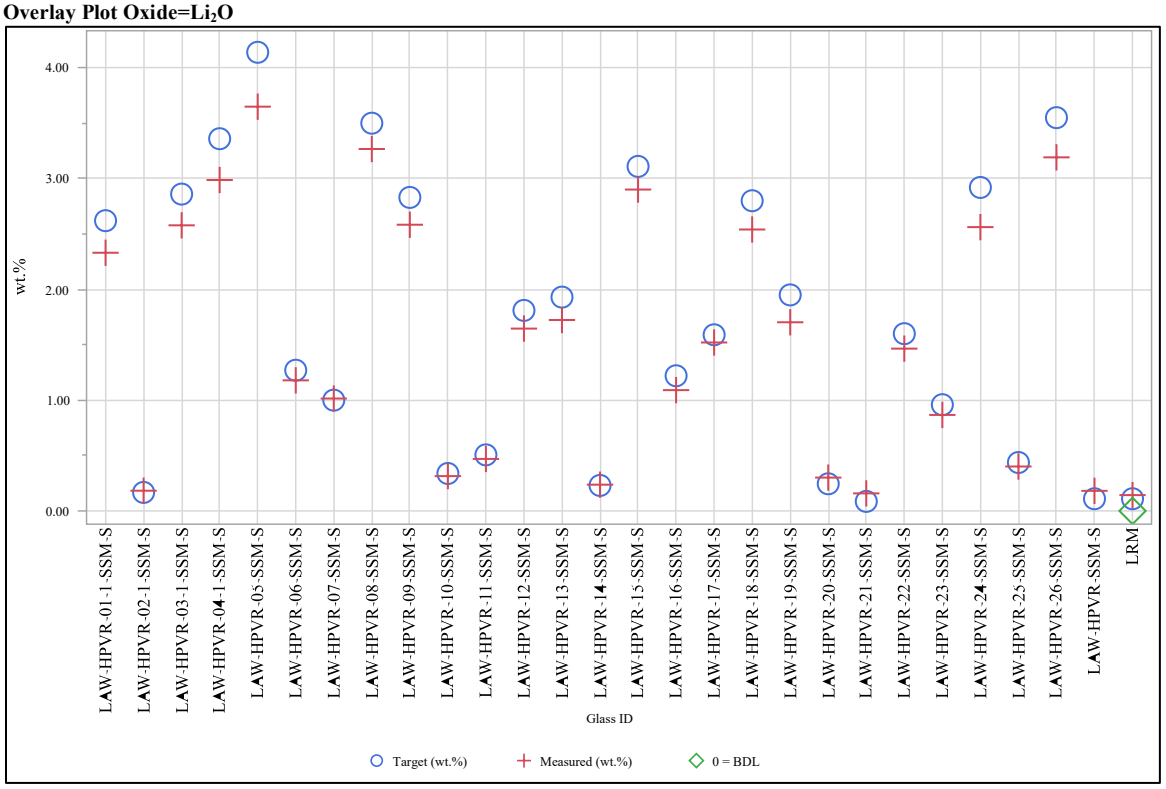


Exhibit A-3. Measured versus Targeted Concentrations by Glass ID by Oxide (continued)

Overlay Plot Oxide=Li_2O



Overlay Plot Oxide=MgO

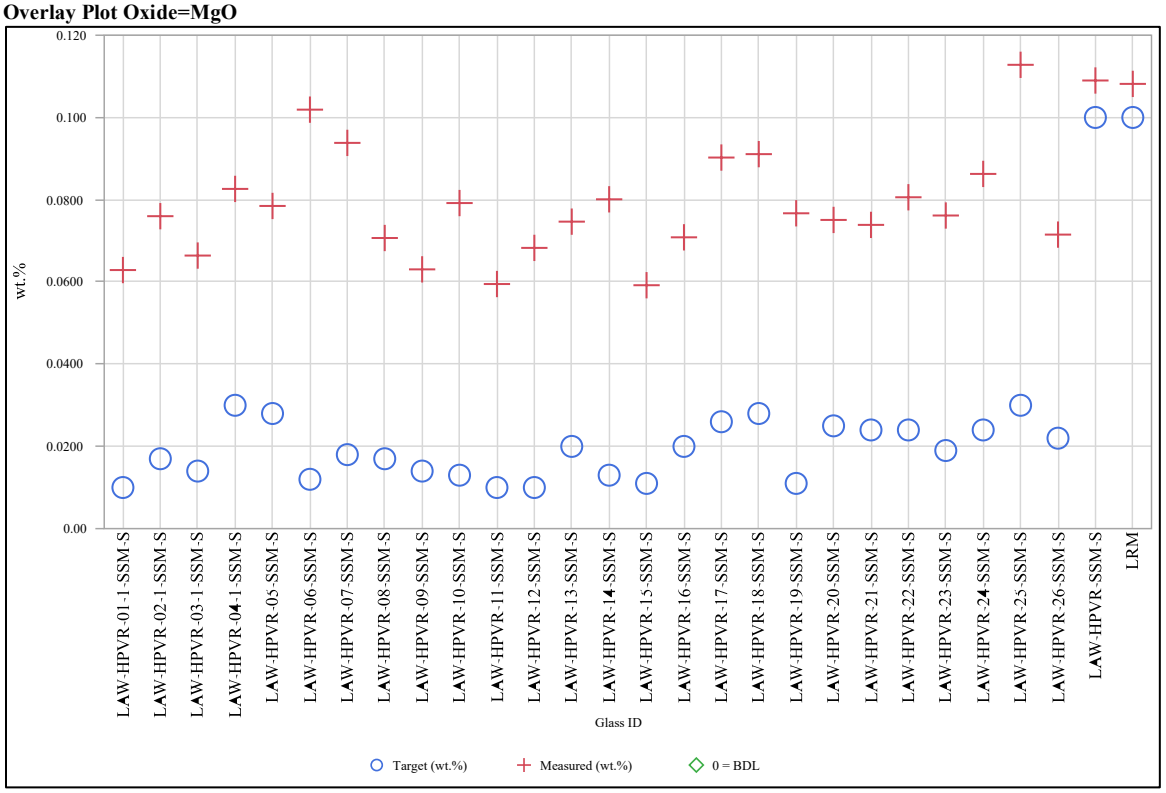
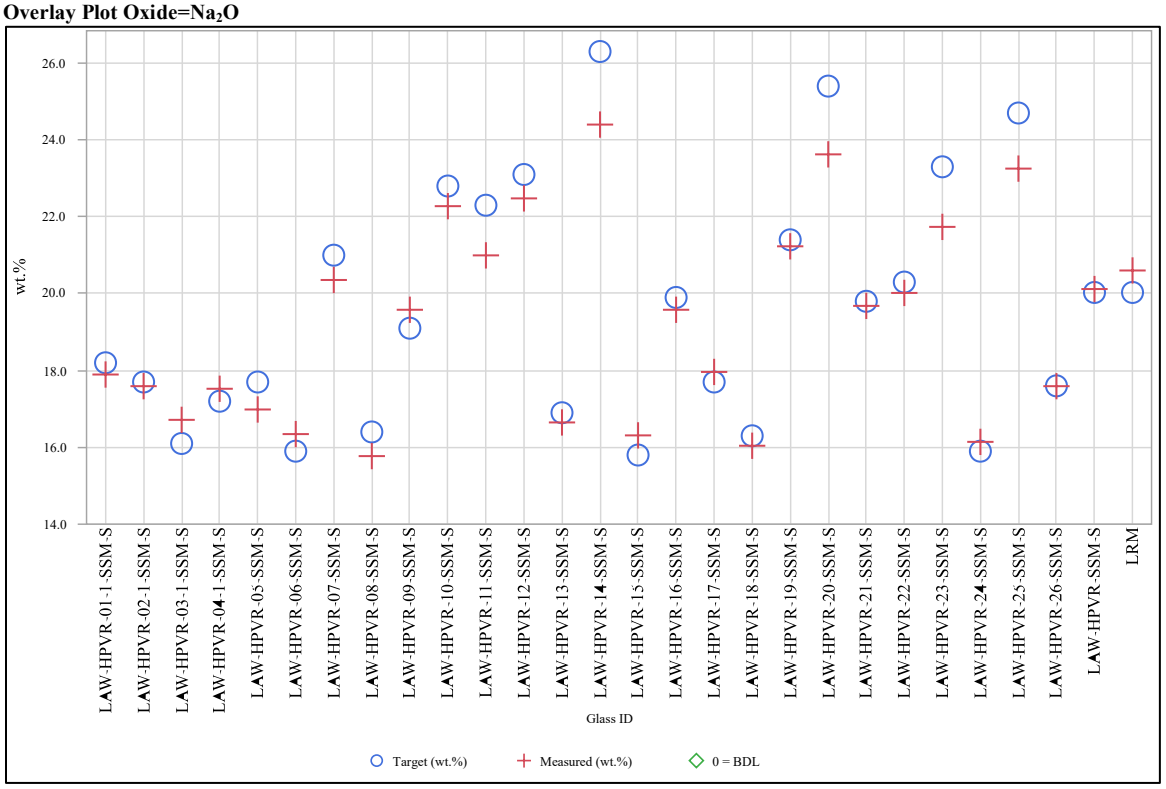


Exhibit A-3. Measured versus Targeted Concentrations by Glass ID by Oxide (continued)

Overlay Plot Oxide=Na_2O



Overlay Plot Oxide=P_2O_5

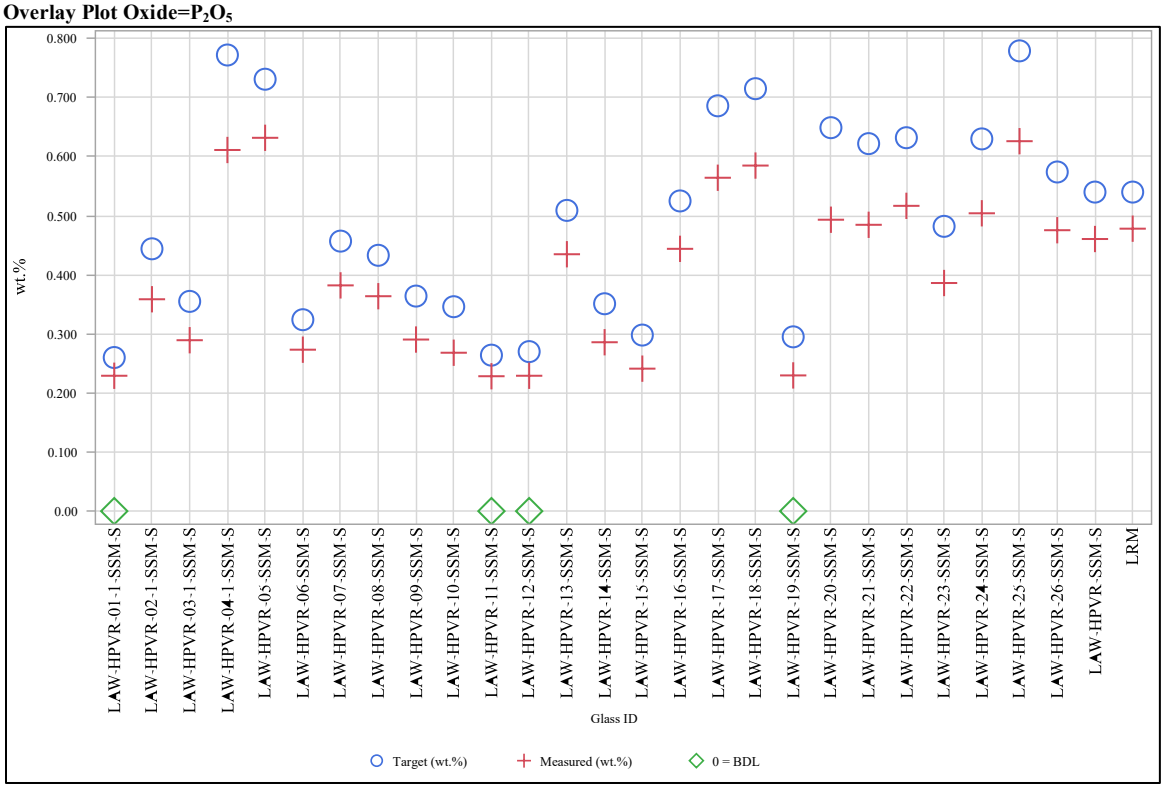
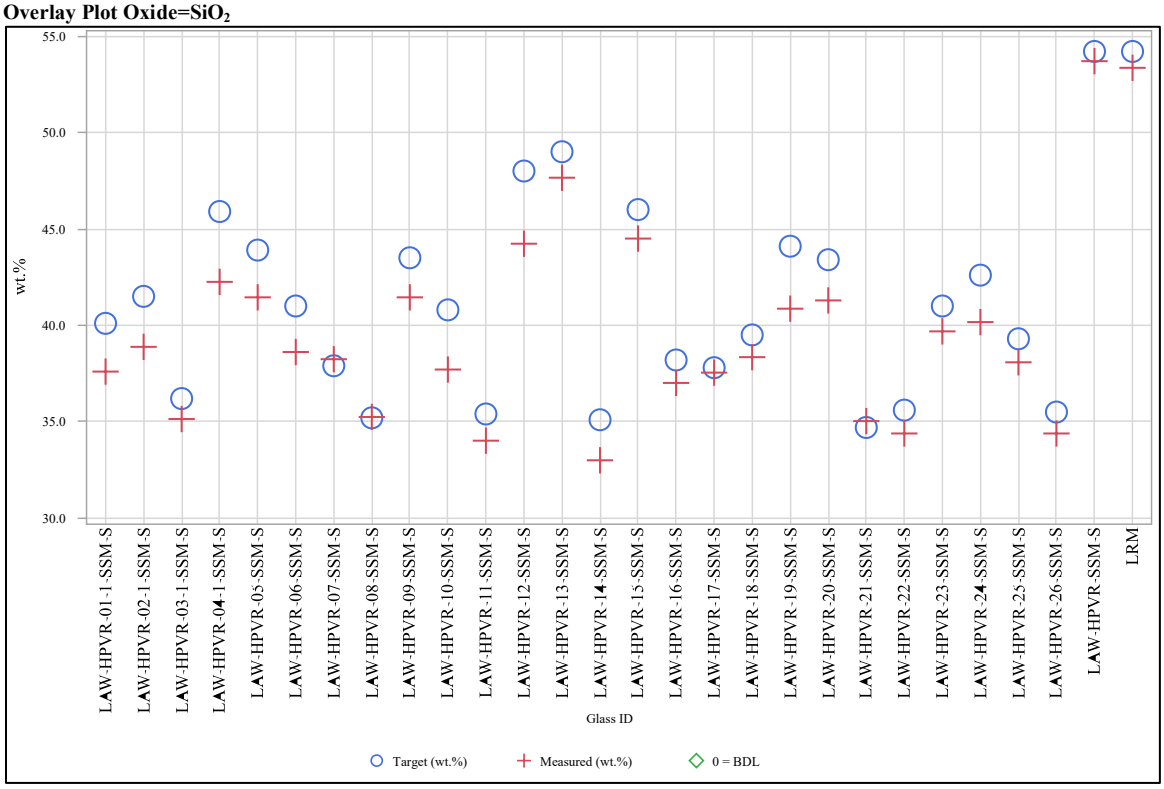


Exhibit A-3. Measured versus Targeted Concentrations by Glass ID by Oxide (continued)

Overlay Plot Oxide=SiO_2



Overlay Plot Oxide=SnO_2

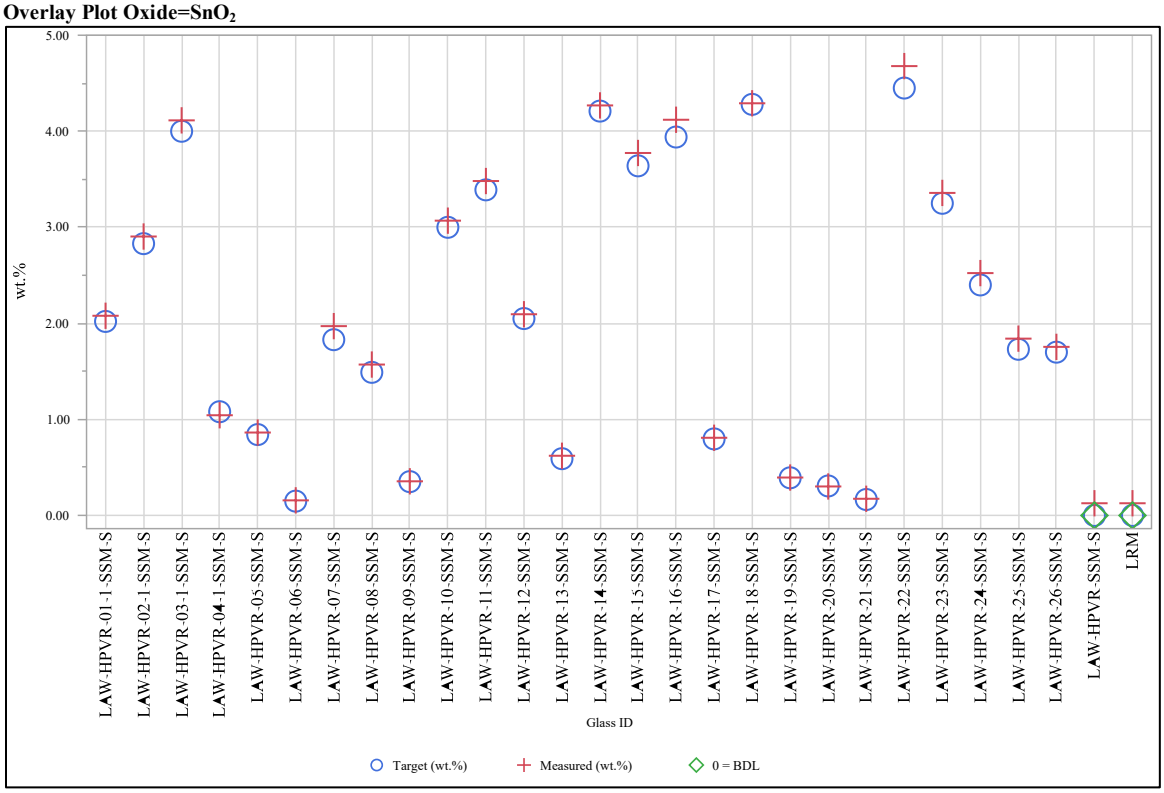
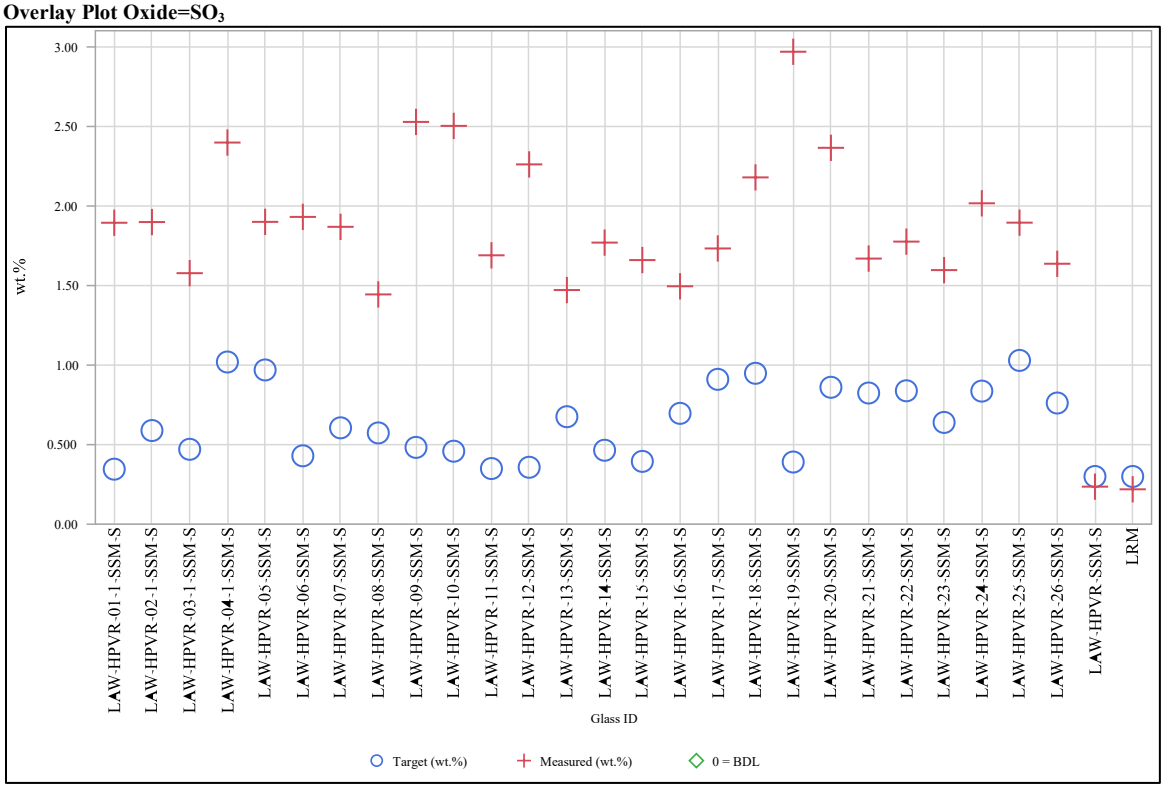


Exhibit A-3. Measured versus Targeted Concentrations by Glass ID by Oxide (continued)

Overlay Plot Oxide=SO_3



Overlay Plot Oxide=TiO_2

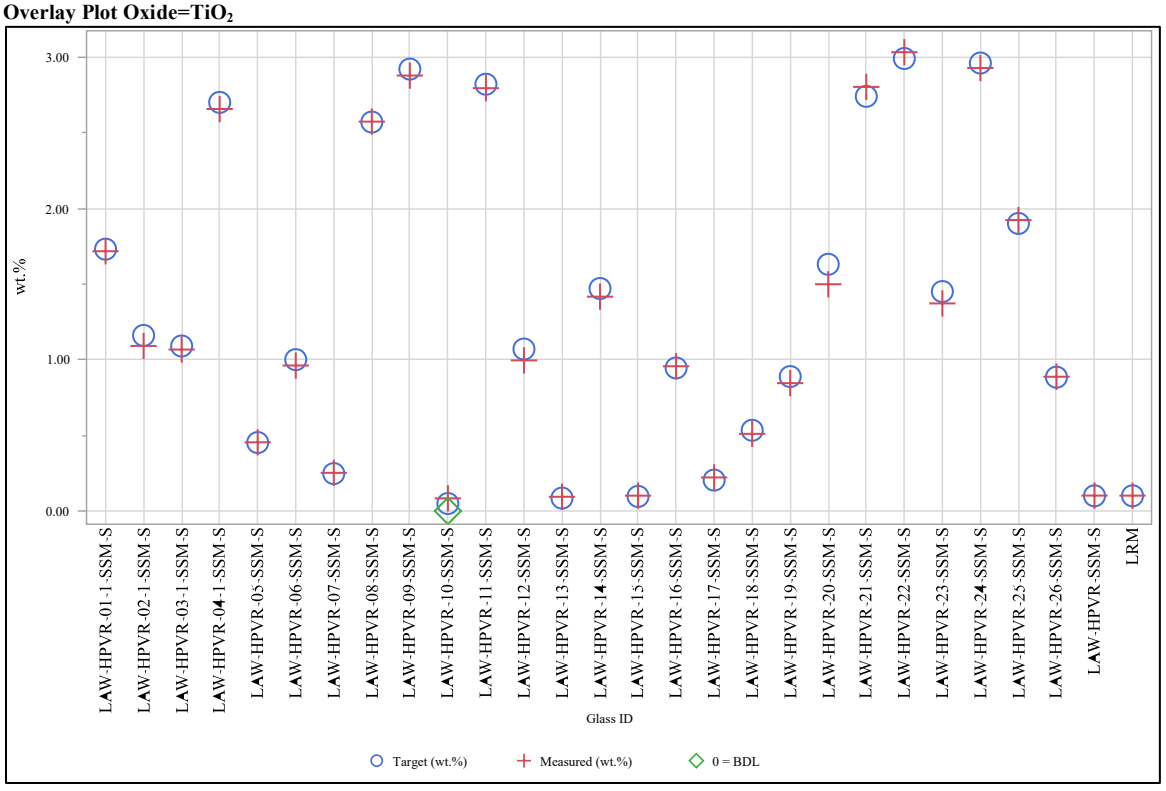
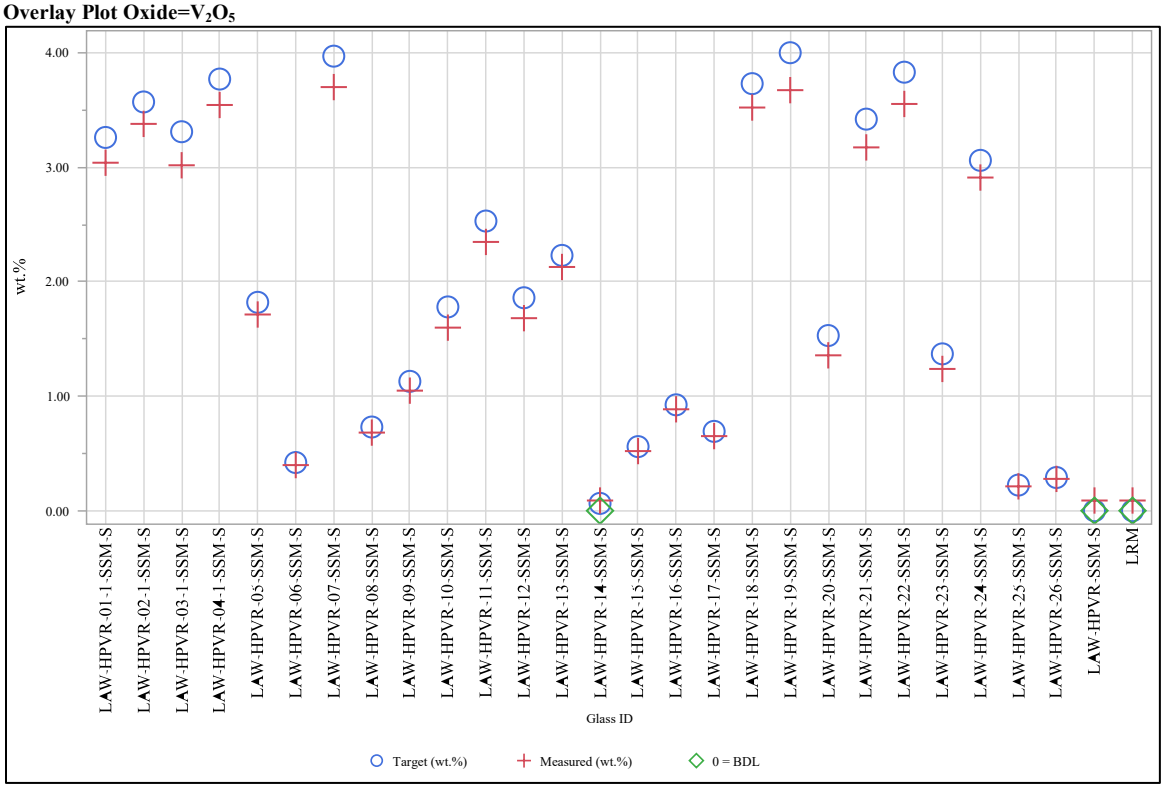


Exhibit A-3. Measured versus Targeted Concentrations by Glass ID by Oxide (continued)

Overlay Plot Oxide=V_2O_5



Overlay Plot Oxide=ZnO

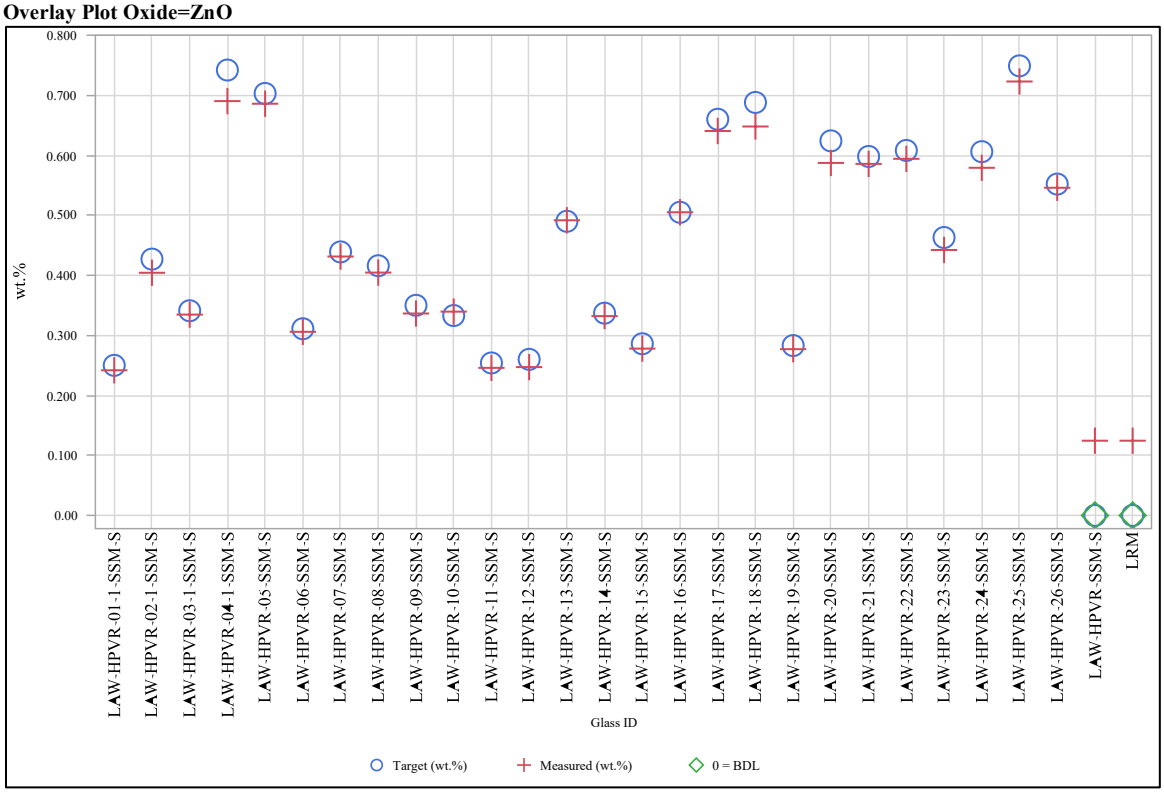
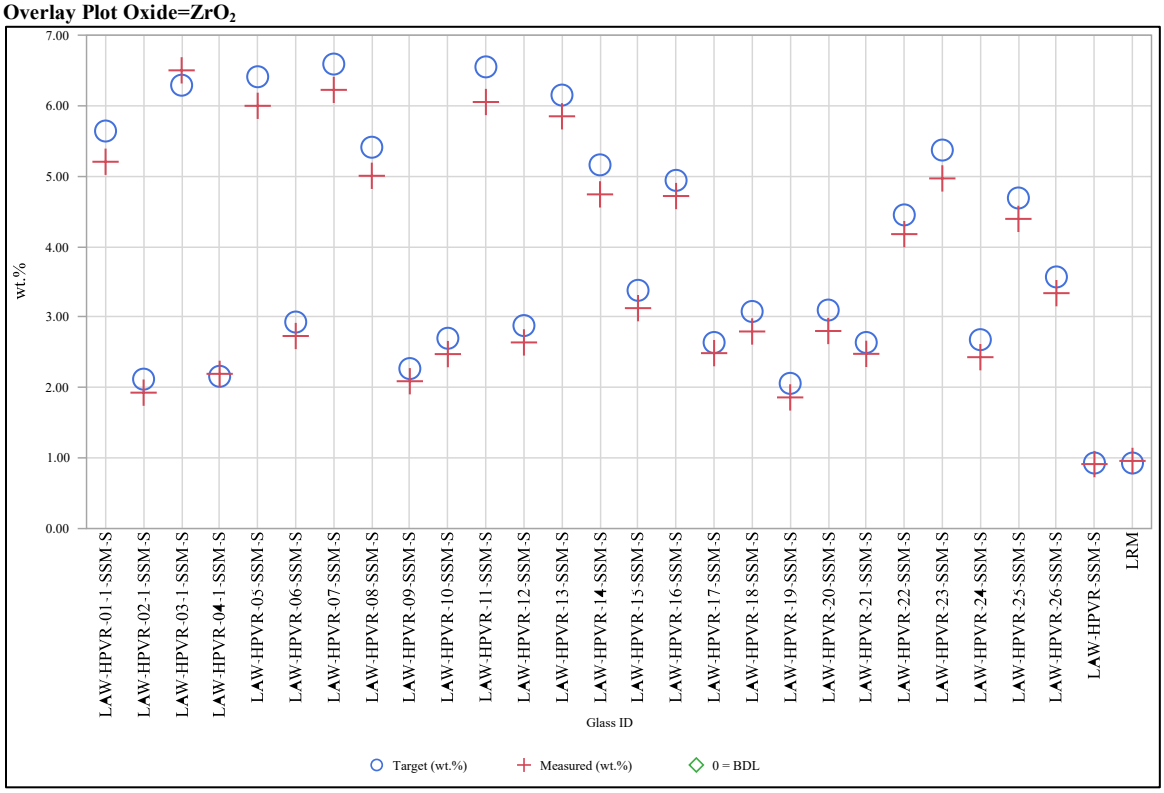


Exhibit A-3. Measured versus Targeted Concentrations by Glass ID by Oxide (continued)

Overlay Plot Oxide=ZrO_2



Overlay Plot Oxide=Sum of Oxides

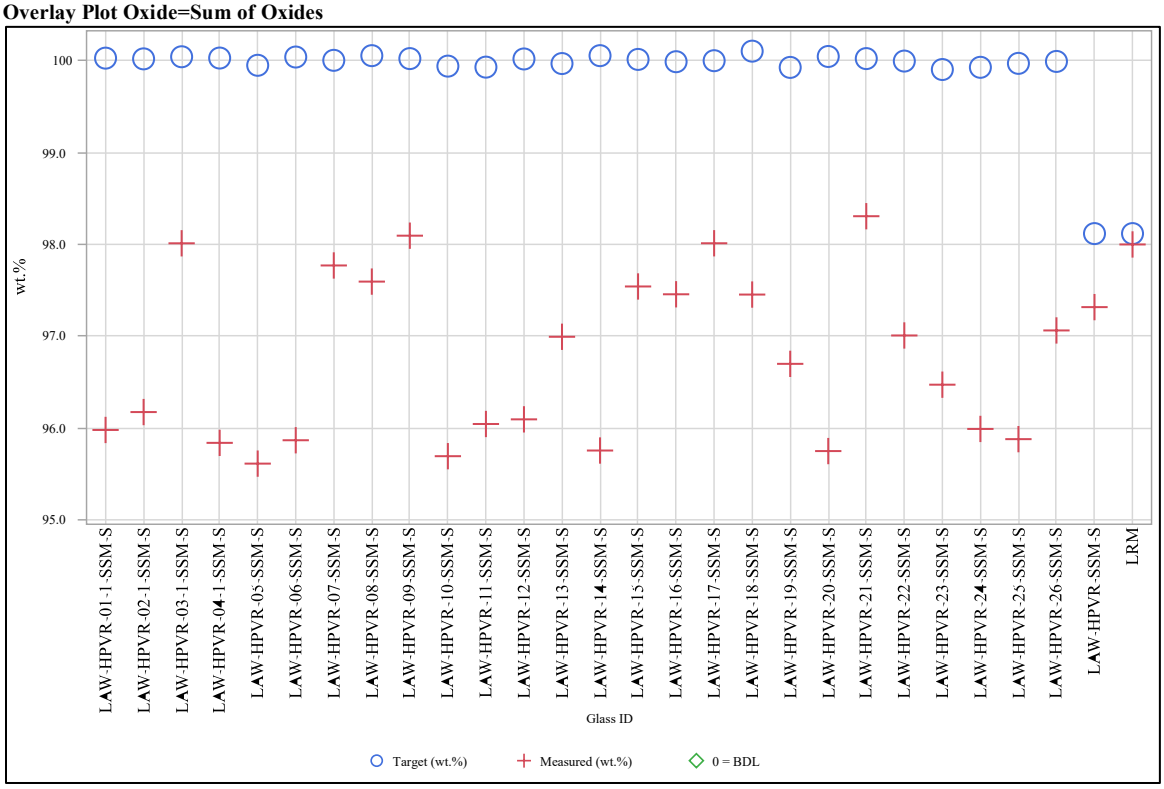
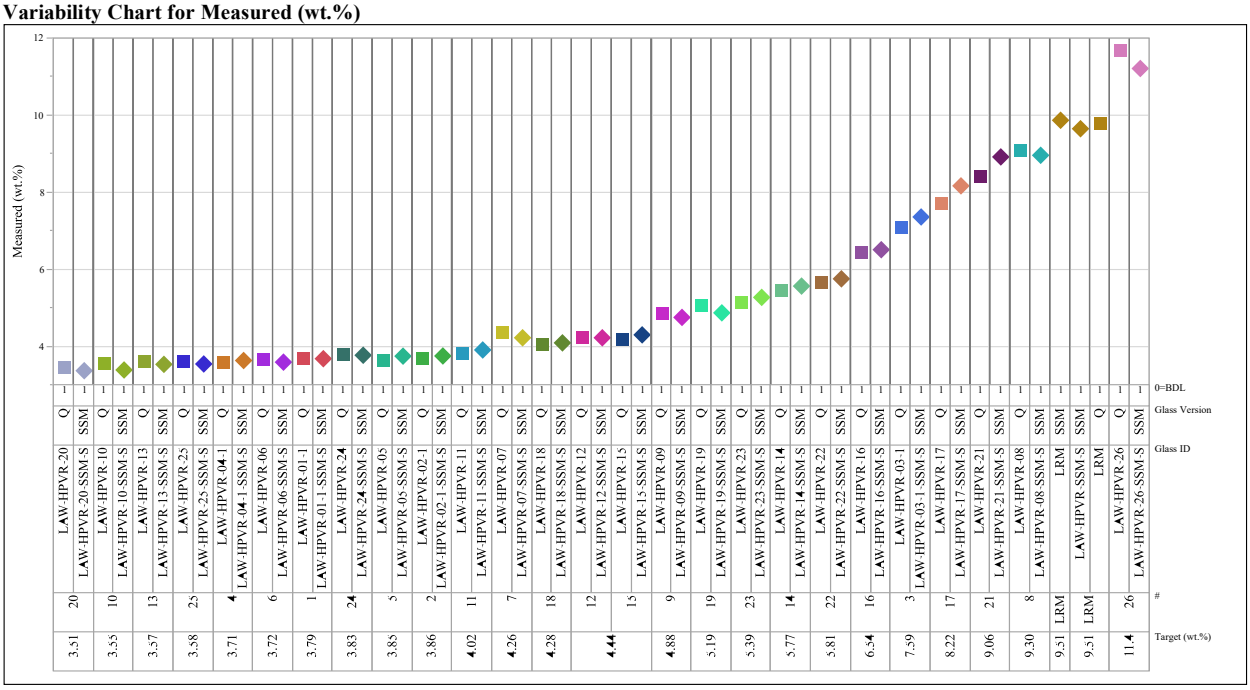


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses

Oxide=Al_2O_3
Variability Chart for Measured (wt.%)



Oxide=B_2O_3
Variability Chart for Measured (wt.%)

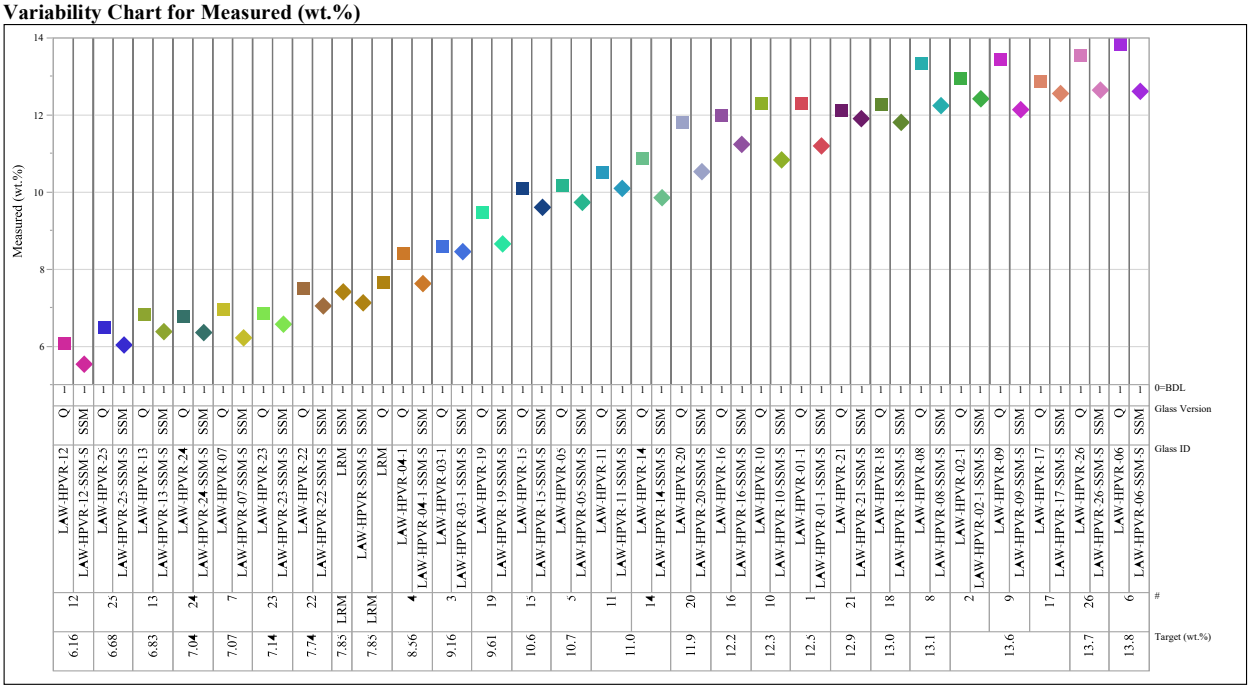
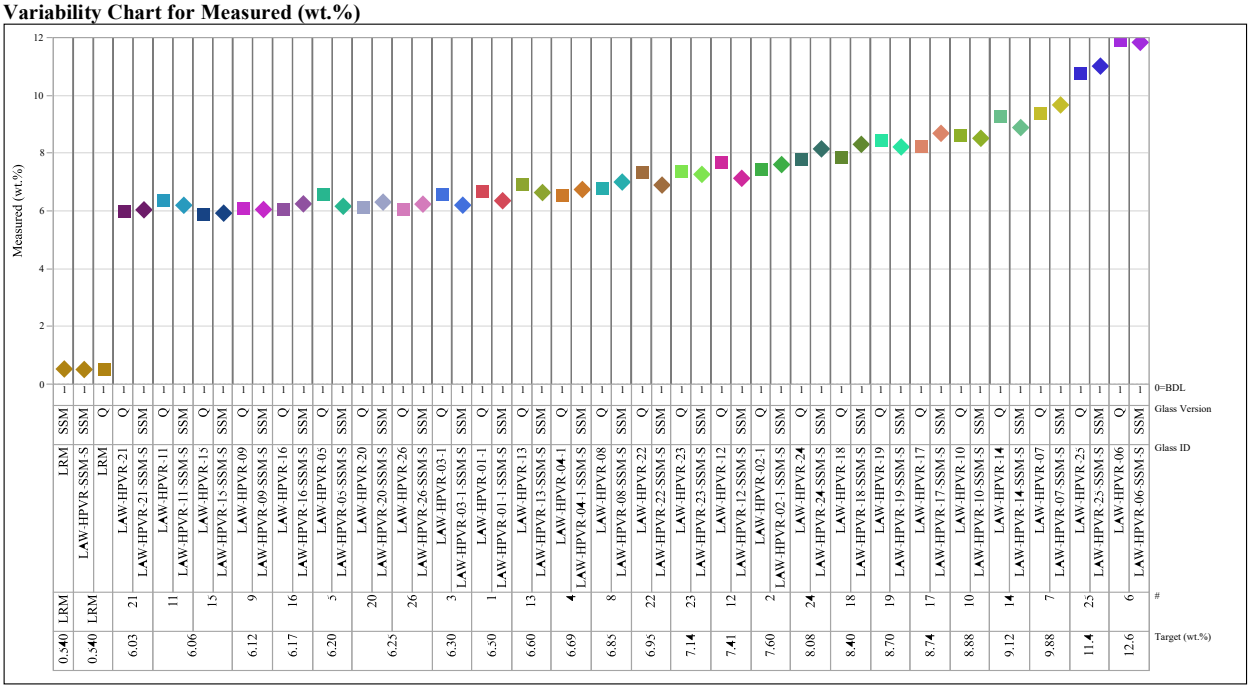


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=CaO
Variability Chart for Measured (wt.%)



Oxide=Cl⁻
Variability Chart for Measured (wt.%)

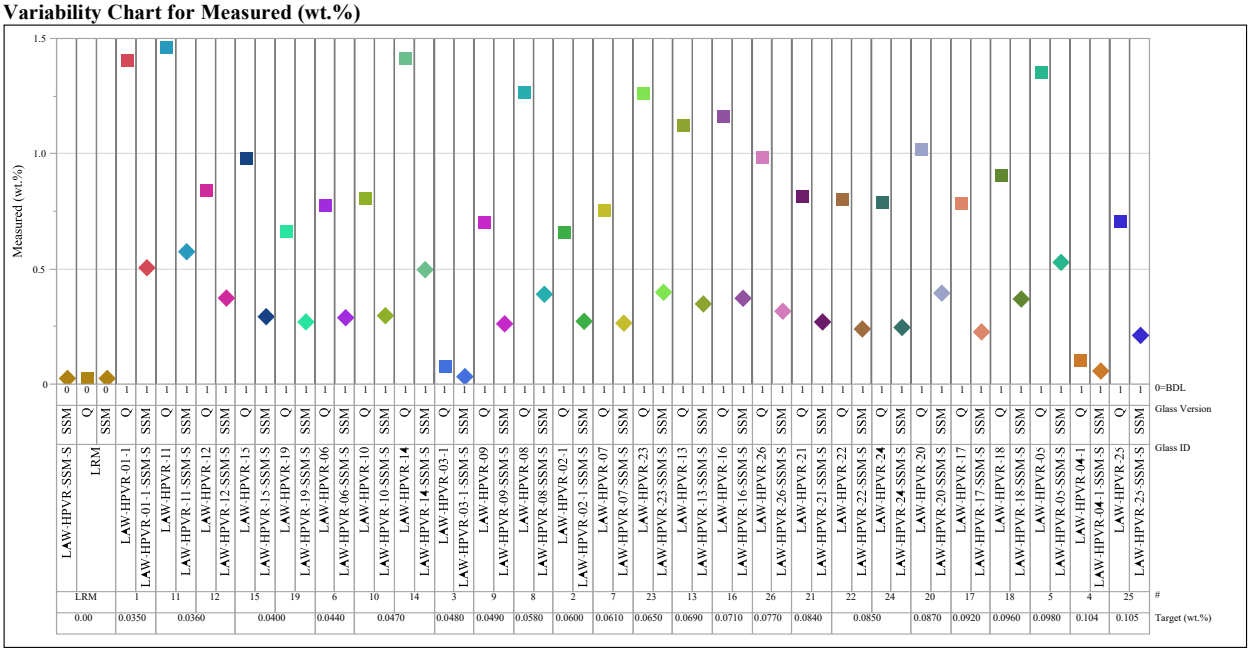
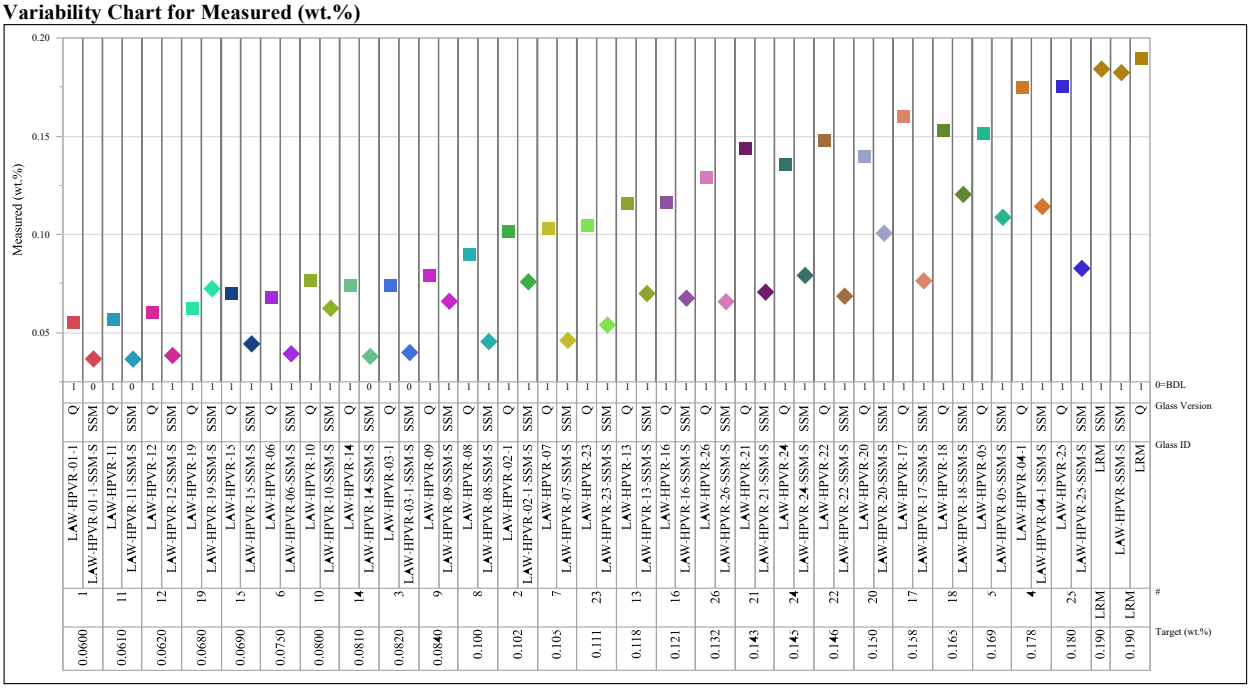


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=Cr_2O_3
Variability Chart for Measured (wt.%)



Oxide=F^-
Variability Chart for Measured (wt.%)

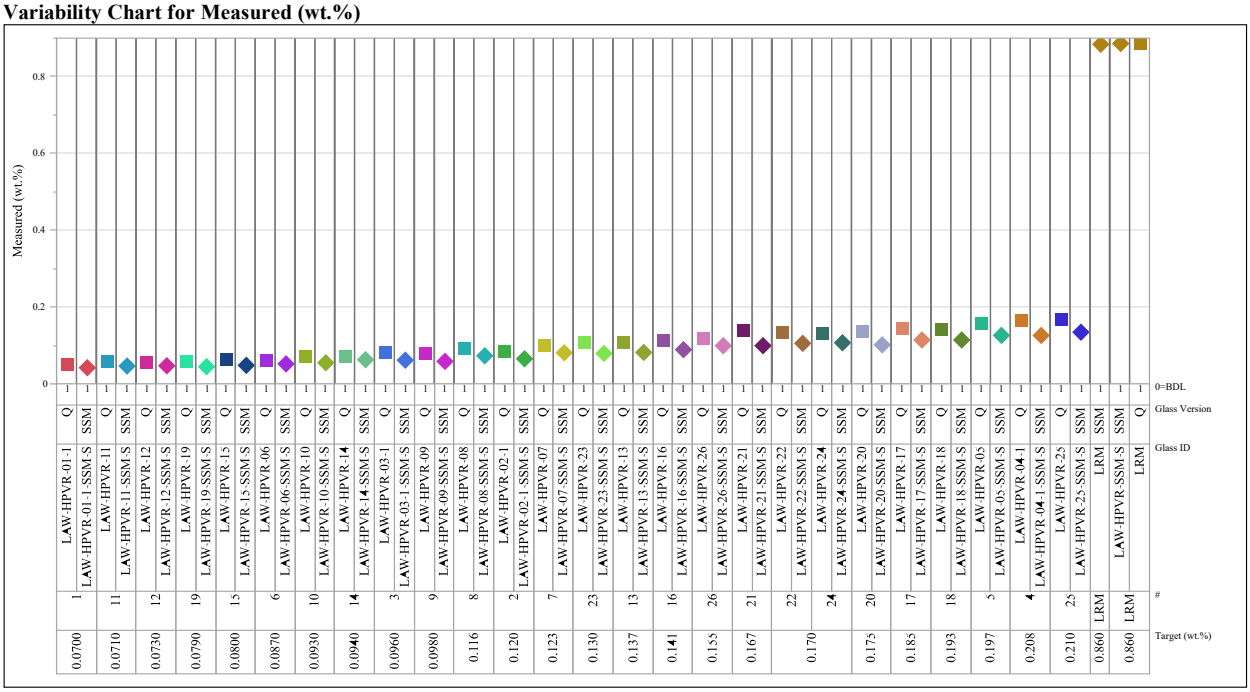
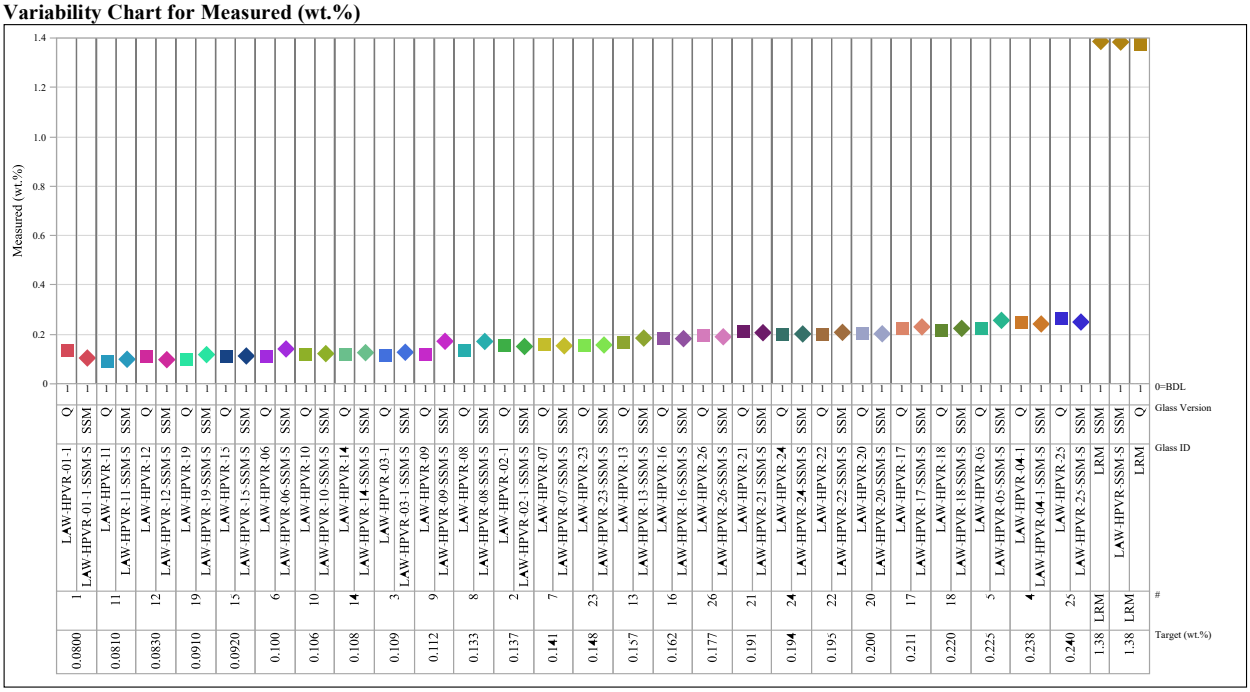


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=Fe_2O_3
Variability Chart for Measured (wt.%)



Oxide=K_2O
Variability Chart for Measured (wt.%)

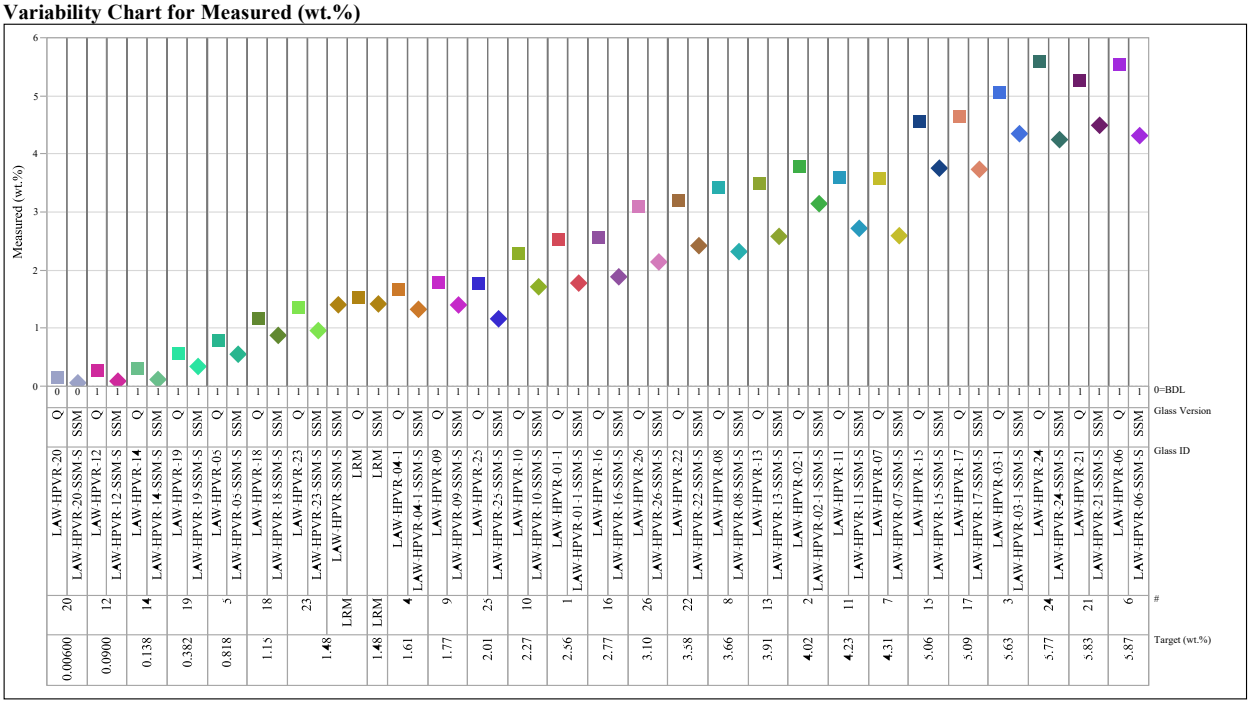
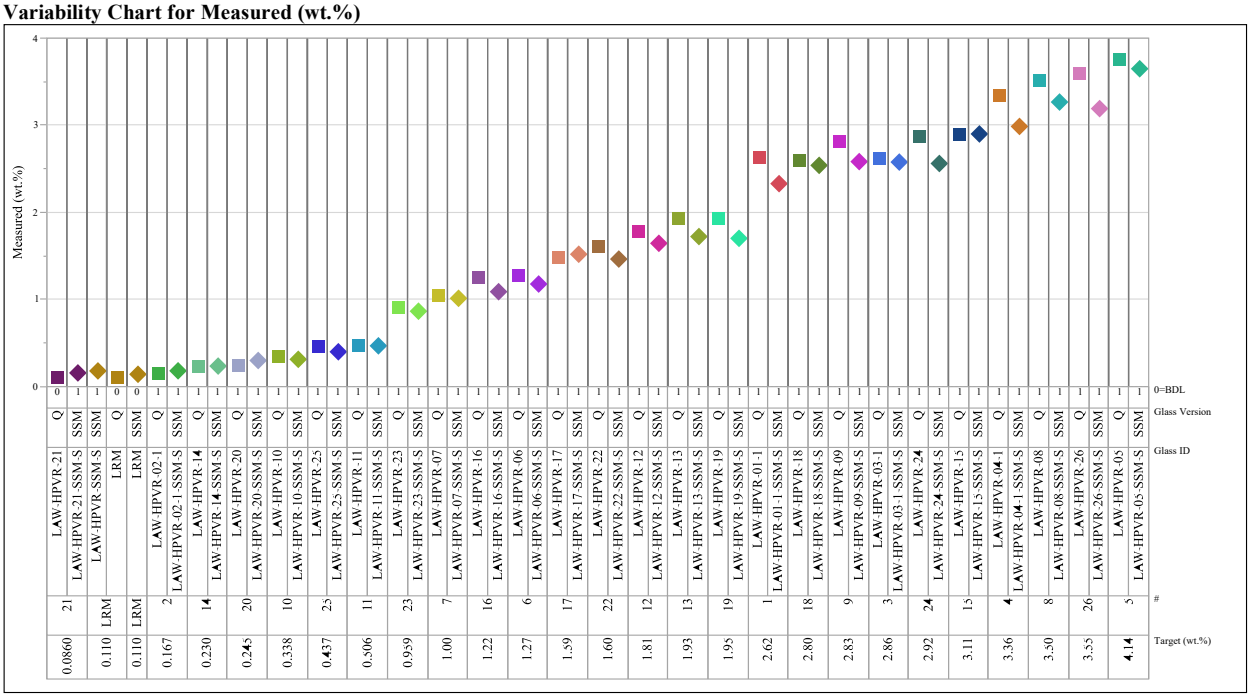


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=Li_2O
Variability Chart for Measured (wt.%)



Oxide=MgO
Variability Chart for Measured (wt.%)

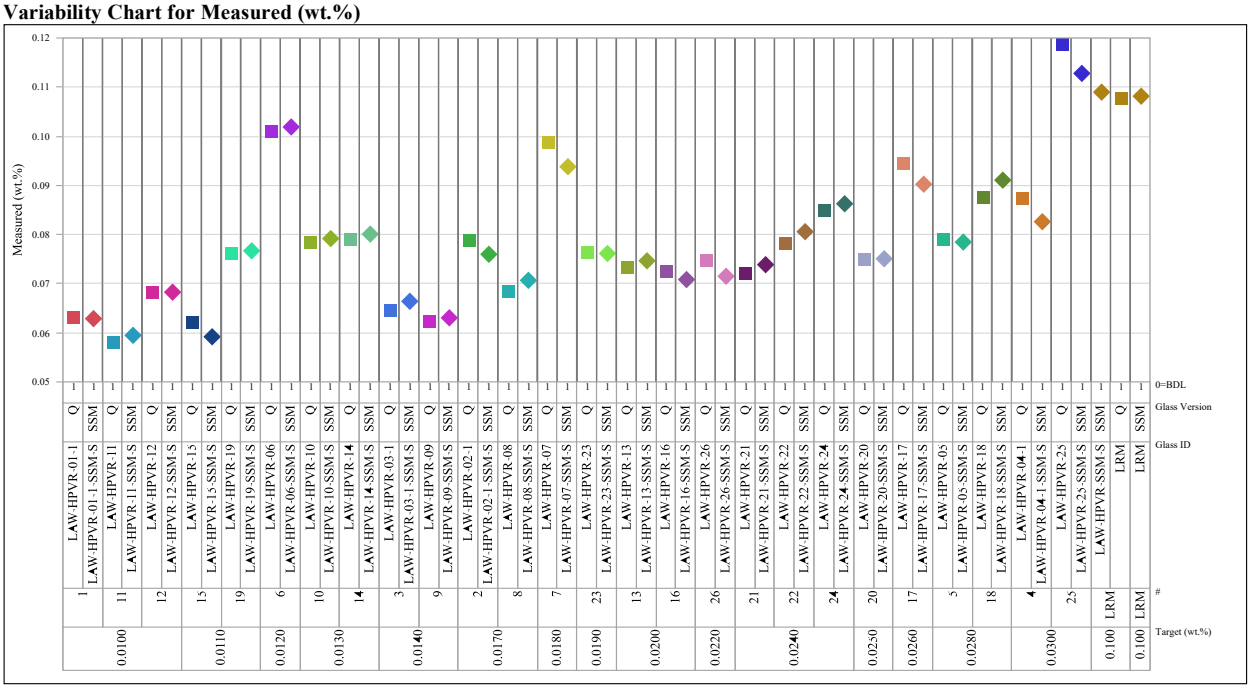
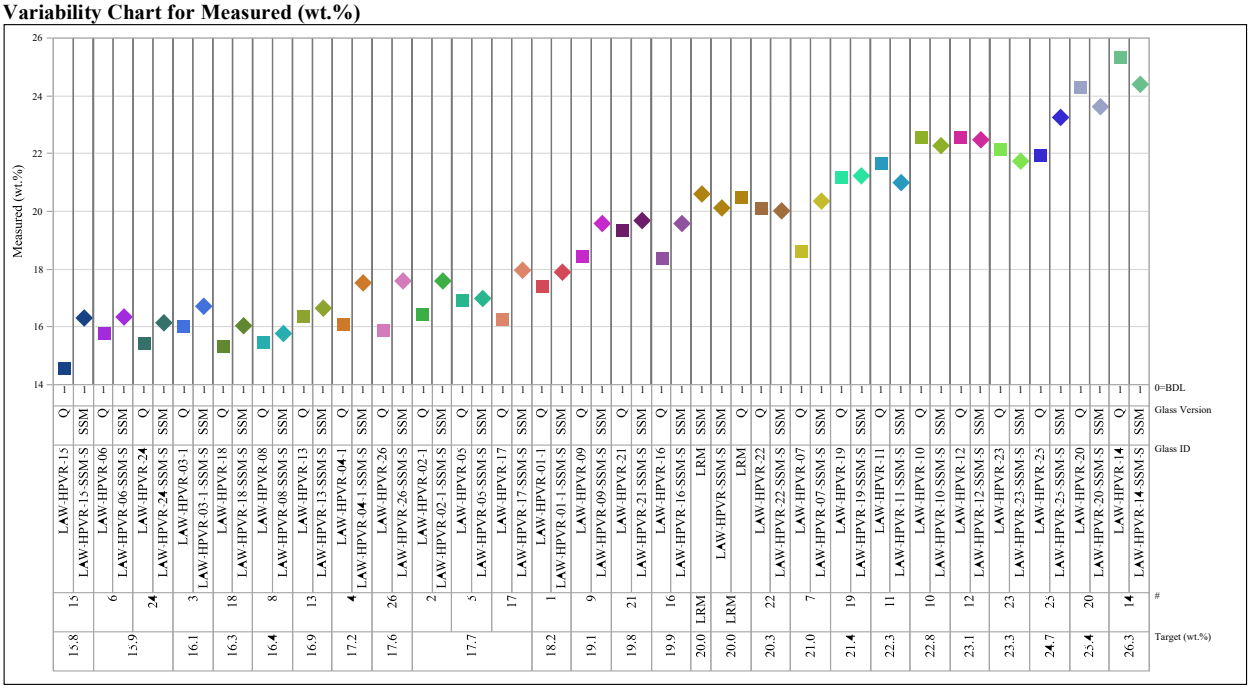


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=Na_2O
Variability Chart for Measured (wt.%)



Oxide=P_2O_5
Variability Chart for Measured (wt.%)

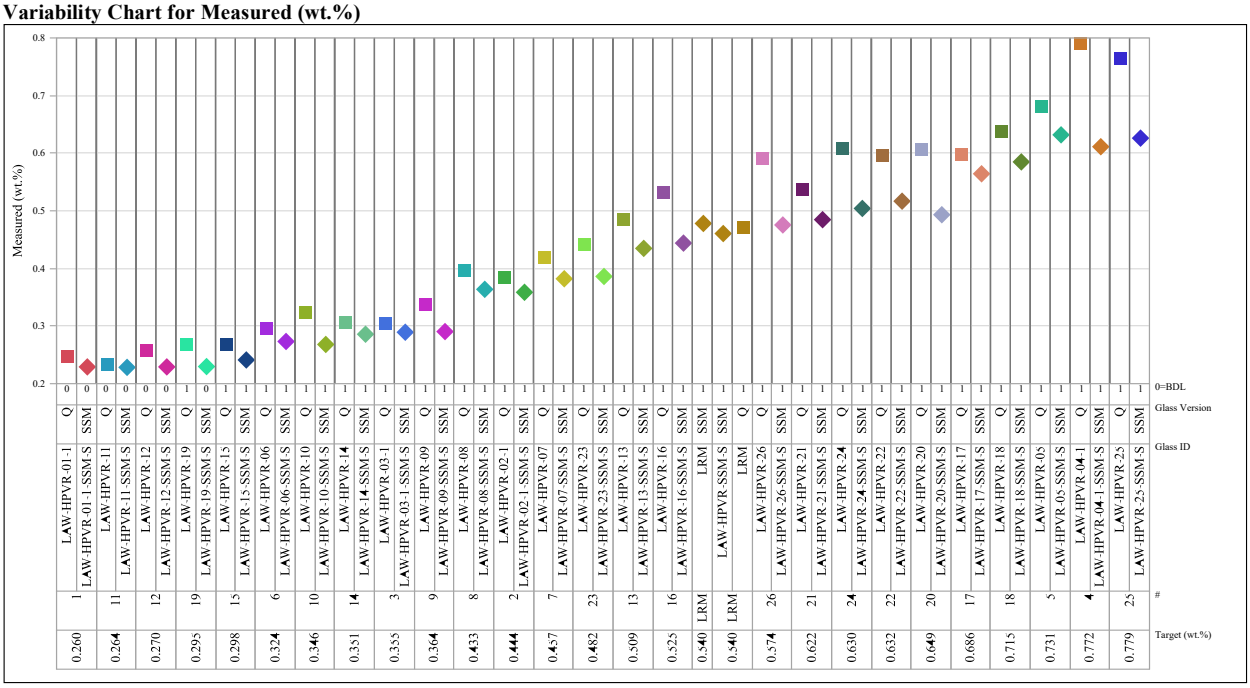
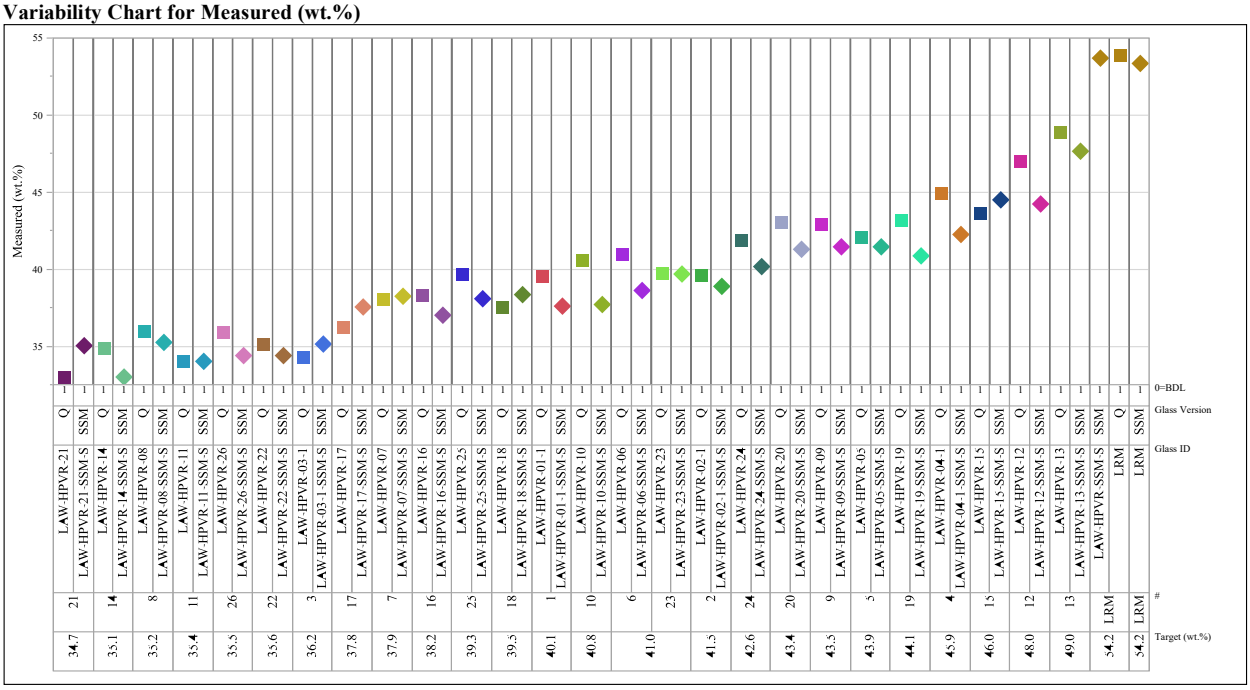


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=SiO_2
Variability Chart for Measured (wt.%)



Oxide=SnO_2
Variability Chart for Measured (wt.%)

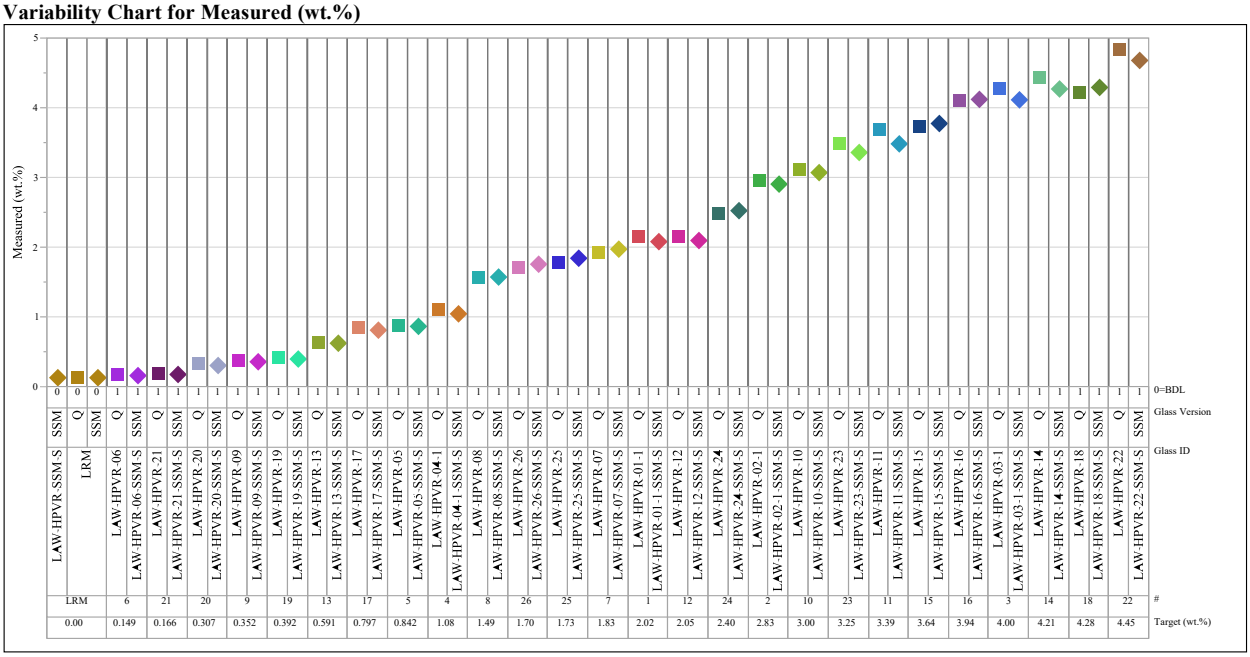
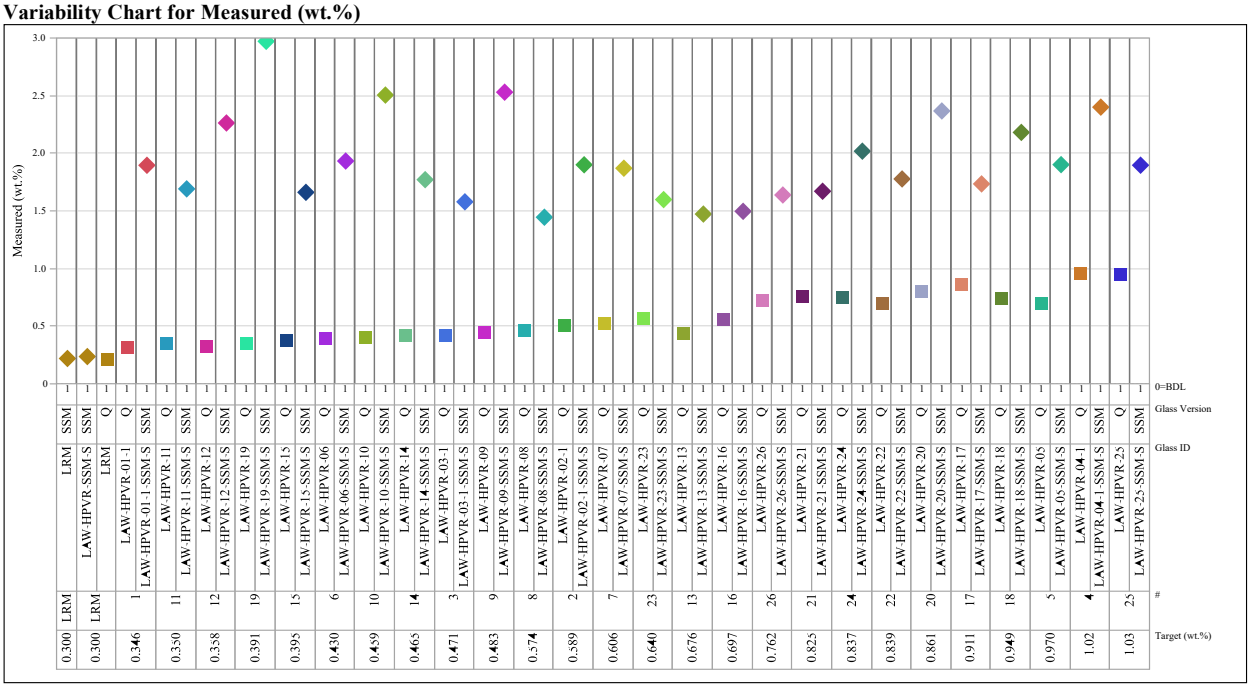


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=SO_3
Variability Chart for Measured (wt.%)



Oxide=TiO_2
Variability Chart for Measured (wt.%)

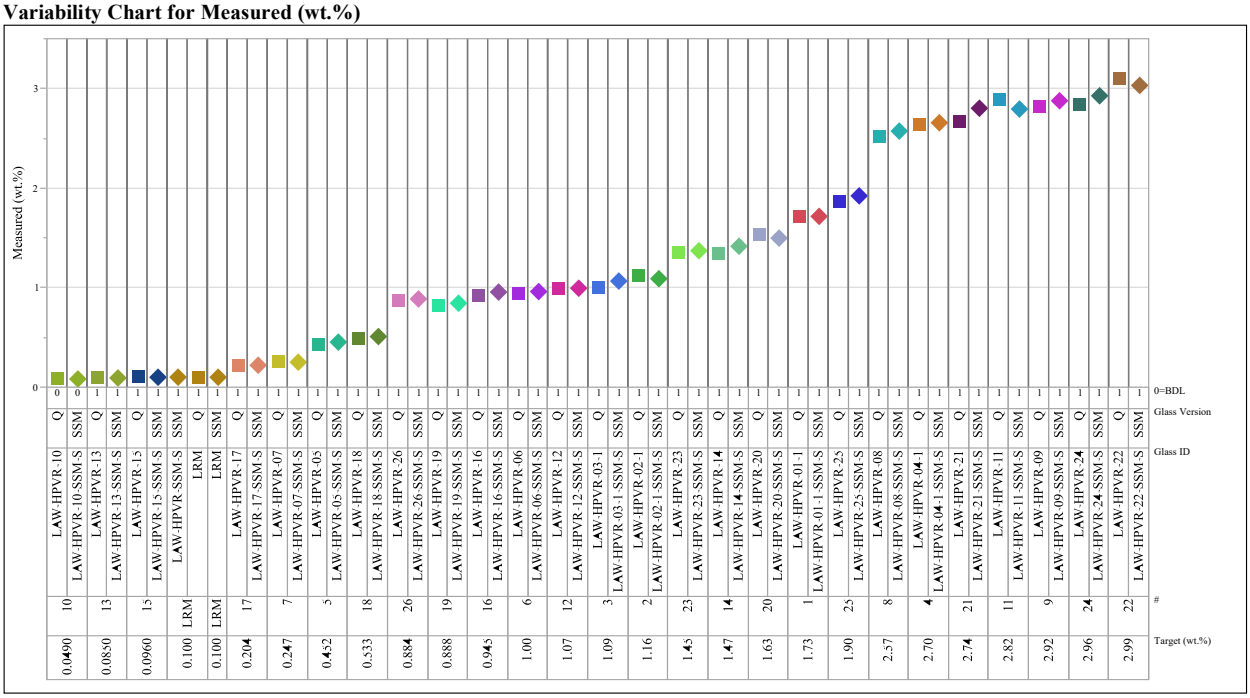
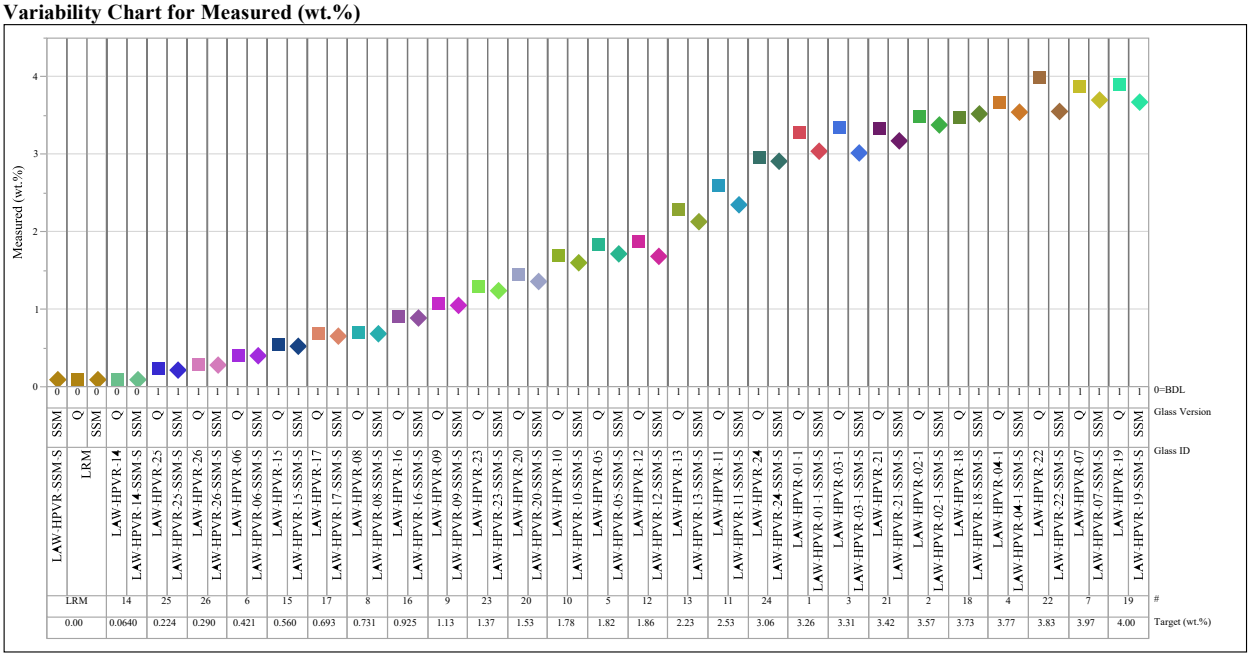


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=V_2O_5
Variability Chart for Measured (wt.%)



Oxide=ZnO
Variability Chart for Measured (wt.%)

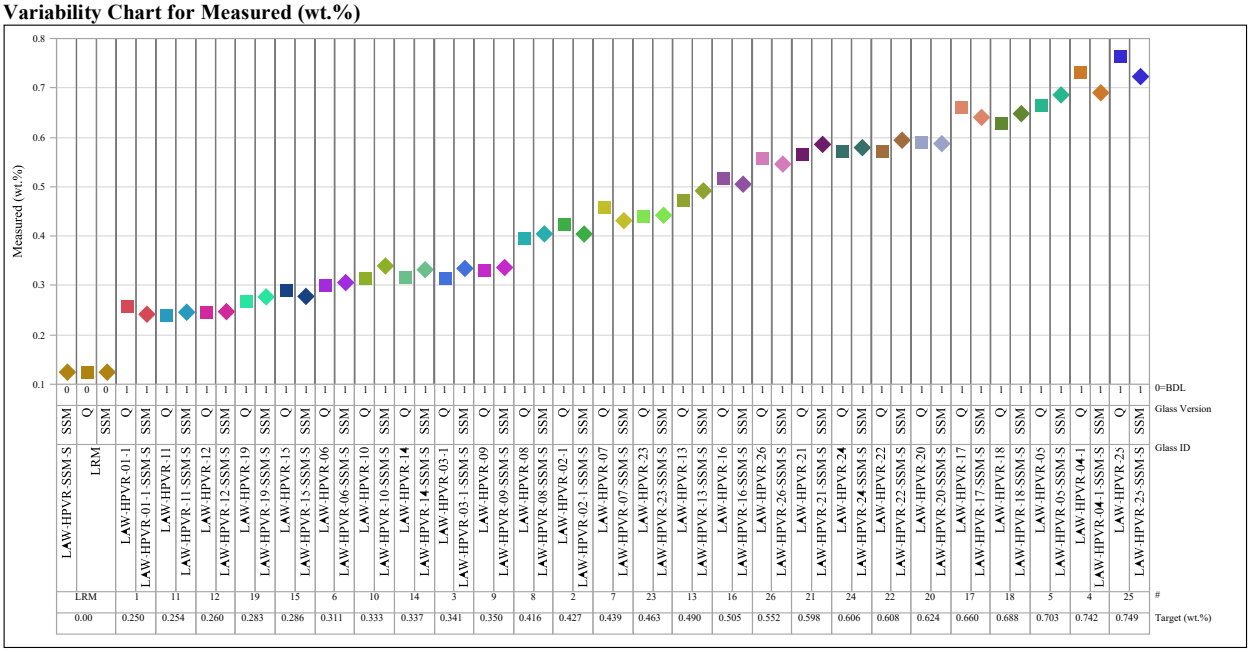
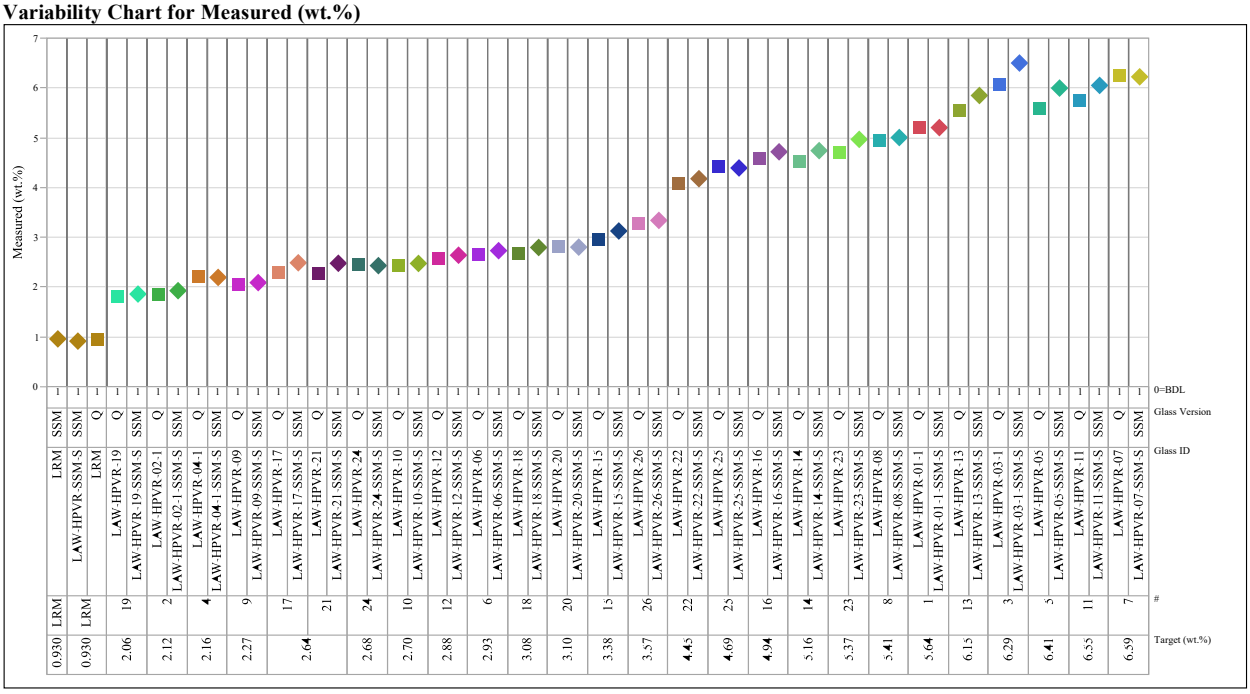
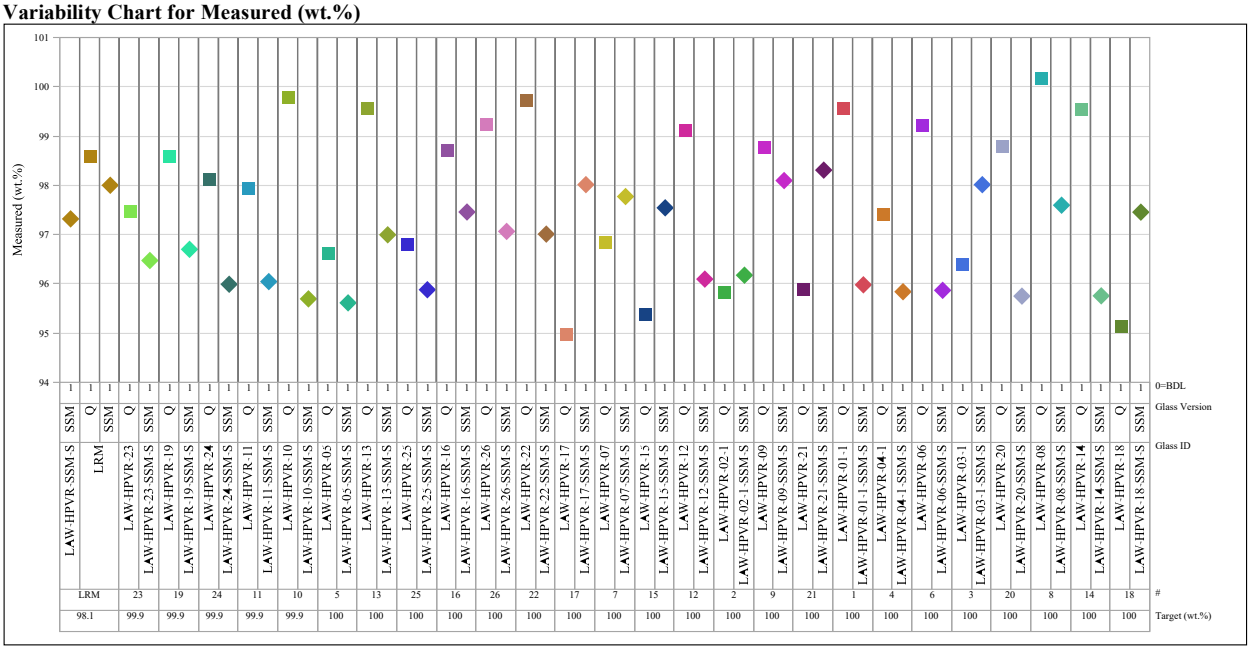


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=ZrO_2
Variability Chart for Measured (wt.%)



Oxide=Sum of Oxides
Variability Chart for Measured (wt.%)



Appendix B. Tables and Exhibits Supporting the LAW HPVR Wash Solution Composition Measurements

Table B-1. Measurements (mg/L) of the SSM Wash Solutions Measured by ICP-OES

PNNL ID	Block	Seq.	Lab ID	Al	B	Ca	Cr	Fe	K	Li	Mg	Na	P	S	Si	Sn	Ti	V	Zn	Zr
soln std	1	1	soln std-11	3.99	19.5	<1.00	<1.00	4.06	9.72	10.1	<1.00	82.1	<1.00	<1.00	48.7	<1.00	<1.00	<1.00	<1.00	<1.00
LAW-HPVR-19-SSM-W	1	2	S-13912-1	<1.00	22.6	5.32	3.43	<1.00	7.93	9.32	<1.00	519	1.01	235	47.5	<1.00	<1.00	29.7	<1.00	<1.00
LAW-HPVR-17-SSM-W	1	3	S-13910-1	<1.00	30.2	1.16	12.5	<1.00	171	9.55	<1.00	526	<1.00	332	17.9	<1.00	<1.00	4.64	<1.00	<1.00
LAW-HPVR-03-1-SSM-W	1	4	S-13896-1	<1.00	21.3	2.58	10.6	<1.00	285	20.4	<1.00	640	5.08	458	13.4	<1.00	<1.00	48.5	<1.00	<1.00
LAW-HPVR-22-SSM-W	1	5	S-13915-1	<1.00	18.1	4.22	16.7	<1.00	172	11.1	<1.00	812	8.96	488	12.1	<1.00	<1.00	55.8	<1.00	<1.00
LAW-HPVR-14-SSM-W	1	6	S-13907-1	<1.00	35.4	2.09	6.14	<1.00	3.89	1.26	<1.00	675	2.59	243	29.0	<1.00	<1.00	<1.00	<1.00	<1.00
LAW-HPVR-11-SSM-W	1	7	S-13904-1	<1.00	23.2	2.35	4.83	<1.00	139	2.36	<1.00	582	3.25	312	13.3	<1.00	<1.00	22.3	<1.00	<1.00
LAW-HPVR-08-SSM-W	1	8	S-13901-1	1.81	22.5	3.07	7.93	<1.00	133	22.8	<1.00	551	3.41	361	11.3	<1.00	<1.00	4.53	<1.00	<1.00
hpstd	1	9	hpstd-11	51.0	<1.00	<1.00	<1.00	49.1	<1.00	<1.00	<1.00	145	<1.00	9.97	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
LAW-HPVR-06-SSM-W	1	10	S-13899-1	<1.00	25.8	15.7	4.21	<1.00	158	6.30	<1.00	369	<1.00	223	40.0	<1.00	<1.00	1.89	<1.00	<1.00
LAW-HPVR-24-SSM-W	1	11	S-13917-1	<1.00	16.3	1.78	13.6	<1.00	250	17.1	<1.00	550	3.49	381	18.5	<1.00	<1.00	26.8	<1.00	<1.00
LAW-HPVR-10-SSM-W	1	12	S-13903-1	<1.00	34.9	3.34	5.88	<1.00	80.5	2.09	<1.00	663	1.18	328	51.6	<1.00	<1.00	14.8	<1.00	<1.00
LAW-HPVR-SSM-W	1	13	S-13920-1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	580	<1.00	386	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
LAW-HPVR-15-SSM-W	1	14	S-13908-1	<1.00	19.7	5.68	3.64	<1.00	173	17.1	<1.00	498	3.07	361	27.4	<1.00	<1.00	2.90	<1.00	<1.00
LAW-HPVR-05-SSM-W	1	15	S-13898-1	<1.00	22.1	<1.00	11.8	<1.00	35.4	33.1	<1.00	703	5.07	408	26.4	<1.00	<1.00	14.6	<1.00	<1.00
soln std	1	16	soln std-12	3.97	19.3	<1.00	<1.00	3.97	9.47	10.2	<1.00	82.2	<1.00	<1.00	48.2	<1.00	<1.00	<1.00	<1.00	<1.00
LAW-HPVR-13-SSM-W	1	17	S-13906-1	<1.00	13.0	1.52	7.10	<1.00	139	13.5	<1.00	692	2.32	452	20.9	<1.00	<1.00	17.1	<1.00	<1.00
LAW-HPVR-16-SSM-W	1	18	S-13909-1	<1.00	23.1	5.11	9.68	<1.00	109	7.90	<1.00	700	5.95	437	8.24	<1.00	<1.00	6.75	<1.00	<1.00
LAW-HPVR-18-SSM-W	1	19	S-13911-1	<1.00	20.2	7.87	6.03	<1.00	40.1	17.2	<1.00	582	2.43	347	17.4	<1.00	<1.00	25.2	<1.00	<1.00
LAW-HPVR-26-SSM-W	1	20	S-13919-1	1.41	21.9	3.65	11.5	<1.00	112	20.4	<1.00	579	5.09	384	7.12	<1.00	<1.00	1.71	<1.00	<1.00
LAW-HPVR-12-SSM-W	1	21	S-13905-1	<1.00	10.1	2.62	3.01	<1.00	2.41	6.77	<1.00	568	2.72	278	35.0	<1.00	<1.00	10.6	<1.00	<1.00
LAW-HPVR-01-1-SSM-W	1	22	S-13894-1	<1.00	25.2	1.61	1.77	<1.00	34.5	11.5	<1.00	337	1.76	148	34.1	<1.00	<1.00	19.3	<1.00	<1.00
LAW-HPVR-02-1-SSM-W	1	23	S-13895-1	<1.00	22.5	12.0	3.22	<1.00	154	1.25	<1.00	653	2.41	418	18.0	<1.00	<1.00	24.4	<1.00	<1.00
hpstd	1	24	hpstd-12	51.6	<1.00	<1.00	<1.00	49.4	<1.00	<1.00	<1.00	145	<1.00	10.1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
LAW-HPVR-25-SSM-W	1	25	S-13918-1	<1.00	17.2	<1.00	18.2	<1.00	81.2	2.36	<1.00	719	3.95	365	30.9	<1.00	<1.00	1.77	<1.00	<1.00
LAW-HPVR-20-SSM-W	1	26	S-13913-1	<1.00	25.1	3.31	5.95	<1.00	<1.00	1.06	<1.00	470	5.24	203	40.0	<1.00	<1.00	8.89	<1.00	<1.00
LAW-HPVR-09-SSM-W	1	27	S-13902-1	<1.00	28.2	2.00	2.98	<1.00	30.3	13.3	<1.00	394	2.44	189	43.2	<1.00	<1.00	5.76	<1.00	<1.00
LAW-HPVR-21-SSM-W	1	28	S-13914-1	<1.00	42.5	2.09	15.6	<1.00	256	<1.00	<1.00	809	6.92	477	11.8	<1.00	<1.00	49.2	<1.00	<1.00
LAW-HPVR-04-1-SSM-W	1	29	S-13897-1	<1.00	15.0	1.91	12.5	<1.00	61.7	22.5	<1.00	670	4.57	434	31.7	<1.00	<1.00	27.9	<1.00	<1.00
LAW-HPVR-07-SSM-W	1	30	S-13900-1	<1.00	16.0	1.83	8.65	<1.00	122	5.60	<1.00	537	<1.00	293	26.1	<1.00	<1.00	42.4	<1.00	<1.00
LAW-HPVR-23-SSM-W	1	31	S-13916-1	<1.00	14.8	2.06	10.1	<1.00	58.0	4.72	<1.00	714	6.29	398	15.0	<1.00	<1.00	11.9	<1.00	<1.00
soln std	1	32	soln std-13	4.09	19.4	<1.00	<1.00	3.99	10.2	10.2	<1.00	82.4	<1.00	<1.00	49.1	<1.00	<1.00	<1.00	<1.00	<1.00
soln std	2	1	soln std-21	3.99	19.9	<1.00	<1.00	4.07	9.79	9.82	<1.00	84.3	<1.00	<1.00	49.2	<1.00	<1.00	<1.00	<1.00	<1.00
LAW-HPVR-20-SSM-W	2	2	S-13913-2	<1.00	25.5	3.09	6.00	<1.00	<1.00	<1.00	<1.00	478	5.17	207	39.7	<1.00	<1.00	8.80	<1.00	<1.00
LAW-HPVR-10-SSM-W	2	3	S-13903-2	<1.00	35.6	2.99	5.99	<1.00	78.2	1.92	<1.00	675	1.03	349	52.5	<1.00	<1.00	14.8	<1.00	<1.00
LAW-HPVR-24-SSM-W	2	4	S-13917-2	<1.00	16.1	1.40	13.5	<1.00	267	16.3	<1.00	614	3.42	453	18.1	<1.00	<1.00	25.8	<1.00	<1.00
LAW-HPVR-22-SSM-W	2	5	S-13915-2	<1.00	20.2	4.33	18.3	<1.00	178	11.3	<1.00	834	9.49	518	13.5	<1.00	<1.00	60.4	<1.00	<1.00
LAW-HPVR-02-1-SSM-W	2	6	S-13895-2	<1.00	22.8	10.5	3.11	<1.00	146	1.12	<1.00	676	2.00	438	17.9	<1.00	<1.00	24.2	<1.00	<1.00
LAW-HPVR-18-SSM-W	2	7	S-13911-2	<1.00	20.5	6.55	6.07	<1.00	39.3	16.7	<1.00	584	1.76	366	17.4	<1.00	<1.00	25.0	<1.00	<1.00
LAW-HPVR-23-SSM-W	2	8	S-13916-2	<1.00	14.9	2.29	10.3	<1.00	55.1	4.48	<1.00	712	6.24	396	15.1	<1.00	<1.00	11.7	<1.00	<1.00
hpstd	2	9	hpstd-21	50.1	<1.00	<1.00	<1.00	49.2	<1.00	<1.00	<1.00	150	<1.00	10.7	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
LAW-HPVR-17-SSM-W	2	10	S-13910-2	<1.00	30.8	1.11	12.4	<1.00	175	9.32	<1.00	554	<1.00	345	18.5	<1.00	<1.00	4.61	<1.00	<1.00
LAW-HPVR-04-1-SSM-W	2	11	S-13897-2	<1.00	15.5	1.55	13.0	<1.00	59.0	21.9	<1.00	670	4.41	425	32.0	<1.00	<1.00	27.9	<1.00	<1.00
LAW-HPVR-06-SSM-W	2	12	S-13899-2	<1.00	26.5	15.0	4.20	<1.00	160	6.13	<1.00	365	<1.00	224	40.4	<1.00	<1.00	1.88	<1.00	<1.00
LAW-HPVR-12-SSM-W	2	13	S-13905-2	<1.00	10.3	2.75	2.84	<1.00	2.38	6.49	<1.00	571	2.67	277	35.1	<1.00	<1.00	10.4	<1.00	<1.00
LAW-HPVR-21-SSM-W	2	14	S-13914-2	<1.00	40.2	<1.00	14.8	<1.00	227	<1.00	<1.00	739	5.63	441	10.6	<1.00	<1.00	45.1	<1.00	<1.00
LAW-HPVR-03-1-SSM-W	2	15	S-13896-2	1.05	21.8	2.68	10.6	<1.00	308	20.2	<1.00	653	4.89	506	14.0	<1.00	<1.00	48.2	<1.00	<1.00
soln std	2	16	soln std-22	3.97	19.7	<1.00	<1.00	4.01	9.72	9.86	<1.00	84.6	<1.00	<1.00	48.7	<1.00	<1.00	<1.00	<1.00	<1.00

Table B-1. Measurements (mg/L) of the SSM Wash Solutions Measured by ICP-OES (continued)

PNNL ID	Block	Seq.	Lab ID	Al	B	Ca	Cr	Fe	K	Li	Mg	Na	P	S	Si	Sn	Ti	V	Zn	Zr
LAW-HPVR-08-SSM-W	2	17	S-13901-2	1.71	23.3	1.93	7.94	<1.00	136	22.8	<1.00	566	2.85	396	11.4	<1.00	<1.00	4.50	<1.00	<1.00
LAW-HPVR-25-SSM-W	2	18	S-13918-2	<1.00	17.4	<1.00	18.3	<1.00	77.6	2.21	<1.00	743	3.60	390	30.3	<1.00	<1.00	1.71	<1.00	<1.00
LAW-HPVR-01-1-SSM-W	2	19	S-13894-2	<1.00	26.2	1.61	1.64	<1.00	33.8	11.1	<1.00	342	1.66	152	34.4	<1.00	<1.00	19.5	<1.00	<1.00
LAW-HPVR-SSM-W	2	20	S-13920-2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	608	<1.00	436	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
LAW-HPVR-13-SSM-W	2	21	S-13906-2	<1.00	13.5	1.56	7.25	<1.00	146	13.5	<1.00	705	2.13	476	21.6	<1.00	<1.00	17.4	<1.00	<1.00
LAW-HPVR-19-SSM-W	2	22	S-13912-2	<1.00	23.6	4.88	3.28	<1.00	7.85	9.34	<1.00	551	<1.00	256	48.8	<1.00	<1.00	30.4	<1.00	<1.00
LAW-HPVR-05-SSM-W	2	23	S-13898-2	<1.00	22.2	<1.00	11.6	<1.00	34.3	31.8	<1.00	772	4.79	481	26.1	<1.00	<1.00	14.4	<1.00	<1.00
hpstd	2	24	hpstd-22	51.7	<1.00	<1.00	<1.00	50.2	<1.00	<1.00	<1.00	151	<1.00	10.2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
LAW-HPVR-09-SSM-W	2	25	S-13902-2	<1.00	28.3	1.91	2.92	<1.00	30.0	12.9	<1.00	397	2.40	204	42.1	<1.00	<1.00	5.58	<1.00	<1.00
LAW-HPVR-16-SSM-W	2	26	S-13909-2	<1.00	23.7	4.99	9.96	<1.00	111	7.72	<1.00	720	5.80	457	8.19	<1.00	<1.00	6.72	<1.00	<1.00
LAW-HPVR-07-SSM-W	2	27	S-13900-2	<1.00	15.7	1.85	8.15	<1.00	118	5.28	<1.00	559	<1.00	321	25.1	<1.00	<1.00	39.7	<1.00	<1.00
LAW-HPVR-14-SSM-W	2	28	S-13907-2	<1.00	39.4	1.33	6.73	<1.00	4.60	1.22	<1.00	755	2.44	302	31.0	<1.00	<1.00	<1.00	<1.00	<1.00
LAW-HPVR-26-SSM-W	2	29	S-13919-2	1.35	23.0	3.54	12.1	<1.00	112	20.3	<1.00	596	4.90	420	7.00	<1.00	<1.00	1.75	<1.00	<1.00
LAW-HPVR-15-SSM-W	2	30	S-13908-2	<1.00	20.6	5.57	3.69	<1.00	175	17.1	<1.00	510	2.86	368	27.8	<1.00	<1.00	2.96	<1.00	<1.00
LAW-HPVR-11-SSM-W	2	31	S-13904-2	<1.00	25.6	2.46	5.05	<1.00	138	2.39	<1.00	602	3.28	341	14.6	<1.00	<1.00	23.7	<1.00	<1.00
soln std	2	32	soln std-23	4.14	20.2	<1.00	<1.00	4.12	10.0	10.0	<1.00	85.1	<1.00	<1.00	49.4	<1.00	<1.00	<1.00	<1.00	<1.00
soln std	3	1	soln std-31	4.00	19.7	<1.00	<1.00	4.05	9.84	9.92	<1.00	84.9	<1.00	<1.00	49.2	<1.00	<1.00	<1.00	<1.00	<1.00
LAW-HPVR-04-1-SSM-W	3	2	S-13897-3	<1.00	15.7	1.62	12.8	<1.00	60.4	22.0	<1.00	657	4.37	425	32.5	<1.00	<1.00	28.3	<1.00	<1.00
LAW-HPVR-19-SSM-W	3	3	S-13912-3	<1.00	23.3	4.95	3.53	<1.00	8.13	9.26	<1.00	553	<1.00	240	49.0	<1.00	<1.00	30.3	<1.00	<1.00
LAW-HPVR-12-SSM-W	3	4	S-13905-3	<1.00	10.4	2.83	3.12	<1.00	2.64	6.72	<1.00	568	2.71	279	36.1	<1.00	<1.00	10.6	<1.00	<1.00
LAW-HPVR-05-SSM-W	3	5	S-13898-3	<1.00	22.1	<1.00	11.8	<1.00	33.7	31.3	<1.00	766	4.81	474	26.1	<1.00	<1.00	14.4	<1.00	<1.00
LAW-HPVR-09-SSM-W	3	6	S-13902-3	<1.00	29.0	2.00	3.18	<1.00	30.3	13.1	<1.00	402	2.44	199	43.6	<1.00	<1.00	5.81	<1.00	<1.00
LAW-HPVR-22-SSM-W	3	7	S-13915-3	<1.00	20.8	4.55	18.7	<1.00	184	11.8	<1.00	850	9.51	516	13.8	<1.00	<1.00	61.9	<1.00	<1.00
LAW-HPVR-25-SSM-W	3	8	S-13918-3	<1.00	18.2	<1.00	19.1	<1.00	81.1	2.41	<1.00	748	3.78	373	32.3	<1.00	<1.00	1.88	<1.00	<1.00
hpstd	3	9	hpstd-31	52.6	<1.00	<1.00	<1.00	50.6	<1.00	<1.00	<1.00	152	<1.00	10.7	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
LAW-HPVR-10-SSM-W	3	10	S-13903-3	<1.00	36.5	3.16	6.27	<1.00	81.2	2.10	<1.00	694	1.02	346	53.7	<1.00	<1.00	15.2	<1.00	<1.00
LAW-HPVR-16-SSM-W	3	11	S-13909-3	<1.00	24.1	5.19	10.2	<1.00	117	7.89	<1.00	716	5.71	451	8.45	<1.00	<1.00	6.87	<1.00	<1.00
LAW-HPVR-13-SSM-W	3	12	S-13906-3	<1.00	13.6	1.62	7.34	<1.00	151	13.6	<1.00	702	2.07	469	21.8	<1.00	<1.00	17.6	<1.00	<1.00
LAW-HPVR-18-SSM-W	3	13	S-13911-3	<1.00	21.0	6.93	6.40	<1.00	39.8	17.2	<1.00	588	1.86	362	18.1	<1.00	<1.00	25.8	<1.00	<1.00
LAW-HPVR-07-SSM-W	3	14	S-13900-3	<1.00	17.2	1.90	9.30	<1.00	128	5.85	<1.00	546	<1.00	299	27.9	<1.00	<1.00	44.4	<1.00	<1.00
LAW-HPVR-03-1-SSM-W	3	15	S-13896-3	1.06	22.3	2.83	11.0	<1.00	311	21.1	<1.00	667	4.98	505	14.5	<1.00	<1.00	49.6	<1.00	<1.00
soln std	3	16	soln std-32	4.12	19.9	<1.00	<1.00	4.06	10.3	10.2	<1.00	85.2	<1.00	<1.00	49.6	<1.00	<1.00	<1.00	<1.00	<1.00
LAW-HPVR-26-SSM-W	3	17	S-13919-3	1.37	22.5	3.66	11.9	<1.00	121	20.7	<1.00	574	4.96	401	7.19	<1.00	<1.00	1.79	<1.00	<1.00
LAW-HPVR-17-SSM-W	3	18	S-13910-3	<1.00	31.3	1.18	12.7	<1.00	179	9.78	<1.00	546	<1.00	341	18.8	<1.00	<1.00	4.73	<1.00	<1.00
LAW-HPVR-06-SSM-W	3	19	S-13899-3	<1.00	26.7	16.0	4.47	<1.00	179	6.37	<1.00	410	<1.00	264	41.4	<1.00	<1.00	1.95	<1.00	<1.00
LAW-HPVR-SSM-W	3	20	S-13920-3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	630	<1.00	421	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
LAW-HPVR-21-SSM-W	3	21	S-13914-3	<1.00	45.2	<1.00	16.3	<1.00	275	<1.00	<1.00	879	6.39	514	12.2	<1.00	<1.00	51.6	<1.00	<1.00
LAW-HPVR-20-SSM-W	3	22	S-13913-3	<1.00	25.6	3.29	6.15	<1.00	<1.00	1.08	<1.00	484	5.12	212	40.5	<1.00	<1.00	9.05	<1.00	<1.00
LAW-HPVR-11-SSM-W	3	23	S-13904-3	<1.00	25.9	2.59	5.20	<1.00	149	2.50	<1.00	610	3.45	332	15.2	<1.00	<1.00	24.4	<1.00	<1.00
hpstd	3	24	hpstd-32	53.0	<1.00	<1.00	<1.00	49.7	<1.00	<1.00	<1.00	153	<1.00	10.6	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
LAW-HPVR-15-SSM-W	3	25	S-13908-3	<1.00	20.2	5.73	3.71	<1.00	179	17.7	<1.00	515	2.84	347	28.4	<1.00	<1.00	2.99	<1.00	<1.00
LAW-HPVR-01-1-SSM-W	3	26	S-13894-3	<1.00	25.8	1.68	1.84	<1.00	35.6	11.6	<1.00	335	1.60	141	35.0	<1.00	<1.00	19.8	<1.00	<1.00
LAW-HPVR-14-SSM-W	3	27	S-13907-3	<1.00	39.0	1.35	6.78	<1.00	5.57	1.32	<1.00	754	2.40	287	31.6	<1.00	<1.00	<1.00	<1.00	<1.00
LAW-HPVR-02-1-SSM-W	3	28	S-13895-3	<1.00	23.3	11.1	3.54	<1.00	156	1.28	<1.00	681	1.94	431	18.5	<1.00	<1.00	25.0	<1.00	<1.00
LAW-HPVR-24-SSM-W	3	29	S-13917-3	<1.00	17.3	1.59	14.1	<1.00	281	18.0	<1.00	620	3.67	456	19.7	<1.00	<1.00	28.0	<1.00	<1.00
LAW-HPVR-08-SSM-W	3	30	S-13901-3	1.82	23.7	2.10	8.05	<1.00	140	24.0	<1.00	567	2.80	387	12.0	<1.00	<1.00	4.72	<1.00	<1.00
LAW-HPVR-23-SSM-W	3	31	S-13916-3	<1.00	15.4	2.47	10.5	<1.00	59.3	4.85	<1.00	739	6.38	410	15.8	<1.00	<1.00	12.2	<1.00	<1.00
soln std	3	32	soln std-33	4.23	20.1	<1.00	<1.00	4.06	10.7	10.4	<1.00	85.1	<1.00	<1.00	50.5	<1.00	<1.00	<1.00	<1.00	<1.00

Table B-2. Measurements (mg/L) of the SSM Wash Solutions Measured by IC

PNNL ID	Block	Seq.	Lab ID	Cl^-	F^-	PO_4^{3-}	SO_4^{2-}
5 ppm ckstd	1	1	5 ppm ckstd	5.06	4.86	4.92	4.56
IC Blank	1	2	IC BLANK 1-1	<5.00	<5.00	<10.0	<10.0
LAW-HPVR-25-SSM-W	1	3	S-13918-1	30.2	<5.00	10.5	1200
LAW-HPVR-19-SSM-W	1	4	S-13912-1	23.6	<5.00	<10.0	792
LAW-HPVR-03-1-SSM-W	1	5	S-13896-1	5.19	<5.00	13.9	1590
LAW-HPVR-16-SSM-W	1	6	S-13909-1	65.6	<5.00	16.1	1390
LAW-HPVR-05-SSM-W	1	7	S-13898-1	93.0	<5.00	13.9	1450
LAW-HPVR-23-SSM-W	1	8	S-13916-1	67.1	<5.00	17.3	1250
LAW-HPVR-04-1-SSM-W	1	9	S-13897-1	6.56	<5.00	11.6	1340
LAW-HPVR-SSM-W	1	10	S-13920-1	<5.00	<5.00	<10.0	1360
LAW-HPVR-20-SSM-W	1	11	S-13913-1	29.3	<5.00	14.3	651
5 ppm ckstd	1	12	5 ppm ckstd	5.13	4.93	4.67	4.67
IC Blank	1	13	IC BLANK 1-2	<5.00	<5.00	<10.0	<10.0
LAW-HPVR-11-SSM-W	1	14	S-13904-1	95.9	<5.00	<10.0	1040
LAW-HPVR-07-SSM-W	1	15	S-13900-1	32.2	<5.00	<10.0	952
LAW-HPVR-09-SSM-W	1	16	S-13902-1	19.9	<5.00	<10.0	621
LAW-HPVR-10-SSM-W	1	17	S-13903-1	41.2	<5.00	<10.0	1080
LAW-HPVR-01-1-SSM-W	1	18	S-13894-1	44.9	<5.00	<10.0	464
LAW-HPVR-24-SSM-W	1	19	S-13917-1	47.5	<5.00	10.1	1420
LAW-HPVR-15-SSM-W	1	20	S-13908-1	42.0	<5.00	<10.0	1100
LAW-HPVR-21-SSM-W	1	21	S-13914-1	57.3	<5.00	17.9	1560
LAW-HPVR-02-1-SSM-W	1	22	S-13895-1	49.5	<5.00	<10.0	1370
5 ppm ckstd	1	23	5 ppm ckstd	5.13	4.97	4.66	4.73
IC Blank	1	24	IC BLANK 1-3	<5.00	<5.00	<10.0	<10.0
LAW-HPVR-12-SSM-W	1	25	S-13905-1	37.7	<5.00	<10.0	878
LAW-HPVR-14-SSM-W	1	26	S-13907-1	67.7	<5.00	<10.0	913
LAW-HPVR-13-SSM-W	1	27	S-13906-1	71.1	<5.00	<10.0	1460
LAW-HPVR-17-SSM-W	1	28	S-13910-1	37.5	<5.00	<10.0	1070
LAW-HPVR-22-SSM-W	1	29	S-13915-1	48.7	<5.00	24.6	1600
LAW-HPVR-18-SSM-W	1	30	S-13911-1	48.5	<5.00	<10.0	1120
LAW-HPVR-26-SSM-W	1	31	S-13919-1	48.9	<5.00	13.4	1240
LAW-HPVR-08-SSM-W	1	32	S-13901-1	68.2	<5.00	<10.0	1200
LAW-HPVR-06-SSM-W	1	33	S-13899-1	35.3	<5.00	<10.0	773
5 ppm ckstd	1	34	5 ppm ckstd	5.21	4.97	4.65	4.68
IC Blank	1	35	IC BLANK 1-4	<5.00	<5.00	<10.0	<10.0
5 ppm ckstd	2	1	5 ppm ckstd	5.19	5.03	4.73	4.51
IC Blank	2	2	IC BLANK 2-1	<5.00	<5.00	<10.0	<10.0
LAW-HPVR-06-SSM-W	2	3	S-13899-2	34.0	<5.00	<10.0	773
LAW-HPVR-03-1-SSM-W	2	4	S-13896-2	5.20	<5.00	13.5	1590
LAW-HPVR-16-SSM-W	2	5	S-13909-2	67.6	<5.00	15.5	1420
LAW-HPVR-08-SSM-W	2	6	S-13901-2	67.9	<5.00	<10.0	1220
LAW-HPVR-14-SSM-W	2	7	S-13907-2	67.6	<5.00	<10.0	922
LAW-HPVR-26-SSM-W	2	8	S-13919-2	50.1	<5.00	13.5	1260
LAW-HPVR-17-SSM-W	2	9	S-13910-2	37.5	<5.00	<10.0	1080
LAW-HPVR-22-SSM-W	2	10	S-13915-2	49.2	<5.00	25.2	1620
LAW-HPVR-02-1-SSM-W	2	11	S-13895-2	49.9	<5.00	<10.0	1380
5 ppm ckstd	2	12	5 ppm ckstd	5.23	5.07	4.83	4.80
IC Blank	2	13	IC BLANK 2-2	<5.00	<5.00	<10.0	<10.0

Table B-2. Measurements (mg/L) of the SSM Wash Solutions Measured by IC (continued)

PNNL ID	Block	Seq.	Lab ID	Cl^-	F^-	PO_4^{3-}	SO_4^{2-}
LAW-HPVR-25-SSM-W	2	14	S-13918-2	30.9	<5.00	10.7	1210
LAW-HPVR-24-SSM-W	2	15	S-13917-2	49.8	<5.00	10.3	1430
LAW-HPVR-SSM-W	2	16	S-13920-2	<5.00	<5.00	<10.0	1380
LAW-HPVR-07-SSM-W	2	17	S-13900-2	31.7	<5.00	<10.0	969
LAW-HPVR-13-SSM-W	2	18	S-13906-2	73.1	<5.00	<10.0	1470
LAW-HPVR-15-SSM-W	2	19	S-13908-2	43.5	<5.00	<10.0	1110
LAW-HPVR-12-SSM-W	2	20	S-13905-2	38.9	<5.00	<10.0	893
LAW-HPVR-09-SSM-W	2	21	S-13902-2	20.6	<5.00	<10.0	632
LAW-HPVR-05-SSM-W	2	22	S-13898-2	95.3	<5.00	13.9	1470
5 ppm ckstd	2	23	5 ppm ckstd	5.27	5.07	4.83	4.81
IC Blank	2	24	IC BLANK 2-3	<5.00	<5.00	<10.0	<10.0
LAW-HPVR-19-SSM-W	2	25	S-13912-2	24.7	<5.00	<10.0	807
LAW-HPVR-10-SSM-W	2	26	S-13903-2	43.1	<5.00	<10.0	1090
LAW-HPVR-04-1-SSM-W	2	27	S-13897-2	6.34	<5.00	12.1	1370
LAW-HPVR-23-SSM-W	2	28	S-13916-2	71.0	<5.00	17.0	1270
LAW-HPVR-20-SSM-W	2	29	S-13913-2	30.4	<5.00	14.5	655
LAW-HPVR-11-SSM-W	2	30	S-13904-2	99.4	<5.00	<10.0	1050
LAW-HPVR-18-SSM-W	2	31	s-13911-2	40.4	<5.00	<10.0	1140
LAW-HPVR-01-1-SSM-W	2	32	S-13894-2	45.8	<5.00	<10.0	467
LAW-HPVR-21-SSM-W	2	33	S-13914-2	57.9	<5.00	18.6	1580
5 ppm ckstd	2	34	5 ppm ckstd	5.13	5.07	4.84	4.82
IC Blank	2	35	IC BLANK 2-4	<5.00	<5.00	<10.0	<10.0
5 ppm ckstd	3	1	5 ppm ckstd	5.10	5.03	4.73	4.65
IC Blank	3	2	IC BLANK 3-1	<5.00	<5.00	<10.0	<10.0
LAW-HPVR-19-SSM-W	3	3	S-13912-3	24.4	<5.00	<10.0	805
LAW-HPVR-20-SSM-W	3	4	S-13913-3	30.3	<5.00	13.8	648
LAW-HPVR-07-SSM-W	3	5	S-13900-3	32.9	<5.00	<10.0	955
LAW-HPVR-18-SSM-W	3	6	S-13911-3	49.9	<5.00	<10.0	1120
LAW-HPVR-06-SSM-W	3	7	S-13899-3	35.6	<5.00	<10.0	761
LAW-HPVR-SSM-W	3	8	S-13920-3	<5.00	<5.00	<10.0	1350
LAW-HPVR-21-SSM-W	3	9	S-13914-3	58.2	<5.00	18.1	1540
LAW-HPVR-22-SSM-W	3	10	S-13915-3	49.5	<5.00	25.4	1620
LAW-HPVR-13-SSM-W	3	11	S-13906-3	74.1	<5.00	<10.0	1430
5 ppm ckstd	3	12	5 ppm ckstd	5.49	4.90	4.60	4.61
IC Blank	3	13	IC BLANK 3-2	<5.00	<5.00	<10.0	<10.0
LAW-HPVR-12-SSM-W	3	14	S-13905-3	38.7	<5.00	<10.0	896
LAW-HPVR-11-SSM-W	3	15	S-13904-3	97.8	<5.00	<10.0	1050
LAW-HPVR-04-1-SSM-W	3	16	S-13897-3	6.50	<5.00	12.0	1380
LAW-HPVR-01-1-SSM-W	3	17	S-13894-3	47.5	<5.00	<10.0	470
LAW-HPVR-26-SSM-W	3	18	S-13919-3	52.2	<5.00	14.0	1280
LAW-HPVR-02-1-SSM-W	3	19	S-13895-3	52.6	<5.00	<10.0	1400
LAW-HPVR-16-SSM-W	3	20	S-13909-3	71.8	<5.00	16.0	1430
LAW-HPVR-23-SSM-W	3	21	S-13916-3	72.4	<5.00	17.2	1270
LAW-HPVR-15-SSM-W	3	22	S-13908-3	44.2	<5.00	<10.0	1110
5 ppm ckstd	3	23	5 ppm ckstd	5.49	5.04	4.78	4.82
IC Blank	3	24	IC BLANK 3-3	<5.00	<5.00	<10.0	<10.0
LAW-HPVR-14-SSM-W	3	25	S-13907-3	69.8	<5.00	<10.0	933

Table B-2. Measurements (mg/L) of the SSM Wash Solutions Measured by IC (continued)

PNNL ID	Block	Seq.	Lab ID	Cl^-	F^-	PO_4^{3-}	SO_4^{2-}
LAW-HPVR-05-SSM-W	3	26	S-13898-3	95.9	<5.00	14.1	1480
LAW-HPVR-08-SSM-W	3	27	S-13901-3	71.5	<5.00	<10.0	1230
LAW-HPVR-03-1-SSM-W	3	28	S-13896-3	5.50	<5.00	14.1	1610
LAW-HPVR-09-SSM-W	3	29	S-13902-3	20.8	<5.00	<10.0	633
LAW-HPVR-25-SSM-W	3	30	S-13918-3	32.6	<5.00	11.2	1220
LAW-HPVR-10-SSM-W	3	31	s-13903-3	31.5	<5.00	<10.0	1090
LAW-HPVR-24-SSM-W	3	32	S-13917-3	51.6	<5.00	10.9	1450
LAW-HPVR-17-SSM-W	3	33	S-13910-3	40.0	<5.00	<10.0	1090
5 ppm ckstd	3	34	5 ppm ckstd	5.47	5.07	4.80	4.66
IC Blank	3	35	IC BLANK 3-4	<5.00	<5.00	<10.0	<10.0

Table B-3. Results for Standards Utilized During the Measurement of the Wash Solutions

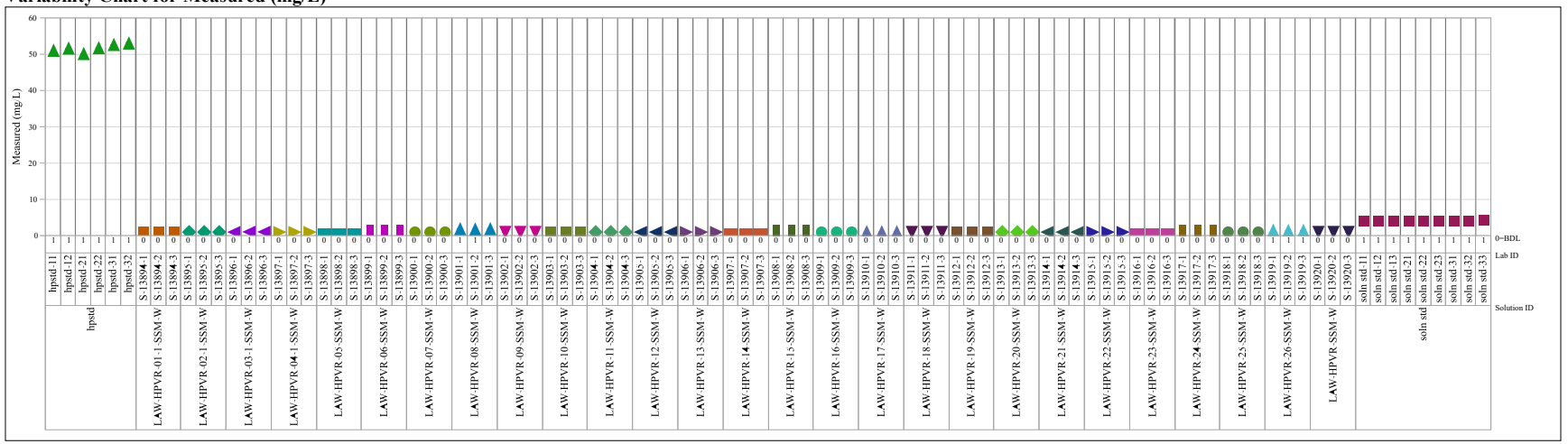
Solution ID	Instrument	Analyte	Reference Value (mg/L)	Mean Measurement (mg/L)
5 ppm ckstd	IC	Cl	5	5.24
5 ppm ckstd	IC	F	5	5.00
5 ppm ckstd	IC	PO4	5	4.69
5 ppm ckstd	IC	SO4	5	4.75
hpstd	ICP	Al	50	51.7
hpstd	ICP	B	0	<1.00
hpstd	ICP	Ca	0	<1.00
hpstd	ICP	Cr	0	<1.00
hpstd	ICP	Fe	50	49.7
hpstd	ICP	K	0	<1.00
hpstd	ICP	Li	0	<1.00
hpstd	ICP	Mg	0	<1.00
hpstd	ICP	Na	150	149
hpstd	ICP	P	0	<1.00
hpstd	ICP	S	10	10.4
hpstd	ICP	Si	0	<1.00
hpstd	ICP	Sn	0	<1.00
hpstd	ICP	Ti	0	<1.00
hpstd	ICP	V	0	<1.00
hpstd	ICP	Zn	0	<1.00
hpstd	ICP	Zr	0	<1.00
soln std	ICP	Al	4	4.06
soln std	ICP	B	20	19.7
soln std	ICP	Ca	0	<1.00
soln std	ICP	Cr	0	<1.00
soln std	ICP	Fe	4	4.04
soln std	ICP	K	10	9.97
soln std	ICP	Li	10	10.1
soln std	ICP	Mg	0	<1.00
soln std	ICP	Na	81	84.0
soln std	ICP	P	0	<1.00
soln std	ICP	S	0	<1.00
soln std	ICP	Si	50	49.2
soln std	ICP	Sn	0	<1.00
soln std	ICP	Ti	0	<1.00
soln std	ICP	V	0	<1.00
soln std	ICP	Zn	0	<1.00
soln std	ICP	Zr	0	<1.00

Table B-4. Average Measurements (mg/L) of the SSM Wash Solutions

		ICP				ICP-OES															
Lab ID	**PNNL ID**	**Cl^-**	**F^-**	**PO_4^{3-}**	**SO_4^{2-}**	**Al**	**B**	**Ca**	**Cr**	**Fe**	**K**	**Li**	**Mg**	**Na**	**P**	**S**	**Si**	**Sn**	**Ti**	**V**	**Zn**	**Zr**
S-13894	LAW-HPVR-01-1-SSM-W	46.1	<5.00	<10.0	467	<1.00	25.7	1.63	1.75	<1.00	34.6	11.4	<1.00	338	1.67	147	34.5	<1.00	<1.00	19.5	<1.00	<1.00
S-13895	LAW-HPVR-02-1-SSM-W	50.7	<5.00	<10.0	1380	<1.00	22.9	11.2	3.29	<1.00	152	1.22	<1.00	670	2.12	429	18.1	<1.00	<1.00	24.5	<1.00	<1.00
S-13896	LAW-HPVR-03-1-SSM-W	5.30	<5.00	13.8	1600	<1.04	21.8	2.70	10.7	<1.00	301	20.6	<1.00	653	4.98	490	14.0	<1.00	<1.00	48.8	<1.00	<1.00
S-13897	LAW-HPVR-04-1-SSM-W	6.47	<5.00	11.9	1360	<1.00	15.4	1.69	12.8	<1.00	60.4	22.1	<1.00	666	4.45	428	32.1	<1.00	<1.00	28.0	<1.00	<1.00
S-13898	LAW-HPVR-05-SSM-W	94.7	<5.00	14.0	1470	<1.00	22.1	<1.00	11.7	<1.00	34.5	32.1	<1.00	747	4.89	454	26.2	<1.00	<1.00	14.5	<1.00	<1.00
S-13899	LAW-HPVR-06-SSM-W	35.0	<5.00	<10.0	769	<1.00	26.3	15.6	4.29	<1.00	166	6.27	<1.00	381	<1.00	237	40.6	<1.00	<1.00	1.91	<1.00	<1.00
S-13900	LAW-HPVR-07-SSM-W	32.3	<5.00	<10.0	959	<1.00	16.3	1.86	8.70	<1.00	123	5.58	<1.00	547	<1.00	304	26.4	<1.00	<1.00	42.2	<1.00	<1.00
S-13901	LAW-HPVR-08-SSM-W	69.2	<5.00	<10.0	1220	1.78	23.2	2.37	7.97	<1.00	136	23.2	<1.00	561	3.02	381	11.6	<1.00	<1.00	4.58	<1.00	<1.00
S-13902	LAW-HPVR-09-SSM-W	20.4	<5.00	<10.0	629	<1.00	28.5	1.97	3.03	<1.00	30.2	13.1	<1.00	398	2.43	197	43.0	<1.00	<1.00	5.72	<1.00	<1.00
S-13903	LAW-HPVR-10-SSM-W	38.6	<5.00	<10.0	1090	<1.00	35.7	3.16	6.05	<1.00	80.0	2.04	<1.00	677	1.08	341	52.6	<1.00	<1.00	14.9	<1.00	<1.00
S-13904	LAW-HPVR-11-SSM-W	97.7	<5.00	<10.0	1050	<1.00	24.9	2.47	5.03	<1.00	142	2.42	<1.00	598	3.33	328	14.4	<1.00	<1.00	23.5	<1.00	<1.00
S-13905	LAW-HPVR-12-SSM-W	38.4	<5.00	<10.0	889	<1.00	10.3	2.73	2.99	<1.00	2.48	6.66	<1.00	569	2.70	278	35.4	<1.00	<1.00	10.5	<1.00	<1.00
S-13906	LAW-HPVR-13-SSM-W	72.8	<5.00	<10.0	1450	<1.00	13.4	1.57	7.23	<1.00	145	13.5	<1.00	700	2.17	466	21.4	<1.00	<1.00	17.4	<1.00	<1.00
S-13907	LAW-HPVR-14-SSM-W	68.4	<5.00	<10.0	923	<1.00	37.9	1.59	6.55	<1.00	4.69	1.27	<1.00	728	2.48	277	30.5	<1.00	<1.00	<1.00	<1.00	<1.00
S-13908	LAW-HPVR-15-SSM-W	43.2	<5.00	<10.0	1110	<1.00	20.2	5.66	3.68	<1.00	176	17.3	<1.00	508	2.92	359	27.9	<1.00	<1.00	2.95	<1.00	<1.00
S-13909	LAW-HPVR-16-SSM-W	68.3	<5.00	15.9	1410	<1.00	23.6	5.10	9.95	<1.00	112	7.84	<1.00	712	5.82	448	8.29	<1.00	<1.00	6.78	<1.00	<1.00
S-13910	LAW-HPVR-17-SSM-W	38.3	<5.00	<10.0	1080	<1.00	30.8	1.15	12.5	<1.00	175	9.55	<1.00	542	<1.00	339	18.4	<1.00	<1.00	4.66	<1.00	<1.00
S-13911	LAW-HPVR-18-SSM-W	46.3	<5.00	<10.0	1130	<1.00	20.6	7.12	6.17	<1.00	39.7	17.0	<1.00	585	2.02	358	17.6	<1.00	<1.00	25.3	<1.00	<1.00
S-13912	LAW-HPVR-19-SSM-W	24.2	<5.00	<10.0	801	<1.00	23.2	5.05	3.41	<1.00	7.97	9.31	<1.00	541	<1.00	244	48.4	<1.00	<1.00	30.1	<1.00	<1.00
S-13913	LAW-HPVR-20-SSM-W	30.0	<5.00	14.2	651	<1.00	25.4	3.23	6.03	<1.00	<1.00	<1.05	<1.00	477	5.18	207	40.1	<1.00	<1.00	8.91	<1.00	<1.00
S-13914	LAW-HPVR-21-SSM-W	57.8	<5.00	18.2	1560	<1.00	42.6	<1.36	15.6	<1.00	253	<1.00	<1.00	809	6.31	477	11.5	<1.00	<1.00	48.6	<1.00	<1.00
S-13915	LAW-HPVR-22-SSM-W	49.1	<5.00	25.1	1610	<1.00	19.7	4.37	17.9	<1.00	178	11.4	<1.00	832	9.32	507	13.1	<1.00	<1.00	59.4	<1.00	<1.00
S-13916	LAW-HPVR-23-SSM-W	70.2	<5.00	17.2	1260	<1.00	15.0	2.27	10.3	<1.00	57.5	4.68	<1.00	722	6.30	401	15.3	<1.00	<1.00	11.9	<1.00	<1.00
S-13917	LAW-HPVR-24-SSM-W	49.6	<5.00	10.4	1430	<1.00	16.6	1.59	13.7	<1.00	266	17.1	<1.00	595	3.53	430	18.8	<1.00	<1.00	26.9	<1.00	<1.00
S-13918	LAW-HPVR-25-SSM-W	31.2	<5.00	10.8	1210	<1.00	17.6	<1.00	18.5	<1.00	80.0	2.33	<1.00	737	3.78	376	31.2	<1.00	<1.00	1.79	<1.00	<1.00
S-13919	LAW-HPVR-26-SSM-W	50.4	<5.00	13.6	1260	1.38	22.5	3.62	11.8	<1.00	115	20.5	<1.00	583	4.98	402	7.10	<1.00	<1.00	1.75	<1.00	<1.00
S-13920	LAW-HPVR-SSM-W	<5.00	<5.00	<10.0	1360	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	606	<1.00	414	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00

Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte

Analyte=Al, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=B, Analysis=ICP
Variability Chart for Measured (mg/L)

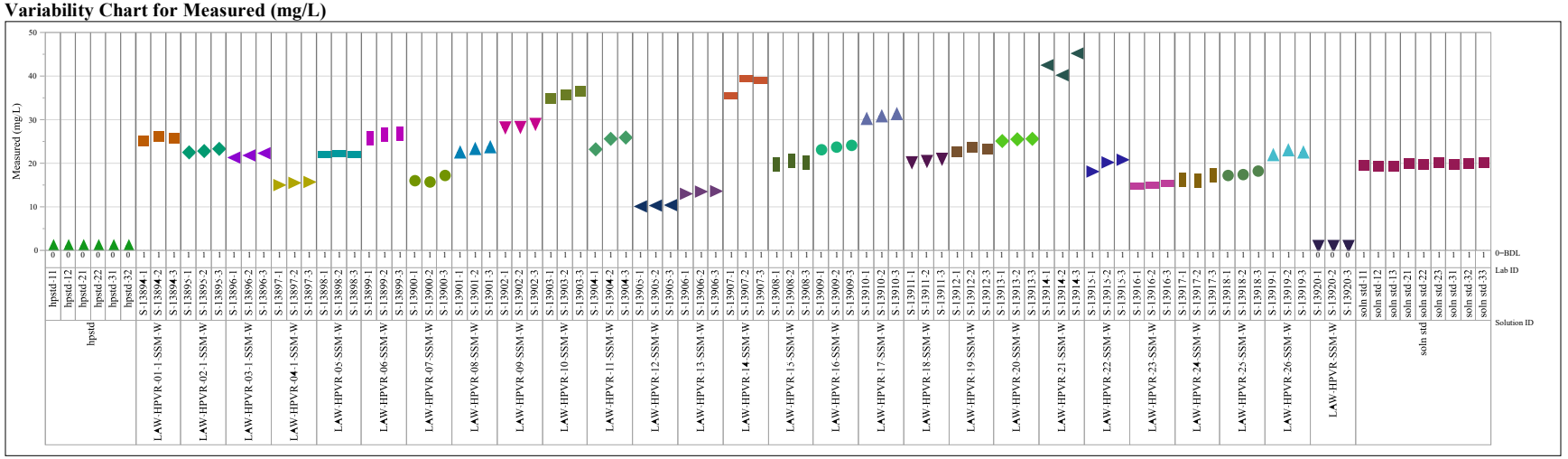
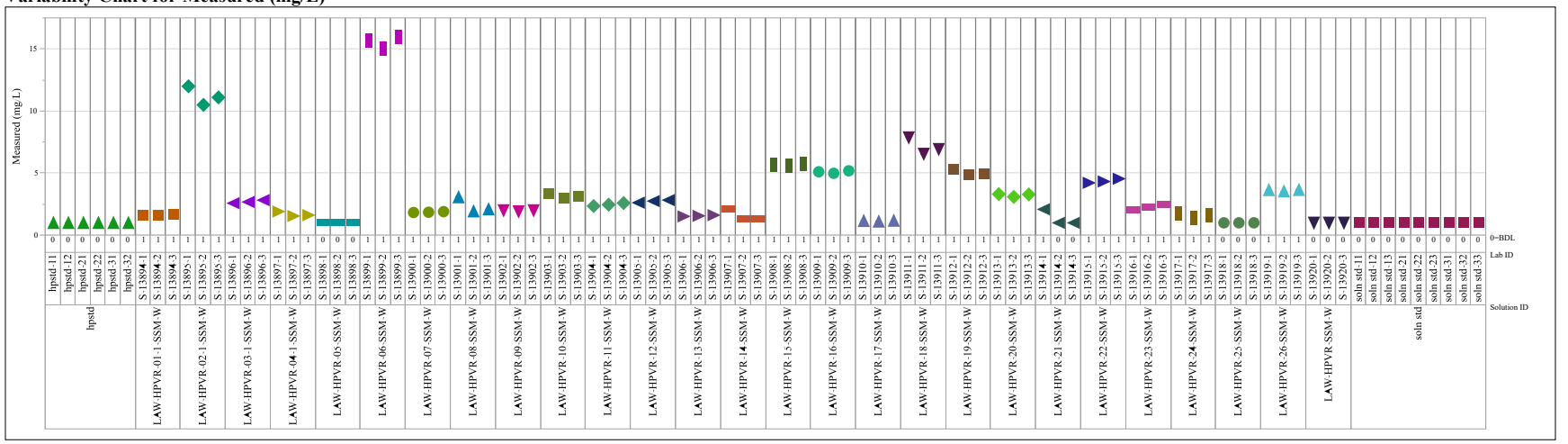


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Ca, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=Cl^-, Analysis=IC
Variability Chart for Measured (mg/L)

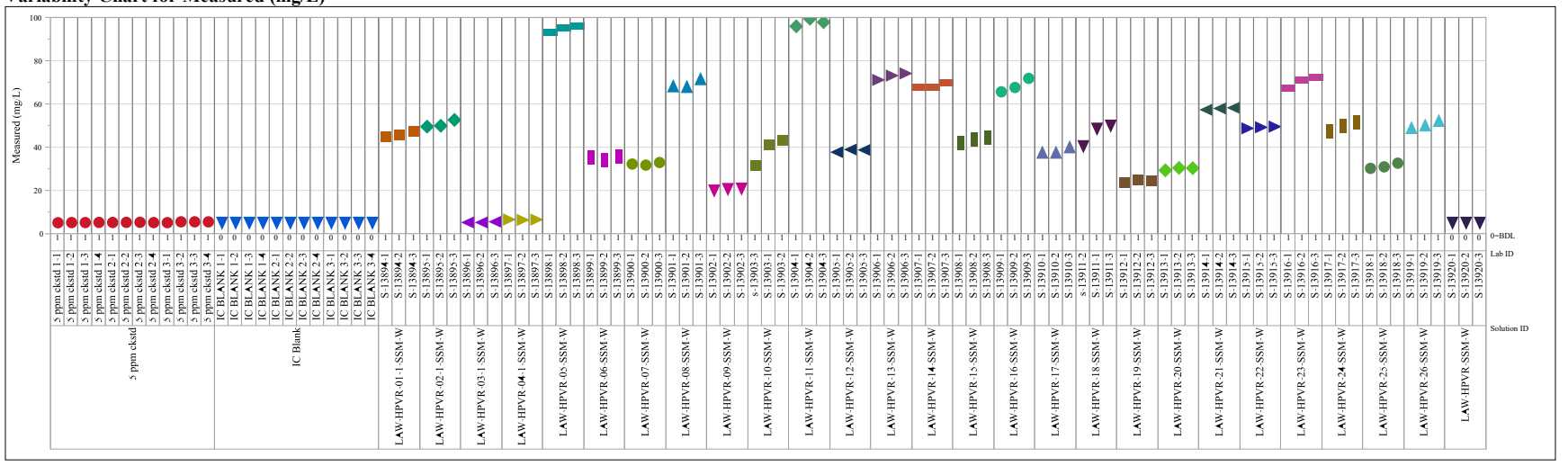
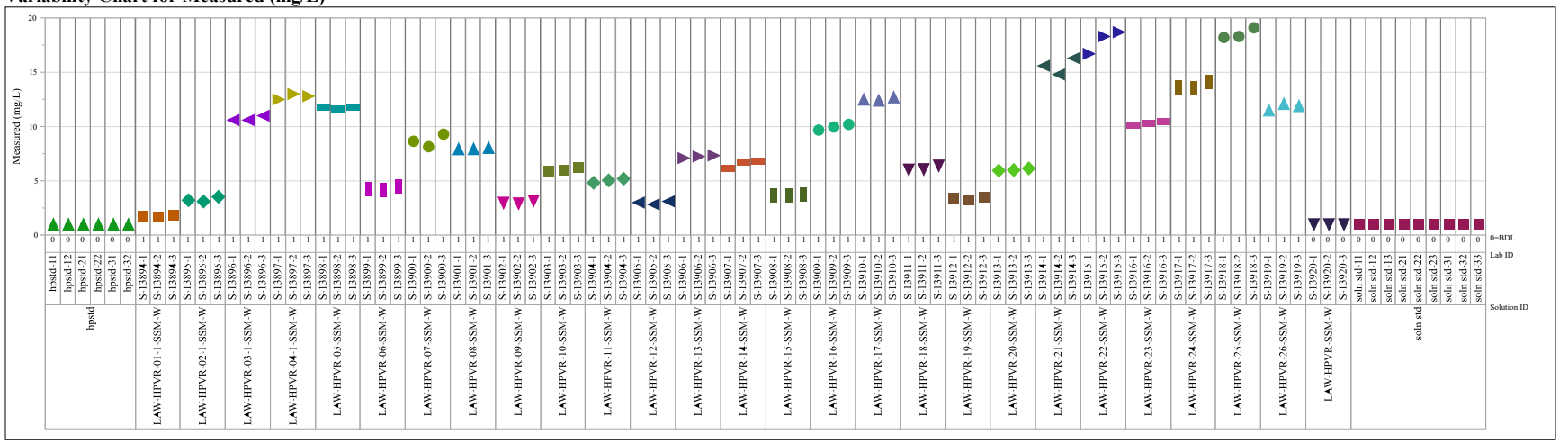


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Cr, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=F-, Analysis=IC
Variability Chart for Measured (mg/L)

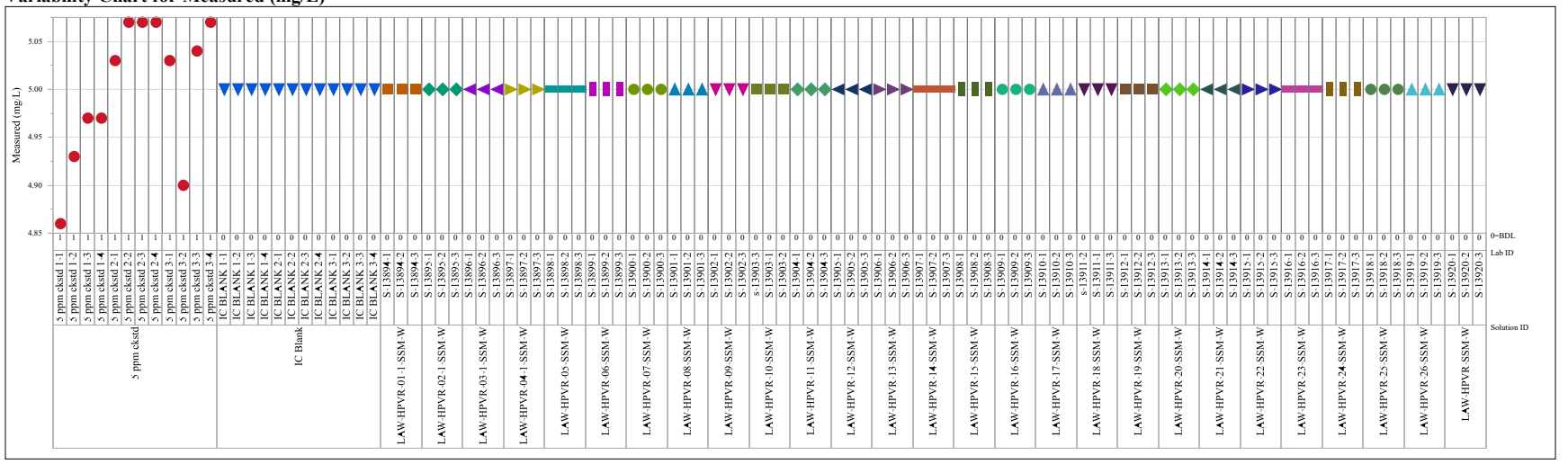
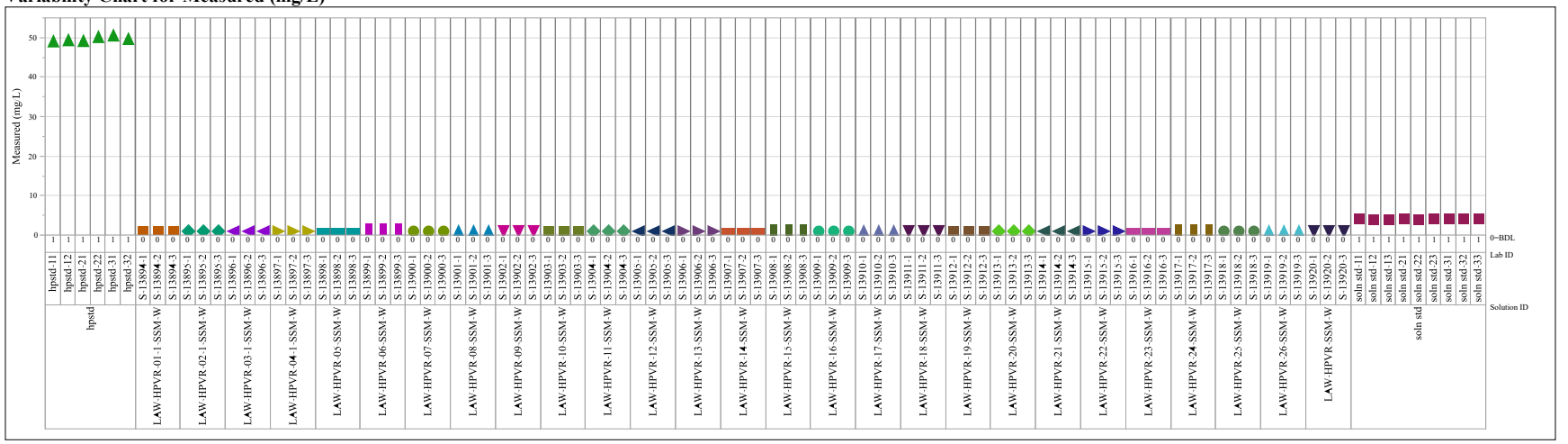


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Fe, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=K, Analysis=ICP
Variability Chart for Measured (mg/L)

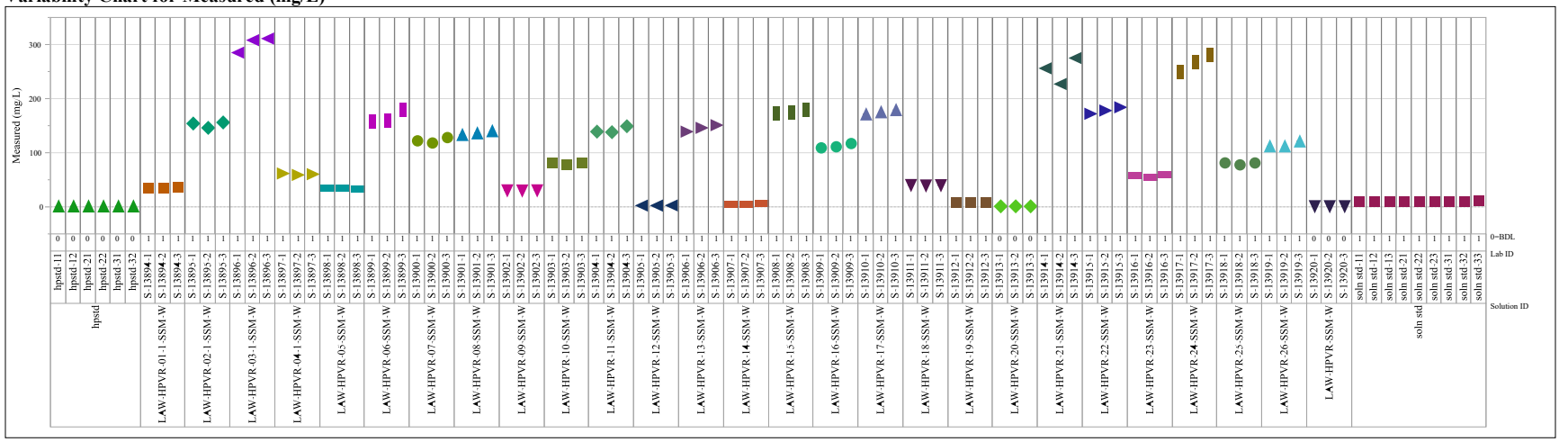
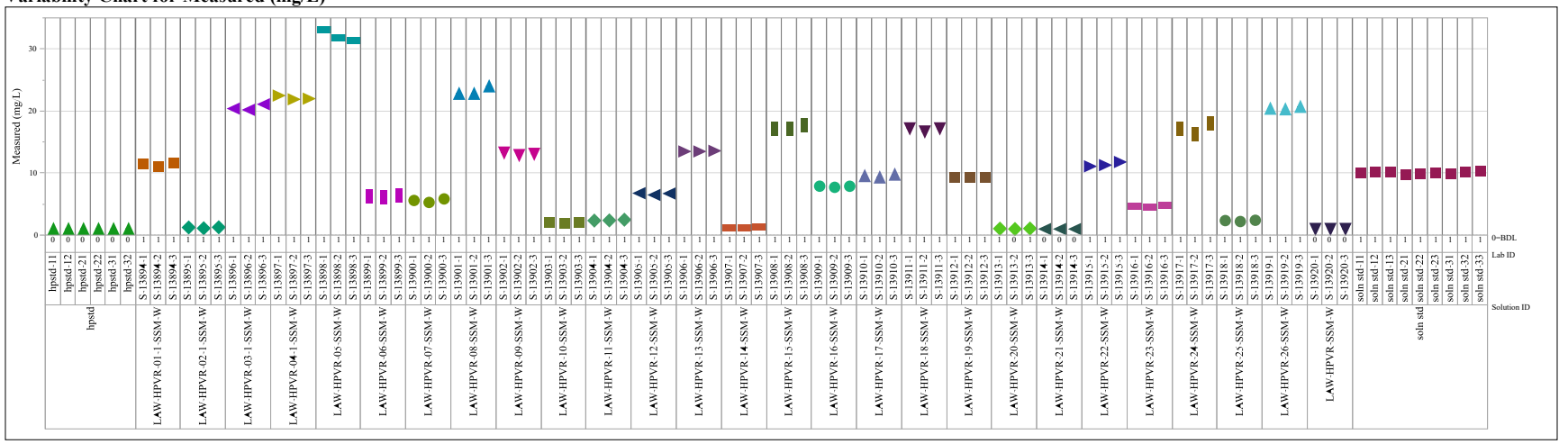


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Li, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=Mg, Analysis=ICP
Variability Chart for Measured (mg/L)

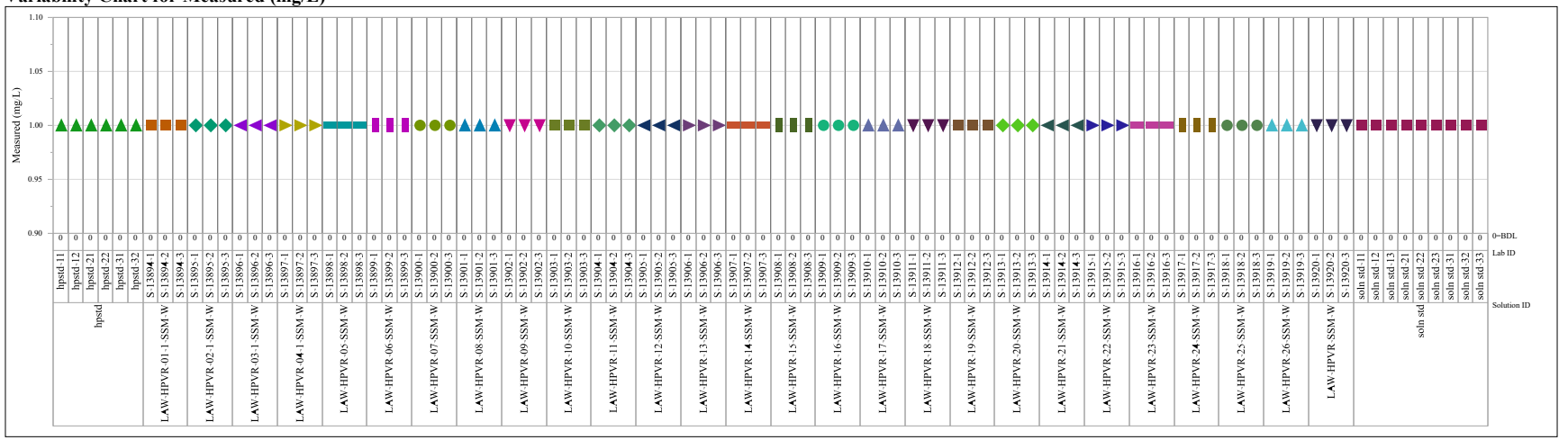
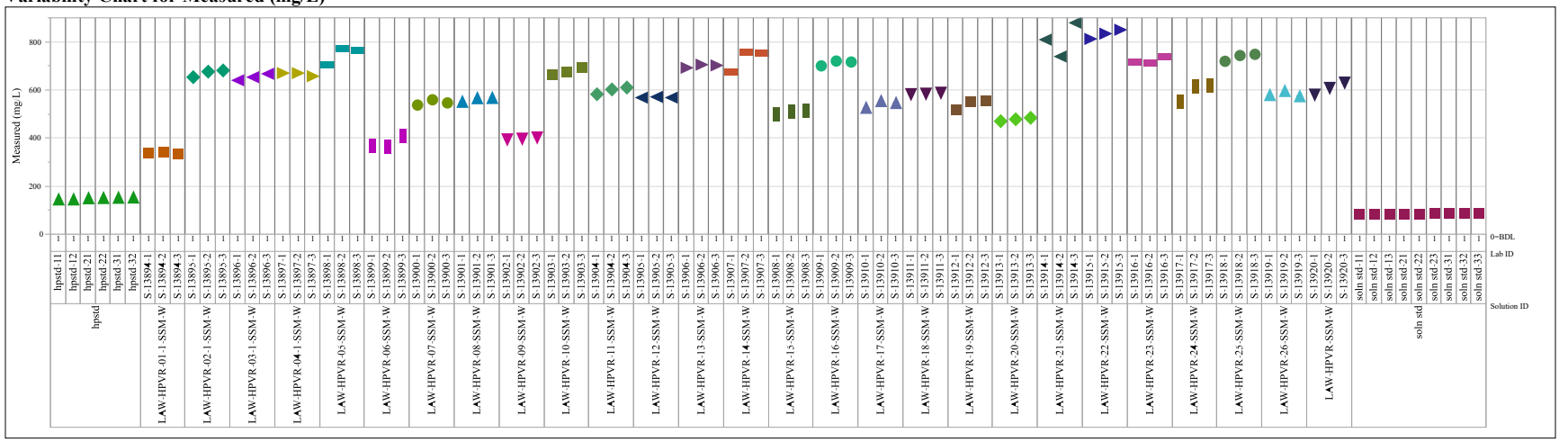


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Na, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=P, Analysis=ICP
Variability Chart for Measured (mg/L)

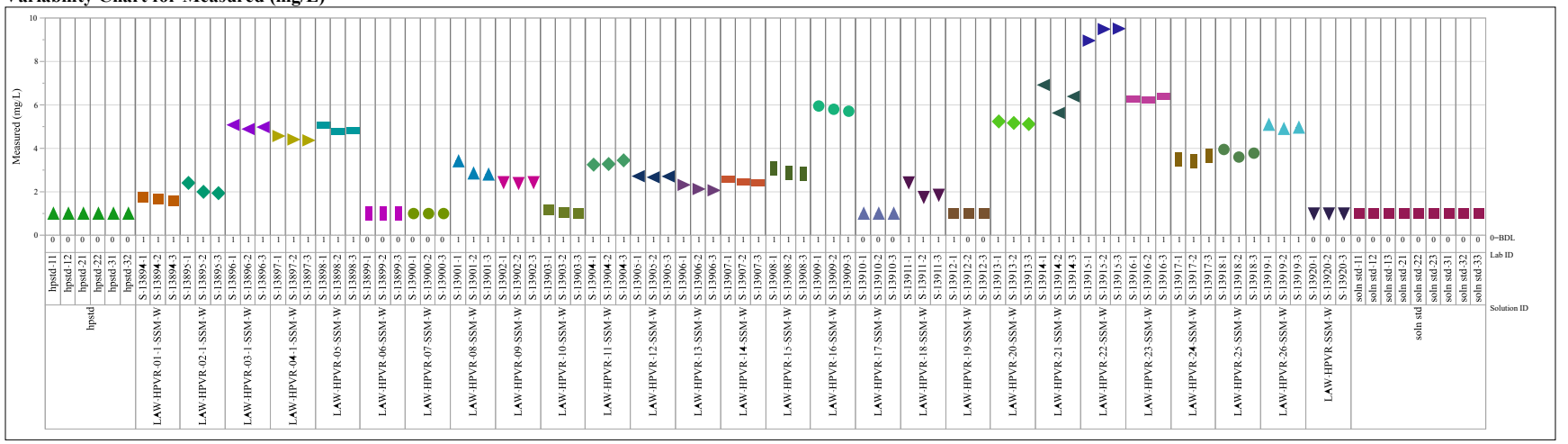
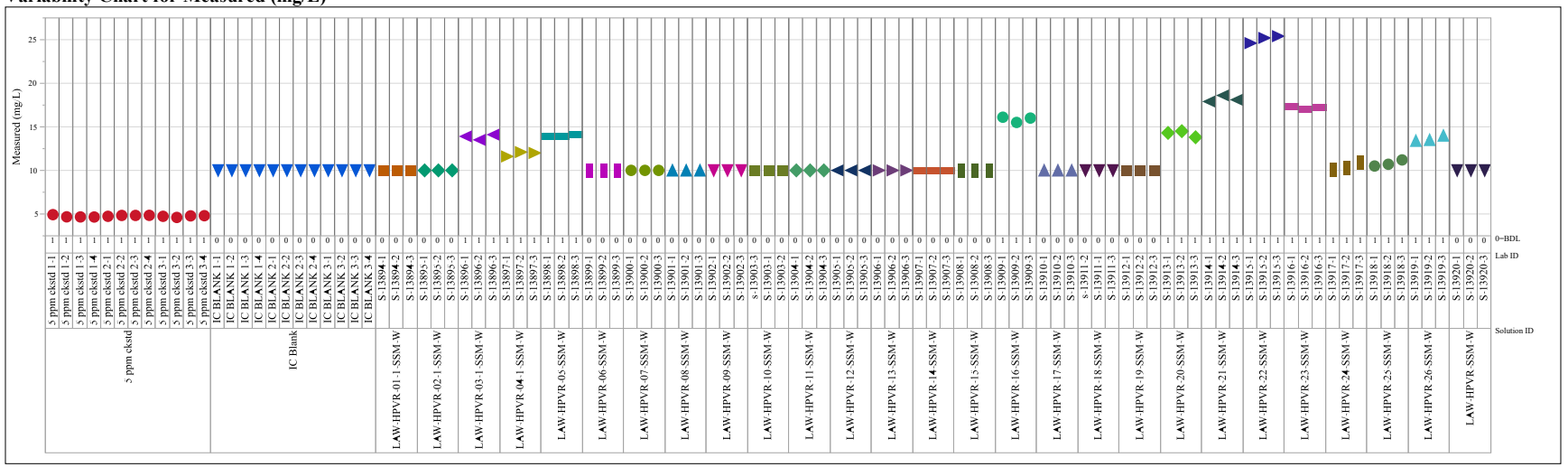


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=PO_4, Analysis=IC
Variability Chart for Measured (mg/L)



Analyte=S, Analysis=ICP
Variability Chart for Measured (mg/L)

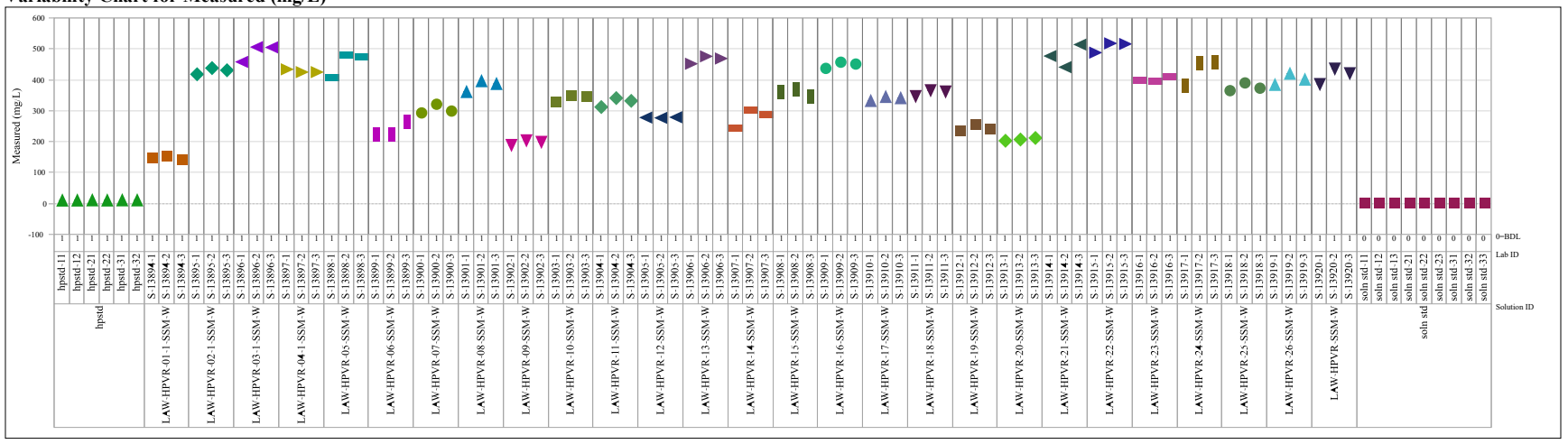
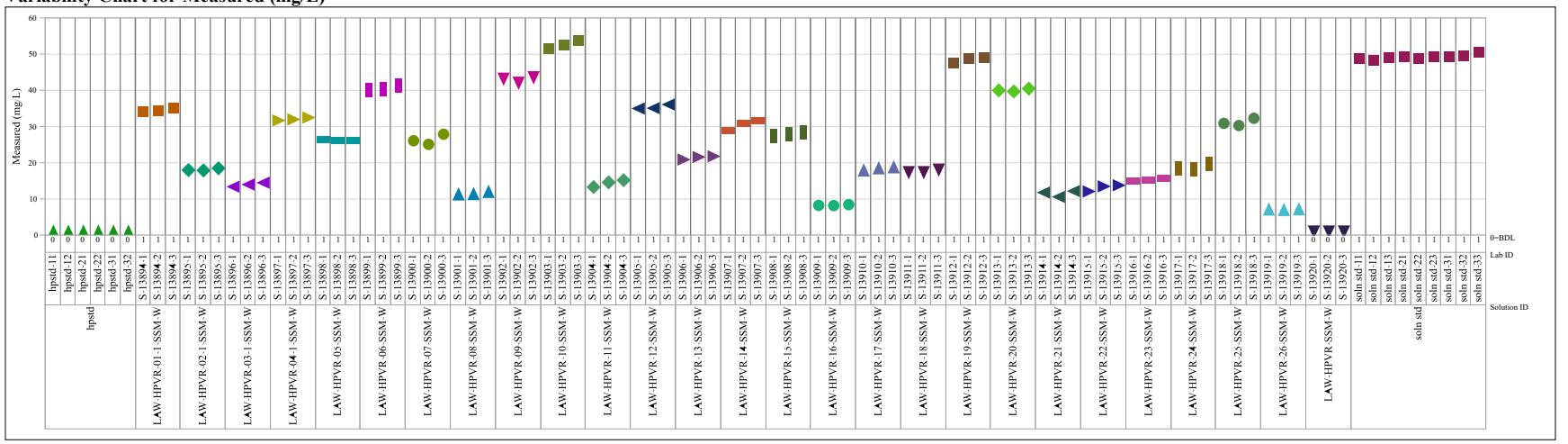


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Si, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=Sn, Analysis=ICP
Variability Chart for Measured (mg/L)

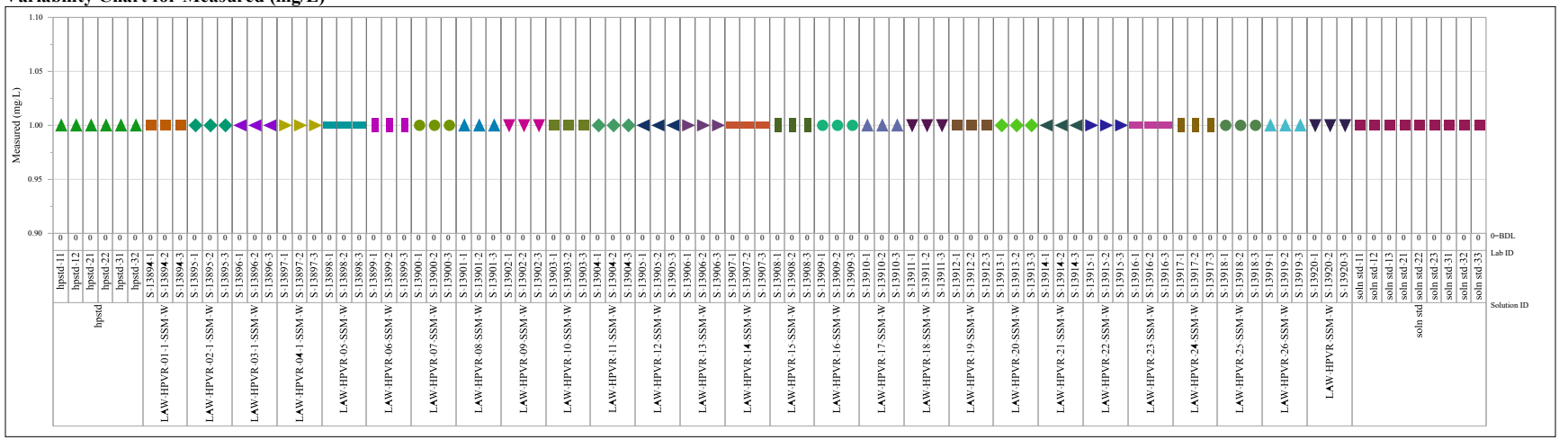
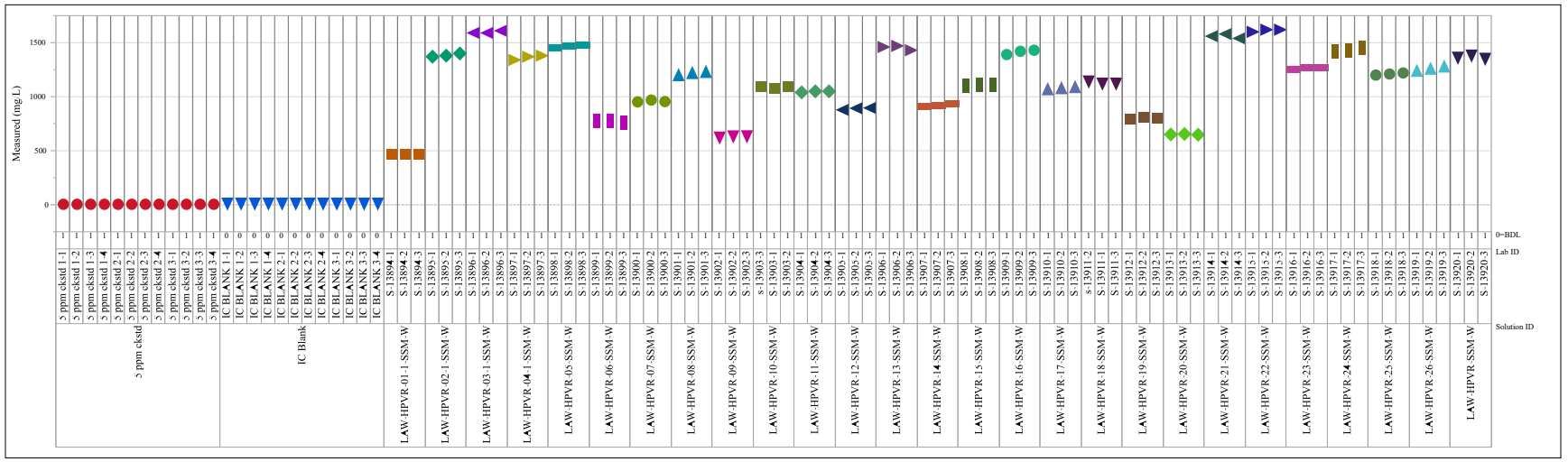


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=SO_4, Analysis=IC
Variability Chart for Measured (mg/L)



Analyte=Ti, Analysis=ICP
Variability Chart for Measured (mg/L)

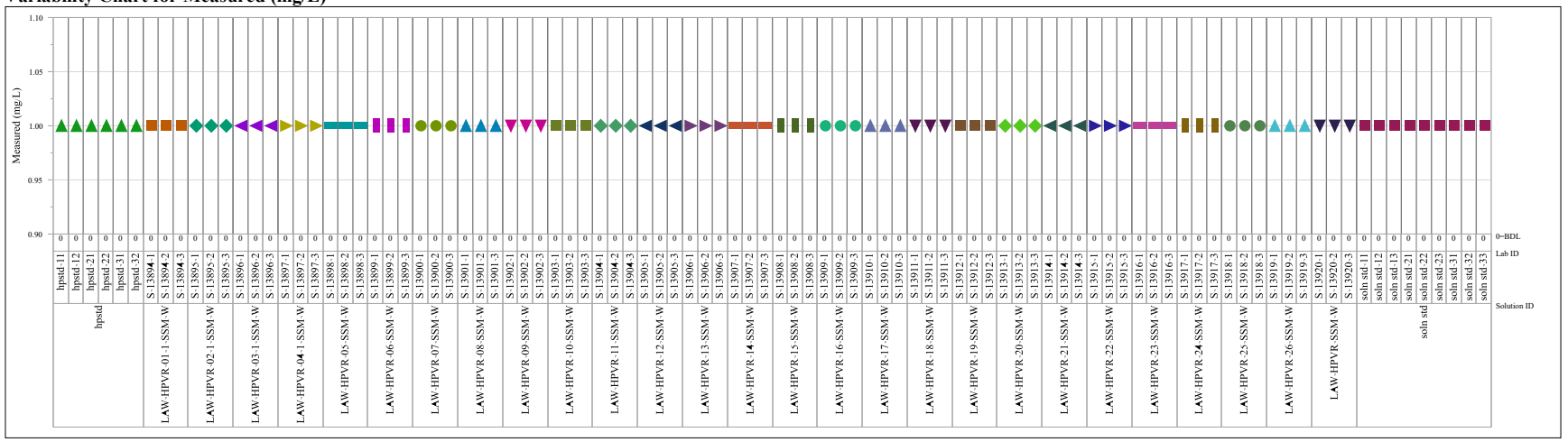
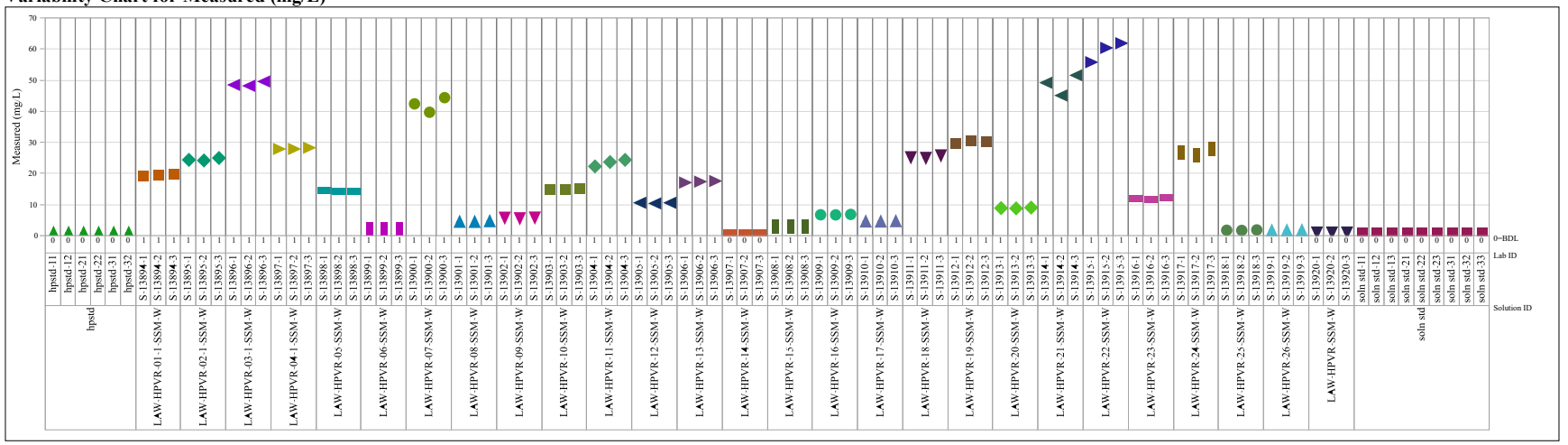


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=V, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=Zn, Analysis=ICP
Variability Chart for Measured (mg/L)

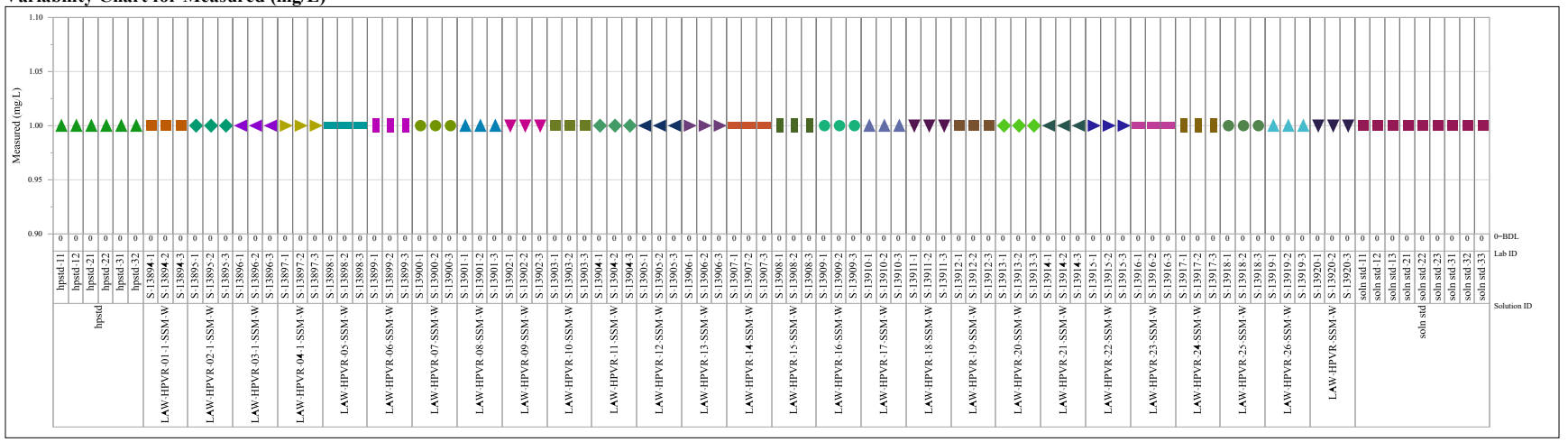
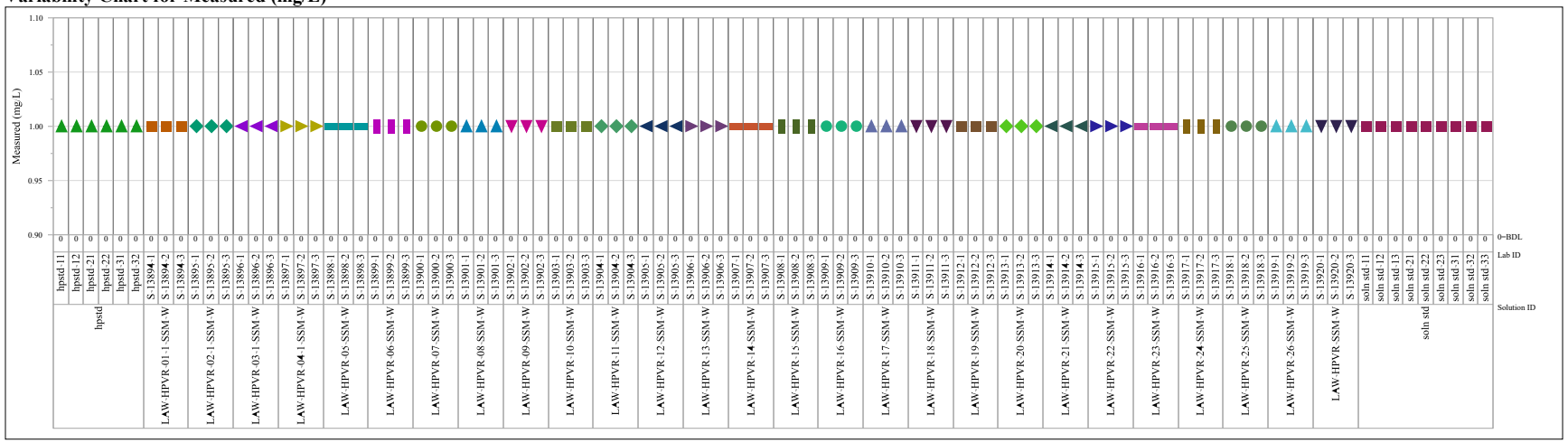


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Zr, Analysis=ICP
Variability Chart for Measured (mg/L)



Distribution:
Jake.Amoroso@srnl.doe.gov
CJ.Bannochie@srnl.doe.gov
Alex.Cozzi@srnl.doe.gov
Charles.Crawford@srnl.doe.gov
Elaine_N_Diaz@orp.doe.gov
William.C.Eaton@pnnl.gov
A.Fellinger@srnl.doe.gov
Holly.Hall@srnl.doe.gov
Erich.Hansen@srnl.doe.gov
Connie.Herman@srnl.doe.gov
Anthony.Howe@srnl.doe.gov
Madison.Hsieh@srnl.doe.gov
Dennis.Jackson@srnl.doe.gov
Fabienne.Johnson@srnl.doe.gov
Albert_A_Kruger@orp.doe.gov
Christine.Langton@srnl.doe.gov
Brady.Lee@srnl.doe.gov
Joseph.Manna@srnl.doe.gov
Daniel.McCabe@srnl.doe.gov
Kandice.Miles@srnl.doe.gov
Gregg.Morgan@srnl.doe.gov
Frank.Pennebaker@srnl.doe.gov
William.Ramsey@srnl.doe.gov
Whitney.Riley@srnl.doe.gov
Renee.Russell@pnnl.gov
Eric.Skidmore@srnl.doe.gov
Anna.Stanfield@srnl.doe.gov
Michael.Stone@srnl.doe.gov
John.Vienna@pnnl.gov

Boyd.Wiedenman@srnl.doe.gov
Richard.Wyrwas@srnl.doe.gov
Records Administration (EDWS)