NEW BRUNSWICK LABORATORY

NBL-ME-2009-SME

SAFEGUARDS MEASUREMENT EVALUATION PROGRAM

2008 Annual Report

B. Srinivasan, Rebecca Thomas, Kattathu Mathew, Gary Sowell, Nancy Hui, Alma Stiffin, Nancy Sanchez, Cherilynn Boele, Usha Narayanan and Jon Neuhoff

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U.S. DEPARTMENT OF ENERGY

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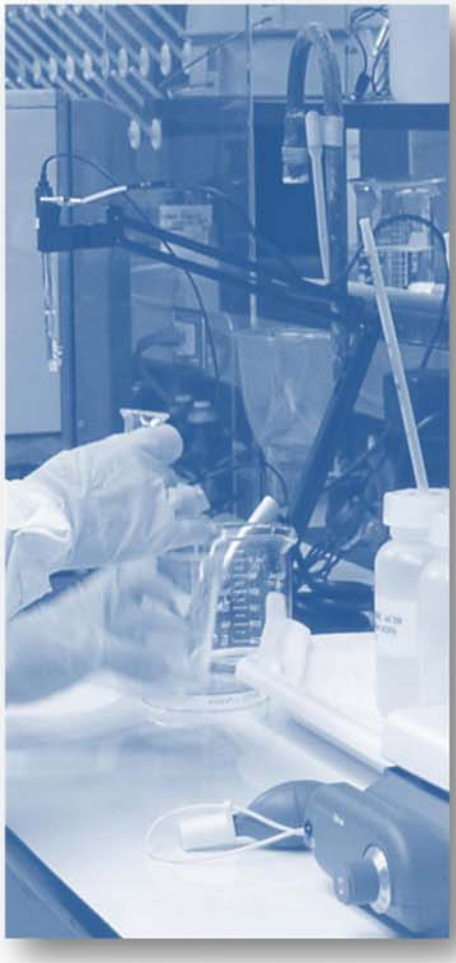

NBL-ME-2009-SME

SAFEGUARDS MEASUREMENT EVALUATION PROGRAM

URANIUM & PLUTONIUM SAMPLES EXCHANGE

2008 Annual Report

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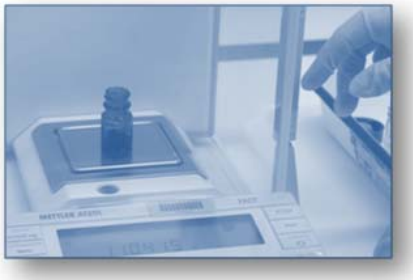
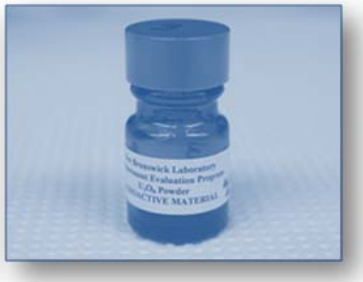
NBL: HISTORY AND MISSION

The New Brunswick Laboratory (NBL) is owned and operated by the United States Department of Energy Office of Science (SC). NBL was established in 1949 as an analytical chemistry laboratory to provide support to the United States Atomic Energy Commission. Located in New Brunswick, NJ at that time, NBL was staffed by scientists from the National Bureau of Standards who had contributed significantly to the Manhattan Project's nuclear material measurement programs. At NBL, they provided the technical expertise and skills to solve problems related to quantitative analyses of uranium-bearing materials.

Over the years, NBL scientists have expanded the capabilities of the laboratory to include chemical and mass spectrometric analyses of plutonium and other actinide elements, research and development activities in chemical analyses techniques, preparation of certified reference materials, and operation of the nuclear safeguards measurement evaluation program.

In 1977, the laboratory moved from New Jersey to its present location at Argonne National Laboratory site in Illinois.

NBL's major mission is to provide technical assistance to the Department of Energy in the following areas: measurement evaluation program operation, certified (nuclear) reference materials preparation and measurement techniques development. Measurement services are available for domestic and international customers in both government and commercial industry. In addition to fulfilling these tasks, the laboratory helps the Department in three other areas: conducting technical audits, resolving shipper/receiver differences in material transfers, and assisting in nuclear nonproliferation programs.

ACKNOWLEDGEMENTS

The Safeguards Measurement Evaluation Program is administered by the United States Department of Energy, Office of Science (SC). The authors of this annual report thank Will Guthrie (NIST) for discussions on uncertainty estimation particularly in applying the GUM method to the evaluation of uncertainties in safeguards measurement results.

ABSTRACT

New Brunswick Laboratory (NBL) has been tasked by the United States Department of Energy, Office of Science (SC) with evaluating the quality of measurement results in nuclear materials accounting at the Department of Energy laboratories. The destructive analyses results are evaluated in the Safeguards Measurement Evaluation (SME) Program, and the non-destructive analyses results in the Calorimetric Exchange (CALEX) Program. This report describes the activities in the SME program during calendar year (CY) 2008. A separate report has been prepared and issued for the CY 2008 CALEX program.

This year, twenty-two laboratories participated in the SME program. This includes six new participants: Oak Ridge National Laboratory (DOE contractor), Nuclear Fuel Service (NRC), two URENCO (Uranium Enrichment Company LTD.) laboratories located in the Netherlands and Germany, National Nuclear Laboratory (Sellafield, England), and Conuar in Argentina. The other participants are Los Alamos National Laboratory, New Brunswick Laboratory, Savannah River Site, and the Y-12 plant, the "Agência Brasiliero-Argentina de Contabilidade e Control de Materials Nucleares" (Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials, or ABACC) network laboratories (five in Argentina and four in Brazil), Nuclear Material Control Center in Japan, International Atomic Energy Agency - Safeguards Analytical Laboratory (SAL), and URENCO Laboratory in England.

Five different types of uranium test samples were used in the CY 2008 program; uranyl nitrate solution (UNH), UO_2 pellets, UO_3 powder, U_3O_8 powder, and UF_6. The test samples were analyzed according to a schedule that specified the frequency and number of measurements to be made. Plutonium test samples were not analyzed this year.

The analysis methods used were Davies and Gray titration (D&G), X-ray fluorescence (XRF), isotope dilution mass spectrometry (IDMS), thermal ionization mass spectrometry (TIMS), UF_6 gas mass spectrometry (GSMS) and inductively coupled plasma mass spectrometry (ICP-MS). The measurement results were evaluated in comparison to the characterized values. A database/statistical analysis system, named as the Safeguards Measurement Evaluation System (SMES), developed in CY 2007 was used to evaluate the accuracy, precision, bias and

day-to-day variation in the measurements. Performance reports based on these evaluations were prepared and submitted to participating facilities.

Test samples for analysis in CY 2009 were packaged in the last quarter of CY 2008 and made ready for shipping. Two of the eleven packages were shipped in that quarter, and the rest shipped in CY 2009. Unacceptably long delays that occurred in shipping the samples are being addressed now. Significant improvement has already been made through appointments of a shipping specialist and an alternate; both are in the process of gaining credentials as DOT certifiers.

Other activities in the CY 2008 program include the following:

- Conduct Measurement Evaluation Program Annual Meeting on July 12, 2008 in Nashville, Tennessee.
- Submit abstract on a technical presentation to be given at the Marc VIII conference in Hawaii in April 2009.
- Submit abstract on a technical presentation to be given at the INMM meeting in Tucson, Arizona in July 2009.
- Provide assistance to LASAL (Laboratorio de Salvaguardas in Rio de Janeiro, Brazil) in characterizing UO_2 pellets made in Brazil for use as test samples in a Measurement Evaluation program for Brazilian laboratories.
- Agree to participate in the Uranium Metal Exchange Program organized by AWE, UK.
- Prepare user manual for the SMES system.

ABBREVIATIONS AND ACRONYMNS
USED IN THIS REPORT

CALEX	Calorimetry Exchange Program
CY	Calendar year, January to December
CY 2008	For this report the period covers Jan 2008 to May 2009
D&G	Davies and Gray Titration
DOE	United States Department of Energy
GSMS	UF_6 Gas Mass Spectrometry
HEU	Highly-enriched uranium (≥ 20 weight percent ^{235}U)
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
IDMS	Isotope Dilution Mass Spectrometry
ITV	International target value
LEU	Low-enriched uranium (≥ 1 and ≤ 20 weight percent ^{235}U)
ME	Measurement Evaluation
N	Number of measurements used to calculate mean RD (%) and SD
NBL	New Brunswick Laboratory
NU	Natural range uranium (≥ 0.3 and ≤ 1 weight percent ^{235}U)
Q	Quarter (1Q = first quarter of a calendar year)
RD (%)	Relative deviation (in percent); also written as % RD
SC	Office of Science
SD	Standard deviation
SME	Safeguards Measurement Evaluation
SMES	Safeguards Measurement Evaluation System
TIMS	Thermal Ionization Mass Spectrometry
UF_6	Uranium (VI) hexafluoride
UNH	Uranyl nitrate solutions
UO_2	Uranium (IV) dioxide
UO_3	Uranium (VI) trioxide
U_3O_8	Uranium (mixed) oxide
u(r)	Random component of uncertainty (indicative of precision)
u(s)	Systematic component of uncertainty (indicative of bias)
XRF	X-Ray Fluorescence

A. INTRODUCTION

New Brunswick Laboratory (NBL) is a nuclear material measurement laboratory of the U.S. Department of Energy's (DOE) Office of Science (SC). An important aspect of NBL's mission is to conduct the measurement evaluation program, a program designed to provide independent verification of internal analytical quality control as practiced by DOE facilities in nuclear material accountability measurements.

The Measurement Evaluation program consists of two parts: the Safeguards Measurement Evaluation (SME) program for evaluating results of destructive analyses (e.g., titration, mass spectrometry) of uranium and plutonium bearing materials, and the Calorimetry Exchange (CALEX) program for evaluating non-destructive analyses measurement results (e.g., calorimetry and gamma ray spectrometry) of plutonium. This annual report describes the SME program activities in CY 2008. A separate report has been prepared and issued for the CALEX program.

B. SAFEGUARDS MEASUREMENT EVALUATION PROGRAM

Material control and accountability measurements are essential elements of nuclear material safeguards. The accountability measurements are carried out either by destructive or non-destructive methods of analysis. The methods must be capable of providing quantitative results within the acceptable limits of accuracy and precision. Large bias and/or poor precision compromise a facility's ability to detect material loss by theft or by diversion.

In the SME program, the elemental and isotopic-abundance measurement results of uranium and plutonium test samples are evaluated for accuracy, precision, and conformity to method/material specific International Target Values (ITVs)[1]. These measurements are usually made as part of the routine analysis with full cognizance to internal quality control practices. If the results reveal inadequate performance (such as insufficient accuracy, poor precision, bias, day-to-day variation) then the laboratories are advised to make improvements. The usual remedial measures are measurement procedures review, implementing proper instrument calibration procedures, checking the validity of calibration and quality control standards, and re-training analysts.

[1] Aigner H., Binner R., Kuhn E. et al. International Target Values 2000 for Measurement Uncertainties in Safeguarding Nuclear Materials. International Atomic Energy Agency Report STR-327

C. CY 2008 SAFEGUARDS MEASUREMENT EVALUATION PROGRAM

C. 1. Summary of Activities and Accomplishments in CY2008

New participants: The Institute for Transuranium Elements (ITU) in Germany, Preston National Nuclear Laboratory at the Springfields Site in the United Kingdom, South African Nuclear Energy Corporation (NECSA), and Safeguards Measurement Laboratories of the Japan Atomic Energy Agency are expected to join the SME program in CY 2009 as new participants.

New test sample: A new test sample of uranium oxide (U_3O_8) was introduced in CY 2008.

CY 2008 program: Only uranium test samples were analyzed in CY 2008. Plutonium samples were not sent since plutonium laboratory operation at NBL continued to remain in "stand down" mode. Twenty-two laboratories participated in the CY 2008 SME program (see Section C.2). Five different types of test samples (UNH solution, UO_2 pellet, UO_3 powder, U_3O_8 powder and UF_6) were used. The measurement methods were x-ray fluorescence (XRF), isotope dilution mass spectrometry (IDMS), and Davies and Gray titration (D&G) for uranium mass fraction determinations; and inductively coupled plasma mass spectrometry (ICP-MS), thermal ionization mass spectrometry (TIMS), and UF_6 gas mass spectrometry (GSMS) for isotopic abundance determinations.

Performance evaluation reports: Measurement results were evaluated in comparison to the respective characterized values. Material/method specific performance evaluation reports were sent to the participant laboratories. The reports were sent within four weeks of receiving the results. There were occasional lapses due to shifting priorities and lack of steady assistance from trained staff for routine work. NBL management is aware of the need to provide additional help to the Measurement Evaluation program operation.

Safeguards Measurement Evaluation System: The new Safeguards Measurement Evaluation System (SMES), a web-based database and data analysis system, was developed in CY 2007 and was used to evaluate CY 2008 results. Quality assurance tests for the SMES were completed in CY 2008 through comparison of evaluation reports generated by SMES with those generated by FoxPro (system used prior to the inception of

SMES). Privacy statements, risk assessment and security plan documents for SMES – documents needed to provide direct access to DOE laboratories for data entry and report retrieval - were prepared and approved. A manual was prepared for use in training the DOE laboratory personnel on SMES.

Measurement results were entered into the SMES database and verified to be error-free, both entry and verification done by NBL staff. The results were evaluated for accuracy, precision, bias, and day-to-day variation using the SMES statistical analysis software.

Shipping CY 2009 test samples: The CY 2009 test samples were packaged in the last quarter of CY 2008 and made ready for shipping. Only two of the eleven packages were shipped in that quarter, and the rest shipped in the first seven months of CY 2009 with unacceptably long delays. The following corrective actions, implemented in stages, are expected to result in a more efficient process for shipping radioactive materials:

i. A new NBL Shipping Specialist was appointed in October 2008. The new appointee recently completed the formal courses to gain the credentials as a DOT certifier.

ii. In the absence of the Shipping Specialist, the Nuclear Material Representative (NMR) will assume that role. The NMR is undergoing similar training to gain DOT certification.

iii. The radioactive material packaging procedure was rewritten to include the new procedures for packing radioactive materials.

iv. The packaging specialist was trained in the new procedures and also on the "drum press" fabricated to press-fit shipping pail lids.

v. NBL management was actively involved in investigating "stop work orders" based on perceived infractions in packing and shipping. The investigation reports are helping to establish an efficient process for shipping radioactive materials.

Annual Reports: The CY 2007 SME program and CY 2007 CALEX program annual reports were prepared and distributed to program participants. It was also uploaded onto the NBL web site, http://www.nbl.doe.gov/.

Measurement Evaluation Program Annual Meeting: The Measurement Evaluation Program Annual Meeting was held in Nashville, Tennessee on July 12, 2008. Fourteen technical papers were presented at the meeting, attended by 35 technical/scientific personnel from various laboratories. The minutes of the meeting was prepared and

distributed to program participants. It was also uploaded onto the NBL web site, http://www.nbl.doe.gov/.

Brazilian Safeguards Measurement Evaluation Program: NBL is providing help to LASAL (Laboratorio de Salvaguardas in Rio de Janeiro) to set up a Measurement Evaluation program for Brazilian laboratories. In this connection, NBL characterized the uranium oxide pellets made in Brazil for potential use as test samples in that program. The uranium mass fraction and uranium isotopic abundance measurement results were determined, and the results evaluated with the assistance of a NIST statistician to determine whether the pellets are sufficiently homogeneous in composition. The results show that the homogeneity is at the borderline of acceptance. Re-determination of uranium mass fraction using the high precision titration method will help to verify the above conclusion.

Atomic Weapons Establishment (AWE) Laboratory Evaluation Program: NBL agreed to participate in the CY 2008 AWE uranium metal exchange program, and received samples of depleted and enriched uranium metal for analyses. These samples could not be analyzed in 2008 due to “stand down” of uranium laboratory operations for several months during the year. Furthermore, the analysts were busy with work related to preparation of documents to Justify Continued Operations (JCO) of the uranium laboratories and readiness assessment inspection to follow the approval of the documents.

SMES User manual: A user manual was prepared for training DOE laboratory personnel to access the SMES for data entry and report retrievals.

Abstracts of technical talks: The following abstracts were prepared and submitted for presentation in international meetings.

> Abstract to Marc VIII conference to be held in April 2009: “Plutonium accountability measurements by non-destructive methods of calorimetry and gamma spectrometry: sources and evaluation of uncertainties in inventory measurements” by B. Srinivasan, Kattathu J. Mathew, Usha Narayanan, William F. Guthrie, and Thomas E. Sampson.

Abstract submitted to INMM meeting to be held in July 2009: NBL Safeguards Measurement Evaluation Program: Uncertainty Estimation in Nuclear Material Accountability Measurements by B Srinivasan, William F. Guthrie, Kattathu J. Mathew, Jon Neuhoff, and Charles E. Pietri.

C.2. CY 2008 SME Program Participants

DOE laboratories participation is mandated by the requirement in Chapter II.4.e. (7) of DOE Manual 474.1-1 of November 2000: *"Each facility's measurement control program must include participation in appropriate inter-laboratory control programs to provide independent verification of internal analytical quality control."* With DOE approval, facilities outside the U.S. also may participate on a voluntary basis. Table C.2.1 lists the CY 2008 program participants.

Table C.2.1 CY 2008 SME Program Participants in Uranium Sample Analysis

ABACC Laboratories
- CAE/CNEA, ARGENTINA
- COMPLEJO FABRIL CORDOBAL (CNEA) ARGENTINA
- LABORATORIO ICP-MS, DDCyE - DIOXITEK, S.A. ARGENTINA
- PFPU/CNEA, ARGENTINA
- UACN/CNEA, ARGENTINA
- CDTN/CNEN, BRAZIL
- CTMSP II, SAO PAULO, BRAZIL
- IEN/CNEN- RJ, BRAZIL
- IPEN/CNEN, BRAZIL
- LASAL/CNEN, BRAZIL

INTERNATIONAL ATOMIC ENERGY AGENCY - SAL
LOS ALAMOS NATIONAL LABORATORY, USA
NEW BRUNSWICK LABORATORY, USA
NRC: NUCLEAR FUEL SERVICES, USA
NUCLEAR MATERIALS CONTROL CENTER, JAPAN
OAK RIDGE NATIONAL LABORATORY, USA
SAVANNAH RIVER SITE, USA
SELLAFIELDS LTD., UK
URANIUM ENRICHMENT COMPANY LTD. (URENCO) Laboratories
- URENCO (GERMANY)
- URENCO (NETHERLANDS)
- URENCO (UK UNLIMITED)

Y-12 Plant - BWXT LLC, USA

C.3. Test Materials Available for Use in CY 2008 Program

The SME Program test samples are made from Certified Reference Materials (CRMs), Working Reference Materials (WRMs), or custom-made. The test samples are characterized for elemental concentrations and/or isotopic abundances. The CY 2008 measurement results were evaluated with reference to the characterized values, but without including the uncertainties in the latter. Uncertainties in the characterized values are expected to be a small fraction of the total uncertainties in the measurement results. Nonetheless, it must be pointed out here that the ISO guidelines document (Guide to the Expression of Uncertainty in Measurement or GUM) recommends a comprehensive evaluation by including uncertainties in reference values as well as in the measurements (see Appendix C). The inevitable march towards compliance to GUM will require a major restructuring and rewrite of the statistical analysis software program in SMES.

Brief descriptions of materials from which CY 2008 test samples originated are listed below:

UNH: Test samples of uranyl nitrate solutions were made at NBL usually by dissolving uranium metal. These samples are useful for mass fraction determinations. Samples for isotopic composition measurements span a wide range, from natural uranium to low enriched uranium to high enriched uranium.

UO_2 pellets: The uranium dioxide (UO_2) pellets were originally made in a single batch at the Westinghouse Commercial Nuclear Fuel Division (a NRC licensee) using a high temperature sintering process at 1700 °C for 20 hours in a reducing atmosphere. The UO_2 pellets are known to be stable. They suffer no compositional change on exposure to air and are resistant to moisture uptake. The pellets serve as a test material for both mass fraction and isotopic composition measurements (low enriched uranium).

UO_3 powder: UO_3 powder is an ideal test material to monitor the capability of a laboratory in analyzing hygroscopic materials. It was used as a test material a number of years ago, discontinued for some time in between, and was re-introduced as a test material a few years ago. The ^{235}U abundance in these samples is about 0.9 wt%.

The integrity of the sample has been questioned by one of the program participants as revealed through inconsistent uranium mass fraction results in the analysis of these samples. NBL attempted to verify the sample integrity through experimental re-determination of uranium mass fraction in pristine samples as well as in samples that were dried at 110º C. The results were inconclusive. The experiments (with and without

drying) will be repeated in CY 2009 under a better designed statistical sampling and analysis plan to decide whether the present stock of UO_3 samples could be used as test samples or to be discarded.

U_3O_8 powder: The U_3O_8 powder was offered as test sample for the first time in CY2008. The source material was prepared in 1984 from highly pure UO_2 pellets at NLO Incorporated. The pellets were crushed, dissolved in nitric acid, and the uranium in solution precipitated with hydrogen peroxide, filtered, dried, calcined at 900 °C, milled, and screened. U_3O_8 powder is suitable for both mass fraction and isotopic measurements studies.

UF_6: The UF_6 samples were made at the Portsmouth Gaseous Diffusion Plant, analyzed for isotopic abundances at the Plant and also at NBL. ^{235}U contents of these samples span a range from depleted uranium to low-enriched uranium. The uranium mass fraction values used in the evaluations are not based on characterization experiments, but calculated values based on the stoichiometric composition of the compound and assuming 100 % purity.

C.4. Measurement Methods Used in CY 2008 Program

The five types of uranium materials in Section C.3 were used as test samples in the CY 2008 program. Table C.4.1 lists the methods used in uranium mass fraction analysis and Table C.4.2 lists the methods used in isotopic abundance measurements. The frequency of participation during the year is also shown split according to material used and method of analysis. For example, laboratory A participated two times by submitting two sets of results during the year from IDMS analysis of UNH solutions; and two times by submitting results from XRF analysis of the solutions (see Table C.4.1). Results submitted during the period extending from January 2008 to May 2009 are counted as CY 2008 results since results for analyses obtained towards the end of 2008 were submitted and evaluated in 2009. In the two tables in this section and in sections following, laboratories are identified by code letters only to provide confidentiality.

Table C.4.1. Materials and methods used to evaluate uranium mass fraction.

Lab Code	UNH	#	UO_2	#	UO_3	#	U_3O_8	#	UF_6	#
A	IDMS	2			IDMS	1				
	XRF	2			XRF	2				
B	D&G	4								
	IDMS	4								
F					D&G	1				
G	D&G	1								
T			D&G	4						
U	D&G	1								
V	IDMS	1	D&G	1	D&G	1				
AB	D&G	2			D&G	1			D&G	1
AE					D&G	1			D&G	3
BA	D&G	2	D&G	1	D&G	1	D&G	1		
BC	D&G	2	D&G	2			D&G	1		
BD			D&G	2						
BE							D&G	1		
BF	D&G	2	D&G	2	D&G	1			D&G	2
EA									D&G	3
EC									D&G	3
ED	D&G	1	D&G	1						
	XRF	1								

- Measurement frequency

Table C.4.2. Materials and methods used to evaluate uranium isotope abundance.

Lab Code	NU	#	LEU	#	HEU	#
A					TIMS	2
B	TIMS	4	TIMS	1	TIMS	3
D			ICP-MS	1	ICP-MS	3
F	TIMS	2	TIMS	1	TIMS	1
G					TIMS	2
T			TIMS	4		
U			TIMS	1	TIMS	1
V	TIMS	1	TIMS	2		
AA			TIMS	4		
AD			ICP-MS	4		
AF			ICP-MS	2		
BC	TIMS	2	GSMS	2		
			TIMS	4		
BE			ICP-MS	2		
EA	ICP-MS	2	ICP-MS	8		
EB	GSMS	1	GSMS	3		
EC	ICP-MS	1	ICP-MS	2		
	GSMS	1	GSMS	2		
ED			ICP-MS	2		
			TIMS	2		

- Measurement frequency

C.5. Statistical Evaluation of Measurement Results

The method specific measurement results are evaluated using the statistical analysis software provided within the SMES program. First, the percent relative difference (% RD) of each experimental result is calculated with respect to the corresponding reference value, the latter obtained from characterization measurements. It is defined as follows:

$$\% \text{ RD} = 100 \text{ X } \{(\text{observed value} - \text{reference value})/\text{reference value}\}.$$

Next, the relative differences are examined for outliers. A particular result is identified as a potential outlier if at least two of the many statistical tests in the SMES show it to be an "outlier" at ≥ 99 % significance level. The outliers are removed only after a thorough review, the review done by the program coordinator and a statistician. The mean % RD (with outliers removed) and the standard deviation for each set of data is then calculated. The data set is then tested for day-to-day variation using standard one-factor analysis of variance (ANOVA). If the ANOVA results indicate no significant variation, then the standard uncertainty is the simple standard deviation (σ) of the results divided by the square root of n, where n is the number of measurements. The coverage factor is the Student's 95 % "t" factor with n-1 degrees of freedom. For example, in a set of 8 results showing no day-to-day variation, the number of degrees of freedom is 7, and the coverage factor is 2.36.

If the ANOVA results indicate significant day-to-day variation (≥ 95 %), then the standard uncertainty in the mean % RD is estimated from a combination of the mean square for the "error" and the mean square for the "model" quantities from the ANOVA, with degrees of freedom determined from Satterthwaite's approximation. For measurements done on two different days, the formula for estimating the standard uncertainty in the mean % RD is reduced to the square root of the mean square for the "model" quantity obtained from ANOVA results. In this case, the Student's 95 % "t" factor for one degree of freedom is 12.7.

The 95 % confidence limit (C.L.) of mean obtained in the manner shown above is included in the statistical report. In graphical representations to test for bias the 95 % confidence interval (C.I.) of the mean is constructed from the C.L. The C.I. represents the interval containing all values between the mean % RD minus the C.L. and the mean % RD plus the C.L. Thus, the 95 % C.L. of the mean are just the two end points of the C.I. A measurement is considered to be bias-free

if the 95 % C.I. included zero. Otherwise, measurement bias is indicated. The simple standard deviation (σ) of the % RDs is a measure of precision.

C.6. Examples of Material/Method Specific Statistical Evaluation Reports

Two examples of the statistical evaluation reports are shown in this section. The first example, shown in Table C.6.1 and Figure C.6.1, is a report for uranium mass fraction analysis results from Davies-Gray titration. There are 8 results from analysis of two samples, each measured in duplicate on each day of two days of analysis. There are no outliers. The mean % RD of the eight results is -0.154% and the standard deviation is 0.083%. Day-to-day variation is not significant (44.3% significance only). Note that day-to-day variation is considered significant if the statistical significance of between-day standard deviation is greater than 95%; it is considered marginally significant if the value lies between 90 and 95%, and not significant if it is less than 90%. In this particular example, the 95 % C.L. of mean is 0.070%. The mean value extended by the 95% confidence interval (-0.154 ± 0.070) % does not include zero leading to the conclusion that negative bias exists in the measurements. The mean % RD of -0.154% is beyond the international target value of 0.1% for systematic component of the uncertainty (u(s)), and the standard deviation of 0.083% is within the international target value of 0.1% for the random component of the uncertainty (u(r)).

The second example in Table C.6.2 and Figure C.6.2 is a report on IDMS measurements for uranium mass fraction. There are 8 results obtained in a similar fashion as in the first example. There are no outliers as in the first example. The mean % RD of the eight results is 0.015% and the standard deviation is 0.149%. Unlike the first example, there is evidence for significant day-to-day variation in these results; the statistical significance is 96.6 %. For this set of measurements, the 95% C.L. is calculated to be 1.319% using a coverage factor of 12.7 corresponding to 1 degree of freedom. The mean value extended by the 95% confidence interval (0.015 ± 1.319) % overlaps with zero, indicating no statistically-significant bias. But, this conclusion is not meaningful because the uncertainty is very large due to day-to-day variation. The mean % RD of -0.015% is within the international target value of 0.1% for systematic component of the uncertainty (u(s)), and the standard deviation of 0.149% is within the international target value of 0.15% for the random component of the uncertainty (u(r)). Note that in this particular example, the usual practice to report the uncertainty with two significant figures is violated; the uncertainty is given with enough significant figures to match the last digit in the mean % RD (0.015%).

Statistical reports, similar to those shown in the above two examples, were generated and distributed for each set of material/method specific analysis results submitted in CY 2008.

Table C.6.1. Sample Data Evaluation Report: day-to-day variation not significant

U.S. Department of Energy
New Brunswick Laboratory
Safeguards Measurement Evaluation Program
Data Evaluation Report

Day to Day ANOVA analysis

Report for Laboratory: XX

U02 Pellet – U Concentration

Davies-Gray Titration

Date of Report: November 30, 2003

Sample Number	Aliquant Number	Analysis Date	Reported %U	% Relative Difference	Analyst Code
95EU0079-1	1	11/03/03	88.126	-0.0034	XXX
95EU0079-1	2	11/03/03	87.990	-0.1577	XXX
95EU0079-2	1	11/03/03	88.031	-0.1112	XXX
95EU0079-2	2	11/03/03	87.892	-0.2689	XXX
95EU0079-1	3	11/04/03	88.030	-0.1123	XXX
95EU0079-1	4	11/04/03	87.950	-0.2031	XXX
95EU0079-2	3	11/04/03	87.922	-0.2349	XXX
95EU0079-2	4	11/04/03	88.002	-0.1441	XXX

Number of Results Analyzed	8
Mean % Difference	-0.154
Mean Absolute % Difference	0.154
95% C.L. of Mean (df = 7)	0.070
Standard Deviation	0.083
Between-Day Standard Deviation (df = 1)	0.054
Within-Day Standard Deviation (df = 6)	0.087
Statistical Significance of Between-Day Standard Deviation	44.3 %

International target value for u[s] in Davies-Gray Titration is 0.1 %.

International target value for u[r] in Davies-Gray Titration is 0.1 %.

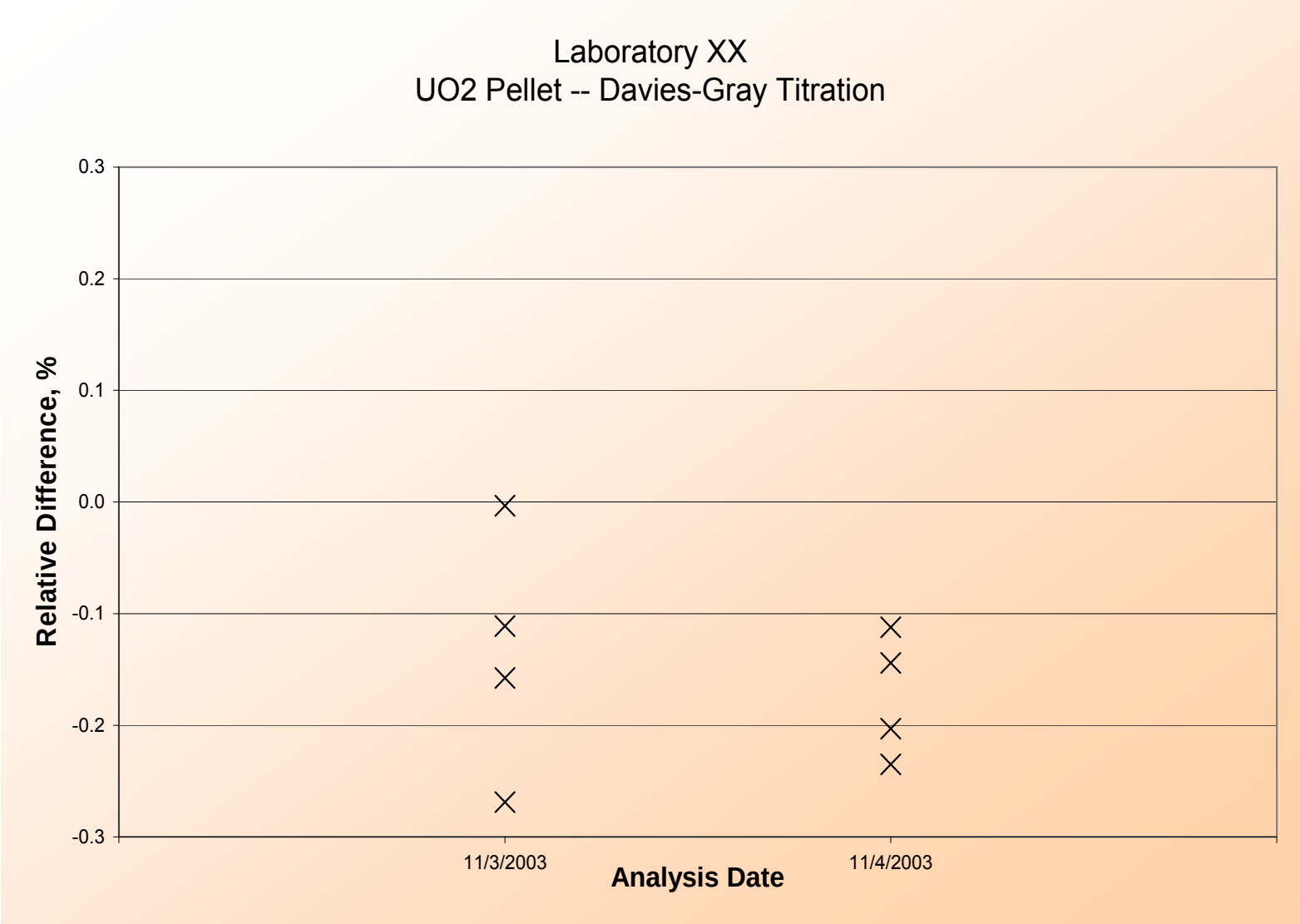


Figure C.6.1. Graphic representation of data shown in Table C.6.1.

Table C.6.2. Sample data evaluation report: day-to-day variation significant

U.S. Department of Energy
New Brunswick Laboratory
Safeguards Measurement Evaluation Program
Data Evaluation Report

Day to Day ANOVA analysis

Report for Laboratory: XX

UNH Solution – U Concentration

IDMS

Date of Report: November 30, 2003

Sample Number	Aliquant Number	Analysis Date	Reported %U	% Relative Difference	Analyst Code
94NU0021-023	1	11/03/03	1.0000	-0.0590	XXX
94NU0021-023	2	11/03/03	1.0003	-0.0290	XXX
94NU0023-079	1	11/03/03	0.9991	-0.0080	XXX
94NU0023-079	2	11/03/03	0.9996	-0.2582	XXX
94NU0021-023	3	11/04/03	1.0022	0.1609	XXX
94NU0021-023	4	11/04/03	1.0004	-0.0190	XXX
94NU0023-079	3	11/04/03	1.0004	0.1221	XXX
94NU0023-079	4	11/04/03	1.0013	0.2122	XXX

Number of Results Analyzed	8
Mean % Difference	0.015
Mean Absolute % Difference	0.109
95% C.L. of Mean (df = 1)	1.319
Standard Deviation	0.149
Between-Day Standard Deviation (df = 1)	0.294
Within-Day Standard Deviation (df = 6)	0.107
Statistical Significance of Between-Day Standard Deviation	96.6 %

International target value for u(s) in IDMS is 0.1 %.

International target value for u(r) in IDMS is 0.15 %.

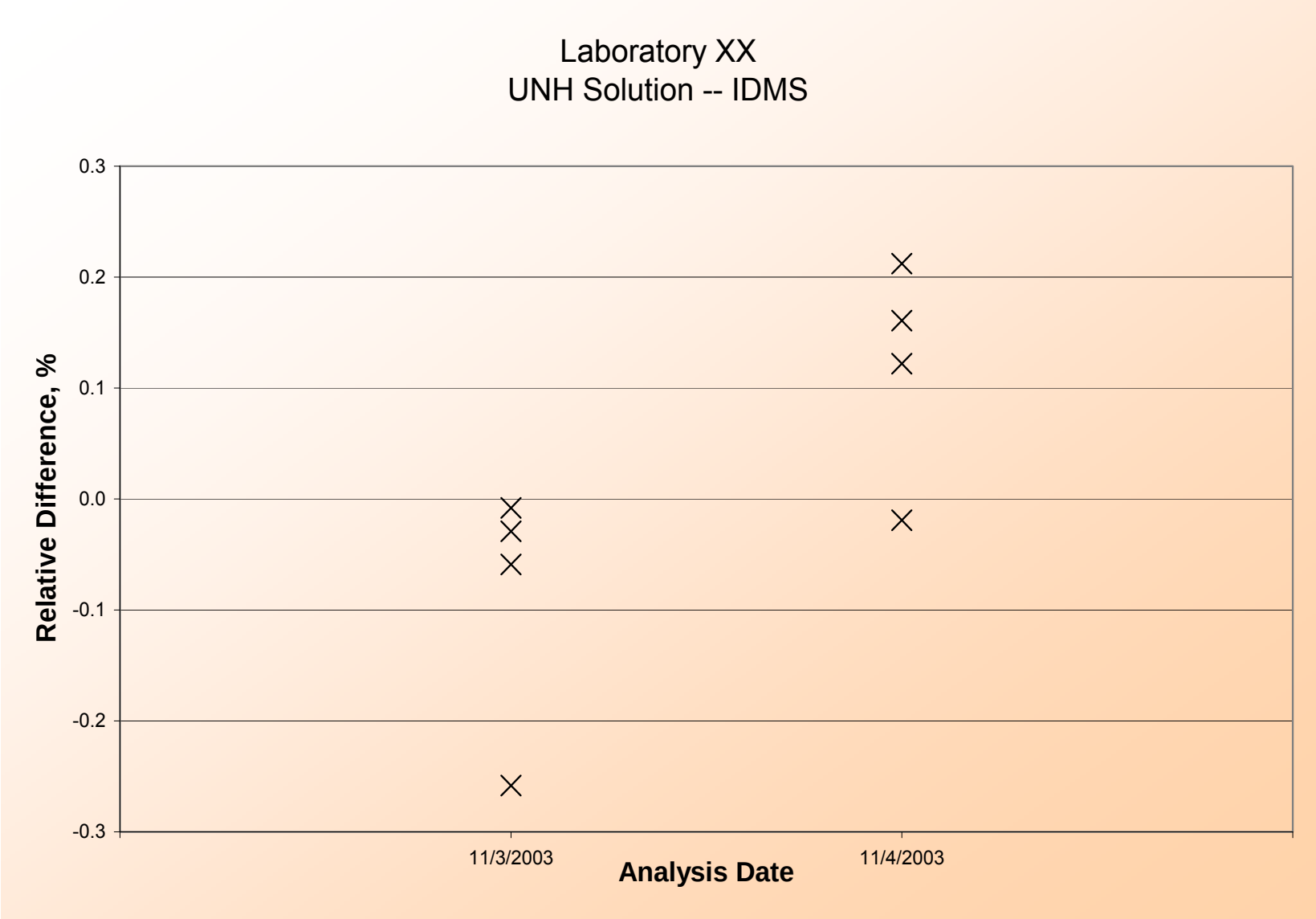


Figure. C.6.2. Graphic representation of data shown in Table C.6.2

D. ANNUAL EVALUATION OF RESULTS AND REPORTING FORMAT

The annual evaluations of CY 2008 measurement results are given in Section E for uranium mass fraction measurements and in Section F for uranium isotopic abundance measurements. In these two sections, the evaluation results are presented according to material type (UNH, UO_2, LEU, HEU etc.) The material/method specific results reported by the facilities during the entire year are taken together for calculating the mean % RD and standard deviation. Day-to-day or period-to-period variations in the measurements are ignored. The mean % RD is compared to the ITV for the systematic uncertainty component (u(s)) and the standard deviation to the ITV for the random uncertainty component (u(r)). Thus, the annual evaluation provides a concise summary of performance with respect to the international target values.

The annual evaluation results for each material are presented in the form of tables and graphs. The tables for each material type contain the following information: methods of analysis, laboratory code, mean % RD and standard deviation for whole year data, number of measurements made in the year and compliance to ITVs. The tabular data is presented in two graphs, one for % RD and the other for standard deviation, to illustrate compliance to the respective ITVs.

The annual evaluations in Sections E and F cannot be used as a basis for inter-laboratory comparison of performance since test samples belonging to different batches were analyzed by the facilities (even though belonging to the same material type). Moreover, the number of measurements made differs from one facility to another.

E. PERFORMANCE EVALUATION FOR MASS FRACTION MEASURMENTS

The annual evaluation of uranium mass fraction results is presented in five sub-sections, E.1 through E.5, arranged according to material types.

E.1 Uranyl Nitrate Solutions (UNH)

Ten laboratories analyzed UNH test samples. Three different methods were used in the analyses; D&G titration, IDMS and XRF. Table E.1.1 shows a summary of the annual evaluation results; number of measurements (N) made during the year, mean % RD, and the standard deviation. Results in compliance with the ITVs are shown with a tick mark (✓); blanks indicate non-compliance. For example, Laboratory AB analyzed UNH solutions by D&G titration and reported 12 results during the year. The mean % RD is -0.056 and the standard deviation is 0.062; both are in compliance with the respective ITVs.

Table E.1.1. Summary of CY 2008 uranium mass fraction measurements in UNH test samples.

Method	Lab Code	Mean % RD	SD	N	ITV compliance	
					u(s) = 0.1	u(r) = 0.1
D&G	AB	-0.056	0.062	12	✓	✓
	B	0.150	0.367	32		
	BA	-0.553	0.389	30		
	BC	-0.257	0.139	33		
	BF	0.016	0.066	16	✓	✓
	ED	0.037	0.167	16	✓	
	G	-0.097	0.020	8	✓	✓
	U	-0.201	0.238	8		
					u(s) = 0.1	u(r) = 0.15
IDMS	A	0.036	0.146	16	✓	✓
	B	-0.447	0.430	32		
	V	0.009	0.027	8	✓	✓
					u(s) = 0.5	u(r) = 0.5
XRF*	A	0.315	0.374	16	✓	✓
	ED	-2.479	0.272	16		

*There are no ITV's for XRF measurements; DOE target values are shown instead.

The calculated values for mean % RD and the standard deviation are also shown graphically in Figures E.1.1 and E.1.2.

In Fig. E.1.1 the diamond symbol represents the mean %RD and the error bars on either side represent one standard deviation of the mean. Symbols falling on the bold horizontal line (in the middle of the graph (% RD = 0)) indicate no difference between the measurements and the characterized value, those falling above the solid line indicates positive deviation, and those falling below the solid line indicate negative deviation. Symbols falling between the dashed lines on either side of the bold horizontal line indicate compliance to the ITV for u(s). For example, the mean % RD of D&G titration results from laboratory AB is in compliance with u(s).

Figure E.1.2 is a bar graph that represents the calculated standard deviation of measurement results. The ITVs for u(r) are shown as horizontal dotted lines. Bars not crossing the dotted line indicate compliance to the ITVs for u(r). For example, the standard deviation of D&G titration results from laboratory AB is in compliance with u(r).

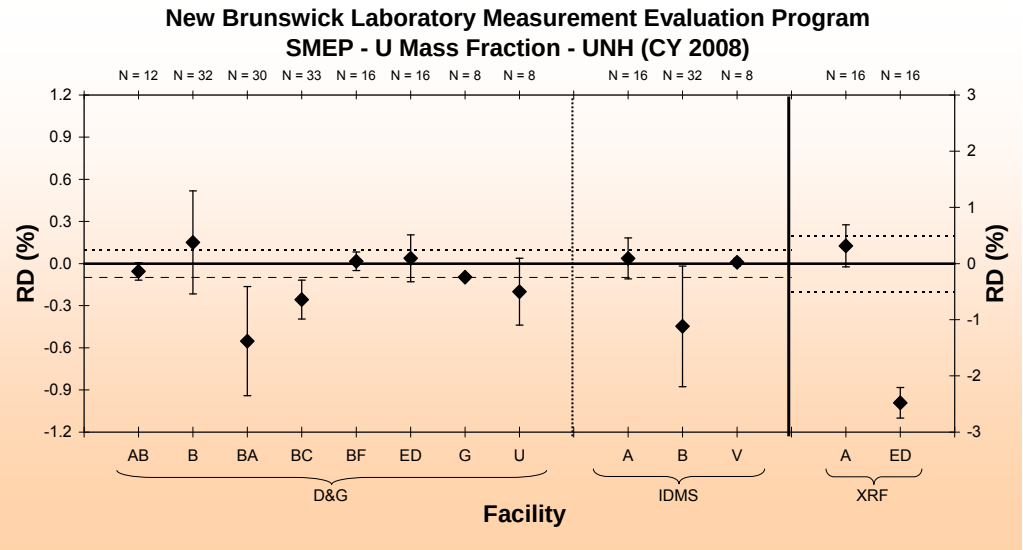


Figure E.1.1. Annual evaluation of results from uranium mass fraction determinations in UNH solutions. The calculated mean % RDs are shown as diamonds. The D&G and IDMS results are scaled to the left y-axis and the XRF data to the right y-axis. The number of valid measurements made by the facility is shown on the upper x-axis, and the facility codes and measurement methods are shown on the lower x-axis. The bold horizontal line represents zero % RD. The dashed lines above and below the bold line represent the ITVs for u(s). All symbols that fall between the dashed lines are in compliance with the ITV for u(s).

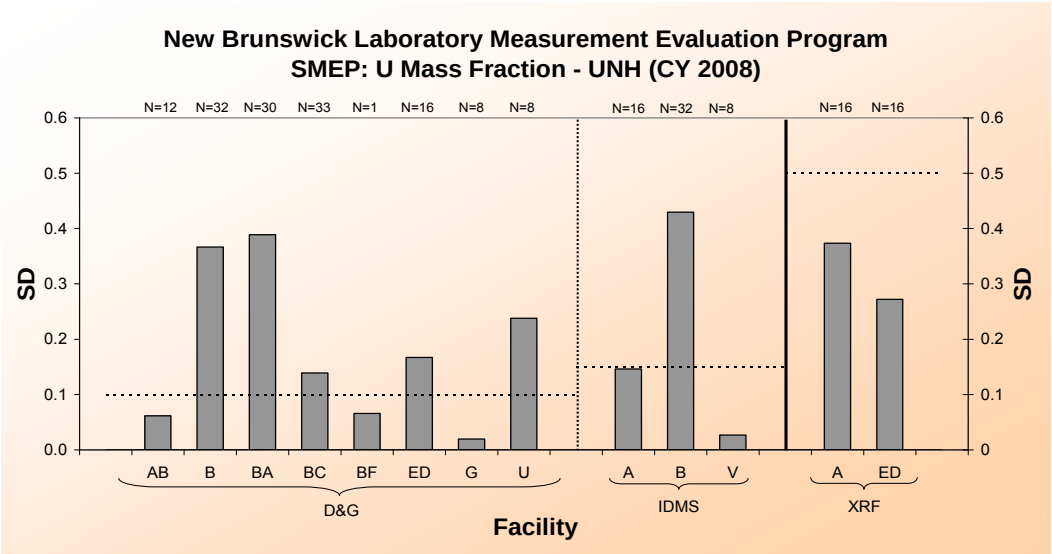


Figure E.1.2. Annual evaluation of results from uranium mass fraction determinations in UNH solutions. The calculated values for the standard deviation are represented as bars. The number of valid measurements made by the facility is shown on the upper x-axis, and the facility codes and measurement methods are shown on the lower x-axis. The dashed lines represent the ITV for u(r) for each method. The bars that do not cross the dashed line are in compliance with u(r).

E.2 Enriched Uranium Dioxide (UO_2) Pellets

Seven laboratories analyzed UO_2 pellets using the D&G method. Table E.2.1 shows a summary of the annual evaluation results, number of measurements (N) made during the year, mean % RD, and the standard deviation. Results in compliance with the ITVs are shown with a tick mark (✓); blanks indicate non-compliance. For example, Laboratory BA reported 21 results during the year with mean % RD of -0.101 and standard deviation of 0.068, both values in compliance with the respective ITVs.

Table E.2.1 Summary of CY 2008 uranium mass fraction measurements in UO_2 pellets.

Method	Lab Code	Mean % RD	SD	N	ITV Compliance	
					u(s) = 0.1	u(r) = 0.1
D&G	BA	-0.101	0.068	21	✓	✓
	BC	-0.125	0.134	36		
	BD	0.008	0.211	24	✓	
	BF	-0.044	0.035	16	✓	✓
	ED	-0.013	0.067	16	✓	✓
	T	0.009	0.070	28	✓	✓
	V	0.019	0.016	8	✓	✓

The calculated values for mean % RD and the standard deviation are also shown graphically in Figures E.2.1 and E.2.2.

In Fig. E.2.1 the triangle symbol represents the mean %RD and the error bars extending from the symbol on either side represent one standard deviation of the mean. Symbols falling on the bold horizontal line (in the middle of the graph (% RD = 0)) indicate no difference between the measurements and the characterized value, those falling above the solid line indicates positive deviation, and those falling below the solid line indicate negative deviation. Symbols falling within the dashed lines on either side of the bold horizontal line indicate compliance to the ITV for u(s). For example, the mean % RD of D&G titration results from laboratory BA is in compliance with u(s).

Figure E.2.2 is a bar graph of the calculated values for standard deviations of measurement results. The ITVs for u(r) are shown as horizontal dotted lines. Bars not crossing the dotted line indicate compliance to the ITVs for u(r). For example, the standard deviation of D&G titration results from laboratory BA is in compliance with u(r).

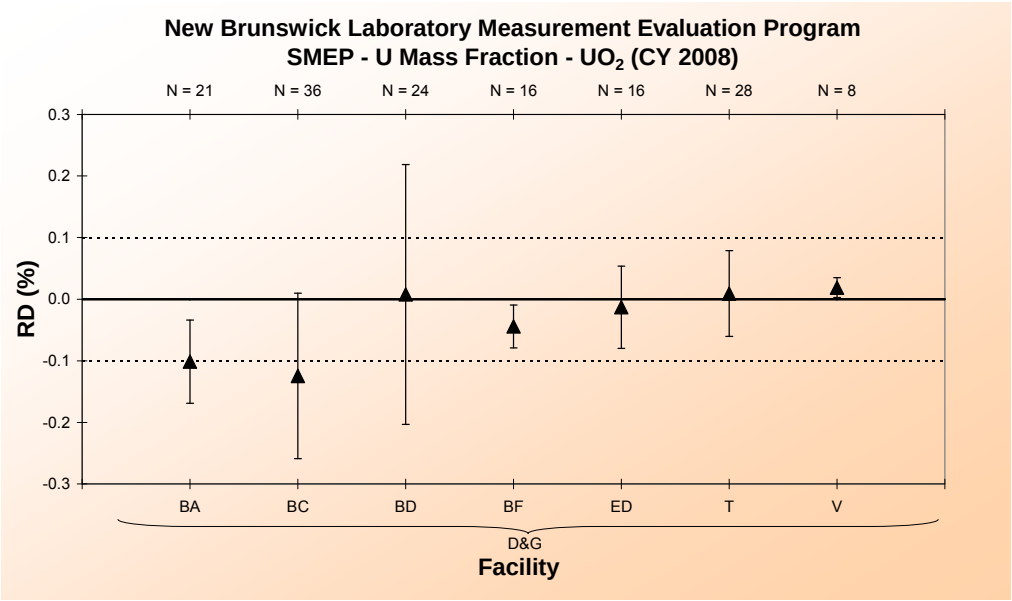


Figure E.2.1. Annual evaluation of results from uranium mass fraction determinations in UO_2 pellets. The calculated mean % RDs are shown as triangles. The number of valid measurements made by the facility is shown on the upper x-axis, and the facility codes and measurement methods are shown on the lower x-axis. The bold horizontal line represents 0 % RD, and the dashed lines above and below the bold line mark the ITVs for u(s). All symbols that fall between the dashed lines are in compliance with the ITV for u(s).

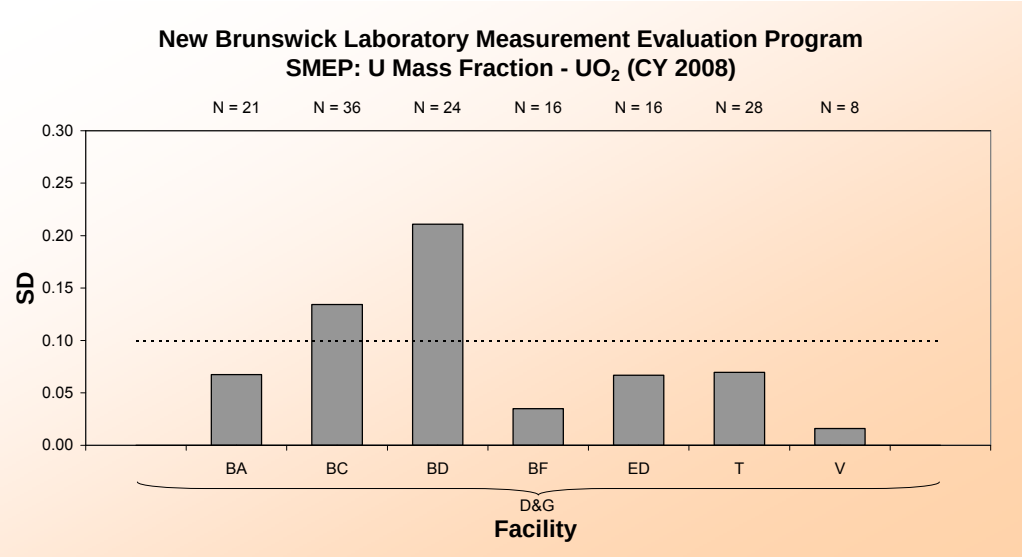


Figure E.2.2. Annual evaluation of results from uranium mass fraction determinations in UO_2 pellets. The calculated values for the standard deviation are represented as bars. The number of valid measurements made by the facility is shown on the upper x-axis, and the facility codes and measurement methods are shown on the lower x-axis. The dashed line represents the ITV for u(r). The bars that do not cross the dashed line are in compliance with u(r).

E.3 Uranium Oxide (UO_3) Powder

Seven laboratories analyzed UO_3 powder test samples. Three different methods were used in the analyses: D&G titration, IDMS and XRF. Table E.3.1 shows a summary of the annual evaluation results; number of measurements (N) made during the year, mean % RD, and the standard deviation. Results in compliance with the ITVs are shown with a tick mark (✓); blanks indicate non-compliance. For example, Laboratory AB analyzed UO_3 powder by D&G titration and reported 12 results during the year. The mean % RD of the 12 results is -0.077 and the standard deviation is 0.037; both are in compliance with the respective ITVs.

One of the participant laboratories encountered problems in UO_3 sample analysis, most likely due to moisture absorption in the samples sent to that laboratory. In order to check the integrity of the samples in storage at NBL, re-characterization experiments were done using pristine samples as well as samples dried at 110º C. The results from those experiments were inconclusive. Another series of tests will be conducted in CY2009 after re-start of uranium laboratory operations.

Table E.3.1 Summary of CY 2008 uranium mass fraction measurements in UO_3 powder.

Method	Lab Code	Mean % RD	SD	N	ITV Compliance	
					u(s) = 0.1	u(r) = 0.1
D&G	AB	-0.077	0.037	12	✓	✓
	AE	-0.081	0.035	8	✓	✓
	BA	-0.198	0.093	28		✓
	BF	-0.033	0.101	8	✓	
	F	-0.040	0.042	16	✓	✓
	V	-0.081	0.037	8	✓	✓
					u(s) = 0.1	u(r) = 0.15
IDMS	A	-0.258	0.251	8		
					u(s) = 0.5	u(r) = 0.5
XRF*	A	-0.428	0.312	16	✓	✓

*There are no ITV's for XRF measurements; DOE target values are shown instead.

The calculated values for mean % RD and the standard deviation are shown graphically in Figures E.3.1 and E.3.2.

In Fig. E.3.1 the circular symbols represent the mean %RD and the error bars extending from the symbol on either side represent one standard deviation of the mean. Symbols falling on the

solid line (in the middle of the graph (% RD = 0) indicate no difference between the measurements and the characterized value, those falling above the solid line indicates positive deviation, and those falling below the bold horizontal line indicate negative deviation. Symbols falling between the dashed lines on either side of the bold horizontal line indicate compliance to the ITV for u(s). For example, the mean % RD of D&G titration results from laboratory AB is in compliance with u(s).

Figure E.3.2 is a bar graph representation of the calculated values for standard deviation of measurement results. The ITVs for u(r) are shown as horizontal dotted lines. Bars not crossing the dotted lines indicate compliance to the ITVs for u(r). For example, the standard deviation of D&G titration results from laboratory AB is in compliance with u(r).

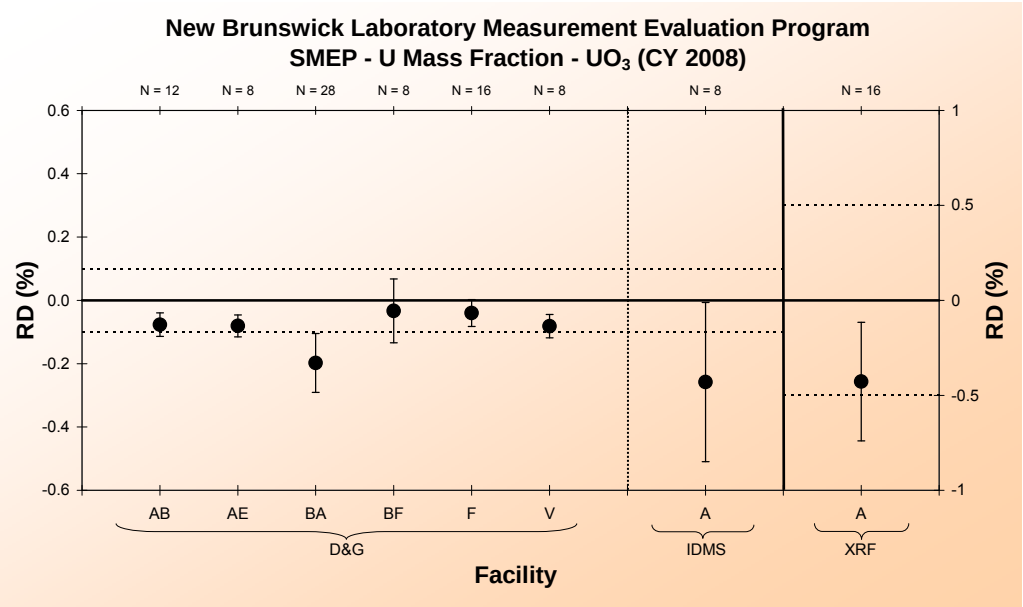


Figure E.3.1 Annual evaluation of results from uranium mass fraction determinations in UO_3 powder. The calculated mean % RDs are shown as solid circles. The D&G and IDMS results are scaled to the left y-axis, and the XRF data to the right y-axis. The number of valid measurements made by the facility is shown on the upper x-axis, and the facility codes and measurement methods are shown on the lower x-axis. The bold horizontal line in the center of the graph represents 0 % RD. The dashed lines enveloping this line represent the ITV limits for u(s) for each measurement type. All symbols that fall between the dashed lines are in compliance with the ITV for u(s).

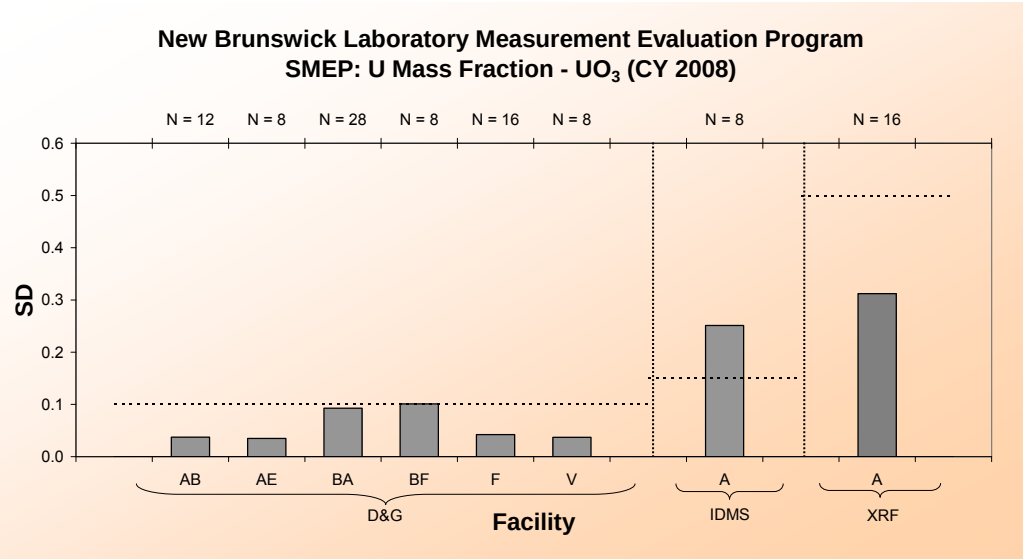


Figure E.3.2 Annual evaluation of results from uranium mass fraction determinations in UO_3 powder. The calculated values for the standard deviation are represented as bars. The number of valid measurements made by the facility is shown on the upper x-axis, and the facility codes and measurement methods are shown on the lower x-axis. The dashed line represents the ITVs for u(r). Bars that do not cross this line are in compliance with the ITV for u(r).

E.4 Uranium Oxide (U_3O_8) Powder

Three laboratories analyzed U_3O_8 powder using the D&G method. Table E.4.1 shows a summary of the annual evaluation results; number of measurements (N) made during the year, mean % RD, and the standard deviation. Results in compliance with the ITVs are shown with a tick mark (✓); blanks indicate non-compliance. For example, Laboratory BA reported 10 results during the year with mean % RD of -0.008 and standard deviation of 0.041, both values in compliance with the respective ITVs.

Table E.4.1. Summary of CY 2008 uranium mass fraction measurements in U_3O_8 powder.

Method	Lab Code	Mean % RD	SD	N	ITV Compliance	
					u(s) = 0.1	u(r) = 0.1
D&G	BA	-0.008	0.041	10	✓	✓
	BC	-0.267	0.180	16		
	BE	-0.197	0.058	8		✓

The calculated values for mean % RD and the standard deviation are shown graphically in Figures E.4.1 and E.4.2.

In Fig. E.4.1 the X symbol represents the mean % RD and the error bars represent one standard deviation of the mean. Symbols falling on the solid line (in the middle of the graph (% RD = 0)) indicate no difference between the measurements and the characterized value, those falling above the solid line indicate positive deviation, and those falling below the solid line indicate negative deviation. Symbols falling within the dashed lines enveloping the bold horizontal line indicate compliance to the ITV for u(s). For example, the mean % RD of D&G titration results from laboratory BA is in compliance with u(s).

Figure E.4.2 is a bar graph representation of the calculated values for standard deviation of measurement results. The ITVs for u(r) are shown as horizontal dotted lines. Bars not crossing the dotted lines indicate compliance to the ITVs for u(r). For example, the standard deviation of D&G titration results from laboratory BA is in compliance with u(r).

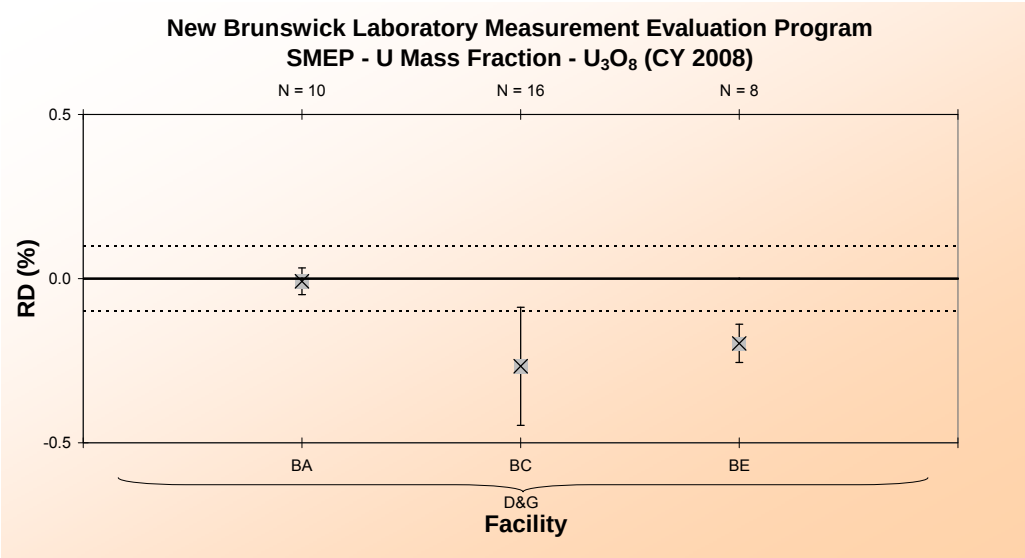


Figure E.4.1. Annual evaluation of results from uranium mass fraction determinations in U_3O_8 powder. The calculated mean % RDs are shown as X. The number of valid measurements made by the facility is shown on the upper x-axis, and the facility codes and measurement methods are shown on the lower x-axis. The bold horizontal line in the center of the graph represents 0 % RD. The dashed lines enveloping this line represent the ITV limits for u(s). All symbols that fall between the dashed lines are in compliance with the ITV for u(s).

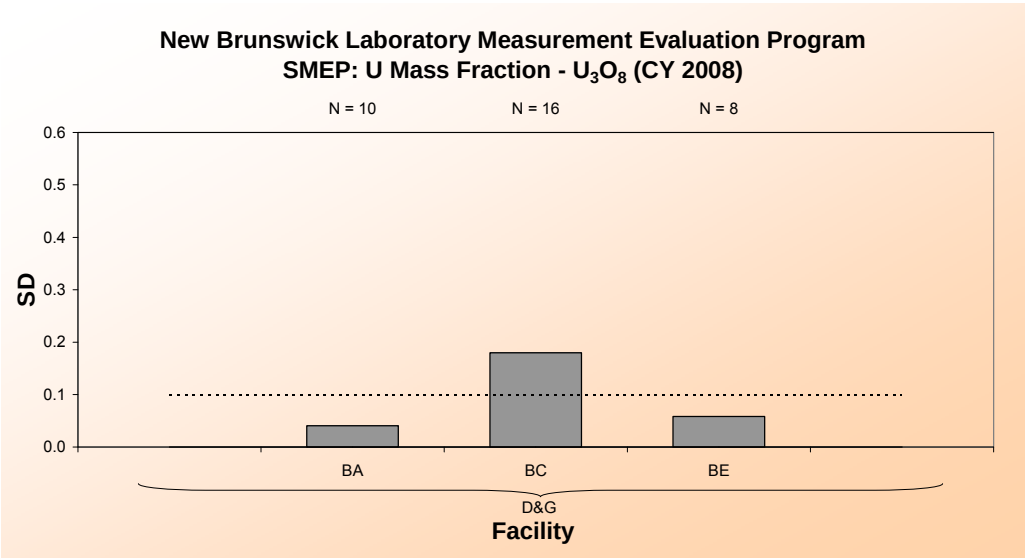


Figure E.4.2. Annual evaluation of results from uranium mass fraction determinations in U_3O_8 powder. The calculated values for the standard deviation are represented as bars. The number of valid measurements made by the facility is shown on the upper x-axis, and the facility codes and measurement methods are shown on the lower x-axis. The dashed line represents the ITV for u(r). Bars that do not cross this line are in compliance with the ITV for u(r).

E.5 Uranium Hexafluoride (UF_6)

Five laboratories analyzed UF_6 samples using the D&G method. Table E.5.1 shows a summary of the annual evaluation results; number of measurements (N) made during the year, mean % RD, and the standard deviation. Results in compliance with the ITVs are shown with a tick mark (✓); blanks indicate non-compliance. For example, Laboratory AB reported 6 results during the year with mean % RD of -0.038 and standard deviation of 0.065, both values in compliance with the respective ITVs.

Table E.5.1. Summary of CY 2008 uranium mass fraction measurements in UF_6 samples.

Method	Lab Code	Mean % RD	SD	N	ITV Compliance	
					u(s) = 0.1	u(r) = 0.1
D&G	AB	-0.038	0.065	6	✓	✓
	AE	-0.073	0.033	20	✓	✓
	BF	-0.899	0.555	29		
	EA	-0.070	0.153	24	✓	
	EC	0.244	0.385	24		

The calculated values for mean % RD and the standard deviation are shown graphically in Figures E.5.1 and E.5.2.

In Fig. E.5.1 the square symbol represents the mean % RD and the error bars represent one standard deviation of the mean. Symbols falling on the bold horizontal line (in the middle of the graph (% RD = 0)) indicate no difference between the measurements and the characterized value, those falling above the solid line indicates positive deviation, and those falling below the solid line indicate negative deviation. Symbols falling within the dashed lines enveloping the bold horizontal line indicate compliance to the ITV for u(s). For example, the mean % RD of D&G titration results from laboratory AB is in compliance with u(s).

Figure E.5.2 is a bar graph representation of the calculated values for standard deviation of measurement results. The ITVs for u(r) are shown as horizontal dotted lines. Bars not crossing the dotted lines indicate compliance to the ITVs for u(r). For example, the standard deviation of D&G titration results from laboratory AB is in compliance with u(r).

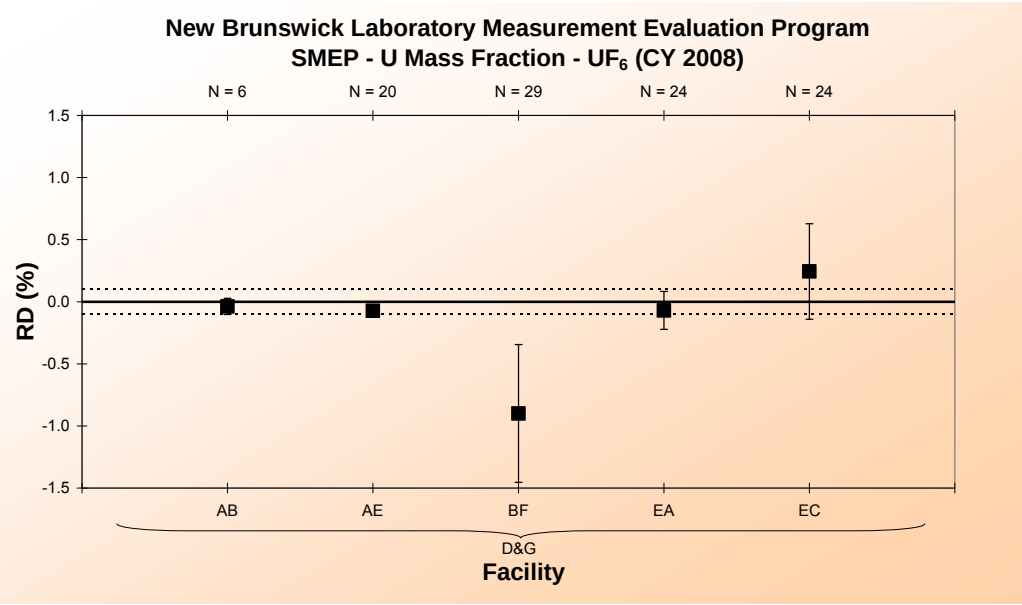


Figure E.5.1. RD (%) values for uranium mass fraction determination in UF_6 samples. The calculated mean % RDs are shown as squares. The number of valid measurements made by the facility is shown on the upper x-axis, and the facility codes and measurement methods are shown on the lower x-axis. The bold horizontal line represents zero % RD. The horizontal dashed lines represent the ITV for u(s). Samples that fall within the region enveloped by the dashed lines conform to the ITV.

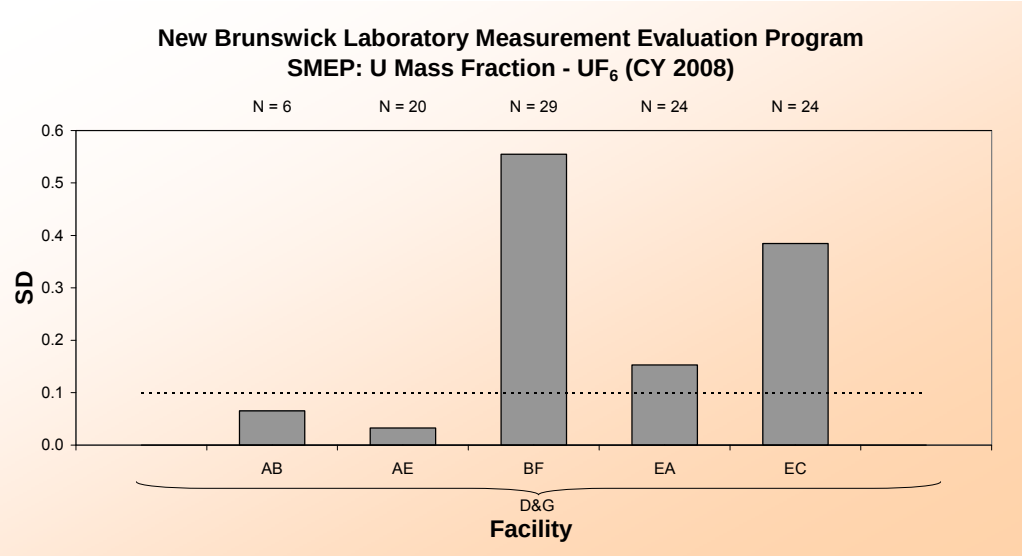


Figure E.5.2 Annual evaluation of results from uranium mass fraction determinations in UF_6 samples. The calculated values for the standard deviation are represented as bars. The number of valid measurements made by the facility is shown on the upper x-axis, and the facility codes and measurement methods are shown on the lower x-axis. The dashed line represents the ITV for u(r). Bars that do not cross the dashed line meet this ITV.

F. ISOTOPE MEASUREMENTS (^{235}U ABUNDANCE)

The annual evaluation of ^{235}U abundance measurement results is presented in three sub-sections, F.1 through F.3, arranged according to ^{235}U content in the test samples: NU samples with ^{235}U in the range of 0.3 wt % to 1.0 wt %, LEU samples with ^{235}U in the range of 1.0 wt % to 20.0 wt %, and HEU samples with ^{235}U abundance greater than 20.0 wt %. The source materials for the test samples are the same as those listed in Section C.3, and shown below:

NU test samples: UNH solution, UO_3 powder, U_3O_8 powder, and UF_6
LEU test samples: UNH solution, UO_2 pellet, and UF_6
HEU test samples: UNH solution

The instrumental methods used in the measurements were: thermal ionization mass spectrometry (TIMS), inductively coupled plasma mass spectrometry (ICP-MS), and UF_6 gas source mass spectrometry (GSMS). Solid samples required dissolution prior to TIMS and ICP-MS analyses.

F.1 NU Test Samples (^{235}U in the range of 0.3 wt % to 1.0 wt %)

Seven laboratories analyzed the natural range uranium test samples. Table F.1.1 shows a summary of the results of the annual evaluation: method of analysis, material analyzed, and number of measurements (N) made during the year, mean % RD, and standard deviation. Note that U_3O_8, UNH and UO_3 samples were analyzed by TIMS, and UF_6 samples by ICP-MS and GSMS. Results in compliance with the ITVs are shown with a tick mark (✓); blanks indicate non-compliance. For example, Laboratory BC analyzed U_3O_8 by TIMS and reported 16 results during the year. The mean % RD is 0.163; it is in compliance with the ITV for u(s). The standard deviation is 0.288; it is not in compliance with the ITV for u(r).

Table F.1.1 Summary of CY 2008 ^{235}U abundance measurements in U test samples.

Method	Lab Code	Material	Mean % RD	SD	N	ITV Compliance	
						u(s) = 0.2	u(r) = 0.2
TIMS	BC	U_3O_8	0.163	0.288	16	✓	
	B	UNH	0.147	0.077	32	✓	✓
	F	UNH, UO_3	-0.010	0.063	16	✓	✓
	V	UO_3	-0.019	0.056	8	✓	✓
						u(s) = 0.2	u(r) = 0.2
ICP-MS*	EA	UF_6	0.061	0.024	16	✓	✓
	EC	UF_6	0.046	0.083	18	✓	✓
						u(s) = 0.1	u(r) = 0.1
GSMS	EB	UF_6	0.039	0.015	8	✓	✓
	EC	UF_6	0.082	0.011	18	✓	✓

*Since there are no ITV's for ICP-MS, they are assumed to be the same as those for TIMS.

The calculated values for mean % RD and the standard deviation are shown graphically in Figures F.1.1 and Figure F.1.2.

In Figure F.1.1 the diamond symbol represents the mean % RD and the error bars extending from the symbol on either side represent one standard deviation of the mean. Symbols falling on the bold horizontal line (in the middle of the graph (% RD = 0)) indicate no difference between the measurements and the characterized value, those falling above the solid line indicate positive deviation, and those falling below the solid line indicate negative deviation. Symbols falling within the dashed lines that envelop the bold horizontal line indicate compliance to the ITV for u(s). For example, the mean % RD of TIMS results from laboratory BC is in compliance with u(s).

Figure F.1.2 is a bar graph of the calculated values for standard deviation of measurement results. The ITVs for u(r) are shown as horizontal dashed lines. Bars not crossing the dashed lines indicate compliance to the ITVs for u(r). For example, the standard deviation of TIMS results from laboratory BC is not in compliance with u(r).

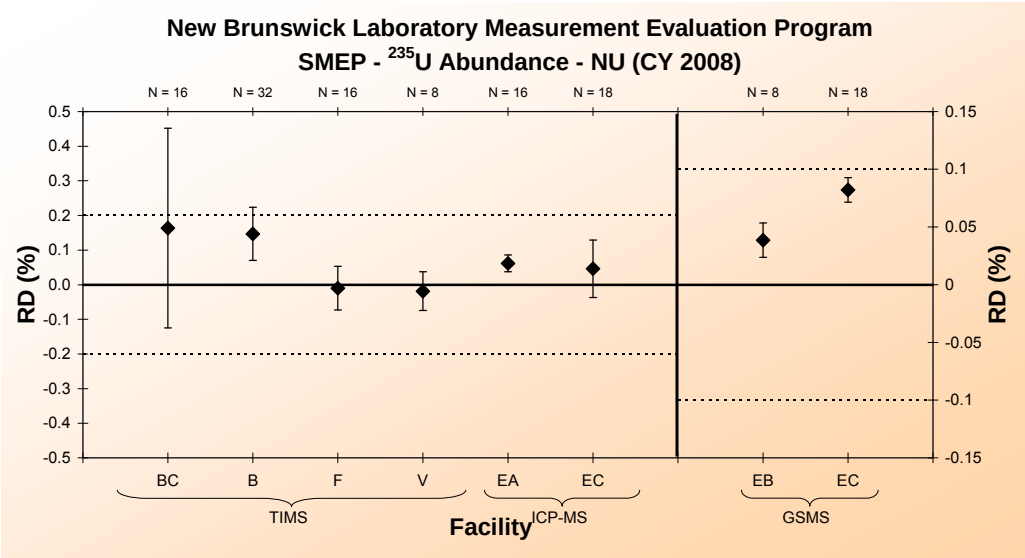


Figure F.1.1. Annual evaluation of ^{235}U abundance determinations. The calculated mean % RDs are shown as diamonds. The TIMS and ICP-MS results are scaled to the left y-axis and the GSMS data to the right y-axis. The number of valid measurements made by the facility is shown on the upper x-axis, and the facility codes and measurement methods are shown on the lower x-axis. The bold horizontal line in the center represents zero % RD, and the dashed lines above and below this mark the ITVs. All symbols that fall within the region enveloped by the dashed lines conform to the ITVs.

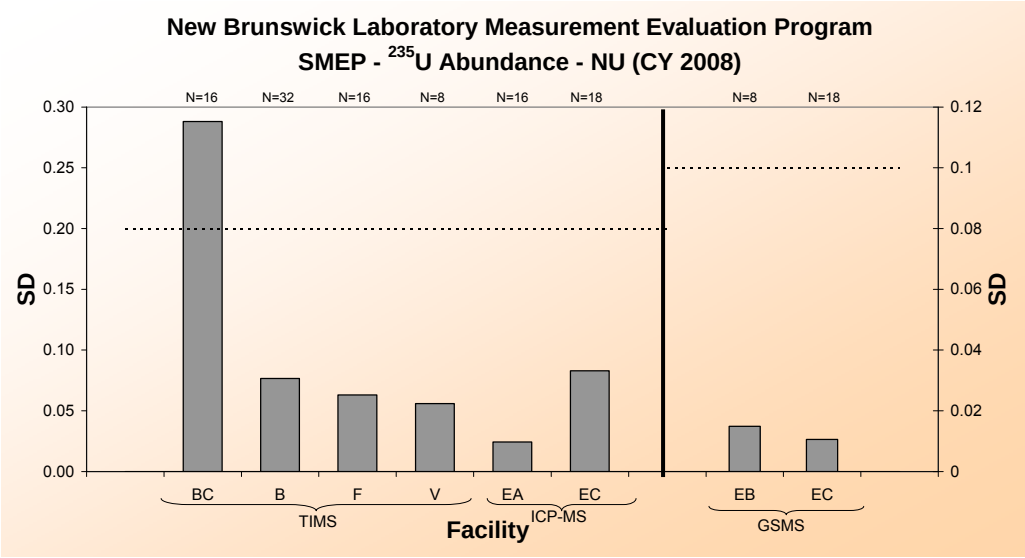


Figure F.1.2. Annual evaluation of ^{235}U abundance determinations. The calculated values for the standard deviation are represented as bars. The number of valid measurements made by the facility is shown on the upper x-axis, and the facility codes and measurement methods are shown on the lower x-axis. TIMS and ICP-MS data is scaled to the left y-axis; GSMS data is scaled to the right y-axis. The dashed lines represent the ITVs for u(r). All bars that do not cross the dashed lines are in compliance with the ITV.

F.2 LEU Test Samples (^{235}U in the range of 1.0 wt % to 20 wt %)

Fifteen laboratories analyzed the LEU test samples. Table F.2.1 shows a summary of the results of the annual evaluation: method of analysis, material analyzed, and number of measurements (N) made during the year, mean % RD, and standard deviation. UNH and UO_2 samples were analyzed by TIMS and ICP-MS, and UF_6 samples by TIMS, ICP-MS and GSMS. Results in compliance with the ITVs are shown with a tick mark (✓); blanks indicate non-compliance. For example, Laboratory B analyzed UNH solution by TIMS and reported 8 results during the year. The mean % RD is 0.101; it is in compliance with the ITV for u(s). The standard deviation is 0.080; it is also in compliance with the ITV for u(r).

Table F.2.1. Summary of CY 2008 ^{235}U abundance measurements in LEU test samples.

Method	Lab Code	Material	Mean % RD	SD	N	ITV Compliance	
						u(s) = 0.1	u(r) = 0.1
TIMS	AA	UNH, UF_6	0.018	0.084	34	✓	✓
	B	UNH	-0.101	0.080	8	✓	✓
	BC	UNH, UO_2	0.033	0.087	36	✓	✓
	ED	UNH	0.157	0.056	8		✓
	F	UO_2	-0.013	0.024	10	✓	✓
	T	UO_2	0.068	0.024	32	✓	✓
	U	UNH	-0.445	0.075	4		✓
	V	UNH, UO_2	0.035	0.016	16	✓	✓
						u(s) = 0.1	u(r) = 0.1
ICP-MS*	AD	UNH	-0.492	0.453	32		
	AF	UNH	-2.318	0.176	32		
	BE	UNH, UO_2	-0.052	0.503	32	✓	
	D	UNH	-0.036	0.854	5	✓	
	EA	UNH, UF_6	0.024	0.037	64	✓	✓
	EC	UF_6	-0.001	0.035	36	✓	✓
	ED	UNH	-0.010	0.036	8	✓	✓
						u(s) = 0.05	u(r) = 0.05
GSMS	BC	UF_6	0.055	0.089	24		
	EB	UF_6	0.043	0.005	16	✓	✓
	EC	UF_6	0.011	0.016	35	✓	✓

*Since there are no ITV's for ICP-MS, they are assumed to be the same as those for TIMS.

The calculated values for mean % RD and the standard deviation are shown graphically in Figures F.2.1 and F.2.2.

In Figure F.2.1 the diamond symbol represents the mean % RD and the error bars extending from either side of the symbol represent one standard deviation of the mean. Symbols falling on the solid line (in the middle of the graph (% RD = 0)) indicate no difference between the measurements and the characterized value, those falling above the solid line indicate positive deviation, and those falling below the solid line indicate negative deviation. Symbols falling within the dashed liens above and below of the bold horizontal line indicate compliance to the ITV for u(s). For example, the mean % RD of TIMS results from laboratory B is in compliance with u(s).

Figure F.2.2 is a bar graph of the calculated values for standard deviations of measurement results. The ITVs for u(r) are shown as horizontal dotted lines. Bars not crossing the dotted lines indicate compliance to the ITVs for u(r). For example, the standard deviation of TIMS results from laboratory B is in compliance with u(r).

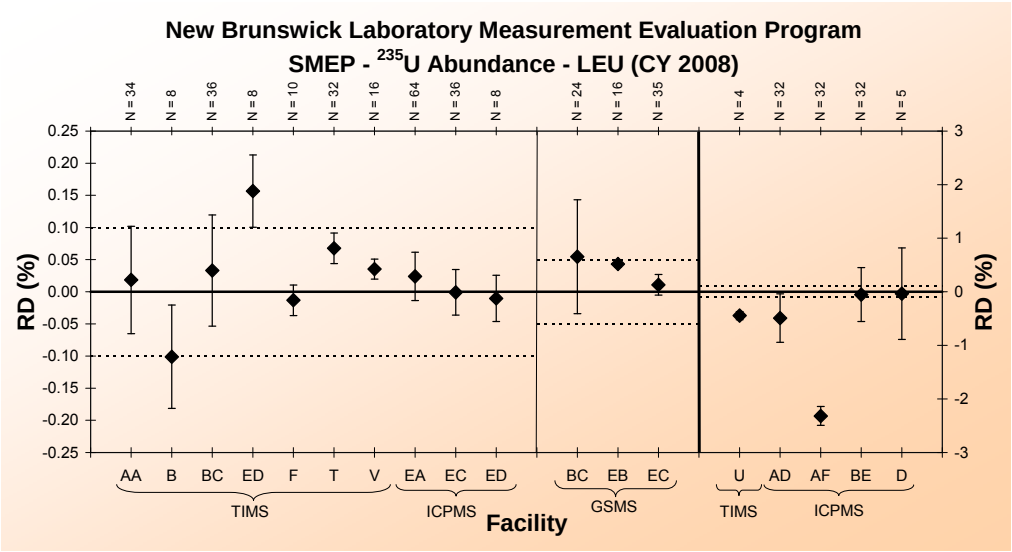


Figure F.2.1. Annual evaluation of ^{235}U abundance determinations. The calculated mean % RDs are shown as diamonds. The results in the two left panels are scaled to the left y-axis. The results in the far right panel are scaled to the right y-axis. The number of valid measurements made by the facility is shown on the upper x-axis, and the facility codes and measurement methods are shown on the lower x-axis. The bold horizontal line in the center represents zero % RD, and the dashed lines above and below this mark the ITVs. All symbols that fall within the region enveloped by the dashed lines conform to the ITVs.

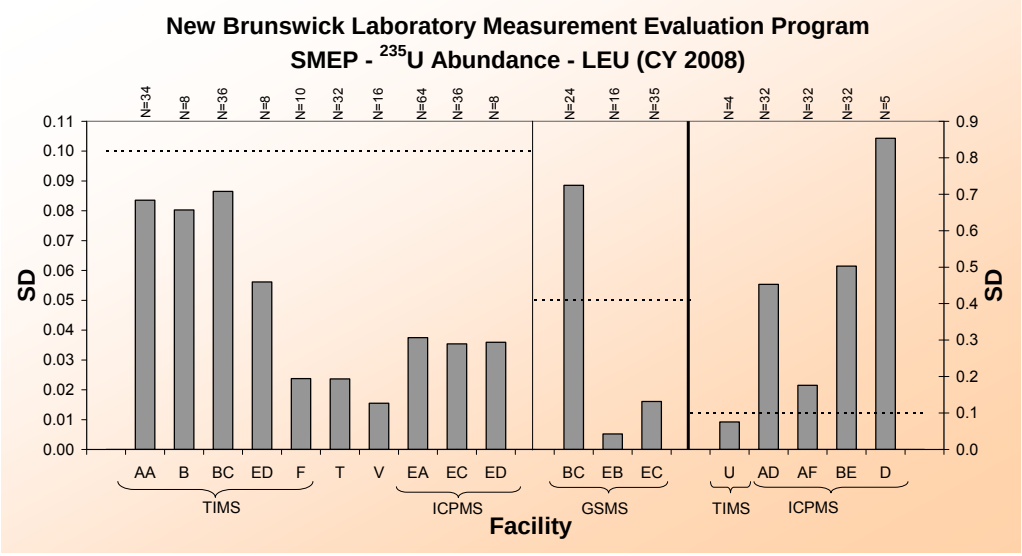


Figure F.2.2. Annual evaluation of ^{235}U abundance determinations. The calculated values for the standard deviation are represented as bars. The results in the two left panels are scaled to the left y-axis. The results in the far right panel are scaled to the right y-axis. The number of valid measurements made by the facility is shown on the upper x-axis, and the facility codes and measurement methods are shown on the lower x-axis. The dashed lines represent the ITVs for u(r). All bars that do not cross the dashed lines are in compliance with the ITV.

In Table F.2.1, the measurement results are separated by the methods used in the analyses, but not by material types. Five laboratories listed in Table F.2.1 analyzed more than one type of material using the same instrumental method as shown below:

Laboratory AA: 16 results from UNH + 18 results from UF_6 by TIMS
Laboratory BC: 16 results from UNH + 20 results from UO_2 by TIMS
Laboratory BE: 16 results from UNH + 16 results from UO_2 by ICP-MS
Laboratory EA: 32 results from UNH + 32 results from UF_6 by ICP-MS
Laboratory V: 8 results from UNH + 8 results from UO_2 by TIMS

Tables F.2.2, F.2.3 and F.2.4 are constructed to show material/method specific results for the LEU measurements. The results in the three tables taken together with the results in Table F.2.1 provide a complete summary of the evaluation of LEU measurements.

Table F.2.2 Summary of CY 2008 ^{235}U abundance measurements in LEU test samples of UNH solutions.

Method	Lab Code	Mean % RD	SD	N	ITV Compliance	
					u(s) = 0.1	u(r) = 0.1
TIMS	AA	-0.023	0.099	16	✓	✓
	B	-0.101	0.080	8	✓	✓
	BC	0.065	0.099	16	✓	✓
	ED	0.157	0.056	8		✓
	U	-0.445	0.080	4		✓
	V	0.040	0.022	8	✓	✓
					u(s) = 0.1	u(r) = 0.1
ICP-MS*	AD	-0.492	0.453	32		
	AF	-2.318	0.186	32		
	BE	0.118	0.484	16		
	D	-0.036	0.854	5	✓	
	EA	0.004	0.033	32	✓	✓
	ED	-0.010	0.036	8	✓	✓

*Since there are no ITV's for ICP-MS, they are assumed to be the same as those for TIMS

Table F.2.3. Summary of CY 2008 ^{235}U abundance measurements in LEU test samples of UO_2 pellets.

Method	Lab Code	Mean % RD	SD	N	ITV Compliance	
					u(s) = 0.1	u(r) = 0.1
TIMS	BC	0.007	0.067	20	✓	✓
	F	-0.013	0.024	10	✓	✓
	T	0.068	0.024	32	✓	✓
	V	0.030	0.000	8	✓	✓
					u(s) = 0.1	u(r) = 0.1
ICP-MS*	BE	-0.222	0.476	16		

*Since there are no ITV's for ICP-MS, they are assumed to be the same as those for TIMS.

Table F.2.4 Summary of CY 2008 ^{235}U abundance measurements in LEU test samples of UF_6.

Method	Lab Code	Mean % RD	SD	N	ITV Compliance	
					u(s) = 0.1	u(r) = 0.1
TIMS	AA	0.055	0.043	18	✓	✓
					u(s) = 0.1	u(r) = 0.1
ICP-MS*	EA	0.044	0.031	32	✓	✓
	EC	-0.001	0.035	36	✓	✓
					u(s) = 0.05	u(r) = 0.05
GSMS	BC	0.055	0.089	24		
	EB	0.043	0.005	16	✓	✓
	EC	0.011	0.016	35	✓	✓

*Since there are no ITV's for ICP-MS, they are assumed to be the same as those for TIMS.

F.3 HEU Test Samples (^{235}U greater than 20 wt %)

Six laboratories analyzed the HEU test samples. Table F.3.1 shows a summary of the results of the annual evaluation: method of analysis, material analyzed, number of measurements made during the year, mean % RD, and standard deviation. The samples were analyzed by TIMS and ICP-MS. Results in compliance with the ITVs are shown with a tick mark (✓); blanks indicate non-compliance. For example, Laboratory A analyzed UNH solution by TIMS and reported 16 results during the year. The mean % RD is 0.010 and the standard deviation is 0.014; both are in compliance with the ITVs for u(s) and u(r), respectively.

Table F.3.1 Summary ^{235}U abundance measurements in HEU materials.

Method	Lab Code	Material	Mean % RD	SD	N	ITV Compliance	
						u(s) = 0.05	u(r) = 0.05
TIMS	A	UNH	0.010	0.014	16	✓	✓
	B	UNH	0.026	0.025	24	✓	✓
	F	UNH	0.029	0.012	12	✓	✓
	G	UNH	0.020	0.018	16	✓	✓
	U	UNH	0.025	0.006	4	✓	✓
						u(s) = 0.05	u(r) = 0.05
ICP-MS*	D	UNH	0.863	0.58	21		

*Since there are no ITV's for ICP-MS, they are assumed to be the same as those for TIMS.

The calculated values for mean % RD and the standard deviation are shown graphically in Figures F.3.1 and F.3.2.

In Figure F.3.1 the diamond symbols represent the mean % RD and the error bars extending from either side of the symbol represents one standard deviation of the mean. Symbols falling on the bold horizontal line (in the middle of the graph (% RD = 0)) indicate no difference between the measurements and the characterized value, those falling above the solid line indicate positive deviation, and those falling below the solid line indicate negative deviation. Symbols falling between the dashed lines above and below the bold horizontal line indicate compliance to the ITV for u(s). For example, the mean % RD of TIMS results from laboratory A is in compliance with u(s).

Figure F.3.2 is a bar graph of the calculated values for standard deviation of measurement results. The ITVs for u(r) are shown as horizontal dotted lines. Bars not crossing the dotted lines indicate compliance to the ITVs for u(r). For example, the standard deviation of TIMS results from laboratory A is in compliance with u(r).

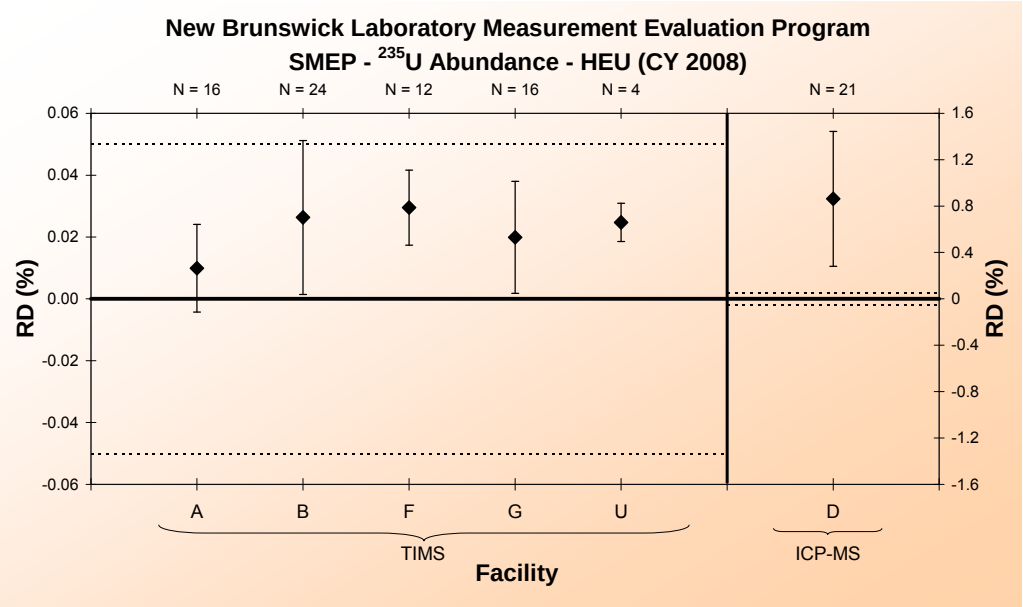


Figure F.3.1. Annual evaluation of ^{235}U abundance determinations. The calculated mean % RDs are shown as diamonds. The TIMS results are scaled to the left y-axis and the ICP-MS data to the right y-axis. The number of valid measurements made by the facility is shown on the upper x-axis, and the facility codes and measurement methods are shown on the lower x-axis. The bold horizontal line represents zero % RD and the dashed lines mark the ITVs for u(s). Data that fall between the dashed lines are in compliance with the ITVs for u(s).

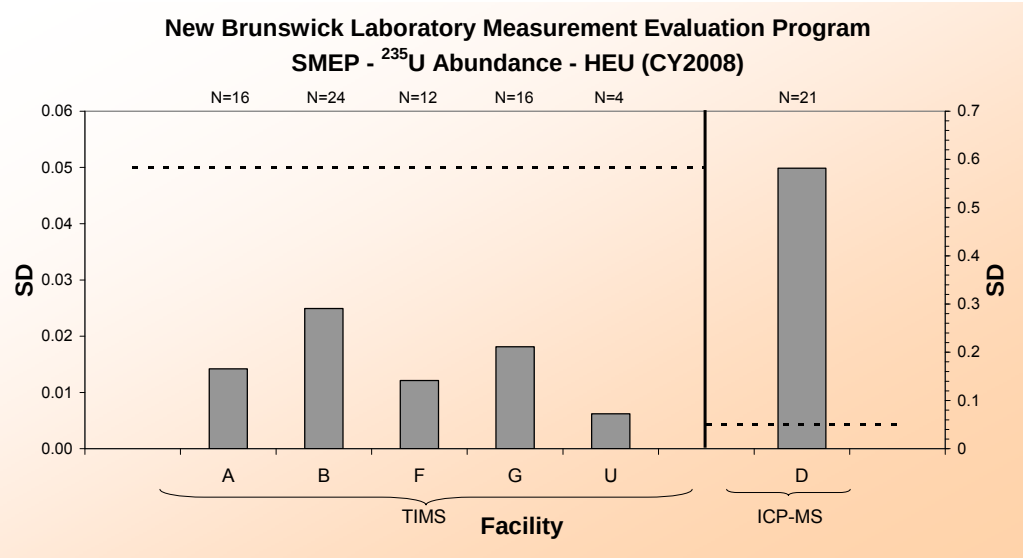


Figure F.3.2. Annual evaluation of ^{235}U abundance determinations. The calculated values for the standard deviation are represented as bars. The number of valid measurements made by the facility is shown on the upper x-axis, and the facility codes and measurement methods are shown on the lower x-axis. TIMS data is scaled to the left y-axis, ICP-MS data is scaled to the right y-axis. The dashed lines represent the ITVs for u(r). Data that do not cross the dashed line are in compliance with the ITVs for u(r).

G. URANIUM MASS FRACTION MEASUREMENTS: THREE-YEAR SUMMARY

A three-year summary of the uranium mass fraction measurement results is presented in Figures G.1 through G.41. Separate graphs are shown for analyses results of each type of material from each participant laboratory. In each figure the mean % RDs (diamond, triangle, circle, X or square symbols) and the standard deviations (error bars on either side of the symbols) are shown. The lower x-axis labels in the figures show the period in which the measurements were made and the methods used in the analyses. The upper x-axis shows the number of results from which the mean % RDs and standard deviations are calculated. These figures provide a visual display of changes in performance during the three year period, CY 2006-2008. Symbols falling on the bold horizontal line (in the middle of the graph (% RD = 0)) indicates no difference between the measurements and the characterized value, those falling above the bold horizontal line indicates positive deviation, and those falling below that line indicate negative deviation. Symbols falling within the dashed lines above and below the bold horizontal line indicate compliance to the ITVs for u(s). Note that separate graphs are not shown to display compliance to the ITVs for u(r).

See Appendix A for a complete set of uranium mass fraction measurement results.

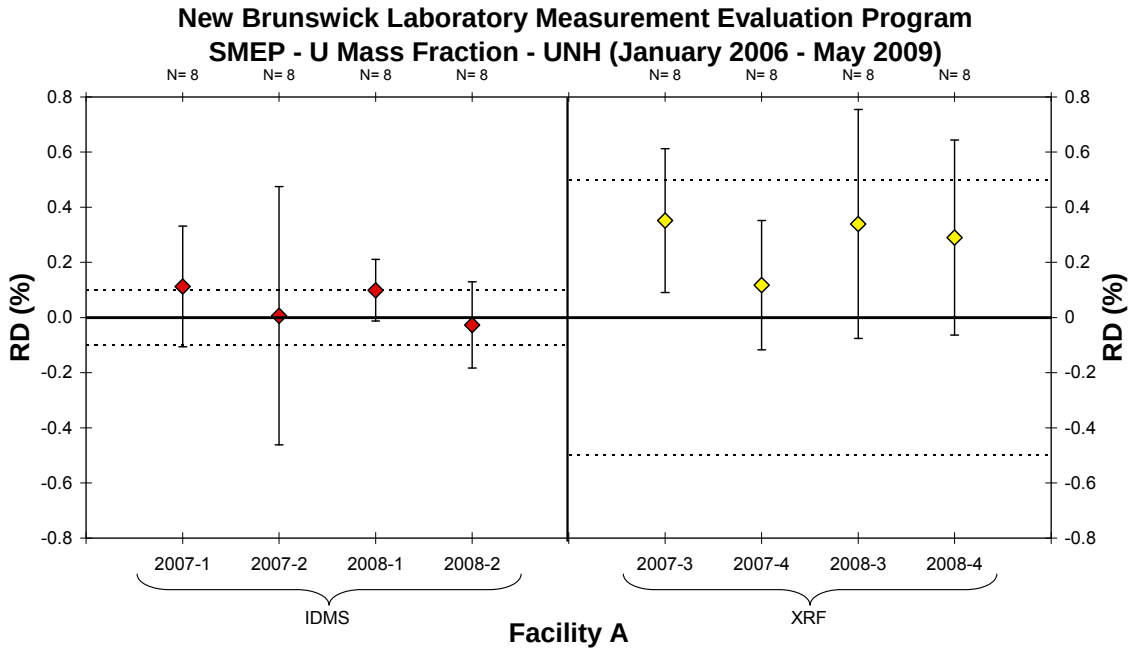


Figure G.1

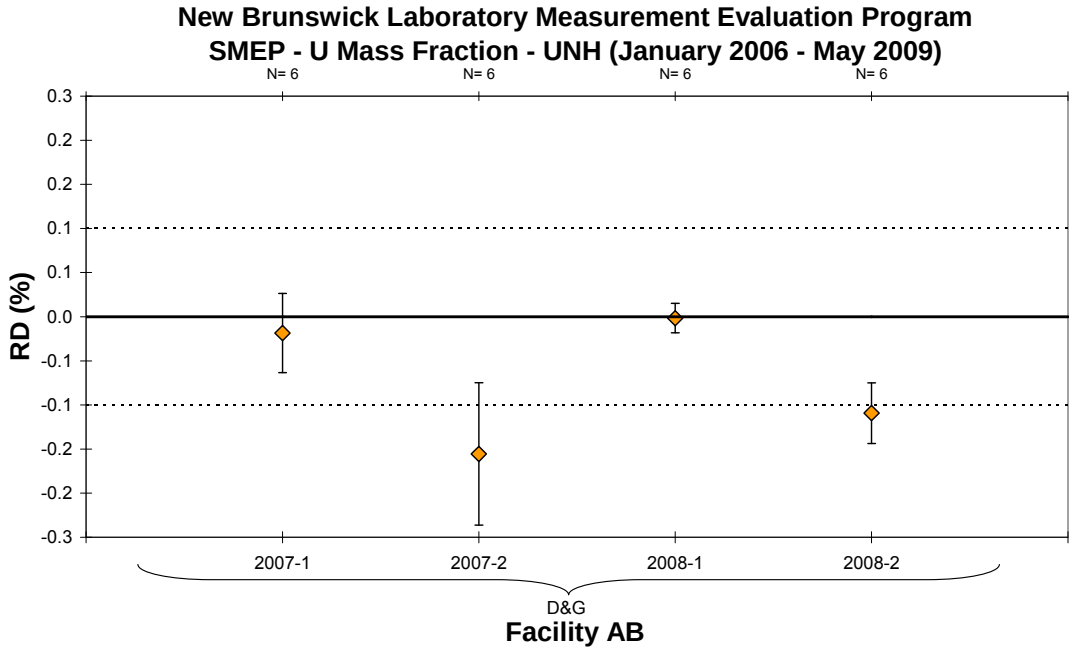


Figure G.2

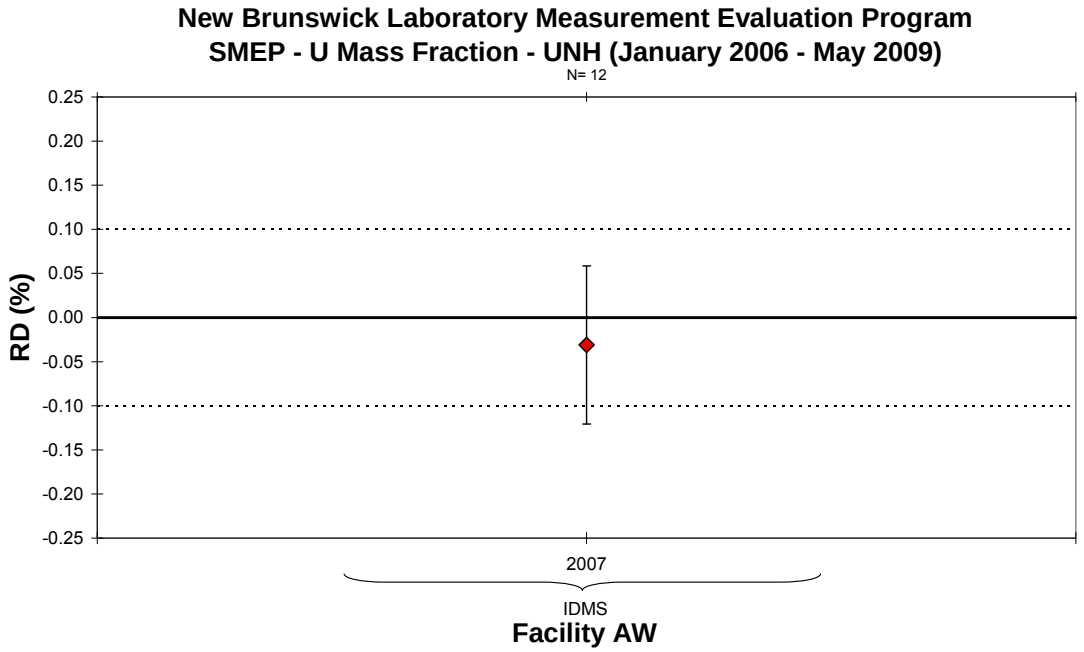


Figure G.3

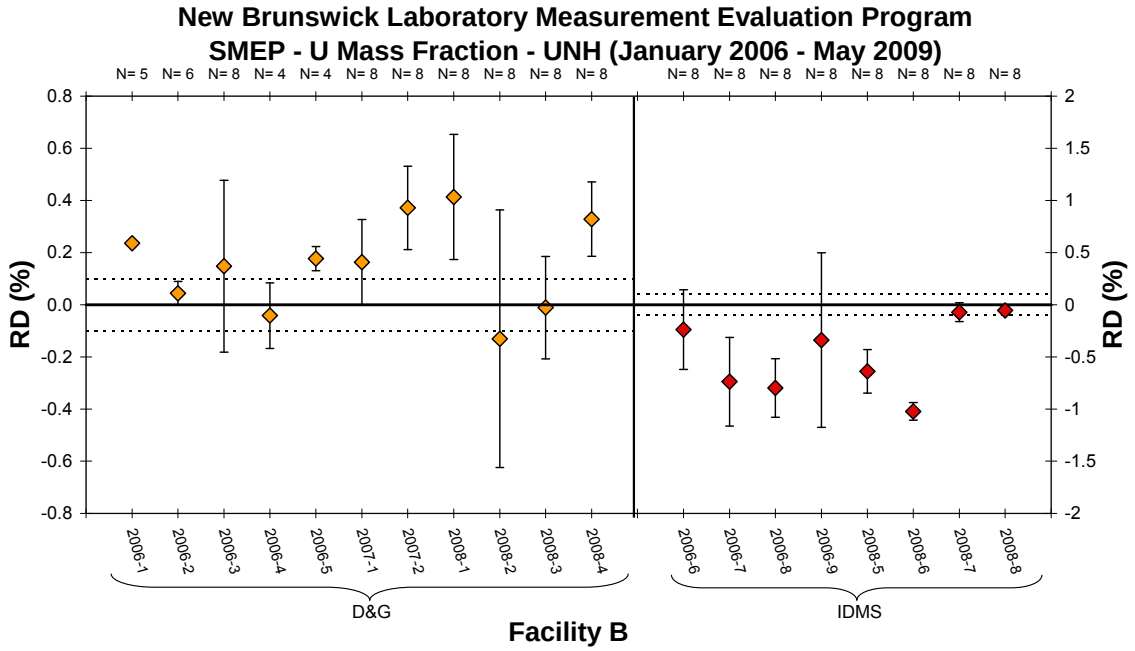


Figure G.4

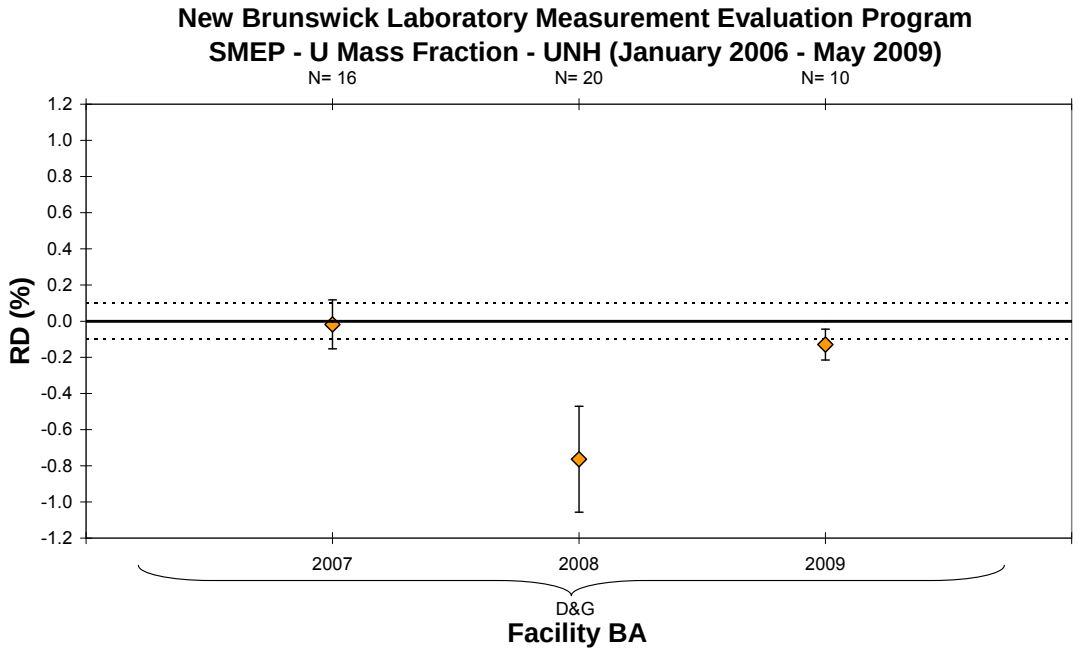


Figure G.5

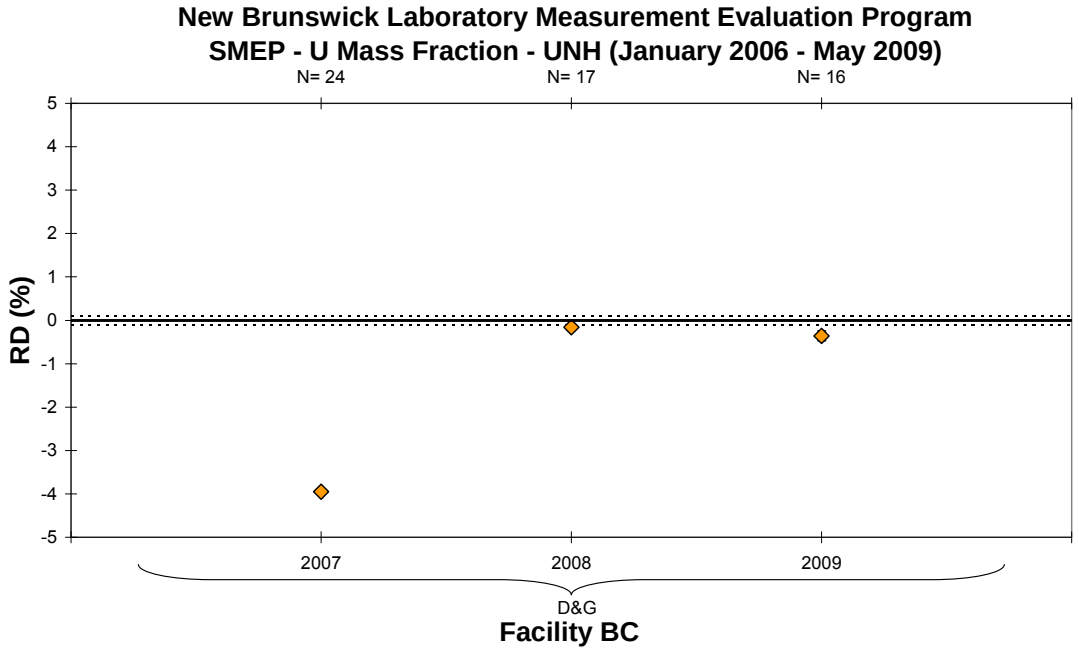


Figure G.6

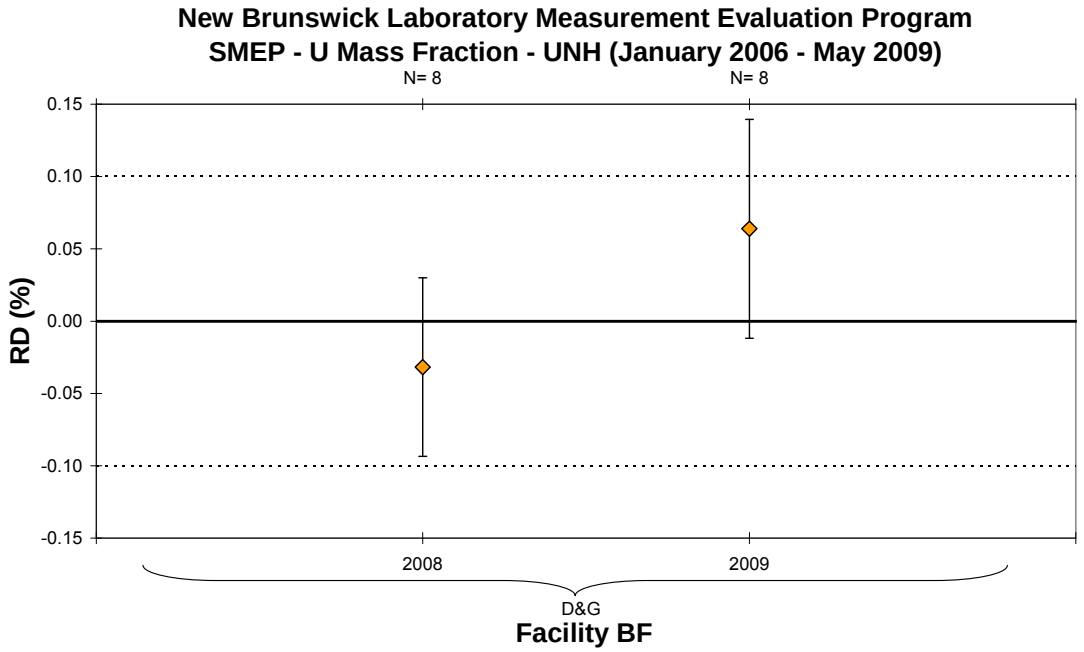


Figure G.7

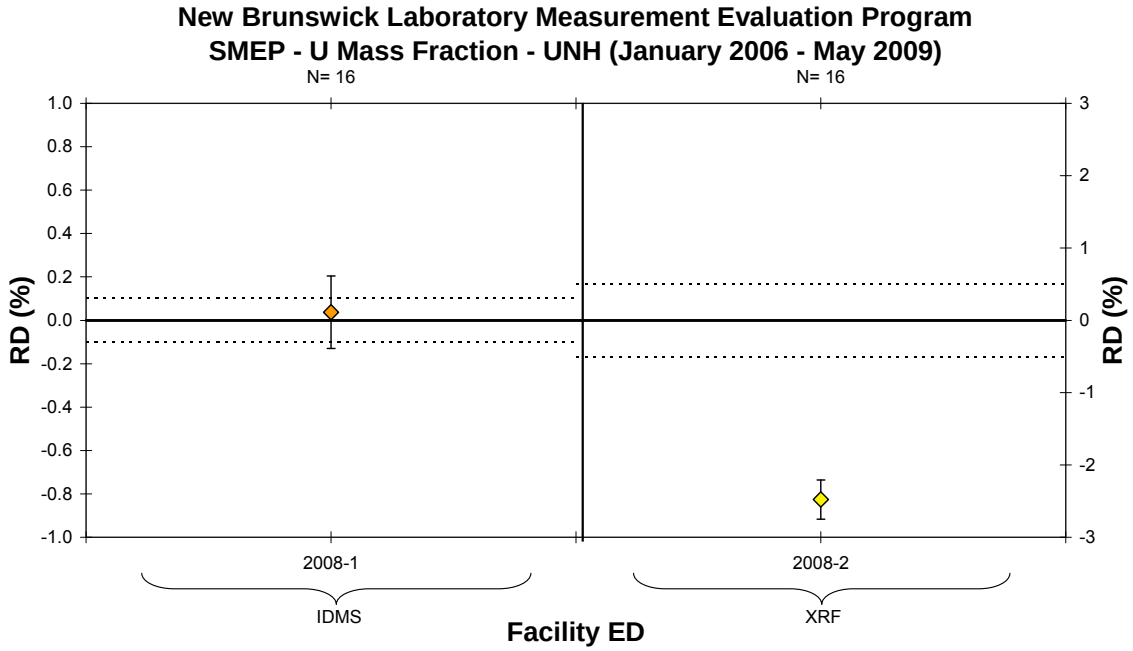
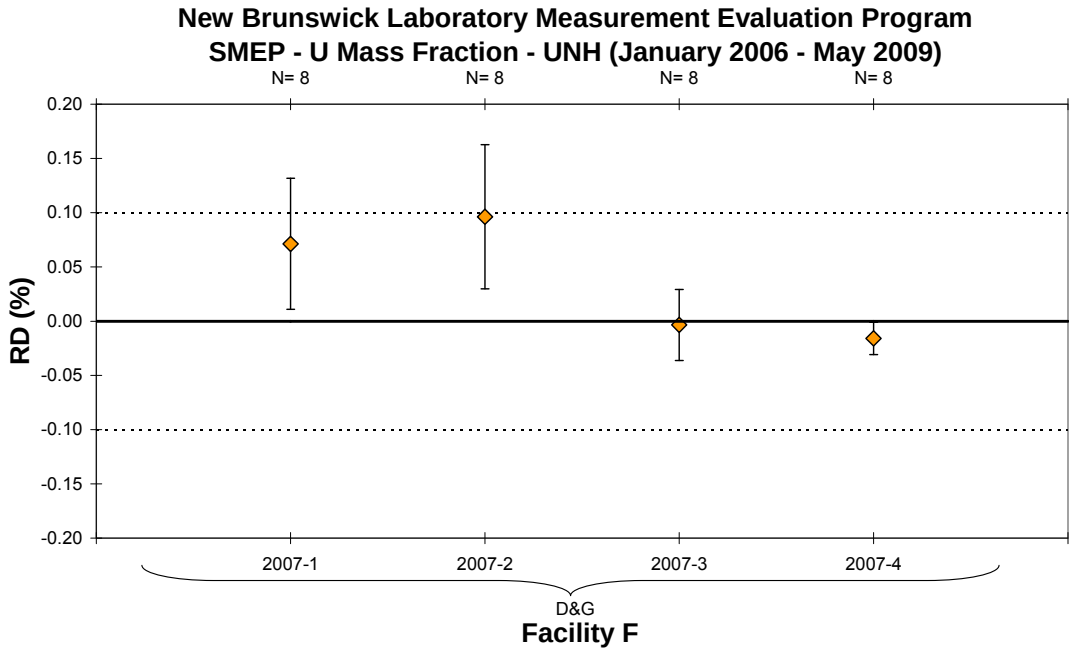


Figure G.8



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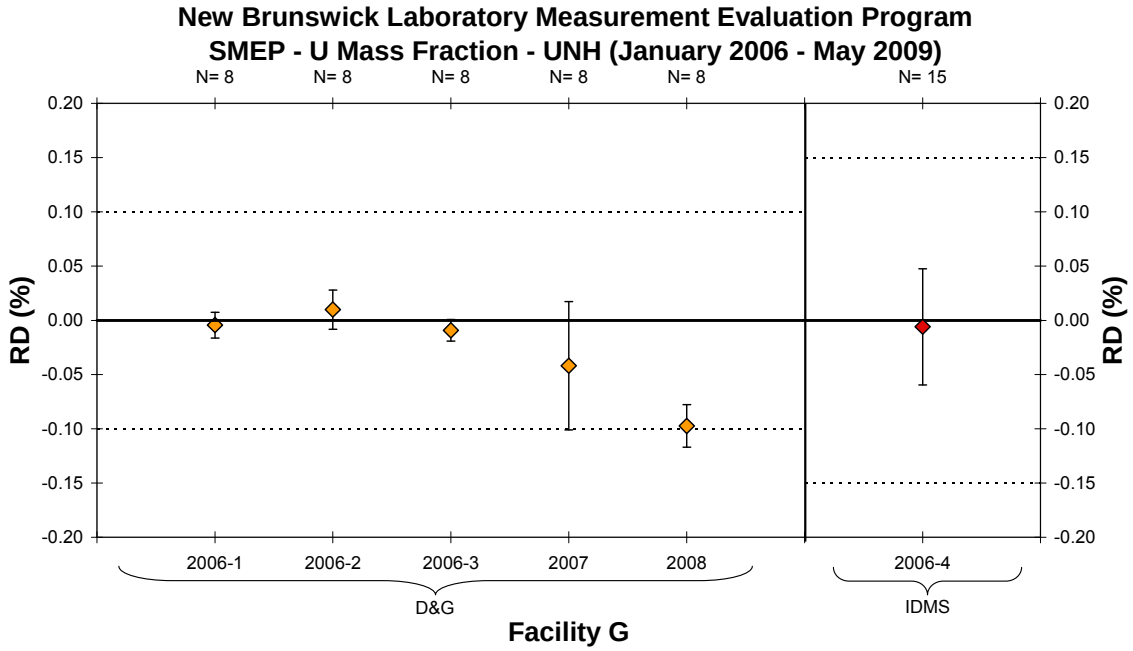


Figure G.10

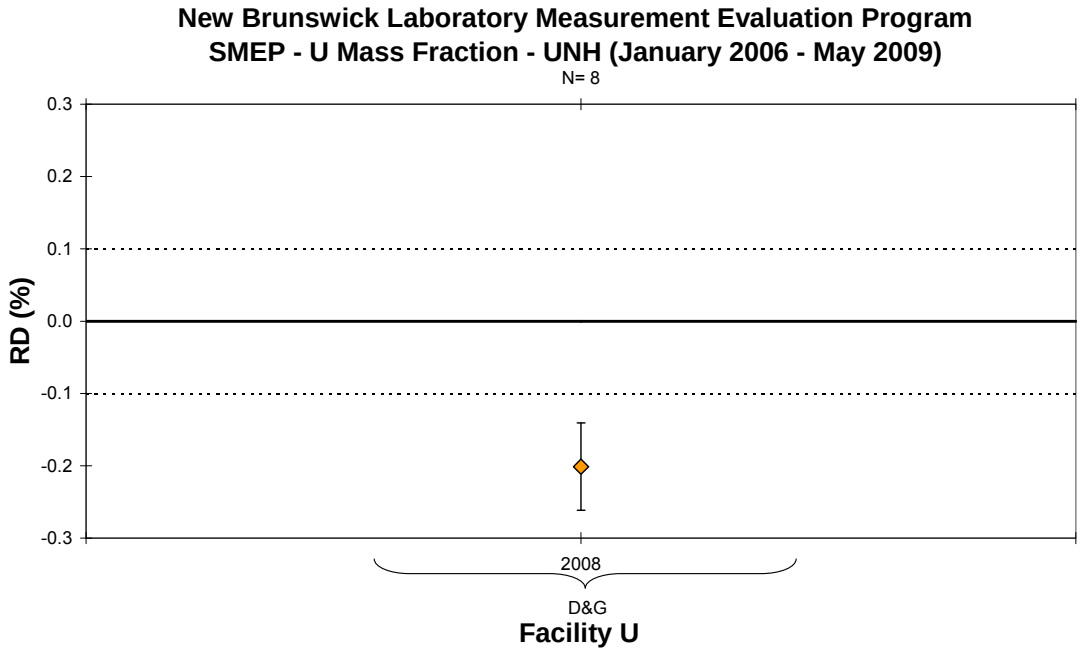


Figure G.11

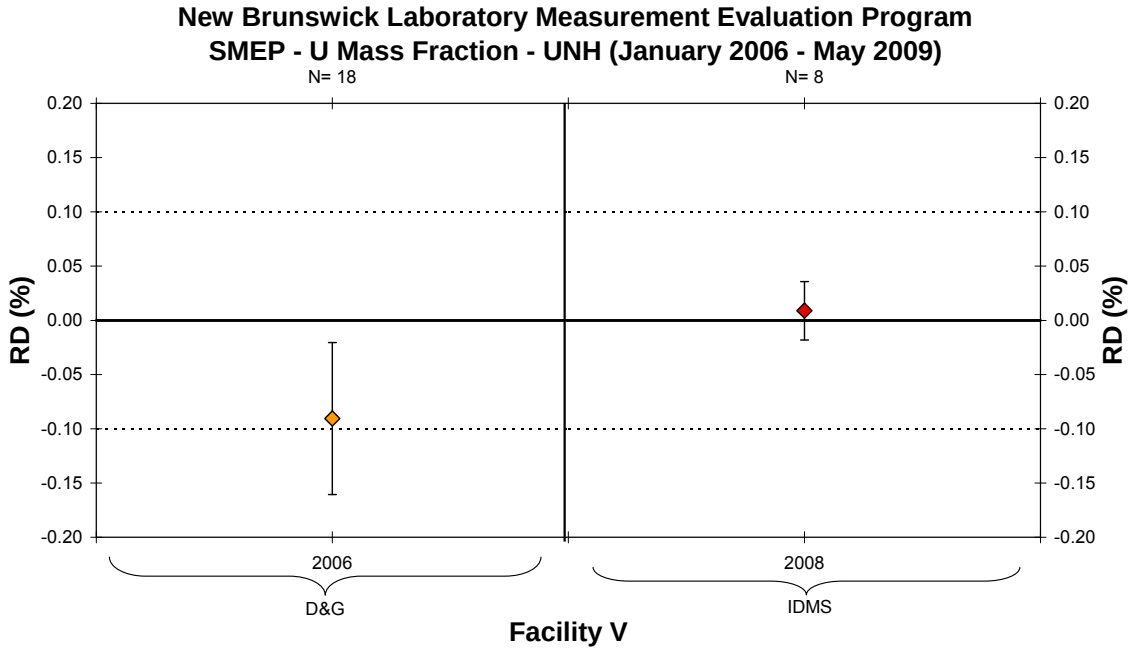
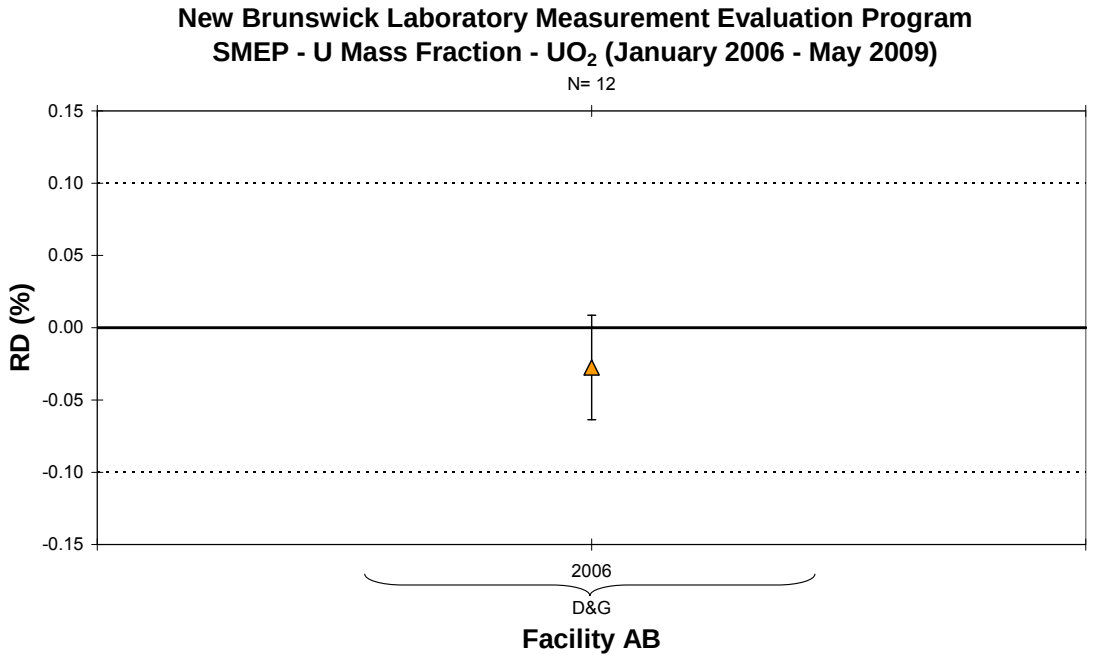


Figure G.12



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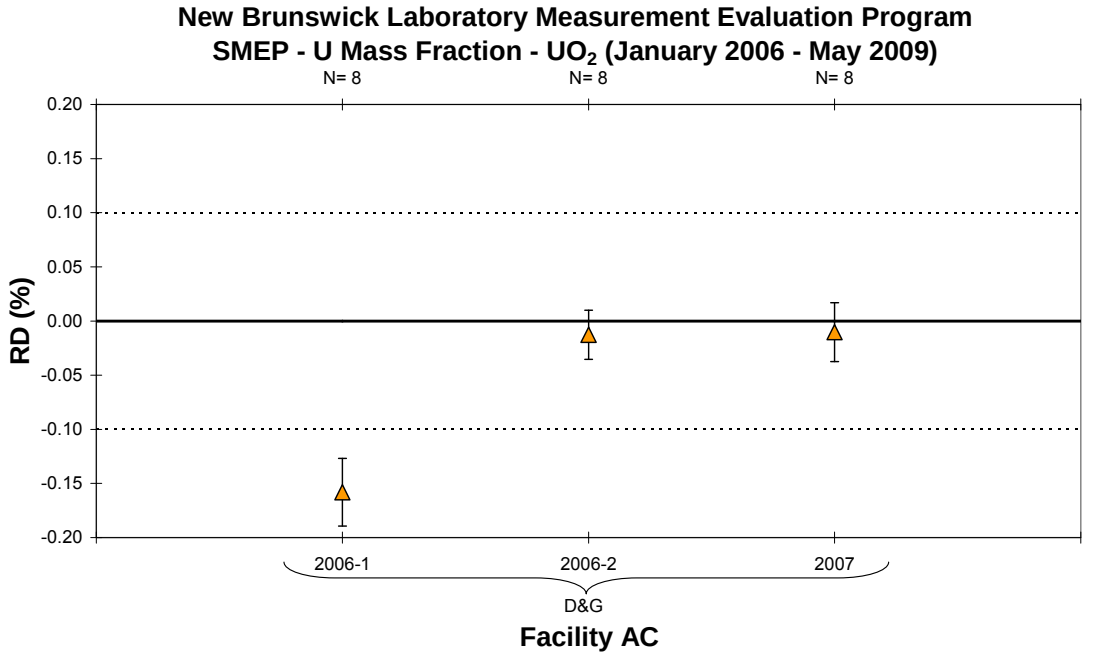
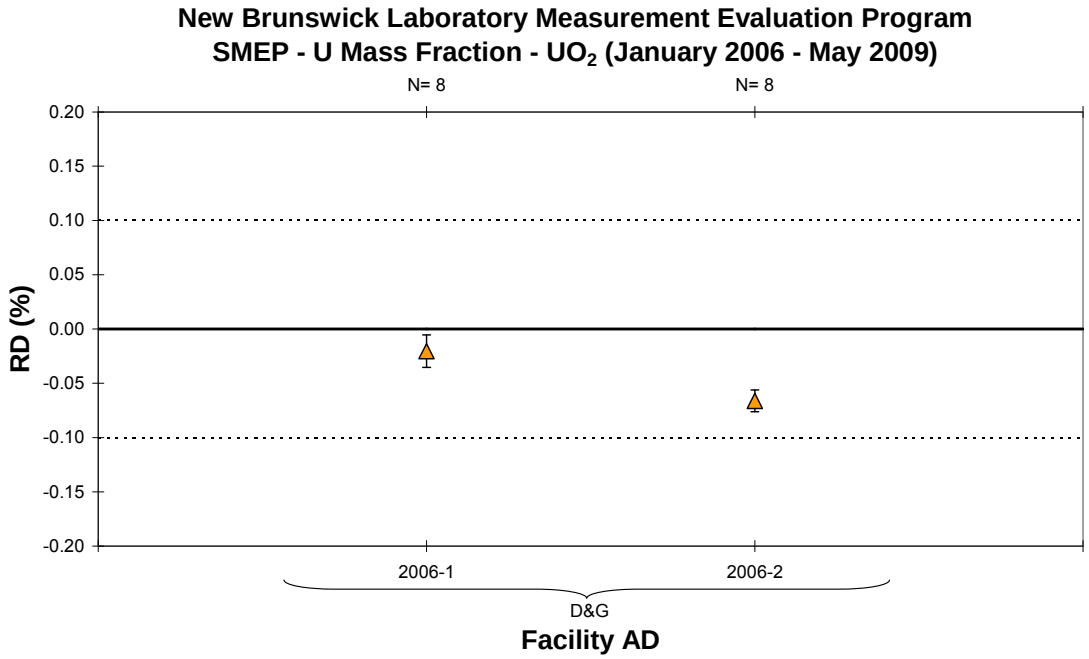


Figure G.14



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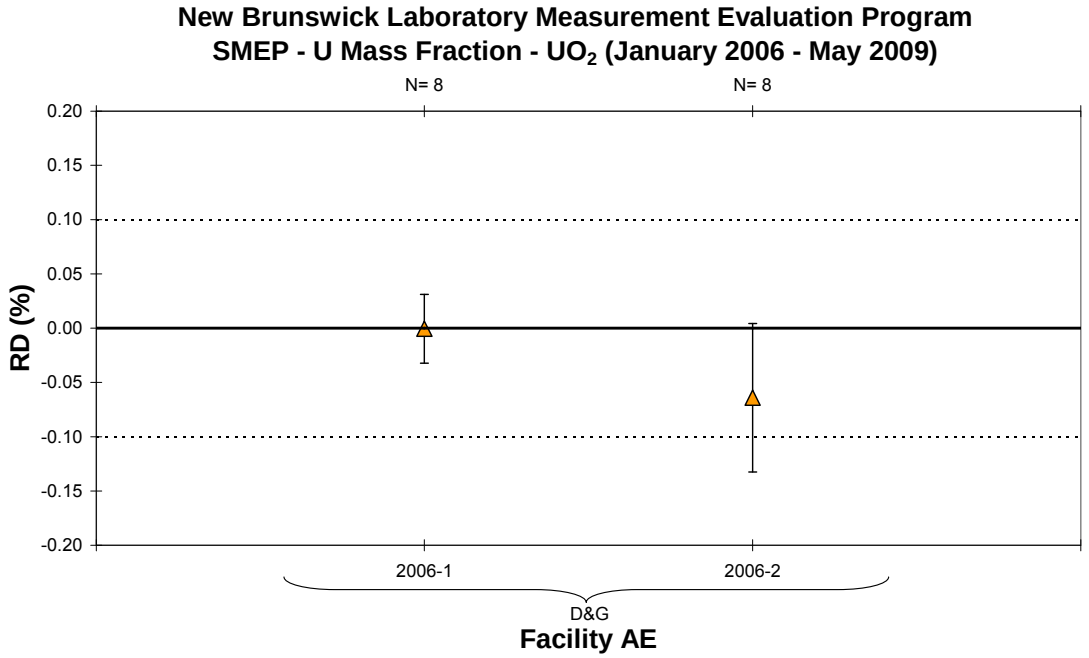
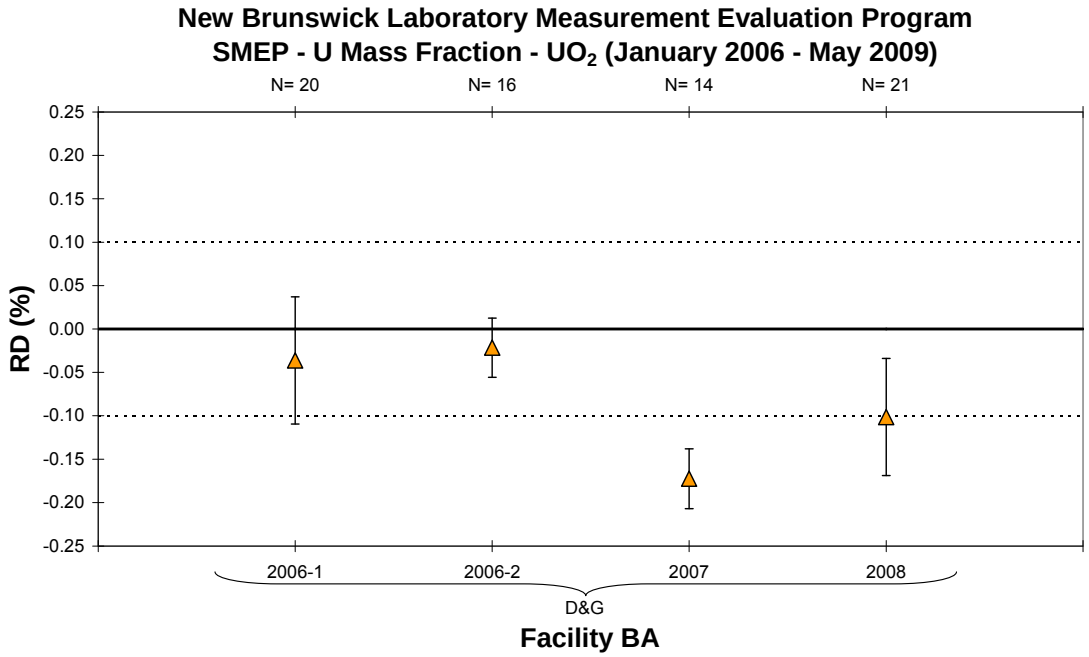


Figure G.16



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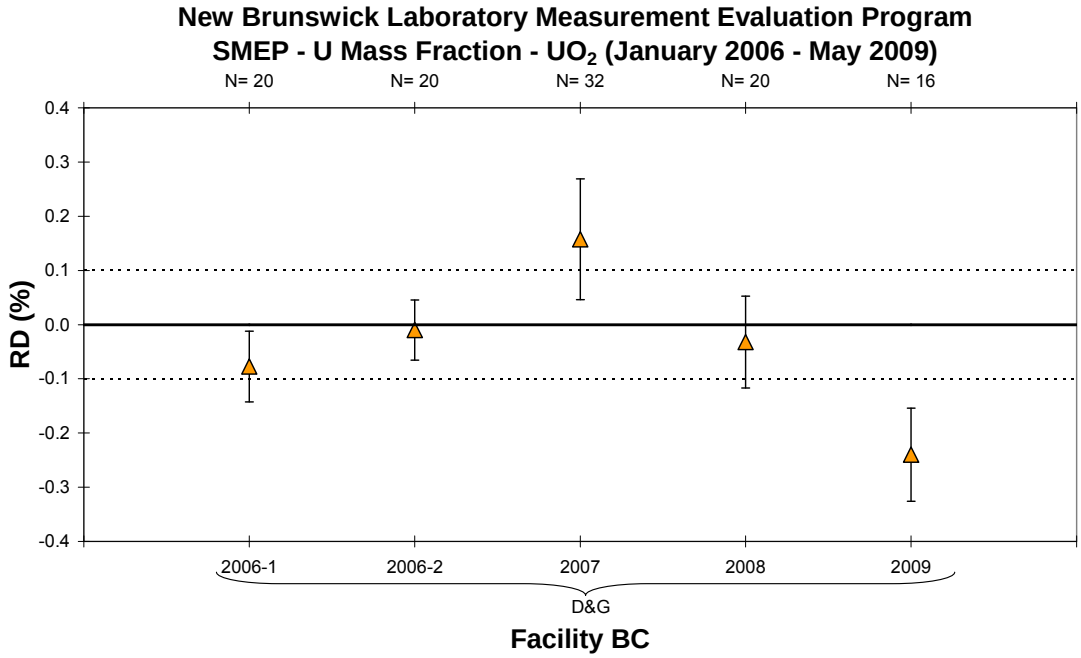


Figure G.18

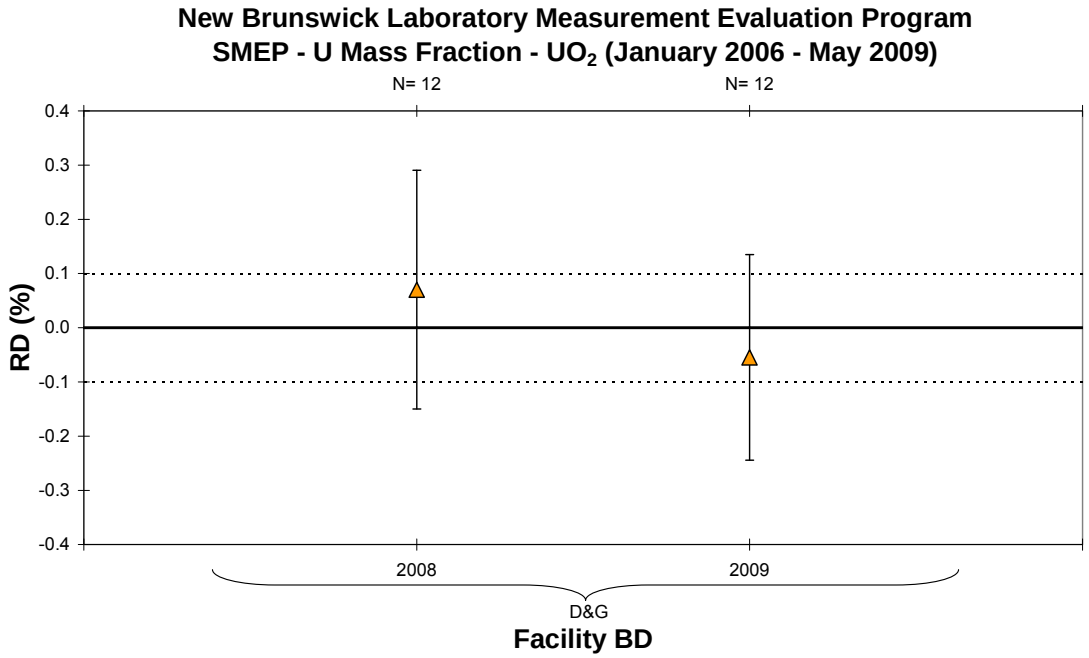


Figure G.19

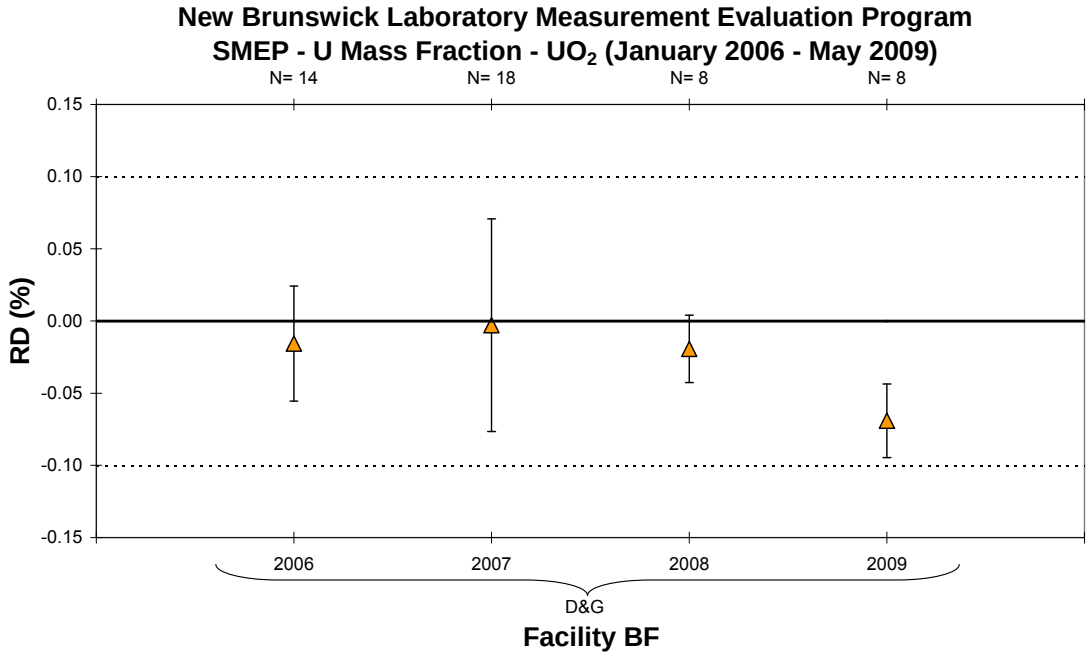
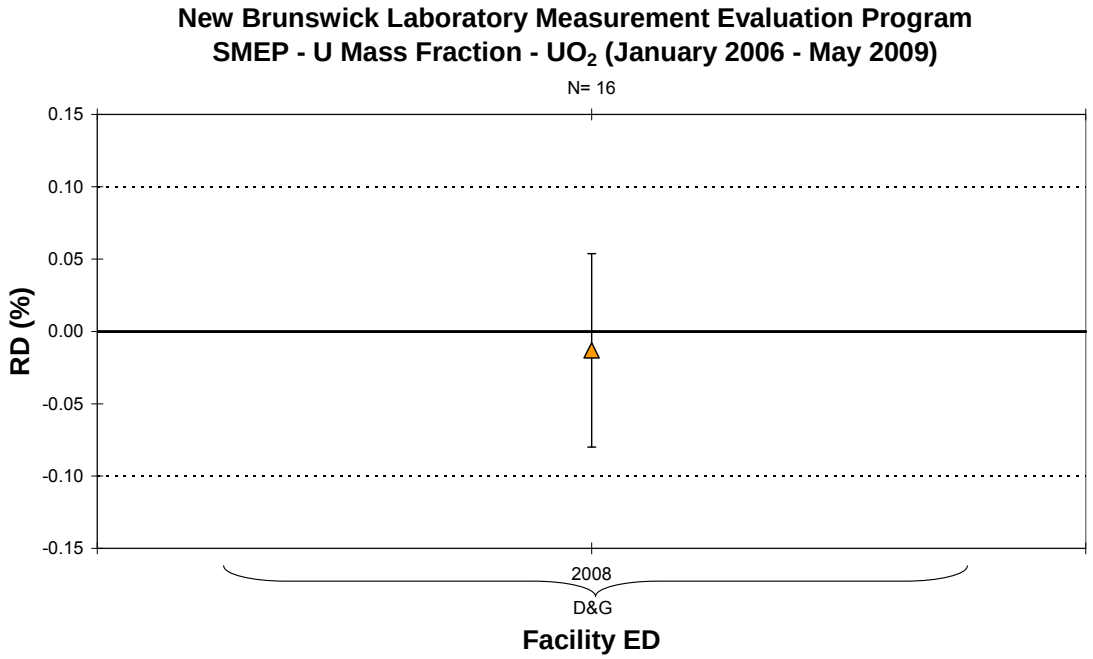


Figure G.20



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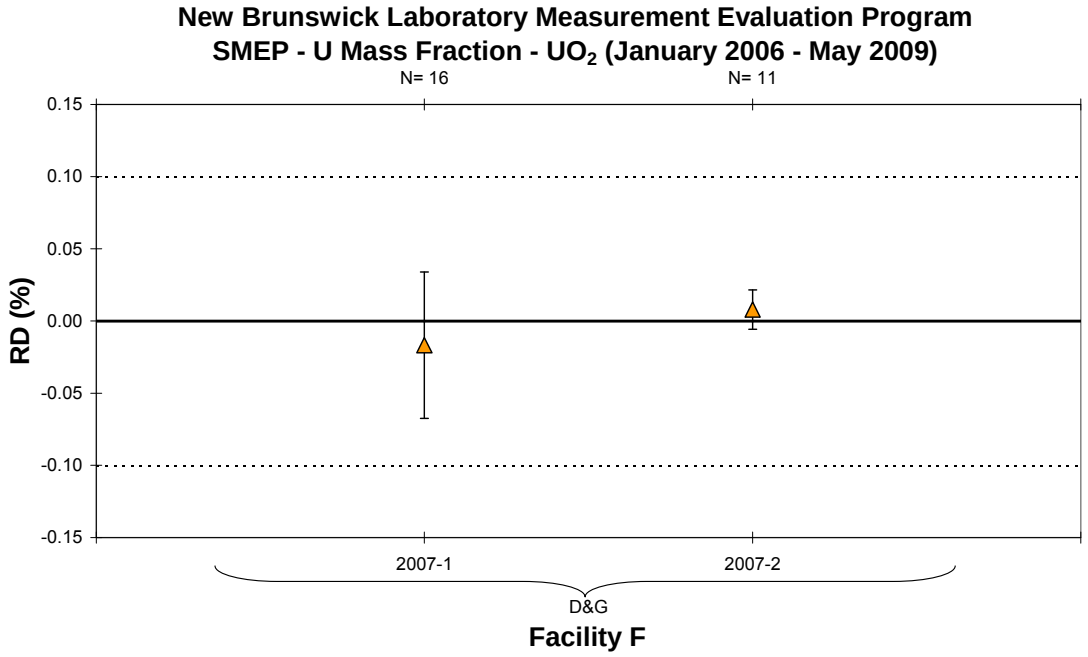

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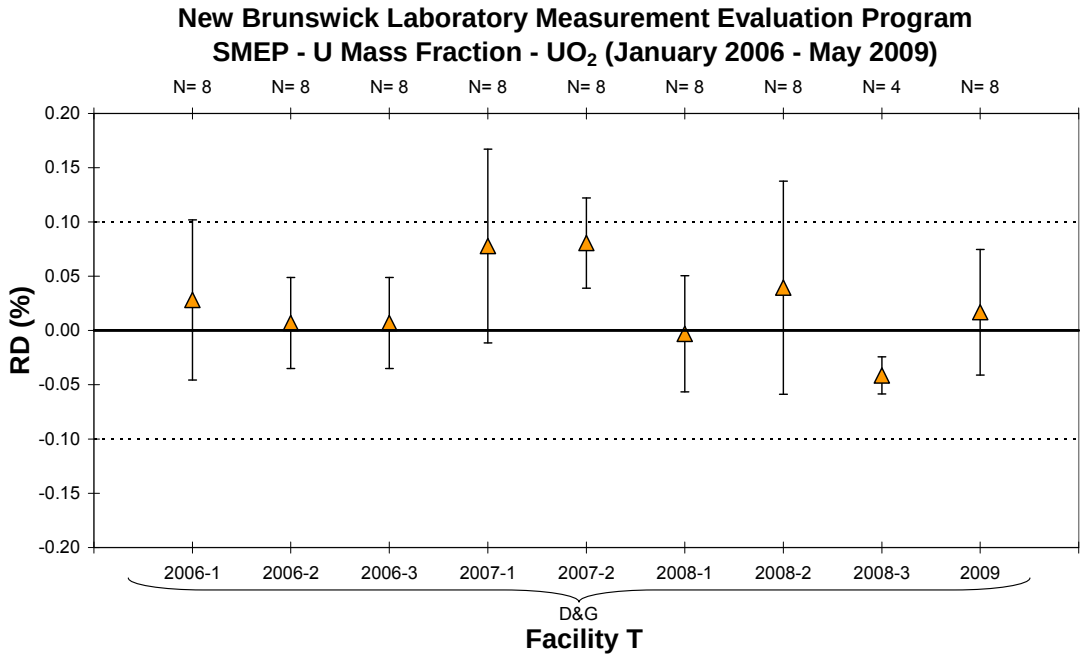

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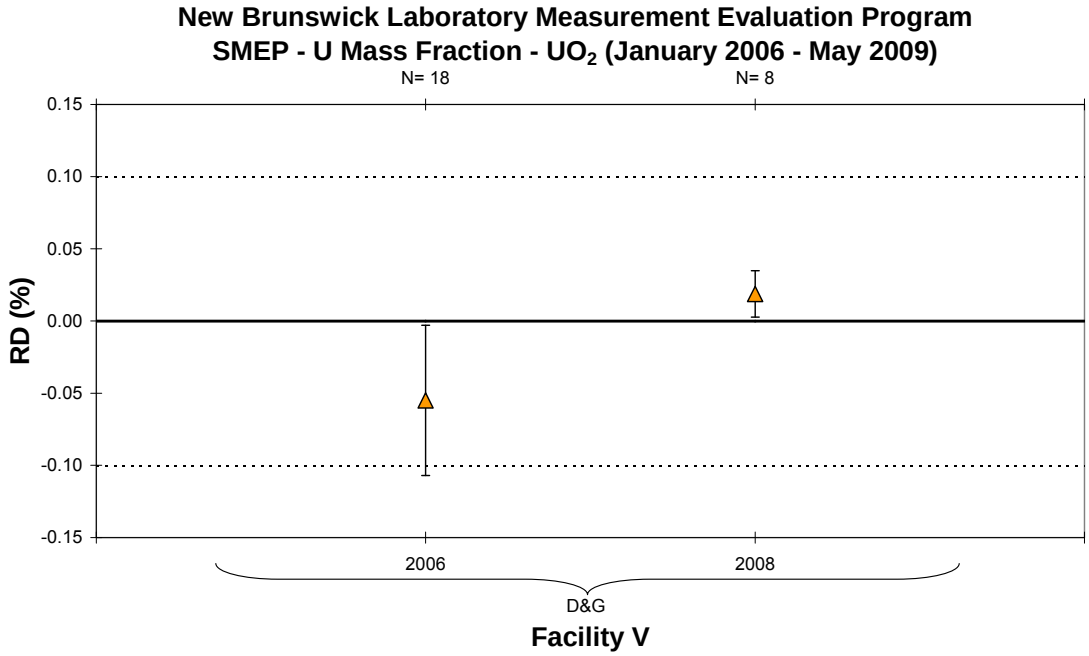

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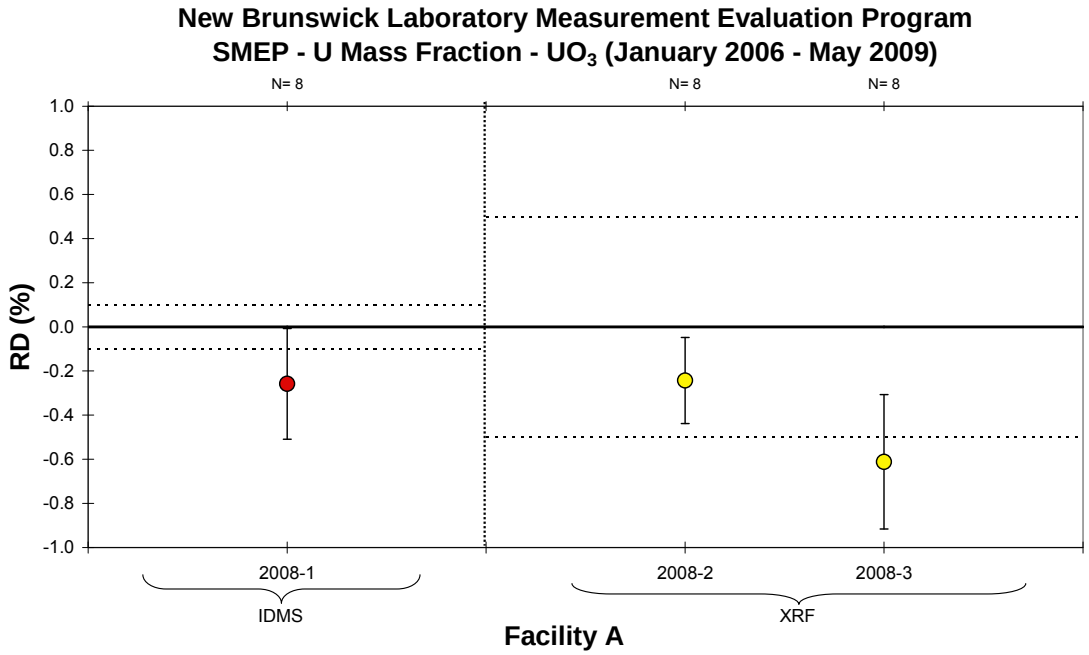

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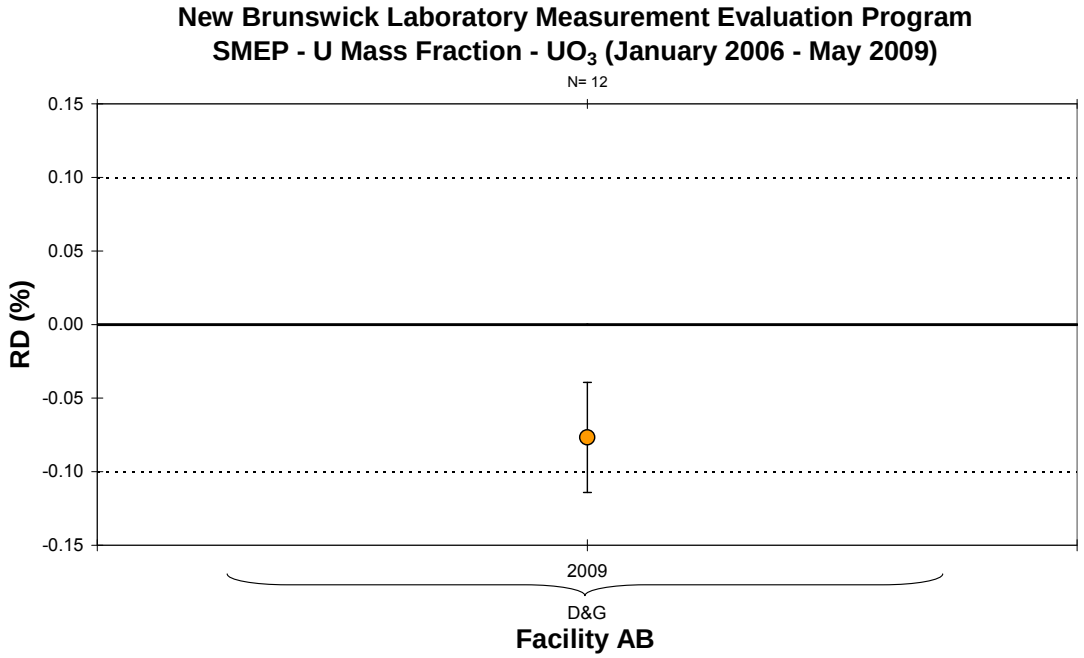

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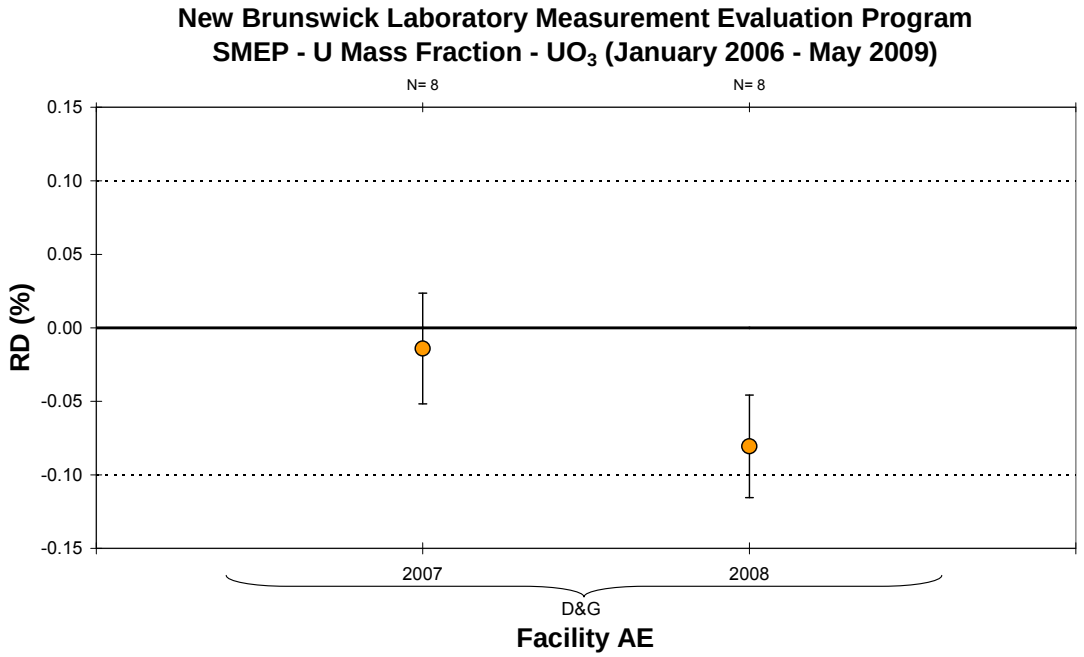

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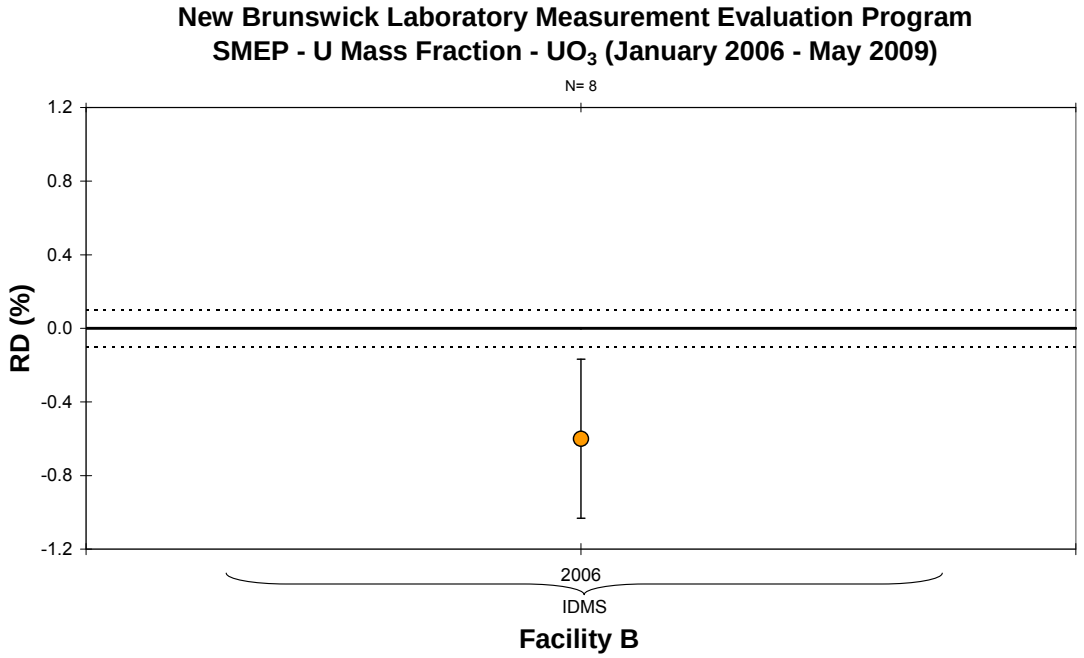

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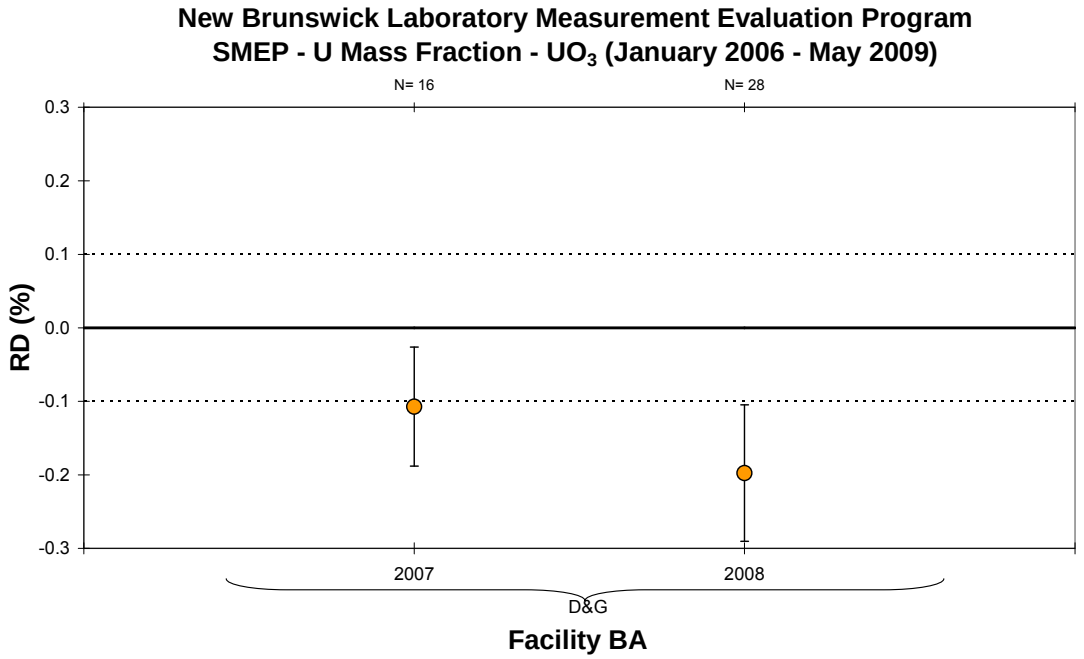

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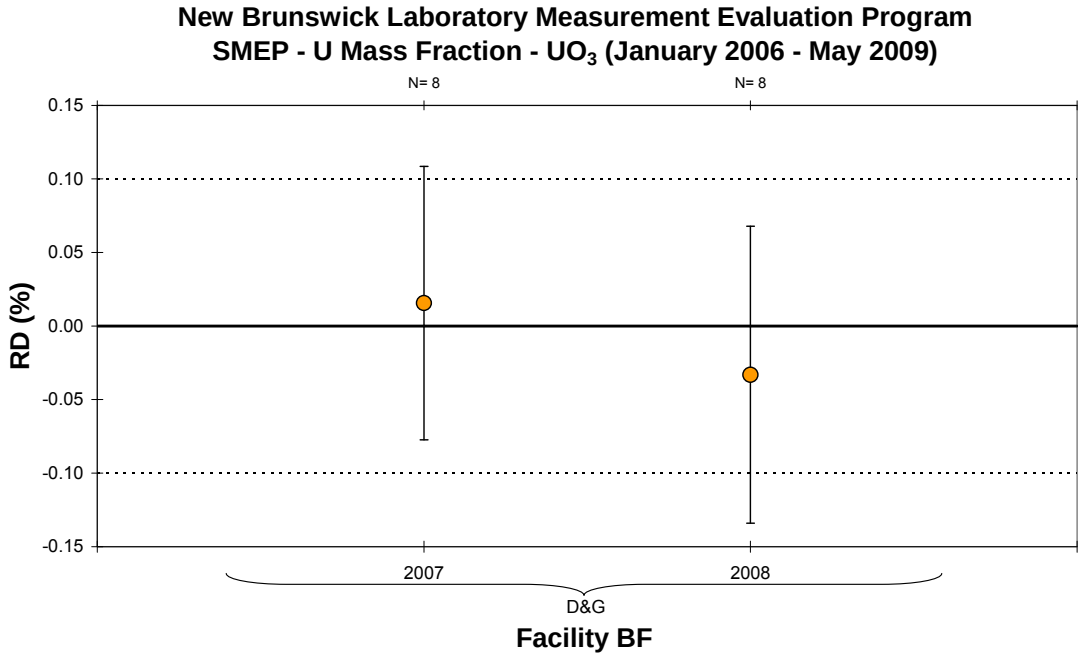

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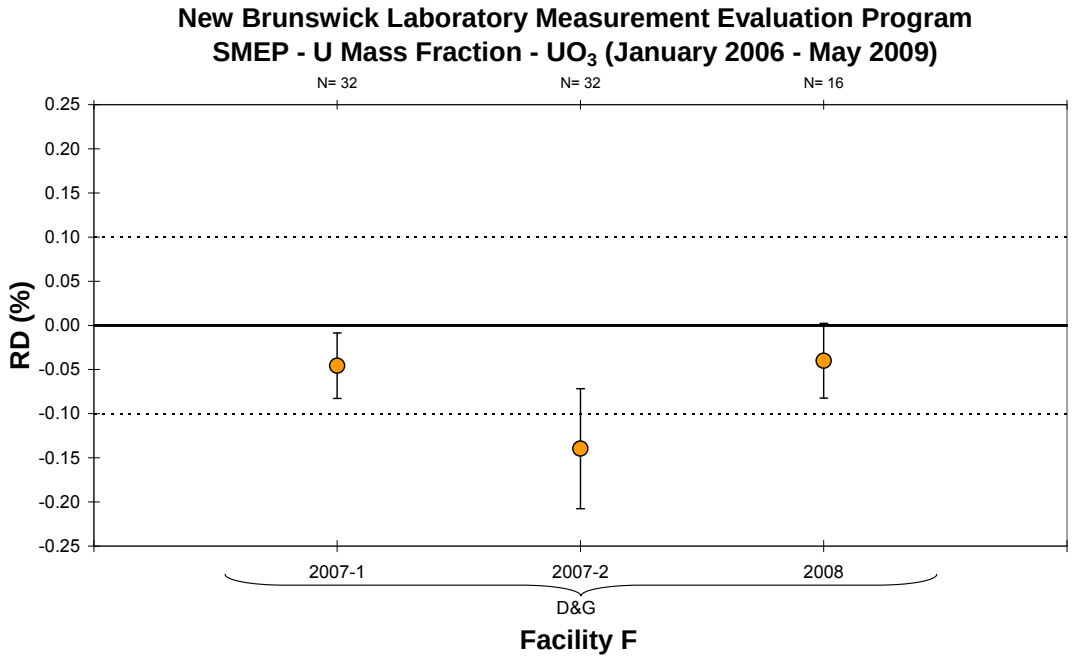

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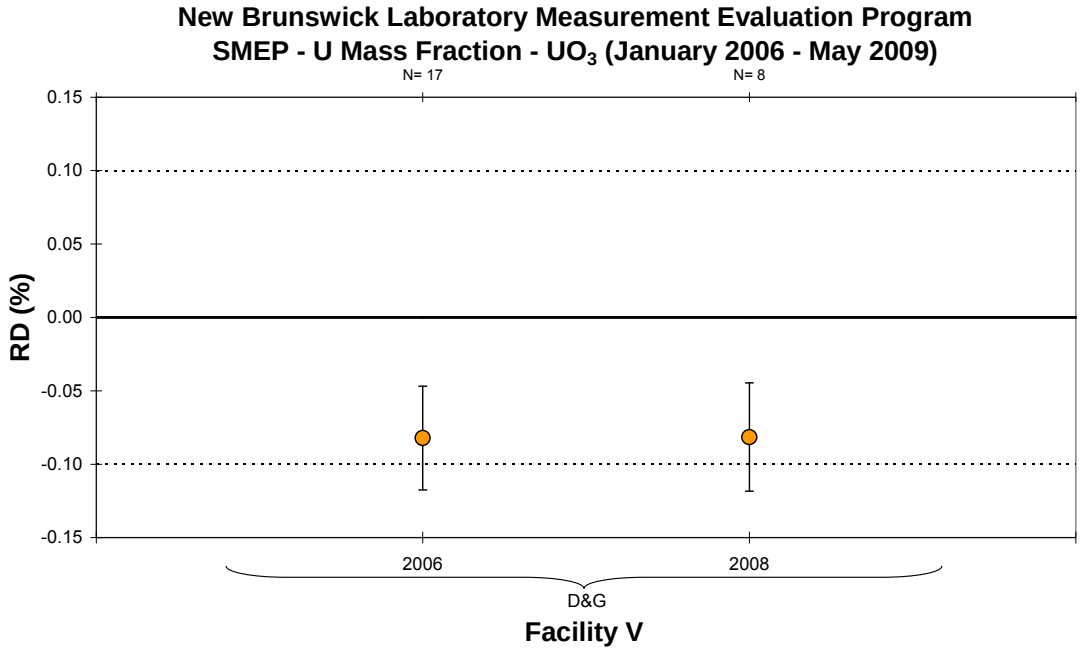

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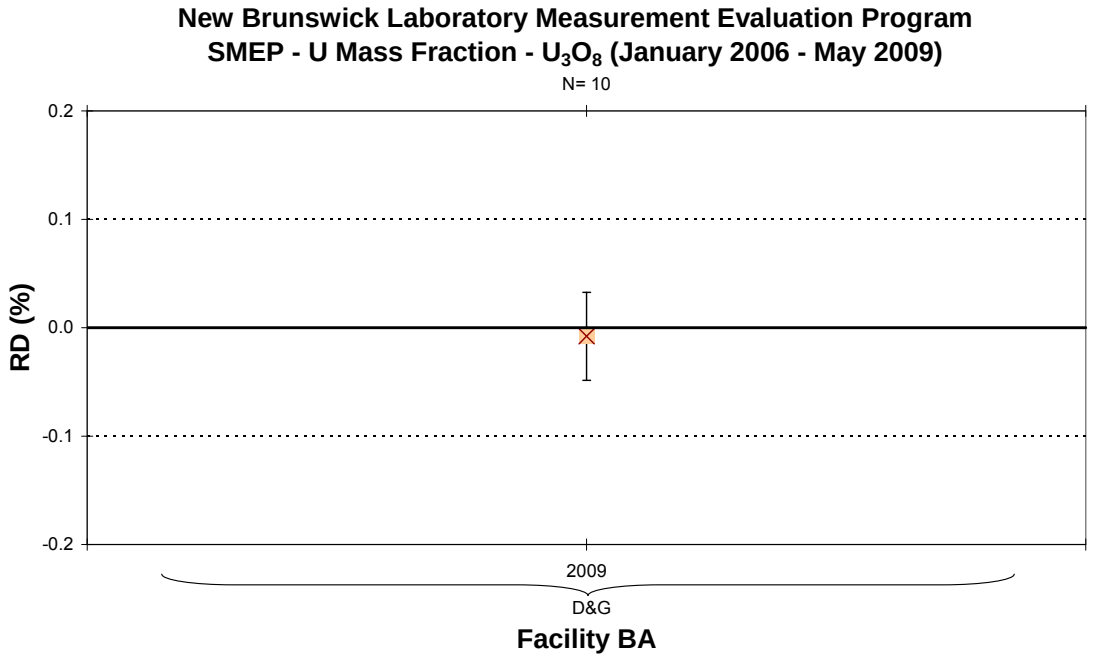

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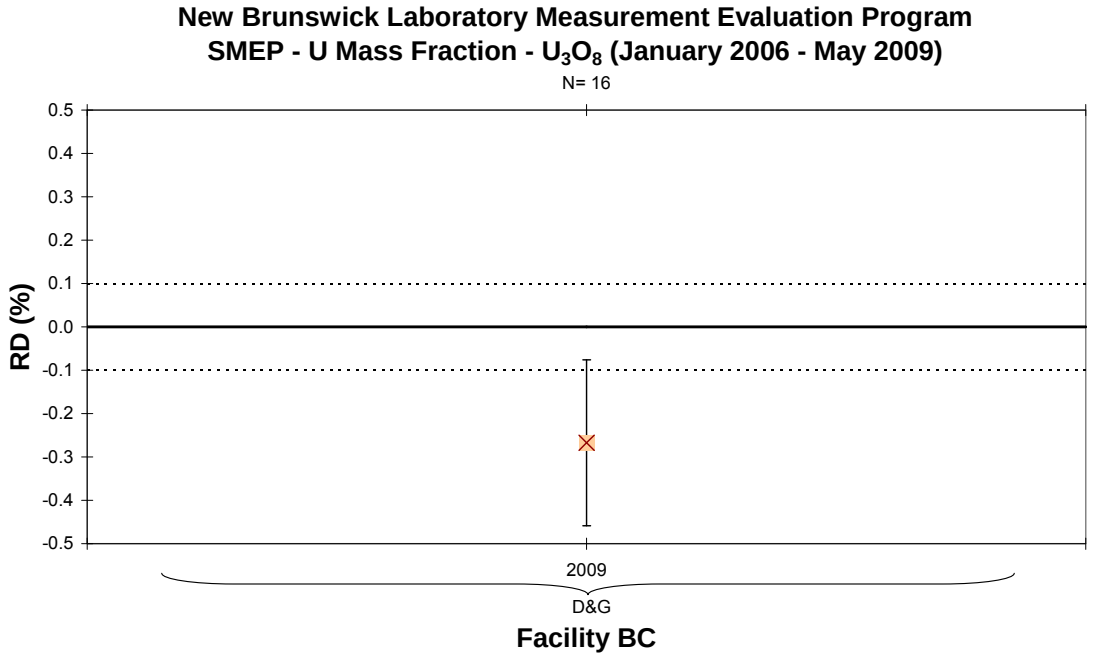

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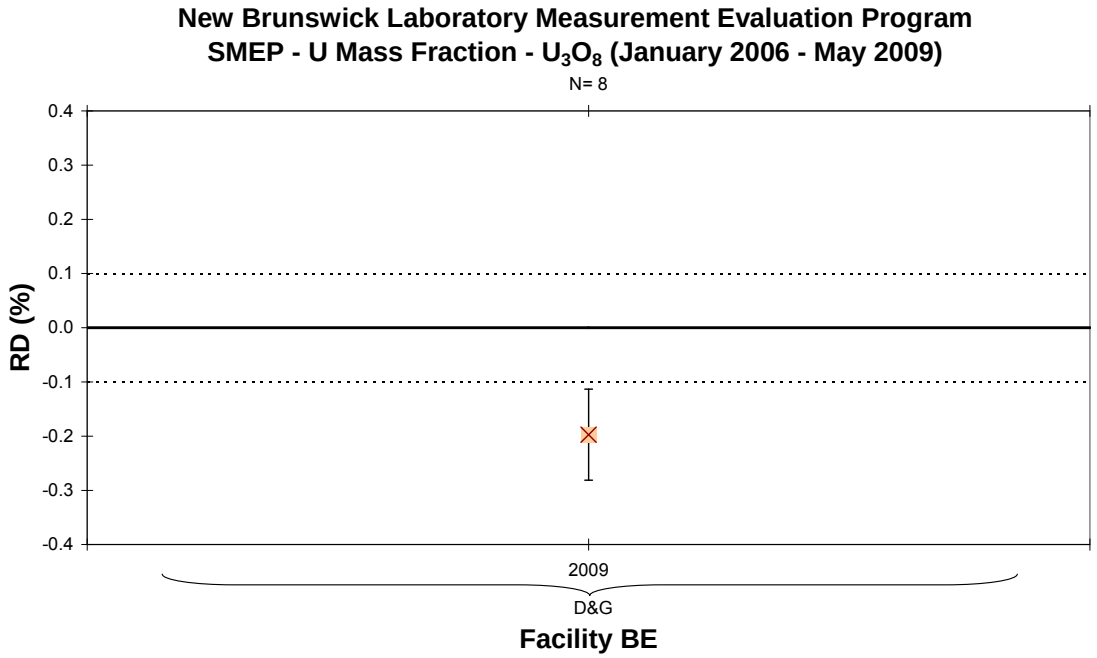

New Brunswick Laboratory Measurement Evaluation Program
SMEP - U Mass Fraction - U_3O_8 (January 2006 - May 2009)
N= 8
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
RD (%)
2009
D&G
Facility BE

Figure G.35

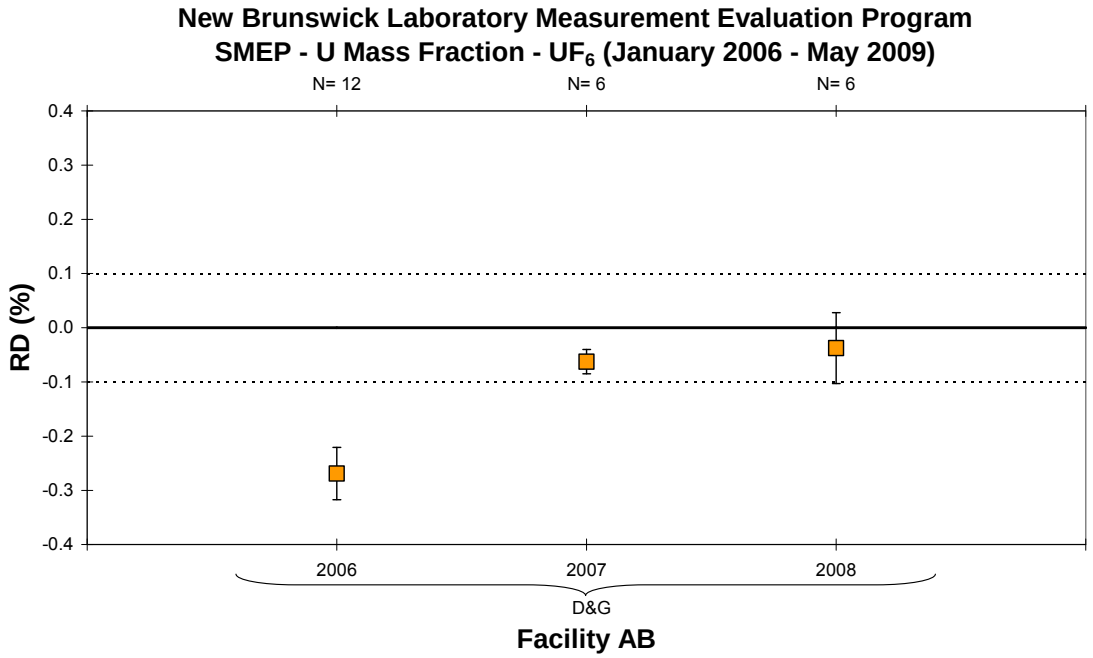


Figure G.36

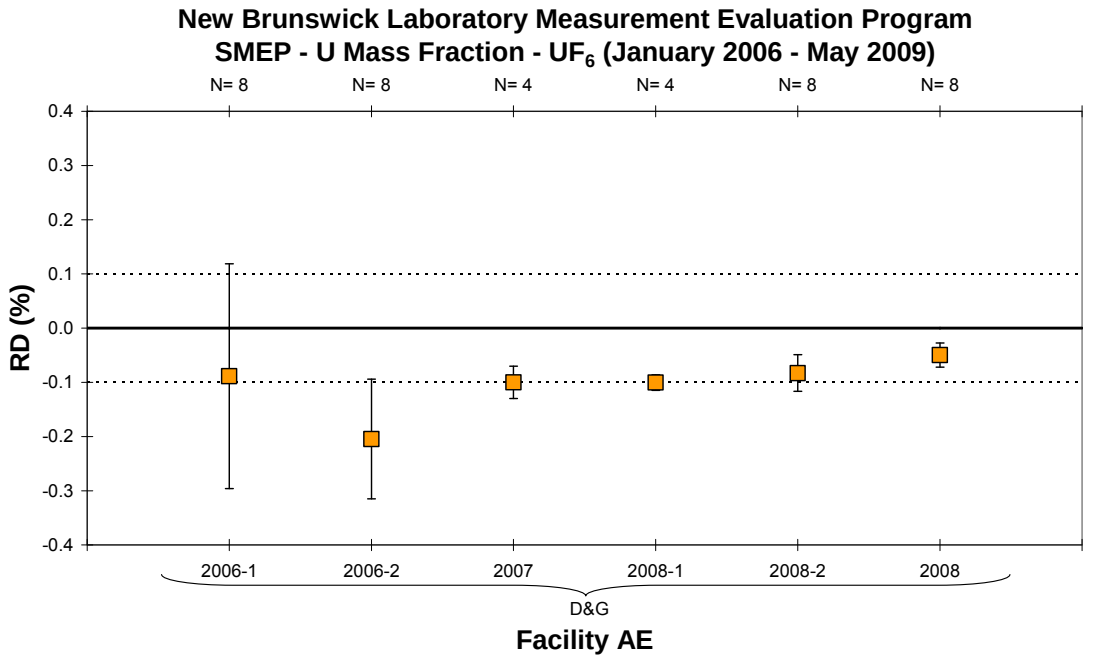


Figure G.37

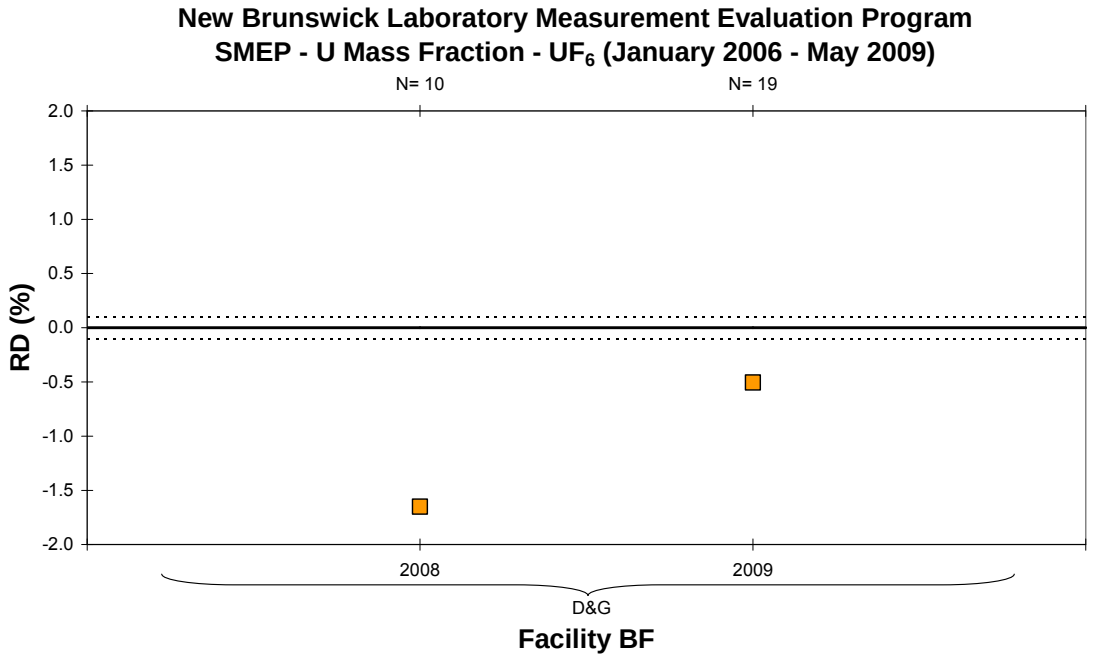


Figure G.38

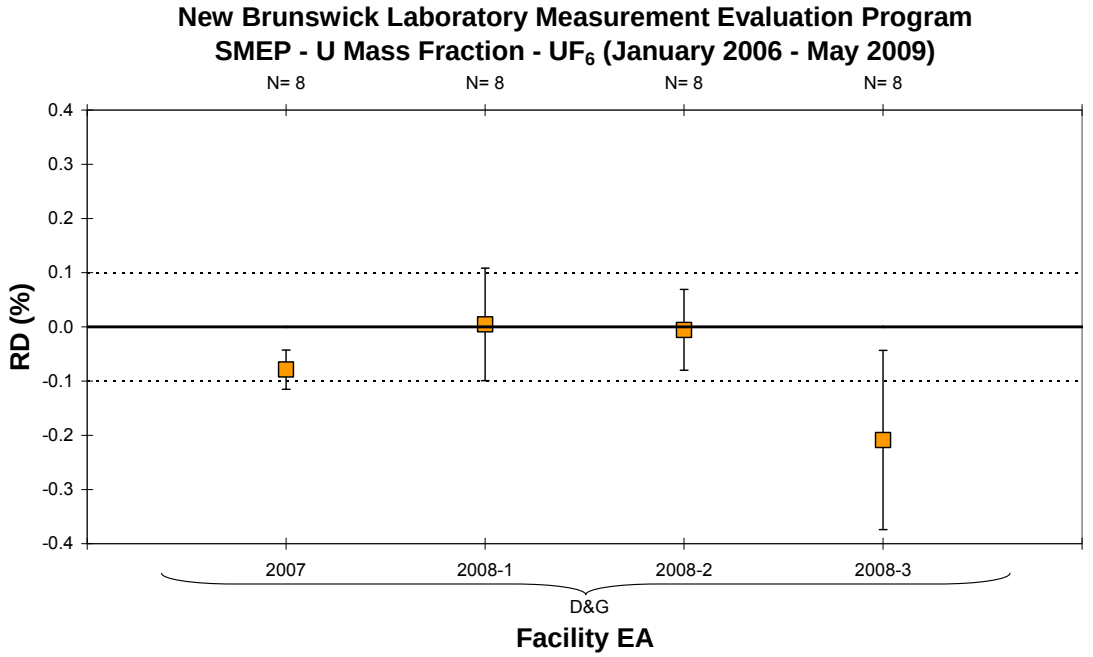


Figure G.39

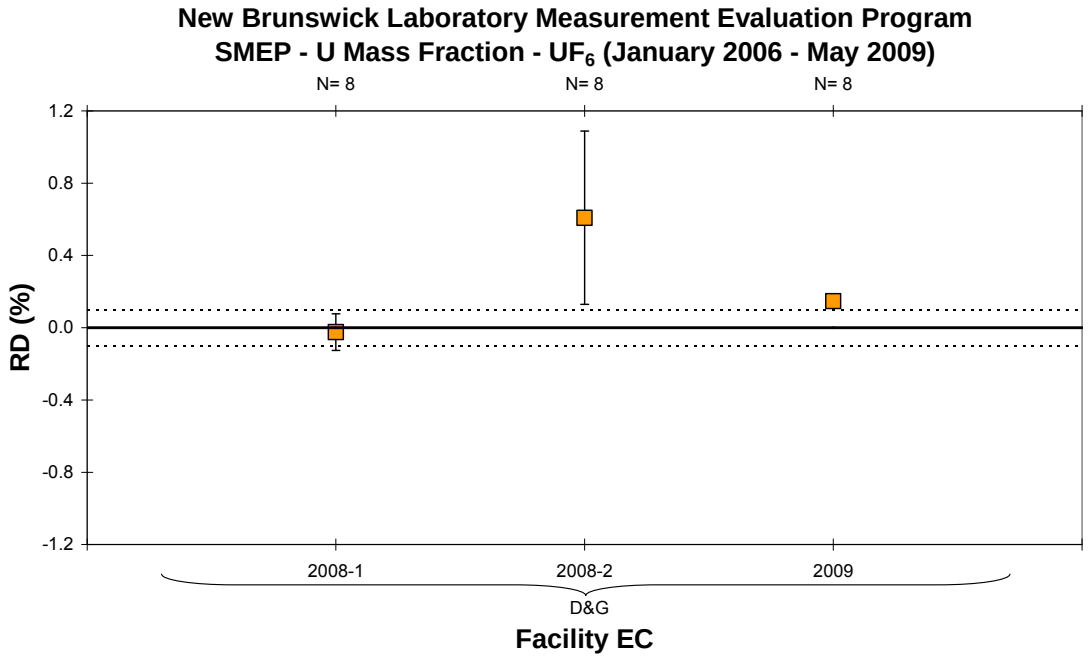


Figure G.40

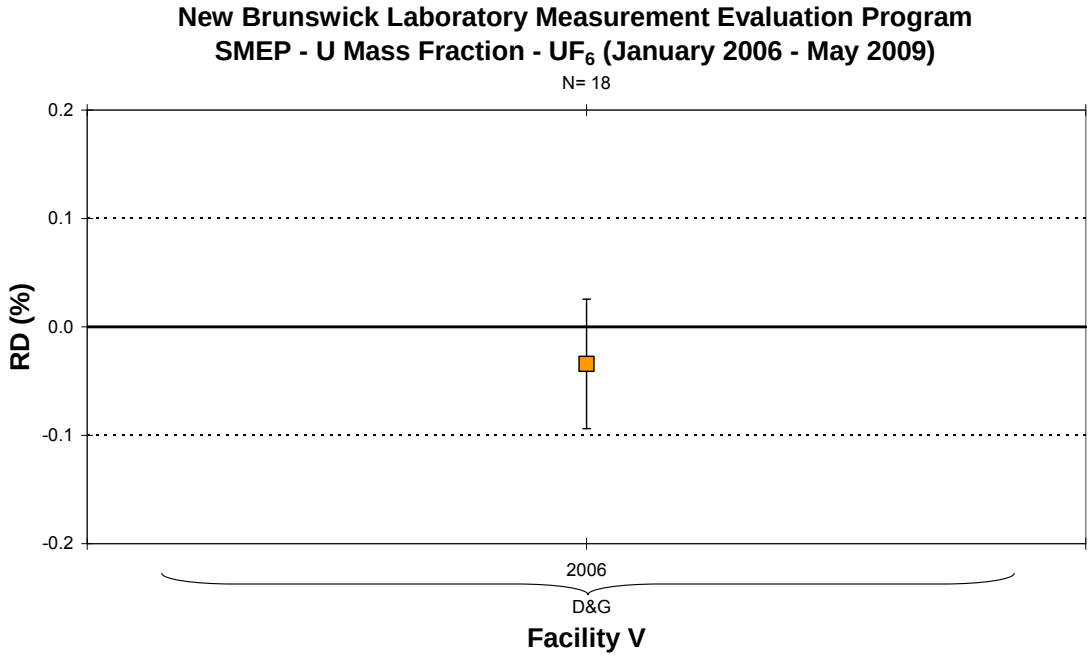


Figure G.41

H. ^{235}U ABUNDANCE MEASUREMENTS: THREE-YEAR SUMMARY

A three year summary of ^{235}U abundance measurement results is presented in Figures H.1 through H.34. Separate graphs are shown for analyses results from each participant laboratory arranged according to material types and ^{235}U abundance levels. The division according to abundance levels is based on the division shown in 2000 ITVs document: ^{235}U abundance range of 0.3 to 1 wt % (NU), ^{235}U abundance in the range of 1 to 20 wt % (LEU), and ^{235}U abundance greater than 20 wt % (HEU). In each figure the mean % RDs (diamond, triangle, circle, X or square symbols) and the standard deviations (error bars on either side of the symbols) are shown. The lower x-axis labels in the figures show the period in which the measurements were made and the methods used in the analyses. The upper x-axis shows the number of results from which the mean % RDs and standard deviations are calculated. These figures provide a visual display of changes in performance during the three year period, CY 2006-2008. Symbols falling on the bold horizontal line (in the middle of the graph (% RD = 0)) indicates no difference between the measurements and the characterized value, those falling above the line indicates positive deviation, and those falling below the line indicate negative deviation. Symbols falling within the dashed lines above and below the bold horizontal line indicate compliance to the ITVs for u(s). Note that separate graphs are not shown to display compliance to the ITVs for u(r).

See Appendix B for a complete set of ^{235}U abundance measurement results.

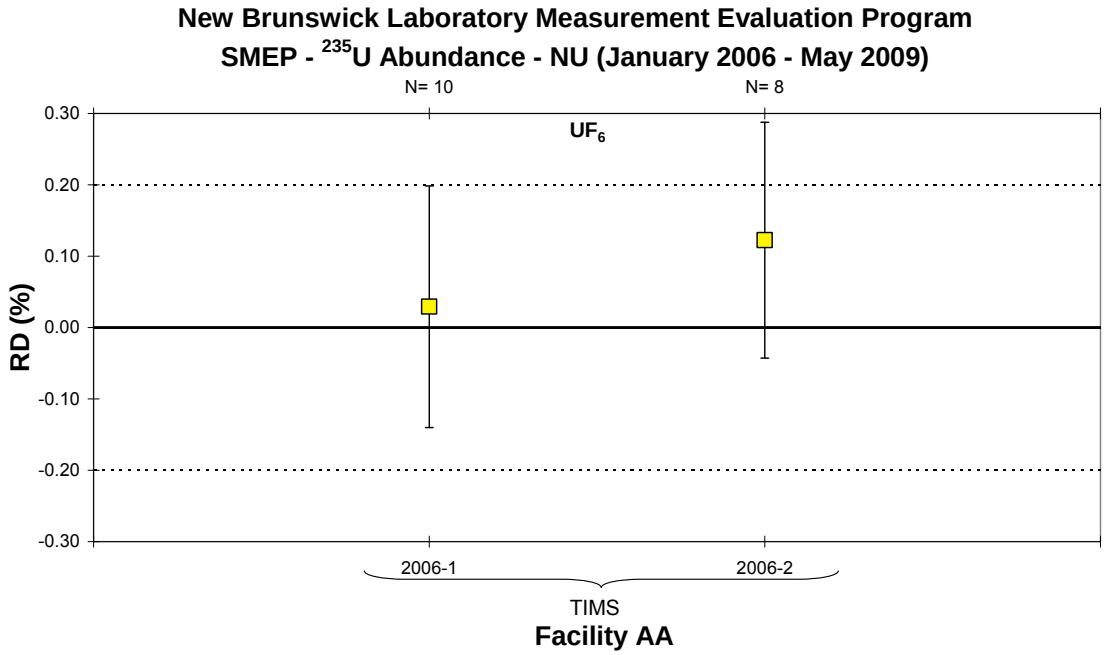


Figure H.1

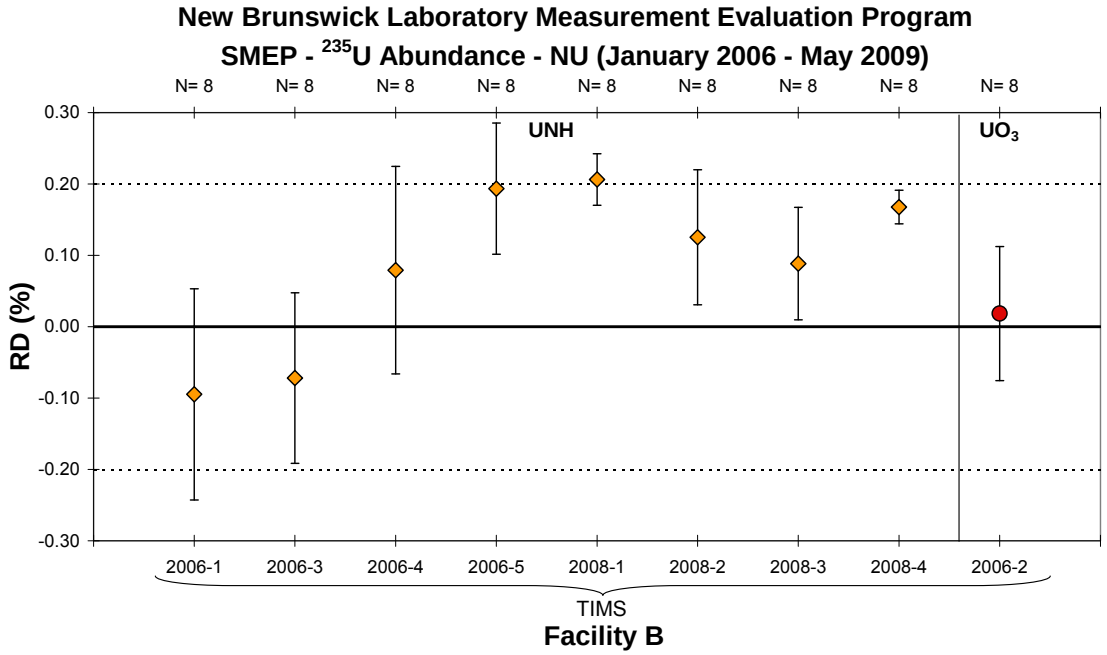
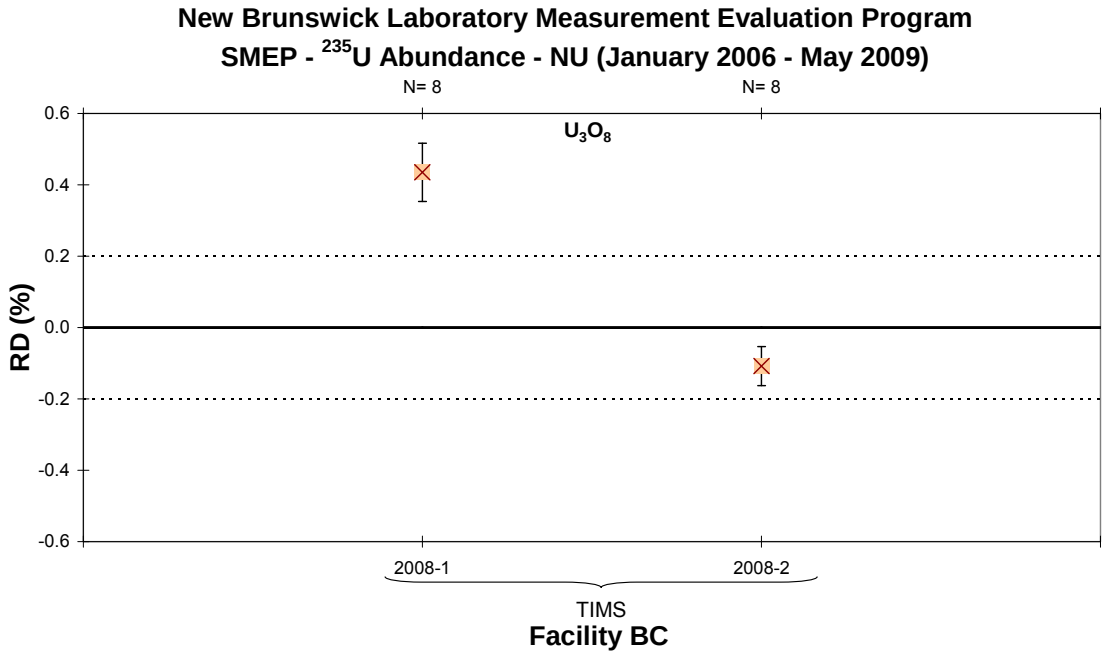


Figure H.2



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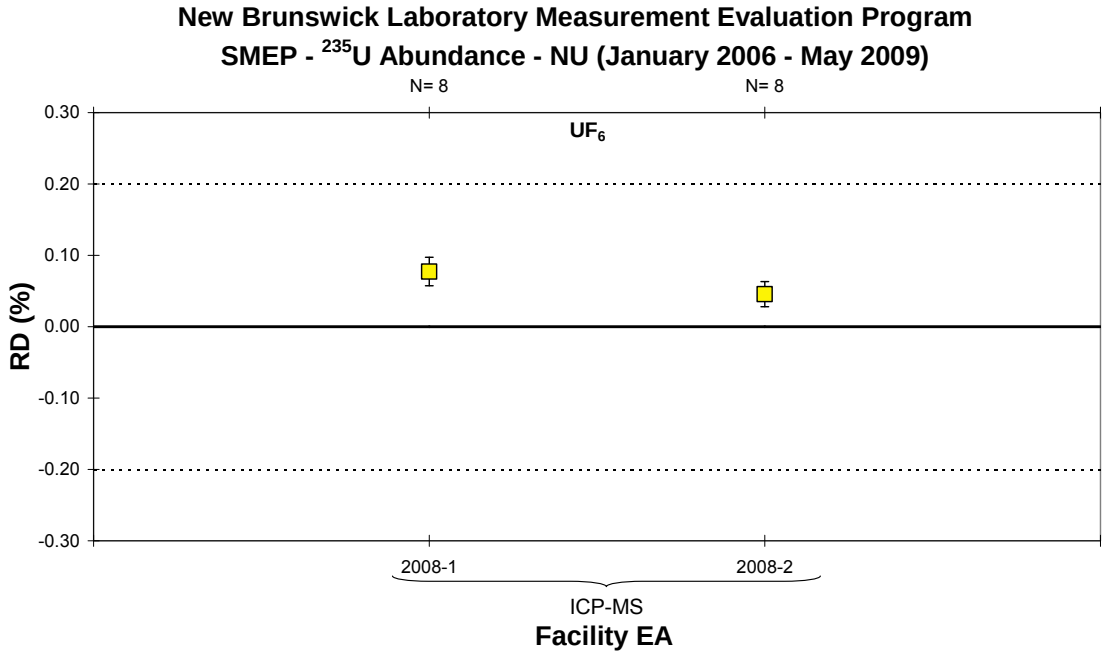


Figure H.4

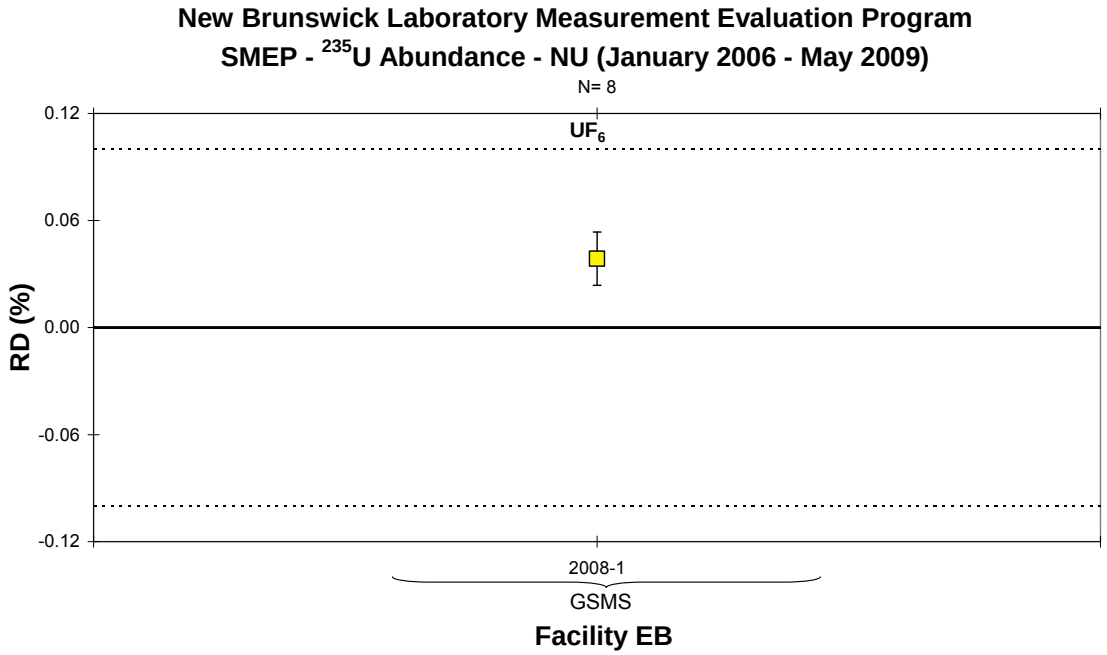


Figure H.5

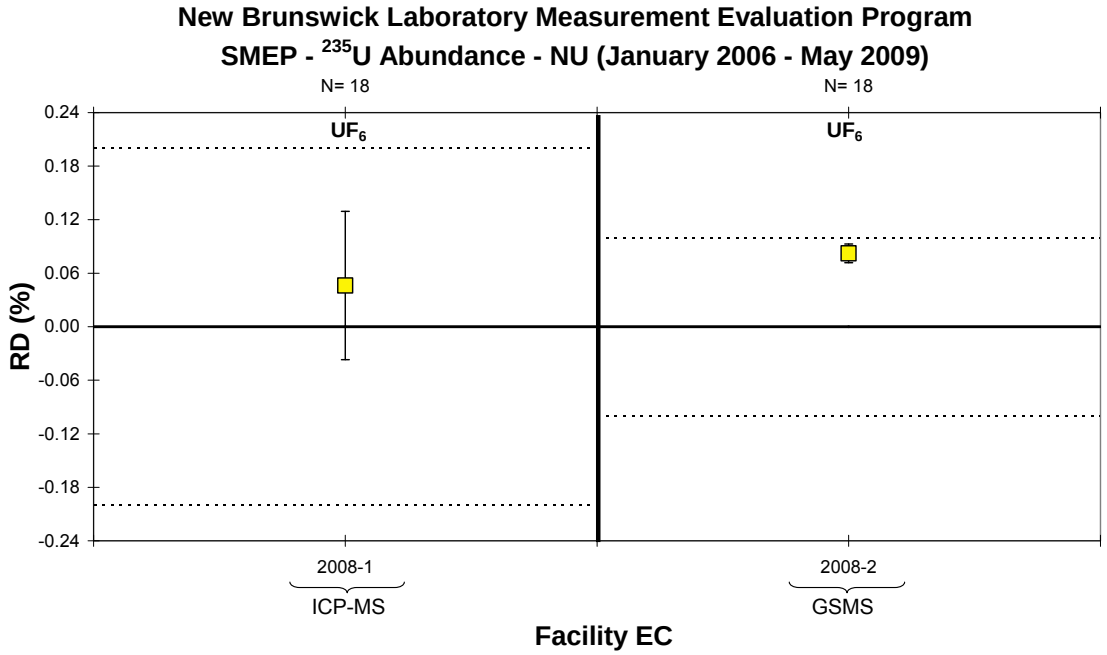


Figure H.6

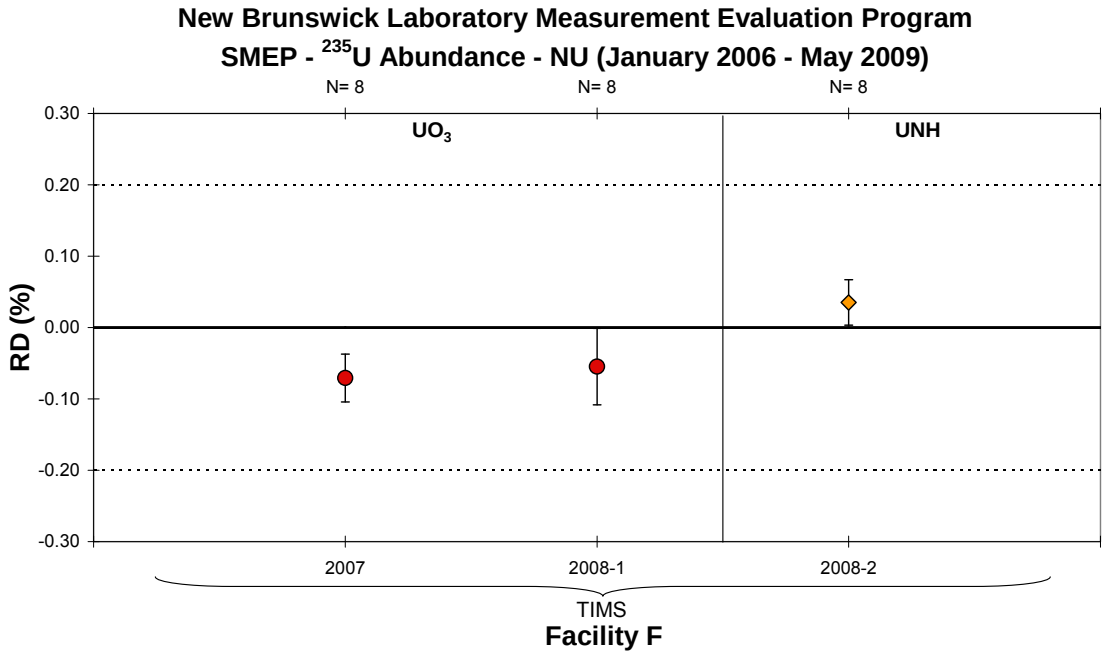


Figure H.7

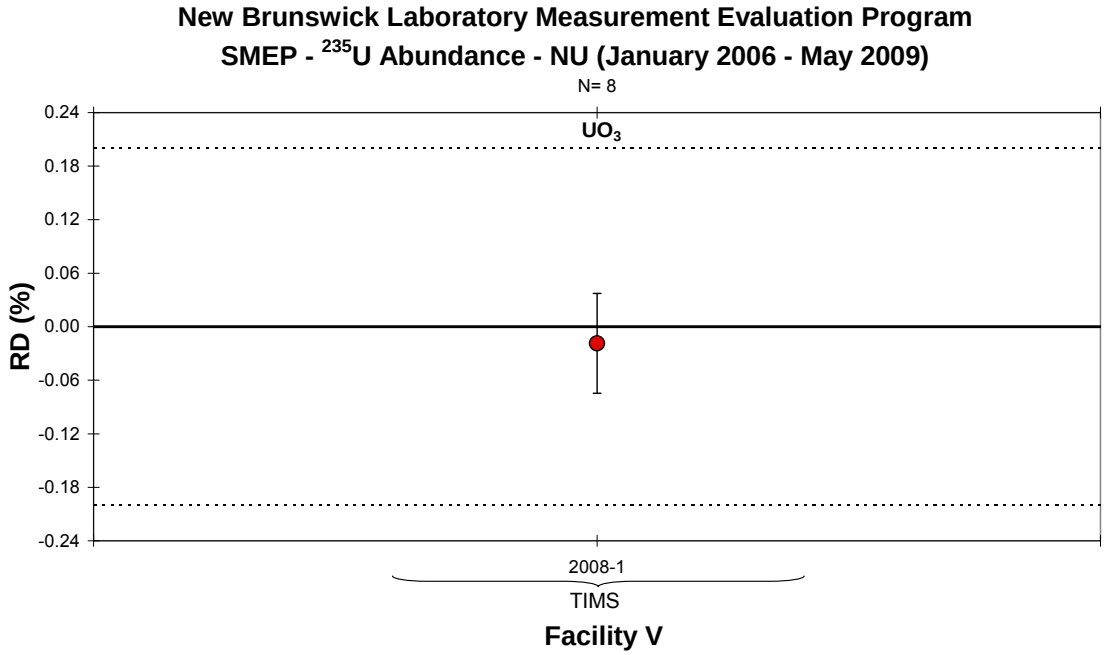


Figure H.8

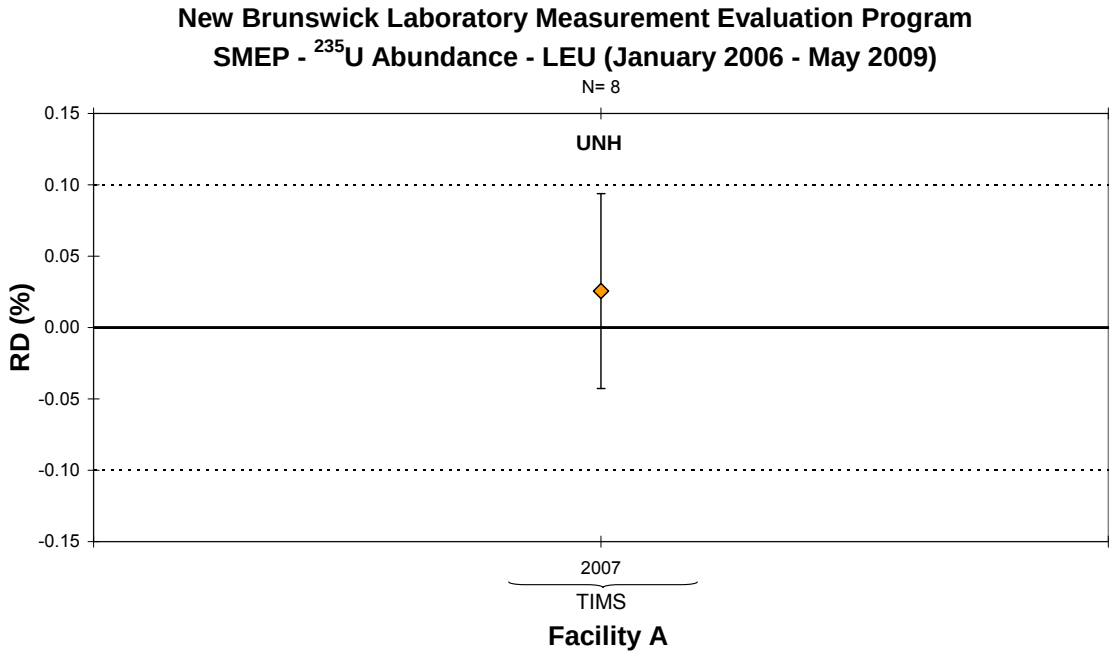


Figure H.9

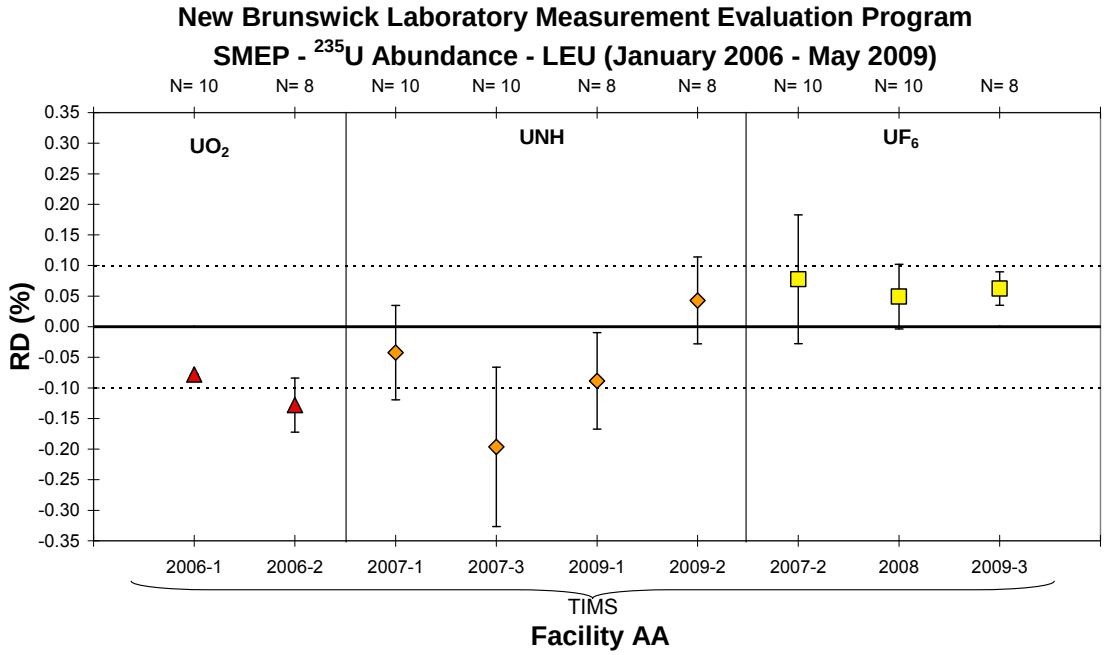
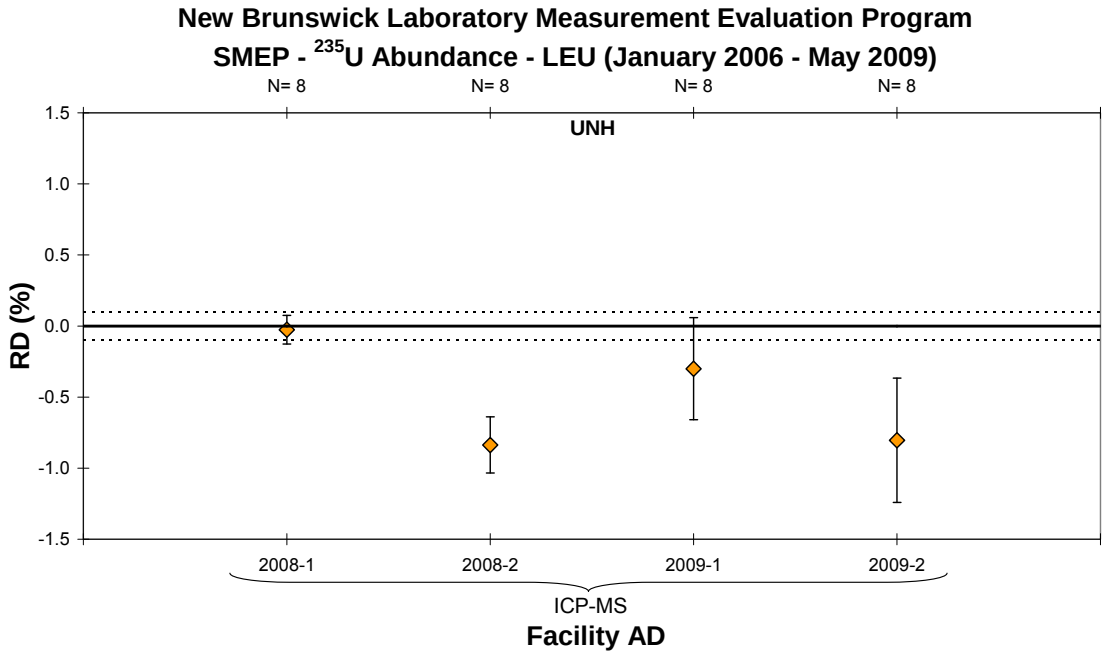


Figure H.10



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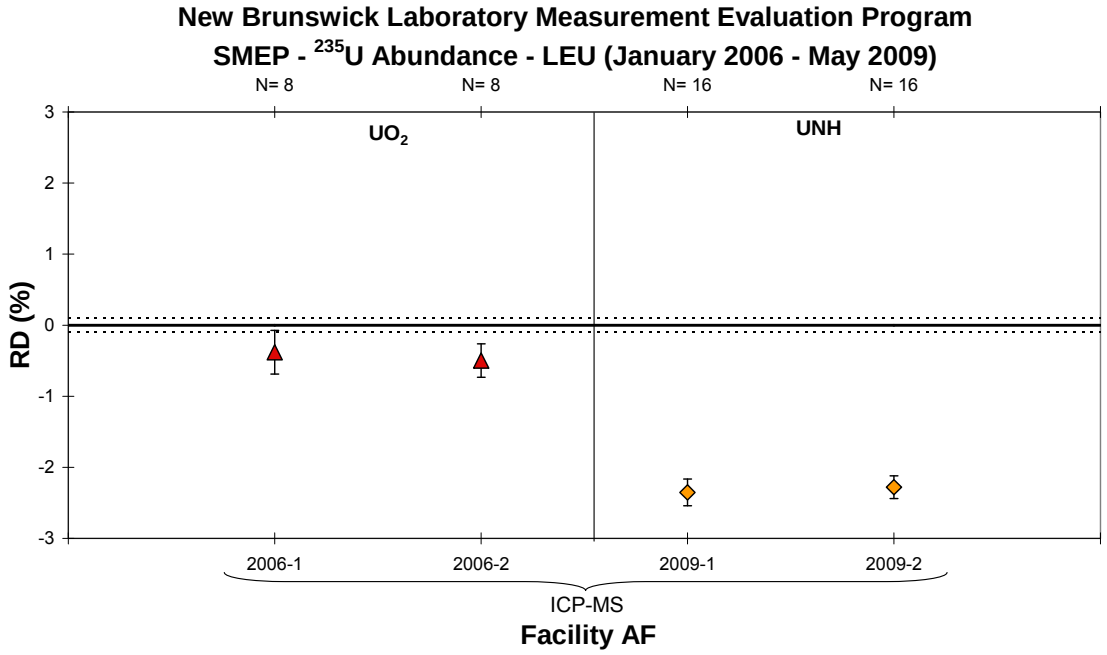
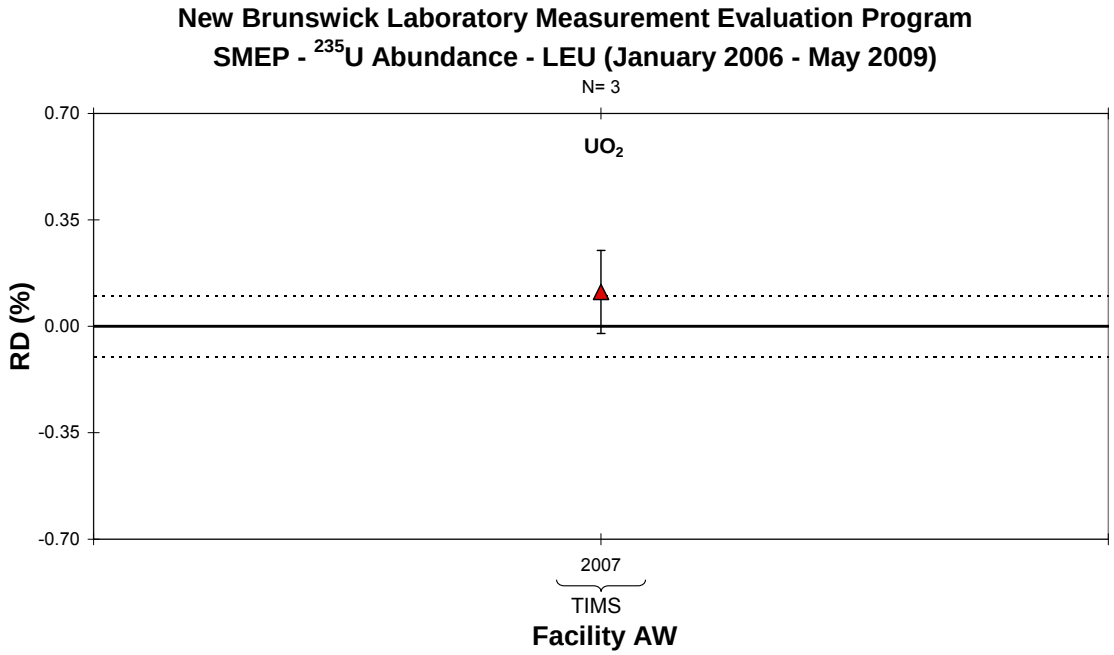


Figure H.12



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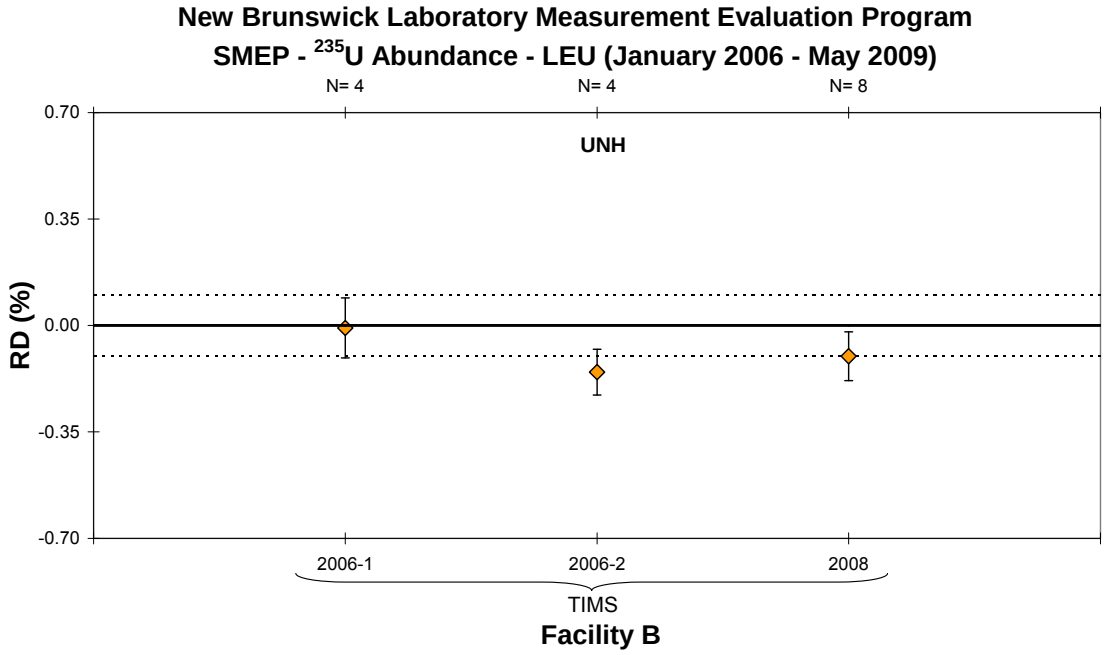
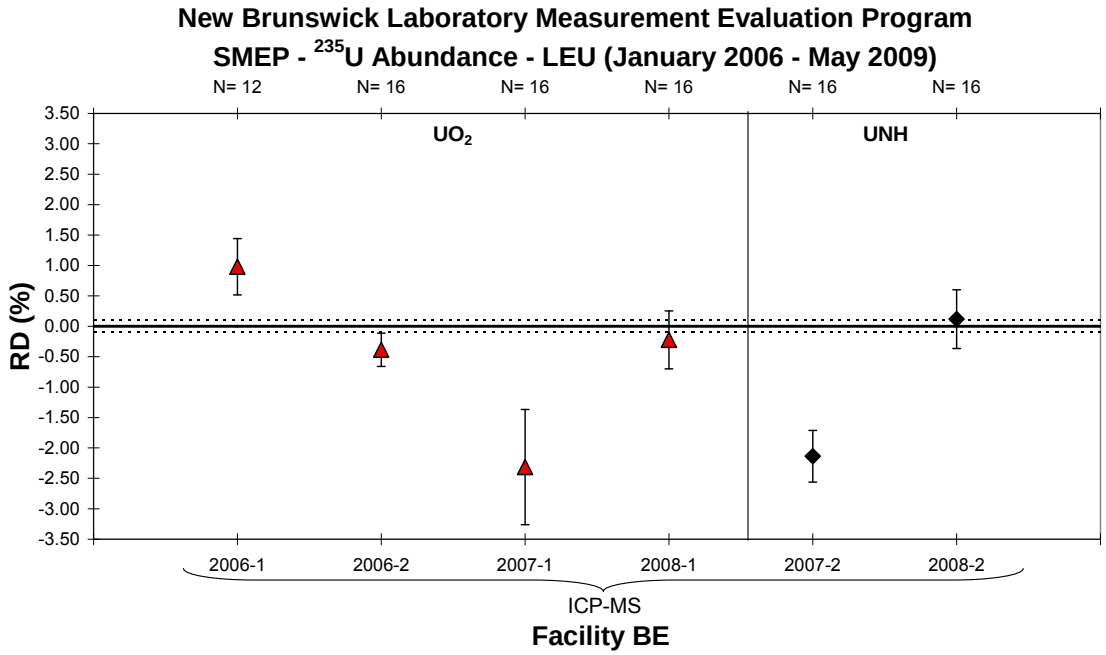


Figure H.14



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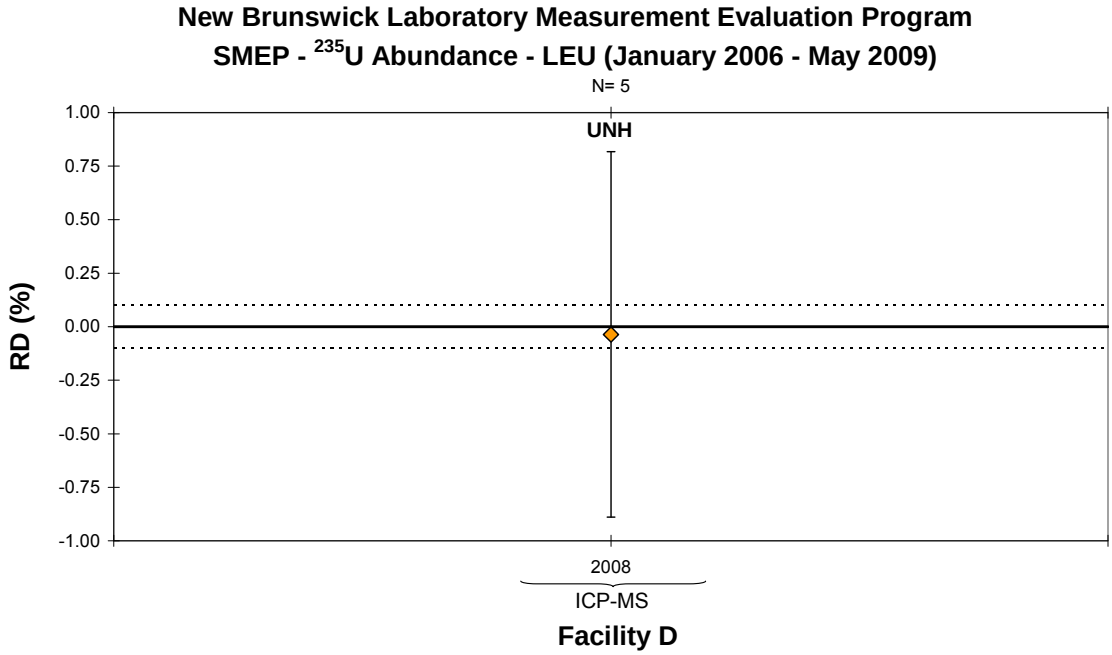

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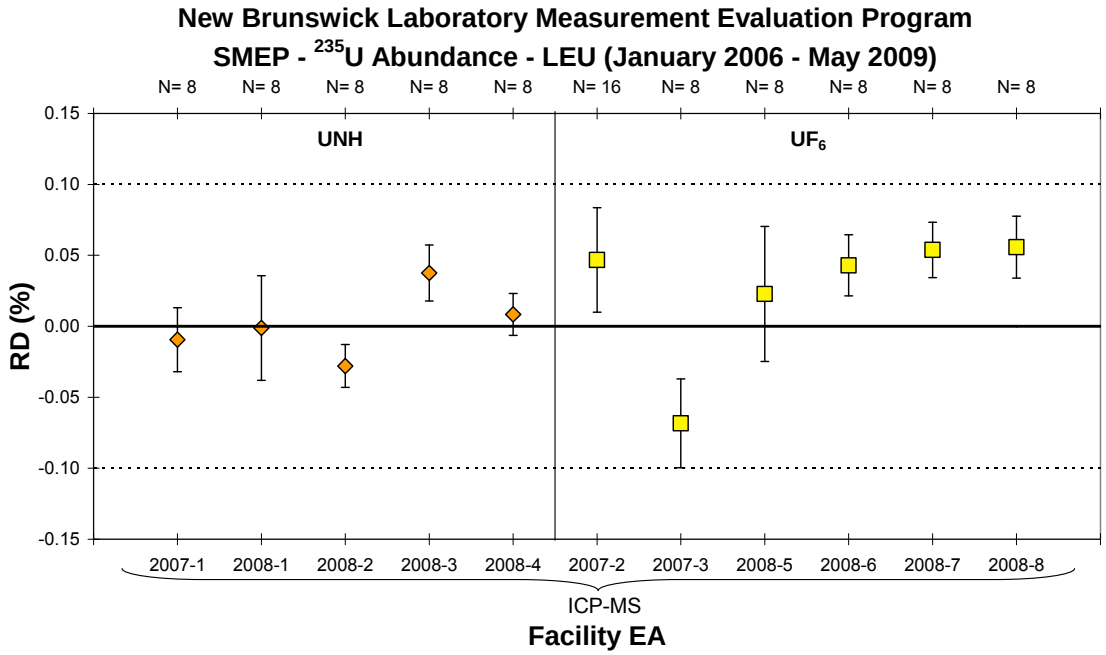

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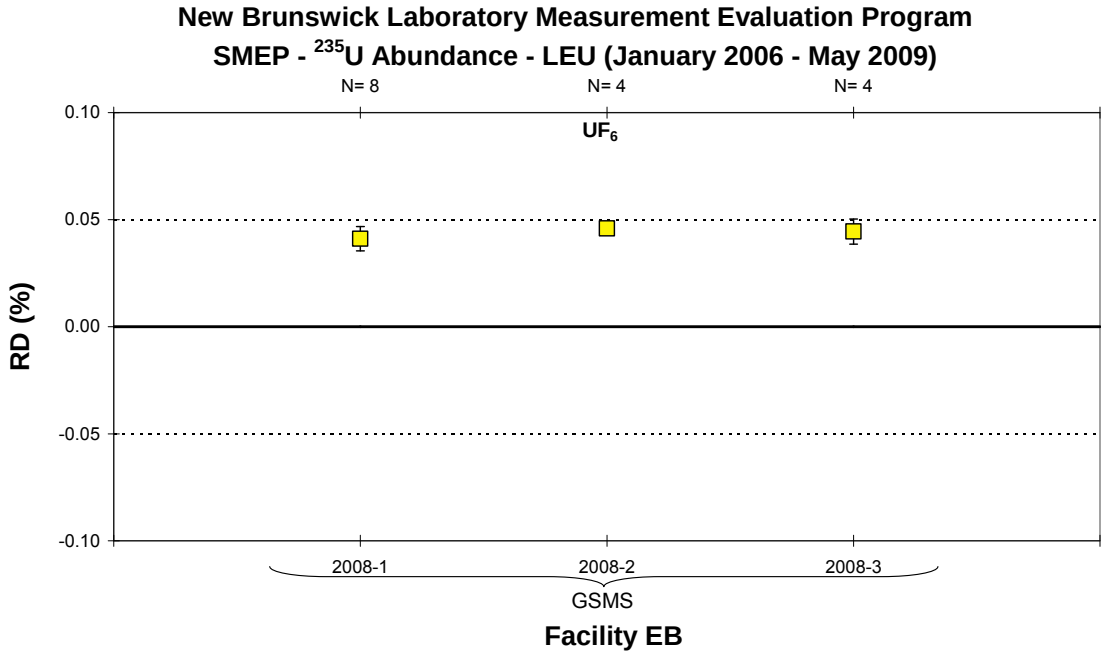

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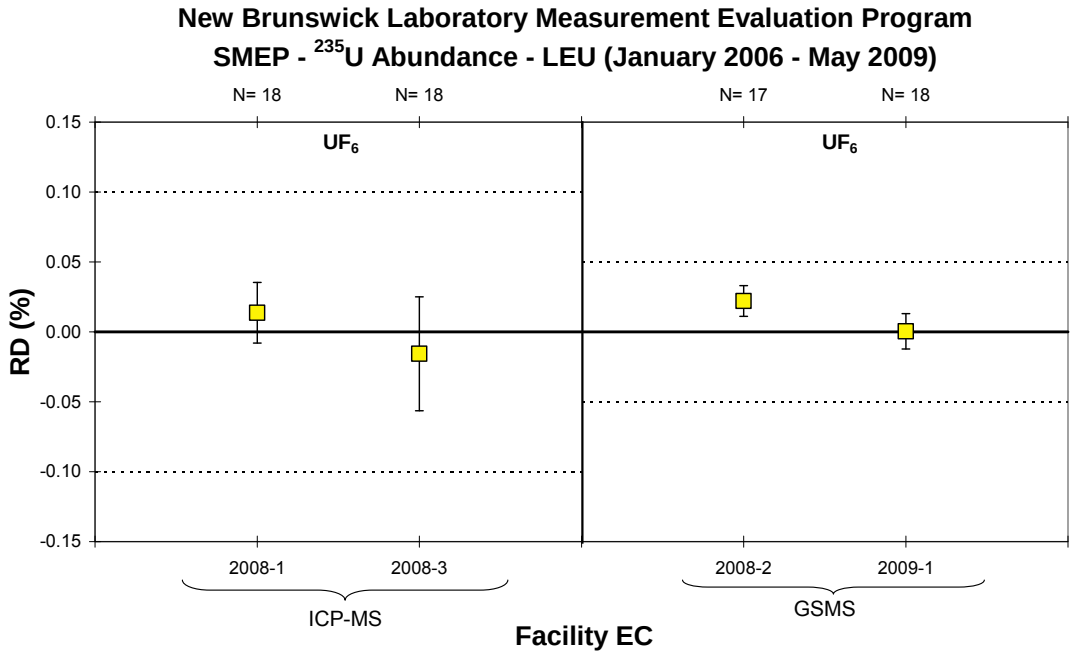

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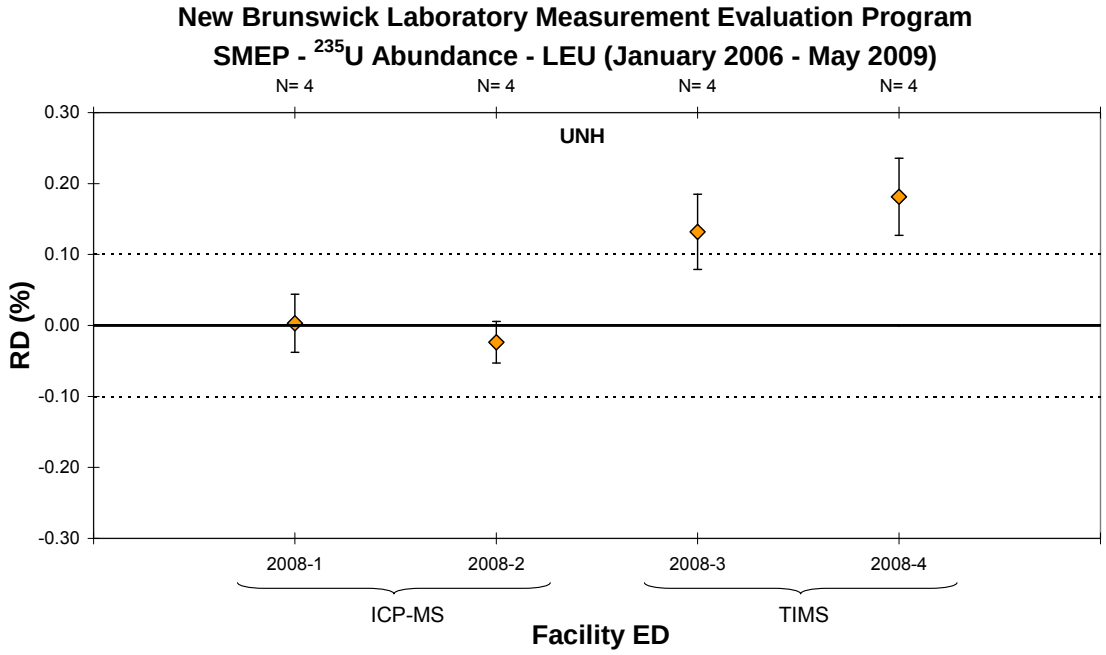

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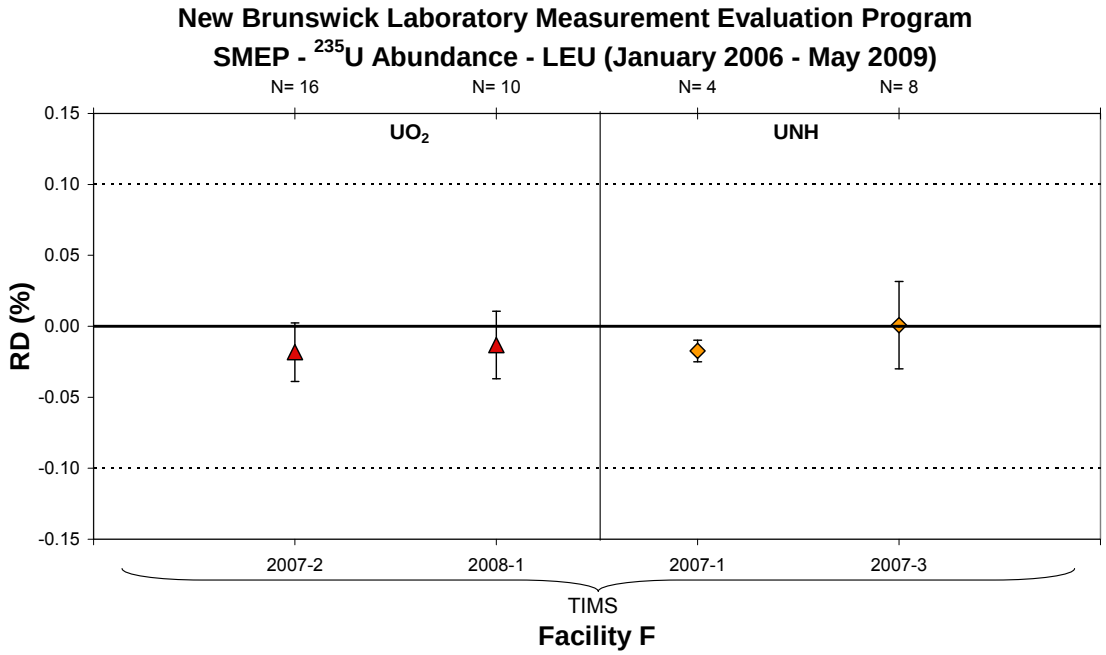

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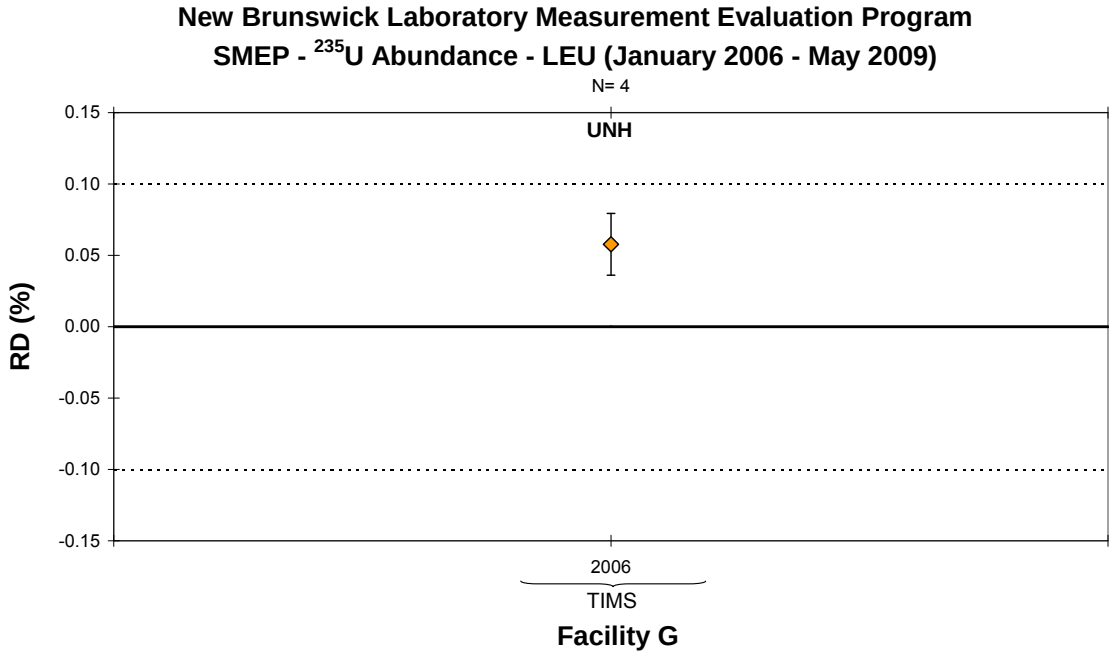

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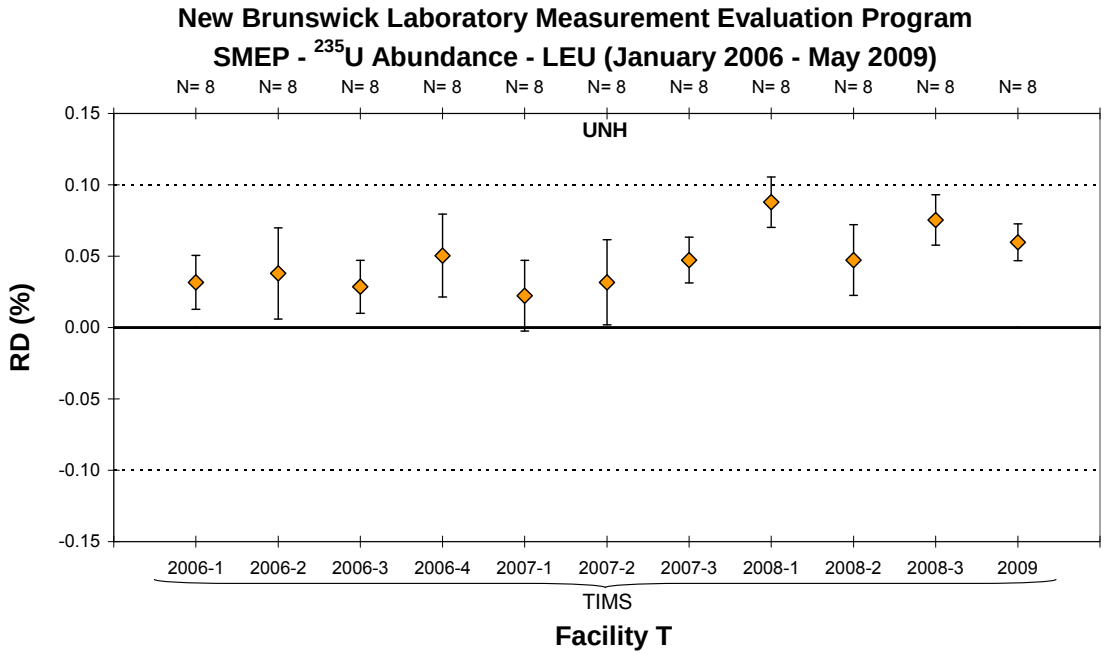

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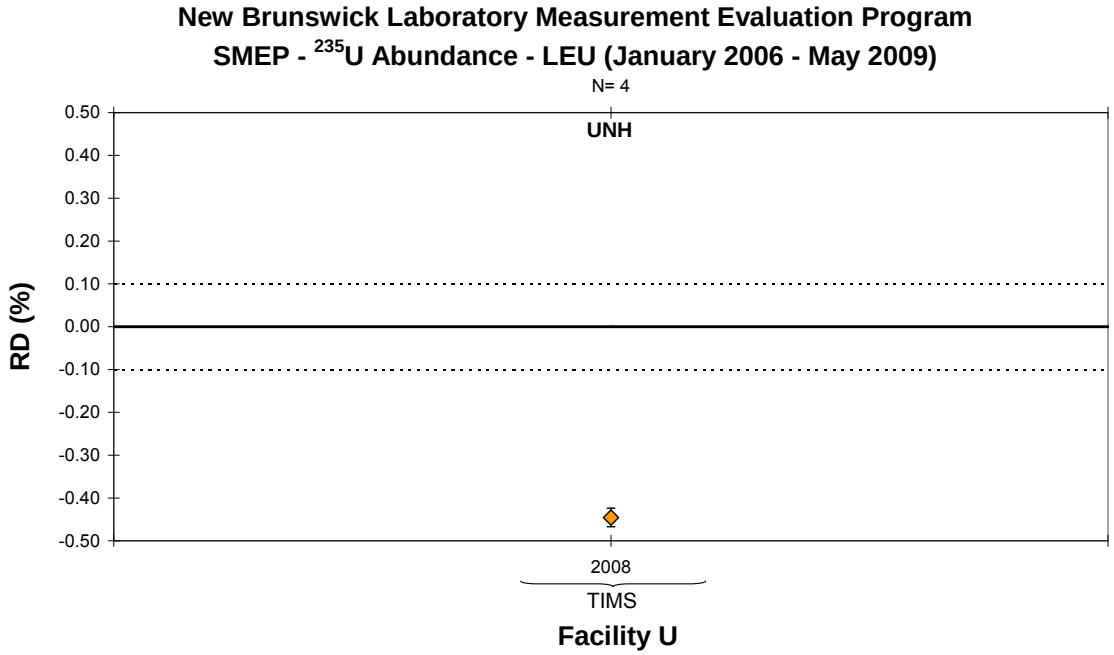

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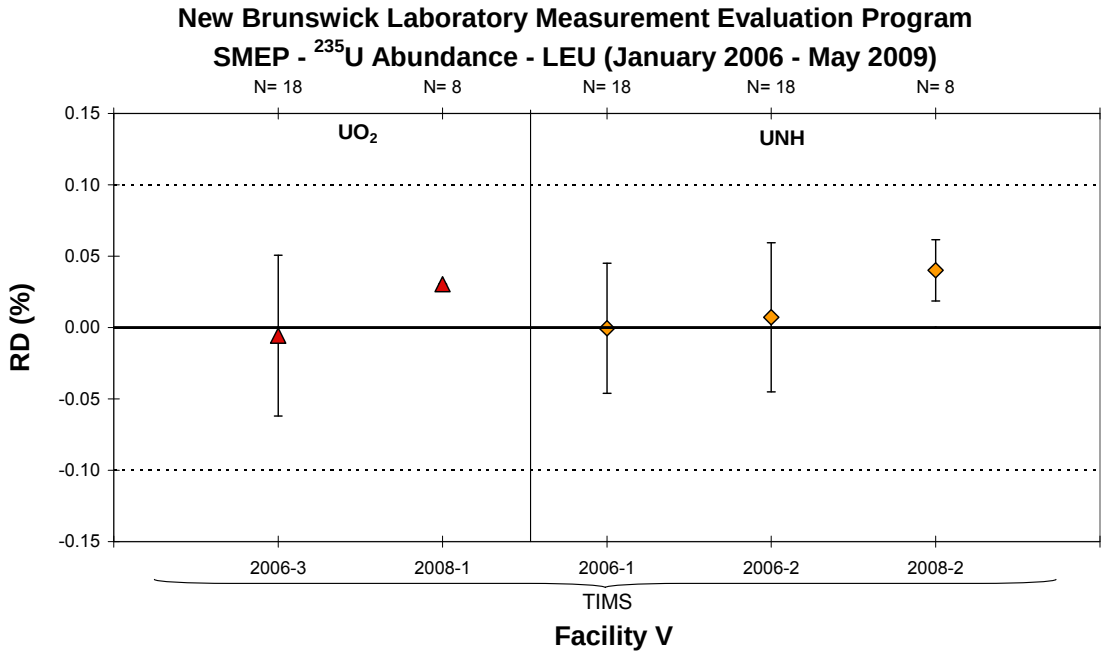

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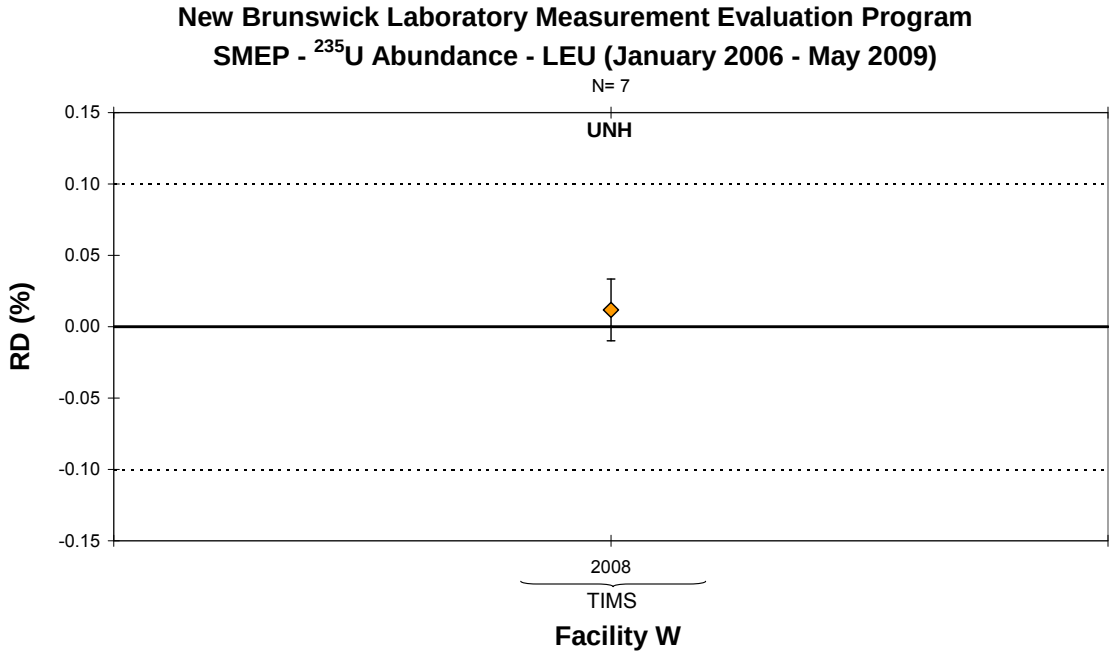

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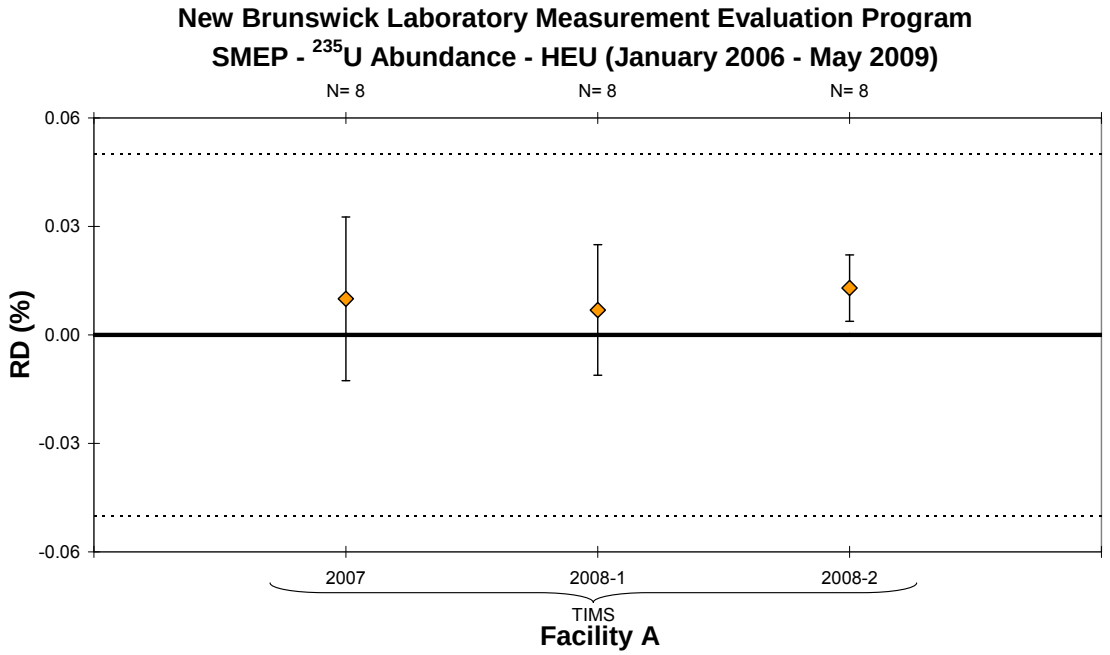

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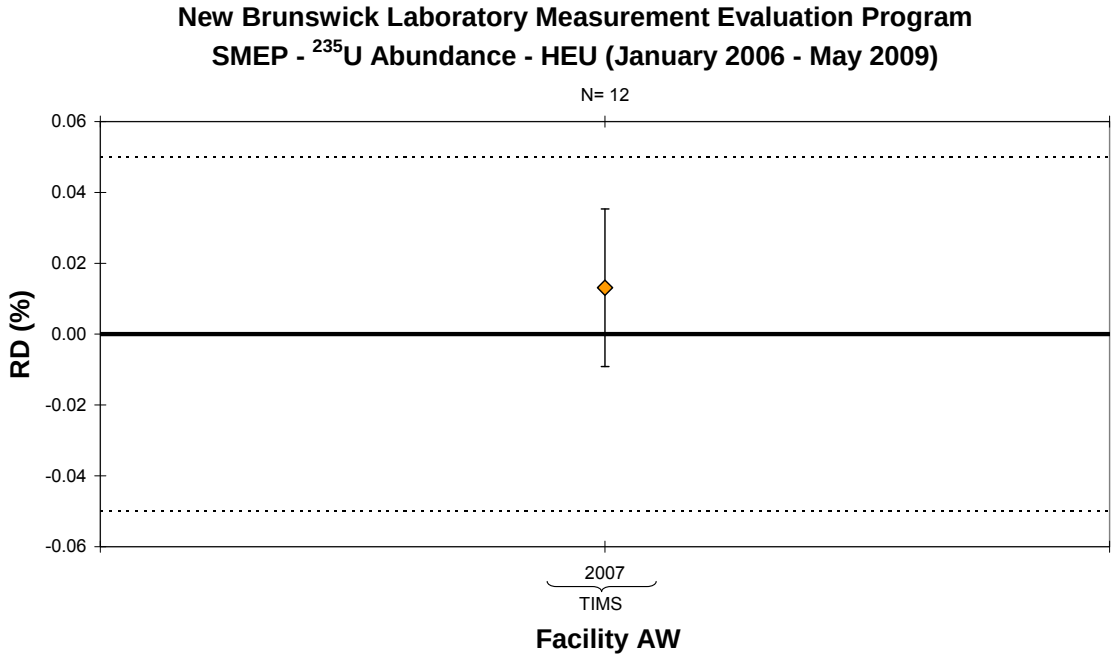

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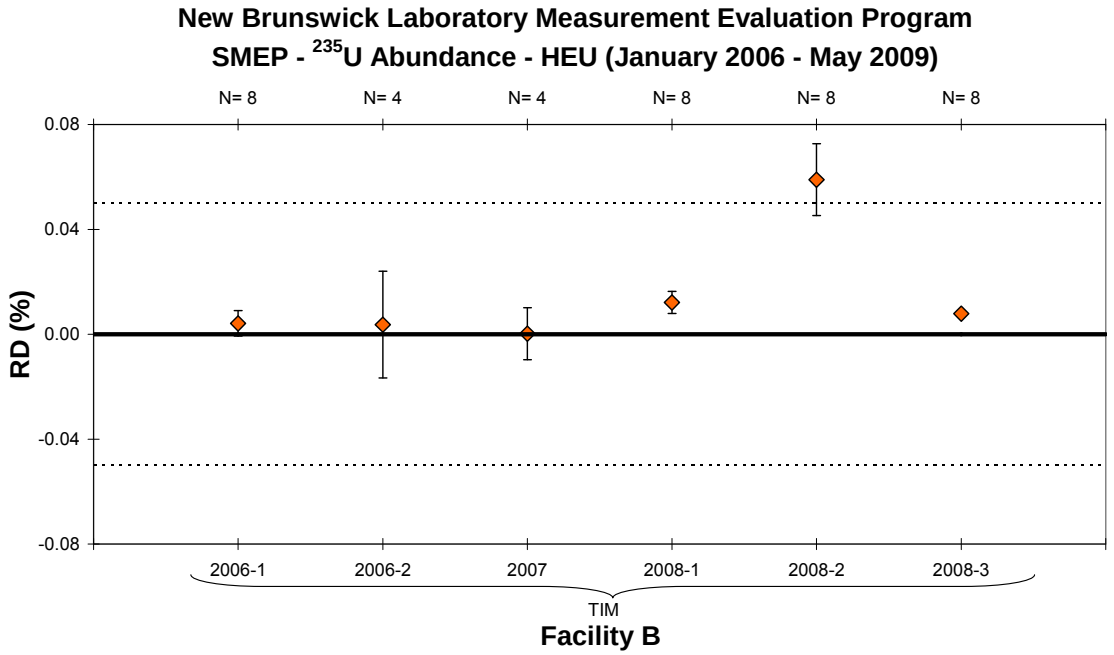

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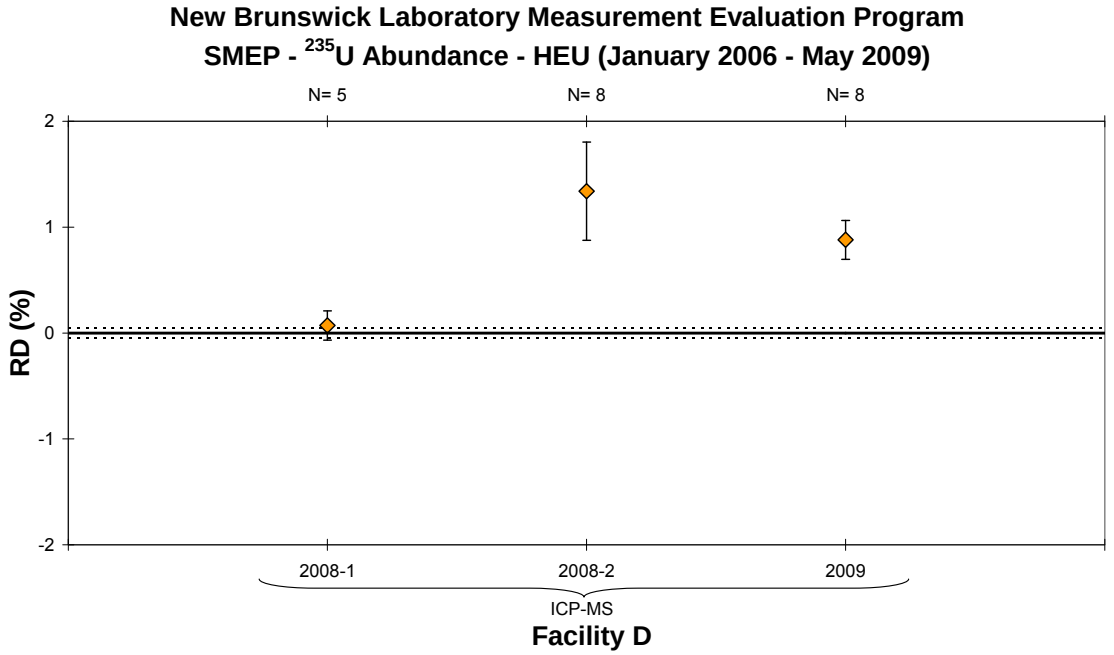

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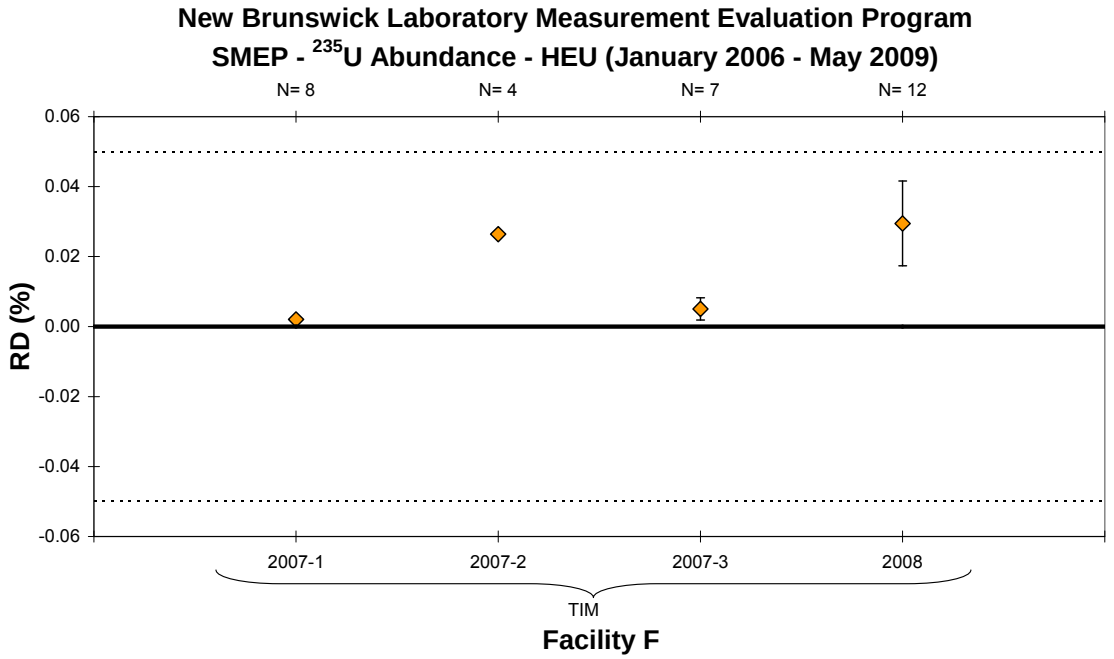

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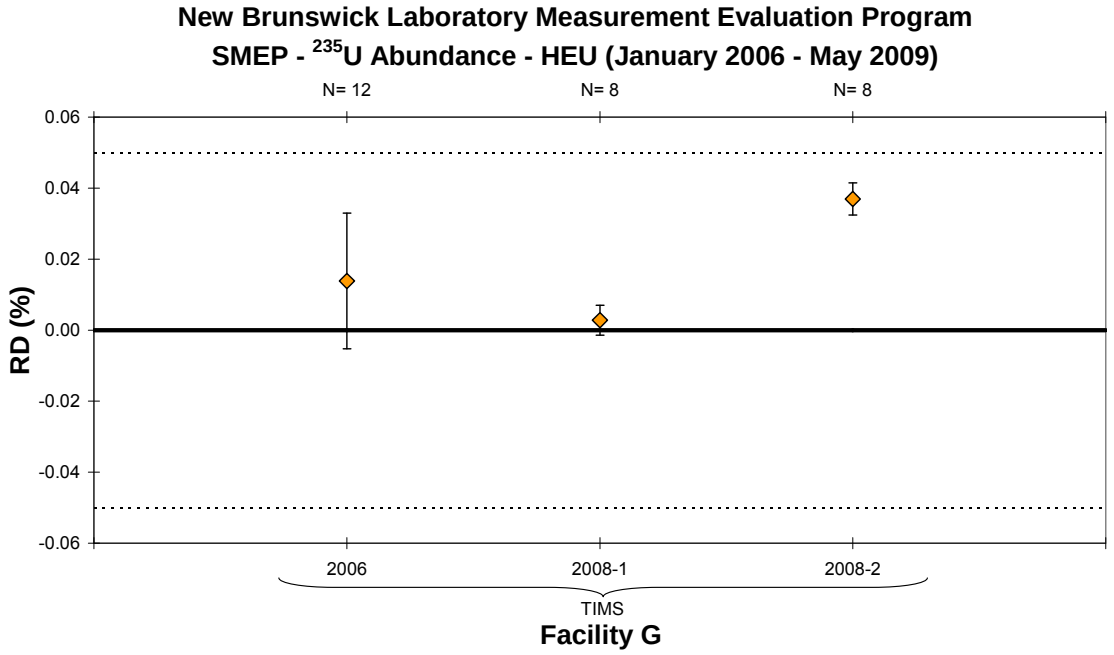

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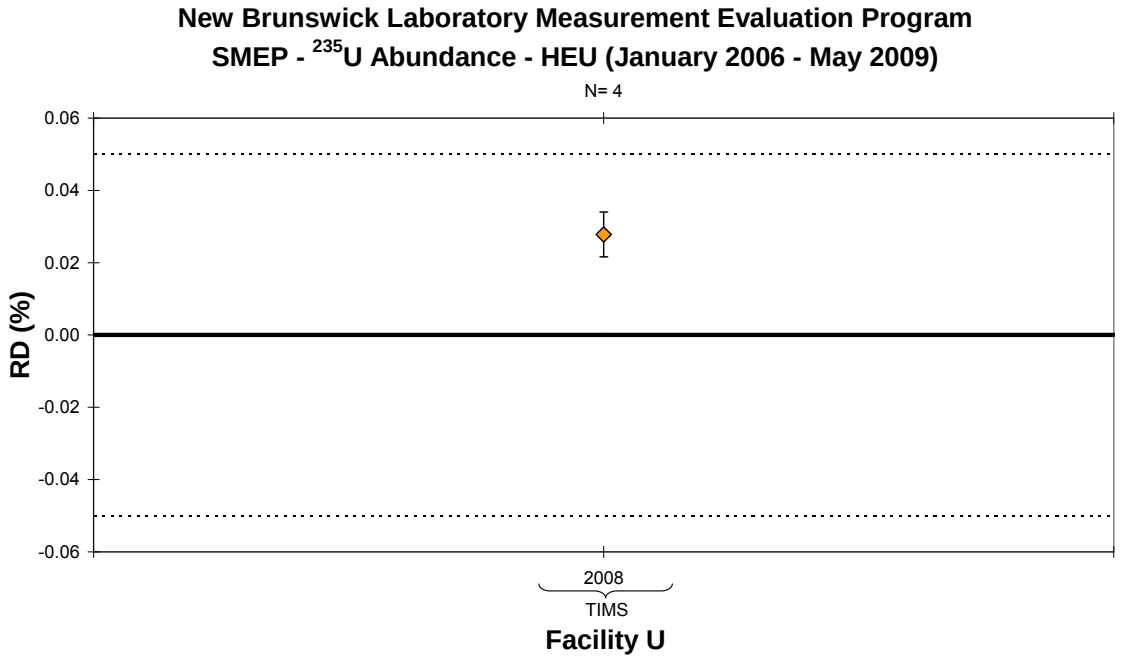

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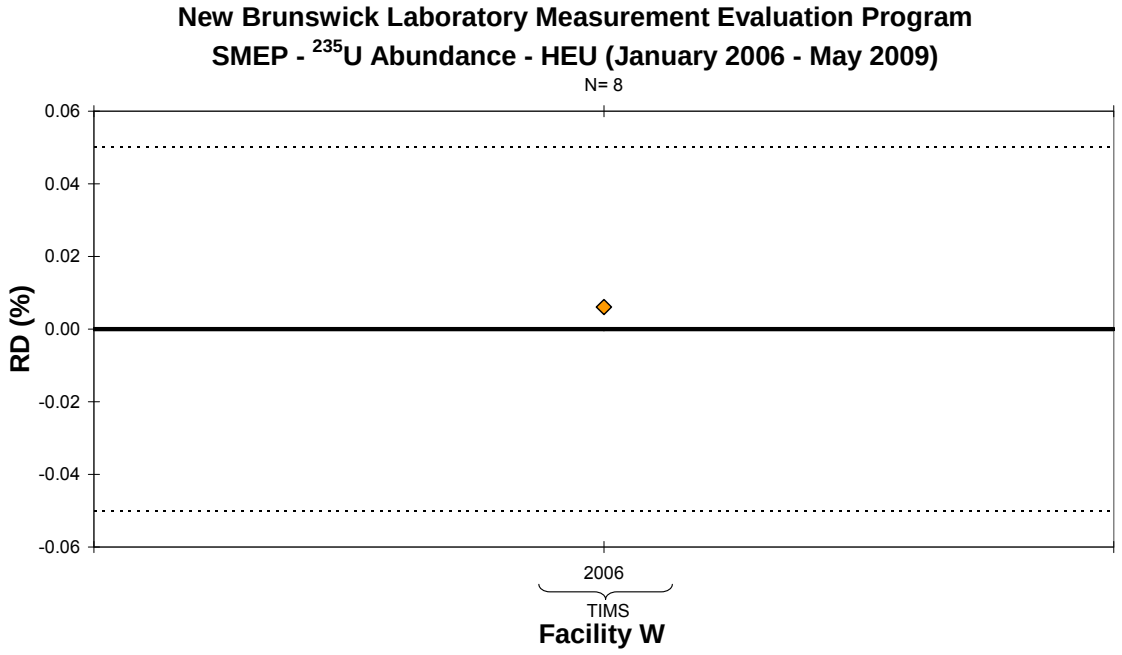

Figure H.34

APPENDICES

APPENDIX A. CY 2006-CY 2008 RESULTS REPORTED TO THE SME PROGRAM FOR URANIUM MASS FRACTION MEASUREMENTS

The tables on the following pages provide a record of uranium mass fraction measurement results reported during the period CY 2006 to CY 2008. Facilities are identified by code letters only. Results are shown by material-type, measurement method, measurement results, reported dates, and % RD. An electronic copy of the results may be obtained upon request.

Table AX.1. Uranium mass fraction measurement in UNH.

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	XRF	A	6/20/07	1.014	0.043
UNH	XRF	A	6/20/07	1.015	0.142
UNH	XRF	A	6/20/07	1.014	0.043
UNH	XRF	A	6/20/07	1.019	0.537
UNH	IDMS	A	6/21/07	1.0155	0.191
UNH	IDMS	A	6/21/07	1.0118	-0.174
UNH	IDMS	A	6/21/07	1.0126	-0.095
UNH	IDMS	A	6/21/07	1.0191	0.547
UNH	IDMS	A	6/25/07	1.0151	0.152
UNH	IDMS	A	6/25/07	1.0142	0.063
UNH	IDMS	A	6/25/07	1.0154	0.182
UNH	IDMS	A	6/25/07	1.0139	0.034
UNH	XRF	A	7/12/07	1.02	0.635
UNH	XRF	A	7/12/07	1.016	0.241
UNH	XRF	A	7/12/07	1.019	0.537
UNH	XRF	A	7/12/07	1.02	0.635
UNH	IDMS	A	9/25/07	1.0123	-0.124
UNH	IDMS	A	9/25/07	1.0131	-0.045
UNH	IDMS	A	9/25/07	1.0126	-0.095
UNH	IDMS	A	9/25/07	1.0116	-0.193
UNH	IDMS	A	9/26/07	1.0112	-0.233
UNH	IDMS	A	9/26/07	1.0252	1.148
UNH	IDMS	A	9/26/07	1.0106	-0.292
UNH	IDMS	A	9/26/07	1.0124	-0.114
UNH	XRF	A	9/27/07	1.017	0.339
UNH	XRF	A	9/27/07	1.015	0.142
UNH	XRF	A	9/27/07	1.014	0.043
UNH	XRF	A	9/27/07	1.011	-0.253
UNH	XRF	A	10/1/07	1.012	-0.154
UNH	XRF	A	10/1/07	1.016	0.241
UNH	XRF	A	10/1/07	1.018	0.438
UNH	XRF	A	10/1/07	1.015	0.142
UNH	XRF	A	2/26/08	1.015	0.142
UNH	XRF	A	2/26/08	1.013	-0.055

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	XRF	A	2/26/08	1.013	-0.055
UNH	XRF	A	2/26/08	1.014	0.043
UNH	XRF	A	2/28/08	1.024	1.030
UNH	XRF	A	2/28/08	1.016	0.241
UNH	XRF	A	2/28/08	1.022	0.833
UNH	XRF	A	2/28/08	1.019	0.537
UNH	IDMS	A	3/3/08	1.0151	0.152
UNH	IDMS	A	3/3/08	1.0130	-0.055
UNH	IDMS	A	3/3/08	1.0141	0.053
UNH	IDMS	A	3/3/08	1.0145	0.093
UNH	IDMS	A	3/4/08	1.0165	0.290
UNH	IDMS	A	3/4/08	1.0146	0.103
UNH	IDMS	A	3/4/08	1.0133	-0.026
UNH	IDMS	A	3/4/08	1.0154	0.182
UNH	XRF	A	5/20/08	1.016	0.241
UNH	XRF	A	5/20/08	1.012	-0.154
UNH	XRF	A	5/20/08	1.022	0.833
UNH	XRF	A	5/20/08	1.013	-0.055
UNH	XRF	A	5/22/08	1.015	0.142
UNH	XRF	A	5/22/08	1.015	0.142
UNH	XRF	A	5/22/08	1.021	0.734
UNH	XRF	A	5/22/08	1.018	0.438
UNH	IDMS	A	6/2/08	1.0151	0.152
UNH	IDMS	A	6/2/08	1.0125	-0.105
UNH	IDMS	A	6/2/08	1.0135	-0.006
UNH	IDMS	A	6/2/08	1.0120	-0.154
UNH	IDMS	A	6/4/08	1.0160	0.241
UNH	IDMS	A	6/4/08	1.0119	-0.164
UNH	IDMS	A	6/4/08	1.0117	-0.184
UNH	IDMS	A	6/4/08	1.0136	0.004
UNH	DG	AB	7/11/07	1.0032	-0.082
UNH	DG	AB	7/11/07	1.0037	-0.032
UNH	DG	AB	7/11/07	1.0035	-0.052
UNH	DG	AB	7/11/07	1.0105	-0.302
UNH	DG	AB	7/11/07	1.0123	-0.124
UNH	DG	AB	7/11/07	1.012	-0.154
UNH	DG	AB	7/12/07	1.0044	0.038
UNH	DG	AB	7/12/07	1.004	-0.002
UNH	DG	AB	7/12/07	1.0042	0.018
UNH	DG	AB	7/12/07	1.0121	-0.144
UNH	DG	AB	7/12/07	1.012	-0.154
UNH	DG	AB	7/12/07	1.013	-0.055
UNH	DG	AB	3/4/08	1.00376	-0.026
UNH	DG	AB	3/4/08	1.00389	-0.013
UNH	DG	AB	3/4/08	1.00409	0.007
UNH	DG	AB	3/4/08	1.01232	-0.122
UNH	DG	AB	3/4/08	1.01217	-0.137
UNH	DG	AB	3/4/08	1.0124	-0.114

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	DG	AB	3/5/08	1.00416	0.014
UNH	DG	AB	3/5/08	1.00418	0.016
UNH	DG	AB	3/5/08	1.00394	-0.008
UNH	DG	AB	3/5/08	1.01314	-0.041
UNH	DG	AB	3/5/08	1.0124	-0.114
UNH	DG	AB	3/5/08	1.01228	-0.126
UNH	IDMS	AW	5/21/07	6.824	0.101
UNH	IDMS	AW	5/21/07	6.8131	-0.059
UNH	IDMS	AW	5/21/07	6.8187	0.023
UNH	IDMS	AW	5/21/07	6.8113	-0.085
UNH	IDMS	AW	5/21/07	4.6939	-0.155
UNH	IDMS	AW	5/21/07	4.6948	-0.136
UNH	IDMS	AW	6/1/07	4.6961	-0.108
UNH	IDMS	AW	6/4/07	6.8111	-0.088
UNH	IDMS	AW	6/4/07	6.821	0.057
UNH	IDMS	AW	6/4/07	4.7053	0.087
UNH	IDMS	AW	6/4/07	4.6985	-0.057
UNH	IDMS	AW	6/4/07	4.7034	0.047
UNH	IDMS	B	1/9/06	0.9978	-0.620
UNH	IDMS	B	1/9/06	0.9984	-0.560
UNH	IDMS	B	1/9/06	0.9957	-0.485
UNH	IDMS	B	1/9/06	0.9977	-0.285
UNH	IDMS	B	1/12/06	1.0015	-0.251
UNH	IDMS	B	1/12/06	1.0006	-0.341
UNH	IDMS	B	1/12/06	1.0057	0.515
UNH	IDMS	B	1/12/06	1.0018	0.125
UNH	DG	B	1/18/06	1.0042	0.018
UNH	DG	B	1/18/06	1.0037	-0.032
UNH	DG	B	1/18/06	1.0015	0.095
UNH	DG	B	1/18/06	1.001	0.045
UNH	DG	B	1/19/06	1.0013	0.075
UNH	DG	B	1/19/06	1.0012	0.065
UNH	DG	B	1/25/06	1.003	0.245
UNH	DG	B	1/26/06	1.0063	0.227
UNH	DG	B	1/26/06	1.0029	0.235
UNH	DG	B	1/30/06	1.0064	0.237
UNH	DG	B	1/30/06	1.0029	0.235
UNH	IDMS	B	3/4/06	0.9957	-0.829
UNH	IDMS	B	3/4/06	0.9962	-0.779
UNH	IDMS	B	3/4/06	0.9962	-0.435
UNH	IDMS	B	3/4/06	1.0004	-0.015
UNH	IDMS	B	3/5/06	0.9914	-1.257
UNH	IDMS	B	3/5/06	1	-0.400
UNH	IDMS	B	3/5/06	0.9899	-1.064
UNH	IDMS	B	3/5/06	0.9893	-1.124
UNH	DG	B	3/29/06	1.00182	-0.048
UNH	DG	B	3/29/06	1.00181	-0.049
UNH	DG	B	3/29/06	1.00706	0.475

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	DG	B	3/29/06	1.00706	0.475
UNH	IDMS	B	4/12/06	1.0007	-0.331
UNH	IDMS	B	4/12/06	0.9982	-0.580
UNH	IDMS	B	4/12/06	0.9958	-0.819
UNH	IDMS	B	4/12/06	0.9956	-0.839
UNH	IDMS	B	4/13/06	0.9916	-1.237
UNH	IDMS	B	4/13/06	0.9932	-1.078
UNH	IDMS	B	4/13/06	0.9959	-0.809
UNH	IDMS	B	4/13/06	0.9971	-0.689
UNH	DG	B	4/27/06	1.0011	-0.120
UNH	DG	B	4/27/06	0.9991	-0.319
UNH	DG	B	4/27/06	1.008	0.569
UNH	DG	B	4/27/06	1.0043	0.200
UNH	IDMS	B	7/22/06	0.9955	-0.678
UNH	IDMS	B	7/22/06	0.9981	-0.419
UNH	IDMS	B	7/22/06	0.9975	-0.305
UNH	IDMS	B	7/22/06	0.994	-0.655
UNH	DG	B	7/24/06	1.00015	-0.215
UNH	DG	B	7/24/06	1.00225	-0.005
UNH	DG	B	7/24/06	1.00024	-0.031
UNH	DG	B	7/24/06	1.0014	0.085
UNH	IDMS	B	7/31/06	1.0167	1.437
UNH	IDMS	B	7/31/06	1.0039	0.160
UNH	IDMS	B	8/1/06	0.9909	-0.964
UNH	IDMS	B	8/1/06	0.9877	-1.284
UNH	DG	B	10/9/06	1.0043	0.200
UNH	DG	B	10/9/06	1.0046	0.229
UNH	DG	B	10/11/06	1.0018	0.125
UNH	DG	B	10/11/06	1.0021	0.155
UNH	DG	B	7/24/07	1.0143	0.073
UNH	DG	B	7/24/07	1.0176	0.399
UNH	DG	B	7/24/07	1.0134	-0.016
UNH	DG	B	7/24/07	1.0139	0.034
UNH	DG	B	7/25/07	1.0137	0.014
UNH	DG	B	7/25/07	1.0164	0.280
UNH	DG	B	7/25/07	1.0172	0.359
UNH	DG	B	7/25/07	1.0152	0.162
UNH	DG	B	10/30/07	1.0177	0.408
UNH	DG	B	10/30/07	1.0187	0.507
UNH	DG	B	10/30/07	1.0176	0.399
UNH	DG	B	10/30/07	1.0135	-0.006
UNH	DG	B	11/4/07	1.0173	0.369
UNH	DG	B	11/4/07	1.0176	0.399
UNH	DG	B	11/4/07	1.0177	0.408
UNH	DG	B	11/4/07	1.0185	0.487
UNH	DG	B	1/17/08	1.0188	0.517
UNH	DG	B	1/17/08	1.0172	0.359
UNH	DG	B	1/18/08	1.0177	0.408

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	DG	B	1/18/08	1.018	0.438
UNH	DG	B	1/18/08	1.0177	0.408
UNH	DG	B	1/18/08	1.0173	0.369
UNH	IDMS	B	1/18/08	10.092	-0.430
UNH	IDMS	B	1/18/08	10.108	-0.272
UNH	IDMS	B	1/18/08	10.053	-0.815
UNH	IDMS	B	1/18/08	10.048	-0.864
UNH	DG	B	1/19/08	1.0132	-0.036
UNH	DG	B	1/19/08	1.0221	0.843
UNH	IDMS	B	1/26/08	10.075	-0.598
UNH	IDMS	B	1/26/08	10.053	-0.815
UNH	IDMS	B	1/26/08	10.076	-0.588
UNH	IDMS	B	1/26/08	10.062	-0.726
UNH	IDMS	B	3/25/08	10.035	-0.993
UNH	IDMS	B	3/25/08	10.029	-1.052
UNH	IDMS	B	3/25/08	10.021	-1.131
UNH	IDMS	B	3/25/08	10.042	-0.923
UNH	DG	B	3/27/08	1.0155	0.191
UNH	DG	B	3/27/08	1.0132	-0.036
UNH	IDMS	B	3/27/08	10.031	-1.032
UNH	IDMS	B	3/27/08	10.024	-1.101
UNH	IDMS	B	3/27/08	10.046	-0.884
UNH	IDMS	B	3/27/08	10.028	-1.062
UNH	DG	B	4/1/08	1.0106	-0.292
UNH	DG	B	4/1/08	1.0141	0.053
UNH	DG	B	4/13/08	1.0011	-1.229
UNH	DG	B	4/13/08	1.0167	0.310
UNH	DG	B	4/13/08	1.011	-0.253
UNH	DG	B	4/13/08	1.0157	0.211
UNH	IDMS	B	6/22/08	10.119	-0.164
UNH	IDMS	B	6/22/08	10.117	-0.184
UNH	IDMS	B	6/22/08	10.135	-0.006
UNH	IDMS	B	6/22/08	10.141	0.053
UNH	IDMS	B	6/27/08	10.124	-0.114
UNH	IDMS	B	6/27/08	10.121	-0.144
UNH	IDMS	B	6/27/08	10.138	0.024
UNH	IDMS	B	6/27/08	10.132	-0.036
UNH	DG	B	7/18/08	1.0098	-0.371
UNH	DG	B	7/18/08	1.0117	-0.184
UNH	DG	B	7/18/08	1.0145	0.093
UNH	DG	B	7/18/08	1.0122	-0.134
UNH	DG	B	7/20/08	1.0155	0.191
UNH	DG	B	7/20/08	1.0144	0.083
UNH	DG	B	7/20/08	1.0144	0.083
UNH	DG	B	7/20/08	1.0151	0.152
UNH	DG	B	8/29/08	1.0184	0.478
UNH	DG	B	8/29/08	1.0184	0.478
UNH	DG	B	8/29/08	1.0155	0.191

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	DG	B	8/29/08	1.0158	0.221
UNH	DG	B	8/30/08	1.0179	0.428
UNH	DG	B	8/30/08	1.0182	0.458
UNH	DG	B	8/30/08	1.0153	0.172
UNH	DG	B	8/30/08	1.0156	0.201
UNH	IDMS	B	10/1/08	10.136	0.004
UNH	IDMS	B	10/1/08	10.134	-0.016
UNH	IDMS	B	10/1/08	10.127	-0.085
UNH	IDMS	B	10/1/08	10.124	-0.114
UNH	IDMS	B	10/9/08	10.128	-0.075
UNH	IDMS	B	10/9/08	10.133	-0.026
UNH	IDMS	B	10/9/08	10.131	-0.045
UNH	IDMS	B	10/9/08	10.127	-0.085
UNH	DG	BA	11/26/07	1.0139	0.034
UNH	DG	BA	11/26/07	1.015	0.142
UNH	DG	BA	11/26/07	1.0142	0.063
UNH	DG	BA	11/26/07	1.0146	0.103
UNH	DG	BA	11/26/07	1.0135	-0.006
UNH	DG	BA	11/26/07	1.0102	-0.332
UNH	DG	BA	11/26/07	1.014	0.043
UNH	DG	BA	11/26/07	1.0139	0.034
UNH	DG	BA	11/27/07	1.0133	-0.026
UNH	DG	BA	11/27/07	1.0147	0.112
UNH	DG	BA	11/27/07	1.0136	0.004
UNH	DG	BA	11/27/07	1.0138	0.024
UNH	DG	BA	11/27/07	1.0112	-0.233
UNH	DG	BA	11/27/07	1.0126	-0.095
UNH	DG	BA	11/27/07	1.0113	-0.223
UNH	DG	BA	11/27/07	1.0142	0.063
UNH	DG	BA	3/17/08	0.9925	-1.147
UNH	DG	BA	3/17/08	0.9877	-1.625
UNH	DG	BA	3/17/08	0.9957	-0.829
UNH	DG	BA	3/17/08	0.9966	-0.739
UNH	DG	BA	3/17/08	0.9959	-0.809
UNH	DG	BA	3/17/08	0.9966	-0.739
UNH	DG	BA	3/17/08	0.9985	-0.550
UNH	DG	BA	3/17/08	0.9951	-0.888
UNH	DG	BA	3/17/08	0.9984	-0.560
UNH	DG	BA	3/17/08	0.9962	-0.779
UNH	DG	BA	3/17/08	0.9987	-0.530
UNH	DG	BA	3/18/08	0.9973	-0.669
UNH	DG	BA	3/18/08	0.9929	-1.108
UNH	DG	BA	3/18/08	0.9956	-0.839
UNH	DG	BA	3/18/08	1	-0.400
UNH	DG	BA	3/18/08	1.0018	-0.221
UNH	DG	BA	3/18/08	0.9969	-0.709
UNH	DG	BA	3/18/08	0.9975	-0.649
UNH	DG	BA	3/18/08	0.9967	-0.729

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	DG	BA	3/18/08	0.9963	-0.769
UNH	DG	BA	1/9/09	1.0020	-0.0299
UNH	DG	BA	1/9/09	1.0021	-0.0200
UNH	DG	BA	1/9/09	1.0002	-0.2095
UNH	DG	BA	1/9/09	0.9989	-0.1649
UNH	DG	BA	1/9/09	0.9994	-0.1149
UNH	DG	BA	1/12/09	1.0006	-0.1696
UNH	DG	BA	1/12/09	1.0021	-0.0200
UNH	DG	BA	1/12/09	1.0001	-0.2195
UNH	DG	BA	1/12/09	0.9981	-0.2449
UNH	DG	BA	1/12/09	0.9995	-0.1049
UNH	DG	BC	9/27/07	0.9644	-3.946
UNH	DG	BC	9/27/07	0.9639	-3.996
UNH	DG	BC	9/27/07	0.9643	-3.956
UNH	DG	BC	9/27/07	0.964	-3.986
UNH	DG	BC	9/27/07	0.9639	-3.996
UNH	DG	BC	9/27/07	0.9647	-3.916
UNH	DG	BC	9/27/07	0.9743	-3.873
UNH	DG	BC	9/27/07	0.974	-3.903
UNH	DG	BC	9/27/07	0.9743	-3.873
UNH	DG	BC	9/27/07	0.974	-3.903
UNH	DG	BC	9/27/07	0.9742	-3.883
UNH	DG	BC	9/27/07	0.9741	-3.893
UNH	DG	BC	10/2/07	0.9639	-3.996
UNH	DG	BC	10/2/07	0.9631	-4.076
UNH	DG	BC	10/2/07	0.9637	-4.016
UNH	DG	BC	10/2/07	0.9638	-4.006
UNH	DG	BC	10/2/07	0.9632	-4.066
UNH	DG	BC	10/2/07	0.9638	-4.006
UNH	DG	BC	10/2/07	0.9734	-3.962
UNH	DG	BC	10/2/07	0.9736	-3.943
UNH	DG	BC	10/2/07	0.9745	-3.854
UNH	DG	BC	10/2/07	0.9738	-3.923
UNH	DG	BC	10/2/07	0.9738	-3.923
UNH	DG	BC	10/2/07	0.9742	-3.883
UNH	DG	BC	10/23/08	9.9914	-0.315
UNH	DG	BC	10/23/08	9.9896	-0.333
UNH	DG	BC	10/23/08	10.0026	-0.204
UNH	DG	BC	10/23/08	10.0098	-0.132
UNH	DG	BC	10/23/08	10.0911	0.679
UNH	DG	BC	10/23/08	10.0097	-0.133
UNH	DG	BC	10/23/08	10.0050	-0.180
UNH	DG	BC	10/23/08	10.0118	-0.112
UNH	DG	BC	10/31/08	10.0118	-0.112
UNH	DG	BC	10/31/08	10.0110	-0.120
UNH	DG	BC	10/31/08	10.0129	-0.101
UNH	DG	BC	10/31/08	10.0203	-0.027
UNH	DG	BC	10/31/08	10.0096	-0.134

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	DG	BC	10/31/08	10.0124	-0.106
UNH	DG	BC	10/31/08	10.0075	-0.155
UNH	DG	BC	10/31/08	10.0046	-0.184
UNH	DG	BC	10/31/08	10.0067	-0.163
UNH	DG	BC	10/31/08	10.0026	-0.204
UNH	DG	BC	3/11/09	9.9576	-0.479
UNH	DG	BC	3/11/09	9.9636	-0.419
UNH	DG	BC	3/11/09	9.9633	-0.422
UNH	DG	BC	3/11/09	9.9633	-0.422
UNH	DG	BC	3/11/09	9.9538	-0.517
UNH	DG	BC	3/11/09	9.9552	-0.503
UNH	DG	BC	3/11/09	9.9529	-0.526
UNH	DG	BC	3/11/09	9.9624	-0.431
UNH	DG	BC	3/20/09	9.9813	-0.242
UNH	DG	BC	3/20/09	9.9857	-0.198
UNH	DG	BC	3/20/09	9.9800	-0.255
UNH	DG	BC	3/20/09	9.9780	-0.275
UNH	DG	BC	3/20/09	9.9783	-0.272
UNH	DG	BC	3/20/09	9.9777	-0.278
UNH	DG	BC	3/20/09	9.9810	-0.245
UNH	DG	BC	3/20/09	9.9780	-0.275
UNH	DG	BF	11/4/08	1.00141	-0.0888
UNH	DG	BF	11/4/08	1.00178	-0.0519
UNH	DG	BF	11/4/08	0.99973	-0.0820
UNH	DG	BF	11/4/08	1.00035	-0.0200
UNH	DG	BF	11/6/08	1.00203	-0.0269
UNH	DG	BF	11/6/08	1.00195	-0.0349
UNH	DG	BF	11/6/08	1.00047	-0.0080
UNH	DG	BF	11/6/08	1.00113	0.0580
UNH	DG	BF	3/17/09	1.00328	0.0978
UNH	DG	BF	3/17/09	1.00341	0.1107
UNH	DG	BF	3/17/09	1.00045	-0.0100
UNH	DG	BF	3/17/09	1.00085	0.0300
UNH	DG	BF	3/18/09	1.00333	0.1028
UNH	DG	BF	3/18/09	1.00327	0.0968
UNH	DG	BF	3/18/09	1.00093	0.0380
UNH	DG	BF	3/18/09	1.00100	0.0450
UNH	DG	ED	8/19/08	10.13	-0.055
UNH	DG	ED	8/19/08	10.16	0.241
UNH	DG	ED	8/19/08	10.12	-0.154
UNH	DG	ED	8/19/08	10.14	0.043
UNH	DG	ED	8/19/08	10.11	-0.253
UNH	DG	ED	8/19/08	10.13	-0.055
UNH	DG	ED	8/19/08	10.14	0.043
UNH	DG	ED	8/19/08	10.15	0.142
UNH	XRF	ED	8/19/08	9.88	-2.522
UNH	XRF	ED	8/19/08	9.94	-1.930
UNH	XRF	ED	8/19/08	9.87	-2.620

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	XRF	ED	8/19/08	9.86	-2.719
UNH	XRF	ED	8/19/08	9.86	-2.719
UNH	XRF	ED	8/19/08	9.91	-2.226
UNH	XRF	ED	8/19/08	9.87	-2.620
UNH	XRF	ED	8/19/08	9.85	-2.818
UNH	DG	ED	8/20/08	10.13	-0.055
UNH	DG	ED	8/20/08	10.14	0.043
UNH	DG	ED	8/20/08	10.16	0.241
UNH	DG	ED	8/20/08	10.17	0.339
UNH	DG	ED	8/20/08	10.16	0.241
UNH	DG	ED	8/20/08	10.14	0.043
UNH	DG	ED	8/20/08	10.13	-0.055
UNH	DG	ED	8/20/08	10.12	-0.154
UNH	XRF	ED	8/20/08	9.94	-1.930
UNH	XRF	ED	8/20/08	9.89	-2.423
UNH	XRF	ED	8/20/08	9.90	-2.324
UNH	XRF	ED	8/20/08	9.87	-2.620
UNH	XRF	ED	8/20/08	9.88	-2.522
UNH	XRF	ED	8/20/08	9.85	-2.818
UNH	XRF	ED	8/20/08	9.89	-2.423
UNH	XRF	ED	8/20/08	9.89	-2.423
UNH	DG	F	7/25/07	1.004	-0.002
UNH	DG	F	7/25/07	1.004	-0.002
UNH	DG	F	7/25/07	1.003	0.070
UNH	DG	F	7/25/07	1.002	-0.030
UNH	DG	F	7/26/07	1.004	-0.002
UNH	DG	F	7/26/07	1.004	-0.002
UNH	DG	F	7/26/07	1.002	-0.030
UNH	DG	F	7/26/07	1.002	-0.030
UNH	DG	F	7/26/07	1.004	-0.002
UNH	DG	F	7/26/07	1.004	-0.002
UNH	DG	F	7/26/07	1.002	-0.030
UNH	DG	F	7/26/07	1.002	-0.030
UNH	DG	F	7/26/07	1.002	-0.030
UNH	DG	F	7/27/07	1.004	-0.002
UNH	DG	F	7/27/07	1.004	-0.002
UNH	DG	F	7/27/07	1.002	-0.030
UNH	DG	F	9/13/07	1.005	0.098
UNH	DG	F	9/13/07	1.005	0.098
UNH	DG	F	9/13/07	1.001	0.045
UNH	DG	F	9/13/07	1.001	0.045
UNH	DG	F	9/14/07	1.006	0.197
UNH	DG	F	9/14/07	1.006	0.197
UNH	DG	F	9/14/07	1.001	0.045
UNH	DG	F	9/14/07	1.001	0.045
UNH	DG	F	9/25/07	1.005	0.098
UNH	DG	F	9/25/07	1.005	0.098
UNH	DG	F	9/25/07	1.001	0.045

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	DG	F	9/25/07	1	-0.055
UNH	DG	F	9/26/07	1.005	0.098
UNH	DG	F	9/26/07	1.005	0.098
UNH	DG	F	9/26/07	1.001	0.045
UNH	DG	F	9/26/07	1.002	0.145
UNH	DG	G	2/22/06	1.00414	0.012
UNH	DG	G	2/22/06	1.00388	-0.014
UNH	DG	G	2/22/06	1.00041	-0.014
UNH	DG	G	2/22/06	1.00052	-0.003
UNH	DG	G	2/23/06	1.00379	-0.023
UNH	DG	G	2/23/06	1.00411	0.009
UNH	DG	G	2/23/06	1.00055	0.000
UNH	DG	G	2/23/06	1.00052	-0.003
UNH	DG	G	4/19/06	1.00428	0.026
UNH	DG	G	4/19/06	1.00425	0.023
UNH	DG	G	4/19/06	1.00252	0.022
UNH	DG	G	4/19/06	1.00228	-0.002
UNH	DG	G	4/20/06	1.00399	-0.003
UNH	DG	G	4/20/06	1.00404	0.002
UNH	DG	G	4/20/06	1.00261	0.031
UNH	DG	G	4/20/06	1.0021	-0.020
UNH	IDMS	G	5/5/06	0.4702	0.017
UNH	IDMS	G	5/5/06	0.4629	-0.013
UNH	IDMS	G	5/5/06	0.463	0.009
UNH	IDMS	G	5/5/06	0.4654	0.015
UNH	IDMS	G	5/5/06	0.4656	0.058
UNH	IDMS	G	5/10/06	0.4701	-0.004
UNH	IDMS	G	5/10/06	0.4703	0.038
UNH	IDMS	G	5/10/06	0.4699	-0.047
UNH	IDMS	G	5/10/06	0.4701	-0.004
UNH	IDMS	G	5/10/06	0.4633	0.073
UNH	IDMS	G	5/11/06	0.4632	0.052
UNH	IDMS	G	5/11/06	0.4651	-0.049
UNH	IDMS	G	5/11/06	0.4648	-0.114
UNH	IDMS	G	5/11/06	0.4652	-0.028
UNH	IDMS	G	5/18/06	0.4649	-0.092
UNH	DG	G	8/24/06	1.00045	-0.010
UNH	DG	G	8/24/06	1.00057	0.002
UNH	DG	G	8/24/06	1.00211	-0.019
UNH	DG	G	8/24/06	1.00205	-0.025
UNH	DG	G	8/25/06	1.00047	-0.008
UNH	DG	G	8/25/06	1.0006	0.005
UNH	DG	G	8/25/06	1.00217	-0.013
UNH	DG	G	8/25/06	1.00224	-0.006
UNH	DG	G	11/16/07	10.1329	-0.027
UNH	DG	G	11/16/07	10.1375	0.019
UNH	DG	G	11/16/07	10.1237	-0.117
UNH	DG	G	11/16/07	10.1254	-0.101

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	DG	G	12/6/07	10.1353	-0.003
UNH	DG	G	12/6/07	10.1395	0.038
UNH	DG	G	12/6/07	10.1311	-0.044
UNH	DG	G	12/6/07	10.1254	-0.101
UNH	DG	G	1/30/08	10.1257	-0.098
UNH	DG	G	1/30/08	10.1253	-0.102
UNH	DG	G	1/30/08	10.1284	-0.071
UNH	DG	G	1/30/08	10.1238	-0.116
UNH	DG	G	1/31/08	10.1269	-0.086
UNH	DG	G	1/31/08	10.1261	-0.094
UNH	DG	G	1/31/08	10.1222	-0.132
UNH	DG	G	1/31/08	10.1274	-0.081
UNH	DG	U	6/5/08	0.01000	-0.400
UNH	DG	U	6/5/08	0.01000	-0.400
UNH	DG	U	6/5/08	0.00999	-0.500
UNH	DG	U	6/5/08	0.01001	-0.301
UNH	DG	U	6/9/08	0.01006	0.197
UNH	DG	U	6/9/08	0.01004	-0.002
UNH	DG	U	6/9/08	0.01003	-0.102
UNH	DG	U	6/9/08	0.01003	-0.102
UNH	DG	V	3/21/06	1.00227	-0.174
UNH	DG	V	3/21/06	1.00217	-0.184
UNH	DG	V	3/21/06	1.00177	-0.224
UNH	DG	V	3/21/06	0.99927	-0.128
UNH	DG	V	3/21/06	1.00017	-0.038
UNH	DG	V	3/21/06	0.99967	-0.088
UNH	DG	V	4/5/06	1.00249	-0.152
UNH	DG	V	4/5/06	1.00229	-0.172
UNH	DG	V	4/5/06	1.00339	-0.063
UNH	DG	V	4/5/06	0.99911	-0.144
UNH	DG	V	4/5/06	1.00011	-0.044
UNH	DG	V	4/5/06	0.99982	-0.073
UNH	DG	V	4/25/06	1.00356	-0.046
UNH	DG	V	4/25/06	1.00356	-0.046
UNH	DG	V	4/25/06	1.00356	-0.046
UNH	DG	V	4/25/06	1.00044	-0.011
UNH	DG	V	4/25/06	1.0006	0.005
UNH	DG	V	4/25/06	1.00052	-0.003
UNH	IDMS	V	7/7/08	1.0140	0.043
UNH	IDMS	V	7/7/08	1.0132	-0.036
UNH	IDMS	V	7/7/08	1.0138	0.024
UNH	IDMS	V	7/7/08	1.0135	-0.006
UNH	IDMS	V	7/15/08	1.0139	0.034
UNH	IDMS	V	7/15/08	1.0138	0.024
UNH	IDMS	V	7/16/08	1.0136	0.004
UNH	IDMS	V	7/16/08	1.0134	-0.016

Table AX.2. Uranium mass fraction measurements in UO_2.

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UO_2	DG	AB	3/30/06	88.128	-0.001
UO_2	DG	AB	3/30/06	88.149	0.023
UO_2	DG	AB	3/30/06	88.123	-0.007
UO_2	DG	AB	3/30/06	88.124	-0.006
UO_2	DG	AB	3/30/06	88.120	-0.010
UO_2	DG	AB	3/30/06	88.044	-0.096
UO_2	DG	AB	3/31/06	88.091	-0.043
UO_2	DG	AB	3/31/06	88.143	0.016
UO_2	DG	AB	3/31/06	88.103	-0.030
UO_2	DG	AB	3/31/06	88.076	-0.060
UO_2	DG	AB	3/31/06	88.071	-0.066
UO_2	DG	AB	3/31/06	88.085	-0.050
UO_2	DG	AC	6/5/06	88.028	-0.115
UO_2	DG	AC	6/5/06	88.037	-0.104
UO_2	DG	AC	6/5/06	87.986	-0.162
UO_2	DG	AC	6/5/06	87.977	-0.172
UO_2	DG	AC	6/6/06	87.970	-0.180
UO_2	DG	AC	6/6/06	87.983	-0.166
UO_2	DG	AC	6/6/06	87.972	-0.178
UO_2	DG	AC	6/6/06	87.964	-0.187
UO_2	DG	AC	11/16/06	88.128	-0.001
UO_2	DG	AC	11/16/06	88.137	0.009
UO_2	DG	AC	11/16/06	88.096	-0.037
UO_2	DG	AC	11/16/06	88.097	-0.036
UO_2	DG	AC	11/17/06	88.129	0.000
UO_2	DG	AC	11/17/06	88.147	0.020
UO_2	DG	AC	11/17/06	88.098	-0.035
UO_2	DG	AC	11/17/06	88.11	-0.022
UO_2	DG	AC	11/20/07	88.071	-0.066
UO_2	DG	AC	11/20/07	88.102	-0.031
UO_2	DG	AC	11/21/07	88.116	-0.015
UO_2	DG	AC	11/21/07	88.128	-0.001
UO_2	DG	AC	11/28/07	88.131	0.002
UO_2	DG	AC	11/28/07	88.147	0.020
UO_2	DG	AC	11/29/07	88.138	0.010
UO_2	DG	AC	11/29/07	88.127	-0.002
UO_2	DG	AD	6/2/06	88.097	-0.036
UO_2	DG	AD	6/2/06	88.126	-0.003
UO_2	DG	AD	6/2/06	88.115	-0.016
UO_2	DG	AD	6/2/06	88.087	-0.048
UO_2	DG	AD	6/5/06	88.113	-0.018
UO_2	DG	AD	6/5/06	88.121	-0.009
UO_2	DG	AD	6/5/06	88.120	-0.010
UO_2	DG	AD	6/5/06	88.109	-0.023
UO_2	DG	AD	11/23/06	88.059	-0.079
UO_2	DG	AD	11/23/06	88.069	-0.068
UO_2	DG	AD	11/23/06	88.075	-0.061
UO_2	DG	AD	11/23/06	88.064	-0.074

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UO_2	DG	AD	11/25/06	88.088	-0.047
UO_2	DG	AD	11/25/06	88.065	-0.073
UO_2	DG	AD	11/25/06	88.075	-0.061
UO_2	DG	AD	11/25/06	88.07	-0.067
UO_2	DG	AE	4/26/06	88.0960	-0.037
UO_2	DG	AE	4/26/06	88.1055	-0.027
UO_2	DG	AE	4/26/06	88.1239	-0.006
UO_2	DG	AE	4/26/06	88.1190	-0.011
UO_2	DG	AE	4/27/06	88.1469	0.020
UO_2	DG	AE	4/27/06	88.1042	-0.028
UO_2	DG	AE	4/27/06	88.1658	0.042
UO_2	DG	AE	4/27/06	88.1668	0.043
UO_2	DG	AE	11/23/06	88.122	-0.008
UO_2	DG	AE	11/23/06	88.164	0.040
UO_2	DG	AE	11/23/06	88.091	-0.043
UO_2	DG	AE	11/23/06	88.095	-0.039
UO_2	DG	AE	11/24/06	88.065	-0.073
UO_2	DG	AE	11/24/06	88.006	-0.140
UO_2	DG	AE	11/24/06	88.06	-0.078
UO_2	DG	AE	11/24/06	87.977	-0.172
UO_2	DG	BA	4/6/06	88.152	0.092
UO_2	DG	BA	4/6/06	88.083	0.014
UO_2	DG	BA	4/6/06	88.125	0.061
UO_2	DG	BA	4/6/06	88.052	-0.022
UO_2	DG	BA	4/6/06	88.099	0.032
UO_2	DG	BA	4/6/06	88.031	-0.045
UO_2	DG	BA	4/6/06	88.027	-0.050
UO_2	DG	BA	4/6/06	88.058	-0.015
UO_2	DG	BA	4/6/06	88.140	0.078
UO_2	DG	BA	4/6/06	88.099	0.032
UO_2	DG	BA	4/7/06	88.032	-0.044
UO_2	DG	BA	4/7/06	88.005	-0.075
UO_2	DG	BA	4/7/06	88.027	-0.050
UO_2	DG	BA	4/7/06	87.936	-0.153
UO_2	DG	BA	4/7/06	88.025	-0.052
UO_2	DG	BA	4/7/06	87.951	-0.136
UO_2	DG	BA	4/7/06	88.048	-0.026
UO_2	DG	BA	4/7/06	87.930	-0.160
UO_2	DG	BA	4/7/06	87.997	-0.084
UO_2	DG	BA	4/7/06	87.966	-0.119
UO_2	DG	BA	11/23/06	88.055	-0.084
UO_2	DG	BA	11/23/06	88.15	0.024
UO_2	DG	BA	11/23/06	88.114	-0.017
UO_2	DG	BA	11/23/06	88.094	-0.040
UO_2	DG	BA	11/23/06	88.131	0.002
UO_2	DG	BA	11/23/06	88.099	-0.034
UO_2	DG	BA	11/23/06	88.137	0.009
UO_2	DG	BA	11/23/06	88.08	-0.056
UO_2	DG	BA	11/24/06	88.102	-0.031
UO_2	DG	BA	11/24/06	88.08	-0.056

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UO_2	DG	BA	11/24/06	88.124	-0.006
UO_2	DG	BA	11/24/06	88.136	0.008
UO_2	DG	BA	11/24/06	88.132	0.003
UO_2	DG	BA	11/24/06	88.152	0.026
UO_2	DG	BA	11/24/06	88.062	-0.076
UO_2	DG	BA	11/24/06	88.113	-0.018
UO_2	DG	BA	11/26/07	88.009	-0.136
UO_2	DG	BA	11/26/07	88.001	-0.145
UO_2	DG	BA	11/26/07	87.987	-0.161
UO_2	DG	BA	11/26/07	88.02	-0.124
UO_2	DG	BA	11/26/07	87.97	-0.180
UO_2	DG	BA	11/26/07	87.977	-0.172
UO_2	DG	BA	11/26/07	87.991	-0.157
UO_2	DG	BA	11/27/07	87.972	-0.178
UO_2	DG	BA	11/27/07	88.01	-0.135
UO_2	DG	BA	11/27/07	87.982	-0.167
UO_2	DG	BA	11/27/07	87.928	-0.228
UO_2	DG	BA	11/27/07	87.962	-0.189
UO_2	DG	BA	11/27/07	87.956	-0.196
UO_2	DG	BA	11/27/07	87.914	-0.244
UO_2	DG	BA	3/17/08	88.12	-0.010
UO_2	DG	BA	3/17/08	88.053	-0.086
UO_2	DG	BA	3/17/08	88.105	-0.027
UO_2	DG	BA	3/17/08	88.052	-0.087
UO_2	DG	BA	3/17/08	88.052	-0.087
UO_2	DG	BA	3/17/08	87.961	-0.191
UO_2	DG	BA	3/17/08	87.998	-0.149
UO_2	DG	BA	3/17/08	88.087	-0.048
UO_2	DG	BA	3/17/08	88.087	-0.048
UO_2	DG	BA	3/17/08	88.023	-0.120
UO_2	DG	BA	3/17/08	88.103	-0.030
UO_2	DG	BA	3/17/08	87.961	-0.191
UO_2	DG	BA	3/18/08	88.105	-0.027
UO_2	DG	BA	3/18/08	87.953	-0.200
UO_2	DG	BA	3/18/08	87.977	-0.172
UO_2	DG	BA	3/18/08	88.122	-0.008
UO_2	DG	BA	3/18/08	88.084	-0.051
UO_2	DG	BA	3/18/08	87.966	-0.185
UO_2	DG	BA	3/18/08	87.958	-0.194
UO_2	DG	BA	3/18/08	88.041	-0.100
UO_2	DG	BA	3/18/08	88.025	-0.118
UO_2	DG	BC	4/13/06	88.06433	-0.073
UO_2	DG	BC	4/13/06	88.15492	0.029
UO_2	DG	BC	4/13/06	88.15719	0.032
UO_2	DG	BC	4/13/06	88.08713	-0.048
UO_2	DG	BC	4/13/06	88.05359	-0.086
UO_2	DG	BC	4/13/06	88.01272	-0.132
UO_2	DG	BC	4/13/06	87.97265	-0.177
UO_2	DG	BC	4/13/06	88.02056	-0.123
UO_2	DG	BC	4/13/06	88.00236	-0.144

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UO_2	DG	BC	4/13/06	88.02031	-0.123
UO_2	DG	BC	4/18/06	88.12967	0.001
UO_2	DG	BC	4/18/06	88.10743	-0.024
UO_2	DG	BC	4/18/06	88.10258	-0.030
UO_2	DG	BC	4/18/06	88.06009	-0.078
UO_2	DG	BC	4/18/06	88.16297	0.039
UO_2	DG	BC	4/18/06	88.01585	-0.128
UO_2	DG	BC	4/18/06	88.03035	-0.112
UO_2	DG	BC	4/18/06	88.01072	-0.134
UO_2	DG	BC	4/18/06	88.03399	-0.108
UO_2	DG	BC	4/18/06	88.01799	-0.126
UO_2	DG	BC	10/17/06	88.07628	-0.060
UO_2	DG	BC	10/17/06	88.10536	-0.027
UO_2	DG	BC	10/17/06	88.11326	-0.018
UO_2	DG	BC	10/17/06	88.09782	-0.035
UO_2	DG	BC	10/17/06	88.07518	-0.061
UO_2	DG	BC	10/17/06	88.20877	0.091
UO_2	DG	BC	10/17/06	88.13921	0.012
UO_2	DG	BC	10/17/06	88.16356	0.039
UO_2	DG	BC	10/17/06	88.19854	0.079
UO_2	DG	BC	10/17/06	88.15852	0.033
UO_2	DG	BC	10/19/06	88.05198	-0.087
UO_2	DG	BC	10/19/06	88.08551	-0.049
UO_2	DG	BC	10/19/06	88.05898	-0.079
UO_2	DG	BC	10/19/06	88.05865	-0.080
UO_2	DG	BC	10/19/06	88.05625	-0.083
UO_2	DG	BC	10/19/06	88.1391	0.011
UO_2	DG	BC	10/19/06	88.15435	0.029
UO_2	DG	BC	10/19/06	88.15698	0.032
UO_2	DG	BC	10/19/06	88.16761	0.044
UO_2	DG	BC	10/19/06	88.13891	0.011
UO_2	DG	BC	10/17/07	88.3862	0.292
UO_2	DG	BC	10/17/07	88.2957	0.189
UO_2	DG	BC	10/17/07	88.3437	0.244
UO_2	DG	BC	10/17/07	88.3748	0.279
UO_2	DG	BC	10/17/07	88.389	0.295
UO_2	DG	BC	10/17/07	88.3956	0.303
UO_2	DG	BC	10/17/07	88.2712	0.161
UO_2	DG	BC	10/17/07	88.2899	0.183
UO_2	DG	BC	10/17/07	88.1584	0.033
UO_2	DG	BC	10/17/07	88.1217	-0.008
UO_2	DG	BC	10/17/07	88.0746	-0.062
UO_2	DG	BC	10/17/07	88.0775	-0.058
UO_2	DG	BC	10/17/07	88.3706	0.274
UO_2	DG	BC	10/17/07	88.364	0.267
UO_2	DG	BC	10/17/07	88.2394	0.125
UO_2	DG	BC	10/17/07	88.2341	0.119
UO_2	DG	BC	10/24/07	88.145	0.018
UO_2	DG	BC	10/24/07	88.1168	-0.014
UO_2	DG	BC	10/24/07	88.1436	0.017

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UO_2	DG	BC	10/24/07	88.1153	-0.016
UO_2	DG	BC	10/24/07	88.3143	0.210
UO_2	DG	BC	10/24/07	88.3189	0.215
UO_2	DG	BC	10/24/07	88.2798	0.171
UO_2	DG	BC	10/24/07	88.2844	0.176
UO_2	DG	BC	10/24/07	88.3438	0.244
UO_2	DG	BC	10/24/07	88.3682	0.271
UO_2	DG	BC	10/24/07	88.3091	0.204
UO_2	DG	BC	10/24/07	88.3335	0.232
UO_2	DG	BC	10/24/07	88.2801	0.171
UO_2	DG	BC	10/24/07	88.3115	0.207
UO_2	DG	BC	10/24/07	88.2435	0.130
UO_2	DG	BC	10/24/07	88.2749	0.166
UO_2	DG	BC	9/16/08	88.0174	-0.127
UO_2	DG	BC	9/16/08	88.1168	-0.014
UO_2	DG	BC	9/16/08	88.0930	-0.041
UO_2	DG	BC	9/16/08	87.9957	-0.151
UO_2	DG	BC	9/16/08	88.0484	-0.091
UO_2	DG	BC	9/16/08	88.0449	-0.095
UO_2	DG	BC	9/16/08	88.0079	-0.137
UO_2	DG	BC	9/16/08	88.0401	-0.101
UO_2	DG	BC	9/16/08	88.0098	-0.135
UO_2	DG	BC	9/16/08	88.0820	-0.053
UO_2	DG	BC	9/19/08	88.2233	0.107
UO_2	DG	BC	9/19/08	88.2732	0.164
UO_2	DG	BC	9/19/08	88.0819	-0.053
UO_2	DG	BC	9/19/08	88.1342	0.006
UO_2	DG	BC	9/19/08	88.1503	0.024
UO_2	DG	BC	9/19/08	88.1260	-0.003
UO_2	DG	BC	9/19/08	88.1907	0.070
UO_2	DG	BC	9/19/08	88.1479	0.021
UO_2	DG	BC	9/19/08	88.0940	-0.040
UO_2	DG	BC	9/19/08	88.1355	0.007
UO_2	DG	BC	3/11/09	87.9292	-0.227
UO_2	DG	BC	3/11/09	87.9320	-0.224
UO_2	DG	BC	3/11/09	87.8618	-0.303
UO_2	DG	BC	3/11/09	87.8403	-0.328
UO_2	DG	BC	3/11/09	87.8943	-0.266
UO_2	DG	BC	3/11/09	87.8198	-0.351
UO_2	DG	BC	3/11/09	87.8066	-0.366
UO_2	DG	BC	3/11/09	87.7830	-0.393
UO_2	DG	BC	3/20/09	87.9899	-0.158
UO_2	DG	BC	3/20/09	88.0127	-0.132
UO_2	DG	BC	3/20/09	87.9912	-0.156
UO_2	DG	BC	3/20/09	88.0156	-0.129
UO_2	DG	BC	3/20/09	87.9811	-0.168
UO_2	DG	BC	3/20/09	87.9330	-0.222
UO_2	DG	BC	3/20/09	87.9644	-0.187
UO_2	DG	BC	3/20/09	87.9236	-0.233
UO_2	DG	BD	12/29/08	88.130	0.001

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UO_2	DG	BD	12/29/08	88.200	0.081
UO_2	DG	BD	12/29/08	87.890	-0.271
UO_2	DG	BD	12/29/08	88.120	-0.010
UO_2	DG	BD	12/29/08	88.230	0.115
UO_2	DG	BD	12/29/08	88.010	-0.135
UO_2	DG	BD	12/30/08	88.590	0.523
UO_2	DG	BD	12/30/08	88.490	0.410
UO_2	DG	BD	12/30/08	88.160	0.035
UO_2	DG	BD	12/30/08	88.140	0.013
UO_2	DG	BD	12/30/08	88.280	0.171
UO_2	DG	BD	12/30/08	88.050	-0.090
UO_2	DG	BD	3/24/09	88.040	-0.101
UO_2	DG	BD	3/24/09	88.450	0.364
UO_2	DG	BD	3/24/09	87.830	-0.339
UO_2	DG	BD	3/24/09	88.040	-0.101
UO_2	DG	BD	3/24/09	88.010	-0.135
UO_2	DG	BD	3/24/09	87.900	-0.260
UO_2	DG	BD	3/25/09	88.100	-0.033
UO_2	DG	BD	3/25/09	87.940	-0.215
UO_2	DG	BD	3/25/09	88.160	0.035
UO_2	DG	BD	3/25/09	88.250	0.137
UO_2	DG	BD	3/25/09	88.060	-0.078
UO_2	DG	BD	3/25/09	88.190	0.069
UO_2	DG	BF	4/4/06	88.061	-0.077
UO_2	DG	BF	4/4/06	88.097	-0.036
UO_2	DG	BF	4/4/06	88.090	-0.044
UO_2	DG	BF	4/12/06	88.122	-0.008
UO_2	DG	BF	4/12/06	88.056	-0.083
UO_2	DG	BF	4/12/06	88.110	-0.022
UO_2	DG	BF	4/12/06	88.138	0.010
UO_2	DG	BF	4/12/06	88.133	0.005
UO_2	DG	BF	4/12/06	88.148	0.022
UO_2	DG	BF	4/12/06	88.147	0.020
UO_2	DG	BF	4/13/06	88.068	-0.069
UO_2	DG	BF	4/13/06	88.142	0.015
UO_2	DG	BF	4/13/06	88.160	0.035
UO_2	DG	BF	4/13/06	88.141	0.014
UO_2	DG	BF	1/15/07	88.122	-0.008
UO_2	DG	BF	1/15/07	88.121	-0.009
UO_2	DG	BF	1/15/07	87.955	-0.197
UO_2	DG	BF	1/15/07	87.998	-0.149
UO_2	DG	BF	1/15/07	88.148	0.022
UO_2	DG	BF	1/15/07	88.125	-0.005
UO_2	DG	BF	1/16/07	88.127	-0.002
UO_2	DG	BF	1/16/07	88.147	0.020
UO_2	DG	BF	1/16/07	88.194	0.074
UO_2	DG	BF	1/16/07	88.204	0.085
UO_2	DG	BF	1/16/07	88.145	0.018
UO_2	DG	BF	1/16/07	88.224	0.108
UO_2	DG	BF	1/16/07	88.105	-0.027

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UO_2	DG	BF	1/16/07	88.178	0.056
UO_2	DG	BF	1/16/07	88.125	-0.005
UO_2	DG	BF	1/16/07	88.126	-0.003
UO_2	DG	BF	1/16/07	88.138	0.010
UO_2	DG	BF	1/16/07	88.094	-0.040
UO_2	DG	BF	8/29/08	88.097	-0.036
UO_2	DG	BF	8/29/08	88.112	-0.019
UO_2	DG	BF	8/29/08	88.089	-0.045
UO_2	DG	BF	10/29/08	88.085	-0.050
UO_2	DG	BF	10/31/08	88.129	0.000
UO_2	DG	BF	10/31/08	88.137	0.009
UO_2	DG	BF	10/31/08	88.111	-0.020
UO_2	DG	BF	10/31/08	88.136	0.008
UO_2	DG	BF	3/19/09	88.035	-0.107
UO_2	DG	BF	3/19/09	88.089	-0.045
UO_2	DG	BF	3/19/09	88.066	-0.072
UO_2	DG	BF	3/19/09	88.069	-0.068
UO_2	DG	BF	3/20/09	88.039	-0.102
UO_2	DG	BF	3/20/09	88.085	-0.050
UO_2	DG	BF	3/20/09	88.065	-0.073
UO_2	DG	BF	3/20/09	88.097	-0.036
UO_2	DG	ED	9/24/08	88.15	0.024
UO_2	DG	ED	9/24/08	88.07	-0.067
UO_2	DG	ED	9/24/08	88.08	-0.056
UO_2	DG	ED	9/24/08	88.06	-0.078
UO_2	DG	ED	9/24/08	88.07	-0.067
UO_2	DG	ED	9/24/08	88.20	0.081
UO_2	DG	ED	9/24/08	88.14	0.012
UO_2	DG	ED	9/24/08	88.05	-0.090
UO_2	DG	ED	9/25/08	88.06	-0.078
UO_2	DG	ED	9/25/08	88.06	-0.078
UO_2	DG	ED	9/25/08	88.15	0.024
UO_2	DG	ED	9/25/08	88.16	0.035
UO_2	DG	ED	9/25/08	88.22	0.103
UO_2	DG	ED	9/25/08	88.17	0.047
UO_2	DG	ED	9/25/08	88.18	0.058
UO_2	DG	ED	9/25/08	88.06	-0.078
UO_2	DG	F	9/14/07	88.154	0.028
UO_2	DG	F	9/14/07	88.098	-0.035
UO_2	DG	F	9/14/07	88.082	-0.053
UO_2	DG	F	9/14/07	88.129	0.000
UO_2	DG	F	9/14/07	88.108	-0.024
UO_2	DG	F	9/14/07	88.139	0.011
UO_2	DG	F	9/14/07	88.108	-0.024
UO_2	DG	F	9/14/07	88.123	-0.007
UO_2	DG	F	9/25/07	88.131	0.002
UO_2	DG	F	9/25/07	88.049	-0.091
UO_2	DG	F	9/25/07	87.991	-0.157
UO_2	DG	F	9/25/07	88.148	0.022
UO_2	DG	F	9/25/07	88.131	0.002

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UO_2	DG	F	9/25/07	88.11	-0.022
UO_2	DG	F	9/25/07	88.158	0.033
UO_2	DG	F	9/25/07	88.169	0.045
UO_2	DG	F	10/2/07	88.119	-0.011
UO_2	DG	F	10/2/07	88.14	0.012
UO_2	DG	F	10/2/07	88.148	0.022
UO_2	DG	F	10/2/07	88.146	0.019
UO_2	DG	F	10/2/07	88.131	0.002
UO_2	DG	F	10/2/07	88.122	-0.008
UO_2	DG	F	10/4/07	88.137	0.009
UO_2	DG	F	10/4/07	88.135	0.007
UO_2	DG	F	10/4/07	88.143	0.016
UO_2	DG	F	10/4/07	88.155	0.030
UO_2	DG	F	10/4/07	88.12	-0.010
UO_2	DG	T	4/12/06	88.23	0.115
UO_2	DG	T	4/12/06	88.20	0.081
UO_2	DG	T	4/12/06	88.17	0.047
UO_2	DG	T	4/12/06	88.22	0.103
UO_2	DG	T	4/19/06	88.04	-0.101
UO_2	DG	T	4/19/06	88.12	-0.010
UO_2	DG	T	4/19/06	88.15	0.024
UO_2	DG	T	4/19/06	88.10	-0.033
UO_2	DG	T	8/23/06	88.09	-0.044
UO_2	DG	T	8/23/06	88.16	0.035
UO_2	DG	T	8/23/06	88.16	0.035
UO_2	DG	T	8/23/06	88.1	-0.033
UO_2	DG	T	8/25/06	88.1	-0.033
UO_2	DG	T	8/25/06	88.12	-0.010
UO_2	DG	T	8/25/06	88.19	0.069
UO_2	DG	T	8/25/06	88.16	0.035
UO_2	DG	T	10/16/06	88.15	0.024
UO_2	DG	T	10/16/06	88.15	0.024
UO_2	DG	T	10/16/06	88.1	-0.033
UO_2	DG	T	10/16/06	88.12	-0.010
UO_2	DG	T	10/24/06	88.03	-0.112
UO_2	DG	T	10/24/06	88.18	0.058
UO_2	DG	T	10/24/06	88.03	-0.112
UO_2	DG	T	10/24/06	88.18	0.058
UO_2	DG	T	11/7/07	88.13	0.001
UO_2	DG	T	11/7/07	88.09	-0.044
UO_2	DG	T	11/7/07	88.1	-0.033
UO_2	DG	T	11/7/07	88.21	0.092
UO_2	DG	T	11/9/07	88.25	0.137
UO_2	DG	T	11/9/07	88.27	0.160
UO_2	DG	T	11/9/07	88.25	0.137
UO_2	DG	T	11/9/07	88.28	0.171
UO_2	DG	T	12/10/07	88.24	0.126
UO_2	DG	T	12/10/07	88.13	0.001
UO_2	DG	T	12/10/07	88.19	0.069
UO_2	DG	T	12/10/07	88.23	0.115

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UO_2	DG	T	12/13/07	88.20	0.081
UO_2	DG	T	12/13/07	88.23	0.115
UO_2	DG	T	12/13/07	88.17	0.047
UO_2	DG	T	12/13/07	88.21	0.092
UO_2	DG	T	5/13/08	88.19	0.069
UO_2	DG	T	5/13/08	88.29	0.183
UO_2	DG	T	5/19/08	88.11	-0.022
UO_2	DG	T	5/19/08	88.09	-0.044
UO_2	DG	T	6/26/08	88.17	0.047
UO_2	DG	T	6/26/08	88.09	-0.044
UO_2	DG	T	6/26/08	88.10	-0.033
UO_2	DG	T	6/26/08	88.14	0.012
UO_2	DG	T	6/26/08	88.16	0.035
UO_2	DG	T	6/26/08	88.03	-0.112
UO_2	DG	T	6/27/08	88.05	-0.090
UO_2	DG	T	6/27/08	88.14	0.012
UO_2	DG	T	6/27/08	88.20	0.081
UO_2	DG	T	6/27/08	88.12	-0.010
UO_2	DG	T	6/27/08	88.18	0.058
UO_2	DG	T	6/27/08	88.26	0.149
UO_2	DG	T	9/11/08	88.08	-0.056
UO_2	DG	T	9/11/08	88.08	-0.056
UO_2	DG	T	9/16/08	88.10	-0.033
UO_2	DG	T	9/16/08	88.11	-0.022
UO_2	DG	T	1/15/09	88.07	-0.067
UO_2	DG	T	1/15/09	88.14	0.012
UO_2	DG	T	1/15/09	88.19	0.069
UO_2	DG	T	1/15/09	88.07	-0.067
UO_2	DG	T	1/16/09	88.17	0.047
UO_2	DG	T	1/16/09	88.19	0.069
UO_2	DG	T	1/16/09	88.13	0.001
UO_2	DG	T	1/16/09	88.19	0.069
UO_2	DG	V	3/21/06	88.031	-0.111
UO_2	DG	V	3/21/06	88.038	-0.103
UO_2	DG	V	3/21/06	88.032	-0.110
UO_2	DG	V	3/21/06	88.070	-0.067
UO_2	DG	V	3/21/06	88.092	-0.042
UO_2	DG	V	3/21/06	88.034	-0.108
UO_2	DG	V	4/5/06	88.085	-0.050
UO_2	DG	V	4/5/06	88.089	-0.045
UO_2	DG	V	4/5/06	88.136	0.008
UO_2	DG	V	4/5/06	87.990	-0.158
UO_2	DG	V	4/5/06	88.108	-0.024
UO_2	DG	V	4/5/06	88.038	-0.103
UO_2	DG	V	4/25/06	88.113	-0.018
UO_2	DG	V	4/25/06	88.074	-0.062
UO_2	DG	V	4/25/06	88.145	0.018
UO_2	DG	V	4/25/06	88.143	0.016
UO_2	DG	V	4/25/06	88.093	-0.041
UO_2	DG	V	4/25/06	88.139	0.011

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UO_2	DG	V	6/20/08	88.144	0.017
UO_2	DG	V	6/20/08	88.167	0.043
UO_2	DG	V	6/20/08	88.141	0.014
UO_2	DG	V	6/20/08	88.151	0.025
UO_2	DG	V	6/30/08	88.163	0.039
UO_2	DG	V	6/30/08	88.135	0.007
UO_2	DG	V	6/30/08	88.125	-0.005
UO_2	DG	V	6/30/08	88.138	0.010

Table AX.3. Uranium mass fraction measurement in UO_3.

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UO_3	XRF	A	6/5/08	82.49	-0.219
UO_3	XRF	A	6/5/08	82.83	0.192
UO_3	XRF	A	6/5/08	82.49	-0.219
UO_3	XRF	A	6/5/08	82.41	-0.316
UO_3	XRF	A	6/11/08	82.45	-0.267
UO_3	XRF	A	6/11/08	82.28	-0.473
UO_3	XRF	A	6/11/08	82.44	-0.279
UO_3	XRF	A	6/11/08	82.37	-0.364
UO_3	XRF	A	6/16/08	82.41	-0.316
UO_3	XRF	A	6/16/08	82.14	-0.642
UO_3	XRF	A	6/16/08	82.59	-0.098
UO_3	XRF	A	6/16/08	82.15	-0.630
UO_3	IDMS	A	6/18/08	82.45	-0.267
UO_3	IDMS	A	6/18/08	82.35	-0.388
UO_3	IDMS	A	6/18/08	82.41	-0.316
UO_3	IDMS	A	6/18/08	82.96	0.350
UO_3	IDMS	A	6/23/08	82.36	-0.376
UO_3	IDMS	A	6/23/08	82.36	-0.376
UO_3	IDMS	A	6/23/08	82.33	-0.412
UO_3	IDMS	A	6/23/08	82.44	-0.279
UO_3	XRF	A	6/23/08	82.03	-0.775
UO_3	XRF	A	6/23/08	82.03	-0.775
UO_3	XRF	A	6/23/08	82.21	-0.558
UO_3	XRF	A	6/23/08	81.76	-1.102
UO_3	DG	AB	2/24/09	82.593	-0.094
UO_3	DG	AB	2/24/09	82.611	-0.073
UO_3	DG	AB	2/24/09	82.587	-0.102
UO_3	DG	AB	2/24/09	82.595	-0.092
UO_3	DG	AB	2/24/09	82.615	-0.068
UO_3	DG	AB	2/24/09	82.566	-0.127
UO_3	DG	AB	2/25/09	82.631	-0.048
UO_3	DG	AB	2/25/09	82.590	-0.098
UO_3	DG	AB	2/25/09	82.587	-0.102
UO_3	DG	AB	2/25/09	82.679	0.010
UO_3	DG	AB	2/25/09	82.593	-0.094
UO_3	DG	AB	2/25/09	82.644	-0.033
UO_3	DG	AE	10/3/07	82.697	0.031
UO_3	DG	AE	10/3/07	82.665	-0.007
UO_3	DG	AE	10/3/07	82.675	0.005
UO_3	DG	AE	10/3/07	82.669	-0.002
UO_3	DG	AE	10/4/07	82.667	-0.005
UO_3	DG	AE	10/4/07	82.59	-0.098
UO_3	DG	AE	10/4/07	82.663	-0.010
UO_3	DG	AE	10/4/07	82.649	-0.027
UO_3	DG	AE	3/17/08	82.586	-0.103
UO_3	DG	AE	3/17/08	82.571	-0.121

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UO_3	DG	AE	3/17/08	82.589	-0.099
UO_3	DG	AE	3/17/08	82.624	-0.057
UO_3	DG	AE	3/18/08	82.66	-0.013
UO_3	DG	AE	3/18/08	82.602	-0.083
UO_3	DG	AE	3/18/08	82.619	-0.063
UO_3	DG	AE	3/18/08	82.584	-0.105
UO_3	IDMS	B	3/2/06	82.0	-0.812
UO_3	IDMS	B	3/2/06	81.8	-1.054
UO_3	IDMS	B	3/2/06	82.1	-0.691
UO_3	IDMS	B	3/2/06	81.8	-1.054
UO_3	IDMS	B	3/9/06	82.0	-0.812
UO_3	IDMS	B	3/9/06	82.4	-0.328
UO_3	IDMS	B	3/9/06	82.5	-0.207
UO_3	IDMS	B	3/9/06	82.8	0.156
UO_3	DG	BA	11/26/07	82.599	-0.087
UO_3	DG	BA	11/26/07	82.606	-0.079
UO_3	DG	BA	11/26/07	82.616	-0.067
UO_3	DG	BA	11/26/07	82.608	-0.076
UO_3	DG	BA	11/26/07	82.635	-0.044
UO_3	DG	BA	11/26/07	82.618	-0.064
UO_3	DG	BA	11/26/07	82.581	-0.109
UO_3	DG	BA	11/26/07	82.616	-0.067
UO_3	DG	BA	11/27/07	82.409	-0.317
UO_3	DG	BA	11/27/07	82.479	-0.232
UO_3	DG	BA	11/27/07	82.578	-0.112
UO_3	DG	BA	11/27/07	82.485	-0.225
UO_3	DG	BA	11/27/07	82.59	-0.098
UO_3	DG	BA	11/27/07	82.664	-0.008
UO_3	DG	BA	11/27/07	82.614	-0.069
UO_3	DG	BA	11/27/07	82.62	-0.062
UO_3	DG	BA	3/19/08	82.485	-0.225
UO_3	DG	BA	3/19/08	82.671	0.000
UO_3	DG	BA	3/19/08	82.592	-0.096
UO_3	DG	BA	3/19/08	82.417	-0.307
UO_3	DG	BA	3/19/08	82.468	-0.246
UO_3	DG	BA	3/19/08	82.557	-0.138
UO_3	DG	BA	3/19/08	82.543	-0.155
UO_3	DG	BA	3/19/08	82.576	-0.115
UO_3	DG	BA	3/19/08	82.421	-0.302
UO_3	DG	BA	3/19/08	82.469	-0.244
UO_3	DG	BA	3/19/08	82.405	-0.322
UO_3	DG	BA	3/19/08	82.431	-0.290
UO_3	DG	BA	3/19/08	82.42	-0.304
UO_3	DG	BA	3/19/08	82.426	-0.296
UO_3	DG	BA	3/20/08	82.528	-0.173
UO_3	DG	BA	3/20/08	82.582	-0.108
UO_3	DG	BA	3/20/08	82.624	-0.057
UO_3	DG	BA	3/20/08	82.635	-0.044

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UO_3	DG	BA	3/20/08	82.529	-0.172
UO_3	DG	BA	3/20/08	82.6	-0.086
UO_3	DG	BA	3/20/08	82.562	-0.132
UO_3	DG	BA	3/20/08	82.488	-0.221
UO_3	DG	BA	3/20/08	82.471	-0.242
UO_3	DG	BA	3/20/08	82.451	-0.266
UO_3	DG	BA	3/20/08	82.43	-0.292
UO_3	DG	BA	3/20/08	82.418	-0.306
UO_3	DG	BA	3/20/08	82.51	-0.195
UO_3	DG	BA	3/20/08	82.507	-0.198
UO_3	DG	BF	7/27/07	82.772	0.122
UO_3	DG	BF	7/27/07	82.768	0.117
UO_3	DG	BF	8/1/07	82.732	0.074
UO_3	DG	BF	8/1/07	82.737	0.080
UO_3	DG	BF	10/3/07	82.635	-0.044
UO_3	DG	BF	10/3/07	82.646	-0.030
UO_3	DG	BF	10/8/07	82.597	-0.090
UO_3	DG	BF	10/8/07	82.584	-0.105
UO_3	DG	BF	3/27/08	82.767	0.116
UO_3	DG	BF	3/27/08	82.575	-0.116
UO_3	DG	BF	3/27/08	82.58	-0.110
UO_3	DG	BF	3/27/08	82.569	-0.123
UO_3	DG	BF	3/28/08	82.764	0.112
UO_3	DG	BF	3/28/08	82.625	-0.056
UO_3	DG	BF	3/28/08	82.589	-0.099
UO_3	DG	BF	3/28/08	82.68	0.011
UO_3	DG	F	9/18/07	82.613	-0.070
UO_3	DG	F	9/18/07	82.627	-0.053
UO_3	DG	F	9/18/07	82.663	-0.010
UO_3	DG	F	9/18/07	82.634	-0.045
UO_3	DG	F	9/18/07	82.632	-0.047
UO_3	DG	F	9/18/07	82.65	-0.025
UO_3	DG	F	9/18/07	82.637	-0.041
UO_3	DG	F	9/18/07	82.611	-0.073
UO_3	DG	F	9/18/07	82.617	-0.065
UO_3	DG	F	9/18/07	82.55	-0.146
UO_3	DG	F	9/18/07	82.53	-0.171
UO_3	DG	F	9/18/07	82.605	-0.080
UO_3	DG	F	9/18/07	82.586	-0.103
UO_3	DG	F	9/18/07	82.615	-0.068
UO_3	DG	F	9/18/07	82.474	-0.238
UO_3	DG	F	9/18/07	82.463	-0.252
UO_3	DG	F	9/19/07	82.616	-0.067
UO_3	DG	F	9/19/07	82.595	-0.092
UO_3	DG	F	9/19/07	82.586	-0.103
UO_3	DG	F	9/19/07	82.635	-0.044
UO_3	DG	F	9/19/07	82.602	-0.083
UO_3	DG	F	9/19/07	82.603	-0.082

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UO_3	DG	F	9/19/07	82.592	-0.096
UO_3	DG	F	9/19/07	82.6	-0.086
UO_3	DG	F	9/19/07	82.597	-0.090
UO_3	DG	F	9/19/07	82.572	-0.120
UO_3	DG	F	9/19/07	82.607	-0.077
UO_3	DG	F	9/19/07	82.573	-0.119
UO_3	DG	F	9/19/07	82.615	-0.068
UO_3	DG	F	9/19/07	82.608	-0.076
UO_3	DG	F	9/19/07	82.52	-0.183
UO_3	DG	F	9/19/07	82.577	-0.114
UO_3	DG	F	9/21/07	82.624	-0.057
UO_3	DG	F	9/21/07	82.647	-0.029
UO_3	DG	F	9/21/07	82.621	-0.060
UO_3	DG	F	9/21/07	82.651	-0.024
UO_3	DG	F	9/21/07	82.603	-0.082
UO_3	DG	F	9/21/07	82.622	-0.059
UO_3	DG	F	9/21/07	82.69	0.023
UO_3	DG	F	9/21/07	82.641	-0.036
UO_3	DG	F	9/21/07	82.569	-0.123
UO_3	DG	F	9/21/07	82.567	-0.126
UO_3	DG	F	9/21/07	82.541	-0.157
UO_3	DG	F	9/21/07	82.51	-0.195
UO_3	DG	F	9/21/07	82.541	-0.157
UO_3	DG	F	9/21/07	82.561	-0.133
UO_3	DG	F	9/21/07	82.443	-0.276
UO_3	DG	F	9/21/07	82.5	-0.207
UO_3	DG	F	9/24/07	82.635	-0.044
UO_3	DG	F	9/24/07	82.663	-0.010
UO_3	DG	F	9/24/07	82.65	-0.025
UO_3	DG	F	9/24/07	82.662	-0.011
UO_3	DG	F	9/24/07	82.641	-0.036
UO_3	DG	F	9/24/07	82.607	-0.077
UO_3	DG	F	9/24/07	82.711	0.048
UO_3	DG	F	9/24/07	82.7	0.035
UO_3	DG	F	9/24/07	82.62	-0.062
UO_3	DG	F	9/24/07	82.624	-0.057
UO_3	DG	F	9/24/07	82.558	-0.137
UO_3	DG	F	9/24/07	82.606	-0.079
UO_3	DG	F	9/24/07	82.591	-0.097
UO_3	DG	F	9/24/07	82.557	-0.138
UO_3	DG	F	9/24/07	82.46	-0.255
UO_3	DG	F	9/24/07	82.421	-0.302
UO_3	DG	F	3/11/08	82.68	0.011
UO_3	DG	F	3/11/08	82.715	0.053
UO_3	DG	F	3/11/08	82.65	-0.025
UO_3	DG	F	3/11/08	82.598	-0.088
UO_3	DG	F	3/13/08	82.594	-0.093
UO_3	DG	F	3/13/08	82.612	-0.071

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UO_3	DG	F	3/13/08	82.633	-0.046
UO_3	DG	F	3/13/08	82.636	-0.042
UO_3	DG	F	3/13/08	82.598	-0.088
UO_3	DG	F	3/13/08	82.669	-0.002
UO_3	DG	F	3/13/08	82.635	-0.044
UO_3	DG	F	3/13/08	82.637	-0.041
UO_3	DG	F	3/14/08	82.682	0.013
UO_3	DG	F	3/14/08	82.635	-0.044
UO_3	DG	F	3/14/08	82.596	-0.091
UO_3	DG	F	3/14/08	82.636	-0.042
UO_3	DG	V	3/21/06	82.588	-0.100
UO_3	DG	V	3/21/06	82.620	-0.062
UO_3	DG	V	3/21/06	82.593	-0.094
UO_3	DG	V	3/21/06	82.609	-0.075
UO_3	DG	V	3/21/06	82.648	-0.028
UO_3	DG	V	3/21/06	82.651	-0.024
UO_3	DG	V	4/5/06	82.577	-0.114
UO_3	DG	V	4/5/06	82.581	-0.109
UO_3	DG	V	4/5/06	82.539	-0.160
UO_3	DG	V	4/5/06	82.586	-0.103
UO_3	DG	V	4/5/06	82.597	-0.090
UO_3	DG	V	4/5/06	82.577	-0.114
UO_3	DG	V	4/25/06	82.610	-0.074
UO_3	DG	V	4/25/06	82.608	-0.076
UO_3	DG	V	4/25/06	82.598	-0.088
UO_3	DG	V	4/25/06	82.647	-0.029
UO_3	DG	V	4/25/06	82.623	-0.058
UO_3	DG	V	6/20/08	82.620	-0.062
UO_3	DG	V	6/20/08	82.593	-0.094
UO_3	DG	V	6/20/08	82.618	-0.064
UO_3	DG	V	6/20/08	82.609	-0.075
UO_3	DG	V	6/30/08	82.551	-0.145
UO_3	DG	V	6/30/08	82.586	-0.103
UO_3	DG	V	6/30/08	82.596	-0.091
UO_3	DG	V	6/30/08	82.656	-0.018

Table AX.4. Uranium mass fraction measurement in U_3O_8.

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
U_30_8	DG	BC	3/25/09	84.6377	-0.156
U_30_8	DG	BC	3/25/09	84.6049	-0.195
U_30_8	DG	BC	3/25/09	84.6280	-0.167
U_30_8	DG	BC	3/25/09	84.6519	-0.139
U_30_8	DG	BC	3/25/09	84.7497	-0.024
U_30_8	DG	BC	3/25/09	84.7255	-0.052
U_30_8	DG	BC	3/25/09	84.7355	-0.040
U_30_8	DG	BC	3/25/09	84.7028	-0.079
U_30_8	DG	BC	3/27/09	84.4258	-0.406
U_30_8	DG	BC	3/27/09	84.3416	-0.505
U_30_8	DG	BC	3/27/09	84.3148	-0.537
U_30_8	DG	BC	3/27/09	84.3357	-0.512
U_30_8	DG	BC	3/27/09	84.4522	-0.375
U_30_8	DG	BC	3/27/09	84.4620	-0.363
U_30_8	DG	BC	3/27/09	84.4886	-0.332
U_30_8	DG	BC	3/27/09	84.4395	-0.390
U_30_8	DG	BA	1/9/09	84.727	-0.051
U_30_8	DG	BA	1/9/09	84.744	-0.030
U_30_8	DG	BA	1/9/09	84.751	-0.022
U_30_8	DG	BA	1/9/09	84.755	-0.018
U_30_8	DG	BA	1/9/09	84.748	-0.026
U_30_8	DG	BA	1/12/09	84.790	0.024
U_30_8	DG	BA	1/12/09	84.790	0.024
U_30_8	DG	BA	1/12/09	84.796	0.031
U_30_8	DG	BA	1/12/09	84.710	-0.071
U_30_8	DG	BA	1/12/09	84.820	0.059
U_30_8	DG	BE	3/31/09	84.56	-0.248
U_30_8	DG	BE	3/31/09	84.60	-0.200
U_30_8	DG	BE	3/31/09	84.66	-0.130
U_30_8	DG	BE	3/31/09	84.58	-0.224
U_30_8	DG	BE	4/1/09	84.66	-0.130
U_30_8	DG	BE	4/1/09	84.53	-0.283
U_30_8	DG	BE	4/1/09	84.58	-0.224
U_30_8	DG	BE	4/1/09	84.65	-0.141

Table AX.5 Uranium Mass Fraction Measurements in UF_6.

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UF_6	DG	AB	4/5/06	67.451	-0.247
UF_6	DG	AB	4/5/06	67.444	-0.257
UF_6	DG	AB	4/5/06	67.413	-0.303
UF_6	DG	AB	4/5/06	67.468	-0.222
UF_6	DG	AB	4/5/06	67.476	-0.210
UF_6	DG	AB	4/5/06	67.496	-0.181
UF_6	DG	AB	4/6/06	67.413	-0.303
UF_6	DG	AB	4/6/06	67.388	-0.340
UF_6	DG	AB	4/6/06	67.396	-0.328
UF_6	DG	AB	4/6/06	67.429	-0.280
UF_6	DG	AB	4/6/06	67.422	-0.290
UF_6	DG	AB	4/6/06	67.439	-0.265
UF_6	DG	AB	7/11/07	67.575	-0.064
UF_6	DG	AB	7/11/07	67.602	-0.024
UF_6	DG	AB	7/11/07	67.558	-0.089
UF_6	DG	AB	7/12/07	67.573	-0.067
UF_6	DG	AB	7/12/07	67.565	-0.079
UF_6	DG	AB	7/12/07	67.582	-0.053
UF_6	DG	AB	3/13/08	67.577	-0.061
UF_6	DG	AB	3/13/08	67.605	-0.019
UF_6	DG	AB	3/13/08	67.556	-0.092
UF_6	DG	AB	3/14/08	67.669	0.075
UF_6	DG	AB	3/14/08	67.547	-0.105
UF_6	DG	AB	3/14/08	67.602	-0.024
UF_6	DG	AE	4/5/06	67.431	-0.277
UF_6	DG	AE	4/5/06	67.414	-0.302
UF_6	DG	AE	4/5/06	67.663	0.066
UF_6	DG	AE	4/5/06	67.7	0.121
UF_6	DG	AE	4/5/06	67.427	-0.283
UF_6	DG	AE	4/5/06	67.438	-0.266
UF_6	DG	AE	4/5/06	67.694	0.112
UF_6	DG	AE	4/5/06	67.698	0.118
UF_6	DG	AE	11/28/06	67.592	-0.039
UF_6	DG	AE	11/28/06	67.554	-0.095
UF_6	DG	AE	11/28/06	67.408	-0.311
UF_6	DG	AE	11/28/06	67.434	-0.272
UF_6	DG	AE	11/29/06	67.485	-0.197
UF_6	DG	AE	11/29/06	67.537	-0.120
UF_6	DG	AE	11/29/06	67.384	-0.346
UF_6	DG	AE	11/29/06	67.444	-0.257
UF_6	DG	AE	10/3/07	67.525	-0.138
UF_6	DG	AE	10/3/07	67.571	-0.070
UF_6	DG	AE	10/4/07	67.561	-0.084
UF_6	DG	AE	10/4/07	67.545	-0.108

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UF_6	DG	AE	3/17/08	67.56	-0.086
UF_6	DG	AE	3/17/08	67.551	-0.099
UF_6	DG	AE	3/18/08	67.537	-0.120
UF_6	DG	AE	3/18/08	67.553	-0.096
UF_6	DG	AE	10/7/08	67.538	-0.116
UF_6	DG	AE	10/7/08	67.58	-0.054
UF_6	DG	AE	10/7/08	67.533	-0.124
UF_6	DG	AE	10/7/08	67.566	-0.075
UF_6	DG	AE	10/8/08	67.532	-0.125
UF_6	DG	AE	10/8/08	67.585	-0.047
UF_6	DG	AE	10/8/08	67.584	-0.048
UF_6	DG	AE	10/8/08	67.566	-0.075
UF_6	DG	AE	3/25/09	67.572	-0.066
UF_6	DG	AE	3/25/09	67.576	-0.060
UF_6	DG	AE	3/25/09	67.575	-0.061
UF_6	DG	AE	3/25/09	67.587	-0.044
UF_6	DG	AE	3/26/09	67.606	-0.016
UF_6	DG	AE	3/26/09	67.566	-0.075
UF_6	DG	AE	3/26/09	67.605	-0.017
UF_6	DG	AE	3/26/09	67.576	-0.060
UF_6	DG	BF	11/28/08	66.449	-1.729
UF_6	DG	BF	11/28/08	66.476	-1.689
UF_6	DG	BF	12/1/08	66.521	-1.606
UF_6	DG	BF	12/1/08	66.513	-1.618
UF_6	DG	BF	12/1/08	66.53	-1.592
UF_6	DG	BF	12/1/08	66.484	-1.677
UF_6	DG	BF	12/1/08	66.484	-1.677
UF_6	DG	BF	1/28/09	66.521	-1.606
UF_6	DG	BF	1/28/09	66.485	-1.659
UF_6	DG	BF	1/28/09	66.495	-1.644
UF_6	DG	BF	3/27/09	67.256	-0.519
UF_6	DG	BF	3/27/09	67.277	-0.488
UF_6	DG	BF	3/27/09	67.236	-0.548
UF_6	DG	BF	3/27/09	67.275	-0.491
UF_6	DG	BF	3/27/09	67.253	-0.523
UF_6	DG	BF	3/27/09	67.3	-0.470
UF_6	DG	BF	3/27/09	67.265	-0.522
UF_6	DG	BF	3/27/09	67.285	-0.493
UF_6	DG	BF	3/27/09	67.295	-0.478
UF_6	DG	BF	3/27/09	67.276	-0.506
UF_6	DG	BF	3/30/09	67.263	-0.508
UF_6	DG	BF	3/30/09	67.275	-0.491
UF_6	DG	BF	3/30/09	67.269	-0.499
UF_6	DG	BF	3/30/09	67.273	-0.493
UF_6	DG	BF	3/30/09	67.266	-0.521

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UF_6	DG	BF	3/30/09	67.281	-0.499
UF_6	DG	BF	3/30/09	67.27	-0.515
UF_6	DG	BF	3/30/09	67.274	-0.509
UF_6	DG	BF	3/30/09	67.274	-0.509
UF_6	DG	EA	6/13/07	67.58	-0.040
UF_6	DG	EA	6/13/07	67.58	-0.040
UF_6	DG	EA	6/13/07	67.55	-0.084
UF_6	DG	EA	6/13/07	67.52	-0.129
UF_6	DG	EA	6/14/07	67.57	-0.055
UF_6	DG	EA	6/14/07	67.57	-0.055
UF_6	DG	EA	6/14/07	67.53	-0.114
UF_6	DG	EA	6/14/07	67.53	-0.114
UF_6	DG	EA	6/10/08	67.69	0.106
UF_6	DG	EA	6/10/08	67.62	0.003
UF_6	DG	EA	6/10/08	67.53	-0.130
UF_6	DG	EA	6/10/08	67.57	-0.071
UF_6	DG	EA	6/12/08	67.69	0.106
UF_6	DG	EA	6/12/08	67.72	0.151
UF_6	DG	EA	6/12/08	67.57	-0.071
UF_6	DG	EA	6/12/08	67.58	-0.056
UF_6	DG	EA	8/20/08	67.59	0.030
UF_6	DG	EA	8/20/08	67.62	0.074
UF_6	DG	EA	8/20/08	67.55	-0.030
UF_6	DG	EA	8/20/08	67.59	0.030
UF_6	DG	EA	8/21/08	67.62	0.074
UF_6	DG	EA	8/21/08	67.57	0.000
UF_6	DG	EA	8/21/08	67.51	-0.089
UF_6	DG	EA	8/21/08	67.48	-0.133
UF_6	DG	EA	11/19/08	67.42	-0.283
UF_6	DG	EA	11/19/08	67.48	-0.194
UF_6	DG	EA	11/19/08	67.35	-0.386
UF_6	DG	EA	11/19/08	67.36	-0.371
UF_6	DG	EA	11/20/08	67.38	-0.342
UF_6	DG	EA	11/20/08	67.53	-0.120
UF_6	DG	EA	11/20/08	67.65	0.058
UF_6	DG	EA	11/20/08	67.59	-0.031
UF_6	DG	EC	5/21/08	67.6769	0.087
UF_6	DG	EC	5/21/08	67.6566	0.057
UF_6	DG	EC	5/21/08	67.6498	0.047
UF_6	DG	EC	5/21/08	67.6769	0.087
UF_6	DG	EC	5/22/08	67.5416	-0.113
UF_6	DG	EC	5/22/08	67.5416	-0.113
UF_6	DG	EC	5/22/08	67.5349	-0.123
UF_6	DG	EC	5/22/08	67.5349	-0.123
UF_6	DG	EC	10/2/08	67.56	-0.076

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UF_6	DG	EC	10/2/08	67.81	0.294
UF_6	DG	EC	10/3/08	68.06	0.664
UF_6	DG	EC	10/3/08	67.81	0.294
UF_6	DG	EC	10/3/08	67.86	0.368
UF_6	DG	EC	10/3/08	68.16	0.812
UF_6	DG	EC	10/7/08	68.42	1.196
UF_6	DG	EC	10/7/08	68.5	1.315
UF_6	DG	EC	2/3/09	67.69	0.123
UF_6	DG	EC	2/3/09	67.68	0.109
UF_6	DG	EC	2/4/09	67.72	0.168
UF_6	DG	EC	2/4/09	67.69	0.123
UF_6	DG	EC	2/5/09	67.72	0.168
UF_6	DG	EC	2/5/09	67.72	0.168
UF_6	DG	EC	2/5/09	67.71	0.153
UF_6	DG	EC	2/5/09	67.72	0.168
UF_6	DG	V	3/21/06	67.553	-0.037
UF_6	DG	V	3/21/06	67.625	0.070
UF_6	DG	V	3/21/06	67.592	0.021
UF_6	DG	V	3/21/06	67.569	-0.013
UF_6	DG	V	3/21/06	67.537	-0.061
UF_6	DG	V	3/21/06	67.564	-0.021
UF_6	DG	V	4/5/06	67.516	-0.092
UF_6	DG	V	4/5/06	67.505	-0.108
UF_6	DG	V	4/5/06	67.538	-0.059
UF_6	DG	V	4/5/06	67.53	-0.071
UF_6	DG	V	4/5/06	67.497	-0.120
UF_6	DG	V	4/5/06	67.48	-0.145
UF_6	DG	V	4/25/06	67.583	0.007
UF_6	DG	V	4/25/06	67.605	0.040
UF_6	DG	V	4/25/06	67.607	0.043
UF_6	DG	V	4/25/06	67.543	-0.052
UF_6	DG	V	4/25/06	67.579	0.001
UF_6	DG	V	4/25/06	67.565	-0.019

APPENDIX B. CY 2006–CY 2008 RESULTS REPORTED TO THE SME PROGRAM FOR ^{235}U ABUNDANCE MEASUREMENTS

The tables on the following pages provide a record of ^{235}U abundance measurement results reported during the period CY 2006 to CY 2008. Facilities are identified by code letters only. Results are shown by material-type, measurement method, measurement results, reported dates, and % RD. An electronic copy of the results may be obtained upon request.

Table BX.1. ^{235}U abundance measurement in NU.

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UF6	TIMS	AA	4/21/06	0.7088	-0.294
UF6	TIMS	AA	4/20/06	0.7100	-0.125
UF6	TIMS	AA	4/21/06	0.7107	-0.027
UF6	TIMS	AA	4/21/06	0.7107	-0.027
UF6	TIMS	AA	4/20/06	0.7109	0.001
UF6	TIMS	AA	4/20/06	0.7109	0.001
UF6	TIMS	AA	4/21/06	0.7117	0.114
UF6	TIMS	AA	4/20/06	0.7119	0.142
UF6	TIMS	AA	4/21/06	0.7127	0.254
UF6	TIMS	AA	4/21/06	0.7127	0.254
UF6	TIMS	AA	11/28/06	0.7095	-0.196
UF6	TIMS	AA	11/27/06	0.7110	0.015
UF6	TIMS	AA	11/28/06	0.7111	0.029
UF6	TIMS	AA	11/27/06	0.7119	0.142
UF6	TIMS	AA	11/28/06	0.7123	0.198
UF6	TIMS	AA	11/27/06	0.7125	0.226
UF6	TIMS	AA	11/28/06	0.7127	0.254
UF6	TIMS	AA	11/27/06	0.7131	0.311
UNH	TIMS	B	1/12/06	0.7088	-0.369
UNH	TIMS	B	1/9/06	0.7099	-0.214
UNH	TIMS	B	1/12/06	0.7103	-0.158
UNH	TIMS	B	1/9/06	0.7110	-0.060
UNH	TIMS	B	1/9/06	0.7111	-0.046
UNH	TIMS	B	1/12/06	0.7111	-0.046
UNH	TIMS	B	1/12/06	0.7117	0.039
UNH	TIMS	B	1/9/06	0.7121	0.095
UNH	TIMS	B	3/4/06	0.7094	-0.285
UNH	TIMS	B	3/4/06	0.7102	-0.172
UNH	TIMS	B	3/5/06	0.7104	-0.144
UNH	TIMS	B	3/4/06	0.7110	-0.060
UNH	TIMS	B	3/5/06	0.7113	-0.017
UNH	TIMS	B	3/5/06	0.7114	-0.003
UNH	TIMS	B	3/5/06	0.7117	0.039
UNH	TIMS	B	3/4/06	0.7119	0.067

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	TIMS	B	4/12/06	0.7109	-0.074
UNH	TIMS	B	4/13/06	0.7111	-0.046
UNH	TIMS	B	4/13/06	0.7114	-0.003
UNH	TIMS	B	4/13/06	0.7114	-0.003
UNH	TIMS	B	4/13/06	0.7116	0.025
UNH	TIMS	B	4/12/06	0.7127	0.179
UNH	TIMS	B	4/12/06	0.7131	0.236
UNH	TIMS	B	4/12/06	0.7137	0.320
UNH	TIMS	B	7/31/06	0.7121	0.095
UNH	TIMS	B	7/22/06	0.7122	0.109
UNH	TIMS	B	7/22/06	0.7122	0.109
UNH	TIMS	B	8/1/06	0.7126	0.165
UNH	TIMS	B	7/31/06	0.7127	0.179
UNH	TIMS	B	7/22/06	0.7133	0.264
UNH	TIMS	B	7/22/06	0.7135	0.292
UNH	TIMS	B	8/1/06	0.7138	0.334
UNH	TIMS	B	1/26/08	0.7118	0.150
UNH	TIMS	B	1/18/08	0.7120	0.178
UNH	TIMS	B	1/18/08	0.7121	0.192
UNH	TIMS	B	1/26/08	0.7121	0.192
UNH	TIMS	B	1/26/08	0.7122	0.206
UNH	TIMS	B	1/18/08	0.7124	0.234
UNH	TIMS	B	1/18/08	0.7124	0.234
UNH	TIMS	B	1/26/08	0.7126	0.263
UNH	TIMS	B	3/27/08	0.7101	-0.089
UNH	TIMS	B	3/25/08	0.7115	0.108
UNH	TIMS	B	3/25/08	0.7116	0.122
UNH	TIMS	B	3/27/08	0.7116	0.122
UNH	TIMS	B	3/25/08	0.7118	0.150
UNH	TIMS	B	3/27/08	0.7120	0.178
UNH	TIMS	B	3/25/08	0.7122	0.206
UNH	TIMS	B	3/27/08	0.7122	0.206
UNH	TIMS	B	6/27/08	0.7105	-0.033
UNH	TIMS	B	6/22/08	0.7107	-0.005
UNH	TIMS	B	6/27/08	0.7113	0.080
UNH	TIMS	B	6/27/08	0.7113	0.080
UNH	TIMS	B	6/22/08	0.7114	0.094
UNH	TIMS	B	6/22/08	0.7116	0.122
UNH	TIMS	B	6/27/08	0.7120	0.178
UNH	TIMS	B	6/22/08	0.7121	0.192
UNH	TIMS	B	10/1/08	0.7117	0.136
UNH	TIMS	B	10/1/08	0.7118	0.150
UNH	TIMS	B	10/9/08	0.7118	0.150
UNH	TIMS	B	10/1/08	0.7119	0.164
UNH	TIMS	B	10/9/08	0.7119	0.164
UNH	TIMS	B	10/1/08	0.7120	0.178
UNH	TIMS	B	10/9/08	0.7121	0.192
UNH	TIMS	B	10/9/08	0.7122	0.206

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UO3	TIMS	B	3/9/06	0.8811	-0.102
UO3	TIMS	B	3/9/06	0.8815	-0.057
UO3	TIMS	B	3/9/06	0.8816	-0.045
UO3	TIMS	B	3/2/06	0.8820	0.000
UO3	TIMS	B	3/9/06	0.8821	0.011
UO3	TIMS	B	3/2/06	0.8823	0.034
UO3	TIMS	B	3/2/06	0.8832	0.136
UO3	TIMS	B	3/2/06	0.8835	0.170
U308	TIMS	BC	11/28/08	0.7142	0.333
U308	TIMS	BC	11/28/08	0.7145	0.375
U308	TIMS	BC	11/26/08	0.7146	0.389
U308	TIMS	BC	11/26/08	0.7147	0.403
U308	TIMS	BC	11/26/08	0.7150	0.445
U308	TIMS	BC	11/28/08	0.7151	0.459
U308	TIMS	BC	11/28/08	0.7152	0.473
U308	TIMS	BC	11/26/08	0.7161	0.600
U308	TIMS	BC	3/20/09	0.7106	-0.173
U308	TIMS	BC	3/13/09	0.7108	-0.145
U308	TIMS	BC	3/13/09	0.7108	-0.145
U308	TIMS	BC	3/20/09	0.7109	-0.131
U308	TIMS	BC	3/20/09	0.7110	-0.117
U308	TIMS	BC	3/13/09	0.7112	-0.089
U308	TIMS	BC	3/13/09	0.7114	-0.060
U308	TIMS	BC	3/20/09	0.7118	-0.004
UF6	ICP-MS	EA	6/16/08	0.7113	0.058
UF6	ICP-MS	EA	6/16/08	0.7113	0.058
UF6	ICP-MS	EA	6/13/08	0.7114	0.072
UF6	ICP-MS	EA	6/13/08	0.7114	0.072
UF6	ICP-MS	EA	6/16/08	0.7114	0.072
UF6	ICP-MS	EA	6/16/08	0.7114	0.072
UF6	ICP-MS	EA	6/13/08	0.7116	0.100
UF6	ICP-MS	EA	6/13/08	0.7117	0.114
UF6	ICP-MS	EA	6/13/08	0.7110	0.016
UF6	ICP-MS	EA	6/13/08	0.7111	0.030
UF6	ICP-MS	EA	6/13/08	0.7112	0.044
UF6	ICP-MS	EA	6/13/08	0.7112	0.044
UF6	ICP-MS	EA	6/16/08	0.7112	0.044
UF6	ICP-MS	EA	6/16/08	0.7113	0.058
UF6	ICP-MS	EA	6/16/08	0.7113	0.058
UF6	ICP-MS	EA	6/16/08	0.7114	0.072
UF6	GSMS	EB	6/23/08	0.7110	0.016
UF6	GSMS	EB	6/19/08	0.71113	0.034
UF6	GSMS	EB	6/20/08	0.71113	0.034
UF6	GSMS	EB	6/20/08	0.71114	0.035
UF6	GSMS	EB	6/24/08	0.71115	0.037
UF6	GSMS	EB	6/24/08	0.71116	0.038
UF6	GSMS	EB	6/23/08	0.71121	0.045
UF6	GSMS	EB	6/19/08	0.71138	0.069

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UF6	GSMS	EC	5/29/08	0.7114	0.072
UF6	GSMS	EC	6/2/08	0.7114	0.072
UF6	GSMS	EC	6/2/08	0.7114	0.072
UF6	GSMS	EC	6/2/08	0.7114	0.072
UF6	GSMS	EC	6/2/08	0.7114	0.072
UF6	GSMS	EC	6/3/08	0.7114	0.072
UF6	GSMS	EC	6/3/08	0.7114	0.072
UF6	GSMS	EC	6/3/08	0.7114	0.072
UF6	GSMS	EC	5/28/08	0.7115	0.086
UF6	GSMS	EC	5/28/08	0.7115	0.086
UF6	GSMS	EC	5/28/08	0.7115	0.086
UF6	GSMS	EC	5/28/08	0.7115	0.086
UF6	GSMS	EC	5/29/08	0.7115	0.086
UF6	GSMS	EC	5/29/08	0.7115	0.086
UF6	GSMS	EC	6/3/08	0.7115	0.086
UF6	GSMS	EC	5/28/08	0.7116	0.100
UF6	GSMS	EC	5/29/08	0.7116	0.100
UF6	GSMS	EC	6/2/08	0.7116	0.100
UF6	ICP-MS	EC	5/22/08	0.7102	-0.097
UF6	ICP-MS	EC	5/22/08	0.7103	-0.083
UF6	ICP-MS	EC	5/24/08	0.7105	-0.055
UF6	ICP-MS	EC	5/24/08	0.7106	-0.041
UF6	ICP-MS	EC	5/25/08	0.7106	-0.041
UF6	ICP-MS	EC	5/21/08	0.7109	0.002
UF6	ICP-MS	EC	5/25/08	0.7109	0.002
UF6	ICP-MS	EC	5/21/08	0.7113	0.058
UF6	ICP-MS	EC	5/26/08	0.7113	0.058
UF6	ICP-MS	EC	5/23/08	0.7114	0.072
UF6	ICP-MS	EC	5/23/08	0.7114	0.072
UF6	ICP-MS	EC	5/22/08	0.7115	0.086
UF6	ICP-MS	EC	5/26/08	0.7116	0.100
UF6	ICP-MS	EC	5/22/08	0.7117	0.114
UF6	ICP-MS	EC	5/23/08	0.7118	0.128
UF6	ICP-MS	EC	5/23/08	0.7119	0.142
UF6	ICP-MS	EC	5/24/08	0.7120	0.156
UF6	ICP-MS	EC	5/24/08	0.7120	0.156
UNH	TIMS	F	4/11/08	0.7198	0.006
UNH	TIMS	F	4/14/08	0.7198	0.006
UNH	TIMS	F	4/11/08	0.7199	0.019
UNH	TIMS	F	4/11/08	0.7199	0.019
UNH	TIMS	F	4/14/08	0.7199	0.019
UNH	TIMS	F	4/11/08	0.7201	0.047
UNH	TIMS	F	4/14/08	0.7203	0.075
UNH	TIMS	F	4/14/08	0.7204	0.089
UO3	TIMS	F	11/23/07	0.88088	-0.127
UO3	TIMS	F	11/21/07	0.88115	-0.096
UO3	TIMS	F	11/23/07	0.88135	-0.074
UO3	TIMS	F	11/21/07	0.88138	-0.070

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UO3	TIMS	F	11/23/07	0.88141	-0.067
UO3	TIMS	F	11/21/07	0.88144	-0.063
UO3	TIMS	F	11/23/07	0.88148	-0.059
UO3	TIMS	F	11/21/07	0.88192	-0.009
UO3	TIMS	F	4/14/08	0.8922	-0.109
UO3	TIMS	F	4/14/08	0.8924	-0.087
UO3	TIMS	F	4/11/08	0.8925	-0.076
UO3	TIMS	F	4/11/08	0.8926	-0.064
UO3	TIMS	F	4/11/08	0.8926	-0.064
UO3	TIMS	F	4/11/08	0.8927	-0.053
UO3	TIMS	F	4/14/08	0.8927	-0.053
UO3	TIMS	F	4/14/08	0.8938	0.070
UO3	TIMS	V	6/23/08	0.881568	-0.049
UO3	TIMS	V	7/7/08	0.881568	-0.049
UO3	TIMS	V	7/7/08	0.881569	-0.049
UO3	TIMS	V	7/7/08	0.881569	-0.049
UO3	TIMS	V	7/7/08	0.881569	-0.049
UO3	TIMS	V	6/23/08	0.88157	-0.049
UO3	TIMS	V	6/23/08	0.882634	0.072
UO3	TIMS	V	6/23/08	0.882635	0.072

Figure BX.2. ^{235}U abundance measurements in LEU.

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	TIMS	A	9/11/07	4.3901	-0.033
UNH	TIMS	A	9/11/07	4.3932	0.038
UNH	TIMS	A	9/12/07	4.3916	0.001
UNH	TIMS	A	9/12/07	4.3989	0.168
UNH	TIMS	A	9/26/07	4.3895	-0.046
UNH	TIMS	A	9/26/07	4.3921	0.013
UNH	TIMS	A	9/27/07	4.3913	-0.005
UNH	TIMS	A	9/27/07	4.3946	0.070
UO2	TIMS	AA	4/5/06	4.0051	-0.078
UO2	TIMS	AA	4/5/06	4.0051	-0.078
UO2	TIMS	AA	4/6/06	4.0051	-0.078
UO2	TIMS	AA	4/6/06	4.0051	-0.078
UO2	TIMS	AA	4/6/06	4.0051	-0.078
UO2	TIMS	AA	4/20/06	4.0051	-0.078
UO2	TIMS	AA	4/20/06	4.0051	-0.078
UO2	TIMS	AA	4/21/06	4.0051	-0.078
UO2	TIMS	AA	4/21/06	4.0051	-0.078
UO2	TIMS	AA	4/21/06	4.0051	-0.078
UO2	TIMS	AA	11/30/06	4.0026	-0.140
UO2	TIMS	AA	11/30/06	4.0027	-0.138
UO2	TIMS	AA	11/30/06	4.0042	-0.101
UO2	TIMS	AA	11/30/06	4.0051	-0.078
UO2	TIMS	AA	12/1/06	4.0009	-0.183
UO2	TIMS	AA	12/1/06	4.0012	-0.175
UO2	TIMS	AA	12/1/06	4.0023	-0.148
UO2	TIMS	AA	12/1/06	4.0058	-0.061
UF6	TIMS	AA	10/4/07	1.3013	-0.069
UF6	TIMS	AA	10/4/07	1.3046	0.184
UF6	TIMS	AA	10/4/07	1.3049	0.207
UF6	TIMS	AA	10/5/07	1.302	-0.015
UF6	TIMS	AA	10/5/07	1.3036	0.108
UF6	TIMS	AA	10/5/07	1.3053	0.238
UNH	TIMS	AA	10/5/07	4.3902	-0.031
UNH	TIMS	AA	10/5/07	4.3968	0.120
UNH	TIMS	AA	10/8/07	4.39	-0.035
UNH	TIMS	AA	10/8/07	4.3904	-0.026
UNH	TIMS	AA	10/8/07	4.3939	0.054
UF6	TIMS	AA	10/17/07	1.3018	-0.031
UF6	TIMS	AA	10/17/07	1.3026	0.031
UF6	TIMS	AA	10/17/07	1.3029	0.054
UF6	TIMS	AA	10/17/07	1.3031	0.069
UNH	TIMS	AA	10/17/07	4.3867	-0.110
UNH	TIMS	AA	10/17/07	4.3868	-0.108
UNH	TIMS	AA	10/17/07	4.3869	-0.106
UNH	TIMS	AA	10/17/07	4.3875	-0.092
UNH	TIMS	AA	10/17/07	4.3876	-0.090

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	TIMS	AA	12/3/07	4.4514	-0.190
UNH	TIMS	AA	12/3/07	4.4523	-0.170
UNH	TIMS	AA	12/3/07	4.4528	-0.158
UNH	TIMS	AA	12/3/07	4.4575	-0.053
UNH	TIMS	AA	12/3/07	4.4577	-0.048
UNH	TIMS	AA	12/3/07	4.4587	-0.026
UNH	TIMS	AA	12/7/07	4.4434	-0.369
UNH	TIMS	AA	12/7/07	4.4436	-0.365
UNH	TIMS	AA	12/7/07	4.4453	-0.327
UNH	TIMS	AA	12/7/07	4.4483	-0.259
UF6	TIMS	AA	3/13/08	2.9844	0.003
UF6	TIMS	AA	3/13/08	2.9847	0.013
UF6	TIMS	AA	3/13/08	2.9848	0.017
UF6	TIMS	AA	3/13/08	2.9862	0.064
UF6	TIMS	AA	3/13/08	2.9867	0.080
UF6	TIMS	AA	3/13/08	2.9878	0.117
UF6	TIMS	AA	3/18/08	2.9832	-0.037
UF6	TIMS	AA	3/18/08	2.9853	0.034
UF6	TIMS	AA	3/18/08	2.9864	0.070
UF6	TIMS	AA	3/18/08	2.9882	0.131
UNH	TIMS	AA	3/16/09	4.454	-0.131
UNH	TIMS	AA	3/16/09	4.4573	-0.057
UNH	TIMS	AA	3/19/09	4.4502	-0.217
UNH	TIMS	AA	3/19/09	4.4579	-0.044
UNH	TIMS	AA	3/19/09	4.4598	-0.001
UNH	TIMS	AA	3/19/09	4.4604	0.012
UNH	TIMS	AA	3/19/09	4.39	-0.035
UNH	TIMS	AA	3/19/09	4.3906	-0.021
UNH	TIMS	AA	3/20/09	4.398	0.147
UNH	TIMS	AA	3/20/09	4.3983	0.154
UNH	TIMS	AA	3/26/09	4.4534	-0.145
UNH	TIMS	AA	3/26/09	4.4543	-0.125
UNH	TIMS	AA	3/26/09	4.3922	0.015
UNH	TIMS	AA	3/26/09	4.3934	0.042
UF6	TIMS	AA	3/31/09	1.3025	0.023
UF6	TIMS	AA	3/31/09	1.3028	0.046
UF6	TIMS	AA	3/31/09	1.303	0.061
UF6	TIMS	AA	3/31/09	1.303	0.061
UF6	TIMS	AA	4/1/09	1.3029	0.054
UF6	TIMS	AA	4/1/09	1.3029	0.054
UF6	TIMS	AA	4/1/09	1.3033	0.085
UF6	TIMS	AA	4/1/09	1.3037	0.115
UNH	TIMS	AA	4/6/09	4.3921	0.013
UNH	TIMS	AA	4/6/09	4.3928	0.029
UNH	ICP-MS	AD	12/18/08	4.3962	0.106
UNH	ICP-MS	AD	12/18/08	4.3918	0.006
UNH	ICP-MS	AD	12/18/08	4.3895	-0.047
UNH	ICP-MS	AD	12/18/08	4.3915	-0.001

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	ICP-MS	AD	12/18/08	4.4291	-0.690
UNH	ICP-MS	AD	12/18/08	4.4185	-0.928
UNH	ICP-MS	AD	12/18/08	4.4301	-0.667
UNH	ICP-MS	AD	12/18/08	4.4278	-0.719
UNH	ICP-MS	AD	12/19/08	4.3933	0.040
UNH	ICP-MS	AD	12/19/08	4.3897	-0.042
UNH	ICP-MS	AD	12/19/08	4.3809	-0.242
UNH	ICP-MS	AD	12/19/08	4.3903	-0.028
UNH	ICP-MS	AD	12/19/08	4.4106	-1.105
UNH	ICP-MS	AD	12/19/08	4.4098	-1.123
UNH	ICP-MS	AD	12/19/08	4.4222	-0.845
UNH	ICP-MS	AD	12/19/08	4.4322	-0.620
UNH	ICP-MS	AD	1/15/09	4.4521	-0.174
UNH	ICP-MS	AD	1/15/09	4.4565	-0.075
UNH	ICP-MS	AD	1/15/09	4.4248	-0.786
UNH	ICP-MS	AD	1/15/09	4.4134	-1.042
UNH	ICP-MS	AD	1/15/09	4.3908	-0.017
UNH	ICP-MS	AD	1/15/09	4.3936	0.047
UNH	ICP-MS	AD	1/15/09	4.3975	0.136
UNH	ICP-MS	AD	1/15/09	4.3899	-0.037
UNH	ICP-MS	AD	1/16/09	4.4129	-1.053
UNH	ICP-MS	AD	1/16/09	4.4169	-0.963
UNH	ICP-MS	AD	1/16/09	4.4085	-1.152
UNH	ICP-MS	AD	1/16/09	4.4068	-1.190
UNH	ICP-MS	AD	1/16/09	4.3636	-0.636
UNH	ICP-MS	AD	1/16/09	4.3628	-0.654
UNH	ICP-MS	AD	1/16/09	4.3651	-0.602
UNH	ICP-MS	AD	1/16/09	4.3635	-0.639
UO2	ICP-MS	AF	6/5/06	3.969	-0.979
UO2	ICP-MS	AF	6/5/06	3.982	-0.654
UO2	ICP-MS	AF	6/5/06	3.995	-0.330
UO2	ICP-MS	AF	6/5/06	3.997	-0.280
UO2	ICP-MS	AF	6/5/06	3.979	-0.729
UO2	ICP-MS	AF	6/5/06	3.981	-0.679
UO2	ICP-MS	AF	6/5/06	3.984	-0.605
UO2	ICP-MS	AF	6/5/06	4.005	-0.081
UO2	ICP-MS	AF	6/6/06	3.991	-0.430
UO2	ICP-MS	AF	6/6/06	4.000	-0.205
UO2	ICP-MS	AF	6/6/06	4.003	-0.130
UO2	ICP-MS	AF	6/6/06	4.007	-0.031
UO2	ICP-MS	AF	6/6/06	3.982	-0.654
UO2	ICP-MS	AF	6/6/06	3.985	-0.580
UO2	ICP-MS	AF	6/6/06	3.99	-0.455
UO2	ICP-MS	AF	6/6/06	4.000	-0.205
UNH	ICP-MS	AF	4/21/09	4.2784	-2.576
UNH	ICP-MS	AF	4/21/09	4.2808	-2.522
UNH	ICP-MS	AF	4/21/09	4.2847	-2.433
UNH	ICP-MS	AF	4/21/09	4.2856	-2.412

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	ICP-MS	AF	4/21/09	4.3575	-2.295
UNH	ICP-MS	AF	4/21/09	4.3538	-2.378
UNH	ICP-MS	AF	4/21/09	4.3556	-2.338
UNH	ICP-MS	AF	4/21/09	4.3535	-2.385
UNH	ICP-MS	AF	4/22/09	4.2785	-2.574
UNH	ICP-MS	AF	4/22/09	4.2847	-2.433
UNH	ICP-MS	AF	4/22/09	4.2797	-2.547
UNH	ICP-MS	AF	4/22/09	4.2928	-2.248
UNH	ICP-MS	AF	4/22/09	4.3655	-2.116
UNH	ICP-MS	AF	4/22/09	4.3478	-2.513
UNH	ICP-MS	AF	4/22/09	4.3574	-2.297
UNH	ICP-MS	AF	4/22/09	4.3660	-2.105
UNH	ICP-MS	AF	5/20/09	4.3040	-1.993
UNH	ICP-MS	AF	5/20/09	4.2999	-2.087
UNH	ICP-MS	AF	5/20/09	4.2937	-2.228
UNH	ICP-MS	AF	5/20/09	4.2777	-2.592
UNH	ICP-MS	AF	5/20/09	4.3531	-2.394
UNH	ICP-MS	AF	5/20/09	4.3550	-2.351
UNH	ICP-MS	AF	5/20/09	4.3606	-2.226
UNH	ICP-MS	AF	5/20/09	4.3737	-1.932
UNH	ICP-MS	AF	5/21/09	4.2922	-2.262
UNH	ICP-MS	AF	5/21/09	4.2975	-2.141
UNH	ICP-MS	AF	5/21/09	4.2925	-2.255
UNH	ICP-MS	AF	5/21/09	4.2876	-2.367
UNH	ICP-MS	AF	5/21/09	4.3528	-2.401
UNH	ICP-MS	AF	5/21/09	4.3572	-2.302
UNH	ICP-MS	AF	5/21/09	4.3699	-2.017
UNH	ICP-MS	AF	5/21/09	4.3510	-2.441
UO2	TIMS	AW	5/16/07	4.3916	0.001
UO2	TIMS	AW	5/21/07	4.4032	0.266
UO2	TIMS	AW	6/4/07	4.3947	0.072
UNH	TIMS	B	3/28/06	4.386	-0.126
UNH	TIMS	B	3/28/06	4.3904	-0.026
UNH	TIMS	B	4/5/06	4.3918	0.006
UNH	TIMS	B	4/5/06	4.3965	0.113
UNH	TIMS	B	7/25/06	4.3806	-0.249
UNH	TIMS	B	7/25/06	4.3886	-0.067
UNH	TIMS	B	10/11/06	4.3845	-0.160
UNH	TIMS	B	10/11/06	4.3855	-0.138
UNH	TIMS	B	6/22/08	4.383	-0.194
UNH	TIMS	B	6/22/08	4.3841	-0.169
UNH	TIMS	B	6/22/08	4.3908	-0.017
UNH	TIMS	B	6/22/08	4.3915	-0.001
UNH	TIMS	B	6/27/08	4.3837	-0.179
UNH	TIMS	B	6/27/08	4.3848	-0.153
UNH	TIMS	B	6/27/08	4.3891	-0.056
UNH	TIMS	B	6/27/08	4.3898	-0.040
UF6	GSMS	BC	4/12/06	3.1885	-0.011

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UF6	GSMS	BC	4/12/06	3.1911	0.071
UF6	GSMS	BC	4/12/06	3.1911	0.071
UF6	GSMS	BC	4/12/06	3.1929	0.127
UF6	GSMS	BC	4/13/06	3.1862	-0.083
UF6	GSMS	BC	4/13/06	3.1913	0.077
UF6	GSMS	BC	4/13/06	3.1943	0.171
UF6	GSMS	BC	4/13/06	3.1991	0.322
UO2	TIMS	BC	4/17/06	4.0046	-0.091
UO2	TIMS	BC	4/17/06	4.0066	-0.041
UO2	TIMS	BC	4/17/06	4.009	0.019
UO2	TIMS	BC	4/17/06	4.0126	0.109
UO2	TIMS	BC	4/26/06	4.0067	-0.038
UO2	TIMS	BC	4/26/06	4.0074	-0.021
UO2	TIMS	BC	4/26/06	4.0077	-0.013
UO2	TIMS	BC	4/26/06	4.0096	0.034
UO2	TIMS	BC	10/9/06	4.0054	-0.071
UO2	TIMS	BC	10/9/06	4.0095	0.032
UO2	TIMS	BC	10/9/06	4.0101	0.047
UO2	TIMS	BC	10/9/06	4.0138	0.139
UO2	TIMS	BC	10/16/06	4.0031	-0.128
UO2	TIMS	BC	10/16/06	4.0083	0.002
UO2	TIMS	BC	10/16/06	4.0122	0.099
UO2	TIMS	BC	10/16/06	4.0128	0.114
UF6	GSMS	BC	10/24/06	3.1883	-0.017
UF6	GSMS	BC	10/24/06	3.1886	-0.007
UF6	GSMS	BC	10/24/06	3.1978	0.281
UF6	GSMS	BC	10/24/06	3.1984	0.300
UF6	GSMS	BC	10/24/06	3.1988	0.312
UF6	GSMS	BC	10/24/06	3.2008	0.375
UF6	GSMS	BC	10/27/06	3.1765	-0.387
UF6	GSMS	BC	10/27/06	3.1807	-0.255
UF6	GSMS	BC	10/27/06	3.1816	-0.227
UF6	GSMS	BC	10/27/06	3.1849	-0.123
UF6	GSMS	BC	10/27/06	3.1873	-0.048
UF6	GSMS	BC	10/27/06	3.1888	-0.001
UF6	GSMS	BC	9/8/08	1.2915	-0.031
UF6	GSMS	BC	9/8/08	1.2924	0.039
UF6	GSMS	BC	9/8/08	1.2928	0.070
UF6	GSMS	BC	9/8/08	1.2929	0.077
UF6	GSMS	BC	9/9/08	1.2929	0.077
UF6	GSMS	BC	9/9/08	1.2934	0.116
UF6	GSMS	BC	9/9/08	1.2934	0.116
UF6	GSMS	BC	9/9/08	1.2948	0.224
UNH	TIMS	BC	10/9/08	4.3918	0.006
UNH	TIMS	BC	10/9/08	4.3955	0.090
UNH	TIMS	BC	10/9/08	4.3982	0.152
UNH	TIMS	BC	10/9/08	4.400	0.193
UNH	TIMS	BC	10/11/08	4.3934	0.042

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	TIMS	BC	10/11/08	4.3945	0.067
UNH	TIMS	BC	10/11/08	4.3996	0.184
UNH	TIMS	BC	10/11/08	4.4013	0.222
UO2	TIMS	BC	12/3/08	4.0049	-0.083
UO2	TIMS	BC	12/3/08	4.0058	-0.061
UO2	TIMS	BC	12/3/08	4.0102	0.049
UO2	TIMS	BC	12/3/08	4.0116	0.084
UO2	TIMS	BC	12/5/08	4.0029	-0.133
UO2	TIMS	BC	12/5/08	4.0057	-0.063
UO2	TIMS	BC	12/5/08	4.0104	0.054
UO2	TIMS	BC	12/5/08	4.0108	0.064
UO2	TIMS	BC	3/2/09	4.0077	-0.013
UO2	TIMS	BC	3/2/09	4.0086	0.009
UO2	TIMS	BC	3/2/09	4.0086	0.009
UO2	TIMS	BC	3/2/09	4.0098	0.039
UO2	TIMS	BC	3/2/09	4.0101	0.047
UO2	TIMS	BC	3/2/09	4.0105	0.057
UO2	TIMS	BC	3/9/09	4.0053	-0.073
UO2	TIMS	BC	3/9/09	4.006	-0.056
UO2	TIMS	BC	3/9/09	4.0076	-0.016
UO2	TIMS	BC	3/9/09	4.0093	0.027
UO2	TIMS	BC	3/9/09	4.012	0.094
UO2	TIMS	BC	3/9/09	4.0128	0.114
UF6	GSMS	BC	3/10/09	1.3008	-0.108
UF6	GSMS	BC	3/10/09	1.301	-0.092
UF6	GSMS	BC	3/10/09	1.3021	-0.008
UF6	GSMS	BC	3/10/09	1.3028	0.046
UF6	GSMS	BC	3/10/09	1.3032	0.077
UF6	GSMS	BC	3/10/09	1.3038	0.123
UF6	GSMS	BC	3/10/09	1.3038	0.123
UF6	GSMS	BC	3/10/09	1.3039	0.131
UF6	GSMS	BC	3/12/09	1.3006	-0.123
UF6	GSMS	BC	3/12/09	1.3011	-0.084
UF6	GSMS	BC	3/12/09	1.3026	0.031
UF6	GSMS	BC	3/12/09	1.3027	0.038
UF6	GSMS	BC	3/12/09	1.3035	0.100
UF6	GSMS	BC	3/12/09	1.3037	0.115
UF6	GSMS	BC	3/12/09	1.3038	0.123
UF6	GSMS	BC	3/12/09	1.3039	0.131
UNH	TIMS	BC	3/30/09	4.388	-0.081
UNH	TIMS	BC	3/30/09	4.3945	0.067
UNH	TIMS	BC	3/30/09	4.396	0.102
UNH	TIMS	BC	3/30/09	4.3986	0.161
UNH	TIMS	BC	3/31/09	4.3884	-0.072
UNH	TIMS	BC	3/31/09	4.3893	-0.051
UNH	TIMS	BC	3/31/09	4.3902	-0.031
UNH	TIMS	BC	3/31/09	4.3909	-0.015
UO2	ICP-MS	BE	4/7/06	4.058	1.242

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UO2	ICP-MS	BE	4/7/06	4.059	1.267
UO2	ICP-MS	BE	4/7/06	4.063	1.366
UO2	ICP-MS	BE	4/7/06	4.067	1.466
UO2	ICP-MS	BE	4/7/06	4.069	1.516
UO2	ICP-MS	BE	4/7/06	4.072	1.591
UO2	ICP-MS	BE	4/20/06	4.024	0.393
UO2	ICP-MS	BE	4/20/06	4.029	0.518
UO2	ICP-MS	BE	4/20/06	4.030	0.543
UO2	ICP-MS	BE	4/20/06	4.030	0.543
UO2	ICP-MS	BE	4/20/06	4.034	0.643
UO2	ICP-MS	BE	4/20/06	4.035	0.668
UO2	ICP-MS	BE	10/3/06	3.979	-0.729
UO2	ICP-MS	BE	10/3/06	3.980	-0.704
UO2	ICP-MS	BE	10/3/06	3.983	-0.629
UO2	ICP-MS	BE	10/3/06	3.984	-0.605
UO2	ICP-MS	BE	10/3/06	3.987	-0.530
UO2	ICP-MS	BE	10/3/06	3.989	-0.480
UO2	ICP-MS	BE	10/3/06	3.990	-0.455
UO2	ICP-MS	BE	10/3/06	3.993	-0.380
UO2	ICP-MS	BE	10/4/06	3.984	-0.605
UO2	ICP-MS	BE	10/4/06	3.994	-0.355
UO2	ICP-MS	BE	10/4/06	3.995	-0.330
UO2	ICP-MS	BE	10/4/06	3.996	-0.305
UO2	ICP-MS	BE	10/4/06	4.000	-0.205
UO2	ICP-MS	BE	10/4/06	4.002	-0.155
UO2	ICP-MS	BE	10/4/06	4.007	-0.031
UO2	ICP-MS	BE	10/4/06	4.021	0.319
UNH	ICP-MS	BE	10/25/07	4.328	-2.957
UNH	ICP-MS	BE	10/25/07	4.334	-2.822
UNH	ICP-MS	BE	10/25/07	4.340	-2.688
UNH	ICP-MS	BE	10/25/07	4.342	-2.643
UNH	ICP-MS	BE	10/25/07	4.358	-2.284
UNH	ICP-MS	BE	10/25/07	4.361	-2.217
UNH	ICP-MS	BE	10/25/07	4.382	-1.746
UNH	ICP-MS	BE	10/25/07	4.387	-1.634
UO2	ICP-MS	BE	10/25/07	3.927	-2.027
UO2	ICP-MS	BE	10/25/07	3.931	-1.927
UO2	ICP-MS	BE	10/25/07	3.935	-1.827
UO2	ICP-MS	BE	10/25/07	3.937	-1.777
UO2	ICP-MS	BE	10/25/07	3.950	-1.453
UO2	ICP-MS	BE	10/25/07	3.956	-1.303
UO2	ICP-MS	BE	10/25/07	3.957	-1.278
UO2	ICP-MS	BE	10/25/07	3.962	-1.153
UNH	ICP-MS	BE	12/12/07	4.365	-2.127
UNH	ICP-MS	BE	12/12/07	4.372	-1.970
UNH	ICP-MS	BE	12/12/07	4.373	-1.948
UNH	ICP-MS	BE	12/12/07	4.373	-1.948
UNH	ICP-MS	BE	12/12/07	4.377	-1.858

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	ICP-MS	BE	12/12/07	4.377	-1.858
UNH	ICP-MS	BE	12/12/07	4.378	-1.836
UNH	ICP-MS	BE	12/12/07	4.386	-1.656
UO2	ICP-MS	BE	12/12/07	3.848	-3.998
UO2	ICP-MS	BE	12/12/07	3.868	-3.499
UO2	ICP-MS	BE	12/12/07	3.872	-3.399
UO2	ICP-MS	BE	12/12/07	3.873	-3.374
UO2	ICP-MS	BE	12/12/07	3.874	-3.349
UO2	ICP-MS	BE	12/12/07	3.898	-2.750
UO2	ICP-MS	BE	12/12/07	3.910	-2.451
UO2	ICP-MS	BE	12/12/07	3.949	-1.478
UNH	ICP-MS	BE	2/4/08	4.427	-0.737
UNH	ICP-MS	BE	2/4/08	4.438	-0.490
UNH	ICP-MS	BE	2/4/08	4.447	-0.288
UNH	ICP-MS	BE	2/4/08	4.451	-0.199
UNH	ICP-MS	BE	2/4/08	4.456	-0.087
UNH	ICP-MS	BE	2/4/08	4.456	-0.087
UNH	ICP-MS	BE	2/4/08	4.481	0.474
UNH	ICP-MS	BE	2/4/08	4.494	0.765
UO2	ICP-MS	BE	2/4/08	3.981	-0.679
UO2	ICP-MS	BE	2/4/08	3.985	-0.580
UO2	ICP-MS	BE	2/4/08	3.991	-0.430
UO2	ICP-MS	BE	2/4/08	4.003	-0.130
UNH	ICP-MS	BE	3/4/08	4.449	-0.244
UNH	ICP-MS	BE	3/4/08	4.461	0.025
UNH	ICP-MS	BE	3/4/08	4.465	0.115
UNH	ICP-MS	BE	3/4/08	4.467	0.160
UNH	ICP-MS	BE	3/4/08	4.470	0.227
UNH	ICP-MS	BE	3/4/08	4.480	0.452
UNH	ICP-MS	BE	3/4/08	4.495	0.788
UNH	ICP-MS	BE	3/4/08	4.505	1.012
UO2	ICP-MS	BE	3/4/08	3.963	-1.128
UO2	ICP-MS	BE	3/4/08	3.975	-0.829
UO2	ICP-MS	BE	3/4/08	3.982	-0.654
UO2	ICP-MS	BE	3/4/08	3.994	-0.355
UO2	ICP-MS	BE	3/4/08	4.002	-0.155
UO2	ICP-MS	BE	3/4/08	4.005	-0.081
UO2	ICP-MS	BE	3/4/08	4.007	-0.031
UO2	ICP-MS	BE	3/4/08	4.010	0.044
UO2	ICP-MS	BE	3/4/08	4.015	0.169
UO2	ICP-MS	BE	3/4/08	4.017	0.219
UO2	ICP-MS	BE	3/4/08	4.027	0.468
UO2	ICP-MS	BE	3/4/08	4.032	0.593
UNH	ICP-MS	D	3/6/08	4.3604	-0.709
UNH	ICP-MS	D	3/6/08	4.3676	-0.545
UNH	ICP-MS	D	3/6/08	4.4359	1.010
UNH	ICP-MS	D	3/7/08	4.3604	-0.709
UNH	ICP-MS	D	3/10/08	4.4255	0.773

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UF6	ICP-MS	EA	3/28/07	1.292	0.008
UF6	ICP-MS	EA	3/28/07	1.292	0.008
UF6	ICP-MS	EA	3/28/07	1.293	0.085
UF6	ICP-MS	EA	3/28/07	1.293	0.085
UF6	ICP-MS	EA	3/28/07	2.986	0.057
UF6	ICP-MS	EA	3/28/07	2.986	0.057
UF6	ICP-MS	EA	3/29/07	1.293	0.085
UF6	ICP-MS	EA	3/29/07	1.293	0.085
UF6	ICP-MS	EA	3/29/07	1.293	0.085
UF6	ICP-MS	EA	3/29/07	1.293	0.085
UF6	ICP-MS	EA	3/29/07	2.985	0.023
UF6	ICP-MS	EA	3/29/07	2.985	0.023
UF6	ICP-MS	EA	3/29/07	2.985	0.023
UF6	ICP-MS	EA	3/29/07	2.986	0.057
UNH	ICP-MS	EA	3/29/07	4.392	0.010
UNH	ICP-MS	EA	3/29/07	4.392	0.010
UNH	ICP-MS	EA	3/29/07	4.392	0.010
UNH	ICP-MS	EA	3/29/07	4.392	0.010
UF6	ICP-MS	EA	3/31/07	2.984	-0.010
UF6	ICP-MS	EA	3/31/07	2.984	-0.010
UNH	ICP-MS	EA	3/31/07	4.390	-0.035
UNH	ICP-MS	EA	3/31/07	4.390	-0.035
UNH	ICP-MS	EA	3/31/07	4.390	-0.035
UNH	ICP-MS	EA	3/31/07	4.391	-0.012
UF6	ICP-MS	EA	6/14/07	4.7874	-0.104
UF6	ICP-MS	EA	6/14/07	4.7876	-0.100
UF6	ICP-MS	EA	6/14/07	4.788	-0.092
UF6	ICP-MS	EA	6/14/07	4.792	-0.008
UF6	ICP-MS	EA	6/21/07	4.7892	-0.067
UF6	ICP-MS	EA	6/21/07	4.7893	-0.065
UF6	ICP-MS	EA	6/21/07	4.7895	-0.061
UF6	ICP-MS	EA	6/21/07	4.790	-0.050
UNH	ICP-MS	EA	4/14/08	4.3899	-0.037
UNH	ICP-MS	EA	4/14/08	4.390	-0.035
UNH	ICP-MS	EA	4/14/08	4.390	-0.035
UNH	ICP-MS	EA	4/14/08	4.3905	-0.024
UNH	ICP-MS	EA	5/4/08	4.3901	-0.033
UNH	ICP-MS	EA	5/4/08	4.3904	-0.026
UNH	ICP-MS	EA	5/4/08	4.3908	-0.017
UNH	ICP-MS	EA	5/4/08	4.3913	-0.005
UNH	ICP-MS	EA	5/21/08	4.3894	-0.049
UNH	ICP-MS	EA	5/21/08	4.3896	-0.044
UNH	ICP-MS	EA	5/21/08	4.390	-0.035
UNH	ICP-MS	EA	5/21/08	4.3909	-0.015
UNH	ICP-MS	EA	5/22/08	4.3916	0.001
UNH	ICP-MS	EA	5/22/08	4.3929	0.031
UNH	ICP-MS	EA	5/22/08	4.3931	0.036
UNH	ICP-MS	EA	5/22/08	4.3939	0.054

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	ICP-MS	EA	8/21/08	4.4615	0.037
UNH	ICP-MS	EA	8/21/08	4.4615	0.037
UNH	ICP-MS	EA	8/21/08	4.4625	0.059
UNH	ICP-MS	EA	8/21/08	4.4627	0.064
UNH	ICP-MS	EA	8/24/08	4.4592	-0.015
UNH	ICP-MS	EA	8/24/08	4.4594	-0.010
UNH	ICP-MS	EA	8/24/08	4.4599	0.001
UNH	ICP-MS	EA	8/24/08	4.4607	0.019
UNH	ICP-MS	EA	8/26/08	4.460	0.003
UNH	ICP-MS	EA	8/26/08	4.4607	0.019
UNH	ICP-MS	EA	8/26/08	4.4616	0.039
UNH	ICP-MS	EA	8/26/08	4.4618	0.043
UNH	ICP-MS	EA	8/27/08	4.4604	0.012
UNH	ICP-MS	EA	8/27/08	4.4606	0.017
UNH	ICP-MS	EA	8/27/08	4.4608	0.021
UNH	ICP-MS	EA	8/27/08	4.4609	0.023
UF6	ICP-MS	EA	9/4/08	4.7705	-0.040
UF6	ICP-MS	EA	9/4/08	4.7713	-0.023
UF6	ICP-MS	EA	9/4/08	4.7718	-0.013
UF6	ICP-MS	EA	9/4/08	4.7724	0.000
UF6	ICP-MS	EA	9/5/08	4.7726	0.004
UF6	ICP-MS	EA	9/5/08	4.7743	0.040
UF6	ICP-MS	EA	9/5/08	4.7747	0.048
UF6	ICP-MS	EA	9/5/08	4.7751	0.057
UF6	ICP-MS	EA	9/7/08	4.7745	0.044
UF6	ICP-MS	EA	9/7/08	4.775	0.054
UF6	ICP-MS	EA	9/7/08	4.7758	0.071
UF6	ICP-MS	EA	9/7/08	4.7766	0.088
UF6	ICP-MS	EA	9/8/08	4.7735	0.023
UF6	ICP-MS	EA	9/8/08	4.7743	0.040
UF6	ICP-MS	EA	9/8/08	4.7753	0.061
UF6	ICP-MS	EA	9/8/08	4.7758	0.071
UF6	ICP-MS	EA	11/27/08	3.2291	0.025
UF6	ICP-MS	EA	11/27/08	3.230	0.053
UF6	ICP-MS	EA	11/27/08	3.2301	0.056
UF6	ICP-MS	EA	11/27/08	3.2304	0.065
UF6	ICP-MS	EA	11/28/08	3.2292	0.028
UF6	ICP-MS	EA	11/28/08	3.230	0.053
UF6	ICP-MS	EA	11/28/08	3.2306	0.071
UF6	ICP-MS	EA	11/28/08	3.2309	0.081
UF6	ICP-MS	EA	11/30/08	3.2296	0.040
UF6	ICP-MS	EA	11/30/08	3.2302	0.059
UF6	ICP-MS	EA	11/30/08	3.2305	0.068
UF6	ICP-MS	EA	11/30/08	3.2308	0.077
UF6	ICP-MS	EA	12/2/08	3.230	0.053
UF6	ICP-MS	EA	12/2/08	3.231	0.084
UF6	ICP-MS	EA	12/3/08	3.2288	0.015
UF6	ICP-MS	EA	12/3/08	3.2299	0.050

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UF6	GSMS	EB	9/10/08	4.77444	0.043
UF6	GSMS	EB	9/10/08	4.77448	0.044
UF6	GSMS	EB	9/15/08	4.77407	0.035
UF6	GSMS	EB	9/15/08	4.77493	0.053
UF6	GSMS	EB	9/16/08	4.77416	0.037
UF6	GSMS	EB	9/16/08	4.7742	0.038
UF6	GSMS	EB	9/17/08	4.77427	0.039
UF6	GSMS	EB	9/17/08	4.77434	0.041
UF6	GSMS	EB	12/4/08	3.19004	0.038
UF6	GSMS	EB	12/4/08	3.19015	0.041
UF6	GSMS	EB	12/4/08	3.1904	0.049
UF6	GSMS	EB	12/4/08	3.19042	0.050
UF6	GSMS	EB	12/8/08	3.19022	0.043
UF6	GSMS	EB	12/8/08	3.1903	0.046
UF6	GSMS	EB	12/8/08	3.19031	0.046
UF6	GSMS	EB	12/8/08	3.19037	0.048
UF6	ICP-MS	EC	5/22/08	4.7701	-0.048
UF6	ICP-MS	EC	5/22/08	4.7722	-0.004
UF6	ICP-MS	EC	5/22/08	4.7749	0.052
UF6	ICP-MS	EC	5/22/08	4.7766	0.088
UF6	ICP-MS	EC	5/23/08	4.7704	-0.042
UF6	ICP-MS	EC	5/23/08	4.7707	-0.036
UF6	ICP-MS	EC	5/23/08	4.7715	-0.019
UF6	ICP-MS	EC	5/23/08	4.7717	-0.015
UF6	ICP-MS	EC	5/24/08	4.7693	-0.065
UF6	ICP-MS	EC	5/24/08	4.7695	-0.061
UF6	ICP-MS	EC	5/24/08	4.7708	-0.034
UF6	ICP-MS	EC	5/24/08	4.7722	-0.004
UF6	ICP-MS	EC	5/25/08	4.7721	-0.006
UF6	ICP-MS	EC	5/25/08	4.7745	0.044
UF6	ICP-MS	EC	5/26/08	4.7702	-0.046
UF6	ICP-MS	EC	5/26/08	4.7704	-0.042
UF6	ICP-MS	EC	5/26/08	4.7708	-0.034
UF6	ICP-MS	EC	5/26/08	4.7719	-0.010
UF6	ICP-MS	EC	8/25/08	3.1891	0.008
UF6	ICP-MS	EC	8/25/08	3.1892	0.011
UF6	ICP-MS	EC	8/26/08	3.1883	-0.017
UF6	ICP-MS	EC	8/26/08	3.1885	-0.011
UF6	ICP-MS	EC	8/26/08	3.1885	-0.011
UF6	ICP-MS	EC	8/26/08	3.1885	-0.011
UF6	ICP-MS	EC	8/26/08	3.1886	-0.007
UF6	ICP-MS	EC	8/26/08	3.1891	0.008
UF6	ICP-MS	EC	8/27/08	3.1892	0.011
UF6	ICP-MS	EC	8/27/08	3.1899	0.033
UF6	ICP-MS	EC	8/27/08	3.190	0.037
UF6	ICP-MS	EC	8/27/08	3.1901	0.040
UF6	ICP-MS	EC	8/27/08	3.1902	0.043
UF6	ICP-MS	EC	8/27/08	3.1906	0.055

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UF6	ICP-MS	EC	8/28/08	3.1888	-0.001
UF6	ICP-MS	EC	8/28/08	3.189	0.005
UF6	ICP-MS	EC	8/28/08	3.1895	0.021
UF6	ICP-MS	EC	8/28/08	3.1898	0.030
UF6	GSMS	EC	9/4/08	3.1888	-0.001
UF6	GSMS	EC	9/4/08	3.1894	0.018
UF6	GSMS	EC	9/9/08	3.1894	0.018
UF6	GSMS	EC	9/9/08	3.1896	0.024
UF6	GSMS	EC	9/9/08	3.1896	0.024
UF6	GSMS	EC	9/9/08	3.1897	0.027
UF6	GSMS	EC	9/10/08	3.1893	0.015
UF6	GSMS	EC	9/10/08	3.1896	0.024
UF6	GSMS	EC	9/10/08	3.1896	0.024
UF6	GSMS	EC	9/10/08	3.190	0.037
UF6	GSMS	EC	9/10/08	3.1903	0.046
UF6	GSMS	EC	9/11/08	3.1893	0.015
UF6	GSMS	EC	9/11/08	3.1895	0.021
UF6	GSMS	EC	9/11/08	3.1896	0.024
UF6	GSMS	EC	9/11/08	3.190	0.037
UF6	GSMS	EC	9/12/08	3.1891	0.008
UF6	GSMS	EC	9/12/08	3.1894	0.018
UF6	GSMS	EC	1/14/09	4.7719	-0.010
UF6	GSMS	EC	1/14/09	4.7719	-0.010
UF6	GSMS	EC	1/14/09	4.772	-0.008
UF6	GSMS	EC	1/14/09	4.7722	-0.004
UF6	GSMS	EC	1/14/09	4.7723	-0.002
UF6	GSMS	EC	1/14/09	4.774	0.034
UF6	GSMS	EC	1/15/09	4.7723	-0.002
UF6	GSMS	EC	1/15/09	4.7725	0.002
UF6	GSMS	EC	1/21/09	4.7722	-0.004
UF6	GSMS	EC	1/21/09	4.7723	-0.002
UF6	GSMS	EC	1/21/09	4.7727	0.006
UF6	GSMS	EC	1/21/09	4.7727	0.006
UF6	GSMS	EC	1/21/09	4.7727	0.006
UF6	GSMS	EC	1/21/09	4.7727	0.006
UF6	GSMS	EC	1/21/09	4.7728	0.008
UF6	GSMS	EC	1/21/09	4.7732	0.017
UF6	GSMS	EC	1/22/09	4.7712	-0.025
UF6	GSMS	EC	1/22/09	4.7719	-0.010
UNH	ICP-MS	ED	8/19/08	4.458	-0.042
UNH	ICP-MS	ED	8/19/08	4.459	-0.019
UNH	ICP-MS	ED	8/19/08	4.389	-0.058
UNH	ICP-MS	ED	8/19/08	4.390	-0.035
UNH	TIMS	ED	8/19/08	4.464	0.093
UNH	TIMS	ED	8/19/08	4.464	0.093
UNH	TIMS	ED	8/19/08	4.398	0.147
UNH	TIMS	ED	8/19/08	4.398	0.147
UNH	ICP-MS	ED	9/10/08	4.461	0.025

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	ICP-MS	ED	9/10/08	4.462	0.048
UNH	ICP-MS	ED	9/10/08	4.391	-0.012
UNH	ICP-MS	ED	9/10/08	4.392	0.010
UNH	TIMS	ED	9/10/08	4.466	0.138
UNH	TIMS	ED	9/10/08	4.469	0.205
UNH	TIMS	ED	9/10/08	4.399	0.170
UNH	TIMS	ED	9/10/08	4.403	0.261
UNH	TIMS	F	3/13/07	4.39049	-0.024
UNH	TIMS	F	3/13/07	4.39055	-0.023
UNH	TIMS	F	3/14/07	4.39085	-0.016
UNH	TIMS	F	3/14/07	4.39122	-0.007
UNH	TIMS	F	9/19/07	4.45874	-0.025
UNH	TIMS	F	9/19/07	4.45923	-0.014
UNH	TIMS	F	9/19/07	4.45999	0.003
UNH	TIMS	F	9/19/07	4.46042	0.012
UO2	TIMS	F	9/19/07	4.0066	-0.041
UO2	TIMS	F	9/19/07	4.0067	-0.038
UO2	TIMS	F	9/19/07	4.00673	-0.037
UO2	TIMS	F	9/19/07	4.00685	-0.034
UO2	TIMS	F	9/19/07	4.00708	-0.029
UO2	TIMS	F	9/19/07	4.00727	-0.024
UO2	TIMS	F	9/19/07	4.00743	-0.020
UO2	TIMS	F	9/19/07	4.00767	-0.014
UNH	TIMS	F	9/20/07	4.45739	-0.055
UNH	TIMS	F	9/20/07	4.46096	0.025
UNH	TIMS	F	9/20/07	4.461	0.025
UNH	TIMS	F	9/20/07	4.46146	0.036
UO2	TIMS	F	9/20/07	4.00681	-0.035
UO2	TIMS	F	9/20/07	4.00692	-0.033
UO2	TIMS	F	9/20/07	4.00736	-0.022
UO2	TIMS	F	9/20/07	4.00782	-0.010
UO2	TIMS	F	9/20/07	4.0081	-0.003
UO2	TIMS	F	9/20/07	4.00857	0.008
UO2	TIMS	F	9/20/07	4.0086	0.009
UO2	TIMS	F	9/20/07	4.00948	0.031
UO2	TIMS	F	6/19/08	4.056341	-0.026
UO2	TIMS	F	6/19/08	4.05658	-0.020
UO2	TIMS	F	6/19/08	4.056768	-0.016
UO2	TIMS	F	6/19/08	4.057357	-0.001
UO2	TIMS	F	6/19/08	4.057411	0.000
UO2	TIMS	F	6/20/08	4.05522	-0.054
UO2	TIMS	F	6/20/08	4.055919	-0.037
UO2	TIMS	F	6/20/08	4.056608	-0.020
UO2	TIMS	F	6/20/08	4.057979	0.014
UO2	TIMS	F	6/20/08	4.058462	0.026
UNH	TIMS	G	5/8/06	4.3928	0.029
UNH	TIMS	G	5/8/06	4.3939	0.054
UNH	TIMS	G	5/8/06	4.3948	0.074

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	TIMS	G	5/8/06	4.3948	0.074
UO2	TIMS	T	1/12/06	4.009	0.019
UO2	TIMS	T	1/12/06	4.009	0.019
UO2	TIMS	T	1/12/06	4.010	0.044
UO2	TIMS	T	1/12/06	4.011	0.069
UO2	TIMS	T	1/19/06	4.009	0.019
UO2	TIMS	T	1/19/06	4.009	0.019
UO2	TIMS	T	1/19/06	4.009	0.019
UO2	TIMS	T	1/19/06	4.010	0.044
UO2	TIMS	T	4/21/06	4.010	0.044
UO2	TIMS	T	4/21/06	4.010	0.044
UO2	TIMS	T	4/21/06	4.011	0.069
UO2	TIMS	T	4/21/06	4.012	0.094
UO2	TIMS	T	4/24/06	4.008	-0.006
UO2	TIMS	T	4/24/06	4.009	0.019
UO2	TIMS	T	4/24/06	4.009	0.019
UO2	TIMS	T	4/24/06	4.009	0.019
UO2	TIMS	T	8/28/06	4.009	0.019
UO2	TIMS	T	8/28/06	4.010	0.044
UO2	TIMS	T	8/28/06	4.010	0.044
UO2	TIMS	T	8/28/06	4.012	0.094
UO2	TIMS	T	8/29/06	4.009	0.019
UO2	TIMS	T	8/29/06	4.010	0.044
UO2	TIMS	T	8/29/06	4.010	0.044
UO2	TIMS	T	8/29/06	4.012	0.094
UO2	TIMS	T	10/17/06	4.009	0.019
UO2	TIMS	T	10/17/06	4.009	0.019
UO2	TIMS	T	10/17/06	4.010	0.044
UO2	TIMS	T	10/17/06	4.010	0.044
UO2	TIMS	T	10/19/06	4.008	-0.006
UO2	TIMS	T	10/19/06	4.009	0.019
UO2	TIMS	T	10/19/06	4.010	0.044
UO2	TIMS	T	10/19/06	4.010	0.044
UO2	TIMS	T	4/26/07	4.008	-0.006
UO2	TIMS	T	4/26/07	4.008	-0.006
UO2	TIMS	T	4/26/07	4.009	0.019
UO2	TIMS	T	4/26/07	4.010	0.044
UO2	TIMS	T	5/16/07	4.009	0.019
UO2	TIMS	T	5/16/07	4.009	0.019
UO2	TIMS	T	5/16/07	4.009	0.019
UO2	TIMS	T	5/16/07	4.011	0.069
UO2	TIMS	T	11/29/07	4.008	-0.006
UO2	TIMS	T	11/29/07	4.009	0.019
UO2	TIMS	T	11/29/07	4.009	0.019
UO2	TIMS	T	11/29/07	4.012	0.094
UO2	TIMS	T	12/11/07	4.009	0.019
UO2	TIMS	T	12/11/07	4.009	0.019
UO2	TIMS	T	12/11/07	4.010	0.044

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UO2	TIMS	T	12/11/07	4.010	0.044
UO2	TIMS	T	12/18/07	4.010	0.044
UO2	TIMS	T	12/18/07	4.010	0.044
UO2	TIMS	T	12/18/07	4.010	0.044
UO2	TIMS	T	12/18/07	4.011	0.069
UO2	TIMS	T	12/19/07	4.009	0.019
UO2	TIMS	T	12/19/07	4.010	0.044
UO2	TIMS	T	12/19/07	4.010	0.044
UO2	TIMS	T	12/19/07	4.011	0.069
UO2	TIMS	T	5/22/08	4.009	0.019
UO2	TIMS	T	5/22/08	4.010	0.044
UO2	TIMS	T	6/30/08	4.011	0.069
UO2	TIMS	T	6/30/08	4.011	0.069
UO2	TIMS	T	6/30/08	4.012	0.094
UO2	TIMS	T	6/30/08	4.013	0.119
UO2	TIMS	T	6/30/08	4.010	0.044
UO2	TIMS	T	6/30/08	4.010	0.044
UO2	TIMS	T	7/1/08	4.011	0.069
UO2	TIMS	T	7/1/08	4.012	0.094
UO2	TIMS	T	7/1/08	4.012	0.094
UO2	TIMS	T	7/1/08	4.012	0.094
UO2	TIMS	T	7/1/08	4.009	0.019
UO2	TIMS	T	7/1/08	4.010	0.044
UO2	TIMS	T	7/16/08	4.011	0.069
UO2	TIMS	T	7/16/08	4.012	0.094
UO2	TIMS	T	9/17/08	4.011	0.069
UO2	TIMS	T	9/17/08	4.012	0.094
UO2	TIMS	T	9/17/08	4.012	0.094
UO2	TIMS	T	9/17/08	4.012	0.094
UO2	TIMS	T	9/19/08	4.010	0.044
UO2	TIMS	T	9/19/08	4.011	0.069
UO2	TIMS	T	9/19/08	4.011	0.069
UO2	TIMS	T	9/19/08	4.011	0.069
UO2	TIMS	T	1/8/09	4.010	0.044
UO2	TIMS	T	1/8/09	4.011	0.069
UO2	TIMS	T	1/8/09	4.011	0.069
UO2	TIMS	T	1/8/09	4.011	0.069
UO2	TIMS	T	1/15/09	4.010	0.044
UO2	TIMS	T	1/15/09	4.010	0.044
UO2	TIMS	T	1/15/09	4.011	0.069
UO2	TIMS	T	1/15/09	4.011	0.069
UNH	TIMS	U	6/18/08	4.435	-0.557
UNH	TIMS	U	6/18/08	4.442	-0.401
UNH	TIMS	U	6/20/08	4.441	-0.423
UNH	TIMS	U	6/20/08	4.442	-0.401
UO2	TIMS	V	3/21/06	4.0057	-0.063
UO2	TIMS	V	3/21/06	4.0062	-0.051
UO2	TIMS	V	3/21/06	4.0064	-0.046

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UO2	TIMS	V	3/21/06	4.0082	-0.001
UO2	TIMS	V	3/21/06	4.011	0.069
UNH	TIMS	V	3/23/06	4.3875	-0.092
UO2	TIMS	V	3/23/06	4.004	-0.106
UNH	TIMS	V	3/24/06	4.3881	-0.078
UNH	TIMS	V	3/24/06	4.3888	-0.062
UNH	TIMS	V	3/24/06	4.3896	-0.044
UNH	TIMS	V	3/24/06	4.3898	-0.040
UNH	TIMS	V	3/24/06	4.3913	-0.005
UNH	TIMS	V	3/24/06	4.4567	-0.071
UNH	TIMS	V	3/24/06	4.4568	-0.069
UNH	TIMS	V	3/24/06	4.458	-0.042
UNH	TIMS	V	3/24/06	4.4581	-0.040
UNH	TIMS	V	3/24/06	4.4596	-0.006
UNH	TIMS	V	3/24/06	4.4611	0.028
UNH	TIMS	V	4/3/06	4.3913	-0.005
UNH	TIMS	V	4/3/06	4.3922	0.015
UNH	TIMS	V	4/3/06	4.3934	0.042
UNH	TIMS	V	4/3/06	4.3937	0.049
UNH	TIMS	V	4/3/06	4.3938	0.051
UNH	TIMS	V	4/3/06	4.3943	0.063
UNH	TIMS	V	4/3/06	4.4654	0.124
UNH	TIMS	V	4/4/06	4.4566	-0.073
UNH	TIMS	V	4/4/06	4.4598	-0.001
UNH	TIMS	V	4/4/06	4.4604	0.012
UNH	TIMS	V	4/4/06	4.4625	0.059
UNH	TIMS	V	4/4/06	4.463	0.070
UO2	TIMS	V	4/5/06	4.0025	-0.143
UO2	TIMS	V	4/5/06	4.0078	-0.011
UO2	TIMS	V	4/5/06	4.008	-0.006
UO2	TIMS	V	4/5/06	4.0096	0.034
UO2	TIMS	V	4/5/06	4.0099	0.042
UO2	TIMS	V	4/7/06	4.0079	-0.008
UNH	TIMS	V	4/25/06	4.3917	0.004
UNH	TIMS	V	4/25/06	4.392	0.010
UNH	TIMS	V	4/25/06	4.3922	0.015
UNH	TIMS	V	4/25/06	4.3922	0.015
UNH	TIMS	V	4/25/06	4.3922	0.015
UNH	TIMS	V	4/25/06	4.3932	0.038
UNH	TIMS	V	4/25/06	4.4599	0.001
UNH	TIMS	V	4/25/06	4.4606	0.017
UNH	TIMS	V	4/25/06	4.4612	0.030
UNH	TIMS	V	4/26/06	4.4608	0.021
UNH	TIMS	V	4/26/06	4.4612	0.030
UNH	TIMS	V	4/26/06	4.4616	0.039
UO2	TIMS	V	4/26/06	4.0088	0.014
UO2	TIMS	V	4/26/06	4.0091	0.022
UO2	TIMS	V	4/26/06	4.0093	0.027

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UO2	TIMS	V	4/26/06	4.0096	0.034
UO2	TIMS	V	4/26/06	4.010	0.044
UO2	TIMS	V	4/26/06	4.010	0.044
UO2	TIMS	V	6/24/08	4.00945	0.030
UO2	TIMS	V	6/24/08	4.00945	0.030
UO2	TIMS	V	6/24/08	4.00945	0.030
UO2	TIMS	V	6/24/08	4.00945	0.030
UNH	TIMS	V	6/30/08	4.46254	0.060
UNH	TIMS	V	6/30/08	4.46255	0.060
UNH	TIMS	V	6/30/08	4.46255	0.060
UNH	TIMS	V	6/30/08	4.46255	0.060
UNH	TIMS	V	7/8/08	4.46075	0.020
UNH	TIMS	V	7/8/08	4.46075	0.020
UNH	TIMS	V	7/8/08	4.46075	0.020
UNH	TIMS	V	7/8/08	4.46076	0.020
UO2	TIMS	V	7/8/08	4.00945	0.030
UO2	TIMS	V	7/8/08	4.00945	0.030
UO2	TIMS	V	7/8/08	4.00945	0.030
UO2	TIMS	V	7/8/08	4.00945	0.030
UNH	TIMS	W	9/1/06	4.392	0.010
UNH	TIMS	W	9/1/06	4.3933	0.040
UNH	TIMS	W	9/2/06	4.3908	-0.017
UNH	TIMS	W	9/2/06	4.3926	0.024
UNH	TIMS	W	9/3/06	4.392	0.010
UNH	TIMS	W	9/4/06	4.3916	0.001
UNH	TIMS	W	9/4/06	4.3921	0.013

Figure BX.3. ^{235}U abundance measurements in HEU.

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	TIMS	A	7/17/07	51.333	0.017
UNH	TIMS	A	7/17/07	51.333	0.017
UNH	TIMS	A	7/17/07	51.336	0.022
UNH	TIMS	A	7/17/07	51.337	0.024
UNH	TIMS	A	7/17/07	51.325	0.001
UNH	TIMS	A	7/17/07	51.343	0.036
UNH	TIMS	A	7/18/07	51.305	-0.038
UNH	TIMS	A	7/18/07	51.325	0.001
UNH	TIMS	A	1/29/08	89.651	-0.031
UNH	TIMS	A	1/29/08	89.677	-0.002
UNH	TIMS	A	1/29/08	89.6880	0.010
UNH	TIMS	A	1/29/08	89.6960	0.019
UNH	TIMS	A	1/30/08	89.68	0.001
UNH	TIMS	A	1/30/08	89.6880	0.010
UNH	TIMS	A	1/30/08	89.6990	0.023
UNH	TIMS	A	1/30/08	89.7010	0.025
UNH	TIMS	A	5/19/08	90.346	0.010
UNH	TIMS	A	5/19/08	90.354	0.019
UNH	TIMS	A	5/19/08	90.3570	0.022
UNH	TIMS	A	5/19/08	90.357	0.022
UNH	TIMS	A	5/28/08	90.3330	-0.005
UNH	TIMS	A	5/28/08	90.3430	0.006
UNH	TIMS	A	5/28/08	90.3470	0.011
UNH	TIMS	A	5/28/08	90.354	0.019
UNH	TIMS	AW	5/21/07	51.3215	-0.006
UNH	TIMS	AW	5/21/07	51.3436	0.037
UNH	TIMS	AW	5/21/07	51.3366	0.024
UNH	TIMS	AW	5/21/07	51.3494	0.049
UNH	TIMS	AW	5/21/07	89.6919	0.015
UNH	TIMS	AW	5/21/07	89.6893	0.012
UNH	TIMS	AW	6/1/07	89.6825	0.004
UNH	TIMS	AW	6/4/07	51.3488	0.047
UNH	TIMS	AW	6/4/07	51.3295	0.010
UNH	TIMS	AW	6/4/07	89.6629	-0.018
UNH	TIMS	AW	6/4/07	89.6753	-0.004
UNH	TIMS	AW	6/4/07	89.6681	-0.012
UNH	TIMS	B	1/29/06	51.3255	0.002
UNH	TIMS	B	1/29/06	51.3245	0.000
UNH	TIMS	B	1/29/06	89.9017	0.012
UNH	TIMS	B	1/29/06	89.8946	0.004
UNH	TIMS	B	3/3/06	51.3254	0.002
UNH	TIMS	B	3/3/06	51.3287	0.008
UNH	TIMS	B	3/3/06	89.8888	-0.003
UNH	TIMS	B	3/3/06	89.8987	0.008
UNH	TIMS	B	3/28/06	89.6567	-0.025
UNH	TIMS	B	3/28/06	89.6820	0.004

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	TIMS	B	4/5/06	89.6910	0.014
UNH	TIMS	B	4/5/06	89.6988	0.022
UNH	TIMS	B	7/25/06	90.346	0.010
UNH	TIMS	B	7/25/06	90.3431	0.007
UNH	TIMS	B	10/11/06	90.3263	-0.012
UNH	TIMS	B	10/11/06	90.334	-0.004
UNH	TIMS	B	1/17/08	90.3459	0.010
UNH	TIMS	B	1/17/08	90.3436	0.007
UNH	TIMS	B	1/17/08	90.3518	0.016
UNH	TIMS	B	1/17/08	90.3512	0.016
UNH	TIMS	B	1/26/08	90.3437	0.007
UNH	TIMS	B	1/26/08	90.3456	0.009
UNH	TIMS	B	1/26/08	90.3521	0.017
UNH	TIMS	B	1/26/08	90.3514	0.016
UNH	TIMS	B	3/25/08	51.3613	0.072
UNH	TIMS	B	3/25/08	51.3608	0.071
UNH	TIMS	B	3/25/08	51.3475	0.045
UNH	TIMS	B	3/25/08	51.3471	0.044
UNH	TIMS	B	3/27/08	51.3613	0.072
UNH	TIMS	B	3/27/08	51.3617	0.072
UNH	TIMS	B	3/27/08	51.3492	0.048
UNH	TIMS	B	3/27/08	51.3491	0.048
UNH	TIMS	B	10/1/08	89.8979	0.008
UNH	TIMS	B	10/1/08	89.8980	0.008
UNH	TIMS	B	10/1/08	89.8982	0.008
UNH	TIMS	B	10/1/08	89.8985	0.008
UNH	TIMS	B	10/9/08	89.8978	0.007
UNH	TIMS	B	10/9/08	89.8983	0.008
UNH	TIMS	B	10/9/08	89.8984	0.008
UNH	TIMS	B	10/9/08	89.8985	0.008
UNH	ICP-MS	D	3/6/08	89.6142	-0.072
UNH	ICP-MS	D	3/6/08	89.7740	0.106
UNH	ICP-MS	D	3/6/08	89.8823	0.227
UNH	ICP-MS	D	3/7/08	89.6142	-0.072
UNH	ICP-MS	D	3/10/08	89.8323	0.171
UNH	ICP-MS	D	9/4/08	51.83958	1.004
UNH	ICP-MS	D	9/4/08	51.89484	1.111
UNH	ICP-MS	D	9/4/08	51.95186	1.222
UNH	ICP-MS	D	9/4/08	52.04035	1.395
UNH	ICP-MS	D	9/5/08	51.80430	0.935
UNH	ICP-MS	D	9/5/08	51.81505	0.956
UNH	ICP-MS	D	9/5/08	52.34685	1.992
UNH	ICP-MS	D	9/5/08	52.40574	2.107
UNH	ICP-MS	D	3/23/09	51.74292	0.815
UNH	ICP-MS	D	3/23/09	51.84800	1.020
UNH	ICP-MS	D	3/23/09	51.88257	1.087
UNH	ICP-MS	D	3/23/09	51.89247	1.107
UNH	ICP-MS	D	3/24/09	51.64658	0.628

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	ICP-MS	D	3/24/09	51.66378	0.661
UNH	ICP-MS	D	3/24/09	51.73858	0.807
UNH	ICP-MS	D	3/24/09	51.79490	0.917
UNH	TIMS	F	1/12/07	89.68024	0.002
UNH	TIMS	F	1/12/07	89.68079	0.002
UNH	TIMS	F	1/12/07	90.33964	0.003
UNH	TIMS	F	1/12/07	90.33819	0.001
UNH	TIMS	F	1/13/07	89.68045	0.002
UNH	TIMS	F	1/13/07	89.68072	0.002
UNH	TIMS	F	1/13/07	90.340	0.003
UNH	TIMS	F	1/13/07	90.33858	0.002
UNH	TIMS	F	3/13/07	51.3386	0.027
UNH	TIMS	F	3/13/07	51.3376	0.026
UNH	TIMS	F	3/14/07	51.3381	0.026
UNH	TIMS	F	3/14/07	51.3379	0.026
UNH	TIMS	F	7/11/07	89.901	0.011
UNH	TIMS	F	7/11/07	89.894	0.003
UNH	TIMS	F	7/11/07	90.3397	0.003
UNH	TIMS	F	7/12/07	89.893	0.002
UNH	TIMS	F	7/12/07	89.898	0.008
UNH	TIMS	F	7/12/07	90.3406	0.004
UNH	TIMS	F	7/12/07	90.3416	0.005
UNH	TIMS	F	4/10/08	51.50699	0.013
UNH	TIMS	F	4/10/08	51.50847	0.016
UNH	TIMS	F	4/10/08	51.50894	0.017
UNH	TIMS	F	4/10/08	51.50905	0.017
UNH	TIMS	F	4/10/08	51.51261	0.024
UNH	TIMS	F	4/10/08	51.51725	0.033
UNH	TIMS	F	4/14/08	51.51628	0.031
UNH	TIMS	F	4/14/08	51.51788	0.034
UNH	TIMS	F	4/14/08	51.51957	0.037
UNH	TIMS	F	4/14/08	51.51995	0.038
UNH	TIMS	F	4/14/08	51.52241	0.043
UNH	TIMS	F	4/14/08	51.52647	0.051
UNH	TIMS	G	5/3/06	89.6817	0.003
UNH	TIMS	G	5/3/06	89.6811	0.003
UNH	TIMS	G	5/3/06	89.8908	0.000
UNH	TIMS	G	5/3/06	89.8908	0.000
UNH	TIMS	G	5/3/06	90.3402	0.003
UNH	TIMS	G	5/3/06	90.3407	0.004
UNH	TIMS	G	5/3/06	90.3356	-0.002
UNH	TIMS	G	5/3/06	90.3351	-0.002
UNH	TIMS	G	5/5/06	51.3442	0.038
UNH	TIMS	G	5/5/06	51.3458	0.042
UNH	TIMS	G	5/8/06	51.3435	0.037
UNH	TIMS	G	5/8/06	51.3457	0.041
UNH	TIMS	G	6/30/08	89.78230	0.004
UNH	TIMS	G	6/30/08	89.78549	0.008

Material	Method Type	Facility	Analysis Date	Reported Result	% RD
UNH	TIMS	G	7/8/08	89.77284	-0.006
UNH	TIMS	G	7/8/08	89.78073	0.003
UNH	TIMS	G	7/8/08	89.78240	0.005
UNH	TIMS	G	7/8/08	89.78303	0.005
UNH	TIMS	G	9/5/08	89.77869	0.000
UNH	TIMS	G	9/5/08	89.78147	0.003
UNH	TIMS	G	6/30/08	51.51713	0.033
UNH	TIMS	G	6/30/08	51.51780	0.034
UNH	TIMS	G	7/8/08	51.51799	0.034
UNH	TIMS	G	7/8/08	51.51803	0.034
UNH	TIMS	G	7/8/08	51.51865	0.036
UNH	TIMS	G	7/8/08	51.51935	0.037
UNH	TIMS	G	9/5/08	51.5218	0.042
UNH	TIMS	G	9/17/08	51.52390	0.046
UNH	TIMS	U	6/18/08	89.701	0.025
UNH	TIMS	U	6/18/08	89.702	0.026
UNH	TIMS	U	6/20/08	89.700	0.024
UNH	TIMS	U	6/20/08	89.712	0.037
UNH	TIMS	W	9/5/06	90.3421	0.005
UNH	TIMS	W	9/5/06	90.3435	0.007
UNH	TIMS	W	9/6/06	90.3425	0.006
UNH	TIMS	W	9/6/06	90.3415	0.005
UNH	TIMS	W	9/7/06	90.3431	0.007
UNH	TIMS	W	9/7/06	90.3425	0.006
UNH	TIMS	W	9/8/06	90.343	0.006
UNH	TIMS	W	9/8/06	90.3431	0.007

APPENDIX C. SME PROGRAM: UNCERTAINTY ESTIMATION IN NUCLEAR MATERIAL ACCOUNTABILITY MEASUREMENTS

NBL Safeguards Measurement Evaluation Program: Uncertainty Estimation in Nuclear Material Accountability Measurements

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Abstract: The NBL Measurement Evaluation (ME) program is designed to provide independent verification of internal quality control as practiced in safeguards analytical laboratories making routine accountability measurements of uranium and plutonium bearing materials. Program participants analyze well-characterized test samples and the results of those analyses are evaluated for accuracy and precision. The average relative deviation of a set of (method/material specific) measurement results with respect to the characterized value is taken as an indicator of accuracy and the standard deviation of the relative deviations is taken as an indicator of precision. Whether the measurements are sufficiently accurate and precise is determined through comparison with the appropriate International Target Values (ITVs) for random [u(r)] and systematic [u(s)] uncertainty components. More recently, increased emphasis is being placed on expressing and using measurement uncertainty in accordance with the Guide to the Expression of Uncertainty in Measurement (GUM). This is done by combining all sources of uncertainty (e.g., uncertainties in characterized values, measurements, and any corrections for systematic effects) that affect each measurement result and incorporating the uncertainty in the interpretation of the results. Some of the potential implications of adopting the GUM method for evaluating uncertainties in nuclear safeguard measurements will be discussed with specific reference to the currently used ITVs and in the contemplated revision of those values.

A. Introduction

The NBL Measurement Evaluation (ME) program is designed to provide independent verification of internal quality control as practiced in safeguards analytical laboratories making routine accountability measurements of uranium and plutonium bearing materials. The United States Department of Energy (DOE) safeguards analytical laboratories are required to participate in the ME program; non-DOE facilities are allowed to participate with DOE approval.

There are two parts to the ME program; the Safeguards Measurement Evaluation (SME) program for measurements done by destructive methods of analyses, and the Calorimetric Exchange (CALEX) program for measurements by non-destructive methods. The results and discussion presented in this paper pertain to evaluation of SME program measurement results only. A similar discussion of CALEX program measurement results is presented in a paper submitted recently for publication [1].

In the SME program, the participants analyze well-characterized samples of uranium and plutonium for elemental content and isotopic abundance using destructive methods of analyses. NBL evaluates each set of material/method specific measurement results by computing the mean relative deviation with respect to the characterized (or accepted) value; the mean relative deviation is a measure of accuracy (or bias) for each lab's result and the standard deviation is an indication of the lab's measurement precision. The accuracy and precision of each set of results are also compared against the material/method specific International Target Values [2] to assess performance. In this particular method of evaluation, which will be referred to as the "traditional" method in this paper, the standard uncertainty associated with the mean relative deviation is calculated from the observed random variation in the measurements alone.

In contrast to the traditional method, an alternative method based on the *Guide to the Expression of Uncertainty in Measurement* (GUM) [3] requires that all known sources of uncertainties are to be combined in determining the standard uncertainty of each measurement result. The major sources of uncertainties are those from the measurements (e.g., random variations in the measurements results and corrections for systematic effects) and the uncertainties associated with the characterized values of the test materials. In this paper, we compare and contrast the uncertainty estimates from the traditional and GUM methods for two sets of SME program measurement results. The conclusions derived from this study are relevant to discussions on the expression of uncertainty in performance evaluation and also to the ongoing work of revision of the International Target Values (hereafter referred to as ITVs).

B. Uranium mass fraction and ^{235}U abundance measurement results

Uncertainty calculations for two sets of measurement results taken from the SME Program database are used here to illustrate the differences between the traditional and GUM methods; one set of results pertains to uranium mass fraction determinations in test samples of UO_2 pellets by the Davies-Gray titration and the other set to ^{235}U abundance measurements in test samples of uranyl nitrate solution by thermal ionization mass spectrometry. In each case, the participant laboratory

analyzed the two samples, each in duplicate on two different days, using their routine accountability measurement procedures. The measurement results of the two sets are shown in Table 1.

Table 1. Measurement results for uranium mass fraction and ^{235}U abundance, and calculated relative deviations (*RD*/%) for each measurement result with respect to the characterized value. The uranium (elemental) mass fraction characterized value is 88.129 % ± 0.020 %, and the ^{235}U (isotopic) mass fraction characterized value is 4.45986 % ± 0.00089 %. The uncertainties are expressed as expanded uncertainty with coverage factor *k* = 2.

U (Elemental) Mass Fraction			^{235}U (Isotopic) Mass Fraction		
	Measurement/%	***RD*/%**		**Measurement/%**	***RD*/%**
Day1	88.07	-0.067	**Day1**	4.4502	-0.217
	88.14	0.012		4.4604	0.012
	88.19	0.069		4.4543	-0.125
	88.07	-0.067		4.4534	-0.145
Day 2	88.17	0.047	**Day 2**	4.4540	-0.131
	88.19	0.069		4.4573	-0.057
	88.13	0.001		4.4598	-0.001
	88.19	0.069		4.4579	-0.044

The analysis protocol as specified above permitted statistical evaluation of the results for day-to-day variation; it was found to be not significant in either set. Similarly, no statistical outliers were identified in either set of data. The relative deviation (RD) expressed as a percentage of each result with respect to the corresponding characterized value is calculated using equation (1).

$$RD = 100\left(\frac{M - C}{C}\right) = 100\left(\frac{M}{C} - 1\right) \tag{1}$$

where M is the measured result and C is characterized value. The calculated RD for each measurement result is shown in Table 1.

C. Traditional method

In the traditional method, the measurement results in Table 1 are evaluated through calculation of the mean *RD*, represented as $\overline{RD}$, using the following equation

$$\overline{RD} = \frac{1}{n}\sum_{i=1}^{n} RD_i \tag{2}$$

where RD_i is the *RD* (as %) for the individual measurements in Table 1 and *n* is the number of measurements being averaged (here $n = 8$).

The standard deviation of the RD_i is evaluated as

$$S = \sqrt{\frac{\sum_{i=1}^{n}\left(RD_i - \overline{RD}\right)^2}{n-1}} \,. \tag{3}$$

The half-width of a 95 % confidence interval for the true mean of the relative deviations ($\overline{RD}$) is computed using the formula

$$W_{\mathrm{h}} = k \cdot \frac{S}{\sqrt{n}} \tag{4}$$

Note that W_{h} has typically been referred to as the 95 % C.L. (Confidence Limit) in the traditional method. W_{h} is calculated as the product of the standard deviation of the mean (also referred to as the standard error) and a coverage factor "k" based on the Student's t-distribution with $n-1$ degrees of freedom (ν). In this case the coverage factor is 2.365 ($\nu = 7$) for both sets of measurements.

The results from the traditional method of calculation are shown in Table 2.

Table 2. Statistical evaluation of uranium mass fraction and uranium isotope abundance measurement results by the traditional method. The material/method specific ITVs are also shown; *u*(s) stands for systematic uncertainty component and *u*(r) for random uncertainty component.

	U (Elemental) Mass fraction	**ITV for U Mass Fraction**	**^{235}U (Isotopic) Mass Fraction**	**ITV for ^{235}U Mass Fraction**
$\overline{RD}$/%	0.017	*u*(s)/% = 0.1	-0.089	*u*(s)/% = 0.1
S/%	0.058	*u*(r)/% = 0.1	0.079	*u*(r)/% = 0.1
W_{h}/%	0.048		0.066	

C.1 Evaluation of measurement results using the traditional method

a) For the uranium mass fraction results, the mean *RD* is 0.017 %, and for the ^{235}U abundance measurements it is -0.089 %; both values are within the respective ITV ranges for *u*(s) showing an acceptable level of accuracy in the measurements.

b) The standard deviation of the RD_i is 0.058 % for uranium mass fraction measurements and 0.079 % for ^{235}U abundance measurements; thus both values are within the respective ITV ranges for *u*(r) showing an acceptable level of precision. Note that precision is determined from the random measurement variation only.

c) The measurements are said to be bias-free if the confidence interval ($\overline{RD} \pm W_h$) for the true mean relative deviation includes zero. A positive bias is indicated if all values in the interval fall above zero and negative bias is indicated if all values fall below zero. Based on the above criterion, the uranium mass fraction result of (0.017 % ± 0.048 %) is bias free, and the ^{235}U abundance result of (-0.089 % ± 0.066 %) shows negative bias.

D. GUM method

In the GUM method, the mean relative deviations ($\overline{RD}$) for the two sets of measurement results are calculated by applying equation (1) to the averages of the measurement results ($\bar{M}$) and the characterized values (C). The combined standard uncertainties in the mean relative deviations are estimated by propagating the uncertainties in the mean measurement results ($\bar{M}$) and in the characterized values (C) using equation (1), which is referred to as the model equation or the measurement equation since it defines how all of the quantities subject to uncertainty are incorporated in the final measurement result. GUM Workbench Pro version 2.3.6[2] [4] from Metrodata GmbH and Excel spread sheets were used for the calculations.

The required inputs for the GUM uncertainty analysis include the value of each quantity in the measurement equation ($\bar{M}$ and *C*, in this case), the standard uncertainty of each value, and the degrees of freedom associated with each standard uncertainty. The characterized values and the

[2]Certain commercial software is identified in this paper in order to specify the analysis procedures adequately. Such identification is not intended to imply recommendation or endorsement by the New Brunswick Laboratory or the National Institute of Standards and Technology, nor is it intended to imply that the software is necessarily the best available for the purpose.

expanded uncertainties for the test materials used here are given in the caption to Table 1. They are converted to standard uncertainties using the formula

$$u(C) = \frac{U(C)}{2} \tag{5}$$

where $U(C)$ is the expanded uncertainty of the accepted value. It is typical to assign a large number of degrees of freedom ($\nu = 60$) to these reference values. The measured values, their associated standard uncertainties, and their degrees freedom are normally furnished by the laboratories making the measurements. Often, these estimates are based on prior knowledge of random variations in measurements and also include uncertainty from other sources (e.g., bias correction uncertainty based on the laboratory's measurement process). In this case, since the laboratories provided the data itself, we computed the standard uncertainties of the input values using the formula:

$$u(\bar{M}) = \sqrt{\frac{\sum_{i=1}^{n}(M_i - \bar{M})^2}{n(n-1)}} \tag{6}$$

It must be noted that the laboratories would have reported the same values as those obtained from equation (6) if corrections to their measurements for systematic effects had negligible uncertainty.

In addition to the analysis based on the random uncertainties estimated directly from the measurement data, two further hypothetical GUM calculations are made to illustrate how the results from the GUM method depend upon the measurement uncertainty estimates from the measurement process and the characterization of the test samples being measured. The first hypothetical case [Case (ii)] examines what would happen if the variation in the measurement process were driven to zero. This illustrates how the uncertainty in the characterized value impacts the results when using the GUM method. The second hypothetical case [Case (iii)] is based on the assumption that the laboratories make systematic corrections to each measurement adding another component of uncertainty equal to 0.07 % of the measured value to the standard uncertainty of the random variation, the latter assumed to be the same as that in Case (i). Thus in Case (iii) the combined standard uncertainty of the measurements is much greater than either Case (i) or Case (ii); it is also much greater than the characterized value uncertainty. The assigned value for effective degrees of freedom ($\nu = 30$) in Case (iii) for the combined standard uncertainties of the means of the measurements reflects the fact that the standard uncertainties associated with the corrections for systematic effects are assumed to be relatively well known compared to the standard uncertainty due to random measurement variation based on the 8 measurements. The inputs required for the GUM analysis are shown in Table 3.

Table 3. Input values for GUM uncertainty analysis of relative deviations.

	U (Elemental) Mass fraction			^{235}U (Isotopic) Mass Fraction		
	Mean Value/%	**Standard Uncertainty/%**	ν	**Mean Value/%**	**Standard Uncertainty/%**	ν
Case (i)						
Characterized value (C)	88.129	0.010	60	4.45986	0.00045	60
Measurement ($\bar{M}$)	88.144	0.018	7	4.45591	0.0012	7
Case (ii)						
Characterized value (C)	88.129	0.010	60	4.45986	0.00045	60
Measurement ($\bar{M}$)	88.144	0.000	7	4.45591	0.00000	7
Case (iii)						
Characterized value (C)	88.129	0.010	60	4.45986	0.00045	60
Measurement ($\bar{M}$)	88.144	0.064	30	4.45591	0.00340	30

Note that, based on their construction, the relative deviations that would be obtained from the two hypothetical cases given in Table 3 [Cases (ii) and (iii)] would each be determined to be consistent with the ITV's using the traditional method. For Case (ii), this is because the individual relative deviations would all have a constant value of RD_i = 0.017 % or RD_i = -0.089 % due to the assumption that there is no random measurement error. For Case (iii), the individual relative deviations would be the same values as shown in Table 1 because the only added uncertainty comes from a systematic effect. The two data sets for Case (i) are also consistent with the ITV's. The results from the GUM analysis are shown in Table 4.

Table 4. Statistical evaluation of uranium mass fraction and uranium isotope abundance measurement results by the GUM method. The GUM uncertainties are expressed as expanded uncertainties with coverage factors obtained from Student's *t*-distribution based on the effective degrees of freedom associated with the standard uncertainty for each quantity.

	U (Elemental) Mass fraction			^{235}U (Isotopic) Mass Fraction		
	Relative Deviation, $RD/\%$	**Expanded Uncertainty,** $U(RD)/\%$	***k***	**Relative Deviation,** $RD/\%$	**Expanded Uncertainty,** $U(RD)/\%$	***k***
GUM Case (i)	0.017	0.051	2.201	-0.089	0.068	2.306
GUM Case (ii)	0.017	0.023	2.000	-0.089	0.020	2.000
GUM Case (iii)	0.017	0.151	2.040	-0.089	0.155	2.042

The results from the GUM method can be compared with the ITV's in a manner similar to the traditional method if the laboratories making the measurements provide an estimate of the relative standard uncertainty associated with a single measurement. For each of the three scenarios being

studied in this section, the relative standard uncertainty (as a percentage of a single measurement result) is computed by multiplying the standard uncertainty of the mean of each set of measurements by $\sqrt{8}$ and adding that value in quadrature (or root-mean-square) to the combined standard uncertainty of any corrections [e.g., systematic effect in Case (iii) only], and dividing the resulting standard deviation by the corresponding mean of the measurement result. The values of the relative standard uncertainties for the three scenarios are given in Table 5.

Table 5. Relative standard uncertainties for a single, typical measurement incorporating all sources of uncertainty associated with the measurement process, but no uncertainty associated with the characterized value of the reference sample. Note the relative standard deviations for the hypothetical case represented by Case (ii) are 0 because this case reflects what would happen if there were negligible uncertainty associated with the measurement process.

	U (Elemental) Mass fraction	^{235}U (Isotopic) Mass Fraction
GUM Case (i)	0.058 %	0.079 %
GUM Case (ii)	0.000 %	0.000 %
GUM Case (iii)	0.091 %	0.105 %

D.1 Evaluation of measurement results using the GUM method

The mean relative deviations for uranium mass fraction (0.017 %) and ^{235}U abundance (-0.089 %) for all three cases in the GUM method are the same as those in the traditional method (by construction). The expanded uncertainties of the relative deviations (see Table 4) depend upon the assumed values for the measurement uncertainties, the standard uncertainties associated with the characterized values of the test samples, and the effective degrees of freedom associated with the standard uncertainty. The relative contributions from the two major sources of uncertainty - the characterized value and the measurement process - are shown in Table 6 for the three cases. Case (i) represents our current best knowledge of values that might typically be observed in real data, Case (ii) covers the case when uncertainty in the characterized value is dominant, and Case (iii) shows what might happen when measurement uncertainty is dominant.

Table 6. Relative contributions from uncertainty in the measurement process and from uncertainty in the characterized values to the combined standard uncertainties computed using the GUM method.

	U (Elemental) Mass fraction		^{235}U (Isotopic) Mass Fraction	
	Characterized	**Measurement**	**Characterized**	**Measurement**
GUM Case (i)	23.5 %	76.5 %	11.4 %	88.6 %
GUM Case (ii)	100.0 %	0.0 %	100.0 %	0.0 %
GUM Case (iii)	2.4 %	97.6 %	1.7 %	98.3 %

Unlike the traditional method, the expanded uncertainty of the mean relative deviation must be taken into consideration under the philosophy of the GUM in order to meaningfully compare its value to the corresponding ITV [u(s)] to assess the significance of systematic deviations from the characterized value of the test sample. Since the values $\overline{RD} \pm U\left(\overline{RD}\right)$, where $U\left(\overline{RD}\right)$ represents the expanded uncertainty of $\overline{\mathrm{RD}}$, delineate a set of statistically plausible values for the true relative deviation, it is necessary to find both endpoints of the expanded uncertainty interval within the target value range [u(s) = ± 0.1 %] to provide high confidence that the true relative deviation is consistent with the ITV.

Applying the above criterion to the results in Table 4, only the two measurement results for the uranium elemental mass fractions represented in Cases (i) and (ii) would be determined to be consistent with the ITV for the systematic component. In the other four cases one or more of the endpoints $\overline{RD} \pm U\left(\overline{RD}\right)$ fall outside the ITV range of u(s) = ± 0.1 %. This shows that the GUM results are more stringent than the traditional analysis in assessing conformance to the systematic component of the target values.

Comparing the relative standard uncertainties in Table 5 to the ITV for the limit on random measurement variation, u(r) = 0.1 %, it is clear that all of the results except for the ^{235}U abundance in Case (iii), would be determined to be consistent the value of u(r). For the ^{235}U abundance in Case (iii), however, neither the mean relative deviation nor the observed level of random variation would be considered consistent with their ITV's.

E. Summary and conclusions

Two sets of measurement results from the SME Program database are evaluated with uncertainties estimated according to GUM and also by another, simpler method (referred to as the traditional method) that accounts for the random component of uncertainty only. The main conclusions of this study are as follows:

1. When applied as outlined here, the GUM method appears to make more stringent comparisons between the measured and characterized values for a test sample than those obtained using the traditional method. This is because the philosophy underlying the GUM method requires all measurement uncertainties to be accounted for when assessing the significance of any comparison. As a result, the currently used international target values might need to be adjusted to appropriately reflect state-of-the-practice measurement capabilities if adapted for use with the GUM methods for uncertainty assessment.

2. An advantage of the GUM method is that it provides a method for quantifying the level of confidence that the true relative deviation between the measured and characterized values of the test sample is within the target value range, $u(s) = \pm 0.1$ %. In contrast, the traditional method only guarantees that the observed mean value, which is subject to measurement error, is within the target range. The same type of quantification could also be provided for the comparison of the random measurement uncertainty to its target value, $u(r)$, but other statistical methods rather than those outlined in the GUM would have to be used for this purpose. We plan to apply the new ideas outlined in this study to a larger number of results in the SME and CALEX program databases. We also plan to investigate additional statistical methods to be used for the comparison of the random component of the measurement uncertainty with $u(r)$. As our ideas and experience continue to evolve during the course of this additional research, we hope to be able to develop and provide a comprehensive review of our findings that will be useful to the ongoing work related to the revision of the International Target Values.

Acknowledgements

The authors would like to thank Usha Narayanan of NBL for useful discussions and review of earlier drafts of this paper. The authors would also like to thank Hung-kung Liu and Georgia Harris of NIST for helpful comments provided as part of the editorial review process.

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