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SAFEGUARDS MEASUREMENT EVALUATION PROGRAM

URANIUM AND PLUTONIUM SAMPLES EXCHANGE REPORT

NEW BRUNSWICK LABORATORY

OCTOBER 2004–JUNE 2006

B. Srinivasan, Willard C. Losinger, Nancy Hui,
Joseph Waggoner, and Jon Neuhoff

U.S. DEPARTMENT OF ENERGY • CHICAGO OFFICE • ARGONNE, ILLINOIS

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NEW BRUNSWICK LABORATORY
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July 2006

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NEW BRUNSWICK LABORATORY: HISTORY AND MISSION

The New Brunswick Laboratory (NBL) is owned and operated by the United States Department of Energy through the offices of Security and Safety Performance Assurance (SP-1) and Technology and Field Assistance (SP-30). The laboratory was established in 1949 as an analytical chemistry laboratory in New Brunswick, New Jersey to provide support to the United States Atomic Energy Commission. At that time, it was staffed by scientists from the National Bureau of Standards who had contributed significantly to nuclear material measurement programs in the Manhattan Project. At the New Brunswick Laboratory, these scientists provided the technical expertise and skills to solve problems related to quantitative analyses of uranium-bearing materials. Over the years, these scientists and others following them have expanded the capabilities of the laboratory to include chemical and mass spectrometric analyses of plutonium and other trans-uranium elements, research and development activities in chemical analysis techniques, preparation of certified reference materials, and operation of the Safeguards Measurement Evaluation Program. In 1977, the laboratory moved from New Jersey to its present location at the Argonne National Laboratory site in Illinois.

The New Brunswick Laboratory serves as the U.S. government's central authority for both nuclear material measurements and measurement evaluation, and is the U.S. government's certifying authority for nuclear reference materials. The major mission of the New Brunswick Laboratory is to provide technical assistance to the Department of Energy in the following areas: measurement evaluation program operation, certified (nuclear) reference materials preparation, measurement techniques development, and measurement services to domestic and international customers. 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 Technology and Field Assistance (SP-30) in the Office of Security and Safety Performance Assurance (SP-1). The authors of this report are grateful to Michael Soriano of NBL for help in correcting coding errors in the database software.

ABSTRACT

The New Brunswick Laboratory has been tasked by the United States Department of Energy office of Technology and Field Assistance (SP-30) in the office of Security and Safety Performance Assurance (SP-1) to evaluate the quality of measurement techniques in nuclear materials accounting practices at Department of Energy facilities. Both destructive and non-destructive methods of analysis come under this purview. The destructive methods are evaluated in the Safeguards Measurement Evaluation Program. The non-destructive methods are evaluated in the Calorimetric Exchange (CALEX) Program. This report describes the activities in the Safeguards Measurement Evaluation Program from October, 2004 through June, 2006. A separate report covers the CALEX Program for the 2005 calendar year.

Several Department of Energy facilities participated in the Safeguards Measurement Evaluation program partly to satisfy a Department of Energy requirement on independent verification of internal analytical control of their measurements. A Nuclear Cycle Development Laboratory in Japan also participated, on a voluntary and cost-recovery basis, as did several laboratories in Argentina and Brazil, and the International Atomic Energy Agency (IAEA) in Vienna, Austria. In addition, the Institute for Reference Materials and Measurements (IRMM) in Belgium recently joined the program and received analysis samples in June, 2006.

The New Brunswick Laboratory sent samples of uranium- and plutonium-bearing materials to the participating laboratories for elemental and isotopic-abundance analyses. The participants analyzed the samples by methods used for accountability measurements at their facilities. The results of their analyses were evaluated by the New Brunswick Laboratory for bias and precision using statistical techniques. Performance evaluation reports were sent to the participants to indicate adequacy or need for improvement.

Prior Safeguards Measurement Evaluation Program annual reports were issued on a fiscal - year basis. The present report covers the period from the beginning of the 2005 fiscal year (October 1, 2004) through June, 2006. Future annual reports will be issued on a yearly basis covering the period July to June.

A. INTRODUCTION

The New Brunswick Laboratory (NBL) is a nuclear material measurement laboratory of the U.S. Department of Energy (DOE). NBL reports to the DOE office of Security and Safety Performance Assurance (SP-1) through the office of Technology and Field Assistance (SP-30). NBL provides technical expertise to the Department for the operation of the Measurement Evaluation Program and for the preparation of certified reference materials. In the Measurement Evaluation Program, NBL evaluates the capabilities of DOE contractor-operated laboratories in nuclear materials accounting measurements. It has two parts; the Safeguards Measurement Evaluation (SME) Program for destructive measurements (e.g. titration, isotope dilution mass spectrometry) of uranium- and plutonium-bearing materials, and the Calorimetry Exchange (CALEX) program for non-destructive measurements of plutonium oxide. In the future, uranium and plutonium measurements by neutron coincidence counting methods will be included in the non-destructive part of the program.

B. SAFEGUARDS MEASUREMENT EVALUATION PROGRAM

Materials Control and Accountability measurements are an essential part of the work in safeguarding nuclear materials. Destructive and non-destructive methods are used in accounting for nuclear materials in processing, storage and transit. These methods must be capable of providing quantitative results within acceptable limits of accuracy and precision. Large measurement errors will compromise the ability to detect material loss in processing, or by theft or diversion.

The SME Program evaluates elemental and isotopic-abundance measurement results of uranium- and plutonium-bearing materials for material control and accountability. Well-characterized samples are sent to the participating laboratories for analysis by techniques that are routinely used in accountability measurements. The results are statistically evaluated by NBL for accuracy and precision. Results falling within the accuracy and precision target values indicate satisfactory performance. Results falling outside of target values indicate the need for improvement. International Target Values (ITVs)[1] are used in performance evaluation. If ITVs are not available for a particular method/material, then DOE target values are used instead (e.g., uranium by x-ray

[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

fluorescence). Despite utmost care, laboratories occasionally fail to meet the target values. In such cases, the laboratories are asked to take corrective action.

C. SAFEGUARDS MEASUREMENT EVALUATION PROGRAM, OCT 2004-JUNE 2006

New Brunswick Laboratory (NBL) sent well-characterized samples of uranium-bearing and plutonium-bearing materials to the participants. The participants analyzed the samples for elemental concentrations and isotopic abundance. The results of analyses were statistically evaluated by NBL. The participants received performance evaluation reports regarding accuracy and precision achieved in the analyses. The participants were also notified whether the accuracy and precision of their measurement results satisfied target values. In addition, summaries of the evaluation reports are presented and discussed at the Measurement Evaluation Program annual meeting. The meeting is held in the same venue as the Institute of Nuclear Materials Management (INMM) annual meeting, and usually the day before the start of the INMM meeting, to maximize participation. Starting in 2006, in accordance with new metrics established for the operation of the NBL Safeguards Measurement Evaluation (SME) Program, the Annual Report will be issued at the annual meeting. This Annual Report covers the period starting from October 2004 and ending in June 2006. Future annual reports will be issued on a yearly basis, July through June.

C.1. SME Program Participants

Several DOE laboratories participated in the SME program during the period between October, 2004 and June, 2006. Their 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."* One laboratory in Japan, the International Atomic Energy Agency (IAEA) in Austria, and several laboratories associated with the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC) participated on a voluntary and cost recovery basis, with prior approval from DOE.

Table 1 lists the laboratories that participated in uranium sample analysis, and Table 2 shows the laboratory that participated in plutonium sample analysis. Idaho National Laboratory (previously Argonne National Laboratory West) did not participate this year because of instrument problems.

Test samples were sent to the Institute for Reference Materials and Measurements (IRMM) in Belgium this year. IRMM will submit the results for evaluation for next year's report.

Table 1. Oct 2004-June 2006 SME Program: Participants in Uranium Sample Analysis

ABACC LABORATORIES (a group of laboratories in Argentina and Brazil)
INTERNATIONAL ATOMIC ENERGY AGENCY (Austria)
LOS ALAMOS NATIONAL LABORATORY (DOE contractor laboratory)
NEW BRUNSWICK LABORATORY (DOE laboratory)
SAVANNAH RIVER SITE (DOE contractor laboratory)
TOKAI SAFEGUARDS ANALYTICAL LABORATORY (Japan)
Y-12 NATIONAL SECURITY COMPLEX (DOE contractor laboratory)

Table 2. Oct 2004-June 2006 SME Program: Participant in Plutonium Sample Analysis

LOS ALAMOS NATIONAL LABORATORY (DOE contractor laboratory)

Nuclear Regulatory Commission (NRC) licensees were regular participants in the program prior to 2001. None of the NRC licensees participated from October, 2004 through June, 2006, possibly because of financial constraints. However, one NRC licensee laboratory (Nuclear Fuel Services in Tennessee) received SME Program samples during 2006, and plans to submit measurement results after June, 2006. NBL would like other NRC licensees to re-join the program, because nuclear-material transfers occur frequently between NRC and DOE facilities, and shipper-receiver differences sometimes occur in these transfers. If both DOE and NRC facilities participate in a common evaluation program, then any differences in material accountability measurements can be easily resolved. NBL would also like to increase the number of international participants; it may prove beneficial for global nuclear safeguards.

C.2. Materials and Measurement Methods

The materials used and the measurement methods evaluated in the SME Program from October, 2004 through June, 2006 are shown in Tables 3 and 4. Table 3 refers to uranium assay, and Table 4 refers to isotopic-abundance measurements of uranium and plutonium. The participants are identified by code letters to provide confidentiality.

Table 3. Oct 2004-June 2006 SME Program: Materials and methods used to evaluate uranium assay. The participating laboratories are identified by code letters only. Numbers next to codes refer to number of times the laboratory participated in the program. For example, B5 means laboratory B participated in the program five times during this time frame.

Method	UNH Solutions	UO_2 Pellets	UF_6	UO_3 Powder
Dichromate Titration	B5 F1	AB1 AC1	AB2 AE1	V1
(Davies-Gray)	G5 V1	AD1 AE	V1	
		BA1 BC1		
		BF1 T2		
		V1		
IDMS	A2 B4			
	G1			A3 B1
XRF	A2			A6

Notes: UNH, uranyl nitrate solutions. UO_2, uranium dioxide pellets. UF_6, uranium hexafluoride. UO_3, uranium trioxide powder. IDMS, isotope dilution mass spectrometry. XRF, x-ray fluorescence.

Table 4. Oct 2004-June 2006 SME program: Materials and methods used to evaluate uranium and plutonium isotopic abundance measurements. The participant laboratories are identified by code letters only. Numbers next to codes refer to number of times the laboratory participated in the program. For example, A2 means laboratory A participated in the program twice during the time frame.

Method	HEU	LEU	Pu Sulfate
TIMS	A2 B5	AA2 B5	G2
	G1	BC1 G1	
		T2 V3	
ICPMS		AF1 BE1	
GSMS		BC1 G1	

Notes. HEU is highly-enriched uranium containing ≥ 20 wt % ^{235}U. LEU is low-enriched uranium containing <20 wt % ^{235}U. Pu sulfate: dried material of either high burn-up or low burn-up composition. TIMS, thermal ionization mass spectrometry. ICPMS, inductively coupled plasma mass spectrometry. GSMS, gas source mass spectrometry.

C. 3. Test Materials Characterization, Shipping and Analysis Schedules

The SME Program test materials were derived from Certified Reference Materials (CRMs), Working Reference Materials (WRMs), or tailor-made materials. These materials were characterized at NBL for elemental concentrations and/or isotopic abundance.

The characterization measurements were performed according to statistical plans with full consideration to quality assurance and traceability of the measurements. Test samples were prepared from the characterized materials for distribution to participants.

Typically, laboratories participating on a quarterly basis received eight samples of each type of test material per year. In each quarter, they analyzed two of the eight samples in duplicate on two different days. This analysis schedule generated at least eight results per quarter, which was sufficient for a meaningful statistical evaluation of the results. Laboratories participating on a quarterly basis received more samples than those participating on semi-annual or annual basis.

C. 4. SME Program Database

The data submitted by the participating laboratories were entered manually into a FoxPro® database. The database program has been in continuous use since 1995. The entered data were verified manually for correctness. The entry and verification tasks are quite labor-intensive. NBL is currently in the process of developing a new database application, based on the IBM Rational Software Development Platform, which will also enable direct electronic transfer of data by participants. The new application will use JAVA server pages, and the data will be stored in a Microsoft SQL Server. Participating laboratories will enter their own measurement results, and retrieve their evaluation reports, via the internet. The application is being written by professional programmers, with proper attention to quality assurance and quality control.

C.5. Statistical Evaluation of Measurement Results

The measurement results were evaluated using statistical techniques. First, the percent relative difference (% RD) of each experimental result was calculated with respect to the corresponding reference value, the latter obtained from characterization measurements. The % RD is defined as follows:

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

Next, each set of % RDs was examined for outliers using a series of statistical tests. A particular result was identified as a potential outlying value if at least two of the statistical tests determined it to be an “outlier” at ≥ 99% significance level. The statistically-identified outlier was removed from the data set only after a thorough review by the statistician and/or the Program

Manager. The data set, without outliers, was then tested to identify significant sources of variation (attributable to day-to-day and/or analyst-to-analyst differences) using standard one-factor analysis of variance (ANOVA). If the ANOVA results indicated no significant variation, then the standard uncertainty was the simple standard deviation (□) of the results divided by the square root of n, where n was the number of measurements. The coverage factor was the 95% Student's "t" factor with n-1 degrees of freedom. For example, in a set of 8 results showing no day-to-day or analyst-to-analyst variation, the number of degrees of freedom is 7, and the coverage factor is 2.36.

If the ANOVA results indicated significant (≥ 95%) day-to-day and/or analyst-to-analyst variation, then the standard uncertainty in the mean % RD was 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. When measurements occurred on only two days (or when measurements were made by only two analysts), then 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 coverage factor was 12.71 (i.e., the 95% Student's "t" factor with one degree of freedom).

The uncertainties shown in the statistical reports were the 95% confidence limit (C.L.) of means. In the figures accompanying the reports, the 95% confidence interval (C.I.) of the mean was constructed from the C.L. Note that 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 was considered to be bias-free if the 95% C.I. included zero. Otherwise, measurement bias was indicated. The simple standard deviation (σ) of the % RDs was the measure of the precision obtained in the analyses.

C.6. Examples of Statistical Evaluation Reports

Two examples of the statistical analysis reports are shown in Figs.1 and 2, the former showing uranium assay results from Davies-Gray titration, and the latter from Isotope Dilution Mass Spectrometry (IDMS) measurements. There are 8 results in each set obtained from analyses of two samples in duplicate on two different days.

There are no outliers in Fig.1. There is no evidence for significant day-to-day variation. The statistical significance is 44.3%. Note that variations are considered significant only if they exceed 95%. The mean % RD value is -0.154 and the uncertainty (95% C.L.) is 0.070. The uncertainty is calculated using a coverage factor of 2.36 corresponding to 7 degrees of freedom. The mean value extended by the confidence limit (-0.154 $\pm$ 0.070) does not include zero, thereby indicating negative bias in the measurements. The standard deviation of the results is 0.083.

There are no outliers in Fig. 2. However, there is evidence for significant day-to-day variation (statistical significance of 96.6%). The mean % RD value is 0.015 and the uncertainty at 95% C.L. is 1.319. The uncertainty is calculated using a coverage factor of 12.7, corresponding to 1 degree of freedom. The mean value extended by the confidence limit (0.015 $\pm$ 1.319) overlaps with zero, indicating no statistically-significant bias. But, this conclusion is not meaningful since the uncertainty is very large. The standard deviation of the results is 0.149.

The bias and precision International Target Values (ITVs) are shown at the bottom of the statistical reports. In Fig.1, the mean % RD of -0.154 is beyond the bias ITV of 0.1%; the precision of 0.083 is within the precision ITV of 0.1%. The measurement suffers from negative bias. In Fig.2, the mean % RD of 0.015 is within the ITV of 0.1%, and the precision of 0.149 is also within the ITV of 0.15%. However, no conclusion is possible regarding bias because of the large uncertainty in % RD.

The bias and precision achieved in the measurements - negative bias in Fig.1 and the day-to-day variation in Fig.2 - are easily seen in the visual representations accompanying the statistical reports. Statistical reports, similar to those shown in Figures 1 and 2, were generated for each set of results submitted by the laboratories. The reports were sent to the laboratories with a cover letter stating the conclusions of the performance evaluation. Copies of the report and the letter were sent to the respective DOE site offices supervising the work done in the laboratories. The site offices are responsible for initiating action for improvements if bias and/or precision in the measurements failed to meet the target values. NBL can provide assistance in bringing improvement through critical review of measurement procedures, and through providing training in experimental techniques.

Figure 1

SAMPLE DATA EVALUATION REPORT

No statistically significant difference due to analysis day

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 bias in Davies-Gray Titration is 0.1%.

International target value for precision in Davies-Gray Titration is 0.1%.

Figure 1 (cont.)

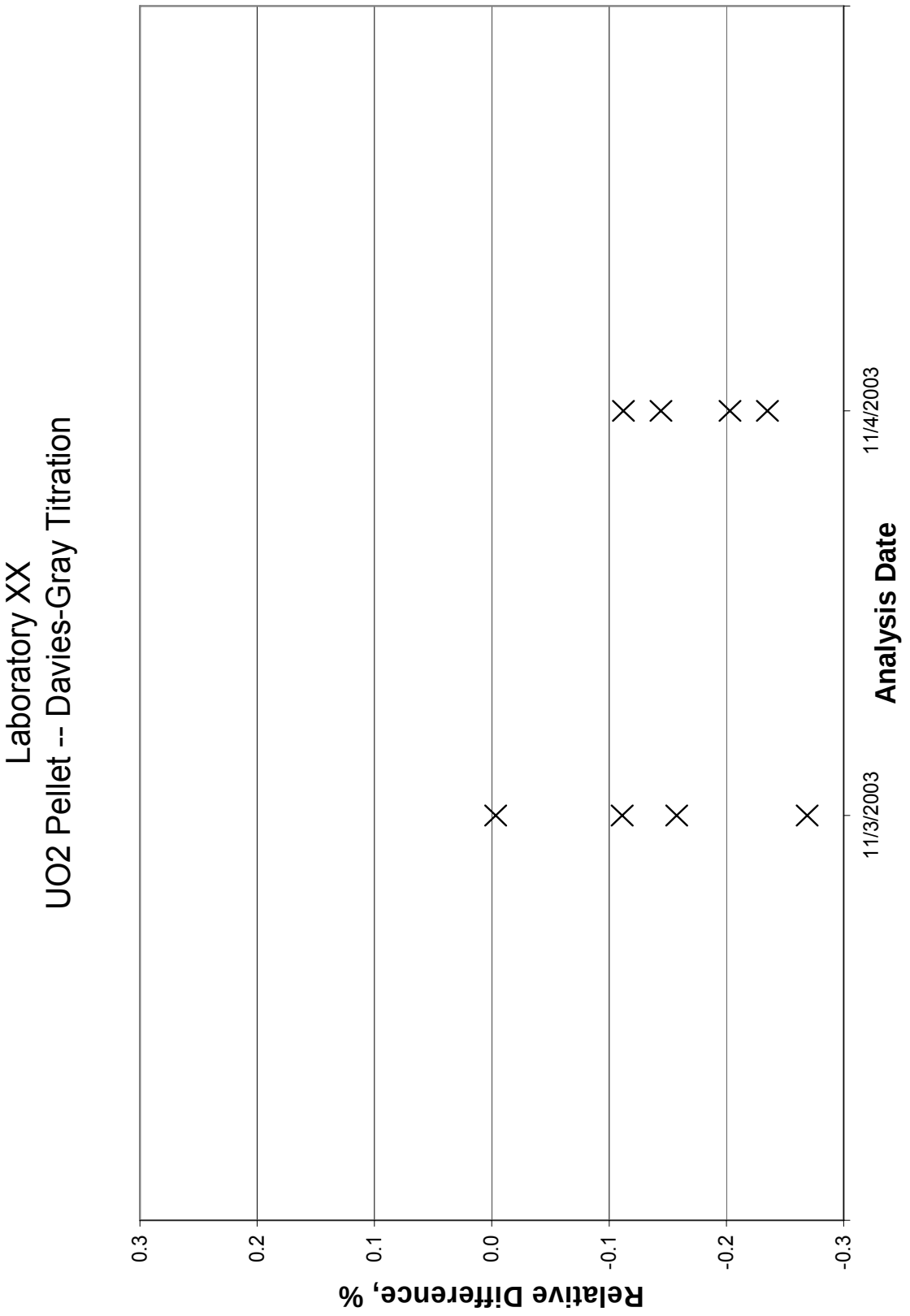


Figure 2

SAMPLE DATA EVALUATION REPORT

Statistically significant difference due to analysis day

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

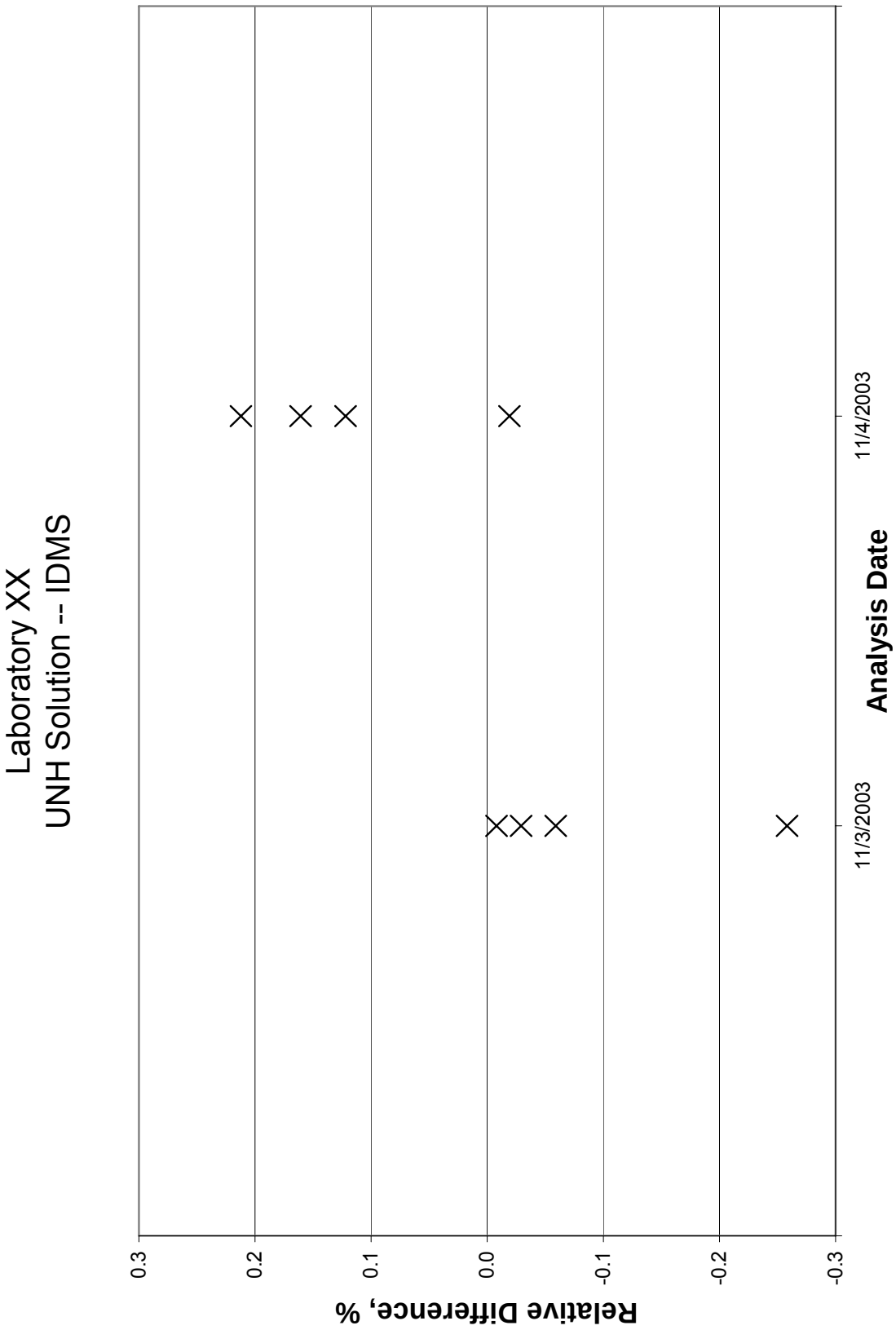
Sample Number	Aliquant Number	Analysis Date	Reported %U	% Relative Difference	Analyst Code
94NU0021-023	1	11/03/03	1.0000	-0.0590	XXX
94NU0021-023	2	11/03/03	1.0003	-0.0290	XXX
94NU0023-079	1	11/03/03	0.9991	-0.0080	XXX
94NU0023-079	2	11/03/03	0.9996	-0.2582	XXX
94NU0021-023	3	11/04/03	1.0022	0.1609	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 bias in IDMS is 0.1%.

International target value for precision in IDMS is 0.15%.

Figure 2 (cont.)



D. ANALYSIS RESULTS AND REPORTING FORMAT, OCT 2004-JUNE 2006

The experimental results submitted by the participating laboratories from October, 2004 through June, 2006 are shown in Appendices A to D, and the results are discussed in Section E. Assay results are discussed first (Sections E.1 to E.4), followed by isotopic abundance results (Sections E.5 and E.6). In these discussions, the laboratories are identified by code letters to maintain confidentiality.

The measurement results were evaluated in terms of the mean % RD and its standard deviation for each material/method/laboratory combination (Tables 5 to 12). The tables also contain the following information: code letter for the participant, the method of analysis, the number of data points (outliers removed), bias target values and precision target values.

The data presented in Tables 5 to 12 are shown graphically in Figures 3 to 18. There are two types of figures: the material-measurement skeletal figures to evaluate bias, and the material-measurement line figures to evaluate precision. In the material-measurement skeletal figures (odd numbers figures between Fig.3 and Fig.18), the mean % RDs are shown as diamonds. The vertical line represents the standard deviation for that set. The bias target values are shown as dotted horizontal lines. If the diamonds (extended by the respective standard deviation of the results) fall within the horizontal lines, then the measurements are said to satisfy the bias target values; those falling outside fail. The magnitude of bias (if any) can be estimated only with reference to the mean % RD and its uncertainty at 95% C.L. No bias is indicated if the mean % RD extended by the uncertainty includes zero. If it fails to include zero, bias is indicated; above zero indicates positive bias and below zero indicates negative bias.

The material-measurement line figures (even number figures between Figure 3 and Figure18) show precisions achieved in the measurements. The vertical line represents the standard deviation associated with each set of mean % RDs. If the top of the vertical line is below the corresponding precision target value - shown as a dotted horizontal line - then the laboratory has satisfied the precision target value. If the vertical line extends beyond the horizontal, then the laboratory has failed the precision criterion. In these figures, the diamonds represent the absolute values of the mean % RDs. The measurements are assumed to be bias-free if the diamonds fall on the abscissa or very close to it. The magnitude of bias can be estimated only with reference to % RD taken in conjunction with 95% C.L. uncertainty.

In Section F, a long-term evaluation is shown in graphical form for uranium assay and isotopic measurement result submitted from October, 2002 through June, 2006. See Figures 19 to 65.

E. PERFORMANCE EVALUATION: MATERIAL BY MATERIAL

The results for uranium assay are given in Sections E.1 to E.4; for uranium isotopic abundance in Section E.5; and for plutonium assay and isotope abundance in Section E.6.

E.1. Uranyl Nitrate Solutions

Test samples of uranyl nitrate solutions were made from both enriched uranium (> 0.7% in ^{235}U) and natural uranium. Three different types of uranyl nitrate solutions were made: one solution from 50% enriched material, three solutions from 90% enriched material, and three solutions from natural uranium. The uranium concentrations of these solutions were in the range of 7 to 10 mg uranium per gram of solution. The uranium contents of the three natural uranium solutions differed from each other by no more than 0.2%. The uranium contents of the three solutions from 90% material also differed from each other by not more than 0.2%. These solutions, with closely-spaced but distinguishably different values for concentrations, are ideal samples to test the analytical skills of a laboratory.

E.1.1. Preparation and Packaging for Shipment

The uranyl nitrate solutions were sent to participating laboratories in flame-sealed glass ampoules with break-off tips. Each ampoule was packed in a plastic bag. The bag was wrapped in absorbent cushioning material and sealed in another large plastic bag. The large bag was then kept inside a screw-cap fiberboard can for shipping.

E.1.2. Reference Value and Uncertainty

NBL used a modified Davies and Gray titration procedure to characterize the uranium concentrations of the test samples in the ampoules. The uncertainties (95% C.L.) in uranium concentrations were as follows: ± 0.1% for the 50% enriched uranium solution, ± 0.02% for the

90% enriched uranium solutions, and in the range of ± 0.02 to ± 0.05% for the natural uranium solutions.

A separate experiment demonstrated that the solutions did not suffer concentration change as a result of flame sealing. Samples withdrawn from sealed ampoules of natural uranium solutions and from the original stock, showed negligible differences between them (the uranium concentrations agreed within a few hundredths of one percent).

E.1.3. Performance Evaluation

The participating laboratories determined the uranium concentrations of the test samples using Davies-Gray titration, isotope dilution mass spectrometry (IDMS), and x-ray fluorescence (XRF). The results, in terms of mean % RDs, are shown in Table 5, along with the target values for each method. The % RDs, along with standard deviations, appear in Fig.3 to evaluate bias and in Fig.4 to evaluate precision. Laboratory B met neither bias nor precision target values for Davies-Gray titration nor for IDMS. All other laboratories satisfied both bias and precision target values.

Table 5. Inter-laboratory performance summary for uranium assay in UNH solutions

Method	Lab code	Mean % RD	Standard deviation	N	ITV (%)#	
					Bias	Precision
Davies-Gray Titration	B	0.243	0.274	34	0.1	0.1
	F	-0.007	0.081	16	0.1	0.1
	G	0.003	0.017	39	0.1	0.1
	V	-0.091	0.070	18	0.1	0.1
IDMS	A	-0.003	0.073	18	0.1	0.15
	B*	-0.715	0.552	32	0.1	0.15
	G*	-0.006	0.054	15	0.1	0.15
X-Ray Fluorescence	A*	-0.148	0.131	16	0.5	0.5

International Target Values are not available for XRF, and therefore DOE target values are shown.

Figure 3

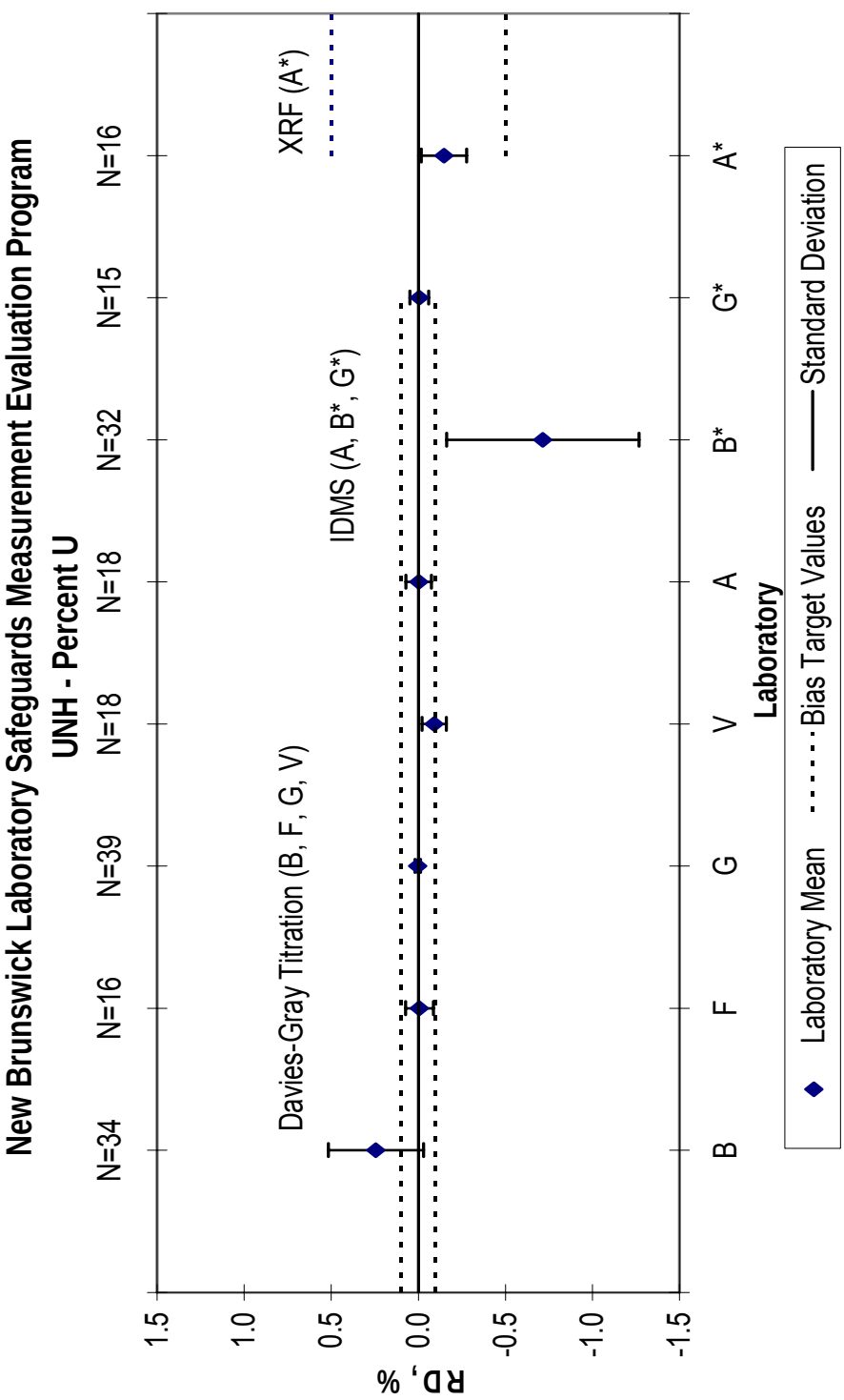
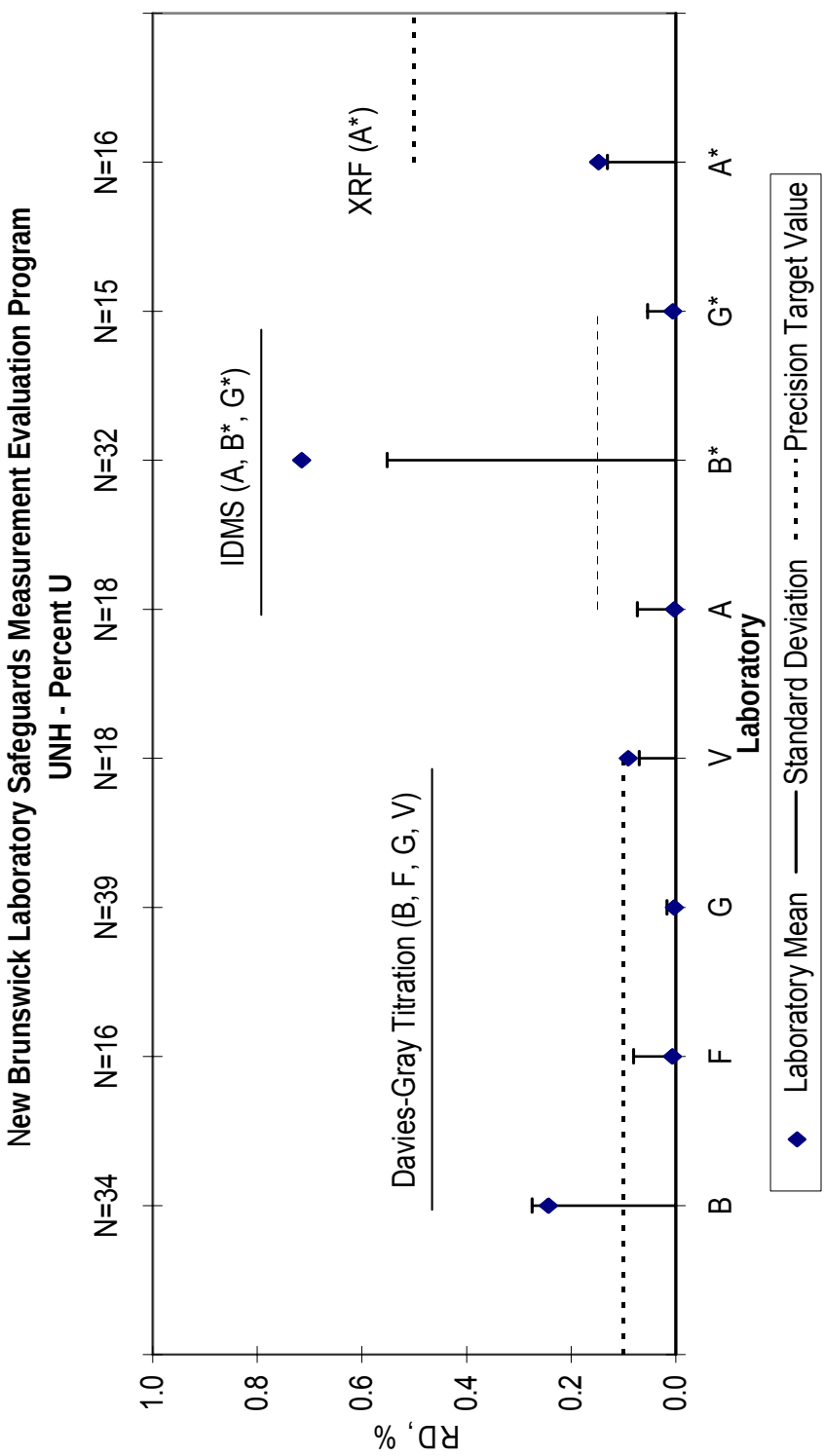

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U
N=34
N=16
N=39
N=18
N=18
N=32
N=15
N=16
Davies-Gray Titration (B, F, G, V)
IDMS (A, B*, G*)
XRF (A*)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
RD, %
B
F
G
V
A
B*
G*
A*
Laboratory
Laboratory Mean
Bias Target Values
Standard Deviation

Figure 4


New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U
N=34
N=16
N=39
N=18
N=18
N=32
N=15
N=16
IDMS (A, B*, G*)
XRF (A*)
Davies-Gray Titration (B, F, G, V)
RD, %
1.0
0.8
0.6
0.4
0.2
0.0
B
F
G
V
A
B*
G*
A*
Laboratory
Laboratory Mean
Standard Deviation
Precision Target Value

E.2. Enriched Uranium Dioxide (UO_2) Pellet

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 served as a test material for both uranium assay and uranium isotopic abundance measurements. The ^{235}U content is about 4.5%.

E.2.1. Preparation and Packaging for Shipment

The UO_2 pellets were wrapped in low-lint tissue to prevent chipping, placed in snap-cap glass bottles, and the bottles sealed in plastic bags. The bottles were shipped in fiberboard cans.

E.2.2. Reference Value and Uncertainty

The elemental uranium concentration of the pellets was determined by the NBL High-Precision Titration method. A uranium metal assay standard was used for quality control and traceability. The uranium concentration was measured with an uncertainty of about ± 0.02% at 95% C.L.

E.2.3. Performance Evaluation

Nine laboratories analyzed the uranium dioxide pellets for uranium concentration using Davies-Gray Titration. The mean of % RDs along with uncertainties are shown in Table 6 along with the target values for each method. The % RDs along with standard deviations are shown in Fig.5 to evaluate bias and in Fig.6 to evaluate precision. Laboratory AC missed the bias criterion. In all other instances, the bias and precisions ITVs were met.

Table 6. Inter-laboratory performance summary for uranium assay in UO_2 Pellets

Method	Lab code	Mean % RD	Standard deviation	N	ITV (%)	
					Bias	Precision
Davies-Gray Titration	AB	-0.028	0.036	12	0.1	0.1
	AC	-0.158	0.031	8	0.1	0.1
	AD	-0.020	0.015	8	0.1	0.1
	AE	-0.001	0.032	8	0.1	0.1
	BA	-0.036	0.073	20	0.1	0.1
	BC	-0.077	0.065	20	0.1	0.1
	BF	-0.016	0.040	14	0.1	0.1
	T	0.038	0.069	16	0.1	0.1
	V	-0.055	0.052	18	0.1	0.1

Figure 5

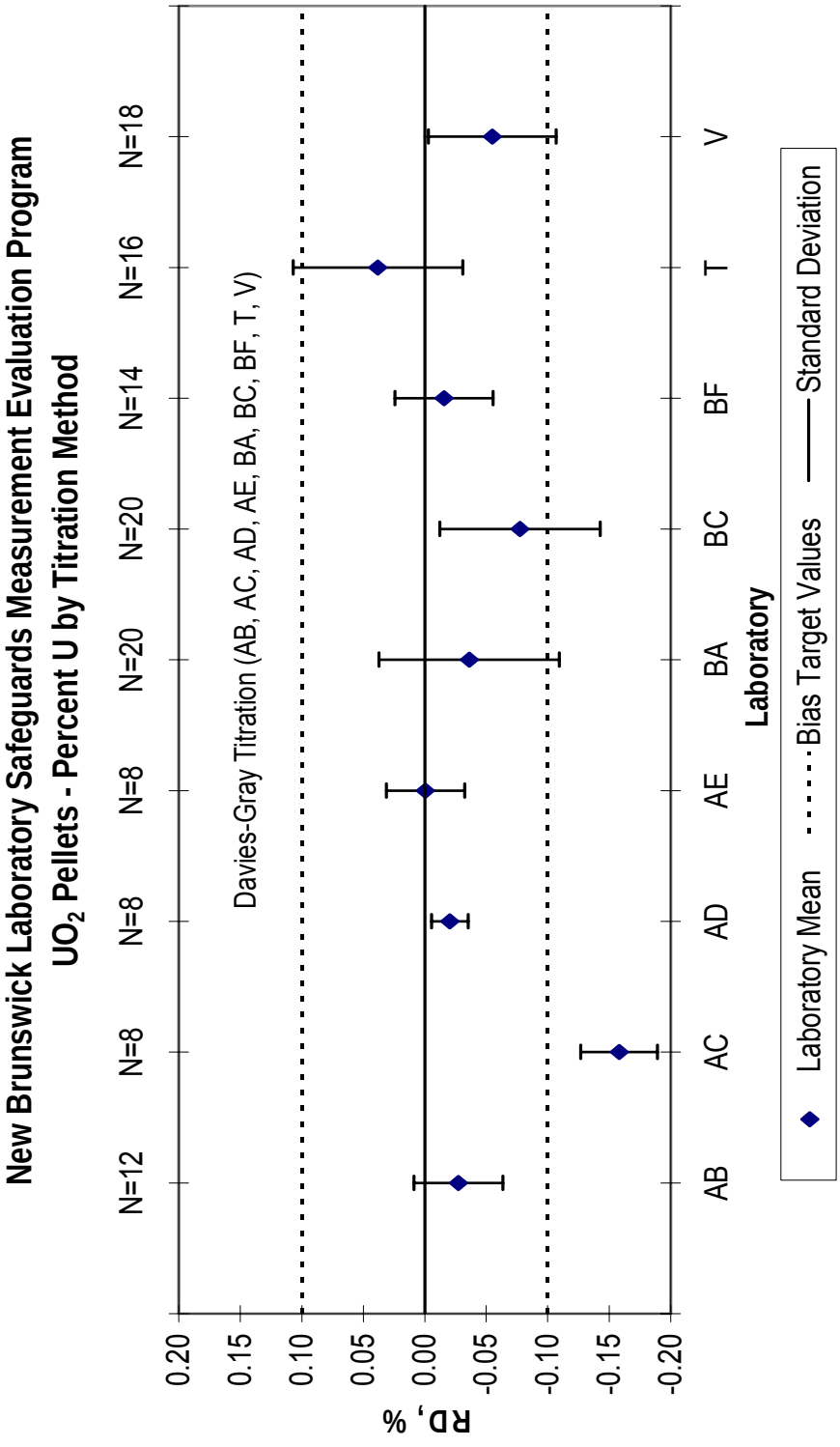
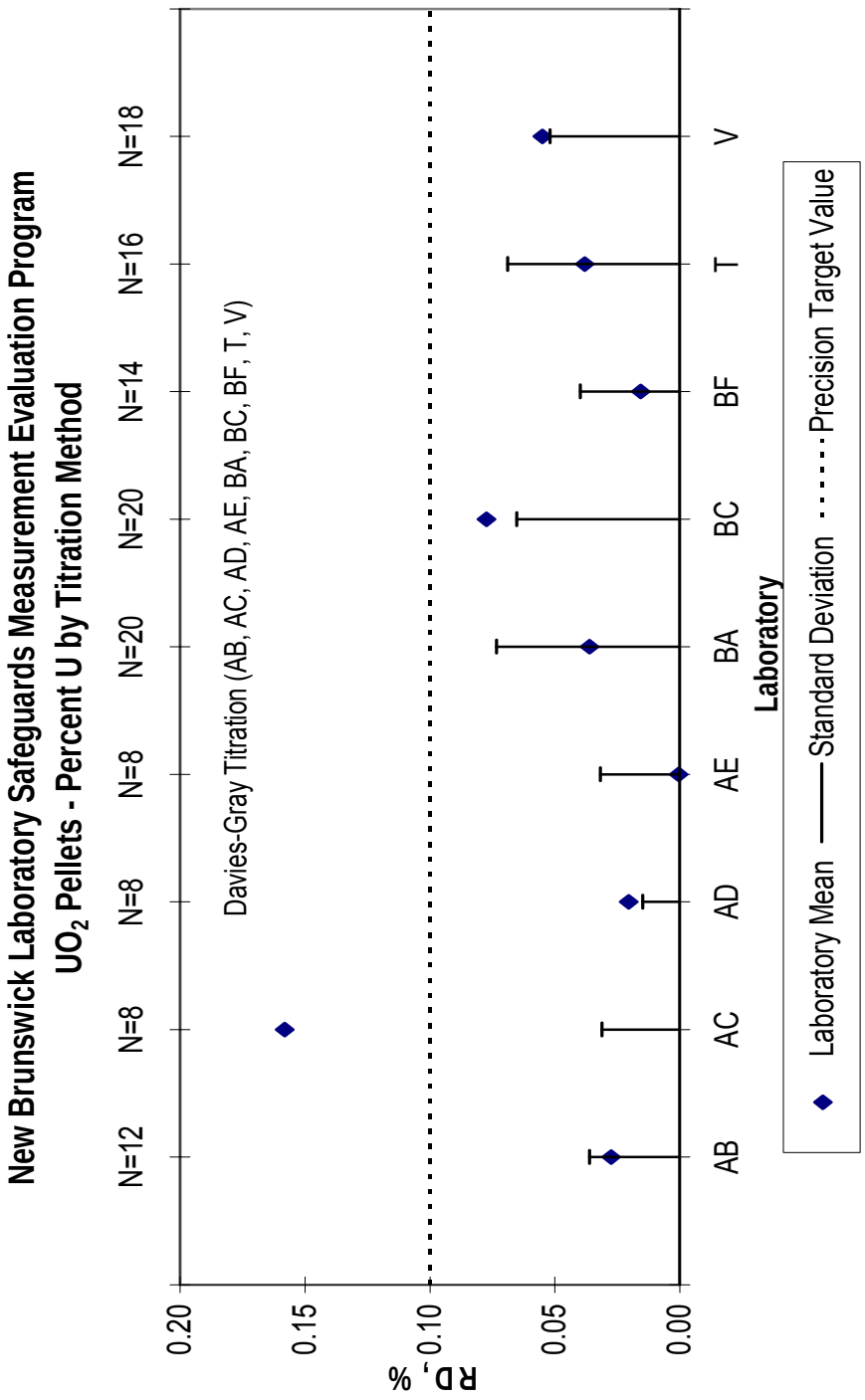

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO2 Pellets - Percent U by Titration Method
Davies-Gray Titration (AB, AC, AD, AE, BA, BC, BF, T, V)
N=12
N=8
N=8
N=8
N=20
N=20
N=14
N=16
N=18
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
RD, %
AB
AC
AD
AE
BA
BC
BF
T
V
Laboratory
Laboratory Mean
Bias Target Values
Standard Deviation

Figure 6


New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO2 Pellets - Percent U by Titration Method
Davies-Gray Titration (AB, AC, AD, AE, BA, BC, BF, T, V)
N=12
N=8
N=8
N=8
N=20
N=20
N=14
N=16
N=18
0.20
0.15
0.10
0.05
0.00
RD, %
AB
AC
AD
AE
BA
BC
BF
T
V
Laboratory
Laboratory Mean
Standard Deviation
Precision Target Value

E.3. Uranium Hexafluoride (UF_6)

In FY 1993, Portsmouth Gaseous Diffusion Plant donated two sampling manifolds to NBL for transferring UF_6 from 2S cylinders to P-10 tubes. One of the two manifolds was used to transfer natural UF_6, and the other for enriched material. These manifolds have been taken out of service. Now, NBL is relying on Portsmouth Gaseous Diffusion facility for the preparation of SME test samples. Portsmouth uses UF_6 material in its custody, but belonging to NBL, for making SME test samples.

E.3.1. Preparation and Packaging for Shipment

The Portsmouth Gaseous Diffusion facility prepared and packaged UF_6 test samples in P-10 tubes. Each test sample contained 7 to 12 g of UF_6 and is about 4% enriched.

E.3.2. Reference Value and Uncertainty

The UF_6 test samples used in the SME Program since October, 2004 were not characterized for assay because of the "stand down" of laboratory activities at NBL. Calculated values (based upon the assumption of 100% purity) were used instead. Characterized isotopic values were based upon Portsmouth data which were verified at NBL using gas source mass spectrometry (GSMS).

E.3.3. Performance Evaluation

From October 2004 to June 2006, three laboratories reported results for uranium assay in UF_6 using Davies-Gray Titration. The mean of % RDs along with uncertainties are shown in Table 7 along with the target values for each method. The % RDs along with standard deviations are shown in Fig.7 to evaluate bias and in Fig.8 to evaluate precision. Laboratory AB missed the bias target value. Laboratory AE missed the precision target values. Laboratory V met both bias and precision target values.

Table 7. Inter-laboratory performance summary for uranium assay in UF_6

Method	Lab code	Mean % RD	Standard deviation	N	ITV (%)	
					Bias	Precision
Davies-Gray Titration	AB	-0.269	0.048	12	0.1	0.1
	AE	-0.089	0.207	8	0.1	0.1
	V	-0.034	0.060	18	0.1	0.1

Figure 7

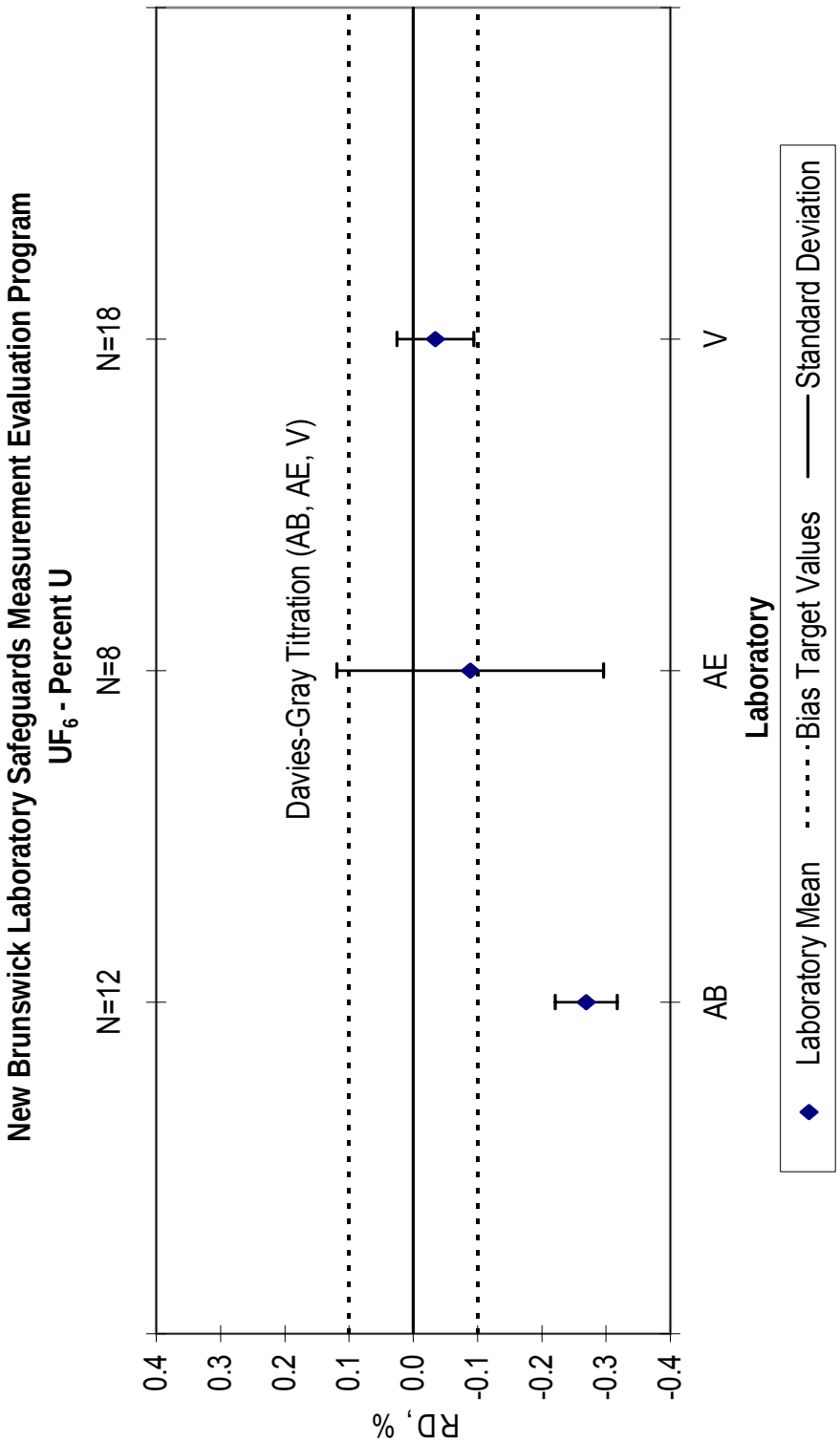
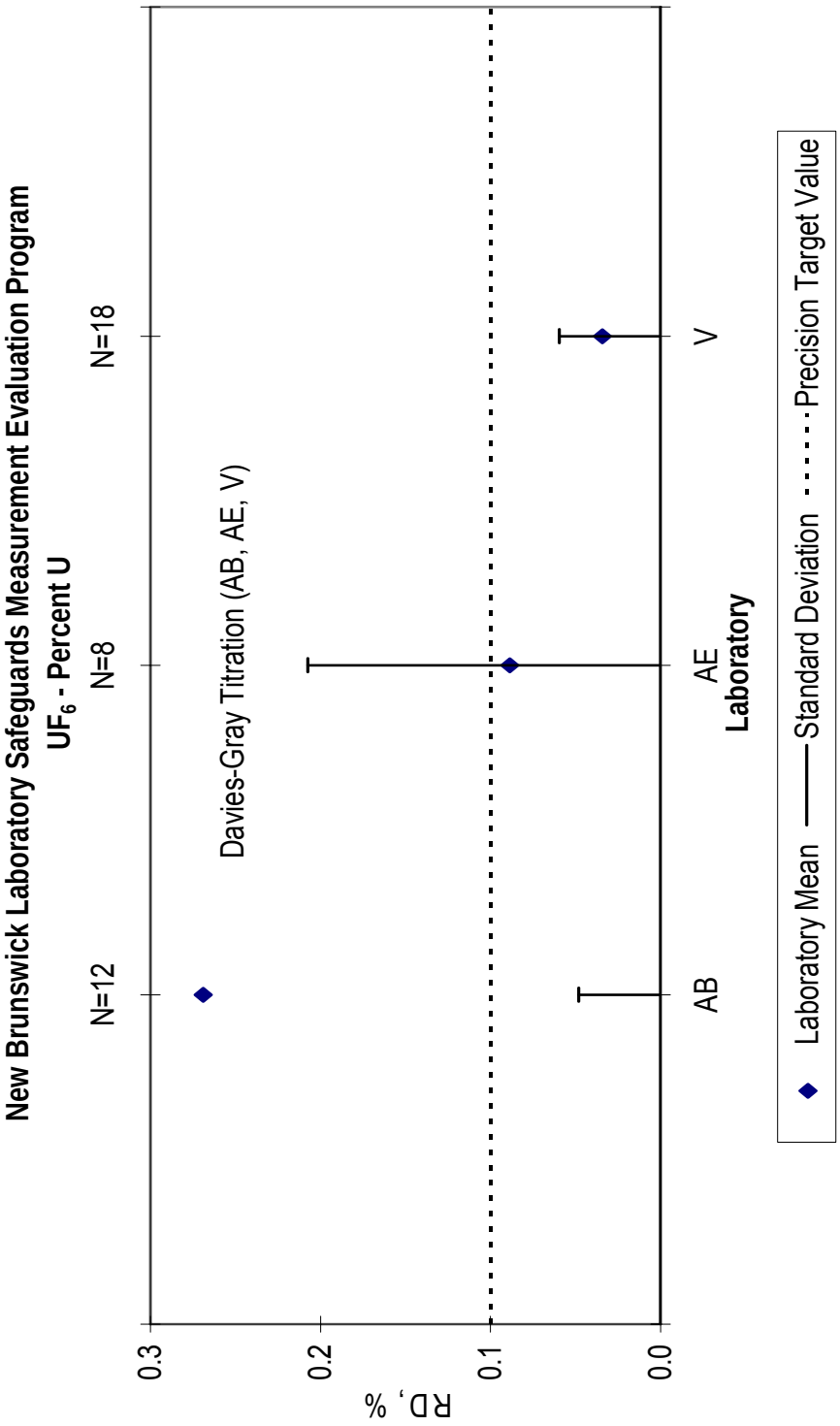

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UF6 - Percent U
Davies-Gray Titration (AB, AE, V)
N=12
N=8
N=18
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
RD, %
AB
AE
V
Laboratory
Laboratory Mean
Bias Target Values
Standard Deviation

Figure 8


New Brunswick Laboratory Safeguards Measurement Evaluation Program
UF6 - Percent U
Davies-Gray Titration (AB, AE, V)
N=12
N=8
N=18
RD, %
0.3
0.2
0.1
0.0
AB
AE
V
Laboratory
Laboratory Mean
Standard Deviation
Precision Target Value

E.4. Uranium Trioxide (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 for a number of years in the past and it was discontinued for some time because of a lack of interest in this material. UO_3 powder was re-introduced as a test material in 2001 at the request of Laboratory A. Three different laboratories analyzed UO_3 powder in the current reporting period.

E.4.1. Preparation and Packaging for Shipment

The test samples come from preparations done several years ago. The samples were packaged into pharmaceutical vials with Teflon-lined stoppers, under dry nitrogen atmosphere. The vials were crimp sealed, then sealed in plastic, and packaged in cardboard tubes for shipping.

E.4.2. Reference Value and Uncertainty

The elemental concentration of uranium in UO_3 material was characterized through analysis of 8 different samples using the NBL-modified Davies and Gray titration method. Quality control and traceability were provided through analysis of a uranium metal assay standard. The uranium content of the test samples differed from the original value by about 0.064%, the new value being lower. The uncertainty (95% C.L.) in the new measurements was 0.012%. Apparently, the concentration of uranium in the UO_3 material was not altered to a significant extent. The newly determined uranium value was used as the characterized value in the program through June, 2006.

E.4.3. Performance Evaluation

Laboratory A analyzed the UO_3 test samples for uranium concentration by isotope dilution mass spectrometry (IDMS), liquid x-ray fluorescence (XRF-L), and solid x-ray fluorescence (XRF-S); Laboratory B used IDMS; and Laboratory V used the Davies-Gray method. The mean % RDs are shown in Table 8, along with the standard deviations and the target values for each method. The mean % RDs and the standard deviations are shown in Fig.9 to evaluate bias and in Fig.10 to evaluate precision. Laboratory A satisfactorily met the bias as well as precision target values for IDMS, XRF-L, and XRF-S. Laboratory B missed the bias and precision targets for IDMS. Laboratory V met both bias and precision target values for Davies-Gray titration. Laboratory A

reported that the sample integrity in some of the samples might have been compromised—a conclusion based upon the observation of clumping (indicative of moisture uptake) in the samples. Visual observation of NBL samples in stock did not show evidence of moisture uptake. This conclusion will be verified through laboratory analysis during the second half of 2006, when NBL uranium laboratory operations are expected to become fully operational.

Table 8. Inter-laboratory performance summary of uranium assay in UO_3

Method	Lab code	Mean % RD	Standard deviation	N	ITV (%)#	
					Bias	Precision
Davies-Gray Titration	V	-0.082	0.035	17	0.1	0.1
IDMS	A	-0.039	0.109	28	0.1	0.15
	B	-0.600	0.433	8	0.1	0.15
XRF-L	A*	-0.307	0.264	24	0.5	0.5
XRF-S	A**	-0.438	0.289	24	0.5	0.5

ITVs are not available for XRF methods; DOE values were used instead.

Figure 9

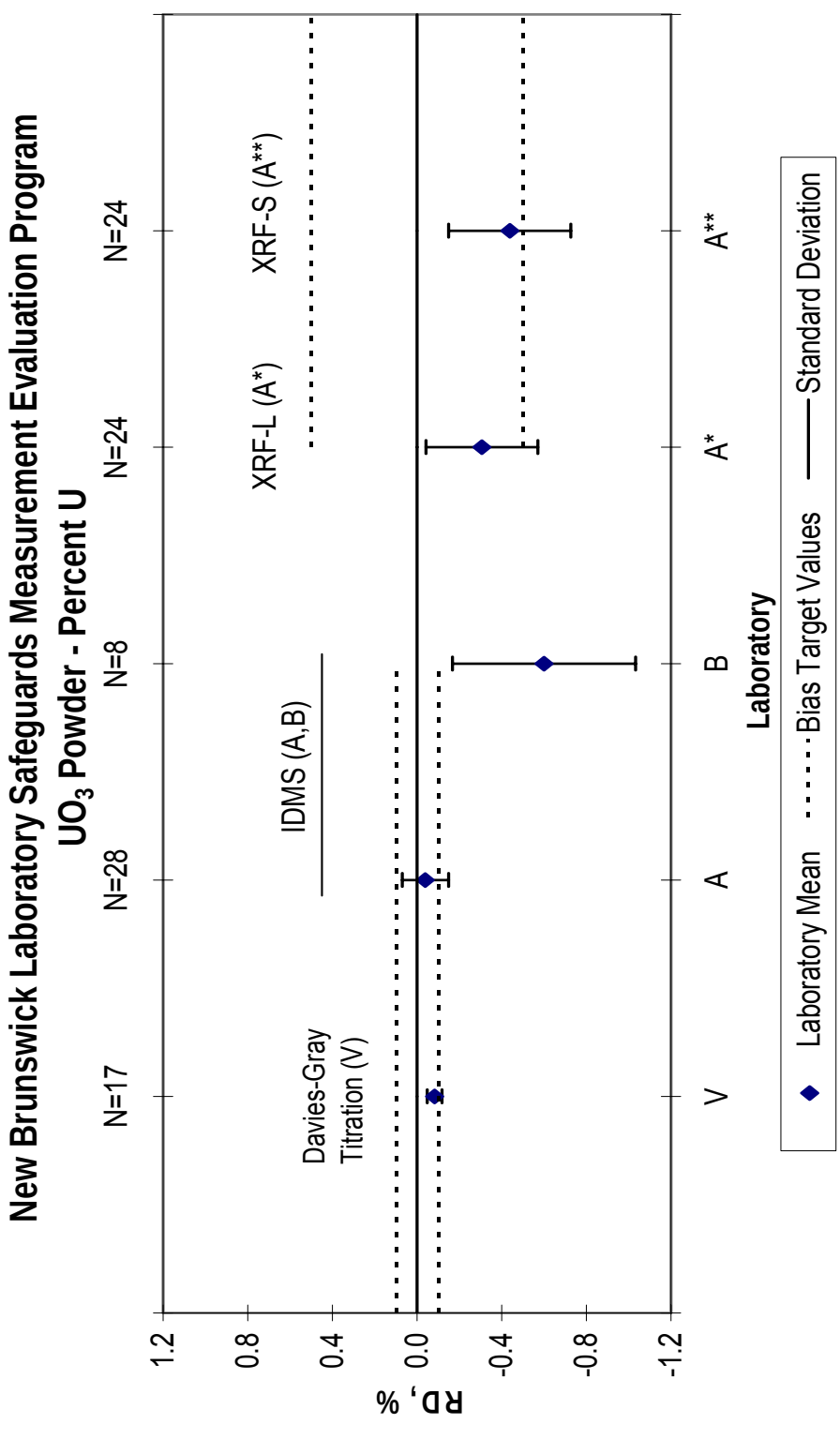
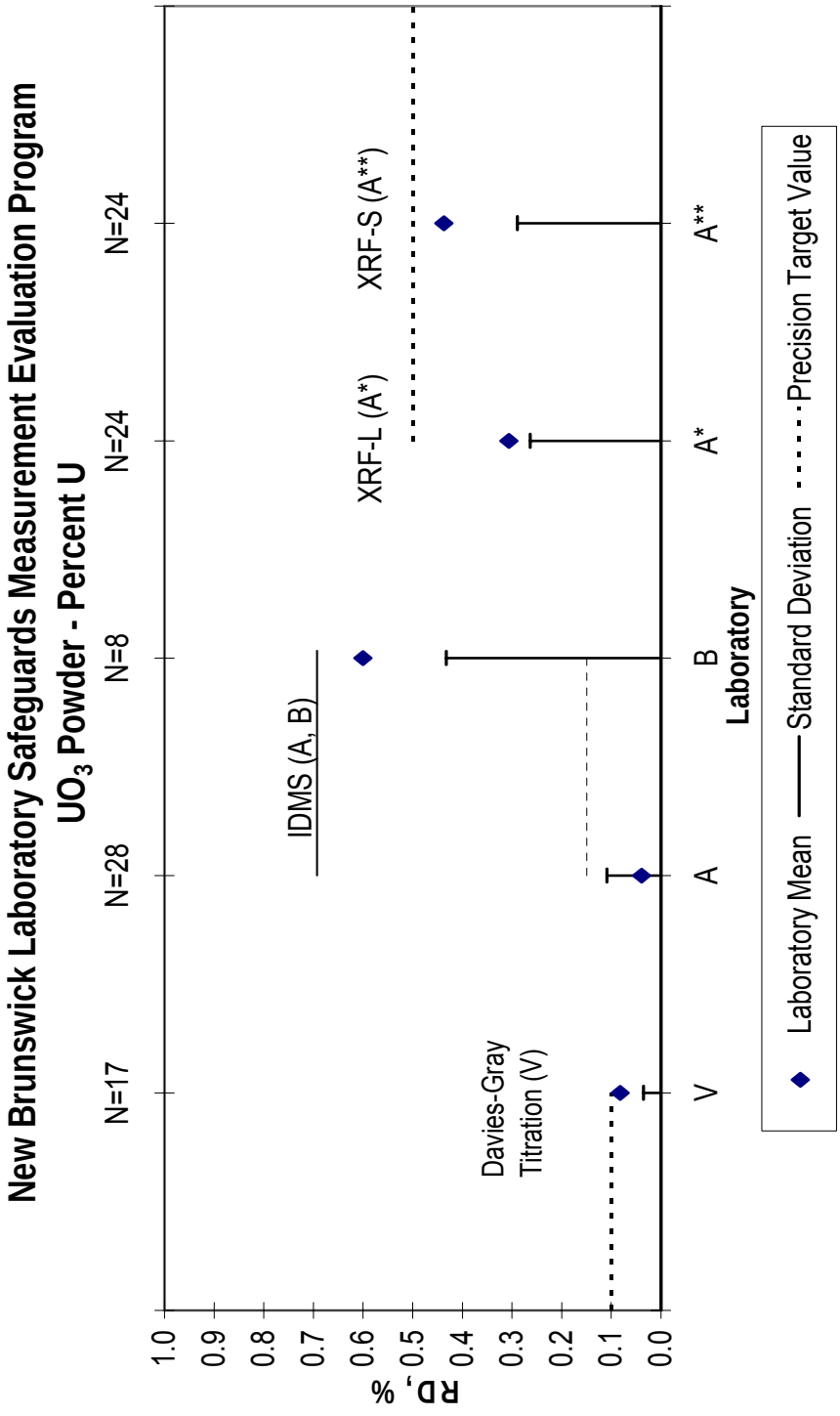

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO_3 Powder - Percent U
N=17
N=28
N=8
N=24
N=24
Davies-Gray Titration (V)
IDMS (A,B)
XRF-L (A*)
XRF-S (A**)
1.2
0.8
0.4
0.0
-0.4
-0.8
-1.2
RD, %
V
A
B
A*
A**
Laboratory
Laboratory Mean
Bias Target Values
Standard Deviation

Figure 10


New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO_3 Powder - Percent U
N=17
N=28
N=8
N=24
N=24
IDMS (A, B)
XRF-L (A*)
XRF-S (A**)
Davies-Gray
Titration (V)
RD, %
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
V
A
B
A*
A**
Laboratory
Laboratory Mean
Standard Deviation
Precision Target Value

E.5. ^{235}U Enrichment

A suite of enriched uranium test samples are available for evaluating isotopic abundance results. Highly-Enriched Uranium (HEU) test samples include three uranyl nitrate solutions with 90% enrichment, and one uranyl nitrate solution with 50% enrichment. Low-Enriched Uranium (LEU) samples comprise one uranyl nitrate solution with 4% enrichment, solid UO_2 pellets of about 4% enrichment, and a UF_6 solid of about 4.5% enrichment.

E.5.1. Preparation and Packaging for Shipment

The uranyl nitrate solutions were packaged in flame-sealed glass ampoules with a break-off tip. The ampoules were sealed in plastic, wrapped in absorbent cushioning, sealed in plastic again, and packaged in cardboard tubes for shipping. Each solution contained 5-10 mg uranium/g solution.

The UO_2 pellets were packaged in a snap-cap glass bottle with a low-lint tissue for cushioning to prevent chipping. The glass bottles are sealed in plastic, and packaged in cardboard tubes for shipping.

The UF_6 test samples in P-10 tubes were packed in sealed plastic bags and shipped in cardboard containers with screw caps.

E.5.2. Reference Value and Uncertainty

The uranium isotopic abundances in the UNH, UO_2, and UO_3 test materials were characterized by thermal ionization mass spectrometry (TIMS). The experimental results were corrected for mass fractionation effects. The correction factors were determined through analyses of appropriate Certified Reference Materials performed under the same conditions as the test materials

UF_6 material was characterized by TIMS and/or gas source mass spectrometry (GSMS). The TIMS measurements required hydrolyzed UF_6 samples. GSMS measurements were performed directly.

The uncertainties (95% C.L.) in ^{235}U abundance by TIMS were as follows: 0.02% for the 4% enriched uranyl nitrate solution; < 0.01% for the 50% and 90% enriched solutions; 0.07% for UO_2

pellets; and 0.053% for UF_6. The uncertainties for the uranyl nitrate solutions did not include the uncertainties in determining the mass fractionation correction factors, whereas the uncertainties in UO_2 and UF_6 included mass fractionation correction factor uncertainties.

E.5.3. Performance Evaluation

The mean % RDs are shown in Table 9 for HEU materials (≥ 20% enriched), and in Table 10 for LEU materials (<20% enriched). Target values are also shown in the tables; the HEU target values are more stringent than those for LEU.

Three laboratories analyzed the HEU samples via thermal ionization mass spectrometry (TIMS). The % RDs along with standard deviations are shown in Fig.11 to evaluate bias and in Fig.12 to evaluate precision. All three laboratories were able to measure ^{235}U abundance within bias and precision target values.

Eight laboratories analyzed the LEU samples: five laboratories (AA, B, G, T and V) used TIMS; one laboratory (BC) analyzed LEU samples by both TIMS and GSMS; two laboratories (AF and BE) used inductively coupled plasma mass spectrometry (ICPMS). The mean % RDs along with standard deviations are shown in Figure 13 to evaluate bias and in Figure 14 to evaluate precision.

Analysis by TIMS: Laboratories AA and B exceeded the bias and precision target values for TIMS. Figure 58 shows that Laboratory B generally had good measurement results except for one report (which was based on eight isotopic measurements of a UO_3 powder where the mean % RD was 1.286, and the standard deviation was 0.095). Ignoring these eight aberrant measurements, Laboratory B had a mean % RD of -0.026 and a standard deviation of 0.146; all of these measurements were made on UNH solutions. The mean % RD was within the ITV for bias, but exceeded the ITV for precision. The other four laboratories (BC, G, T and V) were able to perform analysis within the ITVs.

Analysis by GSMS: Laboratory BC missed the bias and precision ITVs.

Analysis by ICPMS: The two laboratories missed the bias and precision ITVs prescribed for TIMS. Note that ITVs are not available for ICPMS.

Table 9. Inter-laboratory performance summary for ^{235}U enrichment in HEU

Method	Lab code	Mean % RD	Standard deviation	N	ITV (%)	
					Bias	Precision
TIMS	A	-0.004	0.017	16	0.05	0.05
	B	0.004	0.018	28	0.05	0.05
	G	0.014	0.019	12	0.05	0.05

Table 10. Inter-laboratory performance summary for ^{235}U enrichment in LEU

Method	Lab code	Mean % RD	Standard deviation	N	ITV (%)	
					Bias	Precision
TIMS	AA	0.116	0.129	20	0.1	0.1
	B	0.265	0.569	36	0.1	0.1
	BC	-0.005	0.060	8	0.1	0.1
	G	0.058	0.022	4	0.1	0.1
	T	0.035	0.026	16	0.1	0.1
	V	0.000	0.051	54	0.1	0.1
GSMS	BC*	0.093	0.121	8	0.05	0.05
ICPMS	AF	-0.380	0.308	8	NA	NA
	BE	0.980	0.462	12	NA	NA

#ITVs were not available for ICPMS.

Figure 11

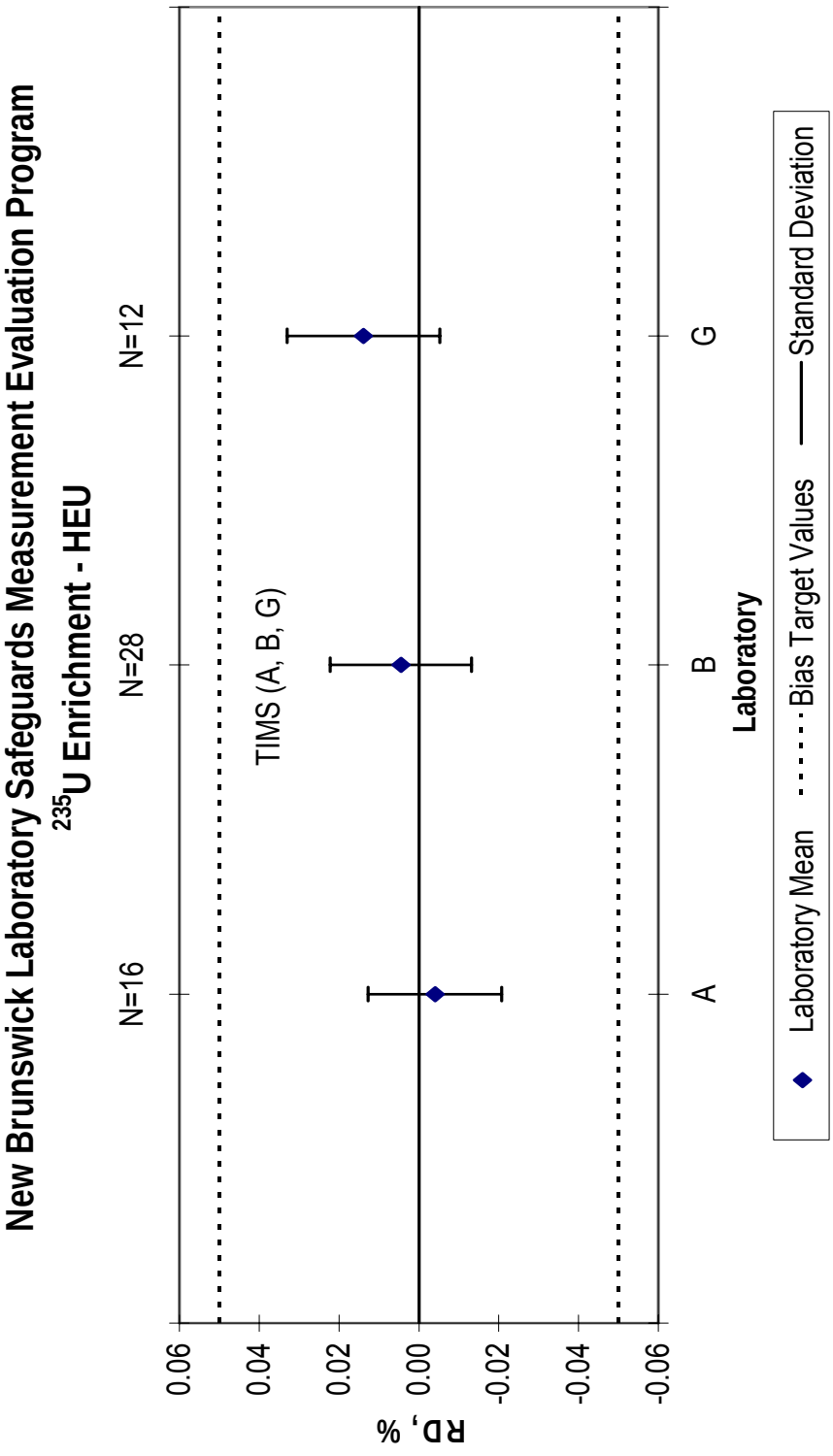

New Brunswick Laboratory Safeguards Measurement Evaluation Program
235U Enrichment - HEU
N=16
N=28
N=12
TIMS (A, B, G)
RD, %
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
A
B
G
Laboratory
Laboratory Mean
Bias Target Values
Standard Deviation

Figure 12

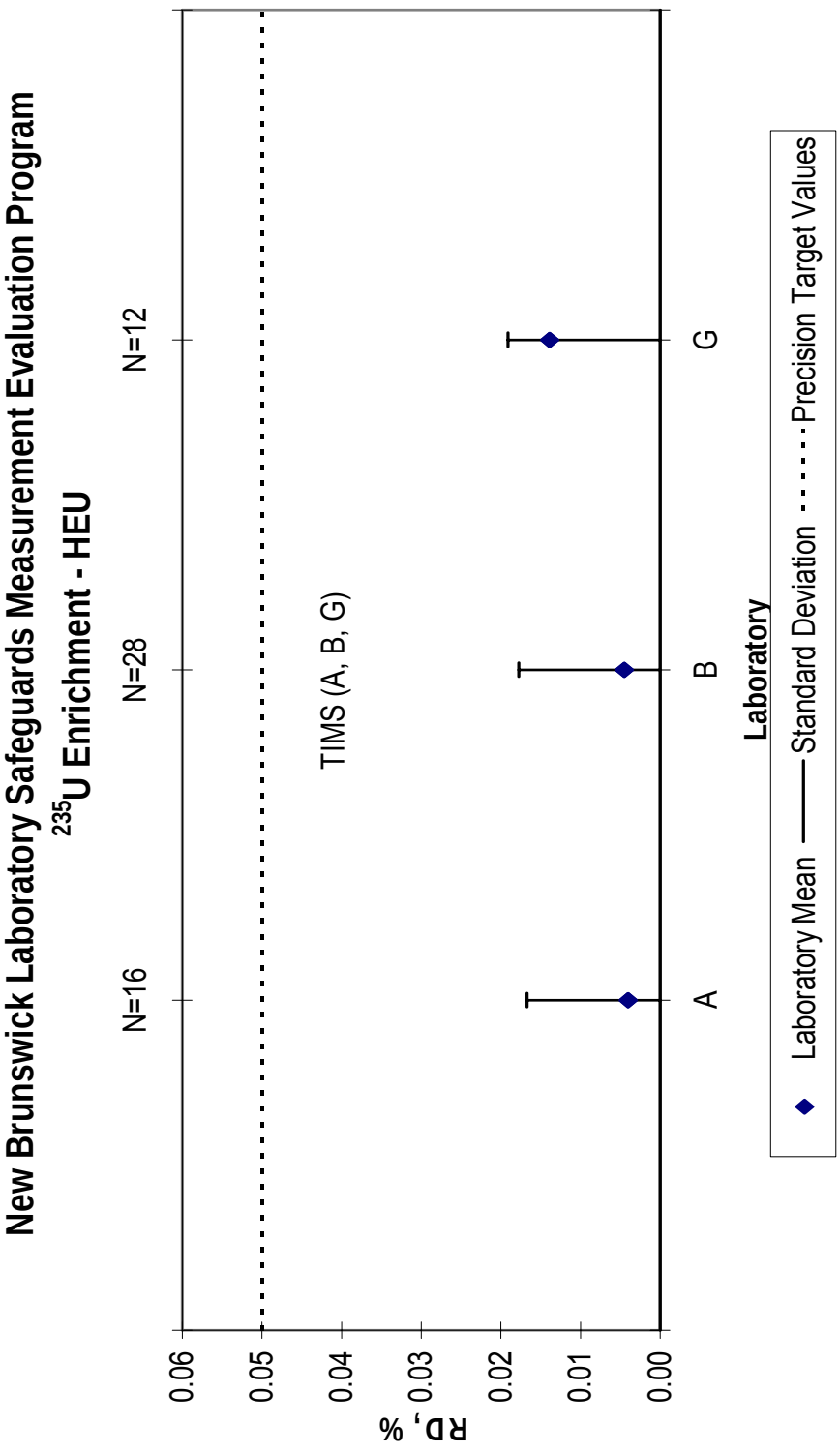

New Brunswick Laboratory Safeguards Measurement Evaluation Program
235U Enrichment - HEU
TIMS (A, B, G)
N=16
N=28
N=12
RD, %
0.06
0.05
0.04
0.03
0.02
0.01
0.00
A
B
G
Laboratory
Laboratory Mean
Standard Deviation
Precision Target Values

Figure 13

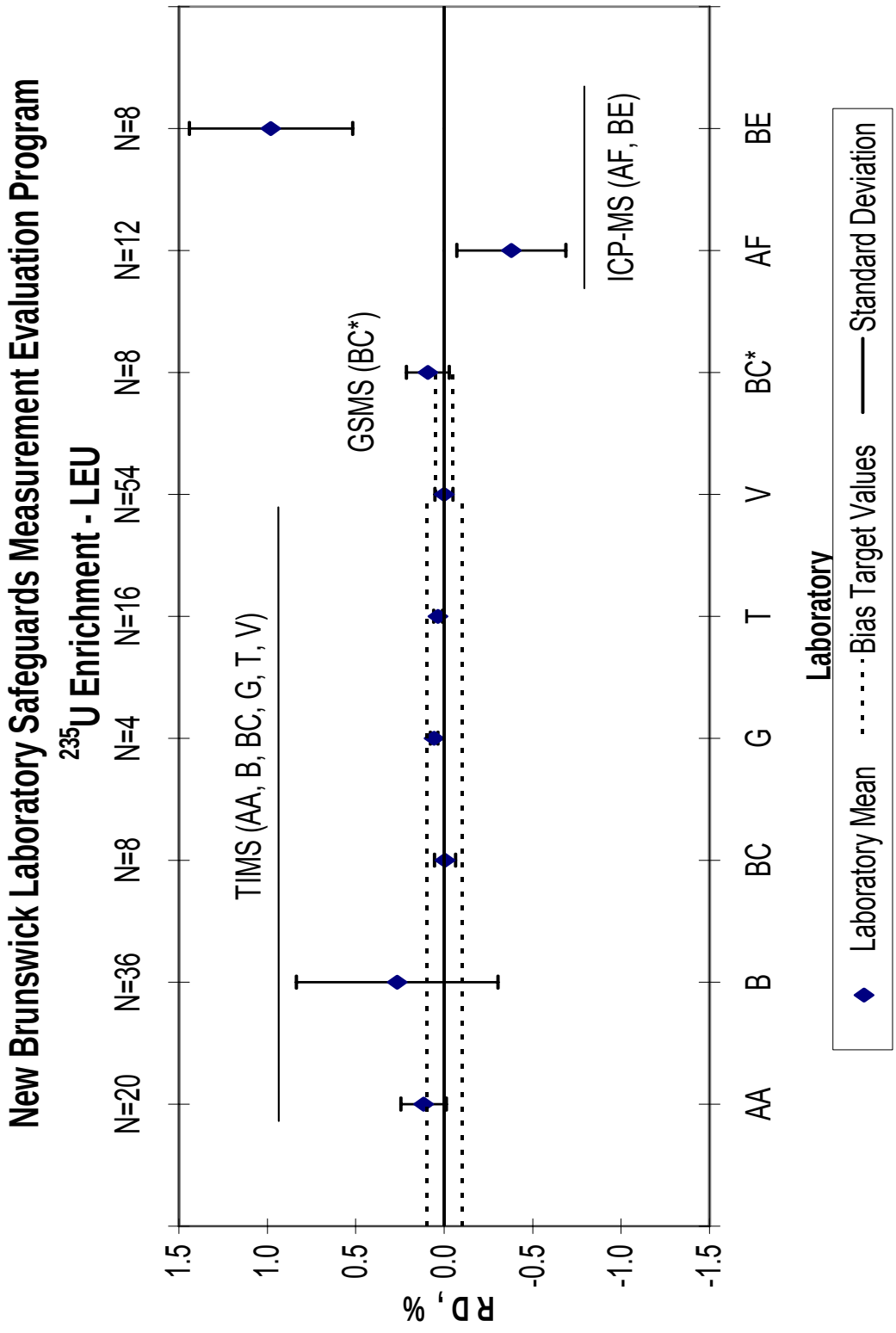
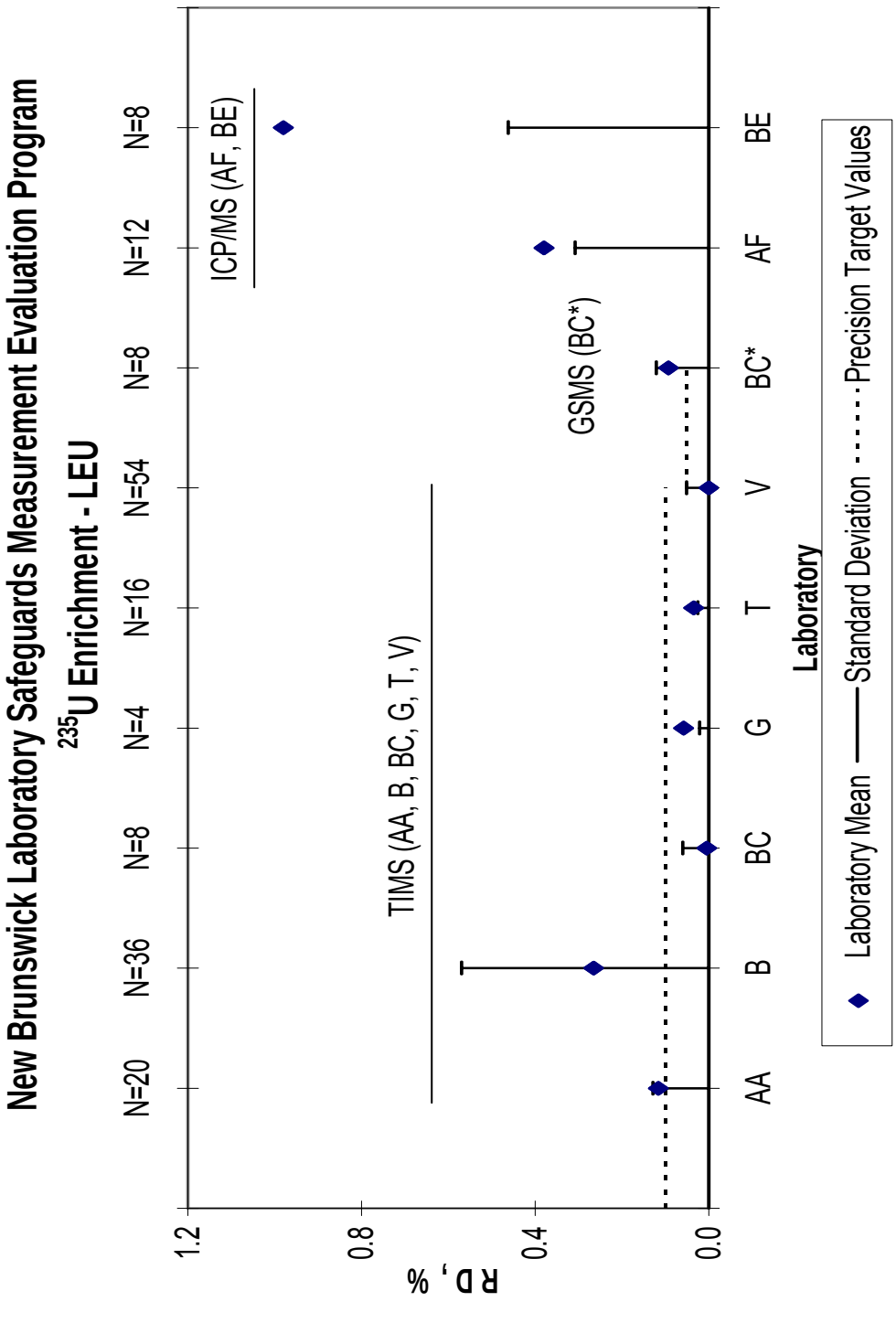

New Brunswick Laboratory Safeguards Measurement Evaluation Program
235U Enrichment - LEU
N=20
N=36
N=8
N=4
N=16
N=54
N=8
N=12
N=8
AA
B
BC
G
T
V
BC*
AF
BE
TIMS (AA, B, BC, G, T, V)
GSMS (BC*)
ICP-MS (AF, BE)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
RD, %
Laboratory
Laboratory Mean
Bias Target Values
Standard Deviation

Figure 14


New Brunswick Laboratory Safeguards Measurement Evaluation Program
235U Enrichment - LEU
N=20
N=36
N=8
N=4
N=16
N=54
N=8
N=12
N=8
ICP/MS (AF, BE)
GSMS (BC*)
TIMS (AA, B, BC, G, T, V)
1.2
0.8
0.4
0.0
RD, %
AA
B
BC
G
T
V
BC*
AF
BE
Laboratory
Laboratory Mean
Standard Deviation
Precision Target Values

E.6. Plutonium Assay and Isotopic Abundance

Test materials for plutonium assay came from two different Certified Reference Materials (CRMs). The CRMs were dissolved, and diluted to the required concentrations using 8M nitric acid. Aliquants containing approximately 20 and 40 micrograms of plutonium were placed in glass bottles and fumed to dryness in the presence of sulfuric acid.

Plutonium isotopic abundance test samples were prepared from three different CRMs. The CRMs were dissolved and diluted to the required concentration using 8M nitric acid. Each aliquant of the test material containing about one milligram of plutonium was placed in a glass bottle and fumed to dryness in the presence of sulfuric acid. The dried test samples were sent to participants without further purification. Note that the samples contain small amounts of isobaric nuclides (^{238}U and ^{241}Am) as impurities that may interfere in plutonium isotopic abundance determination, if not purified prior to analysis.

E.6.1. Preparation and Packaging for Shipment

The plutonium assay samples were contained in glass bottles (20 mL scintillation vials) to facilitate direct addition of isotope dilution mass spectrometry (IDMS) spikes into the test materials. The isotopic test samples were also in the same type of glass bottles. The bottles were placed in a plastic bag, heat sealed; these were again sealed in another plastic bag. The samples were shipped in fiberboard cans.

Pu samples could not be shipped during the past year because of the “stand down” of Pu laboratory operations at NBL. The results reported for the present report were for samples shipped the previous year.

E.6.2. Reference Value and Uncertainty

The characterized values for plutonium concentrations in the test samples were calculated from the certified values for plutonium assay and the masses of reference materials dissolved to make the test solutions. The uncertainties (95% C.L.) were 0.02% for one CRM, and 0.04% for another CRM.

Test samples with a higher abundance of ^{239}Pu (and lower ^{240}Pu) are called “low burn-up” materials, and test samples with alower abundance of ^{239}Pu (and higher ^{240}Pu) are called “high burn-up” materials. The characterized values for plutonium isotopic abundance in the test samples were assumed to be the same as those in the certificates, with appropriate corrections for radioactive decay. The uncertainties (95% C.L.) in the characterized values were assumed to be the same as those reported in the respective certificates. The ranges of isotopic abundance of plutonium nuclides in the three test materials were as follows: ^{238}Pu from 0.05% to 0.25%; ^{239}Pu from 78% to 88%; ^{240}Pu from 12% to 19%; ^{241}Pu from 0.05% to 1.3%; and ^{242}Pu from 0.2% to 1.2%.

E.6.3. Performance Evaluation

No laboratories participated in plutonium assay measurements during the report period, because plutonium test samples could not be sent to participants because of the “stand down” of plutonium laboratory operations. Only one laboratory analyzed test samples for plutonium isotopic abundance using TIMS; the test samples were left-over materials from the previous year. Results for the two major isotopes, ^{239}Pu and ^{240}Pu, were evaluated.

E.6.3.1. ^{239}Pu Abundance

One laboratory (Laboratory G) analyzed low-burnup test samples for isotopic abundance. The mean % RD and standard deviation for the ^{239}Pu measurements are shown in Table 11, together with the target values. The target values for low burn-up samples are more stringent than those for the high burn-up samples. The % RD and standard deviation for ^{239}Pu abundance measurements are shown in Fig.15 to evaluate bias, and again in Fig.16 to evaluate precision. In both figures, the target values corresponding to low burn-up material only are shown. Laboratory G satisfied both bias and precision target values.

Table 11. Inter-laboratory performance summary for ^{239}Pu Abundance in dried plutonium sulfate

Method	Lab code	Mean % RD	Standard deviation	N	Bias ITV (%)		Precision ITV (%)	
					High Burn-up	Low Burn-up	High Burn-up	Low Burn-up
TIMS	G	-0.001	0.003	26	0.04	0.01	0.06	0.01

Figure 15

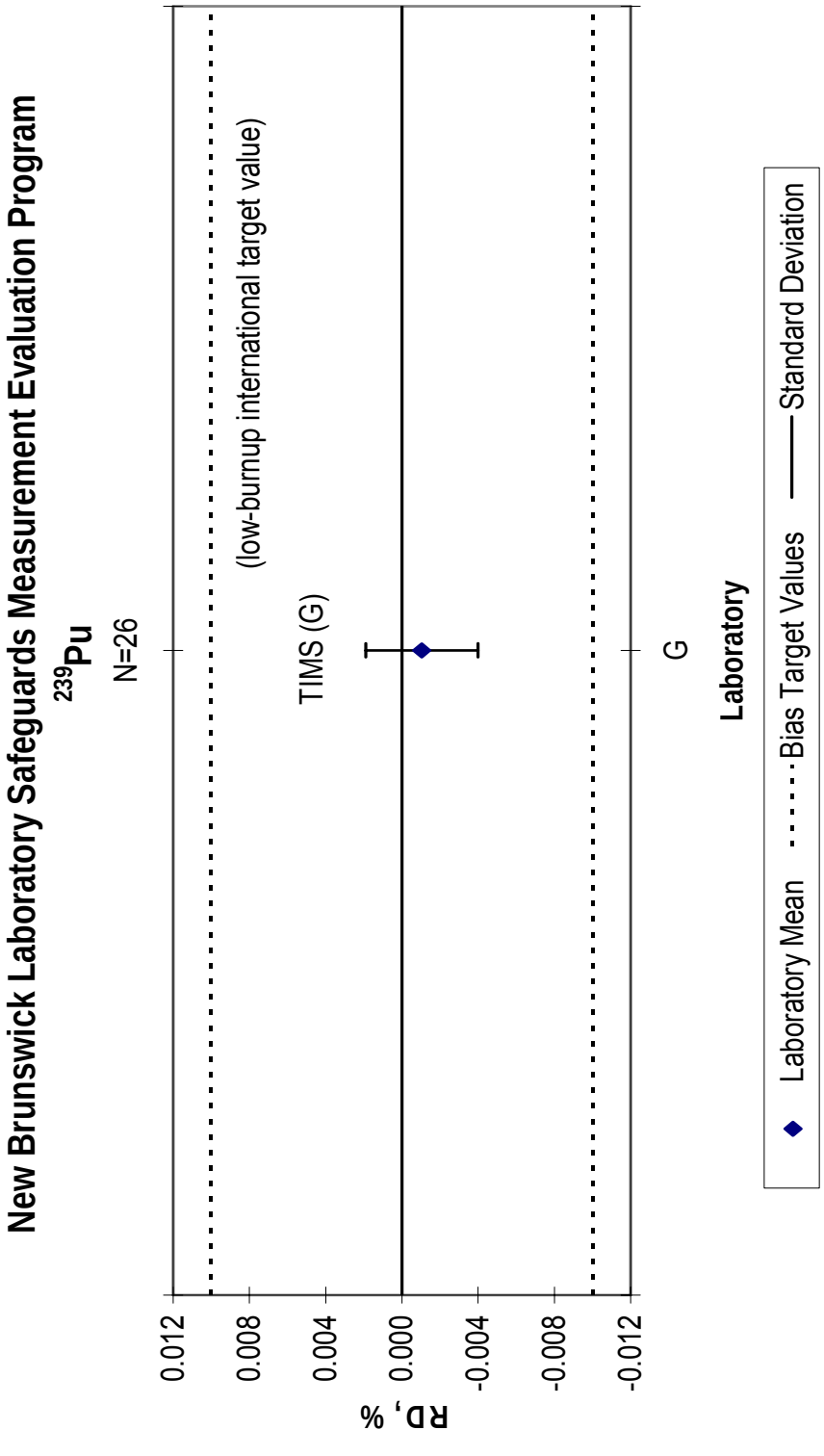
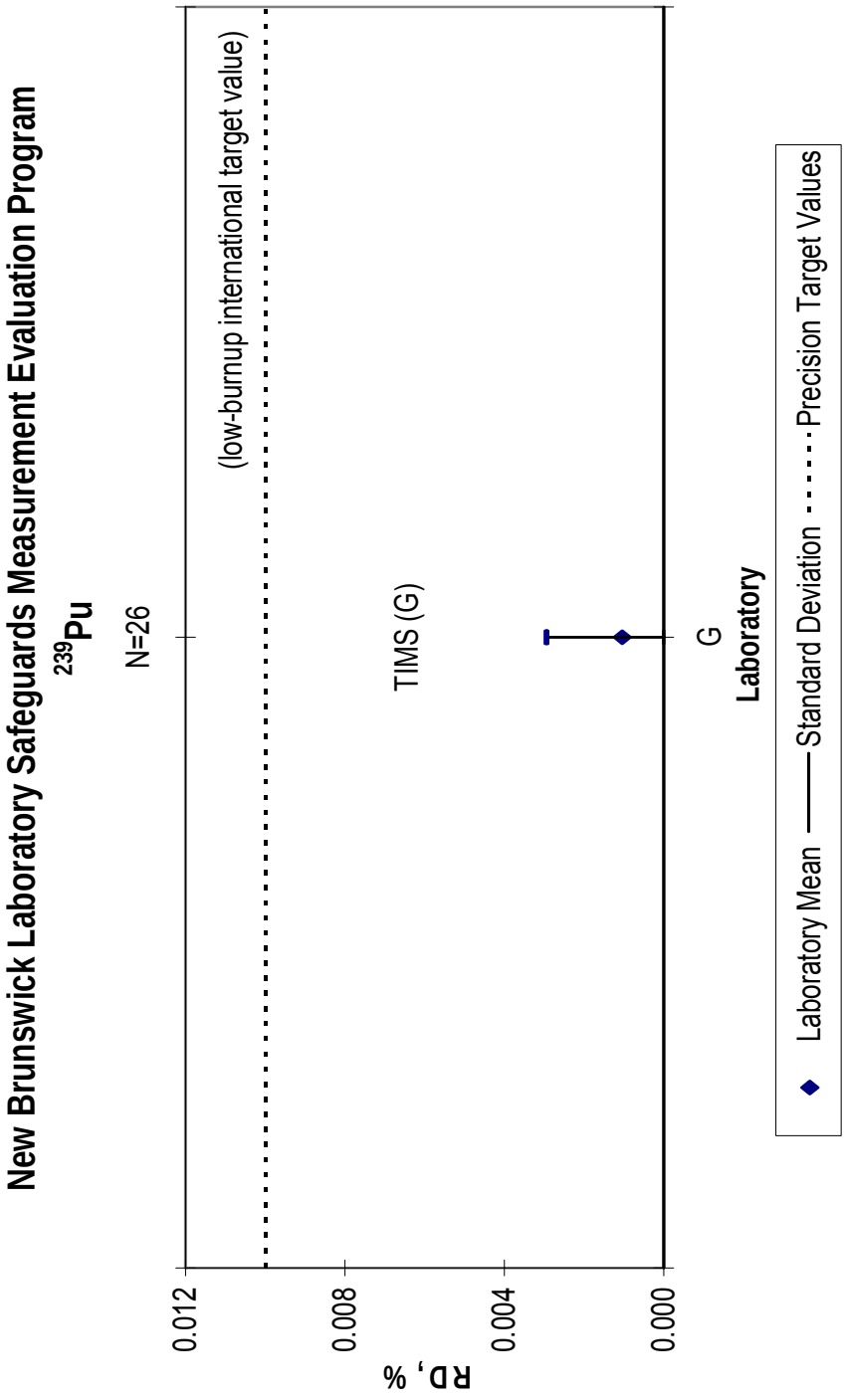

New Brunswick Laboratory Safeguards Measurement Evaluation Program
239Pu
N=26
(low-burnup international target value)
TIMS (G)
G
Laboratory
RD, %
0.012
0.008
0.004
0.000
-0.004
-0.008
-0.012
Laboratory Mean
Bias Target Values
Standard Deviation

Figure 16


New Brunswick Laboratory Safeguards Measurement Evaluation Program
239Pu
N=26
(low-burnup international target value)
TIMS (G)
G
Laboratory
RD, %
0.012
0.008
0.004
0.000
Laboratory Mean
Standard Deviation
Precision Target Values

E.6.3.2. ^{240}Pu Abundance

The mean % RD and standard deviation of Laboratory G's measurements of ^{240}Pu are shown in Table 12, along with the target values. The target values for low burn-up plutonium are less stringent than those for the high burn-up material. The more stringent criteria were used in the evaluation.

The % RDs and the standard deviations for ^{240}Pu abundance measurements are shown in Fig.17 to evaluate bias, and again in Fig.18 to evaluate precision. In both figures, the target values corresponding to high burn-up material are shown. Laboratory G satisfied the ITV for bias, and barely missed the ITV for precision.

Table 12. Inter-laboratory performance summary for ^{240}Pu abundance in dried plutonium sulfate

Method	Lab code	Mean % RD	Standard deviation	N	Bias ITV (%)		Precision ITV (%)	
					High Burn-up	Low Burn-up	High Burn-up	Low Burn-up
TIMS	G	-0.047	0.080	26	0.12	0.15	0.07	0.10

Figure 17

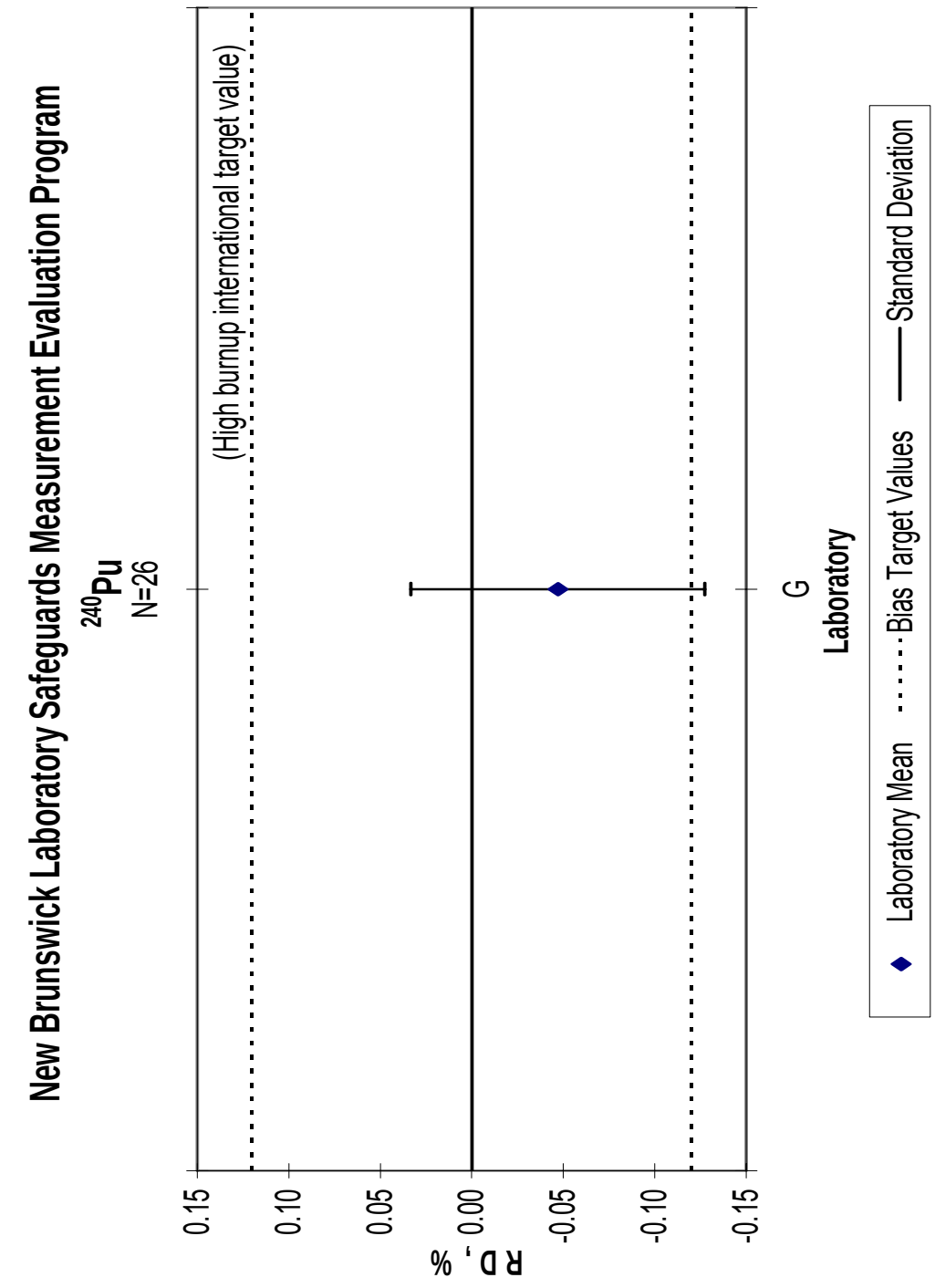
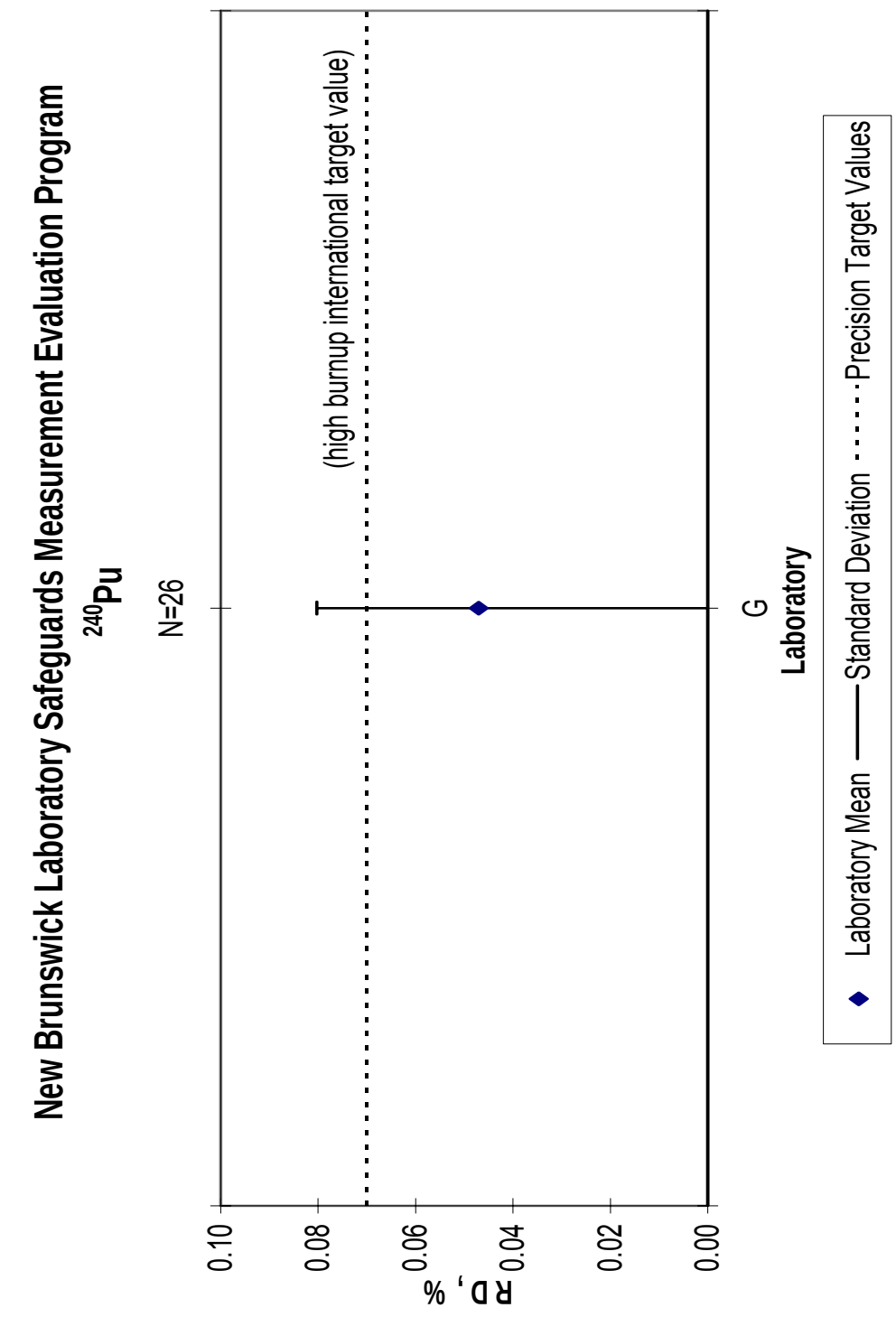

New Brunswick Laboratory Safeguards Measurement Evaluation Program
240Pu
N=26
(High burnup international target value)
RD, %
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
G
Laboratory
Laboratory Mean
Bias Target Values
Standard Deviation

Figure 18


New Brunswick Laboratory Safeguards Measurement Evaluation Program
240Pu
N=26
(high burnup international target value)
RD, %
0.10
0.08
0.06
0.04
0.02
0.00
G
Laboratory
Laboratory Mean
Standard Deviation
Precision Target Values

F. LONG TERM EVALUTION OF URANIUM MEASUREMENTS, OCT 2002-JUNE 2006

The uranium assay and isotopic results submitted by the participating laboratories since October, 2002 are evaluated to provide long-term (3.75 years) evaluation of results covering the period October 2002 to June 2006. Previous annual reports provided long-term evaluation for a three-year period. For example, the SME program report for FY 2004 provided long-term (3 years) evaluation for the period October 2001 to September 2004.

The % RDs calculated from the submitted results are shown in Figs.19 to 65. Each figure contains results from one laboratory for a material/method combination. For example, Fig. 19 shows results from laboratory A for uranyl nitrate solution analyzed by IDMS, and Fig. 20 shows results from the same laboratory for the analysis of the same solution by a different method (XRF). The figures provide a visual display of long-term performance.

Figure 19

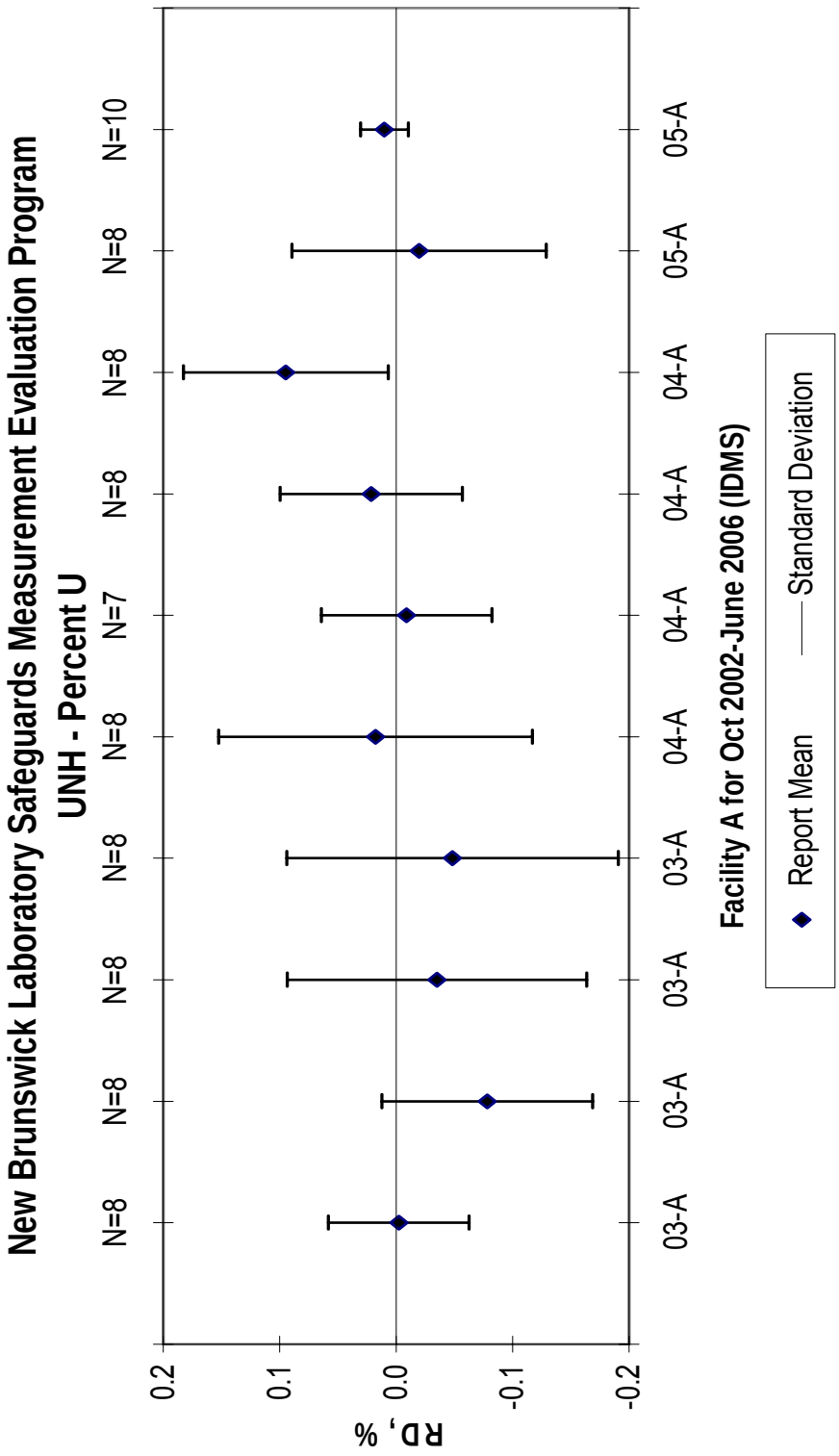

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U
RD, %
0.2
0.1
0.0
-0.1
-0.2
N=8
N=8
N=8
N=8
N=7
N=8
N=8
N=8
N=10
03-A
03-A
03-A
03-A
04-A
04-A
04-A
04-A
05-A
05-A
Facility A for Oct 2002-June 2006 (IDMS)
Report Mean
Standard Deviation

Figure 20

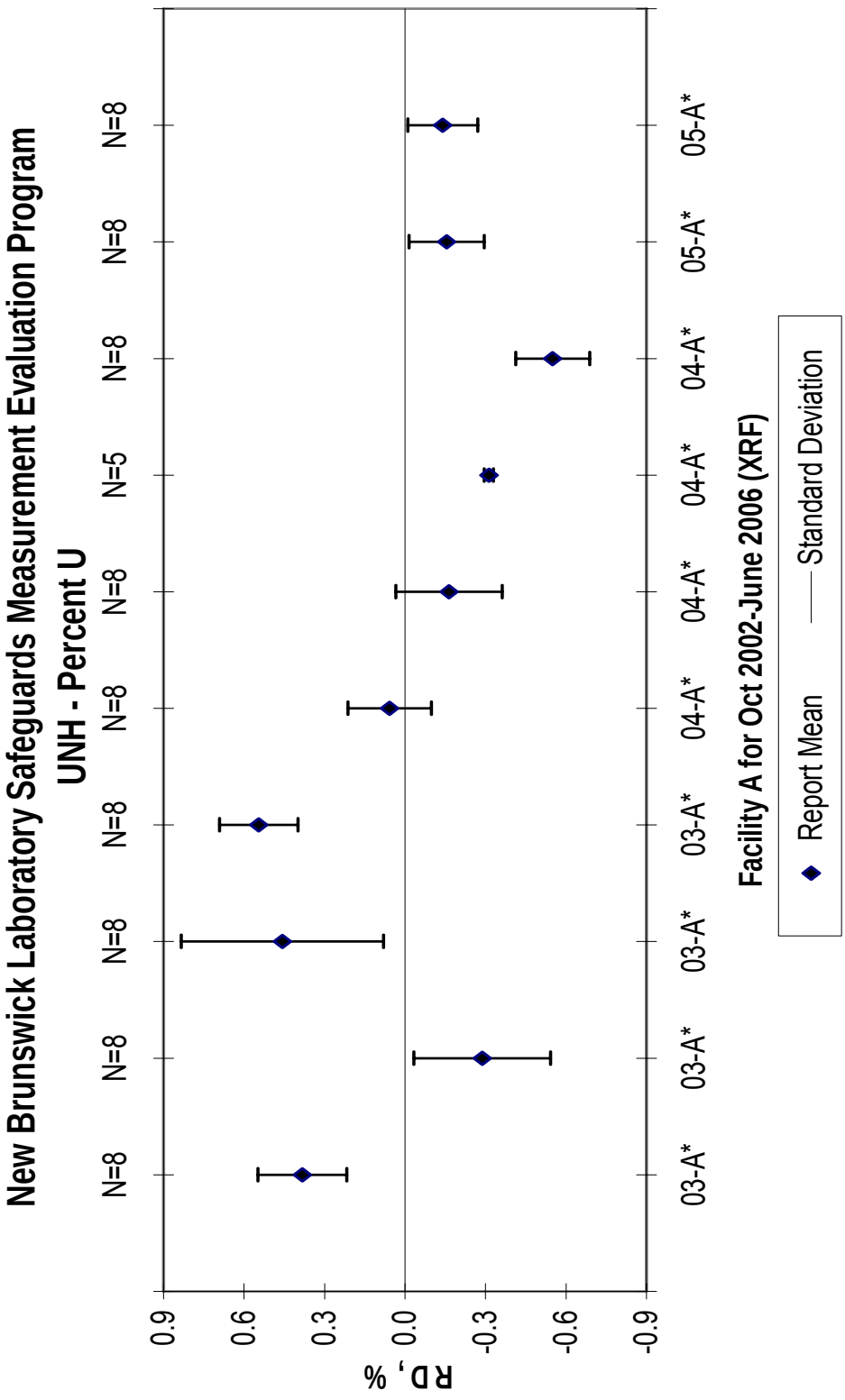

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U
RD, %
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
N=8
N=8
N=8
N=8
N=8
N=5
N=8
N=8
N=8
03-A*
03-A*
03-A*
04-A*
04-A*
04-A*
04-A*
05-A*
05-A*
Facility A for Oct 2002-June 2006 (XRF)
Report Mean
Standard Deviation

Figure 21

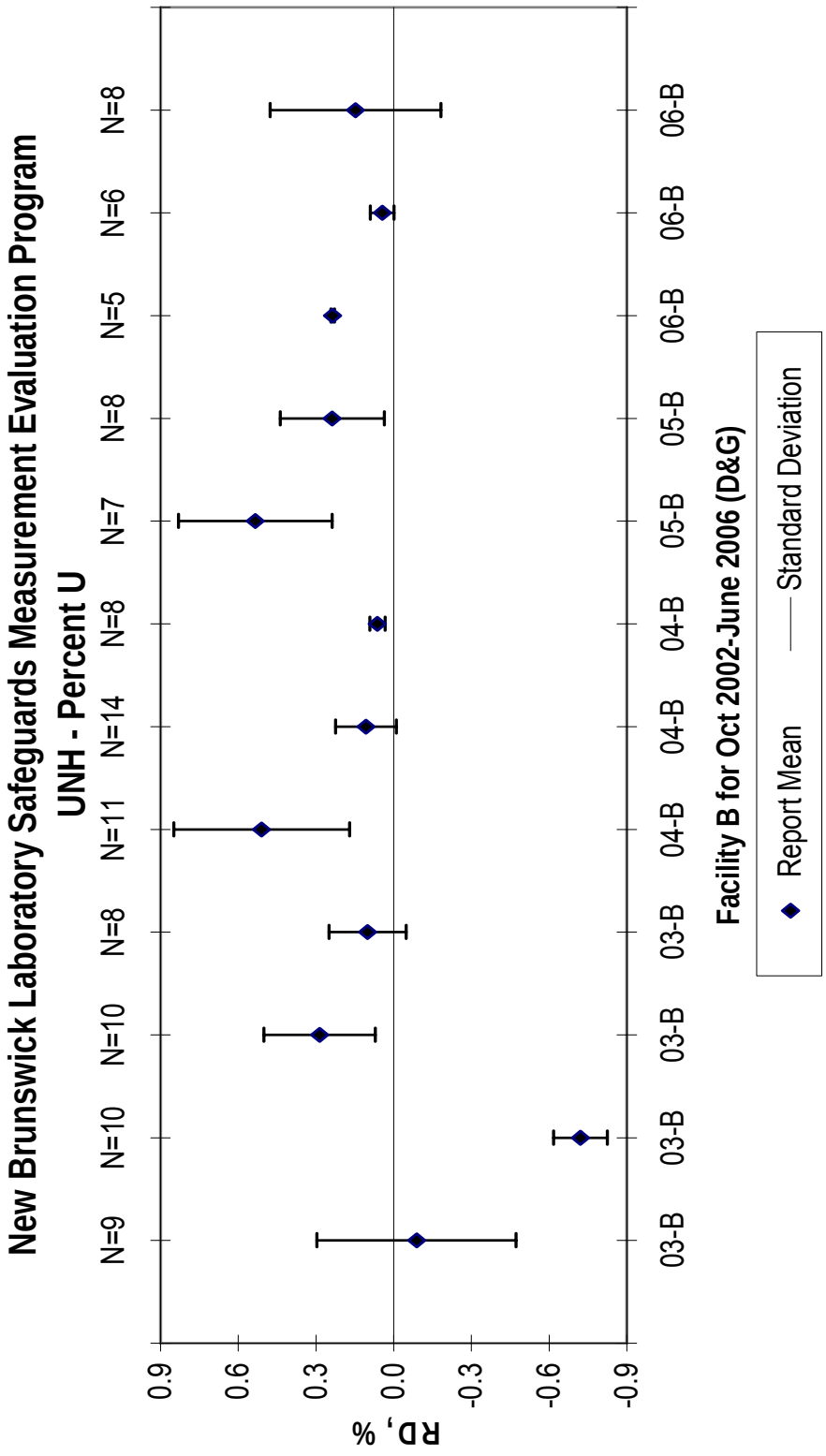

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U
RD, %
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
N=9
N=10
N=10
N=8
N=11
N=14
N=8
N=7
N=8
N=5
N=6
N=8
03-B
03-B
03-B
03-B
04-B
04-B
04-B
05-B
05-B
06-B
06-B
06-B
Facility B for Oct 2002-June 2006 (D&G)
Report Mean
Standard Deviation

Figure 22

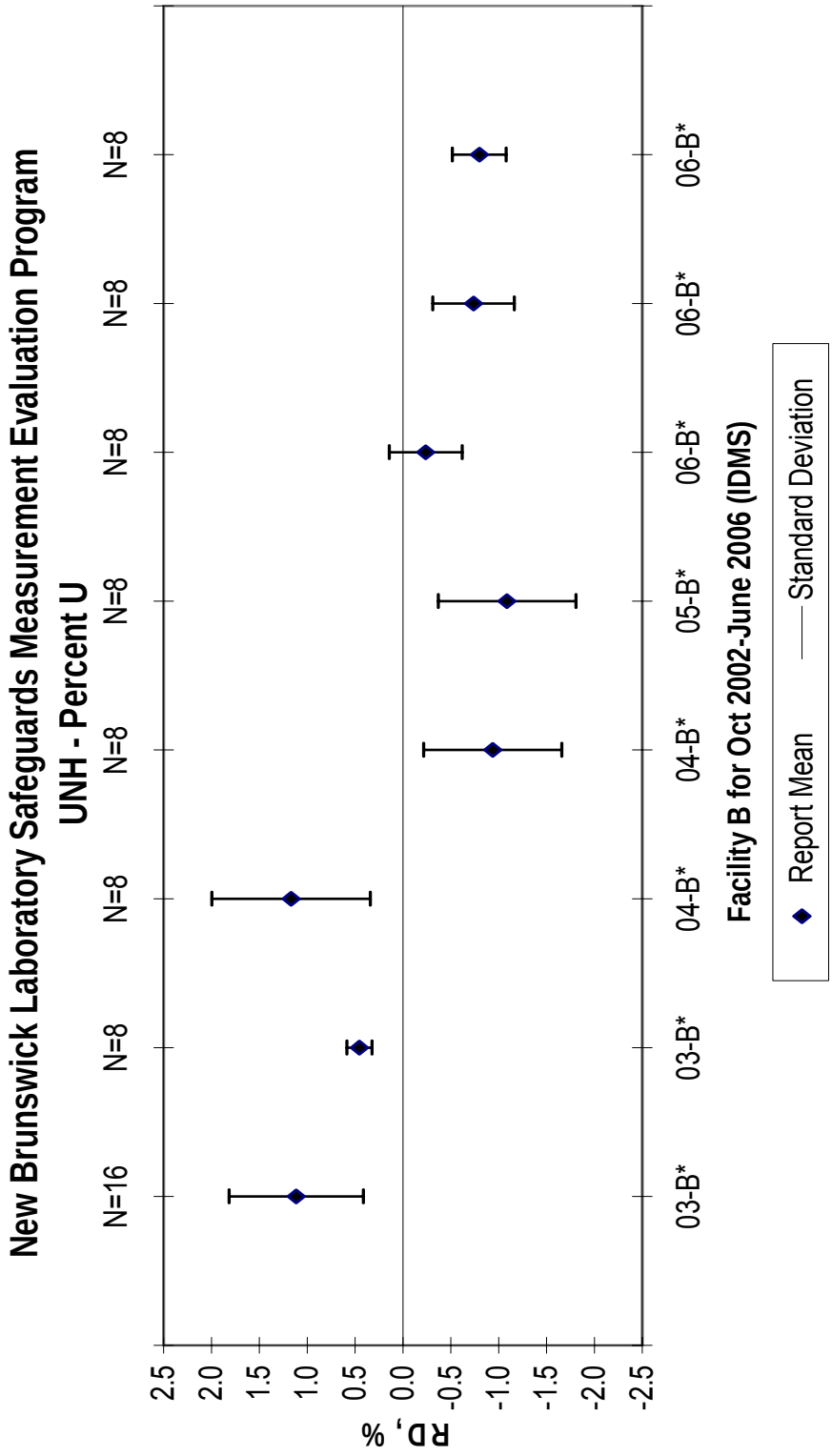

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U
N=16
N=8
N=8
N=8
N=8
N=8
N=8
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
RD, %
03-B*
03-B*
04-B*
04-B*
05-B*
06-B*
06-B*
06-B*
Facility B for Oct 2002-June 2006 (IDMS)
Report Mean
Standard Deviation

Figure 23

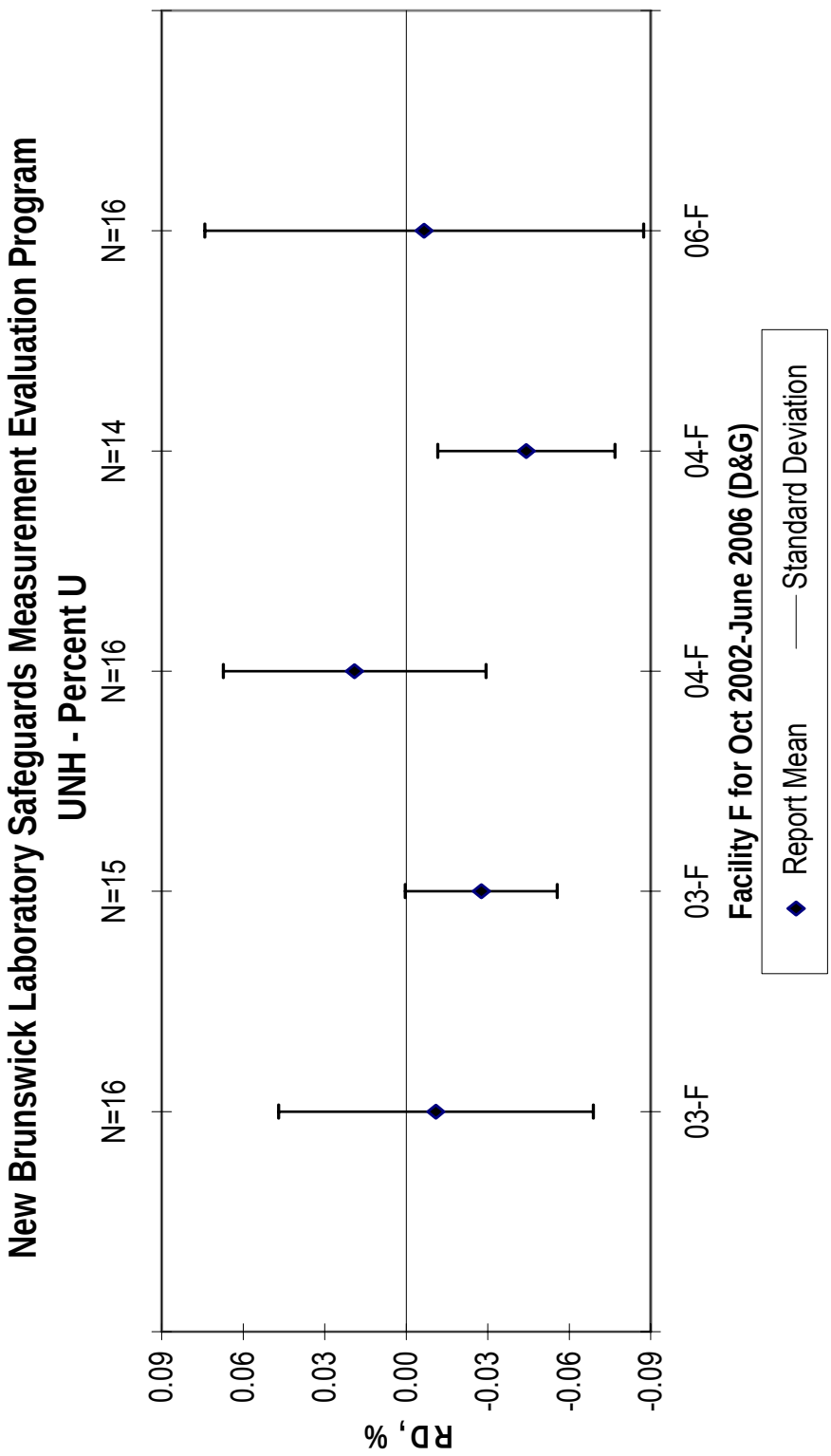

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U
N=16
N=15
N=16
N=14
N=16
0.09
0.06
0.03
0.00
-0.03
-0.06
-0.09
RD, %
03-F
03-F
04-F
04-F
06-F
Facility F for Oct 2002-June 2006 (D&G)
Report Mean
Standard Deviation

Figure 24

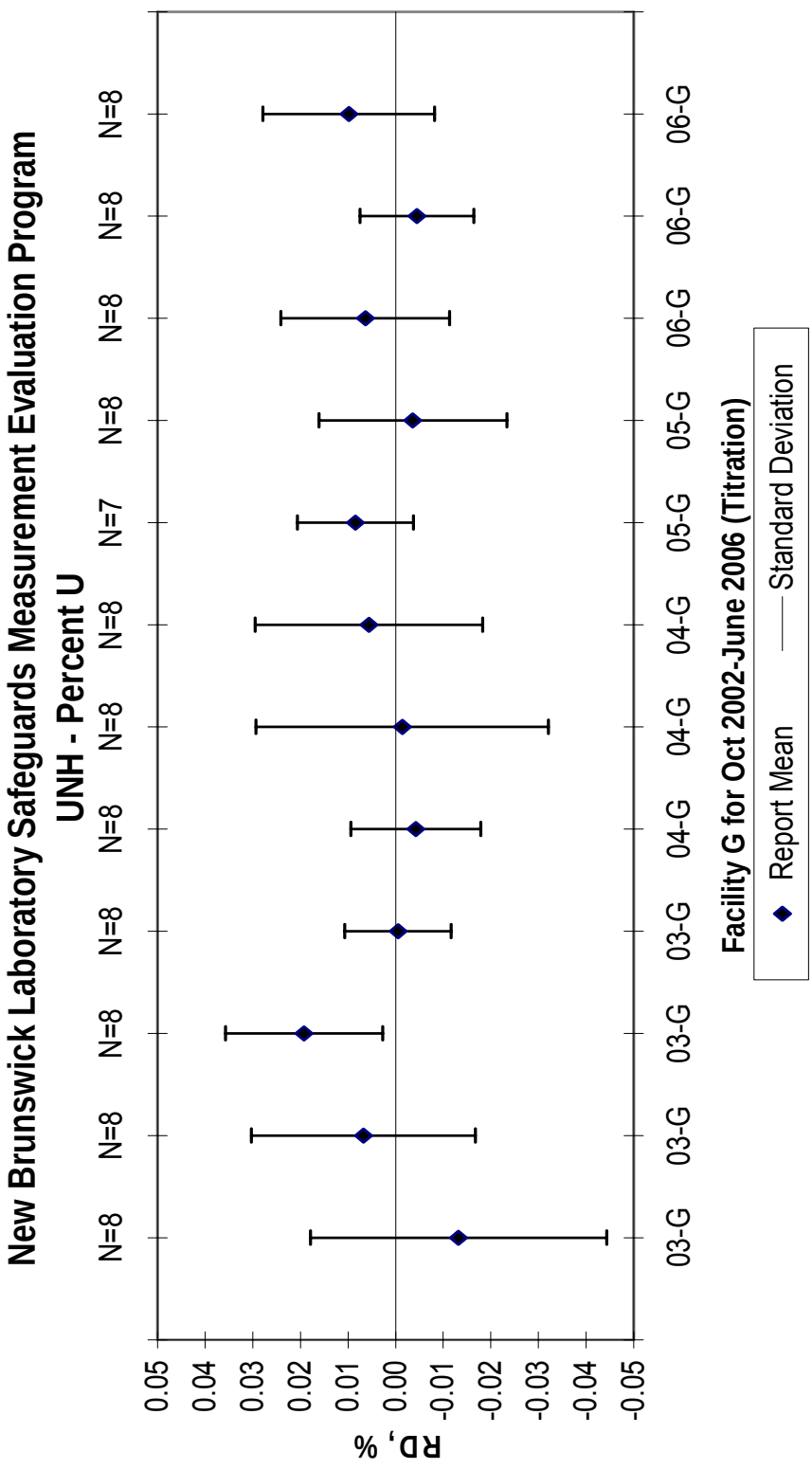

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U
RD, %
0.05
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
-0.05
N=8 N=8 N=8 N=8 N=8 N=8 N=7 N=8 N=8 N=8 N=8
03-G 03-G 03-G 04-G 04-G 04-G 05-G 05-G 06-G 06-G 06-G
Facility G for Oct 2002-June 2006 (Titration)
Report Mean
Standard Deviation

Figure 25

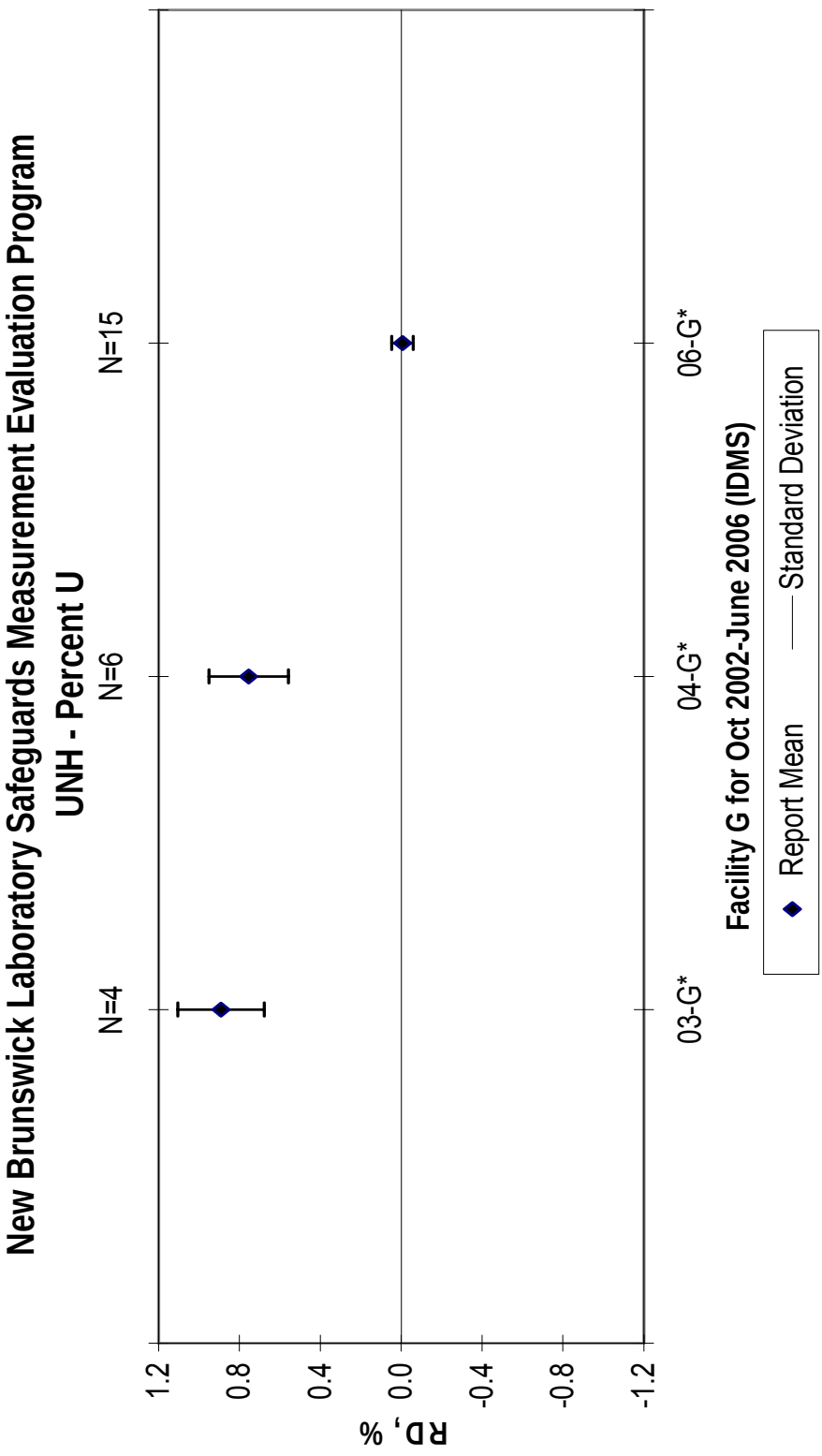

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U
N=4
N=6
N=15
1.2
0.8
0.4
0.0
-0.4
-0.8
-1.2
RD, %
03-G*
04-G*
06-G*
Facility G for Oct 2002-June 2006 (IDMS)
Report Mean
Standard Deviation

Figure 26

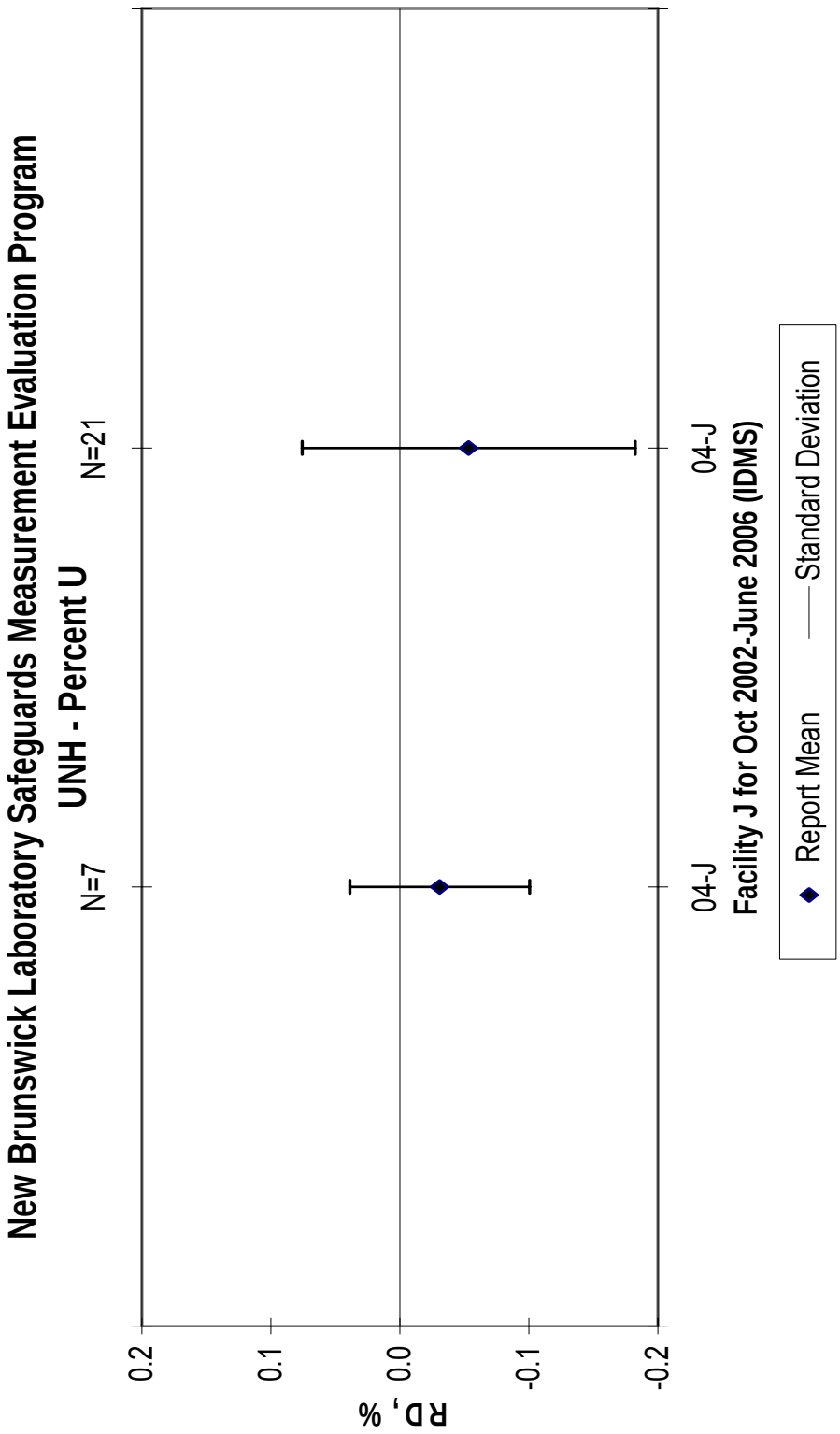

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U
N=7
N=21
04-J
04-J
Facility J for Oct 2002-June 2006 (IDMS)
Report Mean
Standard Deviation
RD, %
0.2
0.1
0.0
-0.1
-0.2

Figure 27

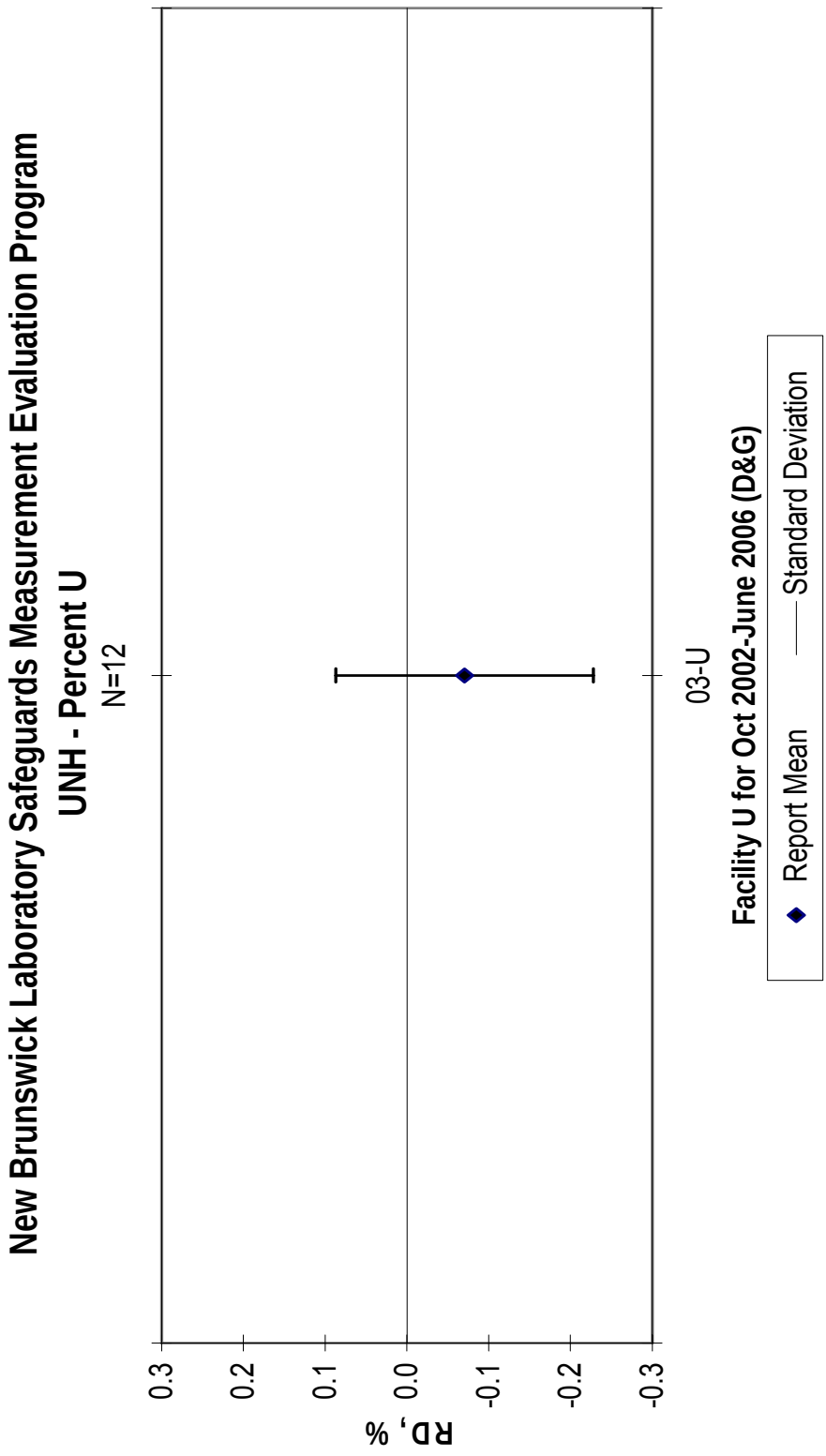

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U
N=12
RD, %
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
03-U
Facility U for Oct 2002-June 2006 (D&G)
Report Mean
Standard Deviation

Figure 28

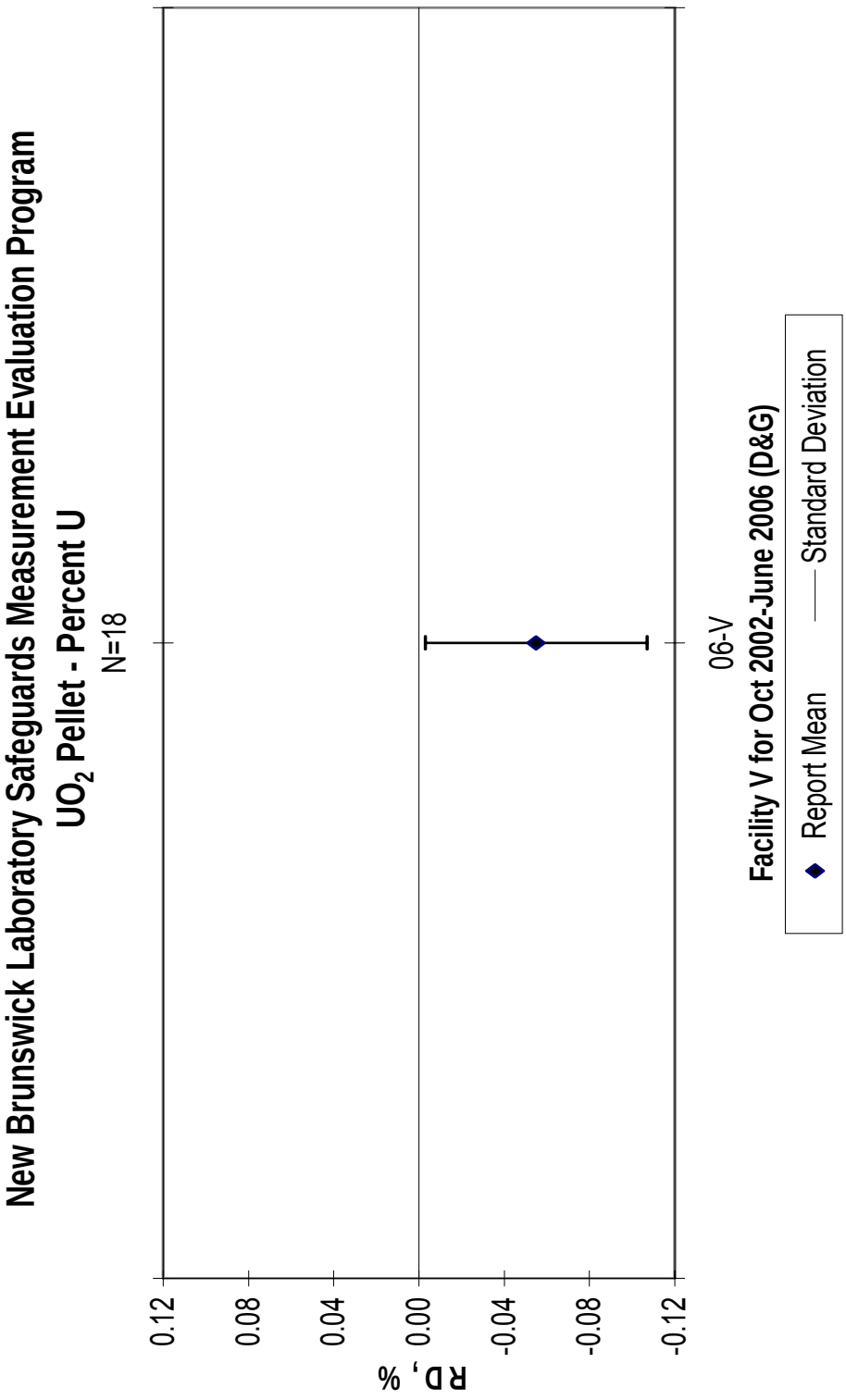

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO_2 Pellet - Percent U
N=18
RD, %
0.12
0.08
0.04
0.00
-0.04
-0.08
-0.12
06-V
Facility V for Oct 2002-June 2006 (D&G)
Report Mean
Standard Deviation

Figure 29

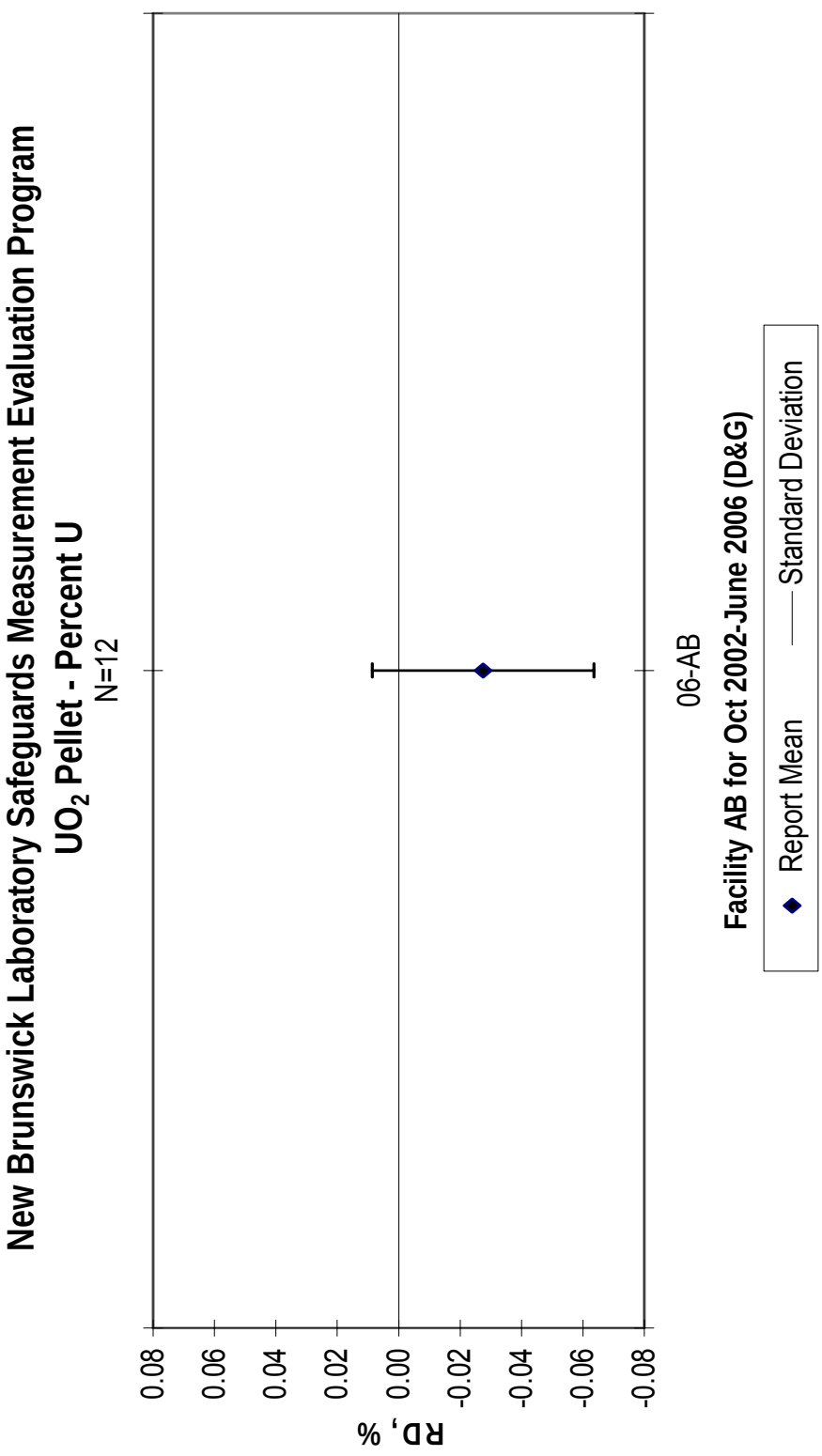

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO2 Pellet - Percent U
N=12
RD, %
0.08
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
-0.08
06-AB
Facility AB for Oct 2002-June 2006 (D&G)
Report Mean
Standard Deviation

Figure 30

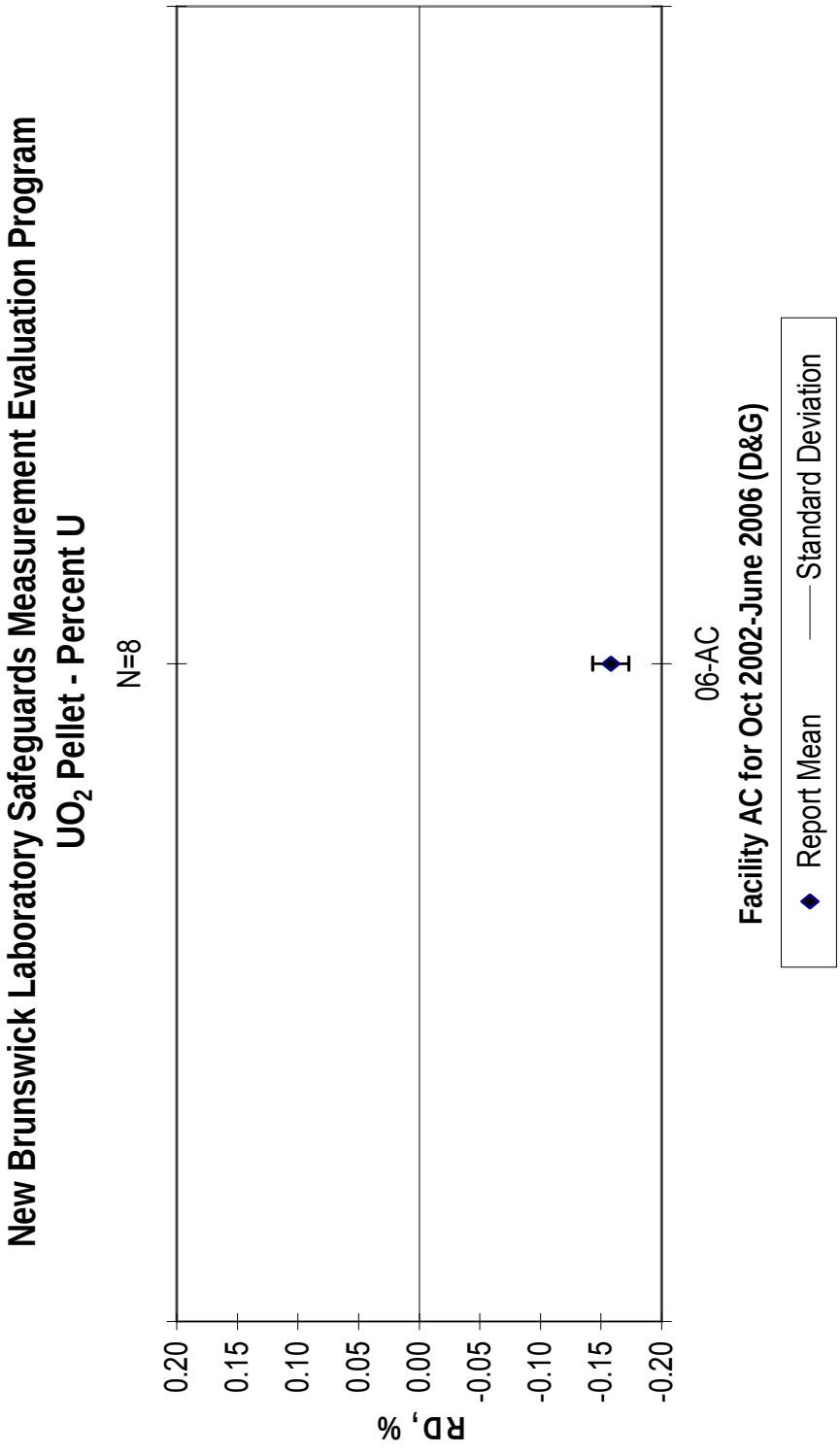

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO2 Pellet - Percent U
N=8
RD, %
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
06-AC
Facility AC for Oct 2002-June 2006 (D&G)
Report Mean
Standard Deviation

Figure 31

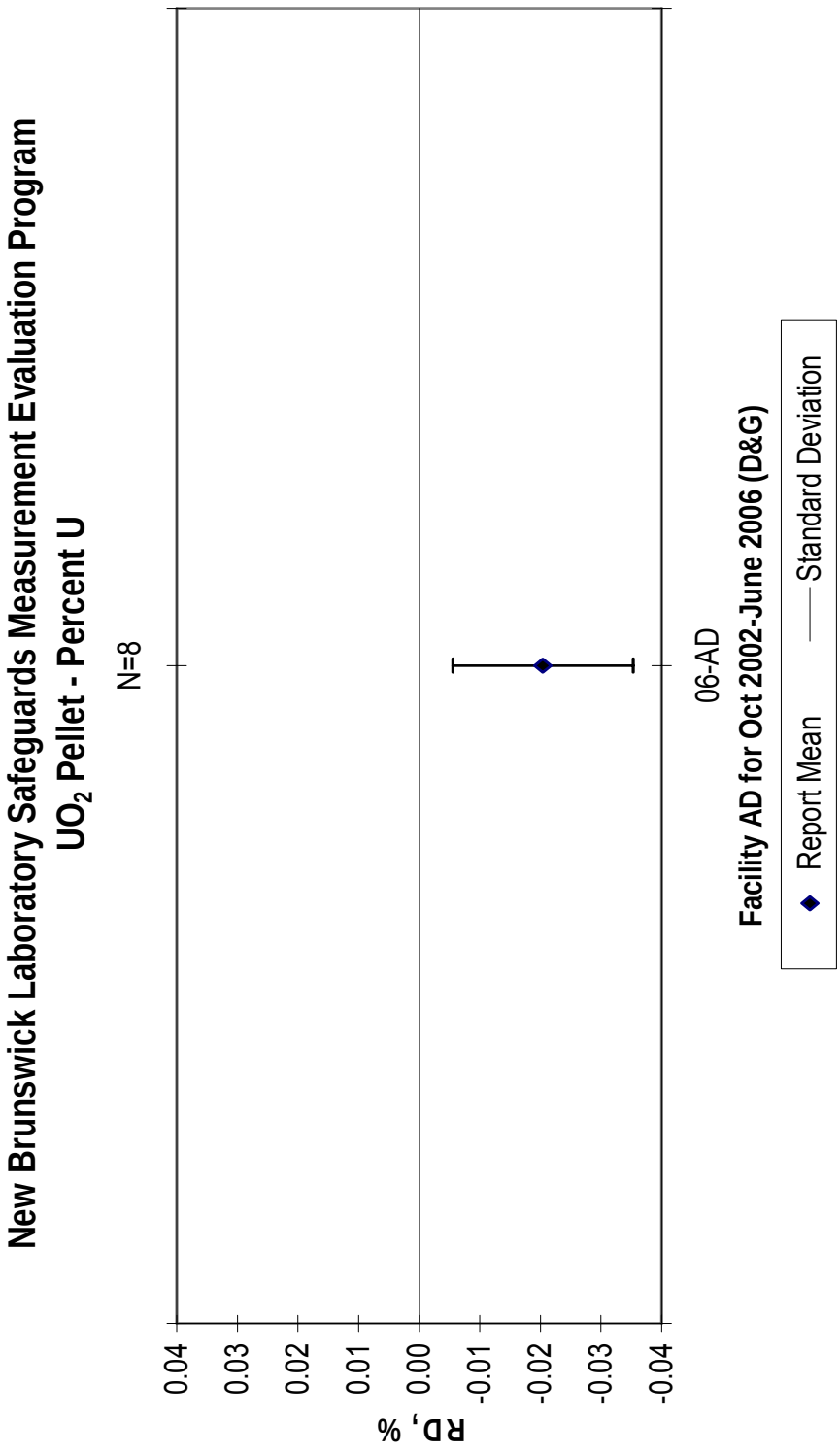

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO2 Pellet - Percent U
N=8
RD, %
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
06-AD
Facility AD for Oct 2002-June 2006 (D&G)
Report Mean
Standard Deviation

Figure 32

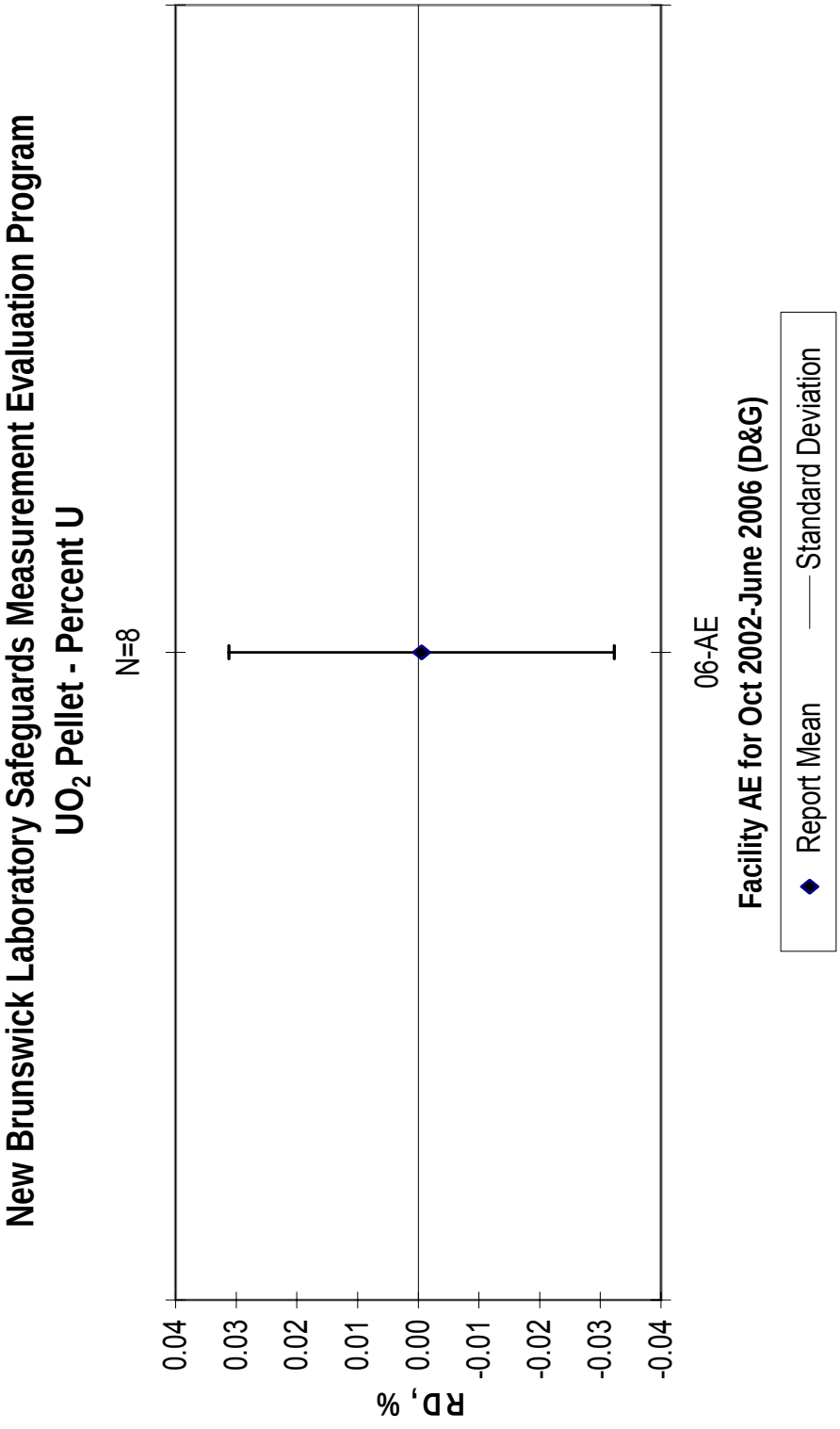

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO2 Pellet - Percent U
N=8
06-AE
Facility AE for Oct 2002-June 2006 (D&G)
Report Mean
Standard Deviation
RD, %
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04

Figure 33

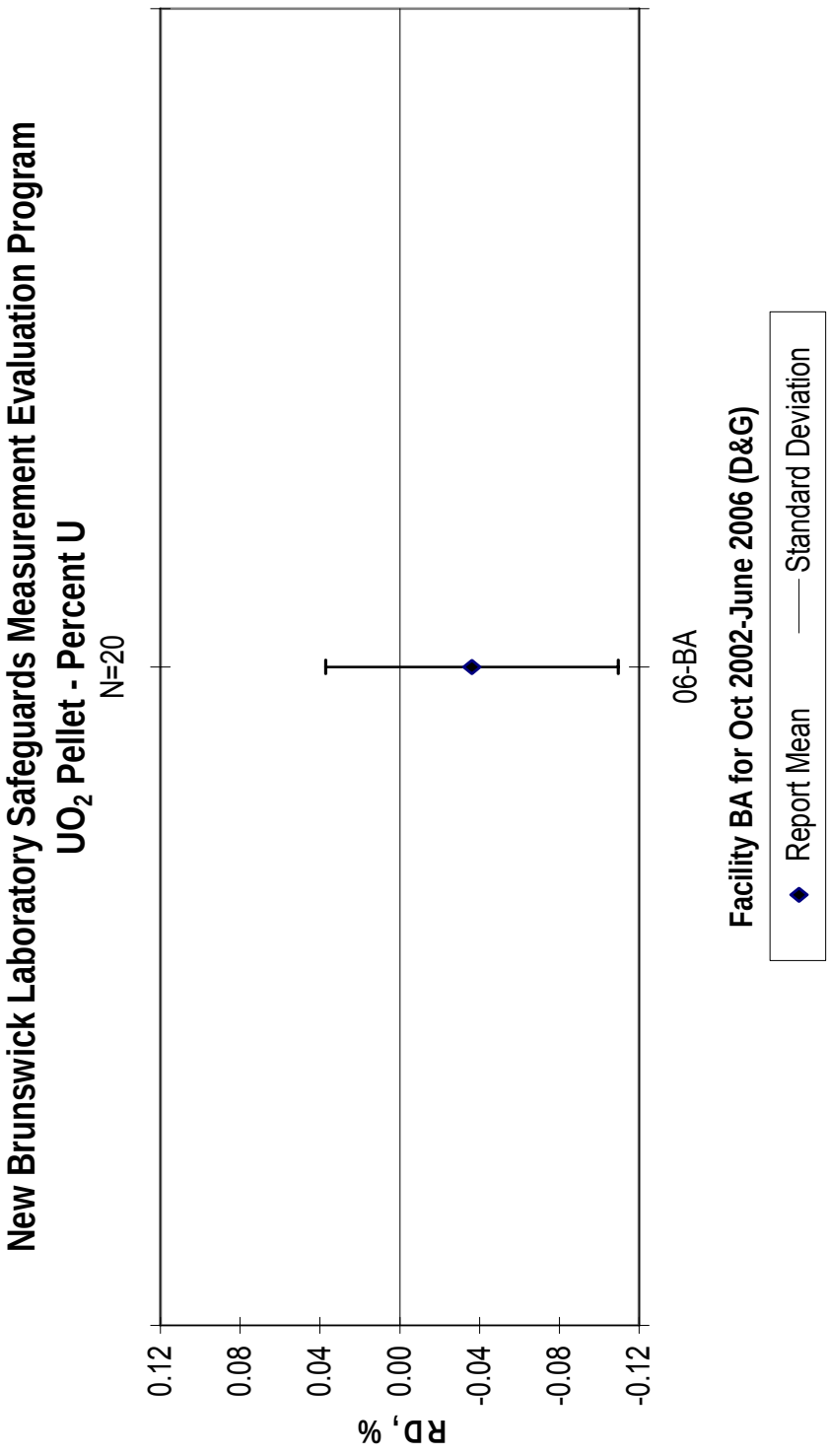

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO2 Pellet - Percent U
N=20
06-BA
RD, %
0.12
0.08
0.04
0.00
-0.04
-0.08
-0.12
Facility BA for Oct 2002-June 2006 (D&G)
Report Mean
Standard Deviation

Figure 34

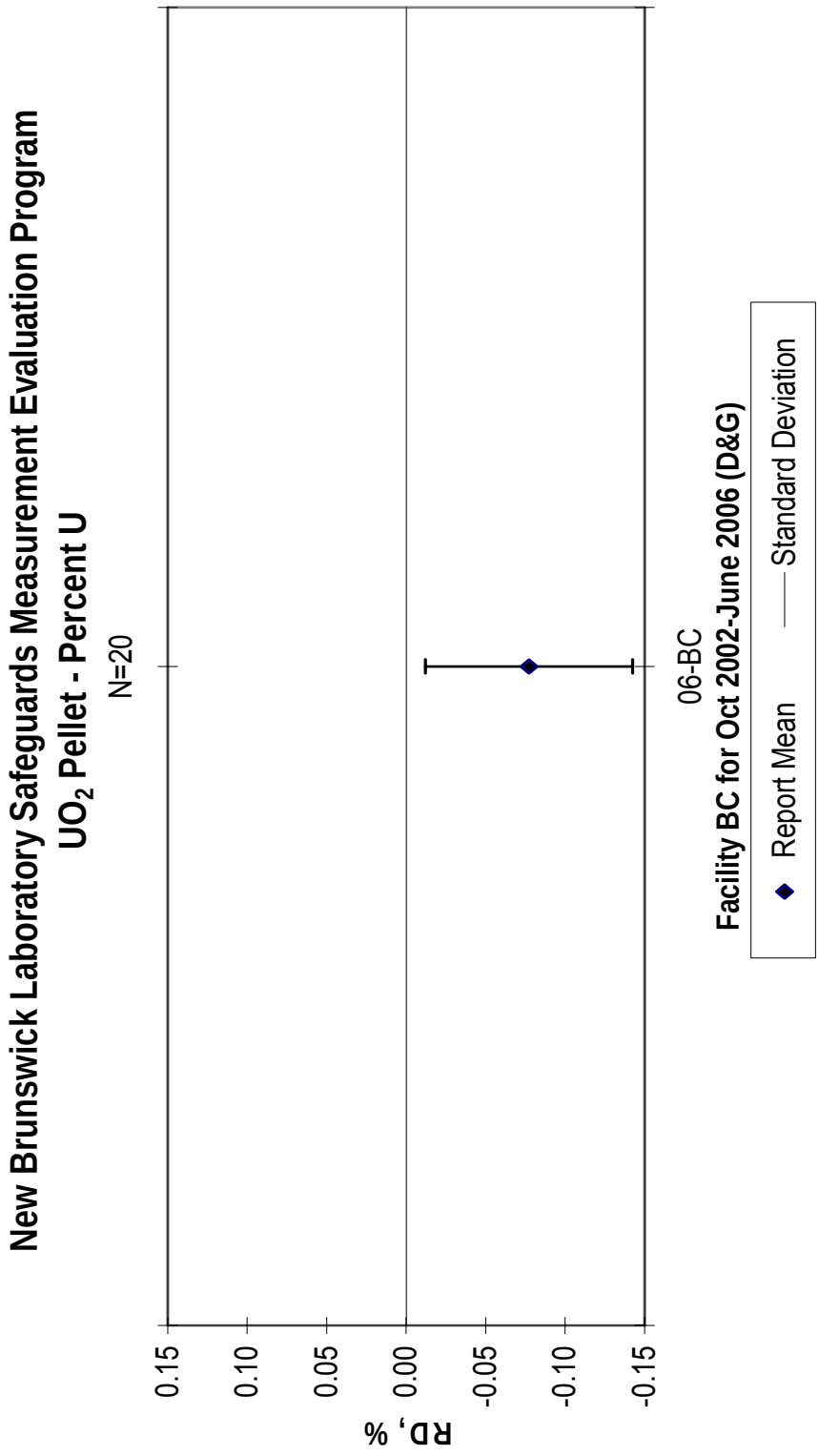

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO2 Pellet - Percent U
N=20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
RD, %
06-BC
Facility BC for Oct 2002-June 2006 (D&G)
Report Mean
Standard Deviation

Figure 35

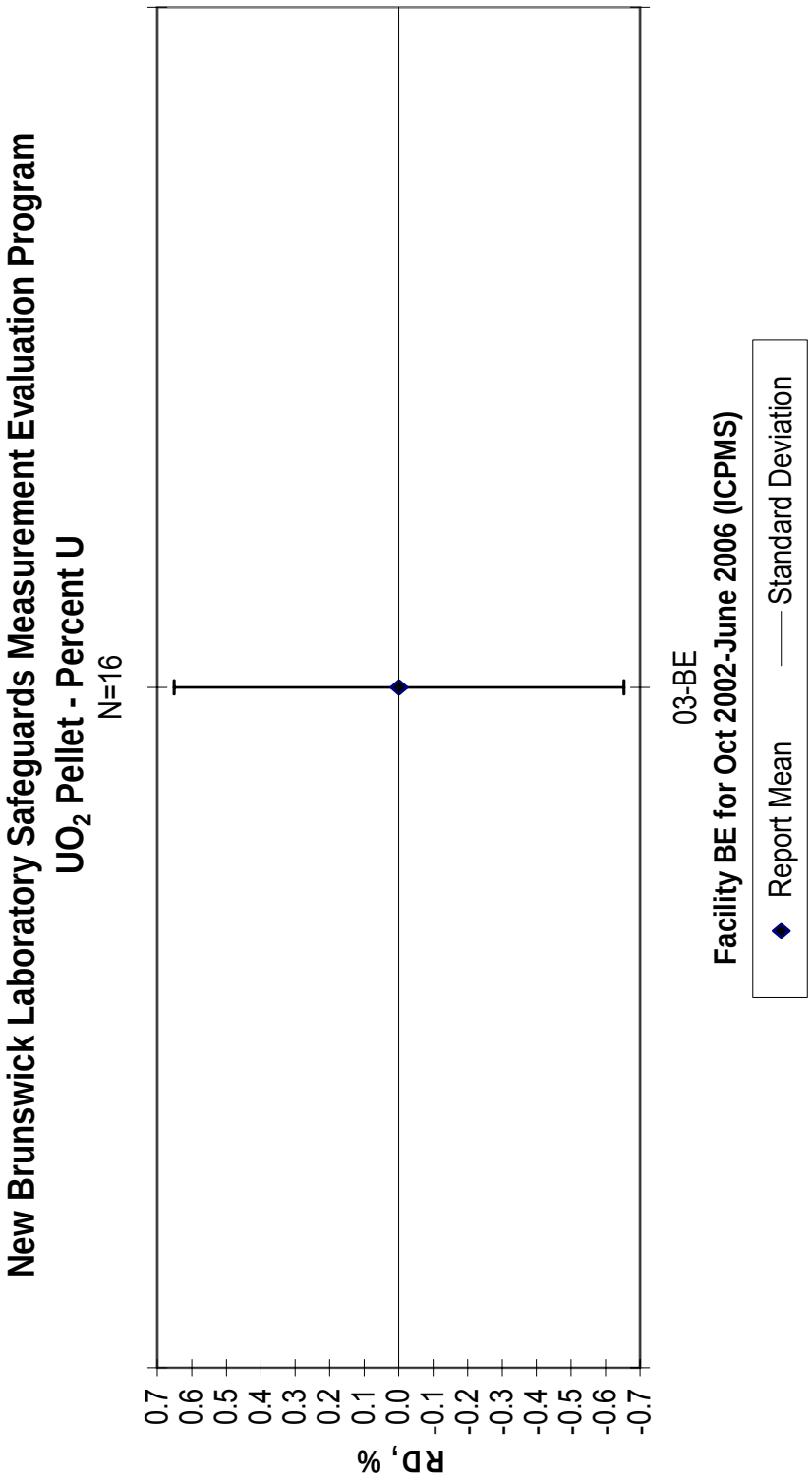

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO2 Pellet - Percent U
N=16
RD, %
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
03-BE
Facility BE for Oct 2002-June 2006 (ICPMS)
Report Mean
Standard Deviation

Figure 36

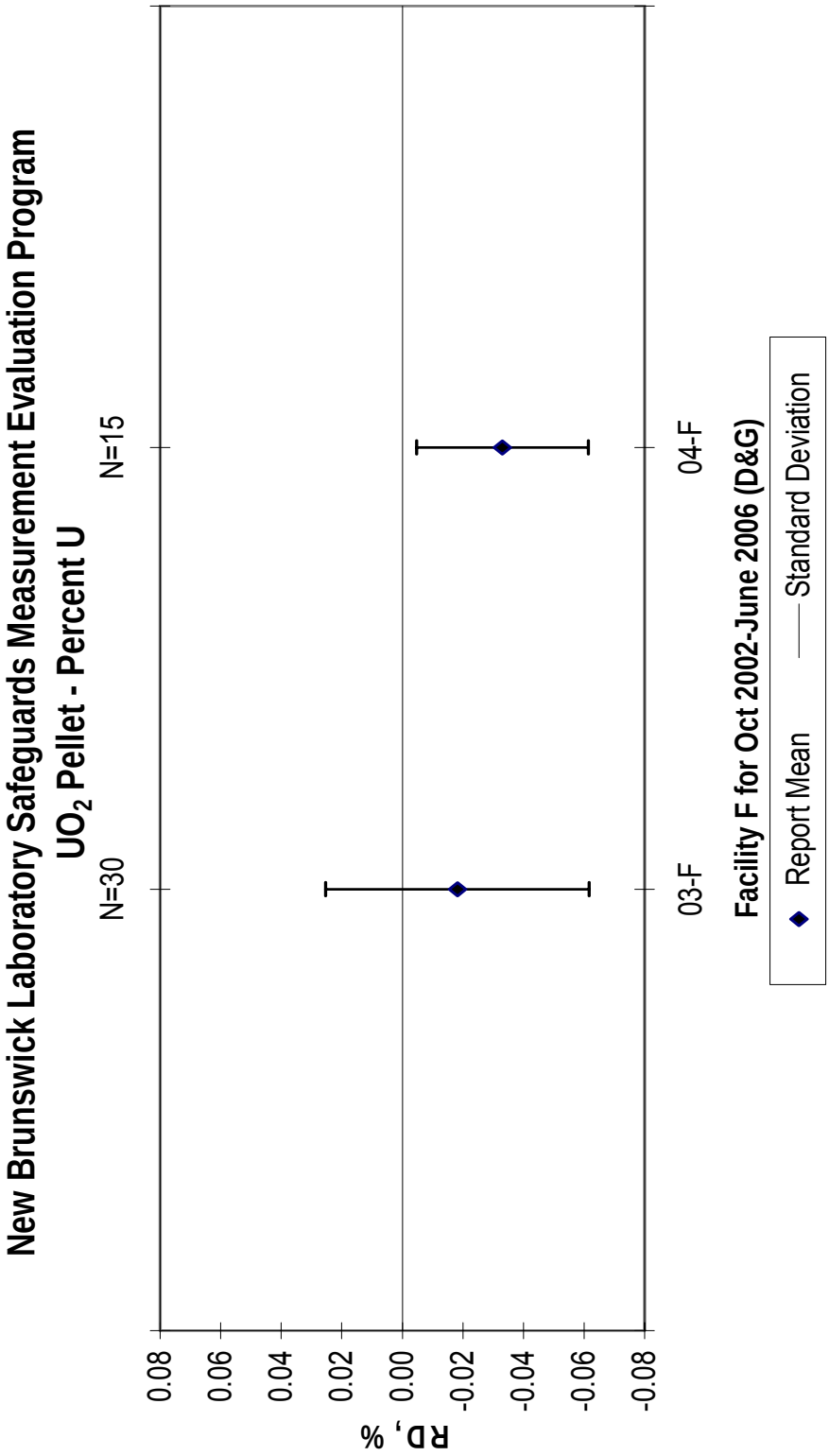

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO2 Pellet - Percent U
N=30
N=15
03-F
04-F
Facility F for Oct 2002-June 2006 (D&G)
Report Mean
Standard Deviation
RD, %
0.08
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
-0.08

Figure 37

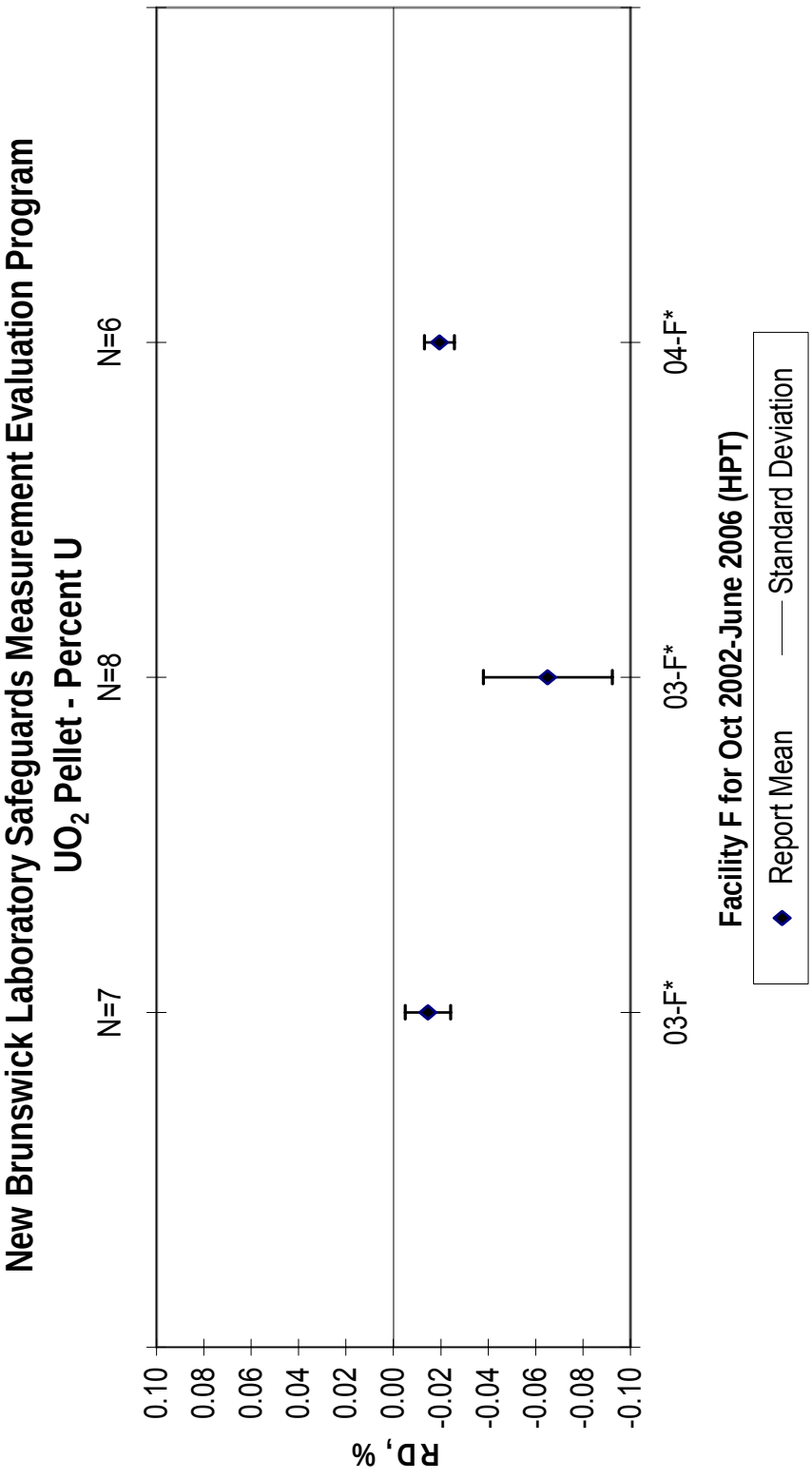

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO2 Pellet - Percent U
N=7
N=8
N=6
0.10
0.08
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
RD, %
03-F*
03-F*
04-F*
Facility F for Oct 2002-June 2006 (HPT)
Report Mean
Standard Deviation

Figure 38

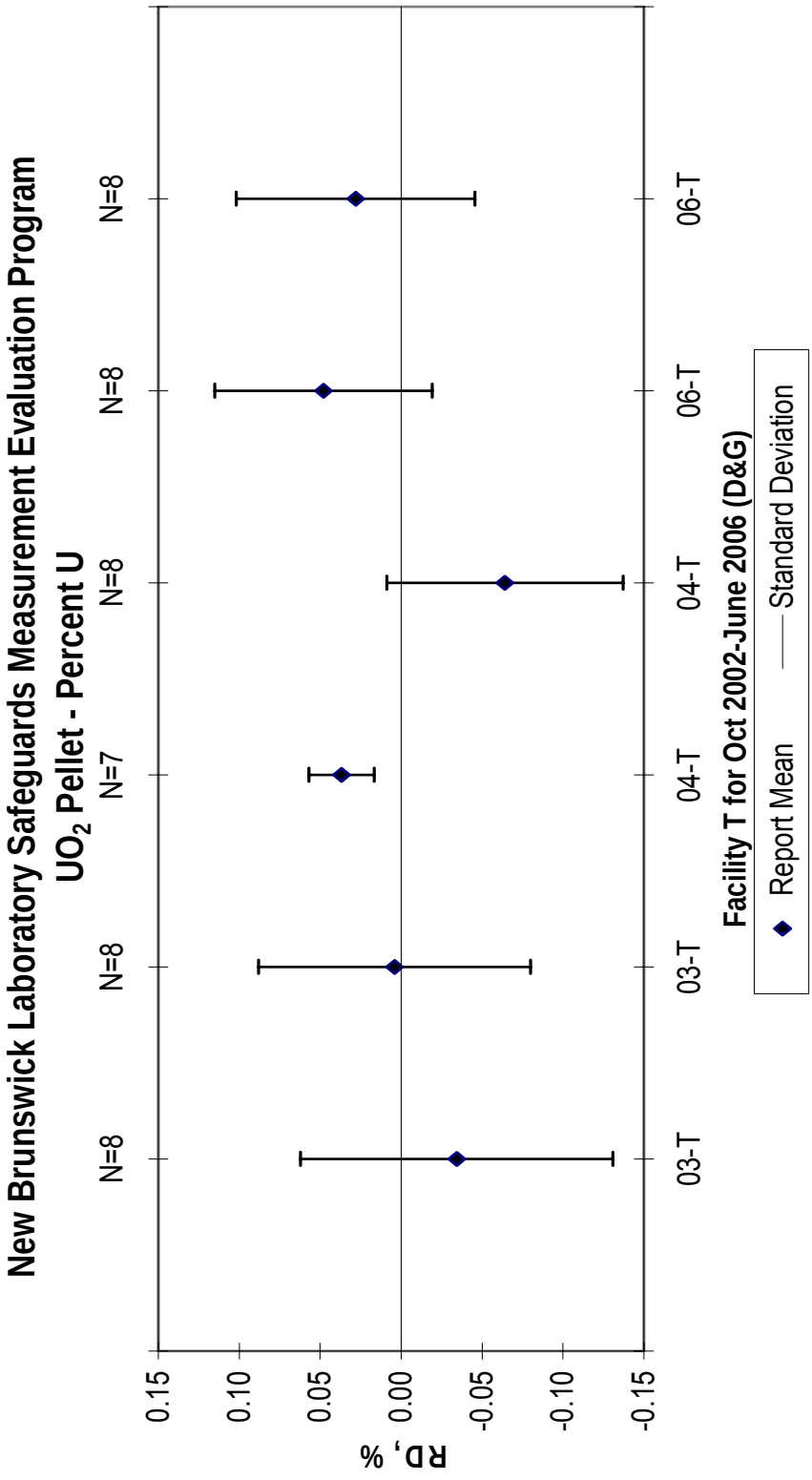

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO2 Pellet - Percent U
RD, %
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
N=8
N=8
N=7
N=8
N=8
N=8
03-T
03-T
04-T
04-T
06-T
06-T
Facility T for Oct 2002-June 2006 (D&G)
Report Mean
Standard Deviation

Figure 39

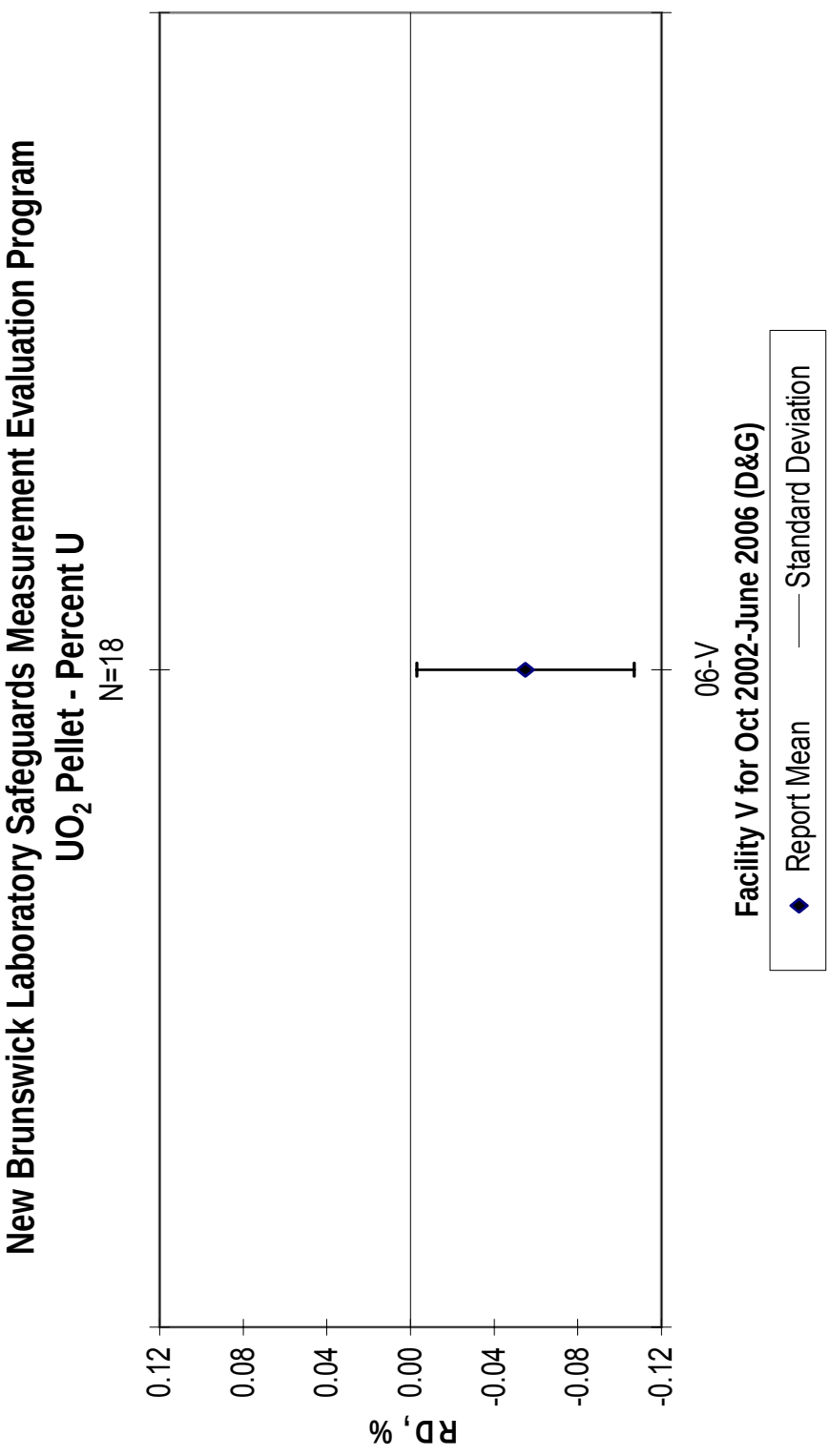

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO2 Pellet - Percent U
N=18
RD, %
0.12
0.08
0.04
0.00
-0.04
-0.08
-0.12
06-V
Facility V for Oct 2002-June 2006 (D&G)
Report Mean
Standard Deviation

Figure 40

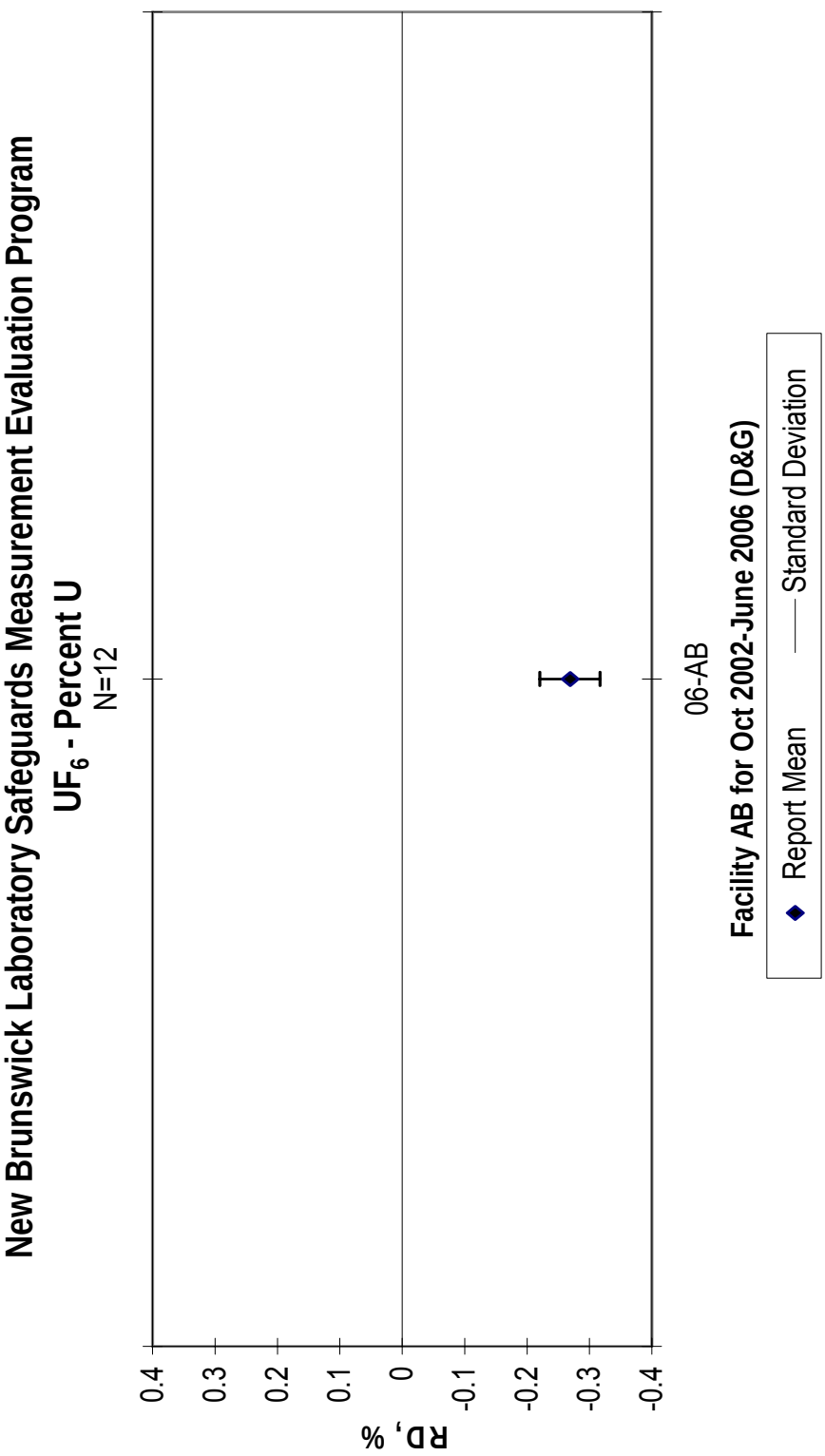

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UF6 - Percent U
N=12
RD, %
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
06-AB
Facility AB for Oct 2002-June 2006 (D&G)
Report Mean
Standard Deviation

Figure 41

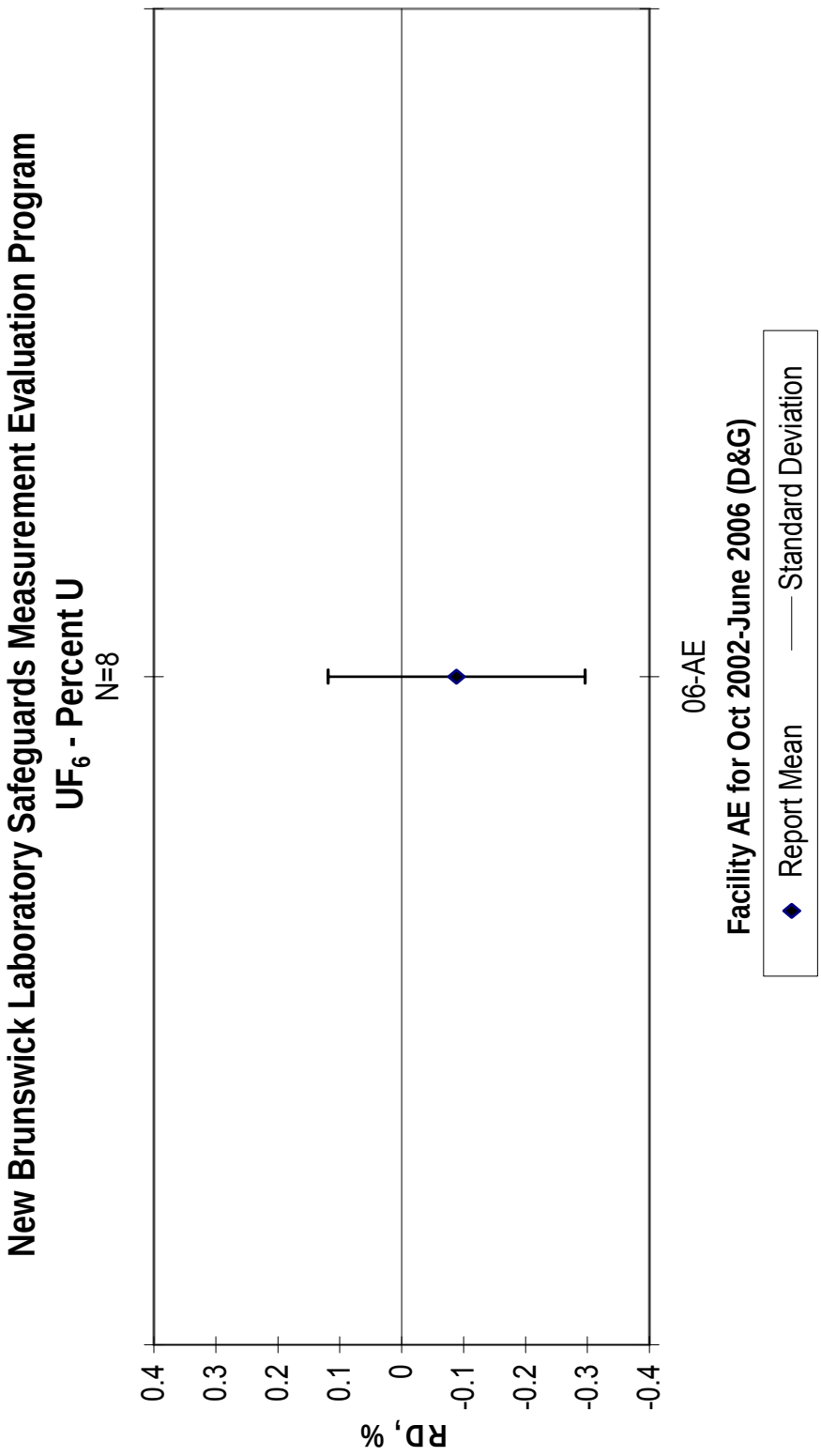

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UF6 - Percent U
N=8
RD, %
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
06-AE
Facility AE for Oct 2002-June 2006 (D&G)
Report Mean
Standard Deviation

Figure 42

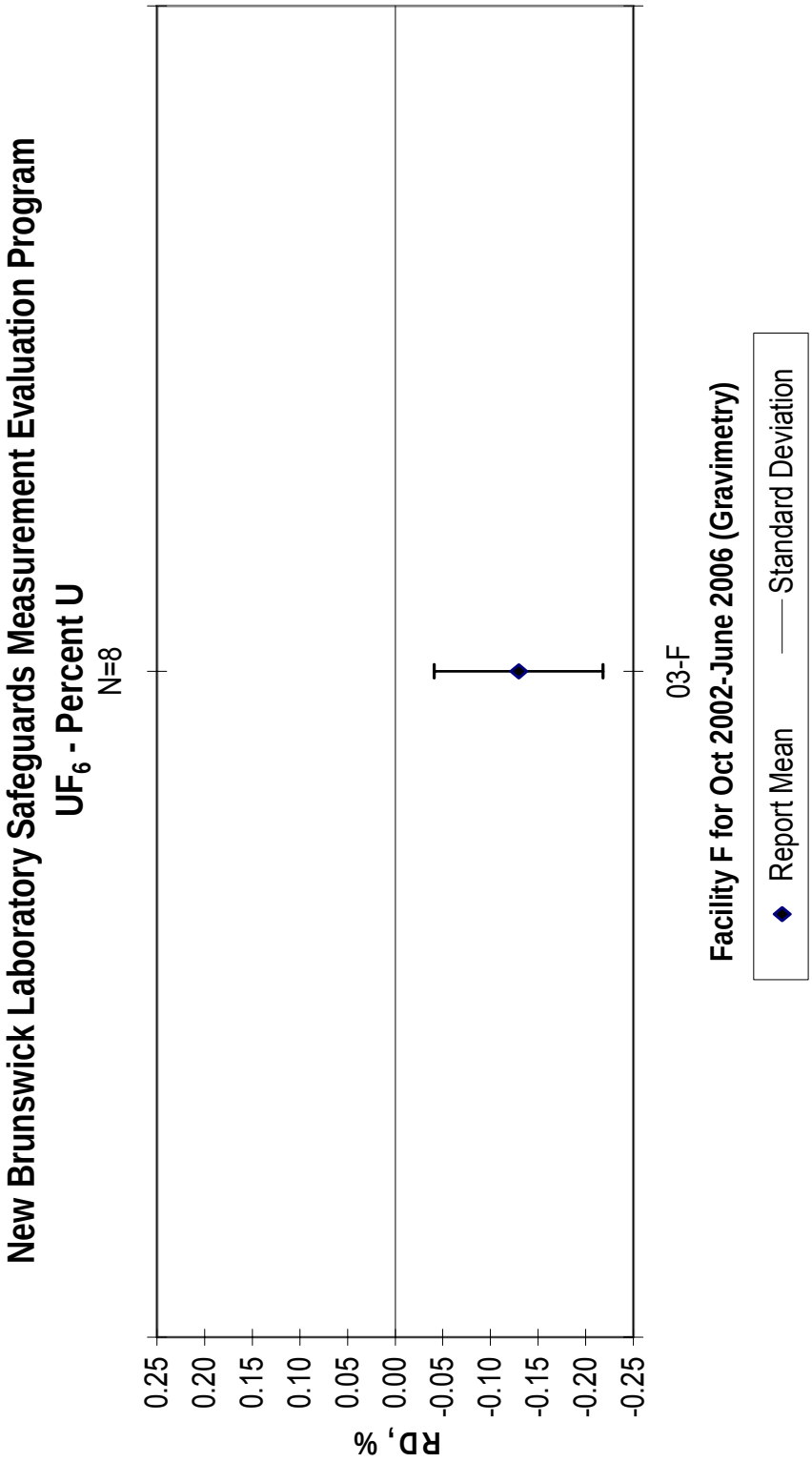

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UF6 - Percent U
N=8
RD, %
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
-0.25
03-F
Facility F for Oct 2002-June 2006 (Gravimetry)
Report Mean
Standard Deviation

Figure 43

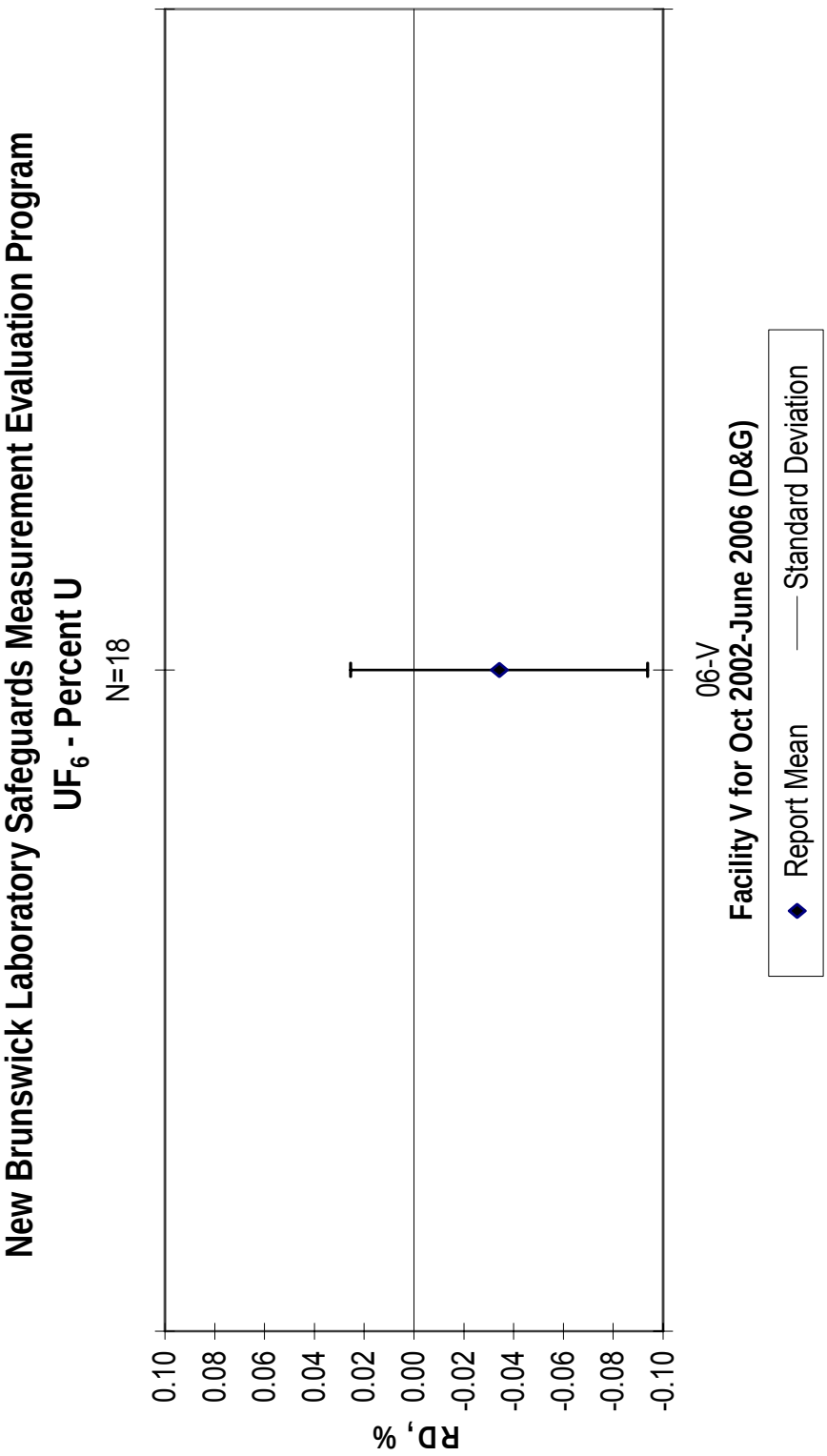

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UF6 - Percent U
N=18
06-V
Facility V for Oct 2002-June 2006 (D&G)
Report Mean
Standard Deviation
RD, %
0.10
0.08
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
-0.08
-0.10

Figure 44

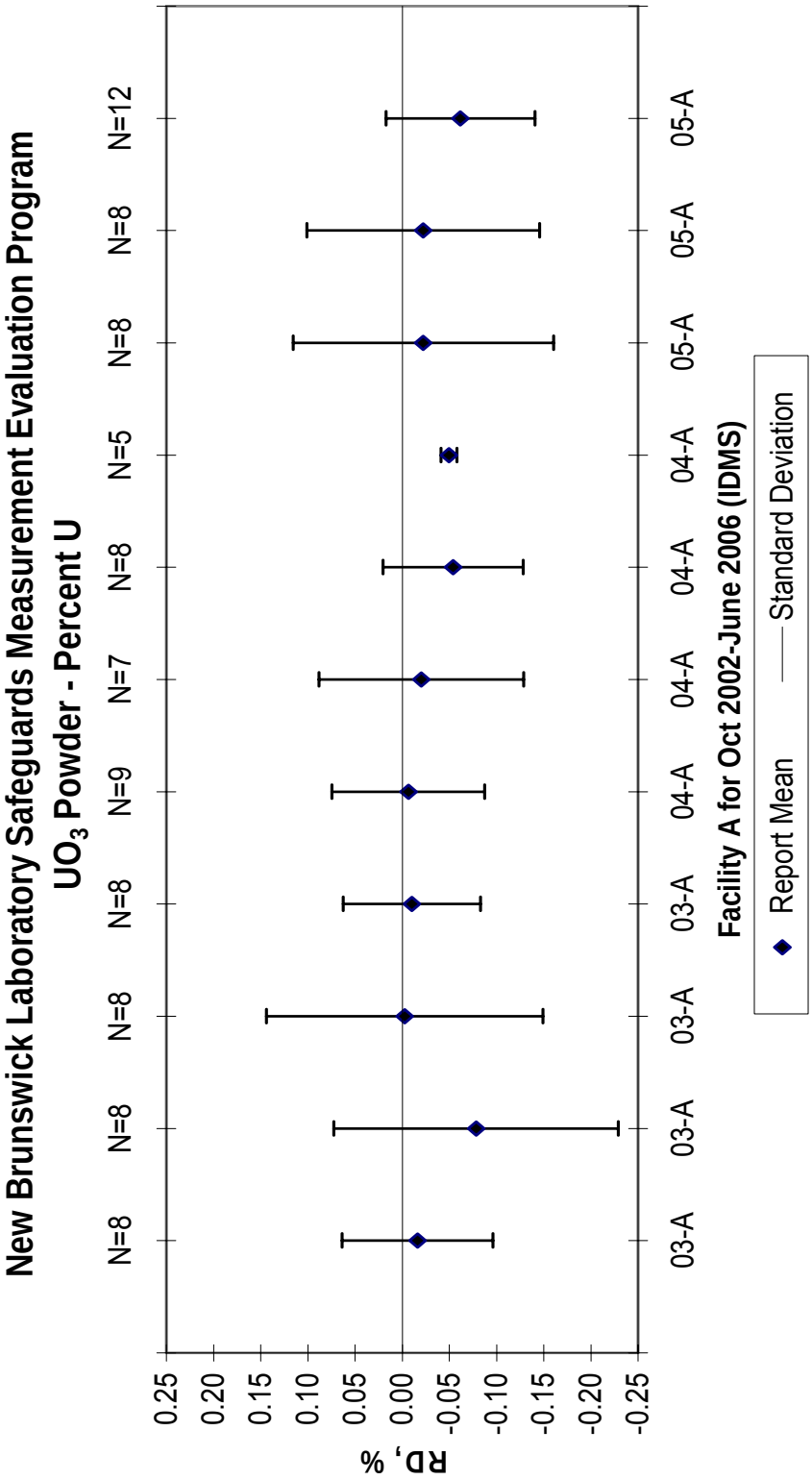

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO_3 Powder - Percent U
RD, %
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
-0.25
N=8 N=8 N=8 N=8 N=9 N=7 N=8 N=5 N=8 N=8 N=12
03-A 03-A 03-A 03-A 04-A 04-A 04-A 04-A 05-A 05-A 05-A
Facility A for Oct 2002-June 2006 (IDMS)
Report Mean
Standard Deviation

Figure 45

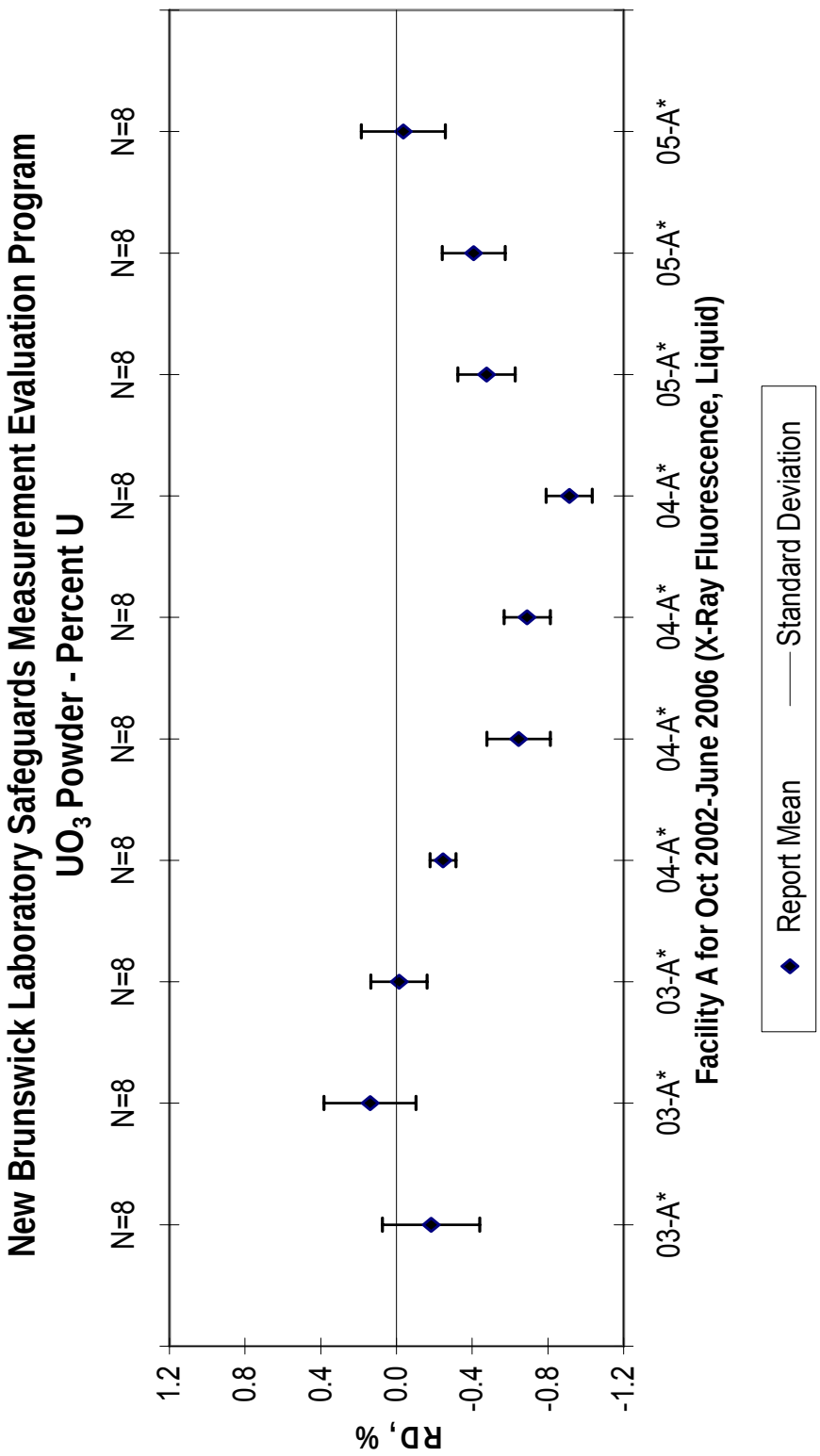

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO3 Powder - Percent U
Facility A for Oct 2002-June 2006 (X-Ray Fluorescence, Liquid)
RD, %
1.2
0.8
0.4
0.0
-0.4
-0.8
-1.2
N=8
03-A*
04-A*
05-A*
Report Mean
Standard Deviation

Figure 46

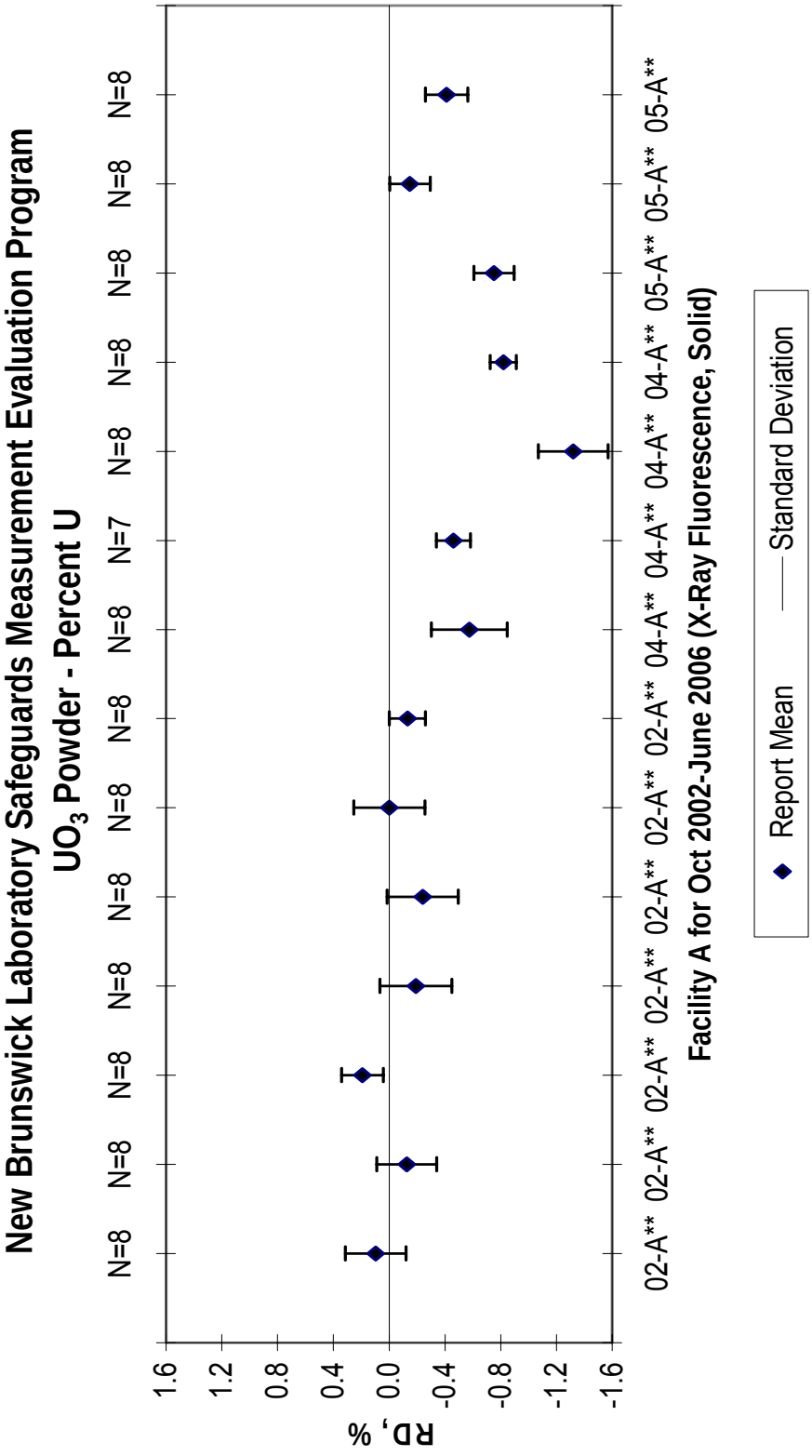

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO3 Powder - Percent U
Facility A for Oct 2002-June 2006 (X-Ray Fluorescence, Solid)
RD, %
1.6
1.2
0.8
0.4
0.0
-0.4
-0.8
-1.2
-1.6
N=8 N=8 N=8 N=8 N=8 N=8 N=8 N=7 N=8 N=8 N=8 N=8 N=8
02-A** 02-A** 02-A** 02-A** 02-A** 02-A** 04-A** 04-A** 04-A** 04-A** 05-A** 05-A** 05-A**
Report Mean
Standard Deviation

Figure 47

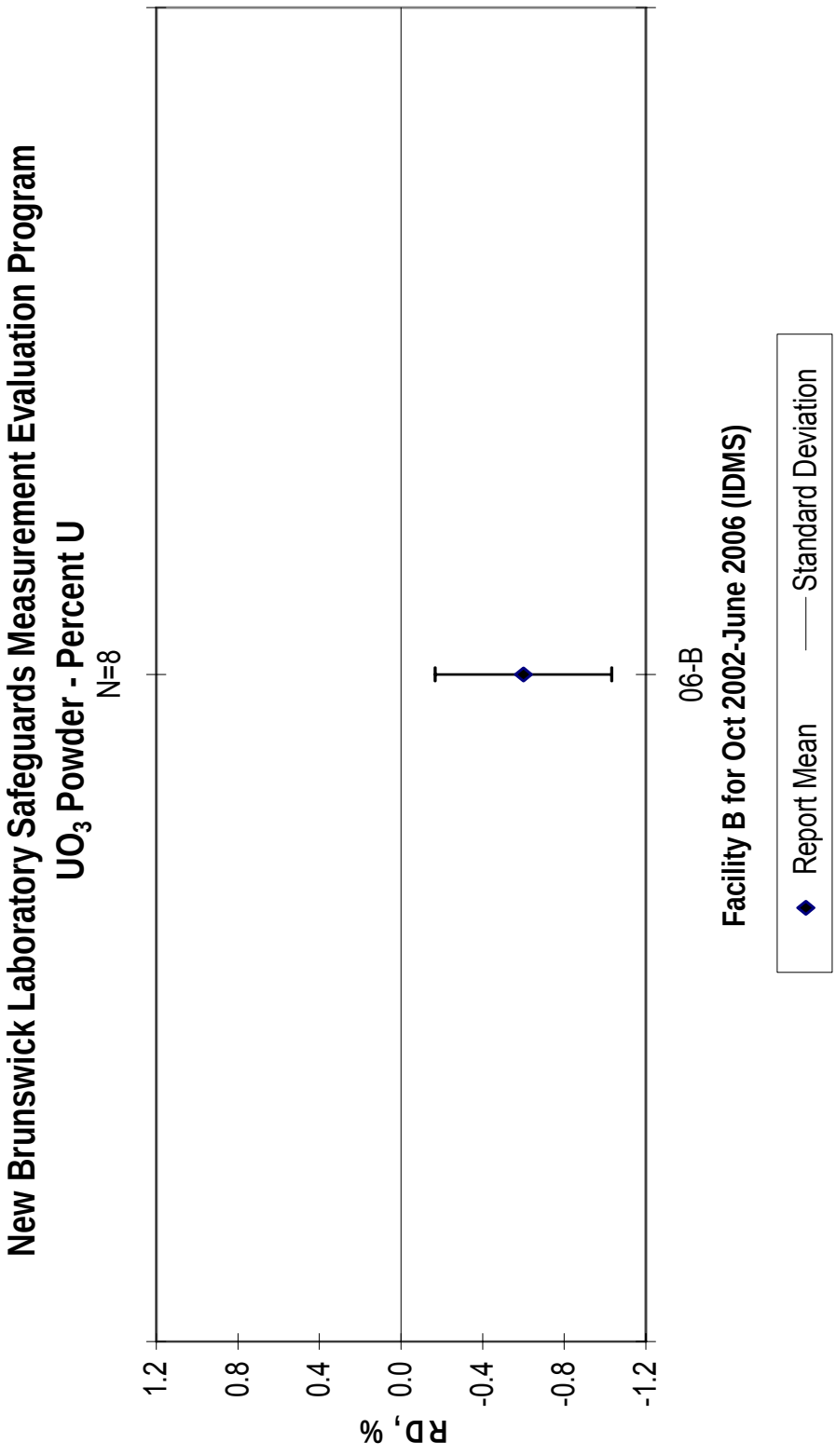

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO3 Powder - Percent U
N=8
06-B
Facility B for Oct 2002-June 2006 (IDMS)
RD, %
1.2
0.8
0.4
0.0
-0.4
-0.8
-1.2
Report Mean
Standard Deviation

Figure 48

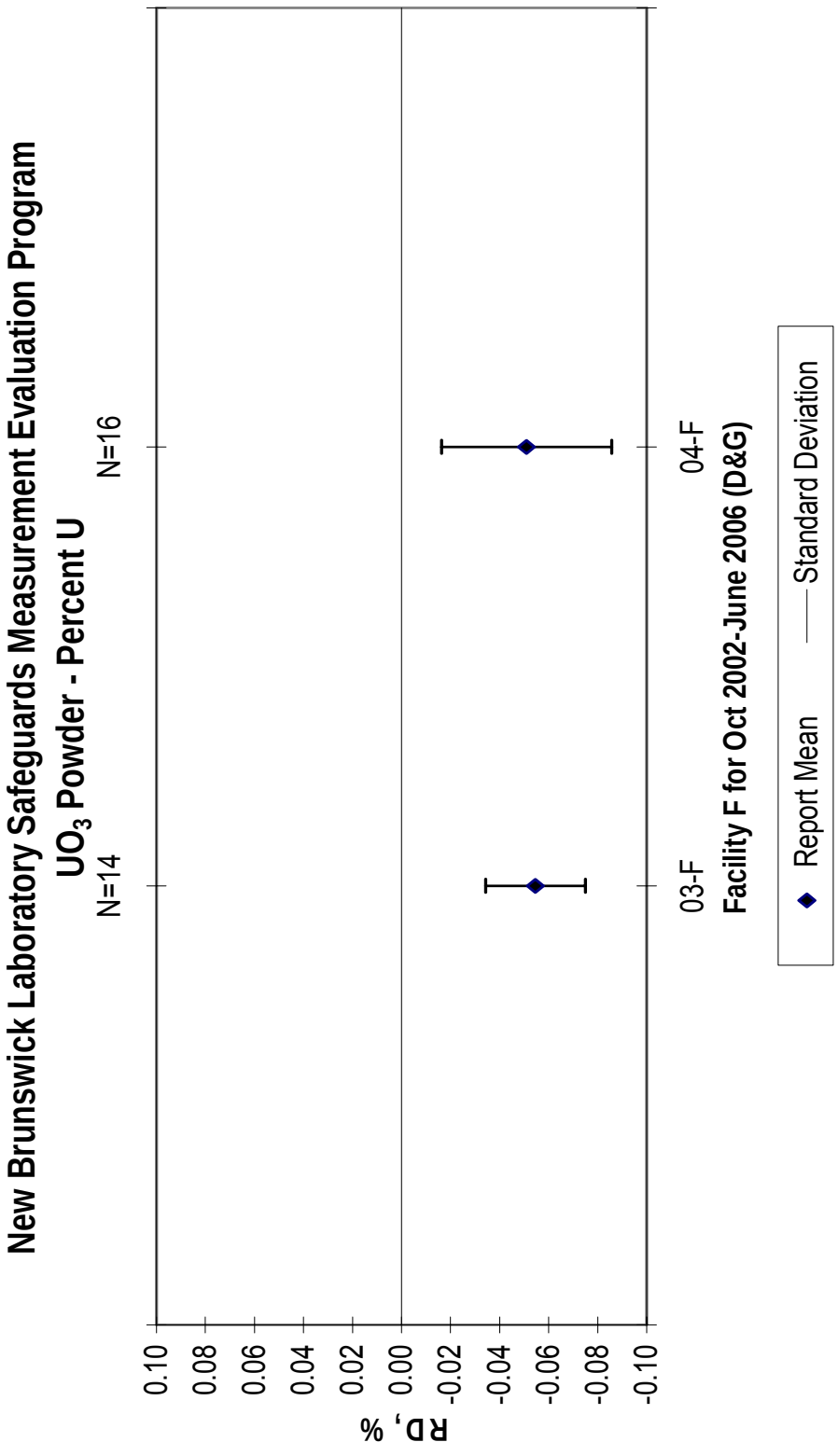

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO_3 Powder - Percent U
N=14
N=16
0.10
0.08
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
RD, %
03-F
04-F
Facility F for Oct 2002-June 2006 (D&G)
Report Mean
Standard Deviation

Figure 49

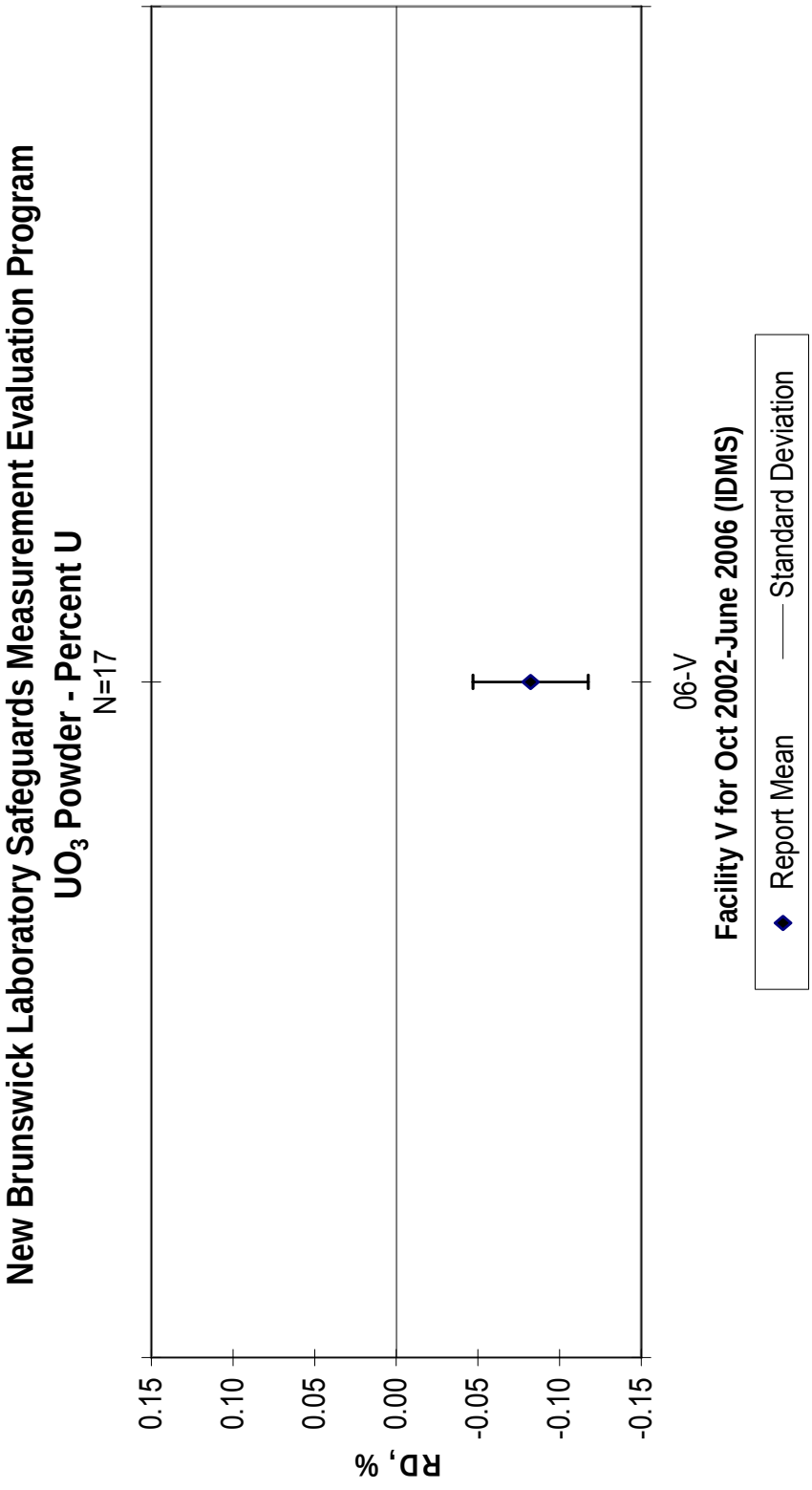

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO3 Powder - Percent U
N=17
RD, %
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
06-V
Facility V for Oct 2002-June 2006 (IDMS)
Report Mean
Standard Deviation

Figure 50

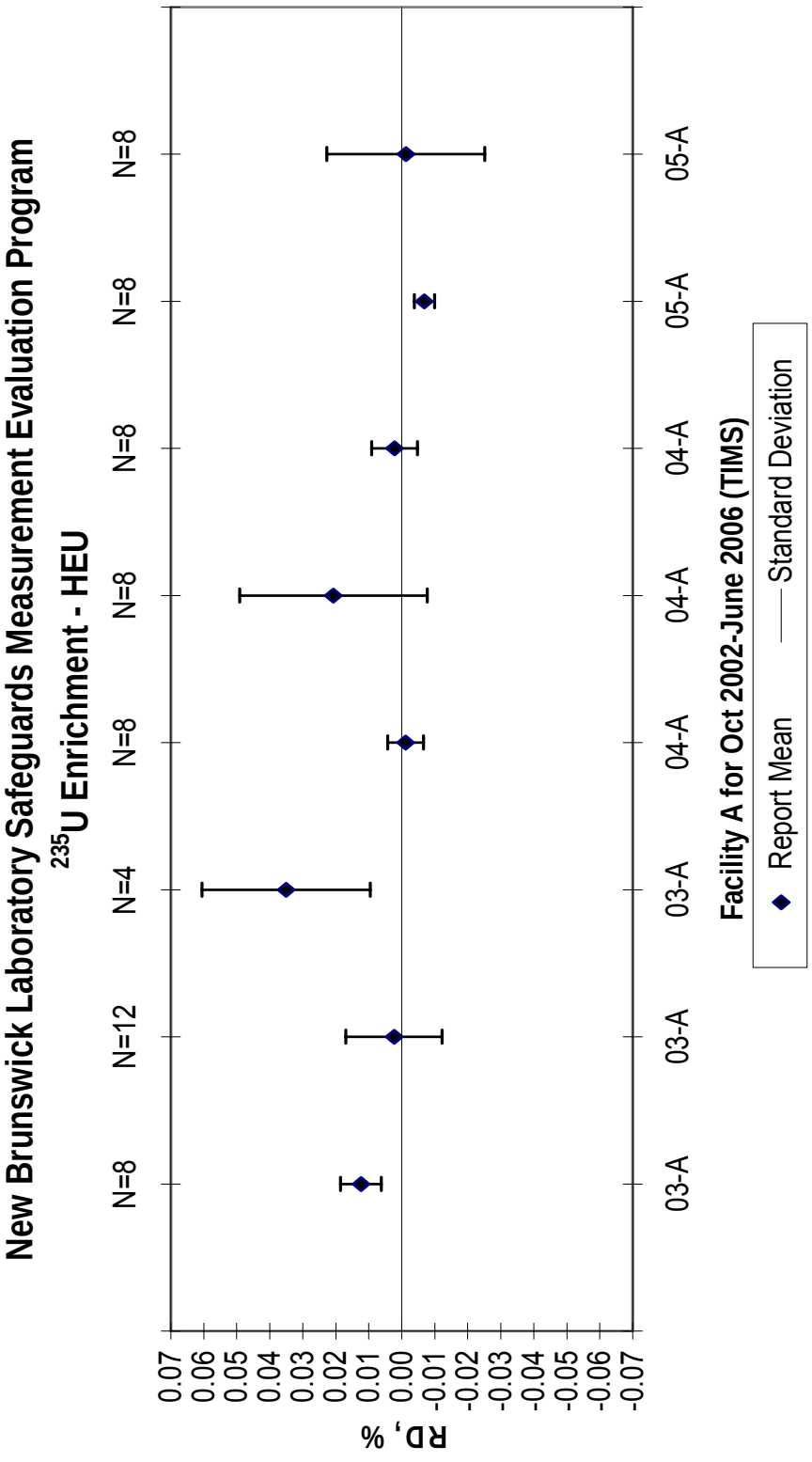

New Brunswick Laboratory Safeguards Measurement Evaluation Program
235U Enrichment - HEU
RD, %
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
N=8
N=12
N=4
N=8
N=8
N=8
N=8
03-A
03-A
03-A
04-A
04-A
04-A
05-A
05-A
Facility A for Oct 2002-June 2006 (TIMS)
Report Mean
Standard Deviation

Figure 51

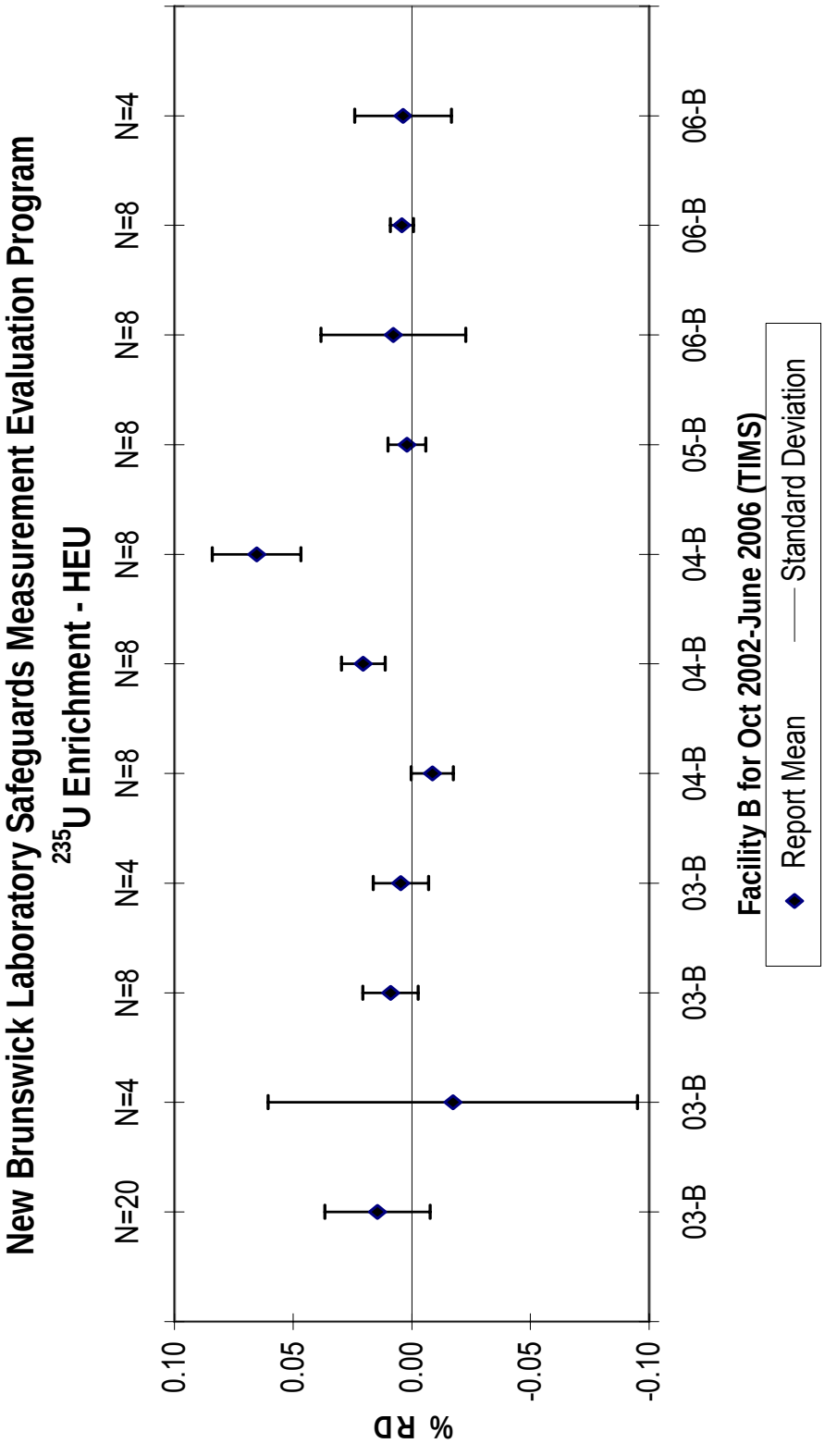

New Brunswick Laboratory Safeguards Measurement Evaluation Program
235U Enrichment - HEU
% RD
0.10
0.05
0.00
-0.05
-0.10
N=20
N=4
N=8
N=4
N=8
N=8
N=8
N=8
N=8
N=4
03-B
03-B
03-B
03-B
04-B
04-B
04-B
05-B
06-B
06-B
06-B
Facility B for Oct 2002-June 2006 (TIMS)
Report Mean
Standard Deviation

Figure 52

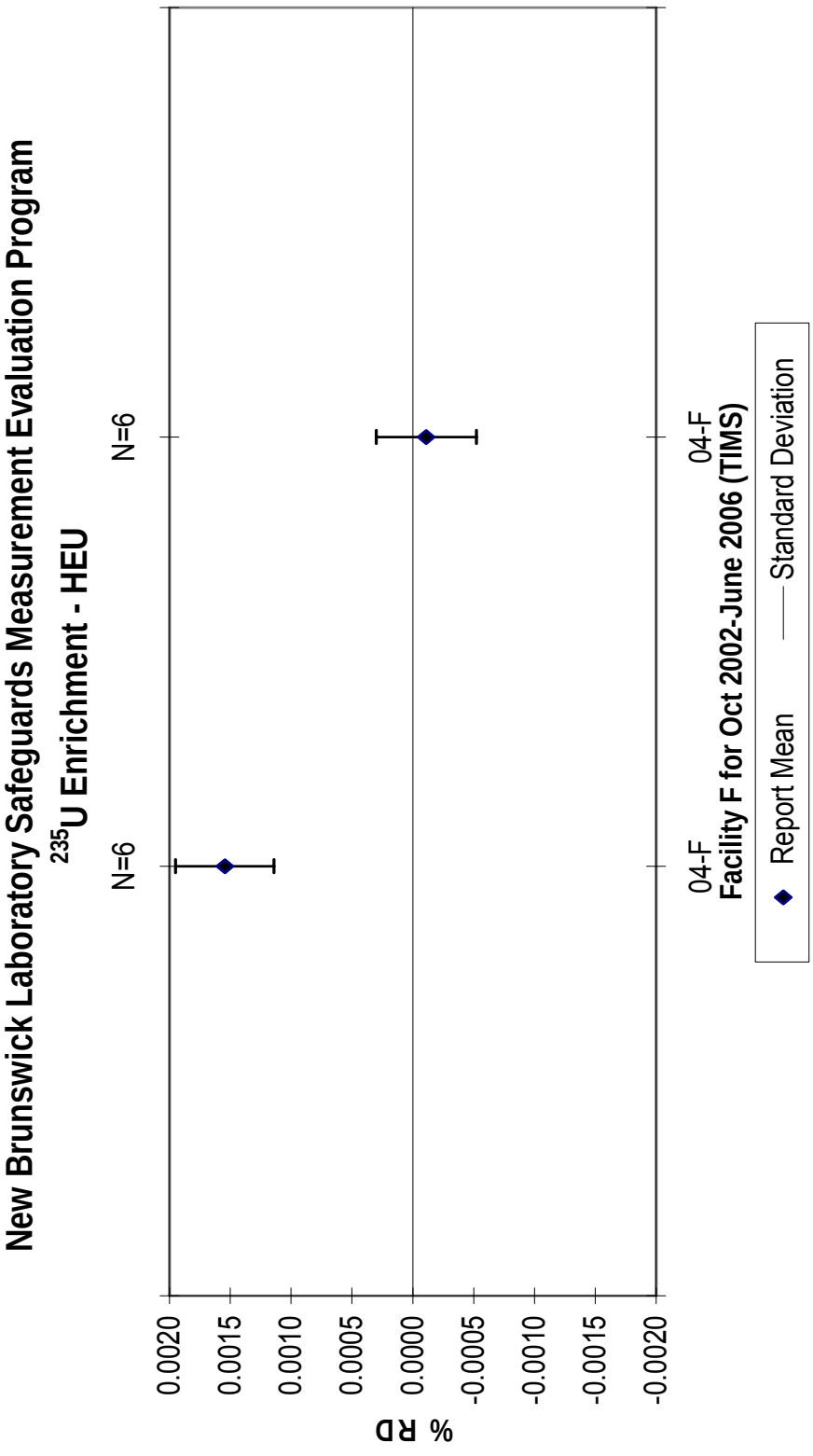

New Brunswick Laboratory Safeguards Measurement Evaluation Program
235U Enrichment - HEU
N=6
N=6
04-F
04-F
Facility F for Oct 2002-June 2006 (TIMS)
Report Mean
Standard Deviation
% RD
0.0020
0.0015
0.0010
0.0005
0.0000
-0.0005
-0.0010
-0.0015
-0.0020

Figure 53

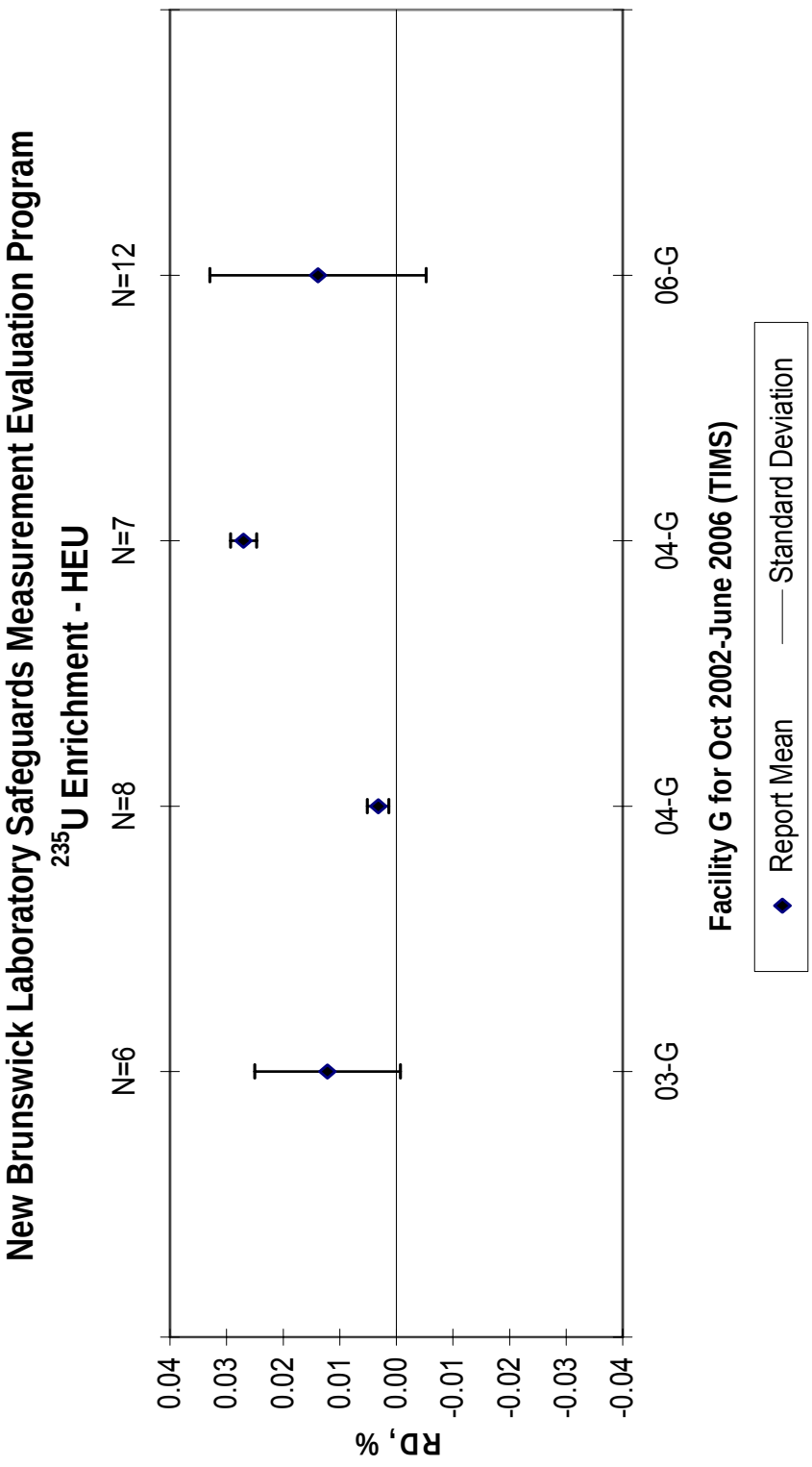

New Brunswick Laboratory Safeguards Measurement Evaluation Program
235U Enrichment - HEU
Facility G for Oct 2002-June 2006 (TIMS)
RD, %
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
N=6
N=8
N=7
N=12
03-G
04-G
04-G
06-G
Report Mean
Standard Deviation

Figure 54

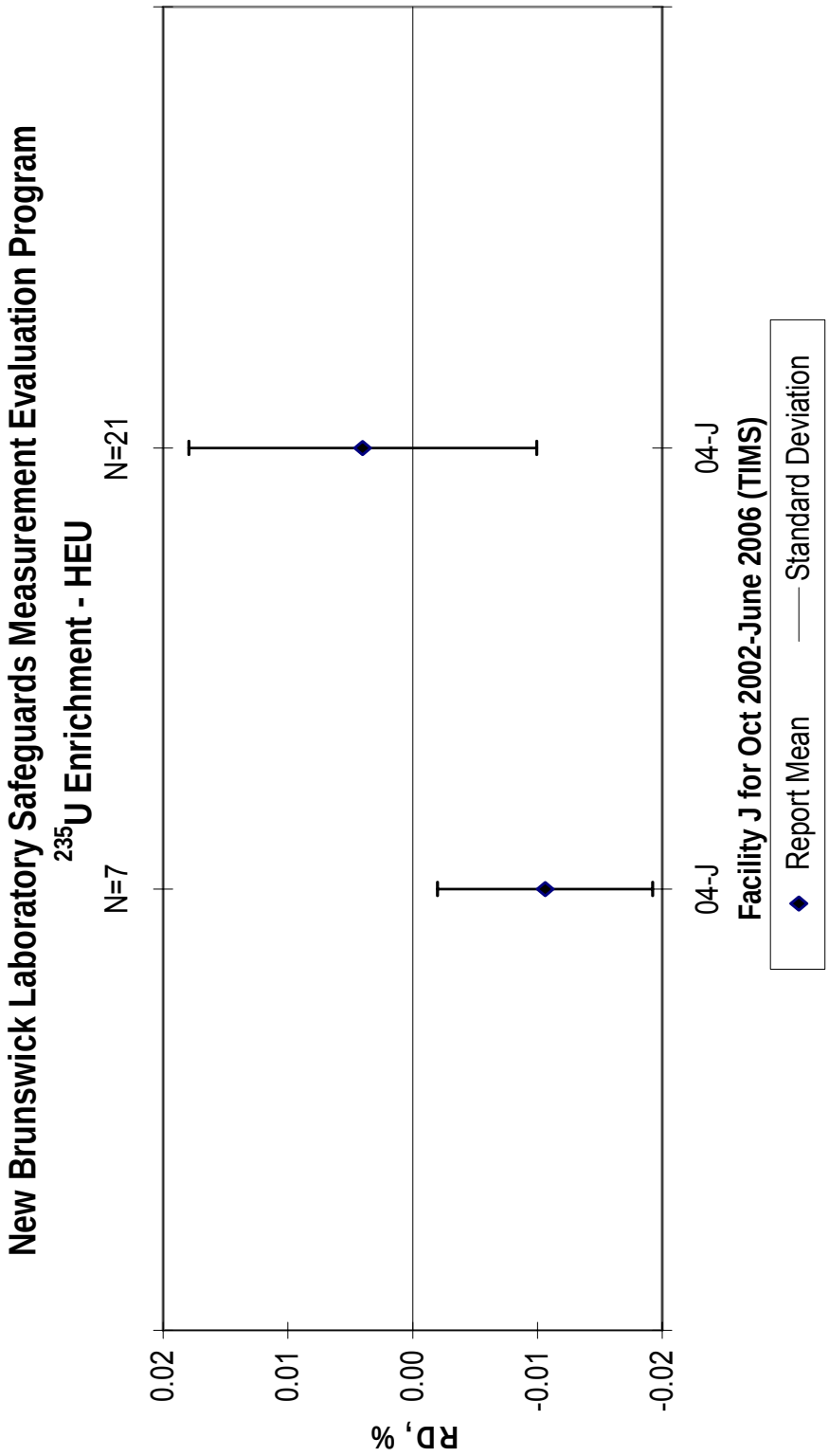

New Brunswick Laboratory Safeguards Measurement Evaluation Program
235U Enrichment - HEU
N=7
N=21
04-J
04-J
Facility J for Oct 2002-June 2006 (TIMS)
Report Mean
Standard Deviation
RD, %
0.02
0.01
0.00
-0.01
-0.02

Figure 55

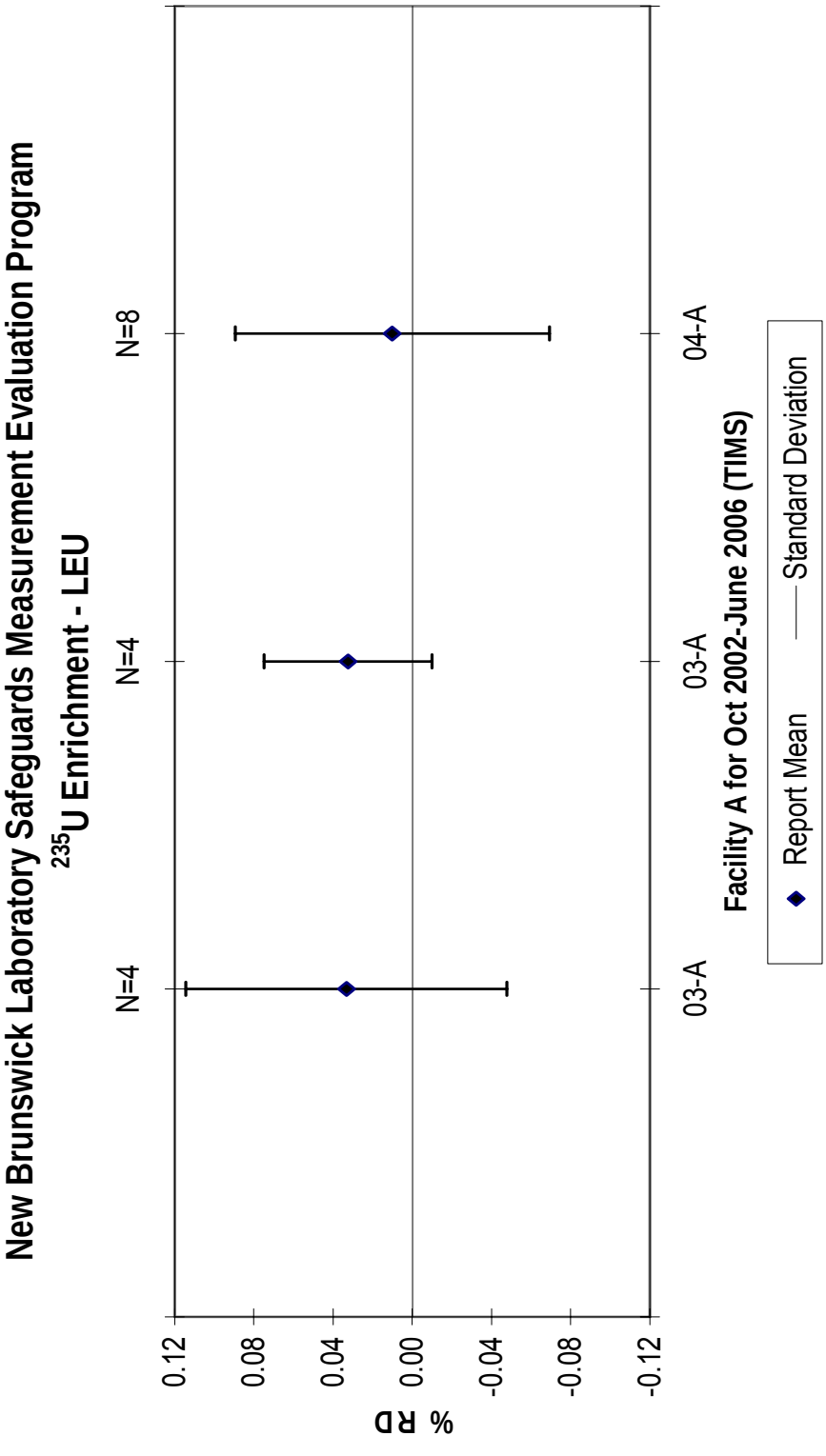

New Brunswick Laboratory Safeguards Measurement Evaluation Program
235U Enrichment - LEU
Facility A for Oct 2002-June 2006 (TIMS)
Report Mean
Standard Deviation
% RD
0.12
0.08
0.04
0.00
-0.04
-0.08
-0.12
N=4
N=4
N=8
03-A
03-A
04-A

Figure 56

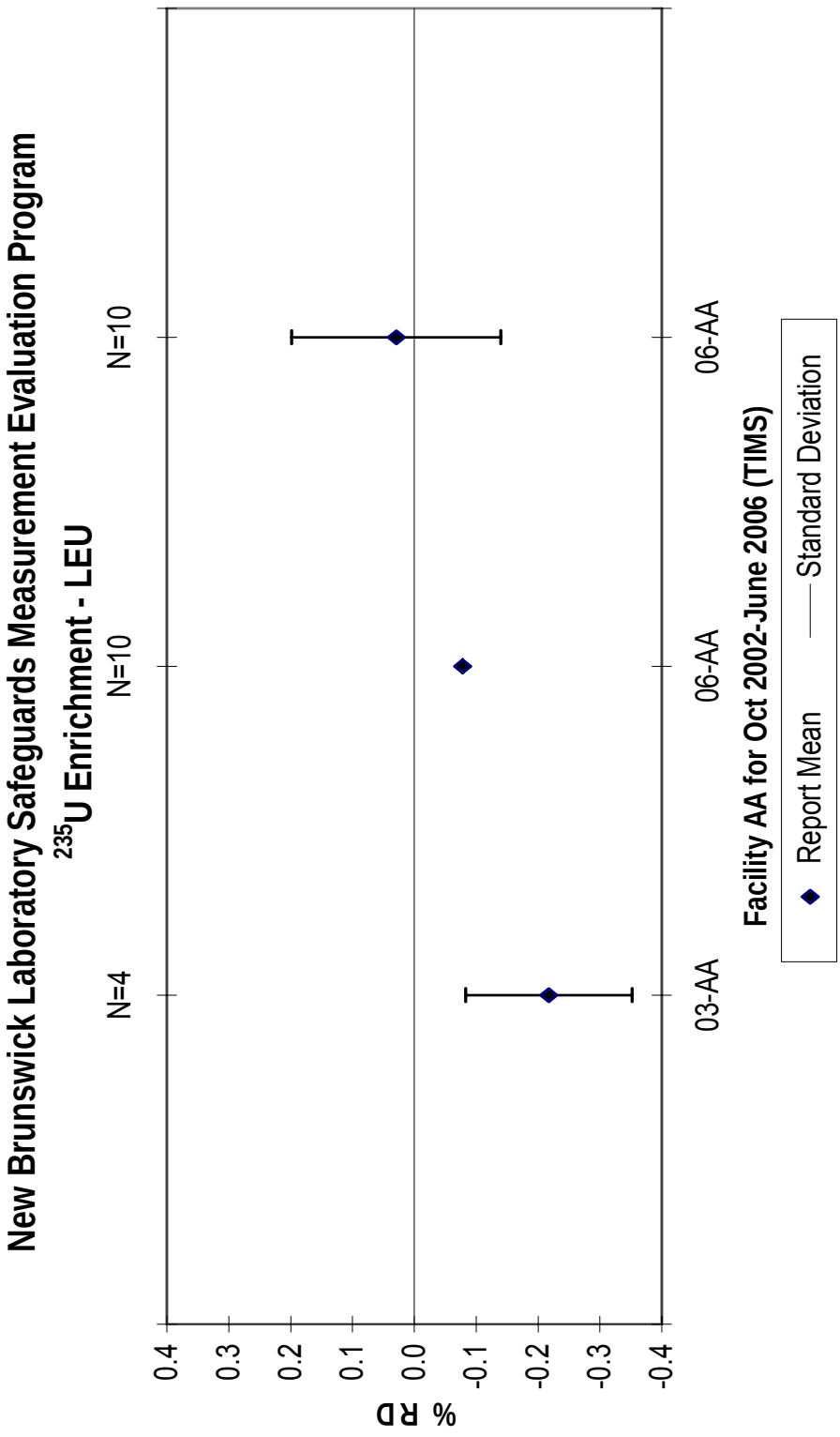

New Brunswick Laboratory Safeguards Measurement Evaluation Program
235U Enrichment - LEU
N=4
N=10
N=10
03-AA
06-AA
06-AA
Facility AA for Oct 2002-June 2006 (TIMS)
% RD
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
Report Mean
Standard Deviation

Figure 57

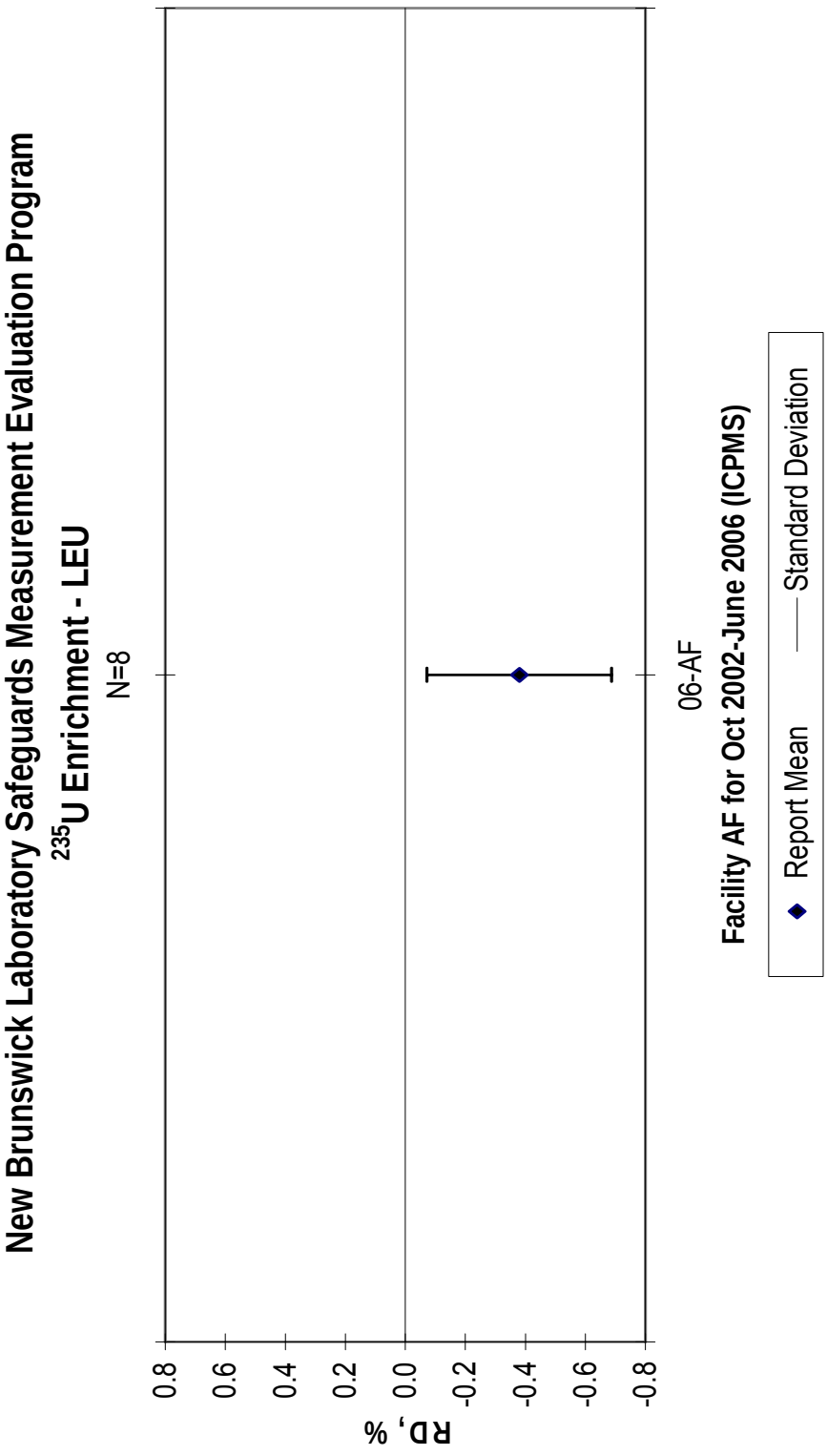

New Brunswick Laboratory Safeguards Measurement Evaluation Program
235U Enrichment - LEU
N=8
RD, %
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
06-AF
Facility AF for Oct 2002-June 2006 (ICPMS)
Report Mean
Standard Deviation

Figure 58

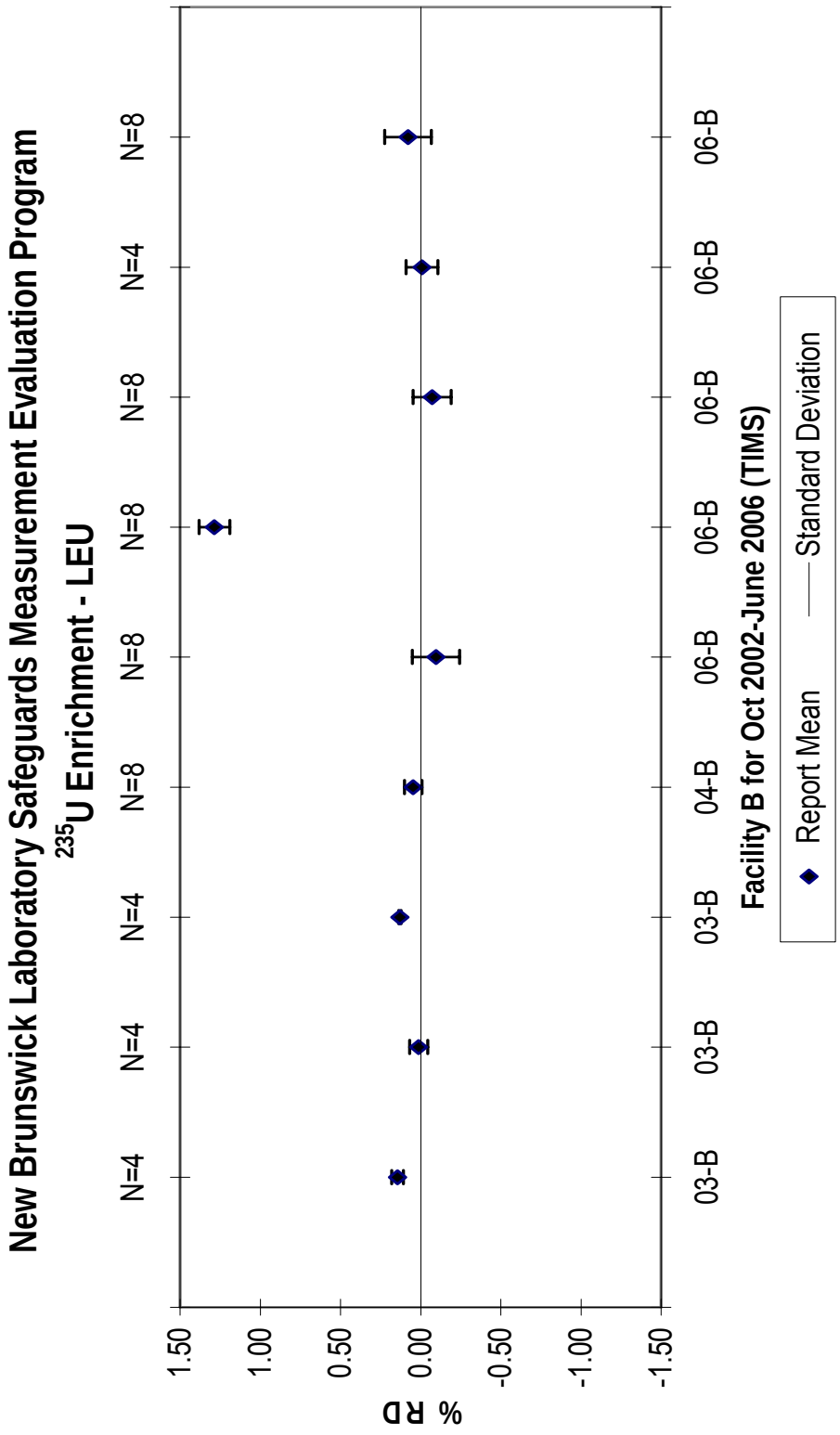

New Brunswick Laboratory Safeguards Measurement Evaluation Program
235U Enrichment - LEU
% RD
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
N=4
N=4
N=4
N=8
N=8
N=8
N=4
N=8
03-B
03-B
03-B
04-B
06-B
06-B
06-B
06-B
Facility B for Oct 2002-June 2006 (TIMS)
Report Mean
Standard Deviation

Figure 59

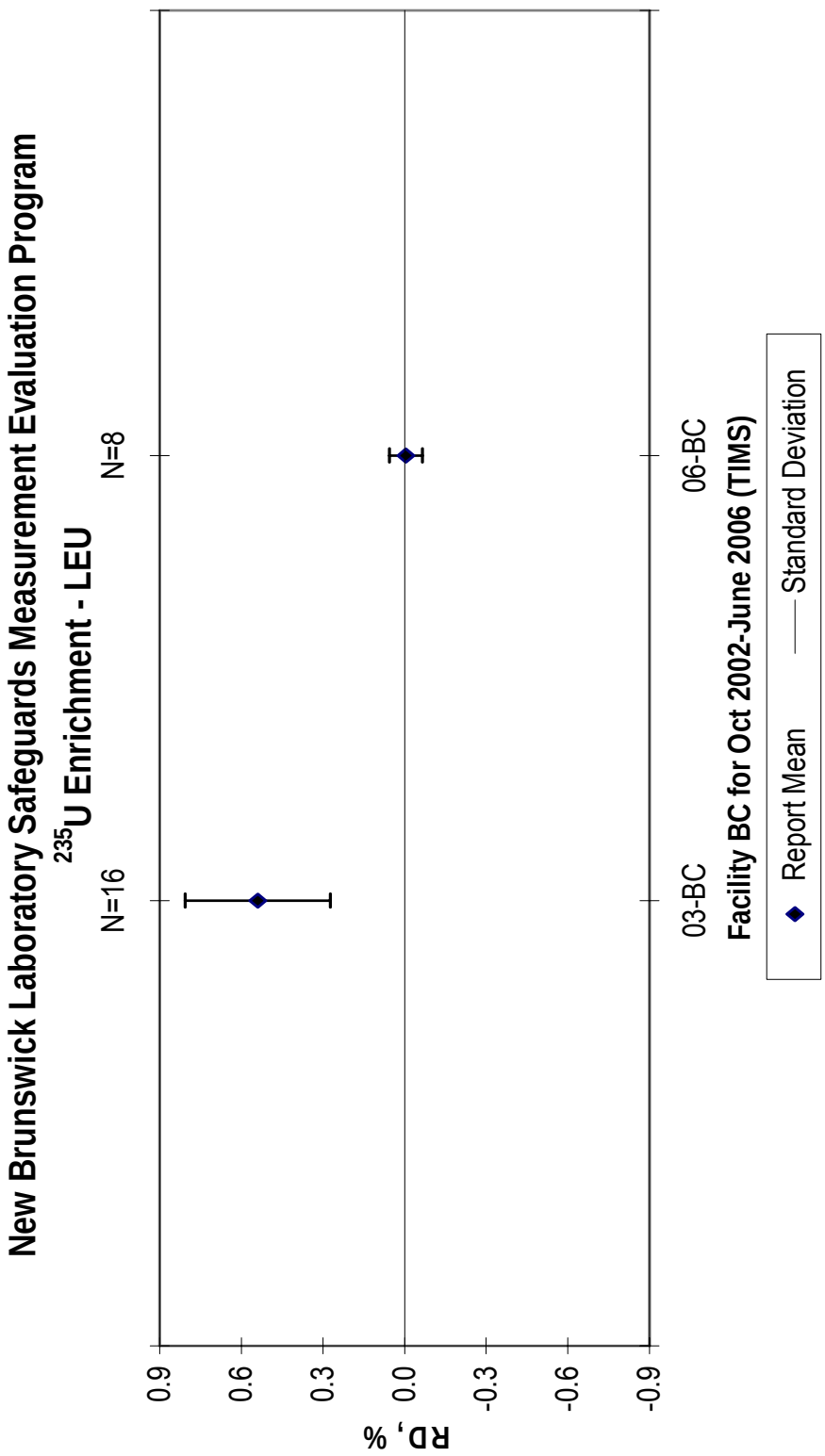

New Brunswick Laboratory Safeguards Measurement Evaluation Program
235U Enrichment - LEU
Facility BC for Oct 2002-June 2006 (TIMS)
RD, %
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
N=16
N=8
03-BC
06-BC
Report Mean
Standard Deviation

Figure 60

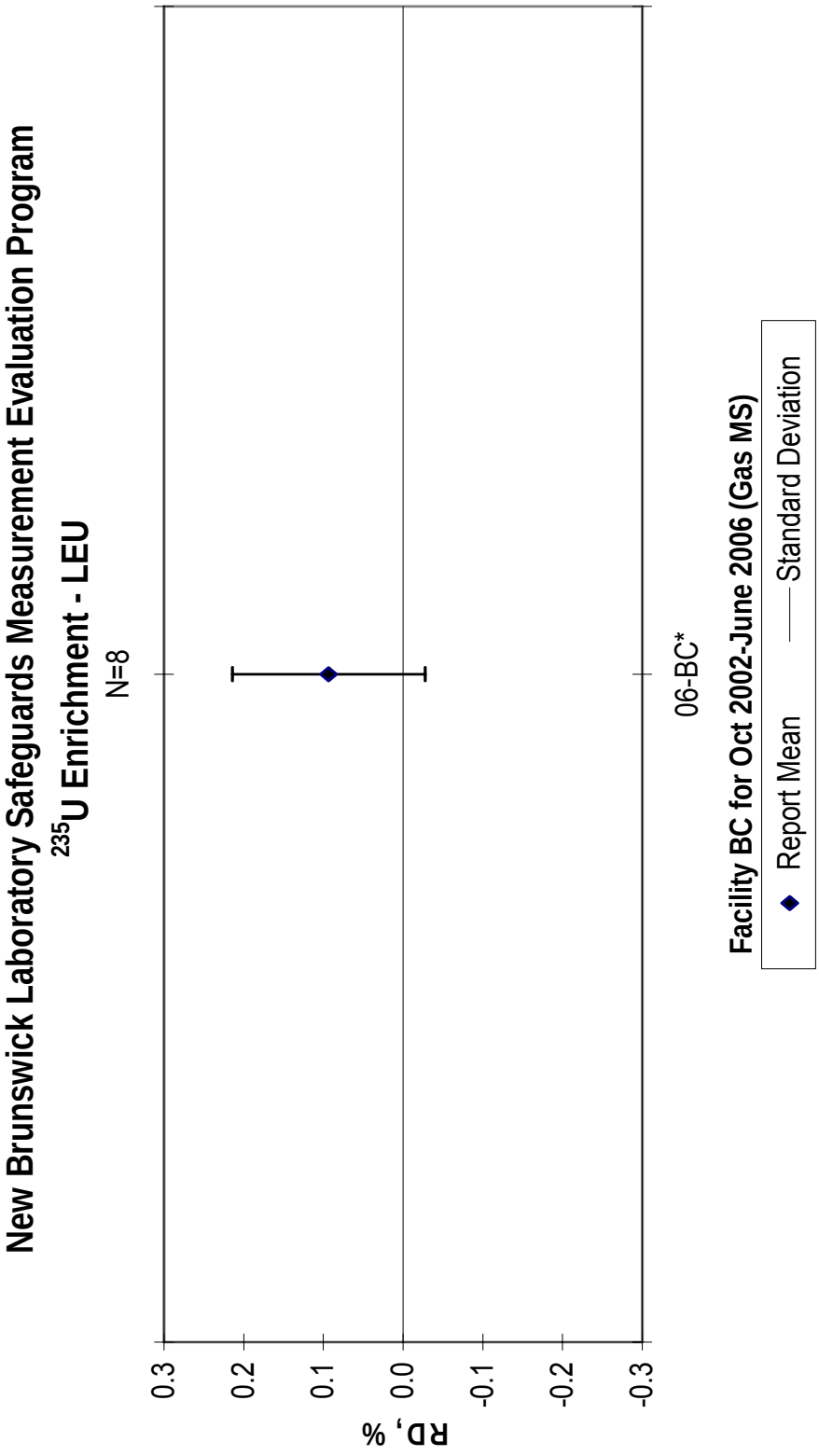

New Brunswick Laboratory Safeguards Measurement Evaluation Program
235U Enrichment - LEU
N=8
RD, %
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
06-BC*
Facility BC for Oct 2002-June 2006 (Gas MS)
Report Mean
Standard Deviation

Figure 61

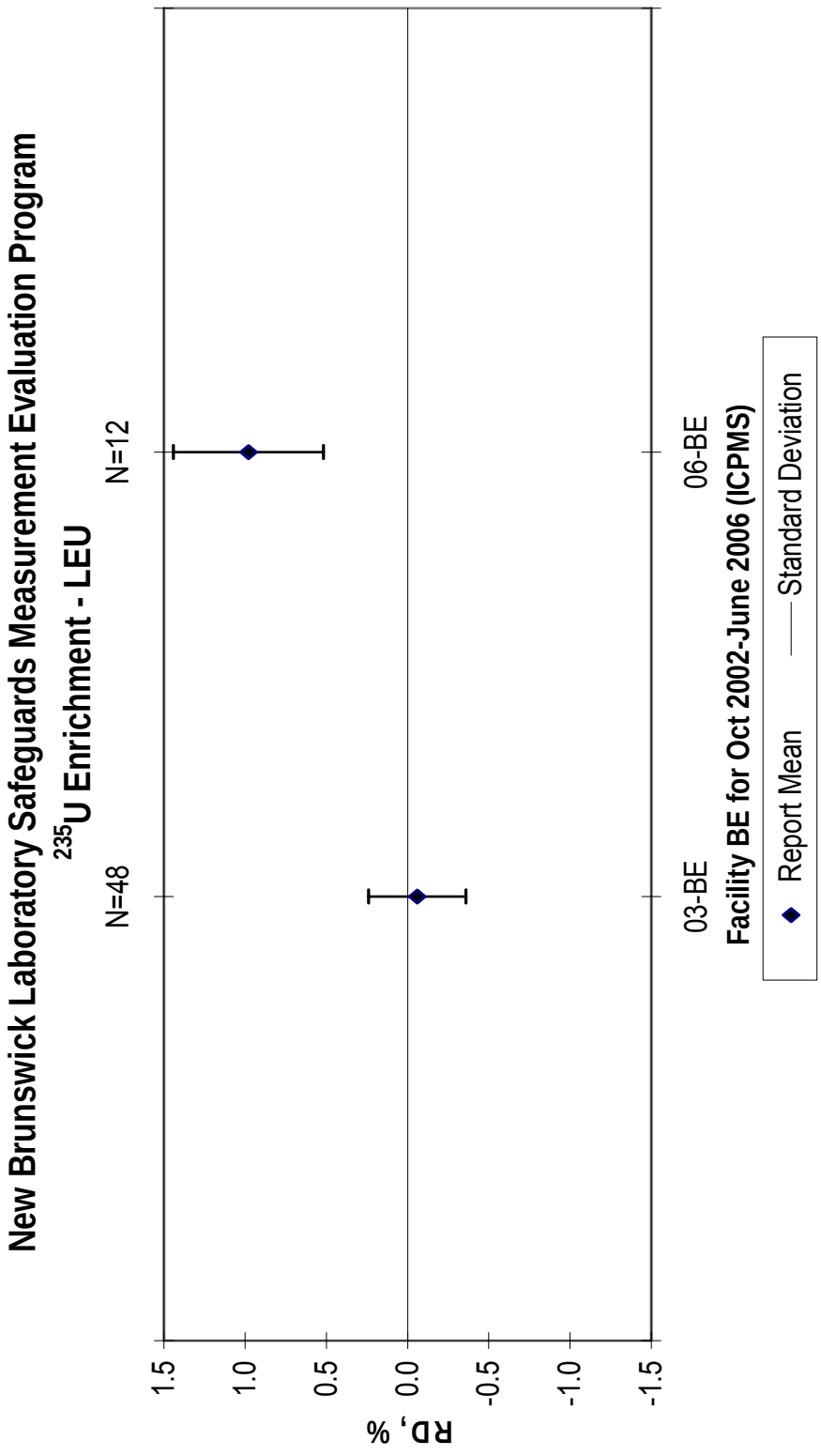

New Brunswick Laboratory Safeguards Measurement Evaluation Program
235U Enrichment - LEU
N=48
N=12
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
RD, %
03-BE
06-BE
Facility BE for Oct 2002-June 2006 (ICPMS)
Report Mean
Standard Deviation

Figure 62

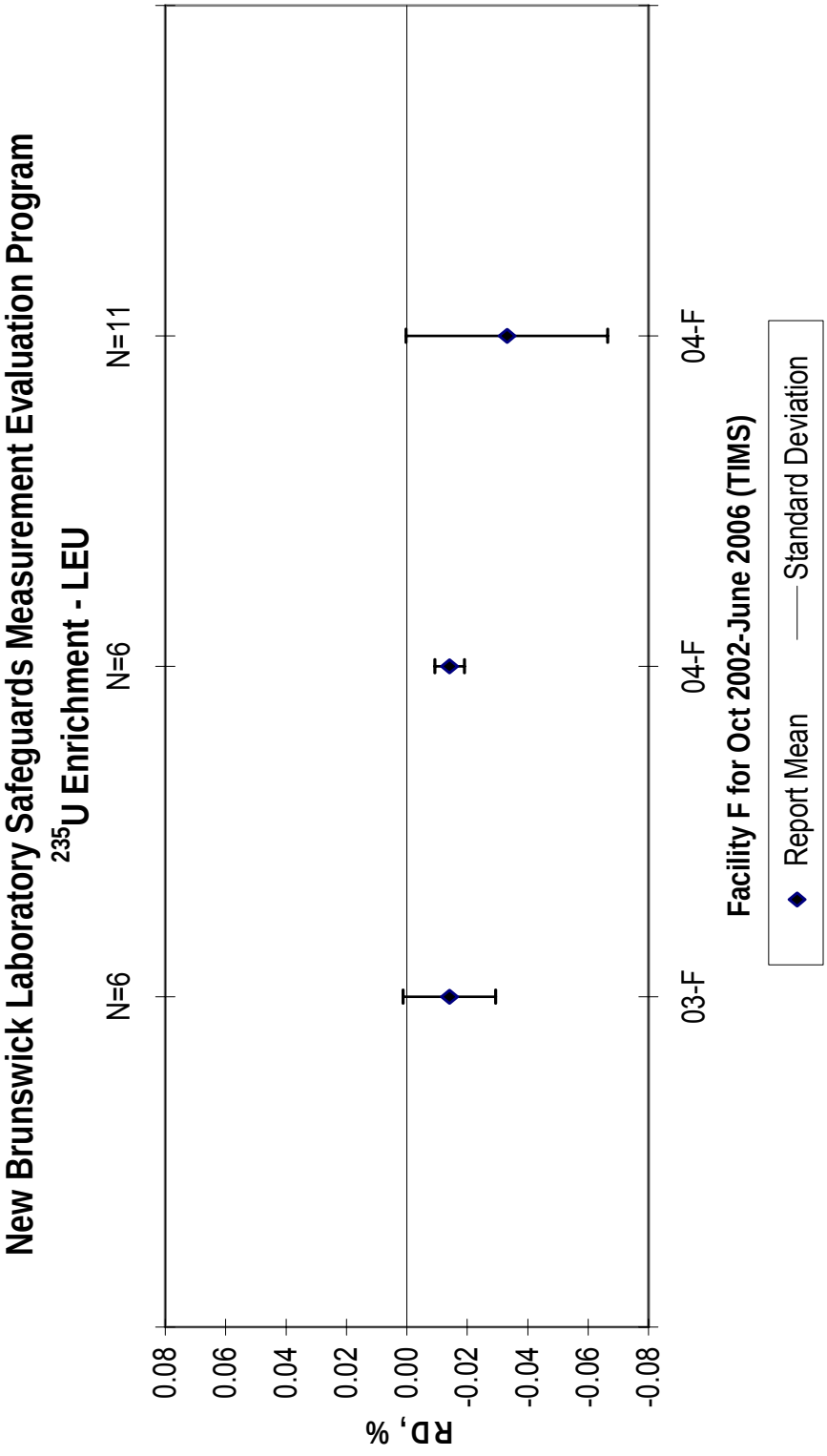

New Brunswick Laboratory Safeguards Measurement Evaluation Program
235U Enrichment - LEU
N=6
N=6
N=11
03-F
04-F
04-F
Facility F for Oct 2002-June 2006 (TIMS)
Report Mean
Standard Deviation
RD, %
0.08
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
-0.08

Figure 63

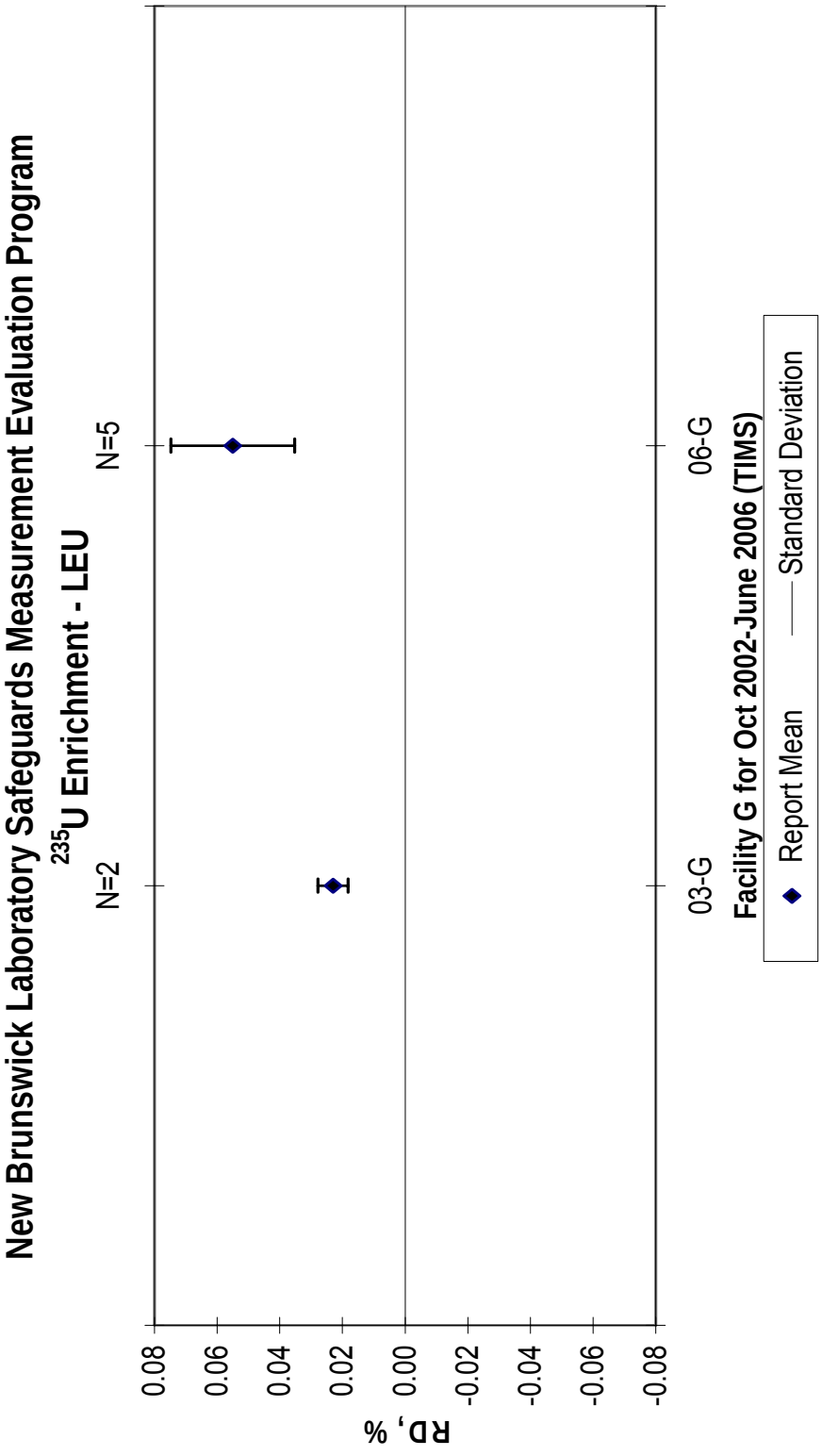

New Brunswick Laboratory Safeguards Measurement Evaluation Program
235U Enrichment - LEU
N=2
N=5
RD, %
0.08
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
-0.08
03-G
06-G
Facility G for Oct 2002-June 2006 (TIMS)
Report Mean
Standard Deviation

Figure 64

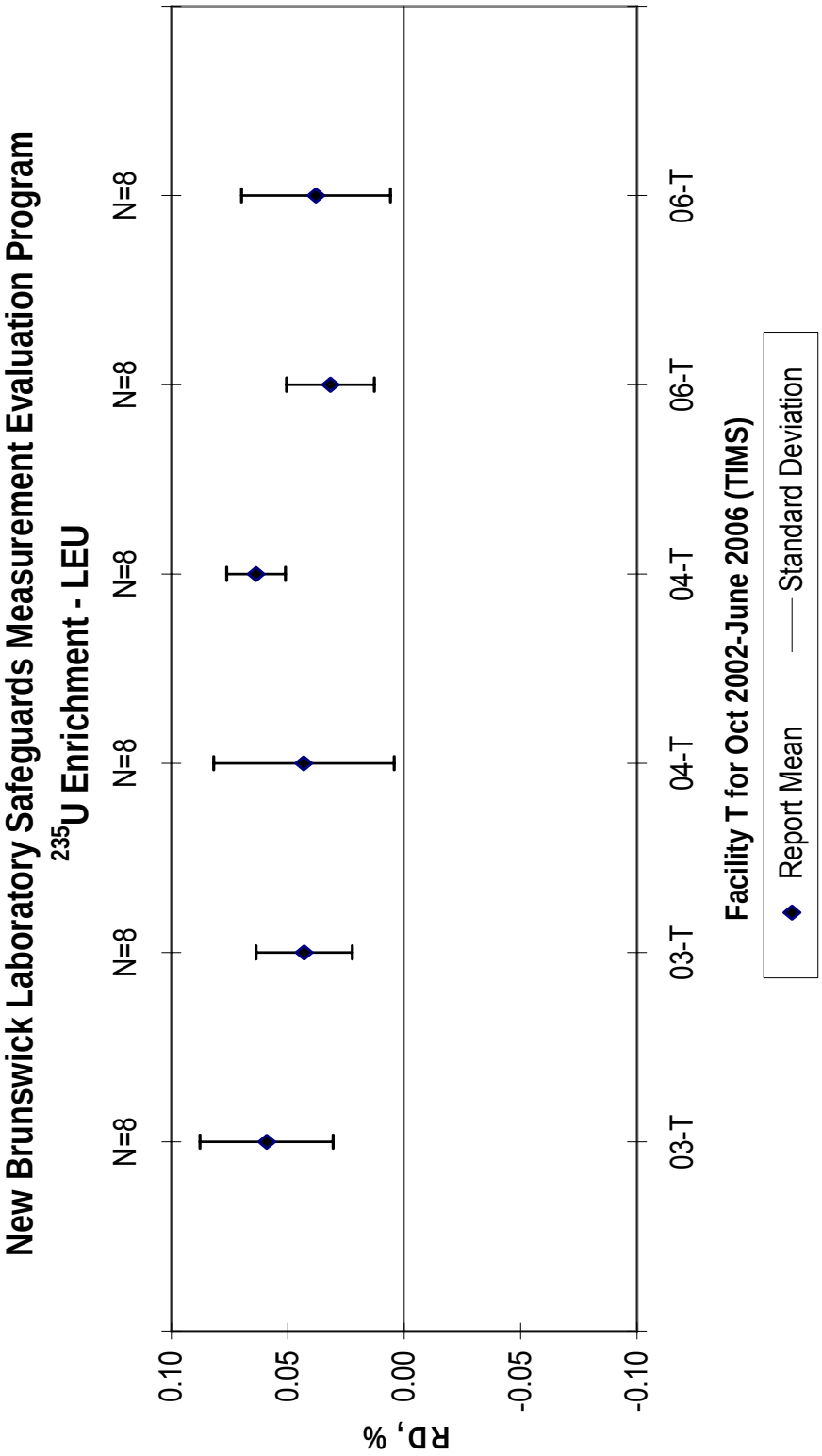
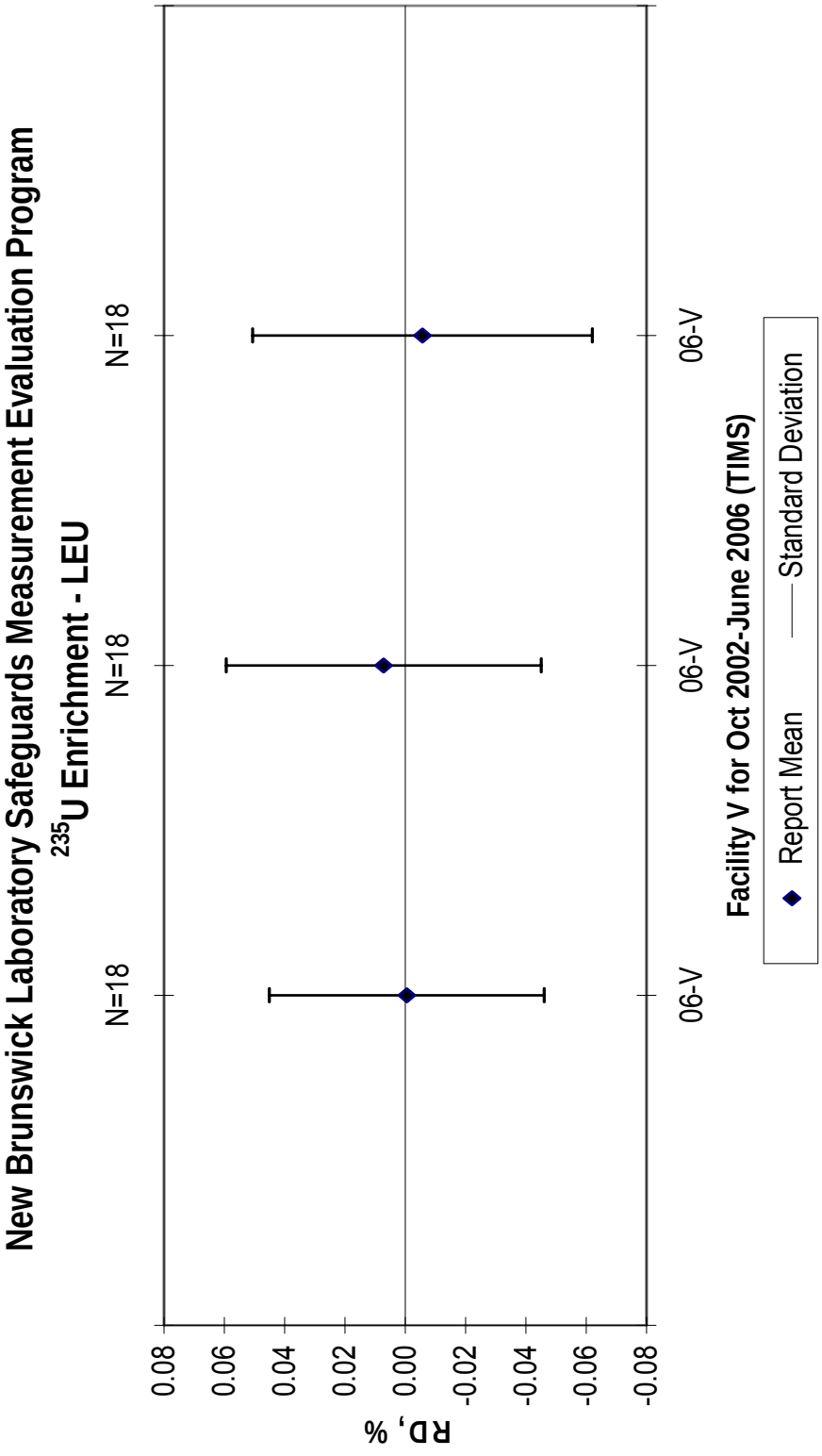

New Brunswick Laboratory Safeguards Measurement Evaluation Program
235U Enrichment - LEU
RD, %
0.10
0.05
0.00
-0.05
-0.10
N=8
03-T
04-T
06-T
Facility T for Oct 2002-June 2006 (TIMS)
Report Mean
Standard Deviation

Figure 65


New Brunswick Laboratory Safeguards Measurement Evaluation Program
235U Enrichment - LEU
N=18
N=18
N=18
06-V
06-V
06-V
Facility V for Oct 2002-June 2006 (TIMS)
Report Mean
Standard Deviation
RD, %
0.08
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
-0.08

APPENDICES

Appendix A: Uranium Assay Results

Appendix B: Uranium Isotopic Results

Appendix C: ^{239}Pu Isotopic Results

Appendix D: ^{240}Pu Isotopic Results

Key to symbols in the tables in the appendices

Material Symbols

UNH	Uranyl Nitrate Solution
UO_2	Uranium Dioxide Pellet
UF_6	Uranium Hexafluoride
UO_3	Uranium Trioxide Powder
HEU	Highly Enriched Uranium
LEU	Low Enriched Uranium

Method Type Symbols

DG	Davies-Gray Titration
IDMS	Isotope Dilution Mass Spectrometry
XRFL	X-Ray Fluorescence - Liquid
XRFS	X-Ray Fluorescence - Solid
TIMS	Thermal Ionization Mass Spectrometry
HPT	High Precision Titration
GSMS	Gas Source Mass Spectrometry
ICPMS	Inductively Coupled Plasma Mass Spectrometry

Appendix A: Uranium Assay Results

Material	Method Type	Facility	Analysis Date	Reported Result	% RD	Analyst
UNH	DG	B	1/22/05	1.0070	0.645	0849
UNH	DG	B	1/23/05	1.00286	0.231	3747
UNH	DG	B	1/23/05	1.00290	0.235	3747
UNH	DG	B	1/22/05	1.0088	0.476	0849
UNH	DG	B	1/22/05	1.0151	1.104	0849
UNH	DG	B	1/23/05	1.0098	0.576	3747
UNH	DG	B	1/23/05	1.0088	0.476	3747
UNH	DG	B	10/7/04	1.0058	0.177	6219
UNH	DG	B	10/7/04	1.0071	0.307	6219
UNH	DG	B	10/7/04	1.0025	-0.151	6219
UNH	DG	B	10/7/04	1.0061	0.207	6219
UNH	DG	B	10/30/04	1.0055	0.495	6219
UNH	DG	B	10/30/04	1.0050	0.445	6219
UNH	DG	B	10/30/04	1.0034	0.285	6219
UNH	DG	B	10/30/04	1.0019	0.135	6219
UNH	DG	B	1/26/06	1.0063	0.227	3747
UNH	DG	B	1/30/06	1.0064	0.237	5011
UNH	DG	B	1/25/06	1.0030	0.245	3747
UNH	DG	B	1/26/06	1.0029	0.235	3747
UNH	DG	B	1/30/06	1.0029	0.235	5011
UNH	DG	B	1/18/06	1.0042	0.018	5011
UNH	DG	B	1/18/06	1.0037	-0.032	5011
UNH	DG	B	1/18/06	1.0015	0.095	5011
UNH	DG	B	1/18/06	1.0010	0.045	5011
UNH	DG	B	1/19/06	1.0013	0.075	5011
UNH	DG	B	1/19/06	1.0012	0.065	5011
UNH	DG	B	3/29/06	1.00182	-0.048	4905
UNH	DG	B	3/29/06	1.00181	-0.049	4905
UNH	DG	B	4/27/06	1.0011	-0.120	3747
UNH	DG	B	4/27/06	0.9991	-0.319	3747
UNH	DG	B	3/29/06	1.00706	0.475	4905
UNH	DG	B	3/29/06	1.00706	0.475	4905
UNH	DG	B	4/27/06	1.0080	0.569	3747
UNH	DG	B	4/27/06	1.0043	0.200	3747
UNH	DG	F	11/17/05	1.0032	-0.082	237
UNH	DG	F	11/17/05	1.0034	-0.062	237
UNH	DG	F	11/18/05	1.0041	0.008	237
UNH	DG	F	11/18/05	1.0040	-0.002	237
UNH	DG	F	11/21/05	1.0043	0.028	231
UNH	DG	F	11/21/05	1.0044	0.038	231
UNH	DG	F	11/22/05	1.0043	0.028	231
UNH	DG	F	11/22/05	1.0049	0.088	231
UNH	DG	F	11/17/05	0.9999	-0.065	237
UNH	DG	F	11/17/05	0.9995	-0.105	237
UNH	DG	F	11/18/05	1.0000	-0.055	237
UNH	DG	F	11/18/05	1.0000	-0.055	237
UNH	DG	F	11/21/05	0.9999	-0.065	231
UNH	DG	F	11/21/05	0.9998	-0.075	231
UNH	DG	F	11/22/05	1.0012	0.065	231
UNH	DG	F	11/22/05	1.0026	0.205	231

Material	Method Type	Facility	Analysis Date	Reported Result	% RD	Analyst
UNH	DG	G	12/9/04	1.00423	0.021	
UNH	DG	G	12/10/04	1.00405	0.003	
UNH	DG	G	12/10/04	1.00392	-0.010	
UNH	DG	G	12/9/04	1.00057	0.002	
UNH	DG	G	12/9/04	1.00059	0.004	
UNH	DG	G	12/10/04	1.00080	0.025	
UNH	DG	G	12/10/04	1.00069	0.014	
UNH	DG	G	3/23/05	1.00412	0.010	
UNH	DG	G	3/23/05	1.00425	0.023	
UNH	DG	G	3/24/05	1.00381	-0.021	
UNH	DG	G	3/24/05	1.00389	-0.013	
UNH	DG	G	3/23/05	1.00253	0.023	
UNH	DG	G	3/23/05	1.00219	-0.011	
UNH	DG	G	3/24/05	1.00201	-0.029	
UNH	DG	G	3/24/05	1.00219	-0.011	
UNH	DG	G	10/4/05	1.00419	0.017	
UNH	DG	G	10/4/05	1.00397	-0.005	
UNH	DG	G	10/5/05	1.00413	0.011	
UNH	DG	G	10/5/05	1.00378	-0.024	
UNH	DG	G	10/4/05	1.00077	0.022	
UNH	DG	G	10/4/05	1.00043	-0.012	
UNH	DG	G	10/5/05	1.00073	0.018	
UNH	DG	G	10/5/05	1.00079	0.024	
UNH	DG	G	2/22/06	1.00414	0.012	
UNH	DG	G	2/22/06	1.00388	-0.014	
UNH	DG	G	2/23/06	1.00379	-0.023	
UNH	DG	G	2/23/06	1.00411	0.009	
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	1.00055	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	4/20/06	1.00399	-0.003	
UNH	DG	G	4/20/06	1.00404	0.002	
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	1.00261	0.031	
UNH	DG	G	4/20/06	1.00210	-0.020	
UNH	DG	V	3/21/06	1.00227	-0.174	1
UNH	DG	V	3/21/06	1.00217	-0.184	1
UNH	DG	V	3/21/06	1.00177	-0.224	1
UNH	DG	V	4/5/06	1.00249	-0.152	1
UNH	DG	V	4/5/06	1.00229	-0.172	1
UNH	DG	V	4/5/06	1.00339	-0.063	1
UNH	DG	V	4/25/06	1.00356	-0.046	1
UNH	DG	V	4/25/06	1.00356	-0.046	1
UNH	DG	V	4/25/06	1.00356	-0.046	1
UNH	DG	V	3/21/06	0.99927	-0.128	1
UNH	DG	V	3/21/06	1.00017	-0.038	1
UNH	DG	V	3/21/06	0.99967	-0.088	1
UNH	DG	V	4/5/06	0.99911	-0.144	1
UNH	DG	V	4/5/06	1.00011	-0.044	1
UNH	DG	V	4/5/06	0.99982	-0.073	1
UNH	DG	V	4/25/06	1.00044	-0.011	1
UNH	DG	V	4/25/06	1.00060	0.005	1
UNH	DG	V	4/25/06	1.00052	-0.003	1

Material	Method Type	Facility	Analysis Date	Reported Result	% RD	Analyst
UNH	IDMS	A	11/8/04	1.0024	-0.161	GPW/JM
UNH	IDMS	A	11/8/04	1.0036	-0.042	GPW/JM
UNH	IDMS	A	11/10/04	1.0037	-0.032	DLB/JM
UNH	IDMS	A	11/10/04	1.0048	0.078	DLB/JM
UNH	IDMS	A	11/8/04	1.0011	-0.120	GPW/JM
UNH	IDMS	A	11/8/04	1.0030	0.070	GPW/JM
UNH	IDMS	A	11/10/04	1.0013	-0.100	DLB/JM
UNH	IDMS	A	11/10/04	1.0038	0.150	DLB/JM
UNH	IDMS	A	9/14/05	1.0038	-0.022	BLM/GPW
UNH	IDMS	A	9/15/05	1.0044	0.038	DLB/GPW
UNH	IDMS	A	9/19/05	1.0042	0.018	WS/GPW
UNH	IDMS	A	9/19/05	1.0041	0.008	WS/GPW
UNH	IDMS	A	9/14/05	1.0004	-0.015	BLM/GPW
UNH	IDMS	A	9/14/05	1.0004	-0.015	BLM/GPW
UNH	IDMS	A	9/15/05	1.0008	0.025	DLB/GPW
UNH	IDMS	A	9/15/05	1.0008	0.025	DLB/GPW
UNH	IDMS	A	9/19/05	1.0008	0.025	WS/GPW
UNH	IDMS	A	9/19/05	1.0007	0.015	WS/GPW
UNH	IDMS	B	1/4/05	0.4698	-0.068	CDN
UNH	IDMS	B	1/4/05	0.4696	-0.111	CDN
UNH	IDMS	B	1/8/05	0.4654	-1.004	JLB
UNH	IDMS	B	1/8/05	0.4655	-0.983	JLB
UNH	IDMS	B	1/4/05	0.4593	-1.296	CDN
UNH	IDMS	B	1/4/05	0.4591	-1.339	CDN
UNH	IDMS	B	1/8/05	0.4562	-1.962	JLB
UNH	IDMS	B	1/8/05	0.4563	-1.941	JLB
UNH	IDMS	B	1/9/06	0.9978	-0.620	PAM
UNH	IDMS	B	1/9/06	0.9984	-0.560	PAM
UNH	IDMS	B	1/12/06	1.0015	-0.251	DDN
UNH	IDMS	B	1/12/06	1.0006	-0.341	DDN
UNH	IDMS	B	1/9/06	0.9957	-0.485	PAM
UNH	IDMS	B	1/9/06	0.9977	-0.285	PAM
UNH	IDMS	B	1/12/06	1.0057	0.515	DDN
UNH	IDMS	B	1/12/06	1.0018	0.125	DDN
UNH	IDMS	B	3/4/06	0.9957	-0.829	WPB
UNH	IDMS	B	3/4/06	0.9962	-0.779	WPB
UNH	IDMS	B	3/5/06	0.9914	-1.257	DDN
UNH	IDMS	B	3/5/06	1.0000	-0.400	DDN
UNH	IDMS	B	3/4/06	0.9962	-0.435	WPB
UNH	IDMS	B	3/4/06	1.0004	-0.015	WPB
UNH	IDMS	B	3/5/06	0.9899	-1.064	DDN
UNH	IDMS	B	3/5/06	0.9893	-1.124	DDN

Material	Method Type	Facility	Analysis Date	Reported Result	% RD	Analyst
UNH	IDMS	G	5/5/06	0.4702	0.017	3061
UNH	IDMS	G	5/10/06	0.4701	-0.004	3060
UNH	IDMS	G	5/10/06	0.4703	0.038	3061
UNH	IDMS	G	5/10/06	0.4699	-0.047	3073
UNH	IDMS	G	5/10/06	0.4701	-0.004	3074
UNH	IDMS	G	5/5/06	0.4629	-0.013	3062
UNH	IDMS	G	5/5/06	0.4630	0.009	3063
UNH	IDMS	G	5/10/06	0.4633	0.073	3075
UNH	IDMS	G	5/11/06	0.4632	0.052	3076
UNH	IDMS	G	5/11/06	0.4651	-0.049	3064
UNH	IDMS	G	5/11/06	0.4648	-0.114	3065
UNH	IDMS	G	5/18/06	0.4649	-0.092	3081
UNH	IDMS	G	5/5/06	0.4654	0.015	3066
UNH	IDMS	G	5/5/06	0.4656	0.058	3067
UNH	IDMS	G	5/11/06	0.4652	-0.028	3080
UNH	IDMS/U-233 spike	B	4/12/06	1.0007	-0.331	JMG
UNH	IDMS/U-233 spike	B	4/12/06	0.9982	-0.580	JMG
UNH	IDMS/U-233 spike	B	4/13/06	0.9916	-1.237	CPT
UNH	IDMS/U-233 spike	B	4/13/06	0.9932	-1.078	CPT
UNH	IDMS/U-233 spike	B	4/12/06	0.9958	-0.819	JMG
UNH	IDMS/U-233 spike	B	4/12/06	0.9956	-0.839	JMG
UNH	IDMS/U-233 spike	B	4/13/06	0.9959	-0.809	CPT
UNH	IDMS/U-233 spike	B	4/13/06	0.9971	-0.689	CPT
UNH	XRFL	A	11/4/04	1.002	-0.030	MER/SJB
UNH	XRFL	A	11/4/04	1.001	-0.130	MER/SJB
UNH	XRFL	A	11/30/04	.999	-0.329	MER/RBD
UNH	XRFL	A	11/30/04	1.003	0.070	MER/RBD
UNH	XRFL	A	11/4/04	.998	-0.255	MER/SJB
UNH	XRFL	A	11/4/04	1.000	-0.055	MER/SJB
UNH	XRFL	A	11/30/04	.998	-0.255	MER/RBD
UNH	XRFL	A	11/30/04	.998	-0.255	MER/RBD
UNH	XRFL	A	9/29/05	1.002	-0.201	ACB
UNH	XRFL	A	9/29/05	1.002	-0.201	ACB
UNH	XRFL	A	10/3/05	1.002	-0.201	ACB
UNH	XRFL	A	10/3/05	1.004	-0.002	ACB
UNH	XRFL	A	9/29/05	1.000	-0.055	ACB
UNH	XRFL	A	9/29/05	1.001	0.045	ACB
UNH	XRFL	A	10/3/05	0.997	-0.355	ACB
UNH	XRFL	A	10/3/05	0.999	-0.155	ACB

Material	Method Type	Facility	Analysis Date	Reported Result	% RD	Analyst
UO_2	DG	AB	3/30/06	88.128	-0.001	AV
UO_2	DG	AB	3/30/06	88.149	0.023	AV
UO_2	DG	AB	3/30/06	88.123	-0.007	AV
UO_2	DG	AB	3/31/06	88.091	-0.043	AV
UO_2	DG	AB	3/31/06	88.143	0.016	AV
UO_2	DG	AB	3/31/06	88.103	-0.030	AV
UO_2	DG	AB	3/30/06	88.124	-0.006	AV
UO_2	DG	AB	3/30/06	88.120	-0.010	AV
UO_2	DG	AB	3/30/06	88.044	-0.096	AV
UO_2	DG	AB	3/31/06	88.076	-0.060	AV
UO_2	DG	AB	3/31/06	88.071	-0.066	AV
UO_2	DG	AB	3/31/06	88.085	-0.050	AV
UO_2	DG	AC	6/5/06	88.028	-0.115	AL
UO_2	DG	AC	6/5/06	88.037	-0.104	AL
UO_2	DG	AC	6/6/06	87.970	-0.180	NDS
UO_2	DG	AC	6/6/06	87.983	-0.166	NDS
UO_2	DG	AC	6/5/06	87.986	-0.162	NDS
UO_2	DG	AC	6/5/06	87.977	-0.172	NDS
UO_2	DG	AC	6/6/06	87.972	-0.178	AL
UO_2	DG	AC	6/6/06	87.964	-0.187	AL
UO_2	DG	AD	6/2/06	88.097	-0.036	EB/CD
UO_2	DG	AD	6/2/06	88.126	-0.003	EB/CD
UO_2	DG	AD	6/2/06	88.115	-0.016	EB/CD
UO_2	DG	AD	6/2/06	88.087	-0.048	EB/CD
UO_2	DG	AD	6/5/06	88.113	-0.018	EB/CD
UO_2	DG	AD	6/5/06	88.121	-0.009	EB/CD
UO_2	DG	AD	6/5/06	88.120	-0.010	EB/CD
UO_2	DG	AD	6/5/06	88.109	-0.023	EB/CD
UO_2	DG	AE	4/26/06	88.0960	-0.037	JR-JM
UO_2	DG	AE	4/26/06	88.1055	-0.027	JR-JM
UO_2	DG	AE	4/26/06	88.1239	-0.006	JR-JM
UO_2	DG	AE	4/26/06	88.1190	-0.011	JR-JM
UO_2	DG	AE	4/27/06	88.1469	0.020	JR-JM
UO_2	DG	AE	4/27/06	88.1042	-0.028	JR-JM
UO_2	DG	AE	4/27/06	88.1658	0.042	JR-JM
UO_2	DG	AE	4/27/06	88.1668	0.043	JR-JM

Material	Method Type	Facility	Analysis Date	Reported Result	% RD	Analyst
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	4/7/06	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	4/6/06	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	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	BC	4/13/06	88.06433	-0.073	ICO
UO_2	DG	BC	4/13/06	88.15492	0.029	ICO
UO_2	DG	BC	4/13/06	88.15719	0.032	ICO
UO_2	DG	BC	4/13/06	88.08713	-0.048	ICO
UO_2	DG	BC	4/13/06	88.05359	-0.086	ICO
UO_2	DG	BC	4/13/06	88.01272	-0.132	ICO
UO_2	DG	BC	4/13/06	87.97265	-0.177	ICO
UO_2	DG	BC	4/13/06	88.02056	-0.123	ICO
UO_2	DG	BC	4/13/06	88.00236	-0.144	ICO
UO_2	DG	BC	4/13/06	88.02031	-0.123	ICO
UO_2	DG	BC	4/18/06	88.12967	0.001	ICO
UO_2	DG	BC	4/18/06	88.10743	-0.024	ICO
UO_2	DG	BC	4/18/06	88.10258	-0.030	ICO
UO_2	DG	BC	4/18/06	88.06009	-0.078	ICO
UO_2	DG	BC	4/18/06	88.16297	0.039	ICO
UO_2	DG	BC	4/18/06	88.01585	-0.128	ICO
UO_2	DG	BC	4/18/06	88.03035	-0.112	ICO
UO_2	DG	BC	4/18/06	88.01072	-0.134	ICO
UO_2	DG	BC	4/18/06	88.03399	-0.108	ICO
UO_2	DG	BC	4/18/06	88.01799	-0.126	ICO

Material	Method Type	Facility	Analysis Date	Reported Result	% RD	Analyst
UO_2	DG	BF	4/4/06	88.061	-0.077	ABC
UO_2	DG	BF	4/4/06	88.097	-0.036	ABC
UO_2	DG	BF	4/4/06	88.090	-0.044	ABC
UO_2	DG	BF	4/12/06	88.122	-0.008	ABC
UO_2	DG	BF	4/12/06	88.056	-0.083	ABC
UO_2	DG	BF	4/12/06	88.110	-0.022	ABC
UO_2	DG	BF	4/12/06	88.138	0.010	ABC
UO_2	DG	BF	4/12/06	88.133	0.005	ABC
UO_2	DG	BF	4/12/06	88.148	0.022	ABC
UO_2	DG	BF	4/12/06	88.147	0.020	ABC
UO_2	DG	BF	4/13/06	88.068	-0.069	ABC
UO_2	DG	BF	4/13/06	88.142	0.015	ABC
UO_2	DG	BF	4/13/06	88.160	0.035	ABC
UO_2	DG	BF	4/13/06	88.141	0.014	ABC
UO_2	DG	T	12/19/05	88.20	0.081	
UO_2	DG	T	12/19/05	88.26	0.149	
UO_2	DG	T	12/19/05	88.24	0.126	
UO_2	DG	T	12/19/05	88.15	0.024	
UO_2	DG	T	12/21/05	88.13	0.001	
UO_2	DG	T	12/21/05	88.18	0.058	
UO_2	DG	T	12/21/05	88.10	-0.033	
UO_2	DG	T	12/21/05	88.11	-0.022	
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	V	3/21/06	88.031	-0.111	1
UO_2	DG	V	3/21/06	88.038	-0.103	1
UO_2	DG	V	3/21/06	88.032	-0.110	1
UO_2	DG	V	4/5/06	88.085	-0.050	1
UO_2	DG	V	4/5/06	88.089	-0.045	1
UO_2	DG	V	4/5/06	88.136	0.008	1
UO_2	DG	V	4/25/06	88.113	-0.018	1
UO_2	DG	V	4/25/06	88.074	-0.062	1
UO_2	DG	V	4/25/06	88.145	0.018	1
UO_2	DG	V	3/21/06	88.070	-0.067	1
UO_2	DG	V	3/21/06	88.092	-0.042	1
UO_2	DG	V	3/21/06	88.034	-0.108	1
UO_2	DG	V	4/5/06	87.990	-0.158	1
UO_2	DG	V	4/5/06	88.108	-0.024	1
UO_2	DG	V	4/5/06	88.038	-0.103	1
UO_2	DG	V	4/25/06	88.143	0.016	1
UO_2	DG	V	4/25/06	88.093	-0.041	1
UO_2	DG	V	4/25/06	88.139	0.011	1

Material	Method Type	Facility	Analysis Date	Reported Result	% RD	Analyst
UF_6	DG	AB	4/5/06	67.451	-0.247	FP
UF_6	DG	AB	4/5/06	67.444	-0.257	FP
UF_6	DG	AB	4/5/06	67.413	-0.303	FP
UF_6	DG	AB	4/6/06	67.413	-0.303	FP
UF_6	DG	AB	4/6/06	67.388	-0.340	FP
UF_6	DG	AB	4/6/06	67.396	-0.328	FP
UF_6	DG	AB	4/5/06	67.468	-0.222	FP
UF_6	DG	AB	4/5/06	67.476	-0.210	FP
UF_6	DG	AB	4/5/06	67.496	-0.181	FP
UF_6	DG	AB	4/6/06	67.429	-0.280	FP
UF_6	DG	AB	4/6/06	67.422	-0.290	FP
UF_6	DG	AB	4/6/06	67.439	-0.265	FP
UF_6	DG	AE	4/5/06	67.431	-0.277	JR-JM
UF_6	DG	AE	4/5/06	67.414	-0.302	JR-JM
UF_6	DG	AE	4/5/06	67.663	0.066	JR-JM
UF_6	DG	AE	4/5/06	67.700	0.121	JR-JM
UF_6	DG	AE	4/5/06	67.427	-0.283	JR-JM
UF_6	DG	AE	4/5/06	67.438	-0.266	JR-JM
UF_6	DG	AE	4/5/06	67.694	0.112	JR-JM
UF_6	DG	AE	4/5/06	67.698	0.118	JR-JM
UF_6	DG	V	3/21/06	67.553	-0.037	1
UF_6	DG	V	3/21/06	67.625	0.070	1
UF_6	DG	V	3/21/06	67.592	0.021	1
UF_6	DG	V	4/5/06	67.516	-0.092	1
UF_6	DG	V	4/5/06	67.505	-0.108	1
UF_6	DG	V	4/5/06	67.538	-0.059	1
UF_6	DG	V	4/25/06	67.583	0.007	1
UF_6	DG	V	4/25/06	67.605	0.040	1
UF_6	DG	V	4/25/06	67.607	0.043	1
UF_6	DG	V	3/21/06	67.569	-0.013	1
UF_6	DG	V	3/21/06	67.537	-0.061	1
UF_6	DG	V	3/21/06	67.564	-0.021	1
UF_6	DG	V	4/5/06	67.530	-0.071	1
UF_6	DG	V	4/5/06	67.497	-0.120	1
UF_6	DG	V	4/5/06	67.480	-0.145	1
UF_6	DG	V	4/25/06	67.543	-0.052	1
UF_6	DG	V	4/25/06	67.579	0.001	1
UF_6	DG	V	4/25/06	67.565	-0.019	1

Material	Method Type	Facility	Analysis Date	Reported Result	% RD	Analyst
UO_3	DG	V	3/21/06	82.588	-0.100	1
UO_3	DG	V	3/21/06	82.620	-0.062	1
UO_3	DG	V	3/21/06	82.593	-0.094	1
UO_3	DG	V	4/5/06	82.577	-0.114	1
UO_3	DG	V	4/5/06	82.581	-0.109	1
UO_3	DG	V	4/5/06	82.539	-0.160	1
UO_3	DG	V	4/25/06	82.610	-0.074	1
UO_3	DG	V	4/25/06	82.608	-0.076	1
UO_3	DG	V	3/21/06	82.609	-0.075	1
UO_3	DG	V	3/21/06	82.648	-0.028	1
UO_3	DG	V	3/21/06	82.651	-0.024	1
UO_3	DG	V	4/5/06	82.586	-0.103	1
UO_3	DG	V	4/5/06	82.597	-0.090	1
UO_3	DG	V	4/5/06	82.577	-0.114	1
UO_3	DG	V	4/25/06	82.598	-0.088	1
UO_3	DG	V	4/25/06	82.647	-0.029	1
UO_3	DG	V	4/25/06	82.623	-0.058	1
UO_3	IDMS	A	11/9/04	82.78	0.132	BLM/JM
UO_3	IDMS	A	11/9/04	82.59	-0.098	BLM/JM
UO_3	IDMS	A	12/7/04	82.67	-0.001	WJS/JM
UO_3	IDMS	A	12/7/04	82.77	0.120	WJS/JM
UO_3	IDMS	A	12/7/04	82.71	0.047	WJS/JM
UO_3	IDMS	A	12/7/04	82.71	0.047	WJS/JM
UO_3	IDMS	A	11/9/04	82.48	-0.231	BLM/JM
UO_3	IDMS	A	11/9/04	82.51	-0.195	BLM/JM
UO_3	IDMS	A	3/23/05	82.68	0.011	BLM/JM
UO_3	IDMS	A	3/23/05	82.69	0.023	BLM/JM
UO_3	IDMS	A	3/24/05	82.48	-0.231	WJS/JM
UO_3	IDMS	A	3/24/05	82.77	0.120	WJS/JM
UO_3	IDMS	A	3/23/05	82.76	0.108	WJS/JM
UO_3	IDMS	A	3/23/05	82.64	-0.037	WJS/JM
UO_3	IDMS	A	3/24/05	82.67	-0.001	BLM/JM
UO_3	IDMS	A	3/24/05	82.53	-0.171	BLM/JM
UO_3	IDMS	A	9/14/05	82.58	-0.110	BLM/JM
UO_3	IDMS	A	9/14/05	82.68	0.011	BLM/JM
UO_3	IDMS	A	9/15/05	82.60	-0.086	DB/JM
UO_3	IDMS	A	9/15/05	82.58	-0.110	DB/JM
UO_3	IDMS	A	9/19/05	82.53	-0.171	WJS/JM
UO_3	IDMS	A	9/19/05	82.68	0.011	WJS/JM
UO_3	IDMS	A	9/14/05	82.55	-0.146	BLM/JM
UO_3	IDMS	A	9/14/05	82.61	-0.074	BLM/JM
UO_3	IDMS	A	9/15/05	82.66	-0.013	DB/JM
UO_3	IDMS	A	9/15/05	82.76	0.108	DB/JM
UO_3	IDMS	A	9/19/05	82.63	-0.050	WJS/JM
UO_3	IDMS	A	9/19/05	82.58	-0.110	WJS/JM

Material	Method Type	Facility	Analysis Date	Reported Result	% RD	Analyst
UO_3	IDMS	B	3/2/06	82.0	-0.812	PAM
UO_3	IDMS	B	3/2/06	81.8	-1.054	PAM
UO_3	IDMS	B	3/9/06	82.0	-0.812	DDN
UO_3	IDMS	B	3/9/06	82.4	-0.328	DDN
UO_3	IDMS	B	3/2/06	82.1	-0.691	PAM
UO_3	IDMS	B	3/2/06	81.8	-1.054	PAM
UO_3	IDMS	B	3/9/06	82.5	-0.207	DDN
UO_3	IDMS	B	3/9/06	82.8	0.156	DDN
UO_3	XRFL	A	11/4/04	82.35	-0.388	MER/SJB
UO_3	XRFL	A	11/4/04	82.20	-0.570	MER/SJB
UO_3	XRFL	A	11/30/04	82.23	-0.533	MER/RBD
UO_3	XRFL	A	11/30/04	82.15	-0.630	MER/RBD
UO_3	XRFL	A	11/4/04	82.41	-0.316	MER/SJB
UO_3	XRFL	A	11/4/04	82.49	-0.219	MER/SJB
UO_3	XRFL	A	11/30/04	82.15	-0.630	MER/RBD
UO_3	XRFL	A	11/30/04	82.24	-0.521	MER/RBD
UO_3	XRFL	A	4/15/05	82.09	-0.703	MER/ACB
UO_3	XRFL	A	4/15/05	82.39	-0.340	MER/ACB
UO_3	XRFL	A	4/18/05	82.29	-0.461	MER/ACB
UO_3	XRFL	A	4/18/05	82.22	-0.546	MER/ACB
UO_3	XRFL	A	4/15/05	82.33	-0.412	MER/ACB
UO_3	XRFL	A	4/15/05	82.39	-0.340	MER/ACB
UO_3	XRFL	A	4/18/05	82.55	-0.146	MER/ACB
UO_3	XRFL	A	4/18/05	82.41	-0.316	MER/ACB
UO_3	XRFL	A	9/15/05	82.87	0.241	ACB
UO_3	XRFL	A	9/15/05	82.77	0.120	ACB
UO_3	XRFL	A	9/27/05	82.51	-0.195	ACB
UO_3	XRFL	A	9/27/05	82.64	-0.037	ACB
UO_3	XRFL	A	9/15/05	82.81	0.168	ACB
UO_3	XRFL	A	9/15/05	82.71	0.047	ACB
UO_3	XRFL	A	9/27/05	82.48	-0.231	ACB
UO_3	XRFL	A	9/27/05	82.34	-0.400	ACB

Material	Method Type	Facility	Analysis Date	Reported Result	% RD	Analyst
UO_3	XRFS	A	11/15/04	82.22	-0.546	MER/RBD
UO_3	XRFS	A	11/15/04	82.16	-0.618	MER/RBD
UO_3	XRFS	A	12/1/04	81.95	-0.872	MER/SJB
UO_3	XRFS	A	12/1/04	81.95	-0.872	MER/SJB
UO_3	XRFS	A	11/15/04	82.06	-0.739	MER/RBD
UO_3	XRFS	A	11/15/04	81.94	-0.884	MER/RBD
UO_3	XRFS	A	12/1/04	81.94	-0.884	MER/SJB
UO_3	XRFS	A	12/1/04	82.17	-0.606	MER/SJB
UO_3	XRFS	A	3/9/05	82.71	0.047	MER/ACB
UO_3	XRFS	A	3/9/05	82.65	-0.025	MER/ACB
UO_3	XRFS	A	3/10/05	82.56	-0.134	MER/ACB
UO_3	XRFS	A	3/10/05	82.46	-0.255	MER/ACB
UO_3	XRFS	A	3/9/05	82.52	-0.183	MER/ACB
UO_3	XRFS	A	3/9/05	82.42	-0.304	MER/ACB
UO_3	XRFS	A	3/10/05	82.67	-0.001	MER/ACB
UO_3	XRFS	A	3/10/05	82.39	-0.340	MER/ACB
UO_3	XRFS	A	9/13/05	82.28	-0.473	ACB
UO_3	XRFS	A	9/13/05	82.21	-0.558	ACB
UO_3	XRFS	A	9/15/05	82.45	-0.267	ACB
UO_3	XRFS	A	9/15/05	82.38	-0.352	ACB
UO_3	XRFS	A	9/13/05	82.24	-0.521	ACB
UO_3	XRFS	A	9/13/05	82.19	-0.582	ACB
UO_3	XRFS	A	9/15/05	82.35	-0.388	ACB
UO_3	XRFS	A	9/15/05	82.55	-0.146	ACB

Appendix B: Uranium Isotopic Results

Material	Method Type	Facility	Analysis Date	Reported Result	% RD	Analyst
HEU	TIMS	A	11/10/04	89.882	-0.010	BLM/JM
HEU	TIMS	A	11/10/04	89.885	-0.007	BLM/JM
HEU	TIMS	A	11/9/04	89.888	-0.003	WJS/GPW
HEU	TIMS	A	11/9/04	89.888	-0.003	WJS/GPW
HEU	TIMS	A	11/10/04	90.328	-0.010	BLM/JM
HEU	TIMS	A	11/10/04	90.331	-0.007	BLM/JM
HEU	TIMS	A	11/9/04	90.328	-0.010	WJS/GPW
HEU	TIMS	A	11/9/04	90.334	-0.004	WJS/GPW
HEU	TIMS	A	9/14/05	51.334	0.019	WS/JM
HEU	TIMS	A	9/14/05	51.330	0.011	WS/JM
HEU	TIMS	A	9/19/05	51.303	-0.042	WS/JM
HEU	TIMS	A	9/19/05	51.313	-0.022	WS/JM
HEU	TIMS	A	9/14/05	89.702	0.026	WS/JM
HEU	TIMS	A	9/14/05	89.697	0.020	WS/JM
HEU	TIMS	A	9/19/05	89.670	-0.010	WS/JM
HEU	TIMS	A	9/19/05	89.669	-0.011	WS/JM
HEU	TIMS	B	1/8/05	89.6706	-0.009	JLB
HEU	TIMS	B	1/8/05	89.6709	-0.009	JLB
HEU	TIMS	B	1/10/05	89.6868	0.009	MDM
HEU	TIMS	B	1/10/05	89.6781	-0.001	MDM
HEU	TIMS	B	1/8/05	90.3376	0.000	JLB
HEU	TIMS	B	1/8/05	90.3453	0.009	JLB
HEU	TIMS	B	1/10/05	90.3425	0.006	MDM
HEU	TIMS	B	1/10/05	90.3469	0.011	MDM
HEU	TIMS	B	12/14/05	51.3445	0.039	PAM
HEU	TIMS	B	12/14/05	51.3451	0.040	PAM
HEU	TIMS	B	12/15/05	51.3140	-0.020	TEB
HEU	TIMS	B	12/15/05	51.3449	0.040	TEB
HEU	TIMS	B	12/14/05	89.8980	0.008	PAM
HEU	TIMS	B	12/14/05	89.8822	-0.010	PAM
HEU	TIMS	B	12/15/05	89.8965	0.006	TEB
HEU	TIMS	B	12/15/05	89.8546	-0.041	TEB
HEU	TIMS	B	1/29/06	51.3255	0.002	PAM
HEU	TIMS	B	1/29/06	51.3245	0.000	PAM
HEU	TIMS	B	3/3/06	51.3254	0.002	DDN
HEU	TIMS	B	3/3/06	51.3287	0.008	DDN
HEU	TIMS	B	1/29/06	89.9017	0.012	PAM
HEU	TIMS	B	1/29/06	89.8946	0.004	PAM
HEU	TIMS	B	3/3/06	89.8888	-0.003	DDN
HEU	TIMS	B	3/3/06	89.8987	0.008	DDN
HEU	TIMS	B	3/28/06	89.6567	-0.025	DDB
HEU	TIMS	B	3/28/06	89.6820	0.004	DDB
HEU	TIMS	B	4/5/06	89.6910	0.014	DDN
HEU	TIMS	B	4/5/06	89.6988	0.022	DDN

Material	Method Type	Facility	Analysis Date	Reported Result	% RD	Analyst
HEU	TIMS	G	5/3/06	89.6817	0.003	
HEU	TIMS	G	5/3/06	89.6811	0.003	
HEU	TIMS	G	5/3/06	89.8908	0.000	
HEU	TIMS	G	5/3/06	89.8908	0.000	
HEU	TIMS	G	5/3/06	90.3402	0.003	
HEU	TIMS	G	5/3/06	90.3407	0.004	
HEU	TIMS	G	5/3/06	90.3356	-0.002	
HEU	TIMS	G	5/3/06	90.3351	-0.002	
HEU	TIMS	G	5/5/06	51.3442	0.038	
HEU	TIMS	G	5/5/06	51.3458	0.042	
HEU	TIMS	G	5/8/06	51.3435	0.037	
HEU	TIMS	G	5/8/06	51.3457	0.041	

Material	Method Type	Facility	Analysis Date	Reported Result	% RD	Analyst
LEU	TIMS	AA	4/5/06	4.0051	-0.078	ALEG
LEU	TIMS	AA	4/5/06	4.0051	-0.078	ALEG
LEU	TIMS	AA	4/6/06	4.0051	-0.078	ALEG
LEU	TIMS	AA	4/6/06	4.0051	-0.078	ALEG
LEU	TIMS	AA	4/6/06	4.0051	-0.078	ALEG
LEU	TIMS	AA	4/20/06	4.0051	-0.078	ALEG
LEU	TIMS	AA	4/20/06	4.0051	-0.078	ALEG
LEU	TIMS	AA	4/21/06	4.0051	-0.078	ALEG
LEU	TIMS	AA	4/21/06	4.0051	-0.078	ALEG
LEU	TIMS	AA	4/21/06	4.0051	-0.078	ALEG
LEU	TIMS	AA	4/20/06	0.7100	-0.125	ALEG
LEU	TIMS	AA	4/20/06	0.7119	0.142	ALEG
LEU	TIMS	AA	4/21/06	0.7117	0.114	ALEG
LEU	TIMS	AA	4/21/06	0.7127	0.254	ALEG
LEU	TIMS	AA	4/21/06	0.7107	-0.027	ALEG
LEU	TIMS	AA	4/20/06	0.7109	0.001	ALEG
LEU	TIMS	AA	4/20/06	0.7109	0.001	ALEG
LEU	TIMS	AA	4/21/06	0.7127	0.254	ALEG
LEU	TIMS	AA	4/21/06	0.7088	-0.294	ALEG
LEU	TIMS	AA	4/21/06	0.7107	-0.027	ALEG
LEU	ICPMS	AF	6/5/06	3.995	-0.330	SR
LEU	ICPMS	AF	6/5/06	3.997	-0.280	SR
LEU	ICPMS	AF	6/5/06	3.982	-0.654	SR
LEU	ICPMS	AF	6/5/06	3.969	-0.979	SR
LEU	ICPMS	AF	6/6/06	3.991	-0.430	SR
LEU	ICPMS	AF	6/6/06	4.007	-0.031	SR
LEU	ICPMS	AF	6/6/06	4.003	-0.130	SR
LEU	ICPMS	AF	6/6/06	4.000	-0.205	SR

Material	Method Type	Facility	Analysis Date	Reported Result	% RD	Analyst
LEU	TIMS	B	1/9/06	0.7099	-0.214	PAM
LEU	TIMS	B	1/9/06	0.7110	-0.060	PAM
LEU	TIMS	B	1/12/06	0.7117	0.039	DDN
LEU	TIMS	B	1/12/06	0.7111	-0.046	DDN
LEU	TIMS	B	1/9/06	0.7111	-0.046	PAM
LEU	TIMS	B	1/9/06	0.7121	0.095	PAM
LEU	TIMS	B	1/12/06	0.7103	-0.158	DDN
LEU	TIMS	B	1/12/06	0.7088	-0.369	DDN
LEU	TIMS	B	3/2/06	0.8835	1.439	PAM
LEU	TIMS	B	3/2/06	0.8820	1.267	PAM
LEU	TIMS	B	3/9/06	0.8811	1.164	DDN
LEU	TIMS	B	3/9/06	0.8815	1.210	DDN
LEU	TIMS	B	3/2/06	0.8832	1.405	PAM
LEU	TIMS	B	3/2/06	0.8823	1.302	PAM
LEU	TIMS	B	3/9/06	0.8821	1.279	DDN
LEU	TIMS	B	3/9/06	0.8816	1.221	DDN
LEU	TIMS	B	3/4/06	0.7094	-0.285	WPB
LEU	TIMS	B	3/4/06	0.7119	0.067	WPB
LEU	TIMS	B	3/5/06	0.7113	-0.017	DDN
LEU	TIMS	B	3/5/06	0.7114	-0.003	DDN
LEU	TIMS	B	3/4/06	0.7110	-0.060	WPB
LEU	TIMS	B	3/4/06	0.7102	-0.172	WPB
LEU	TIMS	B	3/5/06	0.7117	0.039	DDN
LEU	TIMS	B	3/5/06	0.7104	-0.144	DDN
LEU	TIMS	B	3/28/06	4.3860	-0.126	DDB
LEU	TIMS	B	3/28/06	4.3904	-0.026	DDB
LEU	TIMS	B	4/5/06	4.3918	0.006	DDN
LEU	TIMS	B	4/5/06	4.3965	0.113	DDN
LEU	TIMS	B	4/12/06	0.7137	0.320	JMG
LEU	TIMS	B	4/12/06	0.7127	0.179	JMG
LEU	TIMS	B	4/13/06	0.7114	-0.003	CPT
LEU	TIMS	B	4/13/06	0.7116	0.025	CPT
LEU	TIMS	B	4/12/06	0.7131	0.236	JMG
LEU	TIMS	B	4/12/06	0.7109	-0.074	JMG
LEU	TIMS	B	4/13/06	0.7114	-0.003	CPT
LEU	TIMS	B	4/13/06	0.7111	-0.046	CPT
LEU	GSMS	BC	4/12/06	3.1885	-0.011	ET
LEU	GSMS	BC	4/12/06	3.1911	0.071	ET
LEU	GSMS	BC	4/12/06	3.1911	0.071	ET
LEU	GSMS	BC	4/12/06	3.1929	0.127	ET
LEU	GSMS	BC	4/13/06	3.1913	0.077	ET
LEU	GSMS	BC	4/13/06	3.1862	-0.083	ET
LEU	GSMS	BC	4/13/06	3.1943	0.171	ET
LEU	GSMS	BC	4/13/06	3.1991	0.322	ET
LEU	TIMS	BC	4/17/06	4.0046	-0.091	MRPP
LEU	TIMS	BC	4/17/06	4.0090	0.019	MRPP
LEU	TIMS	BC	4/26/06	4.0067	-0.038	MRPP
LEU	TIMS	BC	4/26/06	4.0074	-0.021	MRPP
LEU	TIMS	BC	4/17/06	4.0066	-0.041	MRPP
LEU	TIMS	BC	4/17/06	4.0126	0.109	MRPP
LEU	TIMS	BC	4/26/06	4.0077	-0.013	MRPP
LEU	TIMS	BC	4/26/06	4.0096	0.034	MRPP

Material	Method Type	Facility	Analysis Date	Reported Result	% RD	Analyst
LEU	ICPMS	BE	4/7/06	4.067	1.466	MHK
LEU	ICPMS	BE	4/7/06	4.072	1.591	MHK
LEU	ICPMS	BE	4/7/06	4.069	1.516	MHK
LEU	ICPMS	BE	4/7/06	4.063	1.366	MHK
LEU	ICPMS	BE	4/7/06	4.059	1.267	MHK
LEU	ICPMS	BE	4/7/06	4.058	1.242	MHK
LEU	ICPMS	BE	4/20/06	4.030	0.543	MHK
LEU	ICPMS	BE	4/20/06	4.024	0.393	MHK
LEU	ICPMS	BE	4/20/06	4.030	0.543	MHK
LEU	ICPMS	BE	4/20/06	4.035	0.668	MHK
LEU	ICPMS	BE	4/20/06	4.029	0.518	MHK
LEU	ICPMS	BE	4/20/06	4.034	0.643	MHK
LEU	TIMS	G	5/8/06	4.3939	0.054	
LEU	TIMS	G	5/8/06	4.3948	0.074	
LEU	TIMS	G	5/8/06	4.3928	0.029	
LEU	TIMS	G	5/8/06	4.3948	0.074	
LEU	TIMS	T	1/12/06	4.010	0.044	
LEU	TIMS	T	1/12/06	4.009	0.019	
LEU	TIMS	T	1/12/06	4.011	0.069	
LEU	TIMS	T	1/12/06	4.009	0.019	
LEU	TIMS	T	1/19/06	4.009	0.019	
LEU	TIMS	T	1/19/06	4.009	0.019	
LEU	TIMS	T	1/19/06	4.010	0.044	
LEU	TIMS	T	1/19/06	4.009	0.019	
LEU	TIMS	T	4/21/06	4.010	0.044	
LEU	TIMS	T	4/21/06	4.011	0.069	
LEU	TIMS	T	4/21/06	4.010	0.044	
LEU	TIMS	T	4/21/06	4.012	0.094	
LEU	TIMS	T	4/24/06	4.009	0.019	
LEU	TIMS	T	4/24/06	4.009	0.019	
LEU	TIMS	T	4/24/06	4.009	0.019	
LEU	TIMS	T	4/24/06	4.008	-0.006	

Material	Method Type	Facility	Analysis Date	Reported Result	% RD	Analyst
LEU	TIMS	V	3/24/06	4.3881	-0.078	5
LEU	TIMS	V	4/3/06	4.3943	0.063	5
LEU	TIMS	V	4/3/06	4.3922	0.015	5
LEU	TIMS	V	4/3/06	4.3913	-0.005	5
LEU	TIMS	V	4/25/06	4.3920	0.010	5
LEU	TIMS	V	4/25/06	4.3917	0.004	5
LEU	TIMS	V	4/25/06	4.3922	0.015	5
LEU	TIMS	V	3/24/06	4.3888	-0.062	5
LEU	TIMS	V	3/24/06	4.3898	-0.040	5
LEU	TIMS	V	3/24/06	4.3913	-0.005	5
LEU	TIMS	V	4/3/06	4.3937	0.049	5
LEU	TIMS	V	4/3/06	4.3934	0.042	5
LEU	TIMS	V	4/3/06	4.3938	0.051	5
LEU	TIMS	V	4/25/06	4.3932	0.038	5
LEU	TIMS	V	4/25/06	4.3922	0.015	5
LEU	TIMS	V	4/25/06	4.3922	0.015	5
LEU	TIMS	V	3/24/06	4.4581	-0.040	5
LEU	TIMS	V	3/24/06	4.4567	-0.071	5
LEU	TIMS	V	3/24/06	4.4568	-0.069	5
LEU	TIMS	V	4/3/06	4.4654	0.124	5
LEU	TIMS	V	4/4/06	4.4630	0.070	5
LEU	TIMS	V	4/4/06	4.4625	0.059	5
LEU	TIMS	V	4/25/06	4.4606	0.017	5
LEU	TIMS	V	4/25/06	4.4612	0.030	5
LEU	TIMS	V	4/25/06	4.4599	0.001	5
LEU	TIMS	V	3/24/06	4.4580	-0.042	5
LEU	TIMS	V	3/24/06	4.4596	-0.006	5
LEU	TIMS	V	3/24/06	4.4611	0.028	5
LEU	TIMS	V	4/4/06	4.4566	-0.073	5
LEU	TIMS	V	4/4/06	4.4598	-0.001	5
LEU	TIMS	V	4/4/06	4.4604	0.012	5
LEU	TIMS	V	4/26/06	4.4608	0.021	5
LEU	TIMS	V	4/26/06	4.4616	0.039	5
LEU	TIMS	V	4/26/06	4.4612	0.030	5
LEU	TIMS	V	3/21/06	4.0057	-0.063	5
LEU	TIMS	V	3/21/06	4.0062	-0.051	5
LEU	TIMS	V	3/21/06	4.0064	-0.046	5
LEU	TIMS	V	4/5/06	4.0099	0.042	5
LEU	TIMS	V	4/5/06	4.0078	-0.011	5
LEU	TIMS	V	4/5/06	4.0080	-0.006	5
LEU	TIMS	V	4/26/06	4.0088	0.014	5
LEU	TIMS	V	4/26/06	4.0100	0.044	5
LEU	TIMS	V	4/26/06	4.0091	0.022	5
LEU	TIMS	V	3/21/06	4.0110	0.069	5
LEU	TIMS	V	3/21/06	4.0082	-0.001	5
LEU	TIMS	V	3/23/06	4.0040	-0.106	5
LEU	TIMS	V	4/5/06	4.0096	0.034	5
LEU	TIMS	V	4/5/06	4.0025	-0.143	5
LEU	TIMS	V	4/7/06	4.0079	-0.008	5
LEU	TIMS	V	4/26/06	4.0096	0.034	5
LEU	TIMS	V	4/26/06	4.0093	0.027	5
LEU	TIMS	V	4/26/06	4.0100	0.044	5

Appendix C: ^{239}Pu Isotopic Results

Material	Method Type	Facility	Analysis Date	% RD	Analyst
^{239}Pu	TIMS	G	5/3/06	0.003	
^{239}Pu	TIMS	G	4/19/06	0.001	
^{239}Pu	TIMS	G	5/3/06	0.000	
^{239}Pu	TIMS	G	5/3/06	-0.002	
^{239}Pu	TIMS	G	4/19/06	-0.002	
^{239}Pu	TIMS	G	5/3/06	-0.005	
^{239}Pu	TIMS	G	5/3/06	-0.003	
^{239}Pu	TIMS	G	4/19/06	-0.004	
^{239}Pu	TIMS	G	5/3/06	0.004	
^{239}Pu	TIMS	G	4/19/06	0.000	
^{239}Pu	TIMS	G	2/21/06	-0.003	
^{239}Pu	TIMS	G	2/21/06	0.000	
^{239}Pu	TIMS	G	2/28/06	-0.004	
^{239}Pu	TIMS	G	2/28/06	-0.002	
^{239}Pu	TIMS	G	2/28/06	-0.005	
^{239}Pu	TIMS	G	2/21/06	0.003	
^{239}Pu	TIMS	G	2/28/06	-0.001	
^{239}Pu	TIMS	G	2/21/06	-0.003	
^{239}Pu	TIMS	G	2/21/06	0.002	
^{239}Pu	TIMS	G	2/21/06	0.003	
^{239}Pu	TIMS	G	2/21/06	0.002	
^{239}Pu	TIMS	G	2/21/06	0.003	
^{239}Pu	TIMS	G	5/3/06	-0.004	
^{239}Pu	TIMS	G	5/3/06	-0.005	
^{239}Pu	TIMS	G	4/19/06	-0.002	
^{239}Pu	TIMS	G	4/19/06	-0.005	

Appendix D: ^{240}Pu Isotopic Results

Material	Method Type	Facility	Analysis Date	% RD	Analyst
^{240}Pu	TIMS	G	5/3/06	-0.012	
^{240}Pu	TIMS	G	4/19/06	-0.027	
^{240}Pu	TIMS	G	5/3/06	-0.012	
^{240}Pu	TIMS	G	5/3/06	-0.017	
^{240}Pu	TIMS	G	4/19/06	-0.017	
^{240}Pu	TIMS	G	5/3/06	0.007	
^{240}Pu	TIMS	G	5/3/06	0.017	
^{240}Pu	TIMS	G	4/19/06	-0.025	
^{240}Pu	TIMS	G	5/3/06	-0.008	
^{240}Pu	TIMS	G	4/19/06	-0.025	
^{240}Pu	TIMS	G	2/21/06	0.017	
^{240}Pu	TIMS	G	2/21/06	-0.162	
^{240}Pu	TIMS	G	2/28/06	-0.005	
^{240}Pu	TIMS	G	2/28/06	-0.017	
^{240}Pu	TIMS	G	2/28/06	-0.015	
^{240}Pu	TIMS	G	2/21/06	-0.225	
^{240}Pu	TIMS	G	2/28/06	-0.011	
^{240}Pu	TIMS	G	2/21/06	0.002	
^{240}Pu	TIMS	G	2/21/06	-0.143	
^{240}Pu	TIMS	G	2/21/06	-0.191	
^{240}Pu	TIMS	G	2/21/06	-0.206	
^{240}Pu	TIMS	G	2/21/06	-0.191	
^{240}Pu	TIMS	G	5/3/06	0.036	
^{240}Pu	TIMS	G	5/3/06	0.008	
^{240}Pu	TIMS	G	4/19/06	-0.002	
^{240}Pu	TIMS	G	4/19/06	0.004	