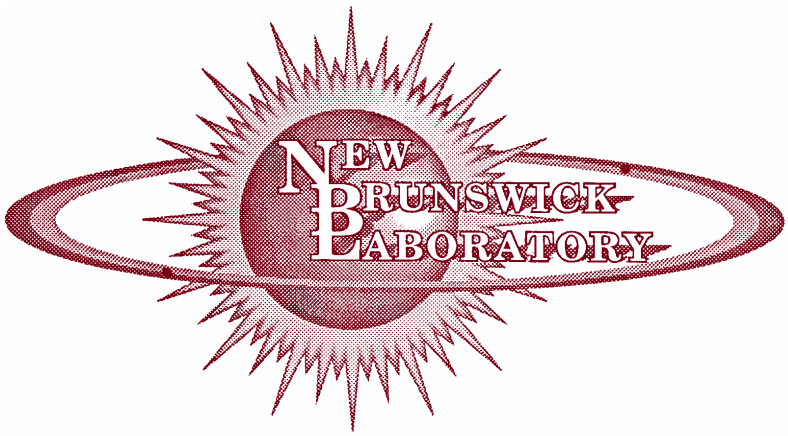
NBL-370
SEPTEMBER 2002

SAFEGUARDS MEASUREMENT EVALUATION PROGRAM

URANIUM SAMPLE EXCHANGE

PLUTONIUM SAMPLE EXCHANGE



FISCAL YEAR 2001

Jay M. Thompson and David T. Baran

U.S. DEPARTMENT OF ENERGY · CHICAGO OPERATIONS OFFICE · ARGONNE, ILLINOIS

NBL-370

U.S. DEPARTMENT OF ENERGY

SAFEGUARDS MEASUREMENT EVALUATION PROGRAM

URANIUM SAMPLE EXCHANGE

PLUTONIUM SAMPLE EXCHANGE

NUCLEAR MATERIALS MEASUREMENT DATA
CONSOLIDATED REPORT
FISCAL YEAR 2001

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DOE AND NBL BACKGROUND AND MISSION

OWNERSHIP

The New Brunswick Laboratory (NBL) is owned and operated by the U.S. Department of Energy (DOE). Although it is part of the DOE Chicago Operations Office system, its primary sponsor is the Office of Plutonium, Uranium, and Special Materials Inventory (SO-62) in the DOE Office of Security.

DOE MISSION

DOE is entrusted to contribute to the welfare of the nation by providing the scientific foundation, technology, policy, and institutional leadership necessary to achieve efficiency in energy use, diversity in energy sources, a more productive and competitive economy, improved environmental quality, and a secure national defense.

NBL MISSION

NBL serves as the U.S. government central authority for nuclear materials measurements and measurement evaluation. It is also the U.S. government certifying authority for nuclear reference materials. These functions assure that the United States maintains an accurate and reliable nuclear safeguards program, particularly in the area of nuclear materials accountability. NBL program and technical capabilities not only enhance domestic nuclear security but also support international nonproliferation efforts. Its nuclear material measurements and measurement evaluation roles allow the federal government to perform independent technical audits and validate nuclear material measurements made by contractors. NBL also has the technical capability for the independent resolution of measurement and safeguards anomalies that may arise from nuclear operations and the transfer of materials between sites.

NBL HISTORY

NBL was established by the Atomic Energy Commission in New Brunswick, NJ in 1949. It was initially staffed by scientists from the National Bureau of Standards who had contributed to the science of measuring nuclear materials for the Manhattan Project. At first, the NBL mission was to provide the federal government with the capability to assay uranium-containing materials for the nation's developing atomic energy program. Over the years, NBL expanded its capabilities, improving methods and procedures, developing new ones, and certifying additional reference materials for use around the world. It incorporated the capability to make plutonium measurements in 1959. During the period from 1975 to 1977, NBL was relocated from New Jersey to the current site at Argonne, Illinois.

Since its beginning, NBL has been a center of excellence in the analytical chemistry and the science of measuring nuclear materials. In this role, NBL continues to make state-of-the-art measurements of elemental and isotopic composition for a wide range of nuclear materials.

ACKNOWLEDGEMENTS

This program is administered by the New Brunswick Laboratory under the auspices of the U. S. Department of Energy, Office of Plutonium, Uranium, and Special Materials Inventory (SO-62) in the DOE Office of Security.

ABSTRACT

The New Brunswick Laboratory has been tasked by the U.S. Department of Energy Office of Security to assess and evaluate the adequacy of measurement technology as applied to materials accounting in U.S. Department of Energy nuclear facilities. The Safeguards Measurement Evaluation Program was developed as a means to monitor and evaluate the quality and effectiveness of nuclear materials accounting destructive measurements by site.

Beginning in Fiscal Year 1996, a cooperative agreement was reached between NBL and the Nuclear Regulatory Commission (NRC), with the approval of the Office of Security, to include selected NRC fuel fabrication licensees in the Program. This agreement was terminated during Fiscal Year 2001.

With the approval of the Department of Energy Office of Security, the first international participant, the Safeguards Analytical Laboratory in Tokai, Japan was added to the Program in Fiscal Year 1997, on a cost-recovery basis. This laboratory is currently performing measurements for uranium assay and enrichment, and plutonium assay and isotopics.

This report presents and statistically analyzes nuclear materials measurement data generated by participants of the Safeguards Measurement Evaluation Program on uranium and plutonium assay and isotopic test materials during Fiscal Year 2001.

INTRODUCTION

New Brunswick Laboratory (NBL) operates the U.S. Government Nuclear Material Standards and Measurements Laboratory as an essential technical element in the fulfillment of the Department of Energy (DOE) statutory responsibility to assure the safeguarding of nuclear materials. The mission of the Laboratory includes serving as a technical extension of the Department of Energy Office of Security in the area of nuclear material control and accountability (MC&A), and providing Federal assessment and oversight of the implementation of MC&A policies and programs for safeguarding nuclear materials.

As part of the assessment of MC&A programs, NBL administers the Safeguards Measurement Evaluation (SME) Program to evaluate the quality and adequacy of destructive safeguards measurements, as performed by DOE contractor facilities. Participation by these DOE facility laboratories enables the fulfillment of a requirement of DOE Manual 474.1-1, issued in August 1999, which states, "Each facility's measurement control program must include participation in appropriate interlaboratory control programs to provide independent verification of internal analytical quality control." [Chapter II.4.e.(7)]

Five U.S. Nuclear Regulatory Commission (NRC) licensees began full participation in the Program in Fiscal Year 1996, under a cooperative agreement between NBL and the NRC, with the approval of the DOE Office of Security; a sixth licensee was added in Fiscal Year 1997. In addition, oversight for both Paducah and Portsmouth Gaseous Diffusion Plants was transferred from DOE to the NRC in Fiscal Year 1997; their participation in the Program continued under the NRC. Licensee participation in the program allows more timely and cost-effective monitoring of measurement performance, compared with the previous practice of analyzing inventory verification samples taken by NRC personnel during on-site inspections. The NRC discontinued its role under the cooperative agreement during Fiscal Year 2001; licensees may continue participation on an individual basis.

With the approval of the DOE Office of Security, the first international participant, the Safeguards Analytical Laboratory in Tokai, Japan was added to the Program in Fiscal Year 1997, on a cost-recovery basis. In Fiscal Year 2001, the laboratory analyzed low-enriched uranium dioxide pellets for both uranium concentration and enrichment, and plutonium for isotopic abundances.

The effectiveness of the DOE, the NRC, and the international nuclear industry to carry out their respective responsibilities for nuclear safeguards primarily depends on their abilities to account for the quantities and isotopic composition of nuclear materials being stored, handled, processed, or transported.

Defensible accountancy data must be continuously generated to provide the final evidence that other aspects of nuclear safeguards, such as physical security and materials control, have been effective. Furthermore, accountancy measurements must be accurate, precise, and compatible with the national measurement base.

Within a given laboratory, these requirements are met through the concurrent analysis of reference materials and samples. These reference materials have well-known values; the ability to reproduce the reference values provides assurance that accurate results are being obtained during sample analysis. It is still possible, however, to experience undetected analytical problems: for example, during the preparation of the reference material for analysis.

Thus, compatibility with the national reference base requires more than the internal use of reference materials for quality control. It requires that measurement results obtained on a given material by a given method and analyst agree, within the statistical uncertainties of the methods, with results obtained by different methods or analysts at different facilities. A sample exchange program can validate the effectiveness of internal quality control, as well serve as a means of intercomparison of analytical performance by all participating laboratories.

CONDUCT OF THE PROGRAM

The Safeguards Measurement Evaluation Program provides external monitoring of the quality and adequacy of destructive safeguards measurements through the distribution of characterized materials traceable to the national measurement base for periodic analysis at participating facilities. Reported measurements are subjected to statistical evaluation. Table 1 contains a list of laboratories participating in the uranium portion of the Program for the Fiscal Year 2001 reporting period. Table 2 contains a list of laboratories participating in the plutonium isotopic portion of the Program.

TABLE 1

URANIUM SAMPLE EXCHANGE PARTICIPATING FACILITIES
ARGONNE NATIONAL LABORATORY–WEST
BWX NAVAL NUCLEAR FUELS
GLOBAL NUCLEAR FUEL – AMERICAS, LLC
LOS ALAMOS NATIONAL LABORATORY
NEW BRUNSWICK LABORATORY
NUCLEAR FUEL SERVICES
PADUCAH GASEOUS DIFFUSION PLANT
PORTSMOUTH GASEOUS DIFFUSION PLANT
SAVANNAH RIVER SITE
FRAMATOME ANP
TOKAI SAFEGUARDS ANALYTICAL LABORATORY
WESTINGHOUSE ELECTRIC COMMERCIAL NUCLEAR FUELS
Y-12 NATIONAL SECURITY COMPLEX

TABLE 2

PLUTONIUM ISOTOPIC EXCHANGE PARTICIPATING FACILITIES
ARGONNE NATIONAL LABORATORY–WEST
LOS ALAMOS NATIONAL LABORATORY
NEW BRUNSWICK LABORATORY
SAVANNAH RIVER SITE
TOKAI SAFEGUARDS ANALYTICAL LABORATORY

Measurement Methods and Laboratory Participation

During Fiscal Year 2001, SME Program participants used six different methods to perform uranium concentration measurements on four different materials, and two different measurement methods to perform isotopic measurements on both low- and high-enriched uranium materials. Additionally, plutonium samples were analyzed for elemental amount by isotope dilution mass spectrometry and isotopic abundances by thermal ionization mass spectrometry. Table 3 illustrates the various materials analyzed and measurement methods used by participating laboratories (identified by laboratory code only).

TABLE 3
LABORATORY PARTICIPATION FOR FISCAL YEAR 2001
BY MATERIAL AND MEASUREMENT METHOD

Table Entries are Facility Codes with the Number of Times Participated in Fiscal Year 2001

UPPER Portion of this Table Shows Methods and Materials for Assay Measurements
LOWER Portion of this Table Shows Methods and Materials for Isotopic Measurements

Method	UNH Solutions	UO_2 Pellets	UO_3 Powder	UF_6	Pu Sulfate
Dichromate Titration	B3 C2 F1 S2 U2	F1 T2	F1		
Ceric Titration	G2				
Gravimetry		M2 P2 R2		C2 E2	
High Precision Titration		F1		F1	
U IDMS	A5 B1 J4		A1		
X-Ray Fluorescence	A5		A2		
Pu IDMS					B1 F1 G1
TIMS LEU	A2 B1	M2 T2		C2 E2 F1	
HEU	A5 B2 F1 J5 P2 U2				
Pu					B2 F1 G1 J1 T3
ICP-MS LEU		R2			
ICP-MS HEU	S2				

Characterization of Test Materials

Characterization measurements were performed at NBL on each of the test materials as packaged for use in the Program, in accordance with a specific characterization plan designed by the NBL Numerical Analysis Group. The plan specified the number of randomly-selected samples to be analyzed to provide the characterized value, and the specific measurement

method to be used. A requirement for concurrent validation of measurements with Certified Reference Materials was incorporated into every characterization protocol. This requirement also provided traceability to the national measurement base. As a participant in the Program, NBL periodically reanalyzes all the materials distributed for analysis both for evaluation of NBL's performance and as a check on the integrity of the materials.

Distribution of Materials and Analysis Requirements

The characterized materials were distributed to the participating facilities with instructions on handling and analysis. For uranium measurements, whenever possible, participants were asked to analyze each of the two samples specified for the measurement period in duplicate on each of two days, producing a total of eight results. This maximized the information available for statistical evaluation while minimizing analytical effort. For plutonium isotopic measurements, only duplicate analyses were requested on each of the samples.

Statistical Analysis and Reporting

During Fiscal Year 1995, a database application for the statistical evaluation of submitted results was developed to facilitate statistical analysis and reporting. This application streamlines the entire process of statistical evaluation, from data entry to report and graphics generation. Starting in Fiscal Year 1996, all uranium data were processed using the new application. In Fiscal Year 1999, the database was upgraded to become Y2K compliant. The application has been adapted to process plutonium data.

All data were reviewed for handling, analysis, and reporting problems before statistical analysis. If necessary, the submitting laboratory was contacted for any necessary clarifications or corrections. For each set of data submitted, individual data evaluation reports were prepared and distributed to the reporting facility and to its oversight agency, either the cognizant DOE Operations Office, or NRC Headquarters. These reports were distributed within three weeks of receipt of raw data, whenever possible, to provide rapid feedback to the participant. In order for this feedback to be most meaningful, timely submission of data to the Program is very important.

In order to normalize the data for reporting, the percent relative difference (% RD), from the reference value, defined as

$$\%RD = [(\text{observed value} - \text{reference value})/\text{reference value}](100\%),$$

was calculated for each reported measurement value.

Outlier tests were performed on each set of data submitted by each participant; further statistical analyses were performed on the data after elimination of statistically significant outliers. Both the mean of the %RDs and the mean of the absolute %RDs were calculated. A 95% confidence limit (C.L.) was calculated for the mean of the %RDs. This C.L. consisted of an estimate of standard uncertainty of the mean multiplied by a coverage factor, i.e.

95% C.L. = standard uncertainty * coverage factor

If the C.L. did not include zero, a bias was reported.

Both within-day variation and variation due to day of analysis were calculated. Comparison of the between-day variation with the within-day variation was accomplished using standard one-factor analysis of variance (ANOVA), with analysis day as the factor. If the ANOVA results indicated no significant excess variation due to analysis day, the standard uncertainty estimate used was the standard error, which is the standard deviation of the mean. This is the simple standard deviation divided by the square root of *n*, where *n* is the number of observations. The coverage factor used was the 95% Student's "t" factor with *n*-1 degrees of freedom.

If the ANOVA results indicated significant excess variation due to analysis day, the standard uncertainty estimate used was the square root of the mean square for the "model" quantity from the ANOVA results. The coverage factor used was the 95% Student's "t" factor with k-1 degrees of freedom, where k was the number of days over which the analyses were performed; since analyses were usually performed over two days, the Student's "t" factor for one degree of freedom was used in the calculations.

Two uranium sample reports are shown in Figures 1 and 2. In Figure 1, the ANOVA results indicate that the data contained no significant excess variation due to analysis day. The 95% C.L. does not include zero, indicating that the mean is significantly biased. Note in Figure 2 that the statistical significance of the between-day standard deviation is more than 95%, indicating that significant excess variation due to analysis day was present. Therefore the 95% C.L. is calculated using the Student's "t" factor for one degree of freedom (for two analysis days). This number is approximately 12.7; the 95% C.L. of the mean then becomes very large. Detecting a statistically significant bias becomes very difficult in this circumstance.

Figure 1

SAMPLE DATA EVALUATION REPORT

No significant excess 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: July 30, 2000

Sample Number	Aliquant Number	Analysis Date	Reported %U	% Relative Difference	Analyst Code
95EU0079-1	1	06/25/00	88.126	-0.0034	XXX
95EU0079-1	2	06/25/00	87.990	-0.1577	XXX
95EU0079-2	1	06/25/00	88.031	-0.1112	XXX
95EU0079-2	2	06/25/00	87.892	-0.2689	XXX
95EU0079-1	3	06/26/00	88.030	-0.1123	XXX
95EU0079-1	4	06/26/00	87.950	-0.2031	XXX
95EU0079-2	3	06/26/00	87.922	-0.2349	XXX
95EU0079-2	4	06/26/00	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%

Figure 2

SAMPLE DATA EVALUATION REPORT

Significant excess 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: May 8, 2000

Sample Number	Aliquant Number	Analysis Date	Reported %U	% Relative Difference	Analyst Code
94NU0021-023	1	04/11/00	1.0000	-0.0590	XXX
94NU0021-023	2	04/11/00	1.0003	-0.0290	XXX
94NU0023-079	1	04/11/00	0.9991	-0.0080	XXX
94NU0023-079	2	04/11/00	0.9996	-0.2582	XXX
94NU0021-023	3	04/15/00	1.0022	0.1609	XXX
94NU0021-023	4	04/15/00	1.0004	-0.0190	XXX
94NU0023-079	3	04/15/00	1.0004	0.1221	XXX
94NU0023-079	4	04/15/00	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%

Annual Reporting

Data sets from each of the participating facilities are consolidated in this report, and presented with comparisons among facilities. The presentation and discussion of submitted data are organized in this report according to the material analyzed. All data are referenced to facility codes to maintain anonymity of the participants.

New International Target Values (ITVs) were published in 2000[1] by the International Atomic Energy Agency, and adopted by the Program in 2001. These target values are intended to be realistic goals for the performance of the methods used. The 2000 ITVs are displayed on most of the comparative graphs in this report.

Two types of graphical formats are used to display the interlaboratory comparisons. The Material-Measurement Skeletal Graphs (Figures 3, 5, 7, 9, 11, 13, 15, 16, 18, and 20) permit a simplified comparison of measurement capabilities by laboratory. The diamond on the vertical line indicates the location of the mean value of the %RDs. The vertical line depicts the standard deviation of the mean %RD. If the mean %RD is between the bias target limit lines, that target value has been met. Laboratory codes are located across the base of the plot; the number of analyses is located across the top of the plot.

The Material-Measurement Line Graphs (Figures 4, 6, 8, 10, 12, 14, 17, 19, and 21) emphasize the precision of the data. The diamond on the vertical line represents absolute value of the mean %RD. If the diamond is near the zero end of the line, the data are unbiased. The height of the line represents the percent relative standard deviation (%RSD), defined as the standard deviation of the mean %RD. If the %RSD is below the precision target limit line, that target value has been met.

Following the interlaboratory comparisons by material, Material-Measurement Skeletal Graphs for all uranium measurements are displayed for each laboratory (Figures 22 through 51). Three years of data are plotted on these graphs, so that longer-term performance may be evaluated.

A complete listing of all data submitted to the Program, sorted by material and laboratory, is included in the Appendix of this report.

[1] Deron, S. et al, "International Target Values 2000 for Measurement Uncertainties in Safeguarding Nuclear Materials", Journal of Nuclear Materials Management XXX, No. 2 (2002).

EVALUATION OF MEASUREMENT PERFORMANCE BY MATERIAL

URANYL NITRATE SOLUTIONS

The analysis of pure uranyl nitrate solutions represents the most direct test of measurement systems for uranium elemental concentration. The first such solution to be analyzed within the Program was donated by the Y-12 Plant, and was used to help resolve a shipper-receiver difference. The solution was intended to be representative of actual material being shipped, which was approximately 50% enriched in ^{235}U. This solution, plus samples from a suite of three high-enriched (approximately 90% ^{235}U) solutions were analyzed by three facilities utilizing isotope dilution mass spectrometry (IDMS) to determine uranium concentration. A suite of three uranyl nitrate solutions of normal enrichment is analyzed by most other Program participants. The use of normal enrichment enables participation by facilities restricted from receiving shipments of enriched materials. These three normal solutions differ from one another in elemental concentration by approximately 0.2%; the ability to differentiate among them demonstrates good analytical capabilities.

Preparation and Packaging for Shipment

The uranyl nitrate solutions are packaged in flame-sealed glass ampules with a break-off tip. Before shipping, the ampules are sealed in plastic, wrapped in absorbent cushioning, sealed in plastic again, and packaged in secondary containers (screw-cap fiberboard cans). The uranium concentrations range from approximately 7 to 10 mg U/g solution.

Reference Value and Uncertainties

The reference values for the 50%-enriched solution and the 90%-enriched solutions were determined by analyzing subsamples taken from ampulated samples. The NBL-modified Davies and Gray titration procedure was used to perform the characterization measurements.

All of the normal enrichment uranium solutions were prepared from NBL dingot metal, the source of Certified Reference Material (CRM) 112-A, Uranium Metal Assay Standard. Because of the possibility of evaporation during the ampulation process, the original suite of normal uranium solutions was characterized after ampulation using the NBL-modified Davies and Gray titration procedure. The characterized values were then used as the reference values in the Program. In all cases, agreement between prepared and characterized values was within a few hundredths of a percent. Because of this good agreement, the characterized values of the new suite of normal uranium solutions were based on prepared values; a more limited number of

measurements were performed to confirm the prepared values. This resulted in a significant savings in analytical effort and in the overall cost of the ampules.

The 95% confidence limit (C.L.) for the 50% enriched solution is ±0.1% of the reference value. The 95% C. L. for each of the high-enriched solutions is approximately ±0.02%. The 95% C.L. for each of the normal enrichment solutions currently in use in the program ranges from ±0.02% to ±0.05%. Although characterized values for the new suite of normal enrichment solutions were based on prepared values, the uncertainties were calculated using measurement data, to produce more conservative uncertainty estimates.

Evaluation of Performance

For Figures 3 and 4, the data are arranged by methods and their target values. Laboratories G, B, C, F, S, and U measure uranium concentration by titration. Facilities A*, B*, and J* measure uranium concentration by IDMS. Facility A** uses x-ray fluorescence (XRF). International Target Values are used for titration and IDMS. There are no specific 2000 International Target Values for XRF, so DOE target values[2] from 1993 are used. Target values for bias are 0.1% for titration and IDMS, and 0.5% for XRF. Target values for precision are 0.1% for titration, 0.15% for IDMS, and 0.5% for XRF. Target values for bias are plotted in Figure 3. Target values for precision are plotted in Figure 4.

As seen in Figure 3, B and C (titration) and B* (IDMS) did not meet the target limits for bias in Fiscal Year 2001. As seen in Figure 4, laboratories B, C, and B* did not meet the target limits for precision. The results from laboratories A*, A**, F, G, J*, and S demonstrate very good accuracy and precision in the measurement of uranyl nitrate solutions. Table 4 presents the numerical values of the plotted data.

Table 4
Interlaboratory Performance Summary
UNH - Percent U

Method	Lab code	Mean	Standard deviation	N
Ceric Titration	G	-0.016	0.035	16
Davies-Gray Titration	B	-0.271	0.117	23
	C	0.158	0.397	16
	F	-0.028	0.032	16
	S	-0.025	0.042	15
	U	0.099	0.147	12
IDMS	A*	0.003	0.144	40
	B*	-0.897	1.162	8
	J*	-0.021	0.084	56
X-Ray Fluorescence	A**	0.223	0.242	40

[2] U.S. DOE Office of Security Affairs/Office of Safeguards and Security, *Measurement Control Guide* and *Measurement Improvement Plan*, 1993.

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U

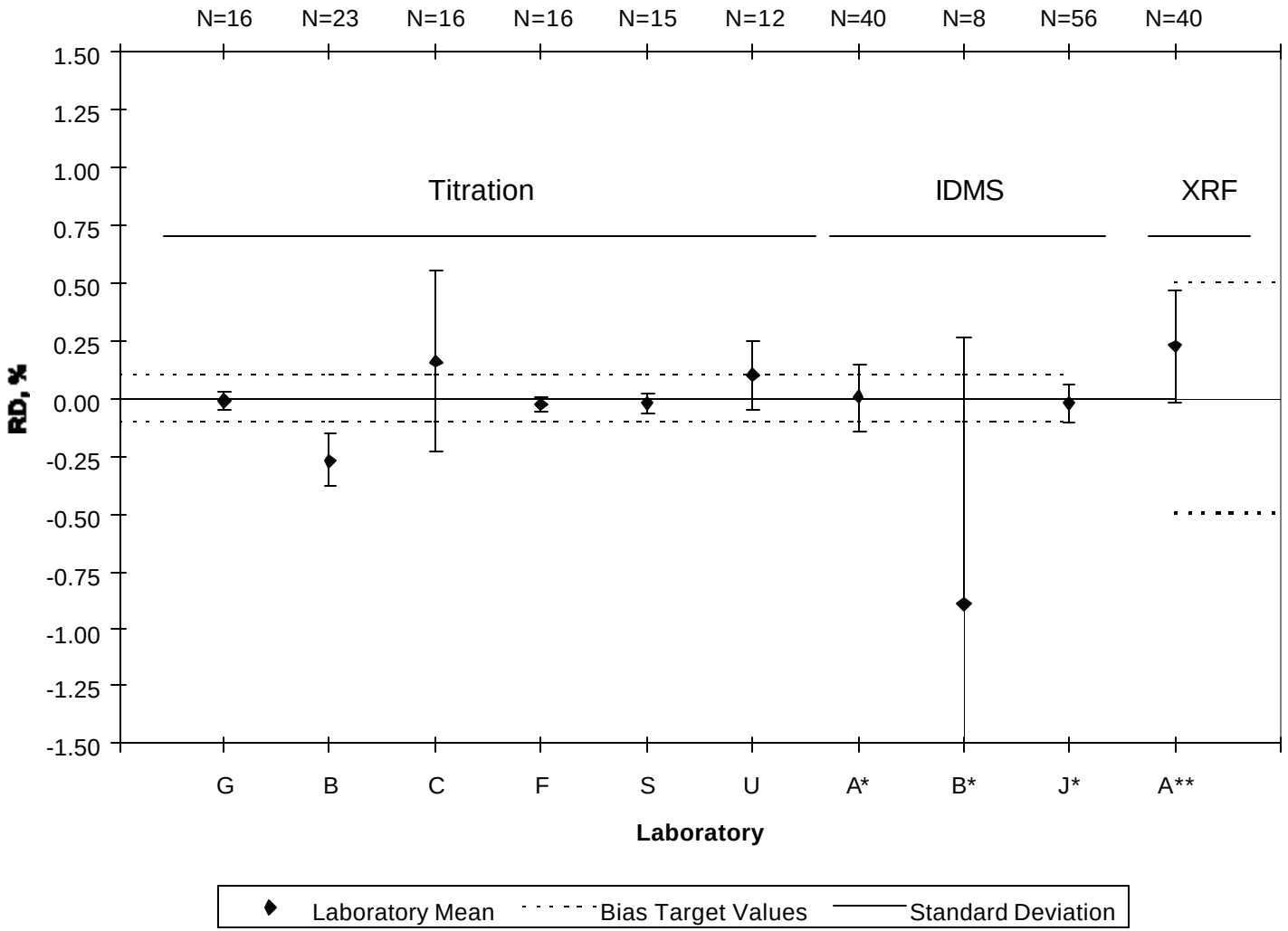


Figure 3

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U

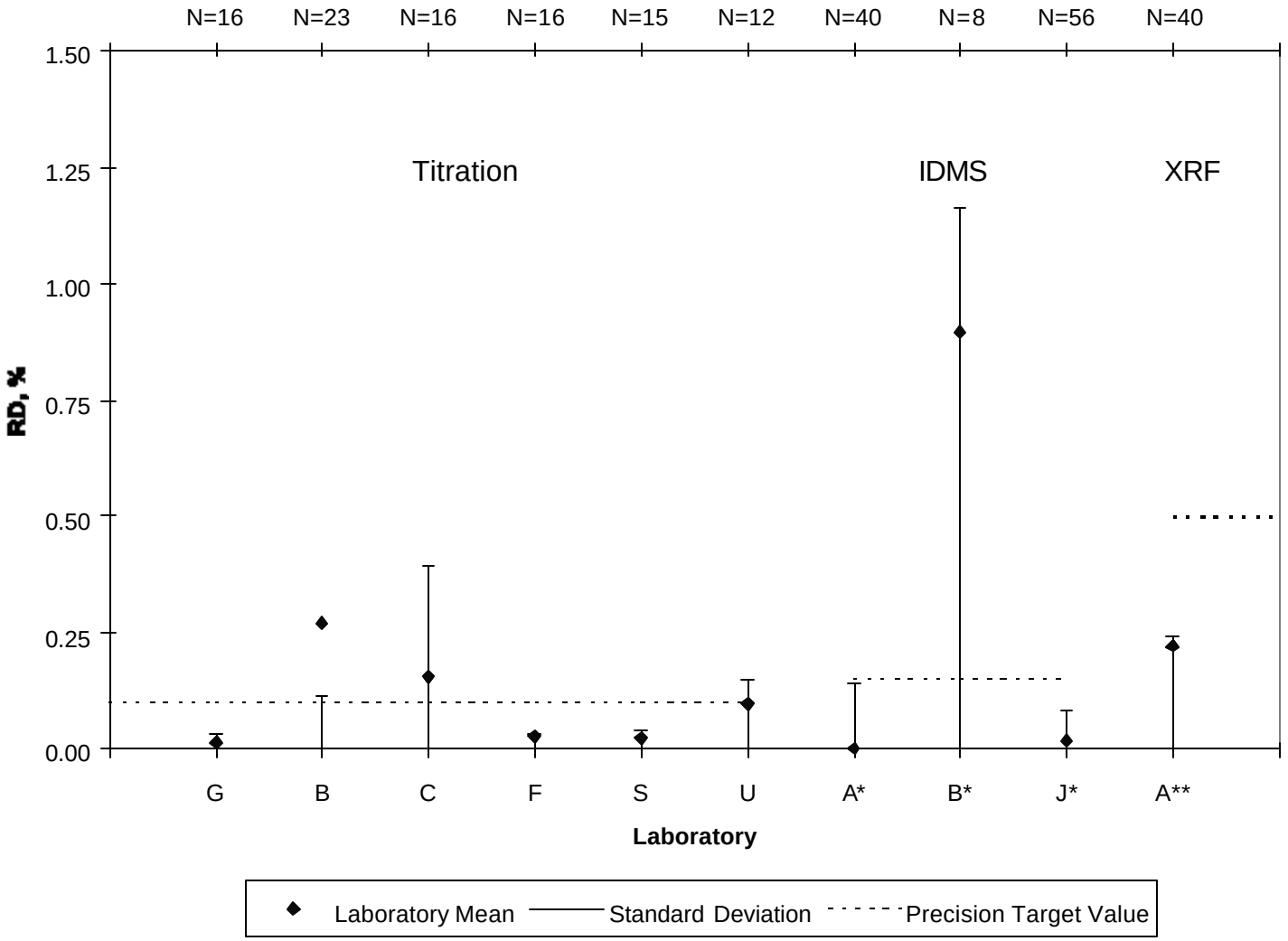


Figure 4

ENRICHED URANIUM DIOXIDE PELLET

As a collaborative effort between DOE and the NRC, NBL has packaged and certified a uranium dioxide pellet material to serve as both a Certified Reference Material (CRM 125-A) and a test material in this Program. Westinghouse Commercial Nuclear Fuel Division, an NRC licensee, supplied the NBL with the base material, a single production batch of UO_2 pellets. These pellets were sintered at 1700°C for 20 hours in a reducing atmosphere in order to produce a ceramic-like material that is resistant to moisture uptake and is stable when exposed to air.

Preparation and Packaging for Shipment

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

Reference Value Uncertainties

Uranium elemental concentration measurements were performed using the NBL high-precision titration. NBL CRM 112-A, Uranium Metal Assay Standard, was used for quality control. The 95% C.L. is less than ±0.02% of the reference value. Uncertainties assigned to the isotopic abundance values are discussed in the Uranium Enrichment section.

Evaluation of Performance

For Figures 5 and 6, the data are arranged by methods and target values. Laboratory F* uses high-precision titration. Laboratories F and T use modified Davies and Gray titration. Laboratories M and R use conventional gravimetric methods. Laboratory P uses atmospheric equilibration, a gravimetric technique. The 2000 International Target Values for titration are 0.1% for both bias and precision. The 2000 ITVs for gravimetric methods are 0.05% for both bias and precision. Data for all methods are within their applicable target limits. Table 5 presents the numerical values of the plotted data.

Table 5
Interlaboratory Performance Summary
UO_2 Pellets - Percent U

Method	Lab code	Mean	Standard deviation	N
Atmospheric Equilibration	P	-0.011	0.001	8
Davies-Gray Titration	F	-0.037	0.029	30
	T	-0.015	0.062	16
Gravimetry	M	0.012	0.003	8
	R	0.024	0.007	7
High Precision Titration	F	0.013	0.010	8

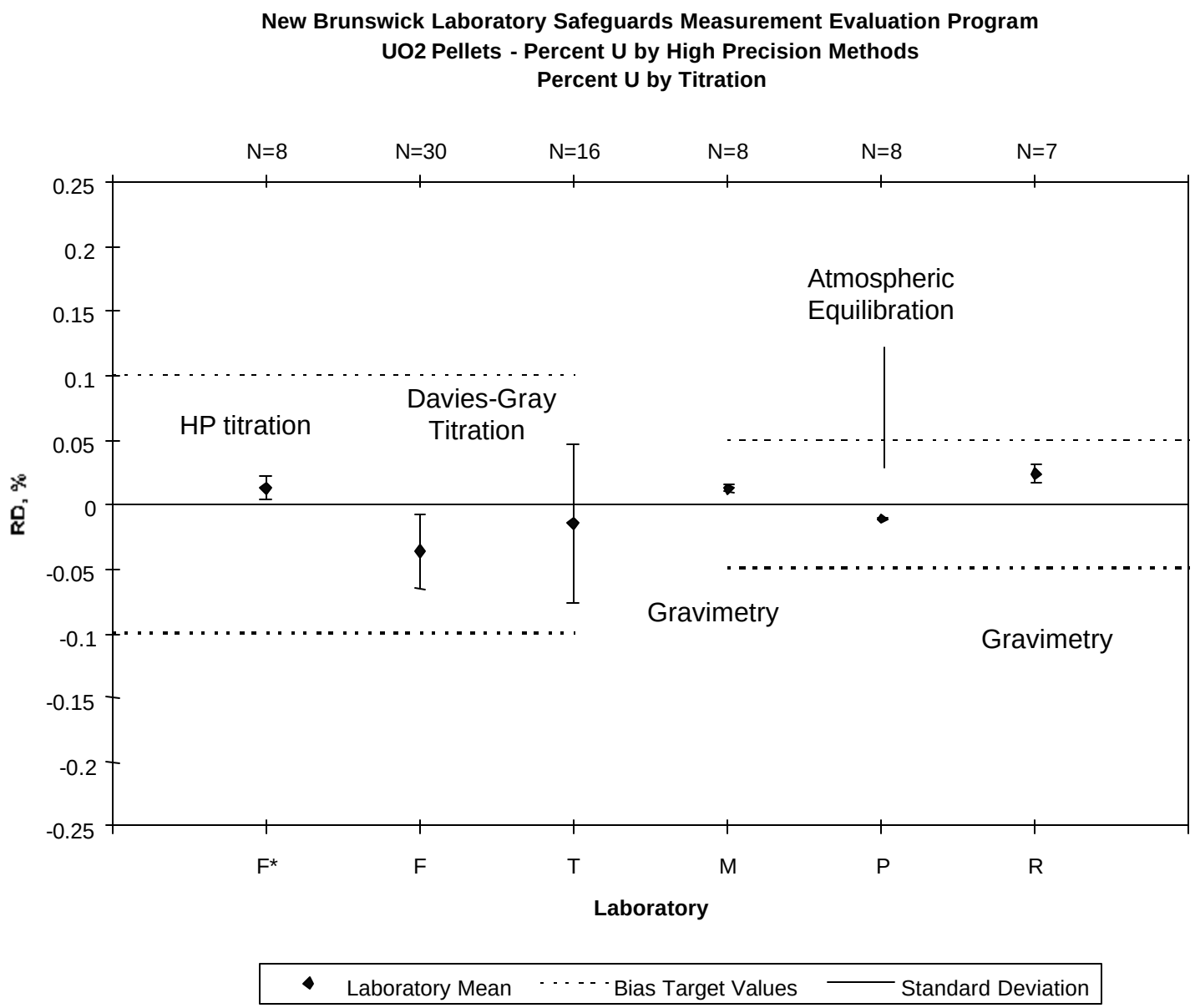

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO2 Pellets - Percent U by High Precision Methods
Percent U by Titration
N=8
N=30
N=16
N=8
N=8
N=7
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
RD, %
Atmospheric
Equilibration
HP titration
Davies-Gray
Titration
Gravimetry
Gravimetry
F*
F
T
M
P
R
Laboratory
Laboratory Mean
Bias Target Values
Standard Deviation

Figure 5

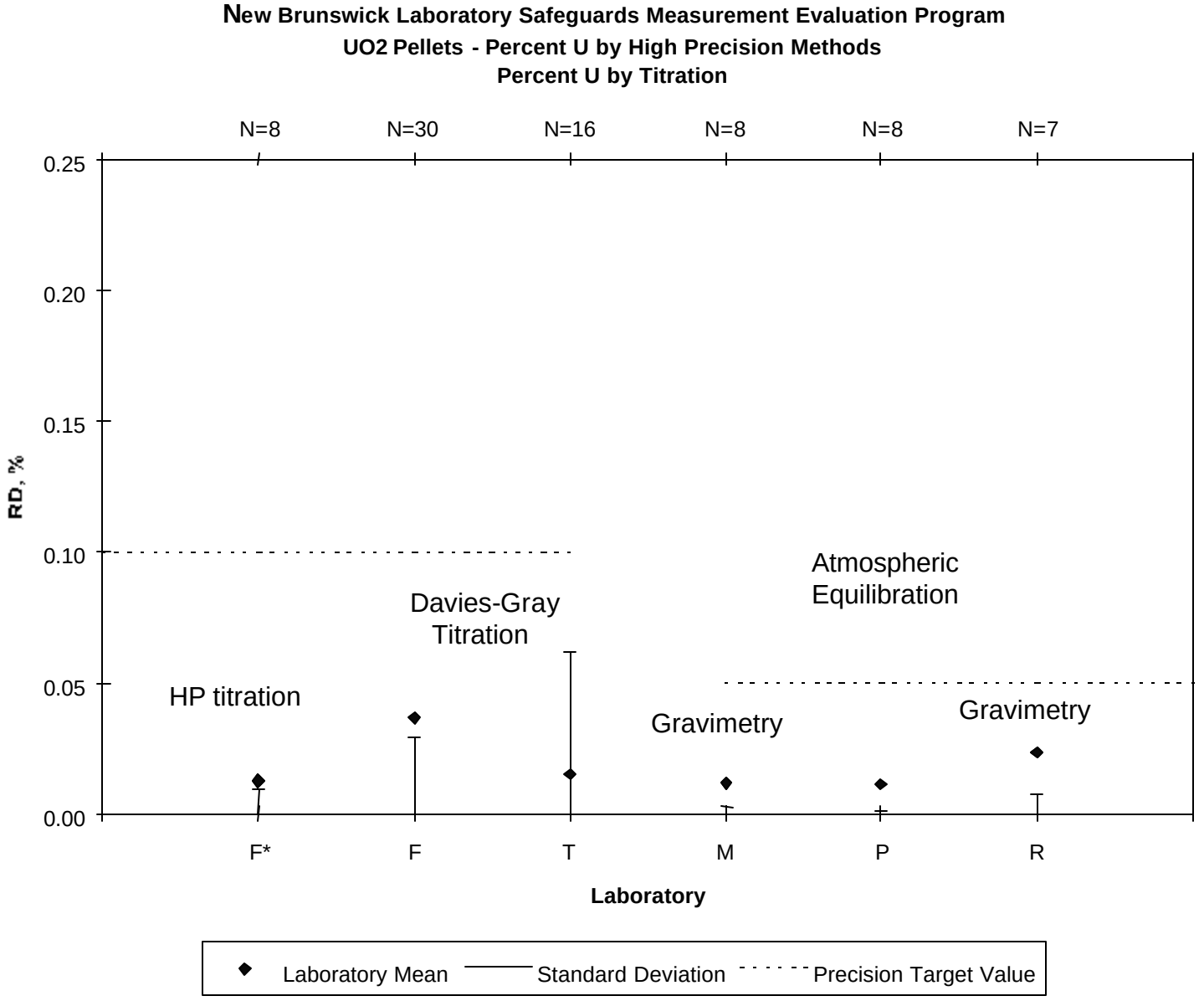

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO2 Pellets - Percent U by High Precision Methods
Percent U by Titration
N=8
N=30
N=16
N=8
N=8
N=7
0.25
0.20
0.15
0.10
0.05
0.00
RD, %
HP titration
Davies-Gray Titration
Atmospheric Equilibration
Gravimetry
Gravimetry
F*
F
T
M
P
R
Laboratory
Laboratory Mean
Standard Deviation
Precision Target Value

Figure 6

URANIUM HEXAFLUORIDE

Portsmouth Gaseous Diffusion Plant donated two sampling manifolds to NBL, to be used to transfer the UF_6 material from 2S cylinders to P-10 tubes for shipment and analysis. One manifold is dedicated to uranium with normal enrichment; the other is being reserved for enriched uranium. With Portsmouth technical assistance and after extensive safety review at the NBL, normal-enrichment UF_6 was added to the Program as a continuing material for analysis in Fiscal Year 1993.

In Fiscal Year 1996, plans were made to add a UF_6 test material characterized for both uranium concentration and ^{235}U enrichment. Because CRM 113, Uranium (Enriched) Hexafluoride, is sold out, the decision was made to certify an appropriate material for use in both the SME and the Reference Material Programs. An enrichment level of approximately 4.5% was chosen for the new CRM because it represents the enrichment level of material supplied to fuel fabrication licensees for pellet production, and also because it is near the enrichment level of Russian downblended UF_6 material shipped to the U.S. During 1998, certification for both uranium concentration and isotopic abundances was completed. The primary users identified for this CRM are the two GDPs. These facilities were converted from DOE contractor sites to NRC licensees in March 1997. Because of the change in their status, this CRM was certified with joint funding from both DOE OSS and the NRC. This CRM (CRM 113-B) was added as a test material to the SME Program in Fiscal Year 2001.

Preparation and Packaging for Shipment

The normal enrichment material is packaged in P-10 tubes under dry nitrogen with each tube containing from 7 to 12 g UF_6. The tubes are heat-sealed in plastic and packaged in secondary containers (produce cans) before shipping. CRM 113-B is currently packaged in 2S cylinders.

Reference Value Uncertainty

Uranium elemental concentration measurements of CRM 113-B were performed using the NBL high-precision titration method. NBL CRM 112-A, Uranium Metal Assay Standard, was used for quality control. Samples of SME Program normal-enrichment UF_6 were analyzed concurrently to provide a check on the extensive handling required to prepare samples for analysis. The 95% C.L. of the uranium concentration of CRM 113-B is 0.033%. Uncertainties assigned to the isotopic values are discussed in the Uranium Enrichment section.

Evaluation of Performance

Figures 7 and 8 display the results of the NRC fuel fabrication licensees which analyzed the pellets by gravimetry, their routine method; and Laboratory F, which used high-precision titration. For gravimetry, the 2000 International Target Values are 0.05% for both bias and precision. Although the 2000 International Target Values for titration (0.1% for both bias and precision) are shown on the figures for high-precision titration, high-precision titration is expected to produce results with uncertainties that are equal to or better than those from gravimetry. All data are within the target values for gravimetry. Table 6 presents the numerical values of the plotted data.

Table 6
Interlaboratory Performance Summary
UF_6 - Percent U

Method	Lab code	Mean	Standard deviation	N
Gravimetry	C	0.040	0.012	8
Gravimetry	E	-0.008	0.014	8
High Precision Titration	F	-0.007	0.015	3

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UF6 - Percent U

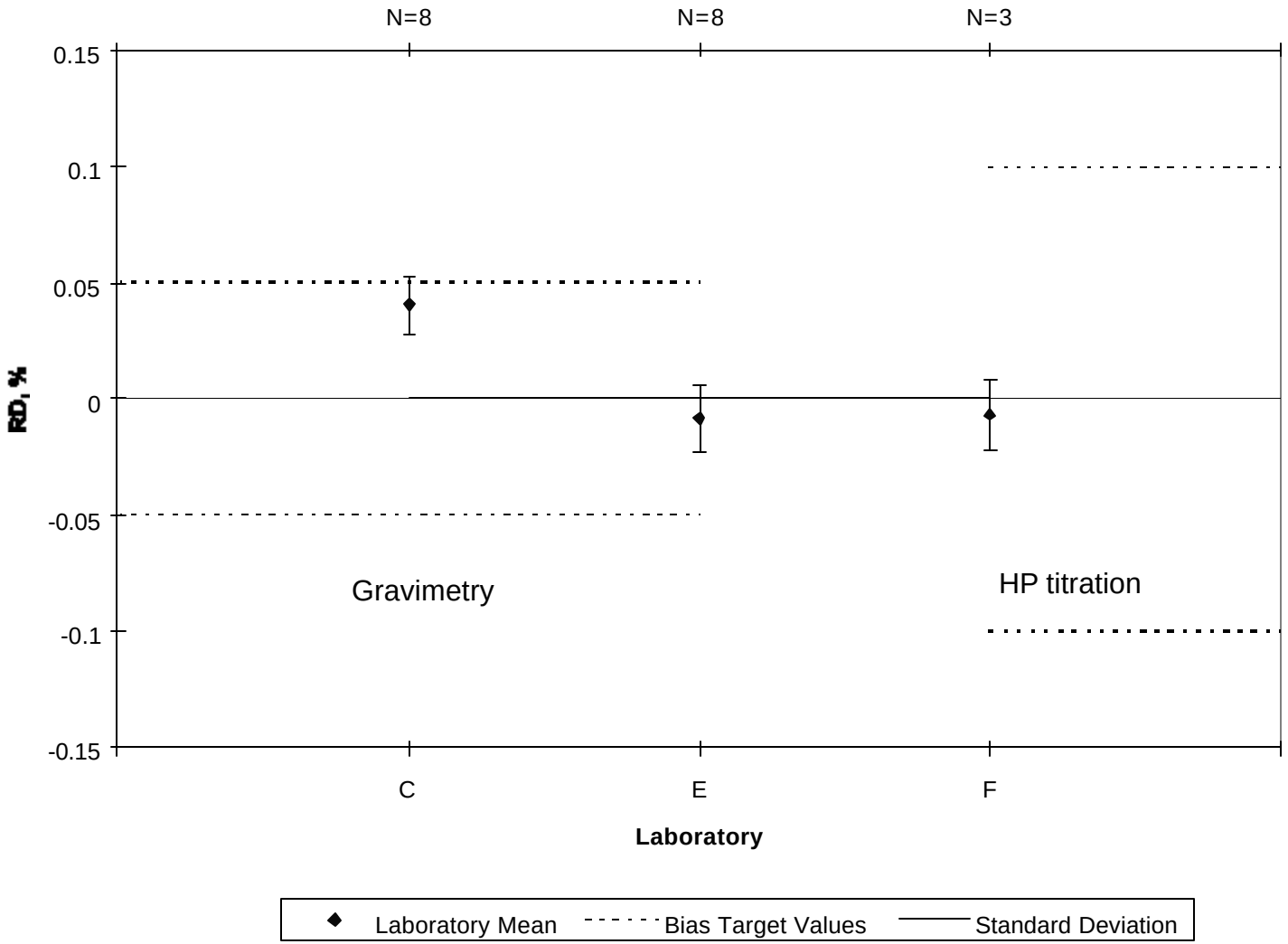


Figure 7

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UF6 - Percent U

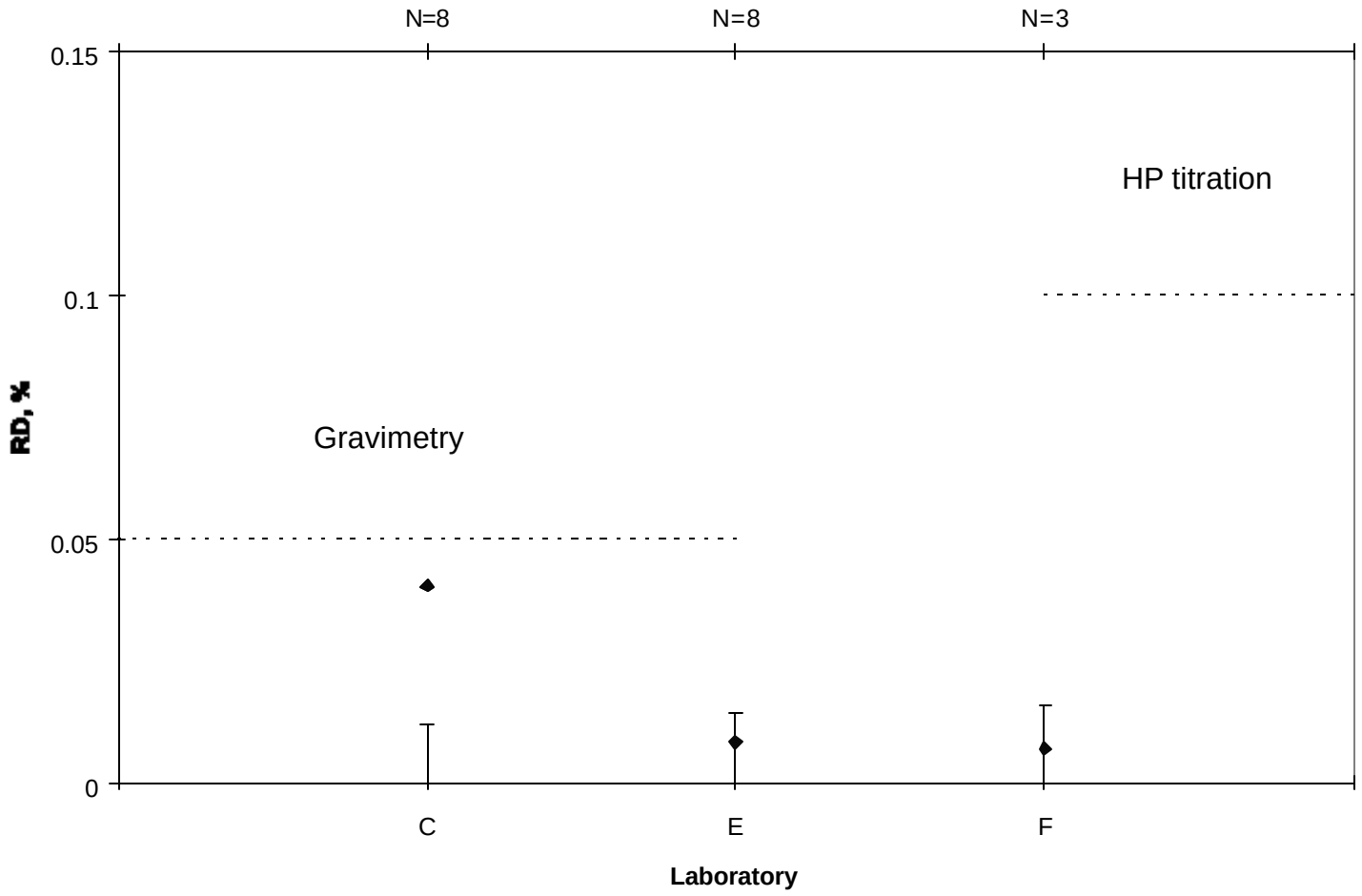


Figure 8

URANIUM OXIDE (UO_3) POWDER

NBL was requested by a DOE Safeguards Measurement Evaluation Program participant to reintroduce a UO_3 powder test material into the Program. This material was previously used in the Program to test the ability of the participating laboratories to handle a hygroscopic material; its use had been discontinued because of lack of interest. The laboratory requesting the reintroduction planned to use three different methods to analyze the material: x-ray fluorescence (XRF) in solid form, XRF in liquid form, and isotope dilution mass spectrometry.

Preparation and Packaging for Shipment

UO_3 powder is packaged under dry nitrogen in pharmaceutical vials closed with Teflon-lined stoppers under a crimped seal. The vial is sealed in plastic, and packaged in a cardboard tube.

Reference Value Uncertainty

The test materials originally had been packaged over five years ago. Since the packaging might have been compromised over such a long period of time, allowing moisture adsorption by the test material, it was necessary to recharacterize the uranium content of the material.

If the material had adsorbed moisture over the time since packaging, it was also necessary to ensure that the packaged material was still sufficiently uniform from unit-to-unit to be a suitable test material. Eight vials were selected for verification analysis. Uranium elemental concentration measurements were performed using the NBL-Modified Davies and Gray Titration. NBL CRM 112-A, Uranium Metal Assay Standard, was used for quality control. The final uranium concentration value differed from the original measured value by -0.064%, with a 95% confidence level of 0.012% of the value. The material was reintroduced to the Program using the updated characterized value.

Evaluation of Performance

For Figures 9 and 10, the data are arranged by methods and their target values. Laboratory F measures uranium concentration by Davies and Gray titration. Facility A measures uranium concentration by three different methods: IDMS (A), XRF – liquid (A*), and XRF – solid (A**). International Target Values are used for titration and IDMS. As noted in the section on uranyl nitrate solutions, there are no specific 2000 International Target Values for XRF, so DOE target values from 1993 are used. Target values for bias are 0.1% for titration and IDMS, and 0.5% for

the XRF methods. Target values for precision are 0.1% for titration, 0.15% for IDMS, and 0.5% for the XRF methods.

As seen in Figure 9, laboratory A (IDMS) did not quite meet the target value for bias in Fiscal Year 2001. As seen in Figure 10, all laboratories met the target limits for precision. Table 7 presents the numerical values of the plotted data.

Table 7
Interlaboratory Performance Summary
UO_3 - Percent U

Method	Lab code	Mean	Standard deviation	N
Davies-Gray Titration	F	0.004	0.031	31
IDMS	A	-0.148	0.143	8
X-Ray Fluorescence Liquid	A*	0.064	0.234	8
X-Ray Fluorescence Solid	A**	-0.314	0.166	8

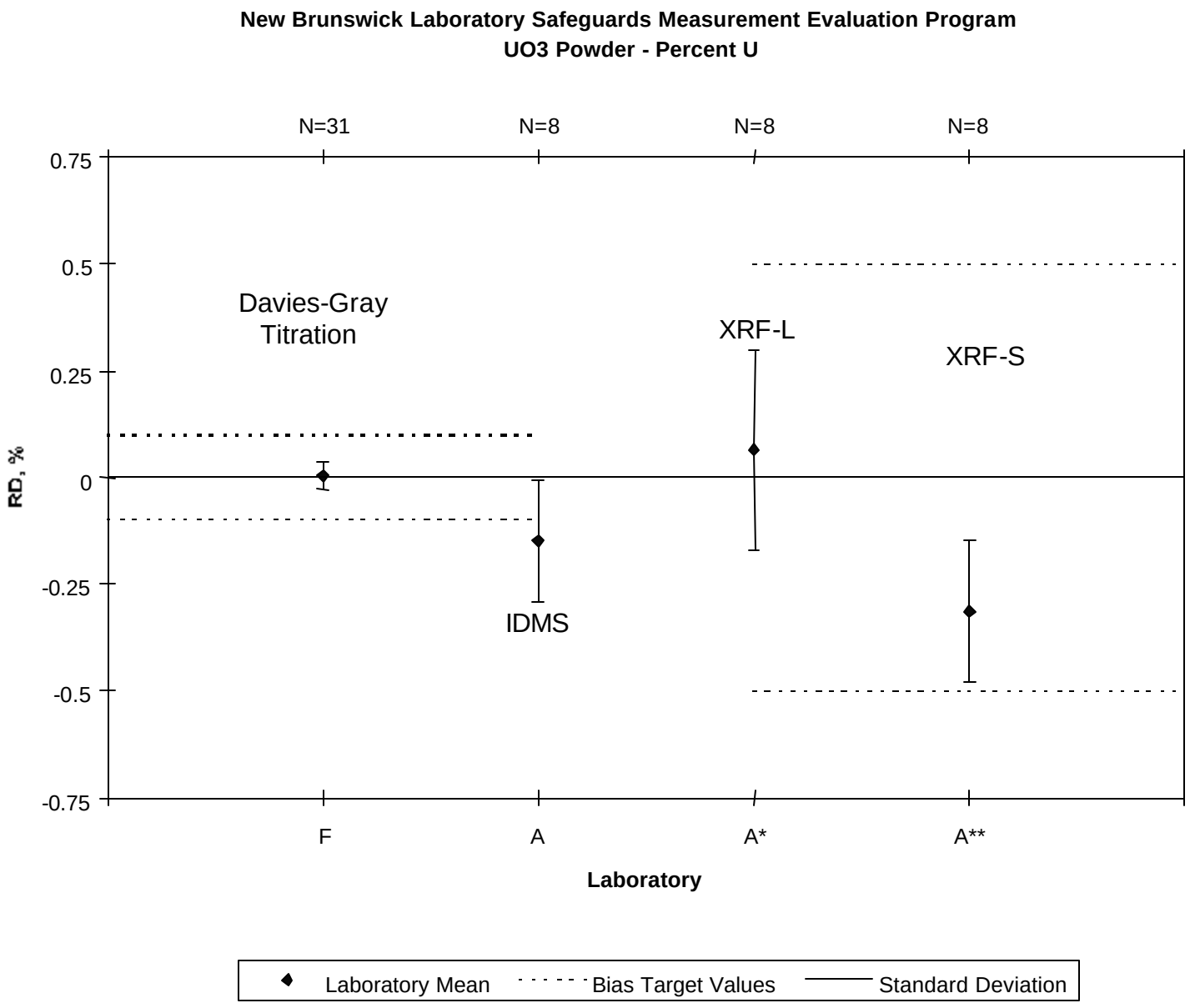

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO3 Powder - Percent U
N=31
N=8
N=8
N=8
0.75
0.5
0.25
0
-0.25
-0.5
-0.75
RD, %
Davies-Gray
Titration
XRF-L
XRF-S
IDMS
F
A
A*
A**
Laboratory
Laboratory Mean
Bias Target Values
Standard Deviation

Figure 9

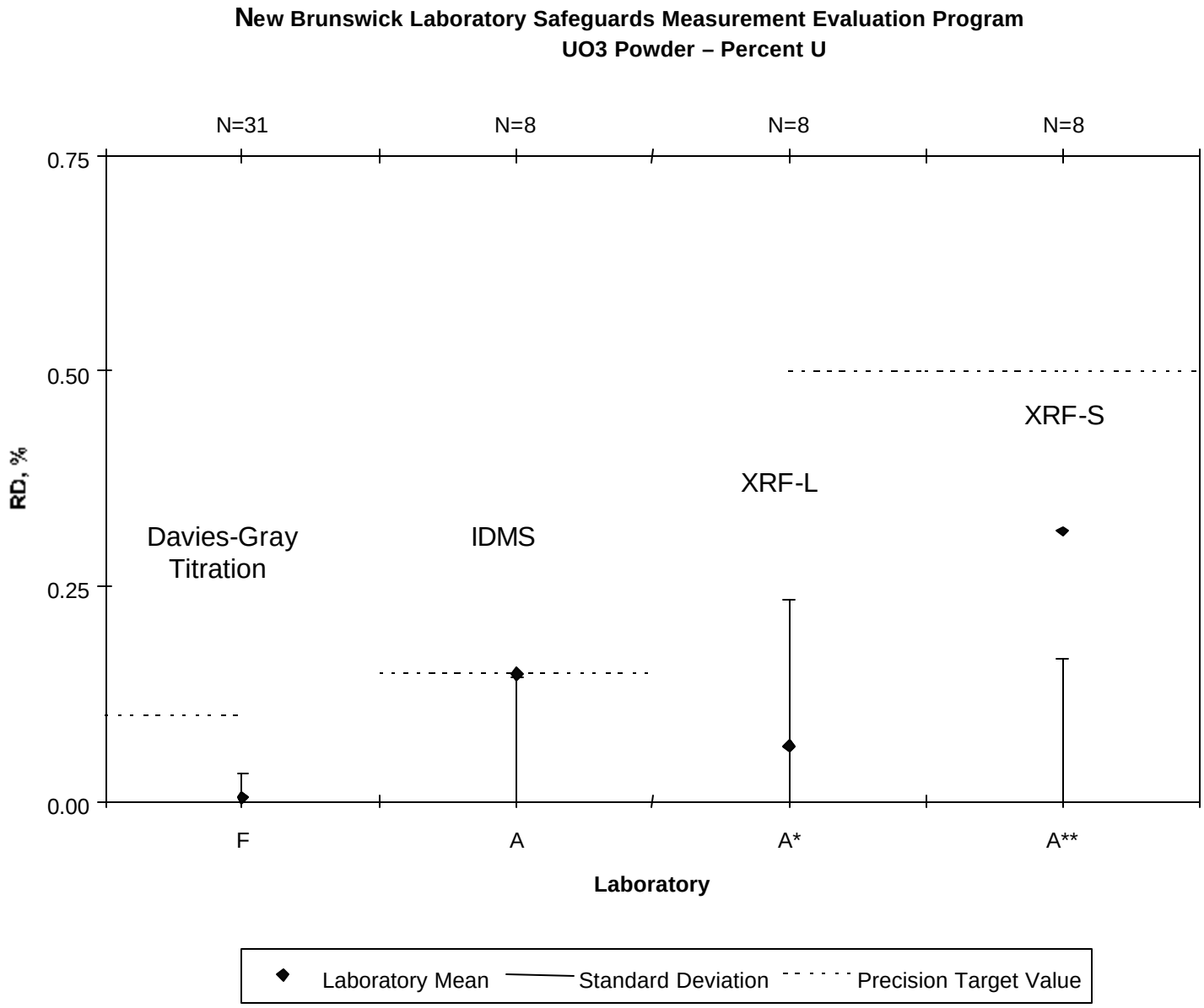

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO3 Powder – Percent U
N=31
N=8
N=8
N=8
0.75
0.50
0.25
0.00
RD, %
Davies-Gray Titration
IDMS
XRF-L
XRF-S
F
A
A*
A**
Laboratory
Laboratory Mean
Standard Deviation
Precision Target Value

Figure 10

URANIUM-235 ENRICHMENT

Five test materials in the form of uranyl nitrate solutions are available for the measurement of uranium enrichment. These test materials include a suite of three solutions prepared from uranium enriched to approximately the 90% level, a solution prepared from uranium enriched to approximately 50%, and a solution prepared from uranium enriched to approximately 4%. NBL and the NRC fuel fabrication licensees are also analyzing the UO_2 pellet (described in another section) for enrichment (approximately 4%), as well as for uranium concentration. The certification of CRM 113-B, 4.5% enriched UF_6, was recently completed. This material was added to the Program in FY2001 to evaluate the performance of gas mass spectrometry at Portsmouth and Paducah Gaseous Diffusion Plants.

Preparation and Packaging for Shipment

The uranyl nitrate solutions are packaged in flame-sealed glass ampules with a break-off tip, and have an elemental concentration ranging from 5-10 mg U/g solution. Before shipping, the ampules are sealed in plastic, wrapped in absorbent cushioning, sealed in plastic again, and packaged in cardboard tubes. The UO_2 pellets are 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 a cardboard tube. CRM 113-B UF_6 material is currently packaged in 2S cylinders.

Reference Value Uncertainties

All isotopic abundance reference values were obtained using thermal ionization mass spectrometry (TIMS). NBL CRMs of approximately equivalent enrichments were used to determine the mass bias correction. The 95% C.L.s of the reference values of the uranyl nitrate solution test materials were determined without propagating the uncertainty on the $^{235}U/^{238}U$ ratio of the CRMs. The assigned C.L.s, which include only analytical variation, are 0.02% for the 4% solution, and less than 0.01% for the 50% and 90% solutions.

Following International Standards Organization guidelines, the C.L.s for all of the isotopic abundance values for the UO_2 pellet (CRM 125-A) were recalculated in Fiscal Year 1997 including the uncertainty on the $^{235}U/^{238}U$ ratio of the CRM used to determine the mass bias correction. The updated 95% C.L. for the ^{235}U enrichment value of the pellet is 0.07%.

The isotopic abundances of CRM 113-B UF_6 were certified using thermal ionization mass spectrometry. The $^{235}U/^{238}U$ ratio was verified by gas mass spectrometry. As with CRM 125-A

above, the uncertainty was included in the 95% C.L. assigned to the ^{235}U enrichment value. The 95% C.L. is 0.053% of the value.

Besides being characterized for isotopic abundances, the 90% enriched solutions and the 50% enriched solution were also characterized for elemental concentration by the NBL-modified Davies and Gray titration. This enables these solutions to be used as test materials for the analysis of uranium concentration by isotope dilution mass spectrometry, as well as for uranium enrichment. As noted in the Enriched Uranium Dioxide Pellet section, the 4% enriched pellet was also certified for elemental concentration by the NBL high-precision titration.

Evaluation of Performance

Laboratories A, B, F, J, M, P, T, and U used TIMS for their analytical method. Laboratories R and S used inductively coupled plasma-mass spectrometry (ICP-MS). Laboratories C and E used gas mass spectrometry for the measurement of low enrichments.

For display, results from the 50% and the 90% enriched solutions were combined on Figures 11 and 12, as these results were generally comparable. The 2000 International Target Values for the analysis of 90% enriched material (0.05% for both precision and bias) are displayed on the comparative graphs. All participating facilities are within the limits for precision and bias for the high-enriched material. Table 8 presents the numerical values of the plotted data.

Table 8
Interlaboratory Performance Summary
^{235}U Enrichment - HEU

Method	Lab code	Mean	Standard deviation	N
TIMS	A	0.0029	0.0146	32
TIMS	B	0.0462	0.0410	20
TIMS	F	0.0020	0.0040	8
TIMS	J	0.0129	0.0173	66
ICPMS	S	0.0024	0.0180	16
TIMS	U	-0.0405	0.0276	12

The 2000 International Target Values for the analysis of low-enriched material by gas mass spectrometry are 0.05% for both precision and bias. Those for TIMS and ICP-MS are 0.1% for both precision and bias. These ITVs are displayed on the LEU comparative graphs (Figures 13

and 14). All participating facilities except laboratories P and R are within the limit for bias; laboratories M, P, and R are outside the limit for precision.

Although statistical evaluation was performed only on the ^{235}U abundance, the test materials are characterized for all isotopic abundances. Reports returned by the NBL to the facility include calculations of %RDs for the other isotopic abundances, for diagnostic purposes. Table 9 presents the numerical values of the plotted data.

Table 9
Interlaboratory Performance Summary
^{235}U Enrichment - LEU

Method	Lab code	Mean	Standard deviation	N
Gas MS	C	-0.017	0.011	16
Gas MS	E	0.013	0.005	16
TIMS	A	0.043	0.079	8
TIMS	B	0.005	0.020	4
TIMS	F	-0.010	0.075	15
TIMS	M	-0.014	0.107	16
TIMS	P	-0.138	0.117	8
ICPMS	R	-0.139	0.177	16
TIMS	T	0.082	0.049	16

New Brunswick Laboratory Safeguards Measurement Evaluation Program
U235 Enrichment - HEU

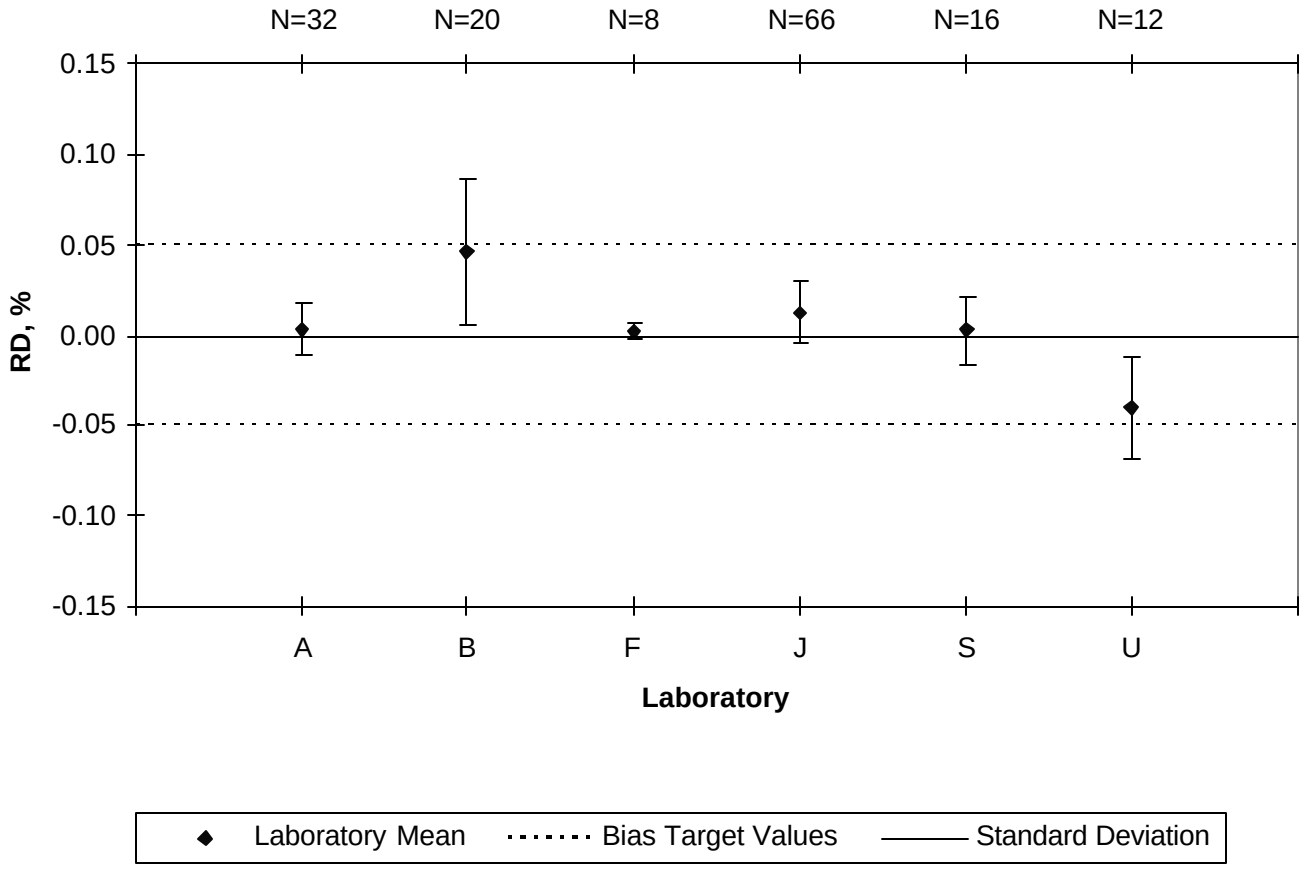


Figure 11

New Brunswick Laboratory Safeguards Measurement Evaluation Program
U235 Enrichment - HEU

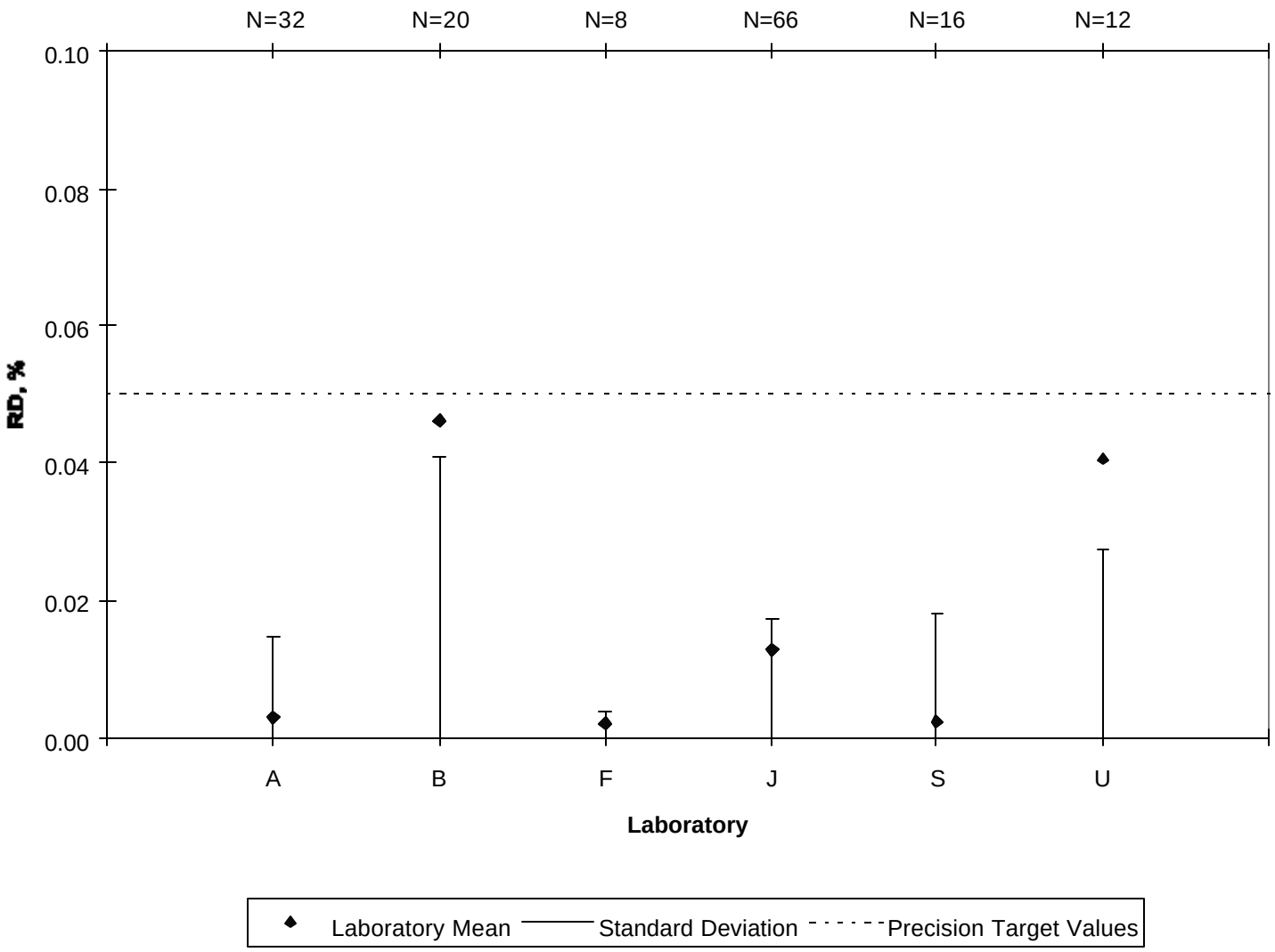


Figure 12

New Brunswick Laboratory Safeguards Measurement Evaluation Program
U235 Enrichment - LEU

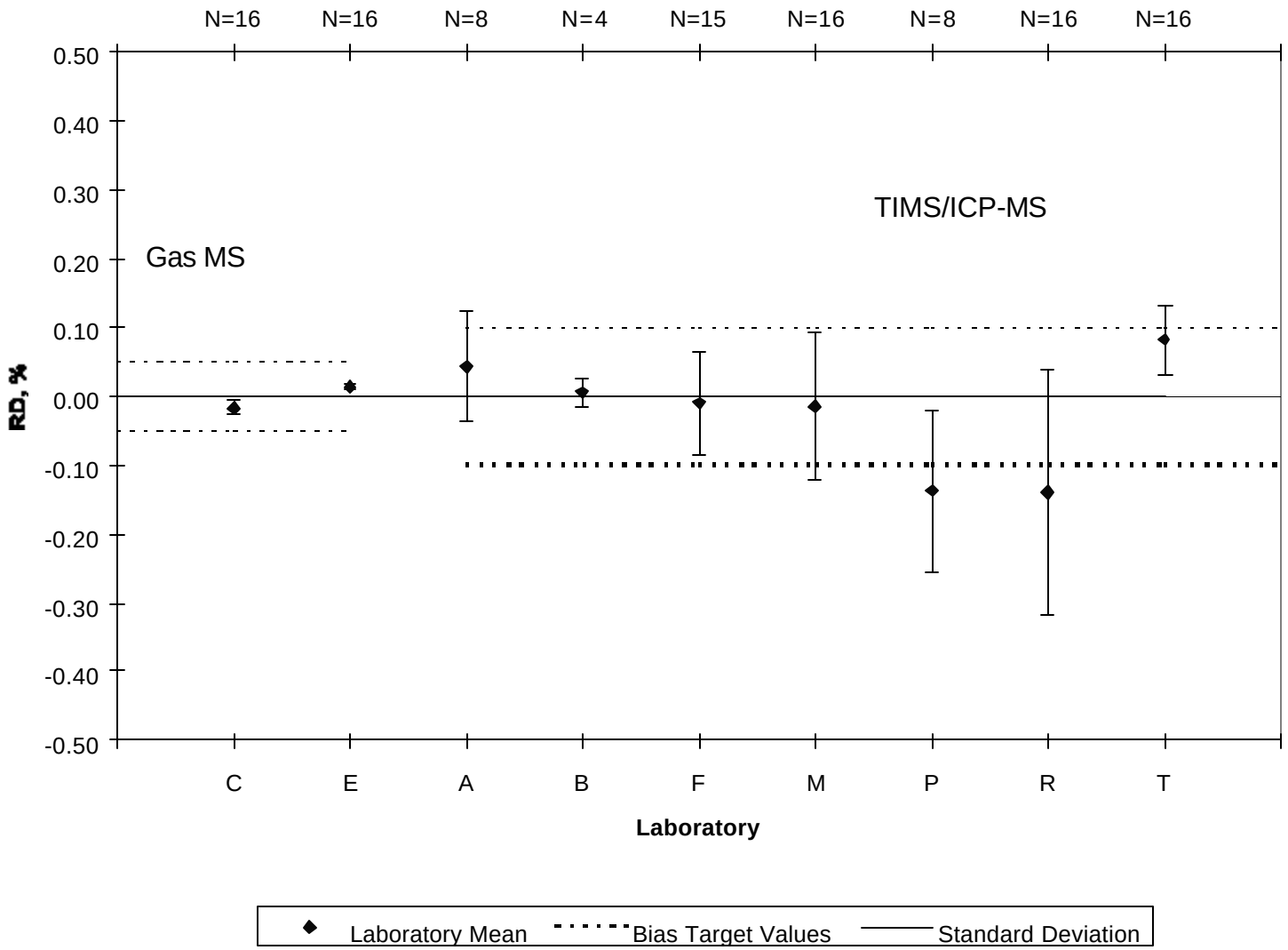


Figure 13

New Brunswick Laboratory Safeguards Measurement Evaluation Program
U235 Enrichment - LEU

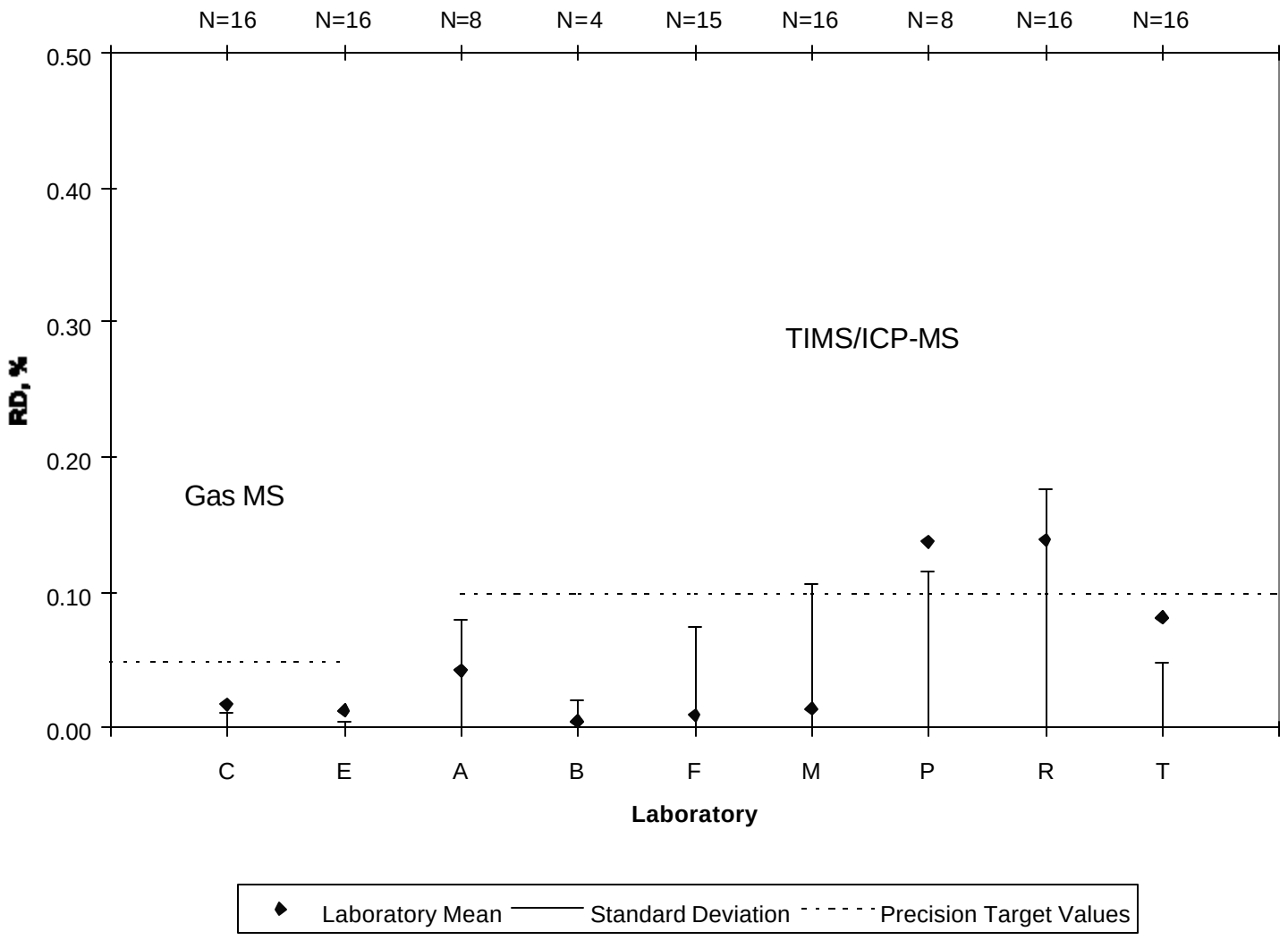


Figure 14

PLUTONIUM ASSAY AND ISOTOPIC ABUNDANCES

The test materials distributed and analyzed for assay of plutonium elemental composition were prepared from CRM 126, Plutonium Metal (Plutonium Assay and Isotopic Standard) and CRM 122, Plutonium Oxide in Powder Form (Plutonium Assay and Isotopic Standard). The CRMs were dissolved, diluted to an appropriate concentration with 8 *M* HNO_3 and aliquants of approximately 20 or 40 µg were placed in glass bottles and fumed to dryness as a sulfate. These samples were specifically intended to be analyzed by isotope dilution mass spectrometry (IDMS).

The test materials for isotopic analysis were prepared from CRM 122 oxide, and CRM 136 and 137, Plutonium Isotopic Standards in the form of plutonium sulfate tetrahydrate. The CRMs were dissolved in 8 *M* HNO_3 and aliquants of approximately 1 mg were placed in glass bottles and fumed to dryness as the sulfate. No purification was performed on the master solutions; due to the age of the CRMs, americium ingrowth is very significant.

Preparation and Packaging for Shipment

The size of the glass bottles chosen to contain the samples for assay analysis was selected to enable the addition of the participant's IDMS spike and the performance of oxidation-reduction reactions for isotopic equilibration directly within the sample container. The glass bottles containing either the assay or the isotopic samples were heat-sealed in plastic twice, and packaged in secondary containers (produce cans) before shipping.

Reference Value Uncertainties

For CRM 126, the uncertainty on the plutonium concentration is approximately 0.02%, expressed as the 95% confidence interval of the mean. For CRM 122, the uncertainty on the plutonium concentration is approximately 0.04%, expressed as the 95% confidence interval of the mean. For the isotopic materials, the abundances of ^{238}Pu range from approximately 0.05% to 0.25%; the ^{239}Pu abundances from 78% to 88%; the ^{240}Pu abundances from 12% to 19%; the ^{241}Pu abundances from 0.05% to 1.3%, and ^{242}Pu abundances from 0.2% to 1.2%. The uncertainties are stated on the CRM certificates; for CRM 122, all uncertainties are expressed as the 95% confidence interval of the mean; for CRMs 136 and 137, all uncertainties are expressed as the 95% confidence interval of a single determination (approximately two sigma).

Evaluation of Performance

As with the uranium materials, all results are reported as percent relative differences. Facilities used IDMS to determine plutonium elemental mass and TIMS to determine isotopic abundances. Only data for the abundances of ^{239}Pu and ^{240}Pu are presented graphically in this report since they are the plutonium isotopes of major concern. Data for ^{238}Pu, ^{241}Pu, and ^{242}Pu were analyzed in individual reports and included in the data listing at the end of this report.

Pu Mass by IDMS

The target values for Pu elemental amount by IDMS are 0.15% for precision and 0.1% for bias. As shown in Figure 15, laboratory B was not within the target value for bias. Laboratories F and G were essentially within the target value for bias, as seen in Figure 16. The y-axis for Figure 16 has a smaller range than that of Figure 15 to better illustrate the performance of laboratories F and G. As shown in Figure 17, all participants performed within the target limit for precision. Table 10 presents the numerical values of the plotted data.

Table 10
Interlaboratory Performance Summary
Pu sulfate –Pu Mass

Method	Lab code	Mean	Standard deviation	N
IDMS	B	-4.730	2.525	8
IDMS	F	0.104	0.087	4
IDMS	G	0.101	0.070	4

^{239}Pu Abundance

Because of the small number of submitted results, results from high- and low-burnup plutonium samples have been combined. However, the 2000 ITVs are different for the two burnup levels. For ^{239}Pu, the target values displayed in Figures 18 and 19 correspond to those for high burnup plutonium (0.06% for precision and 0.04% for bias), which are less limiting than the ITVs for ^{239}Pu in low-burnup material (0.01% for both precision and bias). As can be seen in Figures 18 and 19, all laboratories were within, or almost within, the high-burnup target values for both bias and precision (laboratory B slightly exceeded each target value). The combined graphs should be used to give only a very general overall picture of performance, since they cover a range of

abundances with a corresponding range of expected performance. Table 11 presents the numerical values of the plotted data.

Table 11
Interlaboratory Performance Summary
^{239}Pu Abundance

Method	Lab code	Mean	Standard deviation	N
TIMS	B	0.0443	0.0620	20
TIMS	F	0.0029	0.0010	6
TIMS	J	0.0015	0.0029	6
TIMS	G	0.0054	0.0050	6
TIMS	T	0.0142	0.0106	16

^{240}Pu Abundance

Because of the small number of submitted results, results from high- and low-burnup plutonium samples have been combined. The 2000 ITVs are different for the two burnup levels. For ^{240}Pu, the target values displayed in Figures 20 and 21 correspond to those for low burnup plutonium (0.15% for precision and 0.10% for bias), which are less limiting than the ITVs for ^{240}Pu in low-burnup material (0.12% for precision and 0.07% for bias). As can be seen in Figures 20 and 21, all laboratories were within the low-burnup target values for both bias and precision. Table 12 presents the numerical values of the plotted data.

Table 12
Interlaboratory Performance Summary
^{240}Pu Abundance

Method	Lab code	Mean	Standard deviation	N
TIMS	B	-0.269	0.199	20
TIMS	F	-0.072	0.097	6
TIMS	J	0.011	0.021	6
TIMS	G	-0.042	0.015	6
TIMS	T	-0.110	0.109	16

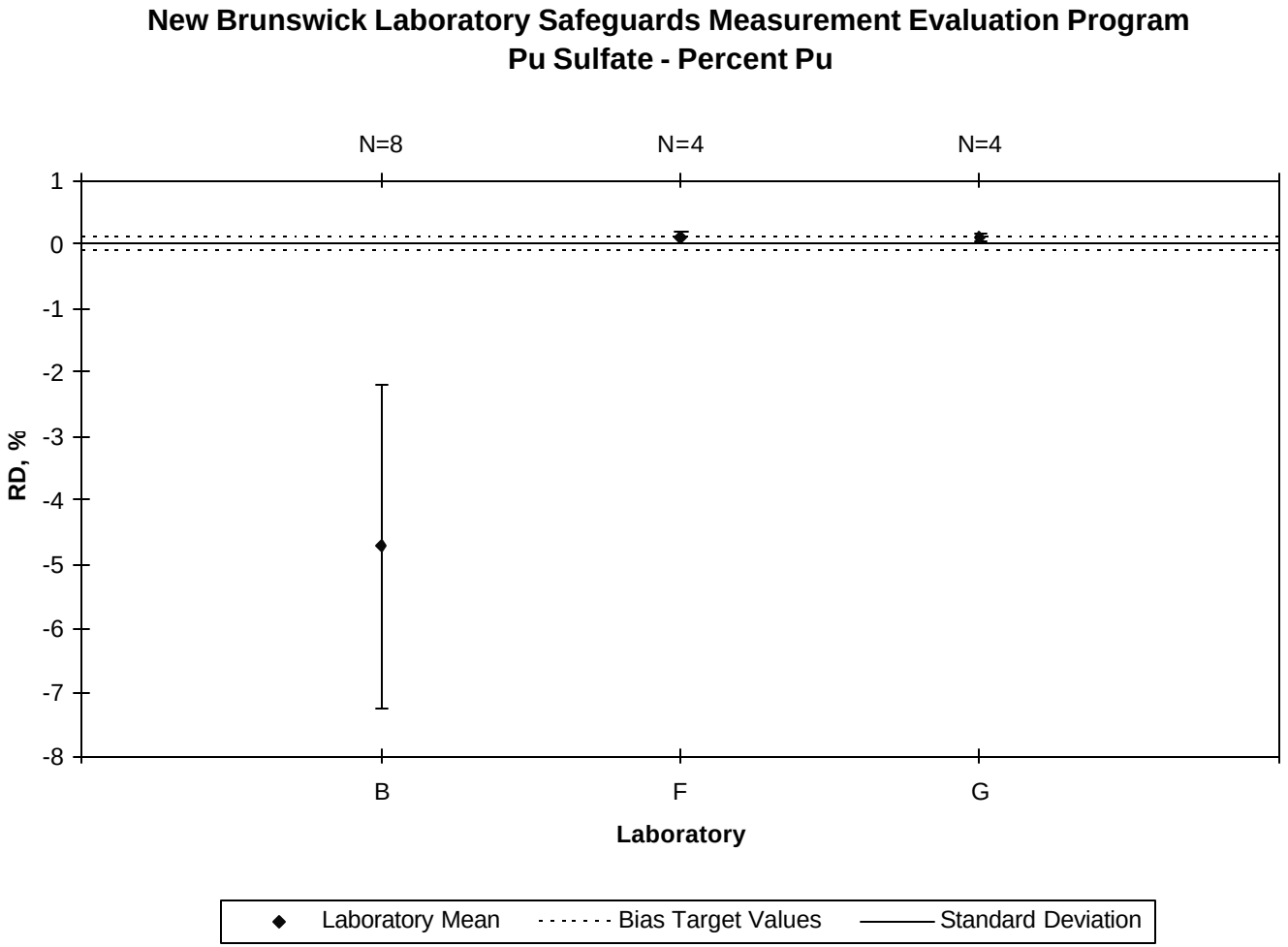

New Brunswick Laboratory Safeguards Measurement Evaluation Program
Pu Sulfate - Percent Pu
N=8
N=4
N=4
1
0
-1
-2
-3
-4
-5
-6
-7
-8
RD, %
B
F
G
Laboratory
Laboratory Mean
Bias Target Values
Standard Deviation

Figure 15

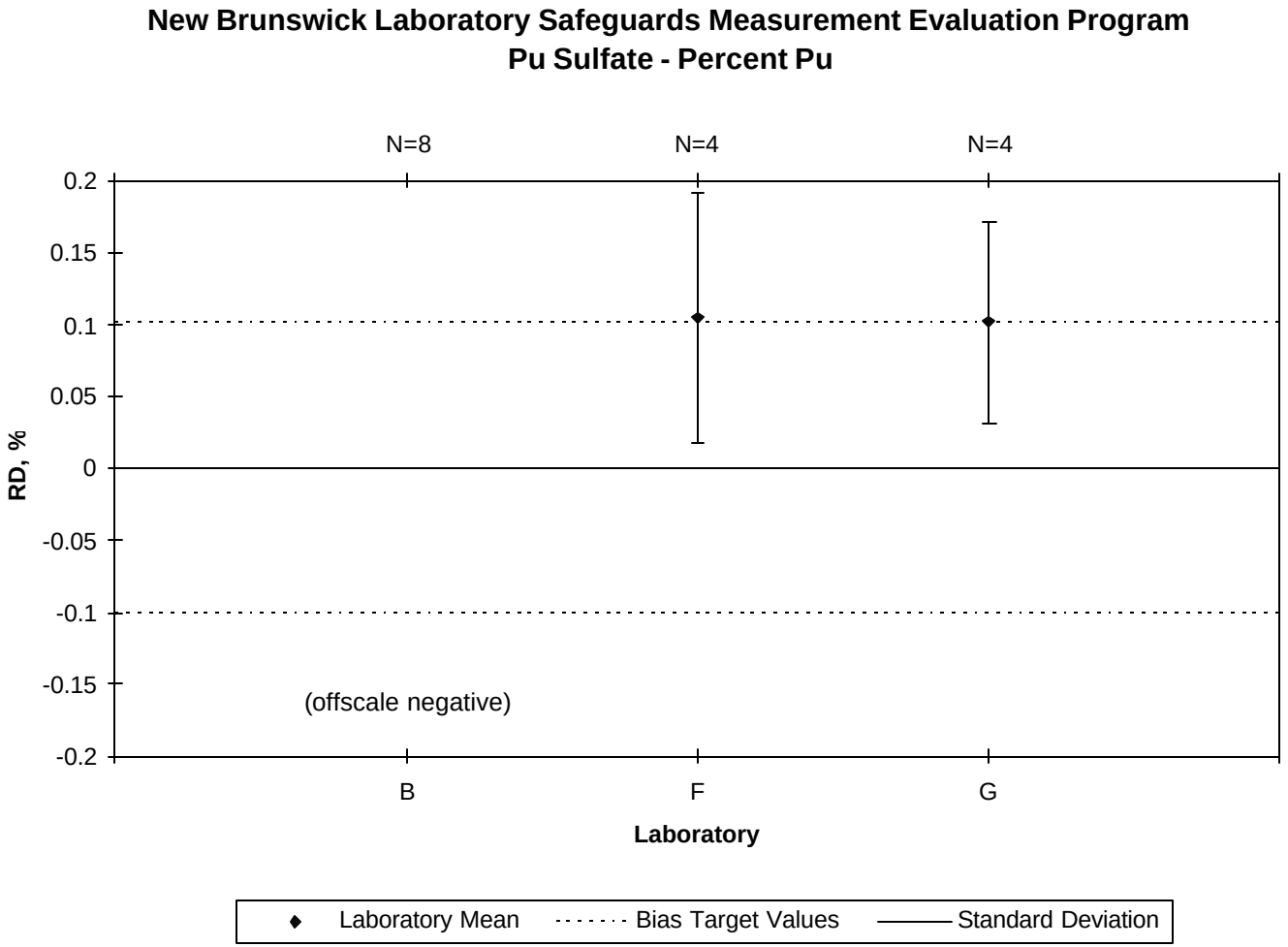

New Brunswick Laboratory Safeguards Measurement Evaluation Program
Pu Sulfate - Percent Pu
N=8
N=4
N=4
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
RD, %
(offscale negative)
B
F
G
Laboratory
Laboratory Mean
Bias Target Values
Standard Deviation

Figure 16

New Brunswick Laboratory Safeguards Measurement Evaluation Program
Pu Sulfate - Percent Pu

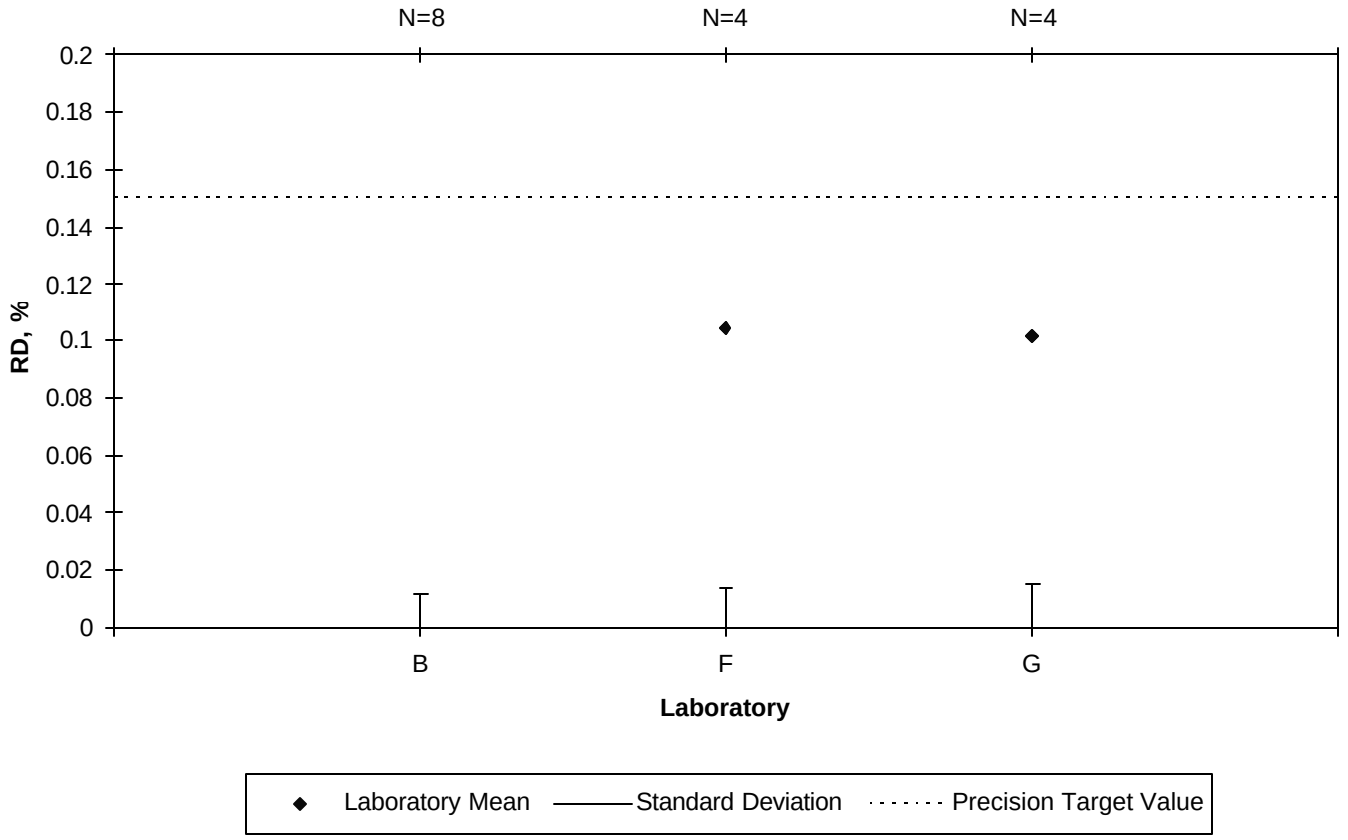


Figure 17

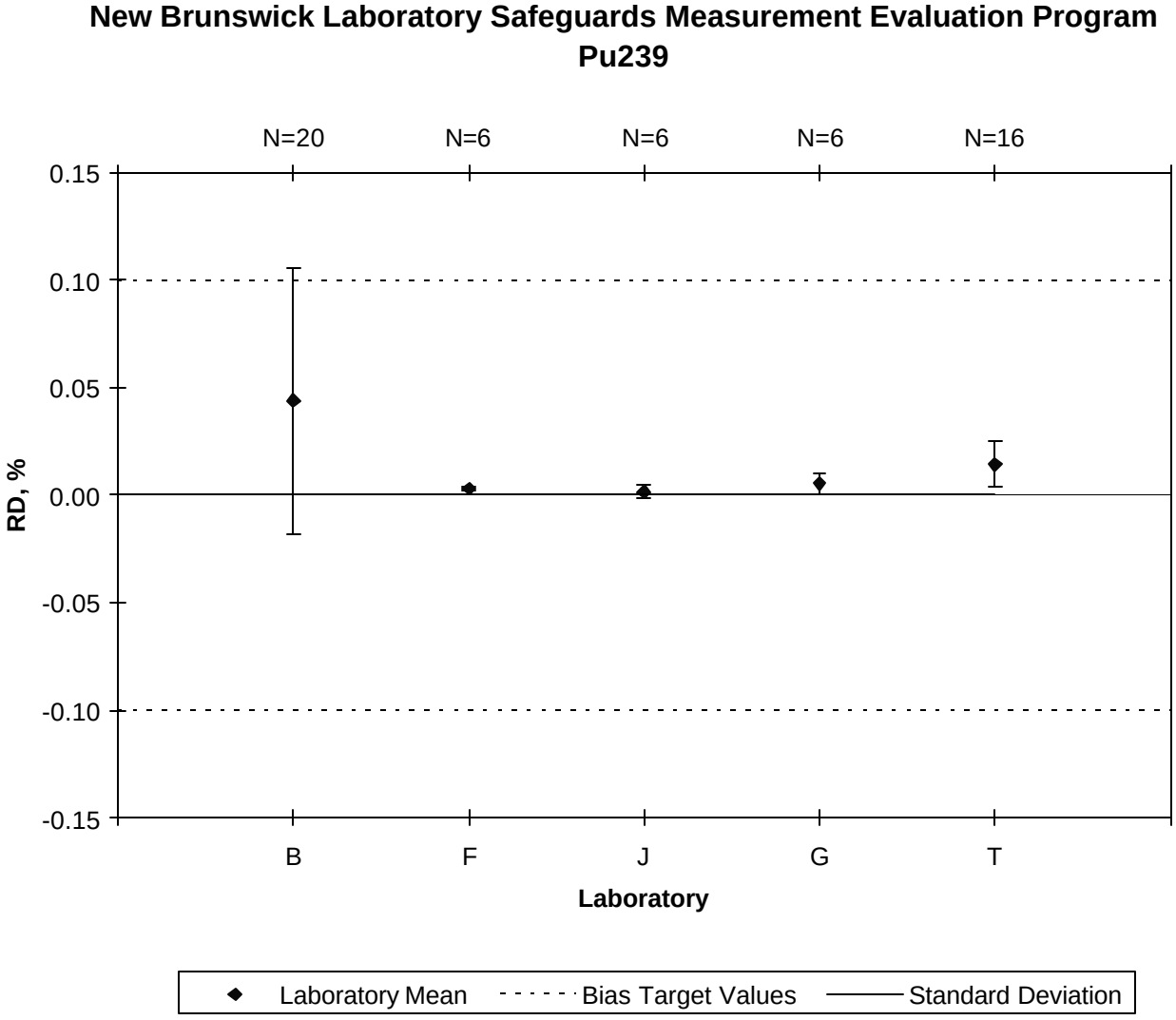
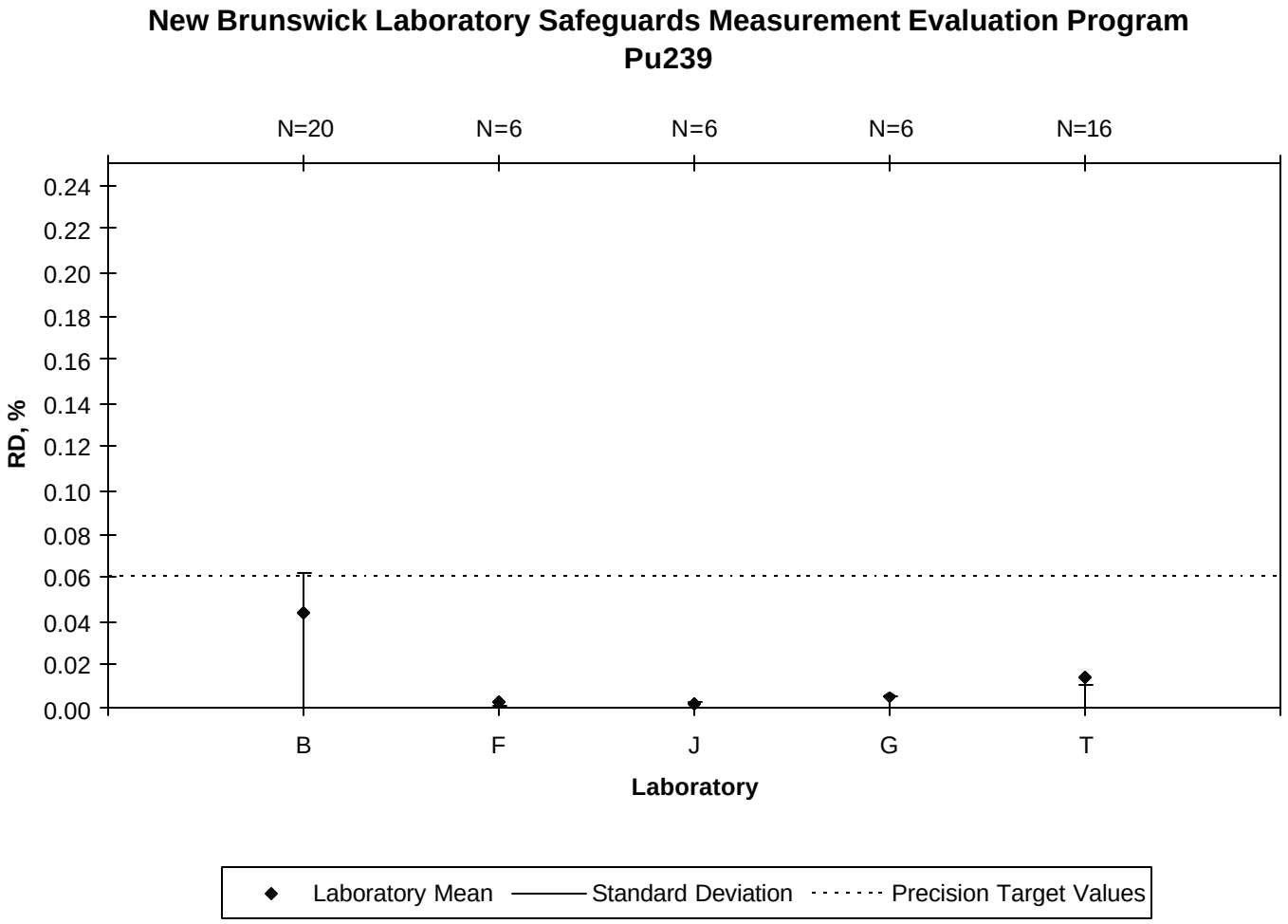

New Brunswick Laboratory Safeguards Measurement Evaluation Program
Pu239
N=20
N=6
N=6
N=6
N=16
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
RD, %
B
F
J
G
T
Laboratory
Laboratory Mean
Bias Target Values
Standard Deviation

Figure 18


New Brunswick Laboratory Safeguards Measurement Evaluation Program
Pu239
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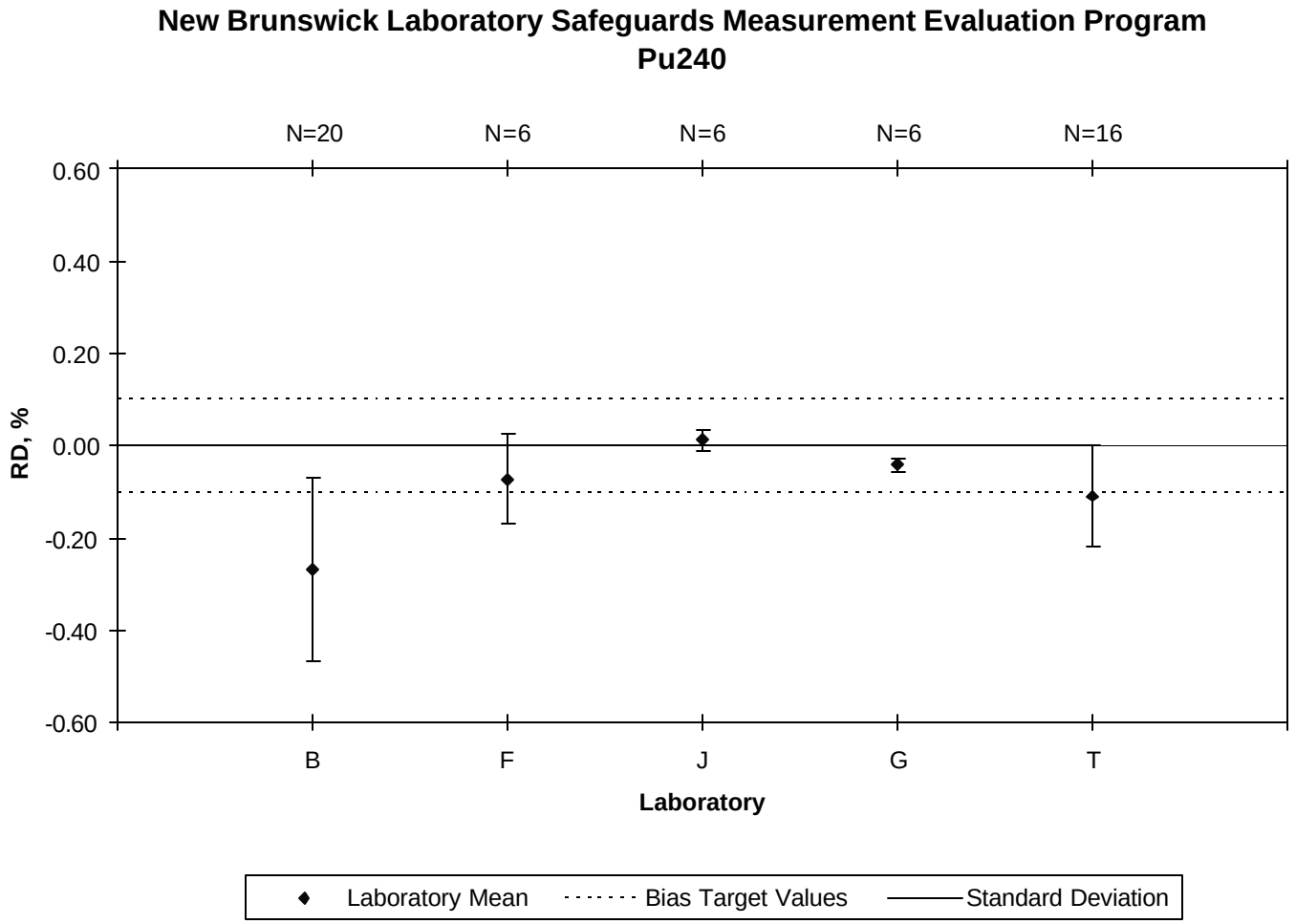
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
RD, %
B
F
J
G
T
Laboratory
Laboratory Mean
Standard Deviation
Precision Target Values

Figure 19


New Brunswick Laboratory Safeguards Measurement Evaluation Program
Pu240
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N=6
N=6
N=6
N=16
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0.40
0.20
0.00
-0.20
-0.40
-0.60
RD, %
B
F
J
G
T
Laboratory
Laboratory Mean
Bias Target Values
Standard Deviation

Figure 20

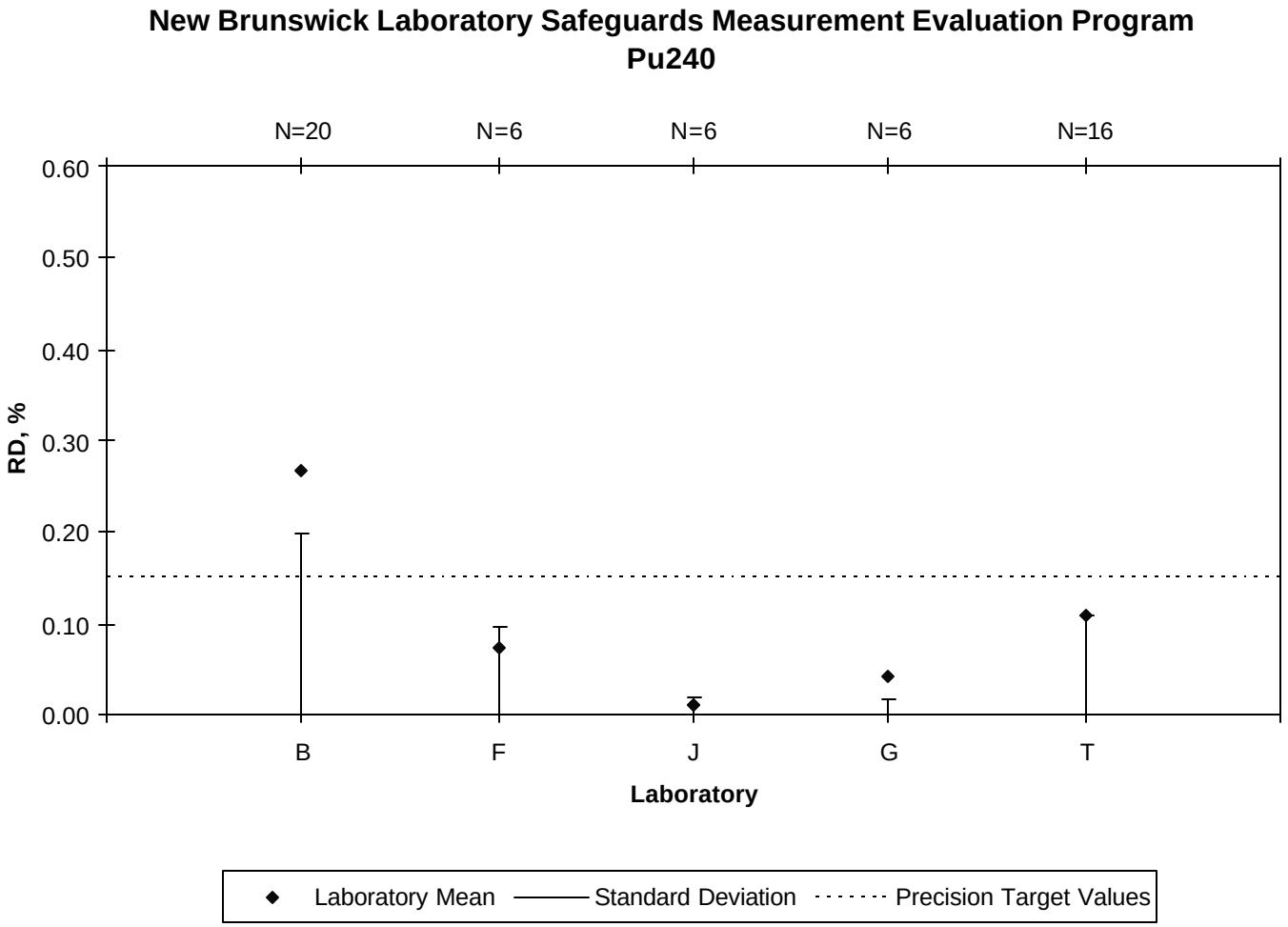

New Brunswick Laboratory Safeguards Measurement Evaluation Program
Pu240
N=20
N=6
N=6
N=6
N=16
0.60
0.50
0.40
0.30
0.20
0.10
0.00
RD, %
B
F
J
G
T
Laboratory
Laboratory Mean
Standard Deviation
Precision Target Values

Figure 21

INDIVIDUAL LABORATORY

URANIUM MATERIAL-MEASUREMENT SKELETAL GRAPHS

FISCAL YEARS 1999 - 2001

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U - IDMS

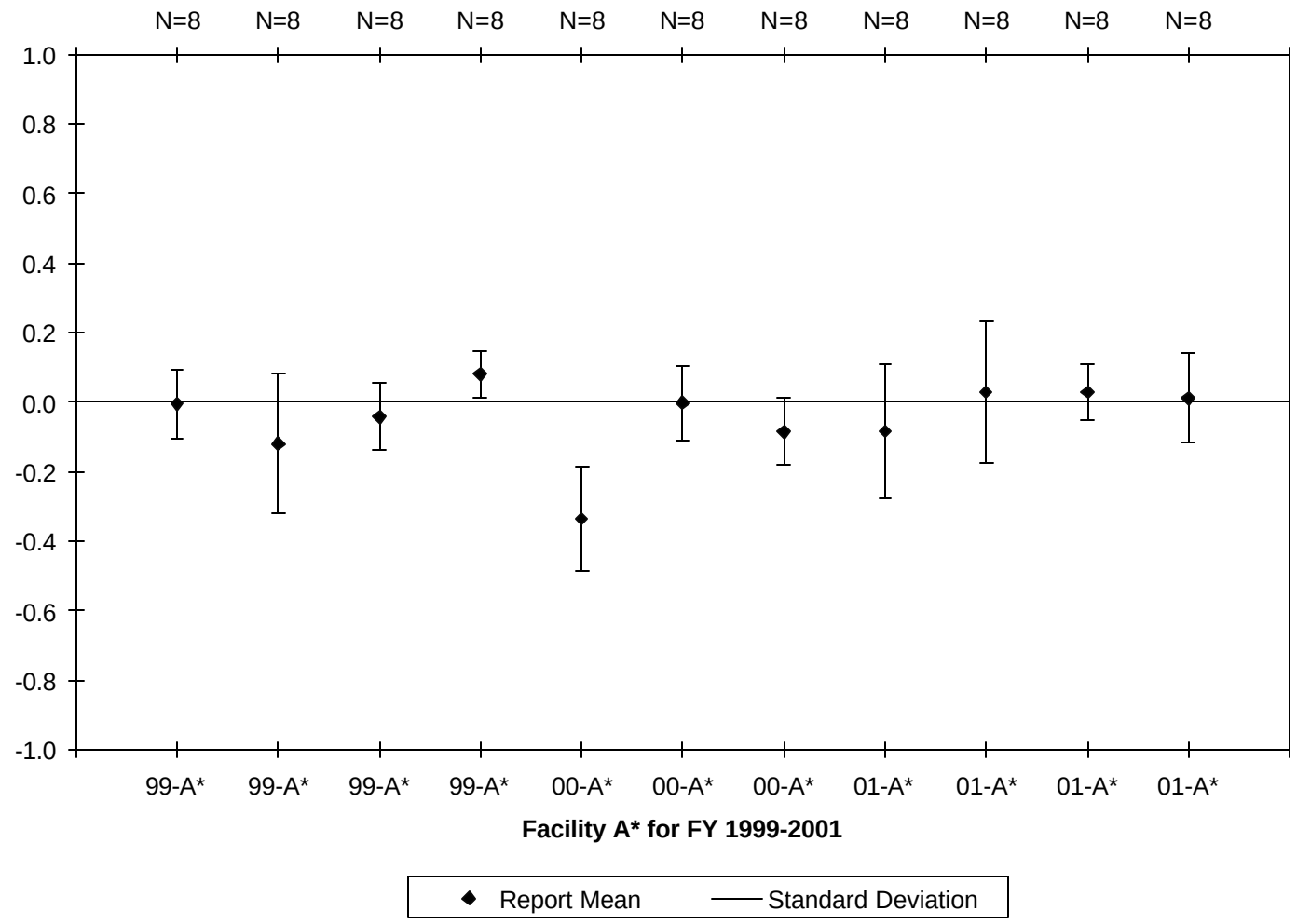


Figure 22

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U - XRF

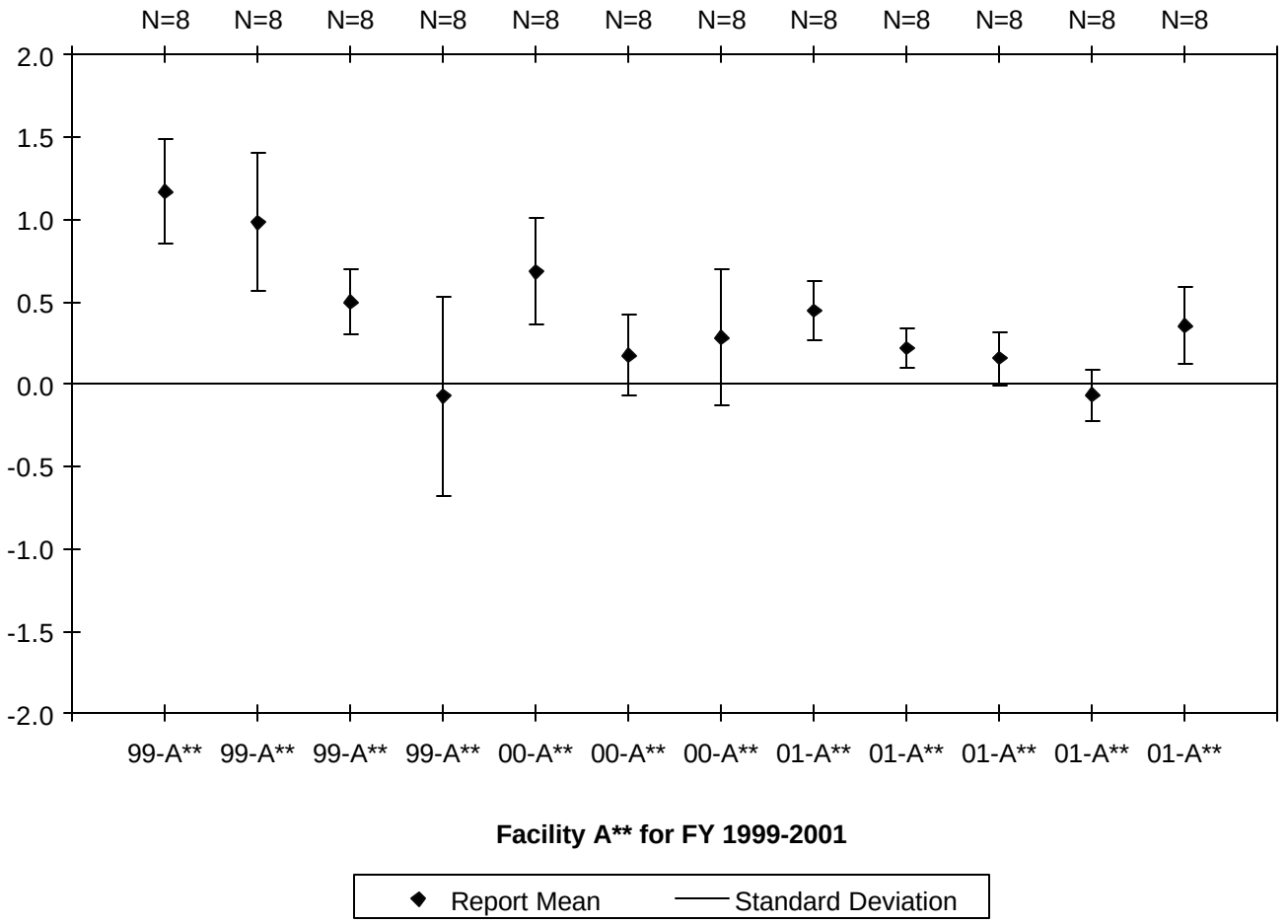


Figure 23

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U - Davies and Gray Titration

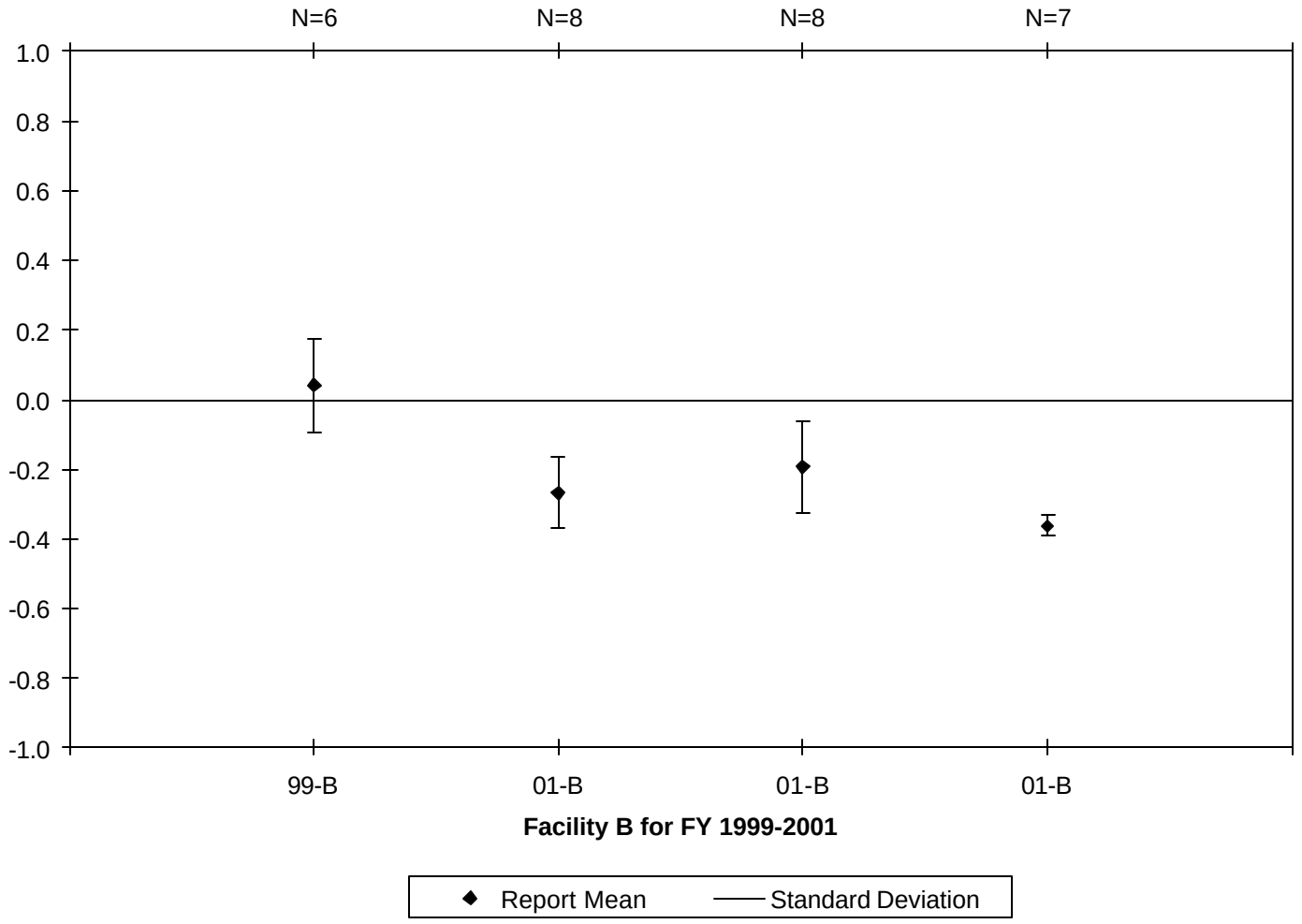


Figure 24

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U - Davies and Gray Titration

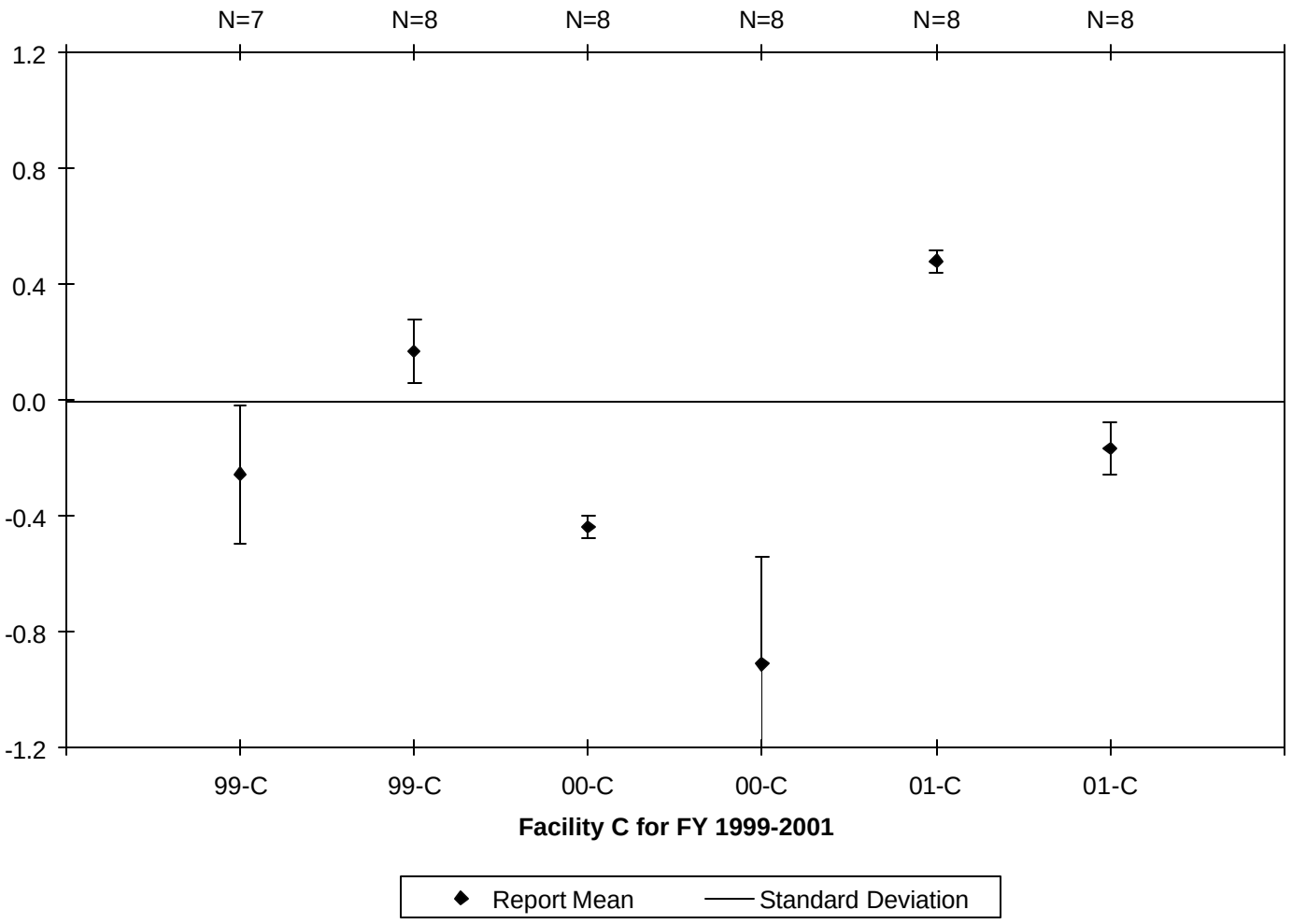


Figure 25

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U - Davies and Gray Titration

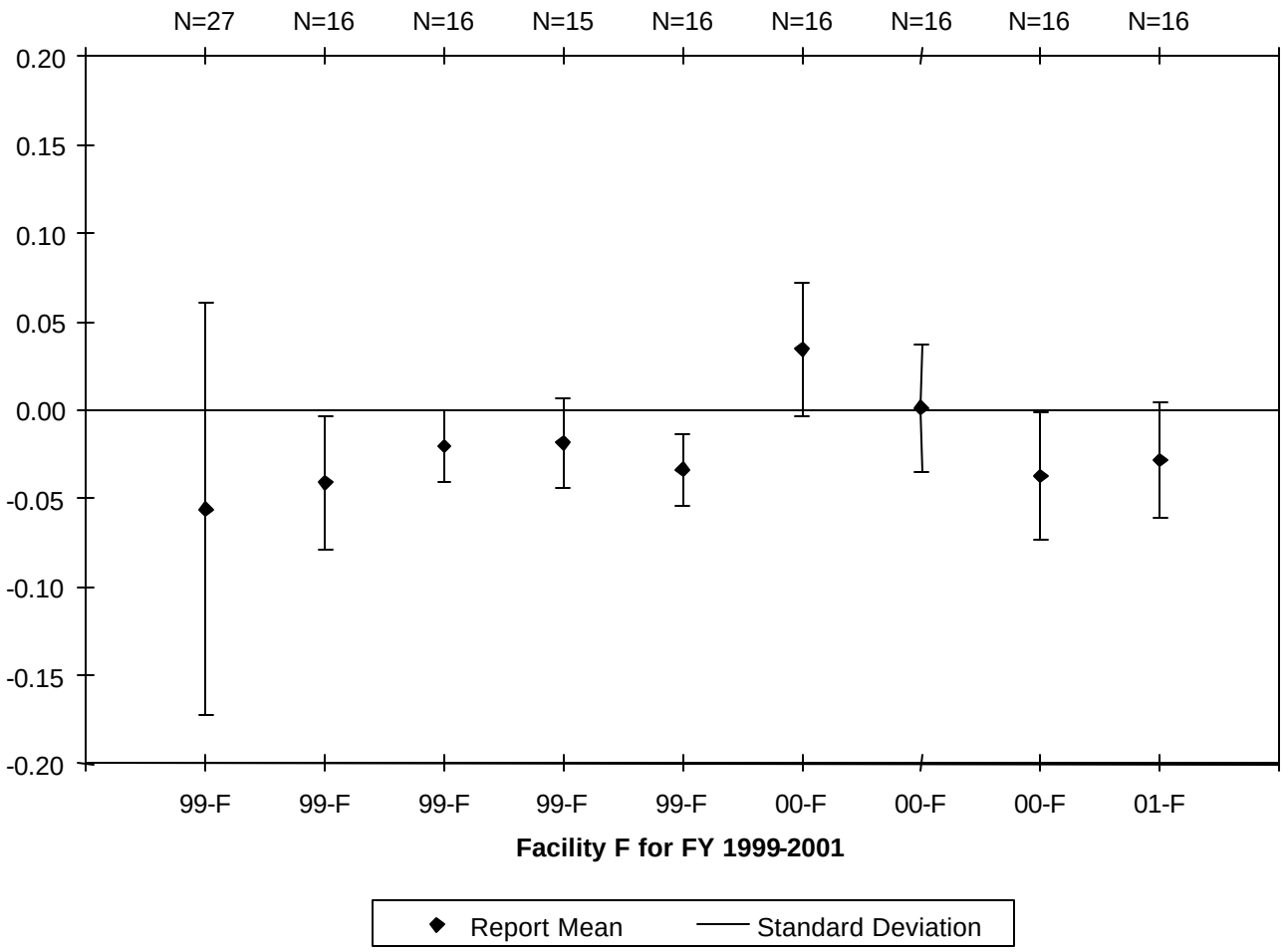


Figure 26

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U - Ceric Titration

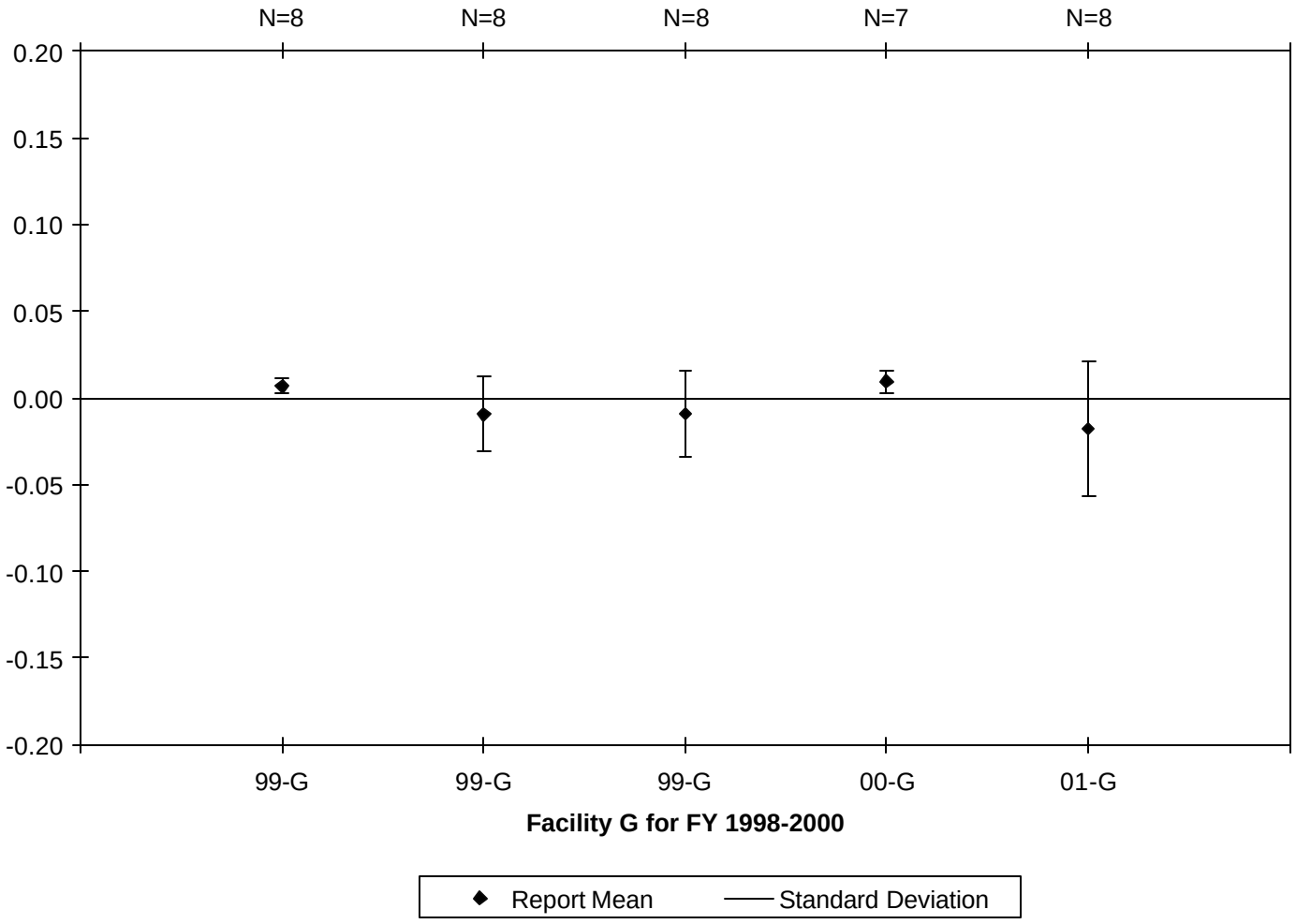


Figure 27

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U - IDMS

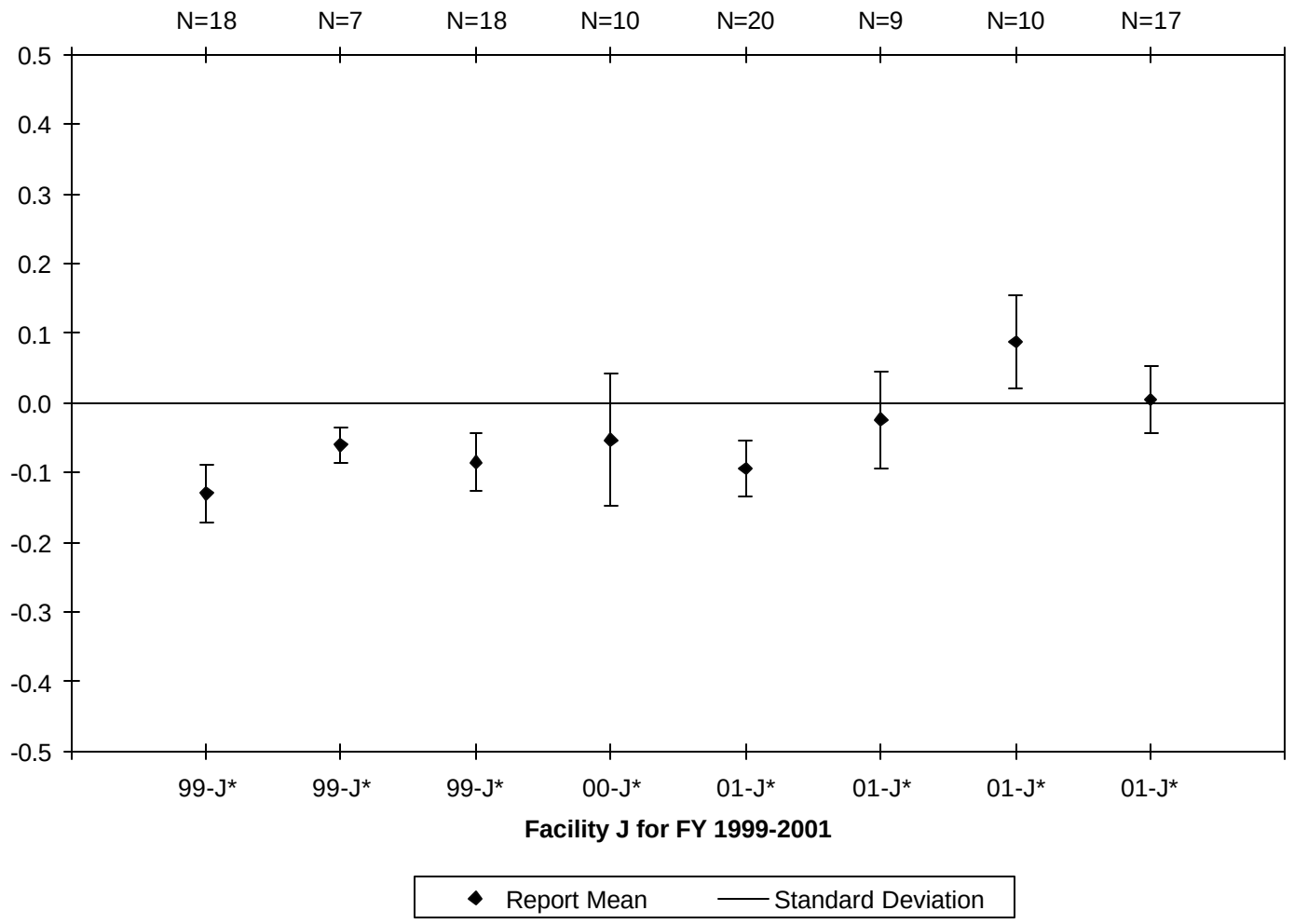


Figure 28

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U - Davies and Gray Titration

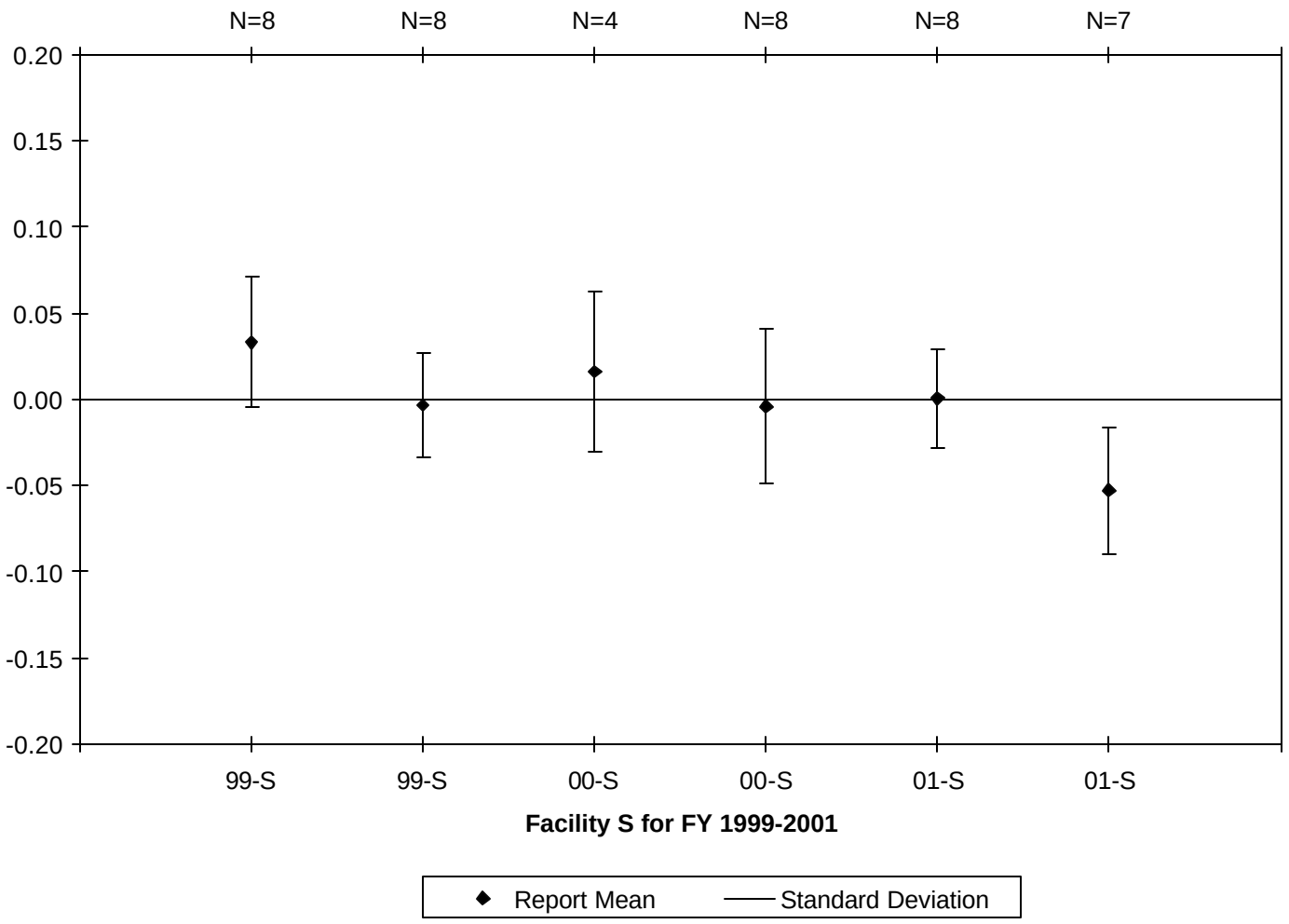


Figure 29

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UNH - Percent U - Davies and Gray Titration

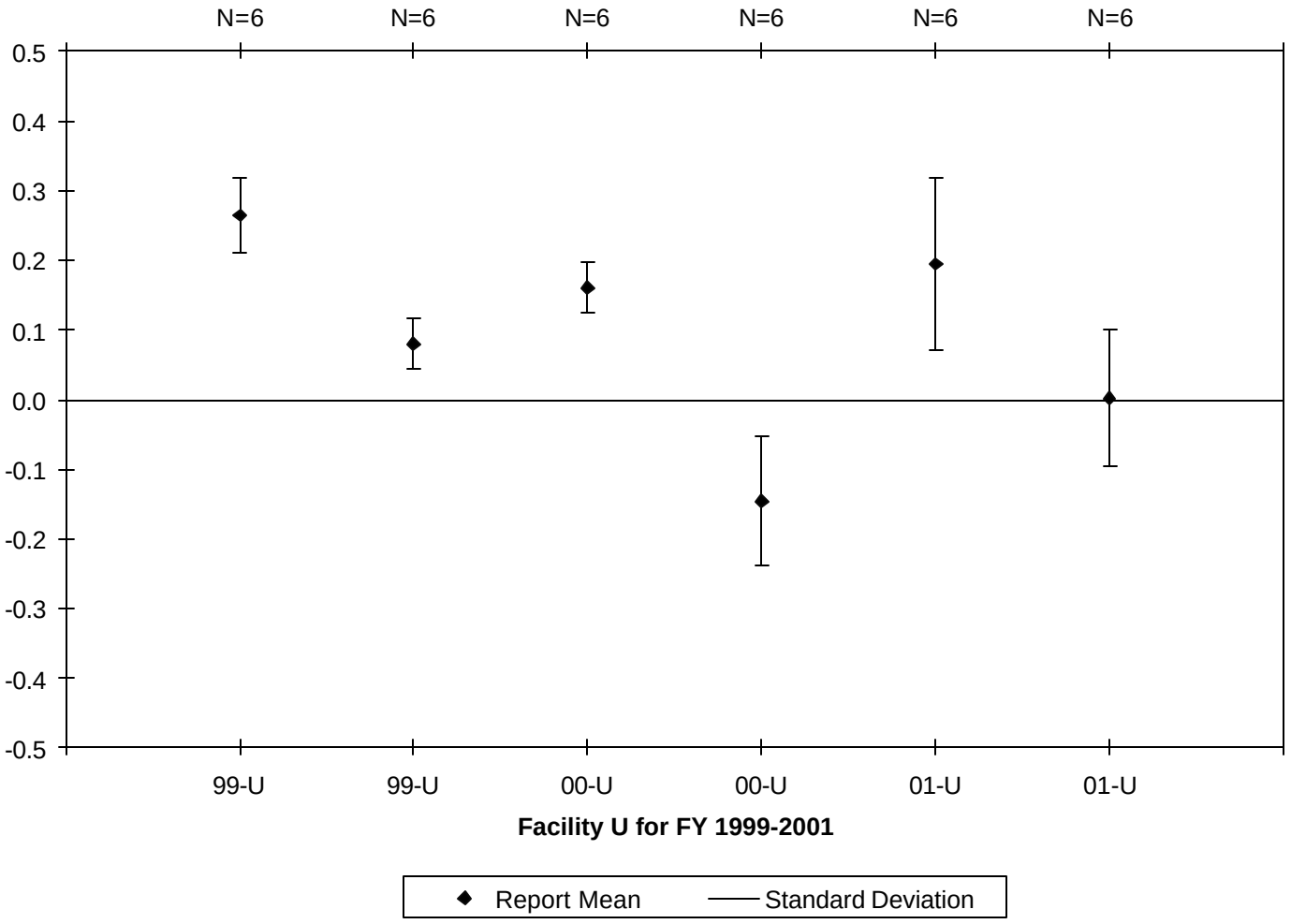
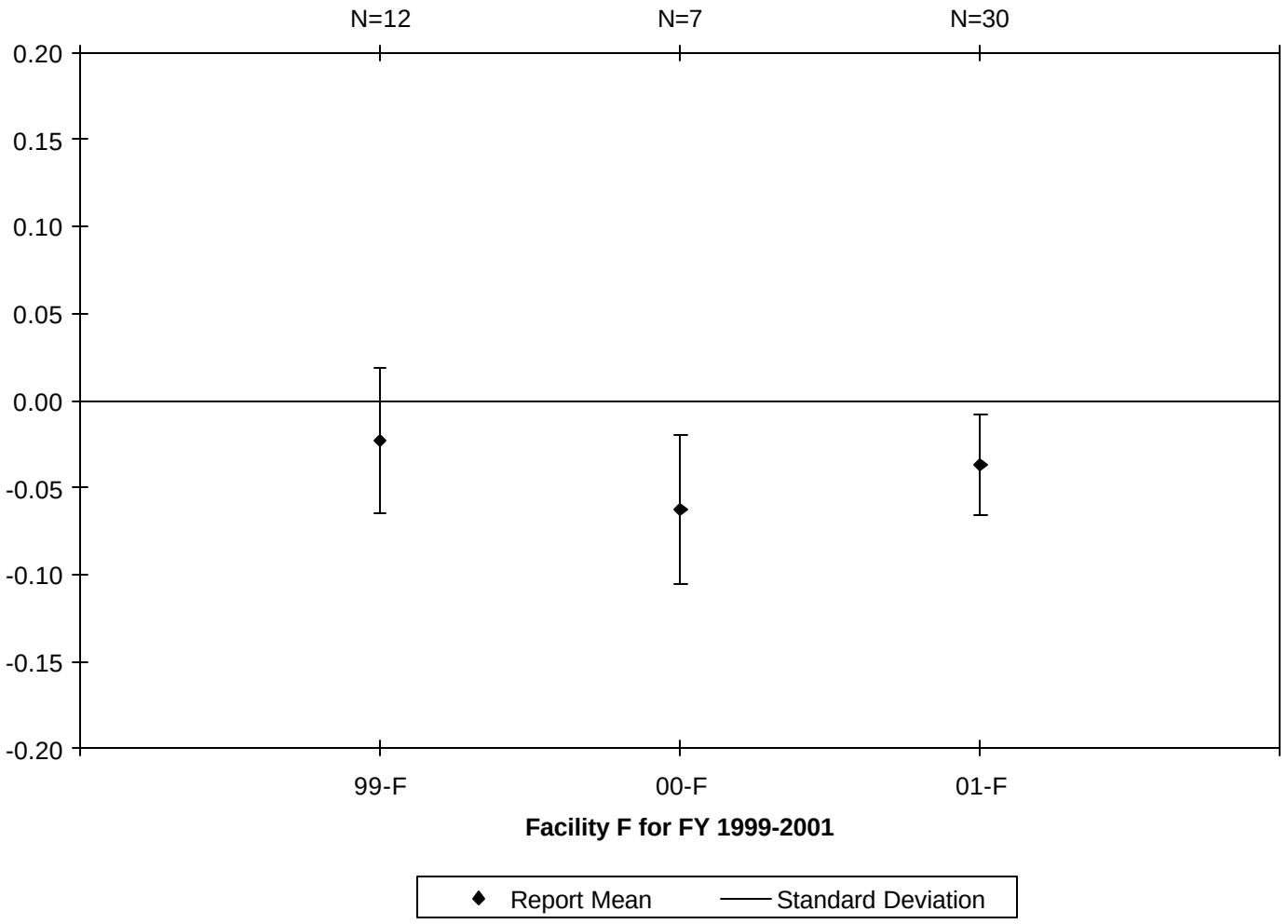


Figure 30

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO2 Pellet - Percent U - Davies and Gray Titration



60

Figure 31

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO2 Pellet - Percent U - High Precision Titration

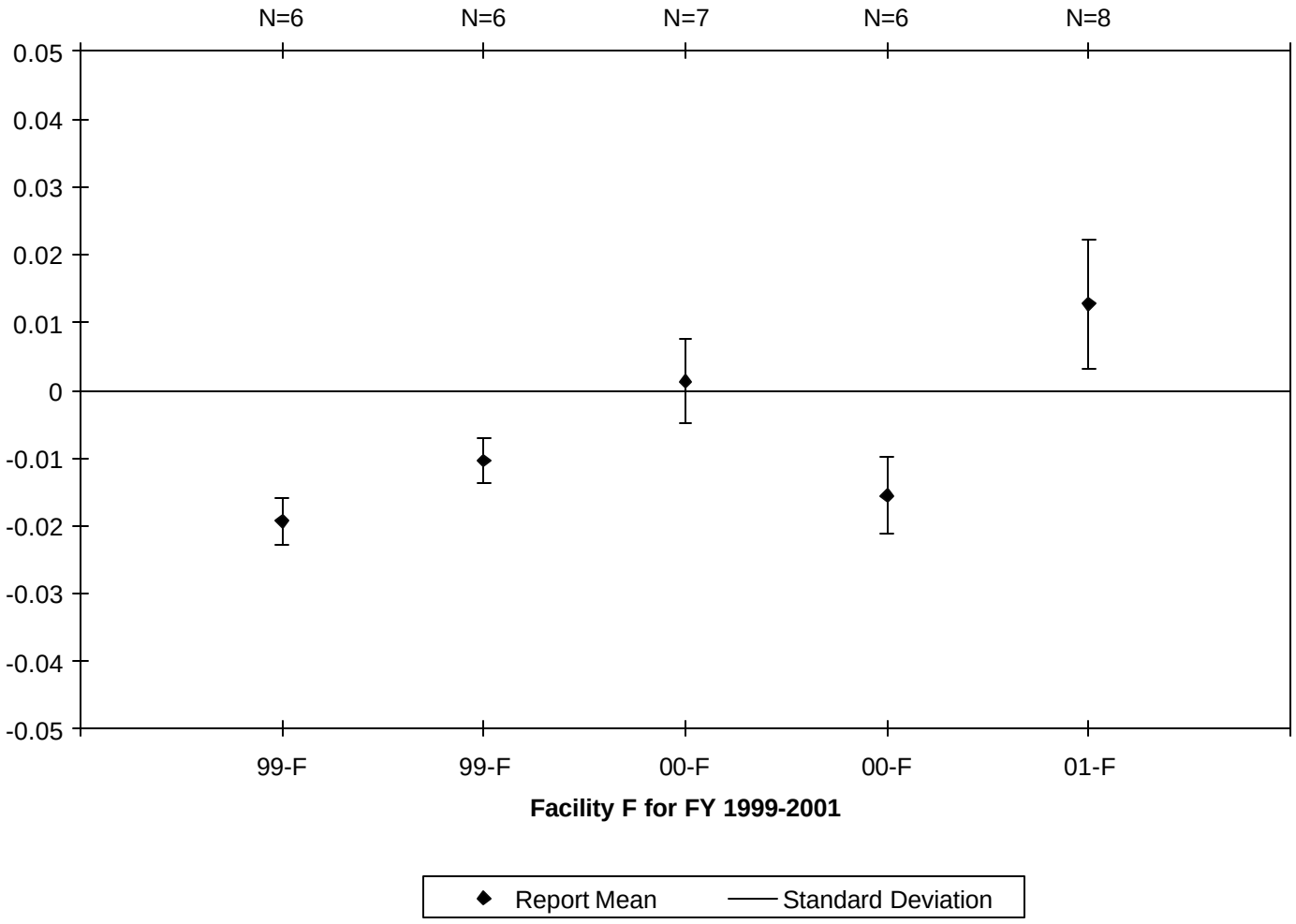


Figure 32

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO2 Pellet - Percent U - Gravimetry

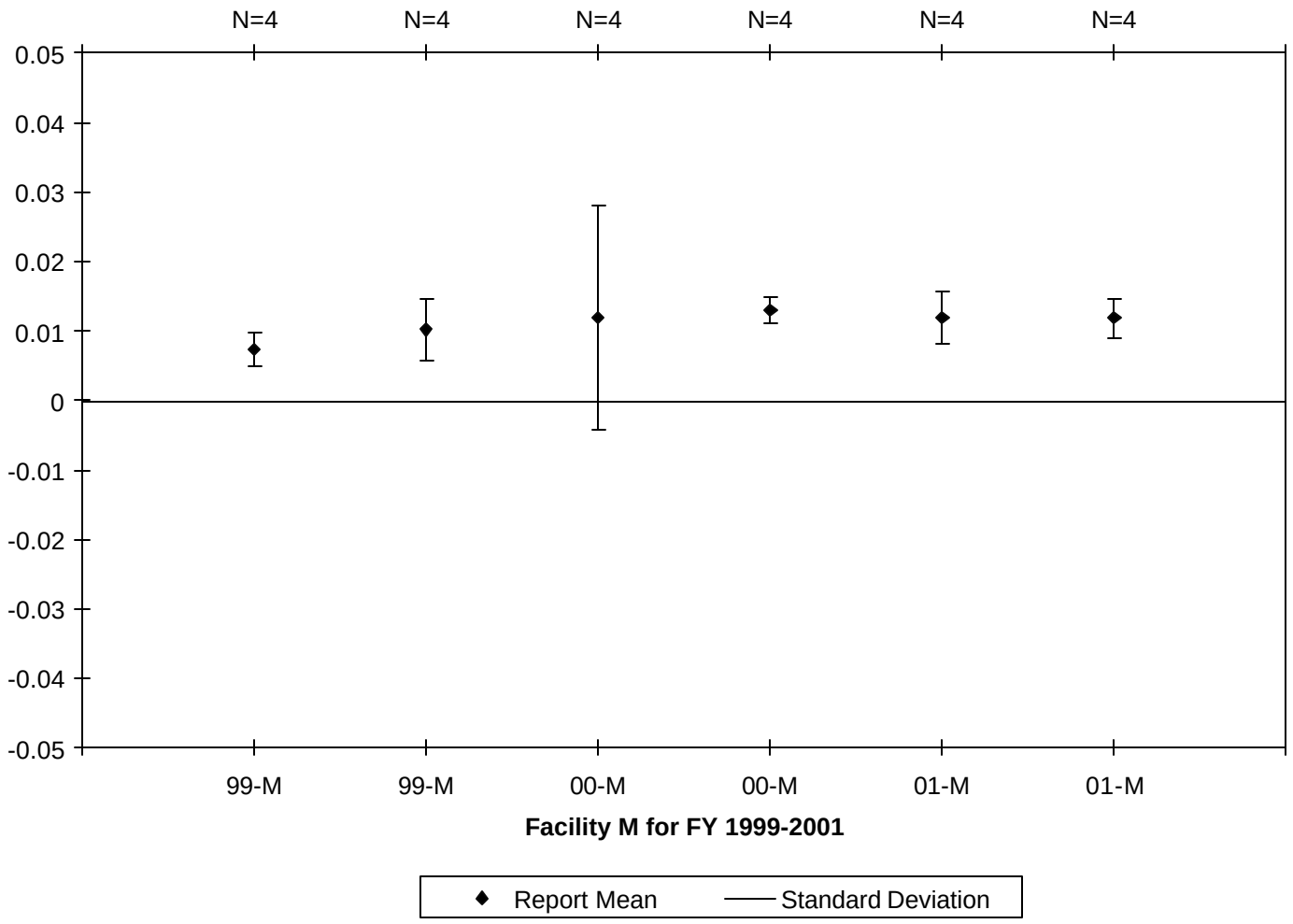


Figure 33

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO2 Pellet - Percent U - Gravimetry and Atmospheric Equilibration

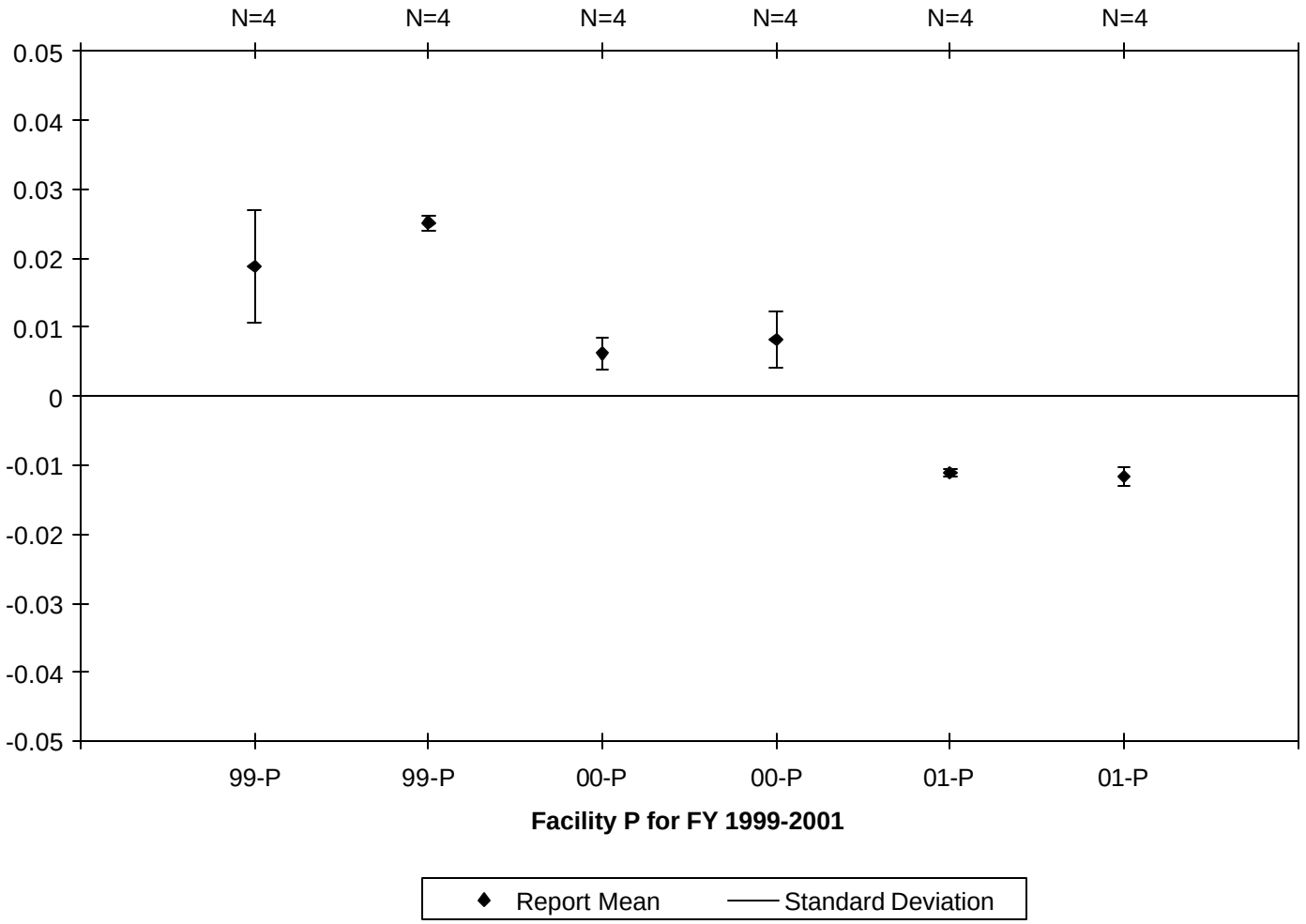


Figure 34

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO2 Pellet - Percent U - Gravimetry

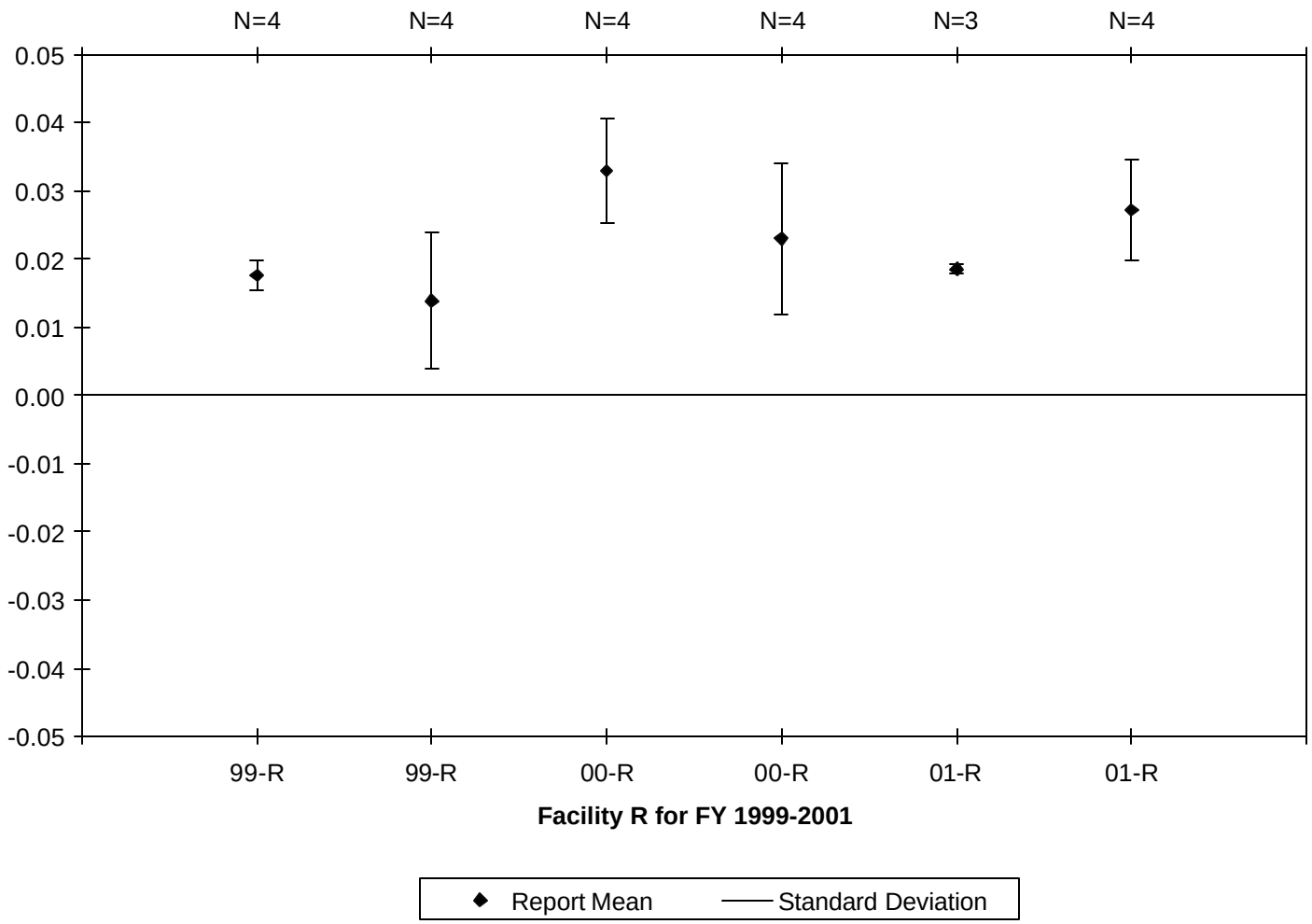


Figure 35

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UO2 Pellet - Percent U - Davies and Gray Titration and IDMS

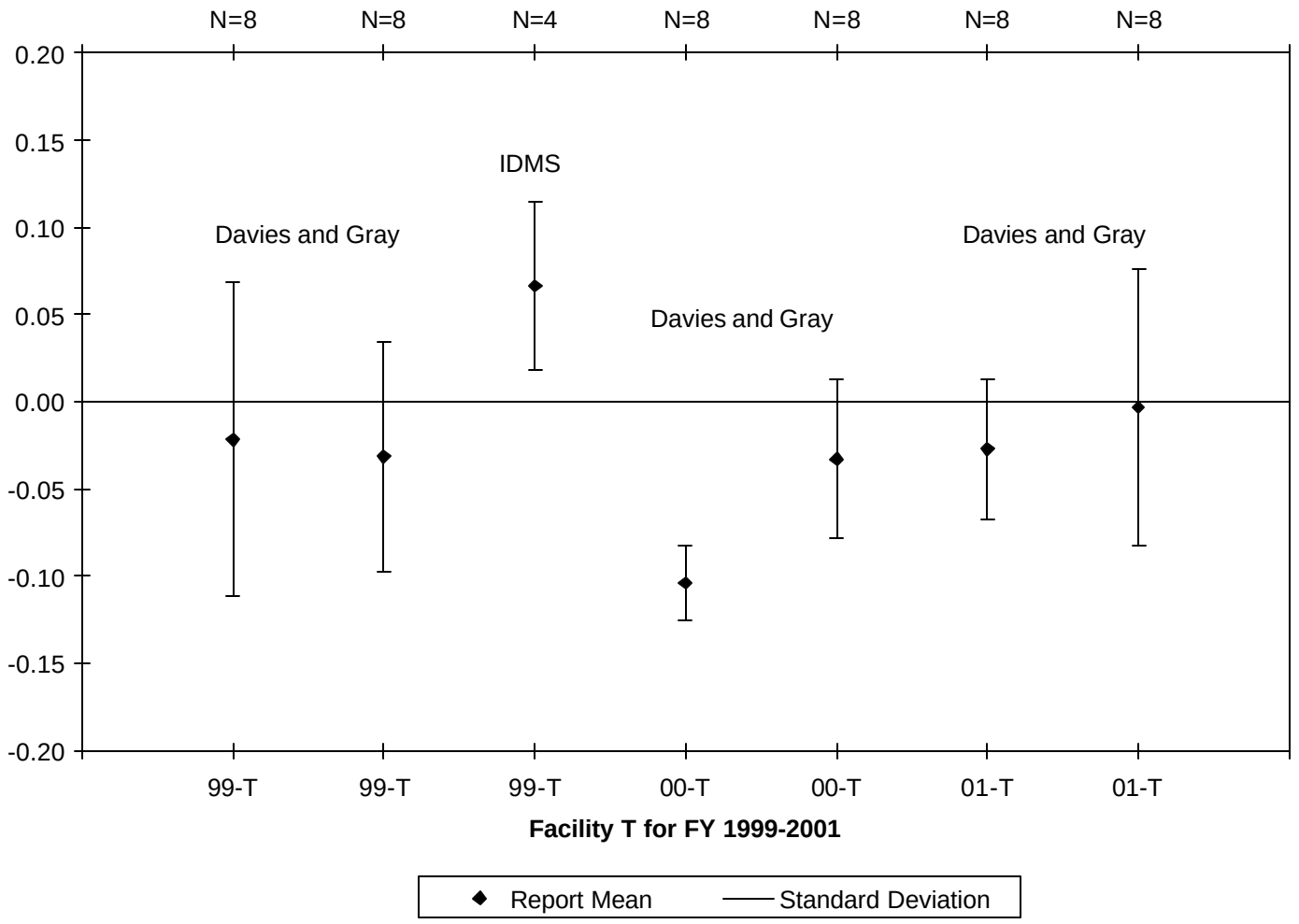


Figure 36

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UF6 - Percent U - Gravimetry

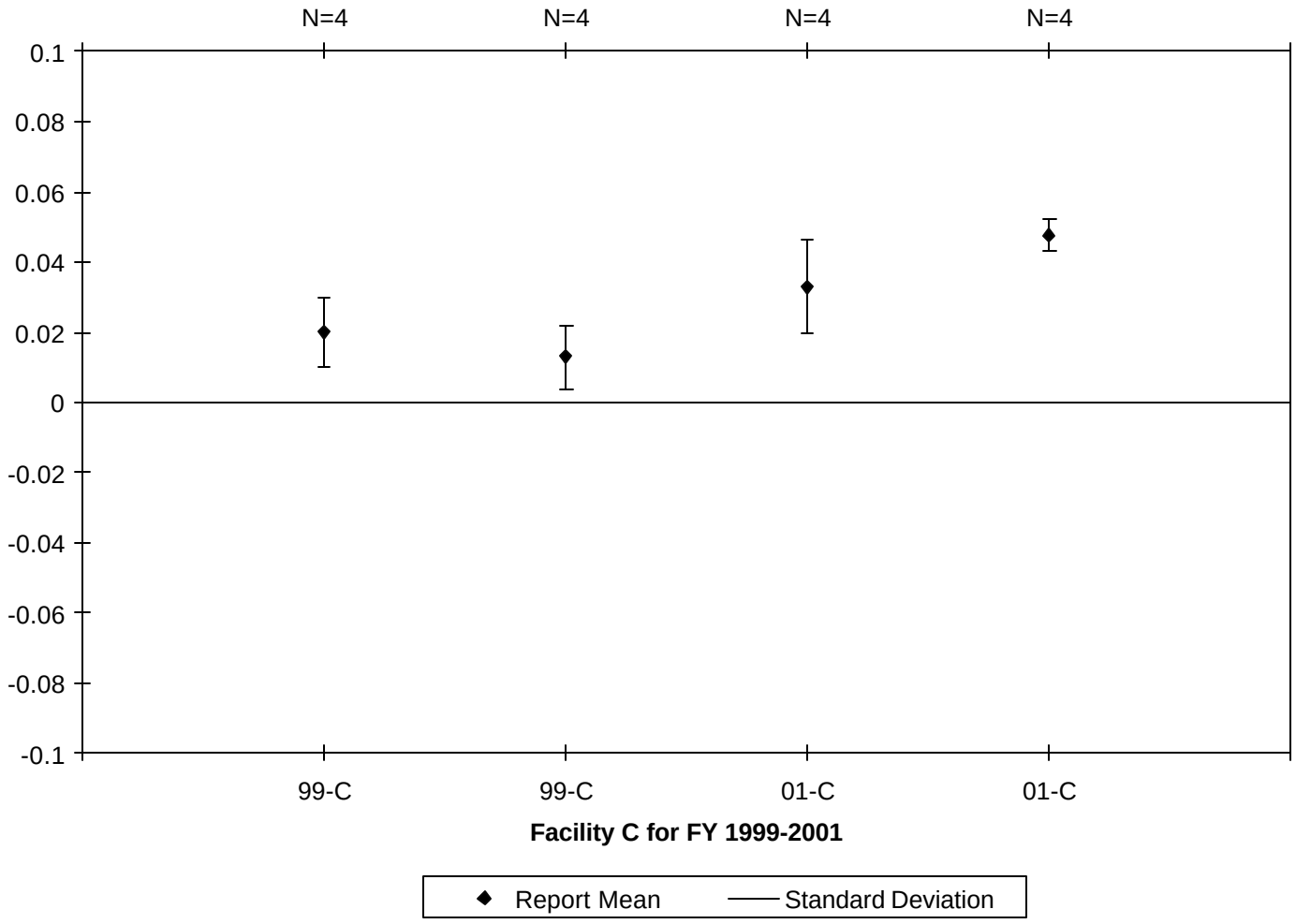


Figure 37

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UF6 - Percent U - Gravimetry

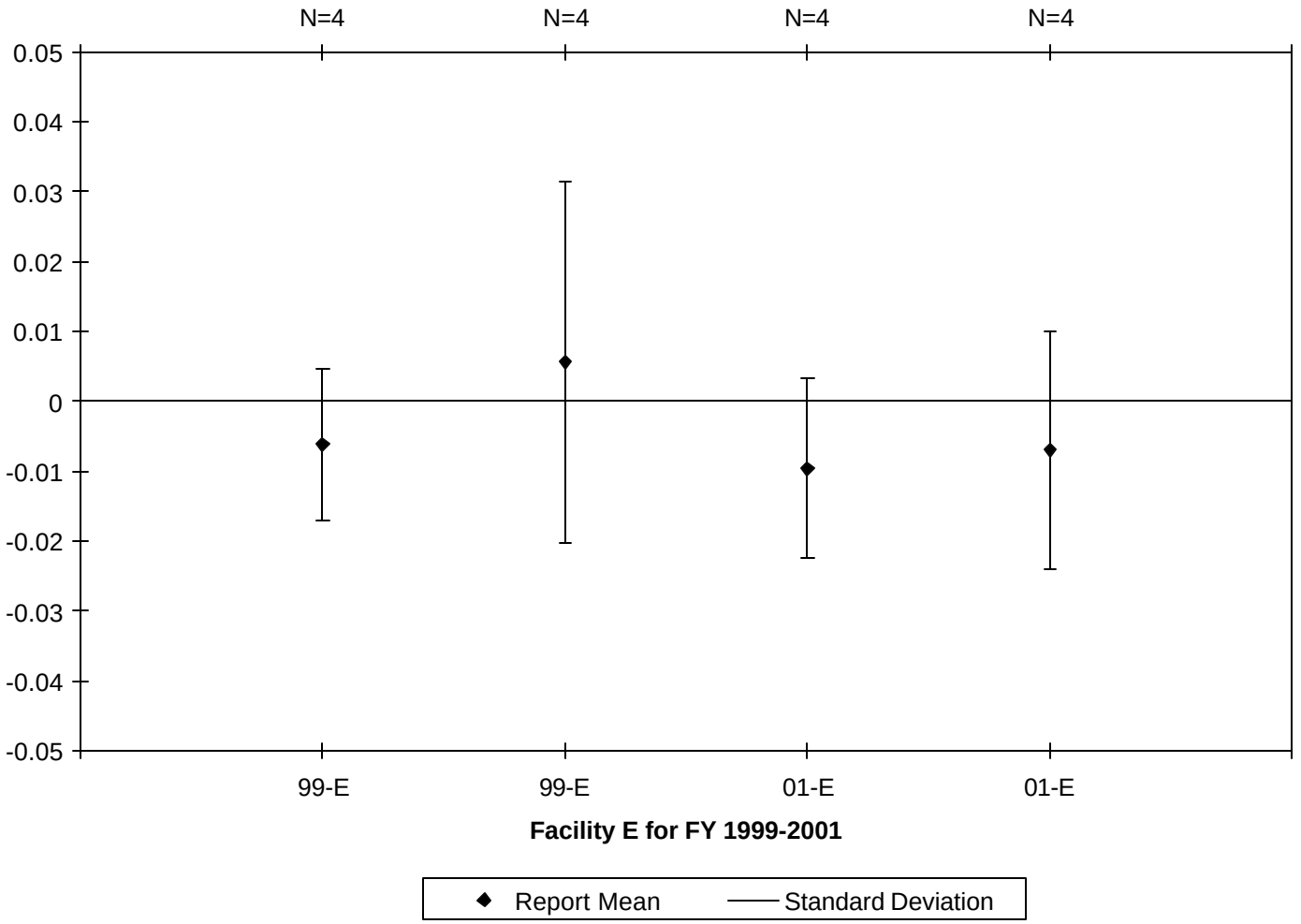


Figure 38

New Brunswick Laboratory Safeguards Measurement Evaluation Program
UF6 - Percent U - High Precision Titration

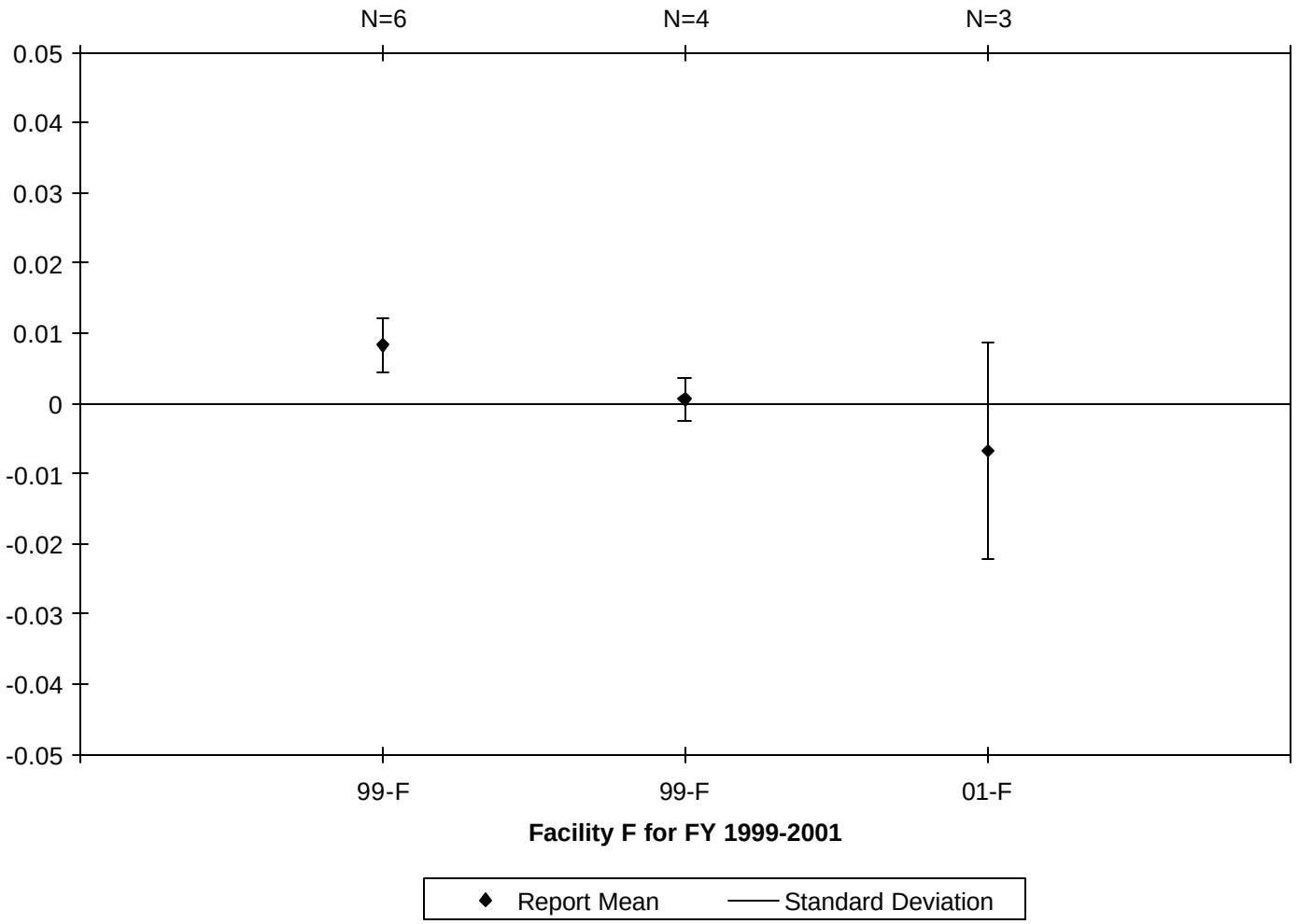


Figure 39

New Brunswick Laboratory Safeguards Measurement Evaluation Program
U235 Enrichment - HEU

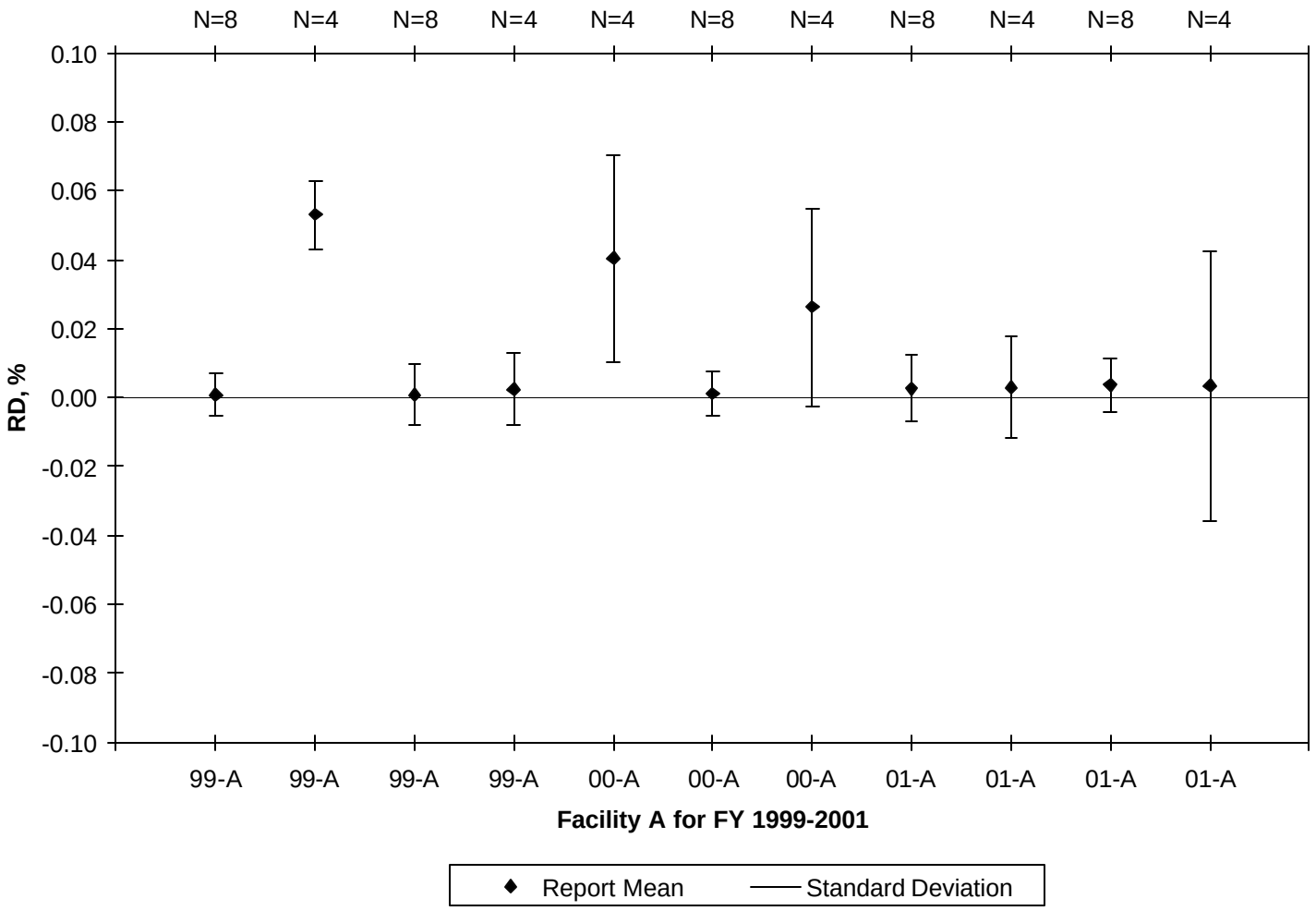


Figure 40

New Brunswick Laboratory Safeguards Measurement Evaluation Program
U235 Enrichment - HEU

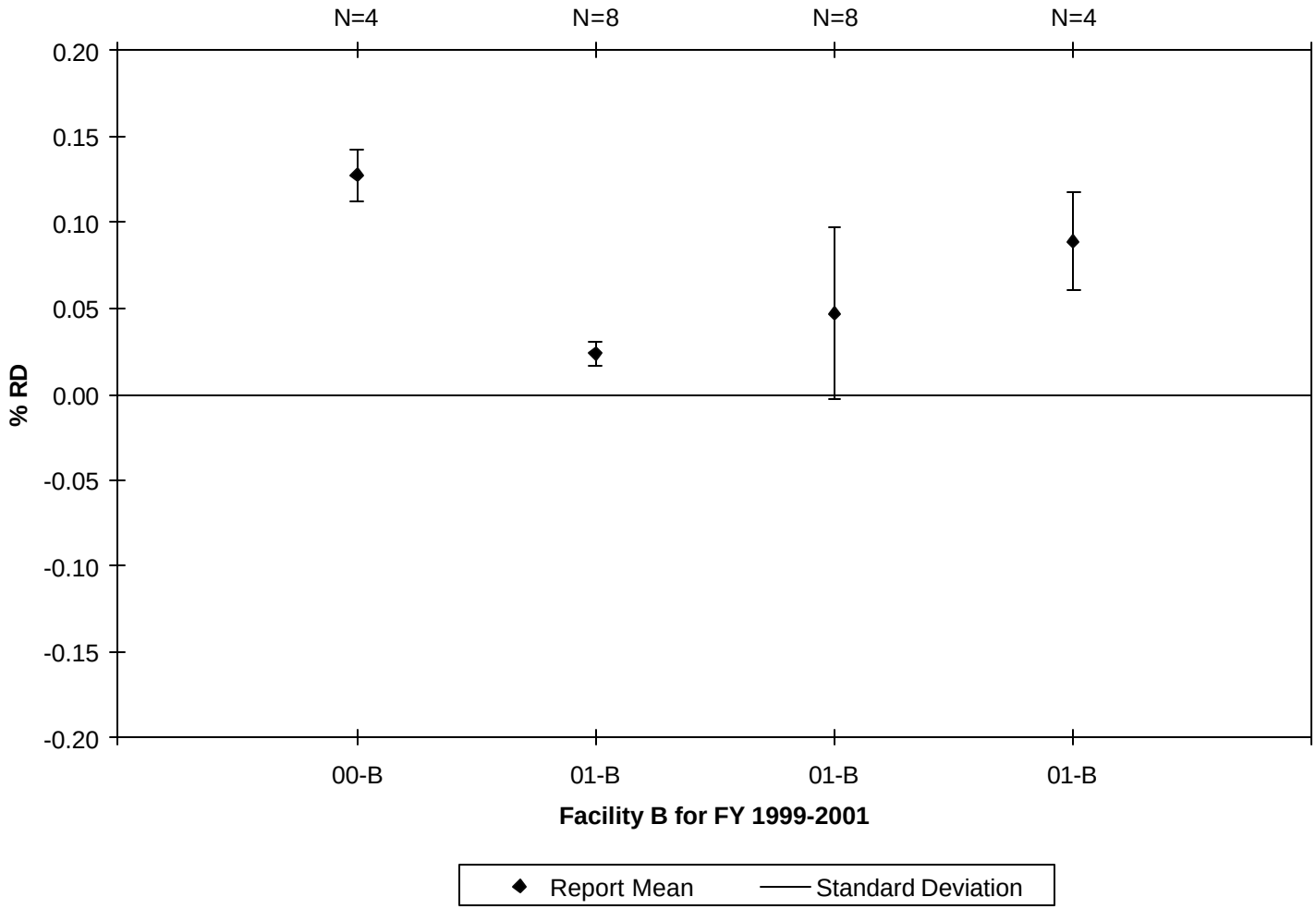


Figure 41

New Brunswick Laboratory Safeguards Measurement Evaluation Program
U235 Enrichment - HEU

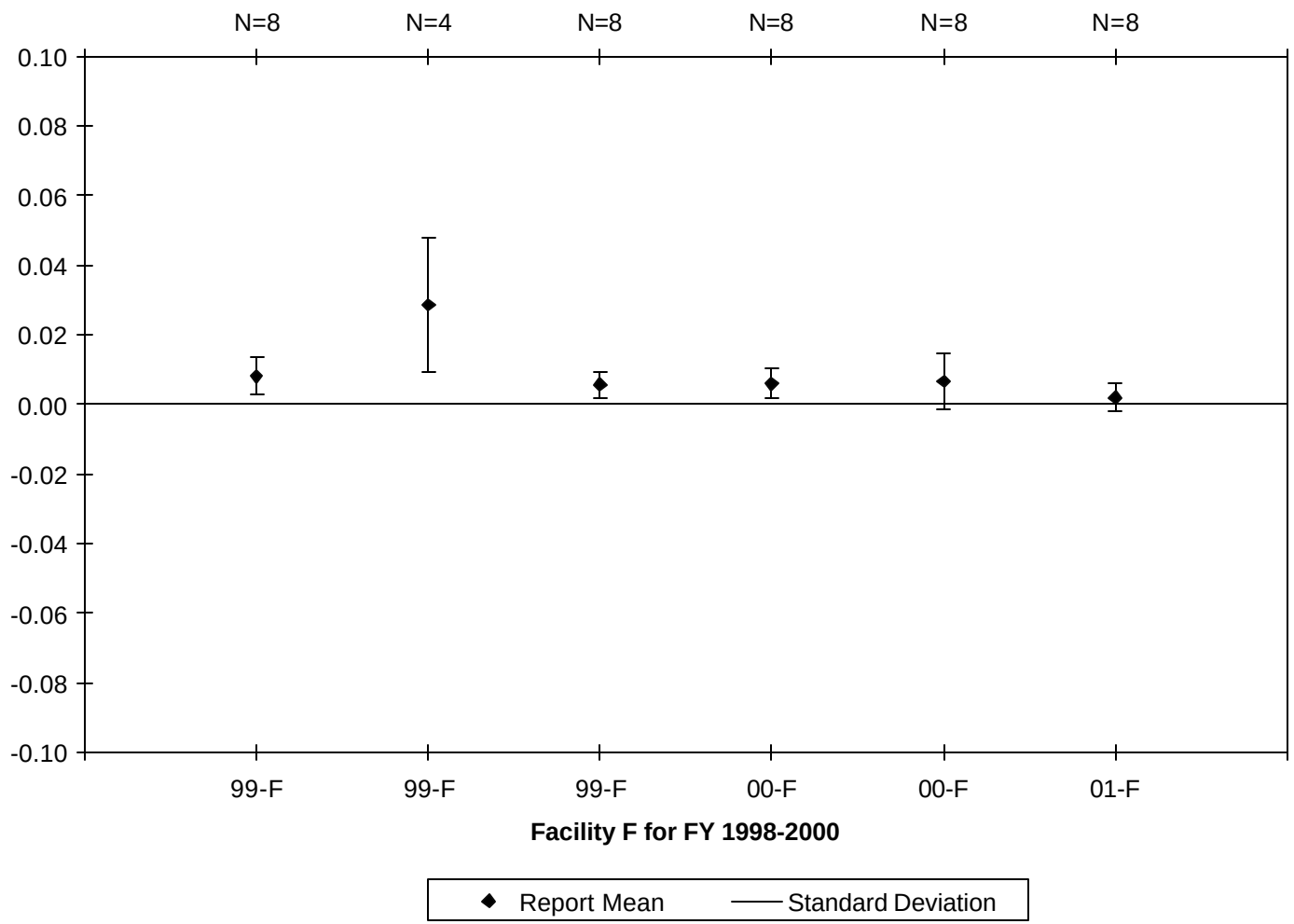


Figure 42

New Brunswick Laboratory Safeguards Measurement Evaluation Program
U235 Enrichment - HEU

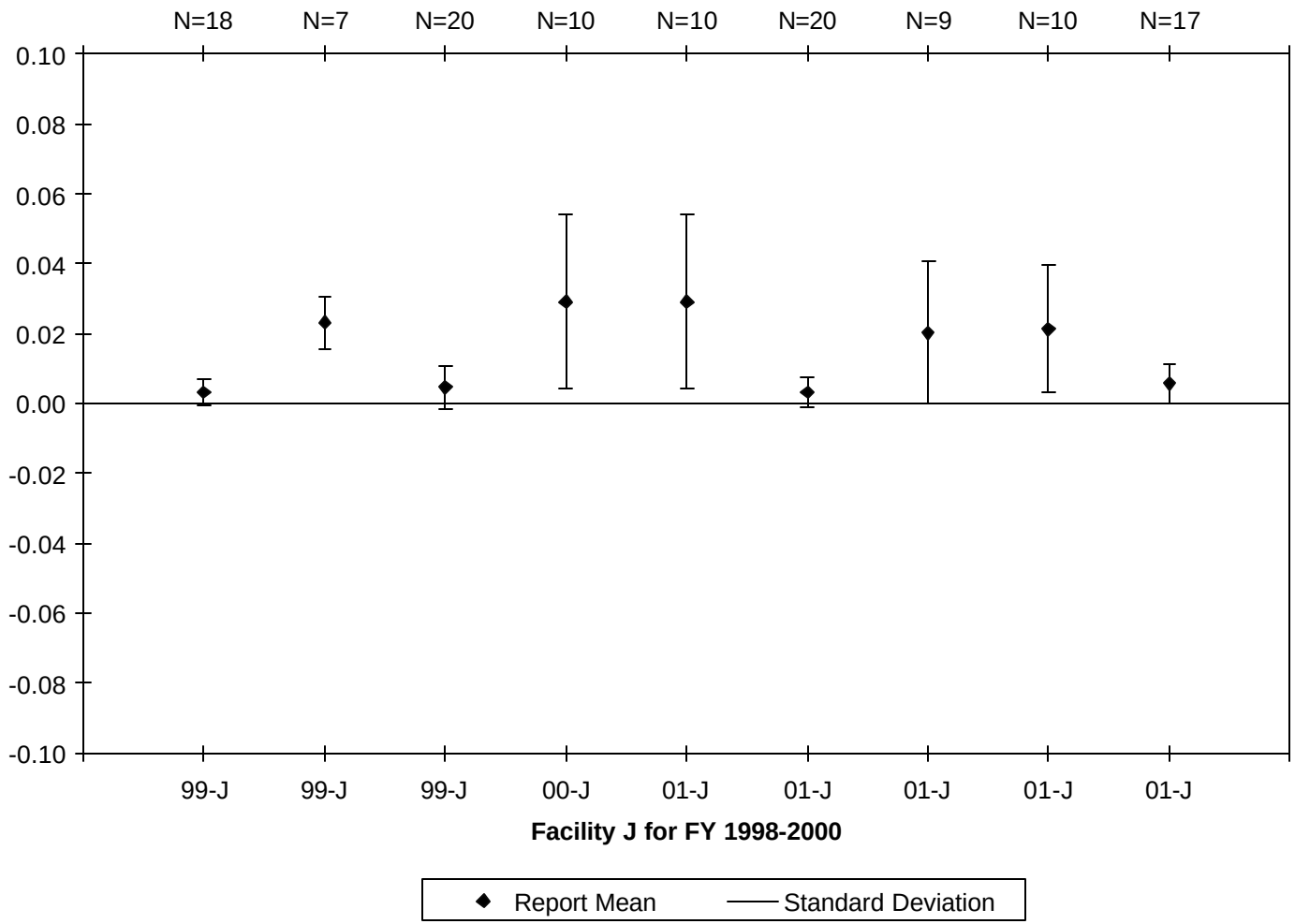


Figure 43

New Brunswick Laboratory Safeguards Measurement Evaluation Program
U235 Enrichment - HEU

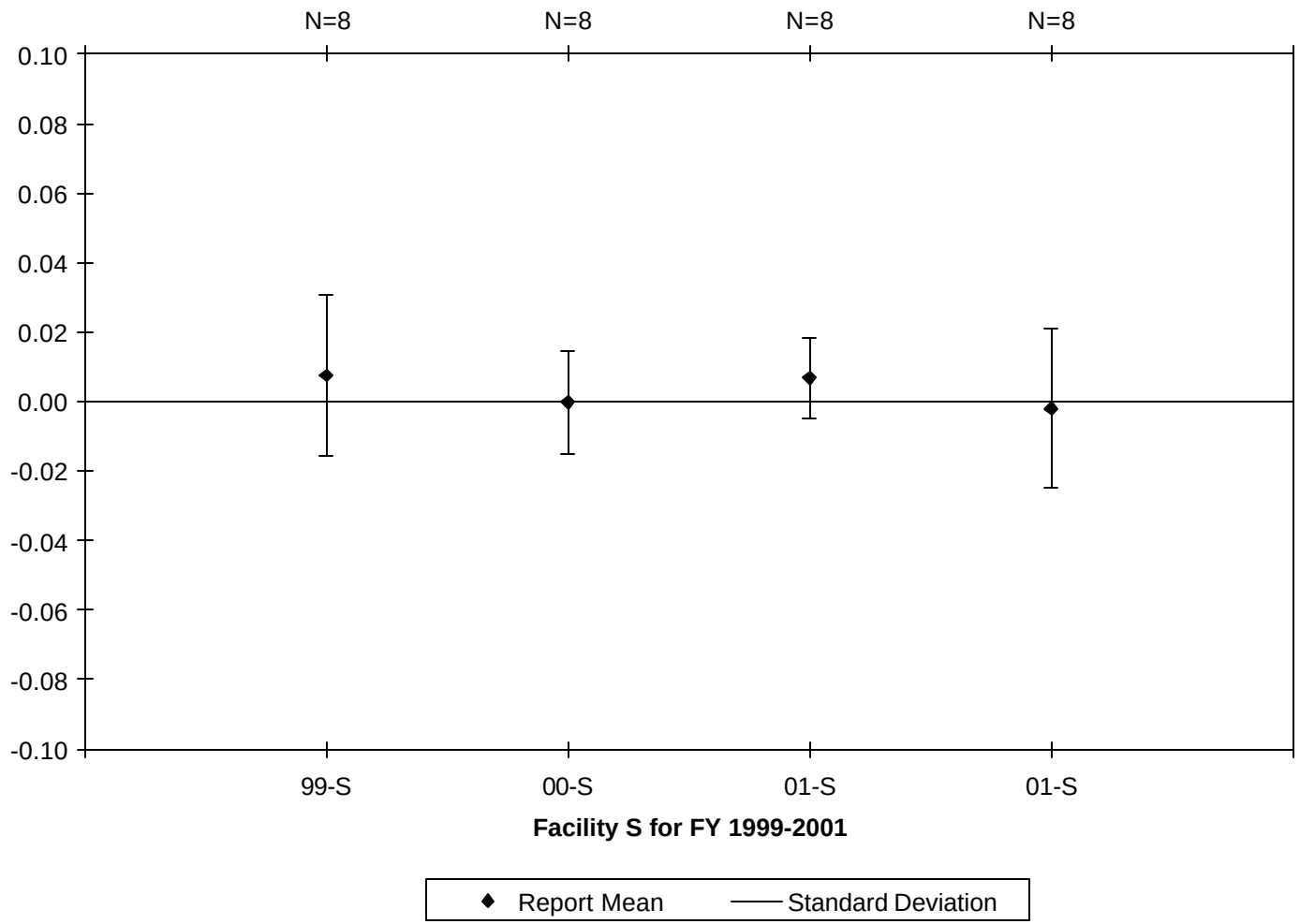


Figure 44

New Brunswick Laboratory Safeguards Measurement Evaluation Program
U235 Enrichment - HEU

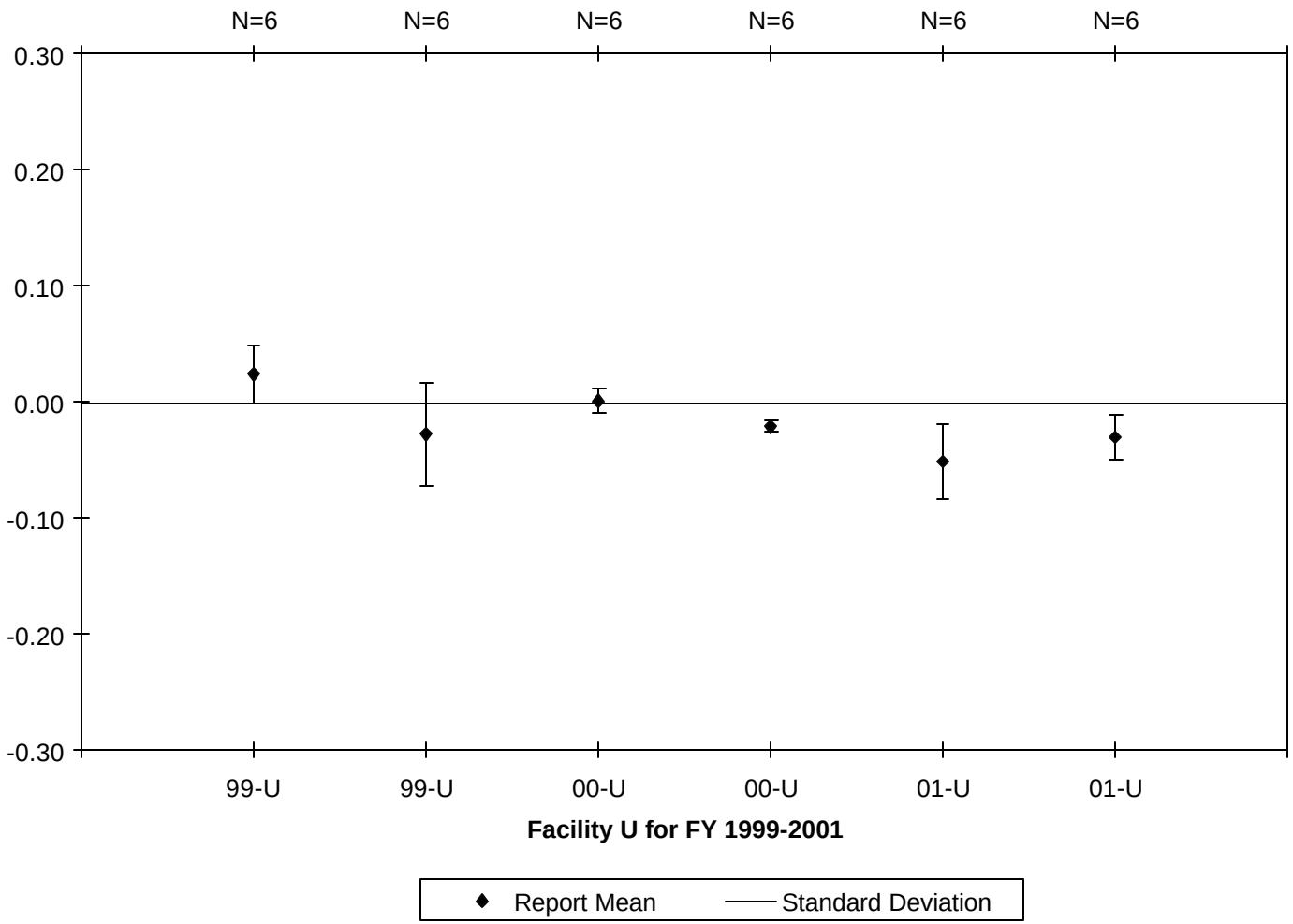


Figure 45

New Brunswick Laboratory Safeguards Measurement Evaluation Program
U235 Enrichment - LEU

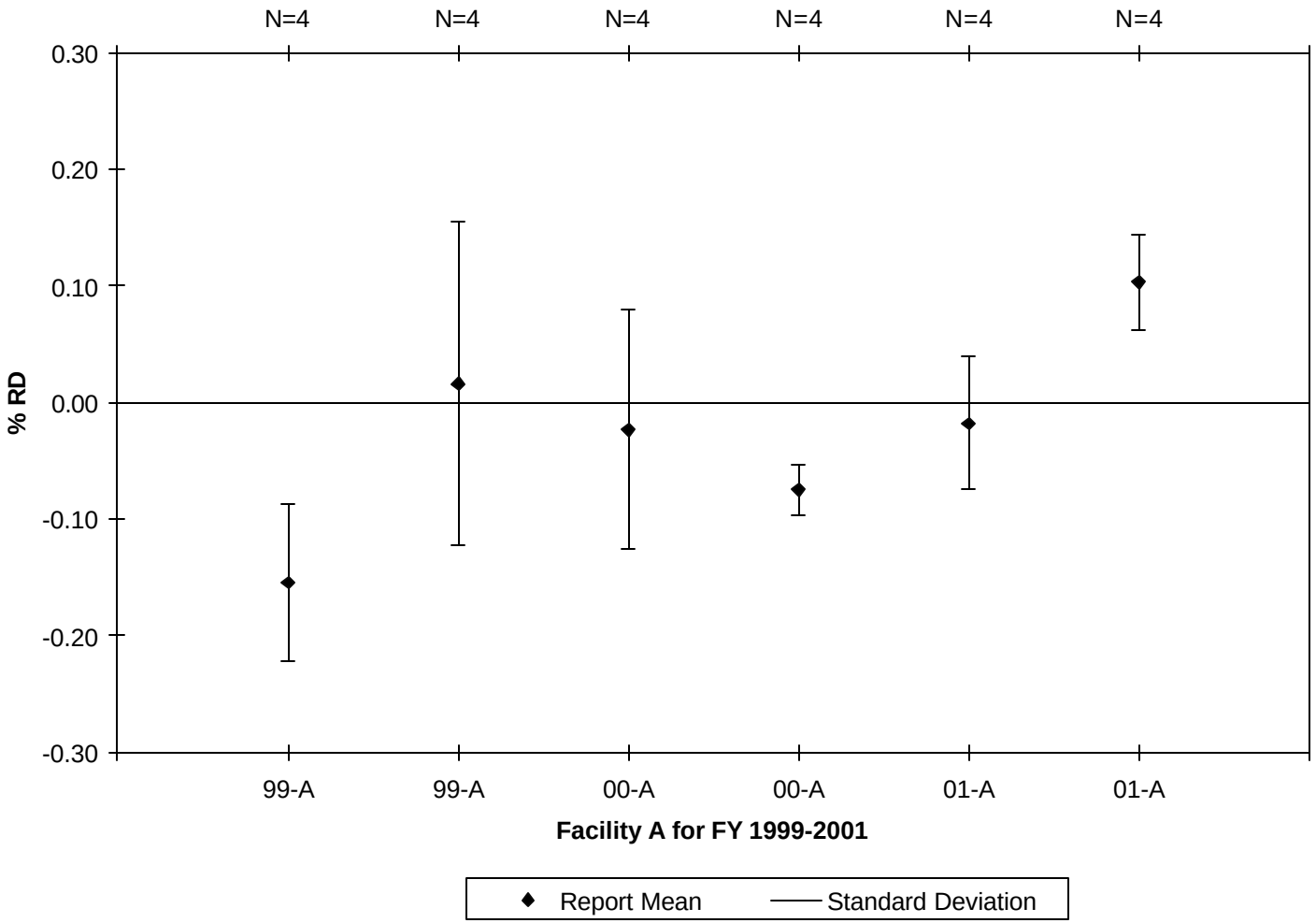


Figure 46

New Brunswick Laboratory Safeguards Measurement Evaluation Program
U235 Enrichment - LEU

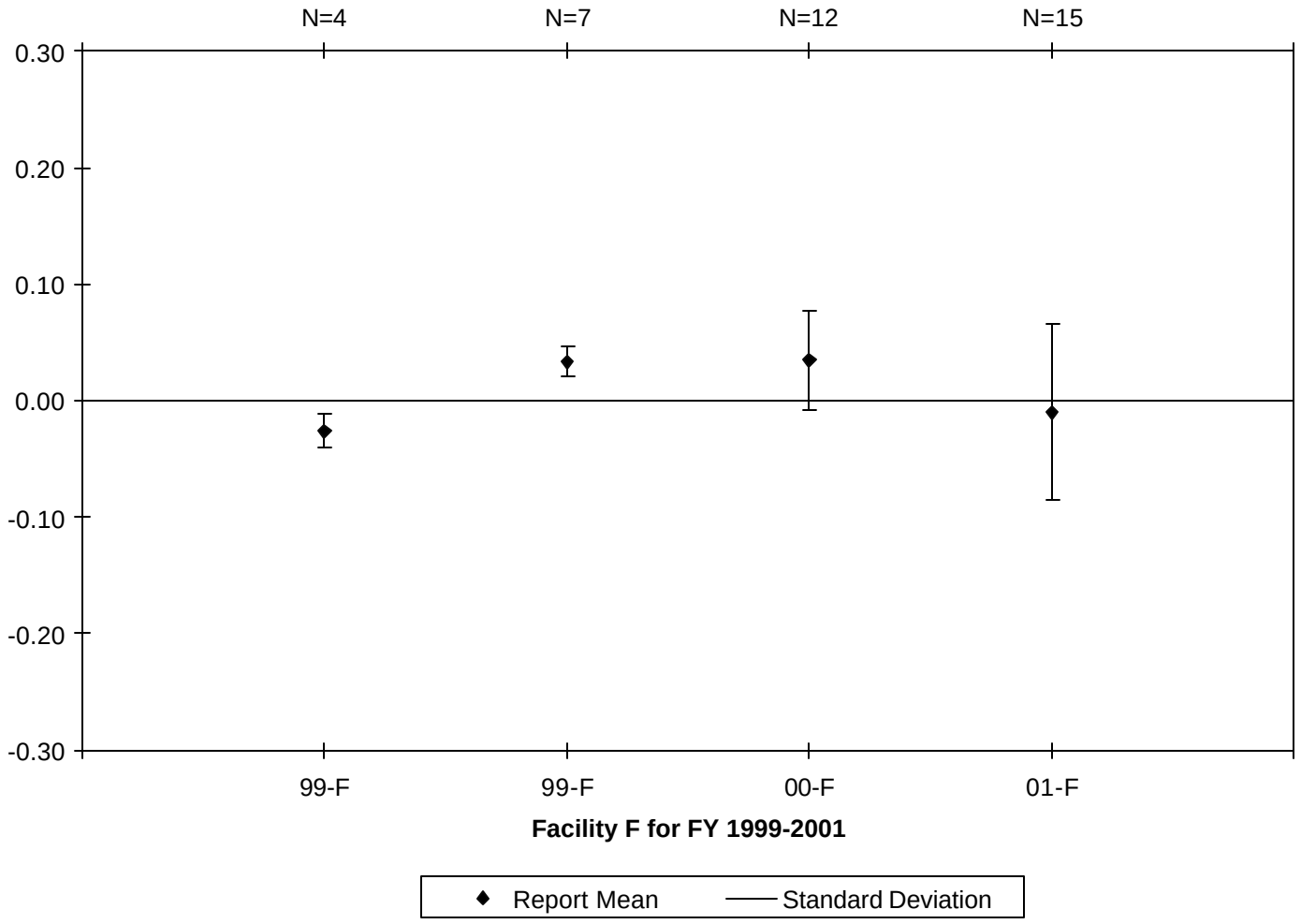


Figure 47

New Brunswick Laboratory Safeguards Measurement Evaluation Program
U235 Enrichment - LEU

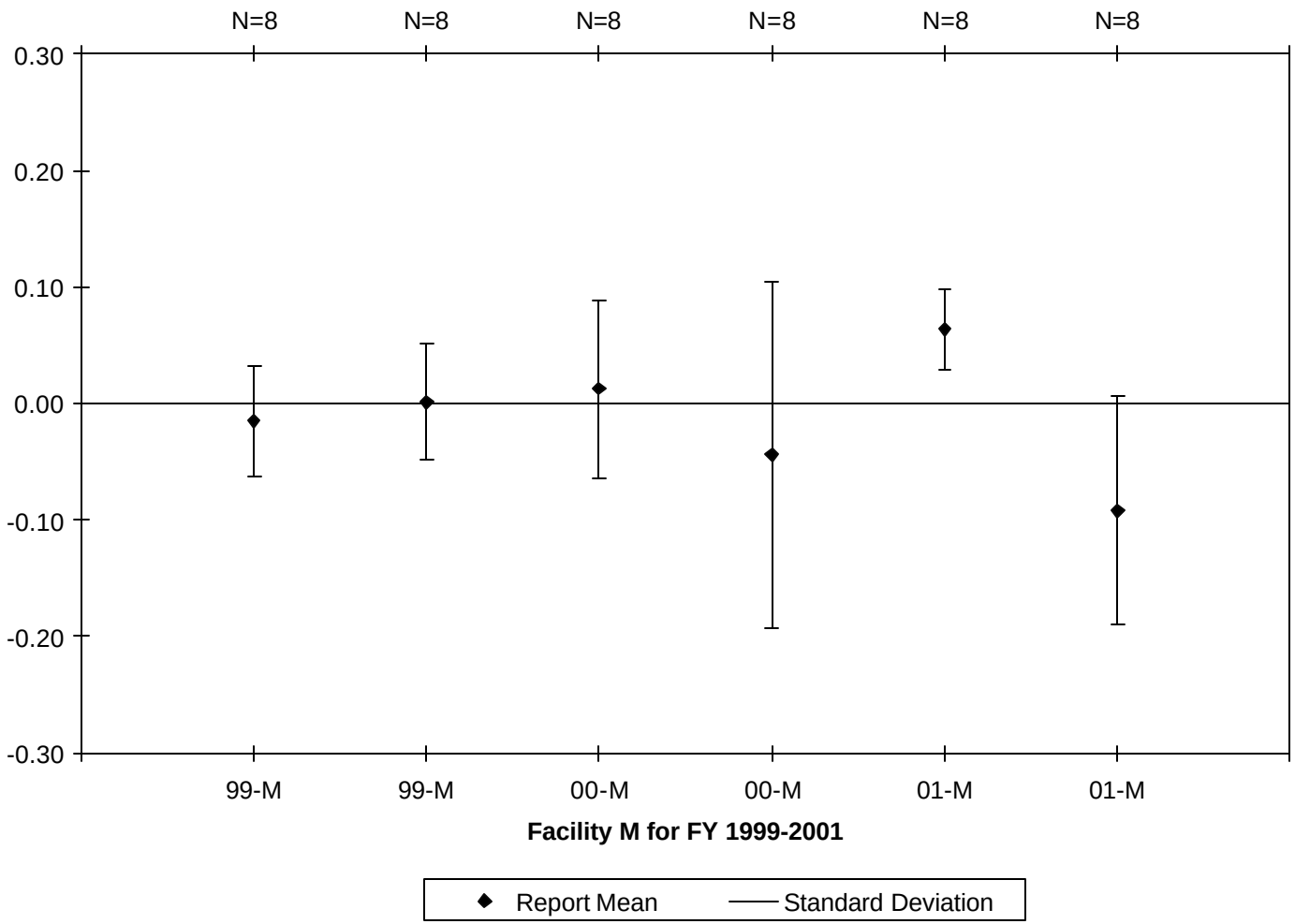


Figure 48

New Brunswick Laboratory Safeguards Measurement Evaluation Program
U235 Enrichment - LEU

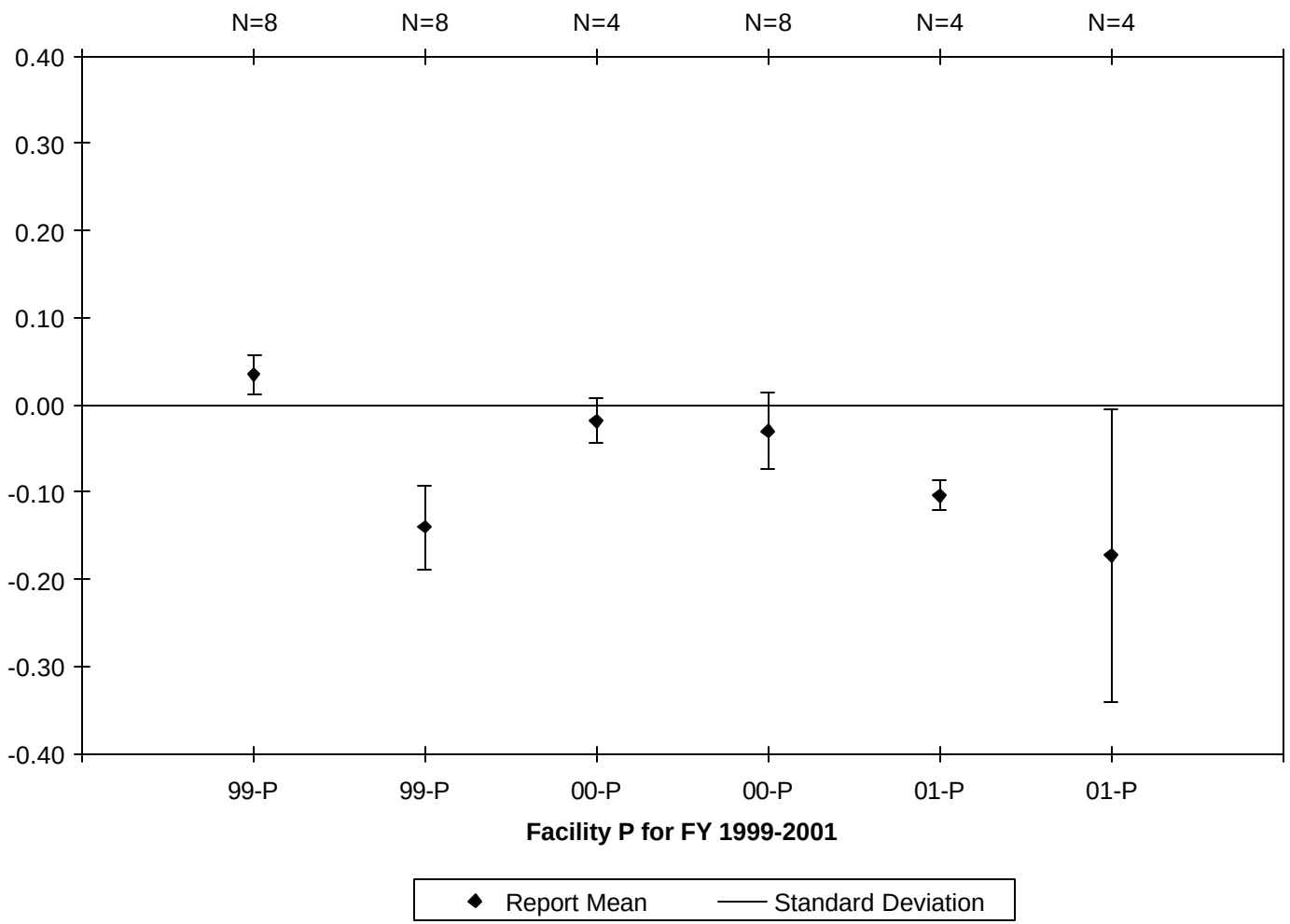


Figure 49

New Brunswick Laboratory Safeguards Measurement Evaluation Program
U235 Enrichment - LEU

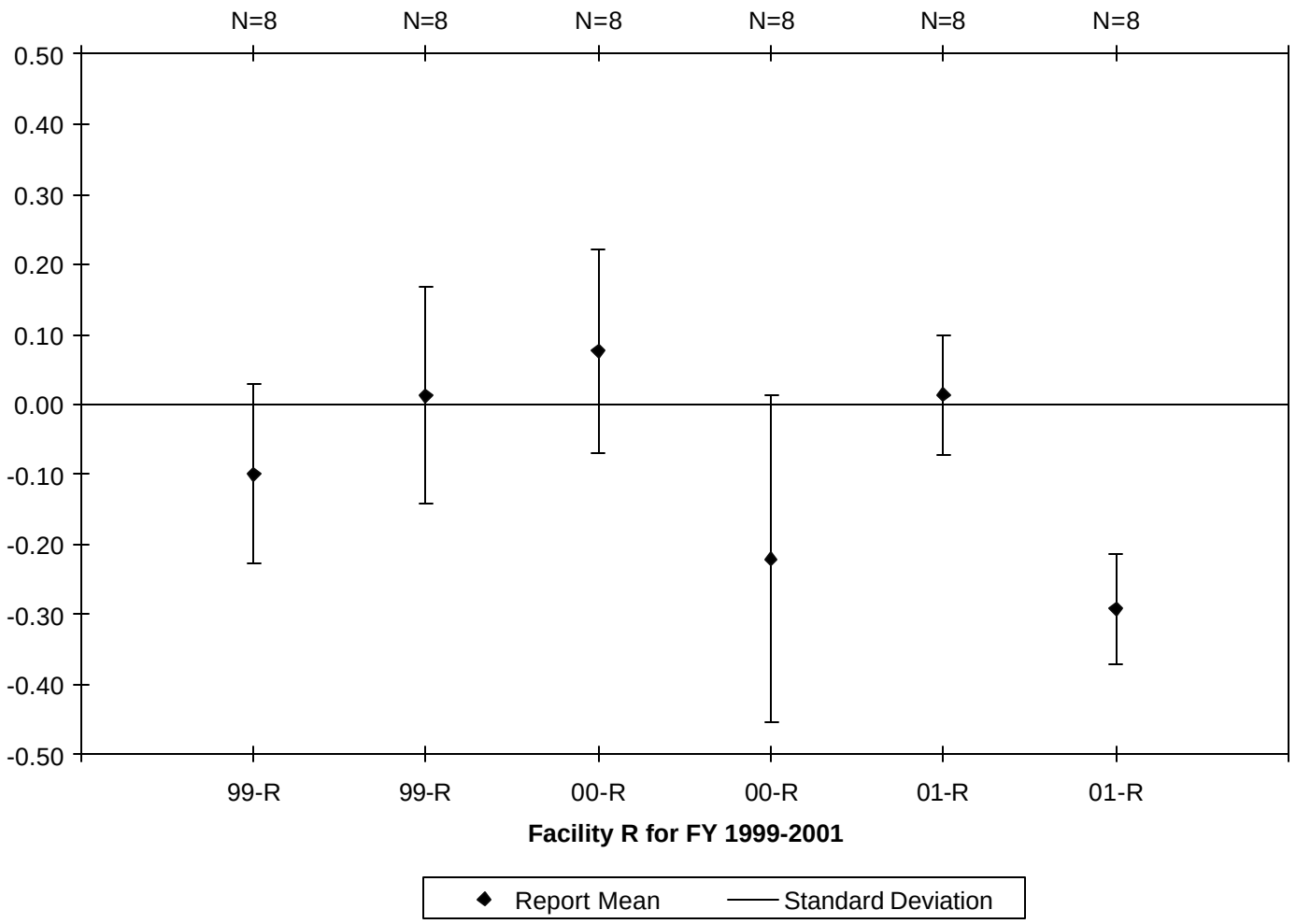


Figure 50

New Brunswick Laboratory Safeguards Measurement Evaluation Program
U235 Enrichment - LEU

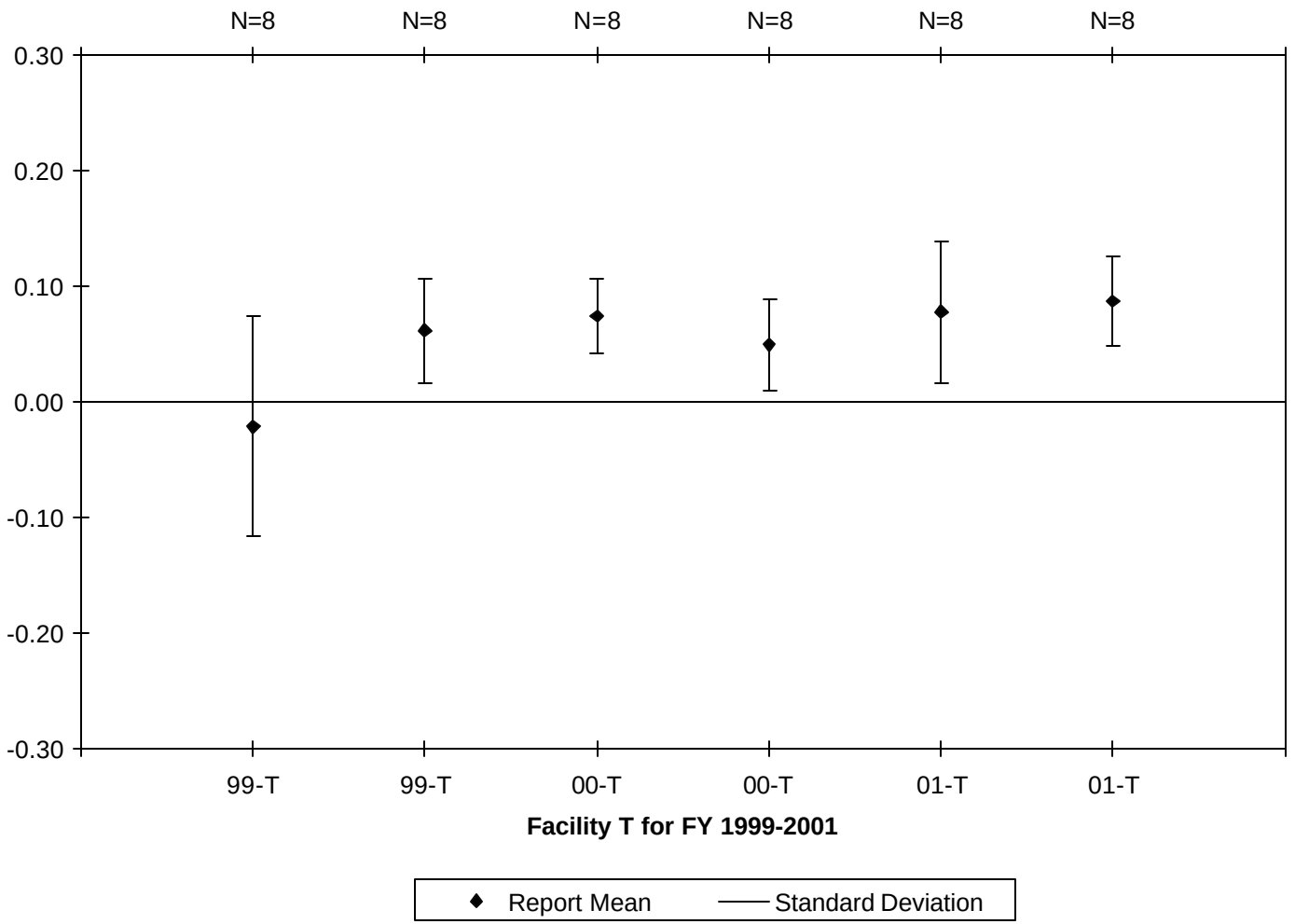


Figure 51

APPENDIX

INDIVIDUAL LABORATORY RESULTS

RESULTS BY MATERIAL/LABORATORY

Material Type Symbols

UF6 = Uranium Hexafluoride
UNH = Uranyl Nitrate Solution
UO2 = Uranium Dioxide Pellet
UO3 = Uranium Trioxide Powder
HEUISO = Uranium Enrichment (High)
LEUISO = Uranium Enrichment (Low)
PU = Dried Pu Sulfate
PUXXX = Plutonium Isotope

Material	Facility	Analysis Date	Reported Result	%RD	Analyst
UF6	C	11/22/99	67.588	0.014798	BLH
UF6	C	11/22/99	67.600	0.032555	BLH
UF6	C	01/12/00	67.609	0.045873	MJT
UF6	C	09/01/00	67.604	0.038474	MJT
UF6	C	09/01/00	67.608	0.044393	BLH
UF6	C	09/01/00	67.607	0.042913	BLH
UF6	C	09/01/00	67.613	0.051792	MJT
UF6	C	09/12/00	67.613	0.051792	MJT
UF6	E	09/12/00	67.566	-0.017757	RWT
UF6	E	09/12/00	67.563	-0.022197	RWT
UF6	E	09/12/00	67.575	-0.004439	RWT
UF6	E	09/28/00	67.582	0.005919	RWT
UF6	E	09/28/00	67.586	0.011838	RWT
UF6	E	10/03/00	67.560	-0.026636	RWT
UF6	E	10/03/00	67.568	-0.014798	RWT
UF6	E	10/03/00	67.579	0.00148	RWT
UF6	F	10/03/00	67.5672	-0.015982	025
UF6	F	10/04/00	67.5855	0.011098	025
UF6	F	10/04/00	67.5676	-0.01539	025
UNH	A	12/15/00	1.008	0.396406	RBD
UNH	A	12/15/00	1.008	0.396406	RBD
UNH	A	12/15/00	1.002	0.14492	RBD
UNH	A	12/15/00	1.004	0.34481	RBD
UNH	A	12/19/00	1.008	0.396406	RBD
UNH	A	12/19/00	1.011	0.695205	RBD
UNH	A	12/19/00	1.007	0.644645	RBD
UNH	A	12/19/00	1.006	0.5447	RBD
UNH	A	12/19/00	0.99951	-0.103943	JW
UNH	A	12/19/00	0.99857	-0.197891	JW
UNH	A	12/19/00	1.0049	0.087648	JW
UNH	A	12/19/00	1.0042	0.017928	JW
UNH	A	12/19/00	0.99761	-0.293838	LHC
UNH	A	12/19/00	0.99879	-0.175903	LHC
UNH	A	12/20/00	1.0013	-0.270911	LHC
UNH	A	12/20/00	1.0067	0.266927	LHC
UNH	A	12/20/00	0.9976	-0.294838	JW

Material	Facility	Analysis Date	Reported Result	%RD	Analyst
UNH	A	12/20/00	1.0007	0.014992	JW
UNH	A	12/20/00	1.003	0.069839	LHC
UNH	A	12/20/00	1.004	0.16961	LHC
UNH	A	12/20/00	1.002	0.14492	LHC
UNH	A	12/20/00	1.002	0.14492	LHC
UNH	A	12/21/00	1.0060	0.369151	JW
UNH	A	12/21/00	1.0023	0	JW
UNH	A	12/21/00	1.0013	0.074959	JW
UNH	A	12/21/00	1.0028	0.224876	JW
UNH	A	12/28/00	1.005	0.26938	RBD
UNH	A	12/28/00	1.004	0.16961	RBD
UNH	A	12/29/00	1.005	0.444755	RBD
UNH	A	12/29/00	1.004	0.34481	RBD
UNH	A	12/29/00	1.0011	-0.119725	JW
UNH	A	12/29/00	1.0018	-0.049885	JW
UNH	A	01/04/01	1.008	0.396406	RBD
UNH	A	01/04/01	1.006	0.197207	RBD
UNH	A	01/04/01	1.005	0.26938	RBD
UNH	A	01/04/01	1.004	0.16961	RBD
UNH	A	01/04/01	1.0024	0.009977	JW
UNH	A	01/04/01	1.0021	-0.019954	JW
UNH	A	01/04/01	1.0056	0.157367	JW
UNH	A	01/04/01	1.0045	0.047808	JW
UNH	A	01/05/01	1.006	0.197207	RBD
UNH	A	01/05/01	1.004	-0.001992	RBD
UNH	A	01/05/01	1.004	0.16961	RBD
UNH	A	01/05/01	1.001	-0.129702	RBD
UNH	A	01/22/01	1.0016	-0.069839	MH
UNH	A	01/22/01	1.0032	0.089793	MH
UNH	A	01/22/01	1.0049	0.087648	MH
UNH	A	01/22/01	1.0033	-0.071712	MH
UNH	A	01/31/01	1.00160	0.104942	JLW
UNH	A	01/31/01	1.00250	0.194893	JLW
UNH	A	01/31/01	1.0041	0.007968	JLW
UNH	A	01/31/01	1.00271	-0.130475	JLW
UNH	A	02/02/01	1.00130	0.074959	MJH
UNH	A	02/02/01	1.00080	0.024986	MJH
UNH	A	02/02/01	1.0042	0.017928	MJH
UNH	A	02/02/01	1.0019	-0.211151	MJH
UNH	A	02/05/01	1.001	0.044975	RBD
UNH	A	02/07/01	0.9971	-0.34481	RBD
UNH	A	02/07/01	1.002	-0.201191	RBD
UNH	A	02/07/01	1.003	-0.101592	RBD
UNH	A	02/07/01	1.001	0.044975	RBD
UNH	A	02/07/01	1.002	0.14492	RBD
UNH	A	02/07/01	1.004	-0.001992	RBD
UNH	A	02/07/01	1.003	-0.101592	RBD
UNH	A	02/07/01	1.0027	0.039908	MJH
UNH	A	02/08/01	1.0023	0	MJH
UNH	A	02/08/01	1.0044	0.037848	MJH
UNH	A	02/08/01	1.0050	0.097608	MJH

Material	Facility	Analysis Date	Reported Result	%RD	Analyst
UNH	A	02/08/01	1.002	-0.029931	ACD/RBD
UNH	A	02/08/01	1.004	0.16961	ACD/RBD
UNH	A	02/08/01	1.002	0.14492	ACD/RBD
UNH	A	02/08/01	1.005	0.444755	ACD/RBD
UNH	A	02/08/01	1.007	0.468921	ACD/RBD
UNH	A	02/09/01	1.008	0.568692	ACD/RBD
UNH	A	02/09/01	1.006	0.5447	ACD/RBD
UNH	A	02/09/01	1.006	0.5447	ACD/RBD
UNH	A	02/09/01	1.0031	0.079816	JW
UNH	A	02/13/01	1.0022	-0.009977	JW
UNH	A	02/13/01	1.0048	0.077688	JW
UNH	A	02/13/01	1.0035	-0.051792	JW
UNH	B	02/13/01	0.9142	-1.235048	381
UNH	B	02/13/01	0.9264	0.08297	381
UNH	B	02/13/01	0.9265	-0.477365	381
UNH	B	02/13/01	0.9233	-0.821102	381
UNH	B	02/13/01	0.8982	-2.963597	382
UNH	B	02/13/01	0.9142	-1.235048	382
UNH	B	02/13/01	0.9399	0.962034	382
UNH	B	02/14/01	0.9171	-1.487093	382
UNH	B	02/14/01	1.0010	-0.129702	L.B.
UNH	B	02/14/01	0.9995	-0.279357	L.B.
UNH	B	02/14/01	1.0013	-0.099771	J.P.
UNH	B	02/14/01	1.0003	-0.370511	J.P.
UNH	B	02/14/01	0.9992	-0.309289	J.P.
UNH	B	02/15/01	1.0010	-0.300791	L.B.
UNH	B	02/15/01	1.0002	-0.380471	J.P.
UNH	B	02/15/01	0.9990	-0.329243	J.P.
UNH	B	02/15/01	0.9987	-0.184898	L.B.
UNH	B	02/15/01	0.9983	-0.224876	J.P.
UNH	B	02/15/01	1.0013	-0.270911	L.B.
UNH	B	02/15/01	1.0023	0	L.B.
UNH	B	02/16/01	1.0021	-0.019954	L.B.
UNH	B	02/16/01	0.9971	-0.34481	L.B.
UNH	B	02/16/01	1.0006	-0.16961	L.B.
UNH	B	02/16/01	0.9978	-0.274849	L.B.
UNH	B	02/19/01	1.0007	-0.330671	L.B.
UNH	B	02/19/01	1.0002	-0.380471	J.P.
UNH	B	02/19/01	0.9970	-0.354805	L.B.
UNH	B	02/19/01	0.9968	-0.374794	J.P.
UNH	B	02/19/01	0.9999	-0.41035	J.P.
UNH	B	02/19/01	1.0004	-0.360551	L.B.
UNH	B	02/19/01	0.9983	-0.224876	L.B.
UNH	B	02/21/01	0.9973	-0.324821	J.P.
UNH	C	02/21/01	1.008	0.568692	KIR
UNH	C	02/21/01	1.007	0.468921	KIR
UNH	C	02/21/01	1.003	0.244865	KIR
UNH	C	02/21/01	1.005	0.444755	KIR
UNH	C	02/21/01	1.006	0.369151	KIR
UNH	C	02/22/01	1.004	0.16961	KIR
UNH	C	02/22/01	1.009	0.844536	KIR

Material	Facility	Analysis Date	Reported Result	%RD	Analyst
UNH	C	02/22/01	1.008	0.74459	KIR
UNH	C	02/22/01	0.9990	-0.49999	KIR
UNH	C	02/22/01	1.001	-0.300791	KIR
UNH	C	02/22/01	1.001	0.044975	KIR
UNH	C	02/22/01	0.997	-0.354805	KIR
UNH	C	02/22/01	1.004	-0.001992	KIR
UNH	C	02/22/01	1.005	0.097608	KIR
UNH	C	02/22/01	0.999	-0.154915	KIR
UNH	C	02/23/01	0.999	-0.154915	KIR
UNH	F	02/23/01	1.00213	-0.016961	197
UNH	F	02/24/01	1.00220	-0.009977	197
UNH	F	02/24/01	0.99988	-0.066963	197
UNH	F	02/26/01	0.99973	-0.081955	197
UNH	F	02/26/01	1.00237	0.006984	164
UNH	F	02/26/01	1.00265	0.03492	164
UNH	F	02/26/01	1.00228	-0.001995	197
UNH	F	02/26/01	1.00056	0.000999	164
UNH	F	02/26/01	0.99986	-0.068962	164
UNH	F	02/26/01	1.00003	-0.051971	197
UNH	F	02/26/01	1.00022	-0.032982	197
UNH	F	02/26/01	1.00218	-0.011972	197
UNH	F	02/26/01	1.00206	-0.023945	164
UNH	F	02/27/01	1.00214	-0.015963	164
UNH	F	02/27/01	0.99999	-0.055969	164
UNH	F	02/27/01	0.99999	-0.055969	164
UNH	G	02/27/01	1.00386	-0.015936	
UNH	G	02/27/01	1.00325	-0.076692	
UNH	G	02/27/01	1.00092	0.03698	
UNH	G	03/01/01	1.00057	0.001999	
UNH	G	03/01/01	1.00354	-0.047808	
UNH	G	03/01/01	1.00346	-0.055776	
UNH	G	03/01/01	1.00067	0.011993	
UNH	G	03/08/01	1.00058	0.002998	
UNH	G	03/08/01	1.00395	-0.006972	
UNH	G	03/09/01	1.00368	-0.033864	
UNH	G	03/09/01	1.00252	0.02195	
UNH	G	03/23/01	1.00228	-0.001995	
UNH	G	03/23/01	1.00364	-0.037848	
UNH	G	03/23/01	1.00335	-0.066732	
UNH	G	03/23/01	1.00204	-0.02594	
UNH	G	04/18/01	1.00267	0.036915	
UNH	J	04/18/01	0.68167	-0.005868	U617
UNH	J	04/18/01	0.93798	-0.112668	U681
UNH	J	04/18/01	0.93814	-0.09563	U682
UNH	J	05/03/01	0.92535	-0.030466	U683
UNH	J	05/03/01	0.92447	-0.125536	U684
UNH	J	05/03/01	0.68149	-0.032272	U699
UNH	J	05/03/01	0.68148	-0.033739	U700
UNH	J	05/03/01	0.93839	-0.069007	U681
UNH	J	05/03/01	0.93840	-0.067942	U682
UNH	J	05/03/01	0.92472	-0.098527	U683

Material	Facility	Analysis Date	Reported Result	%RD	Analyst
UNH	J	05/03/01	0.92431	-0.142821	U684
UNH	J	05/10/01	0.68247	0.111484	U699
UNH	J	05/10/01	0.68160	-0.016136	U700
UNH	J	05/10/01	0.93864	-0.042384	U681
UNH	J	05/10/01	0.93852	-0.055163	U682
UNH	J	06/08/01	0.92526	-0.040189	U683
UNH	J	06/08/01	0.92505	-0.062876	U684
UNH	J	06/08/01	0.68108	-0.092415	U699
UNH	J	06/08/01	0.68091	-0.117352	U700
UNH	J	06/12/01	0.93869	-0.037059	U681
UNH	J	06/12/01	0.93805	-0.105214	U682
UNH	J	06/12/01	0.92457	-0.114732	U683
UNH	J	06/12/01	0.92455	-0.116893	U684
UNH	J	06/12/01	0.68123	-0.070411	U699
UNH	J	06/12/01	0.68196	0.036672	U700
UNH	J	06/12/01	0.93790	-0.121188	U681
UNH	J	06/12/01	0.93777	-0.135032	U682
UNH	J	06/13/01	0.92413	-0.162268	U683
UNH	J	06/13/01	0.92424	-0.150384	U684
UNH	J	06/13/01	0.93112	0.018906	U764
UNH	J	06/13/01	0.93052	-0.045545	U765
UNH	J	06/13/01	0.92598	0.037596	U762
UNH	J	06/13/01	0.92503	-0.065037	U763
UNH	J	06/13/01	0.68291	0.176028	U760
UNH	J	06/13/01	0.68216	0.06601	U761
UNH	J	06/20/01	0.93117	0.024276	U764
UNH	J	06/20/01	0.93064	-0.032655	U765
UNH	J	06/20/01	0.92588	0.026793	U762
UNH	J	06/20/01	0.92592	0.031114	U763
UNH	J	06/20/01	0.68247	0.111484	U760
UNH	J	06/20/01	0.68272	0.148157	U761
UNH	J	06/21/01	0.92506	-0.061796	U762
UNH	J	06/21/01	0.68165	-0.008801	U760
UNH	J	06/21/01	0.68161	-0.014669	U761
UNH	J	06/21/01	0.93099	0.004941	U764
UNH	J	06/21/01	0.93047	-0.050916	U765
UNH	J	06/21/01	0.92533	-0.032626	U762
UNH	J	06/21/01	0.92553	-0.011019	U763
UNH	J	06/21/01	0.68236	0.095348	U760
UNH	J	06/21/01	0.68241	0.102683	U761
UNH	J	06/21/01	0.93113	0.01998	U764
UNH	J	06/25/01	0.93156	0.066169	U765
UNH	J	06/25/01	0.92667	0.11214	U762
UNH	J	06/25/01	0.92598	0.037596	U763
UNH	J	06/25/01	0.68281	0.161359	U760
UNH	J	06/26/01	0.68196	0.036672	U761
UNH	S	06/26/01	0.93946	0.04494	GFB
UNH	S	06/28/01	0.93911	0.007667	GFB
UNH	S	06/28/01	0.92548	-0.016421	GFB
UNH	S	07/11/01	0.92527	-0.039108	GFB
UNH	S	07/11/01	0.93919	0.016187	RRA

Material	Facility	Analysis Date	Reported Result	%RD	Analyst
UNH	S	07/11/01	0.93884	-0.021085	RRA
UNH	S	07/11/01	0.92590	0.028953	RRA
UNH	S	07/11/01	0.92546	-0.018582	RRA
UNH	S	07/11/01	0.92486	-0.083402	RRA
UNH	S	07/13/01	0.92496	-0.072599	RRA
UNH	S	07/13/01	0.93063	-0.033729	RRA
UNH	S	07/17/01	0.93066	-0.030507	RRA
UNH	S	07/17/01	0.92483	-0.086644	OCJ
UNH	S	07/17/01	0.93106	0.01246	OCJ
UNH	S	07/17/01	0.92636	0.078649	OCJ
UNH	S	07/17/01	0.93024	-0.075622	OCJ
UNH	U	07/17/01	0.93954	0.053459	DH
UNH	U	07/18/01	0.92647	0.090533	DH
UNH	U	07/18/01	0.92935	0.401672	DH
UNH	U	07/18/01	0.94084	0.191899	TJ
UNH	U	07/18/01	0.94144	0.255794	TJ
UNH	U	07/23/01	0.92726	0.17588	TJ
UNH	U	07/23/01	0.93993	0.094991	DH
UNH	U	07/23/01	0.93925	0.022576	DH
UNH	U	07/23/01	0.93122	0.029647	DH
UNH	U	07/23/01	0.92980	-0.122886	DH
UNH	U	07/23/01	0.92991	-0.11107	DH
UNH	U	07/24/01	0.93998	0.100315	DH
UO2	F	07/24/01	88.1007	-0.032112	197
UO2	F	07/24/01	88.0921	-0.04187	197
UO2	F	07/24/01	88.0750	-0.061274	197
UO2	F	07/24/01	88.1071	-0.02485	197
UO2	F	07/24/01	88.1453	0.018496	197
UO2	F	07/24/01	88.1155	-0.015318	197
UO2	F	07/24/01	88.1185	-0.011914	197
UO2	F	07/24/01	88.1075	-0.024396	197
UO2	F	07/24/01	88.0819	-0.053444	197
UO2	F	07/25/01	88.0759	-0.060253	197
UO2	F	07/25/01	88.0987	-0.034381	197
UO2	F	07/25/01	88.0972	-0.036083	197
UO2	F	07/25/01	88.0746	-0.061728	197
UO2	F	07/25/01	88.1235	-0.006241	197
UO2	F	07/25/01	88.1294	0.000454	197
UO2	F	07/27/01	88.0937	-0.040055	197
UO2	F	07/27/01	88.0807	-0.054806	164
UO2	F	07/27/01	88.0757	-0.06048	164
UO2	F	07/27/01	88.0747	-0.061614	164
UO2	F	07/30/01	88.0687	-0.068422	164
UO2	F	07/30/01	88.0632	-0.074663	164
UO2	F	07/30/01	88.0442	-0.096223	164
UO2	F	07/30/01	88.1135	-0.017588	164
UO2	F	07/31/01	88.1019	-0.03075	164
UO2	F	07/31/01	88.0804	-0.055146	164
UO2	F	07/31/01	88.1238	-0.0059	164
UO2	F	07/31/01	88.0826	-0.05265	164
UO2	F	07/31/01	88.0728	-0.06377	164

Material	Facility	Analysis Date	Reported Result	%RD	Analyst
UO2	F	07/31/01	88.1580	0.032906	164
UO2	F	07/31/01	88.1168	-0.013843	164
UO2	F	07/31/01	88.1314	0.002723	025
UO2	F	07/31/01	88.1305	0.001702	025
UO2	F	07/31/01	88.1403	0.012822	025
UO2	F	07/31/01	88.1341	0.005787	025
UO2	F	07/31/01	88.1538	0.028141	025
UO2	F	08/01/01	88.1409	0.013503	025
UO2	F	08/01/01	88.1500	0.023829	025
UO2	F	08/06/01	88.1409	0.013503	025
UO2	M	08/06/01	88.135	0.006808	RAM/FMS
UO2	M	08/06/01	88.140	0.012482	RAM/FMS
UO2	M	08/07/01	88.143	0.015886	RAM/FMS
UO2	M	08/07/01	88.140	0.012482	RAM/FMS
UO2	M	08/07/01	88.139	0.011347	RAM
UO2	M	08/07/01	88.137	0.009078	RAM
UO2	M	08/07/01	88.139	0.011347	EFB
UO2	M	08/07/01	88.143	0.015886	EFB
UO2	P	08/07/01	88.120	-0.010212	SMB
UO2	P	08/08/01	88.119	-0.011347	SMB
UO2	P	08/08/01	88.119	-0.011347	SMB
UO2	P	08/08/01	88.119	-0.011347	SMB
UO2	P	08/08/01	88.120	-0.010212	DJR
UO2	P	08/09/01	88.119	-0.011347	DJR
UO2	P	08/09/01	88.117	-0.013616	WLB
UO2	P	08/09/01	88.119	-0.011347	WLB
UO2	R	08/09/01	88.146	0.01929	JM
UO2	R	08/09/01	88.145	0.018155	JM
UO2	R	08/09/01	88.188	0.066947	JM/LB
UO2	R	08/09/01	88.145	0.018155	JM/LB
UO2	R	08/09/01	88.150	0.023829	RWH
UO2	R	08/09/01	88.155	0.029502	RWH
UO2	R	08/09/01	88.161	0.03631	RWH
UO2	R	08/09/01	88.146	0.01929	RWH
UO2	T	08/09/01	88.09	-0.044253	
UO2	T	08/09/01	88.13	0.001135	
UO2	T	08/09/01	88.06	-0.078294	
UO2	T	08/09/01	88.08	-0.0556	
UO2	T	08/09/01	88.16	0.035176	
UO2	T	08/14/01	88.07	-0.066947	
UO2	T	08/14/01	88.13	0.001135	
UO2	T	08/15/01	88.12	-0.010212	
UO2	T	08/15/01	88.13	0.001135	
UO2	T	08/15/01	88.02	-0.123682	
UO2	T	08/15/01	88.11	-0.021559	
UO2	T	08/20/01	88.16	0.035176	
UO2	T	08/20/01	88.19	0.069217	
UO2	T	08/22/01	88.07	-0.066947	
UO2	T	08/22/01	88.24	0.125952	
UO2	T	08/22/01	88.09	-0.044253	
UO3	A	08/22/01	82.33	-0.415128	ACB/RBD

Material	Facility	Analysis Date	Reported Result	%RD	Analyst
UO3	A	08/22/01	82.37	-0.366745	ACB/RBD
UO3	A	08/22/01	82.32	-0.427224	ACB/RBD
UO3	A	08/28/01	82.24	-0.523991	ACB/RBD
UO3	A	08/28/01	82.69	0.020321	ACB/RBD
UO3	A	08/28/01	82.49	-0.221595	ACB/RBD
UO3	A	08/28/01	82.41	-0.318362	ACB/RBD
UO3	A	08/29/01	82.46	-0.257883	ACB/RBD
UO3	A	08/29/01	82.37	-0.366745	JLW
UO3	A	08/29/01	82.42	-0.306266	JLW
UO3	A	08/29/01	82.61	-0.076446	JLW
UO3	A	08/29/01	82.56	-0.136925	JLW
UO3	A	08/29/01	82.54	-0.161116	MJH
UO3	A	08/29/01	82.64	-0.040158	MJH
UO3	A	08/29/01	82.53	-0.173212	MJH
UO3	A	08/29/01	82.74	0.0808	MJH
UO3	A	08/29/01	82.34	-0.403033	ACB/RBD
UO3	A	09/13/01	82.80	0.153375	ACB/RBD
UO3	A	09/13/01	82.85	0.213854	ACB/RBD
UO3	A	09/13/01	82.69	0.020321	ACB/RBD
UO3	A	09/17/01	82.97	0.359004	ACB/RBD
UO3	A	09/17/01	82.63	-0.052254	ACB/RBD
UO3	A	09/17/01	82.86	0.22595	ACB/RBD
UO3	A	09/17/01	82.67	-0.003871	ACB/RBD
UO3	F	09/17/01	82.6849	0.016814	164
UO3	F	09/17/01	82.7341	0.076327	164
UO3	F	09/17/01	82.6914	0.024676	164
UO3	F	09/17/01	82.7062	0.042578	164
UO3	F	09/17/01	82.6903	0.023346	164
UO3	F	09/17/01	82.6772	0.0075	164
UO3	F	09/24/01	82.6305	-0.048989	164
UO3	F	09/24/01	82.6323	-0.046812	164
UO3	F	09/24/01	82.6261	-0.054312	164
UO3	F	09/24/01	82.6515	-0.023587	164
UO3	F	09/26/01	82.6674	-0.004355	164
UO3	F	09/26/01	82.6771	0.007379	164
UO3	F	09/26/01	82.6847	0.016572	164
UO3	F	09/26/01	82.6578	-0.015967	164
UO3	F	09/27/01	82.6736	0.003145	164
UO3	F	09/27/01	82.6422	-0.034837	164
UO3	F	09/27/01	82.7804	0.132332	197
UO3	F	09/27/01	82.7212	0.060723	197
UO3	F	09/28/01	82.6908	0.02395	197
UO3	F	09/28/01	82.6836	0.015241	197
UO3	F	09/28/01	82.6944	0.028305	197
UO3	F	09/28/01	82.6940	0.027821	197
UO3	F	09/28/01	82.6487	-0.026974	197
UO3	F	09/28/01	82.6446	-0.031934	197
UO3	F	09/28/01	82.6753	0.005201	197
UO3	F	09/28/01	82.6474	-0.028547	197
UO3	F	09/28/01	82.6812	0.012338	197
UO3	F	09/28/01	82.6964	0.030724	197

Material	Facility	Analysis Date	Reported Result	%RD	Analyst
UO3	F	09/28/01	82.6886	0.021289	197
UO3	F	09/28/01	82.6712	0.000242	197
UO3	F	09/28/01	82.6876	0.02008	197
UO3	F	09/28/01	82.6536	-0.021047	197
HEU	A	09/28/00	89.691	0.013582	JW
HEU	A	09/28/00	89.685	0.006891	JW
HEU	A	09/28/00	89.889	-0.002381	JW
HEU	A	09/28/00	89.899	0.008744	JW
HEU	A	10/04/00	89.676	-0.003145	LHC
HEU	A	10/04/00	89.672	-0.007605	LHC
HEU	A	10/04/00	89.905	0.015419	LHC
HEU	A	10/04/00	89.882	-0.010168	LHC
HEU	A	12/19/00	51.324	-0.000974	JW
HEU	A	12/19/00	51.335	0.020458	JW
HEU	A	12/20/00	51.317	-0.014613	JW
HEU	A	12/20/00	51.328	0.006819	JW
HEU	A	01/16/01	89.673	-0.006490	JW
HEU	A	01/16/01	89.673	-0.006490	JW
HEU	A	02/07/01	89.895	0.004294	JW
HEU	A	02/07/01	89.895	0.004294	JW
HEU	A	02/08/01	89.897	0.006519	LC
HEU	A	02/08/01	89.893	0.002069	LC
HEU	A	02/08/01	89.694	0.016927	LC
HEU	A	02/08/01	89.686	0.008006	LC
HEU	A	04/18/01	51.318	-0.012665	JLW
HEU	A	04/18/01	51.303	-0.041890	JLW
HEU	A	06/29/01	51.335	0.020458	JLW
HEU	A	06/29/01	51.349	0.047735	JLW
HEU	A	07/24/01	90.342	0.005336	JW
HEU	A	07/24/01	90.345	0.008656	JW
HEU	A	07/24/01	89.688	0.010237	JW
HEU	A	07/24/01	89.678	-0.000914	JW
HEU	A	07/25/01	90.332	-0.005734	MJH
HEU	A	07/25/01	90.332	-0.005734	MJH
HEU	A	07/25/01	89.678	-0.000914	MJH
HEU	A	07/25/01	89.685	0.006891	MJH
HEU	B	12/15/00	89.900	0.009856	381
HEU	B	12/15/00	89.921	0.033218	381
HEU	B	12/15/00	90.356	0.020833	381
HEU	B	12/15/00	90.357	0.021940	381
HEU	B	12/20/00	89.913	0.024318	382
HEU	B	12/20/00	89.909	0.019868	382
HEU	B	12/20/00	90.363	0.028582	382
HEU	B	12/20/00	90.365	0.030796	382
HEU	B	10/18/01	51.3680	0.084755	JLB
HEU	B	10/18/01	51.3701	0.088846	JLB
HEU	B	10/19/01	51.3540	0.057477	ADF
HEU	B	10/19/01	51.3891	0.125866	ADF
HEU	F	07/06/01	89.6781	-0.000803	230
HEU	F	07/06/01	89.6797	0.000981	230
HEU	F	07/06/01	89.8892	-0.002158	230

Material	Facility	Analysis Date	Reported Result	%RD	Analyst
HEU	F	07/06/01	89.8896	-0.001713	230
HEU	F	07/08/01	89.6853	0.007226	230
HEU	F	07/08/01	89.6794	0.000647	230
HEU	F	07/08/01	89.8987	0.008410	230
HEU	F	07/08/01	89.8942	0.003404	230
HEU	J	02/18/00	51.3458	0.041501	
HEU	J	02/18/00	51.3530	0.055529	
HEU	J	02/18/00	51.3522	0.053970	
HEU	J	02/21/00	51.3187	-0.011301	
HEU	J	02/21/00	51.3420	0.034097	
HEU	J	02/21/00	51.3451	0.040137	
HEU	J	02/25/00	51.3225	-0.003897	
HEU	J	02/25/00	51.3273	0.005455	
HEU	J	02/29/00	51.3353	0.021043	
HEU	J	03/13/00	51.3526	0.054750	
HEU	J	02/05/01	51.3300	0.010716	
HEU	J	02/09/01	89.6843	0.006111	
HEU	J	02/09/01	89.6826	0.004215	
HEU	J	02/09/01	89.8862	-0.005496	
HEU	J	02/09/01	89.8955	0.004850	
HEU	J	02/13/01	89.6800	0.001316	
HEU	J	02/13/01	89.6812	0.002654	
HEU	J	02/13/01	89.8941	0.003293	
HEU	J	02/13/01	89.8973	0.006853	
HEU	J	02/13/01	51.3342	0.018899	
HEU	J	02/13/01	51.3383	0.026888	
HEU	J	02/14/01	89.6782	-0.000691	
HEU	J	02/14/01	89.6793	0.000535	
HEU	J	02/14/01	89.8883	-0.003159	
HEU	J	02/14/01	89.8886	-0.002826	
HEU	J	02/14/01	51.3142	-0.020068	
HEU	J	02/14/01	51.3349	0.020263	
HEU	J	02/26/01	89.6763	-0.002810	
HEU	J	02/26/01	89.6842	0.005999	
HEU	J	02/26/01	89.8957	0.005073	
HEU	J	02/26/01	89.8946	0.003849	
HEU	J	02/26/01	51.3446	0.039163	
HEU	J	02/26/01	51.3506	0.050853	
HEU	J	02/27/01	89.6858	0.007783	
HEU	J	02/27/01	89.6874	0.009567	
HEU	J	02/27/01	89.9001	0.009968	
HEU	J	02/27/01	89.8972	0.006741	
HEU	J	02/27/01	51.3393	0.028836	
HEU	J	02/27/01	51.3277	0.006235	
HEU	J	08/22/01	90.3413	0.004561	U764
HEU	J	08/22/01	90.3463	0.010096	U765
HEU	J	08/22/01	89.8941	0.003293	U762
HEU	J	08/22/01	89.9029	0.013082	U763
HEU	J	08/22/01	51.3247	0.000390	U760
HEU	J	08/22/01	51.3371	0.024550	U761
HEU	J	08/29/01	90.3394	0.002457	U764

Material	Facility	Analysis Date	Reported Result	%RD	Analyst
HEU	J	08/29/01	90.3451	0.008767	U765
HEU	J	08/29/01	89.8945	0.003738	U762
HEU	J	08/29/01	89.8923	0.001290	U763
HEU	J	08/29/01	51.3332	0.016951	U760
HEU	J	08/29/01	51.3242	-0.000585	U761
HEU	J	09/13/01	89.9051	0.015530	U762
HEU	J	09/13/01	51.3516	0.052801	U760
HEU	J	09/13/01	51.3485	0.046761	U761
HEU	J	09/17/01	90.3426	0.006000	U764
HEU	J	09/17/01	90.3469	0.010760	U765
HEU	J	09/17/01	89.9015	0.011525	U762
HEU	J	09/17/01	89.8981	0.007743	U763
HEU	J	09/17/01	51.3366	0.023575	U760
HEU	J	09/17/01	51.3317	0.014028	U761
HEU	J	09/28/01	90.3412	0.004450	U764
HEU	J	09/28/01	90.3354	-0.001970	U765
HEU	J	09/28/01	89.8863	-0.005384	U762
HEU	J	09/28/01	89.8921	0.001068	U763
HEU	J	09/28/01	51.3266	0.004092	U760
HEU	J	09/28/01	51.3407	0.031564	U761
HEU	S	02/28/01	89.6810	0.002431	JMG
HEU	S	02/28/01	89.6954	0.018488	JMG
HEU	S	02/28/01	89.8853	-0.006497	JMG
HEU	S	02/28/01	89.8876	-0.003938	JMG
HEU	S	03/08/01	89.6865	0.008564	SEW
HEU	S	03/08/01	89.6755	-0.003702	SEW
HEU	S	03/08/01	89.9047	0.015085	SEW
HEU	S	03/08/01	89.9127	0.023985	SEW
HEU	S	08/14/01	89.8785	-0.014061	RBD
HEU	S	08/14/01	89.9064	0.016976	RBD
HEU	S	08/14/01	90.3224	-0.016361	RBD
HEU	S	08/14/01	90.3662	0.032124	RBD
HEU	S	08/14/01	89.8663	-0.027633	RGT
HEU	S	08/14/01	89.8655	-0.028523	RGT
HEU	S	08/14/01	90.3528	0.017291	RGT
HEU	S	08/14/01	90.3409	0.004118	RGT
HEU	U	02/16/01	89.656	-0.025446	TP
HEU	U	02/16/01	89.868	-0.025742	TP
HEU	U	02/16/01	89.864	-0.030192	TP
HEU	U	02/20/01	89.591	-0.097927	LT
HEU	U	02/20/01	89.603	-0.084546	LT
HEU	U	02/20/01	89.853	-0.042429	TP
HEU	U	08/07/01	90.306	-0.034515	
HEU	U	08/07/01	89.671	-0.008720	
HEU	U	08/07/01	89.665	-0.015411	
HEU	U	08/08/01	89.648	-0.034367	
HEU	U	08/08/01	90.279	-0.064403	
HEU	U	08/08/01	90.317	-0.022339	
LEU	A	12/19/00	4.390	-0.035067	JW
LEU	A	12/19/00	4.388	-0.080610	JW
LEU	A	12/20/00	4.391	-0.012296	JW

Material	Facility	Analysis Date	Reported Result	%RD	Analyst
LEU	A	12/20/00	4.394	0.056017	JW
LEU	A	04/18/01	4.466	0.125549	JLW
LEU	A	04/18/01	4.463	0.058291	JLW
LEU	A	05/17/01	4.467	0.147969	MJH
LEU	A	05/17/01	4.464	0.080710	MJH
LEU	B	10/18/01	4.3907	-0.019128	JLB
LEU	B	10/18/01	4.3925	0.021860	JLB
LEU	B	10/19/01	4.3925	0.021860	ADF
LEU	B	10/19/01	4.3914	-0.003188	ADF
LEU	C	06/12/01	4.4596	-0.017936	G
LEU	C	06/12/01	4.4599	-0.011210	S
LEU	C	06/12/01	4.4594	-0.022420	G
LEU	C	06/12/01	4.4600	-0.008968	S
LEU	C	06/13/01	4.4607	0.006726	F
LEU	C	06/13/01	4.4589	-0.033629	T
LEU	C	06/13/01	4.4606	0.004484	F
LEU	C	06/13/01	4.4593	-0.024661	T
LEU	C	07/17/01	4.4596	-0.017936	F
LEU	C	07/17/01	4.4596	-0.017936	F
LEU	C	07/19/01	4.4592	-0.026903	E
LEU	C	07/19/01	4.4594	-0.022420	E
LEU	C	07/26/01	4.4596	-0.017936	T
LEU	C	07/26/01	4.4596	-0.017936	T
LEU	C	08/06/01	4.4594	-0.022420	S
LEU	C	08/06/01	4.4594	-0.022420	S
LEU	E	06/20/01	4.4610	0.013452	
LEU	E	06/29/01	4.4610	0.013452	
LEU	E	07/09/01	4.4606	0.004484	
LEU	E	07/09/01	4.4608	0.008968	
LEU	E	07/10/01	4.4614	0.022420	
LEU	E	07/10/01	4.4609	0.011210	
LEU	E	07/10/01	4.4609	0.011210	
LEU	E	07/10/01	4.4611	0.015694	
LEU	E	08/10/01	4.4609	0.011210	
LEU	E	08/10/01	4.4608	0.008968	
LEU	E	08/10/01	4.4609	0.011210	
LEU	E	08/10/01	4.4608	0.008968	
LEU	E	08/10/01	4.4609	0.011210	
LEU	E	08/10/01	4.4612	0.017936	
LEU	E	08/10/01	4.4612	0.017936	
LEU	E	08/10/01	4.4612	0.017936	
LEU	F	01/18/01	4.4644	0.038094	098
LEU	F	01/18/01	4.4615	-0.026890	098
LEU	F	01/18/01	4.4572	-0.123244	098
LEU	F	01/18/01	4.4627	0.000000	098
LEU	F	01/18/01	4.4638	0.024649	098
LEU	F	01/18/01	4.4626	-0.002241	098
LEU	F	01/18/01	4.4599	-0.062742	098
LEU	F	01/18/01	4.4664	0.082909	098
LEU	F	02/21/01	4.4581	-0.103077	098
LEU	F	02/21/01	4.4607	-0.044816	098

Material	Facility	Analysis Date	Reported Result	%RD	Analyst
LEU	F	02/21/01	4.4566	-0.136689	098
LEU	F	02/21/01	4.4626	-0.002241	098
LEU	F	02/21/01	4.4633	0.013445	098
LEU	F	02/21/01	4.4659	0.071705	098
LEU	F	02/21/01	4.4682	0.123244	098
LEU	M	02/22/01	4.010	0.044908	VG2
LEU	M	02/22/01	4.011	0.069857	VG2
LEU	M	02/22/01	4.012	0.094806	VG2
LEU	M	02/22/01	4.012	0.094806	VG2
LEU	M	02/23/01	4.008	-0.004990	VG2
LEU	M	02/23/01	4.010	0.044908	VG2
LEU	M	02/23/01	4.011	0.069857	VG2
LEU	M	02/23/01	4.012	0.094806	VG2
LEU	M	07/25/01	4.011	0.069857	VG2
LEU	M	07/25/01	4.007	-0.029939	VG2
LEU	M	07/25/01	4.000	-0.204581	VG2
LEU	M	07/25/01	3.999	-0.229529	VG2
LEU	M	07/26/01	4.007	-0.029939	VG2
LEU	M	07/26/01	4.005	-0.079836	VG2
LEU	M	07/26/01	4.004	-0.104785	VG2
LEU	M	07/26/01	4.003	-0.129734	VG2
LEU	P	07/13/01	4.0027	-0.137219	EFB
LEU	P	07/13/01	4.0048	-0.084826	EFB
LEU	P	07/19/01	4.0062	-0.049898	EFB
LEU	P	07/19/01	3.9914	-0.419141	EFB
LEU	R	02/24/01	4.007	-0.029939	GS
LEU	R	02/24/01	4.012	0.094806	GS
LEU	R	02/24/01	4.010	0.044908	GS
LEU	R	02/24/01	4.005	-0.079836	GS
LEU	R	02/25/01	4.005	-0.079836	GS
LEU	R	02/25/01	4.011	0.069857	GS
LEU	R	02/25/01	4.014	0.144703	GS
LEU	R	02/25/01	4.006	-0.054887	GS
LEU	R	07/28/01	3.993	-0.379223	CHS
LEU	R	07/28/01	3.998	-0.254478	CHS
LEU	R	07/28/01	3.997	-0.279427	CHS
LEU	R	07/28/01	3.992	-0.404171	CHS
LEU	R	07/28/01	3.994	-0.354274	CHS
LEU	R	07/28/01	3.998	-0.254478	CHS
LEU	R	07/28/01	4.001	-0.179632	CHS
LEU	R	07/28/01	3.999	-0.229529	CHS
LEU	T	12/14/00	4.0068	-0.034928	
LEU	T	12/14/00	4.0088	0.014969	
LEU	T	12/20/00	4.0108	0.064867	
LEU	T	12/20/00	4.0118	0.089816	
LEU	T	03/21/01	4.0128	0.114765	
LEU	T	03/21/01	4.0118	0.089816	
LEU	T	03/21/01	4.0138	0.139714	
LEU	T	03/21/01	4.0137	0.137219	
LEU	T	06/08/01	4.0138	0.139714	
LEU	T	06/08/01	4.0128	0.114765	

Material	Facility	Analysis Date	Reported Result	%RD	Analyst
LEU	T	06/08/01	4.0127	0.112270	
LEU	T	06/08/01	4.0128	0.114765	
LEU	T	09/17/01	4.01080	0.064867	
LEU	T	09/17/01	4.0098	0.039918	
LEU	T	09/17/01	4.0098	0.039918	
LEU	T	09/17/01	4.0108	0.064867	
PU	B	03/05/01	32.00000	-3.23439	382
PU	B	03/05/01	32.00000	-3.23439	382
PU	B	03/05/01	33.00000	-1.73629	382
PU	B	03/05/01	33.00000	-1.73629	382
PU	B	03/14/01	31.00000	-6.258316	381
PU	B	03/14/01	31.00000	-6.258316	381
PU	B	03/14/01	31.00000	-7.691666	381
PU	B	03/14/01	31.00000	-7.691666	381
PU	F	04/18/01	33.17200	0.223276	201
PU	F	04/18/01	33.11200	0.041996	201
PU	F	04/18/01	33.10300	0.113411	201
PU	F	04/18/01	33.07800	0.037804	201
PU	G	05/02/01	33.08730	0.100139	C,J
PU	G	05/02/01	33.10150	0.143098	C,J
PU	G	05/02/01	33.78270	0.003552	C,J
PU	G	05/02/01	33.83520	0.158963	C,J
PU238	B	03/05/01	0.24800	2.1286	381
PU238	B	03/05/01	0.24300	0.0696	381
PU238	B	03/05/01	0.20300	0.6899	381
PU238	B	03/05/01	0.20500	1.6739	381
PU238	B	03/05/01	0.00400	183.4869	381
PU238	B	03/05/01	0.00600	325.2303	381
PU238	B	03/09/01	0.24400	0.4814	382
PU238	B	03/09/01	0.24600	1.3134	382
PU238	B	03/09/01	0.20300	0.6899	382
PU238	B	03/09/01	0.20400	1.1860	382
PU238	B	03/09/01	0.00500	254.3586	382
PU238	B	03/09/01	0.00500	254.3586	382
PU238	B	03/09/01	0.00300	112.6152	382
PU238	B	03/09/01	0.00300	112.6152	382
PU238	B	03/09/01	0.00100	-29.1283	382
PU238	B	03/09/01	0.00300	112.6152	382
PU238	B	03/14/01	0.00300	112.6152	381
PU238	B	03/14/01	0.00700	396.1021	381
PU238	B	03/14/01	0.00100	-29.1283	381
PU238	B	03/14/01	0.00200	41.7434	381
PU238	F	04/17/01	0.20210	0.3222	201
PU238	F	04/17/01	0.20230	0.4214	201
PU238	F	04/17/01	0.24280	0.0734	201
PU238	F	04/17/01	0.24280	0.0734	201
PU238	F	04/17/01	0.00200	42.1464	201
PU238	F	04/17/01	0.00200	42.1464	201
PU238	G	05/02/01	0.00270	91.8977	C,J
PU238	G	05/02/01	0.00270	91.8977	C,J
PU238	G	06/06/01	0.20230	0.5232	C,J

Material	Facility	Analysis Date	Reported Result	%RD	Analyst
PU238	G	06/06/01	0.20390	1.3183	C,J
PU238	G	06/06/01	0.24260	0.0908	C,J
PU238	G	06/06/01	0.24320	0.3383	C,J
PU238	J	02/22/00	0.04520	-2.2829	
PU238	J	02/22/00	0.04610	-0.3373	
PU238	J	02/24/00	0.04640	0.3156	
PU238	J	03/01/00	0.04630	0.1124	
PU238	J	03/09/00	0.04570	-1.1678	
PU238	J	03/09/00	0.04540	-1.8166	
PU238	T	12/22/00	0.04480	-2.5261	
PU238	T	12/22/00	0.04680	1.8255	
PU238	T	12/22/00	0.04580	-0.3503	
PU238	T	12/22/00	0.04580	-0.3503	
PU238	T	04/10/01	0.00100	-29.1283	
PU238	T	04/10/01	0.00300	113.2196	
PU238	T	04/10/01	0.20300	0.7549	
PU238	T	04/10/01	0.20500	1.7476	
PU238	T	06/28/01	0.20500	1.9099	
PU238	T	06/28/01	0.20400	1.4128	
PU238	T	06/28/01	0.24370	0.5886	
PU238	T	06/28/01	0.24470	1.0013	
PU238	T	09/19/01	0.24370	0.7558	
PU238	T	09/19/01	0.24370	0.7558	
PU238	T	09/19/01	0.20200	0.5871	
PU238	T	09/19/01	0.20700	3.0769	
PU239	B	03/05/01	78.44000	0.0577	381
PU239	B	03/05/01	78.56600	0.2184	381
PU239	B	03/05/01	85.78800	0.0640	381
PU239	B	03/05/01	85.77100	0.0447	381
PU239	B	03/05/01	97.93100	0.0042	381
PU239	B	03/05/01	97.92800	0.0011	381
PU239	B	03/09/01	78.43300	0.0488	382
PU239	B	03/09/01	78.53800	0.1821	382
PU239	B	03/09/01	85.78700	0.0628	382
PU239	B	03/09/01	85.83600	0.1200	382
PU239	B	03/09/01	97.93400	0.0073	382
PU239	B	03/09/01	97.93200	0.0052	382
PU239	B	03/09/01	97.93500	0.0083	382
PU239	B	03/09/01	97.92900	0.0021	382
PU239	B	03/09/01	97.93900	0.0123	382
PU239	B	03/09/01	97.93700	0.0103	382
PU239	B	03/14/01	97.94100	0.0144	381
PU239	B	03/14/01	97.92900	0.0021	381
PU239	B	03/14/01	97.93600	0.0093	381
PU239	B	03/14/01	97.93100	0.0042	381
PU239	F	04/17/01	85.73920	0.0017	201
PU239	F	04/17/01	85.74030	0.0029	201
PU239	F	04/17/01	78.40160	0.0018	201
PU239	F	04/17/01	78.40360	0.0044	201
PU239	F	04/17/01	97.93040	0.0035	201
PU239	F	04/17/01	97.93010	0.0032	201

Material	Facility	Analysis Date	Reported Result	%RD	Analyst
PU239	G	05/02/01	97.92650	-0.0005	C,J
PU239	G	05/02/01	97.92770	0.0007	C,J
PU239	G	06/06/01	85.74820	0.0052	C,J
PU239	G	06/06/01	85.74810	0.0051	C,J
PU239	G	06/06/01	78.41640	0.0128	C,J
PU239	G	06/06/01	78.41370	0.0093	C,J
PU239	J	02/22/00	87.69720	0.0025	
PU239	J	02/22/00	87.70000	0.0057	
PU239	J	02/24/00	87.69480	-0.0004	
PU239	J	03/01/00	87.69690	0.0016	
PU239	J	03/09/00	87.69830	0.0027	
PU239	J	03/09/00	87.69330	-0.0030	
PU239	T	12/22/00	87.71750	0.0072	
PU239	T	12/22/00	87.71660	0.0062	
PU239	T	12/22/00	87.71730	0.0070	
PU239	T	12/22/00	87.71850	0.0084	
PU239	T	04/10/01	97.93510	0.0084	
PU239	T	04/10/01	97.93080	0.0039	
PU239	T	04/10/01	85.74970	0.0149	
PU239	T	04/10/01	85.74770	0.0125	
PU239	T	06/28/01	85.76130	0.0175	
PU239	T	06/28/01	85.75660	0.0120	
PU239	T	06/28/01	78.43100	0.0279	
PU239	T	06/28/01	78.42750	0.0234	
PU239	T	09/19/01	78.44600	0.0339	
PU239	T	09/19/01	78.44210	0.0290	
PU239	T	09/19/01	85.77630	0.0236	
PU239	T	09/19/01	85.75890	0.0033	
PU240	B	03/05/01	18.96900	-0.0440	381
PU240	B	03/05/01	18.96400	-0.0703	381
PU240	B	03/05/01	12.46500	-0.0464	381
PU240	B	03/05/01	12.46400	-0.0539	381
PU240	B	03/05/01	2.05700	-0.3010	381
PU240	B	03/05/01	2.05700	-0.3010	381
PU240	B	03/09/01	18.97900	0.0087	382
PU240	B	03/09/01	18.95300	-0.1289	382
PU240	B	03/09/01	12.46000	-0.0865	382
PU240	B	03/09/01	12.44900	-0.1747	382
PU240	B	03/09/01	2.05300	-0.4949	382
PU240	B	03/09/01	2.05600	-0.3494	382
PU240	B	03/09/01	2.05500	-0.3978	382
PU240	B	03/09/01	2.05800	-0.2525	382
PU240	B	03/09/01	2.05300	-0.4947	382
PU240	B	03/09/01	2.05000	-0.6402	382
PU240	B	03/14/01	2.05000	-0.6402	381
PU240	B	03/14/01	2.05500	-0.3978	381
PU240	B	03/14/01	2.05700	-0.3009	381
PU240	B	03/14/01	2.05900	-0.2039	381
PU240	F	04/17/01	12.47010	-0.0101	201
PU240	F	04/17/01	12.46890	-0.0197	201
PU240	F	04/17/01	18.97840	-0.0004	201

Material	Facility	Analysis Date	Reported Result	%RD	Analyst
PU240	F	04/17/01	18.97680	-0.0089	201
PU240	F	04/17/01	2.05900	-0.2019	201
PU240	F	04/17/01	2.05920	-0.1922	201
PU240	G	05/02/01	2.06210	-0.0514	C,J
PU240	G	05/02/01	2.06180	-0.0659	C,J
PU240	G	06/06/01	12.46800	-0.0328	C,J
PU240	G	06/06/01	12.46630	-0.0464	C,J
PU240	G	06/06/01	18.97340	-0.0337	C,J
PU240	G	06/06/01	18.97540	-0.0232	C,J
PU240	J	02/22/00	11.62690	0.0114	
PU240	J	02/22/00	11.62260	-0.0256	
PU240	J	02/24/00	11.62830	0.0234	
PU240	J	03/01/00	11.62690	0.0111	
PU240	J	03/09/00	11.62640	0.0064	
PU240	J	03/09/00	11.63010	0.0383	
PU240	T	12/22/00	11.62320	-0.0360	
PU240	T	12/22/00	11.62110	-0.0541	
PU240	T	12/22/00	11.62130	-0.0524	
PU240	T	12/22/00	11.62120	-0.0532	
PU240	T	04/10/01	2.05440	-0.4271	
PU240	T	04/10/01	2.05740	-0.2796	
PU240	T	04/10/01	12.45670	-0.1167	
PU240	T	04/10/01	12.45870	-0.1007	
PU240	T	06/28/01	12.45580	-0.1332	
PU240	T	06/28/01	12.46270	-0.0779	
PU240	T	06/28/01	18.96360	-0.0884	
PU240	T	06/28/01	18.96470	-0.0826	
PU240	T	09/19/01	18.95960	-0.1208	
PU240	T	09/19/01	18.96360	-0.0997	
PU240	T	09/19/01	12.45780	-0.1267	
PU240	T	09/19/01	12.46480	-0.0706	
PU241	B	03/05/01	1.11000	-3.1632	381
PU241	B	03/05/01	1.08000	-5.7804	381
PU241	B	03/05/01	0.96600	-3.7566	381
PU241	B	03/05/01	0.97200	-3.2094	381
PU241	B	03/05/01	0.00700	-6.3044	381
PU241	B	03/05/01	0.00700	-6.3044	381
PU241	B	03/09/01	1.10000	-4.0356	382
PU241	B	03/09/01	1.08900	-4.9455	382
PU241	B	03/09/01	0.96800	-3.5573	382
PU241	B	03/09/01	0.95500	-4.8525	382
PU241	B	03/09/01	0.00700	-6.3044	382
PU241	B	03/09/01	0.00700	-6.2542	382
PU241	B	03/09/01	0.00700	-6.1914	382
PU241	B	03/09/01	0.00700	-6.2542	382
PU241	B	03/09/01	0.00700	-6.1914	382
PU241	B	03/09/01	0.00600	-19.6464	382
PU241	B	03/14/01	0.00700	-6.2542	381
PU241	B	03/14/01	0.00600	-19.5926	381
PU241	B	03/14/01	0.00600	-19.6464	381
PU241	B	03/14/01	0.00800	7.2099	381

Material	Facility	Analysis Date	Reported Result	%RD	Analyst
PU241	F	04/17/01	0.99890	0.0301	201
PU241	F	04/17/01	0.99860	0.0001	201
PU241	F	04/17/01	1.13970	-0.0123	201
PU241	F	04/17/01	1.13930	-0.0474	201
PU241	F	04/17/01	0.00760	2.4949	201
PU241	F	04/17/01	0.00770	3.8436	201
PU241	G	05/02/01	0.00790	6.7568	C,J
PU241	G	05/02/01	0.00690	-6.7568	C,J
PU241	G	06/06/01	0.99210	0.0010	C,J
PU241	G	06/06/01	0.99210	0.0010	C,J
PU241	G	06/06/01	1.13180	-0.0550	C,J
PU241	G	06/06/01	1.13140	-0.0903	C,J
PU241	J	02/22/00	0.44900	-0.4465	
PU241	J	02/22/00	0.45030	-0.1583	
PU241	J	02/24/00	0.44960	-0.2874	
PU241	J	03/01/00	0.44880	-0.3862	
PU241	J	03/09/00	0.44900	-0.2369	
PU241	J	03/09/00	0.44910	-0.2146	
PU241	T	12/22/00	0.43240	-0.2139	
PU241	T	12/22/00	0.43340	0.0168	
PU241	T	12/22/00	0.43240	-0.2139	
PU241	T	12/22/00	0.43240	-0.2139	
PU241	T	04/10/01	0.00810	7.5840	
PU241	T	04/10/01	0.00710	-4.3385	
PU241	T	04/10/01	1.00070	0.1187	
PU241	T	04/10/01	0.99860	-0.0914	
PU241	T	06/28/01	0.98860	-0.0647	
PU241	T	06/28/01	0.98760	-0.1658	
PU241	T	06/28/01	1.12720	-0.1748	
PU241	T	06/28/01	1.12820	-0.0863	
PU241	T	09/19/01	1.11710	0.0089	
PU241	T	09/19/01	1.11510	-0.1702	
PU241	T	09/19/01	0.97650	-0.2104	
PU241	T	09/19/01	0.97550	-0.3126	
PU242	B	03/05/01	1.23300	-0.4688	381
PU242	B	03/05/01	1.14700	-7.4109	381
PU242	B	03/05/01	0.57800	-2.1632	381
PU242	B	03/05/01	0.58800	-0.4701	381
PU242	B	03/05/01	0.00100	-1.2833	381
PU242	B	03/05/01	0.00100	-1.2833	381
PU242	B	03/09/01	1.23300	-0.4688	382
PU242	B	03/09/01	1.17400	-5.2320	382
PU242	B	03/09/01	0.58100	-1.6554	382
PU242	B	03/09/01	0.55500	-6.0564	382
PU242	B	03/09/01	0.00100	-1.2833	382
PU242	B	03/09/01	0.00100	-1.2833	382
PU242	B	03/09/01	0.00100	-1.2833	382
PU242	B	03/09/01	0.00300	196.1500	382
PU242	B	03/09/01	0.00100	-1.2833	382
PU242	B	03/09/01	0.00300	196.1500	382
PU242	B	03/14/01	0.00000	-100.0000	381

Material	Facility	Analysis Date	Reported Result	%RD	Analyst
PU242	B	03/14/01	0.00200	97.4334	381
PU242	B	03/14/01	0.00000	-100.0000	381
PU242	B	03/14/01	0.00100	-1.2833	381
PU242	F	04/17/01	0.58980	-0.1716	201
PU242	F	04/17/01	0.58990	-0.1547	201
PU242	F	04/17/01	1.23750	-0.1127	201
PU242	F	04/17/01	1.23750	-0.1127	201
PU242	F	04/17/01	0.00100	-0.0999	201
PU242	F	04/17/01	0.00110	9.8901	201
PU242	G	05/02/01	0.00080	-20.0799	C,J
PU242	G	05/02/01	0.00090	-10.0899	C,J
PU242	G	06/06/01	0.58930	-0.2635	C,J
PU242	G	06/06/01	0.58950	-0.2297	C,J
PU242	G	06/06/01	1.23580	-0.2582	C,J
PU242	G	06/06/01	1.23630	-0.2178	C,J
PU242	J	02/22/00	0.18120	-0.5134	
PU242	J	02/22/00	0.18070	-0.7879	
PU242	J	02/24/00	0.18100	-0.6232	
PU242	J	03/01/00	0.18110	-0.5688	
PU242	J	03/09/00	0.18070	-0.7890	
PU242	J	03/09/00	0.18200	-0.0752	
PU242	T	12/22/00	0.18220	0.0126	
PU242	T	12/22/00	0.18220	0.0126	
PU242	T	12/22/00	0.18320	0.5615	
PU242	T	12/22/00	0.18220	0.0126	
PU242	T	04/10/01	0.00140	39.8601	
PU242	T	04/10/01	0.00170	69.8302	
PU242	T	04/10/01	0.58990	-0.1537	
PU242	T	04/10/01	0.58990	-0.1537	
PU242	T	06/28/01	0.58930	-0.2667	
PU242	T	06/28/01	0.58920	-0.2836	
PU242	T	06/28/01	1.23450	-0.3668	
PU242	T	06/28/01	1.23490	-0.3345	
PU242	T	09/19/01	1.23360	-0.4530	
PU242	T	09/19/01	1.23540	-0.3078	
PU242	T	09/19/01	0.58740	-0.6002	
PU242	T	09/19/01	0.59390	0.4997	