CONNECTICUT YANKEE ATOMIC POWER COMPANY

HADDAM NECK PLANT

362 INJUN HOLLOW ROAD EAST HAMPTON, CT 06424-3099

MAY - 1 2006

Docket No. 50-213
CY-06-063

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Haddam Neck Plant
Annual Radiological Environmental Operating Report

In accordance with the requirements of Section 2.6.1 of Appendix C of the Quality Assurance Program (QAP) for the Haddam Neck Plant (HNP) and the Radiological Effluent Monitoring and Offsite Dose Calculation Manual, an implementing document of the QAP, an electronic and a hard copy of the Annual Radiological Environmental Operating Report are enclosed.

If you should have any questions regarding this submittal, please contact me at (860) 267-3938.

Sincerely,

Gerard van Noordennen 5-1-06

Gerard P. van Noordennen
Director of Nuclear Safety/Regulatory Affairs

Date

Enclosure: Annual Radiological Environmental Operating Report

cc: S. J. Collins, NRC Region I Administrator
T. B. Smith, NRC Project Manager, Haddam Neck Plant
M. T Miller, Chief, Decommissioning, NRC Region I
E. L. Wilds, Jr., Director, CT DEP Monitoring and Radiation Division
M. Rosenstein, US EPA, Region 1

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ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING

REPORT

HADDAM NECK STATION

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

JANUARY 1, 2005 - DECEMBER 31, 2005

DOCKET NO. 50-213
LICENSE NO. DPR-61

CONNECTICUT YANKEE ATOMIC POWER COMPANY
Haddam, Connecticut

1.0 EXECUTIVE SUMMARY

The Radiological Environmental Monitoring Program (REMP) for the Haddam Neck Plant was continued for the period January through December 2005, in compliance with the Connecticut Yankee Quality Assurance Program (CYQAP) and the Radiological Effluent Monitoring and Off-Site Dose Calculation Manual (REMODCM). This annual report was prepared by the Connecticut Yankee Atomic Power Company (CYAPCO). Sample collection and preparation activities were performed by Normandeau Associates and CYAPCO personnel. Laboratory analyses were performed by Framatome ANP Environmental Laboratory (FANPEL), a subsidiary of AREVA and CYAPCO. A major transition with the REMP occurred on March 31, 2005 when all of the spent nuclear fuel and greater than class C (GTCC) material was removed from the Spent Fuel Pool and was placed in the Independent Spent Fuel Storage Installation (ISFSI). This coupled with the significant radiological source term reduction allowed a number of changes to be made with the REMP. These changes are reflected within this report.

Thermoluminescent dosimeters (TLDs) were used to measure direct gamma exposure in the vicinity of the station and as far away as 12.5 miles. Radiochemical and radiological counting analyses of samples were performed to detect the presence of any station related radioactivity. In the second quarter of 2003, additional sampling locations associated with the onsite ISFSI were selected for the purpose of collecting baseline background information prior to the transfer of spent fuel from the main plant to the ISFSI. The first ISFSI canister containing Greater Than Class C (GTCC) material was placed on the storage pad in April 2004. Over the following eleven months the remainder of the canisters with spent fuel and GTCC were transferred to the storage pad. ISFSI TLDs located in the area around the site boundary showed no significant change in exposure rate in 2005 over the baseline measurements.

Samples included air particulates collected on filters, well water, river water, river bottom sediment, bottom sediment from wetlands near the ISFSI, shellfish and fish. In evaluating the results of these analyses it is necessary to consider the variability of natural and man-made sources of radioactivity, distribution in the environment and uptake in environmental media. This variability is dependent on many factors including station release rates, past spatial variability of radioactive fallout from nuclear weapons tests and on-going redistribution of fallout, contribution from cosmogenic radioactivity, and ground water dynamics. Any one of these factors could cause significant variations in measured levels of radioactivity. Therefore, these factors need to be considered in order to properly explain any variations in radiation detected and to distinguish between natural and station related radioactivity. Changes with the sampling requirements for air particulates collected on filters, broad leaf vegetation, fruits/vegetables and well water were made during 2005 to reflect the significant radioactive source term reduction. These changes were implemented on March 31, 2005 after the completion of the Spent Fuel Transfer Project.

Haddam Neck was permanently shutdown in 1996. Activities in 2005 at the Haddam Neck station were focused on completing the transfer of spent fuel, site decontamination and facility decommissioning. Even though the station is no longer generating power, decommissioning activities include the processing and discharge of liquids containing radioactivity. Monitoring continues for any release of liquid. The levels of radioactivity released post-operation are significantly lower than released during plant operation. The radiological monitoring of the environment through this program will continue to assure the health and safety of the public and workers are maintained at all times.

2.0 INTRODUCTION

2.1 General Plant Site Information

The Connecticut Yankee plant is located in the town of Haddam, Middlesex County, Connecticut, at a point 22 miles south-southeast of Hartford, Connecticut; 25 miles northeast of New Haven, Connecticut; and 16 miles north of Long Island Sound. The site consists of approximately 525 acres and is situated on the east bank of the Connecticut River at an area known as Haddam Neck. The elevation of the site property varies from 10 to 300 feet above sea level, with the area occupied by plant facilities ranging between 10 and 21 feet above sea level. The minimum distance from the reactor containment to the site boundary is approximately 1700 feet.

The plant was designed as a single unit pressurized water reactor which sustained its initial chain reaction in July 1967, with commercial operation beginning in January 1968 and a gross power output of 590 Mw (e). After 28 years of operation, the CY Board of Directors voted in 1996 to permanently close and decommission the power plant. Following two years of planning and preparation, actual decommissioning began in 1998 and continued during 2005 for the period covered by this radiological environmental monitoring report.

2.2 Program Design

The Radiological Environmental Monitoring Program for the Haddam Neck Station was designed with specific objectives.

- To provide an early indication of the appearance or accumulation of any radioactive material in the environment caused by Haddam Neck Station activities.
- To provide assurance to regulatory agencies and the public that the environmental impact for the Haddam Neck Station is known and within anticipated limits.
- To verify the adequacy and proper functioning of station effluent controls and monitoring systems.

These objectives continue to be in force throughout the decommissioning activities at the Haddam Neck Station site. Due to the permanent shutdown status of the plant and the relatively low quantities of radioactive material now on the site, some of the objectives have shifted in degree of importance from the past and continue to change as decommissioning progresses.

The radiological environmental monitoring program continued without modification following the plant shutdown in 1996. The program scope was reduced in 2000 and again in 2005 primarily to reflect the significant reduction of radionuclide source. The onsite radionuclide inventory continues to decrease yearly with shipments of waste to off-site facilities and radioactive decay. The completion of the Fuel Transfer Project has resulted in a significant reduction of available source term that could interact with the environment.

The program was developed to meet the intent of the NRC Regulatory Guide 4.1, Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants; NRC Regulatory Guide 4.8, Environmental Technical Specifications for Nuclear Power Plants; the NRC Branch Technical Position of November 1979, An Acceptable Radiological Environmental Monitoring Program; and NRC NUREG-0472, Radiological Effluent Technical Specifications for PWRs.

The environmental TLD program was developed using NRC Regulatory Guide 4.13, Performance, Testing and Procedural Specifications for Thermoluminescence Dosimetry: Environmental

Applications. The quality assurance program was designed using the guidance given in NRC Regulatory Guide 4.15, Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment.

The sampling requirements of the REMODCM are given in Table E-1 of the ODCM and Table 2.1 of this report. The identification of the required sampling locations is given in Appendix G of the ODCM and Table 2.2 of this report. The monitoring locations are shown graphically in Figures 2.1 and 2.2.

2.3 Monitoring Zones

The REMP is designed to allow comparison of levels of radioactivity in samples from the area potentially influenced by the plant to levels found in areas not influenced by the plant. The first area monitoring locations are designated as indicators and the second area monitoring locations are designated as controls. The distinction between the two areas, for a particular pathway, is based on relative direction from the plant, river flow, and distance. Analysis of survey data from the two areas is used to differentiate between radiation due to plant activities and other sources such as atmospheric nuclear weapons test fallout or seasonal variations in the natural background.

2.4 Pathways Monitored

Four pathway categories; airborne, waterborne, ingestion, and direct radiation were formally monitored by the REMP. Most of these categories were monitored in 2005 by the collection of one or more sample types listed and described below. Some of these samples were eliminated in March of 2005 with the program reductions discussed above.

Airborne Pathway:	Air Particulate Sampling
Waterborne Pathway:	River Water
	Well Water
	Sediment Sampling*
	ISFSI Sediment* and Water Sampling
Ingestion Pathway:	Fruits and Vegetable Sampling*
	Fish and Shellfish Sampling
	Broadleaf Vegetation*
	Milk Sampling (when required and if available)*
Direct Radiation:	TLD Monitoring
	ISFSI TLD Monitoring

*Sampling requirements changed during 2005

2.5 Descriptions of Monitoring Pathways

Sample types and frequency of analysis are given in Table 2.1. The sample locations are listed in Table 2.2 and shown in Figure 2.1 and Figure 2.2. The program as described in this report includes both required samples as specified in the REMODCM and any extra samples.

2.5.1 Air Sampling

Continuous air samplers were installed at five locations as required by the REMODCM until they were permanently shutoff on April 18th 2005. The sampling requirement for air particulate was eliminated on March 31, 2005 with the completion of the Fuel Transfer Project. The sampling pumps at these locations operated continuously at a flow rate of approximately one cubic foot per minute. Airborne particulates were collected by passing air through a 47-mm glass-fiber filter. A dry gas meter was incorporated into the sampling stream to measure the total volume of air sampled in a given interval. The filters were collected biweekly, and to allow for the decay of radon daughter products, they are held at least 100 hours before being analyzed for gross-beta radioactivity (indicated as GR-B in the data tables). The biweekly filters were combined by location at the FANPEL for a quarterly gamma spectroscopy analysis.

2.5.2 River Water Sampling

River water samples are collected from two sampling locations, an indicator and control station. An automatic composite sampler is located at the indicator sampling station (28-I) collecting an equal volume of water every hour. A grab sample is collected once every two weeks at the control sampling station, 30-C. Approval to relocate station 30-C approximately one mile upriver was granted in April and the station is renamed 30-A-C for samples collected from May 2005 on. When CYAPCO elected to self-perform REMP sampling beginning in July 2005, each biweekly river sample was analyzed for gamma emitting nuclides and tritium in lieu of compositing.

2.5.3 Well Water Sampling

Well water samples were collected during the first quarter of 2005 from one onsite well and one off-site well. Gamma isotopic and tritium analyses were performed on each. The sampling requirement for well water was eliminated on March 31, 2005 with the completion of the Fuel Transfer Project and the elimination of the use of the associated wells.

2.5.4 Sediment Sampling

Shoreline sediment samples were formerly collected semiannually from three locations, one near the plant discharge, one downstream and one control station, upstream from the plant. This sampling requirement was changed to annually due to the limited number of discharges and to ensure one additional sample will be taken upon the completion of the Spent Fuel Pool draindown and discharge. A grab sample is collected from each location; dried at the FANPEL and analyzed for gamma-emitting radionuclides.

The June Monthly REMP Activities Report FANPEL provided to CYAPCO indicated that sediment samples were collected June 7th – June 9th, 2005. However, FANPEL can not locate the analysis record for these samples at this time. No Sediment data is available to report at this time. A supplemental report will be submitted if the data records are found.

2.5.5 Milk Sampling

Milk sampling is no longer a requirement of the REMODCM unless indicated by the annual Land Use Census and dose calculations. The sampling requirement for milk was eliminated on March 31, 2005 with the completion of the Fuel Transfer Project.

2.5.6 Fish Sampling

Fish samples were formerly collected semiannually from three river locations, two indicator stations from the vicinity of the intake and discharge and one control station north of the plant. This sampling requirement was changed to annually due to the limited number of discharges and to ensure one additional sample will be taken upon the completion of the Spent Fuel Pool drain down and discharge. The species typically collected are bullheads, perch and /or catfish. The edible portions of the fish are analyzed for gamma-emitting radionuclides.

2.5.7 Shellfish Sampling

Shellfish samples were formerly collected semiannually from two river locations. This sampling requirement was changed to annually due to the limited number of discharges and to ensure one additional sample will be taken upon the completion of the Spent Fuel Pool draindown and discharge. The shellfish is shucked and the muscle portions are analyzed by gamma isotopic analysis.

2.5.8 Food Product Sampling

Food products were formerly collected from two locations near the beginning of the growing season and at the end of the season. The samples were either tuberous vegetables, aboveground vegetables, or fruit. The sampling requirement was formerly one sample collected from a location within 10 miles of the plant and the other from a location beyond 10 miles. The samples were analyzed by gamma isotopic analysis. The sampling requirement for food sampling was eliminated on March 31, 2005 with the completion of the Fuel Transfer Project. Elimination of this sampling requirement preceded the start of the harvest season. Therefore, no food product samples were collected in 2005.

2.5.9 Broad Leaf Vegetation

Leafy vegetation was formerly collected from three locations, one on-site, one at the site boundary and one at a control location. During 2004, broad leaf vegetation was also collected from an extra sampling location, 41-X, that is beyond the minimum requirement of the REMP. These samples were formerly collected monthly during the growing season from April to December. The sampling requirement for broad leaf vegetation was eliminated on March 31, 2005 with the completion of the Fuel Transfer Project. Elimination of this sampling requirement preceded the start of the growing season. Therefore, no broad leaf vegetation samples were collected in 2005.

2.5.10 ISFSI Sediment and Water Sampling

In the second quarter of 2003, seven additional sampling locations (five indicator locations and two extra locations) associated with the placement on-site of an Independent Spent Fuel Storage Installation (ISFSI) were selected for the purpose of collecting baseline background information prior to the transfer of spent fuel from the main plant to the ISFSI. The first ISFSI canister containing Greater Than Class C (GTCC) material was placed on the storage pad on April 20, 2004. All of the Fuel and GTCC canisters were transferred to the ISFSI by March 31, 2005.

The new sample locations are specific to the ISFSI and are beyond the standard REMP that has been in operation over the life of the power plant's license. ISFSI sediment samples were collected from two locations, one at nearby wetland location and one near the ISFSI pad (not required by the REMODCM) on June 7th – June 9th 2005. Normally, a grab sample is taken from each location; then dried and analyzed for gamma-emitting radionuclides. The June 2005 Monthly REMP Activities Report FANPEL provided to CYAPCO indicated that sediment samples were collected June 7th – June 9th, 2005, however, FANPEL can not locate the analysis records for these samples at this time. Therefore, there is presently no sediment data available to report.

The sampling requirement was changed to annually for all sediment sample locations when the REMP sampling frequency was changed due to the limited number of remaining discharges.

Water samples were collected during the first and second quarter of 2005. During the third quarter of 2005, the wetlands area was dry. Gamma isotopic and tritium analysis were performed on water samples collected during the first and second quarter.
This sample point was eliminated from the ISFSI REMP in 2005.

2.5.11 TLD Monitoring

Direct gamma radiation exposure is continuously monitored with the use of Panasonic UD-801AS1 thermoluminescent dosimeters (TLDs). TLDs are posted at fourteen REMODCM required locations and at nine extra locations. The extra locations are mainly within the site boundary and are not part of the REMP. Their function is to monitor the potential impact of on-site activities such as the movement or storage of decommissioned components on site boundary exposure rates.

2.5.12 ISFSI TLD Monitoring

In the second quarter of 2003, seven additional sampling locations (five indicator locations and two extra locations) associated with the placement on-site of an ISFSI were selected for the purpose of collecting baseline background information prior to the transfer of spent fuel from the main plant to the ISFSI. The baseline background collection period ended on April 20, 2004 with the transfer of the first ISFSI canister to the designated storage location. The new sample locations are specific to the ISFSI and are beyond the standard REMP that has been in operation over the life of the power plant's license. New quarterly TLD locations were located in the area surrounding the facility at distances that approximated the site boundary to support future determinations that direct and scatter dose from ISFSI operations remain in compliance with offsite dose limits to the public.

Table 2.1- Required Sampling Frequency & Type of Analysis
(REMODCM Table E-1)

	Exposure Pathway and/or Sample	Number of Locations	Sampling & Collection Frequency	Type of Analysis
1a.	Gamma Exposure – Environmental TLD	14	Quarterly	Gamma Dose - Quarterly
1b..	Gamma Exposure – ISFSI TLD	5	Quarterly	Gamma Dose - Quarterly
2.	Airborne Particulate *	5	Continuous sampler – biweekly filter change	Gross Beta - Biweekly Gamma Isotopic - Quarterly on composite (by location), and on individual filter if gross beta is greater than 10 times the mean of the biweekly control station's gross beta results
3a..	Vegetation – Fruits and Vegetables *	2	One sample near middle & one near end of growing season	Gamma Isotopic on each sample
3b.	Vegetation – Broad Leaf Vegetation *	3	Monthly during growing season (April – December)	Gamma Isotopic on each sample
4.	Milk *	4	Monthly, if required	Gamma Isotopic on each sample - Monthly Sr-89 and Sr-90 - Quarterly
5.	Well Water *	2	Quarterly	Gamma Isotopic and Tritium on each composite
6.	Bottom Sediment *	3	Semiannually	Gamma Isotopic
7.	ISFSI Sediment *	2	Quarterly	Gamma Isotopic
8.	River Water	2	Quarterly Sample - Indicator is continuous composite; Background is composite of grab samples collected biweekly	Gamma Isotopic and Tritium - Quarterly
9.	ISFSI Water #	2	Quarterly	Gamma Isotopic and Tritium
10.	Fish (edible portion) – bullheads and, when available, perch or other edible fish *	3	Semiannual	Gamma Isotopic - Semiannual
11.	Shellfish *	2	Semiannual	Gamma Isotopic - Semiannual

Not a Radiological Environmental Monitoring Program required sample.
* Sample requirements changed during the year as previously indicated.

2.0 Table 2.2 - Environmental Monitoring Program Sampling Types and Locations

Exposure Pathway (Sample Type Designation)	Location Number[1]	Location Name	Distance From Release Point[2] (miles)	Direction From ReleasePoint[2]
Airborne				
a. Filter (AP)*	5-I	On-site-Injun Hollow Rd.	0.4	NW
	6-I	On-site-Substation	0.5	NE
	7-I	Haddam	1.8	SE
	9-I	Higganum	4.3	WNW
	13-C	North Madison	12.5	SW
b. Vegetation *(TV)	6-I	On-site-Substation	0.5	NE
	18-I	Site Boundary	0.4	NW
	13-C	North Madison	12.5	SW
Waterborne				
a. River (WR)	28-I	CT River-E. Haddam Bridge	1.8	SE
	30-C	CT River – Middletown	9.0	NW
b. Well Water *(WW)	15-I	On-site Wells	0.5	ESE
	16-C	Well-State Highway Dept. E. Haddam	2.8	SE
c. Bottom Sediment *(SE)	28-I	CT River-E. Haddam Bridge	1.8	SE
	29-I	Vicinity of Discharge	Within 0.3 Miles	
	30-C	CT River – Middletown	9.0	NW
ISFSI				
a. Bottom Sediment *(IF)	57-IF	Dibble Creek Sediment Sample	0.1	SE
	58-IF	ISFSI Pad Enclosure Soil Sample	0.0	N/A
b. ISFSI Water *(WG)	57-IF	Dibble Creek Water Sample	0.1	SE
	58-IF	ISFSI Drain Pipe Outflow	0.0	N/A
Ingestion				
a. Fruits & Vegetables *(TF)	17-C	Beyond 10 Miles	Beyond 10 miles	SW
	25-I	Within 10 Miles	Within 10 miles	NW
b. Fish *(FH)	26-I	CT River-Near Intake	1.0	WNW
	29-I	Vicinity of Discharge	Within 0.3 miles	
	30-C	CT River - Middletown	7.6	NW
c. Shellfish *(SF)	27-C	CT River-Higganum Light	4.0	WNW
	31-I	Mouth of Salmon River	0.8	ESE

1 I=Indicator C=Control IF=ISFSI

2 The release points are the stack for terrestrial locations and the end of the discharge canal for aquatic locations.

* Sample requirements changed during the year as previously indicated.

Table 2.2 - Environmental Monitoring Program Sampling Types and Locations (*continued*)

Exposure Pathway (Sample Type Designation)	Location Number[1]	Location Name	Distance From Release Point[2] (miles)	Direction From Release Point[2]
Direct Radiation				
TLD	1-I	On-site - Mouth of Discharge Canal	1.1	ESE
	2-I	Haddam-Park Rd.	0.8	S
	3-I	Haddam-Jail Hill Rd.	0.8	WSW
	4-I	Haddam-Ranger Rd.	1.8	SW
	5-I	On-site-Injun Hollow Rd.	0.4	NW
	6-I	On-site-Substation	0.5	NE
	7-I	Haddam	1.8	SE
	8-I	East Haddam	3.1	ESE
	9-I	Higganum	4.3	WNW
	10-I	Hurd Park Rd.	2.8	NNW
	11-C	Middletown	9.0	NW
	12-C	Deep River	7.1	SSE
	13-C	North Madison	12.5	SW
	14-C	Colchester	10.5	NE
	40-X	Near Intake Structure	0.1	SSW
	41-X	Picnic Area	0.3	WNW
	42-X	Environmental Trail	0.1	NW
	43-X	Moodus - Rts 149 & 151	2.5	ENE
	44-X	Shailerville, Horton Rd.	1.0	SE
	45-X	Old Waste Gas Sphere Fence	0.1	E
	46-X	Discharge Canal Fence	0.2	SE
	47-X	Visitor Info Center	0.1	WNW
	48-X	Onsite Met Tower Shack	0.4	WSW
	52-IF	Schmidt Cemetery Onsite	0.5	NNE
	53-IF	ISFSI Haul Route Onsite	0.2	SSW
	54-IF	Rt. 149 Salmon River	1.0	ESE
	55-IF	HV Tower NW of Pad	0.4	NW
	56-IF	Borrow Pit On-Site	0.2	E

[1] I=Indicator C=Control X=Extra (not part of REMP) IF=ISFSI Indicator

[2] The release points are the stack for terrestrial locations and the end of the discharge canal for aquatic locations

Table 2.3 - Environmental Lower Limit of Detection (LLD) Sensitivity Requirements (REMODCM Table E-3)

Analysis	Water (pCi/l)	Airborne Particulate or Gas (pCi/m^3)	Fish (pCi/kg wet)	Milk (pCi/l)	Food Products (pCi/kg/wet)	Sediment (pCi/kg dry)
Gross Beta		0.01				
H-3	2000					
Mn-54	15		130			
Co-60	15		130			150
Zn-65	30		260			
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180

Table 2.4 - Reporting Levels for Radioactivity Concentrations in Environmental Samples (REMODCM Table E-2)

Analysis	Water (pCi/l)	Airborne Particulates or Gases (pCi/m^3)	Fish (pCi/kg wet)	Milk (pCi/l)	Vegetables (pCi/kg,wet)	Shellfish (pCi/kg,wet)
H-3	20000					
Mn-54	1000		30000			140000
Co-60	300		10000			50000
Zn-65	300		20000			80000
Cs-134	30	10	1000	60	1000	5000
Cs-137	50	20	2000	70	2000	8000

Figure 2.1 – Haddam Neck Sampling Locations

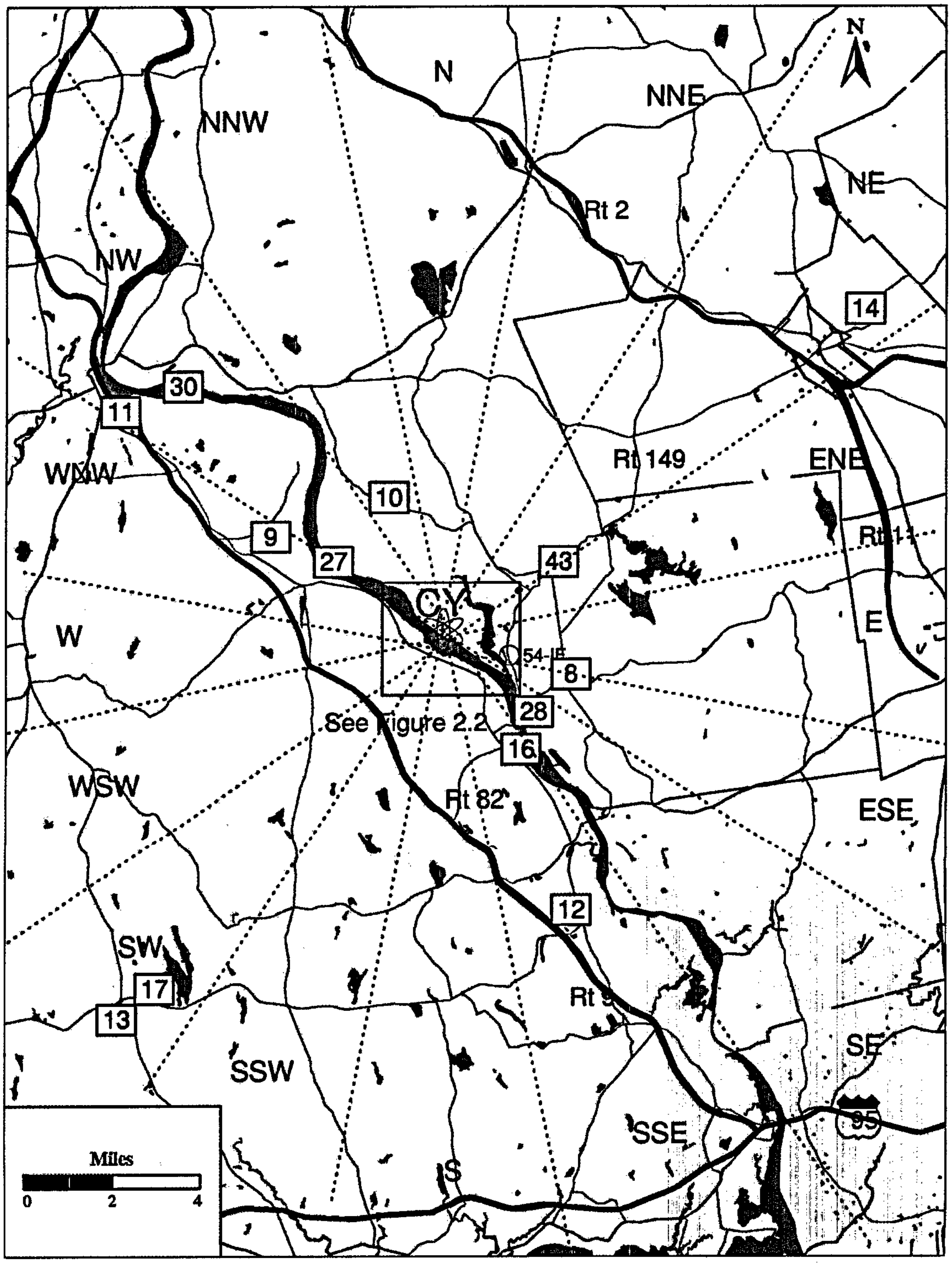
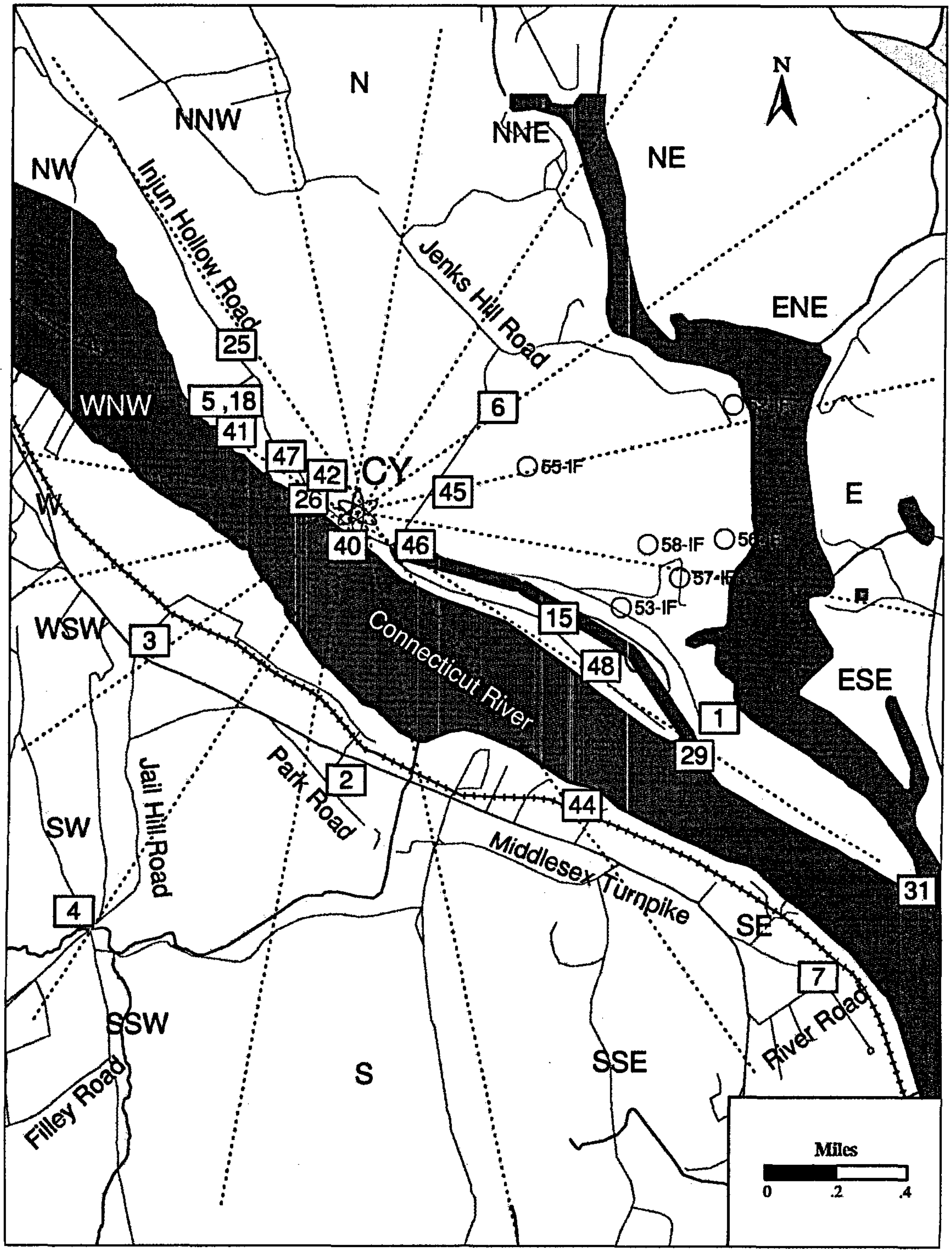


Figure 2.2 – Haddam Neck SamplingLocations



2.6 Samples Collected During 2005

The following table summarizes the number of samples of each type collected during the 2005 reporting period:

Sample Type	Number of Samples Analyzed in 2005	Number of Analyses by Station Type		
		Indicator	Control	Extra
Gamma Exposure environmental TLD	88	39	16	33
ISFSI TLD	35	35	**12**	**10**
Air Particulate*	40	32	8	-
Fish*	6	4	2	-
Bottom Sediment*	Data not available at this time.	-	-	-
Shellfish*	2	1	1	
ISFSI Sediment*	Data not available at this time.	-	-	-
River Water	32	16	16	-
Well Water*	3	1	2	-
Total All Types	**206**	**128**	**57**	**43**

* Sample requirements changed during the year as previously indicated.

3.0 RADIOLOGICAL DATA SUMMARY TABLES

This section summarizes the analytical results of the environmental samples that were collected during 2005. These results, shown in Table 3.1, are presented in a format similar to that prescribed in the NRC's Radiological Assessment Branch Technical Position on Environmental Monitoring (Reference 1). The results are ordered by sample media type and then by radionuclide for the pathways described in Section 2.3. The units for each media type are also given. Table 3.2 provides the same information for TLD direct radiation measurements.

The left-most column contains the radionuclide of interest, the total number of analyses for that radionuclide in 2005, and the number of measurements which exceeded the Reporting Levels found in Table 2.5. The latter are classified as "Non-routine" measurements. The second column lists the required Lower Limit of Detection (LLD) for those radionuclides, which have detection capability requirements specified in Table 2.4. The absence of a value in this column indicates that no LLD is specified in the REMODCM for that radionuclide in that media. The target LLD for any analysis performed is typically 30-40 percent of the most restrictive required LLD.

For each media type and radionuclide, the remaining three columns summarize the data for the following categories of monitoring locations: (1) the Indicator stations, which are within the range of influence of the plant and which could conceivably be affected by plant activities; (2) the station which had the highest mean concentration during 2005, and (3) the Control stations, which are beyond the influence of the plant. Direct radiation monitoring stations (using TLDs) are grouped into Indicator and Control stations.

In each of these columns, for each radionuclide, the following are given:

- The mean value of all concentrations including negative values and values that are not considered "detectable".
- The lowest and highest concentration.
- The number of detectable measurements divided by the total number of measurements.

A sample is considered to yield a "detectable measurement" when the concentration exceeds three times its associated standard deviation. The standard deviation on each measurement represents only the random uncertainty associated with the radioactive decay process (counting statistics), and not the propagation of all possible uncertainties in the analytical procedure.

The radionuclides reported in this section represent those that: 1) had a Reporting Level listed in Table E-2 of the REMODCM or, a LLD requirement in Table E-3 of the REMODCM or 2) had a positive measurement of radioactivity, whether it was naturally-occurring or man-made; or 3) were of specific interest for any other reason. The radionuclides that are routinely analyzed and reported by the FANPEL in a gamma spectroscopy analysis are: Ac/Th-228, Ag-108m, Ag-110m, Ba-140, Be-7, Ce-141, Ce-144, Co-57, Co-58, Co-60, Cr-51, Cs-134, Cs-137, Fe-59, I-131, K-40, La-140, Mn-54, Nb-95, Ru-103, Ru-106, Sb-124, Sb-125, Se-75, Zn-65 and Zr-95. The radionuclides that are routinely analyzed and reported by CYAPCO in a gamma spectroscopy analysis are: Co-58, Co-60, Cs-134, Cs-137, Mn-54 and Zn-65. In no instance did a radionuclide that is not shown in Table 3.1 appear as a "detectable measurement" during 2005.

Data from direct radiation measurements made by TLDs are provided in Table 3.2 in a format essentially the same as above. The complete listing of quarterly TLD data is provided in Table 3.3.

Table 3.1
Radiological Environmental Program Summary
Connecticut Yankee Nuclear Power Co., Haddam Neck Station
(January - December 2005)

MEDIUM: Air Particulates (AP) UNITS: pCi/cubic meter

Radionuclides (No. Analyses) Non-Routine*		Required LLD	Indicator Stations: Mean / Range / No. Detected**	Station With Highest Mean: Station	Station With Highest Mean: Mean / Range / No. Detected**	Control Stations: Mean / Range / No. Detected**
GR-B	(40) (0)	0.01	2.6E -2 (9.2 - 28.3)E -3 (32/ 32)	07	2.7E -2 (1.1 - 2.8)E -2 (8/ 8)	2.5E -2 (1.0 - 2.3)E -2 (8/ 8)
Mn-54	(10) (0)		-2.4E -4 (-2.4 - 8)E -4 (0/ 8)	07	4.8E -4 (1.6 - 8)E -4 (0/ 2)	3.5E -4 (2.9 - 4)E -2 (0/ 2)
Zn-65	(10) (0)		1.3E -3 (-6 - 75)E -4 (0/ 8)	09	3.5E -3 (-6 - 75)E -4 (0/ 2)	2.5E -4 (-2.2 - 2.7)E -3 (0/ 2)
Co-60	(10) (0)		-5.6E -4 (-6.8 - 2.8)E -4 (0/ 8)	07	1.4E -3 (-10 - 2.8)E -3 (0/ 2)	2.1E -3 (7.5 - 35)E -4 (0/ 2)
Cs-134	(10) (0)	0.05	6.2E -4 (-1.0 - 32)E -4 (0/ 8)	07	2.0E -3 (7.9 - 9.0)E -4 (0/ 2)	-1.6E -4 (-13 - 9.8)E -4 (0/ 2)
Cs-137	(10) (0)	0.06	5.1E -4 (-80 - 4.2)E -3 (0/ 8)	07	2.2E -3 (2.0 - 4.2)E -3 (0/ 2)	-8.0E -4 (-20 - 4)E -4 (0/ 2)

* Non-Routine refers to radionuclides that exceeded the Reporting Levels in ODCM Table E-2

** The fraction of sample analyses yielding detectable measurements (i.e. >3 standard deviations) is shown in parentheses.

Table 3.1
Radiological Environmental Program Summary
Connecticut Yankee Nuclear Power Co., Haddam Neck Station
(January - December 2005)

MEDIUM: Fish (FH) UNITS: pCi/kg

Radionuclides (No. Analyses) Non-Routine*		Required LLD	Indicator Stations Mean Range No. Detected**	Station With Highest Mean Station	Station With Highest Mean Mean Range No. Detected**	Control Stations Mean Range No. Detected**
Mn-54	(6) (0)	130	9.8E -1 (-4.1 - 11.5)E 0 (0/ 4)	26-I(BF)	1.2E 1 n/a (one sample taken) (0/ 1)	-5.5E 0 (- 1.1-0)E 1 (0/ 2)
Co-58	(6) (0)		6.3E 0 (-8.4 - 15.3)E 0 (0/ 4)	26-I(PF)	1.5E 1 n/a (one sample taken) (0/ 1)	-3.0E 0 (-3.6 - -2.3)E 0 (0/ 2)
Fe-59	(6) (0)		-9E 0 (-12.9 - 2.3)E 1 (0/ 4)	26-I(PF)	2.3E 1 n/a (one sample taken) (0/ 1)	-4E 0 (-1.3 - 3.7)E 1 (0/ 2)
Co-60	(6) (0)	130	-2.5 E 0 (-10.6 - 6.7)E 0 (0/ 4)	26-I(BF)	6.7E 0 n/a (one sample taken) (0/ 1)	2.3E 0 (1.2 - 3.4)E 0 (0/ 2)
Zn-65	(6) (0)	260	-9.8 E 1 (-3.8 - 2.3)E 1 (0/ 4)	26-I(PF)	2.3E 1 n/a (one sample taken) (0/ 1)	-3.5E 0 (-7 - 0)E 0 (0/ 2)
Cs-134	(6) (0)	130	-7.5E 0 (-3.1 - 1.1)E 1 (0/ 4)	26-I(PF)	1.1E 1 n/a (one sample taken) (0/ 1)	2.7E 0 (1.0 - 4.4)E 0 (0/ 2)
Cs-137	(6) (0)	150	2.9E 1 (2.2 - 4.5)E 1 (1/ 4)	29-I(PF)	4.5E 1 n/a (one sample taken) (0/ 1)	1.5E 1 (6.8 - 23)E 0 (1/ 2)

* Non-Routine refers to radionuclides that exceeded the Reporting Levels in ODCM Table E-2

** The fraction of sample analyses yielding detectable measurements (i.e. >3 standard deviations) is shown in parentheses.

Table 3.1
Radiological Environmental Program Summary
Connecticut Yankee Nuclear Power Co., Haddam Neck Station
(January - December 2005)

MEDIUM: Sediment (SE) UNITS: pCi/kg dry

		Indicator Stations	Station With Highest Mean		Control Stations
Radionuclides (No. Analyses) Non-Routine*	Required LLD	Mean Range No. Detected**	Station	Mean Range No. Detected**	Mean Range No. Detected**

Data Not Available

Table 3.1
Radiological Environmental Program Summary
Connecticut Yankee Nuclear Power Co., Haddam Neck Station
(January - December 2005)

MEDIUM: Shell Fish (SF) UNITS: pCi/kg wet

Radionuclides (No. Analyses) Non-Routine*		Required LLD	Indicator Stations: Mean / Range / No. Detected**	Station With Highest Mean: Station	Station With Highest Mean: Mean / Range / No. Detected**	Control Station: Mean / Range / No. Detected**
Mn-54	(2) (0)	130	-2.0E 0 n/a (One Station) (0/ 1)	31	n/a (One Station)	1.5E 1 n/a (One Station) (0/ 1)
Co-58	(2) (0)		7.0E 0 n/a (One Station) (0/ 1)	31	n/a (One Station)	1.1E 1 n/a (One Station) (0/ 1)
Fe-59	(2) (0)		-1.3E 2 n/a (One Station) (0/ 1)	31	n/a (One Station)	3.7E 1 n/a (One Station) (0/ 1)
Co-60	(2) (0)	130	4.0E 0 n/a (One Station) (0/ 1)	31	n/a (One Station)	-8.0E 0 n/a (One Station) (0/ 1)
Zn-65	(2) (0)	260	-2.3 1 n/a (One Station) (0/ 1)	31	n/a (One Station)	1.1E 1 n/a (One Station) (0/ 1)
Zr-95	(2) (0)		4.3E 1 n/a (One Station) (0/ 1)	31	n/a (One Station)	1.5E 1 n/a (One Station) (0/ 1)
I-131	(2) (0)		1.3E 2 n/a (One Station) (0/ 1)	31	n/a (One Station)	1.0E 2 n/a (One Station) (0/ 1)
Cs-134	(2) (0)	130	1.7E 1 n/a (One Station) (0/ 1)	31	n/a (One Station)	1.0E 1 n/a (One Station) (0/ 2)
Cs-137	(2) (0)	150	-1.2E 1 n/a (One Station) (0/ 1)	31	n/a (One Station)	3.7E 0 n/a (One Station) (0/ 1)

* Non-Routine refers to radionuclides that exceeded the Reporting Levels in ODCM Table E-2

** The fraction of sample analyses yielding detectable measurements (i.e. >3 standard deviations) is shown in parentheses.

Table 3.1
Radiological Environmental Program Summary
Connecticut Yankee Nuclear Power Co., Haddam Neck Station
(January - December 2005)

MEDIUM: ISFSI Sediment (SI) UNITS: pCi/kg dry

		Indicator Stations	Station With Highest Mean		Control Stations
Radionuclides (No. Analyses) Non-Routine*	Required LLD	Mean Range No. Detected**	Station	Mean Range No. Detected**	Mean Range No. Detected**

Data Not Available.

Table 3.1
Radiological Environmental Program Summary
Connecticut Yankee Nuclear Power Co., Haddam Neck Station
(January - Sampling Discontinued after 2nd Quarter of 2005))

MEDIUM: ISFSI Water (WI) UNITS: pCi/liter

Radionuclides (No. Analyses) Non-Routine*	Required LLD	Indicator Stations: Mean / Range / No. Detected**	Station With Highest Mean: Station	Station With Highest Mean: Mean / Range / No. Detected**	Control Stations: Mean / Range / No. Detected**
H-3 (2) (0)	2000	5.5E 2 (3.2 - 7.8)E 2 (0/ 2)	57	N/A (One Sample Location)	NO DATA
Mn-54 (2) (0)	15	-4.1E 0 (-1.3 - -6.9)E 0 (0/ 2)	57	N/A (One Sample Location)	NO DATA
Co-58 (2) (0)		-2.6E 0 (-0.9 - -4.3)E 0 (0/ 2)	57	N/A (One Sample Location)	NO DATA
Fe-59 (2) (0)		-1.06E 1 (-9.2 - -12)E 0 (0/ 2)	57	N/A (One Sample Location)	NO DATA
Co-60 (2) (0)	15	1.6E 0 (0.1 - 3.0)E 0 (0/ 2)	57	N/A (One Sample Location)	NO DATA
Zn-65 (2) (0)	30	0.25E 0 (-2 - 1.5)E 0 (0/ 2)	57	N/A (One Sample Location)	NO DATA
Zr-95 (2) (0)		1.1E 0 (-0.2 - 2.4)E 0 (0/ 2)	57	N/A (One Sample Location)	NO DATA
I-131 (2) (0)		-0.9E 0 (-3.2 - 1.5)E 0 (0/ 2)	57	N/A (One Sample Location)	NO DATA
Cs-134 (2) (0)	15	3.4E 0 (3.3 - 3.5)E 0 (0/ 2)	57	N/A (One Sample Location)	NO DATA
Cs-137 (2) (0)	18	-0.6E 0 (-0.7 - -0.5)E 0 (0/ 2)	57	N/A (One Sample Location)	NO DATA
Ba-140 (2) (0)		6.0E 0 (2.3 - 9.6)E 0 (0/ 2)	57	N/A (One Sample Location)	NO DATA

* Non-Routine refers to radionuclides that exceeded the Reporting Levels in ODCM Table E-2
** The fraction of sample analyses yielding detectable measurements (i.e. >3 standard deviations) is shown in parentheses.

Table 3.1
Radiological Environmental Program Summary
Connecticut Yankee Nuclear Power Co., Haddam Neck Station
(January - December 2005)

MEDIUM: River Water (WR) UNITS: pCi/liter

Radionuclides (No. Analyses) Non-Routine*		Required LLD	Indicator Stations Actual Values Mean Range No. Detected**	Station (1 Indicator Station)	Indicator Stations --LLD Values-- Mean Range No. Detected**	Control Stations --Actual Values-- Mean Range No. Detected**
H-3	(15) (0)	2000	-2.0E 2 (-7.2 - -0.3)E 1 (0/ 2)	28	1.1E 3 (1140 - 1310)E 0 (0/ 13)	9.0E 1 (-2.2 - 4.0)E 2 (0/ 2)
Mn-54	(15) (0)	15	1.1 0 (-0.1 - 2.3)E 0 (0/ 2)	28	4.4E 0 (3.1 - 7.4)E 0 (0/ 13)	1.5E 0 (0.3 - -2.8)E 0 (0/ 2)
Co-58	(15) (0)		1.1E 0 (-0.8 - 2.9)E 0 (0/ 2)	28	4.1E 0 (3.3 - 6.5)E 0 (0/ 13)	2.0E-1 (-0.5 - 0.8)E 0 (0/ 2)
Fe-59	(15) (0)		2.6E 0 (2.3 - 2.6)E 0 (0/ 2)	28	No Data	2.0E 0 (-0.6 - 3.4)E 0 (0/ 2)
Co-60	(15) (0)	15	0.8E 0 (0.0 - 1.5)E 0 (0/ 2)	28	1.2E 0 (9.2 - 15)E 0 (0/ 13)	-6.0E -1 (-1.8 - 0.6)E 0 (0/ 2)
Zn-65	(15) (0)	30	0.7E 0 (-1.7 - 3.0)E 0 (0/ 2)	28	1.0E 1 (3.5 - 17)E 0 (0/ 13)	-3.4E 0 (-6.7 - -0.1)E 0 (0/ 2)
Zr-95	(15) (0)		-2.3E 0 (-0.7 - -3.9)E 0 (0/ 2)	28	No Data	-0.1E 0 (0.1 - 0.1)E 0 (0/ 2)
I-131	(15) (0)		1.1E 1 (-3.2 - 24)E 0 (0/ 2)	28	NO Data	-7.3E 0 (-12 - -2.8)E 0 (0/ 2)
Cs-134	(15) (0)	15	-0.5E 0 (--0.9 - 0.0)E 0 (0/ 2)	28	4.1E 0 (2.6 - 6.5)E 0 (0/ 13)	-5E -1 (-1.6 - 0.5)E 0 (0/ 2)
Cs-137	(15) (0)	18	0.4E 0 (-0.2 - 1.0)E 0 (0/ 2)	30	1.1 1 (5.8 - 15)E 0 (0/ 13)	0.7E 0 (0.3 - 1.2)E 0 (0/ 2)
Ba-140	(15) (0)		1.6E 0 (1.1 - 2.0)E 0 (0/ 2)	28	No Data	1.4E 0 (1.3- 1.4)E 0 (0/ 2)

- Non-Routine refers to radionuclides that exceeded the Reporting Levels in ODCM Table E-2

** The fraction of sample analyses yielding detectable measurements (i.e. >3 standard deviations) is shown in parentheses.

Table 3.1
Radiological Environmental Program Summary
Connecticut Yankee Nuclear Power Co., Haddam Neck Station
(January – June 2005 Site Wells Shutdown June 3, 2005)

MEDIUM: Well Water (WW) UNITS: pCi/liter

Radionuclides (No. Analyses) Non-Routine*		Required LLD	Indicator Stations: Mean / Range / No. Detected**	Station With Highest Mean: Station	Station With Highest Mean: Mean / Range / No. Detected**	Control Stations: Mean / Range / No. Detected**
H-3	(3) (0)	2000	5.3E 2 n/a (One Sample) (0/ 1)	15	n/a (One Sample)	3.5E 2 (-8 - 78)E 1 (0/ 2)
Mn-54	(3) (0)	15	0.4E 0 n/a (One Sample) (0/ 1)	15	n/a (One Sample)	-0.7E 0 (-2.3 - 1.0)E 0 (0/ 2)
Co-58	(3) (0)		-2.9E -0 n/a (One Sample) (0/ 1)	15	n/a (One Sample)	-3.7E 0 (-0.5 - 6.9)E 0 (0/ 2)
Fe-59	(3) (0)		-1.3E 0 n/a (One Sample) (0/ 1)	15	n/a (One Sample)	-7.9E 0 (-8.7 - -7.0)E 0 (0/ 2)
Co-60	(3) (0)	15	-4.3E 0 n/a (One Sample) (0/ 1)	15	n/a (One Sample)	-0.9E 0 (-1.7 - 0.0)E 0 (0/ 2)
Zn-65	(3) (0)	30	-1.0E 1 n/a (One Sample) (0/ 1)	15	n/a (One Sample)	8.4E 0 (- 0.0 - 16.8)E 0 (0/ 2)
Zr-95	(3) (0)		0.2E 0 n/a (One Sample) (0/ 1)	15	n/a (One Sample)	3.2E 0 (- 2.7 - -3.7)E 0 (0/ 2)
I-131	(3) (0)		-7.7E 1 n/a (One Sample) (0/ 1)	15	n/a (One Sample)	-1.1E 0 (-4.0 - 1.8)E 0 (0/ 2)
Cs-134	(3) (0)	15	-0.8E 0 n/a (One Sample) (0/ 1)	15	n/a (One Sample)	-4.5E 0 (4.4 - -4.6)E 0 (0/ 2)
Cs-137	(3) (0)	18	3.3E 0 n/a (One Sample) (0/ 1)	15	n/a (One Sample))	-1.8E 0 (-2.5 - -1.1)E 0 (0/ 2)
Ba-140	(5) (0)		1.7E 0 n/a (One Sample) (0/ 1)	15	n/a (One Sample))	0.75E 0 (4 - 5.5)E 0 (0/ 2)

* Non-Routine refers to radionuclides that exceeded the Reporting Levels in ODCM Table E-2
** *The fraction of sample analyses yielding detectable measurements (i.e. >3 standard deviations) is shown in parentheses.*

Table 3.2 Environmental TLD Measurements 2005

ENVIRONMENTAL TLD DATA SUMMARY
CONNECTICUT YANKEE NUCLEAR POWER STATION
(JANUARY - DECEMBER 2005)
(uR/hr)

	INDICATOR TLDs	CONTROL TLDS	HIGHEST MEAN (14-C)	EXTRA TLDS	ISFSI TLDS
MEAN RANGE (NO. MEASUREMENTS)*	MEAN RANGE (NO. MEASUREMENTS)*	MEAN RANGE (NO. MEASUREMENTS)*	MEAN RANGE (NO. MEASUREMENTS)*	MEAN RANGE (NO. MEASUREMENTS)*	MEAN RANGE (NO. MEASUREMENTS)*
Mean	6.4 ± 0.4	6.3 ± 0.4	7.6 ± 0.4	7.5 ± 1.0	24.8 ± 1.1
Range	4.6 - 7.8	4.7 - 8.2	6.3 - 8.2	5.0 - 12.4	5.6 - 131.6
No. Measurements	39	16	4	33	27

* Each "measurement" is based typically on quarterly readings from five TLD elements. Units are micro-R per hour.

Table 3.3

ENVIRONMENTAL TLD MEASUREMENTS
2005
(Micro-R per hour)

Sta. No.	Description	1ST QUARTER EXP.		1ST QUARTER S.D.	2ND QUARTER EXP.		2ND QUARTER S.D.	3RD QUARTER EXP.		3RD QUARTER S.D.	4TH QUARTER EXP.		4TH QUARTER S.D.	ANNUAL AVE. EXP.
CY-1-I	Onsite Disharge Can	5.64	±	0.26	0	±	0	6.31	±	0.37	6.44	±	0.35	6.13
CY-2-I	Haddam Park Road	5.13	±	0.51	5.87	±	0.3	6.42	±	0.34	6.28	±	0.35	5.93
CY-3-I	Haddam Jail Hill Rd.	5.43	±	0.27	6.37	±	0.33	6.86	±	0.52	6.89	±	0.42	6.39
CY-4-I	Haddam Ranger Road	4.63	±	0.36	5.35	±	0.39	6.03	±	0.48	6.00	±	0.33	5.50
CY-5-I	Onsite Injun Hol Rd.	5.80	*	0.23	6.46	±	0.20	7.30	±	0.49	7.33	±	0.48	6.72
CY-6-I	Onsite Substation	5.50	±	0.26	5.85	±	0.28	6.55	±	0.44	6.88	±	0.45	6.20
CY-7-I	Haddam	6.31	±	0.28	7.51	±	0.23	7.29	±	0.63	7.41	±	0.39	7.13
CY-8-I	East Haddam	5.34	±	0.43	6.31	±	0.36	6.74	±	0.45	7.08	±	0.47	6.37
CY-9-I	Higganum	5.48	±	0.22	6.39	±	0.19	6.52	±	0.54	7.15	±	0.43	6.39
CY-10-I	Hurd Park Road	5.98	±	0.30	6.66	±	0.23	6.81	±	0.33	7.79	±	0.45	6.81
CY-11-C	Middletown	5.08	±	0.31	5.52	±	0.20	5.49	±	0.58	6.04	±	0.44	5.53
CY-12-C	Deep River	5.63	±	0.33	6.33	±	0.28	6.83	±	0.45	6.76	±	0.37	6.39
CY-13-C	North Madison	4.77	±	0.23	5.44	±	0.40	5.93	±	0.41	6.16	±	0.48	5.56
CY-14-C	Colchester	6.34	±	0.36	7.88	±	0.30	7.97	±	0.60	8.23	±	0.48	7.61
CY-40-X	Near Intake Structur *	5.35	±	0.27	5.60	±	0.22	(lost) 0	±	0	6.95	±	0.56	5.97
CY-41-X	Picnic area	5.02	±	0.27	5.54	±	0.18	6.27	±	0.36	6.38	±	0.43	5.80
CY-42-X	Environmental Trail	7.21	±	0.38	7.78	±	0.36	8.11	±	0.49	8.71	±	0.58	7.95
CY-43-X	Moodus-Rts 149&151	6.54	±	0.46	7.27	±	0.22	7.79	±	0.41	7.59	±	0.42	7.30
CY-44-X	Shailerville Horton Rd.	5.63	±	0.37	6.32	±	0.24	6.78	±	0.39	6.88	±	0.39	6.40
CY-45-X	Old Waste Gas Sphere *	9.00	±	0.57	9.94	±	0.37	10.08	±	0.70	8.81	±	0.55	9.46
CY-46-X	Discharge Canal Fen *	10.08	±	0.44	12.44	±	0.39	10.27	±	0.74	9.78	±	0.66	10.64
CY-47-X	Visitor Info Center	5.74	±	0.34	6.27	±	0.22	6.85	±	0.35	6.88	±	0.4	6.44
CY-48-X	Met Shack	(lost) 0	±	0	(lost) 0	±	0	7.21	±	0.39	6.70	±	0.47	6.96
CY-50-X	ISFSI Pad SE End Fen	131.64	±	5.23	130.07	±	3.72	130.44	±	5.63	118.2	±	5.54	127.59
CY-51-X	ISFSI Monitoring ST	6.03	±	0.23	6.43	±	0.33	7.46	±	0.44	6.90	±	0.54	6.71
CY-52-IF	Schmidt Cemetery Onsite**	5.60	±	0.25	6.18	±	0.23	7.17	±	0.44	6.56	±	0.38	6.38
CY-53-IF	ISFSI Haul Route Onsite**	6.16	±	0.36	7.06	±	0.54	7.53	±	0.41	7.69	±	0.52	7.11
CY-54-IF	RT 149 Salmon River**	7.23	±	0.56	(lost)0	±	0	6.98	±	0.51	6.82	±	0.40	7.01
CY-55-IF	HV Tower NW of Pad**	5.97		0.24	7.88		0.80	7.86		0.76	7.45		0.45	7.29
CY-56-IF	Borrow Pit Onsite**	5.99		0.22	6.96		0.29	7.13		0.55	7.04		0.45	6.78

* Extra TLD locations not required by the REMODCM
** ISFSI TLD Locations

4.0 ANALYSIS OF ENVIRONMENTAL RESULTS

4.1 Sampling Program Deviations

The Radiological Effluent Monitoring Manual (REMM) states in Section E.1 that the environmental sampling and analysis program shall be conducted as specified in Table E-1 for locations shown in Appendix G of the ODCM. Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment or other legitimate reasons. If specimens are unobtainable due to sampling equipment malfunction, every effort shall be made to complete corrective action prior to the end of the next sampling period.

All deviations from the sampling schedule shall be documented in the Annual Radiological Environmental Operating Report pursuant to Section F.1 of the REMM. The following deviations are noted for the 2005 sampling program:

- A river water composite sample was collected from Station 28-I on April 4th. The composite sample was found to be only half full indicating that the system did not operate continuously during the sampling period. A sample was taken of the water that had been collected.
- During the change out of the TLDs for the first quarter, one could not be retrieved. Station 48-X was apparently removed during demolition activities on the Met Shack. This was replaced with another TLD in the same general location.
- During the change out of the TLDs for the second quarter, three TLDs could not be retrieved. The TLD at location 1 could not be retrieved due to high water in the access road way. This was retrieved during the second quarter collection activities. The second TLD was the TLD located at Station 48-X, apparently removed during demolition activities in the area near the Met Shack. The third TLD that could not be retrieved was 54-IF.
- During the change out of the TLDs for the third quarter, one TLD could not be retrieved. Station 40-X was apparently removed during demolition preparation activities for the Intake Structure. This was replaced with another TLD in the same general location. All other TLD locations were evaluated to ensure there were no similar conditions that existed.
- The river water composite sample at Station 28-I was not collecting a sample on September 28 due to a problem with the ISCO sampler and subsequently was identified as being caused by a short circuit in the battery system. This was corrected by obtaining subcontractor support and replacing one of the batteries. The system was returned to service on September 30th at 12:29.
- The river water composite sample at Station 28-I was not collecting a sample on December 12 due to what apparently was a frozen line. This was initially corrected by

- The bi-weekly river sample at station 30-A-C, dated 7/25/05, was not analyzed for gamma emitting isotopes. Personnel error as a result of personal extenuating circumstances was the contributing factor for all required analyses not performed. Tritium analysis was performed on the sample.

- Analysis results for sediment samples collected on June 7th thru June 9th can not be located at this time. Narrative from the June Monthly Report from FANAPL to CYAPCO indicates sediment was sampled from Station 28-I, 29-I, 30-C on June 7th thru June 9th and that ISFSI sediment was sampled from station 57-IF and 58-IF on June 8th. FANPEL notified CYAPCO that the analysis report for these sediment samples can not be located at this time.

The following is a list of the missed samples from 2005. The details of these samples are included in the previous section, Section 4.1; Sampling Program Deviations.

Media	Station	LSN	End_Date
Sediment	28-I	L9418-01	06/09/05
	29-I	L9418-02	06/09/05
	30-C	L9418-03	06/09/05
	57-IF	L9418-04	06/09/05
	58-IF	L9418-05	06/09/05
TLD	48-X		03/31/05
	1-I		06/30/05
	48-X		06/30/06
	54-IF		06/30/06
	40-X		09/30/06

adding water to the sample line and was addressed by a more permanent solution of weighing down the line as it entered the river.

- The river water composite sample tube at Station 28-I was found leaking on 1occasion with only a minimal loss of sample was indicated. This sample line will be changed out periodically to minimize the potential for recurrence of the problem.

- The bi-weekly river sample at station 30-A-C, dated 7/25/05, was not analyzed for gamma emitting isotopes. Personnel error as a result of personal extenuating circumstances was the contributing factor for all required analyses not performed. Tritium analysis was performed on the sample.

- Analysis results for sediment samples collected on June 7th thru June 9th can not be located at this time. Narrative from the June Monthly Report from FANAPL to CYAPCO indicates sediment was sampled from Station 28-I, 29-I, 30-C on June 7th thru June 9th and that ISFSI sediment was sampled from station 57-IF and 58-IF on June 8th. FANPEL notified CYAPCO that the analysis report for these sediment samples can not be located at this time.

The following is a list of the missed samples from 2005. The details of these samples are included in the previous section, Section 4.1; Sampling Program Deviations.

Media	Station	LSN	End Date
Sediment	28-I	L9418-01	06/09/05
	29-I	L9418-02	06/09/05
	30-C	L9418-03	06/09/05
	57-IF	L9418-04	06/09/05
	58-IF	L9418-05	06/09/05
TLD	48-X		03/31/05
	1-I		06/30/05
	48-X		06/30/06
	54-IF		06/30/06
	40-X		09/30/06

4.2 Comparison of Achieved LLD with Requirements

Table E-3 of the REMODCM (Table 2.3 in this report) lists the required Lower Limits of Detection (LLDs) for routine environmental sample analyses. On occasion, an LLD is not achieved due to situations such as a low sample volume. In such a case, the REMODCM requires the identification and discussion of the contributing factors in the Annual Radiological Environmental Operating Report. At the FANPEL, the target LLD for any analysis is typically 30-40 percent of the most restrictive required LLD. Expressed differently, the typical sensitivities achieved for each analysis are at least 2.5 to 3 times better than that required by the REMODCM.

For each analysis having an LLD requirement, the *a posteriori* or after the fact LLD (or minimum detectable concentration-MDC) calculated for that analysis was compared with the required *a priori* LLD. More than 150 analyses were performed with a specified LLD requirement for 2005. All the samples analyzed met the required detection limits.

4.3 Results Compared Against Reporting Levels

The REMODCM Section E requires the written notification to the NRC within 30 days whenever a Reporting Level in ODCM Table E-2 is exceeded (Table 2.4 in this report). Reporting Levels are the environmental concentrations that relate to the ALARA design dose objectives of 10 CFR 50, Appendix I. It should be noted that environmental concentrations are averaged over calendar quarters for the purposes of this comparison, and that Reporting Levels apply only to measured levels of radioactivity due to plant effluents. During 2005, no Reporting Levels were exceeded.

4.4 Data Analysis by Media Type

The 2005 REMP data for each media type are discussed below categorized by pathway. Graphical plots of monitoring data are also shown in Figures 4.1 to 4.11. With respect to data plots, all values are plotted, whether they are "detectable" or "non-detectable."

4.4.1 Air Particulate Gross Beta Radioactivity

Air particulates were collected until April 2005 on glass fiber filters bi-weekly at four indicator locations and one control location, and analyzed for gross beta radioactivity. Gamma isotopic analyses are performed on the quarterly composites of each location.

As shown in Figure 4.1, there is no significant difference between the average gross beta concentration at the indicator stations and the control station. Notable in the graph is the distinct annual cycle.

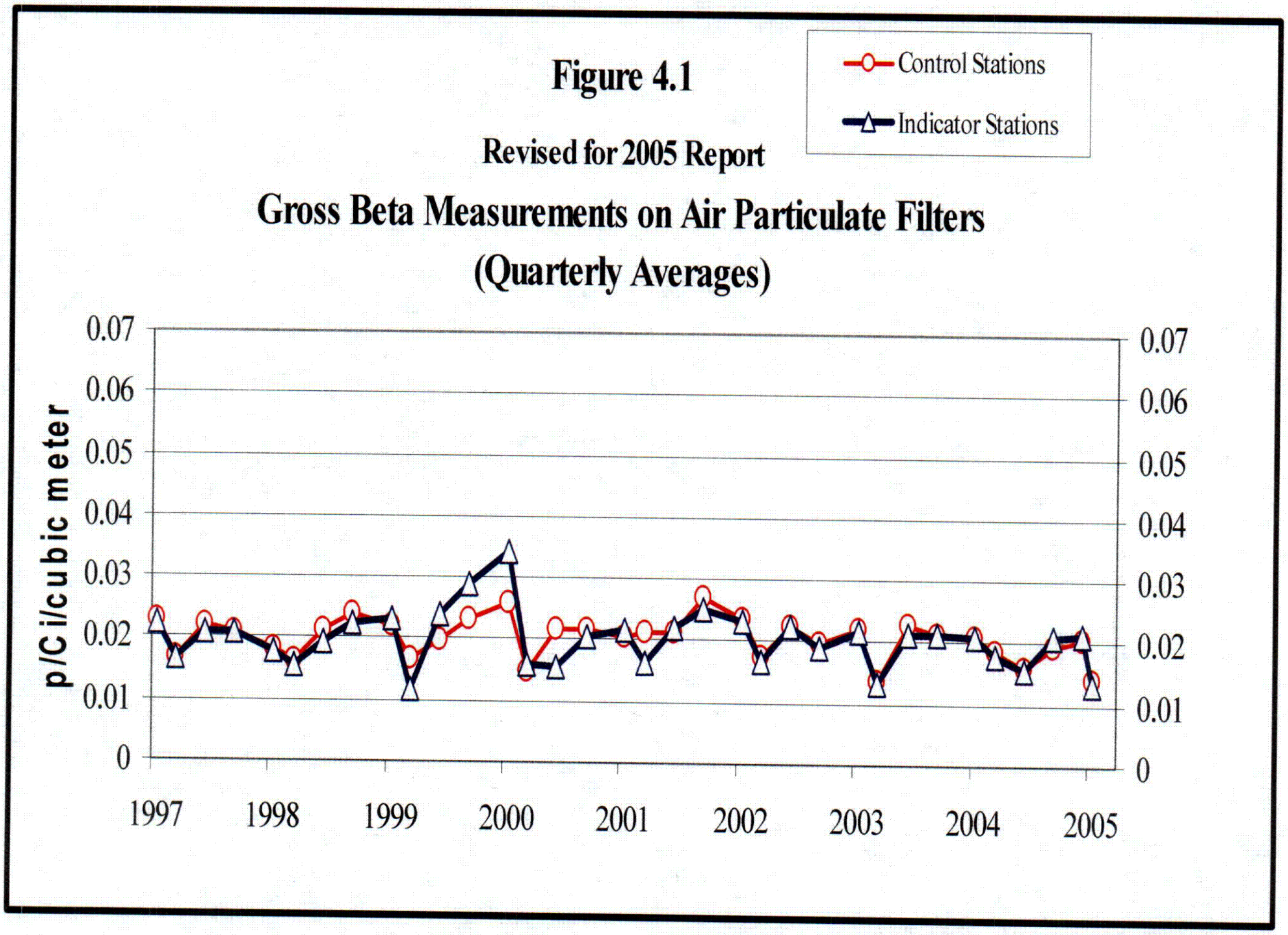
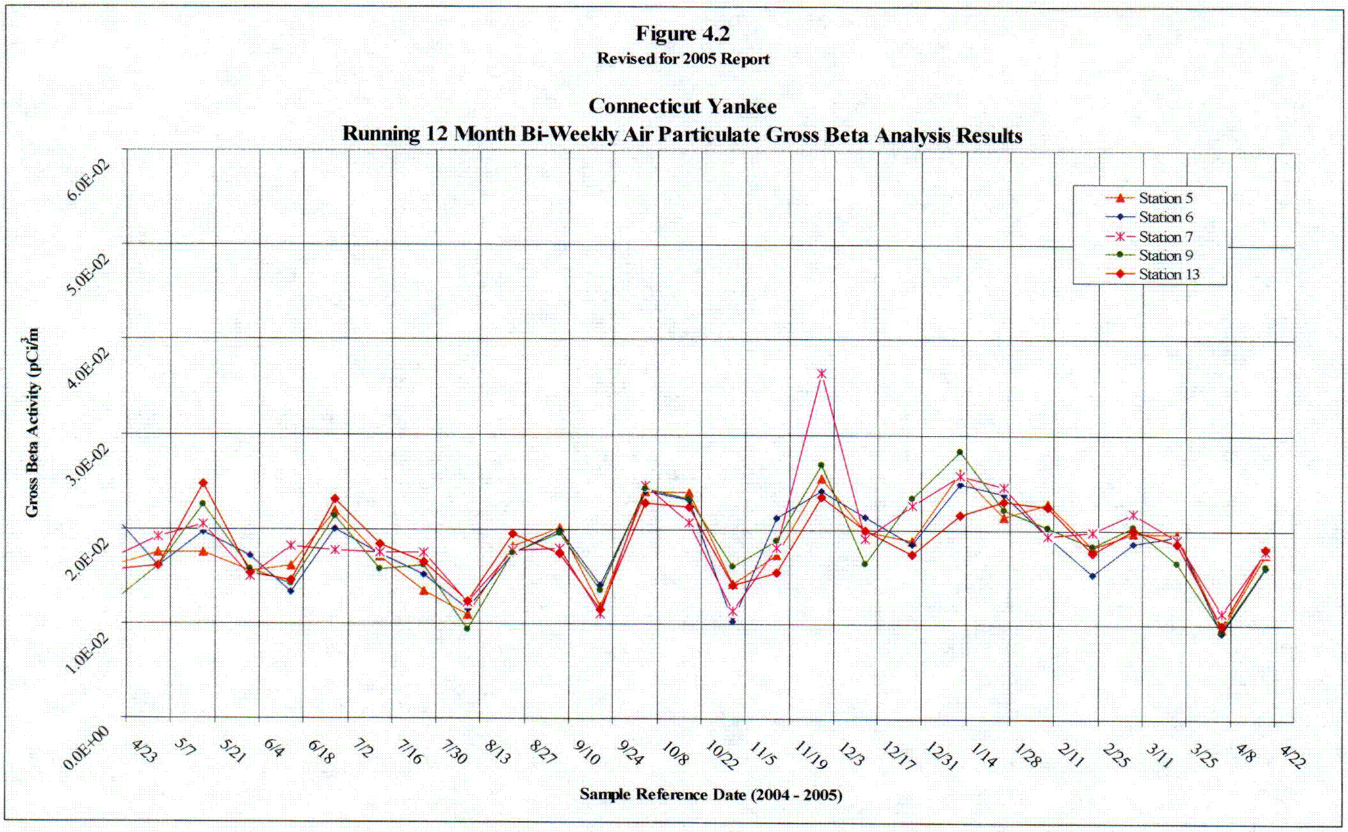


Figure 4.2 shows the biweekly gross beta concentrations at each sampling location required by the ODCM along with the control station in North Madison. The gross beta concentration is seen to fluctuate over the year due to seasonal changes in the naturally occurring airborne radioactivity. The gross beta concentrations at the indicator stations are similar to the control station and fluctuate in the same manner.



The quarterly composites of the bi-weekly air particulate filters are also analyzed for gamma radioactivity. The results, shown in Tables 3.1, indicate the presence of naturally occurring Be-7, which is produced by cosmic processes. No positive results were observed for all the other isotopes.

4.4.2 River Water

River water composite samples were collected biweekly during 2005. The composites were analyzed for gamma radionuclides and H-3. No gamma emitting radionuclides or H-3 were detected in 2005.

4.4.3 Well Water

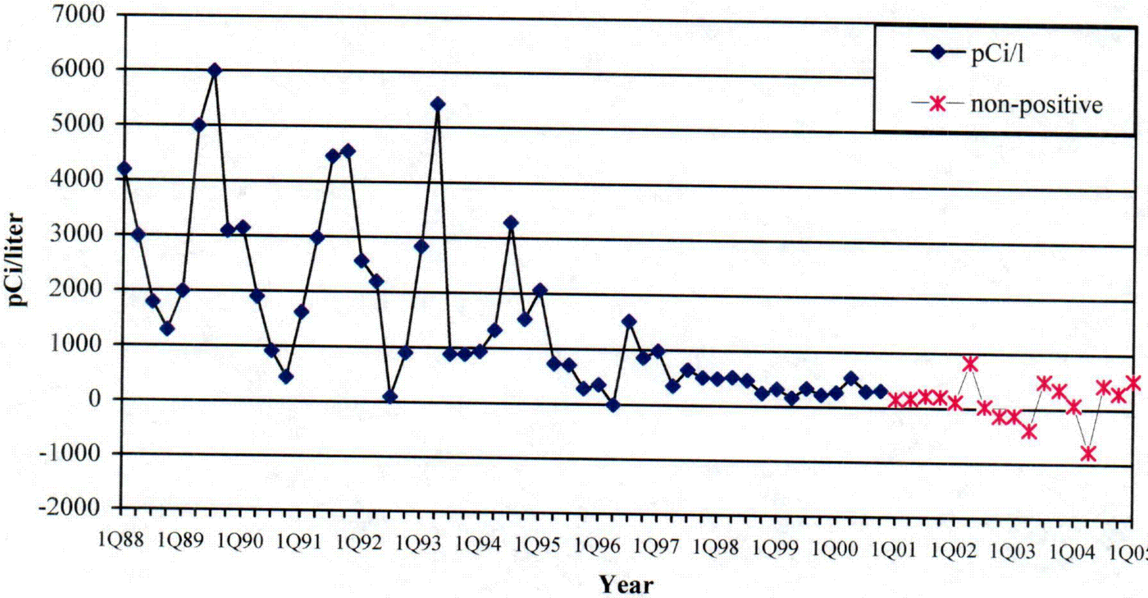
In 2005, samples of water from the onsite wells (location 15) and control station (location 16) were sampled during the first quarter of 2005. The onsite wells previously sampled were taken out of service in June 2005. The on-site wells had in the past indicated the presence of station related H-3. The H-3 is believed to result from the wells proximity to an area influenced by the water in the discharge canal and the ability of H-3 to migrate. In recent years it was discovered that there was a leak in the Refueling Water Storage Tank (RWST) that migrated to the ground water. This tank was subsequently drained and demolished. Debris from the RWST Tank demolition, including the sub-surface pedestal has been removed from the CYAPCO site and the sub-surface soils in the area of the tank farm have been remediated. As a part of the decommissioning process, a series of groundwater monitoring wells were installed. The results of the ground water monitoring evaluation can be found in the "Malcolm Pirnie Ground Water Monitoring Report for Connecticut Yankee Atomic Power Company, Final Report, September 1999" and subsequent Ground Water Monitoring Reports

A downward trend has been observed in the H-3 concentration from the onsite wells since cycle 17 in 1992 due to the replacement of stainless-steel clad fuel with zircaloy clad fuel. The levels of H-3 observed since permanent shutdown in July 1996 represent residual levels of tritium that remain in station process liquids and/or groundwater from beneath the site that are gradually dropping to natural background levels. For 2005, no H-3 was detected in either the indicator or the control stations.

Figure 4.3 shows the H-3 concentration in CY on-site wells since 1988. The concentrations plotted for the only sample in 2005 represent statistically non-positive H-3 concentrations.

Figure 4.3

H-3 Levels in On-site Wells



4.4.4 Bottom Sediment

The REMODCM was changed in 2005 and sample frequency for sediment was reduced from semiannual to annual. Five grab samples of river bottom and ISFSI related sediments were collected on June 7th - June 9th; however FANPEL was unable to locate the analysis results. Sediment sampling is now performed and/or directed by CYAPCO and the final sediment sample of the CYAPCO REMP Program is scheduled to be collected in June 2006. Data from previous sampling events is included below. Figure 4.4 shows that historically, Cs-137 has been detected at both the control and indicator locations indicating that the likely source is weapons fallout. One of the samples collected at the indicator station in the vicinity of the discharge also contained Co-60. The level of Co-60 measured in 2004 is bounded by concentrations observed in previous years as shown in Figure 4.5. No other indications of station related radioactivity were observed in this sample media. Naturally occurring K-40 and Th-232 were also detected in all of the samples.

Figure 4.4

CS-137 IN SEDIMENT

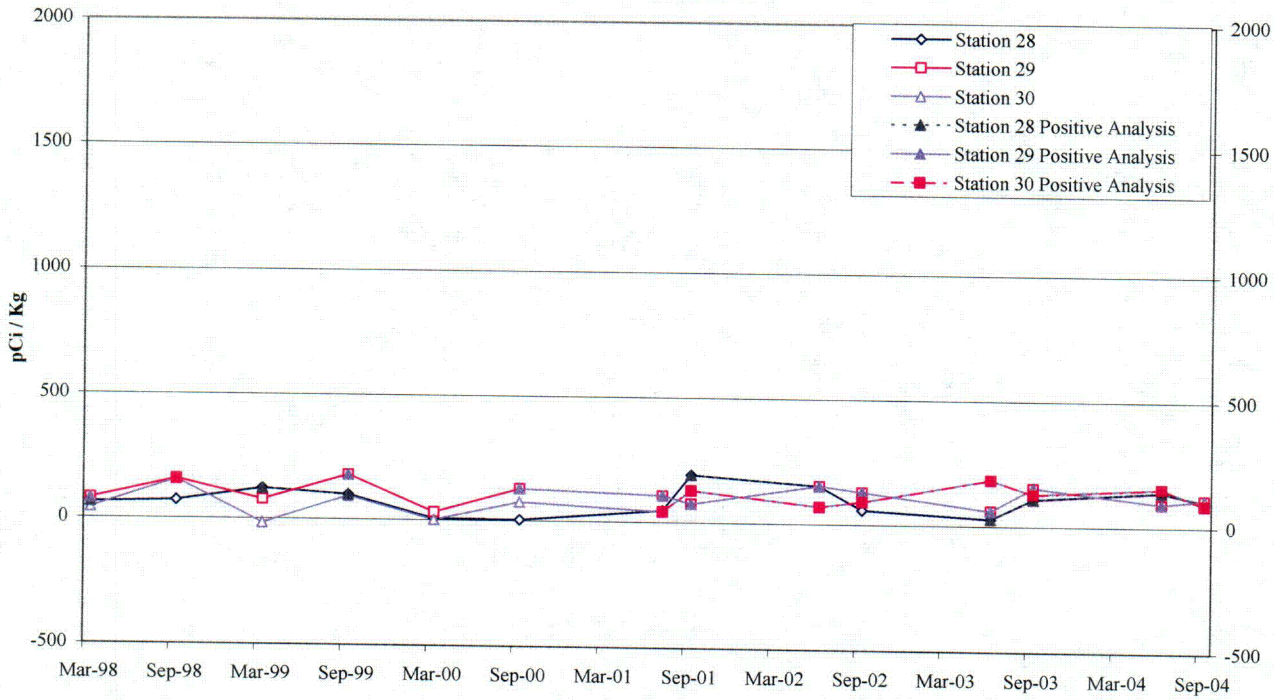
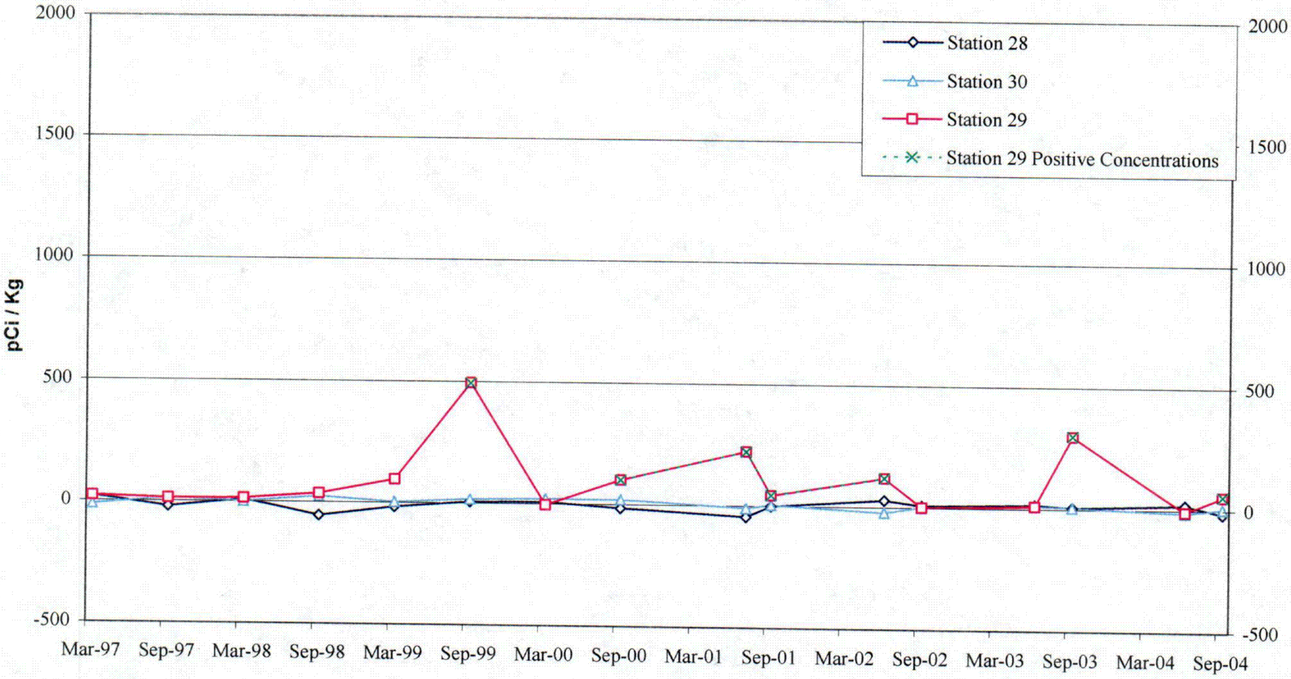


Figure 4.5

CO-60 IN SEDIMENT



4.4.5 Fruits and Vegetables

These samples were no longer required to be collected after the completion of the Fuel Transfer Project. The Fuel Transfer Project was complete prior to the onset of the harvest season; therefore no fruits and vegetables were collected and analyzed in 2005.

4.4.6 Broad Leaf Vegetation

These samples were no longer required to be collected after the completion of the Fuel Transfer Project. The fuel transfer project was complete prior to the onset of the growing season; therefore no broad leaf vegetation samples were collected and analyzed in 2005.

4.4.7 Shellfish

Shellfish samples were collected annually from two locations. Naturally occurring K-40 was detected in two control samples. No other gamma emitting radionuclides were detected in the samples.

4.4.8 Fish

Multiple fish samples were collected annually at three locations. The species collected in 2005 were perch, bullheads and catfish. Cs-137 and K-40 were detected in the samples from indicator stations and all control station samples with the exception there was no Cs-137 detected in the bottom feeder fish sample from the control sample location. Only two of the predator fish samples had a Cs-137 concentration greater than 3 times the 1 sigma counting uncertainty and both of those samples were below the measured MDC.

4.4.9 Gamma Exposure Rate

Direct radiation is continuously measured at 14 locations surrounding Haddam Neck Station and at nine extra on-site locations with thermoluminescent dosimeters (TLDs). The extra on-site locations are not part of the REMP but are used to monitor the impact of on-site decommissioning activities on the site boundary doses. All TLDs are collected quarterly for readout at the FANPEL.

Tables 3.2 and 3.3 show the mean exposure rates for the Indicator and Control categories do not vary significantly in 2005. As shown in Figure 4.6, there is a distinct annual cycle at both indicator and control locations. The lowest point of the cycle occurs during the winter months. This is due primarily to the attenuating effect of the snow cover on radon emissions and on direct irradiation by naturally-occurring radionuclides in the soil. Differing amounts of these radionuclides in the underlying soil, rock or nearby building materials result in different radiation levels between one field site and another.

Figure 4.6
Revised for 2005 Report

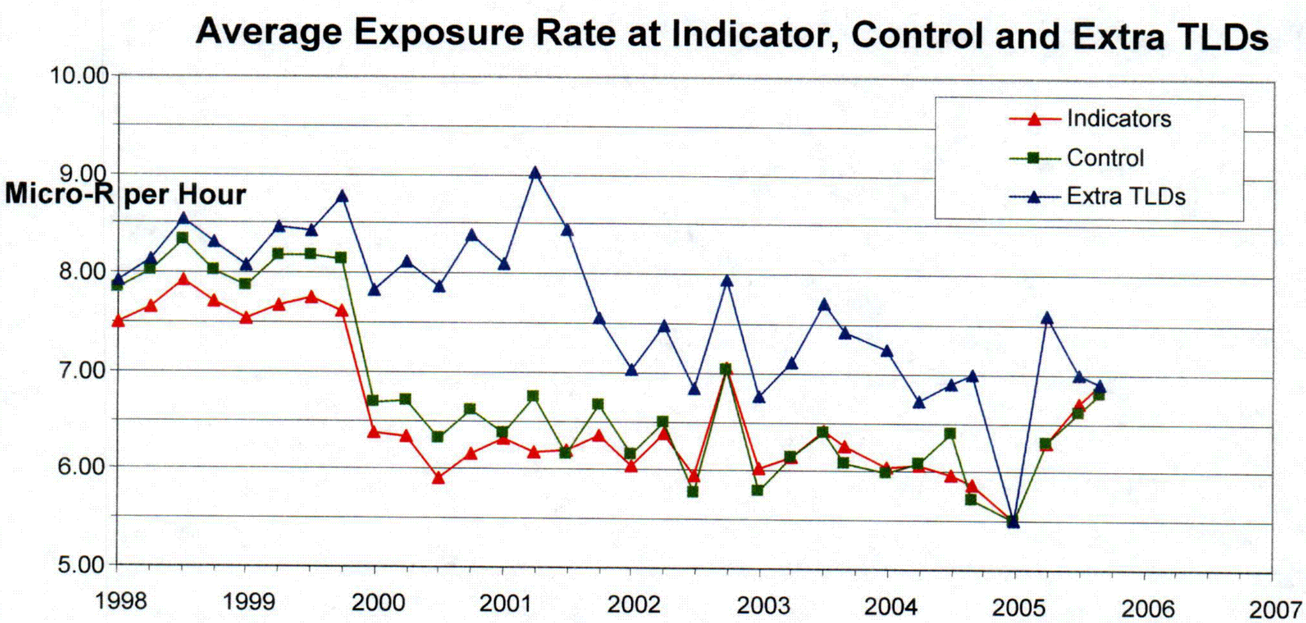


Figure 4.7 shows the exposure rate at all the Indicator TLD locations. There was a slight overall increase in average exposure rate during the latter part of 2005. CYAPCO began self performing REMP field work in July 2005. It is suspected that onsite storage during the time between TLD shipment arrival and TLD dissemination may account for the slight increase. In 2000, the TLDs (Victoreen glass bulb $CaF_2(Mn)$) which had historically been used to measure direct radioactivity around Connecticut Yankee for over 20 years were replaced with Panasonic model UD-804 AS1 TLD. The changeover occurred in February of 2000. The Victoreen glass bulb type TLDs were subject to inherent self-irradiation which was experimentally measured for each dosimeter. This correction for field dosimeters averaged approximately 1 μR/hr. In general, the new Panasonic monthly dosimeters show an average decrease in measured exposure rate by –20% compared to the historical average determined by the Victoreen monthly dosimeters.

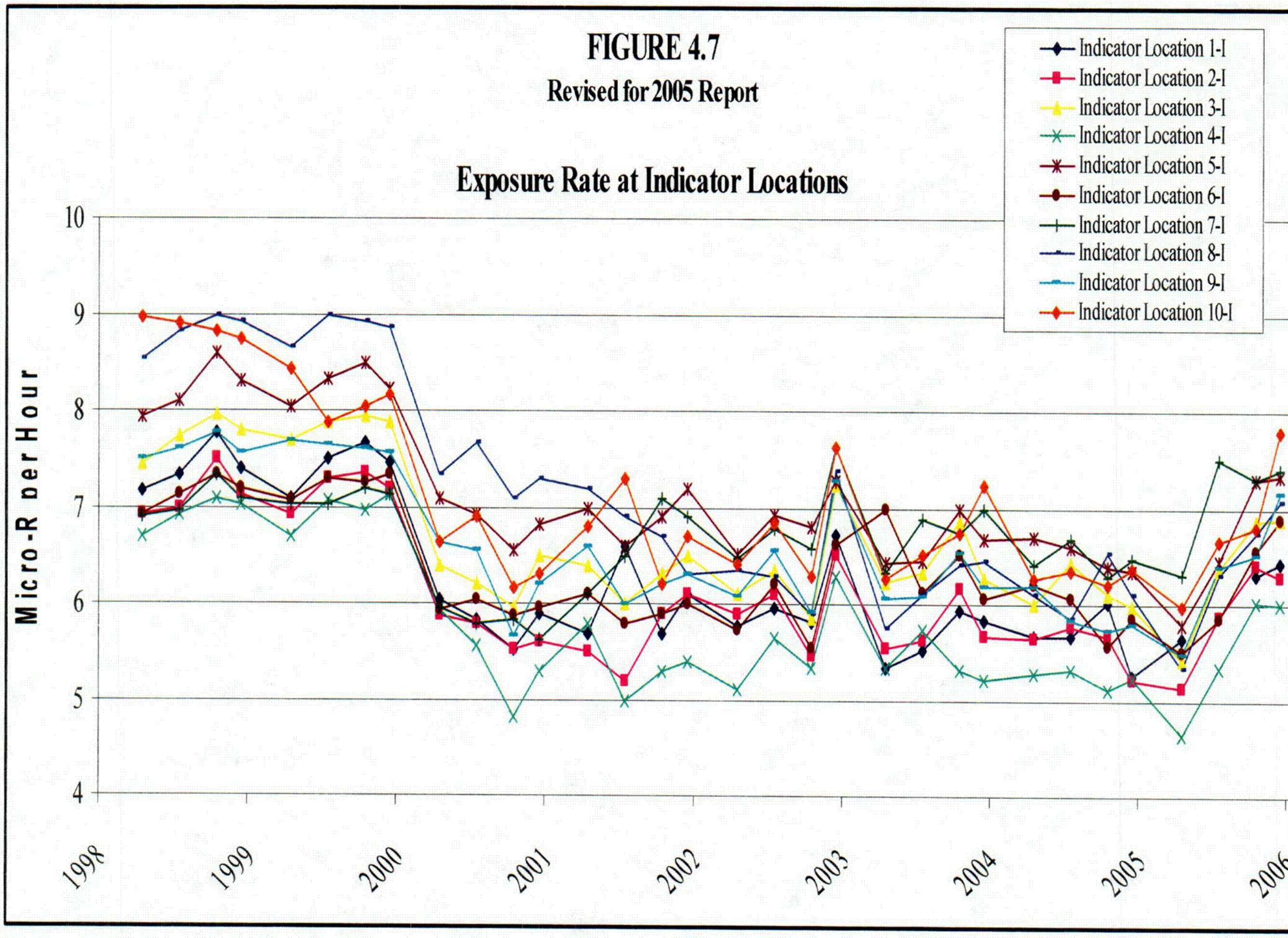
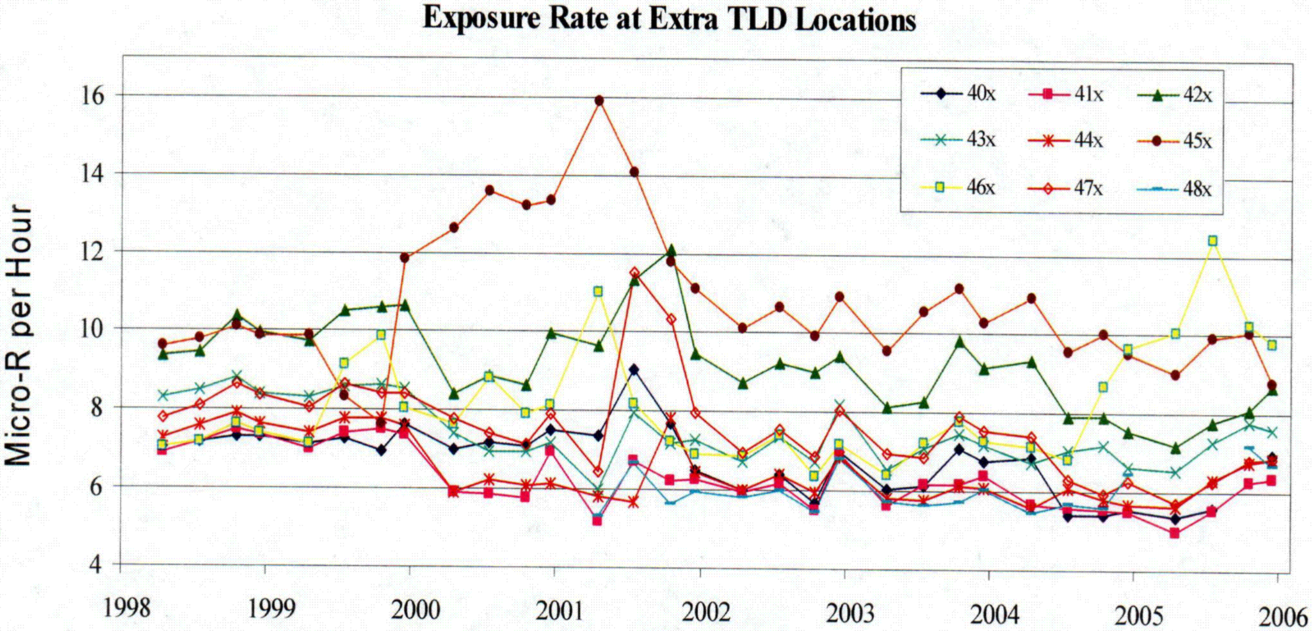


Figure 4.8 shows the exposure rate at the nine Extra TLD locations used to monitor more closely on-site decommissioning activities. TLD #46X showed an increase in exposure rate during 2005. This TLD is located on the north canal fence. Over the course of decommissioning, radioactive material storage area locations frequently changed. During 2005, #46X was located near a large radioactive materials storage area. An increased exposure rate was observed at on-site location #45-X throughout the 2000 and into 2002. This increase was noted toward the end of 1999, coincident with the removal of the steam generators and pressurizer from containment. These components were temporarily stored in the Southeast corner of the Industrial Area 700 feet from location #45-X. The increase in exposure rate due to these components is a localized effect and does not affect an increase in exposure beyond the owner controlled area. The steam generators, reactor head and pressurizer were shipped off site between the second and fourth quarter of 2002. TLD measurements throughout the year demonstrate the general variations in background radiation between the various on-site and off-site locations and include gamma exposure from all sources of radioactivity.

Figure 4.8
Revised for 2005 Report



4.4.10 ISFSI Gamma Exposure Rate

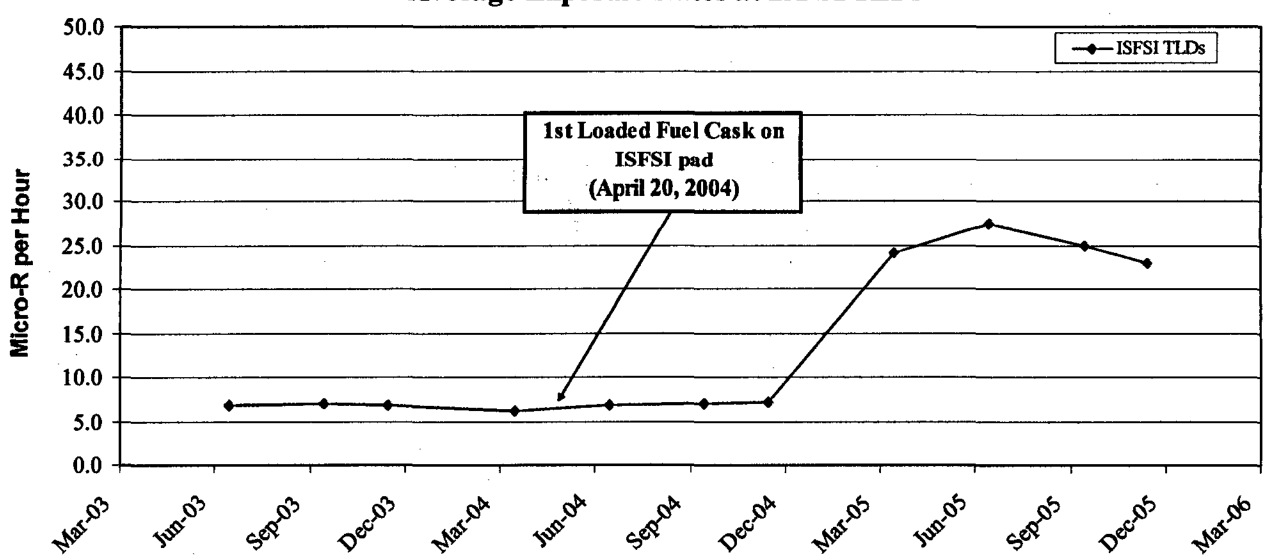
In the second quarter of 2003, additional sampling locations associated with the placement on-site of an Independent Spent Fuel Storage Installation (ISFSI) were selected for the purpose of collecting baseline background information prior to the transfer of spent fuel from the main plant to the ISFSI. These new locations are specific to the ISFSI and are beyond the standard REMP that has been in operation over the life of the power plant's license. New quarterly TLD locations were located in the area surrounding the facility at distances that approximated the site boundary to support future determinations that direct and scatter dose from ISFSI operations remain in compliance with offsite dose limits to the public.

In addition, two locations associated with a hypothetical water pathway were selected for sediment and water sample collections to help confirm that ISFSI operations will have no impact on the wetlands. Figure 4.9 shows the CS-137 levels that exist at both ISFSI sediment locations. Table 3.1 shows that no plant-related nuclides were identified in any of these samples.

Figures 4.9 and 4.10 compare the 2005 ISFSI TLD results with the baseline measurements taken before the first ISFSI canister was placed on the storage facility on April 20, 2004. The initial increase in TLD exposure rate is obviously due to placing fuel and GTCC casks on the ISFSI Pad. The slight decline in TLD exposure rate during 2005 appears to reflect the radioactive decay of the spent fuel and the GTCC material stored on the pad.

Figure 4.9
Revised for 2005 Report

Average Exposure Rates at ISFSI TLDs



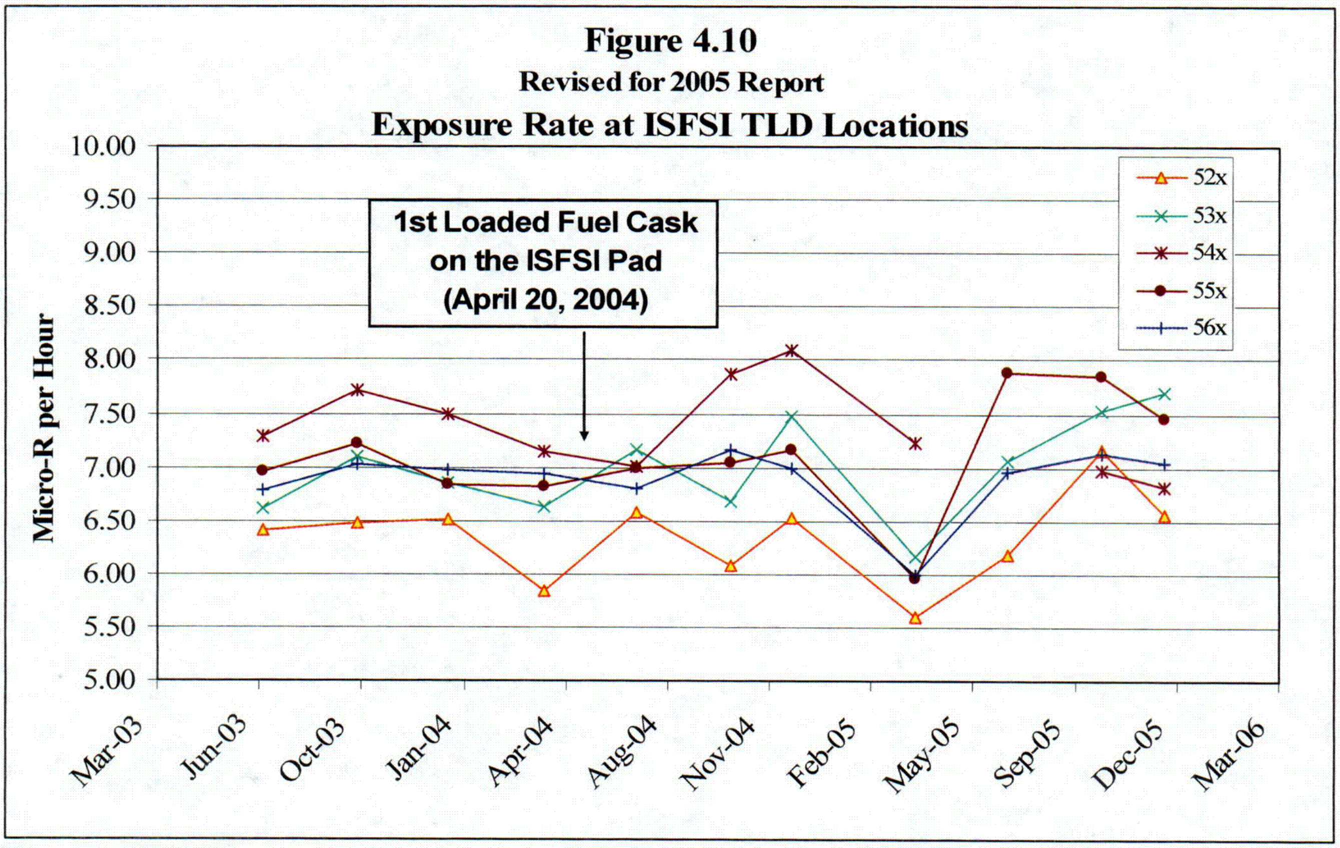


Figure 4.10
Revised for 2005 Report
Exposure Rate at ISFSI TLD Locations
1st Loaded Fuel Cask on the ISFSI Pad (April 20, 2004)
52x
53x
54x
55x
56x
Micro-R per Hour
10.00
9.50
9.00
8.50
8.00
7.50
7.00
6.50
6.00
5.50
5.00
Mar-03
Jun-03
Oct-03
Jan-04
Apr-04
Aug-04
Nov-04
Feb-05
May-05
Sep-05
Dec-05
Mar-06

5.0 OFF-SITE DOSE EQUIVALENT COMMITMENTS

The purpose of this section is to evaluate off-site dose consequences (dose equivalent commitments) associated with the stations' radioactive liquid and airborne effluents. The method utilizes Regulatory Guide 1.109 / REMODCM models and actual measurements of the concentrations of radioactivity in environmental media to compute the dose consequences resulting from the consumption of these foods.

The standards for the maximum dose to an individual of the general public, taken from 40CFR190, is 25 mRem to the whole body, 75 mRem to the thyroid and 25 mRem to any other organ. These standards are a fraction of the average USA background radiation of 300 mRem per year given in NCRP94.

Historically, Cs-137 (mostly from weapons fallout) was identified in the bottom sediment in the area of the plant discharge. Although some may be attributable to plant related operations in past years, these samples represent a pathway that is not involved with a significant exposure to the public. Cs-137 was detected in Predator fish caught from Indicator Stations 29-I and 30-C. The Cs-137 activity for these two samples was above the measured MDC. The measured MDC on these samples was approximately 5 times lower than the required MDC of 150 pCi/L. While Cs137 is an isotope associated with Plant activities, the Cs-137 concentrations detected in the fish most likely came from Cs137 present in the sediment from weapons fallout as the measured concentrations of Cs-137 in the control sample and one of the indicator fish were nearly identical. The Cs-137 activity measured in the fish samples does not represent a significant ingestion pathway from (fish, shellfish, water) for 2005.

References

1. USNRC Radiological Assessment Branch Technical Position, "An Acceptable Radiological Environmental Monitoring Program," Revision 1, November 1979.

2. NCRP Report No. 94, Exposure of the Population in the United States and Canada from Natural Background Radiation, National Council on Radiation Protection and Measurements, 1987.

3. Ionizing Radiation: Sources and Biological Effects, United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), 1982 Report to the General Assembly.

4. Kathren, Ronald L., Radioactivity and the Environment - Sources, Distribution, and Surveillance, Harwood Academic Publishers, New York, 1984.

5. NRC Generic Letter 89-01, Subject: Implementation of Programmatic Controls for Radiological Effluent Technical Specifications in the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of RETS to the Offsite Dose Calculation Manual or to the Process Control Program, dated January 31, 1989.

APPENDIX A

LAND USE CENSUS FOR 2005

2005 Land Use Census Assessment

Due to the current status of the Decommissioning Project, the Land Use Census is not expected to change in a manner that would affect the Radiological Environmental Monitoring Program. The most recent Land Use Census will remain in effect until superseded. During the course of the Decommissioning Project an updated Land Use Census can be obtained at any time as requested or needed. The results of the current applicable Land Use Census are included in this report in compliance with REMODCM Section E-2. The locations identified during the Census are listed in Table A-1. In 2004, Normandeau Associates conducted the Land Use Census and verified the distance and direction for all residence with a portable Global Positioning System (GPS). Pursuant to REMODCM Section E-2, any sampling changes resulting from the Land Use Census must be noted in this report. No changes with the REMP were needed based on this Land Use Census.

TABLE A.1

LAND USE CENSUS LOCATIONS

SECTOR	NEAREST RESIDENCE Km
N	1.18
NNE	1.74
NE	1.69
ENE	1.75
E	2.12
ESE	2.75
SE	1.34
SSE	1.20
S	1.04
SSW	0.93
SW	1.03
WSW	1.22
W	1.40
WNW	0.64
NW	1.09
NNW	1.55

APPENDIX B

Quality Assurance Program

CYAPCO Analytical Laboratory QA and Cross Check Program

Quality Assurance Program

CYAPCO employs a quality assurance program designed to ensure reliable environmental monitoring data. The program includes the use of controlled procedures for all work activities, a nonconformance and corrective action tracking system, systematic internal audits, laboratory quality control and staff training. CYAPCO on-site counting laboratory participates in a 3rd party performance evaluation (PE) program administered by Analytics, Inc on a semi-annual basis. River water samples after July 1st 2005 were analyzed by CYAPCO in the on-site laboratory under the site's Laboratory Quality Assurance Program.

Third Party Cross Check Program

CYAPCO onsite lab participates in a third party cross check program managed by Analytics Inc. to satisfy the requirements of the REMODCM. Unknown spiked samples are processed on a semi-annual basis to evaluate CYAPCO lab performance. The semi-annual cross check results are summarized in Table B.1. Replicate samples were analyzed on multiple detector systems and the average results and standard error on the mean were reported to Analytics. CYAPCO acceptance criteria for these measurements are summarized in Table B.2., according to the requirements of the split sample program. When results fall outside of the acceptance criteria, appropriate, corrective measures are taken. As can be seen in Table B.1 on the next page, all results are within the acceptance (i.e. Agreement) criteria.

Table B.1: Cross Check Results Summary

Nuclide	HNP Value	Known Value	RATIO HNP:Known	Resolution	Comparison
Media: Air Particulate Filter, Analytics # A119946-191, Units (µCi total)					
Ce-141	6.58E-02	6.10E-02	1.08	20	AGREEMENT
Cr-51	6.22E-02	5.82E-02	1.07	20	AGREEMENT
Cs-134	1.26E-02	1.37E-02	0.92	20	AGREEMENT
Cs-137	3.22E-02	2.90E-02	1.11	20	AGREEMENT
Co-58	1.71E-02	1.55E-02	1.11	20	AGREEMENT
Mn-54	2.93E-02	2.48E-02	1.18	20	AGREEMENT
Fe-59	2.17E-02	1.92E-02	1.13	20	AGREEMENT
Zn-65	3.11E-02	2.55E-02	1.22	20	AGREEMENT
Co-60	1.87E-02	1.71E-02	1.10	20	AGREEMENT
Media: Soil, Analytics # A119946-191, Units (µCi/g)					
Ce-141	4.49E-05	4.22E-05	1.06	20	AGREEMENT
Cr-51	4.31E-05	4.03E-05	1.07	20	AGREEMENT
Cs-134	9.33E-06	9.49E-06	0.98	20	AGREEMENT
Cs-137	2.16E-05	2.01E-05	1.07	20	AGREEMENT
Co-58	1.15E-05	1.07E-05	1.07	20	AGREEMENT
Mn-54	1.94E-05	1.71E-05	1.13	20	AGREEMENT
Fe-59	1.50E-05	1.33E-05	1.13	20	AGREEMENT
Zn-65	2.02E-05	1.76E-05	1.15	20	AGREEMENT
Co-60	1.27E-05	1.18E-05	1.07	20	AGREEMENT

Table B.1: Cross Check Acceptance Criteria

Resolution	Agreement Range
4 – 7	0.5 – 2.0
8 – 15	0.6 – 1.66
16 – 50	0.75 – 1.33
51 – 200	0.80 – 1.25
> 200	0.85 – 1.18

AREVA

September 6, 2005
EL 108/05

TO: Distribution

FROM: J. M. Raimondi

SUBJECT: Framatome ANP Environmental Laboratory
Dosimetry Services Semi-Annual Quality Assurance Status Report
(January - June 2005)

Attached for your information and review is the Semi-Annual Status Report covering the Framatome ANP Environmental Laboratory's (E-LAB) Quality Assurance Programs for environmental, extremity, and personnel dosimetry processing for the first half of 2005. During this semi-annual period, 99.0% (297/300) of the individual dosimeters, evaluated against the E-LAB internal performance criteria (high-energy photons only), met the criterion for accuracy and 99.0% (297/300) met the criterion for precision. In addition, 100% (118/118) of the dosimeter sets evaluated against the internal tolerance limits met these criteria.

If you have any questions please contact Christopher Shelton (508) 898-9970 ext. 2500 or myself at (508) 898-9970 ext. 2522.

J. M. Raimondi
Manager, Environmental Laboratory

CAS/cas
Attachment

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FRAMATOME ANP
ENVIRONMENTAL LABORATORY: 29 Research Drive, Westborough, MA 01581-3913
Phone: 508 898-9970 Fax: 508 836-9815 www.us.framatome-anp.com

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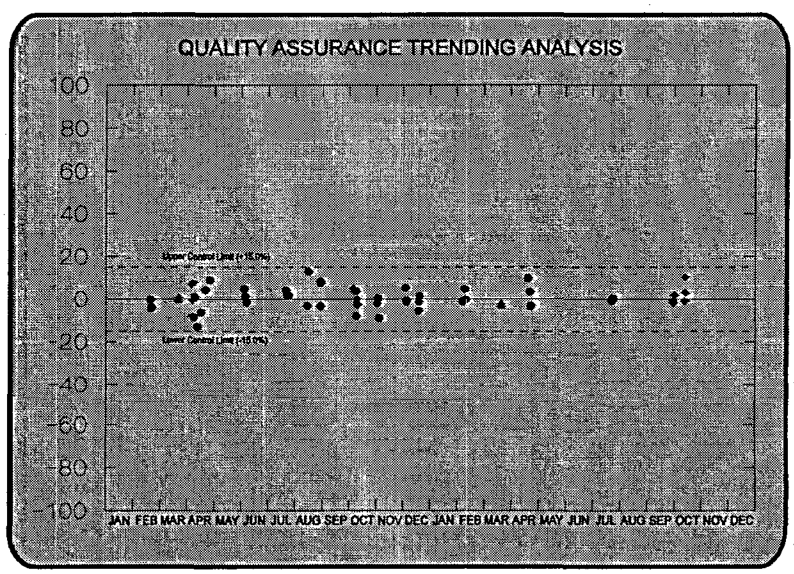
DOSIMETRY SERVICES

SEMI-ANNUAL QUALITY ASSURANCE STATUS REPORT

January – June 2005



FRAMATOME ANP, INC.
ENVIRONMENTAL LABORATORY
29 Research Drive
Westborough, MA 01581-3913
Telephone: (508) 898-9970
Fax: (508) 836-9815

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FRAMATOME ANP
ENVIRONMENTAL LABORATORY

DOSIMETRY SERVICES

SEMI-ANNUAL QUALITY ASSURANCE STATUS REPORT

January-June 2005

EL 108/05

Prepared By:	[signature]	Date:	9/6/2005
Reviewed By:	Jim Girard	Date:	9/13/2005
Approved By:	[signature]	Date:	9/14/2005

Framatome ANP
Environmental Laboratory
29 Research Drive
Westborough, MA 01581-3913

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

LIST OF TABLES

EXECUTIVE SUMMARY

Routine quality control (QC) testing was performed for each type of dosimeter issued by the Framatome ANP Environmental Laboratory (E-LAB) Dosimetry Services Section. The dosimeter types included Panasonic 808 and 814 whole body dosimeters, combination Panasonic 808/814 neutron dosimeters, extremity dosimeters, and Panasonic environmental dosimeters. QC dosimeters were irradiated in-house as well as by a third party. All testing methods used by the accredited third-party tester conform to ANSI N13.11-2001 (Reference 1) or ANSI N13.32-1995 (Reference 2).

The Framatome ANP Environmental Laboratory processed quality control dosimeters that represented over two percent of the nearly thirteen thousand client dosimeters processed during this semi-annual period. The QC percentage for each dosimeter type is listed in Table I. During this semi-annual period, 99.0% (297/300) of the individual dosimeters, evaluated against the E-LAB internal performance criteria (high-energy photons only), met the criterion for accuracy and 99.0% (297/300) met the criterion for precision (Table 2). In addition, 100% (118/118) of the dosimeter sets evaluated against the internal tolerance limits met these criteria (Table 3). Tables 4 and 5 list the third party testing results for this semi-annual period. Trending graphs, which evaluate each dosimeter type, dose depth and performance statistic for High-Energy photon irradiations are given in Appendix A.

NVLAP Certificate of Accreditation and Scope of Accreditation documents for the E-LAB are included in Appendix B.

I. INTRODUCTION

The TLD systems at the Framatome ANP Environmental Laboratory (E-LAB) are calibrated and operated to ensure consistent and accurate evaluation of TLDs. The quality of the dosimetric results reported to E-LAB clients is ensured by the National Voluntary Laboratory Accreditation Program (NVLAP) for dosimetry processing, independent third-party performance testing by Battelle Pacific Northwest Laboratories, in-plant performance testing, and in-house performance testing by the QA Officer and the Dosimetry Services Section.

Standard test methods for in-plant testing of Panasonic whole body and extremity dosimeters are described in the E-LAB report entitled "In-Plant External Dosimetry Quality Assurance Testing Program" (Reference 3). This protocol provides standard test methods that may be used at plant sites utilizing E-LAB dosimeters. The plants have developed their own dosimetry test procedures modeled after Reference 3.

The purpose of the dosimetry quality assurance program is to provide performance documentation of the routine processing of E-LAB dosimeters. This testing provides a statistical measure of the bias and precision of the processing against a reliable standard, which in turn points out any trends or performance changes. Two programs are used:

A. QC Program

Independent outside dosimetry quality control tests are performed on E-LAB Panasonic 808 and 814 whole body dosimeters, combination Panasonic 808/814 neutron dosimeters, extremity, and Panasonic environmental dosimeters. Tests include: (1) third-party testing, (2) the in-plant testing program conducted by various users of E-LAB dosimetry, and (3) the in-house testing program conducted by the E-LAB QA Officer. This testing ensures that dosimeters are irradiated to each ANSI testing category at least once every two years, and submitted as "unknowns" to the Dosimetry Services Section for processing (Reference 1). Additionally, each dosimeter type is tested for photon mixtures quarterly.

Excluded from this report are instrumentation checks conducted by the Dosimetry Services Section. Although instrumentation checks represent an important aspect of the quality assurance program, they are not included as process checks because the doses are known by the processors. Instrumentation checks represent between 5-10% of the TLDs processed. In addition, internal quality control tests, periodically performed by the Dosimetry Services Section, and client initiated quality control tests are not included in this report.

B. QA Program

An internal assessment of Dosimetry Services Section activities is conducted annually by the Laboratory Quality Assurance Officer (Reference 4). The purpose of the assessment is to review analytical procedures, results, materials or components that may indicate opportunities to improve or enhance processes and/or services.

II. PERFORMANCE EVALUATION CRITERIA

A. Performance Statistics

All evaluation criteria are taken from the "Dosimetry Services Section Quality System Manual", Reference 5.

1. Bias

a. For each dosimeter tested, the measure of bias is the percent deviation of the reported result relative to the delivered dose. The percent deviation relative to the delivered dose is calculated as follows:

$$\frac{(H_i' - H_i)}{H_i}100$$

where:

H_i' = the corresponding reported dose for the ith dosimeter (i.e., the reported dose)

H_i = the dose delivered to the ith irradiated dosimeter (i.e., the delivered dose)

b. For each group of test dosimeters, the mean bias is the average percent deviation of the reported result relative to the delivered dose. The mean percent deviation relative to the delivered dose is calculated as follows:

$$\sum\left(\frac{(H_i' - H_i)}{H_i}\right)100\left(\frac{1}{n}\right)$$

where:

H_i' = the corresponding reported dose for the ith dosimeter (i.e., the reported dose)

H_i = the dose delivered to the ith irradiated test dosimeter (i.e., the delivered dose)

n = the number of dosimeters in the test group

2. Precision

For a group of test dosimeters irradiated to a given dose, the measure of precision is the percent deviation of individual results relative to the mean reported dose. At least two values are required for the determination of precision. The measure of precision for the ith dosimeter is:

$$\left(\frac{(H_i' - \bar{H})}{\bar{H}}\right)100$$

where:

H_i' = the reported dose for the ith dosimeter (i.e., the reported dose)

$\bar{H}$ = the mean reported dose; i.e., $\bar{H} = \sum H_i'\left(\frac{1}{n}\right)$

n = the number of dosimeters in the test group

3. American National Standards Institute Performance Statistics

The American National Standards Institute (ANSI) provides a method of characterizing the performance of protection dosimetry in "Personnel Dosimetry Performance - Criteria for Testing" (Reference 1).

a. The performance in a given test category is considered adequate if for the shallow and/or deep dose equivalents (or the absorbed dose):

$$|B| + S \leq L$$

where:

B = the bias of the performance quotient

S = the standard deviation of the performance quotient

L = the tolerance level

b. The bias of the values of the performance quotient, $\bar{P}$ is set equal to the average of these values:

$$B = \bar{P} = \left(\frac{1}{n}\right)\left(\sum P_i\right)$$

where:

The performance quotient, P_i, for the ith dosimeter is defined as:

$$P_i = \frac{[H_i' - H_i]}{H_i}$$

and:

H_i' = the corresponding reported dose equivalent for the ith dosimeter (i.e., the reported dose)

H_i = the dose delivered to the ith irradiated dosimeter (i.e., the delivered dose)

c. The standard deviation of the values of the performance quotient, P_i, is:

$$S = \left[\frac{\left[\Sigma \left(P_i - \bar{P} \right)^2 \right]}{(n-1)} \right]^{\frac{1}{2}}$$

where:

n-1 represents the unbiased sample population, where the summation is performed over all n values of P_i for a particular test in a given radiation category, and for a particular phantom depth (shallow or deep).

B. Tolerance Limits

1. E-LAB Internal Limits

Tolerance limits for bias and precision applied to in-house and accredited third party testing were adopted on November 13, 1987.

These criteria are only applied to individual test dosimeters irradiated with high-energy photons (Cs-137 or Co-60) and are as follows:

Dosimeter Type	Tolerance Limits	
	Bias	Precision
Panasonic Whole Body	± 18.5%	± 16.1%
Extremity	± 32.6%	± 27.2%
Panasonic Environmental	± 20.1%	± 12.8%

The results of dosimeters evaluated against these criteria are summarized in Table 2. Trending graphs for a particular badge type or depth can be found in Appendix A.

2. Internal Tolerance Limits

Further performance testing control limits were added in 1998 to evaluate the sum of bias and precision values for all irradiation categories, not just for high-energy photons. A ±30% tolerance limit was applied to the sum of the bias and precision values for all whole body and environmental dosimeters, while a ±50% tolerance limit was applied for extremity dosimeters. Dosimeters processed during this semi annual period were evaluated against these criteria and the results are shown in Table 3 and Appendix A.

3. American National Standards Institute Tolerance Level (L)

The tolerance level, L, given in Reference 1, is: (a) 0.3 in the accident category I; and (b) 0.4 in the protection categories II through VI. ANSI

N13.11-2001 (Reference 1) includes additional limits on the Performance Quotient Limit (PQL) for Categories II, IV, and V for deep and shallow depths and Category III for shallow depth only. This criterion requires that no more than one of fifteen dosimeters tested in each category may have a bias that exceeds the tolerance level (L).

C. QC Investigation Criteria

E-LAB Manual 120 (Reference 5) specifies the investigative criteria applied to a QC analysis that has failed the E-LAB bias criteria. The criteria are as follows:

1. No investigation is necessary when an individual QC result falls outside the QC performance criteria for accuracy.

2. Investigations are initiated when the mean of a QC processing batch is outside the performance criterion for bias.

3. An investigation is initiated when the trending of at least twelve consecutive processing QC batches for a given process (specific depth dose or dosimeter type) indicates that the mean bias from the known is greater than 60% of the applicable performance criterion.

D. Reporting of Analytical Results

The following guidelines were developed, applicable to reporting of results:

1. All results are to be reported in a timely fashion.

2. If the QA Officer determines that an investigation is required for a process, the results shall be issued as normal. If the QC results, prompting the investigation, have a mean bias from the known of greater than ±20% for environmental dosimetry and greater than ±30% for personnel dosimetry, the results shall be issued with a note indicating that they may be updated in the future, pending resolution of a QA issue.

3. Environmental dosimetry results do not require updating if the investigation has shown that the mean bias between the original results and the corrected results, based on applicable correction factors from the investigation, does not exceed ±20%.

4. Personnel dosimetry results do not require updating if the investigation has shown that the mean bias between the original results and the corrected results, based on applicable correction factors from the investigation, does not exceed ±30%.

III. DATA SUMMARY FOR REPORTING PERIOD JANUARY-JUNE 2005

A. General Discussion

In the sections that follow, the results of performance tests conducted for each type of dosimeter are summarized and discussed. Summaries of the performance tests for the reporting period are given in Tables 2 through 5 and Figures 1 through 31. Results are presented only for performance tests conducted under well-characterized conditions. Where appropriate, results are reported for three depths (7 mg/cm^2, 300 mg/cm^2, and 1000 mg/cm^2) and plotted over the six-month period January-June 2005.

Table 2 provides a summary of individual dosimeter results evaluated against the E-LAB internal acceptance criteria for high-energy photons only (category IV). During this semi-annual period, 99.0% (297/300) of the individual dosimeters, evaluated against these criteria met the tolerance limits for accuracy and 99.0% (297/300) met the criterion for precision.

Table 3 provides a summary of the |B| + S results for each group (N=6) of dosimeters evaluated against the internal tolerance criteria. The data in Table 3 is tabulated by badge type and applies to all ANSI required and non-required categories (see Tables 4 and 5) with the exception of the Category V.A. evaluation at the eye depth (300 mg/cm^2). Overall, 100% (118/118) of the dosimeter sets evaluated against the internal tolerance performance criteria met these criteria.

Tables 4 and 5 present the third party testing results for dosimeters processed during this semi-annual period. Irradiation times occurred during the fourth quarter of 2004 and first quarter of 2005. The results have been separated into NVLAP required categories (Table 4) and non-required tests (Table 5). The environmental TLDs have been included with the non-required group.

B. Result Trending

1. Panasonic Whole Body Dosimeters

One of the main benefits of performing quality control tests on a routine basis is to point out trends or performance changes. Trends or changes are best illustrated in the form of trending graphs where performance is tracked over time. The results of performance tests of Panasonic 808 and 814 whole body dosimeters are presented in Figures 1 through 24 for Category IV irradiations. The results are evaluated against each of the performance criteria listed in Section II, namely: individual dosimeter bias, individual dosimeter precision, and |B| + S. Results are also evaluated for mean bias in accordance with the investigation criteria given in Section II.C.

All of the results presented in Figures 1 through 24 are fade corrected to the irradiation date and plotted sequentially by processing date. This allows assessment of performance without the confounding effect of the variation in number of days between readout and irradiation. Therefore, the results include any bias produced by the fade algorithm.

If fade is not corrected to the date of irradiation, the possibility of a bias due to signal fading exists. When the Dosimetry Services Section processes a TLD, the software calculates a fade correction using one half the number of days between the processing date and the anneal date. The use of the midpoint for fade correction can bias the results of performance tests of TLDs irradiated at either the beginning or end of a wear period. Results for performance tests conducted near the beginning of the period will be biased low and those irradiated near the end of a period will be biased high, assuming there are no other system biases.

In some cases (i.e., when TLDs are irradiated at the end of the wear period and fade corrected to the midpoint) the results of the performance test may fall outside of the control limits even though the system is performing correctly. Therefore, to allow the assessment of performance test results without the TLD signal confounding the data, all Panasonic 808 and 814 test results presented in the tables have been fade corrected to the actual date of irradiation.

Figures 1 through 3 depict the individual bias of each of 54 Panasonic 808 dosimeters, evaluated at three different depths, and plotted sequentially according to processing date. The failure rate was 0% (0/54) for the shallow, eye, and deep depths. The failure rate for individual precision was 0% for the shallow, eye, and deep depths (Figures 4-6). The failure rate for the mean bias was 0% for all three depths (Figures 7-9). Finally, Figures 10-12 depict the |B| + S statistic for each group of 808 dosimeters at each depth. All test sets (9 at each depth) met the internal tolerance criteria of |B|+S < 0.3.

Figures 13 through 15 depict the individual bias of each of 138 Panasonic 814 dosimeters, evaluated at three different depths, versus the date of processing. The failure rate was 0.7% (1/150) for the shallow, eye and deep depths. The failure rate for individual precision was 0% for the shallow and eye depth and 0.7% (1/150) for the deep depth (Figures 16-18). The failure rate for mean bias at all three depths (Figures 19-21) was 0%. As shown in Figures 22-24, 100% of the 25 814 test sets, evaluated at each depth, met the internal tolerance criteria of |B|+S < 0.3.

2. Extremity Dosimeters

Extremity results plotted in Figures 25 -28 are for performance tests conducted at the E-LAB and an accredited third-party testing organization. For all individual extremity TLDs, evaluated during this semi-annual period, 0% (0/48) failed the E-LAB limit for bias of +/- 32.6% (Figure 25). The failure rate was 4.2% (2/48) for precision (tolerance limit of 27.2%) as shown in Figure 26. None of the 8 TLD test sets (n=6) were outside the mean bias limit as shown in Figure 27. For the same reporting period, 100% of the 8 extremity QC test sets met the internal tolerance criteria for bias and precision (|B| + S, Figure 28).

3. Panasonic Environmental Dosimeters

The trending results of performance tests of Panasonic environmental dosimeters are presented in Figures 29-31. For individual Panasonic environmental TLDs, 100% of the 48 tests came within the E-LAB bias and precision tolerance limits (Figures 29 and 30). All 8 Panasonic environmental TLD test sets (mean bias, n=6) were reported within the internal tolerance criteria for bias (Figure 31).

IV. STATUS OF E-LAB CONDITION REPORTS (CR)

During this semi-annual period there were no E-LAB Condition Reports (CR) issued to the Dosimetry Services Section. There are no remaining open action items.

V. STATUS OF AUDITS/ASSESSMENTS

A. Internal

There were no internal audits conducted in the Dosimetry area during the first half of 2005. The annual internal dosimetry audit is scheduled for the third quarter of 2005.

B. External

There were no external audits conducted in the Dosimetry area during the first half of 2005. The biennial NVLAP audit is scheduled for the second half of 2005.

VI. UPDATED PROCEDURES ISSUED DURING JANUARY-JUNE 2005

A list of Dosimetry Services Section procedures, which were updated during this semi-annual period, is included in Table 6.

VII. CONCLUSION AND RECOMMENDATIONS

Inter and intra-laboratory quality control evaluations continue to indicate the whole body, environmental, and extremity dosimetry processing programs at the E-LAB satisfy the criteria specified in the Dosimetry QA Manual. The E-LAB demonstrated the ability to meet all applicable acceptance criteria with a frequency of greater than 99%.

VIII. REFERENCES

1. American National Standard for Dosimetry - Personnel Dosimetry Performance Criteria for Testing, ANSI N13.11-2001, American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018.

2. American National Standard for Performance Testing of Extremity Dosimeters, ANSI N13.32-1995, Health Physics Society, 1313 Dolley Madison Blvd., Suite 402, McLean, VA 22101.

3. "In-Plant External Dosimetry Quality Assurance Testing Program," E-LAB, Revision 2, December 1986.

4. Framatome ANP Environmental Laboratory Quality Control and Audit Assessment Schedule, 2005.

5. E-LAB Manual No.120, Dosimetry Services Section Quality System Manual, Rev 9, June 10, 2004.

TABLE 1

SUMMARY OF NUMBER OF DOSIMETERS PROCESSED, INDEPENDENT PERFORMANCE TESTS AND PERCENT QC

January-June 2005

Dosimeter Type	Number Processed	Number Tested	% QC
Panasonic 808 Whole Body	0	54	N/A
Panasonic 814 Whole Body	9545	150	1.57
Panasonic 808/814 Neutron Dosimeters	721	0	0.00
Extremity	490	48	9.80
Panasonic Environmental	2038	48	2.36
TOTAL	12,794	300	2.34

TABLE 2

PERCENTAGE OF INDIVIDUAL ANALYSES WHICH PASSED E-LAB INTERNAL CRITERIA
January-June 2005 [1]

Dosimeter Type	Number of Dosimeters	Shallow (7 mg/cm^2)		Eye (300 mg/cm^2)		Deep (1000 mg/cm^2)	
		% Passed Bias Tolerance Limit[2]	% Passed Precision Tolerance Limit[3]	% Passed Bias Tolerance Limit[2]	% Passed Precision Tolerance Limit[3]	% Passed Bias Tolerance Limit[2]	% Passed Precision Tolerance Limit[3]
Panasonic 808 Whole Body	54	100	100	100	100	100	100
Panasonic 814 Whole Body	150	99.3	100	99.3	100	99.3	99.3
Extremity	48	100	95.8	No test	No test	No test	No test
Panasonic Environmental	48	100 (free in air)	100 (free in air)	No test	No test	No test	No test

(1) This table summarizes results of all depths for performance tests conducted by E-LAB and the Third-party tester for High Energy Photons.

CONTROL LIMITS FOR E-LAB DOSIMETRY PERFORMANCE TESTS -
APPLICABLE TO INDIVIDUAL TEST DOSIMETERS IRRADIATED TO HIGH ENERGY PHOTONS

Dosimeter Type	Tolerance Limits	
	Bias	Precision
Panasonic Whole Body	± 18.5%	± 16.1%
Extremity	± 32.6%	± 27.2%
Panasonic Environmental	± 20.1%	± 12.8%

(2) The percent deviation of individual results from the delivered dose is used to measure bias.
(3) The percent deviation of individual results from the mean reported dose is used to measure precision.

TABLE 3

PERCENTAGE OF MEAN ANALYSES (N=6) WHICH PASSED TOLERANCE CRITERIA

January-June 2005 [1]

	Shallow (7 mg/cm^2)		Eye (300 mg/cm^2)		Deep (1000 mg/cm^2)	
Dosimeter Type	**Number of Evaluations**	**% Passed Tolerance Limit[2]**	**Number of Evaluations**	**% Passed Tolerance Limit[2]**	**Number of Evaluations**	**% Passed Tolerance Limit[2]**
Panasonic 808 Whole Body	9	100	9	100	9	100
Panasonic 814 Whole Body	25	100	25	100	25	100
Panasonic 808/814 Neutron Dosimeter	0[3]	100	0[3]	100	0[3]	100
Extremity	8	100	N/A	No test	N/A	No test
Panasonic Environmental[4]	8	100	N/A	No test	N/A	No test

(1) This table summarizes results of all depths for performance tests conducted by E-LAB and the Third-party tester.
(2) The mean percent deviation of individual results from the delivered dose is used to determine the bias. The standard deviation of the individual results relative to the mean bias is added to this value to determine the overall performance (|B|+S).
(3) Category VIII has two sets of results at the "deep" depth, (neutron component and neutron/photon mixtures).
(4) Environmental dosimeter results are free in air.

TABLE 4

SUMMARY OF THIRD PARTY QC RESULTS FOR
FOURTH QUARTER 2004 AND FIRST QUARTER 2005
(NVLAP Required Categories)

Dosimeter Type	Exposure Period	NVLAP Category[1]	Shallow (7 mg/cm^2) [2]		Deep (1000 mg/cm^2) [2]	
			Bias% [3,4] ± Std. Dev.%	|B| +S	Bias%[3,4] ± Std. Dev.%	|B| +S
808	[6]	I.A	N/A	N/A		
808	Q4/2004	II.A	7.0 ± 2.3	0.093	2.8 ± 1.6	0.045
808	Q1/2005	II.A	3.5 ± 4.9	0.084	1.6 ± 5.5	0.070
808	[6]	III.A	N/A	N/A		
808	[6]	IV.A				
808	[6]	V.AB				
814	[6]	I.A	N/A	N/A		
814	Q4/2004	II.A	1.0 ± 4.4	0.054	1.8 ± 4.7	0.065
814	Q1/2005	II.A	-3.4 ± 2.9	0.063	-3.2 ± 2.6	0.058
814		III.A	N/A	N/A		
814		IVA				
814	[6]	V.AB				
808/814	[6]	VI.CB	N/A	N/A		
808/814	[6]	VI.CB[5]	N/A	N/A		
808/814	[6]	VI.CB	N/A	N/A		
808/814	[6]	VI.CB[5]	N/A	N/A		
Extremity	Q4/2004	IV.A	-18.0 ± 12.2	0.302	N/A	N/A
Extremity	Q1/2005	IV.A	-3.4 ± 8.4	0.118	N/A	N/A
Extremity	[6]	IV.B			N/A	N/A
Extremity	[6]	IV.B			N/A	N/A
Extremity	[6]	V.C			N/A	N/A
Extremity	[6]	V.D			N/A	N/A

TABLE 4

SUMMARY OF THIRD PARTY QC RESULTS FOR
FOURTH QUARTER 2004 AND FIRST QUARTER 2005
(NVLAP Required Categories)
(continued)

(1) 808/814/808+814 NVLAP Category Key:

I.A = Accident, Photons, General
II.A = Photons, General
III.A = Betas, General
IV.A = Photon Mixtures, General
V.AB = Beta/Photon Mixtures
VI.CB = Neutron/Photon mixtures

Extremity NVLAP Category Key:

IV.A = High Energy Photons (Cs-137)
IV.B = High Energy Photons (Co-60)
V.C = Beta Particles, General (Sr/Y-90, Tl-204)
VI.D = Beta Particles, Slab Uranium

(2) Reported results are fade corrected to the date of irradiation for all dosimeter types other than extremity and environmental.

(3) The bias (B) is calculated as the mean of the percent deviations of individual results from the delivered dose.

(4) The standard deviation (S) is calculated from the deviation of individual biases from the mean bias.

(5) Category VI.CB Neutron component only

(6) These categories were not tested during this semi-annual period.

TABLE 5

SUMMARY OF THIRD PARTY QC RESULTS FOR
FOURTH QUARTER 2004 AND FIRST QUARTER 2005
(NVLAP Non-Required Categories)

Dosimeter Type	Exposure Period	NVLAP Category(1)	Shallow (7 mg/cm^2) (2)		Eye (300 mg/cm^2) (2)	
			Bias% (3,4) ± Std. Dev.%	|B| +S	Bias% (3,4) ± Std. Dev.%	|B| +S
808	(8)	I.A				
808	Q4/2004	II.A	N/A	N/A	3.8 ± 1.8	0.057
808	Q1/2005	II.A	N/A	N/A	2.3 ± 4.6	0.069
808	(8)	III.A				
808	(8)	IV.A	N/A	N/A		
808	(8)	V.AB	N/A	N/A		(7)
814	(8)	I.A				
814	Q4/2004	II.A	N/A	N/A	1.0 ± 4.4	0.054
814	Q1/2005	II.A	N/A	N/A	-4.0 ± 2.6	0.067
814		III.A				
814		IV.A	N/A	N/A		
814	(8)	V.AB	N/A	N/A		(7)
808/814	(8)	VI.CB				
808/814	(8)	VI.CB(5)	N/A	N/A	N/A	N/A
808/814	(8)	VI.CB				
808/814	(8)	VI.CB(5)	N/A	N/A	N/A	N/A
Environ.(6)	Q4/2004	IV	8.2 ± 2.5	0.107	N/A	N/A
Environ.(6)	Q1/2005	IV	0.1 ± 1.6	0.017	N/A	N/A

TABLE 5

SUMMARY OF THIRD PARTY QC RESULTS FOR
FOURTH QUARTER 2004 AND FIRST QUARTER 2005
(NVLAP Non-Required Categories)
(continued)

(1) 808/814/808+814 NVLAP Category Key:

I.A = Accident, Photons, General
II.A = Photons, General
III.A = Betas, General
IV.A = Photon Mixtures, General
V.AB = Beta/Photon Mixtures
VI.CB = Neutron/Photon mixtures

Extremity NVLAP Category Key:

IV.A = High Energy Photons (Cs-137)
IV.B = High Energy Photons (Co-60)
V.C = Beta Particles, General (Sr/Y-90, Tl-204)
VI.D = Beta Particles, Slab Uranium

(2) Reported results are fade corrected to the date of irradiation for all dosimeter types other than extremity and environmental.

(3) The bias (B) is calculated as the mean of the percent deviations of individual results from the delivered dose.

(4) The standard deviation (S) is calculated from the deviation of individual biases from the mean bias.

(5) Category VI.CB Neutron component only.

(6) Results are expressed as the delivered exposure (not dose) for environmental TLDs.

(7) Internal acceptance criteria for this test are currently being evaluated.

(8) These categories were not tested during this semi-annual period.

TABLE 6

UPDATED INSTRUMENTATION GROUP DOSIMETRY SERVICES SECTION
PROCEDURES ISSUED DURING JANUARY-JUNE 2005

Procedure Number	Title	Revision Number	Date
750	Laboratory Training and Qualification Guideline	12 Interim Change	03/01/05 06/14/05

APPENDIX A

DOSIMETRY QUALITY CONTROL TRENDING GRAPHS

JANUARY-JUNE 2005

APPENDIX A

DOSIMETRY QUALITY CONTROL TRENDING GRAPHS
January-June 2005

LIST OF FIGURES

APPENDIX A

DOSIMETRY QUALITY CONTROL TRENDING GRAPHS
January-June 2005

23. 814 Category II (High-Energy Photons) Mean Bias Plus Standard Deviation (B+S) at the Eye Depth Dose

24. 814 Category II (High-Energy Photons) Mean Bias Plus Standard Deviation (B+S) at the Deep Depth Dose

25. Extremity Category IV (High-Energy Photons) Individual Bias at the Shallow Depth Dose

26. Extremity Category IV (High-Energy Photons) Individual Precision at the Shallow Depth Dose

27. Extremity Category IV (High-Energy Photons) Mean Bias at the Shallow Depth Dose

28. Extremity Category IV (High-Energy Photons) Mean Bias Plus Standard Deviation (B+S) at the Shallow Depth Dose

29. Environmental TLDs Individual Bias Cs-137

30. Environmental TLDs Precision Cs-137

31. Environmental TLDs Mean Bias Cs-137

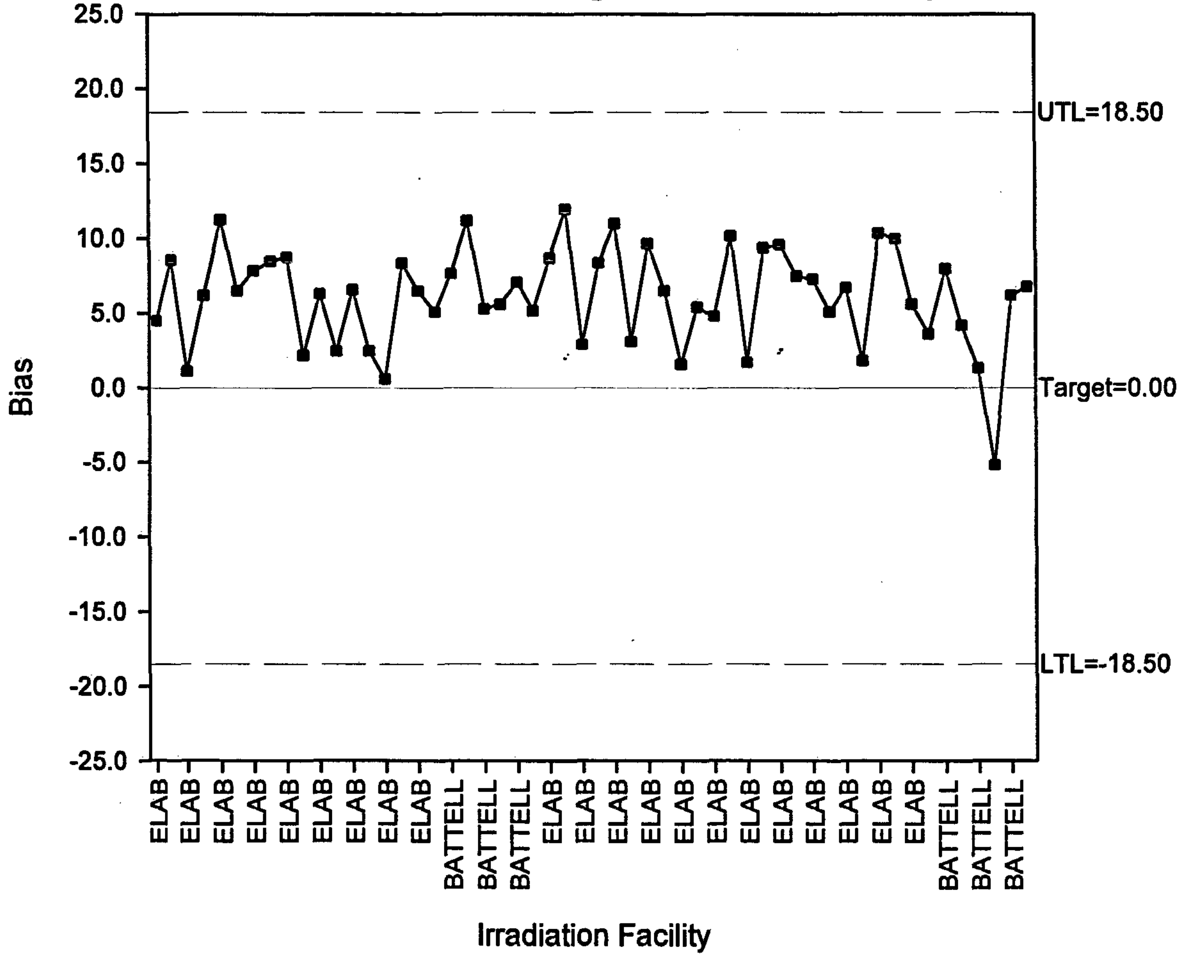
APPENDIX A
QC TESTING DATA FOR THE SEMI-ANNUAL PERIOD
January-June 2005

FIGURE 1

Process Statistics

Total:	54
Rows:	All
Mean:	6.120
Median:	6.500
Std Dev:	3.346
Act % out of TL:	0.00

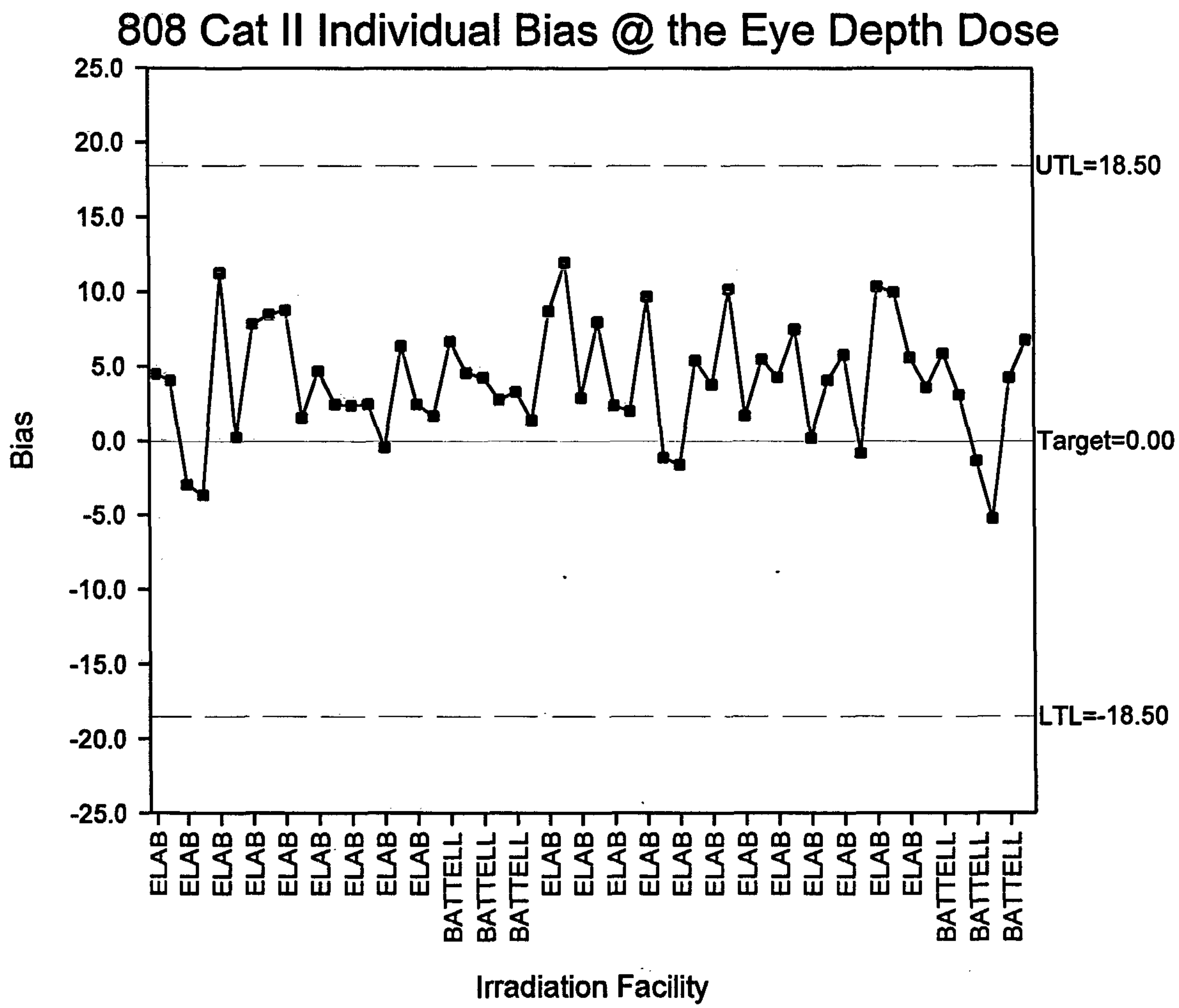
808 Cat II Individual Bias @ the Shallow Depth Dose



APPENDIX A
QC TESTING DATA FOR THE SEMI-ANNUAL PERIOD
January-June 2005

FIGURE 2

Process Statistics	
Total:	54
Rows:	All
Mean:	4.070
Median:	4.100
Std Dev:	3.882
Act % out of TL:	0.00



APPENDIX A
QC TESTING DATA FOR THE SEMI-ANNUAL PERIOD
January-June 2005

FIGURE 3

Process Statistics

Total:	54
Rows:	All
Mean:	2.120
Median:	2.250
Std Dev:	3.989
Act % out of TL:	0.00

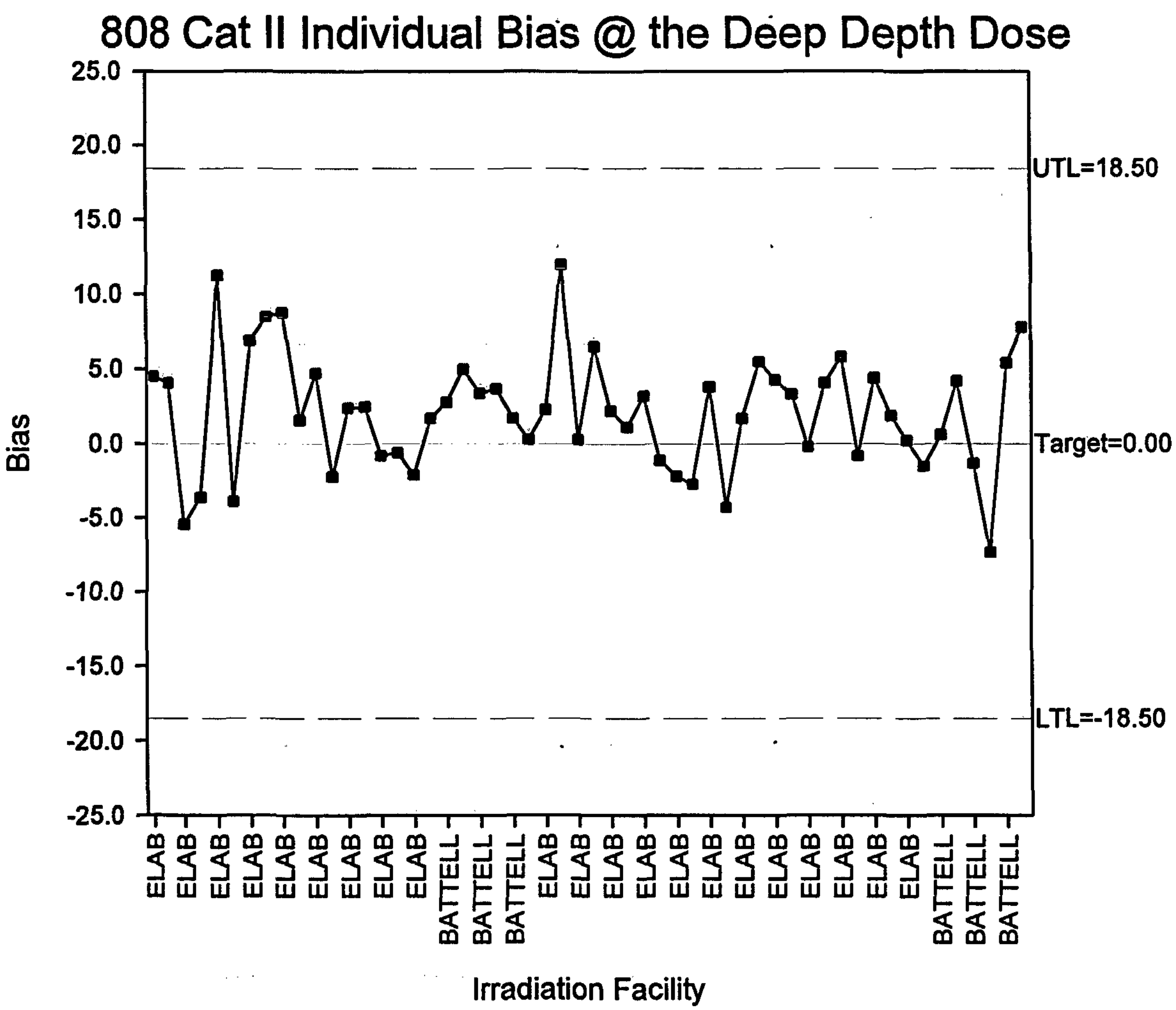


FIGURE 4

Process Statistics

Total:	54
Rows:	All
Mean:	-0.002
Median:	0.250
Std Dev:	2.974
Act % out of TL:	0.00

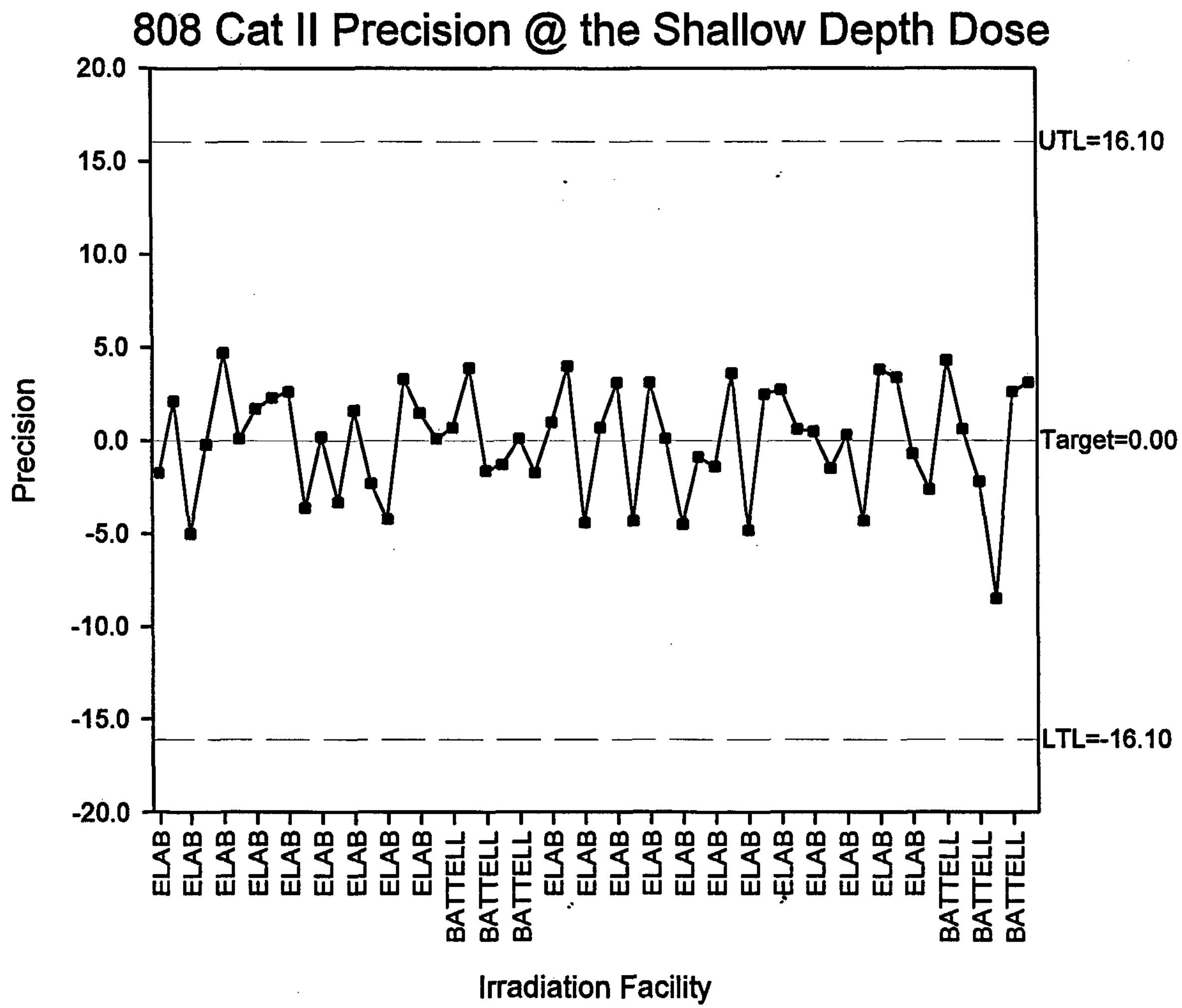


FIGURE 5

Process Statistics

Total:	54
Rows:	All
Mean:	-0.002
Median:	0.050
Std Dev:	3.482
Act % out of TL:	0.00

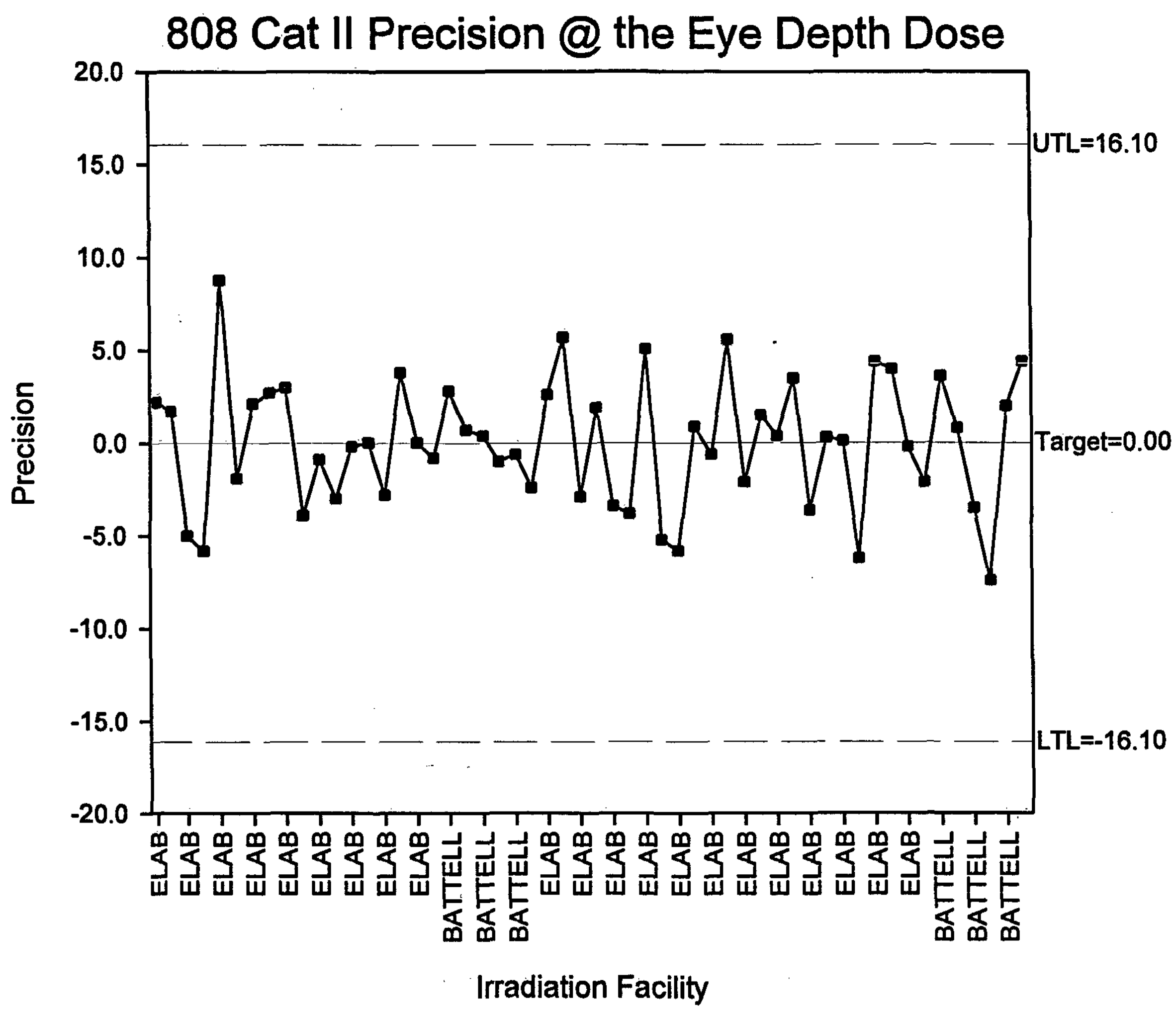


FIGURE 6

Process Statistics

Total:	54
Rows:	All
Mean:	0.002
Median:	0.000
Std Dev:	3.576
Act % out of TL:	0.00

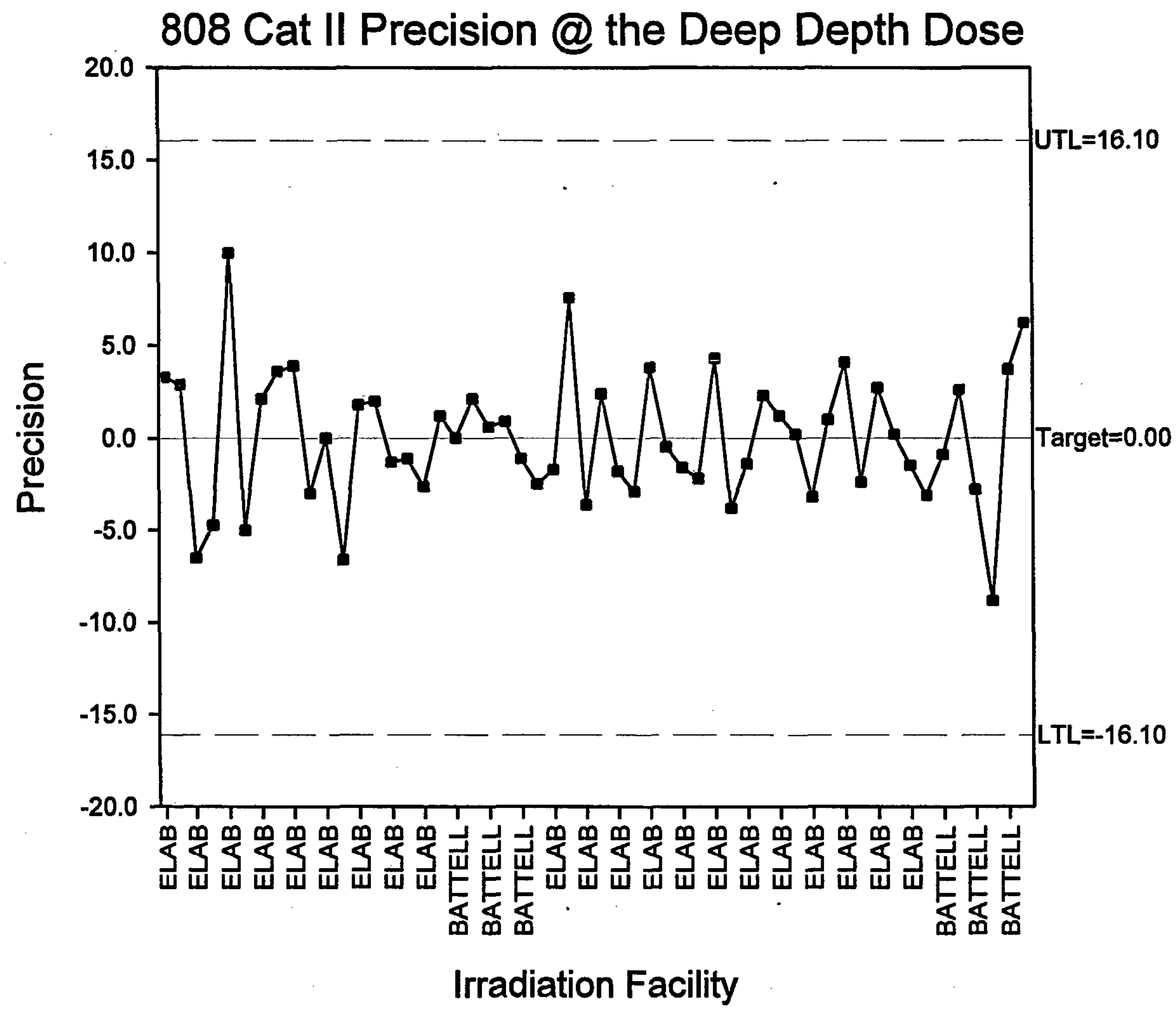


FIGURE 7

Process Statistics

Total:	9
Rows:	All
Mean:	6.122
Median:	6.400
Std Dev:	1.228
Act % out of TL:	0.00

Chart Point

Label:
Value:

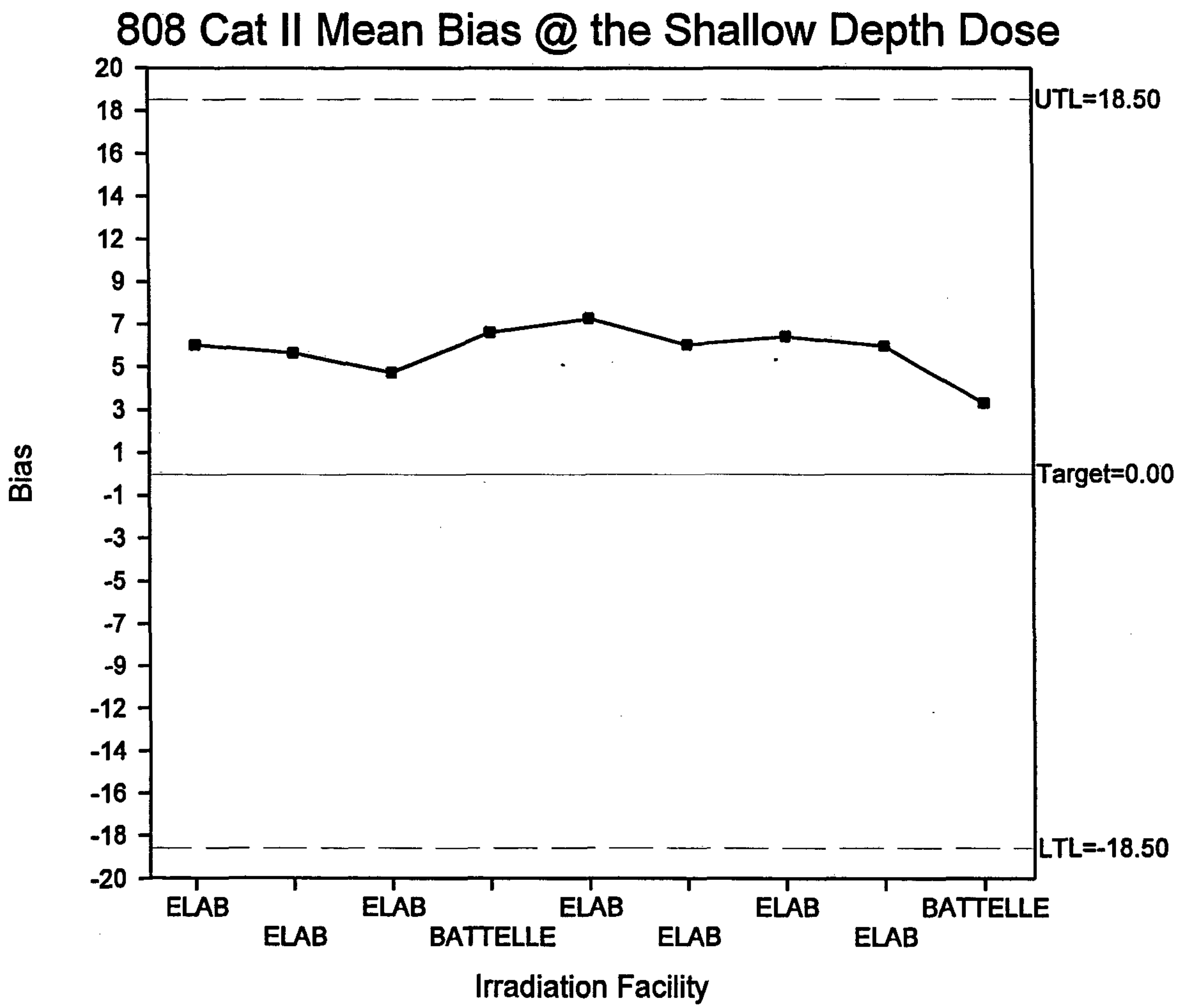


FIGURE 8

Process Statistics

Total:	9
Rows:	All
Mean:	4.078
Median:	3.900
Std Dev:	1.513
Act % out of TL:	0.00

Chart Point

Label:
Value:

808 Cat II Mean Bias @ the Eye Dose Depth

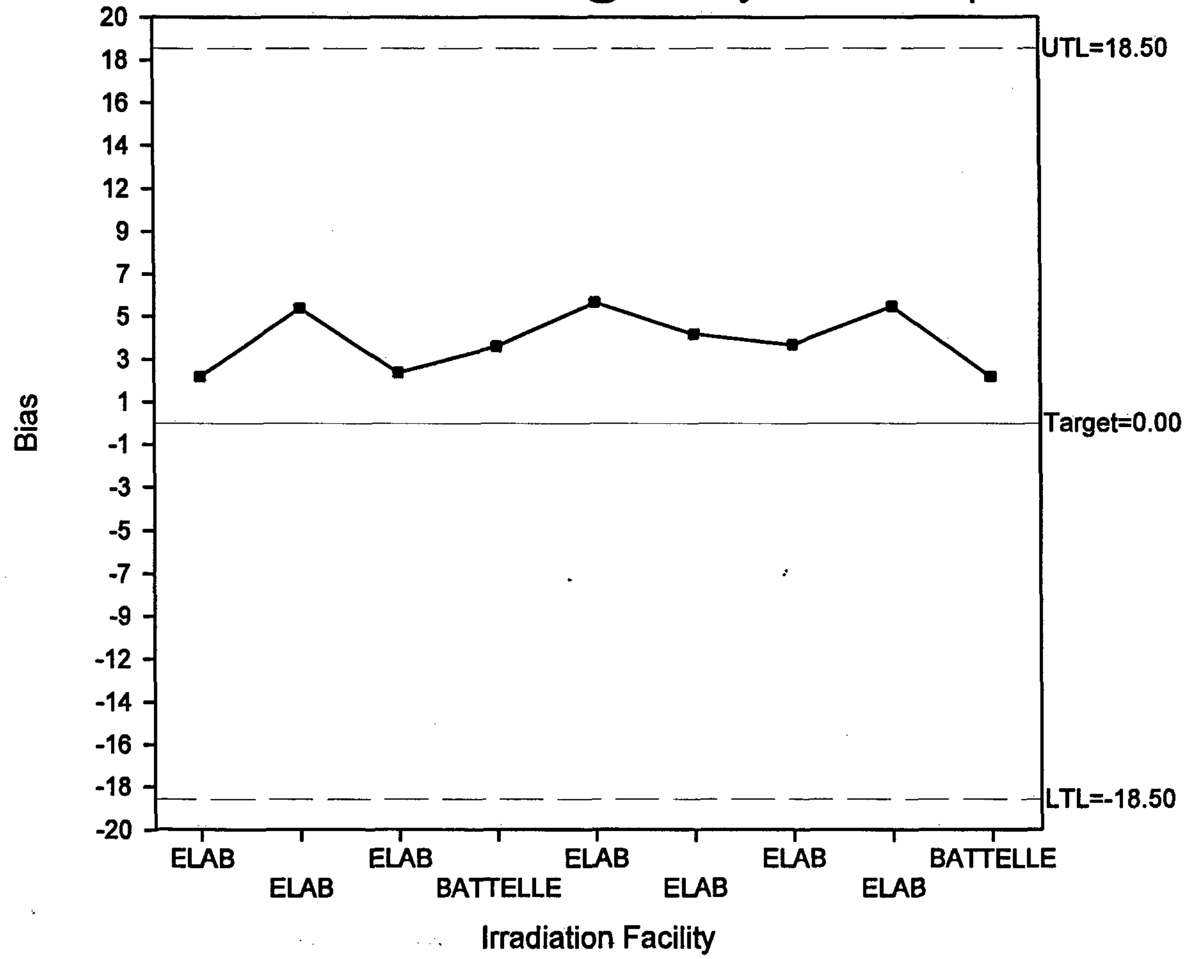


FIGURE 9

Process Statistics

Total:	9
Rows:	All
Mean:	2.133
Median:	1.700
Std Dev:	1.687
Act % out of TL:	0.00

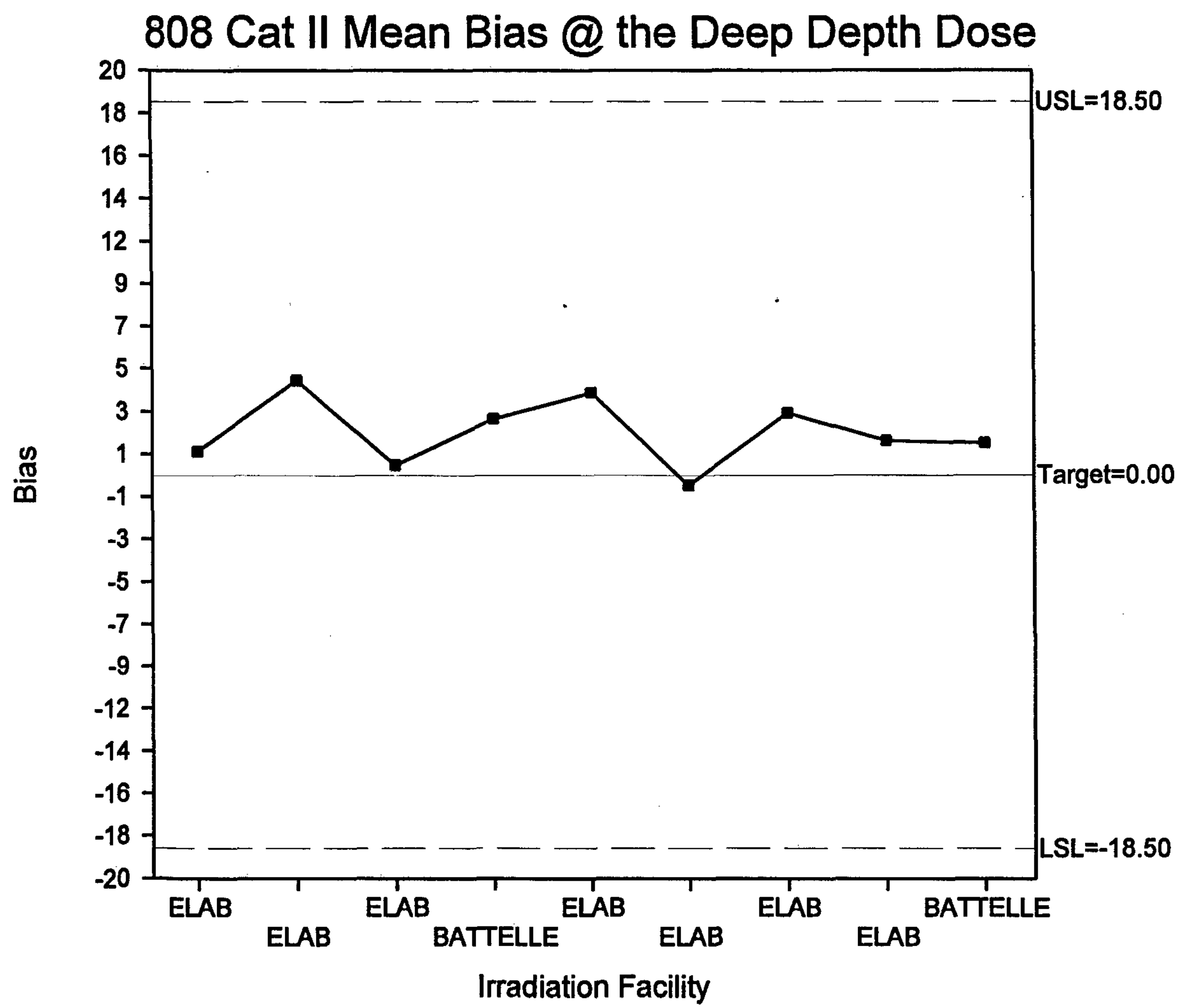


FIGURE 10

808 Cat II Mean Bias+Std Dev. (|B|+S) @ the Shallow Depth Dose

Total:	9
Rows:	All
Mean:	0.095
Median:	0.096
Std Dev:	0.010
Act % out of TL:	0.00

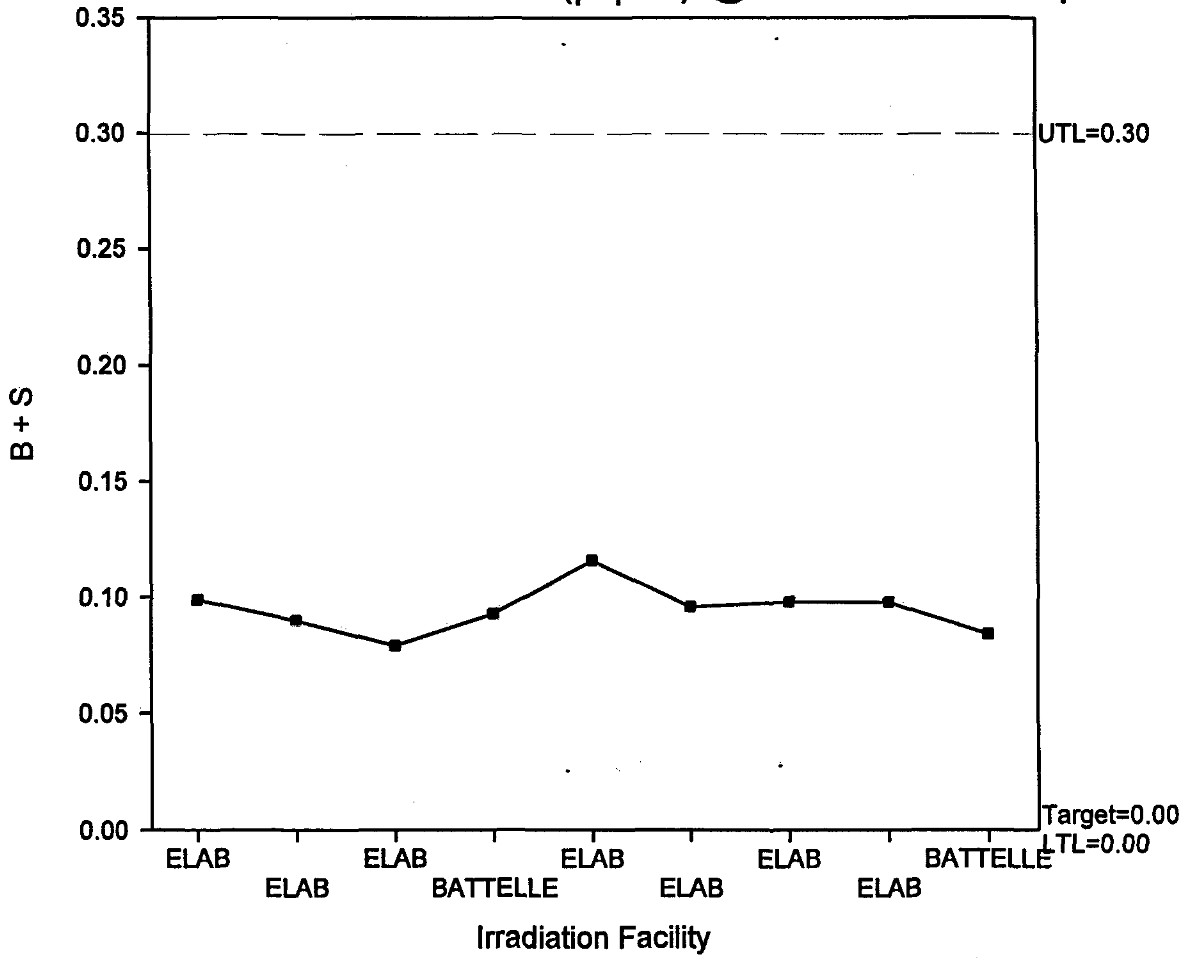
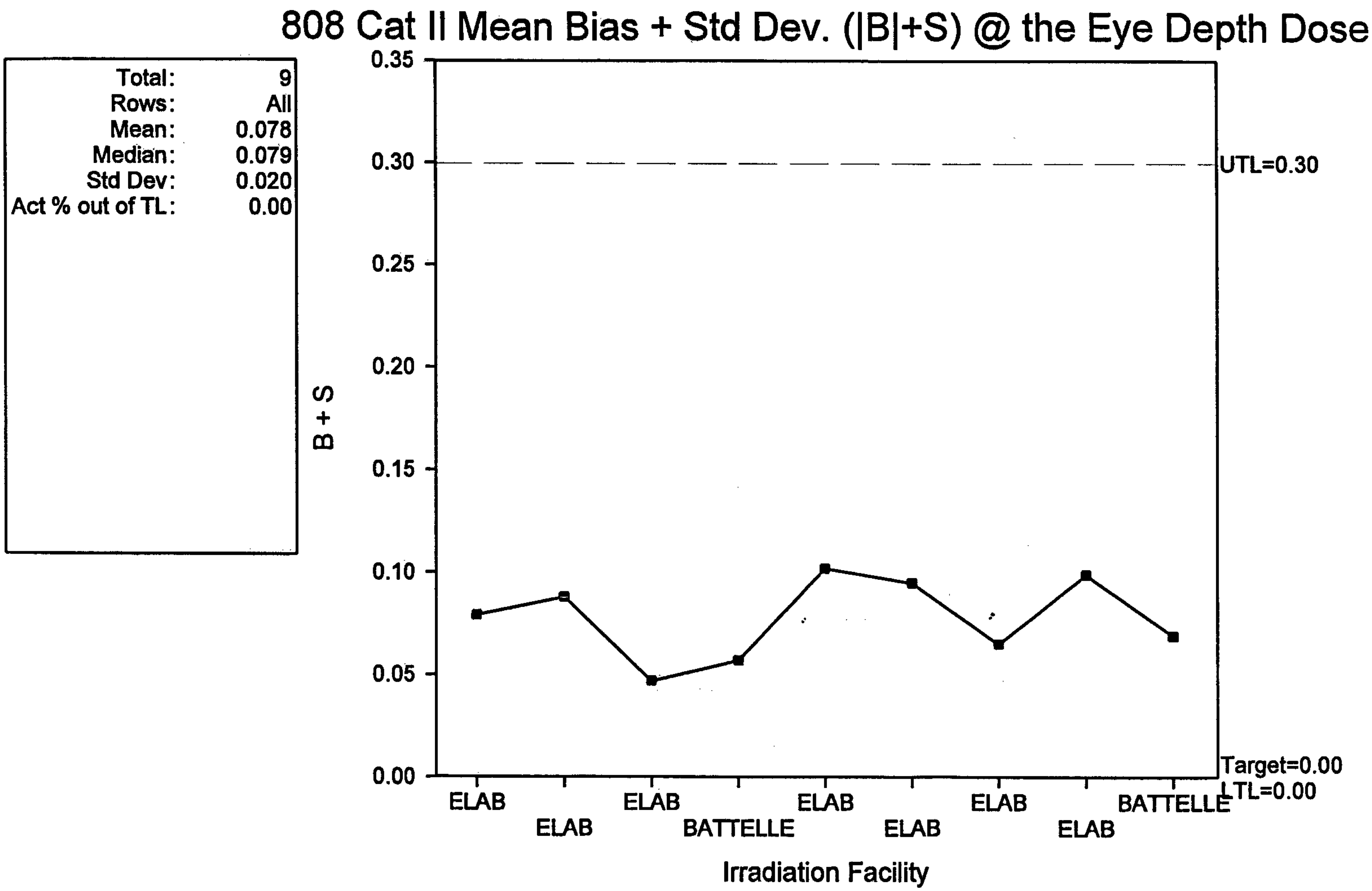


FIGURE 11


808 Cat II Mean Bias + Std Dev. (|B|+S) @ the Eye Depth Dose
Total: 9
Rows: All
Mean: 0.078
Median: 0.079
Std Dev: 0.020
Act % out of TL: 0.00
B + S
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
UTL=0.30
Target=0.00
LTL=0.00
ELAB
ELAB
ELAB
BATTELLE
ELAB
ELAB
ELAB
ELAB
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Irradiation Facility

APPENDIX A
QC TESTING DATA FOR THE SEMI-ANNUAL PERIOD
January-June 2005

FIGURE 12

808 Cat II Mean Bias + Std Dev. (|B|+S) @ the Deep Depth Dose

Total:	9
Rows:	All
Mean:	0.059
Median:	0.052
Std Dev:	0.023
Act % out of TL:	0.00

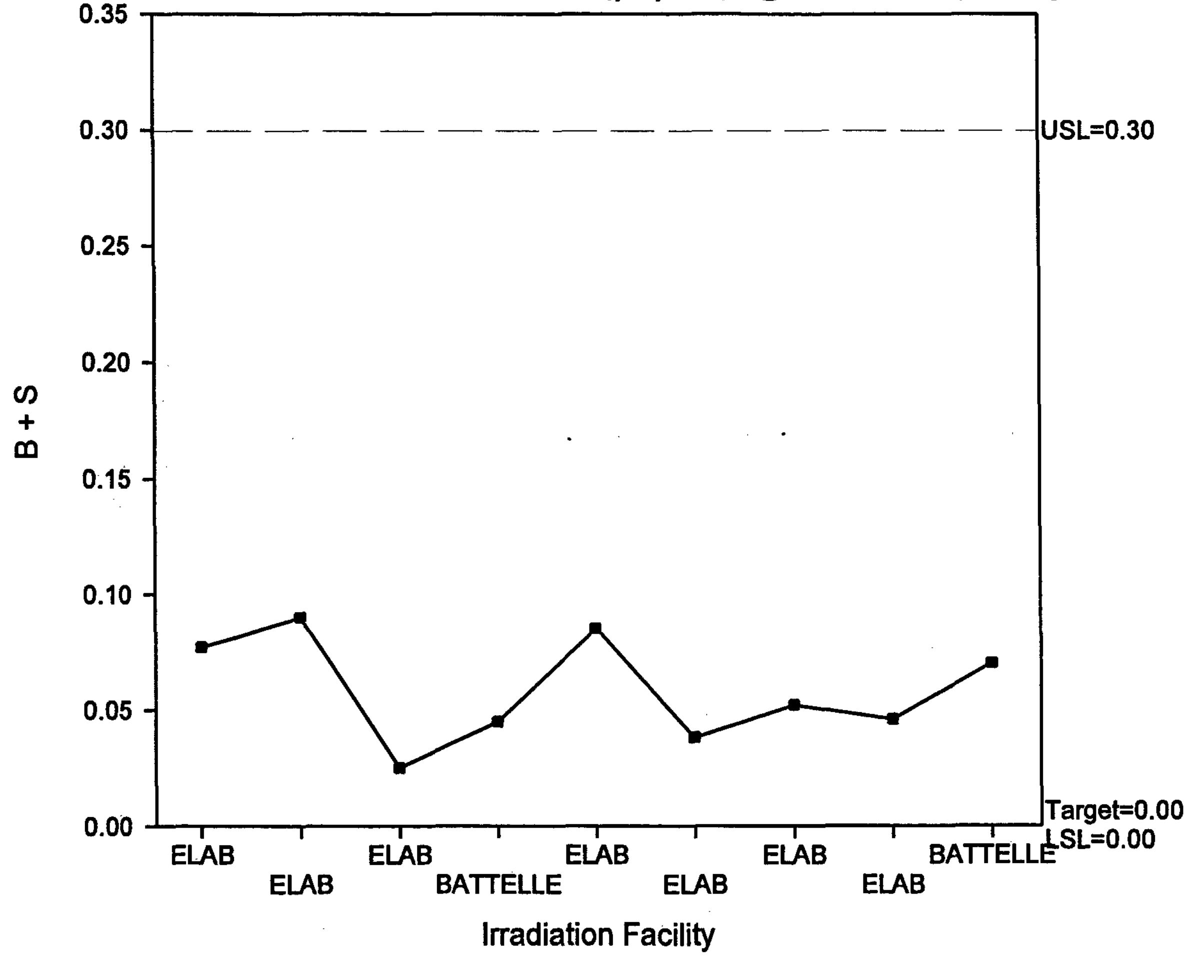
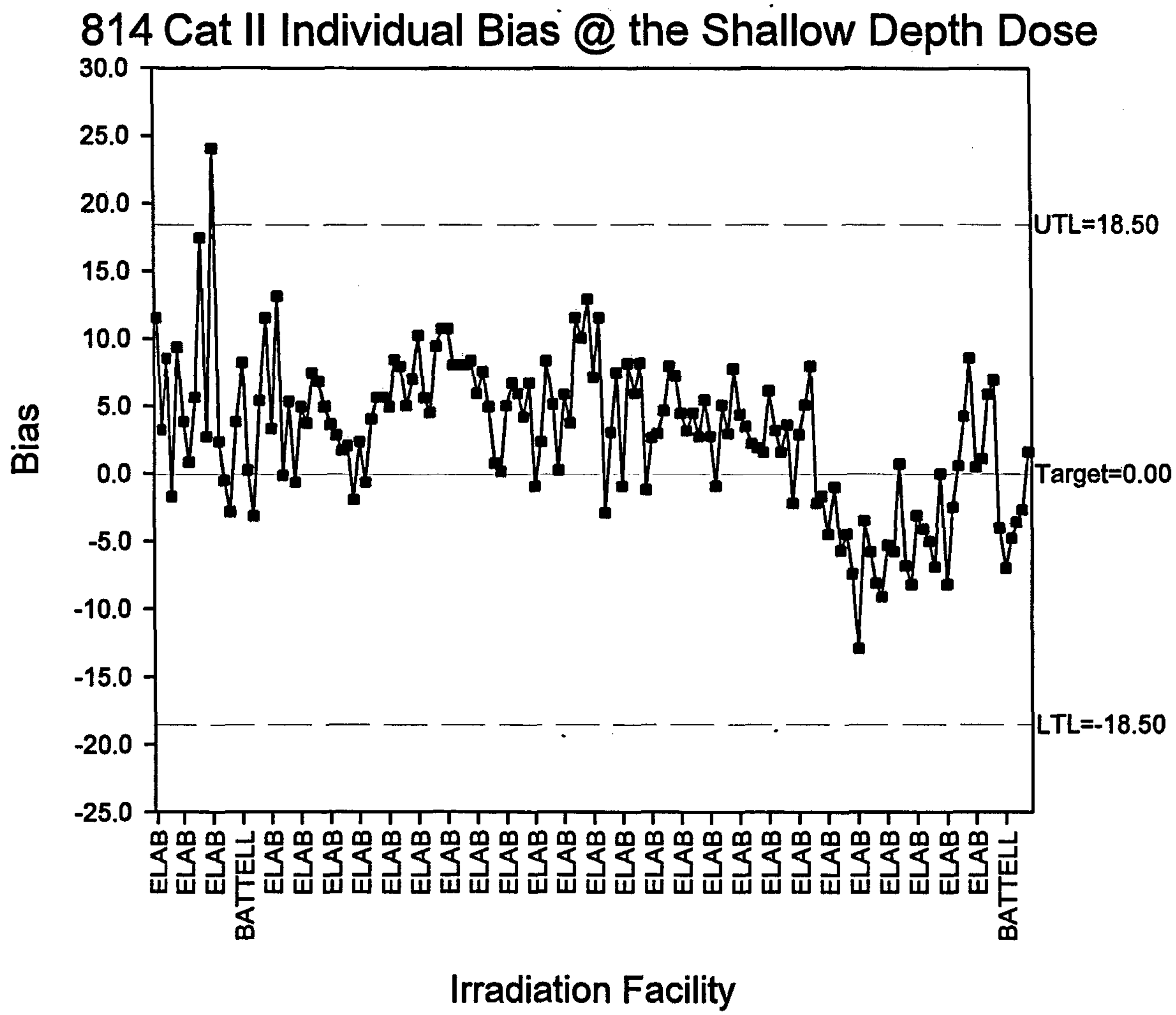


FIGURE 13

Process Statistics

Total:	150
Rows:	All
Mean:	3.015
Median:	3.550
Std Dev:	5.577
Act % out of TL:	0.67



APPENDIX A
QC TESTING DATA FOR THE SEMI-ANNUAL PERIOD
January-June 2005

FIGURE 14

814 Cat II Individual Bias @ the Eye Depth Dose

Process Statistics

Total:	150
Rows:	All
Mean:	2.547
Median:	2.950
Std Dev:	5.699
Act % out of TL:	0.67

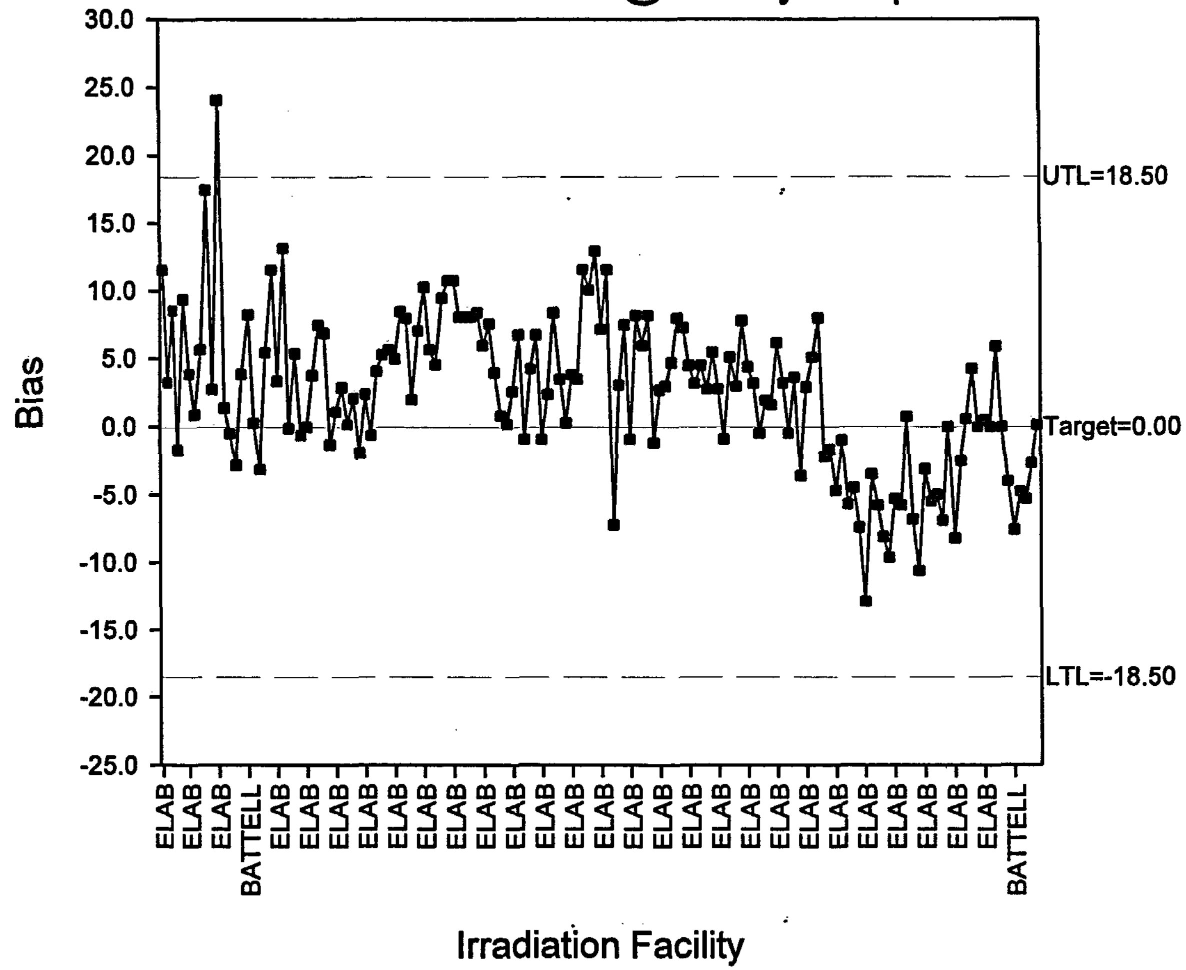


FIGURE 15

Process Statistics

Total:	150
Rows:	All
Mean:	0.345
Median:	-0.050
Std Dev:	6.186
Act % out of TL:	0.67

814 Cat II Individual Bias @ the Deep Depth Dose

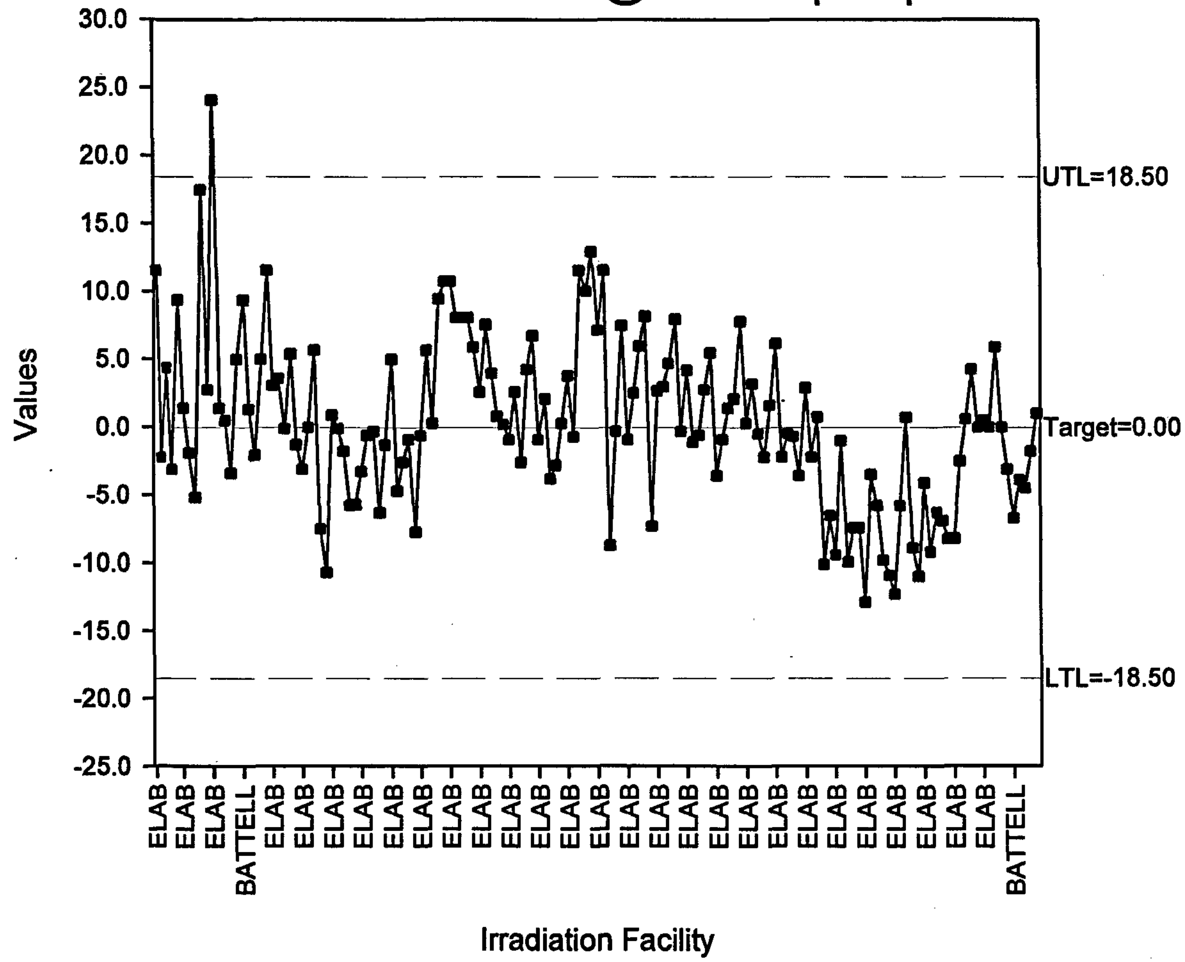
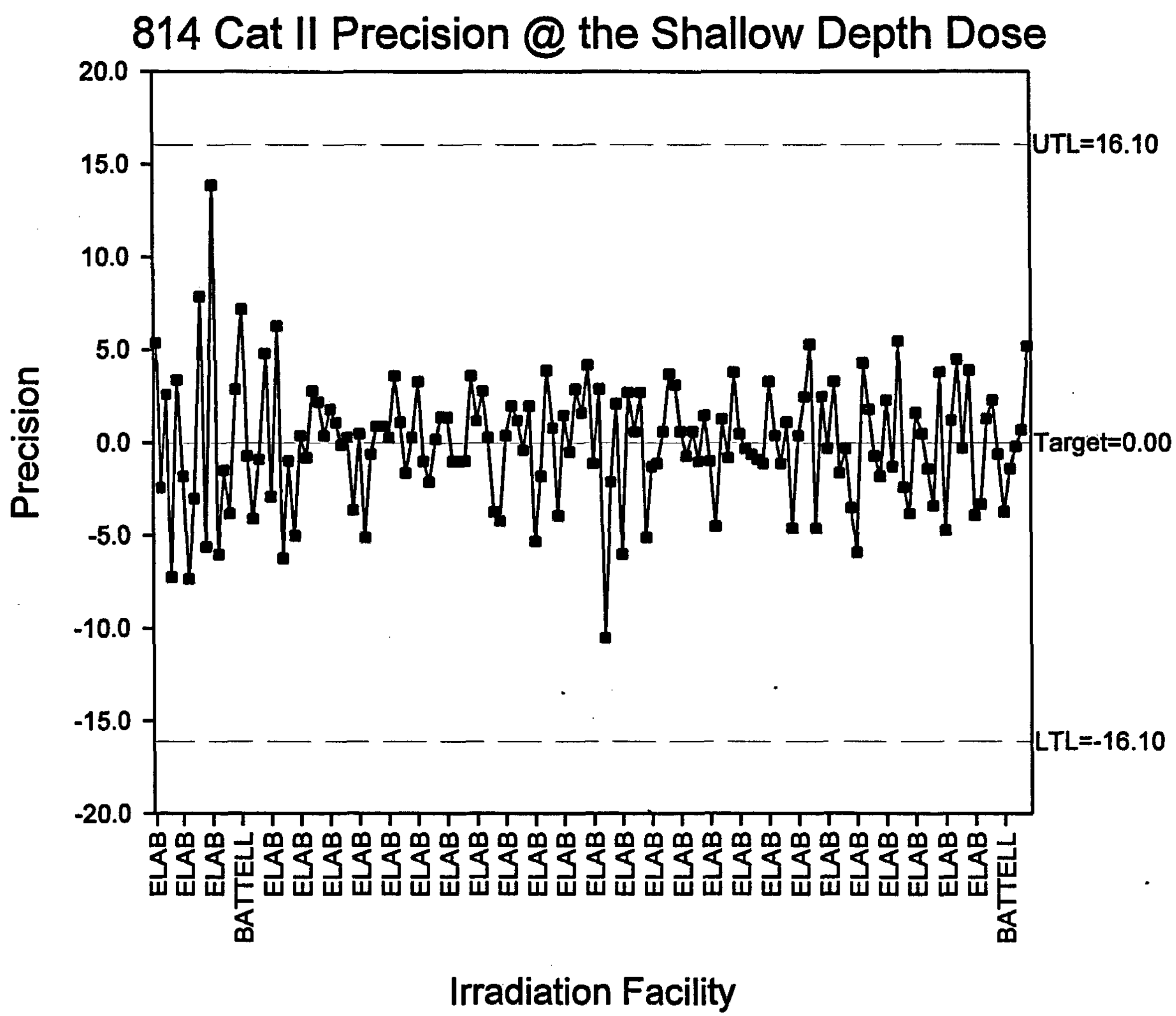


FIGURE 16

Process Statistics

Total:	150
Rows:	All
Mean:	0.001
Median:	0.300
Std Dev:	3.343
Act % out of TL:	0.00

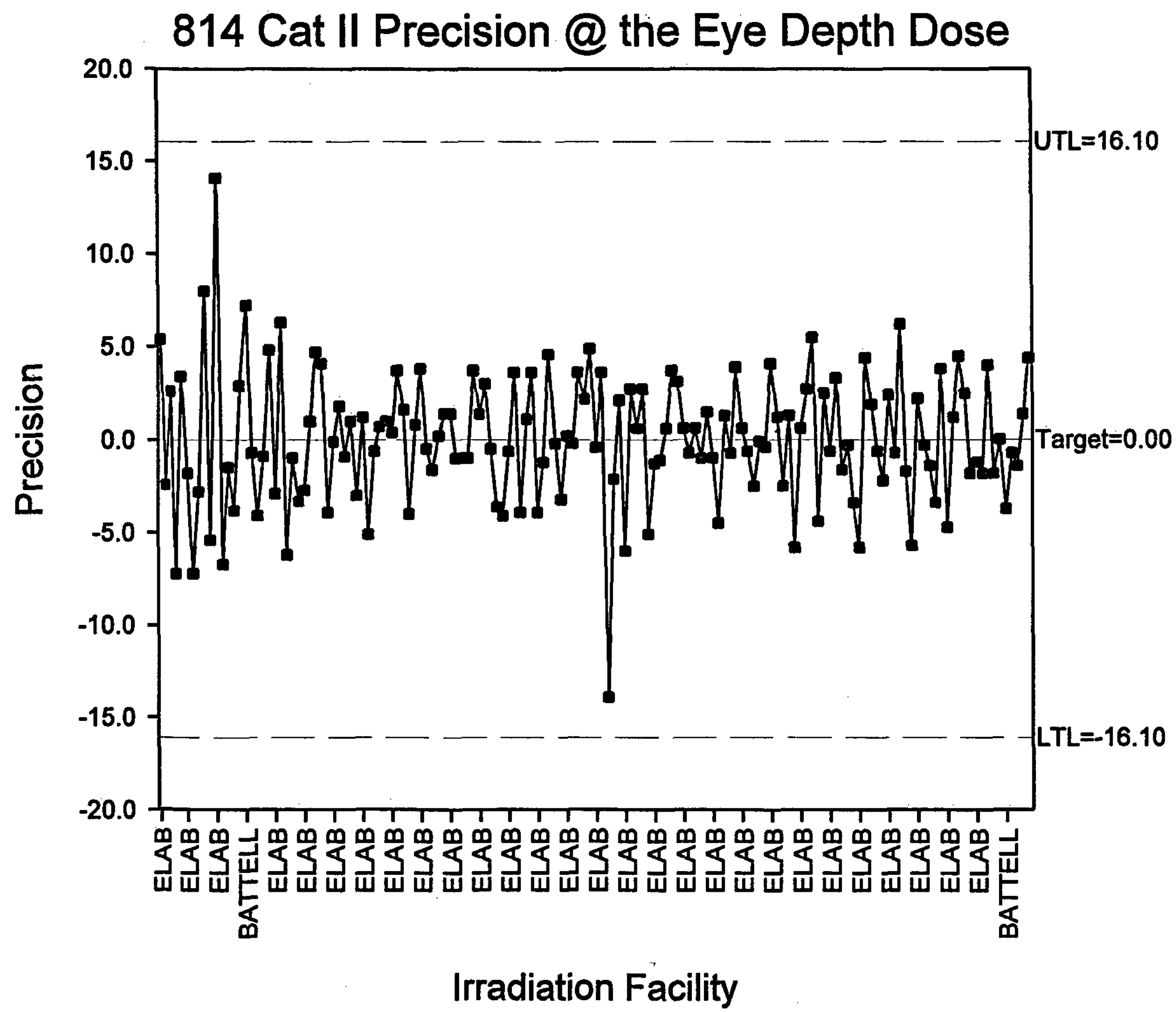


APPENDIX A
QC TESTING DATA FOR THE SEMI-ANNUAL PERIOD
January-June 2005

FIGURE 17

Process Statistics

Total:	150
Rows:	All
Mean:	-0.003
Median:	-0.250
Std Dev:	3.551
Act % out of TL:	0.00



APPENDIX A
QC TESTING DATA FOR THE SEMI-ANNUAL PERIOD
January-June 2005

FIGURE 18

Process Statistics	
Total:	150
Rows:	All
Mean:	0.001
Median:	-0.400
Std Dev:	4.199
Act % out of TL:	0.67

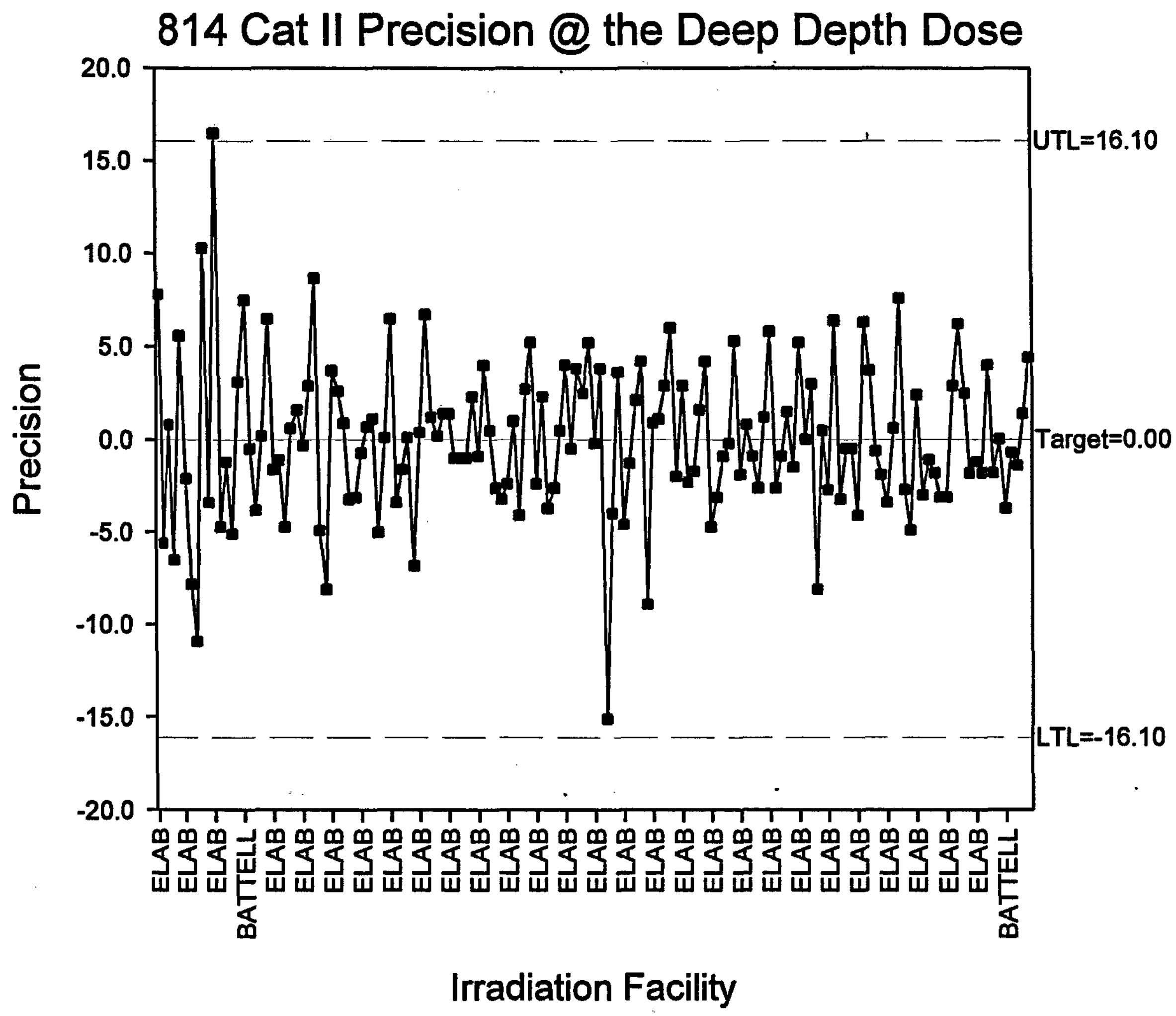
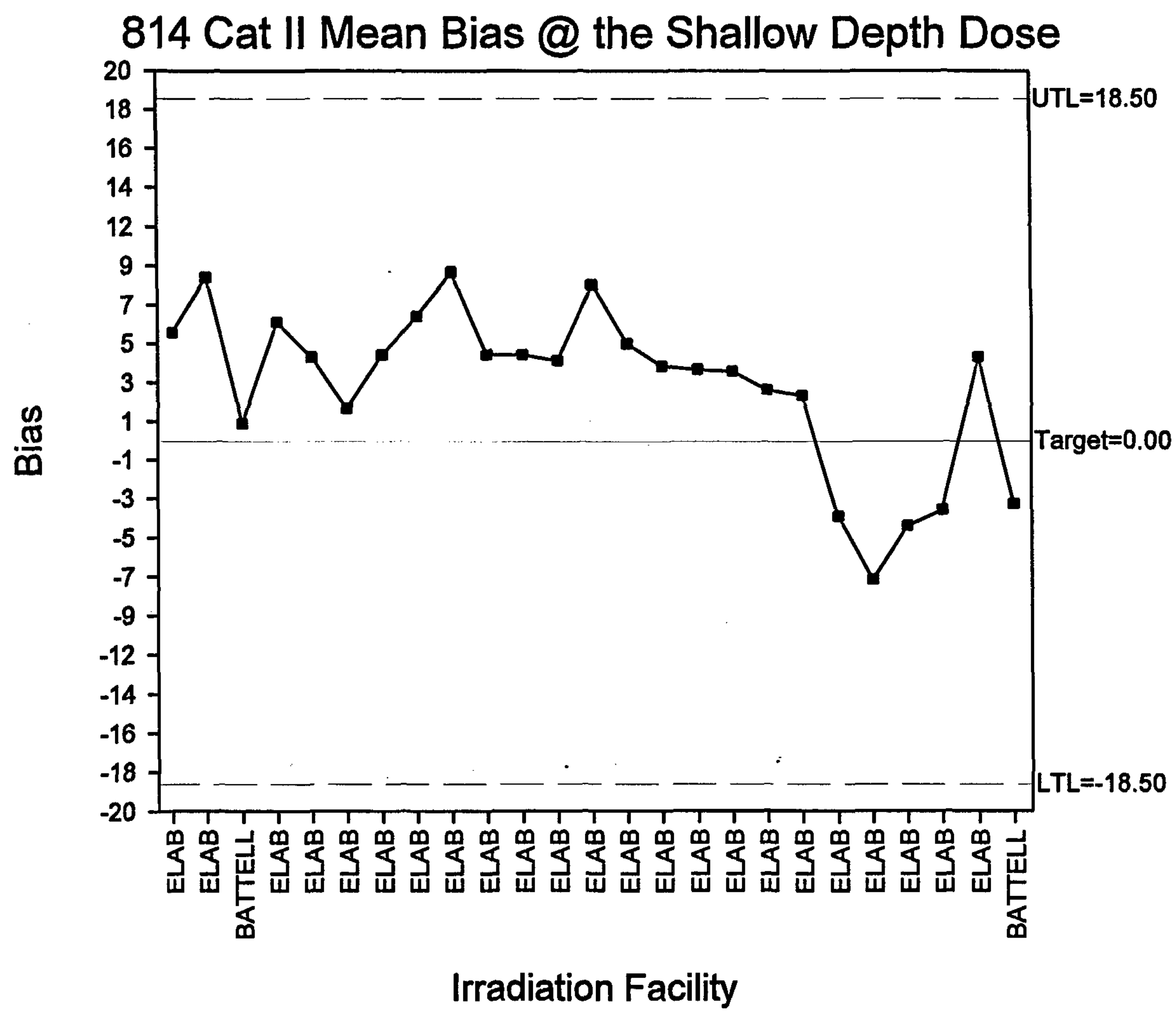


FIGURE 19

Process Statistics

Total:	25
Rows:	All
Mean:	3.016
Median:	4.400
Std Dev:	4.436
Act % out of TL:	0.00



APPENDIX A
QC TESTING DATA FOR THE SEMI-ANNUAL PERIOD
January-June 2005

FIGURE 20

Process Statistics

Total:	25
Rows:	All
Mean:	2.548
Median:	3.700
Std Dev:	4.411
Act % out of SL:	0.00

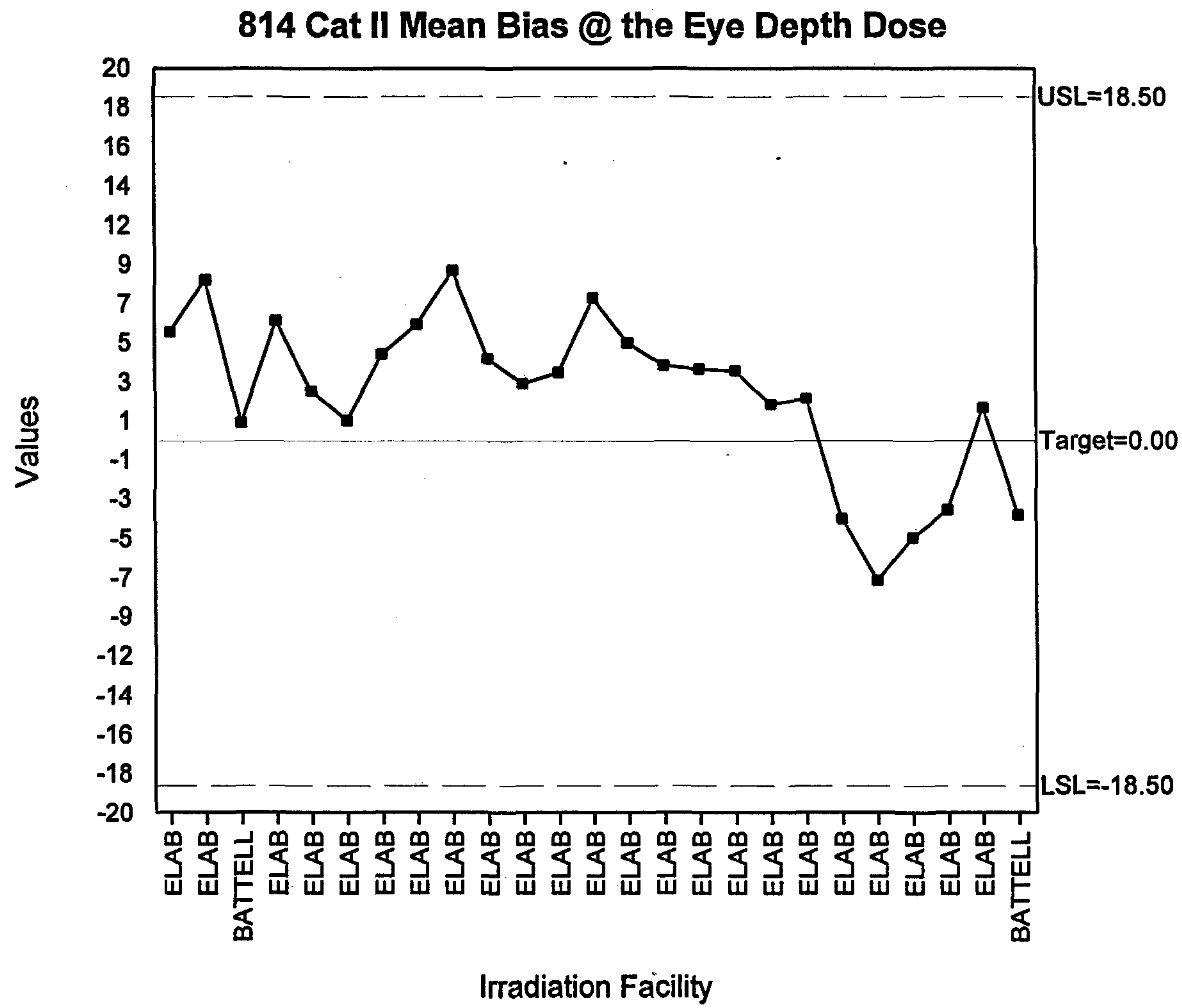


FIGURE 21

Process Statistics

Total:	25
Rows:	All
Mean:	0.344
Median:	1.200
Std Dev:	4.535
Act % out of TL:	0.00

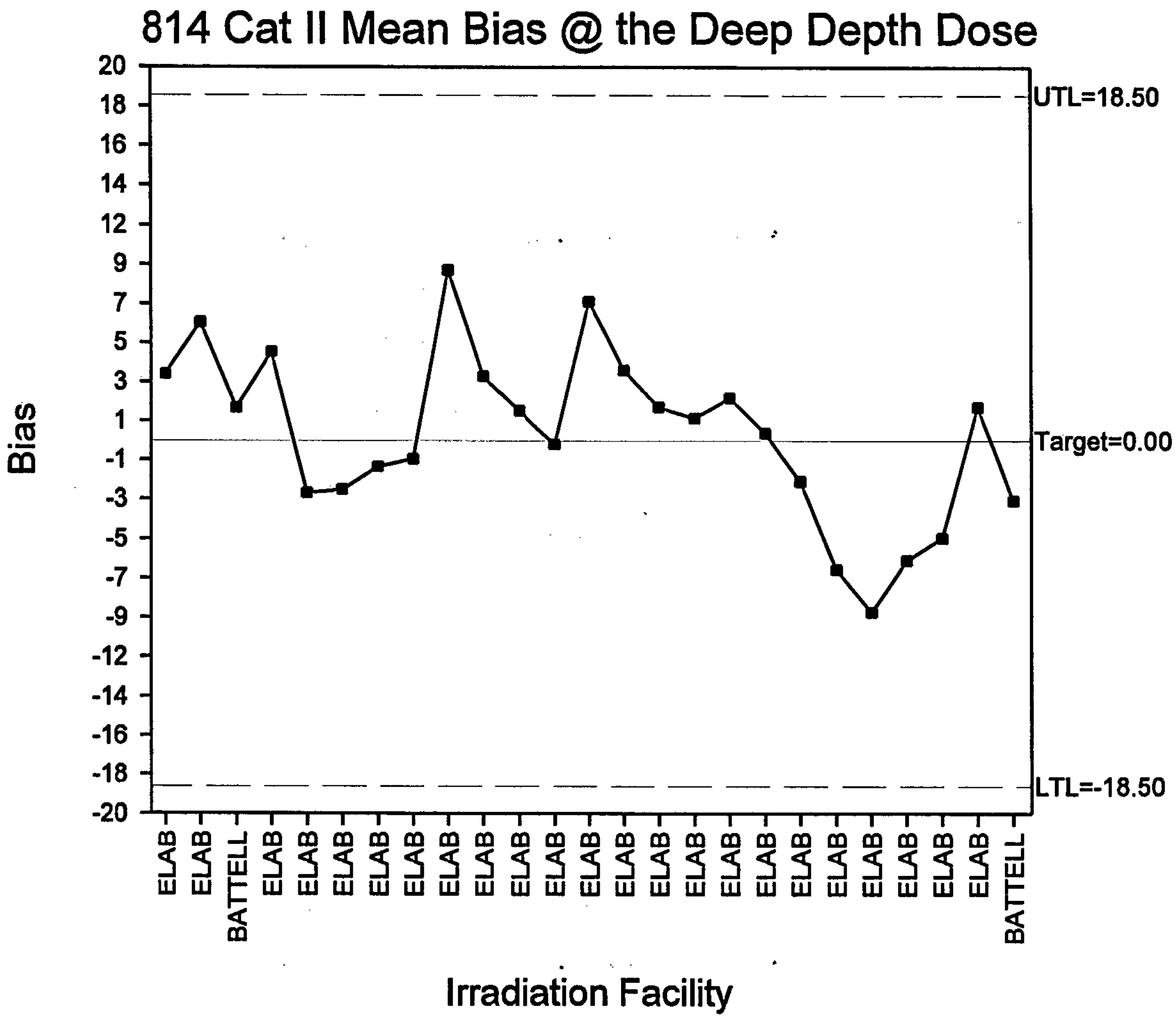


FIGURE 22

814 Cat II Mean Bias+Std Dev (|B|+S) @ the Shallow Depth Dose

Total:	25
Rows:	All
Mean:	0.083
Median:	0.076
Std Dev:	0.032
Act % out of TL:	0.00

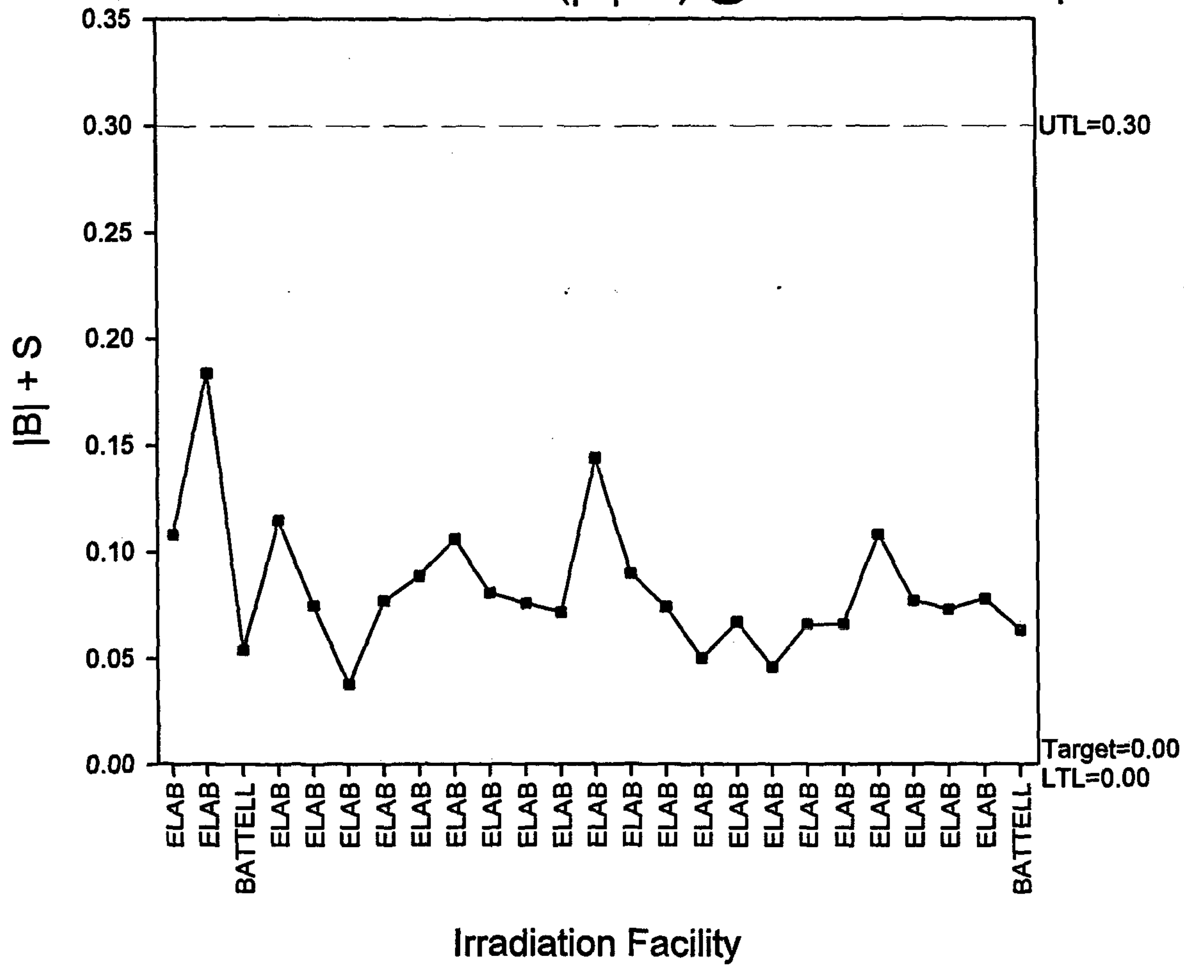


FIGURE 23

814 Cat II Mean Bias + Std Dev. (|B|+S) @ the Eye Depth Dose

Total:	25
Rows:	All
Mean:	0.081
Median:	0.073
Std Dev:	0.034
Range:	0.16
Act % out of TL:	0.00

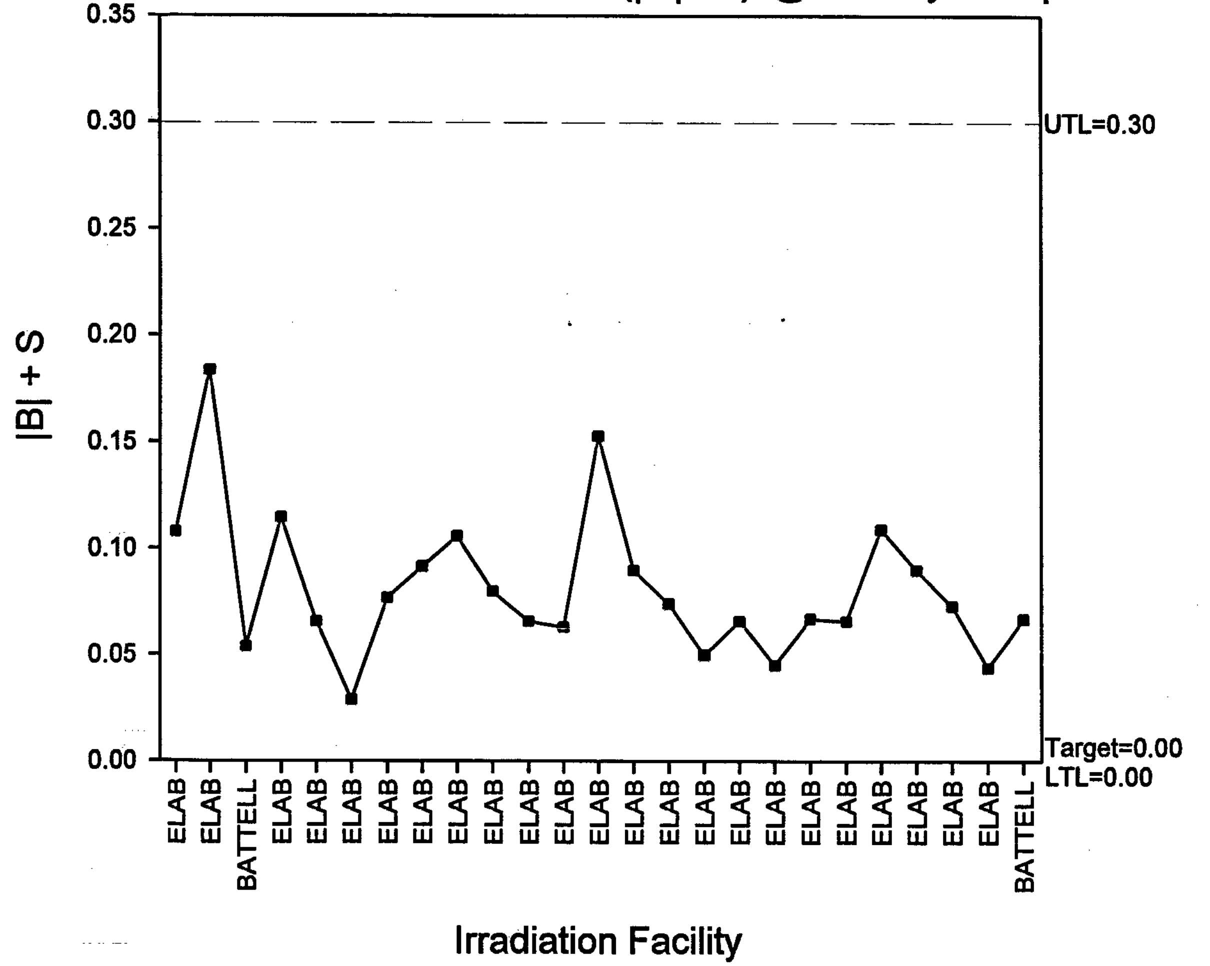
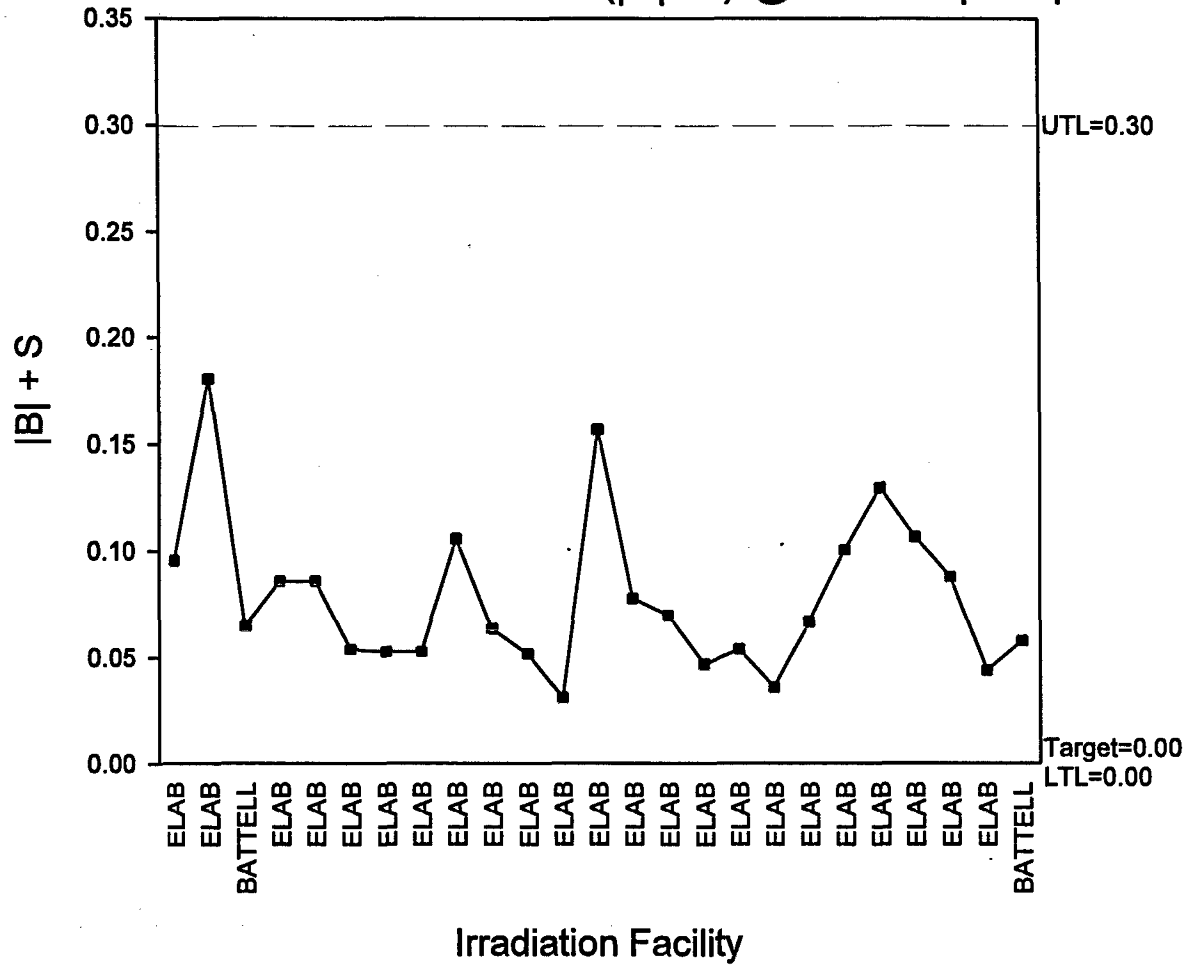


FIGURE 24

814 Cat II Mean Bias + Std Dev. (|B|+S) @ the Deep Depth Dose

Total:	25
Rows:	All
Mean:	0.079
Median:	0.067
Std Dev:	0.037
Act % out of TL:	0.00



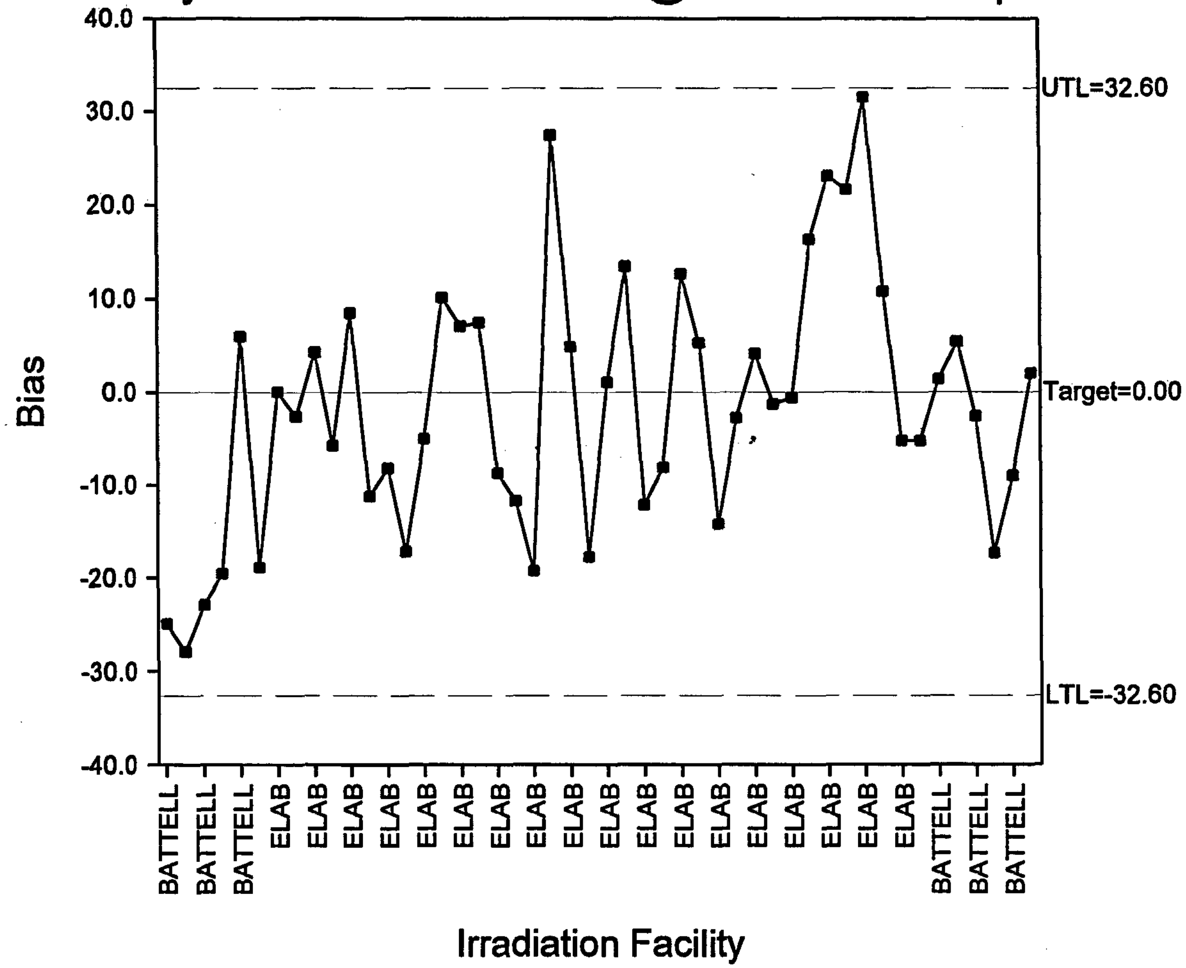
APPENDIX A
QC TESTING DATA FOR THE SEMI-ANNUAL PERIOD
January-June 2005

FIGURE 25

Extremity Cat IV Individual Bias @ the Shallow Depth Dose

Statistics

Total:	48
Rows:	All
Mean:	-1.550
Median:	-1.950
Std Dev:	13.668
Act % out of TL:	0.00



APPENDIX A
QC TESTING DATA FOR THE SEMI-ANNUAL PERIOD
January-June 2005

FIGURE 26

Process Statistics

Total:	48
Rows:	All
Mean:	-0.006
Median:	-1.200
Std Dev:	11.325
Act % out of TL:	4.17

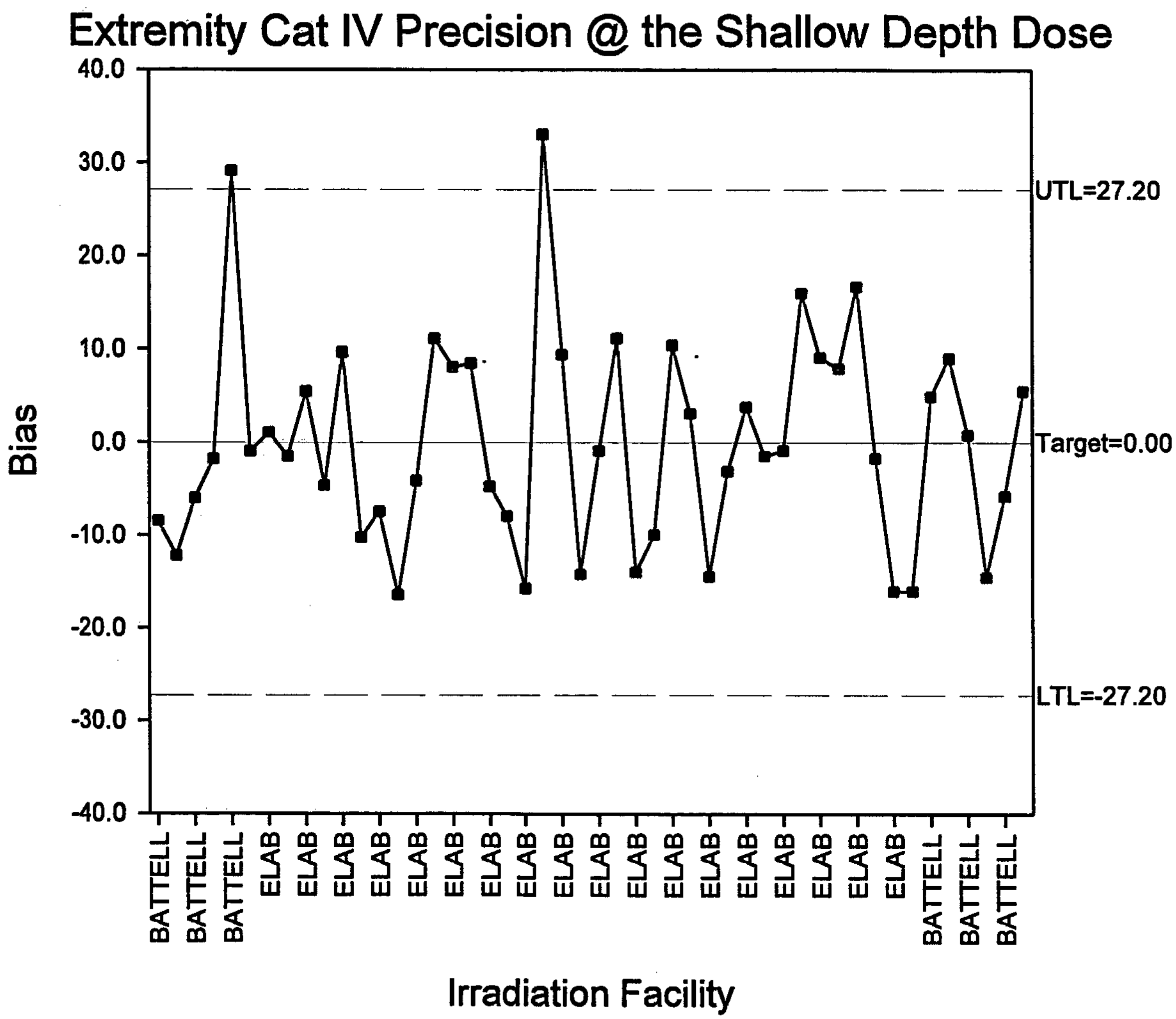
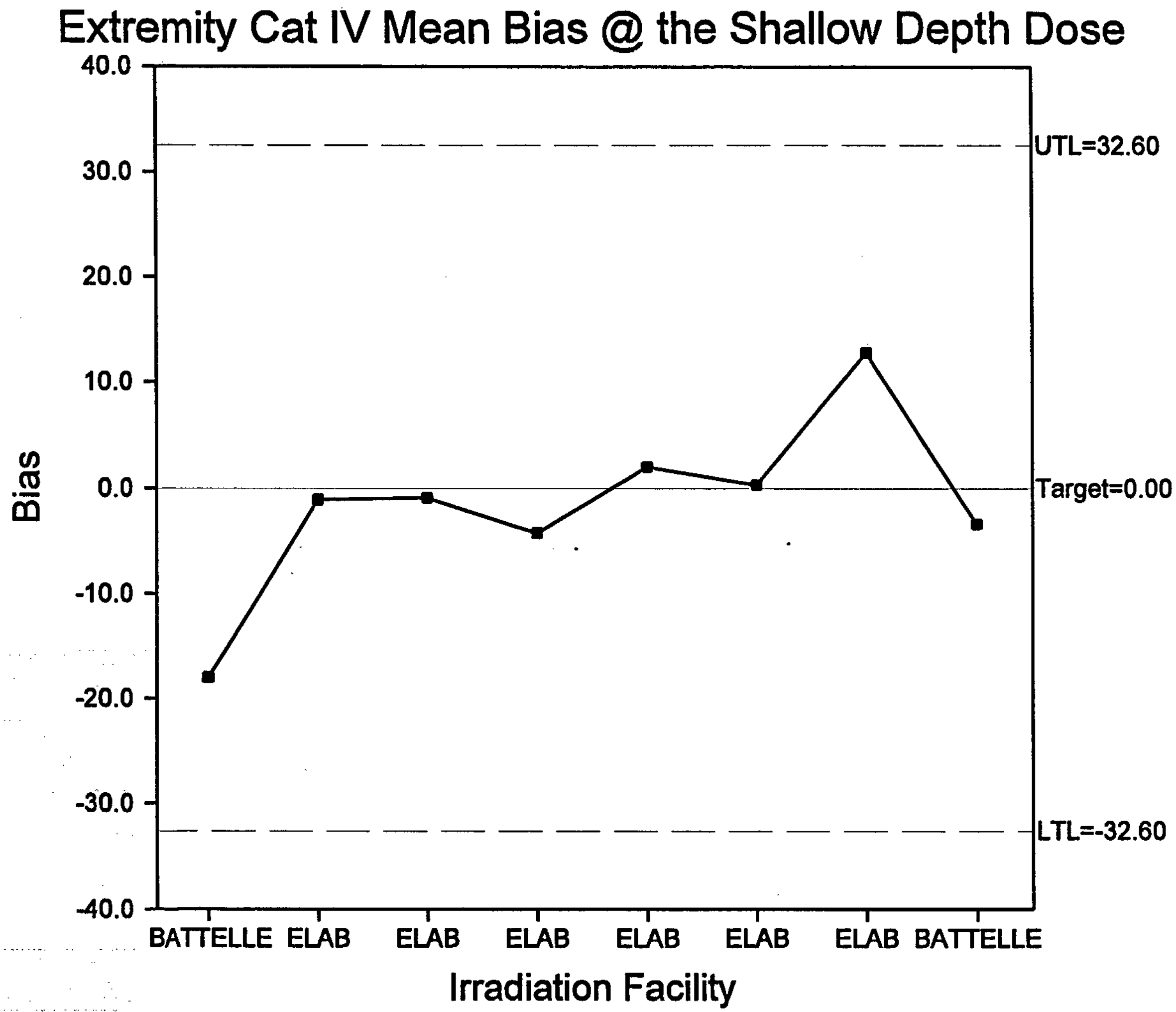


FIGURE 27

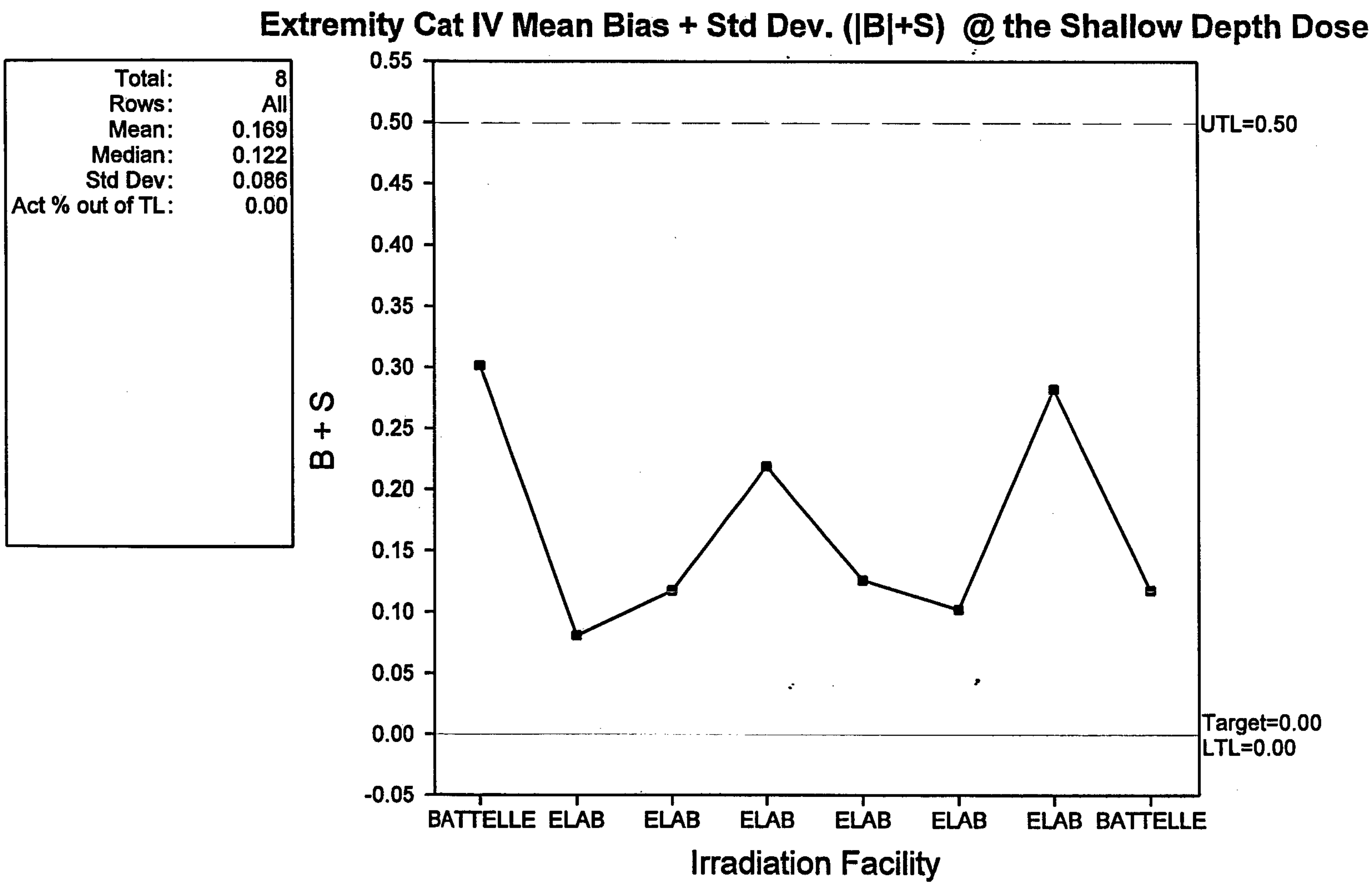
Process Statistics

Total:	8
Rows:	All
Mean:	-1.562
Median:	-1.000
Std Dev:	8.482
Act % out of TL:	0.00



APPENDIX A
QC TESTING DATA FOR THE SEMI-ANNUAL PERIOD
January-June 2005

FIGURE 28



APPENDIX A
QC TESTING DATA FOR THE SEMI-ANNUAL PERIOD
January-June 2005

FIGURE 29

Environmental TLDs Individual Bias Cs-137

Process Statistics

Total:	48
Rows:	All
Mean:	3.867
Median:	2.450
Std Dev:	3.678
Act % out of SL:	0.00

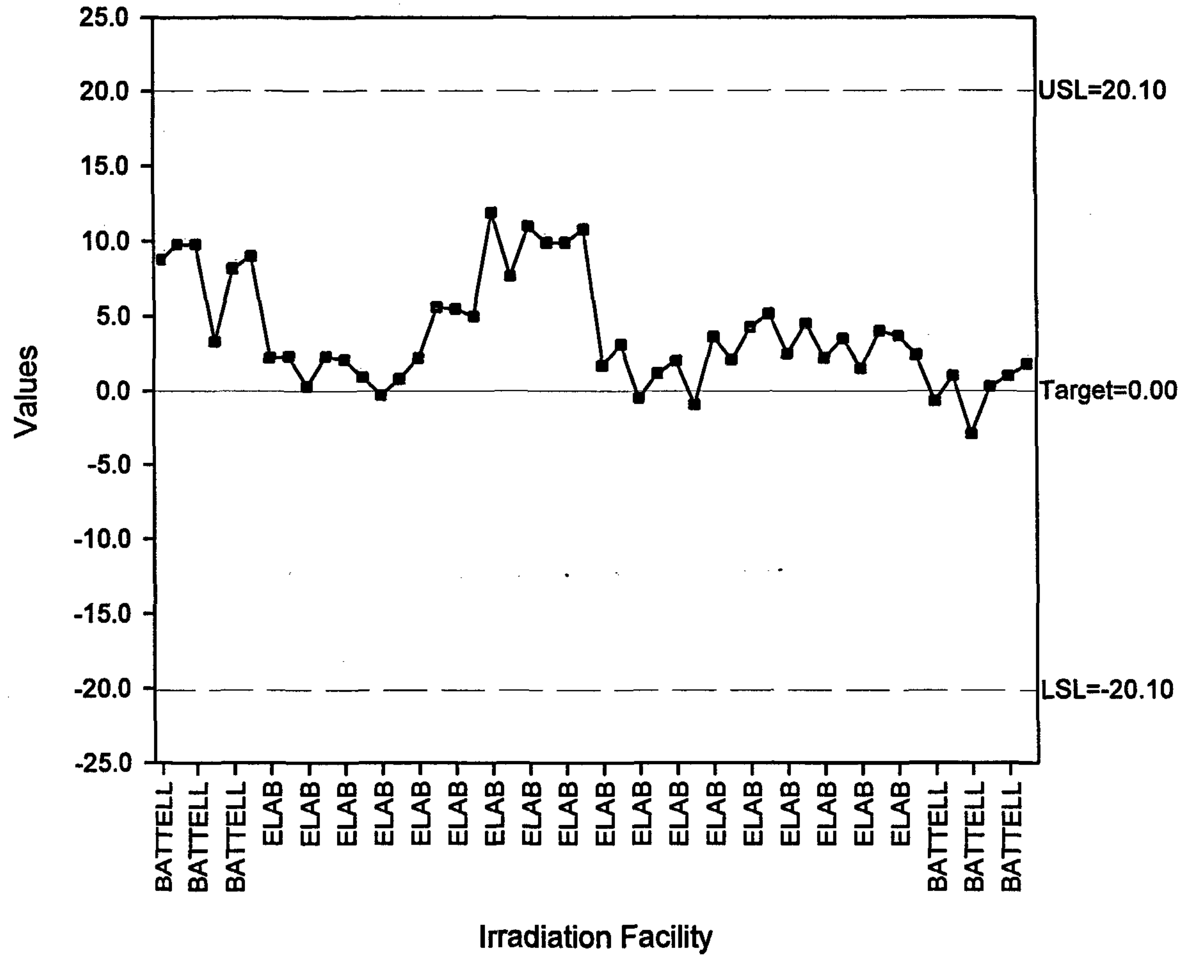


FIGURE 30

Process Statistics

Total:	48
Rows:	All
Mean:	0.006
Median:	0.500
Std Dev:	1.493
Act % out of SL:	0.00

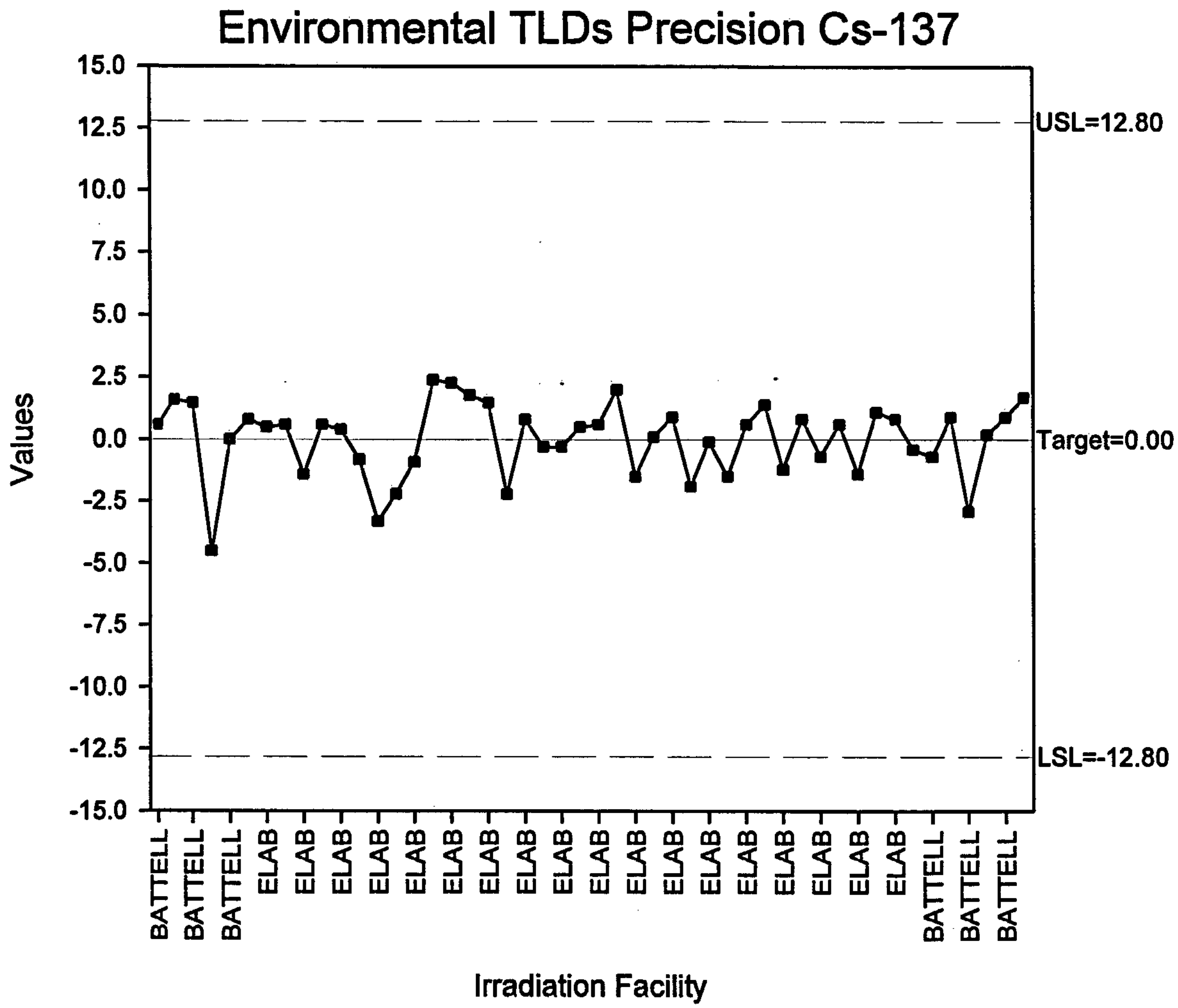
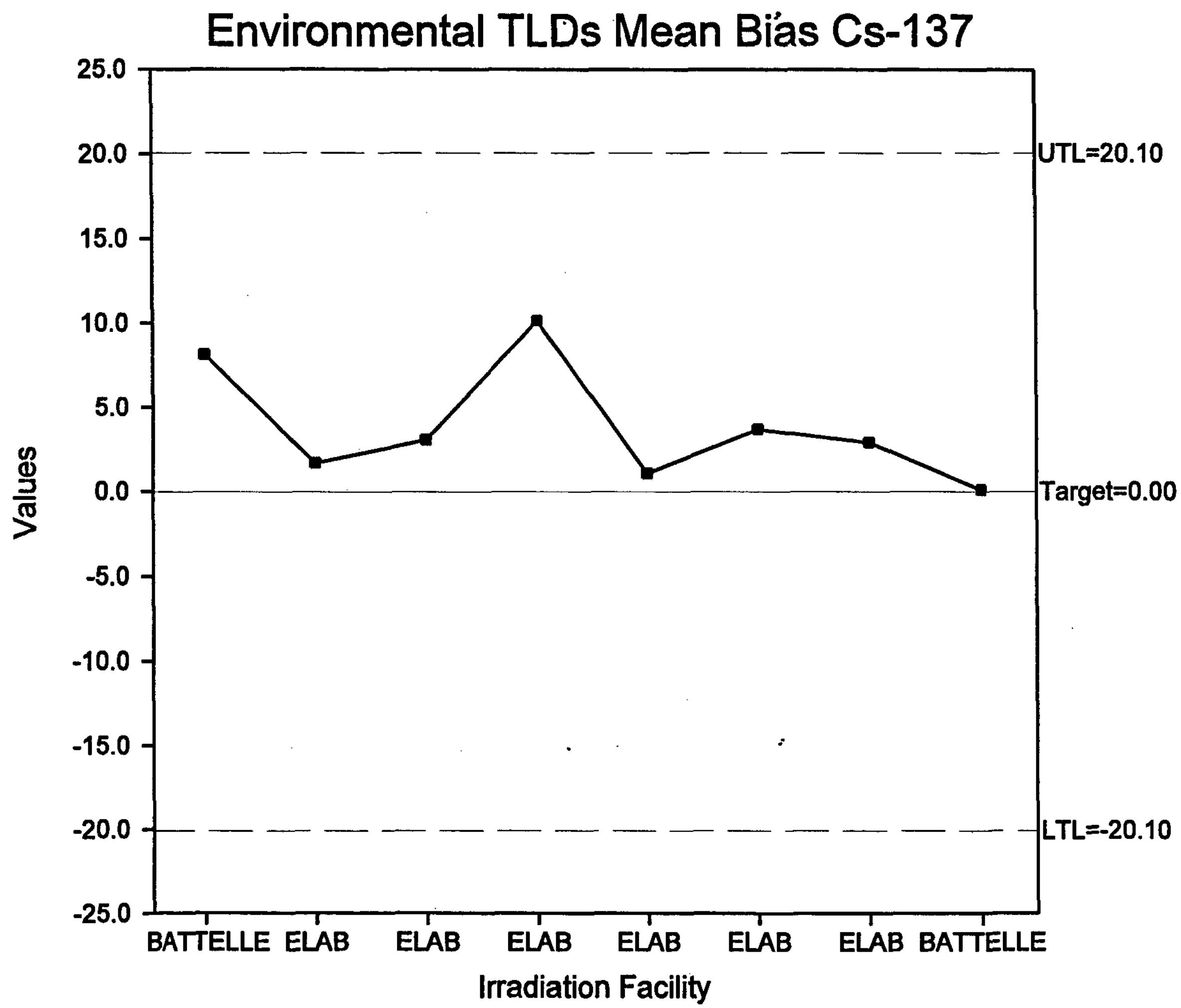


FIGURE 31

Process Statistics

Total:	8
Rows:	All
Mean:	3.875
Median:	3.000
Std Dev:	3.525
Act % out of TL:	0.00



APPENDIX B

NVLAP CERTIFICATE OF ACCREDITATION AND SCOPE OF ACCREDITATION

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

ISO/IEC 17025:1999
ISO 9002:1994

Certificate of Accreditation

FRAMATOME ANP ENVIRONMENTAL LABORATORY
WESTBOROUGH, MA

is recognized by the National Voluntary Laboratory Accreditation Program for satisfactory compliance with criteria set forth in NIST Handbook 150:2001, all requirements of ISO/IEC 17025:1999, and relevant requirements of ISO 9002:1994. Accreditation is awarded for specific services, listed on the Scope of Accreditation, for:

IONIZING RADIATION DOSIMETRY

September 30, 2005
Effective through

For the National Institute of Standards and Technology
NVLAP Lab Code: 100524-0

NVLAP-01C (06-01)

National Institute of Standards and Technology

NVLAP®

National Voluntary Laboratory Accreditation Program

ISO/IEC 17025:1999
ISO 9002:1994

Scope of Accreditation

IONIZING RADIATION DOSIMETRY **NVLAP LAB CODE 100524-0**

FRAMATOME ANP ENVIRONMENTAL LABORATORY
29 Research Drive
Westborough, MA 01581-3913
Mr. Jeffrey M. Raimondi
Phone: 508-898-9970 x2539 Fax: 508-836-9815
E-Mail: Jeffrey.Raimondi@Framatome-ANP.com

Scope of Accreditation:

This facility has been evaluated and deemed competent to process the radiation dosimeters listed below through employing Panasonic automatic reader model UD-710A for whole body dosimeters and a Thermo Electron Rialto XT or Toledo extremity dosimeter reader.

This facility is accredited to process the following dosimeters by virtue of actual demonstration of compliance with ANSI HPS N13.11-2001 and ANSI HPS N13.32-1995 through testing.

Panasonic TLD model UD-808 in a ISA model 830U holder for ANSI-N13.11-2001 categories IA, IIA, IIIA, IVA, VAB.

Panasonic TLD model 814-AS4 in a ISA model 830U holder for ANSI-N13.11-2001 categories IA, IIA, IIIA, IVA, VAB.

Panasonic dual TLD models UD808 and UD814 in a ISA model 830U holder for ANSI-N13.11-2001 category VICB.

Thermo Electron (formerly Bicron-NE) extremity TLD mode 869/A/2B in a ring tape holder for HPS ANSI 13.32 (NIST Handbook 150-4, table 2) categories IVA, IVB, VC, and VD.

September 30, 2005

Effective through

For the National Institute of Standards and Technology

AREVA

March 8, 2006
EL 028/06

TO: Distribution

FROM: J. M. Raimondi

SUBJECT: Framatome ANP Environmental Laboratory
Dosimetry Services Semi-Annual Quality Assurance Status Report
(July-December 2005)

Attached for your information and review is the Semi-Annual Status Report covering the Framatome ANP Environmental Laboratory's (E-LAB) Quality Assurance Programs for environmental, extremity, and personnel dosimetry processing for the second half of 2005. During this semi-annual period, 100% (270/270) of the individual dosimeters, evaluated against the E-LAB internal performance criteria (high-energy photons only), met the criterion for accuracy and 99.6% (269/270) met the criterion for precision. In addition, 100% (111/111) of the dosimeter sets evaluated against the internal tolerance limits met these criteria.

If you have any questions please contact Christopher Shelton (508) 573-6663 or myself at (508) 573-6651.

J. M. Raimondi
Manager, Environmental Laboratory

CAS/cas
Attachment

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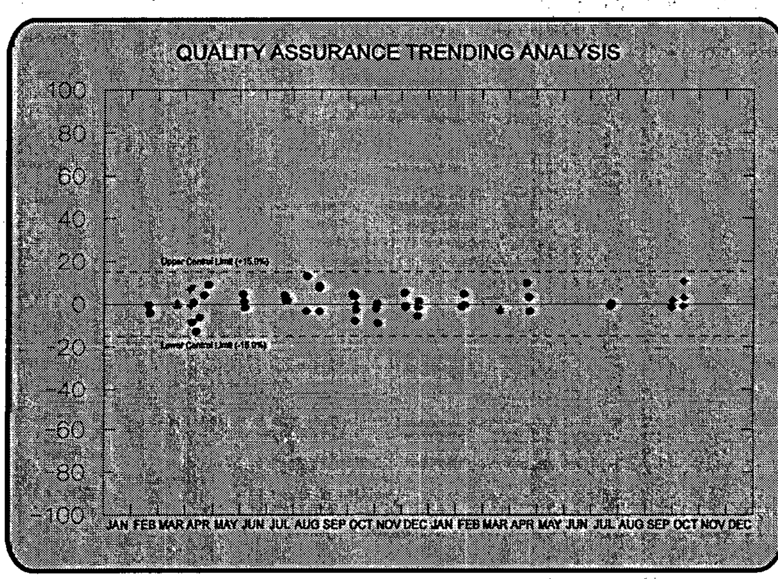
DOSIMETRY SERVICES

SEMI-ANNUAL QUALITY ASSURANCE STATUS REPORT

July – December 2005



FRAMATOME ANP, INC.

ENVIRONMENTAL LABORATORY

29 Research Drive

Westborough, MA 01581-3913

Telephone: (508) 573-6650

Fax: (508) 573-6680

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FRAMATOME ANP
ENVIRONMENTAL LABORATORY

DOSIMETRY SERVICES

SEMI-ANNUAL QUALITY ASSURANCE STATUS REPORT

July-December 2005

EL 028/06

Prepared By: ____________ Date: 2/20/2006

Reviewed By: ____________ Date: 3/8/2006

Approved By: ____________ Date: 3/8/2006

Framatome ANP
Environmental Laboratory
29 Research Drive
Westborough, MA 01581-3913

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

LIST OF TABLES

EXECUTIVE SUMMARY

Routine quality control (QC) testing was performed for each type of dosimeter issued by the Framatome ANP Environmental Laboratory (E-LAB) Dosimetry Services. The dosimeter types included Panasonic 808 and 814 whole body dosi meters, combination Panasonic 808/814 neutron dosimeters, extremity dosimeters, and Panasonic environmental dosimeters. QC dosimeters were irradiated in-house as well as by a third party. All testing methods used by the accredited third-party tester conform to ANSI N13.11-2001 (Reference 1) or ANSI N13.32-1995 (Reference 2).

During this semi-annual period, 100% (270/270) of the individual dosimeters, evaluated against the E-LAB internal performance criteria (high-energy photons only), met the criterion for accuracy and 99.6% (269/270) met the criterion for precision (Table 1). In addition, 100% (111/111) of the dosimeter sets evaluated against the internal tolerance limits met these criteria (Table 2). Tables 3 and 4 list the third party testing results for this semi-annual period. Trending graphs, which evaluate each dosimeter type, dose depth and performance statistic for high-energy photon irradiations are given in Appendix A.

Appendix B contains the current Certificate of Accreditation, Scope of Accreditation, and Biennial NVLAP Test Results. The E-LAB (NVLAP ID 100524) evaluated the necessity of maintaining NVLAP-accreditation for its extremity dosimetry. Due to the continued rising certification costs and the lack of regulatory mandate, the E-LAB decided to permit the NVLAP certification for extremity dosimetry to lapse as of January 2006.

I. INTRODUCTION

The TLD systems at the Framatome ANP Environmental Laboratory (E-LAB, NVLAP Code 100524) are calibrated and operated to ensure consistent and accurate evaluation of TLDs. The quality of the dosimetric results reported to E-LAB clients is ensured by the National Voluntary Laboratory Accreditation Program (NVLAP) for dosimetry processing, independent third-party performance testing by Battelle Pacific Northwest Laboratories, in-plant performance testing, and in-house performance testing by the QA Officer and Dosimetry Services.

Standard test methods for in-plant testing of Panasonic whole body and extremity dosimeters are described in the E-LAB report entitled "In-Plant External Dosimetry Quality Assurance Testing Program" (Reference 3). This protocol provides standard test methods that may be used at plant sites utilizing E-LAB dosimeters. The plants have developed their own dosimetry test procedures modeled after Reference 3.

The purpose of the dosimetry quality assurance program is to provide performance documentation of the routine processing of E-LAB dosimeters. This testing provides a statistical measure of the bias and precision of the processing against a reliable standard, which in turn points out any trends or performance changes. Two programs are used:

A. QC Program

Independent outside dosimetry quality control tests are performed on E-LAB Panasonic 808 and 814 whole body dosimeters, combination Panasonic 808/814 neutron dosimeters, extremity, and Panasonic environmental dosimeters. Tests include: (1) third-party testing, (2) the in-plant testing program conducted by various users of E-LAB dosimetry, and (3) the in-house testing program conducted by the E-LAB QA Officer. Each dosimeter type (excluding combination dosimeters) is tested for photon mixtures quarterly.

Excluded from this report are instrumentation checks conducted by Dosimetry Services. Although instrumentation checks represent an important aspect of the quality assurance program, they are not included as process checks because the doses are known by the processors. Instrumentation checks represent between 5-10% of the TLDs processed. In addition, client initiated quality control tests are not included in this report.

B. QA Program

An internal assessment of Dosimetry Services activities is conducted annually by the Laboratory Quality Assurance Officer (Reference 4). The purpose of the assessment is to review analytical procedures, results, materials or components that may indicate opportunities to improve or enhance processes and/or services.

II. PERFORMANCE EVALUATION CRITERIA

A. Performance Statistics

All evaluation criteria are taken from the "Dosimetry Services Quality System Manual," Reference 5.

1. Bias

a. For each dosimeter tested, the measure of bias is the percent deviation of the reported result relative to the delivered dose. The percent deviation relative to the delivered dose is calculated as follows:

$$\frac{(H_i' - H_i)}{H_i}100$$

where:

H_i' = the corresponding reported dose for the ith dosimeter (i.e., the reported dose)

H_i = the dose delivered to the ith irradiated dosimeter (i.e., the delivered dose)

b. For each group of test dosimeters, the mean bias is the average percent deviation of the reported result relative to the delivered dose. The mean percent deviation relative to the delivered dose is calculated as follows:

$$\sum\left(\frac{(H_i' - H_i)}{H_i}\right)100\left(\frac{1}{n}\right)$$

where:

H_i' = the corresponding reported dose for the ith dosimeter (i.e., the reported dose)

H_i = the dose delivered to the ith irradiated test dosimeter (i.e., the delivered dose)

n = the number of dosimeters in the test group

2. Precision

For a group of test dosimeters irradiated to a given dose, the measure of precision is the percent deviation of individual results relative to the mean reported dose. At least two values are required for the determination of precision. The measure of precision for the ith dosimeter is:

$$\left(\frac{(H_i' - \bar{H})}{\bar{H}}\right)100$$

where:

H_i' = the reported dose for the ith dosimeter (i.e., the reported dose)

$\bar{H}$ = the mean reported dose; i.e., $\bar{H} = \sum H_i' \left(\frac{1}{n}\right)$

n = the number of dosimeters in the test group

3. American National Standards Institute Performance Statistics

The American National Standards Institute (ANSI) provides a method of characterizing the performance of protection dosimetry in "Personnel Dosimetry Performance - Criteria for Testing" (Reference 1).

a. The performance in a given test category is considered adequate if for the shallow and/or deep dose equivalents (or the absorbed dose):

$$|B| + S \leq L$$

where:

B = the bias of the performance quotient

S = the standard deviation of the performance quotient

L = the tolerance level

b. The bias of the values of the performance quotient, $\bar{P}$ is set equal to the average of these values:

$$B = \bar{P} = \left(\frac{1}{n}\right)\left(\sum P_i\right)$$

where:

The performance quotient, P_i, for the ith dosimeter is defined as:

$$P_i = \frac{[H_i' - H_i]}{H_i}$$

and:

H_i' = the corresponding reported dose equivalent for the ith dosimeter (i.e., the reported dose)

H_i = the dose delivered to the ith irradiated dosimeter (i.e., the delivered dose)

c. The standard deviation of the values of the performance quotient, P_i, is:

$$S = \left[\frac{\left[\Sigma\left(P_i - \bar{P}\right)^2\right]}{(n-1)}\right]^{\frac{1}{2}}$$

where:

n-1 represents the unbiased sample population, where the summation is performed over all n values of P_i for a particular test in a given radiation category, and for a particular phantom depth (shallow or deep).

B. Tolerance Limits

1. E-LAB Internal Limits

Tolerance limits for bias and precision applied to in-house and accredited third party testing were adopted on November 13, 1987.

These criteria are only applied to individual test dosimeters irradiated with high-energy photons (Cs-137 or Co-60) and are as follows:

Dosimeter Type	Tolerance Limits	
	Bias	**Precision**
Panasonic Whole Body	± 18.5%	± 16.1%
Extremity	± 32.6%	± 27.2%
Panasonic Environmental	± 20.1%	± 12.8%

The results of dosimeters evaluated against these criteria are summarized in Table 1. Trending graphs for a particular badge type or depth can be found in Appendix A.

2. Internal Tolerance Limits

Further performance testing control limits were added in 1998 to evaluate the sum of bias and precision values for all irradiation categories, not just for high-energy photons. A ±30% tolerance limit was applied to the sum of the bias and precision values for all whole body and environmental dosimeters, while a ±50% tolerance limit was applied for extremity dosimeters. Dosimeters processed during this semi-annual period were evaluated against these criteria and the results are shown in Table 2 and Appendix A.

3. American National Standards Institute Tolerance Level (L)

The tolerance level, L, given in Reference 1, is: (a) 0.3 in the accident category I; and (b) 0.4 in the protection categories II through VI. ANSI N13.11-2001 (Reference 1) includes additional limits on the Performance Quotient Limit (PQL) for Categories II, IV, and V for deep and shallow depths and Category III for shallow depth only. This criterion requires that no more than one of fifteen dosimeters tested in each category may have a bias that exceeds the tolerance level (L).

C. QC Investigation Criteria

E-LAB Manual 120 (Reference 5) specifies the investigative criteria applied to a QC analysis that has failed the E-LAB bias criteria. The criteria are as follows:

1. No investigation is necessary when an individual QC result falls outside the QC performance criteria for accuracy.

2. Investigations are initiated when the mean of a QC processing batch is outside the performance criterion for bias.

D. Reporting of Analytical Results

The following guidelines were developed, applicable to reporting of results:

1. All results are to be reported in a timely fashion.

2. If the QA Officer determines that an investigation is required for a process, the results shall be issued as normal. If the QC results, prompting the investigation, have a mean bias from the known of greater than ±20% for environmental dosimetry and greater than ±30% for personnel dosimetry, the results shall be issued with a note indicating that they may be updated in the future, pending resolution of a QA issue.

3. Environmental dosimetry results do not require updating if the investigation has shown that the mean bias between the original results and the corrected results, based on applicable correction factors from the investigation, does not exceed ±20%.

4. Personnel dosimetry results do not require updating if the investigation has shown that the mean bias between the original results and the corrected results, based on applicable correction factors from the investigation, does not exceed ±30%.

III. DATA SUMMARY FOR REPORTING PERIOD JULY-DECEMBER 2005

A. General Discussion

In the sections that follow, the results of performance tests conducted for each type of dosimeter are summarized and discussed. Summaries of the performance tests for the reporting period are given in Tables 1 through 4 and Figures 1 through 31. Results are presented only for performance tests conducted under well-characterized conditions. Where appropriate, results are reported for three depths (7 mg/cm^2, 300 mg/cm^2, and 1000 mg/cm^2) and plotted for the six-month period July-December 2005.

Table 1 provides a summary of individual dosimeter results evaluated against the E-LAB internal acceptance criteria for high-energy photons only. During this semi-annual period, 100% (270/270) of the individual dosimeters, evaluated against these criteria met the tolerance limits for accuracy and 99.6% (269/270) met the criterion for precision.

Table 2 provides a summary of the |B| + S results for each group (N=6) of dosimeters evaluated against the internal tolerance criteria. The data in Table 2 is tabulated by badge type and applies to all ANSI-required and non-required categories (see Tables 3 and 4) with the exception of the Category V.A. evaluation at the eye depth (300 mg/cm^2). Overall, 100% (111/111) of the dosimeter sets evaluated against the internal tolerance performance criteria met these criteria.

Tables 3 and 4 present the third party testing results for dosimeters processed during this semi-annual period. Irradiation times occurred during the second and third quarters or 2005. The results have been separated into NVLAP required categories (Table 3) and non-required tests (Table 4). The environmental TLDs have been included with the non-required group.

B. Result Trending

1. Panasonic Whole Body Dosimeters

One of the main benefits of performing quality control tests on a routine basis is to point out trends or performance changes. Trends or changes are best illustrated in the form of trending graphs where performance is tracked over time. The results of performance tests of Panasonic 808 and 814 whole body dosimeters are presented in Figures 1 through 24 for Category II irradiations. The results are evaluated against each of the performance criteria listed in Section II, namely: individual dosimeter bias, individual dosimeter precision, and |B| + S. Results are also evaluated for mean bias in accordance with the investigation criteria given in Section II.C.

All of the results presented in Figures 1 through 24 are fade corrected to the irradiation date and plotted sequentially by processing date. This allows assessment of performance without the confounding effect of the variation in number of days between readout and irradiation. Therefore, the results include any bias produced by the fade algorithm.

If fade is not corrected to the date of irradiation, the possibility of a bias due to signal fading exists. When Dosimetry Services processes a TLD, the software calculates a fade correction using one half the number of days between the processing date and the anneal date. The use of the midpoint for fade correction can bias the results of performance tests of TLDs irradiated at either the beginning or end of a wear period. Results for performance tests conducted near the beginning of the period will be biased low and those irradiated near the end of a period will be biased high, assuming there are no other system biases.

In some cases (i.e., when TLDs are irradiated at the end of the wear period and fade corrected to the midpoint) the results of the performance test may fall outside of the control limits even though the system is performing correctly. Therefore, to allow the assessment of performance test results without the TLD signal confounding the data, all Panasonic 808 and 814 test results presented in the tables have been fade corrected to the actual date of irradiation.

Figures 1 through 3 depict the individual bias of each of 48 Panasonic 808 dosimeters, evaluated at three different depths, and plotted sequentially according to processing date. The failure rate was 0% (0/48) for the shallow, eye and deep depths (Figures 1-3). The failure rate for individual precision was 0% (0/48) for the shallow, eye, and deep depths (Figures 4-6). The failure rate for the mean bias was 0% (0/8) for all three depths (Figures 7-9). Finally, Figures 10-12 depict the |B| + S statistic for each group of 808 dosimeters at each depth. All test sets (8 at each depth) met the internal tolerance criteria of |B|+S < 0.3.

Figures 13 through 15 depict the individual bias of each of 156 Panasonic 814 dosimeters, evaluated at three different depths, versus the date of processing. The failure rate was 0% (0/150) for the shallow, eye and deep depths. The failure rate for individual precision was 0% (0/150) for the shallow, eye, and deep depths (Figures 16-18). The failure rate for mean bias at all three depths (Figures 19-21) was 0%. As shown in Figures 22-24, 100% of the 25 814 test sets, evaluated at each depth, met the internal tolerance criteria of |B|+S < 0.3.

2. Extremity Dosimeters

Extremity results plotted in Figures 25 -28 are for performance tests conducted at the E-LAB and an accredited third-party testing organization. For all individual extremity TLDs, evaluated during this semi-annual period, 0% (0/24) failed the E-LAB limit for bias of ±32.6% (Figure 25). The failure rate was 4.2% (1/24) for precision (tolerance limit ±27.2%) as shown in Figure 26. None of the 4 TLD test sets (n=6) were outside the mean bias limit as shown in Figure 27. For the same reporting period, 100% of the 4 extremity QC test sets met the internal tolerance criteria for bias and precision (|B| + S, Figure 28).

3. Panasonic Environmental Dosimeters

The trending results of performance tests of Panasonic environmental dosimeters are presented in Figures 29-31. For individual Panasonic environmental TLDs, 100% of the 48 tests came within the E-LAB bias and precision tolerance limits (Figures 29 and 30). All 8 Panasonic environmental TLD test sets (mean bias, n=6) were reported within the internal tolerance criteria for bias (Figure 31).

C. NVLAP Biennial Testing

NVLAP testing was conducted during this period for the 808, 814 and combination (808+814) badges. All of the tested badges/categories were successfully completed. The summary results for the tests are included in Appendix B along with the current versions of the NVLAP Certificate of Accreditation and Scope of Accreditation. Testing of the extremity dosimeters was not performed since the E-LAB has decided to terminate NVLAP accreditation of these badges due to the rising cost of the accreditation coupled with the lack of a regulatory requirement for accreditation.

IV. STATUS OF E-LAB CONDITION REPORTS (CR)

During this semi-annual period there were no E-LAB Condition Reports (CR) issued for dosimetry processing activities. There are no open action items.

V. STATUS OF AUDITS/ASSESSMENTS

A. Internal

The annual internal audit conducted in the Dosimetry area occurred between September 22, 2005 and November 4, 2005. The audit was conducted to verify that the Dosimetry Quality Manual is effectively implementing the requirements of NIST Handbook 140, 2001 Edition, and NIST Handbook 150-4, 1994 Edition.

The audit concluded that routine processing and QC activities are being performed as required. The audit also noted that the transition to a new dosimetry Technical Director was accomplished in accordance with NVLAP rules. The auditor noted that the E-LAB management has decided to discontinue NVLAP certification for extremity dosimetry in 2006. No findings were issued.

B. External

The NVLAP biennial audit was conducted November 21-22, 2005. The on-site audit reviewed the previous audit's findings and considered them all to be closed. The NVLAP auditor identified a total of 6 findings, one nonconformity and five comments, summarized below.

Finding	Description	Action/Status
Nonconformity #1	Revise QA Manual, brochures, reports to ensure use of NVLAP term/symbol is in accordance with General Accreditation Criteria, Annex A.	COMPLETED – Updated brochures and reports, revised QA Manual 120 (Rev. 11, January 17, 2006).
Comment #1	Update QA Manual to clarify Technical Director and Supervisor responsibilities.	COMPLETED – included in QA Manual 120, Rev. 11, January 17, 2006
Comment #2	Provide notification to customers of upcoming change of extremity dosimeter change of certification.	COMPLETED – included in QA Manual 120, Rev. 11, January 17, 2006
Comment #3	Formalize customer feedback into QA Manual.	COMPLETED – included in QA Manual 120, Rev. 11, January 17, 2006
Comment #4	Add clarifying information in QA Manual on nonconformity programs.	COMPLETED – included in QA Manual 120, Rev. 11, January 17, 2006
Comment #5	Add details to QA Manual on annual management review.	COMPLETED – included in QA Manual 120, Rev. 11, January 17, 2006

VI. UPDATED PROCEDURES ISSUED DURING JULY-DECEMBER 2005

A list of Dosimetry Services Section procedures, which were updated during this semi-annual period, is included in Table 5.

VII. CONCLUSION AND RECOMMENDATIONS

Inter and intra-laboratory quality control evaluations continue to indicate the whole body, environmental, and extremity dosimetry processing programs at the E-LAB satisfy the criteria specified in the Dosimetry QA Manual. The E-LAB demonstrated the ability to meet all applicable acceptance criteria with a frequency of greater than 99%.

VIII. REFERENCES

1. American National Standard for Dosimetry - Personnel Dosimetry Performance Criteria for Testing, ANSI N13.11-2001, American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018.

2. American National Standard for Performance Testing of Extremity Dosimeters, ANSI N13.32-1995, Health Physics Society, 1313 Dolley Madison Blvd., Suite 402, McLean, VA 22101.

3. "In-Plant External Dosimetry Quality Assurance Testing Program," E-LAB, Revision 2, December 1986.

4. Framatome ANP Environmental Laboratory Quality Control and Audit Assessment Schedule, 2005.

5. E-LAB Manual No.120, Dosimetry Services Quality System Manual, Rev. 10, October 24, 2005.

TABLE 1

PERCENTAGE OF INDIVIDUAL ANALYSES WHICH PASSED E-LAB INTERNAL CRITERIA
July-December 2005 [1]

Dosimeter Type	Number of Dosimeters	Shallow (7 mg/cm^2)		Eye (300 mg/cm^2)		Deep (1000 mg/cm^2)	
		% Passed Bias Tolerance Limit[2]	% Passed Precision Tolerance Limit[3]	% Passed Bias Tolerance Limit[2]	% Passed Precision Tolerance Limit[3]	% Passed Bias Tolerance Limit[2]	% Passed Precision Tolerance Limit[3]
Panasonic 808 Whole Body	48	100	100	100	100	100	100
Panasonic 814 Whole Body	150	100	100	100	100	100	100
Extremity	24	100	96.7	N/A	N/A	N/A	N/A
Panasonic Environmental	48	100 (free in air)	100 (free in air)	N/A	N/A	N/A	N/A

(1) This table summarizes results of all depths for performance tests conducted by E-LAB and the Third-party tester for High Energy Photons.

CONTROL LIMITS FOR E-LAB DOSIMETRY PERFORMANCE TESTS -
APPLICABLE TO INDIVIDUAL TEST DOSIMETERS IRRADIATED TO HIGH ENERGY PHOTONS

Dosimeter Type	Tolerance Limits	
	Bias	Precision
Panasonic Whole Body	± 18.5%	± 16.1%
Extremity	± 32.6%	± 27.2%
Panasonic Environmental	± 20.1%	± 12.8%

(2) The percent deviation of individual results from the delivered dose is used to measure bias.
(3) The percent deviation of individual results from the mean reported dose is used to measure precision.

TABLE 2

PERCENTAGE OF MEAN ANALYSES (N=6) WHICH PASSED TOLERANCE CRITERIA

July-December 2005 (1)

	Shallow (7 mg/cm²)		Eye (300 mg/cm²)		Deep (1000 mg/cm²)	
Dosimeter Type	Number of Evaluations	% Passed Tolerance Limit(2)	Number of Evaluations	% Passed Tolerance Limit(2)	Number of Evaluations	% Passed Tolerance Limit(2)
Panasonic 808 Whole Body	8	100	8	100	8	100
Panasonic 814 Whole Body	25	100	25	100	25	100
Panasonic 808/814 Neutron Dosimeter	0(3)	100	0(3)	100	0(3)	100
Extremity	4	100	N/A	N/A	N/A	N/A
Panasonic Environmental(4)	8	100	N/A	N/A	N/A	N/A

(1) This table summarizes results of all depths for performance tests conducted by E-LAB and the Third-party tester.
(2) The mean percent deviation of individual results from the delivered dose is used to determine the bias. The standard deviation of the individual results relative to the mean bias is added to this value to determine the overall performance (|B|+S).
(3) Category VIII has two sets of results at the "deep" depth, (neutron component and neutron/photon mixtures).
(4) Environmental dosimeter results are free in air.

TABLE 3

SUMMARY OF THIRD PARTY QC RESULTS FOR SECOND AND THIRD QUARTERS 2005 (NVLAP Required Categories)

Dosimeter Type	Exposure Period	NVLAP Category(1)	Shallow (7 mg/cm²) (2)		Deep (1000 mg/cm²) (2)	
			Bias% (3,4) ± Std. Dev.%	|B| +S	Bias%(3,4) ± Std. Dev.%	|B| +S
808	(6)	I.A	N/A	N/A		
808	Q2/2005	II.A	2.5 ± 2.5	0.050	-4.1 ± 3.1	0.073
808	Q3/2005	II.A	11.6 ± 0.8	0.123	9.3 ± 2.7	0.120
808	(6)	III.A	N/A	N/A		
808	(6)	IV.A				
808	(6)	V.AB				
814	(6)	I.A	N/A	N/A		
814	Q2/2005	II.A	0.7 ± 6.6	0.072	-13.6 ± 2.6	0.162
814	Q3/2005	II.A	7.3 ± 2.8	0.101	3.8 ± 2.6	0.064
814	(6)	III.A	N/A	N/A		
814	(6)	IV.A				
814	(6)	V.AB				
808/814	(6)	VI.CB	N/A	N/A		
808/814	(6)	VI.CB(5)	N/A	N/A		
808/814	(6)	VI.CB	N/A	N/A		
808/814	(6)	VI.CB(5)	N/A	N/A		
Extremity	Q2/2005	IV.A	-22.7 ± 9.0	0.318	N/A	N/A
Extremity	Q3/2005	IV.A	-3.9 ± 19.5	0.233	N/A	N/A
Extremity	(6)	IV.B			N/A	N/A
Extremity	(6)	IV.B			N/A	N/A
Extremity	(6)	V.C			N/A	N/A
Extremity	(6)	V.D			N/A	N/A

TABLE 3

SUMMARY OF THIRD PARTY QC RESULTS FOR
SECOND AND THIRD QUARTERS 2005
(NVLAP Required Categories)
(continued)

(1) 808/814/808+814 NVLAP Category Key:

I.A = Accident, Photons, General
II.A = Photons, General
III.A = Betas, General
IV.A = Photon Mixtures, General
V.AB = Beta/Photon Mixtures
VI.CB = Neutron/Photon mixtures

Extremity NVLAP Category Key:

IV.A = High Energy Photons (Cs-137)
IV.B = High Energy Photons (Co-60)
V.C = Beta Particles, General (Sr/Y-90, Tl-204)
VI.D = Beta Particles, Slab Uranium

(2) Reported results are fade corrected to the date of irradiation for all dosimeter types other than extremity and environmental.

(3) The bias (B) is calculated as the mean of the percent deviations of individual results from the delivered dose.

(4) The standard deviation (S) is calculated from the deviation of individual biases from the mean bias.

(5) Category VI.CB Neutron component only

(6) These categories were not tested during this semi-annual period.

TABLE 4

SUMMARY OF THIRD PARTY QC RESULTS FOR
SECOND AND THIRD QUARTERS 2005
(NVLAP Non-Required Categories)

Dosimeter Type	Exposure Period	NVLAP Category[1]	Shallow (7 mg/cm^2) [2]		Eye (300 mg/cm^2) [2]	
			Bias% [3,4] ± Std. Dev.%	|B| +S	Bias% [3,4] ± Std. Dev.%	|B| +S
808	[8]	I.A				
808	Q2/2005	II.A	N/A	N/A	-0.3 ± 1.9	0.022
808	Q3/2005	II.A	N/A	N/A	9.8 ± 1.6	0.114
808	[8]	III.A				
808	[8]	IV.A	N/A	N/A		
808	[8]	V.AB	N/A	N/A		[7]
814	[8]	I.A				
814	Q2/2005	II.A	N/A	N/A	-9.1 ± 3.2	0.124
814	Q3/2005	II.A	N/A	N/A	6.3 ± 2.8	0.091
814	[8]	III.A				
814	[8]	IV.A	N/A	N/A		
814	[8]	V.AB	N/A	N/A		[7]
808/814	[8]	VI.CB				
808/814	[8]	VI.CB[5]	N/A	N/A	N/A	N/A
808/814	[8]	VI.CB				
808/814	[8]	VI.CB[5]	N/A	N/A	N/A	N/A
Environ.[6]	Q2/2005	II	4.4 ± 1.6	0.060	N/A	N/A
Environ.[6]	Q3/2005	II	-1.0 ± 1.2	0.022	N/A	N/A

TABLE 4

SUMMARY OF THIRD PARTY QC RESULTS FOR
SECOND AND THIRD QUARTERS 2005
(NVLAP Non-Required Categories)
(continued)

(1) 808/814/808+814 NVLAP Category Key:

I.A = Accident, Photons, General
II.A = Photons, General
III.A = Betas, General
IV.A = Photon Mixtures, General
V.AB = Beta/Photon Mixtures
VI.CB = Neutron/Photon mixtures

Extremity NVLAP Category Key:

IV.A = High Energy Photons (Cs-137)
IV.B = High Energy Photons (Co-60)
V.C = Beta Particles, General (Sr/Y-90, Tl-204)
VI.D = Beta Particles, Slab Uranium

(2) Reported results are fade corrected to the date of irradiation for all dosimeter types other than extremity and environmental.

(3) The bias (B) is calculated as the mean of the percent deviations of individual results from the delivered dose.

(4) The standard deviation (S) is calculated from the deviation of individual biases from the mean bias.

(5) Category VI.CB Neutron component only.

(6) Results are expressed as the delivered exposure (not dose) for environmental TLDs.

(7) Internal acceptance criteria for this test are currently being evaluated.

(8) These categories were not tested during this semi-annual period.

TABLE 5

UPDATED INSTRUMENTATION GROUP DOSIMETRY SERVICES
PROCEDURES ISSUED DURING JULY-DECEMBER 2005

No Dosimetry Processing Procedures were revised during this reporting period.

APPENDIX A

DOSIMETRY QUALITY CONTROL TRENDING GRAPHS

JULY-DECEMBER 2005

APPENDIX A

DOSIMETRY QUALITY CONTROL TRENDING GRAPHS
July-December 2005

LIST OF FIGURES

APPENDIX A

DOSIMETRY QUALITY CONTROL TRENDING GRAPHS
July-December 2005

23. 814 Category II (High-Energy Photons) Mean Bias Plus Standard Deviation (B+S) at the Eye Depth Dose

24. 814 Category II (High-Energy Photons) Mean Bias Plus Standard Deviation (B+S) at the Deep Depth Dose

25. Extremity Category IV (High-Energy Photons) Individual Bias at the Shallow Depth Dose

26. Extremity Category IV (High-Energy Photons) Individual Precision at the Shallow Depth Dose

27. Extremity Category IV (High-Energy Photons) Mean Bias at the Shallow Depth Dose

28. Extremity Category IV (High-Energy Photons) Mean Bias Plus Standard Deviation (B+S) at the Shallow Depth Dose

29. Environmental TLDs Individual Bias Cs-137

30. Environmental TLDs Precision Cs-137

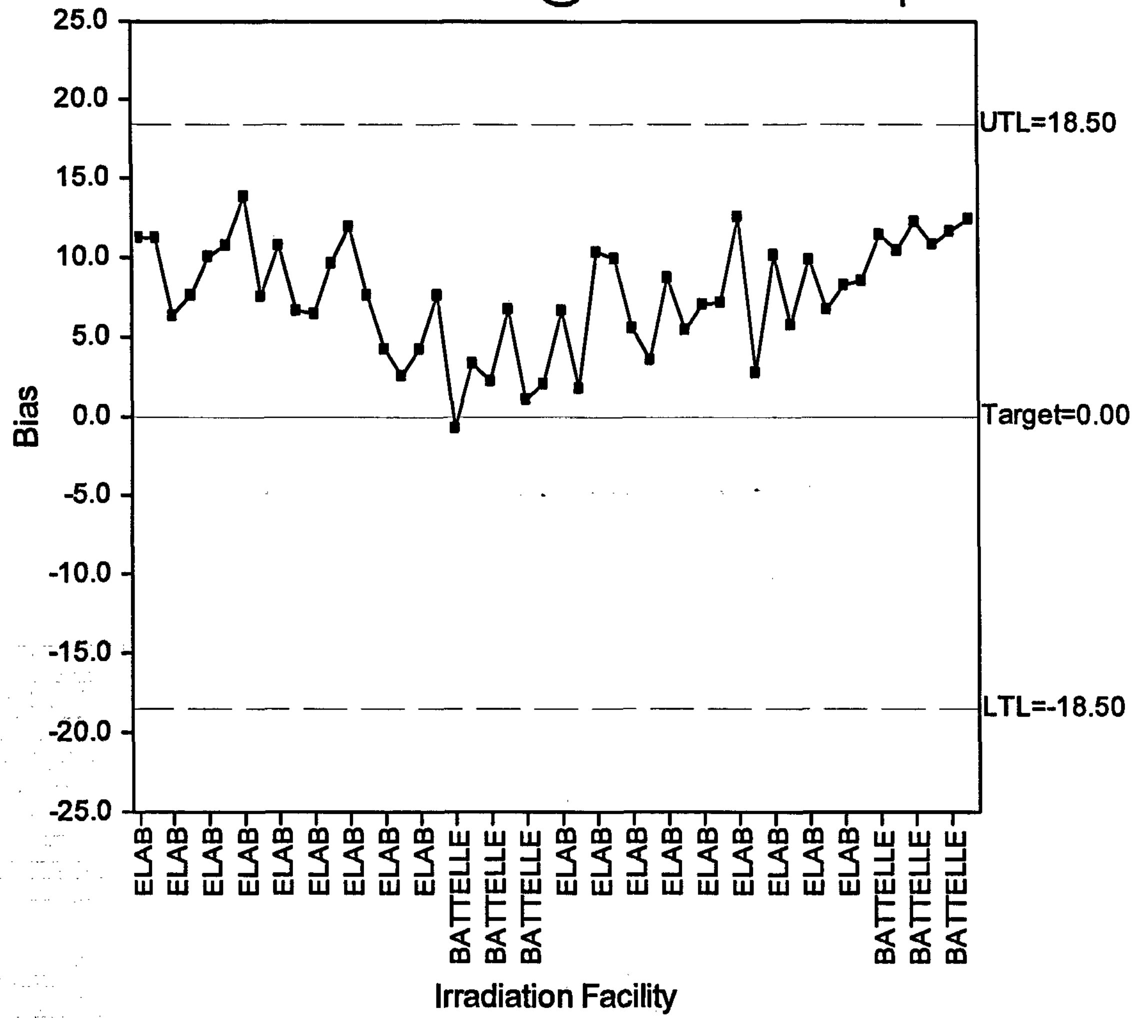
31. Environmental TLDs Mean Bias Cs-137

FIGURE 1

Process Statistics

Total:	48
Rows:	All
Mean:	7.656
Median:	7.700
Std Dev:	3.551
Act % out of TL:	0.00

808 Cat II Individual Bias @ the Shallow Depth Dose



APPENDIX A
QC TESTING DATA FOR THE SEMI-ANNUAL PERIOD
July-December 2005

FIGURE 2

Process Statistics

Total:	48
Rows:	All
Mean:	4.433
Median:	4.500
Std Dev:	4.396
Act % out of TL:	0.00

808 Cat II Individual Bias @ the Eye Depth Dose

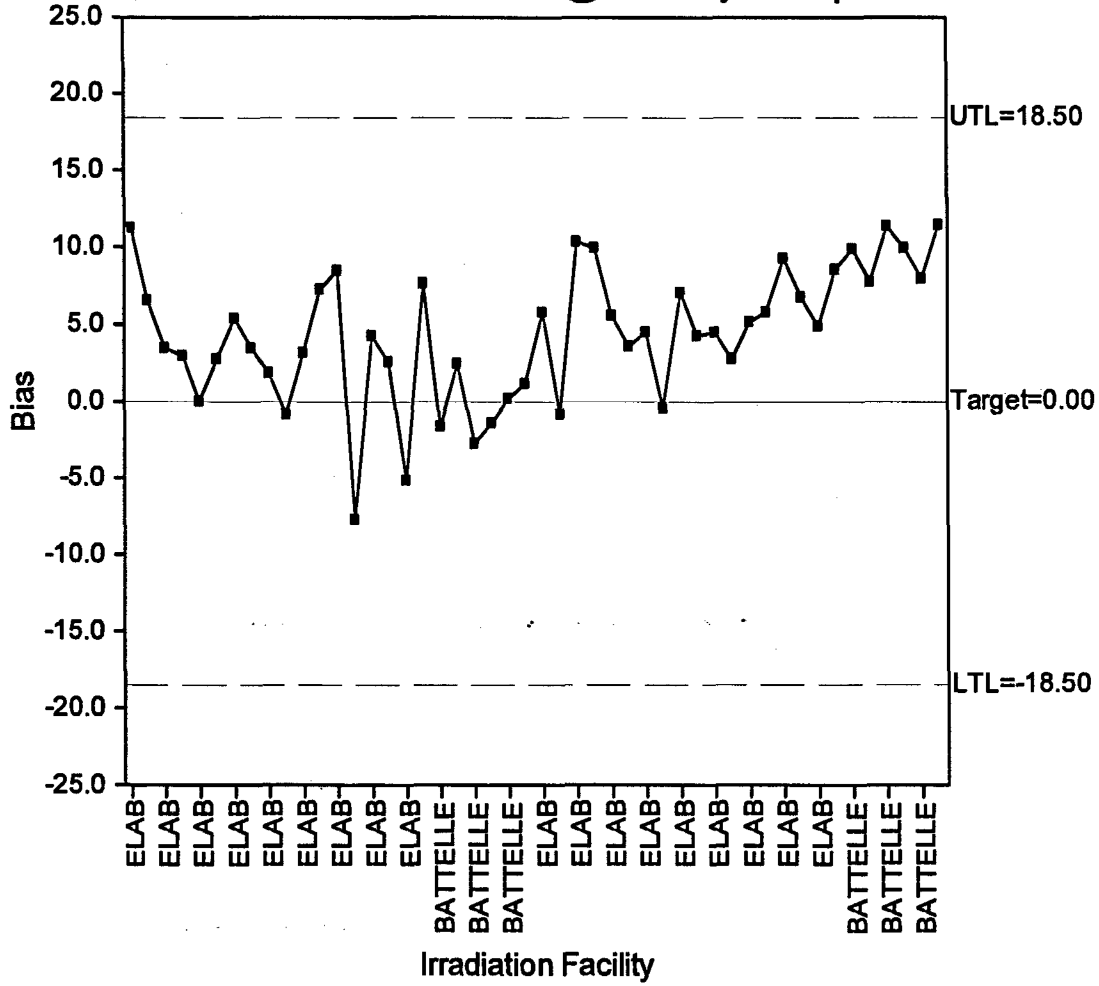


FIGURE 3

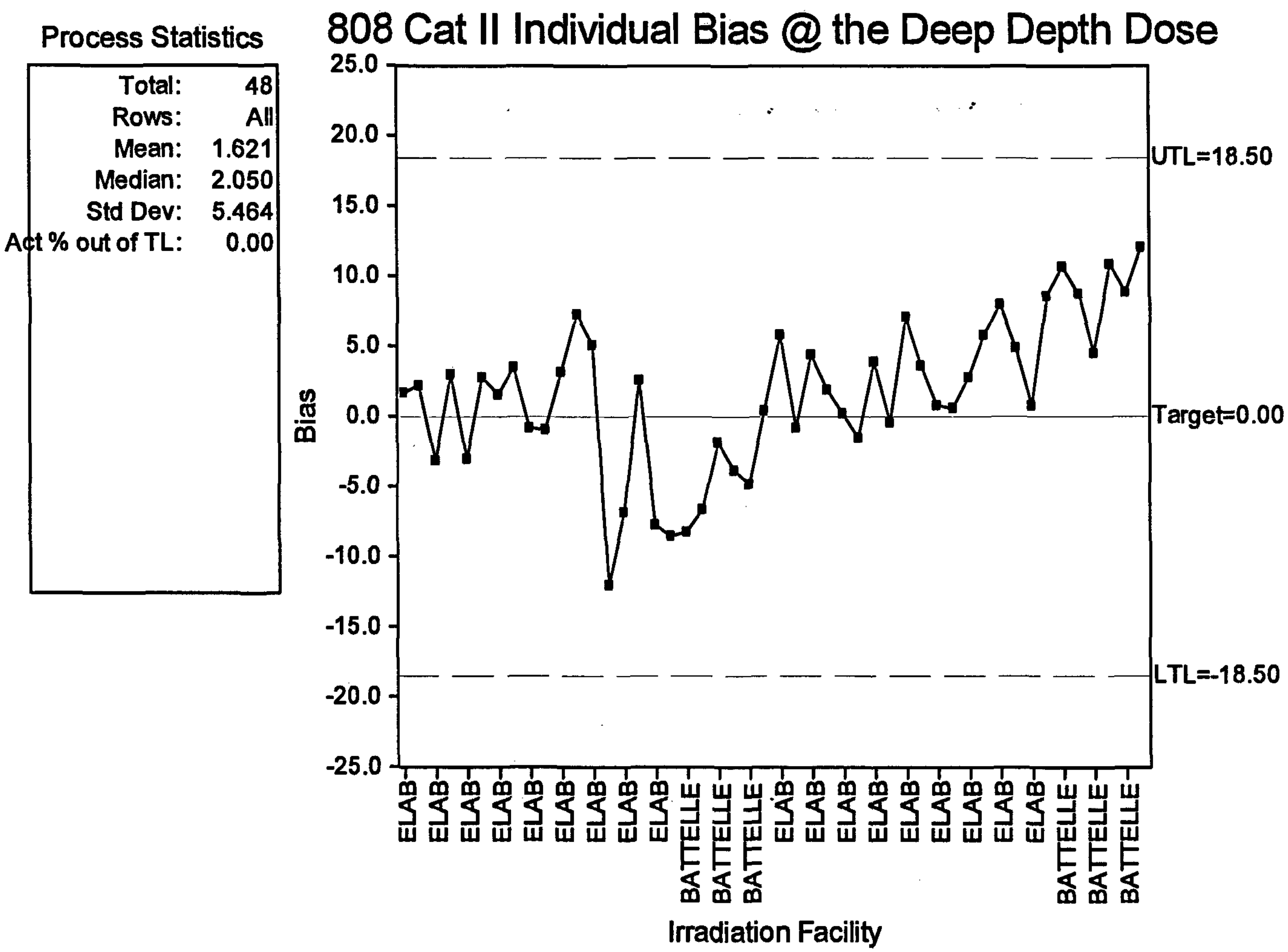
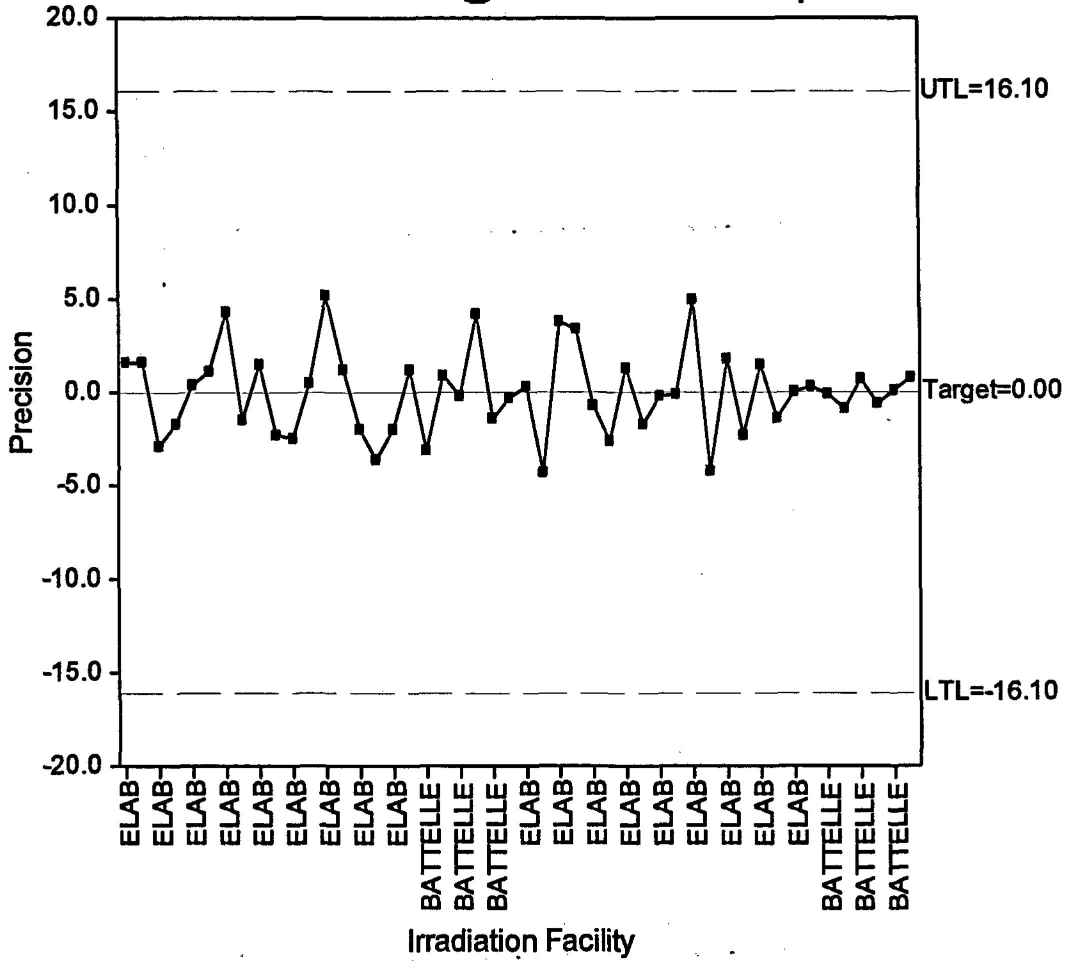

Process Statistics
Total: 48
Rows: All
Mean: 1.621
Median: 2.050
Std Dev: 5.464
Act % out of TL: 0.00
808 Cat II Individual Bias @ the Deep Depth Dose
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
Bias
UTL=18.50
Target=0.00
LTL=-18.50
ELAB
BATTELLE
Irradiation Facility

FIGURE 4

Process Statistics

Total:	48
Rows:	All
Mean:	0.002
Median:	-0.050
Std Dev:	2.296
Act % out of TL:	0.00

808 Cat II Precision @ the Shallow Depth Dose



APPENDIX A
QC TESTING DATA FOR THE SEMI-ANNUAL PERIOD
July-December 2005

FIGURE 5

Process Statistics

Total:	48
Rows:	All
Mean:	0.000
Median:	0.100
Std Dev:	3.176
Act % out of TL:	0.00

808 Cat II Precision @ the Eye Depth Dose

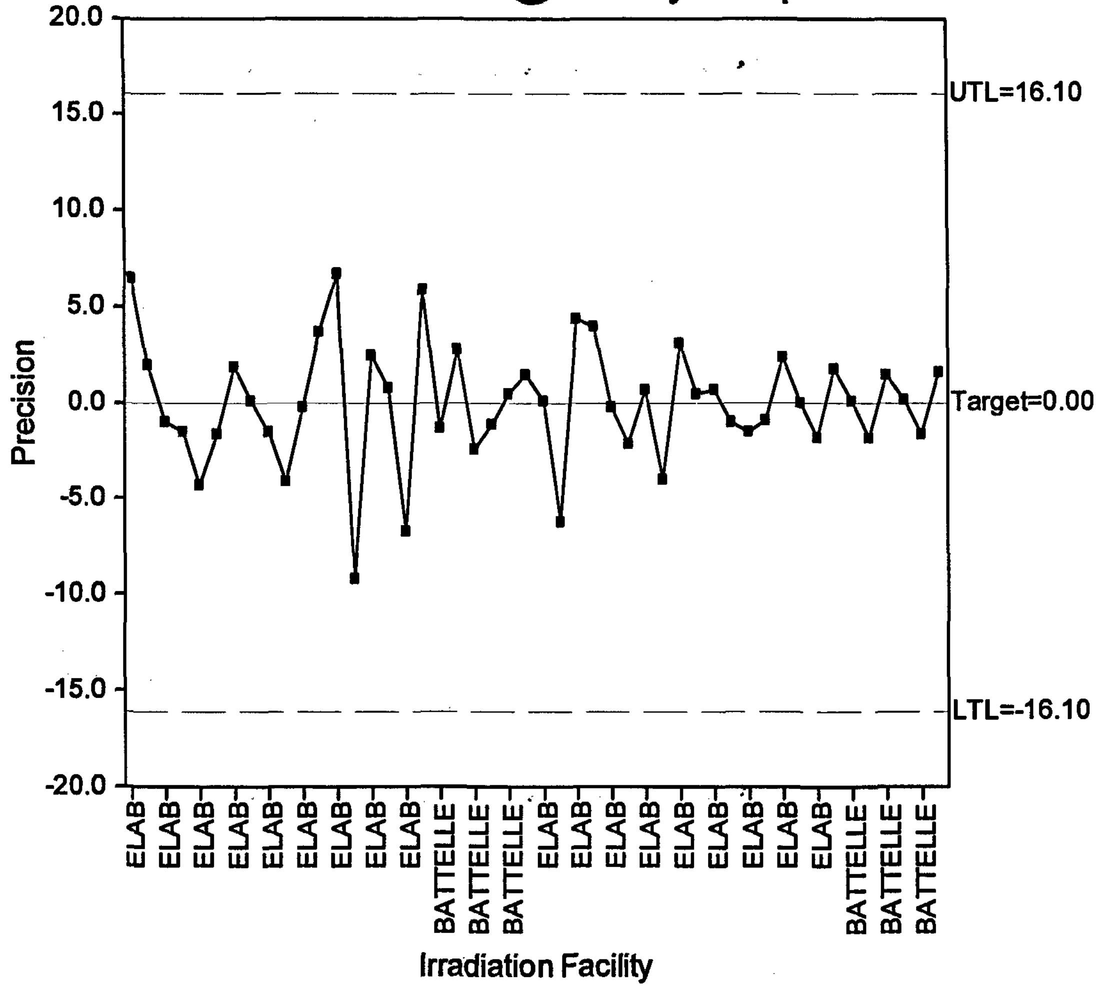


FIGURE 6

Process Statistics

Total:	48
Rows:	All
Mean:	0.000
Median:	-0.050
Std Dev:	3.403
Act % out of TL:	0.00

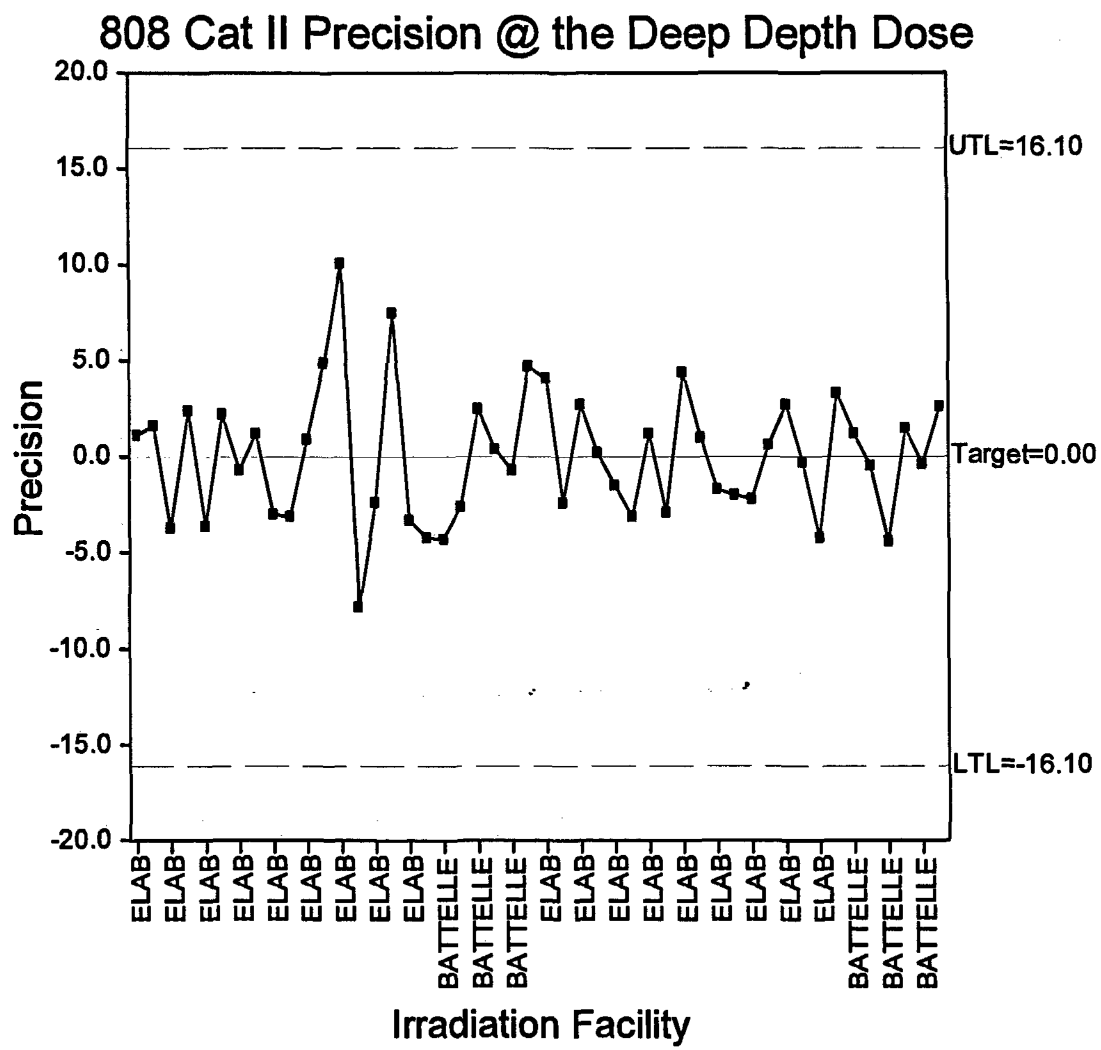


FIGURE 7

Process Statistics

Total:	8
Rows:	All
Mean:	7.775
Median:	7.800
Std Dev:	2.474
Act % out of TL:	0.00

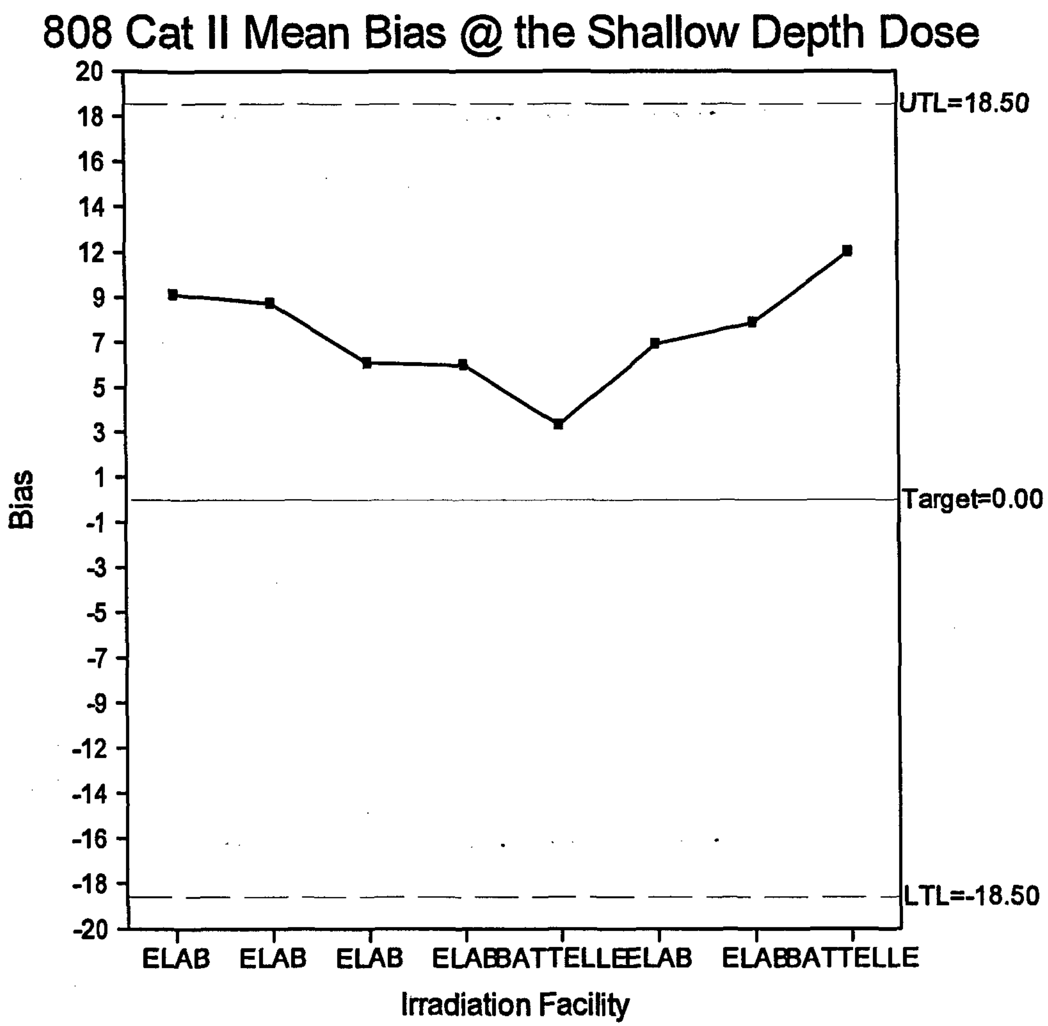


FIGURE 8

Process Statistics

Total:	8
Rows:	All
Mean:	4.763
Median:	4.150
Std Dev:	2.643
Act % out of TL:	0.00

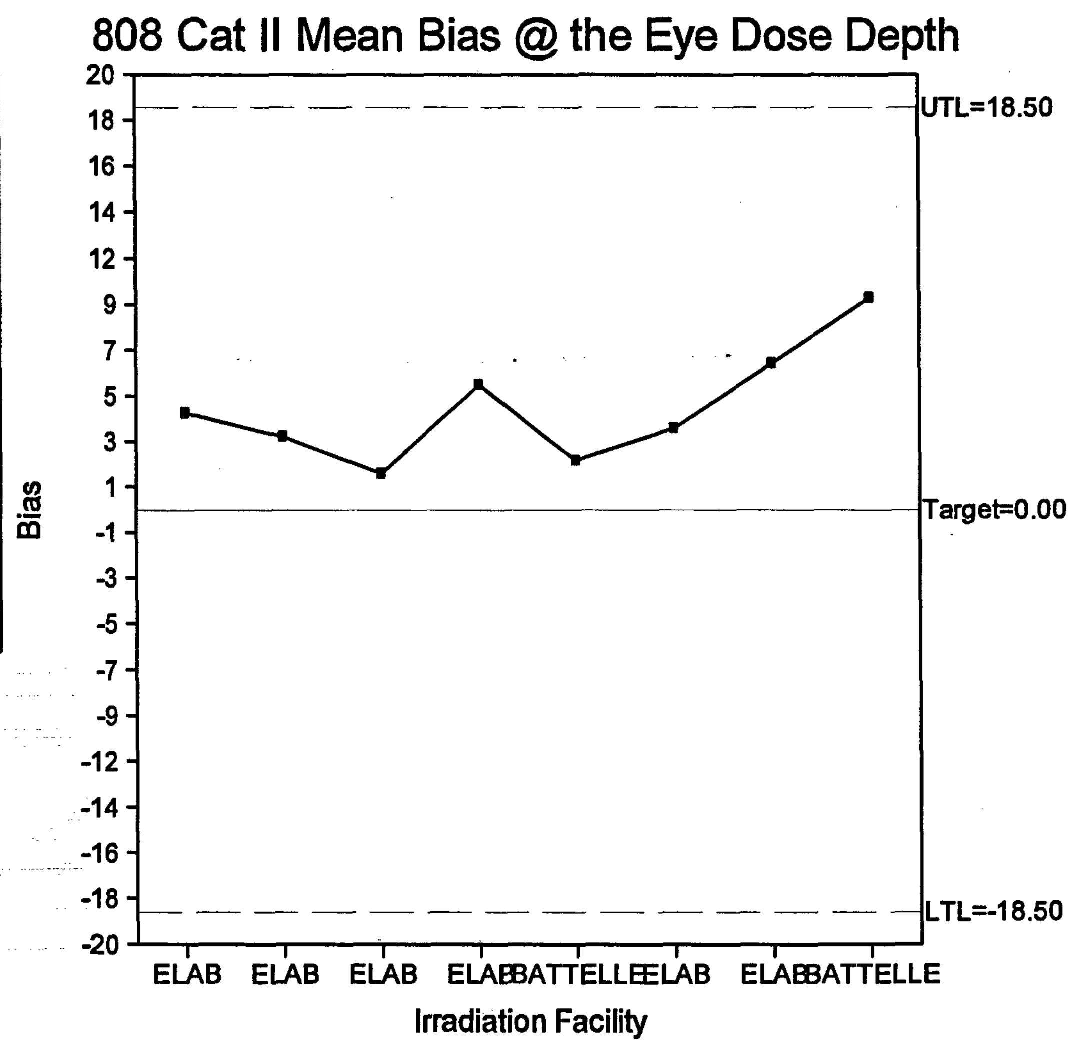


FIGURE 9

Process Statistics

Total:	8
Rows:	All
Mean:	2.338
Median:	2.000
Std Dev:	3.943
Act % out of TL:	0.00

808 Cat II Mean Bias @ the Deep Depth Dose

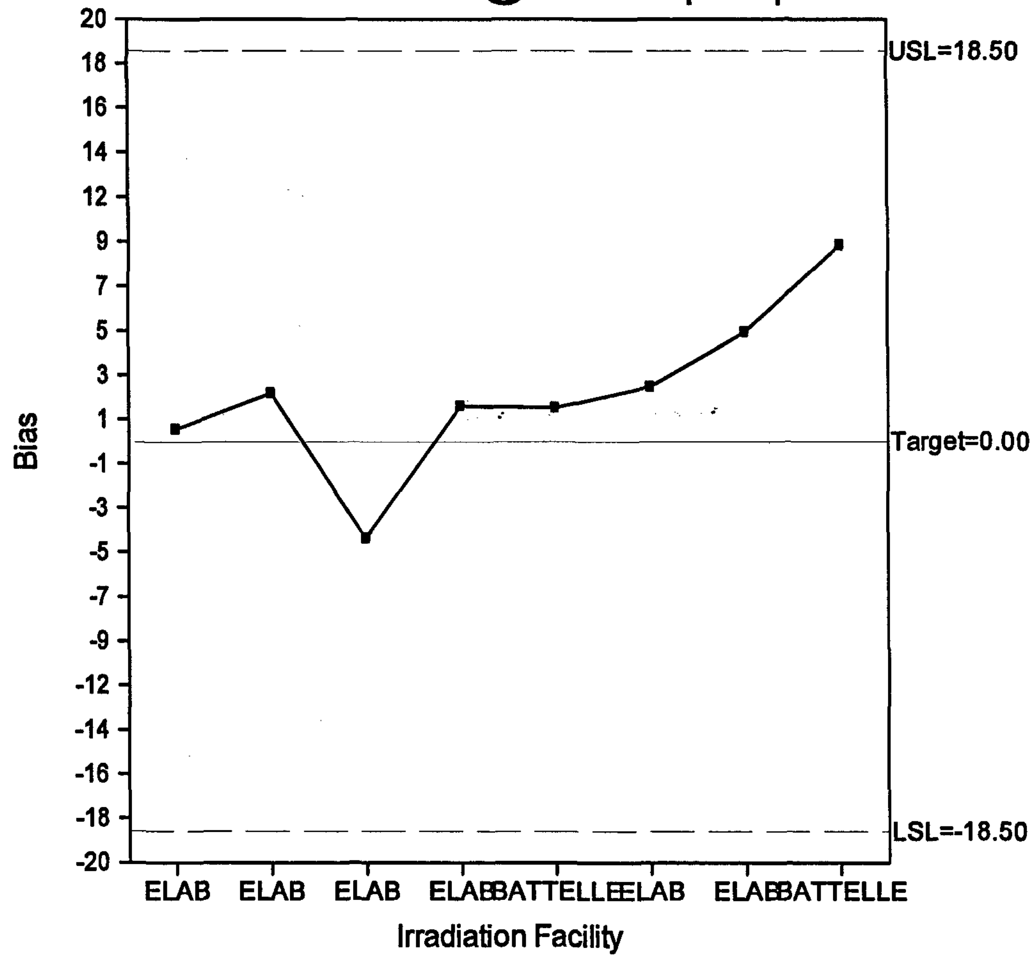


FIGURE 10

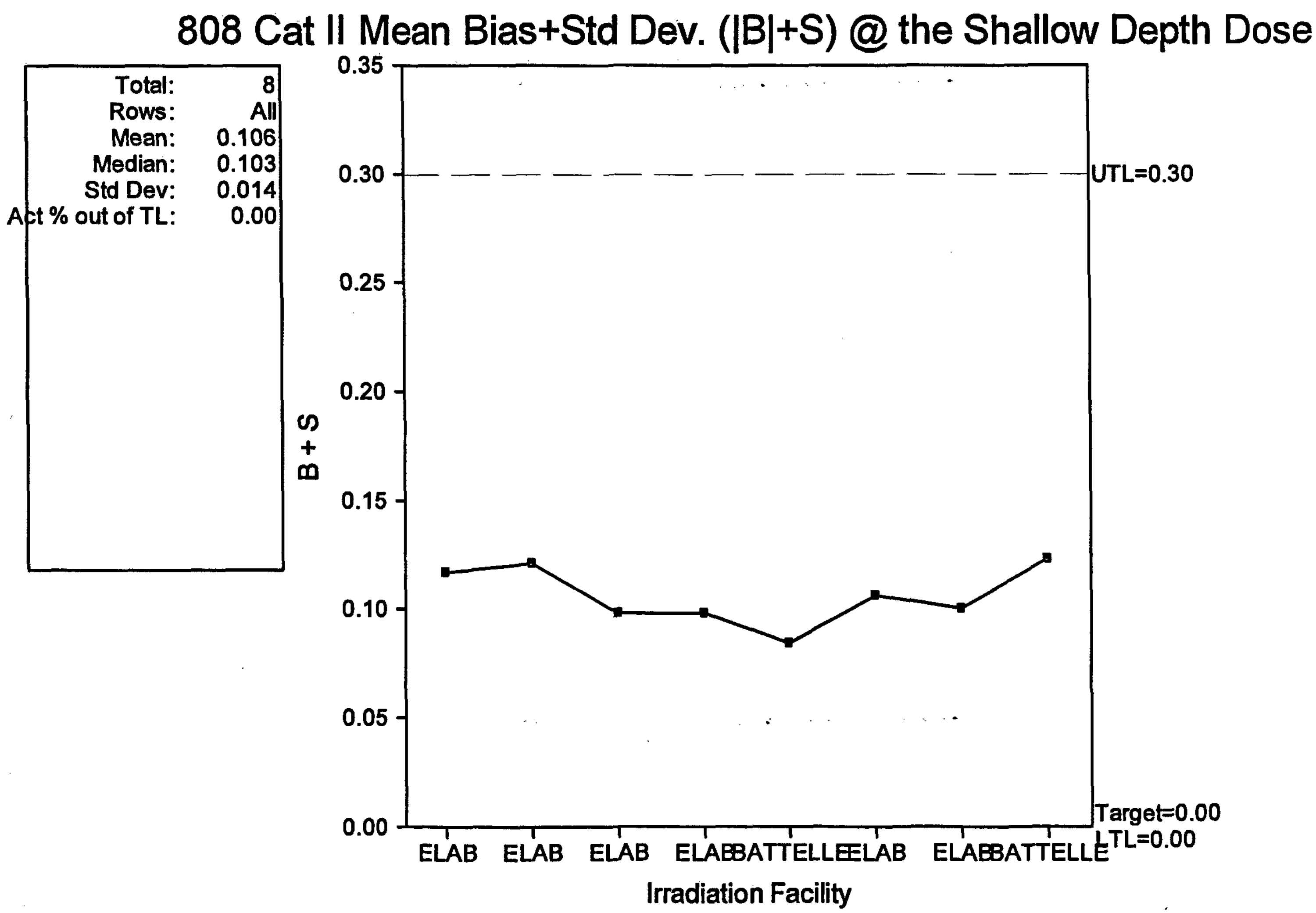
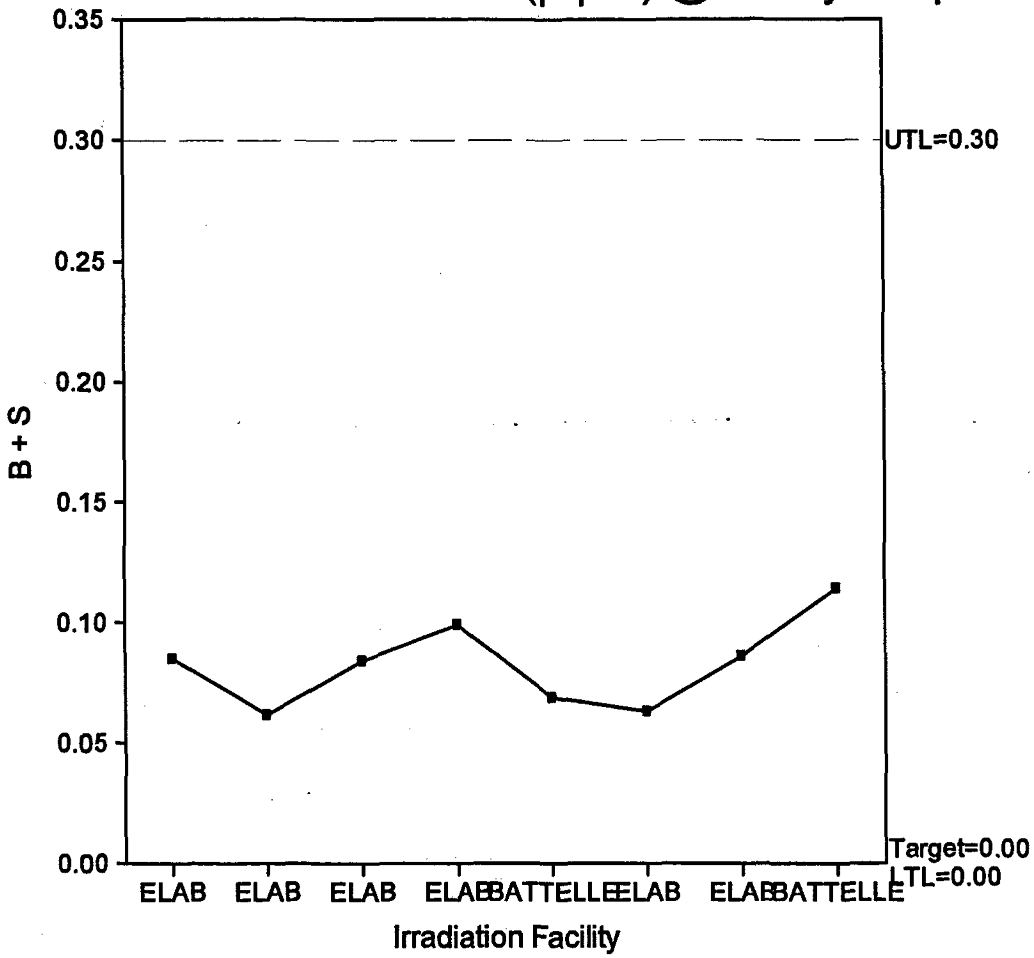

808 Cat II Mean Bias+Std Dev. (|B|+S) @ the Shallow Depth Dose
Total: 8
Rows: All
Mean: 0.106
Median: 0.103
Std Dev: 0.014
Act % out of TL: 0.00
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
B+S
UTL=0.30
Target=0.00
LTL=0.00
ELAB
ELAB
ELAB
ELAB
BATTELLE
ELAB
ELAB
BATTELLE
Irradiation Facility

FIGURE 11

808 Cat II Mean Bias + Std Dev. (|B|+S) @ the Eye Depth Dose

Total:	8
Rows:	All
Mean:	0.083
Median:	0.084
Std Dev:	0.018
Act % out of TL:	0.00



APPENDIX A
QC TESTING DATA FOR THE SEMI-ANNUAL PERIOD
July-December 2005

FIGURE 12

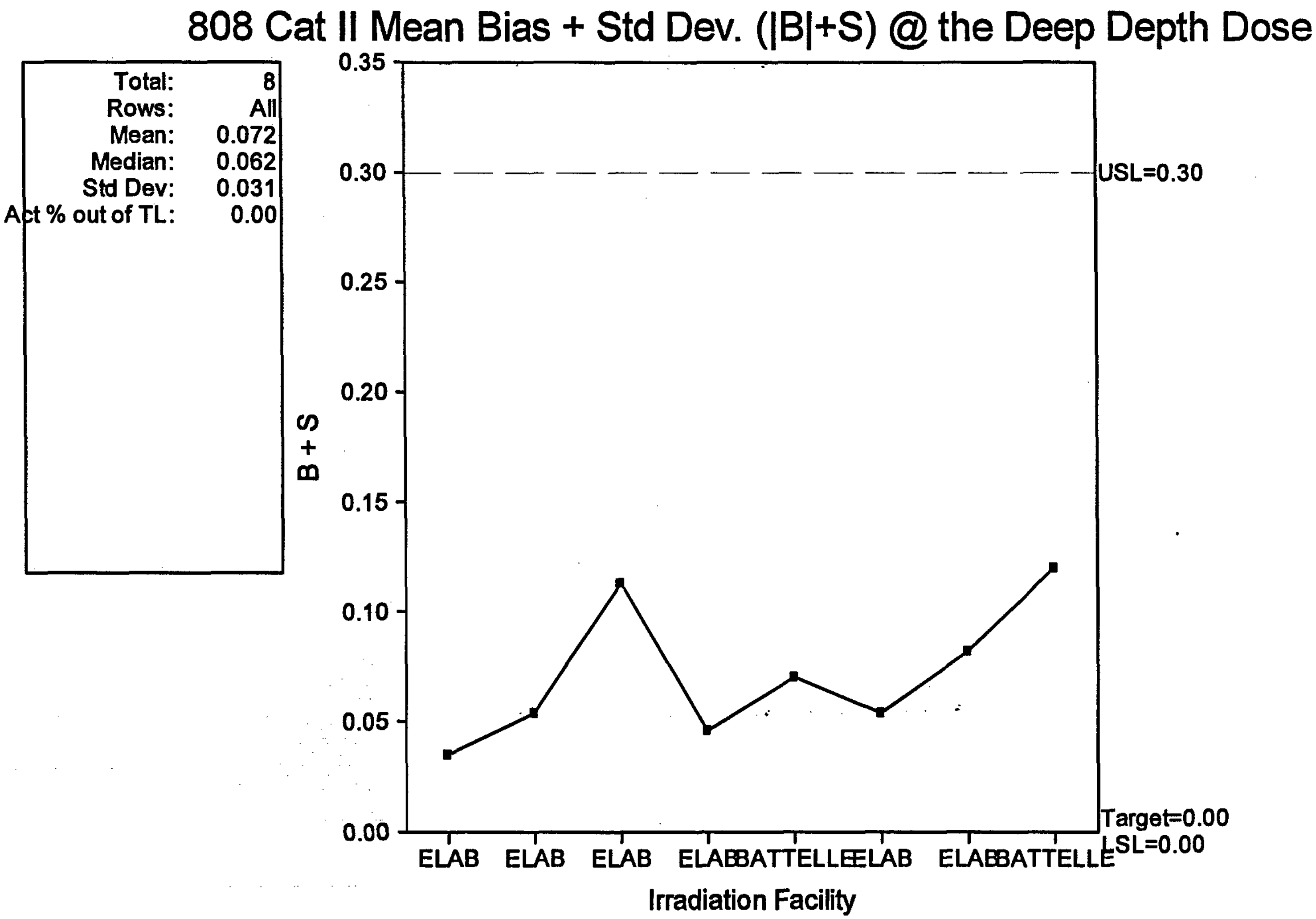
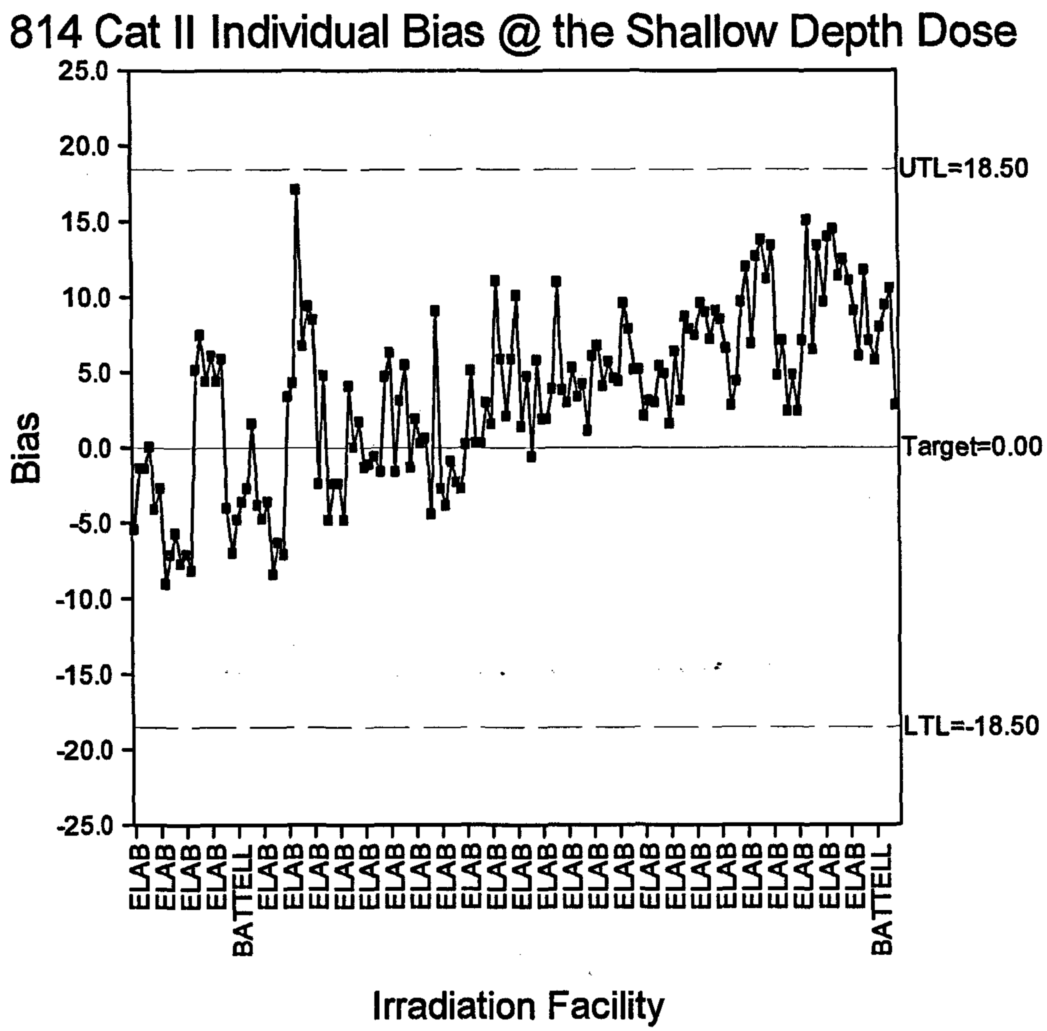


FIGURE 13

Process Statistics

Total:	150
Rows:	All
Mean:	3.494
Median:	4.250
Std Dev:	5.690
Act % out of TL:	0.00

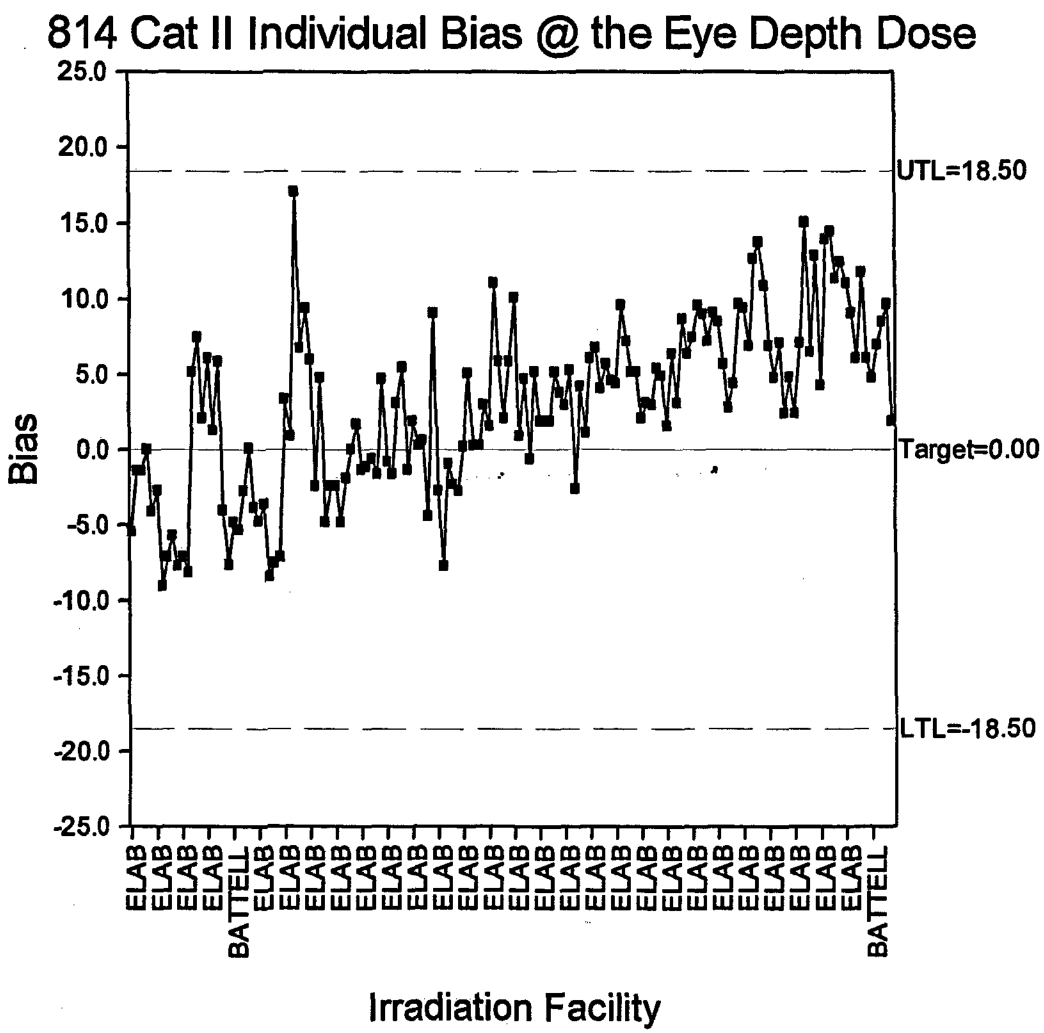


APPENDIX A
QC TESTING DATA FOR THE SEMI-ANNUAL PERIOD
July-December 2005

FIGURE 14

Process Statistics

Total:	150
Rows:	All
Mean:	3.011
Median:	3.250
Std Dev:	5.625
Act % out of TL:	0.00



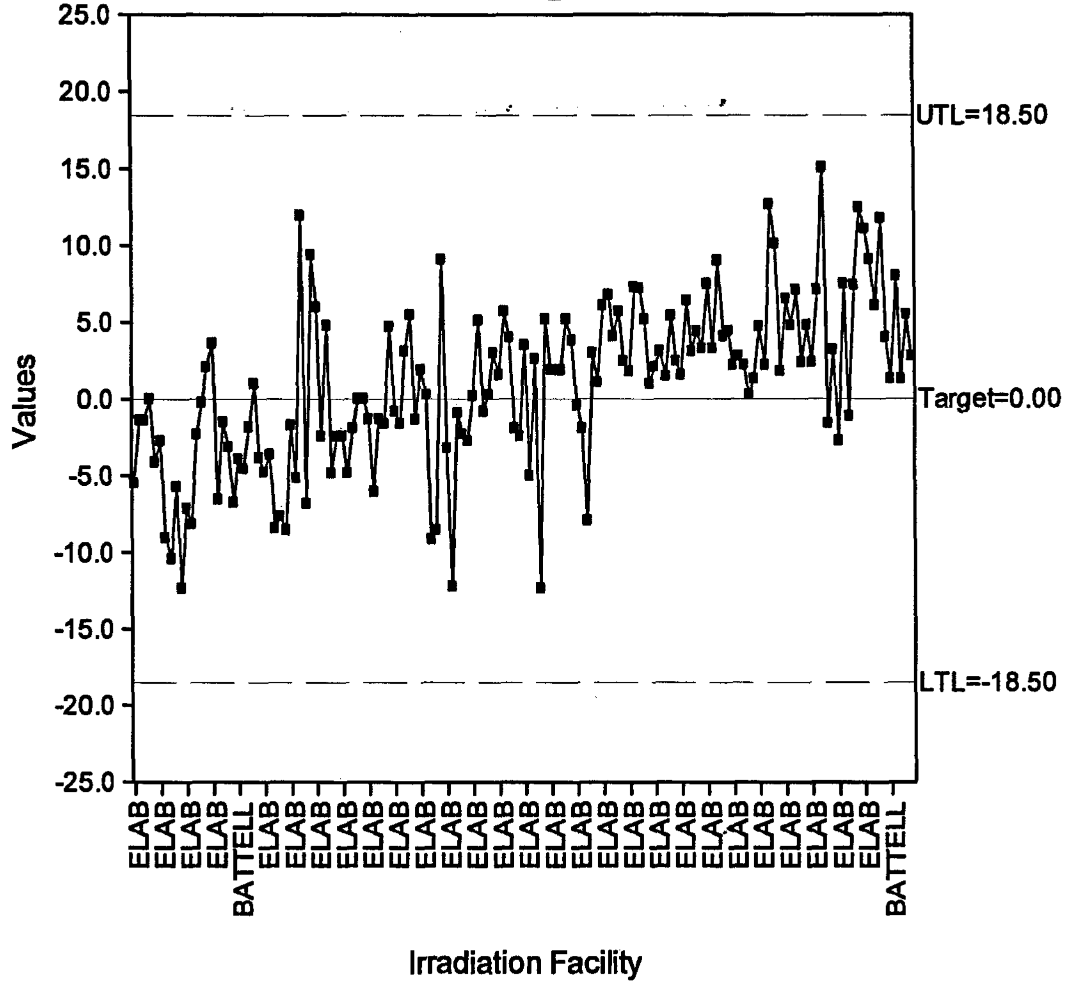
APPENDIX A
QC TESTING DATA FOR THE SEMI-ANNUAL PERIOD
July-December 2005

FIGURE 15

Process Statistics

Total:	150
Rows:	All
Mean:	0.981
Median:	1.600
Std Dev:	5.400
Act % out of TL:	0.00

814 Cat II Individual Bias @ the Deep Depth Dose



APPENDIX A
QC TESTING DATA FOR THE SEMI-ANNUAL PERIOD
July-December 2005

FIGURE 16

Process Statistics

Total:	150
Rows:	All
Mean:	0.001
Median:	-0.200
Std Dev:	2.472
Act % out of TL:	0.00

814 Cat II Precision @ the Shallow Depth Dose

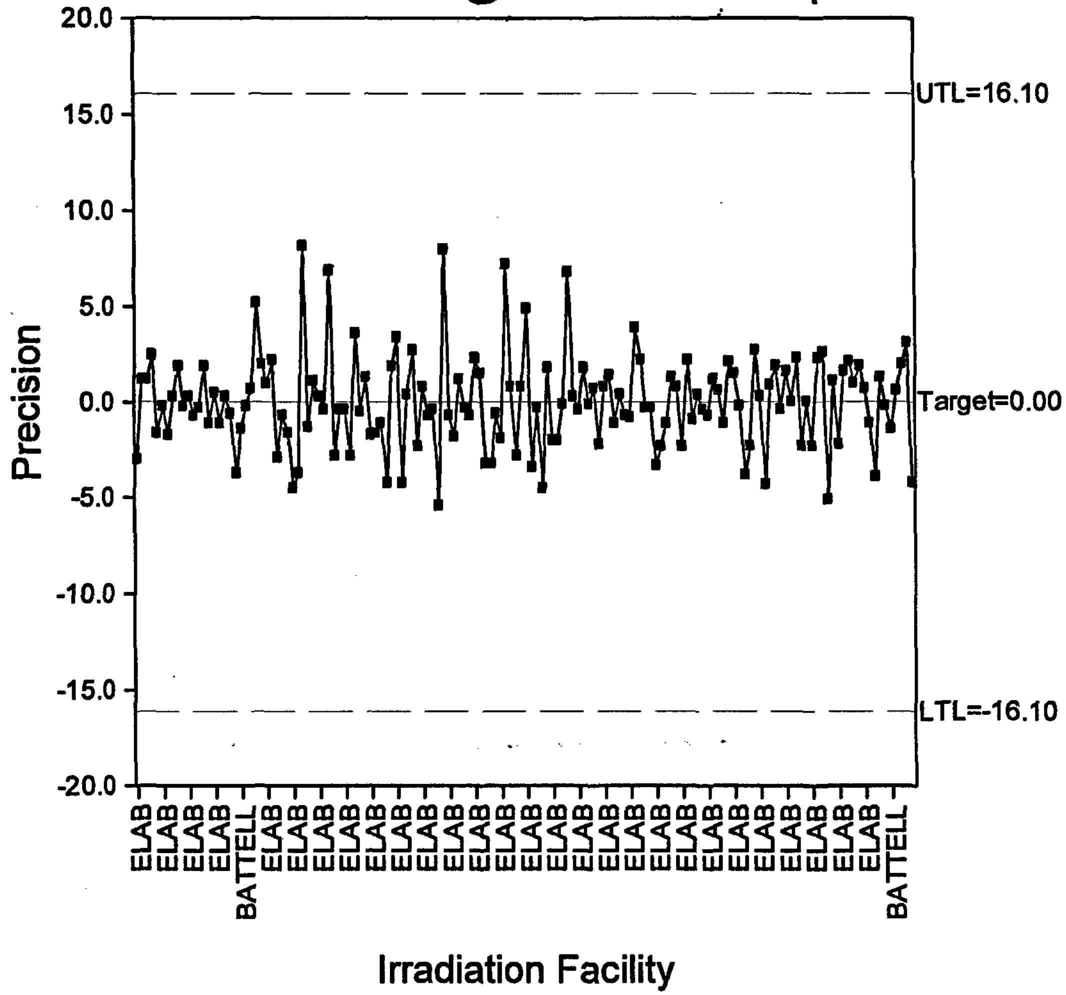


FIGURE 17

Process Statistics

Total:	150
Rows:	All
Mean:	-0.003
Median:	-0.150
Std Dev:	2.594
Act % out of TL:	0.00

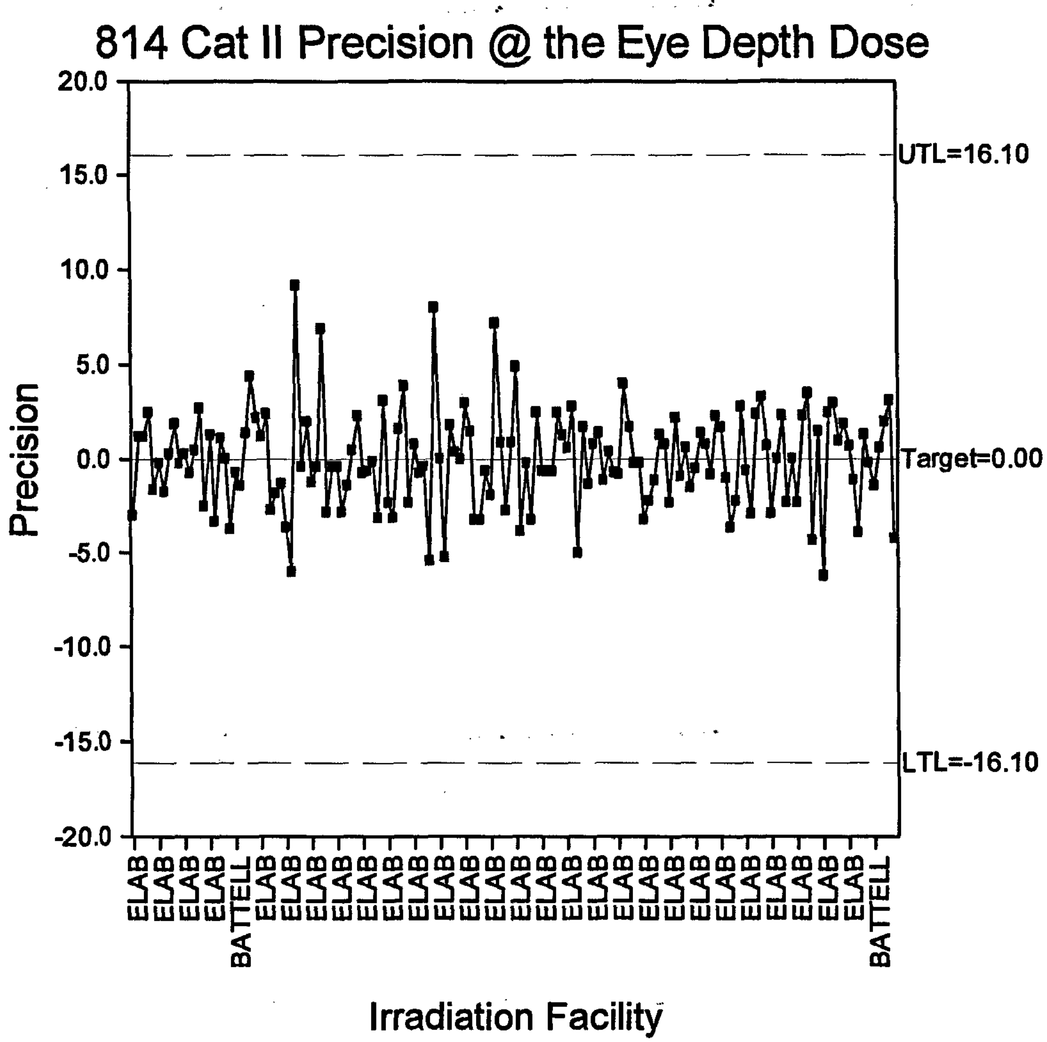


FIGURE 18

Process Statistics

Total:	150
Rows:	All
Mean:	0.005
Median:	0.000
Std Dev:	3.539
Act % out of TL:	0.00

814 Cat II Precision @ the Deep Depth Dose

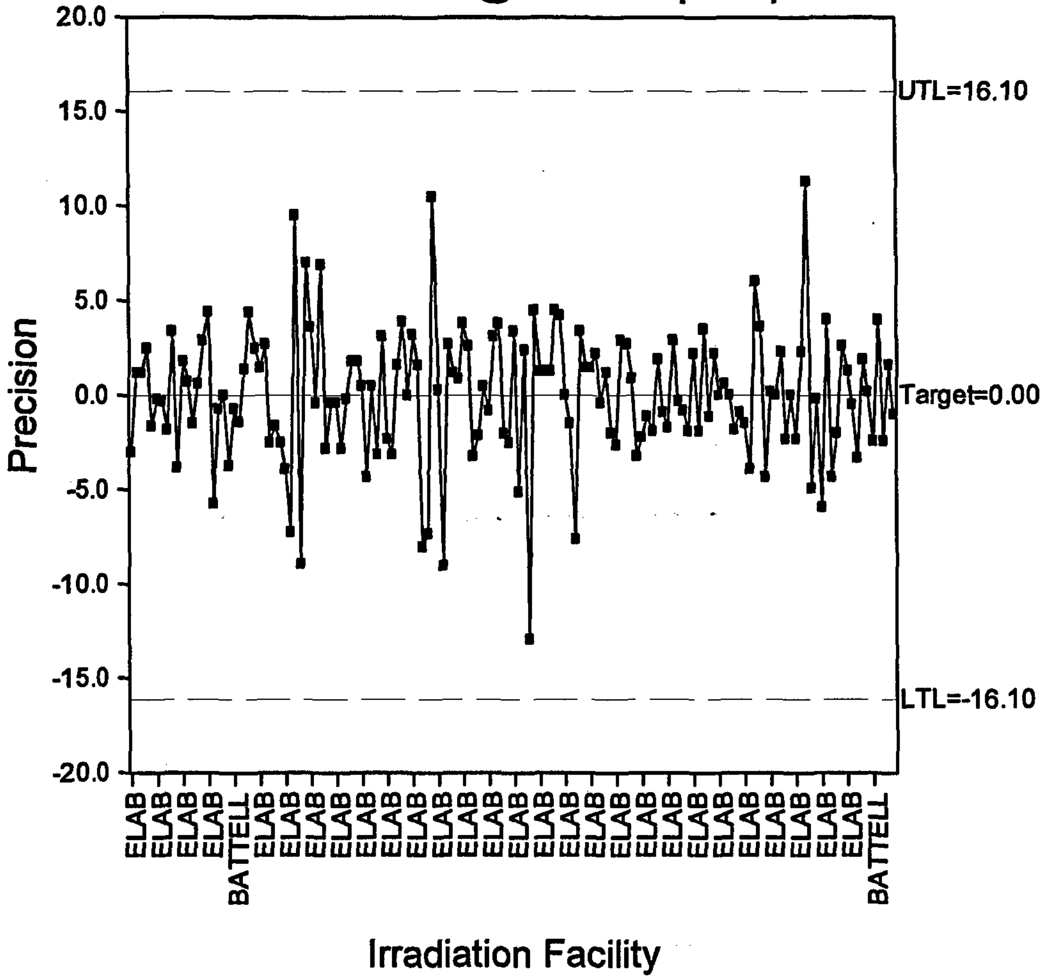
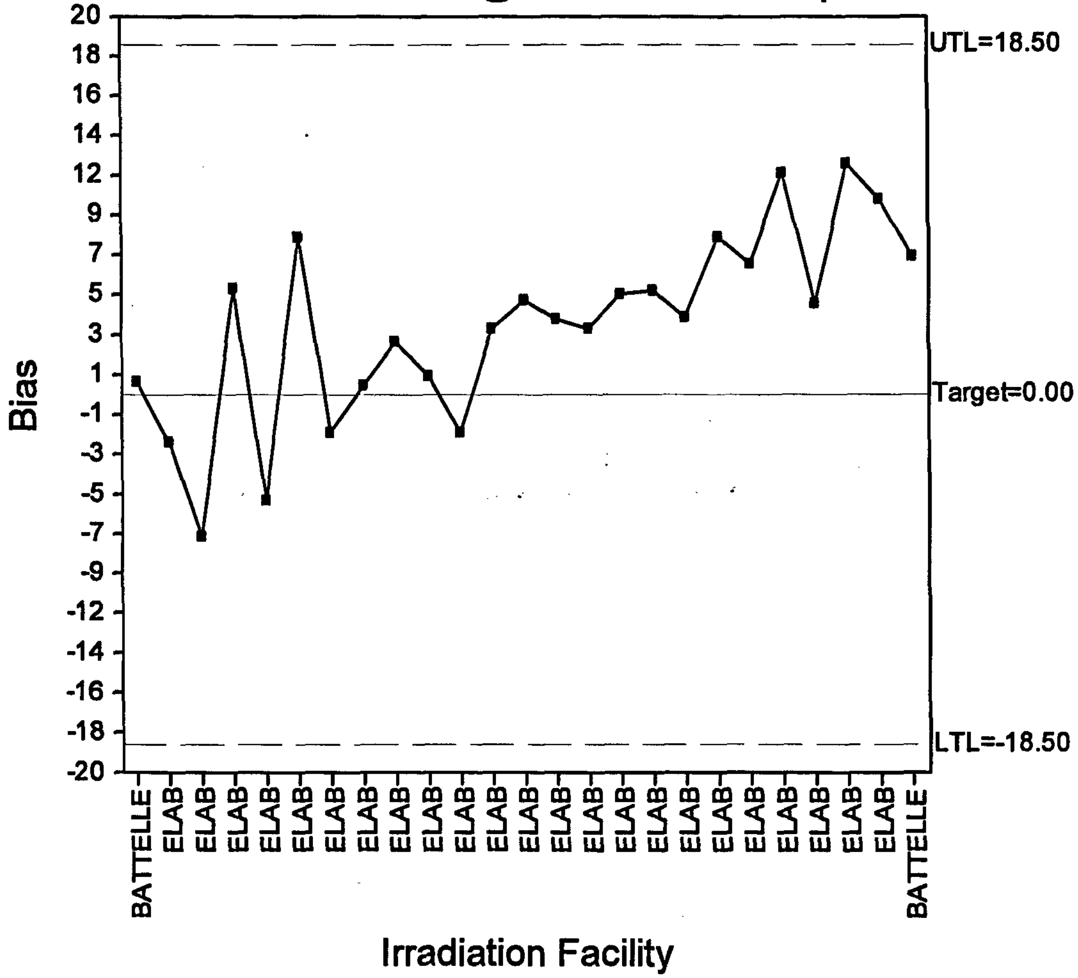


FIGURE 19

Process Statistics

Total:	25
Rows:	All
Mean:	3.668
Median:	4.100
Std Dev:	5.003
Act % out of TL:	0.00

814 Cat II Mean Bias @ the Shallow Depth Dose



APPENDIX A
QC TESTING DATA FOR THE SEMI-ANNUAL PERIOD
July-December 2005

FIGURE 20

814 Cat II Mean Bias @ the Eye Depth Dose

Process Statistics

Total:	25
Rows:	All
Mean:	2.812
Median:	4.100
Std Dev:	5.416
Act % out of SL:	0.00

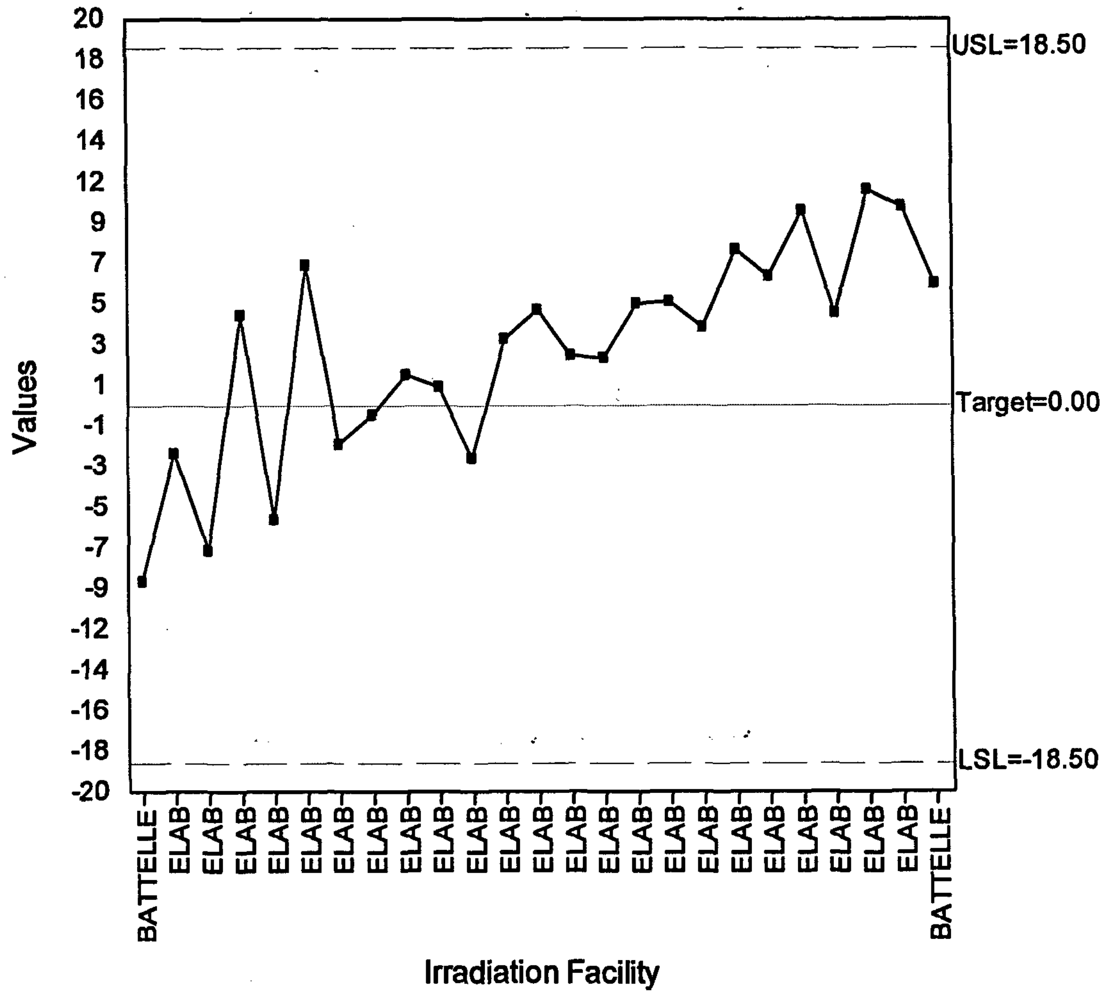


FIGURE 21

Process Statistics

Total:	25
Rows:	All
Mean:	0.568
Median:	1.600
Std Dev:	5.000
Act % out of TL:	0.00

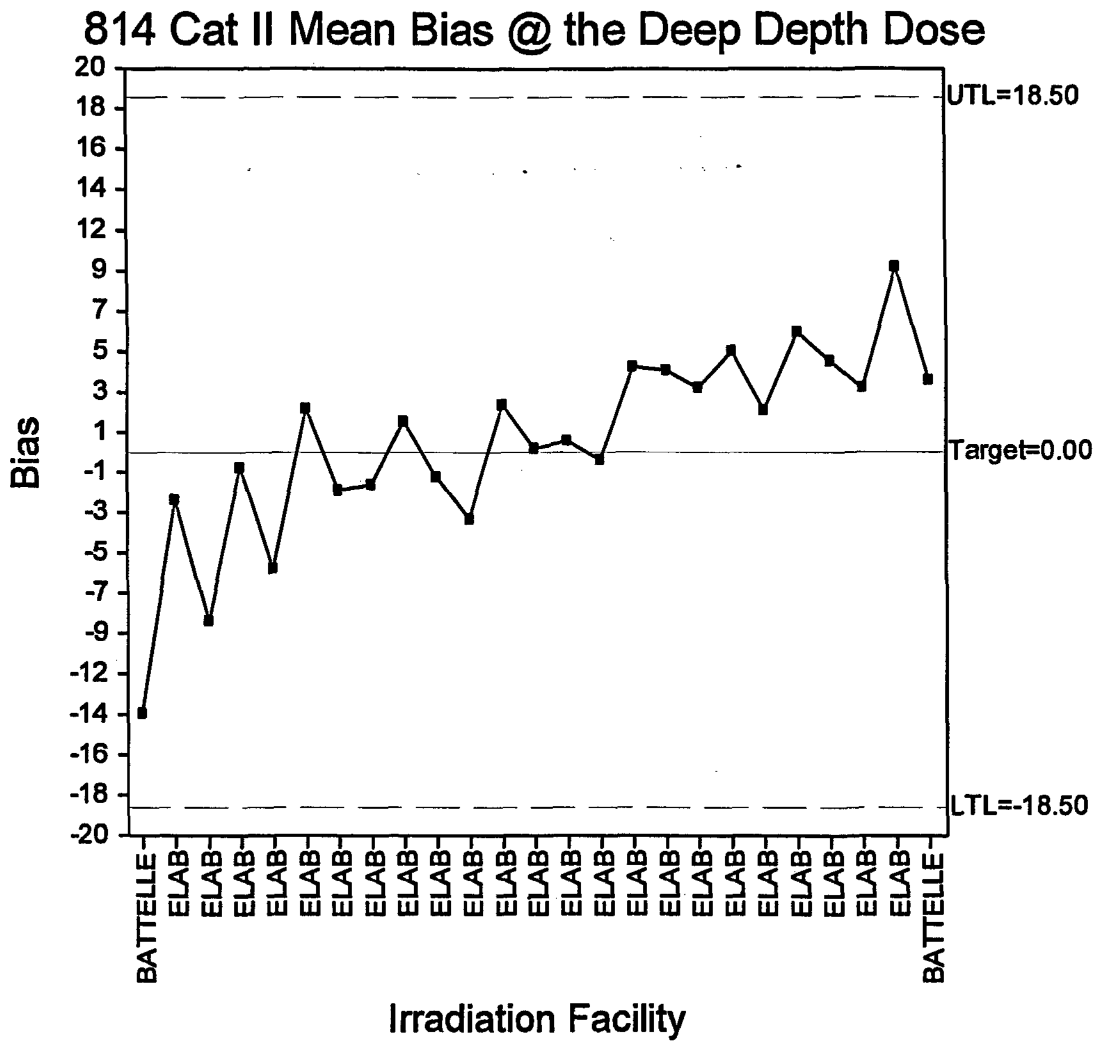


FIGURE 22

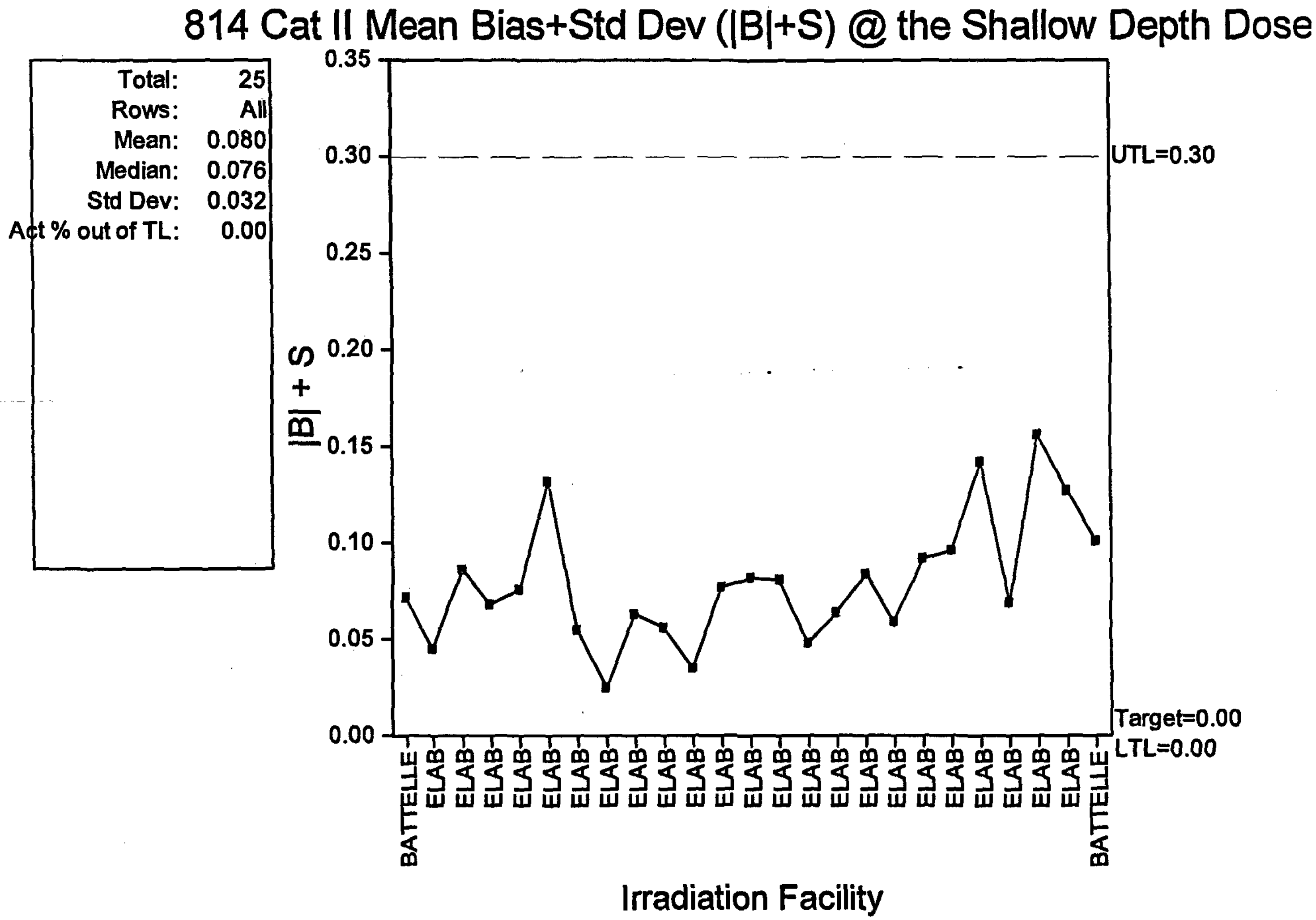
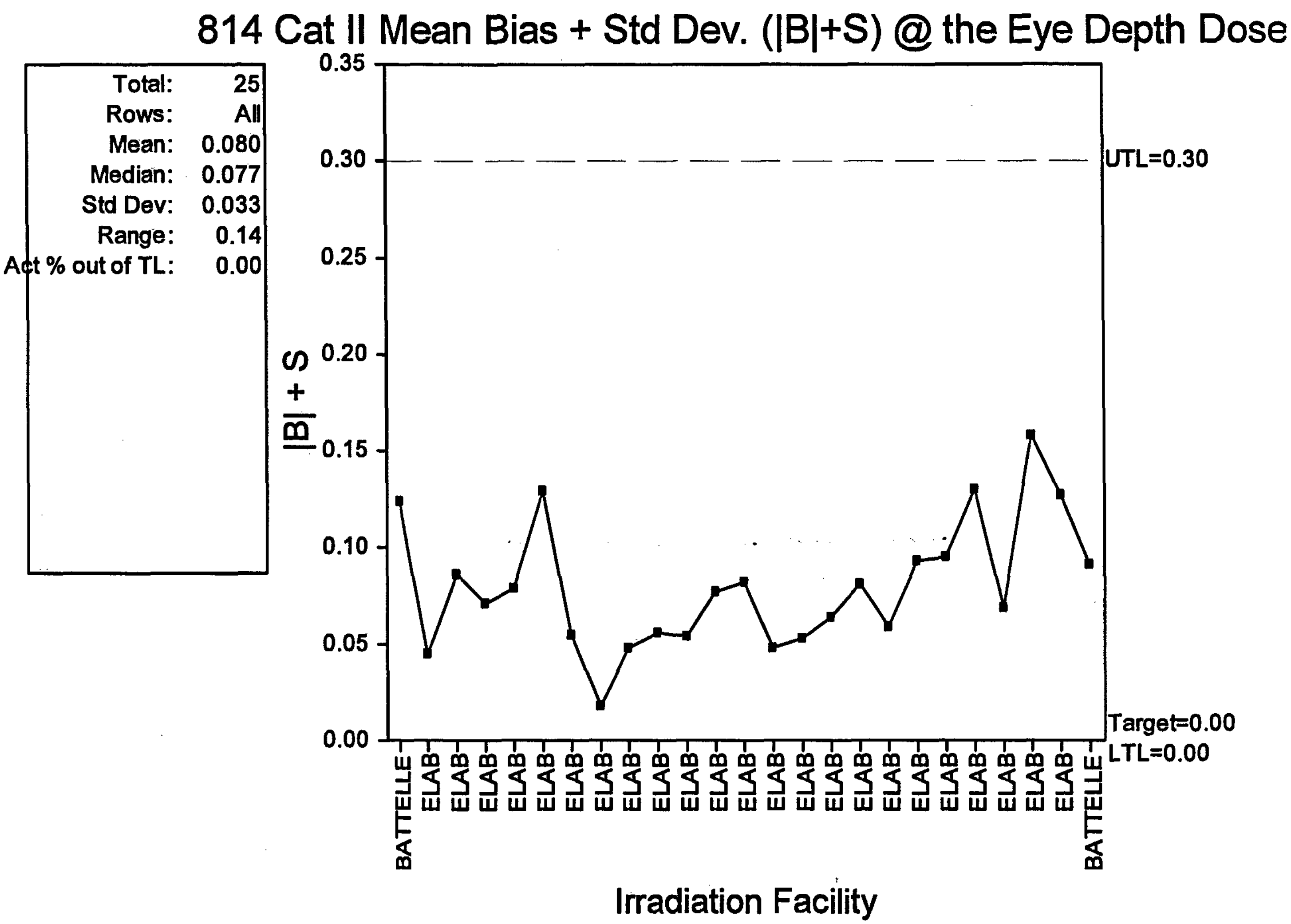

814 Cat II Mean Bias+Std Dev (|B|+S) @ the Shallow Depth Dose
Total: 25
Rows: All
Mean: 0.080
Median: 0.076
Std Dev: 0.032
Act % out of TL: 0.00
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
|B| + S
UTL=0.30
Target=0.00
LTL=0.00
BATTELLE
ELAB
BATTELLE
Irradiation Facility

FIGURE 23


814 Cat II Mean Bias + Std Dev. (|B|+S) @ the Eye Depth Dose
Total: 25
Rows: All
Mean: 0.080
Median: 0.077
Std Dev: 0.033
Range: 0.14
Act % out of TL: 0.00
|B| + S
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
UTL=0.30
Target=0.00
LTL=0.00
BATTELLE
ELAB
BATTELLE
Irradiation Facility

APPENDIX A
QC TESTING DATA FOR THE SEMI-ANNUAL PERIOD
July-December 2005

FIGURE 24

814 Cat II Mean Bias + Std Dev. (|B|+S) @ the Deep Depth Dose

Total:	25
Rows:	All
Mean:	0.073
Median:	0.069
Std Dev:	0.031
Act % out of TL:	0.00

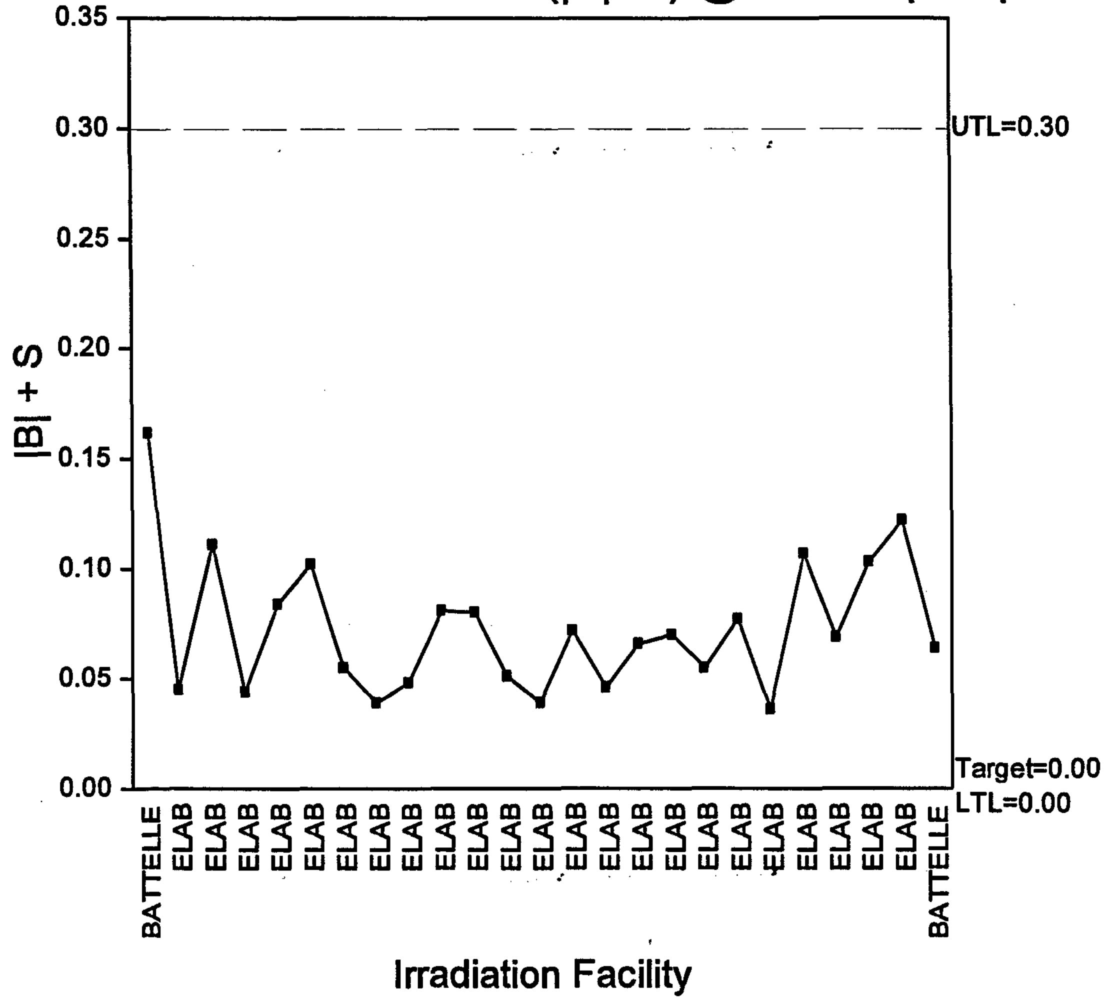


FIGURE 25

Statistics	
Total:	24
Rows:	All
Mean:	-7.646
Median:	-8.250
Std Dev:	12.951
Act % out of TL:	0.00

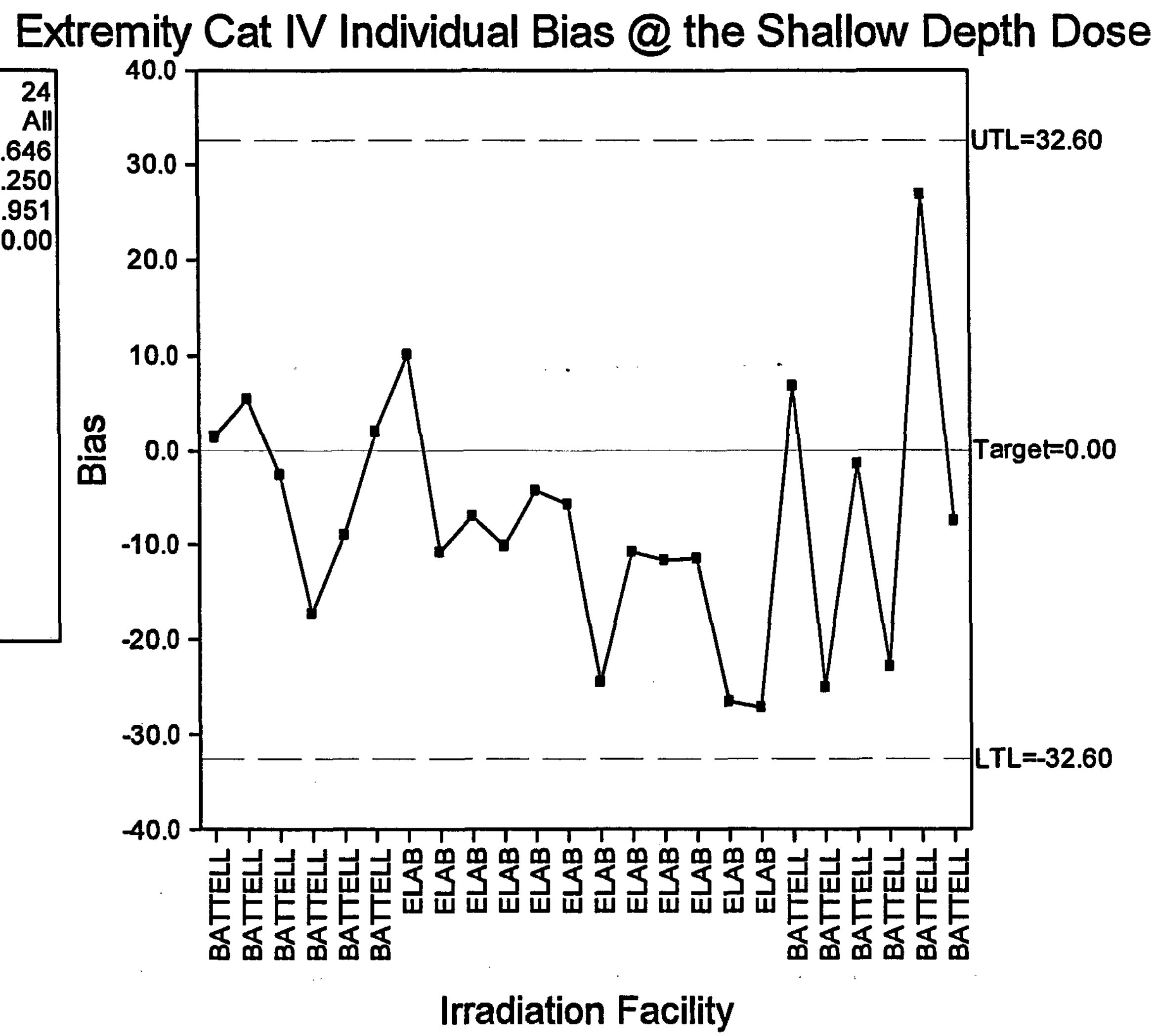


FIGURE 26

Process Statistics

Total:	24
Rows:	All
Mean:	-0.008
Median:	-0.400
Std Dev:	11.895
Act % out of TL:	4.17

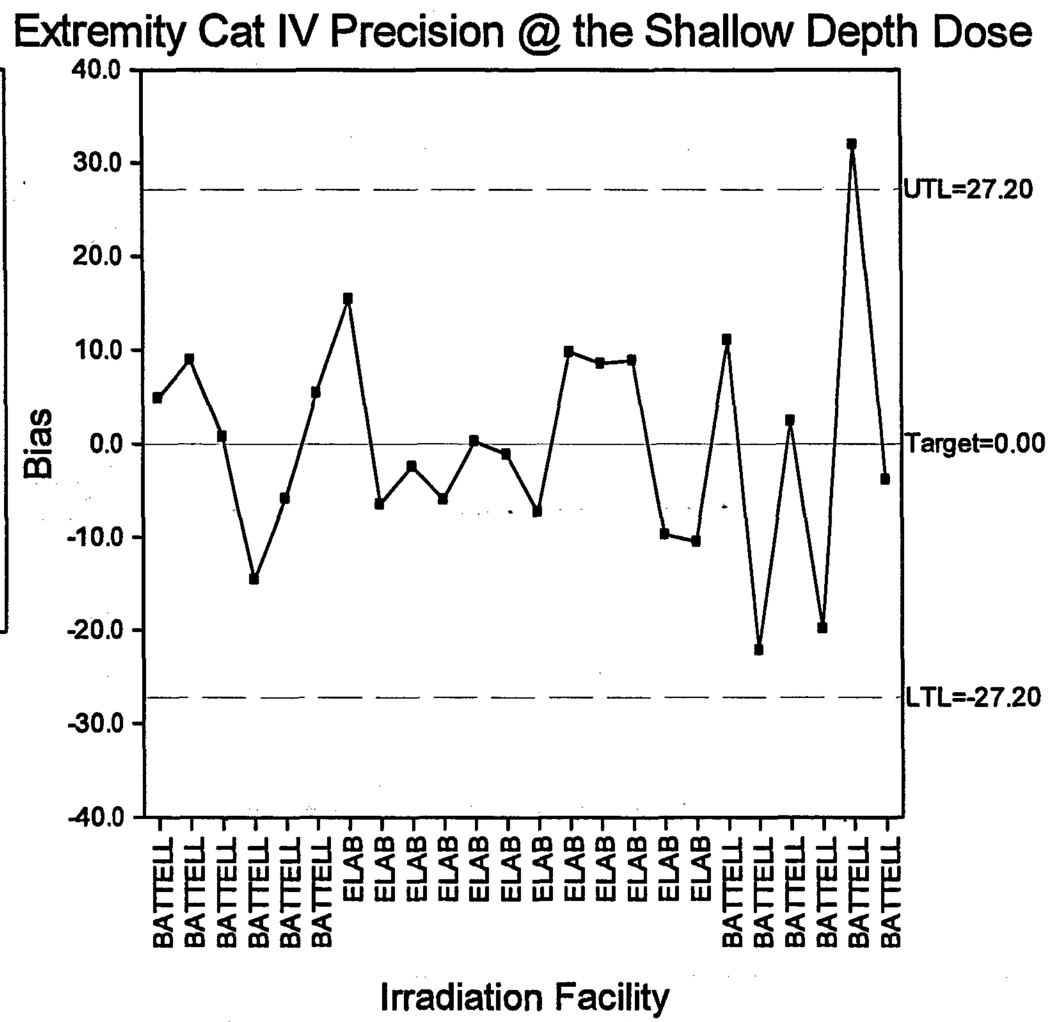


FIGURE 27

Process Statistics

Total:	4
Rows:	All
Mean:	-7.675
Median:	-4.300
Std Dev:	7.369
Act % out of TL:	0.00

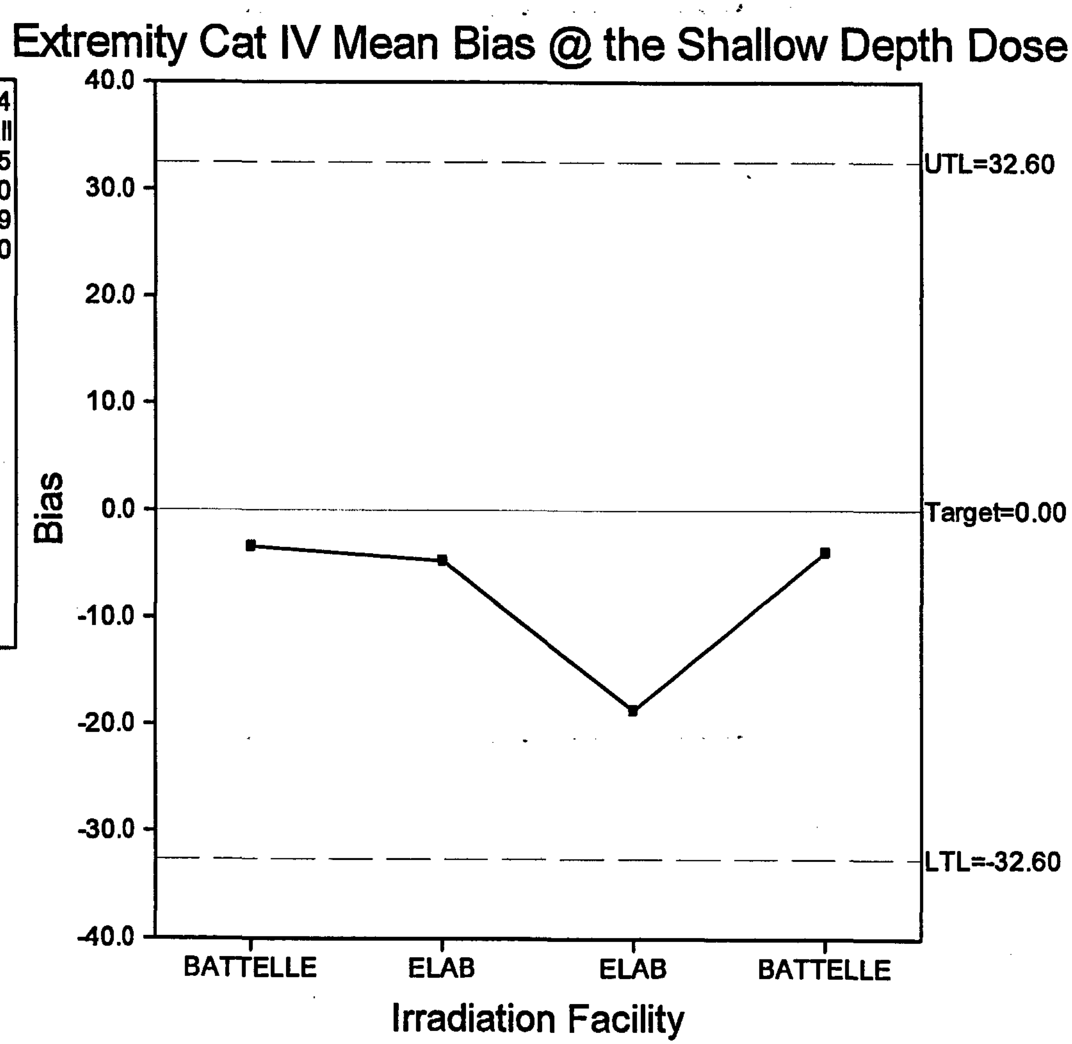


FIGURE 28

Extremity Cat IV Mean Bias + Std Dev. (|B|+S) @ the Shallow Depth Dose

Total:	4
Rows:	All
Mean:	0.186
Median:	0.178
Std Dev:	0.077
Act % out of TL:	0.00

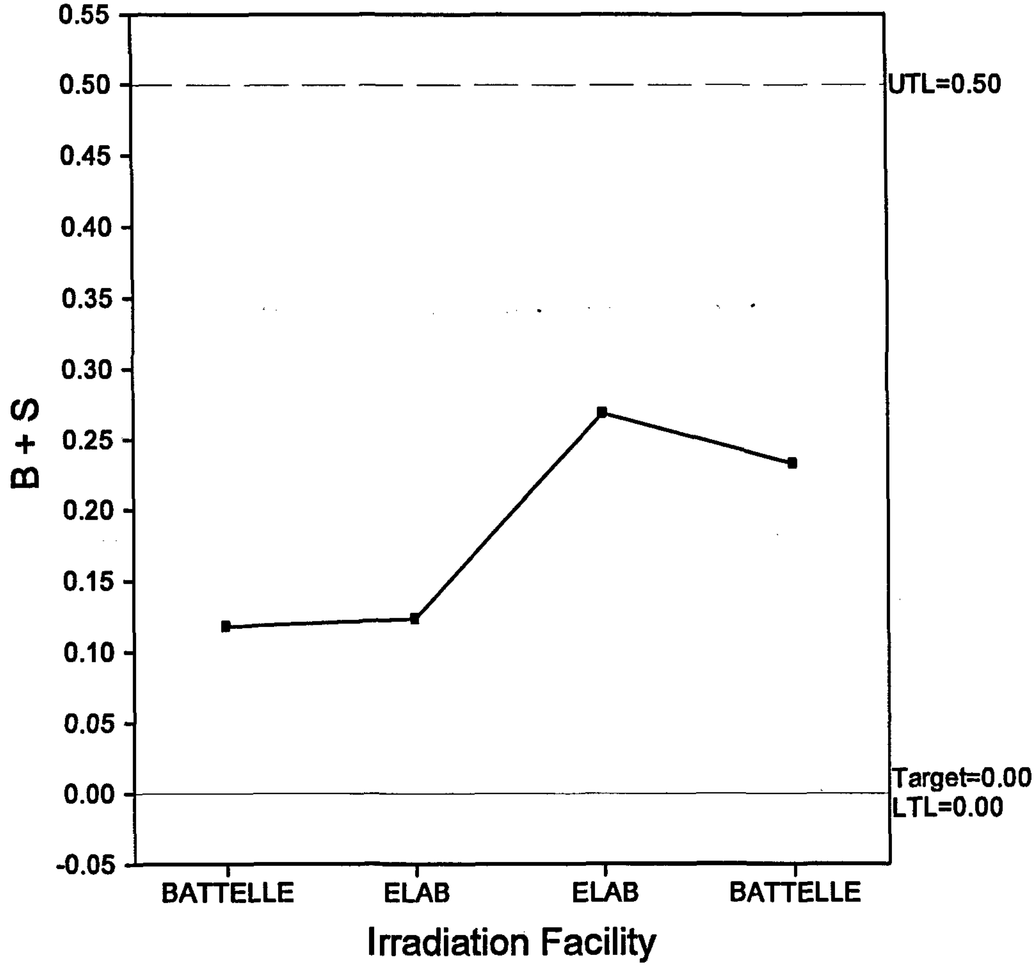


FIGURE 29

Process Statistics

Total:	48
Rows:	All
Mean:	1.292
Median:	0.700
Std Dev:	3.112
Act % out of SL:	0.00

Environmental TLDs Individual Bias Cs-137

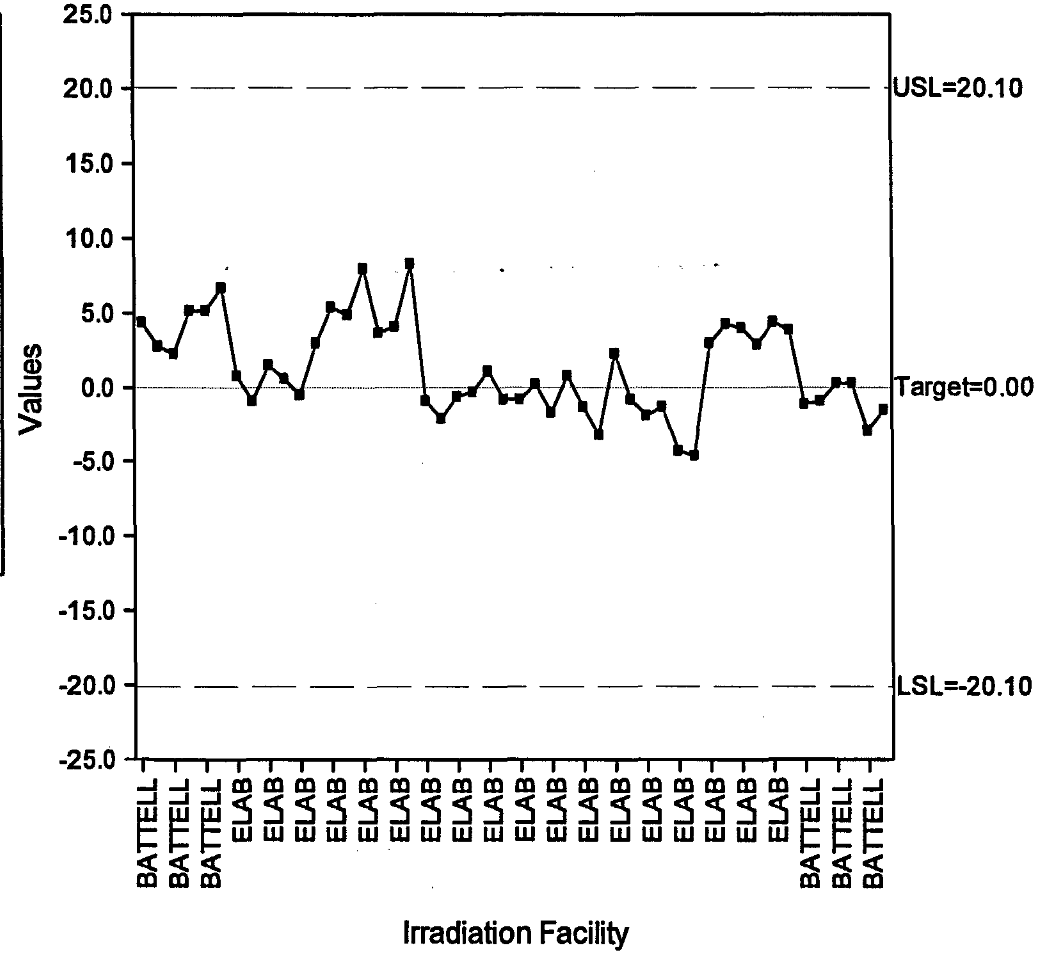


FIGURE 30

Process Statistics

Total:	48
Rows:	All
Mean:	0.002
Median:	-0.050
Std Dev:	1.439
Act % out of SL:	0.00

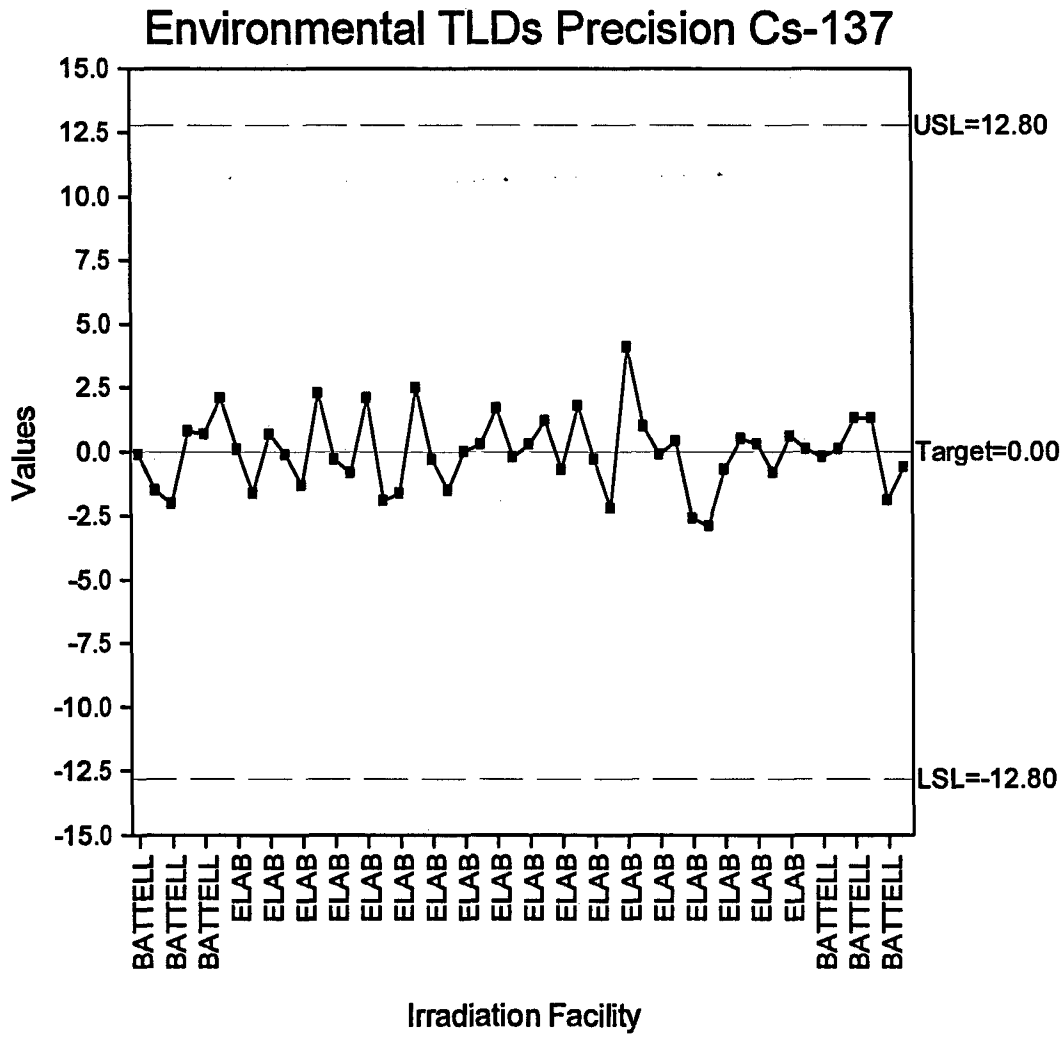
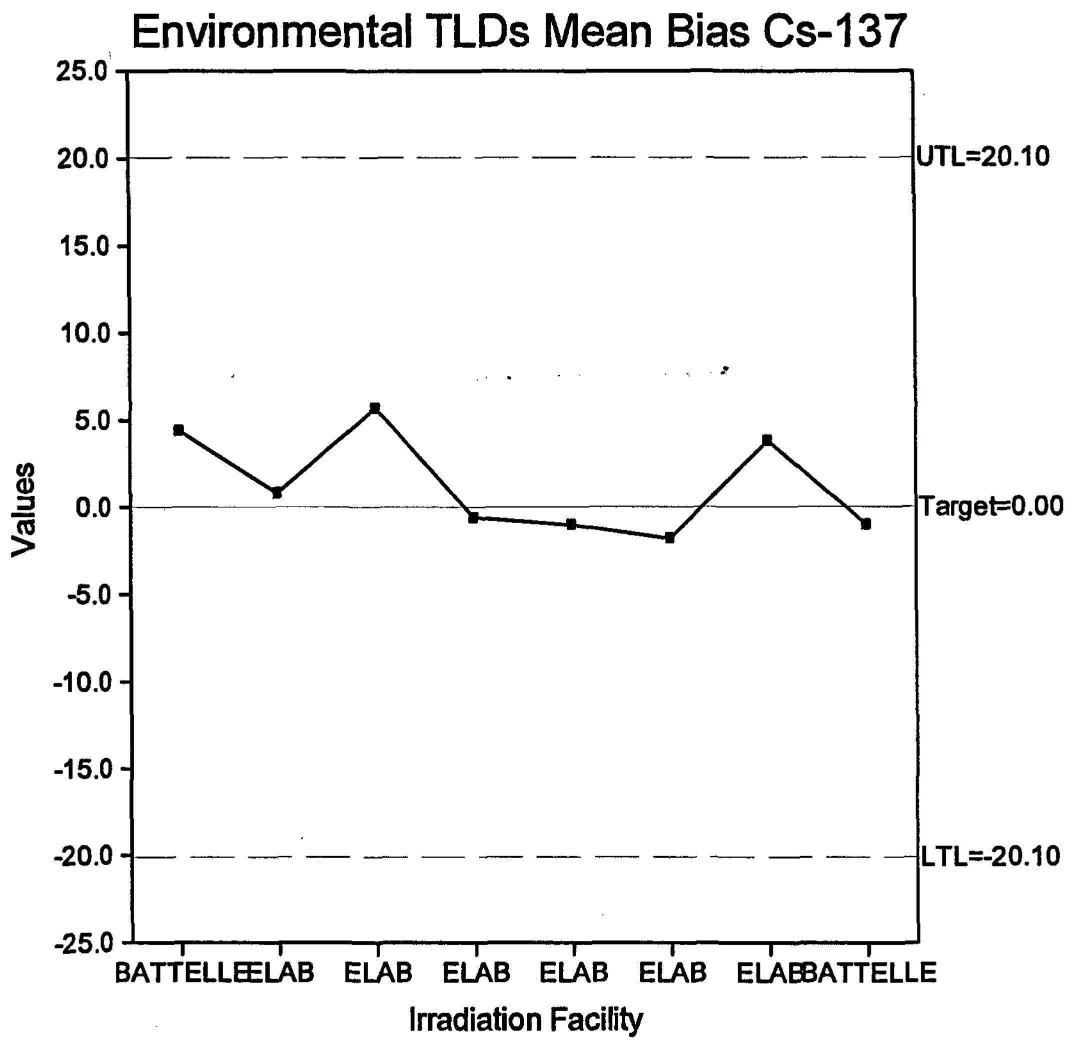


FIGURE 31

Process Statistics

Total:	8
Rows:	All
Mean:	1.287
Median:	0.100
Std Dev:	2.910
Act % out of TL:	0.00



APPENDIX B

NVLAP CERTIFICATE OF ACCREDITATION, SCOPE OF ACCREDITATION, AND BIENNIAL TESTING RESULTS

NVLAP® National Voluntary Laboratory Accreditation Program

SCOPE OF ACCREDITATION TO ISO/IEC 17025:1999

Framatome ANP Environmental Laboratory
29 Research Drive
Westborough, MA 01581-3913
Mr. Jeffrey M. Raimondi
Phone: 508-898-9970 x2539 Fax: 508-836-9815
E-Mail: Jeffrey.Raimondi@Framatome-ANP.com
URL: http://www.us.framatome-anp.com

IONIZING RADIATION DOSIMETRY **NVLAP LAB CODE 100524-0**

Scope of Accreditation:
This facility has been evaluated and deemed competent to process the radiation dosimeters listed below through employing Panasonic automatic reader model UD-710A for whole body dosimeters and a Thermo Electron Rialto XT or Toledo extremity dosimeter reader.

This facility is accredited to process the following dosimeters by virtue of actual demonstration of compliance with ANSI HPS N13.11-2001 and ANSI HPS N13.32-1995 through testing.

Panasonic TLD model UD-808 in a ISA model 830U holder for ANSI-N13.11-2001 categories IA, IIA, IIIA, IVA, VAB.

Panasonic TLD model 814-AS4 in a ISA model 830U holder for ANSI-N13.11-2001 categories IA, IIA, IIIA, IVA, VAB.

Panasonic dual TLD models UD808 and UD814 in a ISA model 830U holder for ANSI-N13.11-2001 category VICB.

Thermo Electron (formerly Bicron-NE) extremity TLD mode 869/A/2B in a ring tape holder for HPS ANSI 13.32 (NIST Handbook 150-4, table 2) categories IVA, IVB, VC, and VD.

2005-10-01 through 2006-09-30
Effective dates

For the National Institute of Standards and Technology

NVLAP-01S (REV. 2005-05-19)

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:1999

NVLAP LAB CODE: 100524-0

Framatome ANP Environmental Laboratory
Westborough, MA

is recognized by the National Voluntary Laboratory Accreditation Program for conformance with criteria set forth in NIST Handbook 150:2001 and all requirements of ISO/IEC Guide 17025:1999. Accreditation is granted for specific services, listed on the Scope of Accreditation, for:

IONIZING RADIATION DOSIMETRY

DEPARTMENT OF COMMERCE ★ UNITED STATES OF AMERICA ★

2005-10-01 through 2006-09-30
Effective dates

For the National Institute of Standards and Technology

NATIONAL VOLUNTARY LABORATORY ACCREDITATION PROGRAM

PERSONNEL DOSIMETRY PERFORMANCE TESTING

SUMMARY OF STATISTICAL RESULTS

PROCESSOR NAME: Framatome ANP Environmental Laboratory
PROCESSOR CODE: 100524 B
DOSIMETER DESCRIPTION: PANASONIC UD-808AS/ISA830U
TEST RESULTS FOR QUARTER: 200504
TESTING STATUS: RENEWAL
TYPE OF DOSIMETER: WHOLEBODY
REPORT PRINTED: 31 January 2006

	SHALLOW DEPTH				DEEP DEPTH			
CATEGORY	B	S	|B| + S	L	B	S	|B| + S	L
IA	NO TEST				-0.027	0.055	0.082	0.30
IB	NO TEST				*****			
IC	NO TEST				*****			
IIA	-0.001	0.029	0.030	0.40	-0.012	0.059	0.071	0.40
IIB	*****				*****			
IIC	*****				*****			
IID	*****				*****			
IIIA	-0.056	0.074	0.129	0.40	NO TEST			
IIIB	*****				NO TEST			
IIIC	*****				NO TEST			
IVA	0.076	0.073	0.149	0.40	0.070	0.085	0.155	0.40
IVB	*****				*****			
IVC	*****				*****			
V	-0.097	0.075	0.172	0.40	-0.008	0.038	0.046	0.40
VI - TOTAL-GEN	NO TEST				*****			
VI - NEUTRON	NO TEST				*****			
VI - TOTAL-MOD	NO TEST				*****			
VI - NEUTRON	NO TEST				*****			

***** PROCESSOR DID NOT PARTICIPATE IN THIS CATEGORY

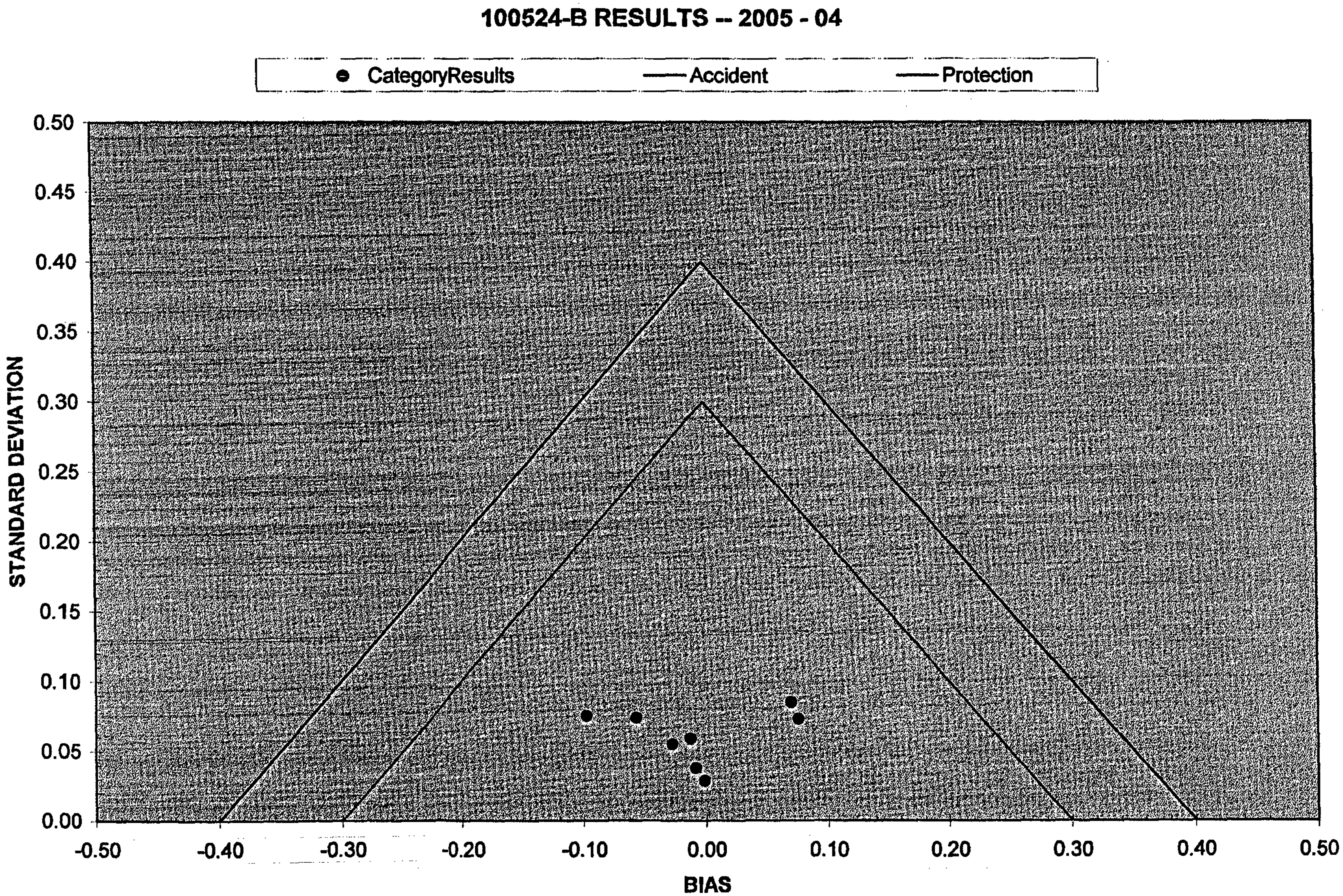
NATIONAL VOLUNTARY LABORATORY ACCREDITATION PROGRAM
PERSONNEL DOSIMETRY PERFORMANCE TESTING

SUMMARY OF PASS/FAIL RESULTS

PROCESSOR NAME:	Framatome ANP Environmental Laboratory
PROCESSOR CODE:	100524 B
DOSIMETER DESCRIPTION:	PANASONIC UD-808AS/ISA830U
TEST RESULTS FOR QUARTER:	200504
TESTING STATUS:	RENEWAL
TYPE OF DOSIMETER:	WHOLEBODY
REPORT PRINTED:	31 January 2006

CATEGORY IA	ACCIDENTS, PHOTONS GENERAL	PASS
CATEGORY IB	ACCIDENTS, PHOTONS CESIUM	*****
CATEGORY IC	ACCIDENTS, PHOTONS M150	*****
CATEGORY IIA	PHOTONS, GENERAL	PASS
CATEGORY IIB	PHOTONS, HIGH E	*****
CATEGORY IIC	PHOTONS, MEDIUM E	*****
CATEGORY IID	PHOTONS, NARROW SPECTRUM	*****
CATEGORY IIIA	BETAS, GENERAL	PASS
CATEGORY IIIB	BETAS, HIGH E	*****
CATEGORY IIIC	BETAS, LOW E	*****
CATEGORY IVA	PHOTON MIXTURES, GENERAL + HIGH E	PASS
CATEGORY IVB	PHOTON MIXTURES, MEDIUM E + HIGH E	*****
CATEGORY IVC	PHOTON MIXTURES, NARROW SPECTRUM + HIGH E	*****
CATEGORY V	BETA/PHOTON MIXTURES	PASS
CATEGORY VI	GENERAL OR BARE NEUTRON/PHOTON MIXTURES	*****
CATEGORY VI - MOD	MODERATED NEUTRON/PHOTON MIXTURES	*****

***** PROCESSOR DID NOT PARTICIPATE IN THIS CATEGORY


100524-B RESULTS -- 2005 - 04
CategoryResults
Accident
Protection
STANDARD DEVIATION
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-0.50
-0.40
-0.30
-0.20
-0.10
0.00
0.10
0.20
0.30
0.40
0.50
BIAS

NATIONAL VOLUNTARY LABORATORY ACCREDITATION PROGRAM

PERSONNEL DOSIMETRY PERFORMANCE TESTING

SUMMARY OF STATISTICAL RESULTS

PROCESSOR NAME: Framatome ANP Environmental Laboratory
PROCESSOR CODE: 100524 C
DOSIMETER DESCRIPTION: PANASONIC UD-814AS4/ISA 830U
TEST RESULTS FOR QUARTER: 200504
TESTING STATUS: RENEWAL
TYPE OF DOSIMETER: WHOLEBODY
REPORT PRINTED: 31 January 2006

	SHALLOW DEPTH				DEEP DEPTH			
CATEGORY	B	S	|B| + S	L	B	S	|B| + S	L
IA		NO TEST			-0.036	0.033	0.069	0.30
IB		NO TEST				*****		
IC		NO TEST				*****		
IIA	0.051	0.054	0.105	0.40	0.028	0.073	0.101	0.40
IIB		*****				*****		
IIC		*****				*****		
IID		*****				*****		
IIIA	0.030	0.075	0.105	0.40		NO TEST		
IIIB		*****				NO TEST		
IIIC		*****				NO TEST		
IVA	0.121	0.071	0.192	0.40	0.098	0.097	0.195	0.40
IVB		*****				*****		
IVC		*****				*****		
V	0.034	0.047	0.080	0.40	0.035	0.048	0.083	0.40
VI - TOTAL-GEN		NO TEST				*****		
VI - NEUTRON		NO TEST				*****		
VI - TOTAL-MOD		NO TEST				*****		
VI - NEUTRON		NO TEST				*****		

***** PROCESSOR DID NOT PARTICIPATE IN THIS CATEGORY

NATIONAL VOLUNTARY LABORATORY ACCREDITATION PROGRAM
PERSONNEL DOSIMETRY PERFORMANCE TESTING

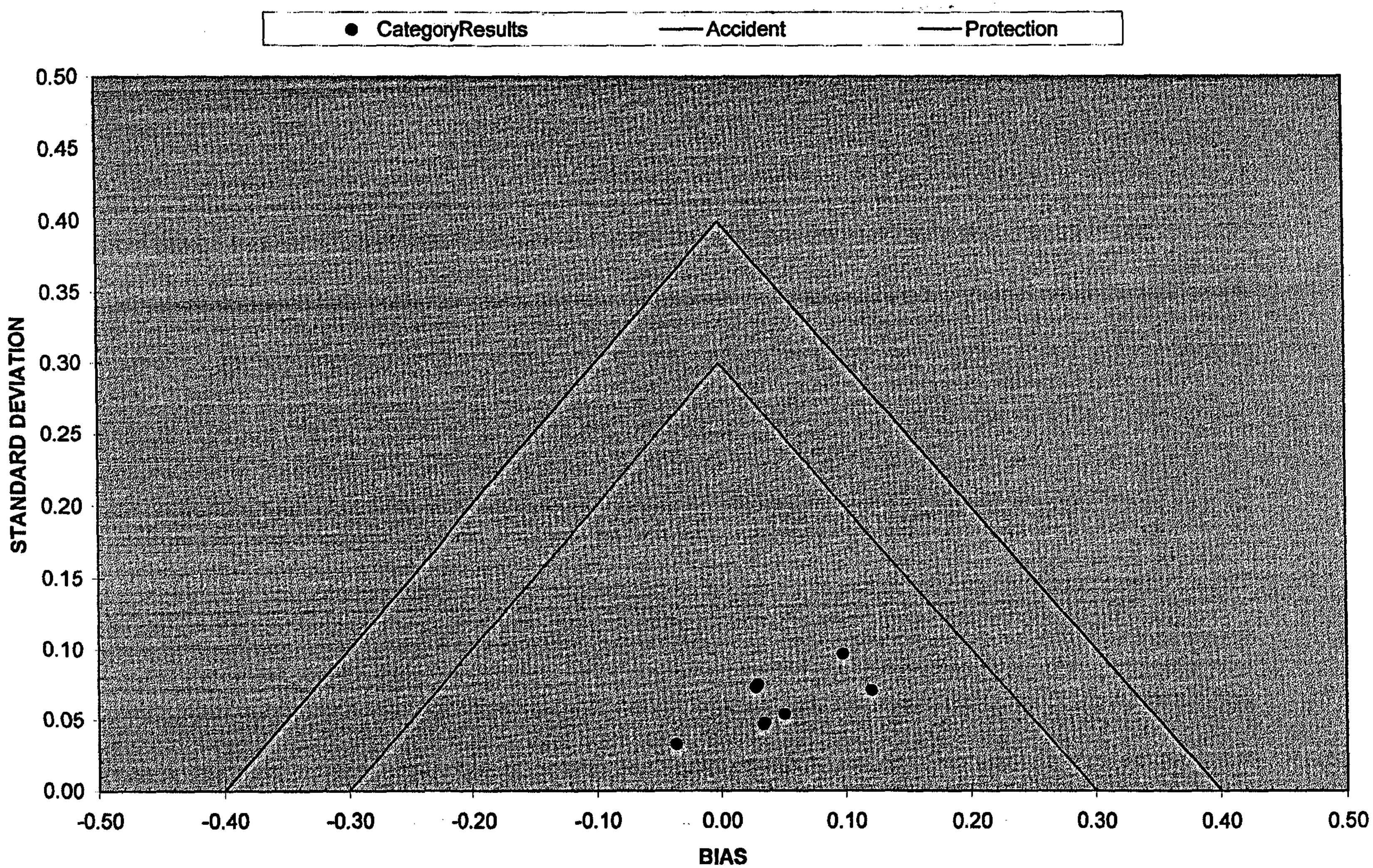
SUMMARY OF PASS/FAIL RESULTS

PROCESSOR NAME:	Framatome ANP Environmental Laboratory
PROCESSOR CODE:	100524 C
DOSIMETER DESCRIPTION:	PANASONIC UD-814AS4/ISA 830U
TEST RESULTS FOR QUARTER:	200504
TESTING STATUS:	RENEWAL
TYPE OF DOSIMETER:	WHOLEBODY
REPORT PRINTED:	31 January 2006

CATEGORY IA	ACCIDENTS, PHOTONS GENERAL	PASS
CATEGORY IB	ACCIDENTS, PHOTONS CESIUM	*****
CATEGORY IC	ACCIDENTS, PHOTONS M150	*****
CATEGORY IIA	PHOTONS, GENERAL	PASS
CATEGORY IIB	PHOTONS, HIGH E	*****
CATEGORY IIC	PHOTONS, MEDIUM E	*****
CATEGORY IID	PHOTONS, NARROW SPECTRUM	*****
CATEGORY IIIA	BETAS, GENERAL	PASS
CATEGORY IIIB	BETAS, HIGH E	*****
CATEGORY IIIC	BETAS, LOW E	*****
CATEGORY IVA	PHOTON MIXTURES, GENERAL + HIGH E	PASS
CATEGORY IVB	PHOTON MIXTURES, MEDIUM E + HIGH E	*****
CATEGORY IVC	PHOTON MIXTURES, NARROW SPECTRUM + HIGH E	*****
CATEGORY V	BETA/PHOTON MIXTURES	PASS
CATEGORY VI	GENERAL OR BARE NEUTRON/PHOTON MIXTURES	*****
CATEGORY VI - MOD	MODERATED NEUTRON/PHOTON MIXTURES	*****

***** PROCESSOR DID NOT PARTICIPATE IN THIS CATEGORY

100524-C RESULTS – 2005 - 04



NATIONAL VOLUNTARY LABORATORY ACCREDITATION PROGRAM
PERSONNEL DOSIMETRY PERFORMANCE TESTING

SUMMARY OF STATISTICAL RESULTS

PROCESSOR NAME: Framatome ANP Environmental Laboratory
PROCESSOR CODE: 100524 D
DOSIMETER DESCRIPTION: PANASONIC DUAL 808AS & 814AS4/ISA830U
TEST RESULTS FOR QUARTER: 200504
TESTING STATUS: RENEWAL
TYPE OF DOSIMETER: WHOLEBODY
REPORT PRINTED: 01 February 2006

CATEGORY	SHALLOW DEPTH B	SHALLOW DEPTH S	SHALLOW DEPTH |B| + S	SHALLOW DEPTH L	DEEP DEPTH B	DEEP DEPTH S	DEEP DEPTH |B| + S	DEEP DEPTH L
IA	NO TEST				*****			
IB	NO TEST				*****			
IC	NO TEST				*****			
IIA	*****				*****			
IIB	*****				*****			
IIC	*****				*****			
IID	*****				*****			
IIIA	*****				NO TEST			
IIIB	*****				NO TEST			
IIIC	*****				NO TEST			
IVA	*****				*****			
IVB	*****				*****			
IVC	*****				*****			
V	*****				*****			
VI - TOTAL-GEN	NO TEST				*****			
VI - NEUTRON	NO TEST				*****			
VI - TOTAL-MOD	NO TEST				-0.010	0.030	0.040	0.40
VI - NEUTRON	NO TEST				-0.058	0.081	0.139	0.40

***** PROCESSOR DID NOT PARTICIPATE IN THIS CATEGORY

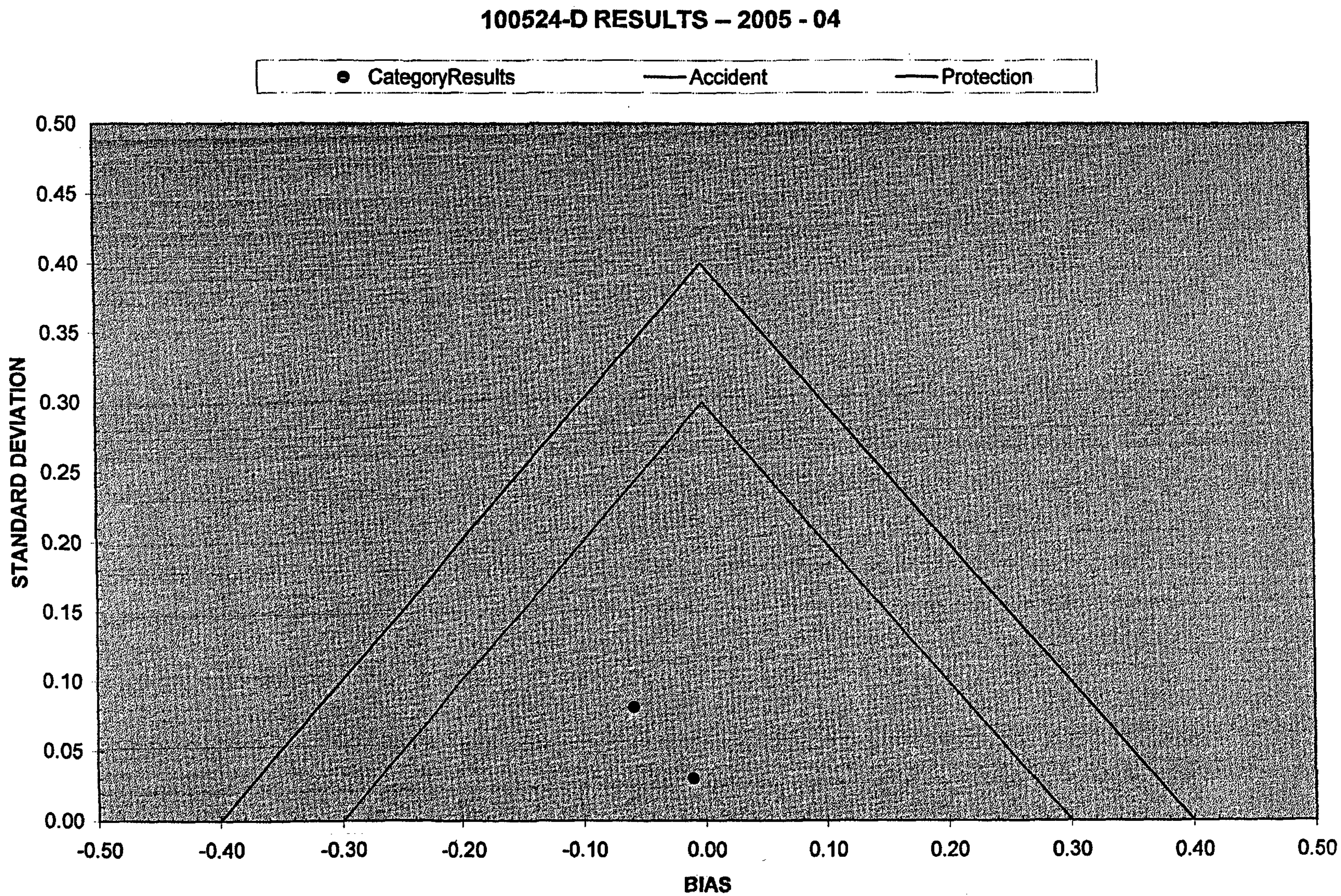
NATIONAL VOLUNTARY LABORATORY ACCREDITATION PROGRAM
PERSONNEL DOSIMETRY PERFORMANCE TESTING

SUMMARY OF PASS/FAIL RESULTS

PROCESSOR NAME:	Framatome ANP Environmental Laboratory
PROCESSOR CODE:	100524 D
DOSIMETER DESCRIPTION:	PANASONIC DUAL 808AS & 814AS4/ISA830U
TEST RESULTS FOR QUARTER:	200504
TESTING STATUS:	RENEWAL
TYPE OF DOSIMETER:	WHOLEBODY
REPORT PRINTED:	01 February 2006

CATEGORY IA	ACCIDENTS, PHOTONS GENERAL	*****
CATEGORY IB	ACCIDENTS, PHOTONS CESIUM	*****
CATEGORY IC	ACCIDENTS, PHOTONS M150	*****
CATEGORY IIA	PHOTONS, GENERAL	*****
CATEGORY IIB	PHOTONS, HIGH E	*****
CATEGORY IIC	PHOTONS, MEDIUM E	*****
CATEGORY IID	PHOTONS, NARROW SPECTRUM	*****
CATEGORY IIIA	BETAS, GENERAL	*****
CATEGORY IIIB	BETAS, HIGH E	*****
CATEGORY IIIC	BETAS, LOW E	*****
CATEGORY IVA	PHOTON MIXTURES, GENERAL + HIGH E	*****
CATEGORY IVB	PHOTON MIXTURES, MEDIUM E + HIGH E	*****
CATEGORY IVC	PHOTON MIXTURES, NARROW SPECTRUM + HIGH E	*****
CATEGORY V	BETA/PHOTON MIXTURES	*****
CATEGORY VI	GENERAL OR BARE NEUTRON/PHOTON MIXTURES	*****
CATEGORY VI - MOD	MODERATED NEUTRON/PHOTON MIXTURES	PASS

***** PROCESSOR DID NOT PARTICIPATE IN THIS CATEGORY


100524-D RESULTS – 2005 - 04
CategoryResults
Accident
Protection
STANDARD DEVIATION
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-0.50
-0.40
-0.30
-0.20
-0.10
0.00
0.10
0.20
0.30
0.40
0.50
BIAS

APPENDIX C

Summary of 2005 REMP Data

TYPE	STATION	LSN	DATE	NUCLIDE	CONC (pCi/m3)	.STD.DEV. (pCi/m3)	MDC (pCi/m3).
				AIR PARTICULATE			
AP	5	L868-1-01	1/10/2005	GROSS BETA	2.61E-2	2.1e-3	.4.0e-3
AP	5	L8782-01	1/24/2005	GROSS BETA	2.14E-2	2.0e-3	4.5e-3
AP	5	L8817-01	2/07/2005	GROSS BETA	2.28E-2	1.9e-3	3.7e-3
AP	5	-L8881-01	2/22/2005	GROSS BETA	1.82E-2	1.8e-3	3.8e-3
AP	5	L8924-01	3/07/2005	GROSS BETA	1.97E-2	2.0e-3	4.6e-3
AP	5	L9006-01	3/22/2005	GROSS BETA	1.96E-2	1.7e-3	3.5e-3
AP	5	L9063-01	4/04/2005	GROSS BETA	9.70E-3	1.6e-3	4.0e-3
AP	5	L9140-01	4/18/2005	GROSS BETA	1.75E-2	1.9e-3	4.6e-3
AP	5	L9091-01	4/4/05	Mn-54	-2.4E-04	7.2e-4	3.0e-3
AP	5	L9557-01	4/18/05	Mn-54	-2.3E-03	2.5e-3	1.0e-2
AP	5	L9091-01	4/4/05	Co-58	-9.0E-04	1.0e-3	4.6e-3
AP	5	L9557-01	4/18/05	Co-58	-3.1E-03	5.0e-3	2.0e-2
AP	5	L9091-01	4/4/05	Fe-59	0.0E+00	3.0e-3	1.3e-2
AP	5	L9557-01	4/18/05	Fe-59	0.0E+00	2.0e-2	7.7e-2
AP	5	L9091-01	4/4/05	Co-60	-6.2E-04	7.6e-4	3.6e-3
AP	5	L9557-01	4/18/05	Co-60	-1.0E-04	2.3e-3	8.9e-3
AP	5	L9091-01	4/4/05	Zn-65	0.0E+00	1.7e-3	7.1e-3
AP	5	L9557-01	4/18/05	Zn-65	5.5E-03	4.8e-3	1.6e-2
AP	5	L9091-01	4/4/05	Zr-95	3.4E-03	1.9e-3	5.8e-3
AP	5	L9557-01	4/18/05	Zr-95	2.4E-02	1.1e-2	4.6e-2
AP	5	L9091-01	4/4/05	I-131	1.4E-02	2.6e-2	9.6e-2
AP	5	L9557-01	4/18/05	I-131	-2.5E+01	20	75
AP	5	L9091-01	4/4/05	Cs-134	1.4E-03	7.8e-4	2.4e-3
AP	5	L9557-01	4/18/05	Cs-134	9.0E-04	2.2e-3	8.2e-3
AP	5	L9091-01	4/4/05	Cs-137	0.0E+00	1.2e-3	4.2e-3
AP	5	L9557-01	4/18/05	Cs-137	-4.0E-04	2.5e-3	9.1e-3
AP	5	L9091-01	4/4/05	Ba-140	0.0E+00	1.2e-2	5.2e-2
AP	5	L9557-01	4/18/05	Ba-140	0.0E+00	7.8e-1	3.1
AP	6	L868-1-02	1/10/2005	GROSS BETA	2.49E-2	2.1e-3	4.1e-3
AP	6	L8782-02	1/24/2005	GROSS BETA	2.38E-2	2.1e-3	4.6e-3
AP	6	L8817-02	2/07/2005	GROSS BETA	1.94E-2	1.8e-3	3.8e-3
AP	6	-L8881-02	2/22/2005	GROSS BETA	1.54E-2	1.7e-3	3.8e-3
AP	6	L8924-02	3/07/2005	GROSS BETA	1.87E-2	2.0e-3	4.7e-3
AP	6	L9006-02	3/22/2005	GROSS BETA	1.94E-2	1.8e-3	3.5e-3
AP	6	L9063-02	4/04/2005	GROSS BETA	9.20E-3	1.6e-3	4.1e-3
AP	6	L9140-02	4/18/2005	GROSS BETA	1.61E-2	1.9e-3	4.6e-3
AP	6	L9091-02	4/4/05	Mn-54	7.4E-04	7.7E4	2.7E-3
AP	6	L9557-02	4/18/05	Mn-54	-1.5E-03	2.1E-3	8.6E-3
AP	6	L9091-02	4/4/05	Co-58	1.6E-03	1.0E-3	3.3E-3
AP	6	L9557-02	4/18/05	Co-58	-1.0E-04	5.5E-3	2.1E-2
AP	6	L9091-02	4/4/05	Fe-59	1.1E-03	2.9E-3	1.2E-2
AP	6	L9557-02	4/18/05	Fe-59	-1.2E-02	2.0E-2	8.0E-2
AP	6	L9091-02	4/4/05	Co-60	1.3E-03	9.2E-4	3.1E-3
AP	6	L9557-02	4/18/05	Co-60	-6.0E-04	2.2E-3	8.9E-3
AP	6	L9091-02	4/4/05	Zn-65	6.0E-04	2.0E-3	7.8E-3
AP	6	L9557-02	4/18/05	Zn-65	1.1E-03	5.0E-3	1.9E-2
AP	6	L9091-02	4/4/05	Zr-95	-4.0E-04	2.2E-3	9.0E-3
AP	6	L9557-02	4/18/05	Zr-95	-7.9E-03	8.7E-3	3.1E-2
AP	6	L9091-02	4/4/05	I-131	1.0E-02	2.7E-2	1.0E-1
AP	6	L9557-02	4/18/05	I-131	-6.0E+00	18	67
AP	6	L9091-02	4/4/05	Cs-134	-1.7E-03	7.8E-4	3.8E-3
AP	6	L9557-02	4/18/05	Cs-134	-1.0E-04	2.3E-3	8.7E-3
AP	6	L9091-02	4/4/05	Cs-137	2.0E-04	1.2E-3	4.4E-3
AP	6	L9557-02	4/18/05	Cs-137	2.0E-04	2.2E-3	8.1E-3
AP	6	L9091-02	4/4/05	Ba-140	-5.0E-03	1.1E-2	5.2E-2
AP	6	L9557-02	4/18/05	Ba-140	0.0E+00	7.5E-1	2.9
AP	7	L868-1-03	1/10/2005	GROSS BETA	2.58E-2	2.1E-3	3.8E-3
AP	7	L8782-03	1/24/2005	GROSS BETA	2.46E-2	2.0E-3	4.3E-3
AP	7	L8817-03	2/07/2005	GROSS BETA	2.14E-2	1.8E-3	3.6E-3

AP	7	-L8881- 03	2/22/2005	GROSS BETA	1.98E-2	1.7E-3	3.6E-3
AP	7	L8924-03	3/07/2005	GROSS BETA	2.18E-2	2.0E-3	4.4E-3
AP	7	L9006-03	3/22/2005	GROSS BETA	1.91E-2	1.7E-3	3.4E-3
AP	7	L9063-03	4/04/2005	GROSS BETA	1.13E-2	1.8E-3	4.7E-3
AP	7	L9140-03	4/18/2005	GROSS BETA	1.79E-2	1.9E-3	4.4E-3
AP	7	L9091-03	4/4/05	Mn-54	1.6E-04	7.6E-4	3.0E-3
AP	7	L9557-03	4/18/05	Mn-54	8.0E-04	2.1E-3	7.8E-3
AP	7	L9091-03	4/4/05	Co-58	1.0E-04	1.1E-3	4.5E-3
AP	7	L9557-03	4/18/05	Co-58	5.9E-03	4.8E-3	1.6E-2
AP	7	L9091-03	4/4/05	Fe-59	2.1E-03	3.6E-3	1.4E-2
AP	7	L9557-03	4/18/05	Fe-59	-4.4E-02	2.0E-2	8.7E-2
AP	7	L9091-03	4/4/05	Co-60	-1.0E-04	7.5E-4	3.3E-3
AP	7	L9557-03	4/18/05	Co-60	2.8E-03	2.5E-3	8.5E-3
AP	7	L9091-03	4/4/05	Zn-65	-2.0E-03	1.3E-3	7.0E-3
AP	7	L9557-03	4/18/05	Zn-65	-2.1E-03	5.4E-3	2.1E-2
AP	7	L9091-03	4/4/05	Zr-95	2.6E-03	2.2E-3	7.4E-3
AP	7	L9557-03	4/18/05	Zr-95	-6.4E-03	8.8E-3	3.1E-2
AP	7	L9091-03	4/4/05	I-131	4.3E-02	2.4E-2	7.5E-2
AP	7	L9557-03	4/18/05	I-131	-8.0E+00	17	63
AP	7	L9091-03	4/4/05	Cs-134	7.9E-04	5.1E-4	1.6E-3
AP	7	L9557-03	4/18/05	Cs-134	3.2E-03	2.0E-3	6.6E-3
AP	7	L9091-03	4/4/05	Cs-137	2.0E-04	1.1E-3	4.1E-3
AP	7	L9557-03	4/18/05	Cs-137	4.2E-03	2.0E-3	6.2E-3
AP	7	L9091-03	4/4/05	Ba-140	1.9E-02	9.6E-3	1.3E-2
AP	7	L9557-03	4/18/05	Ba-140	1.2E+00	7.1E-1	2.2
AP	9	L868-1- 04	1/10/2005	GROSS BETA	2.83E-2	2.4E-3	4.7E-3
AP	9	L868-1- 04	1/24/2005	GROSS BETA	2.22E-2	2.2E-3	5.2E-3
AP	9	L8782-04	2/07/2005	GROSS BETA	2.03E-2	2.0E-3	4.3E-3
AP	9	L8817-04	2/22/2005	GROSS BETA	1.83E-2	1.9E-3	4.4E-3
AP	9	-L8881- 04	3/07/2005	GROSS BETA	2.04E-2	2.2E-3	5.3E-3
AP	9	L8924-04	3/22/2005	GROSS BETA	1.66E-2	1.8E-3	4.0E-3
AP	9	L9006-04	4/04/2005	GROSS BETA	9.40E-3	1.7E-3	4.7E-3
AP	9	L9063-04	4/18/2005	GROSS BETA	1.62E-2	2.1E-3	5.2E-3
AP	9	L9091-04	4/4/05	Mn-54	2.1E-04	9.5E-4	3.7E-3
AP	9	L9557-04	4/18/05	Mn-54	2.0E-04	3.1E-3	1.1E-2
AP	9	L9091-04	4/4/05	Co-58	2.5E-03	1.4E-3	4.4E-3
AP	9	L9557-04	4/18/05	Co-58	-6.0E-03	6.1E-3	2.4E-2
AP	9	L9091-04	4/4/05	Fe-59	-1.2E-03	4.1E-3	1.8E-2
AP	9	L9557-04	4/18/05	Fe-59	-4.0E-03	2.3E-2	8.8E-2
AP	9	L9091-04	4/4/05	Co-60	-3.0E-04	1.3E-3	5.2E-3
AP	9	L9557-04	4/18/05	Co-60	-6.8E-03	3.0E-3	1.3E-2
AP	9	L9091-04	4/4/05	Zn-65	-6.0E-04	1.7E-3	7.6E-3
AP	9	L9557-04	4/18/05	Zn-65	7.5E-03	6.6E-3	2.3E-2
AP	9	L9091-04	4/4/05	Zr-95	-9.0E-04	1.7E-3	7.9E-3
AP	9	L9557-04	4/18/05	Zr-95	1.3E-02	9.0E-3	3.9E-2
AP	9	L9091-04	4/4/05	I-131	-3.2E-02	3.0E-2	1.3E-1
AP	9	L9557-04	4/18/05	I-131	1.0E+01	20	70
AP	9	L9091-04	4/4/05	Cs-134	2.0E-04	1.1E-3	4.1E-3
AP	9	L9557-04	4/18/05	Cs-134	3.0E-04	2.7E-3	9.9E-3
AP	9	L9091-04	4/4/05	Cs-137	5.0E-04	1.3E-3	4.8E-3
AP	9	L9557-04	4/18/05	Cs-137	-8.0E-04	2.7E-3	1.0E-2
AP	9	L9091-04	4/4/05	Ba-140	-1.7E-02	1.5E-2	7.5E-2
AP	9	L9557-04	4/18/05	Ba-140	4.1E-01	7.6E-1	2.9
AP	13	L868-1- 05	1/10/2005	GROSS BETA	2.16E	2.0E-3	4.1E-3
AP	13	L868-1- 05	1/24/2005	GROSS BETA	2.30E-2	2.0E-3	4.1E-3
AP	13	L8782-05	2/07/2005	GROSS BETA	2.25E-2	1.9E-3	3.7E-3
AP	13	L8817-05	2/22/2005	GROSS BETA	1.77E-2	1.8E-3	3.8E-3
AP	13	-L8881- 05	3/07/2005	GROSS BETA	2.01E-2	2.0E-3	4.7E-3
AP	13	L8924-05	3/22/2005	GROSS BETA	1.86E-2	1.7E-3	3.5E-3
AP	13	L9006-05	4/04/2005	GROSS BETA	1.00E-2	1.6E-3	4.1E-3
AP	13	L9063-05	4/18/2005	GROSS BETA	1.81E-2	1.9E-3	4.6E-3
AP	9	L9091-05	4/4/05	Mn-54	2.9E-04	5.9E-4	2.3E-3
AP	9	L9557-05	4/18/05	Mn-54	4.0E-04	2.1E-3	7.9E-3

AP	9	L9091-05	4/4/05	Co-58	-9.0E-04	1.0E-3	4.7E-3
AP	9	L9557-05	4/18/05	Co-58	-1.8E-03	4.5E-3	1.8E-2
AP	9	L9091-05	4/4/05	Fe-59	4.3E-03	4.1E-3	1.4E-2
AP	9	L9557-05	4/18/05	Fe-59	1.9E-02	1.8E-2	6.1E-2
AP	9	L9091-05	4/4/05	Co-60	7.5E-04	9.9E-4	3.6E-3
AP	9	L9557-05	4/18/05	Co-60	3.5E-03	2.4E-3	8.0E-3
AP	9	L9091-05	4/4/05	Zn-65	2.7E-03	1.8E-3	5.9E-3
AP	9	L9557-05	4/18/05	Zn-65	-2.2E-03	4.7E-3	1.9E-2
AP	9	L9091-05	4/4/05	Zr-95	1.4E-03	2.3E-3	8.4E-3
AP	9	L9557-05	4/18/05	Zr-95	-4.0E-04	8.2E-3	3.2E-2
AP	9	L9091-05	4/4/05	I-131	-1.6E-02	2.8E-2	1.1E-1
AP	9	L9557-05	4/18/05	I-131	-2.8E+01	19	74
AP	9	L9091-05	4/4/05	Cs-134	9.8E-04	7.3E-4	2.4E-3
AP	9	L9557-05	4/18/05	Cs-134	-1.3E-03	2.2E-3	8.7E-3
AP	9	L9091-05	4/4/05	Cs-137	-2.0E-03	1.2E-3	5.0E-3
AP	9	L9557-05	4/18/05	Cs-137	4.0E-04	2.1E-3	7.5E-3
AP	9	L9091-05	4/4/05	Ba-140	0.0E+00	1.4E-2	5.9E-2
AP	9	L9557-05	4/18/05	Ba-140	1.8E-01	6.0E-1	2.4
FISH							
FH-BF	26	L9416-02	6/7/05	Mn-54	11.50	6.6	21
FH-BF	26	L9416-02	6/7/05	Co-58	4.80	9.5	34
FH-BF	26	L9416-02	6/7/05	Fe-59	-33.00	39	150
FH-BF	26	L9416-02	6/7/05	Co-60	6.70	6.8	24
FH-BF	26	L9416-02	6/7/05	Zn-65	-38.00	17	73
FH-BF	26	L9416-02	6/7/05	Zr-95	-16.00	17	66
FH-BF	26	L9416-02	6/7/05	I-131	78.00	87	300
FH-BF	26	L9416-02	6/7/05	Cs-134	-11.60	6.8	29
FH-BF	26	L9416-02	6/7/05	Cs-137	21.50	8.7	27
FH-BF	26	L9416-02	6/7/05	Ba-140	-37.00	45	200
FH-PF	26	L9416-01	6/7/05	Mn-54	-2.00	7.7	28
FH-PF	26	L9416-01	6/7/05	Co-58	15.30	8.9	29
FH-PF	26	L9416-01	6/7/05	Fe-59	23.00	25	89
FH-PF	26	L9416-01	6/7/05	Co-60	-6.30	6.9	28
FH-PF	26	L9416-01	6/7/05	Zn-65	23.00	19	63
FH-PF	26	L9416-01	6/7/05	Zr-95	-16.00	14	56
FH-PF	26	L9416-01	6/7/05	I-131	230.00	150	480
FH-PF	26	L9416-01	6/7/05	Cs-134	11.00	7	26
FH-PF	26	L9416-01	6/7/05	Cs-137	25.00	10	32
FH-PF	26	L9416-01	6/7/05	Ba-140	-43.00	55	220
FISH							
FH-BF	29	L9416-05	6/7/05	Mn-54	-1.50	6.1	22
FH-BF	29	L9416-05	6/7/05	Co-58	13.30	7.5	24
FH-BF	29	L9416-05	6/7/05	Fe-59	-2.00	25	92
FH-BF	29	L9416-05	6/7/05	Co-60	0.00	6.6	24
FH-BF	29	L9416-05	6/7/05	Zn-65	-8.00	15	55
FH-BF	29	L9416-05	6/7/05	Zr-95	-3.00	13	50
FH-BF	29	L9416-05	6/7/05	I-131	-30.00	120	440
FH-BF	29	L9416-05	6/7/05	Cs-134	1.60	6.6	23
FH-BF	29	L9416-05	6/7/05	Cs-137	26.00	9.3	29
FH-BF	29	L9416-05	6/7/05	Ba-140	0.00	39	150
FH-PF	29	L9416-04	6/7/05	Mn-54	-4.10	6.8	27
FH-PF	29	L9416-04	6/7/05	Co-58	-8.40	8.9	36
FH-PF	29	L9416-04	6/7/05	Fe-59	-24.00	34	140
FH-PF	29	L9416-04	6/7/05	Co-60	-10.60	6.8	31
FH-PF	29	L9416-04	6/7/05	Zn-65	-16.00	19	75
FH-PF	29	L9416-04	6/7/05	Zr-95	-13.00	17	68
FH-PF	29	L9416-04	6/7/05	I-131	250.00	150	480
FH-PF	29	L9416-04	6/7/05	Cs-134	-31.00	8.8	33
FH-PF	29	L9416-04	6/7/05	Cs-137	45.00	12	32
FH-PF	29	L9416-04	6/7/05	Ba-140	-14.00	53	220
FISH							
FH-BF	30	L9416-07	6/7/05	Mn-54	0.00	7.3	2.7
FH-BF	30	L9416-07	6/7/05	Co-58	-2.30	8.3	31
FH-BF	30	L9416-07	6/7/05	Fe-59	-13.00	28	110
FH-BF	30	L9416-07	6/7/05	Co-60	1.20	6.2	23

FH-BF	30	L9416-07	6/7/05	Zn-65	0.00	17	62
FH-BF	30	L9416-07	6/7/05	Zr-95	33.00	16	51
FH-BF	30	L9416-07	6/7/05	I-131	-70.00	120	460
FH-BF	30	L9416-07	6/7/05	Cs-134	1.00	7.2	26
FH-BF	30	L9416-07	6/7/05	Cs-137	6.80	5.9	20
FH-BF	30	L9416-07	6/7/05	Ba-140	-36.00	36	160
FH-PF	30	L9416-06	6/7/05	Mn-54	-11.00	5.8	23
FH-PF	30	L9416-06	6/7/05	Co-58	-3.60	7	26
FH-PF	30	L9416-06	6/7/05	Fe-59	11.00	25	230
FH-PF	30	L9416-06	6/7/05	Co-60	3.40	5.2	19
FH-PF	30	L9416-06	6/7/05	Zn-65	-7.00	14	53
FH-PF	30	L9416-06	6/7/05	Zr-95	-14.00	13	49
FH-PF	30	L9416-06	6/7/05	I-131	30.00	120	410
FH-PF	30	L9416-06	6/7/05	Cs-134	4.40	6.4	22
FH-PF	30	L9416-06	6/7/05	Cs-137	23.00	7.5	23
FH-PF	30	L9416-06	6/7/05	Ba-140	18.00	41	150
SEDIMENT							
SHELLFISH							
SF	27	L9416-03	6/7/05	Mn-54	15.00	12	42
SF	27	L9416-03	6/7/05	Co-58	11.00	19	73
SF	27	L9416-03	6/7/05	Fe-59	37.00	53	210
SF	27	L9416-03	6/7/05	Co-60	-8.00	14	69
SF	27	L9416-03	6/7/05	Zn-65	11.00	19	79
SF	27	L9416-03	6/7/05	Zr-95	15.00	23	89
SF	27	L9416-03	6/7/05	I-131	100.00	140	510
SF	27	L9416-03	6/7/05	Cs-134	10.00	16	59
SF	27	L9416-03	6/7/05	Cs-137	3.70	9.8	40
SF	27	L9416-03	6/7/05	Ba-140	0.00	61	280
SHELLFISH							
SF	31	L9416-08	6/7/05	Mn-54	-2.00	11	49
SF	31	L9416-08	6/7/05	Co-58	7.00	14	55
SF	31	L9416-08	6/7/05	Fe-59	-129.00	66	340
SF	31	L9416-08	6/7/05	Co-60	4.00	18	73
SF	31	L9416-08	6/7/05	Zn-65	-23.00	32	150
SF	31	L9416-08	6/7/05	Zr-95	43.00	32	110
SF	31	L9416-08	6/7/05	I-131	130.00	150	520
SF	31	L9416-08	6/7/05	Cs-134	17.00	16	58
SF	31	L9416-08	6/7/05	Cs-137	-12.00	14	62
SF	31	L9416-08	6/7/05	Ba-140	-102.00	76	410
ISFSI WATER							
WI	57	L9066-03	4/4/2005	H-3	780	310	950
WI	57	L9501-02	6/27/2005	H-3	320	400	1300
WI	57	L9066-03	4/4/2005	Mn-54	-1.3	2.3	10
WI	57	L9501-02	6/27/2005	Mn-54	-6.9	3.2	14
WI	57	L9066-03	4/4/2005	Co-58	-4.3	2.9	14
WI	57	L9501-02	6/27/2005	Co-58	-0.9	2.9	11
WI	57	L9066-03	4/4/2005	Fe-59	-12	7.4	39
WI	57	L9501-02	6/27/2005	Fe-59	-9.2	7.3	34
WI	57	L9066-03	4/4/2005	Co-60	3	3.6	13
WI	57	L9501-02	6/27/2005	Co-60	-0.1	3.6	14
WI	57	L9066-03	4/4/2005	Zn-65	-2	4.4	21
WI	57	L9501-02	6/27/2005	Zn-65	1.5	6.9	26
WI	57	L9066-03	4/4/2005	Zr-95	2.4	3.7	14
WI	57	L9501-02	6/27/2005	Zr-95	-0.2	6.1	23
WI	57	L9066-03	4/4/2005	I-131	1.5	4.1	16
WI	57	L9501-02	6/27/2005	I-131	-3.2	5.2	20
WI	57	L9066-03	4/4/2005	Cs-134	3.3	2.2	6.9
WI	57	L9501-02	6/27/2005	Cs-134	3.5	2.6	8.6
WI	57	L9066-03	4/4/2005	Cs-137	-0.7	2.9	12
WI	57	L9501-02	6/27/2005	Cs-137	-0.5	3.2	12
WI	57	L9066-03	4/4/2005	Ba-140	2.3	3.5	15
WI	57	L9501-02	6/27/2005	Ba-140	9.6	6	19
RIVER WATER							
WR	28	L9098-01	4/4/2005	H-3	270	300	950

WR	28	L9588-01	6/27/2005	H-3	-310	380	1200
WR	28		7/11/2005	H-3	<1280		*
WR	28		7/25/2005	H-3	<1140		*
WR	28		8/8/2005	H-3	<1160		*
WR	28		8/22/2005	H-3	<1340		*
WR	28		9/6/2005	H-3	<1150		*
WR	28		9/19/2005	H-3	<1180		*
WR	28		10/3/2005	H-3	<1220		*
WR	28		10/17/2005	H-3	<1270		*
WR	28		10/31/2005	H-3	<1220		*
WR	28		11/14/2005	H-3	<1240		*
WR	28		11/28/2005	H-3	<1310		*
WR	28		12/12/2005	H-3	<1270		*
WR	28		1/1/2005	H-3	<1190		*
WR	28	L9098-01	4/4/2005	Mn-54	2.3	1.5	4.9
WR	28	L9588-01	6/27/2005	Mn-54	-0.1	.89	3.2
WR	28		7/11/2005	Mn-54	<5.335		*
WR	28		7/25/2005	Mn-54	<5.248		*
WR	28		8/8/2005	Mn-54	<7.411		*
WR	28		8/22/2005	Mn-54	<5.947		*
WR	28		9/6/2005	Mn-54	<4.397		*
WR	28		9/19/2005	Mn-54	<3.103		*
WR	28		10/3/2005	Mn-54	<4.622		*
WR	28		10/17/2005	Mn-54	<4.009		*
WR	28		10/31/2005	Mn-54	<4.963		*
WR	28		11/14/2005	Mn-54	<3.871		*
WR	28		11/28/2005	Mn-54	<3.576		*
WR	28		12/12/2005	Mn-54	<4.456		*
WR	28		1/1/2005	Mn-54	<5.173		*
WR	28	L9098-01	4/4/2005	Co-58	2.90	1.8	5.9
WR	28	L9588-01	6/27/2005	Co-58	-0.74	.89	3.4
WR	28		7/11/2005	Co-58	<3.298		*
WR	28		7/25/2005	Co-58	<3.532		*
WR	28		8/8/2005	Co-58	<4.770		*
WR	28		8/22/2005	Co-58	<4.478		*
WR	28		9/6/2005	Co-58	<3.476		*
WR	28		9/19/2005	Co-58	<3.444		*
WR	28		10/3/2005	Co-58	<6.003		*
WR	28		10/17/2005	Co-58	<4.907		*
WR	28		10/31/2005	Co-58	<6.538		*
WR	28		11/14/2005	Co-58	<3.784		*
WR	28		11/28/2005	Co-58	<4.405		*
WR	28		12/12/2005	Co-58	<5.216		*
WR	28		1/1/2005	Co-58	<3.897		*
WR	28	L9098-01	4/4/2005	Fe-59	2.30	5.1	20
WR	28	L9588-01	6/27/2005	Fe-59	2.90	3.5	12
WR	28	L9098-01	4/4/2005	Co-60	1.50	1.8	6.6
WR	28	L9588-01	6/27/2005	Co-60	0.00	.81	3
WR	28		7/11/2005	Co-60	<14.08		*
WR	28		7/25/2005	Co-60	<13.84		*
WR	28		8/8/2005	Co-60	<14.62		*
WR	28		8/22/2005	Co-60	<15.03		*
WR	28		9/6/2005	Co-60	<14.56		*
WR	28		9/19/2005	Co-60	<13.11		*
WR	28		10/3/2005	Co-60	<10.80		*
WR	28		10/17/2005	Co-60	<12.47		*
WR	28		10/31/2005	Co-60	<9.228		*
WR	28		11/14/2005	Co-60	<12.67		*
WR	28		11/28/2005	Co-60	<12.08		*
WR	28		12/12/2005	Co-60	<14.01		*
WR	28		1/1/2005	Co-60	<13.29		*
WR	28	L9098-01	4/4/2005	Zn-65	3.00	2.7	9.4
WR	28	L9588-01	6/27/2005	Zn-65	-1.70	1.8	6.9
WR	28		7/11/2005	Zn-65	<7.948		*
WR	28		7/25/2005	Zn-65	<15.50		*
WR	28		8/8/2005	Zn-65	<16.82		*
WR	28		8/22/2005	Zn-65	<17.16		*
WR	28		9/6/2005	Zn-65	<8.902		*
WR	28		9/19/2005	Zn-65	<6.771		*
WR	28		10/3/2005	Zn-65	<12.00		*
WR	28		10/17/2005	Zn-65	<3.535		*
WR	28		10/31/2005	Zn-65	<11.6		*
WR	28		11/14/2005	Zn-65	<14.42		*
WR	28		11/28/2005	Zn-65	<11.74		*
WR	28		12/12/2005	Zn-65	<12.6		*

WR	28		1/1/2005	Zn-65	<5.597		*
WR	28	L9098-01	4/4/2005	Zr-95	-3.90	2.8	13
WR	28	L9588-01	6/27/2005	Zr-95	-0.70	1.8	6.6
WR	28	L9098-01	4/4/2005	I-131	-3.20	3.8	15
WR	28	L9588-01	6/27/2005	I-131	24.10	9	28
WR	28	L9098-01	4/4/2005	Cs-134	0.00	1.6	6.5
WR	28	L9588-01	6/27/2005	Cs-134	-0.91	.74	2.9
WR	28		7/11/2005	Cs-134	<3.678		*
WR	28		7/25/2005	Cs-134	<3.609		*
WR	28		8/8/2005	Cs-134	<4.525		*
WR	28		8/22/2005	Cs-134	<5.651		*
WR	28		9/6/2005	Cs-134	<4.363		*
WR	28		9/19/2005	Cs-134	<2.564		*
WR	28		10/3/2005	Cs-134	<6.505		*
WR	28		10/17/2005	Cs-134	<4.428		*
WR	28		10/31/2005	Cs-134	<4.388		*
WR	28		11/14/2005	Cs-134	<4.969		*
WR	28		11/28/2005	Cs-134	<3.276		*
WR	28		12/12/2005	Cs-134	<4.168		*
WR	28		1/1/2005	Cs-134	<5.261		*
WR	28	L9098-01	4/4/2005	Cs-137	1.00	1.8	6.7
WR	28	L9588-01	6/27/2005	Cs-137	-0.18	.84	3
WR	28		7/11/2005	Cs-137	<9.807		*
WR	28		7/25/2005	Cs-137	<12.46		*
WR	28		8/8/2005	Cs-137	<11.51		*
WR	28		8/22/2005	Cs-137	<12.52		*
WR	28		9/6/2005	Cs-137	<11.98		*
WR	28		9/19/2005	Cs-137	<5.754		*
WR	28		10/3/2005	Cs-137	<13.63		*
WR	28		10/17/2005	Cs-137	<14.69		*
WR	28		10/31/2005	Cs-137	<13.83		*
WR	28		11/14/2005	Cs-137	<13.61		*
WR	28		11/28/2005	Cs-137	<12.37		*
WR	28		12/12/2005	Cs-137	<12.97		*
WR	28		1/1/2005	Cs-137	<11.93		*
WR	28	L9098-01	4/4/2005	Ba-140	1.10	3.7	14
WR	28	L9588-01	6/27/2005	Ba-140	2.00	4.3	15
RIVER WATER							
WR	30	L9098-02	4/4/2005	H-3	400	300	950
WR	30	L9588-02	6/27/2005	H-3	-220	370	1200
WR	30		7/11/2005	H-3	<1280		*
WR	30		7/25/2005	H-3	<1160		*
WR	30		8/8/2005	H-3	<1260		*
WR	30		8/22/2005	H-3	<1340		*
WR	30		9/6/2005	H-3	<1140		*
WR	30		9/19/2005	H-3	<1190		*
WR	30		10/3/2005	H-3	<1190		*
WR	30		10/17/2005	H-3	<1240		*
WR	30		10/31/2005	H-3	<1220		*
WR	30		11/14/2005	H-3	<1240		*
WR	30		11/28/2005	H-3	<1210		*
WR	30		12/12/2005	H-3	<1270		*
WR	30		1/1/2005	H-3	<1180		*
WR	30	L9098-02	4/4/2005	Mn-54	2.8	1.6	5.2
WR	30	L9588-02	6/27/2005	Mn-54	0.27	.7	2.4
WR	30		7/11/2005	Mn-54	<5.792		*
WR	30		7/25/2005	Mn-54	*Missed		*
WR	30		8/8/2005	Mn-54	<2.319		*
WR	30		8/22/2005	Mn-54	<4.906		*
WR	30		9/6/2005	Mn-54	<5.242		*
WR	30		9/19/2005	Mn-54	<3.933		*
WR	30		10/3/2005	Mn-54	<4.93		*
WR	30		10/17/2005	Mn-54	<3.473		*
WR	30		10/31/2005	Mn-54	<1.451		*
WR	30		11/14/2005	Mn-54	<4.165		*
WR	30		11/28/2005	Mn-54	<4.813		*
WR	30		12/12/2005	Mn-54	<1.449		*
WR	30		1/1/2005	Mn-54	<4.605		*
WR	30	L9098-02	4/4/2005	Co-58	-0.50	1.8	7.3
WR	30	L9588-02	6/27/2005	Co-58	0.84	.84	2.9
WR	30		7/11/2005	Co-58	<5.084		*
WR	30		7/25/2005	Co-58	spec		*

WR	30		8/8/2005	Co-58	<6.596		*
WR	30		8/22/2005	Co-58	<5.415		*
WR	30		9/6/2005	Co-58	<4.905		*
WR	30		9/19/2005	Co-58	<4.884		*
WR	30		10/3/2005	Co-58	<1.437		*
WR	30		10/17/2005	Co-58	<6.011		*
WR	30		10/31/2005	Co-58	<3.643		*
WR	30		11/14/2005	Co-58	<6.408		*
WR	30		11/28/2005	Co-58	<5.958		*
WR	30		12/12/2005	Co-58	<4.894		*
WR	30		1/1/2005	Co-58	<2.782		*
WR	30	L9098-02	4/4/2005	Fe-59	3.40	5.4	20
WR	30	L9588-02	6/27/2005	Fe-59	0.60	2.3	8.1
WR	30	L9098-02	4/4/2005	Co-60	-1.80	2.2	9.7
WR	30	L9588-02	6/27/2005	Co-60	0.62	.67	2.3
WR	30		7/11/2005	Co-60	<14.29		*
WR	30		7/25/2005	Co-60	written		*
WR	30		8/8/2005	Co-60	<14.21		*
WR	30		8/22/2005	Co-60	<13.95		*
WR	30		9/6/2005	Co-60	<14.05		*
WR	30		9/19/2005	Co-60	<12.42		*
WR	30		10/3/2005	Co-60	<13.46		*
WR	30		10/17/2005	Co-60	<13.76		*
WR	30		10/31/2005	Co-60	<11.54		*
WR	30		11/14/2005	Co-60	<13.77		*
WR	30		11/28/2005	Co-60	<12.00		*
WR	30		12/12/2005	Co-60	<12.50		*
WR	30		1/1/2005	Co-60	<14.66		*
WR	30	L9098-02	4/4/2005	Zn-65	-6.70	3.9	19
WR	30	L9588-02	6/27/2005	Zn-65	-0.10	1.4	5.1
WR	30		7/11/2005	Zn-65	<10.04		*
WR	30		7/25/2005	Zn-65			*
WR	30		8/8/2005	Zn-65	<15.76		*
WR	30		8/22/2005	Zn-65	<10.51		*
WR	30		9/6/2005	Zn-65	<12.07		*
WR	30		9/19/2005	Zn-65	<9.595		*
WR	30		10/3/2005	Zn-65	<10.62		*
WR	30		10/17/2005	Zn-65	<3.534		*
WR	30		10/31/2005	Zn-65	<11.26		*
WR	30		11/14/2005	Zn-65	<2.901		*
WR	30		11/28/2005	Zn-65	<12.07		*
WR	30		12/12/2005	Zn-65	<3.535		*
WR	30		1/1/2005	Zn-65	<8.175		*
WR	30	L9098-02	4/4/2005	Zr-95	0.10	2.9	12
WR	30	L9588-02	6/27/2005	Zr-95	0.10	1.4	4.9
WR	30	L9098-02	4/4/2005	I-131	-2.80	3.9	16
WR	30	L9588-02	6/27/2005	I-131	-11.70	7.5	27
WR	30	L9098-02	4/4/2005	Cs-134	-1.60	2	8.5
WR	30	L9588-02	6/27/2005	Cs-134	0.52	.71	2.5
WR	30		7/11/2005	Cs-134	<3.845		*
WR	30		7/25/2005	Cs-134			*
WR	30		8/8/2005	Cs-134	<5.893		*
WR	30		8/22/2005	Cs-134	<5.038		*
WR	30		9/6/2005	Cs-134	<4.058		*
WR	30		9/19/2005	Cs-134	<4.184		*
WR	30		10/3/2005	Cs-134	<5.261		*
WR	30		10/17/2005	Cs-134	<3.749		*
WR	30		10/31/2005	Cs-134	<5.07		*
WR	30		11/14/2005	Cs-134	<5.21		*
WR	30		11/28/2005	Cs-134	<5.849		*
WR	30		12/12/2005	Cs-134	<5.555		*
WR	30		1/1/2005	Cs-134	<4.402		*
WR	30	L9098-02	4/4/2005	Cs-137	1.20	1.5	5.4
WR	30	L9588-02	6/27/2005	Cs-137	0.27	.64	2.2
WR	30		7/11/2005	Cs-137	<11.32		*
WR	30		7/25/2005	Cs-137			*
WR	30		8/8/2005	Cs-137	<12.37		*
WR	30		8/22/2005	Cs-137	<12.62		*
WR	30		9/6/2005	Cs-137	<14.97		*
WR	30		9/19/2005	Cs-137	<13.30		*
WR	30		10/3/2005	Cs-137	<11.82		*
WR	30		10/17/2005	Cs-137	<13.21		*
WR	30		10/31/2005	Cs-137	<13.60		*
WR	30		11/14/2005	Cs-137	<11.85		*
WR	30		11/28/2005	Cs-137	<13.03		*

WR	30		12/12/2005	Cs-137	<10.63		*
WR	30		1/1/2005	Cs-137	<12.36		*
WR	30	L9098-02	4/4/2005	Ba-140	1.40	2.1	8.7
WR	30	L9588-02	6/27/2005	Ba-140	1.30	3.2	11
WELL WATER							
WW	15	L9066-01	4/4/2005	H-3	530	310	950
WW	15	L9066-01	4/4/2005	Mn-54	0.4	2	8.1
WW	15	L9066-01	4/4/2005	Co-58	-2.9	1.9	9.8
WW	15	L9066-01	4/4/2005	Fe-59	-1.3	7.6	33
WW	15	L9066-01	4/4/2005	Co-60	-4.3	2.2	12
WW	15	L9066-01	4/4/2005	Zn-65	-10.1	5.3	27
WW	15	L9066-01	4/4/2005	Zr-95	0.2	4.4	18
WW	15	L9066-01	4/4/2005	I-131	-7.7	5.6	23
WW	15	L9066-01	4/4/2005	Cs-134	-0.8	2.4	10
WW	15	L9066-01	4/4/2005	Cs-137	3.3	2.7	9.2
WW	15	L9066-01	4/4/2005	Ba-140	1.7	3.9	16
WELL WATER							
WW	16	L9066-02	4/4/2005	H-3	780	310	950
WW	16	L9501-01	6/27/2005	H-3	-80.00	370	1200
WW	16	L9066-02	4/4/2005	Mn-54	1.0	2.8	11
WW	16	L9501-01	6/27/2005	Mn-54	-2.30	2.4	9.2
WW	16	L9066-02	4/4/2005	Co-58	-6.9	3.5	15
WW	16	L9501-01	6/27/2005	Co-58	-0.50	2	7.8
WW	16	L9066-02	4/4/2005	Fe-59	-7	9.0	39
WW	16	L9501-01	6/27/2005	Fe-59	-8.70	6.5	28
WW	16	L9066-02	4/4/2005	Co-60	-1.7	3.4	14
WW	16	L9501-01	6/27/2005	Co-60	0.00	2.2	8.6
WW	16	L9066-02	4/4/2005	Zn-65	0	5.8	23
WW	16	L9501-01	6/27/2005	Zn-65	16.80	8.8	28
WW	16	L9066-02	4/4/2005	Zr-95	3.7	5.9	21
WW	16	L9501-01	6/27/2005	Zr-95	2.70	3.7	13
WW	16	L9066-02	4/4/2005	I-131	-4	5.7	22
WW	16	L9501-01	6/27/2005	I-131	1.80	4.9	17
WW	16	L9066-02	4/4/2005	Cs-134	4.6	3.3	11
WW	16	L9501-01	6/27/2005	Cs-134	4.40	2.6	8.4
WW	16	L9066-02	4/4/2005	Cs-137	-1.1	2.8	11
WW	16	L9501-01	6/27/2005	Cs-137	-2.50	2.5	9.7
WW	16	L9066-02	4/4/2005	Ba-140	-4	4.0	20
WW	16	L9501-01	6/27/2005	Ba-140	5.50	4.1	14

*MDC reported as concentration