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Big Rock Point Nuclear Plant, 10269 US-31 North, Charlevoix, MI 49720

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Plant Manager

April 27, 1993

Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

**DOCKET 50-155 - LICENSE DPR-6 - BIG ROCK POINT PLANT -
1992 RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT**

Attached is the 1992 Radiological Environmental Monitoring Report for the Big Rock Point Plant. This report covers the period from January 1 through December 31, 1992 and is submitted in accordance with Technical Specification 6.9.2.1.

Gregory C Rittrow for
Patrick M Donnelly

Patrick M Donnelly
Plant Manager

CC. Administrator, Region III, USNRC
NRC Resident Inspector - Big Rock Point

ATTACHMENT

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ATTACHMENT

CONSUMERS POWER COMPANY
BIG ROCK POINT PLANT
DOCKET 50-155

1992 RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT

April 27, 1993

To RJAlexander, Big Rock Point

From TLPopp, Palisades

Date April 22, 1993

Subject BIG ROCK POINT -
ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT - JANUARY-DECEMBER 1992

CC RLBurdette, Big Rock Point
REMP File, Palisades (2)
KMHaas, Palisades (w/o attachments)
DCC: 740/22*07*01*01/LP
740/24*03*10/LP

CONSUMERS POWER COMPANY

Internal Correspondence

TLP93*015

Attached please find the subject report prepared and reviewed in accordance with Palisades' Procedure HP 10.2. This report is accurate, pertinent and complete to the best of our ability in meeting the requirements of Technical Specification 6.9.2.1.

The Big Rock Point Annual Radiological Environmental Monitoring Report was prepared by TLPopp, Radioactive Environmental Monitoring Program Coordinator. Graphs and computer runs were made by RTCurnow, Sr. Engineering Technician. Technical review was performed by MDMennucci, HP Technical Supervisor and KMHaas, RSD Manager, approved the report. Independent technical review and approval was performed by EABogue, Chem/HP Superintendent, Big Rock Point.

Upon approval, this report is sent to the Nuclear Licensing Department for issuance and record.

Report prepared by:

TL Popp
TLPopp, REMP Coordinator — 4-22-93 Date

Technical Review Performed by:

MDMennucci
MDMennucci, HP Technical Supervisor — 4-22-93 Date

Approved by:

KMHaas
KMHaas, RSD Manager — 4/22/93 Date

Technical Review and Approved by:

for EAB
EABogue, Chem/HP Superintendent — 4/26/93 Date

Big Rock Point Annual Radiological Environmental Operating Report

I. Introduction

The 1992 Big Rock Point Annual Radiological Environmental Operating Report provides a summary and data interpretation of the Big Rock Point Radiological Environmental Monitoring Program as conducted during the 1992 reporting period. Reporting requirements are detailed in Technical Specifications 6.9.2.1, 13.2 and Tables 13.3-1 through 13.3-3. Big Rock Pint was off line from January 1 to May 16 for a refueling and baffle outage. Off-line June 3 to June 8 due to turbine control problems. Off-line from August 13 to August 17 and August 20 to August 25 due to turbine work. Off-line August 30 to September 3 to repair a leak on a reactor coolant pump heat exchanger. Off-line October 5 to October 8 to replace a reactor coolant pump seal. Off-line October 30 to November 2 due to substation problems. And off-line again December 7 to December 10 for steam leak repairs and a condenser tube plug.

There are no remaining 1992 laboratory sample analyses pending completion for inclusion into this report. The results of all environmental samples collected are evaluated as follows:

A. Air iodine and particulate, TLDs (monthly and quarterly), and milk data were statistically evaluated at the 95% confidence level (using SAS program) by the methodology detailed in Palisades' Procedure HP 10.2. The data was compared against two criteria: the first criterion is the statistical difference which determine's if sample results from near sites are significantly greater than those from control sites. The second criterion is the evaluation level (twice the statistical difference) which is the minimum detectable difference that exceeds zero at the 95% confidence level. If the evaluation level is exceeded, then correlation of the results with effluent releases is done.

B. Well, water, lake water intake/discharge, sediment, fish and other aquatic biota samples were evaluated using data means comparisons against an appropriate control location (if available) and BRP Technical Specification limits.

II. Discussion and Interpretation of Results

A. Air Samples

Comparison of the gross beta airborne particulate sample data between near-site and control locations resulted in no data exceeding the statistical difference level and no data exceeding the statistical evaluation level. In many instances, control location sample values were greater. There was no Iodine-131 activity reported above minimum detectable levels.

A total of 312 air samples were collected during 1992. However, five (5) sample results were not included in the statistical evaluation. Refer to Enclosure A for specific reasons for sample rejection. The deleted samples constitute 1.6% of the total samples. Technical Specification sensitivities were met on all samples other than those already noted.

The air iodine/particulate samples are collected on a weekly basis from 6 air sampling locations. Air is metered through the sampling unit at a continuous 1 cfm flow rate through a Gelman 47mm air filter (air particulate) and a Scott air iodine cartridge. Both filters are in-line with each other and housed within the same filter holder.

The 1992 air sample results are consistent with actual effluent releases and site-specific meteorology.

B. TLDs - Gamma Dose

There were a total of 216 monthly, 72 quarterly and 18 annual TLDs collected during 1992. No TLDs were reported missing for 1992.

The Big Rock Point gamma assessment program consists of 18 TLD locations: 5 on-site (locations 01, 14, 15, 17, 18), 6 inner ring at site boundary (locations 09, 10, 11, 12, 13, 16), 3 outer ring, 3 to 4.5 miles out, (locations 02, 03, 04), 3 control, 10.5 to 50 miles out, (locations 05, 06, 07), and 1 TLD control placed in a lead storage cave. For 1992 the average monthly gamma readings were: 4.0 mR for the inner ring (site boundary) TLDs; 4.0 mR for the outer ring (1 to 4.5 miles out) TLDs; and 4.2 mR for the control TLD locations. This is consistent with historical data and actual effluent releases. The 5 on-site TLD locations and the lead cave (08) serve as individual references only and are not collectively evaluated.

The monthly and quarterly SAS statistical TLD data evaluations were accomplished by comparing the inner ring TLDs and the outer ring TLDs against the control TLD locations. The annual TLD data evaluation was done by a direct comparison of data points only.

In comparing the inner ring TLDs to the control TLDs, station BRP-12 (SSE site boundary) had the greatest monthly mean. Station BRP-12 also had the greatest quarterly mean and greatest annual exposure value. In comparing the outer ring TLDs to the control TLDs, BRP-06 (Boyne City, 12.0 mi SE) had the greatest monthly and quarterly exposure means, and station BRP-04 (Susan Lake, 3.5 mi SE) had the greatest annual exposure value.

Background and in-transit gamma exposure levels were accounted for and subtracted from the TLD data prior to statistical evaluation. No statistical or evaluating levels were exceeded, and in many instances, control location TLD data was greater than near-site TLD data. BRP Technical specification sensitivities were met.

Environmental gamma doses are measured monthly, quarterly and annually by placement of 3 TLD badges per designated location. Each Teledyne TLD badge contains a 4-zone $CaSO_4$ phosphor wafer (the wafer also includes an additional backup/reserve read-out zone). Sensitivity for the multi-zone TLDs are 0.5 mR with a linear response of 0.1 mR to 1000 R.

C. Milk

A total of 48 individual monthly milk samples were collected from 4 different dairy farms during 1992. Dairy farms 20-JG, 21-DK and 22-RM serve as indicator locations; and dairy farm 23-BB serves as the control location.

Only the Sr-90 data was statistically evaluated; all other activity results were below LLD. The 1992 Sr-90 statistical difference level between the indicator and control locations was exceeded. For the first time in the last five years the evaluation level was not exceeded. However, the overall amount of Sr-90 (pCi/L) detected remained relatively the same. The annual mean of all indicator locations was 4.9 pCi/L in 1987, 4.6 pCi/L in 1988, 4.0 pCi/L in 1989, 3.5 pCi/L in 1990, 3.9 pCi/L in 1991 and 3.7 pCi/L in 1992. Dairy farm location 20-JG (J. Golovich, 4.5 mi. SE) reported the greatest annual mean (indicator location) for 1987, 1988, 1989, 1990, 1991 and 1992. Results were 6.3 pCi/L, 5.5 pCi/L, 4.5 pCi/L, 5.0 pCi/L, 6.3 pCi/L and 5.5 pCi/L, respectively. The dairy farm control location 23-BB (B. Bochniak, 11.5 mi E) reported the following results for 1987 through 1992: 3.0 pCi/L, 2.9 pCi/L, 2.2 pCi/L, 2.2 pCi/L, 2.3 pCi/L and 2.5 pCi/L, respectively.

Evaluation for input data indicates that the Sr-90 activity levels were not caused by Plant effluent in that:

1. Sr-89, I-131, Cs-134 and Cs-137 activity levels were less than LLD for all milk samples. I-131 activity levels were less than LLD for all air samples.

2. The East sector from Big Rock Point has higher X/Q meteorological data than the Southeast sector. Indicator dairy farm location 21-DK (D. Kuebler, 2.5 mi E) had 1992 Sr-90 annual mean of 3.0 pCi/L which is lower than the Golovich data.

3. Selected crop samples from a garden (Kuebler Farm, 2.5 mi E) had minimal detectable levels of Sr-90 activity present with all other identified isotopic activity results reporting below LLD.

Milk samples are required monthly (usually collected by the 1st Thursday of the month) from each designated collection location (4 total). A two-gallon quantity of raw milk (grab sample) is obtained per collection location in order to meet analytical requirements. Samples are treated with a sodium bisulfite (40 grams per gallon) preservative prior to being sent to Teledyne Isotopes for analysis.

D. Lake Water

A total of 36 individual monthly lake water composite samples were collected from 3 locations during 1992. Lake water samples from the Lake-in (plant intake) and the Lake-out (plant discharge) are collected daily and composited into monthly samples. Monthly lake water sample composites from Ludington are collected as control samples.

G. Crops

The collection of food crops/vegetation samples are not required by the BRP Radiological Environmental Monitoring Technical Specifications. There are no regular select locations where food crop samples are collected, however, several crop samples are usually obtained when in season if available. Beans, beets, and tomato leaves were collected September 24, 1992 from Kuebler Farms (2.5 mi E).

Evaluation of the crop sample analytical results was direct. All data was combined and reported. No control location was used.

Of the isotopes listed on Table HP 10.2-2, only the gross beta and Sr-90 analyses resulted in any specific identified activity. All other analyses were less than Technical Specification LLDs. No BRP Technical Specification reporting limits were exceeded nor were any special/supplemental analyses required during 1992.

Food crop samples are obtained seasonally, usually from the E, SE, ESE or SSE meteorological sectors and when specifically requested. When collected, approximately 1 Kg of sample is placed in a sealable plastic bag for shipment to Teledyne Isotopes. No special treatment of the food crop samples with a preservative is necessary.

H. Sediment

A total of 13 individual sediment samples were collected from 6 locations during 1992. Two (2) sediment samples were obtained from the BRP discharge channel; two (2) sediment samples from Nine Mile Point (2-NM, 3 mi ENE); three (3) sediment samples from the Ludington control station; two (2) sediment samples from 1/4 mi south of discharge; two (2) sediment samples from Mt. McSauba (19-MS, 3 mi W); two (2) sediment samples from 1/4 mi north of discharge.

Evaluation of the sediment analytical results was based on data means comparisons between the BRP samples and the Ludington control samples and the BRP Technical Specification reporting limits. The individual BRP sample locations were combined into one indicator location for comparison purposes, however, if any one individual sample location had a greater specific isotopic annual mean than the other location(s), then that location is identified on Table HP 10.2-2.

Of the isotopic analyses listed on Table HP 10.2-2, gross beta, Sr-90, Mn-54, Co-60, and Cs-137 analyses resulted in trace amounts of activity present. All other isotopes analyzed were less than LLD. The station with the highest mean gross beta activity (discharge) was only slightly higher than the Ludington control station mean. All other control station isotopes were less than LLD.

Evaluation of the monthly lake water analytical results was based on a data means comparison between the Lake-in (indicator location), Lake-out (indicator location) and Ludington (control location) samples. In previous reports the Lake-in sample was used as a control sample in combination with the Ludington control sample location. The Lake-in sample location has the potential of being contaminated due to a water heater line outlet originating from the lake water discharge side. Therefore, this location is now being used as an indicator The lake water results were also evaluated against BRP Technical Specification reporting limits.

Tritium and gross beta analyses are required for all lake water samples. The indicator and control location sample means were <500 pCi/L (LLD) for tritium and <4.0 pCi/L (LLD) for gross beta. Lake-out (indicator location) had one sample composite slightly above the LLD (4.4 pCi/L) for the month of January.

Ludington lake-in, BRP lake-in and BRP discharge samples are collected daily for composite into a monthly sample. A one-gallon quantity of sample is sent to Teledyne Isotopes for analysis. No treatment of the water samples with a preservative is necessary.

E. Well Water

A total of 24 individual monthly well water samples were collected from the BRP site well (indicator) and the Ludington well (control) during 1992. Tritium and gross beta analyses are required for each monthly sample.

Evaluation of the monthly well water analytical results was based on a data means comparison between the BRP site well and the Ludington well samples. For all well water samples tritium results were <500 pCi/L (LLD) and <4.0 pCi/L (LLD) for gross beta. No special or supplemental analyses were required during 1992.

A one-gallon grab sample is sent to Teledyne Isotopes for analysis. No treatment of the water samples with a preservative is necessary.

F. Drinking Water

A total of 12 monthly samples were collected from the Charlevoix Municipal Water System (indicator) during 1992. The 12 monthly Ludington well samples serve as the control for the drinking water samples as well as the well water samples. Tritium and gross beta analyses are required for each monthly sample.

Evaluation of the monthly drinking water analytical results was based on a data means comparison between the Charlevoix Municipal Water System and the Ludington well samples. For all drinking water samples, tritium results were <500 pCi/L (<LLD) and <4.0 pCi/L (<LLD) for gross beta. No special or supplemental analyses were required during 1992.

The drinking water samples are collected daily for composite into a monthly sample at Charlevoix and monthly grab samples are obtained from the Ludington well. A one-gallon quantity of sample is sent to Teledyne Isotopes for analysis. No treatment of the water samples with a preservative is necessary.

No BRP Technical Specification reporting levels were exceeded nor were any special or supplemental analyses required during 1992. The August sediment sample taken at the location a quarter mile north of the discharge exceeded the BRP Technical Specification action level for Cs-137 of 1 pCi/g. The sample was re-analyzed to confirm the measurement. The results of the two measurements were 1.41 pCi/g and 2.04 pCi/g. The results are consistent with previous years results.

Sediment samples are collected semi-annually from designated locations. A one liter quantity grab sample is usually obtained a few yards off-shore. No treatment of the samples with a preservative is necessary prior to shipment to Teledyne Isotopes.

I. Fish

A total of twenty (20) individual fish samples were collected from four (4) locations during 1992. Ten (10) samples were obtained from BRP site area (discharge, 1/4 mile south boundary, and 1/4 mile north boundary); and ten (10) samples from the Ludington control station.

Evaluation of the fish analytical results was based on data means comparisons between the BRP samples and the Ludington samples and the BRP Technical Specification reporting limits. The BRP individual sample locations were combined into one individual sample location for comparison purposes, however, if any one individual sample location had a greater specific isotopic annual mean than the other locations, then that location is identified on Table HP 10.2-2.

Of the isotopic analyses listed on Table HP 10.2-2 only gross beta activity was detected. The mean gross beta activity at the highest sample location (0.25 mile north) was less than the mean gross beta activity at the Ludington control station. All other isotopes analyzed were less than LLD. No BRP Technical Specification reporting levels were exceeded, nor were any special analyses required during 1991.

Fish samples are collected semi-annually. If possible, at least two (2) different fish species (i.e., forage, sport fish, etc.) are sampled semi-annually at designated sample locations. When caught, one (1) liter quantity of fish sample is prepared for shipment to Teledyne Isotopes. Each sample is treated with 10 ml of a 10% formaldehyde solution for preservation.

J. Aquatic Biota

The aquatic biota category consists of: crayfish, algae and periphyton. A total of seventeen (17) individual samples were collected from four (4) locations during 1992. Sample types and locations are as follows:

Crayfish: Three (3) samples - BRP discharge, 1/4 mile north boundary, and a composite sample do to a lack of enough crayfish at one location for a one liter sample.

Algae: Six (6) samples BRP (discharge, 1/4 mile south boundary, 1/4 mile north boundary). Two (2) additional samples were obtained from Ludington Pump Storage Locations as a control.

Periphyton: Six (6) samples BRP (discharge, 1/4 mile south boundary, 1/4 mile north boundary).

Evaluation of the biota analytical results was based on a data means comparison with the BRP Technical Specification reporting limits. In the case of the algae samples, an additional comparison was made with the Ludington control samples. All the individual BRP sample locations were combined into one indicator (site) location for comparison purposes, however, if any one individual sample location had a greater specific isotopic annual mean than the other locations, then that location is identified on Table HP 10.2-2.

Isotopic analyses are listed in Table HP 10.2-2 for crayfish. There were trace amounts of activity present in all samples. Activity levels were greatest in the composite sample labeled Big Rock Point in the Teledyne Isotopes report.

Isotopic analyses are listed in Table HP 10.2-2 for periphyton. There were trace amounts of activity present in all samples. Activity levels were greatest in the discharge canal, except for Sr-90 where 1/4 mile south boundary had the greatest mean activity.

Isotopic analyses are listed in Table HP 10.2-2 for algae. The BRP algae samples were the only biota samples evaluated with a control station. There were trace amounts of activity present in all samples. Activity levels were greatest in the discharge canal samples, except for gross beta activity where the 1/4 mile north boundary had the greatest mean activity.

No BRP Technical Specification reporting levels were exceeded nor were any special or supplemental analyses required during 1992. The June periphyton and algae samples taken at the BRP discharge had Mn-54, Co-60, and Cs-137 activities in excess of the BRP Technical Specification action level (1 pCi/g). The August discharge algae sample also had Mn-54 and Co-60 activities in excess of the action level. All of these results were confirmed by re-analysis. The results are consistent with previous years results.

Aquatic biota samples (crayfish, algae and periphyton) are collected semi-annually at designated locations, however, lack of sample media, inclement weather or rough water conditions can either make collecting sufficient sample quantities impossible or wash biota populations out of the immediate sampling vicinity. Because of a lack of crayfish during one sample collection period a composite sample between the three locations was made in order to get an adequate sample. All other aquatic biota samples were available for collection. One liter quantities of biota are sent to Teledyne Isotopes for analysis. Each sample is treated with 10 ml of a 10% formaldehyde solution for preservation.

K. Broad Leaf Vegetation

No broad leaf vegetation samples were collected from the surrounding BRP environs during 1992. The collection of broad leaf vegetation samples serves as a backup and/or alternative sampling media in case any milk sampling location(s) become(s) unavailable. There were no problems associated with the quantity or quality of milk samples for the 1992 reporting year.

L. Gaseous and Liquid Radwaste Effluent Composite Samples

Although not a direct reporting component in the BRP Annual Radiological Environmental Monitoring Report, results of the gaseous and liquid monthly radwaste effluent composite samples are evaluated against overall environmental trending data. This evaluation is the basis for determining isotopic dispersion and deposition patterns within the surrounding environs of BRP. All isotopic values are compared to BRP Technical Specification reporting levels.

Both the gaseous and liquid radwaste effluent composite samples are collected monthly and sent to Teledyne Isotopes for analysis. The liquid effluent composite sample is based on a specific ratioed volume amount of sample collected per total batch volume released. The gaseous radwaste effluent composite sample results are based on analyzing four (4) or five (5) weekly stack gas filters. No special sample treatment with a preservative is required prior to laboratory analysis.

III. Assessment of Big Rock Point's Operational Environmental Impact

In reviewing the 1992 Big Rock Point radiological environmental monitoring data and comparing it to previous operational and pre-operational data, all trending parameters continue to indicate that the operation of Big Rock Point has minimal environmental impact. Most isotopic activity is at environmental "background" levels. Since the Chinese stopped open atmospheric testing of nuclear devices in late 1981-82, environmental background radiation levels continue to decrease. The effect of the Chernobyl fallout (April 1986) on milk, aquatic biota and fish also appears to have had no lasting results. Evidence of an overall environmental isotopic build-up (attributable to Plant effluent) remains negligible as well. In most instances, sample analytical results were below previously established environmental background levels.

Big Rock Point Nuclear Power Plant
Annual Radiological Environmental Operating Report
January 1 to December 31, 1992
Table HP 10.2-1 Sampling and Analysis Summary

Medium	Description	Location	Number of Samples Collected	Type of Analysis	Frequency of Analysis
Air	Continuous at Approx 1 CFM	All: Stations 2-NM thru 7-TR	312	Gross Beta, I-131	Weekly
Lake Water	1 Gallon Composite	Intake, Discharge Ludington	36	Gross Beta, Tritium *Sr-89/*Sr-90, *Gross Alpha	Monthly
Drinking Water	1 Gallon Composite/Grab	Charlevoix, Ludington	12	Gross Beta, Tritium	Monthly
Well Water	1 Gallon Grab/Composite	Site, Ludington	24	Gross Beta, Tritium	Monthly
Milk	2 Gallon Grab	JG, DK, RM, BB	48	I-131, Sr-89, Sr-90, Cs-137, Other Gamma	Monthly
TLD	Continuous	All: Stations BRP-01 thru BRP-18	144 48 12	Gamma	Monthly Quarterly Annual
Crops	Grab	Sector E	3	Gross Beta, I-131, Sr-89/90 Cs-137, Other Gamma	As Requested
Aquatic Biota	Grab	STS, STN, ST Ludington Control	17	Gross beta, Sr-89, Sr-90 CS-137, Other Gamma	Semi-Annual
Fish	Grab	STS, STN, ST, Ludington Control	20	Gross Beta, Sr-89, Sr-90 Cs-137, Other Gamma	Semi-Annual
Sediment	Grab	ST, NM, MS, STS, STN Ludington Control	13	Gross Beta, Sr-89, Sr-90 Cs-137, Other Gamma	Semi-Annual
Other Medium Sampled	Grab		None	Gross Beta, Sr-89, Sr-90 Cs-137, Other Gamma	As Required

*Note: Not Required for Intake

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Table HP 10.2-2 Sample Data Summary

Medium or Pathway Sampled	Analyses Evaluated Versus Total Number of Analyses Performed		Lower Limit of Detection(a)	All Indicator Locations		Location With Greatest Annual Mean(d)		All Control Locations		Nonroutine Measurements
Unit of Measurement			LLD		Mean(b) Range(b)	Name Distance and Direction	Mean(b) Range(b)		Mean(b) Range(b)	
Air (pCi/m^3)	I-131	307/312	0.07	154/156	LLD	LLD		153/156	LLD	None
	Gross Beta	307/312	0.01	154/156	0.018 (0.004-0.035)	ST-7 Control-Traverse City (50 mi SSW)	0.017 (0.007-0.037)	153/156	0.016 (0.006-0.037)	None
TLD (mR) Inner Ring (Site Boundary)	TLD (Monthly) (f)	108/108	10.0	72/72	4.0 (2.9-5.6)	ST-12 Site Boundary (0.9 mi SSE)	4.7 (4.1-5.6)	36/36	4.2 (3.1-7.0)	None
	TLD (Quarterly) (f)	36/36	10.0	24/24	12.1 (9.6-15.5)	ST-12 Site Boundary (0.9 mi SSE)	15.1 (14.1-15.8)	12/12	12.2 (10.4-13.1)	None
	TLD (Annual)	9/9	10.0	6/6	44.0 (34.4-53.9)	ST-12 Site Boundary (0.9 mi SSE)	53.9	3/3	46.0 (45.4-46.4)	None
TLD (mR) Outer Ring	TLD (Monthly) (f)	36/36	10.0	36/36	4.0 (3.2-5.3)	St-06 Control-Boyne City (12 mi SE)	4.6 (4.1-5.4)	36/36(1)	4.2 (3.1-7.0)	None
	TLD (Quarterly) (f)	12/12	10.0	12/12	11.6 (10.6-13.4)	ST-06 Control-Boyne City (12 mi SE)	12.8 (12.5-13.1)	12/12(1)	12.2 (10.4-13.1)	None
	TLD (Annual)	3/3	10.0	3/3	44.0 (39.9-48.3)	ST-04 Susan Lake (3.5 mi SE)	48.3	3/3 (1)	46.0 (45.4-46.4)	None
Milk (pCi/L)	I-131	48/48	1.0	36/36	LLD			12/12	LLD	None
	Sr-89	48/48	5.0	36/36	LLD			12/12	LLD	None
	Sr-90	48/48	1.0	36/36	3.7 (1.4-11.4)	ST-20 J. Golovich (4.5 mi SE)	5.5 (2.4-11.4)	12/12	2.5 (1.6-4.3)	None
	Cs-137	48/48	18.0	36/36	LLD			12/12	LLD	None
	Other Gamma	48/48	15.0	36/36	LLD			12/12	LLD	None

(1) Same control TLDs as Inner Ring.

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Table HP 10.2-2 Sample Data Summary

Medium or Pathway Sampled	Analyses Evaluated Versus Total Number of Analyses Performed		Lower Limit of Detection(a)	All Indicator Locations		Location With Greatest Annual Mean(d)		All Control Locations		Nonroutine Measurements
Lake Water (pCi/L)	Tritium	36/36	500.0	24/24	LLD	LLD		12/12	LLD	None
	(e) Gross Alpha	24/24	1.0	12/12	LLD	LLD		12/12	LLD	None
	Gross Beta	36/36	4.0	24/24	LLD	LLD		12/12	LLD	None
	(e) Sr-89	24/24	5.0	12/12	LLD	LLD		12/12	LLD	None
	(e) Sr-90	24/24	1.0	12/12	LLD	LLD		12/12	LLD	None
Well Water (pCi/L)	Gross Beta	24/24	4.0	12/12	LLD	LLD		12/12	LLD	None
	Tritium	24/24	500.0	12/12	LLD	LLD		12/12	LLD	None
Drinking Water (pCi/L)	Gross Beta	12/12	4.0	12/12	LLD	LLD		12/12(2)	LLD	None
	Tritium	12/12	500.0	12/12	LLD	LLD		12/12(2)	LLD	None
Crops (pCi/g Wet)	Gross Beta	3/3	1.0	3/3	6.35 (4.70-9.38)	ST-21, Kuebler Farms (2.5 mi E)	6.35 (4.70-9.38)	N/A		None
	I-131	3/3	0.06	3/3	LLD	LLD		N/A		None
	Sr-89	3/3	0.025	3/3	LLD	LLD		N/A		None
	Sr-90	3/3	0.005	3/3	0.024 (0.017-0.038)	ST-21, Kuebler Farms (2.5 mi E)	0.024 (0.017-0.038)	N/A		None
	Cs-137	3/3	0.08	3/3	LLD	LLD		N/A		None
	Other Gamma	3/3	0.08-0.10	3/3	LLD	LLD		N/A		None

(2) Same control samples as well water medium.

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Table HP 10.2-2 Sample Data Summary

Medium or Pathway Sampled	Analyses Evaluated Versus Total Number of Analyses Performed		Lower Limit of Detection(a)	All Indicator Locations		Location With Greatest Annual Mean(d)		All Control Locations		Nonroutine Measurements
Sediment (pCi/g Dry)	Gross Beta	13/13	1.0	10/10	9.80 (7.27-13.38)	ST-1, Discharge	11.00 (8.61-13.38)	3/3	9.51 (4.6-12.1)	None
	Sr-89	13/13	0.025	10/10	LLD	LLD		3/3	LLD	None
	Sr-90	13/13	0.005	10/10	0.03 (0.004-0.12)	ST-19, Mt. McSauba (3 mi. W)	0.068 (0.016-0.12)	3/3	LLD	None
	Cs-137	13/13	0.18	10/10	0.29 (0.027-1.41)	ST-25, 0.25 mi North	0.72 (0.039-1.41)	3/3	LLD	None
	Mn-54	13/13	0.08	10/10	0.06 (0.01-0.18)	ST-1, Discharge	0.14 (0.11-0.16)	3/3	LLD	None
	Co-60	13/13	0.05	10/10	0.13 (0.013-0.59)	ST-25, 0.25 mi North	0.30 (0.013-0.59)	3/3	LLD	None
	Other Gamma	13/13	0.08-0.15	10/10	LLD	LLD		3/3	LLD	None
Fish (pCi/g Wet)	Gross Beta	20/20	1.0	10/10	2.21 (1.01-2.65)	ST-25, 0.25 mi North	2.32 (2.29-2.59)	10/10	2.84 (1.57-3.81)	None
	Sr-89	20/20	0.025	10/10	LLD	LLD		10/10	LLD	None
	Sr-90	20/20	0.005	10/10	LLD	LLD		10/10	LLD	None
	Cs-137	20/20	0.15	10/10	LLD	LLD		10/10	LLD	None
	Other Gamma	20/20	0.10-0.26	10/10	LLD	LLD		10/10	LLD	None
Crayfish (pCi/g Wet)	Gross Beta	3/3	1.0	3/3	1.86 (1.57-2.07)	ST-1, BRP Composite	2.07	N/A		None
	Sr-89	3/3	0.025	3/3	LLD	LLD		N/A		None
	Sr-90	3/3	0.005	3/3	0.05 (0.004-0.10)	ST-1, BRP Composite	0.10	N/A		None
	Mn-54	3/3	0.13	3/3	LLD	ST-1, BRP Composite	0.27	N/A		None
	Co-60	3/3	0.13	3/3	LLD	ST-1, BRP Composite	0.27	N/A		None
	Cs-137	3/3	0.15	3/3	LLD	LLD		N/A		None
	Other Gamma	3/3	0.10-0.26	3/3	LLD	LLD		N/A		None

Big Rock Point Nuclear Power Plant
Annual Radiological Environmental Operating Report
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Table HP 10.2-2 Sample Data Summary

Medium or Pathway Sampled	Analyses Evaluated Versus Total Number of Analyses Performed		Lower Limit of Detection(a)	All Indicator Locations		Location With Greatest Annual Mean(d)		All Control Locations		Nonroutine Measurements
Algae (pCi/g Wet)	Gross Beta	8/8	1.0	6/6	3.73 (2.99-5.71)	ST-25, 0.25 mi. North	4.35 (2.99-5.71)	2/2	2.59 (1.30-3.88)	None
	Sr-89	8/8	0.025	6/6	LLD	LLD		2/2	LLD	None
	Sr-90	8/8	0.005	6/6	0.04 (0.006-0.18)	ST-1, Discharge	0.11 (0.031-0.18)	2/2	LLD	None
	Mn-54	8/8	0.13	6/6	1.01 (0.11-2.60)	ST-1, Discharge	2.16 (1.71-2.60)	2/2	LLD	None
	Co-60	8/8	0.13	6/6	0.72 (0.081-2.02)	ST-1, Discharge	1.59 (1.15-2.02)	2/2	LLD	None
	Cs-137	8/8	0.15	6/6	0.17 (0.025-0.56)	ST-1, Discharge	0.40 (0.24-0.56)	2/2	LLD	None
	Other Gamma	8/8	0.10-0.26	6/6	LLD	LLD		2/2	LLD	None
Periphyton (pCi/g Wet)	Gross Beta	6/6	1.0	6/6	3.42 (2.47-4.77)	ST-1, Discharge	3.62 (2.47-4.77)	N/A		None
	Sr-89	6/6	0.025	6/6	LLD	LLD		N/A		None
	Sr-90	6/6	0.005	6/6	0.23 (0.10-0.34)	ST-24, 0.25 mi. South	0.27 (0.20-0.34)	N/A		None
	Mn-54	6/6	0.13	6/6	0.73 (0.065-2.02)	ST-1, Discharge	1.61 (1.20-2.02)	N/A		None
	Co-60	6/6	0.13	6/6	0.63 (0.028-2.05)	ST-1, Discharge	1.52 (0.98-2.05)	N/A		None
	Cs-137	6/6	0.15	6/6	0.39 (0.11-0.88)	ST-1, Discharge	0.57 (0.25-0.88)	N/A		None
	Other Gamma	6/6	0.10-0.26	6/6	LLD	LLD		N/A		None

Big Rock Point Nuclear Power Plant
Annual Radiological Environmental Operating Report
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Table HP 10.2-2 Sample Data Summary

Medium or Pathway Sampled	Analyses Evaluated Versus Total Number of Analyses Performed	Lower Limit of Detection(a)	All Indicator Locations	Location With Greatest Annual Mean(d)	All Control Locations	Nonroutine Measurements
Broad Leaf Veg (pCi/g Wet) (c)	Gross Beta	1.0	No samples collected			
	I-131	0.06				
	Sr-89	0.025				
	Sr-90	0.005				
	Other Gamma	0.08-0.10				
Other analyses performed during year	N/A	N/A	No other analyses performed during 1992			

(a) Nominal Lower Limit of Detection (LLD) as defined in the Big Rock Point Technical Specifications Table 13.3-3 and vendor analytical capabilities.

(b) Mean and range based upon detectable measurements and/or vendor laboratory LLDs.

(c) Supplemental sample when milk is unavailable.

(d) See reporting results for greatest mean sampling location.

(e) Not required for Lake water intake.

(f) Monthly TLD results are normalized for 30 days net; Quarterly TLD results are normalized for 91 days net.

Big Rock Point Nuclear Power Plant
Annual Radiological Environmental Operating Report
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Table HP 10.2-3 High, Low and Mean
Reporting Results for Greatest Mean Sampling Location

Medium	Type of Analysis	Location	High	Low	Mean
Air (pCi/m^3)	I-131	LLD	------	------	0.07
	Gross Beta	ST-7, Control-Traverse City (50 mi SSW)	0.037	0.007	0.017
TLD (mR) Inner Ring (site boundary)	TLD (Monthly) (5)	ST-12, Site Boundary, (0.9 mi SSE)	5.6	4.1	4.7
	TLD (Quarterly) (5)	ST-12, Site Boundary, (0.9 mi SSE)	15.5	14.1	15.1
	TLD (Annual)	ST-12, Site Boundary, (0.9 mi SSE)	------	------	53.9
TLD (mR) Outer Ring	TLD (Monthly) (5)	ST-06, Control-Boyne City (12 mi SE)	5.4	4.1	4.6
	TLD (Quarterly)(5)	ST-06, Control-Boyne City (12 mi SE)	13.1	12.5	12.8
	TLD (Annual)	ST-04, Susan Lake (3.5 Mi SE)	------	------	48.3
Milk (pCi/L)	I-131	LLD	------	------	<1.0
	Sr-89	LLD	------	------	<5.0
	Sr-90	ST-20, J. Golovich (4.5 mi SE)	11.4	2.4	5.5
	Cs-137	LLD	------	------	<18.0
	Cs-134	LLD	------	------	<15.0
	Other Gamma	LLD	------	------	<15.0
Lake Water (pCi/L)	Tritium	LLD	------	------	<300.0
	Gross Alpha (4)	LLD	------	------	<1.0
	Gross Beta	LLD	------	------	<4.0
	Sr-89 (4)	LLD	------	------	<5.0
	Sr-90 (4)	LLD	------	------	<1.0
Well Water (pCi/L)	Tritium	LLD	------	------	<300.0
	Gross Beta	LLD	------	------	<4.0
Drinking Water (pCi/L)	Tritium	LLD	------	------	<300.0
	Gross Beta	LLD	------	------	<4.0

Big Rock Point Nuclear Power Plant
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Table HP 10.2-3 High, Low and Mean
Reporting Results for Greatest Mean Sampling Location

Medium	Type of Analysis	Location	High	Low	Mean
Crops (pCi/g Wet)(1)	Gross Beta	ST-21, Kuebler Farms (2.5 mi E)	9.38	4.70	6.35
	Sr-89	LLD	------	------	<0.025
	Sr-90	ST-21, Kuebler Farms (2.5 mi E)	0.038	0.017	0.024
	Cs-137	LLD	------	------	<0.08
	I-131	LLD	------	------	<0.06
	Other Gamma	LLD	------	------	<0.08-0.10
Sediment (pCi/g Dry)(2)	Gross Beta	ST-1, Discharge	13.38	8.61	11.00
	Sr-89	LLD	------	------	<0.025
	Sr-90	ST-19, Mt. McSauba (3 mi W)	0.12	0.016	0.068
	Cs-137	ST-25, (0.25 mi. N)	1.41	0.039	0.72
	Mn-54	ST-1, Discharge	0.16	0.11	0.14
	Co-60	ST-25, (0.25 mi N)	0.59	0.013	0.30
	Other Gamma	LLD	------	------	<0.08-0.15
Fish (pCi/g Wet)(2)	Gross Beta	ST-25, (0.25 mi. N)	2.59	2.29	2.32
	Sr-89	LLD	------	------	<0.025
	Sr-90	LLD	------	------	<0.005
	Cs-137	LLD	------	------	<0.15
	Other Gamma	LLD	------	------	<0.10-0.26
Crayfish (2) (pCi/g Wet)	Gross Beta	ST-1, BRP Composite	------	------	2.07
	Sr-89	LLD	------	------	<0.025
	Sr-90	ST-1, BRP Composite	------	------	0.10
	Mn-54	ST-1, BRP Composite	------	------	0.27
	Co-60	ST-1, BRP Composite	------	------	0.27
	Cs-137	LLD	------	------	<0.15
	Other Gamma	LLD	------	------	<0.10-0.26

Big Rock Point Nuclear Power Plant
Annual Radiological Environmental Operating Report
January 1 to December 31, 1992
Table HP 10.2-3 High, Low and Mean
Reporting Results for Greatest Mean Sampling Location

Medium	Type of Analysis	Location	High	Low	Mean
Algae (pCi/g Wet)(2)	Gross Beta	ST-25, (0.25 mi N)	5.71	2.99	4.35
	Sr-89	LLD	------	------	<0.025
	Sr-90	ST-1, Discharge	0.18	0.031	0.11
	Mn-54	ST-1, Discharge	2.60	1.71	2.16
	Co-60	ST-1, Discharge	2.02	1.15	1.59
	Cs-137	ST-1, Discharge	0.56	0.24	0.40
	Other Gamma	LLD	------	------	<0.10-0.26
Periphyton (2) (pCi/g Wet)	Gross Beta	ST-1, Discharge	4.77	2.47	3.62
	Sr-89	LLD	------	------	<0.025
	Sr-90	ST-24, (0.25 mi. S)	0.34	0.20	0.27
	Mn-54	ST-1, Discharge	2.02	1.20	1.61
	Co-60	ST-1, Discharge	2.05	0.98	1.52
	Cs-137	ST-1, Discharge	0.88	0.25	0.57
	Other Gamma	LLD	------	------	<0.10-0.26
Broad Leaf Veg (pCi/g Wet)(3)	I-131	No Samples Collected			
	Sr-89				
	Sr-90				
	Other Gamma				
Other analyses performed during year (specify)	N/A	No other analyses performed during 1992			

(1) Samples collected in season (on request)
(2) Two samples per location (collected semi-annually)
(3) Supplemental sample when milk is unavailable
(4) Not required for lake water intake
(5) Monthly TLD results are normalized for 30 days net;
Quarterly TLD results are normalized for 91 days net.

Enclosures

A. Sample Collection Anomalies

B. Big Rock Point 1992 Land Use Census

C. Health Physics Procedure HP 10.9; Big Rock Point Radiological Environmental Program Sample Collection and Shipment procedure (with sample locations, maps, etc.)

D. Big Rock Point 1992 (annual) Radiological Environmental Monitoring program Data as provided by Teledyne Isotopes Midwest laboratory, Northbrook, IL.

E. Teledyne Isotopes Midwest laboratory EPA Interlaboratory Comparison program Results

F. Data Graphs

1. Big Rock Point Air particulate (gross beta) 1992 Trending and Big Rock Point Air Particulate (gross beta) 1987-1992 Operational Comparison Graphs

2. Big Rock Point TLD (gamma) 1992 Trending and Big Rock Point TLD (gamma) Monthly, Quarterly and Annual 1987-1992 Operational Comparison Graphs

3. Big Rock Point Milk (Sr-90) 1992 Trending and Big Rock Point Milk (Sr-90) 1987-1992 Operational Comparison Graphs

4. Big Rock Point well Water (gross beta) 1992 Trending

5. Big Rock Point Lake Water (Charlevoix, Lake-in, and discharge - gross beta); 1960-1962 Pre-operational 1987-1992 Operational Comparison Graphs

6. Big Rock Point Lake Water (Charlevoix control vs. Lake-in gross beta and tritium) 1992 Trending

7. Big Rock Point Fish (gross beta) 1987-1992 Trending and Big Rock Point Fish (gross beta) 1987-1992 Operational Comparison Graphs

8. Big Rock Point Sediment (gross beta) 1987-1992 Trending and Big Rock Point (gross beta) 1987-1992 Operational Comparison Graphs

9. Big Rock Point Aquatic Biota (crayfish, algae, periphyton - gross beta) 1987-1992 Trending and Big Rock Point Aquatic Biota; 1960-1962 Pre-operational/1987-1992 Operational Comparison Graphs (including Ludington Control 1987-1992 algae only)

Enclosure A

Sample Collection Anomalies

Sample Type Affected	Location	Date	Problem	Evaluation
AP/I-131	3-CH	9-17-92	Weekly air sample volume low - results not included in statistical analysis	Pump off due to loose plug - restored power to air pump
AP/I-131	4-SL	3-19-92	Torn filter paper, results not included in statistical analysis	Filter not properly installed in filter holder
AP/I-131	5-PT	2-20-92	Air volume did not pass through filter - results not included in statistical analysis	Filter cartridge became disconnected from pump
AP/I-131	6-BC	9-24-92	Air volume did not pass through filter - results not included in statistical analysis	Vibration induced leak in hose allowed air to bypass filter
AP/I-131	7-TC	8-27-92	Air volume did not pass through filter - results not included in statistical analysis	Filter installed off-center in filter holder

To JLBeer. Bog Rock Point

From JHager, Palisades J Hager

Date October 12, 1992

Subject BIG ROCK POINT -
1992 LAND USE CENSUS

CC MDMennucci, Palisades
GASturm, Palisades
RLBurdette, Big Rock Point
DCC:740/72*10*03/LP

CONSUMERS
POWER
COMPANY

Internal
Correspondence

JH92*032

The attached tables and map are the results of the Big Rock Point Land Use Census conducted by JHager and NKBrott on June 29, 1992. Table 10.11-1 references the distance from Big Rock Point to the nearest residence, garden, beef/dairy cattle and goat per meteorological sector. Table 10.11-2 identifies the locations of the nearest residence, of all gardens (greater than 500 square feet) within a three (3) mile radius of the plant, and all beef/dairy cattle within a five (5) mile radius of the plant. The only goats located while conducting the 1992 BRP Land Use Census were in the SE sector at the 4.00 mile limit. Table 10.11-3 lists the critical receptor locations used in calculation of offsite doses by the GASPAR computer program.

Prior to conducting the BRP 1992 Land Use Census, both the Charlevoix County Agricultural Extension Office and Consumers Power Company Northwestern Region - District Manager's Office (Traverse City) were contacted June 26, 1992 as required in Procedure HP 10.11.

If you have any questions, please contact me.

Revised and Authorized MDMennucci 10-20-92

MDMennucci, HP Technical Supervisor Date

1992 BIG ROCK LAND USE CENSUS REPORT

TABLE 10.11-1

Distance to the nearest residence, garden, milk cow, beef cow and goat in each sector.

SECTOR	RESIDENCE	GARDEN	DAIRY COW	BEEF CATTLE	GOAT
WSW	2.5 mi	>5 mi	>5 mi	>5 mi	>5 mi
SW	1.1 mi	2.5 mi	>5 mi	>5 mi	>5 mi
SSW	1.3 mi	2.3 mi	>5 mi	>5 mi	>5 mi
S	1.9 mi	2.1 mi	>5 mi	2.1 mi	>5 mi
SSE	1.7 mi	1.8 mi	3.5 mi	3.5 mi	>5 mi
SE	1.7 mi	1.7 mi	4.5 mi	2.0 mi	4.0 mi
ESE	1.5 mi	1.8 mi	2.6 mi	2.6 mi	>5 mi
E	1.4 mi	1.4 mi	2.5 mi	2.5 mi	>5 mi
ENE	2.3 mi	>5 mi	>5 mi	>5 mi	>5 mi

1992 BIG ROCK POINT LAND USE CENSUS REPORT

TABLE 10.11-2

Verification of Items

Locations of nearest residence; of all gardens greater than 500 square feet within a three mile radius of plant; and all beef/dairy cattle within a five mile radius of plant.

Sector and Road	Location Description	Item	Number/Comment
WSW Mt. McSauba Road	Birchwood Ranch Shores North Point	Residence	1
SW Dirt Road	Lackin residence 12151 Meanderline (Private Road) Dirt Trail off of Martin Road	Residence	1
SW Waller Road	Meggison 13050 Waller	Garden	1
SW Maple Road	101 Maple Road	Garden	1
SSW Private Drive	Edward K. Shanahan, Private Drive North of US-31	Residence	1
SSW Boyne City Road	Robert Burns South side of road adj. to Mfg Nat'l Bank property	Garden	1
S Boyne Circle	Jackie & Katie 08015 Corner of Chaseview Dr. & Boyne Circle	Garden	1
S See Road	JMcClainathan 08621 See Road	Garden	1
S Boyne City Road	10350 Boyne Boyne City Road	Garden	1
S Boyne City Road	Kilanibe 10300 Boyne City Road	Garden	1
S North (dead) end of See Road	G. Skeel North of Boyne City Road	Residence	1
S See Road	D. Buckner 8398 See Road, approx. 250' South of See Road and Boyne City Road intersection	Cattle	2-Beef

Table 10.11-2 (Cont'd)

Sector and Road	Location Description	Item	Number/Comment
SSE Private Drive	SA Bascom West of Old US-31, adj. Susan Lake	Residence Garden	1 1
SSE Shrigley Road	Hoxie, Box 411 Shrigley Road	Garden	1
SSE	10527 Old Blue Star	Garden	1
SSE Intersection of Boyne City and Quarterline Roads	Lester Ular Farms Southwest corner of intersection	Cattle	30-Beef
SSE Intersection of Boyne City and Quarterline Roads	Jerry & Hazel Haggerty Farms, Southeast corner of intersection	Cattle	8-Dairy
SE Intersection of Old US-31 & Smith Rd.	Daniel & Rebecca Berg 0888 Route 3; Southwest corner of intersection	Residence Garden	1 1
SE	09475 Old Blue Star	Garden	1
SE Intersection of Old US-31 and Shirgley Road	R.M. Jess, 407 Shirgley, Southeast corner of intersection	Cattle	8-Beef
SE Intersection of Maple Grove and Dalton Road	Lee Sneathen, Jr. Farms West side of intersection	Cattle	20-Beef 4-dairy
SE Maple Grove between Quarterline & Dalton Road Intersections	*John & Shirley Golvish East side of Maple Grove Road	Cattle	40-Dairy 5-Beef
SE Quarterline Road Halfway between Burgess & Maple Grove Roads	D. Smith 08218 Quarterline Road (South side of road)	Goat	1

Table 10.11-2 (Cont'd)

Sector and Road	Location Description	Item	Number/Comment
ESE Burgess Road	Ken Hickman 10371 Burgess Road, 1 mile South of US-31	Residence	1
ESE Upper Bay Shore Rd.	CM 1 mile East of Upper Bay Shore & Burgess Road intersection of (South side of road)	Garden	1
ESE Burgess Road	Zook 09210	Garden	1
ESE Upper Bay Shore Road (bisected by E-sector) boundary line	*Dan Kuebler Farms, 1/2 mile West of Upper Bay Shore and Maple Grove Road (North side of road)	Cattle Garden	13-Beef 15-Dairy 1
ESE Stolt Road	Ed Smally, Box 314B, West end (turnaround area) of Stolt road, 3/4 mi from intersection of Stolt and Maple Grove Road	Cattle	1-Dairy 5-Beef
ESE Stolt Road	Thomas Hamlin, Northeast corner intersection of Stolt and Murry Roads	Cattle	3-Dairy 9-Beef
ESE Burnett Road	Ken Larson, 0917 Burnett, Rd. East side	Cattle	5-Dairy 5-Beef
E Burgess Road	Ralph J. Purvis, 1/2 mile South of intersection of 10631 Burgress and US-31	Residence Garden	1 1
E Burnett Road	Leo Burnett, 11033 Northwest corner of intersection of short dead-end road and Maple Grove road; 1/2 mile South of US-31	Garden	1
E Upper Bay Shore Road (bisected by SE sector boundary line)	*Dan Kuebler Farms, 07315 1/2 mile West of Upper Bay Shore and Burgess Road Intersection (North side of road)	Cattle Garden	13-Beef 15-Dairy 1

Table 10.11-2 (Cont'd)

Sector and Road	Location Description	Item	Number/Comment
E Intersection of Maple Grove & Upper Bay Shore Rd	T. McClellan, Northeast corner of intersection of Maple Grove and Upper Bay Shore Road	Cattle	1-Beef
E Burrett Road	Hiram & Margaret Steward, 1/2 mile East of intersection of Upper Bay Shore Road and Burnett Road	Cattle	7-Dairy
E Intersection of Upper Bay Shore & Murry Roads	Raymond Griffin, Northeast corner of intersection	Cattle	3-Dairy 30-Beef
E Intersection of Upper Bay Shore and Murry Roads	John Murry, Southeast corner of intersection	Cattle	3-Beef
E Upper Bay Shore Road	Heimbauchs, on Upper Bay Shore Road between Maple and Burnett Grove	Cattle	2-Dairy 4-Beef
ENE US-31	Werner Cunningham, South side of US-31, 2.3 miles East of BRP Plant	Residence	1

*NOTE: Current milk sampling locations.

1992 BIG ROCK LAND USE CENSUS REPORT

Table 10.11-3

Critical Receptor Identification

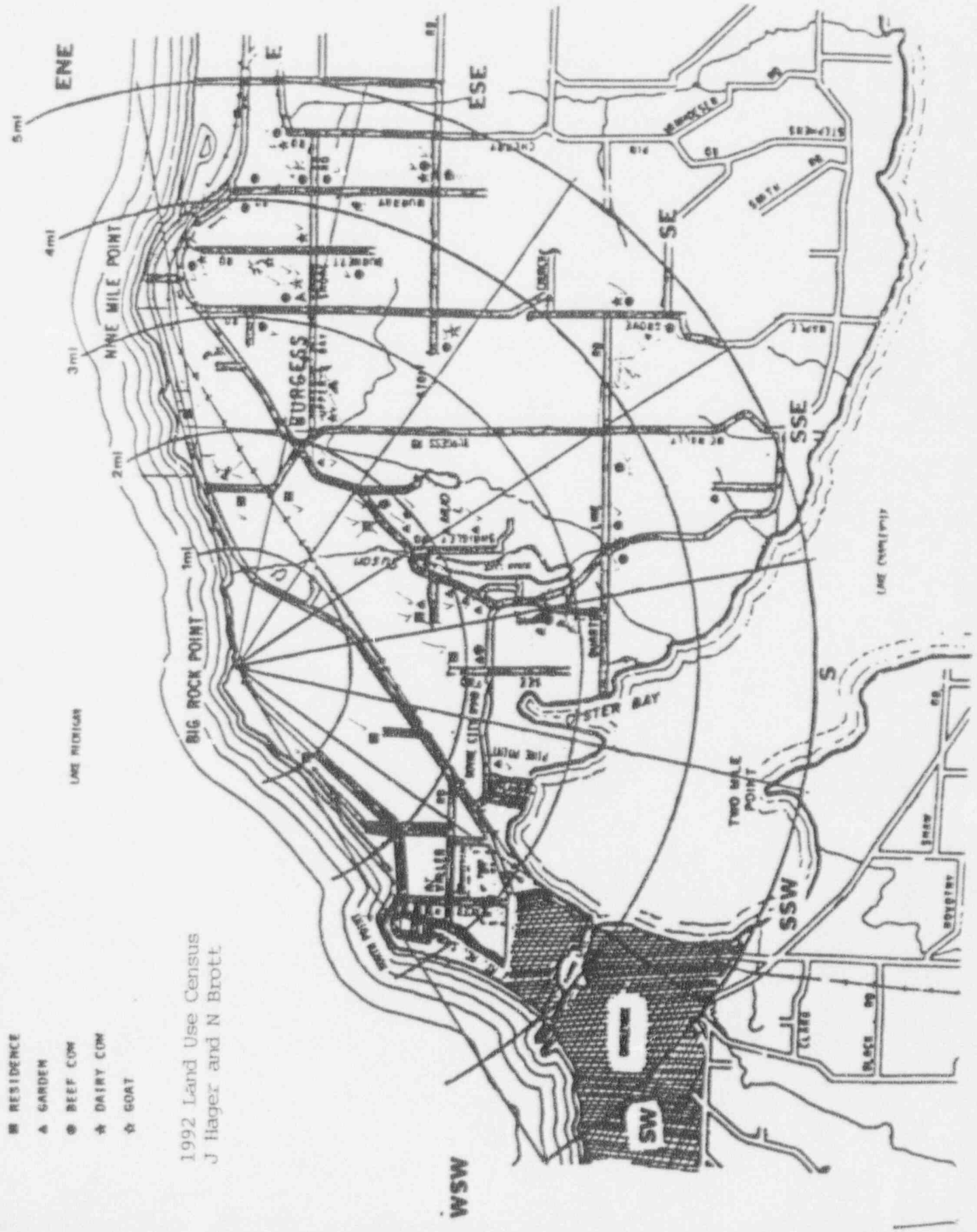
Sector	(miles)	Location/Description	Item	***X/Q (Sec/m3)
E	0.6	**Lexalite Plastics Corp	Factory	4.52E-08
E	1.4	Ralph J. Purvis, 1/2 mi. South of intersection of Burgess and US-31	Residence/ Garden	5.20E-08
E	0.57	Site Boundary	N/A	4.70E-08
E	2.50	*Dan Kuebler Farms, 1/2 mile West of Upper Bay Shore and Burgess Road Intersection (North side of road)	Beef Cattle Dairy Cows	3.75E-08
SE	4.00	D. Smith 08218 Quarterline Road (South side of road)	Goats	1.79E-08

*Note: Current milk sampling location.

**Note: Not used as critical receptor location in BRP GASPAR program, however factory is adjacent to site boundary and staffed 24-hours per day.

***Note: Based on BRP 5-year composite meteorological data, 1984-88.

BRP LAND USE CENSUS MAP



Procedure No HP 10.9
Revision 1
Issued Date 2/16/93

PALISADES NUCLEAR PLANT
HEALTH PHYSICS PROCEDURE

TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

Timothy L. Popp 2/19/93
~~Jeffrey A. Sadzewicz 2/4/93~~
Procedure Sponsor Date

/
Technical Reviewer Date

/ /
User Reviewer Date Rev #

TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

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TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

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ATTACHMENTS

TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

1.0 PURPOSE

1.1 To provide methodology for collection, identification and shipment of environmental samples in support of the Big Rock Point (BRP) Radiological Environmental Monitoring Program (REMP).

2.0 REFERENCES

2.1 SOURCE DOCUMENTS

2.1.1 Big Rock Point Technical Specifications 13.2; Table 13.3-1

2.1.2 Regulatory Guide 4.15(7)

2.1.3 10CFR50, Appendix I

2.1.4 Nuclear Operations Department Procedure H05, "Radiological Environmental Monitoring"

2.1.5 Palisades Administrative Procedure 7.08, "Big Rock Point and Palisades Radiological Environmental Monitoring Program (REMP)"

2.1.6 REMP Sample Shipping Manual, Teledyne Isotopes Midwest Laboratory

2.2 REFERENCE DOCUMENTS

None

3.0 PREREQUISITES

As indicated in procedure.

4.0 PRECAUTIONS AND LIMITATIONS

4.1 This procedure shall be applicable to Big Rock Point CHP, Radiological department, Environmental department and any contractual personnel assigned to collect or evaluate REMP samples.

4.2 Any revisions to this procedure shall be reviewed against Big Rock Point Technical Specifications to verify compliance.

4.3 Deviations from the required sampling schedule shall be documented in the Annual Radiological Environmental Operating Report.

4.4 Every effort shall be made to complete corrective action on malfunctioning sampling equipment prior to the start of the next sampling cycle.

4.5 If the required samples cannot be obtained, then suitable alternative media and new sample locations shall be located within 30 days.

TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

4.6 Environmental monitoring stations and equipment shall be maintained and calibrated as required.

4.7 Samples shall be collected, prepared and shipped for analysis in a timely manner to preserve integrity.

4.8 Collect all samples using the following methodology in accordance with schedule and location data described in Attachments 1 and 2.

5.0 PROCEDURE

5.1 AIR SAMPLE COLLECTION

5.1.1 Precautions

a. New filters and cartridges should be transported and handled such that potential contamination of them is minimized (ie, placed in clean plastic bags, etc).

b. If an air sampling unit is discovered not operating, attempt to find the cause and repair. Document on the air sample collection data form.

c. Air flow meters shall be calibrated annually by General Meter. All inservice air meters will have affixed a valid calibration sticker stating date of calibration, calibration due date and initials of technician performing calibration.

d. Airflow meters should be changed out prior to the expiration of calibration dates. Replacement air meters are available from the BRP Radiological Environmental contact. If an airflow meter is not changed out prior to the calibration expiration date, document the incident on the air sample collection data form.

e. Air station leakage shall be $< 1/8$ cfm. If the replacement of air station components is required due to excessive air leakage, document on the air sample collection data sketch.

5.1.2 Prerequisites

a. Fiber air filters.

b. Absorbent charcoal (carbon) cartridges for iodine sampling.

c. Glassine envelopes or plastic envelopes.

d. Air Sample Data Collection Form (containing installation data).

e. Replacement air sample meters (as required).

TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

5.1.3 Perform the following weekly for each sample location:

a. Open protective cover on air sampler and record the vacuum reading and the integrated gas meter readings onto the sample collection sheet under "Removed" column(s).

b. If airflow meter must be replaced, record tne meter number, date and meter reading for the new replacement airflow meter in the "Remarks" column.

c. Disconnect the air filter holder and observe if vacuum gauge reading exceeds 15 inches of mercury. If vacuum does not exceed 15 inches, then inspect unit for air leakage and perform appropriate maintenance. Document the actions taken in the remarks column on the air sample collection data sheet. e

d. Take filter holder to enclosed vehicle.

e. Remove particulate filter carefully from the holder. Place the filter in a glassine or plastic envelope and identify as outlined in Attachment 3.

f. Remove the charcoal filter cartridge from the holder. Identify as outlined in Attachment 3.

g. Clean out any residue or moisture build-up in filter holder before new replacement filters are installed.

h. Ensure that the new air particulate and charcoal filters are properly centered in filter holder to prevent air leakage. Sample airstream flow must first pass through the particulate filter and then through the charcoal cartridge. Reattach air filter holder to sampler unit.

i. Place hand over filter inlet to form a seal. Record maximum stable vacuum reading obtained and at that time observe the flow indicator on the air flow meter and record the cfm air leakage. The final vacuum shall be $\geq$ 15" Hg and air leakage shall be $<$ 1/8 cfm.

j. Remove hand and record filter operating vacuum on data sheet. Normal vacuum obtained will range between one and 15 inches. If less than one inch of mercury is obtained, significant filter bypass leakage may be occurring. Reposition the filters until a vacuum of between one and 15 inches is obtained (one to five inches preferred). If a filter operating vacuum cannot be maintained, replacement of the airflow meter/pump with another unit may be necessary. e

k. Ensure all pertinent data recorded, date and sign data sheet.

l. Close cover and proceed to the next station(s).

TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

m. Transcribe airflow meter reading and operating vacuum to the "installed readings" columns on the sample collection sheet to be used for the upcoming week's sample collection.

5.2 CITY OF CHARLEVOIX, LAKE (DRINKING) WATER SAMPLE COLLECTION

5.2.1 Prerequisites

a. Clean one-gallon plastic container(s) (labeled as per Attachment 3).

b. Miscellaneous Sample Data Form.

c. The water sample (shall be serviced by the Charlevoix Municipal Water System). The water sample can be collected from any Charlevoix Municipal water supply such as a residence or a gas station etc.

5.2.2 Daily perform the following:

a. Turn on water tap and allow water to run for approximately one minute to purge the line.

b. Collect approximately 125 ml of water and pour into plastic container.

c. Repeat Steps 5.2.2a and 5.2.2b daily for entire month. Note any day's sample not taken in "Remarks" column of Sample Data Form.

d. Seal the container(s) at end of month.

e. Label containers as per Attachment 3.

f. Package and ship samples per Attachment 4.

g. Record on Sample Data Form the location/type, dates, and amount of samples. Under "Remarks," note any other pertinent information (ie, composite sample, start and finish dates, etc if necessary). Sign form in space provided.

5.3 MILK SAMPLE COLLECTION

5.3.1 Precautions

a. Milk samples shall be sent to the laboratory as soon as possible because of the short decay time of I-131. Any undue delay may cause Technical Specifications analytical sensitivity requirements to be elevated.

b. Obtain the best available replacement sample for any missing milk sample(s). Identify new sample location(s) and notify the Chem/HP Supervisor or designate within 24 hours.

TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

c. If milk samples are unavailable, then samples of three different kinds of broad leaf vegetation grown nearest each of two different offsite locations of highest predicted annual average ground level D/Q and one sample of each of the similar broad leaf vegetation grown 10-20 mi distant in the least prevalent wind direction may be used as replacement samples.

5.3.2 Prerequisites

a. Leave two clean plastic one-gallon containers for each sample location

b. Sodium bisulfite preservative (approximately 40 gm per gallon of milk required)

c. Miscellaneous Sample Data Form

5.3.3 Monthly, at each specified sample collection location, perform the following:

a. Obtain two one-gallon grab samples of raw milk and pay milk supplier.

b. Two clean, empty plastic one-gallon containers may be left with milk supplier for the next month's samples when picking up the current month's samples. If problems are encountered in obtaining a sufficient quantity of milk sample, notify either the BRP or RSD Radiological Environmental contact.

c. Add approximately 40gm of sodium bisulfite to each one-gallon container of milk and thoroughly mix. The sodium bisulfite can either be in preprepared packets or "scooped" with a volumetric measure from its container.

d. Label containers as per Attachment 3.

e. Package and ship samples as per Attachment 4.

f. Record on Sample Data Form the location/type, date, and amount of samples. Under "Remarks," note any other pertinent information. Sign form in space provided.

TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

5.4 AQUATIC BIOTA COLLECTION

5.4.1 Precautions

a. Aquatic biota sample collection shall be coordinated between the Radiological Services Department Radioactive Material Control Section and the CPCo Environmental Department.

b. At least one individual in the sample collection party is required to possess a valid MDNR Cultural & Scientific Fish Collectors Permit.

5.4.2 Prerequisites

a. Crayfish spears (with replacement spearheads as required).

b. Plexiglas bottom buckets (or boxes).

c. Wire or stiff nylon brushes.

d. Black felt markers for writing sample identification on containers.

e. Boat with required safety equipment, or waders.

f. Gill nets, weights and floats.

g. Clean plastic one-liter wide-mouth bottles and tape.

h. Miscellaneous Sample Data Forms.

i. 10% formaldehyde solution.

j. Fillet knives.

k. Scrapers (putty knives).

l. Masking or duct tape (for sealing one-liter sample containers).

m. Notify local MDNR Conservation Officer prior to sample collection.

5.4.3 Collect semi-annual samples as follows:

a. Gill nets are placed at the locations specified in Attachment 1 to collect forage and game fish. One liter of flesh should be collected for each species caught for analysis accuracy. Forage fish may be combined if necessary to make a one liter composite sample.

b. Filamentous algae samples may be collected from driftwood or shoreline protection structures at vicinity of discharge.

TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

c. Scrape periphyton from rocks into a pail. When sufficient sample is collected, excess water is gently poured off. The partially solidified periphyton is then transferred to a liter sample bottle.

d. Collect crayfish by hand picking or spearing.

e. Label all containers as per Attachment 3.

f. Package and ship samples per Attachment 4.

g. Record on data sheet location, type, date, amount and under "Remarks" indicate any pertinent information. Sign form in space provided.

5.5 SEDIMENT SAMPLE COLLECTION

5.5.1 Prerequisites

a. Clean one-liter wide-mouth plastic sample bottles.

b. Dredge or hand scoop (as required).

c. Miscellaneous Sample Data Forms.

5.5.2 Collect semiannually at locations specified in Attachment 1. Palisades RSD and/or Environmental Department personnel will collect these samples.

a. Label containers per Attachment 3.

b. Package and ship samples per Attachment 4.

c. Record on Sample Data Form, the location/type, date, and quantity of sample. Under "Remarks," note any other pertinent information. Sign form in space provided.

5.6 ENVIRONMENTAL TLD COLLECTION

5.6.1 Precautions

a. Under no condition shall TLDs be routinely taken into the plant. Site TLDs for Big Rock Point shall be placed in the lead cave located in the security building and the BRP Radiological Environmental Contact or the Chem/HP Supervisor notified immediately.

b. Three TLD badges are present at each location. The badges are labeled location specific and either indicated as MONTHLY, QUARTERLY or ANNUAL to ensure correct replacement. MONTHLY TLD's are to be replaced each month; QUARTERLY TLD's during January, April, July and October and ANNUAL TLD's during January.

TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

5.6.2 Prerequisites

a. Environmental TLDs.

b. Environmental TLD Collection Form.

5.6.3 Monthly, quarterly or annually at each specified TLD location, perform the following as required:

a. Upon receipt of TLDs from the laboratory contractor, all TLDs shall be inventoried and immediately placed in the lead cave (at offsite sample collector's residence). Note date of receipt on TLD Data Form.

b. BRP site and area environmental TLDs shall only be removed from the lead cave for delivery to their proper locations. All control TLDs remain in the lead cave throughout the entire exposure period.

c. Remove and replace TLDs at each location.

d. For any missing TLDs, perform the following:

1. Search immediate area.

2. If lost TLD is found, collect it and perform standard change-out procedure.

3. If lost TLD is not found, post the new TLD in proper location.

4. Record in "Remarks" column of TLD Data Form, any of the above circumstances.

e. Store collected BRP site and area environmental TLDs in lead cave along with control TLDs until ready for mailing to Laboratory contractor. Mark "Do not x-ray" on TLD package.

f. Transportation control TLDs are to be stored in the special lead shield provided by laboratory contractor only after area TLDs are posted. Make sure that the properly matching control TLDs are returned with their designated batch field TLDs. Also, ensure that laboratory contractor's own TLD Data Sheet is completed and enclosed with shipment. Note the date shipped on the TLD Data Form.

g. Record on TLD Data Form location/type, date, and time. Under the "Remarks," note any other pertinent information. Sign form in space provided.

TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

5.7 Obtain best available replacement(s) for any missing sample(s) if required. Notify the BRP or RSD Radiological Environmental Contact with description and location of the replacement sample(s).

5.8 Document any missing samples or malfunctioning equipment on the Sample Data Collection Form(s).

6.0 ACCEPTANCE CRITERIA

Proper completion of procedure

7.0 ATTACHMENTS AND RECORDS

7.1 ATTACDHMENTS

7.1.1 Attachment 1, "Big Rock Point Environmental Sample Collection Schedule"

7.1.2 Attachment 2, "Big Rock Point Sampling Locations"

7.1.3 Attachment 3, "Sample Identification"

7.1.4 Attachment 4, "Sample Packaging and Shipping"

7.1.5 Attachment 5, "Big Rock Point Sample Collection Forms and Records"

7.2 RECORDS

7.2.1 Distribution of the Sample Collection Data Sheets as per Attachment 4.

7.2.2 Sample Data Collection records shall be maintained with all other Radiological Environmental Monitoring Program Surveillance Records and Documentation. All records are considered complete when the Annual Radiological Environmental Operating Report is submitted to the NRC. Records shall be retained in the Uniform File Index (UFI) under: BRP 740/24*03*10/LP.

ENVIRONMENTAL SAMPLE COLLECTION SCHEDULE
Big Rock Point

Exposure Pathway and/or Sample	Number of Samples and Locations*	Sample Type	Collection Frequency
Airborne:			
Particulates	1 - Onsite 3 - Within 5 miles (8 km) of the site boundary in different sectors 2 - Vicinity of communities having the highest calculated annual average ground level D/Q 1 - Control	Continuous at approximately 1 cfm (may be less due to dust loading).	Weekly
Iodines	Same as particulates	Same as particulates	Weekly
Waterborne:			
Lake Water	1 - Intake	Daily composite	Monthly
	1 - Discharge	To obtain a one-gallon sample	
Well Water	1 - Charlevoix Municipal Water System	Daily composite	Monthly
	1 - Site	One-gallon grab sample	Monthly
Ingestion:			
Milk	3 - Within a 2-7 mile (3.2-11.2 km) radius 1 - Control within 10-20 miles (16-32 km)	Two-gallon grab sample	Monthly

NOTE: If milk samples are not available, refer to Step 5.3.1.

*If samples are unavailable at the specified location, an attempt should be made to sample at an alternate location (refer to 4.5).

Exposure Pathway and/or Sample	Number of Samples and Locations*	Sample Type	Collection Frequency
Fish	2 - Locations in vicinity of Plant discharge 1 - Ludington control	One-liter fish flesh	Semiannually
Aquatic Biota:			
(Crayfish, filamentous, algae, periphyton)	1 - Discharge 1 - 1/4 mile north 1 - 1/4 mile south 1 - Ludington control (as available)	One-liter grab sample	Semiannually
Direct:			
TLD	4 - Onsite 6 - Site boundary 3 - Within a 3- to 5-mile (4.8-8 km) radius 3 - 10 to 50 miles (16-80 km) distant	Continuous	Monthly, quarterly and annual
Sediment	1 - 1 to 3 miles east (1.6-4.8 km) of site Nine Mile Pointe 1 - Discharge 1 - Mt McSauba 1 - 1/4 mile South 1 - 1/4 mile North 1 - Ludington (control) (2 samples recommended)	One liter grab sample	Semiannually

*If samples are unavailable at the specified location, an attempt should be made to sample at an alternate location (refer to 4.5).

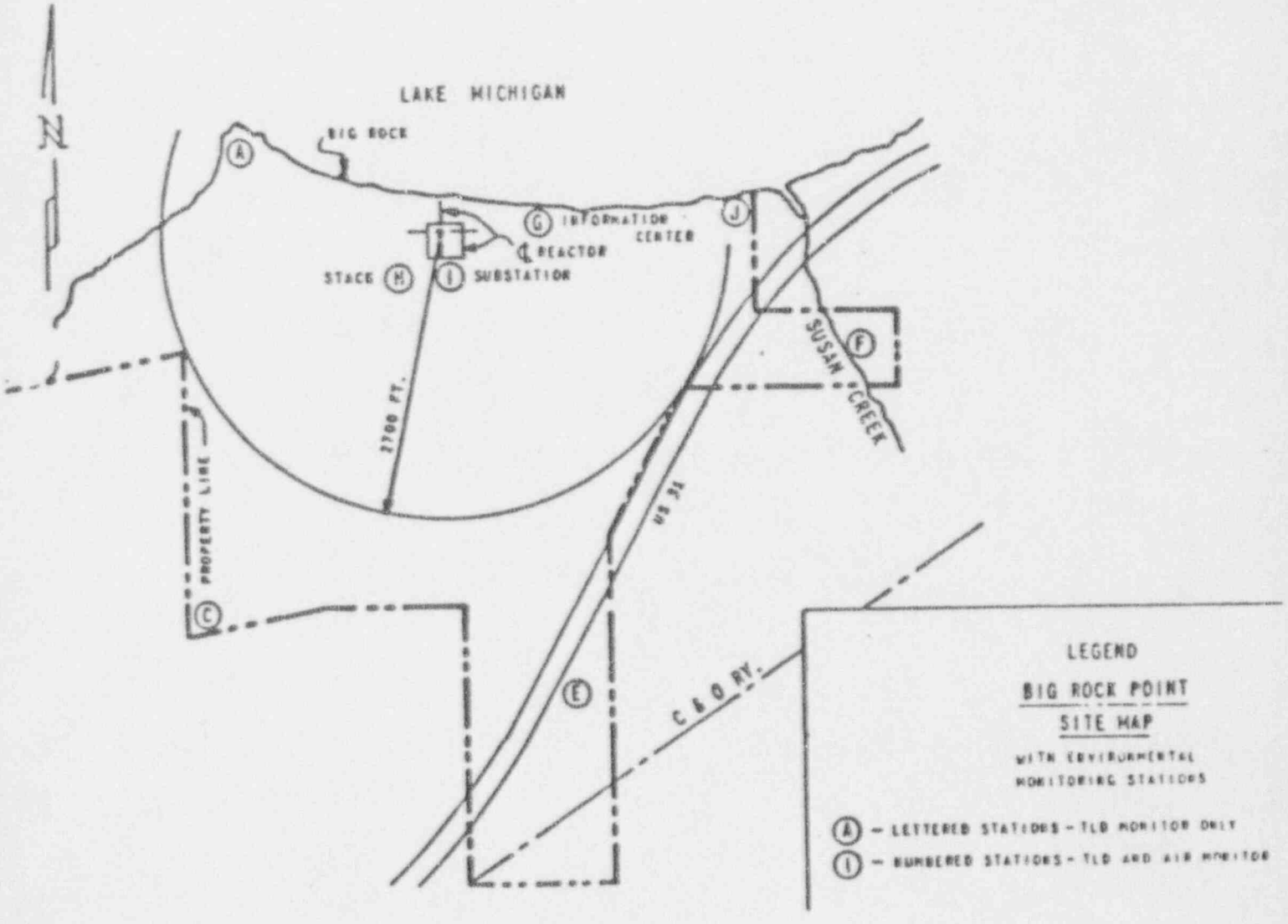
SAMPLING LOCATIONS
Big Rock Point Plant

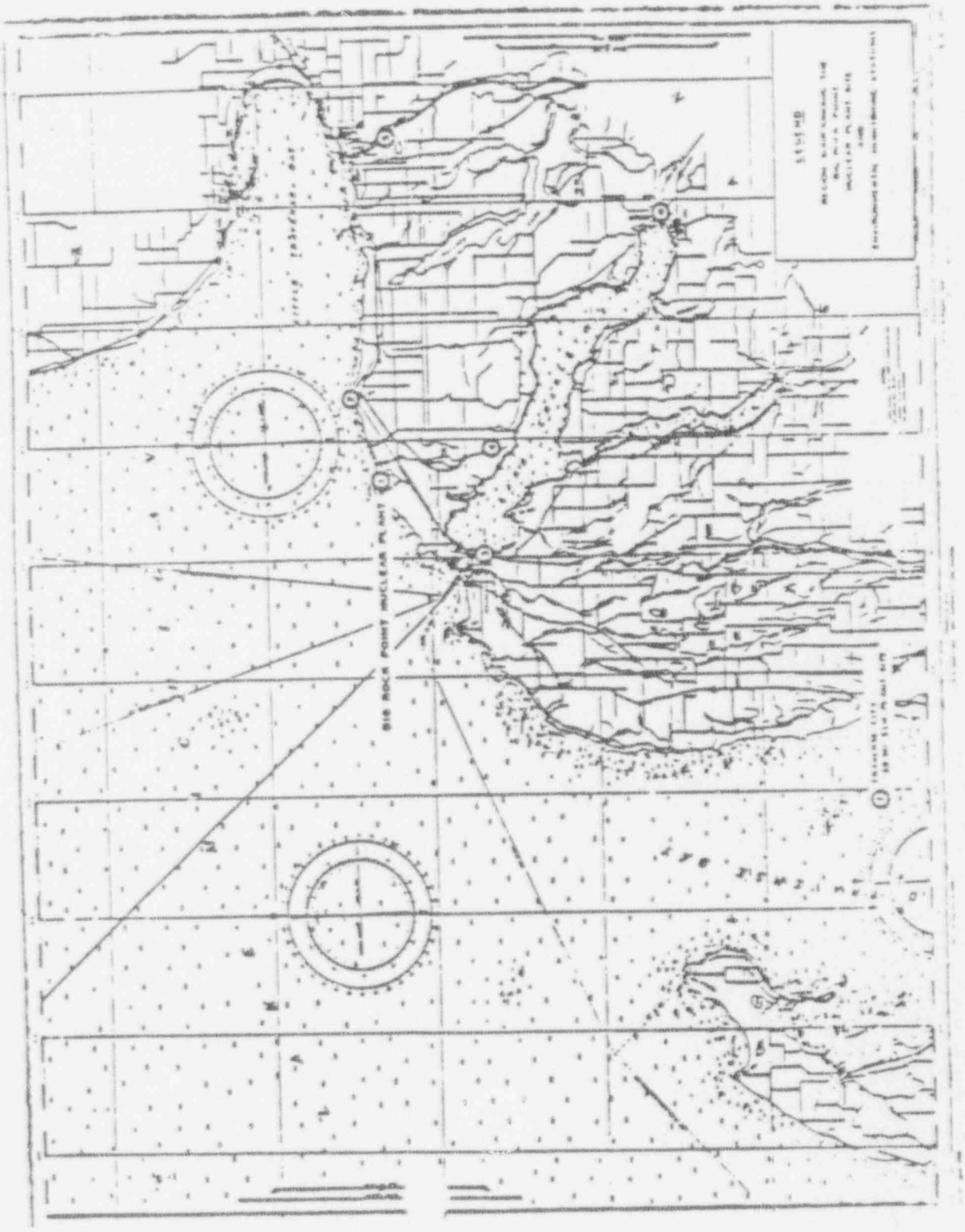
Station	Code	Location	Sample: SEDIMENT	AIR PARTICULATES	AIR IODINE	LAKE WATER	WELL WATER	MILK	BIOTA	TLD	FISH
1	ST	Big Rock Point Nuclear Plant	X	X	X	X	X		X	X	X
2	NM	Nine Mile Point, 3 Miles (4.8 km) E	X	X	X					X	
3	CH	Charlevoix, Michigan 4-1/2 Miles (7.2 km) SW		X	X	X				X	
4	SL	Susan Lake, 3.5 Miles (5.6 km) SE		X	X					X	
5	PT	Petoskey, Michigan 10-1/2 Miles (16.8 km) E		X	X					X	
6	BC	Boyne City, Michigan 12 Miles (19.2 km) SE		X	X					X	
7	TR	Traverse City, Michigan 50 Miles (80 km) SSW		X	X					X	
8	D	Control (Lead Cave) Environmental Contractor's Residence								X	
9	A	Meteorological Tower Foundation								X	
10	B	West Site Boundary on Lake Michigan								X	
11	C	South Site Boundary, Shanahan's Orchard 0.8 Miles (1.3 km) SW								X	
12	E	Southeast Boundary 0.9 Miles (1.4 km) SSE, US-31 Near the abandoned Railway Spur								X	

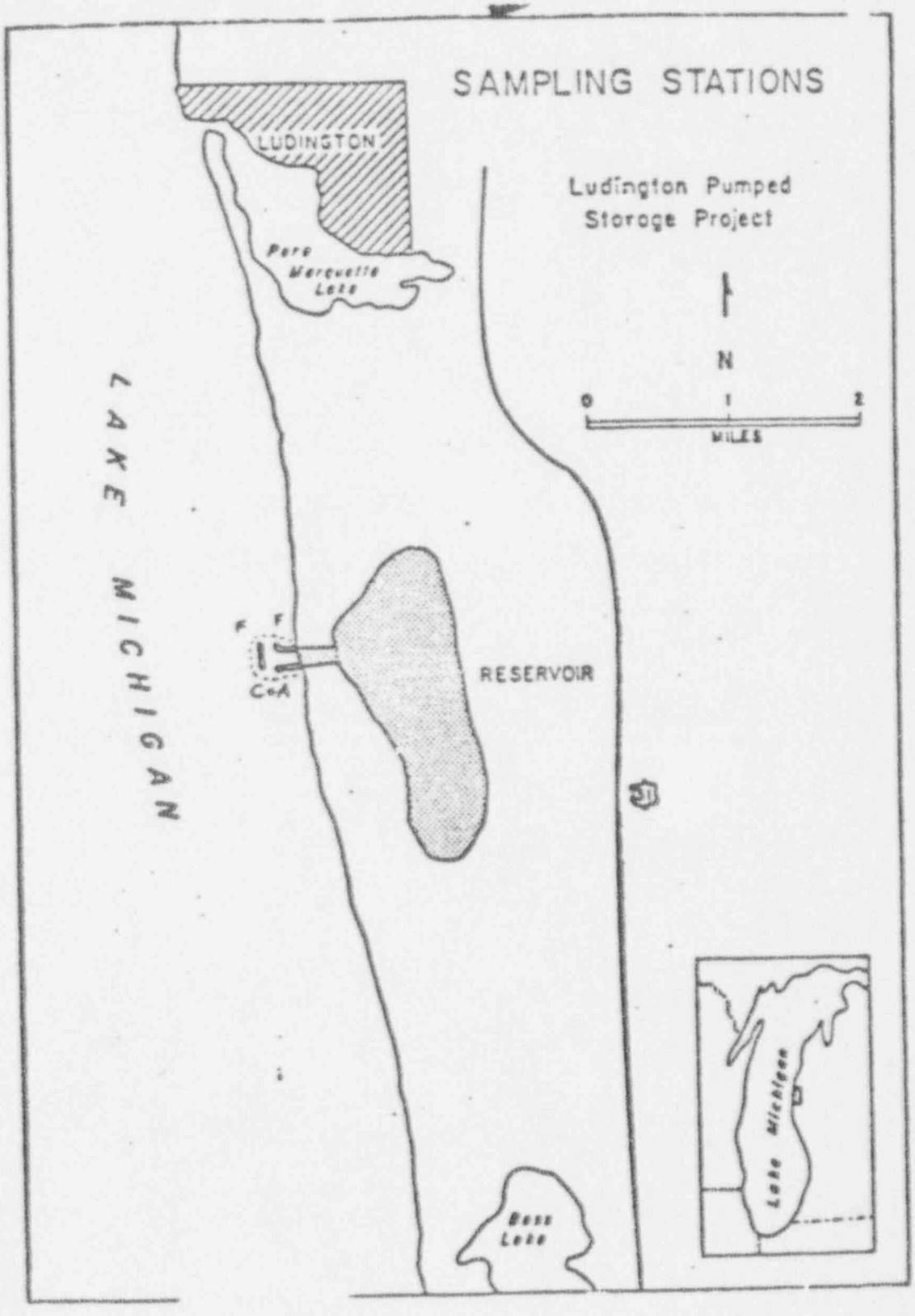
SAMPLING LOCATIONS
Big Rock Point Plant

Station	Code	Location	Sample: SEDIMENT	AIR PARTICULATES	AIR IODINE	LAKE WATER	WELL WATER	MILK	BIOTA	TLD	FISH
13	F	First CP Co Pole in Right of Way South of US-31								X	
14	G	Information Center Site								X	
15	H	Vent Shed (South Side) Site								X	
16	J	Susan Creek Near Lake Michigan								X	
17	K	Discharge Canal (Fisherman)								X	
18	L	Access Control								X	
19	MS	Mt McSauba, PE, 3 Miles (4.8 km) W	X								
20	JG	J Golovich - Maple Grove Road Charlevoix, Michigan 4.5 Miles (7.2 km) SE						X			
21	DK	D L Kuebler, Upper Bay Shore Road, Charlevoix Michigan 2.5 Miles (4 km) E						X			
22	RM	R McCraney, Horton Bay Road Charlevoix, Michigan 6.5 Miles (10.4 km) SSE						X			
23	BB	B Bochniak, Resort Pike Road, Petoskey, Michigan 11.5 Miles (18.4 km) E						X			
e| 24	STS	1/4 Mile (0.4 km) South Boundary	X						X		
e| 25	STN	1/4 Mile (0.4 km) North Boundary	X						X		
26	LP	Ludington Pump Storage	X						X		X

Ⓓ - LEAD CAVE (CHARLEVOIX)






SAMPLING STATIONS
LUDINGTON
Ludington Pumped
Storage Project
Pere
Marquette
Lake
N
0
1
2
MILES
LAKE MICHIGAN
RESERVOIR
Lake Michigan
Bass
Lake

SAMPLE IDENTIFICATION

NOTE: Use waterproof pen. Do not place paper labels inside containers.

1. Collected samples shall be clearly identified.

2. The plant identification shall be written on each sample container as follows:

Big Rock Point	BRP

3. The sample media type can either be written out or abbreviated on container using the below-listed sample identification codes:

   a. Routine Samples:

Air Particulates	AP
Air Iodine	AI
Well Water	WW
Lake Water	LW
Milk	MK
Drinking Water - Raw	DW-RAW
Drinking Water - Treated	DW-TREATED

   b. Special Samples:

Vegetation	VE
Fish	FI
Sediment	SD
Periphyton	PE
Crayfish	CF
Algae	AL

4. The sample location (where collected), sample media type and date of collection shall be indicated on the sample container(s) and shall agree with the data description given on the Sample Data Collection Form(s).

SAMPLE PACKAGING AND SHIPMENT

1. Samples shall be clearly labeled per Attachment 3.

2. Seal all liquid, biota, fish and sediment sample containers with tape to prevent leakage.

3. Ship liquid samples separately from air particulate and air iodine samples and TLDs.

4. Use sufficient packing material (ie, crumpled newspaper) to avoid possible sample container damage during shipment.

5. Package air filters in glassine or plastic envelopes.

6. For TLD shipments, make sure that Laboratory contractor's own TLD data sheet is enclosed with package.

7. Ship milk samples as soon as possible. Be sure to add a sufficient amount (40 grams) of sodium bisulfite as preservative to each sample.

8. Ship food products as soon as possible. No preservative is necessary.

9. Ship fish and biota samples with 10% formaldehyde (preservative) solution added. Only 10 millilites per sample is required.

10. Distribute the appropriate Sample Collection Data Sheet(s) as follows:

    White - Analytical Laboratory
    Yellow - BRP Radiological Environmental Contact
    Pink - Radiological Services Department Environmental Contact (Palisades)
    Gold - Sample Collector

11. Send samples to the following address:

    Teledyne Isotopes Midwest Laboratory
    Att: Laboratory Manager
    700 Landwehr Road
    Northbrook, IL 60062

12. Ship all samples to the Laboratory contractor with minimal delay after collection so as to avoid elevated analytical levels of detection.

CONSUMERS POWER COMPANY _____ PLANT

RADIOLOGICAL ENVIRONMENTAL SAMPLES COLLECTION SHEET
AIR PARTICULATES - AIR IODINE

Date _____
Collector _____

Location		Date-Time			Integrated Gas Meter Reading		Vacuum (In Hg)				Meter Ser and Cal Due	Installation Air Leakage CFM	Remarks
Number	Code	Installed Mo/Day	Removed Mo/Day	Removed Time	As Installed (Cu Ft)	As Removed (Cu Ft)	Installed	Removed	Test	Operating			

Date Received: ________
Date Shipped: ________
Collector: ________

BIG ROCK POINT PLANT
ENVIRONMENTAL TLD REPORT

Station Number - Location	Installed		Collected		Remarks
	Date	Time	Date	Time	

Date ____________________

Collector ________________

______________________________________ PLANT

MISCELLANEOUS RADIOLOGICAL ENVIRONMENTAL SAMPLES

SAMPLE		DATE	TIME	AMOUNT	REMARKS
Location	Type				

TELEDYNE
ISOTOPES

MIDWEST LABORATORY
700 LANDWEHR ROAD
NORTHBROOK, ILLINOIS 60062
(708) 564-0700 FAX (708)564-4517

FINAL
MONTHLY PROGRESS REPORT
TO
CONSUMERS POWER COMPANY
JACKSON, MICHIGAN

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)
FOR
BIG ROCK POINT NUCLEAR GENERATING PLANT

PREPARED AND SUBMITTED
BY
TELEDYNE ISOTOPES MIDWEST LABORATORY
PROJECT NO. 8022

Reporting Period: January-December, 1992

Reviewed and
Approved by: L. G. Hnebner Date 2-22-93

L. G. Hnebner
General Manager

Distribution: M. Mennucci(1 copy)
R. L. Burdette (1 copy)

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (continued)

1.0 INTRODUCTION

The following constitutes the final Monthly Progress Report for the Radiological Environmental Monitoring Program conducted at the Big Rock Point Nuclear Generating Plant, Big Rock, Michigan. Results of completed analyses are presented in the attached tables.

Data obtained in the program are well within the ranges previously encountered in the program and to be expected in the environmental media sampled.

For all gamma isotopic analyses, spectrum is computer scanned from 80 to 2048 KeV. Specifically included are Mn-54, Fe-59, Co-58, Co-60, Zn-65, Zr-95, Nb-95, I-131, Ba-La-140, Cs-134, and Cs-137. Naturally-occurring gamma-emitters, such as K-40 and Ra daughters, are frequently detected but not listed here. Data listed as "<" are at the 4.66 sigma level, others are 2 sigma.

All concentrations, except gross beta, are decay corrected to the time of collection.

All samples were collected within the scheduled period unless noted otherwise in the Listing of Missed Samples.

2.0 LISTING OF MISSED SAMPLES

Sample Type	Location	Expected Collection Date	Reason
Liquid Radwaste	Big Rock	June	Sample not collected.
Liquid Radwaste	Big Rock	July	Sample not collected.
Liquid Radwaste	Big Rock	October	Sample not collected.
Liquid Radwaste	Big Rock	December	Sample not collected.

NOTE: Page 3 is intentionally left out.

Table 1. Airborne particulates and iodine-131
Collection: Weekly
Units: pCi/m^3
Location: ST - Big Rock Point (1)

Date Collected	Volume (m^3)	Gross Beta	I-131	Date Collected	Volume (m^3)	Gross Beta	I-131
01-09-92	224	0.035±0.005	<0.010	07-09-92	218	0.005±0.004	<0.018
01-16-92	224	0.034±0.004	<0.022	07-16-92	217	0.011±0.004	<0.014
01-23-92	226	0.031±0.004	<0.023	07-23-92	214	0.012±0.004	<0.017
01-30-92	211	0.031±0.005	<0.024	07-30-92	216	0.010±0.004	<0.013
02-06-92	226	0.028±0.004	<0.021	08-06-92	212	0.014±0.004	<0.014
02-13-92	200	0.026±0.005	<0.028	08-13-92	214	0.010±0.004	<0.016
02-20-92	224	0.026±0.004	<0.021	08-20-92	218	0.014±0.004	<0.015
02-27-92	200	0.022±0.004	<0.025	08-27-92	211	0.018±0.004	<0.036
03-05-92	225	0.017±0.004	<0.022	09-03-92	213	0.011±0.004	<0.021
03-12-92	223	0.015±0.004	<0.017	09-10-92	218	0.014±0.004	<0.018
03-19-92	231	0.018±0.004	<0.017	09-17-92	214	0.008±0.004	<0.028
03-26-92	220	0.018±0.004	<0.046	09-24-92	218	0.013±0.004	<0.029
04-02-92	227	0.014±0.004	<0.017	10-01-92	212	0.007±0.004	<0.021
1st Qtr. mean ± s.d.		0.024±0.007	<0.046	3rd Qtr. mean ± s.d.		0.011±0.003	<0.036
04-09-92	220	0.015±0.004	<0.018	10-08-92	217	0.018±0.004	<0.020
04-16-92	200	0.019±0.004	<0.019	10-15-92	224	0.012±0.004	<0.021
04-23-92	246	0.007±0.003	<0.015	10-22-92	218	0.011±0.004	<0.020
04-30-92	219	0.019±0.004	<0.015	10-29-92	225	0.025±0.004	<0.034
05-07-92	218	0.011±0.004	<0.014	11-05-92	216	0.006±0.003	<0.022
05-14-92	220	0.015±0.004	<0.017	11-12-92	225	0.014±0.004	<0.018
05-21-92	219	0.013±0.003	<0.018	11-19-92	222	0.014±0.004	<0.022
05-28-92	220	0.013±0.004	<0.016	11-27-92	255	0.007±0.003	<0.025
06-04-92	212	0.012±0.004	<0.015	12-03-92	192	0.023±0.005	<0.018
06-11-92	217	0.010±0.004	<0.029	12-10-92	224	0.012±0.004	<0.018
06-18-92	216	0.011±0.004	<0.027	12-17-92	219	0.011±0.003	<0.017
06-25-92	220	0.008±0.004	<0.019	12-23-92	195	0.035±0.005	<0.037
07-02-92	212	0.008±0.004	<0.036	12-31-92	257	0.020±0.004	<0.021
2nd Qtr. mean ± s.d.		0.012±0.004	<0.036	4th Qtr. mean ± s.d.		0.016±0.008	<0.037

Table 1. Airborne particulates and iodine-131
Collection: Weekly
Units: pCi/m^3
Location: NM - Nine Mile Point (2)

Date Collected	Volume (m^3)	Gross Beta	I-131	Date Collected	Volume (m^3)	Gross Beta	I-131
01-09-92	222	0.029±0.004	<0.010	07-09-92	219	0.005±0.004	<0.018
01-16-92	224	0.029±0.004	<0.022	07-16-92	352	0.007±0.002	<0.009
01-23-92	225	0.026±0.004	<0.023	07-23-92	211	0.009±0.004	<0.017
01-30-92	200	0.027±0.005	<0.025	07-30-92	219	0.010±0.004	<0.012
02-06-92	226	0.029±0.004	<0.020	08-06-92	208	0.014±0.004	<0.014
02-13-92	199	0.024±0.005	<0.028	08-13-92	215	0.012±0.004	<0.016
02-20-92	221	0.014±0.004	<0.021	08-20-92	215	0.010±0.004	<0.015
02-27-92	224	0.013±0.004	<0.022	08-27-92	208	0.019±0.005	<0.036
03-05-92	224	0.020±0.004	<0.022	09-03-92	214	0.014±0.004	<0.021
03-12-92	222	0.016±0.004	<0.017	09-10-92	212	0.007±0.004	<0.019
03-19-92	227	0.015±0.004	<0.017	09-17-92	217	0.012±0.004	<0.028
03-26-92	223	0.018±0.004	<0.046	09-24-92	215	0.014±0.004	<0.029
04-02-92	222	0.017±0.004	<0.018	10-01-92	212	0.012±0.004	<0.021
1st Qtr. mean ± s.d.		0.021±0.006	<0.046	3rd Qtr. mean ± s.d.		0.011±0.004	<0.036
04-09-92	221	0.015±0.004	<0.018	10-08-92	219	0.024±0.004	<0.020
04-16-92	228	0.010±0.003	<0.017	10-15-92	212	0.008±0.004	<0.020
04-23-92	216	0.011±0.004	<0.017	10-22-92	191	0.012±0.004	<0.023
04-30-92	220	0.009±0.004	<0.015	10-29-92	215	0.021±0.004	<0.035
05-07-92	212	0.012±0.004	<0.014	11-05-92	202	0.004±0.003	<0.023
05-14-92	199	0.017±0.004	<0.019	11-12-92	216	0.013±0.004	<0.018
05-21-92	212	0.013±0.003	<0.018	11-19-92	210	0.011±0.004	<0.023
05-28-92	202	0.006±0.004	<0.017	11-27-92	248	0.011±0.003	<0.026
06-04-92	159	0.014±0.005	<0.020	12-03-92	183	0.029±0.005	<0.019
06-11-92	213	0.012±0.004	<0.029	12-10-92	217	0.011±0.004	<0.018
06-18-92	187	0.016±0.004	<0.031	12-17-92	209	0.010±0.003	<0.016
06-25-92	213	0.007±0.004	<0.019	12-23-92	183	0.030±0.005	<0.035
07-02-92	212	0.009±0.004	<0.036	12-31-92	220	0.019±0.004	<0.018
2nd Qtr. mean ± s.d.		0.012±0.003	<0.036	4th Qtr. mean ± s.d.		0.016±0.008	<0.035

Table 1. Airborne particulates and iodine-131
Collection: Weekly
Units: pCi/m^3
Location: CH - Charlevoix (3)

Date Collected	Volume (m^3)	Gross Beta	I-131	Date Collected	Volume (m^3)	Gross Beta	I-131
01-09-92	226	0.035±0.005	<0.010	07-09-92	211	0.005±0.004	<0.018
01-16-92	210	0.034±0.005	<0.024	07-16-92	214	0.011±0.004	<0.015
01-23-92	224	0.029±0.004	<0.023	07-23-92	210	0.007±0.004	<0.017
01-30-92	199	0.030±0.005	<0.025	07-30-92	217	0.013±0.004	<0.013
02-06-92	225	0.030±0.004	<0.021	08-06-92	221	0.017±0.004	<0.013
02-13-92	217	0.014±0.004	<0.026	08-13-92	227	0.015±0.004	<0.015
02-20-92	219	0.027±0.005	<0.021	08-20-92	228	0.013±0.004	<0.014
02-27-92	219	0.017±0.004	<0.023	08-27-92	224	0.023±0.004	<0.034
03-05-92	218	0.026±0.004	<0.023	09-03-92	235	0.012±0.003	<0.019
03-12-92	220	0.013±0.004	<0.018	09-10-92	209	0.010±0.004	<0.019
03-19-92	227	0.021±0.004	<0.017	09-17-92	3[a]	<0.50	<2.01
03-26-92	216	0.016±0.004	<0.047	09-24-92	220	0.016±0.004	<0.028
04-02-92	221	0.013±0.004	<0.018	10-01-92	227	0.014±0.004	<0.020
1st Qtr. mean ± s.d.		0.023±0.008	<0.047	3rd Qtr. mean ± s.d.		0.013±0.005	<0.028
04-09-92	214	0.016±0.004	<0.018	10-08-92	233	0.020±0.004	<0.018
04-16-92	227	0.010±0.003	<0.017	10-15-92	231	0.014±0.004	<0.021
04-23-92	216	0.011±0.004	<0.017	10-22-92	236	0.013±0.003	<0.019
04-30-92	271	0.010±0.003	<0.012	10-29-92	225	0.020±0.003	<0.034
05-07-92	159	0.022±0.005	<0.019	11-05-92	231	0.006±0.003	<0.020
05-14-92	207	0.016±0.004	<0.018	11-12-92	234	0.009±0.003	<0.017
05-21-92	215	0.014±0.003	<0.018	11-19-92	236	0.011±0.003	<0.020
05-28-92	218	0.016±0.004	<0.016	11-27-92	266	0.010±0.003	<0.024
06-04-92	208	0.016±0.004	<0.015	12-03-92	199	0.027±0.005	<0.017
06-11-92	209	0.012±0.004	<0.030	12-10-92	231	0.010±0.003	<0.017
06-18-92	213	0.015±0.004	<0.027	12-17-92	214	0.015±0.004	<0.016
06-25-92	215	0.006±0.003	<0.019	12-23-92	217	0.030±0.004	<0.041
07-02-92	207	0.009±0.004	<0.037	12-31-92	266	0.023±0.004	<0.022
2nd Qtr. mean ± s.d.		0.013±0.004	<0.030	4th Qtr. mean ± s.d.		0.016±0.007	<0.041

[a] Low volume due to power interruption at pump site; LLD for I-131 not met due to low volume. I-131 concentration <2.01 pCi/m^3

Table 1. Airborne particulates and iodine-131
Collection: Weekly
Units: pCi/m^3
Location: SL - South of Susan Lake (4)

Date Collected	Volume (m^3)	Gross Beta	I-131	Date Collected	Volume (m^3)	Gross Beta	I-131
01-09-92	210	0.028±0.005	<0.010	07-09-92	205	<0.006	<0.019
01-16-92	217	0.026±0.004	<0.023	07-16-92	211	0.009±0.004	<0.015
01-23-92	212	0.027±0.004	<0.024	07-23-92	199	0.011±0.004	<0.018
01-30-92	211	0.028±0.004	<0.024	07-30-92	196	0.009±0.004	<0.014
02-06-92	212	0.032±0.004	<0.022	08-06-92	192	0.016±0.005	<0.015
02-13-92	212	0.019±0.004	<0.026	08-13-92	184	0.009±0.005	<0.019
02-20-92	212	0.014±0.004	<0.022	08-20-92	207	0.014±0.004	<0.016
02-27-92	210	0.017±0.004	<0.024	08-27-92	208	0.025±0.005	<0.036
03-05-92	212	0.026±0.004	<0.024	09-03-92	203	0.008±0.004	<0.022
03-12-92	210	0.014±0.004[a]	<0.018	09-10-92	204	0.009±0.004	<0.020
03-19-92	215	<0.005[a]	<0.018	09-17-92	212	0.010±0.004	<0.029
03-26-92	209	0.018±0.004	<0.049	09-24-92	208	0.016±0.004	<0.030
04-02-92	209	0.012±0.004	<0.019	10-01-92	202	0.014±0.004	<0.022
1st Qtr. mean ± s.d.		0.022±0.007	<0.049	3rd Qtr. mean ± s.d.		0.012±0.005	<0.036
04-09-92	206	0.019±0.004	<0.019	10-08-92	205	0.020±0.004	<0.021
04-16-92	216	0.012±0.004	<0.018	10-15-92	214	0.011±0.004	<0.023
04-23-92	206	0.015±0.004	<0.018	10-22-92	207	0.010±0.004	<0.021
04-30-92	214	0.014±0.004	<0.015	10-29-92	212	0.022±0.004	<0.036
05-07-92	204	0.018±0.004	<0.015	11-05-92	204	0.008±0.004	<0.023
05-14-92	203	0.015±0.004	<0.019	11-12-92	210	0.015±0.004	<0.019
05-21-92	211	0.016±0.003	<0.019	11-19-92	212	0.014±0.004	<0.023
05-28-92	206	0.011±0.004	<0.017	11-27-92	241	0.010±0.003	<0.027
06-04-92	84[b]	<0.012	<0.037	12-03-92	181	0.026±0.005	<0.019
06-11-92	202	0.012±0.004	<0.031	12-10-92	208	0.013±0.004	<0.017
06-18-92	213	0.015±0.004	<0.027	12-17-92	214	0.010±0.003	<0.016
06-25-92	206	0.007±0.004	<0.020	12-23-92	179	0.028±0.005	<0.034
07-02-92	202	0.010±0.004	<0.038	12-31-92	245	0.017±0.003	<0.020
2nd Qtr. mean ± s.d.		0.014±0.003	<0.038	4th Qtr. mean ± s.d.		0.016±0.007	<0.034

[a] Filter cracked.

[b] Low volume due to pump failure.

Table 1. Airborne particulates and iodine-131
Collection: Weekly
Units: pCi/m^3
Location: PT - Petosky (5)

Date Collected	Volume (m^3)	Gross Beta	I-131	Date Collected	Volume (m^3)	Gross Beta	I-131
01-09-92	201	0.026±0.005	<0.011	07-09-92	217	0.011±0.004	<0.018
01-16-92	207	0.031±0.004	<0.024	07-16-92	208	0.011±0.004	<0.015
01-23-92	205	0.029±0.005	<0.025	07-23-92	204	0.008±0.004	<0.018
01-30-92	202	0.026±0.005	<0.025	07-30-92	219	0.012±0.004	<0.012
02-06-92	202	0.033±0.005	<0.023	08-06-92	202	0.012±0.004	<0.014
02-13-92	209	0.019±0.004	<0.027	08-13-92	214	0.011±0.004	<0.016
02-20-92	224	<0.005[a]	<0.021	08-20-92	210	0.011±0.004	<0.016
02-27-92	201	0.016±0.004	<0.025	08-27-92	205	0.019±0.005	<0.037
03-05-92	202	0.019±0.004	<0.025	09-03-92	212	0.014±0.004	<0.021
03-12-92	203	0.010±0.004	<0.019	09-10-92	202	0.008±0.004	<0.020
03-19-92	245	0.014±0.004	<0.016	09-17-92	203	0.013±0.004	<0.030
03-26-92	231	0.016±0.004	<0.044	09-24-92	208	0.015±0.004	<0.030
04-02-92	227	0.021±0.004	<0.017	10-01-92	205	0.008±0.004	<0.022
1st Qtr. mean ± s.d.		0.022±0.007	<0.044	3rd Qtr. mean ± s.d.		0.012±0.003	<0.037
04-09-92	223	0.015±0.004	<0.018	10-08-92	207	0.023±0.005	<0.021
04-16-92	230	0.015±0.004	<0.016	10-15-92	202	0.011±0.004	<0.024
04-23-92	208	0.010±0.004	<0.018	10-22-92	208	0.011±0.004	<0.021
04-30-92	219	0.013±0.004	<0.015	10-29-92	213	0.024±0.004	<0.036
05-07-92	238	0.011±0.003	<0.013	11-05-92	204	0.006±0.003	<0.023
05-14-92	199	0.014±0.004	<0.019	11-12-92	212	0.016±0.004	<0.019
05-21-92	145[b]	0.023±0.004	<0.027	11-19-92	210	0.011±0.004	<0.023
05-28-92	213	0.012±0.004	<0.016	11-27-92	238	0.010±0.003	<0.027
06-04-92	214	0.020±0.004	<0.014	12-03-92	184	0.026±0.005	<0.019
06-11-92	212	0.013±0.004	<0.030	12-10-92	211	0.010±0.004	<0.019
06-18-92	214	0.016±0.004	<0.027	12-17-92	212	0.013±0.004	<0.016
06-25-92	213	0.008±0.004	<0.019	12-23-92	181	0.030±0.005	<0.039
07-02-92	206	0.008±0.004	<0.037	12-31-92	265	0.013±0.003	<0.022
2nd Qtr. mean ± s.d.		0.014±0.004	<0.037	4th Qtr. mean ± s.d.		0.016±0.008	<0.036

[a] Filter cartridge disconnected.
[b] Problem with the pump.

Table 1. Airborne particulates and iodine-131
Collection: Weekly
Units: pCi/m^3
Location: BC - Boyne City (6)

Date Collected	Volume (m^3)	Gross Beta	I-131	Date Collected	Volume (m^3)	Gross Beta	I-131
01-09-92	218	0.030±0.004	<0.010	07-09-92	217	0.007±0.004	<0.018
01-16-92	219	0.036±0.005	<0.023	07-16-92	208	0.014±0.004	<0.015
01-23-92	224	0.030±0.004	<0.023	07-23-92	204	0.008±0.004	<0.018
01-30-92	222	0.030±0.004	<0.022	07-30-92	208	0.012±0.004	<0.013
02-06-92	221	0.028±0.004	<0.021	08-06-92	206	0.016±0.004	<0.014
02-13-92	221	0.021±0.004	<0.025	08-13-92	212	0.011±0.004	<0.016
02-20-92	217	0.019±0.004	<0.021	08-20-92	208	0.013±0.004	<0.016
02-27-92	218	0.014±0.004	<0.023	08-27-92	209	0.022±0.005	<0.036
03-05-92	202	0.021±0.004	<0.025	09-03-92	213	0.014±0.004	<0.021
03-12-92	231	0.013±0.004	<0.017	09-10-92	215	0.011±0.004	<0.020
03-19-92	232	0.015±0.004	<0.017	09-17-92	208	0.007±0.004	<0.029
03-26-92	215	0.015±0.004	<0.047	09-24-92	222	<0.004[a]	<0.028
04-02-92	218	0.013±0.004	<0.018	10-01-92	213	0.015±0.004	<0.021
1st Qtr. mean ± s.d.		0.022±0.008	<0.047	3rd Qtr. mean ± s.d.		0.012±0.004	<0.036
04-09-92	214	0.020±0.004	<0.018	10-08-92	217	0.024±0.004	<0.020
04-16-92	223	0.016±0.004	<0.017	10-15-92	219	0.013±0.004	<0.022
04-23-92	213	0.014±0.004	<0.017	10-22-92	214	0.011±0.004	<0.020
04-30-92	216	0.013±0.004	<0.015	10-29-92	231	0.022±0.004	<0.033
05-07-92	213	0.015±0.004	<0.014	11-05-92	204	0.008±0.004	<0.023
05-14-92	210	0.020±0.004	<0.018	11-12-92	221	0.014±0.004	<0.018
05-21-92	210	0.016±0.003	<0.019	11-19-92	221	0.011±0.004	<0.022
05-28-92	211	0.012±0.004	<0.016	11-27-92	251	0.007±0.003	<0.026
06-04-92	214	0.017±0.004	<0.014	12-03-92	188	0.034±0.005	<0.018
06-11-92	209	0.010±0.004	<0.030	12-10-92	223	0.009±0.003	<0.018
06-18-92	216	0.014±0.004	<0.027	12-17-92	224	0.016±0.004	<0.017
06-25-92	212	0.009±0.004	<0.019	12-23-92	189	0.032±0.005	<0.036
07-02-92	206	0.010±0.004	<0.037	12-31-92	249	0.020±0.004	<0.020
2nd Qtr. mean ± s.d.		0.014±0.004	<0.037	4th Qtr. mean ± s.d.		0.017±0.009	<0.036

[a] Air allowed to bypass around filter.

Table 1. Airborne particulates and iodine-131
Collection: Weekly
Units: pCi/m^3
Location: TR - Traverse City (7)

Date Collected	Volume (m^3)	Gross Beta	I-131	Date Collected	Volume (m^3)	Gross Beta	I-131
01-09-92	216	0.028±0.004	<0.010	07-09-92	205	0.008±0.004	<0.032
01-16-92	218	0.035±0.005	<0.023	07-16-92	224	0.010±0.004	<0.017
01-23-92	218	0.032±0.005	<0.024	07-23-92	193	0.010±0.004	<0.015
01-30-92	219	0.026±0.004	<0.023	07-30-92	188	0.014±0.004	<0.016
02-06-92	214	0.031±0.004	<0.022	08-06-92	206	0.016±0.004	<0.017
02-13-92	221	0.020±0.004	<0.025	08-13-92	204	0.015±0.004	<0.021
02-20-92	212	0.022±0.004	<0.022	08-20-92	196	0.019±0.005	<0.018
02-27-92	217	0.014±0.004	<0.023	08-27-92	208	<0.006[a]	<0.032
03-05-92	211	0.017±0.004	<0.024	09-03-92	201	0.016±0.004	<0.016
03-12-92	217	0.016±0.004	<0.018	09-10-92	200	0.014±0.005	<0.019
03-19-92	218	0.017±0.004	<0.018	09-17-92	196	0.012±0.005	<0.014
03-26-92	208	0.015±0.004	<0.049	09-24-92	203	0.016±0.004	<0.021
04-02-92	210	0.013±0.004	<0.019	10-01-92	198	0.015±0.004	<0.037
1st Qtr. mean ± s.d.		0.022±0.008	<0.049	3rd Qtr. mean ± s.d.		0.014±0.003	<0.037
04-09-92	208	0.015±0.004	<0.019	10-08-92	195	0.019±0.005	<0.035
04-16-92	207	0.035±0.005	<0.018	10-15-92	188	0.010±0.004	<0.025
04-23-92	206	0.009±0.004	<0.018	10-22-92	206	0.016±0.004	<0.035
04-30-92	207	0.010±0.004	<0.016	10-29-92	187	0.020±0.005	<0.023
05-07-92	214	0.010±0.004	<0.014	11-05-92	201	0.008±0.004	<0.018
05-14-92	204	0.014±0.004	<0.018	11-12-92	202	0.015±0.004	<0.022
05-21-92	199	0.016±0.003	<0.020	11-19-92	198	0.013±0.004	<0.055
05-28-92	210	0.012±0.004	<0.016	11-26-92	204	0.008±0.004	<0.018
06-04-92	204	0.018±0.004	<0.015	12-03-92	172	0.037±0.006	<0.031
06-11-92	205	0.015±0.004	<0.015	12-10-92	217	0.016±0.004	<0.016
06-18-92	195	0.013±0.004	<0.030	12-17-92	179	0.011±0.004	<0.041
06-25-92	207	0.007±0.004	<0.020	12-23-92	181	0.029±0.005	<0.037
07-02-92	201	0.010±0.004	<0.038	12-31-92	239	0.026±0.004	<0.015
2nd Qtr. mean ± s.d.		0.014±0.007	<0.038	4th Qtr. mean ± s.d.		0.018±0.009	<0.055

[a] Filter off-center in holder; allowed air to bypass filter.

Table 2. Gamma Radiation, as measured by TLDs
Exposure: Monthly
Units: mR/30 days net

Location	January	February	March
Date Placed	01-02-92	02-06-92	03-05-92
Date Removed	02-06-92	03-05-92	04-02-93
In-Transit (mR)	2.3±0.3	3.5±0.2	4.4±0.2
BRP-01 (ST)	9.5±0.4	10.2±0.4	10.2±0.5
BRP-02 (NM)	3.7±0.3	3.4±0.3	3.5±0.3
BRP-03 (CH)	3.8±0.2	3.6±0.3	3.5±0.5
BRP-04 (SL)	4.4±0.3	4.0±0.3	3.9±0.3
BRP-05 (PT)	4.0±0.3	3.1±0.2	3.9±0.3
BRP-06 (BC)	4.3±0.2	4.1±0.2	4.1±0.3
BRP-07 (TR)	3.9±0.2	4.0±0.2	3.7±0.4
Mean ± s.d.	4.8±2.1	4.6±2.5	4.7±2.4
BRP-08 (Shield-Offsite)	3.7±0.3	3.6±0.3[a]	2.4±0.3[b]
BRP-09 (Onsite)	3.1±0.2	3.4±0.2	3.3±0.3
BRP-10 (Onsite)	3.4±0.2	3.6±0.2	3.4±0.3
BRP-11 (Onsite)	4.3±0.3	3.7±0.2	4.4±0.3
BRP-12 (Onsite)	4.5±0.2	4.1±0.3	4.4±0.3
BRP-13 (Onsite)	3.6±0.3	4.0±0.2	3.6±0.3
BRP-14 (Onsite)	60.7±0.9	71.3±0.7	60.2±1.8
BRP-15 (Onsite)	129.8±2.2	113.5±1.2	91.7±1.6
BRP-16 (Onsite)	3.3±0.3	3.1±0.2	3.2±0.4
BRP-17 (Onsite)	8.2±0.4	8.1±0.2	8.8±0.5
BRP-18 (Onsite)	9.5±0.4	9.1±0.2	9.3±0.4
Control 1 (Shield Onsite)	2.1±0.3	2.6±0.3[a]	1.6±0.2[b]
Control 2 (Shield Onsite)	2.1±0.3	2.7±0.3[a]	1.6±0.3[b]

[a] Placed 02-01-92; removed 02-24-92.
[b] Placed 02-24-92; removed 03-28-92.

Table 2. Gamma Radiation, as measured by TLDs (continued)

Location	April	May	June
Date Placed	04-02-92	05-07-92	06-04-92
Date Removed	05-07-92	06-04-92	07-02-92
In-Transit (mR)	1.9±0.2	3.5±0.2	4.6±0.2
BRP-01 (ST)	12.3±0.4	11.5±0.4	11.7±0.4
BRP-02 (NM)	3.5±0.2	3.5±0.3	3.2±0.2
BRP-03 (CH)	4.0±0.3	3.7±0.3	3.7±0.3
BRP-04 (SL)	4.6±0.2	4.4±0.3	4.2±0.3
BRP-05 (PT)	4.0±0.2	3.9±0.3	3.6±0.4
BRP-06 (BC)	4.5±0.3	4.2±0.3	4.3±0.3
BRP-07 (TR)	4.0±0.3	3.7±0.3	3.9±0.3
Mean ± s.d.	5.3±3.1	5.0±2.9	4.9±3.0
BRP-08 (Shield-Offsite)	3.3±0.3[a]	1.9±0.2[b]	3.0±0.3[c]
BRP-09 (Onsite)	3.5±0.2	3.7±0.3	3.2±0.3
BRP-10 (Onsite)	3.8±0.2	3.7±0.3	3.7±0.3
BRP-11 (Onsite)	4.4±0.3	4.5±0.3	4.5±0.4
BRP-12 (Onsite)	4.4±0.2	4.8±0.3	4.4±0.3
BRP-13 (Onsite)	4.1±0.2	4.1±0.3	4.4±0.3
BRP-14 (Onsite)	73.4±0.9	71.2±1.7	70.5±1.4
BRP-15 (Onsite)	90.3±0.8	104.2±1.2	136.5±2.5
BRP-16 (Onsite)	2.9±0.2	3.2±0.2	2.9±0.3
BRP-17 (Onsite)	8.0±0.3	8.8±0.3	7.8±0.5
BRP-18 (Onsite)	8.9±0.3	11.1±0.3	9.7±0.3
Control 1 (Shield Onsite)	2.4±0.3[a]	1.4±0.2[b]	2.3±.02[c]
Control 2 (Shield Onsite)	2.6±0.3a	1.4±0.2b	2.3±0.2[c]

[a] Placed 03-28-92; removed 04-27-92.

[b] Placed 04-27-92.

[c] Placed 05-22-92.

Table 2. Gamma Radiation, as measured by TLDs (continued)

Location	July	August	September
Date Placed	07-02-92	08-06-92	09-03-92
Date Removed	08-06-92	09-03-92	10-01-92
In-Transit (mR)	1.8±0.2	3.9±0.2	4.9±0.2
BRP-01 (ST)	10.7±0.2	8.7±0.5	10.4±0.3
BRP-02 (NM)	4.0±0.2	3.9±0.2	4.1±0.3
BRP-03 (CH)	4.0±0.2	4.4±0.2	4.4±0.3
BRP-04 (SL)	4.4±0.2	4.8±0.2	4.9±0.3
BRP-05 (PT)	4.3±0.2	4.5±0.3	4.6±0.3
BRP-06 (BC)	4.5±0.2	4.7±0.3	5.4±0.7
BRP-07 (TR)	4.0±0.0.3	4.7±0.2	4.2±0.4
Mean ± s.d.	5.1±2.5	5.1±1.6	5.4±2.2
BRP-08 (Shield-Offsite)	3.3±0.2[a]	3.3±0.2[b]	2.5±0.4[c]
BRP-09 (Onsite)	3.6±0.2	3.7±0.2	3.9±0.3
BRP-10 (Onsite)	4.0±0.2	4.3±0.2	4.0±0.4
BRP-11 (Onsite)	4.4±0.2	5.0±0.2	5.0±0.3
BRP-12 (Onsite)	4.9±0.2	5.1±0.3	5.6±0.4
BRP-13 (Onsite)	4.3±0.2	5.0±0.2	5.6±0.3
BRP-14 (Onsite)	67.8±0.5	69.5±0.9	65.8±1.0
BRP-15 (Onsite)	141.0±1.3	109.6±1.4	130.8±1.2
BRP-16 (Onsite)	3.1±0.2	3.3±0.2	3.8±0.4
BRP-17 (Onsite)	8.7±0.3	7.5±0.3	9.0±0.4
BRP-18 (Onsite)	9.6±0.4	9.5±0.3	10.1±1.0
Control 1 (Shield Onsite)	2.0±0.2[a]	2.3±0.2[b]	1.8±0.2[c]
Control 2 (Shield Onsite)	2.0±0.2[a]	2.3±0.2[b]	1.8±0.2[c]

[a] Placed 06-29-92.

[b] Placed 07-27-92.

[c] Placed 08-22-92

Table 2. Gamma Radiation, as measured by TLDs (continued)

	October	November	December
Date Placed	10-01-92	11-05-92	12-03-92
Date Removed	11-05-92	12-03-92	01-07-93
In-Transit (mR)	2.6±0.2	3.6±0.2	3.8±0.2
Location			
BRP-01 (ST)	10.9±0.3	13.0±0.3	12.1±0.4
BRP-02 (NM)	3.8±0.2	3.5±0.2	3.5±0.2
BRP-03 (CH)	4.3±0.4	3.9±0.2	3.7±0.3
BRP-04 (SL)	5.3±0.4	4.2±0.2	4.0±0.2
BRP-05 (PT)	4.0±0.3	7.0±0.3	3.9±0.2
BRP-06 (BC)	4.5±0.4	4.8±0.3	4.1±0.2
BRP-07 (TR)	4.2±0.3	3.7±0.2	4.0±0.3
Mean ± s.d.	5.3±2.5	5.7±3.4	5.0±3.1
BRP-08 (Shield-Offsite)	3.5±0.3[a]	2.1±0.2[b]	2.3±0.3[c]
BRP-09 (Onsite)	3.5±0.2	3.4±0.2	3.5±0.2
BRP-10 (Onsite)	3.8±0.3	3.6±0.2	3.8±0.2
BRP-11 (Onsite)	4.5±0.3	4.2±0.3	4.1±0.2
BRP-12 (Onsite)	5.0±0.3	4.4±0.3	4.4±0.3
BRP-13 (Onsite)	4.4±0.3	4.3±0.3	4.0±0.2
BRP-14 (Onsite)	64.1±0.5	75.7±0.7	71.2±1.0
BRP-15 (Onsite)	138.4±1.1	172.2±0.3	130.6±1.0
BRP-16 (Onsite)	3.8±0.2	3.6±0.2	3.1±0.2
BRP-17 (Onsite)	7.9±0.4	8.9±0.2	8.3±0.3
BRP-18 (Onsite)	9.9±0.4	10.5±0.3	8.5±0.3
Control 1 (Shield Onsite)	1.9±0.2[a]	1.6±0.2[b]	1.7±0.2[c]
Control 2 (Shield Onsite)	2.0±0.2[a]	1.5±0.2[b]	1.7±0.2[c]

[a] Placed 09-25-92.

[b] Placed 10-26-92.

[c] Placed 11-23-92.

Table 3. Gamma Radiation, as measured by TLDs
Exposure: Quarterly
Units: mR/91 days net[a]

	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Date Placed	01-02-92	04-02-92	07-02-92	10-01-92
Date Removed	04-02-92	07-02-92	10-01-92	01-07-92
In-Transit (mR)	2.5±0.6	2.3±0.6	3.0±0.6	2.1±0.7
Location				
BRP-01 (ST)	27.6±0.8	35.5±1.0	30.3±0.6	32.7±0.7
BRP-02 (NM)	10.6±0.7	10.9±0.6	12.0±0.6	11.4±0.6
BRP-03 (CH)	10.8±0.6	11.7±0.7	11.2±0.8	11.7±0.7
BRP-04 (SL)	11.3±0.7	12.5±0.7	12.0±0.7	13.4±0.7
BRP-05 (PT)	10.8±0.7	12.7±0.8	11.6±0.6	13.0±0.6
BRP-06 (BC)	12.7±0.9	12.5±0.7	12.7±0.7	13.1±0.6
BRP-07 (TR)	11.9±0.7	11.8±0.7	10.4±0.7	12.9±0.6
Mean ± s.d.	13.7±6.2	15.4±8.9	14.3±7.1	15.5±7.6
BRP-08 (Shield-Offsite)	9.5±0.7[b]	7.7±0.7[c]	6.9±0.7[d]	7.7±0.6[e]
BRP-09 (Onsite)	10.0±0.7	9.8±0.9	10.4±0.7	10.6±0.7
BRP-10 (Onsite)	11.0±0.8	10.4±0.6	10.4±1.0	10.7±0.6
BRP-11 (Onsite)	13.2±0.7	13.2±0.7	14.0±0.6	12.1±0.6
BRP-12 (Onsite)	14.1±0.8	15.2±0.6	15.4±0.6	15.5±0.6
BRP-13 (Onsite)	13.0±0.7	12.6±0.7	14.1±0.9	12.2±0.7
BRP-14 (Onsite)	191.0±1.7	200.1±2.9	208.1±1.1	196.4±0.7
BRP-15 (Onsite)	300.2±1.5	317.0±0.9	363.5±0.7	422.0±2.9
BRP-16 (Onsite)	10.5±0.7	9.6±0.6	11.4±0.7	10.3±0.7
BRP-17 (Onsite)	28.1±0.7	25.1±0.8	25.5±0.8	24.7±0.7
BRP-18 (Onsite)	29.9±1.5	30.2±0.7	29.1±0.8	27.8±0.7
Control 1 (Shield Onsite)	6.9±0.7[b]	6.3±0.6[c]	6.3±0.7[d]	6.3±0.7[e]
Control 2 (Shield Onsite)	6.9±0.7[b]	6.4±0.6[c]	6.4±0.7[d]	6.3±0.7[e]

[a] In-transit exposure has been subtracted from total exposure.

[b] Placed 01-01-92; removed 03-28-92.

[c] Placed 03-28-92.

[d] Placed 06-29-92.

[e] Placed 09-25-92.

Table 4. Gamma Radiation, as measured by TLDs
Exposure: Annual
Units: mR/365 days net[a]

Location	
Date Placed	01-02-92
Date Removed	01-07-93
In-Transit (mR)	1.9±2.5
BRP-01 (ST)	125.6±2.7
BRP-02 (NM)	39.9±2.5
BRP-03 (CH)	43.8±2.5
BRP-04 (SL)	48.3±2.5
BRP-05 (PT)	46.4±2.5
BRP-06 (BC)	46.3±2.9
BRP-07 (TR)	45.4±2.4
Mean ± s.d.	56.5±30.6
BRP-08 (Shield-Offsite)	29.4±2.4[b]
BRP-09 (Onsite)	34.4±2.5
BRP-10 (Onsite)	41.5±2.5
BRP-11 (Onsite)	49.8±2.4
BRP-12 (Onsite)	53.9±2.6
BRP-13 (Onsite)	48.0±2.5
BRP-14 (Onsite)	754.9±5.5
BRP-15 (Onsite)	1418.9±12.3
BRP-16 (Onsite)	36.6±2.7
BRP-17 (Onsite)	98.4±3.0
BRP-18 (Onsite)	113.9±2.6
Control 1 (Shield Onsite)	23.6±2.5[b]
Control 2 (Shield Onsite)	23.3±2.5[b]

[a] In-transit exposure has been subtracted from total exposure.

[b] Placed 01-01-92

Table 5. Lake Water, Inlet and Discharge
Collection: Monthly Composites
Units: pCi/L

1992 Compositing Period	Lab Code	Gross Alpha	Gross Beta	Sr-89	Sr-90	Tritium
Required LLD		1.0	4.0	5.0	1.0	500
		ST - Big Rock Point NGP - Inlet				
January	BRLW-4435,6	NA[a]	2.5±0.5	NA	NA	133±63
February	4759	NA	2.5±0.6	NA	NA	190±97
March	5153	NA	3.3±0.4	NA	NA	<174
April	5602,3	NA	2.1±0.4	NA	NA	125±66
May	5949	NA	1.9±0.6	NA	NA	100±86
June	6488	NA	1.9±0.5	NA	NA	<190
July	6812	NA	1.8±0.6	NA	NA	<180
August	7289	NA	2.0±0.5	NA	NA	120±94
September	7638	NA	1.6±0.5	NA	NA	124±93
October	8031	NA	1.9±0.6	NA	NA	<168
November	8440,41	NA	2.1±0.8	NA	NA	<176
December	8988	NA	2.5±0.6	NA	NA	<171
		ST - Big Rock Point NGP - Discharge				
January	BRLW-4434	<0.7	4.4±0.6[b]	<0.7	<0.5	195±92
February	4758	<0.4	3.4±0.3	<0.7	<0.4	149±95
March	5152	<0.6	2.9±0.4	<0.5	0.5±0.3	163±93
April	5601	<0.9	2.6±0.6	<1.0	0.5±0.3	144±94
May	5948	<1.0	1.8±0.6	<0.8	<1.0	164±89
June	6487	<0.7	2.2±0.5	<1.2	0.6±0.3	<190
July	6811	<1.0	1.5±0.5	<0.8	<0.5	<180
August	7288	0.5±0.3	1.9±0.3	<0.8	0.6±0.3	<181
September	7639	<0.5	2.0±0.3	<0.8	<0.4	97±92
October	8030	<0.9	1.9±0.7	<1.0	<0.5	<168
November	8442	<0.9	1.7±0.5	<1.2	<0.8	<176
December	8989	<0.4	2.3±0.3	<0.9	<0.7	<171

[a] NA = Not analyzed; analysis not required.

[b] Analysis was repeated; result of reanalysis 4.2±0.6 pCi/L.

Table 5. Ludington Controls
Collection: Monthly
Units: pCi/L

1992 Collection Date	Lab Code	Gross Alpha	Gross Beta	Sr-89	Sr-90	Tritium
Required LLD		1.0	4.0	5.0	1.0	500
		Ludington (Lake In)				
01-31-92	PALW-4527	<1.0	2.1±0.5	<0.8	<0.5	188±93
02-29-92	4822	<0.7	1.4±0.6	<0.7	<0.5	96±93
03-31-92	5370	<0.4	1.9±0.3	<0.7	<0.6	103±88
04-30-92	5670	<0.5	2.0±0.3	<1.0	<0.6	<170
05-31-92	6010	<0.3	1.4±0.3	<0.9	<0.4	<170
07-01-92	6467	<0.3	1.4±0.3	<0.9	0.9±0.4	<170
07-31-92	6828	<0.5	1.6±0.3	<0.9	0.9±0.4	114±94
08-31-92	7428	<0.4	2.2±0.3	<0.7	<0.5	105±95
09-30-92	7636	<0.5	1.9±0.3	<0.9	0.9±0.3	<178
10-31-92	8115	0.8±0.4	3.5±0.4	<1.3	0.6±0.4	<175
11-30-92	8468	<0.5	2.1±0.3	<0.8	<0.5	<176
12-31-92	8981	<0.4	2.4±0.3	<0.7	<0.6	<171
		Ludington (Well Water)				
01-31-92	PAWW-4528	<0.5	<0.8	<1.2	<0.9	160±92
02-29-92	4823	<0.9	<0.9	<0.8	<0.6	<179
03-31-92	5371	<0.5	<0.4	<0.8	<0.5	<170
04-30-92	5671	<0.5	<0.4	<1.0	<0.6	<170
05-31-92	6011	<0.5	<0.4	<1.2	<0.8	<170
07-01-92	6468	0.6±0.3	<1.0	<0.9	<0.6	<166
07-31-92	6829	<0.5	<0.4	<0.8	<0.5	<180
08-31-92	7429	<0.6	<0.4	<0.8	<0.4	<184
09-30-92	7637	<0.6	<0.4	<1.1	<0.5	<168
10-31-92	8116	<0.6	0.8±0.3	<2.4	<0.7	<175
11-30-92	8469	<0.6	<0.4	<0.9	<0.5	<176
12-31-92	8982	<0.6	0.4±0.3	<0.9	<0.5	<171

Table 6. Charlevoix Drinking Water (Lake Water)
Collection: Monthly Composites
Units: pCi/L

1992 Compositing Period	Lab Code	Gross Beta	H-3
Required LLD		4.0	500
January	BRDW-4438	2.2±0.5	130±88
February	4761	2.1±0.3	123±94
March	5155	1.8±0.4	<174
April	5605	1.7±0.6	144±94
May	5951	1.7±0.6	198±90
June	6490	2.0±0.5	90±86
July	6814	3.0±0.6	<179
August	7291	2.2±0.5	117±94
September	7641	2.0±0.3	<178
October	8033	1.5±0.6	<168
November	8444	1.9±0.5	<176
December	8991	2.3±0.6	<171

Table 7. Site Well Water
Collection: Monthly
Units: pCi/L

Collection Date	Lab Code	Gross Beta	H-3
Required LLD		4.0	500
01-31-92	BRWW-4437	1.8±0.5	<166
02-29-92	4760	2.1±0.6	<180
03-31-92	5154	1.6±0.4	<174
04-30-92	5604	1.6±0.6	<169
05-30-92	5950	<0.9	<165
06-30-92	6489	1.6±0.5	<166
07-31-92	6813	2.0±0.6	<180
08-31-92	7290	1.7±0.5	<181
09-30-92	7640	1.5±0.3	<178
11-02-92	8032	<1.2	<168
12-01-92	8443	1.7±0.6	<176
12-31-92	8990	1.8±0.6	<171

Table 8. Milk
Collection: Monthly
Units: pCi/L
Location: J. Golovich Farm (1)

	Sample Description and Concentration				Required LLD
Date Collected	01-09-92	02-13-92	03-12-92	04-09-92	
Lab Code	BRMI-7348	BRMI-7445,6	BRMI-7511	BRMI-7589	
I-131	<0.3	<0.4	<0.2	<0.4	1.0
Sr-89	<0.6	<0.6	<0.6	<0.8	5.0
Sr-90	7.2±0.8	11.4±1.7	5.1±0.7	5.6±0.8	1.0
K-40	1260±140	1280±100	1260±170	1250±120	–
Cs-134	<4.7	<3.6	<7.4	<4.8	15.0
Cs-137	<6.1	<5.5	<8.2	<6.1	18.0
Ba-La-140	<7.0	<4.4	<10.7	<6.6	15.0
Date Collected	05-14-92	06-11-92	07-09-92	08-13-92	
Lab Code	BRMI-7692	BRMI-7870	BRMI-8025	BRMI-8213	
I-131	<0.2	<0.2	<0.2	<0.3	1.0
Sr-89	<0.7	<1.0	<1.1	<1.2	5.0
Sr-90	5.2±0.7	6.1±1.0	5.2±0.9	5.8±0.9	1.0
K-40	1540±180	1190±110	1340±160	1300±100	–
Cs-134	<7.0	<5.4	<6.8	<3.4	15.0
Cs-137	<8.1	<5.7	<7.2	<4.5	18.0
Ba-La-140	<14.8	<11.8	<14.1	<6.6	15.0
Date Collected	09-10-92	10-08-92	11-19-92	12-10-92	
Lab Code	BRMI-8382	BRMI-8557	BRMI-8702	BRMI-8773	
I-131	<0.4	<0.4	<0.3	<0.2	1.0
Sr-89	<0.6	<0.8	<1.0	<0.8	5.0
Sr-90	4.2±0.6	4.7±0.8	3.2±0.6	2.4±0.6	1.0
K-40	1110±150	1530±140	1380±150	1500±170	–
Cs-134	<7.0	<3.4	<6.6	<3.7	15.0
Cs-137	<6.9	<5.5	<7.8	<5.2	18.0
Ba-La-140	<14.2	<8.4	<12.2	<8.5	15.0

Table 8. Milk (continued)
Collection: Monthly
Units: pCi/L
Location: D. Kuebler Farm (2)

	Sample Description and Concentration				Required LLD
Date Collected Lab Code	01-09-92 BRMI-7349	02-13-92 BRMI-7449	03-12-92 BRMI-7512,3	04-09-92 BRMI-7590	
I-131	<0.3	<0.5	<0.2	<0.4	1.0
Sr-89	<0.7	<0.6	<0.5	<0.5	5.0
Sr-90	3.8±0.6	3.9±0.6	3.3±0.4	3.6±0.6	1.0
K-40	1270±140	1270±160	1300±90	1340±140	–
Cs-134	<4.0	<5.6	<4.6	<4.4	15.0
Cs-137	<6.2	<6.1	<4.8	<6.0	18.0
Ba-La-140	<4.8	<5.4	<5.7	<7.0	15.0
Date Collected Lab Code	05-14-92 BRMI-7693	06-11-92 BRMI-7871	07-09-92 BRMI-8026	08-13-92 BRMI-8214	
I-131	<0.2	<0.2	<0.2	<0.2	1.0
Sr-89	<0.6	<1.2	<0.8	<1.4	5.0
Sr-90	2.8±0.6	2.5±0.8	2.3±0.6	1.4±0.6	1.0
K-40	1400±120	1290±140	1200±130	1520±140	–
Cs-134	<5.2	<5.9	<5.3	<3.8	15.0
Cs-137	<5.4	<6.2	<5.5	<4.8	18.0
Ba-La-140	<5.9	<13.1	<14.8	<7.1	15.0
Date Collected Lab Code	09-10-92 BRMI-8383	10-08-92 BRMI-8558	11-19-92 BRMI-8703	12-10-92 BRMI-8774	
I-131	<0.4	<0.4	<0.2	<0.2	1.0
Sr-89	<0.7	<0.8	<0.8	<0.7	5.0
Sr-90	4.1±0.7	3.2±0.5	2.0±0.6	3.5±0.6	
K-40	1320±150	1220±140	1240±120	1550±180	–
Cs-134	<5.9	<4.1	<5.7	<6.7	15.0
Cs-137	<6.6	<5.0	<5.6	<7.5	18.0
Ba-La-140	<13.8	<7.3	<9.1	<9.8	15.0

Table 8. Milk (continued)
Collection: Monthly
Units: pCi/L
Location: R. McCraney Farm (3)

	Sample Description and Concentration				Required LLD
Date Collected	01-09-92	02-13-92	03-12-92	04-09-92	
Lab Code	BRMI-7350	BRMI-7447	BRMI-7510	BRMI-7588	
I-131	<0.3	<0.3	<0.3	<0.4	1.0
Sr-89	<0.9	<0.6	<0.5	<0.3	5.0
Sr-90	4.7±0.7	2.3±0.4	2.3±0.5	2.3±0.4	1.0
K-40	1310±150	1340±110	1100±140	1240±120	–
Cs-134	<4.5	<4.2	<6.0	<4.2	15.0
Cs-137	<5.9	<4.6	<6.9	<5.2	18.0
Ba-La-140	<8.1	<4.4	<7.8	<4.5	15.0
Date Collected	05-14-92	06-11-92	07-09-92	08-13-92	
Lab Code	BRMI-7694	BRMI-7872	BRMI-8027	BRMI-8215,6	
I-131	<0.2	<0.2	<0.2	<0.2	1.0
Sr-89	<0.7	<0.7	<1.0	<0.9	5.0
Sr-90	2.8±0.5	2.9±0.6	2.9±0.6	3.0±0.4	1.0
K-40	1280±110	1350±110	1300±140	1330±100	–
Cs-134	<3.1	<4.8	<5.7	<3.5	15.0
Cs-137	<4.5	<4.9	<6.2	<4.7	18.0
Ba-La-140	<3.4	<6.8	<14.5	<9.0	15.0
Date Collected	09-10-92	10-08-92	11-19-92	12-10-92	
Lab Code	BRMI-8384	BRMI-8559	BRMI-8704	BRMI-8775	
I-131	<0.4	<0.4	<0.2	<0.4	1.0
Sr-89	<1.2[a]	<0.7	<1.0	<0.6	5.0
Sr-90	2.6±0.6[a]	1.9±0.4	2.3±0.6	1.9±0.4	1.0
K-40	1160±110	1310±120	1310±140	1340±150	–
Cs-134	<5.5	<3.6	<6.8	<6.1	15.0
Cs-137	<5.3	<4.3	<7.1	<6.4	18.0
Ba-La-140	<9.1	<14.8	<8.9	<8.2	15.0

[a] Results of reanalysis.

Table 8. Milk (continued)
Collection: Monthly
Units: pCi/L
Location: B. Bochniak Farm (4)

	Sample Description and Concentration				Required LLD
Date Collected	01-09-92	02-13-92	03-12-92	04-09-92	
Lab Code	BRMI-7351	BRMI-7448	BRMI-7509	BRMI-7587	
I-131	<0.3	<0.2	<0.5	<0.4	1.0
Sr-89	<0.6	<0.6	<0.6	<0.8	5.0
Sr-90	4.3±0.6	2.1±0.5	1.8±0.4	1.6±0.4	1.0
K-40	1280±150	1230±120	1280±120	1340±150	–
Cs-134	<4.4	<5.3	<5.2	<5.0	15.0
Cs-137	<5.1	<5.8	<5.3	<6.4	18.0
Ba-La-140	<5.9	<6.8	<6.0	<6.1	15.0
Date Collected	05-14-92	06-11-92	07-09-92	08-13-92	
Lab Code	BRMI-7695	BRMI-7873	BRMI-8028	BRMI-8217	
I-131	<0.2	<0.3	<0.2	<0.2	1.0
Sr-89	<0.6	<1.1	<0.7	<1.7[b]	5.0
Sr-90	2.4±0.6	3.9±0.9	2.6±0.5	2.5±0.5[b]	1.0
K-40	1240±140	1310±120	1390±150	1380±110	–
Cs-134	<4.0	<4.3	<6.0	<4.0	15.0
Cs-137	<6.2	<4.5	<6.5	<4.2	18.0
Ba-La-140	<2.9	<11.2	<13.5	<5.6	15.0
Date Collected	09-10-92	10-08-92	11-12-92	12-10-92	
Lab Code	BRMI-8385	BRMI-8560	BRMI-8705	BRMI-8776	
I-131	<0.5	<0.4	<0.2	<0.2	1.0
Sr-89	<1.0[a]	<0.8	<0.8	<0.8	5.0
Sr-90	2.1±0.5[a]	1.8±0.5	3.2±0.6	2.0±0.5	1.0
K-40	1260±140	1300±100	1350±150	1360±160	–
Cs-134	<6.0	<4.1	<4.7	<6.4	15.0
Cs-137	<5.8	<4.2	<5.0	<6.4	18.0
Ba-La-140	<12.8	<14.4	<5.2	<7.0	15.0

[a] Results of reanalysis

[b] Results of reanalysis, initial results were: Sr-89 <2.9; Sr-90 1.7±1.2

Table 9. Fruits and Vegetables
Collection: Monthly, during harvest season.
Units: pCi/g wet

	Sample Description and Concentration			Required LLD
Location		Kuebler Farm		
Date Collected	09-24-92	09-24-92	09-24-92	
Sample Type	Beans	Beets	Tomatoes	
Lab Code	BRVE-1499	BRVE-1500	BRVE-1501,2	
Gross Beta	4.70±0.21	9.38±0.44	4.96±0.12	1.0
Sr-89	<0.003	<0.016	<0.003	0.025
Sr-90	0.038±0.004	0.018±0.006	0.017±0.002	0.005
I-131	<0.040	<0.040	<0.051	0.06
Mn-54	<0.025	<0.028	<0.028	0.08
Co-58	<0.024	<0.028	<0.030	0.08
Co-60	<0.022	<0.027	<0.027	0.08
Fe-59	<0.060	<0.082	<0.059	0.1
Zn-65	<0.049	<0.064	<0.069	0.1
Zr-Nb-95	<0.037	<0.044	<0.051	0.1
Cs-134	<0.014	<0.018	<0.028	0.08
Cs-137	<0.022	<0.029	<0.026	0.08
Ba-La-140	<0.030	<0.019	<0.032	0.1

Table 10. Fish
Collection: Semiannually
Units: pCi/g wet

	Sample Description and Concentration					Required LLD
Location	Ludington Pumped Storage Plant (Control)					
Date Collected	07-28-92	07-28-92	07-28-92	07-28-92	07-28-92	
Sample Type	Shiners	Sucker	Alewives	Brown Trout	Perch	
Lab Code	PAF-1830	PAF-1831	PAF-1832	PAF-1833	PAF-1834	
Gross Beta	2.17±0.12	2.99±0.11	2.41±0.12	3.00±0.19	1.57±0.13	1.0
Sr-89	<0.006	<0.008	<0.002	<0.007	<0.007	0.025
Sr-90	0.007±0.002	<0.004	<0.001	<0.003	0.007±0.002	0.005
Mn-54	<0.012	<0.016	<0.017	<0.014	<0.020	0.13
Co-58	<0.023	<0.030	<0.027	<0.026	<0.030	0.13
Co-60	<0.011	<0.016	<0.016	<0.009	<0.020	0.13
Fe-59	<0.072	<0.094	<0.094	<0.11	<0.12	0.26
Zn-65	<0.039	<0.049	<0.045	<0.037	<0.049	0.26
Zr-Nb-95	<0.050	<0.053	<0.054	<0.041	<0.062	0.1
Cs-134	<0.012	<0.015	<0.018	<0.011	<0.015	0.13
Cs-137	<0.010	<0.014	<0.015	0.058±0.019	0.035±0.015	0.15
Ba-La-140	<0.012[a]	<0.013[a]	<0.013[a]	<0.011[a]	<0.016[a]	0.1
Location						
Date Collected	07-28-92	11-06-92	11-06-92	11-06-92	11-06-92	
Sample Type	Perch	Rainbow Trout	Rainbow Trout	Sucker	Brown Trout	
Lab Code	PAF-1835,6	PAF-1958	PAF-1959	PAF-1960	PAF-1961,2	
Gross Beta	3.13±0.10	2.83±0.10	3.81±0.12	2.71±0.10	3.77±0.11	1.0
Sr-89	<0.008[b]	<0.006	<0.004	<0.005	<0.005[b]	0.025
Sr-90	0.008±0.003[b]	<0.002	<0.002	<0.002	<0.002[b]	0.005
Mn-54	<0.019	<0.009	<0.025	<0.007	<0.006	0.13
Co-58	<0.026	<0.011	<0.030	<0.010	<0.007	0.13
Co-60	<0.015	<0.010	<0.023	<0.008	<0.007	0.13
Fe-59	<0.10	<0.035	<0.080	<0.028	<0.022	0.26
Zn-65	<0.037	<0.023	<0.054	<0.020	<0.016	0.26
Zr-Nb-95	<0.049	<0.022	<0.060	<0.017	<0.014	0.1
Cs-134	<0.013	<0.008	<0.020	<0.007	<0.006	0.13
Cs-137	0.070±0.013	0.040±0.006	<0.021	0.014±0.005	0.075±0.016	0.15
Ba-La-140	<0.010[a]	<0.087	<0.10	<0.073	<0.052	0.1

[a] LLD at time of counting.

[b] Result of single analysis; not enough sample to duplicate.

Table 10. Fish (continued)

	Sample Description and Concentration			Required LLD
Location	1/4 Mile North			
Date Collected	07-02-92	07-02-92	07-02-92	
Sample Type	Sucker	Brown Trout	Alewives	
Lab Code	BRF-1793	BRF-1794,5	BRF-1796	
Gross Beta	2.59±0.11	2.29±0.06	2.08±0.11	1.0
Sr-89	<0.006	<0.008	<0.009	0.025
Sr-90	0.003±0.002	<0.004	0.005±0.003	0.005
Mn-54	<0.007	<0.007	<0.007	0.13
Co-58	<0.010	<0.009	<0.011	0.13
Co-60	<0.006	<0.006	<0.007	0.13
Fe-59	<0.031	<0.026	<0.029	0.26
Zn-65	<0.016	<0.018	<0.019	0.26
Zr-Nb-95	<0.017	<0.017	<0.019	0.1
Cs-134	<0.005	<0.006	<0.007	0.13
Cs-137	0.054±0.008	0.053±0.011	0.030±0.005	0.15
Ba-La-140	<0.060	<0.061	<0.072	0.1
Date Collected	09-24-92	09-24-92	09-24-92	
Sample Type	Forage	Trout	Trout	
Lab Code	BRF-1851	BRF-1852	BRF-1853	
Gross Beta	1.01±0.06	2.65±0.08	2.63±0.08	1.0
Sr-89	<0.006	<0.005	<0.005	0.025
Sr-90	<0.002	<0.002	0.004±0.002	0.005
Mn-54	<0.010	<0.012	<0.005	0.13
Co-58	<0.010	<0.016	<0.007	0.13
Co-60	<0.008	<0.012	<0.005	0.13
Fe-59	<0.033	<0.049	<0.023	0.26
Zn-65	<0.018	<0.030	<0.014	0.26
Zr-Nb-95	<0.020	<0.030	<0.014	0.1
Cs-134	<0.006	<0.012	<0.005	0.13
Cs-137	0.019±0.008	0.051±0.010	0.073±0.005	0.15
Ba-La-140	<0.060	<0.096	<0.046	0.1

Table 10. Fish (continued)

	Sample Description and Concentration			Required LLD
Location	1/4 Mile South			
Date Collected	07-02-92			
Sample Type	Alewives			
Lab Code	BRF-1797			
Gross Beta	2.32±0.12			1.0
Sr-89	<0.008			0.025
Sr-90	0.005±0.002			0.005
Mn-54	<0.010			0.13
Co-58	<0.010			0.13
Co-60	<0.007			0.13
Fe-59	<0.035			0.26
Zn-65	<0.020			0.26
Zr-Nb-95	<0.020			0.1
Cs-134	<0.006			0.13
Cs-137	0.026±0.008			0.15
Ba-La-140	<0.073			0.1
Location	Discharge			
Date Collected	07-02-92	07-02-92	09-24-92	
Sample Type	Carp	Alewives	Bass	
Lab Code	BRF-1792	BRF-1798	BRF-1850	
Gross Beta	2.38±0.09	2.30±0.11	1.81±0.11	1.0
Sr-89	<0.006	<0.008	<0.005	0.025
Sr-90	0.005±0.002	<0.004	0.004±0.001	0.005
Mn-54	<0.009	<0.007	<0.006	0.13
Co-58	<0.012	<0.010	<0.009	0.13
Co-60	<0.008	<0.006	<0.006	0.13
Fe-59	<0.038	<0.027	<0.026	0.26
Zn-65	<0.019	<0.019	<0.017	0.26
Zr-Nb-95	<0.018	<0.018	<0.017	0.1
Cs-134	<0.006	<0.007	<0.007	0.13
Cs-137	0.036±0.008	0.026±0.005	0.040±0.005	0.15
Ba-La-140	<0.080	<0.065	<0.074	0.1

Table 11. Crayfish
Collection: Semiannually
Units: pCi/g wet

Sample Description and Concentration		Required LLD
Location	Discharge	
Date Collected	09-24-92	
Lab Code	BRBO-321	
Gross Beta	1.57±0.25	1.0
Sr-89	<0.008	0.025
Sr-90	0.004±0.002	0.005
Mn-54	0.040±0.012	0.13
Co-58	<0.013	0.13
Co-60	0.054±0.014	0.13
Fe-59	<0.041	0.26
Zn-65	<0.023	0.26
Zr-Nb-95	<0.026	0.1
Cs-134	<0.008	0.13
Cs-137	0.034±0.009	0.15
Ba-La-140	<0.099	0.1
Location	Big Rock Point	
Date Collected	07-02-92	
Lab Code	BRBO-307	
Gross Beta	2.07±0.29	1.0
Sr-89	<0.009	0.025
Sr-90	0.10±0.007	0.005
Mn-54	0.27±0.028	0.13
Co-58	<0.020	0.13
Co-60	0.27±0.027	0.13
Fe-59	<0.043	0.26
Zn-65	<0.038	0.26
Zr-Nb-95	<0.038	0.1
Cs-134	<0.014	0.13
Cs-137	0.073±0.014	0.15
Ba-La-140	<0.053	0.1

Table 11. Crayfish (continued)

Sample Description and Concentration		Required LLD
Location	1/4 Mi.North	
Date Collected	09-24-92	
Lab Code	BRBO-322	
Gross Beta	1.93±0.31	1.0
Sr-89	<0.007	0.025
Sr-90	0.05±0.006	0.005
Mn-54	<0.012	0.13
Co-58	<0.018	0.13
Co-60	<0.012	0.13
Fe-59	<0.044	0.26
Zn-65	<0.032	0.26
Zr-Nb-95	<0.030	0.1
Cs-134	<0.013	0.13
Cs-137	<0.012	0.15
Ba-La-140	<0.095	0.1

Table 12. Periphyton
Collection: Semiannually
Units: pCi/g wet

	Sample Description and Concentration		Required LLD
Location	Discharge		
Date Collected	06-30-92	08-18-92	
Lab Code	BRBO-304	BRBO-318	
Gross Beta	4.77±0.63	2.47±0.55	1.0
Sr-89	<0.012	<0.010	0.025
Sr-90	0.10±0.017	0.26±0.027	0.005
Mn-54	2.02±0.07[a]	1.20±0.04	0.13
Co-58	<0.037	<0.025	0.13
Co-60	2.05±0.07[a]	0.98±0.030	0.13
Fe-59	<0.065	<0.048	0.26
Zn-65	<0.079	<0.038	0.26
Zr-Nb-95	<0.061	<0.044	0.1
Cs-134	<0.037	<0.015	0.13
Cs-137	0.88±0.043[a]	0.25±0.016	0.15
Ba-La-140	<0.030	<0.008[b]	0.1

[a] Analysis was repeated; result of reanalysis: Mn-54 2.20±0.12
Co-60 2.13±0.12
Cs-137 1.07±0.07

[b] LLD at time of counting.

Table 12. Periphyton (continued)

	Sample Description and Concentration		Required LLD
Location	1/4 Mile North		
Date Collected	06-30-92	08-18-92	
Lab Code	BRBO-305	BRBO-319	
Gross Beta	2.72±0.61	3.44±0.61	1.0
Sr-89	<0.009	<0.014	0.025
Sr-90	0.20±0.009	0.26±0.024	0.005
Mn-54	0.46±0.23	0.55±0.028	0.13
Co-58	<0.013	<0.021	0.13
Co-60	<0.028	0.48±0.026	0.13
Fe-59	<0.029	<0.045	0.26
Zn-65	<0.025	<0.035	0.26
Zr-Nb-95	<0.023	<0.043	0.1
Cs-134	<0.010	<0.014	0.13
Cs-137	0.42±0.018	0.53±0.021	0.15
Ba-La-140	<0.032	<0.010[a]	0.1
Location	1/4 Mile South		
Date Collected	06-30-92	08-18-92	
Lab Code	BRBO-306	BRBO-320	
Gross Beta	4.56±1.42	2.56±0.56	1.0
Sr-89	<0.020	<0.011	0.025
Sr-90	0.34±0.036	0.20±0.024	0.005
Mn-54	0.070±0.010	0.065±0.013	0.13
Co-58	<0.009	<0.017	0.13
Co-60	0.14±0.013	0.072±0.014	0.13
Fe-59	<0.024	<0.041	0.26
Zn-65	<0.018	<0.027	0.26
Zr-Nb-95	<0.018	<0.033	0.1
Cs-134	<0.007	<0.010	0.13
Cs-137	0.14±0.011	0.11±0.014	0.15
Ba-La-140	<0.027	<0.009[a]	0.1

[a] LLD at time of counting.

Table 13. Algae
Collection: Semiannually
Units: pCi/g wet

	Sample Description and Concentration		Required LLD
Location	Ludington North and South Jetty (Control)		
Date Collected	07-28-92	11-05-92	
Lab Code	PASL-338	PASL-363	
Gross Beta	3.88±0.44	1.30±0.13	1.0
Sr-89	<0.018	<0.008	0.025
Sr-90	<0.005	0.087±0.0024	0.005
Mn-54	<0.021	<0.031	0.13
Co-58	<0.022	<0.039	0.13
Co-60	<0.020	<0.034	0.13
Fe-59	<0.055	<0.093	0.26
Zn-65	<0.050	<0.071	0.26
Zr-Nb-95	<0.041	<0.056	0.1
Cs-134	<0.018	<0.028	0.13
Cs-137	<0.018	<0.029	0.15
Ba-La-140	<0.058	<0.032[a]	0.1
Location	1/4 Mile North		
Date Collected	06-30-92	08-18-92	
Lab Code	BRSL-330	BRSL-352	
Gross Beta	5.71±0.27	2.99±0.23	1.0
Sr-89	<0.004	<0.008	0.025
Sr-90	0.006±0.002	0.009±0.003	0.005
Mn-54	0.83±0.033	0.71±0.033	0.13
Co-58	<0.020	<0.027	0.13
Co-60	0.58±0.027	0.38±0.026	0.13
Fe-59	<0.042	<0.062	0.26
Zn-65	<0.037	<0.040	0.26
Zr-Nb-95	<0.033	<0.048	0.1
Cs-134	<0.013	<0.015	0.13
Cs-137	0.076±0.012	0.087±0.014	0.15
Ba-La-140	<0.062	<0.011[a]	0.1

[a] LLD at time of counting.

Table 13. Algae (continued)

	Sample Description and Concentration		Required LLD
Location	1/4 Mile South		
Date Collected	06-30-92	08-18-92	
Lab Code	BRSL-331	BRSL-353,4	
Gross Beta	3.22±0.16	2.69±0.15	1.0
Sr-89	<0.005	<0.014[b]	0.025
Sr-90	0.016±0.002	0.008±0.005[b]	0.005
Mn-54	0.12±0.015	0.11±0.022	0.13
Co-58	<0.014	<0.045	0.13
Co-60	0.083±0.013	0.081±0.025	0.13
Fe-59	<0.041	<0.12	0.26
Zn-65	<0.026	<0.065	0.26
Zr-Nb-95	<0.025	<0.078	0.1
Cs-134	<0.010	<0.024	0.13
Cs-137	0.033±0.008	<0.025	0.15
Ba-La-140	<0.064	<0.028[c]	0.1
Location	Discharge		
Date Collected	06-30-92	08-18-92	
Lab Code	BRSL-329	BRSL-351	
Gross Beta	4.59±1.25	3.19±0.45	1.0
Sr-89	<0.018	<0.010	0.025
Sr-90	0.18±0.027	0.031±0.005	0.005
Mn-54	2.60±0.06[a]	1.71±0.05[d]	0.13
Co-58	<0.042	<0.038	0.13
Co-60	2.02±0.06[a]	1.15±0.05[d]	0.13
Fe-59	<0.11	<0.11	0.26
Zn-65	<0.087	<0.071	0.26
Zr-Nb-95	<0.074	<0.067	0.1
Cs-134	<0.029	<0.024	0.13
Cs-137	0.56±0.035	0.24±0.021	0.15
Ba-La-140	<0.10	<0.017[c]	0.1

[a] Analysis was repeated; result of reanalysis: Mn-54 2.63±0.20, Co-60 2.13±0.18

[b] Result of single analysis; not enough sample to duplicate

[c] LLD at time of counting.

[d] Analysis was repeated; result of reanalysis: Mn-54 2.05±0.06, Co-60 1.23±0.05

Table 14. Bottom Sediments
Collection: Semiannually
Units: pCi/g dry

	Sample Description and Concentration			Required LLD
Location	Ludington (Control)			
Date Collected	07-28-92	11-06-92	11-06-92	
Lab Code	PABS-1167	PABS-1245	PABS-1246	
Gross Beta	4.64±2.71	12.06±1.38	11.84±1.46	1.0
Sr-89	<0.008	<0.011	<0.010	0.025
Sr-90	<0.004	<0.004	<0.005	0.005
Mn-54	<0.007	<0.014	<0.011	0.08
Co-58	<0.010	<0.018	<0.016	0.08
Co-60	<0.009	<0.018	<0.014	0.05
Fe-59	<0.029	<0.054	<0.045	0.1
Zn-65	<0.017	<0.033	<0.028	0.1
Zr-Nb-95	<0.017	<0.033	<0.030	0.1
Cs-134	<0.005	<0.011	<0.009	0.15
Cs-137	0.12±0.008	0.025±0.012	0.029±0.009	0.18
Ba-La-140	<0.045	<0.099	<0.083	0.1
Location	Mt. McSauba			
Date Collected	06-30-92	08-18-92		
Lab Code	BRBS-1152	BRBS-1172		
Gross Beta	11.56±3.19	8.69±1.53		1.0
Sr-89	<0.024	<0.015[b]		0.025
Sr-90	0.12±0.036	0.016±0.004[b]		0.005
Mn-54	<0.017	<0.035		0.08
Co-58	<0.024	<0.055		0.08
Co-60	<0.020	<0.037		0.05
Fe-59	<0.069	<0.062[a]		0.1
Zn-65	<0.047	<0.087		0.1
Zr-Nb-95	<0.043	<0.10		0.1
Cs-134	<0.018	<0.031		0.15
Cs-137	0.11±0.012	<0.027		0.18
Ba-La-140	<0.026[a]	<0.048[a]		0.1

[a] LLD at time of counting.

[b] Corrected Data.

Table 14. Bottom Sediments (continued)

Sample Description and Concentration			Required LLD
Location	Discharge		
Date Collected	06-30-92	08-18-92	
Lab Code	BRBS-1148	BRBS-1168	
Gross Beta	8.61±1.52	13.38±1.93	1.0
Sr-89	<0.015	<0.010	0.025
Sr-90	0.015±0.006	0.005±0.003	0.005
Mn-54	0.11±0.015	0.16±0.019	0.08
Co-58	<0.017	<0.023	0.08
Co-60	0.34±0.023	0.24±0.022	0.05
Fe-59	<0.059	<0.079	0.1
Zn-65	<0.031	<0.036	0.1
Zr-Nb-95	<0.032	<0.045	0.1
Cs-134	<0.010	<0.012	0.15
Cs-137	0.60±0.019	0.36±0.019	0.18
Ba-La-140	<0.007[a]	<0.010[a]	0.1
Location	9 Mi. Point		
Date Collected	06-30-92	08-18-92	
Lab Code	BRBS-1151	BRBS-1171	
Gross Beta	9.81±1.49	7.27±2.00	1.0
Sr-89	<0.010	<0.014	0.025
Sr-90	<0.005	0.027±0.006	0.005
Mn-54	<0.010	<0.044	0.08
Co-58	<0.014	<0.023	0.08
Co-60	<0.014	0.030±0.017	0.05
Fe-59	<0.045	<0.081	0.1
Zn-65	<0.026	<0.041	0.1
Zr-Nb-95	<0.026	<0.049	0.1
Cs-134	<0.008	<0.012	0.15
Cs-137	0.079±0.009	0.050±0.014	0.18
Ba-La-140	<0.007[a]	<0.012[a]	0.1

[a] LLD at time of counting.

Table 14. Bottom Sediments (continued)

	Sample Description and Concentration		Required LLD
Location	1/4 Mile South		
Date Collected	06-30-92	08-18-92	
Lab Code	BRBS-1150	BRBS-1170	
Gross Beta	8.26±1.47	8.53±1.60	1.0
Sr-89	<0.013	<0.021	0.025
Sr-90	0.008±0.004	0.057±0.010	0.005
Mn-54	<0.013	<0.014	0.08
Co-58	<0.017	<0.024	0.08
Co-60	<0.016	<0.016	0.05
Fe-59	<0.051	<0.074	0.1
Zn-65	<0.030	<0.040	0.1
Zr-Nb-95	<0.034	<0.044	0.1
Cs-134	<0.010	<0.016	0.15
Cs-137	0.095±0.013	0.15±0.012	0.18
Ba-La-140	<0.009[a]	<0.020[a]	0.1
Location	1/4 Mile North		
Date Collected	06-30-92	08-18-92	
Lab Code	BRBS-1149	BRBS-1169	
Gross Beta	9.42±1.31	12.50±1.89	1.0
Sr-89	<0.020	<0.022	0.025
Sr-90	0.004±0.003	0.015±0.007	0.005
Mn-54	<0.012	0.18±0.020[b]	0.08
Co-58	<0.016	<0.026	0.08
Co-60	<0.013	0.59±0.029[b]	0.05
Fe-59	<0.051	<0.093	0.1
Zn-65	<0.027	<0.044	0.1
Zr-Nb-95	<0.031	<0.050	0.1
Cs-134	<0.009	<0.013	0.15
Cs-137	0.039±0.008	1.41±0.029[b]	0.18
Ba-La-140	<0.008[a]	<0.011[a]	0.1

[a] LLD at time of counting.

[b] Analysis was repeated; results of reanalysis: Mn-54 0.24±0.06, Co-60 0.88±0.06, Cs-137 2.04±0.07

NOTE: Page 38 is intentionally left out.

Table 15.1. Liquid Radwaste
Collection: Monthly Composite
Units: µCi/ml, except Pu-239 (pCi/L)

	Sample Description and Concentration		
Collection Period	January	February	March
Lab Code	BRRW-437	BRRW-440	BRRW-442
Gross alpha	<3.2 E-09	1.3±0.4 E-08	8.0±4.7 E-09
Sr-89	2.4±0.3 E-07	1.1±0.5 E-07	2.2±0.2 E-07
Sr-90	5.9±0.1 E-07	9.4±0.2 E-07	1.7±0.1 E-07
H-3	1.4±0.1 E-03	1.2 ±0.1E-03	2.1±0.1 E-03
Pu-239	<2.1	<3.5	1.1±0.4
Cr-51	<4.9 E-07	<4.9 E-07	<3.5 E-07
Mn-54	3.7±0.1 E-05	4.3±0.1 E-05	2.2±0.1 E-05
Fe-59	1.4±0.1 E-06	1.1±0.1 E-06	4.6±1.1 E-07
Co-58	1.9±0.1 E-06	7.3±0.7 E-07	4.2±0.5 E-07
Co-60	4.1±0.1 E-05	4.1±0.1 E-05	2.9±0.1 E-05
Zn-65	2.2±0.1 E-06	1.0±0.2 E-06	8.1±1.2 E-07
Zr-95	<9.5 E-08	<1.1 E-07	<8.9 E-08
Nb-95	<6.4 E-08	<6.9 E-08	8.4±4.3 E-08
Ag-110m	6.2±1.2 E-07	<6.3 E-08	4.3±0.5 E-07
Sb-124	<3.7 E-08	<4.2 E-08	<3.4 E-08
Cs-134	1.7±0.1 E-06	7.7±0.6 E-07	1.1±0.1 E-06
Cs-137	6.0±0.1 E-05	5.5±0.1 E-05	2.5±0.1 E-05
Ba-140	<4.8 E-07	<3.8 E-07	<2.7 E-07
La-140	<4.0 E-08	<3.3 E-08	<2.5 E-08
Ce-141	<6.9 E-08	<7.1 E-08	<5.2 E-08
Ce-144	<2.1 E-07	<2.5 E-07	<1.9 E-07

Table 15.1. Liquid Radwaste (continued)

Sample Description and Concentration			
Collection Period	April	May	June
Lab Code	BRRW-448	BRRW-457	NS[a]
Gross alpha	7.9±1.8 E-09	6.0±2.6 E-09	
Sr-89	2.4±1.1 E-07	<4.1 E-09	
Sr-90	1.6±0.2 E-08	3.7±0.1 E-07	
H-3	2.3±0.1 E-03	1.3±0.1 E-03	
Pu-239	1.4±0.2	1.3±0.2	
Cr-51	<2.8 E-07	<3.6 E-07	
Mn-54	1.3±0.1 E-05	1.6±0.1 E-05	
Fe-59	3.1±0.7 E-07	<1.1 E-07	
Co-58	<4.9 E-08	2.1±0.4 E-07	
Co-60	3.0±0.1 E-05	3.6±0.1 E-05	
Zn-65	<1.0 E-07	1.6±0.1 E-06	
Zr-95	<8.3 E-08	<7.8 E-08	
Nb-95	<4.8 E-08	<5.3 E-08	
Ag-110m	2.3±0.1 E-06	2.4±0.3 E-07	
Sb-124	<3.7 E-08	<2.8 E-08	
Cs-134	<3.2 E-08	9.8±0.3 E-07	
Cs-137	<4.9 E-08	2.3±0.1 E-05	
Ba-140	<2.5 E-07	<3.2 E-07	
La-140	<3.0 E-08	<3.2 E-08	
Ce-141	<4.1 E-08	<5.7 E-08	
Ce-144	<1.4 E-07	<1.8 E-07	

[a] NS = no sample; sample not collected.

Table 15.1. Liquid Radwaste (continued)

Sample Description and Concentration					
Collection Period	July	August		September	
Lab Code	NS[a]	BRRW-466		BRRW-468	
Gross alpha		<3.6	E-09	<1.3	E-09
Sr-89		<2.4	E-09	1.4±0.4	E-07
Sr-90		2.0±0.1	E-07	3.7±0.2	E-07
H-3		4.5±0.1	E-04	1.7±0.1	E-04
Pu-239		<1.4	E-01	<1.0	E-01
Cr-51		<4.0	E-07	<2.9	E-07
Mn-54		1.7±0.1	E-05	5.2±0.1	E-06
Fe-59		<1.1	E-07	<1.0	E-07
Co-58		<4.0	E-08	1.0±0.2	E-07
Co-60		2.3±0.1	E-05	2.0±0.1	E-05
Zn-65		6.9±0.5	E-07	<8.2	E-08
Zr-95		<6.6	E-08	<6.2	E-08
Nb-95		<4.8	E-08	<4.1	E-08
Ag-110m		<1.0	E-07	<8.9	E-08
Sb-124		<4.2	E-08	<3.3	E-08
Cs-134		6.5±0.2	E-07	3.1±0.2	E-07
Cs-137		2.6±0.1	E-05	1.5±0.1	E-05
Ba-140		<5.0	E-07	<2.6	E-07
La-140		<4.8	E-08	<2.9	E-08
Ce-141		<5.4	E-08	<4.1	E-08
Ce-144		<1.3	E-07	<1.2	E-07

a NS = No Sample; sample not collected.

Table 15.1.. Liquid Radwaste (continued)

Sample Description and Concentration				
Collection Period	October	November		December
Lab Code	NS[a]	BRW-482		NS[a]
Gross alpha		<2.5	E-09	
Sr-89		4.2±0.3	E-07	
Sr-90		3.0±0.1	E-07	
H-3		1.1±0.1	E-03	
Pu-239		<1.74	E-01	
Cr-51		9.00±4.00	E-07	
Mn-54		2.25±0.01	E-05	
Fe-59		<1.87	E-07	
Co-58		3.82±0.60	E-07	
Co-60		3.56±0.02	E-05	
Zn-65		7.91±1.24	E-07	
Zr-95		<1.05	E-07	
Nb-95		1.38±0.60	E-07	
Ag-110m		4.12±0.42	E-07	
Sb-124		<5.75	E-08	
Cs-134		1.97±0.39	E-07	
Cs-137		8.86±0.07	E-06	
Ba-140		<1.54	E-07	
La-140		<9.94	E-08	
Ce-141		<6.01	E-08	
Ce-144		<1.59	E-07	

a NS = No Sample; sample not collected.

b LLD is at the point of counting.

Table 15.2. Stack Filters
Collection: Monthly Composite
Units: pCi/composite

1992 Collection Period	Lab Code	Gross Alpha	Sr-89	Sr-90	Pu-239
January	BRSP-438	6.5±0.9	7.3±3.3	<2.0	<0.6
February	441	4.4±0.9	41.3±6.0	5.5±1.6	<0.2
March	443	3.9±0.7	<3.6	<2.1	<0.3
April	449	5.4±0.7	<7.3	<4.2	<0.4
May	458	4.5±0.7	230.1±23.4	19.9±4.8	<0.2
June	462	3.8±0.7	500.1±22.4	8.2±2.5	<0.4
July	463	2.9±0.7	591.0±21.7	7.0±2.0	0.3±0.2
August	467	4.1±0.7	381.1±18.1	8.2±2.6	<0.3
September	469	4.0±0.7	251.4±18.2	6.2±2.0	<0.2
October	476	3.6±0.6	613.7±20.3	7.9±2.1	<0.8
November	481	1.2±0.6	1056.0±19.9	9.4±1.3	<0.1
December	483	6.0±0.9	763.1±18.8	8.8±2.2	<0.5

NOTE: Page 44 is intentionally left out.

APPENDIX A

INTERLABORATORY COMPARISON PROGRAM RESULTS

NOTE: TIML participates in intercomparison studies administered by U.S. EPA Environmental Monitoring Systems Laboratory, Las Vegas, Nevada. The results are reported in Appendix A. Also reported are results of in-house spikes and blanks. Appendix A is updated twice a year; the complete Appendix is included in January and July monthly reports only. Please refer to January and July reports for information.

January, 1993

Appendix A

Interlaboratory Comparison Program Results

Teledyne Isotopes Midwest Laboratory (formerly Hazleton Environmental Sciences) has participated in interlaboratory comparison (crosscheck) programs since the formulation of its quality control program in December 1971. These programs are operated by agencies which supply environmental-type samples (e.g., milk or water) containing concentrations of radionuclides known to the issuing agency but not to participant laboratories. The purpose of such a program is to provide an independent check on the laboratory's analytical procedures and to alert it to any possible problems.

Participant laboratories measure the concentration of specified radionuclides and report them to the issuing agency. Several months later, the agency reports the known values to the participant laboratories and specifies control limits. Results consistently higher or lower than the known values or outside the control limits indicate a need to check the instruments or procedures used.

The results in Table A-1 were obtained through participation in the environmental sample crosscheck program for milk, water, air filters, and food samples during the period January 1988 through December 1992. This program has been conducted by the U.S. Environmental Protection Agency Intercomparison and Calibration Section, Quality Assurance Branch, Environmental Monitoring and Support Laboratory, Las Vegas, Nevada.

The results in Table A-2 were obtained for thermoluminescent dosimeters (TLDs) during the period 1976, 1977, 1979, 1980, 1984, and 1985-86 through participation in the Second, Third, Fourth, Fifth, Seventh, and Eighth International Intercomparison of Environmental Dosimeters under the sponsorships listed in Table A-2. Also Teledyne testing results are listed.

Table A-3 lists results of the analyses on in-house spiked samples.

Table A-4 lists results of the analyses on in-house "blank" samples.

Attachment B lists acceptance criteria for "spiked" samples.

Addendum to Appendix A provides explanation for out-of-limit results.

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne Isotopes Midwest Laboratory results for milk, water, air filters, and food samples, 1988 through 1992.[a]

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STW-521	Water	Jan 1988	Sr-89	27.3±5.0	30.0±5.0	21.3-38.7
			Sr-90	15.3±1.2	15.0±1.5	12.4-17.6
STW-523	Water	Jan 1988	Gr. alpha	2.3±1.2	4.0±5.0	0.0-12.7
			Gr. beta	7.7±1.2	8.0±5.0	0.0-16.7
STF-524	Food	Jan 1988	Sr-89	44.0±4.0	46.0±5.0	37.3-54.7
			Sr-90	53.0±2.0	55.0±2.8	50.2-59.8
			I-131	102.3±4.2	102.0±10.2	84.3-119.7
			Cs-137	95.7±6.4	91.0±5.0	82.3-99.7
			K	1011±158	1230±62	1124-1336
STW-525	Water	Feb 1988	Co-60	69.3±2.3	69.0±5.0	60.3-77.7
			Zn-65	99.0±3.4	94.0±9.4	77.7-110.3
			Ru-106	92.7±14.4	105.0±10.5	86.8-123.2
			Cs-134	61.7±8.0	64.0±5.0	55.3-72.7
			Cs-137	99.7±3.0	94.0±5.0	85.3-102.7
STW-526	Water	Feb 1988	H-3	3453±103	3327±362	2700-3954
STW-527	Water	Feb 1988	Uranium	3.0±0.0	3.0±6.0	0.0-13.4
STM-528	Milk	Feb 1988	I-131	4.7±1.2	4.0±0.4	3.3-4.7
STW-529	Water	Mar 1988	Ra-226	7.1±0.6	7.6±1.1	5.6-9.6
			Ra-228	NA[e]	7.7±1.2	5.7-9.7
STW-530	Water	Mar 1988	Gr. alpha	4.3±1.2	6.0±5.0	0.0-14.7
			Gr. beta	13.3±1.3	13.0±5.0	4.3-21.7
STAF-531	Air Filter	Mar 1988	Gr. alpha	21.0±2.0	20.0±5.0	11.3-28.7
			Gr. beta	48.0±0.0	50.0±5.0	41.3-58.7
			Sr-90	16.7±1.2	17.0±1.5	14.4-19.6
			Cs-137	18.7±1.3	16.0±5.0	7.3-24.7
STW-532	Water	Apr 1988	I-131	9.0±2.0	7.5±0.8	6.2-8.8

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STW-533 534	Water (Blind)	Apr 1988				
	Sample A		Gr. alpha	ND[f]	46.0±11.0	27.0-65.0
			Ra-226	ND	6.4±1.0	4.7-8.1
			Ra-228	ND	5.6±0.8	4.2-7.0
			Uranium	6.0±6.0	6.0±6.0	0.0-16.4
	Sample B		Gr. beta	ND	57.0±5.0	48.3-65.7
			Sr-89	3.3±1.2	5.0±5.0	0.0-13.7
			Sr-90	5.3±1.2	5.0±1.5	2.4-7.6
			Co-60	63.3±1.3	50.0±5.0	41.3-58.7
			Cs-134	7.7±1.2	7.0±5.0	0.0-15.7
			Cs-137	8.3±1.2	7.0±5.0	0.0-15.7
STU-535	Urine	Apr 1988	H-3	6483±155	6202±620	5128-7276
STW-536	Water	Apr 1988	Sr-89	14.7±1.3	20.0±5.0	11.3-28.7
			Sr-90	20.0+2.0	20.0±1.5	17.4-22.6
STW-538	Water	Jun 1988	Cr-51	331.7±13.0	302.0±30.0	250.0-354.0
			Co-60	16.0±2.0	15.0±5.0	6.3-23.7
			Zn-65	107.7±11.4	101.0±10.0	83.7-118.3
			Ru-106	191.3±11.0	195.0±20.0	60.4-229.6
			Cs-134	18.3±4.6	20.0±5.0	11.3-28.7
			Cs-137	26.3±1.2	25.0±5.0	16.3-33.7
STW-539	Water	Jun 1988	H-3	5586±92	5565±557	4600-6530
STM-541	Milk	Jun 1988	Sr-89	33.7±11.4	40.0±5.0	31.3-48.7
			Sr-90	55.3±5.8	60.0±3.0	54.8-65.2
			I-131	103.7±3.1	94.0±9.0	78.4-109.6
			Cs-137	52.7±3.1	51.0±5.0	42.3-59.7
			K	1587±23	1600±80	1461-1739
STW-542	Water	Jul 1988	Gr. alpha	8.7±4.2	15.0±5.0	6.3-23.7
			Gr. beta	5.3±1.2	4.0±5.0	0.0-12.7
STF-543	Food	Jul 1988	Sr-89	ND[f]	33.0±5.0	24.3-41.7
			Sr-90	ND	34.0±2.0	30.5-37.5
			I-131	115.0±5.3	107.0±11.0	88.0-126.0
			Cs-137	52.7±6.4	49.0±5.0	40.3-57.7
			K	1190±66	1240±62	1133-1347

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STW-544	Water	Aug 1988	I-131	80.0±0.0	76.0±8.0	62.1-89.9
STW-545	Water	Aug 1988	Pu-239	11.0±0.2	10.2±1.0	8.5-11.9
STW-546	Water	Aug 1988	Uranium	6.0±0.0	6.0±6.0	0.0-16.4
STAF-547	Air Filter	Aug 1988	Gr. alpha	8.0±0.0	8.0±5.0	0.0-16.7
			Gr. beta	26.3±1.2	29.0±5.0	20.3-37.7
			Sr-90	8.0±2.0	8.0±1.5	5.4-10.6
			Cs-137	13.0±2.0	12.0±5.0	3.3-20.7
STW-548	Water	Sep 1988	Ra-226	9.3±0.5	8.4±2.6	6.2-10.6
			Ra-228	5.8±0.4	5.4±1.6	4.0-6.8
STW-549	Water	Sep 1988	Gr. alpha	7.0±2.0	8.0±5.0	0.0-16.7
			Gr. beta	11.3±1.2	10.0±5.0	1.3-18.7
STW-550	Water	Oct 1988	Cr-51	252.0±14.0	251.0±25.0	207.7-294.3
			Co-60	26.0±2.0	25.0±5.0	16.3-33.7
			Zn-65	158.3±10.2	151.0±15.0	125.0-177.0
			Ru-106	153.0±9.2	152.0±15.0	126.0-178.0
			Cs-134	28.7±5.0	25.0±5.0	16.3-33.7
			Cs-137	16.3±1.2	15.0±5.0	6.3-23.7
STW-551	Water	Oct 1988	H-3	2333±127	2316±350	1710-2927
STW-552 553	Water (Blind)	Oct 1988				
	Sample A		Gr. alpha	38.3±8.0	41.0±10.0	23.7-58.3
			Ra-226	4.5±0.5	5.0±0.8	3.6-6.4
			Ra-228	4.4±0.6	5.2±0.8	3.6-6.4
			Uranium	4.7±1.2	5.0±6.0	0.0-15.4
	Sample B		Gr. beta	51.3±3.0	54.0±5.0	45.3-62.7
			Sr-89	3.7±1.2	11.0±5.0	2.3-19.7
			Sr-90	10.7±1.2	10.0±1.5	7.4-12.6
			Cs-134	15.3±2.3	15.0±5.0	6.3-23.7
			Cs-137	16.7±1.2	15.0±5.0	6.3-23.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STM-554	Milk	Oct 1988	Sr-89	40.3±7.0	40.0±5.0	31.3-48.7
			Sr-90	51.0±2.0	60.0±3.0	54.8-65.2
			I-131	94.0±3.4	91.0±9.0	75.4-106.6
			Cs-137	45.0±4.0	50.0±5.0	41.3-58.7
			K	1500±45	1600±80	1461-1739
STU-555	Urine	Nov 1988	H-3	3030±209	3025±359	2403-3647
STW-556	Water	Nov 1988	Gr. alpha	9.0±3.5	9.0±5.0	0.3-17.7
			Gr. beta	9.7±1.2	9.0±5.0	0.3-17.7
STW-557	Water	Dec 1988	I-131	108.7±3.0	115.0±12.0	94.2-135.8
STW-559	Water	Jan 1989	Sr-89	40.0±8.7	40.0±5.0	31.3-48.7
			Sr-90	24.3±3.1	25.0±1.5	22.4-27.6
STW-560	Water	Jan 1989	Pu-239	5.8±1.1	4.2±0.4	3.5-4.9
STW-561	Water	Jan 1989	Gr. alpha	7.3±1.2	8.0±5.0	0.0-16.7
			Gr. beta	5.3±1.2	4.0±5.0	0.0-12.7
STW-562	Water	Feb 1989	Cr-51	245±46	235±24	193.4-276.6
			Co-60	10.0±2.0	10.0±5.0	1.3-18.7
			Zn-65	170±10	159±16	139.2-186.7
			Ru-106	181±7.6	178±18	146.8-209.2
			Cs-134	9.7±3.0	10.0±5.0	1.3-18.7
			Cs-137	11.7±1.2	10.0±5.0	1.3-18.7
STW-563	Water	Feb 1989	I-131	109.0±4.0	06.0±11.0	86.9-125.1
STW-564	Water	Feb 1989	H-3	2820±20	2754±356	2137-3371
STW-565	Water	Mar 1989	Ra-226	4.2±0.3	4.9±0.7	3.7-6.1
			Ra-228	1.9±1.0	1.7±0.3	1.2-2.2
STW-566	Water	Mar 1989	U	5.0±0.0	5.0±6.0	0.0-15.4
STAF-567	Air Filter	Mar 1989	Gr. alpha	21.7±1.2	21.0±5.0	12.3-29.7
			Gr. beta	68.3±4.2	62.0±5.0	53.3-70.7
			Sr-90	20.0±2.0	20.0±1.5	17.4-22.6
			Cs-137	21.3±1.2	20.0±5.0	11.3-28.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STW-568 569	Water (Blind)	Apr 1989				
	Sample A		Gr. alpha	22.7±2.3	29.0±7.0	16.9-41.2
			Ra-226	3.6±0.6	3.5±0.5	2.6-4.4
			Ra-228	2.6±1.0	3.6±0.5	2.7-4.5
			U	3.0±0.0	3.0±6.0	0.0-13.4
	Sample B		Gr. beta	52.3±6.1	57.0±5.0	43.3-65.7
			Sr-89	9.3±5.4	8.0±5.0	0.0-16.7
			Sr-90	7.0±0.0	8.0±1.5	5.4-10.6
			Cs-134	21.0±5.2	20.0±5.0	11.3-28.7
			Cs-137	23.0±2.0	20.0±5.0	11.3-28.7
STM-570	Milk	Apr 1989	Sr-89	26.0±10.0	39.0±5.0	30.3-47.7
			Sr-90	45.7±4.2	55.0±3.0	49.8-60.2
			Cs-137	54.0±6.9	50.0±5.0	41.3-58.7
			K-40	1521±208	1600±80	1461-1739
STW-571[g]	Water	May 1989	Sr-89	<0.7	6.0±5.0	0.0-14.7
			Sr-90	5.0±1.0	6.0±1.5	3.4-8.6
STW-572	Water	May 1989	Gr. alpha	24.0±2.0	30.0±8.0	16.1-43.9
			Gr. beta	49.3±15.6	50.0±5.0	41.3-58.7
STW-573	Water	Jun 1989	Ba-133	50.7±1.2	49.0±5.0	40.3-57.7
			Co-60	31.3±2.3	31.0±5.0	22.3-39.7
			Zn-65	167±10	165±17	135.6-194.4
			Ru-106	123±9.2	128±13	105.5-150.5
			Cs-134	40.3±1.2	39±5	30.3-47.7
			Cs-137	22.3±1.2	20±5	11.3-28.7
STW-574	Water	Jun 1989	H-3	4513±136	4503±450	3724-5282
STW-575	Water	Jul 1989	Ra-226	16.8±3.1	17.7±2.7	13.0-22.4
			Ra-228	13.8±3.7	18.3±2.7	13.6-23.0
STW-576	Water	Jul 1989	U	40.3±1.2	41.0±6.0	30.6±51.4
STW-577	Water	Aug 1989	I-131	84.7±5.8	83.0±8.0	69.1-96.9
STAF-579	Air Filter	Aug 1989	Gr. alpha	6.0±0.0	6.0±5.0	0.0-14.7
			Cs-137	10.3±2.3	10.0±5.0	1.3-18.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STW-580	Water	Sep 1989	Sr-89	14.7±1.2	14.0±5.0	5.3-22.7
			Sr-90	9.7±1.2	10.0±1.5	7.4-12.6
STW-581	Water	Sep 1989	Gr. alpha	5.0±0.0	4.0±5.0	0.0-12.7
			Gr. beta	8.7±2.3	6.0±5.0	0.0-14.7
STW-583	Water	Oct 1989	Ba-133	60.3±10.0	59.0±6.0	48.6-69.4
			Co-60	29.0±4.0	30.0±5.0	21.1-38.7
			Zn-65	132.3±6.0	129.0±13.0	106.5-151.5
			Ru-106	155.3±6.1	161.0±16.0	133.3-188.7
			Cs-134	30.7±6.1	29.0±5.0	20.3-37.7
			Cs-137	66.3±4.6	59.0±5.0	50.3-67.7
STW-584	Water	Oct 1989	H-3	3407±150	3496±364	2866-126
STW-585 586	Water (Blind)	Oct 1989				
	Sample A		Gr. alpha	41.7±9.4	49.0±12.0	28.2-69.8
			Ra-226	7.9±0.4	8.4±1.3	6.2-10.6
			Ra-228	4.4±0.8	4.1±0.6	3.1-5.1
			U	12.0±0.0	12.0±6.0	1.6-22.4
	Sample B		Gr. beta	31.7±2.3	32.0±5.0	23.3-40.7
			Sr-89	13.3±4.2	15.0±5.0	6.3-23.7
			Sr-90	7.0±2.0	7.0±3.0	4.4-9.6
			Cs-134	5.0±0.0	5.0±5.0	0.0-13.7
			Cs-137	7.0±0.0	5.0±5.0	0.0-13.7
STW-587	Water	Nov 1989	Ra-226	7.9±0.4	8.7±1.3	6.4-11.0
			Ra-228	8.9±1.2	9.3±1.2	6.9-11.7
STW-588	Water	Nov 1989	U	15.0±0.0	15.0±6.0	4.6-25.4
STW-589	Water	Jan 1990	Sr-89	22.7±5.0	25.0±5.0	16.3-33.7
			Sr-90	17.3±1.2	20.0±1.5	17.4-22.6
STW-591	Water	Jan 1990	Gr. alpha	10.3±3.0	12.0±5.0	3.3-20.7
			Gr. beta	12.3±1.2	12.0±5.0	3.3-20.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STW-592	Water	Jan 1990	Co-60	14.7±2.3	15±5.0	6.3-23.7
			Zn-65	135.0±6.9	139.0±14.0	114.8-163.2
			Ru-106	133.3±13.4	139.0±14.0	114.8-163.2
			Cs-134	17.3±1.2	18.0±5.0	9.3-26.7
			Cs-137	19.3±1.2	18.0±5.0	9.3-26.7
			Ba-133	78.0±0.0	74.0±7.0	61.9-86.1
STW-593	Water	Feb 1990	H-3	4827±83	4976±498	4113-5839
STW-594	Water	Mar 1990	Ra-226	5.0±0.2	4.9±0.7	4.1-5.7
			Ra-228	13.5±0.7	12.7±1.9	9.4-16.0
STW-595	Water	Mar 1990	U	4.0±0.0	4.0±6.0	0.0-14.4
STAF-596	Air Filter	Mar 1990	Gr. alpha	7.3±1.2	5.0±5.0	0.0-13.7
			Gr. beta	34.0±0.0	31.0±5.0	22.3-39.7
			Sr-90	10.0±0.0	10.0±1.5	7.4-12.6
			Cs-137	9.3±1.2	10.0±5.0	1.3-18.7
STW-597 598	Water (Blind)	Apr 1990				
	Sample A		Gr. alpha	81.0±3.5	90.0±23.0	50.1-129.9
			Ra-226	4.9±0.4	5.0±0.8	3.6-6.4
			Ra-228	10.6±0.3	10.2±1.5	7.6-12.8
			U	18.7±3.0	20.0±6.0	9.6-30.4
	Sample B		Gr. beta	51.0±10.1	52.0±5.0	43.3-60.7
			Sr-89	9.3±1.2	10.0±5.0	1.3-18.7
			Sr-90	10.3±3.1	10.0±1.5	8.3-11.7
			Cs-134	16.0±0.0	15.0±5.0	6.3-23.7
			Cs-137	19.0±2.0	15.0±5.0	6.3-23.7
STM-599	Milk	Apr 1990	Sr-89	21.7±3.1	23.0±5.0	14.3-31.7
			Sr-90	21.0±7.0	23.0±5.0	14.3-31.7
			I-131	98.7±1.2	99.0±10.0	81.7-116.3
			Cs-137	26.0±6.0	24.0±5.0	15.3-32.7
			K	1300.0±69.2	1550.0±78.0	1414.7-1685.3
STW-600	Water	May 1990	Sr-89	6.0±2.0	7.0±5.0	0.0-15.7
			Sr-90	6.7±1.2	7.0±5.0	0.0-15.7
STW-601	Water	May 1990	Gr. alpha	11.0±2.0	22.0±6.0	11.6-32.4
			Gr. beta	12.3±1.2	15.0±5.0	6.3-23.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STW-602	Water	Jun 1990	Co-60	25.3±2.3	24.0±5.0	15.3-32.7
			Zn-65	155.0±10.6	148.0±15.0	130.6-165.4
			Ru-106	202.7±17.2	210.0±21.0	173.6-246.4
			Cs-134	23.7±1.2	24.0±5.0	18.2-29.8
			Cs-137	27.7±3.1	25.0±5.0	16.3-33.7
			Ba-133	100.7±8.1	99.0±10.0	81.7-116.3
STW-603	Water	Jun 1990	H-3	2927±306	2933±358	2312-3554
STW-604	Water	Jul 1990	Ra-226	11.8±0.9	12.1±1.8	9.0-15.2
			Ra-228	4.1±1.4	5.1±1.3	2.8-7.4
STW-605	Water	Jul 1990	U	20.3±1.7	20.8±3.0	15.6-26.0
STW-606	Water	Aug 1990	I-131	43.0±1.2	39.0±6.0	28.6-49.4
STW-607	Water	Aug 1990	Pu-239	10.0±1.7	9.1±0.9	7.5-10.7
STAF-608	Air Filter	Aug 1990	Gr. alpha	14.0±0.0	10.0±5.0	1.3-18.7
			Gr. beta	65.3±1.2	62.0±5.0	53.3-70.7
			Sr-90	19.0±6.9	20.0±5.0	11.3-28.7
			Cs-137	19.0±2.0	20.0±5.0	11.3-28.7
STW-609	Water	Sep 1990	Sr-89	9.0±2.0	10.0±5.0	1.3-18.7
			Sr-90	9.0±2.0	9.0±5.0	0.3-17.7
STW-610	Water	Sep 1990	Gr. alpha	8.3±1.2	10.0±5.0	1.3-18.7
			Gr. beta	10.3±1.2	10.0±5.0	1.3-18.7
STM-611	Milk	Sep 1990	Sr-89	11.7±3.1	16.0±5.0	7.3-24.7
			Sr-90	15.0±0.0	20.0±5.0	11.3-28.7
			I-131	63.0±6.0	58.0±6.0	47.6-68.4
			Cs-137	20.0±2.0	20.0±5.0	11.3-28.7
			K	1673.3±70.2	1700.0±85.0	1552.5-1847.5
STW-612	Water	Oct 1990	Co-60	20.3±3.1	20.0±5.0	11.3-28.7
			Zn-65	115.3±12.2	115.0±12.0	94.2-135.8
			Ru-106	152.0±8.0	151.0±15.0	125.0-177.0
			Cs-134	11.0±0.0	12.0±5.0	3.3-20.7
			Cs-137	14.0±2.0	12.0±5.0	3.3-20.7
			Ba-133	116.7±9.9	110.0±11.0	90.9-129
STW-613	Water	Oct 1990	H-3	7167±330	7203±720	5954-8452

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STW-614 615	Water	Oct 1990				
	Sample A		Gr. alpha	68.7±7.2	62.0±16.0	34.2-89.8
			Ra-226	12.9±0.3	13.6±2.0	10.1-17.1
			Ra-228	4.2±0.6	5.0±1.3	2.7-7.3
			U	10.4±0.6	10.2±3.0	5.0-15.4
	Sample B		Gr. beta	55.0±8.7	53.0±5.0	44.3-61.7
			Sr-89	15.7±2.9	20.0±5.0	11.3-28.7
			Sr-90	12.0±2.0	15.0±5.0	6.3-23.7
			Cs-134	9.0±1.7	7.0±5.0	0.0-15.7
			Cs-137	7.7±1.2	3.0±5.0	0.0-13.7
STW-616	Water	Nov 1990	Ra-226	6.8±1.0	7.4±1.1	5.5-9.3
			Ra-228	5.3±1.7	7.7±1.9	4.4-11.0
STW-617[g]	Water	Nov 1990	U	35.0±0.4	35.5±3.6	29.3-41.7
STW-618	Water	Jan 1991	Sr-89	4.3±1.2	5.0±5.0	0.0 -13.7
			Sr-90	4.7±1.2	5.0±5.0	0.0-13.7
STW-619	Water	Jan 1991	Pu-239	3.6±0.2	3.3±0.3	2.8-3.8
STW-620	Water	Jan 1991	Gr. alpha	6.7±3.0	5.0±5.0	0.0-13.7
			Gr. beta	6.3±1.2	5.0±5.0	0.0-13.7
STW-621	Water	Feb 1991	Co-60	41.3±8.4	40.0±5.0	31.3-48.7
			Zn-65	166.7±19.7	149.0±15.0	123.0-175.0
			Ru-106	209.7±18.6	186.0±19.0	153.0-219.0
			Cs-134	9.0±2.0	8.0±5.0	0.0-16.7
			Cs-137	9.7±1.2	8.0±5.0	0.0-16.7
			Ba-133	85.7±9.2	75.0±8.0	61.1-88.9
STW-622	Water	Feb 1991	I-131	81.3±6.1	75.0±8.0	61.1-88.9
STW-623	Water	Feb 1991	H-3	4310.0±144.2	4418.0±442.0	3651.2-5184.8
STW-624	Water	Mar 1991	Ra-226	31.4±3.2	31.8±4.8	23.5-40.1
			Ra-228	ND[h]	21.1±5.3	11.9-30.3
STW-625	Water	Mar 1991	U	6.7±0.4	7.6±3.0	2.4-12.8

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STAF-626	Air Filter	Mar 1991	Gr. alpha	38.7±1.2	25.0±6.0	14.6-35.4
			Gr. beta	130.0±4.0	124.0±6.0	113.6-134.4
			Sr-90	35.7±1.2	40.0±5.0	31.3-48.7
			Cs-137	33.7±4.2	40.0±5.0	31.3-48.7
STW-627 628	Water	Apr 1991				
	Sample A		Gr. alpha	51.0±6.0	54.0±14.0	29.7-78.3
			Ra-226	7.0±0.8	8.0±1.2	5.9-10.1
			Ra-228	9.7±1.9	15.2±3.8	8.6-21.8
			U	27.7±2.4	29.8±3.0	24.6-35.0
	Sample B		Gr. beta	93.3±6.4	115.0±17.0	85.5-144.5
			Sr-89	21.0±3.5	28.0±5.0	19.3-36.7
			Sr-90	23.0±0.0	26.0±5.0	17.3-34.7
			Cs-134	27.3±1.2	24.0±5.0	15.3-32.7
			Cs-137	29.0±2.0	25.0±5.0	16.3-33.7
STM-629	Milk	Apr 1991	Sr-89	24.0±8.7	32.0±5.0	23.3-40.7
			Sr-90	28.0±2.0	32.0±5.0	23.3-40.7
			I-131	65.3±14.7	60.0±6.0	49.6-70.4
			Cs-137	54.7±11.0	49.0±5.0	40.3-57.7
			K	1591.7±180.1	1650.0±83.0	1506.0-1794.0
STW-630	Water	May 1991	Sr-89	40.7±2.3	39.0±5.0	30.3-47.7
			Sr-90	23.7±1.2	24.0±5.0	15.3-32.7
STW-631	Water	May 1991	Gr. alpha	27.7±5.8	24.0±6.0	13.6-34.4
			Gr. beta	46.0±0.0	46.0±5.0	37.3-54.7
STW-632	Water	Jun 1991	Co-60	11.3±1.2	10.0±5.0	1.3-18.7
			Zn-65	119.3±16.3	108.0±11.0	88.9-127.1
			Ru-106	162.3±19.0	149.0±15.0	123.0-175.0
			Cs-134	15.3±1.2	15.0±5.0	6.3-23.7
			Cs-137	16.3±1.2	14.0±5.0	5.3-22.7
			Ba-133	74.0±6.9	62.0±6.0	51.6-72.4
STW-633	Water	Jun 1991	H-3	13470.0±385.8	12480.0±1248.0	10314.8-14645.2
STW-634	Water	Jul 1991	Ra-226	14.9±0.4	15.9±2.4	11.7-20.1
			Ra-228	17.6±1.8	16.7±4.2	9.4-24.0

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STW-635	Water	Jul 1991	U	12.8±0.1	14.2±3.0	9.0-19.4
STW-636	Water	Aug 1991	I-131	19.3±1.2	20.0±6.0	9.6-30.4
STW-637	Water	Aug 1991	Pu-239	21.4±0.5	19.4±1.9	16.1-22.7
STAF-638	Air Filter	Aug 1991	Gr. alpha	33.0±2.0	25.0±6.0	14.6-35.4
			Gr. beta	88.7±1.2	92.0±10.0	80.4-103.6
			Sr-90	27.0±4.0	30.0±5.0	21.3-38.7
			Cs-137	26.3±1.2	30.0±5.0	21.3-38.7
STW-639	Water	Sep 1991	Sr-89	47.0±10.4	49.0±5.0	40.3-57.7
			Sr-90	24.0±2.0	25.0±5.0	16.3-33.7
STW-640	Water	Sep 1991	Gr. alpha	12.0±4.0	10.0±5.0	1.3-18.7
			Gr. beta	20.3±1.2	20.0±5.0	11.3-28.7
STM-641	Milk	Sep 1991	Sr-89	20.3±5.0	25.0±5.0	16.3-33.7
			Sr-90	19.7±3.1	25.0±5.0	16.3-33.7
			I-131	130.7±16.8	108.0±11.0	88.9-127.1
			Cs-137	33.7±3.2	30.0±5.0	21.3-38.7
			K	1743.3±340.8	1740.0±87.0	1589.1-1890.9
STW-642	Water	Oct 1991	Co-60	29.7±1.2	29.0±5.0	20.3-37.7
			Zn-65	75.7±8.3	73.0±7.0	60.9-85.1
			Ru-106	196.3±15.1	199.0±20.0	164.3-233.7
			Cs-134	9.7±1.2	10.0±5.0	1.3-18.7
			Cs-137	11.0±2.0	10.0±5.0	1.3-18.7
			Ba-133	94.7±3.1	98.0±10.0	80.7-115.3
STW-643	Water	Oct 1991	H-3	2640.0±156.2	2454.0±352.0	1843.3-3064.7
STW-644 645	Water Sample A	Oct 1991	Gr. alpha	73.0±13.1	82.0±21.0	45.6-118.4
			Ra-226	20.9±2.0	22.0±3.3	16.3-27.7
			Ra-228	19.6±2.3	22.2±5.6	12.5-31.9
			U	13.5±0.6	13.5±3.0	8.3-18.7
	Sample B		Gr. beta	55.3±3.1	65.0±10.0	47.7-82.3
			Sr-89	9.7±3.1	10.0±5.0	1.3-18.7
			Sr-90	8.7±1.2	10.0±5.0	1.3-18.7
			Co-60	20.3±1.2	20.0±5.0	11.3-28.7
			Cs-134	9.0±5.3	10.0±5.0	1.3-18.7
			Cs-137	14.7±5.0	11.0±5.0	2.3-19.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STW-646	Water	Nov 1991	Ra-226	5.6±1.2	6.5±1.0	4.8-8.2
			Ra-228	9.6±0.5	8.1±2.0	4.6-11.6
STW-647	Water	Nov 1991	U	24.7±2.3	24.9±3.0	19.7-30.1
STW-648	Water	Jan 1992	Sr-89	42.7±6.4	51.0±5.0	42.3-59.7
			Sr-90	18.3±3.1	20.0±5.0	11.3-28.7
STW-649	Water	Jan 1992	Pu-239	1[illegible]1±0.8	16.8±1.7	13.9-19.7
STW-650	Water	Jan 1992	Gr. alpha	23.7±9.2	30.0±8.0	16.1-43.9
			Gr. beta	27.7±4.2	30.0±5.0	21.3-38.7
STW-651	Water	Feb 1992	I-131	60.3±4.2	59.0±6.0	48.6-69.4
STW-652	Water	Feb 1992	Co-60	40.3±5.0	40.0±5.0	31.3-48.7
			Zn-65	148.0±15.0	150.7±6.1	122.0-174.0
			Ru-106	188.7±28.8	203.0±20.0	168.3-237.7
			Cs-134	31.7±4.2	31.0±5.0	22.3-39.7
			Cs-137	51.0±3.4	49.0±5.0	40.3-57.7
			Ba-133	79.0±3.4	76.0±8.0	62.1-89.9
STW-653	Water	Feb 1992	H-3	7714.0±119.6	7904.0±790.0	6533.4-9274.6
STW-654	Water	Mar 1992	Ra-226	9.0±0.4	10.1±1.5	7.5-12.7
			Ra-228	18.8±0.6	15.5±3.9	8.7-22.3
STW-655	Water	Mar 1992	Ru-222[i]			
STW-656	Water	Mar 1992	U	25.1±1.9	25.3±3.0	20.1-30.5
STW-657	Water	Mar 1992	Ru-222[i]			
STAF-658	Air Filter	Mar 1992	Gr. alpha	7.0±0.0	7.0±5.0	0.0-15.7
			Gr. beta	39.3±1.6	41.0±5.0	32.3-49.7
			Sr-90	13.7±1.6	15.0±5.0	6.3-23.7
			Cs-137	10.0±0.0	10.0±5.0	1.3-18.7
STW-659	Water	Apr 1992				
660	Sample A		Gr. alpha	35.7±6.1	40.0±10.0	22.7-57.3
			Ra-226	12.7±1.2	14.9±2.2	11.1-18.7
			Ra-228	14.5±2.1	14.0±3.5	7.9-20.1
			U	3.9±0.2	4.0±3.0	0.0-9.2

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STW-659	Water	Apr 1992				
660	Sample B		Gr. beta	113.0±7.2	140.0±21.0	103.6-176.4
			Sr-89	12.3±4.2	15.0±5.0	6.3-23.7
			Sr-90	15.0±1.2	17.0±5.0	8.3-25.7
			Co-60	61.0±4.0	56.0±5.0	47.3-64.7
			Cs-134	24.3±1.2	24.0±5.0	15.3-32.7
			Cs-137	24.0±2.0	22.0±5.0	13.3-30.7
STM-661	Milk	Apr 1992	Sr-89	25.3±7.6	38.0±5.0	29.3-46.7
			Sr-90	24.3±3.1	29.0±5.0	20.3-37.7
			I-131	78.7±9.5	78.0±8.0	64.1-91.9
			Cs-137	39.3±2.3	39.0±5.0	30.3-47.7
			K	1610.0±72.1	1710.0±86.0	1560.8-1859.2
STW-662	Water	May 1992	Sr-89	24.0±4.0	29.0±5.0	20.3-37.7
			Sr-90	6.7±1.2	8.0±5.0	0.0-16.7
STM-663	Water	May 1992	Gr. alpha	12.3±2.1	15.0±5.0	6.3-23.7
			Gr. beta	46.0±5.0	44.0±5.0	35.3-52.7
STW-664	Water	Jun 1992	Co-60	20.3±1.2	20.0±5.0	11.3-28.7
			Zn-65	103.3±10.6	99.0±10.0	81.7-116.3
			Ru-106	142.7±23.7	141.0±14.0	116.7-165.3
			Cs-134	14.3±2.3	15.0±5.0	6.3-23.7
			Cs-137	15.0±2.0	15.0±5.0	6.3-23.7
			Ba-133	92.7±11.0	98.0±10.0	80.7-115.3
STW-665	Water	Jun 1992	H-3	2153.3±144.6	2125.0±347.0	1523.0-2727.0
STW-666	Water	July 1992	Ra-226	22.3±2.2	24.9±3.7	18.5-31.3
			Ra-228	16.7±3.1	16.7±4.2	9.4-24.0
STW-667	Water	July 1992	U	3.6±0.3	4.0±3.0	0.0-9.2
STW-668	Water	August 1992	I-131	47.0±3.5	45.0±6.0	34.6-55.4
STW-669	Water	August 1992	Pu-239	8.5±0.9	9.0±0.9	7.4-10.6
STAF-670	Air Filter	August 1992	Gr. alpha	25.7±1.2	30.0±8.0	16.1-43.9
			Gr. beta	69.0±2.0	69.0±10.0	51.7-86.3
			Sr-90	26.0±4.0	25.0±5.0	16.3-33.7
			Cs-137	16.0±0.0	18.0±5.0	9.3-26.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STW-671	Water	Sept. 1992	Sr-89	16.0±4.0	20.0±5.0	11.3-28.7
			Sr-90	14.3±3.1	15.0±5.0	6.3-23.7
STW-672	Water	Sept. 1992	Gr. alpha	43.0±13.1	45.0±11.0	25.9-64.1
			Gr. beta	41.3±18.6	50.0±5.0	41.3-58.7
STM-673	Milk	Sept. 1992	Sr-89	11.0±3.5	15.0±5.0	6.3-23.7
			Sr-90	12.7±1.2	15.0±5.0	6.3-23.7
			I-131	109.7±19.4	100.0±10.0	82.7-117.3
			Cs-137	14.0±3.5	15.0±5.0	6.3-23.7
			K	1540.0±103.9	1750.0±88.0	1597.3-1902.7
STW-674	Water	Oct. 1992	Co-60	11.3±2.3	10.0±5.0	1.3-18.7
			Zn-65	169.7±25.0	148.0±15.0	122.0-174.0
			Ru-106	170.1±2.3	175.0±18.0	143.8-206.2
			Cs-134	9.7±2.3	8.0±5.0	0.0-16.7
			Cs-137	9.7±1.2	8.0±5.0	0.0-16.7
			Ba-133	80.3±9.0	74.0±7.0	61.9-86.1
STW-675	Water	Oct. 1992	H-3	5896.7±136.2	5962.0±596.0	4928.0-6996.0
STW-676 -677	Water	Oct. 1992				
	Sample A		Gr. alpha	24.7±5.0	29.0±7.0	16.9-41.1
			Ra-226	7.1±0.4	7.4±1.1	5.5-9.3
			Ra-228	11.5±1.0	10.0±2.5	5.7-14.3
			U	9.7±0.5	10.2±3.0	5.0-15.4
	Sample B		Gr. beta	42.7±8.1	53.0±10.0	35.7-70.3
			Sr-89	6.7±1.2	8.0±5.0	0.0-16.7
			Sr-90	10.0±2.0	10.0±5.0	1.3-18.7
			Co-60	15.0±2.0	15.0±5.0	6.3-23.7
			Cs-134	5.7±1.2	5.0±5.0	0.0-13.7
			Cs-137	8.0±2.0	8.0±5.0	0.0-16.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STW-678	Water	Nov. 1992	Ra-226	7.5±0.8	7.5±1.1	5.6-9.4
			Ra-228	5.8±0.7	5.0±1.3	2.7-7.3
STW-679	Water	Nov. 1992	U	15.5±1.1	15.2±3.0	10.0-20.4

[a] Results obtained by Teledyne Isotopes Midwest Laboratory as a participant in the environmental sample crosscheck program operated by the Intercomparison and Calibration Section, Quality Assurance Branch, Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency (EPA), Las Vegas, Nevada.

[b] All results are in pCi/l, except for elemental potassium (K) data in milk, which are in mg/l; air filter samples, which are in pCi/filter; and food, which is in mg/kg.

[c] Unless otherwise indicated, the TIML results are given as the mean ± 2 standard deviations for three determinations.

[d] USEPA results are presented as the known values and expected laboratory precision (1s, 1 determination) and control limits as defined by EPA.

[e] NA = Not analyzed.

[f] ND = No data; not analyzed due to relocation of lab.

[g] Sample was analyzed but the results not submitted to EPA because deadline was missed (all data on file).

[h] ND = No data; sample lost during analyses.

[i] ND = No data; special EPA testing.

Table A-2. Crosscheck program results, thermoluminescent dosimeters (TLDs).

Lab Code	TLD Type	Measurement	mR: Teledyne Result ±2σ[a]	mR: Known Value	mR: Average ±2σ[d] (All Participants)
2nd International Intercomparison[b]					
115-2	CaF_2:Mn Bulb	Field	17.0±1.9	17.1	16.4±7.7
		Lab	20.8±4.1	21.3	18.8±7.6
3rd International Intercomparison[e]					
115-3	CaF_2:Mn Bulb	Field	30.7±3.2	34.9±4.8	31.5±3.0
		Lab	89.6±6.4	91.7±14.6	86.2±24.0
4th International Intercomparison[f]					
115-4	CaF_2:Mn Bulb	Field	14.1±1.1	14.1±1.4	16.0±9.0
		Lab (Low)	9.3±1.3	12.2±2.4	12.0±7.4
		Lab (High)	40.4±1.4	45.8±9.2	43.9±13.2
5th International Intercomparison[g]					
115-5A	CaF_2:Mn Bulb	Field	31.4±1.8	30.0±6.0	30.2±14.6
		Lab at beginning	77.4±5.8	75.2±7.6	75.8±40.4
		Lab at the end	96.6±5.8	88.4±8.8	90.7±31.2
115-5B	LiF-100 Chips	Field	30.3±4.8	30.0±6.0	30.2±14.6
		Field at beginning	81.1±7.4	75.2±7.6	75.8±40.4
		Lab at the end	85.4±11.7	88.4±8.8	90.7±31.2
7th International Comparison[h]					
115-7A	LiF-100 Chips	Field	75.4±2.6	75.8±6.0	75.1±29.8
		Lab (Co-60)	80.0±3.5	79.9±4.0	77.9±27.6
		Lab (Cs-137)	66.6±2.5	75.0±3.8	73.0±22.2

Table A-2. Crosscheck program results, thermoluminescent dosimeters (TLDs).

Lab Code	TLD Type	Measurement	mR		
			Teledyne Result ±2σ[a]	Known Value	Average ±2σ[d] (All Participants)
115-7B	CaF_2:Mn Bulbs	Field	71.5±2.6	75.8±6.0	75.1±29.8
		Lab (Co-60)	84.8±6.4	79.9±4.0	77.9±27.6
		Lab (Cs-137)	78.8±1.6	75.0±3.8	73.0±22.2
115-7C	$CaSO_4$:Dy Cards	Field	76.8±2.7	75.8±6.0	75.1±29.8
		Lab (Co-60)	82.5±3.7	79.9±4.0	77.9±27.6
		Lab (Cs-137)	79.0±3.2	75.0±3.8	73.0±22.2
8th International Intercomparison[i]					
115-8A	LiF-100 Chips	Field Site 1	29.5±1.4	29.7±1.5	28.9±12.4
		Field Site 2	11.3±0.8	10.4±0.5	10.1±9.06
		Lab (Cs-137)	13.7±0.9	17.2±0.9	16.2±6.8
115-8B	CaF_2:Mn Bulbs	Field Site 1	32.3±1.2	29,7±1.5	28.9±12.4
		Field Site 2	9.0±1.0	10.4±0.5	10.1±9.0
		Lab (Cs-137)	15.8±0.9	17.2±0.9	16.2±6.8
115-8C	$CaSO_4$:Dy Cards	Field Site 1	32.2±0.7	29.7±1.5	28.9±12.4
		Field Site 2	10.6±0.6	10.4±0.5	10.1±9.0
		Lab (Cs-137)	18.1±0.8	17.2±0.9	16.2±6.8
Teledyne Testing					
89-1	LiF-100 Chips	Lab	21.0±0.4	22.4	–
89-2	Teledyne $CaSO_4$:Dy Cards	Lab	20.9±1.0	20.3	–

Table A-2. (continued)

Lab Code	TLD Type	Measurement	mR: Teledyne Result ±2σ[a]	mR: Known Value	mR: Average ±2σ[d] (All Participants)
Teledyne Testing					
90-1[k]	Teledyne $CaSO_4$:Dy Cards	Lab	20.6±1.4	19.6	–
90-2[l]	Teledyne $CaSO_4$:Dy Cards	Lab	100.8±4.3	100.0	–
91-1[m]	Teledyne $CaSO_4$:Dy Cards	Lab	33.4±2.0	32.0	–
			55.2±4.7	58.8	–
			87.8±6.2	85.5	–
92-1[n]	LiF-100 Chips	Lab	11.1±0.2	10.7	–
			25.6±0.5	25.4	–
			46.4±0.5	46.3	–
92-2[o]	Teledyne $CaSO_4$:Dy Cards	Lab (Reader #1)	20.1±0.1	20.1	–
			40.6±0.1	40.0	–
			60.0±1.3	60.3	–
		Lab (Reader #2)	20.3±0.3	20.1	–
			39.2±0.3	40.0	–
			60.7±0.4	60.3	–

a Lab result given is the mean ±2 standard deviations of three determinations.

b Second International Intercomparison of Environmental Dosimeters conducted in April of 1976 by the Health and Safety Laboratory (HASL), New York, New York, and the School of Public Health of the University of Texas, Houston, Texas.

c Value determined by sponsor of the intercomparison using continuously operated pressurized ion chamber.

d Mean ±2 standard deviations of results obtained by all laboratories participating in the program.

e Third International Intercomparison of Environmental Dosimeters conducted in summer of 1977 by Oak Ridge National Laboratory and the School of Public Health of the University of Texas, Houston, Texas.

f Fourth International Intercomparison of Environmental Dosimeters conducted in summer of 1979 by the School of Public Health of the University of Texas Houston, Texas.

g Fifth International Intercomparison of Environmental Dosimeters conducted in fall of 1980 at Idaho Falls, Idaho and sponsored by the School of Public Health of the University of Texas, Houston, Texas and Environmental Measurements Laboratory, New York, New York, U.S. Department of Energy.

Table A-2. (continued)

Lab Code	TLD Type	Measurement	Teledyne Result ±2σ[a] (mR)	Known Value (mR)	Average ±2σ[d] (All Participants) (mR)

Footnotes (continued)

h Seventh International Intercomparison of Environmental Dosimeters conducted in the spring and summer of 1984 at Las Vegas, Nevada, and sponsored by the U.S. Department of Energy, The U.S. Nuclear Regulatory Commission, and the U.S. Environmental Protection Agency.

i Eighth International Intercomparison of Environmental Dosimeters conducted in the fall and winter of 1985-1986 at New York, New York, and sponsored by the U.S. Department of Energy.

j Chips were submitted in September 1989 and cards were submitted in November 1989 to Teledyne Isotopes, Inc., Westwood, NJ for irradiation.

k Cards were irradiated by Teledyne Isotopes, Inc., Westwood, NJ on June 19, 1990.

l Cards were irradiated by Dosimetry Associates, Inc., Northville, MI on October 30, 1990.

m Irradiated cards were provided by Teledyne Isotopes, INC., Westwood, NJ. Irradiated on October 8, 1991.

n Chips were irradiated by Teledyne Isotopes, Inc., Westwood, NJ on February 26, 1992.

o Cards were irradiated by Teledyne Isotopes, Inc., Westwood, NJ on April 1, 1992.

Table A-3. In-house spiked samples.

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L TIML Result 2s, n=3[a]	Known Activity	Expected Precision 1s, n=3[a]
QC-MI-16	Milk	Feb 1988	Sr-89	31.8±4.7	31.7±6.0	8.7
			Sr-90	25.5±2.7	27.8±3.5	5.2
			I-131	26.4±0.5	23.2±5.0	10.4
			Cs-134	23.8±2.3	24.2±6.0	8.7
			Cs-137	26.5±0.8	25.1±6.0	8.7
QC-MI-17	Milk	Feb 1988	I-131	10.6±1.2	14.3±1.6	10.4
QC-W-35	Water	Feb 1988	I-131	9.7±1.1	11.6±1.1	10.4
QC-W-36	Water	Mar 1988	I-131	10.5±1.3	11.6±1.0	10.4
QC-W-37	Water	Mar 1988	Sr-89	17.1±2.0	19.8±8.0	8.7
			Sr-90	18.7±0.9	17.3±5.0	5.2
QC-MI-18	Milk	Mar 1988	I-131	33.2±2.3	26.7±5.0	10.4
			Cs-134	31.3±2.1	30.2±5.0	8.7
			Cs-137	29.9±1.4	26.2±5.0	8.7
QC-W-38	Water	Apr 1988	I-131	17.1±1.1	14.2±5.0	10.4
QC-W-39	Water	Apr 1988	H-3	4439±31	4176±500	724
QC-W-40	Water	Apr 1988	Co-60	23.7±0.5	26.1±4.0	8.7
			Cs-134	25.4±2.6	29.2±4.5	8.7
			Cs-137	26.6±2.3	26.2±4.0	8.7
QC-W-41	Water	Jun 1988	Gr. alpha	12.3±0.4	13.1±5.0	8.7
			Gr. beta	22.6±1.0	20.1±5.0	8.7
QC-MI-19	Milk	Jul 1988	Sr-89	15.1±1.6	16.4±5.0	8.7
			Sr-90	18.0±0.6	18.3±5.0	5.2
			I-131	88.4±4.9	86.6±8.0	10.4
			Cs-137	22.7±0.8	20.8±6.0	8.7
QC-W-42	Water	Sep 1988	Sr-89	48.5±3.3	50.8±8.0	8.7
			Sr-90	10.9±1.0	11.4±3.5	5.2
QC-W-43	Water	Oct 1988	Co-60	20.9±3.2	21.4±3.5	8.7
			Cs-134	38.7±1.6	38.0±6.0	8.7
			Cs-137	19.0±2.4	21.0±3.5	8.7
QC-W-44	Water	Oct 1988	I-131	22.2±0.6	23.3±3.5	10.4

Table A-3. In-house spiked samples(continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L TIML Result 2s, n=3[a]	Known Activity	Expected Precision 1s, n=3[a]
QC-W-45	Water	Oct 1988	H-3	4109±43	4153±500	724
QC-MI-20	Milk	Oct 1988	I-131	59.8±0.9	60.6±9.0	10.4
			Cs-134	49.6±1.8	48.6±7.5	8.7
			Cs-137	25.8±4.6	24.7±4.0	8.7
QC-W-46	Water	Dec 1988	Gr. alpha	11.5±2.3	15.2±5.0	8.7
			Gr. beta	26.5±2.0	25.7±5.0	8.7
QC-MI-21	Milk	Jan 1989	Sr-89	25.5±10.3	34.0±10.0	8.7
			Sr-90	28.3±3.2	27.1±3.0	5.2
			I-131	540±13	550±20	10.4
			Cs-134	24.5±2.6	22.6±5.5	8.7
			Cs-137	24.0±0.6	20.5±5.0	8.7
QC-W-47	Water	Mar 1989	Sr-89	15.2±3.8	16.1±5.0	8.7
			Sr-90	16.4±1.7	16.9±3.0	5.2
QC-MI-22	Milk	Apr 1989	I-131	36.3±1.1	37.2±5.0	10.4
			Cs-134	20.8±2.8	20.7±8.0	8.7
			Cs-137	22.2±2.4	20.4±8.0	8.7
QC-W-48	Water	Apr 1989	Co-60	23.5±2.0	25.1±8.0	8.7
			Cs-134	24.2±1.1	25.9±8.0	8.7
			Cs-137	23.6±1.2	23.0±8.0	8.7
QC-W-49	Water	Apr 1989	I-131	37.2±3.7	37.2±5.0	10.4
QC-W-50	Water	Apr 1989	H-3	3011±59	3089±500	724
QC-W-51	Water	Jun 1989	Gr. alpha	13.0±1.8	15.0±5.0	8.7
			Gr. beta	26.0±1.2	25.5±8.0	8.7
QC-MI-23	Milk	Jul 1989	Sr-89	19.4±6.5	22.0±10.0	8.7
			Sr-90	27.6±3.5	28.6±3.0	5.2
			I-131	46.8±3.2	43.4±5.0	10.4
			Cs-134	27.4±1.8	28.3±6.0	8.7
			Cs-137	24.1±1.8	20.8±6.0	8.7
QC-MI-24	Milk	Aug 1989	Sr-89	25.4±2.7	27.2±10.0	8.7
			Sr-90	46.0±1.1	47.8±9.6	5.2
QC-W-52	Water	Sep 1989	I-131	9.6±0.3	9.7±1.9	10.4

Table A-3. In-house spiked samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L TIML Result 2s, n=3[a]	Known Activity	Expected Precision 1s, n=3[a]
QC-W-53	Water	Sep 1989	I-131	19.0±0.2	20.9±4.2	10.4
QC-W-54	Water	Sep 1989	Sr-89	25.8±4.6	24.7±4.0	8.7
			Sr-90	26.5±5.3	29.7±5.0	5.2
QC-MI-25	Milk	Oct 1989	I-131	70.0±3.3	73.5±20.0	10.4
			Cs-134	22.1±2.6	22.6±8.0	8.7
			Cs-137	29.4±1.5	27.5±8.0	8.7
QC-W-55	Water	Oct 1989	I-131	33.3±1.3	35.3±10.0	10.4
QC-W-56	Water	Oct 1989	Co-60	15.2±0.9	17.4±5.0	8.7
			Cs-134	22.1±4.4	18.9±8.0	8.7
			Cs-137	27.2±1.2	22.9±8.0	8.7
QC-W-57	Water	Oct 1989	H-3	3334±22	3379±500	724
QC-W-58	Water	Nov 1989	Sr-89	10.9±1.4[d]	11.1±1.0[d]	8.7
			Sr-90	10.4±1.0[d]	10.3±1.0[d]	5.2
QC-W-59	Water	Nov 1989	Sr-89	101.0±6.0[d]	104.1±10.5[d]	18.0
			Sr-90	98.0±3.0[d]	95.0±10.0[d]	16.4
QC-W-60	Water	Dec 1989	Gr. alpha	10.8±1.1	10.6±4.0	8.7
			Gr. beta	11.6±0.5	11.4±4.0	8.7
QC-MI-26	Milk	Jan 1990	Cs-134	19.3±1.0	20.8±8.0	8.7
			Cs-137	25.2±1.2	22.8±8.0	8.7
QC-MI-27	Milk	Feb 1990	Sr-90	18.0±1.6	18.8±5.0	5.2
QC-MI-28	Milk	Mar 1990	I-131	63.8±2.2	62.6±6.0	10.8
QC-MI-61	Water	Apr 1990	Sr-89	17.9±5.5	23.1±8.7	8.7
			Sr-90	19.4±2.5	23.5±5.2	5.2
QC-MI-29	Milk	Apr 1990	I-131	90.7±9.2	82.5±8.5	10.4
			Cs-134	18.3±1.0	19.7±5.0	8.7
			Cs-137	20.3±1.0	18.2±5.0	8.7
QC-W-62	Water	Apr 1990	Co-60	8.7±0.4	9.4±5.0	8.7
			Cs-134	20.0±0.2	19.7±5.0	8.7
			Cs-137	28.7±1.4	22.7±5.0	8.7

Table A-3. In-house spiked samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L TIML Result 2s, n=3[a]	Known Activity	Expected Precision 1s, n=3[a]
QC-W-63	Water	Apr 1990	I-131	63.5±8.0	66.0±6.7	11.4
QC-W-64	Water	Apr 1990	H-3	1941±130	1826.0±350.0	724
QC-W-65	Water	Jun 1990	Ra-226	6.4±0.2	6.9±1.0	1.8
QC-W-66	Water	Jun 1990	U	6.2±0.2	6.0±6.0	10.4
QC-MI-30	Milk	Jul 1990	Sr-89	12.8±0.4	18.4±10.0	8.7
			Sr-90	18.2±1.4	18.7±6.0	5.2
			Cs-134	46.0±1.3	49.0±5.0	8.7
			Cs-137	27.6±1.3	25.3±5.0	8.7
QC-W-68	Water	Jun 1990	Gr. alpha	9.8±0.3	10.6±6.0	8.7
			Gr. beta	11.4±0.6	11.3±7.0	8.7
QC-MI-31	Milk	Aug 1990	I-131	68.8±1.6	61.4±12.3	10.4
QC-W-69	Water	Sep 1990	Sr-89	17.7±1.6	19.2±10.0	8.7
			Sr-90	13.9±1.6	17.4±10.0	5.2
QC-MI-32	Milk	Oct 1990	I-131	34.8±0.2	32.4±6.5	8.7
			Cs-134	25.8±1.2	27.3±10.0	8.7
			Cs-137	25.3±2.0	22.4±10.0	8.7
QC-W-70	Water	Oct 1990	H-3	2355±59	2276±455	605
QC-W-71	Water	Oct 1990	I-131	55.9±0.9	51.8±10.4	10.4
QC-W-73	Water	Oct 1990	Co-60	18.3±2.7	16.8±5.0	8.7
			Cs-134	28.3±2.3	27.0±5.0	8.7
			Cs-137	22.7±1.3	22.4±5.0	8.7
QC-W-74	Water	Dec 1990	Gr. alpha	21.4±1.0	26.1±6.5	11.3
			Gr. beta	25.9±1.0	22.3±5.6	8.7

[a] n=3 unless noted otherwise.
[b] n=2
[c] n=1
[d] Concentration in pCi/mL

Table A-3. In-house spiked samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L TIML Result 2s, n=1[e]	Known Activity	Expected Precision 1s, n=1[e]
QC-MI-33	Milk	Jan 1991	Sr-89	20.7±3.3	21.6±5.0	5.0
			Sr-90	19.0±1.4	23.0±3.0	3.0
			Cs-134	22.2±1.7	19.6±5.0	5.0
			Cs-137	26.1±1.6	22.3±5.0	5.0
QC-MI-34	Milk	Feb 1991	I-131	40.7±1.8	40.1±6.0	6.0
QC-W-75	Water	Mar 1991	Sr-89	18.8±1.5	23.3±5.0	5.0
			Sr-90	16.0±0.8	17.2±3.0	3.0
QC-W-76	Water	Apr 1991	I-131	56.5±1.7	59.0±5.9	5.9
QC-W-77	Water	Apr 1991	Co-60	16.4±2.2	15.7±5.0	5.0
			Cs-134	23.8±2.5	22.6±5.0	5.0
			Cs-137	25.0±2.4	21.1±5.0	5.0
QC-W-78	Water	Apr 1991	H-3	4027±188	4080±408	408
QC-MI-35	Milk	Apr 1991	I-131	48.0±0.8	49.2±6.0	6.0
			Cs-134	19.2±2.0	22.6±5.0	5.0
			Cs-137	22.8±2.2	22.1±5.0	5.0
QC-W-79	Water	Jun 1991	Gr. alpha	7.4±0.7	7.8±5.0	5.0
			Gr. beta	11.0±0.7	11.0±5.0	5.0
QC-MI-36	Milk	Jul 1991	Sr-89	28.1±2.1	34.0±10.0	5.0
			Sr-90	11.6±0.7	11.5±3.0	3.0
			I-131	14.4±1.9	18.3±5.0	5.0
			Cs-137	34.3±3.0	35.1±5.0	5.0
QC-W-80	Water	Oct 1991	Sr-89	27.4±6.9	24.4±5.0	5.0
			Sr-90	11.7±1.4	14.1±5.0	3.0
QC-W-81	Water	Oct 1991	I-131	19.1±0.7	20.6±4.2	6.0
QC-W-82	Water	Oct 1991	Co-60	22.6±2.7	22.1±5.0	5.0
			Cs-134	15.5±1.8	17.6±5.0	5.0
			Cs-137	17.5±2.1	17.6±5.0	5.0
QC-W-83	Water	Oct 1991	H-3	4639±137	4382±438	438
QC-MI-37	Milk	Oct 1991	I-131	23.6±3.2	25.8±5.0	6.0
			Cs-134	22.7±2.8	22.1±5.0	5.0
			Cs-137	38.3±3.0	35.1±5.0	5.0
QC-W-84	Water	Dec 1991	Gr. alpha	6.2±0.6	7.8±5.0	5.0
			Gr. beta	11.0±0.7	11.0±5.0	5.0

Table A-3. In-house spiked samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L TIML Result 2s, n=1[e]	Known Activity	Expected Precision 1s, n=1[e]
QC-MI-39	Milk	Jan 1992	Sr-89	21.6±6.5	31.2±10.0	5.0
			Sr-90	38.7±1.8	42.3±8.5	4.2
			I-131	76.8±0.9	83.7±16.0	8.4
			Cs-134	42.1±5.7	49.4±10.0	5.0
			Cs-137	55.2±6.4	53.0±10.0	5.0
QC-W-85	Water	Mar 1992	Sr-89	26.2±3.1	32.0±10.0	5.0
			Sr-90	24.4±1.4	28.0±6.0	3.0
QC-W-86	Water	Apr 1992	H-3	4080±190	4027±403	403
QC-W-87	Water	Apr 1992	I-131	33.5±0.6	33.2±12.0	6.0
QC-W-88	Water	Apr 1992	Co-60	17.5±2.7	19.7±10.0	5.0
			Cs-134	28.9±2.5	33.5±10.0	5.0
			Cs-137	41.0±3.0	38.9±10.0	5.0
QC-MI-40	Milk	Apr 1992	Cs-134	5[9].0±2.6	55.9±10.0	5.0
			Cs-137	43.7±3.0	38.9±10.0	5.0
QC-W-41	Milk	Apr 1992	I-131	50.3±0.8	55.9±11.2	5.6
QC-W-89	Water	Jun 1992	Gr. alpha	15.3±0.8	13.6±10.0	5.0
			Gr. beta	17.2±0.9	17.6±10.0	5.0
QC-MI-42	Milk	Aug. 1992	Sr-89	41.4±5.9	51.2±10.2	5.0
			Sr-90	48.9±2.5	51.9±10.4	5.2
			Cs-134	20.1±2.8	20.2±10.0	5.0
			Cs-137	26.2±2.7	26.1±10.0	5.0
QC-W-90	Water	Sept. 1992	Sr-89	6.7±3.4	12.6±10.0	5.0
			Sr-90	16.1±1.4	15.6±6.0	3.0
QC-W-91	Water	Oct. 1992	I-131	34.9±2.2	34.9±10.0	6.0
QC-W-92	Water	Oct. 1992	Co-60	11.4±1.9	9.2±10.0	5.0
			Cs-134	18.7±2.3	14.3±10.0	5.0
			Cs-137	14.1±1.8	15.0±10.0	5.0

Table A-3. In-house spiked samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L TIML Result 2s, n=1[e]	Known Activity	Expected Precision 1s, n=1[e]
QC-W-93	Water	Oct. 1992	H-3	3704±186	3904±390	367
QC-W-94	Water	Oct. 1992	H-3	14,925±339	15,616±1,562	1562
QC-W-95	Water	Oct. 1992	I-131	64.2±2.7	67.2±10.0	6.7
QC-MI-43	Milk	Oct. 1992	I-131	19.9±1.0	21.5±6.0	6.0
			Cs-134	14.2±3.4	12.7±10.0	5.0
			Cs-137	14.1±5.2	17.1±10.0	5.0
QC-MI-44	Milk	Oct. 1992	I-131	36.1±1.2	43.0±10.0	6.0
			Cs-134	28.2±4.0	25.4±10.0	5.0
			Cs-137	38.8±5.1	34.2±10.0	5.0

[e] Starting in January 1991, all determinations are single.

Table A-4. In-house "blank" samples.

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Concentration (pCi/L) Acceptance Criteria (4.66 σ)
SPS-5386	Milk	Jan 1988	I-131	<0.1	<1
SPW-5448	"Dead" Water	Jan 1988	H-3	<177	<300
SPS-5615	Milk	Mar 1988	Cs-134	<2.4	<10
			Cs-137	<2.5	<10
			I-131	<0.3	<1
			Sr-89	<0.4	<5
			Sr-90	2.4±0.5[a]	<1
SPS-5650	D.I. Water	Mar 1988	Th-228	<0.3	<1
			Th-230	<0.04	<1
			Th-232	<0.05	<1
			U-234	<0.03	<1
			U-235	<0.03	<1
			U-238	<0.03	<1
			Am-241	<0.06	<1
			Cm-241	<0.01	<1
			Pu-238	<0.08	<1
			Pu-240	<0.02	<1
SPS-6090	Milk	Jul 1988	Sr-89	<0.5	<1
			Sr-90	1.8±0.5	<1
			I-131	<0.4	<1
			Cs-137	<0.4	<10
SPW-6209	Water	Jul 1988	Fe-55	<0.8	<1
SPW-6292	Water	Sep 1988	Sr-89	<0.7	<5
			Sr-90	<0.7	<1
SPS-6477	Milk	Oct 1988	I-131	<0.2	<1
			Cs-134	<6.1	<10
			Cs-137	<5.9	<10
SPW-6478	Water	Oct 1988	I-131	<0.2	<1
SPW-6479	Water	Oct 1988	Co-60	<5.7	<10
			Cs-134	<3.7	<10
			Cs-137	<4.3	<10
SPW-6480	Water	Oct 1988	H-3	<170	<300

Table A-4. In-house "blank" samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Concentration (pCi/L) Acceptance Criteria (4.66 σ)
SPW-6625	Water	Dec 1988	Gr. alpha	<0.7	<1
			Gr. beta	<1.9	<4
SPS-6723	Milk	Jan 1989	Sr-89	<0.6	<5
			Sr-90	1.9±0.5[a]	<1
			I-131	<0.2	<1
			Cs-134	<4.3	<10
			Cs-137	<4.4	<10
SPW-6877	Water	Mar 1989	Sr-89	<0.4	<5
			Sr-90	<0.6	<1
SPS-6963	Milk	Apr 1989	I-131	<0.3	<1
			Cs-134	<5.9	<10
			Cs-137	<6.2	<10
SPW-7561	Water	Apr 1989	H-3	<150	<300
SPW-7207	Water	Jun 1989	Ra-226	<0.2	<1
			Ra-228	<0.6	<1
SPS-7208	Milk	Jun 1989	Sr-89	<0.6	<5
			Sr-90	2.1±0.5[a]	<1
			I-131	<0.3	<1
			Cs-134	<6.4	<10
			Cs-137	<7.2	<10
SPW-7588	Water	Jun 1989	Gr. alpha	<0.2	<1
			Gr. beta	<1.0	<4
SPS-7322	Milk	Aug 1989	Sr-89	<1.4	<5
			Sr-90	4.8±1.0[a]	<1
			I-131	<0.2	<1
			Cs-134	<6.9	<10
			Cs-137	<8.2	<10
SPW-7559	Water	Sep 1989	Sr-89	<2.0	<5
			Sr-90	<0.7	<1
SPW-7560	Water	Oct 1989	I-131	<0.1	<1
SPW-7562	Water	Oct 1989	H-3	<140	<300

Table A-4. In-house "blank" samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Concentration (pCi/L) Acceptance Criteria (4.66 σ)
SPS-7605	Milk	Nov 1989	I-131	<0.2	<1
			Cs-134	<8.6	<10
			Cs-137	<10	<10
SPW-7971	Water	Dec 1989	Gr. alpha	<0.4	<1
			Gr. beta	<0.8	<4
SPW-8039	Water	Jan 1990	Ra-226	<0.2	<1
SPS-8040	Milk	Jan 1990	Sr-89	<0.8	<5
			Sr-90	<1.0	<1
SPS-8208	Milk	Jan 1990	Sr-89	<0.8	<5
			Sr-90	1.6±0.5[a]	<1
			Cs-134	<3.6	<10
			Cs-137	<4.7	<10
SPS-8312	Milk	Feb 1990	Sr-89	<0.3	<5
			Sr-90	1.2±0.3[a]	<1
SPW-8312A	Water	Feb 1990	Sr-89	<0.6	<5
			Sr-90	<0.7	<5
SPS-8314	Milk	Mar 1990	I-131	<0.3	<1
SPS-8510	Milk	May 1990	I-131	<0.2	<1
			Cs-134	<4.6	<10
			Cs-137	<4.8	<10
SPW-8511A	Water	May 1990	H-3	<200	<300
SPS-8600	Milk	Jul 1990	Sr-89	<0.8	<5
			Sr-90	1.7±0.6[a]	<1
			I-131	<0.3	<1
			Cs-134	<5.0	<10
			Cs-137	<7.0	<10
SPM-8877	Milk	Aug 1990	I-131	<0.2	<1
SPW-8925	Water	Aug 1990	H-3	<200	<300

Table A-4. In-house "blank" samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Concentration (pCi/L) Acceptance Criteria (4.66 σ)
SPW-8926	Water	Aug-1990	Gr. alpha	<0.3	<1
			Gr. beta	<0.7	<4
SPW-8927	Water	Aug 1990	U-234	<0.01	<1
			U-235	<0.02	<1
			U-238	<0.01	<1
SPW-8928	Water	Aug 1990	Mn-54	<4.0	<10
			Co-58	<4.1	<10
			Co-60	<2.4	<10
			Cs-134	<3.3	<10
			Cs-137	<3.7	<10
SPW-8929	Water	Aug 1990	Sr-89	<1.4	<5
			Sr-90	<0.6	<1
SPW-69	Water	Sep 1990	Sr-89	<1.8	<5
			Sr-90	<0.8	<1
SPW-106	Water	Oct 1990	H-3	<180	<300
			I-131	<0.3	<1
SPM-107	Milk	Oct 1990	I-131	<0.4	<1
			Cs-134	<3.3	<10
			Cs-137	<4.3	<10
SPW-370	Water	Oct 1990	Mn-54	<1.7	<10
			Co-58	<2.6	<10
			Co-60	<1.6	<10
			Cs-134	<1.7	<10
			Cs-137	<1.8	<10
SPW-372	Water	Dec 1990	Gr. alpha	<0.3	<1
			Gr. beta	<0.8	<4
SPS-406	Milk	Jan 1991	Sr-89	<0.4	<5
			Sr-90	1.8±0.4[a]	<1
			Cs-134	<3.7	<10
			Cs-137	<5.2	<10
SPS-421	Milk	Feb 1991	I-131	<0.3	<1
SPW-451	Water	Feb 1991	Ra-226	<0.1	<1
			Ra-228	<0.9	<1

Table A-4. In-house "blank" samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Concentration (pCi/L) Acceptance Criteria (4.66 σ)
SPW-514	Water	Mar 1991	Sr-89	<1.1	<5
			Sr-90	<0.9	<1
SPW-586	Water	Apr 1991	I-131	<0.2	<1
			Co-60	<2.5	<10
			Cs-134	<2.4	<10
			Cs-137	<2.2	<10
SPS-587	Milk	Apr 1991	I-131	<0.2	<1
			Cs-134	<1.7	<10
			Cs-137	<1.9	<10
SPW-837	Water	Jun 1991	Gr. alpha	<0.6	<1
			Gr. beta	<1.1	<4
SPM-953	Milk	Jul 1991	Sr-89	<0.7	<5
			Sr-90	0.4±0.3[a]	<1
			I-131	<0.2	<1
			Cs-137	<4.9	<10
SPM-1236	Milk	Oct 1991	I-131	<0.2	<1
			Cs-134	<3.7	<10
			Cs-137	<4.6	<10
SPW-1254	Water	Oct 1991	Sr-89	<2.8	<5
			Sr-90	<0.7	<1
SPW-1256	Water	Oct 1991	I-131	<0.4	<1
			Co-60	<3.6	<10
			Cs-134	<4.0	<10
			Cs-137	<3.6	<10
SPW-1259	Water	Oct 1991	H-3	<160	<300
SPW-1444	Water	Dec 1991	Gr. alpha	<0.4	<1
			Gr. beta	<0.8	<4
SPM-1578	Milk	Jan 1992	Sr-89	<0.5	<5
			Sr-90	1.3±0.4[a]	<1
			I-131	<0.2	<1
			Cs-134	<7.2	<10
			Cs-137	<8.0	<10

Table A-4. In-house "blank" samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Concentration (pCi/L) Acceptance Criteria (4.66 σ)
SPW-1860	Water	Mar 1992	Sr-89	<0.6	<5
			Sr-90	<0.4	<1
SPW-2067	Water	Apr 1992	H-3	<168	<300
SPW-2114	Water	Apr 1992	C-14	<1.0	<200
SPW-2119	Milk	Apr 1992	Co-60	<6.3	<10
			Cs-134	<4.5	<10
			Cs-137	<5.4	<10
SPW-2126	Water	Apr 1992	I-131	<0.2	<1
SPM-2133	Milk	Apr 1992	I-131	<0.2	<1
SPW-2220	Water	May 1992	Co-60	<2.1	<10
			Cs-134	<2.1	<10
			Cs-137	<2.3	<10
SPW-2369	Water	Jun 1992	Gr. alpha	<0.4	<1
			Gr. beta	<0.8	<4
SPM-2500	Milk	Aug 1992	I-131	<0.4	<1
			Sr-89	<1.2	<5
			Sr-90	<0.9	<1
SPW-2666	Water	Sept. 1992	Sr-89	<0.8	<5
			Sr-90	<0.5	<1
SPW-2828	Water	Oct. 1992	Co-60	<4.8	<10
			Cs-134	<6.0	<10
			Cs-137	<6.1	<10
			I-131	<0.3	<1
			H-3	<177	<300
SPM-2829	Milk	Oct. 1992	Co-60	<9.3	<10
			Cs-134	<6.4	<10
			Cs-137	<7.2	<10
SPW-3212	Water	Oct 1992	Ra-228	<1.0	<1
SPW-3057	Water	NOv. 1992	Ra-226	<0.03	<1
SPW-3294	Water	Dec. 1992	Gr. alpha	<0.4	<1
			Gr. beta	<0.8	<4

[a] Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.

ATTACHMENT B

ACCEPTANCE CRITERIA FOR "SPIKED" SAMPLES

LABORATORY PRECISION: ONE STANDARD DEVIATION VALUES FOR VARIOUS ANALYSES[a]

Analysis	Level	One Standard Deviation for Single Determination
Gamma Emitters	5 to 100 pCi/liter or kg	5 pCi/liter
	>100 pCi/liter or kg	5% of known value
Strontium-89[b]	5 to 50 pCi/liter or kg	5 pCi/liter
	>50 pCi/liter or kg	10% of known value
Strontium-90[b]	2 to 30 pCi/liter or kg	3.0 pCi/liter
	>30 pCi/liter or kg	10% of known value
Potassium	>0.1 g/liter or kg	5% of known value
Gross alpha	<20 pCi/liter	5 pCi/liter
	>20 pCi/liter	25% of known value
Gross beta	<100 pCi/liter	5 pCi/liter
	>100 pCi/liter	5% of known value
Tritium	<4,000 pCi/liter	$1s = (pCi/liter) = 169.85 \times (known)^{.0933}$
	>4,000 pCi/liter	10% of known value
Radium-226, -228	<0.1 pCi/liter	15% of known value
Plutonium	0.1 pCi/liter, gram, or sample	10% of known value
Iodine-131, Iodine-129[b]	<55 pCi/liter	6 pCi/liter
	>55 pCi/liter	10% of known value
Uranium-238, Nickel-64[b], Technetium-99[b]	<35 pCi/liter	6 pCi/liter
	>35 pCi/liter	15% of known value
Iron-55[b]	50 to 100 pCi/liter	10 pCi/liter
	>100 pCi/liter	10% of known value

[a] From EPA publication, "Environmental Radioactivity Laboratory Intercomparison Studies Program, Fiscal Year, 1981-1982, EPA-600/4-81-004.

[b] TIML limit

ADDENDUM TO APPENDIX A

The following is an explanation of the reasons why certain samples were outside the control limit specified by the Environmental Protection Agency for the Interlaboratory Comparions Program starting January 1988.

Lab Code	Analysis	TIML Result (pCi/L)[a]	EPA Control Limit (pCi/L)[a]	Explanation
STF-524	K	1010.7±158.5[b]	1123.5-1336.5[b]	Error in transference of data. Correct data was 1105±33 mg/kg. Results in the past have been within the limits and TIML will monitor the situation in the future.
STW-532	I-131	9.0±2.0	6.2-8.8	Sample recounted after 12 days. The average result was 8.8±1.7 pCi/L (within EPA control limits). The sample was recounted in order to check the decay. Results in the past have been within the limits and TIML will continue to monitor the situation in the future.
STW-534	Co-60	63.3±1.3	41.3-58.7	High level of Co-60 was due to contamination of beaker. Beaker was discarded upon discovery of contamination and sample was recounted. Recount results were 53.2±3.6 and 50.9±2.4 pCi/L.
STM-554	Sr-90	51.0±2.0	54.8-65.2	The cause of low result was due to very high fat content of milk. It should be noted that 63% of all participants failed this test. Also, the average for all participants was 54.0 pCi/L before the Grubb and 55.8 pCi/L after the Grubb.
STW-560	Pu-239	5.8±1.1	3.5-4.9	The cause of high results is not known though it is suspected that the standard was not properly calibrated by supplier and is under investigation. New Pu-236 standard was obtained and will be used for the next test.
STW-568	Ra-228	2.6±1.0	2.7-4.5	The cause of low results is not known. Next EPA cross check results were within the control limits. No further action is planned.

Lab Code	Analysis	TIML Result (pCi/L)[a]	EPA Control Limit (pCi/L)[a]	Explanation
STM-570	Sr-89	26.0±10.0	30.3-47.7	The cause of low results was falsely high recovery due to suspected incomplete calcium removal. Since EPA sample was used up, internal spike was prepared and analyzed. The results were within control limits (See table A-3, sample QC-MI-24). No further action is planned.
	Sr-90	45.7±4.2	49.8-60.2	
STW-589	Sr-90	17.3±1.2	17.4-22.6	Sample was reanalyzed in triplicate; results of reanalyses were 18.8±1.5 pCi/L. No further action is planned.
STM-599	K	1300.0±69.2[c]	1414.7-1685.3[c]	Sample was reanalyzed in triplicate. Results of reanalyses were 1421.7±95.3 mg/L. The cause of low results was using wrong volume.
STW-601	Gr. alpha	11.0±2.0	11.6-32.4	Sample was reanalyzed in triplicate. Results of reanalyses were 13.4±1.0 pCi/L.
STAF-626	Gr. alpha	38.7±1.2	14.6-35.4	The cause of high results is the difference in geometery between standard used in the TIML lab and EPA filter.
STW-632	Ba-133	74.0±6.9	51.6-72.4	Sample was reanalyzed. Results of the reanalyses were 63.8±6.9 pCi/L within EPA limit.
STM-641	I-131	130.7±16.8	88.9-127.1	The cause of high result is unknown. In-house spike sample was prepared with activity of I-131 68.3±6.8 pCi/L. Result of the analysis was 69.1±9.7 pCi/L.
STM-661	Sr-89	25.3±7.6	29.3-46.7	The cause of low result is unknown. Data was checked for errors. The In-house spike sample was prepared with activity of Sr-89 41.0±10.0 pCi/L. Result of the analysis was 37.2±3.6 pCi/L.

Lab Code	Analysis	TIML Result (pCi/L)[a]	EPA Control Limit (pCi/L)[a]	Explanation
STM-673	K	1540.0±103.9[c]	1597.3-1902.7	Activity was calculated using the wrong volume (3.5 L), instead of 3.25 L. Correction for volume resulted in a value of 1660.0±110.1 mg/L; within EPA control limits.

[a] Reported in pCi/L unless otherwise noted.

[c] Concentrations are reported in mg/L.

APPENDIX B

DATA REPORTING CONVENTIONS

Data Reporting Conventions

1.0. All activities except gross alpha and gross beta are decay corrected to collection time or the end of the collection period.

2.0. Single Measurements

Each single measurement is reported as follows:

$$x \pm s$$

where x = value of the measurement;

s = 2σ counting uncertainty (corresponding to the 95% confidence level).

In cases where the activity is found to be below the lower limit of detection L it is reported as

$$< L$$

where L = the lower limit of detection based on 4.66σ uncertainty for a background sample.

3.0. Duplicate analyses

3.1 Individual results: $x_1 \pm s_1$

$x_1 \pm s_2$

Reported result: $x \pm s$

where $x = (1/2)\ (x_1 \pm x_2)$

$$s = (1/2)\sqrt{s_1^2 + s_2^2}$$

3.2. Individual results: $< L_1$

$< L_2$

Reported result: $< L$

where L = lower of L_1 and L_2

3.3. Individual results: $x \pm s$

$< L$

Reported result: $x \pm s$ if $x \geq L$;

$< L$ otherwise

4.0. Computation of Averages and Standard Deviations

4.1 Averages and standard deviations listed in the tables are computed from all of the individual measurements over the period averaged; for example, an annual standard deviation would not be the average of quarterly standard deviations. The average $\bar{x}$ and standard deviation(s) of a set of n numbers $x_1, x_2 \ldots x_n$ are defined as follows:

$$\bar{x} = \frac{1}{n} \Sigma x$$

$$s = \sqrt{\frac{\Sigma (x-\bar{x})^2}{n-1}}$$

4.2 Values below the highest lower limit of detection are not included in the average.

4.3 If all of the values in the averaging group are less than the highest LLD, the highest LLD is reported.

4.4 If all but one of the values are less than the highest LLD, the single value x and associated two sigma error is reported.

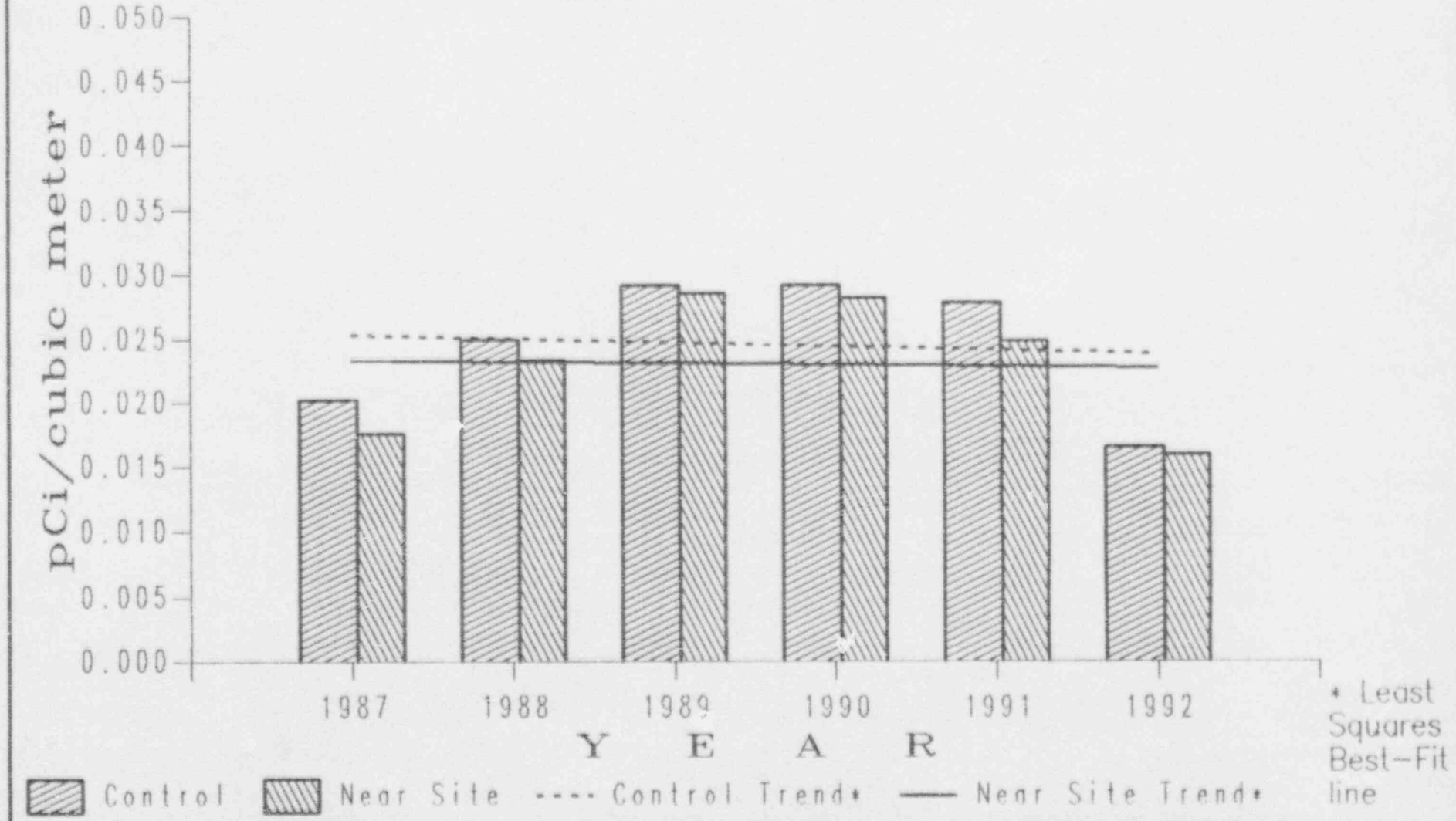
4.5 In rounding off, the following rules are followed:

4.5.1. If the figure following those to be retained is less than 5, the figure is dropped, and the retained figures are kept unchanged. As an example, 11.443 is rounded off to 11.44.

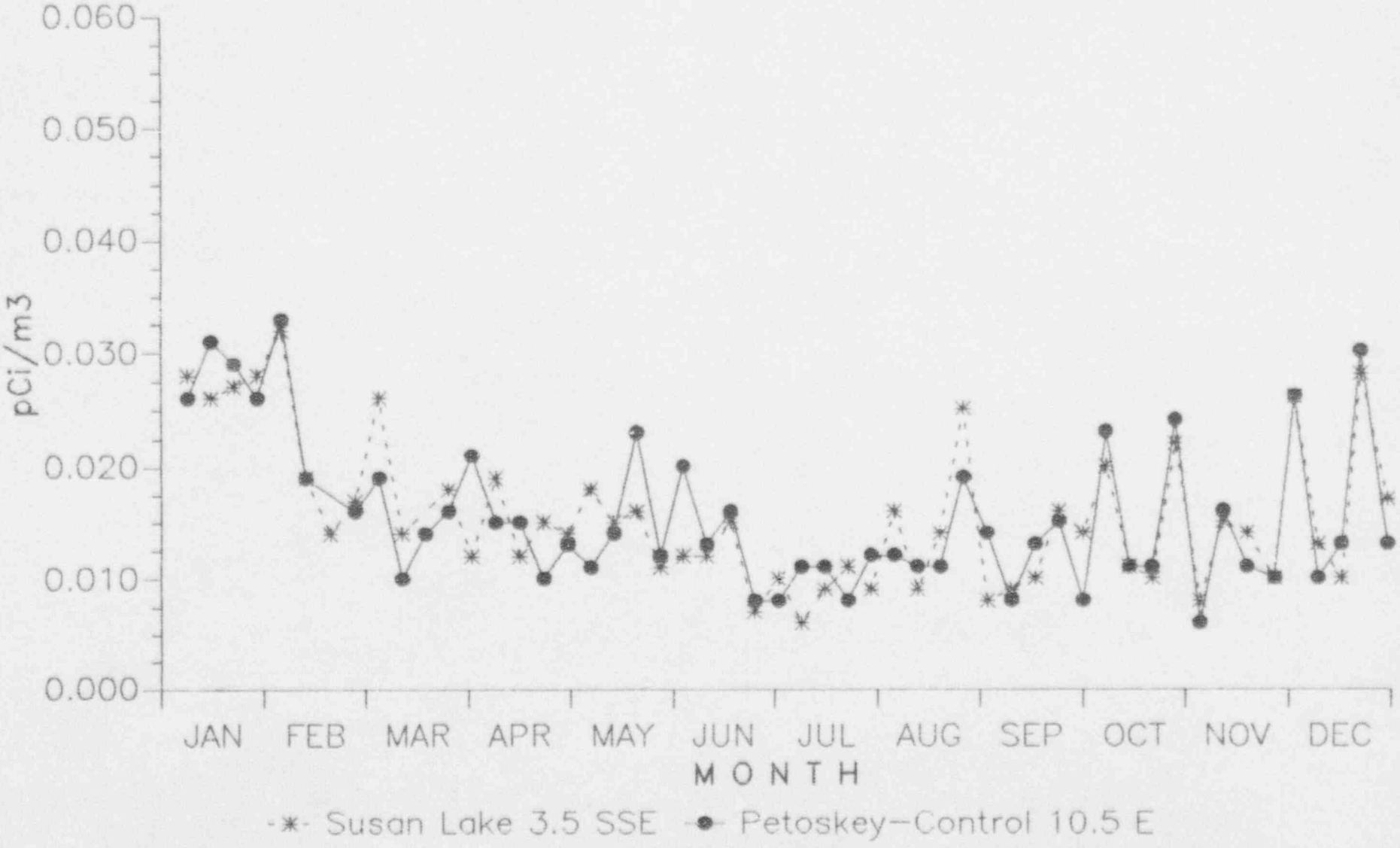
4.5.2. If the figure following those to be retained is greater than 5, the figure is dropped and the last retained figure is raised by 1. As an example, 11.446 is rounded off to 11.45.

4.5.3. If the figure following those to be retained is 5, and if there are no figures other than zeros beyond the five, the figure five is dropped, and the last-place figure retained is increased by one if it is an odd number or it is kept unchanged if an even number. As an example, 11.435 is rounded off to 11.44, while 11.425 is rounded off to 11.42.

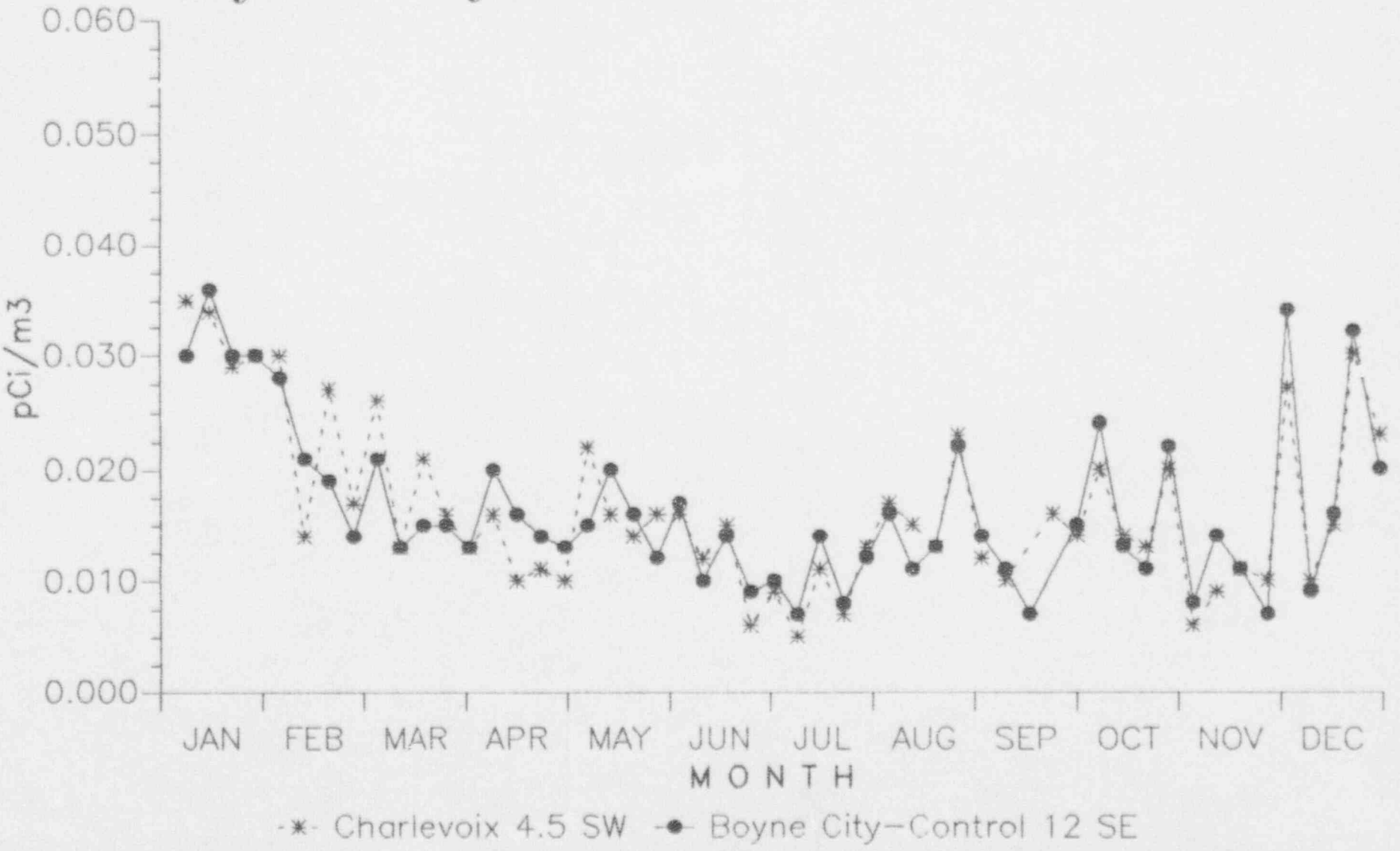
Big Rock Point
Air Particulate Gross Beta
1987 - 1992



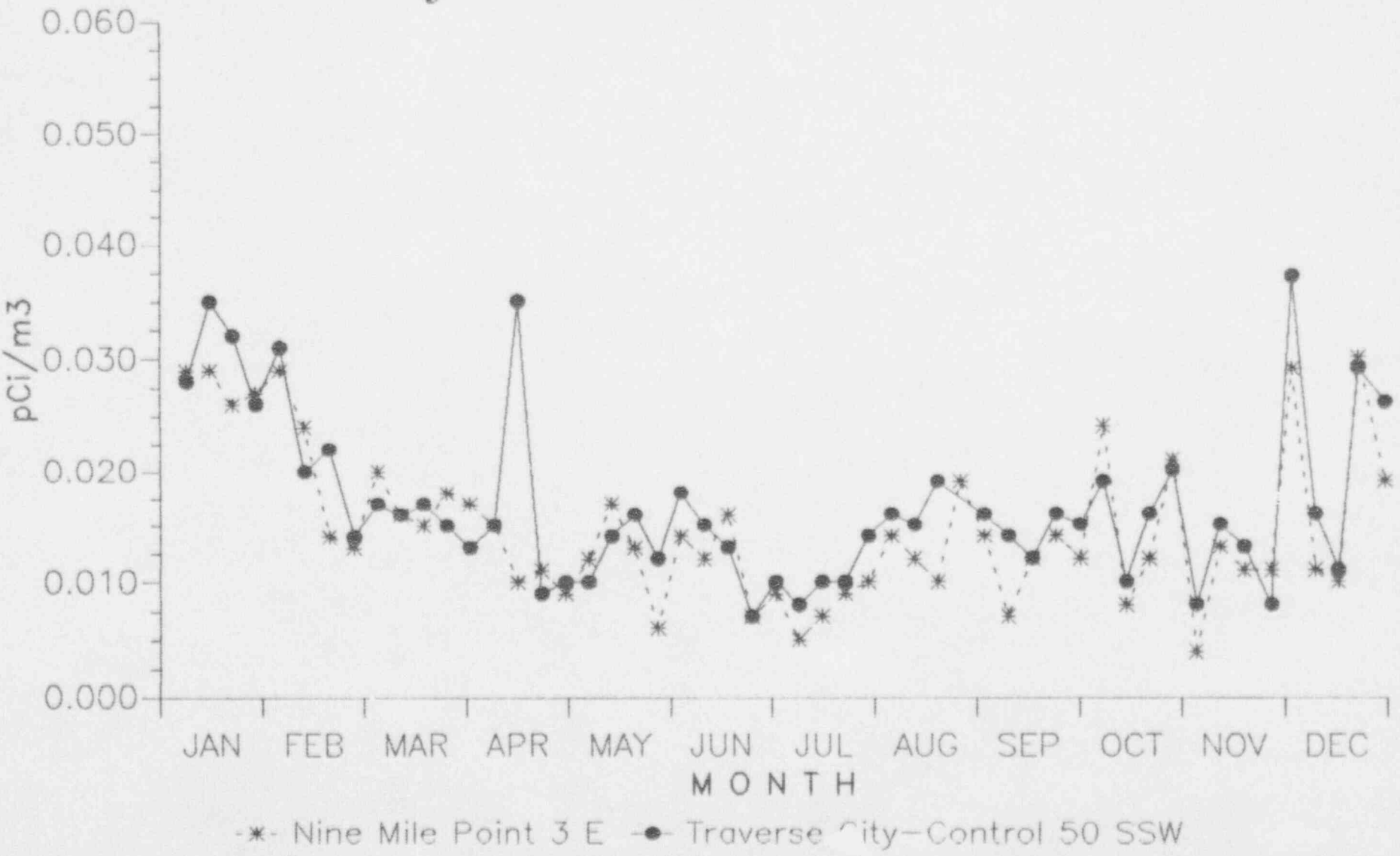
1992 BIG ROCK POINT AIR PARTICULATE
Weekly Gross Beta pCi/Cubic Meter
Petoskey-Control vs Susan Lake



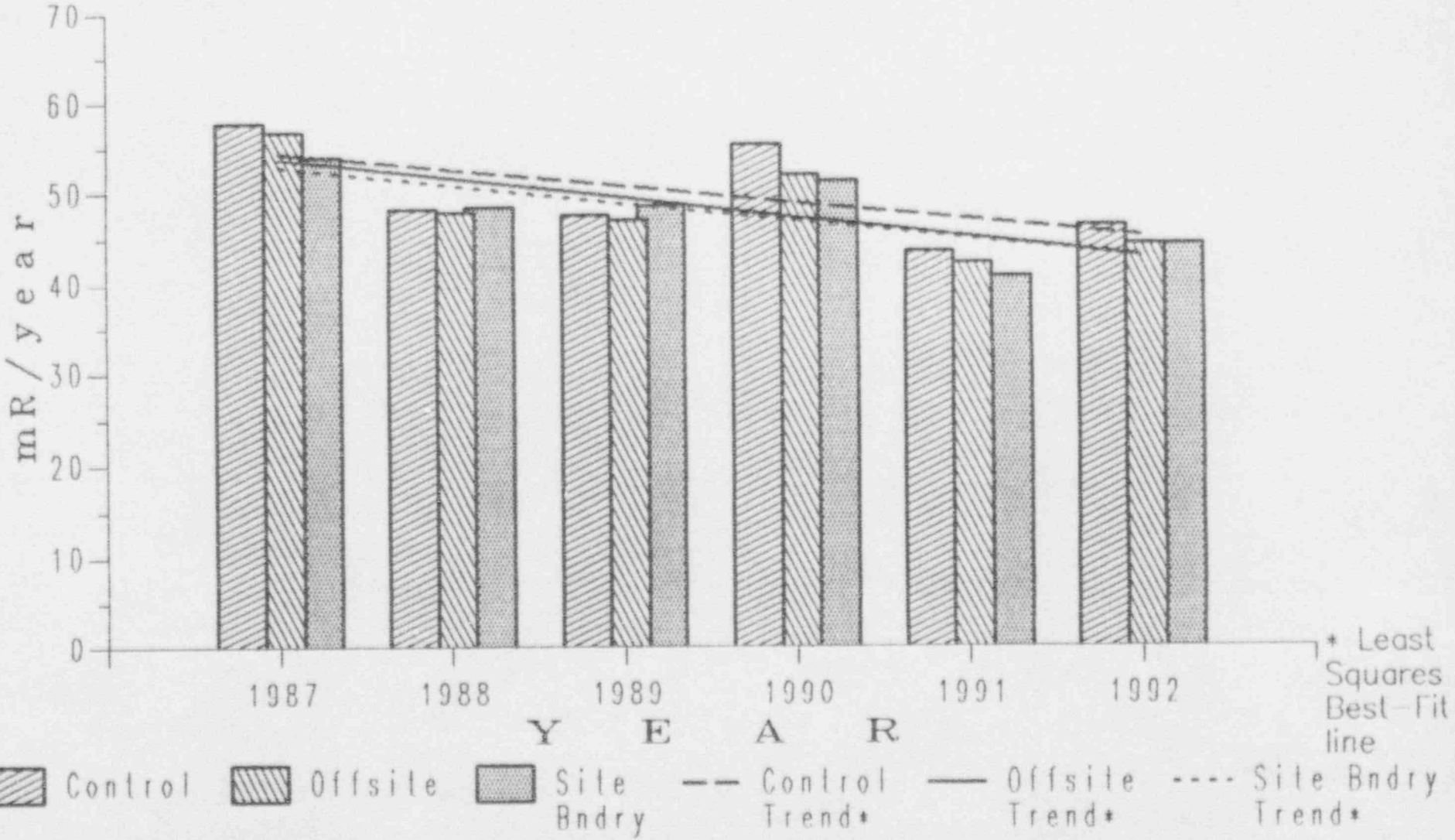
1992 BIG ROCK POINT AIR PARTICULATE
Weekly Gross Beta pCi/Cubic Meter
Boyne City–Control vs Charlevoix



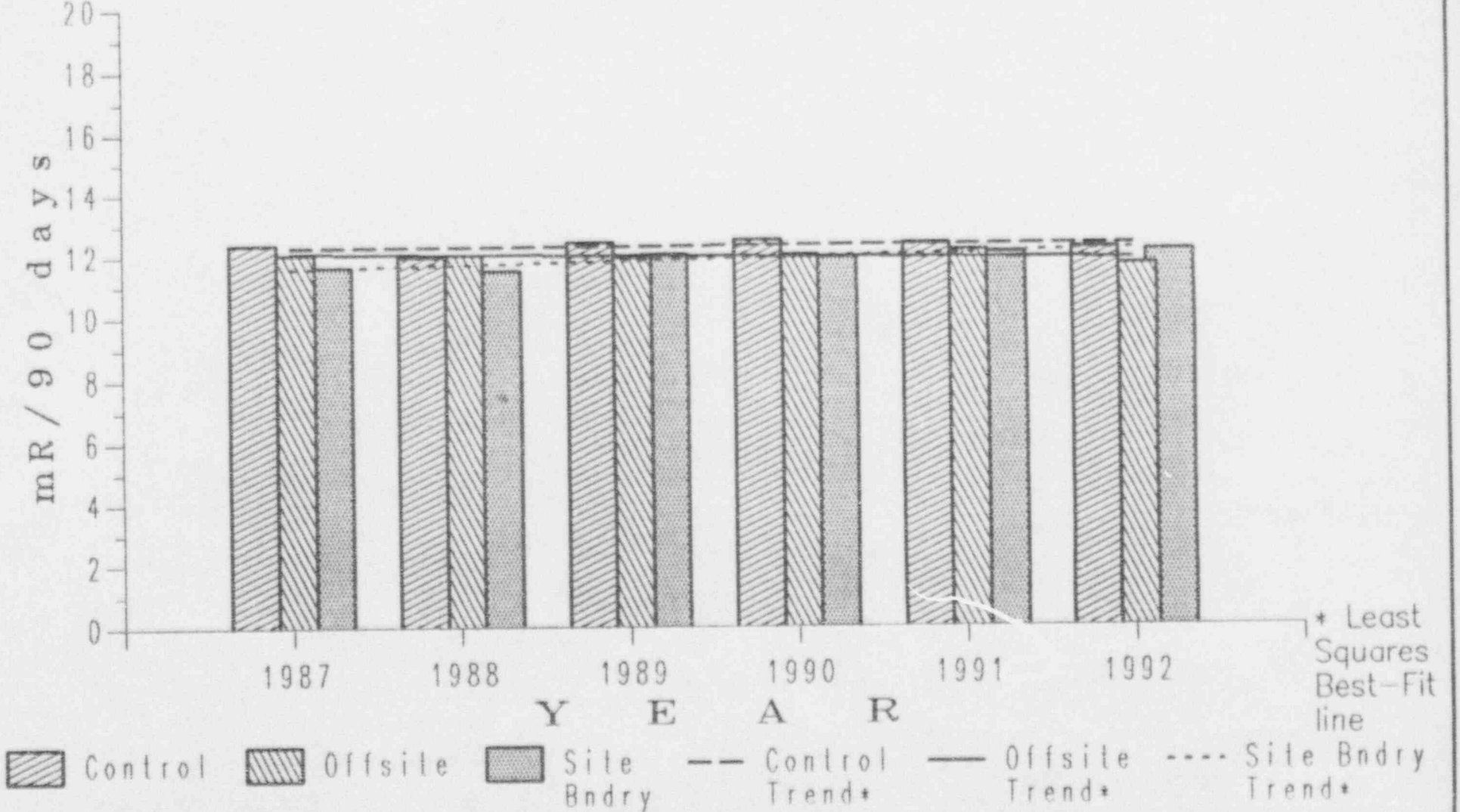
1992 BIG ROCK POINT AIR PARTICULATE
Weekly Gross Beta pCi/Cubic Meter
Traverse City–Control vs Nine Mile Point



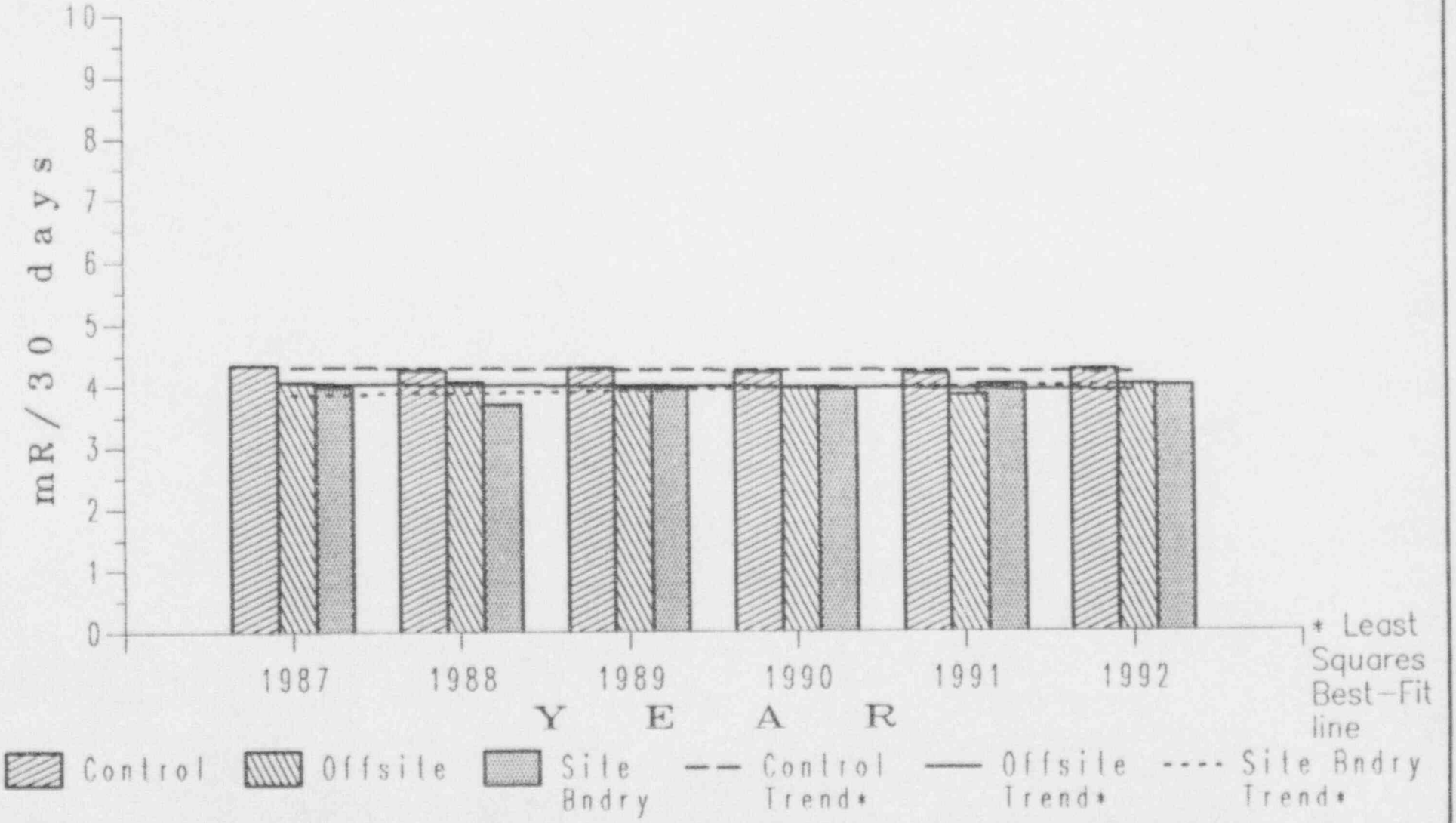
Big Rock Point
Annual TLD's
1987 - 1992



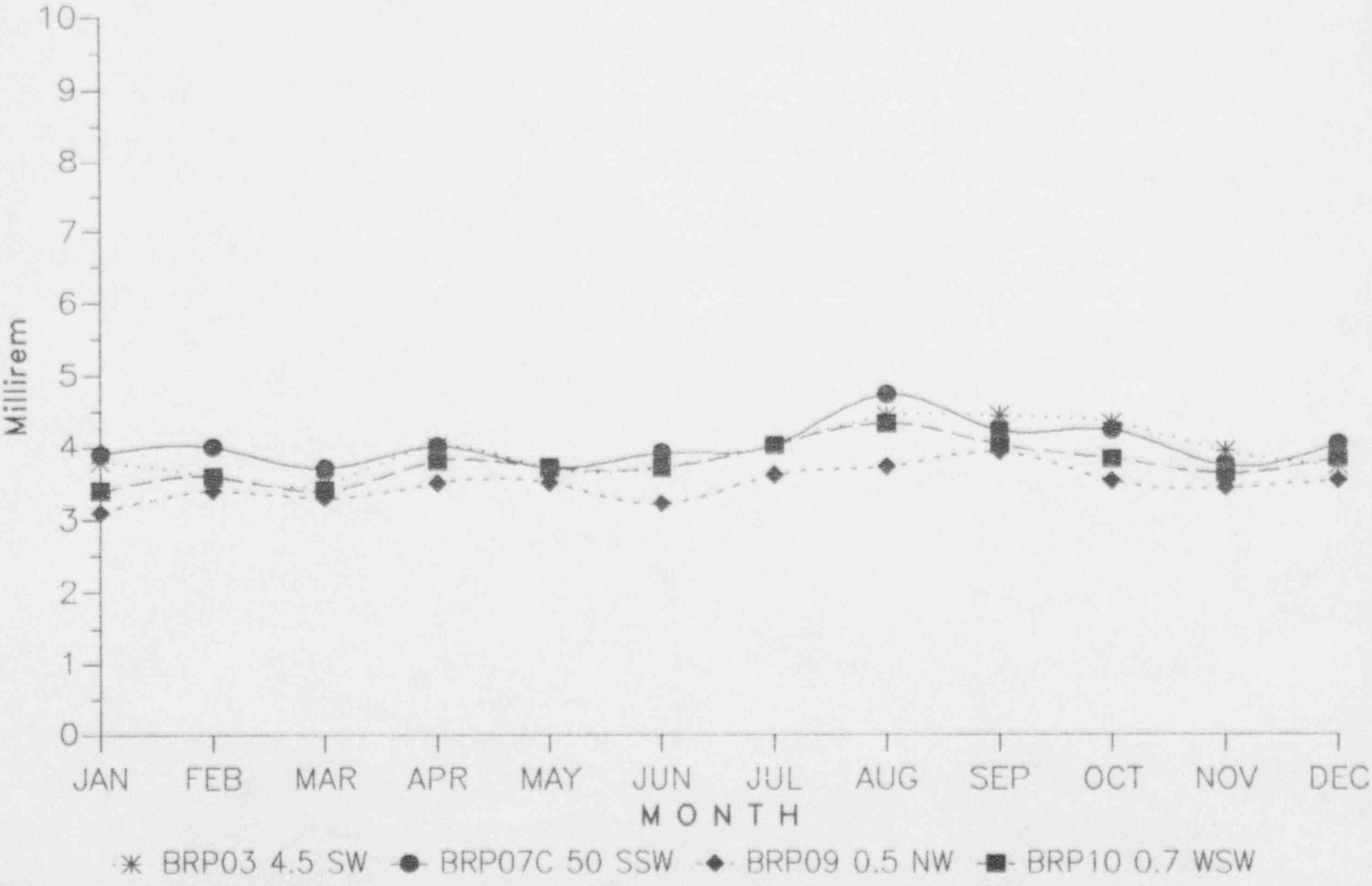
Big Rock Point
Quarterly TLD's
1987 - 1992



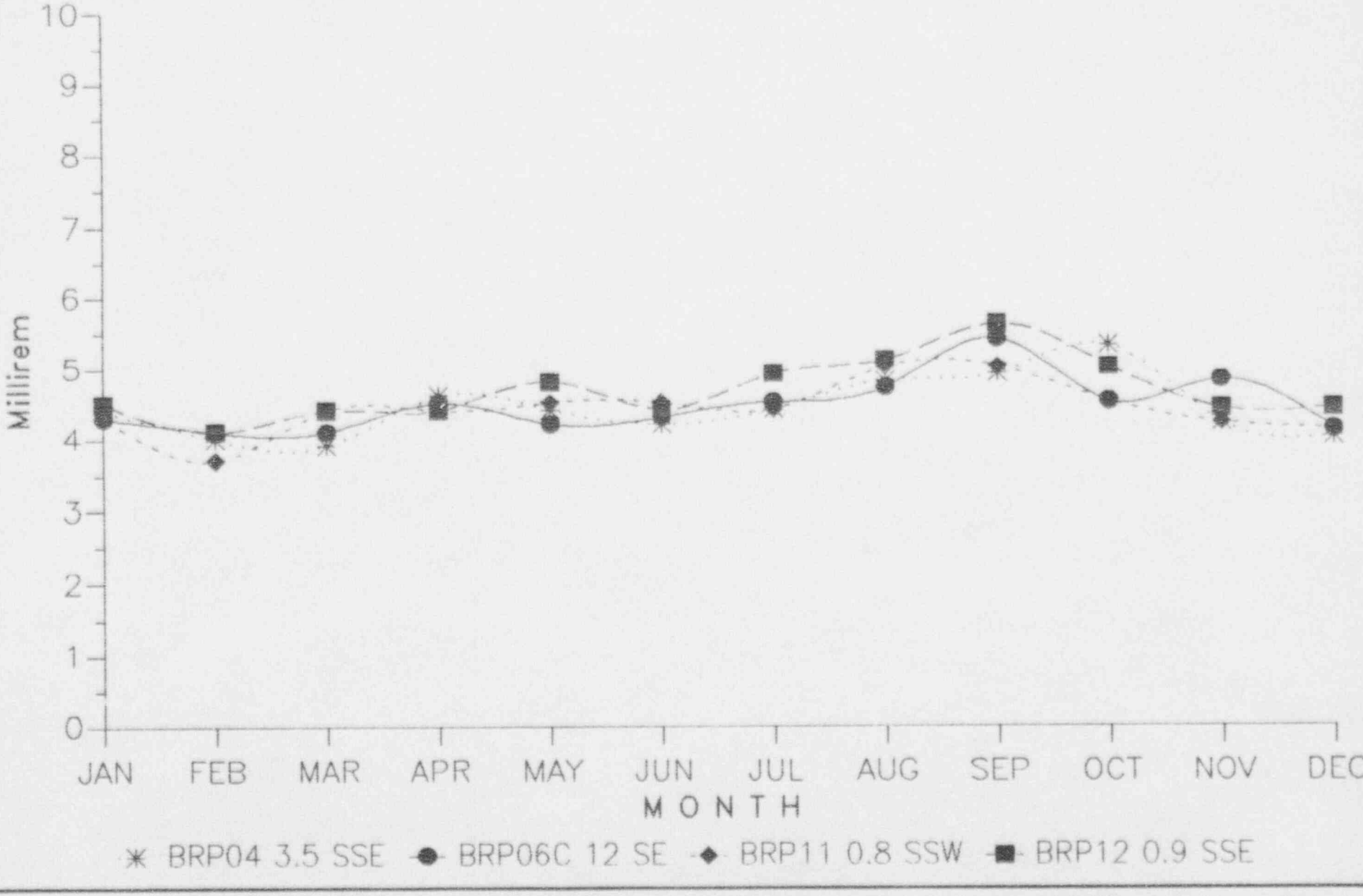
Big Rock Point
Monthly TLD's
1987 - 1992



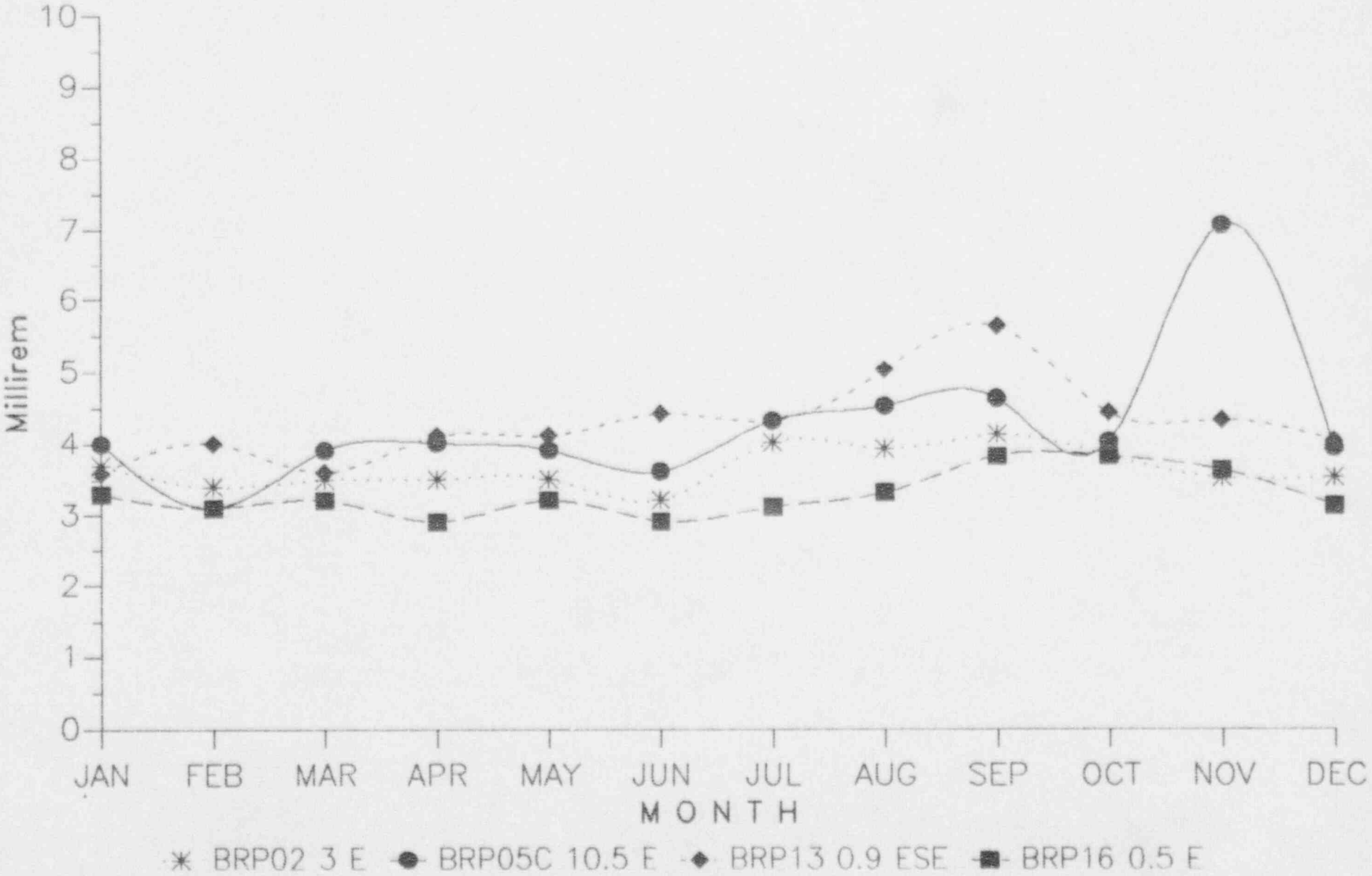
1992 BIG ROCK POINT TLD's
BRP07 Control vs BRP03, BRP09 and BRP10



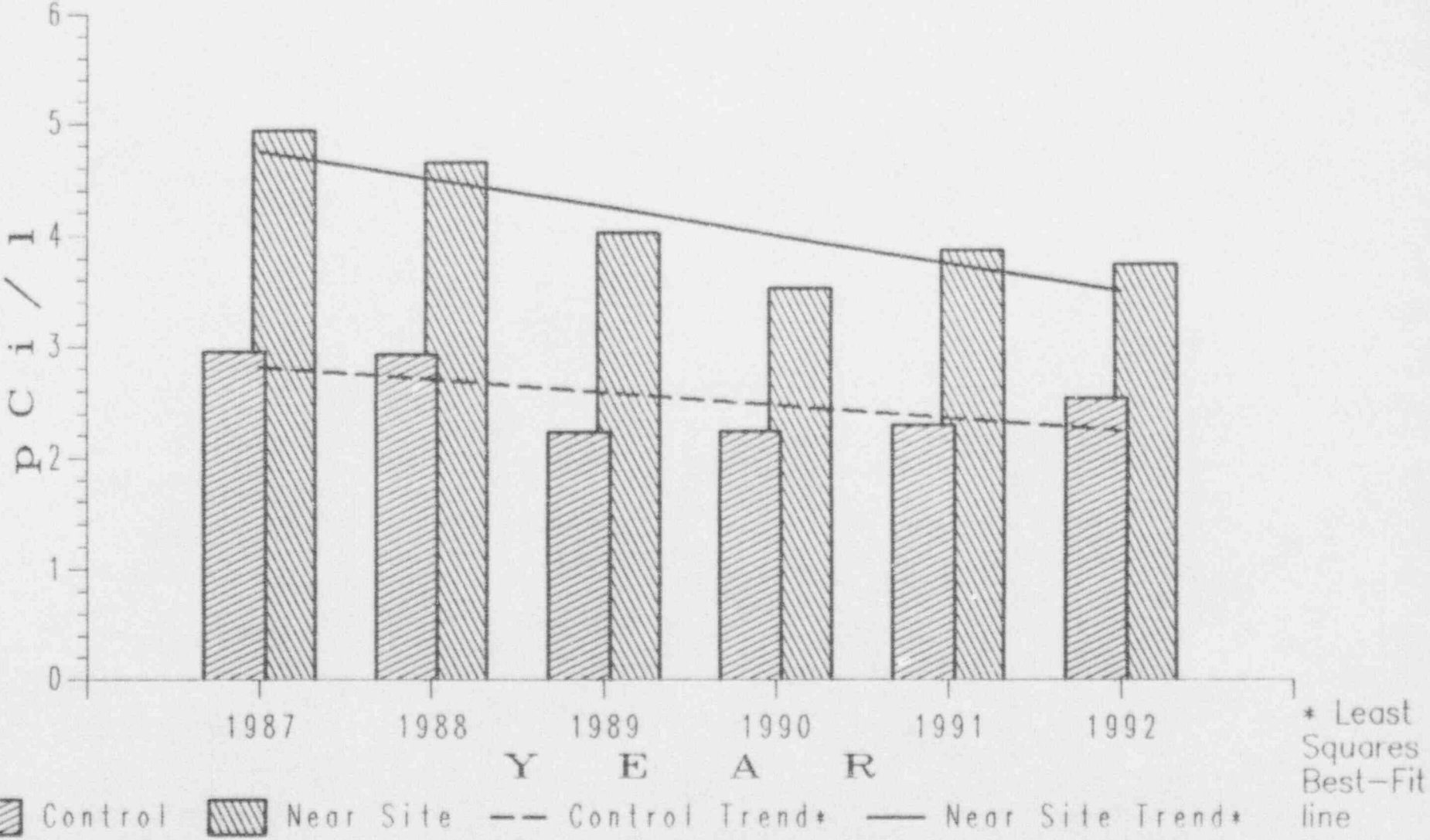
1992 BIG ROCK POINT TLD's
BRP06 Control vs BRP04, BRP11 and BRP12



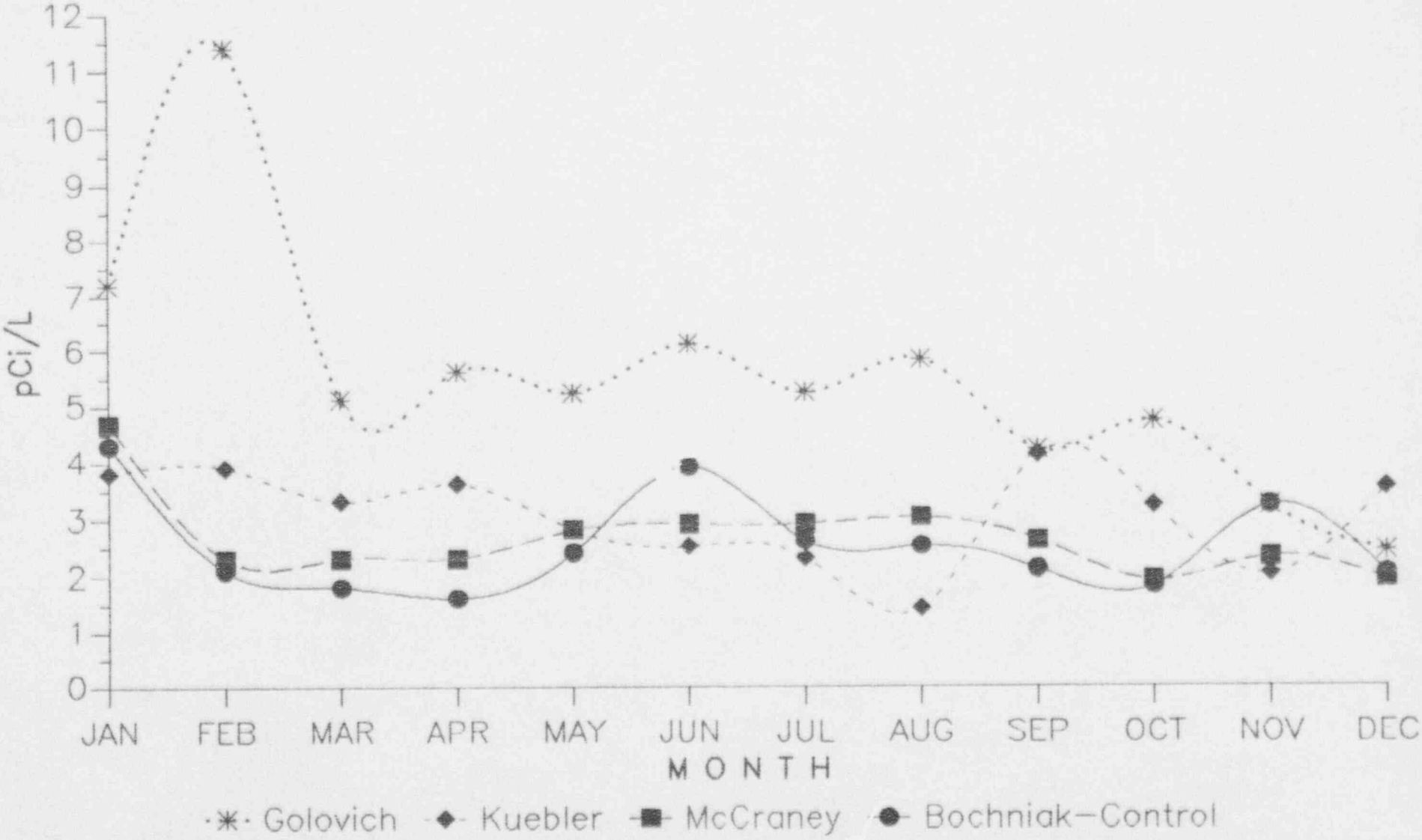
1992 BIG ROCK POINT TLD's
BRP05 Control vs BRP02, BRP13 and BRP16



Big Rock Point
Milk Sr-90
1987 - 1992



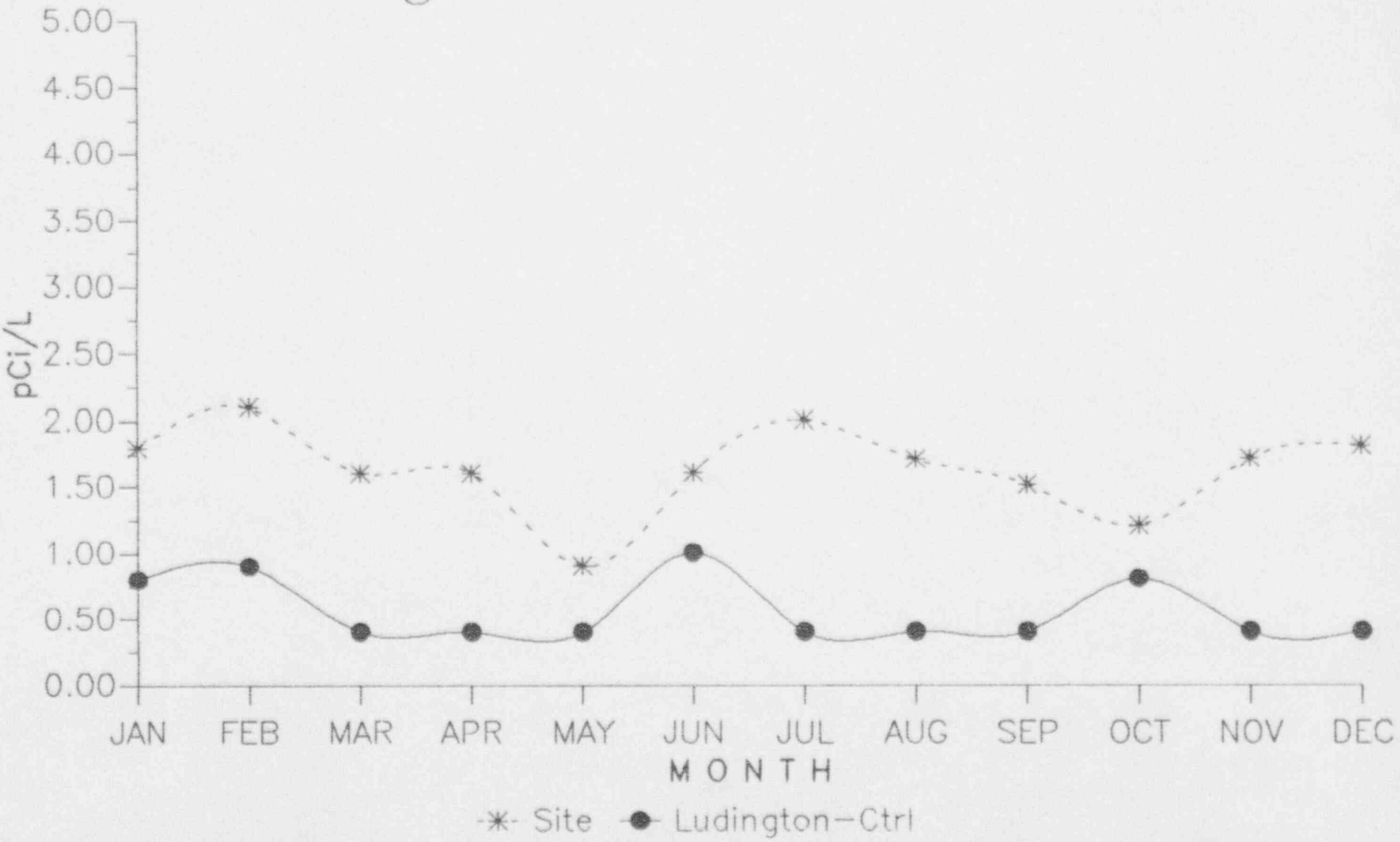
1992 BIG ROCK POINT MILK SAMPLES
Sr-90 pCi/L
Bochniak-Control vs McCraney, Kuebler and Golovich



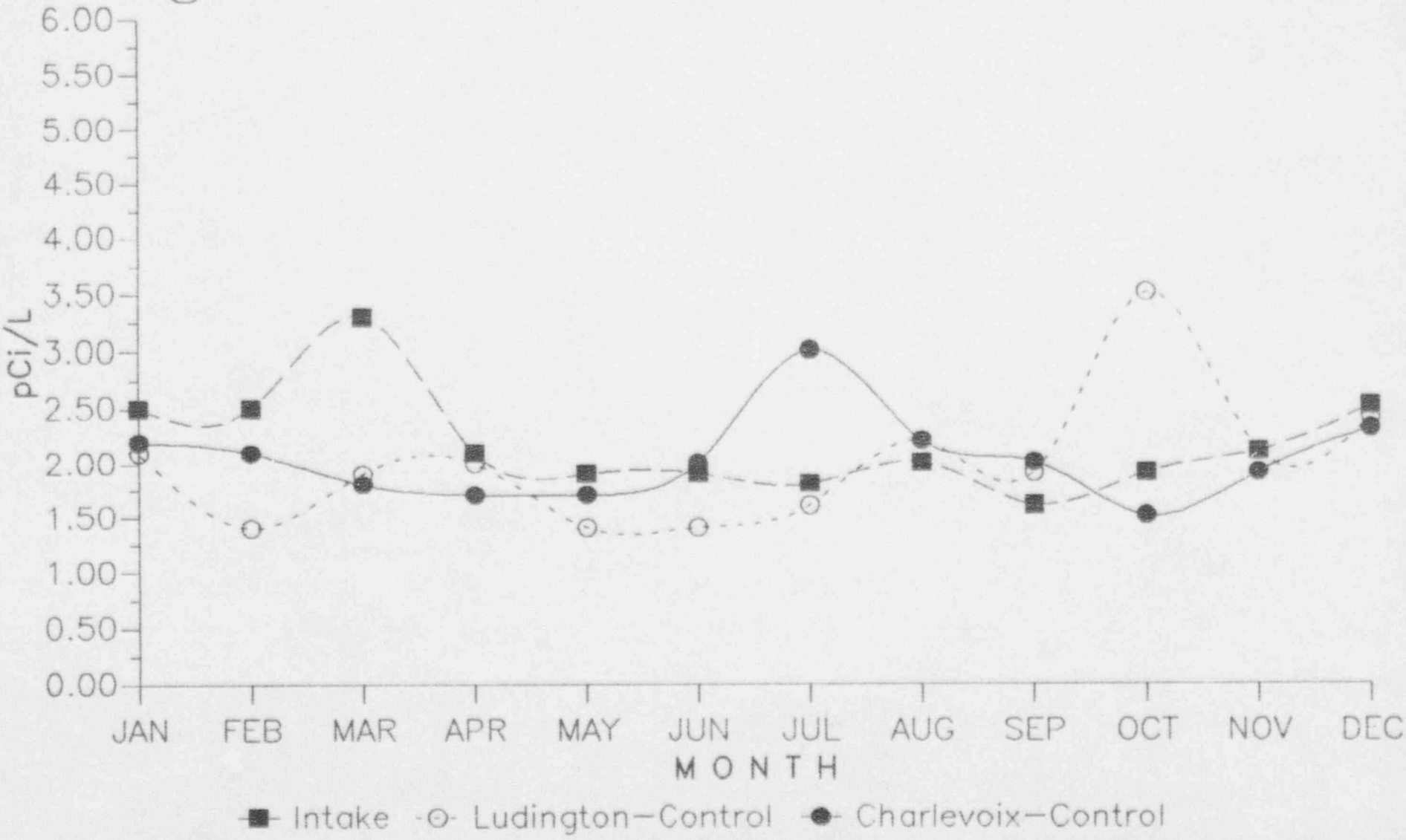
1992 BIG ROCK POINT WELL WATER SAMPLES

Gross Beta pCi/L

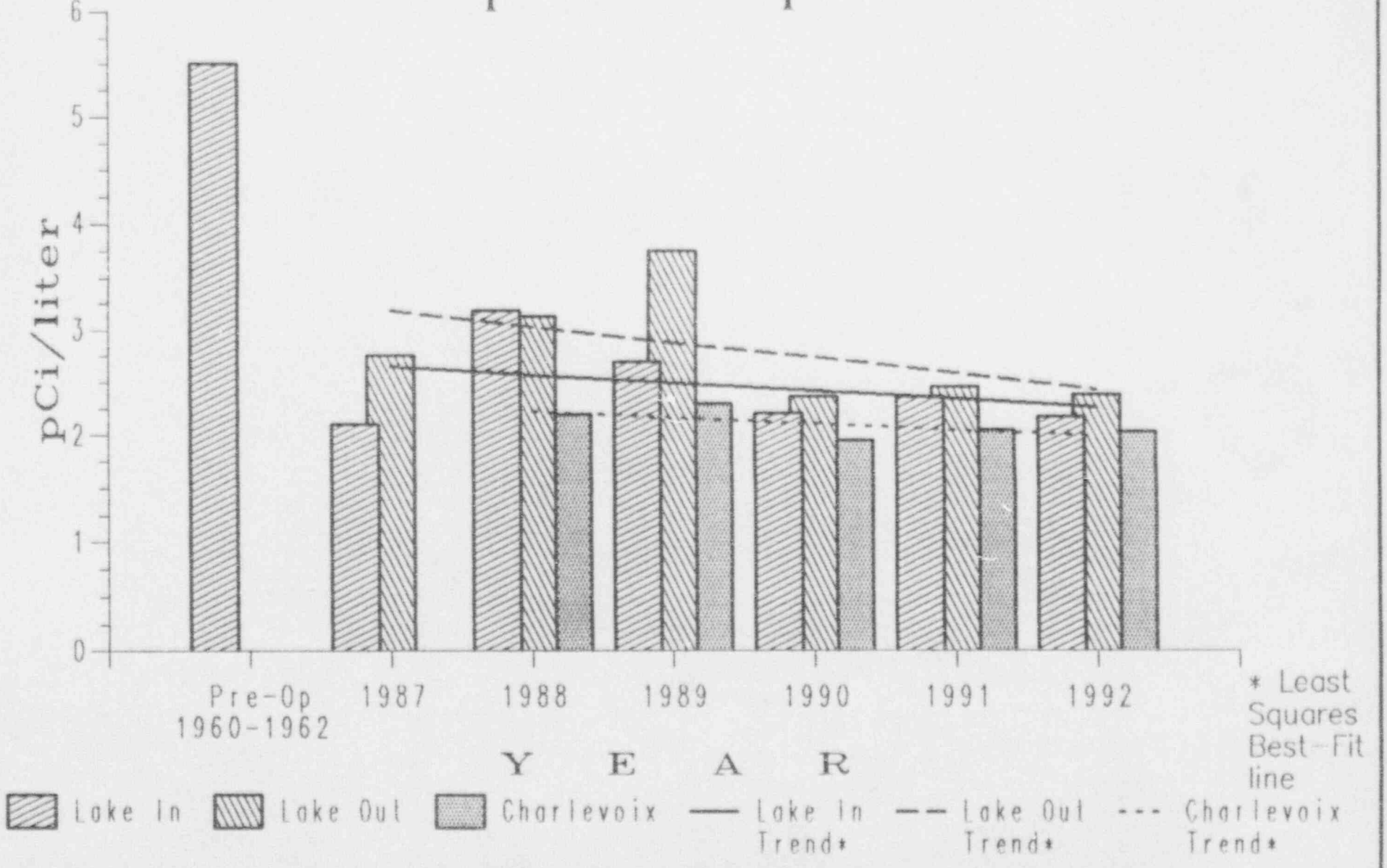
Ludington-Control vs Site Well



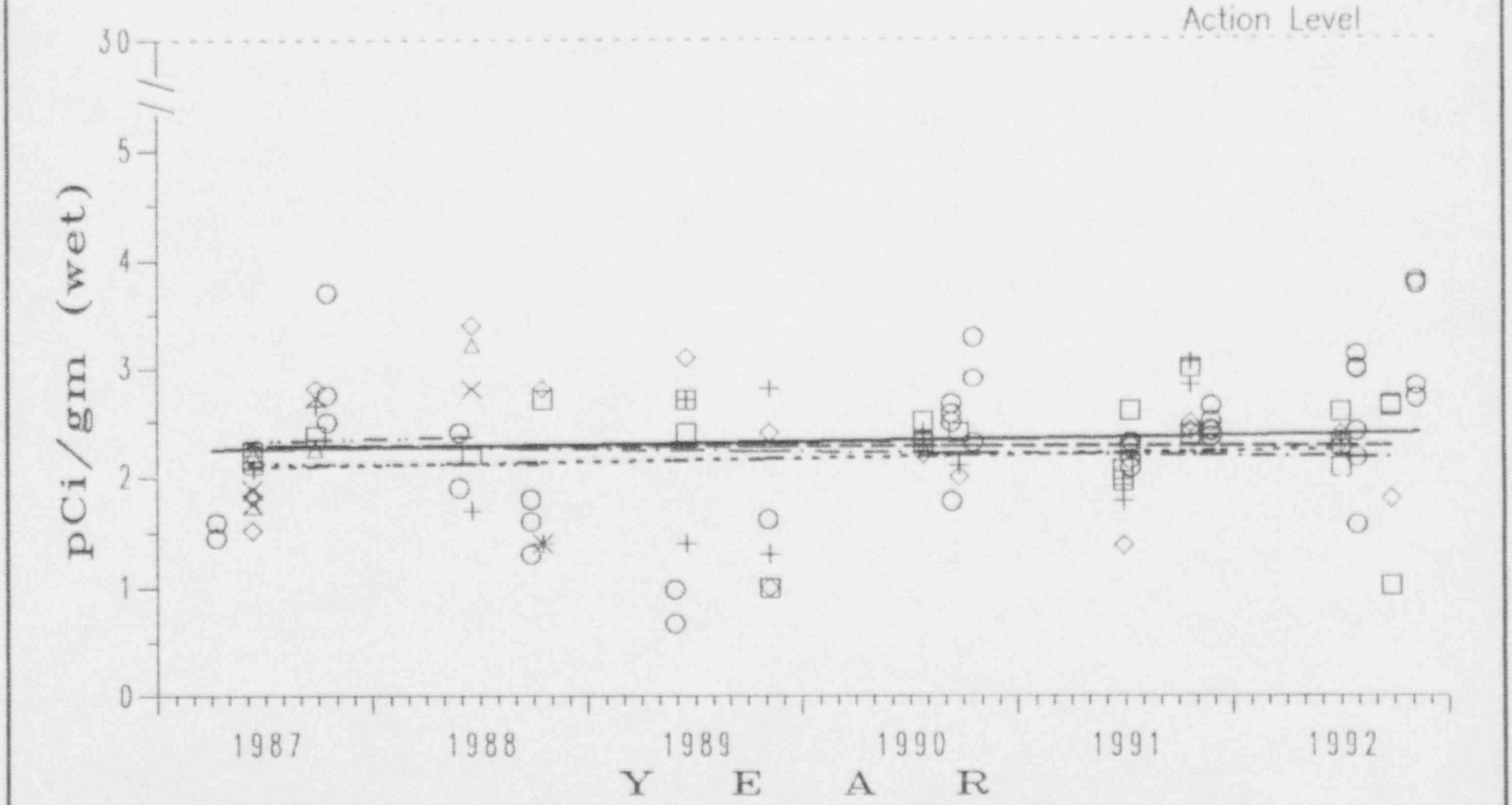
1992 BIG ROCK POINT LAKE WATER SAMPLES
Gross Beta pCi/L
Ludington & Charlevoix–Controls vs Intake



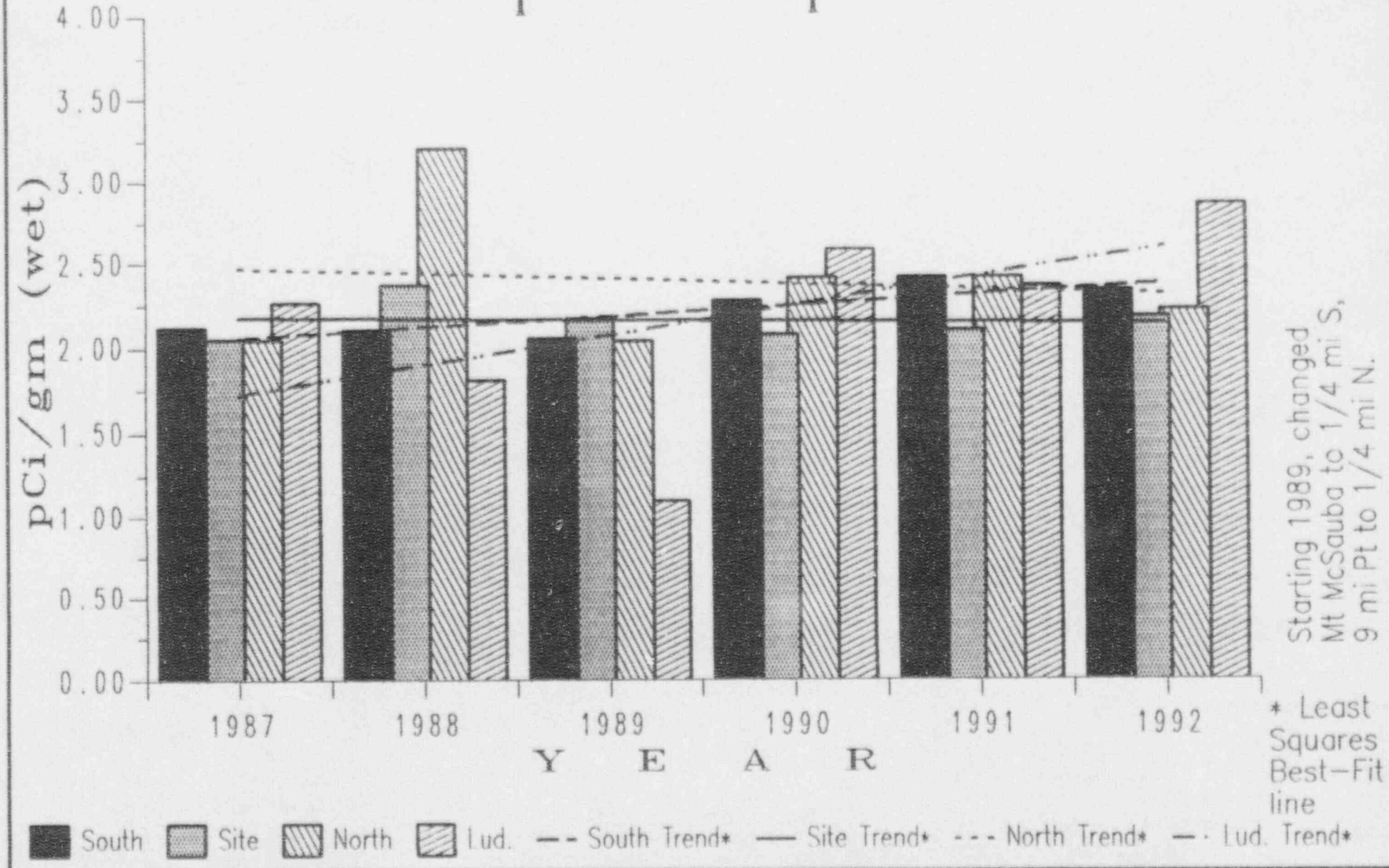
Big Rock Point Lake Water Gross Beta
Pre-Operational vs. Operational



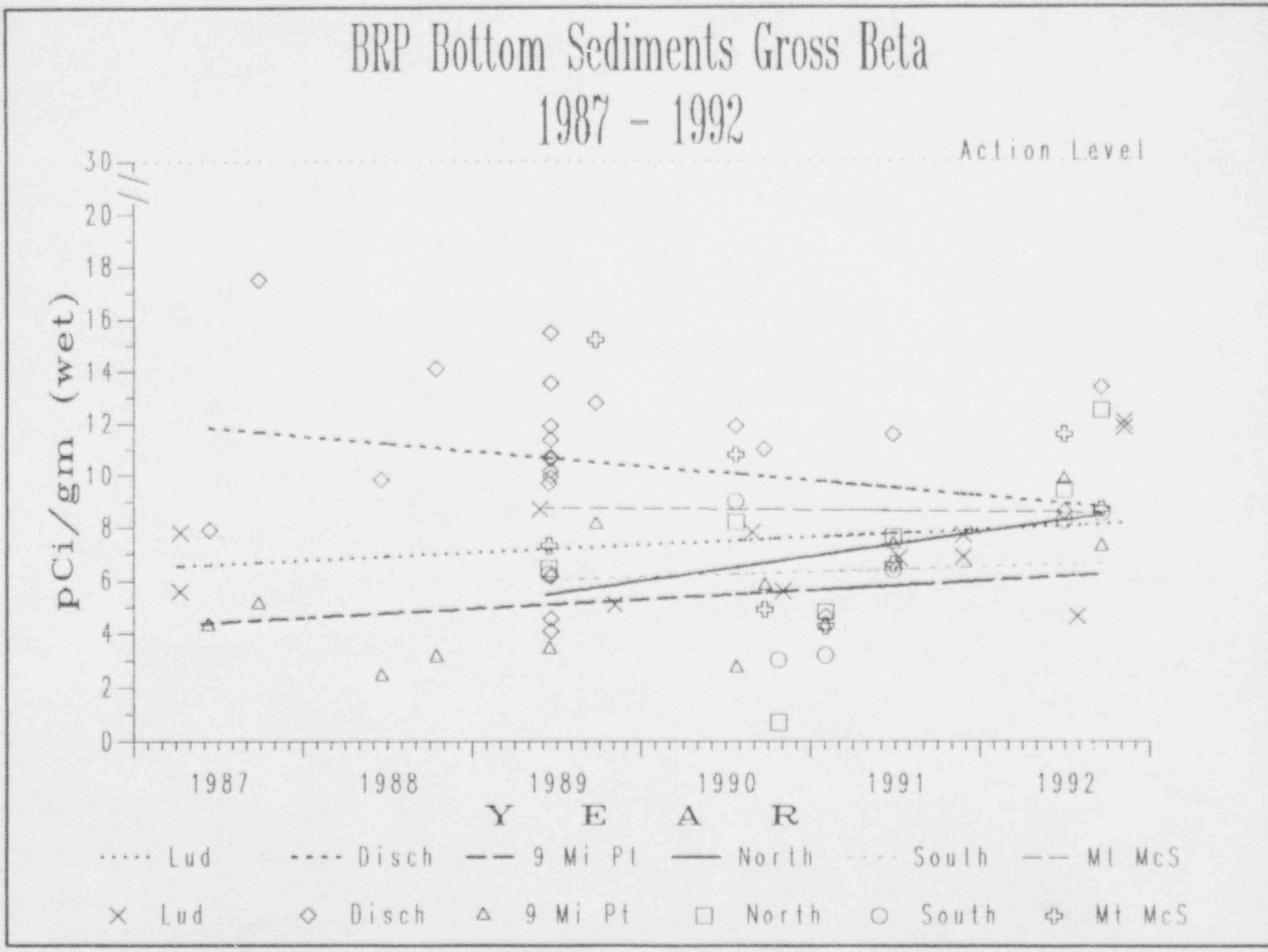
Big Rock Point Fish
Gross Beta 1987 - 1992



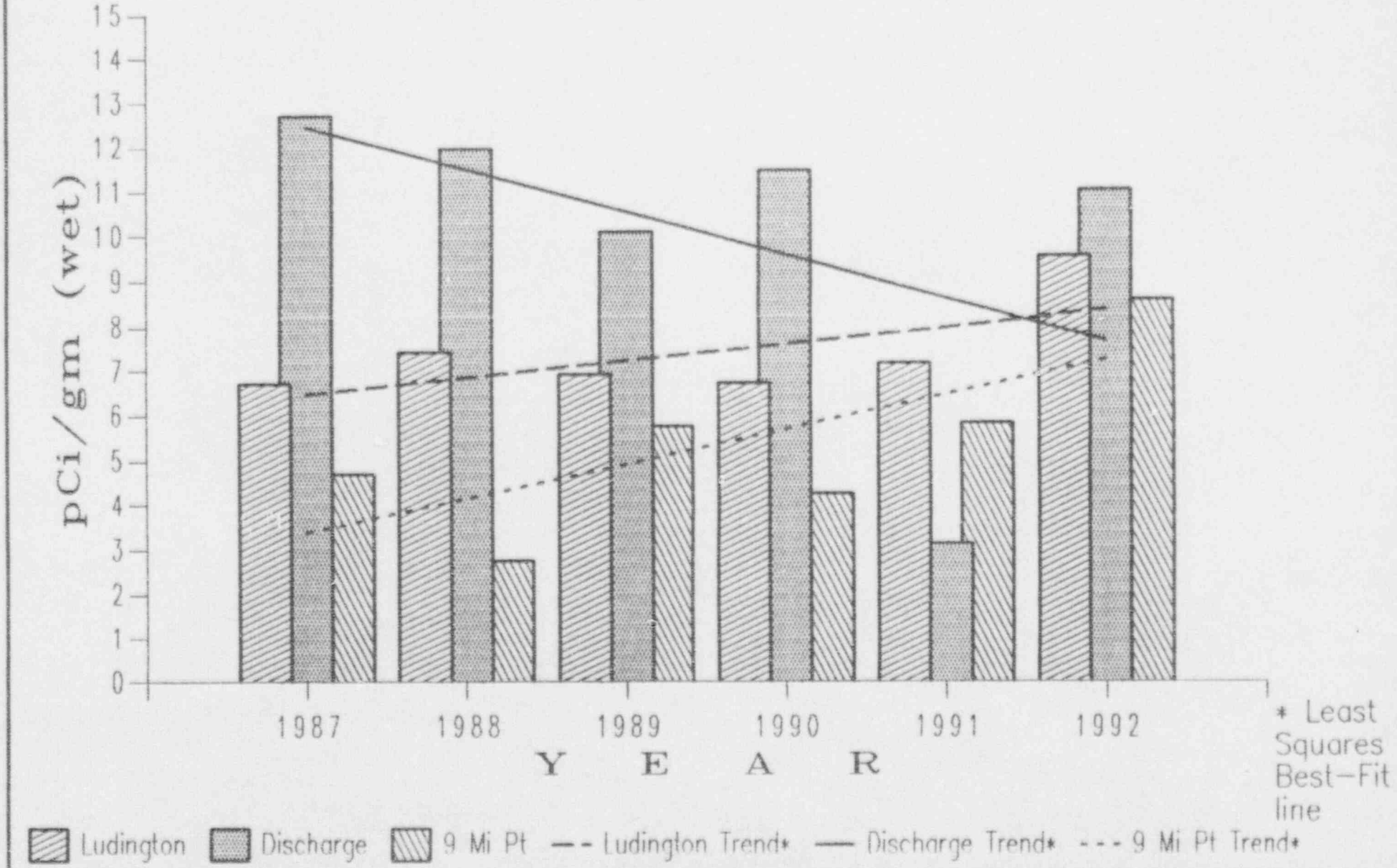
BRP Fish Gross Beta
Pre-Operational vs. Operational



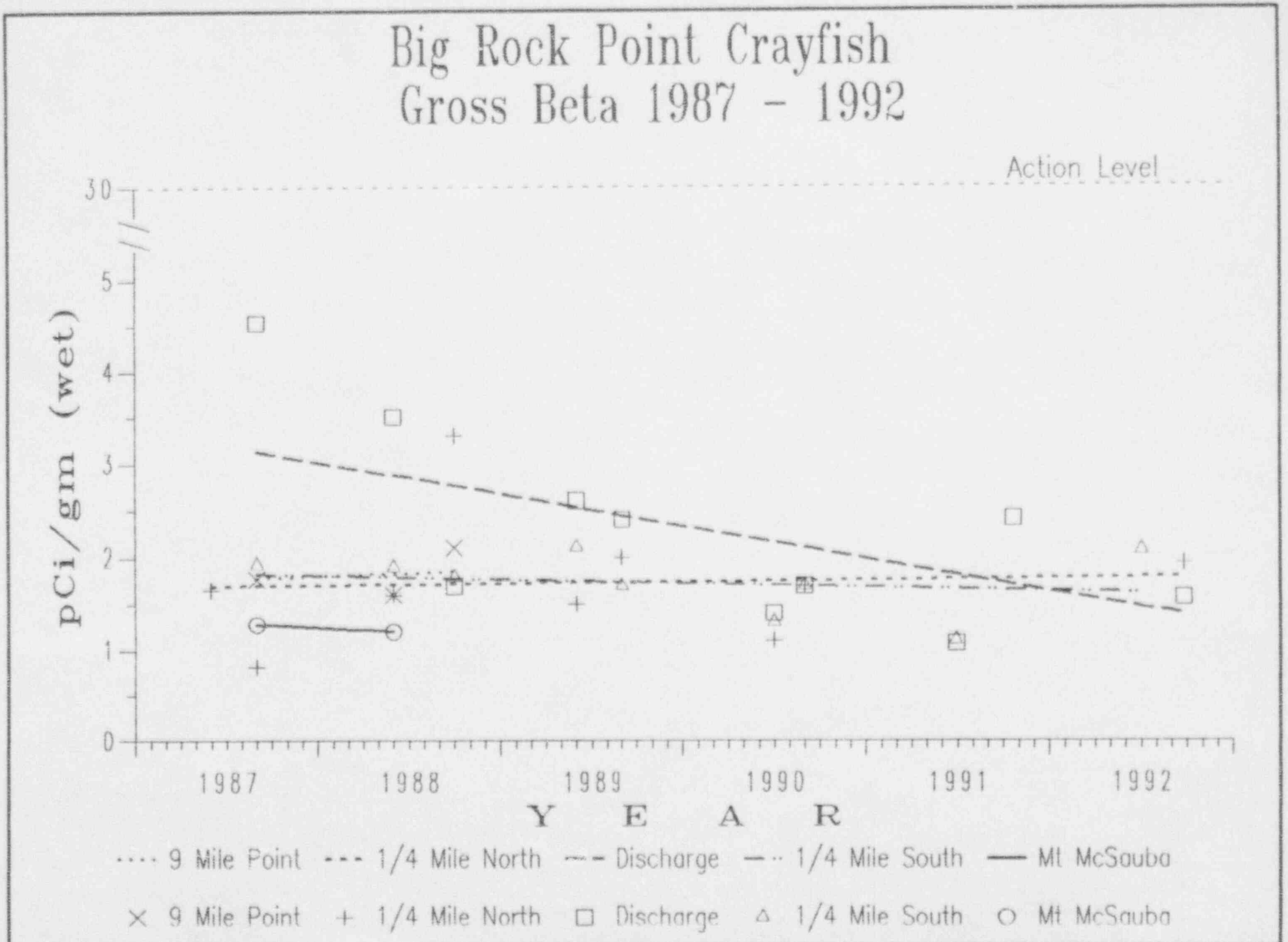
BRP Bottom Sediments Gross Beta
1987 - 1992

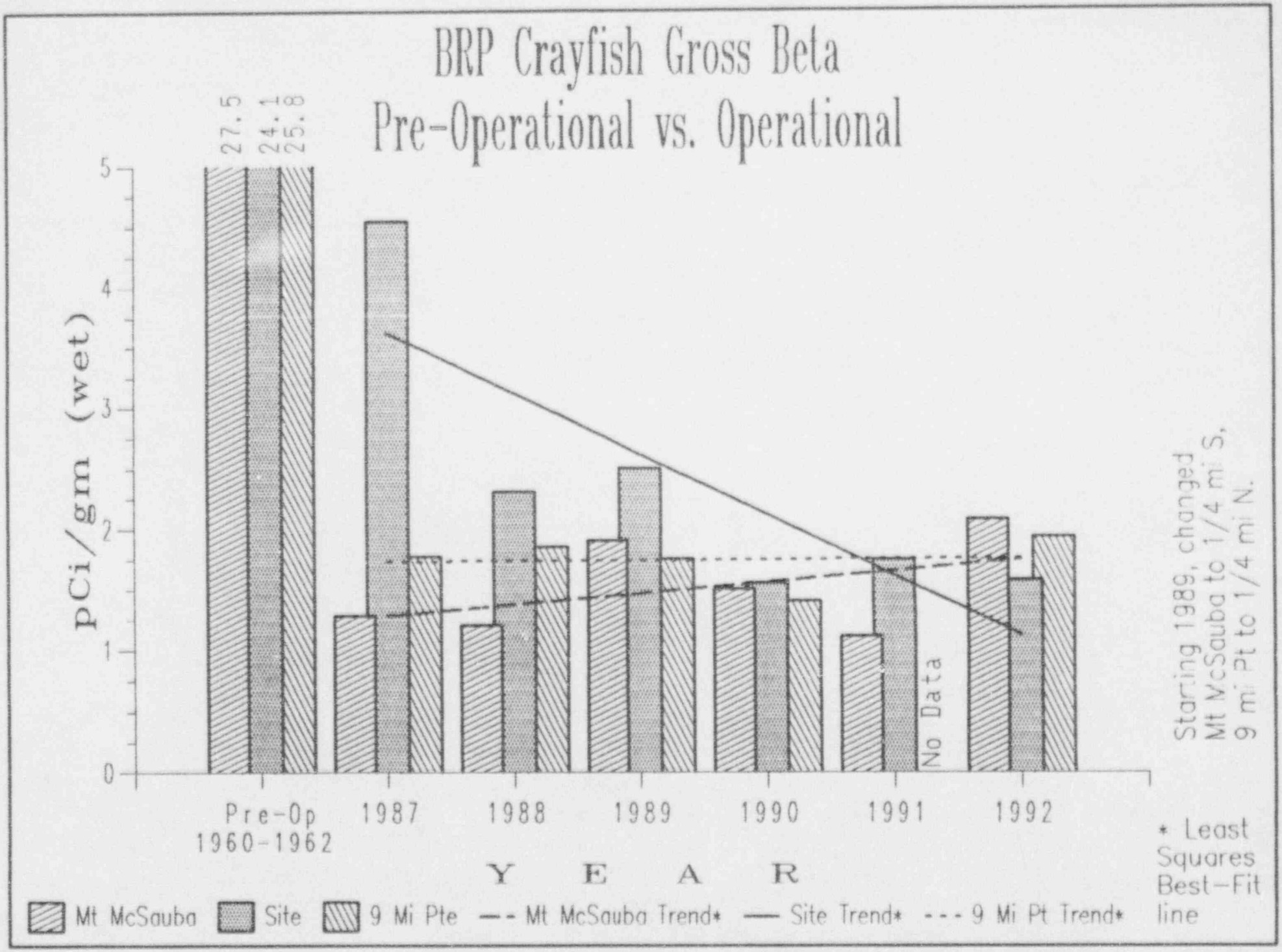


BRP Bottom Sediments Gross Beta
1987 - 1992

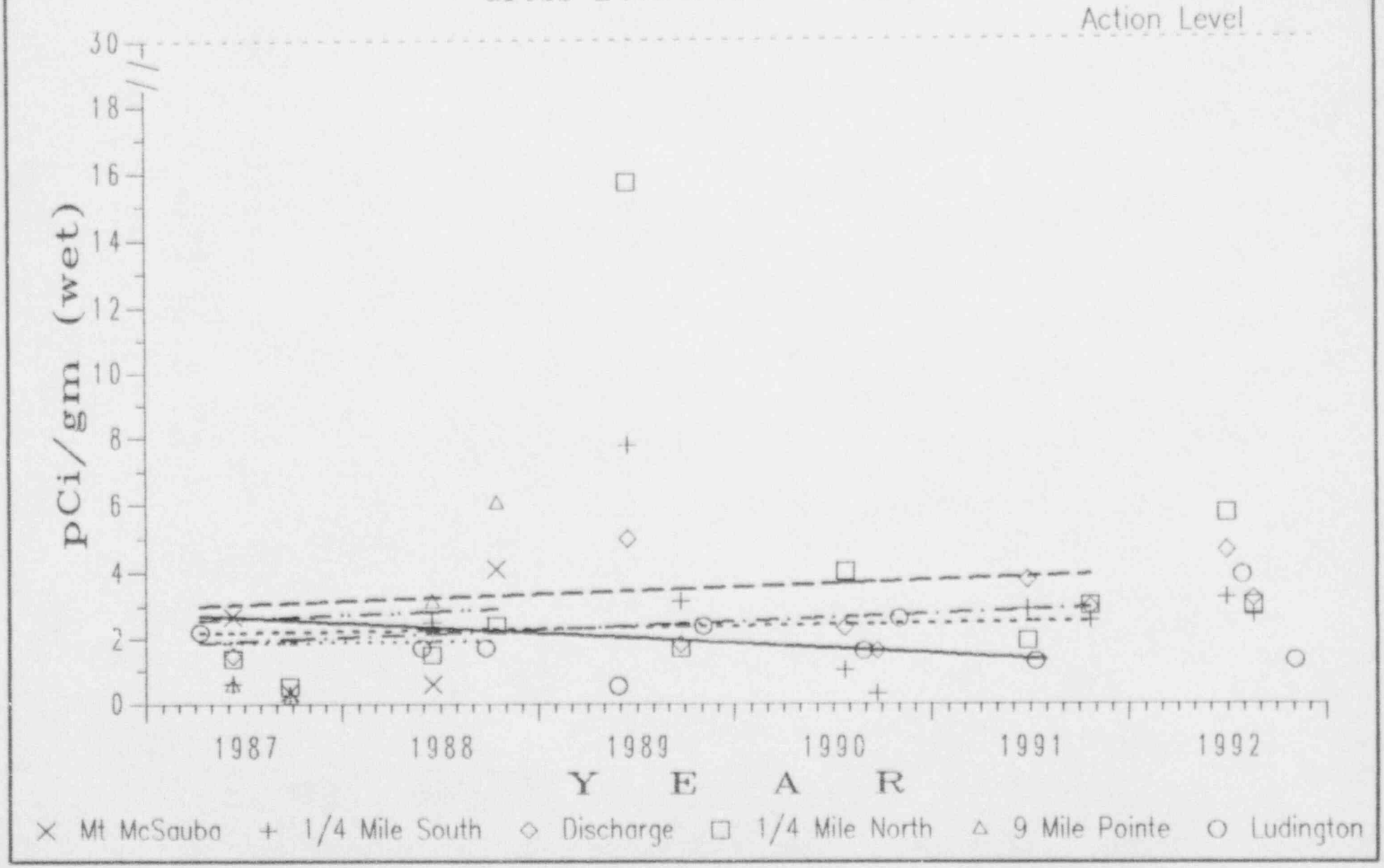


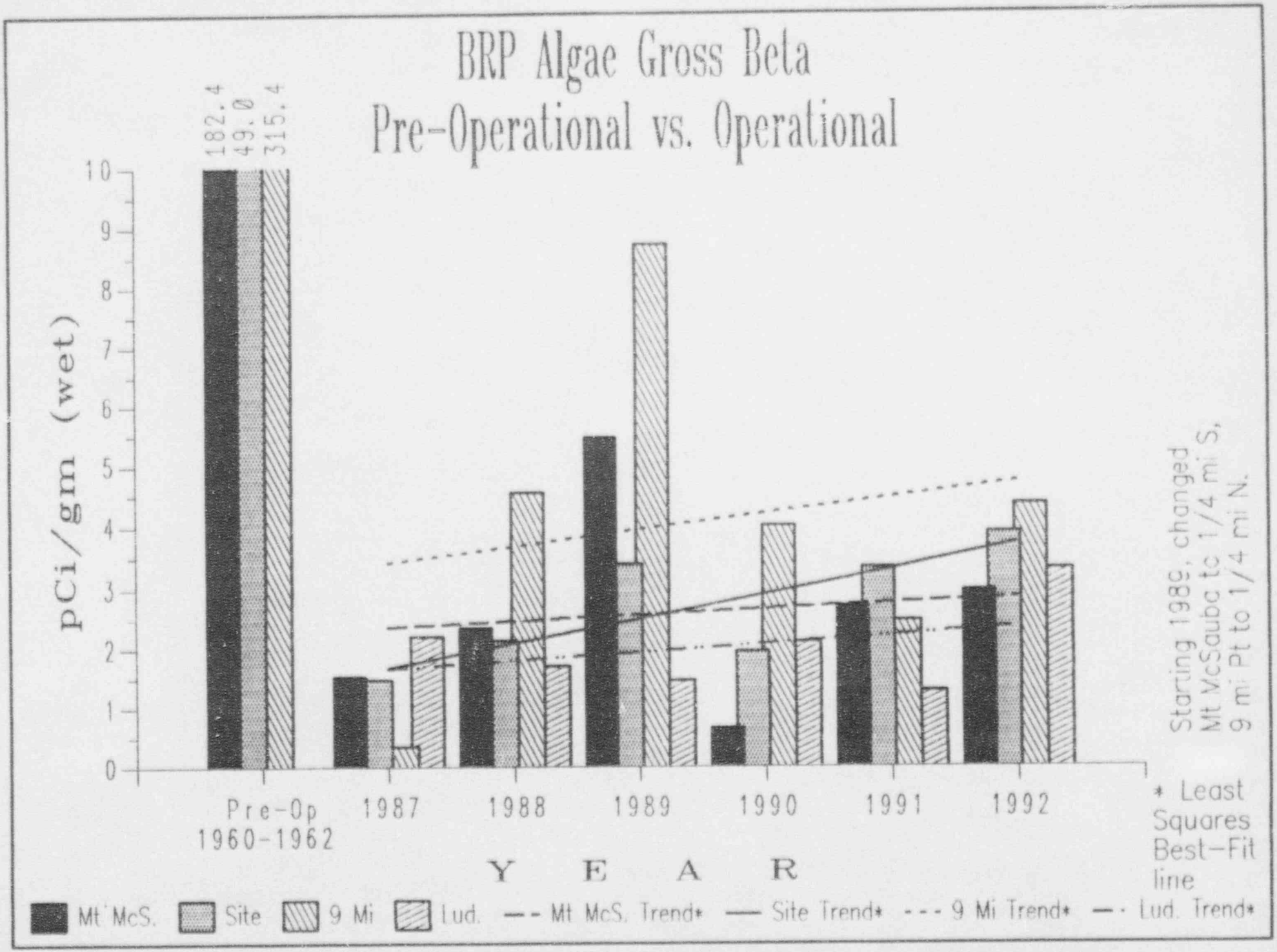
Big Rock Point Crayfish
Gross Beta 1987 - 1992




BRP Crayfish Gross Beta
Pre-Operational vs. Operational
27.5
24.1
25.8
pCi/gm (wet)
0
1
2
3
4
5
Pre-Op
1960-1962
1987
1988
1989
1990
1991
1992
No Data
YEAR
Starting 1989, changed
Mt McSauba to 1/4 mi S.
9 mi Pt to 1/4 mi N.
* Least Squares Best-Fit line
Mt McSauba
Site
9 Mi Pte
Mt McSauba Trend*
Site Trend*
9 Mi Pt Trend*

Big Rock Point Algae
Gross Beta 1987 - 1992




BRP Algae Gross Beta
Pre-Operational vs. Operational
182.4
49.0
315.4
pCi/gm (wet)
0
1
2
3
4
5
6
7
8
9
10
Pre-Op
1960-1962
1987
1988
1989
1990
1991
1992
Y E A R
Starting 1986, changed
Mt McSauba to 1/4 mi S,
9 mi Pt to 1/4 mi N.
* Least
Squares
Best-Fit
line
Mt McS.
Site
9 Mi
Lud.
Mt McS. Trend*
Site Trend*
9 Mi Trend*
Lud. Trend*

BRP Periphyton Gross Beta
Pre-Operational vs. Operational