ATTACHMENT

Consumers Power Company
Palisades Plant
Docket 50-255

1987 RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT

April 29, 1988

140 Pages

OC0488-0119-NL04

1987 Palisades Nuclear Plant Annual Radiological Environmental Operating Report

A. Introduction

The 1987 Palisades Nuclear Plant Annual Radiological Environmental Operating Report provides a summary and data interpretation of the Palisades Radiological Environmental Monitoring Program as conducted during the 1987 reporting period. Reporting requirements are detailed in Technical Specifications 4.11, Table 4.11-1 thru 4.11-3, 6.9.3.1.B and Table 6.9-1. Palisades was off-line for the first quarter of 1987 and returned to service on April 16, 1987. The Plant was also off-line October 1 - November 12, 1987 and December 4, 1987 - January 26, 1988 due to maintenance outages.

There are no remaining 1987 laboratory sample analyses pending completion for inclusion into this report. The results of all environmental samples collected are evaluated as follows:

1. Air iodine and particulates, 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 10.4. The data was compared against two criterium: the first criteria is the statistical difference which indicates that sample results from near sites are greater than those from control sites, but that the difference is not significant. The second criteria 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.

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

B. Discussion and Interpretation of Results

1. Air Sample

Comparison of the airborne particulate sample data between near-site and-control locations did not exceed the statistical difference. In many instances, control location sample values were greater. There was no I-131 activity reported above minimum detectable levels. It should be noted however that air sampling station 1-ST had a three (3) week non-operational period (1/18 thru 2/1/87) due to maintenance being performed on an electrical switch panel that supplies power to the sampling unit. As a result, three (3) I-131 and air particulate filter samples were not obtained for analysis and are not included in the overall total of air filters collected during 1987.

A total of 360 air samples were collected and analyzed during 1987, however six (6) sample results were deleted from statistical evaluation as follows:

Three (3) sample results for I-131 had evaluated LLD's due to low air sample volume flows caused by malfunctioning air meters. The affected sampling stations were: 1-ST on 1/11/87; 2-TH on 5/17/87 and 8-SP on 4/12/87.

Three (3) sample results for air particulate gross beta did not meet LLD requirements due to either a malfunction with the air sampling unit pump or the particulate filter was improperly seated in the air sample holder (allowing for sample by-pass). The affected sampling stations were: 1-ST on 1/11/87; 1-ST on 7/26/87 and 8-SP on 4/12/87.

The deleted samples constituted only 0.48% of both the I-131 and air particulate/gross beta total analyses not used in the statistical evaluations. This is the smallest loss of sample data in recent years. Technical Specification sensitivities were met on all samples other than noted.

Air iodine/particulate samples are collected on a weekly basis from 12 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 1987 air samples results are consistent with actual effluent releases and site-specific meteorology.

2. Lake Water

A total of 24 individual monthly lake water composite samples were collected from two (2) locations during 1987. Lake water samples from the Palisades Lake-in (intake) and the South Haven Municipal Water System (raw water) are collected daily and composited into monthly samples.

Evaluation of the monthly lake water analytical results was based on a data means comparison between the Palisades Lake-in and the South Haven Municipal (control) locations. The lake water results were also evaluated against the Palisades Technical Specification reporting limits.

Gross beta and tritium analyses are required for all lake water samples. Both the Palisades Lake-in and South Haven Municipal (raw water) samples were below the required LLDs. A monthly gross alpha analysis was also performed on the Palisades Lake-in samples for comparison data against the lake-out (discharge) sample results. Results of the gross alpha analyses were below LLD. No Palisades Technical Specification reporting limits were exceeded.

Both the Palisades Lake-in and South Haven Municipal (raw water) water samples are collected daily for composite into a monthly sample. A one (1) one-gallon quantity of Palisades Lake-in sample and two (2) one-gallon quantities of South Haven Municipal (raw water) sample are sent to Teledyne Isotopes for analysis. No treatment of the water samples with preservative is required.

3. Drinking Water

A total of 24 individual monthly drinking water composite samples were collected from the South Haven Municipal Water System. The samples are obtained from 2 collection points: lake water intake (raw) and treated water. Samples are collected daily for composite into a monthly sample.

Evaluation of the drinking water analytical results was based on a data means comparison between the South Haven Municipal lake water intake (raw) and treated water as well as with the Palisades Technical Specification reporting limits. The lake water intake serves as a control. The evaluated data was also trend plotted against the Palisades Lake-in gross beta results.

Both the South Haven Municipal lake water intake and treated drinking water samples require gross beta analyses. A tritium analysis is required for the treated water only. For all samples, the analytical results were below LLD for gross beta and tritium. No special or supplemental analyses were required during 1987 and no Palisades Technical Specification reporting limits were exceeded.

A two-gallon quantity of each sample is sent to Teledyne Isotopes for analysis. No treatment of the water samples with a preservative is required.

4. Well Water

A total of 36 individual monthly well water samples were collected from 3 locations during 1987. The Palisades site well is collected daily and composited into a monthly sample; the State Park and Covert Township Park well water samples are collected as monthly grab samples only.

Evaluation of the monthly well water analytical results was based on a data means comparison between the Palisades site and the State Park/Covert Township Park samples as well as with the Palisades Technical Specification reporting limits. The State Park/Covert Township Park wells serve as controls.

Tritium and gross beta analyses are required for the well water samples. Analytical results were below LLD for tritium at all locations; and below LLD for gross beta at the Palisades site and Covert Township Park wells. The State Park well was reported as having 5 monthly samples slightly above the 4.0 pCi/L gross beta

LLD, however the 1987 mean value for the State Park well gross beta results was only 3.3 pCi/L. The State Park well samples have traditionally had a higher gross beta level than any of the other sampled wells. This has been evaluated in previous reports as not being from power plant origin.

No special or supplemental analyses were necessary during 1987 and no Palisades Technical Specification reporting limits were exceeded.

Two (2) one-gallon quantities of sample per offsite well and one (1) one-gallon quantity from the on-site well are sent to Teledyne Isotopes for analysis. No treatment of the water samples with a preservative is necessary.

5. Milk

A total of 48 individual monthly milk samples were collected from 4 different dairy farms (locations 26-FC, 27-KK, 28-GH and 29-WS) during 1987. The milk samples are obtained as grab samples only (from dairy milk tanks).

With the exception of Sr-90, all isotopic analytical results listed in Table 10.4-2 were less than LLD. Evaluation of the Sr-90 data was done by using the SAS statistical program. The Sr-90 activity between indicator (26-FC, 27-KK and 28-GH) and control (29-WS) locations was just at the SAS difference level but not the SAS evaluation level. No special or supplemental analyses were required during 1987. There were no reportable dairy sampling location changes for 1987 either. No Palisades Technical Specification reporting limits were exceeded.

Milk samples are required monthly (usually collected the 1st week of the month) from each designated location (4 total). Two one-gallon quantities of raw milk (grab sample) are obtained per sample location in order to meet analytical requirements. Each sample quantity is treated with a sodium bisulfite (40 grams per gallon) preservative prior to being sent to Teledyne Isotopes.

6. TLD's - Gamma Dose

There were a total of 287 monthly, 96 quarterly and 24 annual TLDs collected and analyzed during 1987. Only one (1) monthly (ST-11) TLD was reported missing.

The following is detailed for the missing monthly TLD:

a. The May monthly TLD at location 11-KZ was lost in the mail. The off-site sample collector normally receives the TLD (from Kalamazoo) via the mail from a sub-contractor sample collector. The TLD was sent as is usual practice, but it never arrived at the off-site sample collector's home address.

It should be noted that in case any longer term TLDs (quarterly, annual) are stolen/reported missing from any location, spare TLDs are available as replacements.

The Palisades gamma assessment program consists of 24 locations: 1 directly on-site, 9 inner ring (site boundary), 10 outer ring (1.0 to 5.5 miles out, 3 control (30 to 55 miles out) and 1 TLD control placed in a lead storage cave. For 1987, the average monthly gamma readings were: 4.2 mR for the inner ring (site boundary) TLDs; 4.8 mR for the outer ring (1.0 to 5.5 miles out) TLDs; and 4.6 mR for the control TLD locations. The lead cave control TLD recorded an average of 2.5 mR per month. This is consistent with expected effluent releases. The one (1) on-site TLD location (1-ST) serves as an individual reference TLD, however it was evaluated along with the inner ring (site boundary) TLDs in the SAS program.

The monthly and quarterly SAS statistical TLD data evaluations were accomplished by comparing the inner ring TLDs (site boundary locations ST-01 and ST13-21) and the outer ring TLDs (locations ST-02 thru ST-09, ST-23 and ST-24) against the control TLD locations (ST-10 through ST-12). The annual TLD data evaluation was done by direct comparison of data points only.

During the month of April, the outer ring TLD statistical difference was exceeded but not the evaluation level. No quarterly statistical differences were exceeded. In comparing the inner ring TLDs to the control TLDs; the Kalamazoo control location (ST-11, 35 mi SE) had the greatest monthly, quarterly and annual data means as an indicator location. When the same comparison was made between the outer ring and control location TLDs; R. Bus (ST-06, 4.25 mi NE) had the greatest monthly TLD data means for any indicator location.. Location Tower Hill (ST-02, 5,5 mi S) had the greatest quarterly and annual data means .

Background and intransit gamma exposure levels were accounted for and subtracted from the TLD data prior to statistical evaluation.

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

7. Crops

The collection of food crops and vegetation samples (when available and in season) is a requirement within the Palisades Radiological Environmental Monitoring Program. Two principal area crops: apples and blueberries, are regularly collected as specified in Technical Specifications. While there are no pre-designated/special locations where food crops are collected, samples are generally obtained from

the same areas where the air monitoring stations are located within the E, SE or SSE sectors. The collection of food crops assists in verifying stack effluent deposition patterns.

During 1987, 14 crop samples were collected from four locations (7 samples from 4-JS, 3.5 mi SE; 4 samples from 5-PR, 3.5 mi ESE; 1 sample from 6-RB, 4.3 mi NE; and 2 samples from 2-TH, 5.5 mi S). Evaluation of sample analytical results was direct. There was no control location used.

Of the isotopic analyses listed on Table HP 10.4-2, only the gross beta and Sr-90 resulted in any specific activity (slightly above LLD). All other analyses were less than LLD. The crop samples at location 5-PR had the greatest individual means for gross beta; and the crop samples at 2-TH had the greatest individual means for Sr-90.

No Palisades Technical Specification action or reporting levels were exceeded nor were any special/supplemental analyses required during 1987.

Food crop samples are required to be collected when available and in season. When collected, approximately 1 Kg of sample is placed in a sealable plastic bag for shipment to Teledyne Isotopes. No special treatment of the samples with a preservative is necessary.

8. Sediment

A total of 12 individual sediment samples were collected from 5 locations during 1987. Seven (7) sediment samples are obtained from Palisades (discharge, $\frac{1}{2}$ mi South boundary, $\frac{1}{2}$ mi North boundary and South Haven Beach locations) and five (5) samples from the Ludington control station (North Jetty).

Evaluation of the sediment analytical results was based on a data means comparison between the Palisades and Ludington control samples as well as the Palisades Technical Specification reporting limits. The individual Palisades 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 location(s), then that location is identified on Table HP 10.4-2.

Of the isotopic analyses listed on Table HP 10.4-2, only Sr-89 and the other gamma (non-indicative/non-parameter isotopes) category were less than LLD. All other analyses resulted in trace amounts of activity present. The Ludington control and Palisades site locations reported an equal mean gross beta activity level, although the $\frac{1}{2}$ mile site North boundary location had the highest mean individual sample gross beta results. For the Sr-90 isotopic results, the Ludington Control location reported the greater mean activity levels. No Palisades Technical Specification action or reporting

levels were exceeded, nor were any special/supplemental analyses required during 1987.

Sediment samples are collected semi-annually from each designated location. A one (1) liter quantity grab sample usually is obtained off-shore. No treatment of the samples with a preservative is necessary prior to shipment to Teledyne Isotopes.

9. Aquatic Biota - Algae

Although not specified for collection in the Palisades Radiological Environmental Technical Specifications, algae was available in sufficient sample quantities during 1987 to warrant collection and isotopic analysis. The algae was attached to the rock structure implacements designed to prevent high water beach erosion at Palisades. A total of four (4) individual algae samples were collected from two different locations during 1987. Two samples were collected from the Palisades (discharge and $\frac{1}{2}$ mile South Boundary) site location and two (2) algae samples from the Ludington control station (South Jetty). Biota samples are collected semi-annually.

Evaluation of the algae analytical results was based on a data means comparison between the Palisades and Ludington control samples as well as with the Palisades Technical Specification reporting limits. As with the sediment samples, the individual Palisades 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 10.4-2.

Of the isotopic analyses listed in Table HP 10.4-2, only the gross beta and Sr-90 analyses resulted in any specific activity (slightly above LLD). The "other gamma" analyses for the one (1) discharge algae sample were reported with elevated LLDs due to the analyzing of too small a sample size by the contractor laboratory. None of the other algae samples had elevated LLDs. No Palisades Technical Specification reporting limits were exceeded.

It is again expected that sufficient quantities of algae can be collected at Palisades during 1988 for isotopic analysis; however, because of the basic beach terrain features on site, other types of aquatic biota (crayfish and periphyton) will probably continue to be unavailable.

One (1) liter quantities of algae are prepared for shipment to Teledyne Isotopes by treating each sample with 10 ml of a 10% formaldehyde solution for preservation.

10. Fish

A total of 13 individual fish samples were collected from 4 locations during 1987. Seven (7) fish samples were obtained from Palisades (discharge, ½ mile South boundary, ½ mile North boundary) and six (6) samples from the Ludington control station (North Jetty). Fish are collected semi-annually.

Evaluation of the fish analytical results was based on a data means comparison between the Palisades and Ludington control samples as well as with the Palisades Technical Specification reporting limits. As with the sediment samples, the individual Palisades 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 10.4-2.

Of the isotopic analyses listed on Table HP 10.4-2, only Sr-90 and gross beta were greater than LLD. Many Palisades (site) sample locations reported equal or less levels of activity than the control location. No Palisades Technical Specification reporting limits were exceeded nor were any special analyses requested for 1987.

As a minimum, at least two (2) different fish species (ie, forage, sport fish, etc) per designated location per year are collected. In most cases however, that criteria is exceeded. When caught, a 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.

11. Broad Leaf Vegetation

No broad leaf vegetation samples were collected from the surrounding Palisades environs during 1987. 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 1987 reporting year.

C. Assessment of Palisades Operational Environmental Impact

In reviewing the 1987 Palisades radiological environmental monitoring data and comparing it to previous operation and preoperational data, all trending parameters continue to indicate that the operation of Palisades has had an insignificant environmental impact. Most isotopic concentrations are at environmental "background" radiation levels. Since the Chinese stopped the open atmospheric testing of nuclear devices in late 1981-82, environmental background levels of radiation (due to fallout) have shown a continuous decrease. Evidence of an environmental isotopic build-up (attributable to Plant effluents) appears negligible as well.

The effect of the Chernobyl fallout (April 1986) on the 1987 milk, aquatic biota and fish samples appears to be nil. No evidence of a significant isotopic "build-up" could be determined. In most cases, sample analytical results were below previously established environmental background levels.

Enclosures

A. Palisades 1987 Land Use Census

B. Health Physics Procedure 10.10: Palisades Radiological Environmental Program Sample Collection and Shipment Procedure (with sample locations, maps, etc).

C. Palisades 1987 (Annual) Radiological Environmental Monitoring Program Data as provided by Teledyne Isotopes Midwest Laboratory, Northbrook, Ill.

D. Teledyne Isotopes Midwest Laboratory EPA Interlaboratory Comparison Program Results

E. Data Graphs

1. Palisades Air Particulate (gross beta) 1987 Trending and Palisades Air Particulate (gross beta) 1982-1987 Operational Comparison Graphs

2. Palisades Lake Water/Drinking Water (gross beta) 1987 Trending and Palisades Operational Comparison Graphs (bross beta); 1968-1969 (pre-op) and 1982-1987.

3. Palisades Well Water (gross beta) 1987 Trending and Palisades Operational Comparison Graphs; 1968-1969 (pre-op) and 1982-1987.

4. Palisades Milk (Sr-90) 1987 Trending and Palisades Operational Comparison Graphs (Sr-90 and Cs-137); 1968-1969 (pre-op) and 1982-1987.

5. Palisades TLD (gamma) 1987 Trending and Palisades Operational Comparison Graphs (monthly, quarterly and annual); 1968-1969 (pre-op monthly) and 1982-1987.

6. Palisades Sediment (gross beta) 1987 Trending and Palisades Operational Comparison Graphs; 1982-1987.

7. Palisades Fish (gross beta) 1987 Trending and Palisades Operational Comparison Graphs (gross beta, Sr-90 and Cs-137); 1968-1969 (pre-op) and 1982-1987.

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Table HP 10.4-1
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 1-ST thru 12-DG	630	Gross Beta, I-131	Weekly
Lake	1 Gallon Composite	Intake	12	Gross Beta, Gross Alpha, Tritium	Monthly
Drinking Water	1 Gallon Composite	South Haven	24	Gross Beta, Tritium	Monthly
Well Water	1 Gallon Grab	Site, TP, SP	36	Gross Beta, Tritium	Monthly
Milk	2 Gallon Grab	WS, FC, GH, KK	48	I-131, Sr-89 and Sr-90, Cs-137, Other Gamma	Monthly
TLD	Continuous	All: Stations ST-01 thru ST-24	287 96 24	Gamma	Monthly Quarterly Annual
Crops	Grab	JS, PR, RB, TH	14	Gross Beta, Sr-89 and Sr-90 Cs-137, Other Gamma	In Season
Sediment	Grab	Discharge, ½ mi N & S Site Boundary South Haven Beach, Ludington Control	9	Gross Beta, Sr-89 and Sr-90 Cs-137, Other Gamma	Semi-Annual
Aquatic Biota	Grab	Discharge, ½ mi South Boundary, Ludington Control	4	Gross Beta, Sr-89, Sr-90 Other Gamma	As requested
Fish	Grab	Discharge, ½ mi N & S Site Boundary, Ludington Control	13	Gross Beta, Sr-89, Sr-90 Other Gamma	Semi-Annual

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Table HP 10.4-2 Sample Data Summary

Medium or Pathway Sampled / Unit of Measurement	Analyses Evaluated Over Total Number of Analyses Performed		Lower Limit of Detection(a) LLD	All Indicator Locations Mean(b) Range(b)		Location With Greatest Annual Mean(g) Name Distance and Direction	Mean(b) Range(b)	All Control Locations Mean(b) Range(b)		Nonroutine Measurements (c)
Air (pCi/m³)	I-131	627/630	0.07	471/474	LLD	LLD		156/156	LLD	None
	Gross Beta	627/630	0.01	471/474	0.02 (0.005-0.05)	H. Soderberg (5 mi S)	0.03 (0.01-0.05)	156/156	0.02 (0.006-0.05)	None
Lake Water (pCi/L)	Gross Alpha	12/12	1.0	12/12	LLD	LLD		N/A	None	
	Gross Beta	24/24	4.0	12/12	LLD	Lake Intake and South Haven (raw) lake water locations are equal (5.5 mi NNE)		12/12	LLD	None
	Tritium(c)	24/24	500.0	12/12	LLD	LLD		12/12	LLD	None
Drinking Water (pCi/L)	Gross Beta	24/24	4.0	24/24	LLD	South Haven Raw & South Haven Treated Lakewater Locations are equal (5.5 mi NNE)		Not required		None
	Tritium(h)	12/12	500.0	12/12	LLD	LLD		Not required		None
Well Water (pCi/L)(g)	Gross Beta	36/36	4.0	12/12	1.3 (0.4-2.3)	State Park (1 mi N)	3.3 (1.2-5.4)	24/24	2.3 (<0.8-5.4)	None
	Tritium	36/36	500.0	12/12	LLD	LLD		24/24	LLD	None
Milk (pCi/L)	I-131	48/48	1.0	36/36	LLD	LLD		12/12	LLD	None
	Sr-89	48/48	5.0	36/36	LLD	LLD		12/12	LLD	
	Sr-90	48/48	1.0	36/36	4.2 (3.0-6.4)	F.Crnkovich (7.5 mi NE)	4.6 (3.2-6.2)	12/12	3.8 (3.2-4.6)	
	Cs-137	48/48	18.0	36/36	LLD	LLD		12/12	LLD	
	Other Gamma	48/48	15.0	36/36	LLD	LLD		12/12	LLD	

(a) Nominal Lower Limit of Detection (LLD) as defined in MASL-300 (Rev 0/73), pages D-06-01, 02 and 03; Palisades Technical Specifications Table 4.11-3 and vendor analytical capabilities.
(b) Mean and range based upon detectable measurements and/or vendor laboratory LLD's.
(c) Nonroutine reported measurements are defined in the Palisades Technical Specifications, Section 6.9.3.2
(d) Supplemental sample when milk is unavailable.
(e) Monthly TLD results are normalized for 30 days net; Quarterly TLD results are normalized for 91 days net.
(f) See TLD evaluations in report narrative.
(g) See reporting results for greatest mean sampling location.
(h) Tritium analysis required for South Haven treated only.

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Table HP 10.4-2 Sample Data Summary

Medium or Pathway Sampled	Analyses Evaluated Over Total Number of Analyses Performed		Lower Limit of Detection(a)	All Indicator Locations		Location With Greatest Annual Mean(g)		All Control Locations		Nonroutine Measurements (c)
TLD (gamma mR) Inner Ring (Site Boundary)	TLD (monthly)(e)	155/287(f)	10.0	120/252	4.2 (2.0-7.9)	ST-11 (Kalamazoo, 35 mi SSE)	5.2 (3.8-6.9)	35/35	4.6 (3.8-6.9)	None
	TLD (quarterly)(e)	52/96(f)	10.0	40/84	12.1 (9.7-18.4)	ST-11 (Kalamazoo, 35 mi SSE)	14.6 (12.6-16.5)	12/12	13.6 (11.6-16.5)	None
	TLD (annual)	13/24	10.0	10/21	56.8 (49.6-62.4)	ST-11 (Kalamazoo, 35 mi SSE)	68.2	3/3	63.6 (55.8-68.2)	None
TLD (gamma mR) Outer Ring	TLD (monthly)(e)	167/287(f)	10.0	132/252	4.8 (2.6-11.0)	ST-06 (R.Bus, 4.25 mi NE)	5.7 (4.8-8.2)	35/35	4.6 (3.8-6.9)	None
	TLD (quarterly)(e)	56/96(f)	10.0	44/84	14.5 (11.3-20.2)	ST-02 (Tower Hill, 5.5 mi S)	17.8 (15.8-19.4)	12/12	13.6 (11.6-16.5)	None
	TLD (annual)	14/24(f)	10.0	11/21	69.0 (57.4-86.2)	ST-02 (Tower Hill, 5.5 mi S)	86.2	3/3	63.6 (55.8-68.2)	None
Crops (pCi/g wet)	Gross Beta	14/14	1.0	14/14	1.4 (0.09-2.8)	5-PR (P.Rood, 3.5 mi ESE)	1.8 (1.3-2.8)	None		None
	Sr-89	14/14	0.025	14/14	LLD	LLD		None		None
	Sr-90	14/14	0.005	14/14	0.007 (0.001-0.018)	2-TH (Tower Hill, 5.5 mi S)	0.007 (0.006-0.007)	None		None
	I-131	14/14	0.06	14/14	LLD	LLD		None		None
	Other Gamma	14/14	Various 0.5-0.18	14/14	LLD	LLD		None		None
Sediment (pCi/g dry)	Gross Beta	12/12	1.0	7/7	9.3 (3.0-24.0)	½ mi North (site)	24.0	5/5	9.3 (5.6-14.3)	None
	Sr-89	12/12	0.025	7/7	LLD	LLD		5/5	LLD	None
	Sr-90	12/12	0.005	7/7	0.008 (0.003-0.017)	Ludington Control (120 mi N)	0.010 (0.002-0.028)	5/5	0.010 (0.002-0.028)	None
	Cs-137	12/12	0.18	7/7	LLD	LLD	0.19	5/5	LLD	None
	Other Gamma	12/12	Various 0.05-0.15	7/7	LLD	LLD		5/5	LLD	None

(a) Nominal Lower Limit of Detection (LLD) as defined in MASL-300 (Rev 0/73), pages D-06-01, 02 and 03; Palisades Technical Specifications Table 4.11-3 and vendor analytical capabilities.
(b) Mean and range based upon detectable measurements and/or vendor laboratory LLD's.
(c) Nonroutine reported measurements are defined in the Palisades Technical Specifications, Section 6.9.3.2
(d) Supplemental sample when milk is unavailable.
(e) Monthly TLD results are normalized for 30 days net; Quarterly TLD results are normalized for 91 days net.
(f) See TLD evaluations in report narrative.
(g) See reporting results for greatest mean sampling location.
(h) Tritium analysis required for South Haven treated only.

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Medium or Pathway Sampled	Analyses Evaluated Over Total Number of Analyses Performed		Lower Limit of Detection(a)	All Indicator Locations		Location With Greatest Annual Mean(g)		All Control Locations		Nonroutine Measurements (c)
Algae (pCi/g wet)	Gross Beta	4/4	1.0	2/2	2.7 (1.1-4.2)	Lake Discharge	4.2 (4.2)	2/2	1.6 (0.9-2.2)	None
	Sr-89	4/4	0.025	2/2	LLD	LLD		2/2	LLD	None
	Sr-90	4/4	0.005	2/2	0.009 (<0.003-0.014)	½ mi South (site)	0.014 (0.014)	2/2	0.006 (<0.003-0.008)	None
	Other Gamma	4/4	Various 0.10-0.26	2/2	Elevated LLD's	Lake Discharge		2/2	LLD	See Aquatic Biota Narrative
Fish (pCi/g wet)	Gross Beta	13/13	1.0	7/7	2.1 (1.7-2.6)	Ludington Control (120 mi N)	2.3 (1.5-3.7)	6/6	2.3 (1.5-3.7)	None
	Sr-89	13/13	0.025	7/7	LLD	LLD		6/6	LLD	None
	Sr-90	13/13	0.005	7/7	0.049 (0.001-0.015)	½ mi North (site)	0.012 (0.009-0.015)	6/6	0.009 (0.002-0.022)	None
	Other Gamma	13/13	Various 0.1-0.26	7/7	LLD	LLD		6/6	LLD	None
Broadleaf(d) Vegetation (pCi/g wet)	Gross Beta		1.0	No samples Collected				No Samples Collected		None
	I-131		0.06							
	Sr-89		0.025							
	Sr-90		0.005							
	Cs-137		0.08							
	Other Gamma									

(a) Nominal Lower Limit of Detection (LLD) as defined in MASL-300 (Rev 0/73), pages D-06-01, 02 and 03; Palisades Technical Specifications Table 4.11-3 and vendor analytical capabilities.
(b) Mean and range based upon detectable measurements and/or vendor laboratory LLD's.
(c) Nonroutine reported measurements are defined in the Palisades Technical Specifications, Section 6.9.3.2
(d) Supplemental sample when milk is unavailable.
(e) Monthly TLD results are normalized for 30 days net; Quarterly TLD results are normalized for 91 days net.
(f) See TLD evaluations in report narrative.
(g) See reporting results for greatest mean sampling location.
(h) Tritium analysis required for South Haven treated only.

Palisades Nuclear Plant
Annual Radiological Environmental Operating Report
January 1 to December 31, 1987
Table HP 10.4-3 High, Low and Mean Reporting
Results for Greatest Mean Sampling Location

Medium	Type of Analysis	Location	High	Low	Mean
Air (pCi/m³)	Gross Beta	H.Soderberg (5 mi S)	0.05	0.01	0.03
	I-131	LLD	--	--	<0.07
Lake Water (pCi/L)	Gross Alpha	LLD	--	--	<1.0
	Gross Beta	Lake Intake & South Haven (Raw) Lake Water (5.5 mi NNE)	--	--	<4.0
	Tritium	LLD	--	--	<500.00
Drinking Water (pCi/L)	Gross Beta	South Haven Raw & Treated (5.5 mi NNE)	--	--	<4.0
	Tritium(3)	LLD	--	--	<500.00
Well Water (pCi/L)	Gross Beta	State Park (1 mi N)	5.4	1.2	3.3
	Tritium	LLD	--	--	<500.00
Milk (pCi/L)	I-131	LLD	--	--	<1.0
	Sr-89	LLD	--	--	<5.0
	Sr-90	F. Crnkovich (7.5 mi NE)	6.2	3.2	4.6
	Cs-137	LLD	--	--	<18.0
	Other Gamma	LLD	--	--	<15.0
TLD (Gamma-mR)(4) Inner Ring (site boundary)	TLD (Monthly)	ST-11 (Kalamazoo, 35 mi SSE)	6.9	3.8	5.2
	TLD (Quarterly)	ST-11 (Kalamazoo, 35 mi SSE)	16.5	12.6	14.6
	TLD (Annual)	ST-11 (Kalamazoo, 35 mi SSE)	--	--	68.2
TLD (Gamma-mR)(4) Outer Ring	TLD (Monthly)	ST-06 (R.Bus, 4.25 mi NE)	8.2	4.8	5.7
	TLD (Quarterly)	ST-02 (Tower Hill, 5.5 mi S)	19.4	15.8	17.8
	TLD (Annual)	ST-02 (Tower Hill, 5.5 mi S)	--	--	86.2

(1) Samples collected monthly when in season.
(2) Two samples per location (collected semiannually)
(3) Tritium analysis required for South Haven treated only.
(4) Monthly TLD results are normalized for 30 days net; Quarterly TLD results are normalized for 91 days net.
(5) Supplemental sample when milk is unavailable.

Palisades Nuclear Plant
Annual Radiological Environmental Operating Report
January 1 to December 31, 1987
Table HP 10.4-3 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	5-PR (P.Rood, 3.5 mi ESE)	2.8	1.3	1.8
	Sr-89	LLD	--	--	<0.025
	Sr-90	2-TH (Tower Hill, 5.5 mi S)	0.006	0.007	0.007
	Cs-137	LLD	--	--	<0.08
	I-131	LLD	--	--	<0.06
	Other Gamma	LLD	--	--	<0.05
Sediment (pCi/g dry)(2)	Gross Beta	½ Mile North (site)	--	--	24.0
	Sr-89	LLD	--	--	<0.025
	Sr-90	Ludington Control (120 mi N)	0.028	0.002	0.010
	Cs-137	LLD	--	--	<0.18
	Other Gamma	LLD	--	--	<0.05
Algae (pCi/g wet)	Gross Beta	Lake Discharge	--	--	4.2
	Sr-89	LLD	--	--	<0.025
	Sr-90	½ mi South (site)	--	--	0.014
	Other Gamma	Lake Discharge	--	--	Elevated LLD's
Fish (pCi/g wet)	Gross Beta	Ludington Control (120 mi N)	3.7	1.5	2.3
	Sr-89	LLD	--	--	<0.025
	Sr-90	½ Mile North (site)	0.015	0.009	0.012
	Other Gamma	LLD	--	--	<0.10
Broad Leaf Veg (pCi/g wet) (5)	Gross Beta	No samples collected			
	I-131				
	Sr-89				
	Sr-90				
	Other Gamma				

(1) Samples collected monthly when in season.
(2) Two samples per location (collected semiannually)
(3) Tritium analysis on required for South Haven treated only.
(4) Monthly TLD results are normalized for 30 days net; Quarterly TLD results are normalized for 91 days net.
(5) Supplemental sample when milk is unavailable.

MI0587-0028A-HP01

To WLBeckman

From MAMoore MM

Date December 16, 1987

Subject PALISADES PLANT-
1987 LAND USE CENSUS

CC TPNeal
DCC: 950/72*10*03/LP

CONSUMERS
POWER
COMPANY

Internal
Correspondence

MAM87*019

The attached tables and map are the results of the Palisades Land Use Census conducted on July 17, 1987. Table 10.11-1 references the distance from Palisades to the nearest residence, garden, beef/dairy cattle, and goat per meteorological sector. Table 10.11-2 identifies the locations of the nearest residence and garden; and of all beef/dairy cattle and goats within a five-mile radius of Palisades per meteorological sector. Table 10.11-3 lists the critical receptor locations used in calculation of the offsite doses by the GASPAR computer program. An accompanying map illustrates Table 10.11-2.

Prior to conducting the Palisades 1987 Land Use Census, both the Van Buren County Agricultural Extension Office and Consumers Power Company Southwestern Regional Manager's Office were contacted July 15, 1987 as required in Procedure HP 10.11. There were no significant differences noted between the 1986 and 1987 Land Use Census.

If you have any questions, please contact me.

Reviewed and Authorized TPNeal 12/27/87
TPNeal, RMC Administrator Date

IC1287-0259A-HP01

1987 PALISADES LAND USE CENSUS

TABLE 10.11-1

Distance to the nearest residence, garden, dairy/beef cattle and goat in each sector.

SECTOR	RESIDENCE	GARDEN	BEEF CATTLE	DAIRY COW	GOAT
N	>5 mi	>5 mi	>5 mi	>5 mi	>5 mi
NNE	1.6 mi	3.8 mi	>5 mi	>5 mi	>5 mi
NE	1.8 mi	1.8 mi	>5 mi	>5 mi	>5 mi
ENE	1.3 mi	2.9 mi	2.5 mi	4.0 mi	3.8 mi
E	1.0 mi	2.9 mi	3.5 mi	>5 mi	>5 mi
ESE	1.0 mi	1.5 mi	3.1 mi	>5 mi	>5 mi
SE	.9 mi	1.1 mi	3.8 mi	4.3 mi	>5 mi
SSE	.75 mi	1.8 mi	>5 mi	>5 mi	>5 mi
S	.5 mi	1.5 mi	>5 mi	>5 mi	>5 mi
SSW	.75 mi	1.5 mi	>5 mi	>5 mi	>5 mi

1987 PALISADES LAND USE CENSUS

TABLE 10.11-2

Verification of Items

Sector	Location Description	Item	Number/Comment
NNE Ruggles Road	L. Kern-State Park Manager.	Residence	1
NNE 11th Avenue	A. Olson-11th Avenue (West side of road).	Garden	1
NE Blue Star Hwy	L. Swetay, Route 3, Box 133, South Haven-(East side of hwy).	Residence Garden	1 1
ENE 24th Avenue, dead end	Trailer-West 24th Avenue, dead end at sand dune.	Residence	1
ENE CR 380 (20th Ave)	J. Moscov-7345 CR 380, $\frac{1}{4}$ mile East of M-140 and CR 380 intersection (South side of CR 380).	Garden	1
ENE M-140	Robinson, 18800 M-140, Covert (West side of road).	Cattle	3-beef
ENE 72nd Street	Cecil Hodge, 16971 72nd St, 3/8 mile South of 16th Ave and 72nd St intersection (West side of 72nd St.).	Cattle	2-Dairy Cow 7-Beef
ENE 72nd Street	Harlett, 19487 72nd St, $\frac{1}{4}$ mile South of 72nd St and CR 380 intersection (West side of 72nd St.)	Goats	2
ENE 77th Street dead end –	77th St. - 1 mile North of 77th St and 29th Ave intersection.	Residence	1
E 26th Avenue	Brunts - 73536 26th Avenue, $\frac{1}{4}$ mile East of 26th Avenue and M-140 intersection (South side of 26th Avenue).	Garden	1
E 72nd Street	C Mims, 26200 72nd St, intersection of 72nd St and 26th Ave (Northwest corner of intersection).	Cattle	2-Beef

1987 PALISADES LAND USE CENSUS

TABLE 10.11-2 (Cont'd)

E CR 378 (68th Avenue)	R. Rouse, 67872 CR 378, ½ mile North of CR 378 and 30th Ave intersection (just outside of 5 mile limit zone).	Cattle	25-Beef
ESE 7750 Street	O. Ashley - Northwest corner of 7750th St and 28th Ave intersection.	Residence	1
ESE 28th Avenue	Waite, 76729 28th Ave ¼ mile East of 28th Ave and M-140 intersection (South side of 28th Ave).	Garden	1
ESE 30th Avenue	Newell, ½ mile East of M-140 and 30th Ave intersection.	Cattle	1-Beef
ESE 69th Street	Dairy Farm, 69th Street, ½ mile North of 69th Street and 34th Avenue intersection (approximately ½ mile outside of 5 mile limit zone).	Cattle	15-Dairy Cows 10-Beef
SE 7750 Street	Lloyd, 28160 7750th St - ¼ mile South of 7750 St and 28th Ave intersection (West side of 7750th St).	Residence	1
SE 7750 Street	Carl Dunson, 30602 7750th St ½ mile South of 7750th St and 28th Ave intersection (West side of 7750th St).	Garden	1
SE 34th Avenue	L. Burrows - ½ mile East of 34th Ave and M-140 intersection (South side of 34th Ave).	Cattle	15-Beef
SE 36th Avenue	G. Miller, Route 1, Box 20, Covert - ½ mile West of 36th Ave and 72nd St intersection (South side of 36th St).	Cattle	1-Dairy Cow 4-Beef
SSE 29th Avenue	L. Burrows - Route 1, Box 167, Covert - Southwest corner of 29th Ave and Blue Star Hwy intersection.	Residence	1

1987 PALISADES LAND USE CENSUS

TABLE 10.11-2 (Cont'd)

SSE 32nd Avenue	Howard, 77731 32nd Avenue, Covert (South side on 32nd Avenue).	Garden	1
SSE CR 376	Marshall - Southwest corner of CR 376 and M-140 intersection (owner of cattle is J. Donald leasing Marshall property).	Cattle	8-Beef
S 29th Avenue	Residence - Palisades Park; 3/4 mile West of 29th Ave. and Blue Star Hwy intersection (North side of 29th Ave).	Residence	1
S 32nd Avenue	Northwest corner of 32nd Ave and Blue Star Hwy.	Garden	1
SSW 29th Avenue dead end	R. James - 29th Ave, dead end, Palisades Park.	Residence	1
SSW 32nd Avenue	Dead end of dirt road, ½ mile West from 32nd Ave and Blue Star Hwy intersection.	Garden	1

1987 PALISADES LAND USE CENSUS

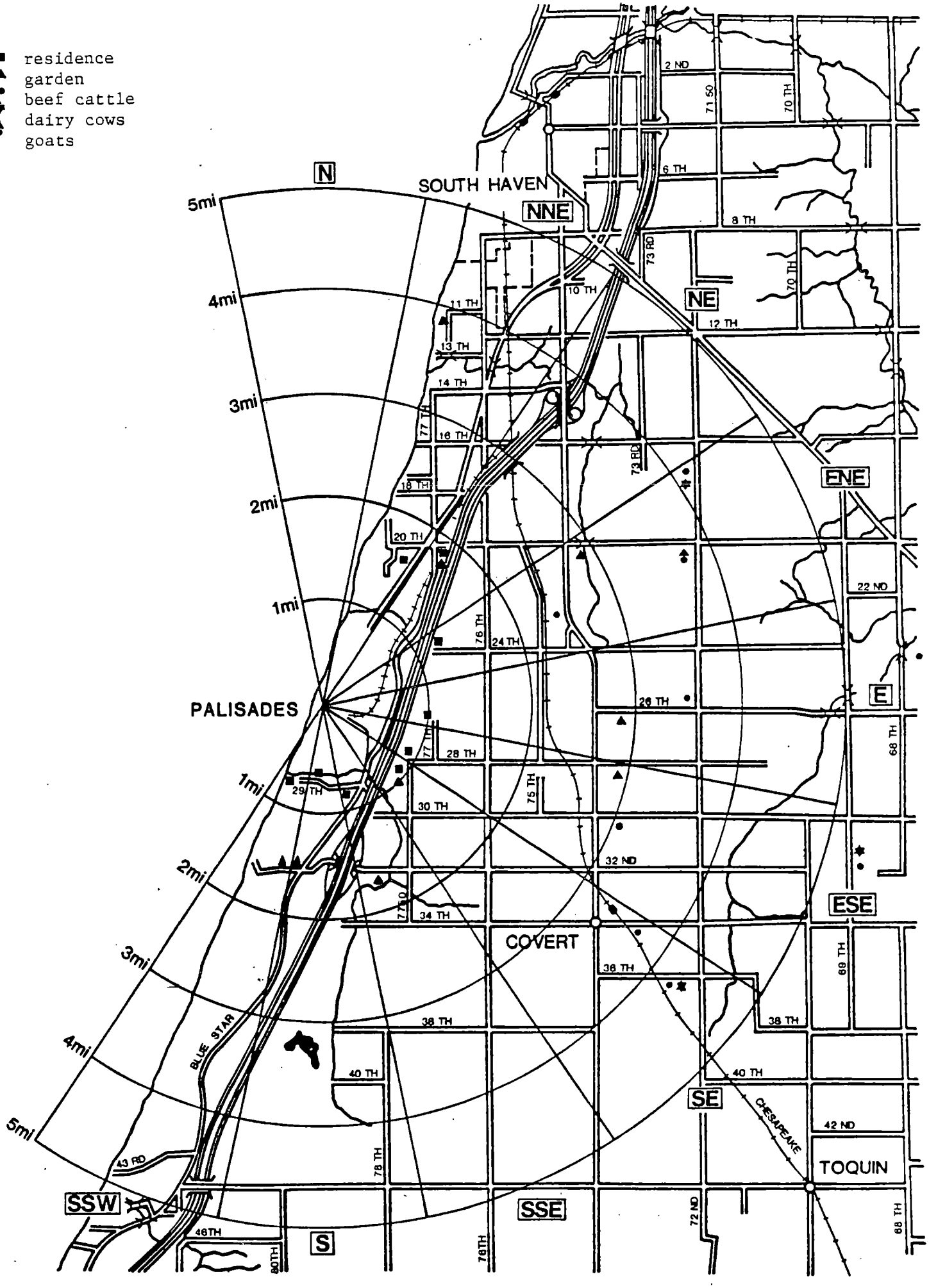
TABLE 10.11-3

Critical Receptor Items

Sector	Distance (Miles)	Location/Description	Item	*X/Q (sec/m^3)
SSE	0.48	Site Boundary	N/A	1.43E-06
S	0.50	Residence, Palisades Park; 3/4 mile West of 29th Avenue and Blue Star intersection.	Residence/ Garden	1.00E-06
ENE	2.50	Robinson, 18800 M-140, Covert (West side of road).	Beef Cattle	1.05E-07
ENE	4.00	Cecil Hodge, 16971 72nd Street, 3/8 mile South of 16th Avenue and 72nd Street intersection (West side of 72nd Street).	Dairy Cow	5.29E-08
ENE	3.80	Harlett, 19487 72nd Street, $\frac{1}{4}$ mile South of 72nd Street and CR 380 intersection.	Goat	5.85E-08

Note:

*Based on Palisades 5-year composite meteorological data, 1978-1982.


residence
garden
beef cattle
dairy cows
goats
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SOUTH HAVEN
PALISADES
COVERT
TOQUIN
BLUE STAR
CHESAPEAKE
5mi
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22 ND
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26 TH
28 TH
29 TH
30 TH
32 ND
34 TH
36 TH
38 TH
40 TH
42 ND
43 RD
46TH
50TH
68 TH
69 TH
70 TH
71 50
72 ND
73 RD
75 TH
76 TH
76TH
77 TH
78 TH

TITLE: PALISADES RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

Table of Contents

ATTACHMENTS

TITLE: PALISADES RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

1.0 PURPOSE

1.1 To provide methodology for collection of environmental samples in support of the Radiological Environmental Monitoring Program (REMP).

2.0 REFERENCES

2.1 Palisades Technical Specifications, Table 4.1-3(6), Section 4.11 and Table 4.11-1 and 6.9.3.2

2.2 Reg Guide 4.15(7)

2.3 10 CFR 50, Appendix I

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

2.5 Palisades Administrative Procedure 7.08, "Radiological Environmental Program Administrative Controls"

2.6 Radiological Environmental Monitoring Sample Shipping Manual, Teledyne Isotopes Midwest Laboratory, Rev 2, September 20, 1985

3.0 PREREQUISITES

As indicated in procedure

4.0 PRECAUTIONS AND LIMITATIONS

4.1 This procedure shall be applicable to Palisades/RSD HP, Environmental Service Department and any contractual personnel assigned to collect or evaluate REMP samples.

4.2 Any revisions to this procedure shall be reviewed against Palisades Technical Specifications to verify compliance to all requirements.

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 end of the next sampling period.

4.5 If it is not possible to obtain the required samples, suitable alternative media and locations shall be substituted within 30 days.

4.6 Samples shall be collected, prepared and shipped for analysis in a timely manner to preserve integrity. Other specific handling precautions for sample media are indicated in Section 5 as required.

TITLE: PALISADES RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

5.0 PROCEDURE

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

5.1 REMP 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. If this cannot be done, replace applicable component and document on air sample collection data sheet.

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

d. Airflow meters will be changed out prior to the expiration of calibration dates. Replacement air meters are available from plant RSD Environmental contact.

e. If air leakage is observed requiring the replacement of an airflow meter, notify the Palisades RSD Radiological Environmental contact within 24 hours of changeout. Document on air sample collection data sheet.

5.1.2 Prerequisites

a. Glass fiber air filters

b. Absorbent cartridges for iodine sampling

c. Glassine envelopes

d. REMP Air Sample Data Sheet (containing installation data)

e. Replacement air sample meters (as required)

5.1.3 Weekly at each sample location perform the following:

a. Open protective cover on air sampler and record the integrated airflow meter readings on the sample data sheet under "Removed" column. Turn machine off.

TITLE: PALISADES RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

NOTE: If airflow meter must be replaced, record the data required in 5.1.3.a as initial readings for the upcoming week's collection and note the change under "Remarks" on the current sample data sheet. Record installed and removed airflow meter readings in the columns provided. Record installed and removed readings of replacement airflow meter under "Remarks."

b. Detach filter holder from sample unit and take to enclosed vehicle.

c. Remove and replace filters while inside vehicle.

NOTE: Center the filter properly to prevent leakage.

d. Label glassine or plastic envelope as per Attachment 3 and place particulate filter in envelope.

e. Identify carbon filter as per Attachment 3.

f. Replace the filter holder. Filters must be positioned so that the airstream first passes through the particulate filter and then through the charcoal cartridge.

g. Turn machine on. Place hand over filter inlet to form a seal. If no noticeable filter vacuum (suction) is felt or if vacuum pump motor does not labor, then significant filter bypass leakage may be occurring. Repeat step f and/or replace filter holder if required.

h. Close cover and proceed to the next station.

i. Record all pertinent information, date and sign data sheet.

j. Be sure to transcribe the removed airflow meter readings taken in Step 5.1.3.a to the installed readings columns on the sample data sheet to be used for the upcoming week's air sample collection.

5.2 REMP LAKE (DRINKING) WATER SAMPLE COLLECTION-SOUTH HAVEN, MICHIGAN

5.2.1 Prerequisites

a. Four clean one-gallon polyethylene containers (labeled as per Attachment 3)

b. REMP Miscellaneous Data Sheet

5.2.2 Monthly perform the following sample collection:

a. Leave four containers with the Plant Superintendent at the South Haven Municipal Water Treatment Plant.

TITLE: PALISADES RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

NOTE: New water sample containers should always be left at the South Haven water treatment plant upon pickup of end-of-month composite samples.

b. Instruct the Plant Superintendent to add approximately 300 mL per day of raw water to container labeled "RAW" and approximately 300 mL per day of treated water to container labeled "TREATED."

c. Return at end of month to collect containers. Obtain verbal verification that Step 5.2.2.b was carried out. Note any deviations in "Remarks" column of data sheet.

d. Record location, sample types (raw and treated) on sample data sheet. Enter "Finish" in "Remarks" column. Sign and date data sheet.

5.3 REMP WELL WATER SAMPLE COLLECTION

5.3.1 Prerequisites

a. Six clean one-gallon polyethylene containers

b. REMP Miscellaneous Data Sheet

5.3.2 Monthly perform the following sample collection:

a. Turn on water supply (or begin pumping water) and allow water to run for approximately one minute to purge the lines.

b. Fill two clean one-gallon polyethylene containers with well water from each sample location.

NOTE: During the winter months the State and Township Park wells may be out of service. When this occurs, note the unavailability of the water samples and document on sample data sheet.

c. Label containers per Attachment 2.

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

5.4 REMP MILK SAMPLE COLLECTION

5.4.1 Precautions

a. Milk samples are required to be sent to the laboratory as soon as possible because of the short half-life of I-131. Any undue delay may cause analytical sensitivity requirements of the Technical Specifications to be altered.

TITLE: PALISADES RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

b. Obtain best available replacement sample for any missing milk sample(s). Identify new sample location(s) and notify Palisades RSD Radiological Environmental contact within 24 hours.

c. If milk samples are unavailable, then samples of three different kinds of broad leaf vegetation grown nearest to Palisades in each of two different offsite locations of the highest predicted annual average ground level D/Q (SE or SSE sectors near site), and one sample of each kind of similar broad leaf vegetation grown 15-30 km distant from Palisades in the least prevalent wind direction (SSW or S sectors) may be used as replacement samples. The new sample locations shall be identified and the REMP procedures revised within 30 days to reflect sampling changes.

5.4.2 Prerequisites

a. Two clean polyethylene one-gallon containers for each sample location

b. Eight pre-measured packets of sodium bisulfite preservative (one packet per gallon)

c. REMP Miscellaneous Data Sheet

5.4.3 Monthly at each sample location perform the following:

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

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

b. Label containers as per Attachment 3.

c. Package and ship samples as per Attachment 4.

d. Record on Data Sheet location, type, date, quantity and under "Remarks" indicate any pertinent information. Sign form in space provided.

5.5 REMP AQUATIC BIOTA COLLECTION

NOTE: Collection to be coordinated between Radiological Services Department RMC Section and the Environmental Services Department.

TITLE: PALISADES RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

5.5.1 Precautions

a. At least one individual in the collection party is required to have a State of Michigan Collector's Permit for fish sample collection.

b. If logistical problems prevent use of a boat to set gill nets from the lake side of Palisades, then the nets can be set offshore from the site boundary (by wading). Notify security prior to using offshore wading method for beach access.

5.5.2 Prerequisites

a. Boat

b. Gill nets (of varying size mesh)

c. Plastic one-liter wide-mouth bottles

d. REMP Miscellaneous Data Sheet

e. 10% formaldehyde solution

f. Fillet knives

g. Black "magic" felt markers writing for sample identification on containers

5.5.3 Semiannually samples shall be collected as follows:

a. The fine mesh gill net is placed in the proximity of the discharge to collect small forage fish. One liter of fish flesh is to be collected for each species caught.

b. The intermediate and larger mesh gill nets are set at the north/south site boundaries to capture larger forage fish and predator-type (game) fish. One liter of flesh is to be collected from each type of fish species caught.

c. Label all containers as per Attachment 3.

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

TITLE: PALISADES RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

5.6 REMP SEDIMENT SAMPLE COLLECTION

5.6.1 Prerequisites

a. One-liter wide-mouth plastic sample bottles

b. Dredge or hand scoop

c. Miscellaneous Data Sheet

5.6.2 Semiannually at each sample location Palisades RSD/Environmental Services Departmental personnel shall collect sediment samples.

a. Record on data sheet location, type, date, quantity and under "Remarks" indicate surface area sampled and depth at which sample was obtained. Sign form in space provided.

5.7 REMP FOOD PRODUCT SAMPLE COLLECTION

5.7.1 Prerequisites

a. Sample containers

b. Miscellaneous Data Sheet

5.7.2 Monthly during the harvest season, food samples shall be collected as follows:

a. Sample selections of the following crops shall be processed:

Strawberries	Turnips
Blueberries	Cauliflower
Grapes	Cabbage - outer leaves only
Apples	Broccoli
Peaches	Collard greens
Pears	

NOTE: As per Technical Specification Table 4.11-1, blueberries and apples must be collected. Other crop samples can be collected on availability.

b. Approximately one kilogram (2.2 lb) of each sample type should be collected. Samples are not to be washed, shaked or cleaned.

c. Samples should not be collected from a single source, but at random from the entire orchard or field.

d. Label all containers as per Attachment 3.

TITLE: PALISADES RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

e. Record on data sheet location, type, date, quantity and under "Remarks" note any unusual conditions. Sign form in space provided.

5.8 REMP TLD SAMPLE COLLECTION

5.8.1 Prerequisites

a. TLDs

b. TLD Data Sheet

5.8.2 Monthly, quarterly and annually at each sample location perform the following:

NOTE: Monthly TLDs are to be changed each month; quarterly TLDs during January, April, July and October; and annual TLDs during January.

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

b. Field 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 sample 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 Data Sheet any of the above circumstances.

e. Store collected field TLDs in lead cave along with control TLDs until ready for mailing to laboratory contractor. Mark "Do not x-ray" on TLD package.

NOTE: Transportation control TLDs are to be stored in a special lead shield provided by laboratory contractor after the field TLDs are posted.

Be certain that designated transportation control TLDs are included with the correct TLD package being mailed to laboratory contractor.

TITLE: PALISADES RADIOLOGICAL ENVIRONMENTAL PROGRAM SAMPLE COLLECTION AND SHIPMENT

Also ensure that laboratory contractor's own TLD data sheet is completed and enclosed with shipment.

f. Record date TLDs are shipped and sign the data sheet.

5.9 Be sure that all collected samples are identified and labeled as per Attachment 3.

5.10 Complete the appropriate Sample Collection Data Sheet and distribute as follows:

White - Analytical Laboratory
Yellow - not required
Pink - Radiological Services Department Environmental Contact (Palisades)
Gold - Sample Collector

5.11 Obtain best available replacement sample for any missing sample. Notify Palisades RSD Radiological Environmental contact with description and location of the replacement sample.

NOTE: Obviously some samples are not replaceable (TLDs, air samples, etc); however, water, milk, crop samples, etc, should be.

5.12 Document any missing samples or malfunctioning equipment on sample data collection sheets.

5.13 Package and ship samples according to Attachment 4.

6.0 ACCEPTANCE CRITERIA

Proper completion of procedure

7.0 RECORDS AND ATTACHMENTS

7.1 RECORDS

7.1.1 Distribution of Sample Collection Data Sheet as per Section 5.10.

7.1.2 Sample data collection sheets shall be retained in the Uniform File Index under DCC number: PAL 950/24*03*10/L

7.2 ATTACHMENTS

Attachment 1, "Palisades Environmental Sample Collection Schedule"
Attachment 2, "Palisades Sample Locations"
Attachment 3, "Sample Identification"
Attachment 4, "Sample Packaging and Shipping"
Attachment 5, "Palisades Sample Collection Forms"

ENVIRONMENTAL SAMPLE COLLECTION SCHEDULE
Palisades Nuclear Plant

Exposure Pathway and/or Sample	Number of Samples and Locations*	Sample Type	Collection Frequency
Airborne:			
Particulates	1 - Onsite 8 - Within a 10 km Radius 3 - 25 to 89 km Distant	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 1 - Discharge	Daily composite to obtain a two-gallon sample	Monthly
Drinking Water	1 - S Haven Municipal System - Raw 1 - S Haven Municipal System - Treated		
Well Water	1 - Site 1 - State Park 1 - Township Park	Two-gallon grab sample	Monthly
Sediment	1 - Within 152.4 m of discharge (500 ft) 1 - Between North boundary and State Park beach 1 - 0.8 km South of discharge 1 - 8.9 km North 1 - Ludington control (2 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).

Exposure Pathway and/or Sample	Number of Samples and Locations*	Sample Type	Collection Frequency
Ingestion:			
Milk	3 - From 5 to 13 km 1 - Control from 15 to 30 km	Two-gallon grab sample	Monthly
Food Products	1 - Each of two principal fruit crops (blueberries and apples).	Two-pound grab sample	At time of harvest
Fish and Invertebrates	2 - Species in vicinity of plant discharge 1 - Ludington control	One-liter fish flesh	In season or semiannually
Direct:			
TLD	1 - On site 10 - Site boundary 9 - Within 12 km radius 3 - Control stations	Continuous	Monthly, Quarterly and Annually

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

PALISADES
SAMPLING LOCATIONS AND MAPS

Station	Code	Location	Sample: Air Particulates	Air Iodine	Lake Water	Well Water	Milk	Crops	Sediment	TLD	Fish	Biota
1	ST	Palisades Nuclear Plant	X	X	X	X			X	X	X	X
2	TH	Tower Hill Farms Intersection of 48th Ave and 80th Street, Coloma, MI 5.5 Miles (8.9 Km) S	X	X						X		
3	HS	Herbert Soderberg 48th Ave, Covert, Michigan 5.5 Miles (8.9 Km) S	X	X						X		
4*	JS	Jerry Sarno 36197 M-140 Covert, Michigan 3.5 Miles (5.6 Km) SE	X	X				X		X		
5	PR	Paul Rood 72723 County Road 378 Covert, Michigan 3.5 Miles (5.6 Km) ESE	X	X				X		X		
6	RB	Richard Bus 73rd Ave South Haven, Michigan 4.25 Miles (7.3 Km) NE	X	X				X		X		
7	SD	Sherman Dairy 72238 County Road 388 South Haven, Michigan 7 Miles (11.3 Km) NNE	X	X								
7a	SN35	Emergency Siren 35 4.75 Miles (7.7 Km) NNE								X		
8	SP	Van Buren State Park 1 Mile (1.6 Km) N	X	X		X				X		

*TLD 22 is a control in lead cave at Location 4-JS.

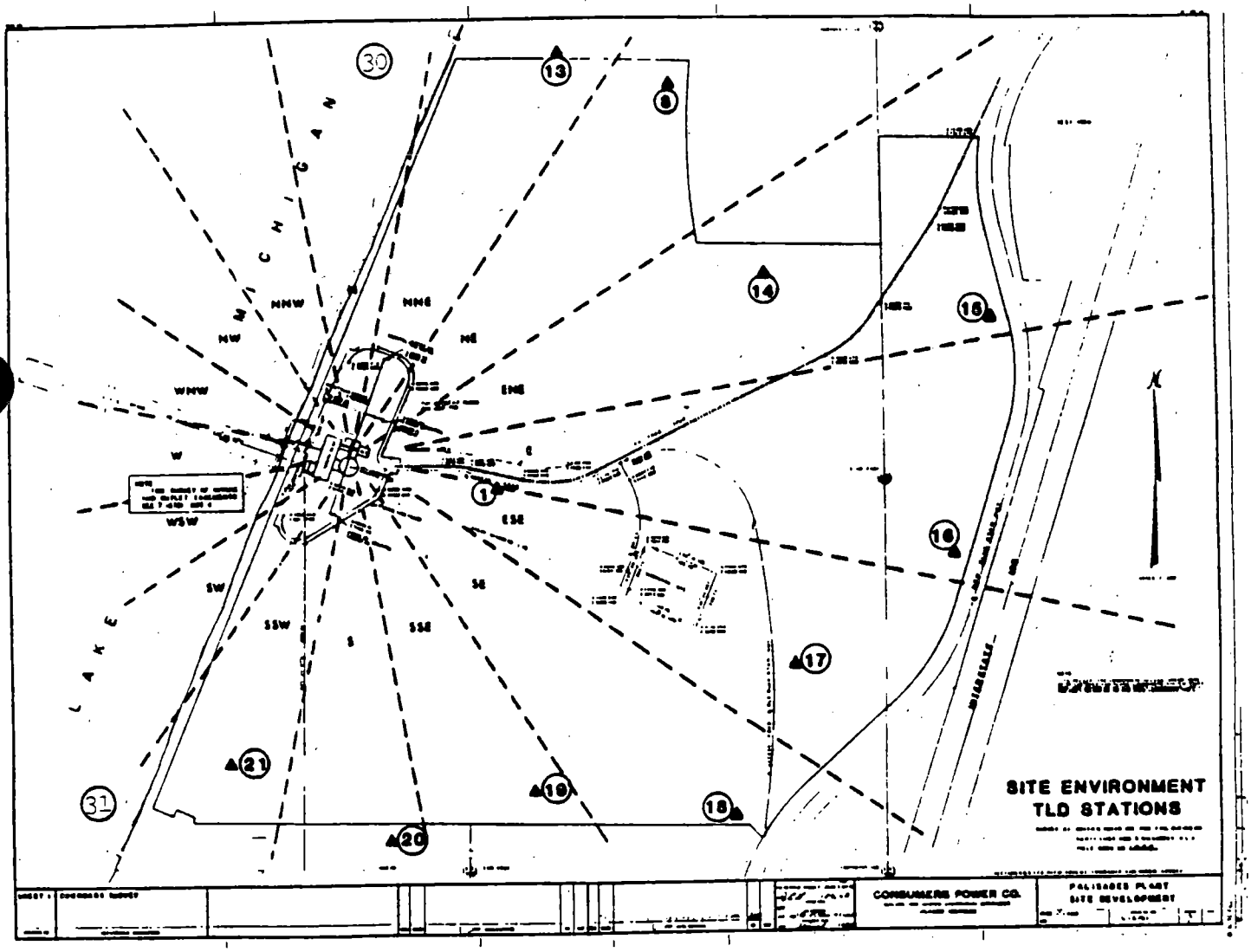
PALISADES
SAMPLING LOCATIONS AND MAPS

Station	Code	Location	Sample: Air Particulates	Air Iodine	Lake Water	Well Water	Milk	Crops	Sediment	TLD	Fish	Biota
9	TP	Covert Township Park 1.5 Miles (2.4 Km) SSW	X	X		X				X		
10	GR	CPCO Region Office Grand Rapids, Michigan 55 Miles (88.7 Km) NNE	X	X						X		
11	KZ	CPCO Region Office Kalamazoo, Michigan 35 Miles (56.4 Km) SSE	X	X						X		
12	DG	Dowagiac, Michigan 30 Miles (48.4 Km) SSE	X	X						X		
13-21	ST-	Perimeter of Palisades								X		
23	SN25	Emergency Siren 25 3 Miles (4.8 Km) ENE								X		
24	SN21	Emergency Siren 22 4.5 Miles (6.4 Km) E								X		
25	SH	South Haven, Michigan 5.5 Miles (8.9 Km) NNE			X				X			
26	FC	Frank Crnkovich 12th Avenue South Haven, Michigan 7.5 Miles (12.1 Km) NE					X					
27	KK-	Kenneth Kemp 70th Avenue South Haven, Michigan 8 Miles (12.9 Km) NE					X					

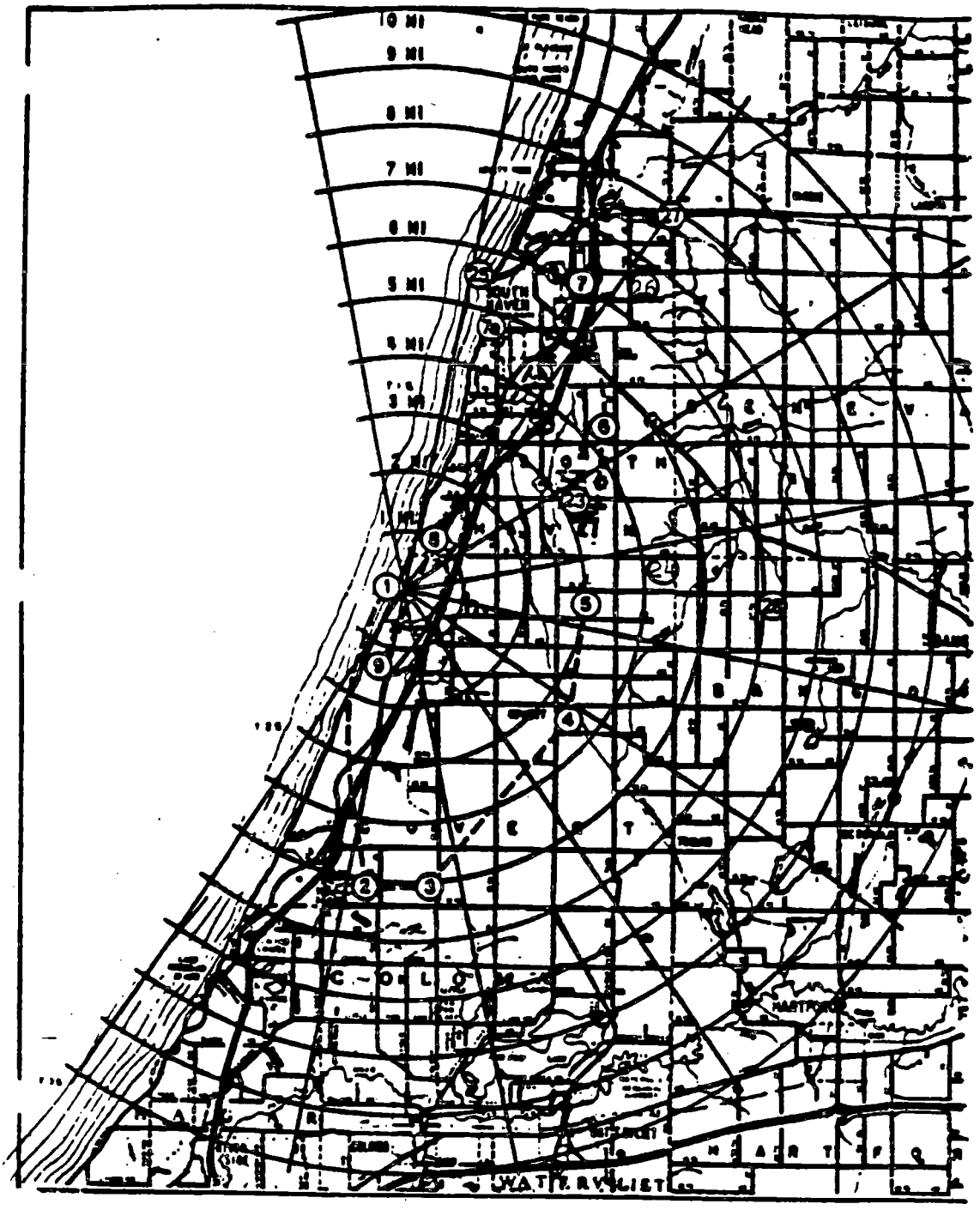
PALISADES
SAMPLING LOCATIONS AND MAPS

Station	Code	Location	Sample									
			Air Particulates	Air Iodine	Lake Water	Well Water	Milk	Crops	Sediment	TLD	Fish	Biota
28	GH	Glenn Hessey 65000 26th Ave Bangor, Michigan 6 Miles (9.7 Km) E					X					
29	WS	William Shine 60364 M-43 West Bangor, Michigan 10 Miles (16.1 Km) E					X					
30	STN	1/2 Mile (0.8 Km) N of Discharge									X	X
31	STS	1/2 Mile (8.0 Km) S of Discharge							X		X	X
32	LP	Ludington Pumped Storage 120 Miles (193.2 Km) N							X		X	X

SITE ENVIRONMENTAL TLD STATIONS



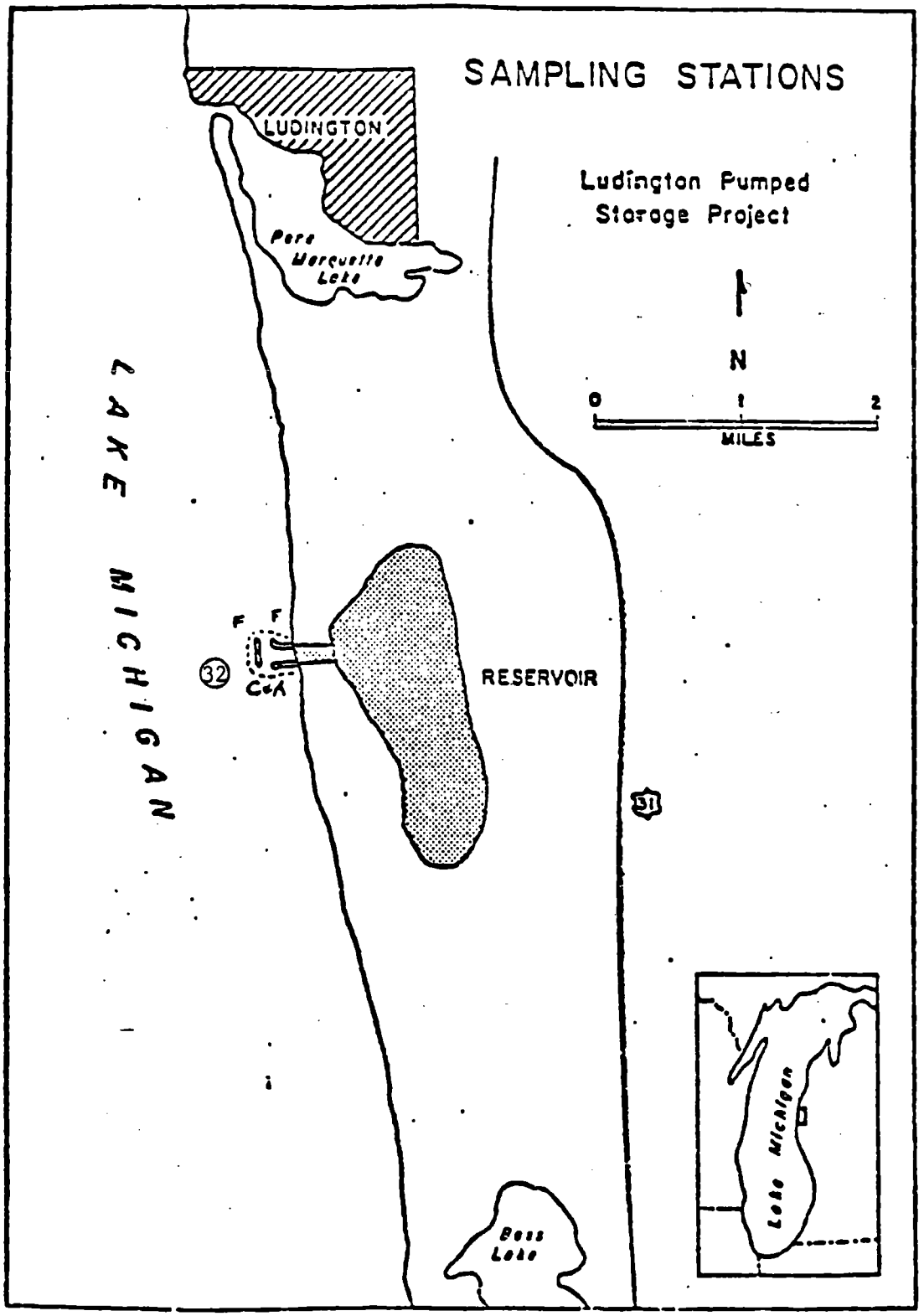
OFFSITE ENVIRONMENTAL TLD LOCATIONS
AND SAMPLE COLLECTION POINTS



Not Shown: (Control Locations)

(10)-Grand Rapids (55mi NNE)
(11)-Kalamazoo (35mi SSE)
(12)-Dowagiac (30mi SSE)
(22)-Control TLD placed in lead cave at location (4)
(29)-William Shine (WS-10mi E)

LUDINGTON CONTROL LOCATION



SAMPLE IDENTIFICATION

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

1. Each sample shall be clearly identified prior to packaging for shipment.

2. The plant name shall be written on sample container using the following identification:

Big Rock Point	BRP
Palisades	PAL

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
Shore Minnow	SM

SAMPLE IDENTIFICATION

4. The date and location where sample was collected (as per Attachment 2) shall be written out on sample container prior to packaging.

5. The sample container identification and data recorded on the sample collection sheet must agree.

SAMPLE PACKAGING AND SHIPMENT

1. Samples shall be clearly labeled per Attachment 3.

2. All liquid, biota, fish and sediment samples shall be sealed with tape to prevent leakage.

3. Liquid samples shall be shipped separately from air particulate and air iodine samples and TLDs.

4. Sufficient packing material (ie, crumpled newspaper) shall be used to avoid possible sample container damage during shipment.

5. Air filters shall be packaged in glassine or plastic envelopes.

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

7. Milk samples shall be shipped as soon as possible. Be sure to add one packet of sodium bisulfite (40 grams) as preservative to each gallon sample prior to shipping.

8. Food products shall be shipped as soon as possible after collection.

9. Fish and biota samples are to be shipped with a 10% formaldehyde solution added (preservative). Only 10 milliliters is required per sample. Samples should be shipped as soon as possible after processing.

10. The white copy of the Collection Data Sheet shall accompany all samples shipped to the analytical laboratory.

11. Samples shall be sent to the following address:

    Teledyne Isotopes Midwest Laboratory
    Att: C Carlson
    1509 Frontage Road
    Northbrook, IL 60062

12. All samples shall be sent to the Laboratory contractor with minimal delay after collection so as to avoid alteration of analytical sensitivity requirements.

PALISADES SAMPLE COLLECTION FORMS

FORM _____
REVISION _____
DATE _____

PALISADES PLANT

ENVIRONMENTAL MONITOR OPERABILITY CHECK & SAMPLE COLLECTION

	INSTALLED (MO/DA/YR)	REMOVED (MO/DA/YR)	GAS METER READING			METER SERIAL NO.	FLOW TEST				REPLACEMENT METER			
			REMOVED TIME	INSTALLED (Ft3)	REMOVED (Ft3)	CAL. DUE DATE	AS FOUND FLOW (SEC/Ft^3)	AS FOUND LEAK (CFM)	AS LEFT FLOW (SEC/Ft^3)	AS LEFT LEAK (CFM)	SERIAL NO. CAL. DUE DATE	CALIB.* ACCURACY ACCEPTABLE	SAMPLE VOL. (FT3)	COMMENTS
1ST														
2TH														
3HS														
4JS														
5PR														
6RB														
7SD														
8SP														
9TP														
10GR														
11KZ														
12DG														

* NOTE: FOR STATIONS WITH REPLACED METER, IF GAS METER TEST AND REPAIR CARD (FORM 116) IS NOT INCLUDED WITH THIS FORM, MARK AS "NO CAL CARD".

TEST PERFORMED BY: _____ DATE: _____
REVIEWED BY: _____ DATE: _____

PALISADES SAMPLE COLLECTION FORMS

Date _____

Collector _____

_____ PLANT

Miscellaneous Radiological Environmental Samples

SAMPLE		DATE	TIME	AMOUNT	REMARKS
Location	Type				
—					

PALISADES SAMPLE COLLECTION FORMS

PALISADES MONTHLY ENVIRONMENTAL TLD REPORT

Station Number – Location	Installed		Collected		Remarks
	Date	Time	Date	Time	
C-1					
C-2					
ST22 ST					
ST5 PR					
ST6 RB					
ST24 SN21					
ST23 SN20					
ST25 SN35					
ST16 ST					
ST15 ST					
ST1 ST					
ST14 ST					
ST8 SP					
ST13 ST					
ST17 ST					
ST18 ST					
ST19 ST					
ST20 ST					
ST21 ST					
ST9 TP					
ST12 DC					
ST3 HS					
ST2 TH					
ST4 JS					
ST10 GR					
ST11 KZ					

TELEDYNE ISOTOPES
MIDWEST LABORATORY
1508 FRONTAGE RD.
NORTHBROOK, IL 60062-4197
(312) 564-0700

MONTHLY PROGRESS REPORT
TO
CONSUMERS POWER COMPANY
JACKSON, MICHIGAN

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
FOR
PALISADES NUCLEAR GENERATING PLANT

PREPARED AND SUBMITTED
BY
TELEDYNE ISOTOPES MIDWEST LABORATORY

PROJECT NO. 8022

Reporting Period: January - December, 1987

Approved by: L. G. Huebner Date 1/30/88
L. G. Huebner
General Manager

Distribution: T.P. Neal (1 copy)

TABLE OF CONTENTS

LIST OF TABLES

1.0 INTRODUCTION

The following constitutes the current Monthly Progress Report for the Radiological Environmental Monitoring Program conducted at the Palisades Nuclear Generating Plant, Covert, Michigan. Results of completed analyses are presented in the attached tables. Missing entries indicate analyses that are not completed and the results will appear in subsequent reports.

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

None of the media sampled this month contained radioactivity attributable to the operation of Palisades Nuclear Generating Plant.

For all gamma isotopic analyses, spectrum is computer scanned from 80 to 2048 KeV. Specifically included are Mn-54, Co-58, Fe-59, 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. Unless noted otherwise, the less than value ("<") reported under "Other Gammas" is for Co-60 and may be higher or lower for other radionuclides.

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

Deviations from Scheduled Sampling and Corrective Actions Taken

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
Air particulate/ air iodine	PA-1	01-18-87 01-25-87 02-01-87	No power to station.
TLD	ST-11	05-31-87	Lost in the field.

NOTE: Page 3 is intentionally left out.

PALISADES

Table 1. Airborne Particulates and Iodine-131
Collection: Weekly
Units: pCi/m^3

Collection Date	1ST PALISADES (5 miles SSE) Volume (m^3)	Gross Beta	I-131	2TH COLOMA (5 miles SSE) Volume (m^3)	Gross Beta	I-131	3HS COVERT (5 miles SE) Volume (m^3)	Gross Beta	I-131
Required LLd		0.01	0.07		0.01	0.07		0.01	0.07
01-04-87	272	0.043±0.005	<0.015	309	0.036±0.004	<0.013	229	0.046±0.005	<0.018
01-11-87	170[a]	0.029±0.005	<0.086[a]	314	0.022±0.003	<0.047	232	0.036±0.005	<0.063
01-18-87	ND[b]	--	--	311	0.030±0.004	<0.042	229	0.037±0.005	<0.057
01-25-87	ND[b]	--	--	317	0.020±0.003	<0.033	232	0.029±0.004	<0.045
02-01-87	ND[b]	--	--	303	0.022±0.004	<0.045	224	0.033±0.005	<0.061
02-08-87	238	0.024±0.004	<0.059	269	0.028±0.004	<0.052	238	0.029±0.004	<0.059
02-15-87	272	0.022±0.004	<0.054	360	0.017±0.003	<0.041	227	0.024±0.004	<0.065
02-22-87	272	0.016±0.003	<0.041	309	0.015±0.003	<0.036	229	0.020±0.004	<0.049
03-01-87	266	0.015±0.003	<0.025	297	0.018±0.003	<0.023	224	0.020±0.004	<0.030
03-08-87	261	0.027±0.004	<0.026	303	0.021±0.003	<0.022	229	0.033±0.005	<0.029
03-15-87	266	0.018±0.003	<0.039	309	0.023±0.003	<0.034	238	0.026±0.004	<0.044
03-22-87	269	0.024±0.004	<0.037	303	0.020±0.003	<0.033	232	0.026±0.004	<0.043
03-29-87	269	0.016±0.004	<0.050	297	0.012±0.003	<0.045	229	0.019±0.004	<0.059
1st Qtr mean ± s.d.		0.023±0.008			0.022±0.006			0.029±0.008	

[a] Low volume and elevated I-131 LLD due to pump malfunction (power loss).
[b] ND = No data; no power to station.

Table 1. Airborne Particulates and Iodine-131 (continued)
Collection: Weekly
Units: pCi/m^3

Collection Date	1ST PALISADES (5 miles SSE) Volume (m^3)	Gross Beta	I-131	2TH COLOMA (5 miles SSE) Volume (m^3)	Gross Beta	I-131	3HS COVERT (5 miles SE) Volume (m^3)	Gross Beta	I-131
04-05-87	269	0.015±0.003	<0.041	190	0.012±0.004	<0.058	241	0.021±0.004	<0.046
04-12-87	261	0.013±0.003	<0.039	292	0.016±0.003	<0.035	224	0.015±0.004	<0.046
04-19-87	263	0.019±0.004	<0.034	295	0.015±0.003	<0.030	224	0.017±0.004	<0.040
04-26-87	266	0.015±0.004	<0.038	300	0.010±0.003	<0.033	232	0.012±0.004	<0.043
05-03-87	263	0.010±0.003	<0.039	300	0.015±0.003	<0.034	229	0.014±0.004	<0.045
05-10-87	258	0.023±0.004	<0.042	300	0.017±0.003	<0.036	221	0.026±0.005	<0.049
05-17-87	263	0.023±0.004	<0.061	156	0.016±0.005	<0.103[a]	227	0.021±0.004	<0.070
05-24-87	261	0.016±0.004	<0.043	289	0.013±0.003	<0.039	221	0.014±0.004	<0.051
05-31-87	266	0.017±0.004	<0.047	297	0.019±0.004	<0.042	187	0.023±0.005	<0.067
06-07-87	252	0.017±0.004	<0.062	278	0.016±0.004	<0.056	212	0.021±0.005	<0.073
06-14-87	258	0.023±0.004	<0.049	283	0.030±0.004	<0.045	218	0.026±0.004	<0.058
06-21-87	252	0.022±0.004	<0.038	278	0.022±0.004	<0.034	204	0.011±0.004	<0.047
06-28-87	252	0.022±0.004	<0.050	280	0.020±0.004	<0.045	198	0.024±0.005	<0.064
2nd Qtr mean±sd		0.018±0.004			0.017±0.004			0.019±0.005	

[a] Elevated LLD level due to low volume.

Table 1. Airborne Particulates and Iodine-131 (continued)
Collection: Weekly
Units: pCi/m^3

Collection Date	1ST PALISADES (5 miles SSE) Volume (m^3)	Gross Beta	I-131	2TH COLOMA (5 miles SSE) Volume (m^3)	Gross Beta	I-131	3HS COVERT (5 miles SE) Volume (m^3)	Gross Beta	I-131
07-05-87	257	0.025±0.004	<0.043	289	0.020±0.003	<0.038	204	0.027±0.005	<0.054
07-12-87	252	0.022±0.004	<0.042	280	0.022±0.004	<0.038	198	0.026±0.005	<0.054
07-19-87	244	0.022±0.004	<0.044	283	0.019±0.003	<0.038	198	0.022±0.004	<0.054
07-26-87	252	<0.005	<0.039	275	0.032±0.004	<0.036	195	0.044±0.006	<0.050
08-02-87	252	0.024±0.004	<0.053	280	0.024±0.004	<0.048	198	0.023±0.005	<0.068
08-09-87	252	0.026±0.004	<0.043	283	0.022±0.004	<0.038	201	0.018±0.004	<0.054
08-16-87	241	0.015±0.004	<0.047	266	0.023±0.004	<0.043	193	0.017±0.004	<0.059
08-23-87	258	0.022±0.004	<0.051	289	0.019±0.003	<0.045	207	0.026±0.004	<0.063
08-30-87	246	0.017±0.003	<0.045	283	0.015±0.002	<0.039	204	0.024±0.003	<0.054
09-06-87	258	0.031±0.004	<0.050	286	0.028±0.004	<0.045	207	0.036±0.051	<0.062
09-13-87	252	0.044±0.005	<0.060	283	0.030±0.004	<0.054	204	0.032±0.005	<0.074
09-20-87	252	0.010±0.003	<0.050	283	0.020±0.003	<0.045	201	0.022±0.004	<0.063
09-27-87	249	0.021±0.004	<0.035	286	0.017±0.003	<0.031	210	0.020±0.004	<0.042
3rd Qtr mean ± s.d.		0.023±0.008			0.022±0.005			0.026±0.008	

Table 1. Airborne Particulates and Iodine-131 (continued)
Collection: Weekly
Units: pCi/m^3

Collection Date	1ST PALISADES (5 miles SSE) Volume (m^3)	Gross Beta	I-131	2TH COLOMA (5 miles SSE) Volume (m^3)	Gross Beta	I-131	3HS COVERT (5 miles SE) Volume (m^3)	Gross Beta	I-131
10-04-87	246	0.020±0.004	<0.039	286	0.019±0.003	<0.034	204	0.029±0.005	<0.047
10-11-87	246	0.012±0.003	<0.048	280	0.012±0.003	<0.042	207	0.014±0.004	<0.057
10-18-87	261	0.023±0.004	<0.038	295	0.026±0.004	<0.034	198	0.041±0.005	<0.050
10-25-87	249	0.018±0.004	<0.050	286	0.014±0.003	<0.044	193	0.021±0.005	<0.065
11-01-87	258	0.020±0.004	<0.047	300	0.019±0.003	<0.041	207	0.015±0.004	<0.059
11-08-87	252	0.047±0.005	<0.043	286	0.036±0.004	<0.038	204	0.034±0.005	<0.053
11-15-87	255	0.042±0.005	<0.042	295	0.042±0.004	<0.036	204	0.054±0.006	<0.052
11-22-87	252	0.023±0.004	<0.044	292	0.023±0.003	<0.038	204	0.028±0.005	<0.055
11-29-87	255	0.030±0.004	<0.038	300	0.024±0.004	<0.052	204	0.040±0.006	<0.047
12-06-87	255	0.015±0.003	<0.046	204	0.010±0.004	<0.057	201	0.018±0.004	<0.058
12-13-87	258	0.025±0.004	<0.041	303	0.017±0.003	<0.034	159	0.019±0.005	<0.066
12-20-87	252	0.020±0.004	<0.042	295	0.009±0.003	<0.036	241	0.013±0.003	<0.044
12-27-87	266	0.033±0.004	<0.053	303	0.014±0.003	<0.047	204	0.030±0.005	<0.069
01-03-88	266	0.028±0.004	<0.046	314	0.028±0.004	<0.039	204	0.044±0.005	<0.060
4th Qtr mean ±s.d.		0.025±0.010			0.021±0.010			0.029±0.013	

PALISADES

Table 2. Airborne Particulates and Iodine-131
Collection: Weekly
Units: pCi/m^3

Collection Date	(3.5 miles ESE) 4JS COVERT Volume (m^3)	Gross Beta	I-131	(3 miles E) 5PR COVERT Volume (m^3)	Gross Beta	I-131	(4.75 miles NE) 6RB SOUTH HAVEN Volume (m^3)	Gross Beta	I-131
Required LLd		0.01	0.07		0.01	0.07		0.01	0.07
01-04-87	280	0.034±0.004	<0.015	292	0.030±0.004	<0.014	280	0.037±0.004	<0.015
01-11-87	286	0.022±0.004	<0.051	294	0.026±0.004	<0.050	280	0.020±0.003	<0.052
01-18-87	286	0.030±0.004	<0.046	297	0.031±0.004	<0.044	286	0.034±0.004	<0.046
01-25-87	286	0.022±0.004	<0.036	297	0.022±0.003	<0.035	286	0.019±0.003	<0.036
02-01-87	280	0.025±0.004	<0.049	292	0.019±0.004	<0.047	280	0.019±0.004	<0.049
02-08-87	275	0.026±0.004	<0.051	300	0.022±0.003	<0.047	286	0.023±0.004	<0.049
02-15-87	303	0.020±0.003	<0.048	294	0.018±0.003	<0.050	280	0.021±0.003	<0.052
02-22-87	283	0.019±0.003	<0.040	292	0.016±0.003	<0.038	280	0.017±0.003	<0.040
03-01-87	259	0.013±0.003	<0.026	283	0.016±0.003	<0.024	269	0.012±0.003	<0.025
03-08-87	293	0.024±0.004	<0.023	278	0.025±0.004	<0.024	272	0.027±0.004	<0.025
03-15-87	283	0.024±0.004	<0.037	286	0.018±0.003	<0.036	272	0.020±0.004	<0.038
03-22-87	278	0.023±0.004	<0.036	286	0.017±0.003	<0.035	275	0.022±0.004	<0.036
03-29-87	272	0.008±0.003	<0.050	286	0.010±0.003	<0.047	278	0.013±0.003	<0.048
1st Qtr mean ± s.d.		0.022±0.007			0.021±0.006			0.022±0.007	

Table 2. Airborne Particulates and Iodine-131 (continued)
Collection: Weekly
Units: pCi/m^3

Collection Date	(3.5 miles ESE) 4JS COVERT Volume (m^3)	Gross Beta	I-131	(3 miles E) 5PR COVERT Volume (m^3)	Gross Beta	I-131	(4.75 miles NE) 6RB SOUTH HAVEN Volume (m^3)	Gross Beta	I-131
04-05-87	286	0.020±0.004	<0.038	292	0.015±0.003	<0.038	283	0.016±0.003	<0.039
04-12-87	266	0.015±0.003	<0.039	275	0.013±0.003	<0.037	272	0.012±0.003	<0.038
04-19-87	263	0.014±0.003	<0.034	278	0.011±0.003	<0.032	263	0.016±0.003	<0.034
04-26-87	272	0.008±0.003	<0.037	280	0.014±0.004	<0.036	275	0.011±0.003	<0.036
05-03-87	263	0.018±0.004	<0.039	275	0.014±0.003	<0.038	269	0.015±0.003	<0.038
05-10-87	269	0.022±0.004	<0.040	278	0.022±0.004	<0.039	272	0.017±0.003	<0.040
05-17-87	266	0.011±0.003	<0.060	275	0.021±0.004	<0.058	269	0.020±0.004	<0.060
05-24-87	263	0.008±0.003	<0.043	275	0.012±0.003	<0.041	269	0.009±0.003	<0.042
05-31-87	272	0.017±0.004	<0.046	280	0.014±0.003	<0.045	272	0.015±0.004	<0.046
06-07-87	255	0.017±0.004	<0.061	269	0.017±0.004	<0.058	255	0.019±0.004	<0.061
06-14-87	261	0.021±0.004	<0.048	275	0.025±0.004	<0.046	266	0.020±0.004	<0.048
06-21-87	263	0.012±0.003	<0.036	275	0.011±0.003	<0.035	266	0.025±0.004	<0.036
06-28-87	258	0.021±0.004	<0.049	272	0.019±0.004	<0.047	263	0.016±0.003	<0.048
2nd Qtr mean±sd		0.016±0.005			0.016±0.004			0.016±0.004	

Table 2. Airborne Particulates and Iodine-131 (continued)
Collection: Weekly
Units: pCi/m^3

Collection Date	(3.5 miles ESE) 4JS COVERT Volume (m^3)	Gross Beta	I-131	(3 miles E) 5PR COVERT Volume (m^3)	Gross Beta	I-131	(4.75 miles NE) 6RB SOUTH HAVEN Volume (m^3)	Gross Beta	I-131
07-05-87	266	0.021±0.004	<0.042	272	0.016±0.003	<0.041	269	0.023±0.004	<0.041
07-12-87	263	0.020±0.004	<0.041	272	0.021±0.004	<0.039	269	0.022±0.004	<0.040
07-19-87	263	0.019±0.004	<0.041	272	0.021±0.004	<0.039	266	0.023±0.004	<0.040
07-26-87	255	0.029±0.004	<0.038	263	0.018±0.004	<0.037	258	0.041±0.005	<0.038
08-02-87	261	0.022±0.004	<0.052	269	0.018±0.004	<0.050	266	0.014±0.003	<0.051
08-09-87	263	0.019±0.003	<0.041	278	0.016±0.003	<0.039	269	0.012±0.003	<0.040
08-16-87	249	0.016±0.003	<0.046	258	0.010±0.003	<0.044	252	0.013±0.003	<0.045
08-23-87	263	0.023±0.004	<0.050	269	0.019±0.003	<0.048	278	0.020±0.003	<0.047
08-30-87	258	0.014±0.002	<0.043	263	0.019±0.003	<0.042	261	0.016±0.002	<0.042
09-06-87	266	0.026±0.004	<0.048	261	0.024±0.004	<0.049	278	0.019±0.003	<0.046
09-13-87	252	0.040±0.005	<0.060	278	0.024±0.004	<0.054	275	0.027±0.004	<0.055
09-20-87	246	0.015±0.003	<0.051	272	0.008±0.003	<0.046	272	0.015±0.003	<0.046
09-27-87	263	0.018±0.003	<0.033	269	0.014±0.003	<0.033	275	0.017±0.003	<0.032
3rd Qtr mean ± s.d.		0.022±0.007			0.018±0.005			0.020±0.008	

Table 2. Airborne Particulates and Iodine-131 (continued)
Collection: Weekly
Units: pCi/m^3

Collection Date	(3.5 miles ESE) 4JS COVERT Volume (m^3)	Gross Beta	I-131	(3 miles E) 5PR COVERT Volume (m^3)	Gross Beta	I-131	(4.75 miles NE) 6RB SOUTH HAVEN Volume (m^3)	Gross Beta	I-131
10-04-87	249	0.019±0.004	<0.039	266	0.024±0.004	<0.036	269	0.025±0.004	<0.036
10-11-87	263	0.009±0.003	<0.045	266	0.012±0.003	<0.044	278	0.012±0.003	<0.042
10-18-87	275	0.021±0.004	<0.036	280	0.032±0.004	<0.035	283	0.026±0.004	<0.035
10-25-87	266	0.016±0.004	<0.047	269	0.011±0.003	<0.047	266	0.014±0.003	<0.047
11-01-87	280	0.019±0.003	<0.044	278	0.023±0.004	<0.044	278	0.01810.003	<0.044
11-08-87	269	0.040±0.004	<0.040	278	0.042±0.004	<0.039	275	0.040±0.004	<0.039
11-15-87	278	0.038±0.004	<0.038	278	0.042±0.004	<0.038	280	0.033±0.004	<0.038
11-22-87	272	0.020±0.003	<0.041	280	0.018±0.003	<0.040	275	0.024±0.004	<0.041
11-29-87	286	0.027±0.004	<0.034	289	0.014±0.003	<0.033	283	0.025±0.004	<0.034
12-06-87	261	0.013±0.003	<0.045	278	0.010±0.003	<0.042	275	0.012±0.003	<0.042
12-13-87	269	0.012±0.003	<0.039	278	0.012±0.003	<0.038	272	0.024±0.004	<0.038
12-20-87	278	0.013±0.003	<0.038	272	0.008±0.003	<0.039	266	0.008±0.003	<0.040
12-27-87	280	0.022±0.004	<0.050	289	0.015±0.003	<0.049	292	0.023±0.004	<0.048
01-03-88	283	0.025±0.004	<0.043	295	0.025±0.004	<0.041	289	0.025±0.004	<0.042
4th Qtr mean ± s.d.		0.021±0.009			0.021±0.011			0.022±0.009	

Table 3. Airborne Particulates and Iodine-131
Collection: Weekly
Units: pCi/m^3

Collection Date	(7.5 miles NNE) 7SD SOUTH HAVEN Volume (m^3)	Gross Beta	I-131	(1 mile N) 8SP STATE PARK Volume (m^3)	Gross Beta	I-131	(1.5 Miles S) COVERT 9TP TOWNSHIP PARK Volume (m^3)	Gross Beta	I-131
Required LLD		0.01	0.07		0.01	0.07		0.01	0.07
01-04-87	294	0.032±0.004	<0.014	289	0.034±0.004	<0.014	309	0.035±0.004	<0.013
01-11-87	294	0.022±0.003	<0.050	286	0.018±0.003	<0.051	297	0.023±0.003	<0.049
01-18-87	297	0.030±0.004	<0.044	292	0.021±0.003	<0.045	311	0.030±0.004	<0.042
01-25-87	300	0.017±0.003	<0.035	294	0.020±0.003	<0.036	306	0.024±0.003	<0.034
02-01-87	292	0.021±0.004	<0.047	289	0.018±0.004	<0.047	306	0.023±0.004	<0.045
02-08-87	303	0.023±0.003	<0.046	294	0.027±0.004	<0.048	311	0.025±0.004	<0.045
02-15-87	292	0.018±0.003	<0.050	289	0.020±0.003	<0.051	303	0.021±0.003	<0.048
02-22-87	297	0.016±0.003	<0.038	286	0.014±0.003	<0.039	303	0.016±0.003	<0.037
03-01-87	286	0.012±0.003	<0.023	283	0.014±0.003	<0.024	297	0.015±0.003	<0.023
03-08-87	286	0.021±0.003	<0.023	280	0.021±0.004	<0.024	292	0.028±0.004	<0.023
03-15-87	252	0.015±0.003	<0.042	289	0.018±0.003	<0.036	272	0.014±0.003	<0.038
03-22-87	292	0.018±0.003	<0.034	283	0.021±0.004	<0.035	297	0.019±0.003	<0.034
03-29-87	286	0.010±0.003	<0.047	286	0.010±0.003	<0.047	294	0.011±0.003	<0.046
1st Qtr mean ± s.d.		0.020±0.006			0.020±0.006			0.022±0.007	

Table 3. Airborne Particulates and Iodine-131 (continued)
Collection: Weekly
Units: pCi/m^3

Collection Date	(7.5 miles NNE) 7SD SOUTH HAVEN Volume (m^3)	Gross Beta	I-131	(1 mile N) 8SP STATE PARK Volume (m^3)	Gross Beta	I-131	(1.5 Miles S) COVERT 9TP TOWNSHIP PARK Volume (m^3)	Gross Beta	I-131
04-05-87	294	0.016±0.003	<0.037	289	0.016±0.003	<0.038	306	0.016±0.003	<0.036
04-12-87	280	0.017±0.003	<0.037	108	0.042±0.009	<0.095	289	0.012±0.003	<0.036
04-19-87	278	0.013±0.003	<0.032	275	0.010±0.003	<0.032	292	0.015±0.003	<0.031
04-26-87	286	0.015±0.004	<0.035	283	0.009±0.003	<0.035	297	0.011±0.003	<0.034
05-03-87	280	0.013±0.003	<0.037	280	0.013±0.003	<0.037	292	0.019±0.003	<0.035
05-10-87	278	0.018±0.004	<0.039	286	0.020±0.004	<0.038	295	0.019±0.003	<0.037
05-17-87	280	0.018±0.003	<0.057	275	0.016±0.003	<0.058	292	0.020±0.003	<0.055
05-24-87	278	0.012±0.003	<0.040	269	0.013±0.003	<0.042	289	0.009±0.003	<0.039
05-31-87	278	0.019±0.004	<0.045	275	0.018±0.004	<0.046	297	0.015±0.003	<0.042
06-07-87	266	0.019±0.004	<0.058	263	0.016±0.004	<0.058	278	0.016±0.004	<0.056
06-14-87	272	0.024±0.004	<0.046	269	0.027±0.004	<0.047	289	0.017±0.003	<0.044
06-21-87	272	0.014±0.003	<0.035	269	0.017±0.003	<0.036	276	0.016±0.003	<0.035
06-28-87	272	0.018±0.003	<0.047	269	0.014±0.004	<0.047	161	0.023±0.005	<0.079
2nd Qtr mean±sd		0.017±0.003			0.018±0.008			0.016±0.004	

Table 3. Airborne Particulates and Iodine-131 (continued)
Collection: Weekly
Units: pCi/m^3

Collection Date	(7.5 miles NNE) 7SD SOUTH HAVEN Volume (m^3)	Gross Beta	I-131	(1 mile N) 8SP STATE PARK Volume (m^3)	Gross Beta	I-131	(1.5 Miles S) COVERT 9TP TOWNSHIP PARK Volume (m^3)	Gross Beta	I-131
07-05-87	275	0.023±0.004	<0.040	269	0.016±0.003	<0.041	170	0.018±0.005	<0.065
07-12-87	272	0.027±0.004	<0.039	266	0.022±0.004	<0.040	286	0.020±0.003	<0.037
07-19-87	275	0.021±0.004	<0.039	272	0.018±0.003	<0.039	295	0.020±0.003	<0.036
07-26-87	258	0.019±0.004	<0.038	261	0.024±0.004	<0.037	280	0.030±0.004	<0.035
08-02-87	272	0.022±0.004	<0.050	263	0.016±0.004	<0.051	283	0.014±0.003	<0.048
08-09-87	283	0.012±0.003	<0.038	272	0.022±0.004	<0.040	292	0.014±0.003	<0.037
08-16-87	266	0.017±0.003	<0.043	261	0.017±0.003	<0.044	278	0.012±0.003	<0.041
08-23-87	283	0.017±0.003	<0.046	275	0.019±0.003	<0.047	295	0.020±0.003	<0.044
08-30-87	278	0.016±0.002	<0.040	269	0.015±0.002	<0.041	283	0.012±0.002	<0.039
09-06-87	289	0.017±0.003	<0.044	278	0.024±0.004	<0.046	297	0.026±0.004	<0.043
09-13-87	280	0.034±0.008	<0.054	269	0.032±0.004	<0.056	286	0.033±0.004	<0.053
09-20-87	286	0.011±0.003	<0.044	269	0.011±0.003	<0.047	292	0.019±0.003	<0.043
09-27-87	283	0.013±0.003	<0.021	266	0.019±0.003	<0.033	292	0.016±0.003	<0.030
3rd Qtr mean ± s.d.		0.022±0.015			0.020±0.005			0.020±0.007	

Table 3. Airborne Particulates and Iodine-131 (continued)
Collection: Weekly
Units: pCi/m^3

Collection Date	(7.5 miles NNE) 7SD SOUTH HAVEN Volume (m^3)	Gross Beta	I-131	(1 mile N) 8SP STATE PARK Volume (m^3)	Gross Beta	I-131	(1.5 Miles S) COVERT 9TP TOWNSHIP PARK Volume (m^3)	Gross Beta	I-131
10-04-87	286	0.014±0.003	<0.034	258	0.019±0.004	<0.037	283	0.016±0.003	<0.034
10-11-87	283	0.011±0.003	<0.042	263	0.007±0.003	<0.045	286	0.010±0.003	<0.041
10-18-87	295	0.032±0.004	<0.034	272	0.021±0.004	<0.036	297	0.033±0.004	<0.033
10-25-87	283	0.012±0.003	<0.044	263	0.013±0.003	<0.048	289	0.012±0.003	<0.043
11-01-87	295	0.019±0.003	<0.041	275	0.016±0.003	<0.044	295	0.020±0.003	<0.041
11-08-87	292	0.038±0.004	<0.037	269	0.042±0.005	<0.040	289	0.044±0.004	<0.037
11-15-87	295	0.033±0.004	<0.036	275	0.038±0.004	<0.038	295	0.036±0.004	<0.036
11-22-87	292	0.021±0.003	<0.038	275	0.020±0.003	<0.041	289	0.022±0.003	<0.039
11-29-87	306	0.020±0.004	<0.031	283	0.029±0.004	<0.034	292	0.027±0.004	<0.033
12-06-87	292	0.010±0.003	<0.040	272	0.011±0.003	<0.043	292	0.010±0.003	<0.040
12-13-87	289	0.017±0.003	<0.036	275	0.018±0.003	<0.038	286	0.018±0.003	<0.037
12-20-87	289	0.005±0.002	<0.037	266	0.008±0.003	<0.040	289	0.010±0.003	<0.037
12-27-87	309	0.016±0.003	<0.046	286	0.017±0.003	<0.049	309	0.022±0.003	<0.046
01-03-88	314	0.027±0.004	<0.039	289	0.028±0.004	<0.042	312	0.027±0.004	<0.039
4th Qtr mean ± s.d.		0.021±0.010			0.020±0.010			0.022±0.010	

Table 4. Airborne Particulates and Iodine-131
Collection: Weekly
Units: pCi/m^3

Collection Date	(55 miles NNE) 10GR GRAND RAPIDS Volume (m^3)	Gross Beta	I-131	(35 miles E) 11KZ KALAMAZOO Volume (m^3)	Gross Beta	I-131	Collection Date	(30 miles SSE) 12DG DOWAGIAC Volume (m^3)	Gross Beta	I-131
Required LLD		0.01	0.07		0.01	0.07			0.01	0.07
01-08-87	309	0.028±0.004	<0.026	218	0.025±0.004	<0.037	01-07-87	258	0.033±0.004	<0.031
01-15-87	317	0.030±0.004	<0.041	218	0.049±0.006	<0.059	01-14-87	266	0.037±0.004	<0.048
01-22-87	309	0.018±0.003	<0.036	221	0.020±0.004	<0.051	01-21-87	263	0.028±0.004	<0.043
01-29-87	320	0.022±0.003	<0.030	226	0.026±0.004	<0.043	01-28-87	272	0.027±0.004	<0.036
02-05-87	311	0.023±0.003	<0.047	218	0.021±0.004	<0.067	02-04-87	292	0.032±0.004	<0.048
02-12-87	314	0.006±0.002	<0.019	218	0.022±0.004	<0.027	02-11-87	235	0.012±0.004	<0.025
02-19-87	320	0.016±0.003	<0.035	218	0.020±0.004	<0.052	02-18-87	263	0.023±0.004	<0.043
02-26-87	303	0.018±0.003	<0.055	221	0.017±0.004	<0.070	02-25-87	266	0.017±0.004	<0.062
03-05-87	306	0.015±0.003	<0.015	178	0.022±0.005	<0.026	03-04-87	252	0.017±0.004	<0.018
03-12-87	309	0.027±0.004	<0.034	167	0.028±0.006	<0.063	03-11-87	261	0.029±0.004	<0.040
03-19-87	306	0.020±0.003	<0.036	167	0.022±0.005	<0.067	03-18-87	261	0.023±0.004	<0.043
03-26-87	297	0.012±0.003	<0.045	272	0.011±0.003	<0.049	03-25-87	263	0.014±0.003	<0.051
04-02-87	314	0.016±0.003	<0.043	278	0.014±0.003	<0.049	04-01-87	258	0.020±0.004	<0.053
1st Qtr mean±sd		0.019±0.007			0.023±0.009				0.024±0.008	

Table 4. Airborne Particulates and Iodine-131 (continued)
Collection: Weekly
Units: pCi/m^3

Collection Date	(55 miles NNE) 10GR GRAND RAPIDS Volume (m^3)	Gross Beta	I-131	(35 miles E) 11KZ KALAMAZOO Volume (m^3)	Gross Beta	I-131	Collection Date	(30 miles SSE) 12DG DOWAGIAC Volume (m^3)	Gross Beta	I-131
04-09-87	309	0.018±0.003	<0.033	275	0.014±0.003	<0.037	04-08-87	258	0.016±0.004	<0.040
04-16-87	297	0.017±0.003	<0.030	266	0.010±0.003	<0.034	04-15-87	258	0.017±0.004	<0.035
04-23-87	295	0.011±0.003	<0.040	269	0.008±0.003	<0.044	04-22-87	252	0.012±0.003	<0.047
04-30-87	295	0.015±0.003	<0.050	269	0.018±0.004	<0.054	04-29-87	258	0.018±0.004	<0.057
05-07-87	300	0.022±0.004	<0.036	272	0.017±0.004	<0.040	05-06-87	289	0.018±0.003	<0.038
05-14-87	297	0.025±0.003	<0.041	261	0.022±0.004	<0.047	05-13-87	218	0.020±0.004	<0.056
05-21-87	295	0.015±0.003	<0.045	263	0.012±0.003	<0.050	05-20-87	249	0.013±0.004	<0.053
05-28-87	295	0.015±0.003	<0.040	263	0.014±0.003	<0.044	05-27-87	255	0.016±0.003	<0.046
06-04-87	289	0.020±0.004	<0.041	258	0.018±0.004	<0.046	06-03-87	252	0.016±0.004	<0.047
06-11-87	292	0.019±0.004	<0.043	263	0.019±0.004	<0.048	06-10-87	249	0.021±0.005	<0.051
06-18-87	286	0.034±0.004	<0.046	258	0.023±0.004	<0.051	06-17-87	246	0.028±0.004	<0.053
06-25-87	283	0.021±0.004	<0.050	258	0.021±0.004	<0.055	06-24-87	252	0.020±0.004	<0.056
2nd Qtr mean±sd		0.019±0.006			0.016±0.005				0.018±0.004	

Table 4. Airborne Particulates and Iodine-131 (continued)
Collection: Weekly
Units: pCi/m^3

Collection Date	(55 miles NNE) 10GR GRAND RAPIDS Volume (m^3)	Gross Beta	I-131	(35 miles E) 11KZ KALAMAZOO Volume (m^3)	Gross Beta	I-131	Collection Date	(30 miles SSE) 12DG DOWAGIAC Volume (m^3)	Gross Beta	I-131
07-02-87	292	0.018±0.003	<0.045	263	0.021±0.004	<0.050	07-01-87	249	0.019±0.004	<0.053
07-09-87	283	0.027±0.004	<0.041	261	0.015±0.003	<0.045	07-08-87	249	0.024±0.004	<0.047
07-16-87	289	0.013±0.003	<0.038	261	0.015±0.004	<0.042	07-15-87	255	0.013±0.003	<0.043
07-23-87	295	0.032±0.004	<0.042	261	0.036±0.004	<0.047	07-23-87	266	0.033±0.004	<0.046
07-30-87	283	0.025±0.004	<0.046	258	0.015±0.004	<0.050	07-29-87	235	0.019±0.004	<0.055
08-06-87	289	0.023±0.004	<0.040	261	0.021±0.004	<0.044	08-05-87	241	0.023±0.004	<0.048
08-13-87	286	0.020±0.003	<0.047	261	0.020±0.004	<0.044	08-12-87	246	0.022±0.004	<0.055
08-20-87	292	0.015±0.003	<0.045	263	0.022±0.004	<0.050	08-19-87	246	0.019±0.004	<0.053
08-27-87	289	0.006±0.002	<0.053	265	0.010±0.003	<0.058	08-26-87	252	0.017±0.004	<0.061
09-03-87	300	0.020±0.003	<0.060	265	0.015±0.003	<0.068	09-02-87	244	0.027±0.004	<0.074
09-10-87	292	0.022±0.003	<0.052	266	0.035±0.004	<0.057	09-09-87	241	0.024±0.004	<0.063
09-17-87	292	0.023±0.003	<0.052	289	0.020±0.003	<0.052	09-16-87	249	0.027±0.004	<0.061
09-24-87	297	0.011±0.003	<0.043	244	0.011±0.003	<0.052	09-23-87	241	0.013±0.003	<0.052
10-01-87	297	0.024±0.003	<0.002 mm	269	0.024±0.004	<0.002 mm	09-30-87	244	0.026±0.004	<0.002 mm
3rd Qtr mean ± s.d.		0.020±0.007			0.020±0.008				0.022±0.006	

Table 4. Airborne Particulates and Iodine-131 (continued)
Collection: Weekly
Units: pCi/m^3

Collection Date	(55 miles NNE) 10GR GRAND RAPIDS Volume (m^3)	Gross Beta	I-131	(35 miles E) 11KZ KALAMAZOO Volume (m^3)	Gross Beta	I-131	Collection Date	(30 miles SSE) 12DG DOWAGIAC Volume (m^3)	Gross Beta	I-131
10-08-87	303	0.009±0.003	<0.054	278	0.013±0.003	<0.059	10-07-87	249	0.008±0.003	<0.066
10-15-87	309	0.026±0.003	<0.043	269	0.021±0.003	<0.050	10-14-87	252	0.019±0.003	<0.053
10-22-87	297	0.021±0.004	<0.055	272	0.022±0.004	<0.061	10-21-87	246	0.021±0.004	<0.067
10-29-87	303	0.013±0.003	<0.051	272	0.013±0.003	<0.057	10-28-87	255	0.013±0.003	<0.061
11-05-87	300	0.036±0.004	<0.051	266	0.045±0.005	<0.057	11-04-87	249	0.042±0.005	<0.061
11-12-87	309	0.018±0.003	<0.018	278	0.016±0.003	<0.019	11-11-87	258	0.023±0.004	<0.021
11-19-87	306	0.040±0.004	<0.037	269	0.043±0.004	<0.042	11-18-87	249	0.038±0.004	<0.045
11-26-87	306	0.016±0.003	<0.004	272	0.018±0.003	<0.044	11-25-87	252	0.020±0.004	<0.048
12-03-87	309	0.012±0.003	<0.038	272	0.008±0.003	<0.043	12-02-87	249	0.008±0.003	<0.047
12-10-87	314	0.012±0.003	<0.045	275	0.012±0.003	<0.051	12-09-87	255	0.009±0.003	<0.055
12-17-87	312	0.016±0.003	<0.038	275	0.008±0.003	<0.044	12-16-87	241	0.015±0.004	<0.050
12-24-87	309	0.030±0.004	<0.046	272	0.030±0.004	<0.052	12-23-87	244	0.039±0.005	<0.038
12-31-87	314	0.026±0.003	<0.054	280	0.024±0.004	<0.061	12-30-87	246	0.033±0.004	<0.069
4th Qtr mean ± s.d.		0.021±0.010			0.021±0.012				0.022±0.012	

Table 4. Gamma Radiation as Measured by TLDs, Monthly Exposure

	January	February	March	April	May	June
Date Placed	01-04-87	02-01-87	03-01-87	04-05-87	05-03-87	05-31-87
Date Received	02-01-87	03-01-87	04-05-87	05-03-87	05-31-87	06-28-87
In-transit (mR)	4.9±0.3	2.8±0.3	4.4±0.3	3.0±0.3	3.3±0.3	4.6±0.3
Location	mR/30 days net[a]					
ST-01	5.8±0.3	4.2±1.0	3.4±0.5	4.1±0.5	4.0±0.4	4.3±0.3
ST-02	4.7±0.7	5.4±0.5	5.1±0.4	5.4±0.6	6.0±0.5	6.7±0.5
ST-03	3.8±0.4	4.1±0.4	4.1±0.4	4.4±0.6	4.6±0.6	7.0±1.0
ST-04	4.3±0.4	5.1±0.5	4.4±0.4	4.9±0.4	4.8±0.4	8.3±2.1
ST-05	3.9±0.5	4.7±0.3	4.0±0.4	5.2±0.6	4.7±0.4	6.3±0.4
ST-06	4.8±0.3	5.4±0.3	5.0±0.3	5.5±0.4	6.0±0.5	8.2±0.6
ST-07A	3.8±0.4	4.3±0.3	4.3±0.6	4.9±0.6	4.5±0.4	7.2±0.6
ST-08	4.1±0.4	4.8±0.5	4.0±0.3	5.3±1.1	4.5±0.4	6.0±0.7
ST-09	3.8±0.4	4.0±0.6	3.8±0.3	3.9±0.5	4.0±0.3	5.0±0.4
ST-10	3.9±0.4[b]	4.3±0.4[d]	4.0±0.4	4.1±0.4	4.1±0.3	5.4±0.4
ST-11	4.7±0.4[b]	3.8±0.4[e]	5.0±0.3	4.2±0.5	ND[g]	5.2±0.5
ST-12	3.9±0.4[c]	4.1±0.3[f]	4.4±0.3	4.6±0.6	4.8±0.4	5.9±0.9
ST-13	3.8±0.5	3.7±0.3	4.0±0.5	3.7±0.4	4.3±0.5	4.4±0.4
ST-14	3.7±0.4	3.6±0.4	3.7±0.2	3.8±0.6	5.3±0.4	4.7±0.4
ST-15	3.3±0.4	3.6±0.4	3.4±0.4	4.0±0.5	4.5±0.5	4.9±0.9
ST-16	3.6±0.3	3.9±0.4	3.7±0.4	4.2±0.6	4.0±0.4	5.8±0.9
ST-17	3.6±0.3	4.0±0.5	3.8±0.4	3.8±0.4	4.2±0.4	5.4±0.7
ST-18	3.7±0.3	4.6±0.6	4.0±0.6	4.3±0.5	4.5±0.4	5.4±0.5
ST-19	4.4±0.8	4.2±0.4	4.1±0.4	4.5±0.6	5.0±0.5	5.6±0.5
ST-20	3.8±0.4	3.8±0.4	4.0±0.4	3.1±0.5	4.4±0.4	5.3±1.4
ST-21	3.6±0.4	4.0±0.3	3.6±0.3	4.1±0.5	4.2±0.4	5.0±0.8
ST-22	1.8±0.4	2.0±0.3	1.9±0.4	2.2±0.5	1.7±0.3	3.5±1.3
ST-23	4.1±0.5	4.5±0.3	4.2±0.4	4.9±0.6	4.6±0.5	11.0±1.1
ST-24	2.6±0.5	4.0±0.4	2.9±0.4	5.4±0.4	3.1±0.3	5.0±0.4
Mean ± s.d.	3.9±0.8	4.2±0.7	4.0±0.7	4.4±0.8	4.4±0.9	5.9±1.6
Control 1	1.0±0.4	2.3±0.4	1.5±0.8	4.2±0.4	1.3±0.4	2.8±0.5
Control 2	2.0±0.4	2.2±0.4	2.1±0.4	2.4±0.4	2.1±0.5	2.7±0.4

[a] In-transit exposure has been subtracted from total exposure.
[b] Placed 01-01-87; removed 01-29-87; in-transit exposure (5.1±0.3)mR.
[c] Placed 01-04-87; removed 01-29-87; in-transit exposure (4.5±0.3)mR.
[d] Placed 01-29-87; removed 03-02-87; in-transit exposure (2.2±0.2)mR.
[e] Placed 01-29-87; removed 02-26-87; in-transit exposure (2.8±0.3)mR.
[f] Placed 01-29-87; removed 03-01-87; in-transit exposure (2.4±0.2)mR.
[g] ND = No data; TLD lost in the field.

Table 4. Gamma Radiation as Measured by TLDs, Monthly Exposure (continued)

	July	August	September	October	November	December
Date Placed	06-28-87	08-02-87	08-30-87	10-05-87	11-01-87	11-29-87
Date Received	08-02-87	09-02-87	10-07-87	11-04-87	12-03-87	01-03-88
In-transit (mR)	2.9±0.3	2.2±0.3	6.9±0.4	3.1±0.3	3.0±0.2	3.8±0.4
Location			mR/30 days net[a]			
ST-01	3.5±0.3	3.7±0.4	3.2±0.4	7.9±1.0	3.2±0.3	4.4±0.7
ST-02	5.3±0.4	5.5±0.3	5.6±1.6	5.5±0.6	6.4±0.6	5.5±0.4
ST-03	4.0±0.4	4.6±0.3	4.5±0.8	4.5±0.5	4.2±0.5	4.9±0.5
ST-04	6.5±3.1	5.1±0.4	5.6±0.6	4.9±0.5	4.8±0.5	6.2±0.5
ST-05	4.5±0.6	5.0±0.4	4.6±0.5	5.1±0.7	4.5±0.4	5.2±0.4
ST-06	5.6±0.4	5.6±0.3	5.4±0.6	5.3±0.4	5.9±0.6	5.5±0.4
ST-07A	4.3±0.3	4.6±0.3	4.3±0.5	4.3±0.4	4.2±0.3	4.7±0.4
ST-08	8.1±0.3	4.4±0.4	4.4±0.7	4.2±0.4	4.3±0.4	4.9±0.4
ST-09	4.5±0.6	3.6±0.3	3.8±0.4	3.8±0.4	3.8±0.3	4.1±0.4
ST-10	3.8±0.3	3.9±0.3	3.8±0.5	4.6±0.5	3.9±0.5	4.4±0.4
ST-11	6.6±1.0	4.4±0.4	6.8±0.8	4.7±0.7	6.9±0.8	4.6±0.4
ST-12	4.4±0.3	4.1±0.4	4.6±0.7	4.6±0.6	4.4±0.3	4.5±0.6
ST-13	3.5±0.3	3.6±0.3	3.7±0.4	3.6±0.4	3.7±0.3	4.0±0.4
ST-14	3.3±0.3	3.7±0.3	3.6±0.5	3.6±0.4	5.1±0.4	4.6±0.7
ST-15	3.8±0.6	3.8±0.4	4.5±0.8	4.4±0.6	7.0±1.2	3.9±0.4
ST-16	3.7±0.3	4.0±0.4	4.0±0.6	3.7±0.3	3.8±0.4	4.2±0.5
ST-17	4.1±0.4	4.0±0.4	3.7±0.6	4.4±0.5	4.3±0.6	4.2±0.3
ST-18	3.8±0.3	4.0±0.3	4.2±0.4	4.0±0.4	4.0±0.4	4.4±0.6
ST-19	4.3±0.7	4.3±0.3	6.5±0.7	4.8±0.4	6.0±0.4	4.6±0.5
ST-20	5.8±0.3	4.0±0.3	4.0±0.5	5.1±0.6	4.6±0.5	4.4±0.4
ST-21	4.0±0.3	2.0±0.4	4.0±0.5	4.1±0.4	3.7±0.3	4.2±0.3
ST-22	4.6±0.3	4.1±0.3	1.9±0.6	2.2±0.4	1.5±0.5	2.1±0.4
ST-23	4.1±0.5	4.6±0.3	4.5±0.7	4.9±0.4	4.5±0.8	4.8±0.4
ST-24	3.2±0.7	3.8±0.3	2.9±0.4	4.2±0.4	3.0±0.3	4.2±0.3
Mean ± s.d.	4.6±1.2	4.2±0.7	4.3±1.1	4.5±1.0	4.5±1.2	4.5±0.8
Control 1	1.1±0.3	2.2±0.7	1.0±0.5	2.3±0.4	1.1±0.4	2.1±0.3
Control 2	1.7±0.4	2.1±0.4	3.9±0.4	2.6±0.5	1.8±0.4	2.2±0.3

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

Table 6. Gamma Radiation as Measured by TLDs, Quarterly Exposure.

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Date Placed	01-04-87	04-05-87	06-28-87	10-05-87
Date Removed	04-05-87	06-28-87	10-05-87	01-03-88
In-Transit (mR)	5.4±0.7	6.0±0.7	4.8±0.8	5.1±0.8
Location		mR/91 days net[a]		
ST-01	11.4±0.7	18.4±1.7	12.9±1.8	14.0±1.1
ST-02	15.8±1.4	19.4±0.8	16.5±1.0	19.3±1.2
ST-03	12.6±1.4	17.3±1.2	13.5±1.0	15.9±1.2
ST-04	12.8±0.8	17.1±0.8	14.3±1.2	16.4±0.9
ST-05	13.2±1.1	17.6±1.3	14.9±1.5	16.2±0.9
ST-06	14.8±0.7	20.2±1.4	16.9±0.9	17.8±0.9
ST-07A	11.6±0.8	13.7±1.0	12.8±0.8	13.2±1.3
ST-08	11.4±1.0	13.4±1.0	12.1±0.8	13.8±1.3
ST-09	11.3±1.0	12.6±0.9	12.1±1.1	12.8±1.0
ST-10	11.6±0.8	13.7±0.8	11.7±0.8	12.8±1.0
ST-11	12.6±1.1	16.5±1.0	13.5±1.0	15.8±0.9
ST-12	12.0±1.0	14.6±1.0	14.1±1.0	14.0±0.8
ST-13	11.1±0.8	14.3±0.9	11.7±0.9	13.0±0.9
ST-14	10.2±0.7	12.6±1.3	10.4±0.8	11.1±0.9
ST-15	9.7±1.0	11.1±0.8	10.8±1.0	11.1±0.9
ST-16	10.7±0.9	11.8±0.8	11.3±0.8	11.6±1.0
ST-17	10.5±1.0	12.7±0.9	10.8±1.1	12.0±0.9
ST-18	10.7±0.9	14.0±1.4	11.6±1.1	13.0±0.9
ST-19	11.3±0.8	14.6±0.9	12.9±1.1	13.8±1.0
ST-20	11.1±0.8	12.2±0.8	11.9±0.9	13.5±1.3
ST-21	10.9±0.8	13.3±0.8	11.7±0.8	13.0±1.0
ST-22	6.4±0.7	6.7±0.8	6.1±0.8	6.3±0.8
ST-23	13.0±0.9	15.0±0.8	14.2±0.8	14.8±1.0
ST-24	11.4±1.1	13.8±0.9	12.0±1.2	13.1±0.9
Mean ± s.d.	11.6±1.8	14.4±3.0	12.5±2.2	13.7±2.6
Control 1	6.4±0.7	6.6±0.8	7.0±1.1	6.4±1.1
Control 2	6.1±0.8	6.4±0.9	6.3±0.8	5.6±1.0

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

Table 7. Gamma Radiation as Measured by TLDs, Annual Exposure.

	1987 Annual
Date Placed	01-01-87
Date Removed	01-03-88
In-Transit (mR)	8.3±2.6
Location	mR/365 days net[a]
P-01	62.4±2.9
P-02	86.2±2.8
P-03	68.4±2.8
P-04	70.8±2.6
P-05	70.9±2.7
P-06	81.0±2.8
P-07A	63.1±4.9
P-08	60.7±2.9
P-09	57.4±3.3
P-10	55.8±3.2
P-11	68.2±3.0
P-12	66.7±2.8
P-13	59.9±2.9
P-14	49.6±3.5
P-15	51.2±2.7
P-16	54.3±3.0
P-17	53.6±3.2
P-18	59.3±2.7
P-19	60.8±2.9
P-20	58.6±3.3
P-21	58.4±3.0
P-22	28.0±2.9
P-23	63.7±2.9
P-24	58.1±4.3
Mean ± s.d.	61.1±11.2
Control 1	27.1±2.7
Control 2	27.2±2.7

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

Table 8. Lake Water, Intake and Discharge
Collection: Monthly Composites of Daily Collections
Units: pCi/l

Compositing Period	Intake				Discharge			
	Lab Code	Gross Alpha	Gross Beta	H-3	Lab Code	Gross Alpha	Gross Beta	H-3
Required LLD		1.0	4.0	500		1.0	4.0	500
January 87	PALW-396	<0.5	2.2±0.4	<169	PALW-397	<0.5	2.1±0.4	<169
February 87	658,9	<0.7	2.0±0.4	<206	660	<0.7	2.0±0.4	217±107
March 87	1157	<0.9	1.4±0.5	<301	1158	<0.9	1.7±0.6	<301
April 87	1435	<0.7	2.7±0.4	<302	1436	<0.7	2.0±0.4	313±150
May 87	1806	<0.6	2.1±0.5	<209	1807	<0.7	2.4±0.5	<209
June 87	2259	<0.8	1.9±0.5	<313	2260	<0.7	2.2±0.4	<313
July 87	2624	<0.6	2.2±0.4	<332	2625,6	<0.6	2.4±0.6	<332
August 87	2896	<0.6	2.0±0.4	<145	2897,8	<0.6	2.5±0.3	980±75
September 87	3347	<0.5	2.0±0.4	<328	3348,9	<0.4	2.3±0.3	4571±370
October 87	3753	<0.5	2.0±0.4	<320	3754	<0.8	2.9±0.4	1230±190
November 87	4171	<0.4	2.0±0.5	<120	4172	<0.4	3.1±0.5	1330±120
December 87	4647	<0.4	2.4±0.4	<102	4648,9	<0.3	2.6±0.4	<180

Table 9. Lake Water, Drinking
Collection: Monthly Composites of Daily Collections
Units: pCi/l

Compositing Period	South Haven Municipal System				
	Treated			Raw	
	Lab Code	Gross Beta	H-3	Lab Code	Gross Beta
Required LLD		4.0	500		4.0
January 87	PALW-395	1.7±0.4	<169	PALW-394	2.0±0.4
February 87	833	2.7±0.4	<146	832	1.8±0.4
March 87	1156	1.4±0.5	<301	1155	1.7±0.5
April 87	1434	3.5±0.7	<302	1433	2.9±0.7
May 87	1805	2.1±0.5	<209	1804	2.8±0.5
June 87	2257,8	2.2±0.6	<313	2256	1.9±0.4
July 87	2623	1.9±0.4	<332	2622	2.0±0.4
August 87	2895	2.0±0.4	<145	2894	2.0±0.4
September 87	3343	2.3±0.4	<328	3342	2.5±0.4
October 87	3748	2.3±0.4	<320	3747	2.4±0.4
November 87	4129	2.5±0.5	<179	4128	2.7±0.5
December 87	4644	1.6±0.6	<183	4643	2.3±0.6

Table 10. Well Water
Collection: Monthly
Units: pCi/l

Collection Date	Lab Code	Gross Beta	Sr-89	Sr-90	H-3	Cs-134	Cs-137	Other Gammas[a]
Required LLD		4.0	5.0	1.0	500	15.0	18.0	15.0
				Site				
Jan, 1987	PAWW-391	1.0±0.5	NA[b]	NA[b]	<169	NA[b]	NA[b]	NA[b]
Feb, 1987	661	1.6±0.6	NA	NA	<206	NA	NA	NA
Mar, 1987	1152	0.4±0.7	NA	NA	<301	NA	NA	NA
Apr, 1987	1432	2.3±0.9	NA	NA	<302	NA	NA	NA
May, 1987	1803	<1.4	NA	NA	<209	NA	NA	NA
Aune, 1987	2255	1.5±0.6	NA	NA	<313	NA	NA	NA
July, 1987	2621	<1.0	NA	NA	<212	NA	NA	NA
Aug, 1987	2893	1.2±0.6	NA	NA	<291	NA	NA	NA
Sept, 1987	3346	1.4±0.5	NA	NA	<328	NA	NA	NA
Oct, 1987	3752	1.2±0.5	NA	NA	<320	NA	NA	NA
Nov, 1987	4174	<1.0	NA	NA	<203	NA	NA	NA
Dec, 1987	4651	1.3±0.6	NA	NA	<196	NA	NA	NA
				State Park				
01-04-87	PAWW-129	4.6±0.6	NA[b]	NA[b]	<165	NA[b]	NA[b]	NA[b]
02-01-87	388,9	3.6±0.2	NA	NA	<94	NA	NA	NA
03-01-87	829	1.2±0.3	NA	NA	<146	NA	NA	NA
04-05-87	1150	3.4±0.5	NA	NA	<301	NA	NA	NA
05-03-87	1431	4.8±0.6	NA	NA	<301	NA	NA	NA
06-01-87	1802	1.8±0.3	NA	NA	<301	NA	NA	NA
07-02-87	2254	1.9±0.4[c]	<1.8	<0.7	<313	<1.94	<2.30	<2.26
08-02-87	2620	1.6±0.3	NA	NA	<212	NA	NA	NA
09-01-87	2892	2.1±0.3	NA	NA	<291	NA	NA	NA
10-07-87	3345	4.3±0.5	NA	NA	<328	NA	NA	NA
11-03-87	3750,1	5.4±0.4	NA	NA	<319	NA	NA	NA
12-02-87	4131	4.8±0.4	NA	NA	<128	NA	NA	NA

[a] See introduction
[b] NA = not anlayzed; analysis not required.
[c] Result of reanalysis.

Table 10. Well Water (continued)

Collection Date	Lab Code	Gross Beta	Sr-89	Sr-90	H-3	Cs-134	Cs-137	Other Gammas[a]
Required LLD		4.0	5.0	1.0	500	15.0	18.0	15.0
				Township Park				
01-07-87	PAWW-130	<1.1	NA[b]	NA[b]	199±90	NA[b]	NA[b]	NA[b]
02-04-87	390,9	1.6±0.5	NA	NA	148±95	NA	NA	NA
03-02-87	830	1.0±0.3	NA	NA	109±82	NA	NA	NA
04-07-87	1151	1.0±0.7	NA	NA	<301	NA	NA	NA
05-04-87	1430	3.5±0.9	NA	NA	<301	NA	NA	NA
06-01-87	1800,1	1.2±0.4[c]	[d]	[d]	<301	<1.71	<1.53	<1.74
07-02-87	2253	1.1±0.5	NA	NA	<313	NA	NA	NA
08-02-87	2619	<0.8	NA	NA	<310	NA	NA	NA
09-02-87	2891	1.3±0.5	NA	NA	<291	NA	NA	NA
10-07-87	3344	1.6±0.5	NA	NA	<328	NA	NA	NA
11-02-87	3749	1.1±0.5	NA	NA	<319	NA	NA	NA
12-02-87	4130	1.7±0.6	NA	NA	<160	NA	NA	NA

[a] See introduction
[b] NA = not analyzed; analysis not required.
[c] Result of reanalysis. The concentration (9.2±0.1) reported previously was a typing error. The result of the original analysis was 1.5±0.7.
[d] Not enough sample for reanalysis; sample leaked from container.

Table 11. In-Plant Water
Collection: Monthly
Units: pCi/l

Collection Date	Lab Code	Gross Alpha	Gross Beta	Sr-89	Sr-90	H-3	Cs-137	Other Gammas[a]
Required LLD		1.0	1.0	5.0	1.0	500	10	10
				Turbine Sump Composite				
Jan., 87	PACW-393	1.3±0.8	11.8±0.9	<5.0	<1.7	510±108	6.4±1.2	<10
Feb., 87	831	<1.0	58.1±8.2	<5.0	<1.0	3969±137	5.6±1.8	<10
Mar., 87	1154	<2.1	15.8±4.8	<5.0	1.8±1.0	4672±217	13.6±2.8	<10
Apr., 87	1522	<2.8	22.8±5.3	<5.0	<1.4	2359±155	14.2±1.4	<10
May., 87	1926	<1.0	163.0±5.6	<5.0	<0.5	4972±220	208.0±6.9	<10
Jun., 87	2338	2.3±1.6	52.5±6.8	<5.0	1.4±0.8	6713±243	11.4±2.4	<10
Jul., 87	2665	<1.5	5.8±2.4	<5.0	0.8±0.4	3220±678	<2.2	<10
Aug., 87	3008	<2.6	26.1±5.3	<5.0	<0.4	1628±155	<2.2	<2.2
Sep., 87	3494	<1.5	20.5±5.5	<5.0	0.7±0.4	3112±103	<1.8	<1.6
Oct., 87	3775	<2.1	13.0±2.5	<5.0	0.9±0.4	<1150	<1.6	<10
Nov., 87	4220	<2.1	80.6±7.9	<5.0	<0.6	2529±751	<1.4	<10
Dec., 87	4690	<1.8	11.7±3.1	<5.0	0.4±0.3	2411±160	5.1±1.7	<10
				Service Water				
Jan., 87	PACW-392	<0.4	2.2±0.4	<1.2	<0.8	<169	<1.9	<10
Feb., 87	662	<0.7	2.1±0.4	<0.5	0.5±0.2	<206	<1.4	<10
Mar., 87	1153	<1.0	1.7±0.5	<1.4	0.9±0.5	<301	<2.6	<10
Apr., 87	1437	<0.7	2.0±0.4	<0.9	<0.9	<302	<2.4	<10
May., 87	1808	<0.6	2.4±0.4	<0.3	0.5±0.2	<209	<1.8	<10
Jun., 87	2261	<0.6	2.7±0.4	<0.8	0.6±0.4	<313	<2.0	<10
Jul., 87	2627	<0.6	2.6±0.4	<0.9	<0.6	<333	<2.3	<10
Aug., 87	2899	<0.4	3.3±0.5	<0.8	<0.7	<202	<6.9	<4.9
Sep., 87	3350	<0.5	2.4±0.4	<0.9	<0.8	<328	<1.7	<1.7
Oct., 87	3755	<0.6	2.1±0.4	<0.5	0.4±0.3	<319	<2.7	<2.5
Nov., 87	4173	<0.5	2.5±0.5	<0.5	0.4±0.2	<152	<2.6	<2.4
Dec., 87	4650	<0.4	2.8±0.4	<0.5	0.7±0.4	<122	<2.7	<2.4

[a] See Introduction.

Table 12. Milk
Collection: Monthly
Units: pCi/l

Collection Date	Lab Code	I-131	Sr-89	Sr-90	Cs-134	Cs-137	Ba-La-140
Required LLD		1.0	5.0	1.0	15.0	18.0	15.0
			GH Glen Hessey				
01-08-87	PAMI-46	<0.3	<0.8	4.2±0.7	<6.0	<8.1	<9.4
02-03-87	100	<0.4	<0.7	4.5±0.8	<6.7	<7.3	<9.4
03-03-87	178	<0.4	<0.8	3.8±0.7	<6.1	<8.0	<12.3
04-08-87	271	<0.2	<1.0	3.5±0.7	<5.7	<6.6	<7.9
05-04-87	339	<0.4	<0.9	3.1±0.8	<6.0	<7.8	<10.3
06-02-87	494	<0.2	<0.7	4.1±0.6	<4.8	<4.8	<3.6
07-06-87	685	<0.4	<0.6	4.1±0.7	<7.2	<7.6	<8.2
08-05-87	875	<0.3	<0.4	3.1±0.3	<5.7	<6.4	<12.7
09-02-87	1024	<0.2	<0.4	3.6±0.5	<6.8	<7.4	<8.8
10-07-87	1246	<0.4	<0.6	3.2±0.7	<5.5	<5.8	<9.2
11-02-87	1374	<0.4	<0.6	4.6±0.8	<5.2	<5.4	<6.4
12-01-87	1461	<0.3	<0.6	4.6±0.7	<8.0	<7.8	<9.9
			KK Kenneth Kemp				
01-08-87	PAMI-47	<0.3	<0.8	4.5±0.7	<7.1	<7.0	<9.7
02-03-87	99	<0.3	<0.7	6.4±0.8	<6.8	<6.8	<6.2
03-02-87	177	<0.6	<0.8	4.5±0.8	<5.0	<8.2	<4.0
04-08-87	270	<0.3	<1.0	3.5±0.7	<3.6	<5.9	<5.3
05-04-87	341	<0.5	<0.8	4.0±0.9	<6.8	<6.3	<9.8
06-02-87	495,6	<0.3	<0.8	4.6±0.9	<5.4	<7.7	<5.8
07-06-87	686	<0.3	<0.7	4.1±0.7	<6.9	<6.7	<10.7
08-05-87	876	<0.4	<0.2	4.4±0.4	<5.8	<5.0	<6.9
09-02-87	1025	<0.2	<0.4	3.0±0.4	<4.0	<4.7	<6.8
10-06-87	1247	<0.3	<0.6	4.5±0.8	<6.7	<8.2	<13.3
11-02-87	1375	<0.3	<0.6	3.6±0.6	<6.5	<6.6	<8.3
12-01-87	1460	<0.3	<0.6	4.0±0.7	<6.5	<7.0	<12.8

Table 12. Milk (continued)

Collection Date	Lab Code	I-131	Sr-89	Sr-90	Cs-134	Cs-137	Ba-La-140
Required LLD		1.0	5.0	1.0	15.0	18.0	15.0
			WS William Shine				
01-06-87	PAMI-49	<0.3	<0.8	4.6±0.8	<6.0	<6.2	<6.9
02-03-87	102	<0.3	<0.7	4.0±0.7	<4.5	<4.9	<5.1
03-02-87	180	<0.3	<0.8	3.7±0.6	<8.0	<11.3	<4.1
04-08-87	273	<0.3	<1.0	3.2±0.7	<4.3	<4.9	<4.1
05-04-87	340	<0.4	<0.7	3.2±0.7	<8.2	<10.3	<3.8
06-02-87	498	<0.2	<0.7	3.5±0.6	<5.8	<6.9	<11.1
07-02-87	687,8	<0.2	<0.7	4.0±0.9	<3.9	<4.3	<5.7
08-03-87	874	<0.3	<0.5	3.5±0.3	<1.4	<1.5	<13.0
09-02-87	1026	<0.2	<0.8	3.8±0.8	<3.2	<3.4	<3.6
10-06-87	1248	<0.5	<0.7	4.2±0.8	<6.1	<7.7	<8.1
11-02-87	1376,7	<0.3	<0.7	4.0±0.7	<8.0	<8.4	<9.3
12-01-87	1448	<0.3	<0.7	4.0±0.7	<4.4	<4.8	<5.6
			FC Frank Crnkovich				
01-06-87	PAMI-48	<0.5	<0.8	4.1±0.7	<6.8	<6.9	<12.7
02-03-87	101	<0.3	<0.8	4.4±0.7	<6.3	<6.0	<8.5
03-02-87	179	<0.2	<0.7	6.2±0.8	<5.0	<5.6	<5.8
04-08-87	272	<0.4	<1.0	4.5±0.7	<5.2	<4.7	<5.4
05-04-87	342,3	<0.3	<0.9	5.3±0.9	<6.4	<6.6	<8.1
06-02-87	497	<0.4	<0.8	5.8±0.9	<6.6	<6.2	<6.3
07-02-87	689	<0.4	<0.9	4.3±0.7	<6.4	<6.9	<9.6
08-03-87	877	<0.4	<0.2	4.3±0.3	<6.3	<7.0	<12.5
09-02-87	1023	<0.2	<0.3	4.5±0.5	<5.3	<8.1	<6.3
10-06-87	1249	<0.6	<0.8	4.2±0.9	<6.0	<6.4	<11.9
11-02-87	1378	<0.3	<0.6	3.8±0.7	<7.1	<8.7	<8.2
12-01-87	1446,7	<0.4	<0.6	3.2±0.6	<6.3	<6.6	<7.5

Table 13. Food Crops
Collection: Semiannually at time of harvest.
Units: pCi/g wet

Sample Description and Concentration				Required LLD
Location	Paul Rude Farm	Jerry Sarno Farm	Jerry Sarno Farm	
Date Collected	07-26-87	07-26-87	07-26-87	
Sample Type	Blueberries	Blueberries	Peaches	
Lab Code	PAVE-209	PAVE-210	PAVE-211	
Gross Beta	2.81±0.09	0.62±0.02	2.15±0.06	1.0
Sr-89	<0.003	<0.001	<0.002	0.025
Sr-90	0.011±0.001	0.006±0.001	<0.001	0.005
I-131	<0.027	<0.012	<0.008	0.06
Mn-54	<0.022	<0.009	<0.007	0.08
Co-58	<0.021	<0.009	<0.007	0.08
Co-60	<0.022	<0.009	<0.008	0.05
Fe-59	<0.052	<0.019	<0.017	0.1
Zn-65	<0.048	<0.021	<0.018	0.1
Zr-Nb-95	<0.021	<0.009	<0.007	0.1
Cs-134	<0.019	<0.009	<0.006	0.08
Cs-137	<0.028	<0.009	<0.006	0.08
Ba-La-140	<0.025	<0.010	<0.008	0.1
Location	Jerry Sarno Farm	Jerry Sarno Farm	Jerry Sarno Farm	
Date Collected	07-26-87	07-26-87	07-26-87	
Sample Type	Plums	Apples	Pears	
Lab Code	PAVE-212	PAVE-213	PAVE-214	
Gross Beta	1.72±0.05	0.89±0.03	1.13±0.03	1.0
Sr-89	<0.001	<0.001	<0.002	0.025
Sr-90	0.007±0.001	0.002±0.001	0.008±0.001	0.005
I-131	<0.015	<0.031	<0.013	0.06
Mn-54	<0.012	<0.028	<0.011	0.08
Co-58	<0.012	<0.021	<0.011	0.08
Co-60	<0.012	<0.029	<0.012	0.05
Fe-59	<0.027	<0.085	<0.026	0.1
Zn-65	<0.033	<0.067	<0.023	0.1
Zr-Nb-95	<0.011	<0.024	<0.012	0.1
Cs-134	<0.012	<0.025	<0.009	0.08
Cs-137	<0.012	<0.027	<0.012	0.08
Ba-La-140	<0.012	<0.030	<0.013	0.1

Table 13. Food Crops (continued)

Sample Description and Concentration				Required LLD
Location		Paul Rude Farm		
Date Collected	09-06-87	09-06-87	09-06-87	
Sample Type	Pears	Plums	Apples	
Lab Code	PAVe-310	PAVe-311,12	PAVe-313	
Gross Beta	1.40±0.04	1.52±0.65	1.27±0.40	1.0
Sr-89	<0.0015	<0.0022	<0.0011	0.025
Sr-90	0.0026±0.0010	0.0026±0.0007	0.0017±0.0007	0.005
I-131	<0.039	<0.033	<0.052	0.06
Mn-54	<0.028	<0.013	<0.026	0.08
Co-58	<0.023	<0.014	<0.027	0.08
Co-60	<0.027	<0.014	<0.022	0.05
Fe-59	<0.063	<0.031	<0.059	0.1
Zn-65	<0.042	<0.042	<0.071	0.1
Zr-Nb-95	<0.020	<0.016	<0.030	0.1
Cs-134	<0.018	<0.011	<0.028	0.08
Cs-137	<0.024	<0.016	<0.026	0.08
Ba-La-140	<0.017	<0.022	<0.044	0.1
Location		Jerry Sarno Farm		
Date Collected	09-06-87	09-06-87		
Sample Type	Blue Grapes	White Grapes		
Lab Code	PAVe-314	PAVe-315		
Gross Beta	1.56±0.04	1.58±0.05		1.0
Sr-89	<0.0020	<0.0013		0.025
Sr-90	0.018±0.002	0.0013±0.0006		0.005
I-131	<0.032	<0.042		0.06
Mn-54	<0.015	<0.020		0.08
Co-58	<0.018	<0.020		0.08
Co-60	<0.015	<0.017		0.05
Fe-59	<0.037	<0.044		0.1
Zn-65	<0.037	<0.051		0.1
Zr-Nb-95	<0.017	<0.022		0.1
Cs-134	<0.015	<0.020		0.08
Cs-137	<0.017	<0.019		0.08
Ba-La-140	<0.020	<0.032		0.1

Table 13. Foods Crops (continued)

Sample Description and Concentration			Required LLD
Location	Richard Buss Farm		
Date Collected	10-12-87		
Sample Type	Apples		
Lab Code	PAVe-346		
Gross Beta	1.24±0.04		1.0
Sr-89	<0.004		0.025
Sr-90	0.005±0.002		0.005
I-131	<0.045		0.06
Mn-54	<0.012		0.08
Co-58	<0.011		0.08
Co-60	<0.014		0.05
Fe-59	<0.038		0.1
Zn-65	<0.028		0.1
Zr-Nb-95	<0.019		0.1
Cs-134	<0.009		0.08
Cs-137	<0.012		0.08
Ba-La-140	<0.031		0.1
Location	Tower Hill Farm		
Date Collected	10-12-87	10-12-87	
Sample Type	Pears	Apples	
Lab Code	PAVe-347	PAVe-348	
Gross Beta	1.04±0.03	0.85±0.03	1.0
Sr-89	<0.003	<0.004	0.025
Sr-90	0.007±0.002	0.006±0.002	0.025
I-131	<0.032	<0.038	0.06
Mn-54	<0.007	<0.008	0.08
Co-58	<0.007	<0.009	0.08
Co-60	<0.006	<0.007	0.05
Fe-59	<0.017	<0.023	0.1
Zn-65	<0.017	<0.020	0.1
Zr-Nb-95	<0.009	<0.011	0.1
Cs-134	<0.007	<0.009	0.08
Cs-137	<0.007	<0.008	0.08
Ba-La-140	<0.015	<0.021	0.01

Table 14. Fish
Collection: Semiannually
Units: pCi/g wet

Sample Description and Concentration				Required LLD
Location	Ludington North Jetty (Control)			
Date Collected	04-10-87	04-10-87	04-10-87	
Sample Type	Sucker	Steelhead	Steelhead	
Lab Code	PAF-201	PAF-202	PAF-203	
Gross Beta	1.45±0.08	1.59±0.07	1.59±0.07	1.0
Sr-89	<0.002	<0.002	<0.003	0.025
Sr-90	0.005±0.001	0.003±0.001	0.006±0.002	0.005
Mn-54	<0.012	<0.007	<0.009	0.13
Co-58	<0.013	<0.007	<0.009	0.13
Co-60	<0.012	<0.007	<0.011	0.13
Fe-59	<0.030	<0.017	<0.025	0.26
Zn-65	<0.027	<0.017	<0.023	0.26
Zr-Nb-95	<0.012	<0.008	<0.010	0.1
Cs-134	<0.009	<0.006	<0.010	0.13
Cs-137	0.036±0.014	0.046±0.006	0.047±0.012	0.15
Ba-La-140	<0.017	<0.011	<0.017	0.1
Location	Ludington North Jetty (Control)			
Date Collected	10-15-87	10-15-87	10-15-87	
Sample Type	Salmon	Perch	Sucker	
Lab Code	PAF-331	PAF-332	PAF-333	
Gross Beta	2.74±0.1	2.49±0.2	3.70±0.2	1.0
Sr-89	<0.004	<0.01	<0.01	0.025
Sr-90	0.002±0.001	0.022±0.006	0.016±0.005	0.025
Mn-54	<0.022	<0.018	<0.013	0.13
Co-58	<0.016	<0.021	<0.014	0.13
Co-60	<0.020	<0.024	<0.016	0.13
Fe-59	<0.047	<0.043	<0.038	0.26
Zn-65	<0.048	<0.052	<0.036	0.26
Zr-Nb-95	<0.013	<0.020	<0.016	0.1
Cs-134	<0.019	<0.018	<0.013	0.13
Cs-137	0.071±0.022	<0.030	<0.015	0.15
Ba-La-140	<0.025	<0.017	<0.021	0.1

Table 14. Fish (continued)

Sample Description and Concentration				Required LLD
Location		Discharge		
Date Collected	06-05-87	06-05-87	06-05-87	
Sample Type	Sucker	Alewife	Perch	
Lab Code	PAF-247,8[a]	PAF-249	PAF-250	
Gross Beta	2.55±0.06	2.48±0.14	2.12±0.16	1.0
Sr-89	<0.002	<0.001	<0.005	0.025
Sr-90	<0.001	<0.001	0.008±0.003	0.005
Mn-54	<0.020	<0.074	<0.028	0.13
Co-58	<0.017	<0.023	<0.031	0.13
Co-60	<0.021	<0.031	<0.032	0.13
Fe-59	<0.039	<0.075	<0.095	0.26
Zn-65	<0.044	<0.050	<0.068	0.26
Zr-Nb-95	<0.017	<0.024	<0.026	0.1
Cs-134	<0.016	<0.021	<0.023	0.13
Cs-137	<0.019	<0.039	0.088±0.031	0.15
Ba-La-140	<0.019	<0.026	<0.037	0.1

Location	Discharge	
Date Collected	08 mm 12-~~16~~-87	
Sample Type	Trout	
Lab Code	PAF-351	
Gross Beta	1.70±0.08	
Sr-89	<0.002	
Sr-90	0.011±0.001	
Mn-54	<0.011	
Co-58	<0.012	
Co-60	<0.012	
Fe-59	<0.027	
Zn-65	<0.024	
Zr-Nb-95	<0.011	
Cs-134	<0.010	
Cs-137	<0.043	
Ba-La-140	<0.013	

[a] Insufficient amount of sample for a duplicate analyses of Sr-89 and Sr-90.

Table 14. Fish (continued)

Sample Description and Concentration			Required LLD
Location	N. Boundary	N. Boundary	
Date Collected	06-05-87	06-05-87	
Sample Type	Shiners	Perch	
Lab Code	PAF-251	PAF-252	
Gross Beta	1.90±0.11	2.09±0.18	1.0
Sr-89	<0.004	<0.004	0.025
Sr-90	0.015±0.003	0.009±0.002[a]	0.005
Mn-54	<0.055	<0.041	0.13
Co-58	<0.020	<0.041	0.13
Co-60	<0.024	<0.042	0.13
Fe-59	<0.055	<0.078	0.26
Zn-65	<0.042	<0.075	0.26
Zr-Nb-95	<0.022	<0.036	0.1
Cs-134	<0.017	<0.030	0.13
Cs-137	<0.031	0.071±0.026	0.15
Ba-La-140	<0.037	<0.059	0.1
Location	S. Boundary		
Date Collected	12-08-87		
Sample Type	Trout		
Lab Code	PAF-352		
Gross Beta	1.71±0.10		
Sr-89	<0.003		
Sr-90	0.004±0.001		
Mn-54	<0.029		
Co-58	<0.032		
Co-60	<0.030		
Fe-59	<0.080		
Zn-65	<0.063		
Zr-Nb-95	<0.029		
Cs-134	<0.026		
Cs-137	0.098±0.041		
Ba-La-140	<0.036		

[a] Corrected result.

Table 15. Algae
Collection: Semiannually
Units: pCi/g wet

Sample Description and Concentration			Required LLD
Location	Ludington North and South Jetty (Control)		
Date Collected	04-10-87	10-15-87	
Lab Code	PASL-45	PASL-91	
Gross Beta	2.2±0.1	0.9±0.1	1.0
Sr-89	<0.010	<0.008	0.025
Sr-90	0.008±0.004	<0.003	0.005
Mn-54	<0.020	<0.017	0.13
Co-58	<0.021	<0.019	0.13
Co-60	<0.018	<0.019	0.13
Fe-59	<0.042	<0.052	0.26
Zn-65	<0.052	<0.042	0.26
Zr-Nb-95	<0.026	<0.020	0.1
Cs-134	<0.028	<0.018	0.13
Cs-137	<0.021	<0.026	0.15
Ba-La-140	<0.040	<0.028	0.1
Location	Discharge	South Boundary	
Date Collected	06-04-87	12-08-87	
Lab Code	PASL-55	PASL-92	
Gross Beta	4.2±0.4	1.1±0.1	1.0
Sr-89	<0.014	<0.002	0.025
Sr-90	<0.003	0.014±0.002	0.005
Mn-54	<0.16[a]	<0.074	0.13
Co-58	<0.18[a]	<0.021	0.13
Co-60	<0.18[a]	<0.020	0.13
Fe-59	<0.38[a]	<0.045	0.26
Zn-65	<0.39[a]	<0.048	0.26
Zr-Nb-95	<0.21[a]	<0.023	0.1
Cs-134	<0.16[a]	<0.021	0.13
Cs-137	<0.16[a]	<0.022	0.15
Ba-La-140	<0.32[a]	<0.027	0.1

[a] The sample was counted for 1020 minutes, but the required LLDs could not be reached because of small sample size.

Table 16. Bottom Sediments
Collection: Semiannually
Units: pCi/g wet

Sample Description and Concentration			Required LLD
	Ludington (Control)		
Location	50 ft. North of North Jetty	300 ft. North of North Jetty	
Date Collected	04-10-87	04-10-87	
Lab Code	PABS-189	PABS-190	
Gross Beta	5.6±1.6	7.8±1.6	1.0
Sr-89	<0.011	<0.016	0.025
Sr-90	0.013±0.005	0.028±0.006	0.005
Mn-54	<0.011	<0.014	0.08
Co-58	<0.012	<0.015	0.08
Co-60	<0.011	<0.015	0.05
Fe-59	<0.027	<0.041	0.1
Zn-65	<0.032	<0.044	0.1
Zr-Nb-95	<0.012	<0.017	0.1
Cs-134	<0.012	<0.016	0.15
Cs-137	<0.009	<0.014	0.18
Ba-La-140	<0.016	<0.017	0.1

Location	50 ft. North of North Jetty	150 ft. North of North Jetty	300 ft. North of North Jetty	
Date Collected	10-15-87	10-15-87	10-15-87	
Lab Code	PABS-277	PABS-278	PABS-279	
Gross Beta	7.6±2.6	14.3±3.0	11.1±2.8	1.0
Sr-89	<0.007	<0.007	<0.006	0.025
Sr-90	0.002±0.002	0.003±0.002	<0.003	0.005
Mn-54	<0.018	<0.016	<0.019	0.08
Co-58	<0.021	<0.020	<0.023	0.08
Co-60	<0.024	<0.023	<0.027	0.05
Fe-59	<0.061	<0.066	<0.078	0.1
Zn-65	<0.050	<0.050	<0.052	0.1
Zr-Nb-95	<0.024	<0.033	<0.028	0.1
Cs-134	<0.014	<0.018	<0.014	0.15
Cs-137	<0.019	<0.015	<0.019	0.18
Ba-La-140	<0.008	<0.022	<0.012	0.1

Table 16. Bottom Sediments (continued)

Sample Description and Concentration			Required LLD
Location	Discharge		
Date Collected	06-05-87	12-08-87	
Lab Code	PABS-217,8	PABS-299,300	
Gross Beta	6.2±3.7	4.2±2.5	1.0
Sr-89	<0.010	<0.007	0.025
Sr-90	0.004±0.003	0.006±0.004	0.005
Mn-54	<0.031	<0.007	0.08
Co-58	<0.026	<0.006	0.08
Co-60	<0.038	<0.010	0.05
Fe-59	<0.064	<0.015	0.1
Zn-65	<0.061	<0.015	0.1
Zr-Nb-95	<0.028	<0.006	0.1
Cs-134	<0.022	<0.006	0.15
Cs-137	0.066±0.022	0.045±0.007	0.18
Ba-La-140	<0.047	<0.006	0.1
Location	South Haven Beach		
Date Collected	06-05-87	12-08-87	
Lab Code	PABS-221	PABS-302	
Gross Beta	11.6±2.9	3.0±2.3	1.0
Sr-89	<0.013[a]	<0.011	0.025
Sr-90	0.0026±0.0015	0.008±0.006	0.005
Mn-54	<0.014	<0.005	0.08
Co-58	<0.018	<0.004	0.08
Co-60	<0.023	<0.007	0.05
Fe-59	<0.048	<0.011	0.1
Zn-65	<0.045	<0.011	0.1
Zr-Nb-95	<0.018	<0.005	0.1
Cs-134	<0.014	<0.004	0.15
Cs-137	<0.017	0.026±0.008	0.18
Ba-La-140	<0.031	<0.005	0.1

[a] Result of reanalysis.

Table 16. Bottom Sediments (continued)

Sample Description and Concentration			Required LLD
Location	1/2 mi. S. Boundary		
Date Collected	06-04-87	12-08-87	
Lab Code	PABS-220	PABS-301	
Gross Beta	6.8±2.6	9.1±1.9	1.0
Sr-89	<0.013	<0.019	0.025
Sr-90	0.010±0.007[a]	<0.017	0.005
Mn-54	<0.018	<0.008	0.08
Co-58	<0.020	<0.008	0.08
Co-60	<0.023	<0.010	0.05
Fe-59	<0.051	<0.018	0.1
Zn-65	<0.048	<0.019	0.1
Zr-Nb-95	<0.021	<0.008	0.1
Cs-134	<0.015	<0.007	0.15
Cs-137	<0.019	0.020±0.007	0.18
Ba-La-140	<0.044	<0.007	0.1
Location	1/2 mi. N. Boundary		
Date Collected	06-04-87		
Lab Code	PABS-219		
Gross Beta	24.0±3.4		1.0
Sr-89	<0.015		0.025
Sr-90	0.011±0.008[a]		0.005
Mn-54	<0.024		0.08
Co-58	<0.025		0.08
Co-60	<0.022		0.05
Fe-59	<0.049		0.1
Zn-65	<0.078		0.1
Zr-Nb-95	<0.037		0.1
Cs-134	<0.042		0.15
Cs-137	<0.025		0.18
Ba-La-140	<0.10		0.1

[a] Corrected result.

Table 17.1. Liquid Radwaste
Collection: Monthly Composite
Units: µCi/ml

Collection Period	Lab Code	Gross Alpha	H-3	Sr-89	Sr-90	Cr-51
January	PARW-95	<1.3 E-08	11.7±0.1 E-04	2.1±0.7 E-08	3.5±0.4 E-08	<1.9 E-06
February	101	<1.2 E-08	8.8±0.1 E-04	7.9±6.6 E-09	1.2±0.2 E-09	<1.5 E-06
March	105	<0.6 E-08	6.5±0.1 E-04	1.6±0.6 E-08	1.6±0.2 E-08	<1.8 E-06
April	117	<0.5 E-08	1.9±0.3 E-02	<1.3 E-09	1.3±0.2 E-08	<5.6 E-07
May	123	<1.0 E-08	2.2±0.1 E-03	6.1±0.7 E-07	9.9±0.3 E-07	<4.6 E-06
June	132	<6.5 E-08	2.1±0.3 E-02	<1.7 E-09	4.8±0.4 E-08	<1.6 E-06
July	136	<4.8 E-08	3.0±0.1 E-02	6.4±2.3 E-09	1.4±0.1 E-08	<1.8 E-06
August	140	<4.8 E-08	3.8±0.4 E-02	<1.4 E-09	1.0±0.2 E-08	<1.1 E-06
September	144	<4.7 E-09	3.1±0.4 E-02	1.1±0.5 E-08	5.5±1.1 E-09	<2.9 E-06
October	148	<5.5 E-09	2.9±0.1 E-02	<2.0 E-09	8.3±0.1 E-07	<5.0 E-06
November	152	<5.2 E-09	4.8±0.1 E-02	1.3±0.3 E-08	6.5±0.9 E-09	<1.8 E-06
December	155	<6.4 E-09	3.7±0.1 E-02	5.1±0.1 E-07	1.7±0.2 E-08	<2.0 E-06

Collection Period	Mn-54	Fe-59	Co-58	Co-60	Zn-65
January	<1.5 E-07	<2.9 E-07	2.4±0.1 E-06	3.1±0.1 E-06	<2.8 E-07
February	3.0±0.7 E-07	<3.4 E-07	4.7±0.8 E-07	1.1±0.1 E-06	<2.7 E-07
March	<9.6 E-07	<2.4 E-07	4.6±0.2 E-07	8.0±0.2 E-06	<2.5 E-07
April	3.5±0.6 E-07	<1.4 E-07	1.9±0.8 E-08	2.4±0.1 E-07	<1.4 E-07
May	3.8±0.6 E-06	<8.6 E-07	1.2±0.4 E-06	6.5±0.6 E-06	<7.4 E-07
June	<1.3 E-07	<3.5 E-07	<1.9 E-07	2.1±0.2 E-06	<2.9 E-07
July	2.0±0.3 E-06	<5.1 E-07	8.6±2.2 E-07	2.4±0.2 E-06	<4.6 E-07
August	3.5±0.9 E-07	<3.2 E-07	1.3±0.9 E-07	1.6±0.2 E-06	<2.7 E-07
September	1.6±1.2 E-07	<3.8 E-07	5.8±2.0 E-07	6.8±1.4 E-06	<2.3 E-07
October	1.4±0.1 E-06	<1.1 E-06	1.7±0.6 E-06	2.7±0.1 E-05	<9.5 E-07
November	<8.7 E-08	<3.0 E-07	1.1±0.1 E-06	1.0±0.1 E-06	<2.0 E-07
December	3.4±0.8 E-07	<2.8 E-07	3.4±0.1 E-05	2.2±0.1 E-06	<2.5 E-07

Table 17.1 Liquid Radwaste (continued)

Collection Period	Zr-95	Nb-95	Ag-110m	Sb-124	Cs-134	Cs-137
January	<2.4 E-07	<1.5 E-07	<3.5 E-07	<7.7 E-08	5.2±0.1 E-06	2.0±0.1 E-05
February	<2.4 E-07	<1.4 E-07	<1.5 E-07	<1.8 E-07	7.9±0.8 E-07	3.4±0.2 E-06
March	<2.2 E-07	<1.2 E-07	<1.1 E-07	<2.5 E-07	6.8±1.4 E-07	4.1±0.3 E-06
April	<1.1 E-07	<6.4 E-08	<5.6 E-08	<8.6 E-08	5.9±0.7 E-07	3.1±0.1 E-06
May	<6.9 E-07	<3.3 E-07	<3.8 E-07	<2.5 E-07	4.3±0.5 E-06	1.9±0.8 E-05
June	<2.7 E-07	<1.6 E-07	<1.4 E-07	<1.9 E-07	7.6±0.2 E-07	4.2±0.3 E-06
July	<3.7 E-07	<2.2 E-07	<4.2 E-07	<2.7 E-07	4.6±1.6 E-07	2.9±0.3 E-06
August	<2.2 E-07	<1.5 E-07	<2.7 E-07	<1.5 E-07	4.5±0.8 E-07	2.6±0.2 E-06
September	<2.8 E-08	<1.7 E-07	<1.5 E-07	<2.3 E-07	9.6±1.8 E-07	4.5±0.3 E-06
October	<7.6 E-07	<4.5 E-07	<5.7 E-07	<3.3 E-07	1.5±0.1 E-05	9.0±0.1 E-05
November	<2.2 E-07	<1.8 E-07	<2.1 E-07	<2.0 E-07	<7.9 E-08	2.3±0.1 E-06
December	<2.7 E-07	<1.7 E-07	<4.9 E-07	<2.7 E-07	4.6±0.2 E-06	1.7±0.1 E-05

Collection Period	Ba-140	La-140	Ce-141	Ce-144	Pu-239
January	<1.0 E-06	<8.4 E-08	<1.9 E-07	<6.2 E-07	NA[a]
February	<9.2 E-07	<2.9 E-07	<2.0 E-07	<5.9 E-07	NA
March	<1.5 E-06	<4.5 E-07	<2.0 E-07	<4.8 E-07	NA
April	<3.0 E-07	<8.0 E-08	<6.9 E-08	<2.4 E-07	NA
May	<3.2 E-06	<4.8 E-07	<4.7 E-07	<1.5 E-06	NA
June	<1.1 E-06	<2.1 E-07	<2.4 E-07	<7.2 E-07	NA
July	<1.2 E-06	<3.1 E-07	<1.9 E-07	<6.3 E-07	NA
August	<1.1 E-06	<2.7 E-07	<1.3 E-07	<3.7 E-07	1.8±0.4 E-09
September	<3.6 E-06	<8.5 E-07	<3.8 E-07	<6.6 E-07	1.6±0.2 E-09[b]
October	<2.9 E-06	<2.8 E-07	<6.1 E-07	<2.0 E-06	1.9±0.3 E-09[b]
November	<3.1 E-06	<7.3 E-07	<2.5 E-07	<4.9 E-07	1.6±0.3 E-09
December	<1.9 E-06	<1.7 E-07	<2.5 E-07	<7.8 E-07	1.4±0.2 E-09

[a] NA = Not analyzed. Analysis not required until August 1987.
[b] Corrected result.

Table 17.2. Stack Filters
Collection: Monthly composite
Units: pCi/composite

Collection Period	Lab Code	Gross Alpha	Sr-89	Sr-90	Pu-239
January, 1987	PASP-96	<1.8	<4.5	<6.4	NA[a]
February, 1987	102	<1.1	<5.4	<2.4	NA
March, 1987	106	<1.1	<3.4	<2.4	NA
April, 1987	118	<1.1	<2.3	<2.2	NA
May, 1987	124	<1.3	<2.0	<1.7	NA
June, 1987	133	<1.3	<7.4	6.9±2.8	NA
July, 1987	137	<0.9	<1.6	1.6±0.8	NA
August, 1987	141	<1.2	15.8±3.7	4.2±1.5	3.2±0.7
September, 1987	143	<1.2	16.8±4.8	<2.3	3.0±0.3
October, 1987	147	<1.1	44.1±8.5	16.6±2.7	4.3±0.8
November, 1987	151	<2.5	6.4±1.6	1.2±0.5	3.6±0.6
December, 1987	154	<2.5	2.0±1.0	0.6±0.4	3.4±0.5

[a] NA = Not analyzed. Analysis not required until August 1987.

Table 17.3. Special Samples - NRC Split Samples
Units: Strontium - pCi/l
Tritium - pCi/ml

Sample Description	Collection Date	Lab Code	Sr-89	Sr-90	H-3
NRC Split					

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

Table 17.4. Special Samples - Reactor Water
Units: pCi/l

Sample Description	Collection Date	Lab Code	Sr-89	Sr-90
SX1023 Primary Coolant				

Appendix A

Interlaboratory Comparison Program Results

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 concentrations 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 May 1984 through June 1987. 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 (TLD's) during the period 1976, 1977, 1979, 1980, 1984, and 1985-1986 through participation in the Second, Third, Fourth, Fifth, Seventh, and Eighth International Intercomparison of Environmental Dosimeters under the sponsorships listed in Table A-2.

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.

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, 1984 through 1987.[a]

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-358	Water	May 1984	Gr. alpha	3.0±0.6	3±5.0	0.0-11.7
			Gr. beta	6.7±1.2	6±5.0	0.0-14.7
STM-366	Milk	June 1984	Sr-89	21±3.1	25±5.0	16.3-33.7
			Sr-90	13±2.0	17±1.5	14.4-19.6
			I-131	46±5.3	43±6.0	32.6-53.4
			Cs-137	38±4.0	35±5.0	26.3-43.7
			K-40	1577±172	1496±75	1336-1626
STW-368	Water	July 1984	Gr. alpha	5.1±1.1	6±5.0	0.0-14.7
			Gr. beta	11.9±2.4	13±5.0	4.3-21.7
STW-369	Water	August 1984	I-131	34.3±5.0	34.0±6.0	23.6-44.4
STW-370	Water	August 1984	H-3	3003±253	2817±356	2200-3434
STF-371	Food	July 1984	Sr-89	22.0±5.3	25.0±5.0	14.3-33.7
			Sr-90	14.7±3.1	20.0±1.5	17.4-22.6
			I-131	<172	39.0±6.0	28.6-49.4
			Cs-137	24.0±5.3	25.0±5.0	14.3-33.7
			K-40	2503±132	2605±130	2379-2831
STAF-372	Air Filter	August 1984	Gr. alpha	15.3±1.2	17±5.0	8.3-25.7
			Gr. beta	56.0±0.0	51±5.0	42.3-59.7
			Sr-90	14.3±1.2	18±1.5	15.6-20.4
			Cs-137	21.0±2.0	15±5.0	6.3-23.7
STW-375	Water	Sept 1984	Ra-226	5.1±0.4	4.9±0.7	3.6-6.2
			Ra-228	2.2±0.1	2.3±0.4	1.7-2.9
STW-377	Water	Sept 1984	Gr. alpha	3.3±1.2	5.0±5.0	0.0-13.7
			Gr. beta	12.7±2.3	16.0±5.0	7.3-24.7
STW-379	Water	Oct 1984	H-3	2860±312	2810±205	2454-3166
STW-380	Water	Oct 1984	Cr-51	<36	40±5.0	31.3-48.7
			Co-60	20.3±1.2	20±5.0	11.3-28.7
			Zn-65	150±8.1	147±5.0	138.3-155.7
			Ru-106	<30	47±5.0	36.3-55.7
			Cs-134	31.3±7.0	31±5.0	22.3-39.7
			Cs-137	26.7±1.2	24±5.0	15.3-32.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result[d] Is, N=1	EPA Result[d] Control Limits
STM-382	Milk	Oct 1984	Sr-89	15.7±4.2	22±5.0	13.3-30.7
			Sr-90	12.7±1.2	16±1.5	13.4-18.6
			I-131	41.7±3.1	42±6.0	31.6-42.4
			Cs-137	31.3±6.1	32±5.0	23.3-40.7
			K-40	1447±66	1517±76	1386-1648
STW-384	Water (Blind)	Oct 1984 Sample A	Gr. alpha	9.7±1.2	14±5.0	5.3-22.7
			Ra-226	3.3±0.2	3.0±0.5	2.2-3.8
			Ra-228	3.4±1.6	2.1±0.3	1.6-2.6
			Uranium	NA[e]		
		Sample B	Gr. beta	48.3±5.0	64±5.0	55.3-72.7
			Sr-89	10.7±4.6	11±5.0	2.3-19.7
			Sr-90	7.3±1.2	12±1.5	9.4-14.6
			Co-60	16.3±1.2	14±5.0	5.3-22.7
			Cs-134	<2	2±5.0	0.0-10.7
			Cs-137	16.7±1.2	14±5.0	5.3-22.7
STAF-387	Air Filter	Nov 1984	Gr. alpha	18.7±1.2	15±5.0	6.3-23.7
			Gr. beta	59.0±5.3	52±5.0	43.3-60.7
			Sr-90	18.3±1.2	21±1.5	18.4-23.6
			Cs-137	10.3±1.2	10±5.0	1.3-18.7
STW-388	Water	Dec 1984	I-131	28.0±2.0	36±6.0	25.6-36.4
STW-389	Water	Dec 1984	H-3	3583±110	3182±360	2558-3806
STW-391	Water	Dec 1984	Ra-226	8.4±1.7	8.6±1.3	6.4-10.8
			Ra-228	3.1±0.2	4.1±0.6	3.0-5.2
STW-392	Water	Jan 1985	Sr-89	<3.0	3.0±5.0	0.0-11.7
			Sr-90	27.3±5.2	30.0±1.5	27.4-32.6
STW-393	Water	Jan 1985	Gr. alpha	3.3±1.2	5±5.0	0.0-13.7
			Gr. beta	17.3±3.0	15±5.0	6.3-23.7
STS-395	Food	Jan 1985	Gr. alpha	4.7±2.3	6.0±5.0	0.0-14.7
			Gr. beta	11.3±1.2	15.0±5.0	6.3-23.7
			Sr-89	25.3±6.4	34.0±5.0	25.3-42.8
			Sr-90	27.0±8.8	26.0±1.5	23.4-28.6
			I-131	38.0±2.0	35.0±6.0	24.6-45.4
			Cs-137	32.7±2.4	29.0±5.0	20.3-37.7
			K-40	1410±212	1382±120	1174-1590

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result[d] Is, N=1	EPA Result[d] Control Limits
STW-397	Water	Feb 1985	Cr-51	<29	48±5.0	39.3-56.7
			Co-60	21.3±3.0	20±5.0	11.3-28.7
			Zn-65	53.7±5.0	55±5.0	46.3-63.7
			Ru-106	<23	25±5.0	16.3-33.7
			Cs-134	32.3±1.2	35±5.0	26.3-43.7
			Cs-137	25.3±3.0	25±5.0	16.3-33.7
STW-398	Water	Feb 1985	H-3	3869±319	3796±634	3162-4430
STM-400	Milk	March 1985	I-131	7.3±2.4	9.0±0.9	7.4-10.6
STW-402	Water	March 1985	Ra-226	4.6±0.6	5.0±0.8	3.7-6.3
			Ra-228	<0.8	9.0±1.4	6.7-11.3
		Reanalysis	Ra-228	9.0±0.4		
STW-404	Water	March 1985	Gr. alpha	4.7±2.3	6±5.0	0.0-14.7
			Gr. beta	11.3±1.2	15±5.0	6.3-23.7
STAF-405	Air Filter	March 1985	Gr. alpha	9.3±1.0	10.0±5.0	1.3-18.7
			Gr. beta	42.0±1.1	36.0±5.0	27.3-44.7
			Sr-90	13.3±1.0	15.0±1.5	12.4-17.6
			Cs-137	6.3±1.0	6.0±5.0	0.0-14.7
STW-407	Water	April 1985	I-131	8.0±0.0	7.5±0.8	6.2-8.8
STW-408	Water	April 1985	H-3	3399±150	3559±630	2929-4189
STW-409	Water	April 1985				
	(Blind) Sample A		Gr. alpha	29.7±1.8	32.0±5.0	23.3-40.7
			Ra-226	4.4±0.2	4.1±0.6	3.1-5.1
			Ra-228	NA[e]	6.2±0.9	4.6-7.8
			Uranium	NA[e]	7.0±6.0	0.0-17.4
	Sample B		Gr. beta	74.3±11.8	72.0±5.0	63.3-80.7
			Sr-89	12.3±7.6	10.0±5.0	1.3-18.7
			Sr-90	14.7±2.4	15.0±1.5	12.4-17.6
			Co-60	14.7±2.4	15.0±5.0	6.3-23.7
			Cs-134	12.0±2.0	15.0±5.0	6.3-23.7
			Cs-137	14.0±2.0	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-413	Water	May 1985	Sr-89	36.0±12.4	39.0±5.0	30.3-47.7
			Sr-90	14.3±4.2	15.0±1.5	12.4-17.6
STW-414	Water	May 1985	Gr. alpha	8.3±4.1	12.0±5.0	3.3-20.7
			Gr. beta	8.7±1.2	11.0±5.0	2.3-19.7
STW-416	Water	June 1985	Cr-51	44.7±6.0	44.0±5.0	45.3-52.7
			Co-60	14.3±1.2	14.0±5.0	5.3-22.7
			Zn-65	50.3±7.0	47.0±5.0	38.3-55.7
			Ru-106	55.3±5.8	62.0±5.0	53.3-70.7
			Cs-134	32.7±1.2	35.0±5.0	26.3-43.7
			Cs-137	22.7±2.4	20.0±5.0	11.3-28.7
STW-418	Water	June 1985	H-3	2446±132	2416±351	1807-3025
STM-421	Milk	June 1985	Sr-89	10.3±4.6	11.0±5.0	2.3-19.7
			Sr-90	9.0±2.0	11.0±1.5	8.4-13.6
			I-131	11.7±1.2	11.0±6.0	0.6-21.4
			Cs-137	12.7±1.2	11.0±5.0	2.3-19.7
			K-40	1512±62	1525±132	1393-1657
STW-423	Water	July 1985	Gr. alpha	5.0±0.0	11.0±5.0	2.3-19.7
			Gr. beta	5.0±2.0	8.0±5.0	0.0-16.7
STW-425	Water	August 1985	I-131	25.7±3.0	33.0±6.0	22.6-43.4
STW-426	Water	August 1985	H-3	4363±83	4480±447	3704-5256
STAF-427	Air Filter	August 1985	Gr. alpha	11.3±0.6	13.0±5.0	4.3-21.7
			Gr. beta	46.0±1.0	44.0±5.0	35.3-52.7
			Sr-90	17.7±0.6	18.0±1.5	15.4-20.6
			Cs-137	10.3±0.6	8.0±5.0	0.0-16.7
STW-429	Water	Sept 1985	Sr-89	15.7±0.6	20.0±5.0	11.3-28.7
			Sr-90	7.0±0.0	7.0±1.5	4.4-9.6
STW-430	Water	Sept 1985	Ra-226	8.2±0.3	8.9±1.3	6.6-11.1
			Ra-228	4.1±0.3	4.6±0.7	3.4-5.8
STW-431	Water	Sept 1985	Gr. alpha	4.7±0.6	8.0±5.0	0.0-16.7
			Gr. beta	4.7±1.2	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] Is, N=1	EPA Result[d] Control Limits
STW-433	Water	Oct 1985	Cr-51	<13	21.0±5.0	12.3-29.7
			Co-60	19.3±0.6	20.0±5.0	11.3-28.7
			Zn-65	19.7±0.6	19.0±5.0	10.3-27.7
			Ru-106	<19	20.0±5.0	11.3-28.7
			Cs-134	17.0±1.0	20.0±5.0	11.3-28.7
			Cs-137	19.3±1.2	20.0±5.0	11.3-28.7
STW-435	water	Oct 1985	H-3	1957±50	1974±345	1376-2572
STW-436 437	Water (Blind)	Oct 1985				
	Sample A		Gr. alpha	53.0±1.0	52.0±13	29.4-74.6
			Ra-226	5.9±0.1	6.3±1.0	4.1-7.9
			Ra-228	8.2±0.1	10.1±1.5	7.5-12.7
			Uranium	NA[e]	8.0±10.4	0.0-18.4
	Sample B		Gr. beta	85.7±2.5	75.0±5.0	76.3-83.7
			Sr-89	21.3±1.5	27.0±5.0	18.3-35.7
			Sr-90	10.3±0.6	9.0±1.5	6.4-11.6
			Co-60	18.3±1.2	18.0±5.0	9.3-26.7
			Cs-134	16.3±1.2	18.0±5.0	9.3-26.7
			Cs-137	19.0±1.0	18.0±5.0	9.3-26.7
STM-439	Milk	Oct 1985	Sr-89	50.3±0.6	48.0±5.0	39.3-56.7
			Sr-90	23.3±0.6	26.0±1.5	23.4-28.6
			I-131	45.7±3.2	42.0±6.0	31.6-52.4
			Cs-137	60.7±0.6	56.0±5.0	47.3-64.7
			K-40	1547±29	1540±77	1406-1674
STW-441	Water	Nov 1985	Gr. alpha	5.3±0.6	10.0±5.0	1.3-18.7
			Gr. beta	11.7±1.2	13.0±5.0	4.3-21.7
STW-443	Water	Dec 1985	I-131	46.7±2.1	45.0±6.0	34.6-55.4
STW-444	Water	Dec 1985	Ra-226	6.5±0.1	7.1±1.1	5.2-9.0
			Ra-228	6.1±0.1	7.3±1.1	5.4-9.2
STW-445	water	Jan 1986	Sr-89	29.7±2.5	31.0±5.0	22.3-39.7
			Sr-90	13.7±0.6	15.0±1.5	12.4-17.6
STW-446	Water	Jan 1986	Gr. alpha	3.0±0.0	3.0±5.0	0.0-11.7
			Gr. beta	5.3±0.6	7.0±5.0	0.0-15.7

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	EPA Result[d] Control Limits
STW-447	Food	Jan 1986	Sr-89	24.3±2.5	25.0±5.0	16.3-33.7
			Sr-90	17.3±0.6	10.0±1.5	7.4-12.6
			I-131	22.7±2.3	20.0±6.0	9.6-30.4
			Cs-137	16.3±0.6	15.0±5.0	6.3-23.7
			K-40	927±46	950±144	701-1199
STW-448	Water	Feb 1986	Cr-51	45.0±3.6	38.0±5.0	29.3-46.7
			Co-60	19.7±1.5	18.0±5.0	9.3-26.7
			Zn-65	44.0±3.5	40.0±5.0	31.3-48.7
			Ru-106	<9.0	0.0±5.0	0.0-8.7
			Cs-134	28.3±2.3	30.0±5.0	21.3-38.7
			Cs-137	23.7±0.6	22.0±5.0	13.3-30.7
STW-449	Water	Feb 1986	H-3	5176±48	5227±525	4317-6137
STW-450	Water	Feb 1986	U total	8.0±0.0	9.0±6.0	0.0-19.4
STW-451	Milk	Feb 1986	I-131	7.0±0.0	9.0±6.0	0.0-19.4
STW-452	Water	March 1986	Ra-226	3.8±0.1	4.1±0.6	3.0-5.2
			Ra-228	11.0±0.5	12.4±1.8	9.2-15.5
STW-453	Water	March 1986	Gr. alpha	6.7±0.6	15.0±5.0	6.3-23.7
			Gr. beta	7.3±0.6	8.0±5.0	0.0-16.7
STW-454	Water	April 1986	I-131	7.0±0.0	9.0±6.0	0.0-19.4
STW-455 456	Water (Blind)	April 1986				
	Sample A		Gr. alpha	15.0±1.0	17.0±5.0	8.3-25.7
			Ra-226	3.1±0.1	2.9±0.4	2.1-3.7
			Ra-228	1.5±0.2	2.0±0.3	1.5-2.5
			Uranium	4.7±0.6	5.0±6.0	0.0-15.4
	Sample B		Gr. beta	28.7±1.2	35.0±5.0	26.3-43.7
			Sr-89	5.7±0.6	7.0±5.0	0.0-15.7
			Sr-90	7.0±0.0	7.0±1.5	4.4-9.6
			Co-60	10.7±1.5	10.0±5.0	1.3-18.7
			Cs-134	4.0±1.7	5.0±5.0	0.0-13.7
			Cs-137	5.3±0.6	5.0±5.0	0.0-13.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result[d] Is, N=1	Control Limits
STAF-457	Air Filter	April 1986	Gr. alpha	13.7±0.6	15.0±5.0	6.3-23.7
			Gr. beta	46.3±0.6	47.0±5.0	38.3-55.7
			Sr-90	14.7±0.6	18.0±1.5	15.4-20.6
			Cs-137	10.7±0.6	10.0±5.0	1.3-18.7
STU-458	Urine	April 1986	Tritium	4313±70	4423±189	4096-4750
STW-459	Water	May 1986	Sr-89	4.3±0.6	5.0±5.0	0.0-13.7
			Sr-90	5.0±0.0	5.0±1.5	2.4-7.6
STW-460	Water	May 1986	Gr. alpha	5.3±0.6	8.0±5.0	0.0-16.7
			Gr. beta	11.3±1.2	15.0±5.0	6.3-23.7
STW-461	Water	June 1986	Cr-51	<9.0	0.0±5.0	0.0-8.7
			Co-60	66.0±1.0	66.0±5.0	57.3-74.7
			Zn-65	87.3±1.5	86.0±5.0	77.3-94.7
			Ru-106	39.7±2.5	50.0±5.0	41.3-58.7
			Cs-134	49.3±2.5	49.0±5.0	40.3-57.7
			Cs-137	10.3±1.5	10.0±5.0	1.3-18.7
STW-462	Water	June 1986	Tritium	3427±25	3125±361	2499-3751
STM-464	Milk	June 1986	Sr-89	<1.0	0.0±5.0	0.0-8.7
			Sr-90	15.3±0.6	16.0±1.5	13.4-18.6
			I-131	48.3±2.3	41.0±6.0	30.6-51.4
			Cs-137	43.7±1.5	31.0±5.0	22.3-39.7
			K-40	1567±114	1600±80	1461-1739
STW-465	Water	July 1986	Gr. alpha	4.7±0.6	6.0±5.0	0.0-14.7
			Gr. beta	18.7±1.2	18.0±5.0	9.3-26.7
STW-467	Water	August 1986	I-131	30.3±0.6	45.0±6.0	34.4-55.4
STW-468	Water	August 1986	Pu-239	11.3±0.6	10.1±1.0	8.3-11.9
STW-469	Water	August 1986	Uranium	4.0±0.0	4.0±6.0	0.0-14.4
STAF-470 471 472	Air Filter	Sept 1986	Gr. alpha	19.3±1.5	22.0±5.0	13.3-30.7
			Gr. beta	64.0±2.6	66.0±5.0	57.3-74.7
			Sr-90	22.0±1.0	22.0±5.0	19.4-24.6
			Cs-137	25.7±1.5	22.0±5.0	13.3-30.7
STW-473	Water	Sept 1986	Ra-226	6.0±0.1	6.1±0.9	4.5-7.7
			Ra-228	8.7±1.1	9.1±1.4	6.7-11.5

Table A-1. (continued).

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-474	Water	Sept 1986	Gr. alpha	16.3±3.2	15.0±5.0	6.3-23.7
			Gr. beta	9.0±1.0	8.0±5.0	0.0-16.7
STW-475	Water	Oct 1986	Cr-51	63.3±5.5	59.0±5.0	50.3-67.7
			Co-60	31.0±2.0	31.0±5.0	22.3-39.7
			Zn-65	87.3±5.9	85.0±5.0	76.3-93.7
			Ru-106	74.7±7.4	74.0±5.0	65.3-82.7
			Cs-134	25.7±0.6	28.0±5.0	19.3-36.7
			Cs-137	46.3±1.5	44.0±5.0	35.3-52.7
STW-476	Water	Oct 1986	H-3	5918±60	5973±597	4938-7008
SPW-477 478	Water (Blind)	Oct 1986				
	Sample A		Gr. alpha	34.0±6.0	40.0±5.0	31.3-48.7
			Ra-226	5.8±0.2	6.0±0.9	4.4-7.6
			Ra-228	2.7±1.0	5.0±0.8	3.7-6.3
			Uranium	11.0±0.0	10.0±6.0	0.0-20.4
	Sample B		Gr. beta	38.7±1.2	51.0±5.0	42.3-59.7
			Sr-89	5.0±0.0	10.0±5.0	1.3-18.7
			Sr-90	3.0±0.0	4.0±1.5	1.4-6.6
			Co-60	24.7±1.2	24.0±5.0	15.3-32.7
			Cs-134	11.0±2.0	12.0±5.0	3.3-20.7
			Cs-137	9.3±1.2	8.0±5.0	0.0-16.7
STM-479	Milk	Nov 1986	Sr-89	7.7±1.2	9.0±5.0	0.3-17.7
			Sr-90	1.0±0.0	0.0±1.5	0.0-2.6
			I-131	52.3±3.1	49.0±6.0	38.6-59.4
			Cs-137	45.7±3.1	39.0±5.0	30.3-47.7
			K-40	1489±104	1565±78	1430-1700
STU-480	Urine	Nov 1986	H-3	5540±26	5257±912	4345-6169
STW-481	Water	Nov 1986	Gr. alpha	12.0±4.0	20.0±5.0	11.3-28.7
			Gr. beta	20.0±3.5	20.0±5.0	11.3-28.7
STW-482	Water	Dec 1986	Ra-226	6.7±0.2	6.8±1.0	5.0-8.6
			Ra-228	5.2±0.2	11.1±1.7	8.2-14.0
STW-483	Water	Jan 1987	Sr-89	19.7±5.0	25.0±5.0	16.3-33.7
			Sr-90	21.0±2.0	25.0±1.5	22.4-27.6

Table A-1. (continued).

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result[d] Is, N=1	Control Limits
STw-484	Water	Jan 1987	Pu-239	17.0±2.3	16.7±1.7	13.8-19.6
STF-486	Food	Jan 1987	Sr-90	36.0±4.0	49.0±10.0	31.7-66.3
			I-131	78.0±3.4	78.0±8.0	64.1-91.9
			Cs-137	89.7±3.0	84.0±5.0	75.3-92.7
			K-40	942±56	980±49	895-1065
STF-487	Food (BlanK)	Jan 1987	SR-90	2.0±0.0	---	
			I-131	<3	---	
			Cs-137	<2	---	
			K-40	993±102	---	
STW-488	Water	Feb 1987	Co-60	49.0±0.0	50.0±5.0	41.3-58.7
			Zn-65	96.0±7.2	91.0±5.0	82.3-99.7
			Ru-106	92.0±20.2	100.0±5.0	91.3-108.7
			Cs-134	53.0±3.4	59.0±5.0	50.3-67.7
			Cs-137	89.3±4.6	87.0±5.0	78.3-95.7
STW-489	Water	Feb 1987	H-3	4130±140	4209±420	3479-4939
STW-490	Water	Feb 1987	Uranium	8.3±1.2	8.0±6.0	0.0-18.4
STM-491	Milk	Feb 1987	I-131	10.0±0.0	9.0±0.9	7.4-10.6
STW-492	Water	Mar 1987	Gr. alpha	3.7±1.2	3.0±5.0	0.0-11.7
			Gr. beta	11.3±1.2	13.0±5.0	4.3-21.7
STW-493	Water	Mar 1987	Ra-226	7.0±0.1	7.3±1.1	5.4-9.2
			Ra-228	7.1±2.3	7.5±1.1	5.5-9.5
STW-494	Water	Apr 1987	I-131	8.0±0.0	7.0±0.7	5.8-8.2
STAF-495	Air Filter	Apr 1987	Gr. alpha	15.0±0.0	14.0±5.0	5.3-22.7
			Gr. beta	41.0±2.0	43.0±5.0	34.3-51.7
			Sr-90	16.3±1.2	17.0±1.5	14.4-19.6
			Cs-137	7.0±0.0	8.0±5.0	0.0-16.7
STW-496 497	Water (Blind)	Apr 1987				
	Sample A		Gr. alpha	30.7±1.2	30.0±8.0	16.1-43.9
			Ra-226	3.9±0.2	3.9±0.6	2.9-4.9
			Ra-228	4.9±0.9	4.0±0.6	3.0-5.0
			Uranium	5.0±0.0	5.0±6.0	0.0-15.4

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	EPA Result[d] Control Limits
STW-496 497	Water (Blind)	Apr 1987				
	Sample B		Gr. Beta	69.3±9.4	66.0±5.0	57.3-74.7
			Sr-89	16.3±3.0	19.0±5.0	10.3-27.7
			Sr-90	10.0±0.0	10.0±1.5	7.4-12.6
			Co-60	8.3±3.0	8.0±5.0	0.0-16.7
			Cs-134	19.0±2.0	20.0±5.0	11.3-28.7
			Cs-137	14.7±1.2	15.0±5.0	6.3-23.7
STU-498	Urine	Apr 1987	H-3	6017±494	5620±795	4647-6593
STW-499	Water	May 1987	Sr-89	38.0±6.0	41.0±5.0	32.3-49.7
			Sr-90	21.0±2.0	20.0±1.5	17.4-22.6
STW-500	Water	May 1987	Gr. alpha	9.0±3.4	11.0±5.0	2.3-19.7
			Gr. beta	10.3±1.2	7.0±5.0	0.0-15.7
STW-501	Water	June 1987	Cr-51	40.0±8.0	41.0±5.0	32.3-49.7
			Co-60	60.3±3.0	64.0±5.0	55.3-72.7
			Zn-65	11.3±5.0	10.0±5.0	1.3-18.7
			Ru-106	78.3±6.4	75.0±5.0	66.3-83.7
			Cs-134	36.7±3.0	40.0±5.0	31.3-48.7
			Cs-137	80.3±4.2	80.0±5.0	71.3-88.7
STW-502	Water	June 1987	H-3	2906±86	2895±357	2277-3513

[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 Vegan, Nevada.

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

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

Lab Code	TLD Type	Measurement	mR: Teledyne Result ±2σ[a]	mR: Known Value[c]	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

Table A-2. (continued)

Lab Code	TLD Type	Measurement	mR: Teledyne Result ±2σ[a]	mR: Known Value[c]	mR: Average ±2σ[d] (all participants)
115-5B	LiF-100 Chips	Field	30.3±4.8	30.0±6.0	30.2±14.6
		Lab 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 Intercomparison[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
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

Table A-2. (Continued)

Lab Code	TLD Type	Measurement	mR: Teledyne Result ±2σ[a]	mR: Known Value[c]	mR: Average ± 2σ[d] (all participants)
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±9.0[b]
		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	32.3±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

[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 (GASL), 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 Dosimeter 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.
[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.

Table A-3. In-house spiked samples.

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l TIML Result n=3	Known Activity	Expected Precision 1s, n=3[a]
QC-MI-6	Milk	Feb. 1986	Sr-89	6.0±1.9	6.4±3.0	8.7
			Sr-90	14.2±1.7	12.9±2.0	5.2
			I-131	34.2±3.8	35.2±3.5	10.4
			Cs-134	32.0±1.8	27.3±5.0	8.7
			Cs-137	35.8±2.1	35.0±5.0	8.7
QC-W-14	Water	Mar. 1986	Sr-89	1.6±0.4	1.6±1.0	7.1
			Sr-90	2.4±0.2	2.4±2.0	4.2
QC-W-15	Water	Apr. 1986	I-131	44.9±2.4	41.5±7.0	10.6
			Co-60	10.6±1.7	12.1±5.0	7.1[b]
			Cs-134	30.2±2.4	25.8±8.0	7.1[b]
			Cs-137	21.9±1.9	19.9±5.0	7.1[b]
QC-MI-7	Milk	Apr. 1986	I-131	39.7±3.3	41.5±7.0	10.4
			Cs-134	28.7±2.8	25.8±8.0	8.7
			Cs-137	21.2±2.8	19.9±5.0	8.7
SPW-1	Water	May 1986	Gross alpha	15.8±1.8	18.0±5.0	5[c]
QC-W-16	Water	June 1986	Gross alpha	16.2±0.7	16.9±2.5	8.7
			Gross beta	38.4±3.5	30.2±5.0	8.7
QC-MI-9	Milk	June 1986	Sr-89	<1.0	0.0	7.1[b]
			Sr-90	12.6±1.8	13.3±3.0	4.2[b]
			I-131	38.9±7.0	34.8±7.0	10.4
			Cs-134	33.0±3.4	36.1±5.0	8.7
			Cs-137	38.5±2.8	39.0±5.0	8.7
SPW-2	Water	June 1986	Gross alpha	16.8±1.8	18.0±5.0	5[c]
SPW-3	Water	June 1986	Gross alpha	17.7±0.8	18.0±5.0	5[c]
QC-W-18	Water	Sep. 1986	Cs-134	34.7±5.6	31.3±5.0	8.7
			Cs-137	51.1±7.0	43.3±8.0	8.7
QC-W-19	Water	Sep. 1986	Sr-89	13.6±4.1	15.6±3.5	7.1[b]
			Sr-90	6.4±1.6	6.2±2.0	4.2[b]

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l TIML Result n=3	Known Activity	Expected Precision 1s, n=3[a]
QC-W-21	Water	Oct. 1986	Co-60	19.2±2.2	18.5±3.0	8.7
			Cs-134	31.7±5.2	25.6±8.0	8.7
			Cs-137	23.8±1.0	21.6±5.0	8.7
QC-MI-11	Milk	Oct 1986	Sr-89	12.3±1.8	14.3±3.0	8.7
QC-W-20	Water	Nov. 1986	H-3	3855±180	3960±350	520[b]
QC-W-22	Water	Dec. 1986	Gross alpha	9.8±1.4	11.2±4.0	8.7
			Gross beta	21.7±2.0	23.8±5.0	8.7
QC-W-23	Water	Jan. 1987	I-131	29.8±2.5	27.9±3.0	10.4
QC-MI-12	Milk	Jan. 1987	I-131	36.5±1.3	32.6±5.0	10.4
			Cs-137	32.6±4.2	27.4±8.0	8.7
SPM-13	Milk	Jan 1987	Sr-89	10.4±2.1	12.2±4.0	8.7
			Sr-90	14.6±1.6	12.6±3.0	5.2
			I-131	49.5±1.2	54.9±8.0	10.4
			Cs-134	<1.6	0.0	8.7
			Cs-137	33.3±0.6	27.4±8.0	8.7
SPW-24	Water	Mar 1987	Sr-89	24.7±3.6	25.9±5.0	8.7
			Sr-90	23.9±3.8	22.8±8.0	5.2
SPW-25	Water	Apr 1987	I-131	28.0±1.9	29.3±5.0	10.6
SPM-14	Milk	Apr 1987	I-131	25.0±2.2	23.9±5.0	10.4
			Cs-134	<2.1	0.0	8.7
			Cs-137	34.2±2.0	27.2±7.0	8.7
SPW-26	Water	Jun 1987	H-3	3422±100	3362±300	520
			Co-60	24.8±1.4	26.5±7.0	8.7
			Cs-134	<2.0	0.0	8.7
			Cs-137	21.2±0.5	21.6±7.0	8.7
SPW-27	Water	Jun 1987	Gr. alpha	8.5±1.9	10.1±4.0	8.7
			Gr. beta	22.6±1.9	21.2±5.0	8.7
SPW-28	Water	Jun 1987	Gr. alpha	8.7±1.3	10.1±4.0	8.7
			Gr. beta	12.2±5.2	9.4±3.0	8.7

[a] n=3 unless noted otherwise.
[b] n=2.
[c] n=1.

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l Results (4.66σ)	Concentration in pCi/l Acceptance Criteria (4.66σ)
BL-1	D.I. Water	Nov. 1985	Gross alpha	<0.1	<1
			Gross beta	<0.4	<4
BL-2	D.I. Water	Nov. 1985	Cs-137 (gamma)	<1.9	<10
BL-3	D.I. Water	Nov. 1985	Sr-89	<0.5	<5
			Sr-90	<0.6	<1
BL-5	D.I. Water	Nov. 1985	Ra-226	<0.4	<1
			Ra-228	<0.4	<1
SPW-2265	D.I. Water	Apr. 1985	Gross alpha	<0.6	<1
			Gross beta	<2.2	<4
			Sr-89	<0.2	<5
			Sr-90	<0.4	<1
			I-131	<0.2	<1
			Cs-137 (gamma)	<7.4	<10
BL-6	D.I. Water	Apr. 1986	Gross alpha	<0.4	<1
BL-7	D.I. Water	Apr. 1986	Gross alpha	<0.4	<1
BL-8	D.I. Water	June 1986	Gross alpha	<0.4	<1
BL-9	D.I. Water	June 1986	Gross alpha	<0.3	<1
SPS-3292	Milk	Jan 1987	I-131	<0.1	<1
			Cs-134	<6.2	<10
			Cs-137	<6.4	<10
SPW-3554	D.I. Water	Feb 1987	H-3	<180	<300
			Gross beta	<2.6	<4
SPS-3555	Milk	Feb 1987	Sr-89	<0.6	<5
			Sr-90	1.9±0.4[a]	<1
SPS-3731	Milk	Mar 1987	Cs-134	<2.2	<10
			Cs-137	<2.5	<10

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l Results (4.66σ)	Concentration in pCi/l Acceptance Criteria (4.66σ)
SPS-3732	D.I. Water	Mar. 1987	Sr-89	<0.9	<5
			Sr-90	<0.8	<1
			I-131	<0.3	<1
			Co-60	<2.3	<10
			Cs-134(G)	<2.2	<10
			Cs-137(G)	<2.4	<10
			Ra-226	<0.1	<1
			Ra-228	<1.0	<1
			Np-237	<0.04	<1
			Th-230	<0.05	<0.1
			Th-232	<0.02	<0.1
			U-234	<0.05	<0.1
			U-235	<0.03	<0.1
			U-238	<0.03	<0.1
SPS-4023	Milk	May 1987	I-131	<0.1	<1
SPS-4203	D.I. Water	May 1987	Gross alpha	<0.7	<1
			Gross beta	<1.7	<4
SPS-4204	Milk	May 1987	Sr-89	<0.5	<5
			Sr-90	2.4±0.6[a]	<1
SPS-4390	Milk	June 1987	Cs-134	<4.7	<10
			Cs-137	<5.2	<10
SPS-4391	D.I. Water	June 1987	Sr-89	<0.4	<5
			Sr-90	<0.4	<1
			I-121	<0.1	<1
			Co-60	<3.8	<10
			Cs-137	<5.7	<10
			Ra-226	<0.1	<1
			Ra-228	<0.9	<1

[a] Low level (1 - 4 pCi/l) of Sr-90 concentration in milk 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 >100 pCi/liter or kg	5 pCi/liter 5% of known value
Strontium-89[b]	5 to 50 pCi/liter or kg >50 pCi/liter or kg	5 pCi/liter 10% of known value
Strontium-90[b]	2 to 30 pCi/liter or kg >30 pCi/liter of kg	3.0 pCi/liter 10% of known value
Potassium	>0.1 g/liter or kg	5% of known value
Gross Alpha	<20 pCi/liter >20 pCi/liter	5 pCi/liter 25% of known value
Gross Beta	<100 pCi/liter >100 pCi/liter	5 pCi/liter 5% of known value
Tritium	<4,000 pCi/liter >4,000 pCi/liter	ls = (pCi/liter) = 169.85 x (known).0933 10% of known value
Radium-226, Radium-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 >55 pCi/liter	6 pCi/liter 10% of known value
Uranium-238, Nickel-63[b], Technetium-99[b]	<35 pCi/liter >35 pCi/liter	6 pCi/liter 15% of known value
Iron-55[b]	50 to 100 pCi/liter	10 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.

Appendix B

Data Reporting Conventions

Data Reporting Conventions

1.0. All activities are decay corrected to collection time.

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

3.0. Duplicate Analyses

3.1. Individual results: $x_1 \pm s_1$
$x_2 \pm s_2$

Reported result: $x \pm s$

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

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

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.

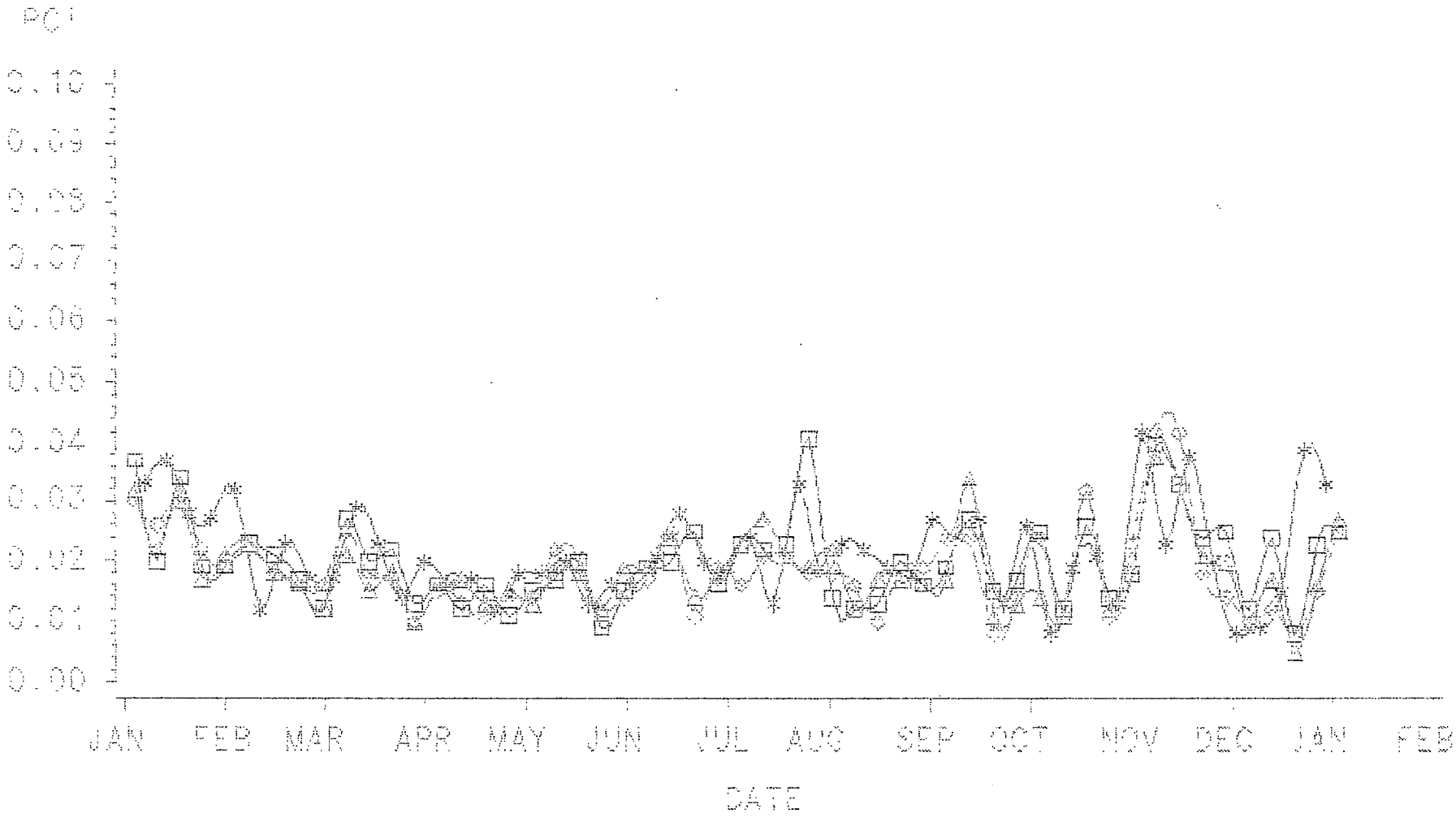
4.5.3. If the figure following those to be retained is 5, and if there are no figures other than zeros beyond the five, the figure 5 is dropped, and the last-place figure retained is increased by one if it is an odd number or it is kept unchanged if an even number. As an example, 11.435 is rounded off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

1987 PALISADES AIR PARTICULATE

04/28/88

DOWAGIAC-CONTROL VS SHERMAN DAIRY R.BUS. F.RUDE

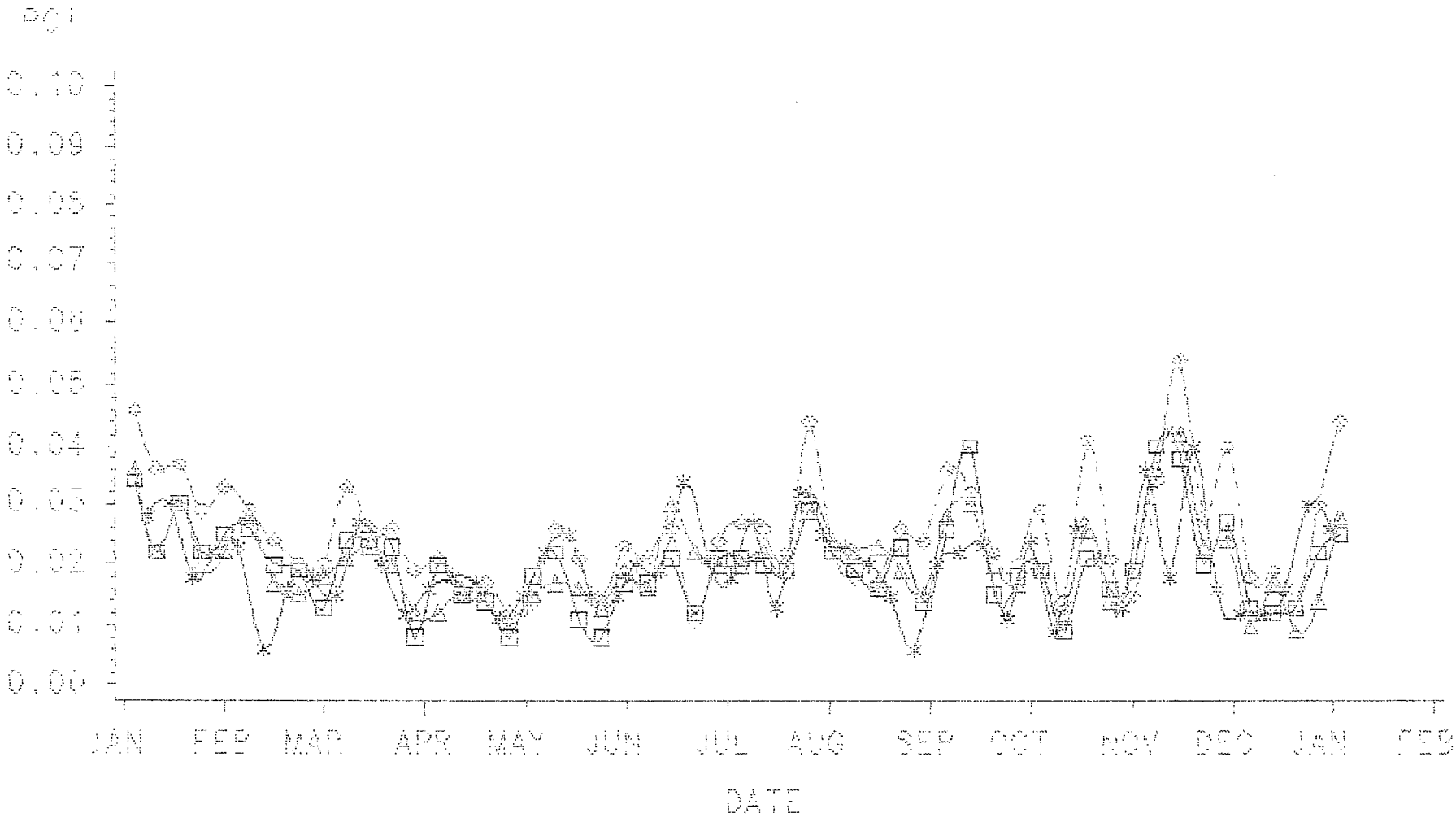
WEEKLY GROSS BETA PCI/CUBIC METER



1987 PALISADES AIR PARTICULATE

GRAND RAPIDS-ONTARIO VS TOWER HILL, H.SODERBERG, J.SARNO

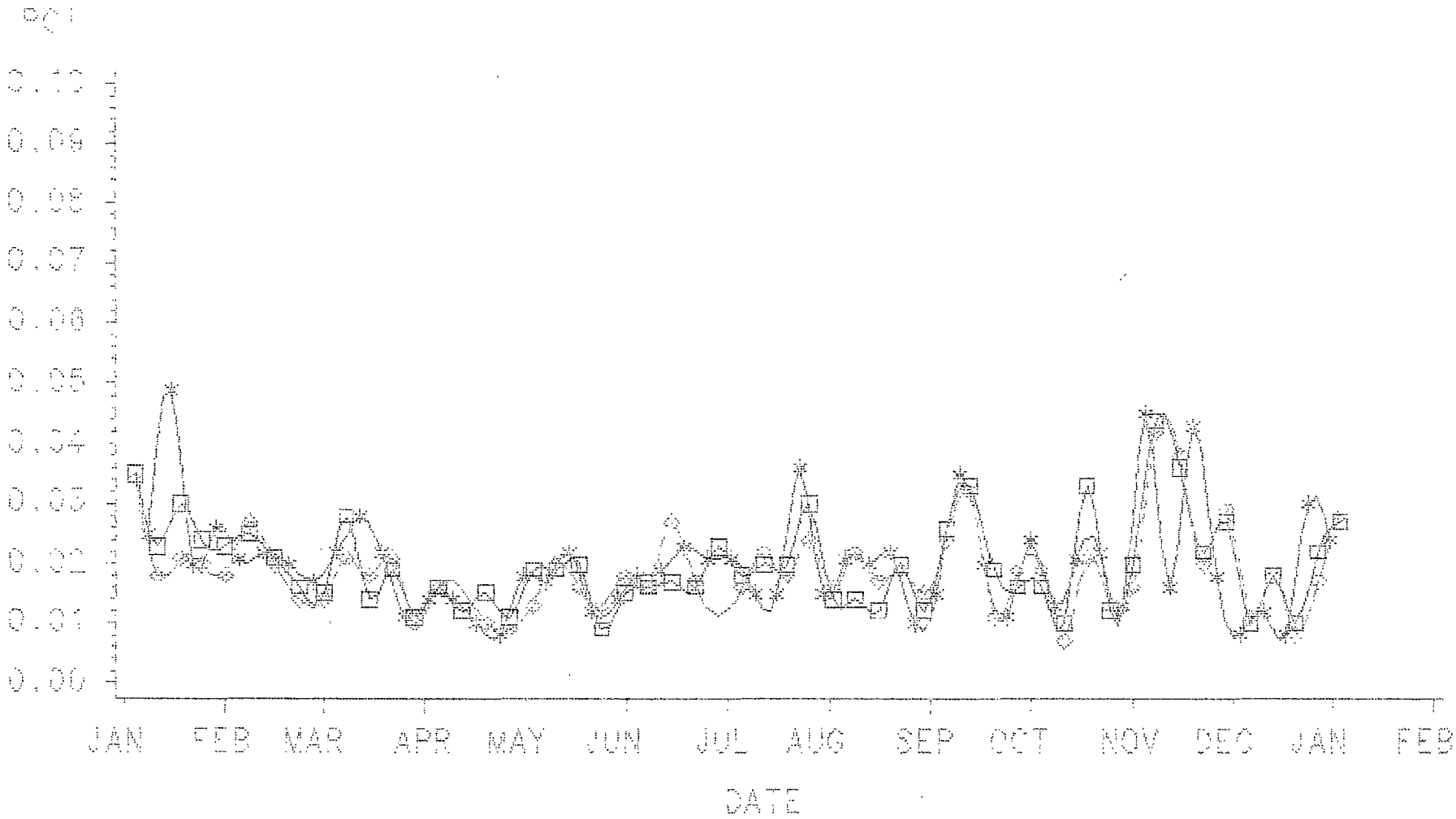
WEEKLY GROSS BETA PCI/CUBIC METER



1987 PALISADES AIR PARTICULATE

04/26/88

KALAMAZOO-CONTROL VS TOWNSHIP PARK, STATE PARK
WEEKLY GROSS BETA PCI/CUBIC METER

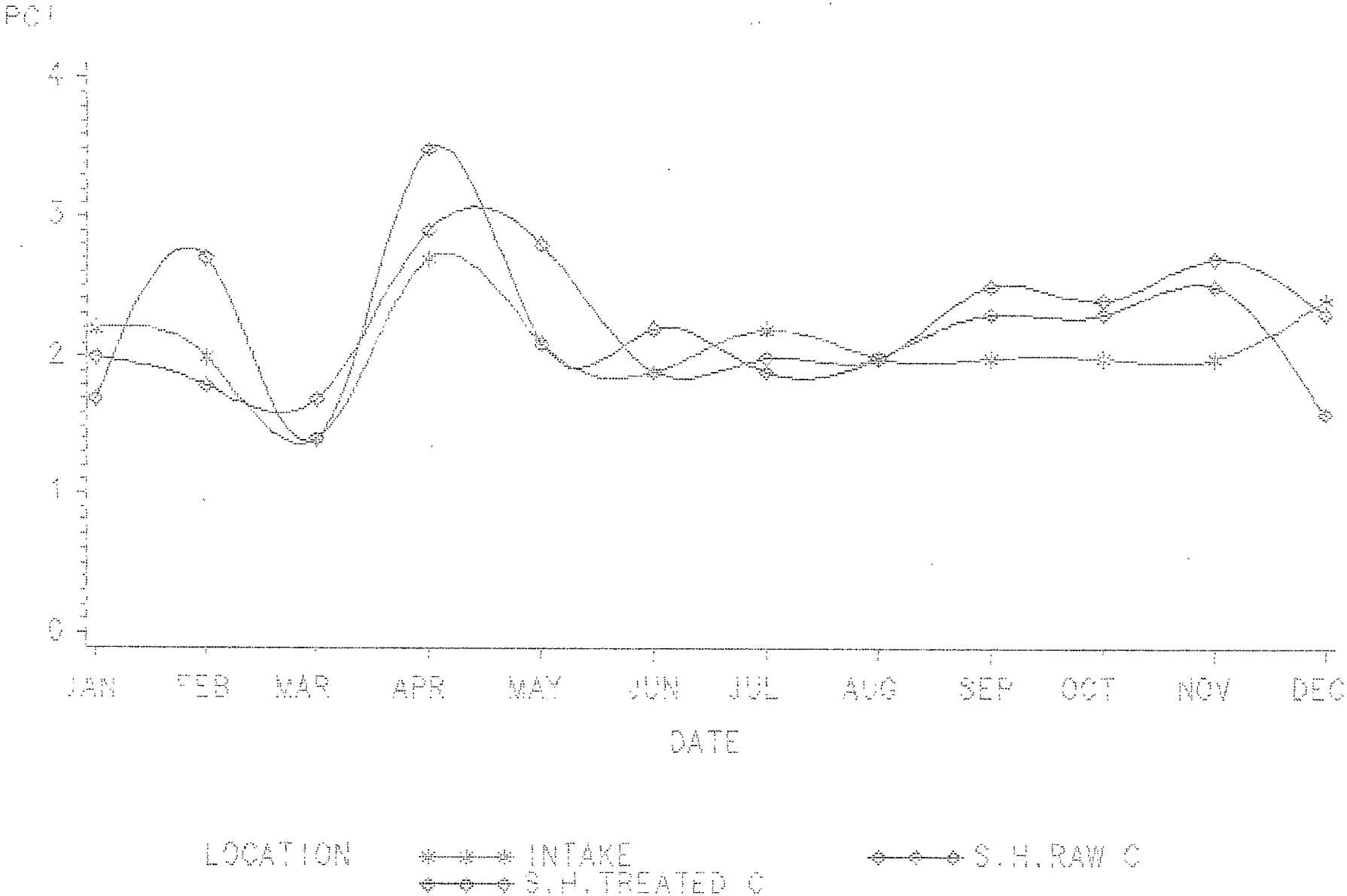


Palisades Air Particulate
Gross Beta
Pre-Operational vs. Operational

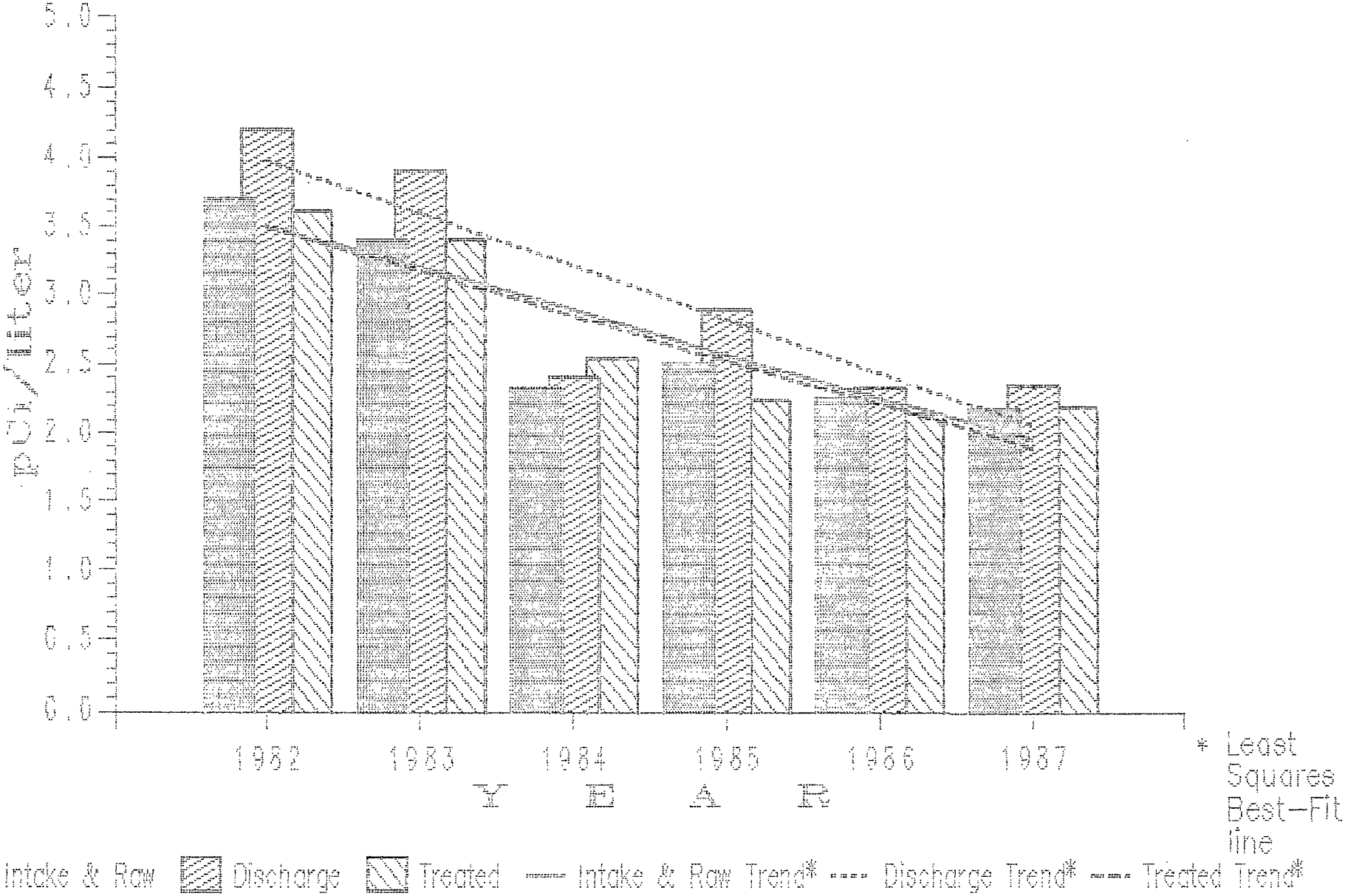
1987 PALISADES LAKE WATER SAMPLES

04/26/88

SOUTH HAVEN TREATED & RAW-CONTROL VS INTAKE
BETA PCI/L

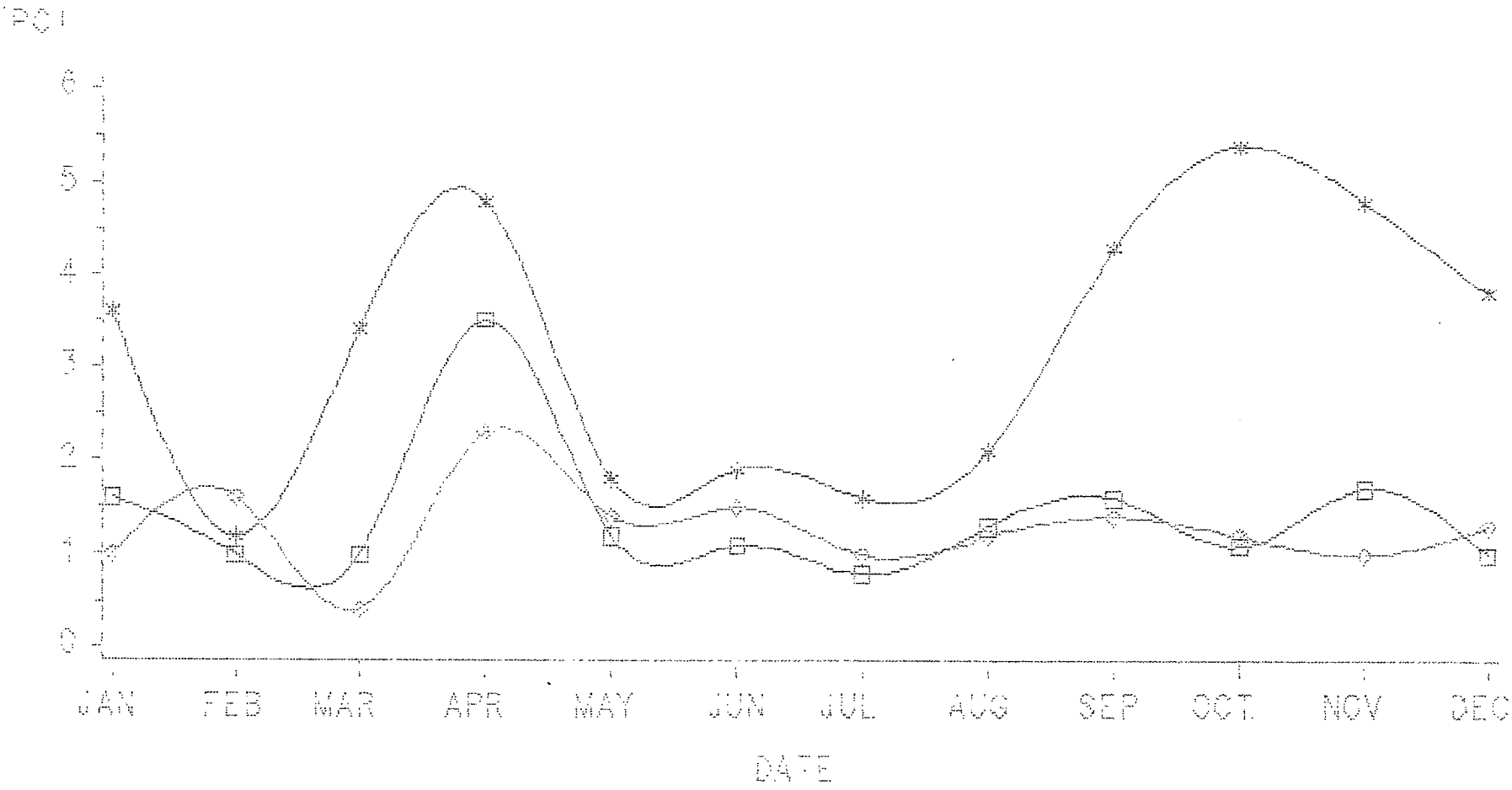


Palisades Lake Water Gross Beta
1982 - 1987

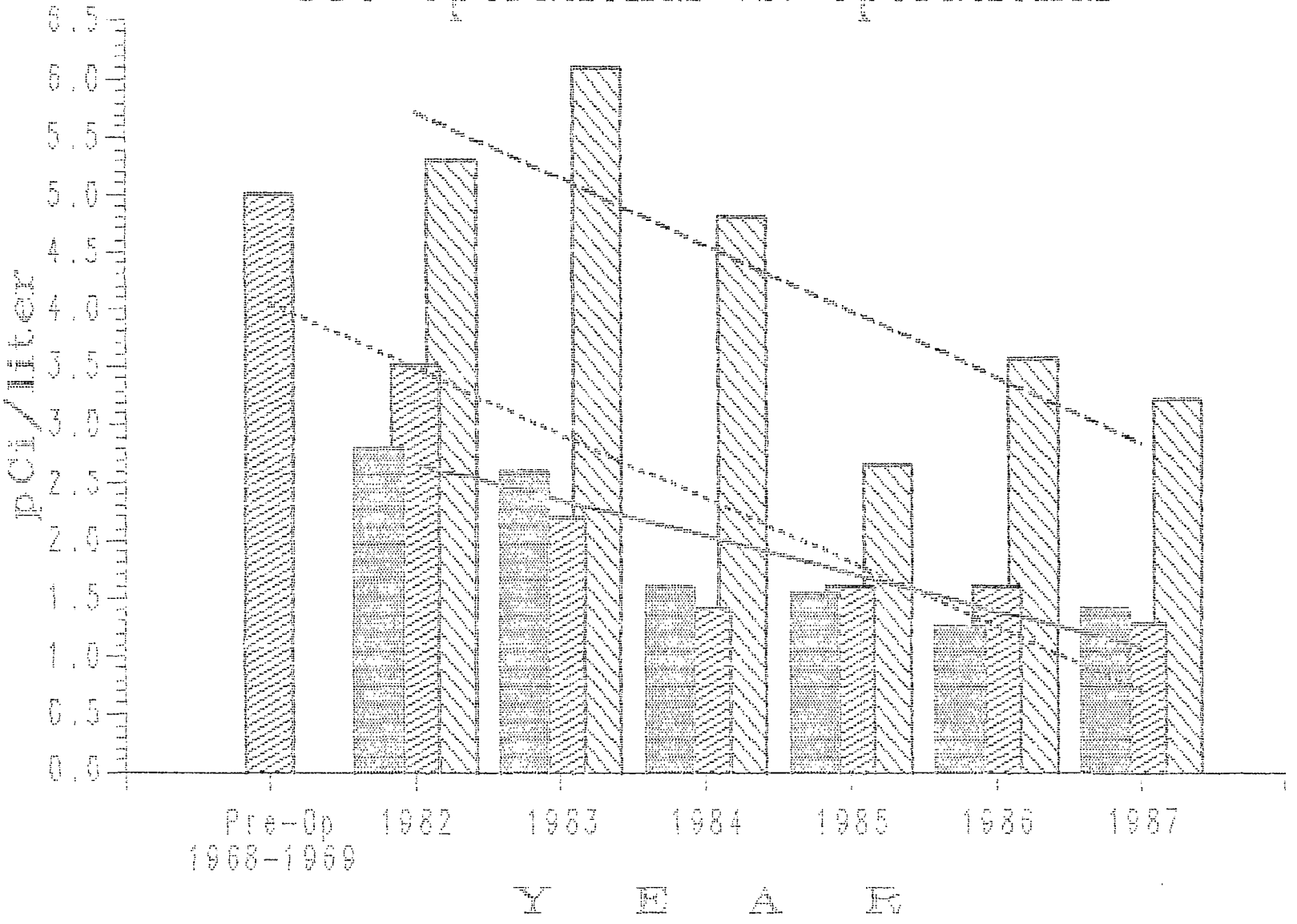


1987 PALISADES REAL WATER SAMPLES

TOWNSHIP PARK & STATE PARK-CONTROL VS SITE
GROSS BETA PCI/L



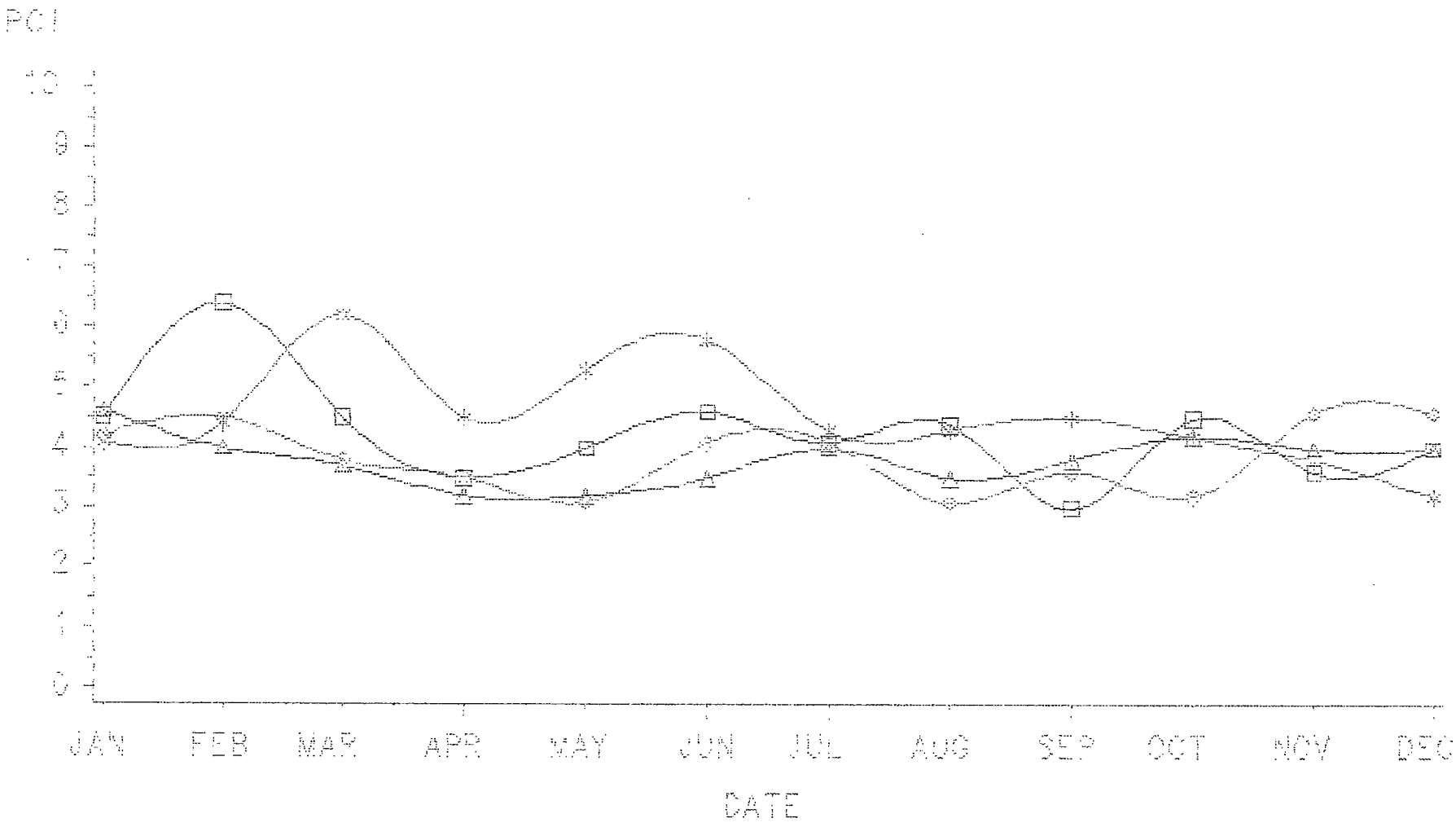
Palisades Well Water Gross Beta
Pre-Operational vs. Operational



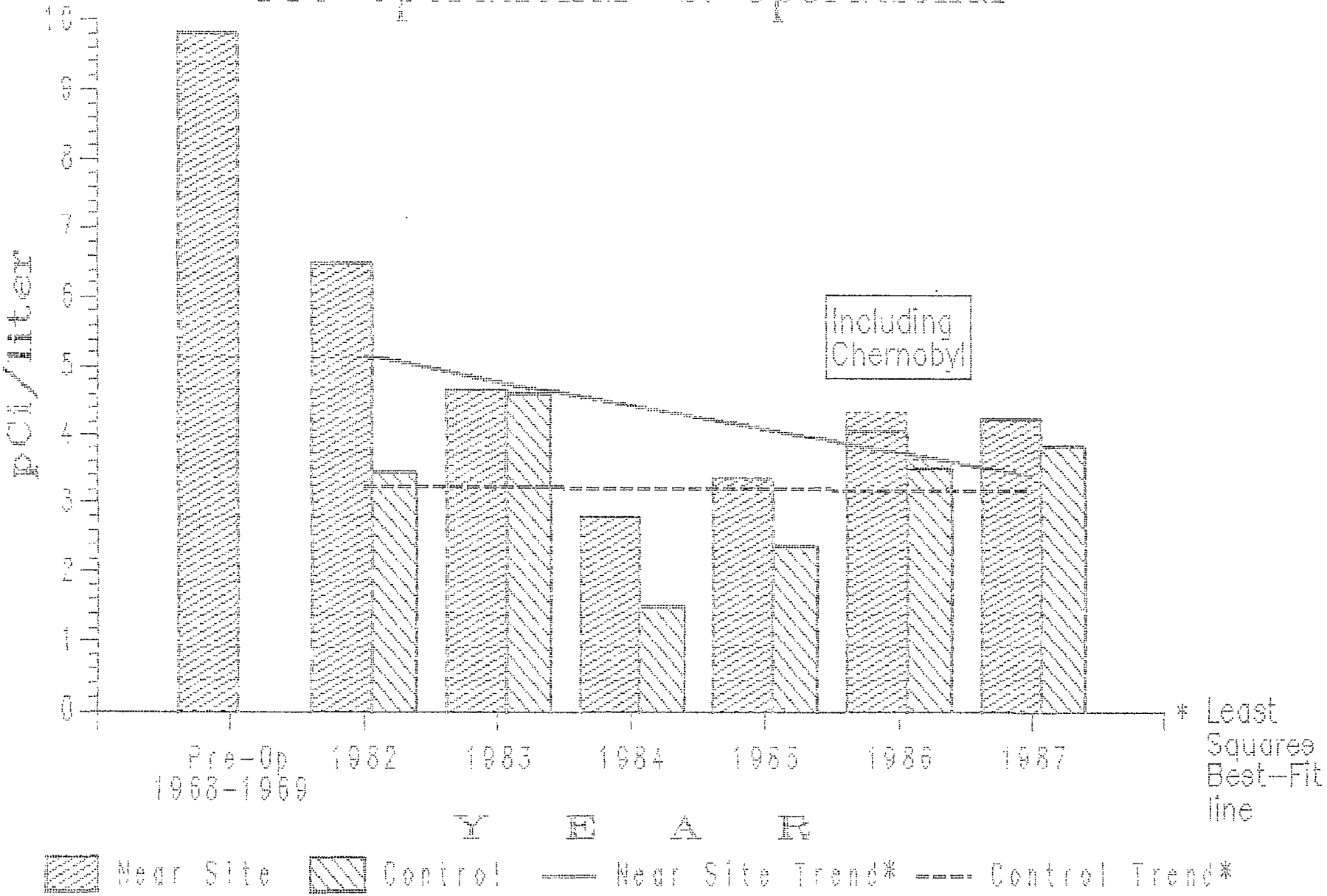
1987 PALISADES MILK SAMPLES

SHINE-CONTROL VS HUSSEY CRNKOVICH KEMP

SR-90 PCI/L

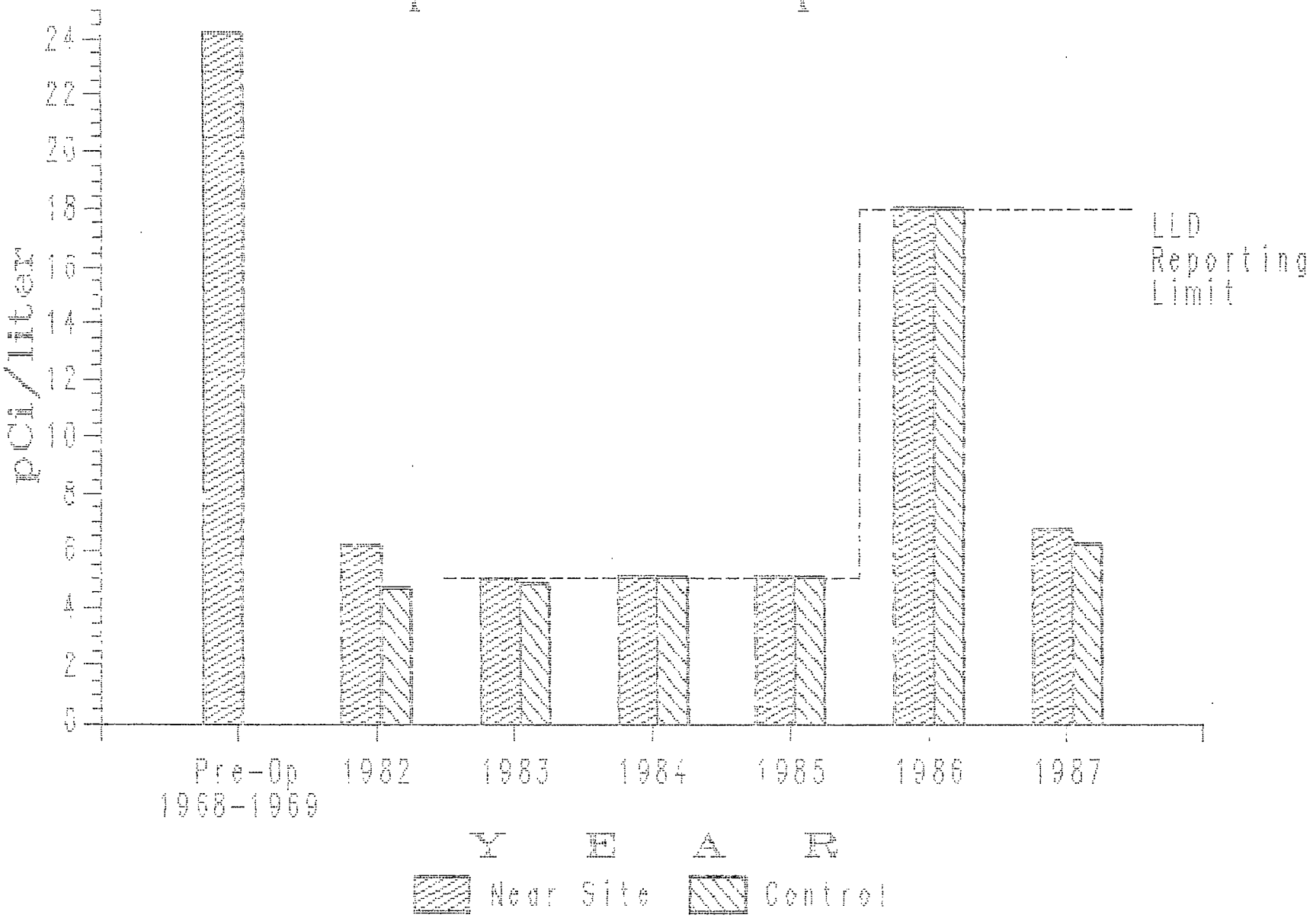


Palisades Milk Sr-90
Pre-Operational vs. Operational



Palisades Milk Cs-137

Pre-Operational vs. Operational

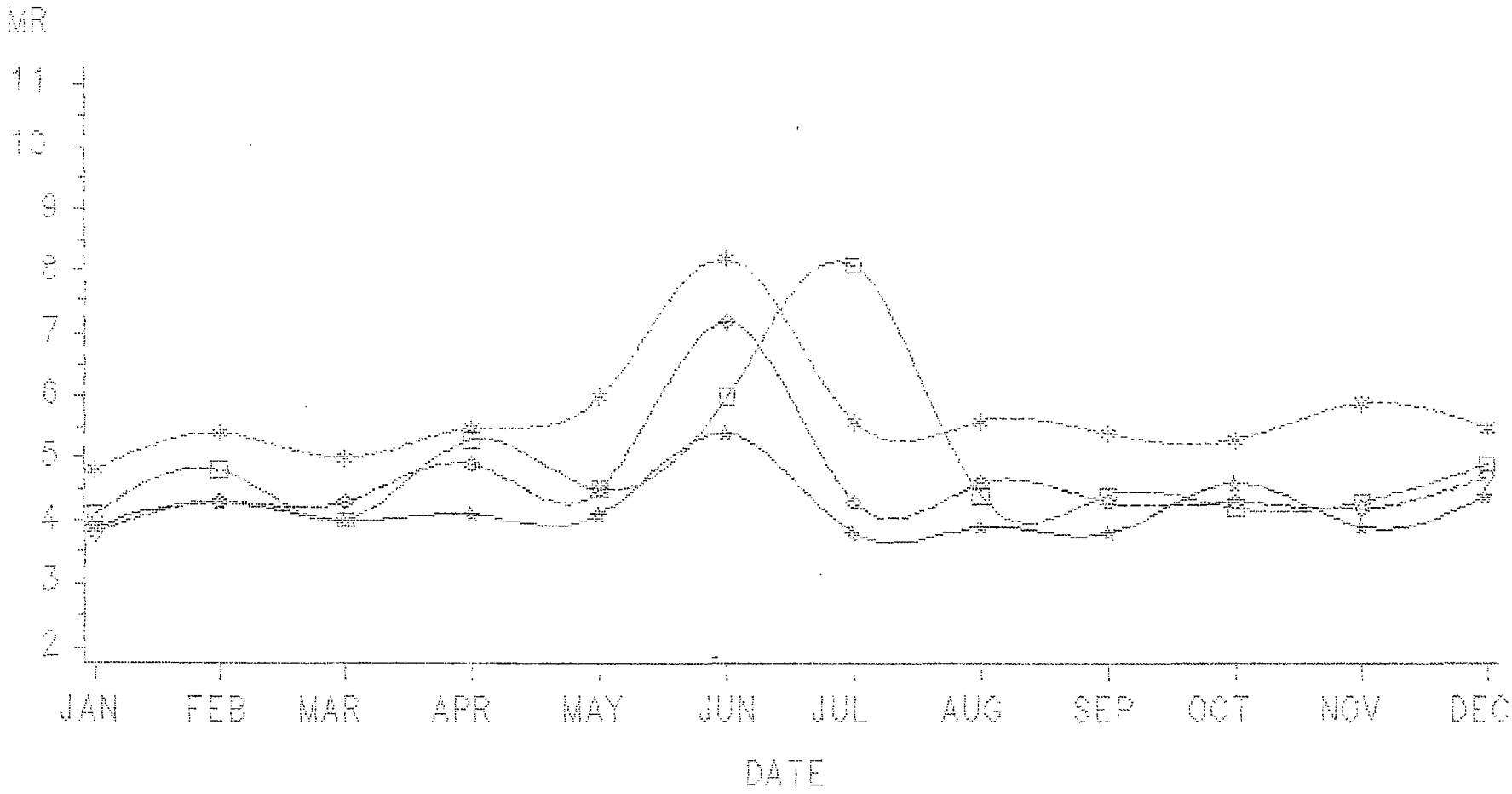


1987 PALISADES TLD

/26/88

ST10 CONTROL VS ST06 ST07A ST08

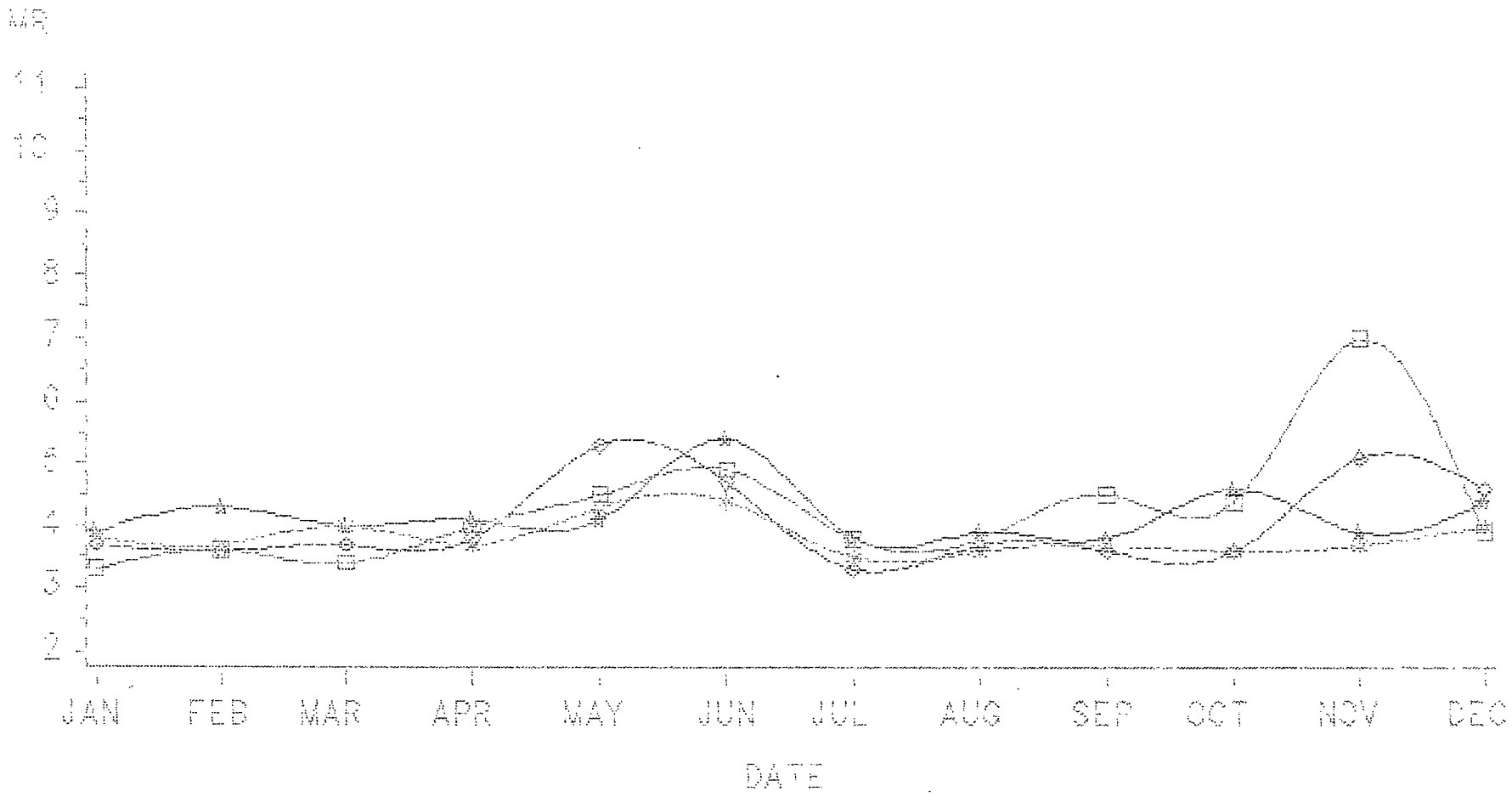
MILLIREM



1987 PALISADES TLD

ST10 CONTROL VS ST13 ST14 ST15

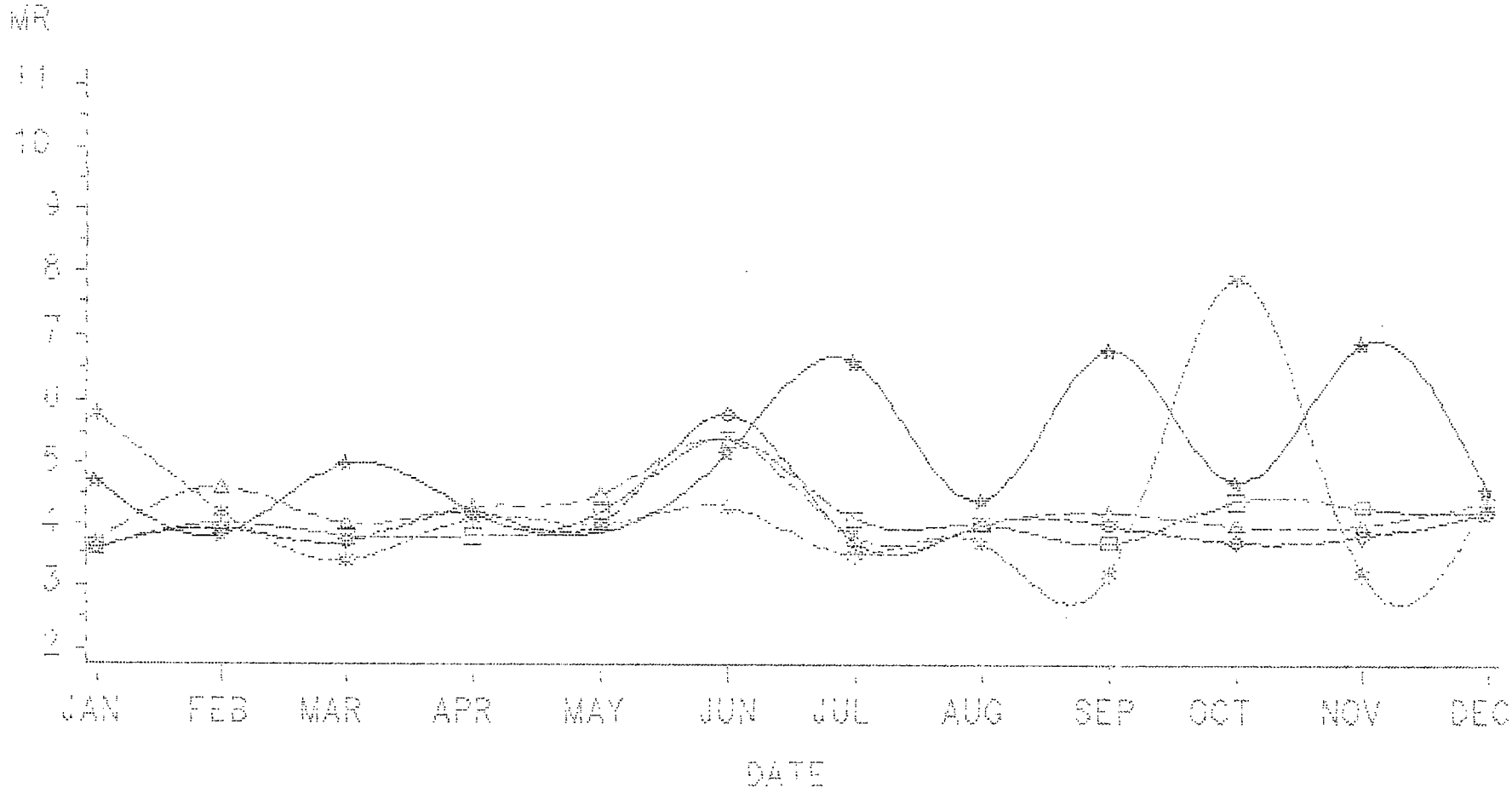
MILLIREM



1987 PALISADES TLD

ST1: CONTROL 75 ST01 ST10 ST17 ST18

MILLIREM



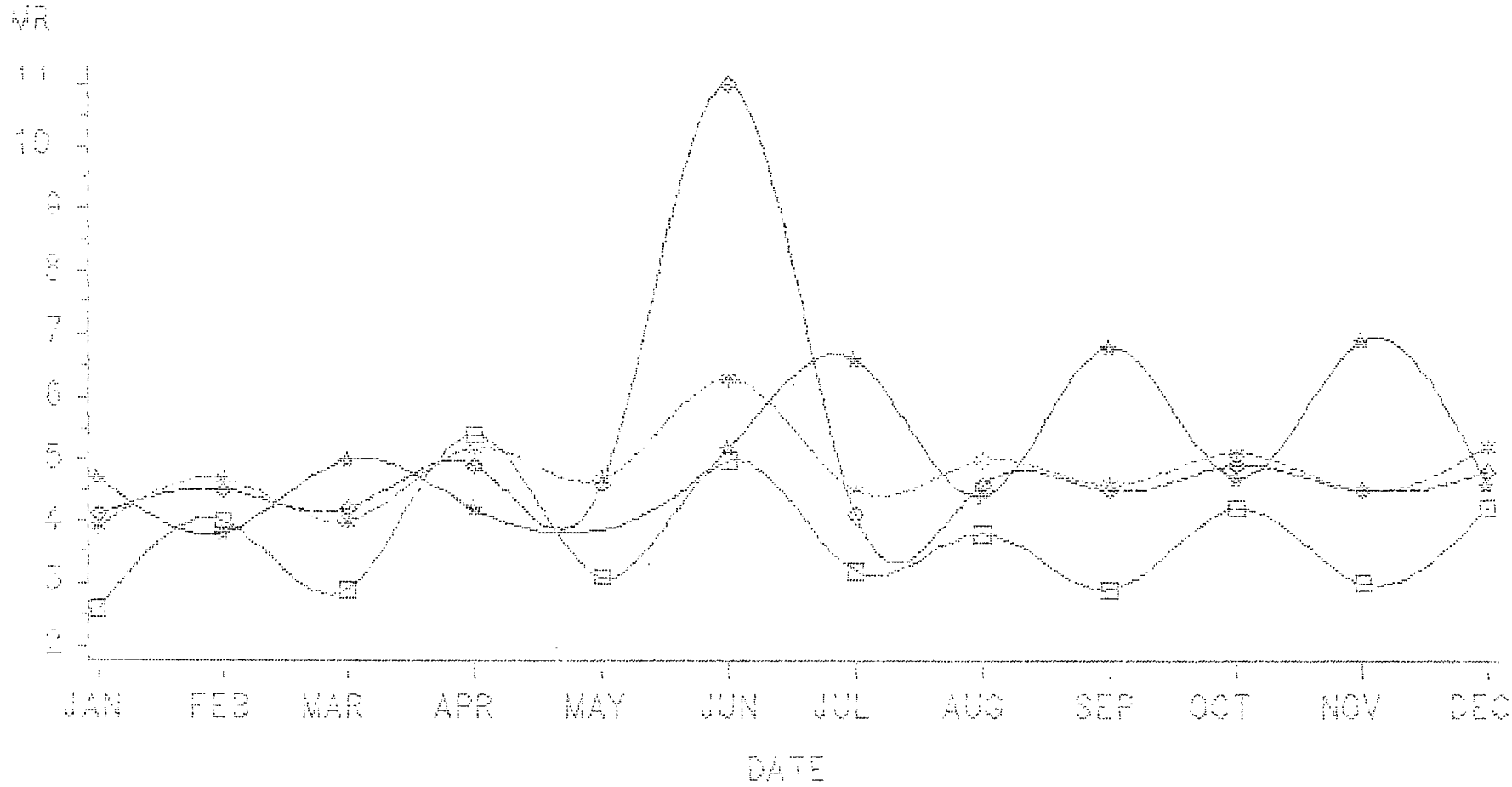
LOCATION

- ST01 0.3 ESE
- ST10 1.5 E
- ST18 1 SE
- ST11C 35 E
- ST17 1 ESE

1987 PALISADES TLD

ST11 CONTROL VS ST06 ST23 ST24

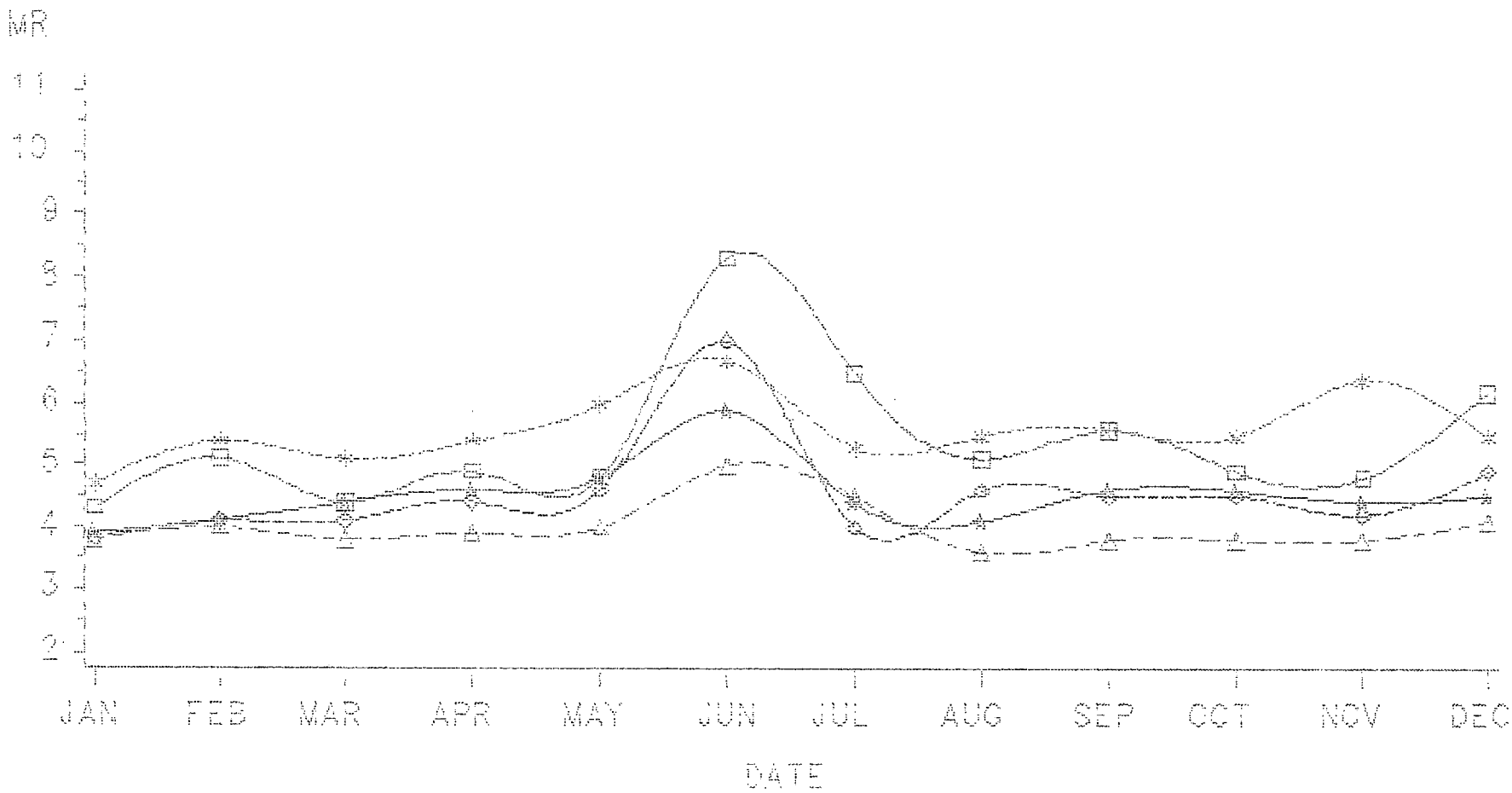
MILLIREM



1987 PALISADES TLD

ST12 CONTROL VS ST02 ST03 ST04 ST09

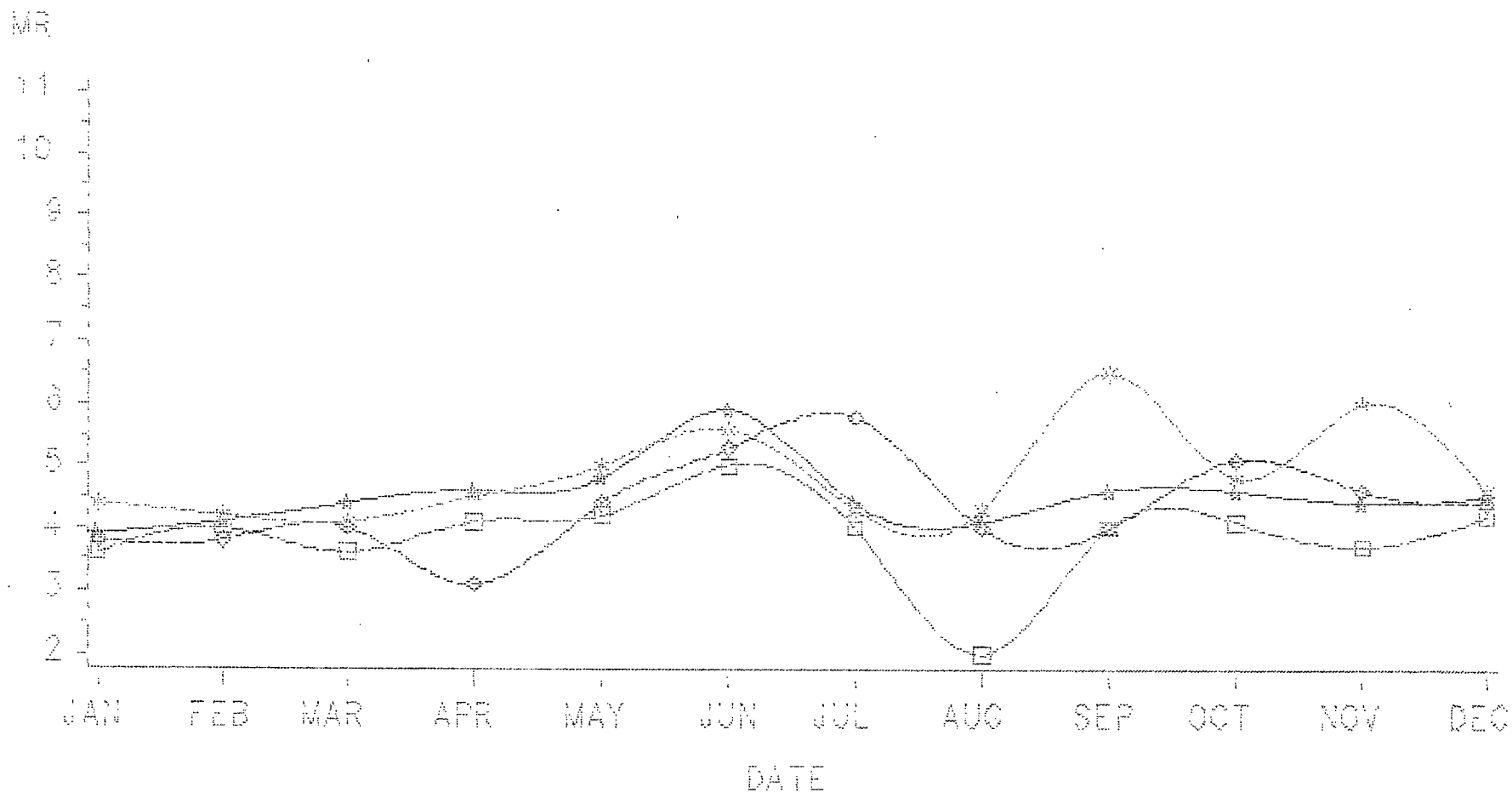
MILLIREM



1987 PALISADES TLD

ST12 CONTROL VS ST19 ST20 ST21

MILLIREM



LOCATION

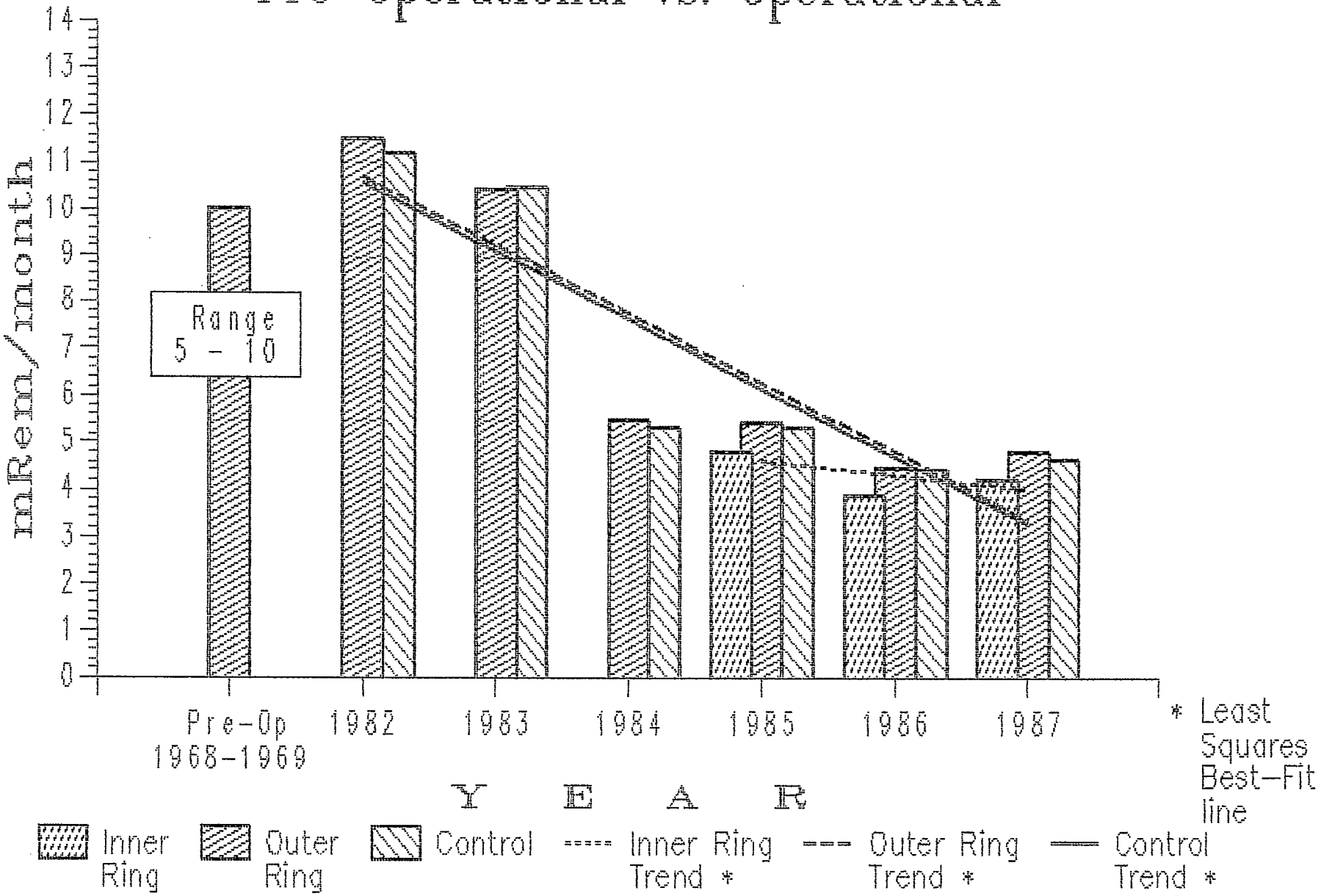
ST12C 30 SSE

ST19 0.7 SSE

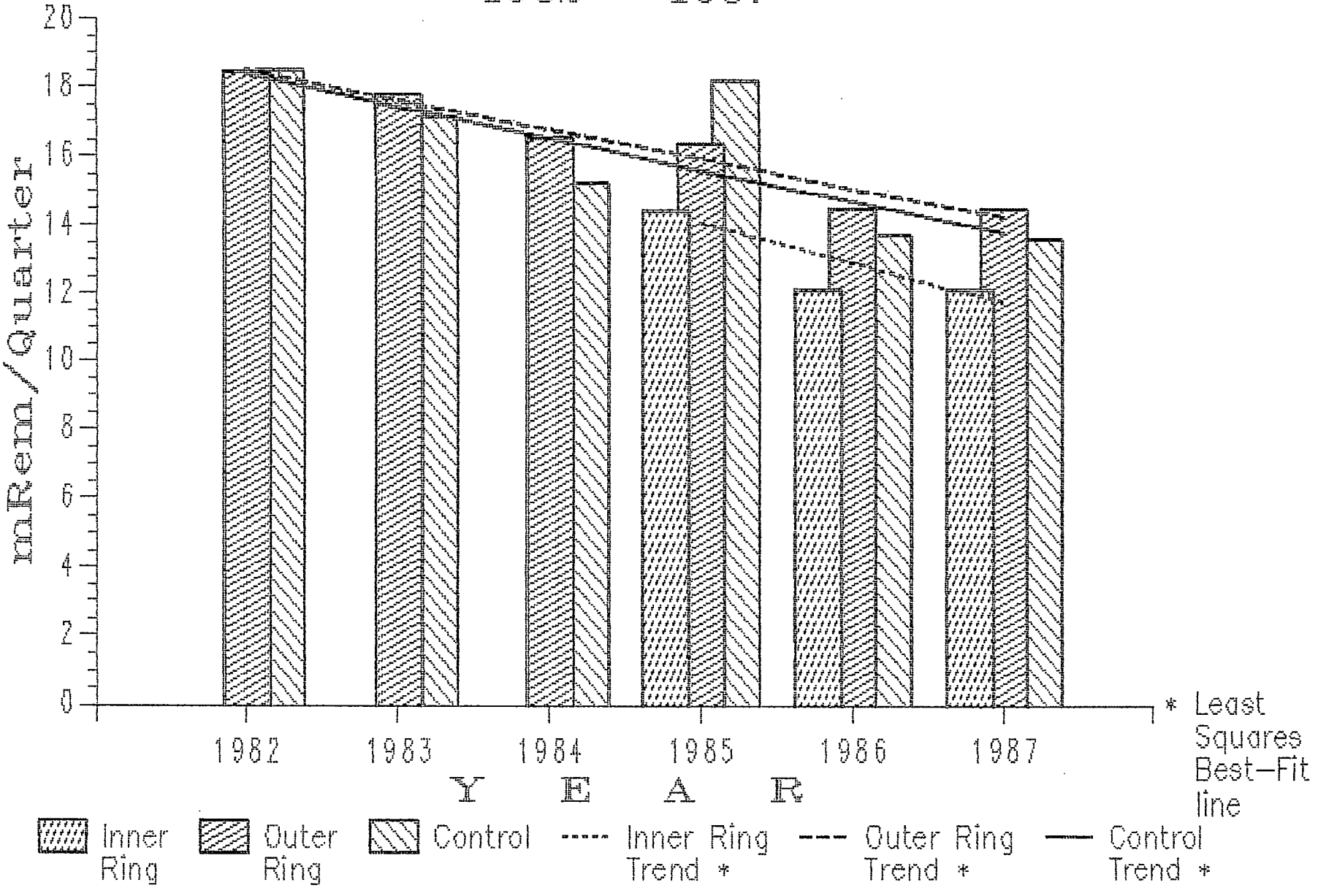
ST20 0.7 S

ST21 0.6 SSW

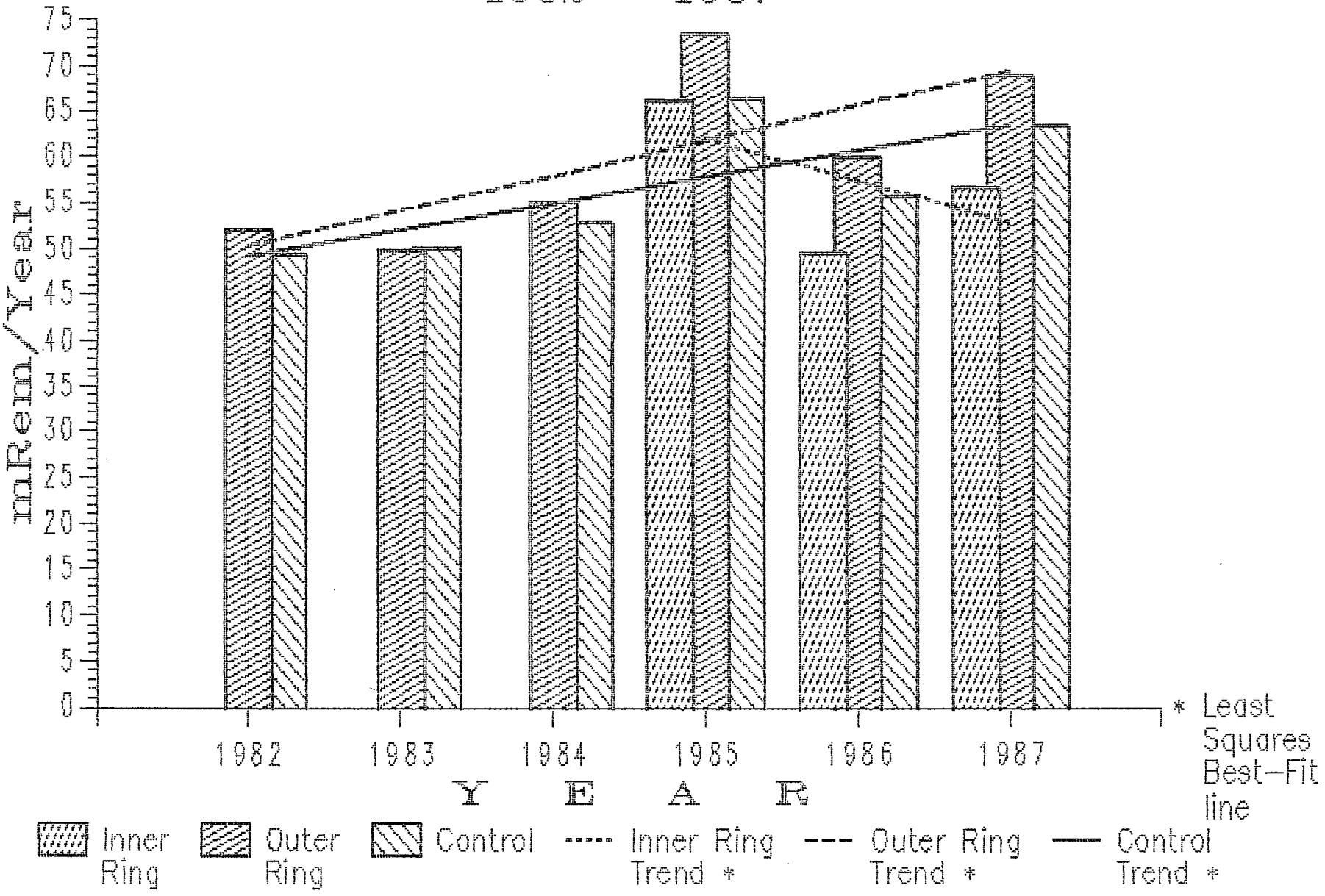
Palisades Monthly Thermoluminescent Dosimeters
Pre-Operational vs. Operational



Palisades Quarterly Thermoluminescent Dosimeters
1982 - 1987

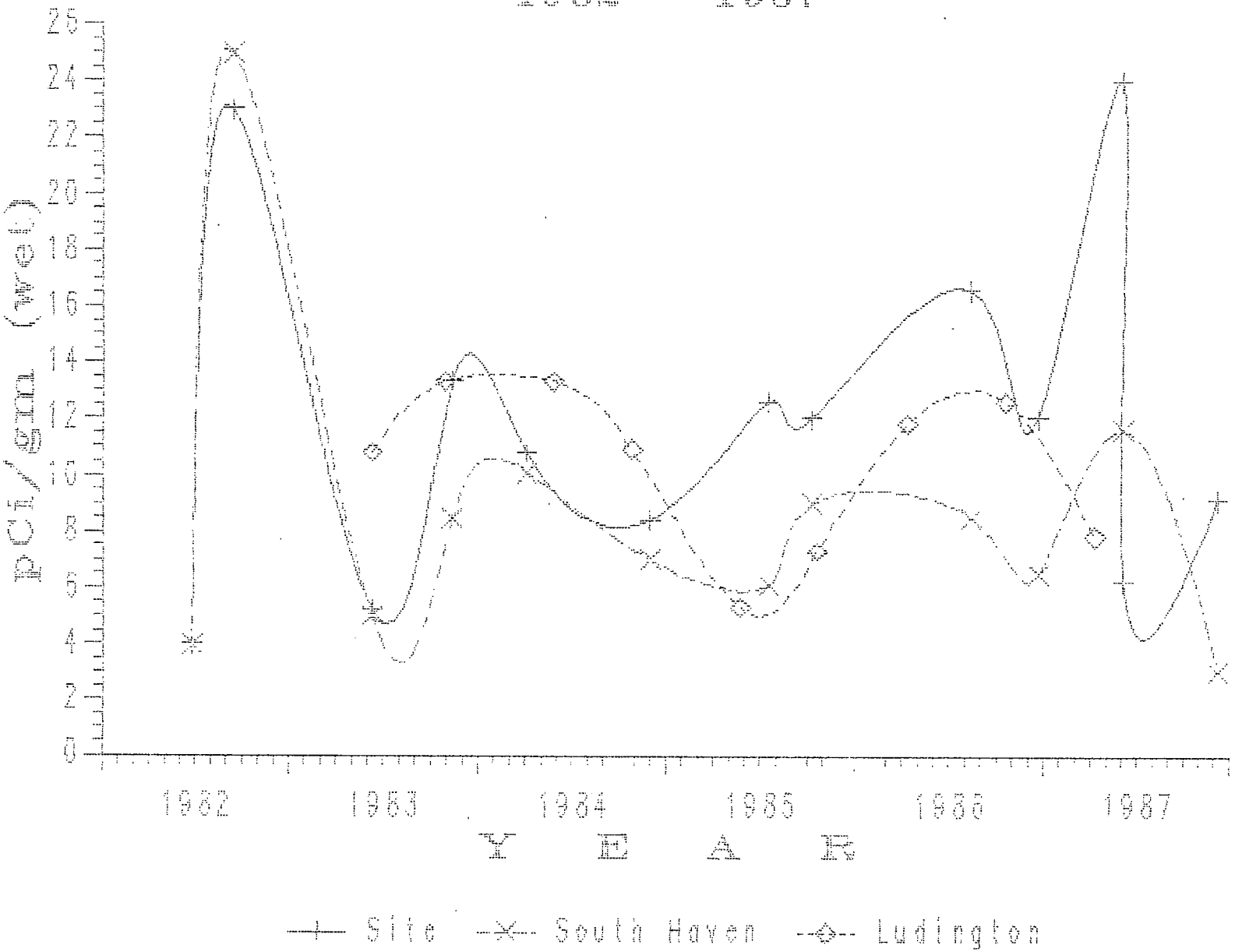


Palisades Annual Thermoluminescent Dosimeters
1982 - 1987

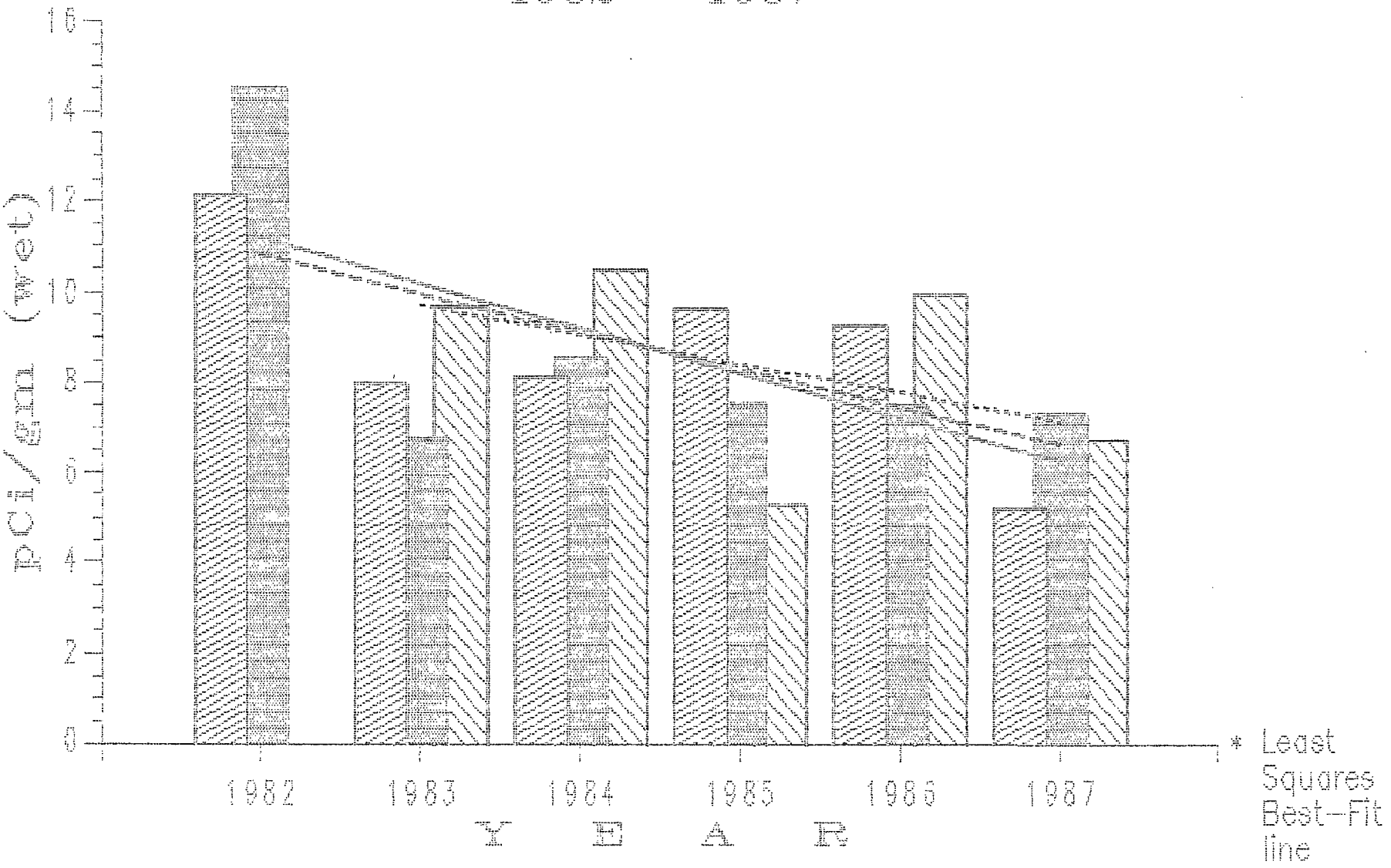


Palisades Sediments Gross Beta

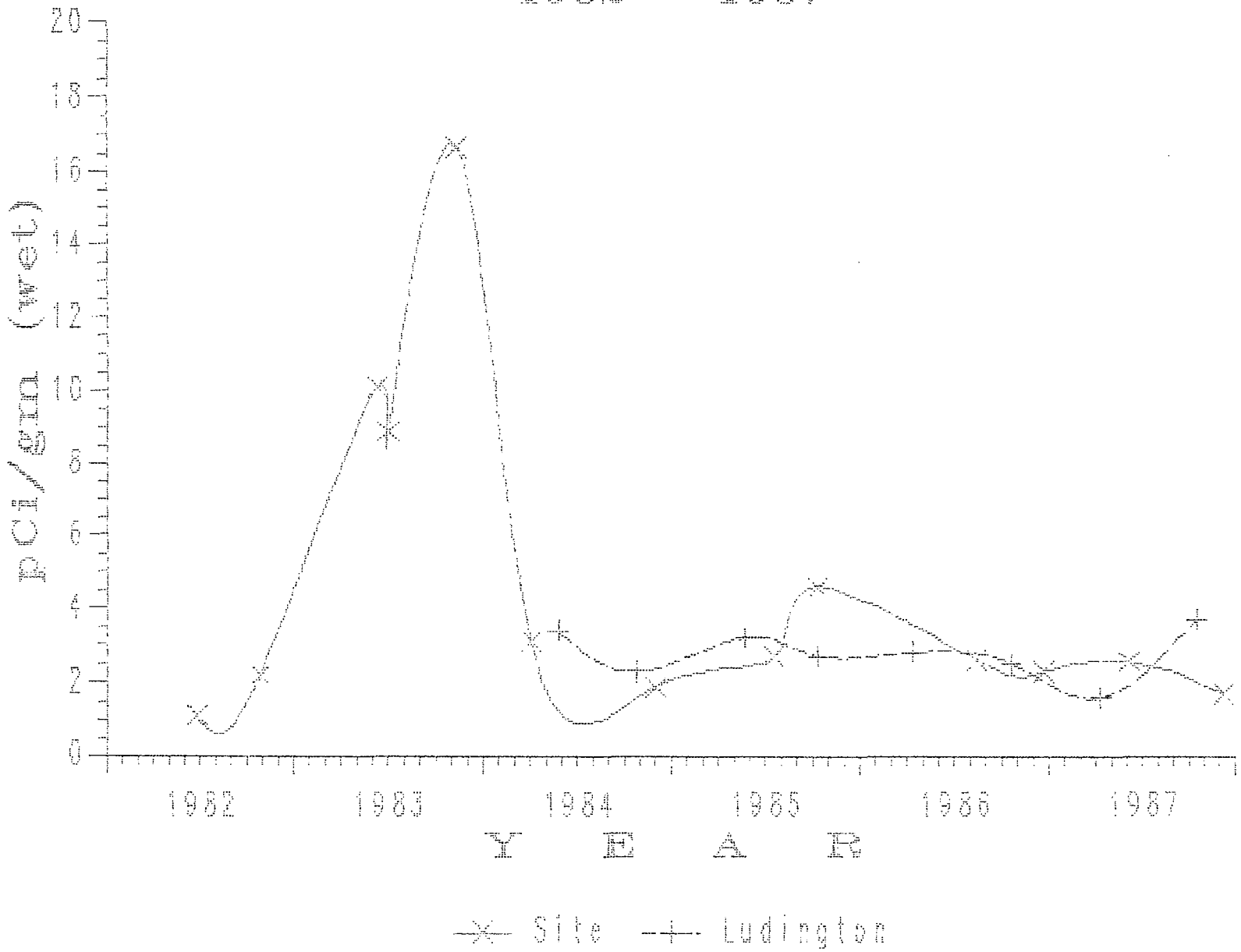
1982 - 1987



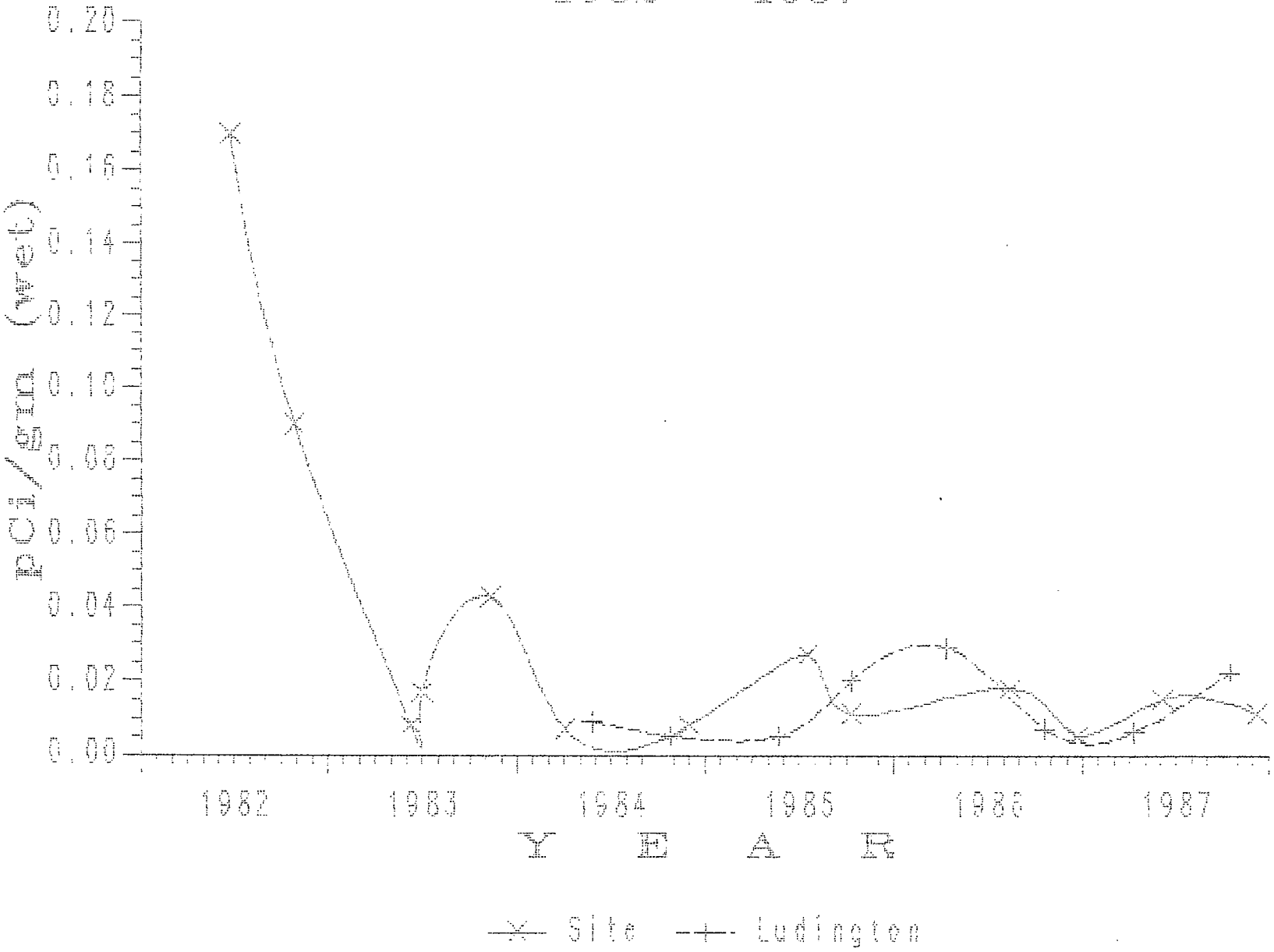
Palisades Sediments Gross Beta
1982 - 1987



Palisades Fish Gross Beta
1982 - 1987

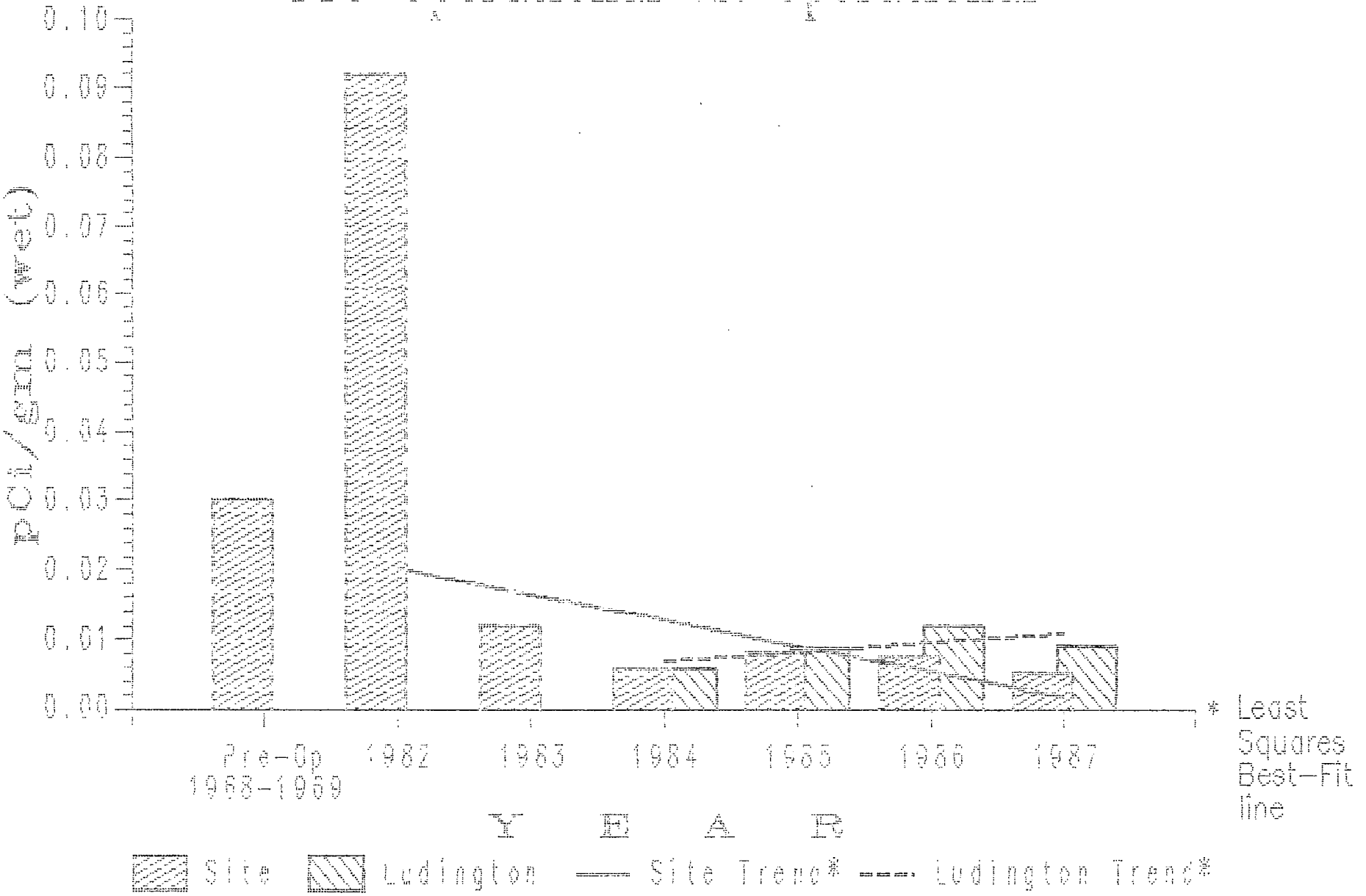


Palisades Fish Sr-90
1982 - 1987



Palisades Fish Gross Beta
1982 - 1987

Palisades Fish Sr-90
Pre-Operational vs. Operational



Palisades Fish Cs-137
Pre-Operational vs. Operational