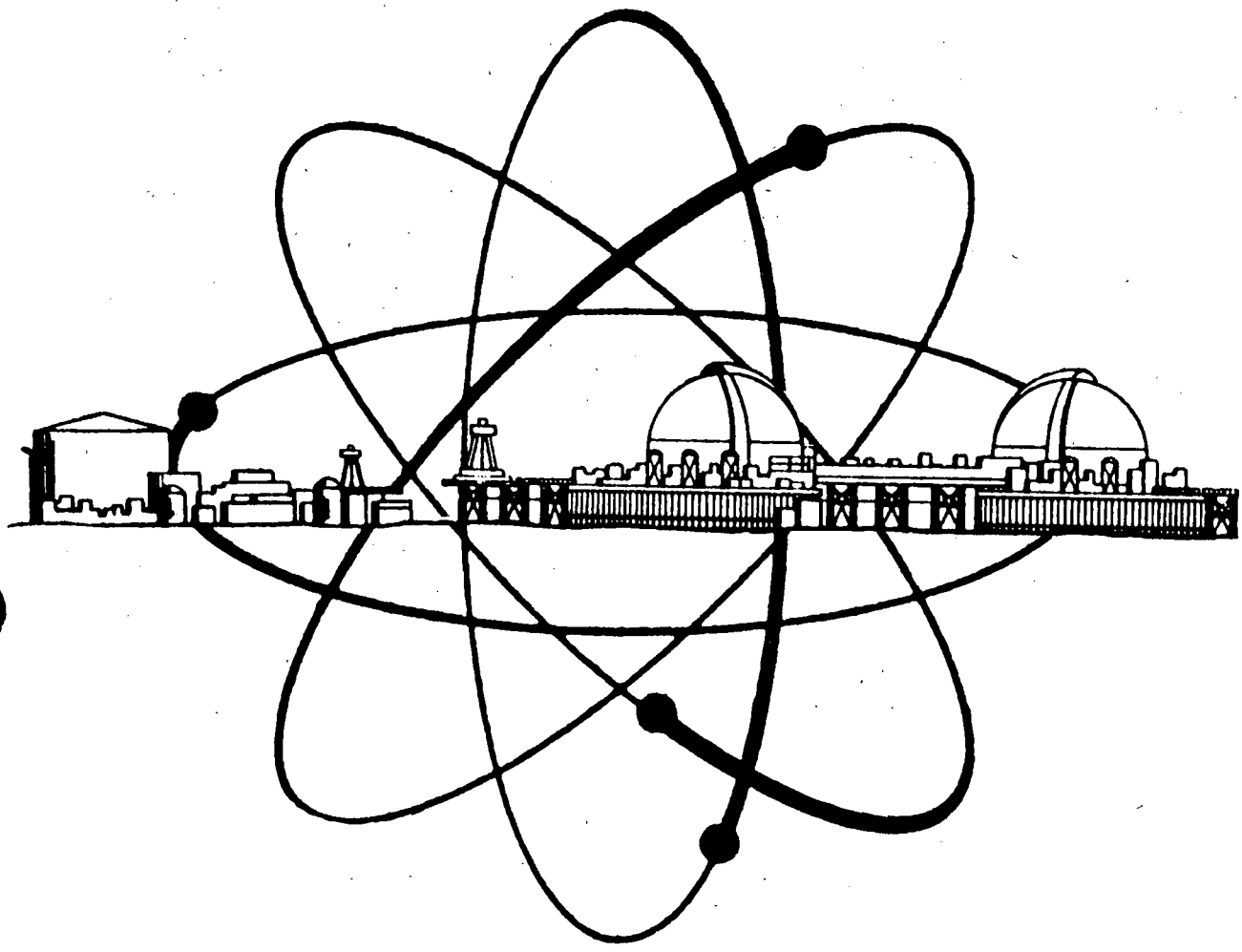
ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT FOR 1993 SAN ONOFRE NUCLEAR GENERATING STATION UNITS 1, 2, & 3

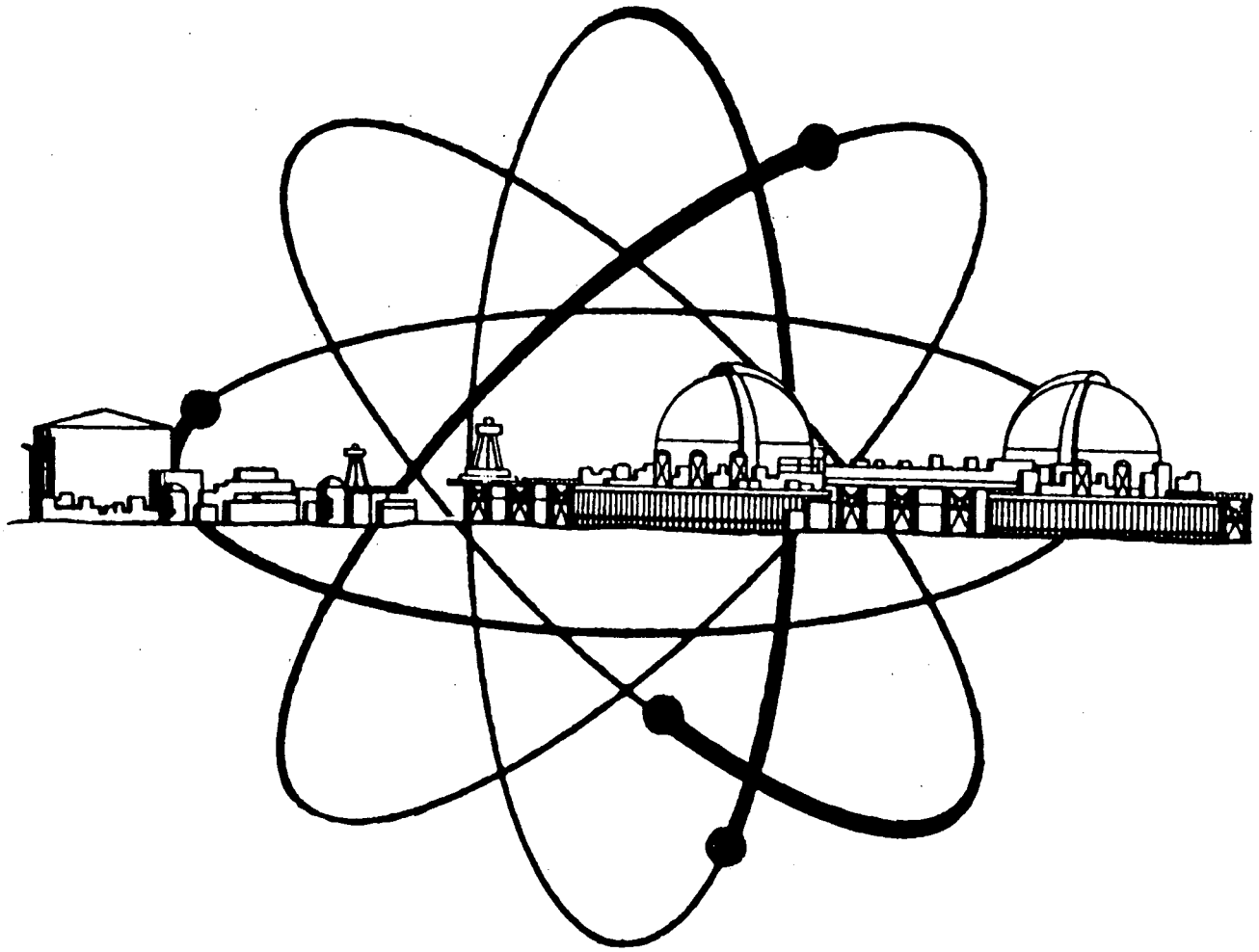


Southern California Edison Company
San Diego Gas and Electric Company

Docket Nos. 50-206, 50-361, 50-362
License Nos. DPR-13, NPF-10, NPF-15

April 30, 1994

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT FOR 1993 SAN ONOFRE NUCLEAR GENERATING STATION UNITS 1, 2, & 3



Southern California Edison Company
San Diego Gas and Electric Company

Docket Nos. 50-206, 50-361, 50-362
License Nos. DPR-13, NPF-10, NPF-15

April 30, 1994

RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT

SAN ONOFRE NUCLEAR GENERATING STATION UNITS 1, 2 AND 3

SOUTHERN CALIFORNIA EDISON COMPANY
SAN DIEGO GAS AND ELECTRIC COMPANY

Prepared by: M. GOEDERS, Ph.D. M. Goeders 04/20/94

Approved by: E. M. GOLDIN, Ph.D. E. M. Goldin 4/25/94

April 30, 1994

TABLE OF CONTENTS

	Page
TABLE OF CONTENTS	i
LIST OF TABLES	ii
LIST OF TABLES OF APPENDIX B	iv
LIST OF FIGURES	vi
I. INTRODUCTION	1
A. The Program	1
B. Objectives	1
C. Sample Collection	2
D. Sources of Radioactivity	3
E. Exposure Pathway	3
F. Regulatory Limits, Guidance and Requirements	4
G. Quality Assurance Program	6
H. Sample Analysis	6
I. Data Management System Using SAS	8
II. RESULTS AND DISCUSSIONS OF 1993 ENVIRONMENTAL DATA	8
A. Direct Radiation	8
B. Airborne Particulate Analysis	13
C. Radioiodine in Air	14
D	18
E. Drinking Water	18
F. Shoreline Sediment (Sand)	20
G. Ocean Bottom Sediments	20
H. Non-Migratory Marine Species (Flesh)	20
I. Local Crops	21
J. Soil	22
K. Kelp Sampling	23
III. CONCLUSIONS	24
IV. REFERENCES	25
V. APPENDICES	
A. Sample Type and Sampling Locations in 1993	26
B. Summary of 1993 Radiological Environmental Data	36
C. Summary of 1993 EPA Interlaboratory Comparison and Quality Control Programs	93
D. Environmental Dose Calculations and Correlation of Effluent Releases With Environmental Concentrations for 1993	103
E. Historical Trending	108
F. Comparison of 1993 Operational Data with Preoperational Data	150
G. Deviation from ODCM Sampling Requirements in 1993	173
H. Land Use Census for 1993	178
I. List of Figures	190
Errata for 1992 Report	229

LIST OF TABLES

Table Number		Page
I-1	A Comparison of USNRC Reporting Levels (RLs) for Radioactivity Concentrations in Environmental Samples and 10CFR20 Values	7
I-2	REMP Sample Summary	9
II-1	Inner Ring Locations Required by SONGS Unit 1 ODCM	11
II-2	Inner Ring Locations Required by SONGS Units 2/3 ODCM	11
II-3	Outer Ring Locations Required by SONGS Unit 1 ODCM	12
II-4	Outer Ring Locations Required by SONGS Units 2/3 ODCM	12
II-5	Deposition Factor, D/Q in m^{-2}, in Landward Sectors as a Function of Distance from EAB (SONGS Unit 1)	15
II-6	Deposition Factor, D/Q in m^{-2}, in Landward Sectors as a Function of Distance from EAB (SONGS Units 2/3)	16
II-7	Locations of Air Samplers for Units 1, 2 and 3 by Sector Analysis (SONGS Units 1, 2 and 3)	17
A-1	Radiological Environmental Monitoring Sample Locations	27
A-2	Sector and Direction Designation for Radiological Environmental Monitoring Sample Location Map	32
1 to 15	Summary of 1993 Radiological Environmental Monitoring Data (Appendix B)	37
C-1	Results of 1993 Interlaboratory Cross-Check and Quality Control Programs	95
D-1	Maximum Whole Body (Critical Organ) Ingestion Dose for SONGS Units 1, 2 and 3 in mrem/Year	105
D-2	Summary of Environmental Doses and Comparison With Regulatory Limits	106
D-3	Comparison of Environmental Concentrations to Projected Values Based on Effluent Release	107
E-1	Concentrations of Radionuclides Detectd in Soil, 1975 - 1933	110
E-2	Concentrations of Cesium-137 Detected in Sand, 1974 - 1933	112
E-3	Gross Beta Activity Detected in Air, 1987 - 1993	114
E-4	Strontium-90 Concentration Detected in Local Crops, 1965 - 1993	116
E-5	Concentrations of Radionuclides Detected in Kelp, 1973 - 1993	122
E-6	Concentrations of Radionuclides Detected in Ocean Bottom Sediments, 1974 - 1993	126
E-7	Concentrations of Radionuclides Detected in Marine Species, 1974 - 1993	133
F-1A	Drinking Water Preoperational and Operational Data (SONGS Unit 1)	159
F-1B	Drinking Water Preoperational and Operational Data (SONGS Units 2 and 3)	159
F-2A	Shoreline Bottom Sediments Preoperational and Operational Data, SONGS Units 2 and 3	1[illegible]
F-2B	Ocean Bottom Sediments Preoperational and Operational Data, SONGS Units 2 and 3	163

LIST OF TABLES

Table Number		Page
F-3	Marine Species Preoperational and Operational Data, SONGS Units 2 and 3	165
F-4A	Local Crops Preoperational and Operational Data, SONGS Unit 1	169
F-4B	Local Crops Preoperational and Operational Data, SONGS Units 2 and 3	169
F-5	Soil Preoperational and Operational Data, SONGS Units 2 and 3	171
F-6	Kelp Preoperational and Operational Data, SONGS Units 2 and 3	172
H-1	SONGS 1 Land Use Census Summary Nearest Use Tables For 1993 (Five-Mile Radius)	182
H-2	SONGS 1 Land Use Census Summary Other Specified Uses Table	184
H-3	SONGS 2/3 Land Use Census Summary Nearest Use Tables For 1993 (Five-Mile Radius)	186
H-4	SONGS 2/3 Land Use Census Summary Other Specified Uses Table for 1993 (Five-Mile Radius)	188

LIST OF TABLES OF APPENDIX B

Table Number		Page
1A	Quarterly Gamma Exposure	37
2	Weekly Airborne Particulates Gross Beta Activity	38
3	Weekly Radioiodine I-131 Activity	39
4A	Quarterly-composite Airborne Particulates Gamma Spectral Analysis	40
4C	Quarterly-Composite Airborne Particulates Gross Alpha and Strontium Activities	42
5	Monthly Ocean Water Gamma Spectral Analysis	43
7	Quarterly-Composite Ocean Water Tritium Activity	46
9A	Monthly Drinking Water Analysis	47
9B	Monthly Drinking Water Solids Gross Alpha and Gross Beta Activities	49
9C	Monthly Drinking Water Filtrate Gross Alpha and Gross Beta Activities	50
9D	Quarterly-Composite Drinking Water Solids Gross Alpha and Gross Beta Activities	51
9E	Quarterly-Composite Drinking Water Filtrate Analysis	52
10	Semi-Annual Shoreline Sediment Gamma Spectral Analysis	55
11	Semi-Annual Ocean Bottom Sediment Gamma Spectral Analysis	58
12A	Quarterly Non-Migratory Marine Animal Analysis (Flesh)	61
13A	Semi-Annual Local Crops Gamma Spectral Analysis	81
13B	Semi-Annual Local Crops Strontium-90 Activity	87
14	Annual Soil Analysis	[illegible]
15	Semi-Annual Kelp Analysis	[illegible]

LIST OF FIGURES

Figure Number		Page
A-1	Radiological Environmental Monitoring Sampling Location	33
A-2	Radiological Environmental Monitoring Sampling Location	34
A-3	Radiological Environmental Monitoring Sampling Locations	35
1	Exposure Pathways to Man	191
2A	Inner Ring Locations vs. Control (SONGS Unit 1)	192
2B	Inner Ring Locations vs. Control (SONGS Units 2 and 3)	193
3A	Outer Ring Locations vs. Control (SONGS Unit 1)	194
3B	Outer Ring Locations vs. Control (SONGS Unit 2 and 3)	195
4A	Control Locations For Sectors P, Q, R, A, B,	196
4B	Control Locations For Sectors C, D, E, F, G,	197
5A	Weekly Airborne Particulates Gross Beta Activity (SONGS Units 1, 2 and 3)	198
5B	Weekly Airborne Particulates Gross Beta Activity (SONGS Units 1, 2, and 3)	199
6	Cobalt-60 In Ocean Bottom Sediments (Operational Period, 1984-1993)	200
7A	Cesium-137 In Ocean Bottom Sediments (Preoperational Period, 1975 to 1983)	201
7B	Cesium-137 In Ocean Bottom Sediments (Operational Period, 1984-1993)	202
8A	Cesium-137 In The Flesh Of Sheephead (Preoperational Period, 1976-1984)	203
8B	Cesium-137 In The Flesh Of Sheephead (Operational Period, 1985-1993)	204
9	Cobalt-60 In The Flesh Of Sheephead (Operational Period, 1986-1993)	205
10	Cesium-137 In The Flesh Of Black Perch (Operational Period, 1987-1993)	206
11A	Cobalt-60 In The Flesh Of Spiny Lobster (Preoperational Period, 1976-1984)	207
11B	Cobalt-60 In The Flesh Of Spiny Lobster (Operational Period, 1985-1993)	208
12A	Cesium-137 In The Flesh Of Spiny Lobster (Preoperational Period, 1976-1984)	209
12B	Cesium-137 In The Flesh Of Spiny Lobster (Operational Period, 1985-1993)	210
13A	Cobalt-60 In The Flesh Of Mollusks (Operational Period, 1986-1993)	211
13B	Cesium-137 In The Flesh Of Mollusks (Preoperational Period, 1986-1993)	212
14A	Direct Radiation Monitoring (Preoperational Period, 1976-1983)	213
14B	Direct Radiation Monitoring (Preoperational Period, 1976-1983)	214
15A	Direct Radiation Monitoring (Operational Period, 1984-1993)	215

LIST OF FIGURES (CONTINUED)

Figure Number		Page
15B	Direct Radiation Monitoring (Operational Period, 1984-1993)	216
16	Monthly Average Airborne Particulates Gross Beta Activity, (Preoperational and Operational Data For SONGS Unit 1, 1965-1974)	217
17A	Monthly Average Airborne Particulates Gross Beta Activity (Preoperational and Operational Periods, 1973-1984)	218
17B	Monthly Average Airborne Particulates Gross Beta Activity (Preoperational and Operational Period, 1985-1993)	219
18	Monthly Average Airborne Particulates Gross Beta Activity (Operational Data For SONGS Units 1, 2, and 3, 1983-1993)	220
19A	Monthly Drinking Water Filtrate Gross Beta Activity (Preoperational and Operational Periods, 1976-1983)	221
19B	Monthly Drinking Water Filtrate Gross Beta Activity (Preoperational and Operational Periods, 1984-1993)	222
20A	Preoperational and Operational Data (Soil) SONGS Units 1, 2 and 3 (Strontium-90), 1977-1993	223
20B	Preoperational and Operational Data (Soil) SONGS Units 1, 2 and 3 (Cesium-137), 1977-1993	2
21A	Preoperational Data (Iodine-131 In Kelp), 1975-1983	225
21B	Operational Data (Iodine-131 In Kelp), 1984-1993	226
22A	Preoperational Data (Cesium-137 In Kelp), 1975-1983	227
22B	Operational Data (Cesium-137 In Kelp), 1984-1993	228

I. INTRODUCTION

San Onofre Nuclear Generating Station (SONGS) consists of three pressurized water nuclear reactors housed in separate containment buildings. Unit 1 attained initial criticality June 1967, and operated until February 1982 when it was shut down for seismic modifications. The Unit was brought back into service during November 1984. Unit 1 was removed from service permanently in November, 1992. Unit 2 and Unit 3 attained initial criticality in July 1982 and August 1983, respectively, and have been in operation since then.

To monitor the operations of SONGS Units 1, 2 and 3, and to fulfill the requirements of the SONGS Offsite Dose Calculation Manuals (ODCMs) for Units 1, 2 and 3, an annual operational Radiological Environmental Monitoring Program (REMP) was conducted at SONGS during 1993. This program was designed to quantify ambient radiation levels in the environs of SONGS, and to identify and quantify concentrations of radioactivity in various environmental media in the vicinity of SONGS which have a potential exposure pathway to man. Thermoluminescent dosimeters (TLDs) were used to measure direct radiation levels. Sampled environmental media included the following: soil, shoreline sediment (beach sand), air, local crops, non-migratory marine species, kelp, drinking water, ocean water, and ocean bottom sediments. Each of the samples were analyzed for both naturally-occurring and SONGS-related radionuclides.

A. The Program

In its operational phase, the 1993 REMP was conducted in accordance with Section 5.0 of the SONGS Unit 1, and Section 5.0 of the SONGS Units 2 and 3 Offsite Dose Calculation Manuals. Administrative control of the program was conducted in accordance with sections 6.9.1.6 and 6.9.1.7 for Unit 1 and sections 6.8.4.f and 6.9.1.6 of Units 2 and 3 Technical Specifications.

All REMP activities were conducted in accordance with the Environmental Monitoring Program Plan and Procedures Manual (EMPP) and the appropriate Station procedures. The EMPP provides the necessary administrative and management controls for the environmental monitoring program as specified in Regulatory Guide 4.8.

B. Objectives

The objectives of the operational REMP are:

1. To fulfill the obligation for radiological surveillance required by Technical Specifications and ODCM. The REMP will provide the following:

    - Monitoring the radiation and radionuclides in the environs of the plant by making representative measurements of radioactivity in the highest potential exposure pathways.

    - Verification of the accuracy of the effluent monitoring program and modeling of the environmental exposure pathways. To conform with 10CFR Part 50, Appendix I, Section IV-B.2, measured radioactivity concentrations in the environmental samples have been compared against predicted (calculated) ones

to evaluate the relationship between quantities of radioactive material released in effluents and resultant radiation doses to individuals from principal pathways of exposure. (Appendix D).

- Inclusion of the program in the ODCM, conformance with the guidance of the Appendix I, 10CFR Part 50, and inclusion of the following:

  - Monitoring, sampling, analyzing, and reporting of radiation and radionuclides in the environment in accordance with the methodology and parameters in the ODCM (see appendices B and I of the report).

  - A land use census to ensure that changes in the use of areas at and beyond the SITE BOUNDARY are identified and that modifications to the monitoring program are made if required by the results of this census. Appendix H of the report identifies changes to the census and the resultant dose increase, if any, to individuals from principal pathways of exposures in conformance with 10CFR Part 50, Appendix I, Section IV. B.3.

  - Participation in an interlaboratory comparison program to ensure that independent checks on the precision and accuracy of the measurements of the radioactive materials in the environmental sample matrices are performed as part of quality assurance requirements for environmental monitoring. Appendix C of the report lists such results.

2. To determine whether there is any significant increase in the concentration of radionuclides in critical pathways.

3. To detect any significant change in ambient gamma radiation levels.

4. To verify that the operation of SONGS Units 1, 2 and 3 have no assessable detrimental effects on the health and safety of the public or the environment.

C. Sample Collection

Samples of various environmental media were obtained in order to meet the stated objectives. The selection of sample types was based on established critical pathways for the transfer of radionuclides through the environment to man, experience gained during the preoperational phase, and the evaluation of data during the operational phase. Sampling locations were determined with consideration given to site meteorology, local demography, and land uses.

Sampling locations were divided into two classes -- indicator and control. Control stations were at locations considered to be unaffected by SONGS operations. All others are considered indicator and may be expected to manifest effects of SONGS operations.

D. Sources of Radioactivity

Plant-specific radionuclides are produced in the normal operation of a nuclear power plant. Most of the fission products are retained within the fuel and its cladding. A small fraction of fission products such as cesium-137 and iodine-131, and activation products such as cobalt-60, are present in the primary reactor cooling system. Noble gases are also produced during the fission process.

Radioactive liquid and gaseous waste releases to the ocean and the atmosphere may contain very minute concentrations of plant-produced radionuclides. The airborne radioactive noble gases released are mostly xenon and krypton which are inert (non-reactive). They do not concentrate in the body, but they contribute to human radiation exposure as an external source for whole body exposure. Xenon-133 and xenon-135 are the major radioactive noble gases released to the atmosphere and their calculated offsite beta and gamma air doses are less than 0.1 mrad per year.

The releases of iodines and particulates in the gaseous and liquid effluents are small. The major radionuclides of interest are I-131, Cs-134, Cs-137, Co-58, and Co-60. The total releases for these radionuclides were below applicable regulatory limits.

Tritium (H-3), the radioactive isotope of hydrogen, is the predominant radionuclide in the liquid effluents and is also present in gaseous effluents. Tritium is produced in the reactor water (coolant) as a result of activation (capture of thermal neutrons) of deuterium in the water and other nuclear reactions.

E. Exposure Pathway

Figure 1 illustrates various exposure pathways resulting in radiation dose to the surrounding population from operation of a nuclear facility. In almost all cases only a few pathways will have real dose potential and require detailed calculations.

a. <u>External Exposure</u>

External exposure to people during normal operations will include radioactive gases in gaseous effluent plumes, radionuclides deposited on soil, and vegetation, or shoreline sediments. Direct exposure from radionuclides in water during recreation or commercial fishing activity is insignificant. Accumulation in sediments has greater potential as a source of exposure. Gamma dosimeters (TLDs) are the usual means of measuring direct radiation exposure since significant dose contributors are gamma-emitters.

b. <u>Internal Exposure</u>

The release of radioactivity in liquid effluents involves pathways such as drinking water, fish consumption and direct exposure from the ocean water by swimming and the shoreline activities. Consumption of fish, crops, or drinking water from the area receiving liquid effluents and breathing contaminated air from the gaseous effluents releases are the most probable sources of internal exposure.

The annual doses calculated from gaseous effluent, tritium, radioiodines, and particulates of the gaseous effluent within a five-mile distance from the plant are summarized in Appendix H, Land Use Census Section. This Appendix also summarizes the maximum annual doses calculated from TLDs (gamma) and noble gases (beta and gamma).

F. Regulatory Limits, Guidance and Requirements

- The Code of Federal Regulations Title 10, Part 50, Appendix I (10CFR50, Appendix I) provides limits on the releases of radioactivity to the environment and the resulting dose to the public. These limits are summarized in the table below:

SOURCE	NRC LIMITS FOR SONGS
Liquid Effluents	< or equal to 3 mrem/yr to the whole body.
	< or equal to 10 mrem/yr any organ.
Gaseous Effluents	< or equal to 10 mrad/yr.
Noble Gases: Gamma: (air dose) Beta (air dose)	< or equal to 20 mrad/yr.
Iodine-131, tritium and particulates with half-lives greater than 8 days	< or equal to 15 mrem to any organ

- The EPA has established environmental radiation protection standards for nuclear power plants in 40CFR190. The standards for normal operation recommended that the dose from all discharges of radioactivity should not exceed the limits specified below. These limits which are applicable to the sum of both liquid and gaseous effluents, and direct radiation are as follows:

1. 25 mrem/yr to the whole body
2. 75 mrem/yr to the thyroid
3. 25 mrem/yr to any other organ

The doses calculated at SONGS are a small fraction of the dose limits established by the Environmental Protection Agency (EPA).

Concentration Levels Established by 40CFR141 in Drinking Water (pCi/l) are as follows:

Gross Alpha	15
Gross Beta	50
Ra-226 and Ra-228	5
Sr-90	8
Uranium	20

Except tritium (H-3) and strontium-90, the concentration of man-made radionuclides ensuring 4 mrem total body or organ dose equivalents shall be calculated on the basis of 2 liters per day drinking water intake.

* 10CFR20 (1993 requirements)

  Sections, 20.106, 20.201, Appendix B, Table II, Concentrations In Air And Water Above Natural Background

GUIDANCE:

* Standard Technical Specifications, NUREG-0472

  Standard Radiological Effluents Technical Specifications for PWRs Based On Regulatory Guide 4.8, Table 2, Rev. 3, 1989

* Regulatory Guide 4.1

  Programs For Monitoring Radioactivity In the Environs Of Nuclear Power Plants, 1975

* Regulatory Guide 4.2

  Preparation Of Environmental Reports For Nuclear Power Stations, 1976

* Regulatory Guide 4.8

  Environmental Technical Specifications For Nuclear Power Plants, 1975

* Regulatory Guide 4.13

  Performance, Testing, And Procedural Specification For Thermoluminescent Dosimetry: Environmental Applications, 1977

* NUREG-0133

  Preparation Of Radiological Effluent Technical Specifications For Nuclear Power Plants

* Regulatory Guide 1.109

  Calculation Of Annual Doses To Man From Releases Of Reactor Effluents For The Purpose Of Evaluating Compliance With 10CFR Part 50, Appendix I.

* NUREG-1301

  Offsite Dose Calculations Manual Guidance: Standard Radiological Effluent Controls For Pressurized Water Reactors, Generic Letter 89-01, Supplement No. 1

* ANSI N545 (TLD's)

  American National Standard Performance, Testing, And Procedural Specifications For Thermoluminesence Dosimetry (Environmental Application), 1975

* Regulatory Guide 4.15

  Quality Assurance For Radiological Monitoring Programs (Normal Operations) - Effluent Streams And The Environment, 1979

* 10CFR50, Appendices I and A

  Establishment Of An Appropriate Surveillance And Monitoring Program, Sections IV.B.2 And IV.B.3 (Appendix I)
  Criterion 64: Monitoring Radioactivity Releases (Appendix A)

G. Quality Assurance Program

To assure quality of sample analyses, a portion of the REMP was devoted to quality control. The main aspects of this part of the program included process quality control, instrument quality control, comprehensive data reviews, and EPA interlaboratory cross-check analyses.

All Radiological Environmental Monitoring Activities for San Onofre are assessed by Quality Assurance Requirements as defined in Regulatory Guide 4.15. The Quality Assurance Program for REMP is described in the Topical Quality Assurance Manual and consists of a series of planned and systematic actions that provide adequate confidence in the REMP activities and check the validity of the monitoring program through routine audits and compliance with written procedures and policies. The QA Program which provides assurance in the results of the REMP are partially performed by the Nuclear Oversight Division and are as follows:

* Performing regular audits of the REMP such as sample collection procedures and methods.

* Assure that the contracted laboratories participate in the US EPA Inter-Laboratory cross-check program.

* Assure that the contracted environmental analysis laboratory split samples for separate analysis such as in-house spiking.

* Providing split samples to an independent laboratory, e.g., Department of Health Services (DHS) and comparing the radioanalytical results for agreement.

In the DHS program, the identical samples are analyzed by an independent laboratory (DHS) and their results are compared against San Onofre contracted laboratory. This comparison provides a valuable QA tool to verify the quality of the analytical laboratories procedures and the radioanalytical data.

H. Sample Analysis

Environmental samples were collected at different locations (listed in Appendix A) in the vicinity of SONGS, and then shipped to a contracted radiological laboratory. A total of 1924 analyses were performed in 1993 (Table I-2). Each sample was analyzed using both standard radioanalytical and radiochemical procedures. The results of the analyses are summarized in Appendix B by sample type and analysis. Several analyses were deleted in 1993 and bases for modification were documented internally.

TABLE I-1

A COMPARISON OF USNRC REPORTING LEVELS (RL) FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES AND 10CFR20 VALUES

Analysis	NRC RL Water (pCi/l)	10CFR20 Values (pCi/l)	NRC RL Airborne Particulate or Gasses (pCi/m^3)	10CFR20 Values (pCi/m^3)	NRC RL Marine Animals (pCi/Kg, wet)	NRC RL Local Crops (pCi/Kg, wet)
H-3 (Ocean)	-	3×10^6	-	2×10^5	-	-
H-3 (Drinking)	2×10^4	2×10^4	-	-	-	-
Mn-54	1×10^3	1×10^5	-	1×10^4	3×10^4	-
Fe-59	4×10^2	6×10^4	-	5×10^3	1×10^4	-
Co-58	1×10^3	1×10^5	-	3×10^4	3×10^4	-
Co-60	1×10^3	5×10^4	-	1×10^4	1×10^4	-
ZN-65	3×10^2	1×10^5	-	4×10^3	2×10^4	-
Zr-Na-95	4×10^2	6×10^4	-	4×10^3	-	-
I-131	2	3×10^2	0.9	1×10^2	-	-
Cs-134	30	9×10^3	10	1×10^3	1×10^3	1×10^2
Cs-137	50	2×10^4	20	2×10^3	2×10^3	1×10^3
Ba-La-140	2×10^2	3×10^4	-	-	-	2×10^3

(a) For drinking water samples. This is 40 CFR Part 141 value. For ocean water, 3E+6 pCi/l is the limit recommended by 10CFR20, Appendix B, Table II, Column II

I. Data Management System Using SAS

The tabulated means, ranges and standard deviations presented in Appendix B were calculated following the standard format specified in Regulatory Guide 4.8. The Statistical Analysis System (SAS) software package was used to perform the statistical analysis and tabulation of the data.

SAS is a computer language and operating system for data analysis. The environmental monitoring program data sets (files), data entry screens, and program components are designed for data input, storage, and retrieval, as well as statistical analysis and generation of reports. There is one EMP SAS data set for each sample (24 total) or composite collected.

The SAS program, which has recently been converted to a PC version, allows the REMP to be easily administered by statistically analyzing the data, graphing, and tabulating them in the format of Regulatory Guide 4.8.

The radiological environmental data are reviewed for accuracy and comparison against NRC reporting levels, and then entered into the SAS database. One of the sub-menus creates a maximum value table which enables the user to single-out measurements exceeding the administrative levels (10% of the NRC reporting levels) established by SCE. Data exceeding these maximum values are flagged.

The impact of SONGS on the surrounding environment was assessed through a series of analyses. These analyses included: environmental dose calculations and correlation of effluent releases with environmental concentrations (Appendix D), historical trending of radionuclide concentrations in sampled environmental media over a period of several years (Appendix E), comparison of operational to preoperational environmental data (Appendix F), summary of deviations from sampling requirements and corrective actions taken (Appendix G), and finally the results of Land Use Census reports for 1993 as well as changes in the Land Uses from 1992 (Appendix H). Summaries and comparisons of indicator to control locations are presented in Section II of the text in this report. Other data comparisons are presented in the Appendices following the text of the report.

II. RESULTS AND DISCUSSIONS OF 1993 ENVIRONMENTAL DATA

A. Direct Radiation

The purpose of this program element was to measure the amount of environmental gamma radiation in the vicinity of SONGS. To accomplish this task, calcium sulfate ($CaSO_4$:Dy) thermoluminescent dosimeters (TLDs) were placed at each of 44 (excluding two laboratory controls and one transit dose TLDs) indicator and control locations, collected, and analyzed at prescribed intervals. The two control locations were in Mission Viejo (Aurora Park at 18.7 miles, NW) and in Oceanside (Fire Station at 15.5 miles, SE). Several other locations may also serve as control TLD's if necessary. The calcium sulfate TLD's were collected quarterly and were replaced with re-zeroed dosimeters. The locations are selected as inner and outer rings for all three Units (Tables II-1 to II-4), as required by Unit 1 and Units 2/3 Offsite Dose Calculation Manuals (ODCMs).

TABLE I-2

REMP SAMPLE ANALYSIS SUMMARY FOR 1993

MEDIUM	ANALYSIS TYPE	FREQUENCY	# OF LOCATIONS	TOTAL # OF ANALYSES IN 1993
Direct Radiation	Dosimetry	Quarterly	47	376
Airborne Particulates	Gross β	Weekly	10	520
Charcoal Cartridge	I-131	Weekly	10	520
Airborne Particulates	Ge(Li)Scan	Quarterly	10	40
Airborne Particulates	Gross α	Quarterly	10	40
Airborne Particulates	Sr-90	Quarterly	10	40
Ocean Water	Ge(Li)Scan	Monthly	4	48
Ocean Water	Gross β	Bi-Monthly	4	(DELETED)
Ocean Water	Gross β (Less K-40)	Bi-Monthly	4	(DELETED)
Ocean Water	H-3	Quarterly	4	16
Ocean Water	H-3	Semi-Annually	4	(DELETED)
Drinking Water	Ge(Li)Scan	Monthly	3	36
Drinking Water (Solids)	Gross α Gross β	Monthly Monthly	3 3	36 36
Drinking Water (Filtrate)	Gross α Gross β	Monthly Monthly	3 3	36 36
Drinking Water (Solids) Drinking Water (Solids)	Gross α Gross β	Quarterly Quarterly	3 3	12 12
Drinking Water (Filtrate)	Ge(Li) Scan	Quarterly	3	12
Drinking Water (Filtrate)	Gross α Gross β	Quarterly Quarterly	3 3	12 12
Shoreline Sediment	Ge(Li) Scan	Semi-Annually	4	8
Ocean Bottom Sediment	Ge(Li) Scan	Semi-Annually	5	10
Marine Species (Flesh) Marine Species (Flesh)	H-3 Ge(Li) Scan	Quarterly Semi-Annually	3 3	(DELETED) 24
Marine Species (Bone) Marine Species (Bone)	Ge(Li) Scan Sr-90	Quarterly Quarterly	3 3	(DELETED) (DELETED)
Crops Crops	Ge(Li)Scan H-3	Semi-Annually Semi-Annually	2 2	8 (DELETED)
Crops Crops	Gross α Sr-90	Semi-Annually Semi-Annually	2 2	8 8
Kelp Kelp	Ge(Li)Scan H-3	Semi-Annually Semi-Annually	4 4	8 (DELETED)
Soil Soil	Ge(Li)Scan Sr-90	Annually Annually	5 5	5 5

Note: For a description of bases for deletion, see text Section H. Total = 1924 Analyses

A total of 175 analyses were performed on TLDs from 44 locations (except a missing one for TLD #38 in the second quarter). Twelve analyses were also performed on transit TLD's. It should be noted that 21 quarterly TLDs or 84 annual ones were deleted from the program in January 1993 (See text, Section for explanation of bases). In addition, TLD numbers 17, 18, and 60 are used only for transit dose (dose contribution during transportation to the lab) and their readings and analyses frequency (12) are not included in the averaging of Appendix B. The environmental dosimetry program is also conducted in accordance with ANSI-N545 standards.

After the samples were analyzed, the measured doses were corrected for pre- and post-field exposure times. Quarterly doses measured by the calcium sulfate TLDs from the indicator locations ranged from 13.1 to 25.2 mrem, with an average dose of 17.3 mrem. The location at the San Onofre State Beach (location No. 55, at 0.2 miles WSW of Unit 1) had the highest TLD reading in the second quarter (25.2 mrem), with an average quarterly dose of 21.8 mrem (uncorrected for background). Subtracting a background dose of 74 mrem/year, the net annual dose for this location was 0.46 mrem based on an occupancy factor of 300 hours per year for beach users. This location therefore had the highest annual reading.

The next highest annual TLD reading was at Southeast Site Boundary (location No. 13, at 0.4 miles SE) ranging from 19.4 mrem to 21.4 mrem with a quarterly average of 20.2 mrem (uncorrected for background). The quarterly doses measured by the calcium sulfate dosimeters for the control locations #31 and #50, on the other hand, ranged from 16.7 to 20.2 mrem with an average dose of 18.5 mrem. Subtracting a background dose of 74 mrem/year, the net annual dose for this location was 0.006 mrem based on an occupancy factors of 8 hours per year.

In most locations, a correlation can be seen between the control and indicat locations (Figures 2-4). Past data, however, indicated that the external radiation level in the former control location of Huntington Beach (location #14) was somewhat higher than indicator locations (Figure 4A) suggesting that other environmental factors reduced its effectiveness as a control location; therefore, Huntington Beach control location is no longer serving as a control location but used as an indicator location. The current "control" is the numerical average of the readings at locations #31 and #50. The positive correlation observed between the control and the indicator locations indicate other factors such as environmental and seasonal variations are responsible and that plant effects are negligible.

In recent years, TLD location #13 has had the highest annual dose due to the proximity of reusable contaminated tools. The removal of these tools resulted in a greatly reduced-value for this location for 1993.

Figures 2 and 3 compare environmental radiation levels of ODCM required indicator and control locations for the operational year 1993 and the previous years. These figures show the comparison between the controls and inner ring as well as the outer ring location.

Because virtually all the measured doses at locations near SONGS were considered comparable to the direct radiation dose measured at the two control locations, it was concluded that SONGS operations had a negligible impact on this environmental medium.

TABLE II-1

INNER RING LOCATIONS REQUIRED BY SONGS UNIT 1 ODCM

Direction (Sector)	Distance in Miles	Angle From True North	TLD	Location Description**
WNW (P)	0.39	297.6	10	Bluff (Adjacent to PIC #1)
NW (Q)	1.22	310.1	8	Non-Commissioned Officers Beach Club
NNW (R)	0.30	326.8*	67	Former SONGS Evaporation Pond (Adjacent to PIC #2)
N (A)	0.54	0.07	40	SCE Training Center (Adjacent to PIC #3)
NNE (B)	0.63	26.6	61	MCB-Camp Pendleton (Adjacent to PIC #4)
NE (C)	0.66	43.4	62	MCB-Camp Pendleton (Adjacent to PIC #5)
ENE (D)	0.72	67.8	63	MCB-CAMP Pendleton (Adjacent to PIC #6)
E (E)	0.76	86.1	64	MCB-Camp Pendleton (Adjacent to PIC #7)
ESE (F)	0.86	120.2	66	MCB-Camp Pendleton (Adjacent to PIC #9)
SE (G)	1.28	121.3	46	San Onofre State Beach Park

* At the border of Sectors Q and R
** PIC - Pressurized in chamber

TABLE II-2

INNER RING LOCATIONS REQUIRED BY SONGS UNITS 2/3 ODCM

Direction (Sector)	Distance in Miles	Angle From True North	TLD #	Location Description
WNW (P)	0.665	298	10	Bluff (Adjacent to PIC #1)
NW (Q)	0.553	313	67	Former SONGS Evaporation Pond (Adjacent to PIC #2)
NNW (R)	0.715	340	40	SCE Training Center (Adjacent to PIC #3)
N (A)	0.696	3	61	MCB-Camp Pendleton (Adjacent to PIC #4)
NNE (B)	0.653	19	62	MCB-Camp Pendleton (Adjacent to PIC #5)
NE (C)	0.584	46	63	MCB-Camp Pendleton (Adjacent to PIC #6)
ENE (D)	0.541	70	64	MCB-Camp Pendleton (Adjacent to PIC #7)
E (E)	0.696	98	65	MCB-Camp Pendleton (Adjacent to PIC #8)
ESE (F)	0.584	121	66	MCB-Camp Pendleton (Adjacent to PIC #9)
SE (G)	1.0	122	46	San Onofre State Beach Park

TABLE II-3

OUTER RING LOCATIONS REQUIRED BY SONGS UNIT 1 ODCM

Direction (Sector)	Distance in Miles	Angle From True North	TLD #	Location Description
P (WNW)	2.42	300.2	22	Former U.S. Coast Guard Stations, San Mateo Point
Q (NW)	5.33	311.6	1	City of San Clemente
R (NNW)	4.76	331.8	19	San Clemente Highlands
A (N)	3.38	355.4	2	Camp San Mateo
B (NNE)	4.66	21.4	35	Range 312 (MCB)
C (NE)	4.32	55.4	36	Range 208C (MCB)
D (ENE)	4.48	70.3	68	Range 210C (MCB)
E (E)	4.73	84.0	4	Camp Horno
F (ESE)	3.28	118.1	6	Old Route 101
G (SE)	3.58	126.3	38	San Onofre State Beach Park

TABLE II-4

OUTER RING LOCATIONS REQUIRED BY SONGS UNITS 2/3 ODCM

Direction (Sector)	Distance in Miles	Angle From True North	TLD #	Location Description
P (WNW)	2.7	300	22	Former U.S. Coast Guard Stations, San Mateo Point
Q (NW)	5.6	319	1	City of San Clemente
R (NNW)	5.0	330	19	San Clemente Highlands
A (N)	5.7	353	33	Camp Talega
B (NNE)	4.7	18	35	Range 312 (MCB)
C (NE)	4.2	52	36	Range 208C (MCB)
D (ENE)	4.3	68	68	Range 210C (MCB)
E (E)	4.5	82	4	Camp Horno
F (ESE)	3.0	118	6	Old Route 101
G (SE)	3.3	127	38	San Onofre State Beach Park

B. Airborne Particulate Analysis

Sample locations are selected in accordance with the requirements of the Unit 1 and units 2/3 Offsite Dose Calculation Manuals (See Tables II-5 and II-6).

The locations with the highest annual average D/Q (deposition factor in $1/m^2$) and the highest occupancy factor were evaluated for Units 2 and 3 and the angles and distance were translated using a spreadsheet to obtain the equivalent distance and angle (Sector) for Unit 1 (Table II-7).

Gross beta analysis is a measure of total radioactivity of beta-emitting radionuclides in a sample. Beta radiation is emitted by many radionuclides, but beta decay gives a continuous energy spectrum rather than the discrete lines or peaks associated with gamma radiation. This makes the identification of beta-emitting radionuclides very difficult. Therefore, gross beta measurements only indicate whether the sample contains normal or abnormal concentrations of beta-emitting radionuclides and does not identify the presence of specific radionuclides. Gross beta measurement then acts as a tool to identify whether or not action may be taken for further analysis.

Air particulate samples were collected on a weekly basis from seven indicator locations (seven required by ODCMs appear in Table II-7) and from a control location situated in the city of Huntington Beach. Figures 5A and 5B show the variation in gross beta activity level in 1993 in different locations. After collection, the samples were analyzed for gross beta activity with a lower limit of detection of 0.001 pCi/m^3 of air. Samples were also composited quarterly and analyzed for 11 naturally-occurring and station-related radionuclides by gamma spectral analysis, radio-strontium by beta counting, and gross alpha radioactivity by alpha counting. Gross beta activity in 358 indicator samples and 51 control samples were above the lower limit of detection. Of the 364 indicator samples, six analyses were invalid. During the five collection periods of 01/26/93 through 02/23/93 air sampler #12 collected low volume due to mechanical problems and #9 also collected a small volume during the collection period of 01/26/93 through 02/02/93. One control sample collected during the collection period of 08/03/93 to 08/10/93 collected a very small volume of air. Air samplers #5 and #7, are not required by ODCMs, Section 5, Table 5-1 (Air Sampler #6 was deleted and #7 was added to the REMP in January 1993).

Gross beta activity was detected in each weekly airborne particulate sample. The concentration of gross beta activity in the samples collected from the indicator locations ranged from 0.002 to 0.045 pCi/m^3, averaging 0.016 pCi/m^3 of air. The concentrations of gross beta activity in the samples from Huntington Beach control location ranged from 0.004 to 0.051 pCi/m^3, averaging 0.017 pCi/m^3 of air. See Figures 5A & 5B for 1993 weekly airborne particulates gross beta activity in the air samples collected from locations required by Section 5.0 of Unit 1 and Units 2/3 Offsite Dose Calculation Manuals (ODCMs).

When the quarterly-composite samples were analyzed for strontium-90 and gross alpha radioactivity, no strontium-90 was detected in any of the composite samples (LLD = 0.0002 pCi/m^3). Gross alpha radioactivity was detected in 14 of the 28 indicator samples (LLD = 0.0002 pCi/m^3). The gross alpha in these samples ranged from 0.004 to 0.008 pCi/m^3 averaging 0.006 pCi/m^3. The control location activity ranged from 0.004 to 0.007 pCi/m^3 averaging 0.006 in two of the four samples. Since the natural radioactivity seen in indicator samples collected from the indicator

locations was comparable to the radioactivity found in samples collected from the control location, the impact of SONGS operations on this environmental medium is considered to be negligible.

Per requirement of Unit 1 and Units 2/3 ODCMs, Section 5, Table 5.1, an assessment was performed to determine whether the gross beta activity of the indicators exceeded 10 times the background (control location #3).

The results indicated that indicator locations maximum gross beta activity in air in 1993 was 0.045 pCi/m^3 and the control location average was 0.017 pCi/m^3. No action was taken since the indicator value of 0.045 pCi/m^3 did not exceed ten times the annual average gross beta activity of the control (0.17 pCi/m^3).

C. Radioiodine in Air

In 1993, weekly air samples for radioiodine were collected by adsorption on charcoal cartridges from seven ODCM-required locations in the vicinity of SONGS and from Huntington Beach (which served as a control location). During 1993, a total of 416 air cartridges (eight locations times 52 weeks per year) were analyzed to detect their iodine-131 radioactivity concentration. Of these 416 air cartridges, 52 were control samples (364 indicators).

Iodine I-131 was not detected in any of the 364 indicator samples analyzed during 1993. The lower limit of detection (LLD) of I-131 in the samples was 0.033 pCi/m^3.

The concentrations of iodine-131 in the 52 samples collected from the control location were all less than the lower limit of detection. See Table 3 of appendices B and I for a listing of radioiodine activity detected in the weekly air samples for 1993.

In conclusion, during 1993, no iodine-131 activity was detected beyond the SONGS Exclusion Area Boundary (EAB) and its impact on the environment is negligible.

D. Ocean Water

In 1993, ocean water samples were collected on a monthly basis in the vicinity of each of the station discharge outfalls (which served as the indicator locations), and from Newport Beach (which served as the control location). Upon collection, each sample was analyzed for 19 naturally-occurring and station-related gamma-emitting radionuclides. Every other month, samples were also analyzed for gross beta activity. Finally, ocean water samples were composited quarterly and analyzed for tritium.

Throughout 1993; potassium-40, radium-226 and thorium-228 were the naturally-occurring gamma-emitting radionuclides detected in the monthly gamma spectral analyses of samples from some of the indicator and control locations. Potassium-40 was detected in each sample. The concentrations of potassium-40 in the 36 samples from the indicator locations ranged from 247 to 387 pCi/l, averaging 308 pCi/l. The concentrations of potassium-40 in the 12 samples from the control location ranged from 250 to 331 pCi/l, averaging 295 pCi/l. Naturally-occurring radium-226 was detected in 3 indicator samples and thorium-228 was detected in two samples from the indicator locations and one sample taken from the Newport Beach Control. Only one indicator sample had a concentration of 2.6 pCi/l of Ce-141 at Unit 3 outfall.

TABLE II-5

DEPOSITION FACTOR, D/Q IN M^{-2} IN LANDWARD SECTORS AS A FUNCTION OF DISTANCE FROM EXCLUSION AREA BOUNDARY (EAB)

(SONGS UNIT 1)

D/Q in m^{-2} (At EAB)*	Sector** (Direction)	Distance in Miles	D/Q in m^{-2} (At Nearest Use)**	Distance In Miles
2.7 E-08	P (WNW)	0.20	2.7 E-08	0.2
7.2 E-08	Q (NW)	0.20	1.7 E-08	0.5
5.2 E-08	R (NNW)	0.21	3.8 E-09	1.1
3.8 E-08	A (N)	0.24	4.3 E-10	3.5
3.1 E-08	B (NNE)	0.29	1.2 E-09	2.1
2.4 E-08	C (NE)	0.36	1.1 E-09	2.3
1.9 E-08	D (ENE)	0.44	7.3 E-10	2.9
2.3 E-08	E (E)	0.55	5.8 E-10	4.2
1.0 E-08	F (ESE)	0.64	5.0 E-09	1.0
6.5 E-09	G (SE)	0.59	2.9 E-09	1.0

* Sectors Q, R, A, B, and P have the highest D/Q at the Exclusion Area Boundary (EAB) of Unit 1.

** Sectors P, Q, F, R, and G, have the highest D/Q at the nearest use location from the Unit 1 release point.

TABLE II-6

DEPOSITION FACTOR, D/Q IN M^{-2} IN LANDWARD SECTORS AS A FUNCTION OF DISTANCE FROM EXCLUSION AREA BOUNDARY (EAB)

(SONGS UNITS 2/3)

D/Q in m^{-2} (At EAB)*	Sector** (Direction)	Distance in Miles	D/Q in m^{-2} (At Nearest Use)**	Distance In Miles
8.8 E-09	P (WNW)	0.37	8.2 E-09	0.4
2.8 E-08	Q (NW)	0.37	1.2 E-08	0.6
2.2 E-08	R (NNW)	0.37	3.2 E-09	1.2
1.9 E-08	A (N)	0.37	4.1 E-10	3.6
2.0 E-08	B (NNE)	0.37	1.2 E-09	2.1
2.3 E-08	C (NE)	0.37	1.2 E-09	2.2
2.4 E-08	D (ENE)	0.37	6.4 E-10	2.8
4.3 E-08	E (E)	0.37	6.4 E-10	4.0
2.8 E-08	F (ESE)	0.37	7.5 E-09	0.8
1.3 E-08	G (SE)	0.37	3.9 E-09	0.8

* Sectors E, Q, F, D, and C have the highest D/Q at the Exclusion Area Boundary of Units 2/3.

** Sectors Q, P, F, G, and R have the highest D/Q at the nearest use locations from Units 2/3 release point.

TABLE II-7

LOCATIONS OF AIR SAMPLERS FOR UNITS 1, 2, AND 3 BY SECTOR ANALYSIS

Location #	Location Name	SONGS UNITS 2/3			SONGS UNIT 1		
		Sector	Angle from True North	Distance (Miles)	Sector	Angle from True North	Distance (Miles)
1	City of San Clemente	Q	319	5.5	Q	320.1	5.24
2	Camp San Onofre	C	39	1.8	C	47.4	1.87
3	Huntington Beach Control	Q	308	37.0	Q	308.1	36.72
9	State Beach Park (Adjacent to PIC #9)	F	121	0.584	F	120.2	0.863
10	Bluff (Adjacent to PIC #1)	P	298	0.665	P	297.6	0.386
11	Mesa EOF (Adjacent to PIC #3)	R	340	0.715	A	0.074	0.538
12	Former SONGS Evaporation Pond (Adjacent to PIC #2)	Q	313	0.553	Q/R*	326.8*	0.291
13	MCB (Camp Pendleton East) (Adjacent to PIC #8)	E	98	0.696	F	103.9	0.962

* Border line of sectors Q and R.

Note: Air sample locations 1, 2, 3, 9, 10, 11, 12, and 13 are all required by ODCM. Locations 5 and 7 are not required by ODCM because they are located within the EAB.

Gross beta activity was not detected in the bimonthly ocean water samples. This analysis was deleted in 1993 because it is not required by ODCM Section 5.0 specifications. From the past data it was determined that potassium-40 accounted for at least 95 percent of the gross beta activity detected in each of the samples.

Tritium was detected in two of the quarterly-composite indicator samples obtained from the SONGS Unit 1 outfall at 82.0 and 136.0 pCi/l.

The highest tritium concentration detected in the ocean water at the SONGS Unit 1 outfall (136 pCi/l) is well below the limit of 3E+06 pCi/l as specified by NRC in 10CFR Part 20, Appendix B, Table II, Column 2. The concentration detected at Unit 1 outfall may have resulted from the simultaneous discharge of the liquid effluent and sampling of the ocean water which did not allow sufficient dilution of the release with the receiving water before the samples were taken.

Virtually all other detected radioactivity in each of the ocean water samples can be attributed to naturally-occurring potassium-40. The variation of potassium-40 in ocean water is considered characteristic of this environmental medium. These data indicate that SONGS operations had a negligible impact on this environmental medium.

E. Drinking Water

In 1993, drinking water samples were collected on a monthly basis from two indicator locations and from a control location situated in Huntington Beach. Upon collection, the samples were analyzed for tritium as well as for 16 naturally-occurring and SONGS-related gamma emitting radionuclides. Afterwards, the samples were filtered so that the suspended solids and filtrate could be analyzed separately for gross alpha and gross beta activity. Samples from each location were also composited quarterly, and filtered in the same manner. In each instance, the suspended solids were analyzed for gross beta concentrations, and the filtrates were analyzed for gross beta activity and for tritium.

It should be noted that drinking water pathway for liquid effluent does not exist at San Onofre.

Part A. Monthly Drinking Water Results

Unfiltered Samples

The only radionuclide detected in one monthly indicator drinking water sample was naturally-occurring potassium-40, at a concentration of 59 pCi/l collected at the control location of Huntington Beach. This was described by the laboratory as a possible laboratory contamination based on the past data base.

Drinking Water Solids

Monthly gross alpha activity was not detected in the drinking water solids (LLD of 0.21 pCi/l).

Gross beta activity was observed in three samples from Municipal Tri-Cities at a range of 0.18 to 0.27 pCi/l. Two samples of the control location detected gross beta at a range of 0.16 to 0.30 pCi/l. The concentration of gross beta activity in the samples of San Clemente Golf Course was below the lower limits of detection (0.74 pCi/l).

Drinking Water Filtrate

Monthly Gross alpha activity was detected only in one of the 12 samples collected from Tri-Cities Municipal Water District Reservoir at a concentration of 1.1 pCi/l. Control location concentration of gross alpha was below the detection limit of 0.44 pCi/l.

Gross beta activity, however, was found in each sample in 1993 (Figures 19A and 19B). Gross beta activity in the filtrate from Tri-Cities Municipal Water District Reservoir and the San Clemente Golf Course Well ranged from 3.0 to 14.0 pCi/l, averaging 9.3 pCi/l. Gross beta activity in the samples collected from Huntington Beach control ranged from 2.0 to 14.0 pCi/l, averaging 9.5 pCi/l.

Part B. Quarterly Drinking Water Composite Results

Drinking Water Solids

Gross alpha activity was not detected in any of the quarterly-composite samples from the Tri-Cities Municipal Water District Reservoir or the San Clemente Golf Course. Gross alpha activity was not detected in the composite samples from Huntington Beach control. The lower limit of detection was 0.21 pCi/l.

Gross beta activity was not detected in any of the quarterly-composite samples collected from the Tri-Cities Municipal Water District Reservoir, San Clemente Golf Course Well and the Huntington Beach control. All the concentrations were below the lower limit of detection of 0.74 pCi/l.

Drinking Water Filtrate

Gross alpha activity was not detected in any of the composite samples collected from Tri-Cities Municipal Water District Reservoir, from San Clemente Golf Course, and Huntington Beach control location (the lower limit of detection was 0.63 pCi/l).

Gross beta activity was detected in each quarterly-composite sample. Gross beta activity in the composite samples from Tri-Cities Municipal Water District Reservoir and the San Clemente Golf Course Well ranged from 5.0 to 15.0 pCi/l, averaging 10.1 pCi/l. Gross beta activity in the samples collected from Huntington Beach ranged from 4.0 to 14.0 pCi/l, averaging 8.2 pCi/l. Tritium was not detected in any of the quarterly composite samples and its concentration was below the lower limit of detection (102 pCi/l).

Conclusions

No plant-related gamma-emitting radionuclides were found in the monthly drinking water or the quarterly-composite samples. Gross alpha and gross beta activities were, however, detected in a number of samples collected throughout 1993. A comparison of the results with the control location (Figures 19A and 19B) indicates that the presence of gross alpha and gross beta in the indicator and control locations is due to natural sources of radioactivity. There is no indication that gross alpha or gross beta due to plant related radionuclides is accumulating in either drinking water filtrate or drinking water solids.

F. Shoreline Sediment (Sand)

Beach sand was collected semiannually in 1993 from three indicator locations, and from a control location situated in Newport Beach. After collection, the samples were analyzed for 19 different plant-related and naturally-occurring radionuclides. The results of the analyses are summarized in Table 10 of the Appendix B in terms of "as received" wet sample weights.

In 1993, three radionuclides were detected in shoreline sediment samples. They include potassium-40, radium-226, and thorium-228. All these three are naturally-occurring (i.e., non-plant related) radionuclides. The variation of the concentrations of these radionuclides in the shoreline sediment samples is considered to be characteristic of this environmental medium. The only plant-related radionuclide detected was cesium-137 in one sample at a concentrations of 0.013 pCi/g, wet at San Onofre Surfing Beach, 0.9 miles Northwest of Units 2 and 3. The presence of cesium-137 may also be attributed to fallout deposition due to nuclear weapons testings.

Because most SONGS-related radionuclides were not detected in the shoreline sediment samples, the impact of SONGS operations on shoreline sediment is considered to be negligible.

G. Ocean Bottom Sediments

To determine the radioactivity in ocean bottom sediments in the vicinity of the Station in 1993, representative samples were collected semiannually near each of the Station discharge outfalls (which served as indicator locations), and from Newport Beach (which served as a control location.

After collection, the samples were analyzed by gamma-spectral analysis for 19 naturally-occurring and station-related radionuclides. The results of these analyses are summarized in Table 11 of Appendix B in terms of "as received" wet sample weights.

In 1993, three radionuclides were detected in ocean bottom sediment samples. They include potassium-40, radium-226, and thorium-228 which are all naturally-occurring (i.e., non-station related) radionuclides. The variation of the concentrations of these radionuclides in the ocean bottom sediment samples is considered to be characteristic of this environmental medium (Figures 6, 7A and 7B). Cesium-137 was also detected in three indicator samples but was not detected in the control location of Laguna Beach. Its concentration ranged from 0.026 to 0.083 pCi/g, wet weight. Other plant-related radionuclides detected in the sediment samples were Mn-54 (one sample), Mo(Tc)-99m (one sample), Co-60 (one sample), and I-31 (one sample) and all well below the reporting levels. The concentrations of these radionuclides in the control station were below the lower limit of detection of the respective radionuclides. No other plant-related radionuclides were detected.

Although SONGS related radionuclides were seen at barely detectable levels in a few ocean bottom sediment samples, the impact of SONGS operations on ocean bottom sediments is considered to be negligible.

H. Non-Migratory Marine Species (Flesh)

During 1993, non-migratory marine species were collected near SONGS Unit outfalls.

Species of adult fish, crustacea and mollusks, were collected on a semi annual basis at the SONGS Unit 1 outfall, at the SONGS Units 2 and 3 outfall and from Laguna Beach. Upon collection, the flesh portion of each sample type was analyzed for three naturally-occurring radionuclides, for 16 gamma-emitting station-related radionuclides, and for aqueous and bound tritium. The results were subsequently reported to Edison in terms of both wet and dry sample weights. Because results based on a wet sample weight are most useful for calculating doses, the results of sample analyses are summarized below in terms of "as received" wet sample weights.

The naturally-occurring radionuclides potassium-40, radium-226, and thorium-228 were detected in most of the samples.

Cesium-137, a plant-related radionuclide was detected in one sample of black perch at 0.010 pCi/g (Unit 1 outfall), one sample of kelp bass at 0.016 pCi/g (Unit 1 outfall), and two sheephead samples at 0.003 and 0.008 pCi/g, at Units 2/3 outfalls respectively. Cobalt-60 and cerium-144 were also detected in one sample of sea hare at 0.007 and 0.010 pCi/g (Unit 1 outfall) respectively. Bound and aqueous tritium as well as bone analyses were deleted from the program because such analyses are not required by ODCMs. No plant-related radionuclides were detected at the Laguna Beach control station.

To determine whether or not these radionuclides are accumulating in the marine animals, concentrations of each of these radionuclides in sheephead (a fish), crustacea, and mollusks were plotted versus time from 1976 through 1993 (Figures 8-13). Trending of these data indicates that the concentrations of each of these radionuclides are greater than or equal to concentrations measured at the control location, but are not accumulating in the marine animals. The presence of station-related radionuclides in the control location samples may be attributed to the reverse current (North and South) and nuclear fallout. The highest concentration of cesium-137 (0.016 pCi/g) detected in the marine animals in 1993 was less than one percent (0.8%) of the reporting level established by Nuclear Regulatory Commission (2 pCi/g, wet).

The sum of the concentrations of marine species averaged over each quarter and divided by the corresponding reporting levels resulted in a fraction much less than one.

Based on these data, it was concluded that (1) SONGS operations has had a negligible impact on this environmental medium, and (2) the potential dose to members of the public from consumption of marine species near SONGS is negligible.

I. Local Crops

Representative fleshy crops were collected semiannually in 1993 from farms in San Clemente (which served as the indicator location), and from a garden situated at SSE of Oceanside (which served as the control location). Leafy vegetable samples were not collected due to their unavailability. After collection, the edible portion of the samples was analyzed quantitatively for 12 gamma-emitting radionuclides, as well as for tritium and radiostrontium by beta counting. The results of the analyses are summarized (below) based on "as received" wet sample weights.

Cucumber, squash, tomato, and strawberries were collected from the San Clemente and Oceanside sampling locations. Upon analysis, naturally-occurring potassium-40 was the only radionuclide detected in the indicator

samples. The concentrations of potassium-40 in the indicator samples ranged from 1.30 to 1.71 pCi/g, wet weight.

Potassium-40 was also detected in the samples from the control location. The concentrations of potassium-40 in the control samples ranged from 1.40 to 3.60 pCi/g, wet weight.

During 1993 period, strontium-90 was also detected in indicator and control samples. Its concentration was 0.0010 pCi/g in both indicator and control samples. The even distribution of this radionuclide between indicator and control locations leads one to conclude that Sr-90 in this medium is mostly the result of factors such as nuclear weapons testing fallout rather than SONGS operations.

No other radionuclides were detected in the samples collected from San Clemente and Oceanside, indicating that SONGS operations had a negligible impact on this environmental medium.

Based on these data, it was concluded that (1) SONGS operations had a negligible impact on this environmental medium, and (2) the potential dose to members of the public from consumption of crops near SONGS is negligible.

J. Soil

To determine if there is evidence of a build-up of radionuclides in the land near SONGS, soil samples were collected from the East Site Boundary (Former Visitor's center), Old Route 101, Basilone Road, and Camp San Onofre (which served as indicator locations in the vicinity of SONGS), and from Huntington Beach which served as a control location. Surface soil was collected from all indicator and control locations at the depth of 3 inches from all locations.

The 12-inch depth sampling which had been performed since 1986 was discontinued in 1992. This sampling was performed to study the radionuclides migration through the soil layers. The results indicated no specific pattern of accumulation or migration into deeper depths. The soil sampling is conducted in accordance with HASL-300 procedures and is not required by ODCMs.

After collection, each soil sample was analyzed for 13 naturally-occurring and SONGS-related gamma-emitting radionuclides via gamma spectral analysis, and for radiostrontium by beta counting. The analyses indicated that potassium-40, and cesium-137 were present in detectable quantities in one or more of the samples. The findings are summarized in terms of dry sample weights.

<u>Surface Soil Sample Results</u>

Two radionuclides were detected in surface soil collected from the indicator and control locations. Potassium-40 was detected in each sample. The concentrations of potassium-40 in the samples from the indicator locations ranged from 6.4 to 17.2 pCi/g, averaging 13.7 pCi/g. The concentration of potassium-40 in one sample from the control location was 19.4 pCi/g, dry weight.

Cesium-137 was detected in samples collected from two locations. The concentration of cesium-137 in the indicator samples ranged from 0.059 to 0.078 pCi/g, dry weight averaging 0.068 pCi/g. Cesium-137 was detected in

one sample collected from the Huntington Beach control location at a concentration of 0.03 pCi/g, dry.

The concentration of strontium-90 in the samples, was below the lower limit of detection of 0.060 pCi/g.

Potassium-40, cesium-137, and strontium-90 were detected in soil profile analyses conducted in previous years. Cesium-137 and strontium-90 concentrations are mostly due to the nuclear weapons testing fallout depositing on soil and retention of these radionuclides due to their long half lives. Cesium-137 is normally retained at the top few inches of soil. Cesium-137 in soil with high clay content usually binds to the silicate structure more than rocky type soil. This can be seen in location no. 1 (Camp San Onofre) and location no. 2 (Old Route 101), which have higher clay contents and higher concentrations of cesium-137. The presence of cesium-137 in the control location supports the fact that the major source of this radionuclide is due to fallout deposition.

To assess the importance of detecting strontium-90 in the surface soil samples, data collected from the indicator locations over a period of several years were compared to similar data collected from Huntington Beach. Concentrations of strontium-90 and cesium-137 in soil have also been plotted versus time in Figures 20A and 20B of the Appendix I. Variation in concentration of certain radionuclides is described in Appendix E, historical trending. These data indicate that the concentrations of each of these radionuclides seen at both indicator and control locations are similar. Because of this, the activity can be attributed to atmospheric nuclear weapons tests and not SONGS operations.

K. Kelp Sampling

Kelp was collected during June and November 1993 from the San Onofre, San Mateo, and Barn Kelp Beds, as well as a control sample from the kelp bed in Laguna Beach. Upon collection, the samples were analyzed by gamma-spectral analysis for 19 different naturally-occurring and Station-related radionuclides. The samples were also analyzed for both aqueous and bound tritium. Gamma-emitting radionuclides detected in the samples included potassium-40, iodine 131, and thorium-228. The results of these analyses are summarized below in terms of wet sample weights.

Naturally-occurring potassium-40 and thorium-228 were detected in several samples. The concentrations of potassium-40 in the samples from the indicator locations ranged from 6.1 to 11.4 pCi/g, averaging 8.9 pCi/g. The concentrations of potassium-40 in the samples from the control location ranged from 7.4 to 9.1 pCi/g, averaging 8.2 pCi/g. Thorium-228 was detected in two samples averaging 0.008 pCi/g.

Iodine-131 was detected in two indicator and one control location samples. The concentration range of iodine-131 in the samples collected from the indicator locations was 0.014 to 0.023 pCi/g. At the control station, the concentration was 0.016 pCi/g. In other locations, it was below the lower limit of detection (LLD = 0.029 pCi/g). The detection of iodine-131 at the control location indicates that medical administration of the radionuclide can be a source of Kelp contamination. Iodine-131 at the indicator station could be due to medical administration and/or plant related releases.

To determine if these radionuclides are accumulating in kelp with time, data were examined from 1972 through 1993. Figures 21A, 21B, 22A & 22B also show the variation in concentration of cesium-137 and iodine-131 in

kelp samples from 1974 to 1993. The data indicate that the concentrations of potassium-40 at both indicator and control locations have remained commensurate, as anticipated. The frequency of detection and concentrations of iodine-131 and cesium-137 in kelp have decreased, in t past few years relative to the years of 1983 through 1988. Doses via the ingestion pathway to members of public have been calculated because San Onofre kelp near SONGS is occasionally harvested. Dose impact from plant-related radionuclides were insignificant. In the case of iodine-131, its 8-day half life relative to the transit time (the time after harvesting to the time of shelving and consuming the food product containing kelp, usually 6-8 weeks) allows the decay of iodine-131 to a much lower level of activity. Doses calculated have shown no significant impact on the maximum individual.

III. CONCLUSIONS

Levels of radioactivity in environmental media depend on many components, including the following: site release rates; meteorology; number, location, size and date of nuclear weapons testing; seasonal variability of fallout; soil conditions; local terrain and variability in the natural environment.

Radiological environmental data collected throughout 1993 have been evaluated to determine the impact, if any, of San Onofre operations on the surrounding environment. To accomplish this, several methods of evaluation were employed, namely:

1. Compilation and verification of all data, as well as a determination of those data considered to be significantly greater than background levels.

2. Environmental Dose Calculations and correlation of effluent releases with environmental concentrations.

3. Examination of time-dependent variations of pertinent radioisotopes in selected environmental media throughout the year at both indicator and control locations.

4. Comparison of radioactivity in various media in 1993 against the levels observed in pre-operational years.

5. Historical trending of radionuclides in various media during operational years.

In comparing these findings to the conservatively-defined limits of the facility operating licenses, it is concluded that the radiological environmental impact of San Onofre Units 1, 2 and 3 operations through 1992 has been negligible, and the resulting dose to man is negligible.

IV. REFERENCES

1. 10CFR20, 10CFR50

2. 1992 Radiological Environmental Operating Report for San Onofre Nuclear Generating Station, April 30, 1993.

3. Land Use Census for SONGS Units 1, 2 and 3 Radiological Environmental Monitoring Program, September 1993.

4. ODCM (Offsite Dose Calculation Manual) for SONGS Units 2 and 3, Section 5.0, 1993.

5. ODCM (Offsite Dose Calculation Manual) for SONGS Unit 1, Section 5.0, 1993.

6. USNRC Draft Regulatory Guide 4.8, Table 1, "Standard Format and Principal Content of Environmental Technical Specifications," December 1975.

7. USNRC Regulatory Guide 4.13, "Performance, Testing and Procedural Specifications for Thermoluminescent Dosimetry - Environmental Applications," 1977.

8. USNRC Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs," Rev. 1, February 1979.

9. SONGS Units 1, 2 and 3, Technical Specifications Section 6.9, Administrative Controls.

11. USNRC Regulatory Guide 1.109, "Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR 50, Appendix I," Rev. 1, October 1977.

12. AIF/NESP-004 Environmental Impact Monitoring of Nuclear Power Plants, February 1975.

13. USNRC NUREG-0133 Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants.

14. USNRC NUREG-1301 Offsite Dose Calculations Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors Generic Letter 89-01, Supplement No. 1, April 1991.

15. NUREG-0543 Methods for Demonstrating LWR Compliance with the EPA Uranium Fuel Cycle Standard (40 CFR Part 190).

16. Annual Radioactive Effluent Release Reports for Unit 1 and Units 2 and 3, 1993.

APPENDIX A

SAMPLE TYPE AND SAMPLING LOCATION

TABLE A-1

RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS

	TYPE OF SAMPLE AND SAMPLING LOCATION***	DISTANCE* (miles)	DIRECTION*
Direct Radiation			
1	City of San Clemente (Former SDG&E Offices)	5.6	NW
2	Camp San Mateo (MCB, Camp Pendleton)	3.5	N
3	Camp San Onofre (MCB, Camp Pendleton)	2.6	NE
4	Camp Horno (MCB, Camp Pendleton)	4.5	E
5	**DELETED**		
6	Old Route 101 (East-Southeast)	3.0	ESE
7	**DELETED**		
8	Noncommissioned Officers Beach Club	1.5	NW
9	**DELETED**		
10	Bluff (Adjacent to PIC #1)	0.7	WNW
11	Former Visitor's Center	0.3**	NW
12	South of Switchyard	0.2**	E
13	Southeast Site Boundary (Bluff)	0.4**	SE
14	Huntington Beach Generating Station	37	NW
15	Southeast Site Boundary (Office Building)	0.2**	SE
16	East Southeast Site Boundary	0.4**	ESE
17	Transit Dose	-	-
18	Transit Dose	-	-
19	San Clemente Highlands	5.0	NNW
20	**DELETED**		
21	**DELETED**		
22	Former U.S. Coast Guard Station - San Mateo Point	2.7	WNW
23	San Clemente General Hospital	8.2	NW
24	**DELETED**		
25	**DELETED**		
26	**DELETED**		
27	**DELETED**		

TABLE A-1

RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS

	TYPE OF SAMPLE AND SAMPLING LOCATION***	DISTANCE* (miles)	DIRECTION*
Direct Radiation (Continued)			
28	**DELETED**		
29	**DELETED**		
30	**DELETED**		
31	Aurora Park - Mission Viejo (CONTROL)	18.7	NNW
32	**DELETED**		
33	Camp Talega (MCB, Camp Pendleton)	5.7	N
34	San Onofre School (MCB, Camp Pendleton)	1.9	NW
35	Range 312 (MCB, Camp Pendleton)	4.7	NNE
36	Range 208C (MCB, Camp Pendleton)	4.2	NE
37	**DELETED**		
38	San Onofre State Beach Park	3.3	SE
39	**DELETED**		
40	SCE Training Center - Mesa (Adjacent to PIC #3)	0.7	NNW
41	Old Route 101 - East	0.4**	E
42	**DELETED**		
43	**DELETED**		
44	Fallbrook Fire Station	18.0	E
45	**DELETED**		
46	San Onofre State Beach Park	1.0	SE
47	Camp Las Flores (MCB, Camp Pendleton)	8.6	SE
48	**DELETED**		
49	Camp Chappo (MCB, Camp Pendleton)	12.8	ESE
50	Oceanside Fire Station (CONTROL)	15.5	SE
51	**DELETED**		
52	**DELETED**		
53	San Diego County Operations Center	45	SE

TABLE A-1

RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS

	TYPE OF SAMPLE AND SAMPLING LOCATION***	DISTANCE* (miles)	DIRECTION*
Direct Radiation (Continued)			
54	Escondido Fire Station	32	ESE
55	San Onofre State Beach (Unit 1, West Southwest)	0.2**	WSW
56	San Onofre State Beach (Unit 1, Southwest)	0.1**	SW
57	San Onofre State Beach (Unit 2)	0.1**	SSW
58	San Onofre State Beach (Unit 3)	0.1**	S
59	SONGS Meteorological Tower	0.3**	WNW
60	Transit Control Storage Area	-	-
61	Mesa - East Boundary (Adjacent to PIC #4)	0.7	N
62	MCB - Camp Pendleton (Adjacent to PIC #5)	0.6	NNE
63	MCB - Camp Pendleton (Adjacent to PIC #6)	0.6	NE
64	MCB - Camp Pendleton (Adjacent to PIC #7)	0.5	ENE
65	MCB - Camp Pendleton (Adjacent to PIC #8)	0.7	E
66	San Onofre State Beach (Adjacent to PIC #9)	0.6	ESE
67	Former SONGS Evaporation Pond (Adjacent to PIC #2)	0.6	NW
68	Range 210C (MCB, Camp Pendleton)	4.3	ENE
Airborne			
1	City of San Clemente (City Hall)	5.5	NW
2	Camp San Onofre (Camp Pendleton)	1.8	NE
3	Huntington Beach Generating Station (CONTROL)	37.0	NW
5	Units 2 and 3 Switchyard	0.13**	NNE
6	**DELETED**		
7	AWS Roof (Added)	0.18**	NW
9	State Beach Park	0.6	ESE
10	Bluff	0.7	WNW
11	Mesa EOF	0.7	NNW
12	Former SONGS Evaporation Pond	0.6	NW
13	Marine Corps Base (Camp Pendleton East)	0.7	E

TABLE A-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS

TYPE OF SAMPLE AND SAMPLING LOCATION***		DISTANCE* (miles)	DIRECTION*
Soil Samples			
1	Camp San Onofre	2.5	NE
2	Old Route 101 - East Southeast	3.0	ESE
3	Basilone Road/I-5 Freeway Offramp	2.0	NW
4	Huntington Beach Generating Station (CONTROL)	37.0	NW
5	Former Visitor's Center (East Site Boundary)	0.2**	NNW
Ocean Water			
A	Station Discharge Outfall - Unit 1	0.5	SSW
B	Outfall - Unit 2	0.7	SW
C	Outfall - Unit 3	0.7	SW
D	Newport Beach (CONTROL)	30.0	NW
Drinking Water			
1	Tri-Cities Municipal Water District Reservoir	8.7	NW
2	San Clemente Golf Course Well	3.5	NNW
3	Huntington Beach (CONTROL)	37.0	NW
Shoreline Sediment (Beach Sand)			
1	San Onofre State Beach (0.6 mile Southeast)	0.6	SE
2	San Onofre Surfing Beach	0.9	NW
3	San Onofre State Beach (3.1 miles Southeast)	3.1	SE
4	Newport Beach North End (CONTROL)	30.0	NW
Local Crops			
1	San Mateo Canyon (San Clemente Ranch)	2.6	NW
2	Southeast of Oceanside (CONTROL)	22.0	SE
Non-Migratory Marine Animals			
A	Unit 1 Outfall	0.9	WSW
B	Units 2 and 3 Outfall	1.5	SSW
C	Laguna Beach (CONTROL)	18.2	NW

TABLE A-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS

TYPE OF SAMPLE AND SAMPLING LOCATION***		DISTANCE* (miles)	DIRECTION*
Kelp			
A	San Onofre Kelp Bed	1.5	SSW
B	San Mateo Kelp Bed	3.8	WNW
C	Barn Kelp Bed	6.3	SSE
D	Laguna Beach (CONTROL)	15.6	NW
Ocean Bottom Sediments			
A	Unit 1 Outfall (0.5 mile East)	0.6	W
B	Unit 1 Outfall (0.6 mile West)	0.8	SSW
C	Unit 2 Outfall	1.6	SW
D	Unit 3 Outfall	1.2	SSW
E	Laguna Beach (CONTROL)	18.2	NW

* Distance (miles) and Direction (sector) are measured relative to Units 2 and 3 midpoint. Direction is determined from degrees true north.

** Distances are within the Units 2 and 3 Site Boundary (0.4 mile in all sectors) and not required by Technical Specification.

*** MCB - Marine Corps Base

PIC Pressurized Ion Chamber

TABLE A-2

SECTOR AND DIRECTION DESIGNATION FOR RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATION MAP

DEGREES TRUE NORTH FROM SONGS 2 AND 3 MID-POINT			NOMENCLATURE	
Sector Limit	Center Line	Sector Limit	22.5° Sector*	Direction*
348.75	0 & 360	11.25	A	N
11.25	22.5	33.75	B	NNE
33.75	45.0	56.25	C	NE
56.25	67.5	78.75	D	ENE
78.75	90.0	101.25	E	E
101.25	112.0	123.75	F	ESE
123.75	135.0	146.25	G	SE
146.25	157.0	168.75	H	SSE
168.75	180.0	191.25	J	S
191.25	202.5	213.75	K	SSW
213.75	225.0	236.25	L	SW
236.25	247.5	258.75	M	WSW
258.75	270.0	281.15	N	W
281.25	292.5	303.75	P	WNW
303.75	315.0	326.25	Q	NW
326.25	337.5	348.75	R	NNW

FIGURE A-1
DECEMBER 1993
REVISION 9

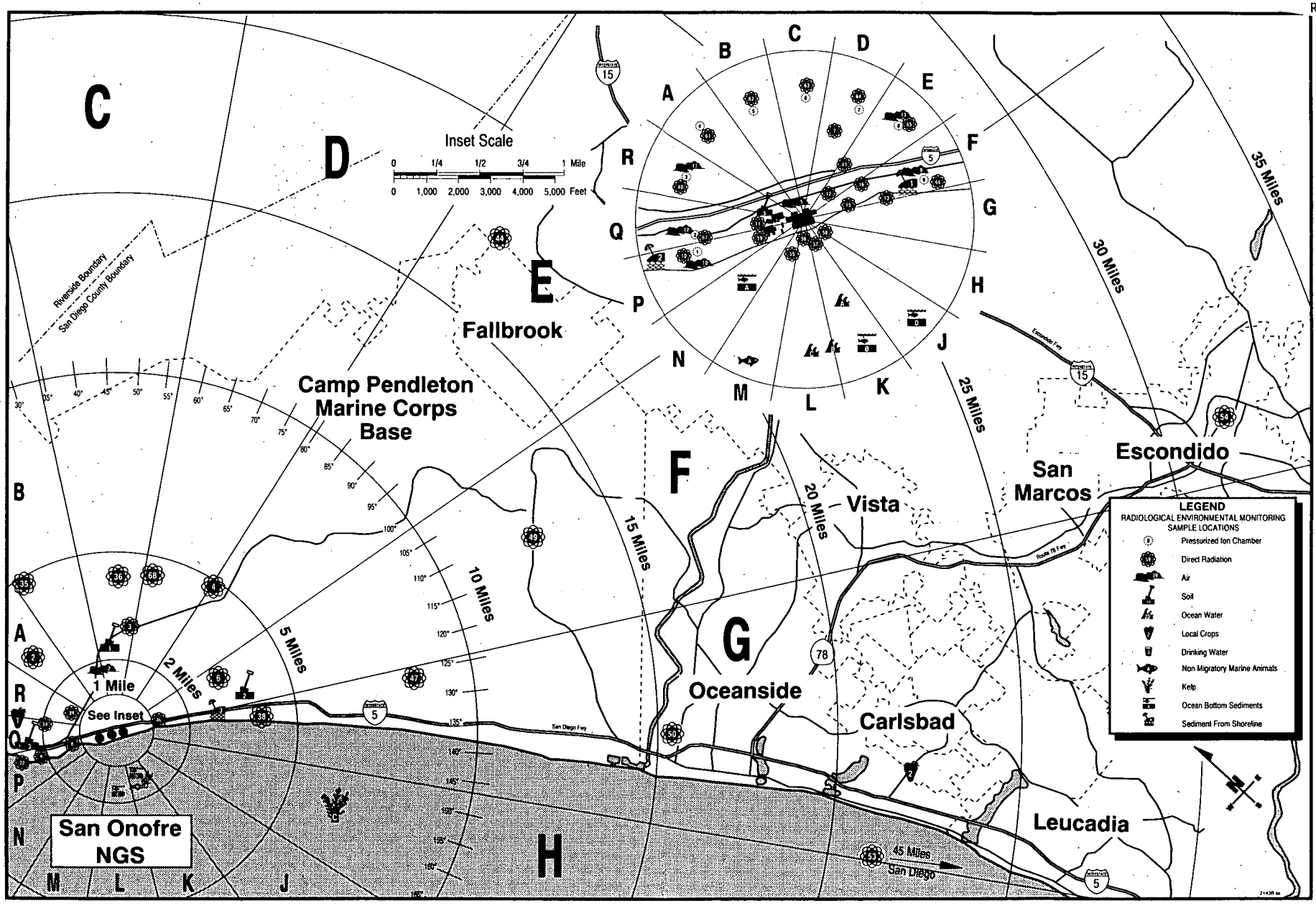


FIGURE A-2
DECEMBER 199
REVISION 9

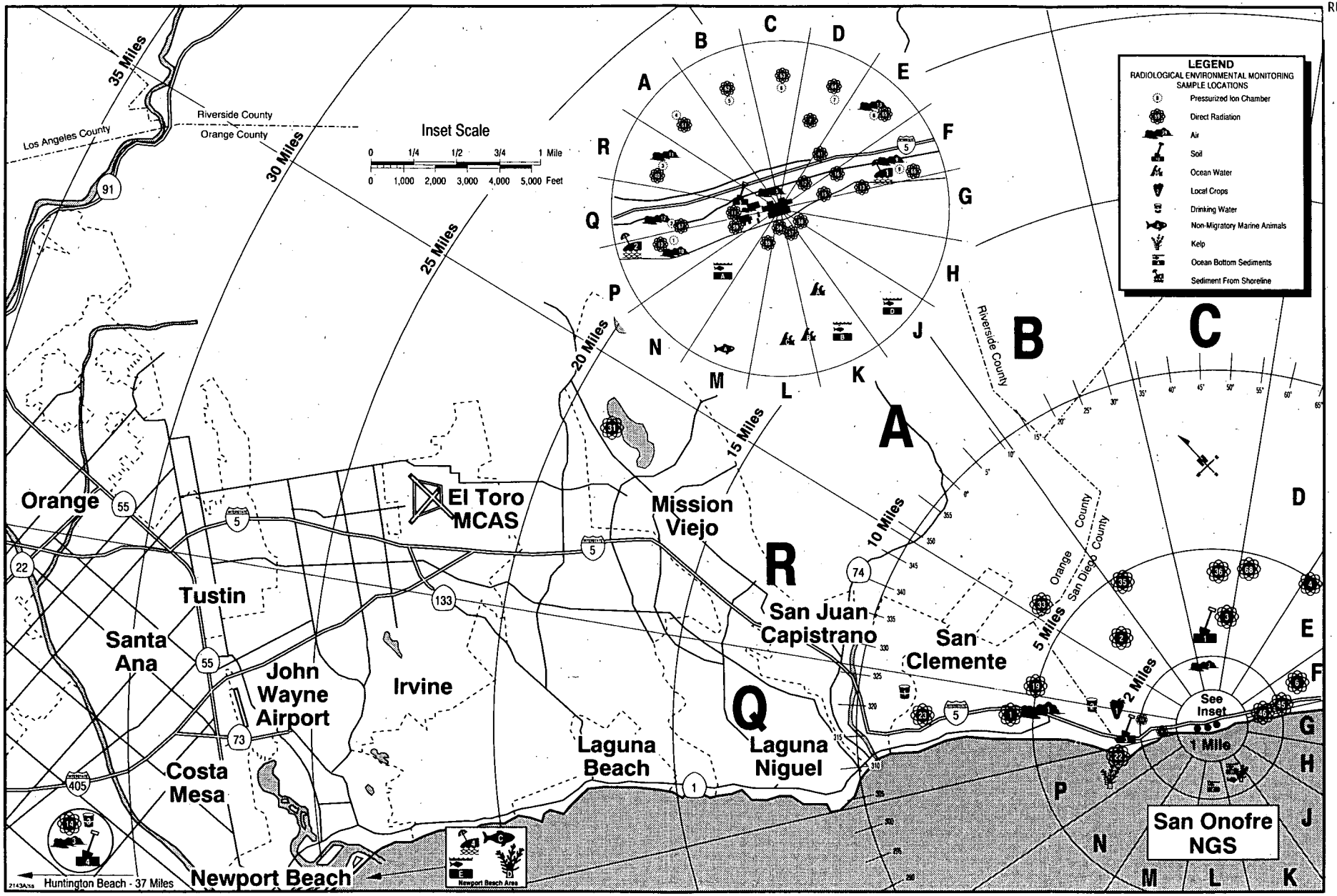
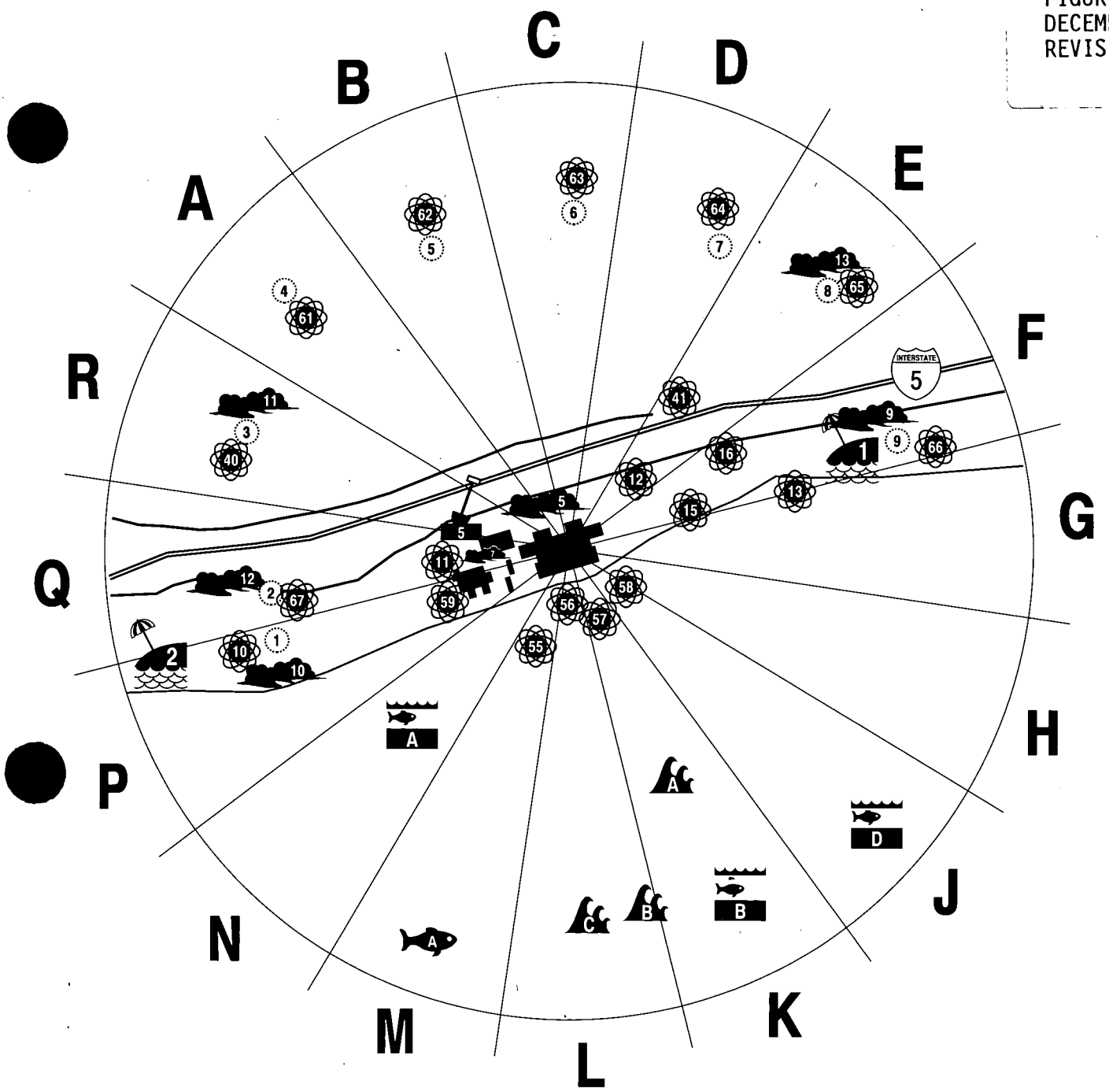
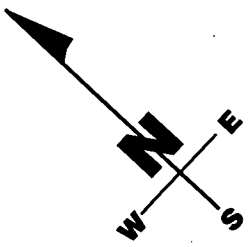


FIGURE A-3
DECEMBER 1993
REVISION 9





Scale

0 1/4 1/2 3/4 1 Mile

0 1,000 2,000 3,000 4,000 5,000 Feet

LEGEND

RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS

- Pressurized Ion Chamber
- Direct Radiation
- Air
- Soil
- Ocean Water
- Local Crops
- Drinking Water
- Non-Migratory Marine Animals
- Kelp
- Ocean Bottom Sediments
- Sediment From Shoreline

2143A/ss

APPENDIX B

SUMMARY OF 1993 RADIOLOGICAL ENVIRONMENTAL DATA

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 1A Quarterly Gamma Exposure (millirem)							
	Gamma Exposure	175	5.0000	17.307(167/168) (13.100-25.200)	San Onofre State Beach (Unit 1) 0.2 mi. WSW	21.825(4/ 4) (19.700-25.200)	18.500(8/ 8) (16.700-20.200)	0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 2 Weekly Airborne Particulates Gross Beta Activity (pCi/cu.m)							
	Gross Beta 416	0.0010	0.0157(358/364) (0.002- 0.045)	Mesa E.O.F. 0.7 mi. NNW	0.0177(52/ 52) (0.003- 0.045)	0.0171(51/ 52) (0.004- 0.051)	0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 3 Weekly Radioiodine I-131 Activity (pCi/cu.m)							
	I-131 416	0.0330	<LLD (0/364)	ALL <LLD	-----	<LLD (0/ 52)	0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 4A Quarterly - Composite Airborne Particulates Gamma Spectral Analysis (pCi/cu.m)							
	Ag-110m	32	0.0010	<LLD (0/ 28)	ALL <LLD	-----	<LLD (0/ 4) 0
	Be-7	32	0.0540	<LLD (0/ 28)	ALL <LLD	-----	<LLD (0/ 4) 0
	Ce-141	32	0.0010	<LLD (0/ 28)	ALL <LLD	-----	<LLD (0/ 4) 0
	Ce-144	32	0.0020	<LLD (0/ 28)	ALL <LLD	-----	<LLD (0/ 4) 0
	Co-58	32	0.0010	<LLD (0/ 28)	ALL <LLD	-----	<LLD (0/ 4) 0
	Co-60	32	0.0010	<LLD (0/ 28)	ALL <LLD	-----	<LLD (0/ 4) 0
	Cs-134	32	0.0010	<LLD (0/ 28)	ALL <LLD	-----	<LLD (0/ 4) 0
	Cs-137	32	0.0010	<LLD (0/ 28)	ALL <LLD	-----	<LLD (0/ 4) 0
	I-131	32	*	<LLD (0/ 28)	ALL <LLD	-----	<LLD (0/ 4) 0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 4A Quarterly - Composite Airborne Partjculates Gamma Spectral Analysis (pCi/cu.m)							
	K-40	32	0.0060	<LLD (0/ 28)	ALL <LLD	-----	<LLD (0/ 4)	0
	Ru-103	32	0.0010	<LLD (0/ 28)	ALL <LLD	-----	<LLD (0/ 4)	0
	Zr(Nb)-95	32	0.0010	<LLD (0/ 28)	ALL <LLD	-----	<LLD (0/ 4)	0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 4C Quarterly-Composite Airborne Particulates Gross Alpha & Strontium Activities (pCi/cu.m)							
	Gross Alpha 32	0.0002	0.0061(14/ 28) (0.004- 0.008)	Former SONGS Evaporation Pond 0.6 mi. NW	0.0070(2/ 4) (0.007- 0.007)	0.0055(2/ 4) (0.004- 0.007)	0
	Sr-90 32	0.0002	<LLD (0/ 28)	ALL <LLD	-----	<LLD (0/ 4)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 5 Monthly Ocean Water Gamma Spectral Analysis (pCi/l)							
	Ag-110m	48	3.1280	<LLD (0/ 36)	ALL <LLD	-----	<LLD (0/ 12) 0
	Ba(La)-140	48	37.351	<LLD (0/ 36)	ALL <LLD	-----	<LLD (0/ 12) 0
	Ce-141	48	6.3400	2.6000(1/ 36) (2.600- 2.600)	Outfall - Unit 3 0.7 mi. SW	2.6000(1/ 12) (2.600- 2.600)	<LLD (0/ 12) 0
	Ce-144	48	15.649	<LLD (0/ 36)	ALL <LLD	-----	<LLD (0/ 12) 0
	Co-57	48	1.7630	<LLD (0/ 36)	ALL <LLD	-----	<LLD (0/ 12) 0
	Co-58	48	5.1110	<LLD (0/ 36)	ALL <LLD	-----	<LLD (0/ 12) 0
	Co-60	48	5.3530	<LLD (0/ 36)	ALL <LLD	-----	<LLD (0/ 12) 0
	Cs-134	48	4.6020	<LLD (0/ 36)	ALL <LLD	-----	<LLD (0/ 12) 0
	Cs-137	48	3.6880	<LLD (0/ 36)	ALL <LLD	-----	<LLD (0/ 12) 0

SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 5 Monthly Ocean Water Gamma Spectral Analysis (pCi/l)							
	Fe-59	48	9.4770	<LLD (0/ 36)	ALL <LLD	-----	<LLD (0/ 12)	0
	I-131	48	14.289	<LLD (0/ 36)	ALL <LLD	-----	<LLD (0/ 12)	0
	K-40	48	42.201	308.06(36/ 36) (247.00-387.00)	Station Discharge Outfall - Unit 1 0.5 mi. SSW	311.92(12/ 12) (276.00-370.00)	294.92(12/ 12) (250.00-331.00)	0
	Mn-54	48	3.7040	<LLD (0/ 36)	ALL <LLD	-----	<LLD (0/ 12)	0
	Mo(Tc)-99m	48	3137.0	<LLD (0/ 36)	ALL <LLD	-----	<LLD (0/ 12)	0
	Ra-226	48	7.4890	16.767(3/ 36) (5.000-35.700)	Outfall - Unit 2 0.7 mi. SW	16.767(3/ 12) (5.000-35.700)	<LLD (0/ 12)	0
	Ru-103	48	4.7210	<LLD (0/ 36)	ALL <LLD	-----	<LLD (0/ 12)	0
	Ru-106	48	31.037	<LLD (0/ 36)	ALL <LLD	-----	<LLD (0/ 12)	0
	Th-228	48	5.1870	3.4000(2/ 36) (3.000- 3.800)	Newport Beach 30 mi. NW	9.1000(1/ 12) (9.100- 9.100)	9.1000(1/ 12) (9.100- 9.100)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean	Range	Control Locations Mean	Range	Number of Nonroutine Reported Measurements
Table 5 Monthly Ocean Water Gamma Spectral Analysis (pCi/l)									
	Zn-65	48	7.7300	<LLD (0/ 36)	ALL <LLD	-----	<LLD (0/ 12)		0
	Zr(Nb)-95	48	7.6930	<LLD (0/ 36)	ALL <LLD	-----	<LLD (0/ 12)		0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 7 Quarterly Composite Ocean Water Tritium Activity (pCi/l)							
	Tritium	16	102.00	109.00(2/ 12) (82.000-136.00)	Station Discharge Outfall - Unit 1 0.5 mi. SSW	109.00(2/ 4) (82.000-136.00)	<LLD (0/ 4)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 9A Monthly Drinking Water Analysis (pCi/l)							
	Ag-110m	36	3.1280	<LLD (0/ 24)	ALL <LLD	-----	<LLD (0/ 12)	0
	Ba(La)-140	36	37.351	<LLD (0/ 24)	ALL <LLD	-----	<LLD (0/ 12)	0
	Be-7	36	38.903	<LLD (0/ 24)	ALL <LLD	-----	<LLD (0/ 12)	0
	Ce-141	36	6.3400	<LLD (0/ 24)	ALL <LLD	-----	<LLD (0/ 12)	0
	Ce-144	36	15.649	<LLD (0/ 24)	ALL <LLD	-----	<LLD (0/ 12)	0
	Co-58	36	5.1110	<LLD (0/ 24)	ALL <LLD	-----	<LLD (0/ 12)	0
	Co-60	36	5.3530	<LLD (0/ 24)	ALL <LLD	-----	<LLD (0/ 12)	0
	Cs-134	36	4.6020	<LLD (0/ 24)	ALL <LLD	-----	<LLD (0/ 12)	0
	Cs-137	36	3.6880	<LLD (0/ 24)	ALL <LLD	-----	<LLD (0/ 12)	0
	Fe-59	36	9.4770	<LLD (0/ 24)	ALL <LLD	-----	<LLD (0/ 12)	0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 9A Monthly Drinking Water Analysis (pCi/l)							
H-3	36	102.00	<LLD (0/ 24)	ALL <LLD	-----	<LLD (0/ 12)	0
I-131	36	0.4910	<LLD (0/ 24)	ALL <LLD	-----	<LLD (0/ 12)	0
K-40	36	42.201	59.000(1/ 24) (59.000-59.000)	Huntington Beach 37 mi. NW	59.000(1/ 12) (59.000-59.000)	59.000(1/ 12) (59.000-59.000)	0
Mn-54	36	3.7040	<LLD (0/ 24)	ALL <LLD	-----	<LLD (0/ 12)	0
Ru-103	36	4.7210	<LLD (0/ 24)	ALL <LLD	-----	<LLD (0/ 12)	0
Zn-65	36	7.7300	<LLD (0/ 24)	ALL <LLD	-----	<LLD (0/ 12)	0
Zr(Nb)-95	36	7.6930	<LLD (0/ 24)	ALL <LLD	-----	<LLD (0/ 12)	0

SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean	Range	Control Locations Mean	Range	Number of Nonroutine Reported Measurements
Table 9B Monthly Drinking Water Solids Gross Alpha and Gross Beta Activities	(pCi/l)								
	Gross Alpha	36	0.2110	<LLD (0/ 24)	ALL <LLD		-----	<LLD (0/ 12)	0
	Gross Beta	36	0.7380	0.2333(3/ 24) (0.180- 0.270)	Tri-Cities Munic. Water Dist. Res. 8.7 mi. NW	0.2333(3/ 12) (0.180- 0.270)		0.2300(2/ 12) (0.160- 0.300)	0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 9C Monthly Drinking Water Filtrate Gross Alpha and Gross Beta Activities (pCi/l)							
	Gross Alpha 36	0.4430	1.1000(1/ 24) (1.100- 1.100)	Tri-Cities Munic. Water Dist. Res. 8.7 mi. NW	1.1000(1/ 12) (1.100- 1.100)	<LLD (0/ 12)	0
	Gross Beta 36	1.4750	9.292(24/ 24) (3.000-14.000)	Tri-Cities Munic. Water Dist. Res. 8.7 mi. NW	10.583(12/ 12) (3.000-14.000)	9.5000(12/ 12) (2.000-14.000)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 9D Quarterly-Composite Drinking Water Solids Gross Alpha and Gross Beta Activities (pCi/l)							
	Gross Alpha 12	0.2110	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 4)	0
	Gross Beta 12	0.7380	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 4)	0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 9E Quarterly-Composite Drinking Water Filtrate Analysis (pCi/l)							
	Ag-110m	12	3.3960	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 4) 0
	Ba(La)-140	12	184.90	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 4) 0
	Be-7	12	57.470	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 4) 0
	Ce-141	12	12.021	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 4) 0
	Ce-144	12	16.838	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 4) 0
	Co-58	12	6.8500	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 4) 0
	Co-60	12	5.4120	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 4) 0
	Cs-134	12	4.7310	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 4) 0
	Cs-137	12	3.6950	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 4) 0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 9E Quarterly-Composite Drinking Water Filtrate Analysis (pCi/l)							
	Fe-59 12	15.044	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 4)	0
	Gross Alpha 12	0.6320	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 4)	0
	Gross Beta 12	0.6990	10.125(8/ 8) (5.000-15.000)	Tri-Cities Munic. Water Dist. Res. 8.7 mi. NW	13.250(4/ 4) (10.000-15.000)	8.2500(4/ 4) (4.000-14.000)	0
	H-3 12	102.00	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 4)	0
	I-131 12	0.5100	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 4)	0
	K-40 12	42.201	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 4)	0
	Mn-54 12	3.9590	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 4)	0
	Ru-103 12	7.9810	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 4)	0
	Zn-65 12	8.4170	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 4)	0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 9E Quarterly-Composite Drinking Water Filtrate Analysis (pCi/l)							
	Zr(Nb)-95 12	10.541	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 4)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 10 Semi-Annual Shoreline Sediment Gamma Spectral Analysis (pCi/g)							
	Ag-110m	8	0.0050	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
	Ce-141	8	0.0110	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
	Ce-144	8	0.0260	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
	Co-57	8	0.0030	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
	Co-58	8	0.0090	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
	Co-60	8	0.0090	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
	Cs-134	8	0.0080	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
	Cs-137	8	0.0060	0.0130(1/ 6) (0.013- 0.013)	San Onofre Surfing Beach 0.9 mi. NW	0.0130(1/ 2) (0.013- 0.013)	<LLD (0/ 2)	0
	Fe-59	8	0.0160	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0

SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 10 Semi-Annual Shoreline Sediment Gamma Spectral Analysis (pCi/g)							
	I-131	8	0.0650	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
	K-40	8	0.0700	12.717(6/ 6) (10.100-18.900)	Laguna Beach (North End) 30 mi. NW	15.650(2/ 2) (12.400-18.900)	15.650(2/ 2) (12.400-18.900)	0
	Mn-54	8	0.0060	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
	Mo(Tc)-99m	8	5.2280	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
	Ra-226	8	0.0120	0.3717(6/ 6) (0.140- 0.680)	San Onofre State Beach 3.1 mi. SE	0.4650(2/ 2) (0.250- 0.680)	0.3150(2/ 2) (0.300- 0.330)	0
	Ru-103	8	0.0080	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
	Ru-106	8	0.0520	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
	Th-228	8	0.0090	0.5233(6/ 6) (0.160- 0.950)	San Onofre State Beach 3.1 mi. SE	0.7300(2/ 2) (0.520- 0.940)	0.5450(2/ 2) (0.320- 0.770)	0
	Zn-65	8	0.0130	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 10 Semi-Annual Shoreline Sediment Gamma Spectral Analysis (pCi/g)							
	Zr(Nb)-95	8	0.0130	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean	Range	Control Locations Mean	Range	Number of Nonroutine Reported Measurements
Table 11 Semi-Annual Ocean Bottom Sediment Gamma Spectral Analysis (pCi/g)									
	Ag-110m	10	0.0050	<LLD (0/ 8)	ALL <LLD		-----	<LLD (0/ 2)	0
	Ce-141	10	0.0110	<LLD (0/ 8)	ALL <LLD		-----	<LLD (0/ 2)	0
	Ce-144	10	0.0260	<LLD (0/ 8)	ALL <LLD		-----	<LLD (0/ 2)	0
	Co-57	10	0.0030	<LLD (0/ 8)	ALL <LLD		-----	<LLD (0/ 2)	0
	Co-58	10	0.0090	<LLD (0/ 8)	ALL <LLD		-----	<LLD (0/ 2)	0
	Co-60	10	0.0090	0.0280(1/ 8) (0.028- 0.028)	Unit 1 Outfall 0.8 mi. SSW	0.0280(1/ 2) (0.028- 0.028)		<LLD (0/ 2)	0
	Cs-134	10	0.0080	<LLD (0/ 8)	ALL <LLD		-----	<LLD (0/ 2)	0
	Cs-137	10	0.0060	0.0567(3/ 8) (0.026- 0.083)	Unit 1 Outfall 0.8 mi. SSW	0.0720(2/ 2) (0.061- 0.083)		<LLD (0/ 2)	0
	Fe-59	10	0.0160	<LLD (0/ 8)	ALL <LLD		-----	<LLD (0/ 2)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 11 Semi-Annual Ocean Bottom Sediment Gamma Spectral Analysis (pCi/g)							
	I-131	10	0.0650	0.0100(1/ 8) (0.010- 0.010)	Unit 2 Outfall 1.6 mi. SW	0.0100(1/ 2) (0.010- 0.010)	<LLD (0/ 2)	0
	K-40	10	0.0700	12.200(8/ 8) (9.800-18.100)	Unit 3 Outfall 1.2 mi. SSW	13.950(2/ 2) (9.800-18.100)	13.100(2/ 2) (12.200-14.000)	0
	Mn-54	10	0.0060	0.0140(1/ 8) (0.014- 0.014)	Unit 1 Outfall 0.8 mi. SSW	0.0140(1/ 2) (0.014- 0.014)	<LLD (0/ 2)	0
	Mo(Tc)-99m	10	5.2280	0.0100(1/ 8) (0.010- 0.010)	Unit 1 Outfall 0.8 mi. SSW	0.0100(1/ 2) (0.010- 0.010)	<LLD (0/ 2)	0
	Ra-226	10	0.0120	0.4387(8/ 8) (0.120- 0.690)	Unit 1 Outfall 0.8 mi. SSW	0.5900(2/ 2) (0.590- 0.590)	0.3600(2/ 2) (0.260- 0.460)	0
	Ru-103	10	0.0080	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 2)	0
	Ru-106	10	0.0520	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 2)	0
	Th-228	10	0.0090	0.5738(8/ 8) (0.130- 0.950)	Unit 1 Outfall 0.8 mi. SSW	0.7750(2/ 2) (0.720- 0.830)	0.5100(2/ 2) (0.390- 0.630)	0
	Zn-65	10	0.0130	<LLD (0/ 8)	ALL <LLD	-----	<LLD (0/ 2)	0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean	Range	Control Locations Mean	Range	Number of Nonroutine Reported Measurements
Table 11 Semi-Annual Ocean Bottom Sediment Gamma Spectral Analysis (pCi/g)									
	Zr(Nb)-95	10	0.0130	<LLD (0/ 8)	ALL <LLD		-----		<LLD (0/ 2)	0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 12A Semi-Annual Non-Migratory Marine Animals Analysis (pCi/g) (flesh type)							
bay mussel	Ag-110m	2 0.0020	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
bay mussel	Ce-141	2 0.0040	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
bay mussel	Ce-144	2 0.0080	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
bay mussel	Co-57	2 0.0010	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
bay mussel	Co-58	2 0.0030	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
bay mussel	Co-60	2 0.0030	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
bay mussel	Cs-134	2 0.0020	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
bay mussel	Cs-137	2 0.0020	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
bay mussel	Fe-59	2 0.0070	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 12A Semi-Annual Non-Migratory Marine Animals Analysis (pCi/g) (flesh type)							
bay mussel	I-131	2	0.1670	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
bay mussel	K-40	2	0.0210	1.9300(2/ 2) (1.660- 2.200)	Units 2/3 Outfall 1.5 mi. SSW	1.9300(2/ 2) (1.660- 2.200)	<LLD (0/ 0)	0
bay mussel	Mn-54	2	0.0020	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
bay mussel	Mo(Tc)-99m	2	204.00	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
bay mussel	Ra-226	2	0.0340	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
bay mussel	Ru-103	2	0.0030	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
bay mussel	Ru-106	2	0.0150	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean	Range	Control Locations Mean	Range	Number of Nonroutine Reported Measurements
Table 12A Semi-Annual Non-Migratory Marine Animals Analysis (pCi/g) (flesh type)									
bay mussel	Th-228	2	0.0020	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)		0
bay mussel	Zn-65	2	0.0040	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)		0
bay mussel	Zr(Nb)-95	2	0.0050	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)		0
black perch	Ag-110m	5	0.0020	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)		0
black perch	Ce-141	5	0.0040	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)		0
black perch	Ce-144	5	0.0080	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)		0
black perch	Co-57	5	0.0010	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)		0
black perch	Co-58	5	0.0030	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)		0
black perch	Co-60	5	0.0030	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)		0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 12A Semi-Annual Non-Migratory Marine Animals Analysis (pCi/g) (flesh type)							
black perch	Cs-134	5	0.0020	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
black perch	Cs-137	5	0.0020	0.0100(1/ 3) (0.010- 0.010)	Unit 1 Outfall 0.9 mi. WSW	0.0100(1/ 1) (0.010- 0.010)	<LLD (0/ 2)	0
black perch	Fe-59	5	0.0070	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
black perch	I-131	5	0.1670	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
black perch	K-40	5	0.0210	2.6533(3/ 3) (2.100- 3.050)	Laguna Beach 18.2 mi. NW	3.7950(2/ 2) (3.500- 4.090)	3.7950(2/ 2) (3.500- 4.090)	0
black perch	Mn-54	5	0.0020	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
black perch	Mo(Tc)-99m	5	204.00	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 12A Semi-Annual Non-Migratory Marine Animals Analysis (pCi/g) (flesh type)							
black perch	Ra-226	5	0.0340	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
black perch	Ru-103	5	0.0030	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
black perch	Ru-106	5	0.0150	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
black perch	Th-228	5	0.0020	0.0210(1/ 3) (0.021- 0.021)	Units 2/3 Outfall 1.5 mi. SSW	0.0210(1/ 2) (0.021- 0.021)	<LLD (0/ 2)	0
black perch	Zn-65	5	0.0040	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
black perch	Zr(Nb)-95	5	0.0050	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
kelp bass	Ag-110m	1	0.0020	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
kelp bass	Ce-141	1	0.0040	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 12A Semi-Annual Non-Migratory Marine Animals Analysis (pCi/g) (flesh type)							
kelp bass	Ce-144	1	0.0080	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
kelp bass	Co-57	1	0.0010	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
kelp bass	Co-58	1	0.0030	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
kelp bass	Co-60	1	0.0030	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
kelp bass	Cs-134	1	0.0020	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
kelp bass	Cs-137	1	0.0020	0.0160(1/ 1) (0.016- 0.016)	Unit 1 Outfall 0.9 mi. WSW	0.0160(1/ 1) (0.016- 0.016)	<LLD (0/ 0)	0
kelp bass	Fe-59	1	0.0070	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 12A Semi-Annual Non-Migratory Marine Animals Analysis (pCi/g) (flesh type)							
kelp bass	I-131	1	0.1670	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
kelp bass	K-40	1	0.0210	3.7000(1/ 1) (3.700- 3.700)	Unit 1 Outfall 0.9 mi. WSW	3.7000(1/ 1) (3.700- 3.700)	<LLD (0/ 0)	0
kelp bass	Mn-54	1	0.0020	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
kelp bass	Mo(Tc)-99m	1	204.00	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
kelp bass	Ra-226	1	0.0340	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
kelp bass	Ru-103	1	0.0030	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
kelp bass	Ru-106	1	0.0150	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
kelp bass	Th-228	1	0.0020	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean	Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 12A Semi-Annual Non-Migratory Marine Animals Analysis (pCi/g) (flesh type)								
kelp bass	Zn-65	1	0.0040	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
kelp bass	Zr(Nb)-95	1	0.0050	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
keyhole limpet	Ag-110m	2	0.0020	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0
keyhole limpet	Ce-141	2	0.0040	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0
keyhole limpet	Ce-144	2	0.0080	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0
keyhole limpet	Co-57	2	0.0010	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0
keyhole limpet	Co-58	2	0.0030	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0
keyhole limpet	Co-60	2	0.0030	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0
keyhole limpet	Cs-134	2	0.0020	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 12A Semi-Annual Non-Migratory Marine Animals Analysis (pCi/g) (flesh type)							
keyhole limpet	Cs-137	2	0.0020	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0
keyhole limpet	Fe-59	2	0.0070	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0
keyhole limpet	I-131	2	0.1670	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0
keyhole limpet	K-40	2	0.0210	<LLD (0/ 0)	Laguna Beach 18.2 mi. NW	1.0200(2/ 2) (0.940- 1.100)	1.0200(2/ 2) (0.940- 1.100)	0
keyhole limpet	Mn-54	2	0.0020	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0
keyhole limpet	Mo(Tc)-99m	2	204.00	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0
keyhole limpet	Ra-226	2	0.0340	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 12A Semi-Annual Non-Migratory Marine Animals Analysis (pCi/g) (flesh type)							
keyhole limpet	Ru-103	2	0.0030	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0
keyhole limpet	Ru-106	2	0.0150	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0
keyhole limpet	Th-228	2	0.0020	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0
keyhole limpet	Zn-65	2	0.0040	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0
keyhole limpet	Zr(Nb)-95	2	0.0050	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0
sea hare	Ag-110m	2	0.0020	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
sea hare	Ce-141	2	0.0040	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
sea hare	Ce-144	2	0.0080	0.0100(1/ 2) (0.010- 0.010)	Unit 1 Outfall 0.9 mi. WSW	0.0100(1/ 2) (0.010- 0.010)	<LLD (0/ 0)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 12A Semi-Annual Non-Migratory Marine Animals Analysis (pCi/g) (flesh type)							
sea hare	Co-57	2	0.0010	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
sea hare	Co-58	2	0.0030	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
sea hare	Co-60	2	0.0030	0.0070(1/ 2) (0.007- 0.007)	Unit 1 Outfall 0.9 mi. WSW	0.0070(1/ 2) (0.007- 0.007)	<LLD (0/ 0)	0
sea hare	Cs-134	2	0.0020	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
sea hare	Cs-137	2	0.0020	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
sea hare	Fe-59	2	0.0070	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
sea hare	I-131	2	0.1670	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 12A Semi-Annual Non-Migratory Marine Animals Analysis (pCi/g) (flesh type)							
sea hare	K-40	2	0.0210	1.3450(2/ 2) (1.190- 1.500)	Unit 1 Outfall 0.9 mi. WSW	1.3450(2/ 2) (1.190- 1.500)	<LLD (0/ 0)	0
sea hare	Mn-54	2	0.0020	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
sea hare	Mo(Tc)-99m	2	204.00	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
sea hare	Ra-226	2	0.0340	0.0350(2/ 2) (0.020- 0.050)	Unit 1 Outfall 0.9 mi. WSW	0.0350(2/ 2) (0.020- 0.050)	<LLD (0/ 0)	0
sea hare	Ru-103	2	0.0030	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
sea hare	Ru-106	2	0.0150	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
sea hare	Th-228	2	0.0020	0.0480(2/ 2) (0.040- 0.056)	Unit 1 Outfall 0.9 mi. WSW	0.0480(2/ 2) (0.040- 0.056)	<LLD (0/ 0)	0
sea hare	Zn-65	2	0.0040	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 12A Semi-Annual Non-Migratory Marine Animals Analysis (pCi/g) (flesh type)							
sea hare	Zr(Nb)-95	2	0.0050	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0)	0
sheephead	Ag-110m	5	0.0020	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
sheephead	Ce-141	5	0.0040	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
sheephead	Ce-144	5	0.0080	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
sheephead	Co-57	5	0.0010	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
sheephead	Co-58	5	0.0030	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
sheephead	Co-60	5	0.0030	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
sheephead	Cs-134	5	0.0020	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
sheephead	Cs-137	5	0.0020	0.0055(2/ 3) (0.003- 0.008)	Units 2/3 Outfall 1.5 mi. SSW	0.0055(2/ 2) (0.003- 0.008)	<LLD (0/ 2)	0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 12A Semi-Annual Non-Migratory Marine Animals Analysis (pCi/g) (flesh type)							
sheephead	Fe-59	5	0.0070	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
sheephead	I-131	5	0.1670	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
sheephead	K-40	5	0.0210	3.4533(3/ 3) (2.930- 3.800)	Units 2/3 Outfall 1.5 mi. SSW	3.7150(2/ 2) (3.630- 3.800)	3.0600(2/ 2) (2.720- 3.400)	0
sheephead	Mn-54	5	0.0020	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
sheephead	Mo(Tc)-99m	5	204.00	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
sheephead	Ra-226	5	0.0340	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
sheephead	Ru-103	5	0.0030	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 12A Semi-Annual Non-Migratory Marine Animals Analysis (pCi/g) (flesh type)							
sheephead	Ru-106	5	0.0150	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
sheephead	Th-228	5	0.0020	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
sheephead	Zn-65	5	0.0040	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
sheephead	Zr(Nb)-95	5	0.0050	<LLD (0/ 3)	ALL <LLD	-----	<LLD (0/ 2)	0
spiny lobster	Ag-110m	6	0.0020	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 2)	0
spiny lobster	Ce-141	6	0.0040	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 2)	0
spiny lobster	Ce-144	6	0.0080	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 2)	0
spiny lobster	Co-57	6	0.0010	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 2)	0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 12A Semi-Annual Non-Migratory Marine Animals Analysis (pCi/g) (flesh type)							
spiny lobster	Co-58	6	0.0030	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 2)	0
spiny lobster	Co-60	6	0.0030	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 2)	0
spiny lobster	Cs-134	6	0.0020	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 2)	0
spiny lobster	Cs-137	6	0.0020	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 2)	0
spiny lobster	Fe-59	6	0.0070	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 2)	0
spiny lobster	I-131	6	0.1670	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 2)	0
spiny lobster	K-40	6	0.0210	3.5650(4/ 4) (2.890- 4.500)	Unit 1 Outfall 0.9 mi. WSW	3.9850(2/ 2) (3.470- 4.500)	3.2000(2/ 2) (2.800- 3.600)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 12A Semi-Annual Non-Migratory Marine Animals Analysis (pCi/g) (flesh type)							
spiny lobster	Mn-54	6	0.0020	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 2) 0
spiny lobster	Mo(Tc)-99m	6	204.00	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 2) 0
spiny lobster	Ra-226	6	0.0340	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 2) 0
spiny lobster	Ru-103	6	0.0030	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 2) 0
spiny lobster	Ru-106	6	0.0150	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 2) 0
spiny lobster	Th-228	6	0.0020	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 2) 0
spiny lobster	Zn-65	6	0.0040	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 2) 0
spiny lobster	Zr(Nb)-95	6	0.0050	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 2) 0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 12A Semi-Annual Non-Migratory Marine Animals Analysis (pCi/g) (flesh type)							
spotfin croaker	Ag-110m	1	0.0020	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
spotfin croaker	Ce-141	1	0.0040	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
spotfin croaker	Ce-144	1	0.0080	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
spotfin croaker	Co-57	1	0.0010	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
spotfin croaker	Co-58	1	0.0030	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
spotfin croaker	Co-60	1	0.0030	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
spotfin croaker	Cs-134	1	0.0020	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
spotfin croaker	Cs-137	1	0.0020	0.0070(1/ 1) (0.007- 0.007)	Unit 1 Outfall 0.9 mi. WSW	0.0070(1/ 1) (0.007- 0.007)	<LLD (0/ 0)	0
spotfin croaker	Fe-59	1	0.0070	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
spotfin croaker	I-131	1	0.1670	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 12A Semi-Annual Non-Migratory Marine Animals Analysis (pCi/g) (flesh type)							
spotfin croaker	K-40	1	0.0210	3.5000(1/ 1) (3.500- 3.500)	Unit 1 Outfall 0.9 mi. WSW	3.5000(1/ 1) (3.500- 3.500)	<LLD (0/ 0)	0
spotfin croaker	Mn-54	1	0.0020	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
spotfin croaker	Mo(Tc)-99m	1	204.00	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
spotfin croaker	Ra-226	1	0.0340	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
spotfin croaker	Ru-103	1	0.0030	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
spotfin croaker	Ru-106	1	0.0150	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean	Range	Control Locations Mean	Range	Number of Nonroutine Reported Measurements
Table 12A Semi-Annual Non-Migratory Marine Animals Analysis (pCi/g) (flesh type)									
spotfin croaker	Th-228	1	0.0020	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)		0
spotfin croaker	Zn-65	1	0.0040	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)		0
spotfin croaker	Zr(Nb)-95	1	0.0050	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)		0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 13A Semi-Annual Local Crops Gamma Spectral Analysis (pCi/g)							
cucumber	Ag-110m	2	0.0010	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0) 0
cucumber	Be-7	2	0.0050	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0) 0
cucumber	Ce-141	2	0.0010	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0) 0
cucumber	Ce-144	2	0.0020	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0) 0
cucumber	Co-58	2	0.0010	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0) 0
cucumber	Co-60	2	0.0010	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0) 0
cucumber	Cs-134	2	0.0010	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0) 0
cucumber	Cs-137	2	0.0010	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0) 0
cucumber	I-131	2	0.0080	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0) 0
cucumber	K-40	2	0.0060	1.5050(2/ 2) (1.300- 1.710)	San Mateo Canyon 2.6 mi. NW	1.5050(2/ 2) (1.300- 1.710)	<LLD (0/ 0) 0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 13A Semi-Annual Local Crops Gamma Spectral Analysis (pCi/g)							
cucumber	Ru-103	2	0.0010	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0) 0
cucumber	Zr(Nb)-95	2	0.0010	<LLD (0/ 2)	ALL <LLD	-----	<LLD (0/ 0) 0
squash	Ag-110m	2	0.0010	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2) 0
squash	Be-7	2	0.0050	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2) 0
squash	Ce-141	2	0.0010	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2) 0
squash	Ce-144	2	0.0020	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2) 0
squash	Co-58	2	0.0010	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2) 0
squash	Co-60	2	0.0010	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2) 0
squash	Cs-134	2	0.0010	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2) 0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 13A Semi-Annual Local Crops Gamma Spectral Analysis (pCi/g)							
squash	Cs-137	2	0.0010	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0
squash	I-131	2	0.0080	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0
squash	K-40	2	0.0060	<LLD (0/ 0)	SE of Oceanside 22 mi. SEside	2.8300(2/ 2) (2.060- 3.600)	2.8300(2/ 2) (2.060- 3.600)	0
squash	Ru-103	2	0.0010	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0
squash	Zr(Nb)-95	2	0.0010	<LLD (0/ 0)	ALL <LLD	-----	<LLD (0/ 2)	0
strawberries	Ag-110m	1	0.0010	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
strawberries	Be-7	1	0.0050	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
strawberries	Ce-141	1	0.0010	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
strawberries	Ce-144	1	0.0020	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 13A Semi-Annual Local Crops Gamma Spectral Analysis (pCi/g)							
strawberries	Co-58	1	0.0010	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
strawberries	Co-60	1	0.0010	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
strawberries	Cs-134	1	0.0010	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
strawberries	Cs-137	1	0.0010	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
strawberries	I-131	1	0.0080	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
strawberries	K-40	1	0.0060	1.4000(1/ 1) (1.400- 1.400)	San Mateo Canyon 2.6 mi. NW	1.4000(1/ 1) (1.400- 1.400)	<LLD (0/ 0)	0
strawberries	Ru-103	1	0.0010	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
strawberries	Zr(Nb)-95	1	0.0010	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 0)	0
tomato	Ag-110m	3	0.0010	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 2)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 13A Semi-Annual Local Crops Gamma Spectral Analysis (pCi/g)							
tomato	Be-7	3	0.0050	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 2) 0
tomato	Ce-141	3	0.0010	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 2) 0
tomato	Ce-144	3	0.0020	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 2) 0
tomato	Co-58	3	0.0010	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 2) 0
tomato	Co-60	3	0.0010	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 2) 0
tomato	Cs-134	3	0.0010	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 2) 0
tomato	Cs-137	3	0.0010	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 2) 0
tomato	I-131	3	0.0080	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 2) 0
tomato	K-40	3	0.0060	1.7100(1/ 1) (1.710- 1.710)	SE of Oceanside 22 mi. SEide	2.2900(2/ 2) (2.280- 2.300)	2.2900(2/ 2) 0 (2.280- 2.300)

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 13A Semi-Annual Local Crops Gamma Spectral Analysis (pCi/g)							
tomato	Ru-103	3	0.0010	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 2) 0
tomato	Zr(Nb)-95	3	0.0010	<LLD (0/ 1)	ALL <LLD	-----	<LLD (0/ 2) 0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 13B Semi-Annual Local Crops Strontium-90 Activity (pCi/g)							
cucumber	Sr-90	2	0.0002	0.0003(1/ 2)	San Mateo Canyon 2.6 mi. NW	0.0003(1/ 2) (0.0000-0.0003)	<LLD (0/ 0)	0
squash	Sr-90	2	0.0002	<LLD (0/ 0)	SE of Oceanside 22 mi. SE	0.0010(2/ 2) (0.0009-0.0010)	0.0010(2/ 2) (0.0009-0.0010)	0
strawberries	Sr-90	1	0.0002	0.0013(1/ 1)	San Mateo Canyon 2.6 mi. NW	0.0013(1/ 1) (0.0000-0.0013)	<LLD (0/ 0)	0
tomato	Sr-90	3	0.0002	<LLD (0/ 1)	SE of Oceanside 22 mi. SE	0.0001(0/ 2) (0.0000-0.0001)	0.0001(0/ 2) (0.0000-0.0001)	0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 14 Annual Soil Analysis - Depth: 3" (pCi/g)							
	Ag-110m 5	0.0050	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 1)	0
	Be-7 5	0.0610	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 1)	0
	Ce-141 5	0.0100	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 1)	0
	Ce-144 5	0.0250	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 1)	0
	Co-58 5	0.0080	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 1)	0
	Co-60 5	0.0080	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 1)	0
	Cs-134 5	0.0070	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 1)	0
	Cs-137 5	0.0060	0.0685(2/ 4) (0.059- 0.078)	Old Route 101-ESE 3.0 mi. ESE	0.0780(1/ 1) (0.078- 0.078)	0.0300(1/ 1) (0.030- 0.030)	0
	I-131 5	0.0620	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 1)	0
	K-40 5	0.0670	13.700(4/ 4) (6.400-17.200)	Huntington Beach Generating Station 37 mi. NW	19.400(1/ 1) (19.400-19.400)	19.400(1/ 1) (19.400-19.400)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean	Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 14 Annual Soil Analysis - Depth: 3" (pCi/g)								
	Ru-103	5	0.0070	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 1)	0
	Sr-89	5	0.0600	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 1)	0
	Sr-90	5	0.0600	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 1)	0
	Zn-65	5	0.0150	<LLD (0/ 4)	ALL <LLD	-----	<LLD (0/ 1)	0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 15 Semi-Annual Kelp Analysis (pCi/g)							
macrocystis p.	Ag-110m	8	0.0020	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
macrocystis p.	Ce-141	8	0.0040	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
macrocystis p.	Ce-144	8	0.0100	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
macrocystis p.	Co-57	8	0.0010	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
macrocystis p.	Co-58	8	0.0040	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
macrocystis p.	Co-60	8	0.0040	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
macrocystis p.	Cs-134	8	0.0030	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
macrocystis p.	Cs-137	8	0.0030	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
macrocystis p.	Fe-59	8	0.0070	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 15 Semi-Annual Kelp Analysis (pCi/g)							
macrocystis p.	I-131	8	0.0290	0.0185(2/ 6) (0.014- 0.023)	San Onofre Kelp Bed 1.5 mi. SSW	0.0230(1/ 2) (0.023- 0.023)	0.0160(1/ 2) (0.016- 0.016)	0
macrocystis p.	K-40	8	0.0310	8.9400(6/ 6) (6.100-11.400)	San Mateo Kelp Bed 3.8 mi. WNW	10.140(2/ 2) (8.880-11.400)	8.2400(2/ 2) (7.380- 9.100)	0
macrocystis p.	Mn-54	8	0.0030	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
macrocystis p.	Mo(Tc)-99m	8	2.0000	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
macrocystis p.	Ra-226	8	0.0050	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
macrocystis p.	Ru-103	8	0.0030	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
macrocystis p.	Ru-106	8	0.0210	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
macrocystis p.	Th-228	8	0.0030	0.0085(2/ 6) (0.007- 0.010)	San Mateo Kelp Bed 3.8 mi. WNW	0.0100(1/ 2) (0.010- 0.010)	<LLD (0/ 2)	0

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
SAN ONOFRE NUCLEAR GENERATING STATION

Docket Nos. 50-206, 50-361, 50-362
San Diego County, California

Reporting period: January 1, 1993 to December 31, 1993

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean Range	Location with Highest Annual Mean Name, Distance and Direction	Mean Range	Control Locations Mean Range	Number of Nonroutine Reported Measurements
Table 15 Semi-Annual Kelp Analysis (pCi/g)							
macrocystis p.	Zn-65	8	0.0060	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0
macrocystis p.	Zr(Nb)-95	8	0.0050	<LLD (0/ 6)	ALL <LLD	-----	<LLD (0/ 2)	0

APPENDIX C

SUMMARY OF 1993 INTERLABORATORY COMPARISON AND QUALITY CONTROL PROGRAMS

The results of the 1993 interlaboratory cross-check program between the Environmental Protection Agency (EPA) and our Contractor Environmental Analysis Laboratory (CEAL) have been summarized in this appendix (Table C-1). The mean results of cross-check analysis have been evaluated against the EPA control limits and corrective actions have been taken by our contractor laboratory for values exceeding the control limits. Likewise, the "normalized ranges" as calculated by EPA have been investigated against the control limit. Trend analyses for different matrices as a function of time were performed on a series of results to track the values that are within the control limits but which exhibit a trend toward these limits. No significant trends were observed in this investigation for the analytical data obtained.

The results of the internal quality control samples were evaluated for the contracted laboratory and no deviations were observed. Approximately, 10% of the samples are quality control samples.

The results of Department of Health Services (DHS) and SONGS radioanalytical data were also evaluated for the 1992 DHS data (split sampling program). The comparison of the data is documented on a yearly basis. The results indicate that for the most media, an acceptable correlation was obtained.

Table C-1
Results of 1993 Interlaboratory Cross-Check Program

Between Environmental Protection Agency (EPA) and Our Contractor
Environmental Analysis Laboratory (CEAL)

1993 Date	Sample Type	Analysis Type	Mean CEAL + s.d.	Known EPA + s.d.	Control Limit	R +SR
FEB	Water (pCi/l)			DELETED		
FEB	Water (pCi/l)			DELETED		
FEB	Water (pCi/l)			DELETED		
FEB	Water (pCi/l)			DELETED		
FEB	Water (pCi/l)			DELETED		
FEB	Water (pCi/l)			DELETED		
JUN	Water (pCi/l)	Co-60	13.67 ± 1.53	15.0 ± 5.0	6.3 - 23.7	0.354
JUN	Water (pCi/l)	Zn-65	110.33 ± 10.02	103.0 ± 10.0	85.7 - 120.3	1.345
JUN	Water (pCi/l)	Ru-106	117.67 ± 23.46	119.0 ± 12.0	98.2 - 139.8	3.314
JUN	Water (pCi/l)	Cs-134	5.67 ± 0.58	5.0 ± 5.0	0.0 - 13.7	0.118
JUN	Water (pCi/l)	Cs-137	8.33 ± 1.53	5.0 ± 5.0	0.0 - 13.7	0.354
JUN	Water (pCi/l)	Ba-133	97.67 ± 5.13	99.0 ± 10.0	81.7 - 116.3	0.591

Table C-1

Results of 1993 Interlaboratory Cross-Check Program

Between Environmental Protection Agency (EPA) and Our Contractor Environmental Analysis Laboratory (CEAL)

1993 Date	Sample Type	Analysis Type	Mean CEAL + s.d.	Known EPA + s.d.	Control Limit	R +SR
NOV	Water (pCi/l)	Co-60	14.00 ± 1.00	30.0 ± 5.0	21.3 - 38.7	*0.236
NOV	Water (pCi/l)	Zn-65	72.00 ± 4.00	150.0 ± 15.0	124.0 - 176.0	*0.315
NOV	Water (pCi/l)	Ru-106	76.33 ± 5.69	201.0 ± 20.0	166.3 - 235.7	*0.325
NOV	Water (pCi/l)	Cs-134	28.33 ± 1.53	59.0 ± 5.0	50.3 - 67.7	*0.354
NOV	Water (pCi/l)	Cs-137	17.33 ± 0.58	40.0 ± 5.0	31.3 - 048.7	*0.118
NOV	Water (pCi/l)	Ba-133	35.33 ± 2.52	79.0 ± 8.0	65.1 - 92.9	*0.369
FEB	Water (pCi/l)	I-131	99.33 ± 10.07	100.0 ± 10.0	82.7 - 117.3	1.435
OCT	Water (pCi/l)	I-131	122.33 ± 2.08	117.0 ± 12.0	96.2 - 137.8	0.197
JAN	Water (pCi/l)	Gross α	14.33 ± 1.53	34.0 ± 9.0	18.4 - 49.6	*0.197
JUL	Water (pCi/l)	Gross α	9.33 ± 1.53	15.0 ± 5.0	6.3 - 23.7	0.354
OCT	Water (pCi/l)	Gross α	23.67 ± 1.53	20.0 ± 5.0	11.3 - 28.7	0.354
JAN	Water (pCi/l)	Gross β	39.33 ± 1.53	44.0 ± 5.0	35.3 - 52.7	0.354

Table C-1
Results of 1993 Interlaboratory Cross-Check Program

Between Environmental Protection Agency (EPA) and Our Contractor
Environmental Analysis Laboratory (CEAL)

1993 Date	Sample Type	Analysis Type	Mean CEAL + s.d.	Known EPA + s.d.	Control Limit	R +SR
JUL	Water (pCi/l)	Gross β	33.00 ± 2.00	43.0 ± 6.9	31.0 - 55.0	0.431
OCT	Water (pCi/l)	Gross β	14.00 ± 0.00	15.0 ± 5.0	6.3 - 23.7	0.000
FEB	Water (pCi/l)	Tritium		DELETED		
JUN	Water (pCi/l)	Tritium	8404 ± 372.00	9844.0 ± 984.0	8137 - 11551	0.442
NOV	Water (pCi/l)	Tritium	5175 ± 53.00	7398.0 ± 740.0	6114 - 8682	*0.085
MAR	Water (pCi/l)	Ra-226	9.60 ± 0.95	9.8 ± 1.5	7.2 - 12.4	0.748
SEP	Water (pCi/l)	Ra-226	14.30 ± 0.20	14.9 ± 2.2	11.1 - 18.7	0.107
NOV	Water (pCi/l)	Ra-226		DELETED		
MAR	Water (pCi/l)	Ra-228	20.50 ± 1.76	18.5 ± 4.6	10.5 - 26.5	0.424

Table C-1

Results of 1993 Interlaboratory Cross-Check Program

Between Environmental Protection Agency (EPA) and Our Contractor Environmental Analysis Laboratory (CEAL)

1993 Date	Sample Type	Analysis Type	Mean CEAL + s.d.	Known EPA + s.d.	Control Limit	R +SR
SEPT	Water (pCi/l)	Ra-228	18.20 ± 1.05	20.4 ± 5.1	11.6 - 29.2	0.243
NOV	Water (pCi/l)	Ra-228		DELETED		
JAN	Water (pCi/l)	Pu-239	19.27 ± 1.50	20.0 ± 2.0	16.5 - 23.5	0.856
AUG	Water (pCi/l)	Pu-239				
JAN	Water (pCi/l)	Sr-90	7.67 ± 0.58	10.0 ± 5.0	1.3 - 18.7	0.118
JUL	Water (pCi/l)	Sr-90	26.00 ± 1.00	25.0 ± 5.0	16.3 - 33.7	0.236
SEP	Water (pCi/l)	Sr-90		DELETED		
FEB	Water (pCi/l)	U-238	6.77 ± 0.29	76.0 ± 3.0	2.4 - 12.8	0.098
AUG	Water (pCi/l)	U-238	27.00 ± 1.00	25.3 ± 3.0	20.1 - 30.5	0.394
NOV	Water (pCi/l)	U-238		DELETED		
APR	Water (pCi/l)	Gross α	108.00 ± 19.08	95.0 ± 24.0	53.4 ± 136.6	0.935

Table C-1
Results of 1993 Interlaboratory Cross-Check Program

Between Environmental Protection Agency (EPA) and Our Contractor
Environmental Analysis Laboratory (CEAL)

1993 Date	Sample Type	Analysis Type	Mean CEAL + s.d.	Known EPA + s.d.	Control Limit	R +SR
APR	Water (pCi/l)	Ra-226	26.97 ± 1.75	24.9 ± 3.7	18.5 ± 31.3	0.543
APR	Water (pCi/l)	Ra-228	ND Submitted	19.0 ± 4.8	10.7 ± 27.3	*ND
APR	Water (pCi/l)	U-(nat)	31.20 ± 0.36	28.9 ± 3.0	23.7 ± 34.1	0.138
APR	Water (pCi/l)	Gross β	148.33 ± 5.51	177.0 ± 27.0	130.2 - 223.8	0.219
APR	Water (pCi/l)	Sr-89	28.00 ± 2.65	41.0 ± 5.0	32.3 - 49.7	*0.591
APR	Water (pCi/l)	Sr-90	29.33 ± 0.58	29.0 ± 5.0	20.3 - 37.7	0.118
APR	Water (pCi/l)	Co-60	37.00 ± 2.65	39.0 ± 5.0	30.3 - 47.7	0.591
APR	Water (pCi/l)	Cs-134	31.00 ± 1.00	27.0 ± 5.0	18.3 - 35.7	0.236
APR	Water (pCi/l)	Cs-137	30.67 ± 3.21	32.0 ± 5.0	23.3 - 40.7	0.709
OCT	Water (pCi/l)	Gross α	37.33 ± 3.06	40.0 ± 10.0	22.7 ± 57.3	0.354
OCT	Water (pCi/l)	Ra-226	10.23 ± 0.84	9.9 ± 1.5	7.3 - 12.5	0.591
OCT	Water (pCi/l)	Ra-228	11.73 ± 0.87	12.5 ± 3.0	7.1 - 17.9	0.324

Table C-1

Results of 1993 Interlaboratory Cross-Check Program

Between Environmental Protection Agency (EPA) and Our Contractor Environmental Analysis Laboratory (CEAL)

1993 Date	Sample Type	Analysis Type	Mean CEAL + s.d.	Known EPA + s.d.	Control Limit	R +SR
OCT	Water (pCi/l)	U(nat)	21.70 ± 0.20	15.1 ± 3.0	9.9 - 20.3	0.079
OCT	Water (pCi/l)	Gross β	68.33 ± 4.73	58.0 ± 10.0	40.7 - 75.3	0.532
OCT	Water (pCi/l)	Sr-89	12.67 ± 0.58	15.0 ± 5.0	6.3 - 23.7	0.118
OCT	Water (pCi/l)	SR-90	11.67 ± 0.58	10.0 ± 5.0	1.3 - 18.7	0.118
OCT	Water (pCi/l)	Co-60	8.33 ± 1.11	10.0 ± 5.0	1.3 - 18.7	0.236
OCT	Water (pCi/l)	Cs-134	8.67 ± 1.53	12.0 ± 5.0	3.3 - 20.7	0.354
OCT	Water (pCi/l)	Cs-137	9.33 ± 0.58	10.0 ± 5.0	1.3 - 18.7	0.118
MAR	Air Filter (pCi/filter)	Gross α		DELETED		
AUG	Air Filter (pCi/filter)	Gross α	16.67 ± 0.58	19.0 ± 5.0	10.3 - 27.7	0.118
MAR	Air Filter (pCi/filter)	Gross β		DELETED		
AUG	Air Filter (pCi/filter)	Gross β	49.67 ± 1.53	47.0 ± 5.0	38.3 - 55.7	0.354

Table C-1
Results of 1993 Interlaboratory Cross-Check Program

Between Environmental Protection Agency (EPA) and Our Contractor
Environmental Analysis Laboratory (CEAL)

1993 Date	Sample Type	Analysis Type	Mean CEAL + s.d.	Known EPA + s.d.	Control Limit	R +SR
MAR	Air Filter (pCi/filter)	Sr-90		DELETED		
AUG	Air Filter (pCi/filter)	Sr-90	17.00 ± 1.00	19.0 ± 5.0	10.3 - 27.7	0.236
MAR	Air Filter (pCi/filter)	Ca-137		DELETED		
AUG	Air Filter (pCi/filter)	Ca-137	8.33 ± 0.58	9.0 ± 5.0	0.3 - 17.7	0.118

Table C-1 (continued)
Results of 1993 Interlaboratory Cross-Check Program

Between Environmental Protection Agency (EPA) and our Contractor
Environmental Analysis Laboratory (CEAL)

The results of the interlaboratory cross-check program showed that 16.7% of the samples fell outside of the control limits range, which is within the (15-20%) the acceptance criterion. The errors were randomly distributed among all of the different samples and different analyses. The values indicated by asterisks were outside of the control limits established by the EPA and corrective actions were taken to eliminate the problems. No food samples were provided by EPA in 1993.

It should be noted that milk is not a pathway at SONGS and, therefore, the laboratory is not committed to performing milk analysis.

Corrective actions were taken for the analyses outside the EPA control limits to prevent recurrence.

*	**Data falling outside of the control limits.**
ND	**EPA provided the samples but no data was provided by the contracted laboratory.**
D	**Deleted from the EPA cross-check program.**

APPENDIX D

ENVIRONMENTAL DOSE CALCULATIONS AND CORRELATION OF EFFLUENT RELEASES WITH ENVIRONMENTAL CONCENTRATIONS FOR 1993

DOSE CALCULATIONS:

Results of ingestion dose calculations have been listed in Table D-1. Data show that the ingestion dose due to consumption of marine species is a very small fraction of the maximum permissible dose, and in most cases the dose is too low (i.e., zero) to be considered significant. The dose values in the table have been calculated by using the USNRC Regulatory Guide 1.109 parameters. The fish consumption rates of 6.9, 16, and 21 kg/year for child, teen, and adult have been taken from Table E-5 of the Guide. Ingestion dose factors for radionuclides of interest in mrem per picocurie ingested were taken from Tables E-11 through E-13 of the Regulatory Guide 1.109.

Table D-2 summarizes the dose calculated based on maximum environmental concentration detected in the samples. This table also compares the environmental doses to the regulatory limits.

Liquid Effluent:

Table D-3 compares measured environmental concentrations with the projected concentrations based on 1993 effluent releases. To calculate the concentrations of radionuclides in different media, Regulatory Guide 1.109 methodology was used. For fish, Equation A-3 of the Guide was used assuming no dilution factor (mixing ratio of 1.0) For shoreline sediments, Equation A-4 of the Guide was used to calculate the projected concentration corresponding to 1993 liquid effluents releases. For kelp, concentrations of radionuclides were calculated using parameters used for marine species.

Gaseous Effluents:

Radionuclides concentrations were estimated using deposition factors used at the sampling locations distances for local crops, surface density of vegetation using NRC values for dry vegetation density as listed in the NRC Radiological Assessment text book, Table 5.2 and 1993 curies released at San Onofre. A comparison was made of the TLD doses measured at the vicinity of San Onofre, to calculated ones, using R_i (dose parameters) for the gaseous effluents for those locations where environmental TLDs existed. The dose calculated from R_i is basically the ground dose due to deposition of plant-related radionuclides while the environmental TLD doses are a combination of natural radioactivity in the soil, contribution of cosmic rays and radionuclides of the gaseous effluent released by the plant. Therefore, a comparison of such doses is not valid due to these other contributing factors. Most of the ground doses are zero while the background is subtracted and correction for cosmic contribution is made indicating that the plant effects are negligible. That same comparison can be made for gross beta measured in air versus the actual predicted concentration based on 1993 releases and X/Q (dispersion factor) but the results are not valid due to naturally-occurring radionuclide contributions to the gross beta radioactivity.

TABLE D-1

MAXIMUM WHOLE BODY (CRITICAL ORGAN) INGESTION DOSE FOR SONGS UNITS 1, 2 AND 3 IN MREM/YEAR (1993)

Radionuclide (Critical Organ)	Concentration (pCi/g, Wet Weight)	Species Type	Annual Whole Body Dose (Critical Organ) Child	Teen	Adult
Co-60	0.007	seahare	7.53 E-4	7.09 E-4	6.94 E-4
(GI-LLI)		"	(1.42 E-3)	(4.10 E-3)	(5.91 E-3)
Cs-137	0.016	kelp bass	5.10 E-3	1.33 E-2	2.40 E-2
(liver)*		"	(3.61 E-2)	(3.81 E-2)	(3.66 E-2)
Ce-144	0.010	seahare	7.66 E-6	5.98 E-6	5.55 E-6
(GI-LLI)			(1.17 E-2)	(2.80 E-2)	(3.46 E-2)

DOSE CONVERSION FACTORS (MREM/pCi)**

	Child	Teen	Adult
Co-60 Whole Body	1.56E-5	6.33E-6	4.72E-6
Co-60 (Critical Organ)	(2.93E-5)	(3.66E-5)	(4.02E-5)
Cs-137 Whole Body	4.62E-5	5.19E-5	7.14E-5
Cs-137 (Critical Organ)	(3.27E-4)	(1.49E-4)	(1.09E-4)
Ce-144 Whole body	1.11E-07	3.74E-08	2.62E-08
Ce-144 (Critical Organ)	(1.70E-04)	(1.75E-04)	(1.65E-04)

Note: Numbers in parenthesis show the dose calculated to critical organ. Annual whole body dose limit is 3 mrem (per reactor), and critical organ dose limit is 10 mrem (per reactor) for the liquid effluent.

* For child the critical organ is bone
** Values obtained from Regulatory Guide 1.109, Tables E-11 through E-13

TABLE D-2

SUMMARY OF ENVIRONMENTAL DOSES AND COMPARISON WITH REGULATORY LIMITS
1993

MEDIA	MAX CONC DETECTED	NRC RL	% OF NRC	CAL DOSE (mrem/year)	DOSE LIMIT	% DOSE LIMIT	COMMENTS
TLD (Direct Radiation)	--	--	--	0.46 (direct exposure)	25 mrem 40CFR190	0.46	This is normalized for an occupancy factor of 1.0 at Horno Canyon at 4.7 miles, east direction.
AIR PARTICULATES	All gaseous effluent radionuclides	--	--	2.06E-02 (Inhalation)	15 mrem 10CFR50, Appendix I	0.14	San Onofre Mobile Home Park is the critical receptor at 1.3 miles in Sector Q.
OCEAN WATER	Tritium = 136 pCi/l	3E+6 pCi/l	0.0045	--	---	---	Tritium at Unit 3 outfall.
DRINKING WATER	All = <LLD	2E+4 pCi/l	0.0	--	3 mrem whole body 10 mrem critical organ	0.0 0.0	This is tritium ingestion dose with child being the limiting age group. (No pathway at SONGS)
SHORELINE SEDIMENT	Cs-137 = 0.013 pCi/g			<0.001 (shoreline exposure)	15 mrem 10CFR50, Appendix I	0.001	This is exposure dose from Cs-137 with teen being the limiting age group.
LOCAL CROPS	Sr-90 = 0.001 pCi/g	--	--	<0.10 (ingestion)	15 mrem 10CFR50, Appendix I	<0.70	This is the dose from Sr-90 ingestion based on a given crop consumption rate per year.
SOIL (GROUND PLANE)	All gaseous effluent radionuclides	--	--	<0.01 (ground exposure)	15 mrem 10CFR50, Appendix I	<0.07	This is ground dose from all radionuclides in the gaseous effluents for the critical receptor.
KELP	All = <LLD	--	--	<0.01 (ingestion)	15 mrem 10CFR50, Appendix I	<0.07	This is the dose from Cs-137 ingestion of kelp to an adult's whole body.

TABLE D-3

COMPARISON OF 1993 ENVIRONMENTAL CONCENTRATIONS
TO PROJECTED VALUES BASED ON EFFLUENT RELEASE

RADIONUCLIDE	PATHWAY	1993 RELEASES (Ci)*	PATHWAY	PREDICTED CONCENTRATION pCi/g, wet	MEASURED CONCENTRATION pCi/g, wet
Mn-54	Fish	6.40E-3	Liquid	2.16E-3	<LLD (0.002)
Co-58	Fish	9.94E-2	Liquid	6.10E-3	<LLD (0.003)
Co-60	Fish	7.98E-2	Liquid	4.90E-3	<LLD (0.003)
Cs-134	Fish	4.92E-1	Liquid	1.21E-2	<LLD (0.002)
Cs-137	Fish	5.74E-1	Liquid	1.41E-2	1.6E-2**
Mn-54	Kelp	6.40E-3	Liquid	2.16E-3	<LLD (0.003)
Co-58	Kelp	9.94E-2	Liquid	6.10E-3	<LLD (0.004)
Co-60	Kelp	7.98E-2	Liquid	4.90E-3	<LLD (0.004)
Cs-134	Kelp	4.92E-1	Liquid	1.21E-2	<LLD (0.003)
Cs-137	Kelp	5.74E-1	Liquid	1.41E-2	<LLD (0.003)
Mn-54	Shoreline	6.40E-3	Liquid	1.53E-4	<LLD (0.006)
Co-58	Shoreline	9.94E-2	Liquid	5.34E-4	<LLD (0.009)
Co-60	Shoreline	7.98E-2	Liquid	1.01E-2	<LLD (0.009)
Cs-134	Shoreline	4.92E-1	Liquid	2.82E-2	<LLD (0.008)
Cs-137	Shoreline	5.74E-1	Liquid	1.41E-1	<LLD (0.006)
Mn-54	Local Crops	1.20E-5	Gaseous	5.30E-3	<LLD ---
Co-58	Local Crops	1.56E-3	Gaseous	6.89E-3	<LLD (0.001)
Co-60	Local Crops	7.94E-5	Gaseous	4.00E-4	<LLD (0.001)
Cs-134	Local Crops	2.46E-5	Gaseous	1.09E-4	<LLD (0.001)
Cs-137	Local Crops	3.98E-5	Gaseous	1.76E-4	<LLD (0.001)
Sr-90	Local Crops	0	Gaseous	0.00E-0	0.001(0.0002)

* These are total Unit 1 and Units 2/3 releases.

** Average concentration of indicator species, maximum concentration of cesium-137 in the samples was 1.6E-2 pCi/g in 1993.

APPENDIX E

HISTORICAL TRENDING

SOIL

Surface Soil samples, although not a requirement of the ODCM, are collected at 3-inch depth annually from Basilone Road, the East Site Boundary, Camp San Onofre, Old Highway 101 (which served as indicator locations), and from Huntington Beach (which served as the control location).

Over the past several years, minute amounts of naturally-occurring and station-related radionuclides have been detected in soil samples collected near San Onofre and in Huntington Beach control. There were detectable differences in the amounts of naturally-occurring potassium-40 seen in samples collected from each of the locations. The difference in the levels, however, is considered indicative of this particular environment. Strontium-90 and cesium-137 were also detected in samples from both the indicator and control locations at different frequencies, in a narrow concentration range. Although detectable, there is no indication that either strontium-90 or cesium-137 is accumulating in the soil near San Onofre. Because Sr-90 and Cs-137 are detected in control locations, and Co-60 is not detected at any location, we concluded that the Sr-90 and Cs-137 are likely due to fallout from weapons testing.

SHORELINE SEDIMENT (SAND)

Shoreline sediment samples are collected semiannually from San Onofre State Beach (0.6 and 3.1 miles southeast of SONGS) and San Onofre Surfing Beach (0.9 mile Northwest) as well as from Newport Beach which serves as the control location.

Cesium-137, a station-related radionuclide, was most frequently detected in several samples of San Onofre Surfing Beach (Table E-2). The range of Cs-137 in these samples was from below detectability to 0.038 pCi/g. The concentration of cesium-137 in all other samples was below the lower limit of detection of 0.006 pCi/g.

Cesium-137 was also detected in Newport Beach control samples. Its presence in the control location 30 miles away from the plant may then be attributed to the natural radioactivity fallout and nuclear weapons testing of the past few decades. Over the past several years, naturally-occurring radionuclides have been detected in varying amounts and at different frequencies in sand samples collected from both the indicator and control locations. The difference in levels of potassium-40, radium-226, and thorium-228 is considered a characteristic of this particular environment. There is also no indication that any station-related radionuclides are accumulating in the environment since they have been below detection limits most of the time in the recent years.

TABLE E-1

CONCENTRATION OF RADIONUCLIDES IN SOIL (pCi/g. dry weight)
(1975 - 1985)

LOCATION	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1. CAMP SAN ONOFRE											
Co-60	--	--	--	--	--	--	--	<LLD	<LLD	<LLD	<LLD
Sr-90	0.03	0.05	0.04	0.05	0.05	0.05	0.02	0.04	0.02	0.04	<LLD
Cs-137	<LLD	0.084	0.09	0.05	<LLD	0.06	0.15	0.02	0.05	0.14	<LLD
2. OLD HIGHWAY 101											
Co-60	--	--	--	--	--	--	--	<LLD	<LLD	<LLD	<LLD
Sr-90	<LLD	<LLD	<LLD	0.02	0.04	<LLD	0.05	0.05	0.03	0.02	0.03
Cs-137	0.088	<LLD	<LLD	<LLD	0.06	<LLD	0.013	0.03	<LLD	0.04	0.08
3. BASILONE ROAD											
Co-60	--	--	--	--	--	--	--	<LLD	<LLD	<LLD	<LLD
Sr-90	<LLD	<LLD	<LLD	0.09	<LLD	<LLD	<LLD	0.02	<LLD	<LLD	<LLD
Cs-137	--	--	<LLD	0.10	<LLD	0.02	<LLD	<LLD	<LLD	<LLD	0.04
4. HUNTINGTON BEACH (Control)											
Co-60	--	--	--	--	--	--	--	--	<LLD	<LLD	<LLD
Sr-90	0.06	<LLD	--	0.04	<LLD	0.03	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	0.042	<LLD	0.040	0.12	<LLD	0.06	<LLD	--	0.07	0.12	<LLD
5. FORMER VISITOR CENTER											
Co-60	--	--	--	--	--	--	--	<LLD	<LLD	<LLD	--
Sr-90	0.022	0.09	--	<LLD	0.08	0.02	<LLD	0.02	<LLD	0.01	0.02
Cs-137	<LLD	0.17	0.04	<LLD	0.20	<LLD	0.05	<LLD	<LLD	<LLD	<LLD

TABLE E-1 (Continued)

CONCENTRATION OF RADIONUCLIDES IN SOIL (pCi/g. dry weight)
(1986 - 1993)

LOCATION	1986	1987	1988	1989	1990	1991	1992	1993
1. CAMP SAN ONOFRE								
Co-60	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	0.03	<LLD	0.04	0.02	<LLD	<LLD	<LLD	
Cs-137	0.11	0.13	0.09	0.09	0.07	0.08	0.10	0.059
2. OLD HIGHWAY 101								
Co-60	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	0.02	<LLD	0.02	<LLD	<LLD	<LLD	<LLD	
Cs-137	0.03	0.03	0.07	<LLD	0.04	0.11	0.40	0.078
3. BASILONE ROAD								
Co-60	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	
Cs-137	<LLD	0.03	<LLD	<LLD	<LLD	0.06	<LLD	<LLD
4. HUNTINGTON BEACH								
Co-60	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	0.02	<LLD	0.02	<LLD	<LLD	<LLD	<LLD	
Cs-137	<LLD	<LLD	0.04	<LLD	0.05	0.04	0.07	0.030
5. EAST SITE BOUNDARY*								
Co-60	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Sr-90	0.04	<LLD	0.04	0.04	<LLD	<LLD	<LLD	
Cs-137	<LLD	<LLD	<LLD	0.18	0.13	0.03	<LLD	<LLD

<LLD - Less than the Lower Limit of Detection as listed in Table 14 of the Appendix B.

TABLE E-2

CONCENTRATIONS OF CESIUM-137 DETECTED IN SAND(pCi/g, wet weight)
(1974-1993)

LOCATION	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1. San Onofre State Beach (0.6 mi SE)	<LLD <LLD	<LLD 0.009	<LLD <LLD	<LLD <LLD	<LLD 0.017	<LLD <LLD	<LLD 0.02	0.02 <LLD	<LLD <LLD	<LLD <LLD
2. San Onofre Surfing Beach	-- <LLD	0.021 0.028	0.016 0.015	0.038 <LLD	0.026 0.011	<LLD 0.022	0.012 <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD
3. San Onofre State Beach (3.1 mi SE)	<LLD <LLD	0.016 <LLD	0.012 <LLD	<LLD <LLD	0.024 <LLD	0.022 <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD	0.02 <LLD
4. Newport Beach Control	<LLD 0.01 5	<LLD <LLD	0.015 <LLD	0.021 0.019	0.028 0.04	<LLD 0.032	<LLD <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD

LOCATION	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1. San Onofre State Beach (0.6 mi SE)	<LLD <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD	0.01 0.04	0.01 <LLD	<LLD <LLD	<LLD <LLD
2. San Onofre Surfing Beach	<LLD <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD	<LLD 0.02	<LLD <LLD	<LLD0 0.013
3. San Onofre State Beach (3.1 mi SE)	<LLD <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD	0.03 <LLD	<LLD <LLD
4. Newport Beach Control	<LLD <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD	<LLD <LLD

AIRBORNE PARTICULATES

Weekly air samples were collected from a number of indicator locations, and from a control location situated in Huntington Beach. The samples were subsequently analyzed for gross beta activity. Average quarterly gross beta activity for this time frame is presented in Table E-3.

To determine whether or not there are any trends toward increasing gross beta activities with time, calculated average quarterly gross beta activities from each indicator location were compared to equivalent data from the Huntington Beach control location. Over the past several years, the average quarterly gross beta activities measured in San Clemente have been consistently below the levels measured in samples from Huntington Beach. Average quarterly gross beta activities measured at the other indicator locations, however, have fluctuated unpredictably, and have often been below the levels measured in samples from Huntington Beach.

A review of the data indicates that there are no trends toward increasing levels of gross beta activity in the air near SONGS, and that the operations of SONGS have had a negligible detectable impact on this environmental medium.

RADIOIODINE

Charcoal cartridges were used for collection and adsorption of I-131 in air samples. The concentration of radioactive iodine in all samples collected from the indicator and control locations below the lower limit of detection. The lower limit of detection (LLD) of I-131 in air samples is 0.033 pCi/m^3.

LOCAL CROPS

During the period of 1965 through 1993, several samples of representative fleshy and a few leafy vegetables were collected at harvest time from the San Mateo Canyons (San Clemente Ranch), which serves as the indicator location, and a location situated SSE of Oceanside. Upon collection, the samples were analyzed for 12 naturally- occurring, and station-related gamma-emitting radionuclides, and for strontium-90. Radionuclides detected during this time period include beryllium-7, potassium-40, strontium-90, and organically-bound tritium. A summary of the radioanalytical data is presented in Table E-4.

Strontium-90 was detected in several crop samples collected from the indicator and control locations over the period of time and its concentration in the indicator samples ranged from below the lower limit of detection of 0.0002 to 0.066 pCi/g wet in June of 1975. Strontium-90 was detected in several samples collected from the control location (SSE of Oceanside). The maximum concentration of strontium-90 in the kale samples collected from SSE of Oceanside was 0.027 pCi/g, wet in 1982. Interestingly, strontium-90 has been detected more frequently in the crop samples of the control than in indicator samples.

Aqueous and organically-bound tritium were deleted from the sampling program in 1993.

TABLE E-3

QUARTERLY AVERAGE OF THE WEEKLY GROSS BETA ACTIVITY DETECTED IN AIR (pCi/m^3)
(1987 - 1990)

YEAR	QTR.	LOC 1 SAN CLEMENTE	LOC 2 CAMP SAN ONOFRE	LOC 3 HUNTINGTON BEACH	LOC 9 STATE BEACH PARK	LOC 10 BLUFF	LOC 11 MESA EOF	LOC 12 EVAPOR POND	LOC 13 MCB* EAST
1987	1	0.017	0.021	0.018	0.018	0.018	0.022	0.020	--
1987	2	0.017	0.018	0.015	0.016	0.019	0.022	0.019	--
1987	3	0.017	0.022	0.020	0.019	0.022	0.026	0.018	--
1987	4	0.023	0.029	0.023	0.023	0.028	0.029	0.025	--
									--
1988	1	0.019	0.022	0.018	0.018	0.025	0.023	0.020	--
1988	2	0.012	0.017	0.014	0.012	0.018	0.017	0.015	--
1988	3	0.016	0.022	0.018	0.014	0.021	0.021	0.019	0.020
1988	4	0.018	0.026	0.028	0.019	0.026	0.028	0.022	0.021
1989	1	0.016	0.023	0.019	0.017	0.024	0.021	0.017	0.019
1989	2	0.012	0.017	0.013	0.013	0.015	0.016	0.015	0.014
1989	3	0.012	0.019	0.014	0.014	0.019	0.018	0.018	0.015
1989	4	0.018	0.029	0.028	0.022	0.034	0.034	0.032	0.023
1990	1	0.015	0.020	0.020	0.017	0.018	0.021	0.020	0.016
1990	2	0.013	0.016	0.012	0.012	0.015	0.016	0.014	0.013
1990	3	0.012	0.016	0.014	0.012	0.014	0.015	0.014	0.016
1990	4	0.020	0.021	0.022	0.014	0.024	0.025	0.022	0.022

TABLE E-3 (continued)

QUARTERLY AVERAGE OF THE WEEKLY GROSS BETA ACTIVITY DETECTED IN AIR (pCi/m^3)
(1991 - 1993)

YEAR	QTR.	LOC 1 SAN CLEMENTE	LOC 2 CAMP SAN ONOFRE	LOC 3 HUNTINGTON BEACH	LOC 9 STATE BEACH PARK	LOC 10 BLUFF	LOC 11 MESA EOF	LOC 12 EVAPOR POND	LOC 13 MCB* EAST
1991	1	0.013	0.006	0.019	0.011	0.020	0.022	0.018	0.015
1991	2	0.010	0.010	0.010	0.009	0.012	0.013	0.012	0.011
1991	3	0.007	0.014	0.009	0.008	0.012	0.014	0.013	0.012
1991	4	0.018	0.025	0.022	0.021	0.024	0.029	0.029	0.023
1992	1	0.010	0.016	0.015	0.012	0.013	0.017	0.015	0.005
1992	2	0.011	0.015	0.012	0.011	0.016	0.014	0.015	0.013
1992	3	0.014	0.016	0.012	0.011	0.013	0.016	0.013	0.015
1992	4	0.023	0.020	0.024	0.021	0.021	0.026	0.021	0.022
1993	1	0.011	0.011	0.014	0.012	0.010	0.012	0.012	0.012
1993	2	0.010	0.010	0.010	0.011	0.010	0.013	0.012	0.011
1993	3	0.014	0.013	0.015	0.012	0.016	0.016	0.015	0.014
1993	4	0.026	0.021	0.029	0.024	0.028	0.030	0.028	0.024

TABLE E-4

STRONTIUM-90 CONCENTRATION IN LOCAL CROPS (pCi/g, wet)
(1965-1993)

COLLECTION DATE	SPECIES	LOCATION 1	LOCATION 2
04/02/65	Cabbage	0.008 0.062	--
10/08/74	"	0.062	--
06/23/75	"	0.066	--
04/07/76	"	0.016	--
04/04/78	"	<LLD	--
11/29/79	"	<LLD	--
04/07/76	Cauliflower	0.047	--
04/04/78	"	<LLD	--
12/13/82	"	0.007	--
06/05/85	"	<LLD	--
11/10/86	"	<LLD	--
06/10/87	"	<LLD	--
12/01/88	"	<LLD	--
11/27/89	"	<LLD	--
06/04/90	"	0.002	--
12/31/90	"	0.0004	--
05/30/91	"	0.0006	--
01/08/65	Celery	<LLD	--
08/21/75	Corn	<LLD	<LLD
08/19/76	"	<LLD	<LLD
08/15/78 09/14/78	"	<LLD --	-- <LLD
08/17/80 09/01/80	" "	<LLD --	-- <LLD
09/02/81	"	<LLD	--
06/25/86	"	<LLD	--
06/23/88	"	<LLD	--

TABLE E-4 (Continued)

STRONTIUM-90 CONCENTRATION IN LOCAL CROPS (pCi/g, wet)
(1965-1993)

COLLECTION DATE	SPECIES	LOCATION 1	LOCATION 2
06/29/89	Corn	<LLD	--
06/23/75	Cucumber	--	0.077
05/18/76	"	--	0.07
07/01/77 05/27/77	"	<LLD --	-- <LLD
06/23/78	"	--	0.04
06/26/79 11/29/79	"	<LLD <LLD	-- --
09/02/81	"	<LLD	--
06/30/82	"	<LLD	--
06/29/83 09/28/83	"	<LLD <LLD	-- --
06/18/84 09/18/84	"	<LLD <LLD	-- --
06/05/85 09/25/85	"	<LLD <LLD	-- --
06/25/86	"	<LLD	--
06/10/87 10/28/87	"	<LLD <LLD	-- <LLD
06/23/88 12/01/88	"	<LLD <LLD	<LLD <LLD
11/27/89	"	<LLD	--
06/04/90 12/31/90	"	-- --	0.0002 0.0003
11/07/91 06/05/91	"	0.0001 --	-- 0.0007
06/22/92 11/02/92	"	<LLD 0.0004	-- --
04/26/93 10/14/93	"	0.0003 <LLD	-- --

TABLE E-4 (Continued)

STRONTIUM-90 CONCENTRATION IN LOCAL CROPS (pCi/g, wet)
(1965-1993)

COLLECTION DATE	SPECIES	LOCATION 1	LOCATION 2
06/26/79	Green Beans	<LLD	--
06/18/84		--	<LLD
06/10/87	"	--	<LLD
06/03/90	"	0.001	--
05/29/91	"	0.0008	--
06/30/82 12/14/82	Kale	-- --	0.027 0.014
08/15/83 09/28/83	"	-- --	0.026 0.018
09/19/84	"	--	0.015
09/25/85	"	--	<LLD
06/25/86 11/10/86	"	-- --	0.01 0.011
04/08/66	Lettuce	0.03	--
06/11/81 09/02/81	Parsley	-- --	0.09 <LLD
06/11/81	Red Cabbage	<LLD	--
11/02/92	Red Pepper	<LLD	--
10/08/74	Squash	0.025	--
05/18/76	"	--	<LLD
06/23/78	"	--	0.06
06/26/79 11/29/79	"	-- --	0.05 <LLD
06/05/85	"	--	<LLD
11/27/89	"	--	<LLD

TABLE E-4 (Continued)

STRONTIUM-90 CONCENTRATION IN LOCAL CROPS (pCi/g, wet)
(1965-1993)

COLLECTION DATE	SPECIES	LOCATION 1	LOCATION 2
12/31/90	"	--	0.0007
06/05/91	Squash	--	0.0004
11/07/91		--	0.0002
04/26/93	"	--	0.0009
10/14/93		--	0.0010
04/02/65	Strawberries	0.029	--
05/27/77	"	--	<LLD
04/26/93	"	0.0013	--
06/05/85	String Beans	--	<LLD
01/08/65	Tomato	<LLD	--
07/09/65		0.0028	--
10/08/74	"	<LLD	--
10/09/74		--	0.046
01/07/75	"	0.013	--
01/08/75		--	0.019
08/21/75		0.018	0.015
08/19/76	"	<LLD	<LLD
01/11/77	"	<LLD	<LLD
12/07/77		<LLD	--
08/15/78	"	--	<LLD
09/14/78		<LLD	--
06/26/79	"	<LLD	--
11/29/79		<LLD	<LLD
08/17/80	"	--	<LLD
09/01/80		<LLD	--
06/11/81	"	<LLD	<LLD
09/02/81		--	<LLD
06/30/82	"	<LLD	<LLD
12/13/82		<LLD	--
12/14/82		--	<LLD

TABLE E-4 (Continued)

STRONTIUM-90 CONCENTRATION IN LOCAL CROPS (pCi/g, wet)
(1965-1993)

COLLECTION DATE	SPECIES	LOCATION 1	LOCATION 2
06/29/83 09/28/83	"	<LLD <LLD	<LLD <LLD
06/18/84 09/19/84	"	<LLD <LLD	<LLD <LLD
09/25/85	Tomato	<LLD	<LLD
06/25/86 11/10/86 11/13/86	"	--<br-- <LLD	<LLD <LLD --
06/10/87 10/28/87	"	-- <LLD	<LLD <LLD
06/22/88 12/01/88	"	-- --	<LLD <LLD
06/29/89 11/27/89	"	<LLD --	<LLD <LLD
12/31/90	"	--	<LLD
11/07/91	"	0.0002	<LLD
06/22/92 11/02/92	"	0.0004 0.0002	0.0003 0.0002
04/26/93 10/14/93	"	-- <LLD	0.0001 <LLD
06/04/90	Zucchini	--	0.001
06/22/92	"	--	0.001
11/02/92	"	--	0.001

LLD = Lower Limit of Detection = 0.0005 pCi/g, wet

Cobalt-60 was detected in two cucumber samples collected in 1975 and 1978 at a concentration of 0.094 and 0.08 pCi/g, wet weight respectively

Finally, cesium-137, a station-related radionuclide, was detected in two kale samples collected in 1983 at the control and kale and tomato samples collected from SSE of Oceanside control location in June 1986 at 0.004 and 0.01 pCi/g, wet respectively. The two kale samples collected in 1983 detected 0.04 and 0.004 pCi/g of cesium-137. Cesium-137 was not detected in any of the samples collected from the indicator locations and its lower limit of detection was 0.001 pCi/g, wet weight.

Several radionuclides were present in minute amounts in crops near SONGS over the past several years. The detectable differences in the concentrations of beryllium-7 and potassium-40 in the samples are considered characteristic of this environment. Because strontium-90 and cesium-137 are detected in the samples from the control locations more frequently than in the samples collected from the indicator locations, the presence of these radionuclides is most likely due to the fallout from nuclear weapons testing, and not from station operations. From this, it was concluded that the operations of SONGS has had a negligible detectable effect on this environmental medium.

KELP

Harvestable kelp is collected semiannually from the San Onofre Kelp Bed, the San Mateo Kelp Bed, the Barn Kelp Bed (occasionally), and from a kelp bed (control) situated in Laguna Beach. Because of its atrophied condition, kelp is not collected from the Barn Kelp Bed near SONGS regularly. Once collected, the kelp is analyzed for 19 naturally-occurring and station-related gamma-emitting radionuclides, and for aqueous and bound tritium. Radionuclides that have been detected in kelp over the past several years include potassium-40, cobalt-58, cobalt-60, zirconium (niobium)-95, iodine-131, and cesium-137. Concentrations of these radionuclides are presented in Table E-5.

Cobalt-60, a station-related radionuclide, has been detected in kelp samples during the years 1972 through 1993. The rest of the samples including the control had concentrations below the LLD.

During the same period, iodine-131, was also identified in 46% of the kelp samples obtained. Since November 1988, iodine-131 was detected in four of 24 indicator samples at a maximum concentration of 0.03 pCi/g in 1991. Iodine-131 was also detected in two samples of the control location at a maximum concentration of 0.03 pCi/g.

Similar to iodine-131, cesium-137 was usually detected in more than 50% of the kelp samples during the period of investigation. Subsequent to November 1987 only one indicator sample and one control sample detected cesium-137 at concentrations of 0.003 and 0.009 pCi/g, wet weight respectively.

In examining data collected over the past years, there is no evidence that any station-related radionuclides are accumulating in kelp near San Onofre (Figures 21 & 22). Indeed detectable levels of station-related radionuclides

TABLE E-5
CONCENTRATION OF RADIONUCLIDES DETECTED IN KELP (pCi/g, wet weight)
(1973 - 1993)

	1973	1974	1975	1976	1977	1978	1979
San Onofre Kelp Bed							
Co-60	--	--	<LLD	<LLD	<LLD	<LLD	<LLD
			<LLD	<LLD	<LLD	<LLD	<LLD
Zr(Nb)-95	--	0.042	0.007	--	0.048	--	--
		0.067	--	0.033	0.014	--	--
I-131	--	--	<LLD	<LLD	0.011	0.008	<LLD
			<LLD	<LLD	0.006	0.015	<LLD
Cs-137	0.08	--	0.005	0.004	0.006	0.005	0.004
	--		0.004	0.004	0.004	0.005	0.009
San Mateo Kelp Bed							
Co-60	--	--	<LLD	<LLD	<LLD	<LLD	<LLD
			<LLD	<LLD	<LLD	<LLD	<LLD
Zr(Nb)-95	--	0.022	0.007	--	0.022	--	--
		0.06	--	0.022	0.014	--	--
I-131	--	--	<LLD	<LLD	0.013	0.007	<LLD
			<LLD	0.006	0.003	0.016	<LLD
Cs-137	--	--	0.006	0.004	<LLD	0.006	0.005
		<LLD	<LLD	0.006	0.005	0.005	0.005
Barn **Kelp Bed**							
Co-60	--	--	<LLD	<LLD	<LLD	--	<LLD
			<LLD	<LLD	<LLD	<LLD	<LLD
Zr(Nb)-95	--	--	0.011	--	0.028	--	--
		0.023	--	0.036	0.014	--	--
I-131	--	--	<LLD	<LLD	0.02	0.008	<LLD
		<LLD	<LLD	0.009	<LLD	<LLD	<LLD
Cs-137	--	--	0.004	0.006	0.002	0.004	0.006
		<LLD	<LLD	0.005	0.007	0.003	<LLD
Newport Beach Kelp Bed							
Co-60	--	--	<LLD	<LLD	<LLD	<LLD	<LLD
		<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zr(Nb)-95	--	--	--	--	0.038	--	--
		0.017	<LLD	0.02	0.010	--	--
I-131	--	--	--	0.006	0.020	0.013	<LLD
		<LLD	<LLD	0.009	0.004	0.028	<LLD
Cs-137	0.08	--	<LLD	<LLD	0.003	0.003	<LLD
	--	<LLD	<LLD	<LLD	0.004	<LLD	<LLD

TABLE E-5 (Continued)

CONCENTRATION OF RADIONUCLIDES DETECTED IN KELP (pCi/g, wet weight)
(1973 - 1993)

	1980	1981	1982	1983	1984	1985	1986
San Onofre Kelp Bed							
Co-60	<LLD	0.009	<LLD	<LLD	0.056	0.004	<LLD
	<LLD	<LLD	<LLD	<LLD	0.017	0.004	<LLD
Zr(Nb)-95	--	0.09	<LLD	<LLD	<LLD	<LLD	<LLD
	0.023	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-131	0.024	0.006	<LLD	0.053	0.220	0.054	0.25
	<LLD	<LLD	<LLD	0.033	0.105	0.008	0.008
Cs-137	<LLD	<LLD	<LLD	0.004	0.005	0.003	0.005
	<LLD	<LLD	<LLD	0.004	<LLD	0.005	0.004
San Mateo Kelp Bed							
Co-60	<LLD	0.006	<LLD	<LLD	0.015	0.002	<LLD
	<LLD	<LLD	<LLD	<LLD	0.008	<LLD	<LLD
Zr(Nb)-95	--	0.064	<LLD	<LLD	<LLD	<LLD	<LLD
	0.02	--	<LLD	<LLD	<LLD	<LLD	<LLD
I-131	0.006	0.014	<LLD	0.049	0.016	0.033	0.24
	<LLD	0.017	<LLD	0.020	0.06	0.013	<LLD
Cs-137	<LLD	<LLD	<LLD	0.004	0.003	0.003	0.006
	<LLD	<LLD	<LLD	0.004	0.006	0.004	0.003
Barn Kelp Bed							
Co-60	<LLD	<LLD	<LLD	<LLD	ND	0.002	NA
	<LLD	<LLD	<LLD	<LLD		ND	NA
Zr(Nb)-95	--	0.068	<LLD	<LLD	ND	<LLD	NA
	0.014	--	<LLD	<LLD		ND	NA
I-131	0.006	0.018	<LLD	0.027	ND	0.019	NA
	0.017	0.011	<LLD	0.015		ND	NA
Cs-137	<LLD	<LLD	<LLD	0.005	ND	0.002	NA
	<LLD	<LLD	<LLD	0.003		ND	NA
Newport Beach Kelp Bed							
Co-60	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zr(Nb)-95	--	0.053	<LLD	<LLD	<LLD	<LLD	<LLD
	0.018	--	<LLD	<LLD	<LLD	<LLD	<LLD
I-131	0.009	0.03	<LLD	0.025	0.009	0.018	0.129
	0.008	0.01	<LLD	0.025	0.024	0.058	0.049
Cs-137	<LLD	<LLD	<LLD	0.004	0.002	<LLD	0.004
	<LLD	<LLD	<LLD	0.003	<LLD	0.006	0.003

TABLE E-5 (Continued)

CONCENTRATION OF RADIONUCLIDES DETECTED IN KELP (pCi/g, wet weight)
(1973 - 1993)

	1987	1988	1989	1990	1991	1992	1993
San Onofre Kelp Bed							
Co-60	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zr(Nb)-95	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-131	0.006	0.056	<LLD	<LLD	0.03	<LLD	0.023
	0.034	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	0.005	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
San Mateo Kelp Bed							
Co-60	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zr(Nb)-95	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-131	0.002	0.082	0.04	<LLD	<LLD	<LLD	<LLD
	0.029	<LLD	<LLD	0.02	<LLD	<LLD	<LLD
Cs-137	0.004	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Barn Kelp Bed							
Co-60	NA	NA	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zr(Nb)-95	NA	NA	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-131	NA	NA	<LLD	0.01	<LLD	<LLD	0.014
	0.016	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	NA	NA	<LLD	0.003	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Newport Beach Kelp Bed							
Co-60	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Zr(Nb)-95	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
I-131	0.028	0.087	0.03	0.007	<LLD	<LLD	0.016
	0.004	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	0.004	<LLD	<LLD	<LLD	<LLD	0.009	<LLD
	0.004	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

have markedly decreased since 1987. A weak intermittent north current (0.5 knots) exists between San Onofre and Laguna Beach. Consequently, the detectable amounts of cesium-137 and iodine-131 in the kelp obtained from Laguna Beach might be due to SONGS operations. However, iodine-131 levels detected at the control also may be attributed to hospital releases within the area of the control station. The reduction in detectable activity at indicator locations is attributable, at least in part, to Edison's commitment to reduce radioactive liquid effluent releases from SONGS.

OCEAN BOTTOM SEDIMENTS

To determine whether or not radionuclides are accumulating in ocean bottom sediments near SONGS, representative samples are collected near each of the SONGS discharge outfalls (which serve as indicator locations), and from Newport Beach (which serves as the control location). After collection, the samples are analyzed for a total of 19 naturally-occurring and station-related radionuclides. Radionuclides detected in ocean bottom sediments over the past twenty years near SONGS are presented in Table E-6 in terms of "as received" wet sample weights.

Plant-related Radionuclides detected during 1974 to 1993 in ocean bottom sediments near SONGS outfalls include: manganese-54, cobalt-60, silver-110m, cesium-137, and cerium-141. The concentrations of cerium-141, cobalt-58, and silver-110m in most of the samples were below the lower limits of detection during the period of investigation.

Cobalt-60 was detected in several indicator samples near Units 1 and 2/3 outfalls during the periods of 1974 to 1993. The maximum concentration of cobalt-60 in the samples was 8.1 pCi/g at San Onofre Unit 1 East (location A) in December 1980. One sample collected May 1985 at the control location had a detectable level of cobalt-60 at a concentration of 0.09 pCi/g, wet in May 1985.

Cesium-137 was detected in several indicator samples collected between 1974 and 1993. The maximum cesium-137 concentration was 0.14 pCi/g in December 1978 in indicator samples. Cesium-137 level was below the LLD of 0.006 pCi/g, in the rest of the samples. Cesium-137 was also detected in control samples with a maximum concentration of 0.043 pCi/g in December 1980 at location A.

Station-related radionuclides were detected in some samples near SONGS at concentrations above those detected at the control location situated in Laguna Beach (Figures 6, 7A and 7B). However, the concentrations of each of these radionuclides in ocean bottom sediments have been diminishing steadily over the past six years. The reduction in detectable activity is attributable, at least in part, to Edison's commitment to reduce radioactive liquid effluent releases from SONGS.

TABLE E-6

CONCENTRATION OF RADIONUCLIDES DETECTED IN OCEAN BOTTOM SEDIMENTS (pCi/g wet weight)
(1974-1993)

LOCATION	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
LOCATION A										
San Onofre Unit 1 East										
Mn-54	--	0.013	--	--	--	--	--	0.035	<LLD	<LLD
	--	--	--	--	--	--	0.49	0.023	<LLD	<LLD
Co-58	--	<LLD	<LLD	<LLD	<LLD	<LLD	0.014	0.046	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	0.11	0.28	1.16	<LLD	<LLD	<LLD
Co-60	--	0.012	<LLD	<LLD	<LLD	<LLD	0.014	0.83	0.4	0.05
	<LLD	<LLD	<LLD	<LLD	0.07	0.05	8.1	0.98	0.1	0.09
Ag-110m	--	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137		0.059	0.038	0.041	0.029	<LLD	0.014	0.04	0.09	<LLD
	0.044	0.035	0.07	0.046	0.14	0.03	0.06	0.053	0.05	<LLD

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Mn-54	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-58	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-60	<LLD	0.09	0.060	0.050	<LLD	<LLD	<LLD	0.011	<LLD	<LLD
	0.08	<LLD	<LLD	<LLD	<LLD	<LLD	0.009	0.014	<LLD	<LLD
Ag-110m	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	0.021	0.020	0.06	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	0.06	0.040	0.040	0.05	0.026

TABLE E-6 (continued)

CONCENTRATION OF RADIONUCLIDES DETECTED IN OCEAN BOTTOM SEDIMENTS (pCi/g wet weight)
(1974-1993)

LOCATION	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
LOCATION B										
San Onofre Unit 1 West										
Mn-54		--	--	--	--	--	--	0.08	<LLD	<LLD
	--	--	--	<LLD	--	--	0.015	--	<LLD	<LLD
Co-58	--	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	0.03	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	0.11	0.2	0.03	<LLD	<LLD	<LLD
Co-60	--	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	0.93	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	0.058	0.032	0.2	0.099	0.11	0.63
Ag-110m	--	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	0.02	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	0.022	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	--	0.019	0.028	0.061	0.035	<LLD	0.015	0.04	<LLD	<LLD
	0.043	0.054	0.052	0.046	0.088	0.040	0.044	0.041	--	<LLD

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Mn-54	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	0.01	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	0.014
Co-58	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-60	<LLD	<LLD	<LLD	<LLD	<LLD	0.08	0.08	0.008	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	0.028
Ag-110m	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	0.025	0.027	0.061
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	0.033	<LLD	0.047	0.083

<LLD = Less than the Lower Limit of Detection

TABLE E-6 (continued)

CONCENTRATION OF RADIONUCLIDES DETECTED IN OCEAN BOTTOM SEDIMENTS (pCi/g wet weight)
(1974-1993)

LOCATION	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
LOCATION C San Onofre Unit 2										
Mn-54	--	--	--	--	--	--	--	--	<LLD	<LLD
					--	--	--	--	<LLD	<LLD
Co-58	--	--	--	--	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
					<LLD	<LLD	<LLD	<LLD	0.07	<LLD
Co-60	--	--	--	--	<LLD	<LLD	<LLD	0.062	<LLD	<LLD
					<LLD	<LLD	<LLD	0.038	<LLD	<LLD
Ag-110m	--	--	--	--	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
					<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	--	--	--	--	0.023	<LLD	<LLD	0.03	<LLD	<LLD
					0.029	<LLD	0.018	<LLD	<LLD	<LLD

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Mn-54	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-58	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-60	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	0.015	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

<LLD = Less than the Lower Limit of Detection

TABLE E-6 (continued)

CONCENTRATION OF RADIONUCLIDES DETECTED IN OCEAN BOTTOM SEDIMENTS (pCi/g wet weight)
(1974-1993)

LOCATION	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
LOCATION D										
San Onofre Unit 3										
Mn-54	--	--	--	--	--	--	--	--	<LLD	<LLD
			--	--	--	--	--	--	<LLD	<LLD
Co-58	--	--	--	--	<LLD	<LLD	0.013	<LLD	<LLD	<LLD
					<LLD	0.015	<LLD	<LLD	<LLD	<LLD
Co-60	--	--	--	--	<LLD	<LLD	0.02	0.04	<LLD	<LLD
					<LLD	<LLD	<LLD	0.021	<LLD	<LLD
Ag-110m	--	--	--	--	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
					<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	--	--	--	--	0.011	0.05	0.044	<LLD	<LLD	<LLD
					<LLD	0.014	<LLD	<LLD	<LLD	<LLD

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Mn-54	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	0.005	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-58	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-60	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	0.017	0.032	<LLD
	<LLD	<LLD	<LLD	0.080	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

<LLD = Less than the Lower Limit of Detection

TABLE E-6 (continued)

CONCENTRATION OF RADIONUCLIDES DETECTED IN OCEAN BOTTOM SEDIMENTS (pCi/g wet weight)
(1974-1993)

LOCATION	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
LOCATION E Newport Beach										
Mn-54		--	--	--	--	--	--	--	<LLD	<LLD
		--	--	--	--	--	--	--	<LLD	<LLD
Co-58		<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
		<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-60		<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
		<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m		<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
		<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137		0.01	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
		0.011	<LLD	<LLD	<LLD	<LLD	0.043	<LLD	<LLD	<LLD

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Mn-54	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-58	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Co-60	<LLD	0.09	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Ag-110m	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cs-137	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	0.011	<LLD	<LLD
	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	0.012	<LLD	<LLD	<LLD

<LLD = Less than the Lower Limit of Detection

MARINE SPECIES

Non-migratory species were collected semi-annually from stations near SONGS outfalls and from the Laguna Beach control location to assess the presence of radioactivity, if any, of plant-related radionuclides in different species. Marine species collected include two species of adult fish, crustacea, and mollusks. The flesh is analyzed for plant-related and naturally-occurring radionuclides, aqueous and bound tritium. Table E-7 presents the selected results for different marine species from 1974 to 1993. The marine species used for the purpose of trending are: sheephead (a fish), black perch (a fish), bay mussel (a mollusk), sea hare (a mollusk), spiny lobster (a crustacean), and keyhole limpet (a mollusk). Radionuclides not listed in Table E-7 were below the lower limit of detection for the period specified.

All mollusks species were plotted vs. time and the results are shown in Figures 13A and 13B.

Averaged concentrations of species caught for the specific collection dates were obtained and percentage of NRC reporting levels were calculated for each radionuclide. The results are listed below.

RADIONUCLIDES (Species)	MAXIMUM CONC. pCi/g	COLLECTION DATE	NRC REPORTING LEVEL (RL) pCi/g	QUART. AVG. CONC.	% OF NRC (RL)
Co-58 (Sea Hare)	12.4	10/04/79	30	2.220	7.40
Co-60 (Sea Hare)	2.0	06/09/81	10	0.378	3.78
Ag-110m (Spiny Lobster)	0.68	12/03/72	8	0.354	4.43
Cs-134 (Sea Hare)	0.022	03/17/76	1	0.000	0.00
Cs-137 (Sheephead)	0.035	05/21/86	2	0.0114	0.57

The average of radionuclides concentrations in all marine species' analyzed in 1993 and normalized by NRC reporting levels, was less than 0.009 pCi/g, wet weight (much less than unity).

Summary

The concentration of radionuclides in marine species may be attributable to the operation of SONGS Units 1, 2, and 3 during the past years. Trending of the data in the past several years to date reveal some accumulation pattern for plant-related radionuclides, cobalt-60 and cesium-137, during 1985 and 1986 and then a decreasing trend in the concentration of these radionuclides from 1987 to 1993. The reduction in the radionuclides concentrations can be attributed, at least in part, to Edison's commitment to decrease radioactive effluent releases which was accomplished by establishment of a Task Force, Liquid Effluent Activity Reduction (LEAR), in 1986. Detection of certain radionuclides in the control location samples may be due to reverse current (North and South) certain times of the year. From these data, it can be concluded that the operations of SONGS Units 1, 2 and 3 has had negligible impact on the environment.

TABLE E-7
CONCENTRATIONS OF RADIONUCLIDES
DETECTED IN MARINE SPECIES (pCi/g, Wet Weight)
1974-1993

DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137	DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137
BAY MUSSEL - Location A											
10/25/74	<LLD	<LLD	0.038	--	<LLD						
04/28/80	0.08	0.026	<LLD	--	<LLD						
03/05/86	0.009	0.011	<LLD		0.0016						
BAY MUSSEL - Location B											
12/12/80	0.026	0.104	<LLD	--	<LLD	03/04/86 05/12/86 08/06/86	<LLD 0.01 <LLD	0.007 0.01 0.019	<LLD <LLD <LLD	<LLD <LLD <LLD	<LLD <LLD <LLD
03/12/81 06/10/81 09/17/81 12/11/81	0.008 0.026 0.011 <LLD	0.091 0.4 0.05 0.53	<LLD <LLD <LLD <LLD	-- -- -- <LLD	0.003 <LLD <LLD <LLD	02/11/87 05/14/87 08/05/87 11/18/87	<LLD <LLD 0.006 <LLD	0.005 0.006 0.003 <LLD	<LLD <LLD <LLD <LLD	<LLD <LLD <LLD <LLD	<LLD <LLD <LLD <LLD
03/04/82 06/10/82 08/09/82 10/26/82	<LLD <LLD <LLD <LLD	0.021 0.005 0.012 0.007	<LLD <LLD <LLD <LLD	<LLD <LLD <LLD <LLD	<LLD <LLD <LLD <LLD	03/04/88 05/27/88 08/05/88 11/03/88	<LLD <LLD <LLD <LLD	<LLD <LLD <LLD <LLD	<LLD <LLD <LLD <LLD	<LLD <LLD <LLD <LLD	<LLD <LLD <LLD <LLD
02/07/83 05/04/83 08/04/83 11/09/83	<LLD <LLD 0.013 0.003	0.037 0.006 0.015 0.004	<LLD <LLD <LLD <LLD	<LLD <LLD <LLD <LLD	<LLD <LLD <LLD <LLD	02/17/89 05/04/89 08/24/89 11/06/89	<LLD <LLD <LLD <LLD	<LLD <LLD <LLD <LLD	<LLD <LLD <LLD <LLD	<LLD <LLD <LLD <LLD	<LLD <LLD <LLD <LLD
02/08/84 05/09/84 08/06/84	0.015 0.01 0.05	0.155 0.055 0.028	<LLD <LLD <LLD	<LLD <LLD <LLD	0.0045 0.0027 <LLD	03/08/90 05/14/90 08/09/90 11/08/90	<LLD <LLD <LLD <LLD	<LLD <LLD <LLD <LLD	<LLD <LLD <LLD <LLD	<LLD <LLD <LLD <LLD	<LLD 0.008 <LLD <LLD
02/07/85 05/16/85 08/06/85	0.16 <LLD 0.012	0.17 0.021 0.028	<LLD <LLD <LLD	<LLD <LLD <LLD	<LLD <LLD 0.006	02/22/91 05/22/91 08/07/91 10/31/91	<LLD <LLD <LLD <LLD	<LLD <LLD <LLD <LLD	<LLD <LLD <LLD <LLD	<LLD <LLD <LLD <LLD	<LLD <LLD <LLD <LLD

TABLE E-7 (Continued)
CONCENTRATIONS OF RADIONUCLIDES
DETECTED IN MARINE SPECIES (pCi/g, Wet Weight)
1974-1993

DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137	DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137
BAY MUSSEL - Location B (Continued)											
03/04/92	<LLD	<LLD	<LLD	<LLD	<LLD	06/15/93	<LLD	<LLD	<LLD	<LLD	<LLD
05/07/92	<LLD	<LLD	<LLD	<LLD	<LLD						
08/14/92	<LLD	<LLD	<LLD	<LLD	<LLD	10/27/93	<LLD	<LLD	<LLD	<LLD	<LLD
10/05/92	<LLD	<LLD	<LLD	<LLD	<LLD						
BAY MUSSEL - Location C											
12/20/74	<LLD	<LLD	<LLD	<LLD	--						
BLACK PERCH - Location A											
10/25/74	<LLD	<LLD	<LLD	--	0.011	04/28/80	<LLD	<LLD	<LLD	--	0.009
						06/19/80	<LLD	<LLD	<LLD	--	0.009
						09/18/80	<LLD	<LLD	<LLD	--	0.006
						12/09/80	<LLD	<LLD	<LLD	--	<LLD
03/20/75	<LLD	<LLD	<LLD	<LLD	<LLD	03/18/81	<LLD	0.033	<LLD	--	0.013
06/25/75	<LLD	<LLD	<LLD	<LLD	<LLD	06/09/81	<LLD	0.045	<LLD	--	0.005
10/01/75	<LLD	<LLD	<LLD	<LLD	0.013	09/17/81	<LLD	0.012	<LLD	--	0.006
12/19/75	<LLD	<LLD	<LLD	--	0.01	12/11/81	<LLD	0.004	<LLD	--	0.006
03/17/76	<LLD	<LLD	<LLD	--	0.008	03/08/82	<LLD	0.006	<LLD	--	0.006
06/22/76	<LLD	<LLD	<LLD	--	0.012	06/09/82	<LLD	<LLD	<LLD	<LLD	0.007
09/21/76	<LLD	<LLD	<LLD	--	0.011	08/05/82	<LLD	0.007	<LLD	<LLD	0.007
12/07/76	<LLD	<LLD	<LLD	--	0.01	10/26/82	<LLD	<LLD	<LLD	<LLD	0.007
03/24/77	<LLD	<LLD	0.021	--	<LLD	02/16/83	<LLD	0.012	<LLD	<LLD	0.007
06/27/77	<LLD	<LLD	0.007	--	0.01	06/16/83	<LLD	0.008	<LLD	<LLD	0.011
10/11/77	<LLD	<LLD	<LLD	--	0.007	08/17/83	<LLD	<LLD	<LLD	<LLD	0.008
12/01/77	<LLD	<LLD	<LLD	--	0.011	11/14/83	<LLD	<LLD	<LLD	<LLD	0.006
04/11/78	<LLD	<LLD	<LLD	--	0.01	02/08/84	<LLD	<LLD	<LLD	<LLD	0.007
06/26/78	<LLD	<LLD	0.004	--	0.01	05/09/84	<LLD	<LLD	<LLD	<LLD	0.008
09/21/78	<LLD	<LLD	<LLD	--	0.014	08/06/84	<LLD	<LLD	<LLD	<LLD	0.039
12/14/78	<LLD	<LLD	0.02	--	0.014	12/06/84	<LLD	0.01	<LLD	<LLD	0.0024
03/16/79	<LLD	<LLD	0.009	--	0.014	02/11/85	<LLD	<LLD	<LLD	<LLD	0.0049
06/27/79	<LLD	<LLD	0.0023	--	0.0068	11/15/85	<LLD	<LLD	<LLD	<LLD	0.0065
09/21/79	<LLD	<LLD	<LLD	--	0.014						
12/11/79	0.011	<LLD	<LLD	--	0.007						

TABLE E-7 (Continued)
CONCENTRATIONS OF RADIONUCLIDES
DETECTED IN MARINE SPECIES (pCi/g, Wet Weight)
1974-1993

DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137	DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137
BLACK PERCH - Location A (Continued)											
03/04/86	<LLD	0.0043	<LLD	<LLD	0.009	03/22/90	<LLD	<LLD	<LLD	<LLD	<LLD
05/21/86	0.009	0.012	<LLD	<LLD	0.009	05/08/90	<LLD	<LLD	<LLD	<LLD	0.005
08/06/86	<LLD	0.008	<LLD	<LLD	0.0051	08/09/90	<LLD	<LLD	<LLD	<LLD	0.004
11/05/86	<LLD	0.002	<LLD	<LLD	0.0051	11/06/90	<LLD	<LLD	<LLD	<LLD	0.005
02/11/87	<LLD	<LLD	<LLD	<LLD	0.0046	02/26/91	<LLD	<LLD	<LLD	<LLD	<LLD
06/04/87	<LLD	0.003	<LLD	<LLD	0.0048	06/18/91	<LLD	<LLD	<LLD	<LLD	<LLD
08/03/87	<LLD	<LLD	<LLD	<LLD	0.0052	08/06/91	<LLD	<LLD	<LLD	<LLD	<LLD
11/18/87	<LLD	<LLD	<LLD	<LLD	0.0051	10/31/91	<LLD	<LLD	<LLD	<LLD	0.005
02/16/88	<LLD	<LLD	<LLD	<LLD	0.0082	03/10/92	<LLD	<LLD	<LLD	<LLD	0.003
05/27/88	<LLD	<LLD	<LLD	<LLD	0.0054	05/18/92	<LLD	<LLD	<LLD	<LLD	0.004
08/05/88	<LLD	<LLD	<LLD	<LLD	0.0036	08/13/92	<LLD	<LLD	<LLD	<LLD	<LLD
11/03/88	<LLD	<LLD	<LLD	<LLD	0.0129	10/13/92	<LLD	<LLD	<LLD	<LLD	0.004
01/15/89	<LLD	<LLD	<LLD	<LLD	0.0065	07/24/93 (Kelp bass)	<LLD	<LLD	<LLD	<LLD	<LLD
05/17/89	<LLD	<LLD	<LLD	<LLD	0.0105						
08/17/89	<LLD	<LLD	<LLD	<LLD	<LLD	11/04/93	<LLD	<LLD	<LLD	<LLD	<LLD
11/01/89	<LLD	<LLD	<LLD	<LLD	0.007						
BLACK PERCH - Location B											
04/11/78	<LLD	<LLD	<LLD	--	0.01	03/04/82	<LLD	<LLD	<LLD	--	0.013
06/26/78	<LLD	<LLD	<LLD	--	0.009	06/09/82	<LLD	<LLD	<LLD	<LLD	0.003
09/14/78	<LLD	<LLD	<LLD	--	0.011	08/05/82	<LLD	<LLD	<LLD	<LLD	0.008
12/14/78	<LLD	<LLD	0.012	--	0.012	10/26/82	<LLD	<LLD	<LLD	<LLD	0.005
03/16/79	<LLD	<LLD	<LLD	--	0.015	02/07/83	<LLD	<LLD	<LLD	<LLD	0.007
06/25/79	<LLD	<LLD	<LLD	--	0.014	05/17/83	<LLD	<LLD	<LLD	<LLD	0.007
09/21/79	0.009	<LLD	<LLD	--	0.008	08/04/83	<LLD	<LLD	<LLD	<LLD	0.006
12/11/79	<LLD	<LLD	<LLD	--	0.013	11/09/83	<LLD	<LLD	<LLD	<LLD	0.007
06/19/80	<LLD	<LLD	<LLD	--	0.008	02/10/84	<LLD	0.002	<LLD	<LLD	0.006
09/17/80	<LLD	<LLD	<LLD	--	0.009	05/09/84	<LLD	<LLD	<LLD	<LLD	0.006
12/12/80	<LLD	<LLD	<LLD	--	0.01	08/06/84	<LLD	<LLD	<LLD	<LLD	0.002
03/12/81	<LLD	<LLD	<LLD	--	<LLD	08/06/85	<LLD	<LLD	<LLD	<LLD	0.0053
06/10/81	<LLD	0.004	<LLD	--	0.004	11/15/85	<LLD	<LLD	<LLD	<LLD	0.0111
09/17/81	<LLD	<LLD	<LLD	--	0.006						
12/11/81	<LLD	<LLD	<LLD	--	0.006						

TABLE E-7 (Continued)
CONCENTRATIONS OF RADIONUCLIDES
DETECTED IN MARINE SPECIES (pCi/g, Wet Weight)
1974-1993

DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137	DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137
BLACK PERCH - Location B (Continued)											
03/04/86	<LLD	<LLD	<LLD	<LLD	<LLD	03/22/90	<LLD	<LLD	<LLD	<LLD	0.0051
05/21/86	<LLD	<LLD	<LLD	<LLD	0.0056	05/14/90	<LLD	<LLD	<LLD	<LLD	0.005
08/05/86	<LLD	<LLD	<LLD	<LLD	0.0057	08/09/90	<LLD	<LLD	<LLD	<LLD	0.006
11/03/86	<LLD	<LLD	<LLD	<LLD	0.0056	11/06/90	<LLD	<LLD	<LLD	<LLD	0.005
02/11/87	<LLD	<LLD	<LLD	<LLD	0.0056	02/22/91	<LLD	<LLD	<LLD	<LLD	<LLD
05/11/87	<LLD	<LLD	<LLD	<LLD	0.0049	06/07/91	<LLD	<LLD	<LLD	<LLD	0.011
08/03/87	<LLD	<LLD	<LLD	<LLD	0.0043	08/06/91	<LLD	<LLD	<LLD	<LLD	<LLD
11/08/87	<LLD	<LLD	<LLD	<LLD	0.0038	10/31/91	<LLD	<LLD	<LLD	<LLD	0.004
02/08/88	<LLD	<LLD	<LLD	<LLD	0.019	03/10/92	<LLD	<LLD	<LLD	<LLD	0.004
05/25/88	<LLD	<LLD	<LLD	<LLD	0.0047	05/14/92	<LLD	<LLD	<LLD	<LLD	<LLD
08/01/88	<LLD	<LLD	<LLD	<LLD	<LLD	08/14/92	<LLD	<LLD	<LLD	<LLD	<LLD
11/03/88	<LLD	<LLD	<LLD	<LLD	<LLD	10/02/92	<LLD	<LLD	<LLD	<LLD	<LLD
02/18/89	<LLD	<LLD	<LLD	<LLD	<LLD	06/15/93	<LLD	<LLD	<LLD	<LLD	<LLD
05/17/89	<LLD	<LLD	<LLD	<LLD	0.006						
08/03/89	<LLD	<LLD	<LLD	<LLD	<LLD	10/25/93	<LLD	<LLD	<LLD	<LLD	<LLD
11/01/89	<LLD	<LLD	<LLD	<LLD	0.0054						
BLACK PERCH - Location C											
12/17/74	<LLD	<LLD	<LLD	--	0.0084						
03/20/75	<LLD	<LLD	<LLD	--	0.009	03/27/78	<LLD	<LLD	<LLD	--	0.008
07/01/75	<LLD	<LLD	<LLD	--	0.008	07/07/78	<LLD	<LLD	<LLD	--	0.011
10/01/75	<LLD	<LLD	<LLD	--	0.009	09/22/78	<LLD	<LLD	<LLD	--	0.009
12/18/75	<LLD	<LLD	<LLD	--	0.012	12/20/78	<LLD	<LLD	<LLD	--	0.007
03/18/76	<LLD	<LLD	<LLD	--	0.012	03/13/79	<LLD	<LLD	<LLD	--	0.01
06/23/76	<LLD	<LLD	<LLD	--	0.011	06/18/79	<LLD	<LLD	<LLD	--	0.004
09/20/76	<LLD	<LLD	<LLD	--	0.013	09/20/79	<LLD	<LLD	<LLD	--	0.01
12/06/76	<LLD	<LLD	<LLD	--	0.01	12/10/79	<LLD	<LLD	<LLD	--	0.007
03/23/77	<LLD	<LLD	<LLD	--	<LLD	03/20/80	<LLD	<LLD	<LLD	--	0.013
06/24/77	<LLD	<LLD	<LLD	--	0.008	06/18/80	<LLD	<LLD	<LLD	--	0.007
10/07/77	<LLD	<LLD	<LLD	--	0.009	09/15/80	<LLD	<LLD	<LLD	--	0.01
12/15/77	<LLD	<LLD	<LLD	--	0.01	12/08/80	<LLD	<LLD	<LLD	--	0.014

TABLE E-7 (Continued)
CONCENTRATIONS OF RADIONUCLIDES
DETECTED IN MARINE SPECIES (pCi/g, Wet Weight)
1974-1993

DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137	DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137
BLACK PERCH - Location C (Continued)											
03/17/81	<LLD	<LLD	<LLD	--	0.007	02/04/88	<LLD	<LLD	<LLD	<LLD	0.005
06/08/81	<LLD	<LLD	<LLD	--	0.01	05/04/88	<LLD	<LLD	<LLD	<LLD	0.0048
09/15/81	<LLD	<LLD	<LLD	--	<LLD	08/01/88	<LLD	<LLD	<LLD	<LLD	<LLD
12/10/81	<LLD	<LLD	<LLD	--	0.007	11/02/88	<LLD	<LLD	<LLD	<LLD	0.0065
03/03/82	<LLD	<LLD	<LLD	--	0.008	02/16/89	<LLD	<LLD	<LLD	<LLD	0.0066
06/07/82	<LLD	<LLD	<LLD	<LLD	0.0061	05/02/89	<LLD	<LLD	<LLD	<LLD	<LLD
08/04/82	<LLD	<LLD	<LLD	<LLD	0.004	08/02/89	<LLD	<LLD	<LLD	<LLD	<LLD
10/27/82	<LLD	<LLD	<LLD	<LLD	0.007	11/03/89	<LLD	<LLD	<LLD	<LLD	0.0042
02/01/83	<LLD	<LLD	<LLD	<LLD	0.006	02/05/90	<LLD	<LLD	<LLD	<LLD	0.004
05/02/83	<LLD	<LLD	<LLD	<LLD	0.007	05/07/90	<LLD	<LLD	<LLD	<LLD	0.004
08/03/83	<LLD	<LLD	<LLD	<LLD	0.007	08/08/90	<LLD	<LLD	<LLD	<LLD	0.003
11/07/83	<LLD	<LLD	<LLD	<LLD	0.006	11/07/90	<LLD	<LLD	<LLD	<LLD	0.004
02/09/84	<LLD	<LLD	<LLD	<LLD	0.004	02/08/91	<LLD	<LLD	<LLD	<LLD	0.0043
05/07/84	<LLD	<LLD	<LLD	<LLD	<LLD	05/17/91	<LLD	<LLD	<LLD	<LLD	0.004
08/07/84	<LLD	<LLD	<LLD	<LLD	0.003	08/07/91	<LLD	<LLD	--	<LLD	<LLD
11/07/84	<LLD	<LLD	<LLD	<LLD	<LLD	10/24/91	<LLD	<LLD	<LLD	<LLD	0.004
02/08/85	<LLD	<LLD	<LLD	<LLD	0.0034	03/04/92	<LLD	<LLD	<LLD	<LLD	0.003
05/17/85	<LLD	<LLD	<LLD	<LLD	0.0071	05/15/92	<LLD	<LLD	<LLD	<LLD	<LLD
08/05/85	<LLD	<LLD	<LLD	<LLD	<LLD	08/12/92	<LLD	<LLD	<LLD	<LLD	<LLD
11/05/85	<LLD	<LLD	<LLD	<LLD	<LLD	10/01/92	<LLD	<LLD	<LLD	<LLD	<LLD
02/28/86	<LLD	<LLD	<LLD	<LLD	0.0073	06/16/93	<LLD	<LLD	<LLD	<LLD	<LLD
05/15/86	<LLD	<LLD	<LLD	<LLD	0.0045						
08/07/86	<LLD	<LLD	<LLD	<LLD	0.0029	11/01/93	<LLD	<LLD	<LLD	<LLD	<LLD
11/06/86	<LLD	<LLD	<LLD	<LLD	0.0046						
02/09/87	<LLD	<LLD	<LLD	<LLD	0.0046						
05/04/87	<LLD	<LLD	<LLD	<LLD	0.0044						
08/03/87	<LLD	<LLD	<LLD	<LLD	0.0044						
11/16/87	<LLD	<LLD	<LLD	<LLD	0.0059						
KEYHOLE LIMPET - Location A											
08/15/91	<LLD	<LLD	<LLD	<LLD	<LLD						
08/13/92	<LLD	<LLD	<LLD	<LLD	<LLD						

TABLE E-7 (Continued)
CONCENTRATIONS OF RADIONUCLIDES
DETECTED IN MARINE SPECIES (pCi/g, Wet Weight)
1974-1993

DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137	DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137
KEYHOLE LIMPET - Location B											
03/19/79	<LLD	<LLD	0.052	--	<LLD						
04/28/80	0.101	0.04	0.033	--	<LLD						
06/19/80	0.054	0.037	0.101	--	<LLD						
09/17/80	0.007	0.021	0.045	--	<LLD						
KEYHOLE LIMPET - Location C											
12/10/79	0.19	0.022	0.042	--	<LLD						
03/20/80	<LLD	<LLD	0.02	--	<LLD	02/28/86	<LLD	0.0021	0.0071	<LLD	<LLD
						05/15/86	<LLD	<LLD	<LLD	<LLD	<LLD
						08/07/86	<LLD	0.002	<LLD	<LLD	<LLD
						11/06/86	<LLD	<LLD	0.007	<LLD	<LLD
03/17/81	<LLD	<LLD	<LLD	--	0.005	02/09/87	<LLD	<LLD	0.0031	<LLD	<LLD
						05/04/87	<LLD	<LLD	0.0048	<LLD	0.003
						08/03/87	<LLD	<LLD	<LLD	<LLD	<LLD
						11/16/87	<LLD	<LLD	0.0023	<LLD	0.0013
03/03/82	<LLD	<LLD	0.005	<LLD	<LLD	02/04/88	<LLD	<LLD	<LLD	<LLD	<LLD
06/07/82	<LLD	<LLD	<LLD	<LLD	<LLD	05/04/88	<LLD	<LLD	<LLD	<LLD	<LLD
08/04/82	<LLD	<LLD	0.004	<LLD	<LLD	08/04/88	<LLD	<LLD	<LLD	<LLD	0.004
10/27/82	<LLD	0.006	0.006	<LLD	<LLD	11/02/88	<LLD	0.006	<LLD	<LLD	<LLD
02/01/83	<LLD	0.006	0.006	<LLD	<LLD	02/16/89	<LLD	<LLD	<LLD	<LLD	<LLD
05/02/83	<LLD	<LLD	<LLD	<LLD	0.003	05/02/89	<LLD	<LLD	<LLD	<LLD	<LLD
08/03/83	<LLD	<LLD	<LLD	<LLD	<LLD	08/02/89	<LLD	<LLD	<LLD	<LLD	<LLD
11/07/83	<LLD	<LLD	0.004	<LLD	<LLD	11/03/89	<LLD	<LLD	<LLD	<LLD	<LLD
05/07/84	<LLD	<LLD	<LLD	<LLD	<LLD	02/05/90	<LLD	<LLD	<LLD	<LLD	<LLD
08/07/84	<LLD	0.002	<LLD	<LLD	<LLD	05/07/90	<LLD	<LLD	<LLD	<LLD	<LLD
11/07/84	<LLD	0.032	<LLD	<LLD	<LLD	08/08/90	<LLD	<LLD	<LLD	<LLD	<LLD
						11/07/90	<LLD	<LLD	<LLD	<LLD	<LLD
02/08/85	<LLD	<LLD	<LLD	<LLD	<LLD						
05/17/85	<LLD	<LLD	<LLD	<LLD	<LLD						
08/05/85	<LLD	0.003	0.006	<LLD	<LLD						
11/05/85	<LLD	0.0021	<LLD	<LLD	<LLD						

TABLE E-7 (Continued)
CONCENTRATIONS OF RADIONUCLIDES
DETECTED IN MARINE SPECIES (pCi/g, Wet Weight)
1974-1993

DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137	DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137
KEYHOLE LIMPET - Location C (Continued)											
02/08/91	<LLD	<LLD	<LLD	<LLD	<LLD	06/16/93	<LLD	<LLD	<LLD	<LLD	<LLD
05/17/91	<LLD	<LLD	<LLD	<LLD	<LLD						
08/07/91	<LLD	<LLD	<LLD	<LLD	<LLD	11/01/93	<LLD	<LLD	<LLD	<LLD	<LLD
10/24/91	<LLD	<LLD	<LLD	<LLD	<LLD						
03/04/92	<LLD	<LLD	<LLD	<LLD	<LLD						
05/15/92	<LLD	<LLD	<LLD	<LLD	<LLD						
08/12/92	<LLD	<LLD	<LLD	<LLD	<LLD						
10/01/92	<LLD	0.005	<LLD	<LLD	<LLD						
OPALEYE - Location A											
08/06/85	<LLD	0.007	<LLD	<LLD	0.0131						
08/08/91	<LLD	<LLD	<LLD	<LLD	0.01						
03/11/92	<LLD	<LLD	<LLD	<LLD	0.01						
05/20/92	<LLD	<LLD	<LLD	<LLD	0.007						
08/14/92	<LLD	<LLD	<LLD	<LLD	0.009						
10/13/92	<LLD	0.007	<LLD	<LLD	0.014						
OPALEYE - Location B											
02/11/85	0.031	0.037	<LLD	<LLD	0.0064						
05/16/85	<LLD	0.039	<LLD	<LLD	0.0041						
SEA HARE - Location A											
03/20/75	<LLD	<LLD	<LLD	--	<LLD	03/24/77	0.093	0.036	0.13	--	0.0047
06/25/75	0.2	0.015	0.17	--	0.0036	06/27/77	0.16	0.38	0.39	--	<LLD
10/01/75	0.158	0.024	0.21	--	0.0031	10/11/77	0.04	0.1	0.092	--	<LLD
12/19/75	<LLD	<LLD	0.101	--	<LLD	12/01/77	0.18	0.12	0.38	--	<LLD
03/17/76	0.0054	0.008	0.044	0.022	0.031	03/08/78	0.071	0.106	0.17	--	<LLD
06/22/76	0.072	0.015	0.03	--	<LLD	06/22/78	0.4	0.072	0.6	--	<LLD
09/21/76	0.23	0.019	0.18	--	<LLD	09/18/78	0.036	0.016	0.09	--	<LLD
12/07/76	0.36	0.052	0.29	--	<LLD	11/29/78	0.26	0.066	0.52	0.005	0.008

TABLE E-7 (Continued)
CONCENTRATIONS OF RADIONUCLIDES
DETECTED IN MARINE SPECIES (pCi/g, Wet Weight)
1974-1993

DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137	DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137
SEA HARE - Location A (Continued)											
02/26/79	0.116	0.082	0.5	--	<LLD	02/13/87	0.006	0.052	<LLD	<LLD	<LLD
06/13/79	0.031	0.044	0.18	--	<LLD	05/29/87	0.011	0.023	<LLD	<LLD	<LLD
10/04/79	12.4	0.8	0.21	--	<LLD	08/08/87	0.054	0.03	<LLD	<LLD	<LLD
12/03/79	2.5	0.34	0.17	--	<LLD	11/21/87	0.019	0.024	<LLD	<LLD	<LLD
12/08/80	0.043	0.138	0.17	--	<LLD	02/18/88	<LLD	0.013	<LLD	<LLD	<LLD
						06/02/88	0.022	0.022	<LLD	<LLD	<LLD
						08/12/88	<LLD	0.03	<LLD	<LLD	<LLD
						11/03/88	0.013	0.017	<LLD	<LLD	<LLD
03/18/81	0.137	1.8	0.16	--	<LLD	02/21/89	<LLD	0.021	<LLD	<LLD	<LLD
06/09/81	0.12	2.0	0.1	--	<LLD	05/09/89	0.085	0.079	<LLD	<LLD	<LLD
09/17/81	0.061	0.22	0.135	--	<LLD	08/19/89	<LLD	0.036	<LLD	<LLD	<LLD
12/11/81	0.053	0.53	0.028	--	<LLD	11/27/89	0.005	0.023	<LLD	<LLD	0.0045
03/05/82	<LLD	0.071	0.03	--	<LLD	03/23/90	<LLD	<LLD	<LLD	<LLD	<LLD
05/26/82	0.031	0.091	0.018	<LLD	<LLD	05/24/90	<LLD	0.003	<LLD	<LLD	<LLD
08/05/82	0.015	0.069	0.014	<LLD	<LLD	08/08/90	<LLD	0.01	<LLD	<LLD	<LLD
11/03/82	<LLD	0.067	0.031	<LLD	0.0027	11/02/90	<LLD	<LLD	<LLD	<LLD	<LLD
02/07/83	0.066	0.41	0.043	<LLD	0.0018	02/13/91	<LLD	<LLD	<LLD	<LLD	<LLD
05/18/83	0.034	0.28	0.024	<LLD	<LLD	05/15/91	<LLD	<LLD	<LLD	<LLD	<LLD
08/11/83	0.025	0.062	<LLD	<LLD	<LLD	11/20/91	<LLD	<LLD	<LLD	<LLD	<LLD
11/09/83	0.007	0.069	0.004	<LLD	<LLD		<LLD	<LLD	<LLD	<LLD	<LLD
02/01/84	0.012	0.134	<LLD	<LLD	0.0028	02/17/92	<LLD	0.001	0.004	<LLD	<LLD
02/15/84	0.012	0.134	<LLD	<LLD	0.0028	05/08/92	<LLD	<LLD	<LLD	<LLD	<LLD
05/16/84	<LLD	0.161	<LLD	<LLD	<LLD	10/25/92	<LLD	<LLD	<LLD	<LLD	<LLD
08/11/84	0.012	0.27	<LLD	<LLD	<LLD						
11/23/84	<LLD	0.6	<LLD	<LLD	<LLD						
02/06/85	<LLD	0.71	<LLD	<LLD	<LLD	06/22/93	<LLD	<LLD	<LLD	<LLD	<LLD
05/07/85	0.29	0.43	<LLD	<LLD	<LLD						
07/31/85	0.36	1.12	<LLD	<LLD	<LLD	10/16/93	<LLD	<LLD	<LLD	<LLD	<LLD
11/15/85	0.31	1.9	<LLD	<LLD	<LLD						
05/25/86	0.018	0.041	<LLD	<LLD	<LLD						
08/19/86	0.0046	0.084	<LLD	<LLD	<LLD						
11/14/86	0.026	0.136	0.0019	<LLD	<LLD						

TABLE E-7 (Continued)
CONCENTRATIONS OF RADIONUCLIDES
DETECTED IN MARINE SPECIES (pCi/g, Wet Weight)
1974-1993

DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137	DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137
SEA HARE - Location B											
06/26/78	<LLD	<LLD	0.011	--	<LLD						
09/21/78	<LLD	<LLD	0.017	--	<LLD						
12/14/78	0.013	<LLD	0.028	--	<LLD						
06/25/79	0.006	0.016	0.033	--	<LLD						
09/27/79	0.39	0.017	0.058	--	<LLD						
12/11/79	0.14	0.03	<LLD	--	0.004						
11/09/85	0.023	0.131	<LLD	<LLD	<LLD						
11/03/86	<LLD	0.014	<LLD	<LLD	<LLD						
SEA HARE - Location C											
12/20/74	<LLD	<LLD	<LLD	--	<LLD	03/13/79	<LLD	<LLD	0.02	--	<LLD
						06/13/79	<LLD	<LLD	<LLD	--	<LLD
						09/20/79	<LLD	<LLD	0.039	--	<LLD
04/30/75	<LLD	<LLD	<LLD	--	<LLD	06/18/80	<LLD	<LLD	<LLD	--	<LLD
07/01/75	<LLD	<LLD	<LLD	--	<LLD	09/15/80	<LLD	0.016	<LLD	--	<LLD
10/01/75	<LLD	<LLD	<LLD	--	<LLD	12/08/80	<LLD	0.012	<LLD	--	<LLD
01/15/76	<LLD	<LLD	<LLD	--	<LLD	06/08/81	<LLD	0.006	<LLD	--	<LLD
03/18/76	<LLD	<LLD	<LLD	--	<LLD	09/15/81	<LLD	0.027	<LLD	--	0.005
06/23/76	<LLD	<LLD	<LLD	--	<LLD	12/10/81	<LLD	0.003	<LLD	--	<LLD
09/20/76	<LLD	<LLD	<LLD	--	<LLD						
12/06/76	<LLD	<LLD	<LLD	--	<LLD						
03/23/77	<LLD	<LLD	<LLD	--	<LLD	02/09/84	<LLD	0.002	<LLD	<LLD	<LLD
06/24/77	<LLD	<LLD	<LLD	--	<LLD						
10/07/77	<LLD	0.018	<LLD	--	<LLD						
12/15/77	<LLD	<LLD	<LLD	--	<LLD						
03/27/78	<LLD	<LLD	<LLD	--	0.005						
07/21/78	<LLD	<LLD	<LLD	--	<LLD						
09/18/78	<LLD	<LLD	<LLD	--	<LLD						
11/29/78	<LLD	<LLD	0.008	--	<LLD						

TABLE E-7
CONCENTRATIONS OF RADIONUCLIDES
DETECTED IN MARINE SPECIES (pCi/g, Wet Weight)
1974-1992

DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137	DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137
SHEEPHEAD - Location A											
03/31/74	--	--	--	--	0.034	03/08/82	<LLD	<LLD	<LLD	<LLD	0.01
12/20/74	<LLD	<LLD	<LLD	--	0.0079	06/09/82	<LLD	<LLD	<LLD	<LLD	0.006
						08/05/82	<LLD	<LLD	<LLD	<LLD	0.007
						10/26/82	<LLD	<LLD	<LLD	<LLD	0.006
03/20/75	<LLD	<LLD	<LLD	--	<LLD	02/07/83	<LLD	<LLD	<LLD	<LLD	0.014
06/25/75	<LLD	<LLD	<LLD	--	0.0127	06/16/83	<LLD	0.039	<LLD	<LLD	0.021
10/01/75	<LLD	<LLD	<LLD	--	0.01	08/17/83	<LLD	<LLD	<LLD	<LLD	0.014
12/19/75	<LLD	<LLD	<LLD	--	0.014	11/09/83	<LLD	<LLD	<LLD	<LLD	0.007
03/17/76	<LLD	<LLD	<LLD	--	0.01	02/08/84	<LLD	0.007	<LLD	0.006	0.022
06/22/76	<LLD	<LLD	<LLD	--	0.013	05/09/84	<LLD	<LLD	<LLD	<LLD	0.007
09/21/76	<LLD	<LLD	<LLD	--	0.011	08/06/84	<LLD	0.27	<LLD	<LLD	0.059
12/07/76	<LLD	<LLD	<LLD	--	0.013	12/06/84	<LLD	0.016	<LLD	<LLD	0.0026
03/24/77	<LLD	<LLD	0.011	--	0.012	02/11/85	<LLD	0.025	<LLD	<LLD	0.003
06/27/77	<LLD	<LLD	0.007	--	0.01	05/20/85	<LLD	0.003	<LLD	<LLD	0.004
10/11/77	<LLD	<LLD	<LLD	--	0.012	08/06/85	<LLD	0.0045	<LLD	<LLD	0.077
12/01/77	<LLD	<LLD	<LLD	--	0.009	11/15/85	<LLD	<LLD	<LLD	<LLD	0.006
04/11/78	<LLD	<LLD	<LLD	--	0.015	03/04/86	0.015	0.027	<LLD	<LLD	0.022
06/27/78	<LLD	<LLD	<LLD	--	0.013	05/21/86	0.015	0.046	<LLD	<LLD	0.035
09/21/78	<LLD	<LLD	<LLD	--	0.014	08/06/86	<LLD	<LLD	<LLD	<LLD	0.005
12/14/78	<LLD	<LLD	<LLD	0.006	0.015	11/03/86	<LLD	<LLD	<LLD	<LLD	0.005
03/19/79	<LLD	<LLD	0.004	--	0.013	02/11/87	<LLD	<LLD	<LLD	<LLD	0.0064
06/28/79	<LLD	<LLD	<LLD	--	0.0078	06/04/87	<LLD	0.011	<LLD	<LLD	0.0088
09/27/79	0.03	<LLD	<LLD	--	0.013	08/03/87	<LLD	<LLD	<LLD	<LLD	0.0096
12/11/79	0.016	<LLD	<LLD	--	0.012	11/18/87	<LLD	<LLD	<LLD	<LLD	0.0051
04/28/80	<LLD	<LLD	0.007	--	0.012	02/16/88	<LLD	<LLD	<LLD	<LLD	0.0082
06/19/80	<LLD	<LLD	<LLD	--	0.009	06/22/88	<LLD	<LLD	<LLD	<LLD	0.0065
09/17/80	<LLD	<LLD	<LLD	--	0.011	08/05/88	<LLD	<LLD	<LLD	<LLD	0.008
12/09/80	<LLD	<LLD	<LLD	--	0.004	11/03/88	<LLD	<LLD	<LLD	<LLD	0.0066
03/18/81	<LLD	0.011	<LLD	--	0.006	02/15/89	<LLD	<LLD	<LLD	<LLD	0.0084
06/09/81	<LLD	0.044	<LLD	--	0.013	05/17/89	<LLD	<LLD	<LLD	<LLD	<LLD
09/17/81	<LLD	0.007	<LLD	--	0.006	08/17/89	<LLD	<LLD	<LLD	<LLD	<LLD
12/11/81	<LLD	0.005	<LLD	--	0.009	11/01/89	<LLD	<LLD	<LLD	<LLD	<LLD

TABLE E-7 (Continued)
CONCENTRATIONS OF RADIONUCLIDES
DETECTED IN MARINE SPECIES (pCi/g, Wet Weight)
1974-1992

DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137	DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137
SHEEPHEAD - Location A (Continued)											
03/22/90	<LLD	<LLD	<LLD	<LLD	0.0078	07/21/93*	<LLD	<LLD	<LLD	<LLD	0.007
05/08/90	<LLD	<LLD	<LLD	<LLD	0.006	Spotfin					
08/09/90	<LLD	<LLD	<LLD	<LLD	0.007	Croaker					
11/06/90	<LLD	<LLD	<LLD	<LLD	0.007	11/04/93	<LLD	<LLD	<LLD	<LLD	<LLD
02/26/91	<LLD	<LLD	<LLD	<LLD	<LLD						
06/18/91	<LLD	<LLD	<LLD	<LLD	0.007						
08/15/91	<LLD	<LLD	<LLD	<LLD	0.008						
11/05/91	<LLD	<LLD	<LLD	<LLD	<LLD						
SHEEPHEAD - Location B											
04/11/78	<LLD	<LLD	<LLD	--	0.012	02/07/83	<LLD	<LLD	<LLD	<LLD	0.009
06/26/78	<LLD	<LLD	<LLD	--	0.014	05/17/83	<LLD	<LLD	<LLD	<LLD	0.013
09/14/78	<LLD	<LLD	--	--	0.014	08/04/83	<LLD	<LLD	<LLD	<LLD	0.01
12/14/78	<LLD	<LLD	<LLD	--	0.01	11/09/83	<LLD	<LLD	<LLD	<LLD	0.011
03/12/79	<LLD	<LLD	<LLD	--	0.013	02/08/84	<LLD	<LLD	<LLD	<LLD	0.015
06/25/79	<LLD	<LLD	<LLD	--	0.01	05/09/84	<LLD	<LLD	<LLD	<LLD	0.01
09/21/79	<LLD	<LLD	<LLD	--	0.017	08/06/84	<LLD	<LLD	<LLD	<LLD	<LLD
12/11/79	<LLD	<LLD	<LLD	--	0.018	11/06/84	<LLD	<LLD	<LLD	<LLD	0.0064
04/28/80	<LLD	<LLD	<LLD	--	0.01	02/07/85	<LLD	0.006	<LLD	<LLD	0.0042
06/17/80	<LLD	<LLD	<LLD	--	0.011	05/16/85	<LLD	<LLD	<LLD	<LLD	0.0089
09/17/80	<LLD	<LLD	<LLD	--	0.014	08/06/85	<LLD	<LLD	<LLD	<LLD	0.009
12/12/80	<LLD	<LLD	<LLD	--	0.011	11/09/85	<LLD	<LLD	<LLD	<LLD	0.0082
03/12/81	<LLD	<LLD	<LLD	--	0.012	03/04/86	<LLD	<LLD	<LLD	<LLD	0.0089
06/10/81	<LLD	<LLD	<LLD	--	0.008	05/20/86	<LLD	<LLD	<LLD	<LLD	0.0104
09/17/81	<LLD	<LLD	<LLD	--	0.006	08/05/86	<LLD	<LLD	<LLD	<LLD	0.005
12/11/81	<LLD	<LLD	<LLD	--	0.01	11/03/86	<LLD	<LLD	0.014	<LLD	0.007
03/04/82	<LLD	<LLD	<LLD	--	0.009	02/11/87	<LLD	<LLD	<LLD	<LLD	0.0075
06/09/82	<LLD	<LLD	<LLD	<LLD	0.008	05/11/87	<LLD	<LLD	<LLD	<LLD	0.0062
08/05/82	<LLD	<LLD	<LLD	<LLD	0.011	08/03/87	<LLD	<LLD	<LLD	<LLD	0.0063
10/26/82	<LLD	<LLD	<LLD	<LLD	0.008	11/18/87	<LLD	<LLD	<LLD	<LLD	0.0078

TABLE E-7 (Continued)
CONCENTRATIONS OF RADIONUCLIDES
DETECTED IN MARINE SPECIES (pCi/g, Wet Weight)
1974-1992

DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137	DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137
SHEEPHEAD - Location B (Continued)											
02/08/88	<LLD	<LLD	<LLD	<LLD	0.0085	02/22/91	<LLD	<LLD	<LLD	<LLD	0.0006
05/25/88	<LLD	<LLD	<LLD	<LLD	0.02	06/07/91	<LLD	<LLD	<LLD	<LLD	0.011
08/05/88	<LLD	<LLD	<LLD	<LLD	0.0087	08/08/91	<LLD	<LLD	<LLD	<LLD	0.007
11/03/88	<LLD	<LLD	<LLD	<LLD	0.0057	10/31/91	<LLD	<LLD	<LLD	<LLD	0.006
02/18/89	<LLD	<LLD	<LLD	<LLD	0.0079	03/10/92	<LLD	<LLD	<LLD	<LLD	0.005
05/17/89	<LLD	<LLD	<LLD	<LLD	0.0062	05/14/92	<LLD	<LLD	<LLD	<LLD	0.005
08/03/89	<LLD	<LLD	<LLD	<LLD	0.007	08/14/92	<LLD	<LLD	<LLD	<LLD	0.004
11/01/89	<LLD	<LLD	<LLD	<LLD	0.0047	10/02/92	<LLD	<LLD	<LLD	<LLD	0.004
03/07/90	<LLD	<LLD	<LLD	<LLD	0.0048	06/15/93	<LLD	<LLD	<LLD	<LLD	0.003
05/14/90	<LLD	<LLD	<LLD	<LLD	0.006						
08/09/90	<LLD	<LLD	<LLD	<LLD	0.007	10/25/93	<LLD	<LLD	<LLD	<LLD	0.008
10/25/90	<LLD	<LLD	<LLD	<LLD	0.033						
SHEEPHEAD - Location C											
12/17/74	<LLD	<LLD	<LLD	--	0.145						
03/20/75	<LLD	<LLD	<LLD	--	0.0108	03/13/79	<LLD	<LLD	<LLD	--	0.006
07/01/75	<LLD	<LLD	<LLD	--	0.014	06/18/79	<LLD	<LLD	<LLD	--	0.007
10/01/75	<LLD	<LLD	<LLD	--	0.013	09/20/79	<LLD	<LLD	<LLD	--	0.12
12/18/75	<LLD	<LLD	<LLD	--	0.013	12/10/79	<LLD	<LLD	<LLD	--	0.009
03/18/76	<LLD	<LLD	<LLD	--	0.015	03/20/80	<LLD	<LLD	<LLD	--	0.007
06/23/76	<LLD	<LLD	<LLD	--	0.01	06/18/80	<LLD	<LLD	<LLD	--	0.005
09/20/76	<LLD	<LLD	<LLD	--	0.0088	09/15/80	<LLD	<LLD	<LLD	--	0.01
12/06/76	<LLD	<LLD	<LLD	--	0.011	12/08/80	<LLD	<LLD	<LLD	--	0.008
03/23/77	<LLD	<LLD	<LLD	--	0.011	03/17/81	<LLD	<LLD	<LLD	--	0.01
06/24/77	<LLD	<LLD	<LLD	--	0.012	06/08/81	<LLD	<LLD	<LLD	--	0.005
10/07/77	<LLD	<LLD	<LLD	--	0.012	09/15/81	<LLD	<LLD	<LLD	--	<LLD
12/15/77	<LLD	<LLD	<LLD	--	0.011	12/10/81	<LLD	<LLD	<LLD	--	0.005
03/27/78	<LLD	<LLD	<LLD	--	0.008	03/03/82	<LLD	<LLD	<LLD	--	0.006
07/07/78	<LLD	<LLD	<LLD	--	0.008	06/07/82	<LLD	<LLD	<LLD	<LLD	0.005
09/22/78	<LLD	<LLD	<LLD	--	0.01	08/04/82	<LLD	<LLD	<LLD	<LLD	0.006
12/20/78	<LLD	<LLD	<LLD	--	0.01	10/27/82	<LLD	<LLD	<LLD	<LLD	0.007

TABLE E-7 (continued)
CONCENTRATIONS OF RADIONUCLIDES
DETECTED IN MARINE SPECIES (pCi/g, Wet Weight)
1974-1992

DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137	DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137
SHEEPHEAD - Location C (continued)											
02/01/83	<LLD	<LLD	<LLD	<LLD	0.007	02/16/89	<LLD	<LLD	<LLD	<LLD	<LLD
05/02/83	<LLD	<LLD	<LLD	<LLD	0.007	05/02/89	<LLD	<LLD	<LLD	<LLD	<LLD
08/03/83	<LLD	<LLD	<LLD	<LLD	0.007	08/02/89	<LLD	<LLD	<LLD	<LLD	<LLD
11/08/83	<LLD	<LLD	<LLD	<LLD	0.007	11/03/89	<LLD	<LLD	<LLD	<LLD	<LLD
02/09/84	<LLD	<LLD	<LLD	<LLD	0.006	02/05/90	<LLD	<LLD	<LLD	<LLD	0.004
05/09/84	<LLD	<LLD	<LLD	<LLD	0.008	05/07/90	<LLD	<LLD	<LLD	<LLD	0.004
08/06/84	<LLD	<LLD	<LLD	<LLD	0.004	08/08/90	<LLD	<LLD	<LLD	<LLD	0.004
11/07/84	<LLD	<LLD	<LLD	<LLD	<LLD	11/07/90	<LLD	<LLD	<LLD	<LLD	0.003
02/08/85	<LLD	<LLD	<LLD	<LLD	<LLD	02/08/91	<LLD	<LLD	<LLD	<LLD	<LLD
05/17/85	<LLD	<LLD	<LLD	<LLD	<LLD	05/17/91	<LLD	<LLD	<LLD	<LLD	<LLD
08/05/85	<LLD	<LLD	<LLD	<LLD	0.004	08/07/91	<LLD	<LLD	<LLD	<LLD	<LLD
11/05/85	<LLD	<LLD	<LLD	<LLD	<LLD	10/24/91	<LLD	<LLD	<LLD	<LLD	0.005
02/28/86	<LLD	<LLD	<LLD	<LLD	0.0053	03/04/92	<LLD	<LLD	<LLD	<LLD	<LLD
05/15/86	<LLD	<LLD	<LLD	<LLD	0.0043	05/15/92	<LLD	<LLD	<LLD	<LLD	0.004
08/07/86	<LLD	<LLD	<LLD	<LLD	0.0041	08/12/92	<LLD	<LLD	<LLD	<LLD	<LLD
11/06/86	<LLD	<LLD	<LLD	<LLD	0.0049	10/01/92	<LLD	<LLD	<LLD	<LLD	<LLD
02/09/87	<LLD	<LLD	<LLD	<LLD	0.0047	06/16/93	<LLD	<LLD	<LLD	<LLD	<LLD
05/04/87	<LLD	<LLD	<LLD	<LLD	0.0049						
08/03/87	<LLD	<LLD	<LLD	<LLD	0.0047	11/01/93	<LLD	<LLD	<LLD	<LLD	<LLD
11/16/87	<LLD	<LLD	<LLD	<LLD	0.0057						
02/04/88	<LLD	<LLD	<LLD	<LLD	0.0082						
05/04/88	<LLD	<LLD	<LLD	<LLD	0.0047						
08/04/88	<LLD	<LLD	<LLD	<LLD	0.0033						
11/02/88	<LLD	<LLD	<LLD	<LLD	<LLD						

TABLE E-7
CONCENTRATIONS OF RADIONUCLIDES
DETECTED IN MARINE SPECIES (pCi/g, Wet Weight)
1974-1992

DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137	DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137
SPINY LOBSTER - Location A											
06/22/71	--	--	0.04	--	0.018	03/21/80	0.08	0.2	0.14	--	<LLD
						09/17/80	<LLD	<LLD	0.048	--	<LLD
						12/09/80	0.017	0.043	0.122	--	<LLD
12/10/72	--	--	0.029	--	--	03/18/81	0.017	0.21	0.12	--	<LLD
12/31/72	--	0.012	0.68	--	--	06/09/81	0.007	0.12	0.133	--	<LLD
						09/17/81	0.016	0.142	0.142	--	<LLD
						12/11/81	<LLD	0.033	0.18	--	0.008
06/30/73	--	--	0.019	--	--	03/08/82	<LLD	0.021	0.059	--	<LLD
12/31/73	--	--	0.095	--	--	06/09/82	<LLD	0.016	0.054	<LLD	0.006
						08/05/82	0.018	0.05	0.058	<LLD	<LLD
						10/26/82	<LLD	0.012	0.032	<LLD	0.005
12/31/74	<LLD	<LLD	0.1813	--	<LLD	08/17/83	<LLD	0.007	0.012	<LLD	0.005
						11/09/83	<LLD	0.008	0.01	<LLD	0.005
03/02/75	<LLD	<LLD	0.104	--	<LLD	02/09/84	0.023	0.066	0.016	<LLD	0.008
06/25/75	0.041	<LLD	0.14	--	<LLD	05/09/84	<LLD	0.152	<LLD	<LLD	<LLD
10/01/75	<LLD	<LLD	0.31	--	<LLD	08/07/84	<LLD	0.088	0.0072	<LLD	0.0072
12/19/75	<LLD	<LLD	0.05	--	<LLD	11/06/84	<LLD	0.019	<LLD	<LLD	<LLD
03/17/76	<LLD	<LLD	0.114	--	<LLD	02/08/85	<LLD	0.04	<LLD	<LLD	<LLD
						05/17/85	<LLD	0.021	<LLD	<LLD	0.007
						08/09/85	<LLD	0.01	<LLD	<LLD	0.0094
						11/09/85	<LLD	<LLD	<LLD	<LLD	0.0058
						03/05/86	<LLD	0.014	0.008	<LLD	0.0051
						05/16/86	<LLD	0.008	0.0084	<LLD	0.0042
09/14/78	<LLD	<LLD	0.33	--	<LLD	08/06/86	<LLD	0.017	0.007	<LLD	0.004
12/14/78	0.036	0.013	0.5	0.018	0.029	11/05/86	<LLD	0.006	0.004	<LLD	0.0047
03/14/79	<LLD	<LLD	0.36	--	<LLD	02/06/87	<LLD	0.005	0.004	<LLD	0.0034
06/20/79	0.013	<LLD	0.22	--	<LLD	05/11/87	<LLD	<LLD	0.006	<LLD	0.0057
09/21/79	<LLD	<LLD	0.16	--	<LLD	08/06/87	<LLD	<LLD	<LLD	<LLD	<LLD
12/11/79	0.2	0.028	0.23	--	<LLD	11/18/87	<LLD	<LLD	<LLD	<LLD	0.0045

TABLE E-7 (Continued)
CONCENTRATIONS OF RADIONUCLIDES
DETECTED IN MARINE SPECIES (pCi/g, Wet Weight)
1974-1992

DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137	DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137
SPINY LOBSTER - Location A (Continued)											
02/08/88	<LLD	<LLD	<LLD	<LLD	<LLD	02/22/91	<LLD	<LLD	<LLD	<LLD	<LLD
05/17/88	<LLD	<LLD	<LLD	<LLD	<LLD	05/29/91	<LLD	<LLD	<LLD	<LLD	<LLD
08/08/88	<LLD	<LLD	<LLD	<LLD	<LLD	08/09/91	<LLD	<LLD	<LLD	<LLD	<LLD
11/03/88	<LLD	<LLD	<LLD	<LLD	0.006	11/05/91	<LLD	<LLD	<LLD	<LLD	<LLD
02/16/89	<LLD	<LLD	<LLD	<LLD	<LLD	03/04/92	<LLD	<LLD	<LLD	<LLD	<LLD
05/09/89	<LLD	<LLD	<LLD	<LLD	<LLD	05/18/92	<LLD	<LLD	<LLD	<LLD	<LLD
08/17/89	<LLD	<LLD	<LLD	<LLD	<LLD	08/14/92	<LLD	<LLD	<LLD	<LLD	<LLD
11/06/89	<LLD	<LLD	<LLD	<LLD	<LLD	10/05/92	<LLD	<LLD	<LLD	<LLD	<LLD
02/06/90	<LLD	<LLD	<LLD	<LLD	<LLD	06/28/93	<LLD	<LLD	<LLD	<LLD	<LLD
05/14/90	<LLD	<LLD	<LLD	<LLD	0.005						
08/10/90	<LLD	<LLD	<LLD	<LLD	<LLD	11/04/93	<LLD	<LLD	<LLD	<LLD	<LLD
10/16/90	<LLD	<LLD	<LLD	<LLD	<LLD						
SPINY LOBSTER - Location B											
09/14/78	<LLD	<LLD	0.15	--	<LLD	03/04/82	<LLD	0.024	0.115	--	<LLD
12/22/78	0.029	0.014	0.39	0.014	0.026	06/10/82	<LLD	0.014	0.055	<LLD	0.011
						08/06/82	<LLD	0.015	0.044	<LLD	0.012
						10/31/82	<LLD	0.007	0.028	<LLD	0.004
03/13/79	<LLD	<LLD	0.29	--	<LLD	05/06/83	<LLD	0.013	0.017	<LLD	0.005
06/22/79	<LLD	<LLD	0.29	--	<LLD	08/17/83	0.009	0.012	0.016	<LLD	<LLD
09/21/79	<LLD	<LLD	0.30	--	<LLD						
12/11/79	0.27	0.034	0.25	--	<LLD						
03/21/80	0.15	0.044	0.27	--	<LLD	02/08/84	<LLD	0.013	0.008	<LLD	0.008
12/12/80	<LLD	0.18	0.1	--	<LLD	05/09/84	<LLD	0.024	0.007	<LLD	<LLD
						08/08/84	<LLD	<LLD	<LLD	<LLD	<LLD
						11/07/84	<LLD	0.079	<LLD	<LLD	<LLD
03/12/81	<LLD	0.033	0.049	--	<LLD	02/07/85	<LLD	0.012	<LLD	<LLD	<LLD
09/17/81	<LLD	0.031	0.135	--	<LLD	05/17/85	<LLD	0.028	0.006	<LLD	0.004
12/11/81	<LLD	0.019	0.092	--	0.005	08/09/85	<LLD	<LLD	<LLD	<LLD	0.0051
						11/08/85	<LLD	0.002	<LLD	<LLD	0.0072

TABLE E-7 (Continued)
CONCENTRATIONS OF RADIONUCLIDES
DETECTED IN MARINE SPECIES (pCi/g, Wet Weight)
1974-1992

DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137	DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137
SPINY LOBSTER - Location B (Continued)											
03/07/86	<LLD	0.006	0.018	<LLD	0.012	02/06/90	<LLD	<LLD	<LLD	<LLD	<LLD
05/16/86	<LLD	0.01	0.013	<LLD	0.0042	05/14/90	<LLD	<LLD	<LLD	<LLD	<LLD
08/13/86	<LLD	0.009	0.015	<LLD	0.0037	08/10/90	<LLD	<LLD	<LLD	<LLD	<LLD
11/03/86	<LLD	0.002	0.014	<LLD	0.0047	10/16/90	<LLD	<LLD	<LLD	<LLD	<LLD
02/06/87	<LLD	<LLD	<LLD	<LLD	<LLD	02/26/91	<LLD	<LLD	<LLD	<LLD	0.0034
05/11/87	<LLD	<LLD	<LLD	<LLD	<LLD	05/29/91	<LLD	<LLD	<LLD	<LLD	<LLD
08/06/87	<LLD	<LLD	<LLD	<LLD	<LLD	08/05/91	<LLD	<LLD	<LLD	<LLD	<LLD
11/18/87	<LLD	<LLD	<LLD	<LLD	0.0043	11/05/91	<LLD	<LLD	<LLD	<LLD	<LLD
02/08/88	<LLD	<LLD	<LLD	<LLD	<LLD	03/10/92	<LLD	<LLD	<LLD	<LLD	<LLD
05/17/88	<LLD	<LLD	<LLD	<LLD	<LLD	05/18/92	<LLD	<LLD	<LLD	<LLD	<LLD
08/02/88	<LLD	<LLD	<LLD	<LLD	<LLD	08/14/92	<LLD	<LLD	<LLD	<LLD	<LLD
11/03/88	<LLD	<LLD	<LLD	<LLD	<LLD	10/13/92	<LLD	<LLD	<LLD	<LLD	<LLD
02/16/89	<LLD	<LLD	<LLD	<LLD	0.0043	06/16/93	<LLD	<LLD	<LLD	<LLD	<LLD
05/17/89	<LLD	<LLD	<LLD	<LLD	<LLD						
08/17/89	<LLD	<LLD	<LLD	<LLD	0.004	10/15/93	<LLD	<LLD	<LLD	<LLD	<LLD
11/06/89	<LLD	<LLD	<LLD	<LLD	<LLD						
SPINY LOBSTER - Location C											
12/31/74	<LLD	<LLD	<LLD	--	0.0055	09/22/78	<LLD	<LLD	0.027	--	<LLD
						12/22/78	<LLD	<LLD	0.036	--	0.008
03/02/75	<LLD	<LLD	<LLD	--	0.014	03/31/79	<LLD	<LLD	0.035	--	0.006
10/01/75	<LLD	<LLD	<LLD	--	<LLD	06/19/79	<LLD	<LLD	0.051	--	<LLD
12/18/75	<LLD	<LLD	<LLD	--	<LLD	09/20/79	<LLD	<LLD	0.023	--	<LLD
						12/10/79	<LLD	<LLD	0.014	--	0.004
03/18/76	<LLD	<LLD	<LLD	<LLD	<LLD	03/20/80	<LLD	<LLD	0.02	--	<LLD
						06/18/80	<LLD	<LLD	<LLD	--	0.015
						09/15/80	<LLD	<LLD	<LLD	--	<LLD
						12/08/80	<LLD	<LLD	<LLD	--	<LLD

TABLE E- (Continued)
CONCENTRATIO RADIONUCLIDES
DETECTED IN MARINE SPECIES (pCi/g, Wet Weight)
1974-1992

DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137	DATE	Co-58	Co-60	Ag-110m	Cs-134	Cs-137
SPINY LOBSTER - Location C (Continued)											
03/17/81	<LLD	<LLD	<LLD	<LLD	0.005	02/04/88	<LLD	<LLD	<LLD	<LLD	<LLD
06/08/81	<LLD	<LLD	<LLD	<LLD	<LLD	05/04/88	<LLD	<LLD	<LLD	<LLD	<LLD
09/15/81	<LLD	<LLD	0.006	<LLD	0.011	08/05/88	<LLD	<LLD	<LLD	<LLD	0.003
12/10/81	<LLD	<LLD	<LLD	<LLD	0.004	11/02/88	<LLD	<LLD	<LLD	<LLD	<LLD
03/03/82	<LLD	<LLD	<LLD	<LLD	<LLD	02/16/89	<LLD	<LLD	<LLD	<LLD	0.003
06/07/82	<LLD	<LLD	<LLD	<LLD	<LLD	05/02/89	<LLD	<LLD	<LLD	<LLD	<LLD
08/04/82	<LLD	<LLD	<LLD	<LLD	<LLD	08/02/89	<LLD	<LLD	<LLD	<LLD	<LLD
10/27/82	<LLD	<LLD	<LLD	<LLD	0.01	11/03/89	<LLD	<LLD	<LLD	<LLD	<LLD
02/01/83	<LLD	<LLD	<LLD	<LLD	<LLD	02/06/90	<LLD	<LLD	<LLD	<LLD	<LLD
05/03/83	<LLD	<LLD	<LLD	<LLD	0.005	05/07/90	<LLD	<LLD	<LLD	<LLD	0.003
08/03/83	<LLD	<LLD	<LLD	<LLD	0.005	08/09/90	<LLD	<LLD	<LLD	<LLD	<LLD
11/08/83	<LLD	<LLD	<LLD	<LLD	0.004	11/07/90	<LLD	0.003	<LLD	<LLD	0.003
02/10/84	<LLD	<LLD	<LLD	<LLD	0.002	02/08/91	<LLD	<LLD	<LLD	<LLD	<LLD
05/08/84	<LLD	<LLD	<LLD	<LLD	0.004	05/17/91	<LLD	<LLD	<LLD	<LLD	<LLD
08/08/84	<LLD	<LLD	<LLD	<LLD	<LLD	08/08/91	<LLD	<LLD	<LLD	<LLD	0.012
11/08/84	<LLD	<LLD	<LLD	<LLD	<LLD	10/31/91	<LLD	<LLD	<LLD	<LLD	<LLD
02/11/85	<LLD	<LLD	<LLD	<LLD	<LLD	03/25/92	<LLD	<LLD	<LLD	<LLD	<LLD
05/20/85	<LLD	<LLD	<LLD	<LLD	0.005	05/21/92	<LLD	<LLD	<LLD	<LLD	<LLD
08/06/85	<LLD	<LLD	<LLD	<LLD	0.0129	08/13/92	<LLD	<LLD	<LLD	<LLD	<LLD
11/06/85	<LLD	<LLD	<LLD	<LLD	0.0051	10/01/92	<LLD	<LLD	<LLD	<LLD	0.008
02/28/86	<LLD	<LLD	<LLD	<LLD	0.004	06/17/93	<LLD	<LLD	<LLD	<LLD	<LLD
05/16/86	<LLD	<LLD	<LLD	<LLD	0.0034						
08/08/86	<LLD	<LLD	<LLD	<LLD	0.0027	11/01/93	<LLD	<LLD	<LLD	<LLD	<LLD
11/06/86	<LLD	<LLD	<LLD	<LLD	0.0033						
02/10/87	<LLD	<LLD	<LLD	<LLD	<LLD						
05/05/87	<LLD	<LLD	<LLD	<LLD	0.0038						
08/04/87	<LLD	<LLD	<LLD	<LLD	<LLD						
11/16/87	<LLD	<LLD	<LLD	<LLD	0.0037						

APPENDIX F

COMPARISON OF 1993 OPERATIONAL DATA WITH PREOPERATIONAL DATA

COMPARISON OF OPERATIONAL DATA WITH PREOPERATIONAL DATA

For comparison of operational data with the preoperational data, all the measurements from January 1979 to July 1982 are used for preoperational phase of SONGS Unit 2. These preoperational data are the actual operational data obtained from the radiological environmental monitoring program for SONGS Unit 1. Unit 1 became critical on June 14, 1967 and was in operation until February 27, 1982. There were 8 refueling outages in this time period. Unit 1 was taken off line from February 27, 1982 to November 27, 1984 to complete NRC backfit modifications related to TMI fire protection and seismic modifications. Unit 1 was in full power operation (90%) since November 27, 1984 with a cycle VIII refueling outage from November 29, 1985 to July 26, 1986, a mid-cycle IX maintenance outage from May 9, 1987 to July 2, 1987, a second mid-cycle IX maintenance outage from February 14, 1988 to August 5, 1988, and cycle IX refueling outage from November 28, 1988 to May 25, 1989. The cycle X refueling outage was initiated on June 30, 1990 and ended March 23, 1991. Unit 1 was permanently shut down on November 30, 1992.

Unit 2 attained initial criticality on July 26, 1982. The six refueling outages were: October 20, 1984 to April 17, 1985, for cycle II; March 15, 1986 to June 12, 1986, for cycle III; August 29, 1987 to December 12, 1987, for cycle IV; September 2, 1989 to December 8, 1989, for cycle V; August 17, 1991 to November 20, 1991 for Cycle VI; and June 5, 1993 to August 8, 1993 for Cycle VII.

Unit 3 attained initial criticality on August 29, 1983. The six refueling outages were: September 14, 1985 to January 11, 1986, for cycle II; January 3, 1987 to March 12, 1987 for cycle III; April 30, 1988 to August 20, 1988, for cycle IV; April 14, 1990 to July 23, 1990 for cycle V, January 24, 1992 to March 30, 1992 for Cycle VI; and October 10, 1993 to December 30, 1993 for Cycle VII.

A variety of environmental samples were analyzed and the radioanalytical results (1979-1982) were compared with the 1993 operational data obtained for SONGS Units 1, 2 and 3.

The following media were evaluated and compared with the operational data of SONGS Units 1, 2 and 3:

A. External Radiation
B. Air Particulates
C. Radioiodine
D. Ocean Water
E. Drinking Water
F. Shoreline Sediments
G. Ocean Bottom Sediments
H. Marine Species
I. Local Crops
J. Soil
K. Kelp

A. Direct Radiation

SONGS Unit 1:
No direct radiation data were obtained in the preoperational period of 1964 to 1967 to compare with the operational data.

SONGS Units 2 and 3:

The operational data for Unit 1 are used as baseline (preoperational data) for Units 2 and 3 (from 1979 to 1982). Figures 14A, 14B; and 15A and 15B compare the environmental radiation levels of indicator and control locations. As can be seen, the control location external radiation level is lower than the indicator locations. Also, a decreasing trend was observed from 1975 to 1993, partly due to the curtailment of the atmospheric nuclear weapons testing. Figure 14B compares the preoperational radiation level in the former control location of Huntington Beach (#14). The variation in radiation level between the controls and indicators is comparable. Simultaneous variation in radiation levels between the control and indicators in the same direction also show that environmental and seasonal effects are contributing to these variations rather than plant operation.

Direct radiation measurements were made quarterly at indicator locations and three transit TLDs in 1993. Dosimeters were collected at a number of inner as well as at outer ring locations as specified by the ODCMs. In order to evaluate the variation in external radiation exposure, a plot was made of direct radiation exposure in mrem, obtained from thermoluminescent dosimeters, versus time for a given number of indicator locations, as well as the two control locations. The figures compare some of the locations and also show the time variation of radiation level during both preoperational (January 1979 - July 1982) and operational periods of January 1993 to December 1993. Figures 14A, 14B, 15A and 15B show a decreasing trend in external radiation through 1993. In the 1993 operational year for Units 2 and 3, all indicator stations ranged from 13.1 to 25.2 millirem with an average of 17.3 millirem while the control locations ranged from 16.7 to 20.2 millirem with an average of 18.5 millirem.

The reduction of environmental factors, such as nuclear weapons testing, has also reduced the natural radiation levels of the environment. Comparison of indicator stations' data with those of the control station's shows that there has not been any significant external radiation impact of SONGS on the environment.

Factors such as meteorology, geographic location, and statistical and seasonal fluctuations may describe the variability in the data seen during the preoperational period for each location. The decrease in radiation levels in the area surrounding SONGS during the preoperational period for the two units may be attributable to a curtailment of the atmospheric nuclear weapons testing, and the continued decay of existing neutron activation and fission products from previous nuclear weapons tests. The levels present in 1993 appear to be a continuation of the general decay pattern established during the preoperational period. Effects due to Station operation, if any, are masked by this background radiation.

The range of quarterly direct radiation doses was larger at both indicator and control locations during the preoperational period than during the 1993 operational period for SONGS Units 2 and 3.

The larger range of quarterly radiation levels observed during the preoperational time span may be attributable to atmospheric nuclear weapons tests that occurred in March of 1978 and on October 15, 1980, as well as the eruption of the Mount St. Helens volcano in May 1980. The noticeable decline in direct radiation levels since 1979 is likely due to a curtailment of the atmospheric nuclear weapons testing. The larger range of annual direct radiation levels seen in 1986 and 1987 may be attributable to the Chernobyl nuclear power plant accident that occurred April 26, 1986, in addition to the continued fallout from weapons testing. Other factors, such as meteorology, geographic locations, and statistical and seasonal fluctuations may also describe the variation in the direct radiation levels.

Because of the above factors, we conclude that SONGS has not had a measurable impact during 1993 on this environmental medium.

B. Air Particulates

SONGS Unit 1:

Before SONGS Unit 1 attained initial criticality, samples of air particulates were collected frequently from indicator and control locations surrounding SONGS, and subsequently analyzed for gross beta activity. Unit 1 achieved initial criticality in 1967 and was in operation until November 1992 when it was shut down permanently. Units 2 and 3 achieved initial criticality in July 1982 and August 1983, respectively.

During the preoperational period of 1964-1967 (Figure 16), detectable gross beta activities at the indicator locations ranged from 0.030 to 3.810 pCi/m^3, averaging 0.307 pCi/m^3. The control location of Oceanside had an average gross beta activity of 0.34 ranging from 0.05 to 2.77 pCi/m^3. During 1993, the gross beta activity at the indicator locations ranged from 0.002 to 0.045 pCi/m^3, and averaging 0.016 pCi/m^3. The control location gross beta activity ranged from 0.004 to 0.051 pCi/m^3 with an average of 0.017 pCi/m^3 (Figure 18). The decrease in activity levels between 1965 and 1993 might be ascribed to the curtailment of atmospheric fallout nuclear weapons testing.

Valid comparisons of preoperational data to operational data are difficult to make in this instance because the actual background levels are masked by activity from fallout caused by weapons testing.

SONGS Units 2 and 3:

All of the measurements obtained from the SONGS Unit 1 operational Radiological Environmental Monitoring Program (REMP) during the period from January 1979 to July 1982 are used as the preoperational baseline for SONGS Units 2 and 3.

Comparisons of preoperational data to 1993 operational data are possible for each of the exposure pathways to man, namely: (1) direct radiation, (2) air particulates (inhalation), (3) ocean water (waterborne), and drinking water (waterborne). Comparisons can also be made between preoperational and operational data for ocean bottom sediment data to ascertain if there has been any significant increase in radioactivity in ocean bottom sediments in the vicinity of the SONGS Units 2 and 3 outfalls.

In order to provide the preoperational data for SONGS 2 and 3, a number of studies were conducted from 1979 to 1983. These preoperational data for SONGS Units 2 and 3 are operational data of SONGS Unit 1 operation. From January 1979 through July 1982 (which is considered to be the preoperational period for SONGS Units 2 and 3), there is a period of noticeably higher gross beta activities in air. This period extends from the fourth quarter of 1980 through the fourth quarter of 1981. These higher activities may be attributable to the atmospheric nuclear weapons tests that occurred in March 1978 and October 15, 1980, as well as the eruption of the Mount St. Helens volcano in May 1980. Because these higher levels mask the normal environmental gross beta levels near SONGS, the data collected during this time frame is not considered valid for comparison with the preoperational data. One of the studies involved measurement of gross beta activity in air particulates. Air samples from different locations near the plant were collected on a weekly basis and analyzed. Figures 16, 17A and 17B presents the monthly variation in the gross beta activity of air particulates in San Clemente and Camp San Onofre locations, and compares the gross beta activity levels of these stations during the preoperational (January 1979 to July 1982) and operational periods (July 1982 to December 1993). As seen in the graph, during most of the time span, the environmental levels of gross beta remained the same for the indicator and the control locations. The minor variations observed are of statistical or seasonal nature depending on the geographical location of each station. The presence of the first major group of peaks observed during February to July 1978 of the preoperational period may be attributed to Chinese atmospheric nuclear weapons testing of March 14, 1978 and the residual fallout activity from the previous atmospheric testing of September 17, 1977. Volcanic activities and other environmental phenomena can be the cause for this increase in gross beta level. During this time period, the Huntington Beach control station was affected as well as the other locations. Since all the locations were affected equally, it may be concluded that the rise in gross beta activity was not plant related. The decrease in gross beta activity level after January 1979 might be ascribed to the curtailment of nuclear weapons testing in the atmosphere. The rise in gross beta activity observed after October 1980 is thought to be the fallout contribution from the Chinese atmospheric nuclear weapons testing of October 15, 1980. The presence of the large group of peaks, observed in the region of October 1980 to August 1981, is attributed to the October 15, 1980 atmospheric nuclear weapons testing and also to the volcanic eruption of Mount Saint Helens located in the state of Washington.

The Chinese testing of October 1980 deposited a large amount of radioactivity in California and raised the background level. During this period, the highest gross beta activity observed at the Huntington Beach Control station was 0.29 pCi/m^3 on May 11, 1981 and 0.56 pCi/m^3 for the indicator location of units 2/3 Switchyard. The May 1980 eruption of Mount Saint Helens and the subsequent volcanic activities also contributed to the elevation of the natural background levels in the environment. The dispersion of the radioactive plume and its travel throughout the country affected the environmental levels at the locations being studied. All the locations, more or less, were affected simultaneously by these environmental factors. All the other minor peaks observed have little significance and their presence is attributed to the statistical deviation of the data points and also seasonal variation and fluctuations in all the locations. Figure 17B also shows the presence of a sharp peak in the month of June which is due to the Chernobyl accident of April 1986. These data suggest that there is no plant-related activity released to the environment, since the operational levels are not significantly different from the preoperational activity levels. A comparison between the control location (Huntington Beach) and the indicator locations did not reveal any significant difference in activity levels. During the preoperational period, gross beta activities measured at the indicator locations ranged from 0.004 to 0.560 pCi/m^3, averaging 0.045 pCi/m^3. The gross beta activities measured at the control location, on the other hand, ranged from 0.005 to 0.290 pCi/m^3, averaging 0.045 pCi/m^3. The average activity in all the indicator locations during operational period of January to December 1993 was found to be 0.016 pCi/m^3, whereas in the Huntington Beach control location it was also found to be 0.017 pCi/m^3. Therefore, it can be concluded that the rise in gross beta activity is not the result of plant operation and is the result of other environmental phenomena. It should be mentioned that the presence of activity due to atmospheric nuclear weapons testing and other environmental phenomena, such as volcanic activities, make the comparison difficult since the background level is affected. In this case, an average baseline of 0.025 pCi/m^3 was used by extrapolation which has remained fairly constant after 1987 and curtailment of Chernobyl contribution to gross beta activity in the air.

C. Radioiodine

SONGS Unit 1:

Radioiodine measurements were not made during the preoperational period of 1964 to 1967, and the operational levels for SONGS Unit 1 have been mostly below the lower limit of detection of 0.033 pCi/m^3.

SONGS Units 2 and 3:

A comparison of radioiodine measurements is not necessary since most of the preoperational and operational data for I-131 level are below the lower limit of detection of 0.033 pCi/m^3.

D. Ocean Water

SONGS Unit 1:

No ocean water samples were collected and analyzed during the preoperational period of SONGS Unit 1, so no comparison can be made with the operational data.

SONGS Units 2 and 3:

Ocean water samples were collected on a monthly basis in the vicinity of each of the Station discharge outfalls (which serve as indicator locations) and from Newport Beach (which serves as a control location). Upon collection, each of the samples are analyzed for 18 naturally-occurring and station-related gamma-emitting radionuclides. Every other month, the samples are also analyzed for gross beta activity. Finally, samples are composited quarterly and are analyzed for tritium.

During the preoperational period, naturally-occurring potassium-40 was the only gamma-emitting radionuclide detected in each of the samples collected from both indicator and control locations. Other gamma-emitting radionuclides were detected in only one ocean water sample. In May 1980, cobalt-58, cobalt-60, cesium-134, and cesium-137 were detected in an ocean water sample collected from the SONGS Unit 1 outfall. Concentrations of the radionuclides in this sample were 11, 6, 380, and 430 pCi/l, in that order.

Tritium was also detected in two of the ocean water samples collected in May 1980 from the SONGS Unit 2 outfall and from Newport Beach control. The tritium activities measured in ocean water were 1900 and 400 pCi/l respectively.

Throughout 1993, naturally-occurring K-40, Ra-226, and Th-228 were the only gamma-emitting radionuclides detected in the monthly gamma spectral analyses of samples collected from the indicator and control locations. Potassium-40 was detected in each sample. One sample had a Ce-141 concentration of 2.6 pCi/l, which may have been an analytical error.

Tritium was detected in two 1993 quarterly-composite samples obtained from SONGS Unit 1 outfall. The concentration of tritium in the rest of the samples was below the lower limits of detection of 102 pCi/l. Tritium concentration was 136 and 82 pCi/l for the first and second quarters of 1993, respectively. The tritium detected was the result of effluent discharge (release to the ocean), at the same time as sampling was in progress. Insufficient dilution received by ocean water resulted in detectable tritium (H-3) concentrations at the Unit outfalls. Radionuclides concentrations in ocean water in 1993 are, for the most part, below the lower limits of detection.

From these data, it was concluded that the operation of SONGS Units 2 and 3 has had a negligible impact on the environment compared to preoperational data.

E. Drinking Water

SONGS Unit 1:

Solids:

Monthly drinking water solid and filtrate gross alpha and beta activities of the two periods have been compared. The operational levels are much lower than the preoperational levels. The contribution of fallout to gross beta activity during the preoperational period prevents useful and accurate comparison with the preoperational data plotted in Figures 19A and 19B. However, gamma spectral analysis was performed on drinking water, and it did not show the presence of any plant-specific radionuclides in detectable levels.

During the preoperational period, the gross alpha activity of the solids was below the lower limit of detection of 0.21 pCi/l. Gross beta activity ranged from 0.37 to 3.00 pCi/l averaging 1.08 pCi/l for the indicator. The control location activity was below the lower limit of detection of 0.74 pCi/l. In 1993 operational period, the monthly gross alpha solids activity was below the LLD in all but one indicator sample. The gross alpha activity of solids in the control location was also below the lower limits of detection in 12 samples. The gross beta activity of solids ranged 0.18 to 0.27 pCi/l, averaging 0.23 pCi/l for three indicator samples. The control location gross beta activity was below the LLD in ten samples. Two samples of the control location detected gross beta at a range of 0.16 to 0.30 averaging 0.23 pCi/l (Table F-1A).

Filtrate:

During the preoperational period, gross alpha was below the lower limit of detection (3.0 pCi/l) and gross beta ranged from 5.2 to 90.0 pCi/l, averaging 28.5 pCi/l. One of the 10 control location samples activities was 32.00 pCi/l. The high activity is attributable to the nuclear weapons testing during the years indicated in the report. The gross alpha activity during the 1993 operational period was below the lower limit of detection for all 12 control samples. Gross alpha activity in one of the 24 indicator samples was detectable in location 1, at 1.1 pCi/l. The gross beta activity during the 1993 operational period ranged from 3.0 to 14.0 pCi/l, averaging 9.2 pCi/l at the indicator locations. The control location gross beta activity ranged from 2.0 to 14.0, averaging 9.5 pCi/l. The decrease in gross beta activity level in 1993 relative to the preoperational period is due to the curtailment of activity from nuclear weapons testing. The gross beta activity was detected in all indicator and control samples.

SONGS Units 2 and 3:

Solids:

Gross alpha activity during the preoperational period ranged from 0.2 to 0.4 pCi/l during January 1979 to July 1982.

The gross beta activity ranged from 0.3 to 2.7 pCi/l in all indicator locations from January 1979 to July 1982. The activity range in Huntington Beach control was 0.6 to 2.2 pCi/l during the same time period. The highest gross beta activity observed during the preoperational time was in September 1980 (2.7 pCi/l) in Tri-Cities Municipal Reservoir and January 1980 in San Clemente (2.2 pCi/l). The average gross beta activity during the preoperational phase was 1.13 pCi/l for all the indicator locations, where in Huntington Beach control it was 1.05 pCi/l. Gross alpha activity was not detected in indicator and control samples during the year 1993. The gross alpha activity was below the LLD of 0.21 pCi/l in the samples. During the operational period, the gross beta activity level of solids in three of 24 indicator samples was in the range of 0.18 to 0.27 pCi/l. All other samples' activities were below the lower limit of detection. All control samples but two, had concentrations below detectability. In general, no increasing trend was observed during the preoperational and operational periods, and all fluctuations are within the statistical deviations of the data points and also due to seasonal and other environmental phenomena. In conclusion, the plant's operations have had no detectable effect on this medium.

TABLE F-1A

DRINKING WATER (pCi/l)
PREOPERATIONAL AND OPERATIONAL DATA*
SONGS UNIT 1

Medium	Period	Analysis Type	Indicator Range	Indicator Average	Control Range	Control Average
Drinking water solids	Pre-op	G. Alpha	<LLD	<LLD	<LLD	<LLD
Drinking water solids	Op	G. Alpha	<LLD	<LLD	<LLD	<LLD
Drinking water solids	Pre-op	G. Beta	0.37-3.00	1.08	<LLD	<LLD
Drinking water solids	Op	G. Beta	0.18-0.27	0.23	0.16-0.30	0.23
Drinking water filtrate	Pre-op	G. Alpha	<LLD	<LLD	<LLD	<LLD
Drinking water filtrate	Op	G. Alpha	<LLD-1.10	<LLD	<LLD	<LLD
Drinking water filtrate	Pre-op	G. Beta	5.2-90.0	28.5	<LLD-32.0	<LLD
Drinking water filtrate	Op	G. Beta	3.0-14.0	9.3	2.0-14.0	9.5

TABLE F-1B

DRINKING WATER (pCi/l)
PREOPERATIONAL AND OPERATIONAL DATA**
SONGS UNITS 2 AND 3

Medium	Period	Analysis Type	Indicator Range	Indicator Average	Control Range	Control Average
Drinking water solids	Pre-op	G. Alpha	0.20-0.40	0.33	0.30-0.60	0.45
Drinking water solids	Op	G. Alpha	<LLD	<LLD	<LLD	<LLD
Drinking water solids	Pre-op	G. Beta	0.30-2.7	1.13	0.6-2.2	1.05
Drinking water solids	Op	G. Beta	0.18-0.27	0.23	0.16-0.30	0.23
Drinking water filtrate	Pre-op	G. Alpha	2.0-5.0	3.71	2.0-6.0	3.0
Drinking water filtrate	Op	G. Alpha	<LLD-1.10	<LLD	<LLD	<LLD
Drinking water filtrate	Pre-op	G. Beta	6.0-20.0	12.1	3.7-21.0	7.84
Drinking water filtrate	Op	G. Beta	3.0-14.0	9.3	2.0-14.0	9.5

* **Preoperational period - January 1964 to June 1967**
Operational period - January to December 1993
** **Preoperational period - January 1979 to July 1982**
Operational period - January to December 1993

Filtrate:

Gross alpha was detected in preoperational samples at a range of 2.0 to 5.0 pCi/l. Gross alpha was detected in one sample in 1993 at a concentration of 1.1 pCi/l.

During the preoperational and operational periods for SONGS Units 2 and 3, drinking water samples were collected on a monthly basis from two indicator locations in the vicinity of SONGS, and from a control location situated in Huntington Beach. After collection, the samples were filtered, and the filtrate and solids analyzed for both gross beta and gross alpha radioactivity. These data indicated that the concentrations of gross alpha and gross beta radioactivities in the samples collected during the operational periods of SONGS Units 2 and 3 are generally comparable to those observed in samples obtained during the preoperational period (Figures 19A and 19B). The variation in gross beta activity during operational period is random for all the locations, and no increasing trend in the operational period is observed. It is worth noting that no drinking water pathway exists for the liquid effluent at SONGS.

The filtrate gross beta activity level in all indicator locations ranged from 6.0 pCi/l to 20.0 pCi/l and averaged 12.1 pCi/l during preoperational time of January 1979 to July 1982. The gross beta activity range of Huntington Beach drinking water was 3.7 to 21.0 pCi/l during the same preoperational time period, averaging 7.8 pCi/l.

The range of gross beta activity of all the indicator locations during the operational period for Units 2 and 3 was 3.0 to 14.0, averaging 9.3 pCi/l; and in Huntington Beach control station, it was 2.0 to 14.0, averaging 9.5 pCi/l. The difference in gross beta activity level of the control a indicator stations may be due to the different origins of the water samples in all three locations. Tri-Cities reservoir activity levels are slightly higher than the other two stations. The higher levels observed in certain months of each year may be attributable to the fallout contribution from atmospheric nuclear weapons testing of the previous years and their effects on the Tri-Cities municipal water reservoir. The radioactive fallout would tend to affect the reservoir more than the other water supplies, such as San Clemente well water and Huntington Beach tap water, because the reservoir is open to the air with only a floating cover; whereas the other water supplies are essentially solidly covered. All the statistical and seasonal fluctuations plus the various natural radioactivity levels (such as K-40) of each type of water sample do contribute to the various gross beta activity levels of the drinking water samples. Comparison between the three stations is therefore complicated due to the presence of different environmental factors. Since tap water, well water, and reservoir water samples have different origins, a high gross beta activity at the Tri-Cities reservoir, due to fallout, would not show up at the Huntington Beach control station (tap water). Another factor which may be responsible for slightly lower levels of gross beta radioactivity in the Huntington Beach Control location is due to its natural origin.

F. Shoreline Sediments (Sand)

SONGS Unit 1:

Samples of shoreline sediments were not collected and analyzed during the preoperational period for SONGS Unit 1. Therefore, no comparison with operational data is possible.

SONGS Units 2 and 3:

Beach sand is collected semiannually from three indicator locations and from a control location situated in Newport Beach. After collection, the samples are analyzed for 19 naturally-occurring and plant-related radionuclides.

To assess the impact of SONGS operations on this environmental medium, preoperational data were compared to 1993 operational data. The only SONGS-related radionuclide detected in shoreline sediment in either time frame was cesium-137 with a range of 0.012 to 0.022 pCi/g, averaging 0.019 in 5 sediment samples (Table F-2A). One control sample Cs-137 activity was 0.032 pCi/g in July 1979. However, three naturally-occurring (non plant-related) radionuclides were detected in shoreline sediments. They include: potassium-40, radium-226, and thorium-228. Although the radionuclide cesium-137 appears in one sample collected in 1993, its concentration of 0.013 pCi/g, is insignificant and comparable to the preoperational period.

Because no station-related radionuclides were detected in shoreline sediment in significant concentrations during the preoperational and 1993 operational periods for SONGS Units 2 and 3, the impact of SONGS on this environmental medium is considered to be negligible.

G. Ocean Bottom Sediments

SONGS Unit 1:

Ocean bottom sediment samples were not collected during the preoperational phase of Unit 1, and therefore no comparison can be made. However, operational data for SONGS 1 did not reveal the presence of any significant radioactivity in the sediment samples.

SONGS Units 2 and 3:

During the preoperational and operational periods, representative samples of ocean bottom sediments were collected semiannually from each of the Station discharge outfalls and from a control station in Laguna Beach. The samples were analyzed for gamma-emitting radionuclides, including cobalt-58, cobalt-60, silver-110m and cesium-137. The results of the analyses are listed in Table F-2B. It is clear in surveying the data that the concentration of each of the radionuclides has decreased with time, or -- as in the case of silver-110m -- has consistently been below the lower limit of detection of that radionuclide.

The variation in activity of the ocean bottom sediments versus time is shown in Figures 6 and 7. During the preoperational period, three naturally-occurring radionuclides were found in each sample collected from the indicator locations. They include potassium-40, radium-226, and thorium-228.

Station-related radionuclides were also detected in samples collected during this time frame. Manganese-54 was detected in 5 of the 28 samples. The concentrations of manganese-54 in these samples ranged from 0.015 to 0.49 pCi/g, averaging 0.13 pCi/g. Cobalt-58 was detected in nine sample

The concentration of cobalt-58 in the samples ranged from 0.013 to 1.16 pCi/g, averaging 0.20 pCi/g. Cobalt-60 was measured in 15 of the 28 samples. The concentration of cobalt-60 in the samples ranged from 0.014 to 8.1 pCi/g, averaging 0.79 pCi/g. Cesium-137 was also detected in 16 of the 28 samples. The concentrations of cesium-137 in the samples ranged from 0.014 to 0.090 pCi/g, averaging 0.039 pCi/g. Cerium-144 was found in two samples. The concentration of cerium-144 in the samples was 0.06 and 0.26 pCi/g respectively.

In the 1993 operational period, naturally-occurring potassium-40, radium-226, and thorium-228 were detected in each sediment sample. The concentrations of station-related radionuclides detected in most ocean bottom sediment samples during 1993 were below the LLD. Cesium-137 concentration was markedly lower than the levels detected in ocean bottom sediments during the preoperational years for Units 2 and 3. Cesium-137 was one of the plant-related radionuclides detected in 1993 in three samples with a concentration range of 0.026 to 0.083, averaging 0.057 pCi/g.

Cobalt-60 was detected in one of the samples in 1993 at a concentration of 0.028 pCi/g. Manganese-54 was detected in one sample of Unit 1 outfall at a level of 0.014 pCi/g, I-131 and Mo(Tc)-99m were also detected in one sample at 0.01 pCi/g at Unit 2 and Unit 1 outfalls respectively.

The results indicate that there has not been a build-up of radionuclides with time in ocean bottom sediments near SONGS. The results also indicate notable decrease in the concentrations of plant-related radionuclides in the ocean bottom sediment during the operational years. The comparison of sediment activity with the preoperational values is difficult due to the small number of samples analyzed. Although cobalt-58, cobalt-60, silver-110m, and cesium-137 are normally associated with nuclear power operations, preoperational study reveals no accumulation trend for these radionuclides, and no increase in levels for these radionuclides was detected during the operational period. Therefore, we conclude that SONGS Units 2 and 3 operation has not had any impact upon this environment (Figures 6, 7A and 7B).

The fact that the concentrations of the radionuclides decreased with time is probably due to the curtailment of atmospheric nuclear weapons tests, and the continued decay of fission and activation products from previous atmospheric nuclear weapons tests.

These results indicate that there has not been a build-up of radionuclides with time in ocean bottom sediment near SONGS.

TABLE F-2A

SHORELINE SEDIMENTS CONCENTRATION (pCi/g, wet weight)
PREOPERATIONAL AND OPERATIONAL DATA*

SONGS UNITS 2 AND 3

Radionuclide	Period	Indicator Range	Indicator Average	Control Range	Control Average
Mn-54	Preop	<LLD	<LLD	<LLD	<LLD
Mn-54	Op	<LLD	<LLD	<LLD	<LLD
Co-58	Preop	<LLD	<LLD	<LLD	<LLD
Co-58	Op	<LLD	<LLD	<LLD	<LLD
Co-60	Preop	<LLD	<LLD	<LLD	<LLD
Co-60	Op	<LLD	<LLD	<LLD	<LLD
Ag-110m	Preop	<LLD	<LLD	<LLD	<LLD
Ag-110m	Op	<LLD	<LLD	<LLD	<LLD
Cs-137	Preop	0.012-0.022	0.019	<LLD-0.032	<LLD
Cs-137	Op	<LLD-0.013	<LLD	<LLD	<LLD
Ce-144	Preop	<LLD	<LLD	<LLD	<LLD
Ce-144	Op	<LLD	<LLD	<LLD	<LLD

TABLE F-2B

OCEAN BOTTOM SEDIMENTS CONCENTRATION (pCi/g, wet weight)
PREOPERATIONAL AND OPERATIONAL DATA*

SONGS UNITS 2 AND 3

Radionuclide	Period	Indicator Range	Indicator Average	Control Range	Control Average
Mn-54	Preop	0.0150-0.49	0.129	<LLD	<LLD
Mn-54	Op	<LLD-0.014	<LLD	<LLD	<LLD
Co-58	Preop	0.013-1.160	0.199	<LLD	<LLD
Co-58	Op	<LLD	<LLD	<LLD	<LLD
Co-60	Preop	0.014-8.100	0.788	<LLD	<LLD
Co-60	Op	<LLD-0.028	<LLD	<LLD	<LLD
Mo(Tc)-99m	Preop	<LLD	<LLD	<LLD	<LLD
Mo(Tc)-99m	Op	<LLD-0.01	<LLD	<LLD	<LLD
Ag-110m	Preop	<LLD-0.020	<LLD	<LLD	<LLD
Ag-110m	Op	<LLD	<LLD	<LLD	<LLD
I-131	Preop	<LLD	<LLD	<LLD	<LLD
I-131	Op	<LLD-0.01	<LLD	<LLD	<LLD
Cs-137	Preop	0.014-0.090	0.039	<LLD-0.043	<LLD
Cs-137	Op	0.026-0.083	0.057	<LLD	<LLD
Ce-144	Preop	0.060-0.26	0.16	<LLD	<LLD
Ce-144	Op	<LLD	<LLD	<LLD	<LLD

***Preop = January 1979 to July 1982**
Operational = January to December 1993

H. Marine Species (Flesh)

SONGS Unit 1:

Marine species were not collected and analyzed during the preoperational period for SONGS Unit 1. Therefore, no comparison with operational data is possible.

SONGS Units 2 and 3:

Non-migratory marine species were collected semi-annually near SONGS to determine the amount of radioactivity that could be consumed by man or in the food chain to man. Marine species caught by the SONGS outfalls and from Laguna Beach include two species of adult fish, crustacea and mollusks. Upon collection, the flesh portion is analyzed for three naturally-occurring radionuclides, for 16 gamma-emitting, station-related radionuclides, and for aqueous and bound tritium. The results are subsequently reported to us in terms of both dry and wet sample weights.

Selected results for different marine species for both the preoperational and 1993 operational periods for Units 2 and 3 are presented in Table F-3. The marine species used for purposes of comparison include: sheephead (a fish), black perch (a fish), bay mussel (a mollusk), spiny lobster (a crustacea), sea hare (a mollusk), and keyhole limpet (a mollusk). Radionuclides activity not included in Table F-3 were below the lower limits of detection for both the preoperational and operational time periods.

In comparing preoperational and operational data for each marine species and radionuclide, it is evident that the concentrations of station-related radionuclides detected in each species during 1993 are commensurate to or less than the concentrations detected in the same marine species during the preoperational period (Figures 8A - 13B).

From these data, it can be concluded that the operation of SONGS Units 1, 2, and 3 in 1993 has had no significant impact on this environmental medium.

TABLE F-3

MARINE SPECIES CONCENTRATIONS (pCi/g, wet weight) PREOPERATIONAL AND OPERATIONAL DATA*

SONGS UNITS 2 AND 3

Sheephead Flesh

Radionuclide	Period	Indicator Range	Indicator Average	Control Range	Control Average
Mn-54	Preop	<LLD	<LLD	<LLD	<LLD
Mn-54	Op	<LLD	<LLD	<LLD	<LLD
Co-57	Preop	<LLD	<LLD	<LLD	<LLD
Co-57	Op	<LLD	<LLD	<LLD	<LLD
Co-58	Preop	0.016-0.030	0.023	<LLD	<LLD
Co-58	Op	<LLD	<LLD	<LLD	<LLD
Fe-59	Preop	<LLD	<LLD	<LLD	<LLD
Fe-59	Op	<LLD	<LLD	<LLD	<LLD
Co-60	Preop	0.005-0.044	0.017	<LLD	<LLD
Co-60	Op	<LLD	<LLD	<LLD	<LLD
Ag-110m	Preop	<LLD-0.004	<LLD	<LLD	<LLD
Ag-110m	Op	<LLD	<LLD	<LLD	<LLD
Cs-134	Preop	<LLD	<LLD	<LLD	<LLD
Cs-134	Op	<LLD	<LLD	<LLD	<LLD
Cs-137	Preop	0.004-0.018	0.010	0.005-0.012	0.007
Cs-137	Op	0.003-0.008	0.006	<LLD	<LLD
Ru-103	Preop	----	----	----	----
Ru-103	Op	<LLD	<LLD	<LLD	<LLD

Black Perch Flesh

Radionuclide	Period	Indicator Range	Indicator Average	Control Range	Control Average
Mn-54	Preop	<LLD	<LLD	<LLD	<LLD
Mn-54	Op	<LLD	<LLD	<LLD	<LLD
Co-57	Preop	<LLD	<LLD	<LLD	<LLD
Co-57	Op	<LLD	<LLD	<LLD	<LLD
Co-58	Preop	0.009-0.011	0.010	<LLD	<LLD
Co-58	Op	<LLD	<LLD	<LLD	<LLD
Fe-59	Preop	<LLD	<LLD	<LLD	<LLD
Fe-59	Op	<LLD	<LLD	<LLD	<LLD
Co-60	Preop	0.004-0.045	0.017	<LLD	<LLD
Co-60	Op	<LLD	<LLD	<LLD	<LLD
Ag-110m	Preop	0.002-0.009	0.006	<LLD	<LLD
Ag-110m	Op	<LLD	<LLD	<LLD	<LLD
Cs-134	Preop	<LLD	<LLD	<LLD	<LLD
Cs-134	Op	<LLD	<LLD	<LLD	<LLD
Cs-137	Preop	0.003-0.015	0.008	0.004-0.014	0.009
Cs-137	Op	<LLD-0.010	<LLD	<LLD	<LLD
Ru-103	Preop	<LLD	<LLD	<LLD	<LLD
Ru-103	Op	<LLD	<LLD	<LLD	<LLD

***Preoperational - January 1979 to July 1982**
Operational = January to December 1993
LLD = Lower Limits of Detection are listed in Appendix B.

TABLE F-3 (continued)

MARINE SPECIES CONCENTRATIONS (pCi/g, wet weight) PREOPERATIONAL AND OPERATIONAL DATA*

SONGS UNITS 2 AND 3

Bay Mussel Flesh

Radionuclide	Period	Indicator Range	Indicator Average	Control Range	Control Average
Mn-54	Preop	0.009-0.025	0.017	<LLD	<LLD
Mn-54	Op	<LLD	<LLD	<LLD	<LLD
Co-57	Preop	<LLD	<LLD	<LLD	<LLD
Co-57	Op	<LLD	<LLD	<LLD	<LLD
Co-58	Preop	0.008-0.080	0.028	----	----
Co-58	Op	<LLD	<LLD	<LLD	<LLD
Fe-59	Preop	<LLD	<LLD	<LLD	<LLD
CO-59	Op	<LLD	<LLD	<LLD	<LLD
Co-60	Preop	0.005-0.40	0.077	<LLD	<LLD
Co-60	Op	<LLD	<LLD	<LLD	<LLD
Ag-110m	Preop	<LLD	<LLD	<LLD	<LLD
Ag-110m	Op	<LLD	<LLD	<LLD	<LLD
Cs-134	Preop	<LLD	<LLD	<LLD	<LLD
Cs-134	Op	<LLD	<LLD	<LLD	<LLD
Cs-137	Preop	0.003-0.006	0.004	<LLD	<LLD
Cs-137	Op	<LLD	<LLD	<LLD	<LLD
Ru-103	Preop	<LLD-0.045	<LLD	<LLD	<LLD
Ru-103	Op	<LLD	<LLD	<LLD	<LLD

Spiny Lobster Flesh

Radionuclide	Period	Indicator Range	Indicator Average	Control Range	Control Average
Mn-54	Preop	<LLD	<LLD	<LLD	<LLD
Mn-54	Op	<LLD	<LLD	<LLD	<LLD
Co-57	Preop	<LLD	<LLD	<LLD	<LLD
Co-57	Op	<LLD	<LLD	<LLD	<LLD
Co-58	Preop	0.007-0.270	0.086	<LLD	<LLD
Co-58	Op	<LLD	<LLD	<LLD	<LLD
Fe-59	Preop	<LLD	<LLD	<LLD	<LLD
Fe-59	Op	<LLD	<LLD	<LLD	<LLD
Co-60	Preop	0.014-0.210	0.060	<LLD	<LLD
Co-60	Op	<LLD	<LLD	<LLD	<LLD
Ag-110m	Preop	<LLD	<LLD	<LLD	<LLD
Ag-110m	Op	<LLD	<LLD	<LLD	<LLD
Cs-134	Preop	<LLD	<LLD	<LLD	<LLD
Cs-134	Op	<LLD	<LLD	<LLD	<LLD
Cs-137	Preop	0.005-0.011	0.008	0.040-0.015	0.008
Cs-137	Op	<LLD	<LLD	<LLD	<LLD
Ru-103	Preop	<LLD	<LLD	<LLD	<LLD
Ru-103	Op	<LLD	<LLD	<LLD	<LLD

TABLE F-3 (continued)

MARINE SPECIES CONCENTRATIONS (pCi/g, wet weight) PREOPERATIONAL AND OPERATIONAL DATA*

SONGS UNITS 2 AND 3

Sea Hare Flesh

Radionuclide	Period	Indicator Range	Indicator Average	Control Range	Control Average
Mn-54	Preop	<LLD	<LLD	<LLD	<LLD
Mn-54	Op	<LLD	<LLD	<LLD	<LLD
Co-57	Preop	0.006-0.017	0.009	<LLD	<LLD
Co-57	Op	<LLD	<LLD	<LLD	<LLD
Co-58	Preop	0.006-12.4	1.233	<LLD	<LLD
Co-58	Op	<LLD	<LLD	<LLD	<LLD
Fe-59	Preop	<LLD	<LLD	<LLD	<LLD
Fe-59	Op	<LLD	<LLD	<LLD	<LLD
Co-60	Preop	0.016-2.000	0.448	0.003-0.027	0.013
Co-60	Op	<LLD-0.007	<LLD	<LLD	<LLD
Zn-65	Preop	<LLD-0.10	<LLD	<LLD	<LLD
Zn-65	Op	<LLD	<LLD	<LLD	<LLD
Ag-110m	Preop	0.018-0.50	0.138	0.020-0.039	0.030
Ag-110m	Op	<LLD	<LLD	<LLD	<LLD
Cs-134	Preop	<LLD	<LLD	<LLD	<LLD
Cs-134	Op	<LLD	<LLD	<LLD	<LLD
Cs-137	Preop	<LLD-0.004	<LLD	<LLD-0.005	<LLD
Cs-137	Op	<LLD	<LLD	<LLD	<LLD
Ru-103	Preop	<LLD	<LLD	<LLD	<LLD
Ru-103	Op	<LLD	<LLD	<LLD	<LLD
CE-144	Preop	<LLD	<LLD	<LLD	<LLD
CE-144	Op	<LLD-0.010	<LLD	<LLD	<LLD

Keyhole Limpet (Flesh)

Radionuclide	Period	Indicator Range	Indicator Average	Control Range	Control Average
Mn-54	Preop	<LLD	<LLD	<LLD	<LLD
Mn-54	Op	<LLD	<LLD	<LLD	<LLD
Co-57	Preop	<LLD	<LLD	<LLD	<LLD
Co-57	Op	<LLD	<LLD	<LLD	<LLD
Co-58	Preop	0.007-0.101	0.054	<LLD-0.190	<LLD
Co-58	Op	<LLD	<LLD	<LLD	<LLD
Fe-59	Preop	<LLD	<LLD	<LLD	<LLD
Fe-59	Op	<LLD	<LLD	<LLD	<LLD
Co-60	Preop	0.021-0.040	0.033	<LLD-0.022	0.022
Co-60	Op	<LLD	<LLD	<LLD	<LLD
Ag-110m	Preop	0.033-0.101	0.054	0.005-0.042	0.022
Ag-110m	Op	<LLD	<LLD	<LLD	<LLD
Cs-134	Preop	<LLD	<LLD	<LLD	<LLD
Cs-134	Op	<LLD	<LLD	<LLD	<LLD
Cs-137	Preop	<LLD	<LLD	<LLD-0.005	<LLD
Cs-137	Op	<LLD	<LLD	<LLD	<LLD
Ru-103	Preop	<LLD	<LLD	<LLD	<LLD
Ru-103	Op	<LLD	<LLD	<LLD	<LLD

I. Local Crops

SONGS Unit 1:

During the preoperational phase of Unit 1, local crops were collected semiannually from both indicator and control locations, and subsequently analyzed for both aqueous and organically-bound tritium, and for strontium-90. Tritium was deleted in the 1993 operational period from the radiological environmental monitoring program. The results of Sr-90 are summarized in Table F-4A.

In short, from 1964 to 1967, no aqueous or organically-bound tritium was detected in samples collected from either the indicator or control locations. Strontium-90, however, was present in detectable amounts in four different types of samples (cabbage, celery, lettuce, and strawberries) collected from the indicator locations near SONGS, and not in any of the samples collected from the control location (Table F-4A).

SONGS Units 2 and 3:

In 1993, strontium-90 was detected in two samples from the indicator and three from the control location, and the concentrations of gamma-emitting plant-related radionuclides were below the lower limits of detection. Potassium-40, a naturally-occurring radionuclide, was detected in samples of cucumber, squash, strawberries, and tomato during the operational period of 1993 (Table F-4B).

In the preoperational period of January 1979 through July 1982, no aqueous tritium was detected in the indicator and control locations samples. Strontium-90 was detected in the control samples of kale, parsley, and squash. Potassium-40 was detected in cucumber, kale, and tomato samples from the indicator and control locations. Cerium-144 and Zr(Nb)-95 were detected in one sample of parsley at the control location at concentrations of 0.12 and 0.09 pCi/g, wet weight respectively.

TABLE F-4A

LOCAL CROPS PREOPERATIONAL AND OPERATIONAL DATA*
(pCi/g, wet weight)

SONGS UNIT 1

Radionuclide	Type**	Period	Indicator Range	Indicator Average	Control Range	Control Average
H-3 Aqueous	All	Preop	<LLD	<LLD	<LLD	<LLD
H-3 Bound	All	Preop	<LLD	<LLD	<LLD	<LLD
Sr-90	All	Preop	0.008-0.030	0.022	<LLD	<LLD
H-3 Aqueous	Deleted					
H-3 Bound	Deleted					
Sr-90	All	Op	<LLD-0.0013	<LLD	<LLD-0.001	<LLD

* Preoperational = January 1964 to June 1967
Operational = January to December 1993

TABLE F-4B

LOCAL CROPS PREOPERATIONAL AND OPERATIONAL DATA*
(pCi/g, wet weight)

SONGS UNITS 2 AND 3

Radionuclide	Type**	Period	Indicator Range	Indicator Average	Control Range	Control Average
H-3 Aqueous	All	Preop	<LLD	<LLD	<LLD	<LLD
H-3 Bound	All	Preop	<LLD	<LLD	<LLD	<LLD
H-3 Aqueous	Deleted					
H-3 Bound	Deleted					
Sr-90	All	Preop	<LLD	<LLD	0.05-0.027	
0.056						
Sr-90	All	Op	<LLD-0.0013	<LLD	<LLD	<LLD

* **Preoperational = January 1979 to July 1982**
Operational = January to December 1993

** **Cabbage, celery, lettuce, strawberries, and tomato samples were collected during preoperational period. Strawberries, cucumber, tomato, and squash samples were collected during 1993 operational period.**

J. Soil

SONGS Unit 1:

No soil data were available for Unit 1 preoperational phase so comparison cannot be made. However, gamma isotopic analysis of soil does not show any significant level of radioactivity in soil (Table F-5); and in most measurements, all the levels were below the lower limit of detection of the radionuclides of interest. Figures 20A and 20B show variation in the concentrations of strontium-90 and cesium-137 since 1977 and compares the radionuclides concentrations with the preoperational levels. No accumulation pattern of plant-related radionuclides in the soil has been observed in the last 17 years.

SONGS Units 2 and 3:

A comparison of operational and preoperational data does not reveal any accumulation pattern of strontium-90 or cesium-137 in soil. Figures 20A and 20B compare variation in the concentrations of strontium-90 and cesium-137 between different locations from 1977 to 1993, respectively. These figures also trend the soil concentrations of the mentioned radionuclides during the preoperational and operational periods.

K. Kelp

SONGS Unit 1:

Samples of kelp were not collected and analyzed during the preoperational period for SONGS Unit 1. Therefore, no comparison with operational data is possible.

SONGS Units 2 and 3:

Kelp is collected semiannually from three indicator locations and from a control location situated in Laguna Beach. After collection, the samples are analyzed by gamma-spectral analysis for 19 naturally-occurring and station-related radionuclides.

To assess the impact of SONGS operations on kelp, preoperational data were compared to 1993 operational data (Table F-6). Radionuclides detected during the preoperational period for SONGS Units 2 and 3 include naturally-occurring potassium-40, manganese-54, cobalt-60, zirconium (niobium)-95, iodine-131, and cesium-137. Of these, only potassium-40, iodine-131 and cesium-137 were present in detectable amounts in the kelp samples collected in 1990. Figures 21 and 22 compare iodine-131 and cesium-137 variation in kelp since 1975. These figures also compare the concentrations of radionuclides detected in kelp in 1993 to preoperational period for SONGS Units 2 and 3.

Though the iodine-131 and cesium-137 released from the liquid effluent have had a detectable effect on kelp beds in the last few years, the dose impact to the member of public resulting from these radionuclides in kelp is insignificant. Although the concentrations of iodine-131 have increased in a random manner, there is no evidence that iodine-131 is steadily increasing in concentration in kelp near SONGS.

TABLE F-5

SOIL PREOPERATIONAL AND OPERATIONAL DATA* (pCi/g, dry weight)

SONGS UNITS 2 AND 3

		Indicator		Control	
Radionuclide	Period	Range	Average	Range	Average
Co-58	Preop	<LLD	<LLD	<LLD	<LLD
Co-58	Op	<LLD	<LLD	<LLD	<LLD
Co-60	Preop	<LLD	<LLD	<LLD	<LLD
Co-60	Op	<LLD	<LLD	<LLD	<LLD
Sr-90	Preop	0.02-0.08	0.044	<LLD-0.03	<LLD
Sr-90	Op	<LLD	<LLD	<LLD	<LLD
Zr(Nb)-95	Preop	<LLD	<LLD	<LLD	<LLD
Zr(Nb)-95	Op	<LLD	<LLD	<LLD	<LLD
Ru-103	Preop	<LLD	<LLD	<LLD	<LLD
Ru-103	Op	<LLD	<LLD	<LLD	<LLD
Ag-110m	Preop	<LLD	<LLD	<LLD	<LLD
Ag-110m	Op	<LLD	<LLD	<LLD	<LLD
I-131	Preop	<LLD	<LLD	<LLD	<LLD
I-131	Op	<LLD	<LLD	<LLD	<LLD
Cs-134	Preop	<LLD	<LLD	<LLD	<LLD
Cs-134	Op	<LLD	<LLD	<LLD	<LLD
Cs-137	Preop	0.02-0.20	0.096	<LLD-0.06	<LLD
Cs-137	Op	0.059-0.078	0.25	<LLD-0.03	<LLD
Ce-141	Preop	<LLD	<LLD	<LLD	<LLD
Ce-141	Op	<LLD	<LLD	<LLD	<LLD
Ce-144	Preop	<LLD	<LLD	<LLD	<LLD
Ce-144	Op	<LLD	<LLD	<LLD	<LLD

*** Preoperational = January 1979 to July 1982**
Operational = January to December 1993

TABLE F-6

KELP PREOPERATIONAL AND OPERATIONAL DATA* (pCi/g, wet weight)

SONGS UNITS 2 AND 3

		Indicator		Control	
Radionuclide	Period	Range	Average	Range	Average
H-3 Aqueous	Preop	<LLD	<LLD	<LLD	<LLD
H-3 Aqueous	Op	0.48	<LLD	<LLD	<LLD
H-3 Bound	Preop	----	----	<LLD	<LLD
H-3 Bound	Op	<LLD-0.48	<LLD	<LLD	<LLD
Mn-54	Preop	<LLD-0.005	<LLD	<LLD	<LLD
Mn-54	Op	<LLD	<LLD	<LLD	<LLD
Co-58	Preop	<LLD	<LLD	<LLD	<LLD
Co-58	Op	<LLD	<LLD	<LLD	<LLD
Co-60	Preop	0.006-0.009	0.008	<LLD	<LLD
Co-60	Op	<LLD	<LLD	<LLD	<LLD
Zr(Nb)-95	Preop	0.014-0.090	0.046	0.018-0.053	0.036
Zr(Nb)-95	Op	<LLD	<LLD	<LLD	<LLD
Ru-103	Preop	<LLD	<LLD	<LLD	<LLD
Ru-103	Op	<LLD	<LLD	<LLD	<LLD
Ag-110m	Preop	<LLD	<LLD	<LLD	<LLD
Ag-110m	Op	<LLD	<LLD	<LLD	<LLD
I-131	Preop	0.006-0.024	0.013	0.008-0.030	0.014
I-131	Op	0.014-0.023	0.018	0.016**	<LLD
Cs-134	Preop	<LLD	<LLD	<LLD	<LLD
Cs-134	Op	<LLD	<LLD	<LLD	<LLD
Cs-137	Preop	0.004-0.009	0.006	<LLD	<LLD
Cs-137	Op	<LLD-0.003	<LLD	<LLD	<LLD

*** Preoperational = January 1979 to July 1982**
Operational = January to December 1993
**** One sample only**

APPENDIX G

DEVIATIONS FROM ODCM SAMPLING REQUIREMENTS

IN 1993

DEVIATIONS FROM SAMPLING REQUIREMENTS

As required by Units 1, and 2/3 Offsite Dose Calculation Manuals (ODCMs), Section 5.0, deviations from sampling requirements for all radiological environmental sampling locations are listed below:

Part I. TERRESTRIAL SAMPLING

a. Weekly Air Sampling:

Air Sampler #1 (City of San Clemente):
Lost 111 hours of collection due to power failure week ending March 16, 1993; and 77.0 hours of collection due to power failure week ending December 14, 1993 (total down time = 188 hours).
Air Sampler #2 (Camp San Onofre):
Lost 4 hours of collection due to a suspected power failure week ending March 30, 1993; 0.4 hours due to replacement of the pump assembly week ending August 10, 1993; and 2.0 hours of collection due to suspected power failure week ending November 2, 1993 (total down time = 6.4 hours).
Air Sampler #3 (Huntington Beach Generating Station):
Collected low air volume (7230 cubic feet) due to dust loading week ending August 10, 1993; and 7470 cubic feet due to dust loading week ending October 26, 1993 (total down time = 0).
Air Sampler #5 (Units 2/3 Switchyard):
Collected low air volume (5060 cubic feet) due to gas meter malfunctioning week ending February 9, 1993; low volume (4700 cubic feet) week ending March 23, 1993; and low volume (4380 cubic feet) due to its pump failure week ending March 30, 1993. The assembly was replaced on March 26, 1993. The indicated volumes were not accurate due to malfunctioning gas meter. This air sampler is located within the EAB and not required by the ODCM (total down time = 0)
Air Sampler #6 (SONGS Met Tower):
The sampler was deleted from the REMP in January 1993. The sampler was located within the EAB and was not required by ODCM.
Air Sampler #7 (AWS Roof):
This sampler, located within the EAB, was added to the REMP in January 1993. During the weekly period ending February 23, 1993, the time lapse meter was not operating properly. The sampler lost 6.5 hours of collection due to gas replacement assembly week ending August 10, 1993 (Total down time = 0).
Air Sampler #9 (State Beach Park):
Lost 63.9 hours of collection due to electrical power failure week ending January 19, 1993; and 161.6 hours of collection due to power failure week ending February 2, 1993, 6.6 hours due to dust loading week ending February 9, 1993, and also lost 2.6 hours due to pump assembly replacement week ending August 10, 1993 (total down time = 234.7 hours).
Air Sampler # 10 (Bluff):
Collected low volume (4610 cubic feet) due to inlet plugged with debris week ending June 29, 1993. It also collected low volume (4580 cubic feet) due to plugged inlet week ending August 3, 1993. It lost 6.4 hours of collection due to replacement of the power assembly week ending August 10, 1993. It also collected low volume (6110 cubic feet) due to dust loading week ending October 12, 1993 (total down time = 6.4 hours).

Air Sampler #11 (Mesa E.O.F.):
Lost 3.1 hours of collection due to a power outage and pump assembly replacement during the week ending August 10, 1993. It collected low volume (7000 cubic feet) due to dust loading week ending October 5, 1993; and 6960 cubic feet due to dust loading week ending October 26, 1993 (total down time = 3.1 hours).
Air Sampler #12 (Former SONGS Evaporation Pond):
Lost 3.7 hours of collection due to a vacuum pump and rotometer repair week ending February 2, 1993 and 6.5 hours due to a power outage week ending August 10, 1993. Low air volume was collected during the weekly period ending September 28, 1993 (total dpwn time = 10.2 hours).
Air Sampler #13 (Camp Pendleton, East):
The sampler lost 2.5 hours of collection due to a pump assembly replacement week ending August 10, 1993. The sampler also lost 50.9 hours of collection due to a transformer problem week ending September 21, 1993 (total down time 53.4 hours).

Note: All air samplers were collected on monday December 20, 1993; instead of tuesday to accommodate manning requirements. This resulted in a six-day collection followed by an eight-day collection.

b. **Direct Radiation:**
During the second quarter of 1993, TLD #38 was found missing and no data was therefore available. Thermoluminescent #15 was relocated 8 feet to the South on November 4, 1993 due to the demolition of the building (K-20) it was installed to. In January 1993, 21 of the 68 environmental TLDs were deleted from the program to reduce the man power and cost. All th changes to the REMP were documented in a report.

c. **Local Crops:**
Fleshy vegetables were collected in April and October 1993. Because leafy vegetables are not harvested at San Clemente Ranch, a second fleshy vegetable sample was collected. Leafy vegetables are collected in one of the San Clemente private gardens listed in the 1993 Land Use Census report but this location is 4.4 miles in the NW direction (Sector Q) from the plant, too distant to be considered a true indicator. SONGS regulatory requirements of the ODCM Section 5.0, specify gamma isotopic analysis of the edible portion of the samples.

d. **Shoreline Sediments:**
No deviations were observed.
e. **Drinking Water:**
No deviations were observed.
f. **Soil:**
No deviations were observed.

PART II. (MARINE SAMPLING)

Marine samples are collected by a contractor, located in La Jolla, California. The fish samples are filleted upon collection and split into two portions. The samples are then frozen and shipped to our contracted laboratory for SCE and to the DHS laboratory (SRL) for the split sampling program.
Marine Species:
a. The frequency of marine sampling collection decreased from quarterly to semiannually in 1993. Because the marine species caught in the vicinity

of SONGS outfalls are of non-seasonal type, the samples can be collected once every 184 days. No deviations were observed.

b. **Ocean Water Sampling:**
No deviations were observed.

c. **Ocean Bottom Sediments**
No deviations were observed.

d. **Kelp:**
No deviations were observed.

FOOTNOTES:

1. Listing of unusual downtime in addition to routine maintenance as follows:

   Total downtime for all air samplers for 1993 (1, 2, 3, 5, 7, 9, 10, 11, 12, and 13) due to weekly filter changeout, quarterly preventive maintenance (P.M.), and the annual gas meter changeout and vacuum gauge calibration checks was approximately 82 minutes for each sampler as follows:

   Weekly Changeout: Approximately 1 minute x 52 = 52 minutes
   Quarterly (P.M.): Approximately 5 minutes x 4 = 20 minutes
   Annual Cal.Check: Approximately 10 minutes x 1 = 10 minutes

2. Corrective actions taken. Performance standard criterion of 95%, averaged on an annual basis is applied for the environmental data collection. Applying a 95% performance standard to the collection of air samplers would permit, the failure to collect each regulatory-required air sampler 2 weeks per year. Any air sampler failing to collect the volume required to meet the sensitivity requirement of 0.07 pCi/m^3 twice per year (7000 cubic feet) will receive bi-weekly inspections. Applying the above criteria, the following corrective actions were taken:

   All environmental air samplers were replaced with HI-Q Environmental air samplers in 1993. Different components of the new samplers were calibrated by the manufacturer. The dates for the new samplers installation were:

   Air sampler #1 : November 16, 1993
   Air sampler #2 : August 6, 1993
   Air sampler #3 : November 16, 1993
   Air sampler #5 : August 6, 1993
   Air sampler #7 : August 6, 1993
   Air sampler #9 : August 5, 1993
   Air sampler #10: August 3, 1993
   Air sampler #11: August 4, 1993
   Air sampler #12: August 5, 1993
   Air sampler #13: August 6, 1993

   The down time of the air samplers #1, #9, and #13 were caused by power outages which were beyond control. The other samplers down times do not require any corrective actions based on 95% annual performance criterion used. Air samplers #5 and #7 are not required by ODCM Section 5.0, and not considered offsite environmental air samplers

because they are located within the Exclusion Area Boundary (EAB) distances of all three units.

3. Environmental TLDs are not collected from ocean-bound sectors due to extreme impracticality of doing so. In addition, information obtained from measuring exposures in the ocean-bound sectors is not of significant value because these sectors are not inhabited by members of public.

A review of the airborne particulate radioactivity data was conducted to determine the impact on gross beta activity measurements resulting from Environmental Air Sampler numbers #1, #3, #9 and #10, out-of-calibration and out of tolerance for the 1993 collection period. A comparison of gross beta activity data indicate no significant variation in data during the out-of-calibration period. The comparison of data for I-131 activity did not show any changes since most of the concentrations were zero and reported below the Lower Limits of Detection of (LLD) 0.033 pCi/m^3.

An assessment of the quarterly-composite air data was also performed. A statistical summary of quarterly gamma spectral analysis did not reveal any differences in the activities of the gamma-emitting radionuclides detected below the LLD.

To assess the impact on the gross beta concentration data reported for air samplers #1, #3, #9 and #10, Metrology Calibration Reports were reviewed and flow correction curves were used to correct the air volume (ft^3) and the reported concentration in pCi/m^3 for out-of-tolerance volumes. The correct concentrations were then plotted against the reported ones for comparison. The overlapping of the two concentration curves suggests that there has not been any variation or significant differences in the data.

Based on a calibration tolerance of ±5%, air samplers #1, #3, #9 and #10 experienced more than 5% variation in the flow volume. The flow correction curves indicate that the air samplers actually underestimated the volume of the air collected, exceeding the tolerance limit of five percent. Applying the appropriate correction factor corresponding to the collected volume from the curves, concentrations were recalculated to obtain the corrected (actual) volume designated as corrected concentration for weekly periods out-of-tolerance. From the monthly air data, it was also found that the elapsed time for air samplers #9 and #10 were zero for the out-of-tolerance period so the air samplers collected air continuously for 168 hours per week for the mentioned period. The total volume in cubic feet is also converted to Standard Cubic Feet Hour (SCFH).

In conclusion, the uniformity of the data does not reflect any unusual trend in the results and these comparisons offer no differences or impact the safety or quality of the REMP data for the year 1993. All gross beta activity measurements were above the lower limits of detection of 0.001 pCi/m^3. All other locations remained the same. Provisions have been made in procedures to prevent recurrence of such incidents in future.

APPENDIX H

LAND USE CENSUS FOR 1993

INTRODUCTION

Purpose Of The Land Use Census

The 1993 Land Use Census (LUC) was conducted using in-house resources for the first time. This census is to identify land uses within the five-mile radius of the San Onofre Nuclear Generation Station (SONGS) as required by ODCM Section 5.2.

The overall objective of this census is to identify important radiological pathways to man. This is accomplished by locating and documenting the nearest residences, milk animals, meat animals, gardens of at least 500 square feet producing fleshy or leafy vegetables (Tables H-1 and H-3) and other specified uses campgrounds, employment, etc. in each of the 16 meteorological sectors within a five-mile radius of SONGS (Tables H-2 and H-4).

Definition of Uses

Residence is defined as any structure (single family house, apartment, mobile home, barracks or similar type unit), which is occupied by an individual(s) or resident(s) for three months (2,000 hours) or longer in a given year.

Other Specified Use is defined as a location occupied by members of the general population as other than their primary residence. The use is divided into two categories: employment and non-employment related.

Employment use is defined as a location occupied by members of the general population engaged in normal work activities regardless of the length of time spent at the location, or regardless of its permanence, including concession stands, restaurants, markets, and guard shacks.

Non-employment related use is defined as a location occupied by members of the general population who are not engaged in normal work activities, including campgrounds, temporary housing, timeshare condominiums, motels, hotels, school, and beaches.

Milk animals are cows, goats or sheep, whose milk is used in dairy products for human consumption.

Meat animals include, but are not limited to, deer, cattle, goats or sheep, whose meat is used for human consumption.

Fresh, leafy vegetables include examples such as lettuce, cabbage, and spinach. Other vegetables, known as "fleshy" vegetables, were also included in the census. Fleshy vegetables include tomatoes, cucumbers, cauliflower, and sweet corn.

1993 HIGHLIGHTS OF CHANGES FROM THE 1992 CENSUS FOR UNIT 1

1. San Clemente Ranch Packing (2.4 miles in sector R) occupancy hours increased from 3000 hours to 3218 hours per year.

2. Enlisted Beach in sector Q was renamed as "51 Area Beach" in 1993. The campground check-in (1.2 miles in sector Q) occupancy hours of this use increased from 2000 to 2250 hours in 1993.

3. A mini exchange was added to this area with occupancy hours of 1040 hours per year. The guard shack hours (1.4 miles in sector Q) decreased from 390 to 325 hours per year. The "51 Area Beach" lifeguard tower (1.3 miles in sector Q) occupancy was recalculated to 2000 hours per year. This is not included as a land use in the PARTS input data set because it is farther than the campground and has less occupancy hours.

4. The San Clemente garden (3.9 miles in Sector Q) was no longer occupied in 1993.

5. Highway patrol weigh station in sectors F (2.1 miles) and G (2.2 miles) occupancy hours decreased from 2000 to 1880 hours in 1993. The highway patrol weigh station, northbound of the San Diego Freeway (2.1 miles in sector F) was not included in the PARTS data set because it is farther than the Border Patrol checkpoint and has less occupancy hours.

Annual doses calculated to the maximum individual (maximum dose) within a five-mile radius of SONGS Units 1, 2 and 3 are calculated using NRC NUREG-0133 PARTS computer code and listed in the ODCM. The results indicated that for 1993, the controlling receptor was San Onofre Mobile Home Park in sector Q at a distance of 1.2 miles from Unit release point. The maximum inhalation, food and ground pathway doses were 5.51E-04 mrem in 1993 for the most critical age group (teen).

1993 HIGHLIGHTS OF CHANGES FROM THE 1992 CENSUS FOR UNITS 2/3

1. San Clemente Ranch Packing (2.6 miles in sector R) occupancy hours increased from 3000 hours to 3218 hours per year.

2. Enlisted Beach in sector Q was renamed as "51 Area Beach" in 1993. The campground check-in (1.4 miles in sector Q) occupancy hours of this use increased from 2000 to 2250 hours in 1993.

3. A mini exchange was added to this area with occupancy hours of 1040 hours per year. The guard shack hours (1.6 miles in sector Q) decreased from 390 to 325 hours per year. The "51 Area Beach" lifeguard tower (1.5 miles in sector Q) occupancy was recalculated to 2000 hours per year. This is not included as a land use in the PARTS input data set because it is farther than the campground and has less occupancy hours.

4. The San Clemente garden (4.1 miles in Sector Q) was no longer occupied in 1993.

5. Highway patrol weigh station in sectors F (1.9 miles) and G (2.0 miles) occupancy hours decreased from 2000 to 1880 hours in 1993. The highway patrol weigh station, northbound of the San Diego Freeway (1.9 miles in sector F) was not included in the PARTS data set because it is farther than the Border Patrol checkpoint and has less occupancy hours.

Annual doses calculated to the maximum individual (maximum dose) within a five-mile radius of SONGS Units 1, 2 and 3 are calculated using NRC NUREG-0133 PARTS computer code and listed in the ODCM. The results indicated that for 1993, the controlling receptor was San Onofre Mobile Home Park in sector Q a a distance of 1.3 miles from Units 2/3 mid-point of releases. The maximum inhalation, food and ground pathway doses were 2.06E-02 mrem in 1993 for the most critical age group (child).

The Study Area

The boundaries of the study area include land in both Orange and San Diego counties. The Orange County portion includes half of the city of San Clemente (population estimated at 42,164 on January 1, 1991) and the San Clemente State Park. The San Diego County portion includes much of the Camp Pendleton U.S. Marine Corps Base, San Onofre State beach and Park, the San Clemente Ranch, the (former) U.S. Coast Guard Facility at San Mateo Point, and the San Onofre Nuclear Generating Station itself.

Methodology and Survey Procedures

The land use census methodology can be summarized as follows: (1) establish land use census procedures; (2) obtain and map existing information and aerial photography; (3) verify data through windshield surveys, interviews and correspondence; (4) prepare a preliminary Southern California Edison (SCE) Form 26-184 and draft land use map for SCE review; (5) prepare a draft report; and (6) revise the draft report based on SCE comments. The Land Use Census Procedures outline in detail the procedures followed in preparing the LUC Documentation Notebook.

An additional study was conducted to evaluate a temporary residential area for outage workers at Parking Lot 1A. That evaluation concluded that San Onofre Mobile homes was still the limiting residence. The temporary facility was removed at the end of the Unit 3 Cycle VII refueling outage.

TABLE H-1
1993 SONGS Units 2/3
Land Use Census Summary Sheet
(Five-Mile Radius)

Land Use Sector (22 1/2°)	Nearest Residence (2,000 Hours/Year)		Closest Other Specified Uses			Nearest Meat and Milk Animals (Specify Meat or Milk Producing)	
	Location (Miles)	Description	Location (Miles)	Description	Maximum Reported Person Exposure (Hours/Year)	Location (Miles)	Description
West Northwest (P)	2.8	Cotton Point Estates	0.4	Surf Beach	667	--	--
Northwest (Q)	1.1	Maintenance Yard on 51 Area Beach	0.6	State Park Office Trailer	400	1.6	Meat animals (sheep)
North Northwest (R)	1.2	San Onofre Mobile Homes	2.6	San Clemente Ranch Packing	3,218*	0.9	Meat animals (sheep)
North (A)	3.6	Camp San Mateo	3.6	Camp San Mateo Motor Pool	2,000	0.2	Meat animals (sheep)
North Northeast (B)	--	--	2.1	Sanitary Landfill	2,000	0.2	Meat animals (sheep)
Northeast (C)	2.3	Camp San Onofre Fire Station	2.2	Camp San Onofre Sewage Treatment Plant	2,000	0.2	Meat animals (sheep)
East Northeast (D)	2.8	Camp San Onofre	3.7	Camp Horno Sewage Treatment Plant	2,000	0.2	Meat animals (sheep)
East (E)	4.0	Camp Horno	4.0	Camp Horno Motor Pool	2,000	0.3	Meat animals (sheep)
East Southeast (F)	--	--	0.8	San Onofre State Beach Entr. (Guard Shack)	1,500	0.5	Meat animals (sheep)
Southeast (G)	--	--	0.8	San Onofre Beach (Campground)	2,000	2.7	Meat animals (sheep)

NOTES:
a. All distances are in miles from SONGS 2/3 site reference point (midpoint of SONGS Units 2/3 containment building).
b All sectors include 22 1/2° with "A" sector centered on True North.
c. A "residence" is a location occupied by an individual 2,000 hours or more in a year.
d. Sectors H, J, K, L, M, and N, are oceanward sectors and therefore land uses are not applicable.
*** Denotes changes from 1992 survey.**

TABLE H-1 (Continued)

1993 SONGS Units 2/3
Land Use Census Summary Sheet
(Five-Mile Radius)

Land Use Sector (22 1/2 °)	Nearest Leafy Vegetable Garden		Nearest Fleshy Vegetable Garden	
	Location (Miles)	Description	Location (Miles)	Description
West Northwest (P)	--	--	--	--
Northwest (Q)	--	--	2.2	San Clemente Ranch
North Northwest (R)	--	--	2.3	San Clemente Ranch
North (A)	--	--	--	--
North Northeast (B)	--	--	--	--
Northwest (C)	--	--	--	--
East Northeast (D)	--	--	--	--
East (E)	--	--	--	--
East Southeast (F)	--	--	--	--
Southwest (G)	--	--	--	--

NOTES: a. All distances are in miles from SONGS Units 2/3 site reference point (midpoint of SONGS Units 2/3 containment building).
b All sectors include 22 1/2 ° with "A" sector centered on True North.
c. A "residence" is a location occupied by an individual 2,000 hours or more in a year.

SCE Form 26-184

TABLE H-2

1993 SONGS Units 2/3
Key to Uses Referenced on
Land Use Map and Text

#	Sector	Use	1993 Distance From SONGS (Miles)	Maximum Reported Person Exposure (Hours/Year)	1992 Distance (Miles)
1A	Q	51 Area Beach Campground Check-in	1.4	2,250*	1.4
1B	Q	Mini Exchange (51 Area Beach)	1.4	1,040*	1.4
2	P	51 Area Beach Guard Shack	1.6	325*	1.6
3	P	Trestles Beach Lookout Tower	2.0	500	2.0
4	P	San Mateo Point	2.7	vacant	2.7
5	Q	Surf Beach Guard Shack	0.7	1,500	0.7
6	Q	Edison Land Uses	1.0	--	1.0
7	Q	Recreation Bldg 51 Area Beach	1.2	2,000	1.2
8	Q	Marine Commercial Uses	1.6	2,000	1.6
9	Q	Basilone Marine Guard Shack and Trailer	2.0	2,100	2.0
10	Q	San Clemente Ranch Administrative Offices	2.5	3,000	2.5
11	Q	State Park Main Offices	3.4	2,000	3.4
12	Q	San Mateo Campground	3.2	resident (6 months)	3.2
13	Q	Beach Concession	3.9	667	3.9
14	Q	Garden (with residence) (3 W. Avenida San Antonio)	4.4	resident (year-round)	4.4
15	Q	Garden (144 W. Avenida Junipero)	4.1	vacant lot*	4.1
16	Q	Garden (with residence) 147 W. Avenida Junipero	4.1	resident (year-round)	4.1
17	Q	Beach Concession	4.9	667	4.9

*** denotes change from 1992 survey**
-- Not applicable

TABLE H-2 (Continued)

1993 SONGS Units 2/3
Key to Uses Referenced on
Land Use Map and Text

#	Sector	Use	1993 Distance From SONGS (Miles)	Maximum Reported Person Exposure (Hours/Year)	1992 Distance (Miles)
18	Q	51 Area Beach Lifeguard Tower	1.5	2,000*	1.5
19	R	Camp San Mateo Sewage Treatment Plant	3.7	2,000	3.7
20	R	Sea Ridge Estates	4.6	resident year-round	4.6
21	R	Cristianitos Road Marine Guard Shack	4.0	2,100	4.0
22	A	SCE Land Uses	0.3	--	0.3
23	A	Gas Station	4.1	2,000	4.1
24	A	Cristianitos Fire Station	4.9	3,600	4.9
25	A	Camp San Mateo Motor Pool*	3.6	2,000	3.6
26	B	Northern Impact Control Tower	3.8	410	3.8
27	B	Ammunition Dump	4.6	--	4.6
28	C	Camp San Onofre	2.6	resident (year-round)	2.6
29	E	Camp Horno Truck Co	4.7	vacant	4.7
30	F	Ranger Station	0.9	83	0.9
31A	F	Border Patrol Checkpoint	1.9	2,500	1.9
31B	F	Highway Patrol Weigh Station (Northbound of San Diego Fwy)	1.9	1,880*	1.9
32	G	Highway Patrol Weigh Station (Southbound of San Diego Fwy)	2.0	1,880*	2.0
33	Q	51 Area Beach Campground and Cottages - Southern End	1.1	1,080	1.1
34	Q	San Onofre Mobile Homes	1.3	resident (year-round)	1.3

* denotes change from 1992 survey
-- Not applicable

TABLE H-3
1993 SONGS Unit 1
Land Use Census Summary Sheet
(Five-Mile Radius)

Land Use Sector (22 1/2 °)	Nearest Residence (2,000 Hours/Year)		Closest Other Specified Uses			Nearest Meat and Milk Animals (Specify Meat or Milk Producing)	
	Location (Miles)	Description	Location (Miles)	Description	Maximum Reported Person Exposure (Hours/Year)	Location (Miles)	Description
West Northwest (P)	2.6	Cotton Point Estates	0.2	Surf Beach	667	--	--
Northwest (Q)	0.9	Maintenance Yard on 51 Area Beach	0.5	State Park Office Trailer	400	--	Meat animals (sheep)
North Northwest (R)	1.1	San Onofre Mobile Homes	2.4	San Clemente Ranch Packing	3,218*	0.9	Meat animals (sheep)
North (A)	3.5	Camp San Mateo	3.5	Camp San Mateo Motor Pool	2,000	0.7	Meat animals (sheep)
North Northeast (B)		--	2.1	Sanitary Landfill	2,000	0.7	Meat animals (sheep)
Northeast (C)	2.4	Camp San Onofre Fire Station	2.3	Camp San Onofre Sewage Treatment Plant	2,000	0.3	Meat animals (sheep)
East Northeast (D)	2.9	Camp San Onofre	3.9	Camp Horno Sewage Treatment Plant	2,000	0.3	Meat animals (sheep)
East (E)	4.2	Camp Horno	4.2	Camp Horno Motor Pool	2,000	0.4	Meat animals (sheep)
East Southeast (F)	--	--	1.0	San Onofre State Beach Entr. (Guard Shack)	1,500	0.7	Meat animals (sheep)
Southeast (G)	--	--	1.0	San Onofre Beach (Campground)	2,000	3.1	Meat animals (sheep)

NOTES:
a. All distances are in miles from SONGS 2/3 site reference point (midpoint of SONGS Unit 1 containment building).
b All sectors include 22 1/2 ° with "A" sector centered on True North.
c. A "residence" is a location occupied by an individual 2,000 hours or more in a year.
d. Sectors H, J, K, L, M, and N are oceanward sectors and therefore land uses are not applicable.
*** Denotes changes from 1992 survey.**

TABLE H-3 (Continued)

1993 SONGS Unit 1
Land Use Census Summary Sheet
(Five-Mile Radius)

Land Use Sector (22 1/2°)	Nearest Leafy Vegetable Garden		Nearest Fleshy Vegetable Garden	
	Location (Miles)	Description	Location (Miles)	Description
West Northwest (P)	--	--	--	--
Northwest (Q)	--	--	1.9	San Clemente Ranch
North Northwest (R)	--	--	2.0	San Clemente Ranch
North (A)	--	--	--	--
North Northeast (B)	--	--	--	--
Northwest (C)	--	--	--	--
East Northeast (D)	--	--	--	--
East (E)	--	--	--	--
East Southeast (F)	--	--	--	--
Southwest (G)	--	--	--	--

NOTES: a. All distances are in miles from SONGS Unit 1 site reference point (midpoint of SONGS Unit 1 containment building).
b All sectors include 22 1/2° with "A" sector centered on True North.
c. A "residence" is a location occupied by an individual 2,000 hours or more in a year.
* Denotes changes from 1992 survey.

SCE Form 26-184

TABLE H-4

1993 SONGS Unit 1
Key to Uses Referenced on
Land Use Map and Text

#	Sector	Use	1993 Distance From SONGS (Miles)	Maximum Reported Person Exposure (Hours/Year)	1992 Distance (Miles)
1	Q	51 Area Beach Campground Check-in	1.2	2,250*	1.2
1B	Q	Mini-Exchange (51 Area Beach)	1.2	1,040*	1.2
2	Q	Enlisted Beach Guard Shack	1.4	325*	1.4
3	P	Trestles Beach Lookout Tower	1.8	500	1.8
4	P	San Mateo Point	2.5	vacant	2.5
5	Q	Surf Beach Guard Shack	0.5	1,500	0.5
6	Q	Edison Land Uses	0.8	--	0.8
7	Q	Enlisted Beach Recreation Bldg.	1.0	2,000	1.0
8	Q	Marine Commercial Uses	1.5	2,000	1.5
9	Q	Basilone Marine Guard Shack and Trailer	1.8	2,100	1.8
10	Q	San Clemente Ranch Administrative Offices	2.3	3,000 from 2,000	2.3
11	Q	State Park Main Offices	3.2	2,000	3.2
12	Q	San Mateo Campground	3.0	resident (6 months)	3.0
13	Q	Beach Concession	3.7	667	3.7
14	Q	Garden (with residence) (3 W. Avenida San Antonio)	4.2	resident (year-round)	4.2
15	Q	Garden (with residence) (144 W. Avenida Junipero)	3.9	vacant lot*	3.9
16	Q	Garden (with residence) 147 W. Avenida Junipero	3.9	resident (year-round)	3.9
17	Q	Beach Concession	4.7	667	4.7

* denotes change from 1992 survey
-- Not applicable

TABLE H-4 (Continued)

1993 SONGS Unit 1
Key to Uses Referenced on
Land Use Map and Text

#	Sector	Use	1993 Distance From SONGS (Miles)	Maximum Reported Person Exposure (Hours/Year)	1992 Distance (Miles)
18	Q	51 Area Beach Lifeguard Tower	1.3	2,000*	1.3
19	A	Camp San Mateo Sewage Treatment Plant	3.5	2,000	3.5
20	R	Sea Ridge Estates	4.4	resident year-round	4.4
21	A	Cristianitos Road Marine Guard Shack	3.9	2,100	3.9
22	B	SCE Land Uses	0.3	--	0.3
23	A	Gas Station	4.0	2,000	4.0
24	A	Cristianitos Fire Station	4.8	3,600	4.8
25	A	Camp San Mateo Motor Pool*	3.5	2,000	3.5
26	B	Northern Impact Control Tower	3.8	410	3.8
27	B	Ammunition Dump	4.6	--	4.6
28	C	Camp San Onofre	2.7	resident (year-round)	2.7
29	E	Camp Horno Truck Co	4.9	vacant	4.9
30	F	Ranger Station	1.1	83	1.1
31A	F	Border Patrol Checkpoint	2.1	2,500	2.1
31B	F	Highway Patrol Weigh Station (Northbound of San Diego Fwy)	2.1	1,880*	2.1
32	G	Highway Patrol Weigh Station (Southbound of San Diego Fwy)	2.2	1,880*	2.2
33	Q	Enlisted Beach Campground and Cottages - Southern End	0.9	1,080	0.9
34	Q	San Onofre Mobile Homes	1.2	resident (year-round)	1.2

* denotes change from 1992 survey
-- Not applicable

SONGS Unit 1 numbering is consistent with numbering of SONGS Units 2/3, but because of sector shift, distances change will not be the same as Units 2/3 distances.

APPENDIX I

FIGURES FOR 1993

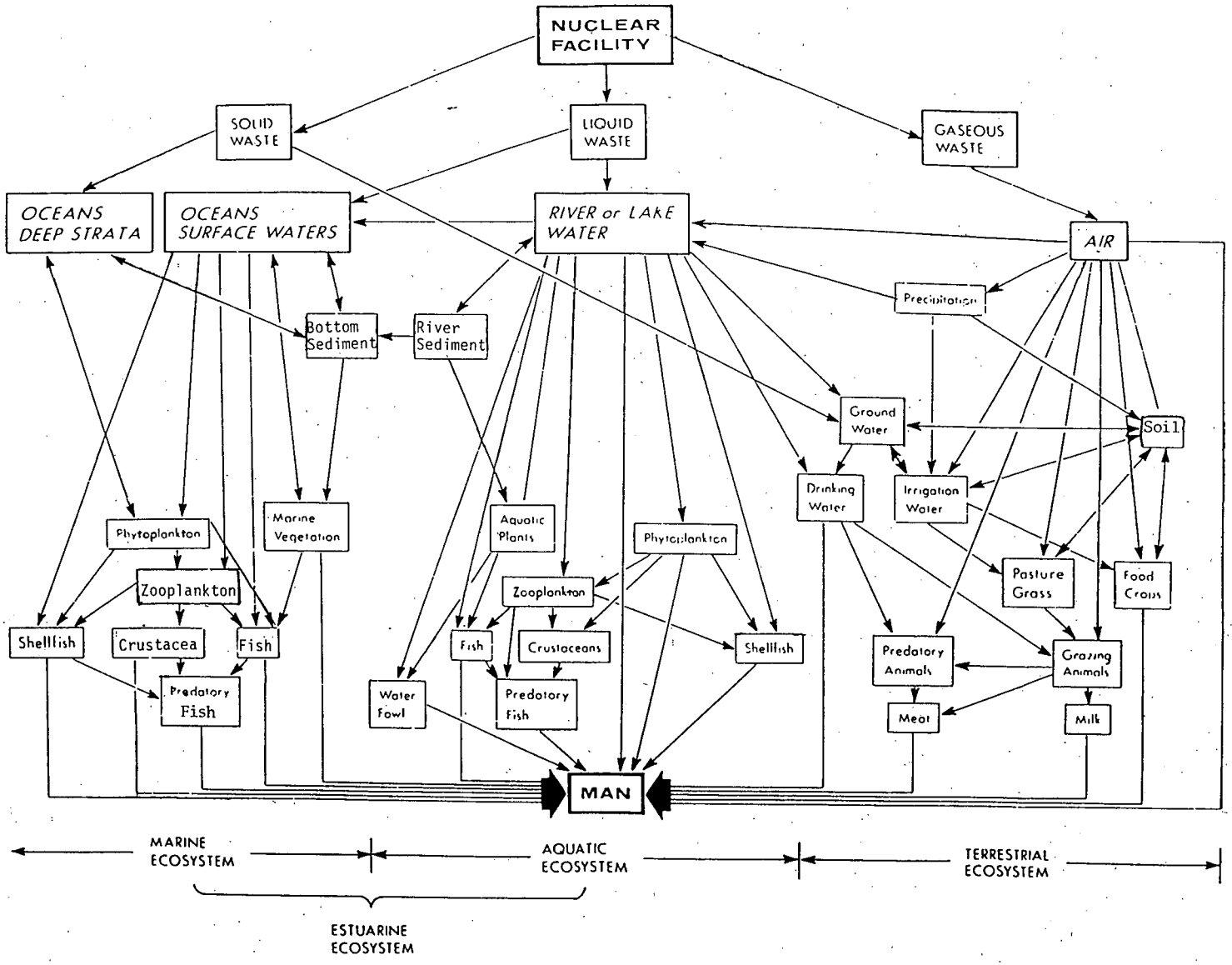


Figure 1. Potential Radiation Exposure Pathways Leading to Man

Direct Radiation Monitoring

Inner Ring Locations Vs. Controls – Quarterly Gamma Exposure (MREM)

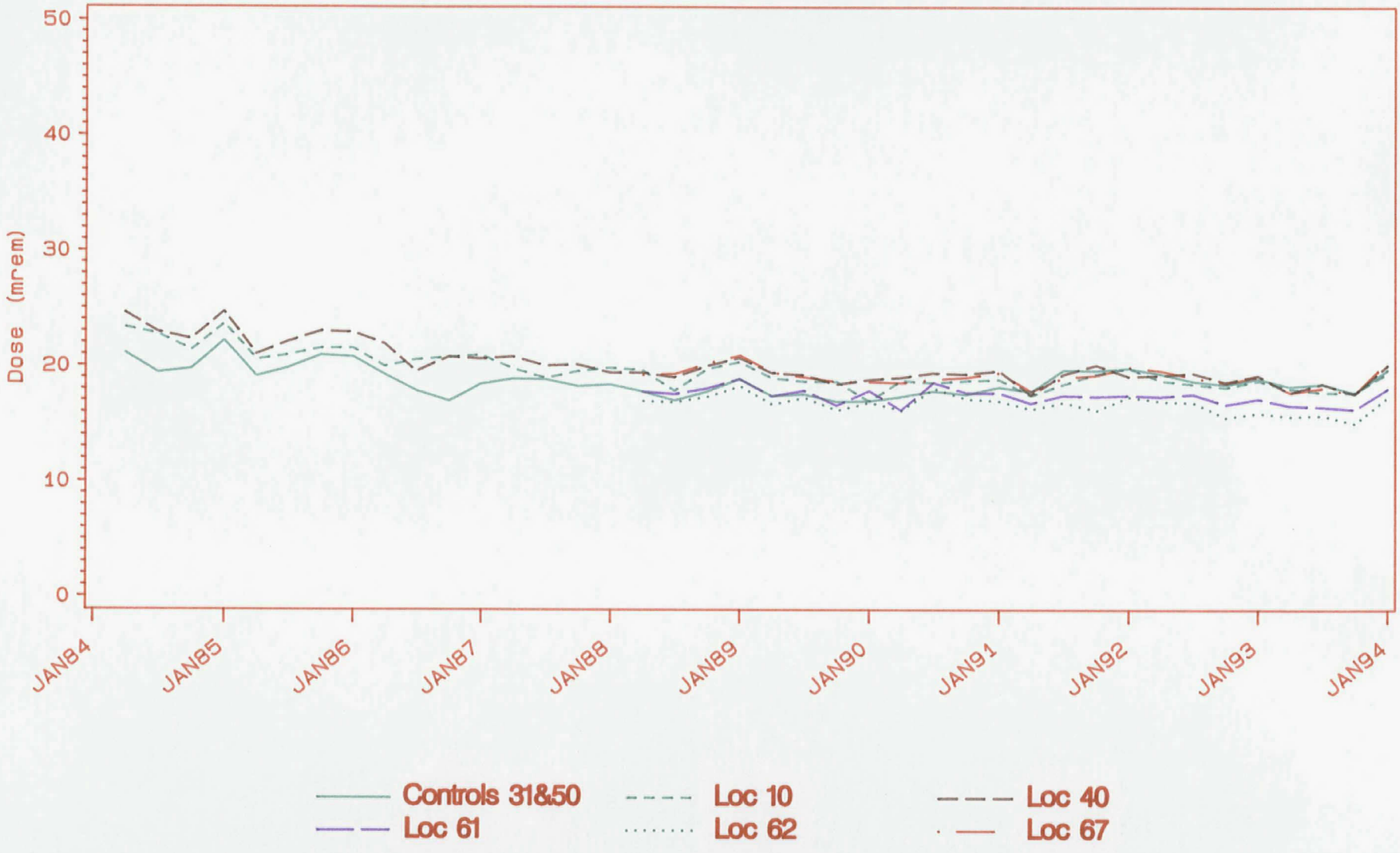


FIGURE 2A

Direct Radiation Monitoring

Inner Ring Locations Vs. Controls – Quarterly Gamma Exposure (MREM)

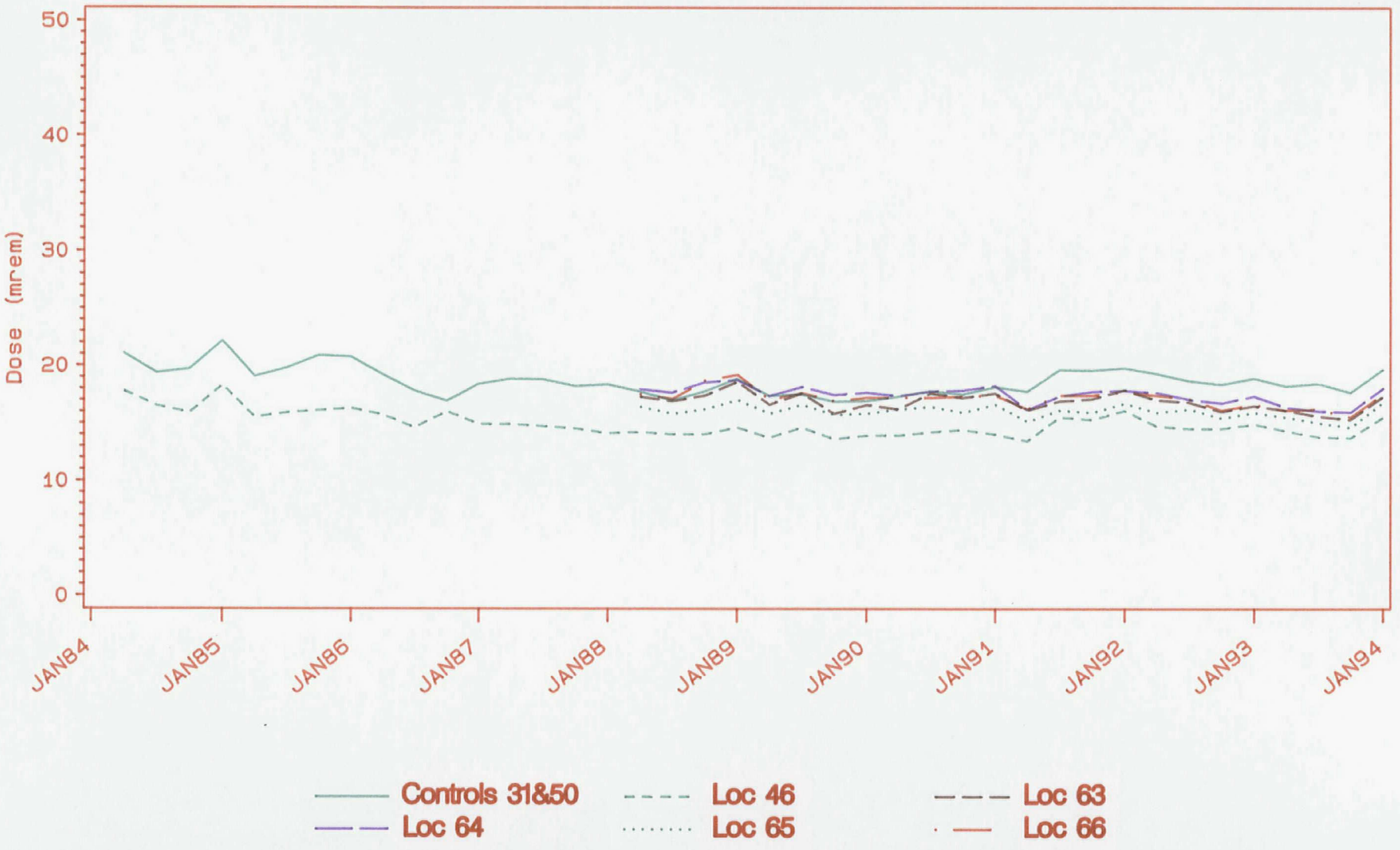


FIGURE 2B

Direct Radiation Monitoring

Outer Ring Locations Vs. Controls – Quarterly Gamma Exposure (MREM)

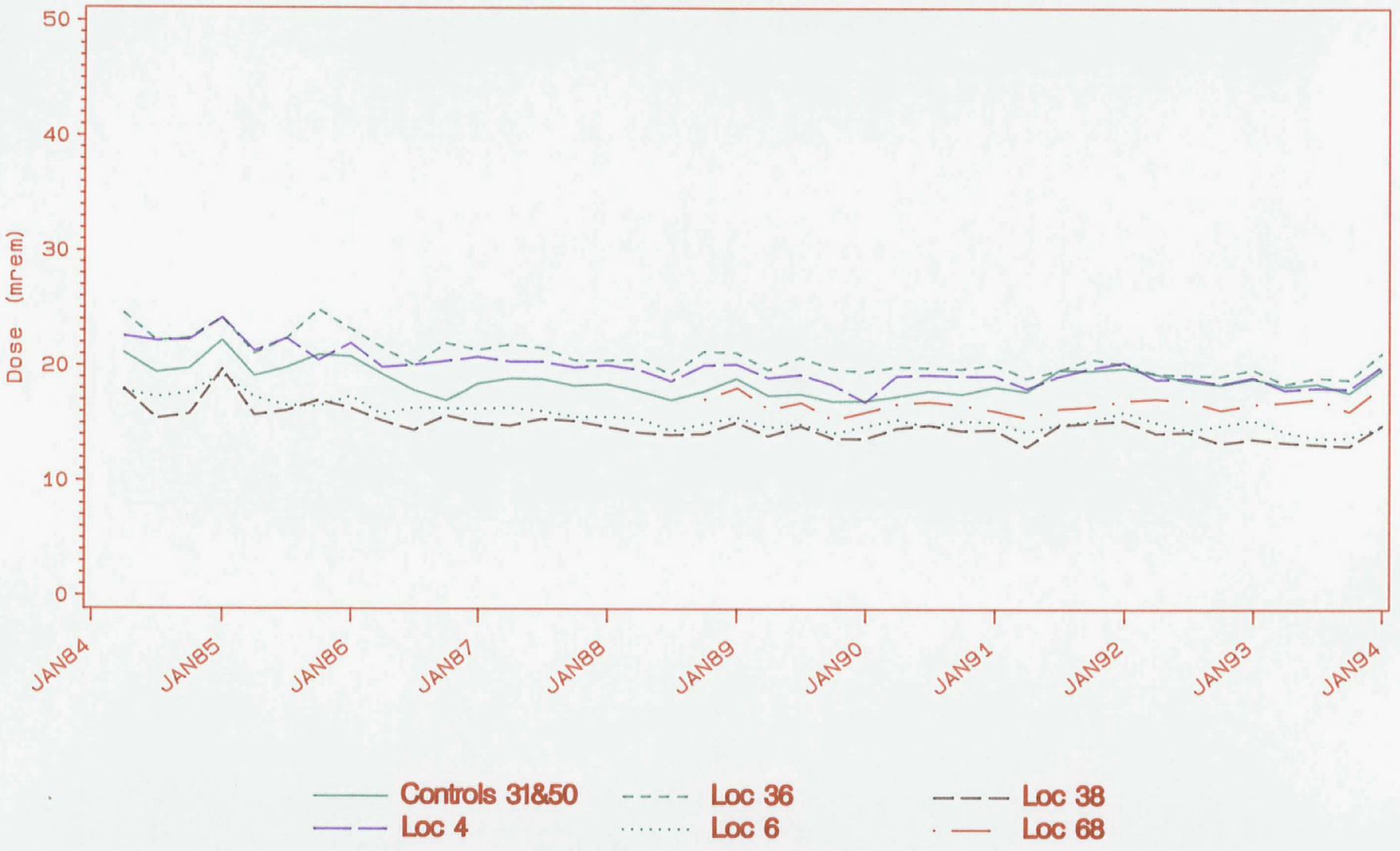


FIGURE 3A

Direct Radiation Monitoring

Outer Ring Locations Vs. Controls – Quarterly Gamma Exposure (MREM)

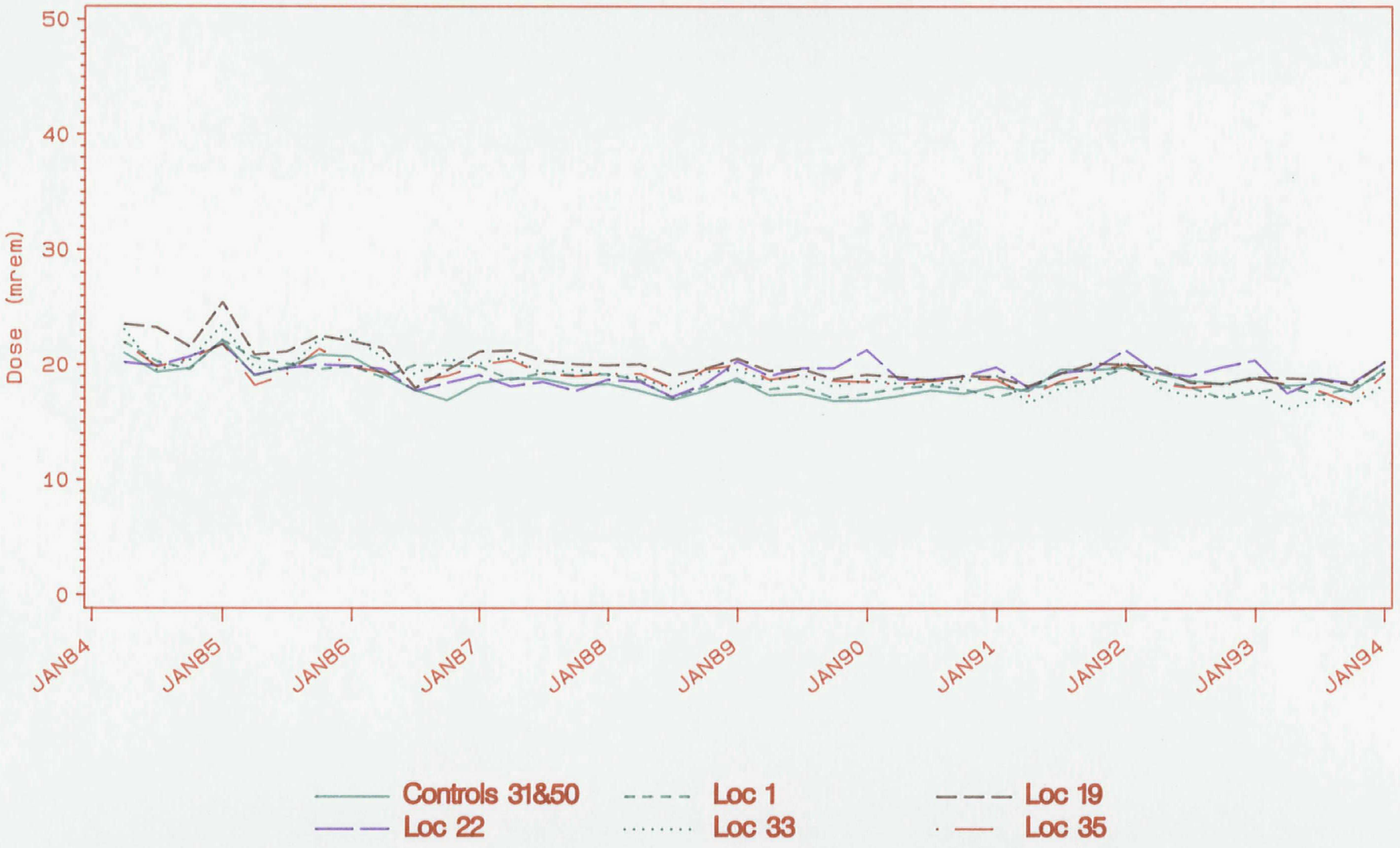


FIGURE 3B

Direct Radiation Monitoring

Control Locations for Sectors P, Q, R, A, B (Quarterly Gamma Exposure)

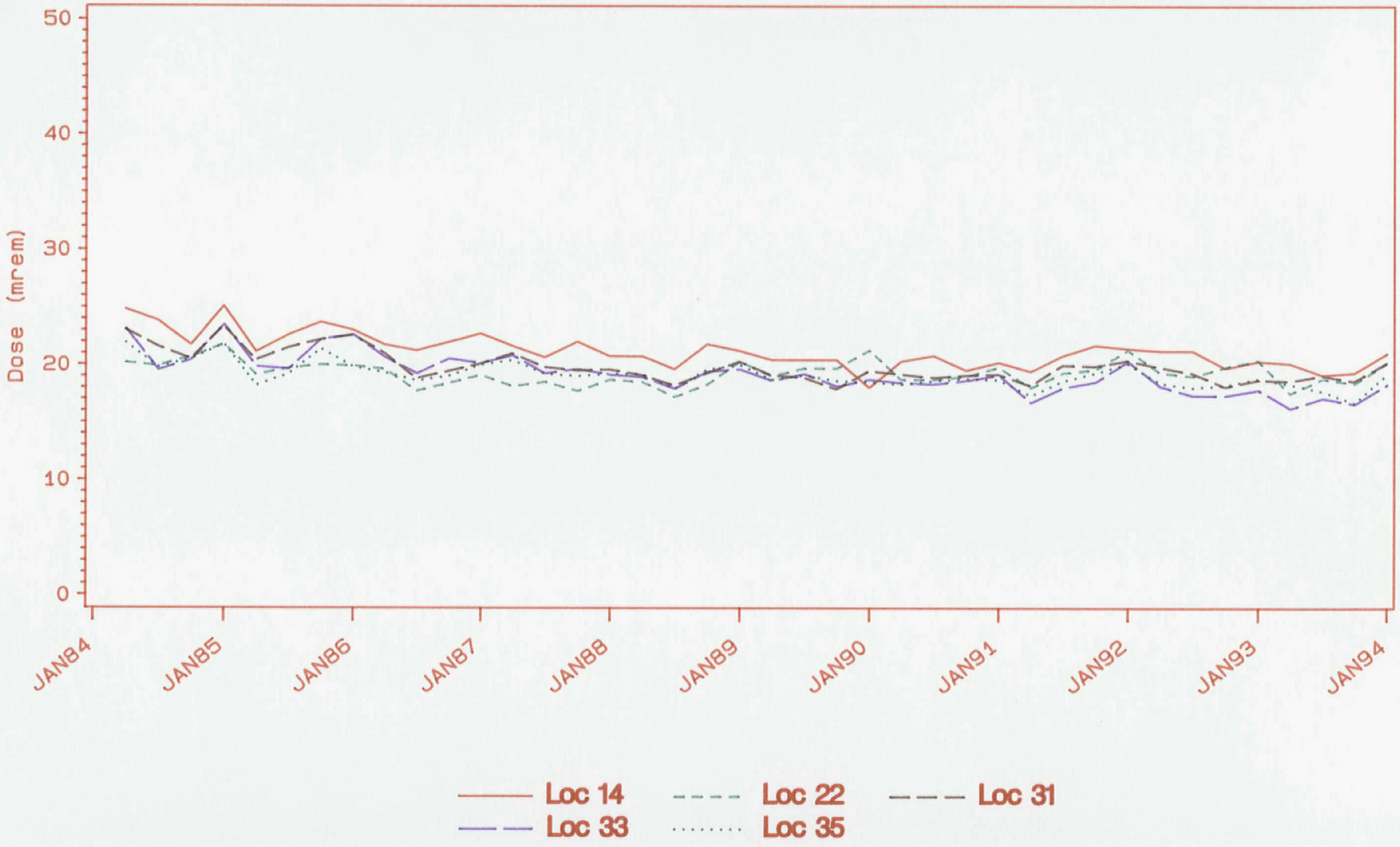


FIGURE 4A

Direct Radiation Monitoring

Control Locations for Sectors C, D, E, F, G (Quarterly Gamma Exposure)

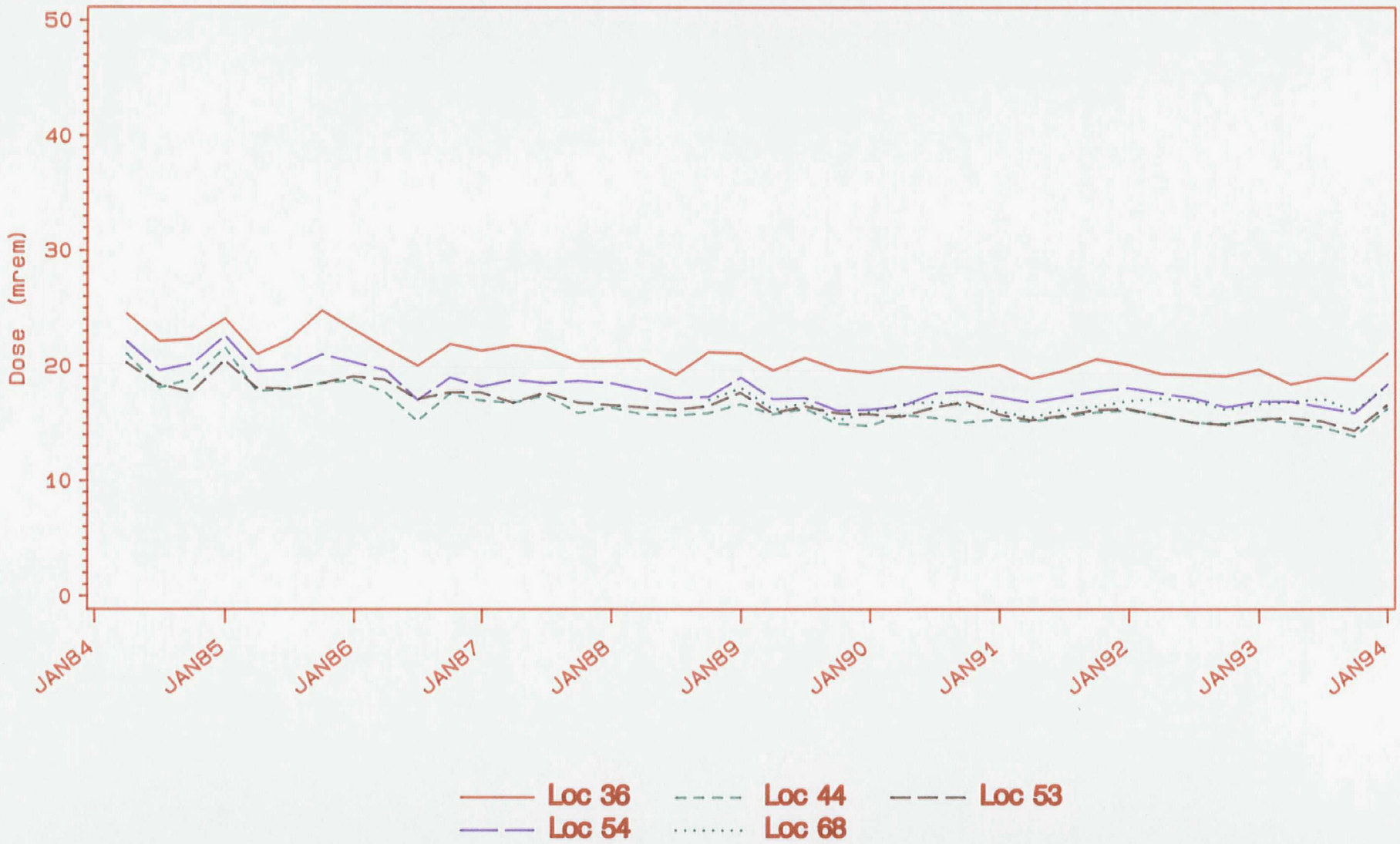


FIGURE 4B

Weekly Airborne Particulate Gross Beta Activity

SONGS Units 1, 2, and 3

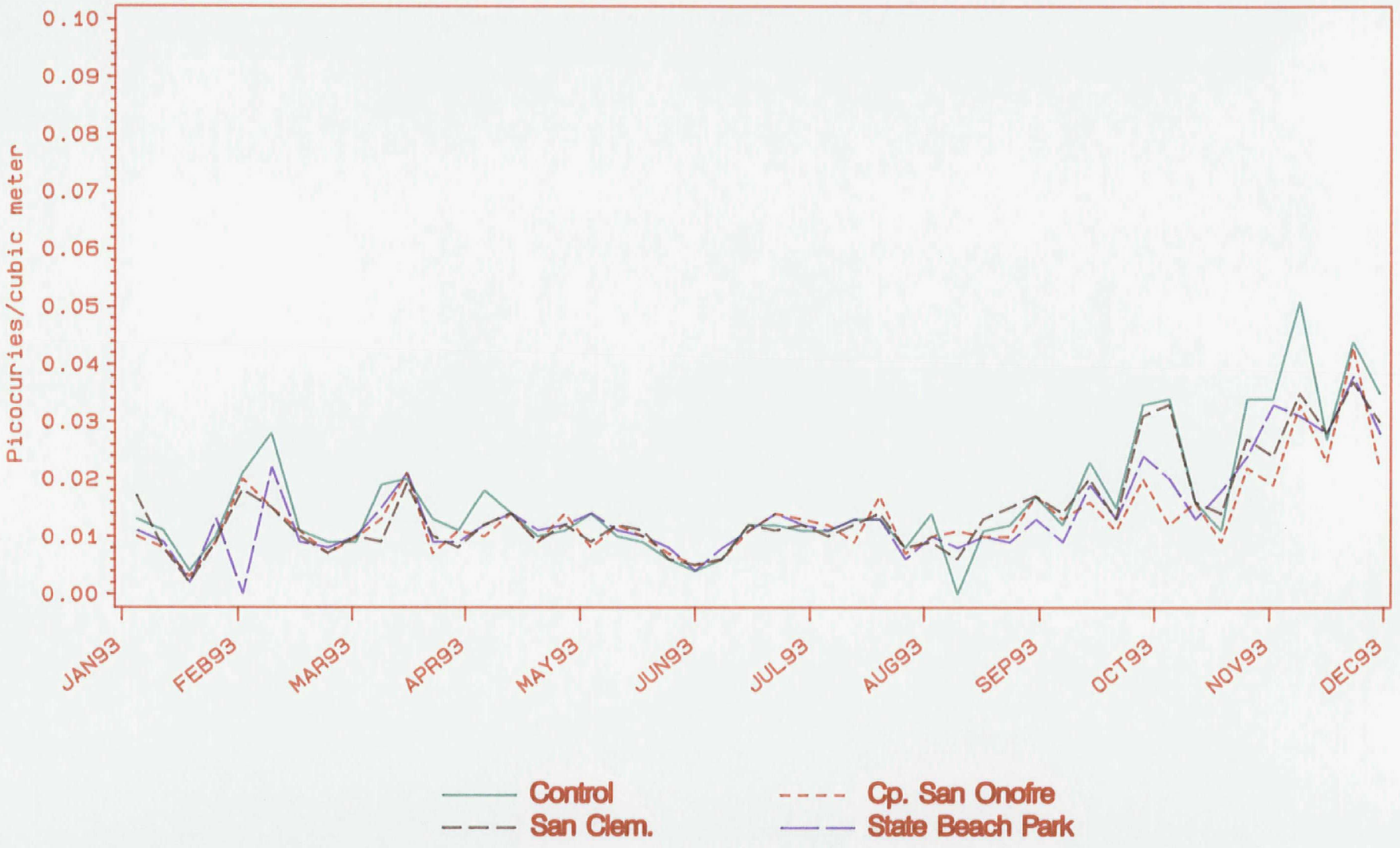


FIGURE 5A

Weekly Airborne Particulate Gross Beta Activity

SONGS Units 1, 2, and 3

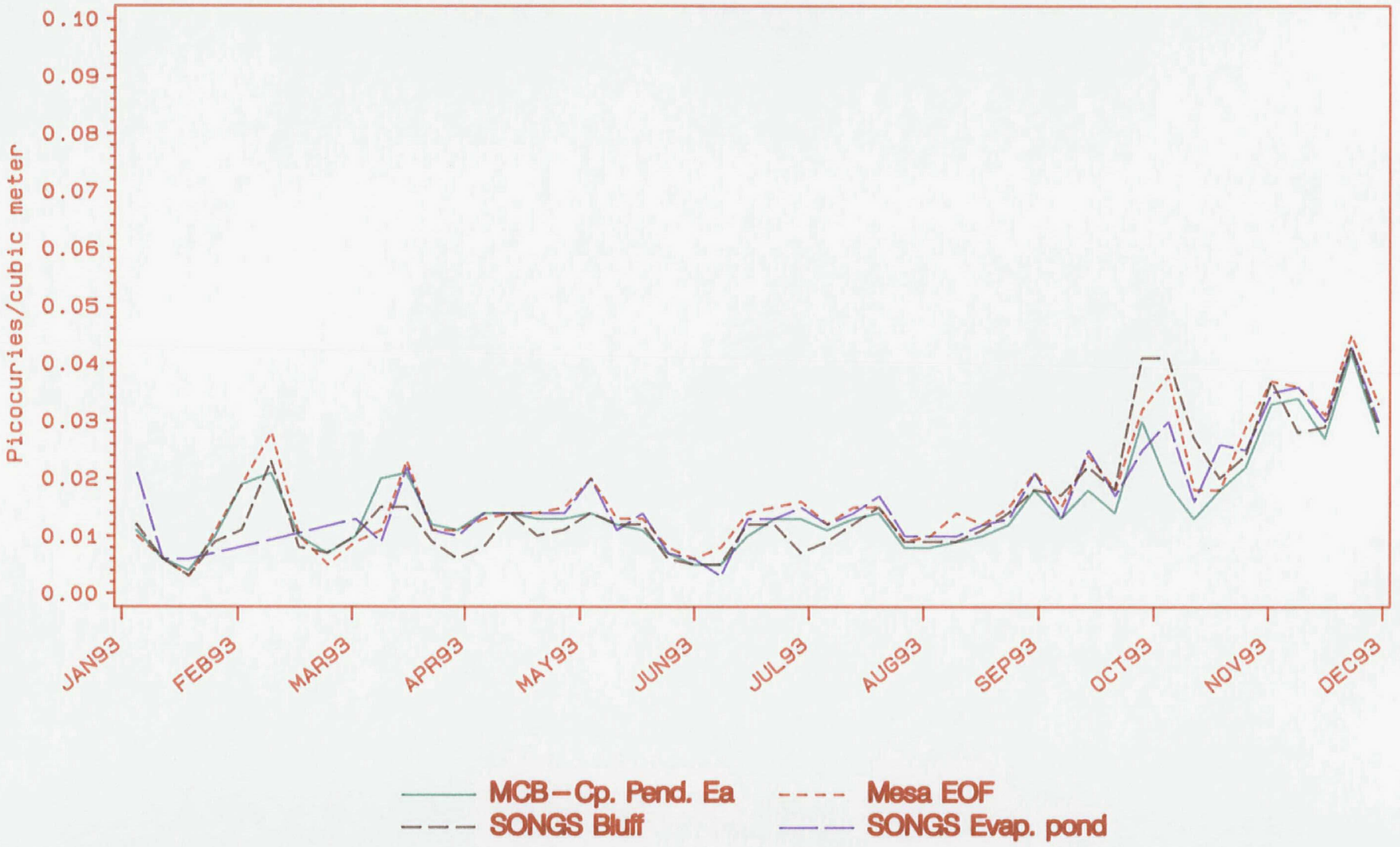


FIGURE 5B

Cobalt–60 in Ocean Bottom Sediments (Operational)

SONGS Units 1, 2, and 3 vs. Control

ELEMENT=Co-60

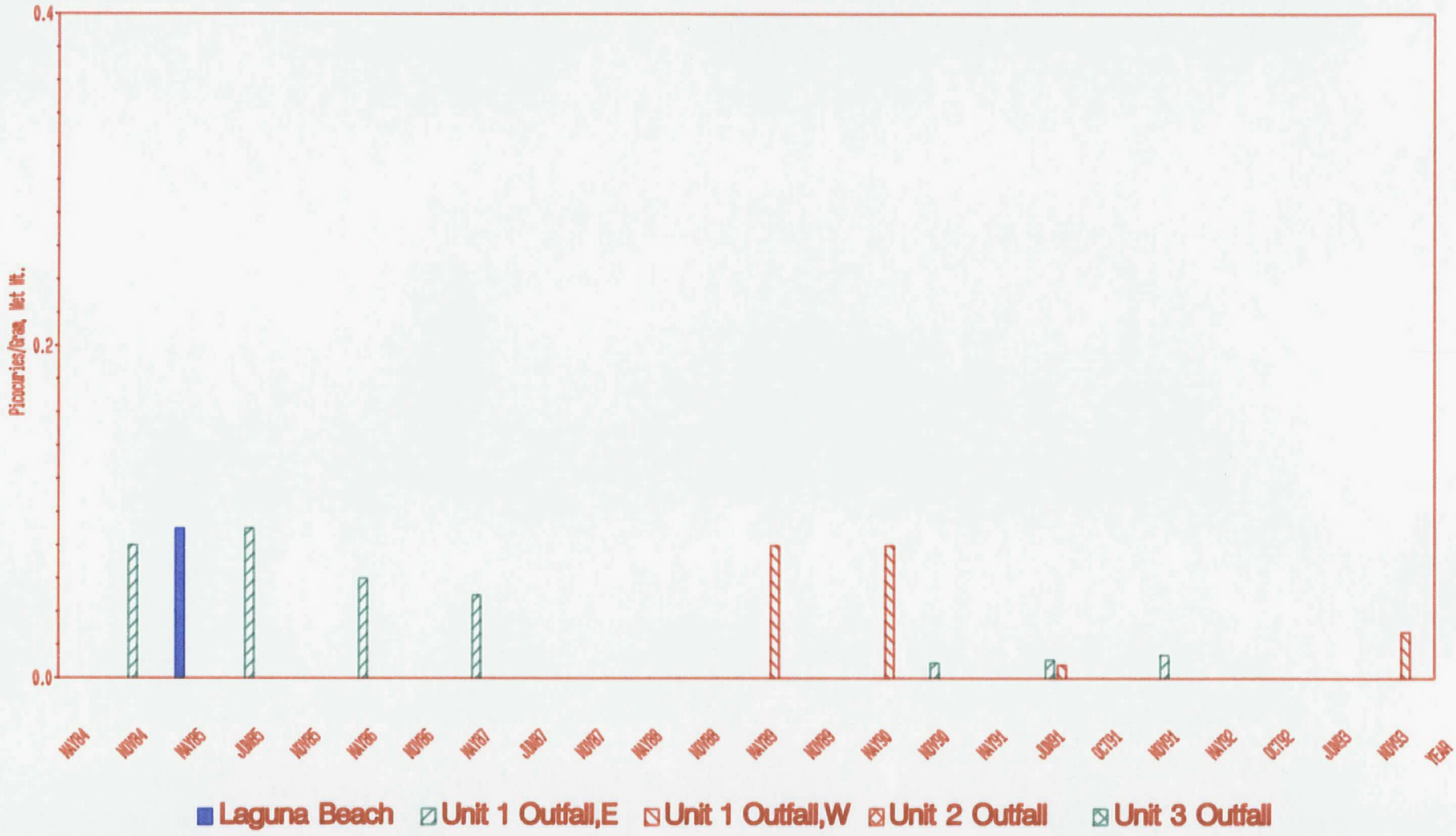


FIGURE 6

Cesium – 137 in Ocean Bottom Sediments (Preoperational)

Units 1, 2 and 3 vs. Control

ELEMENT=Cs-137

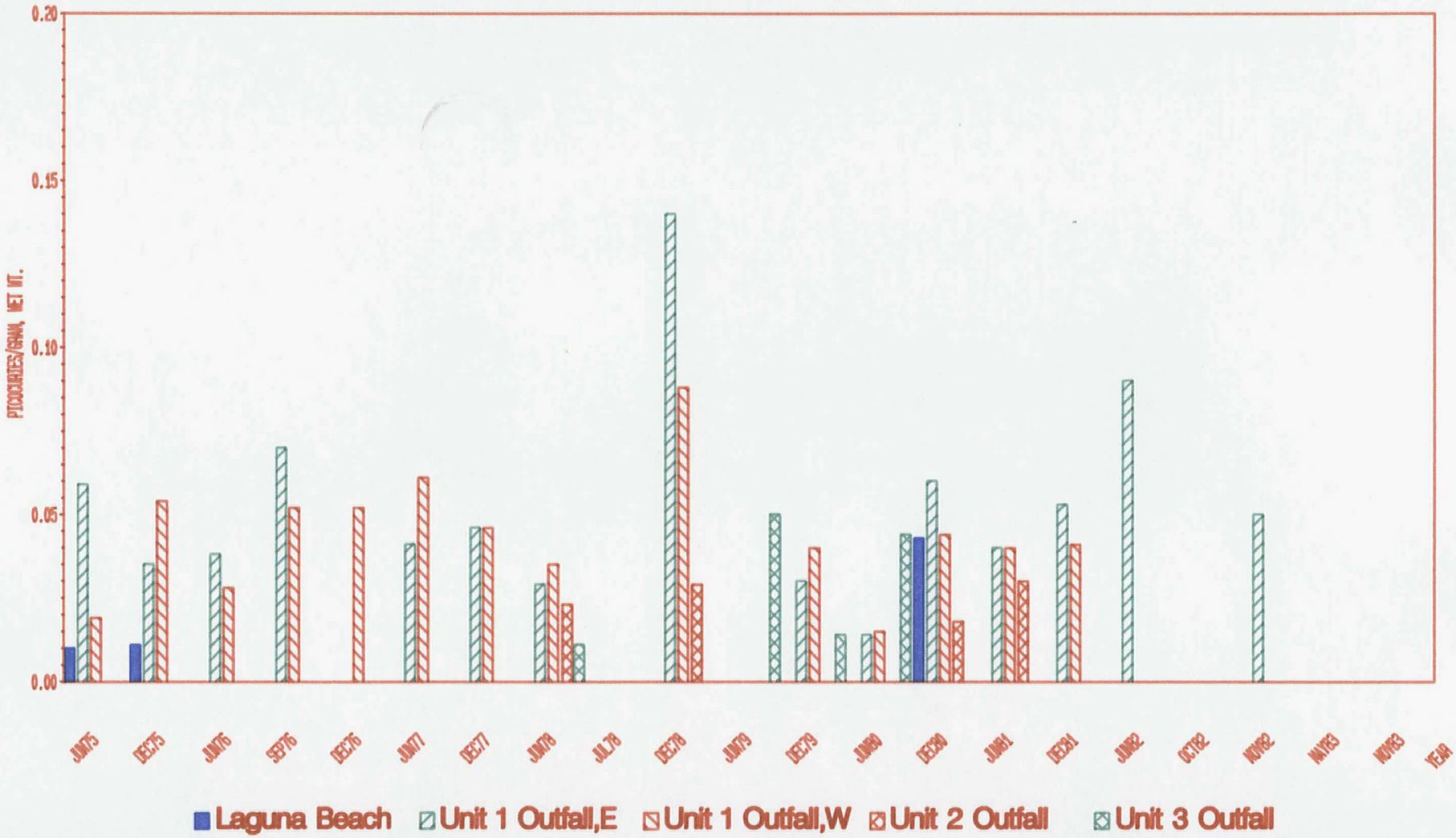


FIGURE 7A

Cesium – 137 in Ocean Bottom Sediments (Operational)

Units 1, 2 and 3 vs. Control

ELEMENT=Cs-137

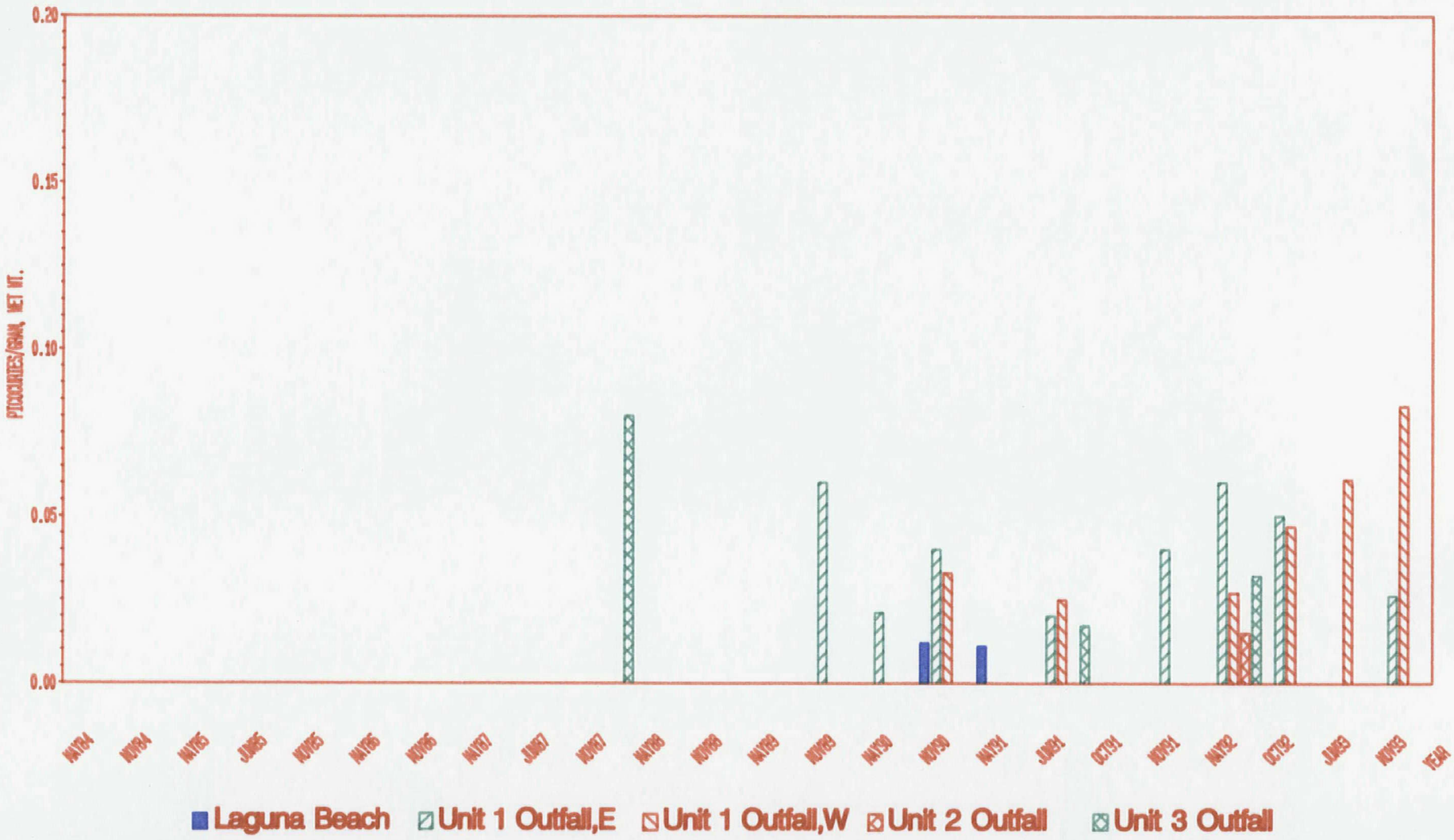


FIGURE 7B

Cesium–137 in the Flesh of Sheephead (Preoperational)

Units 1, 2, and 3 Outfalls vs. Control

ELEMENT=Cs-137 Sample Type= F F=sheephead

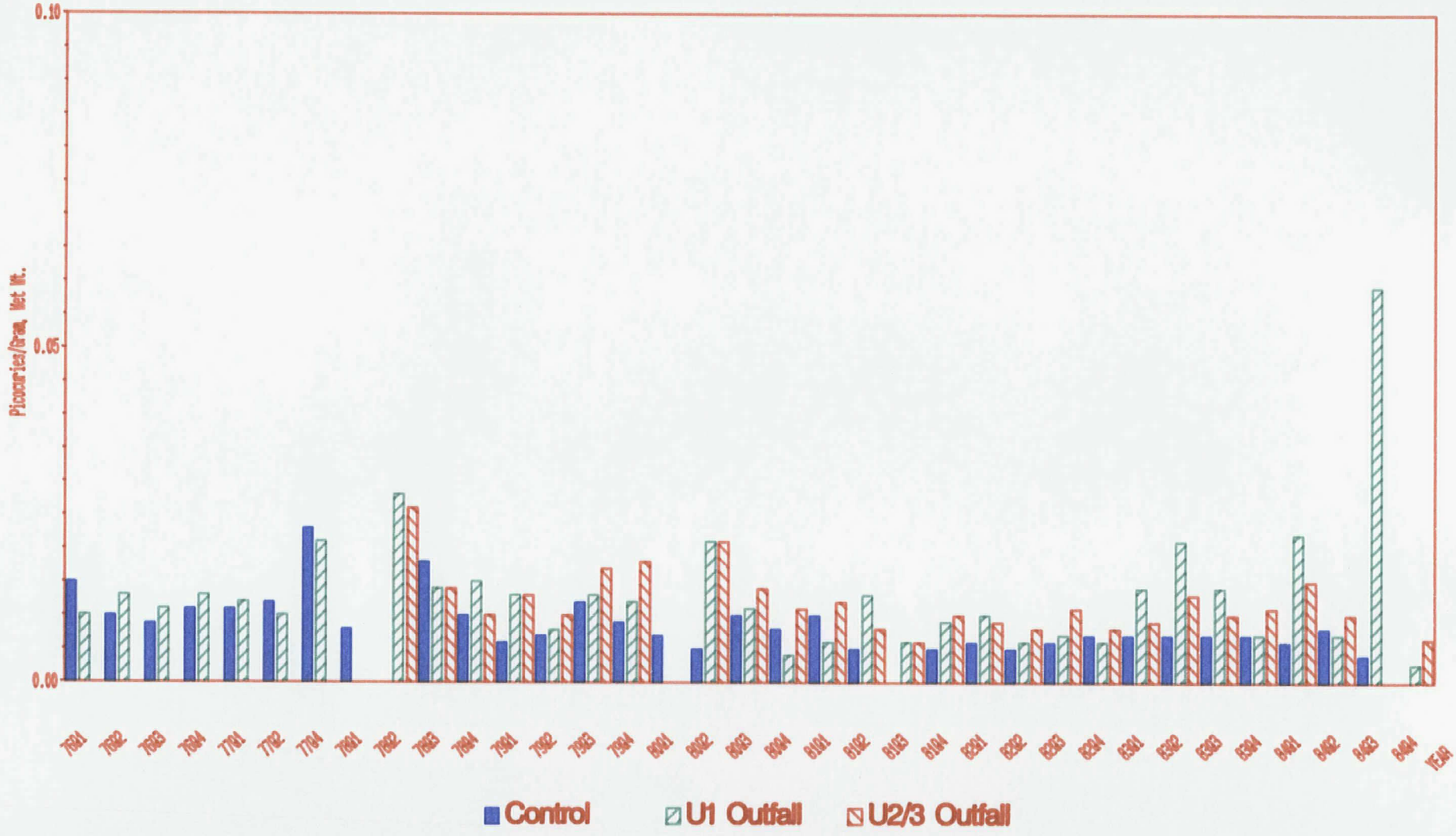


FIGURE 8A

Cesium – 137 in the Flesh of Sheephead (Operational)

Units 1, 2, and 3 Outfalls vs. Control

ELEMENT=Cs-137 Sample Type= s s=sheephead

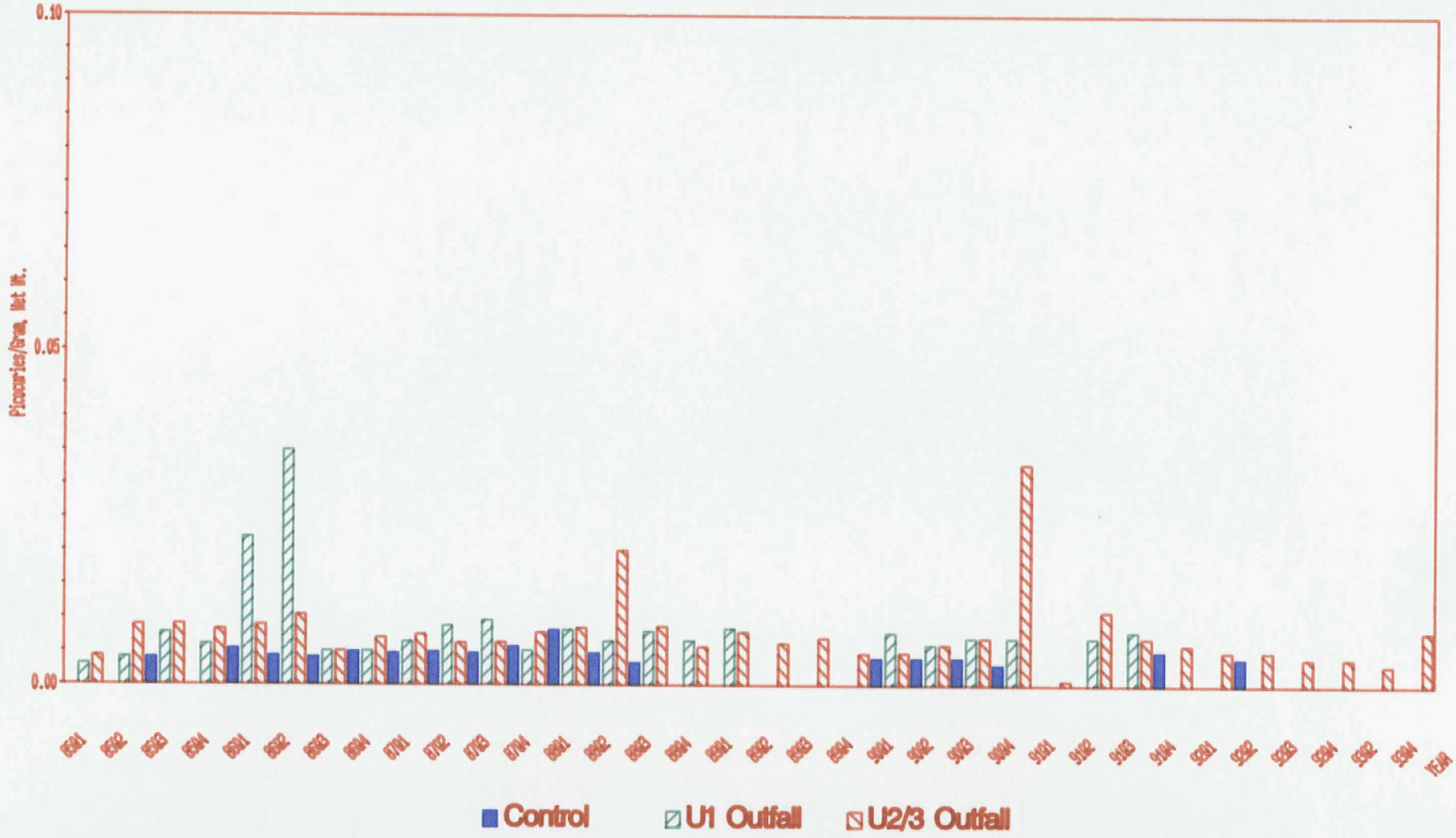


FIGURE 8B

Cobalt–60 in the Flesh of Sheephead (Operational)

Units 1, 2, and 3 Outfalls vs. Control

ELEMENT=Co-60 Sample Type= s s=sheephead

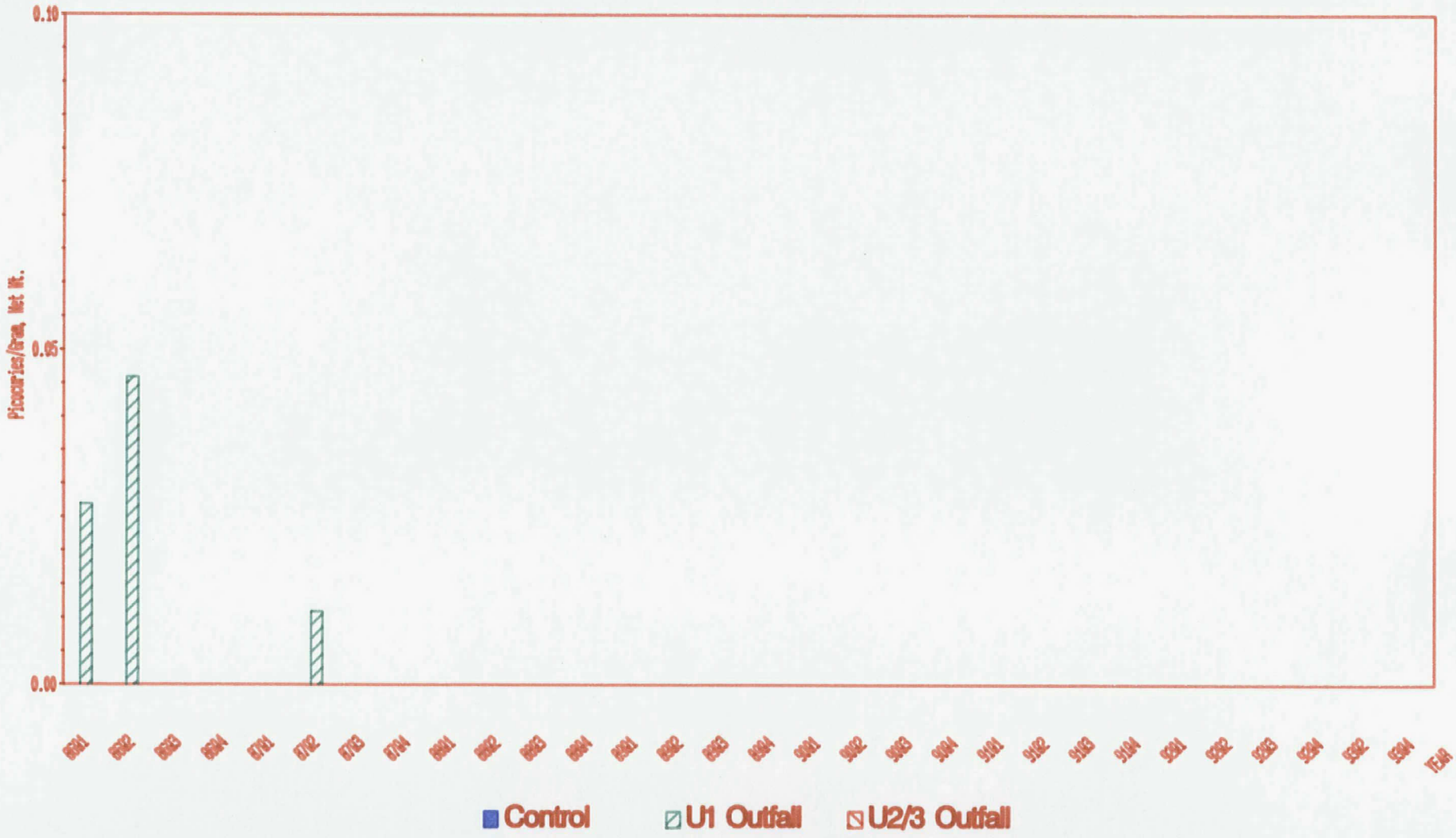


FIGURE 9

Cesium – 137 in the Flesh of Black Perch (Operational)

Units 1, 2, and 3 Outfalls vs. Control

ELEMENT=Cs-137 Sample Type= B B=black perch

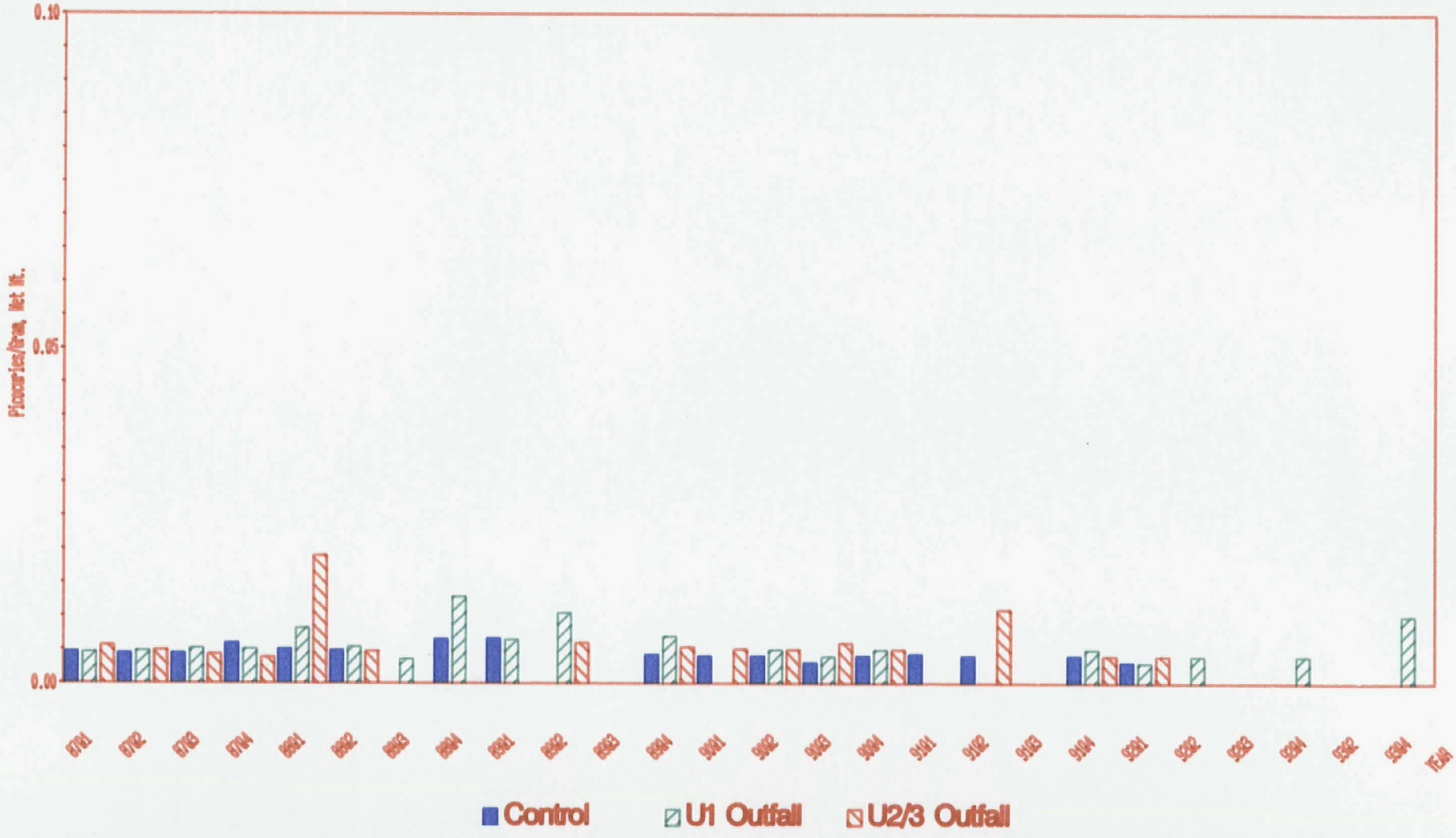


FIGURE 10

Cobalt–60 in the Flesh of Spiny Lobster (Preoperational)

Units 1, 2, and 3 Outfalls vs. Control

ELEMENT=Co-60 Sample Type= 8 8=spiny lobster

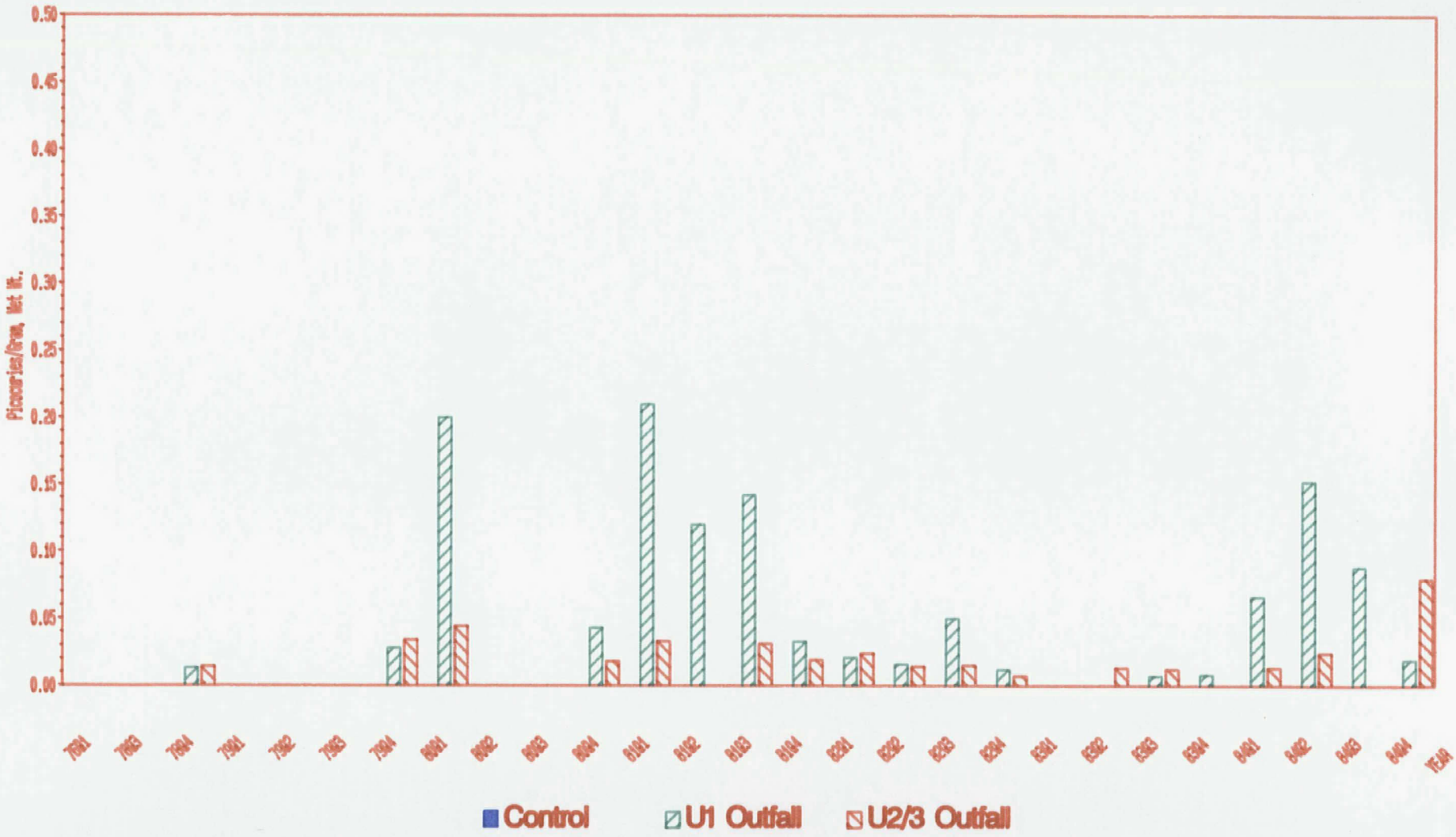


FIGURE 11A

Cobalt–60 in the Flesh of Spiny Lobster (Operational)

Units 1, 2, and 3 Outfalls vs. Control

ELEMENT=Co-60 Sample Type= 8 8=spiny lobster

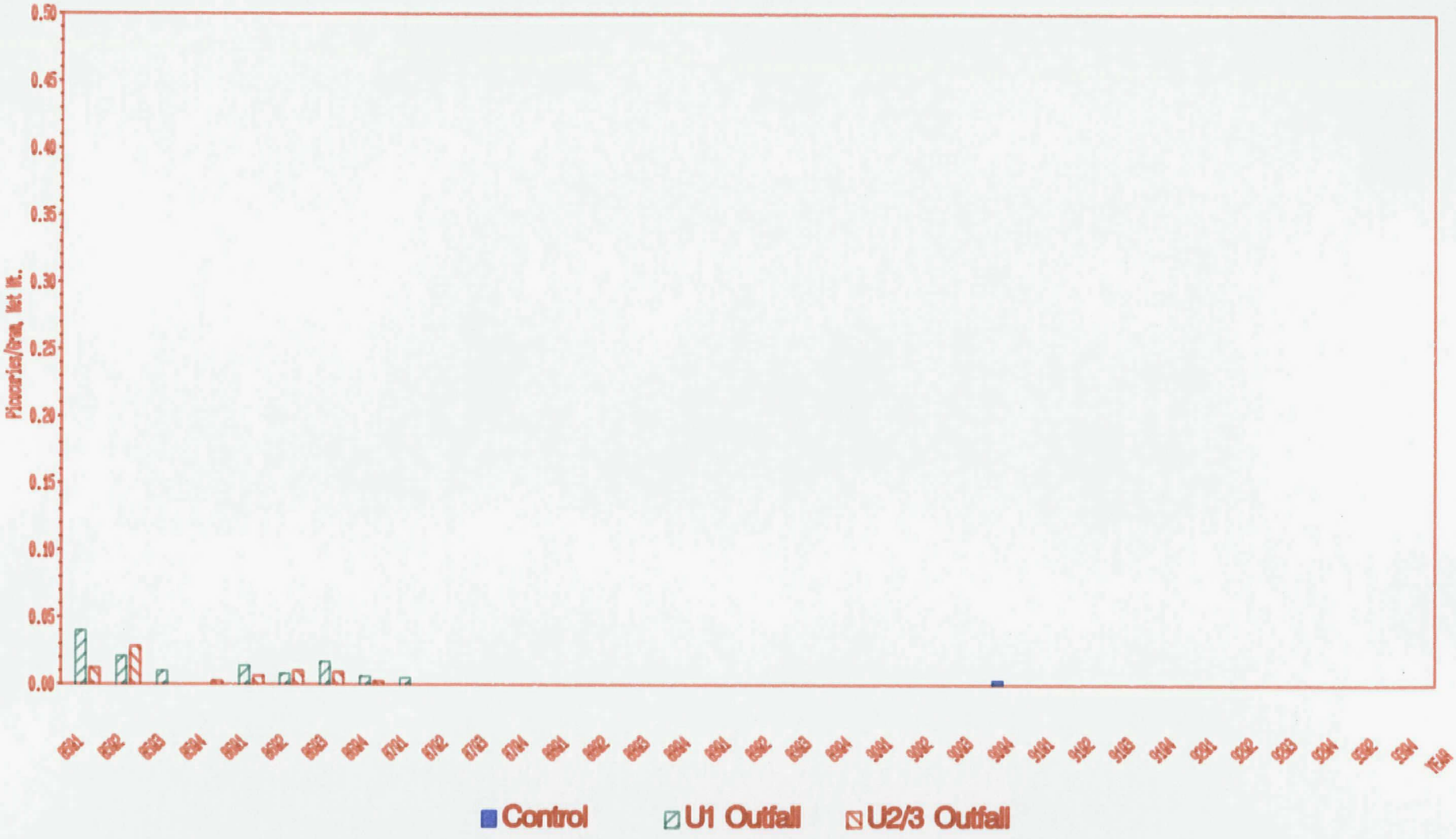


FIGURE 11B

Cesium–137 in the Flesh of Spiny Lobster (Preoperational)

Units 1, 2, and 3 Outfalls vs. Control

ELEMENT=Cs-137 Sample Type= 3 3=spiny lobster

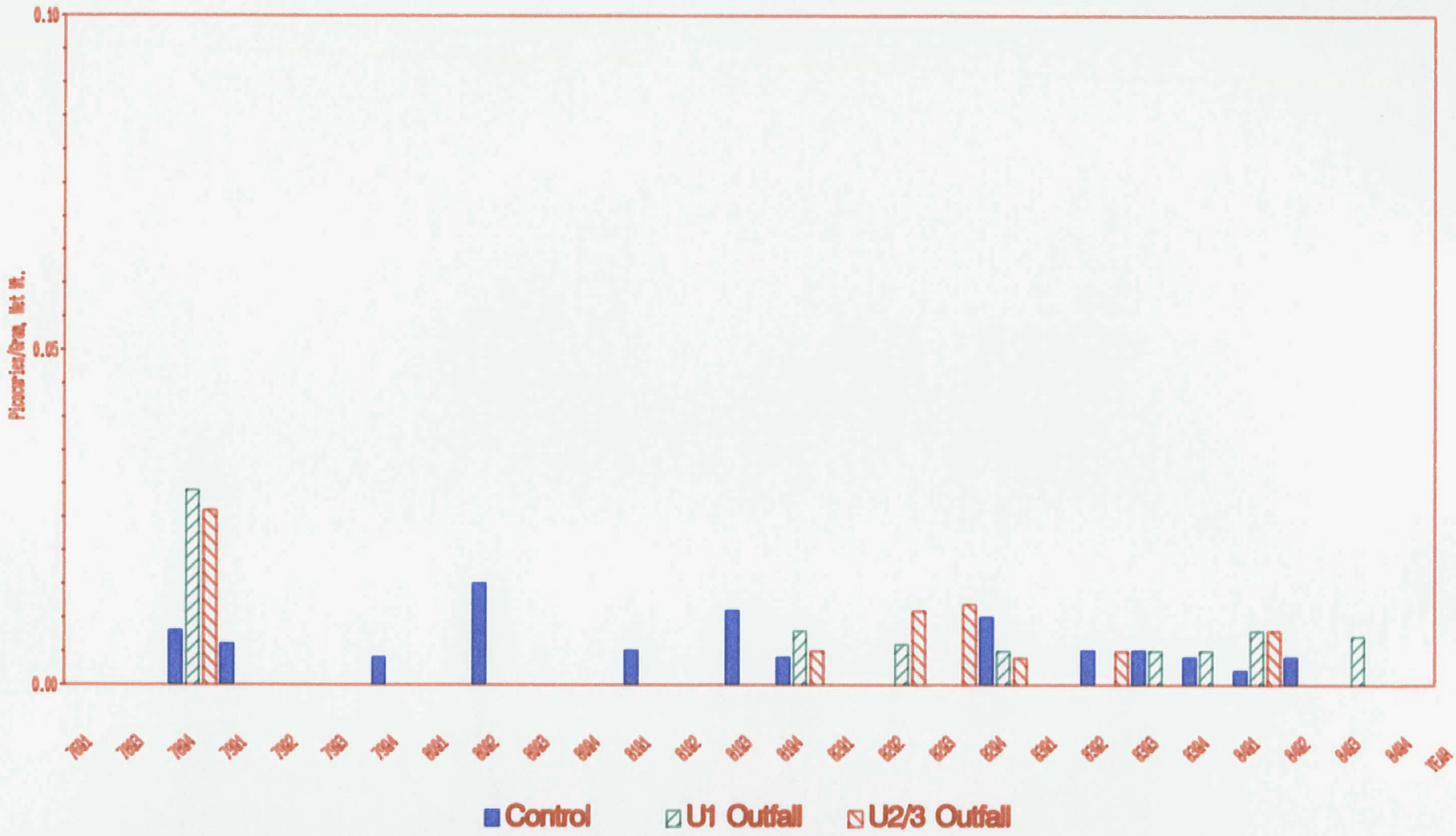


FIGURE 12A

Cesium–137 in the Flesh of Spiny Lobster (Operational)

Units 1, 2, and 3 Outfalls vs. Control

ELEMENT=Cs-137 Sample Type= K K=spiny lobster

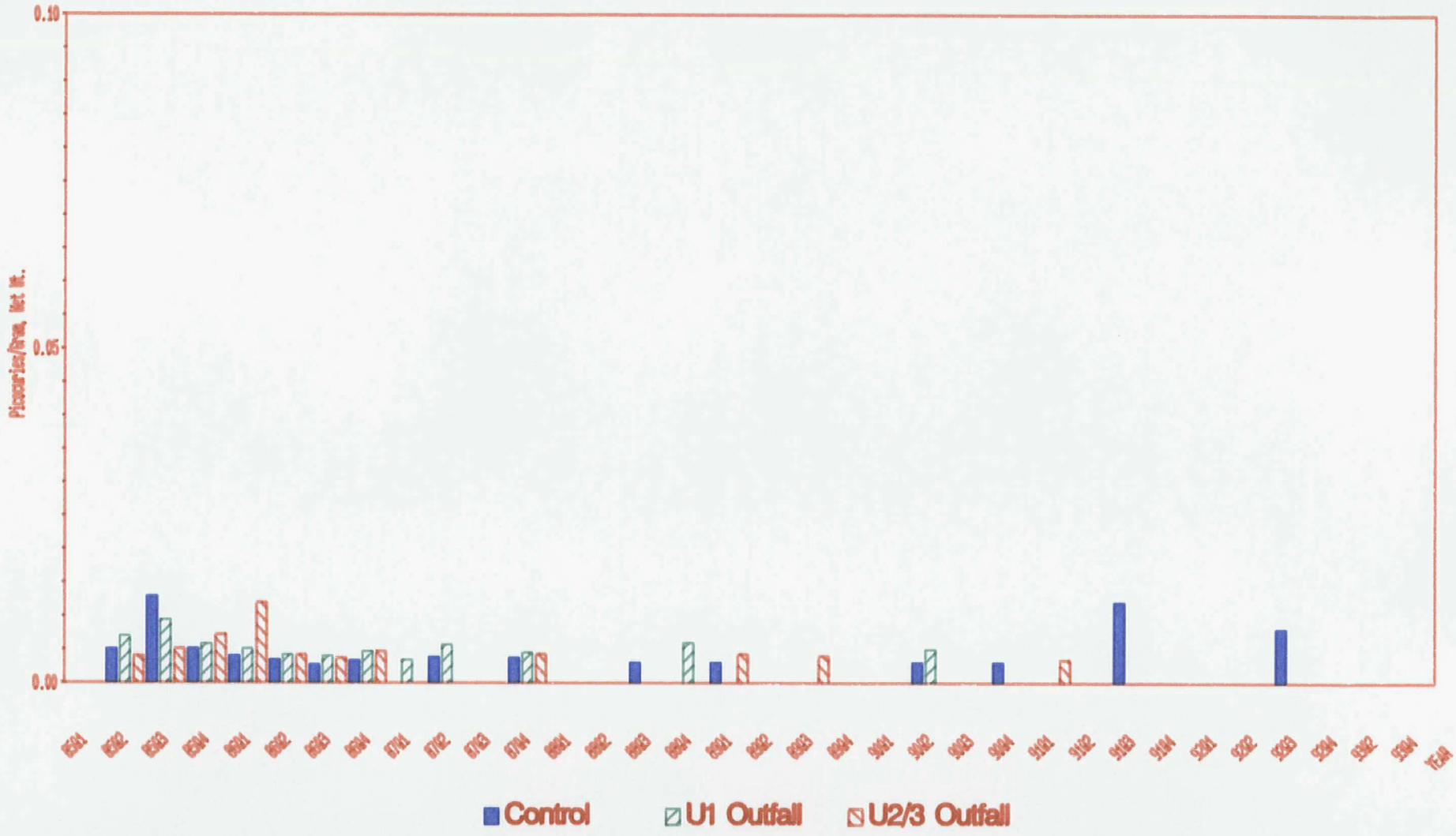


FIGURE 12B

Cobalt–60 in the Flesh of Mollusks (Operational)

Units 1, 2, and 3 Outfalls vs. Control

ELEMENT=Co-60 Sample Type= M M=mollusk

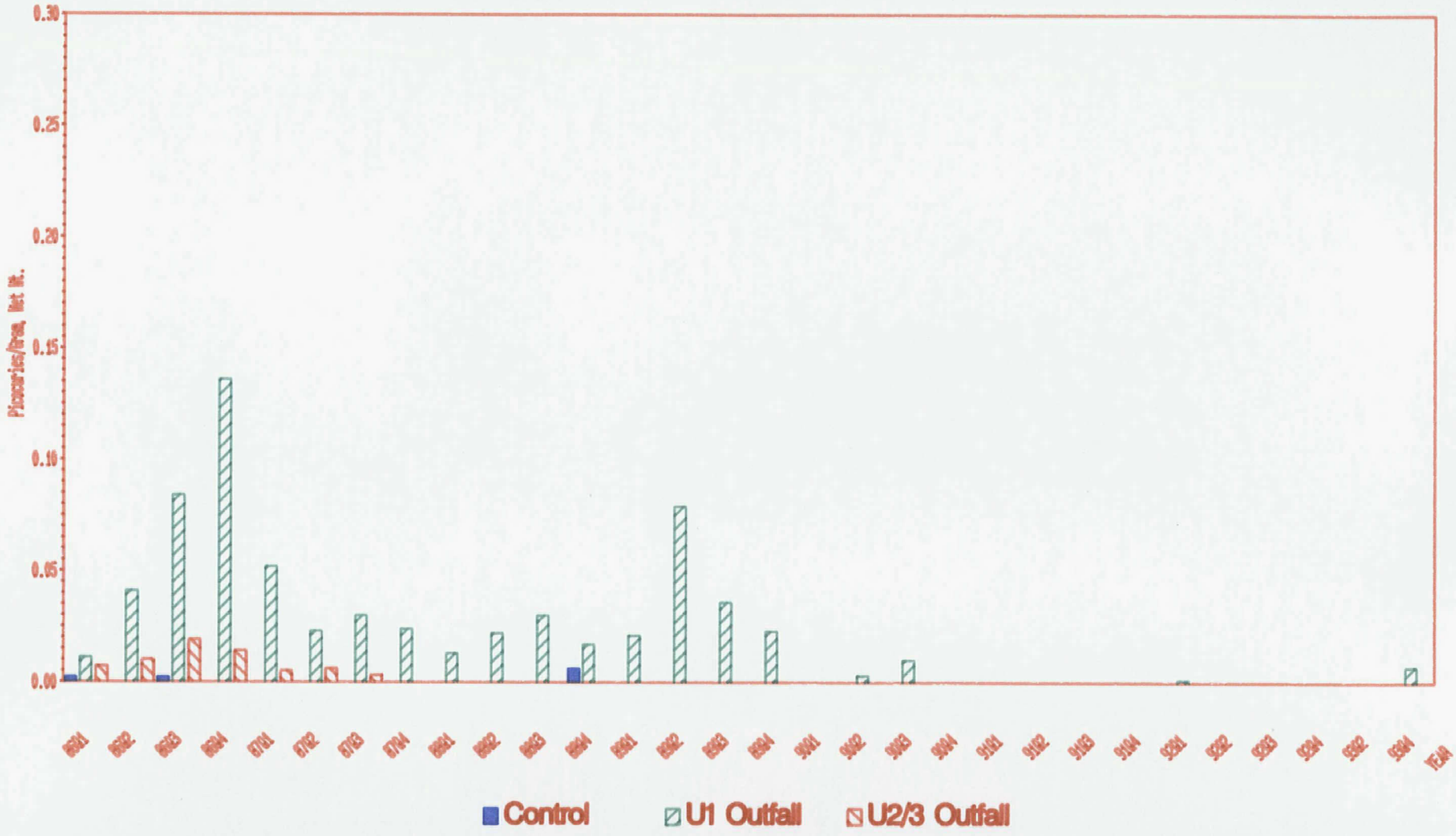


FIGURE 13A

Cesium–137 in the Flesh of Mollusks (Operational)

Units 1, 2, and 3 Outfalls vs. Control

ELEMENT=Cs-137 Sample Type= 3 3=mollusk

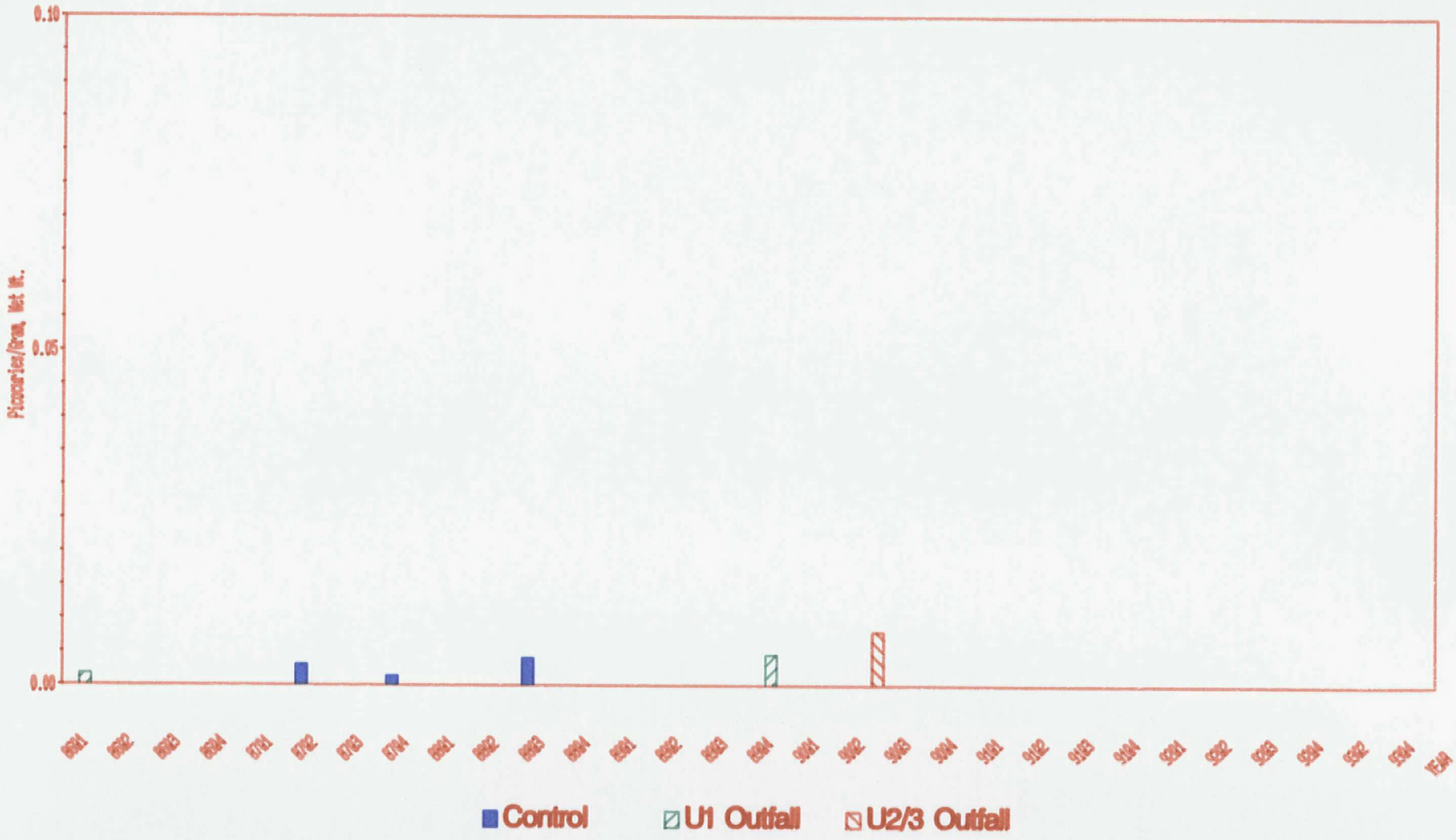


FIGURE 13B

Direct Radiation Monitoring

Preoperational Data (Quarterly Gamma Exposure)

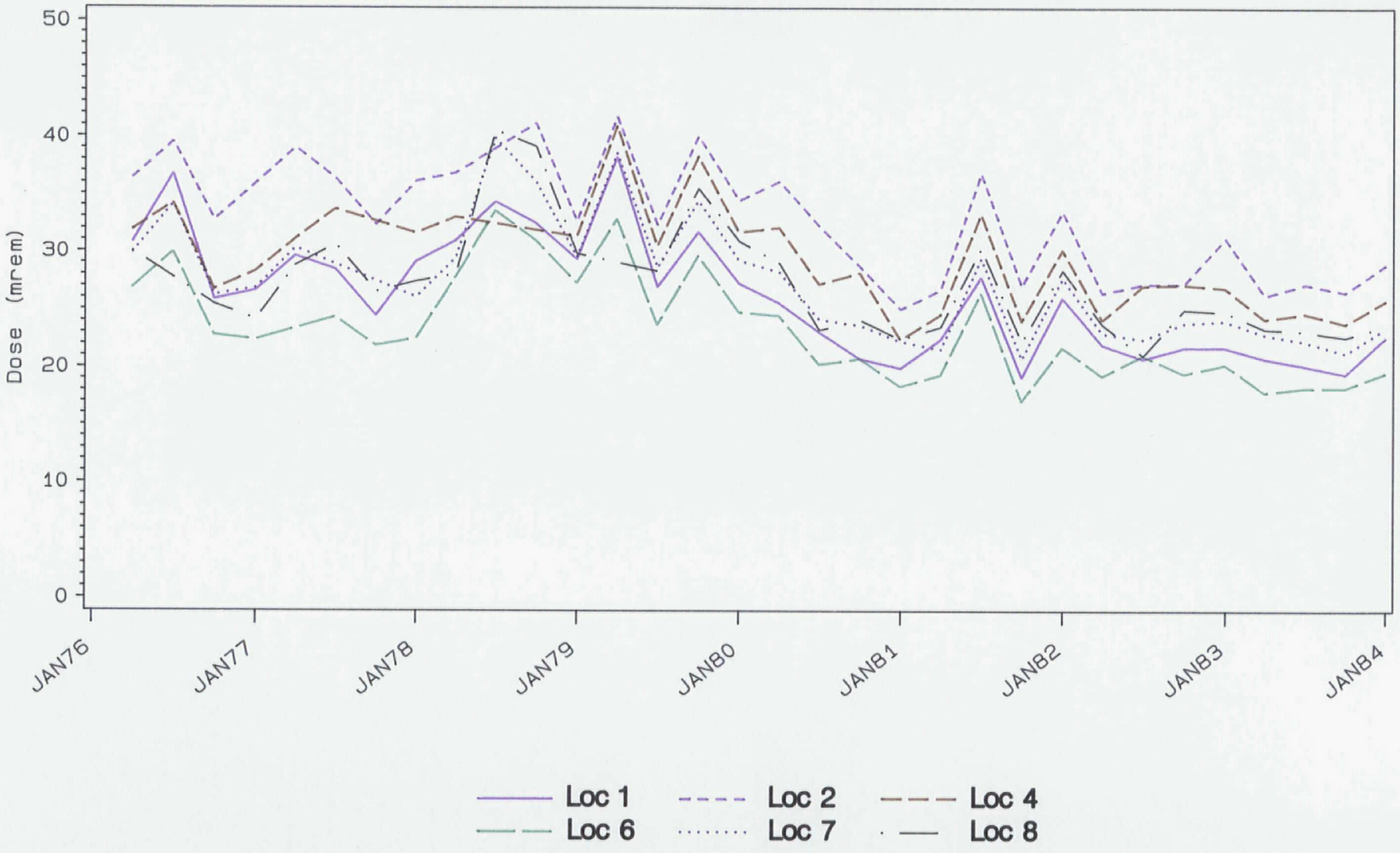


FIGURE 14A

Direct Radiation Monitoring

Preoperational Data (Quarterly Gamma Exposure)

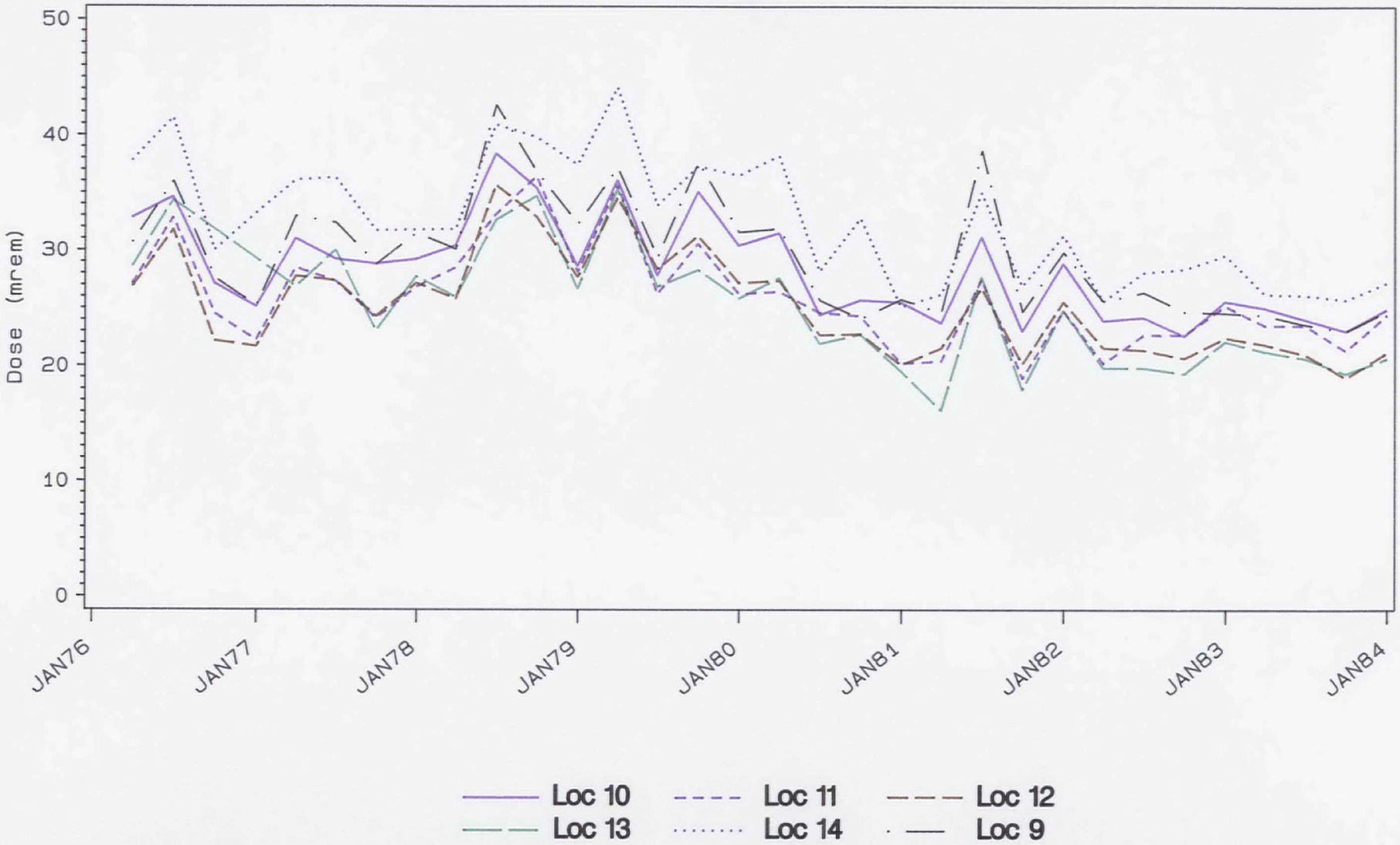


FIGURE 14B

Direct Radiation Monitoring

Operational Data (Quarterly Gamma Exposure)

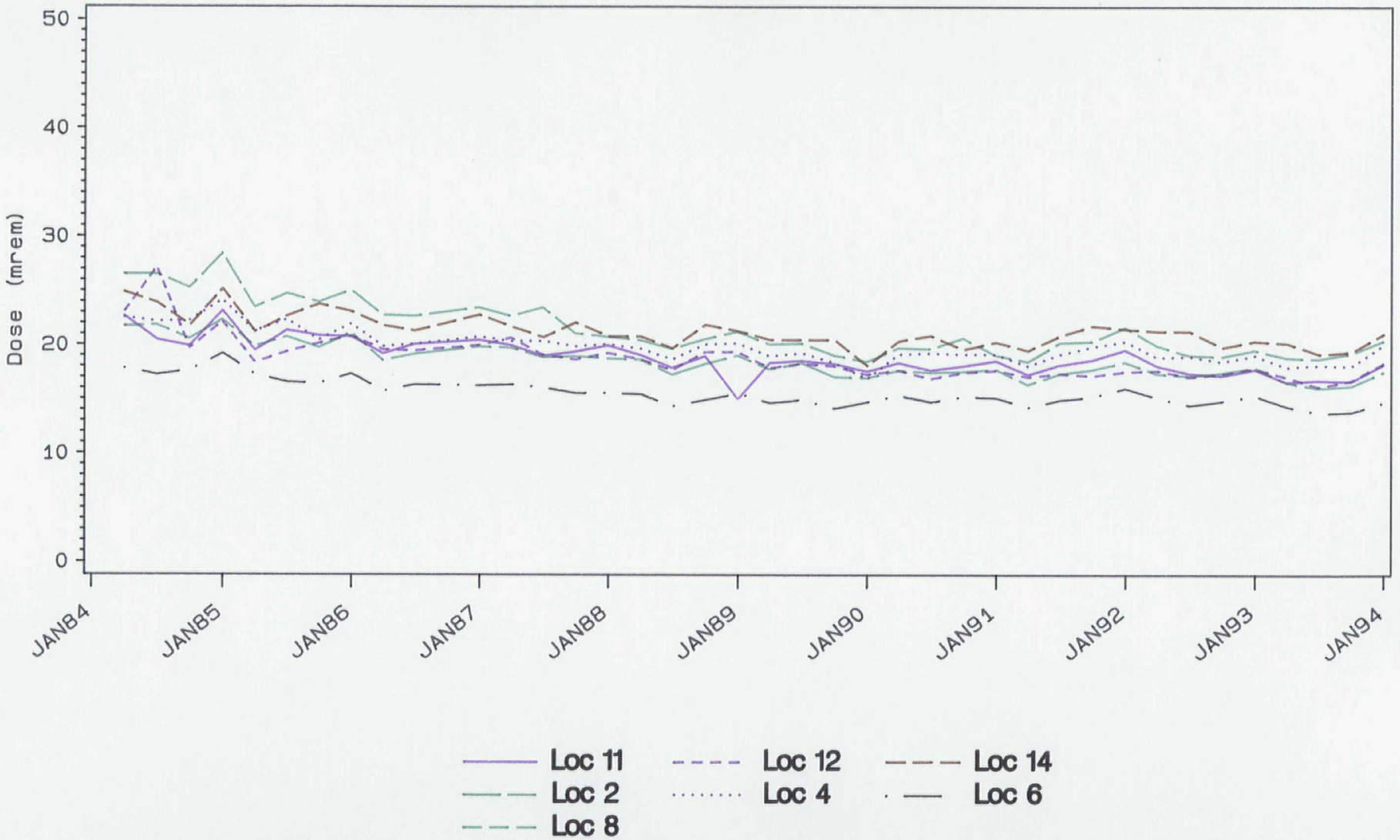


FIGURE 15A

Direct Radiation Monitoring

Operational Data (Quarterly Gamma Exposure)

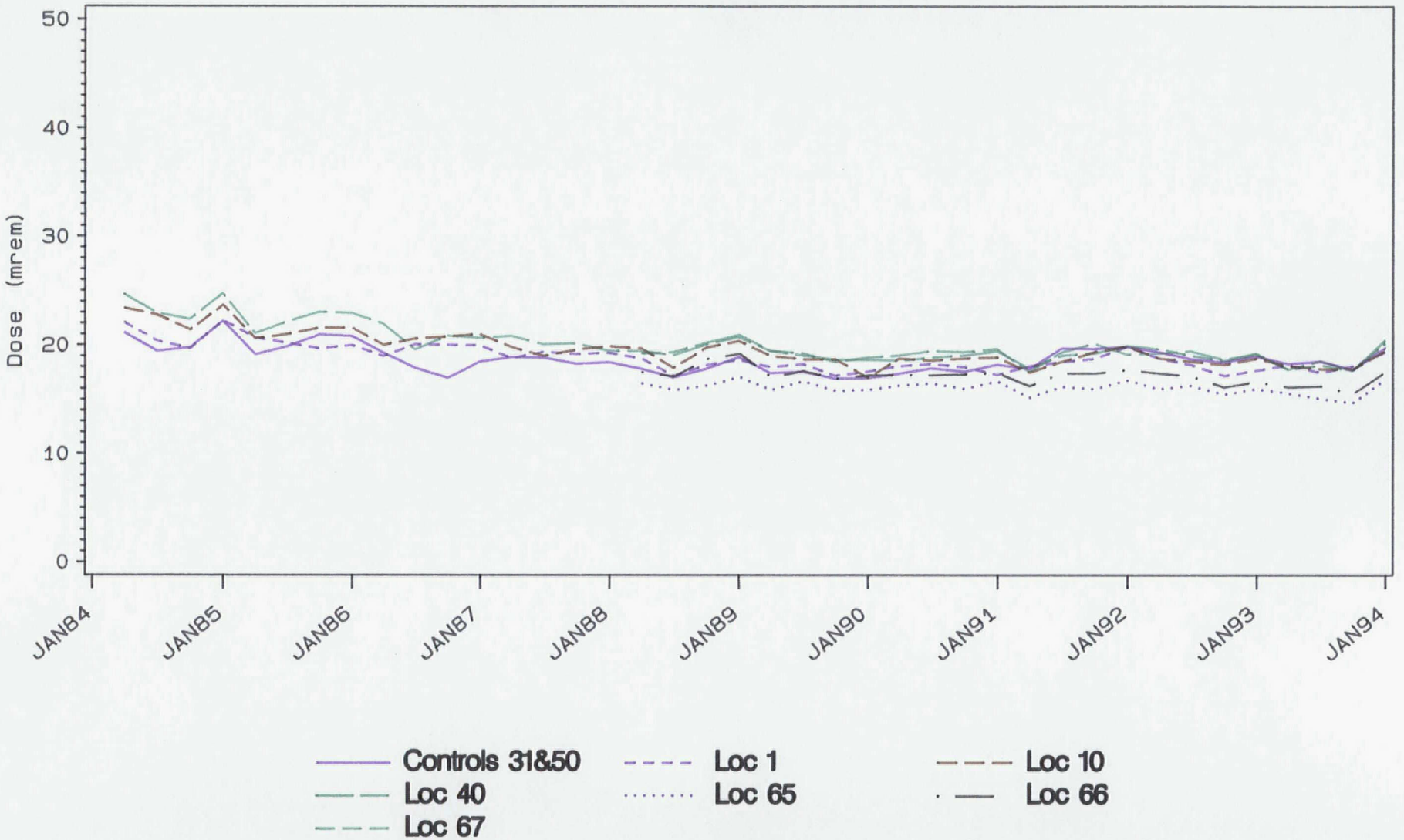


FIGURE 15B

Monthly Average Airborne Particulates Gross Beta Activity

Preoperational and Operational data for SONGS Unit 1

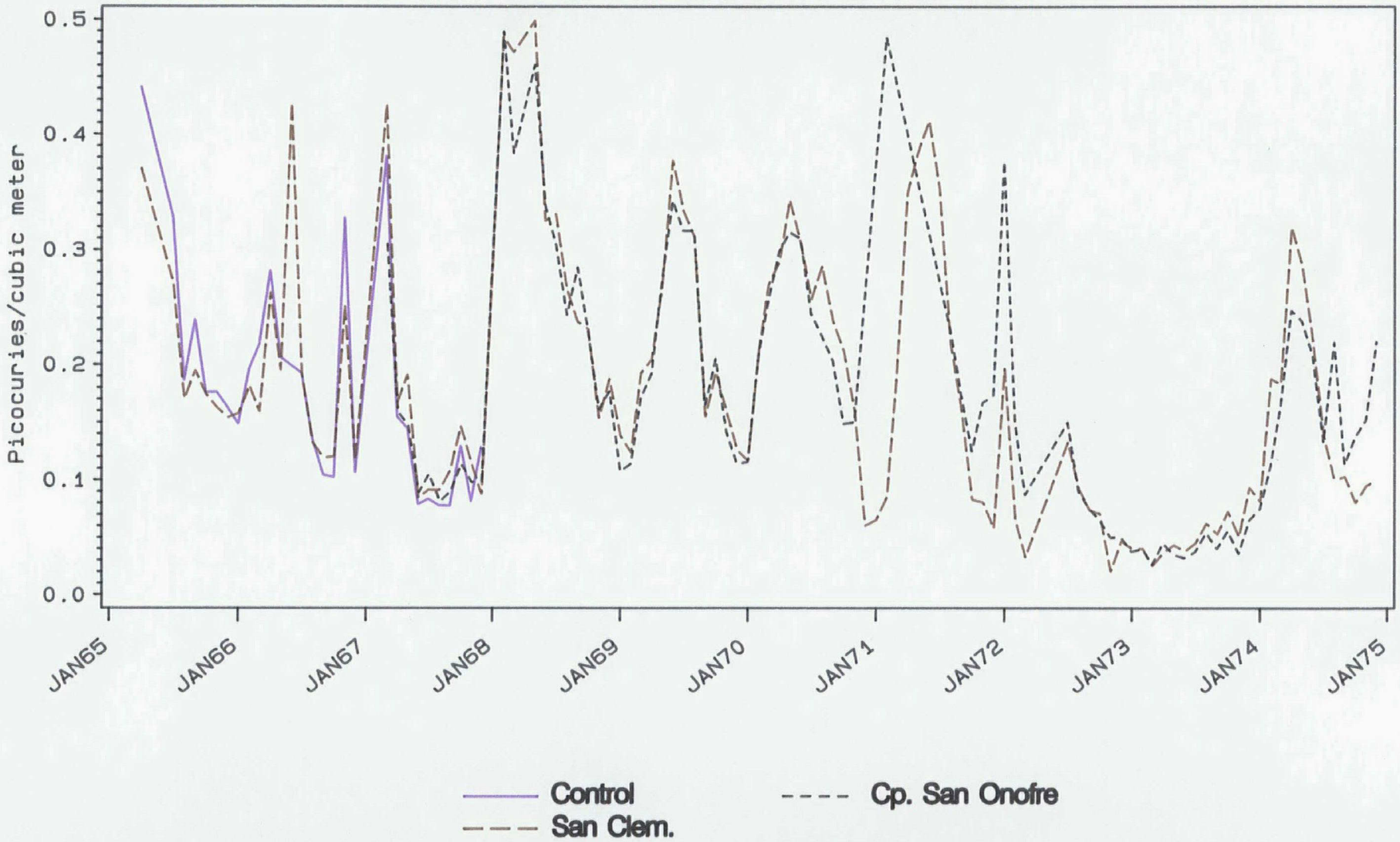


FIGURE 16

Monthly Average Airborne Particulates Gross Beta Activity

Preoperational and Operational data for SONGS Units 1, 2 and 3

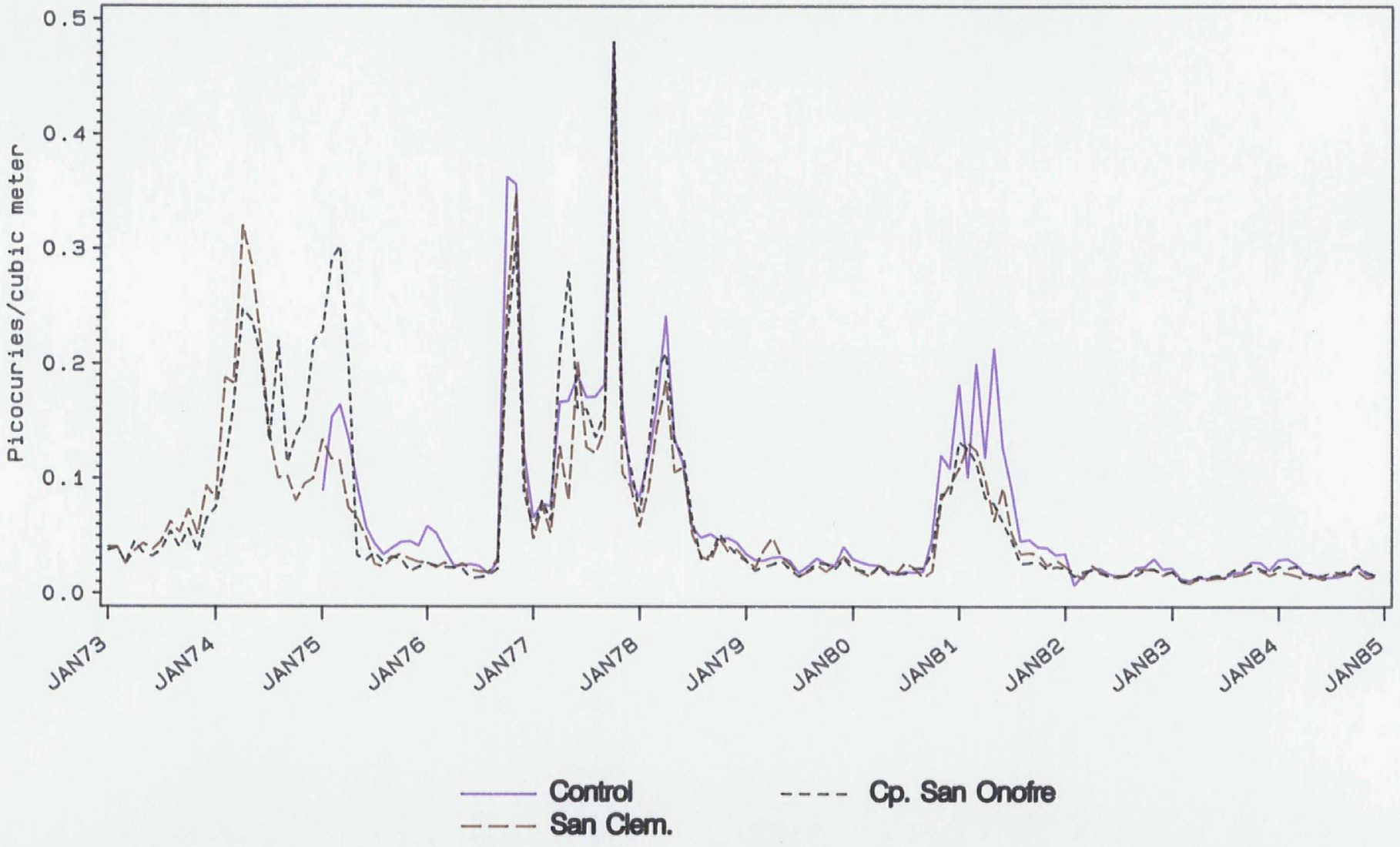


FIGURE 17A

Monthly Average Airborne Particulates Gross Beta Activity

Preoperational and Operational Data for SONGS Units 1, 2 and 3

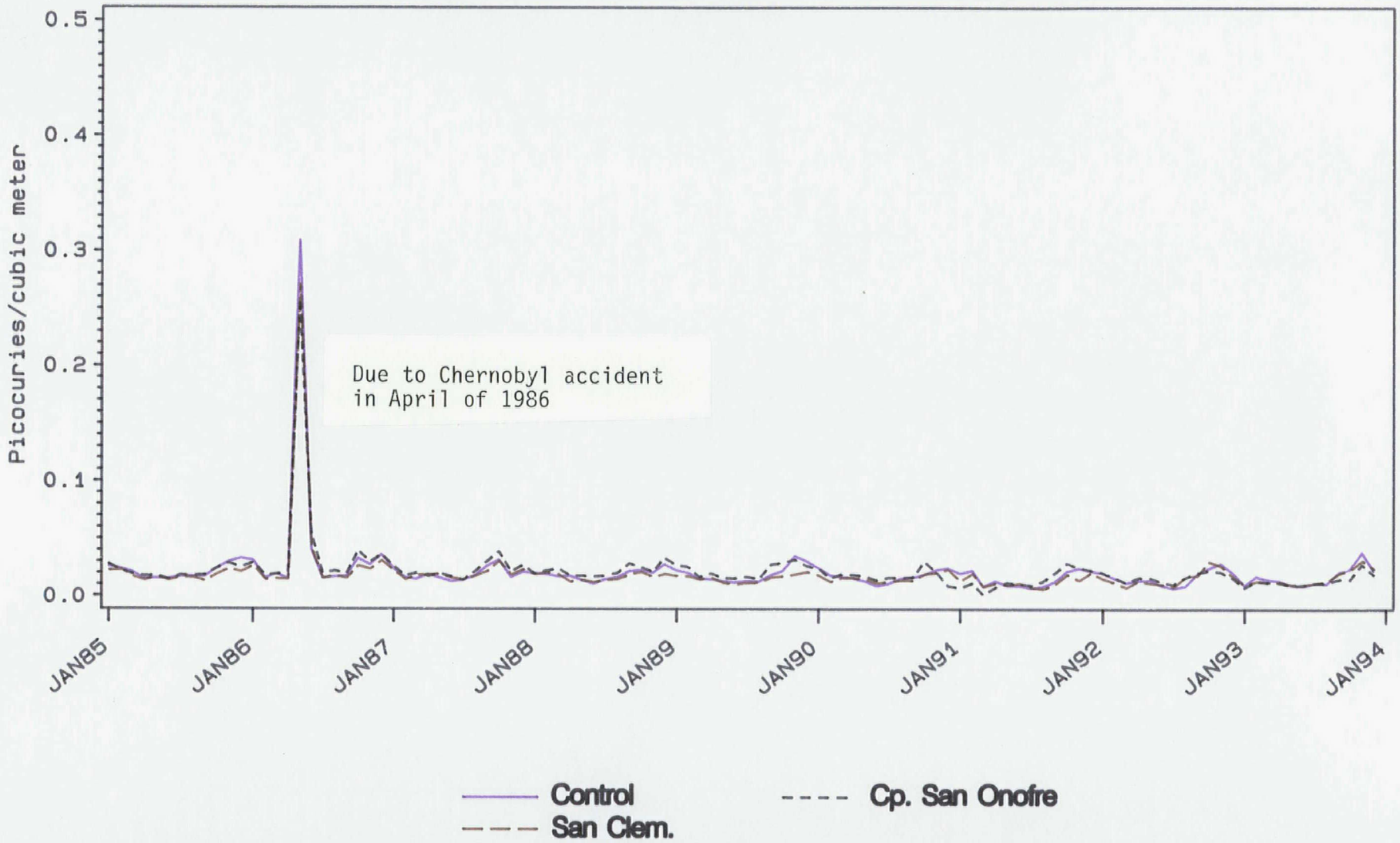


FIGURE 17B

Monthly Average Airborne Particulates Gross Beta Activity

Operational Data for SONGS Units 1, 2 and 3

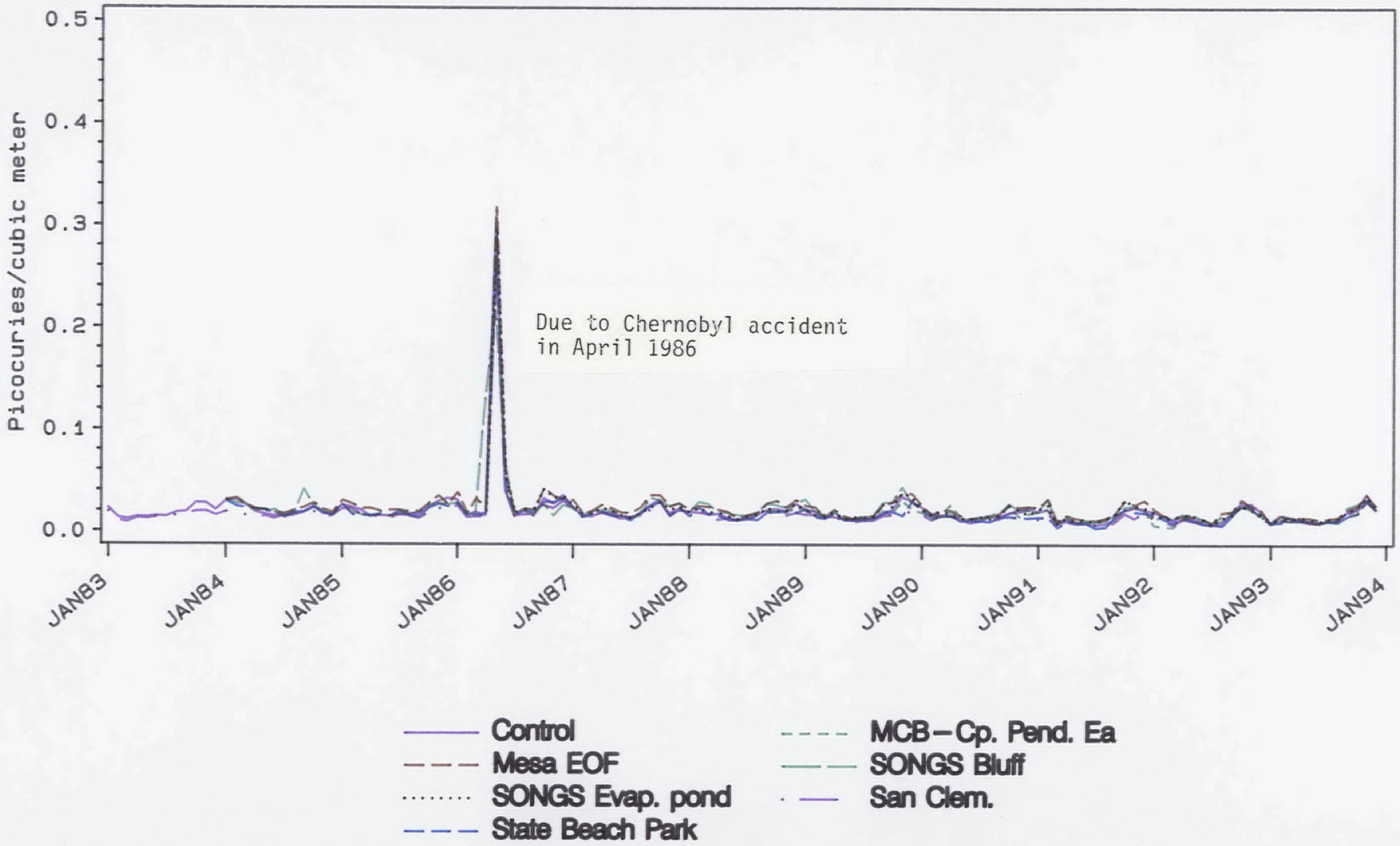


FIGURE 18

Monthly Drinking Water Filtrate Gross Beta Activity

Preoperational and Operational Data – SONGS Units 1, 2 and 3

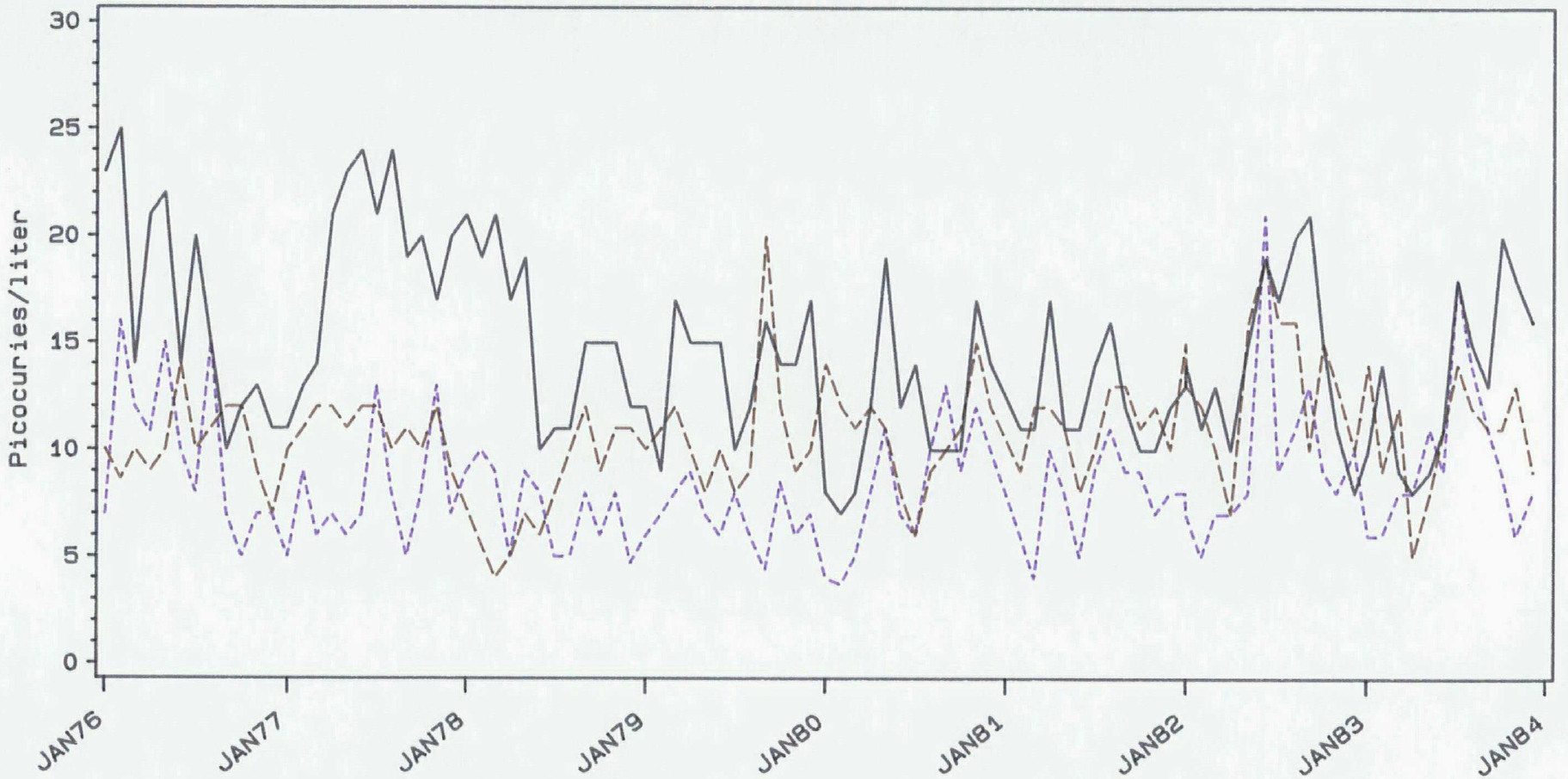


FIGURE 19A

Monthly Drinking Water Filtrate Gross Beta Activity

Preoperational and Operational Data – SONGS Units 1, 2 and 3

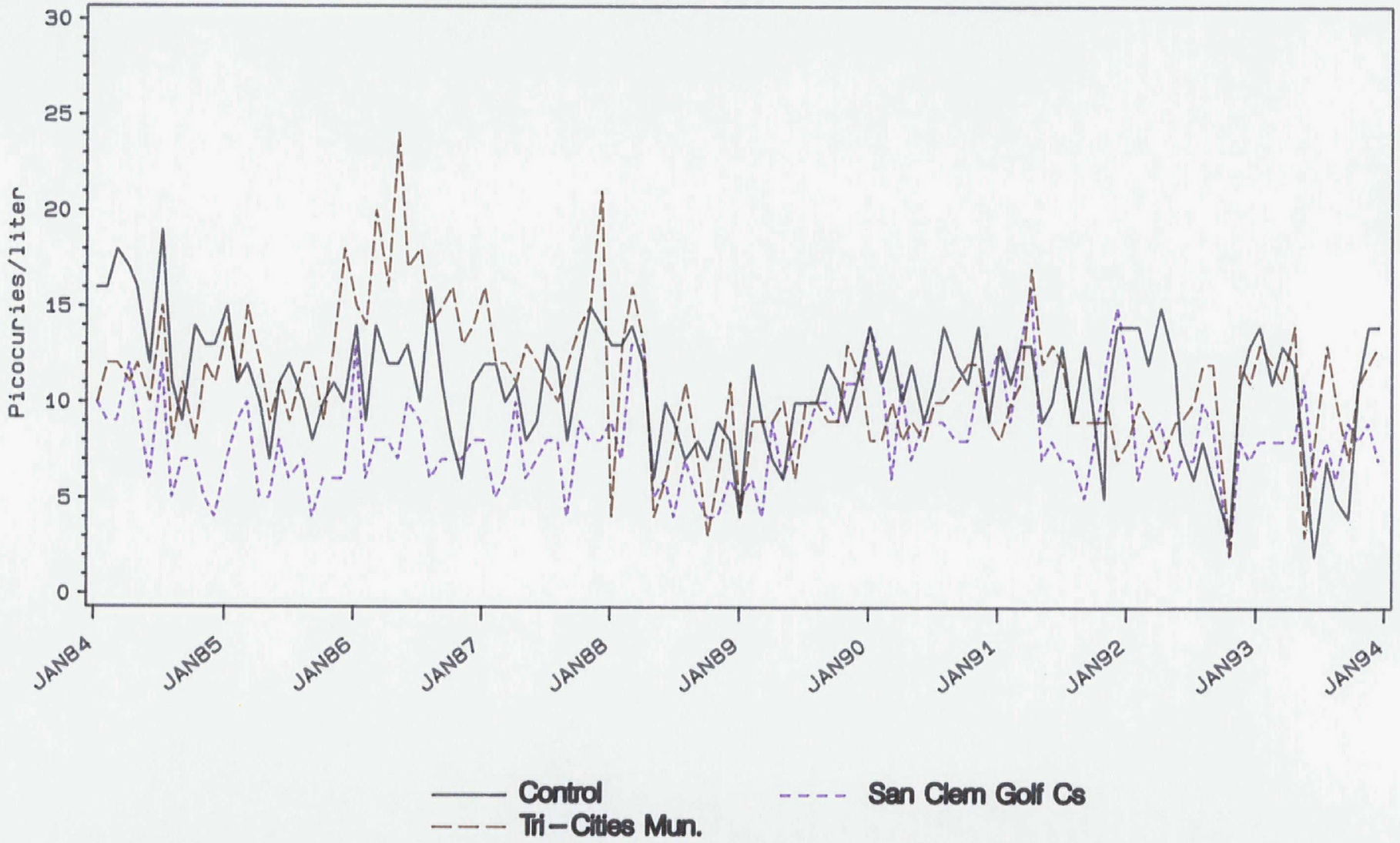


FIGURE 19B

Preoperational and Operational Data (Soil)

SONGS Units 1, 2, and 3 vs. Control

ELEMENT=SR_90

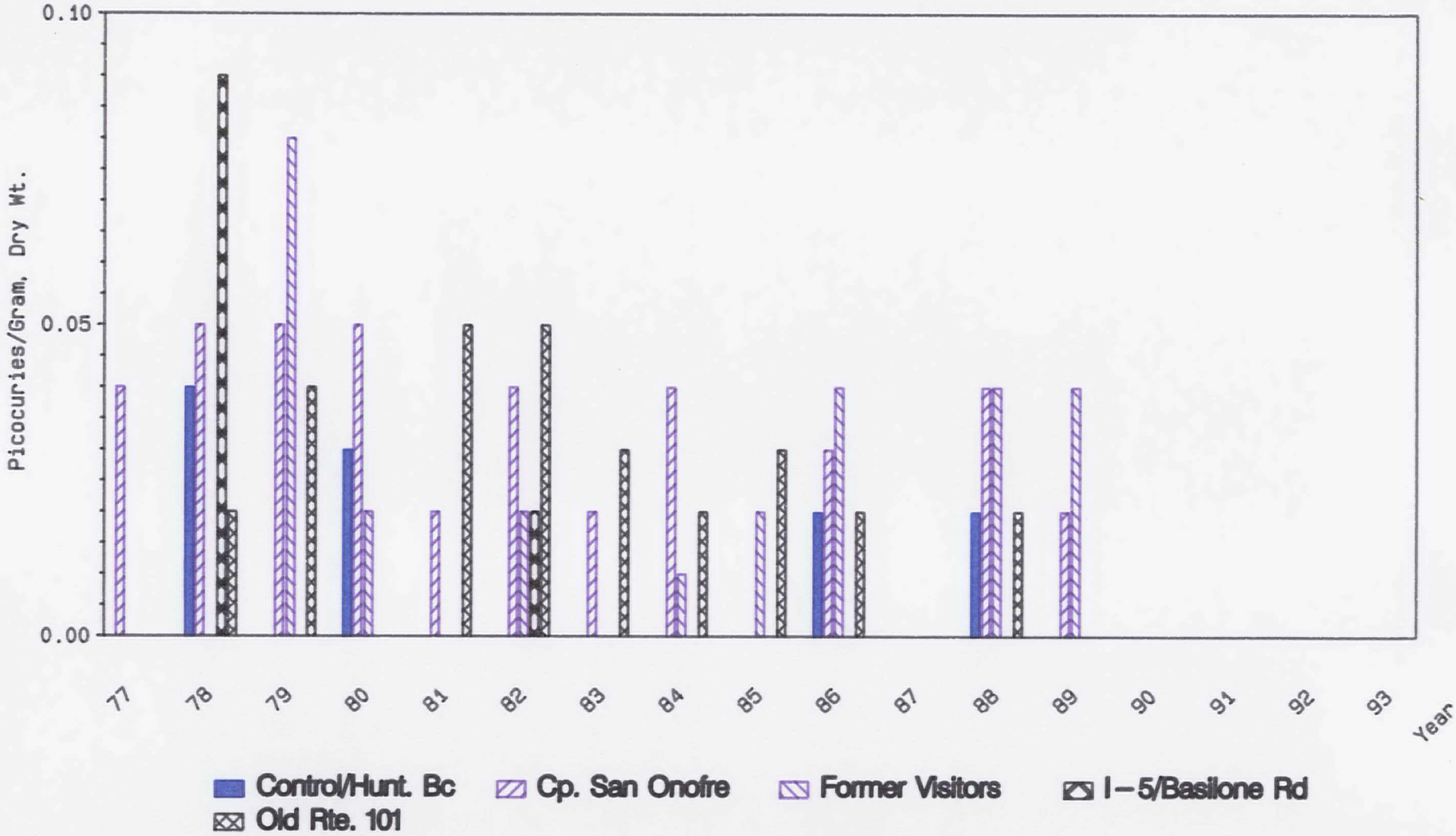


FIGURE 20A

Preoperational and Operational Data (Soil)

SONGS Units 1, 2, and 3 vs. Control

ELEMENT=CS_137

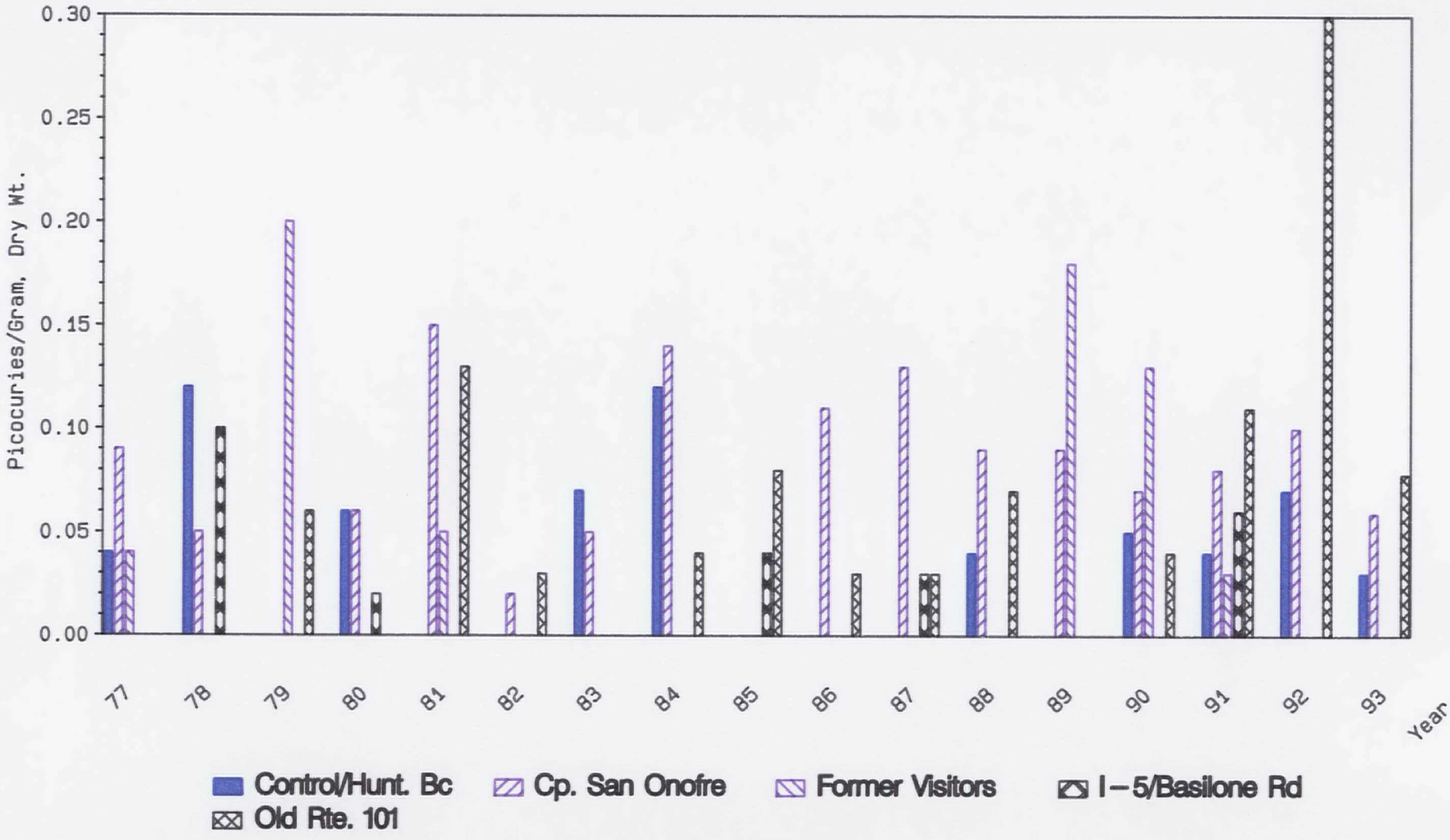


FIGURE 20B

Iodine – 131 in Kelp (Preoperational)

SONGS Units1, 2 and 3 vs. Control

ELEMENT=I-131

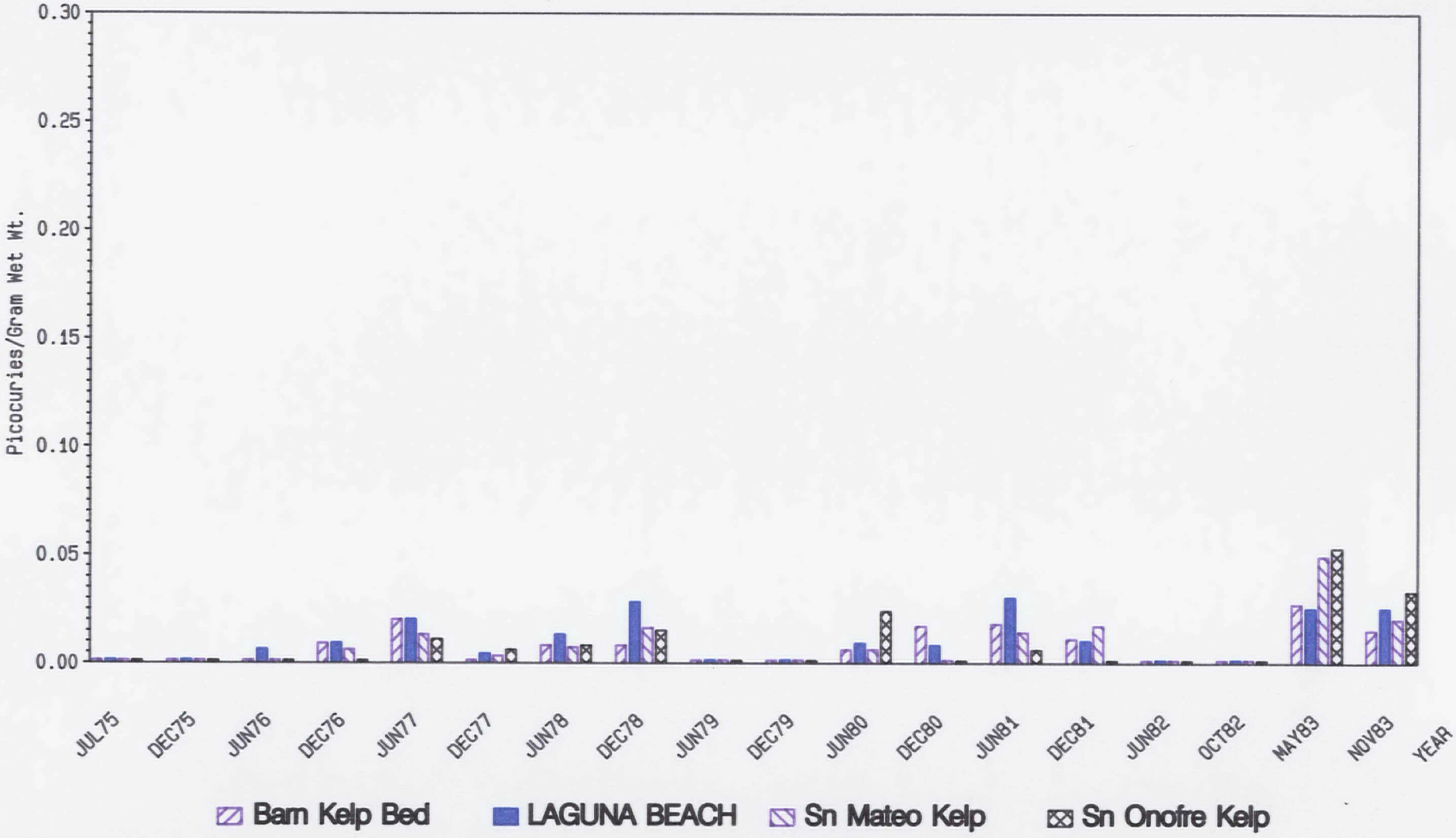


FIGURE 21A

Iodine – 131 in Kelp (Operational)

SONGS Units1, 2 and 3 vs. Control

ELEMENT=I-131

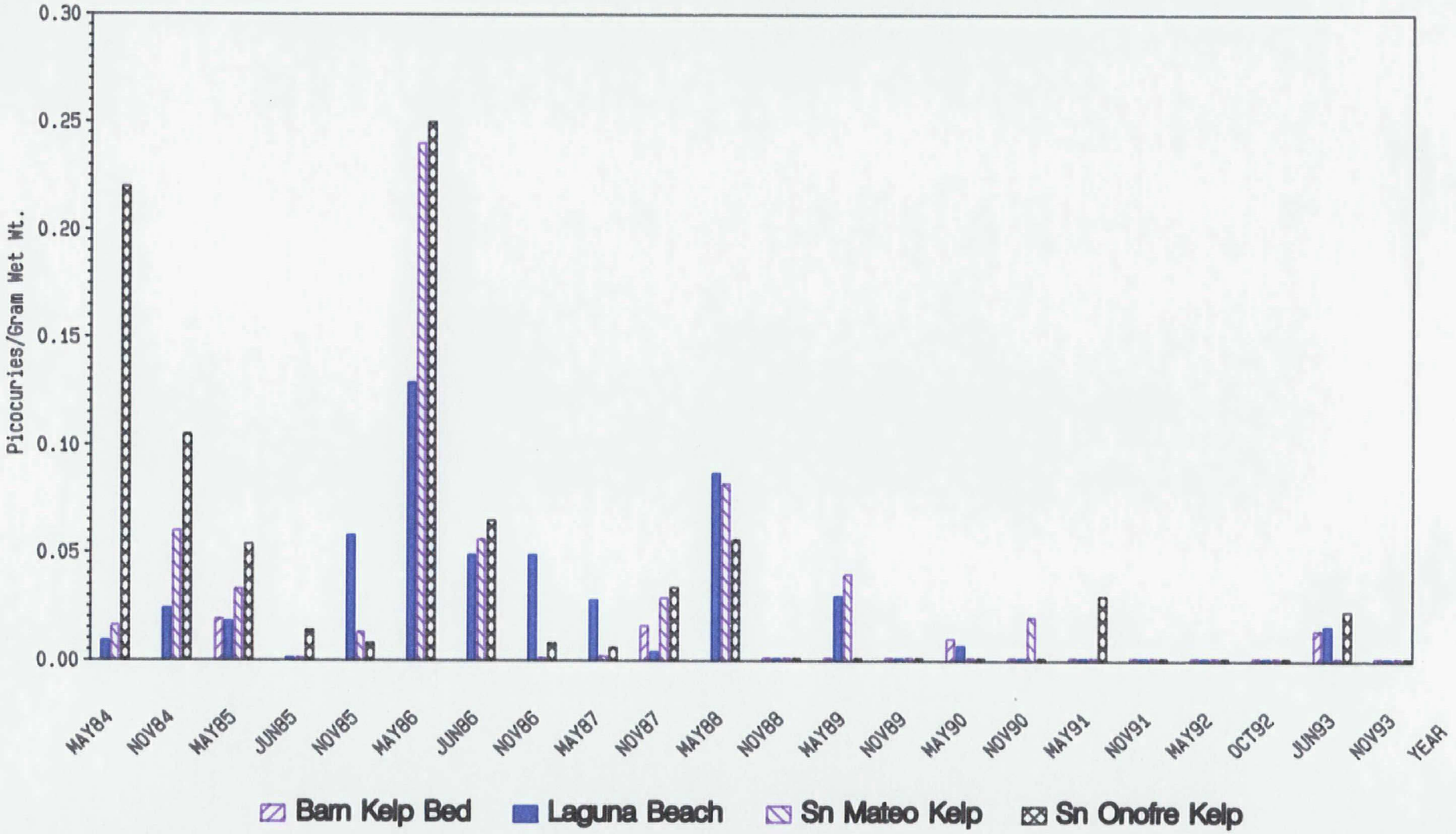


FIGURE 21B

Cesium–137 in Kelp (Preoperational)

SONGS Units 1, 2 and 3 vs. Control

ELEMENT=Cs-137

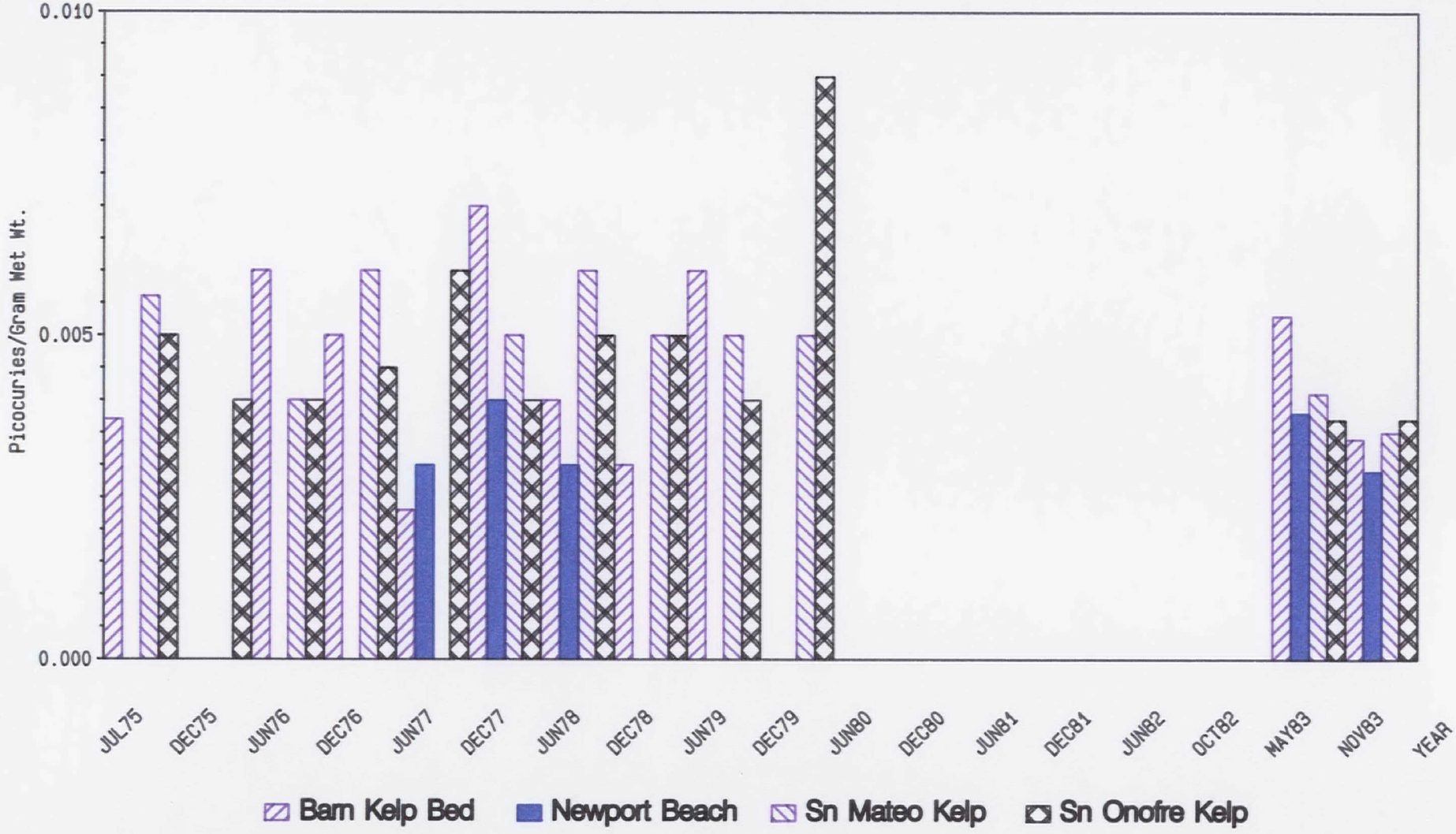


FIGURE 22A

Cesium – 137 in Kelp (Operational)

SONGS Units 1, 2 and 3 vs. Control

ELEMENT=Cs-137

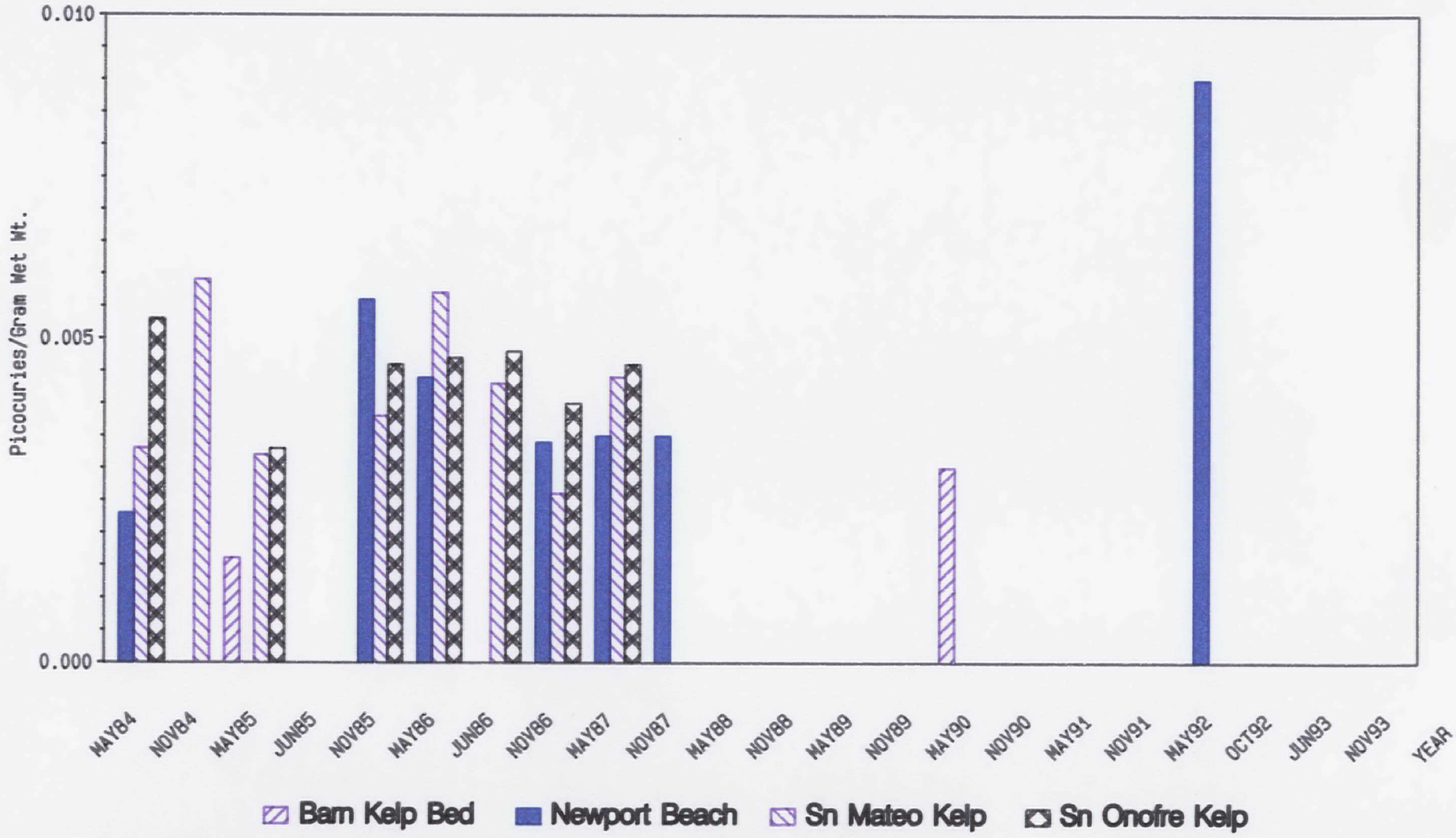


FIGURE 22B

ERRATA FOR 1992 RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

PAGE NUMBER (location)	INCORRECT	CORRECT
Page 9 (Table I-2)	Co-58 missing	Insert Co-58 See Table I-1, 1993 Report
Page 17 (Paragraph 3, Line 17	Figure	Figures
Page 17 (Paragraph 4, Line 34)	Figure 5	Figures 5A and 5B
Page 23 (Table II-8)	Under Date 7/14	Change 0.06 to <LLD
Page 25 (Paragraph 3, Line 14)	Figure 19A and ...	Figures 19A and ...
Page 27 (Paragraph 2, Line 14)	pCi/l	pCi/g
Page 114 (Table 14)	Zr(Nb)-95	Zn-65
Page 130 (Table D-1)	Ag-110m Critical (Organ)	Ag-110m ... (Critical Organ)
Page 134 (Line 14)	Unit 2/3	Units 2/3
Page 134 (Line 3)	Dose (mrem)	CURIES
Page 140 (Table E-2 Title)	...(pCi/g, dry...)	... (pCi/g, wet ...)
Page 183 (Paragraph 1, Line 16)	Figure 19	Figures 17A and 17B
Page 186 (Paragraph 5, Line 13)	Table F-1B	Delete Table F-1B
Page 189 (Paragraph 3, Line 4)	-	Insert " ...7.6 pCi/l (Table F-1B)
Page 189 (Paragraph 3)	The mean gross beta	The range of gross beta
Page 190 (Paragraph 6)	Figures G and F of the text	Delete: "of the text"
Page 193 (Paragraph 2, Line 9)	Newport	Laguna
Page 203 (Paragraph 2, Line 7)	June 10 though June 11	June 9 through June 16
Page 203 (Paragraph 7)	State Beach Park	Bluff
Page 246 (Tables 9b, 9c, 9d)	Location 1	Location 3
Page 246 (Tables 9b, 9c, 9d)	Location 2	Location 1
Page 246 (Tables 9b, 9c, 9d)	Location 3	Location 2