# ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT For 1984

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

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April 30, 1985

## SAN ONOFRE NUCLEAR GENERATING STATION UNITS 1, 2, AND 3 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

FOR 1984

#### Prepared by:

Southern California Edison Company San Diego Gas and Electric Company Docket Numbers 50-206, 50-361, 50-362 License Numbers DPR-13, NPF-10, NPF-15

### Southern California Edison Company

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April 30, 1985

U.S. Nuclear Regulatory Commission Office of Inspection and Enforcement Region V 1450 Maria Lane, Suite 210 Walnut Creek, California 94596-5368

Attention: Mr. J. B. Martin, Regional Administrator

Subject: Docket No. 50-206, 50-361, 50-362 San Onofre Units 1, 2 and 3

Dear Sir:

Enclosed are three copies of the radiological environmental monitoring related report entitled:

"Annual Radiological Environmental Operating Report for 1984".

This report provides detailed environmental impact analyses and data and is submitted in accordance with the requirements for San Onofre Nuclear Generating Station Unit 1 Provisional Operating License No. DPR-13, Appendix A, Section 3.18 and Units 2 and 3 Operating License Nos. NPF-10 and NPF-15, Appendix A, Section 6.9.1.6.

Please contact me if you have any questions concerning this report.

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#### I. INTRODUCTION

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

To monitor the operations of SONGS Units 1, 2, and 3, and to fulfill the requirements of the SONGS Environmental Technical Specifications (ETS), an operational Radiological Environmental Monitoring Program (REMP) was conducted at SONGS during 1984. 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, adult rabbits, and ocean bottom sediments. Each of the samples were analyzed for both naturally occurring, and station-related radionuclides.

#### A. The Program

In its operational phase, the REMP was conducted in accordance with Section 3.2 of the SONGS Unit 1 Environmental Technical Specifications (ETS), and Section 3/4.12.1 of the SONGS Units 2 and 3 Technical Specifications (TS). The objectives of the operational REMP are fourfold:

1. To fulfill the obligation for radiological surveillance required by Technical Specifications.

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.

#### B. 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 demographs, and land uses.

Sampling locations were divided into two classes— indicator and control. Indicator locations were those expected to manifest effects of Station (i.e., SONGS) operations. Control stations were at locations considered to be unaffected by Station operations.

#### C. Sample Analysis

Environmental samples were collected at different locations (listed in Appendix A) in the vicinity of SONGS, and then submitted to a contracted radiological laboratory. Each sample was analyzed using standard chemical procedures. The results of the analyses are presented in Appendix B, and summarized in Appendix C by sample type and analysis. The tabulated means, ranges and standard deviations presented in Appendix C were calculated using standard statistical methods according to the format specified in Regulatory Guide 4.8 (1975).

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 inter-laboratory cross-check analyses. The results of the EPA cross-check analyses are presented in Appendix J

The impact of SONGS on the surrounding environment was assessed through a series of analyses. These analyses included: (1) comparison of data between indicator and control locations for each sample type, (2) identification of radionuclide concentrations exceeding twice background levels, (3) historical trending of radionuclide concentrations in sampled environmental media over a period of four years, and (4) comparison of operational to preoperational environmental data. Summaries, and comparison of indicator to control locations are presented in Section II (page 4) of the report. Other data comparisons are presented in Appendices D through G. II. RESULTS AND DISCUSSIONS OF 1984 ENVIRONMENTAL DATA

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#### A. DIRECT RADIATION

The purpose of this program element was to measure the amount of environmental gamma and beta radiation in the vicinity of SONGS. To accomplish this task, calcium sulfate (CaSO<sub>4</sub>:Dy) and lithium fluoride (LiF) thermoluminescent dosimeters (TLDs) were placed at each of 59 indicator and control locations, collected, and analyzed at prescribed intervals. The control location was situated in Huntington Beach. The calcium sulfate TLDs were collected quarterly and were replaced with re-zeroed dosimeters, while the lithium fluoride dosimeters were collected after an exposure period of one year (i.e., at the end of 1984). A total of 236 calcium sulfate TLDs and 58 lithium fluoride TLDs were collected and analyzed throughout the year.

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After the samples were analyzed, the measured doses were corrected for pre- and post-field exposure times. During the course of the year, the quarterly dose measured by the calcium sulfate TLDs from the indicator locations ranged from 10.4 to 28.4 mrem, with an average dose of 21.2 mrem. San Onofre State Beach had the highest TLD readings for the four quarters. The doses measured at this location ranged from 25.1 to 27.8 mrem, with an average dose of 26.8 mrem. The quarterly dose measured by the calcium sulfate dosimeters from the control location, on the other hand, ranged from 21.7 to 25.1 mrem with an average dose of 23.8 mrem. Figures 1, 2, 3, and 4 present TLD doses measured at five of the indicator locations vs. those measured at the control location during 1984.

The direct radiation dose indicated by the lithium fluoride dosimeters ranged from 37.0 to 87.8 mrem, with an average dose of 69.4 mrem. The dose measured from the control location was 83.1 mrem.

Doses measured at indicator locations were considered significant if they were greater than doses measured at the indicator locations by 25 percent. Using this criterion, it was determined that there were no significant doses at indicator locations during 1984, and that SONGS operations had negligible impact on this environmental medium.

#### B. SOIL SAMPLING

At the end of 1984, soil samples were collected from four indicator locations in the vicinity of SONGS, and a control location situated in Huntington Beach. After collection, each soil sample was analyzed for 12 naturally-occurring and Station related radionuclides via gamma-spectral analysis, and for radiostrontium by beta counting. These analyses indicated that three radionuclides were present in detectable quantities in one or more of the samples, namely: potassium-40, cesium-137, and strontium-90. The findings are summarized below in terms of dry sample weights.

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Potassium-40 was detected in each sample. The concentration of potassium-40 in the samples from the indicator locations ranged from 6.2 to 21 pCi/gm, with an average concentration of 14.6 pCi/gm of sample. The concentration of potassium-40 in the sample from the control location was determined to be 18.9 pCi/gm of sample, which is similar to concentrations measured at the indicator locations.

Cesium-137 was detected in samples from two of the indicator locations, and in the sample from Huntington Beach. Samples from indicator locations containing detectable amounts of cesium-137 were collected from Camp San Onofre, and from Old Route 101. The concentration of cesium-137 in the sample from Camp San Onofre was determined to be 0.14 pCi/gm of sample. The amount of cesium-137 measured in the sample from Old Route 101 was significantly less. In this instance, the concentration of cesium-137 was determined to be 0.04 pCi/gm of sample. The amount of detectable cesium-137 in the sample from Huntington Beach was determined to be 0.12 pCi/gm of sample.

Strontium-90 was found in samples from Camp San Onofre, and Old Route 101. The concentration of strontium-90 in these samples was determined to be 0.04, and 0.02 pCi/gm of sample, respectively. Strontium-90 was not detected in the sample from Huntington Beach.

To determine the impact of SONGS on this environmental medium, it is important to determine the origin, amount, and frequency of occurrence of the activity in the environment, in that order. Potassium-40, a naturally occurring, non-Station related radionuclide, was present as expected in quantities comparable to or less than the values obtained from the control location. The presence of cesium-137 in the soil may be attributable to fallout from atmospheric nuclear weapons testing, and potentially from gaseous effluents emitted from the Station. Because comparable concentrations of cesium-137 were found at the indicator and control locations, the source of the cesium-137 is most likely due to fallout products of weapons testing. Strontium-90 in soil samples may also be ascribed to the decay of fallout from atmospheric nuclear weapons testing, and/or gaseous effluents emitted from the Station. Because strontium-90 was not detected in the samples from the control location, the detected activity in each of the samples may be accredited to Station operations. Since strontium-90 was seen at environmental levels (e.g., picocuries per gram of sample) in only half of the samples from indicator locations, the impact of Station is minimal on this environmental medium.

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#### C. SHORELINE SEDIMENT (BEACH SAND)

Beach sand was collected semiannually from three indicator locations, and from a control station situated in Huntington Beach. After collection, the samples were analyzed for nineteen different Station and non-Station related radionuclides. By the end of the year, three naturally-occurring radionuclides had been detected in the samples: potassium-40, radium-226, and thorium-228. The measured concentrations of these radionuclides are summarized in Table II-1 in terms of "as received" wet sample weights.

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Although the radionuclide concentrations show variation (i.e., from one collection period to another), comparable concentrations of a given radionuclide were observed in both indicator and control samples for the same sampling period.

The fact that no Station-related radionuclides were detected in any of the samples indicates that the operation of SONGS during 1984 had an apparently negligible effect on this environmental medium, and on the public.

### TABLE II-1

## RADIONUCLIDES DETECTED IN BEACH SAND IN 1984

		Co	; <b>π</b>	
Sampling Location:	Date	K-40 (pCi/g)	Ra-226 (pCi/g)	Th-228 (pCi/g)
Newport Beach (Control) 0.5 Miles South of Unit 1	Apr 1984 Apr 1984	17.5 11.5	0.63 0.80 0.28	2.10 1.04 0.36
San Onofre Surfing Beach S. San Onofre State Beach	Apr 1984 Apr 1984	11.3	0.64	0.43
Newport Beach (Control) 0.5 Miles South of Unit l San Onofre Surfing Beach S. San Onofre State Beach	Sep 1984 Sep 1984 Sep 1984 Sep 1984	18.3 13.6 12.7 15.8	0.22 0.21 0.17 0.12	0.41 0.22 0.18 0.13

\*Note: Concentrations are reported in terms of wet sample weights Abbreviations: pCi/g, picocuries per gram; K-40, potassium-40; Ra-226, radium-226; Th-228, thorium-228.

#### D. AIRBORNE PARTICULATE ANALYSIS

Air particulate samples were collected on a weekly basis from eight indicator locations and a control station in Huntington Beach. After collection, the samples were analyzed for gross beta activity with a lower limit of detection of  $0.003 \text{ pCi/m}^3$  of air. Samples were also composited quarterly and analyzed for 11 naturally-occurring and Station-related radionuclides by gamma-spectral analysis, radiostrontium by beta counting, and for gross alpha radioactivity by alpha counting. 9

Gross beta activity was detected in each weekly airborne particulate sample collected in 1984. The concentration of gross beta activity in the samples collected from the indicator locations ranged from 0.008 to 0.108 pCi/m<sup>3</sup>, with an average concentration of 0.020 pCi/m<sup>3</sup> of air. The concentration of gross beta activity in the samples from Huntington Beach, however, ranged from 0.010 to 0.051 pCi/m<sup>3</sup>, with an average concentration of 0.020 pCi/m<sup>3</sup> of air. See Figures 5, 6, 7, and 8.

Beryllium-7 was the only gamma-emitting radionuclide detected in each quarterly composite airborne particulate sample from both indicator and control locations. The concentrations of beryllium-7 in the samples from the indicator locations ranged from 0.061 to 0.130 pCi/m<sup>3</sup>, with an average concentration of 0.088 pCi/m<sup>3</sup> of air. The concentration of beryllium-7 in the samples from the control location ranged from 0.069 to 0.106 pCi/m<sup>3</sup>, with an average concentration of 0.088 pCi/m<sup>3</sup> of sample.

Other than beryllium-7, cesium-134 and cesium-137 were the only other gamma-emitters detected in any of the quarterly composite samples. These two radionuclides were seen in composite samples collected from Huntington Beach during the last two quarters of 1984. The concentrations of cesium-134 in the composite samples for the third and fourth quarters were determined to be 0.008 and 0.002  $pCi/m^3$ , respectively. The concentration of cesium-137 in the composite samples for the third and fourth quarters were 0.021 and 0.005  $pCi/m^3$ , respectively.

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. Gross alpha radioactivity, however, was detected in each composite sample from the first and third quarters, 6 composite samples from the second quarter (i.e., 5 from indicator locations, and 1 from Huntington Beach), and 1 composite sample from the fourth quarter (i.e., from the Northeast Site Boundary). The concentration of gross alpha radioactivity in the samples from the indicator locations ranged from non-detectable to 0.005 pCi/m<sup>3</sup>, with an average concentration of 0.002 pCi/m<sup>3</sup> of air. The concentration of gross alpha radioactivity in the samples from the control location were comparable, ranging from non-detectable to 0.002 pCi/m<sup>3</sup>, with an average concentration of 0.002 pCi/m<sup>3</sup> of air.

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The impact of SONGS on this environmental medium was minimal.

#### E. AIRBORNE RADIOIODINE

Weekly air radioiodine samples were collected by adsorption on charcoal cartridges from eight locations in the vicinity of SONGS, and from a control location situated in Huntington Beach. By the end of 1984, a total of 464 air cartridges had been analyzed for their iodine-131 content.

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No iodine-131 was detected in any offsite sample. Two samples, located onsite as the SONGS Meteorological Tower and the NE Site Boundary (a misnomer) did show detectable levels of iodine-131 during the periods ending April 3, 1984, and May 8, 1984. The concentrations of iodine-131 in these samples were 0.08, and 0.11 pCi/g, respectively.

#### F. LOCAL CROPS

Representative leafy and fleshy crops were collected semi-annually from San Clemente Farms (which served as the indicator location) and from gardens situated South-east of Oceanside (which served as the control station). After collection, the edible portion of the samples was analyzed quantitatively for a total of 12 gamma-emitting radionuclides including cesium-137 and iodine -131 via gamma-spectral analysis, as well as for tritium and radiostrontium by beta counting. The results of the analyses are summarized below for wet sample weights.

During 1984, two sets of tomatoes and cucumbers were collected from the San Clemente Farms. Upon analysis, only two radionuclides were detected in the samples, namely: potassium-40 and organically bound tritium. Potassium-40 was detected in each of the samples. The concentration of potassium-40 in these samples ranged from 1.5 to 2.2 pCi/gm of sample, with an average concentration of 1.8 pCi/gm of sample. Bound tritium, on the other hand, was only detected in the cucumbers and tomatoes collected in the first semiannual sampling period. The concentrations of bound tritium in these samples were 0.40 and 0.52 pCi/gm of sample, respectively.

The crops collected from the control location included green beans and tomatoes for the first semiannual sampling, and kale and tomatoes for the second semiannual sampling. Potassium-40 was detected in each of the samples. The concentration of potassium-40 in the samples ranged from 0.95 to 2.0 pCi/gm of sample, with an average concentration of 1.61 pCi/gm of sample. Bound tritium, on the other hand, was only detected in tomatoes and green beans collected during the first semi-annual sampling period. The concentrations of bound tritium in these samples were 0.5 and 2.1 pCi/gm of sample, in that order.

For each of the sampling periods, the radionuclide concentrations observed at the indicator locations were commensurate with data obtained from the control location, indicating that the operation of San Onofre had no detectable impact on this environmental medium. Although only environmental levels of radioactivity were detected in the samples, dose commitments to the maximum individual were performed for reference according the method outlined in Regulatory Guide 1.109. The dose commitment to the maximum person was determined to be approximately 2.0K-5 mrem per year.

#### G. NON-MIGRATORY MARINE SPECIES PART A. Analysis of Flesh

Fish, crustacea, and mollusks were collected quarterly by each of the Station discharge outfalls, and from a control location in Newport Beach, to determine the amount of radioactivity that could be consumed by man or in the food chain to man. Upon collection, the flesh portion of each sample was analyzed for three naturally occurring radionuclides including potassium-40, radium-226, and thorium-228. The samples were also analyzed for 16 Station-related, gamma-emitting radionuclides including cobalt-58, cobalt-60, silver-110m, and cesium-137. Finally, each sample was analyzed for aqueous and bound tritium, by beta counting. The results of these analyses are summarized below for wet sample weights.

SONGS Unit 1, Sheepshead:

Sheepshead (fish) were collected quarterly during 1984 near the SONGS Unit 1 outfall. Upon analysis, naturally-occuring radium-226 and thorium-228 were not detected in any of the samples. Potassium-40, however, was detected in each set of samples. The concentrations of potassium-40 in these samples ranged from 2.8 to 4.3 pCi/g, averaging 3.4 pCi/g of sample.

Plant-related radionuclides detected in Sheepshead included organically-bound tritium, cobalt-60, cesium-134, and cesium-137. Organically-bound tritium was found in a samples collected during the second quarter at a concentration of 3.8 pCi/g of sample. Cesium-134 was detected in a sample from the first quarter at a concentration of 0.006 pCi/g of sample. Cobalt-60 was observed in samples in the first, third, and fourth quarters at concentrations of 0.007, 0.27, and 0.016 pCi/g of sample, in that order. Finally, cesium-137 was detected in samples from each quarter. The concentrations of cesium-137 in the samples ranged from 0.0026 to 0.059 pCi/g, averaging 0.023 pCi/g of sample.

The potassium-40 levels seen in Sheephead at the SONGS Unit 1 outfall were commensurate with the levels seen at the north control. Organically-bound tritium, cobalt-58, cobalt-60, cesium-134, and cesium-137 levels detected in Sheephead at the SONGS Unit 1 Outfall were commensurate with or higher than the concentrations measured in Sheesphead in Newport Beach. Figures 9, and 10 compare the levels of cobalt-60 and cesium-137 observed in Sheepshead collected near the SONGS Unit 1 outfall to the concentrations seen in Sheepshead collected near Newport Beach.

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These data indicate that the Station had detectable impact on the surrounding environment in 1984.

SONGS Unit 1, Black Perch:

Black Perch (fish) were collected quarterly near the SONGS Unit 1

outfall. Upon analysis, potassium-40 was detected in perch samples from all four quarters. The concentrations of potassium-40 in these samples ranged from 2.3 to 3.6 pCi/g, averaging 3.0 pCi/g of sample. However, no radium-226 or thorium-228 were seen in any of the samples.

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Plant-related radionuclides detected in Black Perch included organically-bound tritium, cobalt-60, and cesium-137. Bound tritium was found in samples from the second quarter at a concentration of 5.0 pCi/g of sample. Cobalt-60 was detected in samples from the fourth quarter at a concentration of 0.010 pCi/g of sample. Cesium-137 was observed in samples from all four quarters. The concentrations of cesium-137 seen in the samples ranged from 0.0024 to 0.039 pCi/g of sample, averaging 0.014 pCi/g of sample.

The potassium-40 levels seen in Black Perch at the SONGS Unit 1 outfall were commensurate with the levels seen at the north control. Organically-bound tritium, cobalt-60, and cesium-137 levels detected in the Black Perch at the SONGS Unit 1 Outfall were commensurate to or higher than the concentrations measured in Black Perch from Newport Beach. Figures 11, and 12 compare the levels of cobalt-60 and cesium-137 observed in Black Perch collected near the SONGS Unit 1 outfall to those seen in Black Perch collected near Newport Beach.

These data indicate that the Station had detectable impact on the surrounding environment in 1984.

SONGS Unit 1, Crustacea:

Spiny Lobster were collected quarterly near the SONGS Unit 1 outfall. Upon analysis, potassium-40 was the only naturally-occurring radionuclide detected in the samples. The concentrations of potassium-40 in the four sample sets ranged from 0.92 to 3.6 pCi/g, averaging 2.2 pCi/g of sample.

Plant-related radionuclides detected in crustacea included aqueous tritium, cobalt-58, cobalt-60, silver-110m, and cesium-137. Aqueous tritium was found in samples from the first quarter at a concentration of 0.08 pCi/g of sample. Cobalt-58 was also detected in crustaeae collected during the first quarter at a concentration of 0.023 pCi/g of sample. Silver-110m was detected in samples from the first and third quarters at concentrations of 0.016 and 0.0072 pCi/g of sample, respectively. Cesium-137 was detected in samples from the first and third quarters at concentrations of 0.008 and 0.0072 pCi/g of sample, in that order. Cobalt-60 was observed in samples from all four quarters. The concentrations of cobalt-60 in these samples ranged from 0.019 to 0.152 pCi/g of sample, averaging 0.081 pCi/g of sample.

The potassium-40 levels seen in crustacea at the SONGS Unit 1 outfall

were commensurate with the levels seen in crustacea from Newport Beach. Aqueous tritium, cobalt-58, cobalt-60, silver-110m, and cesium-137 levels detected in crustaceae samples at the SONGS Unit 1 outfall were commensurate to or higher than the concentrations measured in crustacea from Newport Beach. Figures 13, 14, 15, and 16 compare the levels of cobalt-58, cobalt-60, silver-110m, and cesium-137 observed in crustacea collected near the SONGS Unit 1 outfall to the same radionuclide concentrations seen in crustacea collected near Newport Beach.

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These data indicate that the Station had detectable impact on the surrounding environment in 1984.

SONGS Unit 1, Mollusks:

Sea Hare were collected near the SONGS Unit 1 outfall during each quarter in 1984. Upon analysis, three naturally-occurring radionuclides-- potassium-40, radium-226, and thorium-228-- were detected in varying amounts in samples from each quarter. The concentrations of potassium-40 in these samples ranged from 1.20 to 2.2 pCi/g, averaging 1.7 pCi/g of sample. The concentrations of radium-226 in the samples ranged from 0.023 to 0.07 pCi/g, averaging 0.04 pCi/g of sample. The concentrations of thorium-228 in the samples ranged from 0.031 to 0.46 pCi/g, averaging 0.18 pCi/g of sample.

Station-related radionuclides detected in the Sea Hare included organically-bound tritium, cobalt-58, cobalt-60, and cesium-137. Organically-bound tritium was found in samples from the first quarter at a concentration of 0.9 pCi/g of sample. Cesium-137 was detected in samples from the first quarter at a concentration of 0.0028 pCi/g of sample. Cobalt-58, on the other hand, was observed in samples from the first and third quarters both at concentrations of 0.012 pCi/g of sample. Cobalt-60 was observed in each set of samples. The concentrations of cobalt-60 in these samples ranged from 0.134 to a high of 0.60 pCi/g, averaging 0.29 pCi/g of sample.

The potassium-40 levels seen in mollusks collected near the SONGS Unit 1 outfall were commensurate with the levels seen in samples from the Newport Beach. However, the radium-226 and thorium-228 concentrations in mollusks collected near the SONGS Unit 1 Outfall were higher than those measured in mollusks from Newport Beach. The levels of organically-bound tritium, cobalt-58, cobalt-60, and cesium-137 levels detected in mollusks in the vicinity of the SONGS Unit 1 Outfall were detectably higher than the concentrations measured in mollusks from Newport Beach. Figures 17, 18, and 19 compare the levels of cobalt-58, cobalt-60, and cesium-137 observed in mollusks collected near the SONGS Unit 1 outfall to the concentrations seen in mollusks collected near Newport Beach.

These data indicate that the Station had detectable impact on the surrounding environment in 1984.

#### SONGS Units 2 and 3, Sheepshead:

Sheepshead (fish) were collected near the SONGS Units 2 and 3 outfalls during each quarter of 1984. Upon analysis, potassium-40 was the only naturally-occurring radionuclide detected in Sheepshead. The concentration of potassium-40 in these samples ranged from 2.4 to 3.4 pCi/g, averaging 3.1 pCi/g of sample.

Cesium-137 was the only plant-related radionuclide detected in the samples. Cesium-137 was observed in samples from the first, second, and fourth quarters at concentrations of 0.015, 0.010, and 0.0064 pCi/g of sample.

The levels of potassium-40 seen in Sheepshead at the SONGS Units 2 and 3 outfall were commensurate with the levels seen at the north control. Cesium-137 concentrations in samples from the SONGS Units 2 and 3 Outfall, on the other hand, were commensurate with or greater than the levels of cesium-137 measured in samples from Newport Beach. See Figure 20.

These data indicate that the operations of SONGS had a detectable impact on this environmental medium.

SONGS Units 2 and 3, Black Perch:

Black Perch and barred sand bass (fish) were collected near the SONGS Units 2 and 3 outfalls during each quarter in 1984. Upon analysis, potassium-40 was the only naturally-occurring radionuclide detected in each set of samples. The concentration of potassium-40 in these samples ranged from 2.4 to 2.7 pCi/g, averaging 2.7 pCi/g of sample.

Plant-related radionuclides detected in these samples included aqueous tritium, cobalt-60, and cesium-137. Aqueous tritium and cobalt-60 were found in samples from the first quarter at concentrations of 0.04, and 0.002 pCi/g of sample, respectively. Cesium-137 was observed in samples from all four quarters. The concentrations of cesium-137 in the samples ranged from 0.002 to 0.006 pCi/g of sample, averaging 0.004 pCi/g of sample.

The levels of potassium-40 seen in Black Perch at the SONGS Units 2 and 3 outfall were commensurate with the levels seen in samples collected from the north control. Aqueous tritium, cobalt-60, and cesium-137 concentrations seen in perch samples from the SONGS Units 2 and 3 Outfall, on the other hand, were either commensurate with or greater than the levels of cesium-137 measured in samples from Newport Beach. See Figures 21, and 22.

These data indicate that the operations of SONGS had a detectable effect on this environmental medium.

#### SONGS Units 2 and 3, Crustacea:

Spiny Lobster (crustacea) were collected near the SONGS Units 2 and 3 outfall during each quarter in 1984. Upon analysis, potassium-40 was the only naturally-occurring radionuclide detected in the samples. The concentration of potassium-40 in these samples ranged from 0.74 to 3.3 pCi/g, averaging 2.5 pCi/g of sample.

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Plant-related radionuclides detected in spiny lobster included aqueous and organically-bound tritium, cobalt-60, silver-110m, and cesium-137. Aqueous tritium, organically-bound tritium, and cesium-137 were detected samples collected during the first quarter. The concentrations of these radionuclides were determined to be 0.05, 2.2, and 0.008 pCi/g of sample, respectively. Silver-110m was observed in samples from the first two quarters at concentrations of 0.008 and 0.007 pCi/g of sample, in that order. Cobalt-60 was detected in samples from the first, third, and fourth quarters at concentrations of 0.013, 0.024, and 0.079 pCi/g of sample, respectively.

The levels of potassium-40 seen in crustacea at the SONGS Units 2 and 3 outfall were commensurate with the levels seen in samples from the control location. Cesium-137 and organically-bound tritium were detected <u>less</u> frequently in samples from the SONGS 2 and 3 outfall than in samples from Newport Beach. Concentrations of cobalt-60 and silver-110m seen in crustacea samples from the SONGS Units 2 and 3 Outfall, on the other hand, were greater than the levels of cesium-137 measured in samples from Newport Beach. See Figures 23, 24, and 25.

These data indicate that the operation of SONGS had a detectable impact on this environmental medium.

SONGS Units 2 and 3, Mollusks:

Bay mussel and octopus were collected near the SONGS Units 2 and 3 outfalls during each quarter in 1984. Upon analysis, only one naturally-occurring radionuclide, potassium-40, was detected in each set of quarterly samples. The concentration of potassium-40 in these samples ranged from 0.86 to 2.6 pCi/g, averaging 1.7 pCi/g of sample.

Plant-related radionuclides detected in the mollusks included organically-bound tritium, manganese-54, cobalt-58, cobalt-60, and cesium-137. Manganese-54 was found in mollusks collected during the first quarter at a concentration of 0.003 pCi/g of sample. Both organically-bound tritium and cesium-137 were detected in samples during the first two quarters. The concentrations of bound tritium in these samples was determined to be 0.7 and 1.2 pCi/g of sample, respectively. The concentrations of cesium-137 in the samples were determined to be 0.0045 and 0.0027 pCi/g of sample, in that order. Cobalt-58 and cobalt-60 were detected in samples from all four quarters. The concentrations of cobalt-58 in the samples ranged from 0.010 to 0.05, averaging 0.024 pCi/g of sample. The concentrations of cobalt-60 in these samples ranged from 0.028 to 0.155 pCi/g, averaging 0.072 pCi/g of sample.

The levels of potassium-40 seen in mollusks at the SONGS Units 2 and 3 outfall were commensurate with the levels seen in samples from the control location. Concentrations of Station-related radionuclides seen in mollusks from the SONGS Units 2 and 3 Outfall were commensurate with or greater than the levels of the same radionuclides measured in samples from Newport Beach. See Figures 26, 27, 28, and 29.

These data indicate that the operation of SONGS had a detectable impact on this environmental medium.

#### G. <u>NON-MIGRATORY MARINE SPECIES</u> PART B. Analysis of Shell and Bone

To determine if there is any buildup of radionuclides in this environmental medium, fish, crustacea, and mollusks were collected quarterly by each of the Station discharge outfalls, and from a control location near Newport Beach. Afterwards, the bone portion of each marine animal was analyzed for three naturally-occurring radionuclides including potassium-40, radium-226, and thorium-228. The samples were also analyzed for 16 Station-related, gamma-emitting radionuclides including cobalt-58, cobalt-60, silver-110m, and cesium-137. Finally, each sample was analyzed for strontium-90. The results of these analyses are summarized below for wet sample weights.

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SONGS Unit 1, Sheepshead:

Sheepshead (fish) were collected near SONGS 1 during each quarter of 1984. Upon analysis, two radionuclides were detected in the bones of the fish, namely: potassium-40, and cobalt-60. Potassium-40 was detected in each set of samples. The concentrations of potassium-40 in the samples ranged from 0.18 to 1.6 pCi/g, with an average concentration of 0.7 pCi/g of sample.

Cobalt-60 was the only plant-related radionuclide detected in the Sheephead. Cobalt-60 was observed in samples from the third and fourth quarters. The concentration of cobalt-60 in the samples was 0.13, and 0.03 pCi/g of sample.

The levels of potassium-40 detected in the sheephead samples from the Unit 1 outfall were comparable to the concentrations of potassium-40 measured in Sheephead from Newport Beach. Levels of cobalt-60 samples from SONGS Unit 1 were commensurate to or greater than the concentrations of cobalt-60 in the samples collected from the vicinity of Newport Beach. See Figure 30.

These results indicate that the operations of SONGS had a detectable impact on this environmental medium.

SONGS Unit 1, Black Perch:

Black Perch (fish) were collected near the SONGS Unit 1 outfall during each quarter in 1984. Upon analysis, potassium-40 was the only radionuclide detected in the bone portion of the samples. The concentration of potassium-40 in the four quarterly samples ranged from 0.5 to 1.5 pCi/g, averaging 1.0 pCi/g of sample.

The concentrations of potassium-40 detected in the bones of the Black Perch were commensurate with the levels seen in samples from Newport Beach. Since no plant related radionuclides were detected in the bones, it was concluded that the impact of SONGS operations was negligible on this environmental medium.

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SONGS Unit 1, Crustacea:

Spiny Lobster (crustacea) were collected near the SONGS Unit 1 outfall during each quarter in 1984. Upon analysis, potassium-40 was the only naturally-occurring radionuclide detected in the samples. The concentrations of potassium-40 in the four sample sets ranged from 1.2 to 2.5 pCi/g, averaging 1.8 pCi/g of sample.

One plant-related radionuclide, cobalt-60, was detected in the shell portion of the crustaceae. Cobalt-60 was observed in samples collected throughout the year. The concentrations of cobalt-60 in these samples ranged from 0.043 to 0.158 pCi/g of sample, averaging 0.095 pCi/g of sample.

The concentrations of potassium-40 in the samples collected from the SONGS Unit 1 outfall were commensurate with those seen in crustacea collected near Newport Beach. Cobalt-60, however, was detectable in each set of samples from the SONGS Unit 1 outfall, where it was consistently below detection limits in samples collected from Newport Beach. See Figure 31.

These results indicate that the operations of SONGS had a detectable impact on this environmental medium.

SONGS Unit 1, Mollusks:

Sea Hare were collected from SONGS Unit 1 throughout the year. Since Sea Hare do not possess any bones, these analyses are not applicable.

SONGS Units 2 and 3, Sheepshead:

Sheepshead (fish) were collected near the SONGS Units 2 and 3 outfalls on a quarterly basis during 1984. Upon analysis, potassium-40 was the only radionuclide detected in the bone portion of the Sheephead. The concentrations of potassium-40 in the four quarterly samples ranged from 0.5 to 1.4 pCi/g, with an average concentration of 0.88 pCi/g of sample.

The concentrations of potassium-40 measured in the sheepshead from the control location were commensurate with potassium-40 levels seen in Sheepshead collected near Newport Beach.

Since no Station-related radionucides were detected in the bone portions of the Sheepshead, it was concluded that Station operations had no detectable impact on Sheepshead near SONGS.

SONGS Units 2 and 3, Black Perch:

Black Perch and barred sand bass (fish) were collected near the SONGS

Units 2 and 3 outfalls during each quarter in 1984. Upon analysis, potassium-40 was the only radionuclide detected in the samples. The concentrations of potassium-40 in these samples ranged from 0.3 to 1.53 pCi/g, averaging 0.7 pCi/g of sample.

The concentrations of potassium-40 measured in Black Perch from the control location were commensurate with potassium-40 levels seen in Black perch collected from Newport Beach.

Since no Station-related radionucides were detected in the bone portions of the Black Perch, it was concluded that Station operations no detectable impact on Sheepshead near SONGS.

SONGS Units 2 and 3, Crustacea:

Spiny Lobster (crustacea) were collected on a quarterly basis near the SONGS Unit 1 outfall throughout 1984. Upon analysis, potassium-40 was the only naturally-occurring radionuclide detected in the samples. The concentrations of potassium-40 in these samples ranged from 0.23 to 1.81 pCi/g, averaging 1.7 pCi/g of sample.

Plant-related radionuclides detected in spiny lobster included cobalt-58, cobalt-60, and silver-110m. Cobalt-58 and silver-110m were detected in samples from the first quarter at concentrations of 0.016 and 0.007 pCi/g of sample. Cobalt-60, on the other hand, was detected in samples from the first, second, and fourth quarters at concentrations of 0.013, 0.04, and 0.154 pCi/g of sample, respectively.

The levels of potassium-40 measured in the samples from SONGS Units 2 and 3 were commensurate with those seen in samples collected from the control location. Concentrations of cobalt-58, cobalt-60, and silver-110m, however, were detectable in each set of samples from the SONGS Unit 1 outfall, where these same radionuclides were consistently below detection limits in samples collected from Newport Beach. See Figures 32, 33, and 34.

These data indicate that SONGS operations had a detectable impact on this environmental medium.

SONGS Units 2 and 3, Mollusks:

Bay mussel and octopus were collected near the SONGS Units 2 and 3 outfalls during each quarter in 1984. Upon analysis, only one naturally-occurring radionuclide, potassium-40, was detected in the shell of the bay mussel. (Octopuses do not possess bones or shells). The concentrations of potassium-40 in the bay mussels ranged from 0.1 to 0.29 pCi/g, averaging 0.2 pCi/g of sample.

Cobalt-60 was the only plant-related radionuclide detected in any of the samples. Cobalt-60 was detected in samples from the first and

third quarters at concentrations of 0.05 and 0.02 pCi/g of sample, respectively.

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Both potassium-40 an cobalt-60 were detected in concentrations greater than those measured samples collected near Newport Beach. See Figure 35.

These data indicate that the operations of SONGS had a detectable impact on this environmental medium.

#### H. KELP SAMPLING

Kelp was collected semiannually from the San Onofre and San Mateo Kelp Beds, as well as from a kelp bed in Newport Beach. No samples were collected from the Barn Kelp bed due to its unharvestable condition. Upon collection, the samples were analyzed by gamma-spectral analysis for 19 different station and non-station related radionuclides. The samples were also analyzed for both aqueous and bound tritium. By the end of the year, potassium-40, cobalt-58, cobalt-60, iodine-131, and cesium-137, as well as bound tritium, had been detected in one or more of the samples. The results of these analyses are summarized below in terms of wet sample weights.

Potassium-40 was detected in each semiannual sample. The concentration of potassium-40 in the samples from the indicator locations ranged from 3.3 to 6.5 pCi/gm, with an average concentration of 5.0 pCi/gm of sample. The concentration of potassium-40 in the samples from the control location were similar. Here, the concentration of potassium-40 ranged from 5.6 to 6.9 pCi/gm, with an average concentration of 6.3 pCi/gm of sample.

Iodine-131 was also detected in each of the kelp samples. The concentration of iodine-131 in the samples from the indicator locations ranged from 0.016 to 0.22 pCi/gm, with an average concentration of 0.1 pCi/gm of sample. The concentration of iodine-131 in the samples from the control location were significantly lower. Here, the concentration of iodine-131 ranged from 0.009 to 0.012 pCi/gm, with an average concentration of 0.011 pCi/gm of sample.

Cesium-137 was detected in each sample collected from the indicator locations, and in one sample collected from the control location. The concentration of cesium-137 in the samples from the indicator locations ranged from 0.0033 to 0.0053 pCi/gm, with an average concentration of 0.0045 pCi/gm of sample. The concentration of cesium-137 in the first semiannual kelp sample from the control location was 0.0023 pCi/gm of sample. No cesium-137 was detected in the second semiannual sample collected from the control location.

Cobalt-60 was present in three out of four samples from the indicator locations, but was not detectable in the samples from the control location. The concentration of cobalt-60 in the samples from the indicator locations ranged from 0.014 to 0.056 pCi/gm, with an average concentration of 0.028 pCi/gm of sample.

Cobalt-58 was detectable in the semiannual samples from the San Onofre Kelp Bed, but was not seen in samples from either the San Mateo Kelp Bed or the control location. The concentration of cobalt-58 in the samples from the San Onofre kelp Bed ranged from 0.007 to 0.008 pCi/gm, with an average concentration of 0.008 pCi/gm of sample. Finally, no aqueous tritium was found in any of the samples, and bound tritium was only found in the first semiannual sample from the control location. The concentration of bound tritium in this sample was determined to be 1.8 pCi/gm of sample.

Potassium-40 is a naturally-occuring radionuclide, which is not produced by Station operations. The cobalt-58, cobalt-60, iodine-131, and cesium-137 seen in samples from the indicator locations are most likely attributable to Station operations, considering differences in radionuclide concentrations between indicator and control locations, and potential sources of these radionuclides in the environment.

Because kelp from the San Onofre and San Mateo Kelp Beds was not harvested for commercial uses in 1984, the radioactivity detected in the kelp samples is not in the the critical dose pathway to man. In light of this, the dose commitment to members of the public during 1984 was negligible.

#### I. DRINKING WATER

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 12 naturally-occurring and Station-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 concentrations. 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 concentrations, as well as for tritium.

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The results of the monthly drinking water analyses were similar for both indicator and control locations. Throughout the year, neither gamma-emitting radionuclides nor tritium were detected in any of the unfiltered samples, nor was any alpha radioactivity detected in either the residue or filtrate of the filtered samples. Gross beta activity, however, was detectable in both the drinking water solids and filtrate of each of the samples. The gross beta activity in the drinking water solids from the indicator locations ranged from a low of 0.2 pCi/l to a high of 1.6 pCi/l of water, with an average concentration of 0.73 pCi/l of water. The concentration of gross beta activity in the drinking water solids from the control location in Huntington Beach was comparable. In this case, the gross beta activity ranged from 0.4 to 1.3 pCi/l, with an average concentration of 0.7 pCi/l of water. The concentration of gross beta activity in the filtrate was higher for both the indicator and control locations. The concentration of gross beta activity in the filtrates from the indicator locations ranged from 8 to 19 pCi/l, with an average concentration of 12.8 pCi/l of water. In contrast, the concentration of gross beta activity ranged from 4 to 12 pCi/l of water, with an average concentration of 8 pCi/l of water.

The results of the analyses of the <u>quarterly</u> composite samples for gross alpha and gross beta activities were similar. No gross alpha radioactivity was detected in any of the suspended solids, and no tritium or gross beta activity was detected in any of the filtrates. However, as in the monthly analyses, gross beta activity was detected in both the filtrates and the suspended solids. The concentration of gross beta activity in the suspended solids from the indicator locations ranged from 0.2 to 0.9 pCi/l with an average concentration of 0.5 pCi/l of water. The concentration of gross beta activity in the suspended solids from the control location ranged from 0.2 to 0.8 pCi/l, with an average concentration of 0.6 pCi/l of water.

The gross beta activity in the filtrates from the all locations was higher than the activities detected in the suspended solids. The concentration of gross beta activities in the filtrates from the indicator locations ranged from 11 to 18 pCi/l, with an average concentration of 13 pCi/l of water. The concentration of gross beta activities in the filtrates from the control locations, on the other hand, ranged from 4 to 10 pCi/l, with an average concentration of 7 pCi/l of water.

None of the radioactivity measured in either the monthly or quarterly drinking water samples can be attributed to the operations of SONGS since liquid effluents are released solely into the ocean, and not into potential sources of public drinking water. The significant difference in activity between indicator and control locations, therefore, must be attributable to variability in natural environmental levels.

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#### J. OCEAN WATER

Ocean water samples were collected on a monthly basis from the vicinity of each of the Station discharge outfalls, and from a control location situated in Newport Beach. Upon collection, each of the samples was analyzed for 19 naturally-occuring and Station-related, gamma-emitting radionuclides. Every other month, the samples were also analyzed for gross beta activity. Finally, samples composited quarterly and semiannually were analyzed for tritium.

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Throughout 1984, potassium-40 was the only radionuclide detected in monthly gamma-spectral analyses of samples from both indicator and control locations. Potassium-40 also accounted for at least 99 percent of the detected gross beta activity in each of the samples. A summary of the results is presented in Table II-2. Finally, no tritium was observed in any of the composite ocean water samples.

Because virtually all of the observed radioactivity in each of the samples can be attributed to potassium-40 (which is a naturally-occuring, non-station related radionuclide), it was concluded that the operation of SONGS had negligible detectable impact on this environmental medium.

### TABLE II-2

#### OCEAN WATER DATA 1984

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#### PART A

### Radionuclides Detected in Monthly Gamma-spectral Analyses of Ocean Water Samples SONGS Outfalls and Control Location

Radionucl	<u>ide</u>	Location	Conc. Range (pCi/l)	Ave. Conc. _(pCi/l)
Potassium	-40	SONGS 1	29 <b>0-380</b>	317
	11	SONGS 2	28 <b>0-380</b>	322
<b>**</b>	11	SONGS 3	29 <b>0-380</b>	325
**	11	Newport	280-330	310

#### PART B

Bimonthly Ocean Water Gross Beta Activity

		Activi	ty					
<u>Date</u>		(pCi/	1)		SONGS 1	SONGS 2	SONGS_3	Newport
1/5/84	G.	Beta			78 <b>0</b>	780	870	79 <b>0</b>
1/5/84	G.	Beta	less	K-40	0	0	6	. 0
3/9/84	G.	Beta			8 <b>80</b>	89 <b>0</b>	1120	8 <b>40</b>
3/9/84	G.	Beta	less	K-40	0	0	0	<u> </u> 0
5/7/84	G.	Beta			1130	1170	1120°	970
5/7/84	G.	Beta	less	K-40	6	0	4	0
7/9/84	G.	Beta			84 <b>0</b>	720	700	730
7/9/84	G.	Beta	less	K-40	0	0 .	0	· · · 0
9/10/84	G.	Beta			6 <b>80</b>	720	720	69 <b>0</b>
9/10/84	G.	Beta	less	K-40	0	0	0.	. 0
11/5/84	G.	Beta			6 <b>20</b>	780	770	620
11/5/84	G.	Beta	less	K-40	0	0	0	0

YEARLY AVERAGES				
G. Beta	822	843	883	773
G. Beta less K-40	0	2	0	.1
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Abbreviations: (1) G., gross ; K-40, chemical notation for potassium-40.

#### K. RABBIT SAMPLING

An adult rabbit was collected semiannually from within a two mile distance east of SONGS Unit 1. Upon collection, the flesh portion of each rabbit was analyzed for a total of twelve gamma-emitting radionuclides, including cesium-137 and iodine-131. In addition, the thyroid gland was analyzed for iodine-131, and the femur was analyzed for strontium-89 and strontium-90. The results of these analyses were reported on a dry weight basis.

The results were similar for both of the rabbit samples. No iodine-131, or radiostrontium was found, respectively, in either the thyroid or bone portions of the rabbits, nor were any Station-related radionuclides detected in the flesh portions of the rabbits. The only radionuclide that was present in detectable amounts was potassium-40, a naturally-occurring radionuclide in the environment. The measured concentrations of potassium-40 in the two semiannual samples were 10.1 and 12.0 pCi/g of sample, respectively.

These results indicate that there has been no increase in the concentration of Station-related radionuclides in the rabbit population in the vicinity of SONGS during 1984, and that the impact of SONGS operations on this environmental medium is apparently negligible.

#### L. OCEAN BOTTOM SEDIMENTS

To determine the amount of radioactivity in ocean bottom sediments in the vicinity of the Station, representative samples were collected semiannually from areas near each of the Station discharge outfalls, and from Newport Beach, which served as a control location. After collection, the samples were analyzed by gamma-spectral analysis for a total of 19 naturally-occuring and Station-related radionuclides. By the end of the year, three radionuclides had been detected in the samples, namely: potassium-40, radium-226, and thorium-228. The results of these analyses are summarized below in terms of "as received" wet sample weights.

Potassium-40 was detectable in each sample. The concentration of potassium-40 in the samples from the indicator locations ranged from 8.8 to 16.8 pCi/gm, with an average concentration of 11.0 pCi/gm of sample. The concentration of potassium-40 in the samples from the control location ranged from 11.8 to 14.8 pCi/gm, with an average concentration of 13.3 pCi/gm of sample.

A smaller amount of radium was present in each of the samples. The concentration of radium-226 in the samples from the indicator locations ranged from 0.17 to 0.68 pCi/gm, with an average concentration of 0.37 pCi/gm of sample. The concentration of radium-226 in the samples from the control location were similar. Here, the concentration of radium-226 ranged from 0.13 to 0.50 pCi/gm, with an average concentration of 0.32 pCi/gm of sample.

Thorium-228 was present in each of the samples in about the same concentrations as radium-226. The concentration of thorium-228 in the samples from the indicator locations ranged from 0.21 to 0.90 pCi/gm, with an average concentration of 0.47 pCi/gm. The concentration of thorium-228 in the samples from the control location, on the other hand, ranged from a low of 0.19 to 0.79 pCi/gm, 0.49 pCi/gm of sample.

In addition to this, cobalt-60 was detected in the second semiannual sample from the west side of the SONGS Unit 1 Outfall. The concentration of cobalt-60 in this sample was determined to be 0.08 pCi/gm. No cobalt-60 was detected in the sample from the control location for that same period.

Three of the radionuclides, namely, potassium-40, radium-226, and thorium-228, are naturally-occuring in the environment and are not produced by Station operations. The presence of cobalt-60 in one of the samples, however, may be attributable to liquid effluent releases from the plant. Because cobalt-60 was detected in only one of the samples at "near" environmental levels, it was concluded that the operation of SONGS had minimal impact on this environmental medium.

#### M. CONCLUSIONS

Levels of radioactivity in environmental media depends 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.

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Radiological environmental data collected throughout 1984 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, (i.e., 1.25 times background levels for TLD direct radiation doses, and twice background levels for radionuclide concentrations).
- (2) Graphical examination of time-dependent variations of pertinent radioiostopes in selected environmental media throughout the year at both indicator and control locations.
- (3) Graphical comparison of gross beta radioactivity and specific long-lived gamma-emitters in various media in 1984 against the levels observed in pre-operational years.
- (4) Comparison of data against reportability levels contained in the plant Technical Specifications.
- (5) Projections of doses to members of the public resulting from radionuclides measured in known pathways.

In comparing these findings to the conservatively-define limits of the facility operating licenses, it is concluded that the radiological environmental impact of San Onofre Units 1, 2, and 3 operations through 1984 has been minimal. N. REFERENCES

- (1) Land Use Census for SONGS Unit 2 Radiological Environmental Monitoring Program, 1984.
- (2) ODCM, "Offsite Dose Calcuation Manual for SONGS Units 2/3," 1984.

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- (3) USNRC Draft Regulatory Guide 4.8, "Standard Format and Principal Content of Environmental Technical Specifications", December 1975.
- (4) USNRC Regulatory Guide 4.13, "Performance, Testing, and Procedural Specifications for Tthermoluminescent Dosimetry - Environmental Applications," 1977.
- (5) USNRC Regulatory Guide 4.15, "Qualtiy Assurance for Radiological Monitoring Programs", Rev. 1, February 1979.
- (6) SONGS Unit 1 Provisional Operating License, DPR-13, Appendix B, Section 3.2, effective prior to January 1, 1985.
- (7) SONGS Unit 2 Operating License NPF-10, Appendix A, Section 3/4.12.1.
- (8) SONGS Unit 3 Operating License NPF-15, Appendix A, Section 3/4.12.1.

## APPENDIX A

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## SAMPLE TYPE AND SAMPLE LOCATION

## RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS

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## Sample Type and Sampling Location

Direct Radiation	Distance	Direction
1 City of San Clemente (SDG&E Offices)	5.6	NW
2 Camp San Mateo	3.5	N
2 Camp San Matter	2.6	NE
4 Camp Horno	4.5	B
5 Camp Las Pulgas	8.5	ESE
6 Old Route 101 -ESE	3.0	ESE
7 Old Route 101 -ESE	0.5	ESE
8 Non-commissioned Officers Beach Club	1.2	NW
9 Basilone Road/ I-5 Freeway Offramp	2.0	NW
10 Bluff	0.8	NW
11 Visitor's Center	0.2	NNE
12 South Edge of the Switchyard	0.2	NB
13 Site Boundary	0.13	SE
14 Huntington Beach Generating Station	37.0	NW
15 RSE Site Boundary	0.2	ESE
16 East Site Boundary	0.5	E
17 Transit Dose	<b>-</b> ,	-
18 Transit Dose	<b>.</b>	-
19 San Clemente Highlands	5.0	NNW
20 San Clemente Pier	5.0	NW
21 Concordia Elementary School	3.5	NW
22 Coast Guard Station- San Mateo Point	2.7	WNW
23 San Clemente General Hospital	8.2	NW
24 San Clemente High School	6.0	NW
25 Convalescent Home- San Clemente	8.0	NW
26 Dana Hills High School	11.0	NW
27 U.S. Post Office- Dana Point	10.5	NW
28 Doheny Fire Station- Capistrano Beach	9.5	NW
29 San Juan Capistrano Fire Station	10.8	NW
30 Laguna Reach Fire Station	17.5	NW
31 Aurora Park- Mission Viejo	18.6	NNW
32 Santa Ana Police Department	32.0	NW
33 Camp Talega	5.7	N
34 San Onofre School	1.7	NW
35 Range 312 (Marine Corps Base, Camp Pen	dleton) 4.7	NNE
36 Range 208C (Marine Corps Base, Camp Pen	dleton) 4.0	NB
37 Laguna Niguel Fire Station	13.5	NW
38 San Onofre State Beach Park	3.6	SB
39 Basilone Road Trailer Park	1.4	NNW
40 SCE Training Center- Japanese Mesa	0.8	NW
41 Old Route 101- K	0.3	B
42 Horno Canyon	4.6	B

Distance (miles) and direction (sectors) are measured relative to the midpoint between Units 2 and 3.

## RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS

Sample Type and Sampling Location	Distance	Direction
Direct Radiation (Con't)	· .	
43 Edson Range (Marine Corps Base, Camp Pendleton)	10.6	SE
44 Fallbrook Fire Station	18.0	B
45 Interstate 5 Weigh Station	2.0	ESE
46 San Onofre Beach Park	1.4	SB
47 Camp Las Flores	8.6	SB
48 Mainside (Marine Corps Base, Camp Pendleton)	) 15.0	<b>BSB</b>
49 Camp Chappo	12.8	ESE
50 Oceanside Fire Station	15.5	SE
51 Carlsbad Fire Station	18.6	SE
52 Vista Fire Station	21.0	ESE
53 San Diego County Operations Center	45.0	SE
54 Escondido Fire Station	32.0	ES <b>E</b>
55 San Onofre State Beach (Unit 1)	0.2	W
56 San Onofre State Beach (Unit 1)	0.1	W
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	NW
Airborne		•
1 City of San Clemente (SDG&R Offices)	5.5	NW
2 Camp San Onofre (Camp Pendleton)	1.8	NR
3 Huntington Beach Generating Station	37.0	NW
4 Northeast Site Boundary	0.2	NNR
5 Unite 2 and 3 Switchward	0.13	RSR
6 SONGS Meteorlogical Tower	0.3	NW
9 State Reach Park	0.4	RSR
10 Bluff	0.5	WNW
11 Maga R O F	0.5	NNW
	0.0	
Soil Samples	 	
1 Camp San Onofre	2.5	NE
2 Old Route 101- SE	3.0	SE
3 Basilone/ I-5 Freeway Offramp	2.0	NW
4 Huntington Beach Generating Station	37.0	NW
5 Bast Site Boundary	0.2	NNW
Ocean Water		
		, ,
A Station Discharge Outfall- Unit 1	0.5	SW
B Station Discharge Outfall- Unit 2	0.7	SW
C Station Discharge Outfall- Unit 3	0.7	SW
D Newport Beach	30.0	NW

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A-3

## RADIOLOGICAL ENVIRONMENTAL MONITORING SAMPLE LOCATIONS

Sa	mple Type and Sampling	Location D	istance	Direction
Dr	inking Water	•	• • •	
1	Tri-Cities Municipal W	ater District Reservoir	8.7	NW
. 2	San Clemente Golf Cour	se Well	3.5	NNW
3	Huntington Beach		37.0	NW
Sh	oreline Sediment			
1	San Onofre State Beach	, ,	0.6	SE
2	San Onofre Surfing Bea	ich i i i i i i i i i i i i i i i i i i	0.9	NW
3	San Onofre State Beach	<b>i</b>	3.5	S <b>B</b>
4	Newport Beach (North e	nd)	30.0	NW
Lo	cal Crops		•	
,	Car Makaa Carnar	· · · ·	26	NM
L	San Mateo Canyon		22.0	SR
Z	SK OI UCEANSIGE		22.V	
No	n-migratory Marine Anim	als		
A	Unit 1 Outfall	•	0.6	WSW
В	Units 2 and 3 Outfall		0.7	SSW
C	Newport Beach		30.0	NW
Ke	lp			
A	San Onofre Kelp Bed		1.5	S
- B	San Mateo Kelp Bed		3.5	WNW
c	Barn Kelp Bed **		6.6	SSB
D	Newport Beach		30.0	NW
00	ean Bottom Sediments			
<b>A</b>	Unit 1 Outfall		0.5	SW
B	Unit 1 Outfell	· · · · · · · · · · · · · · · · · · ·	0.6	SW
С	Unit 2 Outfall		1.3	SW
D	Unit 3 Outfall		0.9	SSW
B	Newport Beach		30.0	NW
-				· .
Re	bbit Sampling	ά. 		
1	Adult Rabbit		0.5	B

\*\* Samples were not obtained from the Barn Kelp Bed because it is in a non-harvestable condition.