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REPORT
TO
IOWA ELECTRIC LIGHT & POWER COMPANY
CEDAR RAPIDS, IOWA

# RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)
FOR THE
DUANE ARNOLD ENERGY CENTER
CEDAR RAPIDS, IOWA
DOCKET NO. 50-331

ANNUAL REPORT - PART I
SUMMARY AND INTERPRETATION
JANUARY - DECEMBER 1993

FOR SUBMITTAL TO
THE NUCLEAR REGULATORY COMMISSION

PREPARED AND SUBMITTED
BY
TELEDYNE ISOTOPES MIDWEST LABORATORY
PROJECT NO. 8001

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General Manager

# PREFACE

The staff members of the Teledyne Isotopes Midwest Laboratory were responsible for the acquisition of data presented in this report with the exception of Appendices D and E which were completed by Iowa Electric personnel. All environmental samples, with the exception of aquatic, were collected by personnel of DAEC. Aquatic samples were collected by University of Iowa Hygenic Laboratory personnel.

The report was prepared by L. G. Huebner, General Manager of the TIML, with the exception of Appendices D and E, which were prepared by Iowa Electric personnel. He was assisted in the report preparation by other staff members of the laboratory.

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# 1.0 INTRODUCTION

This report summarizes and interprets results of the Environmental Radiological Monitoring Program conducted by Teledyne Isotopes Midwest Laboratory at the Duane Arnold Energy Center, Cedar Rapids, Iowa, during the period January - December 1993. This Program monitors the levels of radioactivity in the air, terrestrial, and aquatic environments in order to assess the impact of the Plant on its surroundings.

Tabulation of the individual analyses made during the year are included in Part II of this report.

Duane Arnold Energy Center (DAEC) is located in Linn County on the Cedar River, Iowa, and is operated by Iowa Electric Light and Power Company. The Duane Arnold Energy Center is a 565.7 MW(e) boiling water reactor. Initial criticality was attained on 23 March 1974. The reactor reached 100% power on 12 August 1974. Commercial operation began on 1 February 1975.

## 2.0 SUMMARY

The Environmental Radiological Monitoring Program required by the U.S. Nuclear Regulatory Commission (NRC) Technical Specifications for the Duane Arnold Energy Center is described. Results for 1993 are summarized and discussed.

Program findings show background levels of radioactivity in the environmental samples collected in the vicinity of the Duane Arnold Energy Center. No effect on the environment due to the operation of the Duane Arnold Energy Center is indicated.

## 3.0 ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM

### 3.1 Program Design and Data Interpretation

The purpose of the Environmental Radiological Monitoring Program at the Duane Arnold Energy Center (DAEC) is to assess the impact of the plant on its environment. For this purpose, samples are collected from the air, terrestrial, and aquatic environments and analyzed for radioactive content. In addition, ambient gamma radiation levels are monitored by thermoluminescent dosimeters (TLDs).

Sources of environmental radiation include the following:

(1) Natural background radiation arising from cosmic rays and primordial radionuclides;

(2) Fallout from atmospheric nuclear detonations;

(3) Releases from nuclear power plants; and

(4) Industrial and medical radioactive waste.

In interpreting the data, effects due to the DAEC operation must be distinguished from those due to other sources.

A major interpretive aid in assessment of these effects is the design of the monitoring program at the DAEC which is based on the indicator-control concept. Most types of samples are collected both at indicator locations (nearby, downwind, or downstream) and at control locations (distant, upwind, or upstream). A station effect would be indicated if the radiation level at an indicator location was significantly larger than that at the control location. The difference would have to be greater than could be accounted for by typical fluctuations in radiation levels arising from other sources.

An additional interpretive technique involves analyses for specific radionuclides present in the environmental samples collected from the DAEC site. The DAEC's monitoring program includes analyses for strontium-90 and iodine-131, which are fission products, and tritium, which is produced by cosmic rays, atmospheric nuclear detonations, and also by nuclear power plants. Most samples are also analyzed for gamma-emitting isotopes with results for the following groups quantified: zirconium-95, cesium-137, and cerium-144. These three gamma-emitting isotopes were selected as radiological impact indicators because of the different characteristic proportions in which they appear in the fission product mix produced by a nuclear reactor and that produced by a nuclear detonation. Each of the three isotopes is produced in roughly equivalent amounts by a reactor: each constitutes about 10% of the total activity of fission products ten (10) days after reactor shutdown. On the other hand, ten (10) days after a nuclear explosion, the contributions of zirconium-95, cerium-144, and cesium-137 to the activity of the resulting debris are in the approximate ratio 4:1:0.03 (Eisenbud,1963). The other group quantified consists of niobium-95, ruthenium-103 and -106, cesium-134, barium-lanthanum-140, and cerium-141. These isotopes are released in small quantities by nuclear power plants, but to date their major source of injection into the general environment has been atmospheric nuclear testing. Nuclides of the next group, manganese-54, cobalt-58 and-60, and zinc-65, are activation products and arise from activation of corrosion products. They are typical components of nuclear power plant effluents, but are not produced in significant quantities by nuclear detonations.

3.1 Program Design and Data Interpretation (continued)

Nuclides of the final group, beryllium-7, which is of cosmogenic origin, and potassium-40, a naturally-occurring isotope, were chosen as calibration monitors and should not be considered radiological impact indicators.

Characteristic properties of isotopes quantified in gamma-spectroscopic analysis are presented in Table 5.1. Other means of distinguishing sources of environmental radiation can be employed in interpreting the data. Current radiation levels can be compared with previous levels, including those measured before the Plant became operational. Results of the DAEC's Monitoring Program can be related to those obtained in other parts of the world. Finally, results can be related to events known to cause elevated levels of radiation in the environment, e.g., atmospheric nuclear detonations.

3.2 Program Description

The sampling and analysis schedule for the environmental radiological monitoring program at the DAEC is summarized in Table 5.2 and is briefly reviewed below. Table 5.3 defines the sampling location codes used in Table 5.2 and specifies for each location its type (indicator or control) and its distance, direction, and sector relative to the reactor site. The types of samples collected at each location and the frequency of collections are presented in Table 5.4 using codes defined in Table 5.5.

To monitor the air environment, airborne particulates are collected on membrane filters by continuous pumping at twelve (12) locations. Also, airborne iodine is collected by continuous pumping through charcoal filters at six (6) of these locations. Nine (9) of the twelve (12) locations are indicators and three (3) are controls (D-1, D-2, and D-13). Filters are changed and counted weekly. Particulate filters are analyzed for gross beta activity. If gross beta activity exceeds 10 times the yearly mean of the control samples gamma isotopic analysis is performed. Quarterly composites of airborne particulates from each location are gamma scanned on a germanium detector.

Charcoal filters are analyzed weekly for I-131 on all samples.

Ambient gamma radiation is monitored at twelve (12) air sampling locations. In addition, gamma radiation is monitored at thirty-two (32) special locations: seventeen (17) in a circle within 0.5 mi. radius of the DAEC stack; six (6) in 22.5° sectors within 1 mi. of the DAEC stack; and nine (9) in 22.5° sectors between 1 and 3 miles of the DAEC stack. Two TLDs are placed at each location and are exchanged and analyzed quarterly.

Precipitation samples are collected monthly from one location and analyzed for gamma-emitting isotopes. Quarterly composites are analyzed for tritium.

Milk samples are collected monthly from seven (7) locations during the non-grazing season, October through April, and biweekly during the grazing season, May 1 through September 30. One location is a control (D-105) and the rest are indicators. All samples are analyzed for I-131 and gamma-emitting isotopes.

For additional monitoring of the terrestrial environment, grain, hay, and broad leaf natural vegetation samples are collected annually from nine (9) locations: one control (D-105) and eight (8) indicators (D-57, D-58, D-63, D-72, D-93, D-94, D-106 and

3.2 Program Description (continued)

D-16). Grain, hay, and broad leaf (green leafy) vegetation samples are analyzed for gamma-emitting isotopes and at least one broad leaf vegetation is analyzed for iodine-131. When cattle are slaughtered for home use, it is collected annually, during or immediately following a grazing period from animals grazing on-site. The sample is analyzed for gamma-emitting isotopes. Also, potable ground water is collected quarterly from a treated municipal water system (D-53), the inlet to the municipal water treatment system (D-54), and four (4) additional ground water locations (D-55, D-57, D-58, and D-72). The samples are analyzed for gross beta and tritium. If gross beta activity exceeds 10 times yearly mean of the control samples, gamma isotopic, strontium-89, and strontium-90 analyses are performed.

Soil samples are collected once per year at two indicator locations (D-15 and D-16). The samples are analyzed for strontium-90 and gamma-emitting isotopes.

Surface water is collected monthly from five (5) river, pond, and sewage effluent locations, one (1) control (D-49) and four (4) indicator (D-50, D-51, D-99, and D-107). All monthly samples are analyzed for gamma-emitting isotopes. Tritium analyses are performed on quarterly composites from each location. In addition, all samples from Location D-107 (plant sewage discharge) are analyzed for K-40 by flame photometry.

The aquatic environment is also monitored by upstream and downstream (D-49 and D-61) semiannual collections of fish. River bottom sediment is also collected semiannually at the plant's intake and discharge (D-50 and D-51) and downstream of the sewage plant (D-107). The samples are analyzed for gamma-emitting isotopes.

3.3 Program Execution

The program was executed as described in the preceding section with the following exceptions:

(1) Air particulate data was not available for the week of 08-19-93. The samples were lost in shipping. No air particulate/air iodine data was available from location D-5 for the week of 12-09-93. The sample was lost in the field. No air particulate/air iodine data was available from location D-11 on 07-15-93. Power was out at the substation.

(2) Milk was not available from location D-93 for the months of January, February, and December, 1993. Goats were dry.

(3) Milk was no longer available at location D-94 after June 29, 1993. The location has been dropped from the milk program.

(4) Milk was not available from location D-101 for the months of January, February, March, April, and December, 1993. Milk was not available for the first collection in May, 1993. Goats were dry.

(5) Milk was no longer available at location D-106 in December, 1993 . The location has been dropped from the milk program.

(6) Fish was not collected during the first half of 1993. High water levels prohibited collection.

(7) River sediments were not collected during the first half of 1993. High water levels prohibited collection.

## 3.4 Laboratory Procedures

All iodine-131 analyses in milk were made by using a sensitive radio-chemical procedure which involves separation of the element by use of an ion-exchange resin and subsequent beta counting.

All gamma-spectroscopic analyses were performed with high resolution germanium detectors. Levels of iodine-131 in natural vegetation were determined by gamma spectrometry. Levels of airborne iodine-131 in charcoal samples were measured by gamma spectrometry.

Tritium levels were determined by the liquid scintillation technique.

Analytical Procedures used by TIML are specified in detail elsewhere (Teledyne Isotopes Midwest Laboratory, 1993). Procedures are based on those prescribed by the National Center for Radiological Health of the U.S. Public Health Service (U.S. Public Health Service, 1967) and by the Health and Safety Laboratory of the U.S. Atomic Energy Commission (U.S. Atomic Energy Commission, 1972).

Details of TIML's QA program are presented elsewhere (Teledyne Isotopes Midwest Laboratory, 1993 ). The TIML QA Program includes participation in the Interlaboratory Comparison (Crosscheck) Program. Results obtained in the crosscheck program are presented in Appendix A.

## 3.5 Program Modifications

Two locations (D-94 and D-106) were removed from the milk program. Dairy cattle was sold at location D-94 as of July, 1993. Location D-106 was dropped in December, 1993.

## 4.0 RESULTS AND DISCUSSION

All of the scheduled collections and analyses were made on schedule except those listed in Table 5.6.

All results are summarized in Table 5.7 in a format recommended by the Nuclear Regulatory Commission in Regulatory Guide 4.8. For each type of analysis of each sample medium, this table lists the mean and range of all indicator and control locations. The locations with the highest mean and range are also shown.

The tabulated results of all measurements made in 1993 are not included in this section, although references to these results will be made in the discussion. The complete tabulation of the 1993 results is contained in Part II of the 1993 Annual Report on the Environmental Radiological Monitoring Program for the Duane Arnold Energy Center.

### 4.1 Atmospheric Nuclear Detonations and Nuclear Accidents

There were no reported atmospheric nuclear tests in 1993. The last reported test was conducted by the People's Republic of China on October 16, 1980. The reported yield was in the 200 kiloton to 1 megaton range.

There were no reported accidents at nuclear reactor facilities in 1993.

### 4.2 Program Findings

Results obtained show background levels of radioactivity in the environmental samples collected in 1993.

#### Airborne Particulates

The average annual gross beta concentration in airborne particulates was similar at indicator and control locations (0.022 and 0.023 $pCi/m^3$, respectively) and was similar to levels in 1982 (0.026 $pCi/m^3$, at both indicator and control locations), 1983 (0.022 and 0.024 $pCi/m^3$, respectively), 1984 (0.025 and 0.026 $pCi/m^3$, respectively), 1985 (0.024 $pCi/m^3$ at both locations), in 1986 (0.024 $pCi/m^3$, at both indicator and control locations), in 1987 (0.024 and 0.026 $pCi/m^3$, respectively), in 1988 (0.026 and 0.028 $pCi/m^3$, respectively), in 1989 (0.026 and 0.029 $pCi/m^3$, respectively), in 1990 (0.022 and 0.024 $pCi/m^3$, respectively), in 1991 (0.023 and 0.022 $pCi/m^3$, respectively), and in 1992 (0.022 and 0.023 $pCi/m^3$, respectively). The average of 0.024 $pCi/m^3$ for 1986 does not include the results from May 15 to June 12, 1986, which were influenced by the accident at Chernobyl.

A spring peak in beta activity had been observed almost annually for many years (Wilson et al., 1969). It had been attributed to fallout of nuclides from the stratosphere (Gold et al., 1964). It was pronounced in 1981, occurred to a lesser degree in 1982, and did not occur in 1983, 1984, 1985, 1987, 1988, 1989, 1990, 1991, 1992, or 1993. In 1986, the spring peak could not be identified because it was overshadowed by the releases of radioactivity from Chernobyl. Gamma spectroscopic analysis of quarterly composites of air particulate filters yielded similar results for indicator and control locations. Beryllium-7, which is produced continuously in the upper atmosphere by

Airborne Particulates (continued)
cosmic radiation (Arnold and Al-Salih, 1955), was detected in all samples. All other gamma-emitting isotopes were below their respective LLD limits. No plant effect was indicated.

Airborne Iodine
Weekly levels of airborne iodine-131 were below the lower limit of detection (LLD) of 0.07 pCi/$m^3$ in all samples.

Ambient Radiation (TLDs)
At twelve (12) air sampling locations, the TLD readings averaged 14.4 mR/quarter at indicator locations and 13.8 mR/quarter at control locations. At locations within 0.5 mile, 1.0 mile, and 3.0 mile radius of the stack, the measurements averaged 16.8 mR/quarter, 17.6 mR/quarter, and 16.2 mR/quarter, respectively. The average for all locations was 16.1 mR/quarter. This is slightly lower than the estimated average natural background radiation for Middle America, 19.5 mR/quarter, which is based on data on Pages 71 and 108 of the report, "Natural Background Radiation in the United States" (National Council on Radiation Protection and Measurements, 1975). The terrestrial absorbed dose (uncorrected for structural and body shielding) ranges from 8.8 to 18.8 mrad/quarter and averages 11.5 mrad/quarter for Middle America. Cosmic radiation and cosmogenic radionuclides contribute 8.0 mrad/quarter for a total average of 19.5 mrad/quarter. No plant effect was indicated.

Precipitation
In precipitation, the tritium concentration was below the LLD of 330 pCi/L in all samples. No gamma-emitting isotopes were detected. No plant effect was indicated.

Milk
Iodine-131 results were below the detection limit of 1.0 pCi/L in all samples.

No gamma-emitting isotopes, except naturally occurring potassium-40, were detected in any milk samples. This is consistent with the finding of the National Center for Radiological Health that most radiocontaminants in feed do not find their way into milk due to the selective metabolism of the cow. The common exceptions are radioisotopes of potassium, cesium, strontium, barium, and iodine (National Center for Radiological Health, 1968).

In summary, the milk data for 1993 show no radiological effects of the plant operation.

Ground Water
The annual mean for gross beta activity measured 3.5 pCi/L and was similar to the levels observed in 1980 through 1992. The location with the highest mean (7.0 pCi/L) was D-58, a farm 1.0 mile distant from the plant. Tritium was below the LLD of 330 pCi/L in all samples. No plant effect was indicated.

Vegetation

Iodine-131 results in broad leaf vegetation were below the LLD level of 0.060 pCi/g wet weight in all but one sample. The LLD could not be reached for location D-105, due to the small sample size.

Cs-137 was detected in one vegetable sample at a concentration of 0.036 pCi/g wet. Except for potassium-40, which was observed in all vegetation samples ( broadleaf, grain, and forage ), all other gamma-emitting isotopes were below detection limits in all samples. No plant effect is indicated.

Soil

Strontium-90 was detected in both samples and averaged 0.058 pCi/g dry weight.

Cesium-137 was detected in both samples at a concentration of 0.26 pCi/g dry weight. Both strontium-90 and cesium-137 concentrations were similar to levels observed in 1987 (0.08 and 0.30 pCi/g dry weight, respectively), in 1988 (0.064 and 0.33 pCi/g dry weight, respectively), in 1989 (0.046 and 0.18 pCi/g dry weight, respectively), in 1990 (0.066 and 0.21 pCi/g dry weight, respectively), in 1991 (0.064 and 0.34 pCi/g dry weight, respectively), and in 1992 (0.040 and 0.26 pCi/g dry weight, respectively).

The only other gamma-emitting isotope detected was potassium-40 and averaged 13.68 pCi/g dry weight. No plant effect on soil was indicated.

Surface Water

Tritium was below the LLD level of 330 pCi/L in all samples.

All gamma-emitting isotopes were below their respective LLDs.

K-40 was measured at one location, D-107 (sewage effluent). The concentration ranged from 9.1 to 19.9 pCi/L and averaged 15.4 pCi/L.

No plant effect on the radioactivity of surface water was indicated.

Fish

All gamma-emitting isotopes, except naturally-occurring potassium-40, in edible portions were below detection limits. The potassium-40 level was similar at both indicator and control locations (2.80 and 2.68 pCi/g wet weight, respectively). No plant effect on fish was indicated.

River Sediments

River sediments were collected in September and October, 1993, and analyzed for gamma-emitting isotopes. Cobalt-60 was detected in one sample from location D-107 (sewage effluent) at a concentration of 0.035 pCi/g dry weight. Cesium-137 was detected at both indicator and control locations at an average concentration of 0.027 pCi/g dry weight. Potassium-40 ranged from 7.16 to 9.91 pCi/g dry weight and averaged 8.54 pCi/g dry weight.

All other gamma-emitting isotopes were below detection limits. There was no indication of a plant effect on the environment.

## 5.0 TABLES AND FIGURES

Table 5.1 Characteristic properties of isotopes quantified in gamma-spectroscopic analyses.

| Designation | Comment | Isotope | Half-life[a] |
|---|---|---|---|
| I. Naturally Occurring | | | |
| A. Cosmogenic | Produced by interaction of cosmic rays with atmosphere | Be-7 | 53.2 d |
| B. Terrestrial | Primordial | K-40 | $1.26 \times 10^9$ y |
| II. Fission Products[b] | Nuclear detonations constitute the major environmental source | | |
| A. Short-lived | | I-131 | 8.04 d |
| | | Ba-140 | 12.8 d |
| B. Other than Short-lived | | Nb-95 | 35.15 d |
| | | Zr-95 | 65 d |
| | | Ru-103 | 39.35 d |
| | | Ru-106 | 368.2 d |
| | | Cs-134 | 2.061 y |
| | | Cs-137 | 30.174 y |
| | | Ce-141 | 32.5 d |
| | | Ce-144 | 284.31 d |
| III. Activation Products | Typically found in nuclear power plant effluents | Mn-54 | 312.5 d |
| | | Fe-59 | 45.0 d |
| | | Co-58 | 70.78 d |
| | | Co-60 | 5.26 y |
| | | Zn-65 | 245 d |

a Half-lives are taken from Appendix E of Environmental Quarterly, 1 January 1978, EML-334 (U. S. Department of Energy, 1978).
b Includes fission-product daughters.

Table 5.2 Sample collection and analysis program, 1993.

| Exposure Pathway and/or Sample Type | Sampling Location: Sample Point | Sampling Location: Description | Sampling and Collection Frequency | Type and Frequency of Analysis |
|---|---|---|---|---|
| Airborne Particulates | 1 | Cedar Rapids (C) | Continuous operation of sampler with sample collection at least once per week or as required by dust loading | Analyze for gross beta activity more than 24 hours after filter change. Perform gamma isotopic analysis on each sample having gross beta activity greater than ten times the yearly mean of the control samples.<br><br>Composite weekly samples to form a quarterly composite (by location). Analyze quarterly composite for gamma isotopic. |
| | 2 | Marion (C) | | |
| | 3 | Hiawatha | | |
| | 5 | Palo | | |
| | 6 | Center Point | | |
| | 7 | Shellsburg | | |
| | 8 | Urbana | | |
| | 10 | Atkins | | |
| | 11 | Toddsville | | |
| | 13 | Alburnett (C) | | |
| | 15 | On-site North | | |
| | 16 | On-site South | | |
| Airborne Iodine | 2 | Marion (C) | Continuous operation of sampler with sample collection at least once per week. | Analyze each cartridge for iodine-131. |
| | 5 | Palo | | |
| | 7 | Shellsburg | | |
| | 8 | Urbana | | |
| | 11 | Toddville | | |
| | 15 | On-site North | | |
| Ambient Radiation | 1-3, 5-8, 10, 11, 13,15, 16 | Air Particulate Locations | Two dosimeters continuously at each location. Both dosimeters are changed at least quarterly. | Read gamma radiation dose quarterly on one dosimeter. |
| | 18-23, 28-32, 33-41 | Within 0.5 mile of Stack<br>Within 3.0 miles of Stack | | |
| | 43-48, 82-86, 91 | Within 1.0 mile of Stack | | |
| Surface Water | 49 | Lewis Access (C) | Once per month. | Gamma isotopic analyses of each sample (by location).<br><br>Composite monthly samples to form quarterly composite (by location). Analyze quarterly composite for tritium. |
| | 50 | Plant Intake (C) | | |
| | 51 | Plant Discharge | | |
| | 99 | Pleasant Creek | | |
| | 107 | Plant Sewage Dischange | | |

Table 5.2 Sample collection and analysis program, 1993 (continued).

| Exposure Pathway and/or Sample Type | Sampling Location: Sample Point | Sampling Location: Description | Sampling and Collection Frequency | Type and Frequency of Analysis |
|---|---|---|---|---|
| Ground Water (potable) | 53<br>54<br>55<br>57, 58<br>72 | Treated Municipal Water<br>Inlet to Municipal Water Treatment System<br>On-site well<br>Wells off-site and within 4 km of DAEC | Grab sample at least once per quarter | Gross beta and tritium activity analysis on quarterly sample. If gross beta is greater than ten times the yearly mean of control samples, perform gamma isotopic and Sr-89 and Sr-90 analyses. |
| River Sediment | 50<br>51<br>107 | Plant Intake (C)<br>Plant Discharge<br>Sewage Effluent Canal | At least once every six months. | Gamma isotopic analysis of each sample. |
| Vegetation | 16, 57, 58, 63, 72, 93, 94,106, 105 (C) | Farms that raise food crops | Annually at harvest time. One sample of each: grain, green leafy, and forage. At least one sample should be broadleaf vegetation. | Gamma isotopic analysis of edible portions.<br><br>I-131 analysis on broadleaf vegetation. |
| Fish | 49<br>61 | Cedar River upstream of DAEC not influenced by effluent (C)<br>Downstream of DAEC in influence of effluent | One sample per 6 months (once during January through July and once during August through December). | Gamma isotopic analysis on edible portions. |
| Milk[b] | 105 | Control Farm near Amana, Iowa | At least once per two weeks during the grazing season. | <u>During the grazing season</u>: Gamma isotopic and iodine-131 analyses of each sample. |
| | 63, 93 94, 96, 101,106 | Dairy Farms within 10 miles of Site | At least once per month during the non-grazing season. | <u>During the non-grazing season</u>: Gamma isotopic and iodine-131 analyses of each sample. |

Table 5.2 Sample collection and analysis program, 1993 (continued).

| Exposure Pathway and/or Sample Type | Sampling Location: Sample Point | Sampling Location: Description | Sampling and Collection Frequency | Type and Frequency of Analysis |
|---|---|---|---|---|
| Precipitation | | On-site | Monthly | Gamma isotopic on all samples.<br>Tritium on quarterly composites. |
| Meat[c] | | On-site | Annually | Gamma Isotopic |
| Soil | 15, 16 | On-site | Annually | Gamma Isotopic and Sr-90. |

[a] Gamma isotopic analysis and analysis for gamma-emitting nuclides refer to high resolution gamma ray spectrum analysis. Any radionuclide detected at a concentration greater than the lower limit of detection (LLD) should be reported quantitatively; conversely, any radionulcide concentration less than the LLD should not be reported.

[b] The grazing season is considered to be May 1 through September 30.

[c] Meat was not collected in 1993; no animals slaughtered for home use.

Table 5.3 Sampling locations, Duane Arnold Energy Center.

| Code | Type[a] | Sampling Location | | |
|---|---|---|---|---|
| | | Sampling Point | Location Description | Distance and Direction from Site Stack |
| D-1 | C | 1 | Cedar Rapids | 11 mi @ 135°SE |
| D-2 | C | 2 | Marion | 11 mi @ 125°ESE |
| D-3 | | 3 | Hiawatha | 7 mi @ 130°SE |
| D-5 | | 5 | Palo | 3 mi @ 200°SSW |
| D-6 | | 6 | Center Point | 7 mi @ 0°N |
| D-7 | | 7 | Shellsburg | 6 mi @ 255°W |
| D-8 | | 8 | Urbana | 10 mi @ 345°NW |
| D-10 | | 10 | Atkins | 9 mi @ 210°SSW |
| D-11 | | 11 | Toddville | 4 mi @ 90°E |
| D-13 | C | 13 | Alburnett | 9 mi @ 70°ENE |
| D-15 | | 15 | On-site, Northwest | 0.5 mi @ 305°NW |
| D-16 | | 16 | On-site, South | 0.5 mi @ 190°SSE |
| D-18 | | 18 | | 0.5 mi NNE |
| D-19 | | 19 | | 0.5 mi NE |
| D-20 | | 20 | | 0.5 mi ENE |
| D-21 | | 21 | | 0.5 mi ENE |
| D-22 | | 22 | | 0.5 mi E |
| D-23 | | 23 | | 0.5 mi ESE |
| D-28 | | 28 | | 0.5 mi WSW |
| D-29 | | 29 | | 0.5 mi W |
| D-30 | | 30 | | 0.5 mi WNW |
| D-31 | | 31 | | 0.5 mi NW |
| D-32 | | 32 | | 0.5 mi NNW |
| D-33 | | 33 | | 3.0 mi N |
| D-34 | | 34 | | 3.0 mi NNE |
| D-35 | | 35 | | 3.0 mi NE |
| D-36 | | 36 | | 3.0 mi ENE |
| D-37 | | 37 | | 3.0 mi E |
| D-38 | | 38 | | 3.0 mi ESE |
| D-39 | | 39 | | 3.0 mi SE |
| D-40 | | 40 | | 3.0 mi SSE |
| D-41 | | 41 | | 3.0 mi S |
| D-43 | | 43 | | 1.0 mi SSW |
| D-44 | | 44 | | 1.0 mi WSW |
| D-45 | | 45 | | 1.0 mi W |
| D-46 | | 46 | | 1.0 mi WNW |
| D-47 | | 47 | | 1.0 mi WNW |
| D-48 | | 48 | | 1.0 mi NW |
| D-49 | C | 49 | Lewis Access, upstream of DAEC | 4.0 mi NNW |
| D-50 | | 50 | Plant Intake | |
| D-51 | | 51 | Plant Discharge | |
| D-53 | | 53 | Treated Municipal Water | |
| D-54 | | 54 | Inlet to Municipal Water Treatment System | |
| D-55 | | 55 | On-site Well | |

Table 5.3 Sampling locations, Duane Arnold Energy Center (continued).

| Code | Type[a] | Sampling Location | | |
|---|---|---|---|---|
| | | Sampling Point | Location Description | Distance and Direction from Site Stack |
| D-57 | | 57 | Farm (Off-site Well) | 1.0 mi WSW |
| D-58 | | 58 | Farm (Off-site Well) | 0.5 mi WSW-SW |
| D-61 | | 61 | 0.5 mi downstream of plant discharge | |
| D-63 | | 63 | Farm | 1.5 mi WNW |
| D-72 | | 72 | Farm | 2.0 mi SSW |
| D-82 | | 82 | | 0.5 mi SE |
| D-83 | | 83 | | 0.5 mi SSE |
| D-84 | | 84 | | 0.5 mi S |
| D-85 | | 85 | | 0.5 mi SSW |
| D-86 | | 86 | | 0.5 mi SW |
| D-91 | | 91 | | 0.5 mi N |
| D-93 | | 93 | Farm | 2.8 mi NNE |
| D-94 | | 94 | Farm | 2.7 mi N |
| D-96 | | 96 | Farm | 8.0 mi SSW |
| D-99 | | 99 | Pleasant Creek Lake | 2.5 mi WNW |
| D-101 | | 101 | Farm | 4.0 mi E |
| D-105 | C | 105 | Farm | 21.3 mi SSW |
| D-106 | | 106 | Farm | 4.5 mi SE |
| D-107 | | 107 | Sewage Effluent Canal | On-site |

[a] "C" denotes control location. All other locations are indicators.

Table 5.4 Type and Frequency of collection.

| Location | Location Type[a] | Weekly | Monthly | Quarterly | Semiannually | Annually |
|---|---|---|---|---|---|---|
| D-1 | C | AP | | TLD | | |
| D-2 | C | AP, AI | | TLD | | |
| D-3 | | AP | | TLD | | |
| D-5 | | AP, AI | | TLD | | |
| D-6 | | AP | | TLD | | |
| D-7 | | AP AI | | TLD | | |
| D-8 | | AP, AI | | TLD | | |
| D-10 | | AP | | TLD | | |
| D-11 | | AP, AI | | TLD | | |
| D-13 | C | AP | | TLD | | |
| D-15 | | AP, AI | | TLD | | SO |
| D-16 | | AP | | TLD | | SO, G[b] |
| D-18 through D-23 | | | | TLD | | |
| D-28 through D-41 | | | | TLD | | |
| D-43 through D-48 | | | | TLD | | |
| D-49 | C | | SW | | F | |
| D-50 | C | | SW | | RS | |
| D-51 | | | SW | | RS | |
| D-53 | | | WW | | | |
| D-54 | | | WW | | | |
| D-55 | | | WW | | | |
| D-57 | | | WW | | | G[b] |
| D-58 | | | WW | | | G[b] |
| D-61 | | | | | F | |
| D-63 | | | M[c] | | | G[b] |
| D-72 | | | WW | | | G[b] |
| D-82 through D-86 | | | | TLD | | |
| D-91 | | | | TLD | | |
| D-93 | | | M[c] | | | G[b] |
| D-94 | | | M[c] | | | G[b] |
| D-96 | | | M[c] | | | |
| D-99 | | | SW | | | |
| D-101 | | | M[c] | | | |
| D-105 | C | | M[c] | | | G[b] |
| D-106 | | | M[c] | | | G[b] |
| D-107 | | | SW | | RS | |
| On-site | | | P | | | ME |

[a] Control locations are indicated by a "C" in this column. All other locations are indicators.

[b] Vegetation (G) includes green leafy (and broad leaf), grain, and forage.

[c] Monthly from October through April; weekly from May to September.

Table 5.5. Sample codes used in 5.4.

| Code | Description |
|---|---|
| AP | Airborne Particulates |
| AI | Airborne Iodine |
| TLD | Thermoluminescent Dosimeter |
| P | Precipitation |
| M | Milk |
| WW | Well Water |
| G | Vegetation |
| ME | Meat |
| SO | Soil |
| SW | Surface Water |
| F | Fish |
| RS | River Sediment |

Table 5.6. Missed collections and analyses, Duane Arnold Energy Center, 1993.

| Sample | Analysis | Location | Collection Date or Period | Comments |
|---|---|---|---|---|
| Milk | I-131, Gamma | D-93 | 01-05-93 | Sample not available. |
| Milk | I-131, Gamma | D-101 | 01-05-93 | Sample not available. |
| Milk | I-131, Gamma | D-93 | 02-03-93 | Sample not available. |
| Milk | I-131, Gamma | D-101 | 02-06-93 | Sample not available. |
| Milk | I-131, Gamma | D-101 | 03-02-93 | Sample not available. |
| Milk | I-131, Gamma | D-101 | 04-06-93 | Sample not available. |
| Milk | I-131, Gamma | D-101 | 05-04-93 | Sample not available. |
| River Sediment | Gamma | All | January - June, 1993 | Flooding and high water |
| Fish | Gamma | All | January - July, 1993 | Flooding and high water |
| AP/AI | Gross Beta/I-131 | D-11 | 07-15-93 | No power to sampler. |
| AP/AI | Gross Beta/I-131 | All | 08-19-93 | Samples lost in shipment. |
| Milk | I-131, Gamma | D-93 | 12-07-93 | Sample not available. |
| Milk | I-131, Gamma | D-101 | 12-07-93 | Sample not available. |

Table 5.7 Radiological Environmental Program Summary.

Name of Facility Duane Arnold Energy Center — Docket No. 50-331
Location of Facility Linn, Iowa (County, State) — Reporting Period January - December 1993

| Sample Type (Units) | Type and Number of Analyses[a] | LLD[b] | Indicator Locations Mean (F)[c] Range[c] | Location with Highest Annual Mean Location[d] | Location with Highest Annual Mean Mean (F)[c] Range[c] | Control Locations Mean (F)[c] Range | Number Non-Routine Results[e] |
|---|---|---|---|---|---|---|---|
| Airborne particulates (pCi/m$^3$) | GB 610 | 0.004 | 0.022 (457/457) (0.007-0.054) | D-1[f], Cedar Rapids 11 mi. SE | 0.023 (51/51) (0.012-0.048) | 0.023 (153/153) (0.009-0.048) | 0 |
| | GS 48 | | | | | | |
| | Be-7 | 0.012 | 0.063 (36/36) (0.041-0.089) | D-1, Cedar Rapids 11 mi. SE | 0.076 (4/4) (0.068-0.085) | 0.068 (12/12) (0.048-0.093) | 0 |
| | Nb-95 | 0.0021 | <LLD | - | - | <LLD | 0 |
| | Zr-95 | 0.0027 | <LLD | - | - | <LLD | 0 |
| | Ru-103 | 0.0019 | <LLD | - | - | <LLD | 0 |
| | Ru-106 | 0.011 | <LLD | - | - | <LLD | 0 |
| | Cs-134 | 0.0012 | <LLD | - | - | <LLD | 0 |
| | Cs-137 | 0.0011 | <LLD | - | - | <LLD | 0 |
| | Ce-141 | 0.0033 | <LLD | - | - | <LLD | 0 |
| | Ce-144 | 0.0075 | <LLD | - | - | <LLD | 0 |
| Airborne Iodine | I-131 304 | 0.07 | <LLD | - | - | <LLD | 0 |
| TLD, AP Locations (mR/quarter) | Gamma 48 | 1 | 14.4 (36/36) (11.8-18.4) | D-15, Onsite 0.5 mi. NW | 15.2 (4/4) (14.2-16.5) | 13.8 (12/12) (12.0-15.8) | 0 |
| TLD, within 0.5 mi radius of Stack (mR/quarter) | Gamma 68 | 1 | 16.8 (68/68) (12.1-23.9) | D-31, Onsite 0.5 mi. NW | 21.5 (4/4) (19.3-23.9) | None | 0 |
| TLD, within 1.0 mi radius of Stack (mR/quarter) | Gamma 24 | 1 | 17.6 (24/24) (12.1-21.1) | D-44, 1.0 mi. WSW | 19.4 (4/4) (18.9-19.8) | None | 0 |
| TLD, within 3.0 mi radius of Stack (mR/quarter) | Gamma 36 | 1 | 16.2 (36/36) | D-37, 3.0 mi. E | 20.4 (4/4) (19.4-21.6) | None | 0 |
| Precipitation (pCi/L) | H-3 4 | 330 | <LLD | - | - | None | 0 |
| | GS 12 | | | | | | |
| | Mn-54 | 13 | <LLD | - | - | None | 0 |
| | Fe-59 | 18 | <LLD | - | - | None | 0 |
| | Co-58 | 7 | <LLD | - | - | None | 0 |

Table 5.7 Radiological Environmental Program Summary

Name of Facility Duane Arnold Energy Center — Docket No. 50-331
Location of Facility Linn, Iowa (County, State) — Reporting Period January - December 1993

| Sample Type (Units) | Type and Number of Analyses[a] | LLD[b] | Indicator Locations Mean (F)[c] Range[c] | Location with Highest Annual Mean Location[d] | Location with Highest Annual Mean Mean (F)[c] Range[c] | Control Locations Mean (F)[c] Range | Number Non-Routine Results[e] |
|---|---|---|---|---|---|---|---|
| Precipitation (pCi/L) *(continued)* | Co-60 | 9 | <LLD | - | - | None | 0 |
| | Zn-65 | 19 | <LLD | - | - | None | 0 |
| | Nb-95 | 9 | <LLD | - | - | None | 0 |
| | Zr-95 | 14 | <LLD | - | - | None | 0 |
| | I-131 | 19 | <LLD | - | - | None | 0 |
| | Cs-134 | 10 | <LLD | - | - | None | 0 |
| | Cs-137 | 11 | <LLD | - | - | None | 0 |
| | Ba-140 | 47 | <LLD | - | - | None | 0 |
| | La-140 | 12 | <LLD | - | - | None | 0 |
| Milk (pCi/L) | I-131 107 | 1.0 | <LLD | - | - | <LLD | 0 |
| | GS 107 | | | | | | |
| | K-40 | 100 | 1440 (89/89) (820-1920) | D-101, Farm 4.0 mi. E | 1690 (12/12) (1340-1920) | 1370 (18/18) (1220-1590) | 0 |
| | Cs-134 | 15 | <LLD | - | - | <LLD | 0 |
| | Cs-137 | 18 | <LLD | - | - | <LLD | 0 |
| | Ba-140 | 60 | <LLD | - | - | <LLD | 0 |
| | La-140 | 15 | <LLD | - | - | <LLD | 0 |
| Ground Water (pCi/L) | GB 24 | 1.2 | 3.5 (15/24) (1.2-8.3) | D-58, Farm 1.0 mi. WSW-SW | 7.0 (4/4) (5.9-8.3) | None | 0 |
| | H-3 24 | 330 | <LLD | - | - | None | 0 |
| Broad Leaf Vegetation (pCi/g wet) | I-131 5 | 0.060[g] | <LLD | - | - | <LLD | 0 |
| | GS 5 | | | | | | |
| | K-40 | 0.5 | 2.18 (4/4) (2.10-2.22) | D-105, Farm 21.3 mi. SSW | 4.88 (1/1) | 4.88 (1/1) | 0 |
| | Mn-54 | 0.059 | <LLD | - | - | <LLD | 0 |
| | Co-58 | 0.056 | <LLD | - | - | <LLD | 0 |
| | Co-60 | 0.073 | <LLD | - | - | <LLD | 0 |
| | Nb-95 | 0.059 | <LLD | - | - | <LLD | 0 |
| | Zr-95 | 0.10 | <LLD | - | - | <LLD | 0 |
| | Ru-103 | 0.067 | <LLD | - | - | <LLD | 0 |

Table 5.7 Radiological Environmental Program Summary.

Name of Facility Duane Arnold Energy Center — Docket No. 50-331
Location of Facility Linn, Iowa (County, State) — Reporting Period January - December 1993

| Sample Type (Units) | Type and Number of Analyses[a] | LLD[b] | Indicator Locations Mean (F)[c] Range[c] | Location with Highest Annual Mean Location[d] | Location with Highest Annual Mean Mean (F)[c] Range[c] | Control Locations Mean (F)[c] Range | Number Non-Routine Results[e] |
|---|---|---|---|---|---|---|---|
| Broadleaf Vegetation (pCi/g wet) *(continued)* | Ru-106 | 0.56 | <LLD | - | - | <LLD | 0 |
| | Cs-134 | 0.056 | <LLD | - | - | <LLD | 0 |
| | Cs-137 | 0.064 | <LLD | - | - | <LLD | 0 |
| | Ce-141 | 0.089 | <LLD | - | - | <LLD | 0 |
| | Ce-144 | 0.37 | <LLD | - | - | <LLD | 0 |
| Vegetation (Grain) (pCi/g wet) | GS 9 | | | | | | |
| | K-40 | 0.5 | 3.62 (8/8) (2.13-11.23) | D-16, Onsite 0.5 mi. SSE | 11.23 (1/1) | 2.86 (1/1) | 0 |
| | Mn-54 | 0.014 | <LLD | - | - | <LLD | 0 |
| | Co-58 | 0.013 | <LLD | - | - | <LLD | 0 |
| | Co-60 | 0.015 | <LLD | - | - | <LLD | 0 |
| | Nb-95 | 0.015 | <LLD | - | - | <LLD | 0 |
| | Zr-95 | 0.023 | <LLD | - | - | <LLD | 0 |
| | Ru-103 | 0.013 | <LLD | - | - | <LLD | 0 |
| | Ru-106 | 0.11 | <LLD | - | - | <LLD | 0 |
| | Cs-134 | 0.011 | <LLD | - | - | <LLD | 0 |
| | Cs-137 | 0.008 | <LLD | D-16, Onsite 0.5 mi. SSE | 0.036 (1/1) | <LLD | 0 |
| | Ce-141 | 0.021 | <LLD | - | - | <LLD | 0 |
| | Ce-144 | 0.079 | <LLD | - | - | <LLD | 0 |
| Vegetation (Forage) (pCi/g wet) | GS 8 | | | | | | |
| | K-40 | 0.5 | 14.29 (7/7) (3.35-21.68) | D-106, Farm 4.5 mi. SE | 21.68 (1/1) | 16.06 (1/1) | 0 |
| | Mn-54 | 0.046 | <LLD | - | - | <LLD | 0 |
| | Co-58 | 0.072 | <LLD | - | - | <LLD | 0 |
| | Co-60 | 0.064 | <LLD | - | - | <LLD | 0 |
| | Nb-95 | 0.070 | <LLD | - | - | <LLD | 0 |
| | Zr-95 | 0.11 | <LLD | - | - | <LLD | 0 |
| | Ru-103 | 0.060 | <LLD | - | - | <LLD | 0 |
| | Ru-106 | 0.34 | <LLD | - | - | <LLD | 0 |
| | Cs-134 | 0.051 | <LLD | - | - | <LLD | 0 |

Table 5.7 Radiological Environmental Program Summary.

Name of Facility Duane Arnold Energy Center — Docket No. 50-331
Location of Facility Linn, Iowa (County, State) — Reporting Period January - December 1993

| Sample Type (Units) | Type and Number of Analyses[a] | LLD[b] | Indicator Locations Mean (F)[c] Range[c] | Location with Highest Annual Mean Location[d] | Location with Highest Annual Mean Mean (F)[c] Range[c] | Control Locations Mean (F)[c] Range | Number Non-Routine Results[e] |
|---|---|---|---|---|---|---|---|
| Vegetation - Hay (pCi/g wet) *(continued)* | Cs-137 | 0.049 | <LLD | - | - | <LLD | 0 |
| | Ce-141 | 0.060 | <LLD | - | - | <LLD | 0 |
| | Ce-144 | 0.36 | <LLD | - | - | <LLD | 0 |
| Soil (pCi/g dry) | Sr-90 2 | 0.01 | 0.058 (2/2) (0.043-0.074) | D-16, Onsite 0.5 mi. SSE | 0.074 (1/1) | None | 0 |
| | GS 2 | | | | | | |
| | K-40 | 0.5 | 13.68 (2/2) (11.04-16.33) | D-15, Onsite 0.5 mi. NW | 16.33 (1/1) | None | 0 |
| | Mn-54 | 0.021 | <LLD | - | - | None | 0 |
| | Co-58 | 0.026 | <LLD | - | - | None | 0 |
| | Co-60 | 0.034 | <LLD | - | - | None | 0 |
| | Nb-95 | 0.030 | <LLD | - | - | None | 0 |
| | Zr-95 | 0.042 | <LLD | - | - | None | 0 |
| | Ru-103 | 0.020 | <LLD | - | - | None | 0 |
| | Ru-106 | 0.15 | <LLD | - | - | None | 0 |
| | Cs-134 | 0.017 | <LLD | - | - | None | 0 |
| | Cs-137 | 0.060 | 0.26 (2/2) | D-16, Onsite 0.5 mi. SSE | 0.31 (1/1) | None | 0 |
| | Ce-141 | 0.084 | <LLD | - | - | None | 0 |
| | Ce-144 | 0.12 | <LLD | - | - | None | 0 |
| Surface Water (pCi/L) | H-3 20 | 330 | <LLD | - | - | <LLD | 0 |
| | K-40 12 | 0.5 | 15.4 (12/12) (9.1-19.9) | D-107, Onsite Sewage Effluent | 15.4 (12/12) (9.1-19.9) | None | 0 |
| | I-131 60 | 15 | <LLD | - | - | <LLD | 0 |
| | GS 60 | | | | | | |
| | Mn-54 | 15 | <LLD | - | - | <LLD | 0 |
| | Fe-59 | 30 | <LLD | - | - | <LLD | 0 |
| | Co-58 | 15 | <LLD | - | - | <LLD | 0 |
| | Co-60 | 15 | <LLD | - | - | <LLD | 0 |
| | Zn-65 | 30 | <LLD | - | - | <LLD | 0 |

Table 5.7 Radiological Environmental Program Summary.

Name of Facility Duane Arnold Energy Center — Docket No. 50-331
Location of Facility Linn, Iowa (County, State) — Reporting Period January - December 1993

| Sample Type (Units) | Type and Number of Analyses[a] | LLD[b] | Indicator Locations Mean (F)[c] Range[c] | Location with Highest Annual Mean Location[d] | Location with Highest Annual Mean Mean (F)[c] Range[c] | Control Locations Mean (F)[c] Range | Number Non-Routine Results[e] |
|---|---|---|---|---|---|---|---|
| Surface Water (pCi/L) *(continued)* | Nb-95 | 15 | <LLD | - | - | <LLD | 0 |
| | Zr-95 | 30 | <LLD | - | - | <LLD | 0 |
| | Cs-134 | 15 | <LLD | - | - | <LLD | 0 |
| | Cs-137 | 18 | <LLD | - | - | <LLD | 0 |
| | Ba-140 | 60 | <LLD | - | - | <LLD | 0 |
| | La-140 | 15 | <LLD | - | - | <LLD | 0 |
| River Sediments (pCi/g dry) | GS 6 | | | | | | |
| | K-40 | 1.0 | 8.42 (4/4) (7.16-9.91) | D-51, Plant Discharge | 9.65 (2/2) (9.39-9.91) | 8.79 (2/2) (8.51-9.07) | 0 |
| | Mn-54 | 0.019 | <LLD | - | - | <LLD | 0 |
| | Co-58 | 0.022 | <LLD | - | - | <LLD | 0 |
| | Co-60 | 0.026 | 0.035 (1/4) | D-107, Onsite Sewage Effluent | 0.035 (1/4) | <LLD | 0 |
| | Nb-95 | 0.047 | <LLD | - | - | <LLD | 0 |
| | Zr-95 | 0.043 | <LLD | - | - | <LLD | 0 |
| | Ru-103 | 0.038 | <LLD | - | - | <LLD | 0 |
| | Ru-106 | 0.14 | <LLD | - | - | <LLD | 0 |
| | Cs-134 | 0.016 | <LLD | - | - | <LLD | 0 |
| | Cs-137 | 0.018 | 0.026 (3/4) (0.024-0.029) | D-49, Lewis Access 4 mi. NNW | 0.029 (1/4) | 0.029 (1/2) | 0 |
| | Ce-141 | 0.064 | <LLD | - | - | <LLD | 0 |
| | Ce-144 | 0.13 | <LLD | - | - | <LLD | 0 |
| Fish (Edible Portions) (pCi/g wet) | GS 4 | | | | | | |
| | K-40 | 0.5 | 2.8 (2/2) (2.77-2.83) | D-61, Cedar River 0.5 mi. downstream of discharge | 2.80 (2/2) (2.77-2.83) | 2.68 (2/2) (2.62-2.74) | 0 |
| | Mn-54 | 0.021 | <LLD | - | - | <LLD | 0 |
| | Co-58 | 0.017 | <LLD | - | - | <LLD | 0 |
| | Co-60 | 0.032 | <LLD | - | - | <LLD | 0 |
| | Fe-59 | 0.051 | <LLD | - | - | <LLD | 0 |
| | Zn-65 | 0.033 | <LLD | - | - | <LLD | 0 |

Table 5.7 Radiological Environmental Program Summary.

Name of Facility Duane Arnold Energy Center Docket No. 50-331
Location of Facility Linn, Iowa Reporting Period January - December 1993
(County, State)

| Sample Type (Units) | Type and Number of Analyses[a] | LLD[b] | Indicator Locations Mean (F)[c] Range[c] | Location with Highest Annual Mean | | Control Locations Mean (F)[c] Range | Number Non-Routine Results[e] |
|---|---|---|---|---|---|---|---|
| | | | | Location[d] | Mean (F)[c] Range[c] | | |
| Fish (Edible Portions) (pCi/g wet) *(continued)* | Nb-95 | 0.027 | <LLD | - | - | <LLD | 0 |
| | Zr-95 | 0.052 | <LLD | - | - | <LLD | 0 |
| | Ru-103 | 0.026 | <LLD | - | - | <LLD | 0 |
| | Ru-106 | 0.22 | <LLD | - | - | <LLD | 0 |
| | Cs-134 | 0.021 | <LLD | - | - | <LLD | 0 |
| | Cs-137 | 0.023 | <LLD | - | - | <LLD | 0 |
| | Ce-141 | 0.051 | <LLD | - | - | <LLD | 0 |
| | Ce-144 | 0.16 | <LLD | - | - | <LLD | 0 |

[a] GB = gross beta; GS = gamma scan.

[b] LLD = Nominal lower limit of detection based on 4.66 sigma counting error for the background sample.

[c] Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses (F).

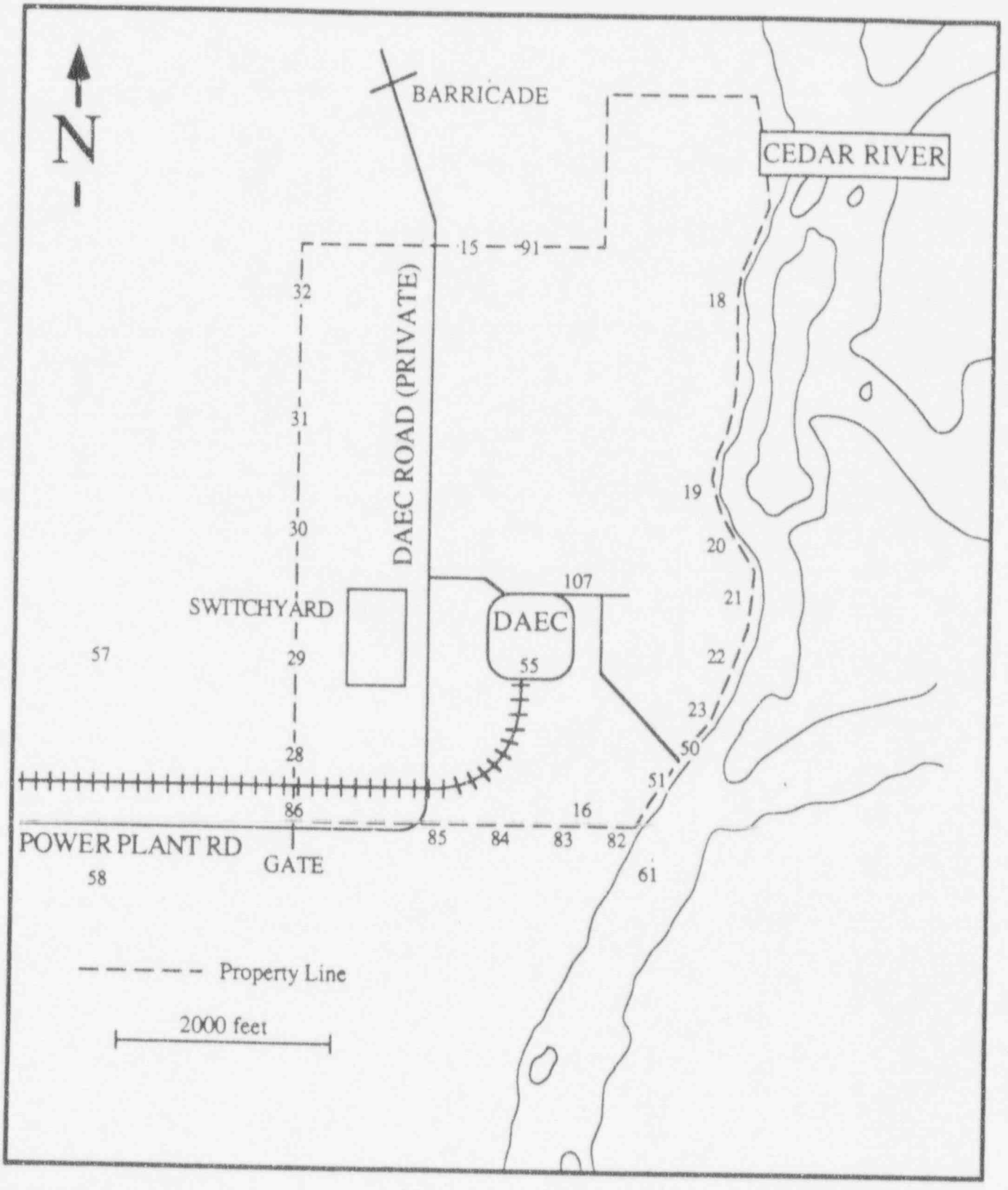
[d] Locations are specified by: (1) Name and code (Table 5.3); and (2) distance, direction, and sector relative to reactor site.

[e] Non-routine results are those which exceed ten times the control station value for the location. If a control station value is not available, the result is considered non-routine if it exceeds ten times the preoperational value for the location.

[f] Three locations (D-1, D-2, D-3) had identical means of 0.023 $pCi/m^3$. Only D-1 is detailed in this summary table.

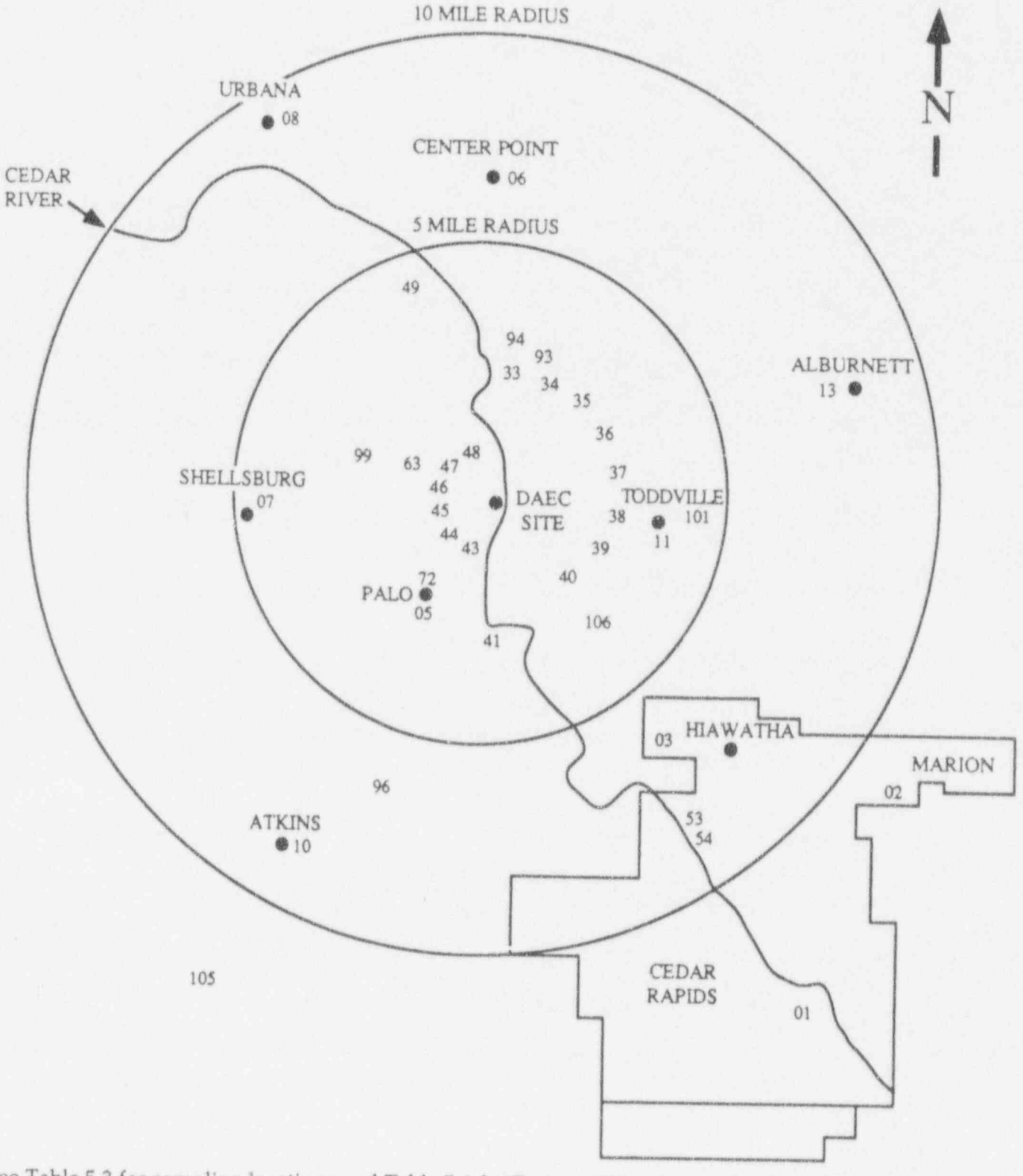
[g] One sample could not reach the required LLD due to small sample size (40 grams).

Figure 5.1 Radiological Environmental Monitoring Program Sampling Stations near the Duane Arnold Energy Center.




See Table 5.3 for sampling locations and Table 5.4 for Type and Frequency of collection.

Figure 5.2 Radiological Environmental Monitoring Program Sampling Stations Outside 0.5 Miles.




See Table 5.3 for sampling locations and Table 5.4 for Type and Frequency of collection.

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# APPENDIX A

## INTERLABORATORY COMPARISON PROGRAM RESULTS

NOTE: Teledyne's Midwest Laboratory participates in intercomparison studies administered by U.S. EPA Environmental Monitoring Systems Laboratory, Las Vegas, Nevada. The results are reported in Appendix A. Also reported are results of in-house spikes and blanks. Appendix A is updated four times a year; the complete Appendix is included in March, June, September and December monthly progress reports only. Please refer to March, June, September and December progress reports for information.

January, 1990 through December, 1993

# Appendix A

## Interlaboratory Comparison Program Results

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

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

The results in Table A-1 were obtained through participation in the environmental sample crosscheck program for milk, water and air filters during the period 1990-1993.

This program is conducted by the U.S. Environmental Protection Agency Intercomparison and Calibration Section, Quality Assurance Branch, Environmental Monitoring and Support Laboratory, Las Vegas, Nevada.

The results in Table A-2 were obtained for Thermoluminescent Dosimeters (TLDs), since 1976 via various International Intercomparisons of Environmental Dosimeters under the sponsorships listed in Table A-2. Also, Teledyne testing results are listed.

Table A-3 lists results of the analyses on in-house "spiked" samples for the past twelve months. Data for previous years are available upon request.

Table A-4 lists results of the analyses on in-house "blank" samples for the past twelve months. Data for previous years are available upon request.

Attachment A lists acceptance criteria for "spiked" samples.

Out-of-limit results are explained directly below the result.

December, 1993

ATTACHMENT A

ACCEPTANCE CRITERIA FOR "SPIKED" SAMPLES

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

| Analysis | Level | One Standard Deviation for single determinations |
|---|---|---|
| Gamma Emitters | 5 to 100 pCi/liter or kg | 5.0 pCi/liter |
| | >100 pCi/liter or kg | 5% of known value |
| Strontium-89[b] | 5 to 50 pCi/liter or kg | 5.0 pCi/liter |
| | >50 pCi/liter or kg | 10% of known value |
| Strontium-90[b] | 2 to 30 pCi/liter or kg | 5.0 pCi/liter |
| | >30 pCi/liter or kg | 10% of known value |
| Potassium | >0.1 g/liter or kg | 5% of known value |
| Gross alpha | ≤20 pCi/liter | 5.0 pCi/liter |
| | >20 pCi/liter | 25% of known value |
| Gross beta | ≤100 pCi/liter | 5.0 pCi/liter |
| | >100 pCi/liter | 5% of known value |
| Tritium | ≤4,000 pCi/liter | 1s = (pCi/liter) = |
| | >4,000 pCi/liter | $169.85 \times (\text{known})^{0.0933}$ |
| | | 10% of known value |
| Radium-226,-228 | <0.1 pCi/liter | 15% of known value |
| Plutonium | 0.1 pCi/liter, gram, or sample | 10% of known value |
| Iodine-131, Iodine-129[b] | ≤55 pCi/liter | 6.0 pCi/liter |
| | >55 pCi/liter | 10% of known value |
| Uranium-238, Nickel-64[b] Technetium-99[b] | ≤35 pCi/liter | 6.0 pCi/liter |
| | >35 pCi/liter | 15% of known value |
| Iron-55[b] | 50 to 100 pCi/liter | 10 pCi/liter |
| | >100 pCi/liter | 10% of known value |
| Others[b] | — | 20% of known value |

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

[b] Teledyne limit.

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c] | EPA Result[d] 1s, N=1 | Control Limits |
|---|---|---|---|---|---|---|
| STW-589 | WATER | Jan, 1990 | | | | |
| | | | Sr-89 | 22.7 ± 5.0 | 25.0 ± 5.0 | 16.3 - 33.7 |
| | | | Sr-90 | 17.3 ± 1.2 | 20.0 ± 1.5 | 17.4 - 22.6 |
| | | | The sample was reanalyzed in triplicate for Sr-90; results of reanalyses were 18.8±1.5 pCi/L. No further action is planned. | | | |
| STW-591 | WATER | Jan, 1990 | | | | |
| | | | Gr. Alpha | 10.3 ± 3.0 | 12.0 ± 5.0 | 3.3 - 20.7 |
| | | | Gr. Beta | 12.3 ± 1.2 | 12.0 ± 5.0 | 3.3 - 20.7 |
| STW-592 | WATER | Jan, 1990 | | | | |
| | | | Ba-133 | 78.0 ± 0.0 | 74.0 ± 7.0 | 61.9 - 86.1 |
| | | | Co-60 | 14.7 ± 2.3 | 15.0 ± 5.0 | 6.3 - 23.7 |
| | | | Cs-134 | 17.3 ± 1.2 | 18.0 ± 5.0 | 9.3 - 26.7 |
| | | | Cs-137 | 19.3 ± 1.2 | 18.0 ± 5.0 | 9.3 - 26.7 |
| | | | Ru-106 | 133.3 ± 13.4 | 139.0 ± 14.0 | 114.8 - 163.2 |
| | | | Zn-65 | 135.0 ± 6.9 | 139.0 ± 14.0 | 114.8 - 163.2 |
| STW-593 | WATER | Feb, 1990 | | | | |
| | | | H-3 | 4827.0 ± 83.0 | 4976.0 ± 498.0 | 4113.0 - 5839.0 |
| STW-594 | WATER | Mar, 1990 | | | | |
| | | | Ra-226 | 5.0 ± 0.2 | 4.9 ± 0.7 | 4.1 - 5.7 |
| | | | Ra-228 | 13.5 ± 0.7 | 12.7 ± 1.9 | 9.4 - 16.0 |
| STW-595 | WATER | Mar, 1990 | | | | |
| | | | Uranium | 4.0 ± 0.0 | 4.0 ± 6.0 | 0.0 - 14.4 |
| STAF-596 | AIR FILTER | Mar, 1990 | | | | |
| | | | Cs-137 | 9.3 ± 1.2 | 10.0 ± 5.0 | 1.3 - 18.7 |
| | | | Gr. Alpha | 7.3 ± 1.2 | 5.0 ± 5.0 | 0.0 - 13.7 |
| | | | Gr. Beta | 34.0 ± 0.0 | 31.0 ± 5.0 | 22.3 - 39.7 |
| | | | Sr-90 | 10.0 ± 0.0 | 10.0 ± 1.5 | 7.4 - 12.6 |
| STW-597 | WATER | Apr, 1990 | | | | |
| | | | Gr. Alpha | 81.0 ± 3.5 | 90.0 ± 23.0 | 50.1 - 129.9 |
| | | | Ra-226 | 4.9 ± 0.4 | 5.0 ± 0.8 | 3.6 - 6.4 |
| | | | Ra-228 | 10.6 ± 0.3 | 10.2 ± 1.5 | 7.6 - 12.8 |
| | | | U | 18.7 ± 3.0 | 20.0 ± 6.0 | 9.6 - 30.4 |
| STW-598 | WATER | Apr, 1990 | | | | |
| | | | Cs-134 | 16.0 ± 0.0 | 15.0 ± 5.0 | 6.3 - 23.7 |
| | | | Cs-137 | 19.0 ± 2.0 | 15.0 ± 5.0 | 6.3 - 23.7 |
| | | | Gross Beta | 51.0 ± 10.1 | 52.0 ± 5.0 | 43.3 - 60.7 |
| | | | Sr-89 | 9.3 ± 1.2 | 10.0 ± 5.0 | 1.3 - 18.7 |

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c] | EPA Result[d] 1s, N=1 | Control Limits |
|---|---|---|---|---|---|---|
| STM-599 | MILK | Apr, 1990 | Sr-90 | 10.3 ± 3.1 | 10.0 ± 1.5 | 8.3 - 11.7 |
| | | | Cs-137 | 26.0 ± 6.0 | 24.0 ± 5.0 | 15.3 - 32.7 |
| | | | I-131 | 98.7 ± 1.2 | 99.0 ± 10.0 | 81.7 - 116.3 |
| | | | K | 1300.0 ± 69.2 | 1550.0 ± 78.0 | 1414.7 - 1685.3 |
| | | | The K analysis was repeated in triplicate; result of reanalysis was 1421.7±95.3 mg/L. No further action is planned. | | | |
| STW-600 | WATER | May, 1990 | Sr-89 | 21.7 ± 3.1 | 23.0 ± 5.0 | 14.3 - 31.7 |
| | | | Sr-90 | 21.0 ± 7.0 | 23.0 ± 5.0 | 14.3 - 31.7 |
| STW-601 | WATER | May, 1990 | Sr-89 | 6.0 ± 2.0 | 7.0 ± 5.0 | 0.0 - 15.7 |
| | | | Sr-90 | 6.7 ± 1.2 | 7.0 ± 5.0 | 0.0 - 15.7 |
| | | | Gr. Alpha | 11.0 ± 2.0 | 22.0 ± 6.0 | 11.6 - 32.4 |
| | | | Gross Alpha analysis was repeated in triplicate; results of reanalyses were 13.4±1.0 pCi/L. No further action is planned. | | | |
| STW-602 | WATER | Jun, 1990 | Gr. Beta | 12.3 ± 1.2 | 15.0 ± 5.0 | 6.3 - 23.7 |
| | | | Ba-133 | 100.7 ± 8.1 | 99.0 ± 10.0 | 81.7 - 116.3 |
| | | | Co-60 | 25.3 ± 2.3 | 24.0 ± 5.0 | 15.3 - 32.7 |
| | | | Cs-134 | 23.7 ± 1.2 | 24.0 ± 5.0 | 18.2 - 29.8 |
| | | | Cs-137 | 27.7 ± 3.1 | 25.0 ± 5.0 | 16.3 - 33.7 |
| | | | Ru-106 | 202.7 ± 17.2 | 210.0 ± 21.0 | 173.6 - 246.4 |
| STW-603 | WATER | Jun, 1990 | Zn-65 | 155.0 ± 10.6 | 148.0 ± 15.0 | 130.6 - 165.4 |
| STW-604 | WATER | Jul, 1990 | H-3 | 2927.0 ± 306.0 | 2933.0 ± 358.0 | 2312.0 - 3554.0 |
| | | | Ra-226 | 11.8 ± 0.9 | 12.1 ± 1.8 | 9.0 - 15.2 |
| STW-605 | WATER | Jul, 1990 | Ra-228 | 4.1 ± 1.4 | 5.1 ± 1.3 | 2.8 - 7.4 |
| STW-606 | WATER | Aug, 1990 | U | 20.3 ± 1.7 | 20.8 ± 3.0 | 15.6 - 26.0 |
| STW-607 | WATER | Aug, 1990 | I-131 | 43.0 ± 1.2 | 39.0 ± 6.0 | 28.6 - 49.4 |
| STAF-608 | AIR FILTER | Aug, 1990 | Pu-239 | 10.0 ± 1.7 | 9.1 ± 0.9 | 7.5 - 10.7 |
| | | | Cs-137 | 19.0 ± 2.0 | 20.0 ± 5.0 | 11.3 - 28.7 |

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c] | EPA Result[d] 1s, N=1 | Control Limits |
|---|---|---|---|---|---|---|
| | | | Gr. Alpha | 14.0 ± 0.0 | 10.0 ± 5.0 | 1.3 - 18.7 |
| | | | Gr. Beta | 65.3 ± 1.2 | 62.0 ± 5.0 | 53.3 - 70.7 |
| | | | Sr-90 | 19.0 ± 6.9 | 20.0 ± 5.0 | 11.3 - 28.7 |
| STW-609 | WATER | Sep, 1990 | | | | |
| | | | Sr-89 | 9.0 ± 2.0 | 10.0 ± 5.0 | 1.3 - 18.7 |
| | | | Sr-90 | 9.0 ± 2.0 | 9.0 ± 5.0 | 0.3 - 17.7 |
| STW-610 | WATER | Sep, 1990 | | | | |
| | | | Gr. Alpha | 8.3 ± 1.2 | 10.0 ± 5.0 | 1.3 - 18.7 |
| | | | Gr. Beta | 10.3 ± 1.2 | 10.0 ± 5.0 | 1.3 - 18.7 |
| STM-611 | MILK | Sep, 1990 | | | | |
| | | | Cs-137 | 20.0 ± 2.0 | 20.0 ± 5.0 | 11.3 - 28.7 |
| | | | I-131 | 63.0 ± 6.0 | 58.0 ± 6.0 | 47.6 - 68.4 |
| | | | K-40 | 1673.3 ± 70.2 | 1700.0 ± 85.0 | 1552.5 - 1847.5 |
| | | | Sr-89 | 11.7 ± 3.1 | 16.0 ± 5.0 | 7.3 - 24.7 |
| | | | Sr-90 | 15.0 ± 0.0 | 20.0 ± 5.0 | 11.3 - 28.7 |
| STW-612 | WATER | Oct, 1990 | | | | |
| | | | Ba-133 | 116.7 ± 9.9 | 110.0 ± 11.0 | 90.9 - 129.0 |
| | | | Co-60 | 20.3 ± 3.1 | 20.0 ± 5.0 | 11.3 - 28.7 |
| | | | Cs-134 | 11.0 ± 0.0 | 12.0 ± 5.0 | 3.3 - 20.7 |
| | | | Cs-137 | 14.0 ± 2.0 | 12.0 ± 5.0 | 3.3 - 20.7 |
| | | | Ru-106 | 152.0 ± 8.0 | 151.0 ± 15.0 | 125.0 - 177.0 |
| | | | Zn-65 | 115.3 ± 12.2 | 115.0 ± 12.0 | 94.2 - 135.8 |
| STW-613 | WATER | Oct, 1990 | | | | |
| | | | H-3 | 7167.0 ± 330.0 | 7203.0 ± 720.0 | 5954.0 - 8452.0 |
| STW-614 | WATER | Oct, 1990 | | | | |
| | | | Gr. Alpha | 68.7 ± 7.2 | 62.0 ± 16.0 | 34.2 - 89.8 |
| | | | Ra-226 | 12.9 ± 0.3 | 13.6 ± 2.0 | 10.1 - 17.1 |
| | | | Ra-228 | 4.2 ± 0.6 | 5.0 ± 1.3 | 2.7 - 7.3 |
| | | | U | 10.4 ± 0.6 | 10.2 ± 3.0 | 5.0 - 15.4 |
| STW-615 | WATER | Oct, 1990 | | | | |
| | | | Cs-134 | 9.0 ± 1.7 | 7.0 ± 5.0 | 0.0 - 15.7 |
| | | | Cs-137 | 7.7 ± 1.2 | 5.0 ± 5.0 | 0.0 - 13.7 |
| | | | Gross Beta | 55.0 ± 8.7 | 53.0 ± 5.0 | 44.3 - 61.7 |
| | | | Sr-89 | 15.7 ± 2.9 | 20.0 ± 5.0 | 11.3 - 28.7 |
| | | | Sr-90 | 12.0 ± 2.0 | 15.0 ± 5.0 | 6.0 - 23.7 |

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c] | EPA Result[d] 1s, N=1 | Control Limits |
|---|---|---|---|---|---|---|
| STW-616 | WATER | Nov, 1990 | | | | |
| | | | Ra-226 | 6.8 ± 1.0 | 7.4 ± 1.1 | 5.5 - 9.3 |
| | | | Ra-228 | 5.3 ± 1.7 | 7.7 ± 1.9 | 4.4 - 11.0 |
| STW-617 | WATER | Nov, 1990 | | | | |
| | | | U | 35.0 ± 0.4 | 35.5 ± 3.6 | 29.3 - 41.7 |
| | | | Sample was analyzed but the results were not submitted to the EPA because the deadline was missed (all data on file). | | | |
| STW-618 | WATER | Jan, 1991 | | | | |
| | | | Sr-89 | 4.3 ± 1.2 | 5.0 ± 5.0 | 0.0 - 13.7 |
| | | | Sr-90 | 4.7 ± 1.2 | 5.0 ± 5.0 | 0.0 - 13.7 |
| STW-619 | WATER | Jan, 1991 | | | | |
| | | | Pu-239 | 3.6 ± 0.2 | 3.3 ± 0.3 | 2.8 - 3.8 |
| STW-620 | WATER | Jan, 1991 | | | | |
| | | | Gr. Alpha | 6.7 ± 3.0 | 5.0 ± 5.0 | 0.0 - 13.7 |
| | | | Gr. Beta | 6.3 ± 1.2 | 5.0 ± 5.0 | 0.0 - 13.7 |
| STW-621 | WATER | Feb, 1991 | | | | |
| | | | Ba-133 | 85.7 ± 9.2 | 75.0 ± 8.0 | 61.1 - 88.9 |
| | | | Co-60 | 41.3 ± 8.4 | 40.0 ± 5.0 | 31.3 - 48.7 |
| | | | Cs-134 | 9.0 ± 2.0 | 8.0 ± 5.0 | 0.0 - 16.7 |
| | | | Cs-137 | 9.7 ± 1.2 | 8.0 ± 5.0 | 0.0 - 16.7 |
| | | | Ru-106 | 209.7 ± 18.6 | 186.0 ± 19.0 | 153.0 - 219.0 |
| | | | Zn-65 | 166.7 ± 19.7 | 149.0 ± 15.0 | 123.0 - 175.0 |
| STW-622 | WATER | Feb, 1991 | | | | |
| | | | I-131 | 81.3 ± 6.1 | 75.0 ± 8.0 | 61.1 - 88.9 |
| STW-623 | WATER | Feb, 1991 | | | | |
| | | | H-3 | 4310.0 ± 144.2 | 4418.0 ± 442.0 | 3651.2 - 5184.8 |
| STW-624 | WATER | Mar, 1991 | | | | |
| | | | Ra-226 | 31.4 ± 3.2 | 31.8 ± 4.8 | 23.5 - 40.1 |
| | | | Ra-228 | | 21.1 ± 5.3 | 11.9 - 30.3 |
| | | | No data for Ra-228 was reported; sample was lost during analysis. | | | |
| STW-625 | WATER | Mar, 1991 | | | | |
| | | | U | 6.7 ± 0.4 | 7.6 ± 3.0 | 2.4 - 12.8 |
| STAF-626 | AIR FILTER | Mar, 1991 | | | | |
| | | | Cs-137 | 33.7 ± 4.2 | 40.0 ± 5.0 | 31.3 - 48.7 |

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c] | EPA Result[d] 1s, N=1 | Control Limits |
|---|---|---|---|---|---|---|
| | | | Gr. Alpha | 38.7 ± 1.2 | 25.0 ± 6.0 | 14.6 - 35.4 |
| | | | The cause of the high Gross Alpha result is the difference in geometry between the standard used in the TIML lab and the EPA filter. | | | |
| | | | Gr. Beta | 130.0 ± 4.0 | 124.0 ± 6.0 | 113.6 - 134.4 |
| | | | Sr-90 | 35.7 ± 1.2 | 40.0 ± 5.0 | 31.3 - 48.7 |
| STW-627 | WATER | Apr, 1991 | | | | |
| | | | Gr. Alpha | 51.0 ± 6.0 | 54.0 ± 14.0 | 29.7 - 78.3 |
| | | | Ra-226 | 7.0 ± 0.8 | 8.0 ± 1.2 | 5.9 - 10.1 |
| | | | Ra-228 | 9.7 ± 1.9 | 15.2 ± 3.8 | 8.6 - 21.8 |
| | | | U | 27.7 ± 2.4 | 29.8 ± 3.0 | 24.6 - 35.0 |
| STW-628 | WATER | Apr, 1991 | | | | |
| | | | Cs-134 | 27.3 ± 1.2 | 24.0 ± 5.0 | 15.3 - 32.7 |
| | | | Cs-137 | 29.0 ± 2.0 | 25.0 ± 5.0 | 16.3 - 33.7 |
| | | | Gross Beta | 93.3 ± 6.4 | 115.0 ± 17.0 | 85.5 - 144.5 |
| | | | Sr-89 | 21.0 ± 3.5 | 28.0 ± 5.0 | 19.3 - 36.7 |
| | | | Sr-90 | 23.0 ± 0.0 | 26.0 ± 5.0 | 17.3 - 34.7 |
| STM-629 | MILK | Apr, 1991 | | | | |
| | | | Cs-137 | 54.7 ± 11.0 | 49.0 ± 5.0 | 40.3 - 57.7 |
| | | | I-131 | 65.3 ± 14.7 | 60.0 ± 6.0 | 49.6 - 70.4 |
| | | | K-40 | 1591.7 ± 180.1 | 1650.0 ± 83.0 | 1506.0 - 1794.0 |
| | | | Sr-89 | 24.0 ± 8.7 | 32.0 ± 5.0 | 23.3 - 40.7 |
| | | | Sr-90 | 28.0 ± 2.0 | 32.0 ± 5.0 | 23.3 - 40.7 |
| STW-630 | WATER | May, 1991 | | | | |
| | | | Sr-89 | 40.7 ± 2.3 | 39.0 ± 5.0 | 30.3 - 47.7 |
| | | | Sr-90 | 23.7 ± 1.2 | 24.0 ± 5.0 | 15.3 - 32.7 |
| STW-631 | WATER | May, 1991 | | | | |
| | | | Gr. Alpha | 27.7 ± 5.8 | 24.0 ± 6.0 | 13.6 - 34.4 |
| | | | Gr. Beta | 46.0 ± 0.0 | 46.0 ± 5.0 | 37.3 - 54.7 |
| STW-632 | WATER | Jun, 1991 | | | | |
| | | | Ba-133 | 74.0 ± 6.9 | 62.0 ± 6.0 | 51.6 - 72.4 |
| | | | Sample was reanalyzed for Ba-133. Result of the reanalysis was 63.8±6.9 pCi/L; within the EPA control limits. | | | |
| | | | Co-60 | 11.3 ± 1.2 | 10.0 ± 5.0 | 1.3 - 18.7 |
| | | | Cs-134 | 15.3 ± 1.2 | 15.0 ± 5.0 | 6.3 - 23.7 |
| | | | Cs-137 | 16.3 ± 1.2 | 14.0 ± 5.0 | 5.3 - 22.7 |
| | | | Ru-106 | 162.3 ± 19.0 | 149.0 ± 15.0 | 123.0 - 175.0 |

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c] | EPA Result[d] 1s, N=1 | Control Limits |
|---|---|---|---|---|---|---|
| | | | Zn-65 | 119.3 ± 16.3 | 108.0 ± 11.0 | 88.9 - 127.1 |
| STW-633 | WATER | Jun, 1991 | | | | |
| | | | H-3 | 13470.0 ± 385.8 | 12480.0 ± 1248.0 | 10314.8 - 14645.2 |
| STW-634 | WATER | Jul, 1991 | | | | |
| | | | Ra-226 | 14.9 ± 0.4 | 15.9 ± 2.4 | 11.7 - 20.1 |
| | | | Ra-228 | 17.6 ± 1.8 | 16.7 ± 4.2 | 9.4 - 24.0 |
| STW-635 | WATER | Jul, 1991 | | | | |
| | | | U | 12.8 ± 0.1 | 14.2 ± 3.0 | 9.0 - 19.4 |
| STW-636 | WATER | Aug, 1991 | | | | |
| | | | I-131 | 19.3 ± 1.2 | 20.0 ± 6.0 | 9.6 - 30.4 |
| STW-637 | WATER | Aug, 1991 | | | | |
| | | | Pu-239 | 21.4 ± 0.5 | 19.4 ± 1.9 | 16.1 - 22.7 |
| STAF-638 | AIR FILTER | Aug, 1991 | | | | |
| | | | Cs-137 | 26.3 ± 1.2 | 30.0 ± 5.0 | 21.3 - 38.7 |
| | | | Gr. Alpha | 33.0 ± 2.0 | 25.0 ± 6.0 | 14.6 - 35.4 |
| | | | Gr. Beta | 88.7 ± 1.2 | 92.0 ± 10.0 | 80.4 - 103.6 |
| | | | Sr-90 | 27.0 ± 4.0 | 30.0 ± 5.0 | 21.3 - 38.7 |
| STW-639 | WATER | Sep, 1991 | | | | |
| | | | Sr-89 | 47.0 ± 10.4 | 49.0 ± 5.0 | 40.3 - 57.7 |
| | | | Sr-90 | 24.0 ± 2.0 | 25.0 ± 5.0 | 16.3 - 33.7 |
| STW-640 | WATER | Sep, 1991 | | | | |
| | | | Gr. Alpha | 12.0 ± 4.0 | 10.0 ± 5.0 | 1.3 - 18.7 |
| | | | Gr. Beta | 20.3 ± 1.2 | 20.0 ± 5.0 | 11.3 - 28.7 |
| STM-641 | MILK | Sep, 1991 | | | | |
| | | | Cs-137 | 33.7 ± 3.2 | 30.0 ± 5.0 | 21.3 - 38.7 |
| | | | I-131 | 130.7 ± 16.8 | 108.0 ± 11.0 | 88.9 - 127.1 |
| | | | The cause of the high result for the I-131 analysis is unknown. An in-house spike sample was prepared with activity for I-131 of 68.3±6.8 pCi/L. Result of TIML's analysis of the in-house spike was 69.1±9.7 pCi/L. | | | |
| | | | K | 1743.3 ± 340.8 | 1740.0 ± 87.0 | 1589.1 - 1890.9 |
| | | | Sr-89 | 20.3 ± 5.0 | 25.0 ± 5.0 | 16.3 - 33.7 |
| | | | Sr-90 | 19.7 ± 3.1 | 25.0 ± 5.0 | 16.3 - 33.7 |
| STW-642 | WATER | Oct, 1991 | | | | |
| | | | Ba-133 | 94.7 ± 3.1 | 98.0 ± 10.0 | 80.7 - 115.3 |
| | | | Co-60 | 29.7 ± 1.2 | 29.0 ± 5.0 | 20.3 - 37.7 |
| | | | Cs-134 | 9.7 ± 1.2 | 10.0 ± 5.0 | 1.3 - 18.7 |

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c] | EPA Result[d] 1s, N=1 | Control Limits |
|---|---|---|---|---|---|---|
| | | | Cs-137 | 11.0 ± 2.0 | 10.0 ± 5.0 | 1.3 - 18.7 |
| | | | Ru-106 | 196.3 ± 15.1 | 199.0 ± 20.0 | 164.3 - 233.7 |
| | | | Zn-65 | 75.7 ± 8.3 | 73.0 ± 7.0 | 60.9 - 85.1 |
| STW-643 | WATER | Oct, 1991 | | | | |
| | | | H-3 | 2640.0 ± 156.2 | 2454.0 ± 352.0 | 1843.3 - 3064.7 |
| STW-644 | WATER | Oct, 1991 | | | | |
| | | | Gr. Alpha | 73.0 ± 13.1 | 82.0 ± 21.0 | 45.6 - 118.4 |
| | | | Ra-226 | 20.9 ± 2.0 | 22.0 ± 3.3 | 16.3 - 27.7 |
| | | | Ra-228 | 19.6 ± 2.3 | 22.2 ± 5.6 | 12.5 - 31.9 |
| | | | U | 13.5 ± 0.6 | 13.5 ± 3.0 | 8.3 - 18.7 |
| STW-645 | WATER | Oct, 1991 | | | | |
| | | | Co-60 | 20.3 ± 1.2 | 20.0 ± 5.0 | 11.3 - 28.7 |
| | | | Cs-134 | 9.0 ± 5.3 | 10.0 ± 5.0 | 1.3 - 18.7 |
| | | | Cs-137 | 14.7 ± 5.0 | 11.0 ± 5.0 | 2.3 - 19.7 |
| | | | Gross Beta | 55.3 ± 3.1 | 65.0 ± 10.0 | 47.7 - 82.3 |
| | | | Sr-89 | 9.7 ± 3.1 | 10.0 ± 5.0 | 1.3 - 18.7 |
| | | | Sr-90 | 8.7 ± 1.2 | 10.0 ± 5.0 | 1.3 - 18.7 |
| STW-646 | WATER | Nov, 1991 | | | | |
| | | | Ra-226 | 5.6 ± 1.2 | 6.5 ± 1.0 | 4.8 - 8.2 |
| | | | Ra-228 | 9.6 ± 0.5 | 8.1 ± 2.0 | 4.6 - 11.6 |
| STW-647 | WATER | Nov, 1991 | | | | |
| | | | U | 24.7 ± 2.3 | 24.9 ± 3.0 | 19.7 - 30.1 |
| STW-648 | WATER | Jan, 1992 | | | | |
| | | | Sr-89 | 42.7 ± 6.4 | 51.0 ± 5.0 | 42.3 - 59.7 |
| | | | Sr-90 | 18.3 ± 3.1 | 20.0 ± 5.0 | 11.3 - 28.7 |
| STW-649 | WATER | Jan, 1992 | | | | |
| | | | Pu-239 | 16.1 ± 0.8 | 16.8 ± 1.7 | 13.9 - 19.7 |
| STW-650 | WATER | Jan, 1992 | | | | |
| | | | Gr. Alpha | 23.7 ± 9.2 | 30.0 ± 8.0 | 16.1 - 43.9 |
| | | | Gr. Beta | 27.7 ± 4.2 | 30.0 ± 5.0 | 21.3 - 38.7 |
| STW-651 | WATER | Feb, 1992 | | | | |
| | | | I-131 | 60.3 ± 4.2 | 59.0 ± 6.0 | 48.6 - 69.4 |
| STW-652 | WATER | Feb, 1992 | | | | |
| | | | Ba-133 | 79.0 ± 3.4 | 76.0 ± 8.0 | 62.1 - 89.9 |
| | | | Co-60 | 40.3 ± 5.0 | 40.0 ± 5.0 | 31.3 - 48.7 |
| | | | Cs-134 | 31.7 ± 4.2 | 31.0 ± 5.0 | 22.3 - 39.7 |

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c] | EPA Result[d] 1s, N=1 | Control Limits |
|---|---|---|---|---|---|---|
| | | | Cs-137 | 51.0 ± 3.4 | 49.0 ± 5.0 | 40.3 - 57.7 |
| | | | Ru-106 | 188.7 ± 28.8 | 203.0 ± 20.0 | 168.3 - 237.7 |
| | | | Zn-65 | 148.0 ± 15.0 | 150.7 ± 6.1 | 122.0 - 174.0 |
| STW-653 | WATER | Feb, 1992 | | | | |
| | | | H-3 | 7714.0 ± 119.6 | 7904.0 ± 790.0 | 6533.4 - 9274.6 |
| STW-654 | WATER | Mar, 1992 | | | | |
| | | | Ra-226 | 9.0 ± 0.4 | 10.1 ± 1.5 | 7.5 - 12.7 |
| | | | Ra-228 | 18.8 ± 0.6 | 15.5 ± 3.9 | 8.7 - 22.3 |
| STW-655 | WATER | Mar, 1992 | | | | |
| | | | Rn-222 | | 0.0 | |
| STW-656 | WATER | Mar, 1992 | No Data; Special EPA testing. | | | |
| | | | U | 25.1 ± 1.9 | 25.3 ± 3.0 | 20.1 - 30.5 |
| STW-657 | WATER | Mar, 1992 | | | | |
| | | | Rn-222 | | | |
| STAF-658 | AIR FILTER | Mar, 1992 | No Data is available; Special EPA testing. | | | |
| | | | Cs-137 | 10.0 ± 0.0 | 10.0 ± 5.0 | 1.3 - 18.7 |
| | | | Gr. Alpha | 7.0 ± 0.0 | 7.0 ± 5.0 | 0.0 - 15.7 |
| | | | Gr. Beta | 39.3 ± 1.6 | 41.0 ± 5.0 | 32.3 - 49.7 |
| | | | Sr-90 | 13.7 ± 1.6 | 15.0 ± 5.0 | 6.3 - 23.7 |
| STW-659 | WATER | Apr, 1992 | | | | |
| | | | Gr. Alpha | 35.7 ± 6.1 | 40.0 ± 10.0 | 22.7 - 57.3 |
| | | | Ra-226 | 12.7 ± 1.2 | 14.9 ± 2.2 | 11.1 - 18.7 |
| | | | Ra-228 | 14.5 ± 2.1 | 14.0 ± 3.5 | 7.9 - 20.1 |
| | | | U | 3.9 ± 0.2 | 4.0 ± 3.0 | 0.0 - 9.2 |
| STW-660 | WATER | Apr, 1992 | | | | |
| | | | Co-60 | 61.0 ± 4.0 | 56.0 ± 5.0 | 47.3 - 64.7 |
| | | | Cs-134 | 24.3 ± 1.2 | 24.0 ± 5.0 | 15.3 - 32.7 |
| | | | Cs-137 | 24.0 ± 2.0 | 22.0 ± 5.0 | 13.3 - 30.7 |
| | | | Gross Beta | 113.0 ± 7.2 | 140.0 ± 21.0 | 103.6 - 176.4 |
| | | | Sr-89 | 12.3 ± 4.2 | 15.0 ± 5.0 | 6.3 - 23.7 |
| | | | Sr-90 | 15.0 ± 1.2 | 17.0 ± 5.0 | 8.3 - 25.7 |
| STM-661 | MILK | Apr, 1992 | | | | |
| | | | Cs-137 | 39.3 ± 2.3 | 39.0 ± 5.0 | 30.3 - 47.7 |
| | | | I-131 | 78.7 ± 9.5 | 78.0 ± 8.0 | 64.1 - 91.9 |

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c] | EPA Result[d] 1s, N=1 | Control Limits |
|---|---|---|---|---|---|---|
| | | | K-40 | 1610.0 ± 72.1 | 1710.0 ± 86.0 | 1560.8 - 1859.2 |
| | | | Sr-89 | 25.3 ± 7.6 | 38.0 ± 5.0 | 29.3 - 46.7 |
| | | | The cause of the low Sr-89 results is unknown. Data were checked for errors. An in-house spike sample was prepared with activity for Sr-89 of 41.0±10.0 pCi/L. Result of the analysis of the in-house spike sample for Sr-89 was 37.2±3.6 pCi/L. | | | |
| | | | Sr-90 | 24.3 ± 3.1 | 29.0 ± 5.0 | 20.3 - 37.7 |
| STW-662 | WATER | May, 1992 | | | | |
| | | | Sr-89 | 24.0 ± 4.0 | 29.0 ± 5.0 | 20.3 - 37.7 |
| | | | Sr-90 | 6.7 ± 1.2 | 8.0 ± 5.0 | 0.0 - 16.7 |
| STW-663 | WATER | May, 1992 | | | | |
| | | | Gr. Alpha | 12.3 ± 2.1 | 15.0 ± 5.0 | 6.3 - 23.7 |
| | | | Gr. Beta | 46.0 ± 5.0 | 44.0 ± 5.0 | 35.3 - 52.7 |
| STW-664 | WATER | Jun, 1992 | | | | |
| | | | Ba-133 | 92.7 ± 11.0 | 98.0 ± 10.0 | 80.7 - 115.3 |
| | | | Co-60 | 20.3 ± 1.2 | 20.0 ± 5.0 | 11.3 - 28.7 |
| | | | Cs-134 | 14.3 ± 2.3 | 15.0 ± 5.0 | 6.3 - 23.7 |
| | | | Cs-137 | 15.0 ± 2.0 | 15.0 ± 5.0 | 6.3 - 23.7 |
| | | | Ru-106 | 142.7 ± 23.7 | 141.0 ± 14.0 | 116.7 - 165.3 |
| | | | Zn-65 | 103.3 ± 10.6 | 99.0 ± 10.0 | 81.7 - 116.3 |
| STW-665 | WATER | Jun, 1992 | | | | |
| | | | H-3 | 2153.3 ± 144.6 | 2125.0 ± 347.0 | 1523.0 - 2727.0 |
| STW-666 | WATER | Jul, 1992 | | | | |
| | | | Ra-226 | 22.3 ± 2.2 | 24.9 ± 3.7 | 18.5 - 31.3 |
| | | | Ra-228 | 16.7 ± 3.1 | 16.7 ± 4.2 | 9.4 - 24.0 |
| STW-667 | WATER | Jul, 1992 | | | | |
| | | | Uranium | 3.6 ± 0.3 | 4.0 ± 3.0 | 0.0 - 9.2 |
| STW-668 | WATER | Aug, 1992 | | | | |
| | | | I-131 | 47.0 ± 3.5 | 45.0 ± 6.0 | 34.6 - 55.4 |
| STW-669 | WATER | Aug, 1992 | | | | |
| | | | Pu-239 | 8.5 ± 0.9 | 9.0 ± 0.9 | 7.4 - 10.6 |
| STAF-670 | AIR FILTER | Aug, 1992 | | | | |
| | | | Alpha | 25.7 ± 1.2 | 30.0 ± 8.0 | 16.1 - 43.9 |
| | | | Beta | 69.0 ± 2.0 | 69.0 ± 10.0 | 51.7 - 86.3 |
| | | | Cs-137 | 16.0 ± 0.0 | 18.0 ± 5.0 | 9.3 - 26.7 |
| | | | Sr-90 | 26.0 ± 4.0 | 25.0 ± 5.0 | 16.3 - 33.7 |

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c] | EPA Result[d] 1s, N=1 | Control Limits |
|---|---|---|---|---|---|---|
| STW-671 | WATER | Sep, 1992 | | | | |
| | | | Sr-89 | 16.0 ± 4.0 | 20.0 ± 5.0 | 11.3 - 28.7 |
| | | | Sr-90 | 14.3 ± 3.1 | 15.0 ± 5.0 | 6.3 - 23.7 |
| STW-672 | WATER | Sep, 1992 | | | | |
| | | | Alpha | 43.0 ± 13.1 | 45.0 ± 11.0 | 25.9 - 64.1 |
| | | | Beta | 41.3 ± 18.6 | 50.0 ± 5.0 | 14.3 - 58.7 |
| STM-673 | MILK | Sep, 1992 | | | | |
| | | | Cs-137 | 14.0 ± 3.5 | 15.0 ± 5.0 | 6.3 - 23.7 |
| | | | I-131(gamma | 109.7 ± 19.4 | 100.0 ± 10.0 | 82.7 - 117.3 |
| | | | K | 1540.0 ± 103.9 | 1750.0 ± 88.0 | 1597.3 - 1902.7 |
| | | | The K activity was calculated using the wrong volume (3.5 L), instead of 3.25 L. Correction for volume resulted in a value of 1660.0±110.1; within EPA control limits. | | | |
| | | | Sr-89 | 11.0 ± 3.5 | 15.0 ± 5.0 | 6.3 - 23.7 |
| | | | Sr-90 | 12.7 ± 1.6 | 15.0 ± 5.0 | 6.3 - 23.7 |
| STW-674 | WATER | Oct, 1992 | | | | |
| | | | Ba-133 | 80.3 ± 9.0 | 74.0 ± 7.0 | 61.9 - 86.1 |
| | | | Co-60 | 11.3 ± 2.3 | 10.0 ± 5.0 | 1.3 - 18.7 |
| | | | Cs-134 | 9.7 ± 2.3 | 8.0 ± 5.0 | 0.0 - 16.7 |
| | | | Cs-137 | 9.7 ± 1.2 | 8.0 ± 5.0 | 0.0 - 16.7 |
| | | | Ru-106 | [illegible]7 ± 2.3 | 175.0 ± 18.0 | 143.8 - 206.2 |
| | | | Zn-65 | [illegible]' ± 25.0 | 148.0 ± 15.0 | 122.0 - 174.0 |
| STW-675 | WATER | Oct, 1992 | | | | |
| | | | H-3 | [illegible] ± 136.2 | 5962.0 ± 596.0 | 4928.0 - 6996.0 |
| STW-676 | WATER | Oct, 1992 | | | | |
| | | | Gr. Alpha | 24.7 ± 5.0 | 29.0 ± 7.0 | 16.9 - 41.1 |
| | | | Ra-226 | 7.1 ± 0.4 | 7.4 ± 1.1 | 5.5 - 9.3 |
| | | | Ra-228 | 11.5 ± 1.0 | 10.0 ± 2.5 | 5.7 - 14.3 |
| | | | Uranium | 9.7 ± 0.5 | 10.2 ± 3.0 | 5.0 - 15.4 |
| STW-677 | WATER | Oct, 1992 | | | | |
| | | | Co-60 | 15.0 ± 2.0 | 15.0 ± 5.0 | 6.3 - 23.7 |
| | | | Cs-134 | 5.7 ± 1.2 | 5.0 ± 5.0 | 0.0 - 13.7 |
| | | | Cs-137 | 8.0 ± 2.0 | [illegible].0 ± 5.0 | 0.0 - 16.7 |
| | | | Gr. Beta | 42.7 ± 8.1 | [illegible].0 ± 10.0 | 35.7 - 70.3 |
| | | | Sr-89 | 6.7 ± 1.2 | 8.0 ± 5.0 | 0.0 - 16.7 |
| | | | Sr-90 | 10.0 ± 2.0 | 110.0 ± 5.0 | 1.3 - 18.7 |

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c] | EPA Result[d] 1s, N=1 | Control Limits |
|---|---|---|---|---|---|---|
| STW-678 | WATER | Oct, 1992 | | | | |
| | | | Ra-226 | 7.5 ± 0.8 | 7.5 ± 1.1 | 5.6 - 9.4 |
| | | | Ra-228 | 5.8 ± 0.7 | 5.0 ± 1.3 | 2.7 - 7.3 |
| STW-679 | WATER | Nov, 1992 | | | | |
| | | | Uranium | 15.5 ± 1.1 | 15.2 ± 3.3 | 10.0 - 20.4 |
| STW-680 | WATER | Jan, 1993 | | | | |
| | | | Sr-89 | 15.0 ± 2.0 | 15.0 ± 5.0 | 6.3 - 23.7 |
| | | | Sr-90 | 10.3 ± 1.2 | 10.0 ± 5.0 | 1.3 - 18.7 |
| STW-681 | WATER | Jan, 1993 | | | | |
| | | | Pu-239 | 17.5 ± 1.6 | 20.0 ± 2.0 | 16.5 - 23.5 |
| STW-682 | WATER | Jan, 1993 | | | | |
| | | | Alpha | 17.1 ± 1.2 | 34.0 ± 9.0 | 18.4 - 49.6 |
| | | | Gross Alpha analysis was repeated with similar results. An investigation of possible causes for the deviation from the EPA was conducted with no cause discovered. The sample was spiked with Th-230; so Alpha Spec Analysis for Th-230 was performed in triplicate with results of 15.5±2.1, 13.4±1.4, and 14.8±2.0. It should be noted that 66% of all participants failed this analysis with a grand average of 17.1. This coupled with the support of the Alpha Spec results leaves TIML cause to believe that there may have been a dilution error at the EPA. It should be noted that on the next Gross Alpha EPA check, TIML reported results that where exactly the known value. Since no apparent cause can be found, and TIML had outstanding results on the following sample, it is felt that no further investigation is needed. | | | | |
| | | | Beta | 46.7 ± 3.2 | 44.0 ± 5.0 | 35.3 - 52.7 |
| STW-683 | WATER | Feb, 1993 | | | | |
| | | | I-131 | 106.0 ± 10.0 | 100.0 ± 10.0 | 82.7 - 117.3 |
| STW-684 | WATER | Feb, 1993 | | | | |
| | | | Uranium | 7.2 ± 0.5 | 7.6 ± 3.0 | 2.4 - 12.8 |
| STW-685 | WATER | Mar, 1993 | | | | |
| | | | Ra-226 | 9.3 ± 1.3 | 9.8 ± 1.5 | 7.2 - 12.4 |
| | | | Ra-228 | 20.8 ± 2.2 | 18.5 ± 4.6 | 10.5 - 26.5 |
| STW-686 | WATER | Apr, 1993 | | | | |
| | | | Alpha | 88.3 ± 8.1 | 95.0 ± 24.0 | 53.4 - 136.6 |
| | | | Ra-226 | 25.4 ± 1.4 | 24.9 ± 3.7 | 18.5 - 31.3 |
| | | | Ra-228 | 17.4 ± 1.2 | 19.0 ± 4.8 | 10.7 - 27.3 |

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c] | EPA Result[d] 1s, N=1 | Control Limits |
|---|---|---|---|---|---|---|
| STW-687 | WATER | Apr, 1993 | Uranium | 27.8 ± 2.2 | 28.9 ± 3.0 | 23.7 - 34.1 |
| | | | Beta | 141.7 ± 9.0 | 177.0 ± 27.0 | 130.2 - 223.8 |
| | | | Co-60 | 41.3 ± 1.2 | 39.0 ± 5.0 | 30.3 - 47.7 |
| | | | Cs-134 | 24.7 ± 1.2 | 27.0 ± 5.0 | 18.3 - 35.7 |
| | | | Cs-137 | 30.0 ± 0.0 | 32.0 ± 5.0 | 23.3 - 40.7 |
| | | | Sr-89 | 28.7 ± 9.4 | 41.0 ± 5.0 | 32.3 - 49.7 |
| | | | The EPA report was received 08-16-93. No cause for the low result for Sr-89 was found. The analyst has been observed performing this procedure with no noted descrepancies. Teledyne will continue to monitor this procedure in the future. No further action is anticipated unless conditions warrant. | | | |
| | | | Sr-90 | 28.0 ± 3.5 | 29.0 ± 5.0 | 20.3 - 37.7 |
| STW-688 | WATER | Jun, 1993 | | | | |
| STW-689 | WATER | Jun, 1993 | H-3 | 9613.3 ± 46.2 | 9844.0 ± 984.0 | 8136.8 - 11551.2 |
| | | | Ba-133 | 101.7 ± 10.3 | 99.0 ± 10.0 | 81.7 - 116.3 |
| | | | Co-60 | 17.3 ± 4.6 | 15.0 ± 5.0 | 6.3 - 23.7 |
| | | | Cs-134 | 5.7 ± 1.2 | 5.0 ± 5.0 | 0.0 - 13.7 |
| | | | Cs-137 | 6.0 ± 2.0 | 5.0 ± 5.0 | 0.0 - 13.7 |
| | | | Ru-106 | 108.0 ± 8.0 | 119.0 ± 12.0 | 98.2 - 139.8 |
| | | | Zn-65 | 114.0 ± 13.2 | 103.0 ± 10.0 | 85.7 - 120.3 |
| STW-690 | WATER | Jul, 1993 | | | | |
| | | | Sr-89 | 28.3 ± 2.3 | 34.0 ± 5.0 | 25.3 - 42.7 |
| | | | Sr-90 | 25.0 ± 1.0 | 25.0 ± 5.0 | 16.3 - 33.7 |
| STW-691 | WATER | Jul, 1993 | | | | |
| | | | Alpha | 15.0 ± 2.7 | 15.0 ± 5.0 | 6.3 - 23.7 |
| | | | Beta | 41.3 ± 4.9 | 43.0 ± 6.9 | 31.0 - 55.0 |
| STW-692 | WATER | Aug, 1993 | | | | |
| | | | Uranium | 24.9 ± 1.4 | 25.3 ± 3.0 | 20.1 - 30.5 |
| STAF-693 | AIR FILTER | Aug, 1993 | | | | |
| | | | Alpha | 17.0 ± 1.0 | 19.0 ± 5.0 | 10.3 - 27.7 |
| | | | Beta | 47.3 ± 0.6 | 47.0 ± 5.0 | 38.3 - 55.7 |
| | | | Cs-137 | 10.0 ± 1.0 | 9.0 ± 5.0 | 0.3 - 17.7 |
| | | | Sr-90 | 19.3 ± 0.6 | 19.0 ± 5.0 | 10.3 - 27.7 |
| STW-694 | WATER | Sep, 1993 | | | | |
| | | | Ra-226 | 15.9 ± 0.7 | 14.9 ± 2.2 | 11.1 - 18.7 |

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[b]: Teledyne Results ±2 Sigma[c] | EPA Result[d] 1s, N=1 | Control Limits |
|---|---|---|---|---|---|---|
| | | | Ra-228 | 21.0 ± 1.6 | 20.4 ± 5.1 | 11.6 - 29.2 |
| STM-695 | MILK | Sep, 1993 | | | | |
| | | | Cs-137 | 49.0 ± 3.0 | 49.0 ± 5.0 | 40.3 - 57.7 |
| | | | I-131 | 125.3 ± 4.5 | 120.0 ± 12.0 | 99.2 - 140.8 |
| | | | K | 1616.7 ± 37.9 | 1679.0 ± 84.0 | 1533.3 - 1824.7 |
| | | | Sr-89 | 19.3 ± 1.5 | 30.0 ± 5.0 | 21.3 - 38.7 |
| | | | Report was received 01-18-94; an investigation is underway as to the cause of the low Sr-89 results. In-house spikes have been prepared and the analysis is in progress (see SPM-4848 and SPM-4849 in future reports). There is no apparent cause of the low Sr-89 results. In-house spikes have been prepared and the analysis is in progress. The analyst has been observed performing this procedure with no discrepancies noted. No further action is planned unless the results of the in-house spikes show a problem. | | | |
| | | | Sr-90 | 22.0 ± 0.0 | 25.0 ± 5.0 | 16.3 - 33.7 |
| STW-696 | WATER | Oct, 1993 | | | | |
| | | | I-131 | 116.7 ± 2.3 | 117.0 ± 12.0 | 96.2 - 137.8 |
| STW-697 | WATER | Oct, 1993 | | | | |
| | | | Gr. Alpha | 39.7 ± 1.5 | 40.0 ± 10.0 | 22.7 - 57.3 |
| | | | Ra-226 | 10.6 ± 0.5 | 9.9 ± 1.5 | 7.3 - 12.5 |
| | | | Ra-228 | 13.2 ± 1.5 | 12.5 ± 3.1 | 7.1 - 17.9 |
| | | | Uranium | 15.3 ± 0.6 | 15.1 ± 3.0 | 9.9 - 20.3 |
| STW-698 | WATER | Oct, 1993 | | | | |
| | | | Beta | 52.0 ± 1.0 | 58.0 ± 10.0 | 40.7 - 75.3 |
| | | | Co-60 | 10.7 ± 0.6 | 10.0 ± 5.0 | 1.3 - 18.7 |
| | | | Cs-134 | 10.0 ± 1.0 | 12.0 ± 5.0 | 3.3 - 20.7 |
| | | | Cs-137 | 12.3 ± 1.2 | 10.0 ± 5.0 | 1.3 - 18.7 |
| | | | Sr-89 | 11.3 ± 0.6 | 15.0 ± 5.0 | 6.3 - 23.7 |
| | | | Sr-90 | 11.0 ± 0.0 | 10.0 ± 5.0 | 1.3 - 18.7 |
| STW-699 | WATER | Oct, 1993 | | | | |
| | | | Alpha | 18.3 ± 2.5 | 20.0 ± 5.0 | 11.3 - 28.7 |
| | | | Beta | 13.7 ± 0.6 | 15.0 ± 5.0 | 6.3 - 23.7 |
| STW-700 | WATER | Nov, 1993 | | | | |
| | | | H-3 | 7310.0 ± 175.2 | 7398.0 ± 740.0 | 6114.1 - 8681.9 |
| STW-701 | WATER | Nov, 1993 | | | | |
| | | | Ba-133 | 75.7 ± 7.6 | 79.0 ± 8.0 | 65.1 - 92.9 |
| | | | Co-60 | 30.7 ± 2.1 | 30.0 ± 5.0 | 21.3 - 38.7 |

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[b]: Teledyne Results ±2 Sigma[c] | EPA Result[d] 1s, N=1 | Control Limits |
|---|---|---|---|---|---|---|
| | | | Cs-134 | 51.3 ± 5.9 | 59.0 ± 5.0 | 50.3 - 67.7 |
| | | | Cs-137 | 41.7 ± 1.2 | 40.0 ± 5.0 | 31.3 - 48.7 |
| | | | Ru-106 | 163.3 ± 3.2 | 201.0 ± 20.0 | 166.3 - 235.7 |
| | | | | The report was received on 02-14-94; the cause of the low Ru-106 is under investigation. It should be noted that the grand average of all participants in this analysis was 175.2 pCi/L, with 54% of the participants outside of limits. | | |
| | | | Zn-65 | 157.0 ± 8.7 | 150.0 ± 15.0 | 124.0 - 176.0 |

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

[b] All results are in pCi/L, except for elemental potassium (K) data in milk, which are in mg/L; air filter samples, which are in pCi/Filter.

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

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

Table A-2. Crosscheck program results; Thermoluminescent Dosimeters. (TLDs).

| Lab Code | TLD Type | Date | Measurement | mR: Teledyne Results ± 2 Sigma | mR: Known Value ± 2 Sigma | mR: Average ± 2 Sigma (All Participants) |
|---|---|---|---|---|---|---|
| 2nd International Intercomparison | | | | | | |
| 115-2 | $CaF_2$: Mn Bulb | Apr, 1976 | | | | |
| | | | Field | 17.0 ± 1.9 | 17.1 | 16.4 ± 7.7 |
| | | | Lab | 20.8 ± 4.1 | 21.3 | 18.8 ± 7.6 |
| Second International Intercomparison of Environmental Dosimeters conducted in April of 1976 by the Health and Safety Laboratory (HASL), New York, New York, and the School of Public Health of the University of Texas, Houston, Texas. | | | | | | |
| 3rd International Intercomparison | | | | | | |
| 115-3 | $CaF_2$: Mn Bulb | Jun, 1977 | | | | |
| | | | Field | 30.7 ± 3.2 | 34.9 ± 4.8 | 31.5 ± 3.0 |
| | | | Lab | 89.6 ± 6.4 | 91.7 ± 14.6 | 86.2 ± 24.0 |
| Third International Intercomparison of Environmental Dosimeters conducted in the summer of 1977 by Oak Ridge National Laboratory and the School of Public Health of the University of Texas, Houston, Texas. | | | | | | |
| 4th International Intercomparison | | | | | | |
| 115-4 | $CaF_2$: Mn Bulb | Jun, 1979 | | | | |
| | | | Field | 14.1 ± 1.1 | 14.1 ± 1.4 | 16.0 ± 9.0 |
| | | | Lab, High | 40.4 ± 1.4 | 45.8 ± 9.2 | 43.9 ± 13.2 |
| | | | Lab, Low | 9.8 ± 1.3 | 12.2 ± 2.4 | 12.0 ± 7.4 |
| Fourth International Intercomparison of Environmental Dosimeters conducted in the summer of 1979 by the School of Public Health of the University of Texas, Houston, Texas. | | | | | | |
| 5th International Intercomparison | | | | | | |
| 115-5A | $CaF_2$: Mn Bulb | Oct, 1980 | | | | |
| | | | Field | 31.4 ± 1.8 | 30.0 ± 6.0 | 30.2 ± 14.6 |
| | | | Lab, End | 96.6 ± 5.8 | 88.4 ± 8.8 | 90.7 ± 31.2 |
| | | | Lab, Start | 77.4 ± 5.8 | 75.2 ± 7.6 | 75.8 ± 40.4 |
| 115-5B | LiF-100 Chips | Oct, 1980 | | | | |
| | | | Field | 30.3 ± 4.8 | 30.0 ± 6.0 | 30.2 ± 14.6 |
| | | | Lab, End | 85.4 ± 11.7 | 88.4 ± 8.8 | 90.7 ± 31.2 |
| | | | Lab, Start | 81.1 ± 7.4 | 75.2 ± 7.6 | 75.8 ± 40.4 |
| Fifth International Intercomparison of Environmental Dosimeters conducted in the fall of 1980 at Idaho Falls, Idaho and sponsored by the School of Public Health of the University of Texas, Houston, Texas and Environmental Measurements Laboratory, New York, New York, U.S. Department of Energy. | | | | | | |
| 7th International Intercomparison | | | | | | |
| 115-7A | LiF-100 Chips | Jun, 1984 | | | | |
| | | | Field | 75.4 ± 2.6 | 75.8 ± 6.0 | 75.1 ± 29.8 |

Table A-2. Crosscheck program results; Thermoluminescent Dosimeters. (TLDs).

| Lab Code | TLD Type | Date | Measurement | mR: Teledyne Results ± 2 Sigma | mR: Known Value ± 2 Sigma | mR: Average ± 2 Sigma (All Participants) |
|---|---|---|---|---|---|---|
| | | | Lab, Co-60 | 80.0 ± 3.5 | 79.9 ± 4.0 | 77.9 ± 27.6 |
| | | | Lab, Cs-137 | 66.6 ± 2.5 | 75.0 ± 3.8 | 73.0 ± 22.2 |
| 115-7B | $CaF_2$: Mn Bulb | Jun, 1984 | | | | |
| | | | Field | 71.5 ± 2.6 | 75.8 ± 6.0 | 75.1 ± 29.8 |
| | | | Lab, Co-60 | 84.8 ± 6.4 | 79.9 ± 4.0 | 77.9 ± 27.6 |
| | | | Lab, Cs-137 | 78.8 ± 1.6 | 75.0 ± 3.8 | 73.0 ± 22.2 |
| 115-7C | $CaSO_4$:Dy Cards | Jun, 1984 | | | | |
| | | | Field | 76.8 ± 2.7 | 75.8 ± 6.0 | 75.1 ± 29.8 |
| | | | Lab, Co-60 | 82.5 ± 3.7 | 79.9 ± 4.0 | 77.9 ± 27.6 |
| | | | Lab, Cs-137 | 79.0 ± 3.2 | 75.0 ± 3.8 | 73.0 ± 22.2 |

Seventh International Intercomparison of Environmental Dosimeters conducted in the spring and summer of 1984 at Las Vegas, Neveda, and sponsored by the U.S. Department of Energy, The Nuclear Regulatory Commission, and the U.S. Environmental Protection Agency. Teledyne did not participate in the Sixth International Intercomparison of Environmental Dosimeters.

8th International Intercomparison

| | | | | | | |
|---|---|---|---|---|---|---|
| 115-8A | LiF-100 Chips | Jan, 1986 | | | | |
| | | | Field, Site 1 | 29.5 ± 1.4 | 29.7 ± 1.5 | 28.9 ± 12.4 |
| | | | Field, Site 2 | 11.3 ± 0.8 | 10.4 ± 0.5 | 10.1 ± 9.1 |
| | | | Lab, Cs-137 | 13.7 ± 0.9 | 17.2 ± 0.9 | 16.2 ± 6.8 |
| 115-8B | $CaF_2$: Mn Bulb | Jan, 1986 | | | | |
| | | | Field, Site 1 | 32.3 ± 1.2 | 29.7 ± 1.5 | 28.9 ± 12.4 |
| | | | Field, Site 2 | 9.0 ± 1.0 | 10.4 ± 0.5 | 10.1 ± 9.0 |
| | | | Lab, Cs-137 | 15.8 ± 0.9 | 17.2 ± 0.9 | 16.2 ± 6.8 |
| 115-8C | $CaSO_4$:Dy Cards | Jan, 1986 | | | | |
| | | | Field, Site 1 | 32.2 ± 0.7 | 29.7 ± 1.5 | 28.9 ± 12.4 |
| | | | Field, Site 2 | 10.6 ± 0.6 | 10.4 ± 0.5 | 10.1 ± 9.0 |
| | | | Lab, Cs-137 | 18.1 ± 0.8 | 17.2 ± 0.9 | 16.2 ± 6.8 |

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

10th International Intercomparison

Table A-2. Crosscheck program results; Thermoluminescent Dosimeters. (TLDs).

| Lab Code | TLD Type | Date | Measurement | mR: Teledyne Results ± 2 Sigma | mR: Known Value ± 2 Sigma | mR: Average ± 2 Sigma (All Participants) |
|---|---|---|---|---|---|---|
| 115-10A | LiF-100 Chips | Aug, 1993 | | | | |
| | | | Field | 25.7 ± 1.4 | 27.0 ± 1.6 | 26.4 ± 10.2 |
| | | | Lab | 22.7 ± 1.6 | 25.9 ± 1.3 | 25.0 ± 9.4 |
| | | | Lab | 62.7 ± 2.6 | 72.7 ± 1.9 | 69.8 ± 20.3 |
| 115-10B | $CaSO_4$:Dy Cards | Aug, 1993 | | | | |
| | | | Field | 26.0 ± 2.3 | 27.0 ± 1.6 | 26.4 ± 10.2 |
| | | | Lab | 24.1 ± 1.7 | 25.9 ± 1.3 | 25.0 ± 9.4 |
| | | | Lab | 69.2 ± 3.0 | 72.7 ± 1.9 | 69.8 ± 20.3 |

Tenth International Intercomparison of Environmental Dosimeters conducted in 1993 at Idaho State University and sponsored by the U.S. Department of Energy and the Idaho State University. The Ninth International Intercomparison of Environmental Dosimeters was not available to Teledyne's Midwest Laboratory.

Teledyne Testing

| | | | | | | |
|---|---|---|---|---|---|---|
| 89-1 | LiF-100 Chips | Sep, 1989 | | | | |
| | | | Lab | 21.0 ± 0.4 | 22.4 | ND |

ND = No Data; Teledyne Testing was only performed by Teledyne.
Chips were irradiated by Teledyne Isotopes, Inc., Westwood NJ. in September, 1989

| | | | | | | |
|---|---|---|---|---|---|---|
| 89-2 | Teledyne $CaSO_4$:Dy Cards | Nov, 1989 | | | | |
| | | | Lab | 20.9 ± 1.0 | 20.3 | ND |

ND = No Data; Teledyne Testing was only performed by Teledyne.
Cards were irradiated by Teledyne Isotopes, Inc., Westwood NJ. in November, 1989.

| | | | | | | |
|---|---|---|---|---|---|---|
| 90-1 | Teledyne $CaSO_4$:Dy Cards | Jun, 1990 | | | | |
| | | | Lab | 20.6 ± 1.4 | 19.6 | ND |

ND = No Data; Teledyne Testing was only performed by Teledyne.
Cards were irradiated by Teledyne Isotopes, Inc., Westwood NJ. on June 19, 1990.

| | | | | | | |
|---|---|---|---|---|---|---|
| 90-2 | Teledyne $CaSO_4$:Dy Cards | Sep, 1990 | | | | |
| | | | Lab | 100.8 ± 4.3 | 100.0 | ND |

ND = No Data; Teledyne Testing was only performed by Teledyne.
Cards were irradiated by Dosimetry Associates, Inc., Northville, MI on October 30, 1990.

Table A-2. Crosscheck program results; Thermoluminescent Dosimeters. (TLDs).

| Lab Code | TLD Type | Date | Measurement | mR Teledyne Results ± 2 Sigma | mR Known Value ± 2 Sigma | mR Average ± 2 Sigma (All Participants) |
|---|---|---|---|---|---|---|
| 91-1 | Teledyne $CaSO_4$:Dy Cards | Oct, 1990 | | | | |
| | | | Lab 1 | 33.4 ± 2.0 | 32.0 | ND |
| | | | Lab 2 | 55.2 ± 4.7 | 58.8 | ND |
| | | | Lab 3 | 87.8 ± 6.2 | 85.5 | ND |
| ND = No Data; Teledyne Testing was only performed by Teledyne. Cards were irradiated by Teledyne Isotopes, Inc., Westwood NJ. on October 8, 1991. | | | | | | |
| 92-1 | LiF-100 Chips | Feb, 1992 | | | | |
| | | | Lab 1 | 11.1 ± 0.2 | 10.7 | ND |
| | | | Lab 2 | 25.6 ± 0.5 | 25.4 | ND |
| | | | Lab 3 | 46.4 ± 0.5 | 46.3 | ND |
| ND = No Data; Teledyne Testing was only performed by Teledyne. Chips were irradiated by Teledyne Isotopes, Inc., Westwood NJ. on February 26, 1992. | | | | | | |
| 92-2 | Teledyne $CaSO_4$:Dy Cards | Apr, 1992 | | | | |
| | | | Reader 1, #1 | 20.1 ± 0.1 | 20.1 | ND |
| | | | Reader 1, #2 | 40.6 ± 0.1 | 40.0 | ND |
| | | | Reader 1, #3 | 60.0 ± 1.3 | 60.3 | ND |
| | | | Reader 2, #1 | 20.3 ± 0.3 | 20.1 | ND |
| | | | Reader 2, #2 | 39.2 ± 0.3 | 40.0 | ND |
| | | | Reader 2, #3 | 60.7 ± 0.4 | 60.3 | ND |
| ND = No Data; Teledyne Testing was only performed by Teledyne. Cards were irradiated by Teledyne Isotopes, Inc., Westwood NJ. on April 1, 1992. | | | | | | |
| 93-1 | Teledyne LiF-100 Chips | Mar, 1993 | | | | |
| | | | Lab 1 | 10.0 ± 1.0 | 10.2 | ND |
| | | | Lab 2 | 25.5 ± 2.2 | 25.5 | ND |
| | | | Lab 3 | 42.7 ± 5.7 | 45.9 | ND |
| ND = No Data; Teledyne Testing was only performed by Teledyne. Cards and Chips were irradiated by Teledyne Isotopes, Inc., Westwood NJ. on March 10, 1993. Due to a potential error of 10-12% when cards where irradiated, results of the testing on the cards will not be published. Data is available upon request. | | | | | | |

Table A-3. In-house "spike" samples.

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[a] Teledyne Results 2s, n=1[b] | Known Activity | Control[c] Limits |
|---|---|---|---|---|---|---|
| QCMI-26 | MILK | Jan, 1990 | | | | |
| | | | Cs-134 | 19.3 ± 1.0 | 20.8 | 10.8 - 30.8 |
| | | | Cs-137 | 25.2 ± 1.2 | 22.8 | 12.8 - 32.8 |
| QCMI-27 | MILK | Feb, 1990 | | | | |
| | | | Sr-90 | 18.0 ± 1.6 | 18.8 | 8.8 - 28.8 |
| QCMI-28 | MILK | Mar, 1990 | | | | |
| | | | I-131 | 63.8 ± 2.2 | 62.6 | 50.1 - 75.1 |
| QCMI-29 | MILK | Apr, 1990 | | | | |
| | | | Cs-134 | 18.3 ± 1.0 | 19.7 | 9.7 - 29.7 |
| | | | Cs-137 | 20.3 ± 1.0 | 18.2 | 8.2 - 28.2 |
| | | | I-131 | 90.7 ± 9.2 | 82.5 | 66.0 - 99.0 |
| QCW-61 | WATER | Apr, 1990 | | | | |
| | | | Sr-89 | 17.9 ± 5.5 | 23.1 | 13.1 - 33.1 |
| | | | Sr-90 | 19.4 ± 2.5 | 23.5 | 13.5 - 33.5 |
| QCW-62 | WATER | Apr, 1990 | | | | |
| | | | Co-60 | 8.7 ± 0.4 | 9.4 | 0.0 - 19.4 |
| | | | Cs-134 | 20.0 ± 0.2 | 19.7 | 9.7 - 29.7 |
| | | | Cs-137 | 28.7 ± 1.4 | 22.7 | 12.7 - 32.7 |
| QCW-63 | WATER | Apr, 1990 | | | | |
| | | | I-131 | 63.5 ± 8.0 | 66.0 | 52.8 - 79.2 |
| QCW-64 | WATER | Apr, 1990 | | | | |
| | | | H-3 | 1941.0 ± 130.0 | 1826.0 | 1141.5 - 2510.5 |
| QCW-65 | WATER | Jun, 1990 | | | | |
| | | | Ra-226 | 6.4 ± 0.2 | 6.9 | 4.8 - 9.0 |
| QCW-66 | WATER | Jun, 1990 | | | | |
| | | | Uranium | 6.2 ± 0.2 | 6.0 | 3.6 - 8.4 |
| QCMI-30 | MILK | Jul, 1990 | | | | |
| | | | Cs-134 | 46.0 ± 1.3 | 49.0 | 39.0 - 59.0 |
| | | | Cs-137 | 27.6 ± 1.3 | 25.3 | 15.3 - 35.3 |
| | | | Sr-89 | 12.8 ± 0.4 | 18.4 | 8.4 - 28.4 |
| | | | Sr-90 | 18.2 ± 1.4 | 18.7 | 8.7 - 28.7 |
| QCW-68 | WATER | Jul, 1990 | | | | |
| | | | Gr. Alpha | 9.8 ± 0.3 | 10.6 | 0.6 - 20.6 |
| | | | Gr. Beta | 11.4 ± 0.6 | 11.3 | 1.3 - 21.3 |
| QCMI-31 | MILK | Aug, 1990 | | | | |
| | | | I-131 | 68.8 ± 1.6 | 61.4 | 49.1 - 73.7 |

Table A-3. In-house "spike" samples.

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[a] Teledyne Results 2s, n=1[b] | Known Activity | Control[c] Limits |
|---|---|---|---|---|---|---|
| QCW-69 | WATER | Sep, 1990 | | | | |
| | | | Sr-89 | 17.7 ± 1.6 | 19.2 | 9.2 - 29.2 |
| | | | Sr-90 | 13.9 ± 1.6 | 17.4 | 7.4 - 27.4 |
| QC MI-32 | MILK | Oct, 1990 | | | | |
| | | | Cs-134 | 25.8 ± 1.2 | 27.3 | 17.3 - 37.3 |
| | | | Cs-137 | 25.3 ± 2.0 | 22.4 | 12.4 - 32.4 |
| | | | I-131 | 34.8 ± 0.2 | 32.4 | 20.4 - 44.4 |
| QCW-70 | WATER | Oct, 1990 | | | | |
| | | | H-3 | 2355.0 ± 59.0 | 2276.0 | 1577.3 - 2974.7 |
| QCW-71 | WATER | Oct, 1990 | | | | |
| | | | I-131 | 55.9 ± 0.9 | 51.8 | 39.8 - 63.8 |
| QCW-73 | WATER | Oct, 1990 | | | | |
| | | | Co-60 | 18.3 ± 2.7 | 16.8 | 6.8 - 26.8 |
| | | | Cs-134 | 28.3 ± 2.3 | 27.0 | 17.0 - 37.0 |
| | | | Cs-137 | 22.7 ± 1.3 | 22.4 | 12.4 - 32.4 |
| QCW-74 | WATER | Dec, 1990 | | | | |
| | | | Gr. Alpha | 21.4 ± 1.0 | 26.1 | 13.1 - 39.2 |
| | | | Gr. Beta | 25.9 ± 1.0 | 22.3 | 12.3 - 32.3 |
| QCMI-33 | MILK | Jan, 1991 | | | | |
| | | | Cs-134 | 22.2 ± 1.7 | 19.6 | 9.6 - 29.6 |
| | | | Cs-137 | 26.1 ± 1.6 | 22.3 | 12.3 - 32.3 |
| | | | Sr-89 | 20.7 ± 3.3 | 21.6 | 11.6 - 31.6 |
| | | | Sr-90 | 19.0 ± 1.4 | 23.0 | 13.0 - 33.0 |
| QCMI-34 | MILK | Feb, 1991 | | | | |
| | | | I-131 | 40.7 ± 1.8 | 40.1 | 28.1 - 52.1 |
| QCW-75 | WATER | Mar, 1991 | | | | |
| | | | Sr-89 | 18.8 ± 1.5 | 23.3 | 13.3 - 33.3 |
| | | | Sr-90 | 16.0 ± 0.8 | 17.2 | 7.2 - 27.2 |
| QCMI-35 | MILK | Apr, 1991 | | | | |
| | | | Cs-134 | 19.2 ± 2.0 | 22.6 | 12.6 - 32.6 |
| | | | Cs-137 | 22.8 ± 2.2 | 22.1 | 12.1 - 32.1 |
| | | | I-131 | 48.0 ± 0.8 | 49.2 | 37.2 - 61.2 |
| QCW-76 | WATER | Apr, 1991 | | | | |
| | | | I-131 | 56.5 ± 1.7 | 59.0 | 47.2 - 70.8 |
| QCW-77 | WATER | Apr, 1991 | | | | |
| | | | Co-60 | 16.4 ± 2.2 | 15.7 | 5.7 - 25.7 |

Table A-3. In-house "spike" samples.

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[a] Teledyne Results 2s, n=1[b] | Known Activity | Control[c] Limits |
|---|---|---|---|---|---|---|
| | | | Cs-134 | 23.8 ± 2.5 | 22.6 | 12.6 - 32.6 |
| | | | Cs-137 | 25.0 ± 2.4 | 21.1 | 11.1 - 31.1 |
| QCW-78 | WATER | Apr, 1991 | | | | |
| | | | H-3 | 4027.0 ± 188.0 | 4080.0 | 3264.0 - 4896.0 |
| QCW-79 | WATER | Jun, 1991 | | | | |
| | | | Gr. Alpha | 7.4 ± 0.7 | 7.8 | 0.0 - 17.8 |
| | | | Gr. Beta | 11.0 ± 0.7 | 11.0 | 1.0 - 21.0 |
| SPM-36 | MILK | Jul, 1991 | | | | |
| | | | Cs-137 | 34.3 ± 3.0 | 35.1 | 25.1 - 45.1 |
| | | | I-131 | 14.4 ± 1.9 | 18.3 | 6.3 - 30.3 |
| | | | Sr-89 | 28.1 ± 2.1 | 34.0 | 24.0 - 44.0 |
| | | | Sr-90 | 11.6 ± 0.7 | 11.5 | 1.5 - 21.5 |
| QCMI-37 | MILK | Oct, 1991 | | | | |
| | | | Cs-134 | 22.7 ± 2.8 | 22.1 | 12.1 - 32.1 |
| | | | Cs-137 | 38.3 ± 3.0 | 35.1 | 25.1 - 45.1 |
| | | | I-131 | 23.6 ± 3.2 | 25.8 | 13.8 - 37.8 |
| QCW-80 | WATER | Oct, 1991 | | | | |
| | | | Sr-89 | 27.4 ± 6.9 | 24.4 | 14.4 - 34.4 |
| | | | Sr-90 | 11.7 ± 1.4 | 14.1 | 4.1 - 24.1 |
| QCW-81 | WATER | Oct, 1991 | | | | |
| | | | I-131 | 19.1 ± 0.7 | 20.6 | 8.6 - 32.6 |
| QCW-82 | WATER | Oct, 1991 | | | | |
| | | | Co-60 | 22.6 ± 2.7 | 22.1 | 12.1 - 32.1 |
| | | | Cs-134 | 15.5 ± 1.8 | 17.6 | 7.6 - 27.6 |
| | | | Cs-137 | 17.5 ± 2.1 | 17.6 | 7.6 - 27.6 |
| QCW-83 | WATER | Oct, 1991 | | | | |
| | | | H-3 | 4639.0 ± 137.0 | 4382.0 | 3505.6 - 5258.4 |
| QCW-84 | WATER | Dec, 1991 | | | | |
| | | | Gr. Alpha | 6.2 ± 6.0 | 7.8 | 0.0 - 17.8 |
| | | | Gr. Beta | 11.0 ± 0.7 | 11.0 | 1.0 - 21.0 |
| QCMI-39 | MILK | Jan, 1992 | | | | |
| | | | Cs-134 | 42.1 ± 5.7 | 49.4 | 39.4 - 59.4 |
| | | | Cs-137 | 55.2 ± 6.4 | 53.0 | 43.0 - 63.0 |
| | | | I-131 | 76.8 ± 0.9 | 83.7 | 67.0 - 100.4 |
| | | | Sr-89 | 21.6 ± 6.5 | 31.2 | 21.2 - 41.2 |
| | | | Sr-90 | 38.7 ± 1.8 | 42.3 | 33.8 - 50.8 |

Table A-3. In-house "spike" samples.

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[a] Teledyne Results 2s, n=1[b] | Known Activity | Control[c] Limits |
|---|---|---|---|---|---|---|
| QCW-85 | WATER | Mar, 1992 | | | | |
| | | | Sr-89 | 26.2 ± 3.1 | 32.0 | 22.0 - 42.0 |
| | | | Sr-90 | 24.4 ± 1.4 | 28.0 | 18.0 - 38.0 |
| QCMI-40 | MILK | Apr, 1992 | | | | |
| | | | Cs-134 | 58.0 ± 2.6 | 55.9 | 45.9 - 65.9 |
| | | | Cs-137 | 43.7 ± 3.0 | 38.9 | 28.9 - 48.9 |
| QCMI-41 | MILK | Apr, 1992 | | | | |
| | | | I-131 | 50.3 ± 0.8 | 55.9 | 44.7 - 67.1 |
| QCW-86 | WATER | Apr, 1992 | | | | |
| | | | H-3 | 4080.0 ± 190.0 | 4027.0 | 3221.6 - 4832.4 |
| QCW-87 | WATER | Apr, 1992 | | | | |
| | | | I-131 | 33.5 ± 0.6 | 33.2 | 21.2 - 45.2 |
| QCW-88 | WATER | Apr, 1992 | | | | |
| | | | Co-60 | 17.5 ± 2.7 | 19.7 | 9.7 - 29.7 |
| | | | Cs-134 | 28.9 ± 2.5 | 33.5 | 23.5 - 43.5 |
| | | | Cs-137 | 41.0 ± 3.0 | 38.9 | 28.9 - 48.9 |
| QCW-89 | WATER | Jun, 1992 | | | | |
| | | | Gr. Alpha | 15.3 ± 0.8 | 13.6 | 3.6 - 23.6 |
| | | | Gr. Beta | 17.2 ± 0.9 | 17.6 | 7.6 - 27.6 |
| QCMI-42 | MILK | Aug, 1992 | | | | |
| | | | Cs-134 | 20.1 ± 2.8 | 20.2 | 10.2 - 30.2 |
| | | | Cs-137 | 26.2 ± 2.7 | 26.1 | 16.1 - 36.1 |
| | | | Sr-89 | 41.4 ± 5.9 | 51.2 | 41.0 - 61.4 |
| | | | Sr-90 | 48.9 ± 2.5 | 51.9 | 41.5 - 62.3 |
| QCW-90 | WATER | Sep, 1992 | | | | |
| | | | Sr-89 | 6.7 ± 3.4 | 12.6 | 2.6 - 22.6 |
| | | | Sr-90 | 16.1 ± 1.4 | 15.6 | 5.6 - 25.6 |
| QCMI-43 | MILK | Oct, 1992 | | | | |
| | | | Cs-134 | 14.2 ± 3.4 | 12.7 | 2.7 - 22.7 |
| | | | Cs-137 | 14.1 ± 5.2 | 17.1 | 7.1 - 27.1 |
| | | | I-131 | 19.9 ± 1.0 | 21.5 | 9.5 - 33.5 |
| QCMI-44 | MILK | Oct, 1992 | | | | |
| | | | Cs-134 | 28.2 ± 4.0 | 25.4 | 15.4 - 35.4 |
| | | | Cs-137 | 38.8 ± 5.1 | 34.2 | 24.2 - 44.2 |
| | | | I-131 | 36.1 ± 1.2 | 43.0 | 31.0 - 55.0 |

Table A-3. In-house "spike" samples

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[a] Teledyne Results 2s, n=1[b] | Known Activity | Control[c] Limits |
|---|---|---|---|---|---|---|
| QCW-91 | WATER | Oct, 1992 | | | | |
| | | | I-131 | 34.9 ± 2.2 | 34.9 | 22.9 - 46.9 |
| QCW-92 | WATER | Oct, 1992 | | | | |
| | | | Co-60 | 11.4 ± 1.9 | 9.2 | 0.0 - 19.2 |
| | | | Cs-134 | 18.7 ± 2.3 | 14.3 | 4.3 - 24.3 |
| | | | Cs-137 | 14.1 ± 1.8 | 15.0 | 5.0 - 25.0 |
| QCW-93 | WATER | Oct, 1992 | | | | |
| | | | H-3 | 3704.0 ± 186.0 | 3904.0 | 3169.2 - 4638.8 |
| QCW-94 | WATER | Oct, 1992 | | | | |
| | | | H-3 | 14925.0 ± 339.0 | 15616.0 | 12492.8 - 18739.2 |
| QCW-95 | WATER | Oct, 1992 | | | | |
| | | | I-131 | 64.2 ± 2.7 | 67.2 | 53.8 - 80.6 |
| QCW-36 | WATER | Dec, 1992 | | | | |
| | | | Alpha | 11.5 ± 2.3 | 15.2 | 9.1 - 21.3 |
| | | | Beta | 26.5 ± 2.0 | 25.7 | 15.4 - 36.0 |
| QCW-96 | WATER | Dec, 1992 | | | | |
| | | | Gr. Alpha | 8.3 ± 0.6 | 10.4 | 0.4 - 20.4 |
| | | | Gr. Beta | 19.8 ± 1.5 | 20.6 | 10.6 - 30.6 |
| SPM-3341 | MILK | Jan, 1993 | | | | |
| | | | Cs-134 | 17.1 ± 2.0 | 21.3 | 11.3 - 31.3 |
| | | | Cs-137 | 21.4 ± 2.0 | 23.8 | 13.8 - 33.8 |
| | | | Sr-89 | 6.7 ± 3.1 | 8.7 | 0.0 - 18.7 |
| | | | Sr-90 | 20.0 ± 1.2 | 19.2 | 9.2 - 29.2 |
| SPM-3387 | MILK | Feb, 1993 | | | | |
| | | | I-131 | 72.5 ± 8.4 | 71.5 | 57.2 - 85.8 |
| SPVE-3401 | VEGETATION (SAW DUST) | Feb, 1993 | | | | |
| | | | I-131 | 994.5 ± 53.2 | 953.7 | 763.0 - 1144.4 |
| SPCH-3402 | CHARCOAL | Feb, 1993 | | | | |
| | | | I-131 | 95.2 ± 12.8 | 95.4 | 76.3 - 114.5 |
| SPW-3434 | WATER | Apr, 1993 | | | | |
| | | | Gr. Alpha | 10.4 ± 1.8 | 10.4 | 0.4 - 20.4 |
| | | | Gr. Beta | 22.0 ± 2.0 | 20.6 | 10.6 - 30.6 |
| SPW-3556 | WATER | Apr, 1993 | | | | |
| | | | Sr-89 | 18.2 ± 5.0 | 22.2 | 12.2 - 32.2 |
| | | | Sr-90 | 20.1 ± 1.8 | 17.0 | 7.0 - 27.0 |

Table A-3. In-house "spike" samples.

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[a] Teledyne Results 2s, n=1[b] | Known Activity | Control[c] Limits |
|---|---|---|---|---|---|---|
| SPW-3597 | WATER | Apr, 1993 | | | | |
| | | | H-3 | 5464.0 ± 219.0 | 5428.0 | 4342.4 - 6513.6 |
| SPW-3599 | WATER | Apr, 1993 | | | | |
| | | | I-131 | 149.8 ± 1.9 | 145.0 | 116.0 - 174.0 |
| SPW-3606 | WATER | Apr, 1993 | | | | |
| | | | Co-60 | 24.8 ± 2.3 | 21.5 | 11.5 - 31.5 |
| | | | Cs-134 | 26.4 ± 1.9 | 26.4 | 16.4 - 36.4 |
| | | | Cs-137 | 33.9 ± 2.6 | 31.7 | 21.7 - 41.7 |
| SPM-3631 | MILK | Apr, 1993 | | | | |
| | | | Cs-134 | 48.8 ± 2.9 | 52.8 | 42.8 - 62.8 |
| | | | Cs-137 | 65.2 ± 2.9 | 63.4 | 53.4 - 73.4 |
| | | | I-131 | 139.8 ± 1.6 | 145.0 | 116.0 - 174.0 |
| SPF-3681 | FISH (JELLO) | May, 1993 | | | | |
| | | | Cs-137 | 68.2 ± 7.7 | 67.6 | 57.6 - 77.6 |
| | | | Concentrations are in pCi/Total Volume (550g). | | | |
| SPW-3842 | WATER | Jun, 1993 | | | | |
| | | | Th-230 | 4.2 ± 0.5 | 4.5 | 2.7 - 6.3 |
| SPW-4160 | WATER | Jun, 1993 | | | | |
| | | | Alpha | 8.9 ± 1.4 | 12.9 | 7.7 - 18.1 |
| | | | Beta | 22.0 ± 1.9 | 31.9 | 19.1 - 44.7 |
| SPW-4232 | WATER | Aug, 1993 | | | | |
| | | | Fe-55 | 1684.0 ± 415.0 | 1420.0 | 1136.0 - 1704.0 |
| SPW-4246 | WATER | Aug, 1993 | | | | |
| | | | Sr-90 | 32.2 ± 2.6 | 30.4 | 24.3 - 36.5 |
| SPM-4247 | MILK | Aug, 1993 | | | | |
| | | | Sr-89 | 29.1 ± 4.9 | 35.4 | 25.4 - 45.4 |
| | | | Sr-90 | 18.3 ± 1.3 | 19.2 | 9.2 - 29.2 |
| SPW-4248 | WATER | Aug, 1993 | | | | |
| | | | H-3 | 9910.0 ± 300.0 | 10430.0 | 8344.0 - 12516.0 |
| SPW-4250 | WATER | Aug, 1993 | | | | |
| | | | Co-60 | 247.0 ± 23.1 | 247.7 | 222.9 - 272.5 |
| | | | Cs-134 | 141.6 ± 15.9 | 141.1 | 127.0 - 155.2 |

Table A-3. In-house "spike" samples.

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[a] Teledyne Results 2s, n=1[b] | Known Activity | Control[c] Limits |
|---|---|---|---|---|---|---|
| | | | Cs-137 | 283.5 ± 27.8 | 247.2 | 222.5 - 271.9 |
| | | | The cause of the high Cs-137 data is unknown. All data was reviewed, no errors where found in the calculations. The employee was observed performing this analysis and no deviations from the procedure where observed. The employee's results have been good in the past; no further action is planned. | | | |
| SPF-4251 | FISH (JELLO) | Aug, 1993 | | | | |
| | | | Cs-134 | 68.8 ± 3.3 | 75.3 | 65.3 - 85.3 |
| | | | Cs-137 | 203.6 ± 8.2 | 198.1 | 178.3 - 217.9 |
| SPS-4262 | SEDIMENT (BOTTOM) | Aug, 1993 | | | | |
| | | | Cs-134 | 74.1 ± 9.9 | 71.0 | 61.0 - 81.0 |
| | | | Cs-137 | 212.4 ± 14.8 | 197.8 | 178.0 - 217.6 |
| SPW-4377 | WATER | Sep, 1993 | | | | |
| | | | I-131 | 39.0 ± 10.0 | 42.1 | 30.1 - 54.1 |
| SPM-4378 | MILK | Sep, 1993 | | | | |
| | | | I-131 | 44.5 ± 5.5 | 42.1 | 30.1 - 54.1 |
| SPCH-4379 | CHARCOAL | Sep, 1993 | | | | |
| | | | I-131 | 90.3 ± 13.5 | 84.3 | 67.4 - 101.2 |
| SPVE-4380 | VEGETATION (SAW DUST) | Sep, 1993 | | | | |
| | | | I-131 | 193.2 ± 20.0 | 170.2 | 136.2 - 204.2 |
| SPW-4381 | WATER | Sep, 1993 | | | | |
| | | | Sr-89 | 21.9 ± 4.0 | 28.8 | 18.8 - 38.8 |
| | | | Sr-90 | 19.5 ± 1.8 | 19.0 | 9.0 - 29.0 |
| SPW-4382 | WATER | Sep, 1993 | | | | |
| | | | I-129 | 18.1 ± 1.0 | 18.6 | 6.6 - 30.6 |
| SPW-4421 | WATER | Oct, 1993 | | | | |
| | | | H-3 | 16900.0 ± 368.0 | 17380.0 | 13904.0 - 20856.0 |
| SPW-4428 | WATER | Oct, 1993 | | | | |
| | | | Co-60 | 19.3 ± 3.1 | 18.3 | 8.3 - 28.3 |
| | | | Cs-134 | 31.5 ± 3.3 | 33.5 | 23.5 - 43.5 |
| | | | Cs-137 | 44.4 ± 3.6 | 43.2 | 33.2 - 53.2 |
| SPM-4426 | MILK | Oct, 1993 | | | | |
| | | | Cs-134 | 30.8 ± 4.5 | 33.0 | 23.0 - 43.0 |
| | | | Cs-137 | 43.4 ± 6.0 | 43.2 | 33.2 - 53.2 |
| | | | I-131 | 49.7 ± 8.6 | 44.5 | 32.5 - 56.5 |

Table A-3. In-house "spike" samples.

| Lab Code | Sample Type | Date Collected | Analyses | Concentration in pCi/L[a] Teledyne Results 2s, n=1[b] | Known Activity | Control[c] Limits |
|---|---|---|---|---|---|---|
| SPW-4427 | WATER | Oct, 1993 | | | | |
| | | | I-131 | 95.2 ± 10.6 | 88.9 | 71.1 - 106.7 |

[a] All results are in pCi/L, except elemental potassium (K) data in milk, which are in mg/L.; air filter samples, which are in pCi/Filter; charcoal which are in pCi/charcoal; and food products which are in mg/kg.

[b] All samples prior to January 1991 are the results or three determinations; after January 1991, all determinations are single.

[c] Control Limits are based on EPA publication; "Environmental Radioactive Laboratory Intercomparison Studies Program", Fiscal Year 1981-1982, EPA-600/4-81-004 (see Attachment A) or limits imposed by Teledyne's Midwest Laboratory.

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

| Lab Code | Sample Type | Sample Date | Analyses | Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD | Teledyne Results (4.66 Sigma) Activity[b] | Acceptance Criteria (4.66 Sigma) |
|---|---|---|---|---|---|---|
| SPW-8039 | WATER | Jan 1990 | | | | |
| | | | Ra-226 | < 0.2 | | < 1.0 |
| SPM-8040 | MILK | Jan 1990 | | | | |
| | | | Sr-89 | < 0.8 | | < 5.0 |
| | | | Sr-90 | < 1.0 | | < 1.0 |
| SPM-8208 | MILK | Jan 1990 | | | | |
| | | | Cs-134 | < 3.6 | | < 10.0 |
| | | | Cs-137 | < 4.7 | | < 10.0 |
| | | | Sr-89 | < 0.8 | | < 5.0 |
| | | | Sr-90 | N/A | 1.6 ± 0.5 | < 1.0 |
| | | | Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual. | | | |
| SPM-8312 | MILK | Feb 1990 | | | | |
| | | | Sr-89 | < 0.3 | | < 5.0 |
| | | | Sr-90 | N/A | 1.2 ± 0.3 | < 1.0 |
| | | | Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual. | | | |
| SPW-8312 | WATER | Feb 1990 | | | | |
| | | | Sr-89 | < 0.6 | | < 5.0 |
| | | | Sr-90 | < 0.7 | | < 1.0 |
| SPM-8314 | MILK | Mar 1990 | | | | |
| | | | I-131 | < 0.3 | | < 1.0 |
| SPM-8510 | MILK | May 1990 | | | | |
| | | | Cs-134 | < 4.6 | | < 10.0 |
| | | | Cs-137 | < 4.8 | | < 10.0 |
| | | | I-131 | < 0.2 | | < 1.0 |
| SPW-8511 | WATER | May 1990 | | | | |
| | | | H-3 | < 200.0 | | < 300.0 |
| SPM-8600 | MILK | Jul 1990 | | | | |
| | | | Cs-134 | < 5.0 | | < 10.0 |
| | | | Cs-137 | < 7.0 | | < 10.0 |
| | | | I-131 | < 0.3 | | < 1.0 |
| | | | Sr-89 | < 0.8 | | < 5.0 |
| | | | Sr-90 | N/A | 1.7 ± 0.6 | < 1.0 |
| | | | Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual. | | | |

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

| Lab Code | Sample Type | Sample Date | Analyses | Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD | Teledyne Results (4.66 Sigma) Activity[b] | Acceptance Criteria (4.66 Sigma) |
|---|---|---|---|---|---|---|
| SPM-8877 | MILK | Aug 1990 | | | | |
| | | | I-131 | < 0.2 | | < 1.0 |
| SPW-8925 | WATER | Aug 1990 | | | | |
| | | | H-3 | < 200.0 | | < 300.0 |
| SPW-8926 | WATER | Aug 1990 | | | | |
| | | | Gr. Alpha | < 0.3 | | < 1.0 |
| | | | Gr. Beta | < 0.7 | | < 5.0 |
| SPW-8927 | WATER | Aug 1990 | | | | |
| | | | U-234 | < 0.01 | | < 1.0 |
| | | | U-235 | < 0.02 | | < 1.0 |
| | | | U-238 | < 0.01 | | < 1.0 |
| SPW-8928 | WATER | Aug 1990 | | | | |
| | | | Co-58 | < 4.1 | | < 10.0 |
| | | | Co-60 | < 2.4 | | < 10.0 |
| | | | Cs-134 | < 3.3 | | < 10.0 |
| | | | Cs-137 | < 3.7 | | < 10.0 |
| | | | Mn-54 | < 4.0 | | < 10.0 |
| SPW-8929 | WATER | Aug 1990 | | | | |
| | | | Sr-89 | < 1.4 | | < 5.0 |
| | | | Sr-90 | < 0.6 | | < 1.0 |
| SPW-69 | WATER | Sep 1990 | | | | |
| | | | Sr-89 | < 1.8 | | < 5.0 |
| | | | Sr-90 | < 0.8 | | < 1.0 |
| SPW-106 | WATER | Oct 1990 | | | | |
| | | | H-3 | < 180.0 | | < 300.0 |
| | | | I-131 | < 0.3 | | < 1.0 |
| SPM-107 | MILK | Oct 1990 | | | | |
| | | | Cs-134 | < 3.3 | | < 10.0 |
| | | | Cs-137 | < 4.3 | | < 10.0 |
| | | | I-131 | < 0.4 | | < 1.0 |
| SPW-370 | WATER | Oct 1990 | | | | |
| | | | Co-58 | < 2.6 | | < 10.0 |
| | | | Co-60 | < 1.6 | | < 10.0 |
| | | | Cs-134 | < 1.7 | | < 10.0 |
| | | | Cs-137 | < 1.8 | | < 10.0 |

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

| Lab Code | Sample Type | Sample Date | Analyses | Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD | Teledyne Results (4.66 Sigma) Activity[b] | Acceptance Criteria (4.66 Sigma) |
|---|---|---|---|---|---|---|
| | | | Mn-54 | < 1.7 | | < 10.0 |
| SPW-372 | WATER | Dec 1990 | | | | |
| | | | Gr. Alpha | < 0.3 | | < 1.0 |
| | | | Gr. Beta | < 0.8 | | < 5.0 |
| SPM-406 | MILK | Jan 1991 | | | | |
| | | | Cs-134 | < 3.7 | | < 10.0 |
| | | | Cs-137 | < 5.2 | | < 10.0 |
| | | | Sr-89 | < 0.4 | | < 5.0 |
| | | | Sr-90 | N/A | 1.8 ± 0.4 | < 1.0 |
| | | | Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual. | | | |
| SPM-421 | MILK | Feb 1991 | | | | |
| | | | I-131 | < 0.3 | | < 1.0 |
| SPM-451 | MILK | Feb 1991 | | | | |
| | | | Ra-226 | < 0.1 | | < 1.0 |
| | | | Ra-228 | < 0.9 | | < 1.0 |
| SPW-514 | WATER | Mar 1991 | | | | |
| | | | Sr-89 | < 1.1 | | < 5.0 |
| | | | Sr-90 | < 0.9 | | < 1.0 |
| SPW-586 | WATER | Apr 1991 | | | | |
| | | | Co-60 | < 2.5 | | < 10.0 |
| | | | Cs-134 | < 2.4 | | < 10.0 |
| | | | Cs-137 | < 2.2 | | < 10.0 |
| | | | I-131 | < 0.2 | | < 1.0 |
| SPM-587 | MILK | Apr 1991 | | | | |
| | | | Cs-134 | < 1.7 | | < 10.0 |
| | | | Cs-137 | < 1.9 | | < 10.0 |
| | | | I-131 | < 0.2 | | < 1.0 |
| SPW-837 | WATER | Jun 1991 | | | | |
| | | | Gr. Alpha | < 0.6 | | < 1.0 |
| | | | Gr. Beta | < 1.1 | | < 5.0 |
| SPM-953 | MILK | Jul 1991 | | | | |
| | | | Cs-137 | < 4.9 | | < 10.0 |
| | | | I-131 | < 0.2 | | < 1.0 |
| | | | Sr-89 | < 0.7 | | < 5.0 |

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

| Lab Code | Sample Type | Sample Date | Analyses | Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD | Teledyne Results (4.66 Sigma) Activity[b] | Acceptance Criteria (4.66 Sigma) |
|---|---|---|---|---|---|---|
| | | | Sr-90 | N/A | 0.4 ± 0.3 | < 1.0 |
| | | | Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual. | | | |
| SPM-1236 | MILK | Oct 1991 | | | | |
| | | | Cs-134 | < 3.7 | | |
| | | | Cs-137 | < 4.6 | | < 10.0 |
| | | | I-131 | < 0.2 | | < 10.0 |
| SPW-1254 | WATER | Oct 1991 | | | | < 1.0 |
| | | | Sr-89 | < 2.8 | | |
| | | | Sr-90 | < 0.7 | | < 5.0 |
| SPW-1256 | WATER | Oct 1991 | | | | < 1.0 |
| | | | Co-60 | < 3.6 | | |
| | | | Cs-134 | < 4.0 | | < 10.0 |
| | | | Cs-137 | < 3.0 | | < 10.0 |
| | | | I-131 | < 0.4 | | < 10.0 |
| SPW-1259 | WATER | Oct 1991 | | | | < 1.0 |
| | | | H-3 | < 160.0 | | |
| SPW-1444 | WATER | Dec 1991 | | | | < 300.0 |
| | | | Gr. Alpha | < 0.4 | | |
| | | | Gr. Beta | < 0.8 | | < 1.0 |
| SPM-1578 | MILK | Jan 1992 | | | | < 5.0 |
| | | | Cs-134 | < 7.2 | | |
| | | | Cs-137 | < 8.0 | | < 10.0 |
| | | | I-131 | < 0.2 | | < 10.0 |
| | | | Sr-89 | < 0.5 | | < 1.0 |
| | | | Sr-90 | N/A | 1.3 ± 0.4 | < 5.0 |
| | | | Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual. | | | < 1.0 |
| SPW-1860 | WATER | Mar 1992 | | | | |
| | | | Sr-89 | < 0.6 | | |
| | | | Sr-90 | < 0.4 | | < 5.0 |
| SPW-2067 | WATER | Apr 1992 | | | | < 1.0 |
| | | | H-3 | < 168.0 | | |
| SPW-2114 | WATER | Apr 1992 | | | | < 300.0 |
| | | | C-14 | < 1.0 | | |
| | | | | | | < 200.0 |

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

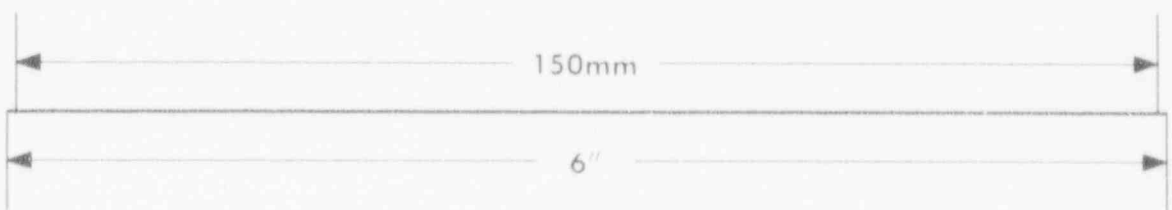
| Lab Code | Sample Type | Sample Date | Analyses | Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD | Activity[b] | Acceptance Criteria (4.66 Sigma) |
|---|---|---|---|---|---|---|
| SPM-2119 | MILK | Apr 1992 | | | | |
| | | | Co-60 | < 6.3 | | < 10.0 |
| | | | Cs-134 | < 4.5 | | < 10.0 |
| | | | Cs-137 | < 5.4 | | < 10.0 |
| SPW-2126 | WATER | Apr 1992 | | | | |
| | | | I-131 | < 0.2 | | < 1.0 |
| SPM-2133 | MILK | Apr 1992 | | | | |
| | | | I-131 | < 0.2 | | < 1.0 |
| SPW-2220 | WATER | May 1992 | | | | |
| | | | Co-60 | < 2.1 | | < 10.0 |
| | | | Cs-134 | < 2.1 | | < 10.0 |
| | | | Cs-137 | < 2.3 | | < 10.0 |
| SPW-2369 | WATER | Jun 1992 | | | | |
| | | | Gr. Alpha | < 0.4 | | < 1.0 |
| | | | Gr. Beta | < 0.8 | | < 5.0 |
| SPM-2500 | MILK | Aug 1992 | | | | |
| | | | I-131 | < 0.4 | | < 1.0 |
| | | | Sr-89 | < 1.2 | | < 5.0 |
| | | | Sr-90 | < 0.9 | | < 1.0 |
| SPW-2666 | WATER | Sep 1992 | | | | |
| | | | Sr-89 | < 0.8 | | < 5.0 |
| | | | Sr-90 | < 0.5 | | < 1.0 |
| SPW-2828 | WATER | Oct 1992 | | | | |
| | | | Co-60 | < 4.8 | | < 10.0 |
| | | | Activity result is not available for this sample. | | | |
| | | | Cs-134 | < 6.0 | | < 10.0 |
| | | | Activity result is not available for this sample. | | | |
| | | | Cs-137 | < 6.1 | | < 10.0 |
| | | | Activity result is not available for this sample. | | | |
| | | | H-3 | < 177.0 | | < 300.0 |
| | | | I-131 | < 0.3 | | < 1.0 |
| | | | Activity result is not available for this sample. | | | |
| SPM-2829 | MILK | Oct 1992 | | | | |
| | | | Co-60 | < 9.3 | | < 10.0 |
| | | | Cs-134 | < 6.4 | | < 10.0 |
| | | | Cs-137 | < 7.2 | | < 10.0 |

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

| Lab Code | Sample Type | Sample Date | Analyses | Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD | Teledyne Results (4.66 Sigma) Activity[b] | Acceptance Criteria (4.66 Sigma) |
|---|---|---|---|---|---|---|
| SPW-3212 | WATER | Oct 1992 | | | | |
| | | | Ra-228 | < 1.0 | | < 1.0 |
| SPW-3057 | WATER | Nov 1992 | | | | |
| | | | Ra-226 | < 0.03 | | < 1.0 |
| SPW-3294 | WATER | Dec 1992 | | | | |
| | | | Gr. Alpha | < 0.4 | | < 1.0 |
| | | | Gr. Beta | < 0.8 | | < 5.0 |
| SPM-3342 | MILK | Jan 1993 | | | | |
| | | | Cs-134 | < 4.1 | -0.9 ± 2.6 | < 10.0 |
| | | | Activity result is not available for this sample. | | | |
| | | | Cs-137 | < 3.9 | 0.8 ± 2.2 | < 10.0 |
| | | | Activity result is not available for this sample. | | | |
| | | | Sr-89 | < 0.7 | -0.9 ± 1.1 | < 5.0 |
| | | | Sr-90 | N/A | 1.6 ± 0.5 | < 1.0 |
| | | | Low levels of Sr-90 concentration in milk (1-5 pCi/L) is not unusual. | | | |
| SPM-3386 | MILK | Feb 1993 | | | | |
| | | | I-131 | < 0.2 | 0.1 ± 0.1 | < 1.0 |
| SPW-3557 | WATER | Mar 1993 | | | | |
| | | | Sr-89 | < 0.5 | 0.3 ± 0.5 | < 5.0 |
| | | | Sr-90 | < 0.5 | 0.1 ± 0.2 | < 1.0 |
| SPW-3598 | WATER | Apr 1993 | | | | |
| | | | H-3 | < 180.0 | 84.7 ± 94.2 | < 300.0 |
| SPW-3600 | WATER | Apr 1993 | | | | |
| | | | I-131 | < 0.2 | 0.1 ± 0.2 | < 1.0 |
| SPW-3601 | WATER | Apr 1993 | | | | |
| | | | Co-60 | < 4.2 | | < 10.0 |
| | | | Activity result is not available for this sample. | | | |
| | | | Cs-134 | < 4.4 | | < 10.0 |
| | | | Activity result is not available for this sample. | | | |
| | | | Cs-137 | < 3.4 | | < 10.0 |
| | | | Activity result is not available for this sample. | | | |
| | | | I-131 | < 0.4 | 0.3 ± 0.9 | < 1.0 |
| SPM-3651 | MILK | May 1993 | | | | |
| | | | Cs-134 | < 4.4 | | < 10.0 |
| | | | Activity result is not available for this sample. | | | |

# 2

## IMAGE EVALUATION TEST TARGET (MT-3)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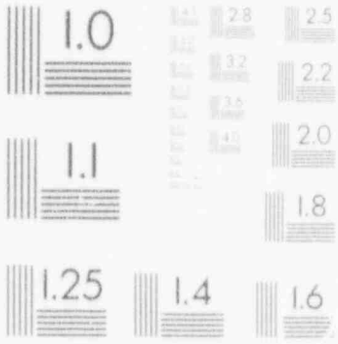
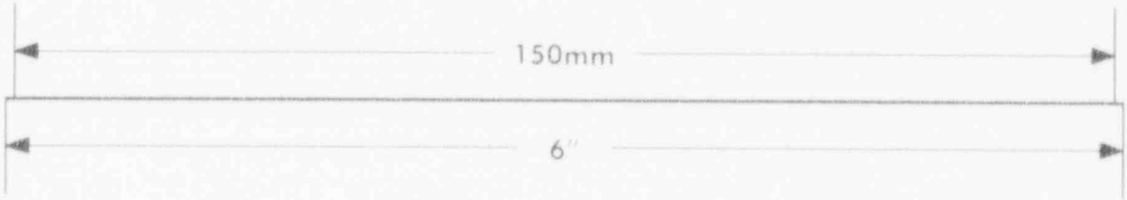
# 2

## IMAGE EVALUATION
## TEST TARGET (MT-3)

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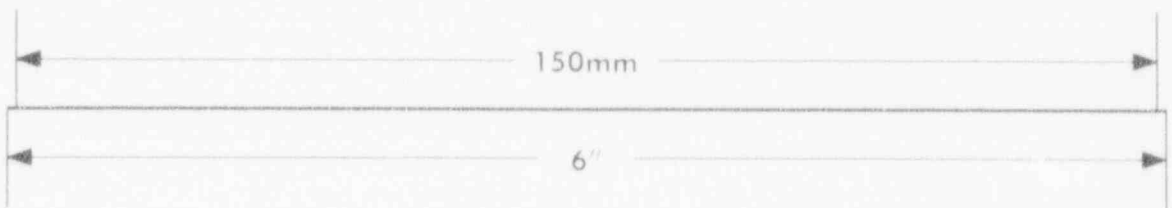
# 2

## IMAGE EVALUATION TEST TARGET (MT-3)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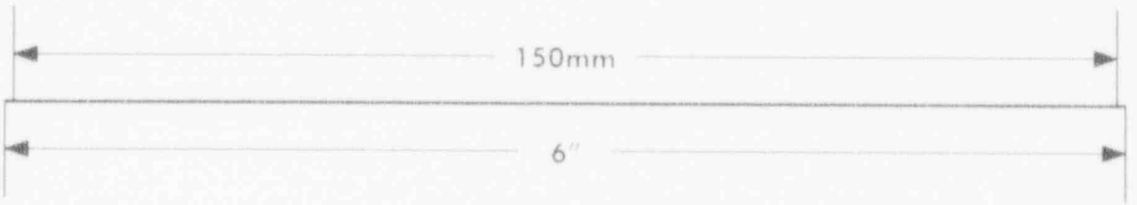
# 2

## IMAGE EVALUATION TEST TARGET (MT-3)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# 2

## IMAGE EVALUATION TEST TARGET (MT-3)


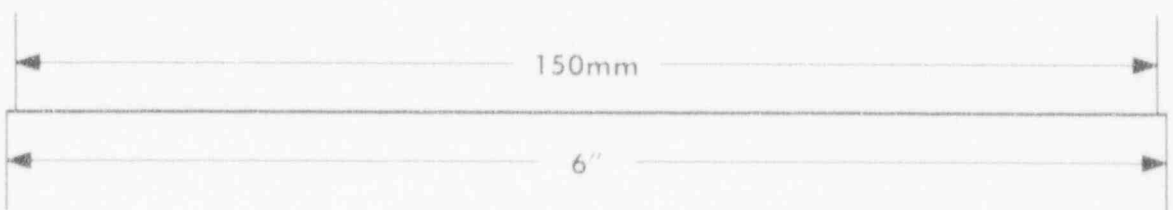


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Table A-4. In-house "blank" samples.

| Lab Code | Sample Type | Sample Date | Analyses | Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD | Teledyne Results (4.66 Sigma) Activity[b] | Acceptance Criteria (4.66 Sigma) |
|---|---|---|---|---|---|---|
| | | | Cs-137 | < 6.3 | | < 10.0 |
| | | | Activity result is not available for this sample. | | | |
| | | | I-131 | < 0.2 | 0.1 ± 0.1 | < 1.0 |
| SPFP-3680 | FOOD | May 1993 | | | | |
| | | | Cs-137 | < 6.5 | 0.0 ± 0.0 | < 10.0 |
| SPW-3844 | WATER | Jun 1993 | | | | |
| | | | Th-228 | < 0.1 | 0.0 ± 0.1 | < 1.0 |
| | | | Th-230 | < 0.1 | 0.2 ± 0.1 | < 1.0 |
| | | | Th-232 | < 0.1 | 0.0 ± 0.0 | < 1.0 |
| SPW-4234 | WATER | Jun 1993 | | | | |
| | | | Gr. Alpha | < 0.3 | 0.0 ± 0.2 | < 1.0 |
| | | | Gr. Beta | < 0.8 | 0.2 ± 0.3 | < 5.0 |
| SPS-4059 | SEDIMENT (BOTTOM) | Jul 1993 | | | | |
| | | | Cs-134 | < 5.0 | 0.0 ± 0.0 | < 10.0 |
| | | | Cs-137 | < 7.2 | 0.0 ± 0.0 | < 10.0 |
| SPVE-4060 | VEGETATION (SAW DUST) | Jul 1993 | | | | |
| | | | Cs-134 | < 4.8 | 0.0 ± 0.0 | < 10.0 |
| | | | Cs-137 | < 6.4 | 0.0 ± 0.0 | < 10.0 |
| | | | I-131(g) | < 13.5 | 0.0 ± 0.0 | < 20.0 |
| SPM-4061 | MILK | Jul 1993 | | | | |
| | | | Cs-134 | < 8.6 | 0.0 ± 0.0 | < 10.0 |
| | | | Cs-137 | < 5.8 | 0.0 ± 0.0 | < 10.0 |
| SPM-4062 | MILK | Jul 1993 | | | | |
| | | | Cs-134 | < 3.8 | 1.5 ± 1.5 | < 10.0 |
| | | | Cs-137 | < 4.4 | -1.6 ± 3.3 | < 10.0 |
| SPW-4063 | WATER | Jul 1993 | | | | |
| | | | Co-60 | < 4.0 | 1.2 ± 2.3 | < 10.0 |
| | | | Cs-134 | < 3.7 | 0.3 ± 1.2 | < 10.0 |
| | | | Cs-137 | < 3.2 | 0.4 ± 3.2 | < 10.0 |
| SPAP-4064 | AIR FILTER (COMPOSITE) | Jul 1993 | | | | |
| | | | Cs-134 | < 2.1 | 0.0 ± 0.0 | < 10.0 |
| | | | Cs-137 | < 2.8 | 0.0 ± 0.0 | < 10.0 |

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

| Lab Code | Sample Type | Sample Date | Analyses | Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD | Activity[b] | Acceptance Criteria (4.66 Sigma) |
|---|---|---|---|---|---|---|
| SPCH-406 | CHARCOAL | Jul 1993 | | | | |
| | | | I-131 | < 0.1 | 0.0 ± 0.0 | < 1.0 |
| | | | Based on a volume of 300 $m^3$ | | | |
| SPW-4233 | WATER | Aug 1993 | | | | |
| | | | Fe-55 | < 506.0 | 0.0 ± 0.3 | < 1000.0 |
| SPM-4235 | MILK | Aug 1993 | | | | |
| | | | Cs-134 | < 8.1 | 1.6 ± 1.8 | < 10.0 |
| | | | Cs-137 | < 4.2 | -1.7 ± 3.4 | < 10.0 |
| | | | I-131 | < 0.1 | 0.0 ± 0.2 | < 1.0 |
| | | | Sr-89 | < 0.8 | -1.0 ± 1.1 | < 5.0 |
| | | | Sr-90 | N/A | 1.8 ± 0.5 | < 1.0 |
| | | | Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual. | | | |
| SPW-4241 | WATER | Aug 1993 | | | | |
| | | | H-3 | < 190.0 | 72.9 ± 99.1 | < 300.0 |
| SPW-4243 | WATER | Aug 1993 | | | | |
| | | | Co-60 | < 7.0 | 0.4 ± 3.1 | < 10.0 |
| | | | Cs-134 | < 7.6 | 0.8 ± 15.6 | < 10.0 |
| | | | Cs-137 | < 5.4 | -0.7 ± 4.2 | < 10.0 |
| | | | I-131 | < 0.5 | 0.0 ± 0.1 | < 1.0 |
| | | | Sr-89 | < 1.1 | -0.6 ± 0.9 | < 5.0 |
| | | | Sr-90 | < 0.7 | 0.4 ± 0.4 | < 1.0 |
| SPW-4244 | WATER | Aug 1993 | | | | |
| | | | Pu-238 | < 1.0 | 0.4 ± 0.7 | < 1.0 |
| | | | Pu-239/240 | < 0.3 | 0.1 ± 0.2 | < 1.0 |
| | | | Th-228 | < 0.4 | -0.1 ± 0.3 | < 1.0 |
| | | | Th-230 | < 0.1 | 0.0 ± 0.1 | < 1.0 |
| | | | Th-232 | < 0.1 | 0.0 ± 0.0 | < 1.0 |
| | | | U-233/234 | < 0.1 | 0.1 ± 0.1 | < 1.0 |
| | | | U-235 | < 0.1 | 0.0 ± 0.1 | < 1.0 |
| | | | U-238 | < 0.1 | 0.1 ± 0.1 | < 1.0 |
| SPW-4245 | WATER | Aug 1993 | | | | |
| | | | Ra-226 | < 0.1 | 0.0 ± 0.0 | < 1.0 |
| | | | Ra-228 | < 0.8 | -0.2 ± 0.5 | < 1.0 |
| SPW-4422 | WATER | Oct 1993 | | | | |
| | | | H-3 | < 180.0 | -27.5 ± 88.9 | < 300.0 |

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

| Lab Code | Sample Type | Sample Date | Analyses | Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD | Activity[b] | Acceptance Criteria (4.66 Sigma) |
|---|---|---|---|---|---|---|

[a] All results are in pCi/L, except for air filter samples, which are in pCi/Filter.
[b] Prior to 1993, results where reported as only an LLD, the activity reported is the net activity result.

December, 1993

ATTACHMENT A

ACCEPTANCE CRITERIA FOR "SPIKED" SAMPLES

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

| Analysis | Level | One Standard Deviation for single determinations |
|---|---|---|
| Gamma Emitters | 5 to 100 pCi/liter or kg<br>>100 pCi/liter or kg | 5.0 pCi/liter<br>5% of known value |
| Strontium-89[b] | 5 to 50 pCi/liter or kg<br>>50 pCi/liter or kg | 5.0 pCi/liter<br>10% of known value |
| Strontium-90[b] | 2 to 30 pCi/liter or kg<br>>30 pCi/liter or kg | 5.0 pCi/liter<br>10% of known value |
| Potassium | >0.1 g/liter or kg | 5% of known value |
| Gross alpha | ≤20 pCi/liter<br>>20 pCi/liter | 5.0 pCi/liter<br>25% of known value |
| Gross beta | ≤100 pCi/liter<br>>100 pCi/liter | 5.0 pCi/liter<br>5% of known value |
| Tritium | ≤4,000 pCi/liter<br>>4,000 pCi/liter | 1s = (pCi/liter) = 169.85 x (known)$^{0.0933}$<br>10% of known value |
| Radium-226, 228 | <0.1 pCi/liter | 15% of known value |
| Plutonium | 0.1 pCi/liter, gram, or sample | 10% of known value |
| Iodine-131,<br>Iodine-129[b] | ≤55 pCi/liter<br>>55 pCi/liter | 6.0 pCi/liter<br>10% of known value |
| Uranium-238,<br>Nickel-64[b]<br>Technetium-99[b] | ≤35 pCi/liter<br>>35 pCi/liter | 6.0 pCi/liter<br>15% of known value |
| Iron-55[b] | 50 to 100 pCi/liter<br>>100 pCi/liter | 10 pCi/liter<br>10% of known value |
| Others[b] | – | 20% of known value |

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

[b] Teledyne limit.

# APPENDIX B

# DATA REPORTING CONVENTIONS

## Data Reporting Conventions

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

2.0 Single Measurements

Each single measurement is reported as follows:

$$x \pm s$$

where $x$ = value of the measurement;

$s = 2\sigma$ counting uncertainty (corresponding to the 95% confidence level).

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

$$<L$$

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

3.0 Duplicate analyses

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

Reported result: $x \pm s$

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

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

3.2 Individual results: $<L_1$

$<L_2$

Reported result: $<L$

where L = lower of $L_1$ and $L_2$

3.3 Individual results: $x \pm s$

$<L$

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

$<L$ otherwise

4.0. Computation of Averages and Standard Deviations

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

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

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

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

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

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

4.5 In rounding off, the following rules are followed:

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

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

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

# APPENDIX C

## Maximum Permissible Concentrations of Radioactivity in Air and Water Above Background in Unrestricted Areas

Table C-1. Maximum permissible concentrations of radioactivity in air and water above natural background in unrestricted areas[a].

| Air | | | Water | |
|---|---|---|---|---|
| Gross alpha | 3 | $pCi/m^3$ | Strontium-89 | 3,000 pCi/L |
| Gross beta | 100 | $pCi/m^3$ | Strontium-90 | 300 pCi/L |
| Iodine-131[b] | 0.14 | $pCi/m^3$ | Cesium-137 | 20,000 pCi/L |
| | | | Barium-140 | 20,000 pCi/L |
| | | | Iodine-131 | 300 pCi/L |
| | | | Potassium-40[c] | 3,000 pCi/L |
| | | | Gross alpha | 30 pCi/L |
| | | | Gross beta | 100 pCi/L |
| | | | Tritium | $3 \times 10^6$ pCi/L |

[a] Taken from Code of Federal Regulations Title 10, Part 20, Table II and appropriate footnotes. Concentrations may be averaged over a period not greater than one year.

[b] From 10 CFR 20 but adjusted by a factor of 700 to reduce the dose resulting from the air-grass-cow-milk-child pathway.

[c] A natural radionuclide.

# APPENDIX D

## SUMMARY OF THE LAND USE CENSUS

# SUMMARY OF 1993 LAND USE CENSUS

The annual Land Use Census for DAEC was completed on August 6, 1993. All milk animals and gardens greater than 500 square feet were identified within three miles for each of 16 sectors. Within five miles, the nearest resident, milk animal and garden in each sector were identified. Additionally, on September 25, 1993 the Cedar River was inspected for water use downstream of DAEC to Cedar Rapids.

There were no new uses of water. Gardening activity was subdued this year due to heavy rains in the spring and summer. A total of 15 new homes were built or under construction since the last census. Most of the new homes were built in the sectors toward Cedar Rapids (SSE, SE and ESE) where increased building rates have been noted in previous land use census. Three new homes were noted in the town of Palo (S and SSW) and four were noted near Pleasant Creek (WNW).

No changes in the DAEC Radiological Environmental Monitoring Program are recommended based on the Land Use Census.

# APPENDIX E

# ANNUAL RADIATION DOSE ASSESSMENT

## ANNUAL RADIATION DOSE ASSESSMENT

The annual offsite radiation dose to a member of the public was determined by assessment of environmental dosimeter results and by calculations based on monitored effluent releases.

### SECTION A. DOSE CONTRIBUTION FROM DIRECT RADIATION

Direct radiation dose from the operation of DAEC was recorded by TLDs placed at locations in the surrounding environment as described in the Offsite Dose Assessment Manual (ODAM).

1. Pre-operational and 1993 TLD results were compared using a paired difference test. No difference in the TLD populations were observed at 0.5 and 1 mile using a confidence level of 99%.

2. As stated in Part 1, page 8 of this report, no plant effect was indicated by the TLDs when dose results were compared to the estimated average natural background for Middle America.

### SECTION B. ESTIMATED OFFSITE DOSE FROM EFFLUENT RELEASES

The contribution of dose to a member of the public most likely to be exposed from effluent releases was calculated by the Meteorological Information and Dose Assessment Systems (MIDAS) computer program in accordance with the ODAM. The calculation methods follow those prescribed by Reg Guide 1.109.

Results of these calculations are discussed below and shown in tabular form on Page E-4:

1. There were no releases of radioactive material to liquid effluents in 1993.

2. The dose to air from noble gases released was 5.25E-3 mrad from gamma radiation at the West site boundary and 6.73E-3 mrad from beta radiation at the West site boundary.

3. The total body dose equivalent to the maximally exposed individual from noble gases was 2.70E-3 mrem, at 805 meters West.

4. The skin dose equivalent to the maximally exposed individual from noble gases was 6.73E-3 mrem, at 805 meters West.

5. The maximally exposed organ due to iodines and particulates with half-lives greater than eight days was the skin of a child at 805 meters West, with an estimated dose equivalent of 1.08E-2 mrem.

CONCLUSION:

No measurable dose due to operation of DAEC was detected by environmental TLDs in 1993. The calculated doses are below the regulatory limits stated in Appendix I to 10 CFR 50 and in 40 CFR 190.

ESTIMATED MAXIMUM OFFSITE INDIVIDUAL DOSES FOR 1993

| TYPE | AGE GROUP | DISTANCE (meters) | DIRECTION | DOSE OR DOSE EQUIVALENT | ANNUAL 10CFR50, APPENDIX I LIMIT |
|---|---|---|---|---|---|
| DIRECTION RADIATION (as measured by TLDs) | | | | NONE | * |
| LIQUIDS RELEASES | | | | NONE | 3 MREM TOTAL BODY<br>10 MREM ANY ORGAN |
| NOBLE GAS | | | | | |
| GAMMA AIR DOSE | | 668 | W | 5.25E-3 MRAD | 10 MRAD |
| BETA AIR DOSE | | 668 | W | 6.73E-3 MRAD | 20 MRAD |
| TOTAL BODY | ALL | 805 | W | 2.70E-3 MREM | * |
| SKIN | ALL | 805 | W | 6.73E-3 MREM | * |
| PARTICULATES & IODINES | | | | | |
| ORGAN DOSE | CHILD-SKIN | 805 | W | 1.08E-2 MREM | 15 MREM |

* NO APPENDIX I LIMIT BUT IS USED TO DETERMINE COMPLIANCE WITH 40 CFR 190 LIMITS OF 25 MREM TOTAL BODY AND 75 MREM THYROID.

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# REPORT
# TO
# IOWA ELECTRIC LIGHT AND POWER
# CEDAR RAPIDS, IOWA

## RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)
## FOR THE
## DUANE ARNOLD ENERGY CENTER
## CEDAR RAPIDS, IOWA
## Docket No. 50-331

## ANNUAL REPORT - PART II
## DATA TABULATIONS AND ANALYSES
## JANUARY - DECEMBER 1993

## FOR SUBMITTAL TO
## THE NUCLEAR REGULATORY COMMISSION

## PREPARED AND SUBMITTED
## BY
## TELEDYNE ISOTOPES MIDWEST LABORATORY
## PROJECT NO. 8001

Approved by: L. G. Huebner

L. G. Huebner
General Manager

22 April 1994

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (continued)

## 1.0 INTRODUCTION

The following constitutes a supplement to the Annual Report for the Radiological Environmental Monitoring Program conducted at the Duane Arnold Energy Center, Cedar Rapids, Iowa in 1993. Results of completed analyses are presented in the attached tables.

For information regarding sampling locations, type and frequency of collection, and sample codes, please see Tables 5.3 - 5.5 and Figures 5.1 and 5.2 of Part I.

## 2.0 LISTING OF MISSED SAMPLES

| Sample Type | Location | Expected Collection Date | Reason |
|---|---|---|---|
| Milk | D-93 | 01-05-93 | Sample not available. |
| Milk | D-101 | 01-05-93 | Sample not available. |
| Milk | D-93 | 02-03-93 | Sample not available. |
| Milk | D-101 | 02-06-93 | Sample not available. |
| Milk | D-101 | 03-02-93 | Sample not available. |
| Milk | D-101 | 04-06-93 | Sample not available. |
| Milk | D-101 | 05-04-93 | Sample not available. |
| River Sediment | All | January - June, 1993 | Flooding and high water |
| Fish | All | January - July, 1993 | Flooding and high water |
| AP/AI | D-11 | 07-15-93 | No power to the sampler. |
| AP/AI | All | 08-19-93 | Samples lost in shipment. |
| Milk | D-93 | 12-07-93 | Sample not available. |
| Milk | D-101 | 12-07-93 | Sample not available. |

# 3.0 DATA TABLES

DUANE ARNOLD

Table 1. Airborne particulates
Analyses: Gross beta
Location: D-1 (Cedar Rapids)
Units: $pCi/m^3$
Collection: Continuous, weekly exchange.

| Date Collected | Volume ($m^3$) | Gross Beta | Date Collected | Volume ($m^3$) | Gross Beta |
|---|---|---|---|---|---|
| Required LLD | | 0.01 | | | 0.01 |
| 01-07-93 | 332[a] | 0.048 ± 0.004 | 07-08-93 | 286 | 0.015 ± 0.003 |
| 01-14-93 | 290 | 0.040 ± 0.004 | 07-15-93 | 284 | 0.016 ± 0.003 |
| 01-21-93 | 334[a] | 0.038 ± 0.004 | 07-22-93 | 284 | 0.016 ± 0.003 |
| 01-28-93 | 250[b] | 0.026 ± 0.004 | 07-30-93 | 329[a] | 0.015 ± 0.003 |
| 02-05-93 | 290[a] | 0.031 ± 0.004 | 08-05-93 | 243[b] | 0.016 ± 0.003 |
| 02-11-93 | 286[b] | 0.029 ± 0.002 | 08-12-93 | 284 | 0.015 ± 0.003 |
| 02-18-93 | 285 | 0.034 ± 0.004 | 08-19-93 | ND[c] | - |
| 02-25-93 | 285 | 0.042 ± 0.003 | 08-26-93 | 285 | 0.020 ± 0.003 |
| 03-04-93 | 287 | 0.040 ± 0.004 | 09-02-93 | 286 | 0.020 ± 0.003 |
| 03-11-93 | 284 | 0.022 ± 0.003 | 09-10-93 | 326[a] | 0.017 ± 0.003 |
| 03-17-93 | 245[a] | 0.023 ± 0.004 | 09-16-93 | 243[b] | 0.020 ± 0.003 |
| 03-25-93 | 327[b] | 0.020 ± 0.003 | 09-23-93 | 286 | 0.014 ± 0.003 |
| 04-01-93 | 285 | 0.014 ± 0.003 | 09-30-93 | 285 | 0.016 ± 0.003 |
| 1st Qtr. Mean±s.d. | | 0.031 ± 0.010 | 3rd Qtr. Mean±s.d. | | 0.017 ± 0.002 |
| 04-08-93 | 285 | 0.015 ± 0.003 | 10-07-93 | 286 | 0.017 ± 0.003 |
| 04-15-93 | 286 | 0.012 ± 0.003 | 10-14-93 | 286 | 0.029 ± 0.004 |
| 04-22-93 | 284 | 0.018 ± 0.003 | 10-21-93 | 285 | 0.033 ± 0.004 |
| 04-29-93 | 286 | 0.021 ± 0.003 | 10-28-93 | 286 | 0.012 ± 0.003 |
| 05-06-93 | 285 | 0.015 ± 0.003 | 11-04-93 | 286 | 0.013 ± 0.003 |
| 05-13-93 | 286 | 0.019 ± 0.003 | 11-11-93 | 286 | 0.026 ± 0.003 |
| 05-20-93 | 285 | 0.016 ± 0.003 | 11-18-93 | 287 | 0.029 ± 0.004 |
| 05-27-93 | 287 | 0.017 ± 0.003 | 11-24-93 | 245[b] | 0.029 ± 0.004 |
| 06-03-93 | 283 | 0.012 ± 0.003 | 12-02-93 | 327[a] | 0.039 ± 0.004 |
| 06-10-93 | 287 | 0.013 ± 0.003 | 12-09-93 | 285 | 0.032 ± 0.004 |
| 06-17-93 | 280 | 0.020 ± 0.002 | 12-16-93 | 285 | 0.031 ± 0.004 |
| 06-24-93 | 291 | 0.019 ± 0.003 | 12-22-93 | 245[b] | 0.029 ± 0.004 |
| 07-01-93 | 286 | 0.015 ± 0.003 | 12-30-93 | 328[a] | 0 031 ± 0.003 |
| 2nd Qtr. Mean±s.d. | | 0.016 ± 0.003 | 4th Qtr. Mean±s.d. | | 0.027 ± 0.008 |
| | | | Cumulative Average: | | 0.023 |
| | | | Previous Annual Average: | | 0.022 |

[a] Eight-day collection.
[b] Six-day collection.
[c] ND - No Data; sample lost in shipment.

DUANE ARNOLD

Table 2. Airborne particulates and charcoal canisters
Analyses: Gross beta and iodine-131 [a]
Location: D-2 (Marion)
Units: $pCi/m^3$
Collection: Continuous, weekly exchange.

| Date Collected | Volume ($m^3$) | Gross Beta | Date Collected | Volume ($m^3$) | Gross Beta |
|---|---|---|---|---|---|
| Required LLD | | 0.01 | | | 0.01 |
| 01-07-93 | 342 [b] | 0.046 ± 0.004 | 07-08-93 | 286 | 0.018 ± 0.003 |
| 01-14-93 | 302 | 0.035 ± 0.004 | 07-15-93 | 285 | 0.013 ± 0.003 |
| 01-22-93 | 349 [b] | 0.030 ± 0.003 | 07-22-93 | 284 | 0.016 ± 0.003 |
| 01-28-93 | 257 [c] | 0.024 ± 0.004 | 07-30-93 | 331 [b] | 0.017 ± 0.003 |
| 02-05-93 | 285 [b] | 0.028 ± 0.004 | 08-05-93 | 241 [c] | 0.014 ± 0.003 |
| 02-11-93 | 284 [c] | 0.031 ± 0.002 | 08-12-93 | 286 | 0.014 ± 0.003 |
| 02-18-93 | 286 | 0.035 ± 0.004 | 08-19-93 | ND [d] | - |
| 02-25-93 | 286 | 0.037 ± 0.003 | 08-26-93 | 286 | 0.020 ± 0.003 |
| 03-04-93 | 288 | 0.037 ± 0.004 | 09-02-93 | 286 | 0.017 ± 0.003 |
| 03-11-93 | 283 | 0.025 ± 0.003 | 09-10-93 | 328 [b] | 0.017 ± 0.003 |
| 03-17-93 | 246 [c] | 0.022 ± 0.004 | 09-16-93 | 242 [c] | 0.017 ± 0.003 |
| 03-25-93 | 325 [b] | 0.016 ± 0.003 | 09-23-93 | 286 | 0.016 ± 0.003 |
| 04-01-93 | 286 | 0.014 ± 0.003 | 09-30-93 | 285 | 0.013 ± 0.003 |
| 1st Qtr. Mean±s.d. | | 0.029± 0.009 | 3rd Qtr. Mean±s.d. | | 0.016 ± 0.002 |
| 04-08-93 | 286 | 0.012 ± 0.003 | 10-07-93 | 287 | 0.024 ± 0.003 |
| 04-15-93 | 285 | 0.016 ± 0.003 | 10-14-93 | 285 | 0.027 ± 0.004 |
| 04-22-93 | 284 | 0.019 ± 0.003 | 10-21-93 | 286 | 0.035 ± 0.004 |
| 04-29-93 | 286 | 0.024 ± 0.003 | 10-28-93 | 285 | 0.022 ± 0.004 |
| 05-06-93 | 285 | 0.014 ± 0.003 | 11-04-93 | 287 | 0.017 ± 0.003 |
| 05-13-93 | 286 | 0.020 ± 0.003 | 11-11-93 | 296 | 0.027 ± 0.003 |
| 05-20-93 | 284 | 0.016 ± 0.003 | 11-18-93 | 284 | 0.032 ± 0.004 |
| 05-27-93 | 288 | 0.014 ± 0.003 | 11-24-93 | 244 [c] | 0.030 ± 0.004 |
| 06-03-93 | 284 | 0.012 ± 0.003 | 12-02-93 | 327 [b] | 0.051 ± 0.004 |
| 06-10-93 | 286 | 0.015 ± 0.003 | 12-09-93 | 285 | 0.034 ± 0.004 |
| 06-17-93 | 281 | 0.020 ± 0.002 | 12-16-93 | 286 | 0.026 ± 0.004 |
| 06-24-93 | 290 | 0.018 ± 0.003 | 12-22-93 | 244 [c] | 0.022 ± 0.004 |
| 07-01-93 | 286 | 0.015 ± 0.003 | 12-30-93 | 328 [b] | 0.030 ± 0.003 |
| 2nd Qtr. Mean±s.d. | | 0.017 ± 0.003 | 4th Qtr. Mean±s.d. | | 0.029 ± 0.008 |
| | | | Cumulative Average: | | 0.023 |
| | | | Previous Annual Average: | | 0.022 |

[a] Iodine-131 concentrations are <0.07 $pCi/m^3$ unless otherwise noted.
[b] Eight-day collection.
[c] Six-day collection.
[d] ND - No Data; sample lost in shipment.

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Table 3. Airborne particulates
Analyses: Gross beta
Location: D-3 (Hiawatha)
Units: $pCi/m^3$
Collection: Continuous, weekly exchange.

| Date Collected | Volume ($m^3$) | Gross Beta | Date Collected | Volume ($m^3$) | Gross Beta |
|---|---|---|---|---|---|
| Required LLD | | 0.01 | | | 0.01 |
| 01-07-93 | 325[a] | 0.049 ± 0.004 | 07-08-93 | 285 | 0.020 ± 0.003 |
| 01-14-93 | 290 | 0.033 ± 0.004 | 07-15-93 | 285 | 0.015 ± 0.003 |
| 01-22-93 | 322[a] | 0.037 ± 0.004 | 07-22-93 | 284 | 0.014 ± 0.003 |
| 01-28-93 | 344[b] | 0.033 ± 0.004 | 07-30-93 | 332[a] | 0.014 ± 0.003 |
| 02-05-93 | 285[a] | 0.035 ± 0.004 | 08-05-93 | 241[b] | 0.015 ± 0.003 |
| 02-11-93 | 284[b] | 0.030 ± 0.002 | 08-12-93 | 285 | 0.013 ± 0.003 |
| 02-18-93 | 286 | 0.038 ± 0.004 | 08-19-93 | ND[c] | - |
| 02-25-93 | 286 | 0.042 ± 0.003 | 08-26-93 | 286 | 0.016 ± 0.003 |
| 03-04-93 | 288 | 0.034 ± 0.004 | 09-02-93 | 286 | 0.016 ± 0.003 |
| 03-11-93 | 283 | 0.022 ± 0.003 | 09-10-93 | 326[a] | 0.017 ± 0.003 |
| 03-17-93 | 246[b] | 0.018 ± 0.004 | 09-16-93 | 244[b] | 0.015 ± 0.003 |
| 03-25-93 | 325[a] | 0.017 ± 0.003 | 09-23-93 | 285 | 0.017 ± 0.003 |
| 04-01-93 | 287 | 0.014 ± 0.003 | 09-30-93 | 285 | 0.012 ± 0.003 |
| 1st Qtr. Mean±s.d. | | 0.031 ± 0.010 | 3rd Qtr. Mean±s.d. | | 0.015 ± 0.002 |
| 04-08-93 | 285 | 0.014 ± 0.003 | 10-07-93 | 287 | 0.024 ± 0.003 |
| 04-15-93 | 285 | 0.013 ± 0.003 | 10-14-93 | 285 | 0.031 ± 0.004 |
| 04-22-93 | 284 | 0.016 ± 0.003 | 10-21-93 | 286 | 0.029 ± 0.004 |
| 04-29-93 | 286 | 0.024 ± 0.003 | 10-28-93 | 285 | 0.023 ± 0.004 |
| 05-06-93 | 285 | 0.013 ± 0.003 | 11-04-93 | 287 | 0.015 ± 0.003 |
| 05-13-93 | 286 | 0.017 ± 0.003 | 11-11-93 | 286 | 0.029 ± 0.004 |
| 05-20-93 | 284 | 0.018 ± 0.003 | 11-18-93 | 285 | 0.030 ± 0.004 |
| 05-27-93 | 286 | 0.018 ± 0.003 | 11-24-93 | 244[b] | 0.032 ± 0.004 |
| 06-03-93 | 284 | 0.010 ± 0.003 | 12-02-93 | 326[a] | 0.045 ± 0.004 |
| 06-10-93 | 286 | 0.012 ± 0.003 | 12-09-93 | 286 | 0.032 ± 0.004 |
| 06-17-93 | 281 | 0.016 ± 0.002 | 12-16-93 | 286 | 0.030 ± 0.004 |
| 06-24-93 | 290 | 0.021 ± 0.003 | 12-22-93 | 244[b] | 0.021 ± 0.004 |
| 07-01-93 | 286 | 0.015 ± 0.003 | 12-30-93 | 328[a] | 0.031 ± 0.003 |
| 2nd Qtr. Mean±s.d. | | 0.016 ± 0.004 | 4th Qtr. Mean±s.d. | | 0.029 ± 0.007 |
| | | | Cumulative Average: | | 0.023 |
| | | | Previous Annual Average: | | 0.024 |

[a] Eight-day collection.
[b] Six-day collection.
[c] ND - No Data; sample lost in shipment.

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Table 4. Airborne particulates and charcoal canisters
Analyses: Gross beta and iodine-131 [a]
Location: D-5 (Palo)
Units: $pCi/m^3$
Collection: Continuous, weekly exchange.

| Date Collected | Volume ($m^3$) | Gross Beta | Date Collected | Volume ($m^3$) | Gross Beta |
|---|---|---|---|---|---|
| Required LLD | | 0.01 | | | 0.01 |
| 01-07-93 | 326 [b] | 0.047 ± 0.004 | 07-08-93 | 284 | 0.017 ± 0.003 |
| 01-14-93 | 285 | 0.035 ± 0.004 | 07-15-93 | 285 | 0.013 ± 0.003 |
| 01-22-93 | 326 [b] | 0.030 ± 0.003 | 07-22-93 | 284 | 0.011 ± 0.003 |
| 01-28-93 | 244 [c] | 0.026 ± 0.004 | 07-30-93 | 329 [b] | 0.016 ± 0.003 |
| 02-05-93 | 286 [b] | 0.026 ± 0.004 | 08-05-93 | 239 [c] | 0.015 ± 0.003 |
| 02-11-93 | 285 [c] | 0.029 ± 0.002 | 08-12-93 | 286 | 0.012 ± 0.003 |
| 02-18-93 | 285 | 0.036 ± 0.004 | 08-19-93 | ND [d] | - |
| 02-25-93 | 286 | 0.038 ± 0.003 | 08-26-93 | 286 | 0.016 ± 0.003 |
| 03-04-93 | 287 | 0.042 ± 0.004 | 09-02-93 | 286 | 0.016 ± 0.003 |
| 03-11-93 | 283 | 0.024 ± 0.003 | 09-10-93 | 326 [b] | 0.019 ± 0.003 |
| 03-17-93 | 245 [c] | 0.021 ± 0.004 | 09-16-93 | 245 [c] | 0.015 ± 0.003 |
| 03-25-93 | 326 [b] | 0.018 ± 0.003 | 09-23-93 | 286 | 0.016 ± 0.003 |
| 04-01-93 | 286 | 0.014 ± 0.003 | 09-30-93 | 285 | 0.015 ± 0.003 |
| 1st Qtr. Mean±s.d. | | 0.030 ± 0.009 | 3rd Qtr. Mean±s.d. | | 0.015 ± 0.002 |
| 04-08-93 | 283 | 0.010 ± 0.003 | 10-07-93 | 285 | 0.022 ± 0.004 |
| 04-15-93 | 285 | 0.012 ± 0.003 | 10-14-93 | 288 | 0.028 ± 0.004 |
| 04-22-93 | 286 | 0.015 ± 0.003 | 10-21-93 | 285 | 0.037 ± 0.004 |
| 04-29-93 | 285 | 0.021 ± 0.003 | 10-28-93 | 284 | 0.024 ± 0.004 |
| 05-06-93 | 285 | 0.011 ± 0.003 | 11-04-93 | 288 | 0.016 ± 0.003 |
| 05-13-93 | 285 | 0.018 ± 0.003 | 11-11-93 | 286 | 0.028 ± 0.004 |
| 05-20-93 | 285 | 0.014 ± 0.003 | 11-18-93 | 285 [c] | 0.032 ± 0.004 |
| 05-27-93 | 286 | 0.016 ± 0.003 | 11-24-93 | 244 | 0.033 ± 0.004 |
| 06-03-93 | 284 | 0.010 ± 0.003 | 12-02-93 | 327 [b] | 0.048 ± 0.004 |
| 06-10-93 | 286 | 0.012 ± 0.003 | 12-09-93 | ND [e] | - |
| 06-17-93 | 283 | 0.011 ± 0.002 | 12-16-93 | 286 | 0.029 ± 0.004 |
| 06-24-93 | 288 | 0.018 ± 0.003 | 12-22-93 | 245 [c] | 0.023 ± 0.004 |
| 07-01-93 | 287 | 0.012 ± 0.003 | 12-30-93 | 327 [b] | 0.034 ± 0.002 |
| 2nd Qtr. Mean±s.d. | | 0.014 ± 0.003 | 4th Qtr. Mean±s.d. | | 0.030 ± 0.008 |
| | | | Cumulative Average: | | 0.022 |
| | | | Previous Annual Average: | | 0.024 |

[a] Iodine-131 concentrations are <0.07 $pCi/m^3$ unless otherwise noted.
[b] Eight-day collection.
[c] Six-day collection.
[d] ND - No Data; sample lost in shipment.
[e] ND - No Data; sample lost in collection.

Table 5. Airborne particulates
Analyses: Gross beta
Location: D-6 (Center Point)
Units: $pCi/m^3$
Collection: Continuous, weekly exchange.

| Date Collected | Volume ($m^3$) | Gross Beta | Date Collected | Volume ($m^3$) | Gross Beta |
|---|---|---|---|---|---|
| Required LLD | | 0.01 | | | 0.01 |
| 01-07-93 | 326[a] | 0.051 ± 0.004 | 07-08-93 | 284 | 0.020 ± 0.003 |
| 01-14-93 | 285 | 0.037 ± 0.004 | 07-15-93 | 286 | 0.015 ± 0.003 |
| 01-22-93 | 326[a] | 0.033 ± 0.004 | 07-22-93 | 284 | 0.016 ± 0.003 |
| 01-28-93 | 244[b] | 0.024 ± 0.004 | 07-30-93 | 332[a] | 0.016 ± 0.003 |
| 02-05-93 | 286[a] | 0.030 ± 0.004 | 08-05-93 | 238[b] | 0.014 ± 0.003 |
| 02-11-93 | 284[b] | 0.031 ± 0.003 | 08-12-93 | 286 | 0.015 ± 0.003 |
| 02-18-93 | 286 | 0.036 ± 0.004 | 08-19-93 | ND[d] | - |
| 02-25-93 | 286 | 0.039 ± 0.003 | 08-26-93 | 286 | 0.019 ± 0.003 |
| 03-04-93 | 288 | 0.038 ± 0.004 | 09-02-93 | 286 | 0.015 ± 0.003 |
| 03-11-93 | 283 | 0.024 ± 0.003 | 09-10-93 | 326[a] | 0.018 ± 0.003 |
| 03-17-93 | 245[b] | 0.021 ± 0.004 | 09-16-93 | 245[b] | 0.015 ± 0.003 |
| 03-25-93 | 326[a] | 0.019 ± 0.003 | 09-23-93 | 286 | 0.014 ± 0.003 |
| 04-01-93 | 286 | 0.012 ± 0.003 | 09-30-93 | 285 | 0.011 ± 0.003 |
| 1st Qtr. Mean±s.d. | | 0.030 ± 0.010 | 3rd Qtr. Mean±s.d. | | 0.016 ± 0.002 |
| 04-08-93 | 282 | 0.012 ± 0.003 | 10-07-93 | 284 | 0.022 ± 0.003 |
| 04-15-93 | 285 | 0.013 ± 0.003 | 10-14-93 | 250 | 0.029 ± 0.004 |
| 04-22-93 | 286 | 0.015 ± 0.003 | 10-21-93 | 277 | 0.026 ± 0.004 |
| 04-29-93 | 285 | 0.025 ± 0.003 | 10-28-93 | 251 | 0.019 ± 0.004 |
| 05-06-93 | 286 | 0.015 ± 0.003 | 11-04-93 | 287 | 0.013 ± 0.003 |
| 05-13-93 | 286 | 0.019 ± 0.003 | 11-11-93 | 261 | 0.027 ± 0.004 |
| 05-20-93 | 285 | 0.016 ± 0.003 | 11-18-93 | 283 | 0.025 ± 0.004 |
| 05-27-93 | 284 | 0.017 ± 0.003 | 11-24-93 | 243[b] | 0.027 ± 0.004 |
| 06-03-93 | 284 | 0.014 ± 0.003 | 12-02-93 | 326[a] | 0.040 ± 0.004 |
| 06-10-93 | 286 | 0.014 ± 0.003 | 12-09-93 | 284 | 0.030 ± 0.004 |
| 06-17-93 | 224[c] | 0.021 ± 0.003 | 12-16-93 | 285 | 0.026 ± 0.004 |
| 06-24-93 | 288 | 0.021 ± 0.003 | 12-22-93 | 245[b] | 0.024 ± 0.004 |
| 07-01-93 | 287 | 0.015 ± 0.003 | 12-30-93 | 328[a] | 0.028 ± 0.003 |
| 2nd Qtr. Mean±s.d. | | 0.017 ± 0.004 | 4th Qtr. Mean±s.d. | | 0.026 ± 0.006 |
| | | | Cumulative Average: | | 0.022 |
| | | | Previous Annual Average: | | 0.024 |

[a] Eight-day collection.
[b] Six-day collection.
[c] Low volume due to power shut off.
[d] ND - No Data; sample lost in shipment.

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Table 6. Airborne particulates and charcoal canisters
Analyses: Gross beta and iodine-131 [a]
Location: D-7 (Shellsburg)
Units: $pCi/m^3$
Collection: Continuous, weekly exchange.

| Date Collected | Volume ($m^3$) | Gross Beta | Date Collected | Volume ($m^3$) | Gross Beta |
|---|---|---|---|---|---|
| Required LLD | | 0.01 | | | 0.01 |
| 01-07-93 | 326 [b] | 0.049 ± 0.004 | 07-08-93 | 284 | 0.019 ± 0.003 |
| 01-14-93 | 285 | 0.036 ± 0.003 | 07-15-93 | 285 | 0.013 ± 0.003 |
| 01-22-93 | 330 [b] | 0.033 ± 0.003 | 07-22-93 | 284 | 0.014 ± 0.003 |
| 01-28-93 | 247 [c] | 0.020 ± 0.004 | 07-30-93 | 329 [b] | 0.013 ± 0.003 |
| 02-05-93 | 289 [b] | 0.015 ± 0.003 | 08-05-93 | 239 [c] | 0.016 ± 0.003 |
| 02-11-93 | 287 [c] | 0.031 ± 0.002 | 08-12-93 | 286 | 0.017 ± 0.003 |
| 02-18-93 | 285 | 0.028 ± 0.004 | 08-19-93 | ND [d] | - |
| 02-25-93 | 286 | 0.027 ± 0.002 | 08-26-93 | 286 | 0.022 ± 0.003 |
| 03-04-93 | 288 | 0.038 ± 0.004 | 09-02-93 | 286 | 0.014 ± 0.003 |
| 03-11-93 | 284 | 0.025 ± 0.003 | 09-10-93 | 326 [b] | 0.016 ± 0.003 |
| 03-17-93 | 246 [c] | 0.018 ± 0.004 | 09-16-93 | 245 [c] | 0.013 ± 0.003 |
| 03-25-93 | 326 [b] | 0.019 ± 0.003 | 09-23-93 | 286 | 0.011 ± 0.003 |
| 04-01-93 | 286 | 0.013 ± 0.003 | 09-30-93 | 285 | 0.010 ± 0.003 |
| 1st Qtr. Mean±s.d. | | 0.027 ± 0.010 | 3rd Qtr. Mean±s.d. | | 0.015 ± 0.003 |
| 04-08-93 | 283 | 0.012 ± 0.003 | 10-07-93 | 285 | 0.018 ± 0.003 |
| 04-15-93 | 285 | 0.008 ± 0.003 | 10-14-93 | 288 | 0.025 ± 0.003 |
| 04-22-93 | 286 | 0.013 ± 0.003 | 10-21-93 | 285 | 0.029 ± 0.004 |
| 04-29-93 | 285 | 0.020 ± 0.003 | 10-28-93 | 286 | 0.014 ± 0.003 |
| 05-06-93 | 284 | 0.012 ± 0.003 | 11-04-93 | 288 | 0.010 ± 0.003 |
| 05-13-93 | 285 | 0.017 ± 0.003 | 11-11-93 | 286 | 0.025 ± 0.003 |
| 05-20-93 | 285 | 0.015 ± 0.003 | 11-18-93 | 284 | 0.032 ± 0.004 |
| 05-27-93 | 286 | 0.014 ± 0.003 | 11-24-93 | 244 [c] | 0.029 ± 0.004 |
| 06-03-93 | 284 | 0.007 ± 0.002 | 12-02-93 | 327 [b] | 0.054 ± 0.004 |
| 06-10-93 | 285 | 0.012 ± 0.003 | 12-09-93 | 285 | 0.041 ± 0.004 |
| 06-17-93 | 283 | 0.020 ± 0.002 | 12-16-93 | 286 | 0.037 ± 0.004 |
| 06-24-93 | 288 | 0.022 ± 0.003 | 12-22-93 | 245 [c] | 0.028 ± 0.004 |
| 07-01-93 | 287 | 0.014 ± 0.003 | 12-30-93 | 327 [b] | 0.031 ± 0.003 |
| 2nd Qtr. Mean±s.d. | | 0.014 ± 0.004 | 4th Qtr. Mean±s.d. | | 0.029 ± 0.011 |
| | | | Cumulative Average: | | 0.021 |
| | | | Previous Annual Average: | | 0.021 |

[a] Iodine-131 concentrations are <0.07 $pCi/m^3$ unless otherwise noted.
[b] Eight-day collection.
[c] Six-day collection.
[d] ND - No Data; sample lost in shipment.

Table 7. Airborne particulates and charcoal canisters
Analyses: Gross beta and iodine-131 [a]
Location: D-8 (Urbana)
Units: $pCi/m^3$
Collection: Continuous, weekly exchange.

| Date Collected | Volume ($m^3$) | Gross Beta | Date Collected | Volume ($m^3$) | Gross Beta |
|---|---|---|---|---|---|
| Required LLD | | 0.01 | | | 0.01 |
| 01-07-93 | 326 [b] | 0.048 ± 0.004 | 07-08-93 | 284 | 0.020 ± 0.003 |
| 01-14-93 | 285 | 0.037 ± 0.004 | 07-15-93 | 286 | 0.013 ± 0.003 |
| 01-22-93 | 326 [b] | 0.034 ± 0.004 | 07-22-93 | 284 | 0.014 ± 0.003 |
| 01-28-93 | 244 [c] | 0.026 ± 0.004 | 07-30-93 | 255 [d] | 0.016 ± 0.003 |
| 02-05-93 | 286 [b] | 0.024 ± 0.004 | 08-05-93 | 235 [c] | 0.013 ± 0.003 |
| 02-11-93 | 284 [c] | 0.028 ± 0.002 | 08-12-93 | 286 | 0.014 ± 0.003 |
| 02-18-93 | 285 | 0.033 ± 0.004 | 08-19-93 | ND [e] | - |
| 02-25-93 | 286 | 0.035 ± 0.003 | 08-26-93 | 278 | 0.021 ± 0.003 |
| 03-04-93 | 287 | 0.036 ± 0.004 | 09-02-93 | 282 | 0.014 ± 0.003 |
| 03-11-93 | 283 | 0.025 ± 0.003 | 09-10-93 | 330 [b] | 0.018 ± 0.003 |
| 03-17-93 | 245 [c] | 0.021 ± 0.004 | 09-16-93 | 245 [c] | 0.016 ± 0.003 |
| 03-25-93 | 326 [b] | 0.018 ± 0.003 | 09-23-93 | 286 | 0.017 ± 0.003 |
| 04-01-93 | 286 | 0.012 ± 0.003 | 09-30-93 | 285 | 0.014 ± 0.003 |
| 1st Qtr. Mean±s.d. | | 0.029 ± 0.009 | 3rd Qtr. Mean±s.d. | | 0.016 ± 0.003 |
| 04-08-93 | 283 | 0.008 ± 0.003 | 10-07-93 | 285 | 0.021 ± 0.003 |
| 04-15-93 | 285 | 0.014 ± 0.003 | 10-14-93 | 288 | 0.024 ± 0.003 |
| 04-22-93 | 286 | 0.018 ± 0.003 | 10-21-93 | 285 | 0.036 ± 0.004 |
| 04-29-93 | 285 | 0.024 ± 0.003 | 10-28-93 | 284 | 0.021 ± 0.003 |
| 05-06-93 | 286 | 0.013 ± 0.003 | 11-04-93 | 288 | 0.016 ± 0.003 |
| 05-13-93 | 286 | 0.015 ± 0.003 | 11-11-93 | 286 | 0.027 ± 0.004 |
| 05-20-93 | 285 | 0.017 ± 0.003 | 11-18-93 | 284 | 0.025 ± 0.004 |
| 05-27-93 | 286 | 0.016 ± 0.003 | 11-24-93 | 244 [c] | 0.030 ± 0.004 |
| 06-03-93 | 284 | 0.012 ± 0.003 | 12-02-93 | 327 [b] | 0.044 ± 0.004 |
| 06-10-93 | 286 | 0.014 ± 0.003 | 12-09-93 | 285 | 0.032 ± 0.004 |
| 06-17-93 | 283 | 0.017 ± 0.002 | 12-16-93 | 286 | 0.025 ± 0.004 |
| 06-24-93 | 288 | 0.017 ± 0.003 | 12-22-93 | 245 [c] | 0.019 ± 0.004 |
| 07-01-93 | 284 | 0.014 ± 0.003 | 12-30-93 | 327 [b] | 0.029 ± 0.003 |
| 2nd Qtr. Mean±s.d. | | 0.015 ± 0.004 | 4th Qtr. Mean±s.d. | | 0.027 ± 0.007 |
| | | | Cumulative Average: | | 0.022 |
| | | | Previous Annual Average: | | 0.023 |

[a] Iodine-131 concentrations are <0.07 $pCi/m^3$ unless otherwise noted.
[b] Eight-day collection.
[c] Six-day collection.
[d] Low volume due to power shut off.
[e] ND - No Data; sample lost in shipment.

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Table 8. Airborne particulates
Analyses: Gross beta
Location: D-10 (Atkins)
Units: $pCi/m^3$
Collection: Continuous, weekly exchange.

| Date Collected | Volume ($m^3$) | Gross Beta | Date Collected | Volume ($m^3$) | Gross Beta |
|---|---|---|---|---|---|
| Required LLD | | 0.01 | | | 0.01 |
| 01-07-93 | 326[a] | 0.052 ± 0.004 | 07-08-93 | 286 | 0.018 ± 0.003 |
| 01-14-93 | 285 | 0.035 ± 0.004 | 07-15-93 | 284 | 0.018 ± 0.003 |
| 01-22-93 | 314[a] | 0.034 ± 0.004 | 07-22-93 | 285 | 0.013 ± 0.003 |
| 01-28-93 | 245[b] | 0.026 ± 0.004 | 07-30-93 | 290 | 0.016 ± 0.003 |
| 02-05-93 | 285[a] | 0.025 ± 0.004 | 08-05-93 | 242[b] | 0.013 ± 0.003 |
| 02-11-93 | 286[b] | 0.027 ± 0.002 | 08-12-93 | 283 | 0.015 ± 0.003 |
| 02-18-93 | 286 | 0.037 ± 0.004 | 08-19-93 | ND[c] | - |
| 02-25-93 | 285 | 0.034 ± 0.003 | 08-26-93 | 286 | 0.023 ± 0.003 |
| 03-04-93 | 287 | 0.035 ± 0.004 | 09-02-93 | 286 | 0.019 ± 0.003 |
| 03-11-93 | 284 | 0.023 ± 0.003 | 09-10-93 | 327[a] | 0.016 ± 0.003 |
| 03-17-93 | 245[b] | 0.020 ± 0.004 | 09-16-93 | 244[b] | 0.018 ± 0.003 |
| 03-25-93 | 327[a] | 0.016 ± 0.003 | 09-23-93 | 285 | 0.017 ± 0.003 |
| 04-01-93 | 285 | 0.011 ± 0.003 | 09-30-93 | 285 | 0.013 ± 0.003 |
| 1st Qtr. Mean±s.d. | | 0.029 ± 0.010 | 3rd Qtr. Mean±s.d. | | 0.017 ± 0.003 |
| 04-08-93 | 285 | 0.009 ± 0.003 | 10-07-93 | 285 | 0.021 ± 0.003 |
| 04-15-93 | 286 | 0.011 ± 0.003 | 10-14-93 | 287 | 0.027 ± 0.004 |
| 04-22-93 | 284 | 0.016 ± 0.003 | 10-21-93 | 286 | 0.032 ± 0.004 |
| 04-29-93 | 285 | 0.022 ± 0.003 | 10-28-93 | 285 | 0.020 ± 0.003 |
| 05-06-93 | 286 | 0.014 ± 0.003 | 11-04-93 | 287 | 0.013 ± 0.003 |
| 05-13-93 | 286 | 0.020 ± 0.003 | 11-11-93 | 286 | 0.028 ± 0.004 |
| 05-20-93 | 285 | 0.015 ± 0.003 | 11-18-93 | 285 | 0.028 ± 0.004 |
| 05-27-93 | 287 | 0.017 ± 0.003 | 11-24-93 | 245[b] | 0.026 ± 0.004 |
| 06-03-93 | 283 | 0.010 ± 0.003 | 12-02-93 | 326[a] | 0.044 ± 0.004 |
| 06-10-93 | 287 | 0.013 ± 0.003 | 12-09-93 | 287 | 0.033 ± 0.004 |
| 06-17-93 | 280 | 0.019 ± 0.002 | 12-16-93 | 284 | 0.029 ± 0.004 |
| 06-24-93 | 291 | 0.018 ± 0.003 | 12-22-93 | 244[b] | 0.029 ± 0.004 |
| 07-01-93 | 286 | 0.014 ± 0.003 | 12-30-93 | 327[a] | 0.030 ± 0.003 |
| 2nd Qtr. Mean±s.d. | | 0.015 ± 0.004 | 4th Qtr. Mean±s.d. | | 0.028 ± 0.007 |
| | | | Cumulative Average: | | 0.022 |
| | | | Previous Annual Average: | | 0.023 |

[a] Eight-day collection.
[b] Six-day collection.
[c] ND - No Data; sample lost in shipment.

DUANE ARNOLD

Table 9. Airborne particulates and charcoal canisters
Analyses: Gross beta and iodine-131 [a]
Location: D-11 (Toddville)
Units: $pCi/m^3$
Collection: Continuous, weekly exchange.

| Date Collected | Volume ($m^3$) | Gross Beta | Date Collected | Volume ($m^3$) | Gross Beta |
|---|---|---|---|---|---|
| Required LLD | | 0.01 | | | 0.01 |
| 01-07-93 | 325 [b] | 0.054 ± 0.004 | 07-08-93 | 285 | 0.019 ± 0.003 |
| 01-14-93 | 285 | 0.034 ± 0.004 | 07-15-93 | ND [d] | - |
| 01-22-93 | 326 [b] | 0.038 ± 0.004 | 07-22-93 | 240 | 0.016 ± 0.003 |
| 01-28-93 | 245 [c] | 0.024 ± 0.004 | 07-30-93 | 330 [b] | 0.012 ± 0.003 |
| 02-05-93 | 285 [b] | 0.027 ± 0.004 | 08-05-93 | 240 [c] | 0.015 ± 0.003 |
| 02-11-93 | 284 [c] | 0.029 ± 0.002 | 08-12-93 | 285 | 0.013 ± 0.003 |
| 02-18-93 | 286 | 0.034 ± 0.004 | 08-19-93 | ND [e] | - |
| 02-25-93 | 286 | 0.035 ± 0.003 | 08-26-93 | 286 | 0.019 ± 0.003 |
| 03-04-93 | 288 | 0.036 ± 0.004 | 09-02-93 | 286 | 0.015 ± 0.003 |
| 03-11-93 | 283 | 0.026 ± 0.003 | 09-10-93 | 326 [b] | 0.018 ± 0.003 |
| 03-17-93 | 246 [c] | 0.022 ± 0.004 | 09-16-93 | 244 [c] | 0.016 ± 0.003 |
| 03-25-93 | 324 [b] | 0.018 ± 0.003 | 09-23-93 | 286 | 0.017 ± 0.003 |
| 04-01-93 | 286 | 0.011 ± 0.003 | 09-30-93 | 285 | 0.013 ± 0.003 |
| 1st Qtr. Mean±s.d. | | 0.030 ± 0.010 | 3rd Qtr. Mean±s.d. | | 0.016 ± 0.002 |
| 04-08-93 | 285 | 0.011 ± 0.003 | 10-07-93 | 284 | 0.021 ± 0.003 |
| 04-15-93 | 285 | 0.014 ± 0.003 | 10-14-93 | 288 | 0.024 ± 0.003 |
| 04-22-93 | 284 | 0.014 ± 0.003 | 10-21-93 | 286 | 0.030 ± 0.004 |
| 04-29-93 | 285 | 0.024 ± 0.003 | 10-28-93 | 285 | 0.018 ± 0.003 |
| 05-06-93 | 286 | 0.014 ± 0.003 | 11-04-93 | 287 | 0.013 ± 0.003 |
| 05-13-93 | 285 | 0.017 ± 0.003 | 11-11-93 | 287 | 0.024 ± 0.003 |
| 05-20-93 | 284 | 0.014 ± 0.003 | 11-18-93 | 285 | 0.024 ± 0.004 |
| 05-27-93 | 288 | 0.013 ± 0.003 | 11-24-93 | 244 [c] | 0.026 ± 0.004 |
| 06-03-93 | 284 | 0.010 ± 0.003 | 12-02-93 | 327 [b] | 0.045 ± 0.004 |
| 06-10-93 | 285 | 0.014 ± 0.003 | 12-09-93 | 286 | 0.030 ± 0.004 |
| 06-17-93 | 282 | 0.018 ± 0.002 | 12-16-93 | 285 | 0.023 ± 0.004 |
| 06-24-93 | 289 | 0.018 ± 0.003 | 12-22-93 | 245 [c] | 0.023 ± 0.004 |
| 07-01-93 | 286 | 0.014 ± 0.003 | 12-30-93 | 327 [b] | 0.030 ± 0.003 |
| 2nd Qtr. Mean±s.d. | | 0.015 ± 0.003 | 4th Qtr. Mean±s.d. | | 0.025 ± 0.007 |
| | | | Cumulative Average: | | 0.022 |
| | | | Previous Annual Average: | | 0.023 |

[a] Iodine-131 concentrations are <0.07 $pCi/m^3$ unless otherwise noted.
[b] Eight-day collection.
[c] Six-day collection.
[d] ND - No Data; no power to sampler.
[e] ND - No Data; sample lost in shipment.

DUANE ARNOLD

Table 10. Airborne particulates
Analyses: Gross beta
Location: D-13 (Alburnett)
Units: $pCi/m^3$
Collection: Continuous, weekly exchange.

| Date Collected | Volume ($m^3$) | Gross Beta | Date Collected | Volume ($m^3$) | Gross Beta |
|---|---|---|---|---|---|
| Required LLD | | 0.01 | | | 0.01 |
| 01-07-93 | 325[a] | 0.048 ± 0.004 | 07-08-93 | 284 | 0.019 ± 0.003 |
| 01-14-93 | 285 | 0.038 ± 0.004 | 07-15-93 | 286 | 0.012 ± 0.003 |
| 01-22-93 | 326[a] | 0.036 ± 0.004 | 07-22-93 | 284 | 0.014 ± 0.003 |
| 01-28-93 | 244[b] | 0.026 ± 0.004 | 07-30-93 | 332[a] | 0.014 ± 0.003 |
| 02-05-93 | 286[a] | 0.026 ± 0.004 | 08-05-93 | 238[b] | 0.015 ± 0.003 |
| 02-11-93 | 284[b] | 0.032 ± 0.003 | 08-12-93 | 286 | 0.013 ± 0.003 |
| 02-18-93 | 285 | 0.034 ± 0.004 | 08-19-93 | ND[c] | - |
| 02-25-93 | 286 | 0.035 ± 0.003 | 08-26-93 | 286 | 0.017 ± 0.003 |
| 03-04-93 | 288 | 0.037 ± 0.004 | 09-02-93 | 286 | 0.015 ± 0.003 |
| 03-11-93 | 283 | 0.024 ± 0.003 | 09-10-93 | 326[a] | 0.015 ± 0.003 |
| 03-17-93 | 245[b] | 0.021 ± 0.004 | 09-16-93 | 245[b] | 0.016 ± 0.003 |
| 03-25-93 | 326[a] | 0.020 ± 0.003 | 09-23-93 | 286 | 0.015 ± 0.003 |
| 04-01-93 | 286 | 0.014 ± 0.003 | 09-30-93 | 285 | 0.013 ± 0.003 |
| 1st Qtr. Mean±s.d. | | 0.030 ± 0.009 | 3rd Qtr. Mean±s.d. | | 0.015 ± 0.002 |
| 04-08-93 | 283 | 0.009 ± 0.003 | 10-07-93 | 284 | 0.021 ± 0.003 |
| 04-15-93 | 285 | 0.015 ± 0.003 | 10-14-93 | 288 | 0.024 ± 0.003 |
| 04-22-93 | 286 | 0.014 ± 0.003 | 10-21-93 | 285 | 0.033 ± 0.004 |
| 04-29-93 | 285 | 0.025 ± 0.003 | 10-28-93 | 284 | 0.017 ± 0.003 |
| 05-06-93 | 286 | 0.014 ± 0.003 | 11-04-93 | 288 | 0.014 ± 0.003 |
| 05-13-93 | 286 | 0.017 ± 0.003 | 11-11-93 | 290 | 0.024 ± 0.003 |
| 05-20-93 | 285 | 0.016 ± 0.003 | 11-18-93 | 284 | 0.027 ± 0.004 |
| 05-27-93 | 284 | 0.016 ± 0.003 | 11-24-93 | 244[b] | 0.031 ± 0.004 |
| 06-03-93 | 284 | 0.011 ± 0.003 | 12-02-93 | 327[a] | 0.045 ± 0.004 |
| 06-10-93 | 286 | 0.015 ± 0.003 | 12-09-93 | 285 | 0.033 ± 0.004 |
| 06-17-93 | 283 | 0.022 ± 0.002 | 12-16-93 | 286 | 0.032 ± 0.004 |
| 06-24-93 | 287 | 0.021 ± 0.003 | 12-22-93 | 245[b] | 0.022 ± 0.004 |
| 07-01-93 | 287 | 0.015 ± 0.003 | 12-30-93 | 328[a] | 0.027 ± 0.003 |
| 2nd Qtr. Mean±s.d. | | 0.016 ± 0.004 | 4th Qtr. Mean±s.d. | | 0.027 ± 0.008 |
| | | | Cumulative Average: | | 0.022 |
| | | | Previous Annual Average: | | 0.024 |

[a] Eight-day collection.
[b] Six-day collection.
[c] ND - No Data; sample lost in shipment.

## DUANE ARNOLD

Table 11. Airborne particulates and charcoal canisters
Analyses: Gross beta and iodine-131 [a]
Location: D-15 (On-site)
Units: $pCi/m^3$
Collection: Continuous, weekly exchange.

| Date Collected | Volume ($m^3$) | Gross Beta | Date Collected | Volume ($m^3$) | Gross Beta |
|---|---|---|---|---|---|
| Required LLD | | 0.01 | | | 0.01 |
| 01-07-93 | 325 [b] | 0.045 ± 0.004 | 07-08-93 | 284 | 0.014 ± 0.003 |
| 01-14-93 | 285 | 0.027 ± 0.004 | 07-15-93 | 285 | 0.009 ± 0.003 |
| 01-22-93 | 327 [b] | 0.037 ± 0.004 | 07-22-93 | 284 | 0.011 ± 0.003 |
| 01-28-93 | 244 [c] | 0.024 ± 0.004 | 07-30-93 | 331 [b] | 0.010 ± 0.002 |
| 02-05-93 | 286 [b] | 0.025 ± 0.004 | 08-05-93 | 239 [c] | 0.011 ± 0.003 |
| 02-11-93 | 285 [c] | 0.027 ± 0.002 | 08-12-93 | 285 | 0.012 ± 0.003 |
| 02-18-93 | 285 | 0.028 ± 0.004 | 08-19-93 | ND [d] | - |
| 02-25-93 | 286 | 0.030 ± 0.003 | 08-26-93 | 286 | 0.015 ± 0.003 |
| 03-04-93 | 288 | 0.037 ± 0.004 | 09-02-93 | 286 | 0.013 ± 0.003 |
| 03-11-93 | 283 | 0.021 ± 0.003 | 09-10-93 | 326 [b] | 0.014 ± 0.003 |
| 03-17-93 | 245 [c] | 0.020 ± 0.004 | 09-16-93 | 245 [c] | 0.016 ± 0.003 |
| 03-25-93 | 325 [b] | 0.017 ± 0.003 | 09-23-93 | 285 | 0.012 ± 0.003 |
| 04-01-93 | 286 | 0.012 ± 0.003 | 09-30-93 | 285 | 0.012 ± 0.003 |
| 1st Qtr. Mean±s.d. | | 0.028 ± 0.009 | 3rd Qtr. Mean±s.d. | | 0.012 ± 0.002 |
| 04-08-93 | 283 | 0.010 ± 0.003 | 10-07-93 | 167 [e] | 0.018 ± 0.005 |
| 04-15-93 | 285 | 0.009 ± 0.003 | 10-14-93 | 242 | 0.021 ± 0.004 |
| 04-22-93 | 286 | 0.014 ± 0.003 | 10-21-93 | 285 | 0.026 ± 0.004 |
| 04-29-93 | 285 | 0.018 ± 0.003 | 10-28-93 | 284 | 0.016 ± 0.003 |
| 05-06-93 | 285 | 0.012 ± 0.003 | 11-04-93 | 288 | 0.013 ± 0.003 |
| 05-13-93 | 285 | 0.015 ± 0.003 | 11-11-93 | 286 | 0.020 ± 0.003 |
| 05-20-93 | 285 | 0.014 ± 0.003 | 11-18-93 | 285 | 0.024 ± 0.004 |
| 05-27-93 | 286 | 0.012 ± 0.003 | 11-24-93 | 244 [c] | 0.028 ± 0.004 |
| 06-03-93 | 284 | 0.007 ± 0.002 | 12-02-93 | 327 [b] | 0.036 ± 0.003 |
| 06-10-93 | 280 | 0.011 ± 0.003 | 12-09-93 | 285 | 0.031 ± 0.004 |
| 06-17-93 | 283 | 0.013 ± 0.002 | 12-16-93 | 286 | 0.024 ± 0.004 |
| 06-24-93 | 288 | 0.015 ± 0.003 | 12-22-93 | 244 [c] | 0.018 ± 0.004 |
| 07-01-93 | 286 | 0.011 ± 0.003 | 12-30-93 | 328 [b] | 0.026 ± 0.003 |
| 2nd Qtr. Mean±s.d. | | 0.012 ± 0.003 | 4th Qtr. Mean±s.d. | | 0.023 ± 0.006 |
| | | | Cumulative Average: | | 0.019 |
| | | | Previous Annual Average: | | 0.019 |

[a] Iodine-131 concentrations are <0.07 $pCi/m^3$ unless otherwise noted.
[b] Eight-day collection.
[c] Six-day collection.
[d] ND - No Data; sample lost in shipment.
[e] Low volume due to electricity found off.

Table 12. Airborne particulates
Analyses: Gross beta
Location: D-16 (on-site)
Units: $pCi/m^3$
Collection: Continuous, weekly exchange.

| Date Collected | Volume ($m^3$) | Gross Beta | Date Collected | Volume ($m^3$) | Gross Beta |
|---|---|---|---|---|---|
| Required LLD | | 0.01 | | | 0.01 |
| 01-07-93 | 322[a] | 0.050 ± 0.004 | 07-08-93 | 284 | 0.017 ± 0.003 |
| 01-14-93 | 275 | 0.041 ± 0.004 | 07-15-93 | 285 | 0.013 ± 0.003 |
| 01-22-93 | 323[a] | 0.036 ± 0.004 | 07-22-93 | 284 | 0.012 ± 0.003 |
| 01-28-93 | 241[b] | 0.024 ± 0.004 | 07-30-93 | 333[a] | 0.014 ± 0.003 |
| 02-05-93 | 283[a] | 0.025 ± 0.004 | 08-05-93 | 239[b] | 0.017 ± 0.003 |
| 02-11-93 | 285[b] | 0.022 ± 0.002 | 08-12-93 | 285 | 0.017 ± 0.003 |
| 02-18-93 | 285 | 0.028 ± 0.004 | 08-19-93 | ND[c] | - |
| 02-25-93 | 286 | 0.028 ± 0.003 | 08-26-93 | 286 | 0.019 ± 0.003 |
| 03-04-93 | 287 | 0.028 ± 0.003 | 09-02-93 | 285 | 0.019 ± 0.003 |
| 03-11-93 | 283 | 0.023 ± 0.003 | 09-10-93 | 326[a] | 0.014 ± 0.003 |
| 03-17-93 | 245[b] | 0.016 ± 0.003 | 09-16-93 | 245[b] | 0.014 ± 0.003 |
| 03-25-93 | 326[a] | 0.014 ± 0.003 | 09-23-93 | 285 | 0.015 ± 0.003 |
| 04-01-93 | 286 | 0.010 ± 0.003 | 09-30-93 | 286 | 0.012 ± 0.003 |
| 1st Qtr. Mean±s.d. | | 0.027 ± 0.011 | 3rd Qtr. Mean±s.d. | | 0.015 ± 0.002 |
| 04-08-93 | 283 | 0.008 ± 0.003 | 10-07-93 | 285 | 0.020 ± 0.003 |
| 04-15-93 | 285 | 0.009 ± 0.003 | 10-14-93 | 288 | 0.025 ± 0.003 |
| 04-22-93 | 286 | 0.013 ± 0.003 | 10-21-93 | 285 | 0.030 ± 0.004 |
| 04-29-93 | 285 | 0.022 ± 0.003 | 10-28-93 | 284 | 0.023 ± 0.004 |
| 05-06-93 | 286 | 0.012 ± 0.003 | 11-04-93 | 288 | 0.013 ± 0.003 |
| 05-13-93 | 286 | 0.013 ± 0.003 | 11-11-93 | 286 | 0.025 ± 0.003 |
| 05-20-93 | 284 | 0.014 ± 0.003 | 11-18-93 | 285 | 0.030 ± 0.004 |
| 05-27-93 | 286 | 0.015 ± 0.003 | 11-24-93 | 244[b] | 0.029 ± 0.004 |
| 06-03-93 | 284 | 0.009 ± 0.002 | 12-02-93 | 327[a] | 0.041 ± 0.004 |
| 06-10-93 | 286 | 0.012 ± 0.003 | 12-09-93 | 285 | 0.031 ± 0.004 |
| 06-17-93 | 283 | 0.016 ± 0.002 | 12-16-93 | 286 | 0.028 ± 0.004 |
| 06-24-93 | 288 | 0.020 ± 0.003 | 12-22-93 | 244[b] | 0.021 ± 0.004 |
| 07-01-93 | 286 | 0.014 ± 0.003 | 12-30-93 | 326[a] | 0.025 ± 0.003 |
| 2nd Qtr. Mean±s.d. | | 0.014 ± 0.004 | 4th Qtr. Mean±s.d. | | 0.026 ± 0.006 |
| | | | Cumulative Average: | | 0.021 |
| | | | Previous Annual Average: | | 0.021 |

[a] Eight-day collection.
[b] Six-day collection.
[c] ND - No Data; sample lost in shipment.

Table 13. Airborne particulate samples, quarterly composites of weekly samples, analysis for gamma-emitting isotopes, 1993.

| | Sample Description and Activity ($pCi/m^3$) | | | |
|---|---|---|---|---|
| | 1st Qtr. | 2nd Qtr. | 3rd Qtr. | 4th Qtr. |
| | D-1 | | | |
| Lab Code | DAP-3502 | DAP-3617 | DAP-3733 | DAP-3853 |
| Volume ($m^3$) | 3780 | 3711 | 3421 | 3717 |
| Be-7 | 0.068±0.015 | 0.085±0.018 | 0.078±0.027 | 0.073±0.018 |
| Nb-95 | <0.0004 | <0.0006 | <0.0008 | <0.0007 |
| Zr-95 | <0.0021 | <0.0016 | <0.0012 | <0.0013 |
| Ru-103 | <0.0007 | <0.0008 | <0.0012 | <0.0004 |
| Ru-106 | <0.0056 | <0.0039 | <0.0093 | <0.0055 |
| Cs-134 | <0.0003 | <0.0003 | <0.0005 | <0.0008 |
| Cs-137 | <0.0003 | <0.0007 | <0.0005 | <0.0005 |
| Ce-141 | <0.0011 | <0.0024 | <0.0030 | <0.0018 |
| Ce-144 | <0.0052 | <0.0059 | <0.0058 | <0.0065 |
| | D-2 | | | |
| Lab Code | DAP-3503 | DAP-3618 | DAP-3734 | DAP-3854 |
| Volume ($m^3$) | 3819 | 3711 | 3426 | 3724 |
| Be-7 | 0.053±0.012 | 0.071±0.016 | 0.062±0.023 | 0.063±0.015 |
| Nb-95 | <0.0008 | <0.0008 | <0.0008 | <0.0006 |
| Zr-95 | <0.0017 | <0.0009 | <0.0012 | <0.0007 |
| Ru-103 | <0.0006 | <0.0009 | <0.0007 | <0.0007 |
| Ru-106 | <0.0039 | <0.0059 | <0.0050 | <0.0046 |
| Cs-134 | <0.0003 | <0.0009 | <0.0012 | <0.0003 |
| Cs-137 | <0.0005 | <0.0008 | <0.0005 | <0.0003 |
| Ce-141 | <0.0022 | <0.0012 | <0.0026 | <0.0013 |
| Ce-144 | <0.0054 | <0.0037 | <0.0037 | <0.0057 |

Table 13. Airborne particulate samples, quarterly composites of weekly samples, analysis for gamma-emitting isotopes, 1993 (continued).

| | Sample Description and Activity ($pCi/m^3$) | | | |
|---|---|---|---|---|
| | 1st Qtr. | 2nd Qtr. | 3rd Qtr. | 4th Qtr. |
| | D-3 | | | |
| Lab Code | DAP-3504 | DAP-3619 | DAP-3735 | DAP-3855 |
| Volume ($m^3$) | 3851 | 3708 | 3424 | 3739 |
| Be-7 | 0.064±0.014 | 0.061±0.017 | 0.066±0.021 | 0.065±0.016 |
| Nb-95 | <0.0006 | <0.0017 | <0.0008 | <0.0009 |
| Zr-95 | <0.0008 | <0.0012 | <0.0018 | <0.0012 |
| Ru-103 | <0.0004 | <0.0008 | <0.0010 | <0.0006 |
| Ru-106 | <0.0036 | <0.0096 | <0.010 | <0.0057 |
| Cs-134 | <0.0004 | <0.0006 | <0.0006 | <0.0006 |
| Cs-137 | <0.0004 | <0.0004 | <0.0005 | <0.0008 |
| Ce-141 | <0.0018 | <0.0017 | <0.0024 | <0.0019 |
| Ce-144 | <0.0044 | <0.0036 | <0.0054 | <0.0062 |
| | D-5 | | | |
| Lab Code | DAP-3505 | DAP-3620 | DAP-3736 | DAP-3856 |
| Volume ($m^3$) | 3750 | 3708 | 3421 | 3430 |
| Be-7 | 0.049±0.014 | 0.062±0.018 | 0.056±0.021 | 0.089±0.017 |
| Nb-95 | <0.0013 | <0.0006 | <0.0008 | <0.0013 |
| Zr-95 | <0.0006 | <0.0011 | <0.0016 | <0.0008 |
| Ru-103 | <0.0017 | <0.0011 | <0.0007 | <0.0014 |
| Ru-106 | <0.0036 | <0.011 | <0.0071 | <0.0058 |
| Cs-134 | <0.0005 | <0.0004 | <0.0005 | <0.0004 |
| Cs-137 | <0.0005 | <0.0003 | <0.0005 | <0.0008 |
| Ce-141 | <0.0012 | <0.0024 | <0.0019 | <0.0020 |
| Ce-144 | <0.0045 | <0.0063 | <0.0075 | <0.0070 |

Table 13. Airborne particulate samples, quarterly composites of weekly samples, analysis for gamma-emitting isotopes, 1993 (continued).

| | Sample Description and Activity ($pCi/m^3$) | | | |
|---|---|---|---|---|
| | 1st Qtr. | 2nd Qtr. | 3rd Qtr. | 4th Qtr. |
| | D-6 | | | |
| Lab Code | DAP-3506 | DAP-3621 | DAP-3737 | DAP-3857 |
| Volume ($m^3$) | 3751 | 3648 | 3424 | 3604 |
| Be-7 | 0.075±0.028 | 0.065±0.020 | 0.063±0.020 | 0.063±0.015 |
| Nb-95 | <0.0015 | <0.0007 | <0.0008 | <0.0005 |
| Zr-95 | <0.0020 | <0.0010 | <0.0012 | <0.0012 |
| Ru-103 | <0.0010 | <0.0006 | <0.0012 | <0.0006 |
| Ru-106 | <0.0075 | <0.011 | <0.0071 | <0.0096 |
| Cs-134 | <0.0007 | <0.0005 | <0.0006 | <0.0007 |
| Cs-137 | <0.0009 | <0.0011 | <0.0006 | <0.0009 |
| Ce-141 | <0.0027 | <0.0028 | <0.0024 | <0.0022 |
| Ce-144 | <0.0057 | <0.0058 | <0.0038 | <0.0051 |
| | D-7 | | | |
| Lab Code | DAP-3507 | DAP-3622 | DAP-3738 | DAP-3716 |
| Volume ($m^3$) | 3765 | 3706 | 3421 | 3716 |
| Be-7 | 0.055±0.016 | 0.065±0.016 | 0.082±0.017 | 0.071±0.016 |
| Nb-95 | <0.0010 | <0.0007 | <0.0021 | <0.0005 |
| Zr-95 | <0.0006 | <0.0020 | <0.0025 | <0.0011 |
| Ru-103 | <0.0015 | <0.0014 | <0.0019 | <0.0005 |
| Ru-106 | <0.0091 | <0.0046 | <0.010 | <0.0074 |
| Cs-134 | <0.0007 | <0.0009 | <0.0009 | <0.0007 |
| Cs-137 | <0.0004 | <0.0007 | <0.0011 | <0.0006 |
| Ce-141 | <0.0010 | <0.0024 | <0.0024 | <0.0013 |
| Ce-144 | <0.0042 | <0.0071 | <0.0058 | <0.0042 |

Table 13. Airborne particulate samples, quarterly composites of weekly samples, analysis for gamma-emitting isotopes, 1993 (continued).

| | Sample Description and Activity ($pCi/m^3$) | | | |
|---|---|---|---|---|
| | 1st Qtr. | 2nd Qtr. | 3rd Qtr. | 4th Qtr. |
| | D-8 | | | |
| Lab Code | DAP-3508 | DAP-3623 | DAP-3739 | DAP-3859 |
| Volume ($m^3$) | 3749 | 3707 | 3336 | 3714 |
| Be-7 | 0.058±0.015 | 0.085±0.019 | 0.066±0.018 | 0.063±0.016 |
| Nb-95 | <0.0014 | <0.0006 | <0.0021 | <0.0005 |
| Zr-95 | <0.0018 | <0.0009 | <0.0027 | <0.0007 |
| Ru-103 | <0.0005 | <0.0011 | <0.0018 | <0.0012 |
| Ru-106 | <0.0071 | <0.0094 | <0.0089 | <0.0039 |
| Cs-134 | <0.0007 | <0.0004 | <0.0008 | <0.0008 |
| Cs-137 | <0.0005 | <0.0005 | <0.0010 | <0.0007 |
| Ce-141 | <0.0021 | <0.0012 | <0.0017 | <0.0025 |
| Ce-144 | <0.0056 | <0.0042 | <0.0049 | <0.0062 |
| | D-10 | | | |
| Lab Code | DAP-3509 | DAP-3624 | DAP-3740 | DAP-3860 |
| Volume ($m^3$) | 3740 | 3711 | 3383 | 3714 |
| Be-7 | 0.064±0.017 | 0.076±0.016 | 0.059±0.021 | 0.063±0.019 |
| Nb-95 | <0.0012 | <0.0009 | <0.0012 | <0.0007 |
| Zr-95 | <0.0009 | <0.0020 | <0.0017 | <0.0007 |
| Ru-103 | <0.0004 | <0.0017 | <0.0012 | <0.0005 |
| Ru-106 | <0.0086 | <0.0048 | <0.0042 | <0.0039 |
| Cs-134 | <0.0004 | <0.0010 | <0.0004 | <0.0008 |
| Cs-137 | <0.0009 | <0.0006 | <0.0007 | <0.0005 |
| Ce-141 | <0.0025 | <0.0022 | <0.0015 | <0.0020 |
| Ce-144 | <0.0031 | <0.0030 | <0.0047 | <0.0028 |

Table 13. Airborne particulate samples, quarterly composites of weekly samples, analysis for gamma-emitting isotopes, 1993 (continued).

| | Sample Description and Activity ($pCi/m^3$) | | | |
|---|---|---|---|---|
| | 1st Qtr. | 2nd Qtr. | 3rd Qtr. | 4th Qtr. |
| | D-11 | | | |
| Lab Code | DAP-3510 | DAP-3625 | DAP-3741 | DAP-3861 |
| Volume ($m^3$) | 3749 | 3708 | 3093 | 3716 |
| Be-7 | 0.050±0.014 | 0.086±0.018 | 0.061±0.017 | 0.065±0.017 |
| Nb-95 | <0.0006 | <0.0006 | <0.0010 | <0.0007 |
| Zr-95 | <0.0012 | <0.0008 | <0.0012 | <0.0007 |
| Ru-103 | <0.0012 | <0.0007 | <0.0013 | <0.0010 |
| Ru-106 | <0.0047 | <0.0055 | <0.0060 | <0.0076 |
| Cs-134 | <0.0008 | <0.0004 | <0.0004 | <0.0006 |
| Cs-137 | <0.0004 | <0.0003 | <0.0009 | <0.0006 |
| Ce-141 | <0.0012 | <0.0002 | <0.0023 | <0.0022 |
| Ce-144 | <0.0064 | <0.0065 | <0.0066 | <0.0061 |
| | D-13 | | | |
| Lab Code | DAP-3511 | DAP-3626 | DAP-3742 | DAP-3862 |
| Volume ($m^3$) | 3749 | 3707 | 3424 | 3718 |
| Be-7 | 0.058±0.009 | 0.093±0.019 | 0.048±0.020 | 0.066±0.015 |
| Nb-95 | <0.0018 | <0.0007 | <0.0007 | <0.0013 |
| Zr-95 | <0.0022 | <0.0008 | <0.0018 | <0.0008 |
| Ru-103 | <0.0014 | <0.0006 | <0.0018 | <0.0004 |
| Ru-106 | <0.0084 | <0.0060 | <0.0081 | <0.0029 |
| Cs-134 | <0.0009 | <0.0006 | <0.0006 | <0.0010 |
| Cs-137 | <0.0008 | <0.0004 | <0.0004 | <0.0007 |
| Ce-141 | <0.0020 | <0.0020 | <0.0021 | <0.0020 |
| Ce-144 | <0.0049 | <0.0053 | <0.0063 | <0.0055 |

Table 13. Airborne particulate samples, quarterly composites of weekly samples, analysis for gamma-emitting isotopes, 1993 (continued).

| | Sample Description and Activity ($pCi/m^3$) | | | |
|---|---|---|---|---|
| | 1st Qtr. | 2nd Qtr. | 3rd Qtr. | 4th Qtr. |
| | D-15 | | | |
| Lab Code | DAP-3512 | DAP-3627 | DAP-3743 | DAP-3863 |
| Volume ($m^3$) | 3750 | 3701 | 3421 | 3551 |
| Be-7 | 0.049±0.009 | 0.050±0.014 | 0.044±0.018 | 0.066±0.016 |
| Nb-95 | <0.0015 | <0.0006 | <0.0007 | <0.0013 |
| Zr-95 | <0.0021 | <0.0014 | <0.0017 | <0.0002 |
| Ru-103 | <0.0012 | <0.0009 | <0.0007 | <0.0007 |
| Ru-106 | <0.0066 | <0.0059 | <0.0038 | <0.0054 |
| Cs-134 | <0.0007 | <0.0006 | <0.0006 | <0.0004 |
| Cs-137 | <0.0009 | <0.0005 | <0.0004 | <0.0007 |
| Ce-141 | <0.0010 | <0.0017 | <0.0033 | <0.0011 |
| Ce-144 | <0.0026 | <0.0055 | <0.0047 | <0.0041 |
| | D-16 | | | |
| Lab Code | DAP-3513 | DAP-3628 | DAP-3477 | DAP-3713 |
| Volume ($m^3$) | 3727 | 3708 | 3423 | 3713 |
| Be-7 | 0.041±0.008 | 0.063±0.016 | 0.061±0.016 | 0.062±0.016 |
| Nb-95 | <0.0014 | <0.0007 | <0.0007 | <0.0011 |
| Zr-95 | <0.0016 | <0.0010 | <0.0010 | <0.0007 |
| Ru-103 | <0.0009 | <0.0010 | <0.0017 | <0.0008 |
| Ru-106 | <0.0054 | <0.0043 | <0.0038 | <0.0061 |
| Cs-134 | <0.0007 | <0.0003 | <0.0008 | <0.0003 |
| Cs-137 | <0.0006 | <0.0005 | <0.0004 | <0.0005 |
| Ce-141 | <0.0012 | <0.0018 | <0.0018 | <0.0009 |
| Ce-144 | <0.0029 | <0.0046 | <0.0034 | <0.0066 |

Table 14. Ambient gamma radiation (TLD), quarterly exposure, 1993.

| Location No. | mR/91 days | | | |
|---|---|---|---|---|
| | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
| Air Particulate Locations | | | | |
| D-1 | 12.9±0.4 | 13.2±0.2 | 14.1±0.3 | 12.0±0.2 |
| D-2 | 15.6±0.3 | 13.0±0.3 | 13.4±0.2 | 14.1±0.3 |
| D-3 | 15.3±0.3 | 12.5±0.3 | 13.8±0.2 | 13.4±0.2 |
| D-5 | 15.1±0.2 | 14.2±0.2 | 14.7±0.2 | 13.3±0.2 |
| D-6 | 15.8±0.3 | 13.5±0.3 | 14.1±0.3 | 12.0±0.3 |
| D-7 | 13.4±0.4 | 15.1±0.2 | 14.1±0.3 | 14.6±0.3 |
| D-8 | 11.8±0.4 | 15.0±0.2 | 18.4±0.3 | 15.4±0.2 |
| D-10 | 14.1±0.2 | 14.9±0.2 | 15.6±0.2 | 15.5±0.3 |
| D-11 | 12.8±0.3 | 14.2±0.4 | 14.8±0.2 | 13.1±0.3 |
| D-13 | 13.1±0.3 | 13.0±0.2 | 15.5±0.2 | 15.8±0.2 |
| D-15 | 16.5±0.3 | 14.7±0.3 | 15.6±0.2 | 14.2±0.4 |
| D-16 | 14.3±0.3 | 14.0±0.3 | 15.4±0.2 | 14.0±0.2 |
| Mean ± s.d. | 14.2±1.4 | 13.9±0.9 | 15.0±1.3 | 14.0±1.3 |
| Within 0.5 Mile of Stack | | | | |
| D-18 | 16.2±0.3 | 16.4±0.3 | 14.2±0.2 | 15.6±0.3 |
| D-19 | 16.4±0.4 | 16.6±0.2 | 13.1±0.2 | 15.3±0.4 |
| D-20 | 19.1±0.4 | 17.0±0.3 | 16.0±0.2 | 15.8±0.2 |
| D-21 | 16.0±0.3 | 15.7±0.3 | 13.9±0.4 | 15.8±0.2 |
| D-22 | 12.7±0.2 | 15.7±0.2 | 17.7±0.2 | 14.3±0.2 |
| D-23 | 14.4±0.3 | 13.7±0.3 | 12.5±0.2 | 12.1±0.2 |
| D-28 | 16.5±0.3 | 18.6±0.2 | 17.0±0.4 | 16.0±0.3 |
| D-29 | 19.1±0.5 | 20.4±0.3 | 17.3±0.4 | 18.5±0.3 |
| D-30 | 20.1±0.5 | 21.0±0.5 | 17.8±0.3 | 17.7±0.2 |
| D-31 | 22.4±0.4 | 23.9±0.2 | 20.5±0.4 | 19.3±0.4 |
| D-32 | 19.8±0.4 | 19.4±0.2 | 19.5±0.3 | 17.4±0.2 |
| D-82 | 15.6±0.7 | 14.2±0.3 | 12.9±0.2 | 13.3±0.2 |
| D-83 | 18.0±0.4 | 17.8±0.3 | 16.7±2.6 | 15.5±0.3 |
| D-84 | 16.5±0.3 | 17.7±0.4 | 16.6±0.2 | 14.7±0.2 |
| D-85 | 15.4±0.3 | 17.3±0.3 | 16.1±0.3 | 14.4±0.2 |
| D-86 | 15.9±0.5 | 20.6±0.3 | 18.0±0.3 | 17.3±0.3 |
| D-91 | 14.4±0.4 | 17.1±0.3 | 17.2±0.4 | 17.0±0.2 |
| Mean ± s.d. | 17.0±2.5 | 17.8±2.6 | 16.3±2.3 | 15.9±1.9 |

Table 14. Ambient gamma radiation (TLD), quarterly exposure (continued)

| Location No. | mR/91 days | | | |
|---|---|---|---|---|
| | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
| Within 1.0 Mile of Stack | | | | |
| D-43 | 12.1±0.4 | 17.9±0.3 | 14.9±0.2 | 14.8±0.2 |
| D-44 | 19.8±0.4 | 19.8±0.3 | 19.1±0.2 | 18.9±0.2 |
| D-45 | 15.2±0.3 | 17.9±0.4 | 14.3±0.2 | 14.4±0.3 |
| D-46 | 19.4±0.8 | 20.8±0.3 | 17.9±0.2 | 16.9±0.3 |
| D-47 | 21.0±0.8 | 17.8±0.3 | 18.9±0.2 | 17.7±0.2 |
| D-48 | 18.7±0.2 | 21.1±0.3 | 13.8±0.4 | 18.3±0.2 |
| Mean ± s.d. | 17.7±3.4 | 19.2±1.5 | 16.5±2.4 | 16.8±1.9 |
| Within 3.0 Miles of Stack | | | | |
| D-33 | 13.6±0.2 | 13.7±0.2 | 11.9±0.2 | 12.4±0.2 |
| D-34 | 14.4±0.3 | 15.8±0.2 | 16.5±0.8 | 13.7±0.3 |
| D-35 | 14.3±0.4 | 16.0±0.3 | 14.2±0.3 | 15.4±0.4 |
| D-36 | 16.4±0.5 | 16.2±0.2 | 16.9±0.3 | 13.0±0.3 |
| D-37 | 21.4±0.3 | 21.6±0.3 | 19.4±0.3 | 19.4±0.3 |
| D-38 | 19.2±0.7 | 17.8±0.3 | 16.9±0.2 | 15.4±0.2 |
| D-39 | 18.0±0.2 | 18.0±0.3 | 16.7±0.3 | 15.8±0.3 |
| D-40 | 17.2±0.5 | 16.0±0.3 | 14.0±0.4 | 14.7±0.3 |
| D-41 | 15.8±0.5 | 17.7±0.4 | 15.6±0.2 | 15.8±0.2 |
| Mean ± s.d. | 16.7±2.5 | 17.0±2.2 | 15.8±2.2 | 15.1±2.0 |

Table 15. Milk samples, analyses for iodine-131 and gamma-emitting isotopes.
Collection: Monthly during non-grazing season (October 1 through April 30); biweekly during grazing season (May 1 through September 30)

| Date Collected | Lab Code | Concentration (pCi/L) I-131 | K-40 | Cs-134 | Cs-137 | Ba-140 | La-140 |
|---|---|---|---|---|---|---|---|
| Indicator | | | Location D-63 | | | | |
| 01-05-93 | DMI-8823,4 | <1.0 | 1250±100 | <15 | <18 | <60 | <15 |
| 02-03-93 | -8881 | <1.0 | 1270±140 | <15 | <18 | <60 | <15 |
| 03-02-93 | -8963 | <1.0 | 1390±120 | <15 | <18 | <60 | <15 |
| 04-06-93 | -9032 | <1.0 | 1380±160 | <15 | <18 | <60 | <15 |
| 05-04-93 | -9105 | <1.0 | 1470±170 | <15 | <18 | <60 | <15 |
| 05-18-93 | -9176 | <1.0 | 1650±140 | <15 | <18 | <60 | <15 |
| 06-03-93 | -9251 | <1.0 | 1300±150 | <15 | <18 | <60 | <15 |
| 06-15-93 | -9313 | <1.0 | 1420±160 | <15 | <18 | <60 | <15 |
| 06-29-93 | -9378 | <1.0 | 1520±180 | <15 | <18 | <60 | <15 |
| 07-13-93 | -9455 | <1.0 | 1440±100 | <15 | <18 | <60 | <15 |
| 07-27-93 | -9519 | <1.0 | 1480±170 | <15 | <18 | <60 | <15 |
| 08-10-93 | -9607 | <1.0 | 1470±160 | <15 | <18 | <60 | <15 |
| 08-24-93 | -9673 | <1.0 | 1500±150 | <15 | <18 | <60 | <15 |
| 09-08-93 | -9745,6 | <1.0 | 1370±130 | <15 | <18 | <60 | <15 |
| 09-21-93 | -9843 | <1.0 | 1390±170 | <15 | <18 | <60 | <15 |
| 10-05-93 | -9885 | <1.0 | 1370±130 | <15 | <18 | <60 | <15 |
| 11-02-93 | -0026 | <1.0 | 1310±170 | <15 | <18 | <60 | <15 |
| 12-07-93 | -0126 | <1.0 | 1140±170 | <15 | <18 | <60 | <15 |

Table 15. Milk samples, analyses for iodine-131 and gamma-emitting isotopes (continued).

| Date Collected | Lab Code | Concentration (pCi/L) I-131 | K-40 | Cs-134 | Cs-137 | Ba-140 | La-140 |
|---|---|---|---|---|---|---|---|
| Indicator | | | Location D-93 | | | | |
| 01-05-93 | NS[a] | -- | -- | -- | -- | -- | -- |
| 02-03-93 | NS | -- | -- | -- | -- | -- | -- |
| 03-02-93 | DMI-8964 | <1.0 | 1460±160 | <15 | <18 | <60 | <15 |
| 04-06-93 | -9033 | <1.0 | 1650±190 | <15 | <18 | <60 | <15 |
| 05-04-93 | -9106 | <1.0 | 1590±150 | <15 | <18 | <60 | <15 |
| 05-18-93 | -9177 | <1.0 | 1580±170 | <15 | <18 | <60 | <15 |
| 06-03-93 | -9252 | <1.0 | 1630±150 | <15 | <18 | <60 | <15 |
| 06-15-93 | -9314 | <1.0 | 1550±150 | <15 | <18 | <60 | <15 |
| 06-29-93 | -9379 | <1.0 | 1800±130 | <15 | <18 | <60 | <15 |
| 07-13-93 | -9456 | <1.0 | 1560±200 | <15 | <18 | <60 | <15 |
| 07-27-93 | -9520 | <1.0 | 1790±200 | <15 | <18 | <60 | <15 |
| 08-10-93 | -9608 | <1.0 | 1660±200 | <15 | <18 | <60 | <15 |
| 08-24-93 | -9674 | <1.0 | 1760±140 | <15 | <18 | <60 | <15 |
| 09-08-93 | -9747 | <1.0 | 1690±140 | <15 | <18 | <60 | <15 |
| 09-21-93 | -9844 | <1.0 | 1740±130 | <15 | <18 | <60 | <15 |
| 10-05-93 | -9886 | <1.0 | 1620±130 | <15 | <18 | <60 | <15 |
| 11-02-93 | -0027 | <1.0 | 1370±120 | <15 | <18 | <60 | <15 |
| 12-07-93 | NS[a] | -- | -- | -- | -- | -- | -- |
| | | | Location D-94 | | | | |
| 01-05-93 | DMI-8825 | <1.0 | 1050±120 | <15 | <18 | <60 | <15 |
| 02-03-93 | -8882 | <1.0 | 950±140 | <15 | <18 | <60 | <15 |
| 03-02-93 | -8965 | <1.0 | 1230±140 | <15 | <18 | <60 | <15 |
| 04-06-93 | -9034 | <1.0 | 1380±150 | <15 | <18 | <60 | <15 |
| 05-04-93 | -9107 | <1.0 | 1420±170 | <15 | <18 | <60 | <15 |
| 05-18-93 | -9178 | <1.0 | 1350±170 | <15 | <18 | <60 | <15 |
| 06-03-93 | -9253 | <1.0 | 820±140 | <15 | <18 | <60 | <15 |
| 06-15-93 | -9315 | <1.0 | 1110±150 | <15 | <18 | <60 | <15 |
| 06-29-93 | -9380 | <1.0 | 980±100 | <15 | <18 | <60 | <15 |
| 07-10-93 | ND[b] | -- | -- | -- | -- | -- | -- |

[a] NS = No Sample; sample not available.

[b] ND = No Data; as of 07-10-93, D-94 removed from program due to cows being sold.

Table 15. Milk samples, analyses for iodine-131 and gamma-emitting isotopes (continued).

| Date Collected | Lab Code | Concentration (pCi/L) I-131 | K-40 | Cs-134 | Cs-137 | Ba-140 | La-140 |
|---|---|---|---|---|---|---|---|
| Indicator | | | Location D-96 | | | | |
| 01-05-93 | DMI-8826 | <1.0 | 1440±170 | <15 | <18 | <60 | <15 |
| 02-06-93 | -8883 | <1.0 | 1480±150 | <15 | <18 | <60 | <15 |
| 03-02-93 | -8966 | <1.0 | 1320±110 | <15 | <18 | <60 | <15 |
| 04-06-93 | -9035 | <1.0 | 1440±120 | <15 | <18 | <60 | <15 |
| 05-04-93 | -9108 | <1.0 | 1380±140 | <15 | <18 | <60 | <15 |
| 05-18-93 | -9179 | <1.0 | 1400±180 | <15 | <18 | <60 | <15 |
| 06-03-93 | -9254 | <1.0 | 1410±170 | <15 | <18 | <60 | <15 |
| 06-15-93 | -9316 | <1.0 | 1510±180 | <15 | <18 | <60 | <15 |
| 06-29-93 | -9381 | <1.0 | 1480±130 | <15 | <18 | <60 | <15 |
| 07-13-93 | -9457 | <1.0 | 1330±180 | <15 | <18 | <60 | <15 |
| 07-27-93 | -9521 | <1.0 | 1340±170 | <15 | <18 | <60 | <15 |
| 08-10-93 | -9609 | <1.0 | 1520±200 | <15 | <18 | <60 | <15 |
| 08-24-93 | -9675 | <1.0 | 1400±180 | <15 | <18 | <60 | <15 |
| 09-08-93 | -9748 | <1.0 | 1440±150 | <15 | <18 | <60 | <15 |
| 09-21-93 | -9845 | <1.0 | 1280±180 | <15 | <18 | <60 | <15 |
| 10-05-93 | -9887 | <1.0 | 1310±160 | <15 | <18 | <60 | <15 |
| 11-02-93 | -0028 | <1.0 | 1400±130 | <15 | <18 | <60 | <15 |
| 12-07-93 | -0127 | <1.0 | 1430±160 | <15 | <18 | <60 | <15 |
| | | | Location D-101 | | | | |
| 01-05-93 | NS[a] | -- | -- | -- | -- | -- | -- |
| 02-06-93 | NS | -- | -- | -- | -- | -- | -- |
| 03-02-93 | NS | -- | -- | -- | -- | -- | -- |
| 04-06-93 | NS | -- | -- | -- | -- | -- | -- |
| 05-04-93 | NS | -- | -- | -- | -- | -- | -- |
| 05-18-93 | DMI-9180 | <1.0 | 1530±160 | <15 | <18 | <60 | <15 |
| 06-03-93 | -9255 | <1.0 | 1670±160 | <15 | <18 | <60 | <15 |
| 06-15-93 | -9317 | <1.0 | 1750±160 | <15 | <18 | <60 | <15 |
| 06-29-93 | -9382 | <1.0 | 1920±190 | <15 | <18 | <60 | <15 |
| 07-13-93 | -9458 | <1.0 | 1700±170 | <15 | <18 | <60 | <15 |
| 07-27-93 | -9522 | <1.0 | 1740±180 | <15 | <18 | <60 | <15 |
| 08-11-93 | -9610 | <1.0 | 1840±140 | <15 | <18 | <60 | <15 |
| 08-24-93 | -9676 | <1.0 | 1890±140 | <15 | <18 | <60 | <15 |
| 09-08-93 | -9749 | <1.0 | 1680±130 | <15 | <18 | <60 | <15 |
| 09-25-93 | -9846 | <1.0 | 1340±150 | <15 | <18 | <60 | <15 |
| 10-05-93 | -9888 | <1.0 | 1500±180 | <15 | <18 | <60 | <15 |
| 11-02-93 | -0029 | <1.0 | 1670±130 | <15 | <18 | 60 | <15 |
| 12-07-93 | NS[a] | -- | -- | -- | -- | -- | -- |

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

Table 15. Milk samples, analyses for iodine-131 and gamma-emitting isotopes (continued).

| Date Collected | Lab Code | Concentration (pCi/L) I-131 | K-40 | Cs-134 | Cs-137 | Ba-140 | La-140 |
|---|---|---|---|---|---|---|---|
| Indicator | | | Location D-106 | | | | |
| 01-05-93 | DMI-8828 | <1.0 | 1480±170 | <15 | <18 | <60 | <15 |
| 02-06-93 | -8885 | <1.0 | 1390±160 | <15 | <18 | <60 | <15 |
| 03-02-93 | -8968 | <1.0 | 1600±150 | <15 | <18 | <60 | <15 |
| 04-06-93 | -9037 | <1.0 | 1330±140 | <15 | <18 | <60 | <15 |
| 05-04-93 | -9110,11 | <1.0 | 1400±110 | <15 | <18 | <60 | <15 |
| 05-18-93 | -9182 | <1.0 | 1200±160 | <15 | <18 | <60 | <15 |
| 06-03-93 | -9257,8 | <1.0 | 1390±90 | <15 | <18 | <60 | <15 |
| 06-15-93 | -9318 | <1.0 | 1520±160 | <15 | <18 | <60 | <15 |
| 06-29-93 | -9384 | <1.0 | 1190±150 | <15 | <18 | <60 | <15 |
| 07-13-93 | -9460 | <1.0 | 1180±160 | <15 | <18 | <60 | <15 |
| 07-27-93 | -9524 | <1.0 | 1250±150 | <15 | <18 | <60 | <15 |
| 08-10-93 | -9612 | <1.0 | 1280±120 | <15 | <18 | <60 | <15 |
| 08-24-93 | -9678 | <1.0 | 1140±120 | <15 | <18 | <60 | <15 |
| 09-08-93 | -9751 | <1.0 | 1230±160 | <15 | <18 | <60 | <15 |
| 09-21-93 | -9848 | <1.0 | 1260±150 | <15 | <18 | <60 | <15 |
| 10-05-93 | -9889 | <1.0 | 1420±160 | <15 | <18 | <60 | <15 |
| 11-02-93 | -0031 | <1.0 | 1380±130 | <15 | <15 | <60 | <15 |
| 12-07-93 | NS[a] | -- | -- | -- | -- | -- | -- |
| Control | | | Location D-105 | | | | |
| 01-05-93 | DMI-8827 | <1.0 | 1400±150 | <15 | <18 | <60 | <15 |
| 02-06-93 | -8884 | <1.0 | 1270±120 | <15 | <18 | <60 | <15 |
| 03-02-93 | -8967 | <1.0 | 1240±140 | <15 | <18 | <60 | <15 |
| 04-06-93 | -9036 | <1.0 | 1220±140 | <15 | <18 | <60 | <15 |
| 05-04-93 | -9109 | <1.0 | 1320±180 | <15 | <18 | <60 | <15 |
| 05-18-93 | -9181 | <1.0 | 1420±160 | <15 | <18 | <60 | <15 |
| 06-03-93 | -9256 | <1.0 | 1480±190 | <15 | <18 | <60 | <15 |
| 06-15-93 | -9329 | <1.0 | 1230±150 | <15 | <18 | <60 | <15 |
| 06-29-93 | -9383 | <1.0 | 1440±140 | <15 | <18 | <60 | <15 |
| 07-13-93 | -9459 | <1.0 | 1590±190 | <15 | <18 | <60 | <15 |
| 07-27-93 | -9523 | <1.0 | 1450±170 | <15 | <18 | <60 | <15 |
| 08-10-93 | -9611 | <1.0 | 1320±170 | <15 | <18 | <60 | <15 |
| 08-24-93 | -9677 | <1.0 | 1440±190 | <15 | <18 | <60 | <15 |
| 09-08-93 | -9750 | <1.0 | 1390±160 | <15 | <18 | <60 | <15 |
| 09-21-93 | -9847 | <1.0 | 1340±150 | <15 | <18 | <60 | <15 |
| 10-05-93 | -9890 | <1.0 | 1310±160 | <15 | <18 | <60 | <15 |
| 11-02-93 | -0030 | <1.0 | 1500±230 | <15 | <18 | <60 | <15 |
| 12-07-93 | -0128 | <1.0 | 1330±160 | <15 | <18 | <60 | <15 |

[a]NS = no sample; location removed from program as of 12-07-93.

Table 16. Ground water samples, analysis for gross beta and tritium.
Collection: Quarterly, 1993.

| Location and Collection Period | Lab Code | Concentration pCi/L | |
|---|---|---|---|
| | | Gross Beta | H-3 |
| D-53 | | | |
| Treated Municipal Water | | | |
| 1st Quarter | DWW-1128 | 2.4±0.6 | <330 |
| 2nd Quarter | -2443 | 1.8±0.5 | <330 |
| 3rd Quarter | -3405 | 2.0±0.5 | <330 |
| 4th Quarter | -4420 | 2.9±0.8 | ≤330 |
| Annual Mean ± s.d. | | 2.3±0.5 | <330 |
| D-54 | | | |
| Inlet to Municipal Water Treatment | | | |
| 1st Quarter | DWW-1129 | 3.0±0.6 | <330 |
| 2nd Quarter | -2444, 5 | 2.6±0.4 | <330 |
| 3rd Quarter | -3406 | 3.8±0.9 | <330 |
| 4th Quarter | -4421 | 2.6±0.8 | ≤330 |
| Annual Mean ± s.d. | | 3.0±0.6 | <330 |
| D-55 | | | |
| On-site Well | | | |
| 1st Quarter | DWW-1130 | <0.8 | <330 |
| 2nd Quarter | -2446 | <0.8 | <330 |
| 3rd Quarter | -3407 | 1.1±0.5 | <330 |
| 4th Quarter | -4422 | ≤1.2 | ≤330 |
| Annual Mean ± s.d. | | 1.1±0.5 | <330 |
| D-57 | | | |
| Bull Farm | | | |
| 1st Quarter | DWW-1131 | 1.2±0.5 | <330 |
| 2nd Quarter | -2447 | <0.8 | <330 |
| 3rd Quarter | -3408 | 1.4±0.5 | <330 |
| 4th Quarter | -4423 | 1.5±0.7 | ≤330 |
| Annual Mean ± s.d. | | 1.4±0.2 | <330 |

Table 16. Ground water samples, analysis for gross beta and tritium, (continued).

| Location and Collection Period | Lab Code | Concentration pCi/L | |
|---|---|---|---|
| | | Gross Beta | H-3 |
| D-58 | | | |
| Franz Farm | | | |
| 1st Quarter | DWW-1132 | 5.9±0.7 | <330 |
| 2nd Quarter | -2448 | 7.2±0.8 | <330 |
| 3rd Quarter | -3409 | 6.4±0.7 | <330 |
| 4th Quarter | -4424 | 8.3±1.1 | <330 |
| Annual Mean ± s.d. | | 7.0±1.0 | <330 |
| D-72 | | | |
| Van Note Farm | | | |
| 1st Quarter | DWW-1133 | <0.8 | <330 |
| 2nd Quarter | -2449 | <0.8 | <330 |
| 3rd Quarter | -3410 | <0.8 | <330 |
| 4th Quarter | -4425 | <1.2 | <330 |
| Annual Mean ± s.d. | | <1.2 | <330 |

Table 17. Vegetation samples (broadleaf), analysis for I-131 and gamma-emitting isotopes. Collection: Annually.

| Sample Description and Activity (pCi/g wet) | | | |
|---|---|---|---|
| | Indicator | | Control |
| Location | D-58 | D-72 | D-105 |
| Date Collected | 07-13-93 | 07-13-93 | 07-13-93 |
| Type | Cabbage | Lettuce | Lettuce |
| Lab Code | DVE-1559 | DVE-1560 | DVE-1541 |
| I-131 | <0.026 | <0.040 | <0.082[a] |
| K-40 | 2.10±0.32 | 2.22±0.20 | 4.88±1.36 |
| Mn-54 | <0.013 | <0.009 | <0.059 |
| Co-58 | <0.006 | <0.008 | <0.056 |
| Co-60 | <0.005 | <0.004 | <0.073 |
| Nb-95 | <0.008 | <0.012 | <0.059 |
| Zr-95 | <0.017 | <0.019 | <0.10 |
| Ru-103 | <0.008 | <0.011 | <0.067 |
| Ru-106 | <0.081 | <0.10 | <0.56 |
| Cs-134 | <0.006 | <0.005 | <0.056 |
| Cs-137 | <0.009 | <0.011 | <0.064 |
| Ce-141 | <0.024 | <0.019 | <0.089 |
| Ce-144 | <0.043 | <0.042 | <0.37 |

| | | |
|---|---|---|
| Location | D-94 | D-106 |
| Date Collected | 06-30-93 | 07-13-93 |
| Type | Lettuce | Cabbage |
| Lab Code | DVE-1529 | DVE-1542 |
| I-131 | <0.034 | <0.009 |
| K-40 | 2.25±0.57 | 2.14±0.22 |
| Mn-54 | <0.021 | <0.009 |
| Co-58 | <0.021 | <0.008 |
| Co-60 | <0.014 | <0.010 |
| Nb-95 | <0.024 | <0.009 |
| Zr-95 | <0.028 | <0.013 |
| Ru-103 | <0.014 | <0.009 |
| Ru-106 | <0.26 | <0.069 |
| Cs-134 | <0.019 | <0.008 |
| Cs-137 | <0.018 | <0.009 |
| Ce-141 | <0.039 | <0.011 |
| Ce-144 | <0.098 | <0.049 |

[a]LLD of <0.060 not reached due to small sample size (40 grams).

Table 18. Vegetation samples (hay and grain), analysis for gamma-emitting isotopes. Collection: Annually.

Sample Description and Activity (pCi/g wet)

| | Indicator | | | |
|---|---|---|---|---|
| Location | D-16 | D-58 | D-63 | D-72 |
| Date Collected | 08-10-93 | 08-10-93 | 08-10-93 | 08-10-93 |
| Type | Hay | Hay | Hay | Hay |
| Lab Code | DVE-1589 | DVE-1590 | DVE-1591 | DVE-1592 |
| K-40 | 3.35±0.64 | 19.27±0.81 | 5.98±0.87 | 21.56±0.88 |
| Mn-54 | <0.029 | <0.029 | <0.028 | <0.023 |
| Co-58 | <0.015 | <0.029 | <0.041 | <0.029 |
| Co-60 | <0.012 | <0.032 | <0.013 | <0.033 |
| Nb-95 | <0.038 | <0.033 | <0.034 | <0.015 |
| Zr-95 | <0.045 | <0.054 | <0.061 | <0.052 |
| Ru-103 | <0.033 | <0.029 | <0.020 | <0.017 |
| Ru-106 | <0.15 | <0.24 | <0.24 | <0.22 |
| Cs-134 | <0.026 | <0.025 | <0.020 | <0.013 |
| Cs-137 | <0.029 | <0.031 | <0.038 | <0.031 |
| Ce-141 | <0.060 | <0.040 | <0.035 | <0.032 |
| Ce-144 | <0.17 | <0.016 | <0.28 | <0.13 |
| Location | D-93 | D-94 | D-106 | D-105 (C) |
| Date Collected | 08-10-93 | 08-20-93 | 08-10-93 | 08-10-93 |
| Type | Hay | Hay | Hay | Hay |
| Lab Code | DVE-1593 | DVE-1622 | DVE-1595 | DVE-1594 |
| K-40 | 8.45±1.38 | 19.71±1.15 | 21.68±1.02 | 16.06±1.32 |
| Mn-54 | <0.029 | <0.042 | <0.035 | <0.046 |
| Co-58 | <0.069 | <0.072 | <0.035 | <0.020 |
| Co-60 | <0.064 | <0.041 | <0.039 | <0.034 |
| Nb-95 | <0.070 | <0.028 | <0.039 | <0.052 |
| Zr-95 | <0.11 | <0.087 | <0.061 | <0.054 |
| Ru-103 | <0.060 | <0.027 | <0.036 | <0.029 |
| Ru-106 | <0.30 | <0.27 | <0.31 | <0.34 |
| Cs-134 | <0.048 | <0.051 | <0.029 | <0.027 |
| Cs-137 | <0.042 | <0.049 | 0.047±0.029 | <0.040 |
| Ce-141 | <0.055 | <0.041 | <0.049 | <0.042 |
| Ce-144 | <0.36 | <0.16 | <0.20 | <0.23 |

Table 18. Vegetation samples, analysis for gamma-emitting isotopes (continued). Collection: Annually.

Sample Description and Activity (pCi/g wet)

| | Indicator | | | | |
|---|---|---|---|---|---|
| Location | D-57 | D-58 | D-63 | D-72 | D-16 |
| Date Collected | 10-12-93 | 10-12-93 | 10-12-93 | 10-12-93 | 10-06-93 |
| Type | Corn | Corn | Corn | Corn | Beans |
| Lab Code | DVE-1718 | DVE-1719 | DVE-1720 | DVE-1721 | DVE-1717 |
| K-40 | 2.86±0.34 | 3.02±0.34 | 2.13±0.25 | 2.19±0.26 | 11.23±0.40 |
| Mn-54 | <0.007 | <0.010 | <0.008 | <0.004 | <0.014 |
| Co-58 | <0.007 | <0.006 | <0.007 | <0.005 | <0.013 |
| Co-60 | <0.004 | <0.007 | <0.003 | <0.003 | <0.015 |
| Nb-95 | <0.009 | <0.003 | <0.006 | <0.004 | <0.015 |
| Zr-95 | <0.007 | <0.011 | <0.013 | <0.009 | <0.023 |
| Ru-103 | <0.007 | <0.011 | <0.012 | <0.008 | <0.013 |
| Ru-106 | <0.039 | <0.098 | <0.027 | <0.054 | <0.11 |
| Cs-134 | <0.008 | <0.005 | <0.007 | <0.005 | <0.011 |
| Cs-137 | <0.004 | <0.008 | <0.006 | <0.005 | 0.036±0.011 |
| Ce-141 | <0.015 | <0.021 | <0.011 | <0.008 | <0.018 |
| Ce-144 | <0.046 | <0.079 | <0.033 | <0.039 | <0.078 |

| | Indicator | | | Control |
|---|---|---|---|---|
| Location | D-93 | D-94 | D-106 | D-105 |
| Date Collected | 10-12-93 | 10-12-93 | 10-12-93 | 10-12-93 |
| Type | Corn | Corn | Corn | Corn |
| Lab Code | DVE-1722 | DVE-1723 | DVE-1725 | DVE-1724 |
| K-40 | 2.29±0.28 | 2.36±0.32 | 2.87±0.31 | 2.86±0.30 |
| Mn-54 | <0.002 | <0.004 | <0.006 | <0.006 |
| Co-58 | <0.007 | <0.003 | <0.008 | <0.003 |
| Co-60 | <0.003 | <0.007 | <0.005 | <0.003 |
| Nb-95 | <0.006 | <0.010 | <0.007 | <0.007 |
| Zr-95 | <0.011 | <0.007 | <0.007 | <0.016 |
| Ru-103 | <0.011 | <0.008 | <0.008 | <0.006 |
| Ru-106 | <0.082 | <0.066 | <0.056 | <0.092 |
| Cs-134 | <0.005 | <0.008 | <0.005 | <0.009 |
| Cs-137 | <0.002 | <0.004 | <0.004 | <0.005 |
| Ce-141 | <0.014 | <0.016 | <0.014 | <0.019 |
| Ce-144 | <0.074 | <0.045 | <0.071 | <0.067 |

Table 19 Surface water samples, analysis for iodine-131 and gamma-emitting isotopes. Collection: Monthly.

Sample Description and Concentration (pCi/L)

| Indicator | D-50 - Plant Intake | | | | | |
|---|---|---|---|---|---|---|
| Date Collected | 01-26-93 | 02-24-93 | 03-29-93 | 04-21-93 | 05-19-93 | 06-23-93 |
| Lab Code | DSW-9129 | DSW-9965 | DSW-1124 | DSW-1512 | DSW-1865 | DSW-2439 |
| I-131 | <15 | <15 | <15 | <15 | <15 | <15 |
| Mn-54 | <15 | <15 | <15 | <15 | <15 | <15 |
| Fe-59 | <30 | <30 | <30 | <30 | <30 | <30 |
| Co-58 | <15 | <15 | <15 | <15 | <15 | <15 |
| Co-60 | <15 | <15 | <15 | <15 | <15 | <15 |
| Zn-65 | <30 | <30 | <30 | <30 | <30 | <30 |
| Nb-95 | <15 | <15 | <15 | <15 | <15 | <15 |
| Zr-95 | <30 | <30 | <30 | <30 | <30 | <30 |
| Cs-134 | <15 | <15 | <15 | <15 | <15 | <15 |
| Cs-137 | <18 | <18 | <18 | <18 | <18 | <18 |
| Ba-140 | <60 | <60 | <60 | <60 | <60 | <60 |
| La-140 | <15 | <15 | <15 | <15 | <15 | <15 |

| Date Collected | 07-28-93 | 08-25-93 | 09-22-93 | 10-27-93 | 11-23-93 | 12-21-93 |
|---|---|---|---|---|---|---|
| Lab Code | DSW-2778 | DSW-3087 | DSW-3401 | DSW-3797 | DSW-4111 | DSW-4416 |
| I-131 | <15 | <15 | <15 | <15 | <15 | <15 |
| Mn-54 | <15 | <15 | <15 | <15 | <15 | <15 |
| Fe-59 | <30 | <30 | <30 | <30 | <30 | <30 |
| Co-58 | <15 | <15 | <15 | <15 | <15 | <15 |
| Co-60 | <15 | <15 | <15 | <15 | <15 | <15 |
| Zn-65 | <30 | <30 | <30 | <30 | <30 | <30 |
| Nb-95 | <15 | <15 | <15 | <15 | <15 | <15 |
| Zr-95 | <30 | <30 | <30 | <30 | <30 | <30 |
| Cs-134 | <15 | <15 | <15 | <15 | <15 | <15 |
| Cs-137 | <18 | <18 | <18 | <18 | <18 | <18 |
| Ba-140 | <60 | <60 | <60 | <60 | <60 | <60 |
| La-140 | <15 | <15 | <15 | <15 | <15 | <15 |

Table 19. Surface water samples, analysis for iodine-131 and gamma-emitting isotopes. Collection: Monthly.

| Sample Description and Concentration (pCi/L) | | | | | | |
|---|---|---|---|---|---|---|
| Indicator | D-51 - Plant Discharge | | | | | |
| Date Collected | 01-26-93 | 02-24-93 | 03-29-93 | 04-21-93 | 05-19-93 | 06-23-93 |
| Lab Code | DSW-9130 | DSW-9966 | DSW-1125 | DSW-1513 | DSW-1866 | DSW-2440 |
| I-131 | <15 | <15 | <15 | <15 | <15 | <15 |
| Mn-54 | <15 | <15 | <15 | <15 | <15 | <15 |
| Fe-59 | <30 | <30 | <30 | <30 | <30 | <30 |
| Co-58 | <15 | <15 | <15 | <15 | <15 | <15 |
| Co-60 | <15 | <15 | <15 | <15 | <15 | <15 |
| Zn-65 | <30 | <30 | <30 | <30 | <30 | <30 |
| Nb-95 | <15 | <15 | <15 | <15 | <15 | <15 |
| Zr-95 | <30 | <30 | <30 | <30 | <30 | <30 |
| Cs-134 | <15 | <15 | <15 | <15 | <15 | <15 |
| Cs-137 | <18 | <18 | <18 | <18 | <18 | <18 |
| Ba-140 | <60 | <60 | <60 | <60 | <60 | <60 |
| La-140 | <15 | <15 | <15 | <15 | <15 | <15 |
| Date Collected | 07-28-93 | 08-25-93 | 09-22-93 | 10-27-93 | 11-23-93 | 12-21-93 |
| Lab Code | DSW-2779 | DSW-3088 | DSW-3402 | DSW-3798 | DSW-4112 | DSW-4417 |
| I-131 | <15 | <15 | <15 | <15 | <15 | <15 |
| Mn-54 | <15 | <15 | <15 | <15 | <15 | <15 |
| Fe-59 | <30 | <30 | <30 | <30 | <30 | <30 |
| Co-58 | <15 | <15 | <15 | <15 | <15 | <15 |
| Co-60 | <15 | <15 | <15 | <15 | <15 | <15 |
| Zn-65 | <30 | <30 | <30 | <30 | <30 | <30 |
| Nb-95 | <15 | <15 | <15 | <15 | <15 | <15 |
| Zr-95 | <30 | <30 | <30 | <30 | <30 | <30 |
| Cs-134 | <15 | <15 | <15 | <15 | <15 | <15 |
| Cs-137 | <18 | <18 | <18 | <18 | <18 | <18 |
| Ba-140 | <60 | <60 | <60 | <60 | <60 | <60 |
| La-140 | <15 | <15 | <15 | <15 | <15 | <15 |

Table 19. Surface water samples, analysis for iodine-131 and gamma-emitting isotopes. Collection: Monthly.

| Sample Description and Concentration (pCi/L) | | | | | | |
|---|---|---|---|---|---|---|
| Indicator | D-99 - Pleasant Creek | | | | | |
| Date Collected | 01-26-93 | 02-24-93 | 03-29-93 | 04-21-93 | 05-24-93 | 06-30-93 |
| Lab Code | DSW-9131 | DSW-9967 | DSW-1126 | DSW-1514 | DSW-1867 | DSW-2441 |
| I-131 | <15 | <15 | <15 | <15 | <15 | <15 |
| Mn-54 | <15 | <15 | <15 | <15 | <15 | <15 |
| Fe-59 | <30 | <30 | <30 | <30 | <30 | <30 |
| Co-58 | <15 | <15 | <15 | <15 | <15 | <15 |
| Co-60 | <15 | <15 | <15 | <15 | <15 | <15 |
| Zn-65 | <30 | <30 | <30 | <30 | <30 | <30 |
| Nb-95 | <15 | <15 | <15 | <15 | <15 | <15 |
| Zr-95 | <30 | <30 | <30 | <30 | <30 | <30 |
| Cs-134 | <15 | <15 | <15 | <15 | <15 | <15 |
| Cs-137 | <18 | <18 | <18 | <18 | <18 | <18 |
| Ba-140 | <60 | <60 | <60 | <60 | <60 | <60 |
| La-140 | <15 | <15 | <15 | <15 | <15 | <15 |
| Date Collected | 07-30-93 | 08-31-93 | 09-28-93 | 10-27-93 | 11-24-93 | 12-15-93 |
| Lab Code | DSW-2780 | DSW-3089 | DSW-3403 | DSW-3794 | DSW-4113 | DSW-4418 |
| I-131 | <15 | <15 | <15 | <15 | <15 | <15 |
| Mn-54 | <15 | <15 | <15 | <15 | <15 | <15 |
| Fe-59 | <30 | <30 | <30 | <30 | <30 | <30 |
| Co-58 | <15 | <15 | <15 | <15 | <15 | <15 |
| Co-60 | <15 | <15 | <15 | <15 | <15 | <15 |
| Zn-65 | <30 | <30 | <30 | <30 | <30 | <30 |
| Nb-95 | <15 | <15 | <15 | <15 | <15 | <15 |
| Zr-95 | <30 | <30 | <30 | <30 | <30 | <30 |
| Cs-134 | <15 | <15 | <15 | <15 | <15 | <15 |
| Cs-137 | <18 | <18 | <18 | <18 | <18 | <18 |
| Ba-140 | <60 | <60 | <60 | <60 | <60 | <60 |
| La-140 | <15 | <15 | <15 | <15 | <15 | <15 |

Table 19. Surface water samples, analysis for iodine-131 and gamma-emitting isotopes. Collection: Monthly.

| Sample Description and Concentration (pCi/L) | | | | | | |
|---|---|---|---|---|---|---|
| Indicator | D-49 - Lewis Access | | | | | |
| Date Collected | 01-26-93 | 02-24-93 | 03-24-93 | 04-21-93 | 05-24-93 | 06-30-93 |
| Lab Code | DSW-9128 | DSW-9963,4 | DSW-1123 | DSW-1511 | DSW-1864 | DSW-2438 |
| I-131 | <15 | <15 | <15 | <15 | <15 | <15 |
| Mn-54 | <15 | <15 | <15 | <15 | <15 | <15 |
| Fe-59 | <30 | <30 | <30 | <30 | <30 | <30 |
| Co-58 | <15 | <15 | <15 | <15 | <15 | <15 |
| Co-60 | <15 | <15 | <15 | <15 | <15 | <15 |
| Zn-65 | <30 | <30 | <30 | <30 | <30 | <30 |
| Nb-95 | <15 | <15 | <15 | <15 | <15 | <15 |
| Zr-95 | <30 | <30 | <30 | <30 | <30 | <30 |
| Cs-134 | <15 | <15 | <15 | <15 | <15 | <15 |
| Cs-137 | <18 | <18 | <18 | <18 | <18 | <18 |
| Ba-140 | <60 | <60 | <60 | <60 | <60 | <60 |
| La-140 | <15 | <15 | <15 | <15 | <15 | <15 |
| Date Collected | 07-30-93 | 08-31-93 | 09-28-93 | 10-27-93 | 11-24-93 | 12-15-93 |
| Lab Code | DSW-2777 | DSW-3085,6 | DSW-3400 | DSW-3796 | DSW-4110 | DSW-4415 |
| I-131 | <15 | <15 | <15 | <15 | <15 | <15 |
| Mn-54 | <15 | <15 | <15 | <15 | <15 | <15 |
| Fe-59 | <30 | <30 | <30 | <30 | <30 | <30 |
| Co-58 | <15 | <15 | <15 | <15 | <15 | <15 |
| Co-60 | <15 | <15 | <15 | <15 | <15 | <15 |
| Zn-65 | <30 | <30 | <30 | <30 | <30 | <30 |
| Nb-95 | <15 | <15 | <15 | <15 | <15 | <15 |
| Zr-95 | <30 | <30 | <30 | <30 | <30 | <30 |
| Cs-134 | <15 | <15 | <15 | <15 | <15 | <15 |
| Cs-137 | <18 | <18 | <18 | <18 | <18 | <18 |
| Ba-140 | <60 | <60 | <60 | <60 | <60 | <60 |
| La-140 | <15 | <15 | <15 | <15 | <15 | <15 |

Table 19. Surface water samples, analysis for Iodine-131 and gamma-emitting isotopes. Collection: Monthly.

| Sample Description and Concentration (pCi/L) | | | | | | |
|---|---|---|---|---|---|---|
| Control | D-107 - Plant Sewage Discharge | | | | | |
| Date Collected | 01-26-93 | 02-24-93 | 03-29-93 | 04-21-93 | 05-24-93 | 06-30-93 |
| Lab Code | DSW-9132,3 | DSW-9968 | DSW-1127 | DSW-1515 | DSW-1868 | DSW-2442 |
| K-40[a] | 18.9 | 17.3 | 16.4 | 14.70 | 12.11 | 9.08 |
| I-131 | <15 | <15 | <15 | <15 | <15 | <15 |
| Mn-54 | <15 | <15 | <15 | <15 | <15 | <15 |
| Fe-59 | <30 | <30 | <30 | <30 | <30 | <30 |
| Co-58 | <15 | <15 | <15 | <15 | <15 | <15 |
| Co-60 | <15 | <15 | <15 | <15 | <15 | <15 |
| Zn-65 | <30 | <30 | <30 | <30 | <30 | <30 |
| Nb-95 | <15 | <15 | <15 | <15 | <15 | <15 |
| Zr-95 | <30 | <30 | <30 | <30 | <30 | <30 |
| Cs-134 | <15 | <15 | <15 | <15 | <15 | <15 |
| Cs-137 | <18 | <18 | <18 | <18 | <18 | <18 |
| Ba-140 | <60 | <60 | <60 | <60 | <60 | <60 |
| La-140 | <15 | <15 | <15 | <15 | <15 | <15 |
| Date Collected | 07-30-93 | 08-31-93 | 09-28-93 | 10-27-93 | 11-24-93 | 12-15-93 |
| Lab Code | DSW-2781 | DSW-3090 | DSW-3404 | DSW-3800 | DSW-4114 | DSW-4419 |
| K-40[a] | 12.98 | 14.70 | 19.90 | 18.16 | 14.70 | 15.57 |
| I-131 | <15 | <15 | <15 | <15 | <15 | <15 |
| Mn-54 | <15 | <15 | <15 | <15 | <15 | <15 |
| Fe-59 | <30 | <30 | <30 | <30 | <30 | <30 |
| Co-58 | <15 | <15 | <15 | <15 | <15 | <15 |
| Co-60 | <15 | <15 | <15 | <15 | <15 | <15 |
| Zn-65 | <30 | <30 | <30 | <30 | <30 | <30 |
| Nb-95 | <15 | <15 | <15 | <15 | <15 | <15 |
| Zr-95 | <30 | <30 | <30 | <30 | <30 | <30 |
| Cs-134 | <15 | <15 | <15 | <15 | <15 | <15 |
| Cs-137 | <18 | <18 | <18 | <18 | <18 | <18 |
| Ba-140 | <60 | <60 | <60 | <60 | <60 | <60 |
| La-140 | <15 | <15 | <15 | <15 | <15 | <15 |

[a] Analyzed by flame photometry.

Table 21. Surface water samples, quarterly composites of monthly samples, analysis for tritium, 1993.

| Location and Collection Period | Lab Code | Concentration (pCi/L) H-3 |
|---|---|---|
| Indicator | | |
| D-50 | | |
| 1st Quarter | DSW-1135 | <330 |
| 2nd Quarter | -2451 | <330 |
| 3rd Quarter | -3413 | <330 |
| 4th Quarter | -4452 | <330 |
| Annual Mean ± s.d. | | <330 |
| D-51 | | |
| 1st Quarter | DSW-1136 | <330 |
| 2nd Quarter | -2452 | <330 |
| 3rd Quarter | -3414 | <330 |
| 4th Quarter | -4453 | <330 |
| Annual Mean ± s.d. | | <330 |
| D-99 | | |
| 1st Quarter | DSW-1138 | <330 |
| 2nd Quarter | -2453 | <330 |
| 3rd Quarter | -3415 | <330 |
| 4th Quarter | -4454 | <330 |
| Annual Mean ± s.d. | | <330 |
| D-107 | | |
| 1st Quarter | DSW-1139 | <330 |
| 2nd Quarter | -2454 | <330 |
| 3rd Quarter | -3416 | <330 |
| 4th Quarter | -4455 | <330 |
| Annual Mean ± s.d. | | <330 |
| Control | | |
| D-49 | | |
| 1st Quarter | DSW-1134 | <330 |
| 2nd Quarter | -2450 | <330 |
| 3rd Quarter | -3412 | <330 |
| 4th Quarter | -4451 | <330 |
| Annual Mean ± s.d. | | <330 |

Table 22. Fish samples, analysis of edible portion for gamma-emitting isotopes. . Collection: Semiannually[a].

| Sample Description and Concentration (pCi/g wet) | | |
|---|---|---|
| Indicator | Downstream D-61 | |
| Date Collected | 10-21-93 | 10-21-93 |
| Type | Carpsucker | Carp |
| Lab Code | DF-2277 | DF-2278 |
| K-40 | 2.83±0.36 | 2.77±0.38 |
| Mn-54 | <0.015 | <0.012 |
| Co-58 | <0.006 | <0.015 |
| Co-60 | <0.012 | <0.010 |
| Fe-59 | <0.039 | <0.030 |
| Zn-65 | <0.024 | <0.031 |
| Nb-95 | <0.027 | <0.006 |
| Zr-95 | <0.032 | <0.022 |
| Ru-103 | <0.019 | <0.009 |
| Ru-106 | <0.11 | <0.14 |
| Cs-134 | <0.014 | <0.017 |
| Cs-137 | <0.017 | <0.017 |
| Ce-141 | <0.042 | <0.011 |
| Ce-144 | <0.11 | <0.058 |
| Control | Upstream D-49 | |
| Date Collected | 10-21-93 | 10-21-93 |
| Type | Carpsucker | Carp |
| Lab Code | DF-2274 | DF-2275, 6 |
| K-40 | 2.74±0.62 | 2.62±0.46 |
| Mn-54 | <0.014 | <0.021 |
| Co-58 | <0.024 | <0.017 |
| Co-60 | <0.032 | <0.008 |
| Fe-59 | <0.042 | <0.051 |
| Zn-65 | <0.027 | <0.033 |
| Nb-95 | <0.027 | <0.021 |
| Zr-95 | <0.052 | <0.042 |
| Ru-103 | <0.021 | <0.026 |
| Ru-106 | <0.22 | <0.18 |
| Cs-134 | <0.012 | <0.021 |
| Cs-137 | <0.014 | <0.023 |
| Ce-141 | <0.024 | <0.051 |
| Ce-144 | <0.16 | <0.078 |

[a] No fish were collected during the first half of 1993 due to high river water levels.

Table 23. River sediment samples, analysis for gamma-emitting isotopes. Collection: Semiannually[a].

| Sample Description and Concentration (pCi/g dry) | | | | |
|---|---|---|---|---|
| | Control | | | |
| Location | D-49 | D-50 | | |
| Date Collected | 09-24-93 | 10-07-93 | | |
| Lab Code | DBS-1333 | DBS-1351 | | |
| K-40 | 8.51±0.43 | 9.07±0.52 | | |
| Mn-54 | <0.014 | <0.012 | | |
| Co-58 | <0.022 | <0.007 | | |
| Co-60 | <0.006 | <0.018 | | |
| Nb-95 | <0.047 | <0.020 | | |
| Zr-95 | <0.043 | <0.036 | | |
| Ru-103 | <0.028 | <0.038 | | |
| Ru-106 | <0.13 | <0.057 | | |
| Cs-134 | <0.014 | <0.012 | | |
| Cs-137 | 0.029±0.016 | <0.018 | | |
| Ce-141 | <0.036 | <0.059 | | |
| Ce-144 | <0.092 | <0.053 | | |
| | Indicator | | | |
| Location | D-51 | D-51 | D-107 | D-107 |
| Date Collected | 09-24-93 | 10-07-93 | 09-24-93 | 10-07-93 |
| Lab Code | DBS-1334 | DBS-1352 | DBS-1335 | DBS-1353 |
| K-40 | 9.39±0.48 | 9.91±0.56 | 7.16±0.40 | 7.23±0.38 |
| Mn-54 | <0.015 | <0.019 | <0.012 | <0.013 |
| Co-58 | <0.008 | <0.009 | <0.014 | <0.007 |
| Co-60 | <0.013 | <0.026 | 0.035±0.012 | <0.018 |
| Nb-95 | <0.014 | <0.020 | <0.017 | <0.008 |
| Zr-95 | <0.040 | <0.040 | <0.038 | <0.024 |
| Ru-103 | <0.011 | <0.013 | <0.014 | <0.015 |
| Ru-106 | <0.060 | <0.14 | <0.12 | <0.090 |
| Cs-134 | <0.016 | <0.012 | <0.013 | <0.011 |
| Cs-137 | 0.025±0.014 | 0.029±0.016 | <0.014 | 0.024±0.014 |
| Ce-141 | <0.051 | <0.064 | <0.063 | <0.019 |
| Ce-144 | <0.095 | <0.13 | <0.094 | <0.058 |

[a] No river sediment samples were collected during the first half of 1993 due to high river water levels.

Table 24. Precipitation samples, analysis for gamma-emitting isotopes. Collection: Monthly, 1993.

| Sample Description and Concentration (pCi/L) | | | | |
|---|---|---|---|---|
| Collection Period | January | February | March | April |
| Lab Code | DP-1212 | DP-1228 | DP-1236 | DP-1239 |
| Mn-54 | <4.1 | <3.7 | <3.3 | <6.9 |
| Fe-59 | <10.9 | <10.1 | <6.4 | <16.4 |
| Co-58 | <4.9 | <3.9 | <2.9 | <6.9 |
| Co-60 | <4.7 | <3.9 | <3.4 | <7.5 |
| Zn-65 | <10.5 | <7.8 | <7.0 | <14.9 |
| Nb-95 | <5.8 | <4.8 | <3.0 | <8.4 |
| Zr-95 | <8.8 | <7.0 | <5.4 | <12.9 |
| I-131 | <15.9 | <15.0 | <3.6 | <9.6 |
| Cs-134 | <4.4 | <3.5 | <3.1 | <7.1 |
| Cs-137 | <4.1 | <3.6 | <3.4 | <6.6 |
| Ba-140 | <33.6 | <31.1 | <12.5 | <32.2 |
| La-140 | <12.2 | <7.4 | <3.7 | <7.5 |
| Collection Period | May | June | July | August |
| Lab Code | DP-1247 | DP-1262 | DP-1271 | DP-1280 |
| Mn-54 | <13.1 | <3.5 | <3.8 | <3.6 |
| Fe-59 | <16.1 | <3.4 | <7.2 | <8.3 |
| Co-58 | <6.9 | <3.0 | <3.4 | <2.1 |
| Co-60 | <6.4 | <3.9 | <3.8 | <4.0 |
| Zn-65 | <12.0 | <2.1 | <5.2 | <6.0 |
| Nb-95 | <8.8 | <4.2 | <4.1 | <4.2 |
| Zr-95 | <9.2 | <3.8 | <5.6 | <10.3 |
| I-131 | <7.8 | <4.9 | <5.4 | <5.0 |
| Cs-134 | <9.9 | <3.9 | <2.8 | <2.8 |
| Cs-137 | <10.9 | <3.8 | <2.9 | <3.8 |
| Ba-140 | <33.0 | <29.6 | <20.5 | <20.8 |
| La-140 | <6.9 | <5.6 | <3.3 | <2.0 |
| Collection Period | September | October | November | December |
| Lab Code | DP-1282 | DP-1291 | DP-1300 | DP-1308 |
| Mn-54 | <2.8 | <8.0 | <6.7 | <3.8 |
| Fe-59 | <8.3 | <17.6 | <13.7 | <5.2 |
| Co-58 | <5.6 | <7.0 | <5.6 | <6.6 |
| Co-60 | <2.8 | <9.0 | <3.2 | <4.6 |
| Zn-65 | <7.6 | <18.6 | <15.9 | <11.6 |
| Nb-95 | <2.3 | <9.4 | <4.8 | <5.5 |
| Zr-95 | <7.6 | <14.2 | <14.1 | <8.4 |
| I-131 | <4.9 | <19.0 | <8.7 | <13.3 |
| Cs-134 | <4.4 | <6.9 | <6.7 | <5.2 |
| Cs-137 | <4.7 | <7.0 | <7.7 | <4.5 |
| Ba-140 | <20.3 | <47.3 | <9.7 | <19.6 |
| La-140 | <4.6 | <8.1 | <3.4 | <6.3 |

Table 25. Precipitation samples, quarterly composites of monthly samples, analysis for tritium, 1993.

| Location and Collection Period | Lab Code | Concentration (pCi/L) H-3 |
|---|---|---|
| 1st Quarter | DP-1237 | <330 |
| 2nd Quarter | -1263 | <330 |
| 3rd Quarter | -1283 | <330 |
| 4th Quarter | -1309 | <330 |

NOTE: Page 43 is intentionally left out.

Table 27. Soil samples, analysis for gamma-emitting isotopes.
Collection: Annually.

| Sample Description and Concentration (pCi/g dry) | | |
|---|---|---|
| Location | D-15 | D-16 |
| Date Collected | 10-12-93 | 10-12-93 |
| Lab Code | DSO-821 | DSO-822 |
| Sr-90 | 0.043±0.010 | 0.074±0.014 |
| K-40 | 16.33±0.69 | 11.04±0.50 |
| Mn-54 | <0.021 | <0.019 |
| Co-58 | <0.026 | <0.024 |
| Co-60 | <0.034 | <0.018 |
| Nb-95 | <0.030 | <0.023 |
| Zr-95 | <0.042 | <0.037 |
| Ru-103 | <0.020 | <0.013 |
| Ru-106 | <0.15 | <0.11 |
| Cs-134 | <0.017 | <0.014 |
| Cs-137 | 0.22±0.03 | 0.31±0.03 |
| Ce-141 | <0.084 | <0.038 |
| Ce-144 | <0.12 | <0.099 |