IES Utilities Inc.
Duane Arnold Energy Center
3277 DAEC Road
Palo, IA 52324-9785

Office: 319.851.7611
Fax: 319.851.7986
www.alliant-energy.com

April 25, 2000
NG-00-0715

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Station O-P1-17
Washington, DC 20555-0001

Subject: Duane Arnold Energy Center
Docket No.: 50-331
Operating License No.: DPR-49
1999 Annual Radiological Environmental Report

Please find attached one (1) copy of the 1999 Annual Radiological Environmental Report for the Duane Arnold Energy Center. This report is transmitted in accordance with the DAEC Offsite Dose Assessment Manual (section 6.4.2) reporting requirements.

Sincerely,

Richard L. Anderson

Richard L. Anderson
Plant Manager - Nuclear

RLA/SF/hc

Attachment

cc: Mr. James E. Dyer (w/attachments)
Regional Administrator
Region III
U. S. Nuclear Regulatory Commission
801 Warrenville Road
Lisle, Illinois 60532-4351

NRC Resident Inspector - DAEC (w/attachments)
B. Mozafari (NRC-NRR) (w/attachments)
E. Protsch - (w/o attachments)
R. Brown - (w/o attachments)
D. Wilson (w/o attachments)
Wendell Aldrich (Safety Committee) (w/attachments)
CTS Project (w/attachments)
DOCU (w/attachments)

C001

TELEDYNE BROWN ENGINEERING

ENVIRONMENTAL SERVICES
MIDWEST LABORATORY
700 LANDWEHR ROAD
NORTHBROOK, ILLINOIS 60062-2310
(847) 564-0700 • FAX (847) 564-4517

REPORT
TO
IES UTILITIES, INC.
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, 1999

FOR SUBMITTAL TO
THE NUCLEAR REGULATORY COMMISSION

PREPARED AND SUBMITTED
BY
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES
MIDWEST LABORATORY
PROJECT NO. 8001

Approved by: _____

Bronia Grob, M.S.
Technical Lead

PREFACE

The staff members of the Teledyne Brown Engineering Environmental Services, 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 DAEC 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 Teledyne Brown Engineering Environmental Services, Midwest Laboratory, with the exception of Appendices D and E, which were prepared by DAEC personnel.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

PART II

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

This report summarizes and interprets results of the Radiological Environmental Monitoring Program conducted by Teledyne Brown Engineering Environmental Services, Midwest Laboratory at the Duane Arnold Energy Center, Palo, Iowa, during the period January - December, 1999. 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 IES Utilities, Inc. 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 Radiological Environmental Monitoring Program required by the U.S. Nuclear Regulatory Commission (NRC) Technical Specifications for the Duane Arnold Energy Center is described. Results for 1999 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. With the exception of D-107, located within the owner controlled area, no effect on the environment due to the operation of the Duane Arnold Energy Center is indicated.

3.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

3.1 Program Design and Data Interpretation

The purpose of the Radiological Environmental 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 locations. Also, airborne iodine is collected by continuous pumping through charcoal filters at six of these locations. Nine of the twelve locations are indicators and three 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 analyzed for gamma emitting isotopes.

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

Ambient gamma radiation is monitored at twelve air sampling locations. In addition, gamma radiation is monitored at thirty-three special locations: seventeen in a circle within 0.5 mi. radius of the DAEC stack; six in 22.5° sectors within 1 mi. of the DAEC stack; and ten 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 five 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 vegetation samples are collected annually, as available, from nine locations: one control (D-105) and eight indicators (D-16, D-57, D-58, D-63, D-72, D-93, D-94, and D-106). Grain, hay and broad leaf (green leafy) vegetation samples are analyzed for gamma-

Program Description (continued)

emitting isotopes and at least one broad leaf vegetation is analyzed for iodine-131. If cattle are slaughtered for home use, a meat sample 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 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 the 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 river, pond and sewage effluent locations, one control (D-49) and four 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) No milk was available from location D-93 for the months of January and February, 1999. No milk was available from location D-101 for the months of January through March and June, 1999 and the week ending July 15, 1999. The goats were dry.

(2) TLD data was not available for the first quarter, 1999 from locations D-39 and D-48. The TLDs were lost in the field.

(3) Collection of air particulates/air iodine and milk for the week ending 07-29-99 was delayed. The samples were collected 08-02-99 and 08-03-99.

(4) TLD data was not available for the third quarter, 1999 from location D-29. The TLD was lost in the field.

3.4 Laboratory Procedures

All iodine-131 analyses in milk were made by using a sensitive radiochemical 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 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 TBEESML are on file and are available for inspection. Procedures are based on those prescribed by the Health and Safety Laboratory of the U.S. Dep't of Energy, Edition 28, 1997, U.S. Environmental Protection Agency for Measurement of Radioactivity in Drinking Water, 1980, and the U.S. Environmental Protection Agency, EERF, Radiochemical Procedures Manual, 1984.

Details of TBEESML's QA program are presented elsewhere (Teledyne Brown Engineering, Environmental Services, Midwest Laboratory, 1999). The TBEESML 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

There were no program modifications during the year, 1999.

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 1999 are not included in this section, although references to these results will be made in the discussion. The complete tabulation of the 1999 results is contained in Part II of the 1999 Annual Report on the Radiological Environmental Monitoring Program for the Duane Arnold Energy Center.

4.1 Atmospheric Nuclear Detonations and Nuclear Accidents

There were no reported atmospheric nuclear tests in 1999.

Accidental nuclear criticality occurred at a Japanese nuclear fuel processing plant on September 30, 1999.

4.2 Program Findings

Results obtained show background levels of radioactivity in the environmental samples collected in 1999.

Airborne Particulates

The average annual gross beta concentrations in airborne particulates were nearly identical at both indicator and control locations (0.026 and 0.027 pCi/m^3, respectively) and were similar to levels observed from 1984 through 1998. The results are tabulated below. The data for 1986 does not include the results from May 19 to June 9, 1986, which were influenced by the accident at Chernobyl.

Year	Indicators	Controls		Year	Indicators	Controls
Concentration (pCi/m^3)				Concentration (pCi/m^3)		
1984	0.025	0.026		1992	0.022	0.023
1985	0.024	0.024		1993	0.022	0.023
1986	0.024	0.024		1994	0.023	0.024
1987	0.024	0.026		1995	0.025	0.024
1988	0.026	0.028		1996	0.024	0.023
1989	0.026	0.029		1997	0.023	0.023
1990	0.022	0.024		1998	0.024	0.024
1991	0.023	0.022		1999	0.026	0.027

Average annual gross beta concentrations in airborne particulates.

Gamma spectroscopic analysis of quarterly composites of air particulate filters yielded similar results for indicator and control locations. Beryllium-7, which is produced

Airborne Particulates (continued)

continuously in the upper atmosphere by cosmic radiation (Arnold and Al-Salih, 1955), was detected in all samples. Traces of Co-60 were observed in two air particulate composites from locations D-6 and D-8. Results of investigation suggest cross-activity from a contaminated sampler pump head. 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 air sampling locations, the TLD readings averaged 14.9 and 14.4 mR/quarter for indicator and control locations, respectively. At locations within 0.5 mile, 1.0 mile, and 3.0 mile radius of the stack, the measurements averaged 17.2 mR/quarter, 18.5 mR/quarter, and 15.4 mR/quarter, respectively. The average for all locations was 16.3 mR/quarter. This is 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 1999 show no radiological effects of the plant operation.

Ground Water

The annual mean for gross beta activity measured 3.4 pCi/L and was similar to the levels observed in 1980 through 1997. The location with the highest mean (5.9 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 broadleaf vegetation were below the LLD level of 0.022 pCi/g wet weight in all samples.

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 0.036 pCi/g dry weight. Cesium-137 was detected at an average concentration of 0.20 pCi/g dry weight. Both strontium-90 and Cesium-137 concentrations were similar to levels observed 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), in 1992 (0.040 and 0.26 pCi/g dry weight, respectively), in 1993 (0.058 and 0.26 pCi/g dry weight, respectively), in 1994 (0.040 and 0.27 pCi/g dry weight, respectively) , in 1995 (0.044 and 0.21 pCi/g dry weight, respectively), in 1996 (0.050 and 0.17 pCi/g dry weight, respectively) and in 1997 (0.051 and 0.20 pCi/g dry weight, respectively) and in 1998 (0.036 and 0.15 pCi/g dry weight, respectively).

The only other gamma-emitting isotope detected was potassium-40 at an average concentration of 14.09 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 10.4-27.7 pCi/L and averaged 17.5 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 (3.42 and 2.92 pCi/g wet weight, respectively). No plant effect on fish was indicated.

River Sediments

River sediments were collected in May and September, 1999, and analyzed for gamma-emitting isotopes. Cobalt-60 was detected in one sample from location D-107 (sewage effluent) at a concentration of 0.044 pCi/g dry weight. Traces of Cesium-137 were detected at both indicator and control locations, at concentrations of 0.070 and 0.037 pCi/g dry weight, respectively. Potassium-40 ranged from 8.57-11.73 pCi/g dry weight and averaged 9.66 pCi/g dry weight.

All other gamma-emitting isotopes were below detection limits.

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	1.26×10^9 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, 1999.

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. 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	1-2 (C), 3, 5-8, 10, 11, 13 (C), 15, 16	Air Particulate Locations	Two dosimeters continuously at each location. Both dosimeters are changed at least quarterly.	Read gamma radiation dose quarterly .
	18-23, 28-32, 33-42	Within 0.5 mile of Stack 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). 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		

(C) denotes control location. All other locations are indicators.

Table 5.2 Sample collection and analysis program, 1999 (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 54 55 57, 58 72	Treated Municipal Water Inlet to Municipal Water Treatment System On-site well 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 51 107	Plant Intake (C) Plant Discharge 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. I-131 analysis on broadleaf vegetation.
Fish	49 61	Cedar River upstream of DAEC not influenced by effluent (C) 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 63, 93, 96, 101	Control Farm near Norway, Iowa Dairy Farms within 10 miles of Site	At least once per two weeks during the grazing season. At least once per month during the non-grazing season.	<u>During the grazing season</u>: Gamma isotopic and iodine-131 analyses of each sample. <u>During the non-grazing season</u>: Gamma isotopic and iodine-131 analyses of each sample.

(C) denotes control location. All other locations are indicators.

Table 5.2 Sample collection and analysis program, 1999 (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. 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 radionuclide 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 1999; no animals slaughtered for home use.

Table 5.3 Sampling locations, Duane Arnold Energy Center.

Code	Type	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-42		42		3.0 mi SSE
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	C	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	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

"C" denotes control location. All other locations are indicators.

Table 5.4 Type and Frequency of collection.

Location	Location Type	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
D-18 through D-23				TLD		
D-28 through D-42				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
D-58			WW			G
D-61					F	
D-63			M			G
D-72			WW			G
D-82 through D-86				TLD		
D-91				TLD		
D-93			M			G
D-94						G
D-96			M			
D-99			SW			
D-101			M			
D-105	C		M			G
D-106			M			G
D-107			SW		RS	
On-site			P			ME

"C" denotes control location. All other locations are indicators.

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, 1999.

Sample Type	Analysis	Location(s)	Collection Date or Period	Comments
MI	I-131, Gamma	D-93	01-05-99	Sample not received; goat dry.
MI	I-131, Gamma	D-101	01-05-99	Sample not received; goat dry.
MI	I-131, Gamma	D-93	02-02-99	Sample not received; goat dry.
MI	I-131, Gamma	D-101	02-02-99	Sample not available.
MI	I-131, Gamma	D-101	03-02-99	Sample not available.
TLD	Ambient Gamma	D-39, D-48	1st Qtr., 99	TLD lost in the field.
MI	I-131, Gamma	D-101	06-02-99	Sample not available.
MI	I-131, Gamma	D-101	06-15-99	Sample not available.
MI	I-131, Gamma	D-101	06-29-99	Sample not available.
MI	I-131, Gamma	D-101	07-15-99	Sample not available.
TLD	Ambient Gamma	D-29	3rd Qtr., 99	TLD lost in the field.

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,1999
	(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 Location[d]	Location with Highest Annual Mean Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range[c]	Number Non-Routine Results[e]
Airborne Particulates (pCi/m³)	GB	624	0.004	0.026 (467/468) (0.008-0.063)	D-1, Cedar Rapids 11 mi. SE	0.029 (52/52) (0.013-0.076)	0.027 (155/156) (0.005-0.076)	0
	GS	48						
	Be-7		0.020	0.087 (36/36) (0.055-0.15)	D-8,Urbana 10 mi. NW	0.10 (4/4) (0.070-0.15)	0.082 (12/12) (0.049-0.125)	0
	Nb-95		0.0031	< LLD			< LLD	0
	Zr-95		0.0032	< LLD			< LLD	0
	Ru-103		0.0024	< LLD			< LLD	0
	Ru-106		0.012	< LLD			< LLD	0
	Cs-134		0.0016	< LLD			< LLD	0
	Cs-137		0.0014	< LLD			< LLD	0
	Ce-141		0.0036	< LLD			< LLD	0
	Ce-144		0.0091	< LLD			< LLD	0
Airborne Iodine (pCi/m³)	I-131	312	0.070	< LLD	-	-	< LLD	0
TLD, AP Locations (mR/quarter)	Gamma	48	1.0	14.9 (36/36) (10.8-21.0)	D-8, Urbana 10 mi. NW	18.2 (4/4) (16.0-21.0)	14.4 (12/12) (12.9-17.5)	0
TLD, within 0.5 mi. of Stack (mR/quarter)	Gamma	67	1.0	17.2 (67/67) (12.8-23.9)	D-31, On-site 0.5 mi. NW	21.3 (4/4) (19.5-23.9)	None	0
TLD, within 1.0 mi. of Stack (mR/quarter)	Gamma	23	1.0	18.5 (23/23) (14.8-22.5)	D-48 1.0 mi. NW	19.7 (3/4) (18.1-22.5)	None	0
TLD, within 1.0 mi. of Stack (mR/quarter)	Gamma	4	1.0	15.4 (39/39) (12.4-19.8)	D-37 3 mi. E	18.7 (4/4) (17.3-19.8)	None	0
Precipitation (pCi/L)	H-3	4	330	< LLD	-	-	< LLD	0
	GS	12						
	Mn-54		8.7	< LLD	-	-	< LLD	0
	Fe-59		17.8	< LLD	-	-	< LLD	0
	Co-58		6.4	< LLD	-	-	< LLD	0
	Co-60		7.9	< LLD	-	-	< LLD	0
	Zn-65		29.6	< LLD	-	-	< LLD	0
	Nb-95		11.7	< 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,1999

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[c]	Number Non-Routine Results[e]
Precipitation (pCi/L) (continued)	Zr-95	15.3	< LLD	-	-	< LLD	0
	I-131	15.8	< LLD	-	-	< LLD	0
	Cs-134	8.6	< LLD	-	-	< LLD	0
	Cs-137	6.5	< LLD	-	-	< LLD	0
	Ba-140	31.1	< LLD	-	-	< LLD	0
	La-140	13.9	< LLD	-	-	< LLD	0
Milk (pCi/L)	I-131 79	0.5	< LLD	-	-	< LLD	0
	GS 79						
	K-40	100	1485 (61/61) (1103-2021)	D-93, Farm 2.8 mi. NNE	1711 (16/16) (1392-2021)	1400 (18/18) (1240-1520)	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	3.4 (13/24) (2.2-6.6)	D-58, Farm 1 mi. WSW-SW	5.9 (4/4) (5.1-6.6)	None	0
	H-3 24	330	< LLD	-	-	< LLD	0
Broadleaf Vegetation (pCi/g wet)	I-131 2	0.022	< LLD	-	-	None	0
	GS 2						
	K-40	0.5	5.89 (1/1)	D-94, Farm 2.7 mi. N	5.89 (1/1)	3.41 (1/1)	0
	Mn-54	0.014	< LLD	-	-	< LLD	0
	Co-58	0.020	< LLD	-	-	< LLD	0
	Co-60	0.017	< LLD	-	-	< LLD	0
	Nb-95	0.027	< LLD	-	-	< LLD	0
	Zr-95	0.023	< LLD	-	-	< LLD	0
	Ru-103	0.021	< LLD	-	-	< LLD	0
	Ru-106	0.16	< LLD	-	-	< LLD	0
	Cs-134	0.018	< LLD	-	-	< LLD	0
	Cs-137	0.017	< LLD	-	-	< LLD	0
	Ce-141	0.030	< LLD	-	-	< LLD	0
	Ce-144	0.12	< 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,1999
	(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 Location[d]	Location with Highest Annual Mean Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range[c]	Number Non-Routine Results[e]
Vegetation	GS 6						
(Grain) (pCi/g wet)	K-40	0.5	2.76 (5/5) (1.87-4.23)	D-16, On-site 0.5 mi. SSE	4.23 (1/1)	2.57 (1/1)	0
	Mn-54	0.012	< LLD	-	-	< LLD	0
	Co-58	0.013	< LLD	-	-	< LLD	0
	Co-60	0.017	< LLD	-	-	< LLD	0
	Nb-95	0.014	< LLD	-	-	< LLD	0
	Zr-95	0.024	< LLD	-	-	< LLD	0
	Ru-103	0.012	< LLD	-	-	< LLD	0
	Ru-106	0.150	< LLD	-	-	< LLD	0
	Cs-134	0.021	< LLD	-	-	< LLD	0
	Cs-137	0.022	< LLD	-	-	< LLD	0
	Ce-141	0.026	< LLD	-	-	< LLD	0
	Ce-144	0.100	< LLD	-	-	< LLD	0
Vegetation	GS 5						
(Forage) (pCi/g wet)	K-40	0.5	13.37 (5/5) (7.16-24.71)	D-72, Farm 2 mi. SSW	24.71 (1/1)	14.77 (1/1)	0
	Mn-54	0.040	< LLD	-	-	< LLD	0
	Co-58	0.044	< LLD	-	-	< LLD	0
	Co-60	0.045	< LLD	-	-	< LLD	0
	Nb-95	0.049	< LLD	-	-	< LLD	0
	Zr-95	0.110	< LLD	-	-	< LLD	0
	Ru-103	0.041	< LLD	-	-	< LLD	0
	Ru-106	0.380	< LLD	-	-	< LLD	0
	Cs-134	0.040	< LLD	-	-	< LLD	0
	Cs-137	0.053	< LLD	-	-	< LLD	0
	Ce-141	0.073	< LLD	-	-	< LLD	0
	Ce-144	0.270	< LLD	-	-	< LLD	0

Table 5.7 Radiological Environmental Program Summary.

Name of Facility: Duane Arnold Energy Center
Location of Facility: Linn, Iowa (County, State)
Docket No.: 50-331
Reporting Period: January-December,1999

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[c]	Number Non-Routine Results[e]
Soil (pCi/gwet)	Sr-90 2	0.01	0.036 (2/2) (0.033-0.038)	D-16, On-site 0.5 mi. SSE	0.038 (1/1)	None	0
	GS 2						
	K-40	0.5	14.09 (2/2) (10.44-17.74)	D-15, On-site 0.5 mi. NW	17.74 (1/1)	None	0
	Mn-54	0.040	< LLD	-	-	None	0
	Fe-59	0.110	< LLD	-	-	None	0
	Co-58	0.069	< LLD	-	-	None	0
	Co-60	0.049	< LLD	-	-	None	0
	Zn-65	0.190	< LLD	-	-	None	0
	Nb-95	0.088	< LLD	-	-	None	0
	Zr-95	0.082	< LLD	-	-	None	0
	Ru-103	0.049	< LLD	-	-	None	0
	Ru-106	0.260	< LLD	-	-	None	0
	Cs-134	0.059	< LLD	-	-	None	0
	Cs-137	0.060	0.20 (2/2) (0.15-0.24)	D-16, On-site 0.5 mi. SSE	0.24 (1/1)	None	0
	Ce-141	0.098	< LLD	-	-	None	0
	Ce-144	0.280	< LLD	-	-	None	0
Surface Water (pCi/L)	H-3 20	330	< LLD	-	-	< LLD	0
	K-40 12	0.5	17.51 (12/12)	D-107, Onsite Sewage Effluent	17.51 (12/12) (10.4-27.7)	None	0
							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
	Nb-95	15	< LLD	-	-	< LLD	0
	Zr-95	30	< LLD	-	-	< LLD	0
	Cs-134	15	< LLD	-	-	< LLD	0
	Cs-137	15	< LLD	-	-	< LLD	0
	Ba-140	15	< LLD	-	-	< LLD	0
	La-140	15	< 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,1999

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[c]	Number Non-Routine Results[e]
Sediments	GS 6						
(pCi/g dry)	K-40	1.0	9.64 (4/4) (8.57-11.73)	D-51, Plant Discharge	10.15 (2/2) (8.57-11.73)	9.70 (2/2) (8.87-10.52)	0
	Mn-54	0.034	< LLD	-	-	< LLD	0
	Fe-59	0.085	< LLD	-	-	< LLD	0
	Co-58	0.035	< LLD	-	-	< LLD	0
	Co-60	0.028	0.044 (1/4)	D-107, Sewage Effluent Canal	0.044 (1/1)	< LLD	0
	Zn-65	0.140	< LLD	-	-	< LLD	0
	Nb-95	0.045	< LLD	-	-	< LLD	0
	Zr-95	0.081	< LLD	-	-	< LLD	0
	Ru-103	0.045	< LLD	-	-	< LLD	0
	Ru-106	0.200	< LLD	-	-	< LLD	0
	Cs-134	0.047	< LLD	-	-	< LLD	0
	Cs-137	0.024	0.070 (2/4) (0.040-0.100)	D-51, Plant Discharge	0.10 (1/1)	0.037 (1/1)	0
	Ce-141	0.085	< LLD	-	-	< LLD	0
	Ce-144	0.220	< LLD	-	-	< LLD	0
Fish	GS 8						
(pCi/g wet)	K-40	1.0	3.42 (4/4) (2.91-4.04)	D-61, Downstream	3.42 (4/4) (2.91-4.04)	2.92 (4/4) (2.58-3.50)	0
	Mn-54	0.019	< LLD	-	-	< LLD	0
	Fe-59	0.100	< LLD	-	-	< LLD	0
	Co-58	0.023	< LLD	-	-	< LLD	0
	Co-60	0.022	< LLD	-	-	< LLD	0
	Zn-65	0.042	< LLD	-	-	< LLD	0
	Nb-95	0.049	< LLD	-	-	< LLD	0
	Zr-95	0.056	< LLD	-	-	< LLD	0
	Ru-103	0.036	< LLD	-	-	< LLD	0
	Ru-106	0.190	< LLD	-	-	< LLD	0
	Cs-134	0.021	< LLD	-	-	< LLD	0
	Cs-137	0.024	< LLD	-	-	< LLD	0
	Ce-141	0.058	< LLD	-	-	< LLD	0
	Ce-144	0.120	< LLD	-	-	< LLD	0

[a] GB = Gross beta; GS = Gamma spectroscopy

[b] LLD = Nominal lower limit of detectionbased 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 exced 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.

6.0 REFERENCES CITED

Arnold, J. R. and H. A. Al-Salih. 1955. Beryllium-7 Produced by Cosmic Rays. Science 121: 451-453.

Eisenbud, M. 1963. Environmental Radioactivity, McGraw-Hill, New York, New York, pp. 213, 275 and 276.

Gold, S., H. W. Barkhau, B. Shlein, and B. Kahn, 1964. Measurement of Naturally Occurring Radionuclides in Air, in the Natural Environment, University of Chicago Press, Chicago, Illinois, 369-382.

Hazleton Environmental Sciences . 1981. Environmental Radiation Monitoring for the Duane Arnold Arnold Energy Center, Annual Report - Part II, Data Tabulations and Analyses, January - December 1980.

Hazleton Environmental Sciences . 1982. Environmental Radiation Monitoring for the Duane Arnold Arnold Energy Center, Annual Report - Part II, Data Tabulations and Analyses, January - December 1981

Hazleton Environmental Sciences . 1983. Environmental Radiation Monitoring for the Duane Arnold Arnold Energy Center, Annual Report - Part II, Data Tabulations and Analyses, January - December 1982.

Hohenemser, C. M. Deicher, A. Ernst, H. Hofsass, G. Lindner, E. Racknagel. 1986. "Chernobyl," Chemtech, October 1986, pp. 596-605.

National Center for Radiological Health, 1968. Radiological Health and Data Reports, Vol. 9, Number 12, 730-746.

Teledyne Isotopes Midwest Laboratory. 1995. Quality Control Program, Revision 0. 20 July 1995.

Teledyne Isotopes Midwest Laboratory. 1994. Quality Control Procedures Manual, Revision 18. 27 September 1994.

Teledyne Brown Engineering Environmental Services, Midwest Laboratory. 1999. Quality Assurance Program Manual, Revision 1, 26 April 1999.

Teledyne Brown Engineering Environmental Services, Midwest Laboratory. 1984 - 2000. Environmental Radiological Monitoring Program for the Duane Arnold Energy Center, Annual Report - Part II, Data Tabulations and Analyses, January - December, 1983 - 1999.

Wilson, D. W., G. M. Ward and J. E. Johnson. 1969. In Environmental Contamination by Radioactive Materials, International Atomic Energy Agency. p.125.

APPENDIX A

INTERLABORATORY COMPARISON PROGRAM RESULTS

NOTE: Teledyne Brown Engineering - Environmental Services, Midwest Laboratory participates in intercomparison studies administered by Environmental Resources Associates, and serves as a replacement for studies conducted previously by the U.S. EPA Environmental Monitoring Systems Laboratory, Las Vegas, Nevada. Results are reported in Appendix A. TLD Intercomparison results, in-house spikes, blanks, duplicates and mixed analyte performance evaluation program results are also reported. Appendix A is updated four times a year; the complete Appendix is included in March, June, September and December monthly progress reports only.

January, 1999 through December, 1999

Appendix A

Interlaboratory Comparison Program Results

Teledyne Brown Engineering Environmental Services Midwest Laboratory has participated in interlaboratory comparison (crosscheck) programs since the formulation of it's 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 past twelve months. Data for previous years is available upon request.

This program was conducted by Environmental Resources Associates and serves to replace studies conducted by the U.S. Environmental Protection Agency.

The results in Table A-2 were obtained for Thermoluminescent Dosimeters (TLDs), 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. All samples are prepared using NIST traceable sources. Data for previous years 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 available upon request.

Table A-5 list results of the in-house "duplicate" program for the past twelve months. Acceptance is based on the difference of the results being less than the sum of the errors. Data for previous years available upon request.

The results in Table A-6 were obtained through participation in the Mixed Analyte Performance Evaluation Program.

The results in Table A-7 were obtained through participation in the Environmental Measurement Laboratory Quality Assessment Program.

Attachment A lists acceptance criteria for "spiked" samples.

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

12-31-99

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 >100 pCi/liter or kg	5.0 pCi/liter 5% of known value
Strontium-89[b]	5 to 50 pCi/liter or kg >50 pCi/liter or kg	5.0 pCi/liter 10% of known value
Strontium-90[b]	2 to 30 pCi/liter or kg >30 pCi/liter or kg	5.0 pCi/liter 10% of known value
Potassium-40	>0.1 g/liter or kg	5% of known value
Gross alpha	≤20 pCi/liter >20 pCi/liter	5.0 pCi/liter 25% of known value
Gross beta	≤100 pCi/liter >100 pCi/liter	5.0 pCi/liter 5% of known value
Tritium	≤4,000 pCi/liter >4,000 pCi/liter	1s = (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 >55 pCi/liter	6.0 pCi/liter 10% of known value
Uranium-238, Nickel-63[b] Technetium-99[b]	≤35 pCi/liter >35 pCi/liter	6.0 pCi/liter 15% of known value
Iron-55[b]	50 to 100 pCi/liter >100 pCi/liter	10 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. Interlaboratory Comparison Crosscheck program, Environmental Resource Associates (ERA), comparison of ERA and Teledyne Midwest Laboratory results[a].

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c]	ERA Result[d] 1s, N=1	Control Limits
STW-861	WATER	Sep, 1999	Ra-226	15.6 ± 0.3	16.5 ± 1.7	12.2 - 20.8
STW-861	WATER	Sep, 1999	Ra-228	3.2 ± 0.3	2.2 ± 0.2	1.2 - 3.1
The activity reported is the average of three separate analyses. Individual results : 2.6, 2.9 and 4.0.						
STW-861	WATER	Sep, 1999	Uranium	39.4 ± 1.2	45.4 ± 4.5	37.7 - 53.1
STW-862	WATER	Nov, 1999	I-131	23.9 ± 0.1	23.3 ± 2.3	18.1 - 28.5

[a] Results obtained by Teledyne Brown Engineering Environmental Services Midwest Laboratory as a participant in the environmental sample crosscheck program operated by Environmental Resource Associates(ERA).

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

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

Lab Code	TLD Type	Date	Measurement	mR: Teledyne Results ± 2 Sigma	mR: Known Value	mR: Average ± 2 Sigma (All Participants)
Teledyne Testing						
98-1	LiF-100 Chips	May, 1998	Lab, 1	15.5 ± 1.3	16.7	-
98-1	LiF-100 Chips	May, 1998	Lab, 2	23.9 ± 0.9	32.4	-
98-1	LiF-100 Chips	May, 1998	Lab, 3	59.8 ± 1.9	60.2	-
98-1	$CaSO_4$: Dy Cards	May, 1998	Reader 1, #1	18.5 ± 0.8	16.7	-
98-1	$CaSO_4$: Dy Cards	May, 1998	Reader 1, #2	27.3 ± 1.7	32.4	-
98-1	$CaSO_4$: Dy Cards	May, 1998	Reader 1, #3	70.0 ± 4.7	60.2	-

Chips and Cards were irradiated by Teledyne Brown Engineering, Westwood, New Jersey, in May, 1998.

Teledyne Testing						
99-1	LiF-100 Chips	Mar, 1999	Lab, 1	14.5 ± 0.5	15.4	-
99-1	LiF-100 Chips	Mar, 1999	Lab, 2	29.3 ± 1.0	31.8	-
99-1	LiF-100 Chips	Mar, 1999	Lab, 3	60.0 ± 0.2	59.1	-
99-1	$CaSO_4$: Dy Cards	Mar, 1999	Reader 1, #1	18.3 ± 0.5	15.4	-
99-1	$CaSO_4$: Dy Cards	Mar, 1999	Reader 1, #2	35.9 ± 1.3	31.8	-
99-1	$CaSO_4$: Dy Cards	Mar, 1999	Reader 1, #3	66.5 ± 4.4	59.1	-

Chips and Cards were irradiated by Teledyne Brown Engineering, Westwood, New Jersey, in March, 1999.

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[a] Teledyne Results 2s, n=1[b]	Known Activity	Control[c] Limits
SPW-140	WATER	Jan, 1999	Ra-226	14.51 ± 0.52	13.79	9.65 - 17.93
SPW-140	WATER	Jan, 1999	Ra-228	9.47 ± 1.49	8.28	5.80 - 10.76
SPW-142	WATER	Jan, 1999	Gr. Alpha	30.82 ± 2.49	33.97	16.99 - 50.96
SPW-142	WATER	Jan, 1999	Gr. Beta	30.87 ± 1.91	30.18	20.18 - 40.18
SPW-254	WATER	Jan, 1999	H-3	37752.00 ± 540.00	38559.00	30847.20 - 46270.80
SPAP-270	AIR FILTER	Jan, 1999	Cs-137	2.04 ± 0.02	1.82	1.09 - 2.55
SPAP-787	AIR FILTER	Jan, 1999	Gr. Beta	5.97 ± 0.02	5.38	0.00 - 15.38
SPW-789	WATER	Jan, 1999	Co-60	44.83 ± 7.11	40.46	30.46 - 50.46
SPW-789	WATER	Jan, 1999	Cs-137	45.17 ± 8.63	37.70	27.70 - 47.70
SPW-791	WATER	Feb, 1999	Ra-226	15.50 ± 0.60	13.80	9.66 - 17.94
SPW-791	WATER	Feb, 1999	Ra-228	6.36 ± 1.39	8.20	5.74 - 10.66
SPW-792	WATER	Feb, 1999	Gr. Alpha	24.36 ± 2.08	33.97	16.99 - 50.96
SPW-792	WATER	Feb, 1999	Gr. Beta	28.98 ± 1.79	30.13	20.13 - 40.13
SPU-1030	WATER	Feb, 1999	Ra-226	38.81 ± 1.30	34.45	24.12 - 44.79
SPW-1460	WATER	Mar, 1999	Ra-226	13.26 ± 0.55	13.79	9.65 - 17.93
SPW-1460	WATER	Mar, 1999	Ra-228	12.53 ± 1.47	16.26	11.38 - 21.13
SPW-1466	WATER	Mar, 1999	Gr. Alpha	61.00 ± 3.08	49.44	24.72 - 74.15
SPW-1466	WATER	Mar, 1999	Gr. Beta	35.52 ± 1.86	30.07	20.07 - 40.07
SPMI-1677	MILK	Mar, 1999	Cs-137	17.17 ± 2.08	18.78	8.78 - 28.78
SPMI-1677	MILK	Mar, 1999	Sr-90	34.94 ± 1.53	31.85	25.48 - 38.22
SPW-1681	WATER	Mar, 1999	Sr-89	49.30 ± 3.85	59.20	47.36 - 71.04
SPW-1681	WATER	Mar, 1999	Sr-90	29.00 ± 1.65	31.85	25.48 - 38.22
SPW-2264	WATER	Apr, 1999	Ra-226	12.44 ± 0.14	13.80	9.66 - 17.94
SPW-2264	WATER	Apr, 1999	Ra-228	18.73 ± 1.92	16.08	11.26 - 20.90
SPAP-2395	AIR FILTER	Apr, 1999	Cs-137	1.86 ± 0.02	1.81	1.09 - 2.53
SPW-2265	WATER	Apr, 1999	Gr. Alpha	62.89 ± 5.90	49.40	24.70 - 74.10
SPW-2265	WATER	Apr, 1999	Gr. Beta	34.52 ± 3.24	30.00	20.00 - 40.00
SPW-2574	WATER	Apr, 1999	H-3	56548.00 ± 648.00	57517.00	46013.60 - 69020.40
SPMI-2686	MILK	Apr, 1999	Cs-134	23.56 ± 5.30	22.30	12.30 - 32.30
SPMI-2686	MILK	Apr, 1999	Cs-137	40.21 ± 7.19	37.50	27.50 - 47.50
SPW-2688	WATER	Apr, 1999	Co-60	20.79 ± 5.61	19.64	9.64 - 29.64
SPW-2688	WATER	Apr, 1999	Cs-134	23.16 ± 6.13	22.29	12.29 - 32.29
SPW-2688	WATER	Apr, 1999	Cs-137	37.49 ± 3.75	31.60	21.60 - 41.60
SPAP-2653	AIR FILTER	Apr, 1999	Gr. Beta	8.96 ± 0.05	8.19	0.00 - 18.19
SPVE-2977	VEGETATION	May, 1999	Cs-134	0.67 ± 0.04	0.68	0.41 - 0.95
SPVE-2977	VEGETATION	May, 1999	Cs-137	0.55 ± 0.05	0.58	0.35 - 0.81
SPW-3314	WATER	May, 1999	Ra-226	13.62 ± 0.35	13.79	9.65 - 17.93
SPW-3314	WATER	May, 1999	Ra-228	16.57 ± 1.73	15.93	11.15 - 20.71
SPSO-3317	SOIL	May, 1999	Cs-134	0.09 ± 0.01	0.07	0.04 - 0.10
SPSO-3317	SOIL	May, 1999	Cs-137	0.54 ± 0.05	0.42	0.25 - 0.59
SPSO-3318	SOIL	May, 1999	Cs-134	0.09 ± 0.02	0.07	0.04 - 0.10

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[a] Teledyne Results 2s, n=1[b]	Known Activity	Control[c] Limits
SPSO-3318	SOIL	May, 1999	Cs-137	0.54 ± 0.02	0.42	0.25 - 0.59
SPW-3315	WATER	May, 1999	Gr. Beta	32.57 ± 1.63	29.95	19.95 - 39.95
SPF-3777	FISH	May, 1999	Cs-134	0.43 ± 0.03	0.52	0.31 - 0.73
SPF-3777	FISH	May, 1999	Cs-137	0.57 ± 0.04	0.60	0.36 - 0.84
SPW-3721	WATER	Jun, 1999	Rn-222	553.52 ± 46.70	610.35	366.21 - 854.49
SPW-4005	WATER	Jun, 1999	Ra-226	13.85 ± 0.42	13.79	9.65 - 17.93
SPW-4005	WATER	Jun, 1999	Ra-228	16.42 ± 1.81	15.77	11.04 - 20.50
SPW-4006	WATER	Jun, 1999	Gr. Alpha	46.32 ± 2.80	49.41	24.71 - 74.12
SPW-4006	WATER	Jun, 1999	Gr. Beta	32.12 ± 1.83	29.90	19.90 - 39.90
SPW-4869	WATER	Jul, 1999	Ra-226	14.00 ± 0.47	13.79	9.65 - 17.93
SPW-4869	WATER	Jul, 1999	Ra-228	14.96 ± 1.53	15.62	10.93 - 20.31
SPW-4870	WATER	Jul, 1999	Gr. Alpha	70.07 ± 3.45	29.84	14.92 - 44.76
SPW-4870	WATER	Jul, 1999	Gr. Beta	84.01 ± 2.62	41.18	31.18 - 51.18
Results for gross alpha and beta appear to be approximately 2x the spike level. The sample volume or spike level is suspect.						
SPW-4964	WATER	Jul, 1999	H-3	60442.00 ± 679.00	56807.00	45445.60 - 68168.40
SPAP-5001	AIR FILTER	Jul, 1999	Cs-137	2.03 ± 0.02	1.79	1.07 - 2.51
SPAP-5003	AIR FILTER	Jul, 1999	Gr. Beta	7.48 ± 0.02	8.15	0.00 - 18.15
SPMI-5348	MILK	Jul, 1999	Sr-89	46.85 ± 4.96	55.53	44.42 - 66.64
SPMI-5348	MILK	Jul, 1999	Sr-90	31.47 ± 1.65	31.60	25.28 - 37.92
SPW-5502	WATER	Jul, 1999	Sr-89	43.27 ± 2.81	51.15	40.92 - 61.38
SPW-5502	WATER	Jul, 1999	Sr-90	31.80 ± 1.56	31.59	25.27 - 37.91
SPF-5676	FISH	Jul, 1999	Cs-134	0.67 ± 0.04	0.65	0.39 - 0.91
SPF-5676	FISH	Jul, 1999	Cs-137	0.63 ± 0.05	0.60	0.36 - 0.83
SPCH-5833	CHARCOAL CANISTER	Aug, 1999	I-131(g)	1.46 ± 0.06	1.40	0.84 - 1.96
SPVE-5826	VEGETATION	Aug, 1999	I-131(g)	1.43 ± 0.09	1.25	0.75 - 1.75
SPMI-5828	MILK	Aug, 1999	Cs-134	31.46 ± 5.05	30.23	20.23 - 40.23
SPMI-5828	MILK	Aug, 1999	Cs-137	39.22 ± 7.60	37.23	27.23 - 47.23
SPMI-5828	MILK	Aug, 1999	I-131	72.33 ± 1.06	79.17	63.34 - 95.00
SPMI-5828	MILK	Aug, 1999	I-131(g)	77.99 ± 8.12	79.17	47.50 - 89.17
SPW-5830	WATER	Aug, 1999	Ra-226	13.82 ± 0.34	13.79	9.65 - 17.93
SPW-5830	WATER	Aug, 1999	Ra-228	13.59 ± 1.80	15.46	10.82 - 20.10
SPW-5831	WATER	Aug, 1999	Gr. Alpha	46.05 ± 2.93	41.17	20.59 - 61.76
SPW-5831	WATER	Aug, 1999	Gr. Beta	35.66 ± 2.01	29.78	19.78 - 39.78
SPW-6076	WATER	Aug, 1999	I-131	83.72 ± 0.98	99.30	79.44 - 119.16
SPW-6076	WATER	Aug, 1999	I-131(g)	105.38 ± 18.30	99.30	59.58 - 109.30
SPW-6542	WATER	Sep, 1999	Ra-226	15.38 ± 0.52	13.79	9.65 - 17.93
SPW-6542	WATER	Sep, 1999	Ra-228	16.48 ± 2.25	15.46	10.82 - 20.10
SPW-6543	WATER	Sep, 1999	Gr. Alpha	47.77 ± 2.69	41.17	20.59 - 61.76
SPW-6543	WATER	Sep, 1999	Gr. Beta	35.25 ± 1.86	29.78	19.78 - 39.78
SPW-7468	WATER	Oct, 1999	Ra-226	14.36 ± 0.41	13.79	9.65 - 17.93

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[a] Teledyne Results 2s, n=1[b]	Known Activity	Control[c] Limits
SPW-6543	WATER	Sep, 1999	Gr. Beta	35.25 ± 1.86	29.78	19.78 - 39.78
SPW-7468	WATER	Oct, 1999	Ra-226	14.36 ± 0.41	13.79	9.65 - 17.93
SPW-7468	WATER	Oct, 1999	Ra-228	13.41 ± 1.45	15.16	10.61 - 19.71
SPW-7469	WATER	Oct, 1999	Gr. Beta	31.37 ± 3.16	29.68	19.68 - 39.68
SPW-7486	WATER	Oct, 1999	I-131	49.26 ± 0.89	48.82	36.82 - 60.82
SPMI-7488	MILK	Oct, 1999	I-131	49.54 ± 0.89	48.82	36.82 - 60.82
SPSO-7761	SOIL	Oct, 1999	Cs-134	0.06 ± 0.01	0.07	0.04 - 0.10
SPSO-7761	SOIL	Oct, 1999	Cs-137	0.53 ± 0.01	0.49	0.29 - 0.69
SPAP-7763	AIR FILTER	Oct, 1999	Cs-137	1.84 ± 0.02	1.79	1.07 - 2.51
SPW-7469	WATER	Oct, 1999	Gr. Alpha	43.55 ± 4.67	41.16	20.58 - 61.74
SPF-8545	FISH	Oct, 1999	Cs-134	0.60 ± 0.03	0.59	0.36 - 0.83
SPF-8545	FISH	Oct, 1999	Cs-137	0.60 ± 0.04	0.59	0.36 - 0.83
SPMI-9028	MILK	Oct, 1999	Cs-134	39.43 ± 6.37	37.43	27.43 - 47.43
SPMI-9028	MILK	Oct, 1999	Cs-137	40.93 ± 9.42	37.05	27.05 - 47.05
SPW-8773	WATER	Nov, 1999	Ra-226	11.30 ± 0.14	13.79	9.65 - 17.93
SPW-8773	WATER	Nov, 1999	Ra-228	15.18 ± 2.26	15.00	10.50 - 19.50
SPW-8774	WATER	Nov, 1999	Gr. Alpha	43.12 ± 3.09	41.15	20.58 - 61.73
SPW-8774	WATER	Nov, 1999	Gr. Beta	31.98 ± 2.06	29.62	19.62 - 39.62
SPW-9133	WATER	Nov, 1999	Co-60	30.70 ± 4.43	29.06	19.06 - 39.06
SPW-9133	WATER	Nov, 1999	Cs-134	40.56 ± 4.53	36.59	26.59 - 46.59
SPW-9133	WATER	Nov, 1999	Cs-137	38.20 ± 6.14	36.98	26.98 - 46.98
SPW-9720	WATER	Nov, 1999	H-3	57335.00 ± 657.00	58177.00	46541.60 - 69812.40
SPW-9717	WATER	Dec, 1999	Ra-228	18.88 ± 1.80	14.80	10.36 - 19.24
SPW-9719	WATER	Dec, 1999	Ra-226	14.91 ± 0.48	13.79	9.65 - 17.93
SPCH-9806	CHARCOAL CANISTER	Dec, 1999	I-131(g)	0.06 ± 0.01	0.06	0.04 - 0.09
SPW-9718	WATER	Dec, 1999	Gr. Alpha	44.82 ± 2.39	44.81	22.41 - 67.22
SPW-9718	WATER	Dec, 1999	Gr. Beta	33.93 ± 1.72	29.54	19.54 - 39.54
SPW-9718	WATER	Dec, 1999	Gr. Beta	33.93 ± 1.72	29.54	19.54 - 39.54

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

[b] All samples are the results of single determinations.

[c] Control limits are based on Attachment A, page A2 of this report.

NOTE: For fish, Jello is used for the spike matrix.

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

Lab Code	Sample Type	Sample Date	Analysis	Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD	Activity[b]	Acceptance Criteria (4.66 Sigma)
SPW-141	WATER	Jan 1999	Gr. Alpha	< 0.470	0.207 ± 0.320	< 1.00
SPW-141	WATER	Jan 1999	Gr. Beta	< 0.890	0.234 ± 0.591	< 3.20
SPW-141	WATER	Jan 1999	Ra-226	< 0.064	0.054 ± 0.030	< 1.00
SPW-141	WATER	Jan 1999	Ra-228	< 1.000	0.460 ± 0.530	< 1.00
SPW-255	WATER	Jan 1999	H-3	< 178.000	23.455 ± 94.510	< 200.00
SPW-790	WATER	Feb 1999	Gr. Alpha	< 0.440	-0.130 ± 0.250	< 1.00
SPW-790	WATER	Feb 1999	Gr. Beta	< 1.010	-0.250 ± 0.610	< 3.20
SPW-790	WATER	Feb 1999	Ra-226	< 0.036	0.026 ± 0.017	< 1.00
SPW-790	WATER	Feb 1999	Ra-228	< 0.850	0.355 ± 0.440	< 1.00
SPW-1461	WATER	Mar 1999	Gr. Alpha	< 0.800	0.060 ± 0.540	< 1.00
SPW-1461	WATER	Mar 1999	Gr. Beta	< 1.600	0.460 ± 1.080	< 3.20
SPW-1461	WATER	Mar 1999	Ra-226	< 0.044	0.071 ± 0.028	< 1.00
SPW-1461	WATER	Mar 1999	Ra-228	< 0.700	0.280 ± 0.350	< 1.00
SPMI-1678	MILK	Mar 1999	Sr-89	< 0.590	-0.190 ± 0.670	< 5.00
SPMI-1678	MILK	Mar 1999	Sr-90		1.020 ± 0.360	< 1.00
Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.						
SPW-1682	WATER	Mar 1999	Sr-89	< 0.530	-0.310 ± 0.450	< 5.00
SPW-1682	WATER	Mar 1999	Sr-90	< 0.590	0.256 ± 0.307	< 1.00
SPW-2263	WATER	Apr 1999	Gr. Alpha	< 0.380	-0.160 ± 0.240	< 1.00
SPW-2263	WATER	Apr 1999	Gr. Beta	< 0.880	0.320 ± 0.580	< 3.20
SPW-2263	WATER	Apr 1999	Ra-226	< 0.013	0.023 ± 0.009	< 1.00
SPW-2263	WATER	Apr 1999	Ra-228	< 0.680	0.310 ± 0.360	< 1.00
SPW-2575	WATER	Apr 1999	H-3	< 158.000	23.150 ± 79.380	< 200.00
SPAP-2652	AIR FILTER	Apr 1999	Gr. Beta	< 0.003	-0.000 ± 0.001	< 3.20
SPW-3316	WATER	May 1999	Ra-226	< 0.027	0.030 ± 0.014	< 1.00
SPW-3316	WATER	May 1999	Ra-228	< 0.800	0.192 ± 0.397	< 1.00
SPW-3316	WATER	May 1999	Gr. Alpha	< 0.830	0.310 ± 0.600	< 1.00
SPW-3316	WATER	May 1999	Gr. Beta	< 1.580	0.220 ± 1.110	< 3.20
SPW-4004	WATER	Jun 1999	Gr. Alpha	< 0.870	-0.030 ± 0.570	< 1.00
SPW-4004	WATER	Jun 1999	Gr. Beta	< 1.740	0.470 ± 1.150	< 3.20
SPW-4004	WATER	Jun 1999	Ra-226	< 0.023	0.036 ± 0.014	< 1.00
SPW-4004	WATER	Jun 1999	Ra-228	< 0.990	0.770 ± 0.551	< 1.00
SPW-4871	WATER	Jul 1999	Gr. Alpha	< 0.660	-0.420 ± 0.470	< 1.00
SPW-4871	WATER	Jul 1999	Gr. Beta	< 1.420	0.400 ± 1.060	< 3.20
SPW-4871	WATER	Jul 1999	Ra-226	< 0.019	0.021 ± 0.013	< 1.00
SPW-4871	WATER	Jul 1999	Ra-228	< 0.620	0.610 ± 0.360	< 1.00

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

Lab Code	Sample Type	Sample Date	Analysis	Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD	Teledyne Results (4.66 Sigma) Activity[b]	Acceptance Criteria (4.66 Sigma)
SPW-4965	WATER	Jul 1999	H-3	< 176.000	8.100 ± 87.800	< 200.00
SPMI-5349	MILK	Jul 1999	Sr-89	< 0.410	-0.750 ± 0.540	< 5.00
SPMI-5349	MILK	Jul 1999	Sr-90		1.140 ± 0.360	< 1.00
Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.						
SPW-5501	WATER	Jul 1999	Sr-89	< 0.450	0.150 ± 0.450	< 5.00
SPW-5501	WATER	Jul 1999	Sr-90	< 0.580	0.280 ± 0.310	< 1.00
SPMI-5829	MILK	Aug 1999	I-131	< 0.240	0.140 ± 0.140	< 0.50
SPW-5832	WATER	Aug 1999	Gr. Alpha	< 0.890	0.570 ± 0.600	< 1.00
SPW-5832	WATER	Aug 1999	Gr. Beta	< 2.000	0.590 ± 1.230	< 3.20
SPW-5832	WATER	Aug 1999	Ra-226	< 0.020	0.090 ± 0.010	< 1.00
SPW-5832	WATER	Aug 1999	Ra-228	< 0.780	0.110 ± 0.370	< 1.00
SPW-6067	WATER	Aug 1999	I-131	< 0.250	0.017 ± 0.170	< 0.50
SPW-6541	WATER	Sep 1999	Gr. Alpha	< 0.770	0.360 ± 0.530	< 1.00
SPW-6541	WATER	Sep 1999	Gr. Beta	< 1.690	0.410 ± 1.130	< 3.20
SPW-6541	WATER	Sep 1999	Ra-226	< 0.020	0.160 ± 0.020	< 1.00
SPW-6541	WATER	Sep 1999	Ra-228	< 1.280	0.018 ± 0.594	< 1.00
SPW-7467	WATER	Oct 1999	Ra-226		0.069 ± 0.014	< 1.00
SPW-7467	WATER	Oct 1999	Ra-228	< 0.892	0.461 ± 0.467	< 1.00
SPW-7487	WATER	Oct 1999	I-131	< 0.260	0.080 ± 0.150	< 0.50
SPMI-7489	MILK	Oct 1999	I-131	< 0.250	0.140 ± 0.150	< 0.50
SPW-8775	WATER	Nov 1999	Ra-226		0.050 ± 0.012	< 1.00
SPW-8775	WATER	Nov 1999	Ra-228	< 0.989	0.380 ± 0.500	< 1.00
SPW-9721	WATER	Nov 1999	H-3	< 158.000	51.400 ± 80.600	< 200.00
SPW-9719	WATER	Dec 1999	Ra-226		0.031 ± 0.013	< 1.00

[a] Liquid sample results are reported in pCi/Liter, air filter sample results are in pCi/filter, charcoal sample results are in pCi/charcoal, and solid sample results are in pCi/kilogram.

[b] The activity reported is the net activity result.

Table A-5. In-house "duplicate" samples.

Lab Codes	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
E-47, 48	Jan, 1999	Gr. Beta	1.206 ± 0.056	1.265 ± 0.061	1.236 ± 0.041
E-47, 48	Jan, 1999	K-40	1.283 ± 0.136	1.394 ± 0.182	1.339 ± 0.114
SW-68, 69	Jan, 1999	K-40 (FP)	1.300 ± 0.130	1.300 ± 0.130	1.300 ± 0.092
LW-153, 154	Jan, 1999	Gr. Beta	1.509 ± 0.647	1.619 ± 0.646	1.564 ± 0.457
WW-373, 374	Jan, 1999	H-3	171.100 ± 83.600	131.700 ± 81.800	151.400 ± 58.481
SW-867, 868	Jan, 1999	H-3	1,149.300 ± 122.100	1,225.000 ± 124.400	1,187.150 ± 87.155
SWT-425, 426	Jan, 1999	Gr. Beta	2.572 ± 0.639	2.646 ± 0.598	2.609 ± 0.438
CW-450, 451	Jan, 1999	Gr. Beta	0.600 ± 1.100	0.700 ± 1.100	0.650 ± 0.778
SW-570, 571	Feb, 1999	K-40 (FP)	1.730 ± 0.173	1.644 ± 0.164	1.687 ± 0.119
LW-614, 615	Feb, 1999	Gr. Alpha	0.354 ± 0.369	0.666 ± 0.390	0.510 ± 0.268
LW-614, 615	Feb, 1999	Gr. Beta	2.213 ± 0.406	2.613 ± 0.442	2.413 ± 0.300
MI-682, 683	Feb, 1999	Co-60	0.200 ± 0.600	-0.400 ± 2.700	-0.100 ± 1.383
MI-682, 683	Feb, 1999	Cs-137	0.300 ± 3.700	0.600 ± 2.700	0.450 ± 2.290
MI-682, 683	Feb, 1999	I-131	0.200 ± 0.300	0.200 ± 0.300	0.200 ± 0.212
WW-968, 969	Feb, 1999	H-3	199.300 ± 89.600	80.900 ± 84.500	140.100 ± 61.580
CW-1042, 1043	Feb, 1999	Gr. Beta	3.200 ± 1.500	3.500 ± 1.530	3.350 ± 1.071
LW-1523, 1524	Feb, 1999	Gr. Beta	1.930 ± 0.567	2.197 ± 0.584	2.063 ± 0.407
MI-1627, 1628	Mar, 1999	K-40	1,340.200 ± 118.000	1,409.300 ± 112.000	1,374.750 ± 81.345
WW-1808, 1809	Mar, 1999	H-3	4.400 ± 83.400	47.400 ± 85.300	25.900 ± 59.648
LW-2937, 2938	Mar, 1999	Gr. Beta	3.044 ± 0.663	3.242 ± 0.660	3.143 ± 0.468
AP-2155, 2156	Mar, 1999	Be-7	0.078 ± 0.017	0.073 ± 0.015	0.075 ± 0.011
AP-2357, 2358	Mar, 1999	Be-7	0.081 ± 0.016	0.086 ± 0.020	0.084 ± 0.013
AP-1991, 1992	Mar, 1999	Be-7	0.218 ± 0.079	0.149 ± 0.062	0.184 ± 0.050
AP-1991, 1992	Mar, 1999	Be-7	0.083 ± 0.011	0.082 ± 0.015	0.083 ± 0.009
LW-2405, 2406	Mar, 1999	Gr. Beta	3.322 ± 0.473	2.292 ± 0.468	2.807 ± 0.333
LW-2474, 2475	Mar, 1999	Gr. Beta	2.003 ± 0.592	2.742 ± 0.648	2.372 ± 0.439
LW-2474, 2475	Mar, 1999	H-3	124.016 ± 84.129	151.507 ± 85.318	137.762 ± 59.910
MI-2019, 2020	Apr, 1999	K-40	1,277.300 ± 173.000	1,377.800 ± 107.000	1,327.550 ± 101.708
MI-2019, 2020	Apr, 1999	Sr-90	0.615 ± 0.366	1.126 ± 0.368	0.871 ± 0.260
WW-2040, 2041	Apr, 1999	Gr. Beta	1.424 ± 0.316	1.233 ± 0.329	1.329 ± 0.228
WW-2040, 2041	Apr, 1999	K-40 (FP)	1.100 ± 0.110	1.100 ± 0.110	1.100 ± 0.078
MI-2134, 2135	Apr, 1999	K-40	1,316.000 ± 147.000	1,485.100 ± 168.000	1,400.550 ± 111.617
AP-2658, 2659	Apr, 1999	Be-7	0.134 ± 0.067	0.175 ± 0.105	0.154 ± 0.062
MI-2019, 2020	Apr, 1999	Calcium	0.850 ± 0.085	0.880 ± 0.088	0.865 ± 0.061
MI-2251, 2252	Apr, 1999	K-40	1,261.900 ± 156.000	1,320.800 ± 141.000	1,291.350 ± 105.139

Table A-5. In-house "duplicate" samples.

Lab Codes	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
MI-2451, 2452	Apr, 1999	K-40	1,647.700 ± 201.000	1,706.300 ± 159.000	1,677.000 ± 128.142
SS-2528, 2529	Apr, 1999	Gr. Beta	7.724 ± 1.978	9.287 ± 1.970	8.505 ± 1.396
SS-2528, 2529	Apr, 1999	K-40	7.530 ± 0.520	8.073 ± 0.388	7.802 ± 0.324
SS-2758, 2759	Apr, 1999	Gr. Beta	6.540 ± 2.200	4.960 ± 2.190	5.750 ± 1.552
SS-2758, 2759	Apr, 1999	K-40	7.483 ± 0.416	7.357 ± 0.432	7.420 ± 0.300
SS-2758, 2759	Apr, 1999	Sr-90	0.006 ± 0.008	-0.005 ± 0.007	0.000 ± 0.005
BS-3093, 3094	Apr, 1999	Gr. Beta	5.180 ± 1.350	5.960 ± 1.370	5.570 ± 0.962
F-3072, 3073	Apr, 1999	K-40	2.991 ± 0.332	2.438 ± 0.347	2.714 ± 0.240
MI-3001, 3002	Apr, 1999	K-40	1,485.800 ± 142.000	1,564.900 ± 162.000	1,525.350 ± 107.713
LW-3149, 3150	Apr, 1999	Gr. Beta	1.982 ± 0.595	2.120 ± 0.612	2.051 ± 0.427
SW-3047, 3048	May, 1999	Gr. Beta	2.281 ± 0.585	2.194 ± 0.567	2.238 ± 0.407
SW-3047, 3048	May, 1999	K-40 (FP)	1.300 ± 0.130	1.400 ± 0.140	1.350 ± 0.096
F-3238, 3239	May, 1999	Gr. Beta	3.329 ± 0.135	3.388 ± 0.144	3.358 ± 0.099
F-3238, 3239	May, 1999	K-40	2.866 ± 0.366	2.792 ± 0.337	2.829 ± 0.249
BS-3195, 3196	May, 1999	K-40	8.610 ± 0.620	9.320 ± 0.540	8.965 ± 0.411
AP-3769, 3770	May, 1999	Be-7	0.135 ± 0.075	0.188 ± 0.097	0.161 ± 0.061
MI-3259, 3260	May, 1999	K-40	1,444.800 ± 94.200	1,460.300 ± 166.000	1,452.550 ± 95.433
AP-3304, 3305	May, 1999	Be-7	0.104 ± 0.083	0.095 ± 0.068	0.099 ± 0.054
G-3461, 3462	May, 1999	Be-7	0.454 ± 0.210	0.350 ± 0.154	0.402 ± 0.130
G-3461, 3462	May, 1999	K-40	5.341 ± 0.492	4.837 ± 0.619	5.089 ± 0.395
SW-3217, 3218	May, 1999	Gr. Alpha	1.223 ± 1.323	2.490 ± 1.230	1.857 ± 0.903
SW-3217, 3218	May, 1999	Gr. Beta	4.956 ± 1.232	5.715 ± 1.221	5.336 ± 0.867
LW-2937, 2938	May, 1999	Gr. Beta	2.379 ± 0.626	2.864 ± 0.641	2.622 ± 0.448
SWU-2853, 2854	May, 1999	Gr. Beta	2.860 ± 0.539	3.065 ± 0.577	2.962 ± 0.395
DW-2878, 2879	May, 1999	Gr. Beta	0.706 ± 0.319	0.849 ± 0.335	0.777 ± 0.231
G-3461, 3462	May, 1999	Gr. Beta	5.205 ± 0.169	5.166 ± 0.110	5.186 ± 0.101
SO-3482, 3483	May, 1999	Cs-137	0.456 ± 0.059	0.467 ± 0.048	0.461 ± 0.038
SO-3482, 3483	May, 1999	Gr. Beta	24.880 ± 1.980	26.170 ± 2.150	25.525 ± 1.461
SO-3482, 3483	May, 1999	K-40	20.631 ± 1.240	20.077 ± 0.906	20.354 ± 0.768
SO-2832, 2833	May, 1999	Cs-137	0.390 ± 0.052	0.403 ± 0.031	0.397 ± 0.030
SO-2832, 2833	May, 1999	K-40	26.000 ± 0.660	24.673 ± 1.240	25.337 ± 0.702
SWT-3675, 3676	May, 1999	Gr. Beta	2.439 ± 0.598	2.530 ± 0.630	2.484 ± 0.434
LW-3699, 3700	May, 1999	Gr. Beta	2.488 ± 0.596	3.002 ± 0.654	2.745 ± 0.442
MI-3748, 3749	Jun, 1999	K-40	1,553.800 ± 178.000	1,408.600 ± 149.000	1,481.200 ± 116.066
SW-4107, 4108	Jun, 1999	Gr. Alpha	3.993 ± 0.919	3.606 ± 0.875	3.800 ± 0.635

Table A-5. In-house "duplicate" samples.

Lab Codes	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
SW-4107, 4108	Jun, 1999	Gr. Beta	6.271 ± 0.754	6.910 ± 0.807	6.591 ± 0.552
SS-4065, 4066	Jun, 1999	K-40	7.350 ± 0.400	7.945 ± 0.370	7.648 ± 0.272
AP-3986, 3987	Jun, 1999	Be-7	0.272 ± 0.147	0.182 ± 0.085	0.227 ± 0.085
G-4007, 4008	Jun, 1999	Be-7	0.830 ± 0.210	0.950 ± 0.200	0.890 ± 0.145
G-4007, 4008	Jun, 1999	K-40	5.790 ± 0.460	4.990 ± 0.400	5.390 ± 0.305
MI-4172, 4173	Jun, 1999	K-40	1,423.600 ± 115.000	1,481.300 ± 129.000	1,452.450 ± 86.409
MI-4293, 4294	Jun, 1999	K-40	1,397.200 ± 179.000	1,388.100 ± 130.000	1,392.650 ± 110.613
AP-4317, 4318	Jun, 1999	Be-7	0.201 ± 0.125	0.213 ± 0.088	0.207 ± 0.076
AP-4894, 4895	Jun, 1999	Be-7	0.092 ± 0.019	0.091 ± 0.014	0.092 ± 0.012
G-4426, 4427	Jun, 1999	Be-7	0.730 ± 0.210	0.630 ± 0.170	0.680 ± 0.135
G-4426, 4427	Jun, 1999	K-40	3.230 ± 0.350	3.400 ± 0.440	3.315 ± 0.281
AP-4454, 4455	Jun, 1999	Be-7	0.205 ± 0.120	0.238 ± 0.087	0.222 ± 0.074
SWU-4601, 4602	Jun, 1999	Gr. Beta	2.209 ± 0.568	1.980 ± 0.589	2.094 ± 0.409
SWU-4601, 4602	Jun, 1999	Gr. Beta	2.209 ± 0.568	1.980 ± 0.589	2.094 ± 0.409
SW-4622, 4623	Jun, 1999	Gr. Beta	2.130 ± 0.854	2.267 ± 0.803	2.198 ± 0.586
AP-4915, 4916	Jun, 1999	Be-7	0.089 ± 0.012	0.094 ± 0.015	0.091 ± 0.010
LW-4974, 4975	Jun, 1999	Gr. Beta	1.916 ± 0.578	2.617 ± 0.644	2.267 ± 0.433
LW-5039, 5040	Jun, 1999	Gr. Beta	2.170 ± 0.610	2.030 ± 0.580	2.100 ± 0.421
LW-5039, 5040	Jun, 1999	H-3	90.659 ± 81.800	162.800 ± 85.000	126.730 ± 58.984
G-4643, 4644	Jul, 1999	Be-7	1.326 ± 0.460	1.555 ± 0.390	1.441 ± 0.302
G-4643, 4644	Jul, 1999	Gr. Beta	5.870 ± 0.151	5.798 ± 0.150	5.834 ± 0.106
G-4643, 4644	Jul, 1999	K-40	5.738 ± 0.780	6.200 ± 0.733	5.969 ± 0.535
SW-4664, 4665	Jul, 1999	Gr. Beta	1.956 ± 0.415	1.836 ± 0.429	1.896 ± 0.298
SW-4664, 4665	Jul, 1999	K-40	1.120	1.120	1.120
WW-4690, 4691	Jul, 1999	Co-60	0.860 ± 1.840	0.374 ± 0.344	0.617 ± 0.936
WW-4690, 4691	Jul, 1999	Cs-137	-0.806 ± 3.130	-2.010 ± 2.610	-1.408 ± 2.038
WW-4690, 4691	Jul, 1999	H-3	399.519 ± 103.570	564.249 ± 109.428	481.884 ± 75.335
WW-4808, 4809	Jul, 1999	Co-60	-0.360 ± 1.910	1.420 ± 25.700	0.530 ± 12.885
WW-4808, 4809	Jul, 1999	Cs-137	0.446 ± 2.260	-1.060 ± 1.720	-0.307 ± 1.420
WW-4808, 4809	Jul, 1999	H-3	72.004 ± 90.621	94.545 ± 91.551	83.274 ± 64.409
MI-4742, 4743	Jul, 1999	K-40	1,344.000 ± 66.000	1,375.000 ± 112.000	1,359.500 ± 65.000
CW-5018, 5019	Jul, 1999	H-3	364.162 ± 92.219	430.163 ± 94.673	397.163 ± 66.082
VE-4873, 4874	Jul, 1999	Be-7	2.023 ± 0.294	1.882 ± 0.338	1.953 ± 0.224
VE-4873, 4874	Jul, 1999	K-40	7.894 ± 0.650	7.394 ± 0.655	7.644 ± 0.461
F-5124, 5125	Jul, 1999	K-40	2.394 ± 0.364	2.802 ± 0.360	2.598 ± 0.256

Table A-5. In-house "duplicate" samples.

Lab Codes	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
VE-5187, 5188	Jul, 1999	K-40	2.990 ± 0.422	3.265 ± 0.446	3.128 ± 0.307
VE-5187, 5188	Jul, 1999	Sr-90	0.005 ± 0.002	0.002 ± 0.002	0.004 ± 0.002
CW-5212, 5213	Jul, 1999	Gr. Beta	2.187 ± 1.449	2.452 ± 1.381	2.320 ± 1.001
CW-5212, 5213	Jul, 1999	Gr. Beta	-0.405 ± 1.220	-0.438 ± 1.196	-0.422 ± 0.854
MI-5260, 5261	Jul, 1999	K-40	1,367.000 ± 172.000	1,462.000 ± 161.000	1,414.500 ± 117.797
MI-5287, 5288	Jul, 1999	K-40	1,417.900 ± 89.000	1,280.700 ± 163.000	1,349.300 ± 92.857
PW-5237, 5238	Jul, 1999	H-3	189.773 ± 96.797	220.943 ± 97.971	205.358 ± 68.862
AP-5329, 5330	Jul, 1999	Be-7	0.168 ± 0.065	0.140 ± 0.122	0.154 ± 0.069
SWU-5379, 5380	Jul, 1999	Gr. Beta	2.571 ± 0.605	2.219 ± 0.611	2.395 ± 0.430
SWU-5379, 5380	Jul, 1999	H-3	484.749 ± 105.455	520.309 ± 106.709	502.529 ± 75.013
G-5354, 5355	Jul, 1999	Be-7	1.120 ± 0.270	1.030 ± 0.160	1.075 ± 0.157
G-5354, 5355	Jul, 1999	K-40	6.160 ± 0.450	5.990 ± 0.530	6.075 ± 0.348
MI-5520, 5521	Jul, 1999	Co-60	-1.180 ± 3.460	-2.330 ± 2.740	-1.755 ± 2.207
MI-5520, 5521	Jul, 1999	Cs-137	1.450 ± 2.200	3.160 ± 2.660	2.305 ± 1.726
MI-5520, 5521	Jul, 1999	I-131	0.184 ± 0.283	0.009 ± 0.285	0.096 ± 0.201
AP-5499, 5500	Jul, 1999	Be-7	0.181 ± 0.070	0.175 ± 0.066	0.178 ± 0.048
CW-5550, 5551	Jul, 1999	Gr. Beta	1.858 ± 1.362	1.361 ± 1.329	1.609 ± 0.952
CW-5550, 5551	Jul, 1999	Gr. Beta	1.208 ± 1.334	-0.174 ± 0.933	0.517 ± 0.814
WW-5575, 5576	Jul, 1999	H-3	224.412 ± 93.866	220.812 ± 93.728	222.612 ± 66.325
MI-5596, 5597	Jul, 1999	K-40	1,355.200 ± 157.000	1,370.900 ± 191.000	1,363.050 ± 123.622
MI-5644, 5645	Jul, 1999	Calcium	0.830 ± 0.083	0.840 ± 0.084	0.835 ± 0.059
MI-5644, 5645	Jul, 1999	K-40	1,327.000 ± 141.000	1,488.000 ± 169.000	1,407.500 ± 110.048
MI-5644, 5645	Jul, 1999	Sr-90	1.300 ± 0.350	1.070 ± 0.350	1.185 ± 0.247
MI-4742, 4743	Aug, 1999	Sr-90	0.502 ± 0.243	0.702 ± 0.303	0.602 ± 0.194
MI-5666, 5667	Aug, 1999	K-40	1,639.000 ± 161.000	1,724.800 ± 207.000	1,681.900 ± 131.120
WW-5756, 5757	Aug, 1999	Gr. Beta	1.704 ± 0.568	2.432 ± 0.567	2.068 ± 0.401
CW-5712, 5713	Aug, 1999	Gr. Beta	1.906 ± 1.360	1.608 ± 1.270	1.757 ± 0.930
CW-5712, 5713	Aug, 1999	Gr. Beta	-0.269 ± 1.174	-0.634 ± 1.076	-0.451 ± 0.796
G-5735, 5736	Aug, 1999	Be-7	2.961 ± 0.296	3.295 ± 0.492	3.128 ± 0.287
G-5735, 5736	Aug, 1999	K-40	6.731 ± 0.548	6.997 ± 0.492	6.864 ± 0.368
LW-8450, 8451	Aug, 1999	Sr-90	0.390 ± 0.310	0.570 ± 0.310	0.480 ± 0.219
SW-5841, 5842	Aug, 1999	Gr. Alpha	2.850 ± 1.675	2.500 ± 1.685	2.675 ± 1.188
SW-5841, 5842	Aug, 1999	Gr. Beta	9.343 ± 1.425	12.378 ± 1.634	10.860 ± 1.084
VE-5905, 5906	Aug, 1999	Co-60	0.013 ± 0.066	-0.000 ± 0.002	0.006 ± 0.033
VE-5905, 5906	Aug, 1999	Cs-137	0.006 ± 0.008	0.001 ± 0.009	0.004 ± 0.006

Table A-5. In-house "duplicate" samples.

Lab Codes	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
CW-6148, 6149	Aug, 1999	H-3	141.545 ± 89.443	74.402 ± 86.675	107.974 ± 62.275
PW-5968, 5969	Aug, 1999	H-3	1,625.921 ± 147.401	1,698.481 ± 149.269	1,662.201 ± 104.891
MI-6072, 6073	Aug, 1999	K-40	1,478.600 ± 163.000	1,675.400 ± 202.000	1,577.000 ± 129.782
G-6116, 6117	Aug, 1999	Be-7	4.178 ± 0.306	4.319 ± 0.378	4.248 ± 0.243
G-6116, 6117	Aug, 1999	K-40	5.525 ± 0.548	5.657 ± 0.486	5.591 ± 0.366
AP-6200, 6201	Aug, 1999	K-40	8.465 ± 0.356	8.822 ± 0.666	8.643 ± 0.378
DW-6121, 6122	Aug, 1999	Gr. Beta	1.229 ± 0.325	1.022 ± 0.332	1.126 ± 0.233
SWU-6345, 6346	Aug, 1999	Gr. Beta	2.417 ± 0.582	1.870 ± 0.587	2.144 ± 0.413
MI-6242, 6243	Aug, 1999	Co-60	-1.160 ± 3.210	-0.075 ± 0.105	-0.617 ± 1.606
MI-6242, 6243	Aug, 1999	Cs-137	-0.395 ± 2.610	0.534 ± 2.270	0.070 ± 1.730
MI-6242, 6243	Aug, 1999	I-131	-0.112 ± 0.226	0.119 ± 0.239	0.003 ± 0.164
VE-6263, 6264	Aug, 1999	Co-60	0.001 ± 0.002	0.009 ± 0.027	0.005 ± 0.013
VE-6263, 6264	Aug, 1999	Cs-137	0.010 ± 0.010	-0.004 ± 0.009	0.003 ± 0.007
SW-6389, 6390	Aug, 1999	K-40 (FP)	13.000 ± 1.300	12.000 ± 1.200	12.500 ± 0.885
SWU-6452, 6453	Aug, 1999	Gr. Beta	2.587 ± 0.598	2.053 ± 0.561	2.320 ± 0.410
WW-6604, 6605	Aug, 1999	Gr. Beta	2.199 ± 0.578	1.878 ± 0.594	2.039 ± 0.414
WW-6677, 6678	Aug, 1999	H-3	202.838 ± 101.400	122.240 ± 98.143	162.539 ± 70.559
WW-6506, 6507	Sep, 1999	Co-60	-0.789 ± 7.010	0.416 ± 1.310	-0.187 ± 3.566
WW-6506, 6507	Sep, 1999	Cs-137	0.568 ± 3.270	0.834 ± 3.180	0.701 ± 2.281
WW-6506, 6507	Sep, 1999	H-3	29,273.964 ± 494.519	30,525.051 ± 504.610	29,899.507 ± 353.264
MI-6410, 6411	Sep, 1999	K-40	1,128.500 ± 159.000	1,355.900 ± 174.000	1,242.200 ± 117.853
VE-6431, 6432	Sep, 1999	Gr. Beta	1.880 ± 0.053	1.917 ± 0.053	1.899 ± 0.037
VE-6431, 6432	Sep, 1999	K-40	1.697 ± 0.202	1.603 ± 0.192	1.650 ± 0.139
VE-6558, 6559	Sep, 1999	K-40	2.200 ± 0.204	2.222 ± 0.189	2.211 ± 0.139
AP-6704, 6705	Sep, 1999	Be-7	0.020 ± 0.055	0.018 ± 0.081	0.019 ± 0.049
VE-6649, 6650	Sep, 1999	Co-60	0.008 ± 0.015	-0.001 ± 0.004	0.004 ± 0.008
VE-6649, 6650	Sep, 1999	Cs-137	-0.001 ± 0.007	-0.001 ± 0.007	-0.001 ± 0.005
AP-6727, 6728	Sep, 1999	Be-7	0.109 ± 0.043	0.158 ± 0.089	0.134 ± 0.049
VE-6793, 6794	Sep, 1999	Gr. Beta	1.115 ± 0.037	1.139 ± 0.035	1.127 ± 0.025
SO-6937, 6938	Sep, 1999	Cs-137	0.225 ± 0.027	0.260 ± 0.040	0.243 ± 0.024
SO-6937, 6938	Sep, 1999	K-40	10.450 ± 0.520	10.428 ± 0.760	10.439 ± 0.460
SO-6937, 6938	Sep, 1999	Sr-90	0.041 ± 0.017	0.034 ± 0.014	0.038 ± 0.011
SWU-7045, 7046	Sep, 1999	Gr. Beta	2.623 ± 0.606	2.720 ± 0.593	2.672 ± 0.424
AP-7087, 7088	Sep, 1999	Be-7	0.091 ± 0.068	0.119 ± 0.054	0.105 ± 0.043
PW-7013, 7014	Sep, 1999	H-3	3,002.639 ± 183.527	3,038.815 ± 184.318	3,020.727 ± 130.053

Table A-5. In-house "duplicate" samples.

Lab Codes	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
SWT-7964, 7965	Sep, 1999	Sr-90	0.826 ± 0.411	0.501 ± 0.285	0.664 ± 0.250
W-7302, 7303	Sep, 1999	H-3	364.860 ± 109.550	221.740 ± 104.150	293.300 ± 75.578
SS-7432, 7433	Sep, 1999	K-40	8.619 ± 0.487	8.049 ± 0.508	8.334 ± 0.352
AP-7541, 7542	Sep, 1999	Be-7	0.086 ± 0.012	0.092 ± 0.014	0.089 ± 0.009
AP-7520, 7521	Sep, 1999	Be-7	0.087 ± 0.012	0.091 ± 0.011	0.089 ± 0.008
PW-7228, 7229	Oct, 1999	H-3	6,053.000 ± 243.000	6,177.000 ± 245.000	6,115.000 ± 172.536
SW-7252, 7253	Oct, 1999	H-3	544.000 ± 116.000	659.000 ± 120.000	601.500 ± 83.451
SO-7344, 7345	Oct, 1999	Cs-137	0.067 ± 0.020	0.066 ± 0.023	0.067 ± 0.015
SO-7344, 7345	Oct, 1999	Gr. Beta	27.800 ± 3.580	26.320 ± 3.550	27.060 ± 2.521
SO-7344, 7345	Oct, 1999	K-40	18.510 ± 0.690	19.680 ± 0.810	19.095 ± 0.532
SO-7344, 7345	Oct, 1999	Sr-90	0.020 ± 0.009	0.014 ± 0.008	0.017 ± 0.006
WW-7365, 7366	Oct, 1999	Gr. Beta	1.712 ± 0.500	1.341 ± 0.482	1.527 ± 0.347
WW-7365, 7366	Oct, 1999	K-40	1.200 ± 0.120	1.100 ± 0.110	1.150 ± 0.081
MI-7323, 7324	Oct, 1999	K-40	1,404.100 ± 111.000	1,374.200 ± 181.000	1,389.150 ± 106.163
F-7478, 7479	Oct, 1999	Co-60	0.010 ± 0.050	0.000 ± 0.010	0.005 ± 0.025
F-7478, 7479	Oct, 1999	Cs-137	0.000 ± 0.010	-0.010 ± 0.010	-0.005 ± 0.007
MI-7728, 7729	Oct, 1999	K-40	1,567.700 ± 170.000	1,471.900 ± 125.000	1,519.800 ± 105.505
MI-7587, 7588	Oct, 1999	K-40	1,263.200 ± 162.000	1,449.800 ± 122.000	1,356.500 ± 101.400
AP-7619, 7620	Oct, 1999	Be-7	0.166 ± 0.071	0.110 ± 0.090	0.138 ± 0.057
SL-7749, 7750	Oct, 1999	Gr. Beta	3.088 ± 0.278	3.320 ± 0.285	3.204 ± 0.199
SL-7749, 7750	Oct, 1999	K-40	1.190 ± 0.560	2.160 ± 0.500	1.675 ± 0.375
BS-7943, 7944	Oct, 1999	Gr. Beta	13.816 ± 2.943	14.263 ± 2.888	14.040 ± 2.062
BS-7943, 7944	Oct, 1999	K-40	11.681 ± 0.551	12.691 ± 0.754	12.186 ± 0.467
G-7898, 7899	Oct, 1999	Be-7	1.315 ± 0.188	1.342 ± 0.186	1.329 ± 0.132
G-7898, 7899	Oct, 1999	K-40	6.436 ± 0.449	6.292 ± 0.486	6.364 ± 0.331
CW-8058, 8059	Oct, 1999	Gr. Beta	2.520 ± 1.490	2.320 ± 1.490	2.420 ± 1.054
F-8379, 8380	Oct, 1999	K-40	2.980 ± 0.240	3.063 ± 0.262	3.021 ± 0.178
F-8171, 8172	Oct, 1999	Co-60	-0.010 ± 0.020	-0.010 ± 0.010	-0.010 ± 0.011
F-8171, 8172	Oct, 1999	Cs-137	-0.010 ± 0.010	0.000 ± 0.010	-0.005 ± 0.007
SWU-8316, 8317	Oct, 1999	Gr. Beta	2.310 ± 0.690	2.248 ± 0.691	2.279 ± 0.488
SWU-8316, 8317	Oct, 1999	H-3	187.623 ± 94.958	223.391 ± 96.366	205.507 ± 67.645
SP-8954, 8955	Oct, 1999	Gr. Beta	6.535 ± 1.721	4.745 ± 1.412	5.640 ± 1.113
CW-8425, 8426	Oct, 1999	Gr. Beta	1.720 ± 1.430	1.510 ± 1.410	1.615 ± 1.004
SS-8474, 8475	Oct, 1999	K-40	9.117 ± 0.719	9.634 ± 0.542	9.376 ± 0.450
LW-8747, 8748	Oct, 1999	Gr. Beta	1.984 ± 0.431	2.120 ± 0.476	2.052 ± 0.321

Table A-5. In-house "duplicate" samples.

Lab Codes	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
G-8572, 8573	Oct, 1999	Be-7	3.500 ± 0.338	3.410 ± 0.235	3.455 ± 0.206
G-8572, 8573	Oct, 1999	Gr. Beta	6.249 ± 0.167	6.679 ± 0.171	6.464 ± 0.120
G-8572, 8573	Oct, 1999	K-40	6.900 ± 0.518	6.961 ± 0.374	6.930 ± 0.319
SW-8506, 8507	Oct, 1999	H-3	5,114.000 ± 212.000	5,279.000 ± 215.000	5,196.500 ± 150.971
LW-8747, 8748	Oct, 1999	H-3	4,144.300 ± 194.900	4,392.700 ± 199.513	4,268.500 ± 139.456
SW-8614, 8615	Nov, 1999	Gr. Beta	3.884 ± 0.886	3.386 ± 0.836	3.635 ± 0.609
CW-8641, 8642	Nov, 1999	Gr. Beta	1.310 ± 1.400	2.250 ± 1.470	1.780 ± 1.015
AP-8688, 8689	Nov, 1999	Be-7	0.153 ± 0.083	0.144 ± 0.058	0.149 ± 0.051
SW-8975, 8976	Nov, 1999	H-3	-70.000 ± 85.000	-68.000 ± 85.000	-69.000 ± 60.104
MI-8928, 8929	Nov, 1999	K-40	1,328.300 ± 144.000	1,366.000 ± 163.000	1,347.150 ± 108.749
AP-9179, 9180	Nov, 1999	Be-7	0.145 ± 0.097	0.103 ± 0.055	0.124 ± 0.056
SW-9151, 9152	Nov, 1999	H-3	3,208.000 ± 174.000	3,517.000 ± 180.000	3,362.500 ± 125.176
SW-9227, 9228	Nov, 1999	Co-60	-1.320 ± 12.400	0.120 ± 0.330	-0.600 ± 6.202
SW-9227, 9228	Nov, 1999	Cs-137	0.060 ± 2.330	-0.530 ± 1.660	-0.235 ± 1.430
SW-9227, 9228	Nov, 1999	Gr. Beta	8.590 ± 1.880	9.810 ± 1.980	9.200 ± 1.365
SWU-9275, 9276	Nov, 1999	Gr. Beta	1.590 ± 0.586	1.404 ± 0.529	1.497 ± 0.395
CW-9307, 9308	Dec, 1999	Gr. Beta	0.700 ± 1.500	2.050 ± 1.630	1.375 ± 1.108
CW-9358, 9359	Dec, 1999	Gr. Beta	3.610 ± 0.460	4.210 ± 0.510	3.910 ± 0.343
CW-9358, 9359	Dec, 1999	H-3	14,646.000 ± 339.000	14,764.000 ± 340.000	14,705.000 ± 240.063
MI-9402, 9403	Dec, 1999	K-40	2,074.100 ± 174.000	1,967.700 ± 134.000	2,020.900 ± 109.809
CW-9423, 9424	Dec, 1999	Gr. Beta	1.870 ± 1.610	1.930 ± 1.610	1.900 ± 1.138
AP-9478, 9479	Dec, 1999	Be-7	0.156 ± 0.098	0.091 ± 0.058	0.123 ± 0.057
BS-9587, 9588	Dec, 1999	K-40	11.890 ± 0.550	11.624 ± 0.740	11.757 ± 0.461
LW-9525, 9526	Dec, 1999	Be-7	2.690 ± 0.630	2.340 ± 0.620	2.515 ± 0.442
AP-9767, 9768	Dec, 1999	Be-7	0.104 ± 0.072	0.144 ± 0.085	0.124 ± 0.056
SWU-9837, 9838	Dec, 1999	Gr. Beta	1.530 ± 0.530	2.504 ± 0.607	2.017 ± 0.403
CW-9870, 9871	Dec, 1999	H-3	1,221.000 ± 123.000	1,027.000 ± 117.000	1,124.000 ± 84.879
SW-9964, 9965	Dec, 1999	Co-60	-0.740 ± 2.710	0.950 ± 2.110	0.105 ± 1.717
SW-9964, 9965	Dec, 1999	Cs-137	-2.910 ± 3.140	1.830 ± 2.230	-0.540 ± 1.926
AP-10027, 10028	Dec, 1999	Be-7	0.059 ± 0.008	0.064 ± 0.011	0.062 ± 0.007
SW-9912, 9913	Dec, 1999	H-3	29.000 ± 87.000	113.000 ± 91.000	71.000 ± 62.948
WW-10069, 10070	Dec, 1999	Gr. Beta	2.539 ± 0.664	2.223 ± 0.591	2.381 ± 0.445

[a] All concentrations are reported in pCi/liter, except solid samples, which are reported in pCi/gram.

[b] Lab codes are comprised of the sample media and the sample numbers. Client codes have been eliminated to protect client anonymity.

Table A-6. Department of Energy's Mixed Analyte Performance Evaluation Program (MAPEP), comparison of MAPEP and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analysis	Concentration[b] Teledyne Result[c]	MAPEP Result[d] 1s, N=1	Control Limits
SPW-846	WATER	Jan, 1999	Co-57	337.60 ± 33.76	358.00	250.60 - 465.40
SPW-846	WATER	Jan, 1999	Cs-137	656.60 ± 65.66	637.00	445.90 - 828.10
SPW-846	WATER	Jan, 1999	Fe-55	724.50 ± 72.45	664.00	464.80 - 863.20
SPW-846	WATER	Jan, 1999	Mn-54	234.20 ± 23.42	229.00	160.30 - 297.70
SPW-846	WATER	Jan, 1999	Pu-238	1.10 ± 0.11	1.45	1.02 - 1.89
SPW-846	WATER	Jan, 1999	Pu-239/40	3.20 ± 0.32	4.04	2.83 - 5.25
SPW-846	WATER	Jan, 1999	Sr-90	40.90 ± 4.09	39.50	27.65 - 51.35
SPW-846	WATER	Jan, 1999	U-233/4	2.70 ± 0.27	2.67	1.87 - 3.47
SPW-846	WATER	Jan, 1999	U-238	20.80 ± 2.08	21.20	14.84 - 27.56
SPW-846	WATER	Jan, 1999	Zn-65	1,508.90 ± 150.90	1,560.00	1,092.00 - 2,028.00
STSO-854	SOIL	Jan, 1999	Am-241	6.16 ± 0.70	6.55	4.59 - 8.52
STSO-854	SOIL	Jan, 1999	Co-57	311.11 ± 3.60	360.00	252.00 - 468.00
STSO-854	SOIL	Jan, 1999	Co-60	134.57 ± 2.15	131.00	91.70 - 170.30
STSO-854	SOIL	Jan, 1999	Cs-134	682.35 ± 4.50	752.00	526.40 - 977.60
STSO-854	SOIL	Jan, 1999	Cs-137	319.50 ± 3.60	331.00	231.70 - 430.30
STSO-854	SOIL	Jan, 1999	K-40	667.04 ± 21.50	652.00	456.40 - 847.60
STSO-854	SOIL	Jan, 1999	Mn-54	349.01 ± 7.00	345.00	241.50 - 448.50
STSO-854	SOIL	Jan, 1999	Pu-238	25.28 ± 1.00	27.50	19.25 - 35.75
STSO-854	SOIL	Jan, 1999	Pu-239/40	45.66 ± 1.00	48.10	33.67 - 62.53
STSO-854	SOIL	Jan, 1999	U-233/4	139.56 ± 1.80	157.00	109.90 - 204.10
STSO-854	SOIL	Jan, 1999	U-238	23.47 ± 0.75	40.70	28.49 - 52.91
The analysis was repeated. Result of reanalysis; 29.5±6.3 Bq/kg.						
STSO-854	SOIL	Jan, 1999	Zn-65	2,697.20 ± 25.00	2,840.00	1,988.00 - 3,692.00

[a] Results obtained by Teledyne Brown Engineering Environmental Services Midwest Laboratory as a participant in the Department of Energy's Mixed Analyte Performance Evaluation Program, Idaho Operations office, Idaho Falls, Idaho.

[b] All results are in Bq/kg or Bq/L as requested by the Department of Energy.

[c] Unless otherwise indicated, the TBEESML results are given as the mean ± 1 standard deviations for three determinations.

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

Table A-7. Environmental Measurements Laboratory Quality Assessment Program (EML), comparison of EML and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analysis	Concentration[b] Teledyne Result[c]	EML Result[d]	Control Limits[e]
STAF-848	AIR FILTER	Mar, 1999	Gr. Alpha	1.24 ± 0.03	1.61 ± 0.16	0.60 - 1.64
STAF-848	AIR FILTER	Mar, 1999	Gr. Beta	1.98 ± 0.04	1.56 ± 0.16	0.60 - 1.64
STW-850	WATER	Mar, 1999	Am-241	1.22 ± 0.16	1.15 ± 0.05	0.73 - 2.58
STW-850	WATER	Mar, 1999	Co-60	54.40 ± 2.00	51.10 ± 3.00	0.92 - 1.18
STW-850	WATER	Mar, 1999	Cs-137	43.50 ± 2.00	39.38 ± 2.41	0.90 - 1.28
STW-850	WATER	Mar, 1999	Fe-55	81.50 ± 19.50	97.40 ± 1.65	0.31 - 1.54
STW-850	WATER	Mar, 1999	Gr. Alpha	1,169.00 ± 37.00	1,090.00 ± 20.00	0.50 - 1.29
STW-850	WATER	Mar, 1999	Gr. Beta	1,274.60 ± 33.30	1,100.00 ± 40.00	0.50 - 1.29
STW-850	WATER	Mar, 1999	H-3	90.30 ± 24.80	121.08 ± 6.78	0.65 - 1.91
STW-850	WATER	Mar, 1999	Ni-63	125.80 ± 6.30	114.00 ± 10.00	0.50 - 1.50
STW-850	WATER	Mar, 1999	Pu-238	0.80 ± 0.01	0.77 ± 0.04	0.78 - 1.42
STW-850	WATER	Mar, 1999	Pu-239/40	1.03 ± 0.07	1.01 ± 0.06	0.78 - 1.42
STW-850	WATER	Mar, 1999	Sr-90	3.63 ± 1.20	4.10 ± 0.05	0.50 - 1.50
STW-850	WATER	Mar, 1999	U-233/4	0.33 ± 0.08	0.27 ± 0.02	0.77 - 1.35
STW-850	WATER	Mar, 1999	U-238	0.33 ± 0.08	0.26 ± 0.02	0.77 - 1.35
STVE-851	VEGETATION	Mar, 1999	Am-241	3.35 ± 0.85	3.52 ± 0.59	0.68 - 2.78
STVE-851	VEGETATION	Mar, 1999	Cm-244	0.56 ± 0.41	1.67 ± 0.54	0.49 - 1.69
STVE-851	VEGETATION	Mar, 1999	Co-60	21.00 ± 1.90	21.45 ± 1.00	0.62 - 1.42
STVE-851	VEGETATION	Mar, 1999	Cs-137	453.90 ± 5.70	467.00 ± 20.00	0.81 - 1.45
STVE-851	VEGETATION	Mar, 1999	K-40	667.60 ± 33.70	656.50 ± 20.00	0.79 - 1.50
STVE-851	VEGETATION	Mar, 1999	Sr-90	704.80 ± 27.80	736.10 ± 7.70	0.48 - 1.29
STSO-852	SOIL	Mar, 1999	Ac-228	45.10 ± 7.40	47.15 ± 2.99	0.50 - 1.50
STSO-852	SOIL	Mar, 1999	Am-241	5.65 ± 2.41	4.89 ± 0.97	0.52 - 2.65
STSO-852	SOIL	Mar, 1999	Bi-214	67.30 ± 3.30	69.90 ± 5.66	0.50 - 1.50
STSO-852	SOIL	Mar, 1999	Cs-137	620.50 ± 5.90	659.50 ± 24.95	0.80 - 1.34
STSO-852	SOIL	Mar, 1999	K-40	355.70 ± 24.60	362.75 ± 20.16	0.73 - 1.67
STSO-852	SOIL	Mar, 1999	Pb-212	47.90 ± 3.00	47.93 ± 2.57	0.50 - 1.50
STSO-852	SOIL	Mar, 1999	Pb-214	70.10 ± 4.80	71.00 ± 7.04	0.50 - 1.50
STSO-852	SOIL	Mar, 1999	Pu-239/40	7.32 ± 1.32	8.11 ± 1.07	0.66 - 1.93
STSO-852	SOIL	Mar, 1999	Sr-90	28.30 ± 3.50	32.40 ± 0.53	0.46 - 2.84
STSO-852	SOIL	Mar, 1999	Th-234	227.40 ± 35.20	138.00 ± 4.08	0.50 - 2.00
STSO-852	SOIL	Mar, 1999	U-233/4	132.90 ± 6.90	140.67 ± 1.16	0.35 - 1.55
STSO-852	SOIL	Mar, 1999	U-238	139.40 ± 7.00	145.00 ± 1.73	0.35 - 1.55
STAF-853	AIR FILTER	Mar, 1999	Am-241	0.14 ± 0.02	0.13 ± 0.01	0.68 - 2.41
STAF-853	AIR FILTER	Mar, 1999	Co-57	3.32 ± 0.06	3.01 ± 0.14	0.62 - 1.22
STAF-853	AIR FILTER	Mar, 1999	Co-60	5.28 ± 0.15	4.96 ± 0.28	0.62 - 1.42
STAF-853	AIR FILTER	Mar, 1999	Cs-137	6.96 ± 0.15	6.05 ± 0.30	0.72 - 1.32
STAF-853	AIR FILTER	Mar, 1999	Pu-238	0.26 ± 0.02	0.27 ± 0.00	0.62 - 1.46

Table A-7. Environmental Measurements Laboratory Quality Assessment Program (EML), comparison of EML and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analysis	Concentration[b] Teledyne Result[c]	EML Result[d]	Control Limits[e]
STAF-853	AIR FILTER	Mar, 1999	Pu-239/40	0.12 ± 0.02	0.12 ± 0.00	0.62 - 1.46
STAF-853	AIR FILTER	Mar, 1999	Sb-125	4.35 ± 0.30	3.59 ± 0.31	0.62 - 1.39
STAF-853	AIR FILTER	Mar, 1999	Sr-90	0.65 ± 0.19	0.64 ± 0.01	0.66 - 2.65
STAF-853	AIR FILTER	Mar, 1999	U-233/4	0.07 ± 0.03	0.06 ± 0.00	0.78 - 3.00
STAF-853	AIR FILTER	Mar, 1999	U-238	0.07 ± 0.03	0.06 ± 0.00	0.78 - 3.00
STW-855	WATER	Sep, 1999	Am-241	1.13 ± 0.24	0.85 ± 0.10	0.75 - 1.49
STW-855	WATER	Sep, 1999	Co-60	54.10 ± 1.10	52.40 ± 2.20	0.80 - 1.20
STW-855	WATER	Sep, 1999	Cs-137	77.10 ± 1.40	76.00 ± 3.40	0.80 - 1.26
STW-855	WATER	Sep, 1999	Fe-55	48.60 ± 6.80	53.00 ± 2.00	0.44 - 1.53
STW-855	WATER	Sep, 1999	H-3	136.00 ± 25.00	80.70 ± 3.70	0.71 - 1.79
STW-855	WATER	Sep, 1999	Pu-238	0.78 ± 0.05	0.79 ± 0.08	0.78 - 1.25
STW-855	WATER	Sep, 1999	Pu-239/40	0.84 ± 0.07	0.87 ± 0.10	0.80 - 1.39
STW-855	WATER	Sep, 1999	Sr-90	2.20 ± 1.00	1.72 ± 1.00	0.75 - 1.50
STW-855	WATER	Sep, 1999	U-233/4	0.50 ± 0.09	0.37 ± 0.02	0.80 - 1.40
STW-855	WATER	Sep, 1999	U-233/4	0.50 ± 0.09	0.37 ± 0.02	0.83 - 1.92
STW-855	WATER	Sep, 1999	U-238	0.46 ± 0.09	0.36 ± 0.02	0.80 - 1.26
Increasing the sample counting time achieved acceptable results (0.42±0.07 Bq/L).						
STW-856	WATER	Sep, 1999	Gr. Alpha	1,543.00 ± 44.00	1,580.00 ± 20.00	0.61 - 1.32
STW-856	WATER	Sep, 1999	Gr. Beta	1,053.00 ± 31.00	740.00 ± 40.00	0.55 - 1.54
STSO-857	SOIL	Sep, 1999	Ac-228	127.30 ± 7.50	124.00 ± 4.80	0.79 - 1.75
STSO-857	SOIL	Sep, 1999	Bi-212	107.40 ± 2.60	140.00 ± 14.00	0.42 - 1.22
STSO-857	SOIL	Sep, 1999	Bi-214	90.10 ± 4.20	69.50 ± 1.80	0.75 - 1.42
STSO-857	SOIL	Sep, 1999	Cs-137	195.90 ± 4.00	204.00 ± 5.00	0.83 - 1.32
STSO-857	SOIL	Sep, 1999	K-40	744.70 ± 37.70	780.00 ± 27.00	0.78 - 1.53
STSO-857	SOIL	Sep, 1999	Pb-212	123.40 ± 3.70	127.00 ± 4.80	0.74 - 1.33
STSO-857	SOIL	Sep, 1999	Pb-214	96.50 ± 5.00	72.00 ± 0.42	0.65 - 1.45
STSO-857	SOIL	Sep, 1999	Sr-90	12.99 ± 1.44	13.00 ± 0.47	0.60 - 3.66
STSO-857	SOIL	Sep, 1999	Th-234	298.70 ± 24.60	198.00 ± 5.60	0.59 - 1.85
STSO-857	SOIL	Sep, 1999	U-233/4	184.40 ± 8.50	190.00 ± 5.20	0.47 - 1.30
STSO-857	SOIL	Sep, 1999	U-238	184.80 ± 8.50	190.00 ± 5.20	0.47 - 1.30
STVE-858	VEGETATION	Sep, 1999	Am-241	3.30 ± 0.88	2.88 ± 0.22	0.68 - 2.70
STVE-858	VEGETATION	Sep, 1999	Cm-244	2.12 ± 0.86	1.61 ± 0.36	0.47 - 1.74
STVE-858	VEGETATION	Sep, 1999	Co-60	17.60 ± 1.90	17.60 ± 1.00	0.69 - 1.46
STVE-858	VEGETATION	Sep, 1999	Cs-137	414.60 ± 5.70	440.00 ± 20.00	0.80 - 1.40
STVE-858	VEGETATION	Sep, 1999	K-40	502.80 ± 34.70	513.00 ± 20.00	0.79 - 1.42
STVE-858	VEGETATION	Sep, 1999	Pu-239/40	4.13 ± 1.00	4.30 ± 0.46	0.68 - 1.59
STAP-859	AIR FILTER	Sep, 1999	Am-241	0.14 ± 0.05	0.13 ± 0.01	0.73 - 2.58
STAP-859	AIR FILTER	Sep, 1999	Co-57	8.10 ± 0.10	7.73 ± 0.03	0.65 - 1.39

Table A-7. Environmental Measurements Laboratory Quality Assessment Program (EML), comparison of EML and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analysis	Concentration[b] Teledyne Result[c]	EML Result[d]	Control Limits[e]
STAP-859	AIR FILTER	Sep, 1999	Co-60	6.70 ± 0.10	6.35 ± 0.41	0.75 - 1.32
STAP-859	AIR FILTER	Sep, 1999	Cs-137	7.10 ± 0.20	6.43 ± 0.42	0.73 - 1.37
STAP-859	AIR FILTER	Sep, 1999	Mn-54	8.80 ± 0.20	7.91 ± 0.45	0.76 - 1.42
STAP-859	AIR FILTER	Sep, 1999	Pu-238	0.05 ± 0.04	0.10 ± 0.01	0.74 - 1.40
STAP-859	AIR FILTER	Sep, 1999	Pu-239/40	0.07 ± 0.02	0.14 ± 0.01	0.76 - 1.44
Insufficient sample volume (15 ml.) for accurate plutonium analyses.						
STAP-859	AIR FILTER	Sep, 1999	Ru-106	5.90 ± 0.80	5.50 ± 1.76	0.59 - 1.30
STAP-859	AIR FILTER	Sep, 1999	Sr-90	0.60 ± 0.20	0.34 ± 0.01	0.61 - 1.93
STAP-859	AIR FILTER	Sep, 1999	U-233/4	0.09 ± 0.03	0.07 ± 0.00	0.83 - 1.92
STAP-859	AIR FILTER	Sep, 1999	U-238	0.07 ± 0.03	0.07 ± 0.01	0.84 - 2.61
STAP-860	AIR FILTER	Sep, 1999	Gr. Alpha	3.18 ± 0.06	2.77 ± 0.26	0.50 - 1.55
STAP-860	AIR FILTER	Sep, 1999	Gr. Beta	3.65 ± 0.06	2.66 ± 0.26	0.72 - 1.67

[a] The Environmental Measurements Laboratory provides the following nuclear species : Air Filters, Soil, Vegetation and Water.

[b] Results are reported in Bq/L with the following exceptions: Air Filter results are reported in Bq/Filter, Soil results are reported in Bq/Kg, Vegetation results are reported in Bq/Kg.

[c] Teledyne results are reported as the mean of three determinations±standard deviation.

[d] The EML result listed is the mean of replicate determinations for each nuclide±the standard error of the mean.

[e] The control limits are reported by EML as the ratio of Reported Value / EML value and are established from percentiles of historic data distributions (1982-1992). The evaluation of this historic data and the development of the control limits is presented in DOE report EML-564.

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

In cases where the activity is less than the lower limit of detection L, it is reported as: <L, where L = the lower limit of detection based on 4.66s uncertainty for a background sample.

3.0. Duplicate analyses

3.1 Individual results: For two analysis results; $x_1 \pm s_1$ and $x_2 \pm s_2$

Reported result: $x \pm s$; where $x = (1/2)(x_1 + x_2)$ and $s = (1/2)\sqrt{s_1^2 + s_2^2}$

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:

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

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

4.3 If all 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 equal to or greater than 5, the figure is dropped and the last retained figure is raised by 1. As an example, 11.445 is rounded off to 11.45.

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 (pCi/m^3)		Water (pCi/L)
Gross alpha	1×10^{-3}	Strontium-89	8,000
Gross beta	1	Strontium-90	500
Iodine-131[b]	2.8×10^{-1}	Cesium-137	1,000
		Barium-140	8,000
		Iodine-131	1,000
		Potassium-40[c]	4,000
		Gross alpha	2
		Gross beta	10
		Tritium	1×10^6

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

b Value 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

Appendix D

Summary of the Land Use Census

The Duane Arnold Energy Center Land Use Census for 1999 was completed during the fourth week of September 1999. All milk animals and gardens greater than 500 square feet were identified within three miles of the plant for each of the 16 meteorological sectors. If none were identified within the three mile range, additional surveys were performed out to a distance of five miles. The Cedar River was surveyed by boat on July 28th, 1999 for water use downstream of the DAEC to Cedar Rapids.

There were 168 gardens found during the performance of the 1999 Census. This number exceeds the number of gardens found in the 1998 survey by 15. This difference can be attributed to the removal of 20 gardens and the addition of 35 new gardens.

Milk animal locations remained unchanged since the 1995 census. Two of the locations have goats that do not provide samples during the winter months.

With the exception of the sector to the North of the plant, the locations of the nearest resident for each sector remained the same in 1999. A new home constructed at 4261 McClintock Road resulted in a change of the nearest receptor for this sector from 2414 meters out, to 1931 meters from the plant.
A total of 18 new homes were built or were under construction within a three miles of the DAEC, compared to the 21 new homes identified in 1998. Most of the new houses built were located in the sectors between the plant and Cedar Rapids (ESE and SE).

The Cedar River survey revealed no new withdrawals of river water compared to previous surveys. Irrigation of the strawberry farm in Palo and fishing remain the only food pathway uses of river water between the DAEC and Cedar Rapids.

As a result of this census, adjustments were made to the MIDAS dose projection software model for the affected changes in receptor distances.

Pursuant to ESP4.4, no changes were observed offsite that could adversely affect the safe operation of the DAEC or that would warrant a UFSAR update such as new gas pipelines, toxic gas installations or airfield strips.

APPENDIX E

ANNUAL RADIATION DOSE ASSESSMENT

Appendix E

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 the DAEC was reported by TLDs placed at locations in the surrounding environment as described in the Offsite Dose Assessment Manual (ODAM).

1. Pre-operational and 1999 TLD results were compared using a paired difference test. No significant differences in the TLD populations were observed for the 0.5 mile and one mile TLD populations 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 System (MIDAS) computer program in accordance with ODAM. The calculation methods follow those prescribed by Reg. Guide 1.109. Because there were no nuclides detected in the environment at or beyond the site boundary that were due to the operation of the DAEC, no comparison of calculated dose from stack releases and dose calculated from environmental contamination was performed.

Results of the MIDAS dose calculations are discussed below and are shown in tabular form on page E-3

1. There were no releases of radioactive material to liquid effluents in 1999.

2. The dose to air from noble gases released was 2.44E-03 mrad from gamma radiation at 481 meters SSE and 1.61E-02 mrad beta radiation at 936 meters NW.

3. The total body dose equivalent to the maximally exposed individual from noble gases was 3.04E-03 mrem, at 805 meters West.

4. The skin dose equivalent to the maximally exposed individual from noble gases was 3.10E-03 mrem, at 805 meters West.

5. The maximally exposed organ due to iodines and particulates with half-lives greater than eight days was the thyroid of a child at 805 meters West, with an estimated dose equivalent of 3.47E-03 mrem.

Conclusion:

No measurable dose due to the operation of the DAEC was detected by environmental TLDs in 1999. 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 1999

Type	Age Group	Distance (meters)	Direction	Dose or Dose Equivalent (mrem)	Annual 10 CFR 50, Appendix I Limit
Direct Radiation (as measured by TLDs)				None	*
Liquid Releases				None	
Noble Gas					
Gamma Air Dose		481	SSE	2.44E-03 mrad	10 mrad
Beta Air Dose		936	NW	1.61E-02 mrad	20 mrad
Total Body	All	805	W	3.04E-03 mrem	*
Skin	All	805	W	3.10E-03 mrad	*
Particulates & Iodines					
Organ Dose	Child - Thyroid	805	W	3.47E-03 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.

TELEDYNE BROWN ENGINEERING
ENVIRONMENTAL SERVICES
MIDWEST LABORATORY

700 LANDWEHR ROAD
NORTHBROOK, ILLINOIS 60062-2310
(847) 564-0700 • FAX (847) 564-4517

REPORT
TO
IES UTILITIES, INC.
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, 1999

PREPARED AND SUBMITTED
BY
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES
MIDWEST LABORATORY

PROJECT NO. 8001

Reviewed and
Approved by _____
Bronia Grob, M.S.
Technical Lead

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, Palo, Iowa in 1999. Results of completed analyses are presented in the attached tables.

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

2.0 LISTING OF MISSED SAMPLES

Sample Type	Analysis	Location(s)	Collection Date or Period	Comments
MI	I-131, Gamma	D-93	01-05-99	Sample not available; goat dry.
MI	I-131, Gamma	D-101	01-05-99	Sample not available; goat dry.
MI	I-131, Gamma	D-93	02-02-99	Sample not available; goat dry.
MI	I-131, Gamma	D-101	02-02-99	Sample not available; goat dry.
MI	I-131, Gamma	D-101	03-02-99	Sample not available; goat dry.
TLD	Ambient Gamma	D-39, D-48	1st Qtr.	TLDs lost in the field.
MI	I-131, Gamma	D-101	06-02-99	Sample not available.
MI	I-131, Gamma	D-101	06-15-99	Sample not available.
MI	I-131, Gamma	D-101	06-29-99	Sample not available.
MI	I-131, Gamma	D-101	07-15-99	Sample not available.
TLD	Ambient Gamma	D-29	3rd Qtr.	TLD lost in the field.

3.0 DATA TABLES

Table 1. Airborne particulates, analysis for 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		0.010			0.010
01-07-99	328	0.036 ± 0.004	07-08-99	285	0.021 ± 0.003
01-14-99	288	0.042 ± 0.004	07-15-99	287	0.019 ± 0.003
01-21-99	280	0.023 ± 0.004	07-22-99	284	0.026 ± 0.004
01-28-99	290	0.029 ± 0.004	08-02-99	451	0.022 ± 0.003
02-04-99	285	0.025 ± 0.004	08-06-99	161	0.019 ± 0.006
02-11-99	286	0.022 ± 0.004	08-12-99	246	0.028 ± 0.004
02-19-99	329	0.018 ± 0.003	08-19-99	284	0.023 ± 0.004
02-25-99	242	0.021 ± 0.004	08-26-99	285	0.035 ± 0.004
			09-02-99	286	0.036 ± 0.004
03-04-99	285	0.017 ± 0.003			
03-11-99	286	0.014 ± 0.003	09-09-99	285	0.038 ± 0.004
03-18-99	285	0.019 ± 0.003	09-16-99	285	0.026 ± 0.004
03-25-99	283	0.023 ± 0.003	09-23-99	286	0.027 ± 0.004
04-01-99	288	0.018 ± 0.003	09-30-99	286	0.028 ± 0.004
1st Quarter Mean ± s.d.		0.024 ± 0.008	3rd Quarter Mean ± s.d.		0.027 ± 0.006
04-08-99	285	0.021 ± 0.003	10-07-99	286	0.034 ± 0.004
04-15-99	285	0.020 ± 0.004	10-14-99	285	0.046 ± 0.004
04-22-99	285	0.015 ± 0.003	10-21-99	285	0.027 ± 0.004
04-29-99	285	0.015 ± 0.003	10-28-99	286	0.017 ± 0.003
05-06-99	285	0.019 ± 0.003	11-04-99	286	0.053 ± 0.005
05-13-99	286	0.013 ± 0.003	11-11-99	286	0.049 ± 0.004
05-20-99	285	0.019 ± 0.003	11-18-99	289	0.052 ± 0.004
05-27-99	285	0.017 ± 0.003	11-24-99	241	0.068 ± 0.006
06-03-99	287	0.023 ± 0.003	12-02-99	326	0.044 ± 0.004
06-10-99	285	0.018 ± 0.003	12-09-99	286	0.064 ± 0.005
06-17-99	285	0.014 ± 0.003	12-16-99	285	0.076 ± 0.006
06-24-99	286	0.023 ± 0.003	12-22-99	244	0.040 ± 0.005
07-01-99	285	0.021 ± 0.004	12-30-99	327	0.034 ± 0.004
2nd Quarter Mean ± s.d.		0.018 ± 0.003	4th Quarter Mean ± s.d.		0.046 ± 0.017
			Cumulative Average		0.029
			Previous Annual Average		0.022

Table 2. Airborne particulates and charcoal canisters, analyses for 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		0.010			0.010
01-07-99	328	0.034 ± 0.004	07-08-99	285	0.022 ± 0.003
01-14-99	288	0.040 ± 0.004	07-15-99	288	0.023 ± 0.003
01-21-99	281	0.022 ± 0.004	07-22-99	283	0.024 ± 0.003
01-28-99	290	0.028 ± 0.004	08-02-99	451	0.021 ± 0.003
02-04-99	285	0.022 ± 0.004	08-06-99	159	0.019 ± 0.006
02-11-99	286	0.018 ± 0.004	08-12-99	247	0.024 ± 0.004
02-19-99	329	0.018 ± 0.003	08-19-99	287	< 0.004[b]
02-25-99	241	0.027 ± 0.004	08-26-99	284	0.005 ± 0.003[b]
			09-02-99	285	0.037 ± 0.004
03-04-99	285	0.010 ± 0.003			
03-11-99	286	0.017 ± 0.003	09-09-99	285	0.039 ± 0.004
03-18-99	285	0.024 ± 0.003	09-16-99	285	0.026 ± 0.004
03-25-99	284	0.027 ± 0.004	09-23-99	286	0.029 ± 0.004
04-01-99	287	0.019 ± 0.003	09-30-99	285	0.025 ± 0.004
1st Quarter Mean ± s.d.		0.024 ± 0.008	3rd Quarter Mean ± s.d.		0.025 ± 0.009
04-08-99	283	0.026 ± 0.004	10-07-99	286	0.024 ± 0.004
04-15-99	285	0.021 ± 0.004	10-14-99	285	0.048 ± 0.004
04-22-99	286	0.020 ± 0.003	10-21-99	285	0.030 ± 0.004
04-29-99	285	0.012 ± 0.003	10-28-99	287	0.027 ± 0.004
05-06-99	278	0.021 ± 0.004	11-04-99	285	0.055 ± 0.005
05-13-99	283	0.014 ± 0.003	11-11-99	286	0.049 ± 0.004
05-20-99	286	0.019 ± 0.003	11-18-99	289	0.053 ± 0.005
05-27-99	285	0.015 ± 0.003	11-24-99	240	0.059 ± 0.005
06-03-99	288	0.024 ± 0.003	12-02-99	327	0.035 ± 0.004
06-10-99	284	0.015 ± 0.003	12-09-99	286	0.046 ± 0.004
06-17-99	287	0.015 ± 0.003	12-16-99	286	0.049 ± 0.005
06-24-99	285	0.030 ± 0.004	12-22-99	244	0.043 ± 0.005
07-01-99	285	0.017 ± 0.003	12-30-99	328	0.042 ± 0.004
2nd Quarter Mean ± s.d.		0.019 ± 0.005	4th Quarter Mean ± s.d.		0.043 ± 0.011
			Cumulative Average		0.028
			Previous Annual Average		0.025

[a] Iodine-131 concentrations are <0.07 pCi/m^3 unless noted otherwise.
[b] Filter light.

Table 3. Airborne particulates, analysis for 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		0.010			0.010
01-07-99	327	0.032 ± 0.003	07-08-99	285	0.023 ± 0.003
01-14-99	288	0.035 ± 0.004	07-15-99	287	0.022 ± 0.003
01-21-99	281	0.017 ± 0.003	07-22-99	284	0.024 ± 0.003
01-28-99	289	0.025 ± 0.003	08-02-99	451	0.022 ± 0.003
02-04-99	285	0.020 ± 0.004	08-06-99	161	0.011 ± 0.006
02-11-99	285	0.015 ± 0.003	08-12-99	246	0.029 ± 0.004
02-19-99	327	0.014 ± 0.003	08-19-99	287	0.022 ± 0.004
02-25-99	242	0.018 ± 0.004	08-26-99	284	0.033 ± 0.004
			09-02-99	286	0.043 ± 0.004
03-04-99	286	0.017 ± 0.003			
03-11-99	286	0.017 ± 0.003	09-09-99	285	0.039 ± 0.004
03-18-99	285	0.020 ± 0.003	09-16-99	285	0.024 ± 0.004
03-25-99	283	0.019 ± 0.003	09-23-99	286	0.033 ± 0.004
04-01-99	288	0.016 ± 0.003	09-30-99	285	0.033 ± 0.004
1st Quarter Mean ± s.d.		0.020 ± 0.006	3rd Quarter Mean ± s.d.		0.028 ± 0.009
04-08-99	284	0.016 ± 0.003	10-07-99	286	0.022 ± 0.004
04-15-99	285	0.016 ± 0.003	10-14-99	285	0.045 ± 0.004
04-22-99	285	0.020 ± 0.003	10-21-99	285	0.030 ± 0.004
04-29-99	286	0.015 ± 0.003	10-28-99	286	0.029 ± 0.004
05-06-99	285	0.015 ± 0.003	11-04-99	286	0.054 ± 0.005
05-13-99	286	0.013 ± 0.003	11-11-99	283	0.040 ± 0.004
05-20-99	286	0.014 ± 0.003	11-18-99	288	0.037 ± 0.004
05-27-99	284	0.015 ± 0.003	11-24-99	242	0.052 ± 0.005
06-03-99	288	0.018 ± 0.003	12-02-99	327	0.030 ± 0.004
06-10-99	284	0.010 ± 0.003	12-09-99	286	0.043 ± 0.004
06-17-99	286	0.015 ± 0.003	12-16-99	285	0.052 ± 0.005
06-24-99	286	0.027 ± 0.004	12-22-99	245	0.038 ± 0.005
07-01-99	285	0.020 ± 0.004	12-30-99	327	0.040 ± 0.004
2nd Quarter Mean ± s.d.		0.016 ± 0.004	4th Quarter Mean ± s.d.		0.039 ± 0.010
			Cumulative Average		0.026
			Previous Annual Average		0.023

Table 4. Airborne particulates and charcoal canisters, analyses for 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		0.010			0.010
01-07-99	328	0.030 ± 0.003	07-08-99	266	0.024 ± 0.004
01-14-99	286	0.041 ± 0.004	07-15-99	287	0.024 ± 0.004
01-21-99	283	0.023 ± 0.004	07-22-99	284	0.024 ± 0.003
01-28-99	287	0.026 ± 0.003	08-02-99	450	0.022 ± 0.003
02-04-99	285	0.028 ± 0.004	08-06-99	161	0.010 ± 0.006
02-11-99	286	0.022 ± 0.004	08-12-99	246	0.026 ± 0.004
02-19-99	328	0.017 ± 0.003	08-19-99	285	0.024 ± 0.004
02-25-99	243	0.020 ± 0.004	08-26-99	286	0.033 ± 0.004
			09-02-99	285	0.034 ± 0.004
03-04-99	285	0.017 ± 0.003			
03-11-99	286	0.016 ± 0.003	09-09-99	286	0.031 ± 0.004
03-18-99	285	0.024 ± 0.003	09-16-99	286	0.028 ± 0.004
03-25-99	284	0.026 ± 0.004	09-23-99	285	0.026 ± 0.004
04-01-99	286	0.018 ± 0.003	09-30-99	286	0.028 ± 0.004
1st Quarter Mean ± s.d.		0.024 ± 0.007	3rd Quarter Mean ± s.d.		0.026 ± 0.006
04-08-99	284	0.020 ± 0.003	10-07-99	285	0.017 ± 0.004
04-15-99	286	0.020 ± 0.004	10-14-99	286	0.043 ± 0.004
04-22-99	285	0.017 ± 0.003	10-21-99	285	0.025 ± 0.004
04-29-99	285	0.013 ± 0.003	10-28-99	288	0.021 ± 0.003
05-06-99	285	0.017 ± 0.003	11-04-99	285	0.047 ± 0.004
05-13-99	286	0.013 ± 0.003	11-11-99	285	0.046 ± 0.004
05-20-99	285	0.016 ± 0.003	11-18-99	287	0.048 ± 0.004
05-27-99	285	0.016 ± 0.003	11-24-99	243	0.063 ± 0.005
06-03-99	286	0.022 ± 0.003	12-02-99	327	0.034 ± 0.004
06-10-99	285	0.016 ± 0.003	12-09-99	285	0.047 ± 0.004
06-17-99	285	0.017 ± 0.003	12-16-99	286	0.047 ± 0.005
06-24-99	285	0.024 ± 0.003	12-22-99	245	0.037 ± 0.005
07-01-99	286	0.020 ± 0.004	12-30-99	327	0.041 ± 0.004
2nd Quarter Mean ± s.d.		0.018 ± 0.003	4th Quarter Mean ± s.d.		0.040 ± 0.013
			Cumulative Average		0.027
			Previous Annual Average		0.024

[a] Iodine-131 concentrations are <0.07 pCi/m^3 unless noted otherwise.

Table 5. Airborne particulates, analysis for 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		0.010			0.010
01-07-99	327	0.033 ± 0.004	07-08-99	285	0.021 ± 0.003
01-14-99	286	0.043 ± 0.004	07-15-99	288	0.024 ± 0.004
01-21-99	283	0.020 ± 0.004	07-22-99	283	0.025 ± 0.003
01-28-99	287	0.022 ± 0.003	08-02-99	451	0.022 ± 0.003
02-04-99	285	0.019 ± 0.003	08-06-99	161	0.014 ± 0.006
02-11-99	286	0.017 ± 0.004	08-12-99	245	0.024 ± 0.004
02-19-99	328	0.017 ± 0.003	08-19-99	286	0.022 ± 0.004
02-25-99	243	0.019 ± 0.004	08-26-99	286	0.028 ± 0.004
			09-02-99	285	0.037 ± 0.004
03-04-99	285	0.020 ± 0.003			
03-11-99	286	0.017 ± 0.003	09-09-99	286	0.037 ± 0.004
03-18-99	285	0.019 ± 0.003	09-16-99	286	0.020 ± 0.004
03-25-99	284	0.021 ± 0.003	09-23-99	285	0.027 ± 0.004
04-01-99	287	0.017 ± 0.003	09-30-99	287	0.027 ± 0.004
1st Quarter Mean ± s.d.		0.022 ± 0.008	3rd Quarter Mean ± s.d.		0.025 ± 0.006
04-08-99	284	0.021 ± 0.003	10-07-99	284	0.023 ± 0.004
04-15-99	285	0.015 ± 0.003	10-14-99	287	0.042 ± 0.004
04-22-99	285	0.015 ± 0.003	10-21-99	285	0.026 ± 0.004
04-29-99	285	0.014 ± 0.003	10-28-99	287	0.027 ± 0.004
05-06-99	285	0.015 ± 0.003	11-04-99	285	0.047 ± 0.004
05-13-99	286	0.010 ± 0.003	11-11-99	285	0.048 ± 0.004
05-20-99	286	0.013 ± 0.003	11-18-99	288	0.046 ± 0.004
05-27-99	285	0.019 ± 0.003	11-24-99	241	0.052 ± 0.005
06-03-99	286	0.022 ± 0.003	12-02-99	327	0.038 ± 0.004
06-10-99	286	0.020 ± 0.004	12-09-99	285	0.046 ± 0.004
06-17-99	285	0.015 ± 0.003	12-16-99	286	0.054 ± 0.005
06-24-99	285	0.023 ± 0.003	12-22-99	245	0.042 ± 0.005
07-01-99	286	0.019 ± 0.004	12-30-99	327	0.043 ± 0.005
2nd Quarter Mean ± s.d.		0.017 ± 0.004	4th Quarter Mean ± s.d.		0.041 ± 0.010
			Cumulative Average		0.026
			Previous Annual Average		0.025

Table 6. Airborne particulates and charcoal canisters, analyses for 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		0.010			0.010
01-07-99	327	0.033 ± 0.004	07-08-99	254	0.018 ± 0.003
01-14-99	286	0.040 ± 0.004	07-15-99	288	0.021 ± 0.003
01-21-99	283	0.017 ± 0.003	07-22-99	283	0.020 ± 0.003
01-28-99	283	0.026 ± 0.004	08-02-99	450	0.018 ± 0.003
02-04-99	289	0.025 ± 0.004	08-06-99	161	0.011 ± 0.006
02-11-99	286	0.019 ± 0.004	08-12-99	245	0.022 ± 0.004
02-19-99	328	0.019 ± 0.003	08-19-99	285	0.018 ± 0.004
02-25-99	243	0.013 ± 0.004	08-26-99	286	0.034 ± 0.004
			09-02-99	285	0.033 ± 0.004
03-04-99	285	0.015 ± 0.003			
03-11-99	286	0.021 ± 0.003	09-09-99	286	0.032 ± 0.004
03-18-99	285	0.018 ± 0.003	09-16-99	286	0.024 ± 0.004
03-25-99	284	0.018 ± 0.003	09-23-99	285	0.031 ± 0.004
04-01-99	286	0.018 ± 0.003	09-30-99	286	0.026 ± 0.004
1st Quarter Mean ± s.d.		0.022 ± 0.008	3rd Quarter Mean ± s.d.		0.024 ± 0.007
04-08-99	283	0.017 ± 0.003	10-07-99	285	0.017 ± 0.004
04-15-99	286	0.018 ± 0.004	10-14-99	287	0.041 ± 0.004
04-22-99	285	0.016 ± 0.003	10-21-99	285	0.031 ± 0.004
04-29-99	285	0.014 ± 0.003	10-28-99	287	0.019 ± 0.003
05-06-99	285	0.012 ± 0.003	11-04-99	285	0.050 ± 0.004
05-13-99	286	0.011 ± 0.003	11-11-99	285	0.047 ± 0.004
05-20-99	285	0.013 ± 0.003	11-18-99	287	0.047 ± 0.004
05-27-99	285	0.015 ± 0.003	11-24-99	242	0.058 ± 0.005
06-03-99	286	0.018 ± 0.003	12-02-99	325	0.037 ± 0.004
06-10-99	285	0.016 ± 0.003	12-09-99	285	0.036 ± 0.004
06-17-99	285	0.011 ± 0.003	12-16-99	286	0.044 ± 0.005
06-24-99	285	0.021 ± 0.003	12-22-99	245	0.040 ± 0.005
07-01-99	286	0.019 ± 0.004	12-30-99	327	0.037 ± 0.004
2nd Quarter Mean ± s.d.		0.015 ± 0.003	4th Quarter Mean ± s.d.		0.039 ± 0.012
			Cumulative Average		0.025
			Previous Annual Average		0.024

[a] Iodine-131 concentrations are <0.07 pCi/m^3 unless noted otherwise.

Table 7. Airborne particulates and charcoal canisters, analyses for 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		0.010			0.010
01-07-99	328	0.029 ± 0.003	07-08-99	282	0.024 ± 0.003
01-14-99	286	0.039 ± 0.004	07-15-99	288	0.023 ± 0.003
01-21-99	283	0.019 ± 0.004	07-22-99	283	0.024 ± 0.003
01-28-99	287	0.025 ± 0.003	08-02-99	443	0.022 ± 0.003
02-04-99	285	0.022 ± 0.004	08-06-99	161	0.009 ± 0.006
02-11-99	285	0.019 ± 0.004	08-12-99	245	0.026 ± 0.004
02-19-99	329	0.015 ± 0.003	08-19-99	285	0.021 ± 0.004
02-25-99	243	0.019 ± 0.004	08-26-99	286	0.030 ± 0.004
			09-02-99	284	0.035 ± 0.004
03-04-99	285	0.017 ± 0.003			
03-11-99	286	0.018 ± 0.003	09-09-99	286	0.055 ± 0.005[b]
03-18-99	285	0.020 ± 0.003	09-16-99	286	0.021 ± 0.004
03-25-99	284	0.019 ± 0.003	09-23-99	285	0.032 ± 0.004
04-01-99	285	0.017 ± 0.003	09-30-99	286	0.026 ± 0.004
1st Quarter Mean ± s.d.		0.021 ± 0.006	3rd Quarter Mean ± s.d.		0.027 ± 0.011
04-08-99	284	0.019 ± 0.003	10-07-99	285	0.021 ± 0.004
04-15-99	286	0.017 ± 0.003	10-14-99	287	0.042 ± 0.004
04-22-99	285	0.013 ± 0.003	10-21-99	285	0.029 ± 0.004
04-29-99	285	0.018 ± 0.003	10-28-99	287	0.028 ± 0.004
05-06-99	285	0.016 ± 0.003	11-04-99	285	0.054 ± 0.005
05-13-99	286	0.011 ± 0.003	11-11-99	285	0.050 ± 0.004
05-20-99	281	0.018 ± 0.003	11-18-99	288	0.048 ± 0.004
05-27-99	284	0.019 ± 0.003	11-24-99	242	0.062 ± 0.005
06-03-99	286	0.021 ± 0.003	12-02-99	327	0.044 ± 0.004
06-10-99	286	0.017 ± 0.003	12-09-99	285	0.045 ± 0.004
06-17-99	285	0.015 ± 0.003	12-16-99	286	0.043 ± 0.005
06-24-99	285	0.026 ± 0.004	12-22-99	245	0.039 ± 0.005
07-01-99	286	0.019 ± 0.004	12-30-99	327	0.039 ± 0.004
2nd Quarter Mean ± s.d.		0.018 ± 0.004	4th Quarter Mean ± s.d.		0.042 ± 0.011
			Cumulative Average		0.027
			Previous Annual Average		0.024

[a] Iodine-131 concentrations are <0.07 pCi/m^3 unless noted otherwise.
[b] Analysis was repeated; result of reanalysis 0.062±0.005 pCi/m^3.

Table 8. Airborne particulates, analysis for 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		0.010			0.010
01-07-99	333	0.034 ± 0.004	07-08-99	284	0.025 ± 0.003
01-14-99	287	0.045 ± 0.004	07-15-99	288	0.023 ± 0.003
01-21-99	280	0.023 ± 0.004	07-22-99	283	0.025 ± 0.003
01-28-99	290	0.027 ± 0.003	08-02-99	451	0.021 ± 0.003
02-04-99	285	0.022 ± 0.004	08-06-99	161	0.012 ± 0.006
02-11-99	286	0.018 ± 0.004	08-12-99	246	0.027 ± 0.004
02-19-99	329	0.017 ± 0.003	08-19-99	284	0.021 ± 0.004
02-25-99	242	0.015 ± 0.004	08-26-99	285	0.032 ± 0.004
			09-02-99	286	0.038 ± 0.004
03-04-99	285	0.016 ± 0.003			
03-11-99	286	0.016 ± 0.003	09-09-99	287	0.031 ± 0.004
03-18-99	284	0.018 ± 0.003	09-16-99	284	0.025 ± 0.004
03-25-99	282	0.021 ± 0.003	09-23-99	289	0.032 ± 0.004
04-01-99	285	0.017 ± 0.003	09-30-99	283	0.027 ± 0.004
1st Quarter Mean ± s.d.		0.022 ± 0.009	3rd Quarter Mean ± s.d.		0.026 ± 0.006
04-08-99	284	0.018 ± 0.003	10-07-99	286	0.021 ± 0.004
04-15-99	286	0.017 ± 0.003	10-14-99	285	0.044 ± 0.004
04-22-99	285	0.018 ± 0.003	10-21-99	285	0.025 ± 0.004
04-29-99	285	0.013 ± 0.003	10-28-99	286	0.028 ± 0.004
05-06-99	283	0.015 ± 0.003	11-04-99	286	0.052 ± 0.004
05-13-99	286	0.008 ± 0.003	11-11-99	285	0.043 ± 0.004
05-20-99	281	0.018 ± 0.003	11-18-99	281	0.051 ± 0.005
05-27-99	285	0.013 ± 0.003	11-24-99	249	0.056 ± 0.005
06-03-99	288	0.026 ± 0.003	12-02-99	326	0.040 ± 0.004
06-10-99	284	0.018 ± 0.003	12-09-99	286	0.051 ± 0.004
06-17-99	287	0.012 ± 0.003	12-16-99	285	0.052 ± 0.005
06-24-99	285	0.026 ± 0.004	12-22-99	244	0.031 ± 0.005
07-01-99	285	0.016 ± 0.003	12-30-99	327	0.036 ± 0.004
2nd Quarter Mean ± s.d.		0.017 ± 0.005	4th Quarter Mean ± s.d.		0.041 ± 0.012
			Cumulative Average		0.026
			Previous Annual Average		0.025

Table 9. Airborne particulates and charcoal canisters, analyses for 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		0.010			0.010
01-07-99	327	0.034 ± 0.004	07-08-99	285	0.025 ± 0.003
01-14-99	288	0.040 ± 0.004	07-15-99	288	0.023 ± 0.003
01-21-99	281	0.022 ± 0.004	07-22-99	283	0.025 ± 0.003
01-28-99	289	0.029 ± 0.004	08-02-99	452	0.018 ± 0.003
02-04-99	285	0.027 ± 0.004	08-06-99	159	0.015 ± 0.006
02-11-99	286	0.021 ± 0.004	08-12-99	247	0.025 ± 0.004
02-19-99	328	0.015 ± 0.003	08-19-99	284	0.022 ± 0.004
02-25-99	241	0.026 ± 0.004	08-26-99	286	0.028 ± 0.004
			09-02-99	286	0.030 ± 0.004
03-04-99	286	0.019 ± 0.003			
03-11-99	285	0.018 ± 0.003	09-09-99	285	0.029 ± 0.004
03-18-99	285	0.020 ± 0.003	09-16-99	285	0.025 ± 0.004
03-25-99	285	0.013 ± 0.003	09-23-99	286	0.030 ± 0.004
04-01-99	288	0.018 ± 0.003	09-30-99	286	0.023 ± 0.004
1st Quarter Mean ± s.d.		0.023 ± 0.008	3rd Quarter Mean ± s.d.		0.024 ± 0.004
04-08-99	283	0.017 ± 0.003	10-07-99	285	0.021 ± 0.004
04-15-99	286	0.020 ± 0.004	10-14-99	285	0.043 ± 0.004
04-22-99	285	0.014 ± 0.003	10-21-99	283	0.026 ± 0.004
04-29-99	285	0.016 ± 0.003	10-28-99	286	0.027 ± 0.004
05-06-99	285	0.015 ± 0.003	11-04-99	285	0.049 ± 0.004
05-13-99	287	0.011 ± 0.003	11-11-99	285	0.046 ± 0.004
05-20-99	286	0.014 ± 0.003	11-18-99	285	0.042 ± 0.004
05-27-99	284	0.012 ± 0.003	11-24-99	241	0.047 ± 0.005
06-03-99	288	0.022 ± 0.003	12-02-99	326	0.038 ± 0.004
06-10-99	284	0.013 ± 0.003	12-09-99	287	0.043 ± 0.004
06-17-99	286	0.011 ± 0.003	12-16-99	285	0.048 ± 0.005
06-24-99	285	0.026 ± 0.004	12-22-99	245	0.039 ± 0.005
07-01-99	285	0.016 ± 0.003	12-30-99	327	0.036 ± 0.004
2nd Quarter Mean ± s.d.		0.016 ± 0.004	4th Quarter Mean ± s.d.		0.039 ± 0.009
			Cumulative Average		0.026
			Previous Annual Average		0.024

[a] Iodine-131 concentrations are <0.07 pCi/m^3 unless noted otherwise.

Table 10. Airborne particulates, analysis for gross beta.
Location: D-13
Units: pCi/m^3
Collection: Continuous, weekly exchange.

Date Collected	Volume (m^3)	Gross Beta	Date Collected	Volume (m^3)	Gross Beta
Required LLD		0.010			0.010
01-07-99	327	0.028 ± 0.003	07-08-99	285	0.022 ± 0.003
01-14-99	286	0.040 ± 0.004	07-15-99	288	0.022 ± 0.003
01-21-99	283	0.019 ± 0.004	07-22-99	283	0.024 ± 0.003
01-28-99	287	0.024 ± 0.003	08-02-99	450	0.019 ± 0.003
02-04-99	287	0.027 ± 0.004	08-06-99	161	0.015 ± 0.006
02-11-99	284	0.021 ± 0.004	08-12-99	245	0.024 ± 0.004
02-19-99	333	0.016 ± 0.003	08-19-99	284	0.019 ± 0.004
02-25-99	239	0.018 ± 0.004	08-26-99	286	0.029 ± 0.004
			09-02-99	285	0.038 ± 0.004
03-04-99	286	0.017 ± 0.003			
03-11-99	286	0.017 ± 0.003	09-09-99	286	0.030 ± 0.004
03-18-99	285	0.018 ± 0.003	09-16-99	286	0.023 ± 0.004
03-25-99	284	0.021 ± 0.003	09-23-99	285	0.025 ± 0.004
04-01-99	287	0.018 ± 0.003	09-30-99	287	0.022 ± 0.004
1st Quarter Mean ± s.d.		0.022 ± 0.007	3rd Quarter Mean ± s.d.		0.024 ± 0.006
04-08-99	284	0.018 ± 0.003	10-07-99	284	0.019 ± 0.004
04-15-99	285	0.016 ± 0.003	10-14-99	285	0.033 ± 0.004
04-22-99	285	0.014 ± 0.003	10-21-99	286	0.022 ± 0.003
04-29-99	285	0.012 ± 0.003	10-28-99	286	0.025 ± 0.003
05-06-99	285	0.016 ± 0.003	11-04-99	285	0.042 ± 0.004
05-13-99	286	0.008 ± 0.003	11-11-99	285	0.039 ± 0.004
05-20-99	286	0.010 ± 0.003	11-18-99	289	0.035 ± 0.004
05-27-99	285	0.016 ± 0.003	11-24-99	241	0.052 ± 0.005
06-03-99	286	0.020 ± 0.003	12-02-99	327	0.030 ± 0.004
06-10-99	286	0.013 ± 0.003	12-09-99	285	0.044 ± 0.004
06-17-99	285	0.015 ± 0.003	12-16-99	286	0.047 ± 0.005
06-24-99	284	0.023 ± 0.003	12-22-99	245	0.037 ± 0.005
07-01-99	286	0.017 ± 0.003	12-30-99	327	0.037 ± 0.004
2nd Quarter Mean ± s.d.		0.015 ± 0.004	4th Quarter Mean ± s.d.		0.036 ± 0.010
			Cumulative Average		0.024
			Previous Annual Average		0.026

Table 11. Airborne particulates and charcoal canisters, analyses for 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		0.010			0.010
01-07-99	328	0.025 ± 0.003	07-08-99	267	0.022 ± 0.003
01-14-99	286	0.024 ± 0.003	07-15-99	286	0.020 ± 0.003
01-21-99	283	0.015 ± 0.003	07-22-99	285	0.023 ± 0.003
01-28-99	287	0.025 ± 0.003	08-02-99	449	0.019 ± 0.003
02-04-99	285	0.026 ± 0.004	08-06-99	161	0.014 ± 0.006
02-11-99	286	0.016 ± 0.003	08-12-99	246	0.024 ± 0.004
02-19-99	328	0.013 ± 0.003	08-19-99	286	0.023 ± 0.004
02-25-99	243	0.024 ± 0.004	08-26-99	285	0.022 ± 0.004
			09-02-99	285	0.037 ± 0.004
03-04-99	283	0.014 ± 0.003			
03-11-99	286	0.017 ± 0.003	09-09-99	286	0.025 ± 0.004
03-18-99	284	0.023 ± 0.003	09-16-99	285	0.015 ± 0.003
03-25-99	285	0.021 ± 0.003	09-23-99	285	0.023 ± 0.004
04-01-99	286	0.019 ± 0.004	09-30-99	285	0.022 ± 0.004
1st Quarter Mean ± s.d.		0.020 ± 0.005	3rd Quarter Mean ± s.d.		0.022 ± 0.006
04-08-99	284	0.017 ± 0.003	10-07-99	286	0.015 ± 0.004
04-15-99	286	0.011 ± 0.003	10-14-99	286	0.033 ± 0.004
04-22-99	285	0.013 ± 0.003	10-21-99	285	0.020 ± 0.003
04-29-99	285	0.016 ± 0.003	10-28-99	286	0.019 ± 0.003
05-06-99	285	0.014 ± 0.003	11-04-99	286	0.037 ± 0.004
05-13-99	286	0.012 ± 0.003	11-11-99	285	0.037 ± 0.004
05-20-99	285	0.015 ± 0.003	11-18-99	286	0.036 ± 0.004
05-27-99	285	0.014 ± 0.003	11-24-99	244	0.044 ± 0.005
06-03-99	286	0.021 ± 0.003	12-02-99	327	0.025 ± 0.004
06-10-99	285	0.017 ± 0.003	12-09-99	285	0.041 ± 0.004
06-17-99	285	0.014 ± 0.003	12-16-99	286	0.048 ± 0.005
06-24-99	285	0.029 ± 0.004	12-22-99	245	0.037 ± 0.005
07-01-99	285	0.015 ± 0.003	12-30-99	327	0.037 ± 0.004
2nd Quarter Mean ± s.d.		0.016 ± 0.005	4th Quarter Mean ± s.d.		0.033 ± 0.010
			Cumulative Average		0.023
			Previous Annual Average		0.020

[a] Iodine-131 concentrations are <0.07 pCi/m^3 unless noted otherwise.

Table 12. Airborne particulates, analysis for 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		0.010			0.010
01-07-99	312	0.034 ± 0.004	07-08-99	285	0.020 ± 0.003
01-14-99	285	0.041 ± 0.004	07-15-99	286	0.022 ± 0.003
01-21-99	279	0.018 ± 0.004	07-22-99	285	0.023 ± 0.003
01-28-99	287	0.023 ± 0.003	08-02-99	404	0.020 ± 0.003
02-04-99	285	0.025 ± 0.004	08-06-99	141	< 0.010
02-11-99	286	0.019 ± 0.004	08-12-99	246	0.022 ± 0.004
02-19-99	328	0.023 ± 0.003	08-19-99	286	0.020 ± 0.004
02-25-99	244	0.022 ± 0.004	08-26-99	285	0.032 ± 0.004
			09-02-99	285	0.037 ± 0.004
03-04-99	285	0.019 ± 0.003			
03-11-99	286	0.021 ± 0.003	09-09-99	286	0.030 ± 0.004
03-18-99	284	0.026 ± 0.004	09-16-99	285	0.023 ± 0.004
03-25-99	285	0.025 ± 0.003	09-23-99	285	0.029 ± 0.004
04-01-99	286	0.020 ± 0.004	09-30-99	285	0.033 ± 0.004
1st Quarter Mean ± s.d.		0.024 ± 0.007	3rd Quarter Mean ± s.d.		0.026 ± 0.006
04-08-99	284	0.020 ± 0.003	10-07-99	286	0.021 ± 0.004
04-15-99	286	0.017 ± 0.003	10-14-99	286	0.044 ± 0.004
04-22-99	285	0.019 ± 0.003	10-21-99	285	0.028 ± 0.004
04-29-99	285	0.018 ± 0.003	10-28-99	286	0.025 ± 0.003
05-06-99	285	0.015 ± 0.003	11-04-99	286	0.053 ± 0.004
05-13-99	286	0.010 ± 0.003	11-11-99	285	0.048 ± 0.004
05-20-99	285	0.021 ± 0.003	11-18-99	286	0.053 ± 0.004[a]
05-27-99	285	0.016 ± 0.003	11-24-99	244	0.059 ± 0.005
06-03-99	286	0.024 ± 0.003	12-02-99	327	0.033 ± 0.004
06-10-99	285	0.017 ± 0.003	12-09-99	285	0.045 ± 0.004
06-17-99	285	0.015 ± 0.003	12-16-99	286	0.047 ± 0.005
06-24-99	285	0.023 ± 0.003	12-22-99	245	0.036 ± 0.005
07-01-99	285	0.012 ± 0.003	12-30-99	327	0.039 ± 0.004
2nd Quarter Mean ± s.d.		0.017 ± 0.004	4th Quarter Mean ± s.d.		0.041 ± 0.012
			Cumulative Average		0.027
			Previous Annual Average		0.022

[a] Volume is estimated; Collection sheet lists volume of 164 m3, equivalent to beta activity of 0.092±0.008 pCi/m3.

DUANE ARNOLD

Table 13. Airborne particulates, analyses for gamma-emitting isotopes.
Collection: Quarterly Composite
Units: pCi/m3

Location	D-1			
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP-2354	DAP-4920	DAP-7547	DAP-10035
Volume (m^3)	3755	3709	3711	3712
Be-7	0.068 ± 0.016	0.095 ± 0.014	0.106 ± 0.013	0.080 ± 0.014
Zr-95	< 0.0020	< 0.0007	< 0.0012	< 0.0010
Nb-95	< 0.0014	< 0.0016	< 0.0008	< 0.0013
Ru-103	< 0.0009	< 0.0004	< 0.0005	< 0.0008
Ru-106	< 0.0090	< 0.0074	< 0.0069	< 0.0048
Cs-134	< 0.0004	< 0.0003	< 0.0005	< 0.0003
Cs-137	< 0.0008	< 0.0006	< 0.0008	< 0.0008
Ce-141	< 0.0015	< 0.0012	< 0.0013	< 0.0010
Ce-144	< 0.0046	< 0.0027	< 0.0038	< 0.0034
Location	D-2			
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP-2355	DAP-4921	DAP-7548	DAP-10036
Volume (m^3)	3755	3700	3710	3714
Be-7	0.078 ± 0.014	0.103 ± 0.019	0.080 ± 0.013	0.064 ± 0.011
Zr-95	< 0.0012	< 0.0013	< 0.0012	< 0.0013
Nb-95	< 0.0006	< 0.0007	< 0.0013	< 0.0009
Ru-103	< 0.0006	< 0.0007	< 0.0007	< 0.0007
Ru-106	< 0.0070	< 0.0043	< 0.0048	< 0.0034
Cs-134	< 0.0005	< 0.0004	< 0.0007	< 0.0004
Cs-137	< 0.0006	< 0.0007	< 0.0004	< 0.0004
Ce-141	< 0.0013	< 0.0007	< 0.0014	< 0.0014
Ce-144	< 0.0038	< 0.0042	< 0.0041	< 0.0032
Location	D-3			
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP-2356	DAP-4922	DAP-7549	DAP-10037
Volume (m^3)	3752	3710	3712	3711
Be-7	0.052 ± 0.021	0.091 ± 0.013	0.099 ± 0.013	0.057 ± 0.010
Zr-95	< 0.0012	< 0.0005	< 0.0022	< 0.0009
Nb-95	< 0.0031	< 0.0003	< 0.0005	< 0.0008
Ru-103	< 0.0018	< 0.0006	< 0.0010	< 0.0006
Ru-106	< 0.011	< 0.0034	< 0.0052	< 0.0048
Cs-134	< 0.0009	< 0.0015	< 0.0002	< 0.0003
Cs-137	< 0.0014	< 0.0008	< 0.0007	< 0.0009
Ce-141	< 0.0030	< 0.0014	< 0.0015	< 0.0016
Ce-144	< 0.0063	< 0.0037	< 0.0038	< 0.0043

DUANE ARNOLD

Table 13. Airborne particulates, analyses for gamma-emitting isotopes.
Collection: Quarterly Composite
Units: pCi/m3

Location	D-5			
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP-2357,8	DAP-4923	DAP-7550	DAP-10038
Volume (m^3)	3752	3708	3693	3714
Be-7	0.084 ± 0.013	0.093 ± 0.015	0.097 ± 0.014	0.062 ± 0.011
Zr-95	< 0.0011	< 0.0006	< 0.0008	< 0.0011
Nb-95	< 0.0005	< 0.0002	< 0.0013	< 0.0005
Ru-103	< 0.0013	< 0.0010	< 0.0013	< 0.0007
Ru-106	< 0.0047	< 0.0050	< 0.0077	< 0.0028
Cs-134	< 0.0004	< 0.0015	< 0.0007	< 0.0008
Cs-137	< 0.0005	< 0.0007	< 0.0004	< 0.0004
Ce-141	< 0.0020	< 0.0022	< 0.0019	< 0.0008
Ce-144	< 0.0034	< 0.0039	< 0.0045	< 0.0018
Location	D-6			
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP-2359[a]	DAP-4924	DAP-7551	DAP-10039
Volume (m^3)	3752	3709	3714	3712
Be-7	0.065 ± 0.013	0.096 ± 0.013	0.088 ± 0.012	0.055 ± 0.013
Zr-95	< 0.0017	< 0.0003	< 0.0017	< 0.0025
Nb-95	< 0.0013	< 0.0009	< 0.0006	< 0.0008
Ru-103	< 0.0011	< 0.0005	< 0.0007	< 0.0008
Ru-106	< 0.0036	< 0.0066	< 0.0064	< 0.0039
Cs-134	< 0.0004	< 0.0003	< 0.0004	< 0.0008
Cs-137	< 0.0008	< 0.0007	< 0.0006	< 0.0008
Ce-141	< 0.0015	< 0.0013	< 0.0012	< 0.0019
Ce-144	< 0.0043	< 0.0026	< 0.0026	< 0.0032
Location	D-7			
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP-2360	DAP-4925	DAP-7552	DAP-10040
Volume (m^3)	3751	3707	3680	3711
Be-7	0.076 ± 0.025	0.091 ± 0.012	0.094 ± 0.015	0.057 ± 0.012
Zr-95	< 0.0019	< 0.0012	< 0.0011	< 0.0010
Nb-95	< 0.0028	< 0.0007	< 0.0005	< 0.0014
Ru-103	< 0.0015	< 0.0009	< 0.0010	< 0.0010
Ru-106	< 0.0080	< 0.0039	< 0.0034	< 0.0037
Cs-134	< 0.0014	< 0.0003	< 0.0006	< 0.0006
Cs-137	< 0.0007	< 0.0010	< 0.0009	< 0.0008
Ce-141	< 0.0036	< 0.0008	< 0.0012	< 0.0020
Ce-144	< 0.0079	< 0.0044	< 0.0021	< 0.0041

[a] Trace of Co-60 detected; 0.0016±0.0006 pCi/m^3; Result of reanalysis, 0.0021±0.0010 pCi/m^3.

Table 13. Airborne particulates, analyses for gamma-emitting isotopes.
Collection: Quarterly Composite
Units: pCi/m3

Location	D-8			
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP-2361	DAP-4926	DAP-7553[a]	DAP-10041
Volume (m^3)	3751	3704	3700	3714
Be-7	0.070 ± 0.015	0.150 ± 0.021	0.096 ± 0.015	0.082 ± 0.012
Zr-95	< 0.0011	< 0.0014	< 0.0020	< 0.0015
Nb-95	< 0.0014	< 0.0015	< 0.0012	< 0.0004
Ru-103	< 0.0011	< 0.0011	< 0.0012	< 0.0008
Ru-106	< 0.0096	< 0.0040	< 0.0077	< 0.0054
Cs-134	< 0.0004	< 0.0015	< 0.0010	< 0.0005
Cs-137	< 0.0005	< 0.0007	< 0.0009	< 0.0005
Ce-141	< 0.0007	< 0.0013	< 0.0015	< 0.0010
Ce-144	< 0.0029	< 0.0045	< 0.0036	< 0.0020
Location	D-10			
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP-2362	DAP-4927	DAP-7554	DAP-10042
Volume (m^3)	3754	3704	3711	3711
Be-7	0.082 ± 0.015	0.150 ± 0.022	0.093 ± 0.013	0.061 ± 0.011
Zr-95	< 0.0010	< 0.0012	< 0.0014	< 0.0009
Nb-95	< 0.0016	< 0.0005	< 0.0011	< 0.0007
Ru-103	< 0.0009	< 0.0009	< 0.0008	< 0.0011
Ru-106	< 0.0041	< 0.0022	< 0.0043	< 0.0058
Cs-134	< 0.0004	< 0.0016	< 0.0006	< 0.0007
Cs-137	< 0.0004	< 0.0007	< 0.0007	< 0.0005
Ce-141	< 0.0013	< 0.0020	< 0.0013	< 0.0014
Ce-144	< 0.0046	< 0.0044	< 0.0017	< 0.0047
Location	D-11			
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP-2363	DAP-4928	DAP-7555	DAP-10043
Volume (m^3)	3754	3709	3712	3705
Be-7	0.062 ± 0.012	0.122 ± 0.020	0.089 ± 0.011	0.058 ± 0.010
Zr-95	< 0.0011	< 0.0009	< 0.0013	< 0.0017
Nb-95	< 0.0007	< 0.0010	< 0.0008	< 0.0007
Ru-103	< 0.0009	< 0.0012	< 0.0009	< 0.0004
Ru-106	< 0.0051	< 0.0044	< 0.0051	< 0.0041
Cs-134	< 0.0005	< 0.0007	< 0.0005	< 0.0006
Cs-137	< 0.0003	< 0.0010	< 0.0004	< 0.0003
Ce-141	< 0.0016	< 0.0013	< 0.0007	< 0.0016
Ce-144	< 0.0031	< 0.0051	< 0.0033	< 0.0036

[a] Trace of Co-60 detected; 0.0058±0.0010 pCi/m^3.

DUANE ARNOLD

Table 13. Airborne particulates, analyses for gamma-emitting isotopes.
Collection: Quarterly Composite
Units: pCi/m3

Location	D-13			
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP-2364	DAP-4929	DAP-7556	DAP-10044
Volume (m^3)	3754	3708	3711	3711
Be-7	0.094 ± 0.026	0.125 ± 0.019	0.086 ± 0.013	0.049 ± 0.013
Zr-95	< 0.0032	< 0.0016	< 0.0020	< 0.0015
Nb-95	< 0.0030	< 0.0007	< 0.0007	< 0.0008
Ru-103	< 0.0016	< 0.0010	< 0.0009	< 0.0008
Ru-106	< 0.012	< 0.0024	< 0.0038	< 0.0080
Cs-134	< 0.0007	< 0.0015	< 0.0007	< 0.0009
Cs-137	< 0.0010	< 0.0006	< 0.0007	< 0.0009
Ce-141	< 0.0032	< 0.0013	< 0.0016	< 0.0019
Ce-144	< 0.0091	< 0.0039	< 0.0036	< 0.0059
Location	D-15			
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP-2365	DAP-4930	DAP-7557	DAP-10045
Volume (m^3)	3750	3707	3691	3714
Be-7	0.088 ± 0.020	0.132 ± 0.020	0.078 ± 0.015	0.057 ± 0.011
Zr-95	< 0.0017	< 0.0010	< 0.0018	< 0.0012
Nb-95	< 0.0006	< 0.0016	< 0.0014	< 0.0009
Ru-103	< 0.0010	< 0.0014	< 0.0012	< 0.0005
Ru-106	< 0.0033	< 0.0035	< 0.0032	< 0.0060
Cs-134	< 0.0004	< 0.0003	< 0.0006	< 0.0004
Cs-137	< 0.0007	< 0.0014	< 0.0008	< 0.0008
Ce-141	< 0.0010	< 0.0023	< 0.0016	< 0.0006
Ce-144	< 0.0054	< 0.0033	< 0.0035	< 0.0015
Location	D-16			
Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Lab Code	DAP-2366	DAP-4931	DAP-7558	DAP-10046
Volume (m^3)	3732	3707	3644	3714
Be-7	0.086 ± 0.016	0.134 ± 0.021	0.092 ± 0.013	0.055 ± 0.008
Zr-95	< 0.0012	< 0.0013	< 0.0010	< 0.0012
Nb-95	< 0.0010	< 0.0015	< 0.0011	< 0.0007
Ru-103	< 0.0015	< 0.0024	< 0.0009	< 0.0007
Ru-106	< 0.0068	< 0.0058	< 0.0032	< 0.0031
Cs-134	< 0.0011	< 0.0014	< 0.0009	< 0.0004
Cs-137	< 0.0004	< 0.0009	< 0.0006	< 0.0005
Ce-141	< 0.0018	< 0.0033	< 0.0009	< 0.0009
Ce-144	< 0.0036	< 0.0042	< 0.0028	< 0.0019

Table 14. Area monitors (TLD), Quarterly, 1999.
Units: mR/91 days

Air Stations	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
D-1 (C)	12.9 ± 0.2	13.6 ± 0.2	12.9 ± 0.2	13.9 ± 0.5
D-2 (C)	13.8 ± 0.2	13.3 ± 0.2	15.1 ± 0.2	14.2 ± 0.4
D-3	13.8 ± 0.3	13.4 ± 0.2	13.5 ± 0.2	14.2 ± 0.3
D-5	13.9 ± 0.3	14.8 ± 0.3	15.1 ± 0.2	16.0 ± 0.2
D-6	13.7 ± 0.2	14.7 ± 0.4	13.3 ± 0.2	16.9 ± 0.4
D-7	13.2 ± 0.2	17.7 ± 0.3[a]	14.4 ± 0.2	11.5 ± 0.2
D-8	17.7 ± 0.3	16.0 ± 0.3	18.1 ± 0.2	21.0 ± 0.2
D-10	13.9 ± 0.3	12.0 ± 0.3	15.9 ± 0.2	18.0 ± 0.2
D-11	10.8 ± 0.2	16.9 ± 0.2	10.9 ± 0.2	12.8 ± 0.3
D-13 (C)	14.4 ± 0.2	14.9 ± 0.2	15.8 ± 0.2	17.5 ± 0.2
D-15	14.7 ± 0.2	14.0 ± 0.3	15.1 ± 0.2	17.4 ± 0.2
D-16	15.0 ± 0.2	15.6 ± 0.2	15.1 ± 0.2	14.4 ± 0.2
Mean ± s.d.	14.0 ± 1.6	14.7 ± 1.6	14.6 ± 1.8	15.7 ± 2.6
Within 0.5 mi. of Stack				
D-18	15.4 ± 0.2	15.6 ± 0.2	15.8 ± 0.2	16.9 ± 0.3
D-19	15.5 ± 0.2	14.8 ± 0.3	14.7 ± 0.2	15.5 ± 0.2
D-20	16.4 ± 0.2	17.3 ± 0.2	17.4 ± 0.2	17.4 ± 0.3
D-21	16.8 ± 0.2	14.7 ± 0.3	17.3 ± 0.2	16.9 ± 0.2
D-22	15.2 ± 0.2	16.1 ± 0.2	15.4 ± 0.2	16.4 ± 0.2
D-23	14.0 ± 0.2	12.8 ± 0.2	14.3 ± 0.2	15.9 ± 0.3
D-28	16.5 ± 0.2	17.6 ± 0.2	19.8 ± 0.2	21.0 ± 0.2
D-29	17.9 ± 0.2	18.8 ± 0.2	ND[b]	21.4 ± 0.2
D-30	19.0 ± 0.2	20.0 ± 0.2	21.3 ± 0.2	22.5 ± 0.3
D-31	19.5 ± 0.2	20.4 ± 0.2	21.3 ± 0.2	23.9 ± 0.3
D-32	18.9 ± 0.2	19.4 ± 0.2	20.1 ± 0.3	22.2 ± 0.3
D-82	14.1 ± 0.2	13.8 ± 0.2	14.3 ± 0.2	16.5 ± 0.3
D-83	15.4 ± 0.2	16.0 ± 0.2	16.2 ± 0.3	16.9 ± 0.3
D-84	16.5 ± 0.2	19.1 ± 0.2[a]	16.4 ± 0.3	16.0 ± 0.2
D-85	15.1 ± 0.2	15.0 ± 0.3	15.9 ± 0.2	16.9 ± 0.2
D-86	17.5 ± 0.2	16.6 ± 0.2	17.1 ± 0.2	18.9 ± 0.3
D-91	16.5 ± 0.2	16.5 ± 0.2	14.9 ± 0.2[a]	17.9 ± 0.2
Mean ± s.d.	16.5 ± 1.6	16.7 ± 2.2	17.0 ± 2.4	18.4 ± 2.7

[a] TLD lost in the field. Readout from emergency TLD.

[b] ND= No data; Both regular and emergency TLDs lost in the field.

DUANE ARNOLD

Table 14. Area monitors (TLD), Quarterly, 1999.
Units: mR/91 days

Within 1.0 mi. of Stack	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
D-43	14.8 ± 0.2	14.9 ± 0.3	16.2 ± 0.2	17.0 ± 0.2
D-44	17.6 ± 0.2	18.8 ± 0.3	20.5 ± 0.3	21.4 ± 0.3
D-45	14.9 ± 0.2	15.8 ± 0.2	16.1 ± 0.4	21.3 ± 0.2[b]
D-46	17.6 ± 0.2	20.0 ± 0.2	20.1 ± 0.3	21.1 ± 0.2
D-47	17.4 ± 0.2	18.8 ± 0.4	19.3 ± 0.2	22.0 ± 0.2
D-48	ND[a]	18.6 ± 0.2	18.1 ± 0.2	22.5 ± 0.2
Mean ± s.d.	16.5 ± 1.5	17.8 ± 2.0	18.4 ± 1.9	20.9 ± 2.0
Within 3.0 mi. of Stack				
D-33	12.7 ± 0.2	13.4 ± 0.2	13.5 ± 0.2	15.5 ± 0.2
D-34	13.2 ± 0.2	14.5 ± 0.2	14.0 ± 0.2	15.9 ± 0.3
D-35	14.0 ± 0.2	13.7 ± 0.3	15.0 ± 0.3	15.9 ± 0.3
D-36	13.9 ± 0.2	14.9 ± 0.3	14.3 ± 0.3	17.0 ± 0.2
D-37	18.3 ± 0.2	17.3 ± 0.2	19.8 ± 0.2	19.3 ± 0.4
D-38	15.5 ± 0.2	16.1 ± 0.2	16.8 ± 0.5	17.5 ± 0.2
D-39	ND[a]	16.0 ± 0.2	18.5 ± 0.2	18.0 ± 0.2
D-40	13.2 ± 0.2	13.3 ± 0.3	12.4 ± 0.2	15.5 ± 0.2
D-41	14.5 ± 0.2	15.0 ± 0.3	16.2 ± 0.2	17.0 ± 0.3
D-42	13.5 ± 0.4	14.7 ± 0.3	14.0 ± 0.2	16.5 ± 0.2
Mean ± s.d.	14.3 ± 1.7	14.9 ± 1.3	15.5 ± 2.3	16.8 ± 1.2

[a] ND = No data; TLD lost in the field.

[b] TLD lost in the field. Readout from emergency TLD.

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)

Location		D-63					
Date	Lab	Concentration (pCi/L)					
Collected	Code	I-131	K-40	Cs-134	Cs-137	Ba-140	La-140
01-05-99	DMI -17	< 1.0	1164 ± 153	< 15	< 18	< 60	< 15
02-02-99	-650	< 1.0	1241 ± 157	< 15	< 18	< 60	< 15
03-02-99	-1318	< 1.0	1237 ± 147	< 15	< 18	< 60	< 15
04-06-99	-2130	< 1.2[b]	1204 ± 91	< 15	< 18	< 60	< 15
05-04-99	-3011	< 1.0	1382 ± 163	< 15	< 18	< 60	< 15
05-18-99	-3406	< 1.0	1424 ± 114	< 15	< 18	< 60	< 15
06-02-99	-3783	< 1.0	1341 ± 121	< 15	< 18	< 60	< 15
06-15-99	-4211	< 1.0	1409 ± 155	< 15	< 18	< 60	< 15
06-29-99	-4658	< 1.0	1414 ± 117	< 15	< 18	< 60	< 15
07-15-99	-5284	< 1.0	1573 ± 175	< 15	< 18	< 60	< 15
08-03-99	-5665	< 1.0	1392 ± 151	< 15	< 18	< 60	< 15
08-17-99	-6095	< 1.0	1530 ± 144	< 15	< 18	< 60	< 15
08-31-99	-6380	< 1.0	1450 ± 111	< 15	< 18	< 60	< 15
09-14-99	-6759	< 1.0	1321 ± 193	< 15	< 18	< 60	< 15
09-28-99	-7121	< 1.0	1383 ± 88	< 15	< 18	< 60	< 15
10-12-99	-7806	< 1.0	1285 ± 104	< 15	< 18	< 60	< 15
11-03-99	-8646	< 1.0	1217 ± 111	< 15	< 18	< 60	< 15
12-06-99	-9401	< 1.0	1117 ± 146	< 15	< 18	< 60	< 15

Location		D-93					
Date	Lab	Concentration (pCi/L)					
Collected	Code	I-131	K-40	Cs-134	Cs-137	Ba-140	La-140
01-05-99	ND[a]	-	-	-	-	-	-
02-02-99	ND[a]	-	-	-	-	-	-
03-02-99	DMI -1319	< 1.0	1392 ± 167	< 15	< 18	< 60	< 15
04-06-99	-2131	< 1.0	1577 ± 196	< 15	< 18	< 60	< 15
05-04-99	-3012	< 1.0	1614 ± 129	< 15	< 18	< 60	< 15
05-18-99	-3407	< 1.0	1630 ± 114	< 15	< 18	< 60	< 15
06-02-99	-3784	< 1.0	1773 ± 128	< 15	< 18	< 60	< 15
06-15-99	-4212	< 1.0	1753 ± 131	< 15	< 18	< 60	< 15
06-29-99	-4659	< 1.0	1816 ± 213	< 15	< 18	< 60	< 15
07-15-99	-5285	< 1.0	1808 ± 129	< 15	< 18	< 60	< 15
08-03-99	-5666,7	< 1.0	1682 ± 131	< 15	< 18	< 60	< 15
08-17-99	-6096	< 1.0	1841 ± 189	< 15	< 18	< 60	< 15
08-31-99	-6381	< 1.0	1786 ± 223	< 15	< 18	< 60	< 15
09-14-99	-6760	< 1.0	1705 ± 144	< 15	< 18	< 60	< 15
09-28-99	-7122	< 1.0	1715 ± 189	< 15	< 18	< 60	< 15
10-12-99	-7807	< 1.0	1515 ± 198	< 15	< 18	< 60	< 15
11-03-99	-8647	< 1.0	1740 ± 138	< 15	< 18	< 60	< 15
12-06-99	-9402, 3	< 1.0	2021 ± 110	< 15	< 18	< 60	< 15

[a] ND=No data; sample not available.

[b] Required LLD of 1.0 pCi/L not reached due to low sample volume (200 ml.)

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)

Location		D-96					
Date	Lab	Concentration (pCi/L)					
Collected	Code	I-131	K-40	Cs-134	Cs-137	Ba-140	La-140
01-05-99	DMI -18	< 1.0	1373 ± 177	< 15	< 18	< 60	< 15
02-02-99	-651	< 1.0	1511 ± 167	< 15	< 18	< 60	< 15
03-02-99	-1320	< 1.0	1367 ± 178	< 15	< 18	< 60	< 15
04-06-99	-2132	< 1.0	1369 ± 124	< 15	< 18	< 60	< 15
05-04-99	-3013	< 1.0	1435 ± 182	< 15	< 18	< 60	< 15
05-18-99	-3408	< 1.0	1455 ± 95	< 15	< 18	< 60	< 15
06-02-99	-3785	< 1.0	1557 ± 190	< 15	< 18	< 60	< 15
06-15-99	-4213	< 1.0	1350 ± 120	< 15	< 18	< 60	< 15
06-29-99	-4660	< 1.0	1410 ± 177	< 15	< 18	< 60	< 15
07-15-99	-5286	< 1.0	1460 ± 133	< 15	< 18	< 60	< 15
08-03-99	-5668	< 1.0	1503 ± 107	< 15	< 18	< 60	< 15
08-17-99	-6097	< 1.0	1572 ± 191	< 15	< 18	< 60	< 15
08-31-99	-6382	< 1.0	1411 ± 105	< 15	< 18	< 60	< 15
09-14-99	-6761	< 1.0	1468 ± 103	< 15	< 18	< 60	< 15
09-28-99	-7123	< 1.0	1312 ± 188	< 15	< 18	< 60	< 15
10-12-99	-7808	< 1.0	1294 ± 165	< 15	< 18	< 60	< 15
11-03-99	-8648	< 1.0	1103 ± 160	< 15	< 18	< 60	< 15
12-06-99	-9404	< 1.0	1452 ± 108	< 15	< 18	< 60	< 15

Location		D-101					
Date	Lab	Concentration (pCi/L)					
Collected	Code	I-131	K-40	Cs-134	Cs-137	Ba-140	La-140
01-05-99	ND[a]	-	-	-	-	-	-
02-02-99	ND[a]	-	-	-	-	-	-
03-02-99	ND[a]	-	-	-	-	-	
04-06-99	DMI -2133	< 1.0	1245 ± 86	< 15	< 18	< 60	< 15
05-04-99	-3014	< 1.0	1304 ± 123	< 15	< 18	< 60	< 15
05-18-99	-3409	< 1.0	1498 ± 142	< 15	< 18	< 60	< 15
06-02-99	ND[a]	-	-	-	-	-	-
06-15-99	ND[a]	-	-	-	-	-	-
06-29-99	ND[a]	-	-	-	-	-	
07-15-99	ND[a]	-	-	-	-	-	
08-03-99	ND[a]	-	-	-	-	-	
08-17-99	ND[a]	-	-	-	-	-	
08-31-99	-6383	< 1.0	1536 ± 165	< 15	< 18	< 60	< 15
09-14-99	-6762	< 1.0	1585 ± 94	< 15	< 18	< 60	< 15
09-28-99	-7124	< 1.0	1545 ± 103	< 15	< 18	< 60	< 15
10-12-99	-7809	< 1.0	1458 ± 183	< 15	< 18	< 60	< 15
11-03-99	-8649	< 1.0	1592 ± 180	< 15	< 18	< 60	< 15
12-06-99	-9405	< 1.0	1553 ± 164	< 15	< 18	< 60	< 15

[a] ND=No data; sample not available.

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)

Location		D-105					
Date	Lab	Concentration (pCi/L)					
Collected	Code	I-131	K-40	Cs-134	Cs-137	Ba-140	La-140
01-05-99	DMI -19	< 1.0	1442 ± 119	< 15	< 18	< 60	< 15
02-02-99	-652	< 1.0	1376 ± 167	< 15	< 18	< 60	< 15
03-02-99	-1321	< 1.0	1456 ± 140	< 15	< 18	< 60	< 15
04-06-99	-2134,5	< 1.0	1401 ± 112	< 15	< 18	< 60	< 15
05-04-99	-3015	< 1.0	1502 ± 156	< 15	< 18	< 60	< 15
05-18-99	-3410	< 1.0	1381 ± 155	< 15	< 18	< 60	< 15
06-02-99	-3786	< 1.0	1374 ± 164	< 15	< 18	< 60	< 15
06-15-99	-4214	< 1.0	1520 ± 117	< 15	< 18	< 60	< 15
06-29-99	-4661	< 1.0	1365 ± 126	< 15	< 18	< 60	< 15
07-15-99	-5287, 8	< 1.0	1349 ± 93	< 15	< 18	< 60	< 15
08-03-99	-5669	< 1.0	1240 ± 108	< 15	< 18	< 60	< 15
08-17-99	-6098	< 1.0	1435 ± 128	< 15	< 18	< 60	< 15
08-31-99	-6384	< 1.0	1415 ± 176	< 15	< 18	< 60	< 15
09-14-99	-6763	< 1.0	1304 ± 161	< 15	< 18	< 60	< 15
09-28-99	-7125	< 1.0	1449 ± 194	< 15	< 18	< 60	< 15
10-12-99	-7810	< 1.0	1316 ± 108	< 15	< 18	< 60	< 15
11-03-99	-8650	< 1.0	1475 ± 182	< 15	< 18	< 60	< 15
12-06-99	-9406	< 1.0	1404 ± 185	< 15	< 18	< 60	< 15

DUANE ARNOLD

Table 16. Well water samples, analyses for gross beta and tritium.
Collection: Quarterly
Units: pCi/L

Location	D-53 Treated Municipal Water			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1737	DWW-3998	DWW-6926	DWW-9127
Gross Beta	2.7 ± 0.7	3.0 ± 0.6	2.5 ± 0.6	2.4 ± 0.6
H-3	< 168	< 155	< 197	< 183
Location	D-54 Inlet to Municipal Water			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1738	DWW-3999	DWW-6927	DWW-9128
Gross Beta	3.1 ± 0.8	3.3 ± 0.7	3.0 ± 0.6	2.3 ± 0.6
H-3	< 168	< 155	< 197	< 183
Location	D-55 On-site Well			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1739	DWW-4000	DWW-6928	DWW-9129
Gross Beta	< 1.2	< 1.0	< 1.0	< 1.1
H-3	< 168	< 155	< 197	< 183
Location	D-57 Bull Farm			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1740	DWW-4001	DWW-6929	DWW-9130
Gross Beta	< 1.1	2.2 ± 0.6	< 1.0	< 1.0
H-3	< 168	< 155	< 197	< 183
Location	D-58 Franz Farm			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1741	DWW-4002	DWW-6930	DWW-9131
Gross Beta	6.1 ± 0.9	5.1 ± 0.8	5.9 ± 0.8	6.6 ± 0.8
H-3	< 168	< 155	< 197	< 183
Location	D-72 Van Note Farm			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1742	DWW-4003	DWW-6931	DWW-9132
Gross Beta	< 1.2	< 1.0	< 1.0	< 1.1
H-3	< 168	< 177	< 197	< 183

DUANE ARNOLD

Table 17. Vegetation (broadleaf), analyses for iodine-131 and other gamma-emitting isotopes.
Collection: Annually
Units: pCi/g wet

	Indicator			
Location	D-57	D-93	D-94	D-106
Lab Code			DVE-5670	
Date Collected			8/3/99	
Sample Type			Rhubarb	
K-40			5.89 ± 0.38	
Mn-54			< 0.014	
Co-58			< 0.020	
Co-60			< 0.017	
Nb-95			< 0.027	
Zr-95			< 0.023	
Ru-103			< 0.021	
Ru-106			< 0.16	
I-131			< 0.022	
Cs-134			< 0.018	
Cs-137			< 0.017	
Ce-141			< 0.030	
Ce-144			< 0.12	

	Control
Location	D-105
Lab Code	DVE-5671
Date Collected	8/3/99
Sample Type	Rhubarb
K-40	3.41 ± 0.30
Mn-54	< 0.013
Co-58	< 0.007
Co-60	< 0.013
Nb-95	< 0.019
Zr-95	< 0.017
Ru-103	< 0.009
Ru-106	< 0.092
I-131	< 0.014
Cs-134	< 0.015
Cs-137	< 0.013
Ce-141	< 0.022
Ce-144	< 0.081

DUANE ARNOLD

Table 18. Vegetation (hay and grain), analyses for gamma-emitting isotopes.
Collection: Annually
Units: pCi/g wet

Location	D-16	D-57	D-58	D-63	D-72
Lab Code	DVE-6932	DVE-6933	DVE-6934	DVE-7126	DVE-6935
Date Collected	9/20/99	9/20/99	9/20/99	9/28/99	9/20/99
Sample Type	Soybeans	Corn	Corn	Corn	Corn
K-40	4.23 ± 0.48	1.87 ± 0.29	2.20 ± 0.27	2.88 ± 0.29	2.61 ± 0.31
Mn-54	< 0.009	< 0.011	< 0.010	< 0.008	< 0.012
Co-58	< 0.013	< 0.007	< 0.008	< 0.011	< 0.010
Co-60	< 0.017	< 0.011	< 0.013	< 0.016	< 0.013
Nb-95	< 0.009	< 0.014	< 0.010	< 0.008	< 0.011
Zr-95	< 0.019	< 0.024	< 0.021	< 0.021	< 0.018
Ru-103	< 0.011	< 0.008	< 0.012	< 0.009	< 0.007
Ru-106	< 0.15	< 0.13	< 0.045	< 0.085	< 0.055
Cs-134	< 0.021	< 0.012	< 0.012	< 0.012	< 0.014
Cs-137	< 0.022	< 0.013	< 0.014	< 0.008	< 0.018
Ce-141	< 0.026	< 0.015	< 0.023	< 0.015	< 0.020
Ce-144	< 0.059	< 0.076	< 0.10	< 0.046	< 0.080

Location	D-105	D-106
Lab Code	DVE-7127	
Date Collected	9/28/99	
Sample Type	Corn	
K-40	2.57 ± 0.29	
Mn-54	< 0.006	
Co-58	< 0.012	
Co-60	< 0.014	
Nb-95	< 0.009	
Zr-95	< 0.023	
Ru-103	< 0.009	
Ru-106	< 0.10	
Cs-134	< 0.013	
Cs-137	< 0.014	
Ce-141	< 0.024	
Ce-144	< 0.081	

DUANE ARNOLD

Table 18. Vegetation (hay and grain), analyses for gamma-emitting isotopes.
Collection: Annually
Units: pCi/g wet

Location	D-16	D-57	D-63	D-72	D-105
Lab Code	DVE-6099	DVE-6100	DVE-6101	DVE-6102	DVE-6103
Date Collected	8/17/99	8/17/99	8/17/99	8/17/99	8/17/99
Sample Type	Hay	Hay	Hay	Hay	Hay
K-40	7.16 ± 0.60	8.71 ± 0.73	11.50 ± 0.74	24.71 ± 1.55	14.77 ± 0.89
Mn-54	< 0.015	< 0.037	< 0.027	< 0.026	< 0.040
Co-58	< 0.028	< 0.017	< 0.022	< 0.044	< 0.030
Co-60	< 0.032	< 0.043	< 0.027	< 0.035	< 0.045
Nb-95	< 0.041	< 0.032	< 0.038	< 0.049	< 0.044
Zr-95	< 0.073	< 0.077	< 0.088	< 0.11	< 0.073
Ru-103	< 0.034	< 0.024	< 0.031	< 0.041	< 0.032
Ru-106	< 0.24	< 0.27	< 0.26	< 0.38	< 0.32
Cs-134	< 0.017	< 0.040	< 0.038	< 0.025	< 0.031
Cs-137	< 0.031	< 0.043	< 0.034	< 0.053	< 0.029
Ce-141	< 0.055	< 0.052	< 0.053	< 0.073	< 0.066
Ce-144	< 0.21	< 0.11	< 0.22	< 0.27	< 0.23

Table 19. Surface water samples, analyses for iodine-131 and gamma-emitting isotopes.
Collectior Monthly
Units: pCi/L
Location: D-49

Date Collected	01-26-99	02-10-99	03-17-99	04-12-99	05-10-99	06-08-99
Lab Code	DSW-513	DSW-852	DSW-1730	DSW-2412	DSW-3187	DSW-3992
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
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 15	< 15	< 15	< 15	< 15	< 15
Cs-137	< 15	< 15	< 15	< 15	< 15	< 15
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

Date Collected	07-21-99	08-30-99	09-20-99	10-12-99	11-17-99	12-06-99
Lab Code	DSW-5356	DSW-6385	DSW-6920	DSW-7811	DSW-9120	DSW-9407
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
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 15	< 15	< 15	< 15	< 15	< 15
Cs-137	< 15	< 15	< 15	< 15	< 15	< 15
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

Table 19. Surface water samples, analyses for iodine-131 and gamma-emitting isotopes.
Collection: Monthly
Units: pCi/L
Location: D-50

Date Collected	01-26-99	02-10-99	03-17-99	04-12-99	05-10-99	06-08-99
Lab Code	DSW-514	DSW-853	DSW-1731,2	DSW-2413	DSW-3188	DSW-3993
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
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 15	< 15	< 15	< 15	< 15	< 15
Cs-137	< 15	< 15	< 15	< 15	< 15	< 15
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

Date Collected	07-21-99	08-30-99	09-20-99	10-12-99	11-17-99	12-06-99
Lab Code	DSW-5357	DSW-6386	DSW-6921	DSW-7812, 3	DSW-9121	DSW-9408
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
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 15	< 15	< 15	< 15	< 15	< 15
Cs-137	< 15	< 15	< 15	< 15	< 15	< 15
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

Table 19. Surface water samples, analyses for iodine-131 and gamma-emitting isotopes.
Collection: Monthly
Units: pCi/L
Location: D-51

Date Collected	01-26-99	02-10-99	03-17-99	04-12-99	05-10-99	06-08-99
Lab Code	DSW-515	DSW-854	DSW-1733	DSW-2414	DSW-3189	DSW-3994
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
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 15	< 15	< 15	< 15	< 15	< 15
Cs-137	< 15	< 15	< 15	< 15	< 15	< 15
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

Date Collected	07-21-99	08-30-99	09-20-99	10-12-99	11-17-99	12-06-99
Lab Code	DSW-5358	DSW-6387	DSW-6922	DSW-7814	DSW-9122	DSW-9409
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
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 15	< 15	< 15	< 15	< 15	< 15
Cs-137	< 15	< 15	< 15	< 15	< 15	< 15
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

Table 19. Surface water samples, analyses for iodine-131 and gamma-emitting isotopes.
Collection: Monthly
Units: pCi/L
Location: D-99

Date Collected	01-26-99	02-10-99	03-17-99	04-12-99	05-10-99	06-08-99
Lab Code	DSW-516	DSW-855	DSW-1734	DSW-2415	DSW-3190	DSW-3995
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
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 15	< 15	< 15	< 15	< 15	< 15
Cs-137	< 15	< 15	< 15	< 15	< 15	< 15
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

Date Collected	07-21-99	08-30-99	09-20-99	10-12-99	11-17-99	12-06-99
Lab Code	DSW-5359	DSW-6388	DSW-6923	DSW-7815	DSW-9123, 4	DSW-9410
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
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 15	< 15	< 15	< 15	< 15	< 15
Cs-137	< 15	< 15	< 15	< 15	< 15	< 15
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

Table 20. Surface water, analyses for potassium-40 by flame photometry, iodine-131 and gamma-emitting isotopes.
Collection: Monthly
Units: pCi/L
Location: D-107

Date Collected	01-26-99	02-10-99	03-17-99	04-12-99	05-10-99	06-08-99
Lab Code	DSW-517	DSW-856	DSW-1735	DSW-2416	DSW-3191	DSW-3996
K-40 (fp)	18.2	19.9	19.9	14.7	10.4	16.4
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
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 15	< 15	< 15	< 15	< 15	< 15
Cs-137	< 15	< 15	< 15	< 15	< 15	< 15
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

Date Collected	07-21-99	08-30-99	09-20-99	10-12-99	11-17-99	12-06-99
Lab Code	DSW-5360	DSW-6389, 90	DSW-6924	DSW-7816	DSW-9125	DSW-9411
K-40 (fp)	14.7	10.8	11.2	21.1	27.7	25.1
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
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 15	< 15	< 15	< 15	< 15	< 15
Cs-137	< 15	< 15	< 15	< 15	< 15	< 15
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

DUANE ARNOLD

Table 21. Surface water, analysis for tritium.
Collection: Quarterly composites of monthly samples.
Units: pCi/L

Location	D-49			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DSW-2463	DSW-4514	DSW-7001	DSW-9517
H-3	< 164	< 175	< 199	< 156

Location	D-50			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DSW-2464	DSW-4515	DSW-7002	DSW-9518
H-3	< 164	< 175	< 191	< 156

Location	D-51			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DSW-2465	DSW-4516	DSW-7003	DSW-9519
H-3	< 164	< 175	< 191	< 156

Location	D-99			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DSW-2466	DSW-4517	DSW-7004	DSW-9520
H-3	< 164	< 175	< 199	< 156

Location	D-107			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DSW-2467	DSW-4518	DSW-7005	DSW-9521
H-3	< 164	< 175	< 199	< 156

DUANE ARNOLD

Table 22. Fish, analyses of edible portion for gamma-emitting isotopes.
Collection: Semiannually
Units: pCi/g wet

Location	Upstream, D-49			
Lab Code	DF-5124, 5	DF-5126	DF-6939	DF-6940
Date Collected	7/11/99	7/11/99	9/16/99	9/16/99
Sample Type	Carp	Carpsucker	Carp	Carpsucker
K-40	2.60 ± 0.26	3.00 ± 0.44	3.50 ± 0.47	2.58 ± 0.38
Mn-54	< 0.011	< 0.019	< 0.014	< 0.015
Fe-59	< 0.037	< 0.067	< 0.046	< 0.031
Co-58	< 0.011	< 0.010	< 0.023	< 0.019
Co-60	< 0.010	< 0.019	< 0.012	< 0.018
Zn-65	< 0.042	< 0.023	< 0.036	< 0.015
Nb-95	< 0.036	< 0.037	< 0.016	< 0.036
Zr-95	< 0.023	< 0.039	< 0.026	< 0.056
Ru-103	< 0.035	< 0.031	< 0.019	< 0.036
Ru-106	< 0.10	< 0.15	< 0.082	< 0.072
Cs-134	< 0.020	< 0.013	< 0.017	< 0.014
Cs-137	< 0.015	< 0.024	< 0.017	< 0.014
Ce-141	< 0.058	< 0.047	< 0.047	< 0.030
Ce-144	< 0.098	< 0.11	< 0.052	< 0.12

Location	Downstream, D-61			
Lab Code	DF-5127	DF-5128	DF-6941	DF-6942
Date Collected	7/11/99	7/11/99	9/16/99	9/16/99
Sample Type	Redhorse	Carpsucker	Carpsucker	Carp
K-40	4.04 ± 0.50	2.91 ± 0.37	3.42 ± 0.38	3.32 ± 0.42
Mn-54	< 0.011	< 0.019	< 0.014	< 0.019
Fe-59	< 0.10	< 0.053	< 0.068	< 0.064
Co-58	< 0.011	< 0.011	< 0.017	< 0.018
Co-60	< 0.014	< 0.021	< 0.008	< 0.022
Zn-65	< 0.021	< 0.032	< 0.018	< 0.025
Nb-95	< 0.035	< 0.038	< 0.013	< 0.049
Zr-95	< 0.054	< 0.023	< 0.018	< 0.018
Ru-103	< 0.020	< 0.018	< 0.019	< 0.029
Ru-106	< 0.19	< 0.10	< 0.10	< 0.15
Cs-134	< 0.021	< 0.018	< 0.004	< 0.009
Cs-137	< 0.019	< 0.014	< 0.013	< 0.017
Ce-141	< 0.045	< 0.035	< 0.045	< 0.025
Ce-144	< 0.079	< 0.061	< 0.052	< 0.099

Table 23. River sediment, analysis for gamma-emitting isotopes.
Collection: Semiannually
Units: pCi/g dry

Location	D-50	
Lab Code	DBS-3193	DBS-6713
Date Collected	5/5/99	9/1/99
K-40	10.52 ± 0.57	8.87 ± 0.46
Mn-54	< 0.018	< 0.016
Fe-59	< 0.077	< 0.049
Co-58	< 0.020	< 0.025
Co-60	< 0.020	< 0.017
Zn-65	< 0.091	< 0.065
Nb-95	< 0.036	< 0.022
Zr-95	< 0.046	< 0.026
Ru-103	< 0.026	< 0.009
Ru-106	< 0.20	< 0.15
Cs-134	< 0.028	< 0.031
Cs-137	< 0.020	0.037 ± 0.018
Ce-141	< 0.074	< 0.025
Ce-144	< 0.16	< 0.10

Location	D-51	
Lab Code	DBS-3194	DBS-6714
Date Collected	5/5/99	9/1/99
K-40	11.73 ± 0.84	8.57 ± 0.47
Mn-54	< 0.034	< 0.013
Fe-59	< 0.084	< 0.021
Co-58	< 0.035	< 0.022
Co-60	< 0.028	< 0.017
Zn-65	< 0.14	< 0.072
Nb-95	< 0.045	< 0.013
Zr-95	< 0.081	< 0.032
Ru-103	< 0.045	< 0.019
Ru-106	< 0.17	< 0.060
Cs-134	< 0.047	< 0.033
Cs-137	0.10 ± 0.034	< 0.017
Ce-141	< 0.085	< 0.042
Ce-144	< 0.22	< 0.10

DUANE ARNOLD

Table 23. River sediment, analysis for gamma-emitting isotopes.
Collection: Semiannually
Units: pCi/g dry

Location	D-107	
Lab Code	DBS-3195,6	DBS-6715
Date Collected	5/5/99	9/1/99
K-40	8.97 ± 0.41	9.28 ± 0.66
Mn-54	< 0.020	< 0.021
Fe-59	< 0.036	< 0.085
Co-58	< 0.025	< 0.027
Co-60	0.044 ± 0.025	< 0.023
Zn-65	< 0.08	< 0.11
Nb-95	< 0.027	< 0.038
Zr-95	< 0.042	< 0.053
Ru-103	< 0.020	< 0.033
Ru-106	< 0.18	< 0.18
Cs-134	< 0.022	< 0.036
Cs-137	< 0.024	0.040 ± 0.022
Ce-141	< 0.063	< 0.071
Ce-144	< 0.13	< 0.095

Table 24. Precipitation, analyses for gamma emitting isotopes.

Collectior Monthly
Units: pCi/L
Location: DAEC

Date Collected	01-26-99	02-10-99	03-17-99	04-12-99	05-10-99	06-08-99
Lab Code	DP-518	DP-857	DP-1736	DP-2417	DP-3192	DP-3997
Mn-54	< 5.7	< 6.2	< 5.6	< 4.7	< 3.8	< 2.6
Fe-59	< 7.9	< 14.9	< 17.8	< 13.3	< 6.4	< 6.0
Co-58	< 5.3	< 5.6	< 5.7	< 5.9	< 2.4	< 2.2
Co-60	< 6.9	< 6.6	< 5.7	< 4.1	< 2.8	< 5.6
Zn-65	< 6.0	< 5.4	< 9.7	< 9.6	< 11.1	< 2.7
Nb-95	< 4.2	< 6.4	< 10.0	< 5.0	< 3.9	< 4.4
Zr-95	< 12.6	< 11.8	< 15.3	< 5.7	< 11.7	< 6.2
I-131	< 7.9	< 10.9	< 15.8	< 6.2	< 4.2	< 5.4
Cs-134	< 7.4	< 3.0	< 7.4	< 5.7	< 2.6	< 7.4
Cs-137	< 5.8	< 6.4	< 5.9	< 6.5	< 2.7	< 3.8
Ba-140	< 30.9	< 24.0	< 29.9	< 19.1	< 10.5	< 7.8
La-140	< 3.8	< 4.8	< 13.9	< 6.0	< 7.0	< 1.4

Date Collected	07-21-99	08-30-99	09-20-99	10-12-99	11-17-99	12-06-99
Lab Code	DP-5361	DP-6391	DP-6925	DP-7817	DP-9126	DP-9412
Mn-54	< 5.3	< 2.8	< 3.5	< 5.0	< 3.3	< 8.7
Fe-59	< 10.8	< 4.4	< 8.2	< 12.6	< 7.7	< 6.5
Co-58	< 6.1	< 1.6	< 3.9	< 6.0	< 6.4	< 4.7
Co-60	< 5.0	< 3.0	< 4.9	< 6.2	< 7.9	< 7.9
Zn-65	< 8.8	< 5.0	< 8.3	< 9.3	< 29.6	< 8.4
Nb-95	< 5.9	< 2.7	< 5.4	< 6.4	< 11.7	< 4.4
Zr-95	< 8.4	< 7.4	< 12.4	< 12.0	< 13.4	< 9.2
I-131	< 10.2	< 3.3	< 7.9	< 5.2	< 7.1	< 6.5
Cs-134	< 4.4	< 5.6	< 4.5	< 4.5	< 7.5	< 8.6
Cs-137	< 6.5	< 5.0	< 5.4	< 6.1	< 4.1	< 6.4
Ba-140	< 29.3	< 8.5	< 21.7	< 19.8	< 27.4	< 31.1
La-140	< 9.1	< 0.9	< 2.6	< 7.9	< 3.6	< 8.7

DUANE ARNOLD

Table 25. Precipitation, analysis for tritium.
Collection: Quarterly composites of monthly samples.
Units: pCi/L

Location	Duane Arnold			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DP-2462	DP-4513	DP-7006	DP-9522
H-3	< 164	< 175	< 199	< 156

DUANE ARNOLD

Table 27. Soil, analysis for strontium-90 and gamma-emitting isotopes.
Collection: Annually
Units: pCi/g dry

Location	D-15	D-16
Lab Code	DSO-6936	DSO-6937, 8
Date Collected	9/20/99	9/20/99
Sr-90	0.033 ± 0.015	0.038 ± 0.011
K-40	17.74 ± 1.06	10.44 ± 0.46
Mn-54	< 0.040	< 0.014
Fe-59	< 0.11	< 0.020
Co-58	< 0.069	< 0.017
Co-60	< 0.049	< 0.020
Zn-65	< 0.19	< 0.075
Nb-95	< 0.088	< 0.018
Zr-95	< 0.082	< 0.034
Ru-103	< 0.049	< 0.016
Ru-106	< 0.26	< 0.16
Cs-134	< 0.059	< 0.013
Cs-137	0.15 ± 0.050	0.24 ± 0.024
Ce-141	< 0.098	< 0.038
Ce-144	< 0.28	< 0.090