50-331 Duane Arnold IELPC

1990 Radiological Enviro Monitoring Program

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1.0 INTRODUCTION

This report summarizes and interprets results of the Environmental Radiological Monitoring Program conducted by Teledyne Isotopes Midwest Laboratory at the Duane Arnold Energy Center, Cedar Rapids, Iowa, during the period January - December, 1990. This Program monitors the levels of radioactivity in the air, terrestrial, and aquatic environments in order to assess the impact of the Plant on its surroundings.

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

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

2.0 SUMMARY

The Environmental Radiological Monitoring Program required by the U.S. Nuclear Regulatory Commission (NRC) Technical Specifications for the Duane Arnold Nuclear Generating Plant is described. Results for 1990 are summarized and discussed.

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

3.0 ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM

3.1 Program Design and Data Interpretation

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

Sources of environmental radiation include the following:

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

(2) Fallout from atmospheric nuclear detonations;

(3) Releases from nuclear power plants; and

(4) Industrial and medical radioactive waste.

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

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

An additional interpretive technique involves analyses for specific radionuclides present in the environmental samples collected from the DAEC site. The DAEC's monitoring program includes analyses for strontium-90 and iodine-131, which are fission products, and tritium, which is produced by cosmic rays, atmospheric nuclear detonations, and also by nuclear power plants. Most samples are also analyzed for gamma-emitting isotopes with results for the following groups quantified: zirconium-95, cesium-137, and cerium-144. These three gamma-emitting isotopes were selected as radiological impact indicators because of the different characteristic proportions in which they appear in the fission product

mix produced by a nuclear reactor and that produced by a nuclear detonation. Each of the three isotopes is produced in roughly equivalent amounts by a reactor: each constitutes about 10% of the total activity of fission products ten (10) days after reactor shutdown. On the other hand, ten (10) days after a nuclear explosion, the contributions of zirconium-95, cerium-144, and cesium-137 to the activity of the resulting debris are in the approximate ratio 4:1:0.03 (Eisenbud, 1963).

The other group quantified consists of niobium-95, ruthenium-103 and -106, cesium-134, barium-lanthanum-140, and cerium-141. These isotopes are released in small quantities by nuclear power plants, but to date their major source of injection into the general environment has been atmospheric nuclear testing. Nuclides of the next group, manganese-54, cobalt-58 and -60, and zinc-65, are activation products and arise from activation of corrosion products. They are typical components of nuclear power plant effluents, but are not produced in significant quantities by nuclear detonations. Nuclides of the final group, beryllium-7, which is of cosmogenic origin, and potassium-40, a naturally-occuring isotope, were chosen as calibration monitors and should not be considered radiological impact indicators.

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

3.2 Program Description

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

To monitor the air environment, airborne particulates are collected on membrane filters by continuous pumping at twelve (12) locations. Also, airborne iodine is collected by continuous pumping through charcoal filters at six (6) of these locations. Nine (9) of the twelve (12) locations are indicators and three (3) are controls (D-1, D-2, and D-13). Filters are changed and counted weekly. Particulate filters are analyzed for gross beta activity. If gross beta activity exceeds 10

times the yearly mean of the control samples gamma isotopic analysis is performed. Quarterly composites of airborne particulates from each location are gamma scanned on a germanium detector.

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

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

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

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

For additional monitoring of the terrestrial environment, grain, hay, and broad leaf natural vegetation samples are collected annually from nine (9) locations: one control (D-105) and eight (8) indicators (D-57, D-58, D-63, D-72, D-93, D-94, D-106 and D-16). Grain, hay, and broad leaf (green leafy) vegetation samples are analyzed for gamma-emitting isotopes and at least one broad leaf vegetation is analyzed for iodine-131. When meat is slaughtered for home use, it is collected annually during or immediately following a grazing period from animals grazing on site. The sample is analyzed for gamma-emitting isotopes. Also, potable ground water is collected quarterly from a treated municipal water system (D-53), the inlet to the municipal water treatment system (D-54), and four (4) additional ground water locations (D-55, D-57, D-58, and D-72). The samples are analyzed for gross beta and tritium. If gross beta activity exceeds 10 times yearly mean of the control samples, gamma isotopic, strontium-89, and strontium-90 analyses are performed.

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

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

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

3.3 Program Execution

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

(1) No TLD data were available for Location D-33 for the second quarter of 1990 because the TLD was lost in the field.

(2) No TLD data were available for Location D-47 for the fourth quarter of 1990 because the TLD was lost in the field.

(3) No milk samples were collected from Locations D-93 and D-101 on 01-03-90 because milch animals were dry during pregnancy.

(4) No milk sample was collected from Location D-101 on 02-06-90 because milch animal was dry during pregnancy.

(5) No milk sample was collected from Location D-101 on 03-06-90 because milch animal was dry during pregnancy.

(6) No milk samples were collected from Locations D-96 and D-105 on 05-29-90 because farmers did not provide samples.

(7) Meat samples were not available in 1990 because no meat animals were slaughtered for home use.

(8) Broadleaf vegetation samples could only be collected from three locations. Samples from all locations were collected and shipped, but except for one were lost at the lab. A second collection was requested, but vegetables were only available from D-57 and D-105 at that time.

3.4 Laboratory Procedures

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

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

Tritium levels were determined by the liquid scintillation technique.

Analytical Procedures used by TIML are specified in detail elsewhere (Teledyne Isotopes Midwest Laboratory, 1985). Procedures are based on those prescribed by the National Center for Radiological Health of the U. S. Public Health Service (U. S. Public Health Service, 1967) and by the Health and Safety Laboratory of the U. S. Atomic Energy Commission (U. S. Atomic Energy Commission, 1972).

Details of TIML's QA Program are presented elsewhere (Teledyne Isotopes Midwest Laboratory, 1990). The TIML QA Program includes participation in the Interlaboratory Comparison (Crosscheck) Program. Results obtained in the crosscheck program are presented in Appendix A.

3.5 Program Modifications

There were no program modifications in 1990.

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 1990 are not included in this section, although references to these results will be made in the discussion. The complete tabulation of the 1990 results is contained in Part II of the 1990 Annual Report on the Environmental Radiological Monitoring Program for the Duane Arnold Energy Center.

4.1 Atmospheric Nuclear Detonations and Nuclear Accidents

There were no reported atmospheric nuclear tests in 1990. The last reported test was conducted by the People's Republic of China on October 16, 1980. The reported yield was in the 200 kiloton to 1 megaton range.

There were no reported accidents at nuclear reactor facilities in 1990.

4.2 Program Findings

Results obtained show background levels of radioactivity in the environmental samples collected in 1990.

Airborne Particulates

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

A spring peak in beta activity had been observed almost annually for many years (Wilson et al., 1969). It had been attributed to fallout of nuclides from the stratosphere (Gold et al., 1964). It was pronounced in 1981, occurred to a lesser degree in 1982, and did not occur in 1983, 1984, 1985, 1987, 1988, 1989, or 1990. In 1986, the spring peak could not be identified because it was overshadowed by the releases of radioactivity from Chernobyl.

Gamma spectroscopic analysis of quarterly composites of air particulate filters yielded similar results for indicator and control locations. Beryllium-7, which is produced continuously in the upper atmosphere by cosmic radiation (Arnold and Al-Salih, 1955), was detected in all samples. All other gamma-emitting isotopes were below their respective LLD limits. No plant effect was indicated.

Airborne Iodine

Weekly levels of airborne iodine-131 were below the lower limit of detection (LLD) of 0.07 pCi/m^3 in all samples with the exception of three samples (<0.73, <0.20, and <0.13 pCi/m^3). The higher LLDs were due to very low volumes.

Ambient Radiation (TLDs)

At twelve (12) air sampling locations, the TLD readings averaged 14.9 mR/quarter at indicator locations and 12.6 mR/quarter at control locations. At locations within 0.5 mile, 1.0 mile, and 3.0 mile radius of the stack, the measurements averaged 17.2 mR/quarter, 18.8 mR/quarter, and 16.4 mR/quarter, respectively. The average for all locations was 16.5 mR/quarter. This is slightly lower than the estimated average natural background radiation for Middle America, 19.5 mR/quarter, which is based on data on Pages 71 and 108 of the report, "Natural Background Radiation in the United States" (National Council on Radiation Protection and Measurements, 1975). The terrestrial absorbed dose (uncorrected for structural and body shielding) ranges from 8.8 to 18.8 mrad/quarter and averages 11.5 mrad/quarter for Middle America. Cosmic radiation and cosmogenic radionuclides contribute 8.0 mrad/ quarter for a total average of 19.5 mrad/quarter. No plant effect was indicated.

Precipitation

In precipitation, the tritium concentration was below the LLD of 330 pCi/L in all samples. All gamma-emitting isotopes were below their respective LLDs. 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 1990 show no radiological effects of the plant operation.

Ground Water

The annual mean for gross beta activity measured 3.1 pCi/L and was similar to the levels observed in 1980 through 1989. The location with the highest mean, 5.0 pCi/L, was D-58, a farm 1.0 miles distant from the plant. Tritium was below the LLD of 330 pCi/L in all samples. No plant effect was indicated.

Vegetation

Iodine-131 results in broad leaf vegetation were below the LLD level of 0.023 pCi/g wet weight in all samples.

Except for potassium-40, which was observed in all samples (broadleaf vegetation, corn, and hay), all other gamma-emitting isotopes were below detection limits in all samples. No plant effect was indicated.

Soil

Strontium-90 was detected in both samples and averaged 0.066 pCi/g dry weight.

Cesium-137 was detected in both samples and averaged 0.21 pCi/g dry weight. Both strontium-90 and cesium-137 concentrations were similar to levels observed in 1987 (0.08 and 0.30 pCi/g dry weight, respectively), in 1988 (0.064 and 0.33 pCi/g dry weight, respectively), and in 1989 (0.046 and 0.18 pCi/g dry weight, respectively).

The only other gamma-emitting isotope detected was potassium-40 and averaged 10.6 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 (plant sewage discharge onsite). The concentration ranged from 17.1 to 31.7 pCi/L and averaged 25.6 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 (3.16 and 2.64 pCi/g wet weight, respectively). No plant effect on fish was indicated.

River Sediments

River sediments were collected in May and November, 1990, and analyzed for gamma-emitting isotopes. Cobalt-60 was detected in two samples from Location D-107 (sewage effluent) and averaged 0.14 pCi/g dry weight. Cesium-137 was detected in two samples and averaged 0.12 pCi/g dry weight. Potassium-40 ranged from 7.08 to 10.31 pCi/g dry weight and averaged 8.49 pCi/g dry weight.

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

5.0 TABLES AND FIGURES

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

Designation	Comments	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
		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, 1990.

Exposure Pathway and/or Sample	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[a] 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	Toddville		
	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 individually for iodine-131.
	5	Palo		
	7	Shellsburg		
	8	Urbana		
	11	Toddville		
	15	On-site North		
Ambient Radiation	1-3, 5-8, 10,11, 13,15, 16	Air Particulate Locations	Two dosimeters continuously at each location. Both dosimeters are changed at least quarterly.	Read gamma radiation dose quarterly on one dosimeter. Anneal and repackage the second dosimeter.
	18-23, 28-32, 82-86, 91	Within 0.5 mile of Stack		

Table 5.2. Sample collection and analysis program, 1990 (continued)

Exposure Pathway and/or Sample	Sampling Location: Sample Point	Sampling Location: Description	Sampling and Collection Frequency	Type and Frequency of Analysis
Ambient Radiation (continued)	33-41	Within 3.0 miles of stack	Two dosimeters continuously at each location. Both dosimeters are changed at least quarterly.	Read gamma radiation dose quarterly on one dosimeter. Anneal and repackage the second dosimeter.
	43-48	Within 1.0 mile of stack		
Surface Water	49	Lewis Access (C)	Once per month.	Gamma isotopic analyses of each sample (by location).
	50	Plant Intake (C)		
	51	Plant Discharge		
	99	Pleasant Creek		Composite monthly samples to form quarterly composite (by location). Analyze quarterly composite for tritium.
	107	Plant Sewage Discharge		
Ground Water (Potable)	53	Treated Municipal Water	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.
	54	Inlet to Municipal Water Treatment System		
	55	On-site well		
	57,58	Wells off-site		
	72	and within 4 km of DAEC		

Table 5.2. Sample collection and analysis program, 1990 (continued)

Exposure Pathway and/or Sample	Sampling Location: Sample Point	Sampling Location: Description	Sampling and Collection Frequency	Type and Frequency of Analysis
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	Cedar River upstream of DAEC not influenced by effluent (C)	One sample per 6 months (once during January through July and once during August through December).	Gamma isotopic analysis on edible portions.
	61	Downstream of DAEC in influence of effluent		

Table 5.2. Sample collection and analysis program, 1990 (continued)

Exposure Pathway and/or Sample	Sampling Location: Sample Point	Sampling Location: Description	Sampling and Collection Frequency	Type and Frequency of Analysis
Milk[b]	105	Control farm near Amana, Iowa	At least once per two weeks during the grazing season.	During the grazing season: Gamma isotopic and iodine-131 analyses of each sample.
	63, 93, 94, 96, 101, 106	Dairy farms within 10 miles of site	At least once per month during non-grazing season.	During the non-grazing season: Gamma isotopic and iodine-131 analyses of each sample.
Precipitation		On-site	Monthly	Gamma isotopic on all samples.
		On-site		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 1990, no animals slaughtered for home use.

Table 5.3 Sampling locations, Duane Arnold Energy Center.

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

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

Code	Type[a]	Sampling Location: Sampling Point	Sampling Location: Location Description	Sampling Location: Distance and Direction from Site Stack
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	
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	Onsite

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

Table 5.4 Type and frequency of collection.

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

Table 5.4 Type and frequency of collection (continued)

Location	Location Type[a]	Weekly	Monthly	Quarterly	Semi-Annually	Annually
D-101			M[c]			
D-105	C		M[c]			G[b]
D-106			M[c]			G[b]
D-107			SW		RS	
On-site			P			ME

[a] Control locations are indicated by a "C" in this column. All other locations are indicators.
[b] Vegetation (G) includes broad leaf vegetation and grain.
[c] Monthly from October through April; weekly from May through September.

Table 5.5. Sample codes used in Table 5.4.

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

Table 5.6. Missed collections and analyses, Duane Arnold Energy Center, 1990.

Sample	Analysis	Location	Collection Date or Period	Comments
Milk	I-131, Gamma	D-93	01-03-90	Sample unavailable.
Milk	I-131, Gamma	D-101	01-03-90	Sample unavailable.
Milk	I-131, Gamma	D-101	02-06-90	Sample unavailable.
Milk	I-131, Gamma	D-101	03-06-90	Sample unavailable.
Milk	I-131, Gamma	D-96	05-29-90	Sample unavailable.
Milk	I-131, Gamma	D-105	05-29-90	Sample unavailable.
TLD	Gamma	D-33	06-28-90	Lost in the field.
TLD	Gamma	D-47	12-18-90	Lost in the field.

Table 5.7. Radiological Environmental Monitoring Program Summary.

Name of Facility Duane Arnold Energy Center Docket No. 50-331

Location of Facility Linn, Iowa (County, State) Reporting Period January - December, 1990

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 of Non-routine Results[e]
Airborne Particulates (pCi/m^3)	GB 636	0.005[f]	0.022 (475/477) (0.007-0.059)	D-8, Urbana 10 mi NW	0.026 (53/53) (0.012-0.048)	0.024 (159/159) (0.007-0.048)	0
	GS 48						
	Be-7	0.012	0.050 (36/36) (0.033-0.070)	D-2, Marion 11 mi ESE	0.058 (4/4) (0.058-0.059)	0.055 (I2/12) (0.042-0.060)	0
	Nb-95	0.0022	<LLD	-	-	<LLD	0
	Zr-95	0.0035	<LLD	-	-	<LLD	0
	Ru-103	0.0017	<LLD	-	-	<LLD	0
	Ru-106	0.014	<LLD	-	-	<LLD	0
	Cs-134	0.0015	<LLD	-	-	<LLD	0
	Cs-137	0.0016	<LLD	-	-	<LLD	0
	Ce-141	0.0030	<LLD	-	-	<LLD	0
	Ce-144	0.0085	<LLD	-	-	<LLD	0
Airborne Iodine	I-131 318	0.079	<LLD	-	-	<LLD	0
TLD, AP Locations (mR/Qtr.)	Gamma 48	1	14.9 (36/36) (10.7-18.4)	D-8, Urbana 10 mi NW	16.8 (4/4) (15.3-18.4)	12.6 (12^h/12) (10.7-I5.5)	0
TLD, Within 0.5 mi radius of stack (mR/Qtr.)	Gamma 68	1	I7.2 (68/68) (11.8-23.8)	D-31, On-site 0.5 mi NW	22.0 (4/4) (20.6-23.8)	None	0
TLD, Within 1.0 mi radius of stack (mR/Qtr.)	Gamma 23	1	18.8 (23/23) (14.0-22.0)	D-47, 1.0 mi WNW	20.7 (3/3) (I9.6-21.4)	None	0
				D-48, 1.0 mi NW	20.7 (4/4) (19.6-22.0)		
TLD, Within 3.0 mi radius of stack (mR/Qtr.)	Gamma 35	1	I6.4 (35/35) (12.0-25.6)	D-37, 3.0 mi E	22.2 (4/4) (I9.3-25.6)	None	0

Table 5.7. Radiological Environmental Monitoring Program Summary (continued)

Name of Facility Duane Arnold Energy Center Docket No. 50-331

Location of Facility Linn, Iowa (County, State) Reporting Period January - December, 1990

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean		Control Locations Mean (F)[c] Range[c]	Number of Non-routine Results[e]
				Location[d]	Mean (F)[c] Range[c]		
Precipitation (pCi/L)	H-3 4	330	<LLD	-	-	None	0
	GS 12						
	Mn-54	29	<LLD	-	-	None	0
	Fe-59	60	<LLD	-	-	None	0
	Co-58	28	<LLD	-	-	None	0
	Co-60	27	<LLD	-	-	None	0
	Zn-65	62	<LLD	-	-	None	0
	Nb-95	32	<LLD	-	-	None	0
	Zr-95	55	<LLD	-	-	None	0
	I-131	41	<LLD	-	-	None	0
	Cs-134	25	<LLD	-	-	None	0
	Cs-137	32	<LLD	-	-	None	0
	Ba-140	119	<LLD	-	-	None	0
	La-140	24	<LLD	-	-	None	0
Milk (pCi/L)	I-131 120	1.0	<LLD	-	-	<LLD	0
	GS 120						
	K-40	100	1390 (103/103) (1050-1930)	D-101, Farm 4.0 mi E	1810 (15/15) (1620-1930)	1250 (17/17) (1110-1400)	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)	Gross Beta 24	0.9	3.1 (16/24) (1.0-6.0)	D-58, Farm 1.0 mi WSW-SW	5.0 (4/4) (3.7-6.0)	None	0
	H-3 24	330	<LLD	-	-	None	0

Table 5.7. Radiological Environmental Monitoring Program Summary (continued)

Name of Facility Duane Arnold Energy Center Docket No. 50-331

Location of Facility Linn, Iowa (County, State) Reporting Period January - December, 1990

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 of Non-routine Results[e]
Broad Leaf Vegetation (pCi/g wet)	I-131 3	0.023	<LLD	-	-	<LLD	0
	GS 3						
	K-40	0.5	3.95 (2/2) (3.10-4.80)	D-105, Farm 21.3 mi SSW	4.82 (1/1) -	4.82 (1/1) -	0
	Mn-54	0.027	<LLD	-	-	<LLD	0
	Co-58	0.030	<LLD	-	-	<LLD	0
	Co-60	0.033	<LLD	-	-	<LLD	0
	Nb-95	0.030	<LLD	-	-	<LLD	0
	Zr-95	0.051	<LLD	-	-	<LLD	0
	Ru-103	0.023	<LLD	-	-	<LLD	0
	Ru-106	0.28	<LLD	-	-	<LLD	0
	Cs-134	0.019	<LLD	-	-	<LLD	0
	Cs-137	0.028	<LLD	-	-	<LLD	0
	Ce-141	0.021	<LLD	-	-	<LLD	0
	Ce-144	0.093	<LLD	-	-	<LLD	0
Vegetation - Corn (pCi/g wet)	GS 8						
	K-40	0.5	2.63 (7/7) (2.28-3.14)	D-72, Farm 2.0 mi SW	3.14 (1/1) -	3.02 (1/1) -	0
	Mn-54	0.036	<LLD	-	-	<LLD	0
	Co-58	0.039	<LLD	-	-	<LLD	0
	Co-60	0.027	<LLD	-	-	<LLD	0
	Nb-95	0.082	<LLD	-	-	<LLD	0
	Zr-95	0.072	<LLD	-	-	<LLD	0
	Ru-103	0.060	<LLD	-	-	<LLD	0
	Ru-106	0.24	<LLD	-	-	<LLD	0
	Cs-134	0.024	<LLD	-	-	<LLD	0
	Cs-137	0.025	<LLD	-	-	<LLD	0
	Ce-141	0.10	<LLD	-	-	<LLD	0
	Ce-144	0.13	<LLD	-	-	<LLD	0

Table 5.7. Radiological Environmental Monitoring Program Summary (continued)

Name of Facility Duane Arnold Energy Center Docket No. 50-331

Location of Facility Linn, Iowa (County, State) Reporting Period January - December, 1990

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 of Non-routine Results[e]
Vegetation - Hay (pCi/g wet)	GS 7						
	K-40	0.5	14.62 (6/6) (7.24-19.70)	D-72, Farm 2.0 mi SW	19.70 (1/1) -	14.10 (1/1) -	0
	Mn-54	0.050	<LLD	-	-	<LLD	0
	Co-58	0.041	<LLD	-	-	<LLD	0
	Co-60	0.035	<LLD	-	-	<LLD	0
	Nb-95	0.056	<LLD	-	-	<LLD	0
	Zr-95	0.080	<LLD	-	-	<LLD	0
	Ru-103	0.045	<LLD	-	-	<LLD	0
	Ru-106	0.32	<LLD	-	-	<LLD	0
	Cs-134	0.034	<LLD	-	-	<LLD	0
	Cs-137	0.038	<LLD	-	-	<LLD	0
	Ce-141	0.081	<LLD	-	-	<LLD	0
	Ce-144	0.22	<LLD	-	-	<LLD	0
Soil (pCi/g dry)	Sr-90 2	0.01	0.066 (2/2) (0.054-0.077)	D-15, On-site 0.5 mi NW	0.077 (1/1) -	None -	0
	GS 2						
	K-40	0.5	10.57 (2/2) (8.49-12.65)	D-15, On-site 0.5 mi NW	12.65 (1/1) -	None -	0 0
	Mn-54	0.042	<LLD	-	-	None	0
	Co-58	0.048	<LLD	-	-	None	0
	Co-60	0.060	<LLD	-	-	None	0
	Nb-95	0.054	<LLD	-	-	None	0
	Zr-95	0.086	<LLD	-	-	None	0
	Ru-103	0.049	<LLD	-	-	None	0
	Ru-106	0.42	<LLD	-	-	None	0
	Cs-134	0.044	<LLD	-	-	None	0
	Cs-137	0.060	0.21 (2/2) (0.14-0.28)	D-15, On-site 0.5 mi NW	0.28 (1/1) -	None	0
	Ce-141	0.071	<LLD	-	-	None	0
	Ce-144	0.27	<LLD	-	-	None	0

Table 5.7. Radiological Environmental Monitoring Program Summary (continued)

Name of Facility Duane Arnold Energy Center Docket No. 50-331

Location of Facility Linn, Iowa Reporting Period January - December, 1990
(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 of Non-routine Results[e]
Surface Water (pCi/L)	H-3 20	330	<LLD	-	-	<LLD	0
	K-40 12	0.5	25.6 (12/12) (17.1-31.7)	D-107, On-site Sewage Effluent	25.6 (12/12) (17.1-31.7)	None	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
	I-131	500	<LLD	-	-	<LLD	0
	Cs-134	15	<LLD	-	-	<LLD	0
	Cs-137	18	<LLD	-	-	<LLD	0
	Ba-140	60	<LLD	-	-	<LLD	0
	La-140	15	<LLD	-	-	<LLD	0
River Sediments (pCi/g dry)	GS 6						
	K-40	1.0	8.49 (4/4) (7.08-10.31)	D-107, On-site Sewage Effluent	8.70 (2/2) (7.08-10.31)	6.90 (2/2) (5.87-7.94)	0
	Mn-54	0.034	<LLD	-	-	<LLD	0
	Co-58	0.034	<LLD	-	-	<LLD	0
	Co-60	0.034	0.14 (2/4) (0.12-0.16)	D-107, On-site Sewage Effluent	0.14 (2/2) (0.12-0.16)	<LLD	0
	Nb-95	0.13	<LLD	-	-	<LLD	0
	Zr-95	0.069	<LLD	-	-	<LLD	0
	Ru-103	0.092	<LLD	-	-	<LLD	0
	Ru-106	0.26	<LLD	-	-	<LLD	0
	Cs-134	0.028	<LLD	-	-	<LLD	0
	Cs-137	0.030	0.12 (2/4) (0.11-0.12)	D-51, Plant Discharge	0.12 (1/2) -	<LLD	0
	Ce-141	0.41	<LLD	-	-	<LLD	0
	Ce-144	0.15	<LLD	-	-	<LLD	0

Table 5.7. Radiological Environmental Monitoring Program Summary (continued)

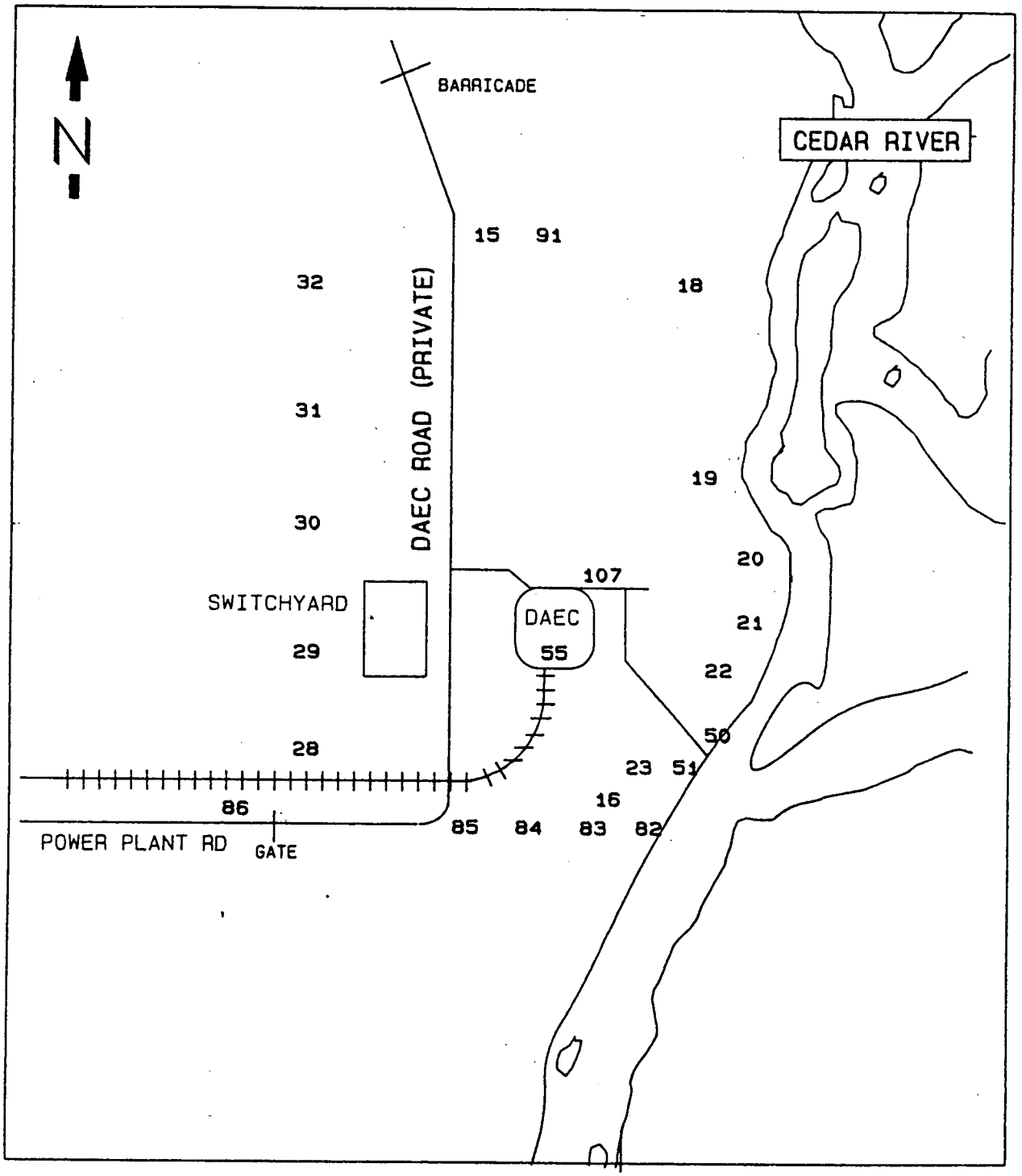
Name of Facility Duane Arnold Energy Center Docket No. 50-331

Location of Facility Linn, Iowa (County, State) Reporting Period January - December, 1990

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 of Non-routine Results[e]
Fish (Edible portion) (pCi/g wet)	GS 11						
	K-40	0.5	3.16 (6/6) (2.50-3.58)	D-61, Cedar River 0.5 mi downstream of discharge	3.16 (6/6) (2.50-3.58)	2.64 (5/5) (2.22-2.85)	0
	Mn-54	0.054	<LLD	-	-	<LLD	0
	Co-58	0.053	<LLD	-	-	<LLD	0
	Co-60	0.062	<LLD	-	-	<LLD	0
	Nb-95	0.053	<LLD	-	-	<LLD	0
	Zr-95	0.10	<LLD	-	-	<LLD	0
	Ru-103	0.058	<LLD	-	-	<LLD	0
	Ru-106	0.44	<LLD	-	-	<LLD	0
	Cs-134	0.047	<LLD	-	-	<LLD	0
	Cs-137	0.058	<LLD	-	-	<LLD	0
	Ce-141	0.096	<LLD	-	-	<LLD	0
	Ce-144	0.39	<LLD	-	-	<LLD	0

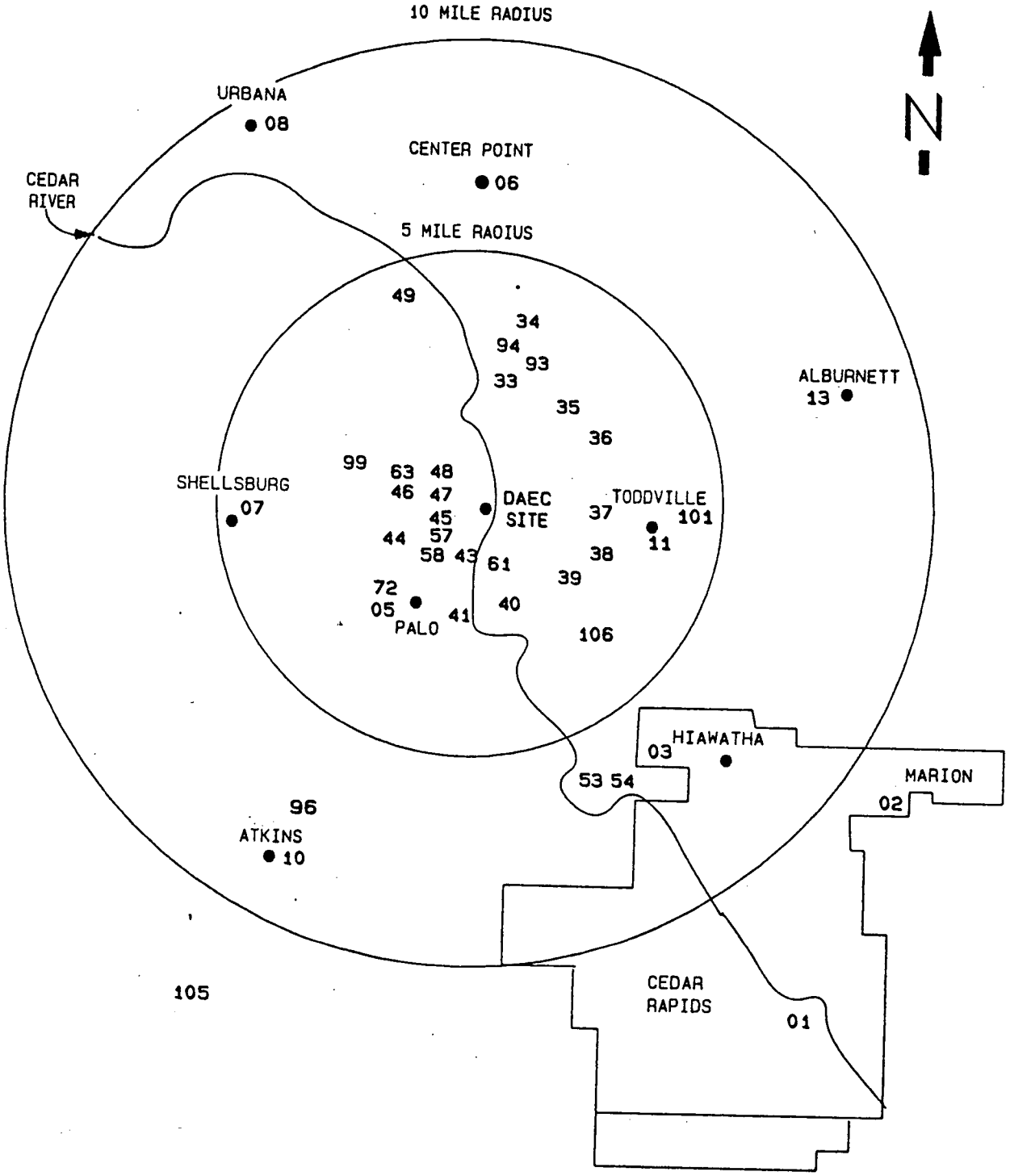
[a] GB = Gross beta; GS = Gamma scan.
[b] LLD = Nominal lower limit of detection based on 4.66 sigma error for background sample.
[c] Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses (F).
[d] Locations are specified by: (1) Name and code (Table 5.3); and (2) distance, direction, and sector relative to reactor site.
[e] Nonroutine results are those which exceed ten times the control station value. If a control station value is available, the result is considered nonroutine if it exceeds ten times the preoperational value for the location.
[f] One (1) result has been excluded in the determination of LLD for gross beta. Higher than normal LLD (<0.043 pCi/m^3) resulted from low volume due to pump malfunction.
[g] LLD for airborne iodine could not be reached at three locations during 1990. Values of 0.73, 0.20, and 0.13 resulted from extremely low volumes due to air sampler pump malfunctions.
[h] One result has been excluded from mean calculation (Location D-1, 1st Qtr. 1990) due to exposure from radiography performed in the area.

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



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

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



See Table 5.3 for Sampling Locations and Table 5.4 for Type and Frequency of collection.

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APPENDIX A

INTERLABORATORY COMPARISON PROGRAM RESULTS

NOTE: TIML participates in intercomparison studies administered by U.S. EPA Environmental Monitoring Systems Laboratory, Las Vegas, Nevada. The results are reported in Appendix A. Also reported are results of in-house spikes and blanks. Appendix A is updated twice a year; the complete Appendix is included in January and July monthly reports only. Please refer to January and July Reports for information.

January, 1991

Appendix A

Interlaboratory Comparison Program Results

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

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

The results in Table A-1 were obtained through participation in the environmental sample crosscheck program for milk, water, air filters, and food samples during the period January 1986 through December, 1990. This program has been conducted by the U.S. Environmental Protection Agency Intercomparison and Calibration Section, Quality Assurance Branch, Environmental Monitoring and Support Laboratory, Las Vegas, Nevada.

The results in Table A-2 were obtained for thermoluminescent dosimeters (TLDs) during the period 1976, 1977, 1979, 1980, 1984, and 1985-1986 through participation in the Second, Third, Fourth, Fifth, Seventh, and Eighth International Intercomparison of Environmental Dosimeters under the sponsorships listed in Table A-2. Also Teledyne testing results are listed.

Table A-3 lists results of the analyses on in-house spiked samples.

Table A-4 lists results of the analyses on in-house "blank" samples.

Attachment B lists acceptance criteria for "spiked" samples.

Addendum to Appendix A provides explanation for out-of-limit results.

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne Isotopes Midwest Laboratory results for milk, water, air filters, and food samples, 1986 through 1990.[a]

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STF-447	Food	Jan 1986	Sr-89	24.3±2.5	25.0±5.0	16.3-33.7
			Sr-90	17.3±0.6	10.0±1.5	7.4-12.6
			I-131	22.7±2.3	20.0±0.6	9.6-30.4
			Cs-137	16.3±0.6	15.0±5.0	6.3-23.7
			K	927±46	950±144	701-1199
STW-448	Water	Feb 1986	Cr-51	45.0±3.6	38.0±5.0	29.3-46.7
			Co-60	19.7±1.5	18.0±5.0	9.3-26.7
			Zn-65	44.0±3.5	40.0±5.0	31.3-48.7
			Ru-106	<9.0	0.0±5.0	0.0-8.7
			Cs-134	28.3±2.3	30.0±5.0	21.3-38.7
			Cs-137	23.7±0.6	22.0±5.0	13.3-30.7
STW-449	Water	Feb 1986	H-3	5176±48	5227±525	4317-6137
STW-450	Water	Feb 1986	U total	8.0±0.0	9.0±6.0	0.0-19.4
STM-451	Milk	Feb 1986	I-131	7.0±0.0	9.0±6.0	0.0-19.4
STW-452	Water	Mar 1986	Ra-226	3.8±0.1	4.1±0.6	3.0-5.2
			Ra-228	11.0±0.5	12.4±1.8	9.2-15.5
STW-453	Water	Mar 1986	Gr. alpha	6.7±0.6	15.0±5.0	6.3-23.7
			Gr. beta	7.3±0.6	8.0±5.0	0.0-16.7
STW-454	Water	Apr 1986	I-131	7.0±0.0	9.0±6.0	0.0-19.4
STW-455 456	Water (Blind)	Apr 1986				
	Sample A		Gr. alpha	15.0±1.0	17.0±5.0	8.3-25.7
			Ra-226	3.1±0.1	2.9±0.4	2.1-3.7
			Ra-228	1.5±0.2	2.0±0.3	1.5-2.5
			Uranium	4.7±0.6	5.0±6.0	0.0-15.4
	Sample B		Gr. beta	28.7±1.2	35.0±5.0	26.3-43.7
			Sr-89	5.7±0.6	7.0±5.0	0.0-15.7
			Sr-90	7.0±0.0	7.0±1.5	4.4-9.6
			Co-60	10.7±1.5	10.0±5.0	1.3-18.7
			Cs-134	4.0±1.7	5.0±5.0	0.0-13.7
			Cs-137	5.3±0.6	5.0±5.0	0.0-13.7

Table A-1. (continued)

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

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-474	Water	Sep 1986	Gr. alpha	16.3±3.2	15.0±5.0	6.3-23.7
			Gr. beta	9.0±1.0	8.0±5.0	0.0-16.7
STW-475	Water	Oct 1986	Cr-51	63.3±5.5	59.0±5.0	50.3-67.7
			Co-60	31.0±2.0	31.0±5.0	22.3-39.7
			Zn-657	87.3±5.9	85.0±5.0	76.3-93.7
			Ru-106	74.7±7.4	74.0±5.0	65.3-82.7
			Cs-134	25.7±0.6	28.0±5.0	19.3-36.7
			Cs-137	46.3±1.5	44.0±5.0	35.3-52.7
STW-476	Water	Oct 1986	H-3	5918±60	5973±597	4938-7008
STW-477	Water (Blind)	Oct 1986				
	Sample A		Gr. alpha	34.0±6.0	40.0±5.0	31.3-48.7
			Ra-226	5.8±0.2	6.0±0.9	4.4-7.6
			Ra-228	2.7±1.0	5.0±0.8	3.7-6.3
			Uranium	11.0±0.0	10.0±6.0	0.0-20.4
	Sample B		Gr. beta	38.7±1.2	51.0±5.0	42.3-59.7
			Sr-89	5.0±0.0	10.0±5.0	1.3-18.7
			Sr-90	3.0±0.0	4.0±1.5	1.4-6.6
			Co-60	24.7±1.2	24.0±5.0	15.3-32.7
			Cs-134	11.0±2.0	12.0±5.0	3.3-20.7
			Cs-137	9.3±1.2	8.0±5.0	0.0-20.4
STM-479	Milk	Nov 1986	Sr-89	7.7±1.2	9.0±5.0	0.3-17.7
			Sr-90	1.0±0.0	0.0±1.5	0.0-2.6
			I-131	52.3±3.1	49.0±6.0	38.6-59.4
			Cs-137	45.7±3.1	39.0±5.0	30.3-47.7
			K	1489±104	1565±78	1430-1700
STU-480	Urine	Nov 1986	H-3	5540±26	5257±912	4345-6169
STW-481	Water	Nov 1986	Gr. alpha	12.0±4.0	20.0±5.0	11.3-28.7
			Gr. beta	20.0±3.5	20.0±5.0	11.3-28.7
STW-482	Water	Dec 1986	Ra-226	6.7±0.2	6.8±1.0	5.0-8.6
			Ra-228	5.2±0.2	11.1±1.7	8.2-14.0
STW-483	Water	Jan 1987	Sr-89	19.7±5.0	25.0±5.0	16.3-33.7
			Sr-90	21.0±2.0	25.0±1.5	22.4-27.6

Table A-1. (continued)

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

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-496 497	Water (Blind)	Apr 1987				
	Sample B		Gr. beta	69.3±9.4	66.0±5.0	57.3-74.7
			Sr-89	16.3±3.0	19.0±5.0	10.3-27.7
			Sr-90	10.0±0.0	10.0±1.5	7.4-12.6
			Co-60	8.3±3.0	8.0±5.0	0.0-16.7
			Cs-134	19.0±2.0	20.0±5.0	11.3-28.7
			Cs-137	14.7±1.2	15.0±5.0	6.3-23.7
STU-498	Urine	Apr 1987	H-3	6017±494	5620±795	4647-6593
STW-499	Water	May 1987	Sr-89	38.0±6.0	41.0±5.0	32.3-49.7
			Sr-90	21.0±2.0	20.0±1.5	17.4-22.6
STW-500	Water	May 1987	Gr. alpha	9.0±3.4	11.0±5.0	2.3-19.7
			Gr. beta	10.3±1.2	7.0±5.0	0.0-15.7
STW-501	Water	Jun 1987	Cr-51	40.0±8.0	41.0±5.0	32.3-49.7
			Co-60	60.3±3.0	64.0±5.0	55.3-72.7
			Zn-65	11.3±5.0	10.0±5.0	1.3-18.7
			Ru-106	78.3±6.4	75.0±5.0	66.3-83.7
			Cs-134	36.7±3.0	40.0±5.0	31.3-48.7
			Cs-137	80.3±4.2	80.0±5.0	71.3-88.7
STW-502	Water	Jun 1987	H-3	2906±86	2895±357	2277-3513
STW-503	Water	Jun 1987	Ra-226	6.9±0.1	7.3±1.1	5.4-9.2
			Ra-228	13.3±1.0	15.2±2.3	11.2-19.2
STM-504	Milk	Jun 1987	Sr-89	57.0±4.3	69.0±5.0	60.3-77.7
			Sr-90	32.0±1.0	35.0±5.0	32.4-37.6
			I-131	64.0±2.0	59.0±6.0	48.6-69.4
			Cs-137	77.7±0.6	74.0±5.0	65.3-82.7
			K	1383±17	1525±76	1393-1657
STW-505	Water	Jul 1987	Gr. alpha	2.3±0.7	5.0±5.0	0.0-13.7
			Gr. beta	4.0±1.0	5.0±5.0	0.0-13.7
STF-506	Food	Jul 1987	I-131	82.7±4.6	80.0±8.0	66.1-93.9
			Cs-137	53.7±3.0	50.0±5.0	41.3-58.7
			K	1548±57	1680±84	1534-1826
STW-507	Water	Aug 1987	I-131	45.7±4.2	48.0±6.0	37.6-58.4

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-508	Water	Aug 1987	Pu-239	5.8±0.2	5.3±0.5	4.4-6.2
STW-509	Water	Aug 1987	Uranium	13.3±0.3	13.0±6.0	2.6-23.4
STAF-510	Air Filter	Aug 1987	Gr. alpha	9.7±0.4	10.0±5.0	1.3-18.7
			Gr. beta	28.3±0.6	30.0±5.0	21.3-38.7
			Sr-90	10.0±0.9	10.0±1.5	7.4-12.6
			Cs-137	10.0±1.0	10.0±5.0	1.3-18.7
STW-511	Water	Sep 1987	Ra-226	9.9±0.1	9.7±1.5	7.2-12.2
			Ra-228	8.1±1.4	6.3±1.0	4.6-8.0
STW-512	Water	Sep 1987	Gr. alpha	2.0±0.6	4.0±5.0	0.0-12.7
			Gr. beta	11.3±1.3	12.0±5.0	3.3-20.7
STW-513	Water	Sep 1987	H-3	4473±100	4492±449	3714-5270
STW-514	Water (Blind)	Oct 1987				
	Sample A		Gr. alpha	29.3±2.6	28.0±7.0	15.9-40.1
			Ra-226	4.9±0.1	4.8±0.7	3.6-6.1
			Ra-228	4.2±1.0	3.6±0.5	2.7-4.5
			Uranium	3.0±0.1	3.0±6.0	0.0-13.4
	Sample B		Sr-89	14.3±1.3	16.0±5.0	7.3-24.7
			Sr-90	9.7±0.4	10.0±1.5	7.4-12.6
			Co-60	16.7±3.0	16.0±5.0	7.3-24.7
			Cs-134	16.7±2.3	16.0±5.0	7.3-24.7
			Cs-137	24.3±3.3	24.0±5.0	15.3-32.7
STW-516	Water	Oct 1987	Cr-51	80.3±17.5	70.0±5.0	61.3-78.7
			Co-60	16.0±2.3	15.0±5.0	6.3-23.7
	Sample A		Zn-65	46.3±5.6	46.0±5.0	37.3-54.7
			Ru-106	57.3±15.4	61.0±5.0	52.3-69.7
			Cs-134	23.7±2.5	25.0±5.0	16.3-33.7
			Cs-137	51.7±3.2	51.0±5.0	42.3-59.7
STU-517	Urine	Nov 1987	H-3	7267±100	7432±743	6145-8719
STW-518	Water	Nov 1987	Gr. alpha	3.0±2.0	7.0±5.0	0.0-15.7
			Gr. beta	15.7±2.3	19.0±5.0	10.3-27.7
STW-519	Water	Dec 1987	I-131	26.0±3.0	25.0±6.0	15.6-36.4

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-520	Water	Dec 1987	Ra-226	5.1±0.8	4.8±0.7	3.6-6.0
			Ra-228	3.4±0.1	5.3±0.8	3.9-6.7
STW-521	Water	Jan 1988	Sr-89	27.3±5.0	30.0±5.0	21.3-38.7
			Sr-90	15.3±1.2	15.0±1.5	12.4-17.6
STW-523	Water	Jan 1988	Gr. alpha	2.3±1.2	4.0±5.0	0.0-12.7
			Gr. beta	7.7±1.2	8.0±5.0	0.0-16.7
STF-524	Food	Jan 1988	Sr-89	44.0±4.0	46.0±5.0	37.3-54.7
			Sr-90	53.0±2.0	55.0±2.8	50.2-59.8
			I-131	102.3±4.2	102.0±10.2	84.3-119.7
			Cs-137	95.7±6.4	91.0±5.0	82.3-99.7
			K	1011±158	1230±62	1124-1336
STW-525	Water	Feb 1988	Co-60	69.3±2.3	69.0±5.0	60.3-77.7
			Zn-65	99.0±3.4	94.0±9.4	77.7-110.3
			Ru-106	92.7±14.4	105.0±10.5	86.8-123.2
			Cs-134	61.7±8.0	64.0±5.0	55.3-72.7
			Cs-137	99.7±3.0	94.0±5.0	85.3-102.7
STW-526	Water	Feb 1988	H-3	3453±103	3327±362	2700-3954
STW-527	Water	Feb 1988	Uranium	3.0±0.0	3.0±6.0	0.0-13.4
STM-528	Milk	Feb 1988	I-131	4.7±1.2	4.0±0.4	3.3-4.7
STW-529	Water	Mar 1988	Ra-226	7.1±0.6	7.6±1.1	5.6-9.6
			Ra-228	NA[e]	7.7±1.2	5.7-9.7
STW-530	Water	Mar 1988	Gr. alpha	4.3±1.2	6.0±5.0	0.0-14.7
			Gr. beta	13.3±1.3	13.0±5.0	4.3-21.7
STAF-531	Air Filter	Mar 1988	Gr. alpha	21.0±2.0	20.0±5.0	11.3-28.7
			Gr. beta	48.0±0.0	50.0±5.0	41.3-58.7
			Sr-90	16.7±1.2	17.0±1.5	14.4-19.6
			Cs-137	18.7±1.3	16.0±5.0	7.3-24.7
STW-532	Water	Apr 1988	I-131	9.0±2.0	7.5±0.8	6.2-8.8

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-533 534	Water (Blind)	Apr 1988				
	Sample A		Gr. alpha	ND[f]	46.0±11.0	27.0-65.0
			Ra-226	ND	6.4±1.0	4.7-8.1
			Ra-228	ND	5.6±0.8	4.2-7.0
			Uranium	6.0±0.0	6.0±6.0	0.0-16.4
	Sample B		Gr. beta	ND	57.0±5.0	48.3-65.7
			Sr-89	3.3±1.2	5.0±5.0	0.0-13.7
			Sr-90	5.3±1.2	5.0±1.5	2.4-7.6
			Co-60	63.3±1.3	50.0±5.0	41.3-58.7
			Cs-134	7.7±1.2	7.0±5.0	0.0-15.7
			Cs-137	8.3±1.2	7.0±5.0	0.0-15.7
STU-535	Urine	Apr 1988	H-3	6483±155	6202±620	5128-7276
STW-536	Water	Apr 1988	Sr-89	14.7±1.3	20.0±5.0	11.3-28.7
			Sr-90	20.0±2.0	20.0±1.5	17.4-22.6
STW-538	Water	Jun 1988	Cr-51	331.7±13.0	302.0±30.0	250.0-354.0
			Co-60	16.0±2.0	15.0±5.0	6.3-23.7
			Zn-65	107.7±11.4	101.0±10.0	83.7-118.3
			Ru-106	191.3±11.0	195.0±20.0	160.4-229.6
			Cs-134	18.3±4.6	20.0±5.0	11.3-28.7
			Cs-137	26.3±1.2	25.0±5.0	16.3-33.7
STW-539	Water	Jun 1988	H-3	5586±92	5565±557	4600-6530
STM-541	Milk	Jun 1988	Sr-89	33.7±11.4	40.0±5.0	31.3-48.7
			Sr-90	55.3±5.8	60.0±3.0	54.8-65.2
			I-131	103.7±3.1	94.0±9.0	78.4-109.6
			Cs-137	52.7±3.1	51.0±5.0	42.3-59.7
			K	1587±23	1600±80	1461-1739
STW-542	Water	Jul 1988	Gr. alpha	8.7±4.2	15.0±5.0	6.3-23.7
			Gr. beta	5.3±1.2	4.0±5.0	0.0-12.7
STF-543	Food	Jul 1988	Sr-89	ND[f]	33.0±5.0	24.3-41.7
			Sr-90	ND	34.0±2.0	30.5-37.5
			I-131	115.0±5.3	107.0±11.0	88.0-126.0
			Cs-137	52.7±6.4	49.0±5.0	40.3-57.7
			K	1190±66	1240±62	1133-1347

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-544	Water	Aug 1988	I-131	80.0±0.0	76.0±8.0	62.1-89.9
STW-545	Water	Aug 1988	Pu-239	11.0±0.2	10.2±1.0	8.5-11.9
STW-546	Water	Aug 1988	Uranium	6.0±0.0	6.0±6.0	0.0-16.4
STAF-547	Air Filter	Aug 1988	Gr. alpha	8.0±0.0	8.0±5.0	0.0-16.7
			Gr. beta	26.3±1.2	29.0±5.0	20.3-37.7
			Sr-90	8.0±2.0	8.0±1.5	5.4-10.6
			Cs-137	13.0±2.0	12.0±5.0	3.3-20.7
STW-548	Water	Sep 1988	Ra-226	9.3±0.5	8.4±2.6	6.2-10.6
			Ra-228	5.8±0.4	5.4±1.6	4.0-6.8
STW-549	Water	Sep 1988	Gr. alpha	7.0±2.0	8.0±5.0	0.0-16.7
			Gr. beta	11.3±1.2	10.0±5.0	1.3-18.7
STW-550	Water	Oct 1988	Cr-51	252.0±14.0	251.0±25.0	207.7-294.3
			Co-60	26.0±2.0	25.0±5.0	16.3-33.7
			Zn-65	158.3±10.2	151.0±15.0	125.0-177.0
			Ru-106	153.0±9.2	152.0±15.0	126.0-178.0
			Cs-134	28.7±5.0	25.0±5.0	16.3-33.7
			Cs-137	16.3±1.2	15.0±5.0	6.3-23.7
STW-551	Water	Oct 1988	H-3	2333±127	2316±350	1710-2927
STW-552 553	Water (Blind)	Oct 1988				
	Sample A		Gr. alpha	38.3±8.0	41.0±10.0	23.7-58.3
			Ra-226	4.5±0.5	5.0±0.8	3.6-6.4
			Ra-228	4.4±0.6	5.2±0.8	3.6-6.4
			Uranium	4.7±1.2	5.0±6.0	0.0-15.4
	Sample B		Gr. beta	51.3±3.0	54.0±5.0	45.3-62.7
			Sr-89	3.7±1.2	11.0±5.0	2.3-19.7
			Sr-90	10.7±1.2	10.0±1.5	7.4-12.6
			Cs-134	15.3±2.3	15.0±5.0	6.3-23.7
			Cs-137	16.7±1.2	15.0±5.0	6.3-23.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STM-554	Milk	Oct 1988	Sr-89	40.3±7.0	40.0±5.0	31.3-48.7
			Sr-90	51.0±2.0	60.0±3.0	54.8-65.2
			I-131	94.0±3.4	91.0±9.0	75.4-106.6
			Cs-137	45.0±4.0	50.0±5.0	41.3-58.7
			K	1500±45	1600±80	1461-1739
STU-555	Urine	Nov 1988	H-3	3030±209	3025±359	2403-3647
STW-556	Water	Nov 1988	Gr. alpha	9.0±3.5	9.0±5.0	0.3-17.7
			Gr. beta	9.7±1.2	9.0±5.0	0.3-17.7
STW-557	Water	Dec 1988	I-131	108.7±3.0	115.0±12.0	94.2-135.8
STW-559	Water	Jan 1989	Sr-89	40.0±8.7	40.0±5.0	31.3-48.7
			Sr-90	24.3±3.1	25.0±1.5	24.4-27.6
STW-560	Water	Jan 1989	Pu-239	5.8±1.1	4.2±0.4	3.5-4.9
STW-561	Water	Jan 1989	Gr. alpha	7.3±1.2	8.0±5.0	0.0-16.7
			Gr. beta	5.3±1.2	4.0±5.0	0.0-12.7
STW-562	Water	Feb 1989	Cr-51	245±46	235±24	193.4-276.6
			Co-60	10.0±2.0	10.0±5.0	1.3-18.7
			Zn-65	170±10	159±16	139.2-186.7
			Ru-106	181±7.6	178±18	146.8-209.2
			Cs-134	9.7±3.0	10.0±5.0	1.3-18.7
			Cs-137	11.7±1.2	10.0±5.0	1.3-18.7
STW-563	Water	Feb 1989	I-131	109.0±4.0	106.0±11.0	86.9-125.1
STW-564	Water	Feb 1989	H-3	2820±20	2754±356	2137-3371
STW-565	Water	Mar 1989	Ra-226	4.2±0.3	4.9±0.7	3.7-6.1
			Ra-228	1.9±1.0	1.7±0.3	1.2-2.2
STW-566	Water	Mar 1989	U	5.0±0.0	5.0±6.0	0.0-15.4
STAF-567	Air Filter	Mar 1989	Gr. alpha	21.7±1.2	21.0±5.0	12.3-29.7
			Gr. beta	68.3±4.2	62.0±5.0	53.3-70.7
			Sr-90	20.0±2.0	20.0±1.5	17.4-22.6
			Cs-137	21.3±1.2	20.0±5.0	11.3-28.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-568 569	Water (Blind)	Apr 1989				
	Sample A		Gr. alpha	22.7±2.3	29.0±7.0	16.9-41.2
			Ra-226	3.6±0.6	3.5±0.5	2.6-4.4
			Ra-228	2.6±1.0	3.6±0.5	2.7-4.5
			U	3.0±0.0	3.0±6.0	0.0-13.4
	Sample B		Gr. beta	52.3±6.1	57.0±5.0	43.3-65.7
			Sr-89	9.3±5.4	8.0±5.0	0.0-16.7
			Sr-90	7.0±0.0	8.0±1.5	5.4-10.6
			Cs-134	21.0±5.2	20.0±5.0	11.3-28.7
			Cs-137	23.0±2.0	20.0±5.0	11.3-28.7
STM-570	Milk	Apr 1989	Sr-89	26.0±10.0	39.0±5.0	30.3-47.7
			Sr-90	45.7±4.2	55.0±3.0	49.8-60.2
			Cs-137	54.0±6.9	50.0±5.0	41.3-58.7
			K-40	1521±208	1600±80	1461-1739
STW-571[g]	Water	May 1989	Sr-89	<0.7	6.0±5.0	0.0-14.7
			Sr-90	5.0±1.0	6.0±1.5	3.4-8.6
STW-572	Water	May 1989	Gr. alpha	24.0±2.0	30.0±8.0	16.1-43.9
			Gr. beta	49.3±15.6	50.0±5.0	41.3-58.7
STW-573	Water	Jun 1989	Ba-133	50.7±1.2	49.0±5.0.	40.3-57.7
			Co-60	31.3±2.3	31.0±5.0	22.3-39.7
			Zn-65	167±10	165±17	135.6-194.4
			Ru-106	123±9.2	128±13	105.5-150.5
			Cs-134	40.3±1.2	39±5	30.3-47.7
			Cs-137	22.3±1.2	20±5	11.3-28.7
STW-574	Water	Jun 1989	H-3	4513±136	4503±450	3724-5282
STW-575	Water	Jul 1989	Ra-226	16.8±3.1	17.7±2.7	13.0-22.4
			Ra-228	13.8±3.7	18.3±2.7	13.6-23.0
STW-576	Water	Jul 1989	U	40.3±1.2	41.0±6.0	30.6-51.4
STW-577	Water	Aug 1989	I-131	84.7±5.8	83.0±8.0	69.1-96.9
STAF-579	Air Filter	Aug 1989	Gr. alpha	6.0±0.0	6.0±5.0	0.0-14.7
			Cs-137	10.3±2.3	10.0±5.0	1.3-18.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-580	Water	Sep 1989	Sr-89	14.7±1.2	14.0±5.0	5.3-22.7
			Sr-90	9.7±1.2	10.0±1.5	7.4-12.6
STW-581	Water	Sep 1989	Gr. alpha	5.0±0.0	4.0±5.0	0.0-12.7
			Gr. Beta	8.7±2.3	6.0±5.0	0.0-14.7
STW-583	Water	Oct 1989	Ba-133	60.3±10.0	59.0±6.0	48.6-69.4
			Co-60	29.0±4.0	30.0±5.0	21.1-38.7
			Zn-65	132.3±6.0	129.0±13.0	106.5-151.5
			Ru-106	155.3±6.1	161.0±16.0	133.3-188.7
			Cs-134	30.7±6.1	29.0±5.0	20.3-37.7
			Cs-137	66.3±4.6	59.0±5.0	50.3-67.7
STW-584	Water	Oct 1989	H-3	3407±150	3496±364	2866-4126
STW-585 586	Water (Blind)	Oct 1989				
	Sample A		Gr. Alpha	41.7±9.4	49.0±12.0	28.2-69.8
			Ra-226	7.9±0.4	8.4±1.3	6.2-10.6
			Ra-228	4.4±0.8	4.1±0.6	3.1-5.1
			U	12.0±0.0	12.0±6.0	1.6-22.4
	Sample B		Gr. Beta	31.7±2.3	32.0±5.0	23.3-40.7
			Sr-89	13.3±4.2	15.0±5.0	6.3-23.7
			Sr-90	7.0±2.0	7.0±3.0	4.4-9.6
			Cs-134	5.0±0.0	5.0±5.0	0.0-13.7
			Cs-137	7.0±0.0	5.0±5.0	0.0-13.7
STW-587	Water	Nov 1989	Ra-226	7.9±0.4	8.7±1.3	6.4-11.0
			Ra-228	8.9±1.2	9.3±1.2	6.9-11.7
STW-588	Water	Nov 1989	U	15.0±0.09	15.0±6.0	4.6-25.4
STW-589	Water	Jan 1990	Sr-89	22.7±5.0	25.0±5.0	16.3-33.7
			Sr-90	17.3±1.2	20.0±1.5	17.4-22.6
STW-591	Water	Jan 1990	Gr. Alpha	10.3±3.0	12.0±5.0	3.3-20.7
			Gr. Beta	12.3±1.2	12.0±5.0	3.3-20.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-592	Water	Jan 1990	Co-60	14.7±2.3	15±5.0	6.3-23.7
			Zn-65	135.0±6.9	139.0±14.0	114.8-163.2
			Ru-106	133.3±13.4	139.0±14.0	114.8-163.2
			Cs-134	17.3±1.2	18.0±5.0	9.3-26.7
			Cs-137	19.3±1.2	18.0±5.0	9.3-26.7
			Ba-133	78.0±0.0	74.0±7.0	61.9-86.1
STW-593	Water	Feb 1990	H-3	4827±83	4976±498	4113-5839
STW-594	Water	Mar 1990	Ra-226	5.0±0.2	4.9±0.7	4.1-5.7
			Ra-228	13.5±0.7	12.7±1.9	9.4-16.0
STW-595	Water	Mar 1990	U	4.0±0.0	4.0±6.0	0.0-14.4
STAF-596	Air Filter	Mar 1990	Gr. Alpha	7.3±1.2	5.0±5.0	0.0-13.7
			Gr. Beta	34.0±0.0	31.0±5.0	22.3-39.7
			Sr-90	10.0±0.0	10.0±1.5	7.4-12.6
			Cs-137	9.3±1.2	10.0±5.0	1.3-18.7
STW-597 598	Water (Blind)	Apr 1990				
	Sample A		Gr. Alpha	81.0±3.5	90.0±23.0	50.1-129.9
			Ra-226	4.9±0.4	5.0±0.8	3.6-6.4
			Ra-228	10.6±0.3	10.2±1.5	7.6-12.8
			U	18.7±3.0	20.0±6.0	9.6-30.4
	Sample B		Gr. Beta	51.0±10.1	52.0±5.0	43.3-60.7
			Sr-89	9.3±1.2	10.0±5.0	1.3-18.7
			Sr-90	10.3±3.1	10.0±1.5	8.3-11.7
			Cs-134	16.0±0.0	15.0±5.0	6.3-23.7
			Cs-137	19.0±2.0	15.0±5.0	6.3-23.7
STM-599	Milk	Apr 1990	Sr-89	21.7±3.1	23.0±5.0	14.3-31.7
			Sr-90	21.0±7.0	23.0±5.0	14.3-31.7
			I-131	98.7±1.2	99.0±10.0	81.7-116.3
			Cs-137	26.0±6.0	24.0±5.0	15.3-32.7
			K	1300.0±69.2	1550.0±78.0	1414.7-1685.3
STW-600	Water	May 1990	Sr-89	6.0±2.0	7.0±5.0	0.0-15.7
			Sr-90	6.7±1.2	7.0±5.0	0.0-15.7
STW-601	Water	May 1990	Gr. Alpha	11.0±2.0	22.0±6.0	11.6-32.4
			Gr. Beta	12.3±1.2	15.0±5.0	6.3-23.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-602	Water	Jun 1990	Co-60	25.3±2.3	24.0±5.0	15.3-32.7
			Zn-65	155.0±10.6	148.0±15.0	130.6-165.4
			Ru-106	202.7±17.2	210.0±21.0	173.6-246.4
			Cs-134	23.7±1.2	24.0±5.0	18.2-29.8
			Cs-137	27.7±3.1	25.0±5.0	16.3-33.7
			Ba-133	100.7±8.1	99.0±10.0	81.7-116.3
STW-603	Water	Jun 1990	H-3	2927±306	2933±358	2312-3554
STW-604	Water	Jul 1990	Ra-226	11.8±0.9	12.1±1.8	9.0-15.2
			Ra-228	4.1±1.4	5.1±1.3	2.8-7.4
STW-605	Water	Jul 1990	U	20.3±1.7	20.8±3.0	15.6-26.0
STW-606	Water	Aug 1990	I-131	43.0±1.2	39.0±6.0	28.6-49.4
STW-607	Water	Aug 1990	Pu-239	10.0±1.7	9.1±0.9	7.5-10.7
STAF-608	Air Filter	Aug 1990	Gr. alpha	14.0±0.0	10.0±5.0	1.3-18.7
			Gr. beta	65.3±1.2	62.0±5.0	53.3-70.7
			Sr-90	19.0±6.9	20.0±5.0	11.3-28.7
			Cs-137	19.0±2.0	20.0±5.0	11.3-28.7
STW-609	Water	Sep 1990	Sr-89	9.0±2.0	10.0±5.0	1.3-18.7
			Sr-90	9.0±2.0	9.0±5.0	0.3-17.7
STW-610	Water	Sep 1990	Gr. alpha	8.3±1.2	10.0±5.0	1.3-18.7
			Gr. beta	10.3±1.2	10.0±5.0	1.3-18.7
STM-611	Milk	Sep 1990	Sr-89	11.7±3.1	16.0±5.0	7.3-24.7
			Sr-90	15.0±0.0	20.0±5.0	11.3-28.7
			I-131	63.0±6.0	58.0±6.0	47.6-68.4
			Cs-137	20.0±2.0	20.0±5.0	11.3-28.7
			K	1673.3±70.2	1700.0±85.0	1552.5-1847.5
STW-612	Water	Oct 1990	Co-60	20.3±3.1	20.0±5.0	11.3-28.7
			Zn-65	115.3±12.2	115.0±12.0	94.2-135.8
			Ru-106	152.0±8.0	151.0±15.0	125.0-177.0
			Cs-134	11.0±0.0	12.0±5.0	3.3-20.7
			Cs-137	14.0±2.0	12.0±5.0	3.3-20.7
			Ba-133	116.7±9.9	110.0±11.0	90.9-129.1
STW-613	Water	Oct 1990	H-3	7167±330	7203±720	5954-8452

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-614 615	Water	Oct 1990				
	Sample A		Gr. alpha	68.7±7.2	62.0±16.0	34.2-89.8
			Ra-226	12.9±0.3	13.6±2.0	10.1-17.1
			Ra-228	4.2±0.6	5.0±1.3	2.7-7.3
			U	10.4±0.6	10.2±3.0	5.0-15.4
	Sample B		Gr. beta	55.0±8.7	53.0±5.0	44.3-61.7
			Sr-89	15.7±2.9	20.0±5.0	11.3-28.7
			Sr-90	12.0±2.0	15.0±5.0	6.3-23.7
			Cs-134	9.0±1.7	7.0±5.0	0.0-15.7
			Cs-137	7.7±1.2	5.0±5.0	0.0-13.7
STW-616	Water	Nov 1990	Ra-226	6.8±1.0	7.4±1.1	5.5-9.3
			Ra-228	5.3±1.7	7.7±1.9	4.4-11.0
STW-617[g]	Water	Nov 1990	U	35.0±0.4	35.5±3.6	29.3-41.7

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

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

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

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

[e] NA = Not analyzed.

[f] ND = No data; not analyzed due to relocation of the lab.

[g] Sample was analyzed but the results not submitted to EPA because deadline was missed (all data on file).

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

Lab Code	TLD Type	Measurement	mR: Teledyne Result ±2σ[a]	mR: Known Value[c]	mR: Average ±2σ[d] (All Participants)
2nd International Intercomparison[b]					
115-2	CaF_2:Mn Bulb	Field	17.0±1.9	17.1	16.4±7.7
		Lab	20.8±4.1	21.3	18.8±7.6
3rd International Intercomparison[e]					
115-3	CaF_2:Mn Bulb	Field	30.7±3.2	34.9±4.8	31.5±3.0
		Lab	89.6±6.4	91.7±14.6	86.2±24.0
4th International Intercomparison[f]					
115-4	CaF_2:Mn Bulb	Field	14.1±1.1	14.1±1.4	16.0±9.0
		Lab (Low)	9.3±1.3	12.2±2.4	12.0±7.4
		Lab (High)	40.4±1.4	45.8±9.2	43.9±13.2
5th International Intercomparison[g]					
115-5A	CaF_2:Mn Bulb	Field	31.4±1.8	30.0±6.0	30.2±14.6
		Lab at beginning	77.4±5.8	75.2±7.6	75.8±40.4
		Lab at the end	96.6±5.8	88.4±8.8	90.7±31.2
115-5B	LiF-100 Chips	Field	30.3±4.8	30.0±6.0	30.2±14.6
		Lab at beginning	81.1±7.4	75.2±7.6	75.8±40.4
		Lab at the end	85.4±11.7	88.4±8.8	90.7±31.2
7th International Intercomparison[h]					
115-7A	LiF-100 Chips	Field	75.4±2.6	75.8±6.0	75.1±29.8
		Lab (Co-60)	80.0±3.5	79.9±4.0	77.9±27.6
		Lab (Cs-137)	66.6±2.5	75.0±3.8	73.0±22.2

Table A-2. (continued)

Lab Code	TLD Type	Measurement	mR: Teledyne Result ±2σ[a]	mR: Known Value[c]	mR: Average ±2σ[d] (All Participants)
115-7B	CaF_2:Mn Bulbs	Field	71.5±2.6	75.8±6.0	75.1±29.8
		Lab (Co-60)	84.8±6.4	79.9±4.0	77.9±27.6
		Lab (Cs-137)	78.8±1.6	75.0±3.8	73.0±22.2
115-7C	$CaSO_4$:Dy Cards	Field	76.8±2.7	75.8±6.0	75.1±29.8
		Lab (Co-60)	82.5±3.7	79.9±4.0	77.9±27.6
		Lab (Cs-137)	79.0±3.2	75.0±3.8	73.0±22.2
8th International Intercomparison[i]					
115-8A	LiF-100 Chips	Field Site 1	29.5±1.4	29.7±1.5	28.9±12.4
		Field Site 2	11.3±0.8	10.4±0.5	10.1±9.06
		Lab (Cs-137)	13.7±0.9	17.2±0.9	16.2±6.8
115-8B	CaF_2:Mn Bulbs	Field Site 1	32.3±1.2	29.7±1.5	28.9±12.4
		Field Site 2	9.0±1.0	10.4±0.5	10.1±9.0
		Lab (Cs-137)	15.8±0.9	17.2±0.9	16.2±6.8
115-8C	$CaSO_4$:Dy Cards	Field Site 1	32.3±0.7	29.7±1.5	28.9±12.4
		Field Site 2	10.6±0.6	10.4±0.5	10.1±9.0
		Lab (Cs-137)	18.1±0.8	17.2±0.9	16.2±6.8
Teledyne Testing[j]					
89-1	LiF-100 Chips	Lab	21.0±0.4	22.4	--
89-2	Teledyne $CaSO_4$:Dy Cards	Lab	20.9±1.0	20.3	--

Table A-2. (continued)

Lab Code	TLD Type	Measurement	mR: Teledyne Result ±2σ[a]	mR: Known Value[c]	mR: Average ±2σ[d] (All Participants)
Teledyne Testing[j]					
90-1[k]	Teledyne $CaSO_4$:Dy Cards	Lab	20.6±1.4	19.6	--
90-1[l]	Teledyne $CaSO_4$:Dy Cards	Lab	100.8±4.3	100.0	--

[a] Lab result given is the mean ±2 standard deviations of three determinations.
[b] Second International Intercomparison of Environmental Dosimeters conducted in April of 1976 by the Health and Safety Laboratory (GASL), New York, New York, and the School of Public Health of the University of Texas, Houston, Texas.
[c] Value determined by sponsor of the intercomparison using continuously operated pressurized ion chamber.
[d] Mean ±2 standard deviations of results obtained by all laboratories participating in the program.
[e] Third International Intercomparison of Environmental Dosimeters conducted in summer of 1977 by Oak Ridge National Laboratory and the School of Public Health of the University of Texas, Houston, Texas.
[f] Fourth International Intercomparison of Environmental Dosimeters conducted in summer of 1979 by the School of Public Health of the University of Texas, Houston, Texas.
[g] Fifth International Intercomparison of Environmental Dosimeter conducted in fall of 1980 at Idaho Falls, Idaho and sponsored by the School of Public Health of the University of Texas, Houston, Texas and Environmental Measurements Laboratory, New York, New York, U.S. Department of Energy.
[h] Seventh International Intercomparison of Environmental Dosimeters conducted in the spring and summer of 1984 at Las Vegas, Nevada, and sponsored by the U.S. Department of Energy, the U.S. Nuclear Regulatory Commission, and the U.S. Environmental Protection Agency.
[i] Eighth International Intercomparison of Environmental Dosimeters conducted in the fall and winter of 1985-1986 at New York, New York, and sponsored by the U.S. Department of Energy.
[j] Chips were submitted in September 1989 and cards were submitted in November 1989 to Teledyne Isotopes, Inc., Westwood, NJ for irradiation.
[k] Cards were irradiated by Teledyne Isotopes, Inc., Westwood, NJ on June 19, 1990.
[l] Cards were irradiated by Dosimetry Associates, Inc., Northville, MI on October 30, 1990.

Table A-3. In-house spiked samples.

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

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

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

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) TIML Result n=3	Known Activity	Expected Precision 1s, n=3[a]
QC-W-29	Water	Jun 1987	Gr. alpha	16.4±1.3	18.9±5.0	8.7
			Gr. beta	15.9±4.0	11.8±4.0	8.7
QC-MI-15	Milk	Jul 1987	Sr-90	19.4±1.6	18.8±3.5	5.2
			I-131	43.5±0.7	45.3±7.0	10.4
			Cs-134	17.9±2.2	16.0±5.3	8.7
			Cs-137	25.4±1.8	22.7±5.0	8.7
QC-W-30	Water	Sep 1987	Sr-89	17.5±3.0	14.3±5.0	8.7
			Sr-90	18.4±2.2	17.5±2.2	5.2
QC-W-31	Water	Oct 1987	H-3	2053±939	2059±306	520
QC-W-32	Water	Dec 1987	Gr. alpha	8.6±1.0	10.1±5.0	8.7
			Gr. beta	15.2±0.1	13.1±3.0	8.7
QC-W-33	Water	Dec 1987	Gr. alpha	7.7±1.4	10.1±5.0	8.7
			Gr. beta	10.9±1.0	7.9±3.0	8.7
QC-W-34	Water	Dec 1987	Gr. alpha	4.0±0.9	5.1±3.0	8.7
			Gr. beta	9.4±0.9	7.9±3.0	8.7
QC-MI-16	Milk	Feb 1988	Sr-89	31.8±4.7	31.7±6.0	8.7
			Sr-90	25.5±2.7	27.8±3.5	5.2
			I-131	26.4±0.5	23.2±5.0	10.4
			Cs-134	23.8±2.3	24.2±6.0	8.7
			Cs-137	26.5±0.8	25.1±6.0	8.7
QC-MI-17	Milk	Feb 1988	I-131	10.6±1.2	14.3±1.6	10.4
QC-W-35	Water	Feb 1988	I-131	9.7±1.1	11.6±1.1	10.4
QC-W-36	Water	Feb 1988	I-131	10.5±1.3	11.6±1.0	10.4
QC-W-37	Water	Mar 1988	Sr-89	17.1±2.0	19.8±8.0	8.7
			Sr-90	18.7±0.9	17.3±5.0	5.2
QC-MI-18	Milk	Mar 1988	I-131	33.2±2.3	26.7±5.0	10.4
			Cs-134	31.3±2.1	30.2±5.0	8.7
			Cs-137	29.9±1.4	26.2±5.0	8.7

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) TIML Result n=3	Known Activity	Expected Precision 1s, n=3[a]
QC-W-38	Water	Apr 1988	I-131	17.1±1.1	14.2±5.0	10.4
QC-W-39	Water	Apr 1988	H-3	4439±31	4176±500	724
QC-W-40	Water	Apr 1988	Co-60	23.7±0.5	26.1±4.0	8.7
			Cs-134	25.4±2.6	29.2±4.5	8.7
			Cs-137	26.6±2.3	26.2±4.0	8.7
QC-W-41	Water	Jun 1988	Gr. alpha	12.3±0.4	13.1±5.0	8.7
			Gr. beta	22.6±1.0	20.1±5.0	8.7
QC-MI-19	Milk	Jul 1988	Sr-89	15.1±1.6	16.4±5.0	8.7
			Sr-90	18.0±0.6	18.3±5.0	5.2
			I-131	88.4±4.9	86.6±8.0	10.4
			Cs-137	22.7±0.8	20.8±6.0	8.7
QC-W-42	Water	Sep 1988	Sr-89	48.5±3.3	50.8±8.0	8.7
			Sr-90	10.9±1.0	11.4±3.5	5.2
QC-W-43	Water	Oct 1988	Co-60	20.9±3.2	21.4±3.5	8.7
			Cs-134	38.7±1.6	38.0±6.0	8.7
			Cs-137	19.0±2.4	21.0±3.5	8.7
QC-W-44	Water	Oct 1988	I-131	22.2±0.6	23.3±3.5	10.4
QC-W-45	Water	Oct 1988	H-3	4109±43	4153±500	724
QC-MI-20	Milk	Oct 1988	I-131	59.8±0.9	60.6±9.0	10.4
			Cs-134	49.6±1.8	48.6±7.5	8.7
			Cs-137	25.8±4.6	24.7±4.0	8.7
QC-W-46	Water	Dec 1988	Gr. alpha	11.5±2.3	15.2±5.0	8.7
			Gr. beta	26.5±2.0	25.7±5.0	8.7
QC-MI-21	Milk	Jan 1989	Sr-89	25.5±10.3	34.0±10.0	8.7
			Sr-90	28.3±3.2	27.1±3.0	5.2
			I-131	540±13	550±20	10.4
			Cs-134	24.5±2.6	22.6±5.5	8.7
			Cs-137	24.0±0.6	20.5±5.0	8.7

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) TIML Result n=3	Known Activity	Expected Precision 1s, n=3[a]
QC-W-47	Water	Mar 1989	Sr-89	15.2±3.8	16.1±5.0	8.7
			Sr-90	16.4±1.7	16.9±3.0	5.2
QC-MI-22	Milk	Apr 1989	I-131	36.3±1.1	37.2±5.0	10.4
			Cs-134	20.8±2.8	20.7±8.0	8.7
			Cs-137	22.2±2.4	20.4±8.0	8.7
QC-W-48	Water	Apr 1989	Co-60	23.5±2.0	25.1±8.0	8.7
			Cs-134	24.2±1.1	25.9±8.0	8.7
			Cs-137	23.6±1.2	23.0±8.0	8.7
QC-W-49	Water	Apr 1989	I-131	37.2±3.7	37.2±5.0	10.4
QC-W-50	Water	Apr 1989	H-3	3011±59	3089±500	724
QC-W-51	Water	Jun 1989	Gr. alpha	13.0±1.8	15.0±5.0	8.7
			Gr. beta	26.0±1.2	25.5±8.0	8.7
QC-MI-23	Milk	Jul 1989	Sr-89	19.4±6.5	22.0±10.0	8.7
			Sr-90	27.6±3.5	28.6±3.0	5.2
			I-131	46.8±3.2	43.4±5.0	10.4
			Cs-134	27.4±1.8	28.3±6.0	8.7
			Cs-137	24.1±1.8	20.8±6.0	8.7
QC-MI-24	Milk	Aug 1989	Sr-89	25.4±2.7	27.2±10.0	8.7
			Sr-90	46.0±1.1	47.8±9.6	8.3
QC-W-52	Water	Sep 1989	I-131	9.6±0.3	9.7±1.9	10.4
QC-W-53	Water	Sep 1989	I-131	19.0±0.2	20.9±4.2	10.4
QC-W-54	Water	Sep 1989	Sr-89	25.8±4.6	24.7±4.0	8.7
			Sr-90	26.5±5.3	29.7±5.0	5.2
QC-MI-25	Milk	Oct 1989	I-131	70.0±3.3	73.5±20.0	10.4
			Cs-134	22.1±2.6	22.6±8.0	8.7
			Cs-137	29.4±1.5	27.5±8.0	8.7
QC-W-55	Water	Oct 1989	I-131	33.3±1.3	35.3±10.0	10.4

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) TIML Result n=3	Known Activity	Expected Precision 1s, n=3[a]
QC-W-56	Water	Oct 1989	Co-60	15.2±0.9	17.4±5.0	8.7
			Cs-134	22.1±4.4	18.9±8.0	8.7
			Cs-137	27.2±1.2	22.9±8.0	8.7
QC-W-57	Water	Oct 1989	H-3	3334±22	3379±500	724
QC-W-58	Water	Nov 1989	Sr-89	10.9±1.4[d]	11.1±1.0[d]	8.7
			Sr-90	10.4±1.0[d]	10.3±1.0[d]	5.2
QC-W-59	Water	Nov 1989	Sr-89	101.0±6.0[d]	104.1±10.5[d]	17.5
			Sr-90	98.0±3.0[d]	95.0±10.0[d]	17.0
QC-W-60	Water	Dec 1989	Gr. alpha	10.8±1.1	10.6±4.0	8.7
			Gr. beta	11.6±0.5	11.4±4.0	8.7
QC-MI-26	Milk	Jan 1990	Cs-134	19.3±1.0	20.8±8.0	8.7
			Cs-137	25.2±1.2	22.8±8.0	8.7
QC-MI-27	Milk	Feb 1990	Sr-90	18.0±1.6	18.8±5.0	5.2
QC-MI-28	Milk	Mar 1990	I-131	63.8±2.2	62.6±6.0	6.3
QC-MI-61	Water	Apr 1990	Sr-89	17.9±5.5	23.1±8.7	8.7
			Sr-90	19.4±2.5	23.5±5.2	5.2
QC-MI-29	Milk	Apr 1990	I-131	90.7±9.2	82.5±8.5	10.4
			Cs-134	18.3±1.0	19.7±5.0	8.7
			Cs-137	20.3±1.0	18.2±5.0	8.7
QC-W-62	Water	Apr 1990	Co-60	8.7±0.4	9.4±5.0	8.7
			Cs-134	20.0±0.2	19.7±5.0	8.7
			Cs-137	28.7±1.4	22.7±5.0	8.7
QC-W-63	Water	Apr 1990	I-131	63.5±8.0	66.0±6.7	6.6
QC-W-64	Water	Apr 1990	H-3	1941±130	1826.0±350.0	724
QC-W-65	Water	Jun 1990	Ra-226	6.4±0.2	6.9±1.0	1.0
QC-W-66	Water	Jun 1990	U	6.2±0.2	6.0±6.0	6.0

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) TIML Result n=3	Known Activity	Expected Precision 1s, n=3[a]
QC-MI-30	Milk	Jul 1990	Sr-89	12.8±0.4	18.4±10.0	8.7
			Sr-90	18.2±1.4	18.7±6.0	5.2
			Cs-134	46.0±1.3	49.0±5.0	8.7
			Cs-137	27.6±1.3	25.3±5.0	8.7
QC-W-68	Water	Jun 1990	Gr. alpha	9.8±0.3	10.6±6.0	8.7
			Gr. beta	11.4±0.6	11.3±7.0	8.7
QC-MI-31	Milk	Aug 1990	I-131	68.8±1.6	61.4±12.3	10.4
QC-W-69	Water	Sep 1990	Sr-89	17.7±1.6	19.2±10.0	8.7
			Sr-90	13.9±1.6	17.4±10.0	5.2
QC-MI-32	Milk	Oct 1990	I-131	34.8±0.2	32.4±6.5	8.7
			Cs-134	25.8±1.2	27.3±10.0	8.7
			Cs-137	25.3±2.0	22.4±10.0	8.7
QC-W-70	Water	Oct 1990	H-3	2355±59	2276±455	605
QC-W-71	Water	Oct 1990	I-131	55.9±0.9	51.8±10.4	10.4
QC-W-73	Water	Oct 1990	Co-60	18.3±2.7	16.8±5.0	8.7
			Cs-134	28.3±2.3	27.0±5.0	8.7
			Cs-137	22.7±1.3	22.4±5.0	8.7
QC-W-74	Water	Dec 1990	Gr. alpha	21.4±1.0	26.1±6.5	11.3
			Gr. beta	25.9±1.0	22.3±5.6	9.7

[a] n = 3 unless noted otherwise.
[b] n = 2 unless noted otherwise.
[c] n = 1 unless noted otherwise.
[d] Concentration in pCi/ml.

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Concentration (pCi/L) Acceptance Criteria (4.66 σ)
BL-1	D.I. Water	Nov 1985	Gross alpha	<0.1	<1
			Gross beta	<0.4	<4
BL-2	D.I. Water	Nov 1985	Cs-137 (gamma)	<1.9	<10
BL-3	D.I. Water	Nov 1985	Sr-89	<0.5	<5
			Sr-90	<0.6	<1
BL-5	D.I. Water	Nov 1985	Ra-226	<0.4	<1
			Ra-228	<0.4	<1
SPW-2265	D.I. Water	Apr 1985	Gross alpha	<0.6	<1
			Gross beta	<2.2	<4
			Sr-89	<0.2	<5
			Sr-90	<0.4	<1
			I-131	<0.2	<1
			Cs-137 (gamma)	<7.4	<10
BL-6	D.I. Water	Apr 1986	Gross alpha	<0.4	<1
BL-7	D.I. Water	Apr 1986	Gross alpha	<0.4	<1
BL-8	D.I. Water	Jun 1986	Gross alpha	<0.4	<1
BL-9	D.I. Water	Jun 1986	Gross alpha	<0.3	<1
SPW-3185	D.I. Water	Jan 1987	Ra-226	<0.1	<1
			Ra-228	<0.9	<1
SPS-3292	Milk	Jan 1987	I-131	<0.1	<1
			Cs-134	<6.2	<10
			Cs-137	<6.4	<10
SPW-3554	D.I. Water	Feb 1987	H-3	<180	<300
			Gross beta	<2.6	<4
SPS-3555	Milk	Feb 1987	Sr-89	<0.6	<5
			Sr-90	1.9±0.4[a]	<1
SPS-3731	Milk	Mar 1987	Cs-134	<2.2	<10
			Cs-137	<2.5	<10

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Concentration (pCi/L) Acceptance Criteria (4.66 σ)
SPS-3732	D.I. Water	Mar 1987	Sr-89	<0.9	<5
			Sr-90	<0.8	<1
			I-131	<0.3	<1
			Co-60	<2.3	<10
			Cs-134	<2.2	<10
			Cs-137	<2.4	<10
			Ra-226	<0.1	<1
			Ra-228	<1.0	<1
			Np-237	<0.04	<1
			Th-230	<0.05	<0.1
			Th-232	<0.02	<0.1
			U-234	<0.05	<0.1
			U-235	<0.03	<0.1
			U-238	<0.03	<0.1
SPS-4023	Milk	May 1987	I-131	<0.1	<1
SPS-4203	D.I. Water	May 1987	Gross alpha	<0.7	<1
			Gross beta	<1.7	<4
SPS-4204	Milk	May 1987	Sr-89	<0.5	<5
			Sr-90	2.4±0.6[a]	<1
SPS-4390	Milk	Jun 1987	Cs-134	<4.7	<10
			Cs-137	<5.2	<10
SPS-4391	D.I. Water	Jun 1987	Sr-89	<0.4	<5
			Sr-90	<0.4	<1
			I-121	<0.1	<1
			Co-60	<3.8	<10
			Cs-137	<5.7	<10
			Ra-226	<0.1	<1
			Ra-228	<0.9	<1
SPW-4627	D.I. Water	Aug 1987	Gross alpha	<0.6	<1
			Gross beta	<1.4	<4
			Tritium	<150	<300
SPS-4628	Milk	Aug 1987	Sr-89	<0.6	<5
			Sr-90	2.4±0.6[a]	<1

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Concentration (pCi/L) Acceptance Criteria (4.66 σ)
SPS-4847	Milk	Sep 1987	Cs-134	<4.4	<10
			Cs-137	<5.3	<10
SPS-4848	D.I. Water	Sep 1987	I-131	<0.2	<1
SPW-4849	D.I. Water	Sep 1987	Co-60	<4.1	<10
			Cs-134	<4.8	<10
			Cs-137	<4.0	<10
			Sr-89	<0.7	<5
			Sr-90	<0.7	<1
SPW-4850	D.I. Water	Sep 1987	Th-228	<0.04	<1
			Th-232	<0.8	<1
			U-234	<0.03	<1
			U-235	<0.03	<1
			U-238	<0.02	<1
			Am-241	<0.06	<1
			Cm-242	<0.04	<1
			Ra-226	<0.1	<1
			Ra-228	<1.0	<2
SPW-4859	D.I. Water	Oct 1987	Fe-55	<0.5	<1
SPS-5348	Milk	Dec 1987	Cs-134	<2.3	<10
			Cs-137	<2.5	<10
SPW-5384	D.I. Water	Dec 1987	Co-60	<2.8	<10
			Cs-134	<2.6	<10
			Cs-137	<2.8	<10
			I-131	<0.2	<1
			Ra-226	<0.1	<1
			Ra-228	<1.2	<2
			Sr-89	<0.5	<1
			Sr-90	<0.4	<1
SPW-5385	D.I. Water	Nov 1987	Gross alpha	<0.4	<1
			Gross beta	<2.2	<4
			Fe-55	<0.3	<1
SPS-5386	Milk	Jan 1988	I-131	<0.1	<1
SPW-5448	"Dead" Water	Jan 1988	H-3	<177	<300

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Concentration (pCi/L) Acceptance Criteria (4.66 σ)
SPS-5615	Milk	Mar 1988	Cs-134	<2.4	<10
			Cs-137	<2.5	<10
			I-131	<0.3	<1
			Sr-89	<0.4	<5
			Sr-90	2.4±0.5[a]	<1
SPS-5650	D.I. Water	Mar 1988	Th-228	<0.3	<1
			Th-230	<0.04	<1
			Th-232	<0.05	<1
			U-234	<0.03	<1
			U-235	<0.03	<1
			U-238	<0.03	<1
			Am-241	<0.06	<1
			Cm-242	<0.01	<1
			Pu-238	<0.08	<1
			Pu-240	<0.02	<1
SPS-6090	Milk	Jul 1988	Sr-89	<0.5	<1
			Sr-90	1.8±0.5	<1
			I-131	<0.4	<1
			Cs-137	<0.4	<10
SPW-6209	Water	Jul 1988	Fe-55	<0.8	<1
SPW-6292	Water	Sep 1988	Sr-89	<0.7	<1
			Sr-90	<0.7	<1
SPS-6477	Milk	Oct 1988	I-131	<0.2	<1
			Cs-134	<6.1	<10
			Cs-137	<5.9	<10
SPW-6478	Water	Oct 1988	I-131	<0.2	<1
SPW-6479	Water	Oct 1988	Co-60	<5.7	<10
			Cs-134	<3.7	<10
			Cs-137	<4.3	<10
SPW-6480	Water	Oct 1988	H-3	<170	<300
SPW-6625	Water	Dec 1988	Gross alpha	<0.7	<1
			Gross beta	<1.9	<4

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Concentration (pCi/L) Acceptance Criteria (4.66 σ)
SPS-6723	Milk	Jan 1989	Sr-89	<0.6	<5
			Sr-90	1.9±0.5[a]	<1
			I-131	<0.2	<1
			Cs-134	<4.3	<10
			Cs-137	<4.4	<10
SPW-6877	Water	Mar 1989	Sr-89	<0.4	<5
			Sr-90	<0.6	<1
SPS-6963	Milk	Apr 1989	I-131	<0.3	<1
			Cs-134	<5.9	<10
			Cs-137	<6.2	<10
SPW-7561	Water	Apr 1989	H-3	<150	<300
SPW-7207	Water	Jun 1989	Ra-226	<0.2	<1
			Ra-228	<0.6	<1
SPS-7208	Milk	Jun 1989	Sr-89	<0.6	<5
			Sr-90	2.1±0.5[a]	<1
			I-131	<0.3	<1
			Cs-134	<6.4	<10
			Cs-137	<7.2	<10
SPW-7558	Water	Jun 1989	Gross alpha	<0.2	<1
			Gross beta	<1.0	<4
SPS-7322	Milk	Aug 1989	Sr-89	<1.4	<5
			Sr-90	4.8±1.0[a]	<1
			I-131	<0.2	<1
			Cs-134	<6.9	<10
			Cs-137	<8.2	<10
SPW-7559	Water	Sep 1989	Sr-89	<2.0	<5
			Sr-90	<0.7	<1
SPW-7560	Water	Oct 1989	I-131	<0.1	<1
SPW-7562	Water	Oct 1989	H-3	<140	<300

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Concentration (pCi/L) Acceptance Criteria (4.66 σ)
SPS-7605	Milk	Nov 1989	I-131	<0.2	<1
			Cs-134	<8.6	<10
			Cs-137	<10	<10
SPW-7971	Water	Dec 1989	Gross alpha	<0.4	<1
			Gross beta	<0.8	<4
SPW-8039	Water	Jan 1990	Ra-226	<0.2	<1
SPS-8040	Milk	Jan 1990	Sr-89	<0.8	<5
			Sr-90	<1.0	<1
SPS-8208	Milk	Jan 1990	Sr-89	<0.8	<5
			Sr-90	1.6±0.5[a]	<1
			Cs-134	<3.6	<10
			Cs-137	<4.7	<10
SPS-8312	Milk	Feb 1990	Sr-89	<0.3	<5
			Sr-90	1.2±0.3[a]	<1
SPW-8312A	Water	Feb 1990	Sr-89	<0.6	<5
			Sr-90	<0.7	<1
SPS-8314	Milk	Mar 1990	I-131	<0.3	<1
SPS-8510	Milk	May 1990	I-131	<0.2	<1
			Cs-134	<4.6	<10
			Cs-137	<4.8	<10
SPW-8511A	Water	May 1990	H-3	<200	<300
SPS-8600	Milk	Jul 1990	Sr-89	<0.8	<5
			Sr-90	1.7±0.6[a]	<1
			I-131	<0.3	<1
			Cs-134	<5.0	<10
			Cs-137	<7.0	<10
SPM-8877	Milk	Aug 1990	I-131	<0.2	<1
SPW-8925	Water	Aug 1990	H-3	<200	<300

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L) Results (4.66 σ)	Concentration (pCi/L) Acceptance Criteria (4.66 σ)
SPW-8926	Water	Aug 1990	Gross alpha	<0.3	<1
			Gross beta	<0.7	<4
SPW-8927	Water	Aug 1990	U-234	<0.01	<1
			U-235	<0.02	<1
			U-238	<0.01	<1
SPW-8928	Water	Aug 1990	Mn-54	<4.0	<5
			Co-58	<4.1	<5
			Co-60	<2.4	<5
			Cs-134	<3.3	<5
			Cs-137	<3.7	<5
SPW-8929	Water	Aug 1990	Sr-89	<1.4	<5
			Sr-89	<0.6	<1
SPW-69	Water	Sep 1990	Sr-89	<1.8	<5
			Sr-90	<0.8	<1
SPW-106	Water	Oct 1990	H-3	<180	<300
SPM-107	Milk	Oct 1990	I-131	<0.4	<1
			Cs-134	<3.3	<5
			Cs-137	<4.3	<5
SPW-370	Water	Oct 1990	Mn-54	<1.7	<5
			Co-58	<2.6	<5
			Co-60	<1.6	<5
			Cs-134	<1.7	<5
			Cs-137	<1.8	<5
SPW-372	Water	Dec 1990	Gross alpha	<0.3	<1
			Gross beta	<0.8	<4

[a] Low level of Sr-90 concentration in milk (1 - 5 pCi/L) is not unusual.

ATTACHMENT B

ACCEPTANCE CRITERIA FOR "SPIKED" SAMPLES

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

Analysis	Level	One Standard Deviation for Single Determination
Gamma Emitters	5 to 100 pCi/liter or kg >100 pCi/liter or kg	5 pCi/liter 5% of known value
Strontium-89[b]	5 to 50 pCi/liter or kg >50 pCi/liter or kg	5 pCi/liter 10% of known value
Strontium-90[b]	2 to 30 pCi/liter or kg >30 pCi/liter of kg	3.0 pCi/liter 10% of known value
Potassium	>0.1 g/liter or kg	5% of known value
Gross Alpha	<20 pCi/liter >20 pCi/liter	5 pCi/liter 25% of known value
Gross Beta	<100 pCi/liter >100 pCi/liter	5 pCi/liter 5% of known value
Tritium	<4,000 pCi/liter >4,000 pCi/liter	ls = (pCi/liter) = 169.85 x (known).0933 10% of known value
Radium-226, Radium-228	<0.1 pCi/liter	15% of known value
Plutonium	0.1 pCi/liter, gram, or sample	10% of known value
Iodine-131, Iodine-129[b]	<55 pCi/liter >55 pCi/liter	6 pCi/liter 10% of known value
Uranium-238, Nickel-63[b], Technetium-99[b]	<35 pCi/liter >35 pCi/liter	6 pCi/liter 15% of known value
Iron-55[b]	50 to 100 pCi/liter >100 pCi/liter	10 pCi/liter 10% of known value

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

[b] TIML limit.

ADDENDUM TO APPENDIX A

The following is an explanation of the reasons why certain samples were outside the control limit specified by the Environmental Protection Agency for the Interlaboratory Comparison Program starting January 1987.

Lab Code	Analysis	TIML Result (pCi/L)[a]	EPA Control Limit (pCi/L)[a]	Explanation
STM-504	Sr-89 Sr-90	57.0±4.3 32.0±1.0	60.3-77.7 32.4-37.6	Milk had high fat content which made analyses difficult. Addition of errors to TIML result would put values within EPA control limits. EPA also had the same problem in analyzing its own sample.
STW-511	Ra-228	8.1±1.4	4.6-8.0	TIML results are usually within EPA control limits. Analysis of the next sample was within EPA control limits. No further action is planned.
STW-516	Cr-51	80.3±17.5	61.3-78.7	Results in the past have been within EPA control limits and TIML will monitor the situation in the future.
STF-524	K	1010.7±158.5[b]	1123.5-1336.5[b]	Error in transference of data. Correct data was 1105±33 mg/kg. Results in the past have been within the limits and TIML will monitor the situation in the future.
STW-532	I-131	9.0±2.0	6.2-8.8	Sample recounted after 12 days. The average result was 8.8±1.7 pCi/L (within EPA control limits). The sample was recounted in order to check the decay. Results in the past have been within the limits and TIML will continue to monitor the situation in the future.

[a] Reported in pCi/L unless otherwise noted.
[b] Concentrations are reported in mg/kg.

Lab Code	Analysis	TIML Result (pCi/L)[a]	EPA Control Limit (pCi/L)[a]	Explanation
STW-534	Co-60	63.3±1.3	41.3-58.7	High level of Co-60 was due to contamination of beaker. Beaker was discarded upon discovery of contamination and sample was recounted. Recount results 53.2±3.6 and 50.9±2.4 pCi/L.
STM-554	Sr-90	51.0±2.0	54.8-65.2	The cause of low result was due to very high fat content in the milk. It should be noted that 63% of all participants failed this test. Also, the average for all participants was 54.0 pCi/L before the Grubb and 55.8 pCi/L after the Grubb.
STW-560	Pu-239	5.8±1.1	3.5-4.9	The cause of high results is not known it is suspected that the standard was not properly calibrated by supplier and is under investigation. New Pu-236 standard was obtained and will be used for the next test.
STW-568	Ra-228	2.6±1.0	2.7-4.5	The cause of low results is not known. Next EPA crosscheck results were within the control limits. No further action is planned.
STM-570	Sr-89 Sr-90	26.0±10.0 45.7±4.2	30.3-47.7 49.8-60.2	The cause of low results was falsely high recovery due to suspected incomplete calcium removal. Since EPA sample was used up, internal spike was prepared and analyzed. The results were within control limits (See table A-3, sample QC-MI-24). No further action is planned.

[a] Reported in pCi/L unless otherwise noted.

Lab Code	Analysis	TIML Result (pCi/L)[a]	EPA Control Limit (pCi/L)[a]	Explanation
STW-589	Sr-90	17.3±1.2	17.4-22.6	Sample was reanalyzed in triplicate; results of reanalyses 18.8±1.5 pCi/L. No further action is planned.
STM-599	K	1300.0±69.2[c]	1414.7-1685.3[c]	Sample was reanalyzed in triplicate. Results of reanalyses, 1421.7±95.3 mg/L. The cause of low results is unknown.
STW-601	Gross Alpha	11.0±2.0	11.6-32.4	Sample was reanalyzed in triplicate. Results of reanalyses, 13.4±1.0 pCi/L.

[a] Reported in pCi/L unless otherwise noted.
[c] Concentrations are reported in mg/L.

APPENDIX B

DATA REPORTING CONVENTIONS

Data Reporting Conventions

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

2.0. Single Measurements

Each single measurement is reported as follows:

$$x \pm s$$

where x = value of the measurement;

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

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

$$<L$$

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

3.0. Duplicate Analyses

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

Reported result: $x \pm s$

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

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

3.2. Individual results: $<L_1$
$<L_2$

Reported result: $<L$

where L = lower of L_1 and L_2

3.3. Individual results: $x \pm s$
$<L$

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

4.0. Computation of Averages and Standard Deviations

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

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

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

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

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

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

4.5. In rounding off, the following rules are followed:

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

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

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

APPENDIX C

MAXIMUM PERMISSIBLE CONCENTRATIONS OF RADIOACTIVITY IN AIR AND WATER ABOVE BACKGROUND IN UNRESTRICTED AREAS

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

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

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

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

[c] A natural radionuclide.

APPENDIX D

SUMMARY OF THE LAND USE CENSUS

SUMMARY OF THE 1990 LAND USE CENSUS

The 1990 land use census was completed in July. It consisted of a house-by-house inspection out to three miles from the Duane Arnold Energy Center for all sectors except the NW and WNW sectors that were surveyed to five miles from the Duane Arnold Energy Center. The Cedar River water usage was surveyed by boat in June. No new uses of river water were found and the main usage of the Cedar River within three miles downstream of the Duane Arnold Energy Center continues to be recreation and fishing.

The land use census showed that no changes are needed in the sampling program as no new station-receptor relationships were created. There were twenty more gardens, as above average rainfall provided better growing conditions than in the previous three years. There were ten more new homes this year. Two new homes were in Palo (south) and eight were in the southeast sector which continues the building trend seen for that sector in the previous two land use census.

APPENDIX E

ANNUAL RADIATION DOSE ASSESSMENT

ANNUAL RADIATION DOSE ASSESSMENT

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

Section A. Dose Contribution from Direct Radiation

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

1. Pre-operational and 1990 TLD results were compared using a paired difference test. No difference in the populations were observed at 0.5, 1, and 3 miles using a confidence level of 99%.

2. As stated earlier in this report (part 1, page 9) no plant effect was indicated by the TLDs, as dose results were less than the estimated average natural background for Middle America.

Section B. Calculated Dose from Effluent Releases

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

Results of these calculations are discussed below:

1. There were no liquid releases in 1990.

2. The doses to air from noble gas released were 8.62E-3 mrad from gamma radiation and 9.92E-3 mrad from beta radiation, both at the south site boundary.

3. The total body dose equivalent to the maximally exposed individual from noble gases was 1.36E-3 mrem, at 1561 meters NNW.

4. The skin dose equivalent to the maximally exposed individual from noble gases was 3.56E-3 mrem, at 1561 meters NNW.

5. The dose equivalent to the maximally exposed individual from iodines and particulates with half-lives greater than eight days was 2.24E-2 mrem to the GI tract of an adult at 1561 meters NNW.

Conclusion

No measurable dose was detected by environmental TLDs in 1990. The calculated dose to the maximally exposed individual for 1990 was 2.38E-2 mrem, and represents the contributions to the total body from noble gases and to an adult GI tract from particulates and iodines. The calculated doses are well below the regulatory limits stated in Appendix I to 10 CFR 50 and in 40 CFR 190.

SUMMARY TABLE OF MAXIMUM INDIVIDUAL DOSES FOR 1990

TYPE	AGE GROUP	DISTANCE (meters)	DIRECTION	DOSE OR DOSE EQUIVALENT
Direct Radiation (as measured by TLDs)				none
Liquids Releases				none
Noble Gas				
Gamma Air Dose		455	S	8.62E-3 mrad
Beta Air Dose		455	S	9.92E-3 mrad
Total Body	All	1561	NNW	1.36E-3 mrem
Skin	All	1561	NNW	3.56E-3 mrem
Particulates and Iodines	Adult GI Tract	1561	NNW	2.24E-2 mrem
TOTAL (total body plus particulates & iodines)				2.38E-2 mrem

TELEDYNE ISOTOPES

MIDWEST LABORATORY

700 LANDWEHR ROAD

NORTHBROOK, ILLINOIS 60062-2310

(708) 564-0700 FAX (708) 564-4517

REPORT
TO
IOWA ELECTRIC LIGHT AND POWER
CEDAR RAPIDS, IOWA

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

ANNUAL REPORT - PART II
DATA TABULATIONS AND ANALYSES
JANUARY - DECEMBER 1990

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

Approved by: L. G. Huebner

L. G. Huebner
General Manager

15 March 1991

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LIST OF TABLES

LIST OF TABLES (continued)

1.0 INTRODUCTION

The following constitutes a Supplement to the Annual Report for the Radiological Environmental Monitoring Program conducted at the Duane Arnold Energy Center, Cedar Rapids, Iowa in 1990. Results of completed analyses are presented in the attached tables.

For information regarding sampling locations, type and frequency of collection, and sample codes, please see Tables 5.3 - 5.5 and Figures 5-1 and 5-2 of Part I.

2.0 LISTING OF MISSED SAMPLES

Sample Type	Location	Expected Collection Date	Reason
Milk	D-93	01-03-90	Animals dry.
Milk	D-101	01-03-90	Animal dry.
Milk	D-101	02-06-90	Animal dry.
Milk	D-101	03-06-90	Animal dry.
Milk	D-96	05-29-90	Farmer did not provide sample.
Milk	D-105	05-29-90	Farmer did not provide sample.
TLD	D-33	06-28-90	TLD lost in the field.
TLD	D-47	12-18-90	TLD lost in the field.

3.0 DATA TABLES

Table 1. Airborne particulates collected at Location D-1, (Cedar Rapids), analysis for gross beta. Collection: Weekly.

Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)	Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)
01-04-90	300	0.035±0.004	07-05-90	295	0.018±0.003
01-11-90	300	0.051±0.005	07-13-90[a]	336	0.014±0.003
01-18-90	299	0.042±0.003	07-19-90[b]	251	0.023±0.004
01-25-90	303	0.026±0.004	07-26-90	287	0.018±0.003
02-01-90	303	0.025±0.003	08-02-90	284	0.018±0.004
02-08-90	302	0.035±0.004	08-09-90	291	0.020±0.004
02-15-90	303	0.024±0.003	08-16-90	280	0.027±0.004
02-22-90	303	0.043±0.004	08-23-90	285	0.011±0.003
03-01-90	302	0.027±0.003	08-30-90	286	0.024±0.003
03-08-90	302	0.029±0.004	09-06-90	284	0.030±0.004
03-15-90	302	0.013±0.003	09-13-90	286	0.032±0.004
03-22-90	303	0.020±0.003	09-21-90[a]	325	0.016±0.003
03-29-90	301	0.026±0.004	09-28-90	304	0.027±0.004
1st Qtr mean±s.d.		0.030±0.010	3rd Qtr mean±s.d.		0.021±0.006
04-05-90	302	0.018±0.003	10-05-90	285	0.021±0.003
04-12-90	303	0.020±0.003	10-12-90	286	0.022±0.003
04-19-90	303	0.024±0.003	10-18-90[b]	246	0.026±0.004
04-26-90	303	0.022±0.003	10-26-90[a]	326	0.025±0.003
05-03-90	293	0.014±0.003	11-01-90[b]	247	0.035±0.004
05-10-90	294	0.019±0.003	11-08-90	286	0.031±0.004
05-17-90	295	0.013±0.003	11-14-90[b]	245	0.032±0.004
05-24-90	295	0.010±0.002	11-21-90	286	0.035±0.004
05-31-90	292	0.012±0.002	11-29-90[a]	326	0.024±0.003
06-07-90	294	0.008±0.003	12-06-90	285	0.022±0.003
06-14-90	295	0.015±0.003	12-13-90	286	0.035±0.004
06-22-90[a]	335	0.014±0.003	12-20-90	285	0.038±0.004
06-28-90[b]	252	0.018±0.003	12-27-90	281	0.043±0.004
			01-03-91	291	0.040±0.004
2nd Qtr mean±s.d.		0.016±0.005	4th Qtr mean±s.d.		0.031±0.007

[a] Eight day collection period.
[b] Six day collection period.

Table 2. Airborne particulates collected at Location D-2, (Marion), analysis for gross beta and iodine-131.[a] Collection: Weekly.

Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)	Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)
01-04-90	287	0.027±0.003	07-05-90	279	0.016±0.003
01-11-90	285	0.034±0.005	07-13-90[b]	316	0.011±0.003
01-18-90	288	0.038±0.003	07-19-90[c]	236	0.016±0.003
01-25-90	283	0.021±0.003	07-26-90	280	0.011±0.003
02-01-90	285	0.019±0.003	08-02-90	277	0.017±0.004
02-08-90	282	0.028±0.004	08-09-90	290	0.015±0.003
02-15-90	283	0.024±0.003	08-16-90	281	0.023±0.003
02-22-90	281	0.036±0.004	08-23-90	286	0.012±0.003
03-01-90	283	0.026±0.003	08-30-90	286	0.028±0.004
03-08-90	282	0.026±0.004	09-06-90	284	0.034±0.004
03-15-90	282	0.014±0.004	09-13-90	286	0.036±0.004
03-22-90	282	0.020±0.003	09-21-90[b]	326	0.017±0.003
03-29-90	282	0.022±0.004	09-28-90	285	0.030±0.004
1st Qtr mean±s.d.		0.026±0.007	3rd Qtr mean±s.d.		0.020±0.009
04-05-90	282	0.014±0.003	10-05-90	285	0.024±0.003
04-12-90	282	0.022±0.003	10-12-90	286	0.026±0.004
04-19-90	284	0.023±0.003	10-18-90[c]	244	0.018±0.004
04-26-90	282	0.022±0.003	10-26-90[b]	326	0.026±0.003
05-03-90	282	0.016±0.004	11-01-90[c]	247	0.042±0.004
05-10-90	285	0.019±0.003	11-08-90	286	0.034±0.004
05-17-90	275	0.011±0.003	11-14-90[c]	244	0.040±0.005
05-24-90	280	0.011±0.002	11-21-90	285	0.039±0.004
05-31-90	275	0.016±0.003	11-29-90[b]	327	0.027±0.004
06-07-90	276	0.011±0.003	12-06-90	286	0.022±0.003
06-14-90	281	0.015±0.003	12-13-90	286	0.040±0.004
06-22-90[b]	314	0.016±0.003	12-20-90	285	0.040±0.004
06-28-90[c]	238	0.011±0.003	12-27-90	283	0.048±0.004
			01-03-91	288	0.046±0.004
2nd Qtr mean±s.d.		0.016±0.004	4th Qtr mean±s.d.		0.034±0.010

[a] Iodine-131 concentrations are <0.07 pCi/m^3 unless noted otherwise.
[b] Eight day collection period.
[c] Six day collection period.

Table 3. Airborne particulates collected at Location D-3, (Hiawatha), analysis for gross beta. Collection: Weekly.

Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)	Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)
01-04-90	292	0.030±0.004	07-05-90	268	0.019±0.003
01-11-90	290	0.036±0.005	07-13-90[a]	303	0.017±0.003
01-18-90	293	0.038±0.003	07-19-90[b]	228	0.023±0.004
01-25-90	231	0.009±0.003	07-26-90	270	0.016±0.003
02-01-90	244	0.018±0.003	08-02-90	268	0.022±0.004
02-08-90	286	0.024±0.004	08-09-90	270	0.020±0.004
02-15-90	286	0.019±0.003	08-16-90	284	0.022±0.003
02-22-90	284	0.034±0.004	08-23-90	286	0.009±0.003
03-01-90	286	0.020±0.003	08-30-90	285	0.022±0.003
03-08-90	285	0.022±0.003	09-06-90	285	0.029±0.004
03-15-90	285	0.012±0.004	09-13-90	285	0.029±0.004
03-22-90	285	0.014±0.003	09-21-90[a]	327	0.014±0.003
03-29-90	285	0.018±0.004	09-28-90	285	0.023±0.004
1st Qtr mean±s.d.		0.023±0.009	3rd Qtr mean±s.d.		0.020±0.006
04-05-90	297	0.011±0.002	10-05-90	284	0.021±0.003
04-12-90	285	0.018±0.003	10-12-90	287	0.021±0.003
04-19-90	286	0.018±0.003	10-18-90[b]	244	0.025±0.004
04-26-90	285	0.013±0.003	10-26-90[a]	327	0.020±0.003
05-03-90	285	0.018±0.004	11-01-90[b]	247	0.033±0.004
05-10-90	286	0.015±0.003	11-08-90	286	0.030±0.004
05-17-90	267	0.017±0.003	11-14-90[b]	245	0.033±0.004
05-24-90	271	0.008±0.002	11-21-90	285	0.031±0.004
05-31-90	266	0.016±0.003	11-29-90[a]	326	0.022±0.003
06-07-90	268	0.008±0.003	12-06-90	286	0.017±0.003
06-14-90	271	0.018±0.003	12-13-90	286	0.035±0.004
06-22-90[a]	305	0.013±0.003	12-20-90	285	0.037±0.004
06-28-90[b]	230	0.018±0.004	12-27-90	254	0.043±0.004
			01-03-91	287	0.040±0.004
2nd Qtr mean±s.d.		0.015±0.004	4th Qtr mean±s.d.		0.029±0.008

[a] Eight day collection period.
[b] Six day collection period.

Table 4. Airborne particulates collected at Location D-5, (Palo), analysis for gross beta and iodine-131.[a] Collection: Weekly.

Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)	Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)
01-04-90	286	0.026±0.003	07-05-90	279	0.018±0.003
01-11-90	285	0.031±0.005	07-13-90[b]	317	0.014±0.003
01-18-90	287	0.030±0.003	07-19-90[c]	242	0.023±0.004
01-25-90	284	0.020±0.003	07-26-90	280	0.018±0.003
02-01-90	285	0.015±0.003	08-02-90	280	0.021±0.004
02-08-90	286	0.023±0.004	08-09-90	289	0.023±0.004
02-15-90	287	0.023±0.003	08-16-90	288	0.023±0.003
02-22-90	288	0.037±0.004	08-23-90	288	0.011±0.003
03-01-90	289	0.024±0.003	08-30-90	288	0.024±0.003
03-08-90	288	0.027±0.004	09-06-90	288	0.028±0.004
03-15-90	288	0.012±0.004	09-13-90	288	0.033±0.004
03-22-90	288	0.017±0.003	09-21-90[b]	330	0.015±0.003
03-29-90	288	0.018±0.004	09-28-90	288	0.021±0.004
1st Qtr mean±s.d.		0.023±0.007	3rd Qtr mean±s.d.		0.021±0.006
04-05-90	287	0.011±0.002	10-05-90	288	0.019±0.003
04-12-90	288	0.021±0.003	10-12-90	21[d]	<0.048
04-19-90	289	0.022±0.003	10-18-90[c]	245	0.028±0.004
04-26-90	288	0.013±0.003	10-26-90[b]	327	0.025±0.003
05-03-90	289	0.014±0.003	11-01-90[c]	246	0.035±0.004
05-10-90	289	0.018±0.003	11-08-90	286	0.033±0.004
05-17-90	288	0.013±0.003	11-14-90[c]	244	0.037±0.004
05-24-90	289	0.012±0.002	11-21-90	287	0.036±0.004
05-31-90	279	0.016±0.003	11-29-90[b]	326	0.024±0.003
06-07-90	279	0.010±0.003	12-06-90	285	0.010±0.003
06-14-90	283	0.018±0.003	12-13-90	284	0.042±0.004
06-22-90[b]	317	0.015±0.003	12-20-90	285	0.042±0.004
06-28-90[c]	241	0.020±0.004	12-27-90	284	0.046±0.004
			01-03-91	287	0.041±0.004
2nd Qtr mean±s.d.		0.016±0.004	4th Qtr mean±s.d.		0.032±0.010

[a] Iodine-131 concentrations are <0.07 pCi/m^3 unless noted otherwise.
[b] Eight day collection period.
[c] Six day collection period.
[d] Low volume due to sample pump failure; I-131 concentration <0.73 pCi/m^3.

Table 5. Airborne particulates collected at Location D-6, (Center Point), analysis for gross beta. Collection: Weekly.

Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)	Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)
01-04-90	275	0.030±0.004	07-05-90	293	0.018±0.003
01-11-90	273	0.042±0.005	07-13-90[a]	334	0.014±0.003
01-18-90	275	0.043±0.004	07-19-90[b]	254	0.019±0.003
01-25-90	273	0.027±0.004	07-26-90	295	0.016±0.003
02-01-90	274	0.023±0.003	08-02-90	294	0.018±0.004
02-08-90	275	0.032±0.004	08-09-90	277	0.023±0.004
02-15-90	265	0.021±0.003	08-16-90	276	0.024±0.004
02-22-90	266	0.035±0.004	08-23-90	277	0.008±0.003
03-01-90	266	0.024±0.003	08-30-90	277	0.023±0.003
03-08-90	265	0.021±0.004	09-06-90	276	0.033±0.004
03-15-90	265	0.014±0.004	09-13-90	277	0.036±0.004
03-22-90	265	0.020±0.003	09-21-90[a]	317	0.018±0.003
03-29-90	265	0.021±0.004	09-28-90	276	0.024±0.004
1st Qtr mean±s.d.		0.027±0.009	3rd Qtr mean±s.d.		0.021±0.008
04-05-90	265	0.013±0.003	10-05-90	277	0.022±0.003
04-12-90	259	0.016±0.003	10-12-90	278	0.022±0.003
04-19-90	249	0.024±0.004	10-18-90[b]	237	0.026±0.004
04-26-90	294	0.020±0.003	10-26-90[a]	317	0.021±0.003
05-03-90	294	0.016±0.003	11-01-90[b]	238	0.036±0.004
05-10-90	294	0.022±0.003	11-08-90	277	0.033±0.004
05-17-90	293	0.012±0.003	11-14-90[b]	242	0.029±0.004
05-24-90	295	0.008±0.002	11-21-90	287	0.045±0.004
05-31-90	294	0.016±0.003	11-29-90[a]	326	0.031±0.004
06-07-90	294	0.009±0.003	12-06-90	285	0.026±0.003
06-14-90	297	0.014±0.003	12-13-90	285	0.044±0.004
06-22-90[a]	333	0.014±0.003	12-20-90	285	0.052±0.004
06-28-90[b]	254	0.018±0.003	12-27-90	282	0.059±0.005
			01-03-90	287	0.055±0.005
2nd Qtr mean±s.d.		0.016±0.005	4th Qtr mean±s.d.		0.036±0.013

[a] Eight day collection period.
[b] Six day collection period.

Table 6. Airborne particulates collected at Location D-7, (Shellsburg), analysis for gross beta and iodine-131[a]. Collection: Weekly.

Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)	Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)
01-04-90	279	0.028±0.004	07-05-90	277	0.025±0.004
01-11-90	279	0.034±0.005	07-13-90[b]	317	0.018±0.003
01-18-90	281	0.029±0.003	07-19-90[c]	242	0.031±0.004
01-25-90	279	0.022±0.004	07-26-90	280	0.022±0.004
02-01-90	280	0.018±0.003	08-02-90	279	0.027±0.004
02-08-90	295	0.026±0.004	08-09-90	286	0.017±0.004
02-15-90	293	0.020±0.003	08-16-90	285	0.011±0.003
02-22-90	294	0.035±0.004	08-23-90	285	0.009±0.003
03-01-90	294	0.023±0.003	08-30-90	285	0.018±0.003
03-08-90	294	0.025±0.004	09-06-90	285	0.022±0.003
03-15-90	294	0.017±0.004	09-13-90[d]	285	0.004±0.002
03-22-90	294	0.020±0.003	09-21-90[b]	326	0.013±0.002
03-29-90	294	0.026±0.004	09-28-90	285	0.017±0.004
1st Qtr mean±s.d.		0.025±0.006	3rd Qtr mean±s.d.		0.019±0.006
04-05-90	293	0.017±0.003	10-05-90	285	0.015±0.003
04-12-90	294	0.021±0.003	10-12-90	286	0.016±0.003
04-19-90	295	0.024±0.003	10-18-90[c]	245	0.016±0.003
04-26-90	294	0.021±0.003	10-26-90[b]	327	0.016±0.003
05-03-90	294	0.017±0.004	11-01-90[c]	246	0.025±0.004
05-10-90	294	0.022±0.003	11-08-90	286	0.020±0.003
05-17-90	279	0.010±0.003	11-14-90[c]	244	0.027±0.004
05-24-90	280	0.011±0.002	11-21-90	287	0.025±0.004
05-31-90	279	0.020±0.003	11-29-90[b]	326	0.022±0.003
06-07-90	279	0.013±0.003	12-06-90	285	0.020±0.003
06-14-90	283	0.016±0.003	12-13-90	285	0.037±0.004
06-22-90[b]	316	0.016±0.003	12-20-90	284	0.039±0.004
06-28-90[c]	241	0.020±0.003	12-27-90	284	0.040±0.004
			01-03-91	287	0.038±0.004
2nd Qtr mean±s.d.		0.018±0.004	4th Qtr mean±s.d.		0.025±0.009

[a] Iodine-131 concentrations are <0.07 pCi/m^3 unless noted otherwise.
[b] Eight day collection period.
[c] Six day collection period.
[d] Filter paper very light; possible pump malfunction. Result not included in mean calculation.

Table 7. Airborne particulates collected at Location D-8, (Urbana), analysis for gross beta and iodine-131[a]. Collection: Weekly.

Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)	Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)
01-04-90	78[b]	0.045±0.010	07-05-90	270	0.018±0.003
01-11-90	287	0.038±0.005	07-13-90[c]	308	0.014±0.003
01-18-90	288	0.048±0.004	07-19-90[d]	234	0.021±0.004
01-25-90	287	0.029±0.004	07-26-90	272	0.015±0.003
02-01-90	288	0.027±0.003	08-02-90	271	0.022±0.004
02-08-90	289	0.035±0.004	08-09-90	280	0.018±0.004
02-15-90	287	0.031±0.004	08-16-90	279	0.024±0.003
02-22-90	289	0.044±0.004	08-23-90	280	0.012±0.003
03-01-90	289	0.035±0.003	08-30-90	279	0.025±0.003
03-08-90	288	0.037±0.004	09-06-90	279	0.028±0.004
03-15-90	288	0.020±0.004	09-13-90	280	0.034±0.004
03-22-90	288	0.025±0.003	09-21-90[c]	320	0.017±0.003
03-29-90	288	0.032±0.004	09-28-90	279	0.023±0.004
1st Qtr mean±s.d.		0.034±0.008	3rd Qtr mean±s.d.		0.021±0.006
04-05-90	287	0.016±0.003	10-05-90	280	0.020±0.003
04-12-90	288	0.028±0.004	10-12-90	281	0.021±0.003
04-19-90	289	0.028±0.003	10-18-90[d]	240	0.024±0.004
04-26-90	288	0.016±0.003	10-26-90[c]	320	0.019±0.003
05-03-90	272	0.018±0.004	11-01-90[d]	240	0.035±0.004
05-10-90	272	0.021±0.003	11-08-90	279	0.026±0.004
05-17-90	271	0.015±0.003	11-14-90[d]	239	0.031±0.004
05-24-90	272	0.013±0.003	11-21-90	287	0.038±0.004
05-31-90	271	0.017±0.003	11-29-90[c]	326	0.023±0.003
06-07-90	271	0.012±0.003	12-06-90	285	0.021±0.003
06-14-90	274	0.019±0.003	12-13-90	285	0.043±0.004
06-22-90[c]	307	0.015±0.003	12-20-90	285	0.042±0.004
06-28-90[d]	234	0.018±0.004	12-27-90	284	0.043±0.004
			01-03-91	287	0.044±0.004
2nd Qtr mean±s.d.		0.018±0.005	4th Qtr mean±s.d.		0.031±0.010

[a] Iodine-131 concentrations are <0.07 pCi/m^3 unless noted otherwise.
[b] Low volume due to air sampler pump malfunction. I-131 concentration <0.20 pCi/m^3.
[c] Eight day collection period.
[d] Six day collection period.

Table 8. Airborne particulates collected at Location D-10, (Atkins), analysis for gross beta. Collection: Weekly.

Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)	Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)
01-04-90	292	0.029±0.003	07-05-90	285	0.020±0.003
01-11-90	292	0.032±0.005	07-13-90[a]	327	0.013±0.003
01-18-90	290	0.039±0.003	07-19-90[b]	244	0.023±0.004
01-25-90	292	0.018±0.003	07-26-90	287	0.017±0.003
02-01-90	291	0.018±0.003	08-02-90	284	0.026±0.004
02-08-90	285	0.024±0.004	08-09-90	308	0.014±0.003
02-15-90	285	0.019±0.003	08-16-90	48[c]	0.017±0.013
02-22-90	285	0.038±0.004	08-23-90	302	0.008±0.003
03-01-90	285	0.022±0.003	08-30-90	304	0.019±0.003
03-08-90	284	0.024±0.004	09-06-90	302	0.023±0.003
03-15-90	284	0.014±0.004	09-13-90	126[d]	0.018±0.006
03-22-90	286	0.018±0.003	09-21-90[a]	272	0.011±0.003
03-29-90	284	0.021±0.004	09-28-90	286	0.016±0.004
1st Qtr mean±s.d.		0.024±0.008	3rd Qtr mean±s.d.		0.017±0.005
04-05-90	284	0.015±0.003	10-05-90	285	0.013±0.003
04-12-90	285	0.019±0.003	10-12-90	287	0.016±0.003
04-19-90	286	0.023±0.003	10-18-90[b]	245	0.018±0.004
04-26-90	286	0.018±0.003	10-26-80[a]	326	0.015±0.003
05-03-90	285	0.018±0.004	11-01-90[b]	246	0.028±0.004
05-10-90	286	0.018±0.003	11-08-90	281	0.021±0.003
05-17-90	284	0.014±0.003	11-14-90[b]	245	0.022±0.004
05-24-90	286	0.012±0.002	11-21-90	285	0.024±0.003
05-31-90	283	0.014±0.003	11-29-90[a]	327	0.017±0.003
06-07-90	287	0.012±0.003	12-06-90	262	0.024±0.004
06-14-90	286	0.020±0.003	12-13-90	263	0.046±0.004
06-22-90[a]	325	0.015±0.003	12-20-90	262	0.049±0.005
06-28-90[b]	245	0.011±0.003	12-27-90	258	0.055±0.005
			01-03-91	268	0.056±0.005
2nd Otr means±s.d.		0.016±0.004	4th Qtr mean±s.d.		0.029±0.016

[a] Eight day collection period.
[b] Six day collection period.
[c] Low volume due to power interruption at sampler pump site.
[d] Low volume due to sampler pump failure.

Table 9. Airborne particulates collected at Location D-11, (Toddville), analysis for gross beta and iodine-131.[a] Collection: Weekly.

Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)	Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)
01-04-90	289	0.019±0.003	07-05-90	277	0.019±0.003
01-11-90	287	0.030±0.005	07-13-90[b]	313	0.015±0.003
01-18-90	290	0.026±0.003	07-19-90[c]	237	0.022±0.004
01-25-90	287	0.020±0.003	07-26-90	279	0.015±0.003
02-01-90	288	0.021±0.003	08-02-90	276	0.022±0.004
02-08-90	289	0.020±0.003	08-09-90	287	0.016±0.003
02-15-90	270	0.023±0.003	08-16-90	284	0.008±0.003
02-22-90	271	0.037±0.004	08-23-90	286	0.008±0.003
03-01-90	272	0.023±0.003	08-30-90	286	0.019±0.003
03-08-90	270	0.026±0.004	09-06-90	285	0.021±0.003
03-15-90	272	0.013±0.004	09-13-90	285	0.022±0.003
03-22-90	270	0.018±0.003	09-21-90[b]	328	0.013±0.002
03-29-90	272	0.020±0.004	09-28-90	285	0.019±0.004
1st Qtr mean±s.d.		0.023±0.006	3rd Qtr mean±s.d.		0.017±0.005
04-05-90	270	0.013±0.003	10-05-90	284	0.015±0.003
04-12-90	271	0.020±0.003	10-12-90	287	0.017±0.003
04-19-90	272	0.023±0.003	10-18-90[c]	244	0.019±0.004
04-26-90	271	0.019±0.003	10-26-90[b]	327	0.022±0.003
05-03-90	271	0.018±0.004	11-01-90[c]	246	0.031±0.004
05-10-90	272	0.016±0.003	11-08-90	286	0.028±0.004
05-17-90	270	0.014±0.003	11-14-90[c]	245	0.030±0.004
05-24-90	273	0.009±0.002	11-21-90	282	0.032±0.004
05-31-90	275	0.015±0.003	11-29-90[b]	323	0.025±0.003
06-07-90	277	0.010±0.003	12-06-90	283	0.020±0.003
06-14-90	280	0.015±0.003	12-13-90	283	0.037±0.004
06-22-90[b]	315	0.016±0.003	12-20-90	280	0.039±0.004
06-28-90[c]	238	0.020±0.004	12-27-90	282	0.040±0.004
			01-03-91	282	0.038±0.004
2nd Qtr mean±s.d.		0.016±0.004	4th Qtr mean±s.d.		0.028±0.009

[a] Iodine-131 concentrations are <0.07 pCi/m^3 unless noted otherwise.
[b] Eight day collection period.
[c] Six day collection period.

Table 10. Airborne particulates collected at Location D-13, (Alburnett), analysis for gross beta. Collection: Weekly.

Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)	Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)
01-04-90	283	0.029±0.004	07-05-90	295	0.016±0.003
01-11-90	282	0.036±0.005	07-13-90[a]	337	0.015±0.003
01-18-90	284	0.037±0.003	07-19-90[b]	256	0.020±0.003
01-25-90	287	0.022±0.003	07-26-90	298	0.017±0.003
02-01-90	288	0.018±0.003	08-02-90	296	0.022±0.004
02-08-90	289	0.026±0.004	08-09-90	298	0.020±0.004
02-15-90	287	0.022±0.003	08-16-90	279	0.019±0.003
02-22-90	289	0.031±0.004	08-23-90	280	0.011±0.003
03-01-90	288	0.021±0.003	08-30-90	280	0.023±0.003
03-08-90	287	0.023±0.003	09-06-90	279	0.032±0.004
03-15-90	287	0.009±0.003	09-13-90	280	0.042±0.004
03-22-90	288	0.018±0.003	09-21-90[a]	320	0.020±0.003
03-29-90	289	0.023±0.004	09-28-90	279	0.031±0.004
1st Qtr mean±s.d.		0.024±0.008	3rd Qtr mean±s.d.		0.022±0.008
04-05-90	287	0.015±0.003	10-05-90	280	0.028±0.004
04-12-90	288	0.019±0.003	10-12-90	281	0.031±0.004
04-19-90	288	0.022±0.003	10-18-90[b]	240	0.034±0.004
04-26-90	288	0.017±0.003	10-26-90[a]	320	0.027±0.003
05-03-90	295	0.014±0.003	11-01-90[b]	241	0.049±0.005
05-10-90	297	0.022±0.003	11-08-90	280	0.038±0.004
05-17-90	296	0.015±0.003	11-14-90[b]	239	0.044±0.005
05-24-90	298	0.010±0.002	11-21-90	281	0.048±0.004
05-31-90	296	0.014±0.003	11-29-90[a]	320	0.033±0.004
06-07-90	299	0.007±0.003	12-06-90	305	0.017±0.003
06-14-90	300	0.016±0.003	12-13-90	305	0.036±0.004
06-22-90[a]	336	0.013±0.003	12-20-90	305	0.034±0.004
06-28-90[b]	256	0.016±0.003	12-27-90	284	0.040±0.004
			01-03-91	307	0.036±0.004
2nd Qtr mean±s.d.		0.015±0.004	4th Qtr mean±s.d.		0.035±0.008

[a] Eight day collection period.
[b] Six day collection period.

Table 11. Airborne particulates collected at Location D-15, (On-site), analysis for gross beta and iodine-131.[a] Collection: Weekly.

Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)	Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)
01-04-90	286	0.027±0.003	07-05-90	310	0.017±0.003
01-11-90	285	0.031±0.005	07-13-90[c]	354	0.011±0.002
01-18-90	286	0.032±0.003	07-19-90[d]	269	0.019±0.003
01-25-90	284	0.020±0.003	07-26-90	312	0.011±0.003
02-01-90	285	0.021±0.003	08-02-90	311	0.018±0.003
02-08-90	291	0.020±0.003	08-09-90	283	0.019±0.004
02-15-90	291	0.022±0.003	08-16-90	282	0.016±0.003
02-22-90	292	0.035±0.004	08-23-90	283	0.008±0.003
03-01-90	292	0.021±0.003	08-30-90	283	0.023±0.003
03-08-90	291	0.024±0.003	09-06-90	282	0.027±0.004
03-15-90	291	0.012±0.004	09-13-90	283	0.022±0.003
03-22-90	291	0.013±0.003	09-21-90[c]	323	0.015±0.003
03-29-90	291	0.021±0.004	09-28-90	283	0.023±0.004
1st Qtr mean±s.d.		0.023±0.007	3rd Qtr mean±s.d.		0.018±0.006
04-05-90	290	0.011±0.002	10-05-90	282	0.018±0.003
04-12-90	291	0.016±0.003	10-12-90	283	0.018±0.003
04-19-90	292	0.021±0.003	10-18-90[d]	244	0.025±0.004
04-26-90	291	0.019±0.003	10-26-90[c]	323	0.017±0.003
05-03-90	291	0.011±0.003	11-01-90[d]	244	0.031±0.004
05-10-90	291	0.012±0.003	11-08-90	283	0.025±0.004
05-17-90	311	0.013±0.003	11-14-90[d]	241	0.030±0.004
05-24-90	83[b]	0.015±0.008	11-21-90	286	0.033±0.004
05-31-90	297	0.016±0.003	11-29-90[c]	327	0.028±0.004
06-07-90	311	0.008±0.002	12-06-90	285	0.019±0.003
06-14-90	314	0.011±0.002	12-13-90	284	0.034±0.004
06-22-90[c]	353	0.011±0.002	12-20-90	285	0.035±0.004
06-28-90[d]	268	0.013±0.003	12-27-90	284	0.038±0.004
			01-03-90	287	0.044±0.004
2nd Qtr mean±s.d.		0.014±0.004	4th Qtr mean±s.d.		0.028±0.008

[a] Iodine-131 concentrations are <0.07 pCi/m^3 unless noted otherwise.
[b] Low volume due to interrupted electrical service at pump; I-131 concentration <0.131 pCi/m^3.
[c] Eight day collection period.
[d] Six day collection period.

Table 12. Airborne particulates collected at Location D-16, (Onsite), analysis for gross beta. Collection: Weekly.

Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)	Date Collected	Volume (m^3)	Gross Beta (pCi/m^3)
01-04-90	289	0.026±0.003	07-05-90	276	0.016±0.003
01-11-90	288	0.033±0.005	07-13-90[a]	314	0.010±0.003
01-18-90	289	0.029±0.003	07-19-90[b]	239	0.022±0.004
01-25-90	287	0.023±0.004	07-26-90	277	0.009±0.003
02-01-90	289	0.021±0.003	08-02-90	308	0.011±0.003
02-08-90	288	0.024±0.004	08-09-90	308	0.016±0.003
02-15-90	288	0.020±0.003	08-16-90	307	0.015±0.003
02-22-90	288	0.033±0.004	08-23-90	309	0.007±0.002
03-01-90	289	0.024±0.003	08-30-90	308	0.021±0.003
03-08-90	288	0.025±0.004	09-06-90	308	0.023±0.003
03-15-90	288	0.016±0.004	09-13-90	308	0.026±0.003
03-22-90	288	0.018±0.003	09-21-90[a]	352	0.015±0.002
03-29-90	288	0.026±0.004	09-28-90	283	0.021±0.004
1st Qtr mean±s.d.		0.024±0.005	3rd Qtr mean±s.d.		0.016±0.006
04-05-90	288	0.015±0.003	10-05-90	308	0.015±0.003
04-12-90	288	0.021±0.003	10-12-90	309	0.021±0.003
04-19-90	288	0.023±0.003	10-18-90[b]	265	0.015±0.003
04-26-90	288	0.021±0.003	10-26-90[a]	352	0.019±0.003
05-03-90	276	0.017±0.004	11-01-90[b]	266	0.034±0.004
05-10-90	283	0.020±0.003	11-08-90	309	0.025±0.003
05-17-90	276	0.011±0.003	11-14-90[b]	263	0.027±0.004
05-24-90	278	0.008±0.002	11-21-90	289	0.028±0.004
05-31-90	277	0.012±0.003	11-29-90[a]	330	0.023±0.003
06-07-90	276	0.011±0.003	12-06-90	288	0.020±0.003
06-14-90	280	0.015±0.003	12-13-90	287	0.038±0.004
06-22-90[a]	314	0.012±0.003	12-20-90	288	0.040±0.004
06-28-90[b]	239	0.013±0.003	12-27-90	287	0.046±0.004
			01-03-91	290	0.043±0.004
2nd Qtr mean±s.d.		0.015±0.005	4th Qtr mean±s.d.		0.028±0.010

[a] Eight day collection period.
[b] Six day collection period.

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

Location	Isotope	Sample Description and Activity (pCi/m^3)			
		1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
D-1	Lab Code	DAP-1870	DAP-2042	DAP-2179	DAP-2439
	Volume (m^3)	3923	3856	3794	3961
	Be-7	0.054±0.010	0.052±0.016	0.053±0.008	0.042±0.007
	Nb-95	<0.0017	<0.0019	<0.0013	<0.0010
	Zr-95	<0.0021	<0.0035	<0.0020	<0.0016
	Ru-103	<0.0011	<0.0008	<0.0007	<0.0008
	Ru-106	<0.0058	<0.011	<0.0062	<0.0067
	Cs-134	<0.0007	<0.0010	<0.0006	<0.0007
	Cs-137	<0.0006	<0.0012	<0.0007	<0.0007
	Ce-141	<0.0011	<0.0020	<0.0008	<0.0011
	Ce-144	<0.0028	<0.0060	<0.0027	<0.0034
D-2	Lab Code	DAP-1871	DAP-2043	DAP-2180	DAP-2440
	Volume (m^3)	3685	3636	3712	3958
	Be-7	0.058±0.008	0.059±0.015	0.058±0.016	0.058±0.012
	Nb-95	<0.0011	<0.0016	<0.0017	<0.0016
	Zr-95	<0.0017	<0.0031	<0.0025	<0.0024
	Ru-103	<0.0010	<0.0013	<0.0013	<0.0008
	Ru-106	<0.0074	<0.0092	<0.0097	<0.0068
	Cs-134	<0.0008	<0.0010	<0.0015	<0.0007
	Cs-137	<0.0007	<0.0014	<0.0013	<0.0009
	Ce-141	<0.0014	<0.0019	<0.0023	<0.0009
	Ce-144	<0.0038	<0.0067	<0.0076	<0.0024

Table 13. Airborne particulate samples, quarterly composites of weekly samples (continued)

Location	Isotope	Sample Description and Activity (pCi/m^3)			
		1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
D-3	Lab Code	DAP-1872	DAP-2044	DAP-2181	DAP-2441
	Volume (m^3)	3632	3602	3644	3929
	Be-7	0.041±0.010	0.052±0.011	0.053±0.009	0.040±0.014
	Nb-95	<0.0010	<0.0016	<0.0019	<0.0016
	Zr-95	<0.0018	<0.0012	<0.0027	<0.0026
	Ru-103	<0.0007	<0.0011	<0.0013	<0.0011
	Ru-106	<0.0055	<0.0059	<0.010	<0.011
	Cs-134	<0.0006	<0.0008	<0.0010	<0.0010
	Cs-137	<0.0006	<0.0008	<0.0012	<0.0011
	Ce-141	<0.0012	<0.0016	<0.0022	<0.0017
	Ce-144	<0.0028	<0.0054	<0.0070	<0.0056
D-5	Lab Code	DAP-1873	DAP-2045	DAP-2182	DAP-2442
	Volume (m^3)	3729	3706	3645	3695
	Be-7	0.047±0.012	0.043±0.014	0.052±0.010	0.042±0.010
	Nb-95	<0.0014	<0.0015	<0.0017	<0.0020
	Zr-95	<0.0021	<0.0013	<0.0021	<0.0030
	Ru-103	<0.0012	<0.0012	<0.0008	<0.0017
	Ru-106	<0.0073	<0.010	<0.0058	<0.014
	Cs-134	<0.0008	<0.0011	<0.0009	<0.0013
	Cs-137	<0.0008	<0.0012	<0.0007	<0.0016
	Ce-141	<0.0023	<0.0018	<0.0009	<0.0026
	Ce-144	<0.0060	<0.0056	<0.0023	<0.0085

Table 13. Airborne particulate samples, quarterly composites of weekly samples (continued)

Location	Isotope	Sample Description and Activity (pCi/m^3) 1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
D-6	Lab Code	DAP-1874	DAP-2046	DAP-2183	DAP-2443
	Volume (m^3)	3502	3715	3723	3903
	Be-7	0.057±0.008	0.049±0.014	0.062±0.017	0.054±0.008
	Nb-95	<0.0011	<0.0011	<0.0015	<0.0010
	Zr-95	<0.0016	<0.0027	<0.0026	<0.0013
	Ru-103	<0.0007	<0.0011	<0.0014	<0.0008
	Ru-106	<0.0068	<0.0099	<0.0098	<0.0073
	Cs-134	<0.0006	<0.0009	<0.0011	<0.0007
	Cs-137	<0.0007	<0.0011	<0.0009	<0.0008
	Ce-141	<0.0009	<0.0017	<0.0024	<0.0009
	Ce-144	<0.0025	<0.0054	<0.0062	<0.0028
D-7	Lab Code	DAP-1875	DAP-2047	DAP-2184	DAP-2444
	Volume (m^3)	3750	3721	3717	3957
	Be-7	0.033±0.016	0.070±0.012	0.047±0.010	0.034±0.011
	Nb-95	<0.0018	<0.0013	<0.0012	<0.0014
	Zr-95	<0.0022	<0.0027	<0.0018	<0.0017
	Ru-103	<0.0013	<0.0008	<0.0007	<0.0008
	Ru-106	<0.0098	<0.0084	<0.0059	<0.0077
	Cs-134	<0.0009	<0.0009	<0.0007	<0.0007
	Cs-137	<0.0010	<0.0012	<0.0007	<0.0010
	Ce-141	<0.0020	<0.0018	<0.0009	<0.0010
	Ce-144	<0.0052	<0.0048	<0.0019	<0.0023

Table 13. Airborne particulate samples, quarterly composites of weekly samples (continued)

Location	Isotope	Sample Description and Activity (pCi/m^3) 1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
D-8	Lab Code	DAP-1876	DAP-2048	DAP-2185	DAP-2445
	Volume (m^3)	3534	3596	3631	3918
	Be-7	0.073±0.010	0.062±0.015	0.050±0.015	0.043±0.014
	Nb-95	<0.0020	<0.0013	<0.0016	<0.0018
	Zr-95	<0.0028	<0.0029	<0.0030	<0.0019
	Ru-103	<0.0015	<0.0008	<0.0010	<0.0012
	Ru-106	<0.011	<0.0093	<0.0093	<0.0080
	Cs-134	<0.0010	<0.0009	<0.0009	<0.0008
	Cs-137	<0.0012	<0.0014	0.0011	<0.0009
	Ce-141	<0.0023	<0.0018	<0.0019	<0.0017
	Ce-144	<0.0059	<0.0058	<0.0059	<0.0054
D-10	Lab Code	DAP-1877	DAP-2049	DAP-2186	DAP-2446
	Volume (m^3)	3735	3708	3375	3840
	Be-7	0.056±0.009	0.061±0.011	0.037±0.009	0.050±0.009
	Nb-95	<0.0012	<0.0015	<0.0020	<0.0016
	Zr-95	<0.0019	<0.0022	<0.0026	<0.0023
	Ru-103	<0.0007	<0.0009	<0.0015	<0.0010
	Ru-106	<0.0036	<0.0079	<0.012	<0.0068
	Cs-134	<0.0004	<0.0007	<0.0011	<0.0007
	Cs-137	<0.0005	<0.0008	<0.0014	<0.0009
	Ce-141	<0.0010	<0.0010	<0.0024	<0.0010
	Ce-144	<0.0027	<0.0023	<0.0074	<0.0022

Table 13. Airborne particulate samples, quarterly composites of weekly samples (continued)

Location	Isotope	Sample Description and Activity (pCi/m^3) 1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
D-11	Lab Code	DAP-1878	DAP-2050	DAP-2187	DAP-2447
	Volume (m^3)	3627	3555	3708	3934
	Be-7	0.059±0.010	0.061±0.015	0.050±0.009	0.035±0.010
	Nb-95	<0.0013	<0.0018	<0.0011	<0.0013
	Zr-95	<0.0018	<0.0023	<0.0017	<0.0025
	Ru-103	<0.0009	<0.0012	<0.0008	<0.0011
	Ru-106	<0.0069	<0.0082	<0.0069	<0.010
	Cs-134	<0.0005	<0.0009	<0.0006	<0.0009
	Cs-137	<0.0005	<0.0013	<0.0008	<0.0010
	Ce-141	<0.0009	<0.0024	<0.0007	<0.0018
	Ce-144	<0.0025	<0.0077	<0.0024	<0.0052
D-13	Lab Code	DAP-1879	DAP-2051	DAP-2188	DAP-2448
	Volume (m^3)	3728	3824	3777	3988
	Be-7	0.048±0.008	0.058±0.010	0.057±0.012	0.060±0.010
	Nb-95	<0.0012	<0.0012	<0.0018	<0.0014
	Zr-95	<0.0018	<0.0018	<0.0028	<0.0018
	Ru-103	<0.0008	<0.0007	<0.0010	<0.0008
	Ru-106	<0.0064	<0.0074	<0.0095	<0.0064
	Cs-134	<0.0006	<0.0006	<0.0010	<0.0007
	Cs-137	<0.0007	<0.0008	<0.0013	<0.0008
	Ce-141	<0.0012	<0.0007	<0.0020	<0.0008
	Ce-144	<0.0032	<0.0025	<0.0054	<0.0024

Table 13. Airborne particulate samples, quarterly composites of weekly samples (continued)

Location	Isotope	Sample Description and Activity (pCi/m^3) 1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
D-15	Lab Code	DAP-1880	DAP-2052	DAP-2189	DAP-2449
	Volume (m^3)	3756	3683	3858	3938
	Be-7	0.046±0.007	0.048±0.013	0.047±0.008	0.047±0.015
	Nb-95	<0.0011	<0.0019	<0.0016	<0.0018
	Zr-95	<0.0016	<0.0023	<0.0021	<0.0030
	Ru-103	<0.0008	<0.0010	<0.0011	<0.0012
	Ru-106	<0.0060	<0.011	<0.0085	<0.0091
	Cs-134	<0.0006	<0.0009	<0.0008	<0.0010
	Cs-137	<0.0007	<0.0011	<0.0010	<0.0012
	Ce-141	<0.0008	<0.0018	<0.0020	<0.0016
	Ce-144	<0.0023	<0.0060	<0.0057	<0.0054
D-16	Lab Code	DAP-1881	DAP-2053	DAP-2190	DAP-2450
	Volume (m^3)	3744	3651	3897	4131
	Be-7	0.048±0.010	0.041±0.010	0.050±0.017	0.043±0.012
	Nb-95	<0.0022	<0.0012	<0.0018	<0.0018
	Zr-95	<0.0032	<0.0016	<0.0026	<0.0020
	Ru-103	<0.0016	<0.0007	<0.0014	<0.0010
	Ru-106	<0.014	<0.0055	<0.011	<0.0086
	Cs-134	<0.0012	<0.0006	<0.0011	<0.0009
	Cs-137	<0.0013	<0.0006	<0.0008	<0.0007
	Ce-141	<0.0030	<0.0008	<0.0020	<0.0016
	Ce-144	<0.0073	<0.0020	<0.0067	<0.0060

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

Location No.	mR/91 days 1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Air Particulate Locations				
D-1	28.5±1.7[a]	15.0±0.6	11.8±0.4	15.5±0.6
D-2	11.2±0.9	13.0±1.2	11.1±0.6	13.2±0.7
D-3	13.6±0.7	14.0±1.2	14.3±1.2	14.3±0.7
D-5	15.3±0.5	16.2±0.8	14.2±1.0	16.4±0.7
D-6	13.2±0.8	15.8±0.4	13.5±1.2	16.9±0.8
D-7	15.6±0.7	17.2±0.6	15.9±1.0	17.1±1.0
D-8	16.1±1.1	17.2±1.0	15.3±0.8	18.4±1.5
D-10	15.5±1.1	17.1±0.7	15.0±0.9	17.4±1.3
D-11	10.8±0.9	14.9±1.0	10.7±1.0	15.9±1.0
D-13	12.3±0.6	12.4±0.6	11.0±1.1	12.6±1.0
D-15	13.4±0.9	13.5±0.5	14.3±1.0	12.8±0.9
D-16	12.4±0.6	14.5±1.0	11.4±0.5	15.9±1.1
Mean ± s.d.	14.8±4.6	15.1±1.7	13.2±1.9	15.5±1.9
Within 0.5 mile of stack				
D-18	14.7±0.6	16.7±1.4	13.4±0.7	16.6±0.6
D-19	15.5±0.6	16.1±0.8	13.9±0.5	16.9±0.7
D-20	17.1±0.9	17.3±0.6	14.4±0.7	16.3±0.7
D-21	15.2±0.8	15.9±0.4	13.1±0.4	16.6±0.6
D-22	16.3±0.7	16.6±1.1	13.2±0.8	16.6±1.0
D-23	16.5±1.0	16.3±0.9	13.2±1.2	16.0±0.7
D-28	17.6±1.0	19.0±0.7	17.9±1.6	21.9±1.4
D-29	19.0±0.8	22.2±0.6	18.4±1.3	23.0±0.9
D-30	20.9±1.4	21.3±1.3	20.6±0.9	21.4±1.0
D-31	21.6±0.8	22.1±1.6	20.6±0.8	23.8±1.1
D-32	21.0±0.6	21.1±1.3	17.9±1.1	19.9±0.6
D-82	16.4±0.8	16.0±1.4	13.1±1.1	16.2±1.5
D-83	17.4±0.4	18.1±1.4	16.0±0.8	17.8±1.1
D-84	15.4±0.8	19.7±1.5	14.6±1.1	18.4±0.6
D-85	14.2±0.9	15.6±1.2	13.0±0.9	16.2±0.6
D-86	18.4±0.9	19.5±1.6	16.9±0.4	20.3±1.3
D-91	13.5±0.8	11.8±0.5	13.1±0.7	15.2±0.8
Mean ± s.d.	17.1±2.4	18.0±2.8	15.5±2.7	18.4±2.7

[a] Elevated level due to exposure from radiography performed in the vicinity of the TLD location.

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

Location No.	mR/91 days			
	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Within 1.0 mile of stack				
D-43	15.8±1.1	17.1±1.3	14.9±1.3	18.4±1.6
D-44	21.3±1.1	18.0±0.4	18.5±1.0	18.6±0.7
D-45	15.2±0.9	17.5±0.6	14.0±1.2	18.5±1.0
D-46	20.1±1.7	20.6±1.0	19.0±0.9	21.5±1.2
D-47	21.4±0.7	21.2±0.8	19.6±0.5	ND[a]
D-48	20.7±1.3	22.0±1.7	19.6±0.7	20.6±0.8
Mean ± s.d.	19.1±2.8	19.4±2.1	17.6±2.5	19.5±1.4
Within 3.0 miles of stack				
D-33	13.3±0.7	ND[a]	12.0±0.6	13.4±0.8
D-34	14.0±0.8	15.5±1.2	12.7±0.7	15.8±0.6
D-35	13.8±0.6	14.9±0.3	13.6±1.0	14.7±0.5
D-36	16.6±0.7	17.4±0.6	14.4±0.6	18.2±1.1
D-37	21.1±0.7	22.8±0.5	19.3±0.6	25.6±1.6
D-38	18.3±0.6	16.6±0.5	16.5±1.1	17.2±0.6
D-39	17.5±1.1	17.4±0.9	15.6±0.9	17.8±1.0
D-40	15.7±0.6	16.2±1.3	14.5±0.9	16.6±0.7
D-41	15.4±0.8	18.6±1.6	14.0±1.2	16.5±1.4
Mean ± s.d.	16.2±2.5	17.4±2.5	14.7±2.2	17.3±3.4

[a] ND = No data; TLD missing.

Table 15. Milk samples, analyses for I-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 and Date Collected	Lab Code	Concentration (pCi/L) I-131	Cs-134	Cs-137	Ba-140	La-140	K-40
Indicator							
D-63							
01-03-90	DMI-4369	<1.0	<15	<18	<60	<15	1250±130
02-06-90	4457	<1.0	<15	<18	<60	<15	1120±110
03-06-90	4528	<1.0	<15	<18	<60	<15	1090±110
04-03-90	4582	<1.0	<15	<18	<60	<15	1350±220
05-01-90	4649	<1.0	<15	<18	<60	<15	1160±210
05-15-90	4736	<1.0	<15	<18	<60	<15	1320±140
05-29-90	4779,80	<1.0	<15	<18	<60	<15	1300±80
06-12-90	4859	<1.0	<15	<18	<60	<15	1260±110
06-26-90	4928	<1.0	<15	<18	<60	<15	1250±160
07-10-90	5008	<1.0	<15	<18	<60	<15	1230±130
07-24-90	5086,7	<1.0	<15	<18	<60	<15	1380±170
08-07-90	5151	<1.0	<15	<18	<60	<15	1300±160
08-21-90	5247	<1.0	<15	<18	<60	<15	1260±160
09-05-90	5313	<1.0	<15	<18	<60	<15	1170±140
09-18-90	5379	<1.0	<15	<18	<60	<15	1070±130
10-02-90	5465,6	<1.0	<15	<18	<60	<15	1210±100
11-06-90	5636	<1.0	<15	<18	<60	<15	1220±160
12-05-90	5700,1	<1.0	<15	<18	<60	<15	1190±100

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

Location and Date Collected	Lab Code	Concentration (pCi/L) I-131	Cs-134	Cs-137	Ba-140	La-140	K-40
Indicator							
D-93							
01-03-90	NS[a]	--	--	--	--	--	--
02-06-90	DMI-4458	<1.0	<15	<18	<60	<15	1230±70
03-06-90	4529	<1.0	<15	<18	<60	<15	1310±110
04-03-90	4583	<1.0	<15	<18	<60	<15	1540±250
05-01-90	4650	<1.0	<15	<18	<60	<15	1520±160
05-15-90	4737	<1.0	<15	<18	<60	<15	1530±140
05-29-90	4781	<1.0	<15	<18	<60	<15	1530±130
06-12-90	4860	<1.0	<15	<18	<60	<15	1610±120
06-26-90	4929	<1.0	<15	<18	<60	<15	1490±170
07-10-90	5009	<1.0	<15	<18	<60	<15	1350±140
07-24-90	5088	<1.0	<15	<18	<60	<15	1600±160
08-07-90	5152	<1.0	<15	<18	<60	<15	1600±130
08-21-90	5248,9	<1.0	<15	<18	<60	<15	1730±110
09-05-90	5314	<1.0	<15	<18	<60	<15	1610±230
09-18-90	5380	<1.0	<15	<18	<60	<15	1660±160
10-02-90	5467	<1.0	<15	<18	<60	<15	1590±170
11-06-90	5637	<1.0	<15	<18	<60	<15	1670±170
12-05-90	5702	<1.0	<15	<18	<60	<15	1500±150
D-94							
01-03-90	DMI-4370	<1.0	<15	<18	<60	<15	1290±105
02-06-90	4459,60	<1.0	<15	<18	<60	<15	1210±80
03-06-90	4530	<1.0	<15	<18	<60	<15	1200±90
04-03-90	4584,5	<1.0	<15	<18	<60	<15	1240±100
05-01-90	4651	<1.0	<15	<18	<60	<15	1110±110
05-15-90	4738	<1.0	<15	<18	<60	<15	1400±140
05-29-90	4782	<1.0	<15	<18	<60	<15	1300±150
06-12-90	4861	<1.0	<15	<18	<60	<15	1210±100
06-26-90	4930	<1.0	<15	<18	<60	<15	1270±160
07-10-90	5010	<1.0	<15	<18	<60	<15	1050±120
07-24-90	5089	<1.0	<15	<18	<60	<15	1220±160
08-07-90	5153	<1.0	<15	<18	<60	<15	1180±140
08-21-90	5254	<1.0	<15	<18	<60	<15	1190±120
09-05-90	5315	<1.0	<15	<18	<60	<15	1120±130
09-18-90	5381	<1.0	<15	<18	<60	<15	1220±150
10-02-90	5468	<1.0	<15	<18	<60	<15	1120±240
11-06-90	5638	<1.0	<15	<18	<60	<15	1090±150
12-05-90	5703	<1.0	<15	<18	<60	<15	1120±120

[a] NS = No sample; sample unavailable.

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

Location and Date Collected	Lab Code	Concentration (pCi/L) I-131	Cs-134	Cs-137	Ba-140	La-140	K-40
Indicator							
D-96							
01-03-90	DMI-4371	<1.0	<15	<18	<60	<15	1280±130
02-06-90	4461	<1.0	<15	<18	<60	<15	1210±90
03-06-90	4531	<1.0	<15	<18	<60	<15	1300±130
04-03-90	4586	<1.0	<15	<18	<60	<15	1200±140
05-01-90	4652	<1.0	<15	<18	<60	<15	1240±120
05-15-90	4739,40	<1.0	<15	<18	<60	<15	1290±80
05-29-90	NS[a]	--	--	--	--	--	--
06-12-90	4862,3	<1.0	<15	<18	<60	<15	1240±80
06-26-90	4931	<1.0	<15	<18	<60	<15	1730±130
07-10-90	5011	<1.0	<15	<18	<60	<15	1080±130
07-24-90	5090	<1.0	<15	<18	<60	<15	1240±160
08-07-90	5154	<1.0	<15	<18	<60	<15	1310±100
08-21-90	5250	<1.0	<15	<18	<60	<15	1250±130
09-05-90	5316	<1.0	<15	<18	<60	<15	1440±250
09-18-90	5382	<1.0	<15	<18	<60	<15	1240±150
10-02-90	5469	<1.0	<15	<18	<60	<15	1150±130
11-06-90	5639	<1.0	<15	<18	<60	<15	1370±120
12-05-90	5704	<1.0	<15	<18	<60	<15	1310±150
D-101							
01-03-90	NS[a]	--	--	--	--	--	--
02-06-90	NS	--	--	--	--	--	--
03-06-90	NS	--	--	--	--	--	--
04-03-90	DMI-4587	<1.0	<15	<18	<60	<15	1710±140
05-01-90	4653	<1.0	<15	<18	<60	<15	1700±180
05-15-90	4741	<1.0	<15	<18	<60	<15	1790±140
05-29-90	4783	<1.0	<15	<18	<60	<15	1780±170
06-12-90	4864	<1.0	<15	<18	<60	<15	1930±160
06-26-90	4932,3	<1.0	<15	<18	<60	<15	1720±90
07-10-90	5012,3	<1.0	<15	<18	<60	<15	1800±170
07-24-90	5091	<1.0	<15	<18	<60	<15	1930±180
08-07-90	5155	<1.0	<15	<18	<60	<15	1830±190
08-21-90	5253	<1.0	<15	<18	<60	<15	1850±190
09-05-90	5317	<1.0	<15	<18	<60	<15	1880±190
09-18-90	5383	<1.0	<15	<18	<60	<15	1880±200
10-02-90	5470	<1.0	<15	<18	<60	<15	1910±180
11-06-90	5640	<1.0	<15	<18	<60	<15	1620±150
12-05-90	5705	<1.0	<15	<18	<60	<15	1810±130

[a] NS = No sample; sample unavailable.

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

Location and Date Collected	Lab Code	Concentration (pCi/L) I-131	Cs-134	Cs-137	Ba-140	La-140	K-40
Indicator							
D-106							
01-03-90	DMI-4373	<1.0	<15	<18	<60	<15	1360±110
02-06-90	4463	<1.0	<15	<18	<60	<15	1250±80
03-06-90	4533	<1.0	<15	<18	<60	<15	1390±140
04-03-90	4589	<1.0	<15	<18	<60	<15	1360±140
05-01-90	4655,6	<1.0	<15	<18	<60	<15	1360±110
05-15-90	4743	<1.0	<15	<18	<60	<15	1450±130
05-29-90	4784,2	<1.0	<15	<18	<60	<15	1480±120
06-12-90	4866	<1.0	<15	<18	<60	<15	1420±120
06-26-90	4935	<1.0	<15	<18	<60	<15	1440±110
07-10-90	5015	<1.0	<15	<18	<60	<15	1180±130
07-24-90	5093	<1.0	<15	<18	<60	<15	1400±160
08-07-90	5157	<1.0	<15	<18	<60	<15	1270±120
08-21-90	5252	<1.0	<15	<18	<60	<15	1440±160
09-05-90	5319	<1.0	<15	<18	<60	<15	1220±110
09-18-90	5385	<1.0	<15	<18	<60	<15	1330±130
10-02-90	5472	<1.0	<15	<18	<60	<15	1270±160
11-06-90	5642	<1.0	<15	<18	<60	<15	1200±110
12-05-90	5707	<1.0	<15	<18	<60	<15	1340±160
Control							
D-105							
01-03-90	DMI-4372	<1.0	<15	<18	<60	<15	1110±150
02-06-90	4462	<1.0	<15	<18	<60	<15	1240±100
03-06-90	4532	<1.0	<15	<18	<60	<15	1360±110
04-03-90	4588	<1.0	<15	<18	<60	<15	1260±140
05-01-90	4654	<1.0	<15	<18	<60	<15	1120±120
05-15-90	4742	<1.0	<15	<18	<60	<15	1290±140
05-29-90	NS[a]	--	--	--	--	--	--
06-12-90	4865	<1.0	<15	<18	<60	<15	1400±150
06-26-90	4934	<1.0	<15	<18	<60	<15	1330±130
07-10-90	5014	<1.0	<15	<18	<60	<15	1150±130
07-24-90	5092	<1.0	<15	<18	<60	<15	1220±110
08-07-90	5156	<1.0	<15	<18	<60	<15	1340±130
08-21-90	5251	<1.0	<15	<18	<60	<15	1250±150
09-05-90	5318	<1.0	<15	<18	<60	<15	1150±110
09-18-90	5384	<1.0	<15	<18	<60	<15	1140±140
10-02-90	5471	<1.0	<15	<18	<60	<15	1290±140
11-06-90	5641	<1.0	<15	<18	<60	<15	1350±140
12-05-90	5706	<1.0	<15	<18	<60	<15	1250±100

[a] NS = No sample; sample unavailable.

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

Location and Period Collected	Lab Code	Concentration (pCi/L) Gross Beta	H-3
D-53			
Treated Municipal Water			
1st Qtr., 1990	DWW-5550,1	3.1±0.4	<330
2nd Qtr., 1990	6744	2.4±0.6	<330
3rd Qtr., 1990	7824,5	3.1±0.2	<330
4th Qtr., 1990	8968	3.1±0.5	<330
Annual Mean ± s.d.		2.9±0.4	<330
D-54			
Inlet to Municipal Water Treatment			
1st Qtr., 1990	DWW-5552	3.8±0.6	<330
2nd Qtr., 1990	6745	2.5±0.6	<330
3rd Qtr., 1990	7826	3.9±0.3	<330
4th Qtr., 1990	8969	3.3±0.5	<330
Annual Mean ± s.d.		3.4±0.6	<330
D-55			
On-site Well			
1st Qtr., 1990	DWW-5553	0.8±0.4	<330
2nd Qtr., 1990	6746	<0.9	<330
3rd Qtr., 1990	7827	0.7±0.2	<330
4th Qtr., 1990	8970	<0.7	<330
Annual Mean ± s.d.		0.8±0.1	<330
D-57			
Bull Farm			
1st Qtr., 1990	DWW-5554	1.3±0.4	<330
2nd Qtr., 1990	6747	<0.9	<330
3rd Qtr., 1990	7828	1.2±0.2	<330
4th Qtr., 1990	8971	1.3±0.4	<330
Annual Mean ± s.d.		1.3±0.1	<330

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

Location and Period Collected	Lab Code	Concentration (pCi/L) Gross Beta	H-3
D-58			
Franz Farm			
1st Qtr., 1990	DWW-5555	3.7±0.5	<330
2nd Qtr., 1990	6748	6.0±0.7	<330
3rd Qtr., 1990	7829	5.8±0.3	<330
4th Qtr., 1990	8972	4.5±0.6	<330
Annual Mean ± s.d.		5.0±1.1	<330
D-72			
Van Note Farm			
1st Qtr., 1990	DWW-5556	0.8±0.4	<330
2nd Qtr., 1990	6749,50	<0.9	<330
3rd Qtr., 1990	7830	1.0±0.3	<330
4th Qtr., 1990	8973,4	0.8±0.3	<330
Annual Mean ± s.d.		0.9±0.1	<330

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

Sample Description and Activity (pCi/g wet)			
	Indicator		Control
Location	D-57	D-94	D-105
Date Collected	09-25-90	06-26-90	10-02-90
Type	Cabbage	Lettuce	Kohlrabi
Lab Code	DVE-1030	DVE-862,3	DVE-1045
I-131	<0.023	<0.017	<0.026
K-40	4.80±0.36	3.10±0.16	4.82±0.67
Mn-54	<0.016	<0.014	<0.027
Co-58	<0.016	<0.016	<0.030
Co-60	<0.017	<0.015	<0.033
Nb-95	<0.017	<0.015	<0.030
Zr-95	<0.026	<0.024	<0.051
Ru-103	<0.016	<0.014	<0.023
Ru-106	<0.14	<0.13	<0.28
Cs-134	<0.014	<0.013	<0.019
Cs-137	<0.015	<0.015	<0.028
Ce-141	<0.012	<0.021	<0.020
Ce-144	<0.046	<0.093	<0.088

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

Sample Description and Activity (pCi/g wet)

	Indicator			
Location	D-57	D-63	D-72	D-93
Date Collected	07-23-90	07-24-90	07-23-90	07-24-90
Type	Hay	Hay	Hay	Hay
Lab Code	DCF-403	DCF-404,5	DCF-406	DCF-407
K-40	17.70±0.58	16.85±0.46	19.70±1.07	7.24±0.44
Mn-54	<0.016	<0.015	<0.036	<0.050
Co-58	<0.021	<0.020	<0.041	<0.019
Co-60	<0.017	<0.017	<0.035	<0.017
Nb-95	<0.024	<0.024	<0.056	<0.024
Zr-95	<0.035	<0.034	<0.080	<0.033
Ru-103	<0.020	<0.020	<0.045	<0.020
Ru-106	<0.14	<0.14	<0.32	<0.13
Cs-134	<0.016	<0.015	<0.034	<0.015
Cs-137	<0.016	<0.015	<0.038	<0.016
Ce-141	<0.034	<0.034	<0.073	<0.033
Ce-144	<0.10	<0.10	<0.22	<0.10

	Indicator		Control
Location	D-94	D-106	D-105
Date Collected	07-24-90	07-24-90	07-24-90
Type	Hay	Hay	Hay
Lab Code	DCF-408	DCF-410	DCF-409
K-40	12.60±0.55	13.68±0.41	14.10±0.65
Mn-54	<0.027	<0.017	<0.034
Co-58	<0.032	<0.018	<0.040
Co-60	<0.024	<0.016	<0.030
Nb-95	<0.039	<0.025	<0.048
Zr-95	<0.059	<0.036	<0.071
Ru-103	<0.036	<0.023	<0.042
Ru-106	<0.23	<0.14	<0.29
Cs-134	<0.023	<0.014	<0.030
Cs-137	<0.026	<0.018	<0.032
Ce-141	<0.066	<0.052	<0.081
Ce-144	<0.18	<0.14	<0.22

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

Sample Description and Activity (pCi/g wet)

	Indicator			
Location	D-57	D-58	D-63	D-72
Date Collected	09-06-90	09-06-90	09-06-90	09-06-90
Type	Corn Feed	Corn Feed	Corn Feed	Corn Feed
Lab Code	DCF-425	DCF-426	DCF-427	DCF-428
K-40	2.85±0.53	2.33±0.46	2.28±0.30	3.14±0.43
Mn-54	<0.036	<0.028	<0.016	<0.023
Co-58	<0.038	<0.059	<0.020	<0.028
Co-60	<0.027	<0.023	<0.012	<0.020
Nb-95	<0.072	<0.071	<0.046	<0.070
Zr-95	<0.058	<0.072	<0.049	<0.054
Ru-103	<0.049	<0.060	<0.034	<0.060
Ru-106	<0.24	<0.20	<0.12	<0.16
Cs-134	<0.024	<0.018	<0.011	<0.019
Cs-137	<0.024	<0.025	<0.013	<0.017
Ce-141	<0.054	<0.077	<0.041	<0.052
Ce-144	<0.098	<0.093	<0.057	<0.069

	Indicator			Control
Location	D-93	D-94	D-106	D-105
Date Collected	09-06-90	09-06-90	09-06-90	09-06-90
Type	Corn Feed	Corn Feed	Corn Feed	Corn Feed
Lab Code	DCF-429	DCF-430	DCF-432	DCF-431
K-40	2.48±0.32	2.45±0.33	2.89±0.36	3.02±0.36
Mn-54	<0.015	<0.017	<0.018	<0.026
Co-58	<0.018	<0.028	<0.023	<0.039
Co-60	<0.011	<0.012	<0.014	<0.020
Nb-95	<0.049	<0.051	<0.056	<0.082
Zr-95	<0.047	<0.037	<0.054	<0.072
Ru-103	<0.046	<0.034	<0.045	<0.050
Ru-106	<0.12	<0.11	<0.17	<0.19
Cs-134	<0.013	<0.013	<0.016	<0.016
Cs-137	<0.016	<0.012	<0.014	<0.022
Ce-141	<0.10	<0.047	<0.047	<0.073
Ce-144	<0.13	<0.065	<0.051	<0.085

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

Location	Sample Description and Activity (pCi/L)				
Indicator - Plant Intake					
D-50	Date Collected	01-26-90	02-26-90	03-27-90	04-27-90
	Lab Code	DSW-4930,1	DSW-5235	DSW-5546	DSW-6178
	Mn-54	<15	<15	<15	<15
	Fe-59	<30	<30	<30	<30
	Co-58	<15	<15	<15	<15
	Co-60	<15	<15	<15	<15
	Zn-65	<30	<30	<30	<30
	Nb-95	<15	<15	<15	<15
	Zr-95	<30	<30	<30	<30
	I-131	<500	<500	<500	<500
	Cs-134	<15	<15	<15	<15
	Cs-137	<18	<18	<18	<18
	Ba-140	<60	<60	<60	<60
	La-140	<15	<15	<15	<15
	Date Collected	05-29-90	06-26-90	07-26-90	08-23-90
	Lab Code	DSW-6300,1	DSW-6739,40	DSW-7172	DSW-7583
	Mn-54	<15	<15	<15	<15
	Fe-59	<30	<30	<30	<30
	Co-58	<15	<15	<15	<15
	Co-60	<15	<15	<15	<15
	Zn-65	<30	<30	<30	<30
	Nb-95	<15	<15	<15	<15
	Zr-95	<30	<30	<30	<30
	I-131	<500	<500	<500	<500
	Cs-134	<15	<15	<15	<15
	Cs-137	<18	<18	<18	<18
	Ba-140	<60	<60	<60	<60
	La-140	<15	<15	<15	<15
	Date Collected	09-25-90	10-30-90	11-26-90	12-21-90
	Lab Code	DSW-7819	DSW-8337,8	DSW-8623	DSW-8964
	Mn-54	<15	<15	<15	<15
	Fe-59	<30	<30	<30	<30
	Co-58	<15	<15	<15	<15
	Co-60	<15	<15	<15	<15
	Zn-65	<30	<30	<30	<30
	Nb-95	<15	<15	<15	<15
	Zr-95	<30	<30	<30	<30
	I-131	<500	<500	<500	<500
	Cs-134	<15	<15	<15	<15
	Cs-137	<18	<18	<18	<18
	Ba-140	<60	<60	<60	<60
	La-140	<15	<15	<15	<15

Table 19. Surface water samples, analysis for gamma-emitting isotopes (continued)

Location	Sample Description and Activity (pCi/L)			
Indicator - Plant Discharge				
D-51	Date Collected	01-26-90	02-26-90	03-27-90	04-27-90
	Lab Code	DSW-4932	DSW-5236	DSW-5547	DSW-6179
	Mn-54	<15	<15	<15	<15
	Fe-59	<30	<30	<30	<30
	Co-58	<15	<15	<15	<15
	Co-60	<15	<15	<15	<15
	Zn-65	<30	<30	<30	<30
	Nb-95	<15	<15	<15	<15
	Zr-95	<30	<30	<30	<30
	I-131	<500	<500	<500	<500
	Cs-134	<15	<15	<15	<15
	Cs-137	<18	<18	<18	<18
	Ba-140	<60	<60	<60	<60
	La-140	<15	<15	<15	<15
	Date Collected	05-29-90	06-26-90	07-26-90	08-23-90
	Lab Code	DSW-6302	DSW-6741	DSW-7173	DSW-7584
	Mn-54	<15	<15	<15	<15
	Fe-59	<30	<30	<30	<30
	Co-58	<15	<15	<15	<15
	Co-60	<15	<15	<15	<15
	Zn-65	<30	<30	<30	<30
	Nb-95	<15	<15	<15	<15
	Zr-95	<30	<30	<30	<30
	I-131	<500	<500	<500	<500
	Cs-134	<15	<15	<15	<15
	Cs-137	<18	<18	<18	<18
	Ba-140	<60	<60	<60	<60
	La-140	<15	<15	<15	<15
	Date Collected	09-25-90	10-30-90	11-26-90	12-21-90
	Lab Code	DSW-7820	DSW-8339	DSW-8624	DSW-8965
	Mn-54	<15	<15	<15	<15
	Fe-59	<30	<30	<30	<30
	Co-58	<15	<15	<15	<15
	Co-60	<15	<15	<15	<15
	Zn-65	<30	<30	<30	<30
	Nb-95	<15	<15	<15	<15
	Zr-95	<30	<30	<30	<30
	I-131	<500	<500	<500	<500
	Cs-134	<15	<15	<15	<15
	Cs-137	<18	<18	<18	<18
	Ba-140	<60	<60	<60	<60
	La-140	<15	<15	<15	<15

Table 19. Surface water samples, analysis for gamma-emitting isotopes (continued)

Location	Sample Description and Activity (pCi/L)				
Indicator - Pleasant Creek					
D-99	Date Collected	01-24-90	02-26-90	03-27-90	04-27-90
	Lab Code	DSW-4933	DSW-5237	DSW-5548	DSW-6180
	Mn-54	<15	<15	<15	<15
	Fe-59	<30	<30	<30	<30
	Co-58	<15	<15	<15	<15
	Co-60	<15	<15	<15	<15
	Zn-65	<30	<30	<30	<30
	Nb-95	<15	<15	<15	<15
	Zr-95	<30	<30	<30	<30
	I-131	<500	<500	<500	<500
	Cs-134	<15	<15	<15	<15
	Cs-137	<18	<18	<18	<18
	Ba-140	<60	<60	<60	<60
	La-140	<15	<15	<15	<15
	Date Collected	05-29-90	06-26-90	07-30-90	08-29-90
	Lab Code	DSW-6303	DSW-6742	DSW-7174	DSW-7585
	Mn-54	<15	<15	<15	<15
	Fe-59	<30	<30	<30	<30
	Co-58	<15	<15	<15	<15
	Co-60	<15	<15	<15	<15
	Zn-65	<30	<30	<30	<30
	Nb-95	<15	<15	<15	<15
	Zr-95	<30	<30	<30	<30
	I-131	<500	<500	<500	<500
	Cs-134	<15	<15	<15	<15
	Cs-137	<18	<18	<18	<18
	Ba-140	<60	<60	<60	<60
	La-140	<15	<15	<15	<15
	Date Collected	09-25-90	10-30-90	11-26-90	12-21-90
	Lab Code	DSW-7821	DSW-8340	DSW-8625	DSW-8966
	Mn-54	<15	<15	<15	<15
	Fe-59	<30	<30	<30	<30
	Co-58	<15	<15	<15	<15
	Co-60	<15	<15	<15	<15
	Zn-65	<30	<30	<30	<30
	Nb-95	<15	<15	<15	<15
	Zr-95	<30	<30	<30	<30
	I-131	<500	<500	<500	<500
	Cs-134	<15	<15	<15	<15
	Cs-137	<18	<18	<18	<18
	Ba-140	<60	<60	<60	<60
	La-140	<15	<15	<15	<15

Table 19. Surface water samples, analysis for gamma-emitting isotopes (continued)

Location	Sample Description and Activity (pCi/L)				
Indicator - Plant Sewage Discharge					
D-107	Date Collected	01-24-90	02-26-90	03-27-90	04-27-90
	Lab Code	DSW-4934	DSW-5238	DSW-5549	DSW-6181
	K-40[a]	17.1	24.7	26.1	25.9
	Mn-54	<15	<15	<15	<15
	Fe-59	<30	<30	<30	<30
	Co-58	<15	<15	<15	<15
	Co-60	<15	<15	<15	<15
	Zn-65	<30	<30	<30	<30
	Nb-95	<15	<15	<15	<15
	Zr-95	<30	<30	<30	<30
	I-131	<500	<500	<500	<500
	Cs-134	<15	<15	<15	<15
	Cs-137	<18	<18	<18	<18
	Ba-140	<60	<60	<60	<60
	La-140	<15	<15	<15	<15
	Date Collected	05-29-90	06-26-90	07-30-90	08-29-90
	Lab Code	DSW-6304	DSW-6743	DSW-7175	DSW-7586
	K-40[a]	26.5	27.2	31.7	28.5
	Mn-54	<15	<15	<15	<15
	Fe-59	<30	<30	<30	<30
	Co-58	<15	<15	<15	<15
	Co-60	<15	<15	<15	<15
	Zn-65	<30	<30	<30	<30
	Nb-95	<15	<15	<15	<15
	Zr-95	<30	<30	<30	<30
	I-131	<500	<500	<500	<500
	Cs-134	<15	<15	<15	<15
	Cs-137	<18	<18	<18	<18
	Ba-140	<60	<60	<60	<60
	La-140	<15	<15	<15	<15

[a] Analyzed by flame photometry.

Table 19. Surface water samples, analysis for gamma-emitting isotopes (continued)

Location	Sample Description and Activity (pCi/L)				
Indicator - Plant Sewage Discharge					
D-107	Date Collected	09-25-90	10-30-90	11-26-90	12-21-90
	Lab Code	DSW-7822	DSW-8341	DSW-8626	DSW-8967
	K-40[a]	24.7	23.8	23.7	27.8
	Mn-54	<15	<15	<15	<15
	Fe-59	<30	<30	<30	<30
	Co-58	<15	<15	<15	<15
	Co-60	<15	<15	<15	<15
	Zn-65	<30	<30	<30	<30
	Nb-95	<15	<15	<15	<15
	Zr-95	<30	<30	<30	<30
	I-131	<500	<500	<500	<500
	Cs-134	<15	<15	<15	<15
	Cs-137	<18	<18	<18	<18
	Ba-140	<60	<60	<60	<60
	La-140	<15	<15	<15	<15

[a] Analyzed by flame photometry.

Table 19. Surface water samples, analysis for gamma-emitting isotopes (continued)

Location	Sample Description and Activity (pCi/L)			
Control - Lewis Access				
D-49	Date Collected	01-24-90	02-26-90	03-27-90	04-27-90
	Lab Code	DSW-4929	DSW-5234	DSW-5545	DSW-6177
	Mn-54	<15	<15	<15	<15
	Fe-59	<30	<30	<30	<30
	Co-58	<15	<15	<15	<15
	Co-60	<15	<15	<15	<15
	Zn-65	<30	<30	<30	<30
	Nb-95	<15	<15	<15	<15
	Zr-95	<30	<30	<30	<30
	I-131	<500	<500	<500	<500
	Cs-134	<15	<15	<15	<15
	Cs-137	<18	<18	<18	<18
	Ba-140	<60	<60	<60	<60
	La-140	<15	<15	<15	<15
	Date Collected	05-29-90	06-26-90	07-30-90	08-29-90
	Lab Code	DSW-6299	DSW-6738	DSW-7171	DSW-7582
	Mn-54	<15	<15	<15	<15
	Fe-59	<30	<30	<30	<30
	Co-58	<15	<15	<15	<15
	Co-60	<15	<15	<15	<15
	Zn-65	<30	<30	<30	<30
	Nb-95	<15	<15	<15	<15
	Zr-95	<30	<30	<30	<30
	I-131	<500	<500	<500	<500
	Cs-134	<15	<15	<15	<15
	Cs-137	<18	<18	<18	<18
	Ba-140	<60	<60	<60	<60
	La-140	<15	<15	<15	<15
	Date Collected	09-25-90	10-30-90	11-26-90	12-21-90
	Lab Code	DSW-7818	DSW-8336	DSW-8622	DSW-8962,3
	Mn-54	<15	<15	<15	<15
	Fe-59	<30	<30	<30	<30
	Co-58	<15	<15	<15	<15
	Co-60	<15	<15	<15	<15
	Zn-65	<30	<30	<30	<30
	Nb-95	<15	<15	<15	<15
	Zr-95	<30	<30	<30	<30
	I-131	<500	<500	<500	<500
	Cs-134	<15	<15	<15	<15
	Cs-137	<18	<18	<18	<18
	Ba-140	<60	<60	<60	<60
	La-140	<15	<15	<15	<15

Table 20. Surface water samples, quarterly composites of monthly samples, analysis for tritium.

Location and Period Collected	Lab Code	Concentration (pCi/L) H-3
Indicator		
D-50		
1st Qtr., 1990	DSW-5618	<330
2nd Qtr., 1990	6942	<330
3rd Qtr., 1990	8176	<330
4th Qtr., 1990	8976	<330
Annual Mean ± s.d.		<330
D-51		
1st Qtr., 1990	DSW-5619	<330
2nd Qtr., 1990	6943	<330
3rd Qtr., 1990	8177	<330
4th Qtr., 1990	8977	<330
Annual Mean ± s.d.		<330
D-99		
1st Qtr., 1990	DSW-5620,1	<330
2nd Qtr., 1990	6944	<330
3rd Qtr., 1990	8178,9	<330
4th Qtr., 1990	8978	<330
Annual Mean ± s.d.		<330
D-107		
1st Qtr., 1990	DSW-5622	<330
2nd Qtr., 1990	6945	<330
3rd Qtr., 1990	8180	<330
4th Qtr., 1990	8979	<330
Annual Mean ± s.d.		<330
Control		
D-49		
1st Qtr., 1990	DSW-5617	<330
2nd Qtr., 1990	6941	<330
3rd Qtr., 1990	8175	<330
4th Qtr., 1990	8975	<330
Annual Mean ± s.d.		<330

Table 21. Fish samples, analysis of edible portion for gamma-emitting isotopes. Collection: Semiannually.

Sample Description and Activity (pCi/g wet)			
	Indicator		
	Downstream D-61		
Date Collected	04-26-90	04-26-90	04-26-90
Type	Carp	Largemouth Bass	Shorthead Redhorse
Lab Code	DF-1025	DF-1026	DF-1027
K-40	2.80±0.26	3.46±0.93	3.35±0.83
Mn-54	<0.013	<0.054	<0.052
Co-58	<0.013	<0.053	<0.051
Co-60	<0.013	<0.050	<0.062
Nb-95	<0.013	<0.053	<0.050
Zr-95	<0.021	<0.10	<0.093
Ru-103	<0.010	<0.053	<0.058
Ru-106	<0.12	<0.43	<0.44
Cs-134	<0.012	<0.047	<0.045
Cs-137	<0.013	<0.057	<0.058
Ce-141	<0.016	<0.090	<0.096
Ce-144	<0.070	<0.37	<0.39
Date Collected	10-29-90	10-29-90	10-29-90
Type	Shorthead Redhorse	Carp	Carpsucker
Lab Code	DF-1314	DF-1315	DF-1316
K-40	3.58±0.46	2.50±0.40	3.25±0.49
Mn-54	<0.019	<0.022	<0.022
Co-58	<0.021	<0.025	<0.020
Co-60	<0.022	<0.026	<0.022
Nb-95	<0.022	<0.028	<0.030
Zr-95	<0.040	<0.041	<0.034
Ru-103	<0.014	<0.020	<0.018
Ru-106	<0.13	<0.16	<0.18
Cs-134	<0.017	<0.017	<0.014
Cs-137	<0.019	<0.024	<0.024
Ce-141	<0.020	<0.023	<0.019
Ce-144	<0.057	<0.088	<0.065

Table 21. Fish samples, analysis of edible portion for gamma-emitting isotopes. (continued)

Sample Description and Activity (pCi/g wet)			
	Control		
	Upstream D-49		
Date Collected	04-26-90	04-26-90	
Type	Carp	Carpsucker	
Lab Code	DF-1028	DF-1029	
K-40	2.71±0.31	2.22±0.51	
Mn-54	<0.013	<0.037	
Co-58	<0.012	<0.044	
Co-60	<0.014	<0.038	
Nb-95	<0.013	<0.040	
Zr-95	<0.025	<0.067	
Ru-103	<0.011	<0.036	
Ru-106	<0.12	<0.35	
Cs-134	<0.013	<0.039	
Cs-137	<0.013	<0.043	
Ce-141	<0.015	<0.048	
Ce-144	<0.071	<0.21	
Date Collected	10-29-90	10-29-90	10-29-90
Type	River Carpsucker	Carp	Buffalo
Lab Code	DF-1310,1	DF-1312	DF-1313
K-40	2.85±0.36	2.59±0.55	2.85±0.33
Mn-54	<0.019	<0.029	<0.017
Co-58	<0.022	<0.026	<0.018
Co-60	<0.021	<0.035	<0.020
Nb-95	<0.033	<0.037	<0.022
Zr-95	<0.039	<0.052	<0.033
Ru-103	<0.028	<0.021	<0.016
Ru-106	<0.16	<0.25	<0.14
Cs-134	<0.019	<0.013	<0.014
Cs-137	<0.025	<0.030	<0.016
Ce-141	<0.036	<0.037	<0.019
Ce-144	<0.12	<0.13	<0.069

Table 22. River sediment samples, analysis for gamma-emitting isotopes. Collection: Semiannually.

Sample Description and Activity (pCi/g dry)			
	Indicator		Control
Location	D-51	D-107	D-50
Date Collected	06-01-90	06-01-90	06-01-90
Lab Code	DBS-779	DBS-780	DBS-778
K-40	7.10±0.56	10.31±0.66	5.87±0.28
Mn-54	<0.022	<0.034	<0.020
Co-58	<0.022	<0.030	<0.021
Co-60	<0.034	0.16±0.047	<0.022
Nb-95	<0.024	<0.053	<0.023
Zr-95	<0.044	<0.069	<0.038
Ru-103	<0.021	<0.039	<0.020
Ru-106	<0.20	<0.26	<0.18
Cs-134	<0.019	<0.028	<0.019
Cs-137	<0.025	0.11±0.032	<0.019
Ce-141	<0.034	<0.049	<0.031
Ce-144	<0.11	<0.13	<0.10
Location	D-51	D-107	D-50
Date Collected	11-15-90	11-15-90	12-27-90
Lab Code	DBS-909	DBS-900	DBS-907
K-40	9.45±0.27	7.08±0.56	7.94±0.46
Mn-54	<0.010	<0.026	<0.020
Co-58	<0.028	<0.034	<0.018
Co-60	<0.009	0.12±0.036	<0.026
Nb-95	<0.13	<0.041	<0.022
Zr-95	<0.058	<0.056	<0.034
Ru-103	<0.092	<0.034	<0.017
Ru-106	<0.080	<0.22	<0.14
Cs-134	<0.013	<0.024	<0.017
Cs-137	0.12±0.007	<0.030	<0.021
Ce-141	<0.41	<0.062	<0.022
Ce-144	<0.12	<0.15	<0.070

Table 23. Precipitation samples, analysis for gamma-emitting isotopes. Collection: Monthly, 1990.

Sample Description and Concentration (pCi/L)				
Collection Period Lab Code	January DP-896	February DP-898[a]	March DP-914	April DP-936
Mn-54	<6	<29	<10	<3
Fe-59	<15	<60	<21	<9
Co-58	<7	<28	<11	<4
Co-60	<7	<27	<9	<3
Zn-65	<13	<62	<19	<6
Nb-95	<7	<32	<10	<5
Zr-95	<11	<55	<19	<7
I-131	<12	<41	<12	<16
Cs-134	<5	<25	<12	<3
Cs-137	<7	<32	<11	<3
Ba-140	<34	<119	<43	<34
La-140	<9	<24	<12	<8
Collection Period Lab Code	May DP-937,8	June DP-946	July DP-956	August DP-965
Mn-54	<9	<4	<9	<3
Fe-59	<16	<10	<25	<8
Co-58	<7	<4	<8	<4
Co-60	<7	<4	<10	<3
Zn-65	<17	<8	<23	<7
Nb-95	<9	<5	<11	<4
Zr-95	<14	<8	<16	<7
I-131	<17	<12	<17	<12
Cs-134	<7	<4	<8	<3
Cs-137	<8	<4	<10	<3
Ba-140	<42	<30	<51	<24
La-140	<13	<10	<13	<4
Collection Period Lab Code	September DP-980	October DP-983	November DP-993	December DP-1002
Mn-54	<8	<4	<5	<3
Fe-59	<15	<13	<10	<9
Co-58	<9	<4	<4	<4
Co-60	<9	<5	<5	<4
Zn-65	<15	<10	<9	<7
Nb-95	<11	<6	<6	<4
Zr-95	<18	<8	<9	<8
I-131	<18	<9	<5	<6
Cs-134	<9	<4	<4	<3
Cs-137	<10	<5	<5	<3
Ba-140	<51	<27	<18	<19
La-140	<10	<8	<4	<6

[a] Elevated LLDs are due to the small sample size (85ml).

Table 24. Precipitation samples, quarterly composites of monthly samples, analysis for tritium.

Location and Period Collected	Lab Code	Concentration (pCi/L) H-3
1st Qtr. 1990	DP-920	<330
2nd Qtr. 1990	954	<330
3rd Qtr. 1990	982	<330
4th Qtr. 1990	1003	<330

NOTE: Page 45 is intentionally left out.

Table 26. Soil samples, analysis for strontium-90 and gamma-emitting isotopes. Collection: Annually.

Sample Description and Activity (pCi/g dry)		
Location	D-15	D-16
Date Collected	11-26-90	11-26-90
Lab Code	DSO-491	DSO-492
Sr-90	0.077±0.015	0.054±0.020
K-40	12.65±1.02	8.49±0.74
Mn-54	<0.042	<0.028
Co-58	<0.048	<0.033
Co-60	<0.060	<0.042
Nb-95	<0.054	<0.034
Zr-95	<0.086	<0.059
Ru-103	<0.049	<0.028
Ru-106	<0.42	<0.28
Cs-134	<0.044	<0.030
Cs-137	0.28±0.065	0.14±0.044
Ce-141	<0.071	<0.047
Ce-144	<0.27	<0.18