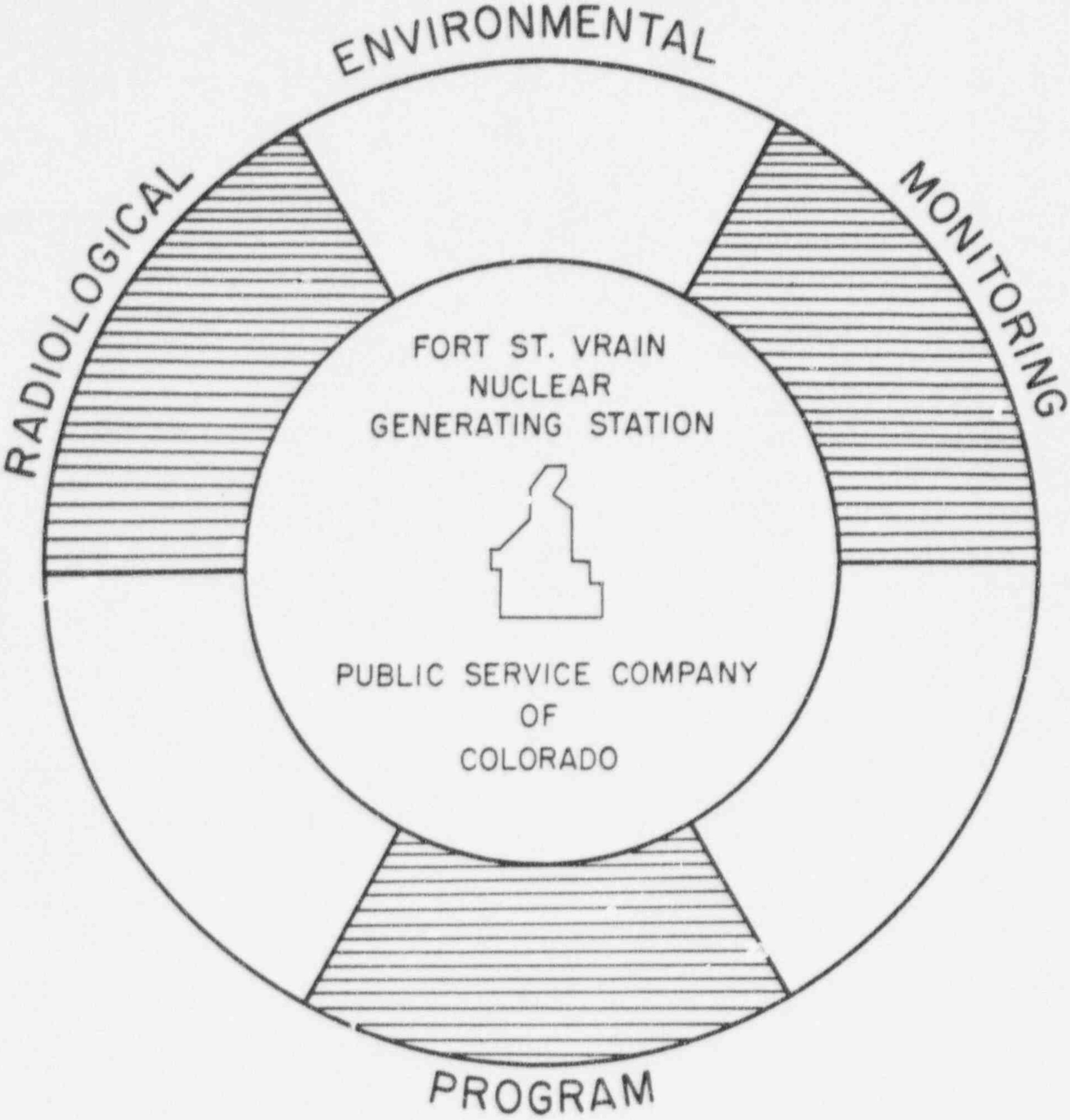

SUMMARY REPORT

1995

COLORADO STATE UNIVERSITY
FORT COLLINS, COLORADO 80523

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

For the Fort St. Vrain Station
Operated by the Public Service Co. of Colorado

Summary Report
for the Period
January 1, 1995 - December 31, 1995

Prepared by: James E. Johnson, Professor, Colorado State University — Date: 4/27/96

Prepared by: Thomas Miller, Lab. Coordinator, Colorado State University — Date: 4/24/96

Prepared by: Timothy E. Schleiger, Senior Health Physicist — Date: 4/29/96

Prepared by: Frederick J. Borst, Radiation Protection Manager — Date: 4/29/96

Acknowledgments

Many persons have contributed to this project since its inception in 1970, and it is important to acknowledge their efforts. There have been many technicians and graduate students working on this project. All have been acknowledged in previous reports, but we here thank them collectively.

We again thank the citizens from whose farms, homes, and ranches we collect the environmental samples. Without their cooperation the project would not be possible.

We also wish to acknowledge and thank Mr. Robert Keiss and his associates as well as the Colorado Division of Wildlife, Fort Collins regional office for assisting with the fish collection. Their cooperation, equipment and expertise made the collection possible.

The persons in this laboratory working directly on the project during 1995 have been:

Roy DePriest	Student Employee
Grant Johns	Student Employee
Vaughn Jones	Research Associate
Charles Sampier	Chief Electronic Technician
Gerald M. Ward	Professor Emeritus

James E. Johnson
Professor and Project Director

Thomas S. Miller
Laboratory Coordinator

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I. Introduction to Radiological Environmental Monitoring Program (REMP) Data for the Period January 1, 1995 - December 31, 1995.

During 1995 the environmental monitoring program was concerned only with the decommissioning phase of the Fort St. Vrain Nuclear Station. The operational phase of the reactor ended on August 18, 1989. Fuel removal operations were completed by June 10, 1992. The spent fuel is stored near by in an Independent Spent Fuel Storage Installation (ISFSI).

A complete and detailed listing of radioactivity released by all effluent routes may be found in the Public Service Company of Colorado Annual Effluent Release Report for 1995 to the U.S. Nuclear Regulatory Commission. When possible in this report, any correlation of radioactivity in environmental samples with the effluent release data is discussed. These discussions are presented in the appropriate sample type section and in the summary section, II.H.

Table III.A.2 lists the LLD values achievable by the counting systems used during 1995 on project samples. These values are given for typical sample sizes, counting times and decay times. The LLD is, therefore, an a priori parameter to indicate the capability of the detection system used. The LLD values in Table III.A.2 were calculated as suggested in NUREG-0472.

Throughout the report, however, when a sample result is listed as less than a specified value, that value is the calculated minimum detectable concentration (MDC). This approach is analogous to that of Currie (NUREG/CR-4007): the MDC is the same as S_c, the critical signal, and the LLD is equal to S_D, the detectable signal. The MDC value applies to the actual sample size, counting time and decay time applicable to that individual sample. It is calculated for each radionuclide as:

$$MDC = \frac{2.33\,\sigma_B}{EYVe^{-\lambda t}}$$

Where: σ_B = Standard deviation of background count rate

E = Counting efficiency, c s^{-1} pCi^{-1}

Y = Chemical yield (if any)

V = Sample volume (or mass)

λ = 0.693/Half-life

t = Decay time between sample collection and analysis

This calculation method assumes that E, Y, and V are constants and makes no allowance for systematic error.

It should be noted that we have not used the notation < MDC for values less than MDC. Rather, we report the result as less than the actual MDC value. Because the MDC is dependent upon variables such as the background count time and sample size, the value will be different for each radionuclide for each sample type and even within sample type.

Essentially all radioactivity values measured on this project are near background levels and, more importantly, near the MDC values for each radionuclide and sample type. It has been well-documented that environmental radioactivity values exhibit great inherent variability. This is partly due to sampling and analytical variability, but most importantly due to true environmental or biological variability. As a result, the overall variability of the surveillance data is quite large, and it is necessary to use mean values from a rather large sample population size to draw any conclusions about the absolute radioactivity concentrations in any environmental pathway.

The arithmetic mean for each sample set is listed in Table II.H.2. All measured values, both positive and negative, are used in the calculations of the arithmetic mean. This is the suggested practice by Gilbert (Health Physics 40:377, 1984) and the NRC (NUREG/CR-4007).

Many sets of data were compared in this report. The statistical test used was either a "t"-test or a paired "t"-test. If data sets are noted to be significantly different or not significantly different, the confidence for the statement is at the 95% level (($\alpha = 0.05$), (1.96σ)).

The Total Effective Dose Equivalent (TEDE) goal for decommissioning as set by the NRC (NUREG/CR-5512) in 1993 is 10 mrem/year for any member of the general public. This is the whole-body dose rate limit excluding background and medical radiation dose rate.

The maximum permissible dose commitment rate set independently by the EPA (40CFR190) for any specified member of the general public from any part of the nuclear fuel cycle is 25 mrem/year.

Dose commitments can be calculated for hypothetical individuals for any mean concentrations noted in unrestricted areas that are significantly above control mean values.

The following is the footnote system used in this report.

- a. Sample lost prior to analysis.
- b. Sample missing at site.
- c. Instrument malfunction.
- d. Sample lost during analysis.
- e. Insufficient weight or volume for analysis.
- f. Sample unavailable.
- g. Analysis in progress.
- h. Sample not collected (actual reason given).
- i. Analytical error (actual reason given).
- N.A. Not applicable.

II. Surveillance Data for January Through December 1995 and Interpretation of Results

A. External Gamma-ray Exposure Rates

The average measured gamma-ray exposure rates expressed in mR/day are given in Table II.A.1. The values were determined by CaF_2:Dy (TLD-200) dosimeters at each of 41 locations (see Figure III.B.1). Two TLD chips per package are installed at each site and the mean value is reported for that site. The mean calculated total exposure is then divided by the number of days that elapsed between pre-exposure and post-exposure annealing to obtain the average daily exposure rate. The TLD devices are changed quarterly at each location. Fading during field exposure is minimized by the post-annealing readout procedure. All TLD's are facing north to ensure consistent solar heating.

The TLD data indicate that the arithmetic mean measured exposure rate (plus 1.96 standard deviations) in the facility area for all of 1995 was 0.41 (0.11) mR/day. The mean exposure rate was 0.40 (0.15) mR/day for the adjacent area and 0.40 (0.14) mR/day for the reference area. These mean values are not significantly different from each other and not different from the mean values measured during 1994.

The exposure rate measured at all sites is due to a combination of exposure from cosmic rays, from natural gamma-ray emitters in the earth's crust and from ground surface deposition of fission products due to previous world-wide fallout. The variation in measured values is due to true variation of the above sources plus the variability due to the measurement method. The purpose of having two TLD rings around the site is not to measure gamma-rays generated from the facility itself, but to document the presence or absence of gamma-ray emitters deposited upon the ground from the reactor effluent. Since the inception of power production by the reactor, there has been no detectable increase in the external exposure rate due to reactor releases. Fallout deposition, from world-wide fallout, from the Chinese nuclear weapon tests, and from the Chernobyl accident, has been detected in the past.

The TLD system is calibrated by exposing chips to a scattered gamma-ray flux produced in a cavity surrounded by uranium mill tailings. This produces a gamma-ray spectrum nearly identical to that from the natural background measured in the site environs. The quality control program includes calibration before readout of each quarterly batch of TLD devices.

For comparison purposes, EPA 402/R (Formerly 520/5) Environmental Radiation Data lists very similar background external exposure rate values measured in Denver. There has always been excellent agreement with the results from this program.

Figure II.A.1 shows the measured mean exposure rate in the Facility Area from 1978 to 1995. The steady decrease in exposure rate over the period is due to the decay and weathering of fission product deposition from previous atmospheric weapon tests.

Table II.A.1 Gamma Exposure Rates (mR/day) 1995

Facility Area	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
F-1	0.39	0.48	0.34	0.37
F-2	0.38	0.50	0.36	0.42
F-3	0.41	0.33	0.49	0.44
F-4	0.40	0.55	0.37	0.43
F-5	0.42	0.43	0.50	0.43
F-6	0.43	0.30	0.38	0.39
F-7	0.41	0.26	0.44	0.40
F-8	0.37	0.52	0.57	0.35
F-9	0.42	0.42	0.40	0.41
F-10	0.37	0.49	0.37	0.44
F-11	0.42	0.42	0.43	0.40
F-12	0.41	0.38	0.45	0.37
F-13	0.39	0.52	0.40	0.43
F-14	0.38	0.23	0.45	0.48
F-15	0.39	0.43	0.36	0.42
F-16	0.40	0.34	0.29	0.47
F-17	0.38	0.45	0.39	0.38
F-18	0.38	0.45	0.44	0.36
X(1.96σ)	0.40(0.04)	0.42(0.18)	0.41(0.13)	0.41(0.07)

Table II.A.1 (cont'd)

Adjacent Area	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
A-1	0.38	0.42	0.46	0.45
A-2	0.39	0.49	0.42	0.40
A-3	0.37	0.49	0.51	0.41
A-4	0.37	b	0.40	0.36
A-5	0.37	0.45	0.34	0.33
A-6	0.36	0.34	0.35	0.33
A-7	0.38	0.44	0.35	0.36
A-8	b	0.35	0.41	0.41
A-9	0.39	0.37	0.56	0.42
A-10	0.38	0.47	0.40	0.47
A-11	0.38	0.43	0.41	0.38
A-12	0.43	0.49	0.38	0.34
A-13	0.38	b	0.31	0.37
A-14	0.35	0.26	0.43	0.41
A-15	0.35	0.33	0.28	0.38
A-16	b	0.37	0.36	0.41
A-17	0.36	0.38	0.38	0.40
A-20	0.38	0.45	0.37	0.46
X(1.96σ)	0.38(0.16)	0.41(0.22)	0.40(0.13)	0.40(0.08)

b - sample missing at site

Table II.A.1 (cont'd)

Reference Area	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
R-1	b	0.36	0.34	0.39
R-2	0.39	0.46	0.39	0.35
R-3	0.41	0.38	0.33	0.43
R-4	0.37	0.45	0.56	0.35
R-7	0.39	0.43	0.38	0.37
X(1.96σ)	0.39(0.28)	0.42(0.07)	0.40(0.16)	0.38(0.06)

b - sample missing at site

Gamma Exposure Rates (mR/day) 1978-1995 (Facility Area Only)

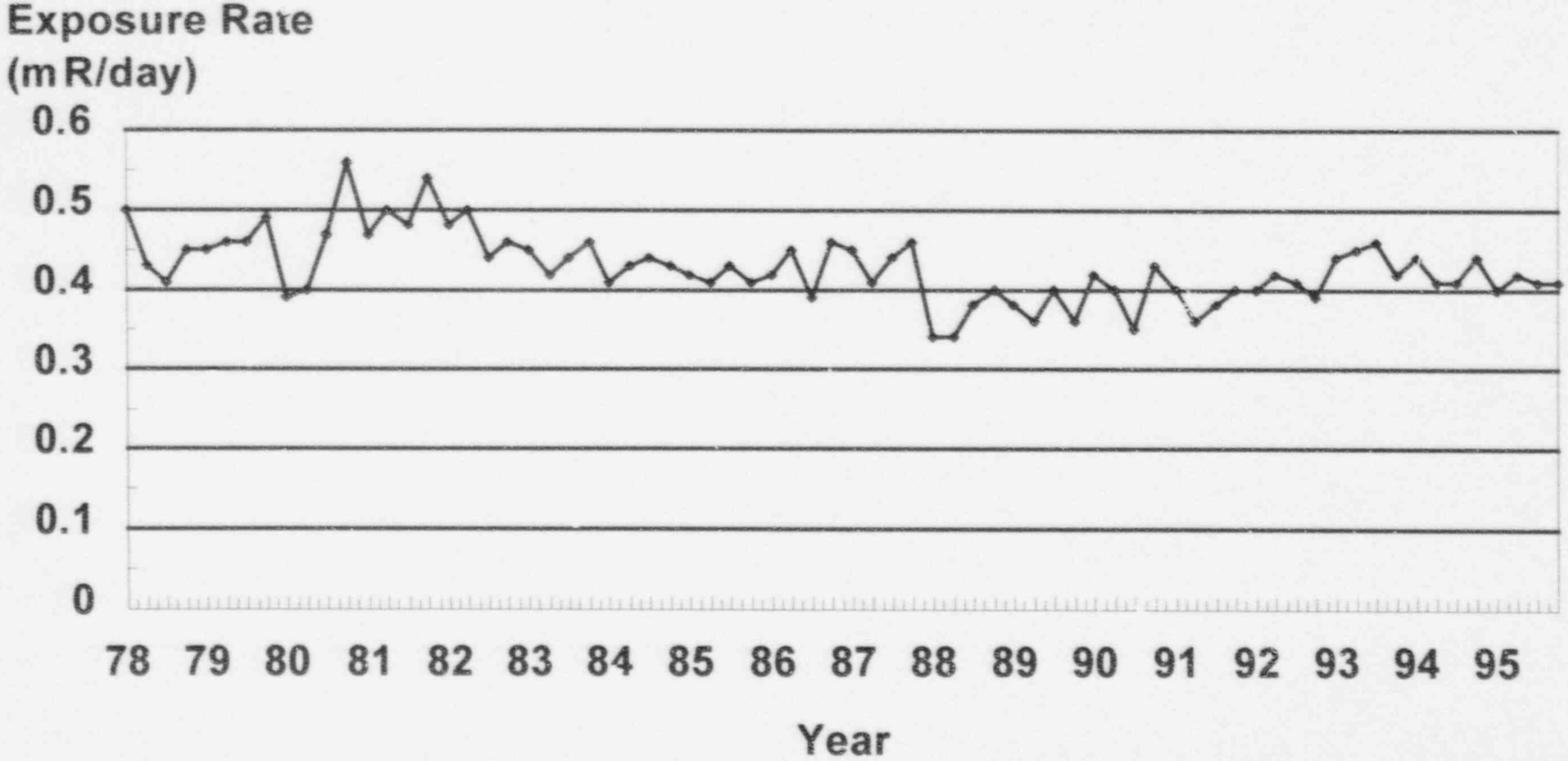


Figure II.A.1

II.B. Ambient Air Concentrations

1. Gross Beta Activity

The air concentrations of long lived particulate gross beta activity measured at the facility and reference sampling sites are listed in Tables II.B.1(a-d) for each quarter of 1995. A-19, while technically in the adjacent zone, is only a few meters from the facility boundary and logically should be considered a facility site. It has been termed a facility site since the inception of the monitoring program. The reference sites R-3, R-4, and R-11 were established on January 1, 1984 and are sufficiently distant to be considered reference (control) locations. (See Table F-4 in ODCM). Note that site F-7 is in the predominant wind direction toward Platteville. Platteville is the nearest community with the highest D/Q.

The reported concentrations are listed in units of femtocuries per cubic meter of ambient air (fCi/m^3), although the measured activity is due to a combination of radionuclides almost all of which are naturally occurring. All air filters are saved for future analysis if warranted due to any possible accident scenario during decommissioning.

The mean gross beta concentration in air for all facility stations for all of 1995 was 19 fCi/m^3. For 1994 the mean value was 28 fCi/m^3. The mean concentration for 1995 for all reference stations was 17 fCi/m^3. These measured mean values were statistically significantly lower at the 95% confidence level.

The gross beta concentrations for 1995 have been added to the plot of air concentrations observed since 1973 (Figure II.B.1). In this figure the half-yearly mean values for the facility sites are plotted with the values from the reference sites. The contribution from the Chernobyl accident is clearly evident in 1986. It can be observed that overall mean values of the facility sites are not significantly different from the reference sites. World-wide fallout, principally due to past Chinese atmospheric nuclear weapon tests, is the predominant contributor above background to the measured values over the period shown.

There has never been a significant difference observed in gross beta air concentrations between facility and reference sites. Thus, it can be concluded that reactor air effluents of particulate fission products or activation products during operation or decommissioning have not been a source of dose commitment for the Fort St. Vrain environs population.

Table II.B.1(a) Concentrations of Long-lived Gross Beta Particulate Activity in Air (fCi/m^3)

1st Quarter 1995

Collection Dates	Facility				Reference		
	F-7	F-9	F-16	A-19	R-3	R-4	R-11
01/07	46(1.8)*	42(1.6)	44(1.7)	39(1.6)	17(1.1)	32(1.5)	40(1.6)
01/14	23(1.1)	24(1.1)	24(1.1)	24(1.2)	13(0.88)	13(0.90)	23(1.2)
01/21	18(1.0)	17(0.90)	18(0.91)	18(1.1)	15(0.92)	14(0.98)	17(1.0)
01/28	30(1.4)	27(1.2)	28(1.2)	31(1.5)	20(1.1)	21(1.2)	22(1.2)
02/04	17(1.0)	16(0.96)	16(0.90)	17(1.1)	15(0.90)	14(0.95)	17(0.97)
02/11	17(0.97)	20(0.97)	18(0.89)	18(1.0)	21(1.1)	16(0.96)	18(0.97)
02/18	37(1.4)	38(1.4)	38(1.4)	23(1.2)	36(1.4)	21(1.1)	35(1.2)
02/25	26(1.2)	25(1.1)	26(1.1)	26(1.2)	21(1.1)	20(1.1)	21(1.1)
03/04	31(1.2)	28(1.2)	35(1.5)	29(1.3)	27(1.1)	27(1.2)	24(1.1)
03/11	30(1.2)	35(1.3)	50(1.7)	31(1.3)	31(1.2)	28(1.2)	32(1.2)
03/18	15(1.0)	15(0.97)	15(0.94)	16(1.1)	14(0.94)	12(0.91)	14(0.98)
03/25	17(1.1)	16(1.0)	16(0.99)	18(1.2)	16(0.98)	15(1.1)	16(1.0)
$\overline{X}$	26	25	27	24	21	19	23
1.96σ	19	15	12	7	14	13	16
	Max:50 Min:15 $\overline{X}$(1.96σ):26(18) n:48				**Max:40 Min:12 $\overline{X}$ (1.96σ):21(14) n:36**		

* - 1.96σ (Due to counting statistics)

Table II.B.1(b) Concentrations of Long-lived Gross Beta Particulate Activity in Air (fCi/m^3)

2[nd] Quarter 1995

Collection Dates	Facility				Reference		
	F-7	F-9	F-16	A-19	R-3	R-4	R-11
04/01	19(1.0)*	18(0.93)	18(1.1)	19(1.1)	18(0.97)	16(0.94)	16(0.93)
04/08	24(1.3)	22(1.1)	23(1.1)	25(1.4)	21(1.1)	20(1.1)	20(1.1)
04/15	17(1.0)	14(0.93)	16(1.0)	17(1.1)	15(0.90)	13(0.93)	13(0.96)
04/22	12(0.79)	11(0.71)	10(0.70)	10(0.85)	11(0.72)	10(0.74)	11(0.73)
04/29	17(0.92)	16(0.84)	17(0.86)	16(0.99)	16(0.86)	15(0.86)	16(0.87)
05/06	11(0.77)	10(0.68)	11(0.72)	11(0.88)	10(0.70)	12(0.94)	12(0.76)
05/12	15(1.0)	13(0.97)	14(0.92)	14(1.1)	12(0.93)	14(0.96)	13(0.96)
05/19	15(0.95)	14(0.87)	14(0.85)	15(1.1)	14(0.95)	12(0.89)	14(0.88)
05/26	25(2.8)	13(0.75)	13(0.74)	12(0.91)	14(0.86)	12(0.78)	13(0.80)
06/02	17(1.4)	13(0.76)	13(0.76)	12(0.94)	13(0.85)	12(0.80)	11(0.75)
06/09	13(0.81)	12(0.75)	13(0.78)	14(1.0)	16(0.97)	13(0.81)	14(0.87)
06/16	19(1.0)	19(0.95)	19(0.96)	20(1.3)	33(1.9)	20(1.1)	19(1.1)
06/23	18(1.0)	18(1.0)	17(1.1)	20(1.2)	25(1.6)	16(1.0)	15(0.98)
06/30	19(0.98)	16(0.84)	19(0.92)	19(1.1)	21(1.1)	20(1.0)	19(0.95)
$\overline{X}$	17	15	16	16	17	15	15
1.96σ	7.9	6.6	7.0	8.3	12.2	6.6	5.8
	Max:25 Min:10	**$\overline{X}$ (1.96σ):16(7.5) n:56**			**Max:33 Min:10**	**$\overline{X}$ (1.96σ):15(8.7) n:42**	

* - 1.96σ (Due to counting statistics)

Table II.B.1(c) Concentrations of Long-lived Gross Beta Particulate Activity in Air (fCi/m^3)

3rd Quarter 1995

Collection Dates	Facility				Reference		
	F-7	F-9	F-16	A-19	R-3	R-4	R-11
07/07	18(0.96)*	17(0.90)	17(0.88)	16(1.1)	19(1.2)	18(0.96)	16(0.89)
07/14	28(1.3)	26(1.2)	27(1.2)	29(1.4)	22(1.3)	25(1.2)	25(1.2)
07/21	23(1.1)	26(1.0)	20(0.98)	18(1.1)	23(1.1)	23(1.1)	21(0.99)
07/28	25(1.2)	23(1.2)	23(1.1)	24(1.3)	27(1.3)	23(1.2)	24(1.2)
08/04	26(1.2)	21(1.1)	22(1.1)	25(1.4)	24(1.3)	24(1.2)	21(1.1)
08/11	30(1.3)	26(1.2)	28(1.2)	27(1.4)	31(1.3)	28(1.2)	27(1.2)
08/18	29(1.3)	27(1.3)	26(1.1)	17(1.8)	28(1.3)	25(1.2)	24(1.2)
08/26	22(1.0)	17(0.97)	21(0.97)	b	21(1.1)	21(1.0)	19(0.97)
09/02	31(1.3)	28(1.3)	28(1.2)	28(1.3)	29(1.4)	28(1.2)	26(1.2)
09/09	23(1.1)	23(1.1)	23(1.1)	22(1.1)	23(1.2)	23(1.1)	21(1.1)
09/16	31(1.3)	29(1.2)	31(1.2)	32(1.3)	31(1.3)	31(1.2)	27(1.2)
09/23	23(1.2)	23(1.1)	13(0.99)	23(1.1)	23(1.1)	20(0.97)	30(1.5)
09/30	28(1.3)	28(1.3)	30(1.1)	29(1.2)	26(1.2)	25(1.2)	26(2.1)
$\bar{X}$	26	24	24	24	25	22	24
1.96σ	7.5	7.4	9.9	9.7	7.2	6.6	7.2
	Max:32 Min:13	**$\bar{X}$(1.96σ):25(8.8) n:51**			**Max:31 Min:16**	**$\bar{X}$(1.96σ):24(7.1) n:39**	

* - 1.96σ (Due to counting statistics)

b - Sample Missing at Site

Table II.B.1(d) Concentrations of Long-lived Gross Beta Particulate Activity in Air (fCi/m^3)

4th Quarter 1995

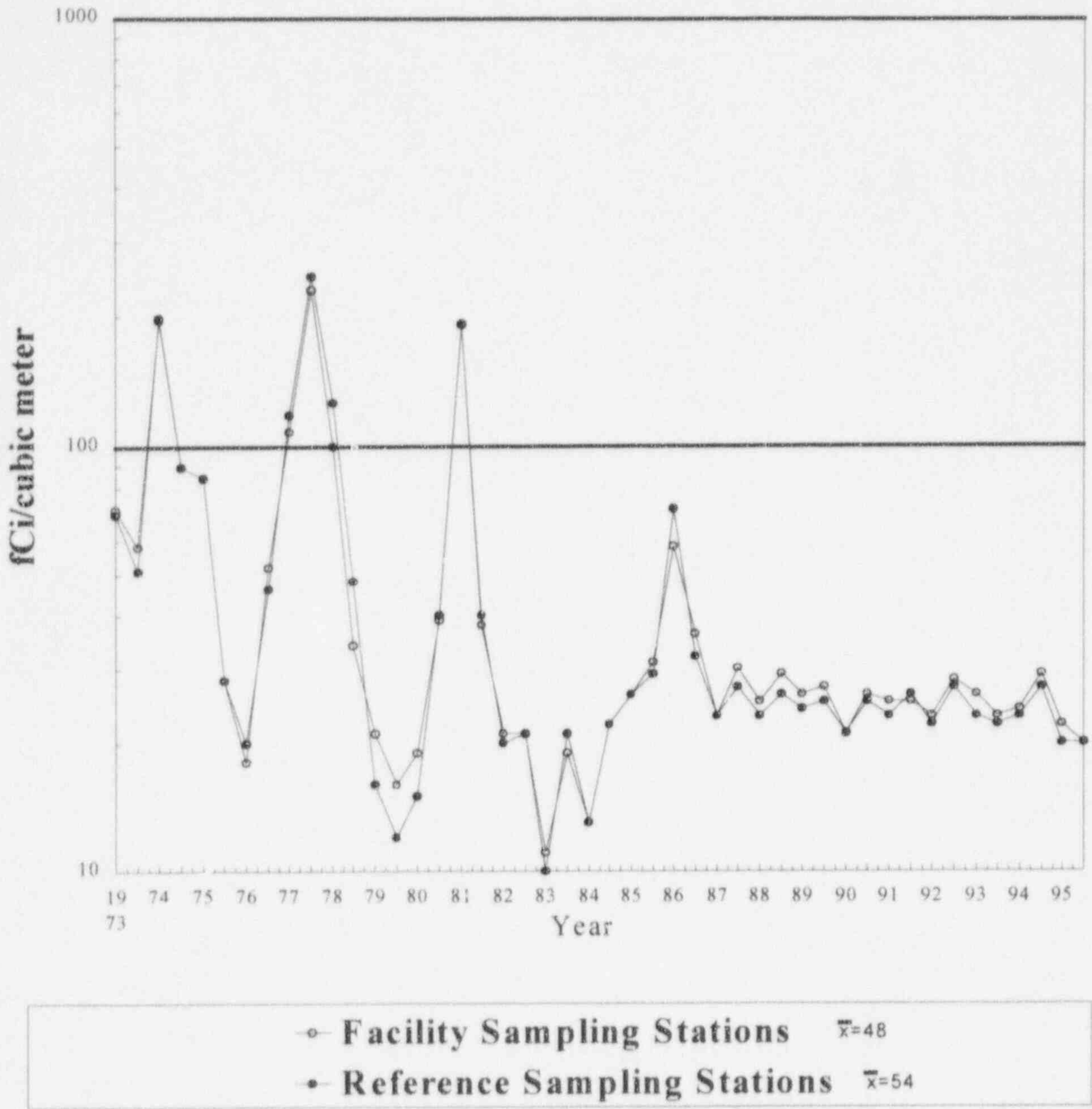
Collection Dates	Facility				Reference		
	F-7	F-9	F-16	A-19	R-3	R-4	R-11
10/07	17 (1.0)*	17 (0.96)	17 (0.88)	16 (0.97)	15 (0.98)	16 (0.98)	15 (0.91)
10/14	26 (1.2)	26 (1.2)	26 (1.1)	26 (1.2)	25 (1.3)	21 (1.1)	22 (1.1)
10/20	23 (1.3)	24 (1.3)	25 (1.2)	25 (1.3)	27 (1.5)	22 (1.3)	22 (1.2)
10/27	19 (1.0)	20 (1.0)	19 (0.97)	22 (1.1)	21 (1.2)	18 (1.1)	16 (0.94)
11/04	27 (1.1)	27 (1.1)	28 (1.1)	27 (1.1)	26 (1.2)	23 (1.2)	23 (1.0)
11/11	25 (1.1)	23 (1.0)	24 (1.0)	24 (1.1)	24 (1.2)	20 (1.1)	22 (1.1)
11/18	19 (1.0)	20 (0.96)	21 (0.95)	21 (1.1)	18 (1.1)	15 (0.98)	18 (0.89)
11/26	27 (1.1)	25 (1.1)	28 (1.1)	29 (1.2)	25 (1.2)	22 (1.0)	21 (1.0)
12/02	21 (1.2)	12 (1.1)	18 (1.1)	19 (1.2)	15 (1.2)	12 (0.98)	14 (1.0)
12/09	24 (1.2)	21 (1.1)	22 (1.0)	23 (1.2)	17 (1.1)	20 (1.1)	20 (1.1)
12/15	27 (1.7)	25 (1.3)	23 (1.2)	25 (1.4)	20 (1.4)	17 (1.1)	21 (1.2)
12/22	b	19 (1.1)	23 (1.2)	29 (1.4)	24 (1.3)	22 (1.2)	20 (1.1)
12/29	b	b	38 (1.3)	42 (1.6)	28 (1.4)	28 (1.2)	30 (1.3)
$\bar{X}$	23	22	24	25	22	20	20
1.96σ	6.8	8.1	10.3	11.8	8.5	7.7	7.7
	Max: 42 **Min: 12**		**$\bar{X}$ (1.96σ):9.9(9.0)** **n:49**		**Max: 30** **Min: 12**	**$\bar{X}$(1.96σ):8.2(8.0)** **n: 39**	

* - 1.96σ (Due to counting statistics)

b - Sample Missing at Site

Figure II.B.1

Gross Beta Concentrations in Air



2. <u>Tritium Activity</u>

Atmospheric water vapor samples were collected continuously by passive absorption on silica gel at all seven air sampling stations (four in the facility area and three in the reference area). The specific activity of tritium in water extracted from these weekly samples in 1995 is listed in Tables II.B.2(a-d).

Inspection of Table II.B.2 shows essentially no detectable tritium activity concentrations in any periods during 1995. This was also true in 1994. There was no evidence of release from effluent air pathways. Inhalation is not a significant pathway for dose to humans. The milk and food pathway are the only significant source of radiation dose to humans from environmental tritium. See results in sections II.D and II.E for these pathways.

Table II.B.2(a) Tritium in Atmospheric Water Vapor (pCi/L)

1st Quarter 1995

Collection Dates	Facility				Reference		
	F-7	F-9	F-16	A-19	R-3	R-4	R-11
01/07	< 430	< 430	< 430	< 430	< 430	< 430	< 430
01/14	< 390	< 390	< 390	< 390	< 390	< 390	< 390
01/21	< 390	< 390	< 390	< 390	< 390	< 390	< 390
01/28	< 380	< 380	< 380	< 380	< 380	< 380	< 380
02/04	< 380	< 380	< 380	< 380	< 380	< 380	< 380
02/11	< 380	< 380	< 380	< 380	< 380	< 380	< 380
02/18	< 390	< 390	< 390	< 390	< 390	< 390	< 390
02/25	< 380	< 380	< 380	< 38u	< 380	< 380	< 380
03/04	< 400	< 400	< 400	< 400	< 400	< 400	< 400
03/11	< 390	< 390	< 390	< 390	< 390	< 390	< 390
03/18	< 390	< 390	< 390	< 390	< 390	< 390	< 390
03/25	< 390	< 390	530(460)*	< 390	< 390	< 390	< 390

Table II.B.2(b) Tritium in Atmospheric Water Vapor (pCi/L)

2nd Quarter 1995

Collection Dates	Facility				Reference		
	F-7	F-9	F-16	A-19	R-3	R-4	R-11
04/01	< 390	< 390	< 390	< 390	< 390	< 390	< 390
04/08	< 380	< 380	< 380	< 380	< 380	< 380	< 380
04/15	< 380	< 380	< 380	< 380	< 380	< 380	< 380
04/22	< 380	< 380	< 380	< 380	< 380	< 380	< 380
04/29	< 490	< 490	< 490	< 490	< 490	< 490	< 490
05/06	< 380	< 380	< 380	< 380	< 380	< 380	410(460)*
05/12	< 370	< 370	< 370	< 370	< 370	< 370	< 370
05/19	< 360	< 360	< 360	< 360	< 360	< 360	< 360
05/26	< 370	< 370	< 370	< 370	< 370	< 370	< 370
06/02	< 370	< 370	< 370	< 370	< 370	< 370	< 370
06/09	< 370	< 370	< 370	< 370	< 370	< 370	< 370
06/16	< 370	< 370	< 370	< 370	< 370	< 370	< 370
06/23	< 370	< 370	< 370	< 370	< 370	< 370	< 370
06/30	< 370	< 370	< 370	< 370	< 370	< 370	< 370

* - 1.96σ (Due to counting statistics)

Table II.B.2(c) Tritium in Atmospheric Water Vapor (pCi/L)

3rd Quarter 1995

Collection Dates	Facility				Reference		
	F-7	F-9	F-16	A-19	R-3	R-4	R-11
07/07	< 360	480(450)*	< 360	1000(450)	< 360	< 360	< 360
07/14	< 370	< 370	< 370	< 370	< 370	< 370	< 370
07/21	< 370	< 370	< 370	< 370	< 370	< 370	< 370
07/28	< 370	< 370	< 370	< 370	< 370	< 370	< 370
08/04	< 370	< 370	< 370	< 370	< 370	< 370	< 370
08/11	< 380	< 380	< 380	< 380	< 380	< 380	< 380
08/18	< 370	< 370	< 370	< 370	< 370	< 370	< 370
08/26	< 380	< 380	< 380	< 380	< 380	< 380	< 380
09/02	< 400	< 400	< 400	< 400	< 400	< 400	< 400
09/09	< 390	< 390	< 390	< 390	< 390	< 390	< 390
09/16	480(480)	< 400	480(480)	< 400	< 400	< 400	< 400
09/23	< 390	< 390	450(470)	< 390	< 390	< 390	590(470)
09/30	< 370	< 370	< 370	< 370	< 370	< 370	< 370

* - 1.96σ (Due to counting statistics)

Table II.B.2(d) Tritium in Atmospheric Water Vapor (pCi/L)

4th Quarter 1995

Collection Dates	Facility				Reference		
	F-7	F-9	F-16	A-19	R-3	R-4	R-11
10/07	< 380	< 380	< 380	< 380	< 380	< 380	< 380
10/14	< 390	< 390	< 390	< 390	< 390	< 390	< 390
10/20	< 390	< 390	< 390	< 390	< 390	< 390	< 390
10/27	< 400	< 400	< 400	< 400	< 400	< 400	< 400
11/04	< 410	< 410	1300(430)*	460(430)	< 410	< 410	< 410
11/11	< 370	< 370	< 370	< 370	< 370	< 370	< 370
11/18	< 390	< 390	< 390	< 390	< 390	< 390	< 390
11/26	< 400	< 400	< 400	< 400	< 400	< 400	< 400
12/02	< 430	< 430	< 430	< 430	< 430	< 430	< 430
12/09	< 400	< 400	< 400	< 400	< 400	< 400	< 400
12/15	< 370	< 370	< 370	< 370	< 370	< 370	< 370
12/22	< 380	< 380	< 380	810(450)	< 380	< 380	< 380
12/29	< 390	< 390	< 390	< 390	< 390	< 390	< 390

* - 1.96σ (Due to counting statistics)

Table II.B.3

Tritium Released (Ci) In Fort St. Vrain Effluents, 1995

MODE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Continuous Gaseous Stack	.21	.081	.25	.66	.16	.11	.095	.11	1.1	.95	0*	0	3.7
Batch Liquid	.071	.26	0.0	.51	.75	.48	.71	.39	.41	.032	.009	0	3.6
TOTAL	.28	.34	.25	1.2	.91	.60	.80	.50	1.5	.98	.009	0	7.4

* - October was the final monthly report of tritium released from the shield water system at the Fort St. Vrain Station in accordance with the Tritium Discharge Understanding of October, 1992. PSCo initiated liquid effluent releases from the shield water system in June, 1993, and has provided monthly tritium release reports since that time. The Fort St. Vrain decommissioning project has progressed to the point that all shield water has been released from the site and the shield water system has been dismantled. Some liquid effluent will continue to be released, largely from cleaning and dismantlement activities that remain to be completed; this liquid effluent will be released in accordance with the controls and requirements in the Fort St. Vrain CDPS Permit and Nuclear Regulatory Commission license.

3. Concentrations of Gamma-ray Emitting Radionuclides in Ambient Air

Table II.B.4 lists measured ambient air concentrations of Cs-134 and Cs-137 during 1995. These results are from gamma-ray spectrum analyses of weekly air filters composited quarterly from each of the seven air sampling stations. Occasional positive values can be noted. However, in every case these are very close to the lower limit of detection. The occasional positive values are either measurement system false positives or Cs-137 concentrations possibly due to resuspension of surface soil. The Cs-137 activity in surface soil is due to Chernobyl or previous world-wide fallout which is bound by clay minerals on the surface of undisturbed soil. For the entire year, the mean of the facility stations was not different from the mean of the reference stations (see Table II.H.2).

Although only Cs-134 and Cs-137 are reported, each gamma-ray spectrum is scanned for evidence of peaks from other fission products and activation products. Only gamma-ray activity due to the naturally occurring background radionuclides was observed. During the second quarter of 1986, however, many other fission product and activation product radionuclides were observed due to the Chernobyl accident. Of these only Cs-137 can still be detected, but at steadily decreasing concentrations.

Due to the time period since the end of operation, there is no logic in I-131 monitoring and it was discontinued in January 1993. It is worthy to note that I-131, due to facility effluent, was never measured in any environmental sample during the operational phase or since the reactor was permanently shut down in August 1989.

Table II.B.4 Radiocesium Concentrations in Ambient Air. (fCi/m^3)

1995 Collection Periods	Radio-nuclide	Facility				Reference		
		F-7	F-9	F-16	A-19	R-3	R-4	R-11
1st Quarter	Cs-134	< 1.8	< 0.66	< 1.8	< 0.68	< 1.6	< 0.77	< 1.7
	Cs-137	< 1.8	0.94(1.0)*	< 1.6	< 0.83	< 1.8	< 0.90	< 1.8
2nd Quarter	Cs-134	< 1.7	< 0.43	< 1.4	0.8(0.94)	< 1.2	< 1.5	< 1.3
	Cs-137	< 1.7	0.7(1.6)	< 1.3	1.6(0.86)	< 1.2	< 1.4	< 1.2
3rd Quarter	Cs-134	< 0.83	< 0.73	< 0.20	< 1.1	1.2(1.0)	< 0.80	< 0.89
	Cs-137	< 0.75	< 0.87	0.63(0.25)	2.0(1.5)	< 0.89	< 0.75	< 1.1
4th Quarter	Cs-134	< 0.60	< 0.47	< 0.36	< 1.0	< 0.76	< 0.70	< 0.79
	Cs-137	1.1(0.8)	0.89(0.57)	0.9(0.45)	1.3(1.2)	< 0.95	1.2(1.0)	< 0.81

* - 1.96σ (Due to counting statistics)

II.C. Radionuclide Concentrations in Water

1. Drinking Water

Drinking water is sampled weekly and composited biweekly at two locations. Location R-6 is the water faucet at the Gilcrest Post Office in Gilcrest, Colorado, and R-3 is from a water hydrant located on the old CSU dairy farm in Fort Collins. The Gilcrest well is the nearest public water supply that could be affected by the facility effluents. R-3 samples are the same as the Fort Collins drinking water supply and serve as a reference location since its source is run-off surface water from the Rocky Mountains to the west. In the past water treatment systems for the two water supplies were very different, however recently Gilcrest has adopted treatment practices that more closely correspond to those of Fort Collins.

Table II.C.1 shows gross beta concentrations measured in 1995 from each water supply. The mean for the Gilcrest site was slightly higher than the Reference site in Fort Collins. This is due to the different supply sources. The city of Gilcrest blends water form two different sources and it does not filter the well supply water as well as Fort Collins and natural radionuclide concentrations due to the suspended solids are responsible for the slightly higher measured concentrations. As can be observed in Table II.H.2, however, the mean for the entire year for the Gilcrest site was again lower than that observed prior to 1993. This decrease was due to a changes in treatment practice by the town of Gilcrest.

Table II.C.2 lists measured tritium concentrations in these same two drinking water sources. There is no significant difference in the yearly mean tritium concentrations in the two drinking water supplies. The EPA limit for community drinking water systems is 20,000 pCi/L for tritium.

The two drinking water supplies were also analyzed biweekly for fission product and activation product concentrations. A three liter aliquot of the original sample is counted directly for the other gamma-ray emitters. Inspection of Table II.C.3 reveals occasional positive values of radionuclide concentration, but with the exception of Cs-137, these are interpreted to be random variations about the detection limit. The Cs-137 is the residue from the 1986 Chernobyl accident fallout as well as from past world-wide fallout from nuclear weapons testing.

Table II.C.1(a) Gross Beta in Drinking Water (pCi/L)

1st and 2nd Quarter 1995

Collection Dates	Gilcrest R-6	Ft. Collins R-3
12/31 01/07	1.1(2.2)*	0.90(0.58)
01/14 01/21	0.33(2.1)	0.96(0.58)
01/28 02/04	1.0(2.3)	0.61(0.57)
02/11 02/18	1.3(2.2)	1.1(0.59)
02/25 03/04	0.40(2.2)	0.73(0.57)
03/11 03/18	0.49(2.1)	0.64(0.57)
03/25 04/01	1.1(2.2)	1.0(0.58)
04/08 04/15	1.0(2.2)	0.59(0.56)
04/22 04/29	2.6(0.58)	0.87(0.58)
05/06 05/12	1.5(2.2)	0.79(0.57)
05/19 05/26	0.69(2.2)	0.61(0.56)
06/02 06/09	0.49(2.2)	0.89(0.58)
06/16 06/23	0.84(2.2)	1.0(0.58)

* - 1.96σ (Due to Counting Statistics)

Table II.C.1(b) Gross Beta in Drinking Water (pCi/L)

3rd and 4th Quarter 1995

Collection Dates	Gilcrest R-6	Ft. Collins R-3
07/14 07/21	1.4(2.2)*	0.78(0.57)
07/28 08/04	0.49(2.2)	0.48(0.56)
08/11 08/18	1.6(2.2)	0.46(0.55)
08/26 09/02	1.1(2.2)	0.90(0.58)
09/09 09/16	0.53(2.2)	0.61(0.56)
09/23 09/30	0.91(2.2)	0.71(0.57)
10/07 10/14	0.49(2.1)	0.51(0.56)
10/20 10/27	0.79(2.2)	0.80(0.58)
11/04 11/11	1.2(2.2)	0.55(0.56)
11/18 11/26	2.0(2.3)	0.85(0.59)
12/02 12/09	0.93(2.2)	0.98(0.59)
12/16 12/23	1.2(2.2)	0.88(0.59)

* - 1.96σ (Due to Counting Statistics)

Table II.C.2(a) Tritium in Drinking Water (pCi/L)

1st and 2nd Quarter 1995

Collection Dates	Gilcrest R-6	Ft. Collins R-3
12/31 01/07	< 390	< 390
01/14 01/21	< 420	< 420
01/28 02/04	< 390	< 390
02/11 02/18	< 390	< 390
02/25 03/04	< 390	< 390
03/11 03/18	< 380	< 380
03/25 04/01	< 390	< 390
04/08 04/15	590(470)*	< 390
04/22 04/29	< 390	< 390
05/06 05/12	< 370	< 370
05/19 05/26	< 370	< 370
06/02 06/09	< 370	< 370
06/16 06/23	< 370	< 370
06/30 07/07	< 360	< 360

Table II.C.2(b) Tritium in Drinking Water (pCi/L)

3rd and 4th Quarter 1995

Collection Dates	Gilcrest R-6	Ft. Collins R-3
07/14 07/21	< 370	< 370
07/28 08/04	< 370	< 370
08/11 08/18	< 370	< 370
08/26 09/02	< 390	< 390
09/09 09/16	< 380	< 380
09/23 09/30	< 380	< 380
10/07 10/14	< 380	< 380
10/20 10/27	< 370	< 370
11/04 11/11	< 380	< 380
11/18 11/26	< 420	< 420
12/02 12/09	< 380	< 380
12/16 12/23	< 450	< 450

Table II.C.3 Radionuclide Concentrations in Bi-weekly Composite of Drinking Water. (pCi/L)

Collection Date	for two weeks ending 01/07/95		for two weeks ending 01/21/95		for two weeks ending 02/11/95	
Radionuclide	Gilcrest R-6	Ft. Collins R-3	Gilcrest R-6	Ft. Collins R-3	Gilcrest R-6	Ft. Collins R-3
Cs-134	<2.0	<1.8	<1.8	<1.9	<2.0	<2.4
Cs-137	<2.5	3.8(2.7)*	<2.3	<2.3	<2.4	<3.0
Zr-95	<4.7	<4.7	<4.4	<4.9	<5.1	<5.7
Nb-95	<1.8	<1.7	<1.7	<1.8	<1.8	<2.2
Co-58	<1.8	<1.7	<1.7	<1.7	<1.8	<2.4
Mn-54	2.3(2.4)	<1.8	<1.9	<1.9	<2.0	<2.4
Zn-65	<5.5	<4.9	<5.2	<5.2	<5.4	<7.3
Fe-59	<4.7	<4.3	<4.3	<5.1	<4.6	<5.7
Co-60	<2.2	<2.0	<2.0	<2.1	<2.2	<2.6
Ba-140	<3.2	<5.0	<5.7	<3.1	<3.2	<6.1
La-140	<3.7	<5.7	<6.6	<3.5	<3.7	<7.0

* - 1.96σ (Due to counting statistics)

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Table II.C.3 Radionuclide Concentrations in Bi-weekly Composite of Drinking Water. (pCi/L)

Collection Date	for two weeks ending 02/18/95		for two weeks ending 03/04/95		for two weeks ending 03/18/95	
Radionuclide	Gilcrest R-6	Ft. Collins R-3	Gilcrest R-6	Ft. Collins R-3	Gilcrest R-6	Ft. Collins R-3
Cs-134	<2.0	<1.9	<1.4	<2.0	<1.1	<1.3
Cs-137	<2.5	3.2(2.9)*	2.1(2.1)	3.3(2.8)	1.9(1.7)	3.9(1.8)
Zr-95	<4.7	<4.6	<3.3	<4.6	<2.7	<3.4
Nb-95	<1.8	<1.7	<1.3	<1.8	<1.2	<1.2
Ce-58	<2.1	<2.0	<1.3	<1.9	<1.1	<1.4
Mn-54	<2.0	<2.0	<1.4	<1.9	<1.1	<1.3
Zn-65	<5.4	<5.3	<3.8	<5.4	<3.5	<3.9
Fe-59	<4.7	<4.6	<3.7	<4.5	<2.8	<2.9
Co-60	<2.1	<2.0	<1.5	<2.1	<1.1	<1.2
Ba-140	<3.3	8.5(7.5)	<3.9	<3.1	<1.8	11(7.7)
La-140	<3.8	9.8(8.6)	<4.5	<3.6	<2.1	13(8.9)

* - 1.96σ (Due to counting statistics)

Table II.C.3 Radionuclide Concentrations in Bi-weekly Composite of Drinking Water. (pCi/L)

Collection Date	for two weeks ending 04/01/95		for two weeks ending 04/15/95		for two weeks ending 04/29/95	
Radionuclide	Gilcrest R-6	Ft. Collins R-3	Gilcrest R-6	Ft. Collins R-3	Gilcrest R-6	Ft. Collins R-3
Cs-134	< 2.0	< 1.5	< 2.0	< 1.4	< 1.2	< 2.0
Cs-137	< 2.5	2.2(2.2)*	< 2.5	3.9(1.9)	3.9(1.8)	3.2(2.9)
Zr-95	< 5.4	< 4.0	< 5.1	< 3.1	< 3.0	< 5.0
Nb-95	< 1.9	< 1.3	< 1.9	1.4(1.6)	< 1.2	< 1.8
Co-58	< 2.1	< 1.4	< 1.8	< 1.2	< 1.2	2.4(2.4)
Mn-54	2.5(2.5)	< 1.5	< 2.0	< 1.3	< 1.3	< 2.0
Zn-65	< 5.4	< 4.2	< 5.6	< 4.0	< 3.9	< 5.4
Fe-59	< 4.8	< 3.5	< 4.8	< 3.0	< 3.3	< 4.7
Co-60	< 2.2	< 1.6	2.4(2.5)	< 1.3	< 1.2	< 2.1
Ba-140	< 3.3	< 2.5	< 5.2	< 3.4	< 3.2	5.6(6.1)
La-140	< 3.8	< 2.9	< 6.0	< 3.9	< 3.7	6.5(7.0)

* - 1.96σ (Due to counting statistics)

Table II.C.3 Radionuclide Concentrations in Bi-weekly Composite of Drinking Water. (pCi/L)

Collection Date	for two weeks ending 05/13/95		for two weeks ending 05/27/95		for two weeks ending 06/10/95	
Radionuclide	Gilcrest R-6	Ft. Collins R-3	Gilcrest R-6	Ft. Collins R-3	Gilcrest R-6	Ft. Collins R-3
Cs-134	<2.0	<0.81	<2.0	<1.9	<2.0	<2.0
Cs-137	<2.4	1.2(1.2)*	<2.5	<2.3	<2.5	<2.4
Zr-95	<4.6	<1.7	<4.7	<4.3	<4.8	<4.6
Nb-95	<1.8	<0.77	<1.8	<1.6	<1.8	<1.8
Co-58	<2.1	<0.89	<1.9	<1.7	<2.0	<1.8
Mn-54	<2.0	<0.79	<2.1	<1.9	<2.0	<2.0
Zn-65	<5.3	<2.2	<5.5	<4.9	<5.5	<5.4
Fe-59	<4.6	2.8(3.2)	<4.7	<5.0	<5.5	<4.9
Co-60	<2.1	<0.77	<2.2	<2.0	<2.2	<2.2
Ba-140	<3.2	4.0(4.7)	<6.9	<5.1	<3.3	<3.2
La-140	<3.7	4.6(5.4)	<8.0	<5.9	<3.8	<3.7

* - 1.96σ (Due to counting statistics)

Table II.C.3 Radionuclide Concentrations in Bi-weekly Composite of Drinking Water. (pCi/L)

Collection Date	for two weeks ending 06/24/95		for two weeks ending 07/08/95		for two weeks ending 07/22/95	
Radionuclide	Gilcrest R-6	Ft. Collins R-3	Gilcrest R-6	Ft. Collins R-3	Gilcrest R-6	Ft. Collins R-3
Cs-134	< 2.1	< 2.2	< 1.1	< 2.3	< 1.2	< 1.8
Cs-137	< 2.5	< 2.7	< 1.3	3.6(3.2)*	2.2(1.8)	< 2.2
Zr-95	< 4.8	< 5.2	< 2.6	< 5.2	< 2.9	< 4.2
Nb-95	< 1.9	< 2.0	< 0.98	< 2.0	< 1.1	< 1.6
Co-58	< 1.9	< 2.1	< 1.0	< 2.1	< 1.2	< 1.8
Mn-54	< 2.1	< 2.2	< 1.1	< 2.3	1.3(1.5)	< 1.8
Zn-65	< 5.5	< 6.0	< 3.0	< 6.2	< 3.3	< 4.8
Fe-59	< 4.7	< 5.0	< 2.5	< 5.3	< 3.4	< 4.2
Co-60	< 2.2	< 2.4	< 1.2	< 2.5	< 1.3	< 1.9
Ba-140	< 5.3	5.4(6.3)	< 3.0	< 3.7	< 2.0	< 2.9
La-140	< 6.2	6.3(7.2)	< 3.4	< 4.2	< 2.3	< 3.3

* - 1.96σ (Due to counting statistics)

Table II.C.3 Radionuclide Concentrations in Bi-weekly Composite of Drinking Water. (pCi/L)

Collection Date	for two weeks ending 07/29/95		for two weeks ending 08/12/95		for two weeks ending 08/26/95	
Radionuclide	Gilcrest R-6	Ft. Collins R-3	Gilcrest R-6	Ft. Collins R-3	Gilcrest R-6	Ft. Collins R-3
Cs-134	<2.0	<2.1	<2.1	1.8(1.4)*	<1.2	<2.2
Cs-137	3.2(2.9)	<2.5	<2.5	<1.4	2.9(1.8)	<2.7
Zr-95	<5.1	<4.8	<4.7	<2.7	<2.9	<5.1
Nb-95	<1.8	<1.9	<1.8	<1.0	<1.1	<2.0
Co-58	<1.9	<1.9	<1.8	<1.2	<1.1	<2.1
Mn-54	<2.0	2.2(2.4)	2.6(2.4)	<1.2	<1.3	<2.2
Zn-65	<5.5	<5.7	<5.6	<3.1	<3.3	<5.8
Fe-59	<4.7	<4.7	<4.6	<2.7	<2.9	<5.1
Co-60	<2.1	<2.2	<2.2	<1.2	<1.3	<2.3
Ba-140	<3.2	<3.3	<7.2	<1.9	<2.0	<3.5
La-140	<3.7	<3.8	<8.3	<2.2	<2.3	<4.1

* - 1.96σ (Due to counting statistics)

Table II.C.3 Radionuclide Concentrations in Bi-weekly Composite of Drinking Water. (pCi/L)

Collection Date	for two weeks ending 09/09/95		for two weeks ending 09/23/95		for two weeks ending 10/07/95	
Radionuclide	Gilcrest R-6	Ft. Collins R-3	Gilcrest R-6	Ft. Collins R-3	Gilcrest R-6	Ft. Collins R-3
Cs-134	< 2.1	< 2.1	< 1.6	< 2.1	< 1.3	< 1.2
Cs-137	< 2.6	< 2.6	2.2(2.3)*	< 2.6	3.1(1.8)	3.4(1.8)
Zr-95	< 5.6	< 4.9	< 3.7	< 4.9	< 2.7	< 3.3
Nb-95	< 1.9	< 1.9	< 1.4	< 1.9	1.9(1.7)	1.8(1.7)
Co-58	< 2.2	< 2.1	< 1.5	< 2.0	< 1.1	< 1.1
Mn-54	< 2.1	< 2.1	< 1.6	< 2.1	< 1.3	< 1.3
Zn-65	< 5.9	< 5.7	< 4.4	< 6.0	< 3.4	< 3.4
Fe-59	< 4.9	< 4.9	< 3.7	< 5.0	8.8(4.8)	< 3.0
Co-60	< 2.2	< 2.2	1.9(2.0)	< 2.3	< 1.2	< 1.1
Ba-140	< 3.4	7.7(8.1)	< 2.5	< 4.6	< 1.9	< 2.0
La-140	< 3.9	8.8(9.3)	< 2.9	< 5.3	< 2.2	< 2.3

* - 1.96σ (Due to counting statistics)

Table II.C.3 Radionuclide Concentrations in Bi-weekly Composite of Drinking Water. (pCi/L)

Collection Date	for two weeks ending 10/21/95		for two weeks ending 11/04/95		for two weeks ending 11/18/95	
Radionuclide	Gilcrest R-6	Ft. Collins R-3	Gilcrest R-6	Ft. Collins R-3	Gilcrest R-6	Ft. Collins R-3
Cs-134	1.2(1.2)*	1.2(1.2)	1.4(1.7)	1.5(1.5)	0.98(1.0)	< 1.4
Cs-137	< 3.8	2.1(1.8)	3.7(2.1)	1.8(1.9)	2.9(1.2)	3.8(2.0)
Zr-95	< 3.5	< 3.3	< 3.4	< 2.9	< 1.8	< 3.1
Nb-95	< 1.8	< 1.6	< 1.6	< 1.3	2.3(1.2)	1.6(1.9)
Co-58	< 1.8	< 1.6	< 1.4	< 1.2	< 0.75	< 1.3
Mn-54	< 1.1	< 1.4	< 1.5	< 1.3	< 0.84	1.9(1.7)
Zn-65	< 3.9	< 4.2	< 5.0	< 3.3	< 2.5	< 4.0
Fe-59	< 3.5	< 3.8	< 3.9	< 3.4	4.3(3.2)	< 3.2
Co-60	< 1.3	< 1.4	< 1.3	< 1.2	< 0.77	< 1.3
Ba-140	< 2.2	< 2.6	< 2.4	< 3.0	< 3.5	< 5.4
La-140	< 2.9	< 2.9	< 2.8	< 3.5	< 4.0	< 6.2

* - 1.96σ (Due to counting statistics)

Table II.C.3 Radionuclide Concentrations in Bi-weekly Composite of Drinking Water. (pCi/L)

Collection Date	for two weeks ending 12/02/95		for two weeks ending 12/16/95		for two weeks ending 12/30/95	
Radionuclide	Gilcrest R-6	Ft. Collins R-3	Gilcrest R-6	Ft. Collins R-3	Gilcrest R-6	Ft. Collins R-3
Cs-134	< 1.4	< 1.4	< 0.98	< 1.2	< 1.2	< 1.4
Cs-137	3.0(2.0)*	2.2(2.1)	1.2(1.5)	1.5(1.8)	1.4(1.5)	2.0(2.1)
Zr-95	< 3.0	< 3.2	< 2.8	< 2.6	< 2.8	< 3.6
Nb-95	2.3(1.7)	2.5(1.6)	< 0.94	< 1.4	< 1.2	< 1.7
Co-58	< 1.3	< 1.2	< 0.88	< 1.1	< 1.1	< 1.3
Mn-54	< 1.3	1.9(1.7)	< 1.0	1.4(1.5)	< 1.6	< 1.4
Zn-65	< 3.9	< 3.9	< 3.0	< 3.9	< 3.2	< 4.6
Fe-59	< 3.7	4.6(4.5)	3.6(4.0)	< 3.0	< 3.4	4.7(5.0)
Co-60	< 1.4	< 1.3	< 0.95	< 1.1	< 1.4	< 1.4
Ba-140	< 2.3	< 2.2	< 5.9	< 4.9	< 4.2	< 2.4
La-140	< 2.6	< 2.5	< 6.7	< 5.6	< 5.0	< 2.7

* - 1.96σ (Due to counting statistics)

2. Surface Water

Surface water is collected from five sites. Since the facility liquid effluent can be directed to either the St. Vrain Creek or the South Platte River, there are upstream and downstream sampling locations on both river courses.

Table II.C.4 shows tritium concentrations measured during 1995 at the four surface water sites and the effluent route site. The arithmetic mean value for the two downstream locations in 1995 was not significantly different from the two upstream locations (Table II.H.2). There were only detectable tritium concentration at A-25, which is the principal effluent route. This can be noted in January, February, July, and October.

Table II.C.5 shows measurements of fission product and activation product concentrations in surface water samples collected monthly. There were occasional positive values, but the mean of the downstream sites was not significantly different from the mean of the upstream sites during 1995 for any of the gamma-ray emitting radionuclides measured. This has been the case since the inception of reactor operations at the Fort St. Vrain site. The occasional positive values are either fallout Cs-137, which can be expected, or values close to the uncertainty limits and assumed to be false positives. Using a 95% confidence interval, 5% of the values are expected to be high false positives.

In addition to the monthly sampling of the South Platte River and St. Vrain Creek, a continuous water sampler collects an aliquot of the effluent stream from the Farm Pond (A-25), at a preset frequency. The sample is dumped after each aliquot into a 5 gallon collection jug. To prevent overflow of the jug in the one week sampling period, the aliquot value and/or the sampling frequency is adjusted. The weekly composites are then combined and analyzed monthly. The results of these samples are shown in Tables II.C.4 and II.C.5.

Periodically throughout the year there was detectable tritium in the Farm Pond overflow (A-25) due to decommissioning activities. These concentrations correspond to the effluent release data. These concentrations were much lower than the EPA drinking water limit (20,000 pCi/L). No elevated tritium concentrations were detected, however, at the downstream location (R-10) during the entire year.

Mean values of the other radionuclides were less than MDC with the exception of Cs-137. The Cs-137 mean in downstream water was not statistically higher than upstream and therefore the activity is concluded to be due to worldwide fallout. The correlation of the tritium concentrations at A-25 with the effluent release information is good.

Table II.C.4 Tritium in Surface Water (pCi/L)

Collected Date	Downstream		Upstream		Effluent
	St. Vrain F-20	S. Platte R-10	St. Vrain A-21	S. Platte F-19	Goosequill A-25
01/14	< 520	< 400	< 520	< 520	530(460)*
02/11	< 380	< 380	< 380	< 380	1700(480)
03/11	< 380	< 380	< 380	< 380	< 390
04/08	< 390	< 390	< 390	< 390	< 390
05/12	< 380	< 380	< 380	< 380	< 380
06/09	< 370	< 370	< 370	< 370	< 370
07/14	< 370	< 370	< 370	< 370	860(450)
08/11	< 370	< 370	< 370	< 370	< 370
09/09	< 370	< 370	< 370	< 370	< 370
10/14	< 370	< 370	< 370	< 370	1700(410)
11/11	< 370	< 370	< 370	< 370	< 380
12/09	< 380	< 380	< 380	< 380	< 380

* - 1.96σ (Due to counting statistics)

Table II.C.5 Radionuclide Concentrations In Surface Water (pCi/L)

Collection Date: January 14, 1995**

Radionuclide	Downstream Sites		Upstream Sites		Effluent
	St. Vrain F-20	S. Platte R-10	St. Vrain A-21	S. Platte F-19	Goosequill A-25
Cs-134	<2.0	1.1(1.3)*	<2.0	<2.2	<2.5
Cs-137	<2.5	4.4(1.6)	<2.4	<2.7	<4.1
Zr-95	<5.3	<2.3	<5.3	<5.6	<5.0
Nb-95	<1.9	<1.0	<1.8	<2.0	<2.6
Co-58	<2.0	<0.97	<1.8	<2.0	<2.2
Mn-54	<2.1	<1.1	<2.0	<2.2	<2.1
Zn-65	<5.5	<3.3	<5.5	<6.3	<4.4
Fe-59	5.8(6.7)	<2.5	<4.6	<5.6	<5.5
Co-60	<2.2	<1.0	<2.2	<2.3	<2.0
Ba-140	<5.9	<1.8	<3.3	<3.5	<3.8
La-140	<6.8	<2.0	<3.8	<4.0	<3.6

* - 1.96σ (Due to counting statistics)
** - A-25 collected January 15, 1995

Table II.C.5 Radionuclide Concentrations In Surface Water (pCi/L)

Collection Date: February 11, 1995**

Radionuclide	Downstream Sites		Upstream Sites		Effluent
	St. Vrain F-20	S. Platte R-10	St. Vrain A-21	S. Platte F-19	Goosequill A-25
Cs-134	< 2.0	2.9(2.9)*	< 2.4	< 2.0	< 1.9
Cs-137	< 2.4	< 3.0	< 3.0	3.4(2.9)	3.9(2.7)
Zr-95	< 5.1	< 5.7	< 5.7	< 5.1	< 4.3
Nb-95	< 1.8	< 2.1	< 2.3	< 1.7	< 1.7
Co-58	< 1.8	< 2.2	< 2.4	< 2.0	< 1.7
Mn-54	< 2.0	< 2.4	< 2.4	< 2.0	< 1.9
Zn-65	< 5.4	< 6.7	< 7.5	< 5.4	< 4.9
Fe-59	< 4.6	< 5.6	< 5.6	< 4.7	< 5.4
Co-60	< 2.0	< 2.7	< 2.7	< 2.1	< 2.0
Ba-140	< 3.1	< 4.0	< 3.9	< 6.0	< 3.0
La-140	< 3.6	< 4.6	< 4.5	< 6.9	< 3.4

* - 1.96σ (Due to counting statistics)
** - A-25 collected February 15, 1995

Table II.C.5 Radionuclide Concentrations In Surface Water (pCi/L)

Collection Date: March 11, 1995**

Radionuclide	Downstream Sites		Upstream Sites		Effluent
	St. Vrain F-20	S. Platte R-10	St. Vrain A-21	S. Platte F-19	Goosequill A-25
Cs-134	< 1.5	< 1.2	< 2.1	< 2.2	< 1.9
Cs-137	3.5(2.2)*	5.6(2.0)	5.2(3.0)	3.7(3.2)	3.5(2.7)
Zr-95	< 4.1	< 2.7	< 4.8	< 5.2	< 4.3
Nb-95	< 1.4	< 1.2	< 1.9	< 2.0	< 1.7
Co-58	< 1.6	< 1.1	< 1.9	< 2.2	< 1.7
Mn-54	1.6(1.9)	< 1.2	< 2.1	< 2.3	< 1.9
Zn-65	< 4.1	< 3.7	< 5.8	< 5.8	< 5.1
Fe-59	< 3.5	< 3.1	< 4.7	< 5.3	< 4.3
Co-60	< 1.6	< 1.2	< 2.2	< 2.3	< 2.0
Ba-140	< 5.2	< 2.0	< 3.3	< 6.2	< 3.0
La-140	< 6.0	< 2.3	< 3.8	< 7.1	< 3.5

* - 1.96σ (Due to counting statistics)
** - A-25 collected March 15, 1995

Table II.C.5 Radionuclide Concentrations In Surface Water (pCi/L)

Collection Date: April 8, 1995**

Radionuclide	Downstream Sites		Upstream Sites		Effluent
	St. Vrain F-20	S. Platte R-10	St. Vrain A-21	S. Platte F-19	Goosequill A-25
Cs-134	< 1.2	< 1.3	< 2.0	< 1.4	< 0.81
Cs-137	2.3(1.9)*	1.7(1.8)	< 2.4	4.2(2.0)	1.4(1.2)
Zr-95	< 3.1	< 2.6	< 5.3	< 3.0	< 2.2
Nb-95	< 1.3	< 1.2	< 1.8	< 1.4	< 0.75
Co-58	< 1.2	< 1.2	< 1.8	< 1.3	< 0.74
Mn-54	< 1.3	1.8(1.4)	< 2.0	< 1.4	< 0.82
Zn-65	< 3.5	< 3.6	< 5.4	< 5.4	< 2.2
Fe-59	< 3.3	< 2.9	< 4.7	< 3.3	3.3(3.4)
Co-60	< 1.2	< 1.1	< 2.2	< 1.3	< 0.73
Ba-140	< 3.4	< 1.9	< 3.3	3.4(3.2)	< 4.7
La-140	< 4.0	< 2.2	< 3.8	3.9(3.6)	< 5.4

* - 1.96σ (Due to counting statistics)
** - A-25 collected April 15, 1995

Table II.C.5 Radionuclide Concentrations In Surface Water (pCi/L)

Collection Date: May 12, 1995**

Radionuclide	Downstream Sites		Upstream Sites		Effluent
	St. Vrain F-20	S. Platte R-10	St. Vrain A-21	S. Platte F-19	Goosequill A-25
Cs-134	< 0.60	< 1.2	< 2.1	< 1.3	< 1.2
Cs-137	2.2(0.91)*	3.3(1.7)	< 2.5	2.9(1.9)	2.7(1.7)
Zr-95	< 1.5	< 2.7	< 4.9	< 3.1	< 2.9
Nb-95	< 0.58	< 1.2	< 1.8	< 1.3	1.1
Co-58	< 0.64	< 1.1	< 2.3	< 1.3	< 1.3
Mn-54	0.71(0.74)	< 1.3	< 2.2	< 1.3	2.0(1.5)
Zn-65	< 1.7	< 3.8	< 5.4	< 3.8	< 3.7
Fe-59	< 1.8	< 3.5	< 6.2	< 3.5	< 3.6
Co-60	< 0.57	< 1.2	< 2.2	< 1.2	< 1.1
Ba-140	< 2.1	< 3.8	< 9.3	< 2.1	< 1.9
La-140	< 2.4	< 4.3	< 11	< 2.4	< 2.2

* - 1.96σ (Due to counting statistics)

** - A-25 collected May 15, 1995

Table II.C.5 Radionuclide Concentrations In Surface Water (pCi/L)

Collection Date: June 9, 1995**

Radionuclide	Downstream Sites		Upstream Sites		Effluent
	St. Vrain F-20	S. Platte R-10	St. Vrain A-21	S. Platte F-19	Goosequill A-25
Cs-134	< 1.3	< 2.3	< 2.0	< 1.2	< 1.3
Cs-137	2.0(1.9)*	< 2.8	< 2.5	2.0(1.8)	3.7(1.9)
Zr-95	< 2.8	< 5.8	< 4.7	< 2.9	< 2.9
Nb-95	< 1.3	< 2.1	< 1.8	< 1.2	< 1.3
Co-58	< 1.3	< 2.1	< 1.8	< 1.3	< 1.4
Mn-54	1.8(1.6)	< 2.3	< 2.0	< 1.2	< 1.3
Zn-65	< 3.4	< 6.1	< 5.3	< 3.4	< 3.4
Fe-59	3.8(4.3)	< 6.0	< 4.7	< 2.9	< 3.2
Co-60	< 1.2	< 2.4	< 2.2	< 1.2	< 1.2
Ba-140	< 3.9	< 3.7	< 3.3	< 2.0	< 6.1
La-140	< 4.5	< 4.3	< 3.8	< 2.4	< 7.0

* - 1.96σ (Due to counting statistics)

** - A-25 collected June 15, 1995

Table II.C.5 Radionuclide Concentrations In Surface Water (pCi/L)

Collection Date: July 14, 1995**

Radionuclide	Downstream Sites		Upstream Sites		Effluent
	St. Vrain F-20	S. Platte R-10	St. Vrain A-21	S. Platte F-19	Goosequill A-25
Cs-134	< 1.1	< 2.2	< 2.0	< 2.0	< 2.5
Cs-137	2.6(1.7)*	< 2.7	3.6 (2.9)	< 2.4	3.9 (3.5)
Zr-95	< 2.6	< 5.1	< 4.8	< 4.7	< 5.7
Nb-95	< 1.1	< 1.9	< 1.8	< 1.8	< 2.2
Co-58	< 1.1	< 2.2	< 2.1	< 2.0	< 2.3
Mn-54	< 1.2	< 2.2	2.6 (2.4)	< 2.0	< 2.5
Zn-65	< 3.2	< 5.8	< 5.5	< 5.3	< 6.7
Fe-59	< 3.3	< 5.9	7.6 (6.6)	< 4.7	< 5.5
Co-60	< 1.1	< 2.5	< 2.2	< 2.1	< 2.7
Ba-140	< 3.3	< 3.6	< 3.3	< 3.2	< 9.2
La-140	< 3.7	< 4.1	< 3.8	< 3.7	< 11

* - 1.96σ (Due to counting statistics)

** - A-25 collected July 15, 1995

Table II.C.5 Radionuclide Concentrations In Surface Water (pCi/L)

Collection Date: August 11, 1995**

Radionuclide	Downstream Sites		Upstream Sites		Effluent
	St. Vrain F-20	S. Platte R-10	St. Vrain A-21	S. Platte F-19	Goosequill A-25
Cs-134	< 2.2	< 1.2	1.3 (1.6)*	< 1.3	< 2.0
Cs-137	< 2.7	3.0 (1.8)	2.8 (1.9)	3.6 (1.9)	< 2.5
Zr-95	< 5.1	< 2.7	< 2.9	< 2.9	6.4 (6.6)
Nb-95	< 2.0	< 1.2	< 1.2	< 1.3	< 1.9
Co-58	< 2.3	1.4 (1.3)	< 1.1	< 1.3	< 1.8
Mn-54	2.6 (2.7)	1.3 (1.4)	< 1.3	< 1.3	< 2.0
Zn-65	< 5.8	< 3.5	< 3.1	< 3.3	< 5.5
Fe-59	< 6.3	< 3.0	< 3.9	< 3.6	< 5.8
Co-60	< 2.3	< 1.2	< 1.2	< 1.3	< 2.3
Ba-140	< 3.6	< 1.9	< 4.2	< 4.0	< 3.3
La-140	< 4.1	< 2.2	< 4.8	< 4.6	< 3.8

* - 1.96s (Due to counting statistics)

** - A-25 collected August 15, 1995

Table II.C.5 Radionuclide Concentrations In Surface Water (pCi/L)

Collection Date: September 9, 1995**

Radionuclide	Downstream Sites		Upstream Sites		Effluent
	St. Vrain F-20	S. Platte R-10	St. Vrain A-21	S. Platte F-19	Goosequill A-25
Cs-134	< 1.2	< 2.0	< 1.3	< 2.0	< 2.0
Cs-137	2.3 (1.8)*	< 2.5	< 1.7	< 2.5	4.1 (2.9)
Zr-95	< 2.7	< 5.2	< 2.9	< 4.8	< 4.6
Nb-95	< 1.1	< 1.9	< 1.4	< 1.8	< 2.1
Co-58	< 1.1	< 1.9	< 1.3	< 1.9	< 1.8
Mn-54	< 1.2	< 2.1	< 1.3	< 2.0	< 1.9
Zn-65	< 3.0	< 5.5	< 3.2	< 5.3	< 5.3
Fe-59	< 2.9	< 4.7	< 3.0	< 4.7	< 4.6
Co-60	< 1.1	< 2.2	< 1.2	< 2.2	< 2.1
Ba-140	< 3.3	< 3.3	< 2.1	8.3 (6.7)	< 3.1
La-140	< 3.8	< 3.8	< 2.4	9.6 (7.7)	< 3.6

* - 1.96σ (Due to counting statistics)

** - A-25 collected September 15, 1995

Table II.C.5 Radionuclide Concentrations In Surface Water (pCi/L)

Collection Date: October 14, 1995**

Radionuclide	Downstream Sites		Upstream Sites		Effluent
	St. Vrain F-20	S. Platte R-10	St. Vrain A-21	S. Platte F-19	Goosequill A-25
Cs-134	< 1.1	< 1.2	< 1.2	< 1.2	< 1.1
Cs-137	< 1.4	2.1(1.7)*	2.2(1.8)	2.9(1.9)	1.5(1.7)
Zr-95	< 2.4	< 3.0	< 3.3	< 3.3	< 3.3
Nb-95	1.5(1.5)	2.3(1.5)	< 1.4	< 1.2	< 1.4
Co-58	< 1.2	< 1.1	< 1.1	< 1.1	< 1.4
Mn-54	1.2(1.4)	< 1.1	< 1.3	< 1.2	2.0(1.5)
Zn-65	< 3.0	< 3.1	< 2.9	< 3.6	< 3.1
Fe-59	< 3.6	< 2.8	< 4.1	< 3.9	< 2.8
Co-60	< 1.1	< 1.2	< 1.2	< 1.1	< 1.1
Ba-140	6.9(6.3)	< 1.9	< 6.6	< 5.3	< 1.9
La-140	8.0(7.2)	< 2.2	< 7.6	< 6.1	< 2.2

* - 1.96σ (Due to counting statistics)
** - A-25 collected October 15, 1995

Table II.C.5 Radionuclide Concentrations In Surface Water (pCi/L)

Collection Date: November 11, 1995**

Radionuclide	Downstream Sites		Upstream Sites		Effluent
	St. Vrain F-20	S. Platte R-10	St. Vrain A-21	S. Platte F-19	Goosequill A-25
Cs-134	< 1.0	< 1.2	< 1.0	< 1.2	< 1.4
Cs-137	1.6(1.5)*	2.4(1.9)	3.3(1.5)	< 1.5	2.3(2.1)
Zr-95	< 2.3	< 2.7	< 2.3	< 3.1	< 3.8
Nb-95	< 0.99	< 1.5	< 1.2	2.1(1.7)	< 1.5
Co-58	< 1.1	< 1.3	< 1.1	< 1.3	< 1.6
Mn-54	< 1.0	1.4(1.5)	< 1.1	1.7(1.5)	< 1.5
Zn-65	< 3.1	< 3.5	< 2.9	< 3.3	< 4.7
Fe-59	< 2.5	< 3.9	< 3.3	< 3.9	5.6(5.5)
Co-60	< 1.0	< 1.2	< 0.95	< 1.1	< 1.3
Ba-140	< 1.6	< 2.0	< 5.2	< 2.0	< 2.4
La-140	< 1.9	< 2.3	< 6.0	< 2.3	< 2.7

* - 1.96σ (Due to counting statistics)

** - A-25 collected November 15, 1995

Table II.C.5 Radionuclide Concentrations In Surface Water (pCi/L)

Collection Date: December 9, 1995**

Radionuclide	Downstream Sites		Upstream Sites		Effluent
	St. Vrain F-20	S. Platte R-10	St. Vrain A-21	S. Platte F-19	Goosequill A-25
Cs-134	< 0.59	< 0.46	< 1.2	< 1.1	< 1.3
Cs-137	4.7(0.88)*	1.7(0.68)	2.9(1.7)	4.6(1.8)	5.1(1.9)
Zr-95	< 1.3	< 1.0	< 2.7	< 2.5	< 2.8
Nb-95	2.1(0.91)	0.52(0.62)	2.0(1.8)	< 1.4	2.0(1.9)
Co-58	< 0.54	< 0.42	< 1.1	< 1.0	< 1.2
Mn-54	< 0.62	< 0.46	< 1.2	< 1.1	< 1.3
Zn-65	< 2.1	< 1.4	< 3.8	< 3.7	< 4.4
Fe-59	< 1.9	2.3(1.6)	4.4(4.9)	3.4(4.2)	< 4.1
Co-60	< 0.56	< 0.43	< 1.1	< 1.1	< 1.2
Ba-140	< 2.8	< 0.73	< 1.9	< 5.1	< 5.9
La-140	< 3.2	< 0.84	< 2.2	< 5.8	< 6.8

* - 1.96σ (Due to counting statistics)
** - A-25 collected December 15, 1995

3. Ground Water

Ground water is sampled quarterly at two locations. These are at F-16, a well on the farm immediately north and the closest to the facility down the hydrological gradient, and at R-5, a well at a personal residence in the town of Milliken. Table II.C.6 lists the measured concentrations of fission products and activation products in ground water. The Cs-137 results are not surprising due to residue of Chernobyl fallout. The other occasional results above MDC are assumed to be statistically false positive values.

Table II.C.7 shows tritium concentrations in the same well water samples. No tritium concentrations above the MDC were observed. Figure II.C.1 shows measured tritium concentrations in the F-16 well from 1984 through 1995. We initiated a weekly sampling of this site beginning early in 1991 and have continued to date. The data for the weekly samples of the F-16 well for 1995 are shown in Table II.J.1 (see Summary section). Figure II.C.2 is a plot of this data for 1993, 1994 and 1995.

For comparison purposes we include Table II.C.8 which lists the Maximum Permissible Concentrations in drinking water from the old 10CFR20.

Table II.C.6 Radionuclide Concentrations in Ground Water (pCi/L)

Radio-nuclide	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter	
	F-16	R-5	F-16	R-5	F-16	R-5	F-16	R-5
Cs-134	2.6(2.7)*	< 1.9	< 1.5	1.8(1.4)	< 2.3	< 2.3	< 1.3	f
Cs-137	< 2.7	< 2.3	4.2(2.2)	3.1(1.6)	4.5(3.4)	9.6(3.4)	4.8(2.0)	f
Zr-95	< 5.1	< 5.2	< 3.6	< 2.6	< 5.5	< 5.3	< 2.8	f
Nb-95	< 1.9	< 1.7	< 1.3	< 1.0	< 2.4	< 2.8	< 1.7	f
Co-58	< 2.3	< 1.8	< 1.4	1.2(1.4)	< 2.1	< 2.1	< 1.2	f
Mn-54	< 2.2	< 1.9	< 1.5	< 1.1	< 2.3	< 2.4	2.2(1.6)	f
Zn-65	< 5.9	< 5.3	< 4.2	< 3.0	< 8.0	< 10	< 4.1	f
Fe-59	< 6.4	< 4.5	< 3.5	< 3.2	< 5.4	< 5.4	< 4.3	f
Co-60	< 2.4	2.4(2.5)	< 1.6	< 1.2	< 2.5	< 2.5	< 1.3	f
Ba-140	< 3.6	< 3.1	< 6.3	< 1.8	4.5(5.4)	< 4.0	< 2.2	f
La-140	< 4.1	< 3.6	< 7.2	< 2.1	5.2(6.2)	< 4.6	< 2.5	f

* - 1.96s (Due to counting statistics)
f - Sample unavailable (Well pump was frozen all quarter)

Table II.C.7 Tritium in Ground Water (pCi/L)

First Quarter 1995 Collected: February 11		Second Quarter 1995 Collected: May 12		Third Quarter 1995 Collected: August 11		Fourth Quarter 1995 Collected: November 11	
F-16	R-5	F-16	R-5	F-16	R-5	F-16	R-5
< 380	< 380	< 370	< 370	< 370	< 370	< 380	f

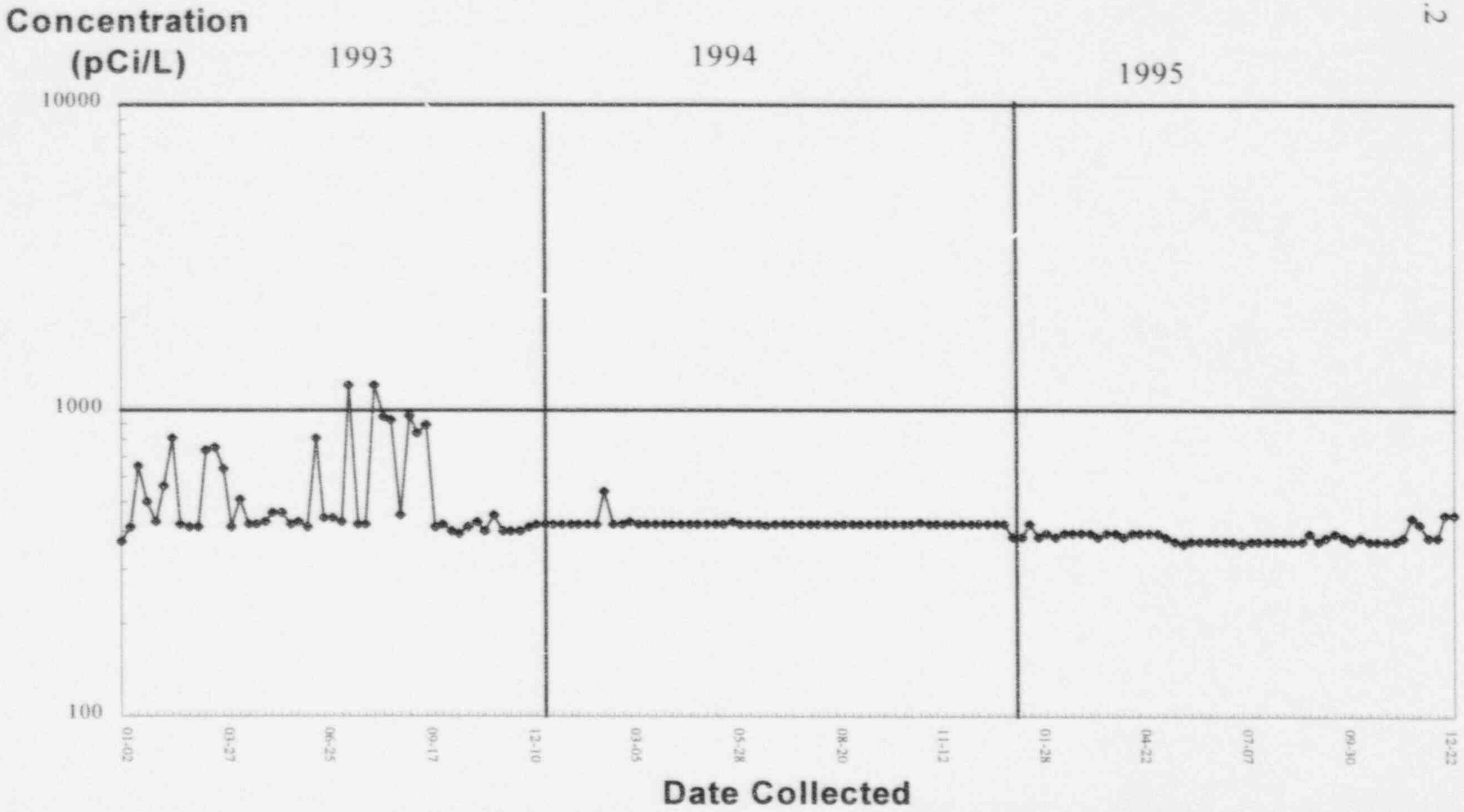
f - Sample Unavailable (Well pump frozen all quarter)

Table II.C.8

Maximum Permissible Concentrations in Drinking Water.
(10CFR20, Appendix B, Table II)

Radionuclide	Concentration(pCi/L)
H-3	3×10^6
I-131	3×10^2
Cs-134	9×10^3
Cs-137	2×10^4
Zr-95	6×10^4
Nb-95	1×10^5
Co-58	1×10^5
Mn-54	1×10^5
Zn-65	1×10^5
Fe-59	6×10^4
Co-60	5×10^4
Ba-140	3×10^4
La-140	2×10^4

Tritium Concentrations at F-16 Well Water



Tritium Concentration in F-16 Well Water
1984-1995

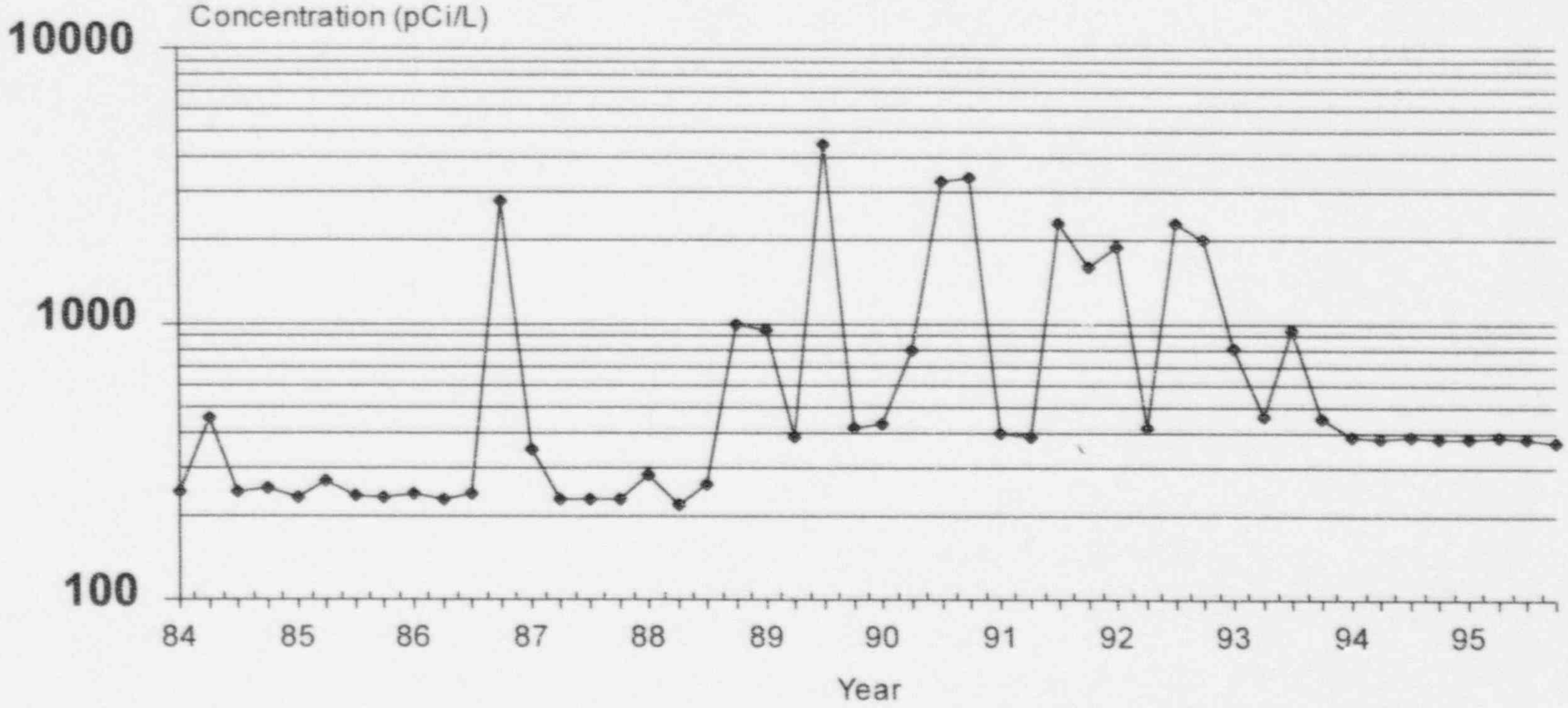


Figure II.C.1

II.D. Milk

The dairy food chain is the critical pathway for potential radiation dose commitment around any nuclear facility. This is true for both chronic and acute releases. The critical individual would be an infant consuming milk produced from cows grazing local pastures. Milk is the critical pathway for potential dose commitment to humans from environmental contamination of H-3 and Cs-137. For this reason milk is sampled extensively to document the presence or absence of radioactivity due to the decommissioning operation

There are no dairies (or personal milk cows) in the facility area which is within a 1.6 km radius from the facility. The five dairies in the adjacent area, 1.6-8 km radius, were selected as they are located in the highest X/Q areas. The description of these locations can be found in Table F-4 of the ODCM and Figure III.B.2. The single reference location dairy, R-8, is 22.5 km Northwest of the facility in the least predominant wind direction. Herd management practices are similar at all dairy locations. The cows in the milking herd are never on pasture but are under dry-lot management which is typical of the Western U.S.

Table II.D.1 lists the concentrations of all gamma-emitting radionuclides that are investigated in milk samples.

Natural-potassium, as measured by K-40, is extremely constant in milk. The mean literature value for cow milk is 1.5 g/L. K concentrations are homeostatically controlled and independent of K intake. K-natural is measured in all milk samples as a quality control measure for the other radionuclides determined in the same sample by gamma-ray spectrometry.

Table II.D.2 lists measured tritium concentrations in milk. Elevated tritium concentrations in milk due to facility effluents were not observed during the operational or defueling phase, or the decommissioning phase to date. During 1995, only two detectable concentrations were observed. These could easily be a false positive values since the mean of the 5 adjacent sites was not statistically greater than the reference site. This implies that any tritium from facility effluent is not contributing radiation dose to humans via the milk pathway. Tritium concentrations in milk should respond rapidly to changes in tritium concentrations of the forage water intake or drinking water intake to the cow. This is due to the short biological half-life for water in the cow (about three days for the lactating cow). As noted in previous reports, the reported tritium concentration in milk is the tritium in water extracted from the milk. Contamination of milk samples by any radionuclide due to facility effluents has never been observed during the operational, defueling or decommissioning phases of the Fort St. Vrain Station.

Table II.D.1 Radionuclide Concentrations in Milk (pCi/L)

Location	A-6	A-18	A-23	A-24	A-26	R-8
Collection Date	01/14		01/14	01/14	01/14	01/14
Cs-134	< 2.3	d	< 2.1	< 1.9	< 2.1	< 2.3
Cs-137	< 2.8	d	< 2.8	< 2.4	3.1(3.1)*	3.3(3.4)
Ba-140	< 4.3	d	< 3.4	< 4.3	< 3.3	< 4.0
La-140	< 4.9	d	< 4.0	< 4.9	< 3.9	< 4.6
Collection Date	02/11	02/11	02/11	02/11	02/11	02/11
Cs-134	< 2.2	< 2.1	< 2.1	< 2.0	< 2.1	< 2.1
Cs-137	5.3(3.1)	< 2.5	< 2.5	< 2.4	< 2.6	< 2.6
Ba-140	< 3.8	< 3.4	< 3.4	< 4.7	5.8(6.3)	< 4.3
La-140	< 4.4	< 3.9	< 3.9	< 5.4	6.6(7.3)	< 4.9

* - 1.96σ (Due to counting statistics)
d - Sample lost during analysis

Table II.D.1 Radionuclide Concentrations in Milk (pCi/L)

Location	A-6	A-18	A-23	A-26	A-28	R-8
Collection Date	03/11	03/11	03/11	03/11	03/11	03/11
Cs-134	< 1.3	< 1.5	< 2.0	< 1.0	< 2.4	2.5(2.5)*
Cs-137	7.7(2.4)	< 1.8	< 2.4	6.7(1.9)	3.0(3.4)	< 2.6
Ba-140	2.2(2.3)	< 2.9	< 4.6	< 1.9	< 4.6	< 3.4
La-140	2.5(2.7)	< 3.4	< 5.3	< 2.1	< 5.3	< 3.9
Collection Date	04/08	04/08	04/08	04/08	04/08	04/08
Cs-134	< 2.2	< 2.2	< 1.9	< 1.5	< 2.2	< 1.4
Cs-137	< 2.6	< 2.7	3.0(2.7)	< 1.9	4.7(3.1)	3.2(2.3)
Ba-140	< 3.4	< 4.5	< 4.2	< 3.4	< 5.5	< 2.0
La-140	< 4.0	< 5.2	< 4.8	< 3.9	< 6.4	< 2.2
Collection Date	05/12	05/12	05/12	05/12	05/12	05/12
Cs-134	< 1.5	< 1.5	< 0.76	< 2.1	< 1.4	< 1.2
Cs-137	4.6(2.6)	3.2(2.6)	3.0(1.4)	< 2.6	2.8(2.7)	< 1.5
Ba-140	< 2.1	< 2.1	< 1.1	< 3.4	< 3.6	< 2.0
La-140	< 2.4	< 2.4	< 1.3	< 3.9	< 4.2	< 2.3

* - 1.96σ (Due to counting statistics)

Table II.D.1 Radionuclide Concentrations in Milk (pCi/L)

Location	A-6	A-18	A-23	A-26	A-28	R-8
Collection Date	06/01	06/01	06/01	06/01	06/01	06/01
Cs-134	< 1.4	< 1.4	< 2.1	< 2.1	< 1.5	< 0.76
Cs-137	5.0(2.5)*	4.7(2.5)	< 2.6	3.1(3.0)	2.6(2.6)	3.2(1.4)
Ba-140	< 2.7	< 2.1	< 3.4	< 6.4	< 2.1	< 1.6
La-140	< 3.1	< 2.4	< 3.9	< 7.3	< 2.4	< 1.8
Collection Date	06/12	06/12	06/12	06/12	06/12	06/12
Cs-134	< 1.4	< 1.3	< 1.4	< 1.5	< 1.4	< 2.2
Cs-137	3.0(2.5)	4.4(2.3)	4.3(2.6)	4.2(2.6)	< 2.1	< 2.6
Ba-140	3.7(2.8)	< 2.0	< 3.5	< 2.3	< 2.6	< 4.0
La-140	4.2(3.3)	< 2.3	< 4.0	< 2.6	< 3.0	< 4.6
Collection Date	06/23	06/23	06/23	06/23	06/23	06/23
Cs-134	< 1.6	< 1.4	< 1.9	< 1.3	< 0.96	< 1.4
Cs-137	2.7(2.8)	3.5(2.5)	< 2.3	5.9(2.3)	1.4(1.4)	5.7(2.5)
Ba-140	< 2.2	< 2.6	< 3.1	< 2.7	< 1.5	3.8(3.0)
La-140	< 2.5	< 3.0	< 3.5	< 3.1	< 1.8	4.3(3.5)

* - 1.96σ (Due to counting statistics)

Table II.D.1 Radionuclide Concentrations in Milk (pCi/L)

Location	A-6	A-18	A-23	A-26	A-28	R-8
Collection Date	07/14	07/14	07/14	07/14	07/14	07/14
Cs-134	< 2.2	< 1.3	< 1.4	< 1.2	< 1.5	< 1.6
Cs-137	< 2.7	4.0(2.5)*	2.9(2.6)	3.6(2.1)	4.8(2.8)	< 2.4
Ba-140	< 4.1	< 2.0	< 2.1	< 2.3	< 3.8	< 2.6
La-140	< 4.8	< 2.4	< 2.4	< 2.7	< 4.4	< 3.0
Collection Date	07/28	07/28	07/28	07/28	07/28	07/28
Cs-134	< 1.5	< 1.5	< 2.2	< 1.4	< 1.0	< 2.5
Cs-137	4.2(2.7)	6.5(2.7)	4.5(3.2)	< 2.0	< 1.3	< 3.0
Ba-140	< 2.3	< 2.9	< 4.5	< 2.6	< 1.7	< 4.0
La-140	< 2.6	< 3.3	< 5.2	< 3.0	< 1.9	< 4.6
Collection Date	08/11	08/11	08/11	08/11	08/11	08/11
Cs-134	< 2.1	< 1.5	< 1.2	< 1.9	< 1.3	< 1.5
Cs-137	< 2.6	< 2.3	4.0(2.1)	< 2.4	5.2(2.3)	6.5(2.6)
Ba-140	< 3.4	3.2(3.5)	< 1.8	< 3.1	< 3.2	< 2.1
La-140	< 3.9	3.7(4.0)	< 2.0	< 3.6	< 3.6	< 2.4

* - 1.96σ (Due to counting statistics)

Table II.D.1 Radionuclide Concentrations in Milk (pCi/L)

Location	A-6	A-18	A-23	A-26	A-28	R-8
Collection Date	08/26	08/26	08/26	08/25	08/26	08/27
Cs-134	< 1.6	< 1.4	< 2.2	< 1.4	< 2.0	< 1.6
Cs-137	4.1(2.7)*	2.5(2.5)	4.1(3.1)	4.8(2.5)	< 2.4	3.7(2.7)
Ba-140	< 2.5	< 2.5	< 4.5	2.6(3.2)	< 3.2	< 2.3
La-140	< 2.8	< 2.8	< 5.1	3.0(3.6)	< 3.7	< 2.7
Collection Date	09/09	09/09	09/09	09/09	09/09	09/09
Cs-134	< 2.2	< 2.1	< 1.4	< 1.2	< 0.76	< 1.3
Cs-137	< 2.6	< 2.5	2.9(2.5)	< 1.5	3.8(1.3)	3.8(2.3)
Ba-140	< 4.3	< 4.4	< 2.0	< 2.7	< 1.1	< 1.9
La-140	< 4.9	< 5.0	< 2.3	< 3.1	< 1.2	< 2.2
Collection Date	09/23	09/23	09/23	09/23	09/23	09/23
Cs-134	< 2.1	< 1.5	< 1.4	< 1.3	< 1.1	< 2.1
Cs-13	< 2.5	2.2(2.6)	4.3(2.5)	2.7(2.3)	3.9(2.0)	< 2.5
Ba-140	< 3.3	< 2.5	< 2.0	< 2.4	< 1.6	< 3.3
La-140	< 3.8	< 2.8	< 2.4	< 2.8	< 1.8	< 3.8

* - 1.96σ (Due to counting statistics)

Table II.D.1 Radionuclide Concentrations in Milk (pCi/L)

Location	A-6	A-18	A-23	A-26	A-28	R-8
Collection Date	10/14	10/14	10/14	10/14	10/14	10/14
Cs-134	< 1.5	< 1.6	< 1.4	< 1.5	< 1.1	< 0.66
Cs-137	2.3(2.7)*	2.3(2.8)	2.5(2.5)	2.8(2.6)	1.7(2.0)	1.9(1.2)
Ba-140	< 2.6	< 2.3	< 3.7	< 2.1	< 1.9	< 0.96
La-140	< 3.0	< 2.6	< 4.3	< 2.4	< 2.2	< 1.1
Collection Date	11/11	11/11	11/11	11/11	11/11	11/11
Cs-134	< 1.6	< 0.65	< 1.5	< 1.6	< 1.5	< 1.6
Cs-137	2.5(2.7)	2.8(1.2)	2.8(2.6)	3.2(3.0)	2.7(2.6)	2.9(2.8)
Ba-140	< 2.3	< 0.95	6.0(5.8)	< 4.3	< 5.1	8.7(7.3)
La-140	< 2.7	< 1.1	6.9(6.7)	< 5.0	< 5.8	10(8.4)
Collection Date	12/09	12/09	12/09	12/09	12/09	12/09
Cs-134	< 1.7	< 1.6	< 1.6	< 1.6	< 1.4	1.0(1.2)
Cs-137	2.3(2.9)	3.6(2.9)	3.2(3.0)	3.1(2.9)	2.7(2.6)	2.6(1.8)
Ba-140	< 3.1	< 3.8	< 4.4	5.4(5.3)	5.3(4.9)	< 1.5
La-140	< 3.6	< 4.4	< 5.0	6.2(6.1)	6.1(5.6)	< 1.7

* - 1.96σ (Due to counting statistics)

Table II.D.2 Tritium in Milk (pCi/L)

Collection Dates	Adjacent						Reference
	A-6	A-18	A-23	A-24	A-26	A-28	R-8
01/14	< 390	< 390	< 390	< 390	< 390	--	< 390
02/11	< 380	< 380	< 380	< 380	520(460)*	--	< 380
03/11	< 390	< 390	< 390	f	< 390	< 390	< 390
04/08	< 380	< 380	< 380	f	1700(340)	< 380	540(320)
05/12	< 370	< 370	< 370	f	< 370	< 370	370(300)
05/26	< 370	< 370	< 370	f	< 370	< 370	< 370
06/12	< 370	< 370	< 370	f	< 370	< 370	< 370
06/23	< 370	< 370	< 370	f	< 370	< 370	< 370
07/14	< 370	< 370	< 370	f	< 370	< 370	< 370
07/28	< 370	< 370	< 370	f	< 370	< 370	< 370
08/11	< 370	< 370	< 370	f	< 370	< 370	< 370
08/26	< 380	< 380	< 380	f	< 380	< 380	< 380
09/09	< 370	< 370	< 370	f	< 370	< 370	< 370
09/23	< 370	< 370	< 370	f	< 370	< 370	< 370
10/14	< 380	< 380	< 380	f	< 380	< 380	< 380
11/11	< 390	< 390	< 390	f	< 390	< 390	< 390
12/09	< 430	< 430	< 430	f	< 430	< 430	< 430

* - 1.96σ Due to counting statistics

f - Sample Unavailable - In March Dairy A-24 shut down operations. Dairy A-28 was located to replace A-24.

II.E. Food Products

Food sampling locations were selected from areas possibly irrigated by surface water downstream of the FSV discharge point or by well water from the aquifer most likely to be contaminated by seepage from the farm pond. The locations of these food product collection sites are described in Table F-4 of the ODCM. One sample of each principal class of food products was collected from these locations. Locations and available produce often change due to owner needs, harvest time, harvest size, etc.

Each sample was homogenized, without drying, immediately after collection. The sample was then counted by gamma-ray spectroscopy. Table II.E.1 lists the date of collection and the results for the 1995 harvest. One food sample showed low but detectable Cs-137 from past Chernobyl world-wide fallout deposition. The gamma-ray spectra were scanned for other radionuclides, but only the naturally occurring radionuclides were observed, presumably due to surface soil deposits.

If Cs-137 was released due to decommissioning, the primary food chain to humans would be through pasture to dairy and beef cattle and to meat and milk. Therefore, in addition to extensive milk sampling, and since beef cattle graze near the effluent routes from the facility, these animals are routinely sampled, slaughtered, and muscle tissue is analyzed for the radionuclides suspected in the effluent. During operation of the reactor, for a significant period (1973-1983) animals were taken quarterly from the pasture and counted in the CSU Whole-Body Counter adapted for large animals. No I-131 or Cs-137 due to plant effluent was ever detected in this herd.

In 1992, one animal that grazed the pastures north of the facility, and also had drinking access to the Goosequill ditch, was slaughtered and the tissue analyzed. Tissues from this animal served as a control for others slaughtered after decommissioning was initiated.

In 1995, two animals were collected for comparison purposes. One animal was removed from pasture on 4/23/95 and another animal was removed 10/08/95. Tables II.E.2a and II.E.2b give the slaughter dates. Each carcass was aged, according to general practice for one week in a cooler. Ground meat samples representing the total carcass were mixed and ten random one-kilogram samples of ground beef were packed into one-Liter Marinelli beakers for gamma-ray spectrum analysis. Subsamples of each were taken for tritium analysis. The tritium activity was measured in the water vacuum distilled from each sample.

There is evidence of Cs-137 activity in both beef animals but no significant tritium activity. The mean of the Cs-137 activity concentration in the two animals was not statistically different than the control animal slaughtered in 1992.

Table II.E.1
Radionuclide Concentrations in Food Products (pCi/kg)
Collection Date: September 8, 1995

Location	Food Type	Cs-134	Cs-137
A-6	Peppers	< 4.7	< 5.3
A-6	Cantaloupe	< 5.2	< 5.9
A-27	Corn	< 9.1	< 10
A-27	Beets	< 6.4	< 7.3
A-27	Rhubarb	< 3.9	7.9(5.3)*
A-27	Tomatoes	< 5.0	< 5.7

* 1.96σ (Due to Counting Statistics.)

Table II.E.2(a) Radionuclide Concentrations in Beef Samples Collected on 4/25/95

Radionuclide concentrations in Beef			
Beef Sample #	K-nat mg/L	Cs-137 pCi/kg	H-3 pCi/L
1	1.0	12(7.5)*	650(310)
2	1.0	< 5.1	< 370
3	1.1	< 3.4	< 370
4	0.97	16(12)	< 370
5	1.0	< 6.9	< 370
6	0.98	11(12)	880(320)
7	1.1	< 6.7	< 370
8	1.0	< 9.6	< 370
9	1.1	9.2(6.1)	< 370
10	1.0	< 6.7	< 370
X(1.96σ)	1.0(0.10)	5.8(11)	< 370

* - 1.96σ (Due to Counting Statistics)

Note:

Cow slaughtered 4/25/95. Cow donated by Ben Houston. Animal grazed on pasture north of FSV, and had access to Goosequill Ditch.

Table II.E.2(b) Radionuclide Concentrations in Beef Samples Collected on 10/10/95

Radionuclide concentrations in Beef			
Beef Sample #	K-nat mg/L	Cs-137 pCi/kg	H-3 pCi/L
1	1.1	21(7.2)*	<410
2	1.3	12(7.7)	<410
3	0.95	9.0(4.0)	<410
4	1.3	7.8(7.1)	<410
5	1.2	4.8(5.7)	<410
6	1.1	6.2(6.0)	<410
7	0.73	7.2(7.2)	<410
8	0.98	<6.1	<410
9	0.82	8.9(7.6)	<410
10	0.99	11(4.9)	<410
X(1.96σ)	1.0(0.35)	9.9(9.7)	<410

* - 1.96σ (Due to Counting Statistics)

Note:

Cow slaughtered 4/25/95. Cow donated by Ben Houston. Animal grazed on pasture north of FSV, and had access to Goosequill Ditch.

II.F. Aquatic Pathways (Fish & Sediment)

Table II.F.1 shows radionuclide concentrations measured in fish samples collected at F-19, A-25 and R-10 on two dates in 1995. The fish were collected by shocking and netting and the composite sample was homogenized without cleaning and analyzed on a wet weight basis. Detectable Cs-137 activity concentrations were observed in upstream, downstream, and effluent fish during 1995. Co-60 was detectable in effluent fish during the first half only. The Co-60 activity can only be traced to the decommissioning efforts. The Cs-137 activity concentrations were approximately the same as observed during 1994. The Cs-137 activity is also attributed to decommissioning effluent.

Assuming ICRP-23 consumption of fish the Total Effective Dose Equivalent (TEDE) commitments for both Co-60 and Cs-137 to an adult would be:

Co-60:	9.5×10^{-3} mrem/year
Cs-137:	2.2×10^{-2} mrem/year
Total:	3.2×10^{-2} mrem/year

The above committed dose rate is negligible compared to the appropriate standards or to the naturally occurring background dose rate of approximately 350 mrem/year in the local environs.

Table II.F.2(a-b) shows the measured concentrations of both Cs-137 and Cs-134 in surface sediment collected at F-1, located at the intersection of the Goosequill and Jay Thomas ditches. There was measurable activity of both Cs-134 and Cs-137 due to the decommissioning effluent. The concentrations observed in 1995 were less than observed in previous years and, in no case, did the Cs-137 concentration exceed the NRC guideline of 15,000 pCi/kg (15 pCi/g). The cesium ions are bound nearly irreversibly by the clay mineral matrix in the sediment and not available for food-chain transport.

Table II.F.3 shows the radiocesium concentration in sediment at locations R-10, the downstream location. At this site, no Cs-134 or Cs-137 was detected.. Therefore, it can be concluded that Cs-137 due to decommissioning work did not reach this downstream location.

Table II.F.1 Radionuclide Concentrations in Fish (pCi/kg)

Collection Date	April 4, 1995			October 5, 1995		
Radionuclide	Upstream F-19	Effluent A-25	Downstream R-10	Upstream F-19	Effluent A-25	Downstream R-10
Cs-134	< 3.0	< 1.9	< 5.3	< 2.6	< 4.0	< 3.9
Cs-137	7.9(4.2)*	16(2.9)	< 5.9	16(3.9)	14(3.6)	18(5.4)
Co-58	< 2.7	< 1.8	< 4.7	< 2.4	< 4.1	< 3.3
Mn-54	< 2.8	< 2.0	< 5.2	8.1(3.4)	< 5.5	< 4.1
Zn-65	< 8.6	< 5.2	< 15	< 11	< 10	< 14
Fe-59	< 7.9	6.2(6.5)	< 14	< 8.4	< 9.2	< 12
Co-60	< 3.4	7.2(2.7)	< 6.1	< 2.8	< 2.4	< 4.1

* 1.96σ (Due to Counting Statistics.)

Table II.F.2a Radiocesium Concentrations in Sediment from Location F-1

Radionuclide	Concentration (pCi/kg)
Collection Date: January 14, 1995	
Cs-134	< 22
Cs-137	170(35)*
Collection Date: February 11, 1995	
Cs-134	31(29)
Cs-137	210(38)
Collection Date: March 11, 1995	
Cs-134	< 25
Cs-137	97(31)
Collection Date: April 8, 1995	
Cs-134	38(38)
Cs-137	260(46)
Collection Date: May 12, 1995	
Cs-134	< 25
Cs-137	84(29)
Collection Date: June 9, 1995	
Cs-134	< 22
Cs-137	74(29)
Collection Date: July 14, 1995	
Cs-134	77(43)
Cs-137	120(71)
Collection Date: August 11, 1995	
Cs-134	< 25
Cs-137	130(35)

* - 1.96σ Due to Counting Statistics

Table II.F.2b Radiocesium Concentrations in Sediment from Location F-1

Radionuclide	Concentration (pCi/kg)
Collection Date: September 9, 1995	
Cs-134	< 38
Cs-137	< 41
Collection Date: October 14, 1995	
Cs-134	< 11
Cs-137	27(24)*
Collection Date: November 11, 1995	
Cs-134	< 25
Cs-137	27(29)
Collection Date: December 2, 1995	
Cs-134	< 13
Cs-137	120(36)

* - 1.96σ Due to Counting Statistics

Table II.F.3 Radiocesium Concentrations in Sediment from Location R-10

Radionuclide	Concentration (pCi/kg)
Collection Date: May 12, 1995	
Cs-134	< 29
Cs-137	< 29
Collection Date: September 9, 1995	
Cs-134	< 25
Cs-137	< 27

* - 1.96σ Due to Counting Statistics

II.G. Sample Cross-check Program

To assure both the accuracy and precision of the environmental data obtained from the radiation surveillance program provided for the Fort St. Vrain facility, Colorado State University participates in a number of interlaboratory and intralaboratory quality assurance programs. The U.S. Environmental Protection Agency (EPA) sponsored laboratory intercomparison studies program is the principal cross-check. This involves the analysis of a variety of environmental media containing various levels of radionuclides. The media, type of analysis and frequency of analysis for the EPA program are summarized below.

Medium	Analysis (radionuclide)	Frequency
Water	H-3	Semiannually
Water	Gross β	Annually
Water	Co-60, Cs-134, Cs-137	Semiannually
Air particulate	Cs-137, Gross β	Annually
Milk	Cs-137	Annually

For each radionuclide analysis of a particular medium, three independent measurements are performed and all results are reported to the EPA. It should be noted that during 1989, the CSU laboratory became certified by the EPA for drinking water analysis.

Table II.G.1 gives the EPA cross-check data for 1995. The EPA uses the parameter, Estimated Laboratory Precision (ELP), calculated as one standard deviation for one determination. The normalized deviation of our mean from the known is calculated as:

$$\frac{\text{CSU mean value - EPA known value}}{\sigma \sqrt{n}}$$

Where: σ = standard deviation of the mean of all participating laboratory results n = number of analyses by our laboratory, normally n=3

The control limit is determined by the mean range of all results and three standard deviations of the range. If any result exceeds three standard deviations from the mean (warning level), the result is unacceptable. Whenever our mean value falls outside this limit, the calculations are rechecked and the sample reanalyzed if possible. During 1995 all results except one were within the warning level. The result exceeding the warning level has the superscript notation 1 in Table II.G.1. The explanation for the incorrect result is given in Table II.G.1.

Table II.G.2 lists independent results for H-3 in water samples split between the CSU laboratory and the laboratory at Fort St. Vrain. The comparison between laboratories in general was acceptable.

Table II.G.3 lists the results of gross beta analyses of the split water samples. The procedural differences between the laboratories were previously investigated and minimized. It is concluded that the differences can be attributed only to total analytical uncertainty.

Table II.G.4 shows results of an intralaboratory cross-check program. Replicate samples are independently analyzed. The replicate results are not statistically different and imply that the precision of the methods is acceptable.

During 1995 approximately 20% of all laboratory calculations that partly involve technician input were recalculated by a different technician. Only an occasional input or calculation error was detected. This result gives further credence to the laboratory results which are not solely computer calculated and listed.

Computer calculations are often recalculated by hand and those done during 1995 were all verified to be correct.

Table II.G.1 EPA Cross-Check Data Summary, 1995.

Date	Radionuclide	CSU Value	EPA Value	1 E.L.P. *	Normalized Deviation from known**
WATER, Tritium (pCi/L)					
Mar 10	^{3}H	6667	7435	744	-1.79
Aug 04	^{3}H	3966	4872	487	-3.15
WATER, Beta (pCi/L)					
Jan 27	Beta	4.67	5.0	5.0	-0.12
WATER, Gamma (pCi/L)					
Jun 09	Co-60	28	40	5	-4.04
	Cs-134	49	50	5	-0.12
	Cs-137	32	35	5	-0.92
Nov 03	Co-60	55	60	5	-1.50
	Cs-134	37	40	5	-0.92
	Cs-137	43	49	5	-1.96
WATER, Performance (pCi/L)					
Apr 18	Beta	45.3	86.6	10	-7.15[1]
	Cs-134	17	20	5	-0.92
	Cs-137	13	11	5	0.69
MILK (pCi/L)					
Sep 29	Cs-137	48	50	5	-0.58
AIR FILTERS (pCi/Filter)					
Aug 25	Beta	91	86.6	10	0.69
	Cs-137	38	25	5	4.50

* E.L.P. = Expected Laboratory Precision.
** Normalized Deviation = (CSU mean - EPA known)/($\sigma\sqrt{n}$);if this value falls between upper & lower warning levels, the accuracy is acceptable.
1. Too long Beta decay period allowed in lab.

Table II.G.2

Tritium Cross-check Analyses on Split Water Samples Determined by Colorado State University and Public Service Company during 1995.

a) 1st and 2nd Quarters

Collection Date	Sample Location	Tritium Concentrations (pCi/L)	
		CSU	PSC
Jan 14	A-25	< 380	< 850
Jan 14	A-21	< 380	< 850
Jan 04	E-41	< 380	< 850
Feb 11	A-25	510(1100)*	1400(1100)
Feb 11	A-21	550(650)	1700(1100)
Feb 01	E-41	< 380	< 840
Mar 11	A-25	520(390)	< 930
Mar 11	A-21	< 380	< 930
Mar 01	E-41	< 380	< 930
Apr 08	A-25	410(380)	< 900
Apr 08	A-21	< 390	1200(1100)
Apr 05	E-41	< 390	< 900
May 12	A-25	3900(350)	2800(1200)
May 12	A-21	< 380	< 940
May 03	E-41	< 370	< 940
Jun 09	A-25	< 370	1200(1100)
Jun 09	A-21	< 370	< 840
Jun 06	E-41	< 370	< 840

* - 1.96σ (Due to Counting Statistics)

Table II.G.2

Tritium Cross-check Analyses on Split Water Samples Determined by Colorado State University and Public Service Company during 1995.

b) 3rd and 4th Quarters

Collection Date	Sample Location	Tritium Concentrations (pCi/L)	
		CSU	PSC
Jul 14	A-25	860(450)*	< 880
Jul 14	A-21	< 390	1800(1100)
Jul 12	E-41	23000(670)	23000(1800)
Aug 11	A-25	< 370	< 860
Aug 11	A-21	< 370	< 860
Aug 09	E-41	< 370	< 860
Sep 09	A-25	< 370	1400(1100)
Sep 09	A-21	< 370	< 850
Sep 11	E-41	< 380	5600(1200)
Oct 14	A-25	< 380	1200(1100)
Oct 14	A-21	< 370	< 860
Oct 04	E-41	< 370	< 860
Nov 11	A-25	< 380	< 850
Nov 11	A-21	< 380	< 850
Nov 08	E-41	< 380	< 850
Dec 09	A-25	< 380	< 1400
Dec 09	A-21	< 380	< 1400
Dec 13	E-41	< 380	< 1400

* - 1.96σ (Due to Counting Statistics)

Table II.G.3

Gross Beta Cross-check Analyses on Split Water Samples Determined by Colorado State University and Public Service Company during 1995.

a) 1st and 2nd Quarters

Collection Date	Sample Location	Gross Beta (pCi/L)	
		CSU	PSC
Jan 14	A-25	8.0(5.9)*	9.8(8.5)
Jan 14	A-21	7.5(5.8)	< 6.4
Jan 04	E-41	7.1(5.8)	11(8.6)
Feb 11	A-25	9.5(6.0)	5.4(7.2)
Feb 11	A-21	6.9(5.9)	15(8.3)
Feb 01	E-41	12(6.1)	12(7.8)
Mar 11	A-25	12(6.1)	< 6.7
Mar 11	A-21	20(6.4)	< 7.0
Mar 01	E-41	7.0(5.8)	< 6.8
Apr 08	A-25	9.0(5.9)	< 23
Apr 08	A-21	7.1(5.8)	< 23
Apr 05	E-41	5.1(5.8)	< 23
May 12	A-25	15.7(11)	19(7.2)
May 12	A-21	8.1(5.9)	11(7.3)
May 03	E-41	8.8(5.9)	14(8.0)
Jun 09	A-25	41(7.2)	12(6.9)
Jun 09	A-21	< 4.3	12(6.9)
Jun 06	E-41	< 4.8	15(8.2)

* - 1.96σ (Due to Counting Statistics)

Table II.G.3

Gross Beta Cross-check Analyses on Split Water Samples Determined by Colorado State University and Public Service Company during 1995.

b) 3rd and 4th Quarters

Collection Date	Sample Location	Gross Beta (pCi/L)	
		CSU	PSC
Jul 14	A-25	58(7.8)*	< 12
Jul 14	A-21	< 4.5	< 10
Jul 12	E-41	19(4.7)	19(5.7)
Aug 11	A-25	25(6.5)	< 5.0
Aug 11	A-21	9.3(6.0)	13(10)
Aug 09	E-41	5.1(5.7)	13(8.7)
Sep 09	A-25	44(7.4)	< 9.1
Sep 09	A-21	5.6(5.8)	22(5.8)
Sep 11	E-41	5.3(5.8)	18(5.6)
Oct 14	A-25	63(8.0)	< 17
Oct 14	A-21	4.0(5.7)	< 17
Oct 04	E-41	< 4.9	< 18
Nov 11	A-25	11(6.1)	15(3.3)
Nov 11	A-21	4.8(5.8)	14(3.5)
Nov 08	E-41	6.0(5.8)	24(3.9)
Dec 09	A-25	6.9(6.1)	12(8.7)
Dec 09	A-21	13(6.4)	18(10)
Dec 13	E-41	8.4(6.0)	11(9.1)

* - 1.96σ (Due to Counting Statistics)

Table II.G.4 Intralaboratory Cross-Check Results (pCi/L). (Replicate Analysis of Same Sample)

Radionuclide	Drinking Water							
	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter	
	A	B	A	B	A	B	A	B
Cs-134	< 2.0	< 2.2	< 2.0	< 1.9	< 2.1	< 2.1	1.4(1.7)*	< 1.4
Cs-137	< 2.5	< 2.8	< 2.4	< 2.3	3.8(3.1)	< 2.5	3.7(2.1)	4.2(2.1)
Zr-95	< 4.7	< 4.5	< 4.6	< 4.4	< 4.9	< 4.7	< 3.4	< 3.1
Nb-95	< 1.8	< 1.5	< 1.8	< 1.8	< 1.9	< 1.8	< 1.6	3.0(1.9)
Co-58	< 2.1	< 1.9	< 2.1	< 1.7	< 1.9	< 1.8	< 1.4	< 1.3
Mn-54	< 2.0	< 2.0	< 2.0	3.1(2.3)	3.2(2.5)	2.6(2.4)	< 1.5	< 1.4
Zn-65	< 5.4	< 5.4	< 5.3	< 5.2	< 5.7	< 5.6	< 5.0	< 4.3
Fe-59	< 4.7	< 4.6	< 4.6	< 4.5	< 6.0	< 4.6	< 3.9	< 3.3
Co-60	< 2.1	< 1.5	< 2.1	< 2.0	< 2.3	< 2.2	< 1.3	< 1.2
Ba-140	< 3.3	< 4.0	< 3.2	< 3.1	< 7.1	< 7.2	< 2.4	< 2.2
La-140	< 3.8	< 3.5	< 3.7	< 3.5	< 8.2	< 8.2	< 2.8	< 2.5
Gross Beta	< 1.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
H-3	< 390	< 410	< 380	< 390	< 380	< 390	< 380	< 390

Radionuclide	Milk							
	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter	
	A	B	A	B	A	B	A	B
Cs-134	< 2.2	< 5.4	< 1.5	< 1.4	< 1.9	< 2.3	< 1.5	< 1.6
Cs-137	5.3(3.1)	9.9(8.0)	4.6(2.6)	5.6(2.5)	< 2.4	< 2.7	3.7(2.6)	7.9(2.8)
Ba-140	< 3.8	< 7.1	< 2.1	< 2.1	< 3.1	7.3(7.4)	< 5.1	8.7(7.3)
La-140	< 4.4	< 8.1	< 2.4	< 2.4	< 3.6	8.4(8.5)	< 5.8	10(8.4)
H-3	< 390	< 380	< 380	< 380	< 380	< 380	< 380	< 390

* - 1.96σ (Due to Counting Statistics)

II.H. Summary and Conclusions

Table II.H.1 summarizes the radiation and environmental radioactivity measurements conducted during 1995 in the environs of the Fort St. Vrain facility. The facility is owned and operated by Public Service Company of Colorado and is in the final stages of decommissioning. The values for each sample type may be compared to pre-operational and operational periods for this facility, as well as to the values from other U.S. environmental monitoring programs (e.g., EPA 520). It must be emphasized, however, that the mean values in Table II.H.1 are only the means of the values greater than MDC, the statistically minimum detectable concentration. The range also is given only for detectable measurements. The mean and range values, therefore, are not the true means or ranges if any of the values in the sample population were less than MDC. The calculational methods and the format of Table II.H.1 is a requirement of the NRC.

Inspection of Table II.H.1 reveals that there were no individual measurements that exceeded the Reporting Level (RL) (see Table F-3 in the ODCM). The Chernobyl world-wide fallout was still observable as Cs-137 in several sample types. Decommissioning activity was observed in Goosequill sediment samples and occasional fish samples.

For the category of gross beta concentrations in drinking water, the mean for the Gilcrest well was again significantly greater than for the reference supply located in Fort Collins. The reason for this observation is solely due to the fact that the town of Gilcrest still doesn't completely filter its drinking water supply. The procedure was improved in the last two years but it is still not complete and the activity concentration is still elevated due to naturally occurring radioactive materials from soil and fertilizer contamination. The following conclusions are drawn:

a. None of the individual fission product or activation product radionuclides measured were significantly higher in the Gilcrest drinking water.

b. Tritium concentrations measured at Gilcrest were not statistically greater than those in Fort Collins.

c. The city of Gilcrest does not filter and treat its well water to the same degree as Fort Collins. This has been verified and evidenced by the fact that the gamma-ray spectra of the suspended solids from Gilcrest water samples show only elevated concentrations of the natural radionuclides. It has been concluded in previous reports that the elevated gross beta concentrations in Gilcrest water are due to elevated concentrations of the naturally occurring U-238, and Th-232 decay products.

For the category of tritium in surface water elevated concentrations were noted at station A-25, the outlet of the Farm pond periodically throughout 1995. A-25 is directly in the principal effluent route and elevated concentrations should be expected when release is significant. Downstream surface water concentrations of tritium have occasionally been elevated, but there is significant dilution before any human use of this water. During 1995 elevated tritium concentrations were not observed downstream and the mean values for the first and second half of 1995 were not significantly different.

Cs-137 was also observed in many environmental samples but is due to the Chernobyl world-wide fallout. The only exception was the elevated Cs-137 in sediment in the liquid effluent pathway. These values, however, are well below NRC guideline values.

Tritium concentrations from well water site F-16 do appear to be less than in 1994 and imply only short term contamination of the aquifer. Typically lateral water movement in western soils is approximately 30 m/year. Weekly sampling was initiated in 1991 to observe the movement more closely, but in any case the well at F-16 is not used for drinking water purposes and elevated tritium concentrations have not been observed in any food chain sample. Residents at the F-16 residence purchase bottled water for their primary consumption.

Table II.H.2 presents an additional summary of mean values for selected sample types. The sample types and radionuclides were chosen on the basis of their importance in documenting possible radiation dose to humans. Air and surface water would be the predominant environmental transport routes and drinking water and milk would be the predominant sources of radiation dose if significant radioactivity release from FSV occurred. Table II.H.2 also allows comparison to the four most recent years of monitoring. All four years were post-operational.

The arithmetic means and standard deviations in Table II.H.2 were calculated for all sample results. It should be repeated that the tabular data presented in the body of this report contain only positive calculated values above the minimum detectable concentration (MDC) levels. Any calculated values less than zero or less than the minimum detectable concentration are listed as less than the actual MDC for that sample analysis. The actual result in all cases was used in the calculation for the arithmetic mean values for the periods in Table II.H.2. Therefore, all values, negative as well as positive, were included. This procedure is now generally accepted and gives a proper estimate of the true mean value. Because of this procedure, however, the values listed in Table II.H.2 cannot be calculated directly from the tabular values in the report. It must be emphasized that while it is true that no sample can contain less than zero radioactivity, due to the random nature of radioactive decay, it is statistically possible to obtain sample count rates less than background and hence a negative result. It is equally true that many sample types do in fact have zero concentrations of certain radionuclides. Therefore, to obtain the correct mean value from the distribution of analytical results, all positive results must be averaged with all negative results. If the negative results were omitted, the resulting arithmetic mean would be falsely biased high.

From the values presented in Tables II.H.1 and II.H.2 and the tabular data of the report, the following observations and conclusions may be drawn:

1. As in every previous report, it was again apparent that for most sample types the variability observed around the mean values was great. This variability is partly due to counting statistics and methodological variation, but principally due to true environmental variation (often termed sampling error). It must be recognized and accounted for in analyses of any set of environmental data before meaningful conclusions can be drawn;

2. Tritium was detected in the effluent pathway periodically throughout 1995. The release of tritium was indeed much less than in operational years. Since the tritium is released as tritiated water, the dilution by the surrounding hydrosphere is great and consequently the mean values of downstream surface water were not statistically greater than upstream concentrations. No tritium was detected in ground water or any food samples;

3. The Chernobyl world-wide fallout has totally obscured what fission product debris has remained in the FSV environs from the October 1980 Chinese atmospheric nuclear weapon test. The biosphere will contain the Chernobyl fallout, particularly Cs-137, for an equally long period. Nuclear weapon test fallout has, since the inception of the project, been noted to be the predominant source term above natural background. The

Chernobyl reactor fire debris was superimposed on the weapons test fallout from 1986 to present. It is the variation in fallout deposition, in addition to the variation in naturally occurring radionuclides, that mandates the large number of environmental samples to detect any possible radioactivity due to facility effluents. A simple comparison of pre-operational and operational values is of little value, for most sample types, because the fallout deposition was considerably greater during the pre-operational period due to world-wide fallout;

4. The prompt and sensitive detection of the Chinese weapon test fallout and the Chernobyl fallout in the past assures that the environmental monitoring program was of adequate scope and sensitivity to detect any accidental releases from the FSV decommissioning; and

5. Release of decommissioning radioactive waste was evident in the Goosequill sediment. Since this is primarily Cs-137 in sediment, its transfer to plant and animal food chains will be negligible.

It can be concluded from the data collected by the environmental monitoring program that the radiation dose commitments calculated for the closest human inhabitants or other parts of the nearby ecosystems due to current facility effluents are negligible. Natural background radiation and the dose commitment from atmospheric fallout are the only known significant sources of radiation dose to the residents of the area.

During the current decommissioning phase of the facility it is concluded that this Radiological Environmental Monitoring Program is more than adequate to detect and quantify any possible routine or accidental release of radioactivity.

Table II.H.1 Radiological Environmental Monitoring Program Annual Summary Fort St. Vrain Station, Platteville, Colorado

Medium or Pathway Samples (Unit of measurement)	Type and Total Number of Analyses Performed	Facility Locations Mean (f) Range	Adjacent Locations Mean (f)[1] Range	Locations with Highest Annual Mean: Name, Distance & Direction	Mean, Range	Reference Locations Mean (f)[1] Range	Number of Nonroutine Reported Measurements
Direct Radiation (mR/day)	TLD(159)	0.41(72/72) 0.23-0.57	0.40(68/72) (0.27-0.56)	F-8 CO 19½ 1.3 km Sec 8	0.45(4/4) (0.35-0.57)	0.40(19/20) (0.33-0.56)	0
Air, Particulates (fCi/m^3)	Gross Beta(360)	19(204/208) (10-50)	---	F-7 CR 21 & 34 1.5 km Sec 7	23(50/52) (11-46)	17(156/156) (10-40)	0
				Gamma Spectrometry			
	Cs-134(28)	0.8(1/16)	---	R-3 Fort Collins 45.1 km	1.2(1/4)	---	0
	Cs-137(28)	1.1(9/16) (0.63-1.6)	---	A-19 Hunter's Cabin 1.7 km Sec 1	1.6(3/4) (1.3-2.0)	1.2(2/12)	0
Air, Atmospheric Water Vapor (pCi/m^3)	H-3(364)	670(9/208) (450-1300)	---	A-19 Hunter's Cabin 1.7 km Sec 1	760(3/52) (460-1000)	500(2/156) (410-590)	0
Drinking Water (pCi/L)	Gross Beta(52)	1.0(26/26) (.33-2.6)	---	R-6 Gilcrest City Water 9.3 km	1.0(26/26) (.33-2.6)	0.77(26/26) (0.46-1.1)	0
	H-3(52)	590(1/26)	---	R-6 Gilcrest City Water 9.3 km	590(1/26)	---	0
				Gamma Spectrometry			
Drinking Water (pCi/L)	Cs-134(52)	1.3(4/26) (0.98-1.5)	---	R-3 Fort Collins City Water 45.1 km	1.5(2/26) (1.2-1.8)	1.5(2/26) (1.2-1.8)	0

Table II.H.1 Radiological Environmental Monitoring Program Annual Summary Fort St. Vrain Station, Platteville, Colorado

Medium or Pathway Samples (Unit of measurement)	Type and Total Number of Analyses Performed	Facility Locations Mean (f) Range	Adjacent Locations Mean (f)[1] Range	Locations with Highest Annual Mean: Name, Distance & Direction	Mean, Range	Reference Locations Mean (f)[1] Range	Number of Nonroutine Reported Measurements
Drinking Water (pCi/L)	Cs-137(52)	2.6(13/26) (1.2-3.9)	---	R-3 Fort Collins City Water 45.1 km	4.2(12/26) (2.0-6.1)	2.8(16/26) (1.2-3.9)	0
	Zr-95(52)	---	---	---	---	---	0
	Nb-95(52)	2.2(3/26) (1.9-2.3)	---	R-6 Gilcrest City Water 9.3 km	2.2(3/26) (1.9-2.3)	1.8(4/26) (1.4-2.5)	0
	Co-58(52)		---	R-3 Fort Collins City Water 45.1 km	2.4(1/26)	2.4(1/26)	0
	Mn-54(52)	2.2(4/26) (1.3-2.6)	---	R-6 Gilcrest City Water 9.3 km	2.2(4/26) (1.3-2.6)	1.9(4/26) (1.4-2.2)	0
	Zn-65(52)	---	---	---	---	---	0
	Fe-59(52)	4.6(3/26) (3.6-8.8)	---	R-6 Gilcrest City Water 9.3 km	4.6(3/26) (3.6-8.8)	4.0(3/26) (2.8-4.7)	0
	Co-60(52)	2.2(2/26) (1.9-2.4)	---	R-6 Gilcrest City Water 9.3 km	2.2(2/26) (1.9-2.4)	---	0
	Ba-140(52)	---	---	R-3 Fort Collins City Water 45.1 km	7.0(6/26) (4.0-11)	7.0(6/26) (4.0-11)	0
	La-140(52)	---	---	R-3 Fort Collins City Water	8.1(6/26) (4.6-13)	8.1(6/26) (4.6-13)	0

Table II.H.1 Radiological Environmental Monitoring Program Annual Summary Fort St. Vrain Station, Platteville, Colorado

Medium or Pathway Samples (Unit of measurement)	Type and Total Number of Analyses Performed	Facility Locations Mean (f) Range	Adjacent Locations Mean (f)[1] Range	Locations with Highest Annual Mean: Name, Distance & Direction	Locations with Highest Annual Mean: Mean, Range	Reference Locations Mean (f)[1] Range	Number of Nonroutine Reported Measurements
				45.1 km			
	H-3(60)	< 390	1200(4/24) (530-1700)	A-25 Farm Pond 2.2 km Sec 1	1200(4/24) (530-1700)	< 380	0
			Gamma Spectrometry				
Surface Water (pCi/L)	Cs-134(60)	---	1.3(1/24)	R-10 S. Platte @ CO 60 10.1 km	2.0(1/12)	2.0(1/12)	0
Surface Water (pCi/L)	Cs-137(60)	3.0(16/24) (1.6-4.7)	3.4(16/24) (1.4-5.2)	A-25 Farm Pond 2.2 km Sec 1	5.3(4/12) (3.5-7.3)	3.0(8/12) (1.7-5.6)	0
	Zr-95(60)	---	6.4(1/24)	A-25 Farm Pond 2.2 km Sec 1	6.4(1/24)	---	0
	Nb-95(60)	2.1(1/24)	2.0(2/24)	F-19 S. Platte 1.2 km Sec 4	2.1(1/24)	1.4(2/12) (0.52-2.3)	0
	Co-58(60)	< 1.3	< 1.3	R-10 S. Platte @ CO 60 10.1 km	1.4(1/12)	1.4(1/12)	0
	Mn-54(60)	1.7(1/24)	2.2(3/24) (1.7-2.0)	A-25 Farm Pond 2.2 km Sec 1	1.5(3/12) (1.3-2.8)	1.5(3/12) (1.3-2.8)	0
	Zn-65(60)	---	---	---	---	---	0
	Fe-59(60)	3.4(1/24)	5.2(4/24) (3.3-7.6)	A-21 St. Vrain Creek 2.4 km Sec 11	5.2(4/24) (3.3-7.6)	---	0
	Co-60(60)	---	---	---	---	---	0
	Ba-140(60)	5.9(2/24) (3.4-8.3)	---	F-19 S. Platte 1.2 km Sec 4	5.9(2/24) (3.4-8.3)	---	0

Table II.H.1 Radiological Environmental Monitoring Program Annual Summary Fort St. Vrain Station, Platteville, Colorado

Medium or Pathway Samples (Unit of measurement)	Type and Total Number of Analyses Performed	Facility Locations Mean (f) Range	Adjacent Locations Mean (f)[1] Range	Locations with Highest Annual Mean: Name, Distance & Direction	Locations with Highest Annual Mean: Mean, Range	Reference Locations Mean (f)[1] Range	Number of Nonroutine Reported Measurements
	La-140(60)	6.8(2/24) (3.9-9.6)	---	F-20 St. Vrain Creek 1.5 km Sec 16	8.0(1/12)	8.0(1/12)	0
Ground Water (pCi/L)	H-3(8)	< 370	---	---	---	< 380	0
				Gamma Spectrometry			
Ground Water (pCi/L)	Cs-134(7)	2.6(1/4)	---	F-16 Russel Ranch 1.5 km Sec 1	2.6(1/4)	1.8(1/3)	0
	Cs-137(7)	4.5(3/4) (4.2-4.8)	---	R-5 Milliken 9.5 km	4.5(3/4) (3.3-3.6)	6.4(2/3) (3.1-9.6)	0
Ground Water (pCi/L)	Zr-95(7)	---	---	---	---	---	0
	Nb-95(7)	---	---	---	---	---	0
	Co-58(7)	---	---	R-5 Milliken 9.5 km	1.2(1/3)	1.2(1/3)	0
	Mn-54(7)	2.2(1/4)	---	F-16 Russel Ranch 1.5 km Sec 1	2.2(1/4)	---	0
	Zn-65(7)	---	---	---	---	---	0
	Fe-59(7)	---	---	---	---	---	0
	Co-60(7)	---	---	R-5 Milliken 9.5 km	2.4(1/3)	2.4(1/3)	0
	Ba-140(7)	4.5(1/4)	---	F-16 Russel Ranch	4.5(1/4)	---	0

Table II.H.1 Radiological Environmental Monitoring Program Annual Summary Fort St. Vrain Station, Platteville, Colorado

Medium or Pathway Samples (Unit of measurement)	Type and Total Number of Analyses Performed	Facility Locations Mean (f) Range	Adjacent Locations Mean (f)[1] Range	Locations with Highest Annual Mean: Name, Distance & Direction	Locations with Highest Annual Mean: Mean Range	Reference Locations Mean (f)[1] Range	Number of Nonroutine Reported Measurements
				1.5 km Sec 1			
Milk (pCi/L)	H-3(102)	---	< 380	R-8 Borba Dairy 23 km	460(2/17) (370-540)	460(2/17) (370-540)	0
Gamma Spectrometry							
Milk (pCi/L)	Cs-134(102)	---	---	R-8 Borba Dairy 23 km	1.8(2/17) (1.0-2.5)	1.8(2/17) (1.0-2.5)	0
	Cs-137(102)	---	3.6(57/85) (1.4-7.7)	R-8 Borba Dairy 23 km	3.7(10/17) (1.9-6.5)	3.7(10/17) (1.9-6.5)	0
	Ba-140	---	4.3(8/85) (2.2-6.0)	R-8 Borba Dairy 23 km	6.0(2/17) (3.8-8.7)	6.0(2/17) (3.8-8.7)	0
	La-140	---	4.9(8/85) (2.5-6.9)	R-8 Borba Dairy 23 km	7.0(2/17) (4.3-10)	7.0(2/17) (4.3-10)	0
Gamma Spectrometry							
Food Products (pCi/kg, wet)	Cs-134	---	---	---	---	---	0
	Cs-137	---	7.9(1/4)	A-27 WCR 36 4.3 km Sec 4	7.9(1/4)	---	0

Table II.H.2 Summary Table of Arithmetic Means and Standard Deviations for Selected Sample Types

	1991		1992		1993		1994		1995	
	$\overline{X}$	1.96σ	$\overline{X}$	1.96σ	$\overline{X}$	1.96σ	$\overline{X}$	1.96σ	$\overline{X}$	1.96σ
H-3	Atmospheric Water Vapor (pCi/L)									
Facility	< 9.4	400	980	830	430	130	520	90	420	120
Reference	< 80	400	780	530	420	50	630	350	410	110
Gross Beta	Air (fCi/m^3)									
Facility	29	31	25	15	24	14	28	9.2	19	11
Reference	25	23	25	12	22	14	24	5.3	17	9.5
I-131										
Facility	1.6	13	25	9.0	-[1]	-	-	-	-	-
Reference	0.52	14	23	6.9	-	-	-	-	-	-
Cs-137										
Facility	0.12	0.69	1.0	0.22	1.6	2.9	0.89	0.61	1.1	0.82
Reference	0.98	1.3	1.1	0.40	1.3	2.3	0.98	0.95	1.2	1.0
H-3	Drinking Water (pCi/L)									
Gilcrest	30	410	550	90	< 430	50	410	680	590	470
Ft. Collins	< 50	350	500	50	< 420	40	< 380	10	< 370	
Gross Beta	Drinking Water (pCi/L)									

[1] No longer analyze for I-131.

	1991		1992		1993		1994		1995	
	$\overline{X}$	1.96σ	$\overline{X}$	1.96σ	$\overline{X}$	1.96σ	$\overline{X}$	1.96σ	$\overline{X}$	1.96σ
Gilcrest	5.8	2.4	4.5	2.3	3.2	2.9	2.6	1.7	1.0	1.0
Ft. Collins	0.95	0.35	0.90	0.31	0.92	0.72	1.2	0.48	0.77	0.35
I-131	Air (fCi/m^3)									
Gilcrest	< 0.028	0.16	0.29	0.14	-	-	-	-	-	-
Ft. Collins	< 0.022	0.20	0.35	0.15	-	-	-	-	-	-
Cs-137										
Gilcrest	2.2	1.6	3.4	1.1	3.8	3.1	4.2	2.3	2.6	1.6
Ft. Collins	1.7	1.2	3.4	0.88	3.4	2.3	3.7	2.4	2.8	1.8
H-3	Surface Water (pCi/L)									
Effluent	1500	2500	770	590	< 420	20	1500	640	590	420
Downstream	6.2	430	990	860	< 420	50	390	550	< 390	-
Upstream	20	420	640	0	< 450	200	570	770	< 390	-
Cs-137										
Effluent	1.7	2.0	3.6	1.4	3.6	2.8	4.3	2.3	3.2	2.2
Downstream	2.3	1.7	3.5	1.2	3.8	2.2	4.5	2.5	2.8	2.2
Upstream	2.0	1.9	3.8	0.89	3.6	2.3	4.1	2.8	3.5	1.6
H-3	Milk									
Facility	< 130	360	760	590	<430	140	760	660	< 430	-
Reference	< 110	400	590	90	<420	20	550	450	< 430	-
I-131										
Facility	0.070	0.39	< 0.32	0.13	-	-	-	-	-	-
Reference	< 0.028	0.24	< 0.37	0.13	-	-	-	-	-	-

Table II.J.1 Tritium Concentrations in F-16 Well Water for 1995

Date Collected	Concentration (pCi/L)
01/07	< 380
01/14	< 380
01/21	< 420
01/28	< 380
02/04	< 390
02/11	< 380
02/18	< 390
02/25	< 390
03/04	< 390
03/11	< 390
03/18	< 380
03/25	< 390
04/01	< 390
04/08	< 380
04/15	< 390
04/22	< 390
04/29	< 390
05/06	< 380
05/12	< 370
05/19	< 360
05/26	< 370
06/02	< 370
06/09	< 370
06/16	< 370
06/23	< 370
06/30	< 370
07/07	< 360
07/14	< 370
07/21	< 370

Table II.J.1 Tritium Concentrations in F-16 Well Water for 1995 (cont.)

Date Collected	Concentration (pCi/L)
07/28	< 370
08/04	< 370
08/11	< 370
08/18	< 370
08/26	< 390
09/02	< 370
09/16	< 380
09/23	< 390
09/30	< 380
10/07	< 370
10/14	< 380
10/20	< 370
10/28	< 370
11/04	< 370
11/11	< 380
11/18	440(500)
11/26	< 420
12/02	< 420
12/09	< 380
12/15	< 380
12/22	< 450
12/29	< 450

* 1.96σ - Due to counting statistics

III. Radiological Environmental Monitoring Program

A. Sample Collection and Analysis Schedule

Table F-1 in the Offsite Dose Calculation Manual (ODCM) outlines the sampling design, the collection frequency and the type of analysis for all environmental samples. It should be repeated that this schedule was adopted January 1, 1984, and while different in certain aspects from the previous schedule, has as its intent the same objective. That objective is to document the radiation and radioactivity levels in the critical pathways of possible dose to humans. Such data is necessary to demonstrate Fort St. Vrain radioactive effluents produce environmental concentrations that are within appropriate environmental protection limits and at the same time are as low as reasonably achievable.

During 1995, there were no changes in the sampling program. Iodine-131 analysis was dropped at the beginning of 1993 for milk and air samples. The operational phase of the facility ended permanently in August of 1989 and due to the short half-life of I-131 (8.05 days), there is no longer any inventory of I-131 present.

Table III.A.1 lists the LLD concentration values for each sample type and radionuclide measured in this report. These LLD values are the actual values pertinent to the sample sizes, counting yields, and counting times used in the project. Typical decay periods were used in the calculations. It should be noted that the LLD values are in all cases equal to or less than those required by the ODCM.

Table F-3 of the ODCM lists the USNRC reporting level for each sample type and radionuclide. No results exceeded the reporting level in 1995.

Table F-4 of the ODCM gives the description of each sampling location by number, sector, and distance from the site. Each of these sampling locations (except certain reference locations) can be identified on scale maps (Figures III.B.1 and III.B.2). Topographical maps showing greater detail, as well as photographs of principal sampling sites are on file in the CSU laboratory.

During September 1995 the land-use census was again conducted to determine the locations of the nearest residence, the nearest milk animal, and the nearest garden producing broad leaf vegetation in each of the 16 meteorological sectors around the reactor. These locations are shown in Table III.C.1. Figure III.C.1 shows these locations in each sector. At the time of the 1995 census it was verified that the closest permanent residence in Sector 16 was the critical receptor with regards to mean annual dose commitment and is at the residence at F-16.

A few residents in the sampling sectors up to a distance of 8 km from the plant have cows or goats that could be used for personal milk consumption. However, from direct discussion with these persons, this is not a common practice and all cow milk produced is transported to commercial processors. The milk produced locally is diluted by a large milk shed, processed and distributed over a large area for consumption. Elevated radionuclide concentrations in milk samples due to Fort St. Vrain station effluents have never been detected during either the operational or decommissioning phases.

TABLE III.A.1
DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS
LOWER LIMIT OF DETECTION (LLD)

Analysis	Water (pCi/l)	Airborne Particulate or Gas (fCi/m^3)	Fish (pCi/kg,wet)	Milk (pCi/l)	Food Products (pCi/kg,wet)	Sediment (pCi/kg,dry)
Gross Beta	4	5	N/A	N/A	N/A	N/A
H-3	2000	N/A	N/A	N/A	N/A	N/A
Cs-134	15	9	130	15	60	150
Cs-137	18	8	150	18	80	180
Mn-54	15	N/A	130	N/A	N/A	N/A
Co-60	15	N/A	130	N/A	N/A	N/A
Zn-65	30	N/A	260	N/A	N/A	N/A

NOTE: This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall be identified and reported.

Figure III.B.1 Close in Sampling Locations

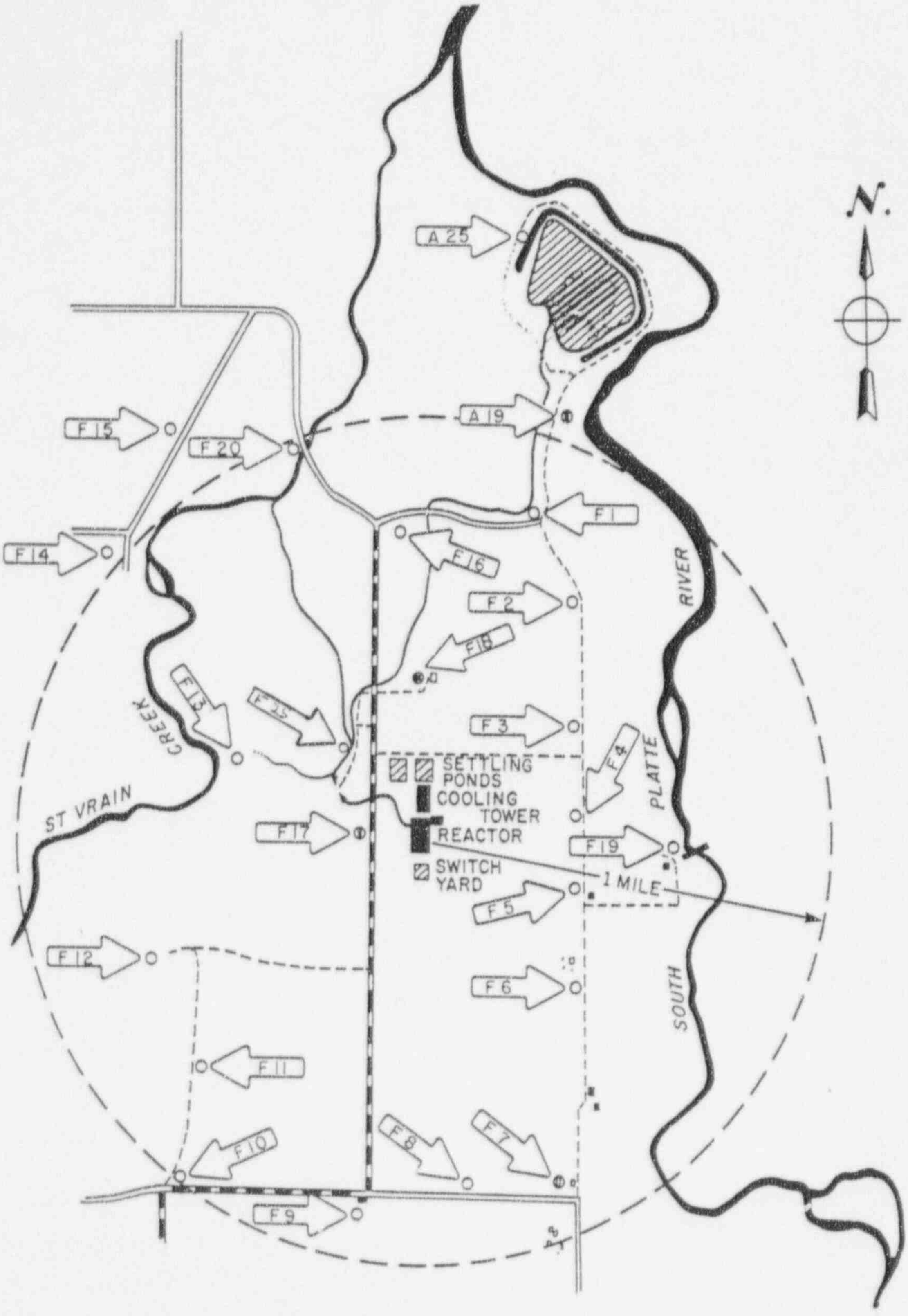


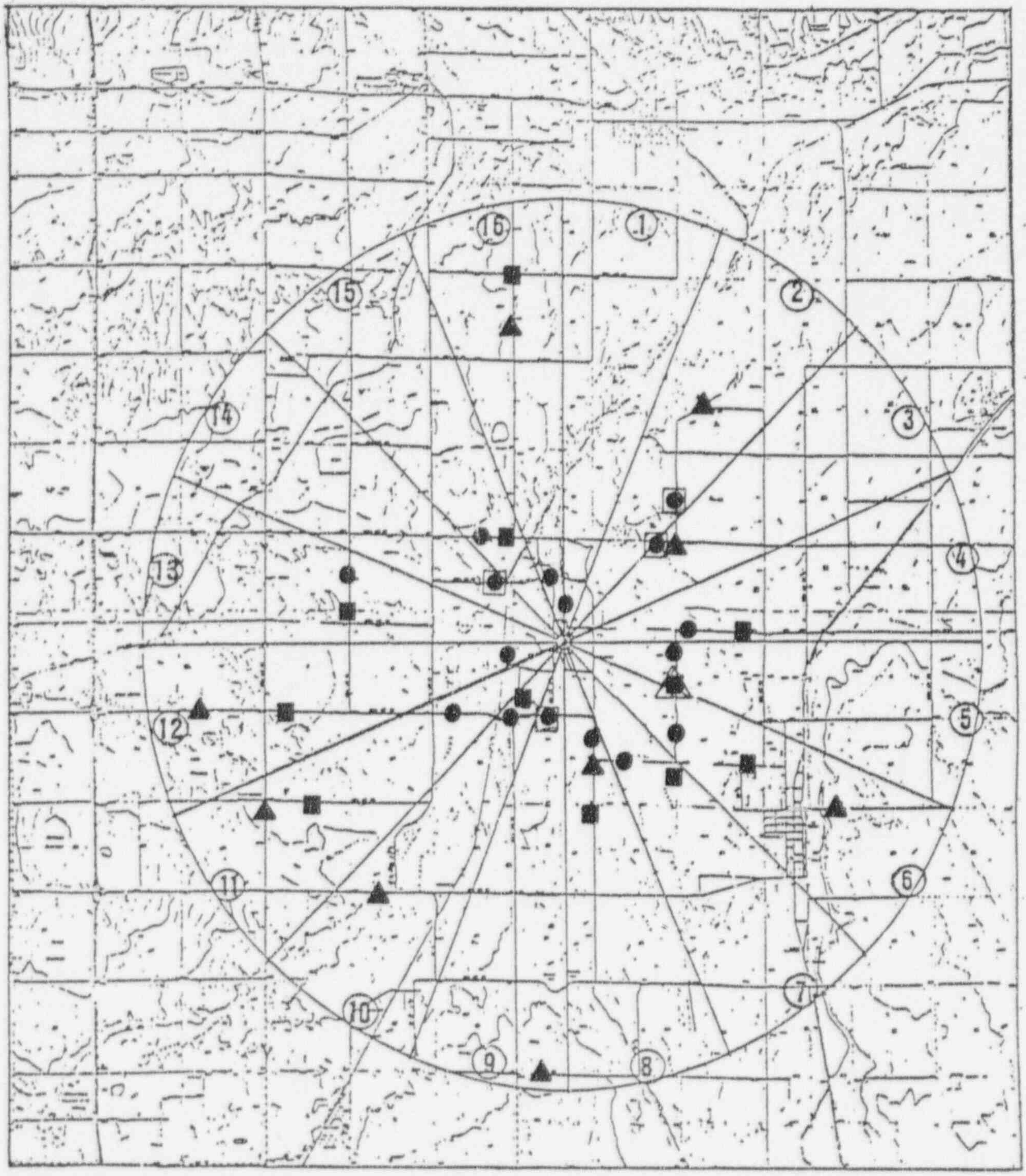
Figure III.B.2 Adjacent and Reference Sampling Locations

Table III.C.1 1995 Land Use Census*

Sector	Nearest Residence	Nearest Garden	Nearest Milk Animal
1	17578 CR 19½	9102 CR 44	**
2	18311 CR 23	19027 CR 23	11258 CR 40
3	11100 CR 38	11100 CR 38	**
4	11247 CR 36	11247 CR 36	11777 CR 36
5	16543 CR 23	16134 CR 23	16134 CR 23
6	16017 CR 23	16017 CR 23	11585 CR 32
7	9999 CR 34	9999 CR 34	**
8	15883 CR 21	15225 CR 21	**
9	9379 CR 34	9456 CR 34	9033 CR 26
10	9061 CR 34	15449 CR 19	7388 CO 66
11	8745 CR 34	6769 CR 32	4513 CR 32
12	Aristocrat Ranch	16202 CR 15	4665 CR 34
13	17038 CR 17	17475 CR 17	**
14	8896 CR 19	17666 CR 17	**
15	18100 CR 19	18995 CR 17	**
16	17926 CR 19½	17926 CR 19½	**

* Census Date: September 8, 1995
** No milk animals

Figure III.C.1 Land Use Census, 1995



● Nearest Residence

■ Nearest Garden

▲ Nearest Milk Animal