

MONTICELLO NUCLEAR GENERATING PLANT		ODCM-07.01
TITLE:	RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM	Revision 7
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1.0 RECORD OF REVISION

<u>Revision No.</u>	<u>Date</u>	<u>Reason for Revision</u>
1	October - 2000	Moved previous ODCM-05.01 (RADIATION ENVIRONMENTAL MONITORING PROGRAM) into this document, changed the title to "RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM" and incorporated Tech Spec section 4.16 "Radiation Environmental Monitoring Program" into this document.
2	November - 2001	Deleted incorrect reference in section 2.1.3.C.
3	November - 2002	Table 4, page 22, TLD M02S from Edgar Klucas Res., 1.1, 148, SE to Krone Residence, 0.5, 223, SW.
4	April - 2003	Table 4, page 20, TLD M-10 _c from Goenner Farm, 12.4, 322, NW to Campbell Farm, 10.6, 357, N.
5	October - 2003	Change in the Critical Garden location.
6	November - 2003	Updated sampling locations on Figures 1, 2 and 3.
7	September - 2004	Change in the Critical Garden location. Change 2.4.1.A. to require cross check program to be NIST traceable. NRC no longer approves cross check programs.

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2.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

2.1 Monitoring Program

2.1.1 Controls

- A. In accordance with T.S.6.8.A, the Radiological Environmental Monitoring Program (REMP) **SHALL** be conducted as specified in Table 1.
- B. Radioanalysis **SHALL** be conducted meeting the requirements of Table 3.

2.1.2 Applicability

At all times.

2.1.3 Action

- A. Whenever the Radiological Environmental Monitoring Program is not being conducted as specified in Table 1 the Annual Radiological Environmental Operating Report **SHALL** include a description of the reasons for not conducting the program as required and plans for preventing a recurrence.
- B. Deviations are permitted from the required sampling schedule if samples are unobtainable due to hazardous conditions, seasonable unavailability, or to malfunctions of automatic sampling equipment. If the latter occurs, every effort **SHALL** be made to complete corrective action prior to the end of the next sampling period.

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- C. With the level of radioactivity in an environmental sampling medium exceeding the reporting levels of Table 2 when averaged over any calendar quarter, submit a special report to the Commission within 30 days from the end of the affected calendar quarter. When more than one of the radionuclides in Table 2 are detected in the sampling medium, this report **SHALL** be submitted if:

$$\frac{\text{concentration (1)}}{\text{limit level (1)}} + \frac{\text{concentration (2)}}{\text{limit level (2)}} + \dots > 1.0$$

When radionuclides other than those in Table 2 are detected and are the result of plant effluents, this report **SHALL** be submitted if the potential annual dose to an individual is equal to or greater than the calendar year limits of ODCM-02.01 (LIQUID EFFLUENTS) Control 1.2.1.A, ODC-M-03.01 (GASEOUS EFFLUENTS) Control 1.2.1.A, or ODCM-03.01 Control 1.3.1.A. This report is not required if the measured level of radioactivity was not the result of plant effluents; however, in such an event, the condition **SHALL** be reported and described in the Annual Radiological Environmental Operating Report.

- D. Although deviations from the sampling schedule are permitted under Paragraph B. above, whenever milk or leafy green vegetation samples can no longer be obtained from the designated sample locations required by Table 1, the Annual Radiological Environmental Operating Report **SHALL** explain why the samples can no longer be obtained and identify the new locations which have been or will be added to and deleted from the monitoring program.

2.1.4 Surveillance Requirements

The radiological environmental monitoring samples **SHALL** be collected pursuant to Table 1 from the specific locations in Table 4 and **SHALL** be analyzed pursuant to the requirements of Table 1 and the detection capabilities required by Table 3.

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2.2 Land Use Census

2.2.1 Controls

A Land Use Census **SHALL** be conducted and **SHALL** identify:

- A. The location of the nearest milk animal, the nearest residence, and the nearest garden of greater than 500 ft² producing fresh leafy vegetables in each of the 16 meteorological sectors within a distance of 5 miles.
- B. The location of ALL milk animals and ALL 500 ft² or greater gardens producing broad leaf vegetation in each of the meteorological sectors within a distance of 3 miles.

2.2.2 Applicability

At all times.

2.2.3 Action

- A. With a Land Use Census identifying a location which yields a calculated dose or dose commitment (via the same exposure pathway) 20 percent greater than at a location from which samples are currently being obtained in accordance with Controls 2.1.1.A., the Annual Radioactive Effluent Release Report for this period **SHALL** identify the new location. The new location **SHALL** be added to the Radiological Environmental Monitoring Program within 30 days. The sampling location, excluding the control station location, having the lowest calculated dose or dose commitment (via the same exposure pathway) may be deleted from this monitoring program after October 31 of the year in which this Land Use Census was conducted.

2.2.4 Surveillance Requirements

- A. The Land Use Census **SHALL** be conducted at least once per year between the dates of May 1 and October 31 by door to door survey, aerial survey, or by consulting local agricultural authorities associations.

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2.3 Sampling

Table 1 and Figure 1 specify the current sampling locations for the radiation environmental monitoring program. These sampling locations are based on the latest land use census.

If it is learned from an annual census that milk animals or gardens are present at the location which yields a calculated thyroid dose greater than those locations previously sampled, the new milk animal or garden locations resulting in the higher calculated doses **SHALL** be added to the surveillance program as soon as practicable. Sample locations (except the control) having lower calculated doses may be dropped from the program at the end of the grazing or growing season (October 31) to keep the total number of sample locations constant.

If the plant begins routine discharges of liquid radioactive effluent into the Mississippi River, a land use survey will be conducted to determine whether any crops are irrigated with water taken from the Mississippi River between the plant discharge canal and a point 5 miles downstream. If edible crops are being irrigated from Mississippi River water, appropriate samples will be collected and analyzed per Table 1.

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2.4 Interlaboratory Comparison Program

2.4.1 Controls

- A. Analyses **SHALL** be performed on radioactive materials supplied as part of an NIST traceable cross-check program. This program involves the analyses of samples provided by a control laboratory and comparison of results with those of the control laboratory as well as with other laboratories which receive portions of the same samples. Media used in this program (air, milk, water, etc.) **SHALL** be limited to those found in the Radiological Environmental Monitoring Program.

2.4.2 Applicability

At all times.

2.4.3 Action

- A. When required analyses are not performed, corrective action **SHALL** be reported in the Annual Radiological Environmental Operating Report.

2.4.4 Surveillance Requirements

- A. The summary results of analyses performed as part of the above required program **SHALL** be included in the Annual Radiological Environmental Operating Report.

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2.5 Bases

2.5.1 Monitoring Program

Control 2.1.1 provides measurements of radiation and radioactive materials in those exposure pathways and for those radionuclides which lead to the highest potential radiation exposures of individuals resulting from the plant operation. This program thereby supplements the radiological effluent monitoring by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and modeling of the environmental exposure pathways. After a specific program has been in effect for at least 3 years of operation, program changes may be initiated based on this experience.

The detection capabilities required by Table 1 are state-of-the art for routine environmental measurements in industrial laboratories. The LLDs for drinking water meet the requirement of 40CFR Part 141.

2.5.2 Land Use Census

Control 2.2.1 is provided to ensure that changes in the use of off-site areas are identified and that modifications to the monitoring program are made if required by the results of this census. The best survey information from door-to-door, aerial or consulting with local agricultural authorities **SHALL** be used. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10CFR Part 50. Restricting the census to gardens of greater than 500 square feet provides assurance that significant exposure pathways via leafy vegetables will be identified and monitored since a garden of this size is the minimum required to produce the quantity (26 kg/year) of leafy vegetables assumed in Regulatory Guide 1.109 for consumption by a child. To determine this minimum garden size, the following assumptions were used: 1) that 20% of the garden was used for growing broad leaf vegetation (i.e., similar to lettuce and cabbage), and 2) a vegetation yield of 2 kg/square meter.

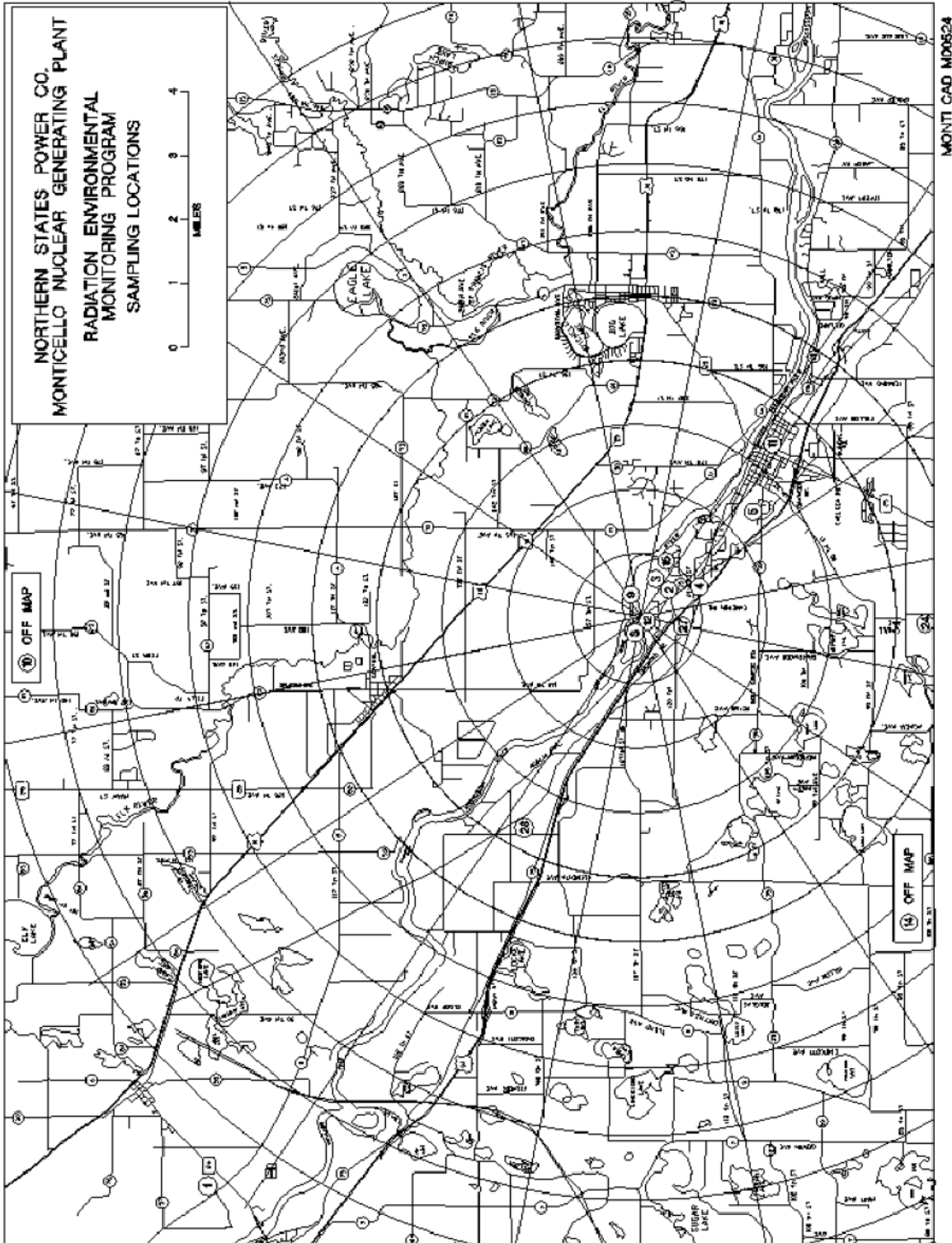
2.5.3 Sampling

Section 2.3, paragraph 3, is worded to conform to LAR-39 and its associated NRC Safety Evaluation (SER).

2.5.4 Interlaboratory Comparison Program

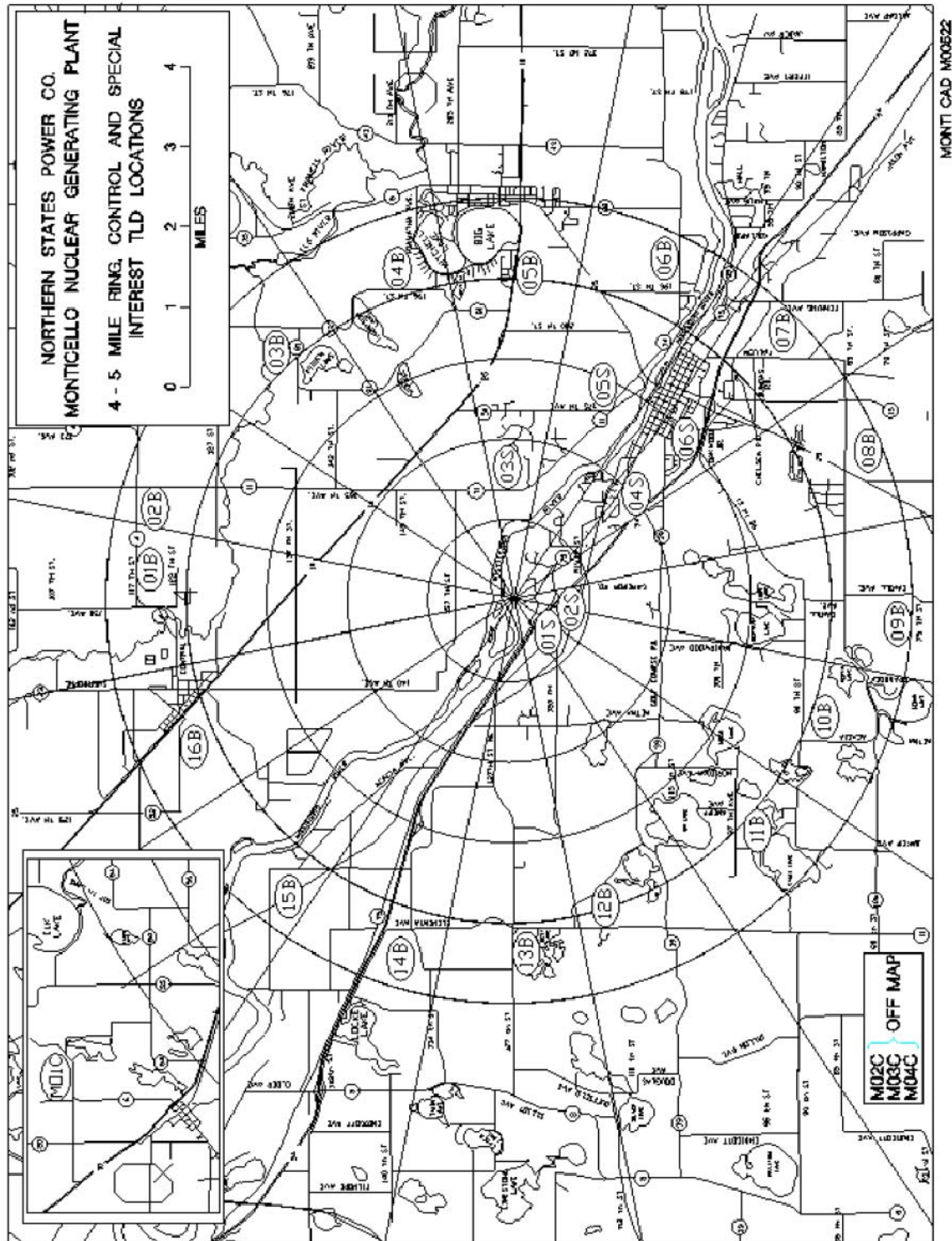
The requirement for participation in an interlaboratory comparison program is provided to ensure that independent checks on the precision and accuracy of the measurements of radioactive material in environmental sample matrices are performed as part of a quality assurance program for environmental monitoring in order to demonstrate that the results are reasonably valid.

Figure 1 Radiation Environmental Monitoring Program Sampling Locations



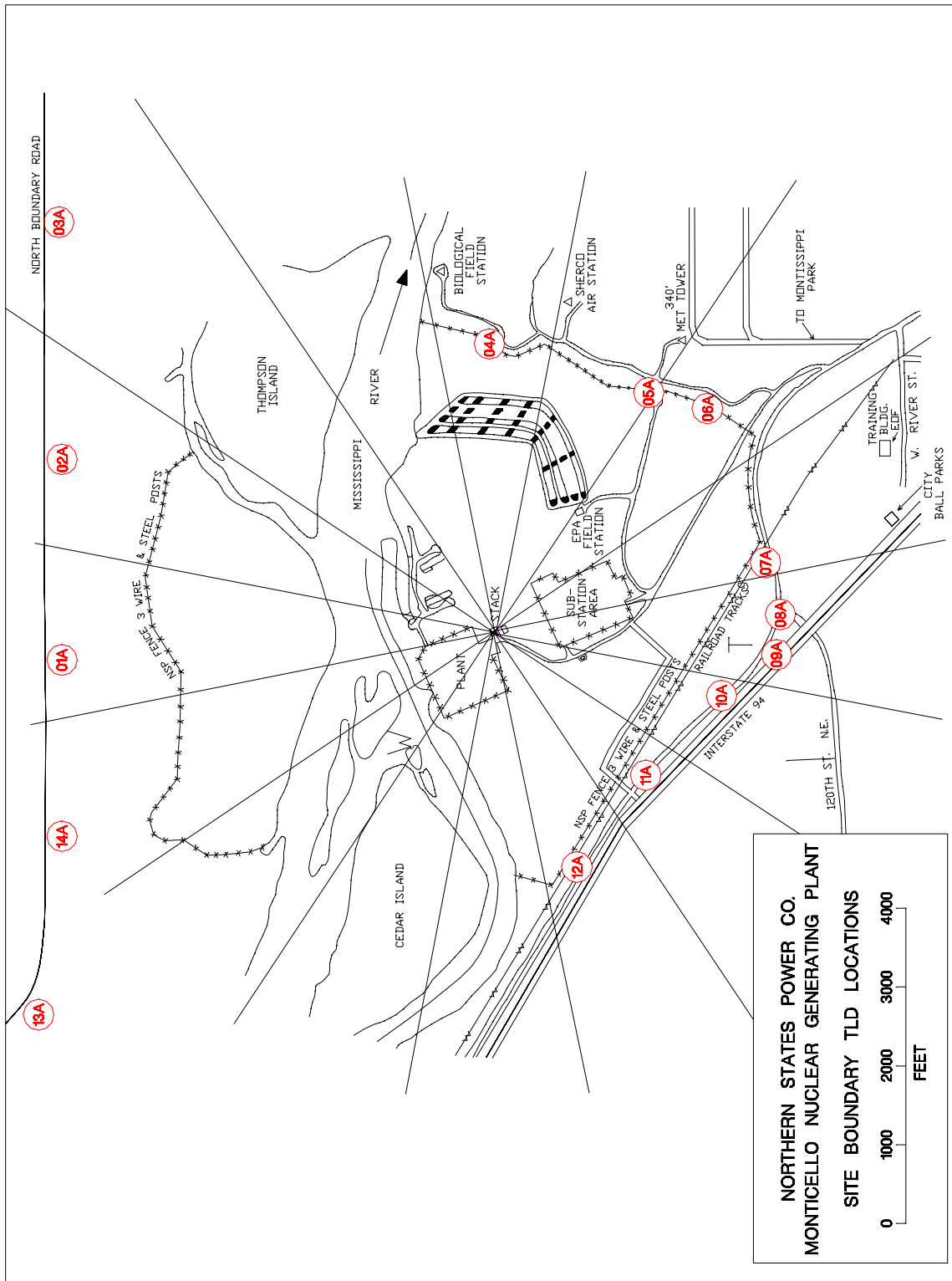
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Figure 2 4 - 5 Mile Ring, Control and Special Interest TLD Locations



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Figure 3 Site Boundary TLD Locations



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Table 1 Monticello Nuclear Generating Plant Radiological Environmental Monitoring Program Sample Collection and Analysis

Exposure Pathway and/or Sample	Number of Samples and Sample Locations**	Sampling and Collection Frequency	Type and Frequency of Analysis
1. <u>Airborne</u> Radioiodine & Particulates	Samples from 5 locations: 3 samples from offsite locations (in different sectors) of the highest calculated annual average ground level D/Q, 1 sample from the vicinity of a community having the highest calculated annual average ground-level D/Q, and 1 sample from a control location specified in Table 4.	Continuous Sampler operation with sample collection weekly.	Radioiodine analysis Weekly for I-131 Particulate: Gross beta activity on each filter weekly*. Analysis SHALL be performed more than 24 hours following filter change. Perform gamma isotopic analysis on composite (by location) sample quarterly.
2. <u>Direct Radiation</u>	40 TLD stations established with duplicate dosimeters placed at the following locations:****	Quarterly	Gamma Dose quarterly

* If gross beta activity in any indication sample exceeds 10 times the yearly average of the control sample, a gamma isotopic analysis is required.

** Sample locations are further described in Table 4.

**** Three control TLD locations have only one dosimeter.

Table 1 Monticello Nuclear Generating Plant Radiological Environmental Monitoring Program Sample Collection and Analysis (cont'd)

Exposure Pathway and/or Sample	Number of Samples and Sample Locations**	Sampling and Collection Frequency	Type and Frequency of Analysis
2. <u>Direct Radiation (cont'd)</u>	<ol style="list-style-type: none"> Using the 16 meteorological wind sectors as guidelines, an inner ring of stations in the general area of the site boundary is established and an outer ring of stations at 4 to 5 mile distance from the plant site is established. Because of inaccessibility, two sectors in the inner ring are not covered. Ten dosimeters are established at special interest areas and four control stations. 		
3. <u>Waterborne</u>			
a. <u>Surface</u>	Upstream & downstream locations.	Monthly composite of weekly samples (water & ice conditions permitting)	<p>Gamma Isotopic analysis of each monthly composite</p> <p>Tritium analysis of quarterly composites of monthly composites</p>

** Sample locations are further described in Table 4.

Table 1 Monticello Nuclear Generating Plant Radiological Environmental Monitoring Program Sample Collection and Analysis (cont'd)

Exposure Pathway and/or Sample	Number of Samples and Sample Locations**	Sampling and Collection Frequency	Type and Frequency of Analysis
3. <u>Waterborne (cont'd)</u> b. Ground	Three samples from wells within 5 miles of the plant site and one sample from a well greater than 10 miles from the plant site.	Quarterly	Gamma Isotopic and tritium analyses of each sample
c. Drinking	One sample from the City of Minneapolis water supply.	Monthly composite of weekly samples	I-131 Analysis and Gross beta and Gamma isotopic analysis of each monthly composite Tritium analysis of quarterly composites of monthly composites
d. Sediment from Shoreline	One sample upstream of plant, one sample downstream of plant, and one sample from shoreline of recreational area.	Semiannually	Gamma isotopic analysis of each sample

** Sample locations are further described in Table 4.

Table 1 Monticello Nuclear Generating Plant Radiological Environmental Monitoring Program Sample Collection and Analysis (cont'd)

Exposure Pathway and/or Sample	Number of Samples and Sample Locations**	Sampling and Collection Frequency	Type and Frequency of Analysis
4. <u>Ingestion</u> a. Milk	One sample from dairy farm having highest D/Q, one sample from each of three dairy farms (if available) calculated to have doses from I-131 >1 mrem/yr, and one sample from 10-20 miles.	Monthly or biweekly if animals are on pasture	Gamma isotopic and I-131 analysis of each sample
b. Fish and Invertebrates	One sample of one game specie of fish located upstream and downstream of the plant site. One sample of Invertebrates upstream and downstream of the plant site.	Samples collected semi-annually	Gamma isotopic analysis on each sample (edible portion only on fish).

** Sample locations are further described in Table 4.

Table 1 Monticello Nuclear Generating Plant Radiological Environmental Monitoring Program
Sample Collection and Analysis (cont'd)

Exposure Pathway and/or Sample	Number of Samples and Sample Locations**	Sampling and Collection Frequency	Type and Frequency of Analysis
4. <u>Ingestion (cont'd)</u> c. Food Products	One sample of corn and potatoes from any area that is irrigated by water in which liquid radioactive effluent has been discharged. ***	At time of harvest	Gamma isotopic analysis of edible portion of each sample
	One sample of broad leaf vegetation from highest D/Q garden and one sample from 10-20 miles.	At time of harvest	I-131 analysis of edible portion of each sample

** Sample locations are further described by in Table 4.

*** As determined by methods outlined in section 2.3.

Table 2 Reporting Levels for Radioactivity Concentrations in Environmental Samples
(Reporting Levels)

Analysis	Water (pCi/l)	Airborne Particulate or Gas (pCi/m ³)	Fish (pCi/kg, wet)	Milk (pCi/l)	Vegetables (pCi/kg, wet)
H-3	2 x 10 ⁴ (a)				
Mn-54	1 x 10 ³		3 x 10 ⁴		
Fe-59	4 x 10 ²		1 x 10 ⁴		
Co-58	1 x 10 ³		3 x 10 ⁴		
Co-60	3 x 10 ²		1 x 10 ⁴		
Zn-65	3 x 10 ²		2 x 10 ⁴		
Zr-Nb-95	4 x 10 ² (b)				
I-131	2(c)	0.9		3	1 x 10 ²
Cs-134	30	10	1 x 10 ³	60	1 x 10 ³
Cs-137	50	20	2 x 10 ³	70	2 x 10 ³
Ba-La-140	2 x 10 ² (b)			3 x 10 ² (b)	

- a - For drinking water samples
- b - Total for parent and daughter
- c - If no drinking water pathways exist, a value of 20 pCi/l may be used.

Table 3 Maximum Values for the Lower Limits of Detection (LLD)^{a,e}

Analysis	Water (pCi/l)	Airborne Particulate or Gas (pCi/m ³)	Fish (pCi/kg, wet)	Milk (pCi/l)	Food Products (pCi/kg, wet)	Sediment (pCi/kg, dry)
gross beta	4 ^b	1 x 10 ⁻²				
³ H	2000 (1000 ^b)					
⁵⁴ Mn	15		130			
⁵⁹ Fe	30		260			
⁵⁸ , ⁶⁰ Co	15		130			
⁶⁵ Zn	30		260			
⁹⁵ Zr-Nb	15 ^c					
¹³¹ I ^d	1 ^b	7 x 10 ⁻²		1	60	
¹³⁴ , ¹³⁷ Cs	15 (10 ^b), 18	1 x 10 ⁻²	130	15	60	150
¹⁴⁰ Ba-La	15 ^c			15 ^c		

Table 3 Maximum Values for the Lower Limits of Detection (LLD)^{a,e} (cont'd)

TABLE NOTATION

a - The LLD is the smallest concentration of radioactive material in a sample that will be detected with 95% probability with 5% probability of falsely concluding that a blank observation represents a "real" signal. For a particular measurement system (which may include radiochemical separation):

$$LLD = \frac{4.66 S_b}{E \cdot V \cdot 2.22 \cdot Y \cdot \exp(-\lambda \cdot \Delta t)}$$

where:

- LLD is the a priori lower limit of detection as defined above (as picocurie per unit mass or volume),
- S_b is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute). Typical values of E, V, Y and Δt **SHALL** be used in the calculations.
- E is the counting efficiency (as counts per transformation)
- V is the sample size (in units of mass or volume)
- 2.22 is the number of transformations per minute per picocurie
- Y is the fraction radiochemical yield (when applicable)
- λ is the radioactive decay constant for the particular radionuclide
- Δ t is the elapsed time between sample collection (or end the sample collection period) and time of counting
- b - LLD for drinking water.
- c - Total for parent and daughter
- d - These LLDs apply only where "I-131 analysis" is specified.
- e - Where "Gamma Isotopic Analysis" is specified, the LLD specifications applies to the following radionuclides: H-3, Mn-54, Fe-59, Co-58, Co-60, Zn-65, Zr-Nb-95, Cs-134, Cs-137 and Ba-La-140. Other peaks which are measurable and identifiable, together with the above nuclides **SHALL** be identified and reported.

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Table 4 Monticello Nuclear Generating Plant Radiological Environmental Monitoring Program Sampling Locations

Type of Sample	Code	Collection Site	Location		
			Distance Miles	Compass Heading	Sector
River water	M-8c	Upstream of plant	w/in 1000 ft upstream of plant intake		
River water	M-9	Downstream of plant	w/in 1000 ft downstream of plant discharge		
Drinking water	M-14	City of Minneapolis	37.0	132	SE
Well water	M-10c	Campbell Farm	10.6	357	N
Well water	M-11	City of Monticello	3.4	126	SE
Well water	M-12	Plant Well No. 11	0.2	232	SW
Well water	M-27	Wise Residence	0.6	198	SSW
Sediment-River	M-8c	Upstream of plant	w/in 1000 ft upstream of plant intake		
Sediment-River	M-9	Downstream of plant	w/in 1000 ft downstream of plant discharge		
Sediment-Shoreline	M-15	Montissippi Park	1.4	114	ESE
Periphyton or Macroinvertebrates	M-8c	Upstream of plant	w/in 1000 ft upstream of plant intake		
	M-9	Downstream of plant	w/in 1000 ft downstream of plant discharge		
Fish	M-8c	Upstream of plant	w/in 1000 ft upstream of plant intake		
Fish	M-9	Downstream of plant	w/in 1000 ft downstream of plant discharge		
Milk	M-10c	Campbell Farm	10.6	357	N
Milk	M-24	Weinand Farm	4.8	178	S
Milk	M-28	Hoglund Farm	3.6	300	WNW

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Table 4 Monticello Nuclear Generating Plant Radiological Environmental Monitoring Program Sampling Locations (cont'd)

Type of Sample	Code	Collection Site	Location		
			Distance Miles	Compass Heading	Sector
Cultivated crops					
(leafy green vegetables)					
	M-27	Available Producer Highest D/Q Garden**	>10.0 0.64	207	SSW
(corn)*					
(potatoes)*					
Particulates and Radio-iodine					
(air)	M-1c	Air Station M-1	11.0	307	NW
(air)	M-2	Air Station M-2	0.9	137	SE
(air)	M-3	Air Station M-3	0.7	104	ESE
(air)	M-4	Air Station M-4	0.9	146	SSE
(air)	M-5	Air Station M-5	2.7	134	SE
Direct Radiation - (general area of the site boundary)					
(TLD)	M01A	Sherburne Ave. So.	0.7	1	N
(TLD)	M02A	Sherburne Ave. So.	0.8	31	NNE
(TLD)	M03A	Sherburne Ave. So.	1.3	55	NE
(TLD)	M04A	Biology Station Rd.	0.6	91	E
(TLD)	M05A	Biology Station Rd.	0.6	118	ESE
(TLD)	M06A	Biology Station Rd.	0.7	130	SE
(TLD)	M07A	County Road 75	0.6	148	SSE
(TLD)	M08A	County Road 75	0.6	170	S
(TLD)	M09A	County Road 75	0.6	192	SSW
(TLD)	M10A	County Road 75	0.5	218	SW
(TLD)	M11A	County Road 75	0.4	240	WSW
(TLD)	M12A	County Road 75	0.4	260	W
(TLD)	M13A	North Boundary Rd.	0.8	324	NW

* Collected only if plant discharges radioactive effluent into the river, then only from river irrigated fields. (See Section 2.1)

** As determined by Annual Land Use Census.

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Table 4 Monticello Nuclear Generating Plant Radiological Environmental Monitoring Program Sampling Locations (cont'd)

Type of Sample	Code	Collection Site	Location		
			Distance Miles	Compass Heading	Sector
(TLD)	M14A	North Boundary Rd.	0.7	340	NNW
Direct Radiation - (about 4 to 5 miles distant from the plant)					
(TLD)	M01B	Sherco No. 1 Air Sta.	4.6	3	N
(TLD)	M02B	County Road 11	4.4	20	NNE
(TLD)	M03B	County Rd. 73 & 81	4.3	53	NE
(TLD)	M04B	County Rd. 73 (196n Street)	4.3	68	ENE
(TLD)	M05B	City of Big Lake	4.4	90	E
(TLD)	M06B	County Rd 14 & 196th Street	4.4	117	ESE
(TLD)	M07B	Monte Industrial Dr.	4.4	136	SE
(TLD)	M08B	Residence Hwy 25 & Davidson Ave	4.7	161	SSE
(TLD)	M09B	Weinand Farm	4.8	178	S
(TLD)	M10B	Reisewitz Farm - Acacia Ave	4.2	204	SSW
(TLD)	M11B	Vanlith Farm - 97th Ave	4.0	226	SW
(TLD)	M12B	Lake Maria St. Park	4.2	254	WSW
(TLD)	M13B	Bridgewater Sta.	4.0	270	W
(TLD)	M14B	Anderson Res. - Cty Rd 111	4.3	289	WNW
(TLD)	M15B	Red Oak Wild Bird Farm	4.3	309	NW
(TLD)	M16B	Sand Plain Research Farm	4.3	341	NNW
Direct Radiation - (special interest locations)					
(TLD)	M01S	Osowski Fun Market	0.6	234	SW
(TLD)	M02S	Krone Residence	0.5	223	SW
(TLD)	M03S	Big Oaks Park	1.6	102	ESE
(TLD)	M04S	Pinewood School	2.4	129	SE

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Type of Sample	Code	Collection Site	Location		
			Distance Miles	Compass Heading	Sector
(TLD)	M05S	Rivercrest Christian Academy	3.1	118	ESE
(TLD)	M06S	Monte Public Works	2.7	134	SE
(TLD)	M01C	Kirchenbauer Farm	11.5	323	NW
(TLD)	M02C	Cty Rd 4 & 15	11.2	47	NE
(TLD)	M03C	Cty Rd 19 & Jason Ave	13.0	100	E
(TLD)	M04C	Maple Lake Water Tower	10.3	226	SW

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Table 4 Monticello Nuclear Generating Plant Radiological Environmental Monitoring Program
Sampling Locations (cont'd)

Notes on Table 4:

"c" denotes control locations. All other locations are indicator locations.

a. Control "leafy green" vegetable will be taken in locations as available outside 10 mi. EPZ.

The letters after TLD code numbers have the following meanings:

- A Locations in the general area of the site boundary;
- B Locations about 4 to 5 miles distant from the plant;
- S Special interest locations.