KEWAUNEE RADIOLOGICAL
ENVIRONMENTAL MONITORING MANUAL

SECTION 1

KEWAUNEE RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM AS REQUIRED BY TECHNICAL SPECIFICATION (3/4.12.1)

Purpose and Scope

The Kewaunee Radiological Environmental Monitoring Manual has been developed in accordance with NUREG 0472 and the Radiological Environmental Technical Specifications. The manual is intended to serve as an inhouse tool for program administration and as a guidance document for contractors providing services associated with the monitoring program.

Periodic reviews of monitoring data and an annual land use census will be used to develop modifications to the existing monitoring program. Upon approval, these modifications will be incorporated into the manual so that it will accurately reflect the current radiological environmental monitoring program in effect for the Kewaunee Nuclear Power Plant.

Section 1 of this manual presents those elements of the Radiological Environmental Monitoring Program which are maintained to fulfill the requirements of the Kewaunee Technical Specification Section (3/4.12.1). Section 2 presents the current study plans for Radiological Environmental Monitoring at Kewaunee which may exceed the minimum Technical Specification requirements in order to preserve data baselines and emergency planning sample goals.

Section 1
Kewaunee Radiological Environmental Monitoring Program

Introduction

The Radiological Environmental Monitoring Program as required by Technical Specification (3/4.12.1) is described in Table (3.12-1) of this manual for the Kewaunee Nuclear Power Plant. The program presents the sampling and analysis schedule which was developed to provide representative measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposures of MEMBERS OF THE PUBLIC resulting from plant operation. This monitoring program implements Section IV.B.2 of Appendix I to 10 CFR Part 50 and thereby supplements the radiological effluent monitoring program 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 the modeling of the environmental exposure pathways. Guidance for the development of this monitoring program is provided by the Radiological Assessment Branch Technical Position on Environmental Monitoring.

The required detection capabilities for environmental sample analyses are tabulated in terms of the lower limits of detection (LLDs). The LLDs required by Table 4.12-1 are considered optimum for routine environmental measurements in industrial laboratories. It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as a a posteriori (after the fact) limit for a particular measurement.

Detailed discussion of the LLD, and other detection limits, can be found in HASL Procedures Manual, HASAL-300 (revised annually), Currie, L.A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry, "Anal. Chem. 40, 586-93 (1968), and Hartwell, J.K., "Detection Limits for Radioanalytical Counting Techniques," Atlantic Richfield Hanford Company Report ARH-SA-215 (June 1975).

The Radiological Environmental Monitoring Program shall be conducted as specified in Table 3.12-1. With the program not being conducted as specified, a description of the reasons for not conducting the program as required and the plans for preventing a recurrence will be prepared and submitted to the Commission in the Annual Radiological Environmental Monitoring Report.

With the level of radioactivity as the result of plant effluents in an environmental sampling medium at a specified location exceeding the reporting levels of Table (3.12-2) when averaged over any calendar quarter, a Special

Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions to be taken to reduce radioactive effluents so that the potential annual dose* to A MEMBER OF THE PUBLIC is less than the calendar year limits will be prepared and submitted to the Commission within 30 days.

When more than one of the radionuclides in Table (3.12-2) are detected in the sampling medium, a special report shall be submitted if:

$$\frac{\text{concentration (1)}}{\text{reporting level (1)}} + \frac{\text{concentration (2)}}{\text{reporting level (2)}} + \ldots \geq 1.0$$

When radionuclides other than those in Table 3.12-2 are detected and are the result of plant effluents, a special report shall be submitted if the potential annual dose to A MEMBER OF THE PUBLIC is equal to or greater than the calendar year limits. 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 Monitoring Report.

With milk, fresh leafy vegetable, or other pathway samples unavailable from one or more of the sample locations required by Table (3.12-1), a sample from an alternative location may be substituted, noting the reason for the unavailability in the Annual Radiological Environmental Monitoring Report. When changes in sampling locations are permanent, the sampling schedule as presented in Table (3.12-1) will be updated to reflect the new routine and alternative sampling locations and this revision will be described in the Annual Radiological Environmental Monitoring Report.

Land Use Census

A land use census is provided to ensure that changes in the use of areas at and beyond the SITE BOUNDARY are identified and that modifications to the radiological environmental monitoring program are made if required by the results of this census. The best information from the door-to-door survey, from aerial survey or from consulting with local agricultural authorities shall be used. This census satisifies the requirements of Section IV.B.3 of Appendix I to 10 CFR Part 50. Restricting the census to gardens of greater than 50 m^2 provided 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 made: 1) 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/m^2.

The land use census shall be conducted to identify within a distance of 8 km (5 miles) the location in each of the 10 meteorological sectors the nearest milk animal, the nearest residence and the nearest garden* of greater than 50 m^2 (500 ft^2) producing broad leaf vegetation.

With the land use census identifying a location(s) that yields a calculated dose or dose commitment (via the same exposure pathway) 20 percent greater than the current highest calculated dose location from which samples are currently being obtained, the new location(s) will be added to the radiological environmental monitoring program within 30 days. The sampling location(s), excluding the control station location, having the lowest calculated dose or dose commitment(s), via the same exposure pathway, may be deleted from the monitoring program. The new location(s) will be identified in the next Annual Radiological Environmental Monitoring Report including revised figure(s) and table for the REMM reflecting the new location(s).

The land use census will be conducted annually during the growing season using reasonable survey methods, such as by a door-to-door survey, aerial survey, or by consulting local agriculture authorities. The results of the land use census shall be included in the Annual Radiological Environmental Monitoring Report.

Interlaboratory Comparison Program

Participation in an approved 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 the quality assurance program for environmental monitoring in order to demonstrate that the results are valid for the purposes of Section IV.B.2 of Appendix I to 10 CFR Part 50.

Analyses will be performed on radioactive materials supplied as part of an Interlaboratory Comparison Program that has been approved by the Commission. A summary of the results obtained will be included in the Annual Radiological Environmental Monitoring Report. With analysis not being performed as required above, corrective actions taken to present a recurrence will be reported to the Commission in the Annual Radiological Environmental Monitoring Report.

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* Broad leaf vegetation sampling of at least three different kinds of vegetation may be performed at the site boundary in each of two different direction sectors with the highest predicted D/Qs in lieu of the garden census.

TABLE (3.12-1)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations[a]	Sampling and Collection Frequency	Type and Frequency of Analysis
1. Direct Radiation[b]	TLD, 5 bulbs/packet, Inner Ring, locations, K-4, K-5, K-27, K-7, K-1	Quarterly	Gamma dose quarterly
	Outer Ring locations, K-2, K-3, K-15, K-17, K-6, K-8		
	Control location, K-16		
	Population center, K-7		
	St. Mary's church, K-6		
	Schiles farm, nearby resident, K-27		
2. Airborne			
Radioiodine and Particulates	3 samples close to the site boundary in highest average X/Q, K-1, K-2, K-7	Continuous sampler operation	
		Iodine-Semi-monthly	Iodine-Semi-monthly
	1 sample from the closest community having the highest X/Q, K-7	Particulates-weekly, or more frequently if required by dust loading.	Particulates-gross beta analysis following filter change.[d] Gamma isotopic of composite (by location) quarterly.[e]
	Control K-16[c]		

TABLE (3.12-1) (Continued)
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations[a]	Sampling and Collection Frequency	Type and Frequency of Analysis
3. Waterborne			
a. Surface[f]	Upstream sample, K-1a. Downstream sample, K-1e,	Monthly grab sample	Gamma isotopic[e] analysis monthly. Composite of grab samples for tritium analysis quarterly.
b. Ground	1 or 2 locations likely to be affected. K-1g, K-1h[g]	quarterly grab sample	Gamma isotopic[e] and tritium analysis quarterly
c. Drinking	1-3 samples of nearest water supplies. K-9, K-14	monthly grab sample	Monthly gross beta and gamma isotopic[e] analysis. Quarterly tritium analysis of the composite of monthly grab samples.
d. Sediment from shoreline	1 sample from downstream area with potential for recreational value. K-1c	semi-annual grab sample	Gamma isotopic[e] analysis, semi-annually
4. Ingestion			
a. Milk	Samples from milking animals in 3 locations within 5 km having the highest dose potential. K-19, K-12, K-5. Alternate K-4 Control K-16	Semi-monthly when animals are on pasture. Monthly otherwise.	Gamma isotopic[e] and I-131 analysis semi-monthly when animals are on pasture. d Monthly otherwise.

TABLE (3.12-1) (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations[a]	Sampling and Collection Frequency	Type and Frequency of Analysis
(Ingestion cont.)			
b. Fish	3 random samplings of commercially and recreationally important species in the vicinity of the discharge. K-1d.	3 times per year	Gamma isotopic[e] on edible portions
c. Food Products	Samples of 3 leaf vegetation grown nearest each of two different offsite locations of highest predicted annual average ground level D/Q if milk sampling is not performed. K-10, K-11.	Monthly when available	Gamma isotopic[e] and I-131 Analysis.
	1 sample of leaf vegetation grown 15-30 km distant, if milk sampling is not performed. K-26.	Monthly when available	Gamma isotopic[e] and I-131 Analysis.

TABLE (3.12-1) (Continued)
Table Notation

[a] Specific parameters of distance and direction sector from the centerline of the reactor, and additional descriptions where pertinent, are provided for each and every sample location in Table (3.12-1) and Table 3.12-1a and Figures 2.1 and 2.2. Deviations from the required sampling schedule will occur if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment and other legitimate reasons. If specimens are unobtainable due to sampling equipment malfunction, reasonable efforts shall be made to complete corrective action prior to the end of the next sampling period. All deviations from the sampling schedule shall be documented in the Annual Radiological Environmental Monitoring Report. It is recognized that, at times, it may not be possible or practicable to continue to obtain samples of the media of choice at the most desired location or time. In these instances suitable alternative media and locations may be chosen for the particular pathway in question and appropriate substitutions made within 30 days in the Radiological Environmental Monitoring Program. The cause of the unavailability of samples for that pathway and the new location(s) for obtaining replacement samples will be identified in the Annual Radiological Environmental Monitoring Report.

[b] For the purposes of this table, a thermoluminescent dosimeter (TLD) is considered to be one phosphor; two or more phosphors in a packet are considered as two or more dosimeters. The 40 stations is not an absolute number. The number of direct radiation monitoring stations may be reduced according to geographical limitations; e.g., some sectors will be over water so that the number of dosimeters may be reduced accordingly.

The frequency of analysis or readout for TLD systems will depend upon the characteristics of the specific system used and should be selected to obtain optimum dose information with minimal fading.

[c] The purpose of this sample is to obtain background information. If it is not practical to establish control locations in accordance with the distance and wind direction criteria, other sites that provide valid background data may be substituted.

[d] Airborne particulate sample filters shall be analyzed for gross beta radioactivity 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air particulate samples is greater than ten times the yearly mean of control samples, gamma isotopic analysis shall be performed on the individual samples.

[e] Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.

TABLE (3.12-1) (Continued)

Table Notation

[f] The "upstream sample" shall be taken at a distance beyond significant influence of the discharge. The "downstream" sample shall be taken in an area beyond but near the mixing zone.

[g] Groundwater samples shall be taken when this source is tapped for drinking or irrigation purposes in areas where the hydraulic gradient or recharge properties are suitable for contamination.

TABLE (3.12.1a)

SAMPLING LOCATIONS

KEWAUNEE NUCLEAR POWER PLANT

Code	Distance (miles)[b] and Sector	Location
K-1		Onsite
K-1a	0.62 N	North Creek
K-1c	0.10 N	500' north of condenser discharge
K-1d	0.10 E	Condenser discharge
K-1e	0.12 S	South Creek
K-1g	0.06 W	South Well
K-1h	0.12 NW	North Well
K-2	9.50 NNE	WPS Operations building in Kewaunee
K-3	6.00 N	Lyle and John Siegmund farm, Rt. 1, Kewaunee
K-4	3.00 N	Dan Stangel farm, Rt. 1, Kewaunee
K-5	3.50 NNW	Ed Paplham farm, Rt. 1, Kewaunee
K-6	6.50 WSW	Leonard Berres farm, Rt. 1, Denmark
K-7	2.75 SSW	Earl Bruemmer farm, Rt. 3, Two Rivers
K-8	5.00 WSW	Saint Mary's Church, Tisch Mills
K-9	11.50 NNE	Rostok Water Intake for Green Bay, two miles north of Kewaunee
K-10	1.50 NNE	Turner farm, Kewaunee site
K-11	1.00 NW	Harlan Ihlenfeld farm
K-12	1.50 WSW	Lecaptain farm, one mile west of site
K-14	2.50 S	Two Creeks Park, 2.5 miles south of site
K-15	9.25 NW	Gas Substation, 1.5 miles north of Stangelville
K-16	26.00 NW	WPS Division Office Building, Green Bay, Wisconsin
K-17	4.25 W	Jansky farm, Rt. 1, Kewaunee
K-19	1.75 NNE	Wayne Paral farm, Rt. 1, Kewaunee
K-26	10.70 SSW	Bertler's Fruit Stand (8.0 miles south of BB)
K-27	1.50 NW	Schlies farm, 0.5 miles west of K-11

[b] Distances are measured from the reactor stack

TABLE (3.12-2)

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

Reporting Levels

Analysis	Water (pCi/l)	Airborne Particulate or Gases (pCi/m^3)	Fish (pCi/kg, wet)	Milk (pCi/l)	Food Products (pCi/kg, wet)
H-3	20,000*				
Mn-54	1,000		30,000		
Fe-59	400		10,000		
Co-58	1,000		30,000		
Co-60	300		10,000		
Zr-Nb-95	400				
I-131	2	0.9		3	100
Cs-134	30	10	1,000	60	1,000
Cs-137	50	20	2,000	70	2,000
Ba-La-140	200			300	

* For drinking water samples, this is 40 CFR Part 141 value. If no drinking water pathway exists, a value of 30,000 pCi/l may be used.

TABLE (4.12-1)

DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS[a]

LOWER LIMIT OF DETECTION (LLD)[b, c]

Analysis	Water (pCi/l)	Airborne Particulate or Gases (pCi/m^3)	Fish (pCi/kg, wet)	Milk (pCi/l)	Food Products (pCi/kg, wet)	Sediment (pCi/kg, dry)
gross beta	4	0.01				
H-3	2000*					
Mn-54	15		130			
Fe-59	30		250			
Co-58,60	15		130			
Zr-Nb-95	15					
I-131	1[d]	0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-La-140	15			15		

* If no drinking water pathway exists, a value of 3000 pCi/l may be used.

TABLE (4.12-1) (Continued)

Table Notation

[a] This list does not mean that only these nuclides are to be considered. Other peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radiological Environmental Monitoring Report.

[b] Required detection capabilities for thermoluminescent dosimeters used for environmental measurements are given in Regulatory Guide 4.13.

[c] The LLD is defined, for purposes of these specifications, as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system, which may include radiochemical separation:

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

Where:

LLD is the a priori lower limit of detection as defined above, as picocuries 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,

E is the counting efficiency, as counts per disintegration,

V is the sample size in units of mass or volume,

2.22 is the number of disintegrations per minute per picocurie,

Y is the fractional radiochemical yield, when applicable,

λ is the radioactive decay constant for the particular radionuclide, and

Δt for environmental samples is the elapsed time between sample collection, or end of the sample collection period, and time of counting,

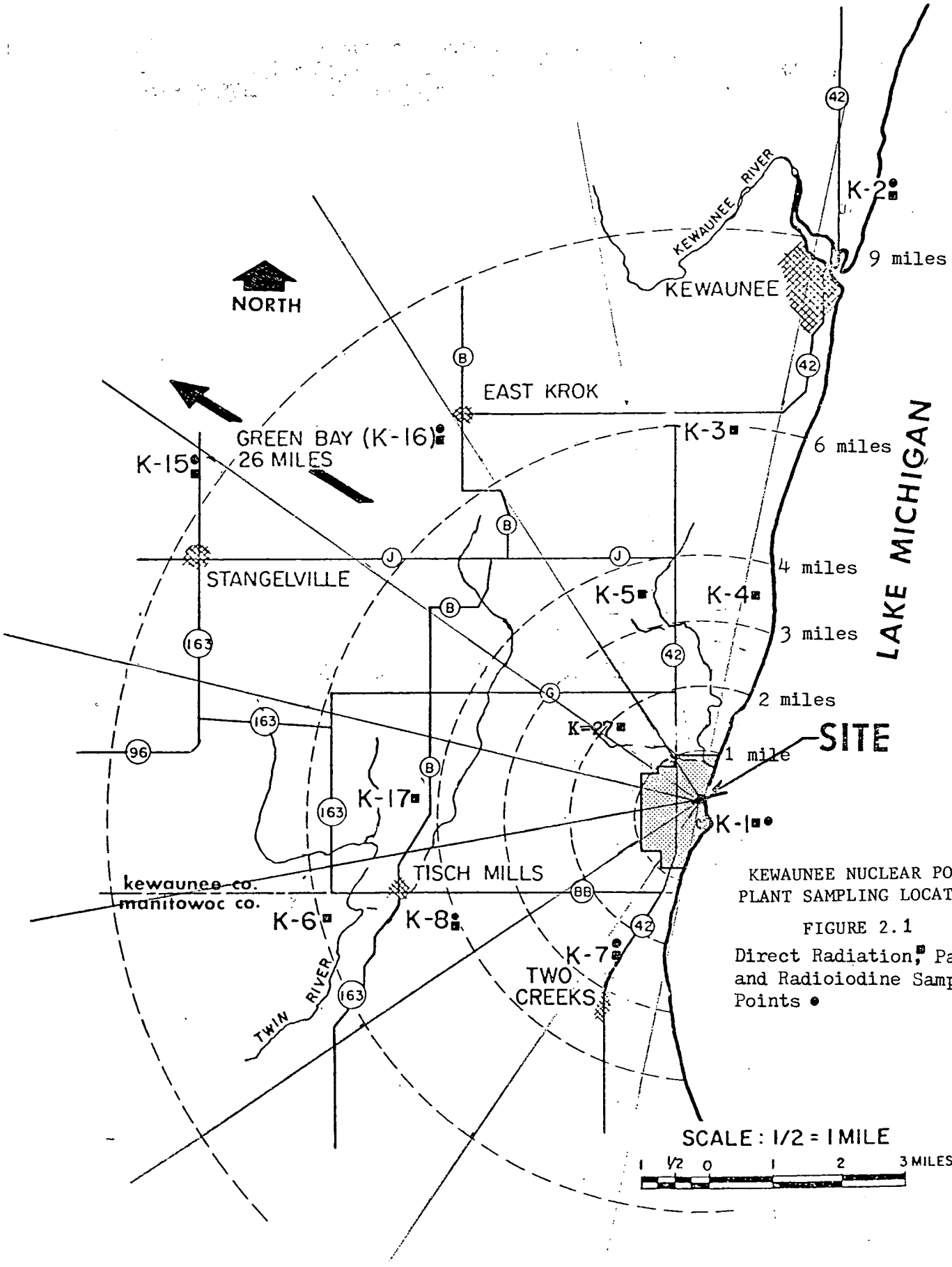
Typical values of E, V, Y, and Δt should be used in the calculation.

TABLE (4.12-1) (Continued)

Table Notation

It should be recognized that the LLD is defined as an a priori (before the fact) limit represanting the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement. Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally background fluctuations, unavoidable small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors shall be identified and described in the Annual Radiological Environmental Operating Report.

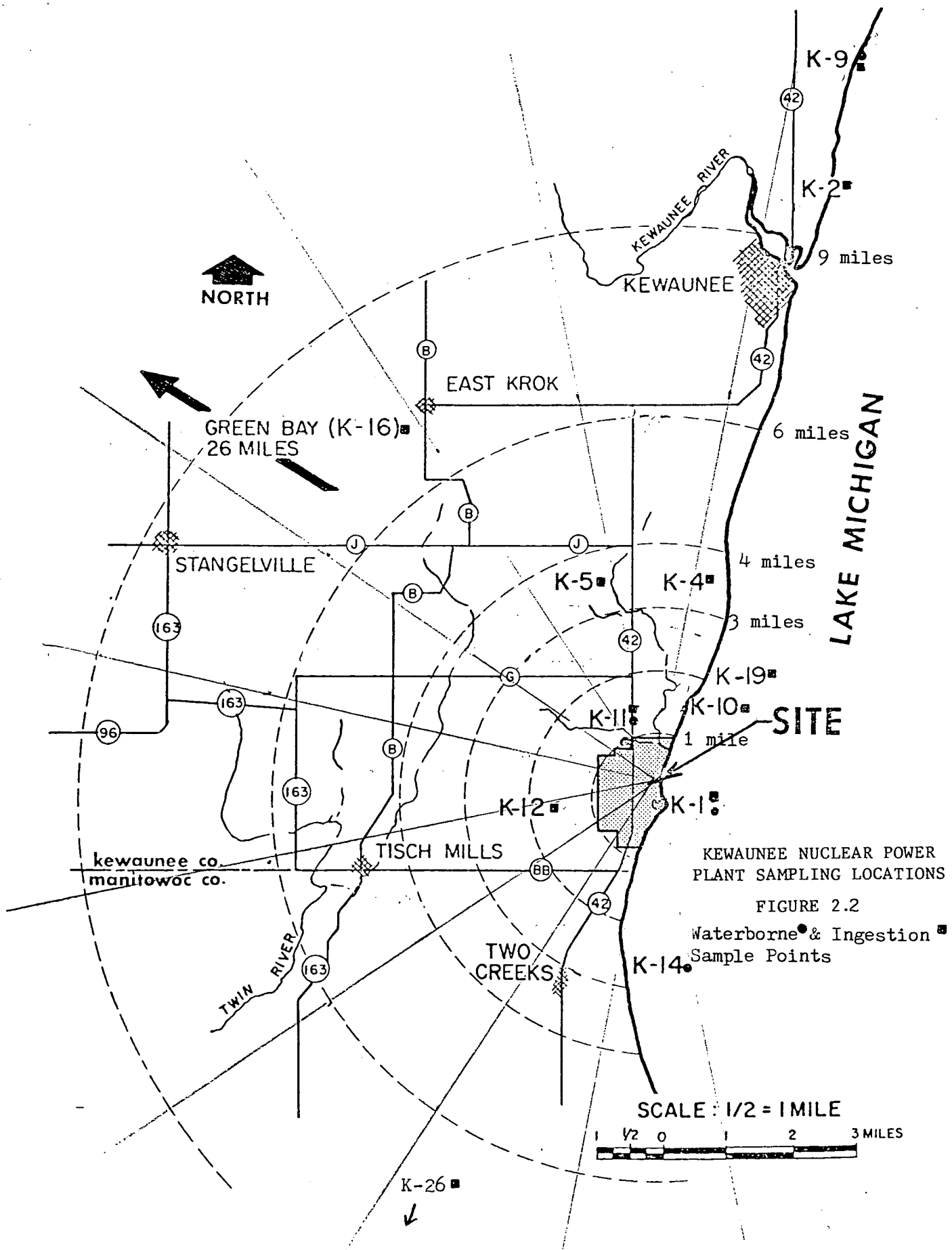
d LLD for drinking water samples. If no drinking water pathway exists, the LLD of gamma isotopic analysis may be used.



KEWAUNEE NUCLEAR POWER PLANT SAMPLING LOCATIONS

FIGURE 2.1

Direct Radiation, Partic. and Radioiodine Sample Points •



KEWAUNEE NUCLEAR POWER PLANT SAMPLING LOCATIONS

FIGURE 2.2

Waterborne● & Ingestion ■ Sample Points

SECTION 2

STUDY PLAN FOR EXPANDED RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM