

STATE OF WISCONSIN

1986

Kewaunee

Environmental Radioactivity Survey

NRC 30-83-647



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STATE OF WISCONSIN DHSS

1986

KEWAUNEE ENVIRONMENTAL RADIOACTIVITY SURVEY

INTRODUCTION

This report is prepared under U.S. Nuclear Regulatory Commission Contract NRC 30-83-647 by the State of Wisconsin, Department of Health and Social Services, Section of Radiation Protection. This report covers the calendar year 1986. Results of environmental radioactivity monitoring are listed in tabular form. The data presented consists of duplicative sample analysis such as air and TLD data and split sample analysis conducted by the state radiation protection laboratory or subcontractor and the licensee. A brief description of sample collection techniques and analytical procedures conducted by the state laboratory is also given. A sample collection summary for 1986 is included in Table 5. The sample summary includes type and number of samples collected, Minimum Detectable Concentrations (MDC's) or Lower Limits of Detection (LLD) as well as the range of reported activities for each type of sample analysis.

SAMPLING TECHNIQUES

Direct Radiation - Thermoluminescent Dosimeters (TLD's)

Continuous monitoring of direct radiation is performed quarterly using thermoluminescent dosimeters. The dosimeters are placed at 43 locations in the area of the Kewaunee and the Point Beach nuclear power plants.

Air Samples

Continuous air samples are collected weekly from two stations. Air particulate samples are collected on 47 mm. glass fiber filters. Air iodine samples are collected using charcoal absorbers mounted in tandem with the air particulate filters. The nominal sampling rate is in the range of 1 - 2.5 cubic feet of air per minute.

Surface Water

A split sample consisting of 3.5 liters of liquid effluent is collected monthly at a point close to the discharge of the Kewaunee effluent channel. This sample is a grab sample and is collected while the plant is discharging liquid to the channel. A background surface water sample is also taken at the Green Bay Pumping Station - Rostok, 11.5 miles NNE.

Milk

A raw milk sample is collected monthly from the D. Stangel farm, 3.0 miles N, of the Kewaunee nuclear power facility.

Sediment

Sediment is collected from four locations on an annual basis.

Fish

Both migratory and non-migratory fish are collected periodically from locations in Lake Michigan near the Point Beach - Kewaunee area.

Food Products

Split samples of food products were collected from a local farm and a fruit stand. Food products that were sampled included cabbage and sweet corn.

ANALYTICAL PROCEDURES

The procedures given are abstracted to present only the basic steps. The analysis of the samples has been subcontracted to the State Laboratory of Hygiene. A detailed description of the procedures used is available from the State Laboratory of Hygiene.

Air Particulate Samples - Beta Gamma

Place the 47 mm. glass fiber filter on a 2-inch stainless steel planchet. Beta count in an external gas flow proportional counter. Calculate activity correcting for counter efficiency.

Air Particulate Samples - Gamma

The quarterly composite of air particulate filters is placed on a Ge(Li) detector and the gamma spectrum is collected. Scan the spectrum for any peaks and print out regions of interest which would include possible plant attributable radionuclides. Calculate the activity for isotopes in the regions of interest, regardless if they are above or below the minimum detectable concentration, correcting for counter efficiency and for decay.

Surface Water - Alpha, Beta Gamma

Filter a 500 ml. aliquot of sample. Evaporate filtrate in a 2-inch stainless steel planchet. Place filter paper in a 2-inch stainless steel planchet and dry at 103 degrees Celsius. Beta and alpha count the soluble and insoluble portions in an external gas flow proportional counter. Calculate activity correcting for counter efficiency and for self-absorption.

Surface Water - Iodine 131 Chemical Extraction

A stable iodine carrier is added to a 2 liter sample of raw milk. The

sample is passed through an anion exchange column and the iodine is removed from the resin by batch/extraction using NaOCl. After reduction to elemental iodine by hydroxylamine hydrochloride, the iodine is extracted into carbon tetrachlorine reduced with bisulfite, and back extracted into water. The iodine is precipitated as palladous iodide with the chemical yield determined gravimetrically and counted in an external gas flow proportional counter correcting for counter efficiency and for decay.

Surface Water - Gamma Isotopic

A 3.5 liter sample is placed in a Marinelli beaker and analyzed on a GeLi detector. Scan the spectrum for any peaks and print out regions of interest which would include possible plant attributable radionuclides. Calculate the activity for isotopes in the regions of interest, regardless if they are above or below the minimum detectable concentration, correcting for counter efficiency and for decay.

Vegetation or Food Product - Alpha, Beta and Gamma Isotopic

Dry sample at 110 degrees Celsius, grind, weigh into stainless steel planchet. Beta and alpha count in an external gas flow proportional counter. Calculate activity correcting for self-absorption and counter efficiency.

The food product sample is finely chopped. The sample is packed to the 500 ml mark of a 500 ml Marinelli beaker, weighed and counted on a Ge(Li) detector. Scan the spectrum for any peaks and print out regions of interest which would include possible plant attributable radionuclides. Calculate the activity for isotopes in the regions of interest, regardless if they are above or below the minimum detectable concentration, correcting for counter efficiency and for decay.

Soil or Sediment - Alpha, Beta and Gamma Isotopic

Dry sample at 110 degrees Celsius, grind and weigh into a stainless steel planchet. Beta and alpha count in an external gas flow proportional counter. Calculate activity correcting for self-absorption and counter efficiency.

The dried sample is added to a 500 ml Marinelli beaker, weighed and counted on a Ge(Li) detector. Scan the spectrum for any peaks and print out regions of interest which would include possible plant attributable radionuclides. Calculate the activity for isotopes in the regions of interest, regardless if they are above or below the minimum detectable concentration, correcting for counter efficiency and for decay.

Milk - Gamma Isotopic

Procedure same as for Surface Water.

Milk - Iodine 131 Chemical Extraction

Procedure same as for Surface Water.

Fish - Gamma Isotopic

A sample is placed in a 500 ml. Marinelli beaker. Place the sample on a GeLi detector and collect the gamma spectrum. Scan the spectrum for any peaks and print out regions of interest which would include possible plant attributable radionuclides. Calculate the activity for isotopes in the regions of interest, regardless if they are above or below the minimum detectable concentration, correcting for counter efficiency and for decay.

Direct Radiation

Thermoluminescent dosimeters are supplied by the U.S. Nuclear Regulatory Commission. The exposed TLD's are shipped to NRC Region I and are read by the Commission.

QUALITY ASSURANCE

The analysis of the samples is performed under subcontract with the State Laboratory of Hygiene (SLH). SLH maintains its own quality assurance program which was also reviewed by the NRC in January, 1985.

Analytical procedures provide for routine replicate analyses to verify methods and instrument operation. Traceable sources are used to regularly calibrate the counters and daily performance checks are made between calibrations. In addition, quality control charts are maintained on the counters.

SLH participates in the EPA Cross Check program. The quality assurance program that the SLH participates in include analysis of blind samples, air filters, food, milk, gamma in water, alpha-beta in water, iodine in water, strontium in water and tritium in water. The EPA Cross Check code for SLH is "AF". A complete listing of the EPA Cross Check results for 1985 and 1986 is included in Table 6.

SENSITIVITIES AND ERROR - WISCONSIN DHSS

Following the recommendations of the Health Physics Society, detection limits will be expressed as a minimum detectable concentration (MDC). The minimum detectable concentration or MDC is an "a priori" estimate of the capability for detecting an activity concentration by a given measurement system, procedure, and type of sample. The MDC should not be viewed as an absolute activity concentration that can or cannot be detected. Minimum detectable concentrations (MDC) are based on the analysis performed and for gamma isotopic analysis have been calculated for a zero decay time. Minimum detectable concentrations (MDC's) are listed in Table 5.

The WI DHSS definition for minimum detectable concentration follows closely the equation for the lower limits of detection as defined in the NRC contract NRC-30-83-647. Activities defined by the equation for MDC will be used in this report.

The MDC for each radioisotope has been calculated from the following equation:

$$\text{MDC} = \frac{4.66 s_b}{E * V * 2.22 * Y * S * \exp(-dt)}$$

Where:

MDC 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,

S is the self-absorption correction factor,

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

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

Guidelines adopted by the U.S. Environmental Protection Agency are used in the reporting of specific analyses. Results from specific analyses will be reported whether the results are negative, zero, or positive. Caution should be exercised in the interpretation of individual negative values. While a negative activity value does not have physical significance, it is significant when taken together with other observations which indicate that the true value of a distribution is near zero. This procedure will allow all of the data to be reported and will allow a statistical evaluation without an arbitrary cutoff of small or negative numbers. An estimation of bias in the nuclide analyses is then possible as well as a better evaluation of distributions and trends in the environmental data. It is important when reviewing the data in the following tables to compare the reported result to the actual minimum detectable concentration (MDC) for that analysis.

Results for specific analyses will be reported as an activity followed by an error term for that analysis. The error term is a plus or minus counting error term at the 2 sigma (95%) confidence interval and is printed as (+/-).

RESULTS AND DISCUSSION

A sample collection summary for 1986 is included in Table 5. The sample summary includes the type and number of samples collected as well as the range of reported activities for each type of sample analysis. Results from the individual sample analyses are listed in Tables 7-20.

Radioactive fallout resulting from the Soviet accident at Chernobyl was detected in WI DHSS and Kewaunee samples collected during the time period of 05/01/86 - 07/01/86. Sample analysis results are discussed in the individual sections and dose calculations are performed in the section Dose to Individuals from Radioactive Fallout from the Soviet Accident at Chernobyl.

Air Particulate

WI DHSS and Kewaunee maintain separate air sampling stations. The indicator site for both WI DHSS and for Kewaunee is located at the meteorological tower, 0.12 miles S. The control site for WI DHSS is located at the Green Bay Pumping Station - Rostok, 11.5 miles NNE, and for Kewaunee at the WPS building - Kewaunee, 9.5 miles NNE.

A summary of reported activities by WI DHSS and Kewaunee from air particulate samples is included in Table 5. Results from the individual sample analyses are listed in Tables 7-10.

The yearly averages, from a log-normal distribution, for the gross beta analysis on the air particulate filters are given in Table 1.

The WI DHSS and Kewaunee yearly averages for gross beta activity from the air particulate filters are comparable and showed no significant differences between their respective indicator and control sites.

Table 1. Comparison of yearly log-normal averages for gross beta activities of the air particulate samples.

WI - Section of Radiation Protection		Kewaunee	
units of pCi/M ³			
Indicator	Control	Indicator	Control
0.015 ± 0.002	0.013 ± 0.002	0.019 ± 0.003	0.017 ± 0.003

The elevated gross beta activities for the time period of 05/06/86 - 06/12/86 are due to radioactive fallout from the Soviet accident at Chernobyl. Elevated gross beta activities were reported by WI DHSS and Kewaunee and were present in samples from both the indicator and the control sites. Elevated gross beta activities were also reported in air particulate samples from the three other WI DHSS environmental monitoring areas.

A summary of reported gamma isotopic activities for WI DHSS and Kewaunee from the monthly or quarterly air particulate filter composites is included in Table 5. Results from the individual sample analyses are listed in Tables 11-12.

In the WI DHSS gamma isotopic analysis, beryllium-7 (Be-7) was detected in all composites from both the indicator and the control sites. Beryllium-7 (Be-7) is a naturally occurring radioisotope that is constantly produced through nuclear reactions between cosmic rays and nuclei in the atmosphere. All other radionuclides were below their respective MDC for the 1st, 3rd and 4th quarter composites.

For Kewaunee, naturally occurring beryllium-7 (Be-7) was detected in all quarterly composites from both the indicator and the control sites. All other radionuclides were below their respective LLD for the 1st, 3rd and 4th quarter composites for 1986.

At the observed lower levels of activity the WI DHSS and Kewaunee data are comparable in the gamma isotopic analysis on the air particulate samples. Influence by the Kewaunee nuclear facility on air quality is not evident when comparing the data from the indicator and control sites for the 1st, 3rd and 4th quarters of 1986.

Radioactive fallout resulting from the Soviet accident at Chernobyl was detected in WI DHSS and Kewaunee samples for the time period of 05/05/86 - 06/12/86. The radioisotopes detected in the WI DHSS sample analysis of the May and June monthly composites of air particulate samples were ruthenium-103 (Ru-103), cesium-134 (Cs-134) and cesium-137 (Cs-137). The indicated radioisotopes were detected in both the control and the indicator composites and the activities from both sites are listed in Tables 11-12. The indicated radioisotopes were also detected in air particulate composites from the three other WI DHSS environmental monitoring areas within Wisconsin at approximately the same activities.

For the 2nd quarter composites, Kewaunee reported activities for ruthenium-103 (Ru-103), cesium-134 (Cs-134) and cesium-137 (Cs-137) for both the indicator and the control sites.

The WI DHSS and Kewaunee data are comparable in the gamma isotopic analysis of the air particulate samples for the 2nd quarter of 1986.

Air Iodine

Air iodine samples are taken at the same sites as the air particulate samples.

A summary of reported air iodine activities for WI DHSS and Kewaunee is included in Table 5. Results from the individual sample analyses are listed in Tables 7-10.

All reported WI DHSS and Kewaunee air iodine (I-131) measurements except for the time period of 05/06/86 - 06/12/86 were below the WI DHSS MDC or the Kewaunee LLD for both the indicator and the control sites.

Radioactive fallout from the Soviet accident at Chernobyl was detected in WI DHSS and Kewaunee air iodine (I-131) measurements. The weekly air iodine (I-131) activity for the time period of 05/06/86 - 06/12/86 was in the range of 0.03 - 0.15 pCi/M³ for WI DHSS and <0.03 - 0.81 pCi/M³ for Kewaunee. Air iodine (I-131) activity was observed at both the indicator and the control sites for WI DHSS and Kewaunee. Elevated air iodine (I-131) activity was also observed in the three other WI DHSS environmental monitoring areas.

Surface Water

Surface water at the effluent channel is collected as a grab sample on a monthly basis and is then split between WI DHSS and Kewaunee. Surface water at the control site, Green Bay Pumping Station - Rostok, is also collected as a grab sample on a monthly basis. The control site is not a split sample as WI DHSS and Kewaunee sample on different days during the month.

A summary of reported activities by WI DHSS and Kewaunee from the monthly surface water samples is included in Table 5. Results from the individual sample analyses are listed in Tables 13-16.

All reported activities from the gamma isotopic analyses by WI DHSS and Kewaunee were below the respective WI DHSS MDC or the respective Kewaunee LLD for both the indicator site (effluent channel) and the control site (Green Bay Pumping Station - Rostok).

The WI DHSS and Kewaunee reported activities for tritium (H-3) are comparable when the WI DHSS monthly activities were quarterly composited. The WI DHSS average gross beta activities for the indicator and control sites are 5.4±1.5 pCi/liter and 3.9±1.5 pCi/liter respectively. The Kewaunee average gross beta activities for the indicator and control sites are 2.9±0.6 pCi/liter and 2.1±0.5 pCi/liter respectively. WI DHSS reported three iodine-131 (I-131) activities above its MDC of 0.4 pCi/liter for samples taken at the effluent channel. The WI DHSS reported activities for iodine-131 (I-131) were 0.6±0.2, 0.7±0.2 and 3.1±0.6 pCi/liter. Kewaunee does not perform a chemical procedure for iodine-131 (I-131) and the reported WI DHSS activities are less than the Kewaunee LLD for iodine-131 (I-131) in its gamma isotopic analysis.

All activities reported by either WI DHSS or Kewaunee are below the standards for uncontrolled areas specified in ICRP Report No. 2 or 10 CFR 20. Plant influence is not evident after comparing the WI DHSS and Kewaunee data from the indicator and control sites.

Radioactive fallout from the Soviet accident at Chernobyl was not evident or detectable in surface water samples.

Fish

One split sample was taken for fish. Additional fish were included for WI DHSS that were collected by the Point Beach facility in the vicinity of the Kewaunee and Point Beach plants.

A summary of reported activities by WI DHSS and Kewaunee for fish samples is included in Table 5. Results from the individual sample analyses are listed in Table 17.

For WI DHSS, the detected levels of activity for cesium-137 (Cs-137) and for naturally occurring potassium-40 (K-40) were also reported in previous years. For Kewaunee, activities for cesium-137 (Cs-137) and naturally occurring potassium-40 (K-40) were also reported.

At the low level of reported activities the WI DHSS and Kewaunee data are comparable.

Radioactive fallout from the Soviet accident at Chernobyl was not evident or detectable in fish samples.

Shoreline Sediments

Split samples were taken for shoreline sediments at four locations.

A summary of reported activities by WI DHSS and Kewaunee for shoreline sediment samples is included in Table 5. Results from the individual sample analyses are listed in Table 18.

From the WI DHSS gamma isotopic analysis, naturally occurring potassium-40 (K-40) and radioisotopes from uranium and thorium decay series were detected in all four samples. Cobalt-60 (Co-60) was detected at site K-1d and all other reported activities were below the respective WI DHSS MDC.

For Kewaunee, activities for cobalt-58 (Co-58), cobalt-60 (Co-60) and cesium-137 (Cs-137) were reported at site K-1d; cesium-137 (Cs-137) at site K-1c; cobalt-60 (Co-60), cesium-134 (Cs-134) and cesium-137 (Cs-137) at site K-1j and cesium-137 (Cs-137) at site K-9. Activities for naturally occurring potassium-40 (K-40) were reported for all four sites. All of the reported Kewaunee activities for cobalt-58 (Co-58), cobalt-60 (Co-60), cesium-134 (Cs-134) and cesium-137 (Cs-137) were less than the respective WI DHSS MDC.

The presence of trace amounts of the radioisotopes cobalt-58 (Co-58), cobalt-60 (Co-60), cesium-134 (Cs-134) and cesium-137 (Cs-137) is probably plant related. The levels of activity for these fission products are less than the required lower limits of detection as stated in the NRC 30-83-647 contract. At these low levels of activity the data for WI DHSS and Kewaunee are comparable.

Radioactive fallout from the Soviet accident at Chernobyl was not evident or detectable in shoreline sediment samples.

Milk

Milk is collected as a grab sample on a monthly basis. A split sample is not taken as WI DHSS and Kewaunee sample on different dates.

A summary of reported activities by WI DHSS and Kewaunee for milk samples is included in Table 5. Results from the individual sample analyses are listed in Table 19.

Wisconsin detected only naturally occurring potassium-40 (K-40) above MDC in its gamma isotopic analysis. All activities for iodine-131 (I-131) were below the MDC of 0.4 pCi/liter.

Kewaunee detected only naturally occurring potassium-40 (K-40) above the respective MDC's in its gamma isotopic analysis. Reported data for iodine-131 (I-131) was less than 0.5 pCi/liter except for the samples from 05/20/86, 06/03/86 and 07/02/86 where iodine-131 (I-131) activities of 1.1 ± 0.2 , 1.5 ± 0.2 and 2.5 ± 0.5 pCi/liter respectively were reported. The reported iodine-131 (I-131) activities by WI DHSS for respective months were less than its MDC of 0.4 pCi/liter. A comparison is not possible since split samples were not taken.

The WI DHSS and Kewaunee data are comparable although a direct comparison is not possible since split samples were not taken. Influence by the Kewaunee nuclear facility is not evident after reviewing the WI DHSS and Kewaunee data.

Radioactive fallout from the Soviet accident at Chernobyl was detected in WI DHSS milk samples during the time period of 05/14/86 - 06/30/86. Milk samples from local farms were collected from the four WI DHSS environmental monitoring areas and pooled milk samples were collected from six major milk cooperatives within Wisconsin. Iodine-131 (I-131) was detected in a majority of the samples at activities ranging from the WI DHSS MDC of 0.4 pCi/liter up to 45 pCi/liter and cesium-137 (Cs-137) in only a couple of samples at activities only slightly above the WI DHSS MDC of 12 pCi/liter. The reported Kewaunee iodine-131 (I-131) activities for the 05/20/86, 06/03/86 and 07/02/86 samples are probably due to radioactive fallout and not from the Kewaunee nuclear facility.

Vegetation - Food Products

A split sample for food products was taken at two locations.

A summary of reported activities by WI DHSS and Kewaunee for food product samples is included in Table 5. Results from the individual sample analyses are listed in Table 20.

The WI DHSS and Kewaunee gamma isotopic analysis detected only naturally occurring potassium-40 in all four samples. Iodine-131 (I-131) was not detected in any of the WI DHSS or Kewaunee samples.

From the comparison of the Wisconsin and the Kewaunee data, influence by the Kewaunee nuclear facility is not evident.

Radioactive fallout from the Soviet accident at Chernobyl was not evident or detectable in the food product samples collected at this time.

Dose to Individuals from Gaseous and Liquid Effluents

Dose calculations for gaseous and liquid effluent releases were performed according to the mathematical models illustrated in USNRC Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I". The doses, listed in Table 2, were calculated for the maximum exposed individual for WI DHSS samples with activities greater than MDC and background levels.

Doses resulting from gaseous and liquid effluent releases are in compliance with 10 CFR Part 50, Appendix I.

Dose to Individuals from Radioactive Fallout from the Soviet Accident at Chernobyl

Dose calculations were performed on samples collected after the Soviet accident at Chernobyl. Radioactive fallout was detected in air particulate and air iodine samples during the period of 05/07/86 - 06/12/86, in milk samples during the period of 05/14/86 - 06/30/86 and in vegetation samples collected in early June, 1986.

Air particulate and air iodine reported activities by WI DHSS were uniform over the four environmental monitoring areas within Wisconsin and the average activities from the four areas were used in the dose calculations. Air particulate and air iodine activities returned to and remained at background levels after 06/30/86.

Analysis of vegetation samples collected 06/02/86 from the WI DHSS LACBWR environmental monitoring area had detectable activities for ruthenium-103 (Ru-103), iodine-131 (I-131) and cesium-137 (Cs-137) in approximately the same proportions as those reported in air particulate composites. Analysis of vegetation samples collected in

September and October from the four WI DHSS environmental monitoring areas had no detectable activities for isotopes present during the period of 04/28/86 - 06/30/86.

Ground deposition affected only the milk pathway since food products were not ready for harvest at that time. Milk samples from local farms were collected from the four WI DHSS environmental monitoring areas and pooled milk samples were collected from six major milk cooperatives within Wisconsin. Iodine-131 (I-131) was detected in a majority of the samples at activities ranging from the WI DHSS MDC of 0.4 pCi/liter up to 45 pCi/liter and cesium-137 (Cs-137) was detected in only a couple of samples at activities only slightly above the WI DHSS MDC of 12 pCi/liter.

Dose calculations were performed according to the mathematical models illustrated in USNRC Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I". The calculated doses represent the dose received during the indicated time period due to radioactive fallout from the Soviet accident at Chernobyl. The doses, listed in Table 4, were calculated for the maximum exposed individual for WI DHSS samples with activities greater than MDC and background levels. The parameters used in the dose calculations are listed in Table 3.

It is important to note that the doses listed in Table 4 are calculated doses for the exposure periods listed in Table 3 and only represent the dose received from exposure to radioactive fallout from the Soviet accident at Chernobyl. From the doses listed in Table 4 it is apparent that the dose to the thyroid is the most important. The thyroid dose is due mainly to the detected activity for iodine-131 (I-131).

The thyroid dose received from air iodine (I-131) is an inhalation dose and was calculated from continuous air sampling. The air iodine (I-131) activity listed in Table 3 is the average activity from four weekly samples.

The thyroid dose from milk is an ingestion dose calculated from detected activities for iodine-131 (I-131) from grab milk samples. Iodine-131 (I-131) for the listed exposure period in Table 3 was detected in milk samples from within Wisconsin at activity levels of <MDC (0.4 pCi/liter) to 45 pCi/liter. One milk sample collected from a local farm by the LACBWR nuclear generating facility had a iodine-131 (I-131) activity of 70 pCi/liter. The activity for iodine-131 (I-131) of 45 pCi/liter listed in Table 3 is probably greater than the average activity detected during the indicated time period but was used for calculation purposes as a worst case possibility.

The activities for iodine-131 (I-131) detected in milk samples is less than the U.S. Food & Drug Administration's (FDA) Preventative Protective Action Guides (PAG's) which would require public health officials to take action to prevent food stuffs from entering commerce if the PAG is exceeded. The FDA PAG's were set up for short-term emergencies such as the Soviet accident at Chernobyl. The FDA

Preventative PAG for Iodine-131 (I-131) is 15000 pCi/liter for peak activity in milk.

The U.S. Environmental Protection Agency's (EPA) limit for iodine-131 (I-131) in water is 3 pCi/liter. The EPA limit is more protective than the FDA's Preventive PAG for iodine-131 (I-131) but this limit was set up for a lifetime consumption of drinking water. Iodine-131 (I-131) was only detected in milk samples for the time period of 05/14/86 - 06/17/86 and it would be difficult to apply the EPA limit for iodine-131 (I-131) in water.

The U.S. Environmental Protection Agency (EPA) in document 40 CFR 190 restricts the annual exposure of the population from all parts of the nuclear fuel cycle, including nuclear power plant. The EPA restriction for annual exposure is 25 millirems to the whole body or any organ, except for the thyroid for which the limit is 75 millirems.

The Wisconsin limits for permissible levels of radiation exposure from external sources in unrestricted areas is defined in the Wis. Adm. Code section HSS 157.12 which have been taken from U.S. Nuclear Regulatory Commission 10 CFR 20. The exposure limit stated in HSS 157.12 is 500 millirem whole body in any one year.

The calculated doses from radioactive fallout from the Soviet accident at Chernobyl listed in Table 4 are below current state and federal regulations and present little risk to the Wisconsin general public.

Table 2. Calculated doses to a maximum exposed individual for WI DHSS samples with activities greater than MDC and background levels.

Sample type	Description	population	Maximum Exposed Individual (mrem/year)		
			whole body	bone	thyroid
fish	average of 5	infant	---	---	---
		child	0.04	0.29	0.00
		teenager	0.11	0.23	0.00
		adult	0.19	0.22	0.00
shoreline sediment	11/03/86 K-1d	infant	---	---	---
		child	0.0008		
		teenager	0.0036		
		adult	0.0007		

Table 3. Parameters used in the dose calculations for the Soviet accident at Chernobyl.

Sample type	time period	Isotope activity	1.109 Table E-5 modification	Dose type	
air particulate	04/28/86-05/31/86	Ru-103	0.038 pCi/M3	E-5/12	Inhalation
		I-131	0.03		
		Cs-134	0.011		
		Cs-137	0.028		
air particulate	06/01/86-06/30/86	Ru-103	0.012 pCi/M3	E-5/12	Inhalation
		Cs-134	0.004		
		Cs-137	0.009		
air iodine	05/07/86-06/04/86	I-131	0.11	E-5/12	Inhalation
milk	05/14/86-06/17/86	I-131	45 pCi/l	E-5/12	Ingestion

Table 4. Calculated doses resulting from radioactive fallout from the Soviet accident at Chernobyl to a maximum exposed individual for Wisconsin samples with activities greater than MDC and background levels.

Sample type	Description	population	Maximum Exposed Individual (mrem/exposure period)		
			whole body	bone	thyroid
air	air particulate 04/28/86-05/31/86	infant	0.0002	0.0017	0.037
		child	0.0006	0.0028	0.041
		teenager	0.0013	0.0021	0.037
		adult	0.0008	0.0015	0.030
air	air particulate 06/01/86-06/30/86	infant	0.0001	0.0005	—
		child	0.0002	0.0009	—
		teenager	0.0004	0.0007	—
		adult	0.0003	0.0005	—
air	air iodine 05/07/86-06/04/86	infant	0.0002	0.0003	0.14
		child	0.0002	0.0004	0.15
		teenager	0.0002	0.0003	0.13
		adult	0.0002	0.0002	0.11
milk	05/14/86-06/17/86	infant	0.034	0.25	17.2
		child	0.030	0.15	7.1
		teenager	0.031	0.06	3.6
		adult	0.030	0.03	2.3

References

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Radiation Protection Standards, Federal Radiation Council, Report No. 2, September 1961.

U.S. Environmental Protection Agency, Environmental Radiation Protection Requirements for Normal Operations of Activities in the Uranium Fuel Cycle, 40 CFR 190, November, 1976.

U.S. Environmental Protection Agency, Upgrading Environmental Radiation Data, Health Physics Society Committee Report HPSR-1 (1980), EPA 520/1-80-012, August 1980.

U.S. Nuclear Regulatory Commission, Title 10, Part 20.

Wisconsin Department of Health and Social Services, Division of Health, Section of Radiation Protection. NRC 30-83-647, 1985 Annual report, Kewaunee Environmental Radioactivity Survey.

Table 5. Sample summary for 1998 from the environmental split sample monitoring program conducted by WI DHSS and Kewaunee.

Sample type (units)	Wisconsin data				Kewaunee data			
	MDC	Number of Samples *a	Analysis	range	NRC MDC	Number Samples *a	Analysis	range
air particulate (pCi/M ³)	0.003	99/98 12	gross beta gamma isotopic	0.002 - 0.220	0.01	104/100 8	gross beta gamma isotopic	<0.004 - 0.206
	0.025	12/12	Be-7	0.058 - 0.099	----	8/8	Be-7	0.041 - 0.095
	0.007	12/0	Zr-95	-0.001 - 0.002	----	8/0	Zr-95	<0.0016 - <0.0050
	0.004	12/6	Ru-103	-0.001 - 0.030	----	8/2	Ru-103	<0.0004 - 0.014
	0.016	12/0	Ru-106	-0.001 - 0.022	----	8/0	Ru-106	<0.0058 - <0.0019
	0.002	12/6	Cs-134	0.000 - 0.013	0.05	8/2	Cs-134	<0.0007 - 0.0071
	0.002	12/6	Cs-137	0.000 - 0.028	0.06	8/2	Cs-137	<0.0019 - <0.013
	0.006	12/0	Ce-141	-0.001 - 0.001	----	8/0	Ce-141	<0.0009 - <0.0059
	0.009	12/0	Ce-144	-0.002 - 0.005	----	8/0	Ce-144	<0.0024 - <0.012
air iodine (pCi/M ³)	0.046	99/8	I-131	-0.06 - 0.15	0.07	104/5	I-131	<0.01 - 0.81
surface water (pCi/liter)	1.6	24/24	gross beta	1.6 - 18.9	4	24/24	gross beta	1.3 - 4.4
	750	24/1	H-3	-310 - 2609	2000	24/1	H-3	<330 - 750
	0.4	24/3	I-131	-0.7 - 0.7	1	24	I-131	analysis not required
		24	gamma isotopic			24	gamma isotopic	
	9	24/0	Mn-54	-6 - 3	15	24/0	Mn-54	<1.4 - <7.7
	20	24/0	Fe-59	-4 - 9	30	24/0	Fe-59	<4.6 - <16.7
	13	24/0	Co-58	-4 - 4	15	24/0	Co-58	<2.1 - <9.2
	11	24/0	Co-60	-3 - 3	15	24/0	Co-60	<1.5 - <9.5
	22	24/0	Zn-65	-14 - 12	30	24	Zn-65	analysis not required
	13	24/0	Cs-134	-3 - 13	15	24/0	Cs-134	<1.4 - <9.3
	12	24/0	Cs-137	-4 - 8	18	24/0	Cs-137	<1.4 - <8.4
	15	24/0	Zr-95	-24 - 8	15	24/0	Zr-95	<2.2 - <9.2
	15	24/0	Ba-140	-10 - 7	15	24/0	Ba-140	<3.2 - <17.8
	shoreline sediment (pCi/kg dry)	740	4/4	gross beta	6000 - 8000	----	4/4	gross beta
		4	gamma isotopic			4	gamma isotopic	
70		4/0	Co-58	-2 - 40	----	4/1	Co-58	<8 - 21
70		4/1	Co-60	-30 - 80	----	4/2	Co-60	<8 - 72
60		4/0	Cs-134	13 - 17	150	4/3	Cs-134	<6 - 77
80		4/0	Cs-137	-2 - 60	180	4/4	Cs-137	14 - 41
400		4/4	K-40	5500 - 6900	----	4/4	K-40	4830 - 5380
100		4/4	Ra-226	200 - 340	----	4	Ra-226	analysis not required
180		4/4	Pb-214	200 - 270	----	4	Pb-214	analysis not required
200		4/4	Bi-214	220 - 290	----	4	Bi-214	analysis not required
300		4/0	Tl-208	90 - 170	----	4	Tl-208	analysis not required
320		4/0	Ac-228	50 - 210	----	4	Ac-228	analysis not required

Table 5. (continued)

Sample type (units)	Wisconsin data				Kewaunee data			
	MDC	Number of Samples *a	Analysis	range	NRC MDC	Number Samples *a	Analysis	range
fish (pCi/kg wet)	550	5/5	5 gamma isotopic K-40	2600 - 3600	----	5/5	5 gamma isotopic K-40	analysis not required
	40	5/0	Mn-54	-9 - 13	130	5	Mn-54	<4 - <33
	120	5/0	Fe-59	-15 - 40	260	5	Fe-59	<15 - <200
	54	5/0	Co-58	-8 - 9	130	5	Co-58	<5 - <56
	50	5/0	Co-60	4 - 30	130	5	Co-60	<4 - <30
	100	5/0	Zn-65	3 - 40	260	5	Zn-65	analysis not required
	45	5/1	Cs-134	-4 - 50	130	5	Cs-134	<5 - <32
	55	5/5	Cs-137	80 - 160	150	5/4	Cs-137	<27 - 130
	milk (pCi/liter)	0.4	12/0	I-131	-0.25 - 0.4	1	12/3	I-131
		12	gamma isotopic			12	gamma isotopic	
120		12/12	K-40	1340 - 1550	----	12/12	K-40	1100 - 1520
12		12/0	Cs-134	-4 - 9	15	12/0	Cs-134	<10
12		12/0	Cs-137	0 - 11	18	12/0	Cs-137	<10
15		12/0	Ba-140	-4 - 6	15	12/0	Ba-140	<15
food product (pCi/kg wet)	740	4/4	gross beta	2000 - 2700	----	4/4	gross beta	1880 - 2580
		4	gamma isotopic			4	gamma isotopic	
	1100	4/0	Be-7	-4 - 100	----	4/0	Be-7	<29 - <97
	600	4/4	K-40	1700 - 2600	----	4/4	K-40	1810 - 3030
	50	4/0	Co-58	-3 - 2	----	4	Co-58	analysis not required
	55	4/0	Co-60	-12 - 20	----	4	Co-60	analysis not required
	80	4/0	Zr-95	-16 - 10	----	4/0	Zr-95	<6 - <20
	60	4/0	I-131	-3 - 4	60	4	I-131	analysis not required
	50	4/0	Cs-134	14 - 40	60	4	Cs-134	analysis not required
	60	4/0	Cs-137	-4 - 16	80	4/0	Cs-137	<3 - <13
	60	4/0	Ru-103	<MDC	----	4/0	Ru-103	<4 - <13
	525	4/0	Ru-106	<MDC	----	4/0	Ru-106	<3 - <110
	50	4/0	Ce-141	<MDC	----	4/0	Ce-141	<7 - <21
135	4/0	Ce-144	<MDC	----	4/0	Ce-144	<26 - <93	

* a - Number of samples / number of analyses detected above MDC or LLD.

Table 6. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and State Laboratory of Hygiene (SLH) results.

Sample Type	Date Collected	Analysis	Concentration in pCi/sample *a		
			SLH result +/- 1 sigma	EPA result +/- 1 sigma	Deviation Known
Water	01-04-85	Sr-89	<1	3+/-5	
		Sr-90	31+/-2	30+/-1.5	0.8
Water	01-18-85	Alpha	4+/-2	5+/-5	-0.3
		Beta	20+/-2	15+/-5	1.6
Food	01-25-85	Sr-89	No data provided	34.0+/-5.0	
		Sr-90	No data provided	26.0+/-1.5	
		I-131	33+/-6	35+/-6	-0.4
		Cs-137	30+/-6	29+/-5	0.2
		K	1290+/-90	1382+/-120	0.9
Water	02-08-85	Cr-51	53+/-18	43+/-5	1.8
		Co-60	18+/-5	20+/-5	-0.7
		Zn-65	59+/-5	55+/-5	1.4
		Ru-106	31+/-5	25+/-5	2.0
		Cs-134	35+/-5	35+/-5	0.0
		Cs-137	25+/-5	25+/-5	0.1
Water	02-15-85	H-3	3927+/-330	3796+/-366	0.6
Milk	03-01-85	I-131	9+/-1.0	9+/-0.9	0.6
Water	03-15-85	Ra-226	4.3+/-0.8	5.0+/-0.75	-1.6
		Ra-228	7.8+/-1.4	9.0+/-1.35	-1.6
Water	03-22-85	Alpha	6+/-3	6+/-5	0.0
		Beta	15+/-2	15+/-5	-0.1
Filter	03-29-85	Alpha	12.7+/-4	10.0+/-5.0	0.9
		Beta	33+/-4	36.0+/-5.0	-1.0
		Sr-90	15+/-2	15.0+/-1.5	0.0
		Cs-137	9.3+/-4	6.0+/-5.0	1.1
Water	04-05-85	I-131	8.0+/-1.0	7.5+/-0.8	1.1
Water	04-12-85	H-3	3480+/-350	3559+/-364	-0.4

Table 6 (continued)

Sample Type	Date Collected	Analysis	Concentration in pCi/sample *a		
			SLH result +/- 1 sigma	EPA result +/- 1 sigma	Deviation Known
Water	04-19-85	Alpha	34.7+/-3	32.0+/-5.0	0.9
		Beta	75.3+/-5	72.0+/-5.0	1.2
		Ra-226	6.9+/-0.6	4.1+/-0.6	8.2
		Ra-228	12.0+/-0.9	6.2+/-0.9	11.1
		U	No data provided	7.0+/-6.0	
		Sr-89	13.3+/-5	10.0+/-5.0	1.2
		Sr-90	12.7+/-1.5	15.0+/-1.5	-2.3
		Co-60	14+/-4	15.0+/-5.0	-0.3
		Cs-134	12+/-4	15.0+/-5.0	-1.0
		Cs-137	10.7+/-4	12.0+/-5.0	-0.5
		Water	05-10-85	Sr-90	15.3+/-1.2
Sr-89	39.0+/-1.5			39.0+/-5.0	0.0
Water	05-24-85	Alpha	11.7+/-2	12.0+/-5.0	-0.1
		Beta	13.7+/-1.8	11.0+/-5.0	0.9
Water	06-07-85	Cr-51	52+/-8	44.0+/-5.0	2.9
		Co-60	13+/-2	14.0+/-5.0	-0.2
		Zn-65	50+/-6	47.0+/-5.0	1.2
		Ru-106	57+/-19	62.0+/-5.0	-1.6
		Cs-134	36+/-3	35.0+/-5.0	0.2
		Cs-137	19+/-3	20.0+/-5.0	-0.2
Water	06-14-85	H-3	2200+/-320	2416+/-351	-1.1
Water	06-21-85	Ra-226	3.2+/-0.5	3.1+/-0.4	0.3
		Ra-228	5.2+/-0.6	4.2+/-0.6	2.7
Milk	06-28-85	Sr-89	No data provided	11.0+/-5.0	
		Sr-90	14+/-2	11.0+/-1.5	3.9
		I-131	12+/-5	11.0+/-6.0	0.3
		Cs-137	11+/-5	11.0+/-5.0	-0.1
		K	1660+/-120	1525+/-76	3.1
Water	07-19-85	Alpha	10.7+/-1.5	11.0+/-5.0	0.6
		Beta	10.0+/-1.5	8.0+/-5.0	0.7
Food	07-26-85	Sr-89	No data provided	33.0+/-5.0	
		Sr-90	No data provided	26.0+/-1.5	
		I-131	32+/-8	35.0+/-6.0	-0.9
		Cs-137	28+/-8	29.0+/-5.0	-0.2
		K	1560+/-100	1514+/-76	1.0
Water	08-09-85	I-131	29+/-10	33.0+/-6.0	-1.3

Table 6 (continued)

Sample Type	Date Collected	Analysis	Concentration in pCi/sample *a		
			SLH result +/- 1 sigma	EPA result +/- 1 sigma	Deviation Known
Water	08-14-85	H-3	4453+/-360	4480+/-448	-0.1
Water	08-23-85	U	5+/-5	4.0+/-6.0	0.3
Filter	08-30-85	Alpha	15.3+/-1.5	13.0+/-5.0	0.8
		Beta	41.0+/-1.5	44.0+/-5.0	-1.0
		Sr-90	19.0+/-1.5	18.0+/-1.5	1.2
		Cs-137	7.7+/-4	8.0+/-5.0	-0.1
Water	09-06-85	Sr-89	23+/-2	20.0+/-5.0	1.2
		Sr-90	6.0+/-1.5	7.0+/-1.5	-1.2
Water	09-13-85	Ra-226	8.7+/-1.3	8.9+/-1.3	-0.3
		Ra-228	3.4+/-0.8	4.6+/-0.7	-2.9
Water	09-20-85	Alpha	7.3+/-1.7	8.0+/-5.0	-0.2
		Beta	10.0+/-1.7	8.0+/-5.0	0.7
Water	10-04-85	Cr-51	<44.	21.0+/-5.0	
		Co-60	19+/-5	20.0+/-5.0	-0.3
		Zn-65	21+/-5	19.0+/-5.0	0.8
		Ru-106	<40	20.0+/-5.0	
		Cs-134	16+/-5	20.0+/-5.0	-1.3
		Cs-137	19+/-5	20.0+/-5.0	-0.2
Water	10-11-85	H-3	1823+/-320	1974+/-345	-0.8
Blind	10-21-85	Alpha	44+/-2	52.0+/-13.0	-1.0
		Beta	76+/-2	75.0+/-5.0	0.3
		Ra-226	5.7+/-0.8	6.30+/-0.95	-1.1
		Ra-228	13.1+/-1.2	10.10+/-1.52	3.4
		U (nat)	10+/-5	8.0+/-6.0	0.5
		Sr-89	29+/-2	27.0+/-5.0	0.8
		Sr-90	8.7+/-1.5	9.0+/-1.5	-0.4
		Co-60	18+/-2	18.0+/-5.0	-0.1
		Cs-134	15+/-5	18.0+/-5.0	-1.0
		Cs-137	19+/-5	18.0+/-5.0	0.2
Milk	10-25-85	Sr-89	No data provided	48.0+/-5.0	
		Sr-90		26.0+/-1.5	5.4
		I-131		42.0+/-6.0	-0.2
		Cs-137		56.0+/-5.0	0.1
		K		1540.+/-77.0	2.0
Water	11-22-85	Alpha	11.3+/-1.8	10.0+/-5.0	0.5
		Beta	17.0+/-1.5	13.0+/-5.0	1.4

Table 6 (continued)

Sample Type	Date Collected	Analysis	Concentration in pCi/sample *a		
			SLH result +/- 1 sigma	EPA result +/- 1 sigma	Deviation Known
Water	12-06-85	I-131	46+/-5	45.0+/-6.0	0.2
Water	12-13-85	Ra-226	6.7+/-1.0	7.10+/-1.07	-0.7
		Ra-228	8.9+/-1.1	7.30+/-1.10	2.6
Water	01-10-86	Sr-89	32.0+/-1.2	31.0+/-5.0	0.3
		Sr-90	13.3+/-0.7	15.0+/-1.5	-1.9
Water	01-24-86	Alpha	4.0+/-1.4	3.0+/-5.0	0.3
		Beta	7.3+/-1.4	7.0+/-5.0	0.1
Food	01-31-86	Sr-89	No data provided	25.0+/-5.0	
		Sr-90	No data provided	10.0+/-1.5	
		I-131	19+/-9	20.0+/-6.0	-0.2
		Cs-137	18+/-8	15.0+/-5.0	0.9
		K	1030+/-170	950+/-143	1.0
Water	02-07-86	Cr-51	LT 40	38.0+/-5.0	
		Co-60	17+/-3	18.0+/-5.0	-0.2
		Zn-65	38+/-6	40.0+/-5.0	-0.6
		Ru-106	LT 31	0.0+/-5.0	
		Cs-134	28+/-3	30.0+/-5.0	-0.6
		Cs-137	23+/-3	22.0+/-5.0	0.5
Water	02-14-86	H-3	4913+/-370	5227+/-523	-1.0
Water	02-21-86	U (nat)	10+/-5	9.0+/-6.0	0.4
Water	02-28-86	I-131	9.0+/-1.0	9.0+/-6.0	0.0
Water	03-14-86	Ra-226	3.9+/-0.5	4.1+/-0.6	-0.7
		Ra-228	11.9+/-1.8	12.4+/-1.9	-0.4
Water	03-21-86	Alpha	15.7+/-1.5	15.0+/-5.0	0.2
		Beta	10.3+/-1.3	8.0+/-5.0	0.8
Water	04-04-86	I-131	8.0+/-1.5	9.0+/-6.0	-0.3
Filter	04-25-86	Alpha	19.0+/-1.5	15.0+/-5.0	1.4
		Beta	47+/-2	47.0+/-5.0	0.1
		Sr-90	17.0+/-1.5	18.0+/-1.5	-1.2
		Cs-137	11.7+/-3	10.0+/-5.0	0.6

Table 6 (continued)

Sample Type	Date Collected	Analysis	Concentration in pCi/sample *a		
			SLH result +/- 1 sigma	EPA result +/- 1 sigma	Deviation Known
Blind	04-20-86	Alpha	14+/-2	17.0+/-5.0	-0.9
		Beta	33+/-3	35.0+/-5.0	-0.7
		Ra-226	3.1+/-0.4	2.90+/-0.44	0.7
		Ra-228	2.1+/-0.3	2.00+/-0.30	0.8
		U (nat)	3.7+/-5.0	5.0+/-6.0	-0.4
		Sr-89	6.7+/-0.9	7.0+/-5.0	-0.1
		Sr-90	6.0+/-0.7	7.0+/-1.5	-1.2
		Co-60	10+/-3	10.0+/-5.0	-0.1
		Cs-134	4+/-2	5.0+/-5.0	-0.3
		Cs-137	5+/-2	5.0+/-5.0	0.0
Water	05-09-86	Sr-89	5.0+/-2	5.0+/-5.0	0.0
		Sr-90	5.0+/-1.5	5.0+/-1.5	0.0
Water	07-06-86	Cr-51	<38	0.0+/-5.0	
		Co-60	65+/-5	66.0+/-5.0	-0.5
		Zn-65	86+/-5	86.0+/-5.0	0.0
		Ru-106	47+/-5	50.0+/-5.0	-0.9
		Cs-134	45+/-5	49.0+/-5.0	-1.4
		Cs-137	8+/-5	10.0+/-5.0	-0.7
Water	06-20-86	Ra-226	7.3+/-1.3	8.6+/-1.3	-1.7
		Ra-228	12.2+/-2.5	16.7+/-2.5	-3.1
Milk	06-27-86	Sr-89	No data provided	0.0+/-5.0	
		Sr-90	16.6+/-1.7	16.0+/-1.5	0.8
		I-131	39+/-5	41.0+/-6.0	-0.5
		Cs-137	38+/-5	31.0+/-5.0	2.4
		K	1660+/-120	1600+/-80	1.4
Water	07-18-86	Alpha	8+/-2	6.0+/-5.0	0.7
		Beta	18+/-2	18.0+/-5.0	-0.7
Food	07-25-86	Sr-89	No data provided	30+/-5	
		Sr-90	No data provided	19+/-1.5	
		I-131	24+/-5	30.0+/-6.0	-1.6
		Cs-137	21+/-5	20.0+/-5.0	0.2
		K	1180+/-120	1150+/-58	0.9
Water	08-08-86	I-131	41+/-10	45.0+/-6.0	-1.2
Water	08-22-86	U (Nat)	4+/-4	4.0+/-6.0	0.1
Water	09-12-86	Ra-226	6.5+/-0.9	6.1+/-0.9	0.8
		Ra-228	10.3+/-1.5	9.1+/-1.4	1.5

Table 6 (continued)

Sample Type	Date Collected	Analysis	Concentration in pCi/sample *a		
			SLH result +/- 1 sigma	EPA result +/- 1 sigma	Deviation Known
Filter	09-12-86	Alpha	20+/-2	22.0+/-5.0	-0.7
		Beta	67+/-2	66.0+/-5.0	0.3
		Sr-90	21.3+/-1.8	22.0+/-1.5	-0.8
		Cs-137	28+/-5	22.0+/-5.0	2.0
Water	09-19-86	Alpha	11.3+/-2	15.0+/-5.0	-1.3
		Beta	8.7+/-1.5	8.0+/-5.0	0.2
Water	10-10-86	Cr-51	61+/-10	59.0+/-5.0	0.6
		Co-60	32+/-5	31.0+/-5.0	0.2
		Zn-65	88+/-5	85.0+/-5.0	1.0
		Ru-106	68+/-5	74.0+/-5.0	-2.2
		Cs-134	29+/-5	28.0+/-5.0	0.3
		Cs-137	46+/-5	44.0+/-5.0	0.6
Water	10-17-86	H-3	5300+/-300	5973+/-597	-2.0
Water	11-21-86	Alpha	16+/-2	20.0+/-5.0	-1.4
		Beta	23.7+/-2	20.0+/-5.0	1.3

* a - pCi/sample refers to the following:

<u>Sample</u>	<u>Units</u>
water	pCi/liter
milk	pCi/liter except for K mg/liter
food	pCi/kg except for K mg/kg
filter	pCi/filter

Table 7. Air particulate gross beta and air iodine (I-131) results for January - June, 1986. Indicator site.

WISCONSIN DIVISION OF HEALTH
SECTION OF RADIATION PROTECTION

Kewaunee
1986

Measurements in units of pCi/M³

WI - Section of Radiation Protection data

Kewaunee data

Meteorological Tower
0.12 miles S

Meteorological Tower
0.12 miles S

Collection date	Air Particulate	Air Iodine	Collection date	Air Particulate	Air Iodine
01/08/86	0.015+/-0.002	-0.006+/-0.03	01/07/86	0.020+/-0.002	<0.03
01/15/86	0.015+/-0.001	0.011+/-0.03	01/14/86	0.020+/-0.002	<0.03
01/24/86	0.019+/-0.001	-0.003+/-0.015	01/21/86	0.026+/-0.003	<0.03
01/29/86	0.017+/-0.002	0.000+/-0.03	01/28/86	0.027+/-0.004	<0.03
02/05/86	0.019+/-0.002	0.000+/-0.02	02/04/86	0.026+/-0.004	<0.03
02/13/86	0.015+/-0.001	0.002+/-0.013	02/11/86	0.017+/-0.003	<0.03
02/19/86	0.023+/-0.002	-0.007+/-0.03	02/18/86	0.027+/-0.004	<0.03
02/27/86	0.015+/-0.001	-0.001+/-0.03	02/25/86	0.025+/-0.004	<0.03
03/06/86	0.012+/-0.001	-0.005+/-0.03	03/04/86	0.020+/-0.003	<0.03
03/12/86	0.013+/-0.002	0.009+/-0.016	03/11/86	0.020+/-0.003	<0.03
03/26/86	0.013+/-0.001	0.002+/-0.015	03/18/86	0.018+/-0.003	<0.03
04/02/86	0.014+/-0.001	0.000+/-0.017	03/25/86	0.015+/-0.003	<0.03
04/10/86	0.008+/-0.001	0.001+/-0.02	04/01/86	0.020+/-0.003	<0.03
04/17/86	0.006+/-0.001	-0.005+/-0.03	04/08/86	0.014+/-0.002	<0.03
04/25/86	0.014+/-0.001	-0.008+/-0.03	04/15/86	0.008+/-0.002	<0.03
05/01/86	0.016+/-0.002	-0.016+/-0.02	04/22/86	0.011+/-0.002	<0.03
05/08/86	0.010+/-0.001	0.002+/-0.017	04/29/86	0.025+/-0.003	<0.03
05/14/86	0.163+/-0.005	0.15+/-0.04	05/06/86	<0.004	<0.03
05/21/86	0.155+/-0.004	0.14+/-0.04	05/13/86	0.102+/-0.005	<0.03
05/29/86	0.112+/-0.003	0.06+/-0.03	05/20/86	0.186+/-0.008	<0.03
06/04/86	0.220+/-0.005	0.04+/-0.03	05/27/86	0.140+/-0.007	0.58+/-0.08
06/12/86	0.040+/-0.002	0.009+/-0.03	06/03/86	<0.004 *a	<0.03
06/19/86	0.016+/-0.001	0.001+/-0.03	06/10/86	0.128+/-0.007	0.27+/-0.08
06/26/86	0.014+/-0.002	-0.013+/-0.03	06/17/86	0.020+/-0.004	<0.03
07/02/86	0.010+/-0.002	0.006+/-0.03	06/24/86	0.022+/-0.003	<0.03
			07/01/86	0.008+/-0.003	<0.03

* a - Filter was light.

Table 8. Air particulate gross beta and air iodine (I-131) results for July - December, 1986. Indicator site.

WISCONSIN DIVISION OF HEALTH
SECTION OF RADIATION PROTECTION

Kewaunee
1986

Measurements in units of pCi/M³

WI - Section of Radiation Protection data

Kewaunee data

Meteorological Tower
0.12 miles S

Meteorological Tower
0.12 miles S

Collection date	Air Particulate	Air Iodine	Collection date	Air Particulate	Air Iodine
07/10/86	0.013+/-0.001	0.009+/-0.02	07/08/86	0.016+/-0.003	<0.03
07/14/86	0.009+/-0.002	-0.002+/-0.03	07/15/86	0.012+/-0.003	<0.03
07/24/86	0.012+/-0.001	-0.012+/-0.03	07/22/86	<0.004	<0.03
07/30/86	0.010+/-0.002	0.009+/-0.02	07/29/86	0.014+/-0.003	<0.03
08/06/86	0.011+/-0.001	-0.001+/-0.017	08/05/86	0.015+/-0.003	<0.03
08/15/86	0.015+/-0.001	-0.003+/-0.03	08/12/86	0.018+/-0.003	<0.03
08/27/86	0.016+/-0.001	0.002+/-0.012	08/19/86	0.023+/-0.003	<0.03
09/03/86	0.018+/-0.002	0.002+/-0.02	08/26/86	0.018+/-0.003	<0.03
			09/03/86	0.022+/-0.003	<0.03
09/18/86	0.011+/-0.001	0.003+/-0.03	09/09/86	0.019+/-0.003	<0.03
09/25/86	0.012+/-0.001	0.004+/-0.016	09/16/86	0.012+/-0.002	<0.03
10/02/86	0.012+/-0.001	-0.03+/-0.04	09/23/86	0.011+/-0.002	<0.03
10/08/86	0.011+/-0.001	0.001+/-0.03	09/30/86	0.019+/-0.003	<0.03
10/17/86	0.009+/-0.001	-0.015+/-0.03	10/07/86	0.014+/-0.003	<0.03
10/22/86	0.021+/-0.002	-0.04+/-0.04	10/14/86	0.017+/-0.003	<0.03
10/30/86	0.020+/-0.002	0.000+/-0.04	10/21/86	0.019+/-0.003	<0.03
11/05/86	0.016+/-0.002	-0.03+/-0.03	10/28/86	0.040+/-0.004	<0.03
11/14/86	0.015+/-0.001	-0.02+/-0.03	11/04/86	0.028+/-0.004	<0.03
11/19/86	0.011+/-0.002	0.006+/-0.02	11/11/86	0.021+/-0.003	<0.03
11/26/86	0.018+/-0.002	-0.013+/-0.019	11/18/86	0.026+/-0.003	<0.03
12/03/86	0.014+/-0.001	-0.02+/-0.03	11/25/86	0.027+/-0.003	<0.03
12/11/86	0.012+/-0.001	0.017+/-0.02	12/02/86	0.024+/-0.003	<0.03
12/17/86	0.020+/-0.002	-0.003+/-0.017	12/09/86	0.019+/-0.003	<0.03
12/23/86	0.020+/-0.002	-0.009+/-0.03	12/16/86	0.006+/-0.002	<0.03
12/31/86	0.029+/-0.002	0.011+/-0.02	12/23/86	0.033+/-0.004	<0.03
			12/30/86	<0.004	<0.03

Table 9. Air particulate gross beta and air iodine (I-131) results for January - June, 1986. Control site.

WISCONSIN DIVISION OF HEALTH
SECTION OF RADIATION PROTECTION

Kewaunee
1986

Measurements in units of pCi/M³

WI - Section of Radiation Protection data

Kewaunee data

Green Bay Pumping Station - Rostok
11.5 miles NNE

NPS building - Kewaunee
9.5 miles NNE

Collection date	Air Particulate	Air Iodine	Collection date	Air Particulate	Air Iodine
01/10/86	0.013+/-0.001	-0.004+/-0.017	01/07/86	0.013+/-0.002	<0.03
01/17/86	0.013+/-0.001	0.005+/-0.03	01/14/86	0.010+/-0.002	<0.03
01/24/86	0.015+/-0.001	0.000+/-0.03	01/21/86	0.021+/-0.002	<0.03
01/31/86	0.016+/-0.001	0.006+/-0.03	01/28/86	0.018+/-0.003	<0.03
02/07/86 *a	0.002+/-0.005	0.018+/-0.09	02/04/86	0.022+/-0.003	<0.03
02/14/86	0.016+/-0.001	0.000+/-0.03	02/11/86	0.011+/-0.003	<0.03
02/28/86	0.015+/-0.001	-0.006+/-0.011	02/18/86	0.017+/-0.003	<0.03
03/07/86	0.012+/-0.001	0.016+/-0.03	02/25/86	0.020+/-0.003	<0.03
03/14/86	0.011+/-0.001	0.02+/-0.03	03/04/86	0.018+/-0.003	<0.03
03/21/86 *a	0.003+/-0.005	-0.03+/-0.12	03/11/86	0.017+/-0.003	<0.03
03/27/86	0.011+/-0.001	0.012+/-0.03	03/18/86	0.015+/-0.003	<0.03
04/04/86	0.011+/-0.001	-0.005+/-0.03	03/25/86	0.009+/-0.003	<0.03
04/11/86	0.008+/-0.001	0.007+/-0.03	04/01/86	0.013+/-0.003	<0.03
04/18/86	0.006+/-0.001	-0.003+/-0.017	04/08/86	0.010+/-0.003	<0.03
04/25/86	0.013+/-0.001	-0.003+/-0.017	04/15/86	0.010+/-0.002	<0.03
05/02/86	0.014+/-0.001	-0.009+/-0.016	04/22/86	0.013+/-0.002	<0.03
05/09/86	0.015+/-0.001	0.006+/-0.03	04/29/86	0.023+/-0.003	<0.03
05/16/86	0.130+/-0.004	0.14+/-0.04	05/06/86	0.013+/-0.002	<0.03
05/23/86	0.156+/-0.004	0.12+/-0.04	05/13/86	0.094+/-0.006	0.18+/-0.01
05/30/86	0.082+/-0.003	0.03+/-0.02	05/20/86	0.206+/-0.010	<0.03
06/06/86	0.155+/-0.004	0.03+/-0.03	05/27/86	0.090+/-0.006	0.81+/-0.02
06/13/86	0.029+/-0.002	0.012+/-0.03	06/03/86	0.176+/-0.006	<0.03
06/20/86	0.013+/-0.001	-0.002+/-0.03	06/10/86	0.086+/-0.005	0.12+/-0.04
06/27/86	0.009+/-0.001	0.006+/-0.04	06/17/86	0.013+/-0.003	<0.03
07/03/86	0.008+/-0.001	0.002+/-0.04	06/24/86	0.018+/-0.002	<0.03
			07/01/86	0.005+/-0.002	<0.03

*a - Filter appeared to be clean. Possible low air flow.

Table 10. Air particulate gross beta and air iodine (I-131) results for July - December, 1986. Control site.

WISCONSIN DIVISION OF HEALTH
SECTION OF RADIATION PROTECTION

Kewaunee
1986

Measurements in units of pCi/M³

WI - Section of Radiation Protection data

Kewaunee data

Green Bay Pumping Station - Rostok
11.5 miles NNE

WPS building - Kewaunee
9.5 miles NNE

Collection date	Air Particulate	Air Iodine	Collection date	Air Particulate	Air Iodine
07/11/86	0.012+/-0.001	-0.001+/-0.03	07/08/86	0.012+/-0.003	<0.03
07/18/86	0.008+/-0.001	0.019+/-0.04	07/15/86	0.005+/-0.002	<0.03
07/25/86	0.005+/-0.001	-0.003+/-0.014	07/22/86	0.004+/-0.002	<0.03
08/01/86	0.009+/-0.001	0.04+/-0.03	07/29/86	0.014+/-0.002	<0.03
08/08/86	0.012+/-0.001	-0.004+/-0.04	08/05/86	0.012+/-0.003	<0.03
08/15/86	0.010+/-0.001	0.006+/-0.03	08/12/86	0.014+/-0.003	<0.03
08/22/86	0.012+/-0.001	0.004+/-0.03	08/19/86	0.019+/-0.003	<0.03
08/28/86	0.017+/-0.002	-0.001+/-0.03	08/26/86	0.019+/-0.003	<0.03
09/05/86	0.015+/-0.001	-0.003+/-0.03	09/02/86	0.017+/-0.003	<0.03
09/12/86	0.012+/-0.001	0.002+/-0.019	09/09/86	0.017+/-0.003	<0.03
09/19/86	0.008+/-0.001	0.008+/-0.04	09/16/86	0.011+/-0.003	<0.03
09/26/86	0.009+/-0.001	-0.007+/-0.04	09/23/86	0.011+/-0.003	<0.03
10/03/86	0.010+/-0.001	-0.001+/-0.02	09/30/86	0.022+/-0.003	<0.03
10/10/86	0.008+/-0.001	0.004+/-0.04	10/07/86	0.014+/-0.003	<0.03
10/17/86	0.010+/-0.001	-0.03+/-0.04	10/14/86	0.016+/-0.003	<0.03
10/24/86	0.020+/-0.002	-0.015+/-0.04	10/21/86	0.017+/-0.003	<0.03
10/31/86	0.021+/-0.002	0.000+/-0.05	10/28/86	0.038+/-0.004	<0.03
11/07/86	0.014+/-0.001	-0.06+/-0.03	11/04/86	0.024+/-0.003	<0.03
11/14/86	0.013+/-0.001	-0.03+/-0.03	11/11/86	0.018+/-0.003	<0.03
11/21/86	0.012+/-0.001	-0.007+/-0.02	11/18/86	0.026+/-0.003	<0.03
			11/25/86	0.022+/-0.003	<0.03
12/05/86	0.015+/-0.001	-0.012+/-0.02	12/02/86	0.026+/-0.003	<0.03
12/12/86	0.014+/-0.001	-0.005+/-0.03	12/09/86	0.018+/-0.003	<0.03
12/19/86	0.022+/-0.002	0.007+/-0.03	12/16/86	0.004+/-0.002	<0.03
12/26/86	0.020+/-0.002	0.012+/-0.03	12/23/86	0.007+/-0.003	<0.03
01/02/87	0.018+/-0.001	-0.015+/-0.03	12/30/86	0.052+/-0.005	<0.03

Table 11. Gamma isotopic results for January - December, 1986 from the quarterly composite of air particulate samples. Indicator site.

WISCONSIN DIVISION OF HEALTH
SECTION OF RADIATION PROTECTION

Kewaunee
1986

Measurements in units of pCi/M³

WI - Section of Radiation Protection data

Meteorological Tower
0.12 miles S

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	May	June
Be-7	0.071+/-0.010	0.095+/-0.015	0.099+/-0.012	0.070+/-0.010	0.09+/-0.03	0.10+/-0.02
Zr-95	0.000+/-0.001	0.002+/-0.002	0.001+/-0.002	0.001+/-0.002	-0.001+/-0.004	0.001+/-0.003
Ru-103	0.000+/-0.001	0.015+/-0.002	0.001+/-0.001	0.000+/-0.001	0.030+/-0.004	0.020+/-0.003
Ru-106	-0.001+/-0.003	0.000+/-0.006	0.000+/-0.004	0.000+/-0.004	0.014+/-0.014	0.022+/-0.011
I-131	-0.004+/-0.03	0.12+/-0.12	0.02+/-0.04	0.03+/-0.03	0.03+/-0.03	0.010+/-0.013
Cs-134	0.000+/-0.000	0.006+/-0.001	0.000+/-0.001	0.000+/-0.001	0.013+/-0.003	0.006+/-0.002
Cs-137	0.000+/-0.000	0.011+/-0.001	0.000+/-0.001	0.000+/-0.001	0.028+/-0.003	0.022+/-0.011
Ce-141	0.001+/-0.001	0.000+/-0.002	0.000+/-0.001	0.001+/-0.001	0.000+/-0.003	0.000+/-0.002
Ce-144	0.000+/-0.002	0.000+/-0.003	0.000+/-0.002	0.000+/-0.002	0.000+/-0.006	0.000+/-0.006

Isotopes other than those reported were not detected.

Kewaunee data

Meteorological Tower
0.12 miles S

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Be-7	0.060+/-0.009	0.065+/-0.010	0.089+/-0.007	0.041+/-0.009
Zr-95	<0.0016	<0.0023	<0.0022	<0.0018
Ru-103	<0.0008	0.0090+/-0.0013	<0.0013	<0.0011
Ru-106	<0.0058	<0.011	<0.0087	<0.0064
Cs-134	<0.0007	0.0055+/-0.0008	<0.0011	<0.0007
Cs-137	<0.0006	0.010+/-0.001	<0.0013	<0.0007
Ce-141	<0.0009	<0.0032	<0.0015	<0.0011
Ce-144	<0.0024	<0.0050	<0.0026	<0.0027

Table 12. Gamma isotopic results for January - December, 1986 from the quarterly composite of air particulate samples. Control site.

WISCONSIN DIVISION OF HEALTH
SECTION OF RADIATION PROTECTION

Kewaunee
1986

Measurements in units of pCi/M³

WI - Section of Radiation Protection data

Green Bay Pumping Station - Rostok
11.5 miles NNE

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	May	June
Be-7	0.062+/-0.011	0.071+/-0.013	0.074+/-0.011	0.058+/-0.010	0.07+/-0.03	0.073+/-0.019
Zr,Nb-95	0.000+/-0.002	0.000+/-0.002	-0.001+/-0.002	0.000+/-0.002	0.000+/-0.005	0.001+/-0.004
Ru-103	0.000+/-0.001	0.013+/-0.002	-0.001+/-0.001	0.000+/-0.001	0.021+/-0.004	0.017+/-0.003
Ru-106	0.000+/-0.004	-0.001+/-0.006	-0.001+/-0.005	0.000+/-0.004	0.009+/-0.017	0.004+/-0.012
I-131	-0.005+/-0.04	0.003+/-0.15	-0.014+/-0.04	-0.009+/-0.03	0.05+/-0.02	0.011+/-0.012
Cs-134	0.000+/-0.000	0.004+/-0.001	0.000+/-0.001	0.000+/-0.001	0.010+/-0.002	0.003+/-0.002
Cs-137	0.000+/-0.000	0.008+/-0.001	0.000+/-0.001	0.000+/-0.001	0.024+/-0.003	0.009+/-0.002
Ce-141	0.000+/-0.002	0.000+/-0.002	-0.001+/-0.002	0.001+/-0.001	0.000+/-0.004	0.000+/-0.003
Ce-144	0.002+/-0.002	0.000+/-0.003	-0.002+/-0.003	0.000+/-0.002	0.000+/-0.008	0.005+/-0.006

Isotopes other than those reported were not detected.

Kewaunee data

MPS building - Kewaunee
9.5 miles NNE

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Be-7	0.094+/-0.008	0.095+/-0.018	0.056+/-0.016	0.060+/-0.011
Zr-95	<0.0019	<0.0050	<0.0044	<0.0030
Ru-103	<0.0017	0.014+/-0.004	<0.0032	<0.0014
Ru-106	<0.0089	<0.019	<0.017	<0.0097
Cs-134	<0.0009	0.0071+/-0.0010	<0.0017	<0.0011
Cs-137	<0.0010	0.013+/-0.001	<0.0019	<0.0012
Ce-141	<0.0012	<0.0059	<0.0056	<0.0024
Ce-144	<0.0035	<0.0059	<0.012	<0.0064

Table 13. Analysis of surface water samples from January - June, 1986. Indicator site.

WISCONSIN DIVISION OF HEALTH
SECTION OF RADIATION PROTECTION

Kewaunee
1986

Measurements in units of pCi/liter

WI - Section of Radiation Protection data

Effluent channel
0.1 mile E

Collection Date	01/06/86	02/03/86	03/03/86	04/02/86	05/05/86	06/02/86
Gross Alpha-sol.	-0.3+/-0.8	0.3+/-1.2	0.6+/-1.0	0.8+/-1.1	1.4+/-1.3	1.5+/-1.4
Gross Alpha-insol	0.3+/-0.6	0.0+/-0.5	0.4+/-0.6	0.0+/-0.5	0.0+/-0.5	-0.2+/-0.6
Gross Beta-sol.	2.4+/-1.1	4.0+/-1.2	3.0+/-1.2	4.3+/-1.3	2.5+/-1.2	2.6+/-1.2
Gross Beta-insol.	-0.2+/-0.9	-0.1+/-0.9	0.6+/-0.9	0.7+/-1.0	0.1+/-0.9	0.7+/-1.0
H-3	-240+/-320	-150+/-300	240+/-320	430+/-320	-110+/-310	180+/-320
Sr-89	-1.2+/-0.5	0.7+/-0.5	1.0+/-0.5	0.7+/-0.4	-0.9+/-0.4	-0.6+/-0.3
Sr-90	0.5+/-0.5	0.0+/-0.4	0.5+/-0.5	0.1+/-0.4	1.4+/-0.4	0.9+/-0.3
I-131	-0.7+/-0.2	0.62+/-0.17	0.7+/-0.2	3.1+/-0.6	-0.07+/-0.13	-5+/-2
Gamma Isotopic						
Mn-54	3+/-5	-1+/-5	0+/-5	1+/-5	-3+/-4	-4+/-5
Fe-59	3+/-12	0+/-12	0+/-10	4+/-13	3+/-9	9+/-16
Co-58	2+/-5	2+/-6	1+/-6	0+/-6	-1+/-4	-2+/-6
Co-60	0+/-5	0+/-6	-3+/-5	3+/-5	-1+/-6	1+/-5
Zn-65	-2+/-9	7+/-12	-3+/-11	2+/-10	-2+/-10	3+/-12
Cs-134	-1+/-5	1+/-5	1+/-5	-1+/-5	-3+/-5	-2+/-5
Cs-137	-1+/-5	2+/-5	0+/-5	2+/-5	0+/-5	0+/-5
Zr-95	-1+/-14	1+/-12	3+/-14	0+/-14	-5+/-11	5+/-18
Ba,La-140	-3+/-13	7+/-11	-9+/-12	-6+/-16	1+/-6	7+/-51

Isotopes other than those reported were not detected.

Kewaunee data

Effluent channel
0.1 mile E

Collection Date	01/06/86	02/03/86	03/03/86	04/02/86	05/05/86	06/02/86
Gross Alpha-sol.	NR	NR	NR	NR	NR	NR
Gross Alpha-insol	NR	NR	NR	NR	NR	NR
Gross Beta-sol.	2.4+/-0.4	2.6+/-0.4	3.1+/-0.7	2.4+/-0.6	2.1+/-0.6	2.1+/-0.7
Gross Beta-insol.	<0.4	<0.5	<0.7	<0.6	<0.4	<0.6
H-3 * a			<330			<330
Sr-89 * a			<0.7			<0.7
Sr-90 * a			1.4+/-0.5			0.8+/-0.4
I-131	NR	NR	NR	NR	NR	NR
Gamma Isotopic						
Mn-54	<2.1	<6.5	<7.0	<5.4	<7.0	<2.2
Fe-59	<4.8	<12.2	<15.1	<16.2	<18.7	<7.7
Co-58	<2.1	<7.7	<6.3	<6.0	<9.2	<3.0
Co-60	<2.2	<6.9	<8.4	<4.9	<9.5	<1.7
Zn-65	NR	NR	NR	NR	NR	NR
Cs-134	<2.0	<7.3	<7.9	<5.9	<9.3	<2.3
Cs-137	<2.0	<7.1	<7.2	<6.0	<8.2	<2.3
Zr-95	<2.2	<7.1	<7.5	<6.2	<9.2	<3.1
Ba,La-140	<4.4	<7.6	<7.0	<5.9	<12.0	<15.0

NR - Analysis is not required.

* a - Analysis is performed on a quarterly composite.

Table 14. Analysis of surface water samples from July - December, 1986. Indicator site.

WISCONSIN DIVISION OF HEALTH
SECTION OF RADIATION PROTECTION

Kewaunee
1986

Measurements in units of pCi/liter

WI - Section of Radiation Protection data

Effluent channel
0.1 mile W

Collection Date	07/01/86	08/04/86	09/08/86	10/02/86	11/03/86	12/02/86
Gross Alpha-sol.	2.7+/-1.9	0.7+/-1.2	0.8+/-1.1	1.6+/-1.5	0.2+/-1.1	0.2+/-1.0
Gross Alpha-insol	0.3+/-0.7	1.4+/-0.9	0.2+/-0.6	0.1+/-0.6	0.2+/-0.6	0.2+/-0.7
Gross Beta-sol.	5.1+/-1.4	2.5+/-1.2	2.4+/-1.2	0.3+/-1.5	3.2+/-1.2	3.0+/-1.2
Gross Beta-insol.	0.3+/-0.9	18.9+/-1.9	0.3+/-0.9	2.0+/-1.0	1.5+/-1.1	1.2+/-1.0
H-3	140+/-320	30+/-320	670+/-330	2600+/-300	410+/-310	420+/-320
Sr-89	-0.1+/-0.3	0.5+/-0.5	-0.8+/-0.4	0.6+/-0.4	0.8+/-0.4	0.8+/-0.4
Sr-90	0.4+/-0.3	0.4+/-0.4	1.4+/-0.4	0.6+/-0.4	0.0+/-0.4	0.04+/-0.4
I-131	-0.5+/-0.2	-0.5+/-0.3	-0.09+/-0.15	<1.0	0.24+/-0.14	<50
Gamma Isotopic						
Mn-54	-5+/-7	-2+/-5	0+/-5	0+/-2	0+/-5	-1+/-2
Fe-59	2+/-17	-1+/-10	-2+/-8	-2+/-5	4+/-9	-4+/-7
Co-58	-4+/-8	-1+/-6	-2+/-5	1+/-2	-1+/-5	-3+/-3
Co-60	-2+/-7	2+/-6	0+/-6	1+/-2	1+/-5	-1+/-1
Zn-65	-9+/-15	1+/-11	10+/-12	2+/-4	-4+/-10	-1+/-4
Cs-134	2+/-8	2+/-6	4+/-6	-2+/-2	1+/-6	0+/-2
Cs-137	-2+/-8	3+/-6	1+/-6	8+/-3	0+/-6	-2+/-2
Zr-95	-17+/-18	-1+/-6	-1+/-12	-3+/-7	5+/-15	-3+/-7
Ba,La-140	1+/-14	-2+/-14	-2+/-6	-8+/-10	1+/-7	<103

Isotopes other than those reported were not detected.

Kewaunee data

Effluent channel
0.1 mile E

Collection Date	07/01/86	08/04/86	09/08/86	10/02/86	11/03/86	12/02/86
Gross Alpha-sol.	NR	NR	NR	NR	NR	NR
Gross Alpha-insol	NR	NR	NR	NR	NR	NR
Gross Beta-sol.	<0.5	<0.4	<0.7	4.4+/-0.7	2.2+/-0.4	2.3+/-0.4
Gross Beta-insol.	2.3+/-0.6	2.3+/-0.6	<1.9+/-0.5	2.1+/-0.5	<0.6	<0.5
H-3 * a			<330			750+/-90
Sr-89 * a			<0.8			<0.8
Sr-90 * a			<0.7			<0.7
I-131	NR	NR	NR	NR	NR	NR
Gamma Isotopic						
Mn-54	<2.3	<2.2	<3.7	<5.1	<5.4	<6.3
Fe-59	<10.0	<7.7	<12.4	<13.4	<12.4	<13.9
Co-58	<3.0	<2.7	<4.5	<6.0	<6.4	<5.2
Co-60	<2.4	<2.6	<4.9	<8.4	<4.4	<8.0
Zn-65	NR	NR	NR	NR	NR	NR
Cs-134	<2.6	<2.5	<4.0	<7.9	<5.8	<5.9
Cs-137	<2.5	<2.8	<5.0	<7.8	<6.1	<6.1
Zr-95	<3.5	<2.7	<4.3	<5.8	<6.1	<6.6
Ba,La-140	<18.5	<8.1	<5.0	<6.9	<7.9	<11.8

NR - Analysis is not required.

* a - Analysis is performed on a quarterly composite.

Table 15. Analysis of surface water samples from January - June, 1986. Control site.

WISCONSIN DIVISION OF HEALTH
SECTION OF RADIATION PROTECTION

Kewaunee
1986

Measurements in units of pCi/liter

WI - Section of Radiation Protection data

Green Bay Pumping
11.5 miles NNE

Collection Date	01/06/86	02/07/86	03/03/86	03/31/86	05/05/86	06/02/86
Gross Alpha-sol.	0.7+/-1.0	0.1+/-0.9	0.9+/-1.0	0.5+/-1.0	0.2+/-0.9	0.0+/-0.9
Gross Alpha-insol.	0.1+/-0.6	0.0+/-0.6	0.6+/-0.6	0.4+/-0.6	0.2+/-0.6	0.4+/-0.7
Gross Beta-sol.	2.4+/-1.1	3.7+/-1.1	3.0+/-1.2	3.2+/-1.2	2.5+/-1.1	2.4+/-1.2
Gross Beta-insol.	0.3+/-0.9	1.8+/-1.0	1.5+/-1.0	1.6+/-1.0	0.8+/-0.9	1.3+/-1.0
H-3	-310+/-320	150+/-300	260+/-320	270+/-330	110+/-320	300+/-310
Sr-89	0.0+/-0.5	-0.4+/-0.5	0.2+/-0.5	0.7+/-0.5	0.4+/-0.3	0.5+/-0.6
Sr-90	0.0+/-0.4	0.3+/-0.5	0.0+/-0.5	0.3+/-0.5	0.4+/-0.3	0.3+/-0.6
I-131	-0.02+/-0.09	-0.03+/-0.07	0.3+/-0.1	0.06+/-0.07	0.4+/-0.1	0.24+/-0.12
Gamma Isotopic						
Mn-54	0+/-5	-3+/-4	-1+/-5	-2+/-5	-1+/-5	-1+/-3
Fe-59	4+/-9	0+/-11	7+/-10	4+/-9	-1+/-9	-1+/-5
Co-58	4+/-5	-2+/-5	-1+/-5	-1+/-4	0+/-5	-2+/-3
Co-60	1+/-5	2+/-5	1+/-5	-2+/-5	0+/-5	0+/-3
Zn-65	12+/-12	-14+/-11	-1+/-10	-2+/-10	-2+/-11	0+/-6
Cs-134	13+/-7	-3+/-5	5+/-5	1+/-5	-1+/-5	-2+/-3
Cs-137	-1+/-5	2+/-5	2+/-6	2+/-6	-2+/-5	0+/-3
Zr-95	-4+/-13	-24+/-14	-4+/-13	-3+/-11	-1+/-12	-7+/-6
Ba,La-140	-3+/-6	-5+/-19	-10+/-20	-2+/-5	0+/-6	-1+/-4

Isotopes other than those reported were not detected.

Kewaunee data

Green Bay Pumping Station - Rostok
11.5 miles NNE

Collection Date	01/06/86	02/03/86	03/03/86	04/02/86	05/04/86	06/02/86
Gross Alpha-sol.	NR	NR	NR	NR	NR	NR
Gross Alpha-insol.	NR	NR	NR	NR	NR	NR
Gross Beta-sol.	2.3+/-0.5	2.0+/-0.6	2.2+/-0.6	2.2+/-0.4	2.5+/-0.7	2.2+/-0.5
Gross Beta-insol.	<0.4	<0.5	<0.7	<0.6	<0.6	<0.6
H-3 * a			<330			<330
Sr-89 * a			<0.8			<0.8
Sr-90 * a			<0.6			<0.7
I-131	NR	NR	NR	NR	NR	NR
Gamma Isotopic						
Mn-54	<7.7	<6.0	<2.7	<5.5	<3.4	<2.2
Fe-59	<13.9	<14.7	<5.0	<12.0	<6.8	<8.0
Co-58	<8.7	<6.6	<2.6	<6.0	<4.2	<2.6
Co-60	<8.0	<6.8	<2.4	<5.3	<2.9	<1.9
Zn-65	NR	NR	NR	NR	NR	NR
Cs-134	<8.3	<7.1	<2.9	<6.5	<3.0	<2.0
Cs-137	<8.4	<6.5	<3.0	<6.8	<3.4	<2.0
Zr-95	<8.7	<6.3	<2.7	<6.7	<4.7	<2.8
Ba,La-140	<12.0	<7.7	<3.2	<9.8	<13.3	<8.5

NR - Analysis is not required.

* a - Analysis is performed on a quarterly composite.

Table 16. Analysis of surface water samples from July - December, 1986. Control site.

WISCONSIN DIVISION OF HEALTH
SECTION OF RADIATION PROTECTION

Kewaunee
1986

Measurements in units of pCi/liter

WI - Section of Radiation Protection data

Green Bay Pumping
11.5 miles NNE

Collection Date	07/02/86	08/04/86	09/03/86	10/01/86	11/04/86	12/04/86
Gross Alpha-sol.	1.3+/-1.4	-0.2+/-0.9	0.7+/-1.0	-0.2+/-0.8	-0.1+/-0.9	-0.2+/-0.9
Gross Alpha-insol	-0.3+/-0.6	0.1+/-0.7	-0.1+/-0.5	0.8+/-0.7	0.6+/-0.7	0.3+/-0.7
Gross Beta-sol.	3.7+/-1.2	2.7+/-1.2	2.2+/-1.2	2.7+/-1.2	3.1+/-1.2	2.3+/-1.2
Gross Beta-insol.	-2.8+/-0.6	8.9+/-1.5	-0.4+/-0.9	1.4+/-1.0	1.0+/-1.0	0.4+/-1.0
H-3	110+/-330	230+/-320	130+/-330	120+/-310	40+/-300	510+/-310
Sr-89	-0.1+/-0.4	-4.5+/-0.7	0.4+/-0.4	-1.0+/-0.4	0.6+/-0.4	0.5+/-0.4
Sr-90	0.6+/-0.3	2.6+/-0.8	0.4+/-0.4	1.1+/-0.4	0.1+/-0.4	0.0+/-0.4
I-131	0.04+/-0.12	0.13+/-0.09	-0.3+/-0.2	0.15+/-0.07	-0.16+/-0.11	0.11+/-0.16
Gamma Isotopic						
Mn-54	-6+/-7	-1+/-5	1+/-5	-1+/-5	0+/-5	-2+/-5
Fe-59	4+/-14	6+/-11	5+/-11	3+/-9	4+/-10	-2+/-9
Co-58	-2+/-7	-1+/-6	3+/-6	1+/-6	1+/-5	0+/-5
Ce-60	-1+/-8	1+/-5	1+/-5	1+/-5	1+/-6	-1+/-6
Zn-65	3+/-16	0+/-10	7+/-12	-3+/-10	5+/-12	5+/-12
Cs-134	-1+/-7	2+/-6	2+/-6	3+/-6	2+/-6	1+/-7
Cs-137	0+/-8	-1+/-5	5+/-6	3+/-6	1+/-6	-4+/-6
Zr-95	-14+/-16	8+/-13	5+/-13	-8+/-12	5+/-13	-2+/-13
Ba,La-140	-3+/-7	-1+/-9	-2+/-7	0+/-6	1+/-7	-2+/-8

Isotopes other than those reported were not detected.

Kewaunee data

Green Bay Pumping
11.5 miles NNE

Collection Date	07/01/86	08/04/86	09/09/86	10/03/86	11/03/86	12/02/86
Gross Alpha-sol.	NR	NR	NR	NR	NR	NR
Gross Alpha-insol	NR	NR	NR	NR	NR	NR
Gross Beta-sol.	1.3+/-0.6	2.0+/-0.4	2.4+/-0.6	2.3+/-0.6	1.5+/-0.5	2.2+/-0.4
Gross Beta-insol.	<0.5	<0.6	<0.7	<0.6	<0.6	<0.5
H-3 * a			<330			<330
Sr-89 * a			<0.7			<0.6
Sr-90 * a			0.7+/-0.4			0.8+/-0.4
I-131	NR	NR	NR	NR	NR	NR
Gamma Isotopic						
Mn-54	<1.4	<3.2	<5.2	<6.5	<7.1	<5.7
Fe-59	<5.4	<7.9	<11.6	<12.9	<13.3	<15.2
Co-58	<2.1	<3.4	<5.0	<5.6	<7.6	<6.9
Ce-60	<1.5	<3.8	<4.3	<7.1	<5.7	<5.6
Zn-65	NR	NR	NR	NR	NR	NR
Cs-134	<1.4	<2.8	<5.5	<5.5	<7.4	<7.6
Cs-137	<1.4	<3.2	<5.3	<6.0	<7.6	<7.1
Zr-95	<3.1	<3.7	<5.9	<5.4	<7.2	<7.6
Ba,La-140	<17.8	<11.9	<9.7	<7.3	<8.0	<6.7

NR - Analysis is not required.

* a - Analysis is performed on a quarterly composite.

Table 17. Analysis of fish samples for 1986.

WISCONSIN DIVISION OF HEALTH
SECTION OF RADIATION PROTECTION

Kewaunee
1986

Measurements in units of pCi/kg (wet)

WI - Section of Radiation Protection

Collection Date	05/14/86	09/03/86	10/02/86	12/10/86	12/10/86
Type	whitefish	brown trout		salmon	trout
Location	Point Beach	Point Beach	Kewaunee	Point Beach	Point Beach
Gamma Isotopic					
K-40	2800+/-500	3600+/-500	3300+/-800	2600+/-400	3100+/-500
Mn-54	-13+/-17	13+/-19	2+/-40	-1+/-14	-8+/-19
Fe-59	-2+/-70	-5+/-50	40+/-140	20+/-30	-3+/-50
Co-58	-1+/-30	7+/-19	-8+/-60	9+/-16	6+/-20
Co-60	18+/-30	30+/-30	8+/-40	8+/-20	6+/-30
Zn-65	70+/-50	30+/-50	5+/-110	40+/-30	40+/-50
Cs-134	7+/-20	20+/-20	50+/-40	23+/-16	14+/-20
Cs-137	60+/-30	150+/-30	160+/-50	140+/-30	130+/-30

Isotopes other than those reported were not detected.

Kewaunee data

Collection Date	04/30/86 05/01/86	08/01/86	08/13/86	10/13/86	10/30/86
Type	Brown trout	bottom feeder	northern	brown trout	brown trout
Location	K-1d	K-1d	K-1d	K-1d	K-1d
Gamma Isotopic					
Mn-54	<8.1	<33	<11	<9	<4
Fe-59	<36	<200	<66	<38	<15
Co-58	<9.8	<56	<18	<11	<5
Co-60	<9.3	<30	<11	<9	<4
Cs-134	<9.1	<32	<11	<9	<5
Cs-137	95+/-6	<27	130+/-10	120+/-10	100+/-10

Table 18. Analysis of shoreline sediments for 1986.

WISCONSIN DIVISION OF HEALTH
SECTION OF RADIATION PROTECTION

Kewaunee
1986

Measurements in units of pCi/kg (dry)

WI - Section of Radiation Protection data

Collection Date	11/03/86	11/03/86	11/03/86	11/03/86
Type	shoreline sed.	shoreline sed.	shoreline sed.	shoreline sed.
Location	K-1c 500 feet N	K-1d discharge	K-1J 500 feet S	K-9 11.5 miles NNE
Analysis				
Gross beta (dry)	7000+/-4000	6000+/-4000	6000+/-4000	8000+/-4000
Gross alpha (dry)	-3000+/-4000	-1900+/-4000	-600+/-5000	-600+/-5000
Gamma Isotopic				
Co-58	1+/-20	-2+/-20	40+/-20	7+/-20
Co-60	15+/-20	80+/-20	60+/-30	-30+/-30
Cs-134	16+/-19	13+/-20	15+/-20	17+/-20
Cs-137	30+/-20	44+/-18	60+/-20	-2+/-20
K-40	6000+/-500	5500+/-500	6400+/-500	6900+/-500
Ra-226 * a	340+/-30	230+/-30	200+/-30	240+/-30
Pb-214 * a	270+/-80	220+/-70	200+/-70	260+/-70
Bi-214 * a	270+/-80	220+/-70	230+/-70	290+/-80
Tl-208 * a	170+/-60	90+/-60	100+/-60	130+/-60
Ac-228 * a	210+/-80	120+/-70	180+/-80	50+/-80

*a - Naturally occurring radioisotopes Ac-228 and Tl-208 are from the Thorium-232 decay series.
Ra-226, Pb-214, and Bi-214 are from the Uranium-238 decay series.
Isotopes other than those reported were not detected.

Kewaunee data

Collection Date	11/03/86	11/03/86	11/03/86	11/03/86
Type	shoreline sed.	shoreline sed.	shoreline sed.	shoreline sed.
Location	K-1c 500 feet N	K-1d discharge	K-1j 500 feet S	K-9 11.5 miles NNE
Analysis				
Gross beta (dry)	5100+/-2500	5800+/-2800	5600+/-2800	6500+/-2700
Gross alpha (dry)	NR	NR	NR	NR
Gamma Isotopic				
Co-58	<8	21+/-4	<19	<27
Co-60	<8	63+/-40	72+/-9	<16
Cs-134	<6	<6	77+/-6	<18
Cs-137	16+/-3	36+/-2	41+/-6	14+/-3
K-40	4890+/-150	4580+/-60	5380+/-130	4830+/-320

NR - Analysis is not required.

Table 19. Analysis of milk samples for January - December, 1986.
Stangel farm.

WISCONSIN DIVISION OF HEALTH
SECTION OF RADIATION PROTECTION

Kewaunee
1986

Measurements in units of pCi/liter

Stangel farm
3.0 miles N

WI - Section of Radiation Protection data

Collection date	01/08/86	02/05/86	03/12/86	04/02/86	05/14/86	06/05/86
Isotope:						
I-131	0.13+/-0.09	-0.18+/-0.07	0.03+/-0.09	-0.13+/-0.07	0.07+/-0.09	0.05+/-0.08
Ba,La-140	-1+/-5	-1+/-5	-4+/-6	-1+/-6	-1+/-7	0+/-5
Cs-134	-1+/-6	9+/-6	2+/-6	-1+/-6	4+/-6	2+/-6
Cs-137	1+/-6	2+/-6	6+/-6	0+/-7	5+/-6	0+/-7
K-40	1370+/-140	1360+/-180	1550+/-190	1410+/-180	1520+/-190	1390+/-180
Sr-90	2.0+/-0.5	3.7+/-0.7	2.7+/-0.7	1.4+/-0.6	4.1+/-1.1	2.8+/-0.6

Collection date	07/09/86	08/06/86	09/03/86	10/08/86	11/05/86	12/03/86
Isotope:						
I-131	0.01+/-0.14	0.4+/-0.2	-0.25+/-0.14	0.02+/-0.06	-0.06+/-0.08	0.02+/-0.06
Ba,La-140	-1+/-5	2+/-6	2+/-7	6+/-8	1+/-7	0+/-6
Cs-134	2+/-6	6+/-7	9+/-7	4+/-9	8+/-6	-4+/-8
Cs-137	9+/-8	8+/-7	9+/-8	11+/-11	4+/-7	0+/-7
K-40	1350+/-180	1350+/-180	1490+/-190	1500+/-200	1420+/-180	1340+/-180
Sr-90	2.5+/-0.5	2.8+/-0.7	4.9+/-0.8	2.0+/-0.6	1.4+/-0.6	2.1+/-1.0

Isotopes other than those reported were not detected.

Kewaunee data

Stangel farm
3.0 miles N

Collection date	01/07/86	02/04/86	03/04/86	04/03/86	05/20/86	06/03/86
Isotope:						
I-131	<0.5	<0.5	<0.5	<0.5	1.1+/-0.2	1.5+/-0.2
Ba,La-140	<15	<15	<15	<15	<15	<15
Cs-134	<10	<10	<10	<10	<10	<10
Cs-137	<10	<10	<10	<10	<10	<10
K-40	1520+/-100	1390+/-250	1470+/-90	1310+/-20	1350+/-70	1390+/-80
Sr-89	<0.7	<0.5	<0.6	<0.4	<0.7	<0.7
Sr-90	2.0+/-0.6	1.6+/-0.5	1.8+/-0.6	1.9+/-0.4	1.3+/-0.4	1.7+/-0.6

Collection date	07/02/86	08/05/86	09/09/86	10/03/86	11/04/86	12/02/86
Isotope:						
I-131	2.5+/-0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ba,La-140	<15	<15	<15	<15	<15	<15
Cs-134	<10	<10	<10	<10	<10	<10
Cs-137	<10	<10	<10	<10	<10	<10
K-40	1380+/-80	1260+/-140	1300+/-140	1240+/-60	1110+/-130	1470+/-90
Sr-89	<0.5	<0.6	<0.5	<0.5	<0.5	<0.8
Sr-90	2.1+/-0.5	2.4+/-0.5	1.7+/-0.5	2.0+/-0.5	1.9+/-0.5	2.3+/-0.5

Table 20. Analysis of food product samples for 1986.

WISCONSIN DIVISION OF HEALTH
SECTION OF RADIATION PROTECTION

Kewaunee
1986

Measurements in units of pCi/kilogram (wet)

WI - Section of Radiation Protection data

Collection Date	09/08/86	09/08/86	09/08/86	09/08/86
Type	tomatoes	corn	cabbage	cabbage
Location	Bertler's K-26 10.7 miles SSW	Bertler's K-26 10.7 miles SSW	Bertler's K-26 10.7 miles SSW	Jansky K-17 4.25 miles W
Analysis				
Gross beta (wet)	2400+/-200	2700+/-700	2000+/-1200	2100+/-400
Gross alpha (wet)	200+/-200	600+/-800	400+/-1300	100+/-300
Gamma Isotopic				
Be-7	-4+/-130	-4+/-130	100+/-170	90+/-180
K-40	1700+/-400	2600+/-400	2100+/-500	2500+/-500
Co-58	-2+/-14	2+/-16	-3+/-18	2+/-19
Co-60	12+/-20	20+/-20	13+/-30	15+/-30
Zr-95	-16+/-40	10+/-40	-15+/-50	5+/-60
I-131	4+/-20	0+/-19	-3+/-30	2+/-30
Cs-134	15+/-17	14+/-16	20+/-20	40+/-20
Cs-137	10+/-18	16+/-19	-4+/-20	2+/-20

Isotopes other than those reported were not detected.

Kewaunee data

Collection Date	09/08/86	09/08/86	09/08/86	09/08/86
Type	tomatoes	corn	cabbage	cabbage
Location	Bertler's K-26 10.7 miles SSW	Bertler's K-26 10.7 miles SSW	Bertler's K-26 10.7 miles SSW	Jansky K-17 4.25 miles W
Analysis				
Gross beta (wet)	2140+/-70	2580+/-80	1880+/-60	2300+/-70
Gross alpha (wet)	NR	NR	NR	NR
Gamma Isotopic				
Be-7	<29	<44	<97	<97
K-40	1880+/-70	3030+/-110	1810+/-140	2370+/-130
Co-58	NR	NR	NR	NR
Co-60	NR	NR	NR	NR
Zr-95	<6	<9	<20	<20
I-131	NR	NR	NR	NR
Cs-134	NR	NR	NR	NR
Cs-137	<3	<5	<13	<13
Ru-103	<4	<5	<13	<12
Ru-106	<3	<41	<91	<110
Ce-141	<7	<9	<21	<21
Ce-144	<26	<34	<93	<92

NR - Analysis is not required.