KEWAUNEE NUCLEAR POWER PLANT

ANNUAL OPERATING REPORT
1979

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1.0 INTRODUCTION

The Kewaunee Nuclear Power Plant is a pressurized water reactor Licensed at 1650 MWt. It is located in Kewaunee County along Lake Michigan's northeast Wisconsin shoreline and is jointly owned by Wisconsin Public Service Corporation, Wisconsin Power and Light Company and Madison Gas and Electric Company. The nuclear steam supply system was purchased from Westinghouse Electric Corporation and is rated for a 1721.4 MWt output. The turbine-generator was also purchased from Westinghouse and is rated at 540 MWe net. The architect/engineer was Pioneer Service and Engineering (PSE) from Chicago.

The Kewaunee Nuclear Power Plant achieved initail criticality on March 7, 1974. Initial power generation was reached April 8, 1974 and the plant was declared commerical on June 16, 1974. Since being declared commercial, Kewaunee has generated 20,183,800 MW hours of electricity with a net plant capacity factor of 73.8% (using net DER).

1.1 Highlights

During the year, the Kewaunee Nuclear Plant was base loaded. The unit was operated at a 75.5% capacity factor (using net MDC) with a gross efficiency of 33.0% The unit and reactor availability was 79.0% and 82.3% respectively. Table 2.1 is a compilation of the monthly summaries of the operating data, Table 2.2 contains the yearly and total summaries of the operating data, and Figure 1.1 provides a histogram of the average daily electrical output of the Kewaunee Plant for 1979.

On May 26 ., the unit was removed from service for refueling number four. Fourty fresh assemblies were loaded for cycle V. The unit was returned to service August 1.

2.0 SUMMARY OF OPERATING EXPERIENCE

January

For the month of January, Kewaunee was base loaded at 100% power with one scheduled backdown for required monthly turbine stop valve test.

On January 9, during the rod movement surveillance procedure, the operator discovered that one bank of rods had lost power to its respective lift coils, thereby disallowing normal control movement of that rod bank. Although normal rod movement was not available, the trip function of that bank was never lost; hence, there were no safety concerns associated with the problem. Subsequent investigation revealed a faulty logic card as the cause of the problem.

On January 10, with Diesel Generator 1B out of service for maintenance, control power was lost to Diesel Generator 1A. A controlled backdown was started and within a short period of time the problem was found to be a blown fuse.

Received Technical Specification amendment number 25 which changed core output to 1650 MW(th) from 1650 MW(th) reactor systems output.

On January 28, completed the monthly turbine stop valve test with the number 1 control valve isolated close.

PLANT SHUTDOWNS: There were no plant shutdowns in the month of January.

February

On February 5, the reactor was manually tripped when ice on the intake structure resulted in low forebay level. The unit was returned to service the same day.

On February 10, load was decreased to 275 MW to change the oil in the feedwater Pump 1B. The unit was back at full load on February 11.

PLANT SHUTDOWNS: February 5 - Forced shutdown - 14.6 hours. Forebay level dropped below minimum required for circ. water pump operation due to heavy lake ice. The circ. water recirc. pump was out of service at the time of this occurrence.

March

On March 3, the unit generation was reduced to 110 MW for the monthly turbine stop valve test. During this power reduction a leak check of the condensor was completed.

On March 11, the reactor was manually tripped because of ice accumulation on the circulating water inlet.

On March 12, a spurious trip occured when the control power was removed from a power range drawer being removed from service.

PLANT SHUTDOWNS: March 11 - Forced shutdown - 17.4 hours. Ice blockage of circ. water inlet structure prevented adequate circ. water flow to maintain vacuum. Manually tripped unit.

March 12 - Forced shutdown - 3.3 hours. Removal of one NI power range's control power fuses caused a unit trip.

April

Load was reduced on April 8 for the monthly stop valve test.

On April 18, fuel arrived on site for Cycle V.

On April 27, the pressurizer level bistables for Safety Injection were tripped.

On April 28 and 29, the Safety Injection actuation logic was changed from 1/3 pressurizer pressure and level to 2/3 low pressure.

PLANT SHUTDOWNS: There were no plant shutdowns for the month of April.

May

Kewaunee was base loaded at 100% power for the first part of May until May 26, when the unit was removed from service for refueling number 4.

PLANT SHUTDOWNS: May 26 - scheduled shutdown - 143.2 hours. Commenced Cycle IV - V refueling.

June

For all of June, the annual refueling outage continued. Fuel movement started on June 3 and was completed on June 9. The reactor vessel head was installed on June 13.

On June 15, while switching in the DC Supply and Distribution System, a spurious Safety Injection generated. This resulted in the pressurized safety injection accumulators discharging into the drained reactor coolant system.

PLANT SHUTDOWNS: May 26 - scheduled shutdown - 384 hours. Refueling continues from May.

Forced shutdown - 336 hours*

*Represents hours outage extended due to increased scope of inspection and repair on turbine, generator, and S/G feedwater nozzles.

July

Feedwater line work was completed on July 11, and startup of the unit was initiated.

On July 19, Reactor Coolant Pump 1B seal leakoff flow could not be established and the unit was drained for seal inspection.

On July 26, seal repair on Reactor Coolant Pump 1B was completed and plant startup was reinitiated.

On July 27, the unit was at hot shutdown.

On July 28, criticality was achieved and zero power physics testing started. Physics testing was completed on July 31, and preparation for putting the unit on line was started.

PLANT SHUTDOWNS: May 26 - scheduled shutdown - 228.8 hours. Refueling outage continues from May.

The following identifies the causes which extended the original outage:

(1) Forced shutdown - 302 hours - Repair of main feedwater to steam generator nozzle welds.

(2) Forced shutdown - 46 hours - Inspection of inaccessable safety related pipe supports.

(3) Forced shutdown - 167.2 hours - Investigation and correction of RCP No. 2 seal leak-off problems.

August

On August 1, the unit was returned to service after refueling.

On August 2, the unit was removed from service for turbine balancing. The unit was returned to service the same day.

On August 9, the unit was removed from service to repair pressurizer safety valve leaks. The unit was returned to service on August 16.

On August 19, the unit was removed from service due to a suspected pressurizer safety and/or POR valve leak. Leakage was determined to be seat leakage on the pressurizer loop seal drain valves and the Reactor Coolant System loop drain valves. The unit was returned to service the same day.

PLANT SHUTDOWNS: May 26 - scheduled shutdown - 13 hours. Refueling outage from May concluded.

August 2 - scheduled shutdown - 6.1 hours. A short outage was taken to adjust balance weights on the turbine.

August 9 - scheduled shutdown - 158.9 hours. Detected leakage through pressurizer safety valves within T.S. limits. An outage was scheduled for repair to prevent valve damage.

August 19 - forced outage - 7.7 hours. Detected leakage in excess of 1 gpm. Turbine taken off line with reactor critical. Miscellaneous drain valves tightened.

<u>September</u>

From September 1 to September 3, a power defect measurement was performed.

On September 3, the monthly turbine stop valve test was completed.

On September 12, a spike in one channel of the OPDT reactor protection system, while another channel was in the tripped condition for surveillance test, caused a reactor trip. The unit was returned to service the same day.

PLANT SHUTDOWNS: September 12 - Forced shutdown - 5.2 hours. A spike on one channel of Over Power Delta T occured while another was in a tripped condition for repair.

October

On October 6, load was reduced to allow inspection and repair of main condensor for tube in leakage. Monthly turbine stop valve test also was completed.

PLANT SHUTDOWNS: There were no plant shutdowns for the month of October.

November

On November 4, the monthly turbine stop valve test was completed.

On November 7, the unit load was reduced to 315 MW to repair an oil cooler leak on a condensate pump motor. The unit was returned to full load on November 8.

On November 14, 1B condensate pump lower motor bearing cooler failed requiring the pump to be removed from service. Reduced load to limits for one pump operation.

On November 25, the monthly turbine stop valve test was completed.

PLANT SHUTDOWNS: There were no plant shutdowns for the month of November.

December

On December 10, during performance of a monthly surveillance test, an error was made which caused a turbine runback with a subsequent over-temperature delta T reactor trip. The unit was returned to full load on December 11.

Some load following was done over the holiday weekend.

PLANT SHUTDOWNS: December 10 - Forced shutdown - 2.9 hours. Overtemperature Delta T reactor trip created by error during surveillance testing.

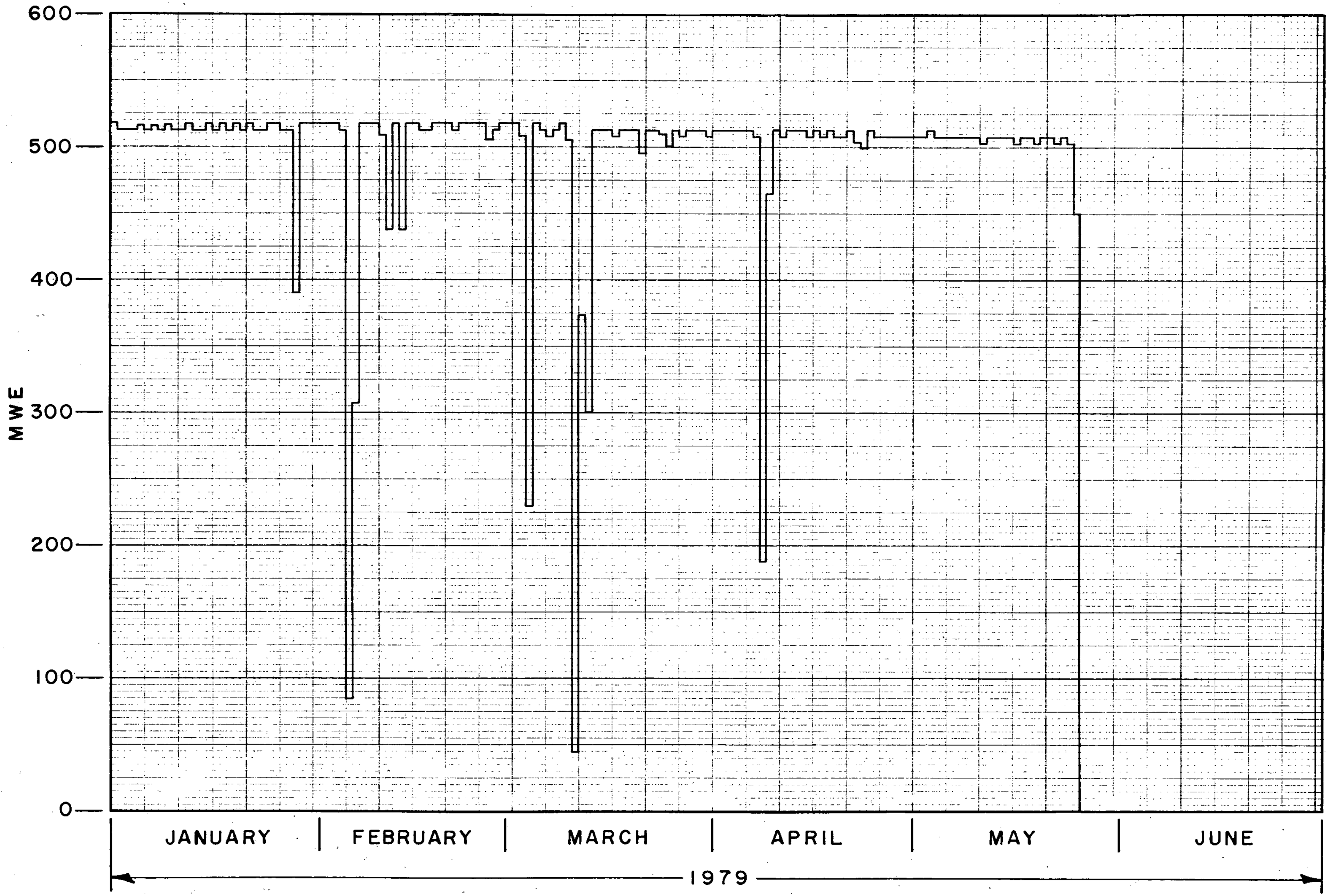

Fig. 11

KEWAUNEE POWER HISTORY
AVERAGE DAILY MWE - NET

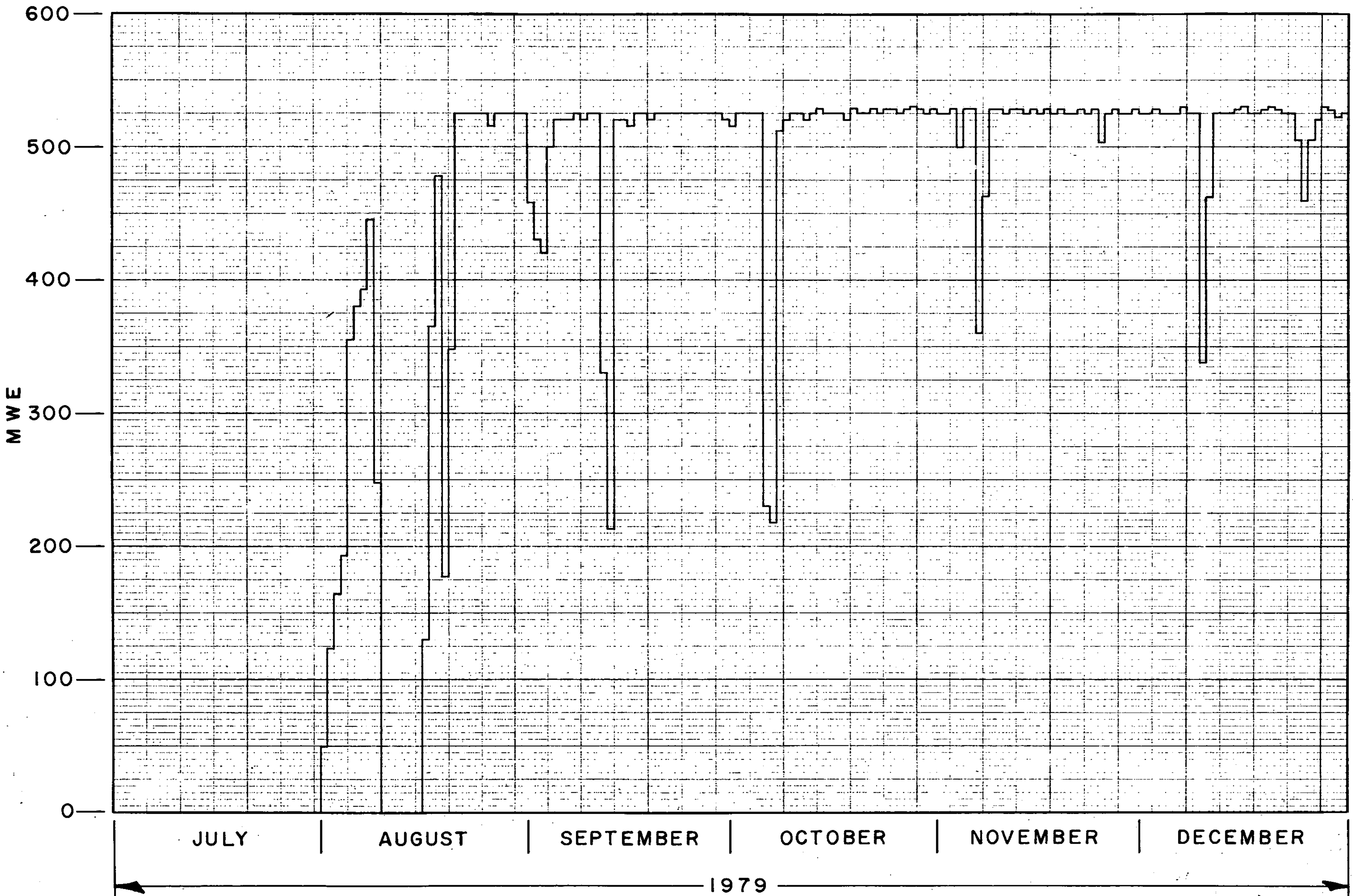

Fig. 1.1 (Cont.)

KEWAUNEE POWER HISTORY
AVERAGE DAILY MWE - NET

ELECTRICAL POWER GENERATION DATA (1979)

MONTHLY

	January	February	March	April	May	June
Hours RX was critical	744.	662.	734.7	719.	601.2	0.
RX Reserve shutdown hours	0	10	9.3	0	0	0
Hours Generator On-Line	744	657.4	723.4	719	600.8	0
Unit Reserve shutdown hours	0	0	0	0	0	0
Gross Thermal Energy Generated (MWH)	1,212,033.	1,047,590.	1,135,718.	1,151,567.	979,438.	0
Gross Elec. Energy Generated (MWH)	398,300	343,300	371,600	375,700	318,200	0
Net Elec. Energy Generated (MWH)	380,003	327,095	353,549	357,396	302,706	0
RX Service Factor	100	98.5	98.8	100	80.8	0
RX Availability Factor	100	100	100	100	80.8	0
Unit Service Factor	100	97.8	97.2	100	80.7	0
Unit Availability Factor	100	97.8	97.2	100	80.7	0
Unit Capacity Factor (using MDC net)	98.8	94.1	91.9	96.1	78.7	0
Unit Capacity Factor (using DER net)	95.5	91.0	88.8	92.9	76.0	0
Unit Forced Outage Rate	0	2.2	2.8	0	0	100
Hour in Month	744	672	744	719	744	720
Net MDC (Mwe)	517	517	517	517	517	517

Table 2.1

ELECTRICAL POWER GENERATION DATA (1979)

MONTHLY

	July	August	September	October	November	December
Hours RX was critical	60	591.9	718.7	745	720	742.2
RX Reserve shutdown hours	0	151.5	0	0	0	0
Hours Generated on-line	0	558.3	714.8	745.	720.	741.1
Unit Reserve shutdown hours	0	0	0	0	0	0
Gross Thermal Energy Generated (MWH)	0	740,156	1,126,633	1,184,602	1,167,457	1,202,648
Gross Elec. Energy Generated (MWH)	0	244,000	375,600	395,200	390,800	400,800
Net Elec. Energy Generated (MWH)	0	230,462	357,334	376,236	372,271	382,237
RX Service Factor	80.7	79.6	99.8	100	100	99.8
RX Availability Factor	80.7	99.9	99.8	100	100	99.8
Unit Service Factor	0	75.0	99.3	100	100	99.6
Unit Availability Factor	0	75.0	99.3	100	100	99.6
Unit Capacity Factor (using MDC Net)	0	59.1	94.7	96.4	98.7	97.7
Unit Capacity Factor (using DER Net)	0	57.9	92.8	94.4	96.6	96.0
Unit Forced Outage Rate	0	1.4	0.7	0	0	0.4
Hours in Month	744	744	720	745	720	744
Net MDC (Mwe)	517	524	524	524	524	526

Table 2.1 (Continued)

ELECTRICAL POWER GENERATION DATA

1979

	YEAR	CUMULATIVE
Hours RX was critical	7,038.7	41,002.4
RX Reserve Shutdown Hours	170.8	2,177.8
Hours Generator On-Line	6,923.7	39,995.9
Unit Reserve Shutdown Hours	0	10.0
Gross Thermal Energy Generated MWH	10,947,842.	61,151,123.
Gross Electrical Energy Gen. MWH	3,613,500.	20,183,800.
Net. Elec. Energy Generated MWH	3,439,289	19,199,078
RX Service Factor	80.4	84.4
RX Availability Factor	82.3	88.8
Unit Service Factor	79.0	82.3
Unit Availability Factor	79.0	82.3
Unit Capacity Factor (using MDC Net)	75.5	75.3
Unit Capacity Factor (using DER Net)	73.4	73.8
Unit Forced Outage Rate	11.5	5.3
Hours in Reporting Period	8,760	48,601

Table 2.2

3.0 PLANT MODIFICATIONS, 10CFR 50.59

No modifications were installed during 1979 which introduced an unreviewed safety question and, therefore, no modifications required prior NRC approval. The following summary of modifications includes those significant modifications completed during 1979 and not previously reported.

Fuel Handling Facilities

The spent fuel pool racks were replaced with high density racks. The new racks have a 10 inch spacing with boron carbide plates sandwiched within the double walled cannisters. The spent fuel pool capacity has been increased from the original 168 spaces to 270 spaces in the north pool and 360 spaces in half of the south pool. The second half of the south pool will be completed around 1987 increasing total capacity to 990 spaces. (DCR 557)

Summary of Safety Evaluation: A Modification Description and Safety Analysis and Environmental Impact Evaluation was prepared and submitted to the NRC for this project.

Chemical and Volume Control System

The boric acid heat tracing system was completely upgraded by changing the sensors and controllers to thermocouple units, adding new circuits in problem areas and replacing the old alarm system with a more advanced system. (DCR 306)

Summary of Safety Evaluation: This modification provided a system that is more reliable, more accurate and readily calibratable.

Safety Injection

The pressurizer safety injection actuation signal was changed from 1 out of 3 pairs of pressurizer level at 5% and pressure at 1815 psig to 2 out of 3 pressure at 1815 psig. The incident at Three Mile Island cast doubt as to the generation of a low level signal upon certain small break LOCA's. (DCR 806)

Summary of Safety Evaluation: Amendment 29 to the Technical Specifications includes a detailed safety evaluation. The 2 out of 3 low pressure signal satisfies the safety requirements for all analyzed accidents and the small break LOCA.

Residual Heat Removal

A 4 inch safety valve was added to the RHR system inside containment to handle pressure transients at refueling conditions. The valve is sized to handle the largest postulated mass or heat input to the primary system. (DCR 653)

Summary of Safety Evaluation: This valve provides overpressurization protection to the primary system at cold shutdown conditions and thus reduces the probability of an overpressurization event. It will also serve to mitigate the consequences of such an event if it did occur.

Piping and valves were added to connect the discharge of RHR heat exchanger 1A to the CVCS letdown line. This provides a method of coolant purification when the reactor coolant system is drained or depressurized. (DCR 733)

Summary of Safety Evaluation: This modification is not nuclear safety related.

Reactor Coolant System

A saturation meter which continuously displays the margin to saturated conditions in the control room was installed at the request of the NRC. (DCR 854)

Summary of Safety Evaluation: This modification is not nuclear safety related as it only provides another indication to aid the control room operator during abnormal conditions.

Fire Protection

The NRC required a review of fire protection at nuclear power plants. The final results were incorporated as a condition of license. Following are the major modifications completed as a result of this review:

Electrical penetrations of fire zone boundaries were upgraded to meet the rating required by the Fire Hazards Analysis. (DCR 750)

Mechanical penetrations of fire zone boundaries were upgraded to the same standards. (DCR 755)

Thermally actuated fire dampers equal to the fire wall ratings were installed where ventilation systems pass through fire zone boundaries. (DCR 781)

Additional ionization smoke detectors were added in various areas to provide complete coverage. (DCR 760)

A six inch curb was constructed in the 1B Diesel Generator room to prevent flow of diesel fuel from one room to the other. (DCR 794)

Sprinkler heads were added in the screenhouse tunnel to protect safeguards cable tray. (DCR 855)

A sprinkler system was added in the cable spreading area to protect safeguards cable. (DCR 652)

A sprinkler system was added to the maintenance materials storage area to protect safeguards cable tray above an area with a high combustible fire loading. (DCR 652)

Summary of Safety Evaluation: The above modifications provide a significant upgrade of the plant fire protection systems. The upgrade reduces the probability of fire related accident and the improved fire control would reduce the consequences of a fire in the plant thus enhancing overall plant safety.

Feedwater

A section of feedwater piping was replaced at both steam generator nozzles. The weld end internal tape was reduced to 5^{o} with the point of transition rounded to reduce stress levels. The change was made after internally initiated cracking was discovered at several nuclear plants. (DCR 825)

Summary of Safety Evaluation: This modification is not nuclear safety related.

Cranes

The turbine building crane was modified from an intermittent duty to a continuous duty design by changes to the resistor load banks, load brake, wiring and switch contacts. The bridge raceway insulated bar was replaced with a festoon system. (DCR 531) The auxiliary building fuel handling crane was modified by changing the radio controls to a telemotive unit and adding a dummy cab for pendant control. (DCR 768) These changes were required for safe operation and to prevent excessive downtime for maintenance when the cranes are required for any major lift.

Summary of Safety Evaluation: This modification is not nuclear safety related.

4.0 LICENSEE EVENT REPORTS

Included in this section is a summary of the 28 Licensee Event Reports (LER) submitted to the NRC in 1979 in accordance with the requirements of Technical Specifications. None of the LER's in 1979 posed a threat to plant operation or public safety.

LER 79-01

During steady full power operation D/G 1A was started to verify operability prior to placing D/G 1B out of service for maintenance. Approximately 80 minutes later, with D/G 1B out of service, a D/G 1A Start-Run-Failure alarm was received indicating loss of control power. A blown fuse in D/G 1A control cabinet caused loss of control power. No circuitry problems were found and a new fuse was installed without incident; D/G 1A was tested and returned to service.

LER 79-02

With D/G 1B out of service for maintenance, D/G 1A manual speed control failed. Controlled reactor shutdown was commenced until D/G 1B could be returned to service allowing the unit to be returned to full operating power. This occurred three times within a month. A pinion and limit switch were replaced and adjusted and the D/G was tested and returned to service.

LER 79-03

During steady full power operation high water level alarms were received for 1A and 1B SFP's. Investigation showed that an incorrect valve lineup during RWST clean-up operations had allowed a transfer of water from the RWST to the SFT. This resulted in a RWST level below the minimum level. RWST level was above the TS limit in less than 1 hour and the unit was returned to full power operation.

LER 79-04

During steady full power operation D/G 1A failed to start during an operability test. The cause was found to be a broken rotor vane which jammed the primary D/G air start motor. D/G 1B was tested to confirm operability. Repairs to D/G 1A were completed within TS required time interval and the D/G was returned to service.

LER 79-05

With the plant at reduced power, surveillance testing of the turbine governor and stop valves was performed. One of the stop valves failed to close completely because of interference with a puller mechanism. The procedure has been modified to prevent re-occurrence.

LER 79-06

During full power operation surveillance testing indicated that a relay in one train of SI logic would not mechanically latch. The mechanical latch mechanism was out of adjustment and would not hold. Following re-adjustment, the relay was satisfactorily tested. The other SI train was fully operational.

LER 79-07

During full power operation surveillance testing indicated that 1 of 6 containment pressure transmitters was out of calibration. Instrument drift caused the pressure transmitter to be out of calibration. The transmitter was recalibrated and returned to service.

LER 79-08

During full power operation, installation of the Boric Acid Heat Tracing design change was in progress when one train of heat tracing on the piping between the BA transfer pumps common discharge header and the BA filter was discovered to be inoperable. System lineup was changed to bypass the effected piping using existing lines. The effected section was then flushed and the failed heat tracing train was repaired and returned to service.

LER 79-09

During normal shutdown operations preparatory to refueling, RCS temperature was being maintained above 350° F while a DCR piping modification was installed on the RHR system. The resulting rate of condensate water usage through the S/G Power Relief Valves for temperature control caused the condensate storage tank (CST) level to be drawn below the TS limit. Service water was available and CST level was returned above the limit within the allowed time.

LER 79-10

With the reactor at hot shutdown conditions during normal operation preparatory to entering refueling, one Auxiliary Building Special ventilation zone (ASV) boundary door was found blocked open. This door was recently replaced as part of required facility security modifications. A CAUTION notice regarding ASV boundary requirements had not been transferred to the new door. The door was shut upon identification. The proper notice has been posted on the door.

LER 79-11

During refueling shutdown, surveillance testing indicated that three of four pressurizer pressure transmitters were out of calibration.

Instrument drift of Foxboro pressure transmitters caused them to be out of calibration. The transmitters were recalibrated with no indication of other problems.

LER 79-12

During normal refueling operations, maintenance work required opening of valve SI-302 A, RHR low head injection to vessel, for line flushing. This valve could not be opened from the control room and was manually opened. The redundant line valve, SI-302B, was tested and operated satisfactorily. A definite cause for this failure could not be identified. Valve SI-302A opened satisfactorily four times from the control room after being manually opened. Inspection of the valve revealed no indications of problems.

LER 79-13

During refueling operations, surveillance testing indicated that all four RCS flow transmitters were out of calibration. Instrument drift of the Foxboro flow transmitters caused them to be out of calibration. The transmitters were recalibrated with no indications of further problems.

LER 79-14

During refueling operations, the full length rod unlatching procedure was being performed when it was realized that containment integrity was not established and that both airlock doors were open. The requirement for establishing containment integrity prior to rod unlatching appears elsewhere in the overall refueling procedures document but is not included in the detailed rod unlatching procedure. Future refueling procedures will include the containment integrity requirement in the detailed rod unlatching procedure.

LER 79-15

During refuelage outage, surveillance testing indicated that one of four steam flow transmitters was out of calibration. Instrument drift of the Barton D/P transmittter caused the out of calibration condition. The instrument was recalibrated with no other problems identified.

LER 79-16

An error in the RWST level instrument calibration procedure in use at the time the pre-op test was performed caused a non-conservative shift in the RWST level indicator. Procedure error was corrected shortly after pre-op test completion but effect on test results was not realized. A "bubbler" system will be installed for narrow range RWST level indication to monitor the required T.S. water volume.

LER 79-17

During refueling outage information was received regarding FW line cracks found at the S/G nozzles of another plant. A decision was made to UT and RT these piping sections at the Kewaunee Plant. The removed FW piping was analyzed and minor cracks were found. The nature of these cracks was identified as combined stress/corrosion cracking. The root cause of these cracks is undetermined. A long range program of investigation is in progress and will include future inspections to detect possible re-occurrence of cracking.

LER 79-18

During refueling outage, the facility was informed by our NSSS vendor that high energy line breaks inside containment can result in heatup of the S/G level reference leg causing an increase in indicated S/G level. This condition was caused by density effects of heating the S/G level reference leg which were not considered by the NSSS vendor in previous system analysis. The S/G lo-lo level trip setpoint has been corrected to account for this source of error.

LER 79-19

During refueling shutdown a review of non-radiological liquid waste discharge records indicated that there was a one day discharge from the waste neutralizing tank that exceeded to total solids limit of ETS 2.2.2. This occurrence was discussed with involved personnel.

LER 79-20

During refueling shutdown a management review of records indicated that daily sampling of the turbine building sump and the water treatment lagoon was not performed on two consecuative days. Samples taken on day before and after were well within WPDES permit limits; therefore, no adverse environmental effects are expected.

LER 79-21

During refueling shutdown surveillance testing, local leakrate testing identified six containment isolation valves with unacceptable as-found leakage. Repairs were made and the valves tested satisfactorily.

LER 79-22

During the power assumption phase of plant startup, SP125 data, Shift Instrument Channel Checks, was not recorded. As much data as possible was obtained from computer logs. The involved operators were instructed on the importance of assuring that all SP requirements are satisfied.

LER 79-23

While at full power operation a safety valve discharge line high temperature alarm was actuated. Two valves in the safety valve loop seal drain line and two RCS drain valves were found to be leaking. The plant was taken to hot shutdown condition for investigation of leakage. After torquing these valves shut calculated leakage was below the TS limit. The plant was returned to operation within 8 hours.

LER 79-24

During steady full power operation, the supply breaker to MCC 1-62F has tripped open 17 times on 9 separate dates. A cause has not been identified. The breaker has operated in normal configuration without tripping for more than a year.

LER 79-25

During steady full power operation one of two D/G sets was left in "Pullout" for 10 hours following its monthly loaded run SP. The D/G SP was recently revised to place the D/G in pullout for 3 hours following test performance. The revised SP did not contain a procedure step placing the D/G back in AUTO. The SP was revised to include this step.

LER 79-26

During steady full power operation surveillance testing of FP system detectors was being performed. The relay which activates the FP control valve solenoid operator was sticking. The relay was cleaned and lubricated and tested satisfactorily.

LER 79-27

During steady full power operation, D/G 1B failed to start during performance of the turbine trip reactor trip logic test step of the reactor protection logic surveillance procedure. The D/G received a start signal from logic circuits and attempted to start. A start failure alarm was annunciated in control room. No faults in the logic or D/G start circuitry were identified. D/G 1B has since been started four times with no problems encountered.

LER 79-28

While inspecting safety related lines for seismic qualification as required by IE Bulletin 79-14 three horizontal pipe restraints were discovered missing on a 16" service water header. A design for these hangers was performed, approved and the hangers were installed.

5.0 FUEL INSPECTION REPORT

During Refueling #4, forty (40) fresh Region G assemblies were loaded for Cycle V. Startup physics testing was performed and the results reported in the Cycle V Physics Report.

The irradiated fuel inspection was performed with an underwater TV camera. All peripheral fuel rods were examined using half face scans. A total of thirteen assemblies were inspected. Representative samples of two assemblies per region were chosen from regions D, E and F. An additional seven Region D assemblies were inspected to verify that fuel rod bow was not a problem.

Overall condition of the fuel was excellent with no evidence of fuel cladding degradation on the peripheral fuel rods examined. Numerous fuel rods were touching the bottom nozzle on Regions D and E fuel. Permanent deformation of the hold down springs was noted on only two assemblies. An axial and radial variation of crud deposits was quite marked on eight of the Region D Assemblies. Complete video tapes were made of all examinations.

6.0 PERSONNEL EXPOSURE AND MONITORING REPORT

Persuant to sections 407(b)(1)(i) and 407(b)(2) of 10CFR20, the following tabulation of the number of individuals receiving exposures within specified ranges and the total number of personnel for whom monitoring was provided is shown on the attached table.

1979

PLANT STAFF & VISITORS

Exp. Range (MR)	# Personnel
No Measurable	452
< 100	138
100-250	58
250-500	45
500-750	43
750-1K	35
1K-2K	24
Grand Total	795

REPORT OF OCCUPATIONAL EXPOSURE DATA

The following tabulation of numbers of personnel exposures and man-rem received by work and job function is shown on the attached table in accordance with section 6.9.1.b of the Kewaunee Nuclear Power Plant Technical Specifications.

U.S.N.R.C. REGULATORY GUIDE 1.16 – REPORTING OF OPERATING INFORMATION

STANDARD FORMAT FOR REPORTING NUMBER OF PERSONNEL AND MAN-REM BY WORK AND JOB FUNCTION ON YEAR OF 1979–KEWAUNEE

WORK AND JOB FUNCTION	NUMBER OF PERSONNEL (GT 100 MREM)			TOTAL MAN-REM		
	STATION EMPLOYEES	UTILITY EMPLOYEES	CONTRACT WORK & OTHER	STATION EMPLOYEES	UTILITY EMPLOYEES	CONTRACT WORK & OTHER
REACTOR OPERATIONS SURVEILLANCE						
MAINTENANCE PERSONNEL	6	1	0	0.277	0.001	0.000
OPERATING PERSONNEL	14	0	1	3.426	0.000	0.000
HEALTH PHYSICS PERSONNEL	0	0	0	0.000	0.000	0.000
SUPERVISORY PERSONNEL	6	0	1	0.869	0.000	0.000
ENGINEERING PERSONNEL	3	3	0	0.147	0.327	0.000
ROUTINE MAINTENANCE						
MAINTENANCE PERSONNEL	36	15	52	5.239	4.331	11.230
OPERATING PERSONNEL	8	0	3	0.806	0.000	0.124
HEALTH PHYSICS PERSONNEL	8	0	8	5.508	0.000	2.419
SUPERVISORY PERSONNEL	3	0	1	0.232	0.000	0.000
ENGINEERING PERSONNEL	3	0	0	0.094	0.000	0.000
INSERVICE INSPECTION						
MAINTENANCE PERSONNEL	8	4	41	0.794	0.334	23.265
OPERATING PERSONNEL	1	0	14	0.016	0.000	5.785
HEALTH PHYSICS PERSONNEL	0	0	0	0.000	0.000	0.000
SUPERVISORY PERSONNEL	1	0	1	0.075	0.000	0.000
ENGINEERING PERSONNEL	1	0	0	0.194	0.636	0.000
SPECIAL MAINTENANCE						
MAINTENANCE PERSONNEL	35	9	61	9.431	0.395	17.525
OPERATING PERSONNEL	6	0	5	0.079	0.000	0.016
HEALTH PHYSICS PERSONNEL	3	0	0	0.123	0.000	0.000
SUPERVISORY PERSONNEL	4	0	1	0.253	0.000	0.000
ENGINEERING PERSONNEL	3	1	3	0.218	0.031	0.284
WASTE PROCESSING						
MAINTENANCE PERSONNEL	20	5	6	1.962	0.152	0.063
OPERATING PERSONNEL	10	0	0	3.527	0.000	0.101
HEALTH PHYSICS PERSONNEL	8	0	0	0.880	0.000	0.000
SUPERVISORY PERSONNEL	1	0	0	0.000	0.000	0.000
ENGINEERING PERSONNEL	1	0	0	0.000	0.000	0.000
REFUELING						
MAINTENANCE PERSONNEL	18	8	4	1.370	2.114	0.228
OPERATING PERSONNEL	11	0	15	0.032	0.000	8.162
HEALTH PHYSICS PERSONNEL	3	0	0	0.002	0.000	0.000
SUPERVISORY PERSONNEL	3	0	1	0.036	0.000	0.000
ENGINEERING PERSONNEL	3	1	0	0.145	0.000	0.000
TOTAL						
MAINTENANCE PERSONNEL	123	47	164	19.073	7.327	52.311
OPERATING PERSONNEL	50	0	38	6.886	0.000	15.188
HEALTH PHYSICS PERSONNEL	22	0	8	6.513	0.000	2.419
SUPERVISORY PERSONNEL	17	0	5	1.464	0.000	0.000
ENGINEERING PERSONNEL	13	7	3	0.798	0.994	0.284
GRAND TOTAL	225	50	218	34.734	8.321	70.202

7.0 ENVIRONMENTAL TECHNICAL SPECIFICATIONS

(APPENDIX B)

This section employs the subsection numbering consistent with the specific subject covered in Appendix B.

2.1 Thermal

2.1.1 Maximum Δ T Across the Condenser

During normal operation of the plant, the ΔT(°F) across the condenser was recorded hourly. The monthly averages and maximums are as follows:

	ΔT (Ave)	ΔT High Day (Ave)	ΔT Maximum Recorded	ΔT Max. Daily (Ave)
Jan	20.5	23.5	25.0	23.2
Feb	17.4	23.5	25.0	22.6
Mar	15.3	23.0	23.9	18.5
Apr	13.3	20.4	25.4	15.4
May	12.9	14.1	16.4	13.8
Jun	--	--	--	--
Jul	--	--	--	--
Aug*	11.5	15.1	16.0	13.2
Sep	14.3	16.4	17.8	15.4
Oct*	13.5	15.1	16.5	14.5
Nov	13.8	14.7	15.0	14.6
Dec	17.6	22.9	24.0	21.6

*Two water boxes open and drained. Values corrected using average inlet temperature and values of operating outlets (Aug 3 and Oct 6).

2.1.2 Maximum Discharge Temperatures

The maximum discharge temperature and the average of the maximum temperature was:

	Discharge Temp. (Max) °F	Discharge Temp. (Ave Max) °F
Jan	67.4	60.4
Feb	72.4	61.0
Mar	65.1	58.6
Apr	65.3	60.0
May	69.8	63.8
Jun	--	--
Jul	--	--
Aug*	81.5	73.3
Sep	78.3	72.8

	Discharge Temp. (Max) ^{o}F	Discharge Temp. (Ave Max) ^{o}F
Oct*	72.5	68.3
Nov	68.7	61.4
Dec	68.1	61.3

*Two water boxes open and drained. Values corrected using only operating outlets (Aug 3 and Oct 6).

2.1.3 Rate of Temperature Change of Condenser Cooling Water, ΔT

During normal power operation, the rate of change of condenser cooling water temperature did not exceed 15^{o}F during normal power increase and 8^{o}F during normal power decrease.

2.2 Chemicals

2.2.1 Chlorination of the Circulating Water System

The circulating water system has not been chlorinated during this period of reporting.

2.2.2 Suspended and Dissolved Solids

The neutralizing tank has been discharging to the lagoon.

2.2.3 Treatment Chemicals

The total amount of raw chemicals used during the calendar year was as follows:

	Totals
1. Primary System	
a. Boric Acid	9,000 lbs.
b. Hydrazine	4.75 gal.
c. Lithium 7 Hydroxide	5.5 lbs.
2. Secondary System	
a. Hydrazine	416.8865 gal.
3. Pre-Treatment System	
a. Ferric Sulfate	10,000 lbs.
b. Lime	0 lbs.
c. Polyelectrolyte	41.465 lbs.
d. Sodium Hypochlorite (15%)	1,710 gal.
e. Sodium Sulfite	1,174 lbs.
4. Demineralizer System	
a. Sodium Hydroxide 50 w/o	516,350 lbs.
b. Sulfuric Acid	421,060 lbs.
5. Potable Water Softeners	
a. Salt (NaCl)	25,200 lbs.
6. Circulating Water System	
a. Sodium Hypochlorite	0 gal.
7. Component Cooling System	
a. Chromates	0 lbs.

2.2.4 Miscellaneous Discharge

The pH and total suspended solids before dilution of the condenser hotwell, turbine building sump, water softening unit and pretreatment system lagoon are characterized as follows:

1. Condenser Hotwell

	pH			Suspended Solids mg/L			Total	
	High	Low	Ave	High	Low	Ave	SS Lbs.	Gallons
Jan	--	--	--	--	--	--	--	--
Feb	7.6	7.6	7.6	2.7	2.7	2.7	1.39	61,875
Mar	8.2	8.2	8.2	1.5	1.5	1.5	1.24	99,500
Apr	--	--	--	--	--	--	--	--
May	8.7	8.7	8.7	6.3	6.3	6.3	3.44	65,625
Jun	--	--	--	--	--	--	--	--
Jul	8.0	7.5	7.75	0.6	0.1	0.35	0.16	68,438
Aug	8.7	7.8	8.3	0.6	0.4	0.5	0.31	76,873
Sep	--	--	--	--	--	--	--	--
Oct	--	--	--	--	--	--	--	--
Nov	--	--	--	--	--	--	--	--
Dec	--	--	--	--	--	--	--	--

2. Turbine Building Sumps

	pH			Suspended Solids mg/L			Total	
	High	Low	Ave	High	Low	Ave	SS Lbs.	Gallons
Jan	8.6	7.1	7.63	11.7	0.4	2.6	11.41	504,120
Feb	8.3	6.8	7.53	19.4	0.2	6.47	29.10	548,000
Mar	8.1	6.7	7.49	28.6	0.3	5.36	27.73	589,220
Apr	8.8	7.2	7.67	29.0	0.5	5.97	33.92	698,590
May	8.6	6.2	7.66	18.1	0.7	5.54	40.30	919,880
Jun	8.3	7.2	7.83	55.5	0.3	5.61	30.04	779,500
Jul	8.5	7.4	7.76	28.0	0.1	3.53	37.20	873,300
Aug	8.5	6.9	7.96	13.8	0.5	4.95	34.63	919,550
Sep	8.8	6.7	7.89	19.4	1.5	5.54	38.01	792,980
Oct	8.8	6.3	7.65	19.5	1.5	6.60	45.91	797,550
Nov	8.1	7.0	7.62	29.3	2.0	8.29	103.87	1,313,680
Dec	8.9	7.0	7.62	34.0	0.3	6.51	118.58	2,645,630

3. Water Softening Unit

	pH			Suspended Solids mg/L			Total	
	High	Low	Ave	High	Low	Ave	SS Lbs.	Gallons
Jan	7.1	7.1	7.1	59.8	59.8	59.8	1.20	2,400
Feb	7.4	6.8	7.1	61.9	18.8	40.0	1.60	4,800
Mar	7.4	7.1	7.25	35.5	14.0	24.75	0.99	4,800
Apr	7.0	6.8	6.9	23.7	11.0	15.33	0.92	7,200
May	7.6	6.9	7.25	68.4	0.2	34.3	1.37	4,800
Jun	7.8	6.8	7.18	29.6	6.2	13.08	1.66	12,000
Jul	7.1	6.9	7.02	29.7	2.6	19.35	1.55	9,600
Aug	7.0	6.9	6.95	17.8	14.7	16.25	0.65	4,800
Sep	7.4	7.1	7.25	31.2	31.1	31.15	1.25	4,800
Oct	7.3	7.1	7.2	44.0	20.8	32.4	1.30	4,800
Nov	7.0	7.0	7.0	44.9	44.9	44.9	0.90	2,400
Dec	--	--	--	--	--	--	--	--

4. Pretreatment System Lagoon

	pH			Suspended Solids mg/L			Total	
	High	Low	Ave	High	Low	Ave	SS Lbs.	Gallons
Jan	7.7	7.4	7.59	36.5	0.1	3.23	33.67	1,211,578
Feb	7.8	6.1	6.52	18.8	0.3	3.10	31.88	1,108,875
Mar	7.5	7.0	7.3	68.2	0.2	5.06	47.45	1,392,668
Apr	7.7	7.3	7.5	35.0	0.1	3.77	44.36	1,333,463
May	7.6	7.3	7.44	17.4	0.1	1.48	15.37	1,186,816
Jun	7.8	7.4	7.55	23.3	0.02	2.37	14.98	774,073
Jul	7.8	7.4	7.56	27.2	0.3	3.12	25.21	983,431
Aug	7.9	7.5	7.88	20.7	0.5	2.91	23.85	1,060,529
Sep	7.9	7.5	7.73	6.0	0.7	2.81	23.41	995,714
Oct	7.9	7.6	7.68	10.8	1.4	3.15	45.60	1,024,148
Nov	8.0	6.1	7.47	67.9	1.6	10.66	10.66	1,054,920
Dec	8.1	7.2	7.54	27.2	1.9	5.99	5.06	1,241,351

4.0 Environmental Surveillance & Special Studies

4.1 Biological

4.1.1 Aquatic

1. Fish Impingement

Fish impingement data is listed on Table 1 (3 pages).

4.2.2 De-Icing Operation

Operation of the de-icing pump during the reporting period.

			Inlet Temperature °F	
Date	On	Off	Maximum	Minimum
1-2 to 1-4	03:50	00:35	45	32
1-4 to 1-27	05:50	15:36	47	32
2-5 to 4-13	03:00	12:30	47	32
12-1 to 12-31	15:30	24:00	47	33

Table 1

FISH IMPINGEMENT DATA

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Alewife - *Alosa pseudoharengus*												
Number	31	0	0	0	23,057	990	546	639	320	196	713	8
Size - cm	15-20				5-23	12-20	11-21	14-20	10-20	11-19	8-20	17-18
Wgt-Kg	1.7				692	30.5	21.3	27.3	10.8	7.7	33.2	.4
Smelt - *Osmerus mordax*												
Number	146	28	254	650	1,571	12	4	496	210	186	990	434
Size - cm	8-19	10-19	7-18	10-24	11-30	12-14	18	10-20	10-18	12-20	7-23	9-30
Wgt-Kg	3.9	.79	7.7	20.3	49.5	.2	.13	17.9	6.2	6.5	33.7	13.2
White Sucker - *Catostomus commersonni*												
Number	4	8	25	85	28	6	4	25	270	52	15	47
Size - cm	51	37-40	36-57	10-50	37-53	40	45	34-40	18-46	24-47	20-25	24-41
Wgt-Kg	5.7	5.7	15.9	76.4	25.2	3.3	2.6	13.6	140.4	29.3	9.7	19.4
Longnose Sucker - *Catostomus catostomus*												
Number	13	20	19	10	3	0	27	25	60	21	38	19
Size - cm	18-30	35-49	40	40	53		37-45	23-45	33-48	31-47	17-35	25-36
Wgt-Kg	5.6	17.3	13.3	6.4	5.3		14.5	7.8	35.0	14.8	8.7	4.5
Yellow Perch - *Perca flavescens*												
Number	4	4	31	10	41	6	4	56	0	0	0	0
Size - cm	19	28	13-30	19-20	17-45	28	27	24-36				
Wgt-Kg	.18	1.3	7.5	1.5	11.0	2.0	1.1	17.6				
Longnose Dace - *Rhinichthys cataractae*												
Number	0	0	0	0	38	162	267	223	90	31	0	31
Size - cm					9-15	10-13	8-13	9-12	7-14	6-8		5-18
Wgt-Kg					.54	2.3	3.2	2.8	1.1	.16		.91

Table 1

FISH IMPINGEMENT DATA

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bullhead - *Ictalurus spp.*												
Number	4	24	19	130	41	6	4	25	10	10	0	4
Size - cm	17	20-29	22-26	10-25	16-28	24	23	20-27	19	24		25
Wgt-Kg	.2	7.0	4.4	15.3	7.4	1.3	.8	5.2	3.6	2.6		1.04
Carp - *Cyprinus carpio*												
Number	4	28	25	20	17	6	4	6	0	0	0	16
Size - cm	61	43-76	45-59	46-76	56-68	50	54	57				40-66
Wgt-Kg	25.8	102.1	50.3	70.0	61.4	9.1	6.3	7.9				41.2
Slimy Sculpin - *Cottus cognatus*												
Number	394	152	409	555	899	180	89	161	130	155	173	376
Size - cm	5-8	5-9	3-8	4-8	4-8	6-8	6-9	5-8	5-7	5-7	6-10	5-10
Wgt-Kg	2.0	.76	2.1	3.3	5.5	.7	.2	.7	.6	.7	1.0	2.7
Lake Trout - *Salvelinus namaycush*												
Number	13	0	0	10	21	6	0	12	0	10	23	12
Size - cm	47-62			17-24	30-76	72		54-65		65	56-60	55-65
Wgt-Kg	35.7			.9	38.5	31.5		40.8		48.8	66.5	32.0
Brown Trout - *Salmo trutta*												
Number	102	20	19	65	10	0	0	0	0	0	30	35
Size - cm	10-53	20-28	21-26	15-28	25-45						46-64	16-25
Wgt-Kg	23.5	4.0	3.6	10.3	9.4						69.7	4.7
Rainbow Trout - *Salmo gairdnerii*												
Number	9	0	0	10	3	6	0	0	0	0	0	4
Size - cm	23-26			18-23	69	33						20
Wgt-Kg	1.6			8.2	9.9	3.2						.30

Table 1

FISH IMPINGEMENT DATA

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Brook Trout - <u>Salvelinus fontinalus</u>												
Number	0	0	0	0	3	0	4	0	0	0	0	8
Size - cm					43		36					21-47
Wgt-Kg					3.1		2.3					7.1
Lake Chub - <u>Hybopsis plumbea</u>												
Number	0	0	0	0	0	0	31	25	0	0	0	4
Size - cm							14-18	7-15				21
Wgt-Kg							1.0	.6				.5
Lake Whitefish - <u>Coregonus clupeaformis</u>												
Number	0	0	0	10	7	0	0	0	0	0	8	4
Size - cm				26-48	33-46						40	46
Wgt-Kg				5.4	5.0						7.0	4.7
Coho - <u>Oncorhynchus kisutch</u>												
Number	0	0	0	0	0	0	0	0	20	0	0	0
Size - cm									66-74			
Wgt-Kg									82.8			
Chinook - <u>Oncorhynchus tshawytscha</u>												
Number	4	4	0	0	0	6	0	0	0	93	30	0
Size - cm	61	40				64				47-67	17-62	
Wgt-Kg	11.8	4.8				24.5				308.9	108.6	
Burbot - <u>Lota lota</u>												
Number	0	0	6	0	3	0	4	0	0	0	8	0
Size - cm			46		47		47				58	
Wgt-Kg			4.5		4.8		2.4				8.1	

8.0 RADIOLOGICAL MONITORING PROGRAM

Attached is the report from Hazleton Environmental Sciences Corporation on the Radiological Monitoring Program for Kewaunee Nuclear Power Plant for 1979.

HAZLETON
ENVIRONMENTAL SCIENCES CORPORATION
1500 FRONTAGE ROAD, NORTHBROOK, ILLINOIS 60062, U.S.A.

REPORT TO

WISCONSIN PUBLIC SERVICE CORPORATION
WISCONSIN POWER AND LIGHT COMPANY
MADISON GAS AND ELECTRIC COMPANY

RADIOLOGICAL MONITORING PROGRAM FOR THE KEWAUNEE NUCLEAR POWER PLANT KEWAUNEE, WISCONSIN

ANNUAL REPORT - PART I
SUMMARY AND INTERPRETATION
January - December 1979
Project No. 8995

PREPARED AND SUBMITTED
BY
HAZLETON ENVIRONMENTAL SCIENCES CORPORATION

Approved by: ______________________
B. G. Johnson, Ph.D.
Vice President and Technical Director

6 February 1980

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Preface

The staff members of the Nuclear Sciences Department of Hazleton Environmental Sciences were responsible for the acquisition of data presented in this report. Assistance in sample collections was provided by the Field Operations Section of Hazleton Environmental Sciences and by Wisconsin Public Service Corporation personnel.

The report was prepared by L. G. Huebner, Director, Nuclear Sciences. He was assisted in the report preparation by the staff members of the Nuclear Sciences Section. The staff members are: C. A. Galioto (Johnson); C. R. Marucut, L. A. Nicia, D. Rieter, and J. Salmorin.

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I. Introduction

The Kewaunee Nuclear Power Plant is a 540 megawatt pressurized water reactor located on the Wisconsin shore of Lake Michigan in Kewaunee County. The Kewaunee Nuclear Power Plant went critical on March 7, 1974. Initial power generation was achieved on April 8, 1974, and the Plant was declared commercial on June 16, 1974. This report summarizes the environmental operational data collected during the period January - December 1979.

Wisconsin Public Service Corporation, as operating company for the Kewaunee Nuclear Power Plant, assumes the responsibility for the environmental program at the Plant and any questions relating to this subject should be directed to them.

II. Summary

Results of sample analyses during the period January-December 1979 are summarized in Table 5. Radionuclide concentrations measured at indicator locations are compared with levels measured at control locations and in preoperational studies. The comparisons indicate backgound-level radioactivities in all samples collected with the following exceptions:

(1) Trace amount of manganese-54 was detected in one out of twelve periphyton samples and trace amounts of cobalt-58 and cobalt-60 were detected in two out of twelve periphyton samples.

(2) Trace amounts of cobalt-58, cobalt-60 and cesium-134 were detected in about half of sixteen bottom sediment samples collected near the condenser discharge are

The presence of the trace amounts of the activation products in these samples is attributed to the plant operations.

III. Methodology

The sampling locations are shown in Figure 1. Table 1 describes the locations, lists for each its direction and distance from the reactor, and indicates which are indicator and which are control locations.

The sampling program monitors the air, terrestrial, and aquatic environments. The types of samples collected at each location and the frequency of collections are presented in Table 2 using sample codes defined in Table 3. Below, the collections and analyses that comprise the program are described. Finally, the execution of the program in the current reporting year is discussed.

A. The Air Program

The airborne particulate samples are collected on 47 mm diameter membrane filters of 0.8 micron porosity at a volumetric rate of approximately one cubic foot per minute. The filters are collected weekly from six locations (K-1f, K-2, K-7, K-8, K-15, and K-16), and dispatched by mail to Hazleton Environmental Sciences for radiometric analysis. The material on the filter is counted for gross alpha and beta activity approximately five days after receipt to allow for decay of naturally-occurring short-lived radionuclides.

Quarterly composites from each sampling station are analyzed for gamma-emitting isotopes by Ge(Li) detector.

The integrated gamma-ray background is measured at air sampling locations (K-1f, K-2, K-7, K-8, K-15, and K-16) and at four milk sampling locations (K-3 through K-6) with ion chambers and thermoluminescent dosimeters (TLD's). Ion chambers are placed in duplicate and read monthly. CaF_2: Mn bulb TLD's are exchanged quarterly and annually.

Charcoal filters are located at locations K-1f, K-2, K-7, K-8, K-15, and K-16. The filters are changed bi-weekly and analyzed for iodine-131 immediately after arrival at the laboratory.

Monthly composites of precipitation samples collected at K-11 are analyzed for tritium activity by liquid scintillation techniques.

B. <u>The Terrestrial Program</u>

Milk samples are collected weekly (one gallon from each location) from May through October and monthly (two gallons from each location) during the rest of the year from four herds that graze within four miles of the reactor site (K-4, K-5, K-12, and K-19) and from two herds that graze between four and ten miles from the reactor site (K-3 and K-6). The milk samples are analyzed for iodine-131, strontium-89 and -90, cesium-137, barium-140, potassium-40, calcium, and stable potassium.

One-gallon water samples are collected quarterly from four off-site wells located at K-10, K-11, K-12, and K-13. Monthly one-gallon water samples are collected from two on-site wells located at K-1g and K-1h.

The gross alpha and beta activities are determined on the total residue of each water sample. The concentration of potassium -40 is calculated from total potassium, which is determined by flame photometry on all samples. The tritium levels in quarterly composites of monthly on-site samples from K-1g are determined by liquid scintillation techniques.

Quarterly composites of monthly grab samples of water from one on-site well (K-1g) are analyzed for strontium-89 and strontium-90.

Domestic meat samples (chickens) are obtained annually (in the third quarter) at Locations K-17, K-20, K-24, and K-25. The flesh is separated from the bones, ashed, and analyzed for gross alpha and gross beta activities and gamma scanned.

Eggs are collected quarterly at Location K-17. The samples are gamma scanned and analyzed for gross alpha, gross beta, strontium-89, and strontium-90 activities.

Vegetable samples (5 varieties) are collected at Location K-18 and two varieties of grain, if available, at Location K-23. The samples are gamma scanned and analyzed for gross alpha, gross beta, strontium-89, and strontium-90 activities.

Grass samples are collected during the second, third and fourth quarters from two on-site locations (K-1b and K-1f) and from six dairy farms (K-3, K-4, K-5, K-6, K-12, and K-19). The samples are gamma scanned and analyzed for gross alpha, gross beta, strontium-89, and strontium-90 activities. During the first quarter cattle feed is collected from the same six dairy farms, and the same analyses are performed.

Soil samples are collected twice a year on-site at K-1f and from the six dairy farms (K-3, K-4, K-5, K-6, K-12, and K-19). The samples are gamma scanned and analyzed for gross alpha and gross beta, strontium-89, and strontium-90 activities.

C. The Aquatic Program

One-gallon water samples are taken monthly from three locations on Lake Michigan: 1) at the point where the condenser water is discharged into Lake Michigan (K-1d); 2) at Two Creeks Park (K-14) located 2.5 miles south of the reactor site; and 3) at the Rostok water intake (K-9) located 11.5 miles north of the reactor site. Additionally, one-gallon water samples are taken monthly from three creeks that pass through the site (K-1a, K-1b, and K-1e). Samples from North and Middle Creeks (K-1a, K-1b) are collected near the mouth of each creek. Samples from the South Creek (K-1e) are collected about ten feet downstream from the point where the outflows from the two drain pipes meet.

The water samples are analyzed for gross alpha and gross beta activity in the total residue, dissolved solids, and suspended solids. The concentration of potassium-40 is calculated from total potassium, which is determined by flame photometry. The tritium activity of the Lake Michigan samples is determined by liquid scintillation techniques. Quarterly composites of monthly grab samples from Lake Michigan are also analyzed for strontium-89 and strontium-90.

Fish samples (2 species) are collected in the second, third, and fourth quarters at Location K-1d. The flesh is separated from the bones, ashed, analyzed for gross alpha and gross beta activity, and gamma scanned. Ashed bone samples are analyzed for gross alpha, gross beta, strontium-89 and strontium-90 activities.

Bottom organisms are collected in the second, third and fourth quarters from the discharge canal area (K-1d), Rostok water intake (K-9), and Two Creeks Park (K-14). Samples are analyzed for gross alpha and gross beta activities and are also gamma scanned if available in sufficient quantity.

Slime samples are collected during the second and third quarters from three Lake Michigan locations (K-1d, K-9, and K-14), from three creek stations (K-1a, K-1b, and K-1e), if available. The samples are analyzed for gross alpha and gross beta. If the quantity is sufficient, they are also gamma scanned and analyzed for strontium -89 and strontium-90 activities.

Bottom sediments are collected four times a year from five locations (K-1c, K-1d, K-1j, K-9, and K-14). The samples are analyzed for gross alpha and gross beta activities and for strontium -89 and strontium-90. Each sample is also gamma scanned. Since it is known that the measured radioactivity per unit mass of sediment increases with decreasing particle size, the sampling procedure is designed to assure collection of very fine particles.

D. Program Execution

Program execution is summarized in Table 4. The program was executed as described in the preceding sections with the following exceptions:

(1) There were no air particulate data for location K-2, for the collection period ending 5-22-79 because of a blown fuse.

(2) There were no air particulate data for location K-7 for the collection periods ending 1-25-79, 1-31-79, 2-07-79, and 3-22-79 because of the pump malfunction.

(3) There was no iodine-131 datum for location K-7 for the collection period ending 1-31-79 because of the pump malfunction.

(4) There were no air particulate data for Location K-16 for the collection periods ending 1-22-79, 1-29-79, and 2-05-79 because of the pump malfunction.

(5) There was no iodine-131 datum for Location K-16 for the collection period ending 1-29-79 because of the pump malfuntion.

(6) No ion chamber data was available for Locations K-2 (June) and K-16 (October), because both chambers read full scale.

(7) One of the two ion chambers at locations K-3 (January), K-3 (February), K-2 (May), K-3 (May), K-16 (May), K-8 (July), K-16 (July), K-2 (August), K-2 (September), K-1f (October), K-5 (October), K-3 (October), K-4 (November), K-5 (November), and K-4 (December) could not be read because the chambers read full scale.

(8) No precipitation was collected in September because there was no rain during that month.

(9) Chickens were not available from Alvin Zahorik farm (K-22) because the farmer no longer raises chickens. The sample was collected from a new location, the Wotachek farm (K-25).

(10) No buckwheat was collected at Location K-23 because it was not grown there in 1979.

(11) On 1-03-79, 2-01-79, and 3-01-79 no surface water could be collected from the South Creek (K-1e) because it was frozen. Substitute samples were taken from Sewage Treatment Pond No. 1.

(12) No gamma-spectroscopic data could be obtained on all nine bottom organism samples. Attempts were made to collect bottom organisms during each sampling period but the population of bottom organisms at the sampling locations was very sparse and it was not possible to collect samples of sufficient size for gamma-spectroscopic analysis.

IV. Results and Discussion

The results for the reporting period January to December 1979 are presented in summary form in Table 5. For each type of analysis of each sampled medium, this table shows the annual mean and range for all indicator locations and for all control locations. The location with the highest annual mean and the results for this location are also given.

The discussion of the results has been divided into three broad categories: the air, terrestrial, and aquatic environments. Within each category, samples will be discussed in the order listed in Table 4. Any references to previous environmental data for the Kewaunee Nuclear Power Plant refer to data collected by Hazleton Environmental Sciences, NALCO Environmental Sciences, or Industrial BIO-TEST Laboratories, Inc.

The tabulated results of all measurements made in 1979 are not included in this section, although references to these results will be made in the discussion. The complete tabulation of the 1979 results is contained in Part II of the 1979 annual report on the Radiological Monitoring Program for the Kewaunee Nuclear Power Plant.

A. The Air Environment

For air particulates, both gross alpha and gross beta measurements yielded annual means that were nearly identical for the indicator and control locations.

Gross alpha and beta activities at all locations were also analyzed by months and quarters. While alpha activity exhibited no definite trend, slightly higher gross beta averages were for the months of January, March and July and the first and third quarters.

Slightly higher activity in March and during the first quarter was due to the normal spring peak in gross beta activity, which has been observed almost annually (1976 was an exception) for many years (Wilson et. al., 1969) and have been attributed to fallout of nuclides from the stratosphere (Gold et. al., 1964).

Gamma-spectroscopic analysis of quarterly composites of air particulate filters yielded only one detectable isotope, beryllium-7 which is produced continuously in the upper atmosphere by cosmic-ray interaction (Arnold and Al-Salih, 1955). The activity detected was slightly higher at the indicator locations.

All other gamma-emitting isotopes were below their respective LLD limits.

Bi-monthly levels of airborne iodine-131 were below the lower limit of detection (LLD) of 0.01 pCi/m^3 at all locations. Thus, there is no indication of an effect of the plant on the local air environment.

Ambient gamma radiation was monitored by ion chambers and TLD's at ten locations, four indicator and six control.

For the ion chambers at the indicator locations, the radiation exposure averaged 6.4±0.8[1] mR(30 days) while for the control locations it was 6.7±1.0mR/(30 days). In both cases, the range was approximately ±50% of the mean. The two means may be considered to be in agreement since their difference is smaller than the sum of their estimated uncertainties. The location with the highest annual mean (7.6±0.4) was the control location K-8, 5 miles WSW of the plant. Since this location is so distant from the plant and since it typically yielded the highest monthly ion-chamber readings during the 1973 pre-operational study, the high result is not attributable to the plant.

The quarterly TLD's at the indicator locations measured a mean dose equivalent of 69.3±7.3 mrem/(365 days), in agreement with the mean at the control locations of 73.1±7.2 mrem/(365 days) and were higher than the means obtained in 1978 (52.2 and 61.6 mrem/(365 days), respectively). The quarterly measurements agreed with the annual measurements which were 71.6±9.0 mrem (365 days) for the indicator and 77.9±9.6 mrem (365 days) for the control locations. All of these values are close to the United States average value of 78 mrem/year due to natural background radiation (National Council on Radiation Protection and Measurements, 1975). The highest means for the quarterly and annual TLD's were 87.3 and 80.0 mrem/(365 days) and occurred at the control locations K-16 and

1 Unless otherwise indicated, uncertainties of average values are standard deviations of the individual measurements over the period averaged. Uncertainties of individual measurements represent probable counting errors at the 95% confidence level.

K-8, respectively.

Precipitation was monitored only at an indicator location, K-11. The tritium level ranged from 127 to 270 pCi/1 and averaged 178 pCi/1. The range is similar to that found in the 1973 pre-operational study and is therefore not attributed to plant operation.

B. The Terrestrial Environment

Of the 198 analyses for iodine-131 in milk all were below the LLD level of 0.5 pCi/1, except for one measurement on the sample collected on 11 June 1979 from control location K-19. The LLD level in this sample was 0.6 pCi/1 and was due to a low chemical yield recovery.

Strontium-89 activity was below the LLD level of 3.2 pCi/l in all samples.

Strontium-90 activity was found in all samples. The mean values were essentially identical for all indicator and control locations (2.8 and 2.7 pCi/l, respectively).

Barium-140 activity was below the LLD of 3.7 pCi/1 in all samples.

Potassium-40 and cesium-137 results averaged slightly higher at the control than at the indicator locations and were essentially identical to the levels observed in 1978. None of the differences among the means are statistically significant.

Due to the chemical similarities between strontium and calcium, and cesium and potassium, organisms tend to deposit cesium 137 in the soft tissue and muscle and strontium-89 and -90 in the bones. Consequently, the ratios of strontium-90 activity to the weight of calcium in milk and cesium-137 activity to the weight of potassium in milk were monitored in order to detect potential environmental accumulation of these radionuclides. No statistically significant variations in the ratios were observed. The measured concentrations of stable potassium and calcium are in agreement with previously determined values of 1.50±0.21 g/1 and 1.16±0.08 g/1, respectively (National Center for Radiological Health 1968).

Except in eight samples, all measurements for gross alpha activity in well water were below the LLD of 3.5 pCi/1. Analysis for radium-226 in samples with levels above the LLD of 3.0 pCi/1 yielded less than 2.0 pCi/1 of radium-226 for all samples.

Gross beta activity in well water was 2.2 pCi/1 in samples from control location. The mean value from all indicator locations was 3.0 pCi/1 and was nearly identical to the values observed in 1977 and 1978 (3.3 pCi/1 and 3.4 pCi/1, respectively.

Tritium activity in the on-site well (K-1g) was below the LLD of 170 pCi/1 in all samples.

The activities of strontium-89 and strontium-90 in well water were below detection limits.

Potassium-40 levels were quite low (under 3.0 pCi/1) in agreement with the previously measured values.

In meat samples (chickens) gross alpha activity was below the LLD of 0.012 pCi/g wet weight in all samples. Gross beta activities averaged 0.40 pCi/g wet weight for indicator locations and 0.50 pCi/g wet weight at the control location. Gamma-spectroscopic analysis showed that most of the beta activity was due to naturally occurring potassium-40. All other gamma-emitting isotopes were below their respective LLD limits.

In egg samples, the gross alpha activity was below the LLD of 0.04 pCi/g wet weight in all samples. Gross beta activity averaged approximately 1.4 pCi/g wet weight, about equal to the activity of the naturally occurring potassium-40 observed in the samples (1.2 pCi/g). The levels of strontium-89 and all other gamma-emitting isotopes were below their LLD's. Strontium-90 was detected in two out of four samples and ranged from 0.004 to 0.036 pCi/g wet weight.

In vegetables, alpha activities were below the LLD of 0.03 pCi/g wet weight in all but one sample. The detected alpha activity was at the LLD level of 0.03 pCi/g wet weight. Gross beta activity was slightly higher at the control location than at the indicator location and was due primarily to the potassium-40 activity. Strontium-89 activity was below the LLD of 0.002 pCi/g wet weight in all but one sample. The detected activity was barely above LLD level (0.003 pCi/g wet weight). Strontium-90 activity was slightly higher at the control location (0.009 pCi/g wet weight) than at the indicator location (0.006 pCi/g wet weight). All other gamma-emitting isotopes were below their respective LLD levels. The sample of oats was of similar composition but the activity was slightly higher due to the lower water content of the grain in comparison with the vegetables.

In grass, gross alpha activity was below the LLD level of 0.17 pCi/g wet weight in all samples. Gross beta activity was identical at indicator and control locations (7.7 pCi/g wet weight) and in both cases was predominantly due to naturally occurring potassium-40 and beryllium-7. All other gamma-emitting isotopes were below their LLD's. In general, the fallout products in samples collected in June were lower than in samples collected in August and

October and attributable to the deposition and accumulation of fallout from earlier nuclear test. Strontium-89 activity, detected in ten samples, was nearly identical at both indicator and control locations (0.06 and 0.5 pCi/g wet weight, respectively). Strontium-90 activity was detected in all samples and was identical at both control and indicator locations (0.06 pCi/g wet weight). Presence of strontium-89 and -90 was due to fallout from previous nuclear tests.

For cattlefeed, gross alpha activity was below the LLD of 0.3 pCi/g wet weight at all control locations and was slightly above LLD level (0.4 pCi/g wet weight) in one sample from the indicator location K-4. Mean gross beta activity was higher at indicator locations (11.1 pCi/g wet weight) than at control locations (8.4 pCi/g wet weight). The highest gross beta level was in the sample from indicator location K-4 (18.7 pCi/g wet weight) and reflected the high potassium-40 level (16.0 pCi/g wet weight) observed in the sample. The pattern was similar to that observed in 1978. Strontium-89 levels were below the LLD level of 0.01 pCi/g wet weight in all but one sample. The detected activity was 0.27 pCi/g wet weight in a sample collected at K-4. Strontium-90 activity was nearly identical at both indicator and control locations (0.12 and 0.10 pCi/g wet weight, respectively). The presence of the radiostrontium is attributable to the fallout from the previous nuclear test. Except for trace amounts at cesium-137 and cerium-144 all other gamma-emitting isotopes were below their respective LLD levels.

No significant differences were found between indicator and control values for soil samples. The difference of 1.5 pCi/g dry weight in mean gross alpha activity between indicator locations and control locations is not statistically significant because the counting uncertainties of the individual measurements are typically 4-6 pCi/g dry weight. Mean gross beta levels were nearly identical at indicator and control locations (24.8 and 27.3 pCi/g dry weight, respectively and is primarily due to the potassium-40 and berillium-7 activities. A trace amount of strontium-89 was detected in only one sample collected in July from indicator location K-19. Strontium-90 was detected in all samples and was slightly higher at control locations (0.13 pCi/g dry weight) than at indicator locations (0.11 pCi/g dry weight). Cerium-137 was detected in all samples and was nearly identical at both indicators and control locations (0.49 and 0.54 pCi/g dry weight, respectively. Except of a trace amount of zircomium-95 detected in one sample, all other gamma-emitting isotopes were below their LLD's.

C. The Aquatic Environment

In surface water, the mean gross alpha activity in suspended solids was slightly above the LLD of 0.5 pCi/1 at indicator locations (0.6 pCi/1) and was below the LLD at control locations. In dissolved solids gross alpha activity was below the LLD of 4.1 pCi/l at all locations.

Mean gross beta activity in suspended solids was below the LLD of 1.0 pCi/1 at the control location and was 1.8 pCi/1 at indicator locations. Mean gross beta activity in dissolved solids was, by a factor of two, higher at indicator locations (5.7 pCi/1) in comparison to the control location (2.7 pCi/1) and was nearly identical to the activities observed in 1978 (5.4 and 2.7 pCi/l). The control sample is the Lake Michigan water which varies very little in activity during the year, while indicator samples include two creek locations (k-la and K-le) which are much higher and exhibit large month-to-month variations in gross beta activities. The K-la creek drains its water from the surrounding fields which are heavily fertilized and K-le creek draws its water mainly from the Sewer Treatment Pond No. 1. In general, gross beta activity levels were high when potassium-40 levels were high and low when potassium-40 levels were low indicating that the fluctuations in beta activity were due to variations in potassium-40 concentrations and not to plant operation. The fact that similar fluctuations at these locations were observed in the 1973 pre-operational study supports this assessment.

Annual mean tritium activity was nearly identical at both indicator and control locations (290 and 270 pCi/l, respectively.)

Strontium-89 activity was below the LLD of 1.2 pCi/1 in all samples. Strontium-90 activity was essentially identical at both indicator and control locations (1.9 and 2.0 pCi/1, respectively).

In fish samples, gross alpha activity was below detection limits in all bones and all but one muscle samples. In muscle, gross beta and potassium-40 levels were nearly identical. The average beta activity of 3.4 pCi/g wet weight was near the middle of the 1973 range of 2.26 to 3.62 pCi/g wet weight. The cesium-137 activity in muscle averaged 0.12 pCi/g wet weight. The strontium-89 level in bones was below the LLD of 0.12 pCi/g wet weight in all but one sample (0.41 pCi/g wet weight) while strontium-90 averaged 0.27 pCi/g wet weight. This activity was near the lower limit of the 1973 range of 0.40 to 1.09 pCi/g dry weight and was similar to the level found in 1978 (0.32 pCi/g wet weight).

Only small amounts of bottom organisms were collected resulting in rather high LLD's. Gross alpha levels were below the LLD of 9 pCi/g dry weight in all samples. Gross beta activities ranged from 18 to 34 pCi/g dry weight. The quantities of bottom organisms were of insufficient quantity for gamma spectral analysis.

In periphyton (slime) samples, strontium-89 levels were below the LLD of 0.15 pCi/g wet weight in all samples. Level of strontium-90 was twice as high at the indicator locations than at the control locations (0.07 and 0.03 pCi/g wet weight respectively) and was due to the higher activity detected in samples collected from North Creek on site (K-1a). Mean values of gross beta (2.9 and 3.0 pCi/g wet weight) levels were nearly identical at indicator and control locations and potassium-40 levels were identical at both indicator and control locations (1.6 pCi/g wet weight). The drainage area of this creek includes fields which are heavily fertilized resulting in high potassium-40 levels and, therefore, in high gross beta. Gamma-spectroscopic analysis of the periphyton sample collected 9-04-79 from the discharge (K-1d) yielded trace-level amounts of the following man-made isotopes: manganese-54, cobalt-58, cobalt-60, and cesium-137. Of these, cersium-137 was also observed at the control location K-9 and in one sample from South Creek (K-1e). Thus, the presence of trace amounts of manganese-54, cobalt-58, and cobalt-60 may be due to plant operation.

In bottom sediment samples, gross alpha levels were below the LLD of 5.3 pCi/g dry weight in all samples.

Mean gross beta levels were higher at control locations (10.1 pCi/g dry weight) than at indicator locations (7.6 pci/g dry weight) and were due mostly to potassium-40.

Mean cesium-137 level (0.16 pCi/g dry weight) was about twice the level observed at the control location (0.08 pCi/g dry weight) and was similar to the level observed in 1978 (0.17 and 0.09 pCi/g dry weight, respectively). Strontium-89 activity was below the LLD level at 0.02 pCi/g dry weight in all samples. Strontium-90 was detected in only one of sixteen samples and was barely above the LLD level at 0.02 pCi/g dry weight (0.03 pCi/g dry weight). Trace amounts of cobalt-58, cobalt-60, and cesium-134 were also detected in botom sediment samples collected near the condenser discharge.

Presence of these activation and fission products in bottom sediments is probably plant related.

V. Figures and Tables

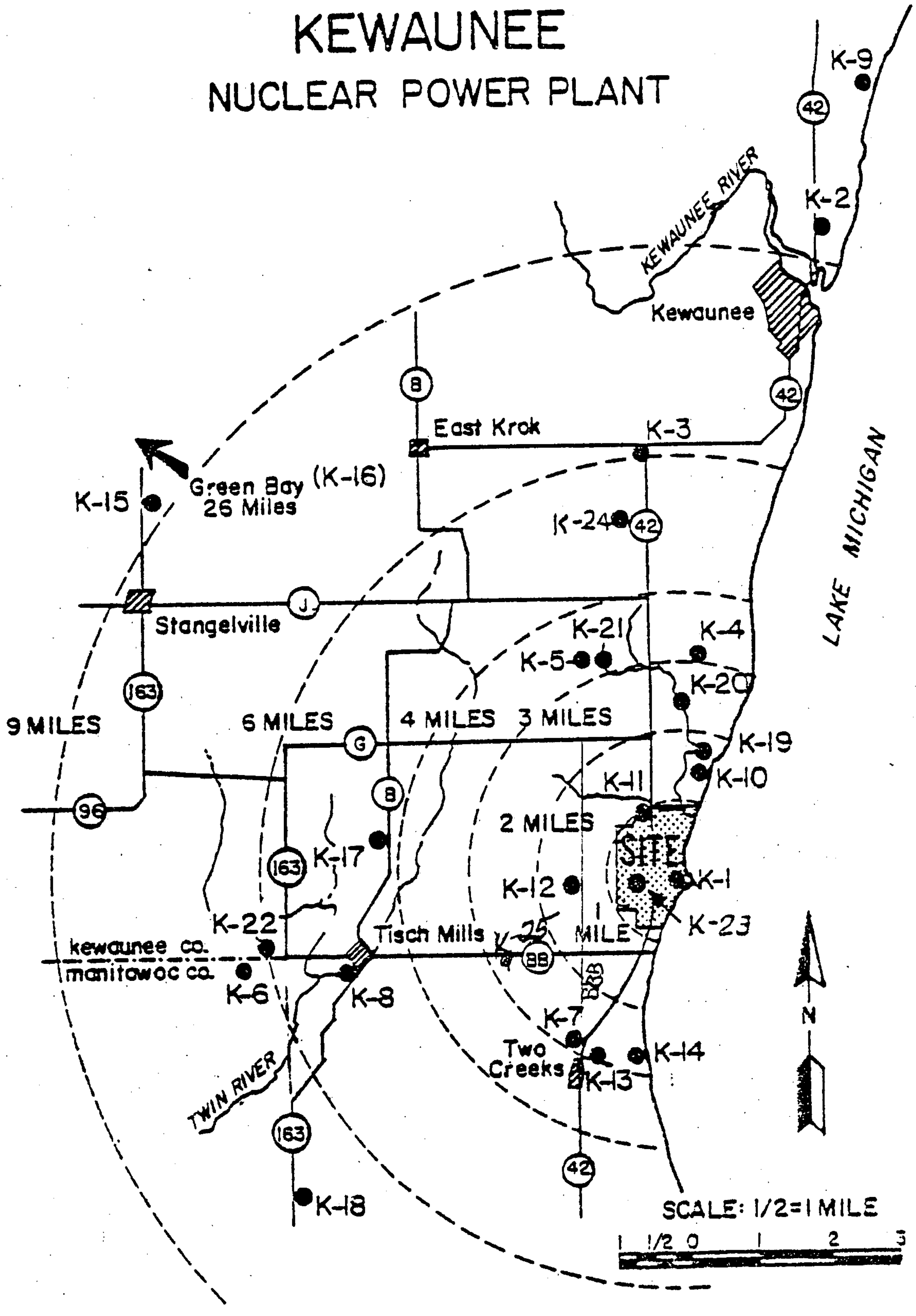

Figure 1. Sampling locations, Kewaunee Nuclear Pcwer Plant.

Table 1. Sampling locations, Kewaunee Power Plant.

Code	Type[a]	Distance (miles)[b] and Sector	Location
K-1			Onsite
1a	I	0.62 N	North Creek
1b	I	0.12 N	Middle Creek
1c	I	0.10 N	500' north of condenser discharge
1d	I	0.10 E	Condenser discharge
1e	I	0.12 S	South Creek
1f	I	0.12 S	Meteorological tower
1g	I	0.06 W	South Well
1h	I	0.12 NW	North Well
1j	I	0.10 S	500' south of condenser discharge
K-2	C	9.5 NNE	WPS Operations building in Kewaunee
K-3	C	6.0 N	Lyle and John Siegmund farm, Route 1, Kewaunee
K-4	I	3.0 N	Dan Stangel farm, Route 1, Kewaunee
K-5	I	3.5 NNW	Ed Paplham farm, Route 1, Kewaunee
K-6	C	6.5 WSW	Leonard Berres farm, Route 1, Denmark
K-7	I	2.75 SSW	Earl Bruemmer farm, Route 3, Two Rivers
K-8	C	5.0 WSW	Saint Mary's Church, Tisch Mills
K-9	C	11.5 NNE	Rostok Water Intake for Green Bay, Wisconsin two miles north of Kewaunee
K-10	I	1.5 NNE	Turner farm, Kewaunee site
K-11	I	1.0 NW	Harlan Ihlenfeld farm
K-12	I	1.5 WSW	Lecaptain farm, one mile west of site
K-13	C	3.0 SSW	Two Creeks general store
K-14	I	2.5 S	Two Creeks Park, 2.5 miles south of site
K-15	C	9.25 NW	Gas Substation, 1.5 miles north of Stangelville
K-16	C	26 NW	WPS Division Office Building, Green Bay, Wisconsin
K-17	I	4.25 W	Jansky farm, Route 1, Kewaunee
K-18	C	7.0 SSW	Schmidt's Food Stand, Route 163 (3.5 miles south of "BB")
K-19	I	1.75 NNE	Wayne Paral farm, Route 1, Kewaunee
K-20	I	2.5 N	Carl Struck farm, Route 1, Kewaunee
K-21[c]	I	3.25 NNW	Bill Hardtke farm, Route 1, Kewaunee
K-22[d]	C	6.25 WSW	Alvin Zahorik farm, Route 1, Denmark
K-23	I	0.5 W	0.5 miles west of plant, Kewaunee Site
K-24	I	5.45 N	Fectum farm, Route 1, Kewaunee
K-25	C		Wotachek farm, Route 1, Denmark

[a] I = indicator; C = control
[b] Distances are measured from reactor stack.
[c] Replaced by K-24 in September 1978.
[d] Replaced by K-25 in September 1979.

Table 2. Type and frequency of collection.

Location	Frequency: Weekly	Bi-weekly	Monthly	Quarterly	Semi-Annually	Annually
K-1					SL	
K-1a			SW		SL	
K-1b			SW	GR[a]		
K-1c				BS[b]	SL	
K-1d			SW	BS[b] BO[a]	FI[a] SL	
K-1e			SW			
K-1f	AP	AI	RC	GR[a] TLD	SO	TLD
K-1g			WW			
K-1h			WW			
K-1j				BS[b]		
K-2	AP	AI	RC	TLD		TLD
K-3			RC,MI[c]	GR[a] TLD CF[d]	SO	TLD
K-4			RC,MI[c]	GR[a] TLD CF[d]	SO	TLD
K-5			RC,MI[c]	GR[a] TLD CF[d]	SO	TLD
K-6			RC,MI[c]	GR[a] TLD CF[d]	SO	TLD
K-7	AP	AI	RC	TLD		TLD
K-8	AP		RC	TLD		TLD
K-9			SW	BS[b] BO[a]	SL	
K-10				WW		
K-11			PR	WW		
K-12			MI[c]	GR[a] CF[d] WW	SO	
K-13				WW		
K-14			SW	BS[b] BO[a]	SL	
K-15	AP	AI	RC	TLD		TLD
K-16	AP	AI	RC	TLD		TLD
K-17				EG		DM,VE
K-18						VE
K-19			MI[c]	GR[a]		
K-20						DM
K-21[e]						DM
K-22[f]						DM
K-23						GRN
K-24						DM
K-25						DM

[a]Three times a year, 2nd (April, May, June), 3rd (July, Aug., Sept.), and 4th (Oct., Nov., Dec.) quarters.
[b]To be collected in May, July, Sept., Nov.
[c]Monthly from November through April; weekly from May through October.
[d]First (January, February, March) quarter only.
[e]Replaced by K-24 in September 1978.
[f]Replaced by K-25 in September 1979.

Table 3. Sample codes used in Table 2.

Code	Description
AP	Airborne Particulate
AI	Airborne Iodine
RC	Radiation Chamber
TLD	Thermoluminescent Dosimeter
PR	Precipitation
MI	Milk
WW	Well Water
DM	Domestic Meat
EG	Eggs
VE	Vegetables
GRN	Grain
GR	Grass
CF	Cattlefeed
SO	Soil
SW	Surface Water
FI	Fish
BO	Bottom Organisms
SL	Slime
BS	Bottom Sediments

Table 4. Sampling summary, January - December 1979.

Sample Type	Collection Type and Frequency[a]	Number of Locations	Number of Samples Collected	Number of Samples Missed	Remarks
Air Environment					
Airborne particulates	C/W	6	304	8	See text p.7
Airborne iodine	C/BW	6	154	2	See text p.7
Ion chambers	C/M	10	221	19	See text p.8
TLD's	C/Q	10	40	0	
	C/A	10	10	0	
Precipitation	C/M	1	10	2	See text p.8
Terrestrial Environment					
Milk (May-Oct)	G/W	6	162	0	
(Nov-Apr)	G/M	6	36	0	
Well water	G/M	2	23	1	See text p.8
	G/Q	4	16	0	
Domestic meat	G/A	4	4[b]	0	
Eggs	G/Q	1	4	0	
Vegetables-5 varieties	G/A	2	6	0	
Grain-oats	G/A	1	1	0	
-buckwheat	G/A	1	0	1	See text p.8
Grass	G/TA	8	24	0	
Cattle Feed	G/A	6	6	0	
Soil	G/SA	7	14	0	
Aquatic Environment					
Surface water	G/M	6	72[c]	0	
Fish-2 varieties	G/TA	1	6	0	
Bottom organisms	G/TA	3	9	0	
Slime	G/SA	6	12	0	
Bottom sediments	G/FA	5	20	0	

[a] Type of collection is coded as follows: C/=continuous; G/=grab. Frequency is coded as folows: /W=weekly; /M=monthly; /Q=quarterly; /SA=semi-annually; /TA=three times per year; /FA=four times per year; /A=annually; /BW=bi-weekly.

[b] One collection was made at a substitute location.

[c] Three collections were made at a substitute location.

Table 5. Environmental Radiological Monitoring Program Summary.

Name of facility Kewaunee Nuclear Generating Plant   Docket No. ________

Location of facility Kewaunee County, Wisconsin (County, state)   Reporting period January-December 1979

Sample Type (Units)	Type and Number of Analyses[a]		LLD[b]	Indicator Locations Mean(F)[c] Range[c]	Location with Highest Annual Mean: Location[d]	Location with Highest Annual Mean: Mean(F) Range	Control Locations Mean(F) Range	Number of Non-routine Results[e]
Airborne Particulates (pCi/m³)	GA	304[f]	0.0005	0.0009 (39/100) (0.0005-0.0039)	K-1f Meteorological Tower, onsite 0.12 mi S	0.0011 (17/52) (0.0005-0.0039)	0.0008 (80/204) (0.0005-0.0034)	0
	GB	304[g]	0.001	0.011 (90/100) (0.001-0.046)	K-1f Meteorological Tower, onsite 0.12 mi S	0.012 (44/52) (0.001-0.046)	0.009 (187/204) (0.001-0.030)	0
	GS	24						
	Be-7		0.014	0.061 (5/8) (0.029-0.101)	K-7 Bruemmer Farm Two Rivers 2.75 mi SSW	0.072 (2/4) (0.043-0.101)	0.040 (11/16) (0.026-0.053)	0
	Nb-95		0.006	<LLD	-	-	<LLD	0
	Zr-95		0.009	<LLD	-	-	<LLD	0
	Ru-103		0.003	<LLD	-	-	<LLD	0
	Ru-106		0.01	<LLD	-	-	<LLD	0
	Cs-137		0.009	<LLD	-	-		
Airborne Iodine (pCi/m³)	I-131	154[h]	0.01	<LLD	-	-	<LLD	0
Ion Chamber (mR/30 days)	Gamma	221	1	6.4 (91/91) (5.0-7.9)	K-8 St. Mary's Church, Tisch Mills 5.0 mi WSW	7.6 (24/24) (6.8-8.6)	6.7 (130/130) (5.0-9.2)	0
TLD-Quarterly (mr/91 days)	Gamma	40	5	16.2 (16/16) (10.8-21.2)	K-8 St. Mary's Church, Tisch Mills 5.0 mi WSW	18.9 (4/4) (14.7-21.0)	17.2 (24/24) (10.8-21.2)	0
TLD-Quarterly (mrem/365 days)	Gamma	10	5	69.3 (4/4) (61.2-78.8)	K-8 St. Mary's Church, Tisch Mills 5.0 mi WSW	80.0 (1/1) —	73.1 (6.6) (63.6-80.0)	0
TLD-Annual (mrem/365 days)	Gamma	10		71.6 (4/4) (65.1-84.9)	K-16 WPS Division Office Building Green Bay 26 Mi NW	87.3 (1/1) —	77.9 (6/6) (64.6-87.3)	0
Precipitation (pCi/l)	H-3	10	71	178 (9/10) (127-270)	-	-	None	0

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Table 5. (Continued)
Name of facility Kewaunee Nuclear Generating Plant

Sample Type (Units)	Type and Number of Analyses[a]		LLD[b]	Indicator Locations Mean(F)[c] Range[c]	Location with Highest Annual Mean: Location[d]	Location with Highest Annual Mean: Mean(F) Range	Control Locations Mean(F) Range	Number of Non-routine Results[e]
Milk (pCi/l)	I-131	198	0.5	<LLD	-	-	<LLD	0
	Sr-89	72	3.2	<LLD	-	-	<LLD	0
	Sr-90	72	0.3	2.8 (48/48) (1.3-4.5)	K-12 Lecaptain Farm 1.5 mi WSW	3.1 (12/12) (2.0-4.5)	2.7 (24/24) (1.9-4.6)	0
	GS	72						0
	K-40		50	1380 (48/48) (790-1640)	K-6 Berres Farm Denmark 6.5 mi WSW	1470 (12/12) (1270-1690)	1460 (24/24) (1270-1690)	0
	Cs-137		3.7	5.1 (21/48) (4.0-8.3)	K-6 Berres Farm Denmark 6.5 mi WSW	6.3 (5/12) (4.3-8.8)	5.7 (11/24) (3.8-8.8)	0
	Ba-140		3.7	<LLD	-	-	<LLD	0
(g/l)	K-stable	72	0.04	1.57 (48/48) (0.90-1.86)	K-6 Berres Farm Denmark 6.5 mi WSW	1.67 (12/12) (1.44-1.92)	1.66 (24/24) (1.44-1.92)	0
(g/l)	Ca	72	0.01	1.05 (48/48) (0.78-1.34)	K-5 Paplham Farm Kewaunee 3.5 mi NNW	1.07 (12/12) (0.81-1.27)	1.05 (24/24) (0.72-1.33)	0
Well Water (pCi/l)	GA	39	3.5	4.3 (6/35) (3.5-6.7)	K-1h North Well on site 0.12 mi NW	5.5 (2/12) (4.3-6.7)	<LLD	0
	GB	39	0.5	2.9 (35/35) (1.0-5.5)	K-12 Lecaptain Farm 1.5 mi WSW	3.7 (4/4) (2.0-5.5)	2.2 (4/4) (0.7/3.1)	0
	H-3	4	170	<LLD	-	-	None	0
	K-40 (flame)	39	0.10	1.9 (35/35) (0.9-2.7)	K-1h North Well onsite 0.12 mi NW	2.3 (12/12) (1.8-2.7)	1.3 (4/4) (1.1-1.4)	0
	Sr-89	4	0.9	<LLD	-	-	None	0
	Sr-90	4	1.4	<LLD	-	-	None	0

Table 5. (Continued)
Name of facility Kewaunee Nuclear Generating Plant

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean(F)[c] Range[c]	Location with Highest Annual Mean: Location[d]	Location with Highest Annual Mean: Mean(F) Range	Control Locations Mean(F) Range	Number of Non-routine Results[e]
Domestic Meat (chickens) (pCi/g wet)	GA 4	0.012	<LLD	-	-	<LLD	0
	GB 4	0.02	0.40 (3/3) (0.15-0.73)	K-20 Struck Farm, Kewaunee 2.5 mi N	0.73 (1/1) -	0.50 (1/1) -	0
	GS 4						
	Be-7	0.2	<LLD	-	-	<LLD	0
	K-40	0.5	0.8 (1/3) -	K-20 Struck Farm, Kewaunee 2.5 mi N	0.8 (1/1) -	<LLD	0
	Nb-95	0.03	<LLD	-	-	<LLD	0
	Zr-95	0.06	<LLD	-	-	<LLD	0
	Ru-103	0.05	<LLD	-	-	<LLD	0
	Ru-106	0.11	<LLD	-	-	<LLD	0
	Cs-134	0.02	<LLD	-	-	<LLD	0
	Cs-137	0.02	<LLD	-	-	<LLD	0
	Ce-141	0.07	<LLD	-	-	<LLD	0
	Ce-144	0.09	<LLD	-	-	<LLD	0
Eggs (pCi/g wet)	GA 4	0.04	<LLD	-	-	None	0
	GB 4	0.01	1.4 (4/4) (1.1-1.9)	K-17 Jansky Farm, Kewaunee 4.25 mi W	1.4 (4/4) (1.1-1.9)	None	0
	Sr-89 4	0.004	<LLD	-	-	None	0
	Sr-90 4	0.003	0.020 (2/4) (0.004-0.036)	K-17 Jansky Farm, Kewaunee 4.25 mi W	0.020 (2/4) (0.004-0.036)	None	0
	GS 4						
	Be-7	0.12	<LLD	-	-	None	0
	K-40	0.01	1.2 (4/4) (0.90-1.4)	K-17 Jansky Farm, Kewaunee 4.25 mi W	1.2 (4/4) (0.90-1.4)	None	0

Table 5. (Continued)
Name of facility Kewaunee Nuclear Generating Plant

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean(F)[c] Range[c]	Location with Highest Annual Mean: Location[d]	Location with Highest Annual Mean: Mean(F) Range	Control Locations Mean(F) Range	Number of Non-routine Results[e]
Eggs (pCi/g wet) (cont'd)	Nb-95	0.02	<LLD	-	-	None	0
	Zr-95	0.02	<LLD	-	-	None	0
	Ru-103	0.02	<LLD	-	-	None	0
	Ru-106	0.1	<LLD	-	-	None	0
	Cs-134	0.01	<LLD	-	-	None	0
	Cs-137	0.009	<LLD	-	-	None	0
	Ce-141	0.05	<LLD	-	-	None	0
	Ce-144	0.08	<LLD	-	-	None	0
Vegetables (pCi/g wet)	GA 6	0.03	<LLD	K-18 Schmidt's Food Stand 7.0 mi SSW	0.03 (1/5) -	0.03 (1/5) -	0
	GB 6	0.04	2.2 (1/1) -	K-18 Schmidt's Food Stand 7.0 mi SSW	2.9 (5/5) (2.4-3.6)	2.9 (5/5) (2.4-3.6)	0
	Sr-89 6	0.002	<LLD	K-18 Schmidt's Food Stand 7.0 mi SSW	0.003 (1/5) -	0.003 (1/5) -	0
	Sr-90 6	0.001	0.006 (1/1) -	K-18 Schmidt's Food Stand 7.0 mi SSW	0.009 (5/5) (0.004-0.025)	0.009 (5/5) (0.004-0.025)	0
	GS 6						
	Be-7	0.19	<LLD	-	-	<LLD	0
	K-40	0.04	0.92 (1/1) -	K-18 Schmidt's Food Stand 7.0 mi SSW	2.1 (5/5) (1.5-2.8)	2.1 (5/5) (1.5-2.8)	0
	Nb-95	0.014	<LLD	-	-	<LLD	0
	Zr-95	0.027	<LLD	-	-	<LLD	0
	Ru-103	0.018	<LLD	-	-	<LLD	0
	Ru-106	0.11	<LLD	-	-	<LLD	0
	Cs-137	0.013	<LLD	-	-	<LLD	0
	Ce-141	0.025	<LLD	-	-	<LLD	0
	Ce-144	0.091	<LLD	-	-	<LLD	0

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Table 5. (Continued)
Name of facility Kewaunee Nuclear Generating Plant

Sample Type (Units)	Type and Number of Analyses[a]		LLD[b]	Indicator Locations Mean(F)[c] Range[c]	Location with Highest Annual Mean: Location[d]	Location with Highest Annual Mean: Mean(F) Range	Control Locations Mean(F) Range	Number of Non-routine Results[e]
Grain - Oats (pCi/g wet)	GA	1	0.08	<LLD	-	-	None	0
	GB	1	0.1	7.8 (1/1) -	K-23 Kewaunee Site 0.5 mi W	7.8 (1/1) -	None	0
	Sr-89	1	0.008	0.016 (1/1) -	K-23 Kewaunee Site 0.5 mi W	0.016 (1/1) -	None	0
	Sr-90	1	0.01	0.018 (1/1) -	K-23 Kewaunee Site 0.5 mi W	0.018 (1/1) -	None	0
	GS	1						
	Be-7		0.1	<LLD	-	-	None	0
	K-40		0.1	7.2 (1/1) -	K-23 Kewaunee Site 0.5 mi W	7.2 (1/1) -	None	0
	Nb-95		0.018	<LLD	-	-	None	0
	Zr-95		0.027	<LLD	-	-	None	0
	Ru-103		0.01	0.066 (1/1) -	K-23 Kewaunee Site 0.5 mi W	0.066 (1/1) -	None	0
	Ru-106		0.17	<LLD	-	-	None	0
	Cs-137		0.013	<LLD	-	-	None	0
	Ce-141		0.044	<LLD	-	-	None	0
	Ce-144		0.13	<LLD	-	-	None	0
Cattlefeed	GA	6	0.2	0.3 (2/4) (0.2-0.4)	K-4 Stangel Farm Kewaunee 3.0 mi N	0.4 (1/1) -	<LLD	0
	GB	6		11.1 (4/4) (2.3-18.7)	K-4 Stangel Farm Kewaunee 3.0 mi N	18.7 (1/1) -	8.4 (2/2) (3.9-12.8)	0
	Sr-89	6	0.01	0.27 (1/4) -	K-4 Stangel Farm Kewaunee 3.0 mi N	0.27 (1/1) -	<LLD	1

Table 5. (Continued)
Name of facility Kewaunee Nuclear Generating Plant

Sample Type (Units)	Type and Number of Analyses[a]		LLD[b]	Indicator Locations Mean(F)[c] Range[c]	Location with Highest Annual Mean: Location[d]	Location with Highest Annual Mean: Mean(F) Range	Control Locations Mean(F) Range	Number of Non-routine Results[e]
Cattlefeed (pCi/g wet) (cont'd)	Sr-90	6		0.12 (4/4) (0.02-0.24)	K-19 Paral Farm Kewaunee 1.75 mi NNE	0.24 (1/1) -	0.10 (2/2) (0.05-0.16)	0
	GS	6						
	Be-7		0.21	0.46 (1/4) -	K-12 Lecaptain Farm 1.5 mi WSW	0.46 (1/1) -	<LLD	0
	K-40		1.0	9.8 (4/4) (2.1-16.0)	K-4 Stangel Farm Kewaunee 3.0 mi N	16.0 (1/1) -	6.9 (2/2) (2.9-10.9)	0
	Nb-95		0.03	<LLD	-	-	<LLD	0
	Zr-95		0.03	<LLD	-	-	<LLD	0
	Ru-103		0.02	<LLD	-	-	<LLD	0
	Ru-106		0.2	<LLD	-	-	<LLD	0
	Cs-134		0.02	<LLD	-	-	<LLD	0
	Cs-137		0.03	0.09 (2/4) (0.08-0.09)	K-4 Stangel Farm Kewaunee 3.0 mi N	0.09 (1/1) -	0.05 (2/2) (0.04-0.05)	0
	Ce-141		0.03	<LLD	-	-	<LLD	0
	Ce-144		0.20	0.45 (2/4) (0.40-0.49)	K-5 Paplham Farm Kewaunee 3.5 mi NNW	0.49 (1/1) -	0.24 (1/2) -	0
Grass (pCi/g wet)	GA	24	0.17	<LLD	-	-	<LLD	0
	GB	24	0.1	7.7 (18/18) (4.5-15.5)	K-5 Paplham Farm Kewaunee 3.5 mi NNW	11.7 (3/3) (8.4-15.5)	7.7 (6.6) (5.5-9.5)	0
	Sr-89	24	0.02	0.06 (8/18) (0.02-0.09)	K-5 Paplham Farm Kewaunee 3.5 mi NNW	0.090 (1/3) -	0.05 (2/6) -	0
					K-19 Paral Farm Kewaunee 1.75 mi NNE	0.090 (1/3) -	(0.03-0.06) -	
	Sr-90	24	0.01	0.06 (18/18) (0.01-0.14)	K-1b Middle Creek onsite 0.10 mi N	0.10 (3/3) (0.06-0.14)	0.06 (6/6) (0.01-0.14)	0
	GS	24						
	Be-7		0.3	1.4 (4/18) (1.2-1.6)	K-4 Stangel Farm Kewaunee 3.0 mi N	1.6 (1/3) -	1.3 (2/6) (1.0-1.5)	0
	K-40		0.1	7.0 (18/18) (4.4-16.3)	K-5 Paplham Farm Kewaunee 3.5 mi NNW	10.9 (3/3) (7.1-16.3)	7.1 (6/6) (5.2-10.2)	0

Table 5. (Continued)
Name of facility Kewaunee Nuclear Generating Plant

Sample Type (Units)	Type and Number of Analyses[a]		LLD[b]	Indicator Locations Mean(F)[c] Range[c]	Location with Highest Annual Mean		Control Locations Mean(F) Range	Number of Non-routine Results[e]
					Location[d]	Mean(F) Range		
Grass (pCi/g wet) (cont'd)	Nb-95		0.05	<LLD	-	-	<LLD	0
	Zr-95		0.07	<LLD	-	-	<LLD	0
	Ru-103		0.05	<LLD	-	-	<LLD	0
	Ru-106		0.4	<LLD	-	-	<LLD	0
	Cs-137		0.04	<LLD	-	-	<LLD	0
	Ce-141		0.09	<LLD	-	-	<LLD	0
	Ce-144		0.19	<LLD	-	-	<LLD	0
Soil (pCi/g dry)	GA	14	3.4	9.6 (10/10) (5.1-15.0)	K-3 Siegmund Farm Kewaunee 6.0 mi N	14.0 (2/2) (11.9-16.1)	11.6 (4/4) (8.5-16.1)	0
	GB	14	1.4	24.8 (10/10) (12.6-32.3)	K-4 Stangel Farm Kewaunee 3.0 mi N	31.3 (2/2) (30.2-32.3)	27.3 (4/4) (21.4-30.6)	0
	Sr-89	14	0.02	0.04 (1/10) -	K-19 Paral Farm 1.75 mi NNE	0.04 (1/2) -	<LLD	0
	Sr-90	14	0.01	0.11 (10/10) (0.03-0.34)	K-12 Lecaptain Farm 1.5 mi WSW	0.20 (2/2) (0.05-0.34)	0.13 (4/4) (0.06-0.22)	0
	GS	14						
	Be-7		0.38	0.87 (1/10) -	K-4 Stangel Farm Kewaunee 3.0 mi N	0.87 (1/2) -	<LLD	0
	K-40		1.4	24.5 (10/10) (13.0-32.8)	K-4 Stangel Farm Kewaunee 3.0 mi N	31.9 (2/2) (30.9-32.8)	26.1 (4/4) (21.8-30.0)	0
	Nb-95		0.05	<LLD	-	-	<LLD	0
	Zr-95		0.11	0.22 (1/10) -	K-4 Stangel Farm Kewaunee 3.0 mi N	0.22 (1/2) -	<LLD	0
	Ru-103		0.06	<LLD	-	-	<LLD	0
	Ru-106		0.37	<LLD	-	-	<LLD	0
	Cs-137		0.05	0.49 (10/10) (0.17-1.33)	K-6 Berres Farm Denmark 6.5 mi WSW	0.78 (2/2) (0.74-0.81)	0.54 (4/4) (0.29-0.81)	0
	Ce-141		0.09	<LLD	-	-	<LLD	0
	Ce-144		0.24	<LLD	-	-	<LLD	0

Table 5. (Continued)
Name of facility Kewaunee Nuclear Generating Plant

Sample Type (Units)	Type and Number of Analyses[a]		LLD[b]	Indicator Locations Mean(F)[c] Range[c]	Location with Highest Annual Mean Location[d]	Mean(F) Range	Control Locations Mean(F) Range	Number of Non-routine Results[e]
Surface Water (pCi/l)	GA(SS)	72	0.5	0.6 (9/60) (0.5-1.2)	K-1a North Creek, onsite 0.62 mi N	0.8 (3/12) (0.5-1.2)	<LLD	0
	GA(DS)	72	4.1	<LLD	-	-	<LLD	0
	GA(TR)	72	4.2	<LLD	-	-	<LLD	0
	GB(SS)	72	1.0	1.8 (20/60) (1.1-3.8)	K-1e South Creek, onsite 0.12 mi S	2.0 (4/12) (1.3-3.1)	<LLD	0
							<LLD	0
	GB(DS)	72	0.4	5.7 (60/60) (1.9-45.6)	K-1a North Creek, onsite 0.62 mi N	12.6 (12/12) (4.5-45.6)	2.7 (12/12) (2.4-3.1)	1
	GB(TR)	72	1.0	6.5 (60/60) (1.9-45.6)	K-1a North Creek, onsite 0.62 mi N	13.9 (12/12) (5.0-45.6)	2.8 (12/12) (2.4-3.2)	1
	H-3	36	220	290 (15/24) (220-440)	K-14 Two Creeks Park 2.5 mi S	290 (9/12) (220-440)	270 (6/12) (220-340)	0
	Sr-89	12	1.2	<LLD	-	-	<LLD	0
	Sr-90	12	1.4	1.9 (2/8) (1.5-2.2)	K-14 Two Creeks Park 2.5 mi S	2.2 (1/4) -	2.0 (2/4) (1.8-2.2)	0
	K-40 (flame)	72		4.0 (60/60) (0.5-48.2)	K-1a North Creek, onsite 0.62 mi N	10.4 (12/12) (3.3-48.2)	1.0 (12/12) (0.9-1.2)	7
Fish-Muscle (pCi/g wet)	GA	6	0.06	0.09 (1/6) -	K-1d Condenser discharge, onsite 0.10 mi E	0.09 (1/6) -	None	0
	GB	6	0.03	2.5 (6/6) (1.7-3.6)	K-1d Condenser discharge, onsite 0.10 mi E	2.5 (6/6) (1.7-3.6)	None	0
	GS	6						
	Be-7		0.27	<LLD	-	-	None	0
	K-40		0.03	2.4 (6/6) (1.5-3.8)	K-1d Condenser discharge, onsite 0.10 mi E	2.4 (6/6) (1.5-3.8)	None	0
	Nb-95		0.21	<LLD	-	-	None	0

Table 5. (Continued)
Name of facility Kewaunee Nuclear Generating Plant

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean(F)[c] Range[c]	Location with Highest Annual Mean: Location[d]	Location with Highest Annual Mean: Mean(F) Range	Control Locations Mean(F) Range	Number of Non-routine Results[a]
Fish-Muscle (pCi/g wet) (cont'd)	Zr-95	0.03	<LLD	-	-	None	0
	Ru-103	0.03	<LLD	-	-	None	0
	Ru-106	0.11	<LLD	-	-	None	0
	Cs-137		0.12 (6/6) (0.02-0.28)	K-1d Condenser discharge, onsite 0.10 mi E	0.12 (6/6) (0.02-0.28)	None	0
	Ce-141	0.06	<LLD	-	-	None	0
	Ce-144	0.11	<LLD	-	-	None	0
Fish-Bones (pCi/g wet)	GA 6	1.2	<LLD	-	-	None	0
	GB 6	0.7	2.2 (6/6) (0.9-2.9)	K-1d Condenser discharge, onsite 0.10 mi E	2.2 (6/6) (0.9-2.9)	None	0
	Sr-89 6	0.12	0.41 (1/6) -	K-1d Condenser discharge, onsite 0.10 mi E	0.41 (1/6) -	None	0
	Sr-90 6	0.10	0.27 (5/6) (0.16-0.51) -	K-1d Condenser discharge, onsite 0.10 mi E	0.27 (5/6) (0.16-0-51)	None	0
Bottom Organisms (pCi/g dry)	GA 9	9.0	<LLD	-	-	None	0
	GB 9	18.3	23 (4/6) (18-33)	K-14 Two Creeks Park 2.5 mi S	26 (2/3) (20-33)	29 (2/3) (23-34)	0
Periphyton (slime) (pCi/g wet)	GA 12	0.76	0.87 (1/10) -	K-1b Middle Creek, onsite 0.12 mi N	0.87 (1/2) -	<LLD	0
	GB 12	0.1	2.9 (10/10) (0.9-4.7)	K-1a North Creek, onsite 0.62 mi N	3.7 (2/2) (2.7-4.7)	3.0 (2/2) (1.2-4.7)	0
	Sr-89 12	0.15	<LLD	-	-	<LLD	0
	Sr-90 12	0.01	0.07 (10/10) (0.01-0.22	K-1a North Creek, onsite 0.62 mi N	0.14 (2/2) (0.06-0.22)	0.03 (2/2) (0.02-0.04)	0

Table 5. (Continued)
Name of facility Kewaunee Nuclear Generating Plant

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean(F)[c] Range[c]	Location with Highest Annual Mean: Location[d]	Location with Highest Annual Mean: Mean(F) Range	Control Locations Mean(F) Range	Number of Non-routine Results[e]
Periphyton (slime) (pCi/g wet) (cont'd)	GS 12						
	Be-7	0.36	0.89 (3/10) (0.71-0.99)	K-1d Condenser discharge, onsite 0.10 mi E	0.96 (1/2) -	<LLD	0
	K-40	0.2	1.6 (10/10) (0.3-2.8)	K-1a North Creek, onsite 0.62 mi N	2.5 (2/2) (2.2-2.8	1.6 (2/2) (0.5-2.8)	0
	Mn-54	0.04	0.13 (1/10) -	K-14 Two Creeks Park 2.5 mi S	0.13 (1/2) -	<LLD	0
	Co-58	0.05	1.03 (2/10) (0.72-1.33)	K-14 Two Creeks Park 2.5 mi S	1.33 (1/2) -	<LLD	2
	Co-60	0.04	0.42 (2/10) (0.22-0.61)	K-14 Two Creeks Park 2.5 mi S	0.61 (1/2) -	<LLD	1
	Nb-95	0.05	<LLD	-	-	<LLD	0
	Zr-95	0.06	<LLD	-	-	<LLD	0
	Ru-103	0.04	<LLD	-	-	<LLD	0
	Ru-106	0.38	<LLD	-	-	<LLD	0
	Cs-134	0.03	<LLD	-	-	<LLD	0
	Cs-137	0.05	0.12 (2/10) (0.07-0.17)	K-1d Condenser discharge, onsite 0.10 mi E	0.17 (1/2) -	0.13 (1/2) -	0
	Ce-141	0.04	<LLD	-	-	<LLD	0
	Ce-144	0.18	<LLD	-	-	<LLD	0
Bottom Sediments (pCi/g dry)	GA 20	5.3	<LLD	-	-	<LLD	0
	GB 20	1.4	7.8 (16/16) (5.8-9.6)	K-9 Rostok Water Intake 11.5 mi NNE	10.1 (4/4) (6.3-12.7)	10.1 (4/4) (6.3-12.7)	0
	Sr-89 20	0.02	<LLD	-	-	<LLD	0
	Sr-90 20	0.02	0.03 (1/16) -	K-14 Two Creeks Park 2.5 mi S	0.03 (1/4) -	<LLD	0
	GS 20						
	K-40	1.4	8.5 (16/16) (4.7-11.7)	K-14 Two Creeks Park 2.5 mi S	9.2 (4/4) (8.2-10.0)	9.0 (4/4) (5.6-11.7)	0

Table 5. (Continued)
Name of facility Kewaunee Nuclear Generating Plant

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean(F)[c] Range[c]	Location with Highest Annual Mean: Location[d]	Location with Highest Annual Mean: Mean(F) Range	Control Locations Mean(F) Range	Number of Non-routine Results[e]
Bottom Sediments (pCi/g dry) (cont'd)	Co-58	0.02	0.13 (7/16) (0.05-0.27)	K-1d Condenser discharge, onsite 0.10 mi E	0.14 (3/4) (0.05-0.27	<LLD	2
	Co-60	0.03	0.11 (4/16) (0.07-0.14)	K-1d Condenser discharge, onsite 0.10 mi E	0.12 (2/4) (0.09-0.14)	<LLD	0
	Cs-134	0.02	0.08 (7/16) (0.07-0.09)	K-1j 500' S of discharge, onsite 0.10 mi S	0.08 (4/4) (0.07-0.09)	<LLD	0
	Cs-137	0.03	0.16 (16/16) (0.07-0.28)	K-1j 500' S of discharge, onsite 0.10 mi S	0.23 (4/4) (0.19-0.28)	0.08 (4/4) (0.07-0.09)	0

[a]GA = gross alpha, GB - gross beta, GS - gamma spectroscopy, SS = suspended solids, DS = dissolved solids, TR = total residue.
[b]LLD - nominal lower limit of detection based on 3 sigma counting error for background sample.
[c]Mean based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses (F)
[d]Locations are specified by station code (Table 1.) and distance (miles) and direction relative to reactor site.
[e]Nonroutine results are those which exceed ten times the control station value. If no control station value is available, the result is considered nonroutine if it exceeds ten times the pre-operational value for the location.
[f]Twenty-two higher LLD values resulting from pump malfunction have been excluded from determination of LLD.
[g]Eight higher LLD values resulting from pump malfunction have been excluded from determination of LLD.
[h]One result of 0.04 has been excluded due to low sample volume.

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Appendix A

Crosscheck Program Results

Appendix A

Crosscheck Program Results

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

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

The results in Table A-1 were obtained through participation in the environmental sample crosscheck program for milk and water samples during the period 1975 through 1979. This program has been conducted by the U. S. Environmental Protection Agency Intercomparison and Calibration Section, Quality Assurance Branch, Environmental Monitoring and Support Laboratory, Las Vegas, Nevada.

The results in Table A-2 were obtained for thermoluminescent dosimeters (TLD's) during the period 1976 and 1977 through participation in the Second the Third International Intercomparison of Environmental Dosimeters under the sponsorships listed in Table A-2.

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Hazleton ES results for milk and water samples, 1975 through 1979[a].

Lab Code	Sample Type	Date Coll.	Analysis	Concentration in pCi/lb HES Result ±2σ[c]	EPA Result ±3σ, n=1[d]
STM-40	Milk	Jan. 1975	Sr-89	<2	0±15
			Sr-90	73±2.5	75±11.4
			I-131	99±4.2	101±15.3
			Cs-137	76±0.0	75±15
			Ba-140	<3.7	0±15.0
			K(mg/l)	1470±5.6	1510±228
STW-45	Water	Apr. 1975	Cr-51	<14	0
			Co-60	421±6	425±63.9
			Zn-65	487±6	497±74.7
			Ru-106	505±16	497±74.7
			Cs-134	385±3	400±60.0
			Cs-137	468±3	450±67.5
STW-47	Water	Apr. 1975	H-3	1459±144	1499±1002
STW-48	Water	Jun. 1975	H-3	2404±34	2204±1044
STW-49	Water	Jun. 1975	Cr-51	<14	0
			Co-60	344±1	350±53
			Zn-65	330±5	327±49
			Ru-106	315±7	325±49
			Cs-134	291±1	304±46
			Cs-137	387±2	378±57
STW-53	Water	Aug. 1975	H-3	3117±64	3200±1083
STW-54	Water	Aug. 1975	Cr-51	223±11	255±38
			Co-60	305±1	307±46
			Zn-65	289±3	281±42
			Ru-106	346±5	279±57
			Cs-134	238±1	256±38
			Cs-137	292±2	307±46
STW-58	Water	Oct. 1975	H-3	1283±80	1203±988
STM-61	Milk	Nov. 1975	Sr-90	68.9±2.1	74.6±11.2
			I-131	64.6±3.8	75±15
			Cs-137	75.6±20	75±15
			Ba-140	<3.7	0
			K(mg/l)	1435±57	1549±233

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] HES Result ±2σ[c]	EPA Result ±3σ, n=1[d]
STW-63	Water	Dec. 1975	H-3	1034±39	1002±972
STW-64	Water	Dec. 1975	Cr-51	<14	0
			Co-60	221±1	203±30.5
			Zn-65	215±6	201±30.2
			Ru-106	171±9	181±27.2
			Cs-134	198±2	202±30.3
			Cs-137	152±4	151±22.7
STW-68	Water	Feb. 1976	H-3	1124±31	1080±978
STW-78	Water	Jun. 1976	H-3	2500±44	2502±1056
STW-84	Water	Aug. 1976	H-3	3097±21	3100±1080
STM-86	Milk	Sep. 1975	Sr-89	29±2.0	45±15
			Sr-90	30±1.0	30±4.5
			I-131	100±8.6	120±18
			Ba-140	50±10.1	85±15
			Cs-137	17±1.5	20±15
			K(mg/l)	-	1540±231
STM-91	Milk	Nov. 1976	I-131	83±0.6	85±15
			Ba-140	<4	0
			Cs-137	12±1.7	11±15
			K(mg/l)	1443±31	1510±228
STW-93	Water	Dec. 1976	Cr-51	105±15	104±15
			Co-60	<4	0
			Zn-65	97±4	102±15
			Ru-106	87±3	99±15
			Cs-134	85±4	93±15
			Cs-137	103±4	101±15
STW-94	Water	Dec. 1976	H-3	2537±15	2300±1049
STM-97	Milk	Mar. 1977	I-131	55±2.5	51±15
			Ba-140	<6	0
			Cs-137	34±1	29±15
			K(mg/l)	1520±35	1550±233
STW-101	Water	Apr. 1977	H-3	1690±62	1760±1023

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] HES Result ±2σ[c]	EPA Result ±3σ, n=1[d]
STM-103	Milk	May 1977	Sr-89	38±2.6	44±15
			Sr-90	12±2.1	10±4.5
			I-131	59±2.1	50±15
			Ba-140	53±4.4	72±15
			Cs-137	14±1.2	10±15
			K(mg/l)	1533±21	1560±234
STW-105	Water	Jun. 1977	Cr-51	<14	0
			Co-60	29±2	29±15
			Zn-65	74±7	74±15
			Ru-106	64±8	62±15
			Cs-134	41±1	44±15
			Cs-137	35±3	33±15
STW-107	Water	Jun. 1977	Ra-226	4.7±0.3	5.1±2.42
STW-113	Water	Aug. 1977	Sr-89	13±0[e]	14±15
			Sr-90	10±2[e]	10±4.5
STW-116	Water	Sep. 1977	Gross Alpha	12±6	10±15
			Gross Beta	32±6	30±15
STW-118	Water	Oct. 1977	H-3	1475±29	1650±1017
STW-119	Water	Oct. 1977	Cr-51	132±14	153±24
			Co-60	39±2	38±15
			Zn-65	51±5	53±15
			Ru-106	63±6	74±15
			Cs-134	30±3	30±15
			Cs-137	26±1	25±15
STW-136	Water	Feb. 1978	H-3	1690±270	1680±1020
STW-137	Water	Feb. 1978	Cr-51	<21	0
			Co-60	36±2	34±15
			Zn-65	32±4	29±15
			Ru-106	41±2	36±15
			Cs-134	47±2	52±15
			Cs-137	<2	0

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] HES Result ±2σ[c]	EPA Result ±3σ, n=1[d]
STW-138[g]	Water	Mar. 1978	Ra-226	5.4±0.1	5.5±0.6
			Ra-228	NA[f]	16.7±2.5
STW-150	Water	Apr. 1978	H-3	2150±220	2220±1047
STW-151	Water	Apr. 1978	Gross Alpha	20±1	20±15
			Gross Beta	56±4	59±15
			Sr-89	19±2	21±15
			Sr-90	8±1	10±4.5
			Ra-226	NA[f]	-
			Ra-228	NA[f]	-
			H-3	112±12	0
			Co-60	19±3	20±15
			Cs-134	16±1	15±15
			Cs-137	<2	0
STM-152	Milk	Apr. 1978	Sr-89	85±4	101±15
			Sr-90	8±1	9±4.5
			I-131	78±1	82±15
			Cs-137	29±3	23±15
			Ba-140	<11	0
			K(mg/l)	1503±90	1500±225
STW-154[g]	Water	May 1978	Gross Alpha	12±1	13±15
			Gross Beta	21±4	18±15
STW-157[g]	Water	Jun. 1978	Ra-226	4.0±1.0	3.7±0.6
			Ra-228	NA[f]	5.6±0.8
STW-159[g]	Water	Jul. 1978	Gross Alpha	19±3	22±6
			Gross Beta	28±3	30±5
STW-162	Water	Aug. 1978	H-3	1167±38	1230±990
STW-165[g]	Water	Sep. 1978	Gross Alpha	4±1	5±5
			Gross Beta	13±1	10±5

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] HES Result ±2σ[c]	EPA Result ±3σ, n=1[d]
STW-167	Water	Oct. 1978	Gross Alpha	19±2	19±15
			Gross Beta	36±2	34±15
			Sr-89	9±1	10±15
			Sr-90	4±0	5±2.4
			Ra-226	5.5±0.3	5.0±2.4
			Ra-228	NA[f]	5.4±2.4
			Cs-134	10±1	10±15
			Cs-137	15±1	13±15
STW-170	Water	Dec. 1978	Ra-226	115±0.6	9.2±1.4
			Ra-228	NA[f]	8.9±4.5
STW-172	Water	Jan. 1979	Sr-89	11±2	14±15
			Sr-90	5±2	6±4.5
STW-175	Water	Feb. 1979	H-3	1344±115	1280±993
STW-176	Water	Feb. 1979	Cr-51	<22	0
			Co-60	10±2	9±15
			Zn-65	26±5	21±15
			Rn-106	<16	0
			Cs-134	8±2	6±15
			Cs-137	15±2	12±15
STW-178	Water	Mar. 1979	Gross Alpha	6.3±3	10±15
			Gross Beta	15±4	16±15

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

[b]All results are in pCi/l, except for elemental potassium (K) data which are in mg/l.

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

[d]USEPA results are presented as the known values ± control limits of 3 for n=1.

[e]Mean ± 2 standard deviations of two determinations.

[f]NA = Not analyzed.

[g]Analyzed but not reported to the EPA.

Table A-2. Crosscheck program results, thermoluminescent dosimeters (TLD's).

Lab Code	TLD Type	Measurement	mR		
			HES Result $\pm 2\sigma$[a]	Known Value	Average $\pm$ 2σ[d] all (participants)
2nd International Intercomparison[b]					
115-2[b]	CaF_2:Mn Bulb	Gamma-Field	17.0±1.9	17.1[c]	16.4±7.7
		Gamma-Lab	20.8±4.1	21.3[c]	18.8±7.6
3rd International Intercomparison[e]					
115-2[e]	CaF_2:Mn Bulb	Gamma-Field	30.7±3.2	34.9±4.8[f]	31.5±3.0
		Gamma-Lab	89.6±6.4	91.7±14.6[f]	86.2±24.0

[a] Lab result given is the mean ± 2 standard deviations of three determinations.

[b] Second International Intercomparison of Environmental Dosimeters conducted in April of 1976 by the Health and Safety Laboratory (HASL), New York, New York, and the School of Public Health of the University of Texas, Houston, Texas.

[c] Value determined by sponsor of the intercomparison.

[d] Mean ± 2 standard deviations of results obtained by all laboratories participating in program.

[e] Third International Intercomparison of Environmental Dosimeters conducted in summer of 1977 by Oak Ridge National Laboratory and the School of Public Health of the University of Texas, Houston, Texas.

[f] Value ± 2 standard deviations as determined by sponsor of the intercomparison

Appendix B

Statistical Notations

Statistical Notations

1. Single Measurement

Each single measurement is reported as $x \pm s$

where x = value of the measurement

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

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

<L

where L = lower limit of detection based on 3 counting uncertainty for a background sample.

2. Computation of Means and Standard Deviations

A. The mean, $\overline{x}$, and standard deviation, s, of a set of n numbers, x, . x_1, ...x_n are defined as follows:

$$\overline{x} = \frac{1}{n} \sum x$$

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

B. Monthly and quarterly means are calculated using all detectable results.

C. Annual means and standard deviations are calculated using only those results which are above the highest lower limit of detection (LLD).

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

E. If the standard deviation is zero, the mean value, $\overline{x}$, and the largest two sigma error are reported.

F. If all values are less than the highest LLD, no value is reported.

G. All numbers are rounded upwards if the last digit is five or greater.

Appendix C

Maximum Permissible Concentrations of Radioactivity in Air and Water

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

Air			Water		
Gross alpha	3	pCi/m3	Strontium-89	3,000	pCi/l
Gross beta	100	pCi/m3	Strontium-90	300	pCi/l
Iodine-131[b]	0.14	pCi/m^3	Cesium-137	20,000	pCi/l
			Barium-140	20,000	pCi/l
			Iodine-131	300	pCi/l
			Potassium-40[c]	3,000	pCi/l
			Gross alpha	30	pCi/l
			Gross beta	100	pCi/l
			Tritium	3×10^6	pCi/l

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

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

[c]A natural radionuclide.