KEWAUNEE NUCLEAR POWER PLANT

ANNUAL OPERATING REPORT
1984

WISCONSIN PUBLIC SERVICE CORPORATION

WISCONSIN POWER & LIGHT COMPANY

MADISON GAS & ELECTRIC COMPANY

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TABLE OF CONTENTS

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 535 MWe net. The architect/engineer was Pioneer Service and Engineering (PSE) from Chicago.

The Kewaunee Nuclear Power Plant achieved initial criticality on March 7, 1974. Initial power generation was reached April 8, 1974, and the plant was declared commercial on June 16, 1974. Since being declared commercial, Kewaunee has generated 39,857,300 MW hours of electricity as of December 31, 1984, with a net plant capacity factor of 76.7% (using net DER).

1.1 Highlights

During the year, the Kewaunee Nuclear Plant was primarily base loaded. The unit was operated at 86.2% capacity factor (using net MDC) with a gross efficiency of 33.1%. The unit and reactor availability were 85.7% and 86.2% 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 1984.

On March 16, 1984, the unit was removed from service for its ninth annual refueling. Thirty-six fresh fuel assemblies were loaded for cycle X. The unit was returned to service on May 7, 1984.

2.0 SUMMARY OF OPERATING EXPERIENCE

January

Normal power operation continued through the entire month of January.

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

February

Normal power operation continued through the entire month of February.

PLANT SHUTDOWNS: There were no plant shutdowns during the month of February.

March

On March 16, the unit was shutdown for refueling.

PLANT SHUTDOWNS: March 16, scheduled shutdown - 360.5 hours. Commenced Cycle IX-X refueling outage.

April

In April, the Cycle IX-X refueling outage continued.

PLANT SHUTDOWNS: April 1, scheduled shutdown - 719.0 hours. Continued Cycle IX-X refueling outage.

May

On May 7, the Cycle IX-X refueling outage was concluded.

On May 8, the unit was released for operation.

PLANT SHUTDOWNS: May 1, scheduled shutdown - 157.6 hours. Continued Cycle IX-X refueling outage. The outage was concluded on May 7.

May 7, forced shutdown - 3.3 hours. Due to an incorrectly wired Auto Stop Trip Pressure Switch a turbine/reactor trip was initiated during testing of the Turbine Thrust Bearing trip circuitry.

May 7, forced shutdown - 5.0 hours. A reactor/turbine trip occurred on "lo-lo" Steam Generator level during unit startup while transferring from manual to automatic feedwater regulation valve control.

May 8, scheduled shutdown - 2.8 hours. A short outage was taken to perform Turbine overspeed trip tests.

June

On June 2 load was reduced to 44% power due to circulating water leakage into the condenser. Inspection of the condenser revealed a leaking instrument line which was repaired and the plant was returned to 100% power.

Normal power operations continued through the month of June.

PLANT SHUTDOWNS: There were no plant shutdowns during the month of June.

July

On July 3, the unit tripped as a result of an instrument bus inverter failure.

PLANT SHUTDOWNS: July 3, forced shutdown - 7.4 hours. An instrument bus inverter failed, causing low voltage on one instrument bus; this resulted in a reactor/turbine trip on low steam generator level coincident with feed flow/steam flow mismatch.

August

On August 5, unit load was reduced for the performance of the monthly turbine stop valve test. The unit was returned to full power the same day.

PLANT SHUTDOWNS: There were no plant shutdowns during the month of August.

September

On September 3, unit load was reduced for the performance of the monthly turbine stop valve test. The unit was returned to full power the same day.

PLANT SHUTDOWNS: There were no plant shutdowns during the month of September.

October

On October 5, unit load was reduced to allow maintenance on an off-site transmission system line. The monthly turbine stop valve test was also conducted during this time. The unit was returned to full power on October 6.

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

November

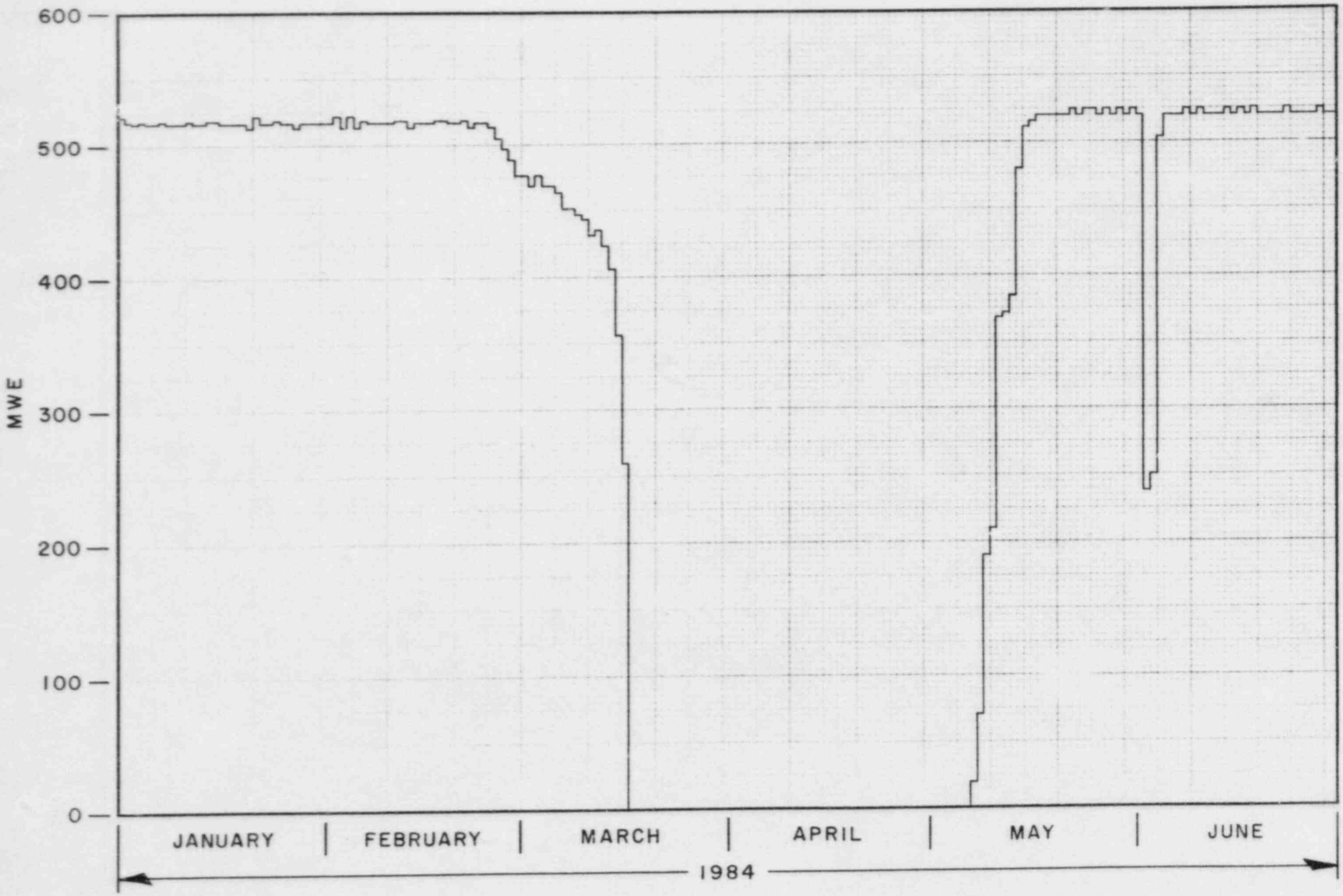
On November 4, unit load was reduced for the performance of the monthly turbine stop valve test. The unit was returned to full power the same day.

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

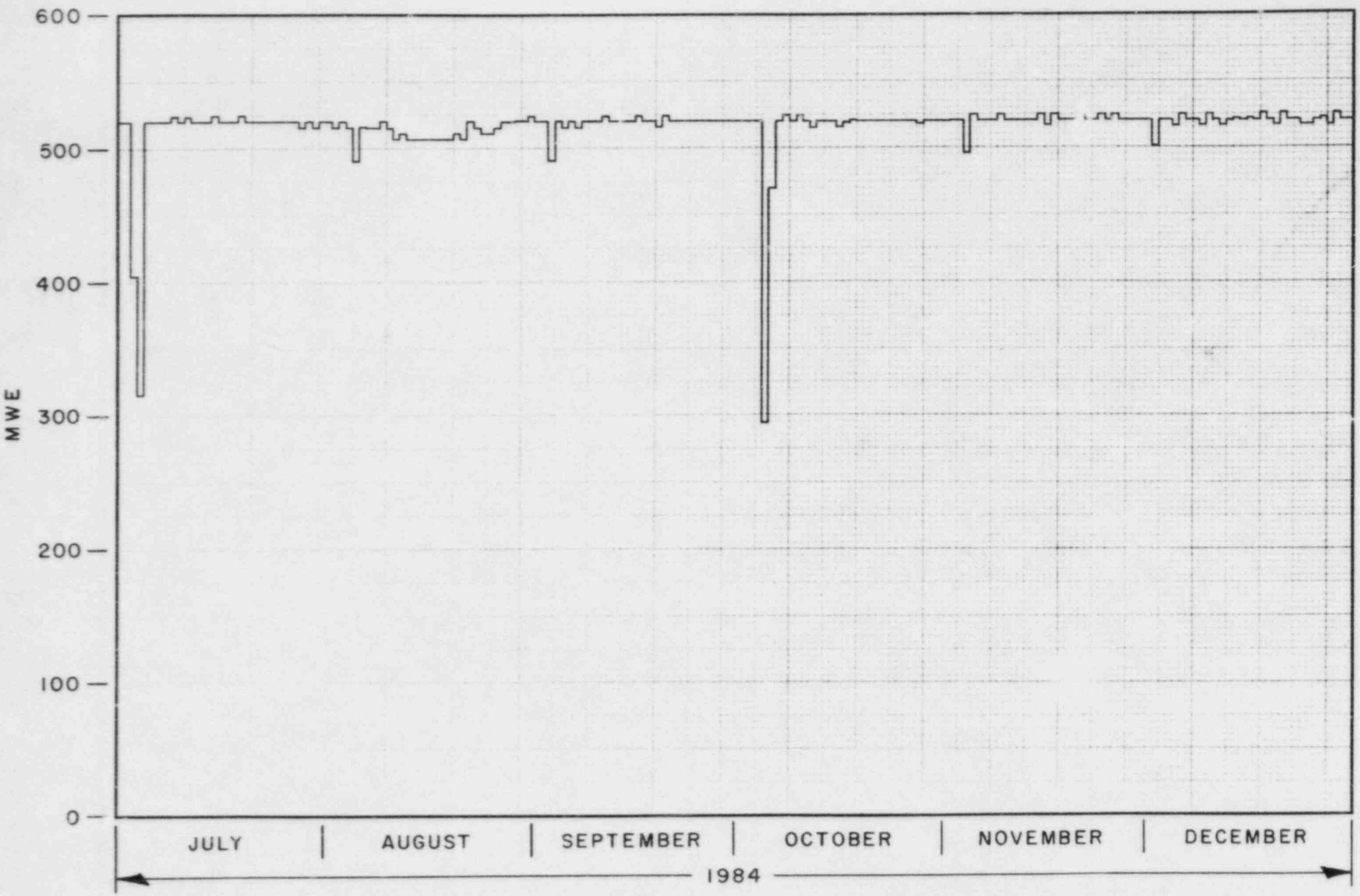
December

On December 2, unit load was reduced for the performance of the monthly turbine stop valve test. The unit was returned to full power the same day.

PLANT SHUTDOWNS: There were no plant shutdowns during the month of December.



KEWAUNEE POWER HISTORY
AVERAGE DAILY MWE - NET



KEWAUNEE POWER HISTORY
AVERAGE DAILY MWE - NET

TABLE 2.1 (Page 1 of 2)

ELECTRICAL POWER GENERATION DATA (1984)

MONTHLY

	January	February	March	April	May	June
Hours RX was critical	744.0	696.0	383.7	0.0	614.0	720.0
RX Reserve Shutdown Hours	0.0	0.0	0.0	0.0	0.0	0.0
Hours Generator On-Line	744.0	696.0	385.5	0.0	575.3	720.0
Unit Reserve Shutdown Hours	0.0	0.0	0.0	0.0	0.0	0.0
Gross Thermal Energy Generated (MWH)	1,225,897	1,139,329	532,963	0.0	837,414	1,114,593
Gross Elec. Energy Generated (MWH)	403,000	374,200	175,100	0.0	276,900	379,800
Net Elec. Energy Generated (MWH)	384,993	357,376	166,154	0.0	262,749	361,333
RX Service Factor	100.0	100.0	51.6	0.0	82.5	100.0
RX Availability Factor	100.0	100.0	51.6	0.0	82.5	100.0
Unit Service Factor	100.0	100.0	51.5	0.0	77.3	100.0
Unit Availability Factor	100.0	100.0	51.5	0.0	77.3	100.0
Unit Capacity Factor (using MDC net)	102.9	102.1	44.4	0.0	70.2	99.8
Unit Capacity Factor (using DER net)	96.7	96.0	41.7	0.0	66.0	93.8
Unit Forced Outage Rate	0.0	0.0	0.0	0.0	1.4	0.0
Hours in Month	744	696	744	719	744	720
Net MDC (Mwe)	503	503	503	503	503	503

TABLE 2.1 (Page 2 of 2)

ELECTRICAL POWER GENERATION DATA (1984)

MONTHLY

	July	August	September	October	November	December
Hours RX was critical	739.8	744.0	720.0	745.0	720.0	744.0
RX Reserve Shutdown Hours	0.0	0.0	0.0	0.0	0.0	0.0
Hours Generator On-Line	736.6	744.0	720.0	745.0	720.0	744.0
Unit Reserve Shutdown Hours	0.0	0.0	0.0	0.0	0.0	0.0
Gross Thermal Energy Generated (MWH)	1,199,335	1,222,297	1,183,431	1,205,018	1,183,532	1,222,229
Gross Elec. Energy Generated (MWH)	398,400	401,200	392,300	399,900	393,000	405,400
Net Elec. Energy Generated (MWH)	379,308	381,602	373,485	380,555	375,244	387,201
RX Service Factor	99.4	100.0	100.0	100.0	100.0	100.0
RX Availability Factor	99.4	100.0	100.0	100.0	100.0	100.0
Unit Service Factor	99.0	100.0	100.0	100.0	100.0	100.0
Unit Availability Factor	99.0	100.0	100.0	100.0	100.0	100.0
Unit Capacity Factor (using MDC net)	101.4	102.0	103.1	101.6	103.6	103.5
Unit Capacity Factor (using DER net)	95.3	95.9	97.0	95.5	97.4	97.3
Unit Forced Outage Rate	1.0	0.0	0.0	0.0	0.0	0.0
Hours in Month	744	744	720	745	720	744
Net MDC (Mwe)	503	503	503	503	503	503

TABLE 2.2

ELECTRICAL POWER GENERATION DATA

1984

	Year	Cumulative
Hours RX was critical	7,570.6	78,750.5
RX Reserve Shutdown Hours	0.0	2,330.5
Hours Generator On-Line	7,528.3	77,340.7
Unit Reserve Shutdown Hours	0.0	10.0
Gross Thermal Energy Generated (MWH)	12,096,038	121,067,124
Gross Elec. Energy Generated (MWH)	3,999,200	39,857,300
Net Elec. Energy Generated (MWH)	3,810,000	37,942,036
RX Service Factor	86.2	85.2
RX Availability Factor	86.2	87.7
Unit Service Factor	85.7	83.7
Unit Availability Factor	85.7	83.7
Unit Capacity Factor (using MDC net)	86.2	79.1
Unit Capacity Factor (using DER net)	81.1	76.7
Unit Forced Outage Rate	0.2	3.6
Hours in Reporting Period	8,784	92,449

3.0 PLANT MODIFICATIONS, TESTS AND EXPERIMENTS

This section is provided in accordance with the requirements of Part 50.59 (b) to Title 10, Code of Federal Regulations (10CFR50.59(b)). This regulation allows licensees to make changes in the facility as described in the Updated Safety Analysis Report, make changes in procedures as described in the Updated Safety Analysis Report, and conduct tests and experiments not described in the Updated Safety Analysis Report, without prior NRC approval, provided the change, test or experiment does not involve a change in the Technical Specifications or an unreviewed safety question. 10CFR50.59(b) requires that such changes be reported on an annual basis.

3.1 Plant Modifications, 10CFR50.59

There were no modifications during 1984 which introduced an unreviewed safety question and, therefore, prior NRC approval was not required.

The following summary of modifications includes those significant modifications completed during 1984 and not previously reported. Many of these modifications are not specifically required to be reported by 10CFR50.59(b) since they do not constitute a change in the facility "as described in the Updated Safety Analysis Report." However, they are considered to be of significance, warranting mention in this report.

Reactor Control and Protection

Reactor Trip and Bypass Breaker overcurrent trip brackets were removed from the trip bar as recommended by Westinghouse. (DCR 1378)

Summary of Safety Evaluation

The brackets were unnecessary since the breakers were not equipped with overcurrent devices. Westinghouse testing showed that additional margin on the trip interaction of the undervoltage attachment was gained by removing the brackets.

Engineered Safeguards

Logic relay circuits for the main feedwater control valves were modified to allow proper continuity verification using the test light. Resistors were added to the test light circuit for SI Block/Reset relays to prevent inadvertent actuation of the relays when in test. (DCR 1360)

Summary of Safety Evaluation

The test light in the original design tested the seal-in relay in parallel with the main relay and thus only verified that one of the two relays was operable. The new design allows individual testing of the main relay and individual tesing of the seal-in relay. The resistors do not affect normal operation of the SI Block/Reset relays since they are in the circuit only when the "push to test" lamp is depressed.

4160-V and 480V Supply and Distribution

A tap change was made on substation transformer B-10. Consequently tap changes were made on the Reserve and Tertiary Auxiliary Transformers and several station transformers. Setpoints on second level and instantaneous undervoltage relays on the safeguard buses were lowered by 2½%. (DCR 1434)

Summary of Safety Evaluation

The tap changes increased the voltage on the most limiting safeguard motors. This, along with a computer loadflow program, which more accurately predicts safeguard bus voltages, allowed the undervoltage relay setpoint change. Technical Specification Amendment 53 was granted for the setpoint change.

480V Supply and Distribution

Installed trip guards on safety related 480V switchgear. These guards prevent accidental tripping of switchgear breakers by personnel and equipment moving through the area. (DCR 1401)

Summary of Safety Evaluation

These trip guards were designed by the breaker manufacturer and are being used on new switchgear breakers. They are attached to the breaker covers and will not affect the operation of the breakers.

Environmental Qualification

Electrical equipment in various systems was upgraded to improve its environmental qualifications. These upgrades included:

- Replacement of several limit switches and installation of Conax seals on these limit switches for valves in Main Feedwater and Main Steam systems. (DCR's 1394 and 1416)
- Replacement of four (4) level transmitters in the Reactor Coolant Systems (DCR-1136)
- Replacement of six (6) damper actuators in the Shield Building Ventilation system. (DCR 1243)

- Replacement of several solenoid valves in Reactor Building Ventilation, Radiation Monitoring, Main Feedwater, Pressurizer Spray, Secondary Sampling, Chemical and Volume Control, Auxiliary Building Special Ventilation, Main Steam, and Miscellaneous Drains and Sumps systems. (DCR's 1143, 1144, 1145, 1154, 1242, 1285, 1286, 1369, and 1416).

Summary of Safety Evaluation

In each case the modification resulted in the component being more qualified for postaccident operation, hence reliability was upgraded.

Reactor Building Ventilation

The Containment Fan Coil Unit discharge ductwork was modified to assure a post accident cooling air flow path. (DCR 1291)

Summary of Safety Evaluation

The addition of emergency discharge dampers and pressure relief dampers in the ductwork downstream of the Containment Fan Coil Units ensures a flow path through the fan coil units postaccident.

Reactor Building Ventilation

The Post-LOCA Hydrogen Recombiner piping was modified to allow for relief of containment pressure during plant operation. (DCR 1327)

Summary of Safety Evaluation

Originally containment pressure was relieved through 36-inch Pratt butterfly valves whose operation against a large differential pressure (i.e. post LOCA) was suspect. The new design provides a separate 2-inch diameter system affording containment pressure relief without using the 36 inch diameter system.

Reactor Building Ventilation

The control circuitry for the CRDM Cooling Fans was modified to allow both fans to run at the same time. (DCR 1349)

Summary of Safety Evaluation

The purpose of this modification was to increase the vessel upper head forced convective cooling during a natural circulation cooldown.

Auxiliary Building Special Ventilation

Seventy-two Clark 120VAC, normally energized, Steam Exclusion logic relays were replaced with GE CR120B relays to eliminate a design problem in the Clark relays which prevented them from dropping out on de-energization. (DCR 980)

Summary of Safety Evaluation

The 72 affected relays are now qualified to IEEE-323-1974 and IEEE-344-1975. Replacing the Clark relays increases the safety and reliability of the Plant. The modification did not change the function of the relays.

Turbine Building and Screenhouse Ventilation

Battery room ventilation ductwork and controls were modified to ensure that the average room temperature will not exceed the room design temperature. The modification will improve battery cell cooling prolonging battery life. (DCR-1184)

Summary of Safety Evaluation

The modification provides a more suitable environment for the batteries increasing their reliability.

Chemical and Volume Control

The AC vari-drive on one of the three positive displacement charging pumps was replaced with a DC drive to provide more reliable service. (DCR 819)

Summary of Safety Evaluation

This modification, though not nuclear safety related, improved the reliability of the charging pumps.

Replace Plant Process Computer

The original plant process computer, Westinghouse P-250, was replaced with a Honeywell 4500C computer. In addition to replacing the existing functions of the P250, the new computer provides data access to the Technical Support Center and the Emergency Operations Facility. The Honeywell also provides the Safety Parameter Display System (SPDS) required by NUREG-0737, Supplement 1. (DCR 1174)

Summary of Safety Evaluation

No safety related functions are performed by the plant process computer. Margin to saturation in the reactor coolant system, thermal power, and nuclear flux calculations, all subject to Techncial Specification limits, are performed on this computer as they had been on the P-250. A separate Safety Analysis Report was issued for the SPDS concluding that this change did not introduce any unreviewed safety questions.

Fire Protection

Significant work was completed on many modifications required by 10CFR50, Appendix R, Fire Protection Program including the following:

- The dedicated shutdown panel has been partially put into service with approximately thirty components operational from the panel.
- The installation of required instrumentation on the dedicated shutdown panel is 50% complete.
- The three hour fire wall installation and penetration sealing is 75% complete throughout the plant.
- Four Containment Fan Coil Units and Service Water Return Motor Valves were repowered to gain cable separation through various fire zones.
- Cable pulling required for separation of safeguard bus trains is approximately 80% complete.
- Fire detection system modifications are 90% complete.
- HVAC system modifications are 95% complete.

(DCR's 1189, 1191, 1192, 1193, 1194, 1195, 1197, 1361)

Summary of Safety Evaluation

These modifications enhance both automatic and operator control of the plant in the event of a fire. They will preclude a fire from affecting the capability to bring the plant to safe shutdown.

Turbine

The turbine supervisory instrumentation was replaced with a

Bentley-Nevada system to provide improved monitoring of the turbine. The electrical generator monitoring was also improved by adding a radio frequency monitor and additional RTD's. (DCR's 891, 1152, 1240)

Summary of Safety Evaluation

These modifications improve the capability to detect problems with the turbine and generator thereby reducing the probability of severe secondary plant transients.

Cranes

Auxiliary Building Crane movement was prevented over the last four feet of its eastward travel by installation of redundant limit switches. (DCR 1328)

Summary of Safety Evaluation

The limit switches will prevent operation of the Auxiliary Building Crane above the RHR heat exchanger discharge piping. These limit switches create an exclusion area preventing an accidental load drop from damaging the RHR heat exchanger discharge piping.

Cranes

A bridge travel limit switch was added to the Turbine Building Crane to prevent movement of the crane over the Battery Rooms. The limit switch can be bypassed under certain circumstances with a key controlled by the Shift Supervisor. (DCR 1393)

Summary of Safety Evaluation

Adding the Turbine Building Crane bridge limit switch will prevent the transport of heavy loads over safety related equipment thereby increasing the safety of the plant.

Lighting

Battery operated lights were added to provide emergency lighting from the Control Room to the Dedicated Shutdown Panel, at buses 1-5, 1-51, 1-52, and at the Diesel Generator 1A Local Control Panel. Some clean up work remains to be done in 1985. (DCR 1542)

Summary of Safety Evaluation

Addition of these battery powered lights increases safety by providing a dependable light source on the path to and at safe shutdown equipment.

Miscellaneous

Numerous equipment changes were required as a result of vendors dropping out of the nuclear market or equipment obsolesence. (DCR's 1407, 1430, 1504, 1532, 1557, 1592)

Summary of Safety Evaluation

These changes involved finding equivalent or better replacement equipment from qualified suppliers and update of the associated documentation, therefore, there were no adverse safety consequences.

Structures

A 67,000 square foot warehouse and office building was constructed to increase staff office areas and to provide increased warehouse storage facilities for the plant. (DCR 1273)

The plant Security System was modified to allow for control of access to the new office warehouse and office building. (DCR 1356)

The Health Physics group facilities were expanded to provide more space and increase the laundry capability for processing controlled area clothing. (DCR 1272)

Summary of Safety Evaluation

These modifications are not nuclear safety related.

Health Physics Equipment

Replaced one of the two portal monitors at the Security Building with a new 'state-of-the-art' monitor, and installed a second at the access point to the controlled area. (DCR 1422)

Summary of Safety Evaluation

The new portal monitors consist of eleven gas flow proportional detectors yielding excellent sensitivity. Contamination control is enhanced by early screening and increased sensitivity of detection.

Pressurizer Relief Valve Repair

The pressurizer vault missile shield was temporarily removed to allow repair of a small leak on a pressurizer power operated relief valve.

Summary of Safety Evaluation

Repair of the leak prevented further degradation thus improving operational safety. Removal of the missile shield allowed this work to be performed at power, eliminating the need for a transient on the RCS.

Full Power Control Rod Position Change

Flow induced vibration wear between the control rod cluster rodlets and the upper internal guide cards was observed at Kewaunee as well as other Westinghouse plants. To prevent clad perforation and distribute the wear the control rods were repositioned from their traditional all rods out position of 228 steps to 226 steps.

Summary of Safety Evaluation

Conservative analyses were performed for repositioning the control rod banks to 222 steps at full power and no adverse affects on core performance, safety limits, or safety system setpoints were determined. The bounding safety analyses assumption remain inviolate and no changes to the Kewaunee Technical Specifications are required for control rod repositioning at 225 steps or above.

3.2 Plant Procedures, 10CFR50.59

There were no procedure revisions during 1984 which introduced an unreviewed safety question or which changed procedures as described in the Updated Safety Analysis Report.

3.3 Tests And Experiments, 10CFR50.59

Core Reload/Physics Testing

Thirty-six (36) fresh region L assemblies were loaded for cycle X. Routine start-up physics testing was performed and reported in the Cycle X start-up report.

Summary of Safety Evaluation

A 10CFR50.90 reload safety analysis was performed and submitted 02/14/84.

4.0 LICENSEE EVENT REPORTS

This section is a summary of the 21 Licensee Event Reports (LER) submitted to the NRC in 1984 in accordance with the requirements of Technical Specifications. None of the LER's in 1984 posed a threat to plant operation or public safety.

LER 84-01

With the plant at 83% power both trains of the Shield Building Ventilation (SBV) system were out of service for approximately 75 minutes. With 1B SBV exhaust fan tagged out of service for performance of the Charcoal Filter Heat Detector Surveillance Test, the surveillance test was mistakenly initiated on train A of the SBV system. Train B had not been demonstrated operable prior to work on train A; although Train B remained in the automatic mode. Both trains of the SBV system were conservatively considered out of service when surveillance testing began on train A. Upon discovery, train B was returned to its normal configuration, demonstrated operable, and returned to service. To prevent recurrence of this event the SBV system filter housings have been clearly marked Train A & B, the surveillance procedure was revised to more clearly distinguish the system components to be tested, requirements for operator verification of changes in status lights on the SI active status panel have been included in the above mentioned surveillance procedure, and provisions for signoff and independent verification of steps which affect the operability of the charcoal filter deluge system have been included in the above mentioned surveillance procedure.

LER 84-02

Just prior to the 1984 refueling outage, at 2% reactor power with the main generator offline, during the turbine overspeed trip test, a turbine/reactor trip occurred. Low electro-hydraulic control oil pressure, due to leaking turbine control valves, caused the start of the second EHC-oil pump. Manual isolation of the leak resulted in an EHC pressure spike causing rapid opening of #4 turbine control valve. Increased steam demand caused steam generator 1B level to swell to the hi-hi setpoint which coincident with P-7 (at power trip permissive) resulted in a turbine/reactor trip. P-7 was enabled by the high impulse pressure caused by the rapid opening of #4 turbine control valve. Immediate operator actions for turbine/reactor trip were taken and systems verified stable.

LER 84-03

During refueling shutdown, underwater inspection of rod cluster control assemblies (RCCA's) revealed three RCCA's with apparent wear marks on the cladding surface. The wear correlated with the full power 'parked' rod position and the control rod guide cards. Vibration of the rodlets against the guide cards was the suspected wear mechanism. The wear did not exceed Westinghouse criteria for RCCA cladding imperfections and it was determined the three affected RCCA's could be used safely through cycle XI. At full power the control rods are now parked at 226 steps rather than 228 steps to spread the wear area. This LER was reported under "other" as one that may be of generic interest.

LER84-04

With the plant in refueling shutdown mode, an inadvertent actuation of 1B Shield Building Ventilation (SBV) recirculation fan occurred. An electrician was changing a normally closed (SBV) system relay to a normally open relay. Removal of the relay face plate released the internal springs of the upper tier causing four contacts to change to the closed position. This contact closure activated the 1B SBV recirculation fan. A description of this event was entered into the Information and Operational Experience Review Program and circulated to appropriate plant and corporate supervisors to review with their people. The Plant Operating Review Committee reviewed equipment control practices during modifications to determine if changes would be appropriate

LER 84-05

With the Plant in refueling shutdown mode during performance of the Diesel Generator Sequence Loading Panel Slave Relay Monitor test, two slave relays inadvertently picked up actuating 4 valves (SI-11A, SI-20A, SI-302, and SW-1300A) and the 1A Control Room Postaccident Recirculation Fan. The same components actuated during the previous test and again during three subsequent tests. The cause of this event was unknown. Subsequent investigations have not revealed any reason for this event. The test was performed six times daily for a short period and the event did not recur. The test is back on its original schedule; monthly.

LER 84-06

During refueling operating mode, while performing local leak rate surveillance tests, containment isolation valves LD-4A and LD-4B (in parallel) both in series with LD-6, were found to have leakage rates greater than the upper measuring limit of the local leak rate tester. Corrective maintenance was performed including replacement of the seat ring gaskets in LD-4A and LD-4B and adjustment of the stroke of LD-6. A technical evaluation was performed reviewing this and previous failures to determine proper long term corrective action.

LER 84-07

During refueling shutdown, the control room operators noticed that both diesel generators were running. Investigation revealed the start was caused by an electrician bumping the 1A Turbine Equipment Terminal Box while installing a conduit. Jarring the terminal box caused a Mercoid switch to actuate the "Reactor Auto Stop Trip" relay resulting in a diesel generator automatic start. The diesel generators were secured and the involved parties cautioned. This was considered an isolated event, hence no further follow-up action was required.

LER 84-08

During post refueling physics testing, an intermediate range hi-flux reactor trip was received on channel N35. The operators performed the immediate actions prescribed in the reactor/turbine trip procedure, placed channel N35 out of service and continued with physics testing. The intermediate range hi-flux reactor trip was due to a detector failure which is a recurring problem following refueling outages. An engineering study was initiated to determine possible long term corrective actions.

LER 84-09

At 25% power, during power escalation following the refueling outage, a turbine/reactor trip occurred during the Turbine Thrust Bearing Trip simulation procedure. Another attempt was made to simulate the turbine thrust bearing trip at 0% power; resulting in a turbine trip. Further investigation revealed an Auto Stop Oil pressure switch incorrectly wired, completing the logic for the direct generator trip when the thrust bearing oil pressure instrument indicates >60 psig. The pressure switch was rewired and returned to normal configuration.

LER 84-10

During plant power escalation from 10% to 25%, the control operator was controlling main feedwater flow in manual. While trying to stabilize a steam generator level oscillation, the lo-lo set point (17% NR) was reached causing a reactor trip. The reactor/turbine trip procedure was followed and stable conditions verified. Sensitivity of manual steam generator level control is being addressed in the control room design review program.

LER 84-11

At 59% power, the 1A Shield Building Recirculation Fan was found to be operating with its associated dampers open. No apparent cause for the fan actuation was evident. An auxiliary contact on the fan motor starter was replaced and the event has not recurred. Incident reports were circulated to operations personnel to make them aware of the possibility of this type of event.

LER 84-12

During full power operation both trains of the Auxiliary Building Special Ventilation (ABSV) System were inadvertently started. An Instrument and Control Technician was returning train B of the Steam Exclusion System back to service. The I&C Technician mistakenly requested the control room operator to depress "Zone SV Area Steam Exclusion Train B" instead of "Steam Exclusion Train B Reset"; and as designed, both trains of the ABSV system started. The error was instantly recognized and both trains of the ABSV system were secured and realigned for normal operation. The persons involved were made aware of the significance of this incident.

LER 84-13

During full power operation, train 'B' of the Auxiliary Building Special Ventilation System (ABSV) was found operating with no apparent cause. The control operator attempted to secure the system, and discovered a blown fuse for the solenoid valve on the ABSV exhaust filter 1B inlet damper. The solenoid failed in the closed position automatically opening the damper and starting the 1B ABSV exhaust fan. Due to similar failures a design change was implemented to replace Johnson solenoid valves with ASCO solenoid valves.

LER 84-14

During full power operation, loss of power occurred on Instrument Bus IV resulting in a partial loss of instrumentation, various alarms, and steam generator (S/G) level control problems. Operators took manual control of S/G levels but could not prevent a reactor trip from lo

S/G level coincident with steam flow/feed flow mismatch on S/G 1B. The loss of power on Instrument Bus IV resulted from a loose connection on the line side of its AC output breaker. Vibration over a period of time caused this loose connection to momentarily separate, dropping the instrument bus voltage approximately 100 V. Preventive maintenance procedures on DC equipment have been revised to include instrument bus inverters to prevent recurrence of this type of event.

LER 84-15

During full power operation, the Refueling Water Storage Tank (RWST) was found to be approximately 1½% below the minimum level required by Technical Specifications. The low tank level was caused by a valve misalignment which occurred when an operator was isolating the spent fuel pool demineralizer post filter for maintenance. Filling operations were started and an orderly shutdown initiated. RWST level was recovered 40 minutes following discovery, and the plant was returned to full power 1 hour and 12 minutes after discovery. All people involved were informed of the significance of this incident. A memo clarifying equipment status control requirements for the Auxiliary Building Filters was written and circulated to the operations personnel.

LER 84-16

During full power operation, investigation of a work request on RM-14, auxiliary building ventilation radiation monitor, lead an I&C Technician to believe there was a loose connection in the control room instrument drawer. By pulling the control and power cable out of the drawer, he unknowingly generated a start signal for train "B" of the Auxiliary Building Special Ventilation (ABVS) system. The control room operators verified the cause, secured the system, and realigned it for normal operation. A copy of the event was routed to the appropriate personnel stressing the importance of communication before work is initiated.

LER 84-17

During full power operation, both fire pumps were without power for approximately two minutes. While performing the annual Fire Pump Flow Test, the equipment operator overlooked a procedural step to close 1B Fire Pump breaker before opening the 1A Fire Pump breaker. The control room operators recieved an alarm and notified the equipment operator to immediately close one fire pump breaker. The fire header pressure remained above the 100 psig Technical Specification limit throughout the incident. The equipment operator was made aware of the significance of the incident and reminded of the importance of procedural adherence.

LER 84-18

During refueling shutdown mode, several Fan Coil Units (FCU) serving ESF equipment were found to have airflows less than nominal design. It was suspected that the reduced airflow was caused by cooling fin fouling. The fins were cleaned and the air flow increased, but was still less than nominal design values. An analysis was performed to determine whether existing airflows provided sufficient cooling capabilities. It was found that some of the FCU's were undersized for normal temperature conditions. Although some units were found to be undersized, and post accident ambient temperatures determined to be higher than first anticipated, the FCU's performance was determined acceptable. Six months later, during power operation. tubeside silt deposits were found and immediately cleaned resulting in increased cooling performance. The FCU's providing cooling for ESF equipment have been included in the Preventive Maintenance Program to prevent recurrence of the heat transfer area fouling. Also an engineering study was initiated to increase cooling capabilities or to provide additional fan coil units. Although not explicitly reportable under the requirements of 10CFR50.73, this event is being reported under OTHER as an item of generic interest.

LER 84-19

During full power operation, there was an inadvertent actuation of train 'B' Auxiliary Building Special Ventilation (ABSV) system, Control Room Postaccident Recirculation Fan 1B, and train 'B' Safeguards Fan Coil Units. The actuation occurred while calibrating the battery room steam exclusion RTD loops when an I&C Technician lifted a single lead which should have resulted in a control room alarm only. However a steam exclusion relay had been miswired, resulting in a 1 of 2 logic for the steam exclusion signal to actuate ESF ventialtion rather than 2 of 3 logic. The miswired relay was rewired. A procedure was developed to check each channel of the steam exclusion system for similar problems.

LER 84-20

During full power operation, the auxiliary operator discovered that the 1B Exhaust Fan of the Auxiliary Building Special Ventilation (ABSV) system was running. Investigation revealed that the coil on the solenoid valve controlling the exhaust damper had burned out, failing the solenoid in the closed position, opening the exhaust damper and starting the 1B Exhaust Fan. Due to similar failures of Johnson Controls solenoid valves a design change was initiated to replace these with ASCO solenoid valves.

LER 84-21

With the plant at full power operation, the Control Room supervisor noticed that the "Boric Acid Tank Out of Service" monitor light was "bright" on the Safety Injection Ready Status Panel. The "bright" light was indication of an abnormal condition. Investigation revealed the Boric Acid Tank selector switch was in the "TK A" position, however the "B" tank was physically aligned to provide suction to the safety injection pumps. Immediate action was taken to position the switch to the "TK B" position. This switch misalignment would have prevented the automatic switchover of the safety injection pump suc tion to the refueling water storage tank after the boric acid tank was emptied. Factors contributing to the switch misalignment included procedural inadequacies, human error, and lack of communications. Short term corrective action included immediately returning the TANK SELECTOR SWITCH to the"TK B" position, investigation and iden tification of why the incident occurred, and discussions among the shift operating crew on the reporting requirements and safety signifi cance. The Plant Manager held meetings with deparment heads and plant supervisors the following morning to stress the importance of avoiding similar situations. The maintenance and operations superintendents stressed to their people the importance of job attentiveness and avoiding personnel errors. Long term corrective action included revising the procedure that caused the event, reviewing plant Surveillance Procedures to eliminate any similar inadequacies, reviewing SI hardware to determine if any modifications are necessary, the control modified to allow clear distinction between bright and dim, and an independent Technical Review will be performed to investigate incidents resulting from personnel error. This event was reported as a 30 day report per 50.73(a)(2)(i) as operation prohibited by the plant's Technical Specifications and per 50.73(a)(2)(v) as an event that could have prevented the fulfillment of a safety function.

5.0 FUEL INSPECTION REPORT

Thirty six (36) fresh Region L assemblies were loaded for Cycle X. Startup physics testing was performed and reported in the Cycle X Startup Report.

The irradiated fuel inspection was performed with an underwater TV camera. All peripheral fuel rods were examined using one-half face scans. Eight assemblies were inspected, including one each of regions A, G, H and I, two region J and two region K. All assemblies except the two from region K exhibited rod slippage to various degrees with the majority having rods in contact with the bottom nozzle. Numerous scrapes to the rodlets, grids and top and bottom nozzles were also noted. However, no damage to the cladding or supporting structures was observed. All assemblies exhibited axially varying crud deposits. The A and one J region assemblies showed slight rod bowing. Overall condition of the fuel was very good with no evidence of fuel cladding degradation on the fuel rods examined. Video tapes were made of all examinations.

6.0 CHALLENGES TO AND FAILURES OF PRESSURIZER SAFETY AND RELIEF VALVES

There were no challenges to or failures of pressurizer safety or relief valves during 1984.

7.0 STEAM GENERATOR TUBE INSPECTION

The Kewaunee Nuclear Power Plant (KNPP) steam generator tubes were eddy current inspected during April, 1984 in accordance with KNPP Technical Specifications and Section XI of the ASME Boiler and Pressure Vessel Code.

The initial inspection program was designed to inspect 100% of the tubes in both steam generators. As a result of the inspection 25 tubes were mechanically plugged.

Five tubes in the 1A steam generator exhibited greater than 50% through wall indications. The 1B steam generator had 8 tubes with >50% indications (>50% through wall requires plugging by KNPP Technical Specifications).

Following analysis of the eddy current data, WPSC management decided to plug three tubes with indications <50% in the 1A steam generator and 9 tubes with indications <50% in the 1B steam generator.

The results of the 1984 steam generator eddy current inspection maintain the Kewaunee Nuclear Power Plant in the C-2 category, requiring the next inspection within 24 months.

Tables 7.1 and 7.2 summarize the 1984 eddy current inspection of the Kewaunee Nuclear Power Plant steam generators.

TABLE 7.1
1A STEAM GENERATOR
1984 EDDY CURRENT EXAMINATION

ROW	COLUMN	% THRU-WALL PENETRATION	PLUGGED	GENERAL INFORMATION
18	6	26		DEGRADED TUBE: A tube with % thru-wall
13	4	20		penetration >20%.
32	16	33		
33	16	31		DEFECTIVE TUBE: A tube with % thru-wall
11	23	26		penetration >50%; or, if significant
3	36	75	X	general tube thinning occurs a defective
7	36	37	X	tube is any tube with % thru-wall
23	36	55	X	penetration >40%.
46	43	23		
17	44	81	X	EXTENT OF 1A STEAM GENERATOR INSPECTION
20	46	39	X	# of tubes inspected — inspected up to
20	47	52	X	
21	47	43	X	3100 — full length
25	47	27		174 — U-bend
21	48	50	X	85 — #7 tube support plate
24	48	26		2 — #1 tube support plate
29	49	24		
11	52	21		Tubes Plugged in Steam
18	52	26		Generator 1A (1984) = 8
11	53	21		
11	55	21		Tubes Plugged in Steam
11	59	27		Generator 1A (1983) = 23
11	60	30		
25	63	20		TOTAL PLUGGED TUBES IN
6	80	25		1A STEAM GENERATOR = 31

TABLE 7.2
(PAGE 1 OF 2)
1B STEAM GENERATOR
1984 EDDY CURRENT INSPECTION

ROW	COLUMN	% THRU-WALL PENETRATION	PLUGGED
32	45	33	
13	46	40	X
6	47	39	
10	47	39	
14	47	23	
25	47	35	X
33	47	30	X
24	48	20	
27	48	42	
30	48	27	
32	48	59	X
33	48	27	
15	49	21	
31	49	22	
27	51	26	
29	52	33	
31	54	50	X
33	54	31	
33	56	36	
27	63	25	
17	64	20	
26	64	57	X
37	64	37	
23	67	63	X
23	68	54	X
33	73	34	
9	19	28	
5	20	33	
8	22	22	
9	23	25	
16	26	35	
26	27	52	X
16	28	33	
25	31	25	
24	32	33	
25	32	47	X
24	33	27	X
25	33	30	X
7	37	45	X
26	37	49	X
31	39	26	

GENERAL INFORMATION

DEGRADED TUBE: A tube with % thru-wall penetration >20%.

DEFECTIVE TUBE: A tube with % thru-wall penetration >50%; or, if significant general tube thinning occurs a defective tube is any tube with % thru-wall penetration >40%.

EXTENT OF 1B STEAM GENERATOR INSPECTION

# of tubes inspected	Inspection up to:
3142	Full length
187	U-bend
1	#1 tube support plate

Tubes plugged in 1B Steam Generator (1984) = 17

Tubes plugged in 1B Steam Generation (1983) = 49

TOTAL PLUBBED TUBES IN 1B STEAM GENERATOR = 76

TABLE 7.2
(PAGE 2 OF 2)
1B STEAM GENERATOR
1984 EDDY CURRENT INSPECTION

ROW	COLUMN	% THRU-WALL PENETRATION	PLUGGED	GENERAL INFORMATION
11	40	36		See page 1 of 2.
15	40	25		
25	41	33		
2	42	90	X	
13	42	29		
16	42	33		
25	42	31		
30	42	30		
31	42	43	X	
32	42	36	X	
16	43	21		
32	43	27		
19	89	23		

8.0 PERSONNEL EXPOSURE AND MONITORING REPORT

Pursuant to 10CFR20.407(a)(2), and 20.407(b), a tabulation of the number of individuals for whom monitoring was provided is shown in table 8.1. Tables 8.2, 8.3, and 8.4 provide a breakdown of the total number of individuals for whom personnel monitoring was provided.

Table 8.1

TOTAL NUMBER OF INDIVIDUALS FOR WHOM PERSONNEL MONITORING WAS PROVIDED IN 1984

Exp. Range (mR)		No. of Personnel
No Measurable		332
< 100		194
100 - 249		95
250 - 499		75
500 - 749		65
750 - 999		34
1000 - 1999		16
2000 - 2999		2
3000 - 3999		1
	Grand Total	814

Table 8.2

TOTAL NUMBER OF CONTRACTORS PROVIDED WITH PERSONAL DOSE MONITORING DEVICES

Exp. Range (mR)		No. of Personnel
No Measurable		211
< 100		103
100 - 249		63
250 - 499		48
500 - 749		42
750 - 999		26
1000 - 1999		11
2000 - 2999		0
3000 - 3999		0
	Total	504

Table 8.3

TOTAL NUMBER OF WPSC PLANT STAFF PROVIDED WITH PERSONAL DOSE MONITORING

Exp. Range (mR)		No. of Personnel
No Measurable		75
< 100		56
100 - 249		26
250 - 499		25
500 - 749		21
750 - 999		7
1000 - 1999		4
2000 - 2999		2
3000 - 3999		1
	Total	217

Table 8.4

TOTAL NUMBER OF PERSONNEL (WPSC NON-PLANT STAFF) PROVIDED WITH PERSONAL DOSE MONITORING DEVICES

Exp. Range (mR)		No. of Personnel
No Measurable		46
< 100		35
100 - 249		6
250 - 499		2
500 - 749		2
750 - 999		1
1000 - 1999		1
2000 - 2999		0
3000 - 3999		0
	Total	93

A tabulation of numbers of personnel exposure and man-rem received by work and job function is shown in Table 8.5 in accordance with Section 6.9.1.b of Kewaunee Nuclear Power Plant Technical Specificaiton. The table shows the total man-rem exposure for the year was 139.172.

Table 8.5

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 1984-KEWAUNEE
NUMBER OF PERSONNEL (GT 100 REM)

WORK AND JOB FUNCTION	STATION EMPLOYEES	UTILITY EMPLOYEES	CONTRACT WORK & OTHER	STATION EMPLOYEES	UTILITY EMPLOYEES	CONTRACT WORK & OTHER
Reactor-Operations Surveillance						
Maintenance Personnel	3	0	9	0.144	0.000	1.687
Operating Personnel	13	0	1	3.787	0.000	0.035
Health Physics Personnel	0	0	0	0.000	0.000	0.000
Supervisory Personnel	3	0	0	0.340	0.000	0.000
Engineering Personnel	5	2	2	0.460	0.141	0.454
Routine Maintenance						
Maintenance Personnel	43	9	63	10.199	2.493	28.859
Operating Personnel	7	0	2	1.235	0.000	0.136
Health Physics Personnel	19	0	16	10.605	0.000	7.952
Supervisory Personnel	2	0	2	0.290	0.000	0.662
Engineering Personnel	1	2	5	0.096	0.247	1.643
Inservice Inspection						
Maintenance Personnel	5	0	14	0.012	0.000	1.233
Operating Personnel	1	0	2	0.000	0.000	0.226
Healtn Physics Personnel	0	0	0	0.000	0.000	0.000
Supervisory Personnel	0	0	0	0.000	0.000	0.000
Engineering Personnel	1	0	0	0.046	0.000	0.000
Special Maintenance						
Maintenance Personnel	43	6	100	7.467	0.260	34.803
Operating Personnel	10	0	0	0.316	0.000	0.000
Helath Physics Personnel	5	0	0	0.382	0.000	0.000
Supervisory Personnel	4	0	1	0.428	0.000	0.080
Engineering Personnel	4	3	10	0.086	0.164	1.496
Waste Processing						
Maintenance Personnel	19	4	6	0.479	1.197	0.774
Operating Personnel	2	0	0	3.204	0.000	0.000
Health Physics Personnel	5	0	1	2.363	0.000	0.321
Supervisory Personnel	0	0	0	0.000	0.000	0.000
Engineering Personnel	0	0	0	0.000	0.000	0.000
Refueling						
Maintenance Personnel	24	4	16	2.484	0.638	6.490
Operating Personnel	3	0	1	0.028	0.000	0.000
Health Physics Personnel	0	0	0	0.000	0.000	0.000
Supervisory Personnel	0	0	9	0.000	0.000	2.730
Engineering Personnel	0	1	0	0.000	0.000	0.000
Total						
Maintenance Personnel	137	24	208	20.785	4.589	73.846
Operating Personnel	36	0	6	8.570	0.000	0.397
Health Physics Personnel	29	0	17	13.350	0.000	8.273
Supervisory Personnel	9	0	12	1.058	0.000	3.472
Engineering Personnel	11	8	17	0.688	0.552	3.593
Grand Total	222	31	260	44.451	5.140	89.581

9.0 RADIOLOGICAL MONITORING PROGRAM

Attached is the report from Teledyne Isotopes on the Radiological Monitoring Program for Kewaunee Nuclear Plant for 1984.

TELEDYNE ISOTOPES
MIDWEST LABORATORY
1509 FRONTAGE RD.
NORTHBROOK, IL 60062-4197
(312) 564-0700

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 1984

PREPARED AND SUBMITTED
BY
TELEDYNE ISOTOPES MIDWEST LABORATORY
PROJECT NO. 8002

Approved by: L. G. Huebner
L. G. Huebner
General Manager

8 February 1985

PREFACE

The staff members of the Teledyne Isotopes Midwest Laboratory were responsible for the acquisition of data presented in this report. Assistance in sample collection was provided by Wisconsin Public Service Corporation personnel.

The report was prepared by L. G. Huebner, General Manager. He was assisted in report preparation by other staff members of the laboratory.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

The Kewaunee Nuclear Power Plant is a 535 megawatt pressurized water reactor located on the Wisconsin shore of Lake Michigan in Kewaunee County. The Kewaunee Nuclear Power Plant became 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 operation data collected during the period January - December 1984.

Wisconsin Public Service Corporation, an 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.

2.0 SUMMARY

Results of sample analyses during the period January - December 1984 are summarized in Table 4.5. Radionuclide concentrations measured at indicator locations are compared with levels measured at control locations and in preoperational studies. The comparisons indicate background-level radioactivities in all samples collected with the following exceptions:

1. Trace amounts of cobalt-58 and cobalt-60 were detected in several bottom sediment samples. The presence of these isotopes in bottom sediment samples is probably plant related.

2. Nine samples collected at discharge (K-1d) and six samples collected at Two Creeks Park (K-14) had elevated tritium levels. The annual mean tritium concentration at the discharge was 1840 pCi/l above background level. The highest concentration was measured in the sample collected on August 6, 1984 and yielded 3730 pCi/l above background level. The presence of tritium in the discharge water is attributable to the Kewaunee Nuclear Plant operation, but the highest discharge rate measured constitutes only 0.12% of the maximum permissible concentration of 3,000,000 pCi/l established in the 10 CFR 20 Document.

   The annual mean tritium concentration in lake water collected at Two Creeks Park was 2470 pCi/l above background level and the maximum was measured in the sample collected on February 1, 1984 (13,690 pCi/l above background level). The source of the elevated levels in samples collected at Two Creeks Park is not clear since this point is equidistant from the Kewaunee and Point Beach Nuclear Plants, either one of which, or both, could have been the source of the elevated tritium level.

3.0 RADIOLOGICAL SURVEILLANCE PROGRAM

Following is a description of the Radiological Surveillance Program and its execution.

3.1 Methodology

The sampling locations are shown in Figure 4-1. Table 4.1 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 4.2 using sample codes defined in Table 4.3. The collections and analyses that comprise the program are described below. Finally, the execution of the program in the current reporting year is discussed.

3.1.1 The Air Program

Airborne Particulates

The airborne particulate samples are collected on 47 mm diameter glass fiber filters 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 TIML 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 location are analyzed for gamma-emitting isotopes by a germanium detector.

Airborne Iodine

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.

Ambient Gamma Radiation - TLDs

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, K-4, K-5, and K-6) with thermoluminiscent dosimeters (TLDs). CaF_2:Mn bulb TLDs are exchanged quarterly and annually.

Precipitation

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

3.1.2 The Terrestrial Program

Milk

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.

Well Water

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 technique.

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

Domestic meat samples (chickens) are obtained annually (in the third quarter) at locations K-20, K-24, K-25, and K-27. The flesh is separated from the bones, gamma scanned, and analyzed for gross alpha, gross beta, strontium-89, and strontium-90 activities.

Eggs

Eggs are collected quarterly at Location K-27. The samples are gamma scanned and analyzed for gross alpha, gross beta, strontium-89, and strontium-90 activities.

Vegetables

Vegetable samples (5 varieties) are collected at locations K-17 and K-26, 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 and Cattle Feed

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

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, gross beta, strontium-89, and strontium-90 activities.

3.1.3 The Aquatic Program

Surface Water

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 in the Lake Michigan samples is determined by liquid scintillation technique. Quarterly composites of monthly grab samples from Lake Michigan are also analyzed for strontium-89 and strontium-90.

Fish

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

Slime

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

Bottom Sediments

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.

3.1.4 Program Execution

Program execution is summarized in Table 4.4. The program was executed as described in the preceding sections with the following exceptions:

(1) Precipitation samples were not collected in March and December 1984 because they were not available.

(2) No buckwheat was collected at location K-23 because it was not grown there in 1984.

(3) There was no air particulate data from Location K-15 for the collection period ending Janury 24, 1984 because the filter paper was lost in the field.

3.1.5 Program Modifications

There were no program modifications during 1984.

3.2 Results and Discussion

The results for the reporting period January to December 1984 are presented in summary form in Table 4.5. 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 4.4. Any discussion of previous environmental data for the Kewaunee Nuclear Power Plant refers to data collected by Teledyne Isotopes Midwest Laboratory or its prececessor, Hazleton Environmental Sciences.

The tabulated results of all measurements made in 1984 are not included in this section, although references to these results will be made in the discussion. The complete tabulation of the 1984 results is contained in Part II of the 1984 annual report on the Radiological Monitoring Program for the Kewaunee Nuclear Power Plant.

3.2.1 Atmospheric Nuclear Detonations

There were no reported atmospheric nuclear tests in 1984. The last reported test was conducted by the People's Republic of China on October 16, 1980. The reported yield was in the 200 kiloton to 1 megaton range.

3.2.2 The Air Environment

Airborne Particulates

For air particulates, both gross alpha and gross beta measurements yielded annual means that were nearly identical for the indicator and control locations. Mean gross alpha activity was slightly higher than in 1983 while mean gross beta activity was indentical to that in 1983. The highest annual means for gross alpha and gross beta were measured at control location K-16, 26 miles NW of the station, and at control location K-9, 9.5 miles NNE of the station, respectively.

Gross alpha and beta activities at all locations were also analyzed by quarters. The activity was higher in the first quarter, declined during the second quarter, and rose slightly during the third and fourth quarters. There was no clear cut evidence of the spring peak, which has been observed almost annually (1976 and 1979 were exceptions) for many years (Wilson et al., 1969). The spring peak has been attributed to fallout of nuclides from the stratosphere (Gold et al., 1964).

Gamma spectroscopic analysis of quarterly composites of air particulate filters yielded similar results for indicator and control locations. Berylium-7, which is produced continously in the upper atmosphere by cosmic radiation (Arnold and Al-Salih, 1955), was detected in nine of twenty-four samples and was the only gamma-emitting isotope detected. There was no indication of a station effect on the data.

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

Airborne Iodine

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 operation on the local air environment.

Ambient Gamma Radiation - TLDs

Ambient gamma radiation was monitored by TLDs at ten locations: four indicator and six control.

The quarterly TLDs at the indicator locations measured a mean dose equivalent of (53.8±7.2)* mR/365 days, in agreement with the mean at the control locations of (51.7±5.0) mR/365 days, and were nearly identical to the means obtained in 1983 (50.4 and 51.3 mR/365 days, respectively). The quarterly measurements agreed within the error with the annual measurements which were (59.2±3.7) mR/365 days, for the indicator and (58.9±6.4) mR/365 days for the control locations. All these values are slightly lower than the United States average value of 78 mR/year due to natural background radiation (National Council on Radiation Protection and Measurements, 1975). The highest means for the quarterly and annual TLDs were 63.9 and 67.8 mR/365 days and occured at control locations K-3 and K-8, respectively.

* 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.

Precipitation

Precipitation was monitored only at an indicator location, K-11. Tritium was detected in four samples and averaged 140 pCi/l. This level of activity is expected in the precipitation and is attributable to the previous nuclear tests in the atmosphere.

3.2.3 The Terrestrial Environment

Milk

Of the 198 analyses for iodine-131 in milk all were below the LLD level of 0.5 pCi/l.

Strontium-89 activity was below the LLD level of 2.9 pCi/l in all samples.

Strontium-90 was found in all but one sample. The mean values were nearly identical for indicator and control locations (1.7 pCi/l and 1.8 pCi/l, respectively).

Barium-140 activity was below the LLD of 10 pCi/l in all samples. Cesium-137 activity was also below the LLD of 10 pCi/l in all samples.

Potassium-40 results were nearly identical at both the indicator and control locations and were essentially identical to the levels observed in 1978, 1979, 1980, 1981, 1982, and 1983.

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/l and 1.16±0.08 g/l, respectively (National Center for Radiological Health, 1968).

Well Water

Gross alpha activity in well water was below the LLD level of 2.8 pCi/l in all samples.

Gross beta activity in well water was 1.9 pCi/l in samples from the control location. The mean value for all indicator locations was 2.3 pCi/l and was nearly identical to the values observed in 1977, 1978, 1979, 1980, 1981, 1982, and 1983 (3.3 pCi/l, 3.4 pci/l, 3.0 pCi/l, 3.0 pCi/l, 3.6 pCi/l, 3.2 pCi/l, and 2.9 pCi/l, respectively).

Tritium activity in the on-site well (K-1g) was below the LLD of 100 pCi/l in all samples.

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

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

Domestic Meat

In meat (chickens), gross alpha activity was similar at both indicator and control locations (0.26 and 0.32 pCi/g wet weight, respectively). Gross beta activity averaged 2.33 pCi/g wet weight for indicator locations and 2.79 pCi/g wet weight for control locations. 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.

Eggs

In egg samples, the gross alpha activity averaged 0.010 pCi/g wet weight. Gross beta activity averaged 1.14 pCi/g wet weight, about equal to the activity of the naturally occurring potassium-40 observed in the samples (1.15 pCi/g). The levels of strontium-89 and strontium-90 and all other gamma-emitting isotopes were below their respective LLD's.

Vegetables

In vegetables, alpha activity averaged 0.58 and 0.23 pCi/g wet weight in indicator and control samples, respectively. Gross beta activity was slightly higher at the indicator location than at the control location and was due primarily to the potassium-40 activity. Strontium-89 activity was below the LLD of 0.028 pCi/g wet weight in all samples. Strontium-90 activity was lower at the control locations than at indicator locations (0.015 pCi/g wet weight and 0.005 pCi/g wet weight, respectively). 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.

Grass and Cattle Feed

In grass, gross alpha activity was essentially identical at both indicator and control locations (0.7 and 0.6 pCi/g wet weight, respectively). Gross beta activity was slightly higher at indicator locations (6.8 pCi/g wet weight) than at the control locations (6.0 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 respective LLD's. Strontium-89 was below the LLD of 0.09 pCi/g wet weight in all samples. Strontium-90 activity was detected in seventeen of twenty-four samples and was higher at indicator than at control locations (0.032 and 0.025 pCi/g wet weight, respectively). Presence of radiostrontium in some of the samples is attributed to the fallout from the previous nuclear tests.

For cattlefeed, the mean gross alpha activity at indicator locations was 0.68 pCi/g wet weight and 0.44 pCi/g wet weight at control locations. Mean gross beta activity was slightly higher at indicator locations (8.80 pCi/g wet weight) than at control locations (7.58 pCi/g wet weight). The highest gross beta level was in the sample from indicator location K-19 (15.96 pCi/g wet weight), and reflected the high potassium-40 level (10.5 pCi/g wet weight) observed in the sample. The pattern was similar to that observed in 1978, 1979, 1980, 1981, 1982, and 1983. Strontium-89 levels were below the LLD level at 0.19 pCi/g wet weight in all samples. Strontium-90 activity was higher at indicator locations than at control locations (0.066 and 0.046 pCi/g wet weight, respectively). The presence of the radiostrontium is attributable to the fallout from the previous nuclear tests. All other gamma-emitting isotopes were below their respective LLD levels.

Soil

No significant differences were found between indicator and control values in soil samples. The difference of 0.1 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 3-5 pCi/g dry weight. Mean gross beta levels were similar at both indicator and control locations (24.6 and 26.8 pCi/g dry weight, respectively), and is primarily due to the potassium-40 activity. Strontium-89 was below the LLD level of

0.29 pCi/g dry weight in all samples. Strontium-90 was detected in six of fourteen samples and was slightly higher at control than at indicator locations (0.18 and 0.15 pCi/g dry weight, respectively). Cesium-137 was detected in all samples and was higher at control locations than at indicator locations (0.62 and 0.30 pCi/g dry weight, respectively). All other gamma-emitting isotopes were below their respective LLD's. The levels of detected activities were similar to those observed in 1979, 1980, 1981, 1982, and 1983.

3.2.4 The Aquatic Environment

Surface Water

In surface water, the gross alpha activity in suspended solids was below the LLD of 1.0 pCi/l in all samples. In dissolved solids, gross alpha activity was detected in five of seventy-two samples and averaged 3.0 pCi/l.

Mean gross beta activity in suspended solids was detected in thirteen samples and averaged 0.6 pCi/l, barely above the detection limit of 0.5 pCi/l. Mean gross beta activity in dissolved solids was higher by a factor of two at indicator locations (5.0 pCi/l) as compared to the control locations (2.7 pCi/l) and was nearly identical to the activities observed in 1978 (5.4 and 2.7 pCi/l), 1979 (5.7 and 2.7 pCi/l), 1980 (5.1 and 2.7 pCi/l), 1981 (4.3 and 2.7 pCi/l), 1982 (4.9 and 2.4 pCi/l), and 1983 (5.1 and 2.6 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-1a and K-1e) which are much higher in activities and exhibit large month-to-month variations in gross beta activities. The K-1a creek drains its water from the surrounding fields which are heavily fertilized and K-1e creek draws its water mainly from the Sewage 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 operations. The fact that similar fluctuations at these locations were observed in the pre-operational studies conducted prior to 1974 supports this assessment.

Annual mean tritium activity was 2310 pCi/l at indicator locations and was below LLD of 220 pCi/l at control locations. The mean activity at the discharge (K-1d) was 1840 pCi/l above the background level of 220 pCi/l and 2470 pCi/l above the background level at Two Creeks Park, located 2.5 miles south of the plant. The elevated annual mean of 1840 pCi/l above background in the discharge water is attributable to the plant operation, but constitutes about 0.06% of the maximum permissible concentration of 3,000,000 pCi/l established in the 10 CFR 20 Document. The highest level of 4730 pCi/l above background level detected in the sample collected August 6, 1984 constitutes less than 0.16% of the permissible level.

The highest level measured at Two Creeks Park was 13,690 pCi/l and constitutes about 0.46% of the permissible level. However, since the Two Creeks Park location is equidistant from the Kewaunee and Point Beach Nuclear Plants, it could not be determined which plant was the source of this activity.

Strontium-89 activity was below the LLD of 1.9 pCi/l in all samples. Strontium-90 activity was detected in one of twelve samples and was 3.2 pCi/l.

Fish

In fish samples, gross alpha activity averaged 0.17 pCi/g wet weight in muscles and was below detection limit in all bone fractions. In muscle, gross beta activity was primarily due to potassium-40 activity. The average beta activity of 2.34 pCi/g wet weight was near the average of the 1973 range of 2.26 to 3.62 pCi/g wet weight. The cesium-137 activity in muscle averaged 0.10 pCi/g wet weight and was nearly identical to the level observed in 1979 and 1980 (0.12 pCi/g wet weight in both years), 1981 (0.15 pCi/g wet weight), in 1982 (0.17 pCi/g wet weight), and in 1983 (0.14 pCi/g wet weight). The strontium-89 and strontium-90 levels were below their respective LLDs.

Periphyton (Slime)

In periphyton (slime) samples, gross alpha activity was nearly identical at both indicator and control samples (0.7 and 0.8 pCi/g wet weight, respectively). Mean gross beta activity was higher at indicator than at control locations (2.1 and 0.8 pCi/g wet weight, respectively). Strontium-89 activity was below the LLD level of 0.41 pCi/g wet weight in all samples. Strontium-90 activity was below the LLD level of 0.10 pCi/g wet weight in all samples. All gamma-emitting isotopes, except naturally-occurring potassium-40, were below their respective LLDs.

Bottom Sediments

In bottom sediment samples, gross alpha levels were below the LLD of 4.2 pCi/g dry weight in all samples but five. The mean detected activity was 6.1 pCi/g dry weight, about the same as in 1983 (6.2 pCi/g dry weight).

The mean gross beta activity was slightly higher at indicator locations than at the control location (8.4 and 7.4 pCi/g dry weight, respectively) and was due mostly to potassium-40. The difference is not statistically significant.

Cesium-137 was detected in sixteen of twenty samples and averaged 0.07 pCi/g dry weight. The level was slightly lower than the levels observed in 1979 (0.12 pCi/g dry weight), in 1980 (0.19 pCi/g dry weight), in 1981 (0.18 pCi/g dry weight), in 1982 (0.13 pCi/g dry weight), and in 1983 (0.16 pCi/g dry weight). Strontium-89 and strontium-90 levels were below their respective LLDs (0.20 and 0.10 pCi/g dry weight, respectively) in all samples. Trace amounts of cobalt-58 (eleven samples) and cobalt-60 (seven samples) were detected near the condenser discharge. Presence of trace amount of these activation products in bottom sediments is probably plant related.

4.0 FIGURES AND TABLES

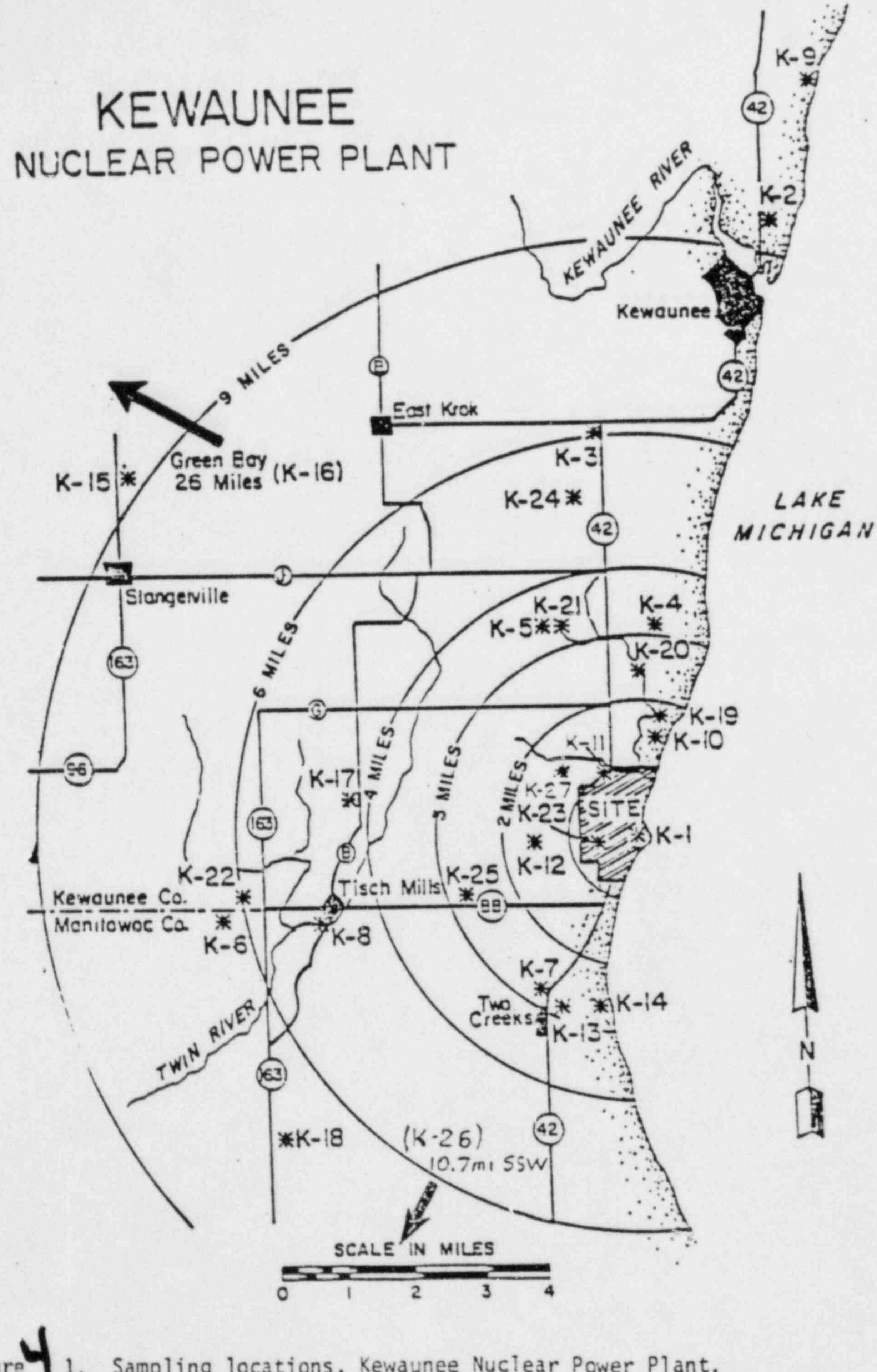


Figure 4.1. Sampling locations, Kewaunee Nuclear Power Plant.

Table 4.1 Sampling locations, Kewaunee Nuclear 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]	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	Rand's 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-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	2.75 WSW	Wotachek farm, Route 1, Denmark
K-26[d]	C	10.7 SSW	Bertler's Fruit Stand (8.0 miles south of "BB")
K-27	I	1.5 NW	Schlies Farm, 0.5 miles west of K-11

[a] I = indicator; C = control

[b] Distances are measured from reactor stack.

[c] The K-6 sampling location was changed on October 17, 1980 because the operator of Berres Farm retired. Berres Farm has been replaced by Novitski Farm, located 0.2 miles West of Berres Farm.

[d] Location K-18 was changed because the Schmidts Food Stand went out of business and was replaced by Bertler's Fruit Stand (K-26).

Table 4.2 Type and frequency of collection.

Location	Frequency					
	Weekly	Bi-weekly	Monthly	Quarterly	Semi-Annually	Annually
K-1						
K-1a			SW		SL	
K-1b			SW	GR[a]	SL	
K-1c				BS[b]		
K-1d			SW	BS[b] FI[a]	SL	
K-1e			SW		SL	
K-1f	AP	AI		GR[a] TLD.	SO	TLD
K-1g			WW			
K-1h			WW			
K-1j				BS[b]		
K-2	AP	AI		TLD		TLD
K-3			MI[c]	GR[a] TLD CF[d]	SO	TLD
K-4			MI[c]	GR[a] TLD CF[d]	SO	TLD
K-5			MI[c]	GR[a] TLD CF[d]	SO	TLD
K-6			MI[c]	GR[a] TLD CF[d]	SO	TLD
K-7	AP	AI		TLD		TLD
K-8	AP	AI		TLD		TLD
K-9			SW	BS[b]	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]	SL	
K-15	AP	AI		TLD		TLD
K-16	AP	AI		TLD		TLD
K-17						DM,VE
K-18[e]						VE
K-19			MI[c]	GR[a] CF[d]	SO	
K-20						DM
K-23						GRN
K-24						DM
K-25						DM
K-26						VE
K-27				EG		

[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-26 in summer of 1982.

Table 4.3 Sample codes used in Table 4.2.

Code	Description
AP	Airborne Particulate
AI	Airborne Iodine
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
SL	Slime
BS	Bottom Sediments

Table 4.4. Sampling summary, January - December 1984.

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	311	1	See text Page 6.
Airborne iodine	C/BW	6	157	0	
TLD's	C/Q	10	40	0	
	C/A	10	10	0	
Precipitation	C/M	1	10	2	See text Page 6.
Terrestrial Environment					
Milk (May-Oct)	G/W	6	162	0	
(Nov-Apr)	G/M	6	36	0	
Well water	G/M	2	24	0	
	G/Q	4	16	0	
Domestic meat	G/A	4	4	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 Page 6.
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	0	
Fish	G/TA	1	4	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 follows: W = weekly; M = monthly; Q = quarterly; SA = semi-annually; TA = three times per year; FA = four times per year; A = annually; BW = bi-weekly.

Table 4.5 Environmental Radiological Monitoring Program Summary.
Name of facility Kewaunee Nuclear Power Plant Docket No. 50-305
Location of facility Kewaunee County, Wisconsin (County, State) Reporting Period January - December 1984

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/m^3)	GA 311	0.003	0.0046 (85/104) (0.0008-0.0156)	K-16, Green Bay 26 mi NW	0.0058 (49/52) (0.0010-0.0125)	0.0050 (177/207) (0.0001-0.0196)	0
	GB 311	0.002	0.018 (96/104) (0.002-0.062)	K-2, Kewaunee 9.5 mi NNE	0.019 (45/52) (0.003-0.058)	0.019 (193/207) (0.002-0.068)	0
				K-7, Bruemer Farm 2.75 mi SSW	0.019 (47/52) (0.003-0.062)		
				K-15, Gas Substation 9.25 mi NW	0.019 (45/51) (0.005-0.046)		
	GS 24						
	Be-7	0.040	0.081 (5/8) (0.051-0.121)	K-7, Bruemer Farm 2.75 mi SSW	0.093 (2/4) (0.065-0.121)	0.078 (4/16) (0.061-0.093)	0
	Nb-95	0.0062	<LLD	-	-	<LLD	0
	Zr-95	0.0068	<LLD	-	-	<LLD	0
	Ru-103	0.0069	<LLD	-	-	<LLD	0
	Ru-106	0.016	<LLD	-	-	<LLD	0
	Cs-137	0.0020	<LLD	-	-	<LLD	0
	Ce-141	0.011	<LLD	-	-	<LLD	0
	Ce-144	0.015	<LLD	-	-	<LLD	0
Airborne Iodine (pCi/m^3)	I-131 157	0.01	<LLD	-	-		0
TLD -Quarterly (mR/91 days)	Gamma 40	5	13.4 (16/16) (10.4-17.6)	K-7, Bruemer Farm 2.75 mi SSW	15.8 (4/4) (13.7-17.6)	12.9 (24/24) (10.7-16.1)	0 0
TLD-Quarterly (mR/365 days)	Gamma 10	5	53.8 (4/4) (46.4-63.5)	K-7, Bruemer Farm 2.75 mi SSW	63.9 (1/1) -	51.1 (6/6) (47.2-59.5)	0
TLD-Annual (mR/365 days)	Gamma 10	5	59.2 (4/4) (55.1-63.9)	K-3, Stangel Farm 3.0 mi N	67.8 (1/1) -	58.9 (6/6) (51.3-67.8)	0

Table 4.5 (Continued)
Name of facility Kewaunee Nuclear Power 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]
Precipitation (pCi/l)	H-3 10	100	140 (4/10) (100-180)	K-11, Inlenfeld Farm 1.0 mi NW	140 (4/10) (100-180)	None	0
Milk (pCi/l)	I-131 198	0.5	<LLD	-	-	<LLD	0
	Sr-89 72	2.9	<LLD	-	-	<LLD	0
	Sr-90 72	0.6	1.7 (48/48) (0.7-3.7)	K-12, Lecaptain Farm 1.5 mi WSW	2.4 (12/12) (1.5-3.7)	1.8 (23/24) (0.9-2.9)	0
	GS 72						
	K-40	50	1310 (48/48) (1070-1540)	K-12, Lecaptain Farm 1.5 mi WSW	1340 (12/12) (1070-1480)	1260 (24/24) (940-1730)	0
	Cs-137	10	<LLD	-	-	<LLD	0
	Ba-140	10	<LLD	-	-	<LLD	0
(g/l)	K-stable 72	1.0	1.48 (48/48) (1.22-1.75)	K-12, Lecaptain Farm 1.5 mi WSW	1.52 (12/12) (1.22-1.68)	1.42 (24/24) (1.07-1.97)	0
(g/l)	Ca 72	0.5	1.1 (48/48) (0.6-1.3)	K-6. Novitsky Farm 6.7 mi WSW	1.3 (12/12) (1.0-1.4)	1.2 (24/24) (1.0-1.4)	0
Well Water (pCi/l)	GA 40	2.8	<LLD	-	-	<LLD	0
	GB 40	0.5	2.3 (36/36) (0.6-4.1)	K-1h, North Well Onsite, 0.12 mi NW	2.8 (12/12) (1.9-4.0)	1.9 (4/4) (1.5-2.1)	0
				K-1g, South Well Onsite, 0.06 mi W	2.8 (12/12) (1.4-4.1)		
	H-3 4	100	<LLD	-	-	None	0
	K-40 (flame) 40	0.10	1.7 (36/36) (0.6-4.1)	K-1g, South Well Onsite, 0.06 mi W	2.0 (12/12) (1.8-2.7)	1.2 (4/4) (1.0-1.4)	0
	Sr-89 4	2.1	<LLD	-	-	None	0
	Sr-90 4	0.5	<LLD	-	-	None	0

Table 4.5 (continued)
Name of facility Kewaunee Nuclear Power 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	0.03	0.26 (3/3) (0.16-0.36	K-24, Fectum Farm 5.45 mi N	0.36 (1/1) -	0.32 (1/1) -	0
	GB 4	0.5	2.33 (3/3) (2.26-2.42)	K-27, Schlies Farm 1.5 mi NW	2.42 (1/1) -	2.79 (1/1) -	0
	GS 4						
	Be-7	0.51	<LLD	-	-	<LLD	0
	K-40	0.5	2.20 (3/3) (2.16-2.35)	K-27, Schlies Farm 1.5 mi NW	2.35 (1/1) -	2.03 (1/1) -	0
	Nb-95	0.15	<LLD	-	-	<LLD	0
	Zr-95	0.086	<LLD	-	-	<LLD	0
	Ru-103	0.13	<LLD	-	-	<LLD	0
	Ru-106	0.11	<LLD	-	-	<LLD	0
	Cs-134	0.014	<LLD	-	-	<LLD	0
	Cs-137	0.012	<LLD	-	-	<LLD	0
	Ce-141	0.20	<LLD	-	-	<LLD	0
	Ce-144	0.11	<LLD	-	-	<LLD	0
Eggs (pCi/g wet)	GA 4	0.05	0.10 (4/4) (0.08-0.14)	K-27, Schlies Farm 1.5 mi NW	0.10 (4/4) (0.08-0.14)	None	0
	GB 4	0.01	1.14 (4/4) (1.00-1.38)	K-27, Schlies Farm 1.5 mi NW	1.14 (4/4) (1.00-1.38)	None	0
	Sr-89 4	0.017	<LLD	-	-	None	0
	Sr-90 4	0.002	<LLD	-	-	None	0
	GS 4						
	Be-7	0.33	<LLD	-	-	None	0
	K-40	0.01	1.15 (4/4) (0.82-1.40)	K-27, Schlies Farm 1.5 mi NW	1.15 (4/4) (0.82-1.40)	None	0

Table 4.5 (continued)
Name of facility Kewaunee Nuclear Power 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		
Eggs (pCi/g wet) (cont'd)	Nb-95		0.063	<LLD	-	-	None	0
	Zr-95		0.065	<LLD	-	-	None	0
	Ru-103		0.051	<LLD	-	-	None	0
	Ru-106		0.26	<LLD	-	-	None	0
	Cs-134		0.019	<LLD	-	-	None	0
	Cs-137		0.021	<LLD	-	-	None	0
	Ce-141		0.089	<LLD	-	-	None	0
	Ce-144		0.13	<LLD	-	-	None	0
Vegetables (pCi/g wet)	GA	6	0.02	0.58 (1/1)	K-17, Jansky Farm 4.25 mi W	0.58 (1/1) -	0.23 (5/5) (0.12-0.30)	0
	GB	6	1.0	4.93 (1/1)	K-27, Jansky Farm 4.25 mi W	4.93 (1/1) -	2.02 (5/5) (1.19-2.90)	0
	Sr-89	6	0.028	<LLD	-	-	<LLD	0
	Sr-90	6	0.003	0.015 (1/1)	K-26, Bertler's Fruit Stand, 10.7 mi SSW	0.015 (1/1) -	0.005 (1/5) -	0
	GS	6						
	Be-7	6	0.10	<LLD	-	-	<LLD	0
	K-40		0.75	2.40 (1/1)	K-17, Jansky Farm 4.25 mi W	2.40 (1/1) -	2.36 (5/5) (1.37-4.00)	0
	Nb-95		0.022	<LLD	-	-	<LLD	0
	Zr-95		0.025	<LLD	-	-	<LLD	0
	Ru-103		0.015	<LLD	-	-	<LLD	0
	Ru-106		0.08	<LLD	-	-	<LLD	0
	Cs-137		0.008	<LLD	-	-	<LLD	0
	Ce-141		0.026	<LLD	-	-	<LLD	0
	Ce-144		0.05	<LLD	-	-	<LLD	0

Table 4.5 (continued)
Name of facility Kewaunee Nuclear Power 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		
Grain - Oats (pCi/g wet)	GA	1	0.1	0.3 (1/1) -	K-23, Kewaunee Site 0.5 mi W	0.3 (1/1) -	None	0
	GB	1	0.1	4.4 (1/1) -	K-23, Kewaunee Site 0.5 mi W	4.4 (1/1) -	None	0
	Sr-89	1	0.009	<LLD	-	-	None	0
	Sr-90	1	0.01	0.040 (1/1) -	K-23, Kewaunee Site 0.5 mi W	0.040 (1/1) -	None	0
	GS	1	0.026		-	-	None	0
	Be-7		0.29	<LLD	-	-	None	0
	K-40		0.1	4.15 (1/1) -	K-23, Kewaunee Site 0.5 mi W	4.15 (1/1) -	None	0
	Nb-95		0.049	<LLD	-	-	None	0
	Zr-95		0.056	<LLD	-	-	None	0
	Ru-103		0.045	<LLD	-	-	None	0
	Ru-106		0.20	<LLD	-	-	None	0
	Cs-137		0.020	<LLD	-	-	None	0
	Ce-141		0.096	<LLD	-	-	None	0
	Ce-144		0.18	<LLD	-	-	None	0
Cattlefeed (pCi/g wet)	GA	6	0.1	0.68 (4/4) (0.18-1.11)	K-4, Stangel Farm 3.0 mi N	1.11 (1/1) -	0.44 (2/2) (0.43-0.44)	0
	GB	6	0.2	8.80 (4/4) (2.97-15.96)	K-19, Paral Farm 1.75 mi NNE	15.96 1/1) -	7.58 (2/2) (7.57-7.58)	0
	Sr-89	6	0.19	<LLD	-	-	<LLD	0
	Sr-90	6	0.01	0.066 (3/4) (0.020-0.111)	K-19, Paral Farm 1.75 mi NNE	0.111 (1/1) -	0.046 (1/2) -	0
	GS	6						
	Be-7		0.15	0.43 (1/2) (0.22-0.64)	K-19, Paral Farm 1.75 mi NNE	0.64 (1/1)	<LLD	0
	K-40		1.0	6.19 (4/4) (1.55-10.50)	K-19, Paral Farm 1.75 mi NNE	10.5 (1/1) -	5.10 (2/2) (4.49-5.71)	0

Table 4.5 (continued)
Name of facility Kewaunee Nuclear Power 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)	Nb-95	0.022	<LLD	-	-	<LLD	0
	Zr-95	0.034	<LLD	-	-	<LLD	0
	Ru-103	0.018	<LLD	-	-	<LLD	0
	Ru-106	0.15	<LLD	-	-	<LLD	0
	Cs-134	0.017	<LLD	-	-	<LLD	0
	Cs-137	0.020	<LLD	-	-	<LLD	0
	Ce-141	0.026	<LLD	-	-	<LLD	0
	Ce-144	0.091	<LLD	-	-	<LLD	0
Grass (pCi/g wet)	GA 24	0.2	0.7 (18/18) (0.3-1.2)	K-5, Paplham Farm 3.5 mi NNW	0.9 (3/3) (0.4-1.2)	0.6 (6/6) (0.2-1.1)	0
				K-19, Paral Farm 1.75 mi NNE	0.9 (3/3) (0.3-1.2)		
	GB 24	1.0	6.8 (18/18) (5.0-8.5)	K-5, Paplham Farm 3.5 mi NNW	7.5 (3/3) (6.8-8.0)	6.0 (6/6) (4.6-7.5)	0
				K-12, LeCaptain Farm 1.5 mi WSW	7.5 (3/3) (6.3-8.3)		
	Sr-89 24	0.090	<LLD	-	-	<LLD	0
	Sr-90 24	0.006	0.032 (12/18) (0.009-0.090)	K-19, Paral Farm 1.75 mi NNE	0.067 (2/3) (0.044-0.090)	0.025 (5/6) (0.007-0.051)	0
	GS 24						
	Be-7	0.31	4.41 (9/18) (1.43-9.75)	K-1b, Middle Creek On site, 0.12 mi N	9.75 (1/3) -	3.10 (3/6) (0.60-6.31)	0
	K-40	0.1	5.44 (18/18) (3.61-8.50)	K-5, Paplham Farm 3.5 mi NNW	6.72 (3/3) (4.69-8.50)	5.74 (6/6) (3.94-8.54)	0
	Nb-95	0.1	<LLD	-	-	<LLD	0
	Zr-95	0.1	<LLD	-	-	<LLD	0
	Ru-103	0.1	<LLD	-	-	<LLD	0
	Ru-106	0.16	<LLD	-	-	<LLD	0

Table 4.5 (continued)
Name of facility Kewaunee Nuclear Power 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]
Grass (pCi/g dry) (cont'd)	Cs-137	0.02	<LLD	-	-	<LLD	0
	Ce-141	0.13	<LLD	-	-	<LLD	0
	Ce-144	0.15	<LLD	-	-	<LLD	0
Soil (pCi/g dry)	GA 14	4.0	9.4 (10/10) (4.8-8.6)	K-1f, Metreorological Tower, 1.12 mi S	12.4 (2/2) (10.7-14.1)	9.5 (4/4) (6.6-11.6)	0
	GB 14	1.4	24.6 (10/10) (16.4-35.5)	K-5, Paplham Farm 3.5 mi WSW	31.4 (2/2) (27.2-35.5)	26.8 (4/4) (25.5-27.9)	0
	Sr-89 14	0.29	<LLD	-	-	<LLD	0
	Sr-90 14	0.05	0.15 (5/10) (0.09-0.20)	K-12, Lecaptain Farm 1.5 mi WSW	0.20 (1/2) -	0.18 (1/4) -	0
	GS 14						
	Be-7	0.33	<LLD	-	-	<LLD	0
	K-40	1.4	14.4 (10/10) (10.0-19.3)	K-5, Paplham Farm 3.5 mi NNW	17.8 (2/2) (16.2-19.3)	15.5 (4/4) (13.6-16.7)	0
	Nb-95	0.06	<LLD	-	-	<LLD	0
	Zr-95	0.07	<LLD	-	-	<LLD	0
	Ru-103	0.05	<LLD	-	-	<LLD	0
	Ru-106	0.22	<LLD	-	-	<LLD	0
	Cs-137	0.05	0.30 (10/10) (0.04-0.95)	K-6, Novitsky Farm 6.7 mi WSW	1.02 (2/2) (1.00-1.05)	0.62 (4/4) (0.14-1.05)	0
	Ce-141	0.11	<LLD	-	-	<LLD	0
	Ce-144	0.21	<LLD	-	-	<LLD	0

Table 4.5 (continued)
Name of facility Kewaunee Nuclear Power 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		
Surface Water (pCi/l)	GA(SS) 72	1.0	<LLD	-	-	<LLD	0
	GA(DS) 72	2.1	3.0 (5/60) (2.4-3.7)	K-1a, North Creek, Onsite, 0.62 mi N	3.0 (2/12) (2.4-3.7)	<LLD	0
				K-1e, South Creek, Onsite, 0.12 mi S	3.0 (3/12) (2.6-3.6)		
	GA(TR) 72	2.7	3.3 (2/60) (3.0-3.6)	K-1e, South Creek, Onsite, 0.12 mi S	3.3 (2/12) (3.0-3.6)	<LLD	0
	GB(SS) 72	0.5	0.6 (13/60) (0.5-1.2)	K-1d, Condenser Discharge, Onsite 0.10 mi E	0.8 (3/12) (0.6-1.2)	<LLD	0
	GB(DS) 72	0.5	5.0 (60/60) (1.6-15.4)	K-1a, North Creek, Onsite, 0.62 mi N	9.2 (12/12) (6.6-13.1)	2.7 (12/12) (2.0-3.2)	0
	GB(TR) 72	1.0	5.2 (60/60) (1.6-15.8)	K-1a, North Creek, Onsite, 0.62 mi N	9.4 (12/12) (6.6-13.1)	2.8 (12/12) (2.0-3.2)	0
	H-3 36	220	2310 (15/24) (270-13910)	K-14, Two Creeks Park, 2.5 mi S	2690 (5/12) (270-13910)	<LLD	0
	Sr-89 12	1.9	<LLD	-	-	<LLD	0
	Sr-90 12	0.9	3.2 (1/8) (1.3-1.5)	K-1d, Condenser Discharge, Onsite 0.10 mi E	3.2 (1/4) -	<LLD	0
	K-40 (flame) 72	0.5	3.7 (60/60) (0.6-19.2)	K-1a, North Creek Onsite, 0.62 mi N	7.0 (12/12) (2.4-9.6)	1.1 (12/12) (1.0-1.4)	0
Fish-Muscle (pCi/g wet)	GA 4	0.05	0.17 (4/4) (0.10-0.24)	K-1d, Condenser Discharge, Onsite 0.10 mi E	0.17 (4/4) (0.10-0.24)	None	0
	GB 4	1.0	2.34 (4/4) (1.02-3.60)	K-1d, Condenser Discharge, Onsite 0.10 mi E	2.34 (4/4) (1.02-3.60)	None	0
	GS 4						
	Be-7	0.59	<LLD	-	-	None	0
	K-40	1.05	2.61 (4/4) (2.28-3.16)	K-1d, Condenser Discharge, Onsite 0.10 mi E	2.61 (4/4) (2.28-3.16)	None	0
	Nb-95	0.14	<LLD	-	-	None	0
	Zr-95	0.12	<LLD	-	-	None	0

Table 4.5 (continued)
Name of facility Kewaunee Nuclear Power 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]
Fish-Muscle (pCi/g wet) (Cont'd)	Ru-103	0.11	<LLD	-	-	None	0
	Ru-106	0.24	<LLD	-	-	None	0
	Cs-137	0.02	0.10 (2/4) (0.09-0.12)	K-1d, Condenser Discharge, Onsite 0.10 mi E	0.10 (2/4) (0.09-0.12)	None	0
	Ce-141	0.19	<LLD	-	-	None	0
	Ce-144	0.14	<LLD	-	-	None	0
Fish-Bones (pCi/g wet)	GA 5	0.95	<LLD	-	-	None	0
	GB 5	1.00	2.04 (4/4) (1.18-3.13)	K-1d, Condenser Discharge, Onsite 0.10 mi E	2.04 (4/4) (1.41-1.94)	None	0
	Sr-89 5	0.12	<LLD	-	-	None	0
	Sr-90 5	0.10	<LLD	-	-	None	0
Periphyton (slime) (pCi/g wet)	GA 12	0.2	1.1 (10/10) (0.2-4.8)	K-1b, Middle Creek Onsite, 0.12 mi N	3.1 (2/2) (1.4-4.8)	0.2 (2/2) (0.2-0.3)	0
	GB 12	0.50	2.1 (10/10) (0.3-4.7)	K-1b, Middle Creek Onsite, 0.12 mi N	3.6 (2/2) (2.4-4.7)	0.8 (2/2) (0.7-0.8)	0
	Sr-89 12	0.41	<LLD	-	-	<LLD	0
	Sr-90 12	0.10	<LLD	-	-	<LLD	0
	GS 12						
	Be-7	1.42	<LLD	-	-	<LLD	0
	K-40	0.50	2.29 (9/10) (0.95-5.28)	K-1e, South Creek, Onsite, 0.12 mi S	4.31 (2/2) (3.33-5.28)	1.99 (2/2) (1.63-2.35)	0

Table 4.5 (Continued)
Name of facility Kewaunee Nuclear Power 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)	Mn-54	0.062	<LLD	-	-	<LLD	0
	Co-58	0.15	<LLD	-	-	<LLD	0
	Co-60	0.068	<LLD	-	-	<LLD	0
	Nb-95	0.45	<LLD	-	-	<LLD	0
	Zr-95	0.28	<LLD	-	-	<LLD	0
	Ru-103	0.32	<LLD	-	-	<LLD	0
	Ru-106	0.48	<LLD	-	-	<LLD	0
	Cs-134	0.054	<LLD	-	-	<LLD	0
	Cs-137	0.049	<LLD	-	-	<LLD	0
	Ce-141	0.82	<LLD	-	-	<LLD	0
	Ce-144	0.26	<LLD	-	-	<LLD	0
Bottom Sediments (pCi/g dry)	GA 20	4.2	6.3 (4/16) (5.0-8.1)	K-1j, Condenser Discharge, Onsite 500' S	8.1 (1/4) -	5.2 (1/4) -	0
	GB 20	1.4	8.4 (16/16) (5.1-11.7)	K-14, Two Creeks Park, 2.5 mi S	10.0 (4/4) (7.8-11.7)	7.4 (4/4) (5.6-8.8)	0
	Sr-89 20	0.20	<LLD	-	-	<LLD	0
	Sr-90 20	0.10	<LLD	-	-	<LLD	0
	GS 20						
	K-40	1.0	4.73 (16/16) (2.96-7.02)	K-14, Two Creeks Park, 2.5 mi S	5.45 (4/4) (4.14-7.01)	4.16 (4/4) (3.40-5.19)	0
	Co-58	0.02	0.23 (11/16) (0.04-0.50)	K-1c, Condenser Discharge, Onsite 0.10 mi N	0.39 (2/4) (0.28-0.50)	<LLD	0

Table 4.5 (continued)
Name of facility Kewaunee Nuclear Power 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		
Bottom Sediments (pCi/g dry) (Con't)	Co-60	0.016	0.085 (7/16) (0.066-0.109)	K-1c, Condenser Discharge, Onsite 0.10 mi N	0.109 (1/4) -	<LLD	0
	Cs-134	0.012	<LLD	-	-	<LLD	0
	Cs-137	0.010	0.077 (14/16) (0.027-0.106)	K-1j, Condenser Discharge, Onsite 0.10 mi S	0.098 (3/4) (0.057-0.106)	0.023 (2/4) (0.016-0.030)	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 4.1), 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.

5.0 REFERENCES

Arnold, J. R. and H. A. Al-Salih. 1955. Beryllium-7 produced by cosmic rays. Science 121: 451-453.

Eisenbud, M. 1963. Environmental Radioactivity, McGraw-Hill, New York, New York, pp. 213, 275, and 276.

Gold, S., H. W. Barkhau, B. Shlein, and B. Kahn, 1964. Measurement of Naturally Occurring Radionuclides in Air, in the Natural Radiation Environment, University of Chicago Press, Chicago, Illinois, 369-382.

Hazleton Environmental Sciences, 1979. Annual Report. Radiological Monitoring Program for the Kewaunee Nuclear Power Plant, Kewaunee, Wisconsin, Final Report - Part II, Data Tabulations and Analysis, January - December 1978.

__________. 1980. Annual Report. Radiological Monitoring Program for the Kewaunee Nuclear Power Plant, Kewaunee, Wisconsin, Final Report - Part II, Data Tabulations and Analysis, January - December 1979.

__________. 1981. Annual Report. Radiological Monitoring Program for the Kewaunee Nuclear Power Plant, Kewaunee, Wisconsin, Final Report - Part II, Data Tabulations and Analysis, January - December 1980.

__________. 1982. Annual Report. Radiological Monitoring Program for the Kewaunee Nuclear Power Plant, Kewaunee, Wisconsin, Final Report - Part II, Data Tabulations and Analysis, January - December 1981.

__________. 1983. Annual Report. Radiological Monitoring Program for the Kewaunee Nuclear Power Plant, Kewaunee, Wisconsin, Final Report - Part II, Data Tabulations and Analysis, January - December 1982.

Industrial BIO-TEST Laboratories, Inc. 1974. Annual Report. Pre-operational Radiological Monitoring Program for the Kewaunee Nuclear Power Plant, Kewaunee, Wisconsin. January - December 1973.

__________. 1975. Semi-annual Report. Radiological Monitoring Program for the Kewaunee Nuclear Power Plant, Kewaunee, Wisconsin. January - June 1975.

NALCO Environmental Sciences. 1977. Annual Report. Radiological Monitoring Program for the Kewaunee Nuclear Power Plant, Kewaunee, Wisconsin, January - December 1976.

___________. 1978. Annual Report. Radiological Monitoring Program for the Kewaunee Nuclear Power Plant, Kewaunee, Wisconsin, Final Report - Part II, Data Tabulations and Analysis, January - December 1977.

National Center for Radiological Health. 1968. Section 1. Milk surveillance. Radiological Health Data Rep., December 9:730-746.

National Council on Radiation Protection and Measurements. 1975. Natural Radiation Background in the United States. NCRP Report No. 45.

Solon, L. R., W. M. Lowder, A. Shambron, and H. Blatz. 1960. Investigations of Natural Environmental Radiation. Science. 131: 903-906.

Teledyne Isotopes Midwest Laboratory. 1984. Annual Report. Radiological Monitoring Program for the Kewaunee Nuclear Power Plant, Kewaunee, Wisconsin, Final Report, Part II, Data Tabulations and Analysis, January - December 1983.

___________. 1985. Annual Report. Radiological Monitoring Program for the Kewaunee Nuclear Power Plant, Kewaunee, Wisconsin, Final Report, Part II, Data Tabulations and Analysis, January - December 1984.

Wilson, D. W., G. M. Ward, and J. E. Johnson, 1969. In Environmental Contamination by Radioactive Materials, International Atomic Energy Agency, p. 125.

Appendix A

Crosscheck Program Results

Appendix A

Crosscheck Program Results

Teledyne Isotopes Midwest Laboratory (formerly Hazleton Environmental Sciences) 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 1980 through 1984. 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, 1977, 1979, 1980, and 1981 through participation in the Second, Third, Fourth, and Fifth 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 Teledyne Isotopes Midwest Laboratory results for milk and water samples, 1980 through 1983[a].

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result ±3σ, n=1[d]
STW-206	Water	Jan. 1980	Gross Alpha	19.0±2.0	30.0±8.0
			Gross Beta	48.0±2.0	45.0±5.0
STW-208	Water	Jan. 1980	Sr-89	6.1±1.2	10.0±0.5
			Sr-90	23.9±1.1	25.5±1.5
STW-209	Water	Feb. 1980	Cr-51	112±14	101±5.0
			Co-60	12.7±2.3	11±5.0
			Zn-65	29.7±2.3	25±5.0
			Ru-106	71.7±1.5	51±5
			Cs-134	12.0±2.0	10±5.0
			Cs-137	30.0±2.7	30±5.0
STW-210	Water	Feb. 1980	H-3	1800±120	1750±340
STW-211	Water	March 1980	Ra-226	15.7±0.2	16.0±2.4
			Ra-228	3.5±0.3	2.6±0.4
STM-217	Milk	May 1980	Sr-89	4.4±2.6[g]	5±5
			Sr-90	10.0±1.0	12±1.5
STW-221	Water	June 1980	Ra-226	2.0±0.0	1.7±0.8
			Ra-228	1.6±0.1	1.7±0.8
STW-223	Water	July 1980	Gross Alpha	31±3.0	38±5.0
			Gross Beta	44±4	35±5.0
STW-224	Water	July 1980	Cs-137	33.9±0.4	35±5.0
			Ba-140	<12	0
			K-40	1350±60	1550±78
			I-131	<5.0	0
STW-225	Water	Aug. 1980	H-3	1280±50	1210±329
STW-226	Water	Sept. 1980	Sr-89	22±1.2	24±8.6
			Sr-90	12±0.6	15±2.6
STW-228	Water	Sept. 1980	Gross Alpha	NA[e]	32.0±8.0
			Gross Beta	22.5±0.0	21.0±5.0
STW-235	Water	Dec. 1980	H-3	2420±30	2240±604

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result ±3σ, n=1[d]
STW-237	Water	Jan. 1981	Sr-89	13.0±1.0	16±8.7
			Sr-90	24.0±0.6	34±2.9
STM-239	Milk	Jan. 1981	Sr-89	<210	0
			Sr-90	15.7±2.6	20±3.0
			I-131	30.9±4.8	26±10.0
			Cs-137	46.9±2.9	43±9.0
			Ba-140	<21	0
			K-40	1330±53	1550±134
STW-240	Water	Jan. 1981	Gross alpha	7.3±2.0	9±5.0
			Gross beta	41.0±3.1	44±5.0
STW-243	Water	Mar. 1981	Ra-226	3.5±0.06	3.4±0.5
			Ra-228	6.5±2.3	7.3±1.1
STW-245	Water	Apr. 1981	H-3	3210±115	2710±355
STW-249	Water	May 1981	Sr-89	51±3.6	36±8.7
			Sr-90	22.7±0.6	22±2.6
STW-251	Water	May 1981	Gross alpha	24.0±5.3	21±5.2
			Gross beta	16.1±1.9	14±5.0
STW-252	Water	Jun. 1981	H-3	2140±95	1950±596
STW-255	Water	Jul. 1981	Gross alpha	20±1.5	22±9.5
			Gross beta	13.0±2.0	15±8.7
STW-259	Water	Sep. 1981	Sr-89	16.1±1.0	23±5
			Sr-90	10.3±0.9	11±1.5
STW-265	Water	Oct. 1981	Gross alpha	71.2±19.1	80±20
			Gross beta	123.3±16.6	111±5.6
			Sr-89	14.9±2.0	21±5
			Sr-90	13.1±1.7	14.4±1.5
			Ra-226	13.0±2.0	12.7±1.9
STW-269	Water	Dec. 1981	H-3	2516±181	2700±355

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result ±3σ, n=1[d]
STW-270	Water	Jan. 1982	Sr-89	24.3±2.0	21.0±5.0
			Sr-90	9.4±0.5	12.0±1.5
STW-273	Water	Jan. 1982	I-131	8.6±0.6	8.4±1.5
STW-275	Water	Feb. 1982	H-3	1580±147	1820±342
STW-276	Water	Feb. 1982	Cr-51	<61	0
			Co-60	26.0±3.7	20±5
			Zn-65	<13	15±5
			Ru-106	<46	20±5
			Cs-134	26.8±0.7	22±5
			Cs-137	29.7±1.4	23±5
STW-277	Water	Mar. 1982	Ra-226	11.9±1.9	11.6±1.7
STW-278	Water	Mar. 1982	Gross alpha	15.6±1.9	19±5
			Gross beta	19.2±0.4	19±5
STW-280	Water	Apr. 1982	H-3	2690±80	2860±360
STW-281	Water	Apr. 1982	Gross alpha	75±7.9	85±21
			Gross beta	114.1±5.9	106±5.3
			Sr-89	17.4±1.8	24±5
			Sr-90	10.5±0.6	12±1.5
			Ra-226	11.4±2.0	10.9±1.5
			Co-60	<4.6	0
STW-284	Water	May 1982	Gross alpha	31.5±6.5	27.5±7
			Gross beta	25.9±3.4	29±5
STW-285	Water	June 1982	H-3	1970±1408	1830±340
STW-286	Water	June 1982	Ra-226	12.6±1.5	13.4±3.5
			Ra-228	11.1±2.5	8.7±2.3
STW-287	Water	June 1982	I-131	6.5±0.3	4.4±0.7
STW-290	Water	Aug. 1982	H-3	3210±140	2890±619
STW-291	Water	Aug. 1982	I-131	94.6±2.5	87±15

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result ±3σ, n=1[d]
STW-292	Water	Sept 1982	Sr-89	22.7±3.8	24.5±8.7
			Sr-90	10.9±0.3	14.5±2.6
STW-296	Water	Oct. 1982	Co-60	20.0±1.0	20±8.7
			Zn-65	32.3±5.1	24±8.7
			Cs-134	15.3±1.5	19.0±8.7
			Cs-137	21.0±1.7	20.0±8.7
STW-297	Water	Oct. 1982	H-3	2470±20	2560±612
STW-298	Water	Oct. 1982	Gross alpha	32±30	55±24
			Gross beta	81.7±6.1	81±8.7
			Sr-89	<2	0
			Sr-90	14.1±0.9	17.2±2.6
			Cs-134	<2	1.8±8.7
			Cs-137	22.7±0.6	20±8.7
			Ra-226	13.6±0.3	12.5±3.2
			Ra-228	3.9±1.0	3.6±0.9
STW-301	Water	Nov. 1982	Gross alpha	12.0±1.0	19.0±8.7
			Gross beta	34.0±2.7	24.0±8.7
STW-302	Water	Dec. 1982	I-131	40.0±0.0	37.0±10
STW-303	Water	Dec. 1982	H-3	1940±20	1990±345
STW-304	Water	Dec. 1982	Ra-226	11.7±0.6	11.0±1.7
			Ra-228	<3	0
STW-306	Water	Jan. 1983	Sr-89	20.0±8.7	29.2±5
			Sr-90	21.7±8.4	17.2±1.5
STW-307	Water	Jan. 1983	Gross alpha	29.0±4.0[g]	29.0±13
			Gross beta	29.3±0.6	31.0±8.7
STM-309	Milk	Feb. 1983	Sr-89	35±2.0	37±8.7
			Sr-90	13.7±0.6	18±2.6
			I-131	55.7±3.2	55±10.4
			Cs-137	29±1.0	26±8.7
			Ba-140	<27	0
			K-40	1637±5.8	1512±131

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b]	
				TIML Result ±2σ[c]	EPA Result ±3σ, n=1[d]
STW-310	Water	Feb. 1983	H-3	2470±80	2560±612
STW-311	Water	March 1983	Ra-226	11.9±1.3	12.7±3.3
			Ra-228	<2.7	0
STW-312	Water	March 1983	Gross alpha	31.6±4.5[g]	31±13.4
			Gross beta	27.0±2.0	28±8.7
STW-313	Water	April 1983	H-3	3240±80	3330±627
STW-316	Water	May 1983	Gross alpha	94±7	64±19.9
			Gross beta	133±5	149±12.4
			Sr-89	19±1	24±8.7
			Sr-90	12±1	13±2.6
			Ra-226	7.9±0.4	8.5±2.25
			Co-60	30±2	30±8.7
			Cs-134	27±2	33±8.7
			Cs-137	29±1	27±8.7
STW-317	Water	May 1983	Sr-89	59.7±2.1	57±8.7
			Sr-90	33.7±1.5	38±3.3
STW-318[f]	Water	May 1983	Gross alpha	12.8±1.5	11±8.7
			Gross beta	49.4±3.9	57±8.7
STM-320	Milk	June 1983	Sr-89	20±0	25±8.7
			Sr-90	10±1	16±2.6
			I-131	30±1	30±10.4
			Cs-137	52±2	47±8.7
			K	1553±57	1486±129
STW-321	Water	June 1983	H-3	1470±89	1529±583
STW-322	Water	June 1983	Ra-226	4.3±0.2	4.8±1.24
			Ra-228	<2.5	0
STW-323	Water	July 1983	Gross alpha	3±1	7±8.7
			Gross beta	21±0	22±8.7
STW-324	Water	August 1983	I-131	13.3±0.6	14±10.4

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result ±3σ, n=1[d]
STAF-326	Air Filter	August 1983	Gross beta	42±2	36±8.7
			Sr-90	14±2	10±2.6
			Cs-137	19±1	15±8.7
STW-328	Water	Sept. 1983	Gross alpha	2.3±0.6	5±8.7
			Gross beta	10.7±1.2	9±8.7
STW-329	Water	Sept. 1983	Ra-226	3.0±0.2	3.1±0.81
			Ra-228	3.2±0.7	2.0±0.52
STW-331	Water	Oct. 1983	H-3	1300±30	1210±570
STW-335	Water	Dec. 1983	I-131	19.6±1.9	20±10.4
STW-336	Water	Dec. 1983	H-3	2870±100	2389±608
STAF-337	Air Filter	Nov. 1983	Gross alpha	18.0±0.2	19±8.7
			Gross beta	58.6±1.2	50±8.7
			Sr-90	10.9±0.1	15±2.6
			Cs-137	30.1±2.5	20±8.7
STW-339	Water	Jan. 1984	Sr-89	47.2±1.9	36±8.7
			Sr-90	22.5±4.0	24±2.6
STW-343	Water	Feb. 1984	H-3	2487±76	2383±607
STM-347	Milk	March 1984	I-131	5.3±1.1	6±1.6
STW-349	Water	March 1984	Ra-226	4.0±0.2	4.1±1.06
			Ra-228	3.6±0.3	2.0±0.52
STW-350	Water	March 1984	Gross alpha	3.8±1.1	5±8.7
			Gross beta	24.2±2.0	20±8.7
STW-354	Water	April 1984	H-3	3560±50	3508±630
STW-355	Water	April 1984	Gross alpha	21.0±4.1	35±15.2
			Gross beta	127.8±4.1	147±12.7
			Sr-89	29.3±2.0	23±8.7
			Sr-90	16.6±0.7	26±2.6
			Ra-226	4.0±1.0	4.0±1.04
			Co-60	32.3±1.4	30±8.7
			Cs-134	33.6±3.1	30±8.7
			Cs-137	33.3±2.2	26±8.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result ±3σ, n=1[d]
STW-358	Water	May 1984	Gross alpha	3.0±0.6	3±8.7
			Gross beta	6.7±1.2	6±8.7
STM-366	Milk	June 1984	Sr-89	21±3.1	25±8.7
			Sr-90	13±2.0	17±2.6
			I-131	46±5.3	43±10.4
			Cs-137	38±4.0	35±8.7
			K-40	1577±172	1496±130
STW-368	Water	July 1984	Gross alpha	5.1±1.1	6±8.7
			Gross beta	11.9±2.4	13±8.7
STW-369	Water	August 1984	I-131	34.3±5.0	34.0±10.4
STW-370	Water	August 1984	H-3	3003±253	3817±617
STF-371	Food	July 1984	Sr-89	22.0±5.3	25.0±8.7
			Sr-90	14.7±3.1	20.0±2.6
			I-131	<172	39.0±10.4
			Cs-137	24.0±5.3	25.0±8.7
			K-40	2503±132	2605±226.0
STAF-372	Air Filter	August 1984	Gross alpha	15.3±1.2	17±8.7
			Gross beta	56.0±0.0	51±8.7
			Sr-90	14.3±1.2	18±2.4
			Cs-137	21.0±2.0	15±8.7
STW-375	Water	Sept. 1984	Ra-226	5.1±0.4	4.9±1.27
			Ra-228	2.2±0.1	2.3±0.60
STW-377	Water	Sept. 1984	Gross alpha	2.7±1.2	5.0±8.7
			Gross beta	11.0±0.0	16.0±8.7
STW-379	Water	Oct. 1984	H-3	2860±312	2810±356
STW-380	Water	Oct. 1984	Cr-51	<36	40±8.7
			Co-60	20.3±1.2	20±8.7
			Zn-65	150±8.1	147±8.7
			Ru-106	<30	47±8.7
			Cs-134	31.3±7.0	31±8.7
			Cs-137	26.7±1.2	24±8.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result ±3σ, n=1[d]
STM-382	Milk	Oct. 1984	Sr-89	15.7±4.2	22±8.7
			Sr-90	12.7±1.2	16±2.6
			I-131	41.7±3.1	42±10.4
			Cs-137	31.3±6.1	32±8.7
			K-40	1447±66	1517±131
STW-384	Water (Blind)	Oct. 1984 Sample A	Gross alpha	9.7±1.2	14±8.7
			Ra-226	3.3±0.2	3.0±0.8
			Ra-228	3.4±1.6	2.1±0.5
			Uranium	NA[e]	5±10.4
		Sample B	Gross beta	48.3±5.0	64±8.7
			Sr-89	10.7±4.6	11±8.7
			Sr-90	7.3±1.2	12±2.6
			Co-60	16.3±1.2	14±8.7
			Cs-134	<2	2±8.7
			Cs-137	16.7±1.2	14±8.7
STW-389	Water	Dec. 1984	H-3	3583±110	3182±624

[a] Results obtained by Teledyne Isotopes Midwest Laboratory 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, and air filter samples which are in pCi/filter.

[c] Unless otherwise indicated, the TIML results are 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=3.

[e] NA = Not analyzed.

[f] Analyzed but not reported to the EPA.

[g] Results after calculations corrected (error in calculations when reported to EPA).

Table A-2. Crosscheck program results, thermoluminescent dosimeters (TLDs).

Lab Code	TLD Type	Measurement	mR: Teledyne Result ±2σ [a]	mR: Known Value	mR: Average ±2σ [a] (all participants)
<u>2nd International Intercomparison</u>[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
<u>3rd International Intercomparison</u>[e]					
115-3[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
<u>4th International Intercomparison</u>[g]					
115-4[g]	CaF_2:Mn Bulb	Gamma-Field	14.1±1.1	14.1±1.4[f]	16.09.0
		Gamma-Lab (Low)	9.3±1.3	12.2±2.4[f]	12.0±7.6
		Gamma-Lab (High)	40.4±1.4	45.8±9.2[f]	43.9±13.2
<u>5th International Intercomparison</u>[h]					
115-5A[h]	CaF_2:Mn Bulb	Gamma-Field	31.4±1.8	30.0±6.0[i]	30.2±14.6
		Gamma-Lab at beginning	77.4±5.8	75.2±7.6[i]	75.8±40.4
		Gamma-Lab at the end	96.6±5.8	88.4±8.8[i]	90.7±31.2

Table A-2. (Continued)

Lab Code	TLD Type	Measurement	mR Teledyne Result $\pm 2\sigma$[a]	Known Value	Average $\pm 2\sigma$[d] (all participants)
115-5B[h]	LiF-100 Chips	Gamma-Field	30.3±4.8	30.0±6[i]	30.2±14.6
		Gamma-Lab at beginning	81.1±7.4	75.2±7.6[i]	75.8±40.4
		Gamma-Lab at the end	85.4±11.7	88.4±8.8[i]	90.7±131.2

[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 (GASL), 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 using continuously operated pressurized ion chamber.
[d] Mean ±2 standard deviations of results obtained by all laboratories participating in the 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 using continuously operated pressurized ion chamber.
[g] Fourth International Intercomparison of Environmental Dosimeters conducted in summer of 1979 by the School of Public Health of the University of Texas, Houston, Texas.
[h] Fifth International Intercomparison of Environmental Dosimeter conducted in fall of 1980 at Idaho Falls, Idaho and sponsored by the School of Public Health of the University of Texas, Houston, Texas and Environmental Measurements Laboratory, New York, New York, U.S. Department of Energy.
[i] Value determined by sponsor of the intercomparison using continuously operated pressurized ion chamber.

Appendix B

Data Reporting Conventions

Data Reporting Conventions

1.0. All activities are decay corrected to collection time.

2.0. Single Measurements

Each single measurement is reported as follows:

$$x \pm s$$

where x = value of the measurement;

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

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

$$<L$$

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

3.0. Duplicate Analyses

3.1. Individual results: $x_1 \pm s_1$
$x_2 \pm s_2$

Reported result: $x \pm s$

where $x = (1/2)\,(x_1 + x_2)$

$$s = (1/2)\sqrt{s_1^2 + s_2^2}$$

3.2. Individual results: $<L_1$

$<L_2$

Reported result: $<L$

where L = lower of L_1 and L_2

3.3. Individual results: $x \pm s$

$<L$

Reported result: $x \pm s$ if $x \geq L$;

$<L$ otherwise

4.0. Computation of Averages and Standard Deviations

4.1 Averages and standard deviations listed in the tables are computed from all of the individual measurements over the period averaged; for example, an annual standard deviation would not be the average of quarterly standard deviations. The average $\overline{x}$ and standard deviations of a set of n numbers $x_1, x_2, \ldots x_n$ are defined as follows:

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

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

4.2 Values below the highest lower limit of detection are not included in the average.

4.3 If all of the values in the averaging group are less than the highest LLD, the highest LLD is reported.

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

4.5. In rounding off, the following rules are followed:

4.5.1. If the figure following those to be retained is less than 5, the figure is dropped, and the retained figures are kept unchanged. As an example, 11.443 is rounded off to 11.44.

4.5.2 If the figure following those to be retained is greater than 5, the figure is dropped, and the last retained figure is raised by 1. As an example, 11.446 is rounded off to 11.45.

4.5.3. If the figure following those to be retained is 5, and if there are no figures other than zeros beyond the five, the figure 5 is dropped, and the last-place figure retained is increased by one if it is an odd number or it is kept unchanged if an even number. As an example, 11.435 is rounded off to 11.44, while 11.425 is rounded off to 11.42.

Appendix C

Maximum Permissible Concentrations of Radioactivity in Air and Water Above Background in Unrestricted Areas

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/m^3	Strontium-89	3,000 pCi/l
Gross beta	100	pCi/m^3	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 from the air-grass-cow-milk-child pathway.

[c] A natural radionuclide.

NRC-85-38 DMB

WISCONSIN PUBLIC SERVICE CORPORATION
P.O. Box 1200, Green Bay, WI 54305

PRIORITY ROUTING

First		Second	
RA		RC	
DRA		EIC	
DRP		SGA	
DRS		ML	
DRSS		DL	
DRMA		OI	
		PAO	

FILE

March 1, 1985

Mr. J. G. Keppler, Regional Administrator
Region III
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL 60137

Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
1984 Annual Operating Report

Enclosed are forty (40) copies of the 1984 Kewaunee Nuclear Power Plant (KNPP) Annual Operating Report. This report is being submitted in accordance with Section 6.9.1.b of the KNPP Technical Specifications.

The 1984 KNPP Annual Operating Report also satisfies the reporting requirements of 10 CFR 20.407(a)(2) and 10 CFR 20.407(b) (personnel monitoring), KNPP Technical Specification 4.2.b.5.b (steam generator inspection), and KNPP Technical Specification 6.9.3.a (environmental monitoring).

Very truly yours,

DIH

D. C. Hintz
Manager - Nuclear Power

GWH/js

Enc.

cc - Mr. Robert Nelson, US NRC
Mr. S. A. Varga, US NRC

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