KEWAUNEE NUCLEAR POWER PLANT

ANNUAL OPERATING REPORT
1985

WISCONSIN PUBLIC SERVICE CORPORATION

WISCONSIN POWER & LIGHT COMPANY

MADISON GAS & ELECTRIC COMPANY

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1.0 INTRODUCTION

The Kewaunee Nuclear Power Plant is a pressurized water reactor licensed at 1650 MWt. It is located in Kewaunee County, Wisconsin along Lake Michigan's northwest 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 41,641,212 MW hours of electricity as of December 31, 1985, with a net plant capacity factor of 76.9 (using net DER).

1.1 Highlights

During the year, the Kewaunee Nuclear Power Plant was primarily base loaded. The unit was operated at 84.0% capacity factor (using net MDC) with a gross efficiency of 33.3%. The unit and reactor availability were 82.4% and 83.0% 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 1985.

On February 8, 1985, the unit was removed from service for its tenth annual refueling/maintenance overhaul. Thirty-six fresh fuel assemblies were loaded for Cycle XI. The unit was returned to service on April 11, 1985.

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

On February 8, the unit was shutdown for refueling/maintenance.

PLANT SHUTDOWNS: February 8, scheduled shutdown - 503.9 hours. Commenced Cycle X-XI refueling outage.

March

In March, the Cycle X-XI refueling outage continued.

PLANT SHUTDOWNS: March 1, scheduled shutdown - 744.0 hours. Continued Cycle X-XI refueling outage.

April

On April 11, the Cycle X-XI refueling outage was concluded.

On April 11, the unit was released for operation.

On April 11, a short outage was taken.

PLANT SHUTDOWNS: April 1, scheduled shutdown - 250.1 hours. Continued Cycle X-XI refueling outage. The outage was concluded on April 11.

April 11, a scheduled shutdown - 1.3 hours. Performed the Turbine Overspeed Trip Test.

May

On May 12, load was reduced to 72% power for the performance of the Monthly Turbine Stop Valve Test. The unit was returned to full load the same day.

On May 20, load was reduced to 50% to permit cleaning of the Condensate pump suction strainers. The unit was returned to full load the next morning.

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

June

On June 16, load was reduced to 72% for performance of the Monthly Turbine Stop Valve Test. The unit was returned to full load the same day.

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

July

On July 14, load was reduced to 72% for the performance of the Monthly Turbine Stop Valve Test. The unit was returned to full load the same day.

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

August

On August 6, load was reduced to an average 187 MWE gross for 32 hours for cleanup of Steam Generator chemistry following contamination of the secondary plant by lake water.

A short outage was required on August 8 for repair of a 2-inch excess steam vent line which ruptured during the Monthly Turbine Stop and Governor Valve Test.

PLANT SHUTDOWNS: August 8, Forced Shutdown - 14.7 hours for repair of a 2-inch excess steam vent line from a MSR which ruptured during the Monthly Turbine Stop and Governor Valve Test.

September

On September 8, load was reduced to 72% power for the Monthly Turbine Stop and Governor 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 6, load was reduced to 72% power for the Monthly Turbine Stop and Governor Valve Test. The unit was returned to full power the same day.

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

November

On November 3, load was reduced to 72% power for the Monthly Turbine Stop and Governor Valve Test. The unit was returned to full power the same day.

On November 13, a structural failure of an air operator for one of the feedwater regulating valves lead to a plant trip. The unit was returned to service on the following day.

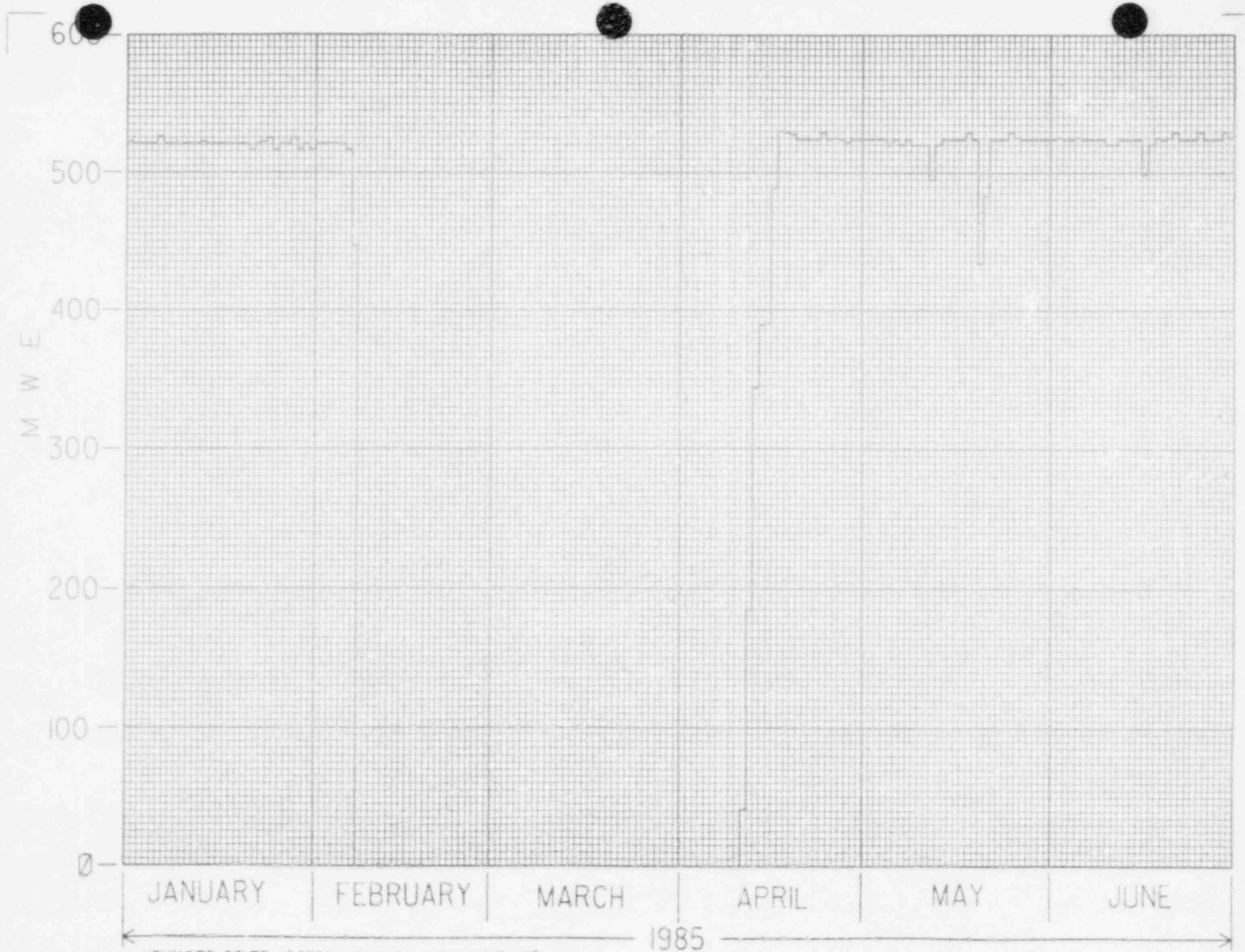
PLANT SHUTDOWNS: On November 13, forced shutdown - 22.8 hours due to a structural failure of an air operator for one of the feedwater regulating valves.

December

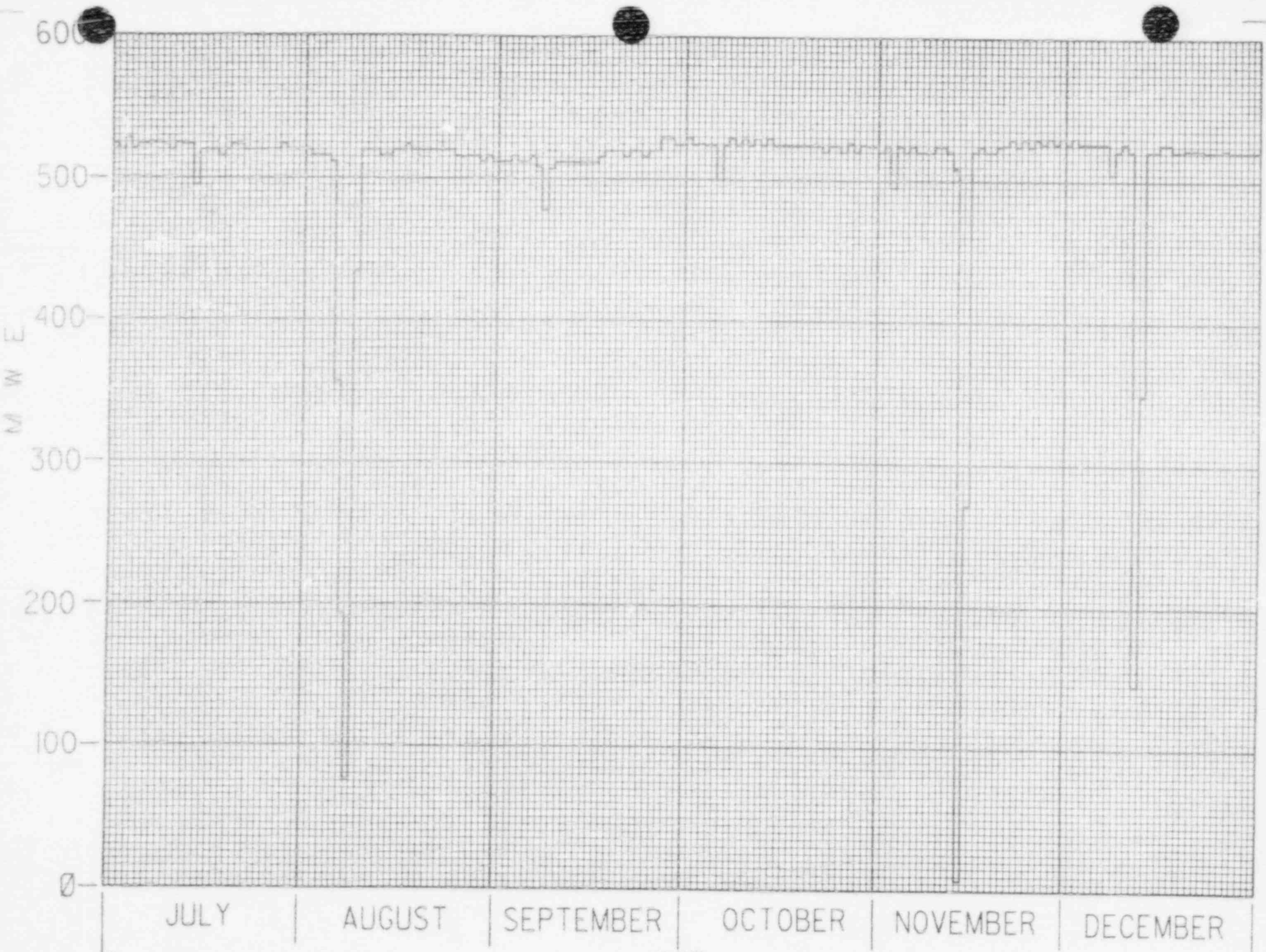
On December 8, load was reduced to 72% power for the Monthly Turbine Stop and Governor Valve Tests. The unit was returned to full power the same day.

On December 12, an instrument bus outage resulted in a reactor trip when the feedwater regulating valve powered from the affected instrument bus went to its failed shut position. The unit was returned to operation the same day.

PLANT SHUTDOWNS: On December 12, forced shutdown - 8.5 hours due to an instrument bus outage.



KEWAUNEE POWER HISTORY AVERAGE DAILY MWE-NET



KEWAUNEE POWER HISTORY AVERAGE DAILY MWE-NET

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ELECTRICAL POWER GENERATION DATA (1985)

MONTHLY

	January	February	March	April	May	June
Hours RX was critical	744.0	168.1	0.0	504.2	744.0	720.0
RX Reserve Shutdown Hours	0.0	0.0	0.0	0.0	0.0	0.0
Hours Generator On-Line	744.0	168.1	0.0	467.6	744.0	720.0
Unit Reserve Shutdown Hours	0.0	0.0	0.0	0.0	0.0	0.0
Gross Thermal Energy Generated (MWH)	1,224,279	271,048	0	682,721	1,212,434	1,179,472
Gross Elec. Energy Generated (MWH)	406,000	89,800	0	231,600	404,900	395,400
Net Elec. Energy Generated (MWH)	387,721	85,656	0	220,130	385,795	377,013
RX Service Factor	100.0	25.0	0.0	70.1	100.0	100.0
RX Availability Factor	100.0	25.0	0.0	70.1	100.0	100.0
Unit Service Factor	100.0	25.0	0.0	65.0	100.0	100.0
Unit Availability Factor	100.0	25.0	0.0	65.0	100.0	100.0
Unit Capacity Factor (using MDC net)	103.6	25.3	0.0	60.9	103.1	104.1
Unit Capacity Factor (using DER net)	97.4	23.8	0.0	57.2	96.9	97.9
Unit Forced Outage Rate	0.0	0.0	0.0	0.0	0.0	0.0
Hours in Month	744	672	744	719	744	720
Net MDC (Mwe)	503	503	503	503	503	503

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ELECTRICAL POWER GENERATION DATA (1985)

MONTHLY

	July	August	September	October	November	December
Hours RX was critical	744.0	735.4	720.0	745.0	701.6	740.2
RX Reserve Shutdown Hours	0.0	0.0	0.0	0.0	0.0	0.0
Hours Generator On-Line	744.0	729.3	720.0	745.0	697.2	735.5
Unit Reserve Shutdown Hours	0.0	0.0	0.0	0.0	0.0	0.0
Gross Thermal Energy Generated (MWH)	1,218,713	1,148,512	1,178,061	1,222,974	1,121,094	1,181,301
Gross Elec. Energy Generated (MWH)	406,800	379,400	389,300	409,400	375,300	393,300
Net Elec. Energy Generated (MWH)	387,658	360,966	370,728	390,317	357,687	375,505
RX Service Factor	100.0	98.8	100.0	100.0	97.4	99.5
RX Availability Factor	100.0	98.8	100.0	100.0	97.4	99.5
Unit Service Factor	100.0	98.0	100.0	100.0	96.8	98.9
Unit Availability Factor	100.0	98.0	100.0	100.0	96.8	98.9
Unit Capacity Factor (using MDC net)	103.6	96.5	102.4	104.2	98.8	100.3
Unit Capacity Factor (using DER net)	97.4	90.7	96.2	97.9	92.9	94.3
Unit Forced Outage Rate	0.0	2.0	0.0	0.0	3.2	1.1
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

1985

	YEAR	CUMULATIVE
Hours RX was critical	7,266.5	86,017.0
RX Reserve Shutdown Hours	0.0	2,330.5
Hours Generator On-Line	7,214.8	84,555.5
Unit Reserve Shutdown Hours	0.0	10.0
Gross Thermal Energy Generated (MWH)	11,649,708	132,716,832
Gross Electrical Energy Gen. (MWH)	3,881,200	43,738,500
Net Elec. Energy Generated (MWH)	3,699,176	41,641,212
RX Service Factor	83.0	85.0
RX Availability Factor	83.0	87.3
Unit Service Factor	82.4	83.6
Unit Availability Factor	82.4	83.5
Unit Capacity Factor (using MDC net)	84.0	79.5
Unit Capcity Factor (using DER net)	78.9	76.9
Unit Forced Outage Rate	0.6	3.3
Hours in Reporting Period	8,760	101,209

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, 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.

Plant Modifications, 10CFR50.59

There were no modifications during 1985 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 1985 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 summary report.

Reactor Control and Protection

Dedicated power sources were provided for the manual reactor trip relays. These relays were on the same circuit as the Main Steam isolation test relays and Main Steam header isolation valve solenoid valves. (DCR 1458).

Summary of Safety Evaluation

Failure of unrelated equipment can no longer effect the manual reactor trip capability; therefore, safety and reliability are enhanced.

480V Supply and Distribution

All continuous duty 440 Volt rated motors that were fed from the safeguards buses were replaced with 460 Volt rated motors, or removed from safeguards power if they were nonsafeguards motors. This modification allows greater flexibility in setting taps on KNPP Auxiliary transformers to meet system extremes in high and low voltage (DCR 1373 Rev. 1)

Summary of Safety Evaluation

This modification will increase motor life and reliability; therefore, plant safety is enchanced.

Safeguards Cooling Modifications

Additional ambient cooling capacity was added in the following areas:

- Auxiliary Building Basement, EL 586'-0" (DCR-1635)
- Auxiliary Building Fan Floor, EL 657'-0" (DCR-1630)
- Turbine Building Basement, EL 586'-0" (DCR-1631)

This capacity was added to ensure that area temperatures do not exceed 104°F during normal operations and long-term operation of safeguards equipment, with or without auxiliary building special ventilation running.

Summary of Safety Evaluation

The additional ambient cooling capacity will prevent area temperatures (both normal and post-accident) from exceeding qualification temperatures of safety related equipment in their respective areas, thereby increasing equipment reliability, and enhancing overall safety.

Reactor Building Vent

Two Control Rod Drive Mechanism (CRDM) cooling coils were installed on top of the reactor vessel missile shield. These cooling units use service water from the discharge of the safeguards Containment Fan Coil Units (CFCU) as their source of cooling water. Containment ambient temperatures have been decreased and the safety function of the service water system is unchanged. (DCR 1114)

Summary of Safety Evaluation

The CRDM cooling coils were installed with one on each train of the service water system, preserving safeguards system separation. The service water flowrate to containment has not changed significantly during normal operation; and following a safety injection signal the CRDM fan coolers are isolated and the service water flow path to the CFCU's is as it was prior to the CRDM fan cooler addition. Because containment ambient temperatures have been reduced, equipment reliability is enhanced. There are no adverse safety consequences.

Environmental Qualification

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

- Replacement of several limit switches for dampers in the Reactor Building Vent and Shield Building Vent Systems (DCR 1545).

- Relocation of Auxiliary Building Special Ventilation, Steam Exclusion, and Shield Building Ventilation power contactors, indicating lights, and associated control components to a mild environment, and repowering the filter assembly humidity alarm modules to prevent environmentally induced degradation of the QA 1 power sources. (DCR 1546)
- Repowered non E-Q pilot solenoid valves in the Service Water System to prevent environmentally induced degradation of control circuits for E-Q Service Water Control Valves. (DCR 1547)
- Separating the power supplies for the control room indicating lights for the Main Steam Isolation Valves in the Main Steam System (DCR 1548).
- Separating the power supplies for the caustic additive valves in the Containment Spray System (DCR 1549).
- Replacement of Pressurizer Power Operated Relief Valve (PORV) solenoid valves. (DCR 1550)
- Replacement of solenoid valves in the Primary Sampling System (DCR 1258).
- Drilling of two (2) weep holes in the Control Room Ventilation Remote Panel to permit condensate drainage (DCR 1417).
- Replacement of damper actuators and associated limit switches in the Shield Building Ventilation System (DCR 1433).
- In the Miscellaneous Drains and Sumps System; replacement of sump level switches and solenoid valves and relocation of the Deaerated Drains Tank pump controls to a low radiation area. (DCR 1369)

Summary of Safety Evaluation

In each case replacement (equipment upgrade), or relocation to a less harsh environment resulted in a higher degree of component reliability during post-accident operation; plant safety was improved.

Reactor Coolant

Piping downstream of the Pressurizer Safety Relief Valves was modified to accommodate stress induced by valve actuation (DCR-1326).

Summary of Safety Evaluation

Stress levels in the affected piping are now within the USAR allowable stresses, and the design meets the requirements of NUREG 0737. As a result, overall plant safety is increased.

Reactor Cavity Boot Seal

A pressure relief valve was installed in the air/N_2 supply to the reactor cavity boot seal. This relief valve was installed to prevent overpressurization of the cavity seal while the seal is being inflated. (DCR 1567)

Also, provided backup nitrogen system to the refueling cavity boot seal and provided a control room alarm for loss of pressure to the cavity boot seal (DCR 1608).

Summary of Evaluation

Plant safety is increased as installation of the pressure relief valve will provide additional assurance that a failure of the reactor cavity boot seal will not occur due to overpressurization. The back-up nitrogen system and low pressure alarm provide additional assurance that a depressurization will not occur.

Main Condenser

The admiralty brass tubes in the main condenser were replaced with Type 439 stainless steel tubes. (DCR 1551)

Summary of Safety Evaluation

This modification will improve condenser reliability. Also, the potential for steam generator copper related problems, to which admiralty brass tubing contributes, was reduced.

Pipe Thinning

Portions of the carbon steel piping in the Heater Drain System and the Bleed Steam System were replaced with stainless steel piping. This change was required due to wall thinning, a result of water impingement erosion. (DCR's 1639, 1640)

Summary of Safety Evaluation

Stainless steel is less susceptible to moisture related erosion than carbon steel. Installation of stainless steel piping, where moist steam is transported, will increase plant reliability by reducing the possibility of an outage due to secondary side unavailability.

Fire Protection

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

- The dedicated shutdown panel has been partially put into service with approximately sixty components operational from the panel.
- The installation of required instrumentation on the dedicated shutdown panel is 75% complete.
- The three hour fire wall installation and penetration sealing is 85% complete throughout the plant.
- Cable pulling required for separation of dedicated and alternate shutdown equipment is approximately 98% complete.
- Fire detection system modifications are complete.
- HVAC system modifications are 98% complete.

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

Summary of Safety Evaluation

These modifications enhance both automatic and manual control of the plant in the unlikely event of a fire. The Appendix R modifications will preclude a fire from affecting the capability to bring the plant to a safe shutdown.

Security

Perimeter detection system zones 7 and 8 were converted from fence mounted to a free standing design. This was done to reduce the large number of false alarms and to eliminate the interference from the security fence (DCR 1685).

Summary of Safety Evaluation

This modification will eliminate interference from the security fence, reduce the excessively high number of false alarms, and permit better access to the security system for maintenance and testing.

Security

Provide security modifications required by the new Office/Warehouse Annex (DCR 1356).

Summary of Safety Evaluation

The design and type of equipment used in the plant security system have not changed. All changes are consistent with 10CFR73. The degree of surveillance or access control is not changed as a result of this modification. Plant safety is not affected.

Makeup Water System Demin and Secondary Sampling System

Installed on-line Dissolved Oxygen Analyzers at the condensate pump discharge. (DCR 1423)

Summary of Safety Evaluation

This modification will enable on-line monitoring of water treatment system performance to verify that oxygen concentration levels are within Kewaunee chemistry guidelines. Plant reliability is enhanced by the ability to detect increasing levels of dissolved O_2 at the condensate pump discharge.

Chemical and Volume Control

The diaphragms were removed from CVC monitor tanks A & B due to problems with pressure equilibration when discharging the tanks. (DCR 1606)

Summary of Safety Evaluation

All condensate in the monitor tanks is discharged to Lake Michigan. The purpose of the diaphragms was to prevent air from being absorbed in the water stored in the monitor tanks. Because the monitor tanks are discharged, and the contents are not sent to the reactor makeup system, there are no safety implications with removing the diaphragms.

Solid Waste Processing (RWS)

Modified and installed the necessary equipment in the Rad Waste System (RWS) solidification system to permit use of High Integrity Containers (HIC) for spent resin shipment (DCR 1414).

Summary of Safety Evaluation

HIC's have been approved for shipment of spent resin under 10CFR61. This design change has no adverse effect on plant safety.

Computer

Added auxiliary feedwater flow, wide range containment pressure and wide range containment sump level indication to the Honeywell Computer for display on the Safety Assessement System (SAS). (DCR 1689)

Summary of Safety Evaluation

The addition of the parameters listed above enhances the Safety Assessment Systems' capability to monitor and display the five important plant functions identified in NUREG 0696, and Supplement 1 to NUREG 0737.

Makeup Water and Secondary Sampling

The scale of the demineralizer and secondary analysis system specific conductivity recorders was changed from a linear to a non-linear scale. Also, the secondary analysis pH recorder scale was changed from 2-12 pH to 6-13 pH. The above changes were made to improve resolution in the range of normal readings. (DCR 1424)

Summary of Safety Evaluation

In each case the modification improved resolution and accuracy of readings, thereby improving trend indications.

Buildings - Structures

Expanded the relay room to house I/O Cabinets for new computer (DCR 1257).

Summary of Safety Evaluation

The expansion was completed following the applicable guidelines in the USAR and 10CFR50 Appendix R requirements. As a result plant safety is unaffected.

Service Water

An ultrasonic flow meter was installed which locally indicates the flow rate in each of the service water headers. (DCR 1372)

Summary of Safety Evaluation

The service water flow indication was provided to more accurately determine the dilution of plant liquid waste discharges during refueling when both circulating water pumps are shutdown. The flow meter has no safety related function.

Miscellaneous

Numerous equipment changes were required as a result of vendors dropping out of the nuclear market or equipment obsolence (DCR's 1289 and 1325).

Summary of Evaluation

These changes involved finding equivalent or better replacement equipment from qualified suppliers and updating the associated documentation. Because the level of quality is equivalent or better, there are no adverse safety consequences.

3.2 Plant Procedures, 10CFR50.59

There were no procedure revisions during 1985 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 M assemblies were loaded for cycle XI. Routine start-up physics testing was performed and reported in the Cycle XI start-up report.

Summary of Safety Evaluation

A 10CFR50.59 reload safety analysis was performed and submitted December 7, 1984.

4.0 LICENSEE EVENT REPORTS

This section is a summary of the 23 Licensee Event Reports (LER) submitted to the NRC in 1985 in accordance with the requirements of 10CFR50.73. None of the events described in 1985s' LER's posed a threat to the health and safety of the public.

LER 85-01

At 1437 on January 22, 1985, during full power operation, there was an inadvertent actuation of the 1B Internal Containment Spray System. The 1B pump ran for 1 minute and 40 seconds discharging an estimated 2500 gallons of borated water into the containment building before being secured. The pump start occurred during the performance of SP55-155, "Engineered Safeguards Logic Test".

When the pump start occurred, the operator verified that it was inadvertent, secured the system and reset containment spray. The operators received various battery ground alarms as a result of instrument malfunctions in containment.

At 1525 it was discovered that the RWST level was below technical specification (TS) limits, refilling was started and preparations were made to begin a plant power reduction. The RWST level was above TS setpoint at 1555 hence no reduction in power was initiated.

Immediate actions were taken to assess the situation and identify the cause. Long term actions were planned to clean the containment interior, and perform an evaluation to identify potential hardware modifications which would prevent reoccurrence.

LER 85-02

On January 25, 1985, with the plant at full power operation, Wisconsin Public Service Corporation was notified by their Architect Engineer that a seismic analysis for the non-safety-related piping section of the Containment Integrated Leak Rate Test Penetration could not be located. This was identified during the evaluation of a proposed modification. To correct this deficiency, a design change was completed during the 1985 refueling/maintenance shutdown with a proper seismic analysis of the as-modified design. WPSC considered this item of sufficient significance to merit reporting to the Commission within the "OTHER" category of 10 CFR 50.73.

LER 85-03

On February 8, 1985, a plant operating mode change was in progress from 15 percent reactor power to hot shutdown. Following the transfer of steam generator level control from main feedwater to auxiliary feedwater and the manual opening of the main generator output breaker, the indicated water level in the 1B Steam Generator went below the lo-lo level setting, (17% narrow range level) initiating a reactor trip. Plant operating procedures were followed to place the plant in the hot shutdown operating mode. This event was initiated by a personnel error. There was no effect on the health and safety of the public. As corrective action the text description of this event was routed to plant reactor operators and the training department.

LER 85-04

At 1230 on February 10, 1985, with the plant in a refueling shutdown, a control room operator noticed the 1B Reactor Coolant Pump running. Subsequent investigations revealed that the pump had inadvertently started due to a grounded condition in the actuation circuitry associated with the 4160V switchgear. The ground was caused by water accumulation in a pressure switch as a result of an inadvertent containment spray (reference LER 50-305/85-01). The ground provided enough current to gate the solid state starting circuitry.

An evaluation of the event showed that due to the location of the safety related switchgear in the plant, and the routing of associated cables, no credible single event would result in actuation of redundant trains of switchgear in a manner which could violate the assumption of the safety analysis. Consequently, the event posed no nuclear safety concerns. This event was reported under OTHER as an item of general interest to the industry.

LER 85-05

On February 11, 1985, with the plant in a refueling shutdown, a control room operator discovered that the 1A Exhaust Fan of the Auxiliary Building Special Ventilation System (ABSV) was running. Investigation revealed that the coil on the solenoid valve controlling air to the Zone SV Exhaust Filter 1A Inlet Damper had burnt out, failing the three-way solenoid valve to the vent position. This opened the inlet damper which in turn opened the exhaust damper and started the fan on Train A of the ABSV system. The system failed in the safe position. There was no impact on the health and safety of the public.

LER 85-06

On February 20, 1985, while shutdown for refueling and during the Steam Generator tube eddy current examination, a tube in the 1A steam generator requiring plugging in 1984 was found plugged in the hot leg only. An adjacent tube, not requiring plugging, was found plugged in the cold leg only. The tube that required plugging had a 55% thru-wall indication in 1984 and a 91% thru-wall indication in 1985. The exact cause of this event remains unknown; however, it is suspected that the cold leg tube sheet was mismarked during the 1984 steam generator tube plugging effort. To prevent recurrence of this event the tubesheet templates, rather than the tubesheets, are marked to identify the tubes to be plugged. These templates are independently verified prior to tube plugging. The installed plugs are verified against the tube plugging list and a video tape is made of the tube sheets for final verification. Twenty-six tubes in the 1A S/G and 22 tubes in the 1B S/G were removed from service as a result of tube plugging in 1985.

LER 85-07

At 1601 on February 25, 1985, while in a refueling shutdown condition, a surveillance procedure on pressurizer pressure transmitters was being conducted. During this procedure the I&C technician performing the calibration asked that the red pressurizer pressure channel be tripped. Following this, he calibrated the white channel. With one channel tripped and another with an artificial input > 2000 psig, the SI signal was reset. This, coincident with steam generator pressure < 500 psig caused a safety injection signal. Plant operating procedures were followed to restore the plant to normal refueling shutdown conditions. No equipment or system failures contributed to this event. This event resulted from the I&C technician in the field requesting the wrong channel be tripped. The surveillance procedure is being revised to prevent reoccurrence. This procedure is only conducted during refueling shutdown. The plant equipment lineup at shutdown prevented this event from having any adverse safety implications.

LER 85-08

At 1647 on February 25, 1985, with the plant in a refueling shutdown condition, alarm 47001-34, "Condenser Low Vacuum Turbine Trip", momentarily cleared and then alarmed again. Following this, both diesel generators started. After investigating the cause, the diesel generators were secured.

Investigation revealed that these two events were caused by maintenance to the turbine trip mechanism located on the turbine pedestal. During this maintenance the turbine manual trip/reset lever was momentarily placed in the latch position allowing turbine auto stop oil pressure to increase to the point where the turbine trip pressure switches were reset. This cleared the Condenser Low Vacuum Turbine Trip alarm. The lever was then placed in the trip position allowing the auto stop oil pressure to decrease. As the pressure fell below 45 psig, the Condenser Low Vacuum Turbine Trip signal and Diesel Generator Start signals were initiated.

To prevent reoccurence, the diesel generator start signal from a turbine trip will be removed from service as part of the shutdown evolution during extended outages and returned to service prior to unit start-up.

This event had minimal impact on plant activities and no effect on the public health and safety.

LER 85-09

On March 12, 1985, with the plant in refueling outage, information was acquired indicating that a contracted employee, performing maintenance at the plant, had received a whole body occupational dose in excess of the 10 CFR 21.101 standard of 1.25 Rems per calendar quarter prior to the licensee determining the individual's accumulated occupational dose as required by this regulation. The worker received an accumulated whole body dose of 1.46 Rems in the month of February, 1985, as indicated by the worker's two thermoluminescent dosimeters (TLD). However, the worker's self-reading dosimeter (SRD) indicated an exposure of only 0.85 Rems. The accumulated occupational dose is normally determined when the SRD exposures reach about 1.1 Rems. Investigations have failed to explain the differences in dosimeter readings, and Wisconsin Public Service Corporation (WPSC) has concluded that this is an isolated incident. The worker's accumulated occupational dose was immediately determined and is well within NRC requirements. In addition, authorization procedures were initiated allowing the worker to exceed the 1.25 Rem limit. During investigation of this event, it was determined that procedural violations occurred in two instances because the worker's TLD was not processed at the SRD action dose of 150 mRem per day. Appropriate personnel have been reinstructed on this procedural requirement. This report was submitted pursuant to the requirements of 10 CFR 20.405 (a)(1)(i).

LER 85-10

On April 5, 1985, the plant was in the Hot Shutdown Operating Mode with the Reactor subcritical, following a refueling outage. Shutdown Banks A & B and Control Bank C were fully withdrawn in preparation for rod drop testing. A reactor trip occurred due to a Steam Flow greater than Feed Flow signal coincident with a Lo Steam Generator (S/G) Level Signal. The operators performed the immediate actions prescribed in the Reactor Trip procedure. Investigation revealed that one transmitter for Feed Flow and one transmitter for Steam Flow were out of calibration resulting in a SF > FF trip signal being present. The Balance of Plant operator allowed the level in Steam Generator 1A to drop to the low level setpoint. Because there was a SF > FF signal present this completed the coincidence, and a RX trip occurred. The Feed Flow and Steam Flow instruments were recalibrated prior to continuing with rod drop testing. The operator was reminded of the importance of reactor trip signals even when the plant is shutdown. No further corrective action is planned. The Reactor Protection System performed as required, and there was no impact on the health and safety of the public.

LER 85-11

At 1100 on April 7, 1985, with the plant in the Hot Shutdown Operating mode following a refueling outage, the Auxiliary Building Special Ventilation System actuated. The system actuated from a steam exclusion signal caused by steam issuing through a blown rupture disk on the boric acid evaporator condenser. Immediate actions were taken to verify proper actuation of the Auxiliary Building Special Ventilation System and investigate the cause. This event occurred because the boric acid evaporator, which was out of service, was isolated with a leaking control valve, rather than the manual isolation valves. Isolating equipment with manual isolation valves, where applicable, was discussed in operator training to prevent recurrence of this type of event.

LER 85-12

At 1522 on April 10, 1985, with the plant in the Hot Shutdown operating mode preparing to start up following a refueling outage, a reactor trip occurred during performance of the surveillance procedure to calibrate the intermediate range nuclear instrumentation channels. The trip was caused by the P-6 relay chattering, which was introduced through the grounding of the test equipment. The chattering bistable blew the control power fuses for intermediate range channel N35 detector. This completed the one out of two actuation logic for an Intermediate Range Hi Flux Reactor Trip. Immediate actions were taken to stop the dilution in progress and verify the reactor trip. The reactor was in the shutdown condition with the control banks inserted prior to the event and the reactor protection system performed as designed, hence there was no impact on public health and safety.

LER 85-13

On May 5, 1985, with the plant at 100% power, while performing SP 56C-093, "Containment Hydrogen Monitor Operational Test," the heat tracing circuit on the suction line to the 1A containment hydrogen analyzer was discovered inoperable. Investigation revealed that this condition had existed since April 4, 1985. On April 4, 1985, the Shift Supervisor issued a work request to repair the inoperable heat tracing circuit. The Shift Supervisor was aware of the recently issued Technical Specification (March 3, 1985) regarding hydrogen monitor operability; however, the loss of one train of redundant heat tracing, although degrading the system, did not clearly render the hydrogen monitor inoperable. Corrective actions were not completed due to the unavailability of spare parts, and on May 5 the failed heat tracing circuit was discovered again. At this time Management evaluations conservatively concluded that the 14-day LCO on hydrogen monitor operability had been exceeded and preparations for an orderly shutdown commenced. Repairs were completed in three hours and a power reduction was not required. Further evaluation concluded that plant operation was within Technical Specifications as the redundant train's heat traced suction line could have been valved into the 1A H_2 monitor. This event was reported under OTHER to identify the significance that auxiliary components have in determining equipment operability. Corrective actions included routing this LER to all SRO's for review and providing training to operations personnel on hydrogen monitor operation. Also, SP 56C-093 was revised to include heat tracing operability in the acceptance criteria.

LER 85-14

At 1730 on June 15, 1985, the Auxiliary Operator found the concrete block, which prevents access to the spent resin storage tank room, removed. The entry way was barricaded and a high radiation area sign posted. The tank was reading 1 to 4 Rem/Hr on contact with a general area background reading of 0.2 to 0.3 Rem/Hr. This was a violation of Technical Specification 6.13.1.b. which requires that each High Radiation Area, where the intensity of radiation is greater than 1 Rem/Hr, be maintained under the administrative control of the Shift Supervisor. The block had been removed on the morning of June 13 to allow design change and maintenance work on the tank. During the day shifts of June 13 and June 14, access was positively controlled by radiation protection personnel providing coverage in the area. During the associated backshifts, when there is minimal activity in the Auxiliary Building, the area was barricaded and posted as a high radiation area. On June 15 when the operations personnel discovered the situation, the on-shift radiation protection technician was directed to survey the area, and the concrete block was returned to its proper location with the locking device secured at 1835. To prevent recurrence, Technical Specification requirements for securing high radiation areas were discussed during the weekly Radiation Protection staff meeting on June 18, 1985.

LER 85-15

On June 17, 1985, Fluor Engineers, Inc. notified Wisconsin Public Service Corporation that the seismic qualification of the emergency diesel generator differential relays could not be conclusively determined. The relays are General Electric Model 12CFD22B1A. With this information and additional details provided in INPO SER 18-84 Supplement 1, "Diesel Generator Differential Relays Not Seismically Qualified", a management decision was made to defeat the differential relays' trip function. This was completed by 1600 on June 17, 1985. The long term resolution of this discrepancy is being evaluated, and details will be provided in a supplemental report.

LER 85-16

On July 25, 1985 at 1101 with the plant at 100% power, a control operator observed the position indication lights for several containment isolation valves and steam exclusion dampers change position. Immediately, an investigation into the cause of the event was initiated and after verifying that plant conditions were normal, the operators returned the equipment to its normal operating configuration. At the time of the event a QC Technician was verifying wire codes in Relay Rack 170, AC Safeguard Bus 5 Distribution Fuse Panel (RR170) from an approved procedure under cognizance of the Shift Supervisor. The event occurred when power was momentarily interrupted to RR170 due to manipulation of an improper crimp on the RR170's power lead. The power interruption caused several containment isolation valves to perform their isolation function and a momentary loss of system redundancy. There was no impact on the health and safety of the public. This event is being reported under 10 CFR 50.73(a)(2)(iv) as an automatic initiation of an Engineered Safety Feature. A procedure was developed to allow crimping RR-170's power lead without interrupting power and was successfully completed on August 2, 1985. A preventative maintenance procedure is being written to visually inspect wire terminations in selected terminal boxes, relay racks, and other electrical enclosures. This procedure will be performed during the 1986 refueling outage and at periodic intervals thereafter.

<u>LER 85-17</u>

On August 8, 1985 at 0032 a manual reactor trip was required in order to isolate a ruptured excess steam vent line from the 1A2 MSR to the 15A feedwater heater. Immediately after the trip, recovery actions were followed per procedure and a post trip review was performed. All of the equipment necessary to ensure a complete reactor and turbine trip operated properly. At 0825 on the same day, when attempting a reactor startup, the operator failed to block the source range hi flux signal and received a reactor trip. A post trip review was performed and all the equipment required to ensure a complete reactor trip functioned normally. A startup was reinitiated and the reactor was critical by 0908. Maintenance completed replacing the ruptured vent line and at 1513 the plant was synchronized to the distribution grid. Cause of the ruptured line was attributed to erosion of the carbon steel piping. An inplace program to examine steamline piping for tube wall thinning and replacement will be continued.

LER 85-18

On August 20, 1985 with the plant at 100% power a management review revealed that the fire hose inspection required by plant Technical Specification 4.15.2 had been performed outside the required 18 month, ± 25% time interval. The surveillance was completed seven days late. Exceeding the surveillance period resulted from a management oversight when a procedure, written to satisfy two Technical Specifications with different surveillance frequencies, was modified consistent with the longer frequency. As corrective action the surveillance procedure will be clarified and the individuals involved counseled on the importance of following administrative directives for procedure modifications. Inspection and hydrostatic testing of the removed hoses has shown them to be acceptable for continued use; hence, there were no safety implications.

LER 85-19

This LER is being submitted under OTHER in response to IE Bulletin 85-02. In accordance with the requirements of IE Bulletin 85-02, a test of the Undervoltage Trip Attachment [UVTA] for each of the Reactor Trip Breakers was made to verify that 20 ounces of force margin exists. Testing was conducted with the plant at 100% power. Results of the testing revealed that two breakers failed the force margin test at the 20 ounce level; however, the reactor trip breakers were demonstrated to trip on demand and were at all times capable of performing their safety-related function. In addition, the reactor trip breakers were proven to pass the force margin test at the 16 ounce level as recommended by Westinghouse, the breaker supplier. Additional measures have been implemented beyond those required in the bulletin until the shunt trip modification is completed. With this report, WPSC will have met all requirement of IE Bulletin 85-02.

LER 85-20

At 2329 on November 13, 1985, while at 100% power, the A train main feedwater control valve failed shut causing a low-low water level in steam generator 1A, and subsequent reactor trip. Two of the four cap screws, which hold the valve actuator to the yoke on the the 1A main feedwater control valve, sheared causing the valve to fail shut. The auxiliary feedwater system started coincident with the low-low steam generator level signal, assuring an adequate heat sink for decay heat removal. Immediately after the trip, recovery actions were followed per E-0, Reactor Trip or Safety Injection, and a post trip review was performed. Other than the damaged feedwater regulating valve, which failed closed, all equipment responded as designed to the trip. The reactor was critical again at 1752, November 14, 1985. The failure mechanism of the cap screws is suspected to be low cycle stress fatigue. The failed cap screws will undergo metallurgical testing in attempt to verify low cycle stress fatigue, or identify any other failure mechanisms. Long term corrective actions will be developed upon completion of the metallurgical evaluation.

LER 85-21

On November 14, 1985, with the plant at 0% reactor power, the Source Range high flux Level Trip setpoint verification test was being conducted prior to reactor startup from the trip of November 13, 1985 (See LER 85-020). The High Flux at Shutdown bistable trip value was read and recorded in place of the high flux Level Trip setpoint on both source range channels. An operations department review on November 26, 1985, with the reactor at 100% power, identified the error when it was noted that the recorded values of the Source Range high flux Level Trips corresponded to those of previous High Flux at Shutdown alarm readings. During the startup of November 14, 1985 the source range response to increasing flux levels was normal, the overlap data for the source and intermediate ranges was normal, the Source Range high flux Level Trip was blocked upon receipt of the P-6 permissive, and the balance of the reactor protection system was operable. During a subsequent reactor startup on December 12, 1985 the source range high flux Trip was tested, with the as-found values satisfactory. There was no effect on the health and safety of the public as a result of this event. This event is considered to be an isolated personnel error, and the individuals responsible have been counseled on the importance of procedure performance. Also, the associated surveillance procedure will be revised to include a lower bound on the Source Range high flux reactor Trip acceptance criterion, such that the value for High Flux at Shutdown will be outside the acceptable range.

LER 85-22

On November 27, 1985 at 100% power, Surveillance Procedure SP 48-046, "Target Band Determination," (Technical Specification 3.10.b.7) was performed outside of the required time interval of each effective full power month. The surveillance was completed 4 1/2 days after the allowable extension to the surveillance interval. Due to a reactor trip on November 13, and restart on November 14, the initial conditions for the procedure, which include no change in Xenon greater than 50 pcm for 48 hours prior to the flux map, could not be met. Calibration of the Nuclear Instrumentation following startup also contributed to the delay in performance of the target band determination. On November 25, 1985 initial conditions for performance of the target band determination were satisfied. As the result of a personnel oversight the Target Band Determination was not performed until November 27, 1985. Failure to complete the surveillance within the required time interval, as soon as plant conditions permit, is reportable per 10 CFR 50.73 (a)(2)(i)(B). The results of SP48-046 showed the target band to be acceptable, hence there were no safety implications.

LER 85-23

At 0135 on December 12, 1985 with the plant at 100% power, a loss of power to Instrument Bus I occurred. This resulted in a partial loss of instrumentation and various alarms. 1B main feedwater control valve also closed due to loss of positioner power. A reactor/turbine trip then occurred due to a Lo Steam Generator Level signal coincident with a Steam Flow/Feedwater Flow mismatch signal on 1B Steam Generator. The control operators performed the recovery actions specified in Emergency Procedure E-0, "Reactor Trip or Safety Injection" and a post-trip review was completed. The Auxiliary Feedwater System started as a result of a lo-lo steam generator level signal, assuring an adequate heat sink for decay heat removal. There was no impact on the health and safety of the public. Investigation of the inverter for Instrument Bus I revealed the constant voltage transformer had failed. The instrument bus was switched to an alternate power supply and the inverter was deenergized. A plant startup was commenced at 0524 on December 12, 1985. At 0711 on December 12 the constant voltage transformer was replaced and the Instrument Bus was returned to its normal power supply.

5.0 FUEL INSPECTION REPORT

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

The irradiated fuel inspection was performed with an underwater TV camera. All peripheral fuel rods were examined using one-half face scans. Ten assemblies were inspected, including one each in regions G, H, I and J and two each in regions A, K, and L. All assemblies 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 one Region H assembly 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 1985.

During the 1985 refueling outage the pressurizer safety and relief valve discharge piping was modified. Two rupture disc/baffle-plate assemblies were installed at the discharge of the pressurizer safety valves to aid in relieving stress following safety valve actuation. This modification is discussed in section 3 of this report.

7.0 SUMMARY OF 1985 STEAM GENERATOR EDDY CURRENT EXAMINATION

APPLICABLE DEFINITIONS:

Degraded Tube: A tube with greater than a 20% thru-wall indication.

Defective Tube: A tube with greater than a 50% thru-wall indication. If significant tube thinning has occurred in the area of the indication, the defective tube criterion is reduced to greater than 40% thru-wall. Defective tubes require plugging.

HISTORICAL SUMMARY OF TUBES PLUGGED IN THE KEWAUNEE STEAM GENERATORS

Number of Tubes Plugged in:	Steam Generator 1A	Steam Generator 1B
1983	23	49
1984	8	17
1985	27	22
TOTAL	58	88
TOTAL AS PERCENT (3388 tubes/generator)	1.7%	2.6%

TABLE 7.1
SUMMARY OF 1985 STEAM GENERATOR EDDY CURRENT EXAMINATION

INSPECTION EXTENT

Steam Generator 1A

Extent of Inspection	Hot Leg	Cold Leg
Full Length	3179	
U-Bend	174	
#1 TSP(1)	4	10
TOTALS	3357	10

Steam Generator 1B

Extent of Inspection	Hot Leg	Cold Leg
Full Length	3129	
U-Bend	188	
#7 TSP(1)	1	1
#2 TSP		2
#1 TSP	4	9
TOTALS	3322	12

(1) Tube support plates, counted up from the tube sheet inspected.

TABLE 7.2 (Page 1 of 3)
1A STEAM GENERATOR
1985 EDDY CURRENT EXAMINATION

ROW	COLUMN	% THRU-WALL PENETRATION	PLUGGED	INDICATION(1) LOCATION
5	1	65	X	H: TSP #1
4	2	44	X	H: TSP #1
7	10	47	X	H: TSP #1
17	11	93	X	H: TE
6	12	83	X	H: TE + 5.8
8	12	92	X	H: TE + 14.5
15	13	88	X	H: TE + 9.5
20	17	89	X	H: TE + 10.9
15	20	86	X	H: TE + 9.8
6	21	SQR	X	H: TE + 3.9
1	28	46	X	H: TSP #1
11	31	61	X	H: TS + 0.1
7	33	50	X	H: TE + 4.9
23	36(2)	91	X	H: TE + 7.0
11	40	SQR	X	H: TE + 5.3
5	47	84	X	H: TE + 3.0
23	47	78	X	H: TS + 0.1
24	47	41	X	H: TS
25	47	(3)	X	H: TS
27	47	66	X	H: TS + 0.3
28	47	58	X	H: TS + 0.4

TABLE 7.2 (Page 2 of 3)
1A STEAM GENERATOR
1985 EDDY CURRENT EXAMINATION

ROW	COLUMN	% THRU-WALL PENETRATION	PLUGGED	LOCATION
32	47	78	X	H: TS + 0.2
6	50	89	X	H: TE + 3.5
17	50	57	X	H: TS + 2.3
33	58	84	X	H: TE + 6.0
4	59	SQR	X	H: TE + 8.1
3	71	74	X	H: TS + 0.2
13	4	38		H: TSP #1
5	14	31		H: TE + 0.8
32	16	31		H: TS
8	19	28		H: TS + 1.1
8	23	24		H: TS + 0.2
11	23	21		H: TSP #1
3	32	23		H: TS + 0.8
36	34	25		H: TS + 45.4
13	42	28		H: TS + 2.6
24	48	21		H: TS + 0.1
8	49	28		H: TS + 0.4
13	50	25		H: TS + 1.5
23	51	22		H: TS + 1.6
18	52	24		H: TS + 1.0
10	56	37		H: TS + 0.6
11	59	30		H: TS + 0.6
11	60	20		H: TS + 0.5
23	65	33		H: TS + 0.9

TABLE 7.3 (Page 3 of 3)
1A STEAM GENERATOR
1985 EDDY CURRENT INSPECTION

ROW	COLUMN	% THRU-WALL PENETRATION	PLUGGED	INDICATION(1) LOCATION
25	65	30		H: TS + 0.8
8	68	32		H: TS + 0.8
19	70	28		H: TS + 0.5
6	72	36		H: TS + 0.4
18	74	25		H: TS + 0.7
6	75	28		H: TS + 0.2
2	77	39		H: TS + 0.4
6	77	21		H: TS + 0.5
6	80	36		H: TS + 0.6
7	83	21		H: TS + 14.0
24	77	20		

(1) H - Inspected From Hot Leg
C - Inspected From Cold Leg
TSP - Tube Support Plate
TS - Tube Sheet
TE - Tube End
SQR - Squirrel
Note that numbers added to TSP, TE, ect., are distances in inches above the indicated landmark in the indicated leg.

(2) Tube R23, C36 was plugged in the hot leg in 1984, the cold leg was plugged in 1985.

(3) Plugged based on 8 x 1 response and bobbin response.

TABLE 7.3 (Page 1 of 5)
1B STEAM GENERATOR
1985 EDDY CURRENT INSPECTION

ROW	COLUMN	% THRU-WALL PENETRATION	PLUGGED	INDICATION(1) LOCATION
9	19	23		H: TS + 22.9
11	19	46	X	H: TE + 5
5	20	37		H: TS + 0.5
8	22	23		H: TS + 0.7
9	22	32		H: TS + 0.6
3	23	25		H: TS + 0.3
9	23	25		H: TS + 0.5
11	25	33		H: TS + 0.6
16	26	25		H: TS + 0.8
16	28	30		H: TS + 0.9
16	30	SQR	X	H: TE + 10.6
24	30	24		H: TE + 2.9
25	30	48	X	H: TE + 3.1
16	31	44	X	H: TS + 1.3
22	31	52	X	H: TE + 4.7
28	31	37		H: TS + 1.1
23	32	25		H: TE + 3.5
24	32	26		H: TE + 3.5
27	32	21		H: TE + 3.1
28	32	31		H: TE + 3.6
5	33	29		H: TE + 4.3
16	34	20		H: TS + 1.9
23	34	29		H: TE + 2.9
30	34	25		H: TE + 4.5

TABLE 7.3 (Page 2 of 5)
1B STEAM GENERATOR
1985 EDDY CURRENT INSPECTION

ROW	COLUMN	% THRU-WALL PENETRATION	PLUGGED	INDICATION(1) LOCATION
16	36	24		H: TS + 2.3
3	37	23		H: TE + 3.2
23	37	28		H: TE + 5.4
24	38	51	X	H: TE + 5.0
30	38	37		H: TS + 0.8
31	39	22		H: TS + 0.2
32	39	27		H: TE + 3.9
15	40	39		H: TS + 4.7
30	40	70	X	H: TS + 0.8
8	41	73	X	H: TE + 3.8
25	41	28		H: TE + 3.5
8	42	30		H: TS + 40.9
13	42	SQR	X	H: TE + 4.4
15	42	29		H: TS + 4.3
16	42	33		H: TS + 4.6
23	42	83	X	H: TE + 3.1
30	42	31		H: TS + 2.6
10	43	23		H: TS + 0.4
16	43	31		H: TE + 4.2
21	43	22		H: TS + 0.5
32	43	22		H: TS + 0.9
13	44	29		H: TS + 2.6

TABLE 7.3 (Page 3 of 5)
1B STEAM GENERATOR
1985 EDDY CURRENT INSPECTION

ROW	COLUMN	% THRU-WALL PENETRATION	PLUGGED	INDICATION(1) LOCATION
26	44	24		H: TE + 4.8
14	45	25		H: TS + 2.6
27	45	59	X	H: TE + 3.4
28	45	29		H: TE + 5.0
32	45	27		H: TS + 0.0
15	46	SQR	X	H: TE + 3.1
26	46	SQR	X	H: TE + 4.4
30	46	40	X	H: TE + 3.5
6	47	37		H: TS + 0.9
10	47	35		H: TS + 1.7
14	47	28		H: TS + 4.6
24	48	29		H: TS + 3.5
27	48	52	X	H: TS + 5.0
30	48	23		H: TS + 3.3
33	48	33		H: TS + 0.8
15	49	21		H: TE + 3.5
17	49	25		H: TS + 4.4
31	49	30		H: TS + 2.8
33	49	22		H: TS + 0.9
25	50	20		H: TE + 5.3
31	50	21		H: TE + 4.5
1	51	85	X	H: TE + 4.2

TABLE 7.3 (Page 4 of 5)
1B STEAM GENERATOR
1985 EDDY CURRENT INSPECTION

ROW	COLUMN	% THRU-WALL PENETRATION	PLUGGED	INDICATION(1) LOCATION
27	51	44	X	H: TE + 4.2
31	51	40	X	H: TE + 3.4
29	52	52	X	H: TS + 5.3
32	52	29		H: TS + 0.0
3	53	30		H: TS + 0.9
21	53	22		H: TE + 4.9
23	53	29		H: TE + 4.1
33	54	28		H: TS + 0.4
33	56	28		H: TS + 0.0
14	58	39		H: TS + 1.1
23	58	24		H: TE + 5.0
27	58	29		H: TE + 3.5
33	58	21		H: TS + 1.5
25	59	35		H: TE + 2.8
33	59	22		H: TS + 2.6
2	60	75	X	H: TE + 3.6
33	60	26		H: TS + 1.7
26	61	31		H: TE + 4.1
23	63	24		H: TS + 1.6
27	63	25		H: TS + 0.2
17	64	20		H: TS + 1.0
37	64	34		H: V-4 + 0
15	72	30		H: TE + 4.5

TABLE 7.3 (Page 5 of 5)
1B STEAM GENERATOR
1985 EDDY CURRENT INSPECTION

ROW	COLUMN	% THRU-WALL PENETRATION	PLUGGED	INDICATION(1) LOCATION
13	73	24		H: TS + 1.4
4	75	23		H: TS + 0.9
33	76	36		H: TSP #1 + 0.0
15	4	28		CL: TSP #2 + 0.0
20	7	28		CL: TSP #2 + 0.0
44	44	21		CL: TSP #6 + 0.0
8	45	26		CL: TSP #3 + 5.4
8	62	44	X	CL: TSP #6 + 0.0
39	64	53	X	CL: TSP #5 + 0.0
39	65	24		CL: TSP #6 + 0.0
35	72	29		CL: TSP #6 + 0.0
33	73	38		CL: TSP #7 + 0.0
35	73	20		CL: TSP #7 + 0.0
33	76	30		CL: TSP #7 + 0.0
16	88	30		CL: TSP #2 + 0.0
19	89	28		CL: TSP #1 + 0.0

(1) H - Inspected from Hot Leg
C - Inspected from Cold Leg
TSP - Tube Support Plate
TE - Tube END
TS - Tube Sheet
SQR - Squirrel

Note: Numbers added to TSP, TE, etc., are distances in inches above the indicated landmark, in the indicated leg.

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 1985

Exp. Range (mR)	No. of Personnel
No Measurable	331
< 100	162
100 - 249	113
250 - 499	99
500 - 749	75
750 - 999	39
1000 - 1999	30
2000 - 2999	0
3000 - 3999	1
4000 - 4999	0
5000 - 5999	0
6000 - 6999	0
7000 - 7999	0
8000 - 8999	0
9000 - 9999	0
10000 - 10999	0
11000 - 11999	0
Grand Total	850

Table 8.2

TOTAL NUMBER OF CONTRACTORS PROVIDED WITH PERSONAL DOSE MONITORING DEVICES

Exp. Range (mR)		No. of Personnel
No Measurable		231
< 100		85
100 - 249		73
250 - 499		55
500 - 749		51
750 - 999		27
1000 - 1999		22
2000 - 2999		0
3000 - 3999		0
	Total	544

Table 8.3

TOTAL NUMBER OF WPSC PLANT STAFF PROVIDED WITH PERSONAL DOSE MONITORING DEVICES

Exp. Range (mR)		No. of Personnel
No Measurable		59
< 100		42
100 - 249		32
250 - 499		36
500 - 749		21
750 - 999		11
1000 - 1999		7
2000 - 2999		0
3000 - 3999		1
	Total	209

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		41
< 100		35
100 - 249		8
250 - 499		8
500 - 749		3
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 Specification. The table shows the total man-rem exposure for the year was 175.995.

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 1985-KEWAUNEE

WORK AND JOB FUNCTION	NUMBER OF PERSONNEL (GT 100 MREM) STATION EMPLOYEES	UTILITY EMPLOYEES	CONTRACT WORK & OTHER	TOTAL MAN-REM STATION EMPLOYEES	UTILITY EMPLOYEES	CONTRACT WORK & OTHER
REACTOR OPERATIONS SURVEILLANCE						
MAINTENANCE PERSONNEL	2	0	11	0.494	0.000	0.940
OPERATING PERSONNEL	20	0	0	5.314	0.000	0.000
HEALTH PHYSICS PERSONNEL	0	0	0	0.000	0.000	0.000
SUPERVISORY PERSONNEL	8	2	0	0.798	0.384	0.000
ENGINEERING PERSONNEL	9	1	4	0.598	0.338	0.393
ROUTINE MAINTENANCE						
MAINTENANCE PERSONNEL	48	17	127	13.862	3.736	44.912
OPERATING PERSONNEL	16	0	2	1.920	0.000	0.440
HEALTH PHYSICS PERSONNEL	17	0	18	10.345	0.000	9.068
SUPERVISORY PERSONNEL	8	0	7	0.592	0.000	3.517
ENGINEERING PERSONNEL	8	0	5	0.912	0.000	0.959
INSERVICE INSPECTION						
MAINTENANCE PERSONNEL	12	1	35	0.303	0.010	8.673
OPERATING PERSONNEL	3	0	8	0.593	0.000	3.857
HEALTH PHYSICS PERSONNEL	0	0	0	0.000	0.000	0.000
SUPERVISORY PERSONNEL	2	0	2	0.018	0.000	0.000
ENGINEERING PERSONNEL	6	0	1	0.680	0.000	0.902
SPECIAL MAINTENANCE						
MAINTENANCE PERSONNEL	42	15	124	7.253	1.650	33.198
OPERATING PERSONNEL	7	0	1	0.368	0.000	0.011
HEALTH PHYSICS PERSONNEL	10	0	0	0.377	0.000	0.000
SUPERVISORY PERSONNEL	4	0	0	0.113	0.000	0.000
ENGINEERING PERSONNEL	4	2	5	0.075	0.371	0.870
WASTE PROCESSING						
MAINTENANCE PERSONNEL	18	12	6	0.400	1.000	0.547
OPERATING PERSONNEL	3	0	0	3.811	0.000	0.000
HEALTH PHYSICS PERSONNEL	7	0	2	3.314	0.000	0.910
SUPERVISORY PERSONNEL	2	0	0	1.069	0.000	0.000
ENGINEERING PERSONNEL	0	0	1	0.000	0.000	0.401
REFUELING						
MAINTENANCE PERSONNEL	8	4	12	0.407	0.288	4.878
OPERATING PERSONNEL	2	0	0	0.001	0.000	0.000
HEALTH PHYSICS PERSONNEL	0	0	0	0.000	0.000	0.000
SUPERVISORY PERSONNEL	3	0	2	0.097	0.000	0.000
ENGINEERING PERSONNEL	2	0	0	0.028	0.000	0.000
TOTAL						
MAINTENANCE PERSONNEL	130	49	315	22.719	6.684	93.148
OPERATING PERSONNEL	51	0	11	12.007	0.000	4.308
HEALTH PHYSICS PERSONNEL	34	0	20	14.036	0.000	9.978
SUPERVISORY PERSONNEL	27	2	11	2.687	0.384	3.517
ENGINEERING PERSONNEL	29	3	16	2.293	0.709	3.525
GRAND TOTAL	271	54	373	53.742	7.777	114.476

9.0 RADIOLOGICAL MONITORING PROGRAM

Attached is the report from Teledyne Isotopes on the Radiological Monitoring Program for Kewaunee Nuclear Plant for 1985.

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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 1985

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

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

7 February 1986

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.

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In addition, the following tables are in the Appendix:

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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 1985.

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 1985 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, cobalt-60, and cesium-137 were detected in several bottom sediment samples collected in the discharge area (K-1c, K-1d, K-1j) and Two Creeks Park (K-14), averaging 0.062, 0.062, and 0.036 pCi/g dry weight above background level for cobalt-58, cobalt-60, and cesium-137, respectively. At the same time, the gross beta concentration averaged 2.8 pCi/l. Assuming that all gross beta activity was due to these three isotopes, cobalt-58 and cobalt-60 would contribute 1.1 pCi/l each and cesium-137 would contribute 0.6 pCi/l of gross beta concentration. These concentrations constitute only 0.0011%, 0.0022%, and 0.003% of the maximum permissible concentrations of 100,000 pCi/l, 50,000 pCi/l, and 20,000 pCi/l for cobalt-58, cobalt-60, and cesium-137, respectively, established in 10 CFR 20 Document.

   The presence of these isotopes in bottom sediment samples is probably plant-related, but the levels are insignificant.

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 540 pCi/l above background level. The highest concentration was measured in the sample collected at discharge (K-1d) on February 2, 1985 and measured 1920 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 0.07% 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 50 pCi/l above background level and the maximum was measured in the sample collected on February 4, 1985 (130 pCi/l, which constitutes about 0.004% of the permissible level). However, because of the associated counting error, a concentration of this low magnitude is indistinguishable from the background 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 six 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 one exception. There were no TLD data for Location K-5 for the fourth quarter of 1985 because the TLD holder was lost in the snow. An attempt was made to find it but was not successful.

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 1985 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 predecessor, Hazleton Environmental Sciences.

The tabulated results of all measurements made in 1985 are not included in this section, although references to these results will be made in the discussion. The complete tabulation of the 1985 results is contained in Part II of the 1985 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 1985. 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 either identical (gross alpha) or nearly identical (gross beta) for the indicator and control locations. Mean gross alpha and gross beta concentrations were slightly lower than in 1984. The highest annual means, which were close to the average means, for gross alpha and gross beta were measured at control location K-16, 26 miles NW of the station, and at indicator location K-1f, 0.12 miles S of the station, respectively.

Gross alpha and beta concentrations 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 seventeen 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 (64.5±8.2)* mR/365 days, in agreement with the mean at the control locations of (62.0±6.4) mR/365 days, and were slightly higher than the means obtained in 1984 (53.8 and 51.7 mR/365 days, respectively). The quarterly measurements agreed within the error with the annual measurements which were (56.8±6.5) mR/365 days, for the indicator and (59.0±4.8) 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 75.4 and 66.3 mR/365 days and occured at indicator location K-7.

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* 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 five samples and averaged 170 pCi/l. This level of activity is expected in the precipitation and is attributable to the recycling of tritium produced by the previous nuclear tests in the atmosphere.

3.2.3 The Terrestrial Environment

Milk

Of the 192 analyses for iodine-131 in milk all were below the LLD level of 0.5 pCi/l.

Strontium-89 concentration was below the LLD level of 2.4 pCi/l in all samples.

Strontium-90 was found in samples. The mean values were nearly identical for indicator and control locations (2.1 pCi/l and 2.2 pCi/l, respectively).

Barium-140 concentration was below the LLD of 10 pCi/l in all samples. Cesium-137 concentration 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 through 1984.

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 concentration in well water was below the LLD level of 2.9 pCi/l in all samples.

Gross beta concentration in well water was 1.6 pCi/l in samples from the control location. The mean value for all indicator locations was 2.6 pCi/l and was nearly identical to the values observed in 1977, 1978, 1979, 1980, 1981, 1982, 1983, and 1984 (3.3 pCi/l, 3.4 pci/l, 3.0 pCi/l, 3.0 pCi/l, 3.6 pCi/l, 3.2 pCi/l, 2.9 pCi/l, and 2.3 pCi/l, respectively).

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

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

Potassium-40 levels were quite low (under 3.1 pCi/l), in agreement with the previously measured values.

Domestic Meat

In meat (chickens), gross alpha concentration was similar at both indicator and control locations (0.15 and 0.12 pCi/g wet weight, respectively). Gross beta concentration averaged 2.69 pCi/g wet weight for indicator locations and 2.59 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 concentration averaged 0.07 pCi/g wet weight. Gross beta concentration averaged 1.04 pCi/g wet weight, about equal to the concentration of the naturally-occurring potassium-40 observed in the samples (1.07 pCi/g). All other gamma-emitting isotopes were below their respective LLD's. The level of strontium-89 was below the LLD of 0.004 pCi/g wet weight. Strontium-90 was detected in one sample and was at the LLD level of 0.002 pCi/g wet weight.

Vegetables

In vegetables, alpha concentration averaged 0.25 and 0.15 pCi/g wet weight in indicator and control samples, respectively. Gross beta concentration 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 0.004 pCi/g wet weight in all samples. Strontium-90 activity was nearly identical at the control location and the indicator location (0.005 pCi/g wet weight and 0.004 pCi/g wet weight, respectively). All other gamma-emitting isotopes were below their respective LLD levels.

below their respective LLD levels. The samples of oats and wheat were of similar composition but the concentration of radionuclides 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 concentration was essentially identical at both indicator and control locations (0.29 and 0.27 pCi/g wet weight, respectively). Gross beta concentration was slightly higher at indicator locations (6.09 pCi/g wet weight) than at the control locations (5.30 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 0.02 pCi/g wet weight in all samples. Strontium-90 activity was detected in all samples and was slightly higher at indicator than at control locations (0.028 and 0.025 pCi/g wet weight, respectively). Presence of radiostrontium in grass samples is attributed to the fallout from the previous nuclear tests.

For cattlefeed, the mean gross alpha concentration was identical at both indicator and control locations (0.9 pCi/g wet weight). Mean gross beta concentration was slightly higher at control locations (8.0 pCi/g wet weight) than at indicator locations (7.6 pCi/g wet weight). The highest gross beta level was in the sample from indicator location K-4 (16.5 pCi/g wet weight), and reflected the high potassium-40 level (17.2 pCi/g wet weight) observed in the sample. The pattern was similar to that observed in 1978 through 1984. Strontium-89 levels were below the LLD level of 0.14 pCi/g wet weight in all samples. Strontium-90 activity was lower at indicator locations than at control locations (0.075 and 0.141 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 0.7 pCi/g dry weight in mean gross alpha concentration 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 (23.2 and 22.7 pCi/g dry weight, respectively), and is primarily due to the potassium-40 activity. Strontium-89 was below the LLD level of

0.11 pCi/g dry weight in all samples. Strontium-90 was detected in thirteen of fourteen samples and was higher at control than at indicator locations (0.33 and 0.09 pCi/g dry weight, respectively). Cesium-137 was detected in twelve samples and was higher at control locations than at indicator locations (0.46 and 0.29 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 through 1984.

3.2.4 The Aquatic Environment

Surface Water

In surface water, the gross alpha concentration in suspended solids was below the LLD of 1.0 pCi/l in all samples. In dissolved solids, gross alpha activity was detected in two of seventy-two samples and averaged 4.5 pCi/l.

Mean gross beta activity in suspended solids was detected in four samples and averaged 0.6 pCi/l, barely above the detection limit of 0.5 pCi/l. Mean gross beta concentration in dissolved solids was higher by a factor of two at indicator locations (5.6 pCi/l) as compared to the control locations (2.5 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), 1983 (5.1 and 2.6 pCi/l), and 1984 (5.0 and 2.7 pCi/l). The control sample is the Lake Michigan water which varies very little in concentration during the year, while indicator samples include two creek locations (K-1a and K-1e) which are much higher in concentrations and exhibit large month-to-month variations in gross beta concentration. 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 concentration levels were high when potassium-40 levels were high and low when potassium-40 levels were low indicating that the fluctuations in beta concentration 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 concentration was 500 pCi/l at indicator locations and was below LLD of 220 pCi/l at control locations. The mean concentration at the discharge (K-1d) was 540 pCi/l above the background level of 220 pCi/l and 50 pCi/l above the background level at Two Creeks Park, located 2.5 miles south of the plant. The elevated annual mean of 540 pCi/l above background in the discharge water is attributable to the plant operation, but constitutes less than 0.02% of the maximum permissible concentration of 3,000,000 pCi/l established in the 10 CFR 20 Document. The highest level of 1920 pCi/l above background level detected in the sample collected February 2, 1985 at the condenser discharge constitutes less than 0.07% of the permissible level.

The highest level measured at Two Creeks Park was 130 pCi/l above background level and constitutes about 0.004% of the permissible level. However, because of the associated counting error, a concentration of this low magnitude is indistinguishable from the background level.

Strontium-89 activity was below the LLD of 1.8 pCi/l in all samples. Strontium-90 activity was detected in one of twelve samples and was 1.2 pCi/l.

Fish

In fish samples, gross alpha concentration averaged 0.11 pCi/g wet weight in muscles and was below detection limit in all bone fractions. In muscle, gross beta concentration was primarily due to potassium-40 activity. The average beta concentration of 2.61 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 concentration in muscle averaged 0.14 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), in 1983 (0.14 pCi/g wet weight), and in 1984 (0.10 pCi/g wet weight). The strontium-89 was below the LLD of 0.10 pCi/g wet weight in all but one sample Strontium-90 was detected in all samples and averaged 0.18 pCi/g wet weight.

Periphyton (Slime)

In periphyton (slime) samples, gross alpha concentration was nearly identical at both indicator and control samples (0.97 and 1.18 pCi/g wet weight, respectively). Mean gross beta concentration was lower at indicator than at control locations (1.69 and 2.87 pCi/g wet weight, respectively). Strontium-89 concentration was below the LLD level of 0.046 pCi/g wet weight in all samples. Strontium-90 concentrations was nearly identical at both endicator and control locations averaging 0.044 and 0.046 pCi/g wet weight, respectively. A trace quantity of Co-58 (0.078 pCi/g wet weight) was detected in one sample and trace quantities of Co-60 (mean 0.096 pCi/g wet weight) were detected in three samples collected at indicator location K-14. All other gamma-emitting isotopes, except naturally-occurring beryllium-7 and potassium-40, were below their respective LLDs.

Bottom Sediments

In bottom sediment samples, gross alpha levels were below the LLD of 3.4 pCi/g dry weight in all samples.

The mean gross beta concentration was slightly higher at indicator locations than at the control location (6.1 and 6.0 pCi/g dry weight, respectively) and was due mostly to potassium-40. The difference is not statistically significant.

Cesium-137 was detected in eighteen of twenty samples and averaged 0.05 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), in 1983 (0.16 pCi/g dry weight), and in 1984 (0.07 pCi/g dry weight). Strontium-89 and strontium-90 levels were below their respective LLDs (0.032 and 0.015 pCi/g dry weight, respectively) in all samples. Trace amounts of cobalt-58 (six samples, mean 0.062 pCi/g dry weight) and cobalt-60 (ten samples, mean 0.062 pCi/g dry weight) were detected near the condenser discharge. The presence of trace amounts of these activation products in bottom sediments is probably plant related.

4.0 FIGURES AND TABLES

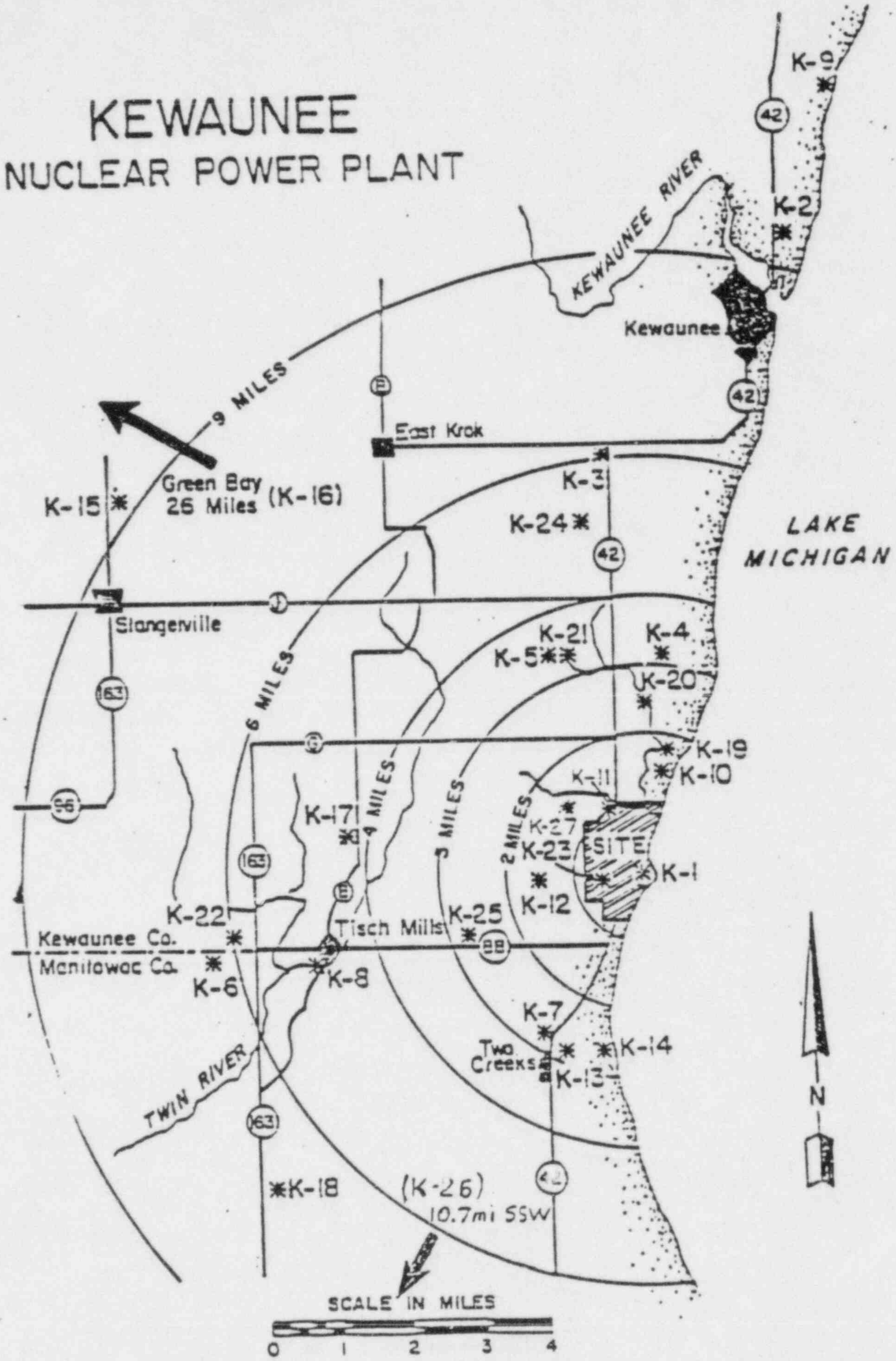

Figure 1. Sampling locations, Kewaunee Nuclear Power Plant.

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	SO	TLD
K-4			MI[c]	GR[a] TLD CF-	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						VE
K-18[e]						
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		DM

[a] Three times a year, 2nd (April, May, June), 3rd (July, Aug., Sept.), and 4th (Oct., Nov., Dec.) quarters.
[b] To be collected in May, July, Sept., Nov.
[c] Monthly from November through April; weekly from May through October.
[d] First (January, February, March) quarter only.
[e] Replaced by K-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	312	0	
Airborne iodine	C/BW	6	156	0	
TLD's	C/Q	10	39	1	See text Page 6.
	C/A	10	10	0	
Precipitation	C/M	1	12	0	
Terrestrial Environment					
Milk (May-Oct)	G/W	6	156	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	7	0	
Grain - oats	G/A	1	1	0	
- wheat	G/A	1	1	0	
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	5	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 1985

Sample Type (Units)	Type and Number of Analyses[a]		LLD[b]	Indicator Locations Mean (F)[c] Range	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	312	0.0027	0.0035 (88/104) (0.0009-0.0112)	K-16, Green Bay 26 mi NW	0.0042 (41/52) (0.0012-0.0120)	0.0035 (167/208) (0.0008-0.0120)	0
	GB	312	0.003	0.016 (103/104) (0.003-0.052)	K-1f, Met Tower Onsite, 0.12 mi S	0.017 (52/52) (0.003-0.052)	0.015 (199/208) (0.002-0.045)	0
	GS	24						
	Be-7		0.022	0.081 (5/8) (0.052-0.143)	K-7, Bruemer Farm 2.75 mi SSW	0.095 (3/4) (0.063-0.143)	0.059 (12/16) (0.041-0.080)	0
	Nb-95		0.0051	<LLD	-	-	<LLD	0
	Zr-95		0.0045	<LLD	-	-	<LLD	0
	Ru-103		0.0037	<LLD	-	-	<LLD	0
	Ru-106		0.013	<LLD	-	-	<LLD	0
	Cs-137		0.0012	<LLD	-	-	<LLD	0
	Ce-141		0.0058	<LLD	-	-	<LLD	0
	Ce-144		0.00[illegible]0	<LLD	-	-	<LLD	0
Airborne Iodine (pCi/m^3)	I-131	312	0.01	<LLD	-	-		0
TLD -Quarterly (mR/91 days)	Gamma	39	5	16.1 (15/15) (13.1-22.1)	K-7, Bruemer Farm 2.75 mi SSW	18.8 (4/4) (15.5-22.1)	15.4 (24/24) (12.7-19.2)	0 0
TLD-Quarterly (mR/365 days)	Gamma	10	5	64.5 (4/4) (56.2-75.4)	K-7, Bruemer Farm 2.75 mi SSW	75.4 (1/1) -	62.0 (6/6) (57.0-72.2)	0
TLD-Annual (mR/365 days)	Gamma	10	5	56.8 (4/4) (52.7-66.3)	K-7, Bruemer Farm 2.75 mi SSW	66.3 (1/1) -	59.0 (6/6) (52.5-65.4)	0

Table 4.5 Environmental Radiological Monitoring Program Summary (continued)

Name of Facility Kewaunee Nuclear Power Plant Docket No. 50-305
Location of Facility Kewaunee County, Wisconsin (County, State) Reporting Period January - December 1985

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range	Location with Highest Annual Mean		Control Locations Mean (F) Range	Number of Non-routine Results[e]
				Location[d]	Mean (F) Range		
Precipitation (pCi/l)	H-3 10	100	170 (5/12) (120-230)	K-11, Inlenfeld Farm 1.0 mi NW	170 (5/12) (120-230)	None	0
Milk (pCi/l)	I-131 192	0.5	<LLD	-	-	<LLD	0
	Sr-89 72	2.4	<LLD	-	-	<LLD	0
	Sr-90 72	0.6	2.1 (48/48) (0.9-3.7)	K-6, Novitsky Farm 6.7 mi WSW	2.5 (12/12) (1.7-3.4)	2.2 (24/24) (1.4-3.4)	0
				K-12, Lecaptain Farm 1.5 mi WSW	2.5 (12/12) (1.0-3.7)		
	GS 72						
	K-40	50	1320 (48/48) (1050-1540)	K-3, Stangel Farm 3.0 mi N	1430 (12/12) (1330-1550)	1340 (24/24) (1130-1550)	0
	Cs-137	10	<LLD	-	-	<LLD	0
	Ba-140	10	<LLD	-	-	<LLD	0
(g/l)	K-stable 72	1.0	1.51 (48/48) (1.19-1.75)	K-3, Stangel Farm 3.0 mi N	1.63 (12/12) (1.51-1.76)	1.53 (24/24) (1.28-1.75)	0
(g/l)	Ca 72	0.5	0.8 (48/48) (0.7-1.4)	K-3, Stangel Farm 3.0 mi N	0.9 (12/12) (0.7-1.6)	0.9 (24/24) (0.6-1.6)	0
				K-6, Novitsky Farm 6.7 mi WSW	0.9 (12/12) (0.6-1.7)		
Well Water (pCi/l)	GA 40	2.9	<LLD	-	-	<LLD	0
	GB 40	2.9	2.6 (26/36) (1.0-5.0)	K-1h, North Well Onsite, 0.12 mi NW	4.0 (12/12) (1.9-5.0)	1.6 (4/4) (1.0-2.1)	0
	H-3 4	100	<LLD	-	-	None	0
	K-40 (flame) 40	0.10	2.0 (36/36) (0.6-3.1)	K-1g, South Well Onsite, 0.06 mi W	2.5 (12/12) (2.1-3.1)	1.2 (4/4) (1.0-1.4)	0
	Sr-89 4	0.5	<LLD	-	-	None	0
	Sr-90 4	0.3	<LLD	-	-	None	0

Table 4.5 Environmental Radiolcgical Monitoring Program Summary (continued)

Name of Facility Kewaunee Nuclear Power Plant — Docket No. 50-305
Location of Facility Kewaunee County, Wisconsin (County, State) — Reporting Period January - December 1985

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range	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	0.04	0.15 (3/3) (0.12-0.19)	K-27, Schlies Farm 1.5 mi NW	0.19 (1/1) -	0.12 (1/1) -	0
	GB 4	0.03	2.69 (3/3) (2.57-2.79)	K-27, Schlies Farm 1.5 mi NW	2.79 (1/1) -	2.59 (1/1) -	0
	GS 4						
	Be-7	0.07	<LLD	-	-	<LLD	0
	K-40	0.5	3.04 (3/3) (2.63-3.20)	K-27, Schlies Farm 1.5 mi NW	3.20 (1/1) -	2.56 (1/1) -	0
	Nb-95	0.011	<LLD	-	-	<LLD	0
	Zr-95	0.018	<LLD	-	-	<LLD	0
	Ru-103	0.010	<LLD	-	-	<LLD	0
	Ru-106	0.058	<LLD	-	-	<LLD	0
	Cs-134	0.008	<LLD	-	-	<LLD	0
	Cs-137	0.007	<LLD	-	-	<LLD	0
	Ce-141	0.015	<LLD	-	-	<LLD	0
	Ce-144	0.032	<LLD	-	-	<LLD	0
Eggs (pCi/g wet)	GA 4	0.03	0.07 (3/4) (0.05-0.09)	K-27, Schlies Farm 1.5 mi NW	0.07 (3/4) (0.05-0.09)	None	0
	GB 4	0.01	1.04 (4/4) (0.86-1.14)	K-27, Schlies Farm 1.5 mi NW	1.04 (4/4) (0.86-1.14)	None	0
	Sr-89 4	0.004	<LLD	-	-	None	0
	Sr-90 4	0.002	0.002 (1/4) -	K-27, Schlies Farm 1.5 mi NW	0.002 (1/1) -	None	0
	GS 4						
	Be-7	0.077	<LLD	-	-	None	0
	K-40	0.01	1.07 (4/4) (0.84-1.50)	K-27, Schlies Farm 1.5 mi NW	1.07 (4/4) (0.84-1.50)	None	0

Table 4.5 Environmental Radiological Monitoring Program Summary (continued)

Name of Facility Kewaunee Nuclear Power Plant Docket No. 50-305
Location of Facility Kewaunee County, Wisconsin (County, State) Reporting Period January - December 1985

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range	Location with Highest Annual Mean: Location[d]	Location with Highest Annual Mean: Mean (F) Range	Control Locations Mean (F) Range	Number of Non-routine Results[e]
Eggs (pCi/g wet) (cont'd)	Nb-95	0.016	<LLD	-	-	None	0
	Zr-95	0.020	<LLD	-	-	None	0
	Ru-103	0.012	<LLD	-	-	None	0
	Ru-106	0.091	<LLD	-	-	None	0
	Cs-134	0.011	<LLD	-	-	None	0
	Cs-137	0.012	<LLD	-	-	None	0
	Ce-141	0.020	<LLD	-	-	None	0
	Ce-144	0.061	<LLD	-	-	None	0
Vegetables (pCi/g wet)	GA 7	0.02	0.25 (1/1)	K-17, Jansky Farm 4.25 mi W	0.25 (1/1) -	0.15 (6/6) (0.07-0.23)	0
	GB 7	0.1	3.95 (1/1)	K-17, Jansky Farm 4.25 mi W	3.95 (1/1) -	2.51 (6/6) (1.47-3.85)	0
	Sr-89 7	0.004	<LLD	-	-	<LLD	0
	Sr-90 7	0.001	0.004 (1/1) -	K-26, Bertler's Fruit Stand, 10.7 mi SSW	0.005 (5/5) 0.003-0.008	0.005 (5/5) 0.003-0.008	0
	GS 7						
	Be-7	0.035	<LLD	-	-	<LLD	0
	K-40	0.75	2.02 (1/1)	K-17, Jansky Farm 4.25 mi W	2.02 (1/1) -	1.91 (6/6) (0.39-3.34)	0
	Nb-95	0.0040	<LLD	-	-	<LLD	0
	Zr-95	0.0064	<LLD	-	-	<LLD	0
	Ru-103	0.0043	<LLD	-	-	<LLD	0
	Ru-106	0.033	<LLD	-	-	<LLD	0
	Cs-137	0.0042	<LLD	-	-	<LLD	0
	Ce-141	0.0077	<LLD	-	-	<LLD	0
	Ce-144	0.0032	<LLD	-	-	<LLD	0

Table 4.5 Environmental Radiological Monitoring Program Summary (continued)

Name of Facility Kewaunee Nuclear Power Plant — Docket No. 50-305
Location of Facility Kewaunee County, Wisconsin (County, State) — Reporting Period January - December 1985

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range	Location with Highest Annual Mean: Location[d]	Location with Highest Annual Mean: Mean (F) Range	Control Locations Mean (F) Range	Number of Non-routine Results[e]
Grain - Oats (pCi/g wet)	GA 2	0.18	<LLD	-	-	None	0
	GB 2	0.1	3.62 (2/2) (1.90-5.33)	K-23, Kewaunee Site 0.5 mi W	3.62 (2/2) (1.90-5.33)	None	0
	Sr-89 2	0.005	<LLD	-	-	None	0
	Sr-90 2	0.002	0.017 (1/2) (0.004-0.030)	K-23, Kewaunee Site 0.5 mi W	0.017 (1/2) (0.004-0.030)	None	0
	GS 2	0.026		-	-	None	0
	Be-7	0.2	1.20 (2/2) (0.49-1.90)	-	1.20 (2/2) (0.49-1.90)	None	0
	K-40	0.1	3.79 (2/2) (3.46-4.12)	K-23, Kewaunee Site 0.5 mi W	3.79 (2/2) (3.46-4.12)	None	0
	Nb-95	0.010	<LLD	-	-	None	0
	Zr-95	0.015	<LLD	-	-	None	0
	Ru-103	0.007	<LLD	-	-	None	0
	Ru-106	0.061	<LLD	-	-	None	0
	Cs-137	0.007	<LLD	-	-	None	0
	Ce-141	0.013	<LLD	-	-	None	0
	Ce-144	0.044	<LLD	-	-	None	0
Cattlefeed (pCi/g wet)	GA 6	0.2	0.9 (4/4) (0.3-2.0)	K-4, Stangel Farm 3.0 mi N	2.0 (1/1) -	0.9 (2/2) (0.4-1.4)	0
	GB 6	0.1	7.6 (4/4) (2.6-16.5)	K-4, Stangel Farm 3.0 mi N	16.5 (1/1) -	8.0 (2/2) (4.3-11.7)	0
	Sr-89 6	0.14	<LLD	-	-	<LLD	0
	Sr-90 6	0.039	0.075 (1/4) -	K-6, Novitsky Farm 6.7 mi WSW	0.235 (1/1) -	0.141 (2/2) (0.047-0.235)	0
	GS 6						
	Be-7	0.15	0.79 (4/4) (0.29-1.96)	K-4, Stangel Farm 3.0 mi N	1.96 (1/1)	0.40 (2/2) (0.36-0.43)	0
	K-40	1.0	7.46 (4/4) (3.30-17.20)	K-4, Stangel Farm 3.0 mi N	17.2 (1/1) -	7.57 (2/2) (4.17-10.97)	0

Table 4.5 Environmental Radiological Monitoring Program Summary (continued)

Name of Facility Kewaunee Nuclear Power Plant Docket No. 50-305
Location of Facility Kewaunee County, Wisconsin (County, State) Reporting Period January - December 1985

Sample Type (Units)	Type and Number of Analyses[a]		LLD[b]	Indicator Locations Mean (F)[c] Range	Location with Highest Annual Mean		Control Locations Mean (F) Range	Number of Non-routine Results[e]
					Location[d]	Mean (F) Range		
Cattlefeed (pCi/g wet) (cont'd)	Nb-95		0.015	<LLD	-	-	<LLD	0
	Zr-95		0.024	<LLD	-	-	<LLD	0
	Ru-103		0.013	<LLD	-	-	<LLD	0
	Ru-106		0.12	<LLD	-	-	<LLD	0
	Cs-134		0.012	<LLD	-	-	<LLD	0
	Cs-137		0.013	<LLD	-	-	<LLD	0
	Ce-141		0.024	<LLD	-	-	<LLD	0
	Ce-144		0.090	<LLD	-	-	<LLD	0
Grass (pCi/g wet)	GA	24	0.11	0.29 (17/18) (0.11-0.50)	K-12, LeCaptain Farm 1.5 mi WSW	0.38 (3/3) (0.30-0.42)	0.27 (6/6) (0.15-0.45)	0
	GB	24	0.1	6.09 (18/18) (2.94-9.68)	K-12, LeCaptain Farm 1.5 mi WSW	7.78 (3/3) (6.70-8.95)	5.30 (6/6) (3.02-8.55)	0
	Sr-89	24	0.020	<LLD	-	-	<LLD	0
	Sr-90	24	0.006	0.028 (18/18) (0.010-0.057)	K-1b, Middle Creek On Site, 0.12 mi N	0.043 (3/3) (0.034-0.057)	0.025 (6/6) (0.007-0.069)	0
	GS	24						
	Be-7		0.3	2.20 (18/18) (0.57-5.73)	K-1b, Middle Creek On site, 0.12 mi N	2.93 (3/3) (0.60-5.73)	1.50 (6/6) (0.43-2.75)	0
	K-40		0.1	6.88 (18/18) (4.50-8.96)	K-5, Paplham Farm 3.5 mi NNW	7.74 (3/3) (6.85-8.20)	7.54 (6/6) (6.32-8.28)	0
	Nb-95		0.1	<LLD	-	-	<LLD	0
	Zr-95		0.1	<LLD	-	-	<LLD	0
	Ru-103		0.1	<LLD	-	-	<LLD	0
	Ru-106		0.1	<LLD	-	-	<LLD	0

Table 4.5 Environmental Radiological Monitoring Program Summary (continued)

Name of Facility: Kewaunee Nuclear Power Plant — Docket No. 50-305
Location of Facility: Kewaunee County, Wisconsin (County, State) — Reporting Period: January - December 1985

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range	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	K-6, Novitsky Farm 6.7 mi WSW	0.066 (1/3) -	0.066 (1/6)	0
	Ce-141	0.1	<LLD	-	-	<LLD	0
	Ce-144	0.1	<LLD	-	-	<LLD	0
Soil (pCi/g dry)	GA 14	2.7	6.3 (10/10) (3.5-9.6)	K-5, Paplham Farm 3.5 mi WSW	7.8 (2/2) (6.0-9.6)	7.0 (3/4) (5.7-9.0)	0
	GB 14	2.0	23.2 (10/10) (17.1-29.5)	K-5, Paplham Farm 3.5 mi WSW	25.6 (2/2) (24.6-26.7)	22.7 (4/4) (20.2-25.9)	0
	Sr-89 14	0.11	<LLD	-	-	<LLD	0
	Sr-90 14	0.01	0.09 (9/10) (0.01-0.17)	K-6, Novitsky Farm 6.7 mi WSW	0.55 (2/2) (0.22-0.89)	0.33 (4/4) (0.06-0.89)	0
	GS 14						
	Be-7	0.41	<LLD	-	-	<LLD	0
	K-40	1.4	16.7 (10/10) (11.4-20.7)	K-5, Paplham Farm 3.5 mi NNW	19.3 (2/2) (17.8-20.7)	17.4 (4/4) (15.1-19.6)	0
	Nb-95	0.15	<LLD	-	-	<LLD	0
	Zr-95	0.07	<LLD	-	-	<LLD	0
	Ru-103	0.09	<LLD	-	-	<LLD	0
	Ru-106	0.11	<LLD	-	-	<LLD	0
	Cs-137	0.01	0.29 (8/10) (0.05-0.49)	K-6, Novitsky Farm 6.7 mi WSW	0.59 (2/2) (0.39-0.78)	0.46 (4/4) (0.27-0.78)	0
	Ce-141	0.07	<LLD	-	-	<LLD	0
	Ce-144	0.08	<LLD	-	-	<LLD	0

Table 4.5 Environmental Radiological Monitoring Program Summary (continued)

Name of Facility Kewaunee Nuclear Power Plant Docket No. 50-305
Location of Facility Kewaunee County, Wisconsin (County, State) Reporting Period January - December 1985

Sample Type (Units)	Type and Number of Analyses[a]		LLD[b]	Indicator Locations Mean (F)[c] Range	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	2.7[f]	4.5 (2/60) (3.3-5.7)	K-1a, North Creek, Onsite, 0.62 mi N	5.7 (1/12) -	<LLD	0
	GA(TR)	72	3.7[f]	5.7 (1/60) -	K-1a, North Creek, Onsite, 0.62 mi N	5.7 (1/12) -	<LLD	0
	GB(SS)	72	0.5	0.6 (4/60) (0.5-0.6)	K-14, Two Creeks Park, 2.5 mi S	0.8 (1/12) -	<LLD	0
	GB(DS)	72	0.99	5.6 (58/60) (0.9-31.2)	K-1a, North Creek, Onsite, 0.62 mi N	11.4 (12/12) (4.0-31.2)	2.5 (12/12) (1.6-3.6)	0
	GB(TR)	72	1.39	5.8 (57/60) (1.4-31.2)	K-1a, North Creek, Onsite, 0.62 mi N	11.4 (12/12) (4.0-31.2)	2.5 (12/12) (1.6-3.6)	0
	H-3	36	220	500 (9/24) (230-2140)	K-1d, Condenser Discharge, Onsite 0.10 mi E	760 (4/12) (230-2140)	<LLD	0
	Sr-89	12	1.8	<LLD	-	-	<LLD	0
	Sr-90	12	1.1	1.2 (1/8) -	K-1d, Condenser Discharge, Onsite 0.10 mi E	1.2 (1/4) -	<LLD	0
	K-40 (flame)	72	0.5	4.4 (60/60) (1.0-29.3)	K-1a, North Creek Onsite, 0.62 mi N	8.7 (12/12) (4.1-29.3)	1.4 (12/12) (0.6-2.2)	0
Fish-Muscle (pCi/g wet)	GA	5	0.05	0.11 (5/5) (0.09-0.13)	K-1d, Condenser Discharge, Onsite 0.10 mi E	0.11 (5/5) (0.09-0.13)	None	0
	GB	5	1.0	2.61 (5/5) (2.42-2.85)	K-1d, Condenser Discharge, Onsite 0.10 mi E	2.61 (5/5) (2.42-2.85)	None	0

Table 4.5 Environmental Radiological Monitoring Program Summary (continued)

Name of Facility Kewaunee Nuclear Power Plant Docket No. 50-305
Location of Facility Kewaunee County, Wisconsin (County, State) Reporting Period January - December 1985

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range	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)	GS 5						
	Be-7	0.41	<LLD	-	-	None	0
	K-40	1.05	2.73 (5/5) (2.22-3.04)	K-1d, Condenser Discharge, Onsite 0.10 mi E	2.73 (5/5) (2.22-3.04)	None	0
	Nb-95	0.061	<LLD	-	-	None	0
	Zr-95	0.045	<LLD	-	-	None	0
	Ru-103	0.045	<LLD	-	-	None	0
	Ru-106	0.12	<LLD	-	-	None	0
	Cs-137	0.012	0.14 (4/5) (0.09-0.18)	K-1d, Condenser Discharge, Onsite 0.10 mi E	0.14 (4/5) (0.09-0.18)	None	0
	Ce-141	0.081	<LLD	-	-	None	0
	Ce-144	0.084	<LLD	-	-	None	0
Fish-Bones (pCi/g wet)	GA 5	0.92	<LLD	-	-	None	0
	GB 5	0.5	1.15 (5/5) (0.86-1.44)	K-1d, Condenser Discharge, Onsite 0.10 mi E	1.15 (5/5) (0.86-1.44)	None	0
	Sr-89 5	0.10	0.35 (1/5) -	K-1d, Condenser Discharge, Onsite 0.10 mi E	0.35 (1/5) -	None	0
	Sr-90 5	0.10	0.18 (5/5) (0.11-0.26)	K-1d, Condenser Discharge, Onsite 0.10 mi E	0.18 (5/5) (0.11-0.26)	None	0
Periphyton (slime) (pCi/g wet)	GA 12	0.66	0.97 (2/10) (0.74-1.20)	K-1e, South Creek Onsite, 0.12 mi S	1.20 (1/2) -	1.18 (1/2) -	0
	GB 12	0.1	1.69 (10/10) (0.20-3.51)	K-1a, North Creek Onsite, 0.62 mi N	3.14 (2/2) (2.76-3.51)	2.87 (2/2) (0.64-5.10)	0
	Sr-89 12	0.046	<LLD	-	-	<LLD	0
	Sr-90 12	0.005	0.044 (9/10) (0.006-0.186)	K-1a, North Creek Onsite, 0.62 mi N	0.097 (2/2) (0.008-0.186)	0.046 (2/2) (0.020-0.071)	0

Table 4.5 Environmental Radiological Monitoring Program Summary (continued)

Name of Facility Kewaunee Nuclear Power Plant Docket No. 50-305
Location of Facility Kewaunee County, Wisconsin Reporting Period January - December 1985
(County, State)

Sample Type (Units)	Type and Number of Analyses[a]		LLD[b]	Indicator Locations Mean (F)[c] Range	Location with Highest Annual Mean: Location[d]	Location with Highest Annual Mean: Mean (F) Range	Control Locations Mean (F) Range	Number of Non-routine Results[e]
Periphyton (Slime) (pCi/g wet) (cont'd)	GS	12						
	Be-7		0.84	1.02 (1/10) -	K-9, Rostok Water Intake, 11.5 mi NNE	1.11 (1/2) -	1.11 (1/2) -	0
	K-40		0.50	1.85 (10/10) (0.63-5.37)	K-1a, North Creek, Onsite, 0.62 mi N	3.95 (2/2) (2.52-5.37)	1.83 (2/2) (1.38-2.27)	0
	Mn-54		0.027	<LLD	-	-	<LLD	0
	Co-58		0.051	0.078 (1/10) -	K-14, Two Creeks Park, 2.5 mi S	0.078 (1/2) -	<LLD	0
	Co-60		0.031	0.096 (3/10) (0.072-0.130)	K-14, Two Creeks Park, 2.5 mi S	0.130 (1/2) -	<LLD	0
	Nb-95		0.048	<LLD	-	-	<LLD	0
	Zr-95		0.077	<LLD	-	-	<LLD	0
	Ru-103		0.058	<LLD	-	-	<LLD	0
	Ru-106		0.16	<LLD	-	-	<LLD	0
	Cs-134		0.030	<LLD	-	-	<LLD	0
	Cs-137		0.025	<LLD	-	-	<LLD	0
	Ce-141		0.13	<LLD	-	-	<LLD	0
	Ce-144		0.16	<LLD	-	-	<LLD	0
Bottom Sediments (pCi/g dry)	GA	20	3.4	<LLD	-	-	<LLD	0
	GB	20	1.0	6.1 (16/16) (2.3-10.4)	K-1c, Condenser Discharge, Onsite 0.10 mi N	6.6 (4/4) (5.1-8.4)	6.0 (4/4) (5.3-7.7)	0
	Sr-89	20	0.032	<LLD	-	-	<LLD	0
	Sr-90	20	0.015	<LLD	-	-	<LLD	0

Table 4.5 Environmental Radiological Monitoring Program Summary (continued)

Name of Facility Kewaunee Nuclear Power Plant Docket No. 50-305
Location of Facility Kewaunee County, Wisconsin (County, State) Reporting Period January - December 1985

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range	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) (cont'd)	GS 20						
	K-40	1.0	4.10 (16/16) (2.84-5.13)	K-14, Two Creeks Park, 2.5 mi S	4.78 (4/4) (3.21-5.92)	4.73 (4/4) (3.56-5.98)	0
	Co-58	0.022	0.062 (6/16) (0.026-0.104)	K-1d, Condenser Discharge, Onsite 0.10 mi E	0.077 (2/4) (0.054-0.099)	<LLD	0
	Co-60	0.019	0.062 (10/16) (0.027-0.092)	K-1d, Condenser Discharge, Onsite 0.10 mi E	0.083 (3/4) (0.068-0.092)	<LLD	0
	Cs-134	0.014	<LLD	-	-	<LLD	0
	Cs-137	0.011	0.055 (1[illegible]/16) (0.023-0.094)	K-1d, Condenser Discharge, Onsite 0.10 mi E	0.073 (4/4) (0.057-0.094)	0.019 (2/4) (0.013-0.024)	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 Non-routine results are those which exceed ten times the control station value. If no control station value is available, the result is considered non-routine if it exceeds ten times the pre-operational value for the location.

f One result (<4.0 pCi/l for dissolved solids and 4.4 pCi/l in total residue) has been excluded from the determination of LLD. It resulted from a high solids content in the sample.

g One result (<5.6 pCi/l for dissolved solids and <6.0 pCi/l for total residue has been excluded from the determination of LLD. It resulted from a high solids content in the sample.

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Appendix A

Interlaboratory Comparison Program Results

Appendix A

Interlaboratory Comparison 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, water, air filters, and food samples during the period 1982 through October 1985. 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, water, air filters, and food samples, 1982 through 1985.[a]

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

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-291	Water	Aug. 1982	I-131	94.6±2.5	87±15
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±4.09	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-40	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	2817±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	3.3±1.2	5.0±8.7
			Gross beta	12.7±2.3	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 ±2 [c]	EPA Result ±3, 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
STAF-387	Air Filter	Nov. 1984	Gross alpha	18.7±1.2	15±8.7
			Gross beta	59.0±5.3	52±8.7
			Sr-90	18.3±1.2	21±2.6
			Cs-137	10.3±1.2	10±8.7
STW-388	Water	Dec. 1984	I-131	28.0±2.0	36±10.4
STW-389	Water	Dec. 1984	H-3	3583±110	3182±624
STW-391	Water	Dec. 1984	Ra-226	8.4±1.7	8.6±2.2
			Ra-228	3.1±0.2	4.1±1.1
STW-392	Water	Jan. 1985	Sr-89	<3.0	3.0±8.7
			Sr-90	27.3±5.2	30.0±2.6
STW-393	Water	Jan. 1985	Gross alpha	3.3±1.2	5±8.7
			Gross beta	17.3±3.0	15±8.7
STS-395	Food	Jan. 1985	Sr-89	25.3±6.4	34.0±5.0
			Sr-90	27.0±8.8	26.0±1.5
			I-131	38.0±2.0	35.0±6.0
			Cs-137	32.7±2.4	29.0±5.0
			K-40	1410±212	1382±120

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-397	Water	Feb. 1985	Cr-51	<29	48±8.7
			Co-60	21.3±3.0	20±8.7
			Zn-65	53.7±5.0	55±8.7
			Ru-106	<23	25±8.7
			Cs-134	32.3±1.2	35±8.7
			Cs-137	25.3±3.0	25±8.7
STW-398	Water	Feb. 1985	H-3	3869±319	3796±634
STM-400	Milk	March 1985	I-131	7.3±2.4	9.0±0.9
STW-402	Water	March 1985	Ra-226	4.6±0.6	5.0±1.3
			Ra-228	<0.8	9.0±2.3
		Reanalysis	Ra-228	9.0±0.4	
STW-404	Water	March 1985	Gross alpha	4.7±2.3	6±8.7
			Gross beta	11.3±1.2	15±8.7
STAF-405	Air Filter	March 1985	Gross alpha	9.3±1.0	10.0±8.7
			Gross beta	42.0±1.1	36.0±8.7
			Sr-90	13.3±1.0	15.0±2.6
			Cs-137	6.3±1.0	6.0±8.7
STW-407	Water	April 1985	I-131	8.0±0.0	7.5±1.3
STW-408	Water	April 1985	H-3	3399±150	3559±630
STW-409	Water	April 1985			
	(Blind) Sample A		Gross alpha	29.7±1.8	32.0±5.0
			Ra-226	4.4±0.2	4.1±0.6
			Ra-228	NA[e]	6.2±0.9
			Uranium	NA[e]	7.0±6.0
	Sample B		Gross beta	74.3±11.8	72.0±5.0
			Sr-89	12.3±7.6	10.0±5.0
			Sr-90	14.7±2.4	15.0±1.5
			Co-60	14.7±2.4	15.0±5.0
			Cs-134	12.0±2.0	15.0±5.0
			Cs-137	14.0±2.0	12.0±5.0

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2 [c]	EPA Result ±3 , n=1[d]
STW-413	Water	May 1985	Sr-89	36.0±12.4	39.0±5.0
			Sr-90	14.3±4.2	15.0±1.5
STW-414	Water	May 1985	Gross alpha	8.3±4.1	12.0±5.0
			Gross beta	8.7±1.2	11.0±5.0
STW-416	Water	June 1985	Cr-51	44.7±6.0	44.0±5.0
			Co-60	14.3±1.2	14.0±5.0
			Zn-65	50.3±7.0	47.0±5.0
			Ru-106	55.3±5.8	62.0±5.0
			Cs-134	32.7±1.2	35.0±5.0
			Cs-137	22.7±2.4	20.0±5.0
STW-418	Water	June 1985	H-3	2446±132	2416±351
STM-421	Milk	June 1985	Sr-89	10.3±4.6	11.0±8.7
			Sr-90	9.0±2.0	11.0±2.6
			I-131	11.7±1.2	11.0±10.4
			Cs-137	12.7±1.2	11.0±8.7
			K-40	1512±62	1525±132
STW-423	Water	July 1985	Gross alpha	5.0±0.0	11.0±8.7
			Gross beta	5.0±2.0	8.0±8.7
STW-425	Water	August 1985	I-131	25.7±3.0	33.0±10.4
STW-426	Water	August 1985	H-3	4363±83	4480±776
STAF-427	Air Filter	August 1985	Gross alpha	11.3±0.6	13.0±8.7
			Gross beta	46.0±1.0	44.0±8.7
			Sr-90	17.7±0.6	18.0±2.6
			Cs-137	10.3±0.6	8.0±8.7
STW-429	Water	Sept. 1985	Sr-89	15.7±0.6	20.0±8.7
			Sr-90	7.0±0.0	7.0±2.6
STW-430	Water	Sept. 1985	Ra-226	8.2±0.3	8.9±2.3
			Ra-228	4.1±0.3	4.6±1.2
STW-431	Water	Sept. 1985	Gross alpha	4.7±0.6	8.0±8.7
			Gross beta	4.7±1.2	8.0±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-433	Water	Oct. 1985	Cr-51	<13	21.0±8.7
			Co-60	19.30.6	20.0±8.7
			Zn-65	19.7±0.6	19.0±8.7
			Ru-106	<19	20.0±8.7
			Cs-134	17.0±1.0	20.0±8.7
			Cs-137	19.3±1.2	20.0±8.7
STW-435	Water	Oct. 1985	H-3	1957±50	1974±598

[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; air filter samples, which are in pCi/filter; and food, which is in pCi/kg.

[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 3σ for n = 1.

[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[d] (all participants)
2nd International Intercomparison[b]					
115-2[b]	CaF_2:Mn Bulb	Gamma-Field	17.0±1.9	17.1[c]	16.4±7.7
		Gamma-Lab	20.8±4.1	21.3[c]	18.8±7.6
3rd International Intercomparison[e]					
115-3[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
4th International Intercomparison[g]					
115-4[g]	CaF_2:Mn Bulb	Gamma-Field	14.1±1.1	14.1±1.4[f]	16.0±9.0
		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
5th International Intercomparison[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±31.2

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

$$s = \sqrt{s_1^2 + s_2^2}$$

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 deviation(s) 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.

PUBLIC SERVICE

WISCONSIN PUBLIC SERVICE CORPORATION

February 28, 1986

Mr. Richard C. DeYoung, Director
Office of Inspection and Enforcement
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Changes Made to Facility Per 10 CFR 50.59

Enclosed is a copy of the 1985 Kewaunee Nuclear Power Plant (KNPP) Annual Operating Report. This report is being sent to you in accordance with 10 CFR 50.59(b). Section 3 of the report describes those facility changes allowed by 10 CFR 59.59(a)(1).

The 1985 KNPP Annual Operating Report satisfies the reporting requirements of KNPP Technical Specification 6.9.1.b (annual reporting requirements), 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,

DCH

D. C. Hintz
Manager - Nuclear Power

GWH/jms
Enc.
cc - Mr. Robert Nelson, US NRC - w/o attach.
     Mr. George Lear, US NRC - w/o attach.

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