Operating Experience Report

Irradiated Fuel Storage at Morris Operation

REVISION INDEX for Revision B4 September 1980

Incorporates changes and Appendix B3, environmental monitoring report for 1979.

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NEDO-20969B
CLASS I

Operating Experience Report

IRRADIATED FUEL STORAGE

at

MORRIS OPERATION

January 1972 to December 1979

K. J. Eger

SPENT FUEL SERVICES OPERATION
NUCLEAR FUEL AND SERVICES DIVISION • GENERAL ELECTRIC COMPANY
SAN JOSE, CALIFORNIA 95125

GENERAL ELECTRIC

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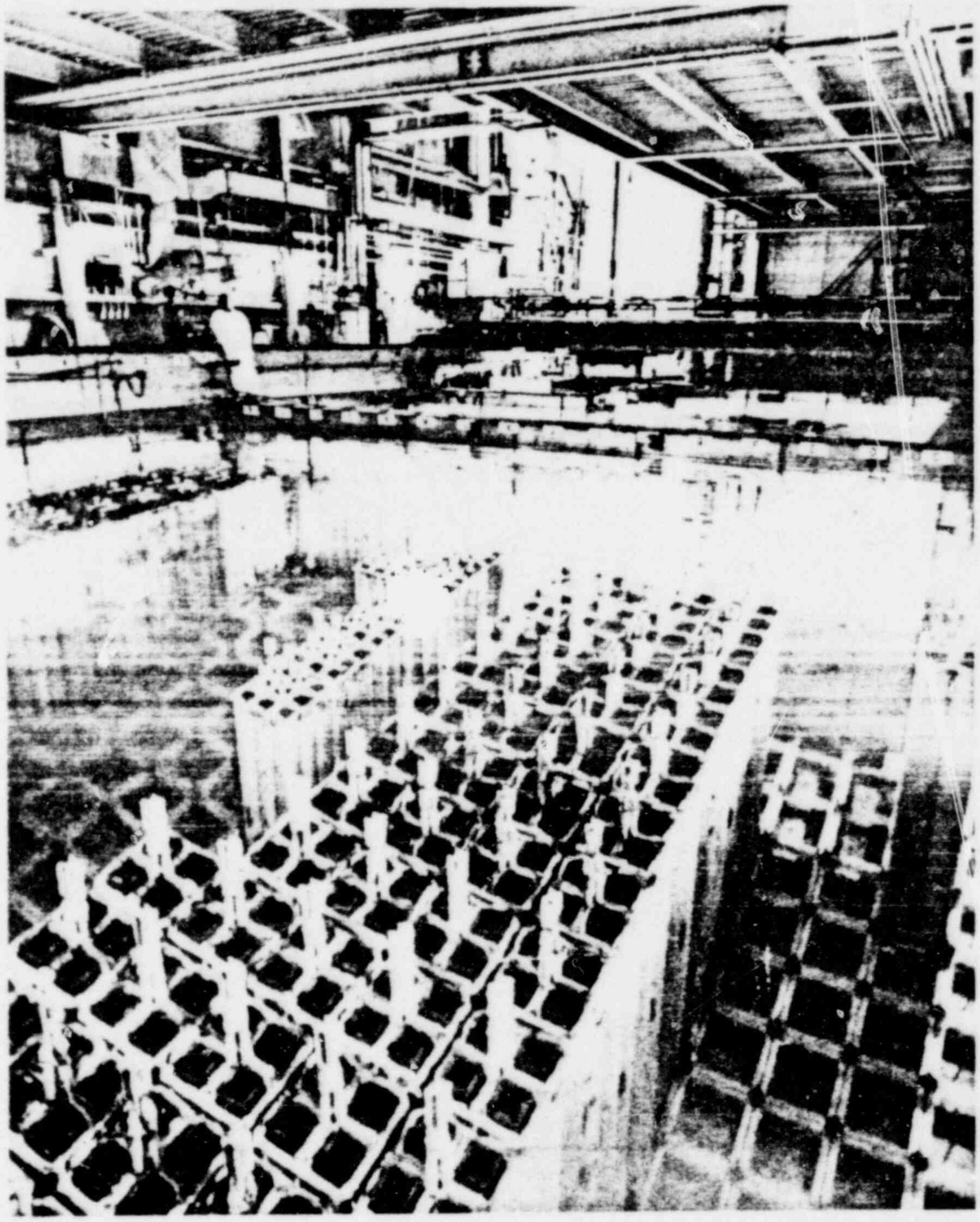

FUEL STORAGE BASIN AREAS AT MORRIS OPERATION: VIEW ACROSS THE TWO FUEL STORAGE BASINS AT MORRIS OPERATION, WITH THE CASK RECEIVING AREA IN THE BACKGROUND (LIGHTED AREA). IRRADIATED FUEL IN THE FOREGROUND IS STORED IN STAINLESS STEEL BASKET ASSEMBLIES, WHICH ARE LOCKED INTO A SUPPORT GRID ON THE FLOOR OF THE BASIN. WATER DEPTH IS ABOUT 14 FEET TO THE TOPS OF THE FUEL BUNDLES, WITH A TOTAL DEPTH OF ABOUT 28 FEET.

POOR ORIGINAL

OPERATING EXPERIENCE – IRRADIATED FUEL STORAGE
MORRIS OPERATION

REVISION SUMMARY

Revision & Amendment	Date	Summary
NEDO-20969B	5/78	Reissue and update – Replaced issue dated 8/75
NEDO-20969B1	9/78	Incorporates errata and Appendix B1, environmental monitoring report for 1977
NEDO-20969B2	1/79	Update to incorporate 1978 data
NEDO-20969B3	4/79	Incorporates Appendix B2, environmental monitoring report for 1978
NEDO-20969B4	9/80	Incorporates changes and Appendix B3, environmental monitoring report for 1979

Revision Coding Key: New or changed information is indicated by vertical bars in the right-hand margin opposite the new or changed information: "N" indicates new information; "E" indicates editorial changes or corrections.

Document Number Key: NEDO 20969B1

- NEDO – Prefix
- 20969 – Serial
- B – Revision Series
- 1 – Revision Amendment

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1. INTRODUCTION AND SUMMARY

1.1 PURPOSE AND SCOPE

General Electric Company owns and operates the Morris Operation, a facility near Morris, Illinois, for the storage of irradiated nuclear fuel from light water reactors. The Morris Operation is a functional component of General Electric's Nuclear Fuels and Services Division (NFSD), with headquarters at San Jose, California. E

This report contains a discussion of operating experience at Morris Operation for the period between January 1972 and the date shown on the cover and title page of this issue. This report will normally be revised annually by issuing replacement or new pages to incorporate operating experiences from the preceding year. E

1.2 THE MORRIS OPERATION

The fuel storage facility at Morris Operation includes water-filled basins equipped with cranes, a water cleanup system, waste management systems, and other provisions required to receive irradiated fuel and store it under water for an interim period, until final disposition.[1-1] The fuel storage facility is designed to protect the integrity of the fuel rods under all operating conditions and during seismic or meteorological events. Special provisions can be made for storage of damaged or leaking fuel. Security measures are in effect to protect stored fuel as required by Federal regulations.

Detailed descriptions of the facility and fuel storage operations are contained in General Electric publication NEDO-21326C, *Consolidated Safety Analysis Report for Morris Operation.*[1-2]

1-1 Statement by the President of the United States on Nuclear Power Policy, April, 1977.

1-2 Also, NEDO-21326, revisions A through A4, which are consolidated by NEDO-21326C.

1.3 SUMMARY OF OPERATIONS

Since 1972, more than 1000 bundles of irradiated fuel from BWR and PWR[1-3] power plants have been received and stored at the Morris Operation facility. Effective control of radioactive material in the basin water and other factors, such as water temperature, cask contamination, and airborne radioactivity, as well as safe and efficient methods of cask and fuel handling, have been demonstrated. There has been no appreciable fuel leakage as determined by measurement of radioactivity in the basin water. Fuel shipments by truck and rail have been completed safely and efficiently. These years of operations have resulted in no significant environmental impact.

Experience in storage of irradiated nuclear fuel from light water reactors, both in the United States and abroad, has demonstrated that this is a technically uncomplicated and passive operation. There are no forces involved in fuel storage at Morris Operation with the potential for causing an energy release large enough to disperse the fuel in a form that could be carried, in any biologically significant quantity, to an off-site location to pose a threat to public health and safety.

1-3 Boiling Water Reactor (BWR) and Pressurized Water Reactor (PWR), are the two principal forms of Light Water Reactors (LWR).

2. IRRADIATED FUEL RECEIPT AND STORAGE

2.1 PRINCIPAL FACILITIES AND ACTIVITIES

Fuel receipt and storage operations constitute the principal activities at Morris Operation. The facilities directly involved in fuel receipt and storage are the concrete, stainless-steel-lined basins; cranes and lifting equipment; stainless-steel fuel storage baskets and mounting grid, and the fuel shipping casks. Activities include cask receipt, with associated monitoring and flushing operations; cask unloading, and; movement of fuel baskets to storage positions.

2.2 IRRADIATED FUEL RECEIPT

The first fuel for storage at Morris Operation was received in January 1972. Fuel has been received every year since then, with the largest quantity (512 fuel bundles) received in 1976. The first shipments were made in IF-100 and IF-200 shipping casks from Connecticut Yankee and San Onofre nuclear power plants. Beginning in 1975, the NFS-4 casks were used to ship fuel from Point Beach and San Onofre. The IF-300 casks (Figure 2-1) were used during 1975-1977 to ship fuel from Dresden reactors to Morris Operation. Although over only a short distance (about 2 miles), this activity provided valuable experience in handling these large casks.

2.2.1 Fuel In Storage

Figure 2-2 shows the accumulation of irradiated fuel in storage according to fuel origin. The illustration is based on a weight per fuel bundle of about 0.4 TeU and 0.2 TeU for PWR and BWR fuel respectively.[2-1] Fuel received through the cutoff date for this report is listed in Table 2-1. E

2-1 TeU: Metric ton of uranium as contained in fuel rods; equal to one megagram (Mg).

Table 2-1

FUEL RECEIPTS FROM JANUARY 1972

Reactor Origin	Assemblies	TeU	Spaces#
PWR			
Haddam Neck	80	33	20
Point Beach	109	42	27-1/4
San Onofre	254	90	63-2/4
	443	165	110-3/4
BWR			
Dresden	753	145	83-6/9
Lacrosse*	8	1	8/9
	761	146	84-5/9
TOTAL##	1204	311	195+

NOTES

#"Space" - one basket, either PWR or BWR. Fraction (2/4, etc.) indicates partial basket loads (2 out of 4, etc.).

##Fraction of basin capacity occupied 12/31/79 = 47.3%
Available spaces, including parking = 415

*Temporary storage; to be returned.

2.2.2 Cask Experience

Since 1972, casks have been received, unloaded, and reshipped safely and efficiently. During this period only a few events occurred involving casks that required reporting to the USNRC. These events included a cask tipping incident in 1972, minor damage to a cask sealing surface in 1976, and the receipt of casks with cavity inner valves open in 1977. Casks have been received with minor smearable contamination on the surface, but this was not caused by leakage of the cask contents, and health and safety standards were not exceeded.

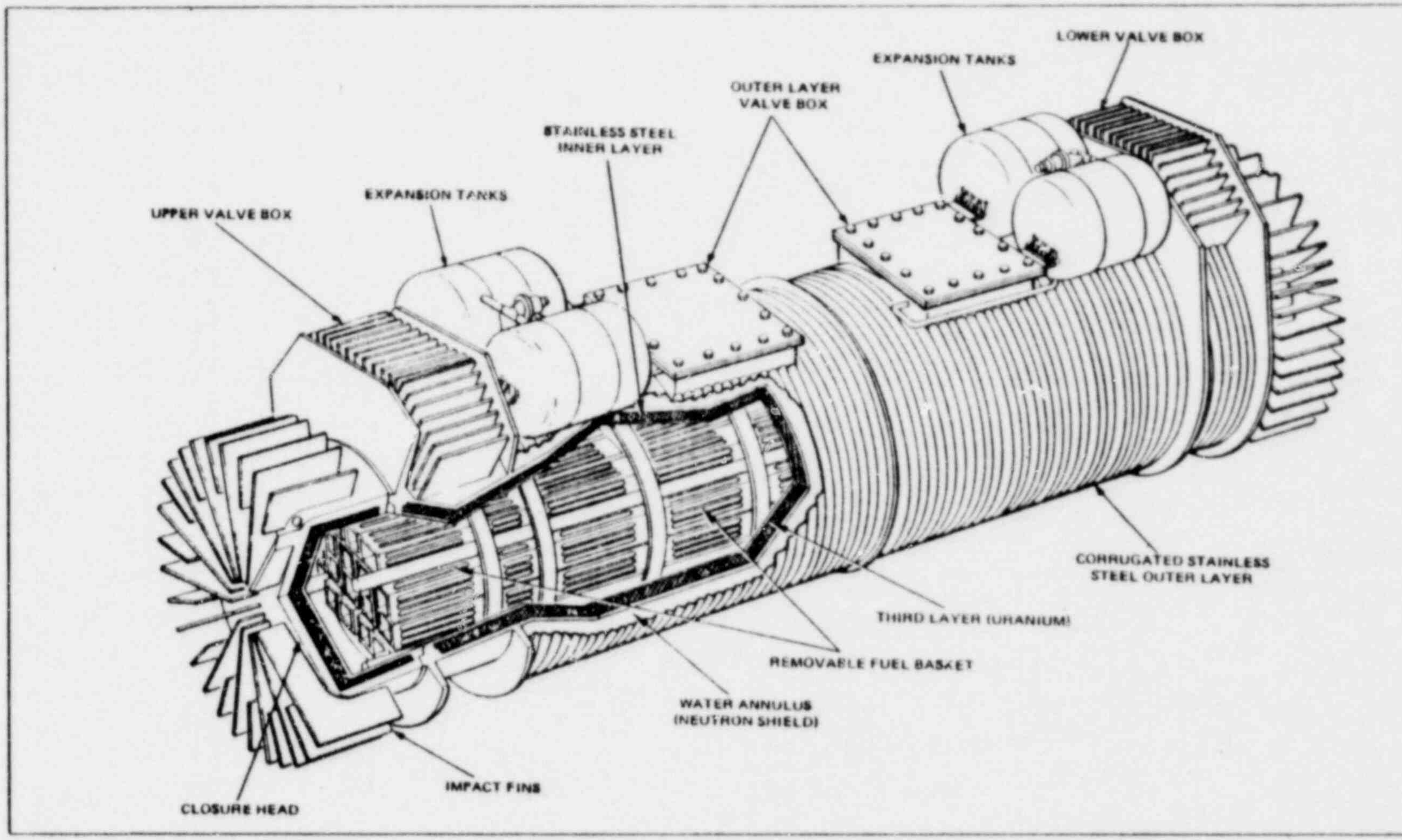


Figure 2-1. IF-300 Irradiated Fuel Shipping Cask: Using different inserts, spacers, baskets and closure heads, the cask can accommodate 7 PWR or 18 BWR fuel bundles. Demineralized water or air may be used as internal heat transfer media. The cask is about 18 ft long, 6 ft in diameter (overall), and weighs about 53 tons empty and 64 tons with fuel. Licensed by USNRC, the cask will withstand accident conditions, dissipate decay heat and present negligible radiation at the cask surface. It is a multi-modal cask, usually shipped in a special, skidmounted enclosure on a 100-ton rail car with self-contained cooling air system and other equipment.

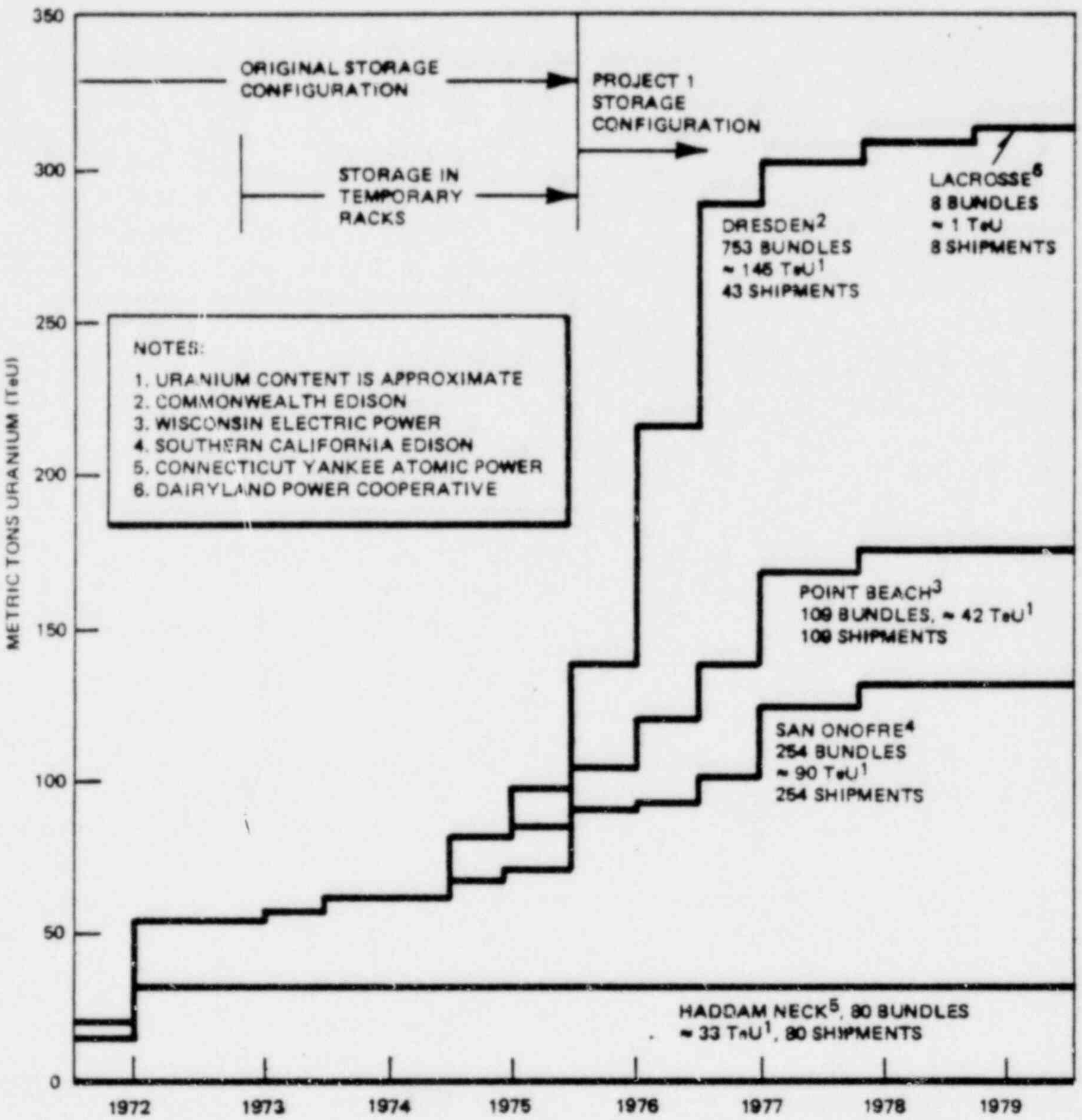


Figure 2-2. History of Fuel Receipts at Morris Operation

2.3.1 Liner Leakage

Water collected in the basin leak detection sump is routinely sampled and analyzed to determine basin leakage rate versus intrusion water from surrounding rock strata. The liner leak rate has been less than one liter per day. The remaining water flow has come from the surrounding rocks (intrusion water) rather than from the basin.

2.3.2 Expansion Gate Leakage

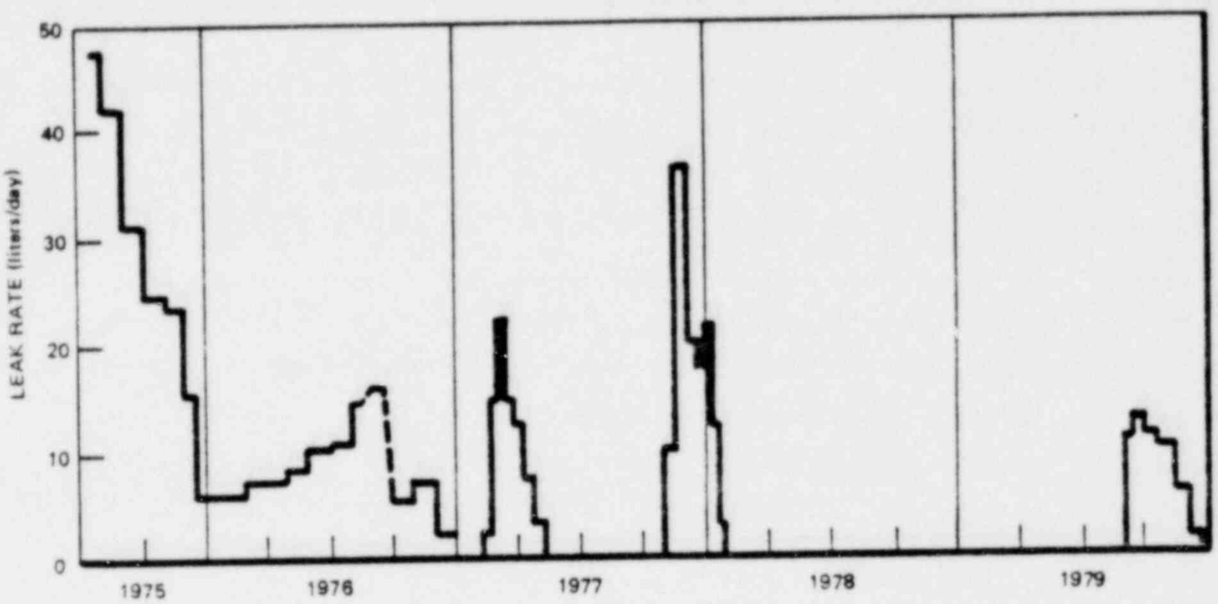
A small leak in the expansion gate was discovered in late 1971. A sump was constructed in the bottom of the gate opening to collect the water, which is jetted to the low activity waste (LAW) vault. In 1975 a level indicator and recorder were installed to record the leak rate. Rates vary from nearly 50 ℓ/day to less than 1 ℓ/day (see Figure 2-3). The leakage appears to be influenced by both basin water temperature and ambient temperature.

2.3.3 Cranes and Lifting Equipment

Experience with the three principal cranes (125 ton radio-controlled cask handling crane; 5 ton fuel handling crane; and 7-1/2 ton basin crane) has been very good. Routine maintenance programs for this machinery are in effect, including scheduled inspections. Several types of yokes are available to meet lifting requirements for casks now in use, as well as the necessary grapples for movement of baskets and fuel bundles. No deficiencies of safety significance have been found in this equipment.

2.3.4 Fuel Storage System

The fuel storage system utilizes uniformly spaced baskets (26-inch square baskets on 27-inch centers), consisting primarily of vertical sections of



N Figure 2-3. History of the Basin Expansion Gate Leak Rate

3. SUPPORT SYSTEMS

3.1 PRINCIPAL EQUIPMENT AND ACTIVITIES

The support systems include the basin water cooling system, basin water cleanup system, the ventilation system, and waste management systems. Experience with these systems is discussed in this section. Conventional plant systems, such as the on-site water system and electrical system, are not discussed; experience with these systems has not disclosed any operational characteristics or problems peculiar to nuclear fuel storage.

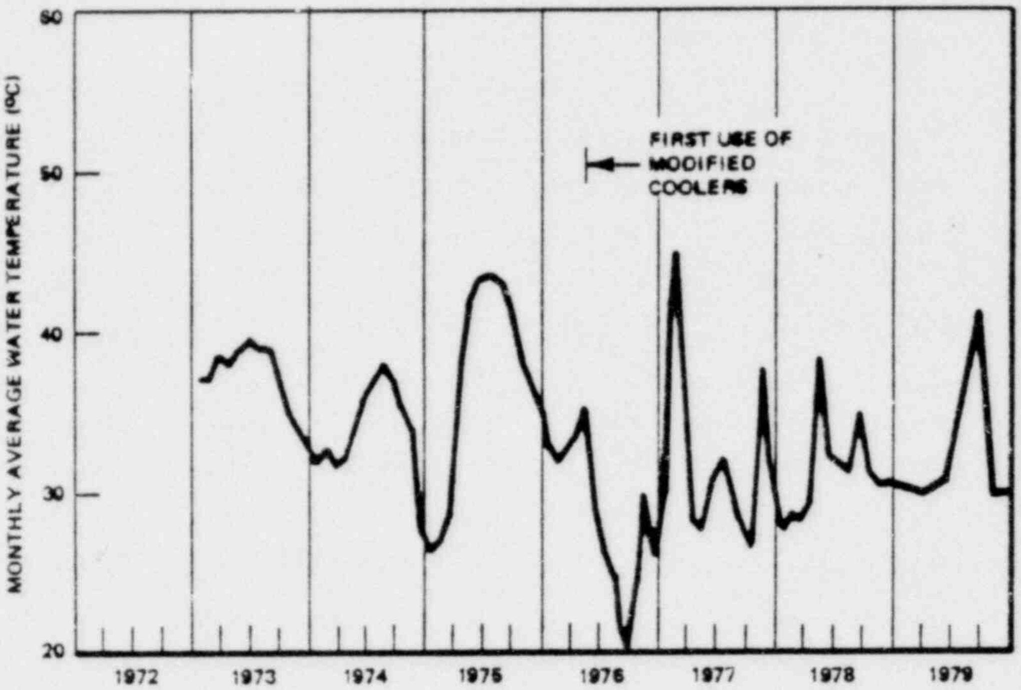
3.2 BASIN WATER COOLING SYSTEM

The basin water cooling system includes a pumping system to circulate basin water through one or more of three sections of finned-tube heat exchangers cooled by fan driven ambient air. The coolers are mounted outside of, and adjacent to the southwest wall of the Basin 2 area. Since construction, the coolers have been modified by the addition of heaters, an enclosure, and a pneumatic blow-down system, and one section has been refitted with stainless steel components.

3.2.1 System Modification

The basin water cooling system was first used in 1973 but was shut down almost immediately because of contamination of basin water by corrosion products (rust particles, etc.) from carbon steel components of the system. An intensive filter compaign returned the basin water to its normal clarity in a few days. The coolers were not operated again until May 1976, after one cooler section of three tube bundles and related piping had been replaced with stainless steel components.

During this period, basin water was cooled by evaporation, and conduction through the basin walls. The temperature of the basin water followed seasonal ambient temperature variations (Figure 3-1).



N Figure 3-1. History of Basin Water Temperature at Morris Operation

When the modified cooler was placed in operation in May 1976, there was a sharp reduction in water temperature. Since then the coolers have been run continuously except for maintenance and repairs, operational tests, and periods during summer days when the ambient air temperature is the same as or higher than basin water temperature. During hot summer weather, the cooler is normally run at night when cooling is more efficient and turned off during the day to conserve energy.

3.2.2 Cooler Freezeup

In January 1977 a single cooler section was being used, when electrical power to the plant failed during bitter cold weather with high winds (wind chill factor - 67°F). Water in the cooler froze and caused a leak at a tube-header junction. After the cooler thawed (about 50 hours later), the system was shut down and drained. A small amount of gravel under the coolers became slightly contaminated by basin water that leaked from the cooler and was removed and disposed of as low level waste.

A pneumatic quick drain system, insulation on the pipes and distribution boxes, and additional propane heaters have been installed to prevent a reoccurrence of cold weather problems. Cooling system pumps have been connected to the standby electrical power system.

Pending these modifications and warmer weather, the coolers remained shut down and basin water temperature was allowed to come to equilibrium. The increase from 31°C in January of 1977 to 45°C in March (averages) shown in Figure 3-1 resulted from this cooler shutdown.[3-1] With the onset of warmer weather, an undamaged portion of the cooler was placed in operation and the damaged section was repaired.

3.2.2.1 Heat Load

The heat input to the basin from decay of radioactivity in the fuel increased gradually with an increase in the amount of fuel stored, and decreased as a function of time in storage. Figure 3-2 shows the approximate heat load history. The increases in 1975, 1976, and 1977 reflect the receipt of more recently discharged fuel, some out of the reactor only 128 days at the time of receipt at Morris Operation.

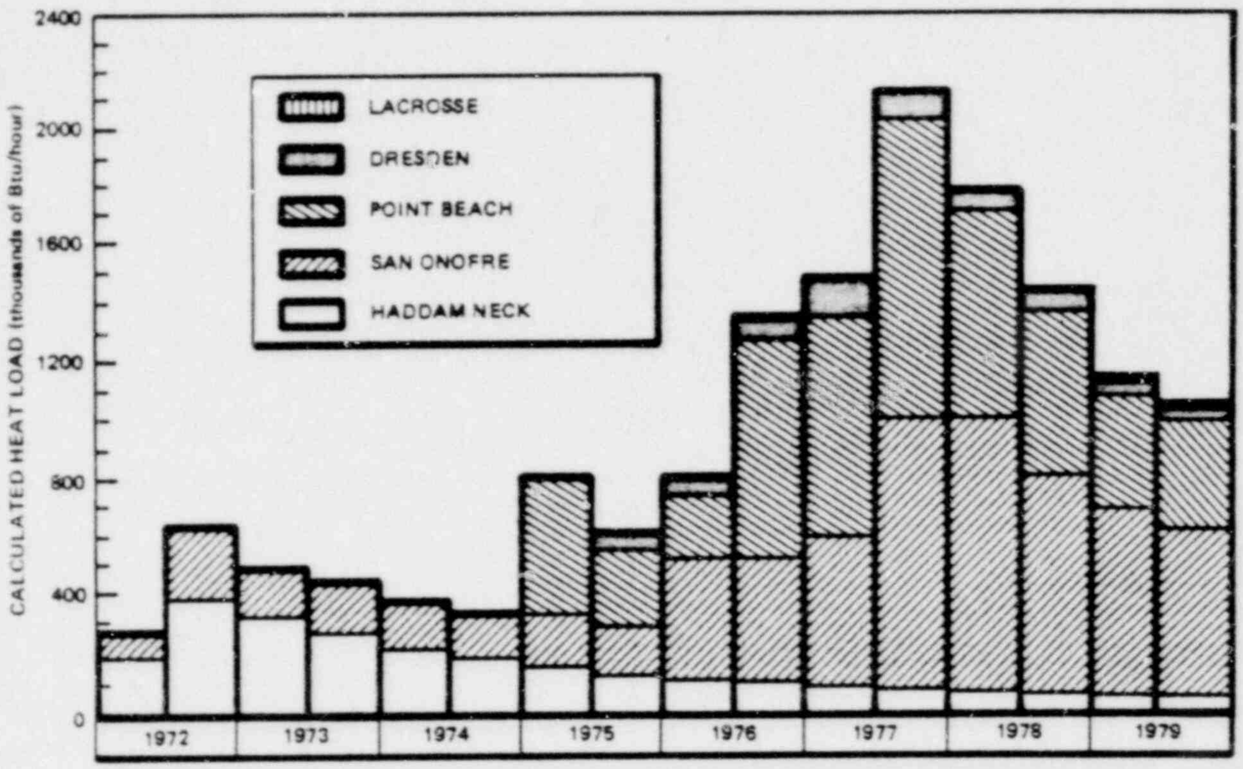
3.2.2.2 Cooler Contamination

Radioactive material from the basin water accumulates on the inner surfaces of cooler piping, tubes, and headers. A sample of material taken from the inner surface of the cooler piping in March 1977 contained Cs-134 (15%), Cs-137 (45%), and Co-60 (40%). Average monthly exposure rates are shown in Figure 3-3. The rapid increase in the second half of 1977 was caused by the underwater cleaning of an insert for the IF-300 cask. Chemical cleaning techniques introduced in 1978 provided improved control of cooler exposure rates.

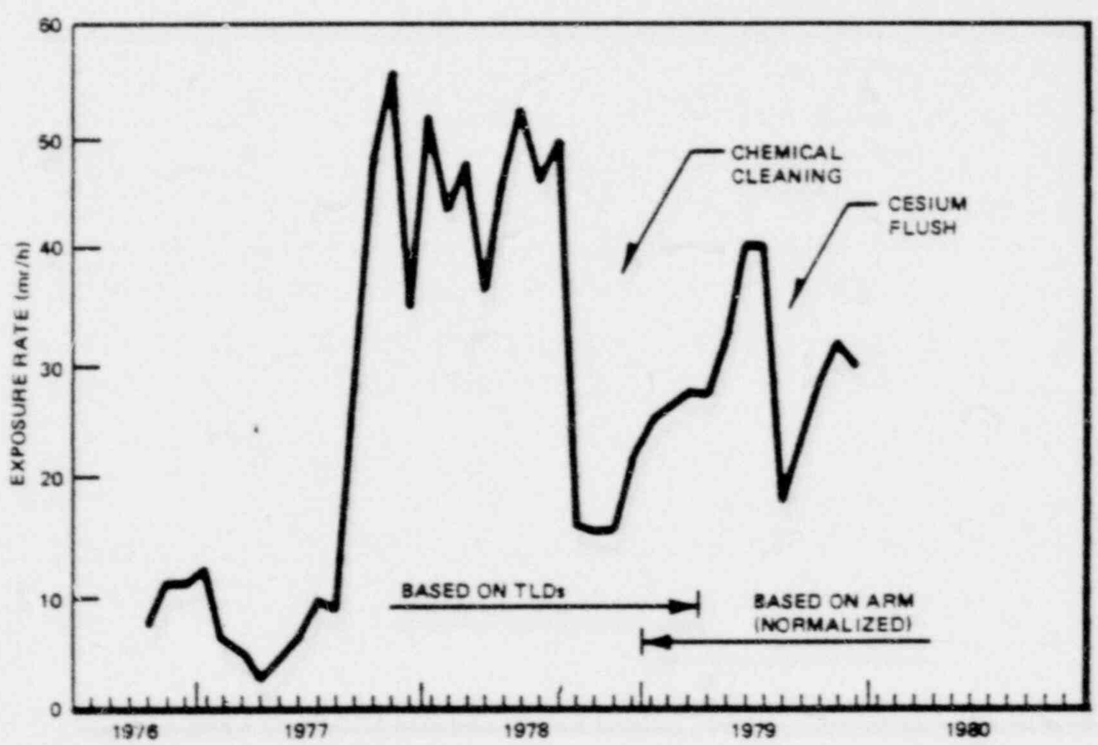
3.2.3 Cooler Operation Summary

In summary, experience has shown that the fin-fan coolers will provide the cooling service required by water basin fuel storage, but that cold weather provisions

3-1 The scale of Figure 3-1 does not show the equilibrium period (about 47°C for two weeks).



N Figure 3-2. History of the Heat Generated by Fuel Stored at Morris Operation



N Figure 3-3. History of Cooler Exposure Rates and corrosion-resistant construction are necessary. Contamination buildup in the cooler system was sharply reduced beginning in mid-1978 using new chemical decontamination techniques. E

3.3 BASIN WATER CLEANUP SYSTEM

The basin water cleanup system is a precoated filter-demineralizer system with associated pumps, valving and controls. The filter is located in a shielded room to protect operating personnel from accumulated radioactive material.

3.3.1 Operational History

From the beginning of fuel storage operations in 1972, soluble radionuclides, principally radiocesium and radiocobalt,[3-2] were found to transfer to the basin water (Figure 3-4). The concentration of these chemicals has been controlled by a mixture of anion and cation exchange resins used in conjunction with a cellulose fiber filter aid. The filter system removes both particulate and ionic chemical materials.

The decision to increase the storage capacity of the basins to about 750 TeU[3-3] stimulated an investigation of the transfer mechanism for radiochemicals from fuel to water, and of improved methods of removing these chemicals from the basin water. Sharp changes in basin radioactive inventory during June - December 1975 reflect tests conducted during this investigation, including periods when the inventory was deliberately allowed to increase as a part of the test program.

Based on the results of these tests, the filter charge was altered in early 1976 to include Zeolon-100[3-4], an inorganic ion exchange medium with high specificity and affinity for cesium. As a result, the removal rate of radiocesium was improved. The concentrations of radiocesium and radiocobalt have

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3-2 From 1972 through 1975, radiocobalt constituted only a few percent of the total radioactive material in basin water. Radiocesium was the predominant constituent.

3-3 Referred to as Project 1. Because of anticipated fuel mix (as of March, 1978) the capacity will probably be about 700 TeU.

3-4 A proprietary product of the Norton Co.

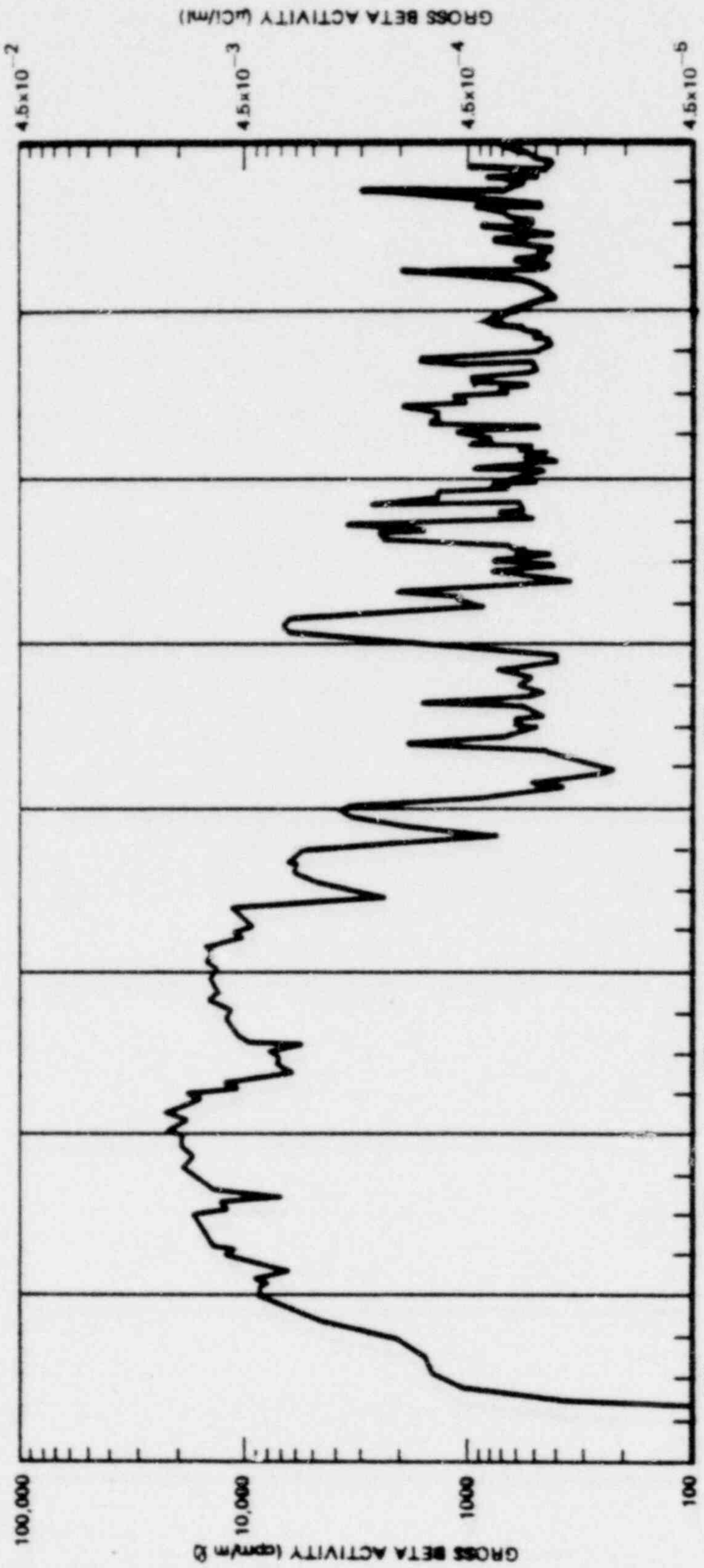

Figure 3-4. History of Morris Operation Basin Water Activity

averaged about 3×10^{-4} and 1×10^{-4} μci/mℓ, respectively, except for periods when the filter system was not operated (MPC_w for restricted areas for Cs-134[3-5] is 3×10^{-4}; for Co-60 it is 1×10^{-3}).

The history of the concentration of tritium in the basin water is shown in Figure 3-5. This data is consistent with an annual transfer from fuel of 120 to 135 mCi. This quantity is reduced by an effective basin water evaporative loss of 50 to 100 gal/day. The concentration of tritium is expected to reach equilibrium, when the losses through evaporation and tritium decay equal the transfer rate, at about 5.5×10^{-4} μCi/mℓ. E

3.3.2 Chemical Cleanup

In early 1972 a substantial quantity of sodium nitrate ($NaNO_3$) was introduced into the basin water. This material had been used as antifreeze in several casks and contaminated the basin water to the extent of at least 250 parts per million. This reduced the effectiveness of the resin ion-exchanger in control of chloride and radiocesium. No special efforts were made to remove the $NaNO_3$ other than one period of increased filter change frequency in late 1972. This resulted in a brief acceleration of the reduction in $NaNO_3$ concentration (Figure 3-6). The chloride concentration remained relatively constant through the entire period when $NaNO_3$ was present at concentrations greater than 10 parts per million. The routine use of the filter system resulted in gradual removal of the sodium nitrate. In March of 1976 the frequency of filter change was accelerated - on one occasion, six changes were made in two days. As the sodium nitrate approached five parts per million, the chloride concentration began to drop rapidly. By the end of April 1976, chloride, sodium, and nitrate were all below analytical detection limits (0.02 ppm Cl, 0.2 ppm Na, and 0.2 ppm NO_3), where they have remained.

3-5 Cs-134 is used as a basis, since it is more restrictive than the MPC for Cs-137. E

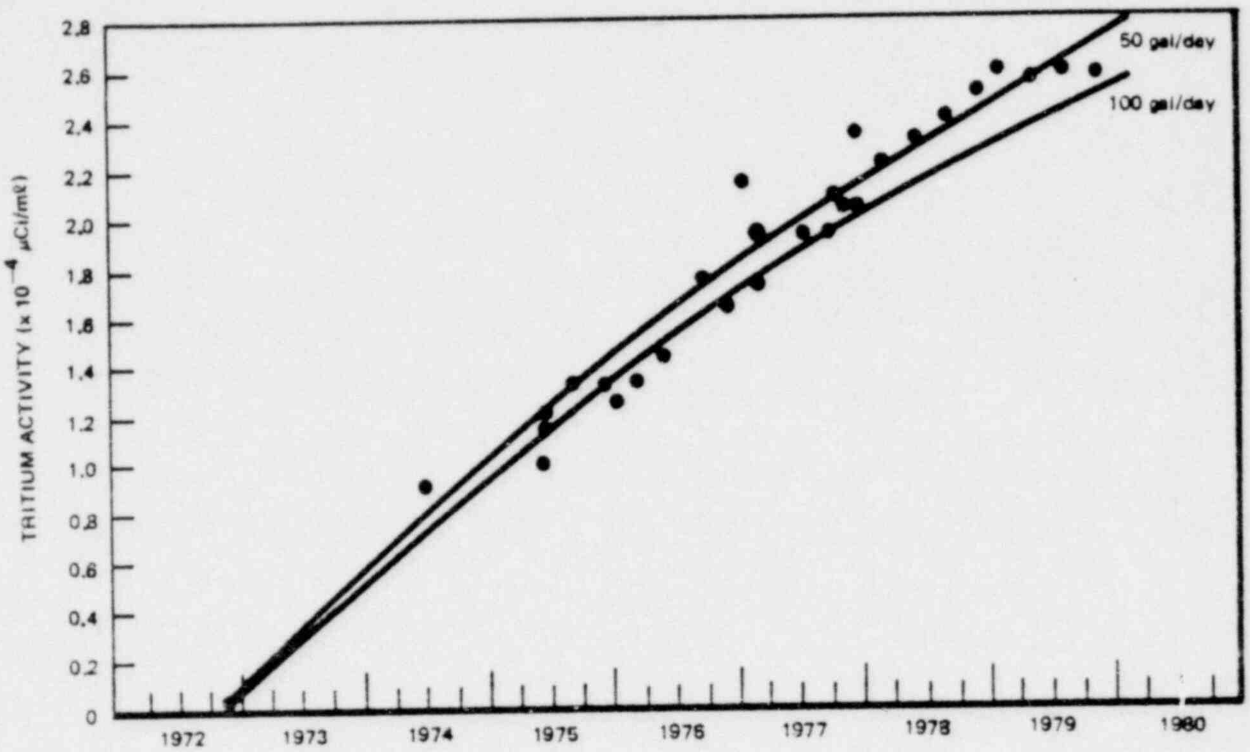

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Figure 3-5. Tritium Activity

Table 3-1

IONIC IMPURITIES IN BASIN WATER
(October 1975)

Element	PPM	Method
Li	0.02	SSMS*
Mg	0.01	SSMS
Al	0.01	SSMS
Cl	0.8	SSMS
K	0.08	SSMS
U	0.008	SSMS
NO_3	7.9	Wet Chem.
B_4O_7	2.7	Wet Chem.
Cl	1.6**	Wet Chem.
SO_4	0.05	Wet Chem.

*Spark Source Mass Spectrography

**Limit of detection

2 kilograms of Zeolon-100 are needed to partition the radiocesium in the basin so that 88% is captured by the exchanger and only 12% remains in the water. For example, the application of 2 kilograms of Zeolon-100 to the basin filter three times in succession would reduce an initial basin inventory of 1000 curies to less than 2. In this case, as with any true ion-exchanger which is not pushed to capacity, the limiting rate of removal is determined by the rate of approach to equilibrium. Since the turn-over rate of the basin water is 45 hours, the time to reach equilibrium is several days.[3-8]

3-8 Details of these studies are contained in the following paper: L. L. Denio, D. E. Knowlton, E. E. Voiland; *Control of Nuclear Fuel Storage Basin Water Quality by use of Powdered Ion Exchange Resin and Zeolites*; ASME 77-JPGC-NE-15 (June, 1977).

3.4 VENTILATION SYSTEM

Air quality in the Morris Operation fuel storage areas (main building), and environs is controlled through the building ventilation system, the sand filter, and the stack.

3.4.1 Work Area Air Concentrations

Table 3-2 gives the concentrations of particulate radioactive materials in air within the building and in the exhaust air. Without exception, these concentrations have been much less than the applicable MPC values.

Table 3-2

AVERAGE CONCENTRATIONS OF RADIOACTIVE MATERIAL IN AIR IN WORK AREAS AT MORRIS OPERATION

($\times 10^{-12}$ μCi/mℓ)

Gross α[1] and Gross β[2]	Decontamination Area					
	Upper	Lower	Basin	Canyon[4]	Laboratory	Outside Air
1976						
α	0.06	Note 3	0.11	0.04	0.08	0.19
β	2.6	Note 3	2.2	7.9	0.27	0.49
1977						
α	0.01	0.05	0.03	0.03	0.04	0.10
β	0.23	15.0	4.00	4.3	0.24	0.46
1978						
α	0.03	0.10	0.04	0.03	0.04	0.06
β	0.99	25.0	3.1	3.9	0.28	0.42
1979						
α	0.07	0.15	0.08	0.05	0.07	0.08
β	2.9	14.9	0.75	20.8	0.32	0.39

<u>Notes</u>:
1. U natural $MPC_A = 1 \times 10^{-10}$ μCi/mℓ
2. Cs-134 $MPC_A = 1 \times 10^{-8}$ μci/mℓ
3. Single monitor in decontamination area until 1977.
4. Related to use of evaporator. Canyon area not considered as a work area - no routine activity.

An increase in concentrations in the basin exhaust plenum occurred during the fourth quarter of 1976 and was attributed to work in a temporary greenhouse erected to control contamination while cutting up hardware from the original fuel storage system on the decon pad. Ventilation air from the greenhouse was exhausted directly into the plenum. The 1979 increase in the canyon was caused by LAW evaporator operation with the cell cover removed. E

Concentrations of airborne radioactivity in many portions of the building, as typified by values in the Laboratory, are lower than those in the outside air. This is the result of filtration of the air as it is drawn into the building. Concentrations of radioactive material in the building exhaust air, downstream of the sand filter, have been lower than the applicable MPC values. The amount of radioactive materials released to the environment by way of the stack is shown on Table 3-3. E

Table 3-3

SUMMARY OF RELEASES OF RADIOACTIVE MATERIAL AT MORRIS OPERATION VIA THE MAIN STACK N

Half Year	Gross Alpha Activity		Gross Beta Activity	
	Amount μCi ***	Highest Off-Site Concentration*1 μCi/mℓ	Amount μCi ***	Highest Off-Site Concentration*2 μCi/mℓ
2nd Half 1974**	78	6.6×10^{-19}	115	9.6×10^{-19}
1st Half 1975	16	3.8×10^{-20}	51	1.2×10^{-19}
2nd Half 1975	10	3.2×10^{-20}	33	1.0×10^{-19}
1st Half 1976	7	2.7×10^{-20}	18	6.8×10^{-20}
2nd Half 1976	11	4.5×10^{-20}	28	1.2×10^{-19}
1st Half 1977	4	2.3×10^{-20}	15	8.5×10^{-20}
2nd Half 1977	6	3.1×10^{-20}	119	6.1×10^{-19}
1st Half 1978	3	1.3×10^{-20}	15	6.7×10^{-20}
2nd Half 1978	20	1.2×10^{-19}	52	3.0×10^{-19}
1st Half 1979	4	1.7×10^{-20}	30	1.3×10^{-19}
2nd Half 1979	5	3.2×10^{-20}	28	1.8×10^{-19}

NOTES: *Calculated average over the period indicated

**Data not tabulated prior to July 1974

***To obtain average concentration in μCi/mℓ divide by 1.93×10^{14} mℓ (total flow in 6 mo.)

1. U natural $MPC_A = 5 \times 10^{-12}$ μCi/mℓ
2. Co-60 $MPC_A = 3 \times 10^{-10}$ μCi/mℓ

3.4.2 The Sand Filter

The sand filter has operated effectively in removing radioactive particulates from the main building exhaust air. Two incidents occurred that reduced air flow capacity.

3.4.2.1 Sand Filter Problems

In May 1972 a plugged ventilation line between the fluorine building and the sand filter, and an increase in the pressure drop across the sand filter prompted a sand filter inspection. The top surface of the sand was found to be caked with electrolyte from the fluorine building. The top layer of sand was raked to return it to its original consistency, and the vent lation line from the fluorine building was routed directly to the air via a 35-ft stack. In addition, monitoring of the sand filter at various depths was begun. (Since then the fluorine generating equipment and hydrogen fluoride have been removed from the site.)

In 1973 another increase in sand filter pressure drop was observed, this time in the bottom of the filter. Inspection via an air-tunnel entry uncovered a partial clogging of the inlet screens. This was attributed to process start-up work. The screens were cleaned, and a second set of screens, more readily accessible than the first, was placed upstream.

3.4.2.2 Filter Efficiency

Efforts have been made to determine the particulate removal efficiency of the sand filter. The first time the downstream activity was so low it could not be determined, and the second time, the downstream activity was near the threshold for detection. Based on the values determined in the second assessment the efficiency was found to be 98.9% for Co-60 and 99.8% for Cs-137 and Cs-134.

3.5 WASTE WATER MANAGEMENT

There are three categories of waste water at Morris Operations; water contaminated with radioactive materials, industrial waste water, and sanitary wastes. Each of these categories is discussed in the following paragraphs.

3.5.1 Radioactive Waste Water

The accumulation of contaminated water at Morris Operation began in 1972 with the first receipt of irradiated fuel and the initiation of cold startup tests of MFRP using natural uranium. The LAW vault was filled to near capacity in October 1973. About 300,000 gallons were transferred to the cladding vault to give additional latitude in the use of the LAW vault, and boiloff of the LAW solution was begun. No liquid radioactive waste has been shipped or otherwise moved from the site.[3-9]

3.5.1.1 LAW Dewatering

In the initial boil-off campaign, water in the LAW vault was reduced from 454,000 gallons to 169,000 gallons over a 4-month period. Most of the water in the cladding vault was then transferred back to the LAW vault and boiled off. Since the conclusion of this campaign, contaminated water has been collected continuously from fuel storage activities and periodically boiled off (usually in the autumn). Two-to-three months of boiloff have accommodated the buildup of LAW vault liquid for an entire year. The accumulation and boildown of radioactive waste water since the end of the first campaign is shown in Table 3-4.

Contaminated water in the LAW vault has increased as new material accumulated each year from fuel receiving and storage, and concentrations have increased as a result of the boildown campaigns. A quantitative assessment of the actual contents of the vault is complicated by the existence of a slurry at the bottom of the vault and the resultant heterogeneity. Best estimates of the

[3-9] Refer to NEDO-21326, Chapter 5, for information regarding sources of low activity waste collected in the LAW and cladding vaults.

Table 3-4
HISTORY OF LAW VAULT USAGE

Activity	Date	LAW Vault Net Change (Gallons)
Accumulation	to 10-5-73	+589,000
Transfer to Cladding	to 10-17-73	-135,000
Evaporation and Accumulation	to 2-18-75	-285,000
Jet from Cladding Vault, normal	to 5-20-75	+76,000
Evaporation and Accumulation		
Pump from Cladding Vault	to 6-4-75	+166,000
Evaporate	to 10-25-75	-229,000
Accumulate	to 9-1-76	+171,000
Evaporate	to 11-6-76	-183,000
Accumulate	to 10-13-77	+167,000
Evaporate	to 12-15-77	-105,000
Accumulate	to 6-9-78	+64,000
Pump from Cladding Vault	to 6-11-78	+50,000
Accumulate	to 9-24-78	+43,000
Evaporate	to 11-5-78	-139,000
Accumulate	to 5-19-79	+70,000
Evaporate	to 6-8-79	-78,000
Accumulate	to 7-6-79	+9,000
Evaporate	to 8-10-79	-60,000
Accumulate	to 12-31-79	+23,000
Balance	on 12-31-79	215,000

concentrations of radioactive material in the vault at various times are given in Table 3-5. Boildown campaigns have been largely uneventful. However, in the initial campaign (January 1975), a steam shutdown coincident with an over-filled condition in the boiler allowed some contaminated water to enter the utility steam system and an estimated 50 microcuries of beta emitting isotopes were released to the process sewer. This release was not detectable at the site boundary.

The most frequent maintenance item has been the failure of pumps in the LAW vault. The caustic nature of the solution has resulted in seal failures, and the pumps have occasionally had to be replaced.

Table 3-5

HISTORY OF LAW VAULT CONTENTS

N

Date	Volume of Vault Contents (Gallons)	Approximate Gross β Concentrations* μCi/mℓ	Approximate Density* g/cm^3
3-6-74	367,000	0.014	
2-18-75	169,000	0.039	
6-5-75	411,000	0.033	1.060
11-16-75	187,000	0.13	1.141
8-15-76	343,000	0.11	1.000
12-12-76	206,000	0.27	1.204
2-20-77	224,000	0.21	1.122
10-9-77	338,000	0.18	1.080
6-4-78	297,000	0.33	1.079
6-11-78	347,000	0.25	1.089
9-24-78	390,000	0.15	1.008
11-5-78	251,000	0.40	1.105
5-13-79	326,000	0.41	1.095
6-9-79	245,000	0.47	1.118
7-1-79	249,000	0.42	1.109
8-12-79	198,000	0.57	1.148
12-30-79	221,000	0.55**	1.143

*The density and concentration of the solution in the LAW vault vary with depth. These values should not be used to compute the total solids or activity in the vault.

**The major contributing isotopes were the following:

Cs-137	0.41	μCi/mℓ
Cs-134	0.053	μCi/mℓ
Co-60	0.089	μCi/mℓ

3.5.1.2 Cladding Vault

By comparison to the LAW vault, the cladding vault has been little used. Table 3-6 shows the activity in the cladding vault over about the same period as Table 3-5 for the LAW vault. Because of little use, the increase in concentrations and activities in the cladding vault have been much smaller. New accumulations since the initial retransfer of water back to the LAW vault have averaged only about 7,000 gallons per year. Cladding vault use is summarized in Table 3-7.

Table 3-6

HISTORY OF CLADDING VAULT RADIOACTIVE MATERIAL CONCENTRATION

Date	Gross β (μCi/mℓ)
July 1973	0.004×10^{-3}
November 1973	0.97×10^{-3}*
January 1975	5.1×10^{-3}
November 1975	5.3×10^{-3}
November 1977	4×10^{-3}
November 1978	1.5×10^{-3}
July 1979	2.4×10^{-3}

*Estimated from the then current LAW Vault Activity.

Table 3-7

HISTORY OF CLADDING VAULT USAGE

Event	Date	Cladding Vault Net Change (Gallons)
Accumulation	to 10-5-73	+ 49,000
Transfer from LAW Vault	to 10-17-73	+ 146,000
Accumulation	to 2-18-75	+ 17,000
Partial Jet-out to LAW Vault	to 5-20-75	- 23,000
Pump-out to LAW Vault	to 6-4-75	- 156,000
Accumulation	to 6-9-78	+ 31,000
Pump-out to LAW Vault	to 6-11-78	- 50,000
Accumulation	to 12-31-79	+ 5,000
	on 12-31-79	19,000

3.5.1.3 Radioactive Waste Summary

During the operation of the vaults, there have been few problems. The accumulation of water in the leak detection system (which is collected and returned as radioactive waste water) has been so small that measurements of it are uncertain. Best values of leakage as determined by modified isotope dilution techniques are given in Table 3-8.

Table 3-8

RECENT VAULT LEAK DETECTION EXPERIENCE

Date	Number of Determinations	Calculated Leak Rate* LAW Vault (ℓ/day)	Cladding Vault (ℓ/day)
1979	7	<0.1	<0.1
1978	6	1.6	<0.1
1977	4	0.4	0.2
1976	8	2.4	<0.1

*Determined by a modified isotopic dilution analysis

N

3.5.2 Industrial Waste Water

Operation of the process sewer began in 1971, when the process waste water consisted of well water with traces of boiler chemicals. The application for renewal of the State permit was denied in May 1974 because the process sewer discharges, in combination with those of the sanitary sewer, did not comply with lower levels required by new State of Illinois regulations. Discharges continued pending system modifications, which were completed in September 1976. The process sewer line was then diverted through the sanitary lagoons to a holding pond so that its effluents no longer leave the site. Monitoring of this water on a regular basis has shown no detectable radioactive material.[3-10]

The evaporation pond has operated under a State permit since its first use in May 1971. There has been no significant buildup of water since then, and most of the bottom remained dry. A leak in the pond via an old farm drain tile was discovered in November of 1977 and plugged in December. The release of chemicals, mainly nitrates, was monitored through sampling at the retention basin at the Corps of Engineers Pump Station where this and other water was collected for discharge to the Kankakee River. No significant concentrations were ever found, indicating that any losses from the pond were substantially diluted by

3-10 There have been three instances of concentrations up to 6×10^{-6} µCi/mℓ reported, but these measurements are suspected to be cross contamination in laboratory processes. The unrestricted area MPC_w is 9×10^{-6} µCi/mℓ (Cs-134). E the time they reached the pump station. The evaporation pond supports a variety of wildlife.

3.5.3 Sanitary Waste Water

The two sanitary lagoons were first operated in 1968 under a State permit. Modifications to the system were made ending in September 1976 in order to bring the system into compliance with new rules and definitions which became effective in July of 1974. Now the sanitary waste from the lagoons is collected in a holding pond to be used for irrigation of adjacent GE-owned farmland. Monitoring of the effluent from the lagoons has shown no detectable radioactive material.[3-11]

3.6 SOLID WASTE MANAGEMENT

Table 3-9 summarizes the production and shipment of solid radioactive waste. All of the material listed was sent through Nuclear Engineering to Sheffield, Illinois for burial. The large number of shipments and volume shipped in 1976 consisted largely of contaminated hardware replaced during the Project I modification of the plant. Solid nonradioactive waste is collected and disposed of through conventional commercial waste disposal channels.

3-11 There have been five instances of concentrations of up to 2×10^{-6} μCi/mℓ being reported but these reports are suspected to be cross contamination in laboratory processes. The unrestricted area MPC_w is 9×10^{-6} μCi/mℓ (Cs-134).

E

Table 3-9

SHIPMENT OF SOLID (DRY) RADIOACTIVE WASTE
FROM MORRIS OPERATION

N

Year	Number of Shipments	Volume (Cubic Feet)	Approximate Activity (Curies)
1972	3	1,300	0.06
1973	5	2,700	0.18
1974	6	3,700	2.4
1975	2	1,100	4.2
1976	20*	14,200	3.4
1977	3	2,500	1.5
1978**	3	1,900	3.1
1979	2	1,300	1.1
Total	44	28,700	15.9
Average			
Per Shipment	-	650	0.4
Per Year	5.45	3,600	2.0
Per Cubic Foot	-	-	0.00055

*Largely contaminated hardware replaced during Project I modification.

**1978 data corrected (Revision B4).

4. RADIOLOGICAL SAFETY

4.1 ROUTINE ACTIVITIES INVOLVING EXPOSURES

Employees at Morris Operation receive radiation exposure as a result of their duties. Certain routine activities have a higher potential for personnel exposure than others due to the nature of the work, its location, or its duration. The potential for the higher exposures exists in working with, or in the immediate vicinity of:

a. Fuel shipping casks -

Activities include monitoring, degriming, venting, flushing, head loosening, draining, head tightening, and decontamination;

b. Basin filter and associated piping -

Activities include solution makeup, maintenance, housekeeping, and filter rework;

c. Basin water -

Activities include all jobs in the fuel storage basin enclosure.

Until the summer of 1975 the most significant radiation area was the area above the basin, because of radioactive contaminants in the water. There were a few locally higher level areas such as near casks during unloading, near the cask flush line, and near the decontamination (decon) pad sump. However, since 1975, radiation exposure rates from the basin water have been reduced, the cask flush line has been shielded, and other improvements in radiation reduction have been made.

4.2 CURRENT SOURCES

The primary sources of exposure at the time of writing were contaminated piping and contaminated surfaces on the decon pad. Most of this contamination is fixed and is difficult to remove, with Co-60 the most common isotope. However, Co-58 activity has been greater during times when 120 to 150 day old fuel is received. Cesium-134 and -137 are also invariably present in significant quantities.

The three commonly used areas where exposure rates are currently the highest are the decon pad, the basin pump room, and areas near the basin coolers. Of these three, the occupancy rate of the decon pad is highest, so that area has the highest potential for personnel exposure.

4.3 EXTERNAL EXPOSURES

Three approaches were selected to study the personnel exposure experience at Morris Operation; determination of exposures by year, exposures by job title, and exposures from cask handling operations by cask type and operation.

Figure 4-1 shows the history of annual exposures at Morris Operation superimposed on a bar graph which gives the amount of fuel handled for each year. The increase of 1976 over 1975 in tons of fuel received per man-rem exposure is due to the use of the IF-300 cask. (3.6 tons of fuel per cask versus 0.4 tons per NAC-1 or NFS-4 casks). However, this benefit is partially offset, in comparison to 1972, because recent fuel shipments have been accompanied by more crud, and fuel burn-ups have been higher.

Table 4-1 gives the breakdown of exposures by job category. Since Operations personnel unload and decontaminate casks, their exposures are highest. Maintenance personnel as a group receive the next highest percentage of the total site exposure, but when exposure is figured on a per man basis Safety personnel exposures are higher than maintenance personnel. Safety personnel survey the casks in and out and survey the radiation dose rates and levels of contamination throughout the facility. Contractor personnel may exceed exposures for other personnel; see notes on Table 4-1.

N

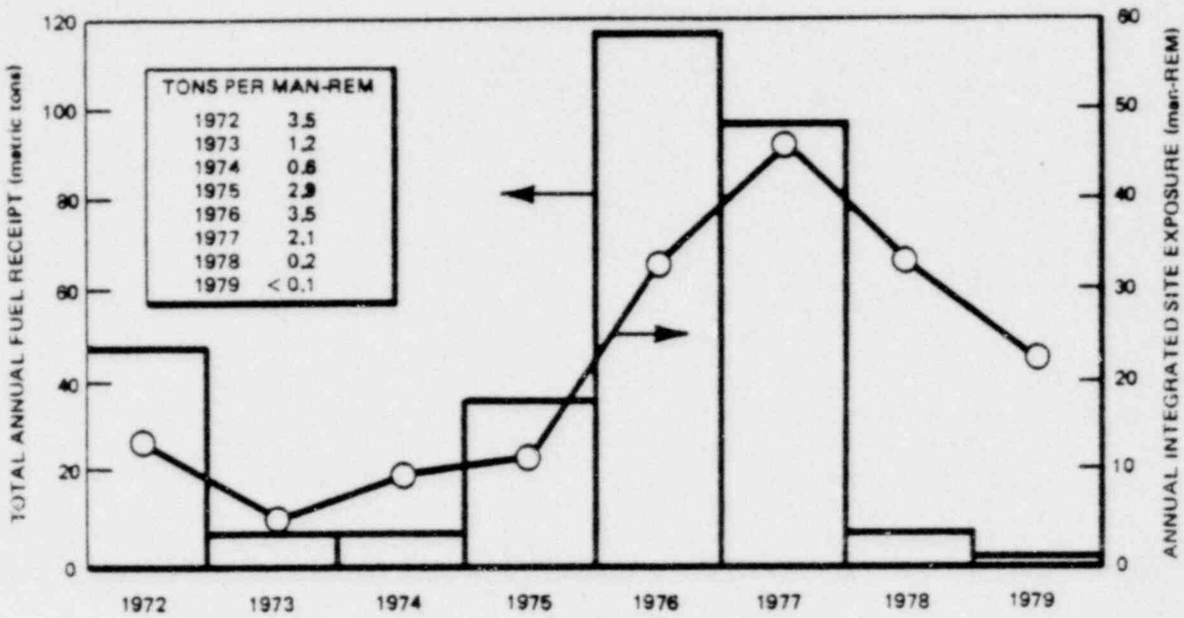

Figure 4-1. Work and Exposure Experience at Morris Operation

4.4 INTERNAL EXPOSURE

Results of whole body counting performed annually for Morris Operation personnel parallel the fuel receiving experience. Body burdens of 1 to 2 percent of the Maximum Permissible Body Burden (see footnote, Table 4-2) were seen mostly in Operations personnel, and primarily in 1972, 1975 and 1976 when fuel receiving was most intense. Table 4-2 summarizes this data.

N

Table 4-1

PERSONNEL EXPOSURES AT MORRIS OPERATION BY JOB CATEGORY

Job Category	Persons(1)	Total Exposure (Person-Rem) 1976	1977	1978	1979	Percent of 4-Year Total
Operations	19	21.6	30.9	21.4	12.4	64
Maintenance	9	2.9	6.7	7.2	3.5	15
Safety	4	3.5	4.0	3.3	1.7	9
Others	27	1.3	2.1	0.8	0.7	4
Contractors	'79 = 59(2)	3.2	2.2	0.5	4.6	8
Totals		32.5	45.9	33.2	22.9	100

Notes: 1. Numbers are typical for past 4 years, except contractor personnel where number for most recent year is specified.
2. Of 59 contractors in 1979, 20 had measurable exposure. Contractors worked on IF-300 shipping cask insert modification program.

N

Table 4-2

SUMMARY OF ANNUAL WHOLE BODY COUNTING RESULTS FOR MORRIS OPERATION PERSONNEL

Month and Year	Number of Persons Having Detectable Isotopes	Average Body Burden as Percentage of the Applicable MPBB**	Metric Tons of Fuel Received*
December 1972	27	0.9	46
November 1973	--	--	6
December 1974	--	--	6
January 1976	21	1.0	35
January 1977	26	1.5	116
November 1977	21	1.3	95
November 1978	25	1.3	7
November 1979	20	0.4	1

*See Figure 2-2; fuel received since preceding count.

**Applicable body burdens in order of importance:

Co-60 = 1.1 μCi
Cs-137 = 30 μCi
Cs-134 = 20 μCi

4.5 "AS LOW AS REASONABLY ACHIEVABLE"

It is the policy of General Electric Morris Operation to minimize personnel exposures. This policy is in full accord with the regulatory principle, "as low as reasonably achievable" (ALARA). Factors which bear on the attainment of this end are the facility design, its use, and the critical review of operational results.

Keeping exposures ALARA is achieved through personnel training, operating experience reviews, administrative controls, and engineered facility maintenance and modification.

Personnel are trained and retrained in safety, and in the conduct of their particular job. In addition, specific training is provided prior to the use of any specialized equipment, i.e., cranes. Periodic work unit safety meetings and facility wide meetings are held as needed to complement these training programs. Administrative controls require that both work and safety considerations must be defined beforehand, so that the most effective way for doing the work and the proper deployment of protective clothing and equipment can be determined.

4.5.1 Review Practices

A primary method for achieving ALARA is through the critical review of operating experience. Reviews result in identification of the cause of any unnecessary or economically preventable exposures, and identify action to eliminate them. Success in this approach has been seen in the reduction in exposure from basin water contaminants and the reduction in decon pad exposure rates through shielding of the cask flush line. In addition, a reduction in exposure rates on the decon scaffolding during unbolting of the IF-300 cask head has been achieved through the construction and use of a temporary shield. Table 4-3 gives a summary of the activities to achieve and maintain exposures ALARA and the conditions which resulted. An estimate of man-Rem saved is also included.

N

Table 4-3

RESULTS OF SPECIFIC EXPOSURE REDUCTION ACTIVITIES

Activity	Reduction	Estimated Avoidance of Exposure (Person-Rem)		
		1977[a]	1978[b,g]	1979[e]
Replacement and Shielding of the Cask Flush Line	95% of Line Exposure Rate 25% of Area Exposure Rate	1.0	1.9	1.2
Basin Water Cleanup	97% of Activity	3.0	1.8	1.0
Fabrication of Shielding Band for the IF-300	64% of Exposure Rate	1.5	-	-
Cesium Flush of Coolers[c]	100% Cesium Activity 27% of Exposure Rate	1.2	0.4	-
Coolers Freeze-Thaw Flush[c]	40% of Exposure Rate	0.6	0.6	-
Use of Torque Wrenches for removing/replacing IF-300 Cask Head	70% of Time	2.7	2.4	2.4[f]
Cooler Decontamination	86% of Exposure Rate	-	4.4	5.9
BWR Cask Insert Cleaning	99% of Exposure Rate	-	d	-
Cesium Flush of Coolers	65% of Exposure Rate	-	-	0.8
		10.0	11.5	11.3

[a]1977 exposures are estimated to have been decreased by 18% through these exposure reduction activities.

[b]1978 exposures are estimated to have been decreased by 26% through these exposure reduction activities.

[c]Parts of tests and investigations referenced in Section 3.2.3.

[d]Cleaning permitted basket (insert) modification, otherwise modification impossible. Result - reduced exposure in transit and receiving locations.

[e]1979 exposures are estimated to have been decreased by 33% through these reduction activities.

[f]Use of torque wrenches for IF-300 head removal at other facilities provides exposure avoidance in addition to that shown here.

[g]Data corrected for cooler decontamination in 1979.

APPENDIX B-3

ENVIRONMENTAL SAMPLING AND ANALYSIS
FOR
DRESDEN NUCLEAR POWER STATION

INCLUDING
GENERAL ELECTRIC'S MORRIS OPERATION

BY

EBERLINE INSTRUMENT CORPORATION
MIDWEST FACILITY

NOTE

In 1979 a separate environmental report for Morris Operation was not prepared; instead, a combined report for DNPS and Morris Operation is used.

ENVIRONMENTAL SAMPLING AND ANALYSIS

FOR

DRESDEN NUCLEAR POWER STATION

DECEMBER 1979

SUBMITTED BY

EBERLINE INSTRUMENT CORPORATION

Midwest Facility

Approved: Chandrasekaran - [signature] Date: 01/19/80
Chandrasekaran, E. S., Mgr.

The attached table lists results of radiochemical analyses on the special samples collected weekly from two locations in the Dresden cooling lake.

These samples are not part of the regular environmental radiological monitoring program and the results are not included in the regular reports. We will, however, collect, analyze, and report the results on a monthly basis until further notice.

cc: B. B. Stephenson, Dresden
J. Golden, Ceco
C. Schwarz, EIC/Sfe

Radioactivity in Water Samples from Dresden Cooling Lake
(Weekly Collections)

Collection Date	Dresden Road Crossing: pCi/l Gross β	Dresden Road Crossing: pCi/l/nuclide γ Emitters	County Line Road Crossing: pCi/l Gross β	County Line Road Crossing: pCi/l/nuclide γ Emitters
01/06/79	<5	<10	<5	<10
01/14/79	4±1	<10	(a)	(a)
01/21/79	4±2	<10	6±2	<10
01/28/79	4±3	<10	<5	<10
02/04/79	3±2	<10	5±2	<10
02/11/79	5±2	<10	4±1	<10
02/18/79	5±2	<10	17±3	<10
02/25/79	<5	<10	4±2	<10
03/03/79	<5	<10	3±2	<10
03/10/79	10±2	<10	5±2	<10
03/17/79	<5	<10	<5	<10
03/24/79	4±2	<10	<5	<10
03/31/79	3±2	<10	<5	<10
04/07/79	10±2	<10	4±2	<10
04/14/79	8±3	<10	11±3	<10
04/21/79	7±3	<10	8±3	<10
04/29/79	4±2	<10	13±2	<10
05/05/79	<5	<10	10±3	<10
05/12/79	4±2	<10	<5	<10
05/19/79	6±2	<10	5±2	<10
05/26/79	<5	<10	<5	<10
06/03/79	10±2	<10	<5	<10
06/09/79	6±2	<10	6±2	<10
06/16/79	5±2	<10	<5	<10
06/23/79	5±2	<10	<10	<10
06/29/79	4±2	<10	3±3	<10

Collection Date	Dresden Road Crossing: pCi/l Gross β	Dresden Road Crossing: pCi/l/nuclide γ Emitters	County Line Road Crossing: pCi/l Gross β	County Line Road Crossing: pCi/l/nuclide γ Emitters
07/07/79	4±2	<10	5±2	<10
07/14/79	<5	<10	4±2	<10
07/20/79	3±2	<10	<5	<10
07/28/79	<5	<10	<5	<10
08/04/79	<5	<10	4±2	<10
08/10/79	3±2	<10	<5	<10
08/19/79	15±3	<10	<5	<10
08/25/79	4±1	<10	5±1	<10
09/03/79	<5	<10	17±3	<10
09/08/79	5±3	<10	3±3	<10
09/15/79	3±2	<10	4±3	<10
09/22/79	14±2	<10	14±2	<10
09/30/79	<5	<10	<5	<10
10/06/79	10±3	<10	4±2	<10
10/13/79	4±3	<10	<5	<10
10/20/79	5±3	<10	3±2	<10
10/27/79	4±2	<10	5±3	<10
11/04/79	6±2	<10	<5	<10
11/10/79	4±2	<10	5±3	<10
11/17/79	6±2	<10	8±2	<10
11/24/79	4±2	<10	4±2	<10
12/01/79	4±2	<10	5±2	<10
12/08/79	3±2	<10	4±2	<10
12/15/79	8±2	<10	7±2	<10
12/22/79			6±2	<10
12/29/79	8±2	<10	5±3	<10

(a) Not available due to severe weather conditions.

Introduction

During the month indicated on the cover of this report, environmental sampling at, and in the vicinity of, the power station was performed on a weekly basis. This report lists the results of analyses available as of the closing day of the month for samples collected in the program. Blank spaces following dates indicate that work on this sample was not completed in time for inclusion in the monthly report.

Discussion of Results and Summary

Results of analyses available unless noted below do not indicate the presence of discernable amounts of radioactivity due to station operations in the environmental media sampled.

Deviations from Scheduled Sampling and Corrective Actions Taken

All samples were collected within the scheduled periods unless otherwise noted in the Listing of Missed Samples.

DRESDEN

LISTING OF MISSED SAMPLES

Sample Type	Location	Expected Collection Date	Reason
AP	D-01,02,06	01/13/79	Snow conditions.
SW	D-29,30	January	Drifting and closed roads.
AP	D-02	02/11/79	Malfunctioning pump.
CW	D-19-1	07/14/79	Sampling apparatus out of order.
CW	D-18	07/28,08/04/79	Sampling apparatus needs repairs.
M	D-25	08/10	Dorin sold his cows. Station replaced ASAP.
M	D-25	09/29	-

AIRBORNE IODINE-131* and GROSS BETA in AIR PARTICULATE FILTERS (Weekly Collections)

Week Ending	D-01 ONS 1 Volume (m^3)	D-01 ONS 1 Gross Beta	D-02 ONS 2 Volume (m^3)	D-02 ONS 2 Gross Beta	D-03 ONS 3 Volume (m^3)	D-03 ONS 3 Gross Beta	D-04** Collins Rd. Volume (m^3)	D-04** Collins Rd. Gross Beta	D-05** Bennitt Farm Volume (m^3)	D-05** Bennitt Farm Gross Beta	D-06** Pheasant Trail Volume (m^3)	D-06** Pheasant Trail Gross Beta
	Gross Beta 10^{-2} pCi/m^3											
01/06/79	290	4±1	290	6±1	295	6±1	290	7±1	285	8±1	290	5±1
01/13/79	(a)		(a)		325	7±1	325	8±1	300	6±1	(a)	
01/21/79	620	6±1	620	6±1	301	9±1	290	2±1	285	9±2	605	7±1
01/28/79	290	6±1	290	5±1	290	7±1	290	3±1	285	6±1	290	4±1
02/04/79	285	7±1	265	8±1	285	9±1	285	5±1	285	9±1	250	11±1
02/11/79	280	6±1	(a)		285	8±1	285	5±1	285	9±1	285	8±1
02/18/79	280	4±1	285	3±1	285	6±1	280	4±1	285	7±1	230	6±1
02/25/79	290	4±1	290	7±1	290	3±1	290	7±1	290	8±1	290	1±1
03/03/79	245	2±1	240	1±1	245	6±1	245	3±1	240	4±1	245	3±1
03/10/79	285	4±1	285	2±1	285	4±1	290	3±1	285	4±1	285	4±1
03/17/79	290	6±1	290	3±1	290	6±1	285	3±1	290	5±1	285	6±1
03/24/79	285	5±1	285	3±1	285	5±1	285	3±1	290	5±1	85	8±2
03/31/79	285	5±1	285	3±1	280	7±1	285	3±1	280	6±1	35	<6
04/07/79	285(b)	6±1	285(b)	3±1	285	6±1	285	4±1	285	<1	215	<1
04/14/79	285	6±1	285	3±1	280	5±1	285	3±1	285	6±1	150	<1
04/21/79	285	4±1	285	3±1	285	6±1	285	3±1	285	5±1	285	4±1
04/29/79	330	5±1	330	1±1	330	4±1	330	2±1	330	4±1	325	3±1
05/05/79	245	5±1	245	3±1	245	7±1	245	1±1	240	4±1	245	7±1
05/12/79	280	3±1	280	3±1	275	4±1	280	2±1	280	3±1	275	5±1
05/19/79	285	4±1	290	4±1	290	5±1	290	1±1	290	4±1	290	6±1
05/26/79	290	3±1	290	5±1	285	4±1	290	4±1	290	3±1	285	4±1
06/03/79	325	1±1	290	6±1	325	6±1	325	6±1	325	5±1	310	6±1
06/09/79	245	5±1	280	6±1	245	6±1	240	6±1	245	5±1	240	5±1
06/16/79	285	5±1	285	7±1	280	6±1	285	5±1	285	4±1	270	6±1
06/23/79	285	4±1	285	4±1	285	4±1	285	4±1	285	4±1	285	7±1
06/29/79	245	5±1	335	9±1	245	6±1	245	5±1	245	5±1	245	5±1

(a) See Introduction Page. (b) Mean volumes - temporary pumps.

* Iodine Cartridges are sampled alternate weeks. Concentrations are <0.10 pCi/m^3 unless otherwise noted.
** Stations shared by Dresden and G.E.

AIRBORNE IODINE-131* and GROSS BETA in AIR PARTICULATE FILTERS
(Weekly Collections)

	Gross Beta 10^{-2} pCi/m^3							Collins		Bennitt		Pheasant
	D-01 ONS 1		D-02 ONS 2		D-03 ONS 3		D-04** Rd.		D-05** Farm		D-06** Trail	
Week Ending	Volume (m^3)	Gross Beta	Volume (m^3)	Gross Beta	Volume (m^3)	Gross Beta	Volume (m^3)	Gross Beta	Volume (m^3)	Gross Beta	Volume (m^3)	Gross Beta
07/07/79	325	9±1	245	8±1	325	7±1	325	6±1	325	6±1	320	7±1
07/14/79	285	9±1	330	15±1	285	9±1	285	8±1	285	7±1	255	9±1
07/20/79	245	4±1	245	7±1	245	7±1	245	3±1	245	4±1	245	4±1
07/28/79	335	5±1	320	5±1	335	5±1	335	4±1	330	4±1	335	4±1
08/04/79	280	3±1	255	5±1	280	5±1	280	5±1	280	3±1	255	5±1
08/10/79	245	3±1	240	6±1	250	6±1	250	6±1	250	4±1	230	6±1
08/19/79	365	3±1	365	3±1	365	1±1	365	3±1	365	2±1	365	2±1
08/25/79	250	1±1	250	4±1	250	4±1	250	3±1	250	3±1	250	5±1
09/03/79	370	3±1	375	3±1	375	4±1	370	4±1	365	3±1	375	5±1
09/08/79	200	1±1	195	4±1	200	4±1	200	4±1	205	5±1	200	2±1
09/15/79	285	5±1	290	4±1	290	4±1	290	4±1	290	4±1	290	4±1
09/22/79	280	2±1	280	4±1	280	5±1	280	5±1	280	4±1	280	7±1
09/30/79	320	3±1	325	6±1	320	5±1	320	6±1	320	6±1	320	7±1
10/06/79	250	2±1	245	4±1	250	4±1	250	5±1	250	4±1	250	4±1
10/14/79	325	2±1	290	7±1	325	2±1	325	2±1	325	1±1	320	3±1
10/20/79	245	6±1	250	12±1	245	6±1	245	5±1	245	1±1	245	5±1
10/27/79	290	3±1	285	6±1	285	3±1	290	2±1	290	3±1	285	2±1
11/04/79	320	6±1	325	9±1	325	3±1	325	3±1	325	3±1	325	3±1
11/10/79	250	6±1	255	15±2	250	6±1	250	5±1	250	9±1	250	4±1
11/17/79	280	7±1	275	7±1	280	6±1	280	5±1	280	9±1	280	6±1
11/24/79	290	6±1	295	7±1	295	6±1	290	6±1	290	8±1	290	6±1
12/01/79	285	4±1	285	4±1	285	3±1	285	4±1	285	5±1	285	4±1
12/08/79	290	3±1	280	2±1	290	4±1	290	3±1	290	2±1	285	4±1
12/15/79	285	3±1	275	3±1	285	4±1	285	4±1	270	3±1	285	4±1
12/22/79	280	5±1	280	5±1	280	4±1	280	6±1	280	6±1	280	5±1
12/29/79	280	3±1	280	2±1	280	3±1	280	2±1	280	2±1	285	3±1

* Iodine Cartridges are sampled alternate weeks. Concentrations are <0.10 pCi/m^3 unless otherwise noted.
** Stations shared by Dresden and G.E.

DRESDEN

IODINE-131 in MILK

Collection Date	pCi/l at time of collection D-24 Davidson Farm	D-25 Dorin Farm (c) Corbin Farm	D-26 Mather Farm
	GRAZING SEASON - MAY through OCTOBER (Weekly Collections)		
05/05/79	<0.5	<0.5	<0.5
05/12/79	<0.5	<0.5	<0.5
05/19/79	<0.5	<0.5	<0.5
05/26/79	<0.5	<0.5	<0.5
06/03/79	<0.5	<0.5	<0.5
06/09/79	<0.5	<0.5	<0.5
06/16/79	<0.5	<0.5	<0.5
06/23/79	<0.5	<0.5	<0.5
06/29/79	<0.5	<0.5	<0.5
07/07/79	<0.5	<0.5	<0.5
07/14/79	<0.5	<0.5	<0.5
07/20/79	<0.9(a)	<0.5	<0.7(a)
07/28/79	<0.5	<0.5	<0.5
08/04/79	<0.6(a)	<0.8(a)	<0.5
08/10/79	<0.5	(b)	<0.5
08/19/79	<0.5	-	<0.5
08/25/79	<0.5	<0.5	<0.5
09/03/79	<0.5	<0.5	<0.5
09/08/79	<0.5	<0.5	<0.5
09/15/79	<0.5	<0.5	<0.5
09/22/79	<0.5	<0.5	<0.5
09/29/79	<0.5	(b)	<0.5
10/06/79	<0.5	<0.5	<0.5
10/14/79	<0.5	<0.5	<0.5
10/20/79	<0.5	<0.5	<0.5
10/27/79	<0.5	<0.5	<0.5
	NON-GRAZING SEASON - NOVEMBER through APRIL (Monthly Collections)		
01/06/79	<5	<5	<5
02/04/79	<5	<5	<5
03/03/79	<5	<5	<5
04/07/79	<5	<5	<5
11/04/79	<5	<5	<5
12/01,08/79	<5	<5	<5

(c) New farm, Corbin, replaces Dorin as of 08/25/79. Code number remains same.
(b) See Listing of Missing Samples page.
(a) Lower sensitivity due to low chemical yield.

GROSS BETA in COOLING WATER SAMPLES
(Weekly Collections)

	pCi/l		
	Background Station	Indicator Stations	
Collection Date	INLET CANAL D-18	DISCHARGE CANAL D-19-1	DISCHARGE CANAL D-20-2/3
01/06/79	22±5	10±3	5±1
01/14/79	5±2	11±2	7±2
01/21/79	5±2	4±2	5±2
01/28/79	<5	3±2	<5
02/04/79	4±3	<5	14±3
02/11/79	4±2	3±2	4±2
02/18/79	4±2	4±2	3±2
02/25/79	5±2	3±2	5±2
03/03/79	<5	<5	4±3
03/10/79	10±2	<5	6±2
03/17/79	6±2	8±3	<5
03/24/79	6±2	8±2	6±2
03/31/79	5±2	7±2	4±2
04/07/79	54±5	40±4	28±3
04/14/79	11±3	10±3	8±3
04/21/79	<5	15±3	15±3
04/29/79	7±2	10±3	7±2
05/05/79	7±3	16±3	10±3
05/12/79	4±2	8±3	6±2
05/19/79	6±2	6±2	<5
05/26/79	<5	<5	<5
06/02/79	<5	<5	<5
06/09/79	<5	5±2	<5
06/16/79	3±3	7±3	<5
06/23/79	3±2	8±3	5±2
06/30/79	<5	3±2	<5
07/07/79	<5	10±3	<5
07/14/79	4±2	(a)	<5
07/20/79	3±2	5±3	2±2
07/28/79	(a)	<5	<5
08/04/79	(a)	9±3	4±2
08/13/79	5±2	3±2	6±2
08/21,25/79	<5	<5	<5
08/28,09/01/79	<5	<5	<5
09/05/79	<5	<5	4±2
09/15/79	3±3	4±3	<5
09/22/79	8±3	7±3	<5
09/30/79	4±2	7±3	5±3
10/06/79	<5	<5	<5
10/13/79	5±3	<5	5±2
10/20/79	<5	10±3	11±3
10/27/79	8±2	4±1	4±2
11/04/79	8±2	6±2	5±2
11/10/79	4±2	6±2	3±2
11/17/79	7±3	5±2	<5
11/24/79	3±2	6±2	4±2
12/01/79	3±2	7±3	3±2
12/08/79	4±2	4±2	3±2
12/15/79	<5	<5	10±3
12/22/79	5±2	6±2	5±2
12/29/79	5±2	3±2	6±2

(a) See Listing of Missed Samples Page.

DRESDEN

RADIOACTIVITY IN SURFACE WATER SAMPLES
(Monthly Collections)

Collection Date	pCi/1 Sanitary Lagoon D-29* Gross α	Gross β	Evaporation Pond D-30* Gross α	Gross β
January (a)	-	-	-	-
February (2/25)	8±7	10±4	2±1	20±4
March (3/10)	<1	12±6	<1	17±6
April (5/05)	<2	7±3	<2	5±2
May (6/03)	<2	5±2	<2	<5
June (6/23)	1±1	6±3	<2	4±3
July (7/20)	2±1	10±3	<0.5	6±3
August (8/04)	<3	5±2	<3	6±2
September 9/15)	<3	7±3	<3	5±3
October (10/06)	1±1	6±2	<1	5±2
November (11/17)	3±2	10±3	<4	6±2
December (12/22)	2±1	13±3	<2	6±2

RADIONUCLIDES IN SURFACE WATER
(Monthly Composites of Weekly Collections)

D-21 Illinois River at EJ&E RR Bridge

Collection Date	Gamma Emitters pCi/1
January	<10
February	<10
March	<10
April	<10
May	<10
June	<10
July	<10
August	<10
September	<10
October	<10
November	<10
December	<10

(a) See Listing of Missed Samples.
G.E. Station

DRESDEN

RADIOACTIVITY IN WELL WATER SAMPLES
(Quarterly Collections)

Collection Period	pCi/1 D-23* Thorsen Well Gross β	 Tritium	 D-32** L.A.W. Well Gross β	 Tritium
1st Qtr.	<5	330±120	5±2	260±140
2nd Qtr.	10±3	200±100	6±3	<200
3rd Qtr.	4±2	240±110	10±2	250±100
4th Qtr.	5±2	500±140	9±2	190±90

RADIOACTIVITY IN SURFACE WATER SAMPLES
(Quarterly Collections)

Collection Period	D-22* Morris Water Works Gross β	 Tritium	D-31* Goose Lake Corp. of Eng. pCi/1 Gross β	 Tritium	D-33* Pond West of MFRP Gross β	 Tritium
1st Qtr.	5±2	<200	12±2	190±120	8±2	190±110
2nd Qtr.	5±3	640±120	5±3	320±130	5±2	120±100
3rd Qtr.	7±3	220±120	4±3	350±120	<5	160±110
4th Qtr.			16±3	660±90	8±2	180±80

* Station shared by Dresden and G.E.
** G.E. Station.

DRESDEN

RADIONUCLIDES IN FISH SAMPLES
(Semiannaul Collections)

D-28	Dresden Pool of Illinois River	
Collection Date	Species	Gamma Emitters pCi/g wet
05/26/79	Carp	<0.1
(Above discharge) 06/79	Unknown	<0.1
(Below discharge) 06/79	Unknown	<0.1
(Upstream) 08/29/79	Drum	<0.1
	Redhorse	<0.1
	Mooneye	<0.1
	Gizzard Shad	<0.1
	Carp	<0.1
	Goldfish	<0.1
	Carpsuckers	<0.1
(Downstream) 08/29/79	Shorthead Redhorse	<0.1
	Channel catfish	<0.1
	Alewives	<0.1
	Mooneye	<0.1
	Carp	<0.1
	Longnose Gar	<0.1
	Carpsuckers	<0.1
	Drum	<0.1
	Gizzard Shad	<0.1

RADIONUCLIDES IN SEDIMENT SAMPLES
(Annual Collection)

D-27	Dresden Lock and Dam	
Collection	pCi/g wet	
Date	Cs-137	Other γ
06/03/79	0.6±0.1	<0.2, Co-60=0.2±0.1
07/20/79	0.8±0.2	<0.2

DRESDEN

GAMMA RADIATION

Average mR/Qtr. Using Thermoluminescent Dosimeters

Date Annealed:	12/11/78	03/12/79	06/11/79	09/28/79
Date Read:	03/21/79	06/18/79	10/09/79	12/17/79
(a)Read	03/22/79			

Location	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
On-Site Indicator Stations				
D-01 On-Site 1	14.3±1.3	14.3±3.9	12.6±1.3	16.9±3.9
D-02 On-Site 2	13.0±2.6	12.4±1.3	13.0±1.3	16.9±2.6
D-03 On-Site 3	13.0±1.3	11.7±1.3	11.2±4.2	16.9±3.9
*D-04 Collins Road	(a)13.0±1.3	13.0±3.9	13.0±1.3	16.9±2.6
Average	13.3±1.6	12.9±2.6	12.5±2.0	16.9±3.3
Off-Site Indicator Stations				
*D-05 Bennitt Farm	13.0±1.3	14.3±2.6	14.3±2.6	18.2±3.9
*D-06 Pheasant Trail	(a)12.0±2.0	9.2±0.9	10.5±1.4	14.3±1.3
*D-07 Clay Products	12.2±1.4	12.7±2.3	11.1±3.0	16.9±2.6
*D-08 Prairie Park	(a)11.2±2.1	12.5±4.6	10.4±1.2	16.9±3.9
Average	12.1±1.7	12.2±2.6	11.6±2.1	16.8±2.9
Background Stations				
*D-09 Coal City	10.7±2.2	9.8±1.3	8.2±1.4	14.3±1.3
*D-10 Goose Lake Village	(a)11.7±1.2	12.7±2.2	12.1±2.3	16.9±2.6
*D-11 Morris	11.7±1.2	10.8±1.0	10.5±1.4	14.3±1.3
D-12 Lisbon	11.3±1.4	13.0±2.6	9.8±1.0	15.6±2.6
*D-13 Minooka	11.3±1.2	10.8±2.7	9.8±2.1	14.3±1.3
*D-14 Channahon	11.3±1.6	12.1±3.6	10.5±1.0	15.6±1.3
*D-15 Joliet Brandon Rd.	12.2±1.2	12.7±2.9	10.9±2.3	16.9±1.3
D-16 Elwood	12.1±1.6	14.3±2.6	10.4±1.0	15.6±1.3
D-17 Wilmington	12.2±1.4	13.0±2.6	10.5±1.2	14.3±1.3
Average	11.6±1.4	12.1±2.4	10.3±1.5	15.3±1.6

* Stations shared by Dresden and G.E.

QUALITY CONTROL ANALYSES SUMMARY

DECEMBER 1979

The tables below summarize results of samples run for process quality control purposes during the subject month. These listings are in addition to such measurements as detector backgrounds, check source values, radiometric-gravimetric comparisons, system calibrations, etc. Detailed listings of each measurement are maintained at the laboratory and are available for inspection if required.

BLANK SAMPLES

Nuclide Analyzed	Number of Determinations	Number of analyses exceeding the LLD for that analysis
Gross Beta	17	0
Gross Alpha	14	0
Iodine-131	24	0
Strontium-89	1	0
Strontium-90	1	0
Gamma Emitters	5	0
Tritium H-3	4	0

SPLIT SAMPLES

Nuclide Analyzed	Number of Det'ns	No. agreeing within 2σ	No. agreeing within 3σ	No. differing by > 3σ
Gross Beta	6	6	0	0
Gross Alpha	1	1	0	0
Iodine-131	1	1	0	0
Strontium-89	7	7	0	0
Strontium-90	7	7	0	0
Gamma Emitters	3	3	0	0
Tritium H-3	6	6	0	0
Calcium-45	1	1	0	0

SPIKED SAMPLES

Nuclide Analyzed	No. of Det'ns	Within 2σ of known	Within 3σ of known	differing from known by > 3σ
Gross Beta	13	13	0	0
Strontium-90	6	6	0	0
Tritium H-3	2	2	0	0
Gamma Emitters	5	5	0	0

EPA INTERCOMPARISON RESULTS

1979

Sample Type	Analysis	Agency Value	Control Limits (3σ,n=1)	MWF Measured ±2σ error	Units
Air Filter	Gross α	5	15	3±1	pCi/filter
Air Filter	Gross β	18	15	20±2	pCi/filter
Air Filter	Sr-90	6	4.5	7±2	pCi/filter
Air Filter	Cs-137	6	15	9±1	pCi/filter
Water	Gross α	6	15	7±2	pCi/l
Water	Gross α	10	15	13±1	pCi/l
Water	Gross β	16	15	14±2	pCi/l
Water	Gross β	16	15	18±3	pCi/l
Water	H-3	1280	993	12[illegible]0±300	pCi/l
Water	H-3	2270	1047	2300±200	pCi/l
Water	Sr-89	14	15	9±1	pCi/l
Water	Sr-90	6	4.5	5±1	pCi/l

USDOE QUALITY ASSESSMENT PROGRAM

1979

Sample Type	Nuclide	Known	Measured $\pm 2\sigma$ error	Units
Air	Co-57	0.116 E+03	0.131±0.013 E+03	pCi/filter
Air	Sr-90	0.135 E+02	0.155±0.025 E+02	pCi/filter
Air	Ru-106	0.174 E+03	0.167±0.020 E+03	pCi/filter
Air	Sb-125	0.749 E+03	0.823±0.082 E+03	pCi/filter
Air	Cs-134	0.985 E+02	0.947±0.095 E+02	pCi/filter
Air	Ca-45	0.134 E+03	0.230±0.023 E+03	pCi/filter
Soil	K-40	0.216 E+02	0.235±0.024 E+02	pCi/g
Soil	Sr-90	0.200 E+00	0.200±0.080 E+00	pCi/g
Soil	Cs-137	0.240 E+00	0.266±0.027 E+00	pCi/g
Tissue	K-40	0.840 E+01	0.900±0.090 E+01	pCi/g
Tissue	Sr-90	0.440 E-02	<0.200 E+00	pCi/g
Tissue	Cs-137	0.230 E-01	0.120±0.030 E-01	pCi/g
Vegetation	K-40	0.225 E+03	0.220±0.022 E+03	pCi/g
Vegetation	Sr-90	0.573 E+01	0.593±0.059 E+01	pCi/g
Vegetation	Cs-137	0.256 E+00	0.280±0.030 E+00	pCi/g
Water	H-3	0.124 E+02	0.130±0.013 E+02	pCi/ml
Water	Na-22	0.843 E+00	0.907±0.091 E+00	pCi/ml
Water	Mn-54	0.737 E+00	0.800±0.096 E+00	pCi/ml
Water	Co-60	0.871 E+00	0.970±0.097 E+00	pCi/ml
Water	Cs-137	0.980 E+00	0.117±0.012 E+01	pCi/ml

POOR ORIGINAL

DRESDEN Collection Schedule Quarter: 4th 1979

NOTE: For samples scheduled for collection at intervals of one month or greater, "Date Scheduled" indicates the target date for obtaining the sample(s). Samples should be obtained as close to that date as possible, and in any event, before the next scheduled target collection. Dates of unsuccessful sampling attempts are to be noted on the weekly sample collection data sheet.

Month:		OCTOBER				NOVEMBER				DECEMBER				
Scheduled Date:		6	13	20	27	3	10	17	24	1	8	15	22	29
Type:Freq.	Code	AP/CC	AP	AP/CC	AP	AP/CC	AP	AP/CC	AP	AP/CC	AP	AP/CC	AP/TLD	AP/CC
AP: W CC: Bi-W TLD: Q	D-01	10/06	10/14	✓	✓	11/04	✓	✓	✓	✓	✓	✓	✓	✓
	-02													
	-03													
	-04													
	-05													
	-06													
	-07													
	-08													
	-09													
	-10													
	-11													
	-12													
	-13													
	-14													
	-15													
	-16													
	-17													
Servicing: W		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Rotameter: M		10/06				11/04				12/01				
Rotam. Calib.: Q		not accomplished during 4th quarter												
Milk: W/M	D-24	✓	10/14	✓	✓	11/03 11/04				12/01 ✓				
	-25	✓		✓	✓					12/08				
	-26	✓		✓	✓					✓				

NOTES

TLDs exchanged 12/15

DRESDEN Collection Schedule
Page 2

Quarter: 4th 1979

NOTES

Month:		OCTOBER				NOVEMBER				DECEMBER					
Scheduled Date:		6	13	20	27	03	10	17	24	01	8	15	22	29	
Type:Freq.	Code	/	/	/	/	/	/	/	/	/	/	/	/	/	
Cooling Water: W	D-18	✓	10/14	✓	✓	11/04	✓	✓	✓	✓	✓	✓	✓	✓	
	-19-1	✓	{	✓	✓	{	✓	✓	✓	✓	✓	✓	✓	✓	
	-20 2/3	✓	}	✓	✓	}	✓	✓	✓	✓	✓	✓	✓	✓	
SW: W	D-21	✓	⊥	✓	✓	⊥	✓	✓	✓	✓	✓	✓	✓	✓	
Surface Water: M	D-29	10/06				11/17				12/22					
	-30	⊥				⊥				⊥					
Surface Water: Q	D-22	12/15 01/12/80✓													
	-31	12/22													
	-33	12/22													
Well Water: Q	D-23	11/10 - 11/17✓													
	-32	✓													
Fish: SA	D-28	NOT SAMPLED THIS QUARTER													
Sediment:A	D-27	NOT SAMPLED THIS QUARTER													
Dairy Census: A		NOT REQUIRED THIS QUARTER													
Exch. Water Temp. charts: M		10/06✓				11/03✓				12/01✓					
Lake Water: W	D-34	✓	10/14	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	-34	✓	⊥	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

CC. John Golden
Regge Moire
Fred Jones
Al Lewis
Chandra
Kathy Kohl
Collector File

09/79 - kk

POOR ORIGINAL