INSTRUCTIONS FOR UPDATING YOUR OFFSITE DOSE CALCULATION MANUAL (ODCM)

Changes to the ODCM are identified by a vertical line in the right margin of the page. To update your copy, remove and destroy the following pages and figures and insert pages and figures as indicated, and as updated pages are applicable to your volume only. Destroy those pages of this revision which do not apply to your particular volume of the ODCM.

REMOVE	INSERT
LA SALLE COUNTY STATION	
Chapter 2.0	
Pages 2.1-17 and 2.1-18	Pages 2.1-17 and 2.1-18
Page 2.2-4	Page 2.2-4
Chapter 4.0	
Page 4-i	Page 4-i
Pages 4.1-1 and 4.1-2	Pages 4.1-1 through 4.1-3
Chapter 8.0	
Pages 8.1-4 through 8.1-6	Pages 8.1-4 through 8.1-6
Page 8.4-2	Page 8.4-2
Pages 8.4-5 and 8.4-6	Pages 8.4-5 and 8.4-6
QUAD CITIES	
Chapter 8.0	
Pages 8-i through 8-iii	Pages 8-i through 8-iii
Pages 8.1-1 through 8.1-9	Pages 8.1-1 through 8.1-10
Pages 8.2-1 through 8.2-6	Pages 8.2-1 through 8.2-6
Page 8.3-1	Page 8.3-1
Pages 8.4-1 through 8.4-8	Pages 8.4-1 through 8.4-8
Figures 8.4-1 and 8.4-2	Figures 8.4-1 and 8.4-2

F_F Meat Fraction (days/kg)

The fraction of the animal's daily intake of radionuclide i which appears in each kilogram of flesh. See Table 7.1-4.

t_s Slaughter to Consumption Time (hr)

The time from slaughter consumption, See Table 7.1-2.

2.1.2.1.2 Inhalation + Food Pathways Dose, Calendar Year (Four Consecutive Quarters)

$$3.17 \times 10^{-8} \times 10^{6} R_a \sum_i DFA_{ija} \left[(\chi/Q)_s A'_{is} + (\chi/Q)_v A'_{iv} + (\chi/Q) A'_{ig} \right] +$$

$$\frac{t_r}{365} \sum_i DFI_{ija} \left[U_a^P f_p C_i^P + U_a^M C_i^M + U_a^V f_V C_i^V + U_a^F C_i^F \right] \leq 15 \text{ mrem} \quad (2.17)$$

2.1.2.2 10 CFR 20 Release Rate Limit

The maximum dose rate to an organ of an adult from all radionuclides, radioactive materials in particulate form, and radionuclides other than noble gases with half-lives greater than 8 days shall be limited to the values given by the equations which follow. For purposes of demonstrating compliance with the Technical Specifications, the dose to the adult from the inhalation pathway shall be considered limiting.

$$10^6 \, R_a \sum_i DFA_{ija} \left[(\chi/Q)_s \, Q'_{is} + (\chi/Q)_v \, Q'_{iv} + (\chi/Q)_g \, Q'_{ig} \right] +$$

$$K \sum_i DFI_{ija} \, U_a^M \, C_i^M < 1500 \text{ mrem/yr} \qquad (2.18)$$

K Seasonal Adjustment Factor

K is a seasonal adjustment factor to account for nongrazing. For purposes of demonstrating technical compliance for the inhalation pathway, $K = 0$ throughout the year.

C_i^M Milk Concentration (pCi/liter)

The concentration of radionuclide i in milk.

$$C_i^M = F_M \, C_i^f \, W_f \exp(-\lambda_i \, t_M) \qquad (2.19)$$

C_i^f Feed Concentration (pCi/kg)

The concentration of radionuclide i in feed.

$$C_i^f = d_i \times r \; \frac{\left[1 - \exp(-\lambda_{Ei} \, t_e)\right]}{Y_v \quad \lambda_{Ei}} \qquad (2.20)$$

(Note that this assumes feed to be 100% pasture grass.)

d_i Deposition Rate ($pCi/m^2 \times hr$)

$$d_i = 3600 \times 10^6 \times \left[Q'_{is} \, (D/Q)_s + Q'_{iv} \, (D/Q)_v + Q'_{ig} \, (D/Q)_g \right] \qquad (2.21)$$

C_i^t Concentration in the Discharge Tank (μCi/ml)

The concentration of radionuclide i in the (radwaste discharge or other similar) tank.

F^r Flow Rate, Radwaste Discharge (ft^3/sec)

The flow rate of radwaste from the discharge tank to the initial dilution stream.

F^d Flow Rate, Initial Dilution Stream (ft^3/sec)

The flow rate of the initial dilution stream which carries the radionuclides to the unrestricted area boundary (e.g., the blowdown from cooling tower or lake or the circulating cooling water flow).

MPC_i Maximum Permissible Concentration (μCi/ml)

The maximum permissible concentration of nuclide i (or unknown nuclide) in water in the unrestricted area (see Table 7.1-10; or 10 CFR 20, Appendix B, Table II, Column 2 including Note 3.c).

2.2.3 10 CFR 20 Maximum Permissible Concentrations at the Nearest Surface Water Supply

The quantity of radionuclides, excluding tritium and dissolved or entrained noble gases, in outdoor tanks without overflow pipes connected to other storage tanks shall be limited to ensure that in the case of an overflow, the annual average concentration of radioactivity in the potable water of the nearest surface water supply is less than the 10 CFR 20, Appendix B, Table II, Column 2 limits.

The annual average concentration of each radionuclide in the potable water of the nearest surface water supply is calculated as follows:

$$C_i^w = C_i^t \left(\frac{F^t}{F_o^w + F^t} \right) M_o^w \ \exp\left(-\lambda_i \times t_o^w\right) \times \frac{t_o}{8760} \qquad (2.29)$$

4.0 AQUATIC TRANSPORT AND DOSE MODELS

TABLE OF CONTENTS

4.0 AQUATIC TRANSPORT AND DOSE MODELS

4.1 AQUATIC TRANSPORT

Dose via the aquatic pathway is discussed in Section 2.2. Two dilution factors are considered; F, the flow of the receiving body of water; and 1/M, an additional dilution factor.

4.1.1 River Model

For purposes of calculating the drinking water dose from liquid effluents discharged into a river, it is assumed that total mixing of the discharge in the river flow (F^w) occurs prior to consumption. No additional dilution is assumed to occur; thus $1/M^w$ equals 1.0. The river flow is taken as the long-term (generally 10 years) average. The nearest potable water intakes on the receiving bodies of water are described in a footnote to Table 7.2-1.

For the fish consumption pathway, a near-field dilution flow F^f is used; $1/M^f = 1.0$.

4.1.2 Lake Michigan Model

For purposes of calculating dose from liquid effluents discharged to Lake Michigan, it is assumed that the concentration of radioactivity is diluted initially in the condenser cooling water of flow (F^c) and then by an additional factor $1/M^w$ of 60 prior to consumption as potable water. The dilution factor of 60 is the product of the initial entrainment dilution (factor of 10); the plume dilution (factor of 3 over approximately 1 mile); and the current direction frequency (annual average factor of 2).

For the fish ingestion pathway only, it is assumed the radioactivity is diluted fully in a hypothetical river of flow F^f; $1/M^f = 1.0$. To determine F^f, it was assumed that the near shore lake current (which can vary in width from 2 to 10 miles) constitutes a "river" 5 miles wide, 50 feet deep (the average lake depth from shore to 5 miles near Zion), and flows at the offshore, measured average speed of 0.2 mile per hour. This results in $F^f = 4.0 \times 10^5$ ft^3/sec.

4.1.3 Symbols Used In Section 4.1

SYMBOL	NAME	UNIT
F	Flow of the Receiving Body of Water	
$1/M$	Additional Dilution Factor	
F^w	Average Flow Rate (Drinking Water Pathway)	(ft^3/sec)
$1/M^w$	Additional Dilution Factor (Drinking Water Pathway)	
F^f	Near-Field Flow Rate (Fish Ingestion Pathway)	(ft^3/sec)
$1/M^f$	Additional Dilution Factor (Fish Ingestion Pathway)	
F^c	Average Flow of the Condenser Cooling Water During the Period of Discharge	(gal/min)

The mid- and high-range detection systems consists of solid-state CdTe(Cl) detectors, shielded sample chambers, and pre-ampliers. Signals from the three detection systems are processed by a microprocessor which also controls the system pumps and monitors process stream and sample flowrates. The individual detection system outputs and other system parameters are displayed on a digital readout and control module. A three-pen recorder is utilized to record the individual detection system results in $\mu Ci/cm^3$. The detection system whose output is indicative of the existing release activity is converted by the microprocessor to µCi/sec utilizing the existing process stream flowrate and recorded on a single-pen recorder. This µCi/sec value is also compared to an operator-entered alarm point.

The recorders and digital readout and control module are located in the main control room. The sample conditioning skid, detection skid, and microprocessor are located in the auxiliary building on the 796 ft 6 in. elevation. Power is supplied to this monitor from Division 1 power.

Detector efficiencies are initially determined by calibration with Xe-133 gas. Once operational, efficiency factors will be based on monitor response and isotopic analysis data.

The alarm setpoint for this monitor will be selected to ensure that the combined release rate of the station vent stack and SGTS stack does not exceed the most conservative release limit determined from Equations 8.1 and 8.3 by setting the alarm point at or below one-half the release limit.

8.1.4 Standby Gas Treatment Stack Monitor

Release of radioactivity from the standby gas treatment system (SGTS) stack is monitored by one of three SGTS monitoring systems.

Two of the systems consist of a beta sensitive scintillation detector for particulate; a beta sensitive scintillation detector for low-range noble gas; a beta sensitive scintillation detector for high-range noble gas; and a gamma sensitive scintillation detector for iodine. Provisions are made for system inlet and outlet grab samples.

The monitoring system uses a microprocessor to analyze the data from the beta and gamma scintillation detectors. This microprocessor performs background subtraction and compares the radiation values against operator entered alarm limits. A four-pen strip chart recorder records the monitoring system output. Alarms are located in the main control room.

Power is supplied to this monitor subsystem from Division 2 power. The equipment for each monitoring channel is skid mounted and located on the 786 ft 6 in. elevation in the auxiliary building.

The third SGTS monitor (0PLD2J) utilizes an isokinetic probe to sample the effluent stream prior to discharge into the atmosphere. The offline monitor consists of three detection systems. Gas flow through the system is provided by vacuum pumps; one for the low-range detection system and one for the mid- and high-range detection systems. A sample conditioning skid, upstream of the detection system, filters particulate and iodine and provides for collection of particulate and iodine grab samples.

The low-range detection system consists of a beta scintillation detector, a shielded sampling chamber, and a preamplifier. The mid- and high-range detection systems consist of solid-state CdTe(Cl) detectors, shielded sample chambers, and preamplifiers. Signals from the three detection systems are processed by a microprocessor which also controls the system pumps and monitors process stream and sample flowrates.

The individual detection system outputs and other system parameters are displayed on a digital readout and control module. A three-pen recorder is utilized to record the individual detection system results in $\mu Ci/cm^3$. The detection system whose output is indicative of the existing release activity is converted by the microprocessor to $\mu Ci/sec$ utilizing the existing process stream flowrate and recorded on a single-pen recorder. This $\mu Ci/sec$ value is also compared to an operator-entered alarm point.

The recorders and digital readout and control module are located in the main control room. The sample conditioning skid, detection skid, and microprocessor are located in the auxiliary building on the 796 ft 6 in. elevation. Power is supplied to this monitor from Division 2 power.

Detector efficiencies are initially determined by calibration with Xe-133 gas. Once operational, efficiency factors will be based on monitor response and isotopic analysis data.

The alarm setpoint for this monitor will be selected to ensure that the combined release rate of the station vent stack and SGTS stack does not exceed the most conservative release limit determined from Equations 8.1 and 8.3 by setting the alarm point at or below one-half the release limit.

8.1.5 SJAE Off-Gas Monitors

The steam jet air ejector (SJAE) monitor subsystem continually measures and records the gamma radiation in the off-gas as it is drawn from the main condenser by the steam jet air ejectors before it passes through the holdup line and carbon beds enroute to the station vent stack.

TABLE 8.4-1

RADIOLOGICAL MONITORING PROGRAM

(1982 - 1984)

SAMPLE MEDIUM	TYPE AND FREQUENCY OF ANALYSIS*	COLLECTION SITES	FREQUENCY OF COLLECTING	NONROUTINE REPORTING LEVELS
1. Airborne				
a. Particulate Filter	Gross beta - W. Sr 89, 90 - Q. comp. Gamma Spec. - Q. comp.	Seneca, Marseilles, Ottawa, Grand Ridge Streator, Ransom, Route 6 at Gonnam Road, Kernan, and six stations near the site (see Figure 8.4-1)	Continuous operation of a sampler for a week	Cs-134, 10 pCi/m^3 Cs-137, 20 pCi/m^3
b. Charcoal Cartridge	I-131	Same as for 1a	Continuous operation of a [illegible]pler for [illegible] weeks	0.9 pCi/m^3
2. TLD	Gamma Radiation	Same as for 1a, plus 24 other sites distributed near the site boundary and at 5 miles (see Figures 8.4-1 and 8.4-2) Minimum of 2 TLD's per packet	Quarterly	None
3. Surface Water	Sr-89, 90 - Q. comp. Gamma Spec. - M. comp. Gross beta - W. Tritium - Q. comp.	Illinois River at intake of Illinois Nitrogen Corp. Illinois River at Marseilles Illinois River at Ottawa Illinois River at Seneca South Kickapoo Creek Cooling lake near recreation area	Weekly	**

TABLE 8.4-2

RADIOLOGICAL MONITORING PROGRAM

(1985 and Later)

SAMPLE MEDIA	COLLECTION SITE	TYPE OF ANALYSIS	FREQUENCY	NONROUTINE REPORTING LEVELS**
1. Air Monitoring	a. Onsite and near field* 1. Nearsite Station 1 2. Onsite Station 2 3. Onsite Station 3 4. Nearsite Station 4 5. Onsite Station 5 6. Nearsite Station 6	a. Filter - gross beta***	a. Continuous operation of a sampler for a week	Cs-134, 10; Cs-137, 20 pCi/m^3
		b. Charcoal - I-131	b. Continuous operation of a sampler for 2 weeks	0.9 pCi/m^3
		c. Sampling Train - Test and Maintenance	c. Weekly	Not Applicable
	b. Far Field* 7. Seneca 8. Marseilles 9. Grand Ridge 10. Streator 11. Ransom 12. Kernan 13. Route 6 at Gonnam Road 14. Ottawa	a. Filter Exchange	a. Continuous operation of a sampler for a week	Cs-134, 10; Cs-137, 20 pCi/m^3 when analyses are made
		b. Charcoal Exchange	b. Continuous operation of a sampler for 2 weeks	0.9 pCi/m^3 when analyses are made
		c. Sampling Train - Test and Maintenance	c. Weekly	Not Applicable

REVISION 10
SEPTEMBER 1983

TABLE 8.4-2 (Cont'd)

SAMPLE MEDIA	COLLECTION SITE	TYPE OF ANALYSIS	FREQUENCY	NONROUTINE REPORTING LEVELS**
2. TLD	a. Same as Item 1, Air Monitoring Sites*	Gamma Radiation	Quarterly	None
	b. Plus 24 other sites distributed about the site boundary and at 5 miles* (minimum of 2 TLD's per packet)			
3. Fish	a. Marseilles Pool of Illinois River	Gamma Isotopic	Semi-annual	pCi/kg wet weight Mn-54 3×10^4 Co-58 3×10^4 Zn-65 2×10^4 Cs-137 2×10^3 Fe-59 1×10^4 Co-60 1×10^4 Cs-134 1×10^3
4. Milk	a. Three nearby dairies or private animals including the nearest, if possible	I-131	a. Weekly during grazing season, May to October	pCi/l I 131, 3 Cs-134, 70 Cs-137, 60 Ba-La-140, 300
			b. Monthly, November to April	Same as above

8.0 RADIOACTIVE EFFLUENT TREATMENT SYSTEMS, MODELS FOR SETTING GASEOUS AND LIQUID EFFLUENT MONITOR ALARM AND TRIP SETPOINTS, AND ENVIRONMENTAL RADIOLOGICAL MONITORING

TABLE OF CONTENTS

8.0 RADIOACTIVE EFFLUENT TREATMENT SYSTEMS, MODELS FOR SETTING GASEOUS AND LIQUID EFFLUENT MONITOR ALARM AND TRIP SETPOINTS, AND ENVIRONMENTAL RADIOLOGICAL MONITORING

LIST OF TABLES

8.0 RADIOACTIVE EFFLUENT TREATMENT SYSTEMS, MODELS FOR SETTING GASEOUS AND LIQUID EFFLUENT MONITOR ALARM AND TRIP SETPOINTS, AND ENVIRONMENTAL RADIOLOGICAL MONITORING

LIST OF FIGURES

8.0 RADIOACTIVE EFFLUENT TREATMENT SYSTEMS, MODELS FOR SETTING GASEOUS AND LIQUID EFFLUENT MONITOR ALARM AND TRIP SETPOINTS, AND ENVIRONMENTAL RADIOLOGICAL MONITORING

8.1 GASEOUS RELEASES

8.1.1 System Design

8.1.1.1 Gaseous Radwaste Treatment System

A gaseous radwaste treatment system shall be any system designed and installed to reduce radioactive gaseous effluents by collecting primary coolant system off-gases from the primary system and providing for delay or holdup for the purpose of reducing the total radioactivity prior to release to the environment.

8.1.2 Alarm and Trip Setpoints

Alarm and trip setpoints of gaseous effluent monitors at the principal points of release of ventilation exhaust air containing radioactivity are established to ensure that the release limits of 10 CFR 20 are not exceeded. The setpoints are found by solving Equations 2.9 and 2.10 for each class of release.

For this evaluation the radioactivity mixture in the exhaust air is assumed to have the composition of gases listed in Table 3-3 from "Technical Derivation of BWR 1971 Design Basis Radioactive Material Source Terms", NEDO-10871, March 1973, General Electric Company. This mixture of radioactive gases is representative of the activity found at the point of release from the fuel with no radioactive decay accounted for.

Equation 2.9 is rewritten using the fractional composition of each nuclide, f_i, and a total release rate, Q_t, for each class:

$$1.11 \sum_i \left[Q_{ts}(\bar{S}_i \times f_i) + Q_{tv}(\bar{V}_i \times f_i) \right] < 500 \ \frac{\text{mrem}}{\text{yr}} \quad (8.1)$$

f_i Fractional Radionuclide Composition

The release rate of radionuclide i divided by the total release of all radionuclides.

Q_{ts} Total Release Rate, Stack Release (μCi/sec)

The release rate for all radionuclides due to a stack release.

Q_{tv} Total Release Rate, Vent Release (μCi/sec)

The release rate for all radionuclides due to a vent release.

Equation 8.1 can be solved for Q_t for each class of release for release limit determinations.

Similarly, Equation 2.10 can be rewritten:

$$\sum_i \left\{ \bar{L}_i \left[(X/Q)_s \, Q_{ts} f_i \exp(-\lambda_i R/3600u_s) + (X/Q)_v \, Q_{tv} f_i \exp(-\lambda_i R/3600u_v) \right] + 1.11 \left[S_i Q_{ts} f_i + V_i Q_{tv} f_i \right] \right\} < 3000 \frac{\text{mrem}}{\text{yr}} \quad (8.2)$$

Equation 8.2 can be solved for Q_t for each class of release and a corresponding release limit be determined. The most conservative release limit determined from Equations 8.1 and 8.2 will be used in selecting the appropriate alarm and trip setpoints for each class of release.

The exact settings will be selected to ensure that 10 CFR 20 limits are not exceeded.

Surveillance frequencies for gaseous effluent monitors will be as stated in Table 4.2-4 of the Technical Specifications. Calibration methods will be consistent with the definitions found in Section 1.0 of the Technical Specifications.

8.1.3 Main Chimney Releases

8.1.3.1 Chimney Noble Gas Monitors

Releases of radioactive noble gases from the main chimney release point are continuously monitored by an off-line monitoring system consisting of two instrument channels, each of which uses a scintillation detector as its sensing element. Samples of the effluent stream are taken high in the chimney, where good mixing is ensured, and drawn through a constant flow-and-pump network, past the detectors.

Each monitoring channel consists of a 2-inch by 2-inch sodium iodide-thallium activated scintillation detector, shielded sample chamber, pulse preamplifier, and process radiation (log count) monitor with integral power supply for providing high voltage to the detector. The channels share a common recorder and common trip auxiliaries unit whose output initiate high radiation alarm annunciations. The recorder, alarms, and remote control switches for the chimney gas monitoring system are located in the main control room. The sample pumps and detectors, with local controls, are located in the chimney sample house at the base of the chimney.

Power is supplied to the process radiation monitors from the station 48/24-Vdc battery systems. The monitor display has a logarithmic scale with a range of 10^{-1} to 10^{6} counts per second. The detectors equipment part numbers are RE 1/2-1731A and RE 1/2-1731B.

The main chimney noble gas monitor alarm setpoints will be selected to ensure that the combined release rate of the main chimney and the reactor building vent stack does not exceed the most conservative release limit determined from Equations 8.1 and 8.2.

8.1.3.2 SJAE Off-Gas Monitors

The major source of radioactive noble gases is from each unit's off-gas system. Each unit's off-gas system has its own radiation detection instrumentation capable of isolating the off-gas release pathway.

Off-gas from the main condenser is monitored for gross gamma activity downstream of the steam jet air ejectors (SJAE) and prior to release to the main chimney. Continuous radiation monitoring is maintained on the off-gas hold-up pipe. The off-gas monitoring system for each unit is performed in two channels, each of which includes a gamma sensitive ion-chamber detector, and a logarithmic radiation monitor with integral power supply. The two channels share a common two-pen recorder and a trip auxiliaries unit whose output feeds an interval timer. System controls, alarm annunciators, recorder, and displays are located on panels in the main control room. The ion-chamber detectors are mounted adjacent to and at the beginning of the off-gas hold-up pipe, a 36-inch diameter header whose function is to contain the off-gas for a period of time dependent on off-gas flow and allow for radioactive decay prior to release to the chimney.

A high radiation condition in the hold-up pipe will initiate an interval timer with a variable setting of 0 to 15 minutes. When the preselected time interval has elapsed, an isolation valve at the inlet to the chimney from the off-gas system will automatically close, preventing release of radioactive gases from the affected off-gas system.

Power is supplied to the off-gas process radiation monitors from the station's 48/24-Vdc battery systems. Power to the interval timer is from the 120-Vac essential service bus. The timer provides the signal to the solenoid-operated valves which control the air supply to the air-operated isolation

valve (equipment part number AO 1(2)-5406). The monitor display is a logarithmic scale and has a range of 1 to 10^6 units (mR/hr). The detectors equipment part numbers are RE 1(2)-1733A and RE 1(2)-1733B.

The SJAE monitor alarm setpoints will be selected to ensure that the combined release rate of the main chimney and station vent stack does not exceed the most conservative release limit determined from Equations 8.1 and 8.2.

8.1.3.3 Allocation of Effluents from Common Release Points

Radioactive gaseous effluents released from the main chimney are comprised of contributions from both units. Under normal operating conditions, it is difficult to allocate the radioactivity between units due to fuel performance, in-plant leakage, power history, and other variables. Consequently, allocation will normally be made evenly between the units. During extended unit shutdowns or periods of known differences, the apportionment will be adjusted accordingly. The allocation of the effluents will be made on a monthly basis.

8.1.4 Reactor Building Ventilation Stack Releases

8.1.4.1 Ventilation Stack Monitors

Releases of radioactive noble gases from each reactor building's ventilation system are monitored prior to introduction to the ventilation stack. Two sensor and converter (detector) units are located in each unit's reactor building exhaust duct, and provide continuous gamma radiation monitoring.

The sensor is a Geiger-Mueller tube, polarized by high voltage from the power supply. The output signal from each sensor converter is applied to an indicator and trip unit, where

it is amplified and used to drive a meter. This unit also provides trip functions for upscale and downscale alarms through auxiliary units. A downscale trip in either channel annunciates a low radiation (malfunction) alarm. An upscale trip in either channel initiates a reactor building ventilation system high-high radiation alarm. Control logic is such that one channel high level trip or two channel low level trips will shut down and isolate the reactor building ventilation system for both units and initiate the standby gas treatment system.

The exhaust duct monitors provide a signal to a two-pen recorder which will annunciate a high radiation condition in the exhaust duct. This is an alarm only, and does not initiate corrective action. The recorder, controls, indicator and trip units, alarms, and annunciators are located on panels in the main control room.

The power supply to each sensor channel is supplied from a different power source. The A channel is fed from the 120-Vac.

A reactor protection system and the B channel are fed from the 120-Vac B reactor protection system.

The indicating meters have a logarithmic scale with a range of 0.01 to 100 mR/hr. The sensor and converter units have equipment part numbers RE 1(2)-1735A and RE 1(2)-1735B.

Each reactor building's ventilation system is isolated by closure of two air-operated butterfly valves (AO 1(2)A-5741 and AO 1(2)B-5741) located in series downstream of the reactor building ventilation supply fans, and by closure of two air-operated butterfly valves (AO 1(2)A-5742 and AO 1(2)B-5742) located in series downstream of the radiation sensors and upstream of the exhaust fans. Air supplies to these valves

are controlled by solenoid valves powered from the 125-Vdc station battery systems. The control logic relays which operate these solenoids are powered by the 120-Vac essential service bus.

The reactor building ventilation stack monitor alarm setpoint will be 2 mR/hr above background. Using an empirical relationship of mR/hr and μ/Ci/sec at design flowrates, the calculated reactor building ventilation stack release rate will be employed in Equation 8.1 and 8.2 to select the most conservative main chimney monitor alarm setpoints.

8.1.4.2 Allocation of Effluents from Common Release Points

Radioactive gaseous effluents released from the reactor building vent stack are comprised of contributions from both units. Estimates of noble gas contributions from each unit will be made by analyzing grab samples from the individual units. Allocations of radioiodine and radioactive particulate releases will be made by analyzing samples taken from continuous samples on each unit. The allocation of the effluents will be made on a monthly basis.

8.1.5 Symbols Used in Section 8.1

SYMBOL	NAME	UNIT
Q_{ts}	Total Release Rate, Stack Release	(μCi/sec)
$\overline{S}_i$	Gamma Whole Body Dose Constant, Stack Release	(mrad/yr per μCi/sec)
f_i	Fractional Radionuclide Composition	
Q_{tv}	Total Release Rate, Ground Level	(μCi/sec)
$\overline{V}$	Gamma Whole Body Dose Constant, Vent Release	(mrad/yr per μCi/sec))
Q_{is}	Release Rate of Nuclide i, Stack Release	(μCi/sec)
Q_{iv}	Release Rate of Nuclide i, Vent Release	(μCi/sec)
$\overline{L}_i$	Beta Skin Dose Constant	(mrem/yr per μCi/m^3)
$(\chi/Q)_s$	Relative Effluent Concentration, Vent Stack Release	(sec/m^3)
λ_i	Radiological Decay Constant	(hr^{-1})
R	Downwind Range	(m)
u_s	Average Wind Speed, Stack Release	(m/sec)

SYMBOL	NAME	UNIT
$(\chi/Q)_v$	Relative Effluent Concentration, Vent Release	(sec/m^3)
u_v	Average Wind Speed, Vent Release	(m/sec)
S_i	Gamma Dose Constant, Stack Release	(mrad/yr per µCi/sec)
V_i	Gamma Dose Constant, Stack Release	(mrad/yr per µCi/sec)

8.1.6 Constants Used In Section 8.1

NUMERICAL VALUE	NAME	UNIT
1.11	Conversion Constant	(mrem/mrad)
3600	Conversion Constant	(sec/hr)

8.2 LIQUID RELEASES

8.2.1 System Design

A liquid radwaste treatment system shall be a system designed and installed to treat radioactive liquid effluents by collecting the liquids, providing for retention or holdup, and providing for treatment by demineralization to reduce the total radioactivity prior to the release of liquids to the environment.

8.2.2 Alarm Setpoints

Alarm setpoints of liquid effluent monitors at the principal release points are established to ensure that the limits of 10 CFR 20 are not exceeded in the unrestricted area. The concentration limit (C_{lim}) in the discharge line prior to dilution in the initial dilution stream is:

$$C_{lim} = MPC \left[\frac{F^d_{ave} + F^r_{max}}{F^r_{max}} \right] \quad (8.3)$$

C_{lim} Limiting Concentration in Discharge Line (μCi/ml)

The maximum concentration in the discharge line permitted to be discharged to the initial dilution stream.

MPC Weighted Maximum Permissible Concentration (μCi/ml)

$$MPC = \frac{\sum_{i=1}^{n} C_i}{\sum_{i=1}^{n} \frac{C_i}{MPC_i}} \quad \text{or} \quad \frac{\sum_{i=1}^{n} A_i}{\sum_{i=1}^{n} \frac{A_i}{MPC_i}} \quad (8.4)$$

where:

C_i = µCi/ml of nuclide i;

MPC_i = maximum permissible concentration µCi/ml of nuclide i; and

A_i = µCi of nuclide i released in time t.

Fr_{max} Maximum Flow Rate, Radwaste Discharge (ft^3/sec)

The maximum flow rate of radwaste from the discharge tank to the initial dilution stream.

F^d_{ave} Average Flow Rate, Initial Dilution Stream (ft^3/sec)

The average flow rate of the initial dilution stream which carries the radionuclides to the unrestricted area boundary.

Surveillance frequencies for liquid effluent monitors will be as stated in Table 4.2-3 of the Technical Specifications.

Calibration methods will be consistent with the definitions found in Section 1.0 of the Technical Specifications.

8.2.3 Radwaste Discharge Line Releases

8.2.3.1 Radwaste Discharge Monitor

The radwaste discharge line is continuously monitored for radioactivity with a gamma sensitive detector.

The monitoring channel consists of a 2-inch by 2-inch sodium iodide-thallium activated scintillation detector, pulse preamplifier, and process radiation (log count) monitor. The sensing element is positioned on a vertical section of the process liquid piping.

The radwaste discharge monitor provides a signal to a recorder and trip auxiliary which initiates a high radiation alarm. The process radiation monitor, alarm, and annunciator are located on the panels in the main control room.

The recorder is located in the radwaste control room.

The process liquid monitor has a logarithmic scale with a range of 10^{-1} to 10^{6} counts per second. The monitor is powered from the station's 48/24-Vdc battery system.

The radwaste discharge line detector (RE 1/2-1721) is mounted adjacent to the discharge piping after the flow control valves and prior to the selection of several alternate discharge routes.

The alarm setpoint for the radwaste discharge monitor is established at or below the maximum concentration determined by Equation 8.3. The concentration is converted to an alarm setpoint using an efficiency curve developed for the monitor through use of a Cs-137/Ba-137m liquid calibration source.

8.2.3.2 Allocation of Effluents from Common Release Points

Radioactive liquids effluents released from the radwaste treatment system are comprised of contributions from both units. Under normal operating conditions, it is difficult to allocate the radioactivity between the units. Consequently, allocation will normally be made evenly between the units. During extended unit shutdown or periods of significant plant input differences, the apportionment will be adjusted accordingly. The allocation of the effluents will be made on a monthly basis.

8.2.3.3 Administrative and Procedural Controls for Radwaste Discharges

Administrative and procedural controls have been implemented to ensure proper control of radioactive liquid radwaste discharges,

to preclude a release in excess of 10 CFR 20 limits. The discharge rate for each batch is calculated by a technician and then independently verified by two operating staff personnel.

A single river discharge tank has been designated and modified from which all radwaste discharges will normally be released. This tank has manual inlet and discharge valves which can be locked.

The inlet valve is locked closed during recirculation of the tank prior to sampling and during the discharge to preclude an accidental addition to the tank which could change its activity.

The discharge valve is locked closed at all times except during the discharge. All other lines, which tie-in with the discharge line, are locked closed. The high and low flow control valves are selected by a key-lock switch which allows the use of only one of the two flow control valves at any one time. The key to this switch and the locked valves is under the administrative control of the radwaste foreman.

A documented valve checklist is prepared for each batch discharge. The proper valve lineup is checked by the operator and the radwaste foreman, prior to release. If any sudden significant increase of the radiation monitor occurs during the discharge, the release is terminated. These controls are documented in Station Operating and Administrative Procedures.

8.2.4 Service Water Header Releases

8.2.4.1 Service Water Effluent Monitors

Each unit's main service water effluent header is continuously monitored for radioactivity with a gamma sensitive detector.

Each monitoring channel consists of a 2-inch by 2-inch sodium iodide-thallium activated scintillation detector, pulse pre-amplifier, and process radiation (log count) monitor. The sensing element for each channel is positioned on a vertical section of the process liquid piping.

The service water effluent monitor on each unit provides a signal to a recorder and trip auxiliary, which initiates a high radiation alarm. The process radiation monitor, recorder, alarm, and annunciator are located on the panels in the main control room.

The process liquid monitors have logarithmic scales with a range of 10^{-1} to 10^{6} counts per second. The monitors are powered from the station's 48/24-Vdc battery system.

The service water system detectors (RE 1(2)-1724) are located adjacent to the main service water effluent header on each unit prior to release to the discharge bay.

The alarm setpoints for the service water effluent monitor are established at or below the maximum concentration determined by Equation 8.3.

8.2.5 Determination of Initial Dilution Stream Flow Rates

For those release paths which have installed flow monitoring instrumentation, that instrumentation will be used to determine the flow rate of the initial dilution stream. This instrumentation will be operated and maintained as prescribed by the Technical Specifications. For those release paths which do not have installed flow monitoring instrumentation, flow rates will be determined by use of appropriate engineering data such as pump curves, differential pressures, or valve position indication.

8.2.6 Symbols Used In Section 8.2

SYMBOL	NAME	UNIT
C_{lim}	Liquid Release Limit	(μCi/ml)
MPC	Weighted Maximum Permissible Concentration	(μCi/ml)
C_i	Nuclide Concentration	(μCi/ml)
MPC_i	Maximum Permissible Concentration	(μCi/ml)
A_i	Nuclide Quantity Released	(μCi)
F^r_{max}	Maximum Flow Rate, Radwaste Discharge	(ft^3/sec)
F^d_{ave}	Average Flow Rate, Initial Dilution Stream	(ft^3/sec)

8.3 SOLIDIFICATION OF WASTE/PROCESS CONTROL PROGRAM

The process control program (PCP) shall contain the sampling, analysis, and formulation determination by which solidification of radioactive wastes from liquid systems is ensured.

8.4 ENVIRONMENTAL RADIOLOGICAL MONITORING

The environmental radiological monitoring program to be performed in the environs around Quad-Cities Station is given in Table 8.4-1.

Figure 8.4-1 shows the 16 fixed air sampling sites and TLD locations; also shown are the "outer ring" (approximately 5 miles distant) TLD locations. Figure 8.4-2 shows the "inner ring" TLD locations. The TLD's are code numbered as follows: XYY-N.

Where:

X = 1 means inner ring,

X = 2 means outer ring, and

YY-N is an identification code.

The practical lower limits of detection for this program are given in Table 8.4-2.

TABLE 8.4-1

RADIOLOGICAL MONITORING PROGRAM

SAMPLE MEDIA	COLLECTION SITE	TYPE OF ANALYSIS	FREQUENCY	NONROUTINE REPORTING LEVELS*
1. Air Monitoring	a. Onsite and near field** 1. Onsite No. 1 2. Onsite No. 2 3. Onsite No. 3 4. Nitrin 5. Saddle Club Dairy Farm 6. Hanson's Boat Landing	a. Filter - gross beta***	a. Continuous operation of a sampler for a week	Cs-134, 10; Cs-137, 20 pCi/m^3
		b. Charcoal - I-131	b. Continuous operation of a sampler for 2 weeks	0.9 pCi/m^3
		c. Sampling Train - test and maintenance	c. Weekly	Not applicable
	b. Far Field** 7. Clinton 8. Sikkema Farm 9. Erie 10. Hillside 11. Port Byron 12. Bettendorf 13. Princeton 14. Utica Ridge Road 15. Dewitt 16. Low Moor	a. Filter exchange	a. Continuous operation of a sampler for a week	Cs-134, 10; Cs-137, 20 pCi/m^3 when analyses are made
		b. Charcoal exchange	b. Continuous operation of a sampler for 2 weeks	0.9 pCi/m^3 when analyses are made
		c. Sampling Train - test and maintenance	c. Weekly	Not applicable

TABLE 8.4-1 (Cont'd)

SAMPLE MEDIA	COLLECTION SITE	TYPE OF ANALYSIS	FREQUENCY	NONROUTINE REPORTING LEVELS*
2. TLD	a. Same as Item 1, Air Monitoring Sites**	Gamma radiation	Quarterly	None
	b. Plus 40 other sites distributed about the site boundary and at 5 miles** (minimum of 2 TLD's per packet)			
3. Fish	a. Pool 14 of Mississippi River (Q-23)	Gamma isotopic	Semi-annual	pCi/kg wet weight Mn-54 3×10^4 Co-58 3×10^4 Zn-65 2×10^4 Cs-137 2×10^3 Fe-59 1×10^4 Co-60 1×10^4 Cs-134 1×10^3
4. Milk	a. Two nearby dairies or private animals including the nearest, if possible (Q-17, Q-18)	I-131	a. Weekly during grazing season, May to October	pCi/l I-131, 3 Cs-134, 70 Cs-137, 60 Ba-La-140, 300
			b. Monthly, November to April	Same as 4a

TABLE 8.4-1 (Cont'd)

SAMPLE MEDIA	COLLECTION SITE	TYPE OF ANALYSIS	FREQUENCY	NONROUTINE REPORTING LEVELS*	
5. Surface Water	Q-19 East Moline Water Works Q-20 Davenport Water Works	Gamma isotopic	Monthly analysis of weekly composites	Nuclides	pCi/l
				H-3	20,000
				Mn-54	1,000
				Fe-59	100
				Co-58	600
				Co-60	300
				Zn-65	200
				Zr-Nb-95	400
				I-131	2
				Cs-134	30
				Cs-137	50
				Ba-La-140	100
6. Cooling Water Sample	Q-21 Inlet Q-22 Discharge	Gross beta	Weekly	None	
7. Sediment	Q-23 Lock and Dam No. 14	Gamma isotopic	Annual	None	
8. Dairy Census	a. Site boundary to 2 miles	a. Enumeration annually by a door-to-door or equivalent counting technique	During grazing season		
	b. 2 miles to 5 miles	b. Enumeration annually by using referenced information from county agricultural agents or other reliable sources	During grazing season		

TABLE 8.4-1 (Cont'd)

SAMPLE MEDIA	COLLECTION SITE	TYPE OF ANALYSIS	FREQUENCY	NONROUTINE REPORTING LEVELS*

*Average concentration over calendar quarter.

**See Figure 8.4-1

***A gamma isotopic analysis shall be performed whenever the gross beta concentration in a sample exceeds by five times (5x) the average concentration of the preceding calendar quarter for the sample location.

†See Figure 8.4-2

††A gamma isotopic analysis shall be performed if I-131 from the plant is found above the LLD.

†††Provided by station personnel.

TABLE 8.4-2

PRACTICAL LOWER LIMITS OF DETECTION (LLD)

FOR ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM

SAMPLE MEDIA	ANALYSIS	LLD (4.66)	UNITS
Airborne "Particulate"	Gross Beta*	0.01	pCi/m^3
	Gamma Isotopic	0.01	pCi/m^3
	Sr-89, 90	0.01	pCi/m^3
Airborne I-131	Iodine-131	0.10	pCi/m^3
Liquids	Sr-89	10	pCi/l
	Sr- 90	2	pCi/l
	I-131	5**	pCi/l
	Cs-134	10	pCi/l
	Cs-137	10***	pCi/l
	Tritium	0.2	pCi/ml
	Gross Beta*	5	pCi/l
	Gamma Isotopic	20	pCi/l/nuclide
Vegetation	Gross Beta*	2	pCi/g wet
	I-131	0.03	pCi/g wet
	Sr-89, 90	1	pCi/g wet
	Gamma Isotopic	0.2	pCi/g wet
Soil, Sediment	Gross Beta*	2	pCi/g dry
	Sr-89, 90	1	pCi/g dry
	Gamma Isotopic	0.2	pCi/g dry
Animal Tissue	Sr-89, 90	0.1	pCi/g wet
	I-131 - Thyroid	0.1	pCi/g wet
	Cs-134, 137	0.1	pCi/g wet
	Gross Beta*	1.0	pCi/g wet
	Gamma Isotopic	0.2	pCi/g wet

*Referenced to Cs-137.
**0.5 pCi/l on milk samples collected during the pasture season.
***5.0 pCi/l on milk samples.

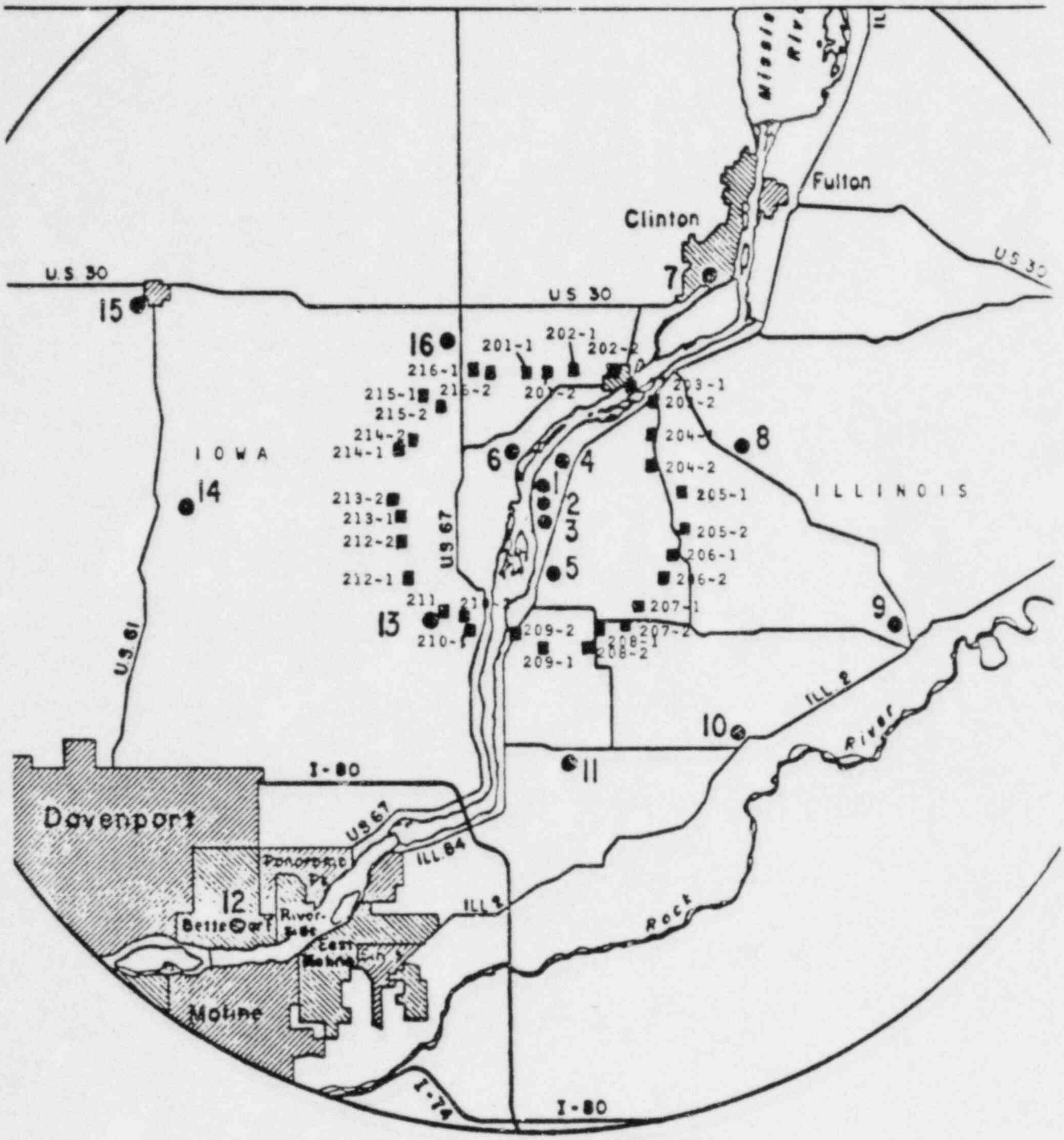
TABLE 8.4-3

ENVIRONMENTAL RADIOLOGICAL MONITORING SAMPLING CODES

MONITORING SITES		AIR	TLD	SURFACE WATER	WELL WATER	FISH	AQUATIC PLANTS AND SEDIMENT	MILK	PRECIPITATION, FEED, GRASS	VEGETABLES
Q-01	Onsite No. 1	X	X							
Q-02	Onsite No. 2	X	X							
Q-03	Onsite No. 3	X	X							
Q-04	Nitrin	X	X							
Q-05	Saddle Club Dairy Farm	X	X							
Q-06	Hanson's Boad Landing	X	X							
Q-07	Clinton	X	X							
Q-08	Sikkema Farm	X	X							
Q-09	Erie	X	X							
Q-10	Hillside	X	X							
Q-11	Port Byron	X	X							
Q-12	Bettendorf	X	X							
Q-13	Princeton	X	X							
Q-14	Utica Ridge Road	X	X							
Q-15	Dewitt	X	X							
Q-16	Low Moor	X	X							
Q-17	Hansen Dairy Farm							X	X	
Q-18	Musal Dairy Farm							X	X	

TABLE 8.4-3 (Cont'd)

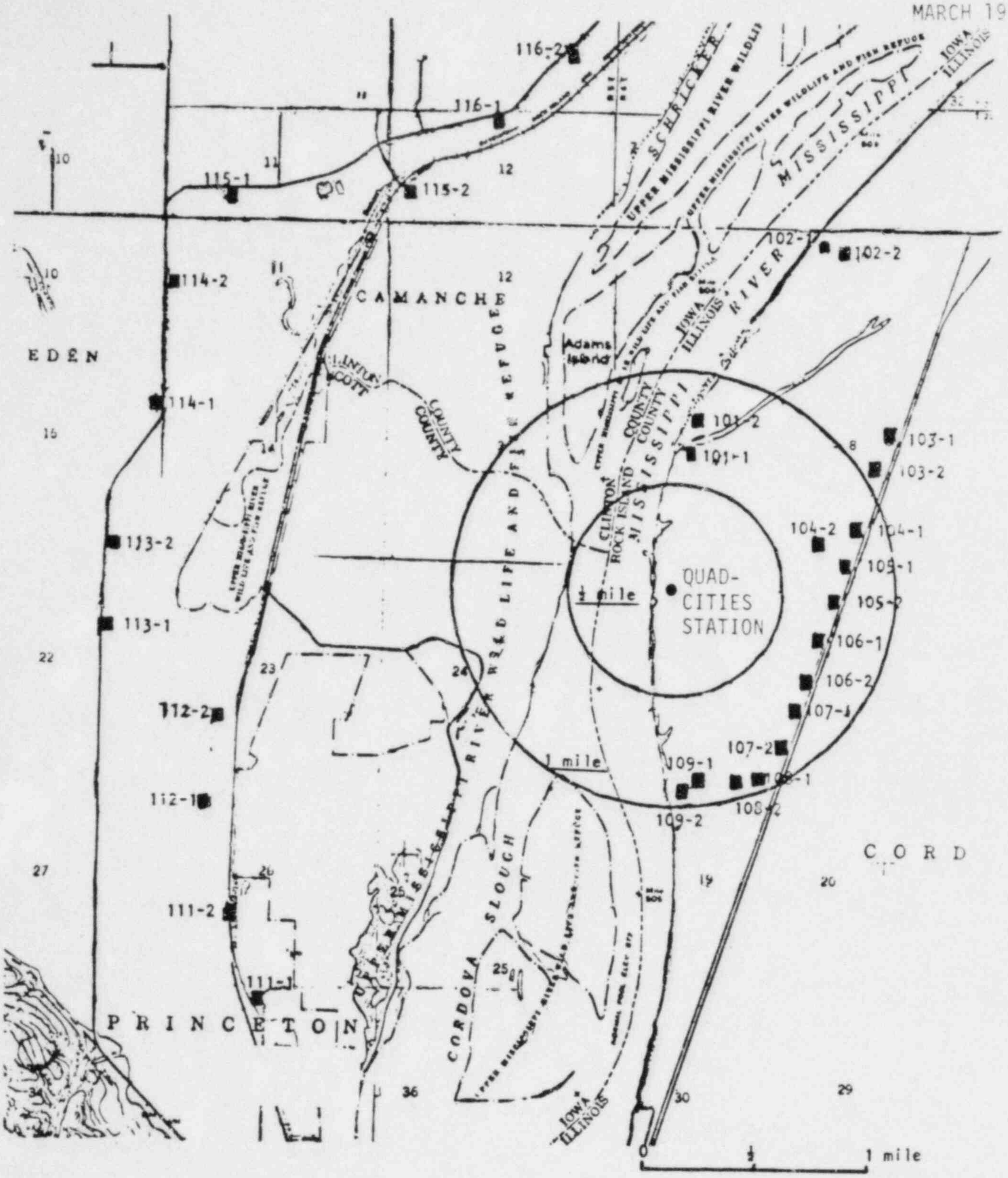
MONITORING SITES		AIR	TLD	SURFACE WATER	WELL WATER	FISH	AQUATIC PLANTS AND SEDIMENT	MILK	PRECIPITATION, FEED, GRASS	VEGETABLES
Q-19	East Moline Water Works			X						
Q-20	Davenport Water Works			X						
Q-21	Inlet Canal			X						
Q-22	Discharge Canal			X						
Q-23	Lock and Dam #14 (Mississippi River)						X			
Q-24	Pool #14 of Mississippi River					X				



QUAD-CITIES STATION
Units 1 & 2

FIGURE 8.4-1

FIXED AIR SAMPLING SITES
AND OUTER RING TLD LOCATIONS



QUAD-CITIES STATION
Units 1 & 2

FIGURE 8.4-2

INNER RING TLD LOCATIONS