MONTHLY NRC

SUMMARY OF OPERATING EXPERIENCE,

CHANGES, TESTS, AND EXPERIMENTS

PER REGULATORY GUIDE 1.16 AND 10 CFR 50.59

FOR

DRESDEN NUCLEAR POWER STATION

COMMONWEALTH EDISON COMPANY

UNIT	DOCKET	LICENSE
1	050-010	DPR-2
2	050-237	DPR-19
3	050-249	DPR-25

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1.0 Introduction

Dresden Nuclear Power Station is a three reactor generating facility owned and operated by the Commonwealth Edison Company of Chicago, Illinois. Dresden Station is located at the confluence of the Kankakee and Des Plaines Rivers, in Grundy County, near Morris, Illinois.

Dresden Unit 1 is a General Electric Boiling Water Reactor with a design net electrical output rating of 200 megawatts electrical (MWe). The unit is retired in place with all nuclear fuel removed from the reactor vessel. Therefore, no Unit 1 operating data is provided in this report.

Dresden Units 2 and 3 are General Electric Boiling Water Reactors with design net electrical output ratings of 794 MWe each.

Waste heat is rejected to a man-made cooling lake using the Kankakee River for make-up and the Illinois River for blowdown.

The Architect-Engineer for Dresden Units 2 and 3 was Sargent and Lundy of Chicago, Illinois.

This report was compiled by Gerrine Paramore of the Dresden Technical Staff, telephone number (815)942-2920 extension 2364.

2.0 SUMMARY OF OPERATING EXPERIENCE FOR NOVEMBER, 1989

2.1 UNIT 2 MONTHLY OPERATING EXPERIENCE SUMMARY

11-01-89 to 11-30-89	Unit 2 entered the month on line and operating at approximately 770 MWe. The unit operated in Economic Generation Control or at loads requested by the System Load Dispatcher for the remainder of the month.

2.0 SUMMARY OF OPERATING EXPERIENCE FOR NOVEMBER 1989

2.2 UNIT 3 MONTHLY OPERATING EXPERIENCE SUMMARY

11-01-89 to 11-30-89	Unit 3 entered the month on line and operating at approximately 773 MWe. The unit operated in Economic Generation Control or at loads requested by the System Load Dispatcher for the remainder of the month.

3.0 OPERATING DATA STATISTICS

3.1 OPERATING DATA REPORT - UNIT TWO

DOCKET NO. 050-237
UNIT DRESDEN TWO
DATE: DECEMBER 1, 1989
COMPLETED BY: G.M. PARAMORE
TELEPHONE (815) 942-2920

OPERATING STATUS

1. REPORTING PERIOD NOVEMBER 1989 — GROSS HOURS IN REPORTING PERIOD 720

2. CURRENTLY AUTHORIZED POWER LEVEL (MWt) 2,527 — MAX DEPEND CAPACITY (MWe-Net) 772; DESIGN ELECTRICAL RATING (MWe-Net) 794

3. POWER LEVEL TO WHICH RESTRICTED (IF ANY) (MWe-Net) N/A

4. REASONS FOR RESTRICTION (IF ANY)

	REPORTING PERIOD DATA		
	THIS MONTH	YEAR-TO-DATE	CUMULATIVE
5. TIME REACTOR CRITICAL (HOURS)	720.0	6,733.9	130,279.8
6. TIME REACTOR RESERVE SHUTDOWN (HOURS)	0.0	0.0	0.0
7. TIME GENERATOR ON-LINE (HOURS)	720.0	6,621.9	124,647.3
8. TIME GENERATOR RESERVE SHUTDOWN (HOURS)	0.0	0.0	0.0
9. THERMAL ENERGY GENERATED (MWHt-Gross)	1,699,164	14,687,898	257,179,760
10. ELECTRICAL ENERGY GENERATED (MWHe-Gross)	549,054	4,703,724	82,188,457
11. ELECTRICAL ENERGY GENERATED (MWHe-Net)	523,495	4,469,459	77,712,365
12. REACTOR SERVICE FACTOR (%)	100.0	84.0	76.0
13. REACTOR AVAILABILITY FACTOR (%)	100.0	84.0	76.0
14. SERVICE FACTOR (%)	100.0	82.6	72.7
15. AVAILABILITY FACTOR	100.0	82.6	72.7
16. CAPACITY FACTOR (USING MDC) (%)	94.2	72.2	58.7
17. CAPACITY FACTOR (USING DESIGN MWe) (%)	91.6	70.2	57.1
18. FORCED OUTAGE FACTOR (%)	0.0	1.9	10.8

19. SHUTDOWNS SCHEDULED OVER THE NEXT 6 MONTHS
(TYPE DATE AND DURATION OF EACH)

125VDC TEST OUTAGE, 12-13-89, 13 DAYS

20. IF SHUTDOWN AT END OF REPORT PERIOD, ESTIMATED DATE OF STARTUP

3.2 OPERATING DATA REPORT - UNIT THREE

DOCKET NO. 050-249
UNIT DRESDEN THREE
DATE: DECEMBER 1, 1989
COMPLETED BY: G.M. PARAMORE
TELEPHONE (815) 942-2920

OPERATING STATUS

1. REPORTING PERIOD NOVEMBER 1989 — GROSS HOURS IN REPORTING PERIOD 720

2. CURRENTLY AUTHORIZED POW[illegible]VEL (MWt): 2,527 — MAX DEPEND CAPACITY (MWe-Net) 773; DESIGN ELECTRICAL RATING (MWe-Net) 794

3. POWER LEVEL TO WHICH RESTRICTED (IF ANY) (MWe-Net) N/A

4. REASONS FOR RESTRICTION (IF ANY)

	REPORTING PERIOD DATA		
	THIS MONTH	YEAR-TO-DATE	CUMULATIVE
5. TIME REACTOR CRITICAL (HOURS)	720.0	7,272.7	120,181.0
6. TIME REACTOR RESERVE SHUTDOWN (HOURS)	0.0	0.0	0.0
7. TIME GENERATOR ON-LINE (HOURS)	720.0	7,186.2	112,310.3
8. TIME GENERATOR RESERVE SHUTDOWN (HOURS)	0.0	0.0	0.0
9. THERMAL ENERGY GENERATED (MWHt-Gross)	1,576,281	16,544,568	231,529,027
10. ELECTRICAL ENERGY GENERATED (MWHe-Gross)	510,399	5,341,913	74,730,622
11. ELECTRICAL ENERGY GENERATED (MWHe-Net)	487,720	5,095,218	70,832,644
12. REACTOR SERVICE FACTOR (%)	100.0	90.7	74.7
13. REACTOR AVAILABILITY FACTOR (%)	100.0	90.7	74.7
14. SERVICE FACTOR (%)	100.0	89.6	69.8
15. AVAILABILITY FACTOR	100.0	89.6	69.8
16. CAPACITY FACTOR (USING MDC) (%)	87.6	82.2	56.9
17. CAPACITY FACTOR (USING DESIGN MWe) (%)	85.3	80.1	55.4
18. FORCED OUTAGE FACTOR (%)	0.0	3.1	12.1

19. SHUTDOWNS SCHEDULED OVER THE NEXT 6 MONTHS
(TYPE DATE AND DURATION OF EACH)

REFUEL OUTAGE, 12-3-89, 10 WEEKS

20. IF SHUTDOWN AT END OF REPORT PERIOD, ESTIMATED DATE OF STARTUP

3.3 AVERAGE DAILY UNIT POWER LEVEL

DOCKET NO. 050-237

UNIT II

DATE DECEMBER 1, 1989

COMPLETED BY G. PARAMORE

TELEPHONE 815/942-2920

MONTH NOVEMBER, 1989

DAY	AVERAGE DAILY POWER LEVEL (MWe-Net)	DAY	AVERAGE DAILY POWER LEVEL (MWe-Net)
1	729	17	738
2	743	18	717
3	741	19	666
4	736	20	718
5	723	21	738
6	737	22	724
7	759	23	711
8	745	24	707
9	755	25	707
10	758	26	696
11	591	27	742
12	724	28	764
13	733	29	710
14	759	30	766
15	741	31	
16	732		

3.4 AVERAGE DAILY UNIT POWER LEVEL

DOCKET NO. 050-249

UNIT III

DATE DECEMBER 1, 1989

COMPLETED BY G.P. PARAMORE

TELEPHONE 815/942-2920

MONTH NOVEMBER, 1989

DAY	AVERAGE DAILY POWER LEVEL (MWe-Net)	DAY	AVERAGE DAILY POWER LEVEL (MWe-Net)
1	704	17	688
2	660	18	686
3	728	19	684
4	714	20	680
5	713	21	638
6	712	22	648
7	709	23	629
8	698	24	626
9	706	25	623
10	705	26	628
11	702	27	637
12	699	28	644
13	694	29	657
14	691	30	652
15	689	31	
16	679		

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DOCKET NO.	050-237
UNIT NAME	DRESDEN UNIT II
DATE	December 1, 1989
COMPLETED BY	G. Paramore
TELEPHONE	(815)942-2920

3.5 UNIT SHUTDOWNS AND POWER REDUCTIONS

REPORT MONTH NOVEMBER, 1989

NO.	DATE	TYPE[1]	DURATION (HOURS)	REASON[2]	METHOD OF SHUTTING DOWN REACTOR[3]	LICENSEE EVENT REPORT #	SYSTEM CODE[4]	COMPONENT CODE[5]	CAUSE & CORRECTIVE ACTION TO PREVENT RECURRENCE
7	None	-	-	-	-	-	-	-	

1
F: Forced
S: Scheduled

2
Reason:
A-Equipment Failure (Explain)
B-Maintenance or Test
C-Refueling
D-Regulatory Restriction
E-Operator Training & Licensee Examination
F-Administrative
G-Operational Error
H-Other (Explain)

3
Method:
1-Manual
2-Manual Scram
3-Automatic Scram
4-Other (Explain)
5-Load Reduction

4
Exhibit G-Instructions for Preparation of Data Entry Sheets for Licensee Event Report (LER) File (NUREG-0161)

5 Exhibit I - Same Source

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DOCKET NO. 050-249
UNIT NAME DRESDEN UNIT III
DATE December 1, 1989
COMPLETED BY G. Paramore
TELEPHONE (815)942-2920

3.6 UNIT SHUTDOWNS AND POWER REDUCTIONS

REPORT MONTH NOVEMBER, 1989

NO.	DATE	TYPE[1]	DURATION (HOURS)	REASON[2]	METHOD OF SHUTTING DOWN REACTOR[3]	LICENSEE EVENT REPORT #	SYSTEM CODE[4]	COMPONENT CODE[5]	CAUSE & CORRECTIVE ACTION TO PREVENT RECURRENCE
5	None	-	-	-	-	-	-	-	-

1
F: Forced
S: Scheduled

2
Reason:
A-Equipment Failure (Explain)
B-Maintenance or Test
C-Refueling
D-Regulatory Restriction
E-Operator Training & Licensee Examination
F-Administrative
G-Operational Error
H-Other (Explain)

3
Method:
1-Manual
2-Manual Scram
3-Automatic Scram
4-Other (Explain)
5-Load Reduction

4
Exhibit G-Instructions for Preparation of Data Entry Sheets for Licensee Event Report (LER) File (NUREG-0161)

5 Exhibit I - Same Source

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3.7 STATION MAXIMUM DAILY ELECTRICAL LOAD DATA
DRESDEN STATION
NOVEMBER, 1989

DAY	HOUR ENDING	MAXIMUM DAILY LOAD KW
1	0100	1,553,400
2	1800	1,558,100
3	0100	1,549,900
4	0800	1,526,800
5	1900	1,513,800
6	0400	1,513,800
7	1700	1,549,500
8	0500	1,545,400
9	0600	1,551,700
10	0600	1,548,400
11	2200	1,449,800
12	1100	1,506,500
13	2400	1,507,200
14	1300	1,533,100
15	1100	1,497,700
16	0500	1,497,700
17	1600	1,496,600
18	0400	1,495,900
19	2000	1,490,100
20	0900	1,488,300
21	0300	1,467,400
22	1300	1,472,700
23	0700	1,411,700
24	2200	1,412,200
25	1600	1,410,600
26	0800	1,408,900
27	1700	1,489,000
28	2300	1,502,500
29	0100	1,452,800
30	1500	1,501,900
TOTAL		44,903,400

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4.0 UNIQUE REPORTING REQUIREMENTS

4.1 MAIN STEAM RELIEF VALVE OPERATIONS

Relief valve operations during the reporting period, November, 1989, are summarized in the following table. The table includes information as to which relief valve was actuated, how it was actuated, and the circumstances resulting in its actuation.

Unit	Date	Valves Actuated	No. and Type of Actuations	Plant Conditions	Description of Events

None

4.2 OFF-SITE DOSE CALCULATION MANUAL (ODCM) CHANGES

The Commonwealth Edison Emergency Preparedness Staff has recently implemented an overall revision to the ODCM in order to enhance its readability and incorporate various changes in accordance with NUREG 0472 Revision 3 involving establishment of the child's thyroid, as opposed to the infant's as the most sensitive organ for the inhalation of airborne effluents.

This information was summarized in the May, 1989 Dresden Operating Data report. However, it was determined that additional clarifying information be provided in this report. The following information is therefore provided in order to document editorial changes implemented during the Onsite and Offsite review process. As identified previously, these changes did not reduce the accuracy or reliability of dose calculations or setpoint determinations.

4.2.1 ODCM Revision Summary

Revisions to the Offsite Dose Calculation Manual (ODCM) are reportable to the NRC in accordance with stations' Technical Specifications. The ODCM contains the models for the public dose assessment from gaseous effluents, liquid discharges, and direct radiation. In 1988, in response to the NRC's request to make the ODCM a more readable document as well as to incorporate certain changes, Commonwealth Edison rewrote its ODCM. This summary describes the principal non-edited changes.

The NRC, in NUREG 0472, Rev. 3, Draft 7, has identified the child's thyroid and not the infant's as the most sensitive organ regarding the inhalation of airborne effluents. Dresden, LaSalle, and Quad Cities Stations' 10CFR20 instantaneous release rate limits have been revised to restrict the dose rate to the child's thyroid to less or equal to 1500 mrem/yr.

Hydrogen addition to the primary coolant increases the boiling water reactors' turbine N-16 sky shine by a magnitude of 5. This phenomenon is now included in the ODCM formulation. In addition the sky shine calculation is written for LaSalle County Station as well as revised in Dresden and Quad Cities.

Most of the ODCM documentation has been either clarified, corrected or deleted. Plume depletion, terrain factors and heat content were not accounted for in the original for D/Q, X/Q and plume rise calculations. They are described in the revised document.

It was implied that the X/Q dose factors were calculated assuming a mono-energetic gamma energy having an average gamma ray energy per disintegration for each radionuclide. Also, it was assumed that the corrected tissue absorptions were made using a tissue energy absorption coefficient equivalent to this same average gamma ray energy for each radionuclide. Actually, the dose factors and the tissue energy absorption coefficients referenced were calculated using the photon energy spectra for each radionuclide. The tissue energy absorptions coefficients are negligible and have been deleted from the text.

4.2.1 ODCM Revision Summary (Cont'd)

Formulas and parameters for determining the maximum permissible concentrations (MPC's) have been eliminated from the section on radioactivity in storage tanks. The maximum limits, in curies, are found in the site specific sections.

The potential direct radiation dose from stations' interim radwaste storage facilities is discussed. The radwaste containers will have a contact dose rate of 5 R/hr and the expected radiation levels will be minimal at the site boundary.

The distance dependent parameters were adjusted to the values reported in the 1988 census for nearest residents and/or nearest milch animal. This also affected the D/Q tables and BWR turbine N-16 sky shine calculation.

The time of travel from the station liquid discharge to the nearest community water supply was reevaluated for Braidwood and Quad Cities.

This ODCM revision was initially On-site Reviewed at Dresden Station under On-Site Review 89-8, as reported in the May, 1989 Operating Data Report. However, as part of the review process, the Dresden On-Site Review Committee recommended various editorial changes, which were then incorporated and re-reviewed under On-Site Review 89-23, for which the on-site review process was completed on June 9, 1989. Off-site review of the editorial changes was then completed on July 18, 1989. These changes, which were editorial in nature and did not technically affect the summary previously included in the May, 1989 report, are provided in section 4.2.2 below as a clarification.

4.2.2 ODCM Page Change Information

page vii	added:	mi mile
page 4-11	changed:	rays to particles
page 4-23	added:	First (in equation
page 4-34	corrected:	addition
page A-43	added: changed: added:	Dresden 1/2/3: 3.8.D four to five Dresden
page A-57	corrected:	during
page B-10	corrected:	and
page B-12	corrected:	sector
page B-13	corrected:	sector
page D-23	added:	data for stability classes B, C, D and E
page E-8	corrected:	based
page E-10	corrected:	photon

NOTE: Table 11-1 was extended 1 page, subsequent pages in Chapter 11 are moved back one.

page 11-10 (Draft 11-9)	added: changed:	Footnotes 2 to a and made it a footnote
page 11-11 (Draft 11-10)	changed:	a to b, b to c and c to d
page F-2	changed:	Limits on outdoor tanks to read: Refer to section 3.8.D of Technical Specifications of Units 1, 2, and 3 for specific limits.

FWHM	full width at half maximum
gal	gallon
GE	General Electric
GI	gastrointestinal tract
GM	Geiger-Mueller
gpm	gallons per minute
HEPA	high-efficiency particulate air
hr	hour
H-3	tritium (hydrogen-3)
JFD	joint frequency distribution
Kcal	kilocalorie
keV	kilo-electron-volt (10^3 electron volts)
kg	kilogram
km	kilometer
Kr	krypton
L	liter
LCO	limiting condition for operation
LLD	lower limit of detection
LLI	lower large intestine
m	meter
MeV	mega-electron-volt (10^6 electron volts)
mg	milligram
mi	mile
mL	milliliter
MPC	maximum permissible concentration
mph	miles per hour

types of radionuclides, except tritium for PWRs (see Table 4-1). Tritium does not contribute significantly to the external radiation dose due to a plume because it has no gamma emissions and because its beta emission is very weak (maximum energy 18.6 keV, corresponding to a range in air of about 0.5 cm).

These noble gases emit both photons (gamma and x-rays) and electrons (beta particles and monoenergetic electrons). The emitted photons and electrons can both have energies ranging up to more than 4 MeV. The photons can travel considerable distances. For example, the mean free path in air of gamma radiation at various energies is as follows:

Photon Energy (MeV)	Mean Free Path (ft)
0.1	160
1	400
4	820

In contrast, the ranges of the emitted electrons are relatively low:

Maximum Beta Energy (MeV)	Range (ft)
0.1	0.44
1	10
4	51

This difference affects the types of doses a plume can produce at ground level. For example, gamma radiation from a narrow plume at an elevation of 300 feet (a typical release height) could reach the ground but beta radiation could not. The difference also affects the way in which doses due to photon and electron radiation are evaluated (see Sections 4.2.1.1 and 4.2.1.2).

with time at a rate d_i and then approaches a constant equilibrium value of d_i/λ_i. Equilibrium occurs when the rate of deposition equals the rate of loss due to decay.

Equation 4-7

Equation 4-7 is used to obtain the deposition rate d_i from a station's measured release of radionuclide i:

$(D/Q)_s$	Relative Deposition Factor, Stack Release Rate of deposition of radioactivity at a specified location per unit of radioactivity release rate for a stack release.	$[m^{-2}]$
1E6	Conversion Constant Converts µCi to pCi.	[pCi/µCi]
A'_{is}	Cumulative Radionuclide Release from from a Stack Release Point, Adjusted for Radiodecay Measured cumulative release of radionuclide i from a stack release point, reduced to account for radiodecay in transit from the release point to the point of deposition (see Equation A-3 of Appendix A).	[µCi]

Equation 4-7 may be understood as follows:

- The factor $[(1E6)\ (A'_{is})/(24t_r)]$ is the release rate [pCi/hr].
- The relative deposition factor $(D/Q)_s$ is the deposition rate $[(pCi/hr)/m^2]$ per unit release rate [pCi/hr].
- The product of release rate and the relative deposition factor is the deposition rate $[(pCi/hr)/m^2]$.

Comment

Note that if there is no release of radionuclide i during a given time period, then d_i is zero, $C^G{}_i$ is zero, and the doses due to direct radiation from contained sources at the station. When evaluation of total dose is required for a station, the following contributions are summed:

- Doses due to airborne and liquid effluents from the station.
- Doses due to liquid effluents from upstream CECo stations.
- Doses due to nitrogen-16 skyshine, if the station has a boiling water reactor.

Section A.3 of Appendix A discusses the assumptions made regarding location of dose receptors for these evaluations.

Equation A-35 of Appendix A is used to evaluate skyshine dose. A complicating factor in the calculation is the practice at some stations of adding hydrogen to reactor coolant to improve coolant chemistry. The addition of hydrogen can increase the dose rate due to skyshine by up to a factor of 5 (Reference 39, Page 8-1). The skyshine dose determined by Equation A-35 of Appendix A depends on the following factors:

- The distance of the location considered from the turbine.
- The number of hours per year that the location is occupied by a dose recipient.
- The total energy [MWe-hr] generated by the station with hydrogen addition.
- The total energy [MWe-hr] generated by the station without hydrogen addition.

The Technical Specifications of some CECo stations contain a somewhat similar provision. For exact requirements, see the following specifications:

- Braidwood 1/2: 3.11.1.4
- Byron 1/2: 3.11.1.4
- Dresden 1/2/3: 3.8.D
- La Salle 1/2: 3.11.1.4
- Zion 1/2: 3.11.5

For most of these stations specific numerical limits are specified on the number of Curies in affected tanks. However, for La Salle, the quantity of radioactivity in an outside temporary tank is limited to less than or equal to "the limits calculated in the ODCM."

Application

Table F-1 of Appendix F provides information on the limits applicable to each of the five affected stations. For Braidwood, Byron, Dresden, and Zion, the limits are as stated in the station Technical Specifications. For La Salle, the limit for an outside temporary tank is taken as 10 Ci with tritium and dissolved or entrained noble gases excluded. This value is the same as specified for an outside temporary tank at Braidwood and Byron.

A.2.5 Operability and Use of the Liquid Radwaste Treatment System

Requirement

Standard Technical Specifications (Reference 2) require that the liquid radwaste treatment system be operable and that to the whole body or 5 mrem to any organ during any calendar quarter) or 3.11.1.2.b (3 mrem to the whole body or 10 mrem to any organ during any calendar year).

- **Zion**

  Action a of Specification 3.11.2 requires the station to demonstrate that radiation exposures to all members of the public are less than the 40 CFR 141 standard whenever the calculated dose from the release of radioactive materials in liquid effluents from the site exceeds twice the limits specified in 3.11.2.A.1 (3 mrem to the whole body and 10 mrem to any organ during any calendar quarter).

A.4.3 Application

The projection or calculation of dose due to the drinking water pathway is made using Equation A-30. Projections are made using projected radionuclides releases in place of measured releases A_i. Doses calculated using Equation A-30 may differ from doses determined by the methodology prescribed in 40 CFR 141.16.

When required, a station prepares a special report on radiological impact at the nearest community water system. This system is taken as the one listed in Table A-2 of this appendix. The report should include the following:

- The doses calculated by Equation A-30.
- A statement identifying the dose calculation methodology (e.g., a reference to this manual).
- A statement that the doses calculated by CECo methodology are not necessarily the same as doses calculated by the methodology prescribed in 40 CFR 141.16.
- The data used by CECo to calculate the doses. This information includes the amounts of radioactivity released and the flow rate and dilution values used (see Table F-1). This information is provided to assist the operator of the community water system in performing its own dose assessment.

B.2.1 Mathematical Representation

In a widely-used form of the Gaussian plume model, the distribution of radioactivity in a plume is represented mathematically by the equation below (see Figure B-4):

$$\chi(x,y,z) = [Q/(2\pi\sigma_y\sigma_z u)]\exp(-y^2/2\sigma_y^2) \times \{\exp[-(z-h_e)^2/2\sigma_z^2] + \exp[-(z+h_e)^2/2\sigma_z^2]\} \quad \text{(B-9)}$$

$\chi(x,y,z)$ — Radioactivity Concentration [$\mu Ci/m^3$]

The concentration of radioactivity at point (x,y,z). The x-, y-, and z-axes are defined as follows (see Figure B-4):

- **x** — Downwind Distance [m]

  Distance from the stack along an axis parallel to the wind direction.

- **y** — Crosswind Distance [m]

  Distance from the plume centerline along an axis parallel to the crosswind direction.

- **z** — Vertical Distance [m]

  Distance from the ground (grade level at the stack) along an axis parallel to the vertical direction.

Q — Release Rate [$\mu Ci/sec$]

Release rate of radioactivity.

σ_y, σ_z — Horizontal and Vertical Dispersion Coefficients [m]

Standard deviations of the Gaussian distributions describing the plume cross-sections in the y and z directions, respectively. The values of σ_y and σ_z depend on several parameters:

case, it is reasonable to assume that the wind blows with equal likelihood toward all directions within the sector. From Equation B-9, the following equation for ground level radioactivity concentration can be derived:

$$\chi_{sector} = [2.032\ f\ Q/(\sigma_z\ u\ x)]\exp(-h_e^2/2\sigma_z^2) \qquad \text{(B-10)}$$

χ_{sector}	Sector-Averaged Ground Level Concentration The time-averaged concentration of radioactivity in a sector on the ground at a distance x from the release point.	[µCi/m³]
2.032	Constant A dimensionless constant.	
f	Sector Fraction The fraction of time that the wind blows into the sector.	
Q	Release Rate Release rate of radioactivity.	[µCi/sec]

The other parameter definitions are the same as for Equation B-9.

B.3 RELATIVE CONCENTRATION FACTOR X/Q

The relative concentration factor X/Q (called "chi over Q") provides a simple way of calculating the radioactivity concentration at a given point in an effluent plume when the release rate is known:

$$X = Q\ (X/Q) \qquad \text{(B-11)}$$

X	Concentration of Radioactivity Concentration of radioactivity at point (x,y,z) in the atmosphere.	[µCi/m³]

Q — Release Rate [µCi/sec]

Release rate of radioactivity.

X/Q — Relative Concentration Factor [sec/m^3]

Relative concentration factor for point (x,y,z). The airborne radioactivity concentration at (x,y,z) per unit release rate.

Expressions for X/Q based on Gaussian plume models can be obtained from the equations for concentration X in Section B.2 simply by dividing both sides of each equation by the release rate Q. For example, from Equation B-10, we obtain the following expression for the sector-averaged X/Q:

$$(X_{sector}/Q) = [2.032\ f/(\sigma_z\ u\ x)]\exp(-h_e^2/2\sigma_z^2) \qquad \text{(B-12)}$$

The values of X/Q used in ODCM calculations are both sector-averaged and time-averaged. The time averaging is based on the historical average atmospheric conditions of a specified multi-year time period (see Section 4.1.5) and is accomplished by use of the joint frequency distribution discussed in Section B.1.2. The formulas used to obtain the time- and sector-averaged X/Q are based on Equation B-12, but vary depending on whether the release is a stack, ground level, or vent release. The three cases are discussed below.

B.3.1 Stack Release

For a stack release, the relative concentration factor is designated $(X/Q)_s$. Its value is obtained by the following formula:

$$(X/Q)_s = (2.032/R)\Sigma\{\ f_s(n,\theta,c) \times [\exp(-h_e^2/2\sigma_z^2)]/(u_n\sigma_z)\ \} \qquad \text{(B-13)}$$

The summation is over wind speed classes n and atmospheric stability classes c.

Table D-9

Atmospheric Stability Classes

Description	Pasquill Stability Class	σ_θ[a] (degrees)	Temperature Change with Height (°C/100 m)
Extremely Unstable	A	>22.5	<-1.9
Moderately Unstable	B	17.5 to 22.5	-1.9 to -1.7
Slightly Unstable	C	12.5 to 17.5	-1.7 to -1.5
Neutral	D	7.5 to 12.5	-1.5 to -0.5
Slightly Stable	E	3.8 to 7.5	-0.5 to 1.5
Moderately Stable	F	2.1 to 3.8	1.5 to 4.0
Extremely Stable	G	0 to 2.1	>4.0

[a] σ_θ is the standard deviation of horizontal wind direction fluctuation over a period of 15 minutes to 1 hour.

Interim Radwaste Storage Facilities

Since the Environmental Reports were written, interim radwaste storage facilities have been constructed at four CECo stations, Dresden, La Salle, Quad-Cities, and Zion. These facilities were designed to serve as temporary repositories for solid radwaste before shipment offsite.

The offsite dose consequences of these facilities were analyzed in a series of calculations (References 56 through 59), which were based on a design basis radwaste container assumed to have a contact dose rate of 5 R/hr. Annual doses for 100% occupancy at the point of maximum offsite exposure were found to be as follows:

- 0.6 mrem/yr for La Salle and Quad-Cities and much less than 0.6 mrem/yr for Zion (see the last paragraph on Page 7 of Reference 56 and the last paragraph on Page 3 of Reference 57).
- 1.6 mrem/yr for Dresden (see the next-to-last paragraph on Page 3 of Reference 58 and the last paragraph on Page 3 of Reference 59).

Since occupancy at the points of maximum offsite exposure is likely to be much less than 100%, doses due to the interim radwaste storage facilities are judged negligible in comparison with 40 CFR 190 limits.

E.4 BASES OF CHAPTER 4, METHODOLOGY

Most of the material in this chapter is based on Appendix A. Additional information on bases is provided below.

E.4.1 Introduction of Time Factors

In explaining the equations of Appendix A, a factor t (representing the time period of concern) is sometimes added to the

$$\bar{x} = 1/\mu \qquad \text{(E-1)}$$

$$\mu = (\mu/\rho)\rho \qquad \text{(E-2)}$$

$\bar{x}$	Mean Free Path The average distance traveled by a photon before interacting with matter.	[cm]
μ	Attenuation Coefficient of Air Probability of photon absorption or scattering per unit distance traveled in air.	[cm^{-1}]
ρ	Density of Air	[g/cc]

The results for photon mean free path in Section 4.2.1 are based on data in Reference 61. For a 4-MeV photon, the calculation is as follows:

μ/ρ = 0.0308 cm^2/g (per Table 5.2 of Reference 61)

ρ = 0.001293 g/cc (per Table 1.3 of Reference 61)

μ = (0.0308 cm^2/g) (0.001293 g/cc) = 3.982E-5 cm^{-1}

Range of Beta Radiation in Air

The results for beta radiation range in Section 4.2.1 are based on equations in Reference 38. The range of beta radiation with a maximum energy greater than 2.5 MeV is given by the following equation (Reference 38, Page 100):

$$R = (530)(E_{max}) - 106 \qquad \text{(E-3)}$$

R	Range	[mg/cm^2]
E_{max}	Maximum Beta Energy	[MeV]

For E_{max} = 4 MeV,

Table 11-3 (Cont'd)

Notes:

1. Other radionuclides which are measurable and identifiable by gamma-ray spectrometry, together with the nuclides indicated in Table 11-3, shall also be identified and reported when an actual analysis is performed on a sample. Nuclides which are below the LLD for the analyses shall not be reported as being present at the LLD level for that nuclide.

Footnotes:

a. The LLD is the smallest concentration of radioactive material in a sample that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation)

$$LLD = \frac{(4.66) \cdot (S_b)}{(A) \cdot (E) \cdot (V) \cdot (2.22) \cdot (Y) \cdot (\exp(-\lambda \Delta t)) \cdot (t)}$$

LLD is the *a priori* lower limit of detection for a blank sample or background analysis as defined above (as pCi per unit mass or volume).

S_b is the square root of the background count or of a blank sample count; it is the estimated standard error of a background count or a blank sample count as appropriate (in units of counts).

E is the counting efficiency (as counts per disintegration).

A is the number of gamma-rays emitted per disintegration for gamma-ray radionuclide analysis (A = 1.0 for gross alpha and tritium measurements).

V is the sample size (in units of mass or volume).

2.22 is the number of disintegrations per minute per picocurie.

Y is the fractional radiochemical yield when applicable (otherwise Y = 1.0).

λ is the radioactive decay constant for the particular radionuclide (in units of reciprocal minutes).

Δt is the elapsed time between the midpoint of sample collection and the start time of counting. (Δt = 0.0 for environmental samples and for gross alpha measurements.)

Table 11-3 (Cont'd)

General Notes (Cont'd):

t is the duration of the count (in units of minutes).

The value of S_b used in the calculation of the LLD for a detection system shall be based on an actual observed background count or a blank sample count (as appropriate) rather than on an unverified theoretically predicted value. Typical values of E, V, Y, t, and Δt shall be used in the calculation.

For gamma-ray radionuclide analyses the background counts are determined from the total counts in the channels which are within plus or minus one FWHM (full width at half maximum) of the gamma-ray photopeak energy normally used for the quantitative analysis for that radionuclide. Typical values of the FWHM shall be used in the calculation.

The LLD for all measurements is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular sample measurement.

b. Referenced to Cs-137.

c. For thyroid.

d. 0.5 pCi/L on samples collected during the pasture season.

Table F-1

Aquatic Environmental Dose Parameters

Water and Fish Ingestion Parameter

Parameter[a]	Value
U^w, water usage, L/hr	0.042
U^f, fish consumption, kg/hr	2.4E-4
$1/M^w$	1
$1/M^f$	1
F^w, cfs	1.37E4
F^f, cfs	1.08E4
t^f, hr[b]	24
t^w, hr[c]	106

Limits on Radioactivity in Unprotected Outdoor Tanks

Refer to Section 3.8.D of the Technical Specifications of Units 1, 2, and 3 for specific limits.

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[a] The parameters are defined in Section A.2.1 of Appendix A.

[b] t^f (hr) = 24 hr (all stations) for the fish ingestion pathway

[c] t^w (hr) = 106 (distance to Peoria is 106 miles; flow rate of 1 mph assumed)

4.3 MAJOR CHANGES TO THE RADIOACTIVE WASTE TREATMENT SYSTEMS

There were no major changes to the radioactive waste treatment systems at Dresden during November, 1989.

4.4 FAILED FUEL ELEMENT INDICATIONS

4.4.1 Unit 2

Dresden Unit 2 fuel performance during November 1989 continued to show no indications of leaking fuel. This is based on the sum of the activities of the six noble gases as measured at the recombiner. Based on the reported data, Unit 2 had acceptable fuel performance.

4.4.2 Unit 3

Dresden Unit 3 fuel performance during November 1989 continued to show no indications of leaking fuel. This is based on the sum of the activities of the six noble gases as measured at the recombiner. Based on the reported data, Unit 3 had acceptable fuel performance.

5.0 PLANT OR PROCEDURE CHANGES, TESTS, EXPERIMENTS, AND SAFETY RELATED MAINTENANCE

5.1 Amendments to Facility License or Technical Specifications

The license amendments and/or Technical Specification changes which were approved and implemented for use during the reporting period are listed below.

5.1.1 Unit 2

None

5.1.2 Unit 3

None

5.2 Changes to Procedures Which are Described in the FSAR (Units 2 and 3)

Table 5.2.1, attached, summarizes the revisions to procedures described in the FSAR which were approved during the reporting period.

TABLE 5.2.1

CHANGES TO PROCEDURES WHICH ARE DESCRIBED IN THE FSAR (UNITS 2 AND 3)

PROCEDURE TYPE	PROCEDURE NO.	PROCEDURE TITLE/DESCRIPTION	SUMMARY OF CHANGES
Dresden Administrative Procedure (DAP)	DAP 12-7	Dresden Station As Low As is Reasonably Achievable (ALARA) Exposure Control Program	1
Dresden Instrument Surveillance (DIS)	DIS 500-2	Reactor Vessel Low Water Level Scram and Low Low Water Level Isolation Analog Trip System Calibration	2, 4

NOTES: 1. Administrative change; intent of procedure unchanged.
2. Changed for clarification, intent of procedure unchanged.
3. Changed to incorporate requirements for new equipment; intent of procedure unchanged
4. Changed to implement improved testing/calibration methodology; intent of procedure unchanged.

5.3 Significant Tests and Experiments Not Described in the FSAR (UNITS 2 and 3)

Significant special procedures involving tests not described in the FSAR which were approved during the month are listed below.

Procedure No.	Procedure Title/Description
SP 89-10-111	Procedure provides for the local leak rate testing (LLRT) of the oxygen analyzer line, which is to be replaced during the Unit 3 refuel outage.
SP 89-11-114	This procedure was utilized to precondition the new inlet recirculation sample lines installed for the hydrogen water chemistry verification system. Preconditioning was accomplished by injecting a small stream of highly oxygenated water into the sample line after normal sample flow is established.
SP 89-11-116	This procedure was utilized to adjust the recirculation speed controller settings to minimize undershoots, overshoots and oscillatory behavior experienced by Units 2 and 3 during Economic Generation Control operation.
SP 89-11-118	The purpose of this test was to detail the steps necessary to operate a temporary submersible pump in place of the high conductivity sump pump, which was out of service.
SP 89-11-121	This procedure was utilized to analyze minor main turbine bypass valve oscillations.

5.4 Safety related maintenance (Units 2 and 3)

Safety related maintenance activities are summarized in the attached tables.

DRESDEN UNIT 2
5.4 SAFETY RELATED MAINTENANCE

EQUIPMENT	NATURE OF MAINTENANCE	LER OR OUTAGE NUMBER	MALFUNCTION CAUSE	MALFUNCTION RESULT	CORRECTIVE ACTION
LPRM 2C-24-41	PREVENTIVE WR U57040	N/A	---------	---------	PERFORMED PROCEDURE AND CALIBRATED. FOUND NO PROBLEMS
2-XO-1501-19B	CORRECTIVE WR U72193	N/A	---------	---------	REPLACED SPRING PACK, GASKETS AND GREASE
2A & 2B SBLC MOTORS	PREVENTIVE WR U72345	N/A	---------	---------	REPLACED GREASE FITTINGS
CALIBRATION COMMAND UNIT	CORRECTIVE WR U72365	N/A	---------	---------	REPLACED COMMAND UNIT PER PACKAGE
2A-202 RECIRC PUMP DECON CONNECTION	PREVENTIVE WR U78122	N/A	---------	---------	REMOVED BLANK FLANGE, INSTALLED DECON SPOOL AND HOSE. REMOVED SPOOL AND HOSE AND REINSTALLED BLANK FLANGE
2B-202 RECIRC PUMP DECON FLANGE	PREVENTIVE WR U78123	N/A	---------	---------	REMOVED BLANK FLANGE, INSTALLED DECON SPOOL AND HOSE. REMOVED SPOOL AND HOSE AND REINSTALLED BLANK FLANGE
MOV 2-3702	PREVENTIVE WR U78921	N/A	---------	---------	MOUNTED VOTES SENSOR ON VALVE YOKE AND TESTED
MOV 2-1501-13B	PREVENTIVE WR U78984	N/A	---------	---------	MOUNTED VOTES SENSOR ON VALVE YOKE AND TESTED
MOV 2-1501-22A	PREVENTIVE WR U78995	N/A	---------	---------	MOUNTED VOTES SENSOR ON VALVE YOKE AND TESTED
MOV 2-2301-47	PREVENTIVE WR U78985	N/A	---------	---------	MOUNTED VOTES SENSOR TO VALVE YOKE AND TESTED

EQUIPMENT	NATURE OF MAINTENANCE	LER OR OUTAGE NUMBER	MALFUNCTION CAUSE	MALFUNCTION RESULT	CORRECTIVE ACTION
MOV 2-2301-10	PREVENTIVE WR [illegible]	N/A	----------	----------	MOUNTED VOTES SENSOR ON VALVE YOKE AND TESTED
HPCI OIL SYSTEM	PREVENTIVE WR 081627	N/A	----------	----------	INSTALLED AND REMOVED HPCI TEST EQUIPMENT
2-2420-B DW RAD MON/TORUS RAD MON	PREVENTIVE WR [illegible]	N/A	----------	----------	INSTALLED NEW HUMAN FACTORS SCALE
2-2302 HPCI BOOSTER PUMP UNION	CORRECTIVE WR [illegible]	N/A	----------	----------	REPAIRED LEAK IN HPCI BOOSTER PUMP UNION
2-2300-LOF HPCI LUBE OIL DUPLEX FILTER	CORRECTIVE WR [illegible]	N/A	----------	----------	CHANGED FILTER ELEMENT, WROTE WR085464 TO REPLACE CANISTER
LPRM 40-57A	CORRECTIVE WR 085270	N/A	----------	----------	TROUBLESHOT PER PROCEDURE AND BURNED OFF WHISKERING
M-1153D-89 2/2 SBGT RESTRAINT	PREVENTIVE WR 085395	N/A	----------	----------	REMOVED AND REINSTALLED SBGT RESTRAINT FOR REPLACEMENT OF EXHAUST FAN
2-5200 MISC U2 D/G ENGINE COOLING WATER SYSTEM	PREVENTIVE WR 085531	N/A	----------	----------	INSTALLED PIPE PLUG AND TIGHTENED
2-2452B U2 O2 H2O2 ANALYZER SAMPLE PUMP	CORRECTIVE WR 085640	N/A	----------	----------	REPLACED ANALYZER PUMP
LPRM 2C-24-41	CORRECTIVE WR 065079	N/A	----------	----------	PERFORMED PROCEDURE AND CLEARED SPIKING

DRESDEN UNIT 2
SAFETY RELATED MAINTENANCE

EQUIPMENT	NATURE OF MAINTENANCE	LER OR OUTAGE NUMBER	MALFUNCTION CAUSE	MALFUNCTION RESULT	CORRECTIVE ACTION
2-1501-44C CCSW PUMP	CORRECTIVE WR D86250	N/A	---------	---------	REPACKED AND RAN PUMP FOR PACKING ADJUSTMENT
U2 TURBINE REACTOR BUILDING INTERLOCK	CORRECTIVE WR D86481	N/A	---------	---------	REMOVED HEX HEAD CAP PLUG AND ADJUSTED, REINSTALLED PLUG AND CYCLED DOOR
LPRM 16-17A	PREVENTIVE WR D86643	N/A	---------	---------	CHECKED THE APRM METER READING AND FOUND NO PROBLEMS
LPRM 40-25A	CORRECTIVE WR D86458	N/A	---------	---------	BURNED OFF WHISKER IN DETECTOR PER PROCEDURES
MO VALVE FF2-1501-21B	CORRECTIVE WR D86617	N/A	---------	---------	DISCONNECTED AND RECONNECTED MO VALVE PER PROCEDURE
U2 250V BATTERY CHARGER	CORRECTIVE WR D87286	N/A	---------	---------	ADJUSTED FLOAT AND EQUALIZE
2-2391-01A D2 HPCI LO PRESSURE ISOLATION TRIP CARD	CORRECTIVE WR D87319	N/A	---------	---------	ELEVATED HI GROSS FAIL SETPOINTS FOR HPCI CARDS
REACTOR BUILDING INTERLOCK DOOR	CORRECTIVE WR D87486	N/A	---------	---------	TIGHTENED LOOSE SCREWS AND REPLACED BROKEN ONES
2-2391-01C HPCI LO PRESSURE ISOLATION TRIP CARD	CORRECTIVE WR D87637	N/A	---------	---------	REPLACED MTU CARD AND TESTED
517 REACTOR INTERLOCK	CORRECTIVE WR D88028	N/A	---------	---------	ADJUSTED OPENING SPEED OF DOOR

DRESDEN UNIT 3
SAFETY RELATED MAINTENANCE

EQUIPMENT	NATURE OF MAINTENANCE	LER OR OUTAGE NUMBER	MALFUNCTION CAUSE	MALFUNCTION RESULT	CORRECTIVE ACTION
3A-1501-44 CCSW PUMP	CORRECTIVE WR 080397	N/A	---------	---------	REMOVED 2 RINGS OF PACKING. CLEANED STUFFING BOX AND LUBED NEW PACKAGE AND REPACKED
3B-1501-44 CCSW PUMP	CORRECTIVE WR 080397	N/A	---------	---------	REPACKED WITH NEW PACKING RINGS AND ADJUSTED
3-MO-1501-19B	PREVENTIVE WR 082736	N/A	---------	---------	REBUILT LIMITORQUE
3-P305-101 & 112 HPCI ISOLATION VALVES	PREVENTIVE WR 084216	N/A	---------	---------	PERFORMED MAG PARTICLE INSPECTION AND STEM AND WEDGE ASSEMBLIES
U3 HPCI OIL FILTERS	CORRECTIVE WR 085202	N/A	---------	---------	CLEANED FILTERS; INSTALLED NEW GASKETS, FILTERS AND CANISTERS
U3 D/G ENGINE COOLING WATER SYSTEM	PREVENTIVE WR 085529	N/A	---------	---------	INSTALLED PIPE PLUG AND TIGHTENED
FI3-1159 U3 SLC TEST FLOW METER	CORRECTIVE WR 085572	N/A	---------	---------	REPLACED THREAD SEALANT ON FLOWMETER FITTING
AO 3-2599-3B	CORRECTIVE WR 087612	N/A	---------	---------	STRAIGHTENED OUT BENT ACTUATING ARM AND CYCLED VALVE
3-2406-A CHANNEL A POST LOCA H2/O2 RECORDER	CORRECTIVE WR 087691	N/A	---------	---------	REPLACED BELT DRIVE ON RECORDER

DRESDEN UNIT 2/3
SAFETY RELATED MAINTENANCE

EQUIPMENT	NATURE OF MAINTENANCE	LER OR OUTAGE NUMBER	MALFUNCTION CAUSE	MALFUNCTION RESULT	CORRECTIVE ACTION
2/3 SPARE SAFETY VALVES	CORRECTIVE MR 072977	N/A	--------	--------	REBUILT VALVE
2/3 2301 SPARE HPCI TURBINE OIL FILTERS	CORRECTIVE MR 073416	N/A	--------	--------	REWELDED NEW STUD ON OIL CANISTER
U.T. CALIBRATION STANDARD	CORRECTIVE MR 032952	N/A	--------	--------	INSTALLED NEW RECIRC CAP SCREW
2/3-3900 MISC D/G ENGINE COOLING WATER SYSTEM	PREVENTIVE MR 028530	N/A	--------	--------	INSTALLED PIPE PLUG AND TIGHTENED
2/3 DIESEL GENERATOR T/C	CORRECTIVE MR 036851	N/A	--------	--------	REPAIRED BREAK AND FUNCTIONALLY TESTED T/C PER PROCEDURE

5.5 Completed Safety Related Modifications (Units 2 and 3)

Unit 2 and Unit 3 safety related modification packages closed during the month of November, 1989 are listed below. Only modifications which have been completely closed are listed; modifications which are authorized for use but not completely closed will be reported based on the date of their final closure. For ease of reference, the changes have been identified by their design change control modification number.

Modification No.	Description
None	No safety related modification packages closed during the month of November, 1989.

5.6 Temporary System Alterations (Unit 2 and Unit 3)

A "Temporary System Alteration" refers to electrical jumpers, lifted leads, removed fuses, fuses turned to non-conducting position, fuses moved from normal to reserve holder, temporary power supplies, test switches in alternate positions, temporary blank flanges, and spool pieces. Alterations controlled and documented as part of a routine out-of-service or other procedure, alterations which are a normal feature of system design, and hoses installed as part of a venting or draining process are not included.

5.6.1 Unit 2

Temporary System Alteration No.	Description	Installation Date	Removal Date
II-76-89	Alteration to replace a 1000 μF capacitor with a 1500 μF capacitor in the High Pressure Coolant Injection (HPCI) system signal converter due to degradation of the filter network resulting in the HPCI motor gear unit oscillating off the high speed stop.	11-15-89	-
II-77-89	Alteration to connect a red hose from the fire protection stand pipe header at the Reactor Building roof drain tap to facilitate monthly stand pipe flow tests.	11-15-89	-
II-78-89	Installation of a furmanite elbow over the existing elbow between the HPCI 2301-28 and 2301-29 valves to repair a steam leak.	11-24-89	-

5.6.3 Unit 3

Temporary System Alteration No.	Description	Installation Date	Removal Date
III-44-89	Alteration to connect a red hose from the fire protection stand pipe header to the RB roof drain tap to facilitate monthly stand pipe flow tests.	11-15-89	-
III-45-89	Alteration to take the HPCI 2301-10 valve out of service to facilitate the replacement of the valve's packing due to leakage.	11-15-89	11-18-89
III-46-89	Alteration to remove the oil pump flow meters (3, 7, 11, 15, 21) to clear the main transformer trouble alarm. The oil pumps were out of service.	11-20-89	-
III-47-89	Alteration to remove the oil pump flow meters (1, 9, 17, 23 and 25) to clear the main transformer trouble alarm. The oil pumps were out of service.	11-21-89	-