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CALCULATION TITLE PAGE

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CLIENT & PROJECT	PAGE 1 OF 8
NPPD - Control Room Habitability Study	
CALCULATION TITLE (Indicative of the Objective): Dispersion Coefficients (χ/Q's) at the NPPD Cooper Nuclear Station Control Room for Accident Release Releases of Radionuclides	QA CATEGORY (✓) ☑ I - NUCLEAR SAFETY RELATED ☐ II ☐ III ☐ ____ OTHER

CALCULATION IDENTIFICATION NUMBER				OPTIONAL WORK PACKAGE NO.
J.O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	
13095.16	EED	PR(P)-001		

* APPROVALS - SIGNATURE & DATE			REV. NO OR NEW CALC NO.	SUPERSEDES * CALC. NO OR REV. NO.	CONFIRMATION * REQUIRED (✓)	
PREPARER(S)/DATE(S)	REVIEWER(S)/DATE(S)	INDEPENDENT REVIEWER(S)/DATE(S)			YES	NO
Barbara Riedesel 10/30/80	Sun-Ki Oh 11-2-80	Sun-Ki Oh 11-2-80				✓

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				00418	

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13095.16 FR-001		2/3

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
D.L. Reider / 10/30/90	11/2/90	

SUBJECT/TITLE: X/Q's at NPPD's Cooper Nuclear Station Control Room for stack Releases

QA CATEGORY / CODE CLASS:

PROBLEM: Calculate X/Q's for the Cooper Nuclear Station control room (CR) for accidental releases of radionuclides from the 325 foot stack.

ASSUMPTIONS: 1. Worst Case meteorological conditions exist for any given situation. For non-fumigation conditions, extremely unstable conditions give the worst case. For fumigation conditions, extremely stable conditions give the worst case.

2. The reactor building, which partially blocks the path of the plume from the stack to the CR, does not decrease the concentrations of substances in the plume. This is a conservative assumption

REFERENCES

1. Murphy & Campe, "Nuclear Power Plant Control Room Ventilation System Design for Meeting Criterion 19" from the 13th AEC Air Cleaning Conf., Aug. 1974
2. Safety Analysis Report, Cooper Nuclear Station, Nebraska Public Power District, Vol. VIII, 1972
3. Safety Analysis Report, Cooper Nuclear Station, Nebraska Public Power District, Vol II, 1972
4. Nebraska Public Power District Drawing 4003 Rev. 9
5. U.S.AEC Regulatory Guide 1.3 "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors" June 1974
6. USNRC Regulatory Guide 1.145 "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants" Rev. 1 Aug. 1979

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For stack releases: For ground level releases, stable conditions give worst case.

CALCULATION SHEET

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13095.16 PR-001		
PREPARER/DATE: BL Reider/10/30/80	REVIEWER/CHECKER/DATE: R OK 11/2/80	INDEPENDENT REVIEWER/DATE
SUBJECT/TITLE: S/G's at DPPD: Coastal Range for Stack Releases		QA CATEGORY/CODE CLASS

I Wind Speed Data

Mean wind speeds under accident conditions were calculated according to methods in Murphy & Campe (ref 1). Cumulative frequencies of occurrance correspond to the time periods listed below:

Cumulative Frequency	Time Period
5%	0-8 h
10%	8-24 h
20%	1-4 d
40%	4-30 d

Ref 2, pgs 2.26-1.9 to 2.26-1.12 lists wind speed frequencies according to compass direction, for the 97 m (318') Meteorological Tower, for 1970 & 1971. Ref 2, pgs 2.26-2.13 to 2.26-2.21 lists wind speed frequencies according to compass direction, for the 47m (155') Meteorological Tower. Both data were collected ~99% of the 1970-1971 time period. Cumulative frequencies below are over all compass directions.

97 m Tower

Wind Speed (m/h)	Cumulative Freq (%)
(Calm) <1	.03
1-3	1.48 ← 5%
4-7	13.69 ← 10% ← 20%
8-12	41.33 ← 40%

47 m Tower

Wind Speed (m/h)	Cumulative Freq (%)
(Calm) <1	.03
1-3	1.45 ← 5%
4-7	13.59 ← 10% ← 20%
8-12	41.24 ← 40%

Data is not broken down enough to determine "exact" mean wind speeds at 5%, 10%, & 20%; therefore, 5% is assumed at 4 mi/h, 10% at 7 m/h, and 20% at 8 m/h, as listed below in m/sec:

Time Period	Wind Speed $\bar{\mu}$ (m/sec)
0-8 h	1.79
8-24 h	3.13
1-4 d	3.57
4-30 d	5.36

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CALCULATION SHEET

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PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
BL Reider 10/30/80	[illegible] 11/2/80	

SUBJECT/TITLE χ/Q's at NPPD's Cooper Nuclear Station Control Room for Stack Releases

QA CATEGORY/CODE CLASS

III $\frac{\chi}{Q}$ CALCULATIONS

Although there is a vent on the S corner of the Reactor Building (RB), the stack (or elevated release point) is expected to be the release point for most of the radionuclides in the event of an accident. The stack is 170 m (560') to the SE of the Control Room (CR) (ref 4) and is 98 m (325') high (ref 3). There are no structures upwind which might affect stack emission (i.e. the stack is > 2.5 times the height of adjacent upwind structures) (ref 6).

χ/Q values are calculated for the CR without taking into consideration the RB, which partially obscures the CR, and may decrease the effect the plume would have on the CR

Plume rise is not calculated, the plume height is assumed to be equal to the stack height as indicated in ref 6.

Fumigation conditions are assumed for the first ½ h of the release, as indicated in ref 6 for power plants more than 2 miles from large bodies of water.

The most conservative stability conditions are assumed. For fumigation conditions, stability class F is assumed, for non fumigation conditions, stability class A is assumed.

ref 6: Non-fumigation conditions

$$\frac{\chi}{Q} = \left(\bar{\mu}\,\pi\,\sigma_y\sigma_z\right)^{-1} e^{\left[-h_e^2/2\sigma_z^2\right]}$$

Assumption is correct

Where: $\frac{\chi}{Q}$ = dispersion factor in sec/m³

$\bar{\mu}$ = mean wind speed for accident conditions from ref in m/sec at a distance of

σ_y = lateral dispersion coefficient in m at 170 m from the source

σ_z = vertical dispersion coefficient in m at 170 m from the source

h_e = effective height of stack = 98m (325') (ref 3)

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PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
B. Reider 10/30/80	11-2-80	

SUBJECT/TITLE: χ/Q's at 1990's Cooper Nuclear Station Control Room for Stack Releases

RA CATEGORY/CODE CLASS

for nonfumigation conditions, stability class A is assumed.

$\bar{\sigma}_y$ @ 170m, A, = 40 m (ref 6)

$\bar{\sigma}_z$ @ 170m, A, = 25 m (ref 6)

0-8h conditions

$\bar{\mu}$ = 1.79 m/sec

σ_y = 40m

σ_z = 25m

he = 98m

$$\frac{\chi}{Q} = \left(1.79\ \text{m/sec} \times \pi \times 40 \times 25\right)^{-1} e^{-\frac{(98)^2}{2(25)^2}}$$

$$= 8.19 E-8\ \text{sec/m}^3$$

8-24h conditions

$\bar{\mu}$ = 3.13 m/sec

$$\frac{\chi}{Q} = 4.68 E-8\ \text{sec/m}^3$$

1-4d conditions

$\bar{\mu}$ = 3.57 m/sec

$$\frac{\chi}{Q} = 4.11 E-8\ \text{sec/m}^3$$

4-30d conditions

$\bar{\mu}$ = 5.36 m/sec

$$\frac{\chi}{Q} = 2.73 E-8\ \text{sec/m}^3$$

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ref 6: Fumigation conditions:

Fumigation conditions assume there is vertical downward mixing of the plume. Ref 5 says "fumigation should always be assumed to occur" from accidental releases from stacks.

F stability class is used (ref 6); $\sigma_y = 7.5$ m

$\bar{\mu}$: ref 6 uses 2 m/sec; site specific 5% frequency is 1.79 m/sec, site specific data is used in these calculations.

$h_e = 98$ m

$$\frac{\chi}{Q} = \left((2\pi)^{1/2} \bar{\mu} \sigma_y h_e \right)^{-1}$$

$$= \left((2\pi)^{1/2} \cdot 1.79 \frac{m}{sec}, 7.5m, 98m \right)^{-1}$$

$$= 3.03 E-4 \text{ sec/m}^3$$

Fumigation conditions exist for 0.5 h. For 0-8 h, the time weighted χ/Q is

$$1/16 (3.03E-4) + 13/16 (8.17E-8) = 1.90E-5 \text{ sec/m}^3$$

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BKReider 10/30/90	11-2-90	

SUBJECT/TITLE χ/Q's at WPPD's Columbia Nuclear Station Control Room for Stack Releases

QA CATEGORY/CODE CLASS

III For Comparison, Reg Guide 1.3 χ/Q's were obtained for fumigation conditions

refs, Tables I A to I D
100 m elevation
170 m distance except where noted

time period	χ/Q (sec/m³)	notes
0-8h	1.0E-6	@ 200m
8-24h	9.0E-7	
1-4d	5.0E-7	@ 200
4-30d	7E-8	estimated for 170 m; @ 300m χ/Q = 1.3E-6 sec/m³

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CALCULATION SHEET

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PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
D.L.Raider/10/30/80	11-2-80	

SUBJECT/TITLE: χ/Q's at NPPD's Cooper Nuclear Station Control Room for Stack Releases

QA CATEGORY/CODE CLASS:

SUMMARY: χ/Q's for the Cooper Nuclear Control Room under Accident Conditions; Release of Radionuclides from the Elevated Release Point (Stack).

Time Period	χ/Q (sec/m³)
0-.5h	3.03 E-4
.5-8h	8.19 E-8
8-24h	4.68 E-8
1-4d	4.11 E-8
4-30d	2.73 E-8

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