Title: Review of Scientech Calculation 17080-M-06, EAB and LPZ Meteorological Dispersion - Accident Analysis	Calculation No: NEDC 99-036
System/Structure: HVAC, SGT, SC / ERP	Task Identification No: N/A
Component: N/A	Design Change No: N/A
Classification: [X] Essential; [ ] Non-Essential	Discipline: Mechanical Design

Calc. Description:

PURPOSE:

This calculation incorporates by attachment Scientech Engineering Calculation No. 17080-M-06, Rev. 0, prepared under Task Agreement 99A-C20, in accordance with CNS Engineering Procedure 3.4.7, Section 4. The calculation determines meteorological dispersion factors (X/Q values) at the Exclusion Area Boundary (EAB) and Low Population Zone (LPZ) for use in the Offsite Dose Calculations for the postulated Design Basis Accidents, i.e., Loss of Coolant Accident (LOCA), Fuel Handling Accident (FHA), Main Steam Line Break (MSLB), and Control Rod Drop Accident (CRDA). This calculation has been prepared as a Status 2 calculation for NRC review and will be as-built upon NRC approval.

RESULTS:

The results for a ground level release and for an elevated release are tabulated in Section 10, Table 10-1 of Scientech's calculation at various time intervals.

ATTACHMENTS:

1. Scientech Engineering Calculation No. 17080-M-06, Rev.0 .
2. Reviewer Comments and Resolutions

0	2	Original Issue	Scientech, Inc. 11/17/99	J. J. Drasler 12/3/99	N/A	12/10/99
Rev. No.	Status	Revision Description	Prepared By/Date	Reviewed By/Date	Independent Design Verification/Date	Approved By/Date

Status Codes

1. As - Built
2. Information Only
3. For Construction
4. Superseded or Deleted

Nebraska Public Power District

DESIGN CALCULATION CROSS REFERENCE INDEX

NEDC: 99-036 Preparer: Scientech, Inc. Reviewer: J. J. Drasler

Rev. No: 0 Date: 11/17/99 Date: 12/3/99

Item No.	DESIGN INPUTS	Rev. No.	PENDING CHANGES TO DESIGN INPUTS
1	Burns and Roe Dwg 2194	N03	none
2	Burns and Roe Dwg 4004	N01	none
3	Burns and Roe Dwg 4005, Sht 2	N01	none
4	Burns and Roe Dwg 4506	N06	none
5	CNS Dwg 2.2 (P3-A-45)	N02	none
6	TS 4.1.1	178	none
7	TS 4.1.2	178	none
8	USAR Table II-3-3	NA	none
9	Reg Guide 1.3	2	none
10	Reg Guide 1.25	3/23/72	none
11	FSAR Q/A 2.13, Amendment 23	NA	none
12	CNS SER 50-298	2/14/73	none

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DESIGN CALCULATION CROSS REFERENCE INDEX

NEDC: 99-036 Preparer: Scientech, Inc. Reviewer: J. J. Drasler

Rev. No: 0 Date: 11/17/99 Date: 12/3/99

Item No.	Affected Documents	Rev. No.	CHANGE Required	Action Item Tracking Number (If change is required)
1	NEDC 99-032	0	initial issue	N/A - concurrent approval
2	NEDC 99-033	0	initial issue	N/A - concurrent approval
3	NEDC 99-034	0	initial issue	N/A - concurrent approval
4	NEDC 99-035	0	initial issue	N/A - concurrent approval

Nebraska Public Power District

DESIGN CALCULATIONS SHEET

NEDC: 99-036 Preparer: Scientech, Inc. Reviewer: J. J. Drasler

Rev. No: 0 Date: 11/17/99 Date: 12/3/99

PURPOSE

This calculation incorporates by attachment Scientech Engineering Calculation No. 17080-M-06, Rev. 0, prepared under Task Agreement 99A-C20, in accordance with CNS Engineering Procedure 3.4.7, Section 4. The calculation determines atmospheric dispersion factors (X/Q values) at the Exclusion Area Boundary (EAB) and Low Population Zone (LPZ) for use in the Offsite Dose Calculations for the postulated Design Basis Accidents, i.e., Loss of Coolant Accident (LOCA), Fuel Handling Accident (FHA), Main Steam Line Break (MSLB), and Control Rod Drop Accident (CRDA).

EXTENT OF REVIEW

Scientech's calculation was performed under their own QA program, which included an independent technical review. Therefore, the NPPD review does not include in-depth checks of mathematical calculations, but rather focuses on general acceptability of design inputs, assumptions, methodology, and conclusions. Any significant comments or concerns identified during the review have been resolved with Scientech and incorporated.

REVIEW SUMMARY

Scientech's calculation is organized into a single main portion.

1. **Purpose** - The purpose of the calculation is as given above and as stated in Section 1 of Scientech's calculation. This section was reviewed and found to be acceptable.

2. **Design Inputs** - Design Inputs are identified throughout the text and particularly in Section 4 of Scientech's calculation with the reference for the design inputs listed in Section 5. The design inputs were reviewed and found to be acceptable.

   The Exclusion Area Boundary (EAB) coincides with the site boundary shown on TS Figure 4.1-1. The Low Population Zone (LPZ) boundary is defined by TS 4.1.2 as a one mile radius circle with the center at the reactor.

   Documents comprising CNS-controlled source documents whose revision could impact input used in this calculation are identified on the Cross Reference Index in the front of this calculation. Non-status 1 inputs were verified using additional information and were found to be acceptable for use in this calculation.

3. **Assumptions** - Major assumptions are identified in Section 6 of Scientech's calculation. Additional assumptions are inferred in the input documents used and identified throughout Scientech's calculation by inference according to context and use. The assumptions were reviewed and found to be acceptable.

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DESIGN CALCULATIONS SHEET

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4. **Methodology** - The methodology is described in Section 3, Technical Approach and detailed calculations are presented in Section 8. In general, meteorological dispersions coefficients at the two receptor locations (EAB and LPZ) are calculated for two release conditions: a ground level release and an elevated release from the ERP using methodology presented in Regulatory Guides 1.3 and 1.25. The ground level release is corrected for building wake effects in the 0-8 hour time interval. Fumigation conditions are considered for the elevated release in the 0-30 minute interval.

   The methodology was reviewed and found to be acceptable.

5. **Results / Conclusions** - Results are given in Section 10 of Scientech's calculation. Table 10-1 gives the calculated X/Q values for the different releases and time intervals considered.

   The results and conclusions sections were reviewed and found to be acceptable. The calculated X/Q values for the LPZ and EAB are acceptable for use in the CNS Offsite Dose calculations.

SCIENTECH.

ENGINEERING CALCULATION

CLIENT/PROJECT NPPD/Cooper CALC. NO. 17080-M-06 REV. 0

TITLE EAB and LPZ Meteorological Dispersion- Accident Analyses

AUTHOR/DATE:	VERIFIED BY/DATE:	APPROVED BY/DATE:
R. F. Ely, Jr.	11/17/99	M Donovan 11/17/99

Purpose

The purpose of this calculation is to establish the location of receptor points and the meteorological dispersion factors (X/Q) for the Exclusion Area Boundary (EAB) and Low Population Zone (LPZ) to be used for accident analyses.

Results

Meteorological dispersion factors (X/Q) for the Exclusion Area Boundary (EAB) and Low Population Zone (LPZ) to be used for accident analyses were developed for ground level releases and for releases from the elevated release point (ERP) using the methodology presented in Regulatory Guides 1.3 and 1.25. Building wake effects and fumigation are considered. The numerical results are:

	Ground Level Release (sec/m^3)	Elevated Release (sec/m^3)
EAB		
0-0.5 hours	5.2E-4	1.2E-4
0.5-2 hours	5.2E-4	1.6E-5
LPZ		
0-0.5 hours	2.9E-4	1.4E-4
0.5-8 hours	2.9E-4	4.0E-5
8-24 hours	7.3E-5	1.6E-5
1-4 days	2.5E-5	5.8E-6
4-30 days	5.2E-6	1.7E-6

SUPERSEDED BY REV. SUPPLEMENTED BY CALC. NO.:	QUALITY CLASS ■ SAFETY-RELATED ☐ NON-SR ☐ OTHER	DISTRIBUTION ■ PROJECT ■ DCC ☐ OTHER	VERIFICATION METHOD ■ REVIEW ☐ ALT. ANALYSIS

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1.0 PURPOSE OF ANALYSIS

The purpose of this calculation is to establish the location of receptor points and meteorological dispersion factors (X/Q) for the Exclusion Area Boundary (EAB) and Low Population Zone (LPZ) to be used for accident analyses.

2.0 INTENDED USE OF ANALYSIS RESULTS

The objective of this analysis is to establish design basis X/Qs for the EAB and LPZ to be used in the determination of radiological consequences from postulated design basis accidents.

3.0 TECHNICAL APPROACH

The location of the EAB and LPZ are defined by the Technical Specifications. The specific points to be used as receptor points will be determined consistent with the approach described in the CNS SER. X/Qs are then determined using site specific data from the figures presented in Regulatory Guides 1.3 and 1.25. Building wake effects and fumigation are then considered.

4.0 DESIGN INPUT INFORMATION

4.1 Improved Tech Spec 4.1.1 (Site Area and Exclusion Area Boundary) states "The Site and Exclusion Area Boundaries coincide with each other and shall be as shown on Figure 4.1-1."

4.2 The minimum distance from the ERP to the site boundary = 920 meters; this is in the ESE sector (Ref. 5.8).

4.3 Improved Tech Spec 4.1.2 (Low Population Zone) states "The low population zone is all the land within a circle with its center at the reactor and a radius of 1 mile as shown on Figure 4.1-1."

4.4 Maximum elevation of terrain at various distances from the elevated release point (ERP) are provided in USAR Table II-3-3.

4.5 Reactor Building Parameters

- RB roof elevation (parapet top of steel) 1052'-9" (Ref.. drawing BR5700-4506)
- Grade elevation in vicinity of RB 903' (Ref. drawing BR5700-4004)
- Minimum width 112'-9" (Ref. drawing BR5700-4506)

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4.6 Elevated Release Parameters

- Top of concrete footing = 891' MSL (Ref. drawing BR5700-4005)
- Height of tower including discharge pipe) = 325' (Ref. drawing BR5700-2194)
- Top of discharge pipe = 891' + 325' = 1216' MSL

5.0 REFERENCES

5.1 Regulatory Guide 1.3, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors," Rev. 2, 6/74.

5.2 Regulatory Guide 1.25, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors," 3/23/72.

5.3 CNS Drawing BR5700-2194, Rev. N03.

5.4 CNS Drawing BR5700-4004, Rev. N01.

5.5 CNS Drawing BR5700-4005, Rev. N01.

5.6 CNS Drawing BR5700-4506, Rev. N06.

5.7 CNS Drawing 2 2(P3-A-45), Cooper Nuclear Station Site and Property Boundary, Rev. N02.

5.8 FSAR Question No. 2.13, Amendment No. 27.

5.9 Safety Evaluation by the Directorate of Licensing, USAEC, in the Matter of NPPD CNS, Nehama County, Nebraska, Docket No. 50-298, issued 2/14/73.

5.10 Technical Specification 4.1.1, Site Area and Exclusion Area Boundary.

5.11 Technical Specification 4.1.2, Low Population Zone.

5.12 USAR Table II-3-3.

6.0 MAJOR ASSUMPTIONS

6.1 The distances from the elevated release point (ERP) to the EAB and LPZ are used as representative of the distance from the plant to the respective receptor points. Correction for the actual distance from the Turbine Building and Reactor Building to these points is not made, because of the small difference with respect to the overall distances.

7.0 COMPUTER CODES AND COMPUTER USED

None

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8.0 DETAILED CALCULATIONS

8.1 Location of EAB and LPZ Receptor Points

The NRC used the nearest point on the site boundary as the receptor point for determination of dose consequences at the EAB in the SER. Per Design Input 4.2, this point is 920 meters east-southeast of the ERP. The ERP is closer to this point than either the Reactor Building or the Turbine building; thus, this distance is conservative for releases from the buildings (see also Assumption 6.1). The elevation of the EAB receptor point is 890' MSL per USAR Table II-3-3. Note, the elevation of the terrain is relatively constant east of the plant (all sectors from north to south).

An inspection of USAR Table II-3-3 shows that the highest elevation at one mile (i.e. the LPZ), is 1050' MSL west-southwest of the plant. This will be used as the LPZ receptor point. The distance to the LPZ is 1609 meters (1 mile * 5280 feet/mile * 0.3048 m/foot).

8.2 Determination of Base X/Qs

The effective release height with respect to a receptor is the difference between the release height (1216' MSL per §4.6) and the receptor. Thus, the effective release heights are:

EAB = 1216' - 890' = 326' = 99 meters (rounded to 100 m)

LPZ = 1216' – 1050' = 166 ' = 51 meters (rounded to 50 m)

Using the EAB and LPZ parameters determined in §8.1 and the effective release heights determined above, the following X/Qs are obtained from the figures presented in Regulatory Guides 1.3 and 1.25:

	Ground Level Release (s/m^3)	Elevated Release (s/m^3)
EAB		
0-2 hour	7.3E-4	1.6E-5
LPZ		
0-8 hours	3.2E-4	4.0E-5
8-24 hours	7.3E-5	1.6E-5
1-4 days	2.5E-5	5.8E-6
4-30 days	5.2E-6	1.7E-6

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8.3 *Building Wake Considerations*

The NRC allows reduction of the 0-8 hour ground level release concentrations by a factor for additional dispersion produced by the turbulent wake of the Reactor Building (Regulatory Guide 1.3, C.2.h(1)). This factor is determined as described below.

The minimum cross sectional area of the Reactor Building is determined using the parameters listed in §4.5 (credit is not taken for other buildings adjacent to the Reactor Building):

RB roof elevation	1052'-9"
Grade elevation in vicinity of RB	903'
Minimum width	112'-9"

Height = 1052'9" – 903' = 149.75'
Minimum area = 149.75' * 112.75 = 16,884 ft^2 = 1569 m^2

Using a shape factor of 0.5 in accordance with Regulatory Guide 1.3. C.2.h(1) and Regulatory Guide 1.25 C.2.a(4),

0.5 A = 784 m^2

Parametric curves on Figure 2 of Regulatory Guide 1.25 are provided for 0.5A values of 500 m^2 and 1000 m^2. Instead of interpolating, the values for 500 m^2 are conservatively used (the EAB factor is rounded up from 1.35, since the actual 0.5A value is higher than 500 m^2).

	Distance from Structure (meters)	Correction Factor
EAB	920	1.4
LPZ	1609	1.1

The ground level release X/Q's obtained in §8.2 are corrected for building wake for the initial 0-8 hour time period.

	X/Q without Building Wake (s/m^3)	X/Q Corrected for Building Wake (s/m^3)
EAB		
0-2 hour	7.3E-4	5.2E-4
LPZ		
0-8 hour	3.2E-4	2.9E-4

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8.4 Fumigation Considerations

Regulatory Guides 1.3 and 1.25 specify that a fumigation condition impacting elevated releases is assumed to exist at the time of the accident and continue for 0.5 hour (ground level releases are not affected). The following X/Qs are obtained from Figure 4 of Regulatory Guide 1.25:

EAB	1.2E-4 s/m^3
LPZ	1.4E-4 s/m^3

9.0 COMPUTER INPUT AND OUTPUT

None

10.0 SUMMARY OF RESULTS

The X/Qs for the exclusion area boundary and the low population zone as corrected for building wake and fumigation for the appropriate time periods are presented in Table 10-1.

Table 10-1: Meteorological Dispersion (X/Q) for Design Basis Accident Evaluations

	Ground Level Release (sec/m^3)	Elevated Release (sec/m^3)
EAB		
0-0.5 hours	5.2E-4 (1)	1.2E-4 (2)
0.5-2 hours	5.2E-4 (1)	1.6E-5
LPZ		
0-0.5 hours	2.9E-4 (1)	1.4E-4 (2)
0.5-8 hours	2.9E-4 (1)	4.0E-5
8-24 hours	7.3E-5	1.6E-5
1-4 days	2.5E-5	5.8E-6
4-30 days	5.2E-6	1.7E-6

Notes:

1. Includes building wake considerations.
2. Includes fumigation considerations.

11.0 CONCLUSIONS

None