ENERCON SERVICES, INC.	CALCULATION COVER SHEET	CALC. NO. TXUT-001-ER-5.3-CALC-005
		REV. 2
		PAGE NO. 1 OF 34
Title: Plume Characteristics of Proposed New Cooling Towers at Comanche Peak		Client: LUMINANT
		Project: MITS003

Item	Cover Sheet Items	Yes	No
1	Does this calculation contain any open assumptions that require confirmation? (If YES, identify the assumptions.) _____	☐	☒
2	Does this calculation serve as an "Alternate Calculation"? (If YES, identify the design verified calculation.) **Design Verified Calculation No.** _____	☐	☒
3	Does this calculation supersede an existing calculation? (If YES, identify the superseded calculation.) **Superseded Calculation No.** _____	☐	☒

Scope of Revision:

Rev. 2: Several formatting and editorial changes were made.

Revision Impact on Results:

The changes are purely editorial and do not affect the input, results, and conclusions.

Study Calculation	☐	**Final Calculation**	☒
Safety-Related	☐	**Non-Safety Related**	☒

Print Name and Sign

Originator: Frank Kenny	**Date:** 3/18/2009
Design Verifier: Ralph Berger (review only)	**Date:** 3/19/2009
Approver:	**Date:** 3/19/09

ENERCON SERVICES, INC.	CALCULATION REVISION STATUS SHEET	CALC. NO. TXUT-001-ER-5.3-CALC-005 REV. 2 PAGE NO. 2 OF 34

CALCULATION REVISION STATUS

REVISION	DATE	DESCRIPTION
0	3/7/08	Issued for use
1	4/2/08	Revised flow rate
2	3/18/09	Editorial Changes

PAGE REVISION STATUS

PAGE NO.	REVISION	PAGE NO.	REVISION
1 – 34	2		

ATTACHMENT REVISION STATUS

ATTACHMENT NO.	PAGE NO.	REVISION NO.	ATTACHMENT NO.	PAGE NO.	REVISION NO.
1	1 of 1	2			

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1. Objective

To estimate plume characteristics for cooling towers at the Comanche Peak Steam Electric Station.

The Comanche Peak Nuclear Power Plant (CPNPP) consists of two Westinghouse Pressurized Water reactors (PWRs) owned by Luminant. The plant is located at Glen Rose, Texas, about 40 miles southwest of Fort Worth. Two new units are proposed for the site. Although located on the shore of Squaw Creek Reservoir, cooling water for the new units is to be provided by water from nearby Lake Granbury. Squaw Creek is used for cooling the existing Units 1 and 2 but does not have the capacity for additional units (Reference 2.3). Figure 1 shows the site.

2. References

2.1. Google Earth (for site location and images showing general site topography)

2.2. SACTI User's Manual: Cooling-Tower-Plume Prediction Code, EPRI CS-3403-CCM, April 1984

2.3. Intake Water Temperature Reduction Alternatives, TXU, Comanche Peak SES, available at http://www.erm-smg.com/TXU%20Comanche%20Peak.pdf

2.4. Optimization Study for Secondary-Side Cooling Water System, TXU Comanche Peak Units 3 and 4, CWS-15-05-100-001, 8/15/2007.

2.5. Comanche Peak Steam Electric Station site meteorology data, hourly observations, years 2001 through 2006

2.6. Mineral Wells, TX, National Weather Station meteorology data, hourly observations, years 2001 through 2006

2.7. Stephenville, TX, mixing height data

2.8. NRC Environmental Standard Review Plan, NUREG-1555

2.9. Cooling Tower Drift Mass Distribution, Excel Drift Eliminators, Marley Cooling Technologies Sales Brochure, faxed to Enercon 12/4/2001. (Note: the same drop spectrum data is available online at pg 4 of http://awmasandiego.org/SDC-2002/4-1-lindahl.pdf.)

2.10. Table 2.3-46, " Sample Results From Lake Granbury Surface Water Monitoring Events (2007-2008)," CPNPP Cooling Tower Environmental Report

2.11. Emails transmitting tower height information and meteorology data (contained in Attachment 1)

2.12. CPNPP Units 3&4, Conceptual Hydraulic Analysis of Circulating Water System, Washington Group International, Rev. C, March 2008

3. Design Requirements

There are no defined design requirements for plumes. The output from this calculation will be used to support environmental considerations associated with proposed cooling towers at this site.

4. Assumptions

4.1. The meteorological data described in Section 5 are representative of future conditions.

4.2. The SACTI computer software is used with all its associated assumptions per Reference 2.2. It is noted that the accuracy of the SACTI code has been recognized by the NRC (Section 5.3.3.1 of Reference 2.8).

4.3. The meteorological data is a hybrid of various data sources, but the impact of merging these sources is assumed to be insignificant compared to the inherent uncertainties of predicting future meteorological conditions. The wind speeds and direction are taken from the site meteorology tower (Reference 2.5, referred to here as "site met data"), the temperature, humidity, and cloud cover data are from the national weather station at Mineral Wells located 25 miles to the northwest (Reference 2.6), and the mixing height data is from the airport at Stephenville, 20 miles to the southwest (Reference 2.7). Images from Reference 2.1 indicate no major terrain changes that would cause any of these locations to have a different micro climate from the other two. The site is at 840 feet elevation, while Mineral Wells is at 974 ft and Stephenville is 1321 ft with no intervening hills or valleys.

4.4. Consistent with the SACTI manual guidance (Table D-1 of Reference 2.2), the terrain around CPNPP is described as level with minor roughness due to a few surrounding trees and farmland. Table D-1 recommends use of 5 to 10 cm for low woods, so a value of 5 cm is used.

4.5. A number of required but non-critical data inputs are based on scaling to the LMDCT example in the SACTI manual (Reference 2.2). The Reference 2.2 cell discharge diameter/center-to-center ratio is 9.14/11. The airflow rate to MW heat dissipation is 13818/1400 kg/sMW.

5. Design Input

5.1 SITE DATA

5.1.1 Latitude: 32° 17' 54"N (Reference 2.1)

5.1.2 Longitude: 97° 47' 07"W (Reference 2.1)

5.1.3 Ground level elevation: 840' above mean sea level (Reference 2.1)

5.1.4 Ground characterization: Flat farmland or reservoir surface (Reference 2.1). Figure 1 is roughly 5 miles across and top to bottom. The highest elevation in this view is about 1000 feet at about 2.5 miles west of the site. The lowest elevation is about 600 feet at about 2.5 miles to the southeast. For the purpose of plume modeling, this topography can be considered flat with no obstructions.

Note: the site location is used for meteorological and insolation purposes. Insolation is the sunlight energy deposited at the site and is an input required by the SACTI code. The exact positioning of the towers within the site does not affect the study results, but the orientation with respect to North does.

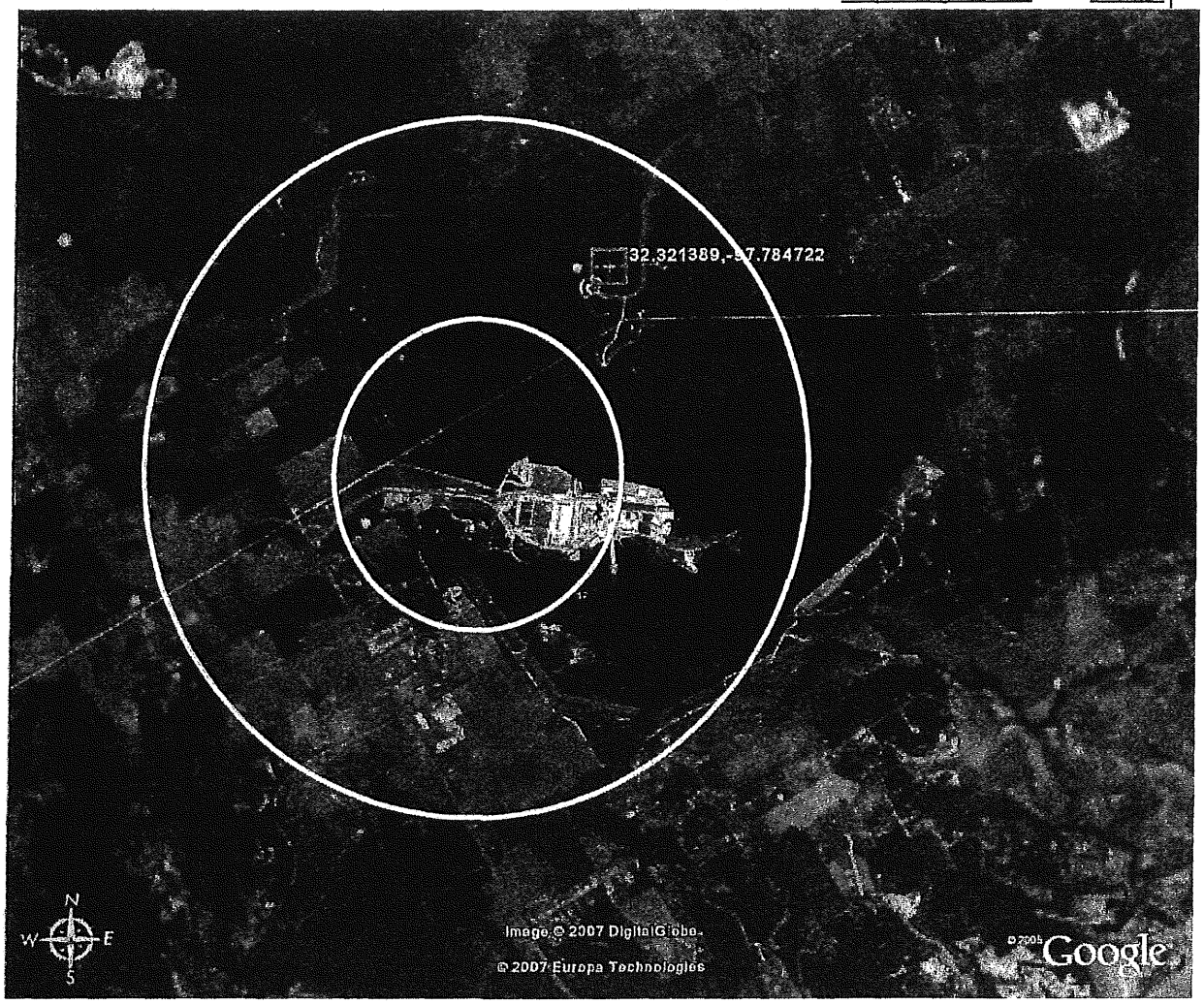

Figure 1: Site (from Reference 2.1). Lake Granbury is 4 miles to the Northeast. The circles shown are approximately 1 and 2 miles in radius centered on the proposed cooling towers.

5.2 METEOROLOGICAL DATA

5.2.1. Six years of hourly site met data collected from 1/1/2001 to 12/31/2006 (Reference 2.5, transmitted by Reference 2.11)

5.2.2. Six years of hourly Mineral Wells met data, TX, data collected from 1/1/2001 to 12/31/2006 (Reference 2.6, transmitted by Reference 2.11)

5.2.3. Mixing height data is replicated below in Table 1. This data is entered into the file mixht.tap for use by the code. The data was collected at Stephenville for the six years 1984 through 1990 (Reference 2.7, transmitted by Reference 2.11). The average monthly mixing heights are used in conjunction with the 6 years of the site and Mineral Wells met data. This mixing height data is located in the file cpmixht.txt for use by the code.

5.2.4. The tower height at which the met data was collected is about 10 m (Reference 2.11)

Table 1: Mixing Height Data

Month	Avg. Morning (m)	Avg. Afternoon (m)
Jan	576	1195
Feb	491	1207
Mar	709	2154
Apr	422	2158
May	694	1830
Jun	425	1454
July	365	1825
Aug	306	2046
Sep	463	1583
Oct	367	1249
Nov	482	1191
Dec	437	1030

The meteorological data from References 2.5 and 2.6 are converted into standard CD144 meteorological tape format. The CD144 format requires each line to contain IYEAR(2), IMONTH(2), IDAY(2), IH(2), ICH(3), IDP(2), IWD(2), IWS(2), IDB(2), IWB(2), IRH(2), IOSC(1) where numbers in parentheses indicate the number of digits for each entry.

where:
IYEAR is the year
IMONTH is the month (1 to 12)
IDAY is the day of the month
IH is the hour
ICH is the ceiling height in hundreds of feet (each digit is a separate entry in the array)
IDP is the dew point temperature in degrees F
IWD is the wind direction in tens of degrees east of north
IWS is the wind speed in knots
IDB is the dry bulb temperature in degrees F
IWB is the wet bulb temperature in degrees F
IRH is the relative humidity in percent
IOSC is the fraction of sky cover in tenths of sky covered (0 = clear blue sky)

The input format in standard FORTRAN nomenclature is:
(5X,4I2,ich3A1,19X,idpA1,I2,iwdA2,iwsA1,I1,4X,idbA1,I2,iwbA1,I2,irhA1,I2,23X,A1)

where lower case letters have been added to help identify which data are associated with which variable. For example, IDP, which is a two-member array, reads its first element as 1 character, and the next two digits as integers. This approach is necessary to recognize data blanks or dashes without generating an "Invalid integer" fatal error.

Excel files are used to convert the site data (from Reference 2.5, provided in files CPSES 2001.xls through CPSES 2006.xls) into input format. The new Excel files are named cp2001.xls through cp2006.xls. In a file such as cp2001.xls, the first four columns A, B, C, and D are the year, month, day, and hour. These are converted into the correct format in Columns N through R according to the FORTRAN nomenclature above, that is, 2001/1/1/0 is converted to 5X,4I2 or 0000001010100. The wind direction and wind speed in mph appear in columns E and F. These are converted into two digit values in columns V and W. Note that the wind direction is rounded off to the nearest 10 degrees and wind speed is divided by 1.15 and rounded up to the nearest whole number to convert to knots. Thus a wind direction of 203.3° and 13.9 mph is converted to A2, A1,I1 or 2013.

The Mineral Wells data of Reference 2.6 was provided in files named simply 2001.xls through 2006.xls. Since these data were originally not in perfect hourly order (some hours were missing or some intermediate times were added), these were converted in files mw2001.xls through mw2006.xls by lookup function to provide the data in perfect hour order. These files also make certain updates, such as converting sky cover from CLR to 0, from FEW to 2, from SCT to 5, from BRK to 7, and from OVC or VV to -. These codes, 0, 2, 5, 7, and -, represent 0% cloud cover, 20% cloud cover, 50% cloud cover, 70% cloud cover and 100% cloud cover, respectively. Once these data in, for example, mw2001.xls have been sorted as described in columns AC through AH (the ceiling height, dew point, dry bulb temperature, wet bulb temperature, humidity, and sky cover), this information is cut and pasted into the cp2001.xls file described above.

The final met data is contained in files like cp2001.xls in cells N2.AC8761. These data are then cut and pasted into the Word file cpMet.txt. Final manipulation is to remove all tabs and change the years from 01 through 06 to 81 through 86. This is a historic holdover from earlier SACTI analyses that straddled the year 2000 and caused Y2K issues.

The met data files are contained in the companion CD to this calculation as described in Section 9.

5.3 MECHANICAL FORCED-DRAFT COOLING TOWERS

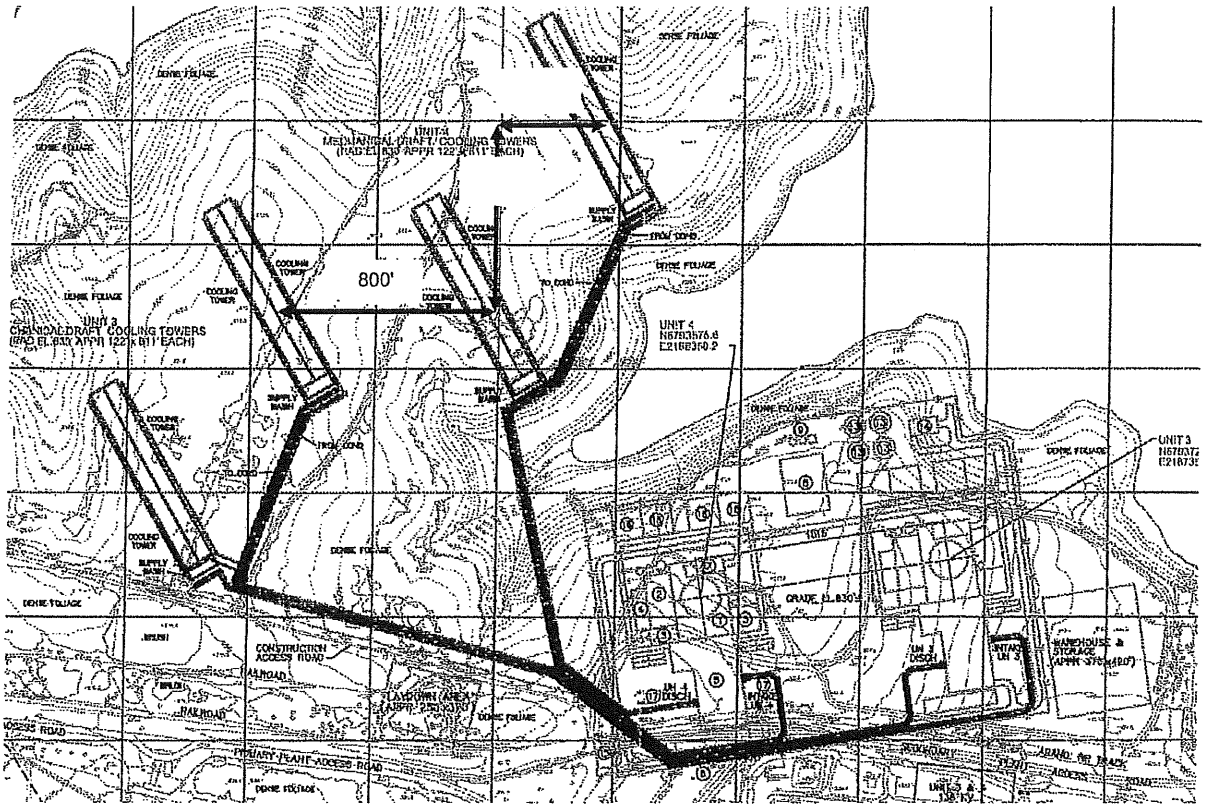

Figure 2: Each Rectangular tower cluster is 122' by 811'. Grid is 500 ft squares. North is upward.

5.3.1. Heat rejected: The total heat rejection is 9970 MBtu/hr per unit (Table 3 of Reference 2.4), which is 9970 MBtu/hr* 0.2931 MW/MBtu/hr = 2922 MWt. Since there are two units, this is a site total of 5844 MWt.

5.3.2. The water flow rate is 1,317,720 gpm per unit by Section 3.0 of Reference 2.12.

5.3.3. The inlet and outlet temperatures are 104.0°F and 88.5°F by Table 3 of Reference 2.4.

5.3.4. Total dissolved solids are 4000 mg/l by Table 3 of Reference 2.4.

5.3.5. Drift is 0.0005% of circulating water flow by Table 3 of Reference 2.4. This makes the drift .000005*1317720 gpm/unit*2 units = 13.2 gpm total.

5.3.6. There are 15 cells per 54.7' by 811' tower (base dimensions 61' x 811') for a total of 60 cells per unit or 120 cells for the site (Table 4 of Reference 2. 4, case 1Ba). They are assumed to be arranged as in Figure 2 (from Reference 2.4) in rectangles of 30 cells (122' by 811' per Figure 2) along an axis that is approximately 30 degrees west of north.

5.3.7. Height: 55' (17m) above ground level. This is an assumed height based on other mechanical draft towers, such as 55.4' for the example tower in Reference 2.2 and 52'7" for mechanical draft towers at the Grand Gulf nuclear power plant.

5.3.8. Cell exit diameter: 45.5' (13.9m). This is an assumed diameter per assumption 4.5 based on a Reference 2.2 ratio of discharge diameter to cell dimension, specifically 9.14/11 * 54.7' = 45.45'.

5.3.9. Air flow rate for all cells combined (both units) is 127,000 lbm/s (58,000 kg/s). This is an assumed flow rate per assumption 4.5 based on a Reference 2.2 flow to MW ratio, specifically 13818/1400*5844 = 58000 kg/s.

5.3.10. Sodium salts in cooling water: 720 mg/l (.00072 gm/gm). This value is based on the maximum sodium concentration measured near the intact structure of 288 mg/L multiplied by a cycle concentration factor of 2.5. (Reference 2.10)

5.3.11. Chlorides in cooling water: 1120 mg/L. This value is based on the maximum chloride concentration measured near the intact structure of 448 mg/L multiplied by a cycle concentration factor of 2.5. (Reference 2.10)

5.3.12. Density of sodium salt: 2.17 gm/cm^3. The value of 2.17 gm/cm is a generic value from the plume software manual for salts (pg. 4-54,Reference 2.2).

5.3.13. Density of chlorides: 2.17 gm/cm^3 (the same value as sodium salt is used, since this is both the common form of sodium salts and chloride salts).

5.3.14. Density of total dissolved solids: 2.5 gm/cm^3. Since the exact composition of total dissolved solids is not known, a representative value of 2.5 gm/cm^3 is used based on enveloping typical densities, for example, ferric nitrate is 1.68 gm/L, ferric sulfate is 1.9, ferric chloride is 1.93, sodium salts average 2.17, potassium nitrate is 1.28, and magnesium nitrate is 1.46.

5.3.15. Drop Mass Spectrum: Values used in previous LMDCT modeling effort based on standard Marley forced draft cooling tower (Reference 2.9). The data provided by Marley did not contain bounding limits for smallest or largest size. Since the program requires this, arbitrary limits were added at half the smallest size and about twice the largest size listed by Marley.

Table 2: Drop Mass Spectrum

Mass in Range	Droplet Size in Microns Provided by Marley	Used in Program
0.12	<10 microns	5-10
0.08	10-15	10-15
0.20	15-35	15-35
0.20	35-65	35-65
0.20	65-115	65-115
0.10	115-170	115-170
0.05	170-230	170-230

0.04	230-375	230-375
0.008	375-525	375-525
0.002	>525	525-1000

6. Methodology

The models of the plumes are developed using the Seasonal and Annual Cooling Tower Impact (SACTI) plume modeling software that has been recognized by the NRC for this purpose (Section 5.3.3.1 of Reference 2.8). This calculation produces predictions of the plume visible size, ground fogging, icing, and salt deposition effects. The tabular results can be used for satisfying environmental reporting requirements.

To determine three different deposition rates for each compound of interest (sodium salt, chlorides, and total dissolved solids), three runs were made. The only difference was in the dissolved salt concentrations and densities. Plume characteristics were not changed noticeable by these changes, but the deposition rates were. The plume characteristic tables were taken from the first case run, which modeled total dissolved solids.

7. Calculation

7.1 BACKGROUND

The plumes are modeled with the SACTI computer programs originally developed by the Electric Power Research Institute (EPRI). A copy of this code has been purchased directly from the author for use in analyses such as this one. The meteorological data is described in Section 5.2.

7.2 LMDCT MODEL DESCRIPTION

The LMDCT has 120 cells in 4 housings. Unfortunately, SACTI is limited to just 20 as a practical maximum. The advised approach is to model the LMDCT with larger cells that represent the adjacent ones in the same number of housings. In this case, each housing, which is in reality two rows of 15 cells each, is modeled with one row of 5 cells. This simplification is a necessity of the code. Since the total mass and energy release is correct, and since the plumes will merge in a relatively short distance, the impact of the simplification is acceptable.

PREP (reads and analyzes met data, defines plume categories)

card 1: Comanche Peak: Linear Mechanical Cooling Tower Plume Model (120 cells)

card 2: ISTOP: Number of days in record period (52580 for the records available from the six years 2001 to 2006)
ISKIP: 1 to process every record
IOUT: 0 to generate full listing (1 to suppress)
IMIX: 2 to use daily mixing height data

IUR: 1 to use rural terrain
IWIND: 2 to use delta-T stability class method (sigma-T data is not available)
NFOG: 1 to calculate fogging and icing
NDRIFT: 1 to calculate drift
ITOWER: 3 to model linear mechanical draft cooling towers
ITAPE: 1 since data is in cd144 format
IZONE: 6 since Central Time Zone

card 3: ALAT: 32.30 (equals 32+17/60+54/3600)
ALONG: 97.79 (equals 97+47/60+7/3600)
ROUGHT: 5 cm, which is the appropriate value to represent the flat farm fields surrounding the site per Assumption 4.4.
HREF: 10 m met tower Reference 2.5 and 2.6 height per input 5.2.4
HTERR: 0 m terrain modification due to flat terrain

card 4: TWRHT: m tower height is 55' per input 5.3.7. This is 55*0.3048 = 17 m.
TWRDM: m effective diameter (=sqrt(total area*4/π) so $\pi D_e^2/4$ = total area). The single top diameter is 13.9m by input 5.3.8, giving a single cell area of $\pi 13.9^2/4$ so the effective diameter is sqrt($120*13.9^2$) = 152m.
TWRHE: Total heat dissipated is 5844 MWt as developed per input 5.3.1.
TWRAF: Total airflow is 58,000 kg/s per input 5.3.9.

card 5: Twelve monthly clearness index based on Fort Worth, TX, data contained in the SACTI Manual (Reference 2.2) Appendix B. Values are, January to December:
.54 .55 .59 .34 .59 .66 .64 .66 .65 .63 .60 .56

card 6: Twelve monthly values for average daily insolation based on Fort Worth, TX, data contained in the SACTI Manual (Reference 2.2) Appendix B. Values are, from January to December:
10.54 13.42 17.77 12.25 23.46 26.85 25.59 24.59 20.91 16.48 12.46 10.20

cards 7 to 12: Names of files containing data or being written. Note that the met data is in cpMet.txt and the mixing height data is in cpmixht.txt.

The input file prep.usr is as follows:

```
Comanche Peak: Linear Mechanical Cooling Tower Plume Model (120 cells)
 52580      1 0 2 1 2 1 1 3 1 6
  32.30      97.79       5.0       10.0        0.0
  17.0      152.0     5844.0      58000.0
.54.55.59.34.59.66.64.66.65.63.60.56
10.5413.4217.7712.2523.4626.8525.5924.5920.9116.4812.4610.20
cpMet.txt
fort.2
fort.3
fort.4
prep.out
cpmixht.txt
```

The input echo is repeated here to demonstrate correct input:

```
*****************************************************************************************
  EPRI PLUME AND DRIFT ANALYSIS SYSTEM PREPROCESSOR CODE, PRE-RELEASE VERSION 09-01-90
  CASE STUDY: Comanche Peak: Linear Mechanical Cooling Tower Plume Model (120 cells)
*****************************************************************************************

      INPUT INFORMATION
      -----------------
```

```
SURFACE TAPE TYPE:              CD144
TOWER TYPE:               LINEAR MECHANICAL DRAFT
TOWER HEIGHT (M):               17.00
TOWER DIAMETER (M):            152.00
TOWER HEAT (KW):           5844000.00
TOWER AIR FLOW (KG/S):       58000.00
SITE LATITUDE:                  32.30
SITE LONGITUDE:                 97.79
SITE TIME ZONE:               CENTRAL
ROUGHNESS HEIGHT (CM):           5.00
REFERENCE 2.    HEIGHT (M):          10.00

RECORD STOPPING SWITCH:         52580
RECORD SKIPPING FACTOR:             1
HOURLY RECORD PRINT LOG:        NOT SELECTED
BI-DAILY MIXING HEIGHT TAPE:    SELECTED
MIXING HEIGHT TYPE:             RURAL
FOGGING/ICING OPTION:           SELECTED
DRIFT OPTION:                   SELECTED
```

MONTHLY CLEARNESS INDEX

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
.540	.550	.590	.340	.590	.660	.640	.660	.650	.630	.600	.560

TOTAL DAILY SOLAR ENERGY DEPOSITION
(LONG-TERM AVERAGE FOR MONTH)

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
10.54	13.42	17.77	12.25	23.46	26.85	25.59	24.59	20.91	16.48	12.46	10.20

The MULT program runs the plume code for the multiple sources. Its input is described as follows.

MULT (analyzes each plume)
cards 1 to 3: Names of files containing data or being written
card 4: Title: Comanche Peak: Linear Mechanical Cooling Towers (120 cells)
card 5: IOUT: 2 for maximum printout
NFOG: 1 to run fogging cases
NDRIFT: 1 to run drift analysis
NFRAD: Fogging, Ice radials. 0 leads to a default of 16, with each radial distance 100m out to 1600m.
SMAXP: 10000 m maximum distance to calculate plume
SMAXF: 1600 m maximum distance for fogging analysis
NPORTS: 20 cells (maximum allowed by code)
NPLATE: 0 defaults to equal NPORTS
NTWRS: 4 tower housing for LMDCTs
ISOURC: 0 for multiple ports (would be 1 for a single tower)
NEXPL: 0 external plates for direct user input (no building wakes modeled)
cards 6 to 25: X, Y coordinates of tower cells in meters from center point

The below Figure 3 shows how the LMDCT center points were calculated. The Y-direction is true North, the X-direction is true East. Although the actual number of cells is 120, due to

code limitations, only 20 cells can be entered. The approach was to model each housing, which is correctly 2 x 15 or 30 cells, as 1 x 5 or 5 cells. To keep the total length correct (811'), the cell lengths were assumed to be 811/5 = 162.2 feet each.

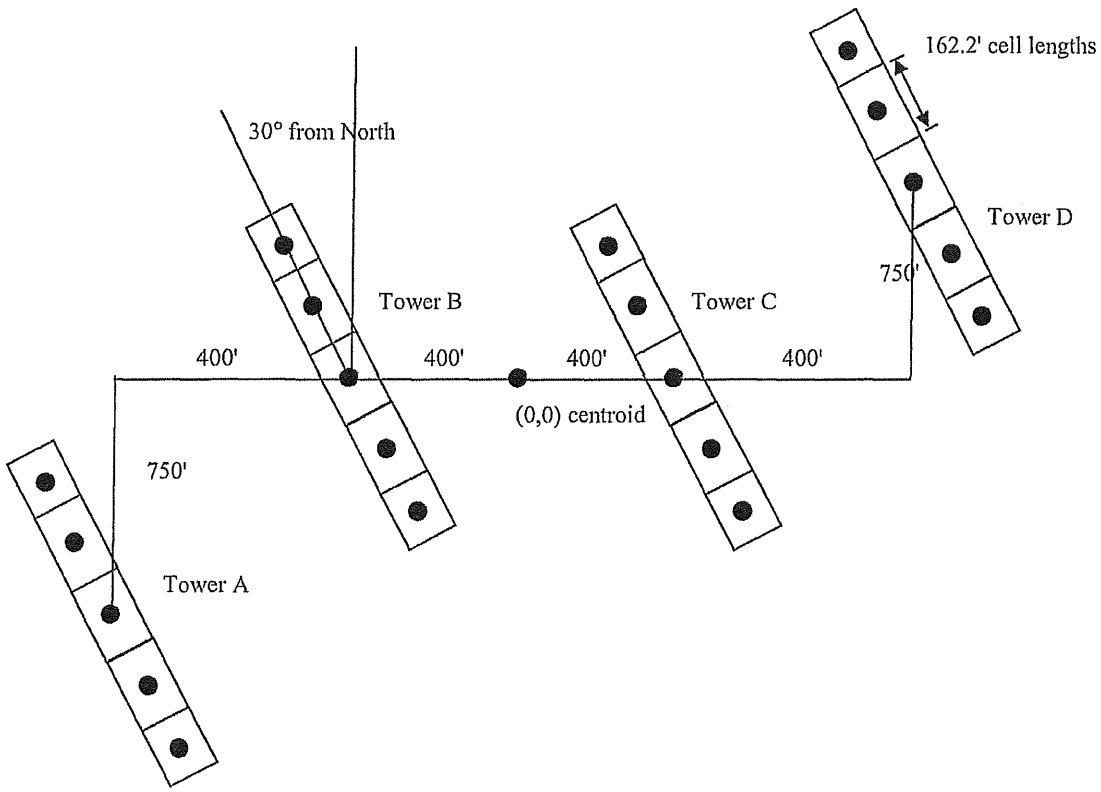

Figure 3: Linear Mechanical-Draft Cooling Towers, Relative Coordinate Calculation
(Y is direction of true North, X of true East)

By inspection of Figure 3, the center of Tower A is at (-800', -750'). The center of Tower B is at (-400', 0'). The center of Tower C is (400', 0'). The center of Tower D is (800', 750'). Each cell relative to its housing center is at an x-value of 162.2' * cell number * sin(30), and a y-value of 162.2'*cell number*cos(30), where cell numbers are 2,1,0,-1, and -2. This, plus a conversion to metric units, gives the cell locations as shown in Table 3.

Table 3: Cell Center Location Coordinates

	x (ft)	y (ft)	x (m)	y (m)
Tower A	-962.2	-588	-293.3	-179.2
	-881.1	-669	-268.6	-203.9
center-A	-800	-750	-243.8	-228.6
	-718.9	-831	-219.1	-253.3
	-637.8	-912	-194.4	-278.0
Tower B	-562.2	162	-171.4	49.4
	-481.1	81	-146.6	24.7
center-B	-400	0	-121.9	0.0
	-318.9	-81	-97.2	-24.7
	-237.8	-162	-72.5	-49.4
Tower C	237.8	162	72.5	49.4
	318.9	81	97.2	24.7
center-C	400	0	121.9	0.0
	481.1	-81	146.6	-24.7
	562.2	-162	171.4	-49.4
Tower D	637.8	912	194.4	278.0
	718.9	831	219.1	253.3
center-D	800	750	243.8	228.6
	881.1	669	268.6	203.9
	962.2	588	293.3	179.2

card 26: NWD: Number of critical wind directions (3), followed by values in degrees east of North: (0 degrees, 60 degrees to be transverse to axis, and 150 degrees to be parallel to axis)

card 27: Wind Equivalent Array for 16 wind direction starting with north and moving clockwise in 22.5° increments 223321122332211. Here 1 is parallel to the axis, 2 is roughly 30° to axis, and 3 is cross axis (See below Figure 4).

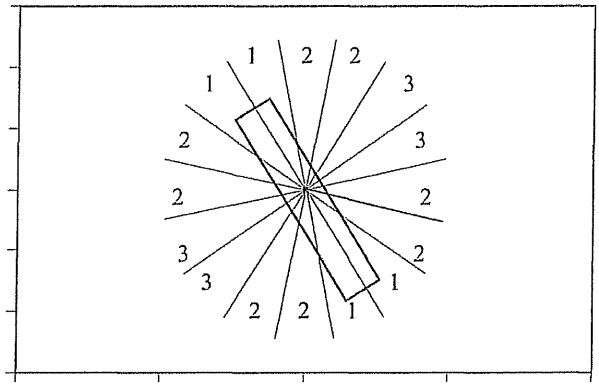

Figure 4: Showing Wind Direction Axes Relative to LMDCT Axis

card 28: TWRADM: Left blank, this is the diameter of a circular mechanical draft cooling tower.
DA: Length of each Linear mechanical draft tower housing (811' or 247.2m).

DB: Width of linear mechanical draft towers (122' or 37.2m).
THTWR: Degrees east of north of the LMDCT long axis (150).
cards 29 - 32: XTWR: m X-coordinate of the center of the LMDCT houses from Table 3.
YTWR: m Y-coordinate of the center of the LMDCT houses from Table 3.
card 33: Label to identify drift data. DRIFT DEPOSITION SPECTRUM
card 34: NDROPS: # of drop sizes (11)
DRIFTR: gm/s total drift rate from all sources. This value is 13.2 gpm per input 5.4. At 62 lbm/ft^3 density, this is:

13.2 gpm/7.481 gal/ft^3*62 lbm/ft^3 *1min/60s*453.59 gm/lbm
= 827 gm/s

CWSC: gm TDS/gm solution. This is 4000 mg/l by input 5.3.4, or 4 mg/gm, or .004 gm/gm
SDENS: gm/cm TDS density equal to 2.5 g/cm^3 by input 5.3.14.
cards 35 to end: DROPS(I) Ith drop diameter (μm). The data is from Table 2.

The mult.usr input file is as follows:

```
fort.3
mult.out
fort.8
Comanche Peak: Linear Mechanical Cooling Towers (120 cells)
  2  1  1  0   10000.0    1600.0 20  0  4  0  0
   -293.3    -179.2
   -268.6    -203.9
   -243.8    -228.6
   -219.1    -253.3
   -194.4    -278.0
   -171.4      49.4
   -146.6      24.7
   -121.9       0.0
    -97.2     -24.7
    -72.5     -49.4
     72.5      49.4
     97.2      24.7
    121.9       0.0
    146.6     -24.7
    171.4     -49.4
    194.4     278.0
    219.1     253.3
    243.8     228.6
    268.6     203.9
    293.3     179.2
 3        0.0      60.0      150.0
 2  2  3  3  2  2  1  1  2  2  3  3  2  2  1  1
                247.2      37.2      150.0
  -243.8       -228.6
  -121.9          0.0
   121.9          0.0
```

```
    243.8        228.6
TOTAL DISSOLVED SOLIDS: DRIFT DEPOSITION SPECTRUM
11           827.0    .004        2.5
       5.0     0.00       0.0
      10.0     0.12       0.0
      15.0     0.08       0.0
      35.0     0.20       0.0
      65.0     0.20       0.0
     115.0     0.20       0.0
     170.0     0.10       0.0
     230.0     0.05       0.0
     375.0     0.04       0.0
     525.0     0.008      0.0
    1000.0     0.002      0.0
```

The TABLES program summarizes the MULT output for the seasons and places it into more convenient tabular format. Its input is described as follows.

TABLES (averages plume results and presents results)

cards 1 to 5: Names of files containing data or being written
card 6: NSEASNQ: 5 seasons to be examined (the 5th is "Annual")
MM: Number of sector partitions to use in shadowing (0 results in the default of 13)
cards 7 to 16: The first card names the season, the second gives the first and last Julian day of the season.
card 17: RSTAR: Effective radius of the combined plume source, 0 leaves it to be calculated
card 18: NXL: Number of grids for length frequency (0 results in default of 100)
NXH: Number of grids for height frequency (0 results in default of 100)
NXR: Number of grids for radius frequency (0 results in default of 100)
NXS: Number of grids for shadowing table (0 results in default of 40)
NXD: Number of grids for deposition table (0 results in default of 40)

Print out of Tables.usr:

```
fort.2
fort.4
tables.out
fort.8
fort.9
  5  0
WINTER
                        335   59
SPRING
                         60  151
SUMMER
                        152  243
FALL
                        244  334
ANNUAL
                          0    0
0.0
  0  0  0  0  0
```

This model was also run for sodium salt and chlorides as well. The only changes were in the Mult.usr deck and relate to the concentration and density of solids. The total dissolved solids case had been:

```
TOTAL DISSOLVED SOLIDS: DRIFT DEPOSITION SPECTRUM
11          827.0    .004        2.5
```

The sodium salt case should replaces the value of .004 with .00072 based on the sodium concentration from Input 5.3.12. Therefore the input is

```
SODIUM SALTS: DRIFT DEPOSITION SPECTRUM
11          827.0    .00072      2.17
```

The chlorides case becomes (using inputs 5.3.11 and 5.3.13):

```
CHLORIDES: DRIFT DEPOSITION SPECTRUM
11          827.0    .00112      2.17
```

Although the code requires that input files be named mult.usr and output files named tables.out, these are renamed multTDS, multNa, multCl, TablesTDS, TablesNa and TablesCl to define the files by the compound assumed in the deposition analysis. The subscript becomes .doc so that formatting such as a landscape page set up can be saved. A list of files is contained in Section 9.

8. Results and Conclusions

8.1 RESULTS

The input files described above were run on a PC. The results are contained in the output files with name formats tables.doc, and in the Excel file results.xls. They are summarized here.

8.2 VISIBLE PLUMES

Tables 4a and 4b present the plume lengths by season. The average length in meters in Table 4a is calculated in file results.xls by summing up the length*frequency change, and then dividing by the total frequency in the given direction. For example, if the lengths in meters were 1000, 2000, 3000, 4000, and the frequencies of being at least that long were 1.5, 0.8, 0.4, 0, respectively, then the average length would be calculated as [1000*(1.5-.8) + 2000*(.8-.4) + 3000* (.4-0)]/1.5 = 1800 m. Note: the actual lengths produced by SACTI are given in divisions of 100 meters each, so the round off error is much smaller than in this example. Table 4b is identical only the length unit is miles (generated by multiplying the length in meters by (1ft/.3048m*1mile/5280ft) .

Tables 5 through 8 present the percent frequency of plume lengths versus direction.

The total dissolved solids, sodium salts, and chlorides deposition rates are described in Tables 9, 10, and 11. The SACTI code produces salt deposition in units of kg/km^2-month. These can be converted to English units of lbm/(100-acre-months) by multiplying by (2.205 lbm/kg)*(1/2.471 km^2/100 acres) = 0.893 (lbm- km^2/100-acre-kg).

Water deposition is shown in Table 12. These data can be converted into inches per year by 0.893 (lbm- km^2/100-acre-kg)*1ft^3/62.4 lbm * 1/100 acre * 1 acre/43560 ft^2 * 12 inch/ft * 12 months/yr = 4.7e-7. Results show all areas beyond a quarter mile of the towers see less than 1/1000 in/yr added precipitation.

Plume shadowing is presented in Table 13. Fogging is shown in Table 14, and rime icing on Table 15. It is seen that fogging and icing will occur on occasion out to a full mile from the cooling towers, but mostly along a direction directly to the north or south. As seen in Figure 1, fogging and icing is predicted to occur almost exclusively in areas of wetlands or lake surface.

Table 4a: Average Plume Lengths in Meters

	Winter	Spring	Summer	Fall	Annual
Plume from LMDCT moving in the indicated direction					
S	6380	4080	2630	3930	4740
SSW	6090	3470	1960	3020	3620
SW	5060	2050	950	1980	2240
WSW	4980	2670	880	2360	2370
W	6680	3900	1440	4020	3740
WNW	6710	3420	1660	3000	3400
NW	6590	3480	1910	3120	3440
NNW	5420	2620	1250	2690	2690
N	4580	2390	1100	2640	2500
NNE	4140	2690	1400	3300	2880
NE	2920	2430	960	3210	2390
ENE	4060	3050	1400	4080	3390
E	5340	3340	2550	4640	4250
ESE	5890	4240	3430	5250	5110
SE	5010	3810	2610	4390	4430
SSE	5180	3450	2150	3920	4210
All	5290	2980	1470	3280	3250

Table 4b: Average Plume Lengths in Miles

	Winter	Spring	Summer	Fall	Annual
Plume from LMDCT moving in the indicated direction					
S	3.96	2.54	1.63	2.44	2.95
SSW	3.78	2.16	1.22	1.88	2.25
SW	3.14	1.27	0.59	1.23	1.39
WSW	3.09	1.66	0.55	1.47	1.47
W	4.15	2.42	0.89	2.5	2.32
WNW	4.17	2.13	1.03	1.86	2.11
NW	4.09	2.16	1.19	1.94	2.14
NNW	3.37	1.63	0.78	1.67	1.67
N	2.85	1.49	0.68	1.64	1.55
NNE	2.57	1.67	0.87	2.05	1.79
NE	1.81	1.51	0.6	1.99	1.49
ENE	2.52	1.9	0.87	2.54	2.11
E	3.32	2.08	1.58	2.88	2.64
ESE	3.66	2.63	2.13	3.26	3.18
SE	3.11	2.37	1.62	2.73	2.75
SSE	3.22	2.14	1.34	2.44	2.62
All	3.29	1.85	0.91	2.04	2.02

Table 5: Winter Plume Percent Frequency by Length and Direction

	0 - <500 m (0 to 1/3 mile)	500 - <1000 m (1/3 - 2/3 mile)	1000 - <8000 m (2/3 - 5 miles)	8000 m and longer (>5 miles)	Total Freq
Plume from LMDCT moving in the indicated direction					
S	2.46	0	2.13	4.6	9.19
SSW	0.97	0	1.01	1.5	3.48
SW	0.49	0.41	0.22	0.8	1.92
WSW	0.45	0.24	0.14	0.61	1.44
W	0.7	0	0.95	1.59	3.24
WNW	0.83	0	1.3	1.98	4.11
NW	1.3	0.29	2.34	4.36	8.29
NNW	3.41	0.35	2.68	4.7	11.14
N	7.47	0	3.82	5.12	16.41
NNE	2.73	0	1.64	1.42	5.79
NE	1.98	0.89	0.74	0.67	4.28
ENE	1.79	0.72	0.79	1.26	4.56
E	1.09	0	1.07	1.14	3.3
ESE	1.42	0	1.38	1.95	4.75
SE	2.64	0.35	1.92	2.92	7.83
SSE	3.62	0.23	1.59	4.17	9.61
All	33.4	3.5	23.7	38.8	99.35

Table 6: Spring Plume Percent Frequency by Length and Direction

	0 - <500 m (0 to 1/3 mile)	500 - <1000 m (1/3 - 2/3 mile)	1000 - <8000 m (2/3 - 5 miles)	8000 m and longer (>5 miles)	Total Freq
Plume from LMDCT moving in the indicated direction					
S	2.93	0	1.44	1.47	5.84
SSW	2.53	0	1.1	0.87	4.5
SW	2	0.65	0.34	0.4	3.39
WSW	1.3	0.51	0.25	0.46	2.52
W	2.15	0	1	1	4.15
WNW	2.69	0	0.93	1.01	4.63
NW	4.69	0.37	2.13	2.16	9.35
NNW	11.64	0.39	2.85	3.23	18.11
N	17.52	0	3.76	3.37	24.65
NNE	2.61	0	0.81	0.53	3.95
NE	1.85	0.35	0.43	0.4	3.03
ENE	1.22	0.37	0.35	0.46	2.4
E	1.22	0	0.5	0.38	2.1
ESE	1.03	0	0.55	0.58	2.16
SE	1.65	0.11	0.81	0.96	3.53
SSE	2.92	0.09	1	1.28	5.29
All	60.0	2.8	18.3	18.6	99.62

Table 7: Summer Plume Percent Frequency by Length and Direction

	0 - <500 m (0 to 1/3 mile)	500 - <1000 m (1/3 - 2/3 mile)	1000 - <8000 m (2/3 - 5 miles)	8000 m and longer (>5 miles)	Total Freq
Plume from LMDCT moving in the indicated direction					
S	1.82	0	0.51	0.37	2.7
SSW	2.41	0	0.46	0.33	3.2
SW	2.5	0.25	0.08	0.19	3.02
WSW	2.52	0.18	0.08	0.17	2.95
W	4.15	0	0.62	0.32	5.09
WNW	5.3	0	0.83	0.56	6.69
NW	10.59	0.33	2.17	1.61	14.7
NNW	15.96	0.45	2.13	1.18	19.72
N	20.73	0	1.98	1.17	23.88
NNE	4.84	0	0.83	0.28	5.95
NE	2.84	0.47	0.23	0.13	3.67
ENE	1.57	0.29	0.19	0.14	2.19
E	1.04	0	0.4	0.15	1.59
ESE	0.75	0	0.38	0.24	1.37
SE	0.75	0.04	0.29	0.18	1.26
SSE	1.21	0.04	0.24	0.24	1.73
All	79.0	2.0	11.4	7.2	99.71

Table 8: Fall Plume Percent Frequency by Length and Direction

	0 - <500 m (0 to 1/3 mile)	500 - <1000 m (1/3 - 2/3 mile)	1000 - <8000 m (2/3 - 5 miles)	8000 m and longer (>5 miles)	Total Freq
Plume from LMDCT moving in the indicated direction					
S	3.73	0	1.51	1.83	7.07
SSW	2.82	0	0.64	0.91	4.37
SW	2.14	0.31	0.19	0.44	3.08
WSW	1.95	0.18	0.18	0.52	2.83
W	2.91	0	0.97	1.65	5.53
WNW	3.38	0	0.89	1.06	5.33
NW	6.83	0.35	2.26	2.54	11.98
NNW	8.37	0.49	2.64	2.26	13.76
N	11.03	0	3.11	2.31	16.45
NNE	2.87	0	1.46	0.8	5.13
NE	1.72	0.63	0.52	0.76	3.63
ENE	1.2	0.47	0.37	0.93	2.97
E	0.99	0	0.85	0.66	2.5
ESE	1.15	0	0.95	1.16	3.26
SE	1.99	0.19	1.17	1.42	4.77
SSE	3.3	0.15	0.85	2.08	6.38
All	56.4	2.8	18.6	21.3	99.03

Table 9: Annual Sodium Salt Deposition in kg/(km^2-month).
Directions are directions that the plume is headed. Values can be converted to lbm/100-acre-month by multiplying by 0.893.

(mi)	(m)	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.06	100	8.45	6.35	4.55	4.81	4.23	5.86	1.4	1.97	57.24	10.24	4.28	2.92	2.38	2.98	0.53	0.79
0.12	200	5.77	4.33	2.11	2.16	3.11	4.43	1.35	1.9	38.46	7.17	2.16	1.5	1.72	2.04	0.46	0.68
0.19	300	0.68	0.48	0.51	0.42	0.75	0.95	1.32	1.87	2.44	0.74	0.74	0.5	0.29	0.31	0.39	0.61
0.25	400	0.25	0.17	0.5	0.4	0.45	0.57	1.31	1.88	0.87	0.31	0.72	0.47	0.17	0.13	0.36	0.59
0.31	500	0.22	0.15	0.49	0.39	0.42	0.55	1.24	1.74	0.81	0.3	0.69	0.45	0.13	0.12	0.31	0.49
0.37	600	0.21	0.14	0.32	0.26	0.33	0.42	1.01	1.47	0.68	0.25	0.47	0.3	0.1	0.12	0.24	0.35
0.43	700	0.19	0.13	0.19	0.15	0.18	0.2	0.7	1.19	0.49	0.17	0.26	0.18	0.1	0.11	0.21	0.28
0.5	800	0.19	0.13	0.02	0.01	0.17	0.19	0.61	1.13	0.48	0.17	0.02	0.02	0.09	0.1	0.2	0.28
0.56	900	0.15	0.1	0.02	0.01	0.15	0.16	0.59	1.11	0.39	0.14	0.02	0.02	0.08	0.08	0.2	0.28
0.62	1000	0.14	0.1	0.02	0.01	0.14	0.16	0.51	0.96	0.36	0.13	0.02	0.02	0.07	0.08	0.17	0.24
0.68	1100	0.14	0.1	0.02	0.01	0.14	0.16	0.12	0.15	0.36	0.13	0.02	0.02	0.07	0.08	0.06	0.05
0.75	1200	0.14	0.09	0.02	0.01	0.14	0.15	0.12	0.15	0.36	0.13	0.02	0.02	0.07	0.08	0.06	0.05
0.81	1300	0.13	0.09	0.02	0.01	0.13	0.14	0.12	0.15	0.34	0.12	0.02	0.02	0.07	0.07	0.06	0.05
0.87	1400	0.12	0.08	0.02	0.01	0.11	0.13	0.12	0.15	0.32	0.11	0.02	0.02	0.06	0.07	0.06	0.05
0.93	1500	0.12	0.08	0.02	0.01	0.11	0.13	0.12	0.15	0.32	0.11	0.02	0.02	0.06	0.07	0.06	0.05
0.99	1600	0.12	0.08	0.02	0.01	0.11	0.12	0.12	0.15	0.3	0.11	0.02	0.02	0.06	0.07	0.06	0.05
1.06	1700	0.08	0.06	0.02	0.01	0.07	0.08	0.12	0.15	0.2	0.07	0.02	0.02	0.04	0.05	0.06	0.05
1.12	1800	0.05	0.02	0.02	0.01	0.02	0.03	0.12	0.15	0.11	0.03	0.02	0.02	0.02	0.03	0.06	0.05
1.18	1900	0.04	0.02	0.02	0.01	0.02	0.03	0.12	0.15	0.09	0.03	0.02	0.02	0.02	0.02	0.06	0.05
1.24	2000	0.03	0.02	0.02	0.01	0.02	0.02	0.12	0.15	0.07	0.02	0.02	0.02	0.01	0.02	0.06	0.05
1.3	2100	0.03	0.02	0.02	0.01	0.02	0.02	0.1	0.12	0.07	0.02	0.02	0.02	0.01	0.02	0.04	0.04
1.37	2200	0.03	0.02	0.01	0.01	0.02	0.02	0.09	0.12	0.07	0.02	0.02	0.02	0.01	0.02	0.04	0.04
1.43	2300	0.02	0.01	0.01	0.01	0.01	0.01	0.08	0.11	0.06	0.01	0.02	0.02	0.01	0.01	0.04	0.04
1.49	2400	0.02	0.01	0.01	0.01	0.01	0.01	0.06	0.08	0.05	0.01	0.02	0.02	0.01	0.01	0.03	0.03
1.55	2500	0.02	0.01	0.01	0.01	0.01	0.01	0.05	0.06	0.05	0.01	0.02	0.02	0.01	0.01	0.02	0.02
1.62	2600	0.02	0.01	0.01	0.01	0.01	0.01	0.03	0.04	0.05	0.01	0.02	0.02	0.01	0.01	0.01	0.02
1.68	2700	0.02	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.05	0.01	0.02	0.02	0.01	0.01	0.01	0.02
1.74	2800	0.02	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.04	0.01	0.01	0.01	0	0.01	0.01	0.02
1.8	2900	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.04	0.01	0.01	0.01	0	0.01	0.01	0.02
1.86	3000	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.04	0.01	0.01	0.01	0	0.01	0.01	0.02
1.93	3100	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.04	0.01	0.01	0.01	0	0.01	0.01	0.01
1.99	3200	0.01	0.01	0.01	0	0.01	0.01	0.02	0.03	0.04	0.01	0.01	0.01	0	0.01	0.01	0.01
2.05	3300	0.01	0.01	0	0	0.01	0.01	0.02	0.02	0.04	0.01	0.01	0.01	0	0.01	0.01	0.01
2.11	3400	0.01	0.01	0	0	0.01	0.01	0.02	0.02	0.04	0.01	0.01	0.01	0	0.01	0.01	0.01
2.17	3500	0.01	0.01	0	0	0.01	0.01	0.02	0.02	0.04	0.01	0.01	0.01	0	0.01	0.01	0.01
2.24	3600	0.01	0.01	0	0	0.01	0.01	0.02	0.02	0.04	0.01	0.01	0.01	0	0	0.01	0.01
2.3	3700	0.01	0.01	0	0	0.01	0.01	0.02	0.02	0.04	0.01	0.01	0.01	0	0	0.01	0.01
2.36	3800	0.01	0.01	0	0	0.01	0.01	0.02	0.02	0.04	0.01	0.01	0.01	0	0	0.01	0.01
2.42	3900	0.01	0.01	0	0	0.01	0.01	0.02	0.02	0.04	0.01	0.01	0.01	0	0	0.01	0.01
2.49	4000	0.01	0.01	0	0	0.01	0.01	0.01	0.02	0.04	0.01	0.01	0.01	0	0	0.01	0.01
2.55	4100	0.01	0.01	0	0	0.01	0.01	0.01	0.02	0.04	0.01	0.01	0.01	0	0	0.01	0.01
2.61	4200	0.01	0.01	0	0	0.01	0.01	0.01	0.02	0.04	0.01	0.01	0.01	0	0	0.01	0.01

Table 10: Annual Chlorides Deposition in kg/(km^2-month).
Directions are directions that the plume is headed. Values can be converted to lbm/100-acre-month by multiplying by 0.893.

(mi)	(m)	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.06	100	13.13	9.88	7.07	7.47	6.59	9.12	2.18	3.06	89	15.93	6.65	4.53	3.7	4.63	0.82	1.22
0.12	200	8.97	6.74	3.28	3.35	4.84	6.89	2.1	2.95	59.8	11.16	3.36	2.34	2.68	3.17	0.71	1.06
0.19	300	1.07	0.76	0.79	0.65	1.17	1.48	2.05	2.92	3.82	1.15	1.15	0.78	0.45	0.48	0.61	0.95
0.25	400	0.39	0.28	0.77	0.62	0.71	0.9	2.04	2.93	1.37	0.49	1.12	0.73	0.26	0.21	0.56	0.91
0.31	500	0.35	0.23	0.76	0.61	0.67	0.87	1.94	2.71	1.28	0.47	1.08	0.7	0.2	0.19	0.48	0.77
0.37	600	0.33	0.22	0.5	0.4	0.52	0.66	1.57	2.29	1.08	0.4	0.72	0.46	0.16	0.19	0.38	0.55
0.43	700	0.3	0.21	0.3	0.23	0.29	0.32	1.09	1.85	0.78	0.28	0.4	0.27	0.15	0.17	0.33	0.44
0.5	800	0.3	0.2	0.03	0.02	0.28	0.3	0.96	1.76	0.76	0.27	0.04	0.04	0.15	0.16	0.32	0.44
0.56	900	0.24	0.16	0.03	0.02	0.24	0.26	0.92	1.73	0.62	0.22	0.04	0.04	0.12	0.13	0.31	0.44
0.62	1000	0.23	0.15	0.03	0.02	0.23	0.25	0.79	1.48	0.58	0.21	0.04	0.04	0.12	0.12	0.27	0.38
0.68	1100	0.23	0.15	0.03	0.02	0.23	0.25	0.19	0.24	0.58	0.21	0.04	0.04	0.12	0.12	0.09	0.08
0.75	1200	0.23	0.15	0.03	0.02	0.22	0.25	0.19	0.24	0.58	0.21	0.04	0.04	0.12	0.12	0.09	0.08
0.81	1300	0.21	0.14	0.03	0.02	0.21	0.23	0.19	0.24	0.54	0.2	0.04	0.04	0.11	0.11	0.09	0.08
0.87	1400	0.2	0.14	0.03	0.02	0.19	0.21	0.19	0.24	0.51	0.19	0.04	0.04	0.1	0.11	0.09	0.08
0.93	1500	0.2	0.14	0.03	0.02	0.19	0.21	0.19	0.24	0.51	0.19	0.04	0.04	0.1	0.11	0.09	0.08
0.99	1600	0.19	0.12	0.03	0.02	0.17	0.18	0.19	0.24	0.47	0.17	0.04	0.04	0.1	0.1	0.09	0.08
1.06	1700	0.11	0.06	0.03	0.02	0.06	0.07	0.19	0.24	0.26	0.08	0.04	0.04	0.05	0.06	0.09	0.08
1.12	1800	0.07	0.04	0.03	0.02	0.04	0.05	0.19	0.24	0.17	0.05	0.04	0.04	0.03	0.04	0.09	0.08
1.18	1900	0.06	0.03	0.03	0.02	0.03	0.04	0.19	0.24	0.15	0.04	0.04	0.04	0.02	0.03	0.09	0.08
1.24	2000	0.05	0.03	0.03	0.02	0.03	0.03	0.19	0.24	0.12	0.03	0.04	0.04	0.02	0.03	0.09	0.08
1.3	2100	0.05	0.03	0.02	0.02	0.03	0.03	0.15	0.19	0.12	0.03	0.03	0.03	0.02	0.03	0.07	0.07
1.37	2200	0.05	0.03	0.02	0.02	0.03	0.03	0.15	0.18	0.12	0.03	0.03	0.03	0.02	0.03	0.07	0.06
1.43	2300	0.04	0.02	0.02	0.02	0.02	0.02	0.13	0.17	0.1	0.02	0.03	0.03	0.01	0.02	0.06	0.06
1.49	2400	0.03	0.02	0.02	0.02	0.02	0.02	0.1	0.12	0.08	0.02	0.03	0.03	0.01	0.01	0.05	0.05
1.55	2500	0.03	0.02	0.02	0.02	0.02	0.02	0.08	0.1	0.08	0.02	0.03	0.03	0.01	0.01	0.04	0.04
1.62	2600	0.03	0.02	0.02	0.01	0.02	0.02	0.05	0.06	0.08	0.02	0.03	0.03	0.01	0.01	0.02	0.03
1.68	2700	0.03	0.02	0.02	0.01	0.02	0.02	0.05	0.06	0.08	0.02	0.03	0.02	0.01	0.01	0.02	0.03
1.74	2800	0.03	0.01	0.01	0.01	0.01	0.02	0.05	0.06	0.08	0.02	0.02	0.02	0.01	0.01	0.02	0.03
1.8	2900	0.02	0.01	0.01	0.01	0.01	0.01	0.05	0.06	0.07	0.01	0.02	0.02	0.01	0.01	0.02	0.03
1.86	3000	0.02	0.01	0.01	0.01	0.01	0.01	0.04	0.05	0.07	0.01	0.02	0.02	0.01	0.01	0.02	0.02
1.93	3100	0.02	0.01	0.01	0.01	0.01	0.01	0.04	0.05	0.07	0.01	0.02	0.02	0.01	0.01	0.02	0.02
1.99	3200	0.02	0.01	0.01	0.01	0.01	0.01	0.04	0.04	0.07	0.01	0.01	0.01	0.01	0.01	0.02	0.02
2.05	3300	0.02	0.01	0.01	0.01	0.01	0.01	0.03	0.04	0.07	0.01	0.01	0.01	0.01	0.01	0.02	0.02
2.11	3400	0.02	0.01	0.01	0.01	0.01	0.01	0.03	0.04	0.07	0.01	0.01	0.01	0.01	0.01	0.01	0.02
2.17	3500	0.02	0.01	0.01	0.01	0.01	0.01	0.03	0.04	0.07	0.01	0.01	0.01	0.01	0.01	0.01	0.02
2.24	3600	0.02	0.01	0.01	0.01	0.01	0.01	0.03	0.04	0.07	0.01	0.01	0.01	0.01	0.01	0.01	0.02
2.3	3700	0.02	0.01	0.01	0.01	0.01	0.01	0.03	0.04	0.07	0.01	0.01	0.01	0.01	0.01	0.01	0.02
2.36	3800	0.02	0.01	0.01	0.01	0.01	0.01	0.03	0.04	0.07	0.01	0.01	0.01	0.01	0.01	0.01	0.02
2.42	3900	0.02	0.01	0.01	0.01	0.01	0.01	0.03	0.04	0.07	0.01	0.01	0.01	0.01	0.01	0.01	0.02
2.49	4000	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.07	0.01	0.01	0.01	0.01	0.01	0.01	0.01
2.55	4100	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.07	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Table 11: Annual Total Dissolved Solids Deposition in kg/(km^2-month). Directions are directions that the plume is headed. Values can be converted to lbm/100-acre-month by multiplying by 0.893.

(mi)	(m)	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.06	100	47.2	35.6	25.6	27.1	23.9	33.0	7.9	11.2	319.4	57.3	24.1	16.4	13.4	16.7	3.0	4.5
0.12	200	32.3	24.4	11.7	11.9	17.6	25.1	7.6	10.8	214.9	40.2	12.0	8.3	9.7	11.5	2.6	3.8
0.19	300	3.9	2.8	2.9	2.3	4.5	5.6	7.5	10.7	13.7	4.2	4.2	2.8	1.7	1.8	2.2	3.4
0.25	400	1.6	1.2	2.8	2.2	2.8	3.6	7.4	10.7	5.4	2.0	4.0	2.6	1.1	0.8	2.1	3.3
0.31	500	1.4	1.0	2.7	2.2	2.7	3.5	7.0	9.9	5.0	1.9	3.9	2.5	0.8	0.8	1.7	2.8
0.37	600	1.3	1.0	1.8	1.5	2.1	2.7	5.7	8.4	4.3	1.6	2.6	1.7	0.7	0.7	1.4	2.0
0.43	700	1.2	0.9	1.1	0.8	1.3	1.5	4.0	6.8	3.2	1.2	1.4	1.0	0.7	0.7	1.2	1.6
0.5	800	1.2	0.9	0.1	0.1	1.3	1.4	3.5	6.5	3.2	1.2	0.2	0.1	0.6	0.7	1.2	1.6
0.56	900	1.0	0.8	0.1	0.1	1.2	1.3	3.4	6.4	2.7	1.0	0.2	0.1	0.6	0.5	1.2	1.6
0.62	1000	1.0	0.7	0.1	0.1	1.1	1.2	2.4	4.5	2.5	0.9	0.2	0.1	0.5	0.5	0.8	1.2
0.68	1100	0.9	0.7	0.1	0.1	1.1	1.2	0.7	0.9	2.5	0.9	0.2	0.1	0.5	0.5	0.3	0.3
0.75	1200	0.7	0.4	0.1	0.1	0.6	0.7	0.7	0.9	1.9	0.7	0.2	0.1	0.4	0.4	0.3	0.3
0.81	1300	0.7	0.4	0.1	0.1	0.5	0.6	0.7	0.9	1.8	0.6	0.2	0.1	0.3	0.4	0.3	0.3
0.87	1400	0.6	0.4	0.1	0.1	0.5	0.5	0.7	0.9	1.7	0.6	0.2	0.1	0.3	0.4	0.3	0.3
0.93	1500	0.6	0.4	0.1	0.1	0.5	0.5	0.7	0.9	1.7	0.6	0.2	0.1	0.3	0.4	0.3	0.3
0.99	1600	0.6	0.3	0.1	0.1	0.4	0.5	0.7	0.9	1.6	0.5	0.2	0.1	0.3	0.3	0.3	0.3
1.06	1700	0.4	0.2	0.1	0.1	0.2	0.2	0.7	0.9	0.9	0.3	0.2	0.1	0.2	0.2	0.3	0.3
1.12	1800	0.3	0.2	0.1	0.1	0.2	0.2	0.7	0.9	0.7	0.2	0.2	0.1	0.1	0.2	0.3	0.3
1.18	1900	0.2	0.1	0.1	0.1	0.1	0.2	0.7	0.9	0.7	0.2	0.2	0.1	0.1	0.1	0.3	0.3
1.24	2000	0.2	0.1	0.1	0.1	0.1	0.1	0.7	0.9	0.6	0.1	0.2	0.1	0.1	0.1	0.3	0.3
1.3	2100	0.2	0.1	0.1	0.1	0.1	0.1	0.6	0.8	0.6	0.1	0.1	0.1	0.1	0.1	0.3	0.3
1.37	2200	0.2	0.1	0.1	0.1	0.1	0.1	0.6	0.7	0.6	0.1	0.1	0.1	0.1	0.1	0.2	0.2
1.43	2300	0.2	0.1	0.1	0.1	0.1	0.1	0.5	0.6	0.5	0.1	0.1	0.1	0.1	0.1	0.2	0.2
1.49	2400	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.5	0.4	0.1	0.1	0.1	0.0	0.1	0.2	0.2
1.55	2500	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.4	0.4	0.1	0.1	0.1	0.0	0.1	0.1	0.2
1.62	2600	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.4	0.1	0.1	0.1	0.0	0.1	0.1	0.1
1.68	2700	0.1	0.1	0.1	0.0	0.1	0.1	0.2	0.3	0.4	0.1	0.1	0.1	0.0	0.1	0.1	0.1
1.74	2800	0.1	0.1	0.1	0.0	0.1	0.1	0.2	0.3	0.4	0.1	0.1	0.1	0.0	0.1	0.1	0.1
1.8	2900	0.1	0.1	0.1	0.0	0.1	0.1	0.2	0.3	0.4	0.1	0.1	0.1	0.0	0.1	0.1	0.1
1.86	3000	0.1	0.1	0.1	0.0	0.1	0.1	0.2	0.3	0.4	0.1	0.1	0.1	0.0	0.1	0.1	0.1
1.93	3100	0.1	0.1	0.0	0.0	0.1	0.1	0.2	0.2	0.4	0.1	0.1	0.1	0.0	0.1	0.1	0.1
1.99	3200	0.1	0.1	0.0	0.0	0.1	0.1	0.2	0.2	0.4	0.1	0.1	0.1	0.0	0.1	0.1	0.1
2.05	3300	0.1	0.1	0.0	0.0	0.1	0.1	0.2	0.2	0.4	0.1	0.1	0.1	0.0	0.1	0.1	0.1
2.11	3400	0.1	0.1	0.0	0.0	0.1	0.1	0.2	0.2	0.4	0.1	0.1	0.1	0.0	0.1	0.1	0.1
2.17	3500	0.1	0.1	0.0	0.0	0.1	0.1	0.2	0.2	0.4	0.1	0.1	0.1	0.0	0.0	0.1	0.1
2.24	3600	0.1	0.1	0.0	0.0	0.1	0.1	0.2	0.2	0.4	0.1	0.1	0.1	0.0	0.0	0.1	0.1
2.3	3700	0.1	0.1	0.0	0.0	0.1	0.1	0.2	0.2	0.4	0.1	0.1	0.0	0.0	0.0	0.1	0.1
2.36	3800	0.1	0.1	0.0	0.0	0.1	0.1	0.2	0.2	0.4	0.1	0.1	0.0	0.0	0.0	0.1	0.1
2.42	3900	0.1	0.1	0.0	0.0	0.1	0.1	0.2	0.2	0.4	0.1	0.1	0.0	0.0	0.0	0.1	0.1
2.49	4000	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.2	0.4	0.1	0.1	0.0	0.0	0.0	0.1	0.1
2.55	4100	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.2	0.4	0.1	0.1	0.0	0.0	0.0	0.1	0.1
2.61	4200	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.2	0.4	0.1	0.1	0.0	0.0	0.0	0.1	0.1

Table 12:Annual Water Deposition in kg/(km^2-month).
Directions are directions that the plume is headed.
Note: these can be converted to inches/yr of increased precipitation by multiplying by 4.7×10^{-7}

(mi)	(m)	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.06	100	12000	8800	5800	6100	5900	8100	1800	2600	80000	14000	5400	3700	3300	4100	680	1000
0.12	200	8000	6000	2600	2700	4300	6100	1700	2500	53000	10000	2700	1900	2400	2800	550	860
0.19	300	920	650	640	520	1000	1300	1700	2500	3200	980	910	610	370	420	490	770
0.25	400	330	220	620	500	530	670	1600	2400	1100	390	870	580	190	180	460	740
0.31	500	290	190	610	490	490	630	1500	2200	980	360	840	560	150	160	380	600
0.37	600	280	180	400	320	390	490	1200	1900	850	310	560	370	140	160	320	460
0.43	700	260	170	240	190	240	270	910	1600	650	230	320	220	130	150	280	390
0.5	800	250	170	25	20	230	250	830	1500	640	230	34	33	120	140	280	390
0.56	900	200	140	25	20	200	220	810	1500	510	190	34	33	100	110	270	390
0.62	1000	190	130	25	20	190	210	580	1100	470	170	34	33	98	100	200	280
0.68	1100	190	120	25	20	180	200	170	200	470	170	34	33	96	99	75	70
0.75	1200	170	97	25	20	130	150	170	200	410	140	34	33	81	89	75	70
0.81	1300	150	87	25	20	110	130	170	200	380	130	34	33	74	83	75	70
0.87	1400	140	81	25	20	100	110	170	200	350	120	34	33	70	79	75	70
0.93	1500	140	81	25	20	100	110	170	200	350	120	34	33	70	79	75	70
0.99	1600	130	74	25	20	91	100	170	200	320	110	34	33	66	75	75	70
1.06	1700	80	42	25	20	46	50	170	200	170	57	34	33	35	45	75	70
1.12	1800	58	30	25	20	31	35	170	200	120	37	34	33	22	31	75	70
1.18	1900	49	25	25	20	26	30	170	200	110	30	34	33	18	26	75	70
1.24	2000	42	21	25	20	21	24	170	200	87	24	34	33	15	21	75	70
1.3	2100	42	21	21	15	21	24	130	160	87	24	31	28	15	21	60	56
1.37	2200	39	19	21	15	19	21	120	150	81	21	30	27	13	20	55	52
1.43	2300	30	14	21	15	15	16	100	130	66	16	30	27	10	16	47	46
1.49	2400	21	11	21	15	12	13	83	98	50	12	30	27	7	11	37	38
1.55	2500	21	11	18	13	12	13	65	76	50	12	27	24	7	11	30	31
1.62	2600	21	11	16	12	12	13	38	45	50	12	26	22	7	11	18	21
1.68	2700	21	11	12	9	12	13	37	44	50	12	20	18	7	11	17	20
1.74	2800	17	9	12	8	10	11	37	44	43	10	19	17	5	8	17	20
1.8	2900	14	8	12	8	8	10	36	43	38	8	19	17	4	7	17	20
1.86	3000	14	8	9	7	8	10	34	40	38	8	15	14	4	7	17	19
1.93	3100	14	8	7	6	8	10	28	33	38	8	12	11	4	7	14	16
1.99	3200	14	8	6	5	8	10	27	32	38	8	10	10	4	7	13	15
2.05	3300	14	8	5	5	8	10	22	27	38	8	9	9	4	7	11	13
2.11	3400	14	8	5	5	8	9	19	24	37	8	9	9	4	6	10	12
2.17	3500	11	6	5	5	6	7	19	24	32	7	9	9	3	5	10	12
2.24	3600	11	6	5	5	6	7	19	24	32	7	9	9	3	5	10	12
2.3	3700	11	6	4	4	6	7	19	24	32	7	7	7	3	5	10	12
2.36	3800	11	6	4	4	6	7	19	24	32	7	7	7	3	5	10	12
2.42	3900	11	6	4	4	6	7	18	23	32	7	7	7	3	5	9	11
2.49	4000	11	6	4	4	6	7	15	19	32	7	7	7	3	5	7	9
2.55	4100	11	6	4	4	6	7	15	19	32	7	7	7	3	5	7	9
2.61	4200	11	6	4	4	6	7	15	19	32	7	7	7	3	5	7	9

Table 13: Annual Hours/yr of Plume Shadow. Directions are directions from the tower.

(mi)	(m)	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.25	400	2037.8	2271.1	2897.1	3825.1	4616.9	4171.6	3598.3	3186.5	3036.8	3109.5	3782	4279.2	3424.3	2424.5	1952.8	1915.9
0.37	600	1501.2	1511.8	1612.4	2233.5	2864.5	2790	2733.7	2534.9	2208.9	1968.6	2026.1	2180.6	1979.3	1652.6	1500.5	1539.3
0.5	800	1221	1122.5	1107.3	1611.9	1977.3	2306.2	2260.2	2041.8	1686	1424.9	1284.1	1523.8	1312.1	1243.7	1222.4	1231.2
0.62	1000	1077.4	952	871.5	1267	1593.5	1968.6	1967.9	1725.1	1421.6	1112.5	971.2	1149.1	995.4	976.9	1002.2	1085.5
0.75	1200	924.7	831.4	736.5	1047.7	1328	1687.6	1755.7	1486	1247.3	910.8	717.1	845	766.7	835.9	854.2	962.4
0.87	1400	777.9	679.2	637.3	889.1	1139.7	1469.6	1581.9	1307.5	1080.7	745	568.5	654.8	620.3	721.1	713.8	834.4
0.99	1600	616.8	585.9	580.6	793.4	969.9	1280.1	1446.4	1179.1	908.9	604.2	483.6	546.2	488.7	619.3	621	748.4
1.12	1800	495.9	515.3	535.3	728	861.7	1133	1338.5	1054.8	782.6	485.6	429.7	474	410.5	550.7	560.3	688.4
1.24	2000	437.3	456.3	497	657.2	740.8	997.2	1222.3	949.3	690.9	404	376.5	416.6	355	487.7	500.4	612.9
1.37	2200	382.3	408.1	464.3	607.8	659.6	906	1130	827.5	613	351.3	320.1	373	310.1	447.4	458.4	529.6
1.49	2400	336.7	378.3	436.9	578	607.2	842.5	1017.6	749.4	559.2	317.2	275.7	335	274.5	403.2	388.7	480
1.62	2600	307.1	340.2	416.5	538.2	549.6	792.2	947.9	670.3	518.6	294.1	236.7	307	244.2	363.9	362.5	432.4
1.74	2800	276.9	320.5	387.3	505.7	518	735.6	886.8	616.1	486.7	279.8	216.6	274	227.1	329	346.4	394.2
1.86	3000	257.5	298	362.5	474.4	489	685.6	818.6	575.2	452.8	268.8	191.6	247.5	209.5	312.2	330.6	355.5
1.99	3200	246.9	284.7	342.4	452.7	449.3	654.6	778.8	531.9	432	252.6	175.4	219.6	196.4	285	313.5	331.3
2.11	3400	229.1	267.6	327.9	414.6	428.5	617.1	738.4	504.9	411.5	244.4	163.3	199.2	182.7	271.8	294.1	306.6
2.24	3600	219.3	252.8	318.4	375.7	411.1	573.5	695.8	486.7	388.7	235.7	154.6	183.1	171.3	260.5	279.9	285.6
2.36	3800	210.1	243	308.6	339.1	392.8	556.7	653.3	466.8	367.8	227.8	142.1	171.5	159.7	245	270.2	266.7
2.49	4000	201.2	228	301.6	314.5	383.1	542.6	631.1	444.7	347.5	213.1	137.6	157	152.1	231.9	258.5	257.4
2.61	4200	191.1	214.6	293.6	298	377.1	520.1	609.7	416.8	333.4	206.9	132.4	142.7	145.4	222	246.2	251.1
2.73	4400	178.4	204.2	283.1	280.3	371.3	495.4	579.5	404.4	323.6	201.2	126.5	128.2	140.7	214.6	238	242.7
2.86	4600	166.1	195.4	269	264.6	361.6	470.8	560.8	389	317.6	196	120.6	124.2	139.4	206.6	227.8	236.7
2.98	4800	152.1	181.1	259.6	257.7	354.2	457	550.2	374.4	298	191.3	116.1	114.3	130	196.3	218.9	220.7
3.11	5000	144.7	167.8	248.3	251.6	345.1	445.4	533.8	362.2	289	186.5	110.8	110.8	125.4	188.8	209.9	204.4
3.23	5200	134.5	158.8	236.5	239	338.2	427.9	517.8	350.5	280.5	182.3	106.2	102.3	122.4	181.9	196.3	187.9
3.36	5400	120	149.5	219.6	227.6	332.3	409.8	500.1	341.5	268.3	174.6	101.3	93.3	118.9	176.7	183.8	176.7
3.48	5600	114	141.5	211.9	223.8	324.1	400.5	487.3	328.2	254.5	171.6	100.3	88.4	117.8	172	179.7	167.7
3.6	5800	104.3	128.7	198.4	213.8	317.5	375.5	476.5	319.2	249.3	167.3	95.7	86	116.1	163.8	163.7	155.7
3.73	6000	98.3	125.8	189.9	206.6	311.6	362.2	460.5	309.8	243	156.6	92.4	82.8	111.9	158.3	160.6	145.7
3.85	6200	95.3	115.3	181.2	198.4	309.5	352.2	449.7	300.6	234.9	152.1	90.5	78.9	105.2	155.1	152.9	137.9
3.98	6400	89.3	111.3	174.7	189.3	307.3	344.2	432.5	295.7	227.4	144.5	86.1	73.1	101.5	150.1	141.9	134.9
4.1	6600	82.3	101.1	165.7	178.2	302.4	322.6	420.9	286.3	217.4	138.7	83.1	68.9	100.5	145.5	133.7	128.9
4.23	6800	76	97.9	162.3	169.5	294.9	315.1	402.5	280.3	211	135.2	82.1	66.5	99.5	139.1	131.7	121.9
4.35	7000	67	92.9	156.4	161.8	289	309.8	395.6	275.2	201.9	127.2	79	63	97.9	134.4	128.4	116.9
4.47	7200	58.9	90.9	147.6	157.4	287	301.8	385.4	262	188.4	121.3	74.8	59.9	93.6	127.1	124.4	114.9
4.6	7400	53.4	86.6	141.2	150.2	282.2	294.5	368.2	254.9	176.1	115.3	71.8	54.9	92.6	120.1	119.8	105.5
4.72	7600	44.4	83.9	135.1	146.1	277.2	287.3	360	246	168.7	110.3	68.7	52.5	87.7	113.7	109.6	97.2
4.85	7800	39.4	70.8	128.9	138.9	275.2	275.7	343	236.6	158.6	106.3	65.1	49.7	85.8	111.9	106.7	91.2
4.97	8000	35.4	60	118.4	134	270.6	266.5	333.1	225.4	151.4	101.8	62.8	48.6	79.9	110.9	99.8	81.2

Table 14: Annual Hours/yr of Fogging. Directions are directions from the tower.

(mi)	(m)	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.06	100	98	57.2	14.8	4	4.9	6	11	47.8	89.5	60.3	19.6	5.1	2.6	5.4	7.1	45.2
0.12	200	92.7	73.9	21.6	5.3	5.7	6.8	15	68.2	96.9	77.9	27.5	7.3	3.8	5	22.9	106.3
0.19	300	86.3	35.4	13.6	0.5	2.5	6.3	1.5	24.4	90.3	35.1	19	4.2	1.5	5	10.3	56.1
0.25	400	128.5	44.1	7.3	0.4	2.1	12.4	1.1	19	157.4	42	9.7	3.6	1	8	12.3	60.1
0.31	500	103.7	28	0.4	0.3	1	9.1	0	7.4	119.4	22.5	0.3	2.4	0.5	6.4	11	53.6
0.37	600	83.3	22.6	0.3	0.3	1	6.3	1.8	11.8	87.3	16	0.3	1.6	0.5	5	16.9	63.9
0.43	700	77.3	18.4	0.3	0.2	1	5.4	0	4	76.4	13.8	0.2	1.5	0.4	4.6	4.1	23.3
0.5	800	61.1	7.2	0.1	0	1	3	0	1.3	49.5	7.2	0	0.9	0.1	3.5	1.2	6.3
0.56	900	60.6	7.2	0.1	0	1	3	0	1.2	49.5	7.2	0	0.5	0.1	3.5	0.1	1.2
0.62	1000	48.8	3.8	0	0	1	1.5	0	0.7	29.4	3.9	0	0.5	0	2.7	0	0.7
0.68	1100	38	1	0	0	1	0	0	0	12	1	0	0.5	0	2	0	0
0.75	1200	38	1	0	0	1	0	0	0	12	1	0	0.5	0	2	0	0
0.81	1300	38	1	0	0	1	0	0	0	12	1	0	0.5	0	2	0	0
0.87	1400	37.6	1	0	0	1	0	0	0	12	1	0	0.5	0	2	0	0
0.93	1500	29.9	1	0	0	0.6	0	0	0	12	1	0	0.5	0	2	0	0
0.99	1600	22.8	0.9	0	0	0.4	0	0	0	10.5	0.9	0	0.5	0	1.7	0	0

Table 15: Annual Hours/yr of Rime Icing. Directions are directions from the tower.

(mi)	(m)	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.06	100	64.3	41.9	14.2	3.4	3.6	5.4	11	45.3	80.6	57.7	19.6	5.1	2.3	4	6.8	32
0.12	200	66.5	54.1	19.7	4.6	4.7	6	14.9	62.2	86.8	73.4	27.5	7.3	3.3	4	10	49.8
0.19	300	60.8	25.7	13.1	0.2	1.5	6	1.5	20.8	80.3	32.6	19	4.2	1.3	4	1.5	19
0.25	400	103	33.5	6.8	0	1.1	12	1.1	15	147.4	39.5	9.7	3.6	0.8	7	0.9	13
0.31	500	78.3	19.9	0	0	0	8.8	0	3.8	109.4	20.9	0.3	2.4	0.3	5.4	0.8	11.1
0.37	600	58	14.8	0	0	0	6	1.8	8.3	77.3	15.3	0.3	1.6	0.3	4	5.8	17.2
0.43	700	52.3	12.2	0	0	0	5.2	0	1.7	68.2	13.1	0.2	1.5	0.2	3.6	0.2	3.2
0.5	800	36.5	5.5	0	0	0	3	0	0	43	7	0	0.9	0	2.5	0	0.2
0.56	900	36.5	5.5	0	0	0	3	0	0	43	7	0	0.5	0	2.5	0	0
0.62	1000	25.5	2.7	0	0	0	1.5	0	0	25.6	3.9	0	0.5	0	1.7	0	0
0.68	1100	15	0	0	0	0	0	0	0	9	1	0	0.5	0	1	0	0
0.75	1200	15	0	0	0	0	0	0	0	9	1	0	0.5	0	1	0	0
0.81	1300	15	0	0	0	0	0	0	0	9	1	0	0.5	0	1	0	0
0.87	1400	14.6	0	0	0	0	0	0	0	9	1	0	0.5	0	1	0	0
0.93	1500	14.5	0	0	0	0	0	0	0	9	1	0	0.5	0	1	0	0
0.99	1600	12.7	0	0	0	0	0	0	0	7.8	0.9	0	0.5	0	0.9	0	0

8.3 CONCLUSIONS

A summary of Plume lengths is presented in Table 16. Figure 1 indicates distances of 1 and 2 miles from the site to assist with visualizing the impact of these plumes. In most cases, the plumes tend to lie either towards the North (over the Squaw Creek Reservoir or undeveloped shoreline) or to the South (over the approach to the existing units).

Table 16:Visible Plume Length Summary

	Winter	Spring	Summer	Fall
Most Frequent Plume Heading Directions	N,NNW,SSE,S	N,NNW,NW	N,NNW,NW	N,NNW,NW,S
Percent of Plumes < 1/3 miles	33.4	60.0	79.0	56.4
Percent of Plumes >1/3 to 2/3 mile	3.5	2.8	2.0	2.8
Percent of Plumes >2/3 to 5 miles	23.7	18.3	11.4	18.6
Percent of Plumes >5 Miles	38.8	18.6	7.2	21.3

Estimates of deposits and shading from the plumes are given in Tables 9 through 13. Fogging and icing estimates are given in Tables 14 and 15. While fogging and icing may occur infrequently out as far as a mile, their occurrence is predicted to be limited to lake surface or undeveloped shoreline.

9. Companion CD files

Met Data

- 2001.xls, 2002.xls, 2003.xls, 2004.xls, 2005.xls, 2006.xls - Mineral Wells NWS data
- mw2001.xls, mw2002.xls, mw2003.xls, mw2004.xls, mw2005.xls, mw2006.xls - Mineral Wells NWS data manipulated as described in Section 5.2
- CPSES 2001.xls, CPSES 2002.xls, CPSES 2003.xls, CPSES 2004.xls, CPSES 2005.xls, CPSES 2006.xls - Comanche Peak site met tower data
- cp2001.xls, cp2002.xls, cp2003.xls, cp2004.xls, cp2005.xls, cp2006.xls - Comanche Peak site and Mineral Wells NWS data manipulated as described in Section 5.2
- cpMet.txt - final combine met data used by SACTI programs
- Stephenville Mixing Height.xls - mixing height data from Stephenville Airport
- cpMixHt.xls conversion of Stephenville Mixing Heights into desired format
- cpMixHt.txt - final daily mixing height file used by SACTI program

SACTI files

- prep.usr - preparation file that analyses met data
- multTDS.doc, multNa.doc, multCl.doc - input files with cooling tower specifics
- tables.usr - defines tables to be produced
- TableTDS.doc, TablesNA.doc, TablesCl.doc - output files, which differ only in chemistry compounds to be highlighted in deposition rates
- cpResults.xls - Excel file that creates Tables 4 through 16 from the output files

ATTACHMENT 1

MISCELLANEOUS DATA SOURCES

Text of Reference 2.11 12/12/07 2:07 pm email, Morris to Berger

Ralph,
Lower CPNPP met tower instrumentation is at 10 meters. The Mineral Wells AP instrumentation seems to be at 40 feet. CPNPP met tower wind speed is in mph.

Marvin Morris
ENERCON Services, Inc.

678-797-5029

Text of Reference 2.11 11/29/07 1:37 pm email, Morris to Berger

Ralph,
I have the CPSES met data for 2001-2006 which is what I'm using for the X/Q's. I also have local mixing height data for Stephenville, Tx (1984-1985, 1987-1990). I'm also using data from the Mineral Wells airport (closest first order station) and have this data for 2001-2006 to match the CPSES data. However, as you're aware the airport data does not have mixing height data (hence the Stephenville data). So, I should have all the met data you need. I'll post this data in the e-room.

Marvin Morris
ENERCON Services, Inc.

678-797-5029