USER'S MANUAL: COOLING-TOWER-PLUME PREDICTION CODE (Revision 1)

A computerized methodology for predicting seasonal/annual impacts of visible plumes, drift, fogging, icing, and shadowing from single and multiple sources

---

Research Project 906-1

Prepared by

Engineering and Environmental Science
1711 Lincoln Road
Champaign, Illinois 61821

Principal Investigators

W. E. Dunn
L. Coke
A. J. Policastro

Prepared for

Electric Power Research Institute
3412 Hillview Avenue
Palo Alto, California 94304

EPRI Project Manager
J. A. Bartz
Heat, Waste, and Water Management Program
Coal Combustion System Division

September 1987

ABSTRACT

This report presents an updated user's guide to a mathematical model for the prediction of the seasonal/annual physical impacts of cooling tower plumes, drift, fogging, icing, and shadowing. The model is aimed at providing predictions that may be used in the licensing of power plants with cooling towers. The submodels for these physical impacts provide improvements in theory and performance compared to existing methods. Validation with field and laboratory data has been done in all situations where good quality data exist. The seasonal/annual methodology employs a technique which reduces the available meterological record at a site to approximately 30-100 categories. The plume submodels are then run once for a representative of each category and results are summed up to provide predictions for a season or a year.

The model allows the treatment of any number of natural- or mechanical-draft cooling towers in any geometric orientation. The model is easy to use and requires a minimal amount of user input. It is set up to run with a TDF-14 or CD-144 ground-level meteorological tape or standard NRC meteorological tape. The model encompasses four computer codes in which the output of one is the input for the next. In this way, intermediate output which may be informative is saved and may be examined. The use of a sequence of four codes permits more flexibility to the user allowing him the opportunity to better define the type and scale of printed output he wishes.

This user's guide describes changes made to the April 1984 version of the model. It also provides a complete discussion of model inputs and outputs for this version of the computer code. Also, in this manual, the model is applied in two case studies, one for a site with three nearly colinear natural-draft cooling towers, and the other for a site with two linear mechanical-draft cooling towers oriented parallel to each other. Input and output to the codes are presented and described.

ACKNOWLEDGMENTS

The authors of this report would like to extend their appreciation to the many users of the April 1984 version of the SACTI code for their helpful comments on the model and computer code. This new version of the code is mainly the result of implementing their suggestions for a more user-friendly input and output environment.

In addition, we would like to thank Mr. John Bartz for his continued support and encouragement as technical monitor for this project. His comments and suggestions on enhancing the usefulness of our work to the utility industry and others were very helpful.

CONTENTS

(Note: Page “x” is blank)

ILLUSTRATIONS

TABLES

SUMMARY AND CONCLUSIONS

An updated user's manual is presented for the prediction of the seasonal/annual impacts of cooling tower plumes, salt-drift deposition, plume fogging, icing, and shadowing. The earlier version of the user's manual (EPRI CS-3403-CCM) presented new computer codes for

(a) plume shadowing, fogging and icing, and

(b) a computerized methodology for the prediction of long-term physical impacts of natural- and mechanical-draft cooling towers on a seasonal (spring, summer, winter, fall) or annual basis. These impacts are vapor plume persistence, drift deposition, fogging, icing, and shadowing.

Predictions of plume impacts on a seasonal/annual basis are often required for the licensing of power plants with cooling towers. This revised user's manual includes changes made to the computer codes based upon feedback on experience in applying the model to practical problems. Comments on the model were provided by the users of the model as well as the model developers themselves. Changes to the computer code were made largely to enhance the user-friendliness of the codes in terms of input and to allow the user greater flexibility in applying the model. A summary of the capabilities of the model follow.

The seasonal/annual methodology used in the model has evolved from earlier methods. Most other techniques apply a very simple plume and drift model on an hour-by-hour basis to obtain predictions over a season or year. With the hour-by-hour method, the plume and drift models must be overly simplified in order to hold computational resource requirements within reasonable bounds. A far more efficient methodology is based on the realization that only a relative small number (perhaps 35) of truly distinct plumes can be identified at any given site. Thus, the most cost effective approach to the problem of making seasonal/annual impact predictions is to first identify the different categories of plumes which may be expected and then use the most reliable plume and drift models to predict potential impacts for each of these categories. Various types of seasonal/annual averages may then be computed using the predicted plume and drift behaviors for each category and a tabulation of the frequency of occurrence of each category during the season or year of interest. A major component of the category scheme methodology concerns the systematic identification of representative plume categories, since such categories vary with tower characteristics and the prevailing meteorology of the site. The method is based on the use of key nondimensional variables as indicators of relative plume length. For multiple-source configurations, the concept of representative wind directions is introduced so that the effects of local geometry (orientation of towers to wind directions) can also be included in a cost effective manner. In this approach, each of the 16 traditional wind directions is associated with one of those typically 3 to 5 representative directions. Treatment of the very complex configurations typical of current designs is easily handled in this manner.

The theory and performance of the plume and drift model used in the seasonal/annual methodology is described in detail in EPRI CS-1683. The plume model is of integral type and accounts for plume merging in a way that treats the trajectories of each plume separately and accounts for their relative orientation at the time of merging. Tower wake effects are also included. The drift model has a treatment of evaporation consistent with observational data which leads to a different final state of a droplet: a porous particle instead of the commonly assumed solid crystalline particle.

Ground-level fogging and icing are predicted for mechanical-draft cooling towers. Fogging is assumed to occur when the visible plume strikes the ground. Icing occurs when the visible plume strikes the ground under freezing conditions. Ten additional categories of environmental conditions have been chosen to represent the fogging/icing cases. The effect of wind direction is also considered in determining the fogging/icing patterns.

The computation of plume shadowing is done on an hour-by-hour basis to correctly account for the position of the sun in the sky and its effect on shadow location. The characteristics of the plume category representative of each hour are used in place of a separate calculation for each hour individually.

This report serves as an updated user's guide to the four FORTRAN computer programs which together permit seasonal/annual predictions to be made. These four codes and their respective roles in the overall scheme may be summarized as follows.

PREPROCESSOR PROGRAM -	reads data tapes, eliminates unusable records, adds tower exit conditions to each valid record, calculates key nondimensional variables for each valid record, produces enhanced database, determined plume categories, and generates representative cases for each category.
PLUME PROGRAM -	determines plume and drift predictions for representative cases for each plume category.
TABLES PROGRAM -	uses enhanced data base and predictions of PLUME program to produce tables of predicted impact by distance and wind direction for specified season(s).
PAGEPLOT PROGRAM -	generates line printer "plots" of tables produced by TABLES program.

Two case studies are presented as examples of the use of the model. The first involves two linear mechanical-draft cooling towers patterned after the Gaston Plant in Alabama. The second case study is for three natural-draft towers in the orientation at the Amos Plant in West Virginia. The meteorology for Chicago O'Hare International Airport was chosen in order to encounter sufficiently cold conditions to illustrate fogging and icing.

The model and associated computer codes may be obtained from the Electric Power Research Institute. The model is identified as SACTI (Seasonal/Annual Cooling Tower Impacts model).

Section 1

INTRODUCTION

The design and licensing of nuclear and fossil-fueled electric generating stations in the U.S. require that an assessment of the potential environmental impact be made. The normal first step in the assessment process is for the utility or their consultant to prepare a detailed Environmental Report which sets forth the physical and ecological features of the site, gives the design parameters of the station and presents an assessment of the environmental acceptability of the proposed plant along with that of several alternative designs or sites. The Federal or State licensing agency then reviews the Environmental Report, conducts an independent assessment and issues an Environmental Impact Statment which includes its findings and recommendations concerning the station.

Nearly every Environmental Report and Environmental Impact Statement must consider cooling towers either as the proposed cooling system or as a reasonable alternative. The potential adverse impacts of cooling towers which are often considered include:

(a) aesthetic impact of the visible plume,

(b) deposition of cooling tower drift releases (small droplets of liquid water often containing high concentrations of dissolved or suspended solids),

(c) ground-level fogging and icing,

(d) shadowing by the plume,

(e) ground-level temperature and humidity increases, and

(f) noise.

Except for noise, all of these impacts are dependent on the dispersion of the cooling tower plume and, thus, prediction of the plume has become the primary consideration in preparing environmental assessments of the cooling towers. These effects are local to the towers environs (say within 10 km radius).

Long range effects (e.g. cloud or storm generation) are generally treated qualitatively.

Some of the above local environmental impacts depend on the average behavior of the plume. For example, the effect on the crop yield of a particular field may well depend on the reduction of sunshine during the growing season. Similarly, the effects of drift deposition are believed to correlate with total integrated exposure. In other cases, the impact depends on "worst case" behavior. For example, the impact on a resort area may well depend on the small frequency of unusually severe cases. Moreover, decision makers most often prefer quantitative estimates to subjective descriptions such as "light," "moderate," or "heavy." Thus, the assessment methodology must provide reliable numerical predictions of both average and worst-case behaviors.

The basics of an improved theory relating to the prediction of items (a)-(d) were presented in a user's guide for the associated computer programs. That user's guide is identified as Ref. 1 below and was published in April 1984. That work was an outgrowth of an earlier model evaluation study (2-4) carried out by the present authors in 1976-1978 and an EPRI-sponsored model improvement effort (5-10) completed during 1979-1980. Subsequent to the publication of the user's manual, changes were made to the computer codes based upon feedback of users on their experience in applying the model to practical problems. Comments on the model were provided by the model developers as well as outside users.

Changes to the computer code were made largely to enhance the user friendliness of the codes in terms of input and to allow the user with greater flexibility in applying the model. A summary of these changes is listed below:

1. Upwards Compatability

Careful consideration was given to maintaining upwards compatability. There were no changes made that affected predictions in a way that significant differences occurred from the earlier version of the codes. The most significant difference is that the new version predicts slightly shorter visible plumes in some cases.

The two test cases provided with the code use the same geometry and input cards as before, except that FORTRAN 77 expects additional file name information. The meteorological tape is now in CD-144 format instead of TDF-14, and the time period of the runs now represents a full year period (different from the original). Also, the linear mechanical-draft test case now uses a mixing height tape input to illustrate that user option, whereas in the earlier version, neither test case demonstrated that feature. The natural-draft cooling tower test case is intended to be the first simple test attempted by the user; it therefore employs a constant mixing height differing only slightly from the sample case provided earlier. The new mixing height value used is more consistent with the seasonal/annual methodology because it represents the value for non-precipitation cases rather than all cases.

2. Source Code Transportability

All codes are now ANSI FORTRAN 77 compatible. FORTRAN 77 specific code lines are identified in columns 73-80 so that the codes can easily be made FORTRAN IV compatible once these lines are deleted. If ever substitution is required, the FORTRAN IV replacement lines are contained as comments.

Code compatibility has been improved for both FORTRAN 77 and FORTRAN IV applications. Compatibility validation has been performed on the following systems:

(a) IBM CMS/MVS using the FORTG1, FORTHX, FORTHXE, and FORTVS compilers, and the WATFIV compiler,

(b) DEC VAX/VMS FORTRAN compiler,

(c) Ridge UNIX f77 compiler, and

(d) MSDOS (IBM PC/XT/AT compatables) Lahey FORTRAN 77 compiler.

3. Test Case Transportability

A new test case is provided to help users install and validate the system of computer codes. Based on user feedback, the TDF-14 meterological tape used in the previous test case created complications due to its record structure and non-ASCII special characters. The test case now uses a CD-144 tape which has card-image format and uses only standard ASCII characters. An additional advantage is that the size of the data file has been trimmed to exactly the time duration of the test case, saving more than two megabytes of storage.

4. General Code Improvements

FORTRAN 77 data file support was added to each code. Version dates were added for identification of code changes. Better documentation was included to clarify user input card formats. Some system specific code statements were revised to meet ANSI portability requirements. All known bugs were fixed. The format of WRITE statements for the user standard print output was modified where required to limit the maximum line length to 128 characters maximum. This change was made in response to user problems on systems that do not support the previous maximum of 132 characters. All format strings were converted from Hollerith to quote format in keeping with current standards.

5. Specific Code Improvements and Bug Fixes

A. PREPROCESSOR

A system-independent FORTRAN 77 algorithm was added to the TDF-14 tape input routine for decoding the special characters. Internal documentation was added to help programmers handle the special character set in FORTRAN IV environments. Several coding options were provided as comment lines for dealing with various machines. Direct access support was also added.

The MIXHT routine was modified to give the appropriate message and error exit when a sychronization or end of file problem occurs. The previous search algorithm worked only when the first record was synchronized with the meteorological tape record time, and also failed to report end-of-file error conditions in some cases.

Some variable initialization problems were fixed to insure variables were set to zero. The earlier version could sometimes erroneously flag the first meteorological tape record as a bad record; this problem could possibly occur on systems that do not automatically initialize data to zero.

Coding logic has been added to prevent generation of a saturated ambient environment as a representation of a plume category. Avoidance of exact equality of dew point and dry bulb was done by slightly perturbing the dry bulb and dew point temperatures when they were chosen to be the same.

B. PLUME Code

A more efficient visible radius routine, VEDGE, was implemented in the PLUME code to correct a bug which occasionally caused a false zero to be returned.

An enhancement was added to permit better user-control of wake-related modeling options through the NUSER variable. The code section for plates was revised to support this new feature.

The source radius may now be changed between the PREPROCESSOR and PLUME code; previously the value was fixed. This option for changing that radius may be exercised for sites where sources are widely separated.

Improvements were made to optimize array storage and eliminate unnecessary arrays so that the code requires less overhead. The new version requires approximately 512K storage and can be run on microcomputers.

Coding statements were added to guard against unusual numerical conditions (e.g. square root of negative values), which could possibly result under extreme physical conditions or unusual geometry.

The handling of integrator stiffness problems due to merging of many plumes and various extreme conditions was improved by additional code checks at critical points. A warning message and appropriate logic are now provided; a stiffness condition no longer stops execution.

Code cleanup eliminated some variables and arrays and produced modest improvement in execution time.

C. TABLES and PAGEPLOT Programs

Only minor changes and modifications for compatibility and transportability were required.

This user's manual is written as an update to the earlier manual. It was prepared as a self-contained document for the user; however, the theoretical discussion appearing in Section 2 of the earlier user's manual was not repeated here. That discussion remains valid and the user is encouraged to acquire a copy of that earlier manual (1) for a discussion of the theory. The model is denoted as SACTI (Seasonal/Annual Cooling Tower Impacts model) and may be obtained by contacting Mr. John Bartz of the Electric Power Research Institute.

REFERENCES

1. A. J. Policastro, L. Coke, M. Wastag, W. Dunn, P. Gavin, B. Boughton, and R. A. Carhart. User's Manual: Cooling-Tower-Plume Prediction Code. Argonne National Laboratory, University of Illinois at Urbana, and University of Illinois at Chicago. EPRI Report No. EPRI CS-3403-CCM. April 1984.

2. A. J. Policastro, R. A. Carhart, S. E. Ziemer, K. Haake. Evaluation of Mathematical Models for Characterizing Plume Behavior from Cooling Towers. Vol. 1. Dispersion from Single and Multiple Source Natural Draft Cooling Towers. Division of Environmental Impact Studies. Argonne National Laboratory. U.S. Nuclear Regulatory Commision Report NUREG/CR-1581. June 1979.

3. A. J. Policastro, W. E. Dunn, M. L. Breig, J. P. Ziebarth. Evaluation of Mathematical Models for Characterizing Plume Behavior from Cooling Towers. Vol. 2. Salt Drift Deposition from Natural Draft Cooling Towers. Division of Environmental Impact Studies. Argonne National Laboratory, U.S. Nuclear Regulatory Commission Report NUREG/CR-1581. February 1979.

4. W. E. Dunn, G. K. Cooper, and P. M. Gavin. Evaluation of Mathematical Models for Characterizing Plume Behavior From Cooling Towers. Vol. 3. Plume Rise from Mechanical Draft Cooling Towers. Division of Environmental Impact Studies. Argonne National Laboratory. U.S. Nuclear Regulatory Commision Report NUREG/CR-1581. December 1979.

5. A. J. Policastro, W. Dunn, and R. Carhart. Studies on Mathematical Models for Characterizing Plume and Drift Behavior From Cooling Towers. Executive Summary. EPRI Report No. EPRI CS-1683. April 1981.

6. A. J. Policastro and M. Wastag. Studies on Mathematical Models for Characterizing Plume and Drift Behavior From Cooling Towers. Vol. 1. Mathematical Model for Single Source (Single-Tower) Cooling Tower Plume Dispersion. EPRI Report No. EPRI CS-1683. Volume 1. January 1981.

7. R. A. Carhart, A. J. Policastro, S. Ziemer, K. Haake, and W. Dunn. Studies on Mathematical Models for Characterizing Plume and Drift Behavior From Cooling Towers Vol. 2. Mathematical Model for Single-Source (Single Tower) Cooling Tower Plume Dispersion. EPRI Report No. EPRI CS-1683. Volume 2. January 1981.

8. W. E. Dunn, P. Gavin, B. Boughton, A. J. Policastro, and J. Ziebarth. Studies on Mathematical Models for Characterizing Plume and Drift Behavior From Cooling Towers. Volume 3. Mathematical Models for Single-Source (Single-Tower) Cooling Tower Plume Dispersion. EPRI Report No. EPRI CS-1683. Volume 3. January 1981.

9. A. J. Policastro, R. A. Carhart and M. Wastag. Studies on Mathematical Models for Characterizing Plume and Drift Behavior From Cooling Towers. Volume 4. Mathematical Models for Multiple-Source (Multiple-Tower) Cooling Tower Plume Dispersion. EPRI Report No. EPRI CS-1683. Volume 4. January 1981.

10. A. J. Policastro, W. E. Dunn, M. Breig, and K. Haake. Studies on Mathematical Models for Characterizing Plume and Drift Behavior From Cooling Towers. Volume 5. Mathematical Models for Multiple-Source (Multiple-Tower) Cooling Tower Plume Dispersion. EPRI Report No. EPRI CS-1683. Volume 5. January 1981.

Section 2

SEASONAL/ANNUAL COOLING TOWER IMPACT CODES PROGRAM INPUTS AND OUTPUTS

This section contains a description of the inputs and outputs for each of the Seasonal/Annual Cooling Tower Impact codes.

THE PREPROCESSOR CODE

The PREPROCESSOR Code is the first program that is run in the seasonal/annual prediction system. It is basically what its name implies, a code that processes (prepares) raw data into a form that will be appropriate for the rest of the system. The code was written with two major purposes in mind:

(1) to read a site-specific meteorological tape only once within the entire system in order to minimize computer input and output, and

(2) to create as much output data at an early stage as possible so that the user can make decisions to minimize effort and cost in executing the remaining programs in the system package.

A brief outline of the basic functions of the PREPROCESSOR Code follows:

(a) read through a tape consisting of hourly meteorological observations,

(b) discard any tape records if the data are invalid or missing,

(c) select parameters from each tape record necessary for the remaining codes,

(d) calculate other (derived) parameters internally necessary for the remaining codes,

(e) compute cooling tower exit conditions for each hourly record,

(f) create an output disk or tape file in binary format of the information needed for the system from the tape records,

(g) create typical plume cases that will represent standard weather conditions based on a statistical analysis of site meteorology obtained from the tape,

(h) create representative fogging cases for those categories which are represented at this site,

(i) produce frequency tables and statistics of basic meteorological parameters, and

(j) output most of this information to a printer.

INPUT

The execution of the PREPROCESSOR requires the user to supply two sets of data into the input stream. The user must provide (a) a meteorological tape which consists of hourly surface or meteorological tower observations for at least one year, and (b) input control parameters that set up and determine the flow of the program with respect to user selected options.

The PREPROCESSOR code is capable of handling any of three standard weather tapes: CD-144, TDF-14 and NRC Format. Two of the three tapes are produced by the National Climatic Center in Asheville, North Carolina. These tapes, the CD-144 and the TDF-14, contain basically the same Weather Service information, but their format structures are somewhat different. The CD-144 tape was designed to simulate a punched card deck (80 characters per record), which was the only method for organizing and archiving weather data at one time. The CD-144 tape was set up to retain this format and to serve as a convenient form for transferring older Weather Service records from cards to tape. Later, a new tape format was incorporated to handle the increase in data recorder for each weather observations. This tape, the TDF-14, is similar to the CD-144 tape, but with a more compact structure.

If the proposed plant is a nuclear plant, applicants (utilities) are expected to furnish their own meteorological data tape to the Nuclear Regulatory Commission in NRC standard form. The Preprocessor can accept this tape if it is in the format recommended by the NRC. The format was designed to provide concise meteorological data needed to estimate potential radiation doses, as well as to aid in the site assessment and licensing of nuclear power plants. There are fewer variables per record compared to the CD-144 and TDF-14 tapes, but these variables are largely those most useful for this system of codes. (The CD-144 and TDF-14 tapes contain much data that is not relevant for the code.)

The user must provide the tape characteristics, i.e., blocksize, record length, and record format. The meteorological tape should be set up to be read under file 1. The user also needs to input information to the PREPROCESSOR through file 5. The information consists of four card image records.

Program Name:	PREPROCESSOR
Format:	Standard FORTRAN card format, ANSI X3.9-1978 (FORTRAN 77) compatible. The source code is also mostly compatible with ANSI X3.9-1966 (FORTRAN IV) except for limited input/output and character data features. Source lines unique to FORTRAN 77 are marked by the text F77 in the sequence columns 73-80. These lines can be deleted to make the source code FORTRAN IV compatible; alternative FORTRAN IV code is provided in comment statements where substitution is required.
Source Code Length:	1934 FORTRAN source records plus 1129 comment cards for 3063 total.
Runtime Memory Requirements:	Approximately 162,000 bytes (Compiler dependent)
Input Files:	File 1 (FT01F001)--Meteorological Tape File 5 (FT05F001)--User prepared
Output Files:	File 2 (FT02F001)--Intended to be disk file for use by TABLES in Seasonal/Annual system File 3 (FT-3F001)--Intended to be disk file for use by PLUME MODEL in Seasonal/Annual system File 4 (FT04F001)--Intended to be disk file for use by TABLES in Seasonal/Annual system

File 6 (FT06F001)--Intended to be PRINTER

Card Image User Input: File 5

CARD 1

NAME	FORMAT	DESCRIPTION
ITITLE	80A1	An 80 character title for the case study to identify output. This title will be put at the top of every printed page of output through file 6.

CARD 2

NAME	FORMAT	DESCRIPTION
ISTOP	I6	Indicator to stop processing tape records after ISTOP records. If ISTOP = 0, then process all the records read in.
ISKIP	I6	Increment for processing tape records: 1 = Every record will be processed N = Every Nth record will be processed.
IOUT	I2	Output control ... The code always prints the user input data and the frequency tables, but the list of records can be suppressed. 00 = Full listing 01 = Suppress records from printing.
IMIX	I2	Mixing height indicator: 01 = Single value used for all records which will be input in following card 02 = Bi-daily mixing height tape will be used and read in under File 11.

IUR	I2	Mixing height control switch: 01 = Rural mixing height will be used 02 = Urban mixing height will be used
IWIND	I2	Stability class computation preference switch (applicable only to NRC tape): 01 = Sigma Theta method 02 = Delta-T method.
NFOG	I2	Switch for fogging/icing calculations: 00 = No fogging/icing calculations 01 = Calculate fogging/icing.
NDRIFT	I2	Switch for drift calculations: 00 = No drift calculations 01 = Calculate drift.
ITOWER	I2	Type of tower: 01 = Natural draft. 02 = Circular mechanical 03 = Linear mechanical
ITAPE	I2	Type of tape: 01 = CD-144 02 = NRC 03 = TDF-14
IZONE	I2	Time zone of site: 05 = Eastern 06 = Central 07 = Mountain 08 = Pacific.

CARD 3

NAME	FORMAT	DESCRIPTION
ALAT	F10.5	Site latitude in degrees north latitude.
ALONG	F10.5	Site longitude in degrees west longitude.
ROUGHT	F10.5	Roughness height (cm).
HREF	F10.5	Reference height of met data (m).
HTMIX	F10.5	(Applicable only when IMIX = 1). This value will be used as the mixing height for all records.
HTERR	F10.5	Reference height for terrain modification.

CARD 4

NAME	FORMAT	DESCRIPTION
TWRHT	F10.5	Height of tower (m).
TWRDM	F10.5	Tower effective diameter (m)
TWRHE	F10.5	Total heat dissipation rate (MW).
TWRAF	F10.5	Input airflow rate (kg/s).

CARD 5

NAME	FORMAT	DESCRIPTION
CKT	12F3.2	Monthly clearness index (See Appendix B; 12 values are needed.)

CARD 6

NAME	FORMAT	DESCRIPTION
HAVG	12F5.2	Total average daily solar insolation for each month. (See Appendix B; 12 values are needed.)

CARD 7 (used with FORTRAN 77 only)

NAME	FORMAT	DESCRIPTION
FNAME	(A32)	File name of user's surface tape data as fits the operating system convention.
IFORM	(I2)	Surface data format, 0 = sequential, 1 = direct access. This flat is useful if system copy utilities were used to convert to tape to a direct access disk file.

CARD 8 (used with FORTRAN 77 only)

NAME	FORMAT	DESCRIPTION
FNAME	(A32)	File name of internal data file to be used eventually by the TABLES program.

CARD 9 (used with FORTRAN 77 only)

NAME	FORMAT	DESCRIPTION
FNAME	(A32)	File name of plume category data for eventual use by the PLUME code.

CARD 10 (used with FORTRAN 77 only)

NAME	FORMAT	DESCRIPTION
FNAME	(A32)	File name of internal binary data for eventual use by the TABLES code.

CARD 11 (used with FORTRAN 77 only)

NAME	FORMAT	DESCRIPTION
FNAME	(A32)	File name of standard print output.

CARD 12 (used with FORTRAN 77 only)

NAME	FORMAT	DESCRIPTION
FNAME	(A32)	File name of optional mixing height tape.

By setting IMIX=2, the user may choose to supply a TD-9689 bi-daily mixing height tape, available from the National Climatic Center. The TD-9689 tape contains daily records of morning and afternoon mixing heights.

The code calculates hourly mixing heights from the twice-daily mixing heights by an interpolation scheme involving the previous day's mixing height and the following day's mixing height. The year(s) on this tape do not have to match the year(s) on the weather tape. Only the Julian dates will be checked and matched. The user must insure that dates and hours for the mixing height tape records match with those on the corresponding surface tape. Otherwise (if IMIX = 2 is selected) the PREPROCESSOR will terminate abnormally.

OUTPUT

Printer File 6

The PREPROCESSOR Code sends every valid meteorological record to the printer, through unit 6, as a user option. If the meteorological record is discarded by the code because of a missing or invalid piece of data, a message is printed simply stating that the record is bad. No indication of what is in the record was bad or why it was unsuitable will be given. An explanation of the printed variables is given at the end of this section.

Frequency distribution tables of certain variables as a function of wind direction are computed and printed after the listing of meteorological records. The wind direction field is divided into 16 sectors with each sector equal to 22.5 degrees. North is set to 0 degrees, so if the wind direction is within 11.25 degrees of 0, the wind direction for the meteorological record is considered to be from the north. Every variable frequency range is summed over 16 wind sectors and listed in the last column of the table. The last column (labeled SUM), when added down will give a total of 1.0. It should be noted that this column is a summation and not an average over wind directions.

At the end of every table except the first one, there is a short list of basic statistics for that table. The method of moments was applied to these statistics in order to minimize computation time. These statistics were added to help the user assess the data and aid in the analysis of the site under study. All of the tables are self-explanatory except for the last table: Plume length/K/Stability Frequency Table. The stability categories in the table are:

Pasquill Stability Class	Stability Category Number
A	1
B	1
C	1
D	2
E	2
F	3
G	3

The K (ratio of wind speed at averaging height to plume exit velocity) categories are:

K-Range	Category
0.0 - 1.0	1
1.0 - 2.0	2
2.0 - Over	3

The averaging height for the determination of K is 300 m for NDCTs, 200 m for CMDCTs and 150 m for LMDCTs.

Disk or Tape File 2

A binary file of all valid processed meteorological records is written through unit 2 to an output device specified by the user.

This output is usually a disk or tape. The writing is done by means of an unformatted WRITE statement. It is not appropriate to set unit 2 to be a card punch or a line printer. There is no need to examine this file once it has been created. In fact, there is no way to view this file since it is represented in essentially the same form as it is represented within the computer. The only thing that can easily be done with this file is to read it back in for later program steps in the system.

The primary advantage of this method of writing is speed within the computer. The internal steps that must be taken to format information according to the description in a FORMAT statement require considerable time. Since PREPROCESSOR handles a large quantity of data, the difference in computer time is definitely appreciable.

The data written to this binary file are:

NAME	DESCRIPTION
IREC	Record number
IYEAR	Year
IMONTH	Month
IDAY	Day
JD	Julian date
IHOUR	Hour (24-hour clock)
ILBIN	Length parameter-bin index
IKBIN	K-bin index
ISTBIN	Stablity class bin index

IWBIN	Wind speed bin index
IFCAT	Fogging category number
WD	Wind direction (degrees E of N)
V	Ratio of initial plume excess temperature to temperature excess at end of the visible plume
FR	Initial densimetric Froude number
HLH	Mixing height (m)
HDBEAM	Beam component of solar insolation for hour (mj/m2)
HDTOT	Total solar insolation for hour (mj/m2)
DD	Hours attributable to current record (normally)
THETA	Solar altitude in degrees: measured as angle of a vector from ground to sun above horizontal
PHI	Solar azimuth in degrees: measured as angle of a vector from ground to sun clockwise from south
FK	Ratio of wind speed at averaging height to plume exit velocity
PL	Plume length parameter
PH	Plume height parameter

The next sections present the input/output for the PLUME model, the TABLES program, and the PAGEPLOT routine.

THE PLUME MODEL

Program Name: PLUMEMODEL

Format: Standard FORTRAN card format, ANSI X3.9-1978 (FORTRAN 77) compatible. The source code is also mostly compatible with ANSI X3.9-1966 (FORTRAN IV) except for limited input/output and character data features. Source lines unique to FORTRAN 77 are marked by the text F77 in the sequence columns 73-80. These lines can be deleted to make the source code FORTRAN IV compatible; alternative FORTRAN IV code is provided in comment statements where substitution is required.

Source Code Length: 3411 FORTRAN source records plus 3381 comment cards for 6792 total.

Runtime Memory Requirements: Approximately 370,000 bytes (Compiler depende

Input Files: File 3 (FT03F001) -- Produced by PREPROCESSOR Seasonal/Annual system
File 5 (FT05F001) -- User prepared

Output Files: File 6 (FT06F001) -- Intended to be PRINTER
File 8 (FT08F001) -- Intended to be disk file for use by TABLES in Seasonal/Annual system.

Card Image User Input: File 5

CARD N1 (used with FORTRAN 77 only)

NAME	FORMAT	DESCRIPTION
FNAME	(A32)	File name of unit 3 plume category data as created the PREPROCESSOR program.

CARD N2 (used with FORTRAN 77 only)

NAME	FORMAT	DESCRIPTION
FNAME	(A32)	File name for standard print output

CARD N3 (used with FORTRAN 77 only)

NAME	FORMAT	DESCRIPTION
FNAME	(A32)	File name of plume and drift data for eventual use by the TABLES code.

CARD 1

NAME	FORMAT	DESCRIPTION
ALABEL	20A4	General heading for all cases

CARD 2

NAME	FORMAT	DESCRIPTION
IOUT	I3	Output control switch (Printer) 0 = Only label and input constants 1 = Plume variables, but no tower conditions 2 = Plume variables and tower conditions
NFOG	I3	Number of fogging/icing cases 0 = do not run any fogging cases, even if they have been generated by PREPROCESSOR ≠ 0 run fogging cases
NDRIFT	I3	Number of drift cases 0 = do not run drift with any case, but run plume dispersion for all non-fogging/icing cases. NCAT (≠0) run the standard category cases (NCAT is the total number of categories selected by the PREPROCESSOR).

NSHADW	I3	NCAT ≠ 0 run the standard category cases (NCAT is the total number of categories selected by the PREPROCESSOR)
NFRAD	I3	Number of fogging/icing radials to be read in. (If zero is chosen and NFOG >0, a default of 16 occurs.)
SMAXP	F10.1	Maximum distance (m) for plume and/or drift calculations to be made
SMAXF	F10.1	Maximum distance (m) for fogging calculations to be made (default is 1600)
NPORTS	I3	Number of source output ports (cells).
NUSER	I3	Number of user-specified plates for wake entrainment. A value of 0 defaults to the standard values based upon the tower type. If non-zero, the user assumes responsibility for computing all plate parameters and supplying the proper additional input cards according to the formats in the user's plate section of the code.
NTWRS	I3	Number of tower housings (leave blank for NDCT).
ISOURC	I3	Option control switch for effective source mode 000 = Multiple ports 001 = Effective source mode
NEXPL	I3	Number of external plates for direct user input

CARDS 3 THROUGH (AT MOST 19)

(All omitted if NFRAD = 0; radial limit is 50)

NAME	FORMAT	DESCRIPTION
RAD(1)	F10.2	First radial distance for fogging (m)
.		
.		
.		
RAD(8)	F10.2	Eighth radial distance (m)
.		
.		
.		

etc., 8 values per card for as many cards as needed to specify NFRAD values. If NFRAD = 0, then no cards of this type are read and the RAD array is set by default to 100 m intervals out of 1600 m.

The following cards are read in if NPORTS $\geq$1:

CARD 4 "NPORTS" cards required)

NAME	FORMAT	DESCRIPTION
XC	F10.1	X-coordinate of port (m)
YC	F10.1	Y-coordinate of port (m)

CARD 5

NAME	FORMAT	DESCRIPTION
NWD	I3	Number of representative wind directions (maximum of 5)

USERWD(1)	F10.1	First wind direction (degrees east of north)
USERWD(2)	F10.1	Second wind direction (degrees east of north)
USERNW(3)	F10.1	Third wind direction (degrees east of north)
USERWD(4)	F10.1	Fourth wind direction (degrees east of north)
USERWD(5)	F10.1	Fifth wind direction (degrees east of north)

CARD 6

NAME	FORMAT	DESCRIPTION
IWEQN	12I3	Wind equivalent array for the 16 wind direction sector. (1 ≤ IWEQN ≤ NWD).

CARD 7

NAME	FORMAT	DESCRIPTION
TWRADM	F10.1	Actual diameter of CMDCT housing (m)
DA	F10.1	Length of LMDCT housing (m)
DB	F10.1	Width of LMDCT housing (m)
THTWR(1)	F10.1	Direction of long axis of LMDCT (degrees east of north)
THTWR(2)	F10.1	Direction of long axis of LMDCT (degrees east of north)
THTWR(3)	F10.1	Direction of long axis of LMDCT (degrees of east north)

THTWR(4)	F10.1	Direction of long axis of LMDCT (degrees east of north)

CARD 8 ("NTWRS" cards required)

NAME	FORMAT	DESCRIPTION
XTWR	F10.1	Tower housing X-coordinate of center (m)
YTWR	F10.1	Tower housing Y-coordinate of center (m)

The following cards are required only if NEXPL 0. There must be NEXPL sets c the following.

CARD P1

NAME	FORMAT	DESCRIPTION
CH	F8.1	Wake height scale (m)
CL	F8.1	Wake height scale (m)
CW	F8.1	Wake height scale (m)

CARD P2

NAME	FORMAT	DESCRIPTION
XPLAT	F10.1	X-coordinate of plate
XPLAT	F10.1	Y-coordinate of plate

CARD P3

NAME	FORMAT	DESCRIPTION
SPAN	F10.1	Span of plate (m)
CHORD	F10.1	Chord of plate (m)

The following cards are needed if NDRIFT = 1.

CARD 1D

NAME	FORMAT	DESCRIPTION
DLABEL	20A4	Label to identify drift data

CARD 2D

NAME	FORMAT	DESCRIPTION
NDROPS	I2	Number of drop sizes
DRIFTR	E10.3	Drift rate (gm/s) (total drift rate from all sources)
CWSC	E10.3	Cooling water salt concentration (gm salt/gm solution)
SDENS	F10.3	Salt density (gm/cm^3)

CARDS 3D THROUGH (NDROPS+2)D

NAME	FORMAT	DESCRIPTION
DROP(I)	F10.0	Ith drop diameter (m)

MASFRAC(I)	E10.3	Fraction of mass emission rate (DRIFTR) between drops (I-1) and I. (Set to zero for first drop.)
DRPCON(I)	E10.3	Salt mass fraction for I'th drop interval (a zero value defaults to CWSC)

TABLES PROGRAM

Program Name:	TABLES
Format:	Standard FORTRAN card format, ANSI X3.9-1978 (FORTRAN 77) compatible. The source code is also mostly compatible with ANSI X3.9-1966 (FORTRAN IV) except for limited input/output and character data features. Source lines unique to FORTRAN 77 are marked by the text F77 in the sequence columns 73-80. These lines can be deleted to make the source code FORTRAN IV compatible; alternative FORTRAN IV code is provided in comment statements where substitution is required.
Source Code Length:	939 FORTRAN source records plus 1293 comment cards for 2232 total.
Runtime Memory Requirements:	Approximately 360,000 bytes (Compiler dependent)
Input Files:	File 4 (FT04F001) -- produced by PREPROCESSOR File 5 (FT05F001) -- user prepared File 8 (FT08F001) -- produced by PLUME model
Output Files:	File 6 (FT06F001) -- Intended to be PRINTER File 9 (FT09F001) -- Intended to be disk file for use by PAGEPLOT in Seasonal/Annual system.
Card image user input:	FILE 5

CARD N1 (used with FORTRAN 77 only)

NAME	FORMAT	DESCRIPTION
FNAME	(A32)	File name of binary meteorological data passed by PREPROCESSOR code on unit 2.

CARD N2 (used with FORTRAN 77 only)

NAME	FORMAT	DESCRIPTION
FNAME	(A32)	File name of plume category passed from the PREPROCESSOR code on unit 4.

CARD N3 (used with FORTRAN 77 only)

NAME	FORMAT	DESCRIPTION
FNAME	(A32)	File name of standard print output.

CARD N4 (used with FORTRAN 77 only)

FNAME	(A32)	File name of plume and drift prediction data created by the PLUME code on unit 8.

CARD N5 (used with FORTRAN 77 only)

NAME	FORMAT	DESCRIPTION
FNAME	(A32)	File name of SEASONAL/ANNUAL TABLES data for passing to the PAGEPLOT code on unit 9.

CARD 1

NAME	FORMAT	DESCRIPTION
NSEASN	I3	Number of seasons (up to 5) that user wants to examine
MM	I3	Number of sector partitions to use in shadowing (default 1)

The next pair of cards are repeated once for each user-defined season.

CARD 2

NAME	FORMAT	DESCRIPTION
SEASON	5A4	User selected season name

CARD 3

NAME	FORMAT	DESCRIPTION
NHOURS	I5	The number of hours in the user-defined season
IREC1	I5	The first tape record number in the user's season
IREC2	I5	The last tape record number in the user's season
IYEAR1	I5	The first year number in the user's season
IYEAR1	I5	The last year in the user's season
JD1	I5	The first Julian day in the user's season
JD1	I5	The last Julian day in the user's season

IHOUR1	I5	The first hour in the user's season
IHOUR2	I5	The last hour in the user's season

Tower Effective Radius Card:

NAME	FORMAT	DESCRIPTION
RSTAR	F10.3	Effective radius of the combined plume sources.

Grid Bracket Selection Card:

NAME	FORMAT	DESCRIPTION
NXL	I3	Number of grids for length frequency table (Default 100)
NXH	I3	Number of grids for height frequency table (Default 100)
NXR	I3	Number of grids for radius frequency table (Default 100)
NXS	I3	Number of grids for shadowing table (Default 40)
NXD	I3	Number of grids for shadowing table (Default 40)

Now follow a variable number of grid radial cards, as many as required for the number of grids specified by the preceding grid bracket card. The format of each grid radial card is: 10F8.0

THE PLOTTING ROUTINE PAGEPLOT

Program name:	PAGEPLOT
Format:	Standard FORTRAN card format, ANSI X3.9-1978 (FORTRAN 77) compatible. The source code is also mostly compatible with ANSI X3.9-1966 (FORTRAN IV) except for limited input/output and character data features. Source lines unique to FORTRAN 77 are marked by the text F77 in the sequence columns 73-80. These lines can be deleted to make the source code FORTRAN IV compatible; alternative FORTRAN IV code is provided in comment statements where substitution is required.
Source Code Length:	224 FORTRAN source records plus 387 comment cards for 611 total.
Runtime Memory Requirements:	Approximately 105,000 bytes (Compiler dependent)
Input Files:	File 5 (FT05F001) -- User prepared File 9 (FT09F001) -- Produced by TABLES in Seasonal/Annual system,
Output Files:	File 6 (FT06F001) -- Intended to be PRINTER

Card image input: FILE 5

CARD N1 (used with FORTRAN 77 only)

NAME	FORMAT	DESCRIPTION
FNAME	(A32)	File name of standard print output.

CARD N2 (used with FORTRAN 77 only)

NAME	FORMAT	DESCRIPTION
FNAME	(A32)	File name of SEASONAL/ANNUAL output from TABLES for PAGEPLOT code input on unit 9.

CARD 1

NAME	FORMAT	DESCRIPTION
ISIZE	I8	Size identifier for plots 1 = 21 rows by 42 columns (52 cols. total) 2 = 52 rows by 102 columns (112 col.s total)
ISCALE	I3	Isoplot length scale identifier 1 = (-2 km to +2 km) 2 = (-5 km to +5 km) 3 = (-10 km to +10 km) 4 = (-20 km to +20 km)
CONT(1)	F10.2	First contour value desired in same units as table to be plotted
CONT(2)	F10.2	Second contour value desired in same units as table to be plotted
CONT(3)	F10.2	Third contour value desired in same units as table to be plotted
CONT(4)	F10.2	Fourth contour value desired in same units as table to be plotted

Card image input: FILE 9

CARD 1

NAME	FORMAT	DESCRIPTION
ALABEL	20A4	Label describing physical effect plotted including units

CARD 2

NAME	FORMAT	DESCRIPTION
BLABEL	20A4	Label describing site and/or meteorological data source

CARD 3

NAME	FORMAT	DESCRIPTION
CLABEL	5A4	Label describing season selected

CARDS 4 THROUGH (2*NRAD+4) have FORMAT (10E8.3)

RAD(1) Ith radial distance (km)

AR(I,J) I:1 to 16, 1 to NRAD (max. 50) gives the values of the environmental effect to be plotted, where I labels the 22.5 degree sector clockwise from and J labels the radial distance in accord with RAD(J). With the above format each radial will occupy two cards.

Array will be stored as:
RAD(1), AR(1,1),AR(2,1),...,AR(9,1)
AR(10,1),AR(11,1),...,AR(16,1)

```
RAD(2),AR(1,2),....
AR(10,2),AR(11,2)...
```

Etc.

Section 3

CASE STUDIES ILLUSTRATING APPLICATION OF THE SEASONAL/ANNUAL MODEL

CASE STUDY 1: APPLICATION TO LINEAR MECHANICAL-DRAFT COOLING TOWERS

The site in this example has two parallel liner mechanical-draft towers separated by a distance of 140 meters. Each tower has 9 cells equally spaced 11 meters apart measured center to center. The tower housing is 16.9 meters high, 98.8 meters long and 22.2 meters wide. The parallel housings are oriented so as to lie at a 45 degree angle with respect to north along a line north-west and south-east. Figure 3-1 provides a sketch of the tower configuration. Table 3-1 summarizes the information to be used concerning the drift as emitted from the cooling tower. Predictions are required on a seasonal and annual basis using one year of NWS data from Chicago, Illinois.

The PREPROCESSOR code requires a single effective-source for determining categories of plumes which are used to create seasonal/annual predictions. The combined air flow rate from all 18 cells is 13,818 kg/s. The effective source diameter is 38.78 meters, and the total heat dissipation rate is 1400 MW.

The example site is geographically located near Chicago at latitude 42 degrees north and longitude 88 degrees west and the available meteorological tape represents one year of data consisting of 8760 hourly records in the format of a CD144 tape. No records will be skipped in this run. The mixing height will be taken as urban. Fogging and icing will be computed since this is a mechanical-draft cooling tower.

The data on monthly clearness indices and solar insolation are supplied along with the preceding information on 6 cards as input to the PREPROCESSOR code. A listing of the entire input required by the codes is given in Tables 3-2 to 5-5. The PREPROCESSOR code input is listed in Table 3-2. The PLUME code input as listed in Table 3-3. Tables 3-4 and 3-5 present the TABLES and PAGE PLOT input.

After running the PREPROCESSOR code, we find that we have 10 fogging and 31 plume cases for input to the plume and drift code. At this point, the plume code must be run. The user input file for the PLUME code will specify fogging and drift switches of 1 so that these features are computed. Plumes will be computed to a centerline distance of 10,000 meters and the default number of 16 fogging radials will be generated. The input will specify 18 cells for multiple plume releases and two tower housings for the purpose of computing wake entrainment.

The coordinates of each cell in north-south coordinates must be provided. It is important to select a central original representative of the site configuration as the center of the coordinate system for specifying the cell information because subsequent calculations for drift deposition and fogging/icing will be relative to this origin. The tower housing coordinates and dimensions are also required.

The user must also decide on the number of wind directions and the angles that are to be run for the plume set. In this example, 3 directions of 0, 45 and 180 degrees east of north were selected, and 16 sectors were assigned to corresponding wind directions based on symmetry considerations.

Finally, the drift spectrum is provided in Table 3-1 for this example. It represents a typical mechanical-draft spectrum with 31 drop sizes. The data in this example were taken from measurements at the Pittsburg, California mechanical-draft cooling towers. The total salt emission rate for all 18 cells of one mechanical-draft cooling tower were 171.36 g/s, the cooling water sale concentration was 0.005 g salt/g solution, and the density of dry salt was 2.17 g/cm^3. along with this information, the drop size for each of the 31 bins and the mass fraction for that bin were supplied.

The PLUME code was run using the above information, and automatically, the relevant data files for the TABLES code were created. To run the TABLES code, the user need only specify the choice of radial spacing, season definitions for each season (up to 5), and the effective-source radius. In this example, the defaults of 4 calendar seasons plus annual and default grid increments for the TABLES output were used. Table 3-6 provides a computer listing of the input files required to run the PREPROCESSOR, PLUME, TABLES, AND PAGE PLOT codes.

Tables 3-7 to 3-19 present samples of the computer output from Case 1. Selected results will be presented from the TABLES and PAGE PLOT routines. Tables 3-7 to 3-9 present the results of the PLUME model runs for the 30 categories chosen by the PREPROCESSOR code. Table 3-7 presents runs for each of the 30 categories with the wind direction at a 45° angle to the line of towers. Table 3-8 presents similar runs for the 30 categories for the wind direction at 90° to the centerline of the cooling tower. Table 3-9 presents the results of 30 runs of the PLUME code with wind direction angle leading to the in-line case (180° wind direction angle with respect to cooling tower axis). Table 3-10 provides a table of the frequency of occurrence of the 30 categories with wind direction. Table 3-11 provides auxiliary tables useful for Appendix D calculations of the effects of complex terrain.

Table 3-12 lists the probability that the visible plume will be longer than a given length (e.g., 1400 m) in a particular wind direction (e.g., plume headed north).

Table 3-13 presents the hours of shadowing in the winter season by the plume at a given distance and a given direction. Tables 3-14 to 3-16 present other measures of plume shadowing:

- Table 3-14 - total solar energy loss at a given point in mj/m^2 due to the plume's shadow.
- Table 3-15 - percent of the energy loss compared to the total solar heat flux at a point on the ground.
- Table 3-16 - percent loss of the direct (beam) energy incident on the ground due to the plume shadow.

Table 3-17 provides the salt drift deposition in kg/km^2-mo at each point on the ground. All values in this and other tables refer to the sector averaged value for the sector represented by the "distance from tower" and "wind direction".

Table 3-18 presents the hours of plume fogging for the winter as a function of direction and distance from the tower.

Table 3-19 lists the hours of rime ice at any distance and direction from the tower.

Figures 3-2 to 3-9 present line printer plots of the tables presented in Tables 3-12 to 3-19. The scale is in kilometers and the center of the tower complex is represented by two @ symbols located at (0,0). All tabular values are rounded off to the nearest contour values as printed out in the legend. A rerun of the PAGE PLOT code with user inputted contour values may provide results that better satisfy the user's needs.

Table 3-1. Characteristics of drift emissions from the mechanical-draft cooling tower in Case Study 1

Drop Spectrum	
Diameter (Microns)	Mass Fraction
0 - 10	0.0
10 - 20	0.0053
20 - 30	0.0430
30 - 40	0.0741
40 - 50	0.0651
50 - 60	0.0548
60 - 70	0.0351
70 - 90	0.0326
90 - 110	0.0178
110 - 130	0.0095
130 - 150	0.0076
150 - 180	0.0011
180 - 210	0.0117
210 - 240	0.0132
240 - 270	0.0141
270 - 300	0.0182
300 - 350	0.0267
350 - 450	0.0229
450 - 500	0.0151
500 - 600	0.0433
600 - 700	0.0351
700 - 800	0.0382
800 - 900	0.0273
900 - 1000	0.0171
1000 - 1200	0.0319
1200 - 1400	0.0332
1400 - 1600	0.0643
1600 - 1800	0.0221
1800 - 2000	0.307
2000 - 2200	0.1540

Drift rate	171.36 g/s (total for 18 cells for one tower)
Salt concentration in cooling water	0.005g salt (NaCl/g solution)
Density of dry salt	2.17g/cm^3

Table 3-2. PREPROCESSOR Model input form -- Mechanical-Draft Cooling Tower Case Study

Card 1

			Columns
ITITLE	TITLE: Linear Mechanical Draft Cooling Tower -- Dual Array Configuration		(1-80).

Card 2:

ISTOP	Number of Records Read (0 = All).............	8760	(1-6).
ISKIP	Skip Control (1 = No Skip, 2 = Every Other)..	1	(7-12).
IOUT	Output Control (0 = Full, 1 = No Records)....	1	(13-14).
IMIX	Mixing Height Switch (1 = Ave., 2 = Tape)....	2	(15-16).
IUR	Mixing Height Type (1 = Rural, 2 = Urban)....	2	(17-18).
IWIND	Stability Class Switch for NRC Tape (1 = Sigma Theta, 2 = Delta-T).............	0 (N/A)	(19-20).
NFOG	Fog Calculations ? (0 = No, 1 = Yes).........	1	(21-22).
NDRIFT	Drift Calculations ? (0 = No, 1 = Yes).......	1	(23-23).
ITOWER	Type of Tower (1 = NDCT, 2 = CMDCT, 3 = LMDCT)................................	3	(25-26).
ITAPE	Type of Tape (1 = CD-144, 2 = NRC, 3 = TDF-14).................................	1	(27-28).
IZONE	Time Zone (5 = Eastern, 6 = Central, 7 = Mountain, 8 = Pacific).................	6	29-30).

Card 3:

ALAT	Site Latitude in Degrees North Latitude......	42	(1-10).

Table 3-2 (Continued)

ALONG	Site Longitude in Degrees West Longitude.....	88	(11-20).
ROUGHT	Roughness Height (cm).......................	1.0	(21-30).
HREF	Reference Height of Met Tape (m)............	10.0	(31-40).
HTMIX	Annual Average Mixing Height (m) (Only if IMIX = 1).......................	(N/A)	(41-50).

Card 4:

TWRHT	Tower Effective Height (m)..................	16.9	(1-10).
TWRDM	Tower Effective Exit Diameter (m)...........	38.78	(11-20).
TWRHE	Tower Effective Heat Rejection (MW).........	1400.0	(21-30).
TWRAF	Tower Effective Air Flow (kg/s).............	13818.0	(31-40).

Card 5:

CKT(1)	January Clearness Index.....................	51	(1-3).
CKT(2)	February Clearness Index....................	50	(4-6).
CKT(3)	March Clearness Index.......................	52	(7-9).
CKT(4)	April Clearness Index.......................	48	10-12).
CKT(5)	May Clearness Index.........................	53	(13-15).
CKT(6)	June Clearness Index........................	56	(16-18).
CKT(7)	July Clearness Index........................	55	(19-21).
CKT(8)	August Clearness Index......................	57	(22-24).
CKT(9)	September Clearness Index...................	55	(25-27).
CKT(10)	October Clearness Index.....................	52	(28-30).
CKT(11)	November Clearness Index....................	43	(31-33).
CKT(12)	December Clearness Index....................	43	(34-36).

Table 3-2 (Continued)

Card 6:

HAVG(1)	January Daily Solar Insolation (mj/m^2).......	7.15	(1-5).
HAVG(2)	February Daily Solar Insolation (mj/m^2)......	9.70	(6-10).
HAVG(3)	March Daily Solar Insolation (mj/m^2).........	13.63	(11-15).
HAVG(4)	April Daily Solar Insolation (mj/m^2).........	16.31	(16-20).
HAVG(5)	May Daily Solar Insolation (mj/m^2)	20.78	(21-25).
HAVG(6)	June Daily Solar Insolation mj/m^2	23.13	(26-30).
HAVG(7)	July Daily Solar Insolation (mj/m^2)	22.04	(31-35).
HAVG(8)	August Daily Solar Insolation (mj/m^2)........	20.32	(36-40).
HAVG(9)	September Daily Solar Insolation (mj/m^2).....	16.06	(41-45).
HAVG(10)	October Daily Solar Insolation (mj/m^2)	11.08	(46-50).
HAVG(11)	November Daily Solar Insolation (mj/m^2)......	6.57	(51-55).
HAVG(12)	December Daily Solar Insolation (mj/m^2)......	5.48	(56-60).

Table 3-3. PLUME Model input form -- Mechanical-Draft Cooling Tower Case Study

Card 1:

			Columns
ALABEL	General Heading: Linear Mechanical-Draft Cooling Tower Example -- Dual Line Array Configuration................................		(1-80).

Card 2:

IOUT	Output Control Switch........................ (0 = Plume Variables Only, 1 = Plume Variables and Tower Conditions, 2 = Only Label and Input Constants)	2	(1-3).
NFOG	Fogging/Icing Control Switch.................	1	(4-6).
NDRIFT	Number of Drift Cases (0 = No Drift, 1 = Run Drift)..............................	1	(7-9).
NFRAD	Number of Fogging/Icing Radials..............	Blank	(10-12).
SMAXP	Maximum Distance for Plume Calculations (m)..	10000.0	(13-22).
SMAXF	Maximum Distance for Fogging Calculations....	Blank	(23-32).
NPORTS	Number of Source Exit Ports (Cells)..........	18	(33-35).
NUSER	Number of User-Specified Plates for Wake Entrainment............................	0	(36-38).
NTWRS	Number of Tower Housing (Leave Blank if NDCT)..................................	2	(39-41).
ISOURC	Effective Source Mode Switch (0 = Multiple Mode, 1 = Effective Source)................	0	(42-44).

Table 3-3 (Continued)

Card 3 is omitted since NFRAD=0 so 16 default radials are generated.

Card 3:	(Repeated so as to supply NFRAD Values)		
RAD(1)	First Radial Distance (km)..................	N/A	(1-10).
RAD(2)	Second Radial Distance (km).................	N/A	(11-20).
RAD(3)	Third Radial Distance (km)..................	N/A	(21-30).
RAD(4)	Fourth Radial Distance (km).................	N/A	(31-40).
RAD(5)	Fifth Radial Distance (km)..................	N/A	(41-50).
RAD(6)	Sixth Radial Distance (km)..................	N/A	(51-60).
RAD(7)	Seventh Radial Distance (km)	N/A	(61-70).
RAD(8)	Eight Radial Distance (km)..................	N/A	(71-80).
Card 4:	(Repeated once for each cell)		
XC	X-Coordinate of Cell(1).....................	18.38	(1-10).
YC	Y-Coordinate of Cell(1).....................	80.61	(11-20).
XC	X-Coordinate of Cell(2)	26.16	(1-10).
YC	Y-Coordinate of Cell(2)	72.83	(11-20).
XC	X-Coordinate of Cell(3)	33.94	(1-10).
YC	Y-Coordinate of Cell(3)	65.05	(11-20).
XC	X-Coordinate of Cell(4)	41.72	(1-10).
YC	Y-Coordinate of Cell(4)	57.28	(11-20).
XC	X-Coordinate of Cell(5)	49.50	(1-10).
YC	Y-Coordinate of Cell(5).....................	49.50	(11-20).
XC	X-Coordinate of Cell(6)	57.27	(1-10).
YC	Y-Coordinate of Cell(6)	41.72	(11-20).
XC	X-Coordinate of Cell(7)	65.05	(1-10).
YC	Y-Coordiante of Cell(7)	33.94	(11-20).

Table 3-3 (Continued)

XC	X-Coordinate of Cell(8)......................	72.83	(1-10)
YC	Y-Coordinate of Cell(8)	26.16	(11-20)
XC	X-Coordinate of Cell(9)	80.16	(1-10)
YC	Y-Coordinate of Cell(9)	-18.38	(11-20)
XC	X-Coordinate of Cell(10)	-80.61	(1-10)
YC	Y-Coordinate of Cell(10)	-18.38	(11-20)
XC	X-Coordinate of Cell(11)	-72.83	(1-10)
YC	Y-Coordinate of Cell(11)	-26.16	(11-20)
XC	X-Coordinate of Cell(12)	-65.05	1-10)
YC	Y-Coordinate of Cell(12)	-33.94	(11-20)
XC	X-Coordinate of Cell(13)	-57.27	(1-10)
YC	Y-Coordinate of Cell(13)	-41.72	(11-20)
XC	X-Coordinate of Cell(14)	-49.50	(1-10)
YC	Y-Coordinate of Cell(14)	-49.50	(11-20)
XC	X-Coordinate of Cell(15)	-41.72	(1-10)
YC	Y-Coordinate of Cell(15)	-57.28	(11-20)
XC	X-Coordinate of Cell(16)	-33.94	(1-10)
YC	Y-Coordinate of Cell(16)	-65.05	(11-20)
XC	X-Coordinate of Cell(17)	-26.16	(1-10)
YC	Y-Coordinate of Cell(17)	-72.83	(11-20)
XC	X-Coordinate of Cell(18)	-18.38	1-10)
YC	Y-Coordinate of Cell(18)	-80.61	(11-20)

Card 5:

NWD	Number of Representative Wind Directions.....	3	(1-3)
USERWD(1)	First Wind Direction (degrees east of north).	135.0	(4-13).
USERWD(2)	Section Wind Direction (degrees east of north)	0.0	(14-23).

USERWD(3)	Third Wind Direction (degrees east of north).	45.0	(24-33).
USERWD(4)	Fourth Wind Direction (degrees east of north)	Blank	(34.43)
USERWD(5)	Fifth Wind Direction (degrees east of north).	Blank	(44-53).
Card 6:			
IWEQN(1)	Wind Equivalence Number for Sector 1.........	2	(1-3).
IWEQN(2)	Wind Equivalence Number for Sector 2.........	3	(4-6).
IWEQN(3)	Wind Equivalence Number for Sector 3.........	3	(7-9).
IWEQN(4)	Wind Equivalence Number for Sector 4.........	3	(10-12).
IWEQN(5)	Wind Equivalence Number for Sector 5.........	2	(13-15).
IWEQN(6)	Wind Equivalence Number for Sector 6.........	1	(16-18).
IWEQN(7)	Wind Equivalence Number for Sector 7.........	1	(19-21).
IWEQN(8)	Wind Equivalence Number for Sector 8.........	1	(22-24).
IWEQN(9)	Wind Equivalence Number for Sector 9.........	2	(25-27).
IWEQN(10)	Wind Equivalence Number for Sector 10........	3	(28-30).
IWEQN(11)	Wind Equivalence Number for Sector 11........	3	(31-33).
IWEQN(12)	Wind Equivalence Number for Sector 12........	3	(34-36).
IWEQN(13)	Wind Equivalence Number for Sector 13........	2	(37-39).
IWEQN(14)	Wind Equivalence Number for Sector 14........	1	(40-42).
IWEQN(15)	Wind Equivalence Number for Sector 15........	1	(43-45).
IWEQN(16)	Wind Equivalence Number for Sector 16........	1	(46-48).
Card 7:	(Omitted for natural draft cooling tower)		
TWRADM	Diameter of CMDCT Housing (m):...............	Blank	(1-10).
DA	Length of LMDCT Housing (m)..................	98.8	(11-20).
DB	Width of LMDCT Housing (m)...................	22.2	(21-30).

Table 3-3 (Continued)

THTWR(1)	LMDCT Long Axis Direction (degrees east of north)..................................	135.0	(31-40).
THTWR(2)	LMDCT Long Axis Direction (degrees east of north)......................................	135.0	(41-50).
THTWR(3)	LMDCT Long Axis Direction (degrees east of north)......................................	Blank	(51-60).
THTWR(4)	LMDCT Long Axis Direction (degrees east of north)......................................	Blank	(61-70).

<u>Card 8</u>: (Omitted for NDCT, otherwise supply 1 per tower housing)

XTWR	X-Coordinate of Tower Housing Center (m).....	49.5	(1-10).
YTWR	Y-Coordinate of Tower Housing Center (m).....	49.5	(11-20).
XTWR	X-Coordinate of Tower Housing Center (m).....	-49.5	(1-10).
YTWR	Y-Coordinate of Tower Housing Center (m).....	-49.5	(11-20).

The following cards P1-P3 are not required since NPLATE = 0.

<u>Card P1</u>:

CH	Wake Height Scale (m)........................	N/A	(1-8).
CL	Wake Length Scale (m)........................	N/A	(9-16).
CW	Wake Width Scale (m)..........................	N/A	(17-24).

<u>Card P2</u>:

XPLAT	X-Coordinate of Plate (m)....................	N/A	(1-10).
YPLAT	Y-Coordinate of Plate (m)....................	N/A	(11-20).

Card P3:

SPAN	Span of Plate (m)............................	N/A	(1-10).
CHORD	Chord of Plate (m)...........................	N/A	(11-20).

Card 1D: These Cards are Required Since NDRIFT = 1.

DLABEL Drift Label: Linear Mechanical Draft Cooling Tower Example --Typical Drift Emission Spectrum

Card 2D:

NDROPS	Number of Drop Sizes.........................	31	(1-2).
DRIFTR	Drift Rate (g/s).............................	171.36	(3-12).
CWSC	Cooling Water Salt Concentration (g salt/ g solution................................	0.005	(13-22).
SDENS	Salt Density (g/cm^3).........................	2.17	(23-32).

Card 3D: (One card for each drop bin):

DROPS	Ith Range in Drop Diameter (μm)..............	see below	(1-10).
MASFRAC	Fraction of Mass Emission Rate in that Range.......................................	see below	(11-20).
DRPCON	Fraction of Salt in I'th Drop (g salt/ g solution) (0.0 Defaults to CWSC).........	0.0	(21-30).

10.0	0.0
20.0	0.0053
30.0	0.0430
40.0	0.0741
50.0	0.0651
60.0	0.0548
70.0	0.0351
90.0	0.0326
110.0	0.0178
130.0	0.0095
150.0	0.0076

Table 3-3 (Continued)

180.0	0.0011
210.0	0.0117
240.0	0.0132
270.0	0.0141
300.0	0.0182
350.0	0.0267
450.0	0.0229
500.0	0.0151
600.0	0.0433
700.0	0.0351
800.0	0.0382
900.0	0.0273
1000.0	0.0171
1200.0	0.0319
1400.0	0.0332
1600.0	0.0643
1800.0	0.0221
2000.0	0.0307
2200.0	0.1540

Table 3-4. TABLES input form -- Mechanical-Draft Cooling Tower Case Study

			Columns
Card 1:			
NSEASN	Number of Seasons............................	5	(1-3).
MM	Number of Shadowing Sector Partitions........	0	(4-6).
Card 2:			
SEASON	Season Name..................................	Winter	(1-20).
Card 3:	Blank (for defaults)		
NHOURS	Number of Hours in Season....................	Blank	(1-5).
IREC1	First Record in Season.......................	Blank	(6-10).
IREC2	Last Record in Season........................	Blank	(11-15).
IYEAR1	First Year in Season.........................	Blank	(16-20).
IYEAR2	Last Year in Season..........................	Blank	(21-25).
JD1	First Day in Season..........................	Blank	(26-30).
JD2	Last Day in Season...........................	Blank	(31-35).
IHOUR1	First Hour in Season.........................	Blank	(36-40).
IHOUR2	Last Hour in Season..........................	Blank	(41-45).

Card 2 and Card 3 format for each of 4 other seasons:

Spring	(1-20).
Blank	(1-45).
Summer	(1-20).
Blank	(1-45).
Fall	(1-20).
Blank	(1-45).
Annual	(1-20).
Blank	(1-45).

Table 3-4 (Continued)

Card 4:

RSTAR	Effective Radius of Combined Plume Sources (m)................................	Blank	(46-55).

Card 5:

NXL	Number of Length Divisions.................... (Blank Field Defaults to 100)	Blank	(1-3).
NXH	Number of Height Divisions.................... (Blank Field Defaults to 100)	Blank	(4-6).
NXR	Number of Radial Divisions.................... (Blank Field Defaults to 100)	Blank	(7-9).
NXS	Number of Shadowing Radials................... (Blank Field Defaults to 40)	Blank	(10-12).
NXD	Number of Drift Radials....................... (Blank Field Defaults to 100)	Blank	(13-15).

Card 6 And Up: not required since defaults were used

If NXL is non-zero, provide NXL radials in meters for length table.

If NXH is non-zero, provide NXH radials in meters for height table.

Etc.

The format of these cards is 10F8.0

Table 3-5. PAGE PLOT input form -- Mechanical-Draft Cooling Tower Case Study

Card 1: Supply 5 seasons x 9 tables/season = 45 blank cards for defaults

ISIZE	Plot Size Identifier........................ (1 = 21 Rows by 42 Columns 2 = 51 Rows by 102 Columns)	Blank	(1-3).
ISCALE	Isoplot Length Scale........................ (Blank Field Defaults to 2) (1 = -2 km to + 2 km 2 = -5 km to + 5 km 3 = -10 km to +10 km 4 = -20 km to + 20 km)	Blank	(4-6).
CONT(1)	First Contour Value.........................	Blank	(7-16).
CONT(2)	Second Contour Value........................	Blank	(17-26).
CONT(3)	Third Contour Value.........................	Blank	(27-36).
CONT(4)	Fourth Contour Value........................	Blank	(37-46).

Table 3-6. Listing of input files for PREPROCESSOR, PLUME, TABLES, and PAGEPLOT codes for Case Study 1

```
 LINEAR MECHANICAL DRAFT COOLING TOWER--DOUBLE LINE ARRAY CONFIGURATION
  8760     1 1 2 2 0 1 1 3 1 6
42.0     88.0      1.0       10.0        .0
 16.9     38.78    1400.0     13818.0
 51 50 52 48 53 56 55 57 55 52 43 43
7.15 9.70 13.6316.3120.7823.1322.0420.3216.0611.086.57 5.48
```

```
 LINEAR MECHANICAL DRAFT COOLING TOWER -- DUAL LINE ARRAY CONFIGURATION
 2  1  1  0   10000.0        0.0 18  0  2  0
     18.38     80.61
     26.16     72.83
     33.94     65.05
     41.72     57.28
     49.50     49.50
     57.27     41.72
     65.05     33.94
     72.83     26.16
     80.61     18.38
    -80.61    -18.38
    -72.83    -26.16
    -65.05    -33.94
    -57.27    -41.72
    -49.50    -49.50
    -41.72    -57.28
    -33.94    -65.05
    -26.16    -72.83
    -18.38    -80.61
  3     135.0       0.0      45.0
  2  3  3  3  2  1  1  1  2  3  3  3  2  1  1  1
                 98.8     22.2     135.0     135.0
     49.50     49.50
    -49.50    -49.50
LINEAR MECHANICAL COOLING TOWER EXAMPLE -- TYPICAL DRIFT DEPOSITION SPECTRUM
31          171.36   .005         2.17
       10.0    0.0000      0.0
       20.0    0.0053      0.0
       30.0    0.0443      0.0
       40.0    0.0741      0.0
       50.0    0.0651      0.0
       60.0    0.0548      0.0
       70.0    0.0351      0.0
       90.0    0.0326      0.0
      110.0    0.0178      0.0
      130.0    0.0095      0.0
      150.0    0.0076      0.0
      180.0    0.0110      0.0
      210.0    0.0117      0.0
      240.0    0.0132      0.0
      270.0    0.0141      0.0
      300.0    0.0182      0.0
      350.0    0.0267      0.0
      400.0    0.0233      0.0
      450.0    0.0229      0.0
      500.0    0.0151      0.0
      600.0    0.0433      0.0
      700.0    0.0351      0.0
      800.0    0.0332      0.0
      900.0    0.0273      0.0
     1000.0    0.0171      0.0
     1200.0    0.0319      0.0
     1400.0    0.0332      0.0
     1600.0    0.0643      0.0
     1800.0    0.0221      0.0
     2000.0    0.0307      0.0
     2200.0    0.1540      0.0
```

Table 3-6 (Continued)

```
 3  0
WINTER
                    335   59
SPRING
                     68  151
SUMMER
                    152  243
FALL
                    244  334
ANNUAL
                      0    0
0.0
  0  0  0  0  0
```

10	5.00	2.00	1.00	0.50
10	80.0	50.0	30.0	20.0
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
20	0000	0000	0000	0000
20	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
20	0000	0000	0000	0000
20	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
20	0000	0000	0000	0000
20	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
20	0000	0000	0000	0000
20	0000	0000	0000	0000
10	10.0	5.0	2.0	0.50
10	200.	100.	50.	25.
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
20	0000	0000	0000	0000
20	0000	0000	0000	0000

Table 3-7. Summary output of PLUME code providing listing of visible plume length, rise, and final visible radius for wind Direction of 45° to line of towers

EPRI SEASONAL/ANNUAL TABLES PROGRAM. VERSION 09-01-86

LINEAR MECHANICAL DRAFT COOLING TOWER -- DUAL LINE ARRAY CONFIGURATION

SUMMARY OF PLUME PREDICTIONS WHEN WIND IS FROM 0.0 DEGREES EAST OF NORTH

CAT NO.	PLUME LENGTH	PLUME HEIGHT	PLUME RADIUS
11	12.60	14.4	6.10
12	13.30	13.7	6.30
13	14.80	18.5	6.60
14	12.20	8.0	5.00
15	23.90	16.5	8.10
16	22.50	18.4	11.00
17	23.20	17.6	11.00
18	28.80	18.1	12.50
19	32.20	21.9	13.90
20	32.00	22.1	14.00
21	45.50	28.9	17.80
22	299.20	105.4	37.90
23	305.20	115.3	39.50
24	357.00	115.2	46.40
25	442.10	147.9	52.80
26	519.40	167.2	52.70
27	609.40	208.0	62.10
28	778.40	252.4	66.10
29	4319.70	754.9	168.40
30	4221.50	737.2	167.50
31	4020.30	725.5	199.50
32	3218.20	659.5	185.70
33	4423.80	739.0	224.50
34	3823.90	689.4	210.20
35	3527.60	645.0	213.10
36	3824.00	686.3	236.80
37	2523.10	570.5	202.50
38	2796.20	534.1	197.90
39	2329.20	187.2	122.50
40	8153.00	713.9	257.80
41	9988.70+	427.5+	190.60+

* A PLUS SIGN INDICATES THAT THE VISIBLE PLUME DID NOT END WITHIN A CENTERLINE DISTANCE OF 10000.0 METERS

Table 3-8. Summary of output of PLUME code providing listing of visible plume length, rise, and final visible radius for wind direction of 90° (crossflow)

EPRI SEASONAL/ANNUAL TABLES PROGRAM. VERSION 09-01-86

LINEAR MECHANICAL DRAFT COOLING TOWER -- DUAL LINE ARRAY CONFIGURATION

SUMMARY OF PLUME PREDICTIONS WHEN WIND IS FROM 45.0 DEGREES EAST OF NORTH

CAT NO.	PLUME LENGTH	PLUME HEIGHT	PLUME RADIUS
11	51.20	37.3	19.90
12	53.50	33.4	19.50
13	55.80	47.4	20.20
14	71.60	19.4	18.20
15	129.20	49.5	25.70
16	142.90	68.3	30.10
17	154.00	68.4	31.20
18	236.00	77.1	29.60
19	221.80	86.7	32.80
20	258.60	102.3	36.50
21	308.50	111.7	42.60
22	400.50	120.1	45.70
23	405.90	135.7	47.80
24	502.80	143.8	50.80
25	572.80	170.6	54.20
26	668.60	197.9	58.50
27	760.00	239.2	63.70
28	1051.10	308.1	69.50
29	4525.40	751.7	157.00
30	4527.00	739.0	165.30
31	4224.70	727.1	195.20
32	3322.10	659.3	181.10
33	4629.20	736.6	213.80
34	3927.60	687.4	204.30
35	3632.10	640.9	203.00
36	3928.10	684.6	225.10
37	2626.50	569.9	200.40
38	2903.00	531.6	193.60
39	2447.80	161.5	114.30
40	8456.20	712.2	259.60
41	9991.80+	374.1+	190.50+

* A PLUS SIGN INDICATES THAT THE VISIBLE PLUME DID NOT END WITHIN A CENTERLINE DISTANCE OF 10000.0 METERS

Table 3-9. Summary of output of PLUME code providing listing of visible plume length, rise, and final visible radius for wind direction of 180° (in line)

EPRI SEASONAL/ANNUAL TABLES PROGRAM. VERSION 09-01-86

LINEAR MECHANICAL DRAFT COOLING TOWER -- DUAL LINE ARRAY CONFIGURATION

SUMMARY OF PLUME PREDICTIONS WHEN WIND IS FROM 135.0 DEGREES EAST OF NORTH

CAT NO.	PLUME LENGTH	PLUME HEIGHT	PLUME RADIUS
11	17.50	16.5	5.90
12	18.40	15.4	6.10
13	15.20	18.2	6.40
14	27.20	11.3	6.10
15	15.20	12.1	7.20
16	27.90	19.5	8.60
17	28.50	18.7	11.60
18	29.10	18.1	10.90
19	37.60	22.7	13.10
20	37.40	23.1	14.60
21	60.50	33.1	17.30
22	202.10	83.7	25.80
23	226.80	99.6	28.00
24	298.10	112.0	30.90
25	352.80	133.5	34.20
26	428.50	159.3	50.40
27	535.10	198.5	58.10
28	704.40	244.7	62.60
29	927.70	279.6	67.60
30	4118.40	740.6	166.50
31	3917.20	729.2	198.80
32	3117.70	658.4	185.80
33	4221.50	738.4	215.70
34	3619.40	693.7	208.20
35	3425.30	646.2	210.60
36	3621.40	685.9	228.80
37	2522.90	572.9	207.20
38	2899.80	533.4	247.10
39	2237.70	170.1	118.70
40	8153.20	713.6	292.80
41	9985.90+	479.0+	187.60+

* A PLUS SIGN INDICATES THAT THE VISIBLE PLUME DID NOT END WITHIN A CENTERLINE DISTANCE OF 10000.0 METERS

Table 3-10. Frequency of occurrence of 30 categories with wind direction for Case Study 1 -- one year of data

************************ FREQUENCY PERCENTAGE BY CATEGORY AND WIND DIRECTION ************************
LINEAR MECHANICAL DRAFT COOLING TOWER -- DUAL LINE ARRAY CONFIGURATION
SEASON=WINTER

CATEGORY NUMBER	WIND FROM N / PLUME HEADED S	NNE / SSW	NE / SW	ENE / WSW	E / W	ESE / WNW	SE / NW	SSE / NNW	S / N	SSW / NNE	SW / NE	WSW / ENE	W / E	WNW / ESE	NW / SE	NNW / SSE	SUM
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.22	0.22	0.22	0.0	0.0	0.0	0.22	0.0	0.0	0.0	0.22	0.0	0.0	1.11
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.30	0.30	0.0	0.0	0.0	0.0	0.0	0.60
19	0.0	0.0	0.13	0.13	0.13	0.13	0.0	0.25	0.13	0.0	0.0	0.13	0.0	0.0	0.0	0.0	1.02
20	0.14	0.0	0.0	0.07	0.0	0.07	0.0	0.07	0.29	0.0	0.07	0.0	0.0	0.0	0.0	0.07	0.79
21	0.0	0.05	0.05	0.0	0.05	0.0	0.0	0.0	0.05	0.09	0.05	0.0	0.0	0.0	0.0	0.0	0.32
22	0.0	0.05	0.0	0.0	0.05	0.0	0.05	0.05	0.11	0.0	0.22	0.0	0.0	0.0	0.0	0.05	0.60
23	0.33	0.33	0.99	0.33	0.0	0.0	0.0	0.99	0.0	0.0	0.33	0.0	0.0	0.0	0.0	0.0	3.29
24	0.05	0.0	0.19	0.09	0.0	0.0	0.0	0.05	0.09	0.0	0.23	0.09	0.19	0.05	0.05	0.0	1.06
25	0.09	0.05	0.09	0.05	0.0	0.05	0.0	0.09	0.0	0.05	0.28	0.28	0.0	0.0	0.0	0.0	1.02
26	0.0	0.14	0.19	0.14	0.05	0.0	0.0	0.0	0.14	0.09	0.14	0.09	0.09	0.0	0.0	0.0	1.06
27	0.0	0.0	0.28	0.19	0.28	0.0	0.0	0.09	0.09	0.05	0.65	0.14	0.0	0.0	0.05	0.0	1.81
28	0.0	0.23	0.19	0.23	0.14	0.0	0.14	0.05	0.23	0.09	0.19	0.19	0.05	0.0	0.05	0.0	1.76
29	0.05	0.09	0.56	0.28	0.09	0.05	0.05	0.0	0.09	0.14	0.56	0.14	0.0	0.0	0.05	0.05	2.18
30	0.05	0.56	0.56	0.60	0.0	0.19	0.09	0.0	0.23	0.14	0.46	0.19	0.09	0.0	0.0	0.09	3.24
31	0.0	0.19	0.65	0.37	0.19	0.05	0.0	0.14	0.28	0.32	0.19	0.28	0.0	0.0	0.0	0.0	2.64
32	0.05	0.51	0.79	0.42	0.28	0.0	0.09	0.28	0.19	0.14	0.46	0.23	0.0	0.0	0.05	0.0	3.47
33	0.09	0.42	0.51	0.60	0.14	0.05	0.05	0.14	0.14	0.42	0.74	0.14	0.09	0.0	0.0	0.05	3.56
34	0.09	0.28	0.93	0.74	0.09	0.14	0.09	0.37	0.28	0.46	0.83	0.32	0.0	0.0	0.0	0.0	4.63
35	0.0	0.42	0.46	0.56	0.32	0.09	0.14	0.32	0.42	0.28	1.11	0.28	0.09	0.0	0.05	0.0	4.54
36	0.14	0.23	0.83	0.46	0.09	0.05	0.19	0.19	0.42	0.88	0.74	0.19	0.05	0.0	0.05	0.0	4.49
37	0.09	0.46	0.83	0.56	0.28	0.19	0.14	0.28	0.32	0.65	0.74	0.28	0.09	0.05	0.0	0.05	5.00
38	1.90	3.15	9.26	4.72	1.30	0.93	1.34	1.48	2.45	1.34	2.55	1.67	0.93	0.32	0.09	0.23	33.66
39	0.51	1.02	2.18	0.97	0.37	0.09	0.28	0.23	0.28	0.23	0.56	0.56	0.28	0.09	0.19	0.19	8.01
40	0.05	0.09	0.69	0.88	0.05	0.0	0.05	0.60	1.48	1.53	1.25	0.56	0.09	0.0	0.0	0.0	7.31
41	0.0	0.0	0.0	0.05	0.0	0.0	0.0	0.0	0.0	0.14	0.09	0.0	0.0	0.0	0.0	0.0	0.28
TOTALS	3.62	8.25	20.33	12.65	4.11	2.27	2.69	5.67	7.70	7.56	12.73	5.73	2.04	0.73	0.60	0.77	97.45

Table 3-11. Summary of statistics on meteorological data needed for application of Appendix.D on complex terrain

******************************** STABILITY CLASS BY WIND DIRECTION ********************************

LINEAR MECHANICAL DRAFT COOLING TOWER -- DUAL LINE ARRAY CONFIGURATION

SEASON=WINTER

STABILITY CLASS	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
(PLUME HEADED)	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	STAG.
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.01	0.01	0.00	0.04	0.0	0.02	0.02	0.01	0.01	0.00	0.0	0.0	0.0	0.0	0.06	0.04
3	0.06	0.11	0.10	0.04	0.07	0.16	0.03	0.03	0.08	0.03	0.04	0.02	0.02	0.17	0.08	0.13	0.07
4	0.39	0.41	0.47	0.49	0.35	0.49	0.43	0.59	0.58	0.70	0.77	0.59	0.48	0.08	0.31	0.38	0.23
5	0.37	0.26	0.26	0.30	0.33	0.21	0.33	0.25	0.25	0.21	0.12	0.27	0.32	0.58	0.23	0.19	0.10
6	0.18	0.19	0.15	0.16	0.17	0.14	0.17	0.10	0.07	0.03	0.05	0.12	0.18	0.08	0.38	0.25	0.49
7	0.0	0.03	0.01	0.01	0.05	0.0	0.02	0.01	0.01	0.02	0.02	0.0	0.0	0.08	0.0	0.0	0.08

*************** WIND SPEED DISTRIBUTION BY DIRECTION AT REFERENCE HEIGHT OF 200. METERS ***************

LINEAR MECHANICAL DRAFT COOLING TOWER -- DUAL LINE ARRAY CONFIGURATION

SEASON=WINTER

WIND RANGE	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
(PLUME HEADED)	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	STAG.
1	0.03	0.01	0.00	0.01	0.05	0.02	0.0	0.02	0.01	0.01	0.0	0.0	0.02	0.17	0.08	0.06	1.00
2	0.86	0.77	0.48	0.43	0.71	0.60	0.60	0.38	0.40	0.23	0.19	0.30	0.55	0.58	0.85	0.69	0.0
3	0.11	0.23	0.52	0.56	0.24	0.37	0.40	0.60	0.60	0.75	0.81	0.70	0.43	0.25	0.08	0.25	0.0

******************************** COMBINED FACTORS BY WIND DIRECTION ********************************

LINEAR MECHANICAL DRAFT COOLING TOWER -- DUAL LINE ARRAY CONFIGURATION

SEASON=WINTER

COMBINED CLASS*	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
(PLUME HEADED)	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	STAG.
1	0.00	0.00	0.00	0.00	0.01	0.00	0.0	0.00	0.00	0.00	0.0	0.0	0.00	0.03	0.01	0.01	0.11
2	0.05	0.09	0.05	0.02	0.08	0.10	0.03	0.02	0.03	0.01	0.01	0.00	0.01	0.10	0.07	0.13	0.0
3	0.01	0.03	0.06	0.02	0.03	0.06	0.02	0.03	0.05	0.03	0.03	0.01	0.01	0.04	0.01	0.05	0.0
4	0.02	0.00	0.00	0.01	0.03	0.02	0.0	0.02	0.01	0.01	0.0	0.0	0.02	0.11	0.04	0.04	0.32
5	0.65	0.51	0.35	0.34	0.48	0.42	0.46	0.32	0.33	0.21	0.17	0.26	0.43	0.39	0.46	0.39	0.0
6	0.09	0.15	0.37	0.44	0.16	0.26	0.30	0.50	0.50	0.68	0.72	0.60	0.34	0.17	0.04	0.14	0.0
7	0.01	0.00	0.00	0.00	0.01	0.00	0.0	0.00	0.00	0.00	0.0	0.0	0.00	0.03	0.03	0.02	0.57
8	0.16	0.17	0.08	0.07	0.15	0.08	0.11	0.04	0.03	0.01	0.01	0.04	0.10	0.10	0.33	0.17	0.0
9	0.02	0.05	0.08	0.09	0.05	0.05	0.08	0.07	0.05	0.04	0.05	0.09	0.08	0.04	0.03	0.06	0.0

* COMBINED CLASSES ARE DEFINED AS FOLLOWS:
1=UNSTABLE, LOW WIND 2=UNSTABLE, MODERATE WIND 3=UNSTABLE, HIGH WIND
4=NEUTRAL, LOW WIND 5=NEUTRAL MODERATE WIND 6=NEUTRAL, HIGH WIND
7=STABLE, LOW WIND 8=STABLE, MODERATE WIND 9=STABLE, HIGH WIND

Table 3-12. Frequency of occurrence of plume length with distance and direction -- winter season

PLUME LENGTH FREQUENCY TABLE

LINEAR MECHANICAL DRAFT COOLING TOWER -- DUAL LINE ARRAY CONFIGURATION

SEASON=WINTER

DISTANCE FROM TOWER (M)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	SUM
(WIND FROM / PLUME HEADED)	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	SUM
50.	3.62	8.25	20.33	12.65	4.11	2.27	2.69	5.67	7.70	7.56	12.73	5.73	2.04	0.73	0.60	0.77	97.45
100.	3.48	8.25	20.33	12.65	3.71	1.85	2.69	5.35	7.24	7.56	12.73	5.73	2.04	0.51	0.60	0.70	95.41
150.	3.48	8.25	20.33	12.65	3.71	1.85	2.69	5.35	7.24	7.56	12.73	5.73	2.04	0.51	0.60	0.70	95.41
200.	3.48	8.25	20.33	12.65	3.71	1.85	2.69	5.35	7.24	7.56	12.73	5.73	2.04	0.51	0.60	0.70	95.41
250.	3.48	8.25	20.33	12.43	3.71	1.85	2.69	5.35	7.24	7.34	12.73	5.73	2.04	0.51	0.60	0.70	94.97
300.	3.48	8.25	20.20	12.30	3.71	1.85	2.64	4.31	7.24	7.04	12.42	5.60	2.04	0.51	0.60	0.65	92.83
350.	3.48	8.25	20.20	12.23	3.66	1.85	2.64	4.26	7.13	7.04	12.35	5.60	2.04	0.46	0.56	0.65	92.39
400.	3.15	8.21	20.15	12.23	3.66	1.85	2.64	4.26	7.13	6.94	12.31	5.60	2.04	0.46	0.56	0.65	91.83
450.	3.10	8.21	20.15	12.23	3.66	1.81	2.64	4.17	7.04	6.94	12.31	5.60	1.85	0.46	0.56	0.65	91.37
500.	3.01	7.82	19.17	11.90	3.66	1.81	2.64	4.17	7.04	6.94	11.76	5.60	1.85	0.46	0.56	0.65	89.03
550.	3.01	7.82	19.17	11.90	3.66	1.81	2.64	4.17	7.04	6.94	11.76	5.60	1.85	0.46	0.56	0.65	89.03
600.	3.01	7.82	18.98	11.81	3.61	1.81	2.64	4.07	6.90	6.94	11.53	5.51	1.76	0.46	0.51	0.65	88.01
650.	3.01	7.78	18.89	11.76	3.61	1.81	2.64	4.07	6.90	6.90	11.25	5.23	1.76	0.46	0.51	0.65	87.22
700.	3.01	7.78	18.89	11.76	3.33	1.81	2.64	4.07	6.81	6.90	11.25	5.23	1.76	0.46	0.51	0.65	86.85
750.	3.01	7.64	18.70	11.62	3.33	1.81	2.64	4.07	6.81	6.81	11.11	5.14	1.76	0.46	0.51	0.65	86.06
800.	3.01	7.64	18.70	11.62	3.33	1.81	2.50	4.03	6.81	6.81	11.11	5.14	1.76	0.46	0.46	0.65	85.83
850.	3.01	7.64	18.43	11.44	3.19	1.81	2.50	4.03	6.57	6.76	10.46	5.00	1.71	0.46	0.46	0.65	84.12
900.	3.01	7.64	18.43	11.44	3.19	1.81	2.50	4.03	6.57	6.76	10.46	5.00	1.71	0.46	0.46	0.65	84.12
950.	3.01	7.64	18.43	11.44	3.19	1.81	2.50	4.03	6.57	6.76	10.46	5.00	1.71	0.46	0.46	0.65	84.12
1000.	3.01	7.64	18.43	11.44	3.19	1.76	2.45	4.03	6.57	6.76	10.46	5.00	1.71	0.46	0.42	0.60	83.93
1050.	3.01	7.64	18.43	11.44	3.19	1.76	2.45	4.03	6.57	6.76	10.46	5.00	1.71	0.46	0.42	0.60	83.93
1100.	3.01	7.64	18.43	11.44	3.19	1.76	2.45	4.03	6.57	6.76	10.46	5.00	1.71	0.46	0.42	0.60	83.93
1150.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
1200.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
1250.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
1300.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
1350.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
1400.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
1450.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
1500.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
1550.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
1600.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
1650.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
1700.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
1750.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
1800.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
1850.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
1900.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
1950.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
2000.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
2050.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
2100.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
2150.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
2200.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
2250.	3.01	7.41	18.24	11.20	3.19	1.76	2.45	4.03	6.57	6.67	10.28	4.81	1.71	0.46	0.42	0.60	82.82
2300.	3.01	7.41	18.24	11.20	3.19	1.67	2.18	3.80	6.57	6.67	10.28	4.81	1.71	0.37	0.23	0.42	81.76
2350.	3.01	7.41	18.24	11.20	3.19	1.67	2.18	3.80	6.57	6.67	10.28	4.81	1.71	0.37	0.23	0.42	81.76
2400.	2.50	7.41	18.24	11.20	2.82	1.67	2.18	3.80	6.30	6.67	10.28	4.81	1.44	0.37	0.23	0.42	80.32
2450.	2.50	7.41	18.24	11.20	2.82	1.67	2.18	3.80	6.30	6.67	10.28	4.81	1.44	0.37	0.23	0.42	80.32
2500.	2.50	6.39	16.06	10.23	2.82	1.67	2.18	3.80	6.30	6.44	9.72	4.26	1.44	0.37	0.23	0.42	74.81

PLUME LENGTH FREQUENCY TABLE

LINEAR MECHANICAL DRAFT COOLING TOWER — DUAL LINE ARRAY CONFIGURATION

SEASON=WINTER

DISTANCE FROM TOWER (M)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	SUM
PLUME HEADED	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	SUM
2550.	2.50	6.39	16.06	10.23	2.82	1.67	2.18	3.80	6.30	6.44	9.72	4.26	1.44	0.37	0.23	0.42	74.81
2600.	2.41	6.39	16.06	10.23	2.55	1.48	2.04	3.52	5.97	6.44	9.72	4.26	1.34	0.32	0.23	0.37	73.33
2650.	2.41	6.39	16.06	10.23	2.55	1.48	2.04	3.52	5.97	6.44	9.72	4.26	1.34	0.32	0.23	0.37	73.33
2700.	2.41	5.93	15.23	9.68	2.55	1.48	2.04	3.52	5.97	5.79	8.98	3.98	1.34	0.32	0.23	0.37	69.81
2750.	2.41	5.93	15.23	9.68	2.55	1.48	2.04	3.52	5.97	5.79	8.98	3.98	1.34	0.32	0.23	0.37	69.81
2800.	2.41	5.93	15.23	9.68	2.55	1.48	2.04	3.52	5.97	5.79	8.98	3.98	1.34	0.32	0.23	0.37	69.81
2850.	0.51	5.93	15.23	9.68	1.25	1.48	2.04	3.52	3.52	5.79	8.98	3.98	0.42	0.32	0.23	0.37	63.24
2900.	0.51	5.93	15.23	9.68	1.25	1.48	2.04	3.52	3.52	5.79	8.98	3.98	0.42	0.32	0.23	0.37	63.24
2950.	0.51	5.93	15.23	9.68	1.25	0.56	0.69	2.04	3.52	5.79	8.98	3.98	0.42	0.0	0.14	0.14	58.84
3000.	0.51	2.78	5.97	4.95	1.25	0.56	0.69	2.04	3.52	4.44	6.44	2.31	0.42	0.0	0.14	0.14	36.16
3050.	0.51	2.78	5.97	4.95	1.25	0.56	0.69	2.04	3.52	4.44	6.44	2.31	0.42	0.0	0.14	0.14	36.16
3100.	0.51	2.78	5.97	4.95	1.25	0.56	0.69	2.04	3.52	4.44	6.44	2.31	0.42	0.0	0.14	0.14	36.16
3150.	0.51	2.78	5.97	4.95	1.25	0.56	0.69	2.04	3.52	4.44	6.44	2.31	0.42	0.0	0.14	0.14	36.16
3200.	0.51	2.78	5.97	4.95	1.25	0.56	0.60	1.76	3.52	4.44	6.44	2.31	0.42	0.0	0.09	0.14	35.74
3250.	0.51	2.78	5.97	4.95	1.25	0.56	0.60	1.76	3.52	4.44	6.44	2.31	0.42	0.0	0.09	0.14	35.74
3300.	0.46	2.78	5.97	4.95	0.97	0.56	0.60	1.76	3.33	4.44	6.44	2.31	0.42	0.0	0.09	0.14	35.23
3350.	0.46	2.78	5.97	4.95	0.97	0.56	0.60	1.76	3.33	4.44	6.44	2.31	0.42	0.0	0.09	0.14	35.23
3400.	0.46	2.27	5.19	4.54	0.97	0.56	0.60	1.76	3.33	4.31	5.97	2.08	0.42	0.0	0.09	0.14	32.68
3450.	0.46	2.27	5.19	4.54	0.97	0.56	0.60	1.76	3.33	4.31	5.97	2.08	0.42	0.0	0.09	0.14	32.68
3500.	0.46	2.27	5.19	4.54	0.97	0.46	0.46	1.44	3.33	4.31	5.97	2.08	0.42	0.0	0.05	0.14	32.08
3550.	0.46	2.27	5.19	4.54	0.97	0.46	0.46	1.44	3.33	4.31	5.97	2.08	0.42	0.0	0.05	0.14	32.08
3600.	0.46	2.27	5.19	4.54	0.65	0.46	0.46	1.44	2.92	4.31	5.97	2.08	0.32	0.0	0.05	0.14	31.25
3650.	0.46	2.27	5.19	4.54	0.65	0.46	0.46	1.44	2.92	4.31	5.97	2.08	0.32	0.0	0.05	0.14	31.25
3700.	0.46	1.85	4.72	3.98	0.65	0.28	0.19	0.88	2.92	4.03	4.86	1.81	0.32	0.0	0.0	0.14	27.08
3750.	0.46	1.85	4.72	3.98	0.65	0.28	0.19	0.88	2.92	4.03	4.86	1.81	0.32	0.0	0.0	0.14	27.08
3800.	0.46	1.85	4.72	3.98	0.65	0.28	0.19	0.88	2.92	4.03	4.86	1.81	0.32	0.0	0.0	0.14	27.08
3850.	0.46	1.85	4.72	3.98	0.65	0.28	0.19	0.88	2.92	4.03	4.86	1.81	0.32	0.0	0.0	0.14	27.08
3900.	0.23	1.85	4.72	3.98	0.46	0.28	0.19	0.88	2.22	4.03	4.86	1.81	0.28	0.0	0.0	0.14	25.93
3950.	0.23	1.85	4.72	3.98	0.46	0.28	0.19	0.88	2.22	4.03	4.86	1.81	0.28	0.0	0.0	0.14	25.93
4000.	0.23	1.34	2.96	2.78	0.46	0.23	0.19	0.74	2.22	2.69	3.29	1.30	0.28	0.0	0.0	0.14	18.84
4050.	0.23	1.34	2.96	2.78	0.46	0.23	0.19	0.74	2.22	2.69	3.29	1.30	0.28	0.0	0.0	0.14	18.84
4100.	0.23	1.34	2.96	2.78	0.28	0.23	0.19	0.74	1.94	2.69	3.29	1.30	0.28	0.0	0.0	0.14	18.38
4150.	0.23	1.34	2.96	2.78	0.28	0.23	0.19	0.74	1.94	2.69	3.29	1.30	0.28	0.0	0.0	0.14	18.38
4200.	0.23	1.34	2.96	2.78	0.28	0.05	0.09	0.74	1.94	2.69	3.29	1.30	0.28	0.0	0.0	0.05	18.01
4250.	0.23	1.34	2.96	2.78	0.28	0.05	0.09	0.74	1.94	2.69	3.29	1.30	0.28	0.0	0.0	0.05	18.01
4300.	0.19	1.16	2.31	2.41	0.28	0.0	0.05	0.60	1.71	2.36	3.10	1.02	0.19	0.0	0.0	0.0	15.37
4350.	0.19	1.16	2.31	2.41	0.28	0.0	0.05	0.60	1.71	2.36	3.10	1.02	0.19	0.0	0.0	0.0	15.37
4400.	0.14	1.16	2.31	2.41	0.19	0.0	0.05	0.60	1.62	2.36	3.10	1.02	0.19	0.0	0.0	0.0	15.14
4450.	0.14	1.16	2.31	2.41	0.19	0.0	0.05	0.60	1.62	2.36	3.10	1.02	0.19	0.0	0.0	0.0	15.14
4500.	0.05	1.16	2.31	2.41	0.05	0.0	0.05	0.60	1.48	2.36	3.10	1.02	0.09	0.0	0.0	0.0	14.68
4550.	0.05	1.16	2.31	2.41	0.05	0.0	0.05	0.60	1.48	2.36	3.10	1.02	0.09	0.0	0.0	0.0	14.68
4600.	0.05	0.51	1.20	1.53	0.05	0.0	0.05	0.60	1.48	2.08	2.08	0.69	0.09	0.0	0.0	0.0	10.42
4650.	0.05	0.51	1.20	1.53	0.05	0.0	0.05	0.60	1.48	2.08	2.08	0.69	0.09	0.0	0.0	0.0	10.42
4700.	0.05	0.09	0.69	0.93	0.05	0.0	0.05	0.60	1.48	1.67	1.34	0.56	0.09	0.0	0.0	0.0	7.59
4750.	0.05	0.09	0.69	0.93	0.05	0.0	0.05	0.60	1.48	1.67	1.34	0.56	0.09	0.0	0.0	0.0	7.59
4800.	0.05	0.09	0.69	0.93	0.05	0.0	0.05	0.60	1.48	1.67	1.34	0.56	0.09	0.0	0.0	0.0	7.59
4850.	0.05	0.09	0.69	0.93	0.05	0.0	0.05	0.60	1.48	1.67	1.34	0.56	0.09	0.0	0.0	0.0	7.59
4900.	0.05	0.09	0.69	0.93	0.05	0.0	0.05	0.60	1.48	1.67	1.34	0.56	0.09	0.0	0.0	0.0	7.59
4950.	0.05	0.09	0.69	0.93	0.05	0.0	0.05	0.60	1.48	1.67	1.34	0.56	0.09	0.0	0.0	0.0	7.59
5000.	0.05	0.09	0.69	0.93	0.05	0.0	0.05	0.60	1.48	1.67	1.34	0.56	0.09	0.0	0.0	0.0	7.59

Table 3-13. Hours of shadowing with distance and direction due to plume shadow -- winter season

HOURS OF PLUME SHADOWING TABLE

LINEAR MECHANICAL DRAFT COOLING TOWER -- DUAL LINE ARRAY CONFIGURATION

SEASON=WINTER

DISTANCE FROM TOWER (M)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	AVG
	WIND FROM																
	PLUME HEADED																
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	AVG
200.	236.5	291.0	372.0	401.3	396.2	385.8	373.8	326.1	300.7	314.7	311.3	219.6	153.1	117.8	147.5	188.4	283.5
400.	35.5	70.3	133.5	278.6	251.8	198.2	143.3	118.1	147.9	161.6	162.5	76.9	36.9	32.8	49.5	36.5	120.9
600.	12.0	26.0	77.3	203.8	190.1	132.2	78.7	79.2	97.6	108.4	111.3	49.4	20.5	19.2	17.3	18.0	77.5
800.	10.0	19.0	54.2	167.0	152.3	99.1	51.2	67.7	77.1	88.9	74.2	38.7	17.4	12.7	13.0	10.0	59.5
1000.	7.0	14.0	46.0	137.2	136.7	75.1	37.7	57.7	61.5	72.4	59.6	33.9	13.9	10.7	9.0	8.0	48.8
1200.	5.0	11.0	41.0	125.8	124.4	66.1	32.6	48.8	54.1	59.9	51.6	31.7	11.0	10.7	9.0	6.0	43.0
1400.	4.0	10.0	36.0	116.5	106.1	58.4	25.2	43.0	48.9	50.8	40.3	26.4	8.5	9.6	6.0	4.0	37.1
1600.	2.0	7.0	30.0	109.5	99.9	53.7	22.9	38.4	43.8	46.1	36.0	22.2	7.9	8.6	5.0	4.0	33.6
1800.	1.0	3.0	27.0	103.9	95.8	49.4	21.1	35.0	40.8	43.1	33.2	18.3	7.3	8.6	5.0	3.0	31.0
2000.	1.0	2.0	24.0	100.9	90.9	41.9	20.1	30.2	39.8	42.1	30.2	13.7	5.4	7.0	5.0	1.0	28.5
2200.	1.0	0.0	20.0	88.5	85.8	36.4	17.0	27.9	35.8	40.7	25.2	13.7	4.1	6.0	4.0	1.0	25.5
2400.	1.0	0.0	13.0	81.5	80.6	33.2	16.0	27.9	33.8	37.9	25.2	12.3	4.1	6.0	4.0	0.0	23.5
2600.	1.0	0.0	12.0	65.5	78.6	25.9	16.0	26.9	33.8	33.6	25.2	12.3	3.1	6.0	4.0	0.0	21.5
2800.	0.0	0.0	8.0	44.5	74.2	21.1	14.0	24.8	32.8	31.6	24.2	12.9	3.1	6.0	2.0	0.0	18.7
3000.	0.0	0.0	7.0	32.2	69.8	19.0	11.3	24.8	29.4	31.6	23.4	12.2	3.1	4.0	2.0	0.0	16.9
3200.	0.0	0.0	5.0	24.4	64.4	13.8	10.3	23.8	26.0	30.2	21.4	12.2	2.1	3.0	1.0	0.0	14.9
3400.	0.0	0.0	4.0	21.9	59.4	12.8	10.3	17.8	23.0	27.2	19.3	10.2	2.1	3.0	1.0	0.0	13.3
3600.	0.0	0.0	3.0	20.9	54.4	12.8	8.8	17.8	22.0	25.2	19.3	9.2	2.1	3.0	1.0	0.0	12.5
3800.	0.0	0.0	3.0	13.9	51.1	8.9	7.8	17.8	21.0	21.2	18.3	7.2	2.1	2.5	0.0	0.0	10.9
4000.	0.0	0.0	1.0	9.9	42.1	8.9	6.8	15.8	17.6	20.2	18.3	5.4	1.1	2.5	0.0	0.0	9.4
4200.	0.0	0.0	1.0	6.5	39.1	6.6	4.6	14.8	15.6	19.2	18.3	5.4	1.1	2.5	0.0	0.0	8.4
4400.	0.0	0.0	0.0	6.5	38.1	6.6	4.6	13.8	13.9	14.2	15.3	5.4	0.0	2.5	0.0	0.0	7.6
4600.	0.0	0.0	0.0	5.5	34.8	6.6	3.6	13.8	13.9	14.2	15.3	4.9	0.0	1.5	0.0	0.0	7.1
4800.	0.0	0.0	0.0	5.5	26.6	5.9	3.0	13.8	13.9	13.2	15.3	4.9	0.0	1.5	0.0	0.0	6.5
5000.	0.0	0.0	0.0	5.5	22.2	5.9	2.0	13.8	12.5	9.2	15.3	4.0	0.0	1.5	0.0	0.0	5.7
5200.	0.0	0.0	0.0	5.5	15.4	4.8	2.0	13.8	11.5	9.2	14.3	4.0	0.0	0.5	0.0	0.0	5.1
5400.	0.0	0.0	0.0	5.5	13.2	4.8	2.0	12.6	10.5	8.2	14.3	4.0	0.0	0.5	0.0	0.0	4.7
5600.	0.0	0.0	0.0	5.5	8.2	4.8	2.0	10.3	8.5	7.2	12.3	4.0	0.0	0.0	0.0	0.0	3.9
5800.	0.0	0.0	0.0	5.5	8.2	3.7	2.0	9.0	7.5	6.2	11.3	4.0	0.0	0.0	0.0	0.0	3.6
6000.	0.0	0.0	0.0	5.5	7.2	3.7	2.0	7.9	7.5	6.2	11.3	4.0	0.0	0.0	0.0	0.0	3.5
6200.	0.0	0.0	0.0	5.5	7.2	3.7	2.0	7.9	7.5	6.2	11.3	4.0	0.0	0.0	0.0	0.0	3.5
6400.	0.0	0.0	0.0	5.5	5.8	3.7	2.0	5.2	7.5	6.2	11.3	4.0	0.0	0.0	0.0	0.0	3.2
6600.	0.0	0.0	0.0	5.5	5.8	3.7	2.0	5.2	7.5	6.2	10.3	4.0	0.0	0.0	0.0	0.0	3.1
6800.	0.0	0.0	0.0	5.5	5.8	3.7	2.0	5.2	7.5	6.2	9.5	4.0	0.0	0.0	0.0	0.0	3.1
7000.	0.0	0.0	0.0	5.5	4.7	3.7	2.0	5.2	6.5	6.2	9.5	4.0	0.0	0.0	0.0	0.0	3.0
7200.	0.0	0.0	0.0	4.5	4.7	3.7	2.0	4.0	5.5	6.2	9.5	4.0	0.0	0.0	0.0	0.0	2.8
7400.	0.0	0.0	0.0	4.5	3.5	3.1	2.0	4.0	5.5	6.2	8.7	4.0	0.0	0.0	0.0	0.0	2.6
7600.	0.0	0.0	0.0	4.0	3.5	1.9	2.0	4.0	5.5	6.2	8.7	4.0	0.0	0.0	0.0	0.0	2.5
7800.	0.0	0.0	0.0	4.0	3.5	1.9	2.0	4.0	5.5	6.2	8.7	3.0	0.0	0.0	0.0	0.0	2.4
8000.	0.0	0.0	0.0	4.0	3.5	1.3	2.0	4.0	5.5	5.2	7.7	3.0	0.0	0.0	0.0	0.0	2.3

Table 3-14. Total solar energy loss at a given distance and direction due to plume shadow -- winter season

****************************** TOTAL SOLAR ENERGY LOSS TABLE (MJ/M**2) ******************************
LINEAR MECHANICAL DRAFT COOLING TOWER -- DUAL LINE ARRAY CONFIGURATION
SEASON=WINTER

DISTANCE FROM TOWER (M)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	AVG
WIND FROM → PLUME HEADED	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	AVG
200.	87.9	118.7	166.5	175.3	170.5	170.5	177.3	156.5	134.2	137.1	129.5	80.0	47.4	35.9	40.1	59.5	117.9
400.	11.1	27.0	63.5	119.4	97.9	66.1	49.3	41.0	58.5	67.2	58.5	17.0	8.2	7.4	11.1	9.6	44.5
600.	5.6	14.9	37.5	95.4	65.8	39.2	25.4	25.0	38.2	44.8	40.1	9.3	4.1	5.1	5.8	7.5	29.0
800.	5.2	11.7	29.0	82.2	47.6	26.1	16.2	20.6	30.2	35.9	26.7	5.0	3.7	4.2	4.5	4.8	22.1
1000.	3.5	8.8	25.5	69.3	41.6	19.6	13.2	15.9	23.6	29.2	22.2	4.5	2.6	3.5	3.5	4.1	18.2
1200.	2.9	6.3	22.2	63.6	36.1	15.3	11.3	12.4	21.8	24.8	19.1	4.1	1.9	3.5	3.5	3.7	15.8
1400.	2.3	5.9	20.0	58.6	30.2	13.7	9.5	11.2	19.4	21.6	14.8	3.6	1.6	3.4	2.0	2.8	13.8
1600.	1.2	4.1	17.1	54.7	27.9	12.9	8.8	10.2	18.5	18.6	13.3	3.2	1.6	3.0	1.7	2.8	12.5
1800.	0.4	1.5	15.2	52.3	26.9	11.7	8.0	9.5	16.6	17.3	12.3	3.0	1.6	3.0	1.7	2.0	11.4
2000.	0.4	0.7	13.2	50.6	25.2	9.9	7.1	8.6	16.3	16.8	10.8	2.1	1.3	2.7	1.7	0.6	10.5
2200.	0.4	0.0	11.2	44.2	23.3	8.8	6.7	7.9	14.0	16.6	8.9	2.1	1.1	2.0	1.5	0.6	9.3
2400.	0.4	0.0	7.7	39.3	21.6	8.5	6.5	7.9	13.2	15.8	8.9	2.1	1.1	2.0	1.5	0.0	8.5
2600.	0.4	0.0	7.3	29.5	20.4	6.9	6.5	7.0	13.2	14.0	8.9	2.1	1.0	2.0	1.5	0.0	7.5
2800.	0.0	0.0	5.0	18.8	18.2	5.6	5.8	6.1	12.2	13.2	8.2	2.1	1.0	2.0	0.8	0.0	6.2
3000.	0.0	0.0	4.6	13.6	16.6	5.0	4.7	6.1	11.2	13.2	8.1	2.1	1.0	1.1	0.8	0.0	5.5
3200.	0.0	0.0	3.5	11.0	14.5	2.8	4.2	5.7	10.2	12.9	6.8	2.1	0.5	0.4	0.2	0.0	4.7
3400.	0.0	0.0	2.8	10.3	12.6	2.1	4.2	3.3	8.5	12.2	6.4	1.3	0.5	0.4	0.2	0.0	4.1
3600.	0.0	0.0	2.1	9.8	10.3	2.1	3.5	3.3	7.7	10.9	6.4	1.2	0.5	0.4	0.2	0.0	3.7
3800.	0.0	0.0	2.1	6.6	9.5	1.1	2.7	3.3	7.3	9.3	5.9	0.4	0.5	0.4	0.0	0.0	3.1
4000.	0.0	0.0	0.6	4.9	6.9	1.1	2.3	2.9	5.7	9.0	5.9	0.3	0.1	0.4	0.0	0.0	2.5
4200.	0.0	0.0	0.6	3.3	6.0	0.4	1.6	2.1	4.4	8.5	5.9	0.3	0.1	0.4	0.0	0.0	2.1
4400.	0.0	0.0	0.0	3.3	5.9	0.4	1.6	1.8	4.1	6.3	4.5	0.3	0.0	0.4	0.0	0.0	1.8
4600.	0.0	0.0	0.0	2.9	5.0	0.4	0.9	1.8	4.1	6.3	4.5	0.3	0.0	0.2	0.0	0.0	1.7
4800.	0.0	0.0	0.0	2.9	3.9	0.3	0.9	1.8	4.1	6.1	4.5	0.3	0.0	0.2	0.0	0.0	1.6
5000.	0.0	0.0	0.0	2.9	3.5	0.3	0.0	1.8	3.9	4.2	4.5	0.3	0.0	0.2	0.0	0.0	1.4
5200.	0.0	0.0	0.0	2.9	2.1	0.2	0.0	1.8	3.3	4.2	3.6	0.3	0.0	0.0	0.0	0.0	1.1
5400.	0.0	0.0	0.0	2.9	1.7	0.2	0.0	1.6	2.8	3.5	3.6	0.3	0.0	0.0	0.0	0.0	1.0
5600.	0.0	0.0	0.0	2.9	0.8	0.2	0.0	1.5	2.2	2.9	2.1	0.3	0.0	0.0	0.0	0.0	0.8
5800.	0.0	0.0	0.0	2.9	0.8	0.2	0.0	1.3	1.6	2.5	1.8	0.3	0.0	0.0	0.0	0.0	0.7
6000.	0.0	0.0	0.0	2.9	0.6	0.2	0.0	1.2	1.6	2.5	1.8	0.3	0.0	0.0	0.0	0.0	0.7
6200.	0.0	0.0	0.0	2.9	0.6	0.2	0.0	1.2	1.6	2.5	1.8	0.3	0.0	0.0	0.0	0.0	0.7
6400.	0.0	0.0	0.0	2.9	0.4	0.2	0.0	0.7	1.6	2.5	1.8	0.3	0.0	0.0	0.0	0.0	0.7
6600.	0.0	0.0	0.0	2.9	0.4	0.2	0.0	0.7	1.6	2.5	1.5	0.3	0.0	0.0	0.0	0.0	0.6
6800.	0.0	0.0	0.0	2.9	0.4	0.2	0.0	0.7	1.6	2.5	1.4	0.3	0.0	0.0	0.0	0.0	0.6
7000.	0.0	0.0	0.0	2.9	0.3	0.2	0.0	0.7	1.3	2.5	1.4	0.3	0.0	0.0	0.0	0.0	0.6
7200.	0.0	0.0	0.0	2.3	0.3	0.2	0.0	0.6	1.2	2.5	1.4	0.3	0.0	0.0	0.0	0.0	0.5
7400.	0.0	0.0	0.0	2.3	0.1	0.1	0.0	0.6	1.2	2.5	1.4	0.3	0.0	0.0	0.0	0.0	0.5
7600.	0.0	0.0	0.0	2.3	0.1	0.0	0.0	0.6	1.2	2.5	1.4	0.3	0.0	0.0	0.0	0.0	0.5
7800.	0.0	0.0	0.0	2.3	0.1	0.0	0.0	0.6	1.2	2.5	1.4	0.1	0.0	0.0	0.0	0.0	0.5
8000.	0.0	0.0	0.0	2.3	0.1	0.0	0.0	0.6	1.2	2.3	1.2	0.1	0.0	0.0	0.0	0.0	0.5

Table 3-15. Percent of energy loss compared to the total solar heat flux incident on the ground -- winter season

************************************ PERCENT TOTAL ENERGY LOSS TABLE ************************************

LINEAR MECHANICAL DRAFT COOLING TOWER -- DUAL LINE ARRAY CONFIGURATION

SEASON=WINTER

DISTANCE FROM TOWER (M)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	AVG
	WIND FROM																
	PLUME HEADED																
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	AVG
200.	14.0	19.0	26.6	28.0	27.2	27.2	28.3	25.0	21.4	21.9	20.7	12.8	7.6	5.7	6.4	9.5	18.8
400.	1.8	4.3	10.1	19.1	15.6	10.6	7.9	6.6	9.3	10.7	9.3	2.7	1.3	1.2	1.8	1.5	7.1
600.	0.9	2.4	6.0	15.2	10.5	6.3	4.1	4.0	6.1	7.1	6.4	1.5	0.6	0.8	0.9	1.2	4.6
800.	0.8	1.9	4.6	13.1	7.6	4.2	2.6	3.3	4.8	5.7	4.3	0.8	0.6	0.7	0.7	0.8	3.5
1000.	0.6	1.4	4.1	11.1	6.6	3.1	2.1	2.5	3.8	4.7	3.5	0.7	0.4	0.6	0.6	0.7	2.9
1200.	0.5	1.0	3.5	10.1	5.8	2.4	1.8	2.0	3.5	4.0	3.0	0.7	0.3	0.6	0.6	0.6	2.5
1400.	0.4	0.9	3.2	9.4	4.8	2.2	1.5	1.8	3.1	3.5	2.4	0.6	0.2	0.5	0.3	0.5	2.2
1600.	0.2	0.7	2.7	8.7	4.5	2.1	1.4	1.6	3.0	3.0	2.1	0.5	0.2	0.5	0.3	0.5	2.0
1800.	0.1	0.2	2.4	8.4	4.3	1.9	1.3	1.5	2.6	2.8	2.0	0.5	0.2	0.5	0.3	0.3	1.8
2000.	0.1	0.1	2.1	8.1	4.0	1.6	1.1	1.4	2.6	2.7	1.7	0.3	0.2	0.4	0.3	0.1	1.7
2200.	0.1	0.0	1.8	7.1	3.7	1.4	1.1	1.3	2.2	2.7	1.4	0.3	0.2	0.3	0.2	0.1	1.5
2400.	0.1	0.0	1.2	6.3	3.5	1.4	1.0	1.3	2.1	2.5	1.4	0.3	0.2	0.3	0.2	0.0	1.4
2600.	0.1	0.0	1.2	4.7	3.3	1.1	1.0	1.1	2.1	2.2	1.4	0.3	0.2	0.3	0.2	0.0	1.2
2800.	0.0	0.0	0.8	3.0	2.9	0.9	0.9	1.0	2.0	2.1	1.3	0.3	0.2	0.3	0.1	0.0	1.0
3000.	0.0	0.0	0.7	2.2	2.7	0.8	0.8	1.0	1.8	2.1	1.3	0.3	0.2	0.2	0.1	0.0	0.9
3200.	0.0	0.0	0.6	1.8	2.3	0.5	0.7	0.9	1.6	2.1	1.1	0.3	0.1	0.1	0.0	0.0	0.7
3400.	0.0	0.0	0.5	1.6	2.0	0.3	0.7	0.5	1.4	1.9	1.0	0.2	0.1	0.1	0.0	0.0	0.6
3600.	0.0	0.0	0.3	1.6	1.6	0.3	0.6	0.5	1.2	1.7	1.0	0.2	0.1	0.1	0.0	0.0	0.6
3800.	0.0	0.0	0.3	1.1	1.5	0.2	0.4	0.5	1.2	1.5	0.9	0.1	0.1	0.1	0.0	0.0	0.5
4000.	0.0	0.0	0.1	0.8	1.1	0.2	0.4	0.5	0.9	1.4	0.9	0.1	0.0	0.1	0.0	0.0	0.4
4200.	0.0	0.0	0.1	0.5	1.0	0.1	0.3	0.3	0.7	1.4	0.9	0.1	0.0	0.1	0.0	0.0	0.3
4400.	0.0	0.0	0.0	0.5	0.9	0.1	0.3	0.3	0.7	1.0	0.7	0.1	0.0	0.1	0.0	0.0	0.3
4600.	0.0	0.0	0.0	0.5	0.8	0.1	0.1	0.3	0.7	1.0	0.7	0.1	0.0	0.0	0.0	0.0	0.3
4800.	0.0	0.0	0.0	0.5	0.6	0.1	0.1	0.3	0.7	1.0	0.7	0.1	0.0	0.0	0.0	0.0	0.3
5000.	0.0	0.0	0.0	0.5	0.6	0.1	0.0	0.3	0.6	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.2
5200.	0.0	0.0	0.0	0.5	0.3	0.0	0.0	0.3	0.5	0.7	0.6	0.0	0.0	0.0	0.0	0.0	0.2
5400.	0.0	0.0	0.0	0.5	0.3	0.0	0.0	0.3	0.4	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.2
5600.	0.0	0.0	0.0	0.5	0.1	0.0	0.0	0.2	0.3	0.5	0.3	0.0	0.0	0.0	0.0	0.0	0.1
5800.	0.0	0.0	0.0	0.5	0.1	0.0	0.0	0.2	0.3	0.4	0.3	0.0	0.0	0.0	0.0	0.0	0.1
6000.	0.0	0.0	0.0	0.5	0.1	0.0	0.0	0.2	0.3	0.4	0.3	0.0	0.0	0.0	0.0	0.0	0.1
6200.	0.0	0.0	0.0	0.5	0.1	0.0	0.0	0.2	0.3	0.4	0.3	0.0	0.0	0.0	0.0	0.0	0.1
6400.	0.0	0.0	0.0	0.5	0.1	0.0	0.0	0.1	0.3	0.4	0.3	0.0	0.0	0.0	0.0	0.0	0.1
6600.	0.0	0.0	0.0	0.5	0.1	0.0	0.0	0.1	0.3	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.1
6800.	0.0	0.0	0.0	0.5	0.1	0.0	0.0	0.1	0.3	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.1
7000.	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.1	0.2	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.1
7200.	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.1	0.2	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.1
7400.	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.1	0.2	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.1
7600.	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.1	0.2	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.1
7800.	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.1	0.2	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.1
8000.	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.1	0.2	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.1

Table 3-16. Percent loss of direct (beam) energy incident on the ground due to plume shadow -- winter season

PERCENT BEAM ENERGY LOSS TABLE

LINEAR MECHANICAL DRAFT COOLING TOWER -- DUAL LINE ARRAY CONFIGURATION

SEASON=WINTER

DISTANCE FROM TOWER (M)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	AVG
WIND FROM / PLUME HEADED	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	AVG
200.	22.9	30.9	43.3	45.6	44.3	44.3	46.1	40.7	34.9	35.6	33.7	20.8	12.3	9.3	10.4	15.5	30.7
400.	2.9	7.0	16.5	31.1	25.5	17.2	12.8	10.7	15.2	17.5	15.2	4.4	2.1	1.9	2.9	2.5	11.6
600.	1.5	3.9	9.8	24.8	17.1	10.2	6.6	6.5	9.9	11.6	10.4	2.4	1.1	1.3	1.5	1.9	7.5
800.	1.3	3.1	7.6	21.4	12.4	6.8	4.2	5.3	7.9	9.3	6.9	1.3	1.0	1.1	1.2	1.3	5.7
1000.	0.9	2.3	6.6	18.0	10.8	5.1	3.4	4.1	6.1	7.6	5.8	1.2	0.7	0.9	0.9	1.1	4.7
1200.	0.7	1.6	5.8	16.5	9.4	4.0	2.9	3.2	5.7	6.4	5.0	1.1	0.5	0.9	0.9	1.0	4.1
1400.	0.6	1.5	5.2	15.2	7.9	3.6	2.5	2.9	5.0	5.6	3.8	0.9	0.4	0.9	0.5	0.7	3.6
1600.	0.3	1.1	4.4	14.2	7.3	3.3	2.3	2.7	4.8	4.8	3.5	0.8	0.4	0.8	0.4	0.7	3.2
1800.	0.1	0.4	3.9	13.6	7.0	3.0	2.1	2.5	4.3	4.5	3.2	0.8	0.4	0.8	0.4	0.5	3.0
2000.	0.1	0.2	3.4	13.1	6.5	2.6	1.9	2.2	4.2	4.4	2.8	0.6	0.3	0.7	0.4	0.2	2.7
2200.	0.1	0.0	2.9	11.5	6.1	2.3	1.7	2.1	3.6	4.3	2.3	0.6	0.3	0.5	0.4	0.2	2.4
2400.	0.1	0.0	2.0	10.2	5.6	2.2	1.7	2.1	3.4	4.1	2.3	0.6	0.3	0.5	0.4	0.0	2.2
2600.	0.1	0.0	1.9	7.7	5.3	1.8	1.7	1.8	3.4	3.7	2.3	0.6	0.3	0.5	0.4	0.0	2.0
2800.	0.0	0.0	1.3	4.9	4.7	1.5	1.5	1.6	3.2	3.4	2.1	0.6	0.3	0.5	0.2	0.0	1.6
3000.	0.0	0.0	1.2	3.5	4.3	1.3	1.2	1.6	2.9	3.4	2.1	0.5	0.3	0.3	0.2	0.0	1.4
3200.	0.0	0.0	0.9	2.9	3.8	0.7	1.1	1.5	2.6	3.4	1.8	0.5	0.1	0.1	0.1	0.0	1.2
3400.	0.0	0.0	0.7	2.7	3.3	0.6	1.1	0.9	2.2	3.2	1.7	0.3	0.1	0.1	0.1	0.0	1.1
3600.	0.0	0.0	0.5	2.6	2.7	0.6	0.9	0.9	2.0	2.8	1.7	0.3	0.1	0.1	0.1	0.0	0.9
3800.	0.0	0.0	0.5	1.7	2.5	0.3	0.7	0.9	1.9	2.4	1.5	0.1	0.1	0.1	0.0	0.0	0.8
4000.	0.0	0.0	0.2	1.3	1.8	0.3	0.6	0.7	1.5	2.3	1.5	0.1	0.0	0.1	0.0	0.0	0.7
4200.	0.0	0.0	0.2	0.9	1.6	0.1	0.4	0.6	1.2	2.2	1.5	0.1	0.0	0.1	0.0	0.0	0.5
4400.	0.0	0.0	0.0	0.9	1.5	0.1	0.4	0.5	1.1	1.6	1.2	0.1	0.0	0.1	0.0	0.0	0.5
4600.	0.0	0.0	0.0	0.8	1.3	0.1	0.2	0.5	1.1	1.6	1.2	0.1	0.0	0.1	0.0	0.0	0.4
4800.	0.0	0.0	0.0	0.8	1.0	0.1	0.2	0.5	1.1	1.6	1.2	0.1	0.0	0.1	0.0	0.0	0.4
5000.	0.0	0.0	0.0	0.8	0.9	0.1	0.0	0.5	1.0	1.1	1.2	0.1	0.0	0.1	0.0	0.0	0.4
5200.	0.0	0.0	0.0	0.8	0.5	0.1	0.0	0.5	0.8	1.1	0.9	0.1	0.0	0.0	0.0	0.0	0.3
5400.	0.0	0.0	0.0	0.8	0.4	0.1	0.0	0.4	0.7	0.9	0.9	0.1	0.0	0.0	0.0	0.0	0.3
5600.	0.0	0.0	0.0	0.8	0.2	0.1	0.0	0.4	0.6	0.7	0.5	0.1	0.0	0.0	0.0	0.0	0.2
5800.	0.0	0.0	0.0	0.8	0.2	0.0	0.0	0.3	0.4	0.6	0.5	0.1	0.0	0.0	0.0	0.0	0.2
6000.	0.0	0.0	0.0	0.8	0.2	0.0	0.0	0.3	0.4	0.6	0.5	0.1	0.0	0.0	0.0	0.0	0.2
6200.	0.0	0.0	0.0	0.8	0.2	0.0	0.0	0.3	0.4	0.6	0.5	0.1	0.0	0.0	0.0	0.0	0.2
6400.	0.0	0.0	0.0	0.8	0.1	0.0	0.0	0.2	0.4	0.6	0.5	0.1	0.0	0.0	0.0	0.0	0.2
6600.	0.0	0.0	0.0	0.8	0.1	0.0	0.0	0.2	0.4	0.6	0.4	0.1	0.0	0.0	0.0	0.0	0.2
6800.	0.0	0.0	0.0	0.8	0.1	0.0	0.0	0.2	0.4	0.6	0.4	0.1	0.0	0.0	0.0	0.0	0.2
7000.	0.0	0.0	0.0	0.8	0.1	0.0	0.0	0.2	0.4	0.6	0.4	0.1	0.0	0.0	0.0	0.0	0.2
7200.	0.0	0.0	0.0	0.6	0.1	0.0	0.0	0.2	0.3	0.6	0.4	0.1	0.0	0.0	0.0	0.0	0.1
7400.	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.2	0.3	0.6	0.4	0.1	0.0	0.0	0.0	0.0	0.1
7600.	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.2	0.3	0.6	0.4	0.1	0.0	0.0	0.0	0.0	0.1
7800.	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.2	0.3	0.6	0.4	0.0	0.0	0.0	0.0	0.0	0.1
8000.	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.2	0.3	0.6	0.3	0.0	0.0	0.0	0.0	0.0	0.1

Table 3-17. Salt drift deposition as a function of distance and direction -- winter season

************************************ PLUME SALT DEPOSITION TABLE (KG./(KM.**2-MO.)) ************************************

LINEAR MECHANICAL DRAFT COOLING TOWER -- DUAL LINE ARRAY CONFIGURATION

SEASON=WINTER

ISTANCE FROM TOWER (M)	WIND FROM: N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	AVG
	PLUME HEADED: S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	AVG
100.	6597.	13445.	33690.	22522.	7560.	4470.	5306.	12161.	16159.	16735.	24562.	10585.	3881.	1426.	1142.	1495.	11358.
200.	859.	2025.	4966.	2905.	865.	413.	489.	1155.	1500.	1580.	2707.	1349.	484.	127.	125.	153.	1356.
300.	155.	539.	1319.	806.	162.	68.	81.	233.	355.	456.	778.	361.	92.	32.	37.	43.	345.
400.	65.76	236.79	541.97	309.16	91.64	32.79	62.67	97.84	190.85	157.64	299.27	154.01	40.87	16.29	29.23	31.90	147.42
500.	81.91	154.79	362.48	219.08	82.58	16.82	32.99	43.67	121.40	122.41	220.84	105.97	46.44	8.84	15.61	16.13	103.25
600.	47.55	115.24	280.52	166.44	57.02	12.50	19.93	31.68	94.22	95.23	162.41	76.50	26.54	4.52	6.97	7.49	75.30
700.	35.89	63.74	152.38	88.73	35.35	11.78	17.82	29.86	69.26	44.60	87.70	43.23	20.50	3.82	5.56	6.08	44.77
800.	18.03	46.01	106.28	65.54	18.24	10.58	15.94	27.02	35.83	36.84	69.68	32.67	10.56	3.39	4.43	5.03	31.63
900.	15.63	37.57	86.35	56.74	16.46	7.36	10.31	20.25	30.18	34.60	59.81	26.54	9.05	2.17	2.85	3.43	26.21
1000.	12.97	32.35	74.19	48.30	14.52	5.25	6.90	16.67	27.87	30.74	50.61	22.48	7.02	1.28	2.20	2.50	22.24
1100.	9.52	26.55	64.40	40.68	13.34	5.10	6.46	16.30	24.74	26.79	43.17	18.85	5.80	1.13	1.91	2.21	19.18
1200.	8.38	19.06	49.19	29.87	11.48	4.80	6.13	15.03	22.64	20.09	30.20	13.68	5.19	1.02	1.71	1.93	15.03
1300.	7.22	16.55	41.99	23.96	8.05	4.24	5.79	11.50	18.46	11.94	21.17	10.44	4.43	0.84	1.37	1.51	11.84
1400.	6.19	14.63	38.22	21.84	5.92	3.85	5.19	10.54	13.61	10.28	18.92	9.31	3.51	0.84	1.13	1.28	10.33
1500.	5.66	12.57	32.69	.18.97	5.11	2.91	3.87	7.10	9.69	9.47	16.84	8.10	2.94	0.76	0.70	0.93	8.64
1600.	5.39	7.03	17.09	10.74	5.06	2.44	3.19	5.95	9.56	6.84	11.98	5.12	2.90	0.67	0.52	0.81	5.96
1700.	4.86	6.66	16.41	10.21	4.66	2.35	3.12	5.82	9.14	6.30	11.17	4.89	2.66	0.65	0.52	0.79	5.64
1800.	3.81	6.24	15.53	9.48	3.84	2.33	3.11	5.70	7.66	5.68	9.87	4.50	2.13	0.64	0.52	0.77	5.11
1900.	3.10	6.02	14.90	9.14	3.20	2.27	3.10	5.38	6.57	5.38	9.46	4.30	1.78	0.64	0.51	0.74	4.78
2000.	3.07	5.33	13.26	8.40	3.08	2.48	3.39	5.67	6.32	5.10	8.75	3.77	1.74	0.72	0.51	0.79	4.52
2100.	3.04	5.16	12.86	8.13	3.03	2.61	3.56	5.79	6.01	5.01	8.49	3.65	1.71	0.76	0.45	0.75	4.44
2200.	3.62	7.25	19.04	11.27	3.37	2.40	3.24	5.32	6.64	5.89	10.17	4.75	1.93	0.70	0.40	0.69	5.42
2300.	4.44	8.62	23.00	13.28	3.94	2.21	2.98	5.02	7.68	6.47	11.10	5.44	2.25	0.64	0.38	0.65	6.13
2400.	4.27	8.30	22.38	12.80	3.79	2.20	2.98	5.01	7.51	6.31	10.42	5.23	2.12	0.64	0.38	0.64	5.94
2500.	3.68	6.88	18.67	10.62	3.52	2.03	2.72	4.72	7.00	5.37	8.95	4.38	1.93	0.57	0.36	0.60	5.12
2600.	2.71	5.58	14.80	8.24	2.81	1.62	2.12	4.04	5.61	3.85	6.98	3.37	1.43	0.42	0.31	0.49	4.02
2700.	2.52	5.06	13.70	7.48	2.35	1.59	2.09	3.44	4.87	3.20	5.90	3.02	1.36	0.40	0.29	0.46	3.61
2800.	2.49	5.04	13.70	7.48	2.08	1.52	2.08	3.08	4.62	3.06	5.67	3.02	1.34	0.40	0.29	0.46	3.52
2900.	2.41	4.67	12.65	6.94	1.93	1.40	1.97	2.76	3.95	2.84	5.20	2.78	1.27	0.40	0.24	0.37	3.24
3000.	1.72	3.50	9.31	5.24	1.46	1.01	1.45	2.14	2.72	2.33	4.23	2.15	0.91	0.29	0.19	0.26	2.43
3100.	1.64	3.50	9.31	5.24	1.39	0.95	1.37	1.98	2.60	2.33	4.23	2.15	0.87	0.28	0.18	0.24	2.39
3200.	1.64	3.49	9.29	5.23	1.39	0.87	1.22	1.68	2.60	2.32	4.17	2.09	0.87	0.27	0.14	0.24	2.34
3300.	1.64	3.43	9.12	5.17	1.39	0.87	1.21	1.67	2.60	2.31	4.07	2.04	0.87	0.27	0.12	0.23	2.31
3400.	1.64	3.31	8.84	5.05	1.39	0.90	1.23	1.71	2.60	2.28	3.95	2.00	0.87	0.28	0.12	0.23	2.27
3500.	1.64	3.31	8.83	5.04	1.39	0.90	1.23	1.71	2.60	2.28	3.94	2.00	0.87	0.28	0.12	0.23	2.27
3600.	1.45	2.68	7.00	4.12	1.27	0.78	1.06	1.52	2.37	2.00	3.43	1.67	0.78	0.24	0.11	0.20	1.92
3700.	1.18	2.52	6.55	3.89	1.08	0.66	0.89	1.33	2.02	1.92	3.30	1.59	0.65	0.20	0.10	0.17	1.75
3800.	1.16	2.52	6.55	3.89	1.07	0.66	0.89	1.33	1.98	1.92	3.30	1.59	0.59	0.20	0.10	0.17	1.75
3900.	1.12	2.42	6.31	3.71	1.03	0.64	0.87	1.30	1.94	1.86	2.98	1.51	0.57	0.19	0.10	0.17	1.67
4000.	1.12	2.32	6.16	3.57	1.03	0.61	0.85	1.26	1.94	1.79	2.80	1.46	0.57	0.18	0.10	0.16	1.62
4100.	1.12	1.99	5.25	3.07	1.03	0.61	0.85	1.26	1.94	1.59	2.51	1.26	0.57	0.18	0.10	0.16	1.47
4200.	0.73	1.37	3.49	2.15	0.75	0.40	0.54	0.92	1.41	1.33	2.01	0.92	0.37	0.11	0.08	0.11	1.04
4300.	0.63	1.35	3.42	2.09	0.68	0.37	0.50	0.88	1.27	1.29	1.93	0.90	0.32	0.10	0.08	0.10	0.99
4400.	0.61	1.33	3.38	2.06	0.68	0.37	0.50	0.88	1.27	1.27	1.88	0.88	0.32	0.10	0.08	0.10	0.98
4500.	0.60	1.33	3.34	2.02	0.68	0.37	0.50	0.88	1.27	1.20	1.82	0.86	0.32	0.10	0.08	0.10	0.97
4600.	0.55	1.31	3.26	1.92	0.68	0.37	0.50	0.87	1.27	1.03	1.68	0.80	0.32	0.10	0.08	0.10	0.93
4700.	0.55	1.31	3.26	1.92	0.68	0.37	0.50	0.87	1.27	1.03	1.68	0.80	0.32	0.10	0.08	0.10	0.93
4800.	0.53	1.23	3.11	1.82	0.64	0.37	0.50	0.86	1.22	0.91	1.55	0.75	0.31	0.10	0.08	0.10	0.88
4900.	0.52	1.11	2.77	1.64	0.64	0.34	0.48	0.83	1.20	0.85	1.45	0.68	0.30	0.09	0.08	0.09	0.82
5000.	0.36	0.85	2.01	1.26	0.52	0.24	0.33	0.66	0.99	0.74	1.24	0.55	0.22	0.06	0.07	0.07	0.64

************************************ PLUME SALT DEPOSITION TABLE (KG./(KM.**2-MO.)) ************************************

LINEAR MECHANICAL DRAFT COOLING TOWER -- DUAL LINE ARRAY CONFIGURATION

SEASON=WINTER

DISTANCE FROM TOWER (M)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	AVG
WIND FROM / PLUME HEADED	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	AVG
5100.	0.30	0.85	2.01	1.26	0.46	0.23	0.31	0.59	0.89	0.74	1.24	0.55	0.19	0.05	0.06	0.07	0.61
5200.	0.30	0.85	2.01	1.26	0.46	0.23	0.32	0.59	0.90	0.74	1.24	0.55	0.19	0.05	0.06	0.07	0.61
5300.	0.30	0.85	2.01	1.25	0.43	0.24	0.32	0.60	0.78	0.74	1.23	0.55	0.18	0.05	0.06	0.07	0.60
5400.	0.30	0.85	2.01	1.25	0.43	0.23	0.32	0.58	0.77	0.74	1.23	0.55	0.18	0.05	0.06	0.07	0.60
5500.	0.30	0.85	2.01	1.25	0.43	0.23	0.32	0.58	0.77	0.74	1.23	0.55	0.18	0.05	0.06	0.07	0.60
5600.	0.30	0.85	2.00	1.24	0.43	0.23	0.31	0.58	0.77	0.74	1.23	0.54	0.18	0.05	0.06	0.06	0.60
5700.	0.29	0.84	1.97	1.22	0.41	0.22	0.31	0.58	0.75	0.72	1.21	0.53	0.18	0.05	0.05	0.06	0.59
5800.	0.28	0.78	1.86	1.15	0.38	0.22	0.30	0.57	0.71	0.64	1.11	0.49	0.17	0.05	0.05	0.06	0.55
5900.	0.28	0.71	1.76	1.08	0.35	0.19	0.28	0.53	0.69	0.61	1.02	0.45	0.17	0.04	0.05	0.05	0.52
6000.	0.28	0.64	1.65	1.02	0.31	0.19	0.27	0.50	0.65	0.59	0.94	0.42	0.16	0.04	0.05	0.05	0.48
6100.	0.28	0.64	1.65	1.02	0.29	0.18	0.25	0.43	0.62	0.59	0.94	0.42	0.15	0.04	0.04	0.05	0.47
6200.	0.28	0.51	1.26	0.81	0.29	0.18	0.25	0.43	0.62	0.53	0.83	0.35	0.15	0.04	0.04	0.05	0.41
6300.	0.21	0.36	0.82	0.59	0.24	0.14	0.19	0.37	0.54	0.42	0.68	0.27	0.12	0.03	0.03	0.04	0.32
6400.	0.11	0.34	0.75	0.53	0.17	0.10	0.11	0.29	0.37	0.39	0.62	0.24	0.07	0.01	0.02	0.03	0.26
6500.	0.11	0.34	0.75	0.53	0.17	0.10	0.11	0.28	0.37	0.39	0.62	0.24	0.07	0.01	0.02	0.03	0.26
6600.	0.11	0.34	0.75	0.53	0.17	0.09	0.11	0.27	0.37	0.39	0.62	0.24	0.07	0.01	0.02	0.03	0.26
6700.	0.11	0.34	0.75	0.53	0.17	0.08	0.10	0.23	0.37	0.39	0.62	0.24	0.07	0.01	0.02	0.03	0.25
6800.	0.11	0.34	0.75	0.53	0.17	0.08	0.10	0.23	0.37	0.39	0.62	0.24	0.07	0.01	0.02	0.03	0.25
6900.	0.11	0.34	0.75	0.53	0.17	0.08	0.10	0.23	0.37	0.39	0.62	0.24	0.07	0.01	0.02	0.03	0.25
7000.	0.13	0.33	0.73	0.52	0.19	0.08	0.10	0.23	0.44	0.38	0.61	0.23	0.07	0.01	0.02	0.03	0.26
7100.	0.13	0.31	0.68	0.48	0.19	0.08	0.10	0.23	0.43	0.35	0.57	0.22	0.07	0.01	0.02	0.03	0.24
7200.	0.13	0.31	0.68	0.48	0.18	0.08	0.10	0.23	0.41	0.35	0.57	0.22	0.07	0.01	0.02	0.03	0.24
7300.	0.12	0.28	0.65	0.44	0.16	0.07	0.09	0.22	0.38	0.33	0.49	0.20	0.06	0.01	0.02	0.02	0.22
7400.	0.09	0.27	0.64	0.43	0.13	0.07	0.09	0.22	0.31	0.32	0.46	0.19	0.06	0.01	0.02	0.02	0.21
7500.	0.09	0.25	0.62	0.40	0.13	0.07	0.09	0.22	0.31	0.31	0.44	0.18	0.06	0.01	0.02	0.02	0.20
7600.	0.09	0.24	0.61	0.39	0.12	0.07	0.09	0.21	0.29	0.31	0.44	0.18	0.06	0.01	0.02	0.02	0.20
7700.	0.09	0.22	0.55	0.36	0.10	0.07	0.09	0.21	0.27	0.25	0.38	0.17	0.05	0.01	0.02	0.02	0.18
7800.	0.09	0.22	0.53	0.35	0.10	0.07	0.09	0.20	0.27	0.23	0.37	0.17	0.05	0.01	0.02	0.02	0.17
7900.	0.09	0.22	0.53	0.35	0.10	0.06	0.08	0.15	0.27	0.23	0.37	0.17	0.05	0.01	0.02	0.02	0.17
8000.	0.08	0.22	0.53	0.35	0.10	0.06	0.08	0.14	0.23	0.23	0.36	0.16	0.04	0.01	0.02	0.02	0.16
8100.	0.07	0.21	0.51	0.34	0.10	0.06	0.07	0.13	0.23	0.23	0.34	0.16	0.04	0.01	0.01	0.02	0.16
8200.	0.07	0.21	0.51	0.34	0.10	0.06	0.07	0.12	0.23	0.23	0.34	0.16	0.04	0.01	0.01	0.02	0.16
8300.	0.07	0.21	0.51	0.34	0.10	0.06	0.07	0.12	0.23	0.23	0.34	0.16	0.04	0.01	0.01	0.02	0.16
8400.	0.07	0.21	0.51	0.34	0.10	0.06	0.07	0.12	0.23	0.23	0.34	0.16	0.04	0.01	0.01	0.02	0.16
8500.	0.07	0.20	0.47	0.31	0.09	0.06	0.07	0.12	0.22	0.20	0.31	0.15	0.04	0.01	0.01	0.02	0.15
8600.	0.07	0.18	0.43	0.28	0.09	0.05	0.07	0.12	0.21	0.18	0.28	0.13	0.04	0.01	0.01	0.02	0.14
8700.	0.07	0.18	0.43	0.28	0.09	0.05	0.06	0.12	0.21	0.18	0.28	0.13	0.04	0.01	0.01	0.02	0.14
8800.	0.07	0.18	0.43	0.28	0.09	0.05	0.06	0.12	0.21	0.18	0.28	0.13	0.04	0.01	0.01	0.02	0.14
8900.	0.07	0.18	0.43	0.28	0.09	0.04	0.06	0.12	0.21	0.18	0.28	0.13	0.04	0.01	0.01	0.02	0.13
9000.	0.07	0.17	0.43	0.27	0.08	0.04	0.06	0.12	0.21	0.18	0.27	0.13	0.04	0.01	0.01	0.02	0.13
9100.	0.07	0.17	0.43	0.27	0.08	0.04	0.06	0.12	0.20	0.18	0.27	0.13	0.04	0.01	0.01	0.02	0.13
9200.	0.07	0.17	0.43	0.27	0.08	0.04	0.06	0.12	0.20	0.18	0.27	0.13	0.04	0.01	0.01	0.02	0.13
9300.	0.07	0.17	0.44	0.29	0.08	0.04	0.06	0.12	0.21	0.21	0.30	0.14	0.04	0.01	0.01	0.02	0.14
9400.	0.06	0.16	0.42	0.28	0.07	0.04	0.06	0.13	0.21	0.22	0.29	0.13	0.04	0.01	0.01	0.01	0.13
9500.	0.06	0.16	0.42	0.28	0.07	0.04	0.06	0.13	0.21	0.22	0.29	0.13	0.04	0.01	0.01	0.01	0.13
9600.	0.06	0.16	0.42	0.28	0.07	0.04	0.06	0.13	0.21	0.22	0.29	0.13	0.04	0.01	0.01	0.01	0.13
9700.	0.06	0.16	0.42	0.28	0.07	0.04	0.06	0.12	0.21	0.22	0.29	0.13	0.04	0.01	0.01	0.01	0.13
9800.	0.06	0.16	0.42	0.28	0.07	0.04	0.05	0.11	0.20	0.22	0.29	0.13	0.04	0.01	0.01	0.01	0.13
9900.	0.06	0.16	0.42	0.28	0.07	0.04	0.05	0.11	0.20	0.22	0.29	0.13	0.04	0.01	0.01	0.01	0.13
10000.	0.06	0.13	0.34	0.24	0.07	0.04	0.05	0.11	0.20	0.20	0.27	0.12	0.04	0.01	0.01	0.01	0.12

Table 3-18. Hours of plume fogging as a function of direction from the tower and distance -- winter season

**************** HOURS OF PLUME FOGGING TABLE ****************

LINEAR MECHANICAL DRAFT COOLING TOWER -- DUAL LINE ARRAY CONFIGURATION

SEASON=WINTER

DISTANCE FROM TOWER (M)	WIND FROM N / PLUME HEADED S	NNE / SSW	NE / SW	ENE / WSW	E / W	ESE / WNW	SE / NW	SSE / NNW	S / N	SSW / NNE	SW / NE	WSW / ENE	W / E	WNW / ESE	NW / SE	NNW / SSE	AVG / AVG
100.	0.0	0.1	0.7	0.9	0.7	0.1	0.0	1.0	5.1	11.8	14.4	9.0	1.7	0.0	0.0	0.0	43.6
200.	0.0	0.0	0.3	1.0	0.3	0.0	0.0	0.0	3.1	10.5	13.1	6.5	1.0	0.0	0.0	0.0	35.8
300.	0.0	0.0	0.3	1.0	0.3	0.0	0.0	0.0	1.6	8.5	11.2	4.5	0.6	0.0	0.0	0.0	27.8
400.	0.0	0.0	0.1	1.0	0.1	0.0	0.0	0.0	1.0	7.1	10.1	3.1	0.1	0.0	0.0	0.0	22.6
500.	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	5.6	7.1	1.2	0.0	0.0	0.0	0.0	14.9
600.	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	5.1	4.6	0.2	0.0	0.0	0.0	0.0	10.9
700.	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	3.5	2.2	0.0	0.0	0.0	0.0	0.0	6.5
800.	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	2.6	2.0	0.0	0.0	0.0	0.0	0.0	5.1
900.	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	1.7	0.9	0.0	0.0	0.0	0.0	0.0	3.1
1000.	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	1.5	0.5	0.0	0.0	0.0	0.0	0.0	2.5
1100.	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	1.5	0.5	0.0	0.0	0.0	0.0	0.0	2.5
1200.	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	1.5	0.5	0.0	0.0	0.0	0.0	0.0	2.5
1300.	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	1.5	0.5	0.0	0.0	0.0	0.0	0.0	2.2
1400.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5
1500.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5
1600.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5

Table 3-19. Hours of rime ice as a function of distance and direction from the tower

************************************** HOURS OF RIME ICING TABLE **************************************

LINEAR MECHANICAL DRAFT COOLING TOWER -- DUAL LINE ARRAY CONFIGURATION

SEASON=WINTER

DISTANCE FROM TOWER (M)	WIND FROM																
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	AVG
	PLUME HEADED																
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	AVG
100.	0.0	0.1	0.7	0.9	0.7	0.1	0.0	0.2	0.8	0.9	0.8	0.2	0.0	0.0	0.0	0.0	5.6
200.	0.0	0.0	0.3	1.0	0.3	0.0	0.0	0.0	0.5	1.0	0.5	0.0	0.0	0.0	0.0	0.0	3.5
300.	0.0	0.0	0.3	1.0	0.3	0.0	0.0	0.0	0.3	1.0	0.3	0.0	0.0	0.0	0.0	0.0	3.0
400.	0.0	0.0	0.1	1.0	0.1	0.0	0.0	0.0	0.2	1.0	0.2	0.0	0.0	0.0	0.0	0.0	2.5
500.	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
600.	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
700.	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7
800.	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	1.1
900.	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	1.0
1000.	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	1.0
1100.	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	1.0
1200.	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	1.0
1300.	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.7
1400.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5
1500.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5
1600.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5

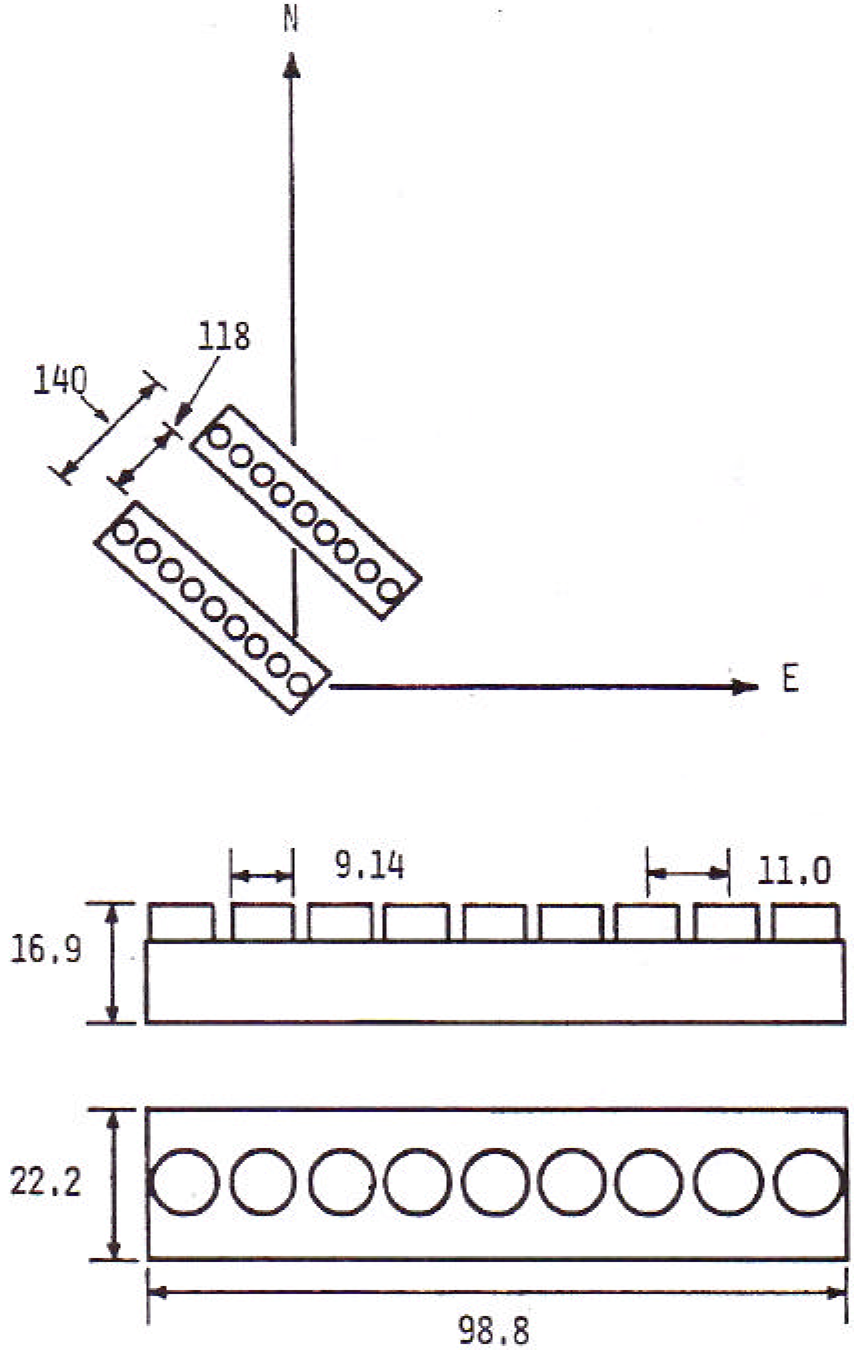


Figure 3-1. Sketch of geometry and orientation of mechanical-draft cooling towers used in Case Study 1.

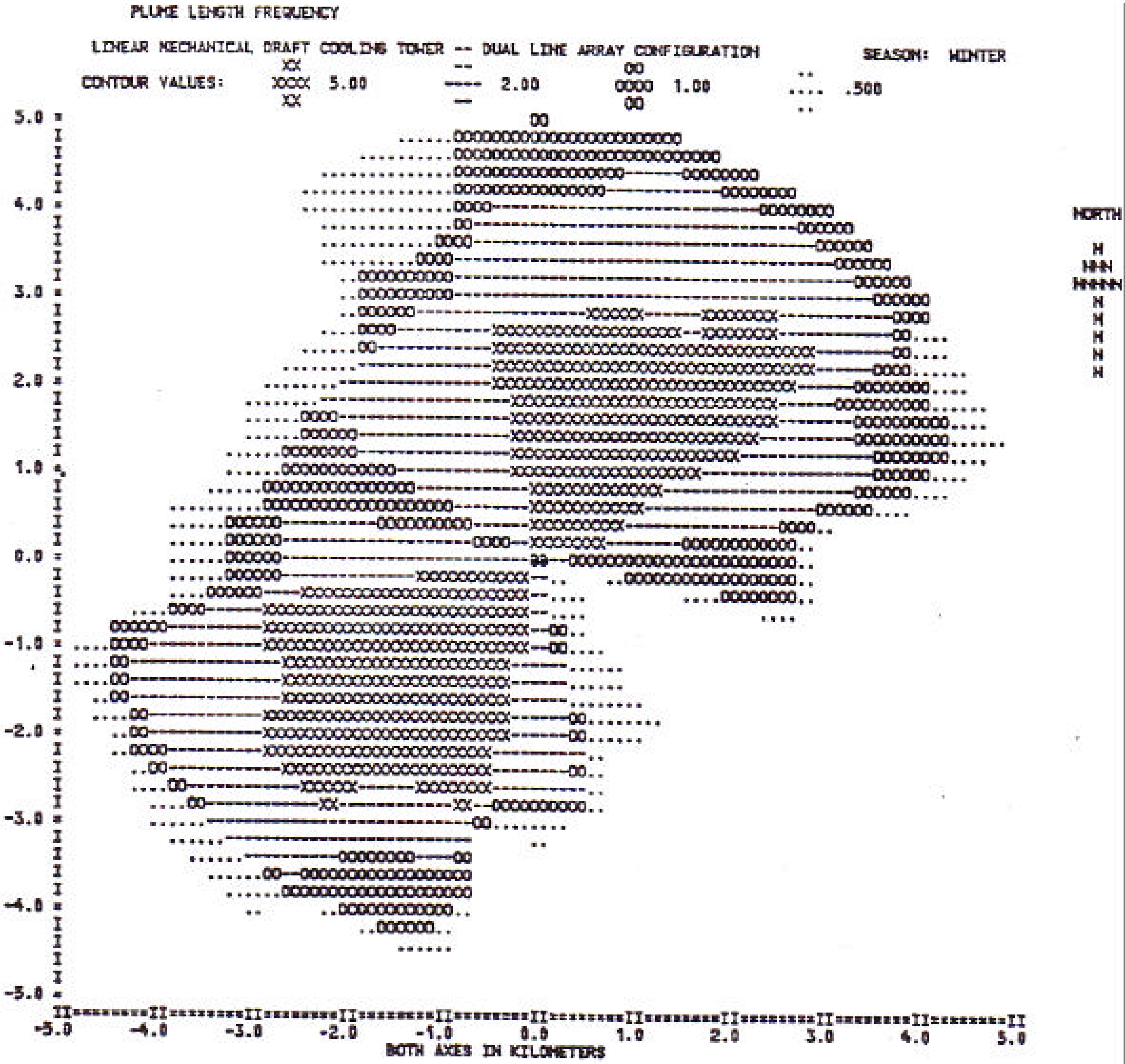


Figure 3-2. Isopleth plot of results presented in Table 3-12 (frequency of occurrence of visible plume).

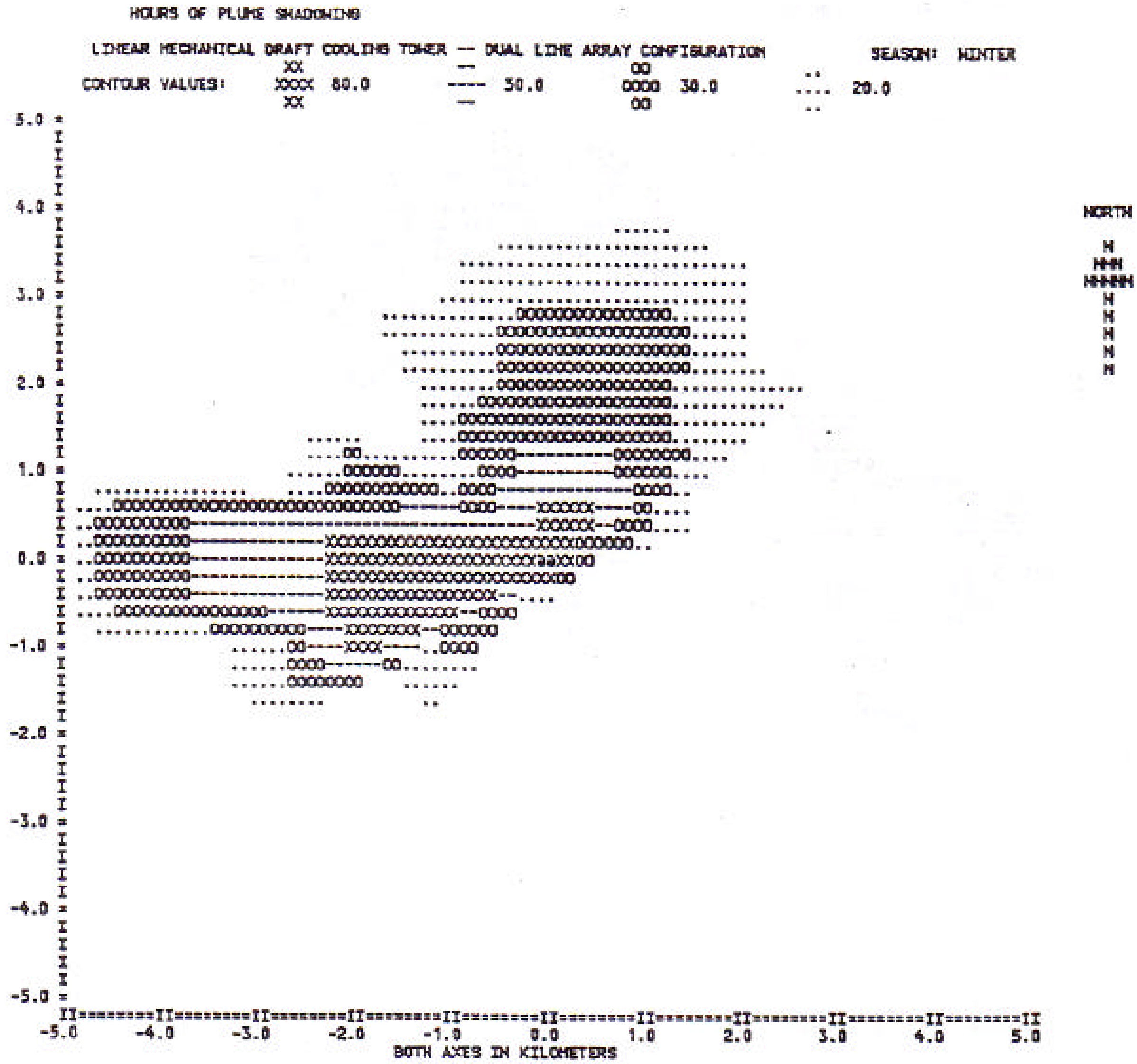


Figure 3-3. Isopleth plot of results presented in Table 3-13 (hours of shadowing).

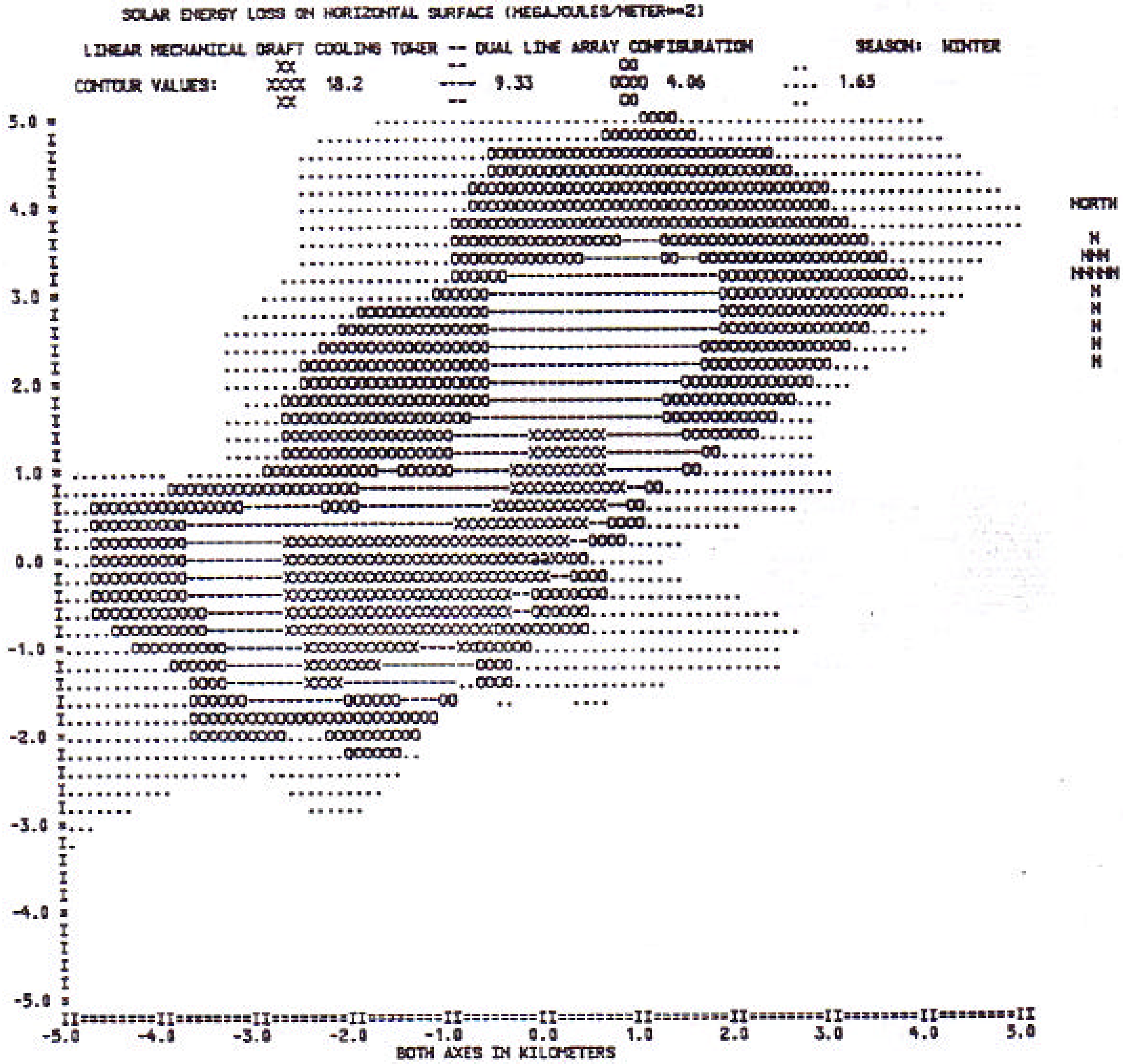


Figure 3-4. Isopleth plot of results presented in Table 3-14 (total solar energy loss due to plume shadowing).

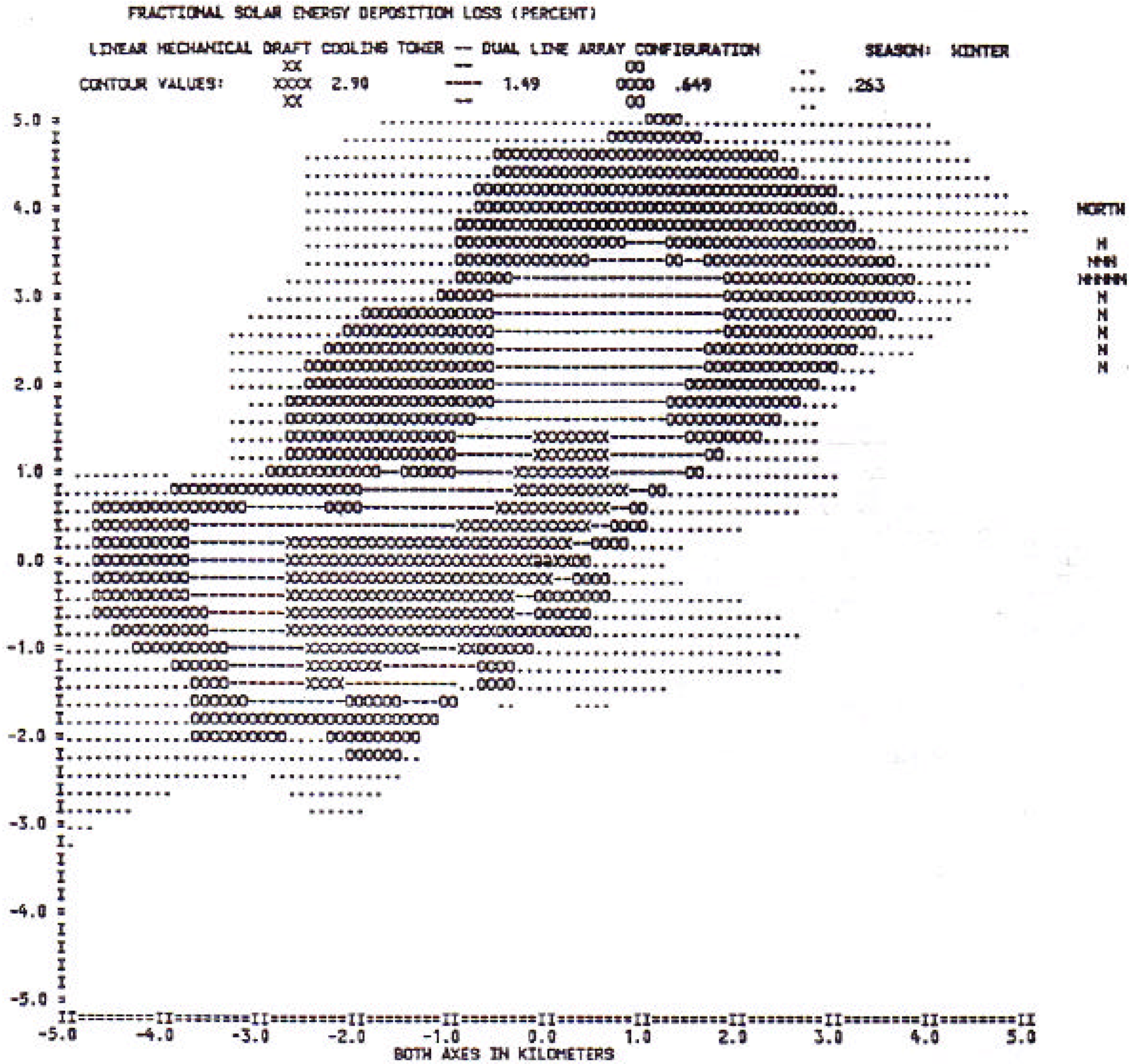


Figure 3-5. Isopleth plot of results presented in Table 3-15 (percent energy loss due to plume shadowing).

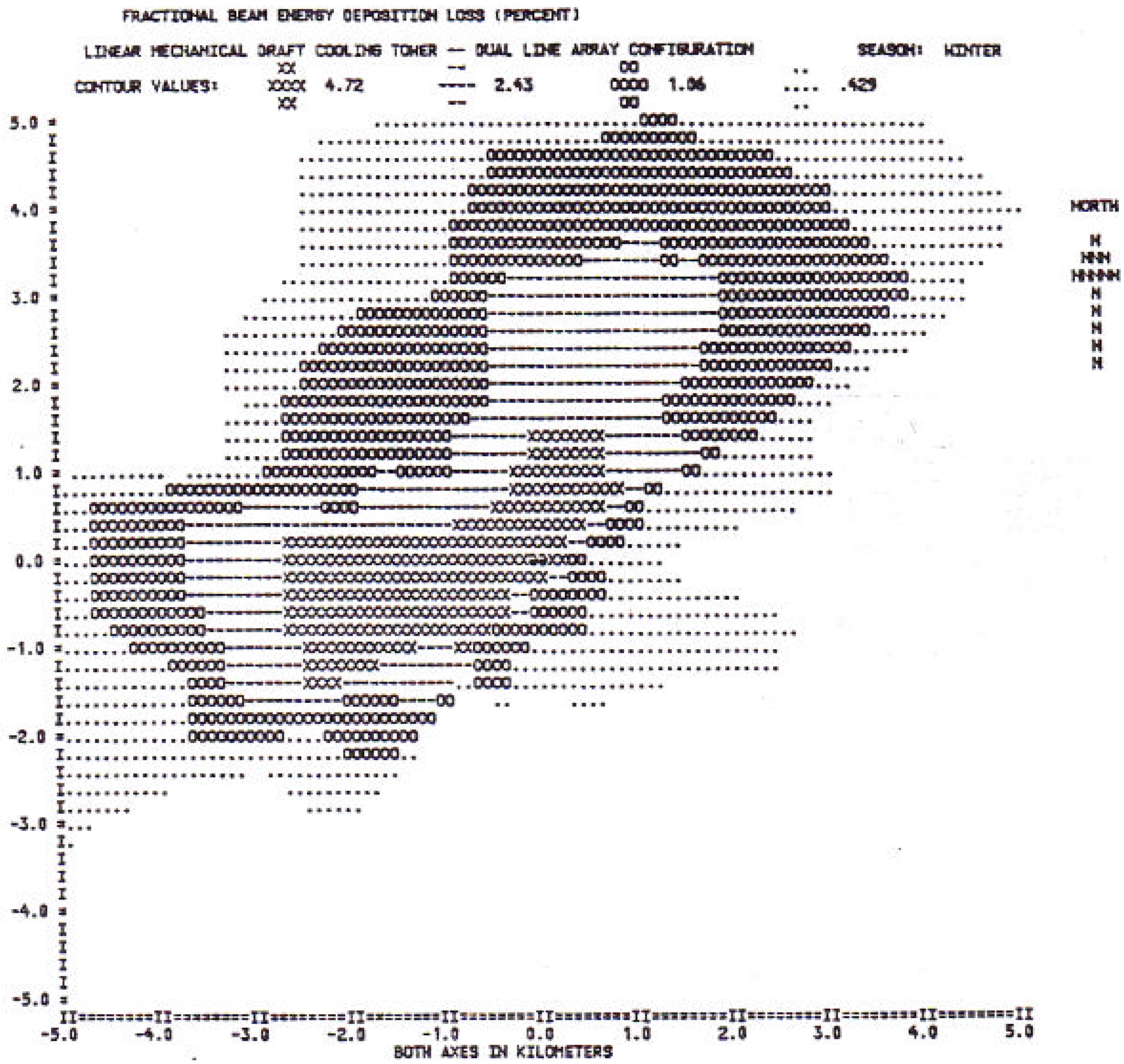


Figure 3-6. Isopleth plot of results presented in Table 3-16 (percent energy loss of direct [beam] energy due to plume shadowing).

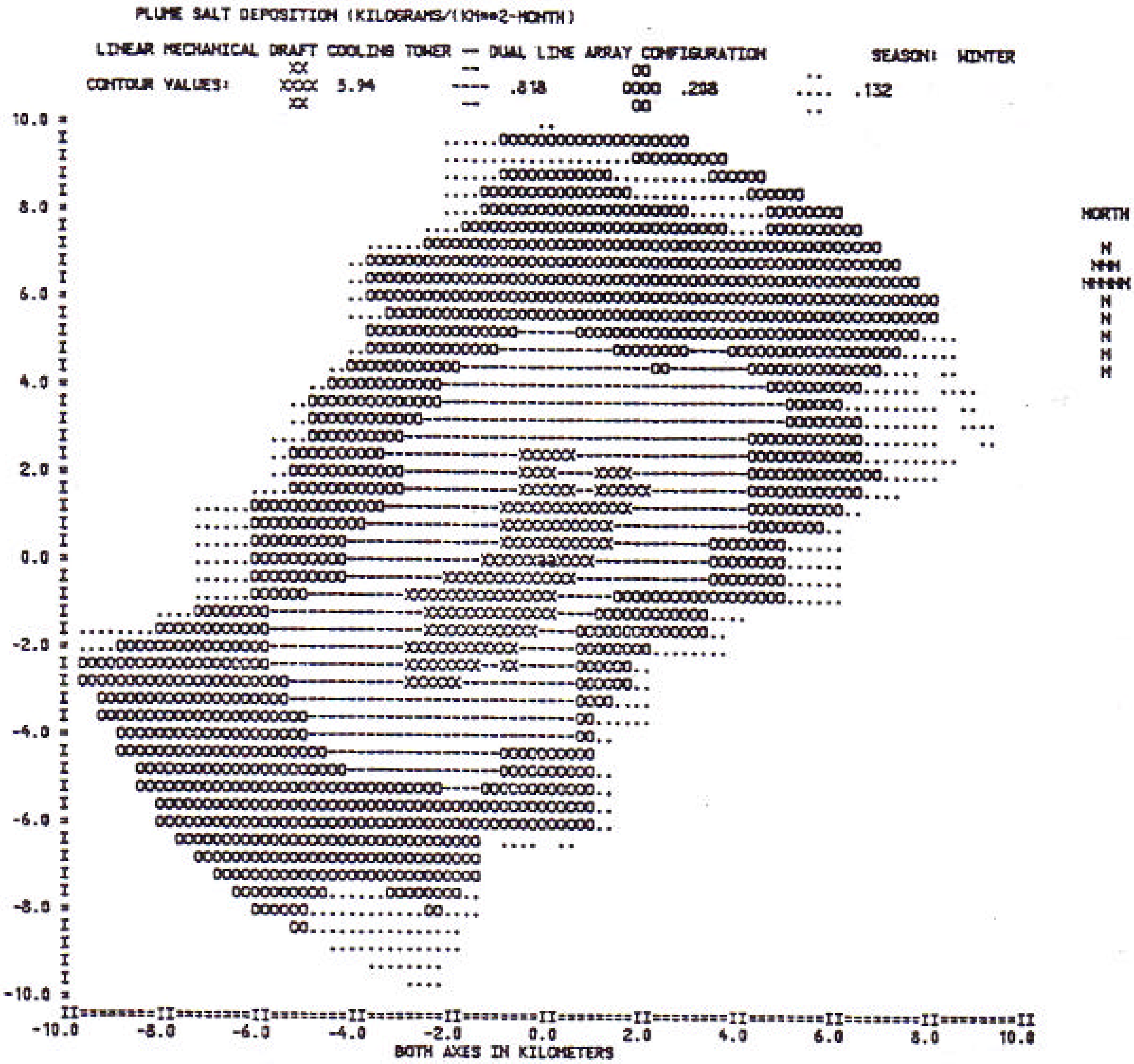


Figure 3-7. Isopleth plot of results presented in Table 3-17 (salt drift deposition).

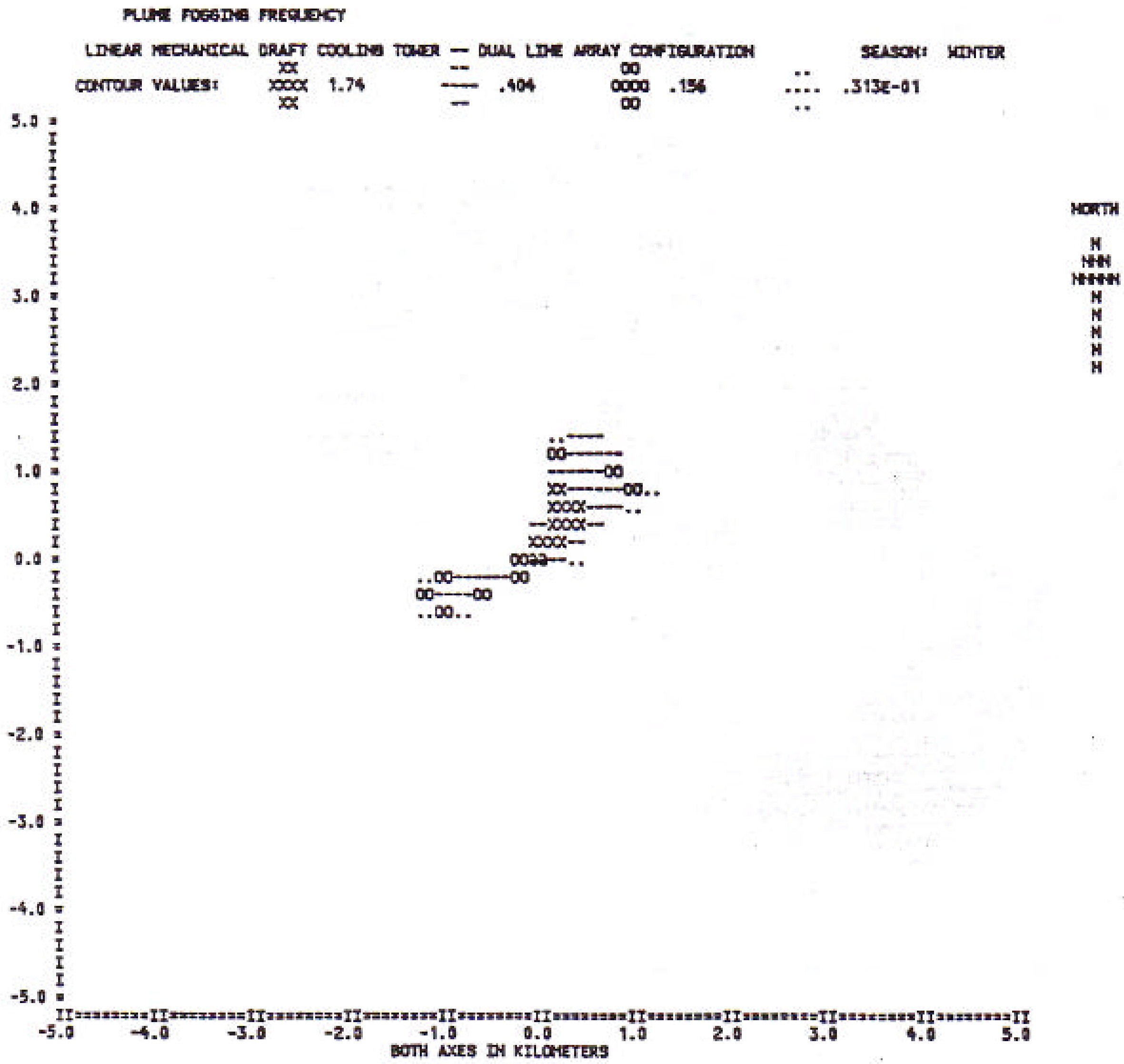


Figure 3-8. Isopleth plot of results presented in Table 3-18 (hours of plume fogging).

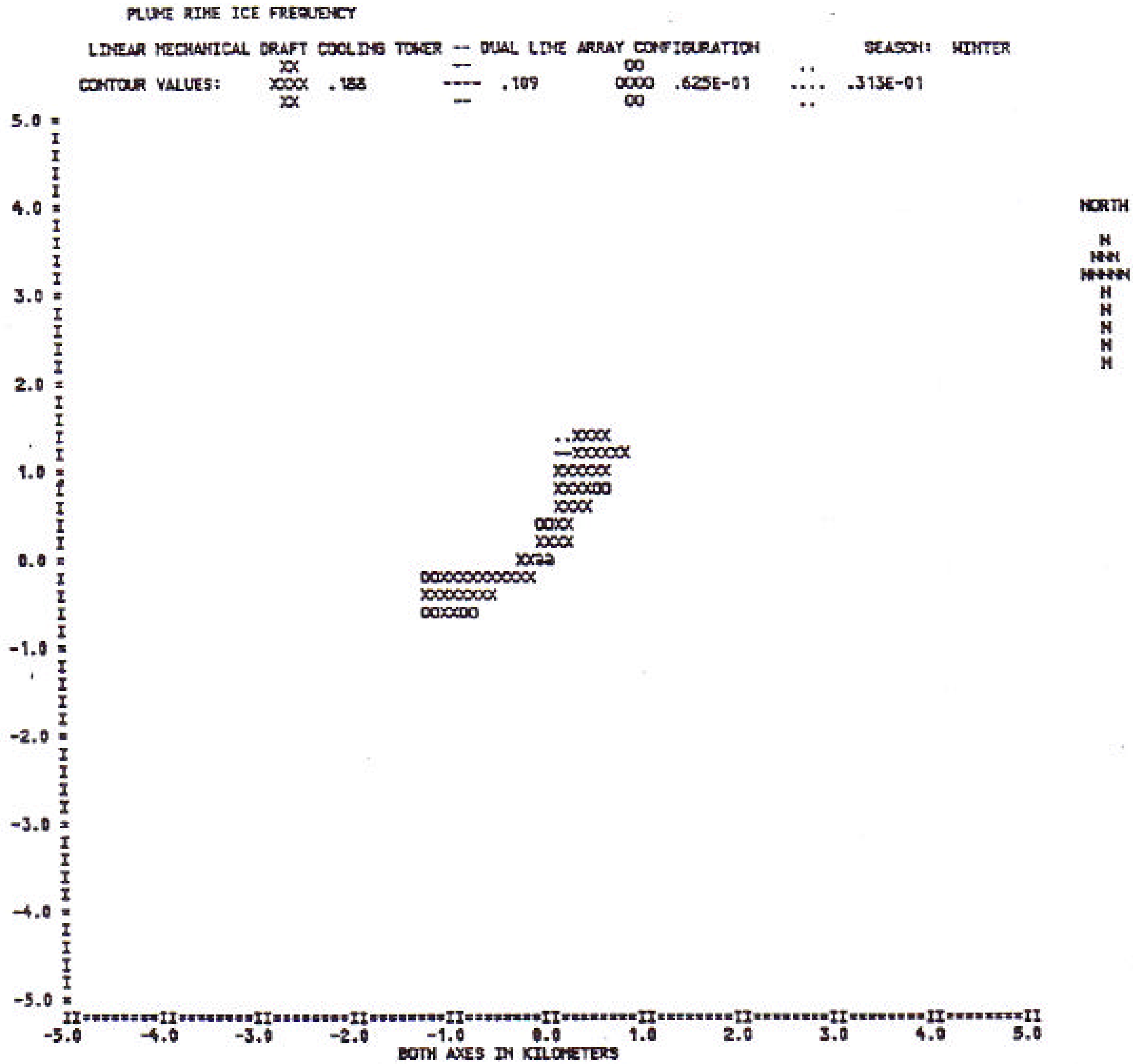


Figure 3-9. Isopleth plot of results presented in Table 3-19 (hours of rime ice).

CASE STUDY 2: APPLICATION TO NATURAL-DRAFT COOLING TOWERS

The site in this example consists of 3 nearly colinear natural-draft cooling towers. The geometry and size of towers is similar to the configuration at the Amos Power Plant. The representative tower height is taken as 124.0 meters and the effective diameter for the combined source is 113.76 meters. The heat flux at full capacity is taken to be 3648 MW. The towers are oriented so as to lie at approximately an 11.25 degree angle measured counterclockwise from north along a line joining NNW and SSE.

The PREPROCESSOR code requires a single effective source for determining categories for plumes representing the seasonal/annual predictions. The combined air flow rate from all 3 towers is 55000 kg/s.

The example site is geographically located near Chicago at latitude 42 degrees north and longitude 88 degrees west and the available meteorological tape represents one year of data consisting of 8760 hourly records in the format of a CD144 tape. No records will be skipped and the mixing height will be for urban surroundings. Fogging and icing will not be computed in this sample case since this is a natural-draft tower (ITOWER=1). The central time zone is presumed.

The known meteorological data for monthly clearness indices and solar insolation are supplied along with the preceding information on 6 cards as input to the PREPROCESSOR code.

Our run of the PREPROCESSOR code leads to 35 cases for input to the plume and drift code. At this point, the PLUME code must be run. The user file for the PLUME code will specify a fogging switch of 0 and drift switch of 1 so that only drift features are computed. Plumes will be computed to a centerline distance of 10000 meters and the default number of 16 fogging radials will be generated. The input will specify 3 towers as multiple plume sources and no tower housings for purposes of computing wake entrainment. This will cause the default method to generate 1 plate per source (based on the tower diameter) for use in computing the wake of each tower.

The coordinates of each NDCT in north-south coordinates must be provided. It is important to select a central origin representative of the site configuration as the coordinate system for specifying the tower information because subsequent calculations for drift deposition will be in relation to this origin. The tower housing coordinates and dimensions are also required.

The user must also decide on the number of wind directions and angles that are to be run for the plume set. In the example, 3 directions of 157.5, 11.25, and 67.5 degrees east of north were selected, and these wind directions were assigned to the 16 sectors based on symmetry considerations.

Finally the drift spectrum is provided in Table 3-20. The spectrum represents the annual average of the spectra measured at the Chalk Point natural-draft cooling tower by Environmental Systems Corporation. For this example, a typical natural-draft spectrum with 30 drop sizes was used. The total emission rate for each tower was 94.46 g/s giving a total of 283.38 g/s. The cooling water salt concentration was 0.005 g salt/g solution and the density of dry salt was 2.17 g/cm^3. Along with this information, the drop size for each of the 30 bins and the mass fraction for that bin were supplied.

The PLUME code was run using the above information, and automatically the relevant data files for the TABLES code were created. To run the TABLES code, the user need only specify the choice of radial spacing, season definitions for each season (up to 5), and the effective site radius (if different from the geometrical cross-section). In this example, the defaults of 4 calendar seasons plus annual and default grids were used.

Tables 3-21 to 3-25 list the filled-out input forms for the natural-draft cooling tower case. Input files are listed in computer compatible format in Table 3-26.

Selected results of the TABLES program are given for the winter season in Tables 3-27 to 3-39. These results parallel the tables presented for the mechanical-draft problem in Case Study 1. Figures 3-11 to 3-18 represent isopleth plots of results given in Tables 3-27 to 3-34.

Table 3-20. Characteristics of drift emission from the natural-draft cooling tower in Case Study 2

Drop Spectrum	
Diameter (Microns)	Mass Fraction
0 - 10	0.0000
10 - 30	0.1875
30 - 50	0.1810
50 - 70	0.1013
70 - 90	0.0784
90 - 110	0.0674
110 - 130	0.0592
130 - 150	0.0537
150 - 180	0.0642
180 - 210	0.0498
210 - 240	0.0337
240 - 270	0.0218
270 - 300	0.0137
300 - 350	0.0142
350 - 400	0.0105
400 - 450	0.0086
450 - 500	0.0076
500 - 600	0.0127
600 - 700	0.0107
700 - 800	0.0080
800 - 900	0.0068
900 - 1000	0.0053
1000 - 1100	0.0019
1100 - 1200	0.0007
1200 - 1300	0.0005
1300 - 1400	0.0003
1400 - 1500	0.0002
1500 - 1600	0.0001
1600 - 1700	0.0001
1700 - 1800	0.0001

Drift rate	283.38 (sum for three towers)
Salt concentration in cooling water	0.005 g NaCl/g solution
Density of dry salt	2.17 g/cm^3

Table 3-21. PREPROCESSOR Model input form - Natural-Draft Cooling Tower Case Study

Card 1:

Variable	Description	Value	Columns
ITITLE	TITLE: Natural Draft Cooling Tower with CD144 Met Tape.................		(1-80).

Card 2:

Variable	Description	Value	Columns
ISTOP	Number of Records Read (0 = All)............	8760	(1-6).
ISKIP	Skip Control (1 = No Skip, 2 = Every Other)	1	(7-12).
IOUT	Output Control (0 = Full, 1 = No Records)...	1	(13-14).
IMIX	Mixing Height Switch (1 = Ave., 2 = Tape)...	1	(15-16).
IUR	Mixing Height Type (1 = Rural, 2 = Urban)...	2	(17-18).
IWIND	Stability Class Switch for NRC Tape (1 = Sigma Theta, 2 = Delta-T)............	0 (N/A)	(19-20).
NFOG	Fog Calculations ? (0 = No, 1 = Yes)........	0	(21-22).
NDRIFT	Drift Calculations ? (0 = No, 1 = Yes)......	1	(23-24).
ITOWER	Type of Tower (1 = NDCT, 2 = CMDCT, 3 = LMDCT)..................................	1	(25-26).
ITAPE	Type of Tape (1 = CD-144, 2 = NRC, 3 = TDF-14)................................	1	(27-28).
IZONE	Time Zone (5 = Eastern, 6 = Central, 7 = Mountain, 8 = Pacific)................	6	(29-30).

Card 3:

Variable	Description	Value	Columns
ALAT	Site Latitude in Degrees North Latitude.....	42	(1-10).
ALONG	Site Longitude in Degrees West Longitude....	88	(11-20).
ROUGHT	Roughness Height (cm).......................	1.0	(21-30).
HREF	Reference Height of Met Tape (m)............	10.0	(31-40).
HTMIX	Annual Average Mixing Height (m) (Only if IMIX = 1)........................	1113.0	(41-50).

Card 4:

TWRHT	Tower Effective Height (m)..................	124.0	(1-10).
TWRDM	Tower Effective Exit Diameter (m)...........	113.76	(11-20).
TWRHE	Tower Effective Heat Rejection (MW).........	3648.0	(21-30).
TWRAF	Tower Effective Air Flow (kg/s).............	55000.0	(31-40).

Card 5:

CKT(1)	January Clearness Index.....................	51	(1-3).
CKT(2)	February Clearness Index....................	50	(4-6).
CKT(3)	March Clearness Index.......................	52	(7-9).
CKT(4)	April Clearness Index.......................	48	(10-12).
CKT(5)	May Clearness Index.........................	53	(13-15).
CKT(6)	June Clearness Index........................	56	(16-18).
CKT(7)	July Clearness Index........................	55	(19-21).
CKT(8)	August Clearness Index......................	57	(22-24).
CKT(9)	September Clearness Index...................	55	(25-27).
CKT(10)	October Clearness Index.....................	52	(28-30).
CKT(11)	November Clearness Index....................	43	(31-33).
CKT(12)	December Clearness Index....................	43	(34-36).

Card 6:

HAVG(1)	January Daily Solar Insolation (mj/m^2)......	7.15	(1-5).
HAVG(2)	February Daily Solar Insolation (mj/m^2).....	9.70	(6-10).
HAVG(3)	March Daily Solar Insolation (mj/m^2)........	13.63	(11-15).
HAVG(4)	April Daily Solar Insolation (mj/m^2)........	16.31	(16-20).
HAVG(5)	May Daily Solar Insolation (mj/m^2)..........	20.78	(21-25).
HAVG(6)	June Daily Solar Insolation (mj/m^2).........	23.13	(26-30).
HAVG(7)	July Daily Solar Insolation (mj/m^2).........	22.04	(31-35).
HAVG(8)	August Daily Solar Insolation (mj/m^2).......	20.32	(36-40).
HAVG(9)	September Daily Solar Insolation (mj/m^2)....	16.06	(41-45).

Table 3-21 (Continued)

HAVG(10)	October Daily Solar Insolation (mj/m^2)......	11.08	(46-50).
HAVG(11)	November Daily Solar Insolation (mj/m^2).....	6.57	(51-55).
HAVG(12)	December Daily Solar Insolation (mj/m^2).....	5.48	(56-60).

Table 3-22. PLUME Model input form - Natural-Draft Cooling Tower Case Study

Card 1:

ALABEL	General Heading: Natural-Draft Cooling Tower With CD-144 Met Tape.....................		(1-80).

Card 2:

IOUT	Output Control Switch...................... (0 = Plume Variables Only, 1 = Plume Variables and Tower Conditions, 2 = Only Label and Input Constants)	2	(1-3).
NFOG	Fogging/Icing Control Switch................ (0 = No Fogging, 1 = Run Fogging Cases)	0	(4-6).
NDRIFT	Number of Drift Cases (0 = No Drift, 1 = Run Drift)...........................	1	(7-9).
NFRAD	Number of Fogging/Icing Radials.............	Blank	(10-12).
SMAXP	Maximum Distance for Plume Calculations (m)	10000.0	(13-22).
SMAXF	Maximum Distance for Fogging Calculations (m)	Blank	(23-32).
NPORTS	Number of Source Output Ports (Towers)......	3	(33-35).
NUSER	Number of User-Specified Plates for Wake Entrainment...........................	0	(36-38).
NTWRS	Number of Tower Housings (Leave Blank if NDCT)..................................	Blank	(39-41).
ISOURC	Effective Source Mode Switch (0 = Multiple Mode, 1 = Effective Source)...............	0	(42-44).

Card 3 is omitted since NFRAD = 0 so 16 default radials are generated.

Table 3-22 (Continued)

Card 3: (Repeated so as to supply NFRAD Values)

RAD(1)	First Radial Distance (km)..................	N/A	(1-10).
RAD(2)	Second Radial Distance (km).................	N/A	(11-20).
RAD(3)	Third Radial Distance (km)..................	N/A	(21-30).
RAD(4)	Fourth Radial Distance (km).................	N/A	(31-40).
RAD(5)	Fifth Radial Distance (km)..................	N/A	(41-50).
RAD(6)	Sixth Radial Distance (km)..................	N/A	(51-60).
RAD(7)	Seventh Radial Distance (km)................	N/A	(61-70).
RAD(8)	Eighth Radial Distance (km).................	N/A	(71-80).

Card 4: (Repeated once for each tower)

XC	X-Coordinate of Tower (1)..................	-54.2	(1-10).
YC	Y-Coordinate of Tower (1)..................	179.5	(11-20).
XC	X-Coordinate of Tower (2)..................	0.0	(1-10).
YC	Y-Coordinate of Tower (2)..................	0.0	(11-20).
XC	X-Coordinate of Tower (3)..................	96.1	(1-10).
YC	Y-Coordinate of Tower (3)..................	-161.3	(11-20).

Card 5:

NWD	Number of Representative Wind Directions....	3	(1-3).
USERWD(1)	First Wind Direction (degrees east of north)	157.5	(4-13).
USERWD(2)	Second Wind Direction (degrees east of north)	11.25	(14-23).
USERWD(3)	Third Wind Direction (degrees east of north)	67.5	(24-33).
USERWD(4)	Fourth Wind Direction (degrees east of north)	Blank	(34-43).
USERWD(5)	Fifth Wind Direction (degrees east of north)	Blank	(44-53).

Table 3-22 (Continued)

Card 6:

IWEQN(1)	Wind Equivalence Number for Sector 1........	2	(1-3).
IWEQN(2)	Wind Equivalence Number for Sector 2........	2	(4-6).
IWEQN(3)	Wind Equivalence Number for Sector 3........	3	(7-9).
IWEQN(4)	Wind Equivalence Number for Sector 4........	4	(10-12).
IWEQN(5)	Wind Equivalence Number for Sector 5........	3	(13-15).
IWEQN(6)	Wind Equivalence Number for Sector 6........	2	(16-18).
IWEQN(7)	Wind Equivalence Number for Sector 7........	2	(19-21).
IWEQN(8)	Wind Equivalence Number for Sector 8........	1	(22-24).
IWEQN(9)	Wind Equivalence Number for Sector 9........	2	(25-27).
IWEQN(10)	Wind Equivalence Number for Sector 10.......	2	(28-30).
IWEQN(11)	Wind Equivalence Number for Sector 11.......	3	(31-33).
IWEQN(12)	Wind Equivalence Number for Sector 12.......	3	(34-36).
IWEQN(13)	Wind Equivalence Number for Sector 13.......	3	(37-39).
IWEQN(14)	Wind Equivalenc Number for Sector 14.......	2	(40-42).
IWEQN(15)	Wind Equivalence Number for Sector 15.......	2	(43-45).
IWEQN(16)	Wind Equivalence Number for Sector 16.......	1	(46-48).

Card 7: (Omitted for natural-draft cooling tower)

TWRADM	Diameter of CMDCT Housing (m)...............	N/A	(1-10).
DA	Length of LMDCT Housing (m).................	N/A	(11-20).
DB	Width of LMDCT Housing (m)..................	N/A	(21-30).
THTWR(1)	LMDCT Long Axis Direction 0.0 (degrees east of north)...............................	N/A	(31-40).
THTWR(2)	LMDCT Long Axis Direction (degrees east of north)..................................	N/A	(41-50).
THTWR(3)	LMDCT Long Axis Direction (degrees east of north)..................................	N/A	(51-60).
THTWR(4)	LMDCT Long Axis Direction (degrees east of north)..................................	N/A	(61-70).

Table 3-22 (Continued)

Card 8:	(Omitted for NDCT, otherwise supply 1 per tower housing)		
XTWR	X-Coordinate of Tower Housing Center (m)....	N/A	(1-10).
YTWR	Y-Coordinate of Tower Housing Center (m)....	N/A	(11-20).

The following cards P1-P3 are not required since NPLATE - 0.

Card P1:

CH	Wake Height Scale (m)........................	N/A	(1-8).
CL	Wake Length Scale (m)........................	N/A	(9-16).
CW	Wake Width Scale (m).........................	N/A	(17-24).

Card P2:

XPLAT	X-Coordinate of Plate (m)...................	N/A	(1-10).
YPLAT	Y-Coordinate of Plate (m)...................	N/A	(11-20).

Card P3:

SPAN	Span of Plate (m)...........................	N/A	(1-10).
CHORD	Chord of Plate (m)..........................	N/A	(11-20).

Card 1D: These Cards are Required Since NDRIFT = 1

DLABEL Drift Label: Typical Natural Draft Cooling Tower Drift Emission Spectrum

Table 3-22 (Continued)

Card 2D:

NDROPS	Number of Drop Sizes........................	30	(1-2).
DRIFTR	Drift Rate (g/s)............................	283.38	(3-12).
CWSC	Cooling Water Salt Concentration (g salt/ g/solution................................	0.005	(13-22).
SDENS	Salt Density (g/cm^3)........................	2.17	(23-32).

Card 3D: (One card for each drop bin):

DROPS	I'th Range in Drop Diameter (μm)............	see below	(1-10).
MASFRAC	Fraction of Mass Emission Rate in that Range.......................................	see below	(11-20).
DRPCON	Fraction of Salt in I'th Drop (g salt/ g solution) (0.0 Defaults to CWSC)........	0.0	(21-30).

10.0	0.0
20.0	0.0053
30.0	0.0430
40.0	0.0741
50.0	0.0651
60.0	0.0548
70.0	0.0351
90.0	0.0326
110.0	0.0178
130.0	0.0095
150.0	0.0076
180.0	0.0011
210.0	0.0117
240.0	0.0132
270.0	0.0141
300.0	0.0182
350.0	0.0267
450.0	0.0229

Table 3-22 (Continued)

500.0	0.0151
600.0	0.0433
700.0	0.0351
800.0	0.0382
900.0	0.0273
1000.0	0.0171
1200.0	0.0319
1400.0	0.0332
1600.0	0.0643
1800.0	0.0221
2000.0	0.0307
2200.0	0.1540

Table 3-23 TABLES input form - Natural-Draft
Cooling Tower Case Study

Card 1:

NSEASN	Number of Seasons...........................	5	(1-3).
MM	Number of Shadowing Sector Partitions.......	0	(4-6).

Card 2:

SEASON	Season Name.................................	Winter	(1-20).

Card 3: Blank (for defaults)

NHOURS	Number of Hours in Season...................	Blank	(1-5).
IREC1	First Record in Season......................	Blank	(6-10).
IREC2	Second Record in Season.....................	Blank	(11-15).
IYEAR1	First Year in Season........................	Blank	(16-20).
IYEAR2	Last Year in Season.........................	Blank	(21-25).
JD1	First Day in Season.........................	Blank	(26-30).
JD2	Last Day in Season..........................	Blank	(31-35).
IHOUR1	First Hour in Season........................	Blank	(36-40).
IHOUR2	Last Hour in Season.........................	Blank	(41-45).

...Repeat format of Cards 2 and 3 for each of the other 4 seasons:

....	Spring	(1-20).
....	Blank	(1-45).
....	Summer	(1-20).
....	Blank	(1-45).
....	Fall	(1-20).
....	Blank	(1-45).
....	Annual	(1-20).
....	Blank	(1-45).

Table 3-23 (Continued)

Card 4:

RSTAR	1-1 Effective Radius of Combined Plume Sources (m)...............................	Blank	(46-55).

Card 5:

NXL	Number of Length Divisions.................. (Blank Field Defaults to 100)	Blank	(1-3).
NXH	Number of Height Divisions.................. (Blank Field Defaults to 100)	Blank	(4-6).
NXR	Number of Radial Divisions.................. (Blank Field Defaults to 100)	Blank	(7-9).
NXS	Number of Shadowing Radials................. (Blank Field Defaults to 40)	Blank	(10-12).
NXD	Number of Drift Radials..................... (Blank Field Defaults to 100)	Blank	(13-15).

Card 6 And Up: not required since defaults were used

If NXL is non-zero, provide NXL radials in meters for length table.
If NXH is non-zero, provide NXH radials in meters for height table.
Etc.
The format of these cards if 10F8.0.

Table 3-24 PAGE PLOT input form - Natural-Draft Cooling Tower Case Study

<u>Card 1</u>:	Supply 5 seasons x 9 tables/season = 45 blank cards for defaults		
ISIZE	Plot Size Identifier........................ (1 = 21 Rows by 42 Columns 2 = 51 Rows by 1-2 Columns)	Blank	(1-3).
ISCALE	Isoplot Length Scale........................ (Blank Field Defaults to 2) (1 = m-2 km to +2 km 2 = -5 km to +5 km 3 = -10 km to +10 km 4 = -20 km to +20 km	Blank	(4-6).
CONT(1)	First Contour Value.........................	Blank	(7-16).
CONT(2)	Second Contour Value........................	Blank	(17-26).
CONT(3)	Third Contour Value.........................	Blank	(27-36).
CONT(4)	Fourth Contour Value........................	Blank	(37-46).

Table 3-25. Listing of input files for PREPROCESSOR, PLUME, TABLES, and PAGEPLOT codes for Case Study 2

```
NATURAL DRAFT COOLING TOWER EXAMPLE USING CD144 MET TAPE
  8760      1 1 1 2 0 0 1 1 1 6
42.0       88.0       1.0        10.0       1113.0
124.0      113.76     3648.0      55000.0
 51 50 52 48 53 56 55 57 55 52 43 43
7.15 9.70 13.6316.3120.7823.1322.0420.3216.0611.086.57 5.48
```

```
NATURAL DRAFT COOLING TOWER EXAMPLE USING CD144 MET TAPE
  2  0  1  0   10000.0        0.0  3  0  0  0  0
     -54.2       179.5
       0.0         0.0
      96.1      -161.3
  3      157.5      11.25       67.5
  2  2  3  3  3  2  2  1  2  2  3  3  3  2  2  1
 TYPICAL NATURAL DRAFT COOLING TOWER DRIFT SPECTRUM
30        283.38    .005          2.17
       10.   .0000         .0
       30.   .1875         .0
       50.   .1810         .0
       70.   .1013         .0
       90.   .0784         .0
      110.   .0674         .0
      130.   .0592         .0
      150.   .0537         .0
      180.   .0642         .0
      210.   .0498         .0
      240.   .0337         .0
      270.   .0218         .0
      300.   .0137         .0
      350.   .0142         .0
      400.   .0105         .0
      450.   .0086         .0
      500.   .0076         .0
      600.   .0127         .0
      700.   .0107         .0
      800.   .0080         .0
      900.   .0068         .0
     1000.   .0053         .0
     1100.   .0019         .0
     1200.   .0007         .0
     1300.   .0005         .0
     1400.   .0003         .0
     1500.   .0002         .0
     1600.   .0001         .0
     1700.   .0001         .0
     1800.   .0001         .0
```

5 0

WINTER	335	59
SPRING	60	151
SUMMER	152	243
FALL	244	334
ANNUAL	0	0

0.0

0 0 0 0 0

10	5.00	2.00	1.00	0.50
10	60.0	50.0	30.0	20.0
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
20	0000	0000	0000	0000
20	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
20	0000	0000	0000	0000
20	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
20	0000	0000	0000	0000
20	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
20	0000	0000	0000	0000
20	0000	0000	0000	0000
10	10.0	5.0	2.0	0.50
10	200.	100.	50.	25.
10	0000	0000	0000	0000
10	0000	0000	0000	0000
10	0000	0000	0000	0000
20	0000	0000	0000	0000
20	0000	0000	0000	0000

Table 3-26. Summary output of PLUME code providing listing of visible plume length, rise, and final visible radius for wind direction of 15° to line of towers

EPRI SEASONAL/ANNUAL TABLES PROGRAM, VERSION 09-01-86

NATURAL DRAFT COOLING TOWER EXAMPLE USING CD144 MET TAPE

SUMMARY OF PLUME PREDICTIONS WHEN WIND IS FROM 11.3 DEGREES EAST OF NORTH

CAT NO.	PLUME LENGTH	PLUME HEIGHT	PLUME RADIUS
1	119.80	119.4	37.30
2	166.70	89.5	33.70
3	183.20	78.1	31.00
4	137.10	58.7	29.70
5	222.50	55.9	26.80
6	438.10	-0.3	32.90
7	254.50	48.5	25.20
8	193.80	227.0	55.10
9	281.50	208.2	56.70
10	557.90	252.1	82.50
11	624.80	161.2	72.00
12	659.60	209.0	81.70
13	746.60	186.8	81.40
14	839.70	221.2	87.90
15	988.30	246.4	92.30
16	1182.90	288.6	99.90
17	6001.50	1008.1	296.60
18	6711.90	1008.5	316.60
19	7015.90	1008.2	366.80
20	5797.70	1005.1	378.00
21	6204.20	1007.2	373.70
22	6002.80	1003.5	421.10
23	6101.80	1008.5	448.10
24	6510.10	1006.8	425.10
25	5594.70	1009.9	446.00
26	9785.80	1024.5	505.90
27	9889.60+	1024.6+	477.20+
28	9887.80+	1029.5+	510.10+
29	9882.40+	1028.3+	680.90+
30	9868.90+	1034.8+	727.60+
31	9870.50+	1038.1+	727.00+
32	9865.10+	1043.5+	754.90+
33	9789.40+	1059.1+	927.80+
34	9954.00+	173.2+	915.70+
35	9901.50+	1055.6+	602.30+

* A PLUS SIGN INDICATES THAT THE VISIBLE PLUME DID NOT END WITHIN A CENTERLINE DISTANCE OF 10000.0 METERS

Table 3-27. Summary of output of PLUME code providing listing of visible plume length, rise, and final visible radius for wind direction of 90° (crossflow)

EPRI SEASONAL/ANNUAL TABLES PROGRAM, VERSION 09-01-86

NATURAL DRAFT COOLING TOWER EXAMPLE USING CD144 MET TAPE

SUMMARY OF PLUME PREDICTIONS WHEN WIND IS FROM 67.5 DEGREES EAST OF NORTH

CAT NO.	PLUME LENGTH	PLUME HEIGHT	PLUME RADIUS
1	119.80	119.4	37.30
2	166.70	89.4	33.70
3	183.20	78.0	31.00
4	137.10	58.7	29.70
5	212.70	53.8	26.80
6	408.30	4.3	26.60
7	244.60	47.2	25.20
8	226.80	257.2	82.00
9	259.10	210.8	68.10
10	319.50	158.9	48.20
11	382.20	113.1	41.70
12	421.40	147.8	47.00
13	504.50	133.6	46.50
14	599.30	164.6	66.20
15	698.60	179.4	79.60
16	869.10	218.2	75.50
17	1210.40	289.0	108.80
18	6917.90	1008.4	352.40
19	7726.10	1002.3	322.90
20	6409.90	1004.5	354.00
21	6512.30	1008.0	415.00
22	6310.70	1005.7	464.40
23	6209.20	1005.6	465.70
24	7422.10	1003.8	407.80
25	5701.70	1008.0	488.00
26	9893.40+	1026.9+	510.70+
27	9896.80+	1026.3+	517.80+
28	9894.40+	1031.7+	552.70+
29	9889.70+	1032.3+	698.00+
30	9875.30+	1037.8+	751.70+
31	9877.00+	1041.2+	745.60+
32	9871.10+	1046.2+	755.80+
33	9802.90+	1061.1+	960.30+
34	9965.00+	136.2+	893.40+
35	9903.70+	1060.3+	624.50+

* A PLUS SIGN INDICATES THAT THE VISIBLE PLUME DID NOT END WITHIN A CENTERLINE DISTANCE OF 10000.0 METERS

Table 3-28. Summary output of PLUME code providing listing of visible plume length, rise, and final visible radius for wind direction of 180° (in line)

EPRI SEASONAL/ANNUAL TABLES PROGRAM, VERSION 09-01-86

NATURAL DRAFT COOLING TOWER EXAMPLE USING CD144 MET TAPE

SUMMARY OF PLUME PREDICTIONS WHEN WIND IS FROM 157.5 DEGREES EAST OF NORTH

CAT NO.	PLUME LENGTH	PLUME HEIGHT	PLUME RADIUS
1	119.80	119.4	37.30
2	166.70	89.5	33.70
3	183.20	78.1	31.00
4	137.10	58.7	29.70
5	349.80	77.9	37.10
6	723.50	11.9	45.80
7	353.40	60.4	34.80
8	193.80	227.0	55.10
9	217.70	187.6	51.00
10	386.10	191.7	62.40
11	319.10	107.6	41.40
12	749.40	261.5	78.30
13	709.80	231.4	70.30
14	1152.30	313.9	87.60
15	1399.40	356.0	93.20
16	5697.40	1009.6	221.00
17	5390.70	1009.4	256.30
18	6103.20	1008.5	271.60
19	5391.80	1012.9	303.10
20	5287.00	1009.4	341.40
21	4881.60	1014.0	331.40
22	4881.40	1013.2	382.80
23	4880.50	1012.9	388.30
24	4676.60	1016.4	377.00
25	8583.50	1015.5	402.80
26	8674.20	1022.3	422.90
27	9130.30	1022.1	433.70
28	9879.00	1028.7	461.40
29	9872.00+	1028.0+	638.40+
30	9856.10+	1033.5+	706.40+
31	9860.20+	1036.8+	693.40+
32	9854.70+	1041.6+	705.70+
33	9777.00+	1061.0+	895.30+
34	9945.70+	218.9+	829.50+
35	9888.90+	1058.3+	590.50+

* A PLUS SIGN INDICATES THAT THE VISIBLE PLUME DID NOT END WITHIN A CENTERLINE DISTANCE OF 10000.0 METERS

Table 3-29. Frequency of occurrence of 30 categories with wind direction for Case study 2 -- one year of data

************************ FREQUENCY PERCENTAGE BY CATEGORY AND WIND DIRECTION ************************
NATURAL DRAFT COOLING TOWER EXAMPLE USING CD144 MET TAPE
SEASON=WINTER

CATEGORY NUMBER	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
	WIND FROM																
	PLUME HEADED																
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	SUM
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.05
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.05	0.74	0.46	0.28	0.00	0.00	0.00	1.57
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.21	0.00	0.21	0.21	0.21	0.00	0.00	0.21	0.21	0.00	0.85	0.00	0.00	0.00	0.00	0.00	2.13
11	0.10	0.00	0.00	0.10	0.00	0.10	0.00	0.00	0.00	0.29	0.48	0.00	0.00	0.10	0.00	0.00	1.16
12	0.00	0.00	0.00	0.00	0.11	0.22	0.00	0.11	0.43	0.11	0.22	0.00	0.00	0.00	0.00	0.11	1.30
13	0.00	0.00	0.05	0.05	0.05	0.00	0.00	0.05	0.10	0.05	0.25	0.10	0.05	0.00	0.00	0.00	0.74
14	0.00	0.09	0.05	0.05	0.05	0.00	0.05	0.05	0.09	0.00	0.14	0.05	0.00	0.00	0.00	0.05	0.65
15	0.05	0.05	0.14	0.05	0.00	0.00	0.00	0.09	0.05	0.14	0.51	0.05	0.00	0.00	0.00	0.00	1.11
16	0.31	0.00	0.78	0.31	0.00	0.16	0.00	0.16	0.31	0.31	0.94	0.16	0.00	0.16	0.16	0.00	3.75
17	0.06	0.18	0.24	0.00	0.06	0.00	0.00	0.12	0.12	0.06	0.18	0.18	0.00	0.00	0.00	0.00	1.20
18	0.00	0.05	0.32	0.28	0.23	0.00	0.00	0.05	0.14	0.19	0.56	0.23	0.05	0.00	0.05	0.00	2.13
19	0.00	0.23	0.19	0.32	0.19	0.00	0.14	0.05	0.19	0.42	0.56	0.19	0.00	0.00	0.00	0.00	2.45
20	0.05	0.23	0.74	0.37	0.09	0.09	0.05	0.05	0.14	0.28	0.32	0.14	0.00	0.00	0.09	0.05	2.69
21	0.05	0.42	0.65	0.69	0.09	0.14	0.09	0.09	0.23	0.19	0.46	0.23	0.05	0.00	0.00	0.05	3.43
22	0.00	0.19	0.42	0.42	0.14	0.05	0.05	0.23	0.51	0.05	0.60	0.19	0.00	0.00	0.00	0.05	2.87
23	0.05	0.74	1.06	0.46	0.32	0.05	0.09	0.23	0.14	0.37	0.51	0.37	0.05	0.00	0.05	0.00	4.49
24	0.14	0.28	0.74	0.74	0.14	0.05	0.05	0.14	0.14	0.32	0.69	0.09	0.09	0.00	0.00	0.05	3.66
25	0.05	0.46	0.60	0.79	0.14	0.14	0.14	0.42	0.28	0.46	0.46	0.23	0.00	0.00	0.00	0.00	4.17
26	0.05	0.23	0.93	0.51	0.23	0.09	0.19	0.42	0.56	0.65	0.60	0.19	0.09	0.00	0.05	0.00	4.77
27	0.19	0.32	0.74	0.42	0.19	0.14	0.14	0.09	0.51	0.56	0.60	0.05	0.05	0.00	0.05	0.05	4.07
28	0.09	0.37	1.02	0.60	0.23	0.19	0.19	0.46	0.79	0.69	0.88	0.42	0.05	0.14	0.00	0.09	6.20
29	0.19	0.42	1.06	0.46	0.14	0.05	0.00	0.37	0.60	0.74	0.65	0.32	0.37	0.05	0.00	0.00	5.42
30	0.28	0.60	1.81	0.69	0.28	0.19	0.09	0.32	0.56	0.32	0.56	0.23	0.19	0.05	0.00	0.09	6.25
31	0.28	0.19	1.76	0.60	0.23	0.05	0.19	0.19	0.56	0.23	0.69	0.32	0.37	0.05	0.19	0.09	5.97
32	0.23	0.56	1.39	0.74	0.19	0.19	0.42	0.23	0.19	0.37	0.32	0.23	0.05	0.05	0.00	0.00	5.14
33	1.39	2.08	4.21	3.06	0.74	0.32	0.60	0.74	0.93	0.56	0.56	0.74	0.23	0.14	0.09	0.14	16.53
34	0.00	0.19	0.46	0.19	0.05	0.00	0.05	0.00	0.05	0.00	0.05	0.19	0.00	0.00	0.00	0.00	1.20
35	0.00	0.14	0.60	0.42	0.00	0.09	0.19	0.09	0.37	0.19	0.46	0.46	0.09	0.00	0.00	0.00	3.10
	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
TOTALS	3.74	8.00	20.17	12.52	4.09	2.27	2.69	5.00	8.17	7.58	13.89	5.81	2.04	0.72	0.71	0.80	98.19

Table 3-30. Summary of statistics on meteorological data needed for application of Appendix D on complex terrain

******************************* STABILITY CLASS BY WIND DIRECTION *******************************
NATURAL DRAFT COOLING TOWER EXAMPLE USING CD144 MET TAPE
SEASON=WINTER

STABILITY CLASS	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
PLUME HEADED	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	STAG.
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.01	0.01	0.00	0.04	0.00	0.02	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.06	0.04
3	0.06	0.11	0.10	0.04	0.07	0.16	0.03	0.03	0.08	0.03	0.04	0.02	0.02	0.17	0.08	0.13	0.07
4	0.39	0.41	0.47	0.49	0.35	0.49	0.43	0.59	0.58	0.70	0.77	0.59	0.48	0.08	0.31	0.38	0.23
5	0.37	0.26	0.26	0.30	0.33	0.21	0.33	0.25	0.25	0.21	0.12	0.27	0.32	0.58	0.23	0.19	0.10
6	0.18	0.19	0.15	0.16	0.17	0.14	0.17	0.10	0.07	0.03	0.05	0.12	0.18	0.08	0.38	0.25	0.49
7	0.00	0.03	0.01	0.01	0.05	0.00	0.02	0.01	0.01	0.02	0.02	0.00	0.00	0.08	0.00	0.00	0.08

*************** WIND SPEED DISTRIBUTION BY DIRECTION AT REFERENCE HEIGHT OF 300. METERS **************
NATURAL DRAFT COOLING TOWER EXAMPLE USING CD144 MET TAPE
SEASON=WINTER

WIND RANGE	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
PLUME HEADED	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	STAG.
1	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	1.00
2	0.72	0.52	0.27	0.30	0.54	0.60	0.43	0.21	0.28	0.14	0.14	0.22	0.48	0.67	0.92	0.69	0.00
3	0.28	0.48	0.73	0.69	0.43	0.40	0.57	0.79	0.72	0.86	0.86	0.78	0.52	0.33	0.08	0.31	0.00

******************************* COMBINED FACTORS BY WIND DIRECTION *******************************
NATURAL DRAFT COOLING TOWER EXAMPLE USING CD144 MET TAPE
SEASON=WINTER

COMBINED CLASS*	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
PLUME HEADED	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	STAG.
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11
2	0.04	0.06	0.03	0.01	0.06	0.10	0.02	0.01	0.02	0.01	0.01	0.00	0.01	0.11	0.07	0.13	0.00
3	0.02	0.06	0.08	0.03	0.05	0.06	0.03	0.04	0.06	0.03	0.04	0.01	0.01	0.06	0.01	0.06	0.00
4	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.32
5	0.55	0.35	0.20	0.24	0.37	0.42	0.33	0.18	0.23	0.12	0.12	0.19	0.38	0.44	0.50	0.39	0.00
6	0.21	0.32	0.53	0.55	0.29	0.28	0.43	0.66	0.60	0.78	0.77	0.67	0.42	0.22	0.04	0.18	0.00
7	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57
8	0.13	0.11	0.04	0.05	0.12	0.08	0.08	0.02	0.02	0.01	0.01	0.03	0.09	0.11	0.36	0.17	0.00
9	0.05	0.10	0.12	0.12	0.09	0.06	0.11	0.09	0.06	0.04	0.06	0.10	0.10	0.06	0.03	0.08	0.00

* COMBINED CLASSES ARE DEFINED AS FOLLOWS:
1=UNSTABLE, LOW WIND 2=UNSTABLE, MODERATE WIND 3=UNSTABLE, HIGH WIND
4=NEUTRAL, LOW WIND 5=NEUTRAL MODERATE WIND 6=NEUTRAL, HIGH WIND
7=STABLE, LOW WIND 8=STABLE, MODERATE WIND 9=STABLE, HIGH WIND

Table 3-31. Frequency of occurrence of plume length with distance and direction -- winter season

************************************ PLUME LENGTH FREQUENCY TABLE ************************************
NATURAL DRAFT COOLING TOWER EXAMPLE USING CD144 MET TAPE
SEASON=WINTER

DISTANCE FROM TOWER (M)	WIND FROM: N PLUME HEADED: S	NNE SSW	NE SW	ENE WSW	E W	ESE WNW	SE NW	SSE NNW	S N	SSW NNE	SW NE	WSW ENE	W E	WNW ESE	NW SE	NNW SSE	SUM SUM
50.	3.74	8.00	20.17	12.52	4.09	2.27	2.69	5.00	8.17	7.58	13.89	5.81	2.04	0.72	0.71	0.80	98.19
100.	3.74	8.00	20.17	12.52	4.09	2.27	2.69	5.00	8.17	7.58	13.89	5.81	2.04	0.72	0.71	0.80	98.19
150.	3.74	8.00	20.17	12.52	4.09	2.27	2.69	5.00	8.17	7.58	13.89	5.81	2.04	0.72	0.71	0.80	98.19
200.	3.74	8.00	20.17	12.52	4.09	2.27	2.69	5.00	8.17	7.58	13.89	5.81	2.04	0.72	0.71	0.80	98.19
250.	3.74	8.00	20.17	12.52	4.09	2.27	2.69	5.00	8.17	7.58	13.89	5.81	2.04	0.72	0.71	0.80	98.19
300.	3.74	8.00	20.17	12.52	4.09	2.27	2.69	5.00	8.17	7.58	13.84	5.81	2.04	0.72	0.71	0.80	98.15
350.	3.74	8.00	20.17	12.52	4.09	2.27	2.69	5.00	8.17	7.58	13.84	5.81	2.04	0.72	0.71	0.80	98.15
400.	3.74	8.00	19.96	12.31	3.87	2.27	2.69	5.00	8.17	7.58	12.99	5.81	2.04	0.72	0.71	0.80	96.66
450.	3.74	8.00	19.96	12.21	3.87	2.27	2.69	4.79	8.17	7.58	12.51	5.81	2.04	0.72	0.71	0.80	95.86
500.	3.74	8.00	19.96	12.21	3.77	2.27	2.69	4.79	8.17	7.53	11.55	5.34	1.76	0.72	0.71	0.80	94.01
550.	3.74	8.00	19.96	12.21	3.77	2.27	2.69	4.79	8.17	7.53	11.55	5.34	1.76	0.72	0.71	0.80	94.01
600.	3.74	8.00	19.91	12.16	3.72	2.27	2.69	4.79	8.17	7.53	11.30	5.24	1.71	0.72	0.71	0.80	93.47
650.	3.52	8.00	19.86	12.12	3.67	2.27	2.69	4.79	7.95	7.53	11.16	5.20	1.71	0.72	0.71	0.80	92.72
700.	3.43	8.00	19.86	12.12	3.67	2.18	2.69	4.79	7.95	7.24	11.16	5.20	1.71	0.62	0.71	0.80	92.14
750.	3.43	8.00	19.73	12.07	3.67	1.96	2.69	4.79	7.52	7.14	10.66	5.15	1.71	0.62	0.71	0.80	90.64
800.	3.43	8.00	19.73	12.07	3.67	1.96	2.69	4.58	7.42	7.09	10.66	5.15	1.71	0.62	0.71	0.69	90.18
850.	3.43	8.00	19.73	12.07	3.67	1.96	2.69	4.58	7.42	7.09	10.66	5.15	1.71	0.62	0.71	0.69	90.18
900.	3.43	7.91	19.73	12.07	3.67	1.96	2.64	4.58	7.33	7.09	10.66	5.15	1.71	0.62	0.71	0.69	89.95
950.	3.43	7.91	18.94	11.76	3.67	1.96	2.64	4.58	7.33	7.09	9.72	5.00	1.71	0.62	0.71	0.69	87.77
1000.	3.43	7.91	18.94	11.76	3.67	1.96	2.64	4.58	7.33	7.09	9.72	5.00	1.71	0.62	0.71	0.69	87.77
1050.	3.38	7.87	18.94	11.76	3.67	1.96	2.64	4.58	7.28	6.95	9.72	5.00	1.71	0.62	0.71	0.69	87.49
1100.	3.38	7.87	18.94	11.76	3.67	1.96	2.64	4.58	7.28	6.95	9.72	5.00	1.71	0.62	0.71	0.69	87.49
1150.	3.38	7.87	18.94	11.76	3.67	1.96	2.64	4.58	7.28	6.95	9.72	5.00	1.71	0.62	0.71	0.69	87.49
1200.	3.38	7.87	18.94	11.76	3.67	1.96	2.64	4.58	7.28	6.95	9.72	5.00	1.71	0.62	0.71	0.69	87.49
1250.	3.07	7.87	18.94	11.76	3.67	1.81	2.64	4.54	6.97	6.63	9.72	5.00	1.71	0.46	0.56	0.65	85.99
1300.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.54	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.33
1350.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.54	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.33
1400.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.54	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.33
1450.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
1500.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
1550.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
1600.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
1650.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
1700.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
1750.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
1800.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
1850.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
1900.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
1950.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
2000.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
2050.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
2100.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
2150.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
2200.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
2250.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
2300.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
2350.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
2400.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
2450.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
2500.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23

Table 3-31 (Continued)

PLUME LENGTH FREQUENCY TABLE

NATURAL DRAFT COOLING TOWER EXAMPLE USING CD144 MET TAPE

SEASON=WINTER

DISTANCE FROM TOWER (M)	WIND FROM: N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	SUM
	PLUME HEADED: S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	SUM
2550.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
2600.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
2650.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
2700.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
2750.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
2800.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
2850.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
2900.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
2950.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
3000.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
3050.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
3100.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
3150.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
3200.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
3250.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
3300.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
3350.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
3400.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
3450.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
3500.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
3550.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
3600.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
3650.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
3700.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
3750.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
3800.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
3850.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
3900.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
3950.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
4000.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
4050.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
4100.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
4150.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
4200.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
4250.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
4300.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
4350.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
4400.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
4450.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
4500.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
4550.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
4600.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
4650.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
4700.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.44	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.65	85.23
4750.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.30	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.60	85.05
4800.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.30	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.60	85.05
4850.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.30	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.60	85.05
4900.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	4.30	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.60	85.05
4950.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	3.75	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.51	84.40
5000.	3.07	7.87	18.70	11.76	3.61	1.81	2.64	3.75	6.97	6.63	9.54	4.81	1.71	0.46	0.56	0.51	84.40

Table 3-32. Hours of shadowing with distance and direction due to plume shadow -- winter season

HOURS OF PLUME SHADOWING TABLE

NATURAL DRAFT COOLING TOWER EXAMPLE USING CD144 MET TAPE

SEASON=WINTER

DISTANCE FROM TOWER (M)	WIND FROM: N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	AVG
	PLUME HEADED: S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	AVG
200.	286.6	329.4	337.0	334.5	332.8	335.0	314.0	288.3	263.3	249.6	224.6	197.8	180.9	178.0	194.1	263.9	269.4
400.	58.7	124.8	282.2	307.6	323.8	327.7	310.7	281.7	260.1	236.3	198.0	113.7	53.2	33.3	50.7	51.6	188.4
600.	27.5	56.8	231.2	287.2	292.9	287.2	252.7	201.1	191.1	185.5	159.9	59.1	28.3	21.7	23.4	18.2	145.2
800.	16.0	38.8	191.7	271.1	276.0	235.6	184.1	120.2	137.0	135.1	119.7	44.6	19.4	16.9	11.3	17.3	114.7
1000.	16.0	33.2	157.6	262.9	248.0	204.6	130.4	87.2	110.3	107.1	102.7	31.5	15.3	15.9	11.7	17.3	97.0
1200.	14.0	28.0	142.3	246.8	221.2	170.8	101.7	77.7	96.3	92.1	81.2	33.1	17.3	14.1	8.7	11.3	84.8
1400.	14.0	27.0	121.3	237.9	205.0	146.6	75.7	64.0	87.6	79.1	72.1	31.0	16.2	13.6	9.7	11.3	75.8
1600.	13.0	28.0	114.1	230.5	193.6	128.6	65.7	59.0	79.6	78.0	66.1	30.1	17.2	13.6	9.7	9.3	71.0
1800.	12.0	28.0	107.8	224.5	179.6	118.6	54.7	51.0	76.6	69.9	54.8	29.7	15.2	12.8	8.7	9.3	65.8
2000.	12.0	27.0	104.9	211.2	166.0	106.1	50.7	47.0	71.6	69.9	48.4	30.0	16.0	13.7	8.7	9.3	62.0
2200.	11.0	26.3	102.9	205.2	158.5	96.7	46.8	44.0	67.6	65.2	46.1	29.7	14.9	13.7	7.7	9.3	59.1
2400.	11.0	25.3	99.9	200.2	151.5	87.7	41.5	44.1	65.6	61.9	42.1	25.3	12.2	13.7	6.7	9.3	56.1
2600.	11.0	24.3	97.9	196.1	138.7	80.7	39.3	43.1	63.6	57.9	40.1	24.9	11.2	12.7	7.7	9.3	53.6
2800.	11.0	23.3	90.7	189.3	131.7	74.2	38.0	44.1	58.6	56.9	38.8	26.3	11.3	11.7	8.8	9.3	51.5
3000.	11.0	23.3	84.6	186.3	123.7	72.2	34.4	39.1	57.6	56.9	37.8	26.3	11.3	10.7	9.8	8.3	49.6
3200.	10.0	23.3	83.6	183.3	121.7	70.9	31.3	37.4	55.6	55.9	35.5	26.3	11.3	10.7	8.8	8.3	48.4
3400.	9.0	22.3	80.3	180.3	118.7	66.2	28.9	35.4	53.6	55.9	32.5	25.9	11.3	10.7	8.8	8.3	46.8
3600.	9.0	22.3	76.1	174.3	115.7	65.0	25.7	34.2	55.6	53.9	31.5	24.2	11.3	11.5	8.8	8.3	45.5
3800.	10.3	22.3	74.1	166.1	112.7	62.8	23.6	35.3	53.6	52.5	31.5	23.1	11.3	11.5	8.8	8.3	44.2
4000.	9.3	22.3	72.1	158.0	111.7	61.1	23.2	35.3	53.6	52.5	32.5	21.3	11.3	11.5	7.8	8.3	43.2
4200.	8.3	22.3	70.1	155.0	109.7	56.2	21.2	32.9	51.6	51.5	30.5	21.0	11.3	11.5	6.4	6.0	41.6
4400.	6.0	22.3	66.0	149.0	107.5	55.1	19.9	31.5	49.6	49.5	30.2	21.0	11.3	11.5	5.1	6.0	40.1
4600.	6.0	22.3	65.0	149.0	104.2	50.5	18.9	31.5	49.6	49.5	30.2	19.1	11.3	11.5	5.1	6.0	39.4
4800.	4.0	22.3	59.0	148.0	102.2	50.5	18.9	28.8	48.6	49.5	32.0	17.4	11.3	11.5	5.1	6.0	38.4
5000.	4.0	21.3	57.0	147.0	98.8	47.0	18.9	28.8	48.6	48.1	27.9	16.5	11.3	10.5	5.1	6.0	37.3
5200.	4.0	18.3	55.0	144.0	94.8	41.8	18.9	27.1	46.6	47.9	27.9	14.7	11.3	10.5	5.1	5.0	35.8
5400.	4.0	17.3	52.0	141.0	92.8	41.8	17.9	27.1	45.3	45.9	25.8	14.4	11.3	9.0	5.1	5.0	34.7
5600.	3.0	17.3	51.0	137.0	91.8	41.8	17.9	27.1	45.3	44.9	25.8	13.5	11.3	7.8	3.1	5.0	34.0
5800.	3.0	17.3	49.0	135.0	88.8	41.8	15.9	26.1	45.3	43.9	25.8	13.5	11.3	7.8	4.0	5.0	33.3
6000.	3.0	17.3	49.0	133.0	87.8	38.6	15.2	26.1	45.3	41.9	24.8	13.5	11.3	7.8	4.0	5.0	32.7
6200.	3.0	16.3	48.0	130.0	84.8	37.4	14.2	26.1	43.3	41.9	24.8	12.5	11.3	6.8	4.0	3.0	31.7
6400.	3.0	15.3	48.0	130.0	84.8	36.3	14.2	24.7	41.9	41.9	23.8	12.5	9.0	6.8	4.0	3.0	31.2
6600.	3.0	14.3	47.0	129.0	82.8	35.1	13.2	23.7	40.9	40.9	22.8	11.6	9.0	6.8	3.0	3.0	30.4
6800.	3.0	14.3	46.0	126.0	81.8	34.1	13.2	21.7	40.9	36.9	22.8	11.0	9.0	5.8	3.0	3.0	29.5
7000.	3.0	12.3	45.0	123.0	81.8	33.0	12.2	20.7	40.9	34.9	22.8	11.0	9.0	5.8	3.0	2.0	28.8
7200.	2.0	10.3	44.0	123.0	79.8	33.0	12.2	19.4	39.9	34.9	22.8	9.6	9.0	5.8	3.0	2.0	28.2
7400.	2.0	7.3	43.0	122.0	78.8	30.7	12.2	19.4	39.9	32.7	22.8	9.6	9.0	5.8	3.0	2.0	27.5
7600.	2.0	7.3	43.0	118.0	76.8	26.7	12.2	18.1	39.9	32.7	21.8	9.6	9.0	5.8	3.0	1.0	26.7
7800.	0.0	6.3	40.9	115.6	76.8	26.7	12.2	16.8	37.9	32.7	21.8	9.6	9.0	4.8	3.0	1.0	25.9
8000.	0.0	4.3	37.9	113.6	75.8	26.7	12.2	16.8	36.9	27.7	20.3	9.6	9.0	4.8	2.1	0.0	24.9

Table 3-33. Total solar energy loss at a given distance and direction due to plume shadow -- winter season

****************************** TOTAL SOLAR ENERGY LOSS TABLE (MJ/M**2)******************************
NATURAL DRAFT COOLING TOWER EXAMPLE USING CD144 MET TAPE
SEASON=WINTER

'ISTANCE FROM TOWER (M)	WIND FROM N / PLUME HEADED S	NNE / SSW	NE / SW	ENE / WSW	E / W	ESE / WNW	SE / NW	SSE / NNW	S / N	SSW / NNE	SW / NE	WSW / ENE	W / E	WNW / ESE	NW / SE	NNW / SSE	AVG / AVG
200.	147.0	172.0	175.0	175.2	177.2	180.8	179.0	166.5	147.6	133.9	117.2	99.4	90.9	93.9	97.5	134.5	143.0
400.	18.0	53.4	145.9	157.0	167.4	170.8	173.3	165.8	147.5	124.4	94.5	44.9	17.9	9.5	12.2	12.7	94.7
600.	10.3	22.9	119.9	146.4	145.6	141.4	131.9	109.4	102.7	94.2	69.0	22.6	9.5	6.6	7.2	6.6	71.6
800.	6.8	19.4	100.9	137.3	133.3	105.1	83.9	52.0	67.3	69.9	51.9	13.6	5.9	5.4	4.7	6.8	54.0
1000.	6.8	18.0	83.7	131.6	113.1	83.7	51.1	32.2	52.1	55.7	43.9	9.1	4.7	5.5	4.2	6.8	43.9
1200.	6.4	16.6	73.7	123.8	97.0	63.8	36.6	26.2	42.0	46.6	36.6	8.6	4.6	4.3	2.7	4.9	37.1
1400.	6.4	15.8	62.7	119.8	87.4	50.2	25.5	19.1	37.2	39.5	32.3	7.9	3.8	4.3	3.0	4.9	32.5
1600.	5.8	15.5	59.2	116.0	81.8	41.0	22.1	16.5	32.2	38.1	30.1	5.7	3.8	4.0	3.0	4.5	29.9
1800.	5.4	15.5	56.5	112.3	72.4	36.1	17.9	13.8	30.1	34.2	25.8	5.5	2.8	3.9	2.7	4.5	27.5
2000.	5.4	14.8	54.6	105.6	63.9	30.6	16.6	12.5	27.8	34.2	23.0	5.3	2.9	3.9	2.7	4.5	25.5
2200.	4.8	14.4	53.5	101.8	60.5	27.2	15.4	10.9	25.9	32.8	20.7	4.8	2.8	3.9	2.4	4.5	24.1
2400.	4.8	13.8	50.9	98.0	56.5	23.8	14.4	10.9	24.6	30.9	18.8	3.9	2.2	3.9	2.2	4.5	22.7
2600.	4.8	13.2	50.3	95.8	50.2	21.9	13.4	10.7	24.1	27.7	17.8	3.8	2.0	3.5	2.4	4.5	21.6
2800.	4.8	12.6	47.3	92.8	46.1	19.3	13.1	10.9	21.1	26.7	17.2	3.8	1.6	3.0	2.5	4.5	20.5
3000.	4.8	12.6	44.1	90.8	41.4	18.6	12.6	8.9	20.5	26.7	17.0	3.8	1.6	2.8	2.6	4.1	19.5
3200.	4.4	12.6	43.7	88.8	40.8	17.4	12.2	8.7	19.4	26.4	16.1	3.8	1.6	2.8	2.1	4.1	19.0
3400.	3.6	11.8	42.4	87.2	39.1	15.8	11.9	8.0	18.6	26.4	14.2	3.7	1.6	2.8	2.1	4.1	18.3
3600.	3.6	11.8	40.2	83.1	37.2	15.6	11.1	7.5	19.1	25.3	13.7	3.6	1.6	2.8	2.1	4.1	17.6
3800.	3.8	11.8	38.8	79.3	35.8	15.3	10.8	7.6	18.6	25.0	13.7	3.5	1.6	2.8	2.1	4.1	17.2
4000.	3.5	11.8	37.2	76.0	35.5	15.0	10.7	7.6	18.6	25.0	13.7	3.4	1.6	2.8	1.7	4.1	16.8
4200.	3.2	11.8	36.0	74.2	34.3	14.0	9.9	7.2	17.6	24.4	13.0	3.4	1.6	2.8	1.3	3.2	16.1
4400.	2.8	11.8	34.1	70.1	33.5	13.8	9.6	6.9	17.0	23.3	12.5	3.4	1.6	2.8	1.1	3.2	15.5
4600.	2.8	11.8	33.2	70.1	32.1	13.3	9.4	6.9	17.0	23.3	12.5	3.2	1.6	2.8	1.1	3.2	15.3
4800.	2.0	11.8	30.3	69.7	31.6	13.3	9.4	6.5	16.0	23.3	12.5	3.1	1.6	2.8	1.1	3.2	14.9
5000.	2.0	11.4	28.8	69.0	30.3	12.8	9.4	6.5	16.0	23.0	11.2	3.1	1.6	2.5	1.1	3.2	14.5
5200.	2.0	10.7	27.8	67.3	27.6	11.4	9.4	6.2	15.1	22.1	11.2	3.0	1.6	2.5	1.1	2.9	13.9
5400.	2.0	10.3	26.2	65.4	26.7	11.4	8.5	6.2	14.8	21.3	10.1	2.9	1.6	2.2	1.1	2.9	13.4
5600.	1.7	10.3	25.5	63.8	26.0	11.4	8.5	6.2	14.8	20.7	10.1	2.9	1.6	1.9	0.6	2.9	13.1
5800.	1.7	10.3	24.7	63.2	24.8	11.4	7.4	6.0	14.8	20.1	10.1	2.9	1.6	1.9	0.6	2.9	12.8
6000.	1.7	10.3	24.7	61.8	24.5	10.6	7.4	6.0	14.8	19.1	9.9	2.9	1.6	1.9	0.6	2.9	12.5
6200.	1.7	10.1	23.8	59.3	22.9	10.4	7.0	6.0	14.4	19.1	9.9	2.4	1.6	1.2	0.6	2.2	12.0
6400.	1.7	9.7	23.8	59.3	22.9	10.2	7.0	5.7	14.2	19.1	9.6	2.4	1.2	1.2	0.6	2.2	11.9
6600.	1.7	9.1	23.5	58.9	22.1	10.1	6.4	5.5	13.7	18.8	9.0	2.4	1.2	1.2	0.5	2.2	11.6
6800.	1.7	9.1	23.0	57.6	21.8	10.0	6.4	4.3	13.7	16.2	9.0	2.4	1.2	1.0	0.5	2.2	11.3
7000.	1.7	7.8	22.7	56.0	21.8	9.9	5.4	4.1	13.7	14.9	9.0	2.4	1.2	1.0	0.5	1.6	10.9
7200.	1.4	6.7	22.1	56.0	20.9	9.9	5.4	3.9	13.2	14.9	9.0	2.3	1.2	1.0	0.5	1.6	10.6
7400.	1.4	4.7	21.5	55.4	20.0	9.6	5.4	3.9	13.2	13.8	9.0	2.3	1.2	1.0	0.5	1.6	10.3
7600.	1.4	4.7	21.5	53.3	19.1	9.2	5.4	3.7	13.2	13.8	8.0	2.3	1.2	1.0	0.5	0.9	9.9
7800.	0.0	4.1	20.8	52.2	19.1	9.2	5.4	3.6	12.4	13.8	8.0	2.3	1.2	0.9	0.5	0.9	9.6
8000.	0.0	2.3	19.2	50.8	18.6	9.2	5.4	3.6	11.5	11.0	7.6	2.3	1.2	0.9	0.5	0.0	9.0

Table 3-34. Percent of energy loss compared to the total solar heat flux incident on the ground -- winter season

************************************ PERCENT TOTAL ENERGY LOSS TABLE ************************************

NATURAL DRAFT COOLING TOWER EXAMPLE USING CD144 MET TAPE
SEASON=WINTER

DISTANCE FROM TOWER (M)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	AVG
	WIND FROM																
	PLUME HEADED																
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	AVG
200.	23.5	27.5	27.9	28.0	28.3	28.9	28.6	26.6	23.6	21.4	18.7	15.9	14.5	15.0	15.6	21.5	22.8
400.	2.9	8.5	23.3	25.1	26.7	27.3	27.7	26.5	23.6	19.9	15.1	7.2	2.9	1.5	2.0	2.0	15.1
600.	1.6	3.7	19.1	23.4	23.3	22.6	21.1	17.5	16.4	15.0	11.0	3.6	1.5	1.1	1.2	1.1	11.4
800.	1.1	3.1	16.1	21.9	21.3	16.8	13.4	8.3	10.8	11.2	8.3	2.2	0.9	0.9	0.8	1.1	8.6
1000.	1.1	2.9	13.4	21.0	18.1	13.4	8.2	5.1	8.3	8.9	7.0	1.5	0.8	0.9	0.7	1.1	7.0
1200.	1.0	2.6	11.8	19.8	15.5	10.2	5.8	4.2	6.7	7.4	5.8	1.4	0.7	0.7	0.4	0.8	5.9
1400.	1.0	2.5	10.0	19.1	14.0	8.0	4.1	3.1	5.9	6.3	5.2	1.3	0.6	0.7	0.5	0.8	5.2
1600.	0.9	2.5	9.5	18.5	13.1	6.5	3.5	2.6	5.1	6.1	4.8	0.9	0.6	0.6	0.5	0.7	4.8
1800.	0.9	2.5	9.0	17.9	11.6	5.8	2.9	2.2	4.8	5.5	4.1	0.9	0.5	0.6	0.4	0.7	4.4
2000.	0.9	2.4	8.7	16.9	10.2	4.9	2.7	2.0	4.4	5.5	3.7	0.9	0.5	0.6	0.4	0.7	4.1
2200.	0.8	2.3	8.5	16.3	9.7	4.3	2.5	1.7	4.1	5.2	3.3	0.8	0.4	0.6	0.4	0.7	3.9
2400.	0.8	2.2	8.1	15.7	9.0	3.8	2.3	1.7	3.9	4.9	3.0	0.6	0.4	0.6	0.3	0.7	3.6
2600.	0.8	2.1	8.0	15.3	8.0	3.5	2.1	1.7	3.9	4.4	2.8	0.6	0.3	0.6	0.4	0.7	3.5
2800.	0.8	2.0	7.6	14.8	7.4	3.1	2.1	1.7	3.4	4.3	2.7	0.6	0.2	0.5	0.4	0.7	3.3
3000.	0.8	2.0	7.0	14.5	6.6	3.0	2.0	1.4	3.3	4.3	2.7	0.6	0.2	0.4	0.4	0.7	3.1
3200.	0.7	2.0	7.0	14.2	6.5	2.8	2.0	1.4	3.1	4.2	2.6	0.6	0.2	0.4	0.3	0.7	3.0
3400.	0.6	1.9	6.8	13.9	6.2	2.5	1.9	1.3	3.0	4.2	2.3	0.6	0.2	0.4	0.3	0.7	2.9
3600.	0.6	1.9	6.4	13.3	5.9	2.5	1.8	1.2	3.0	4.0	2.2	0.6	0.2	0.5	0.3	0.7	2.8
3800.	0.6	1.9	6.2	12.7	5.7	2.4	1.7	1.2	3.0	4.0	2.2	0.6	0.2	0.5	0.3	0.7	2.7
4000.	0.6	1.9	5.9	12.1	5.7	2.4	1.7	1.2	3.0	4.0	2.2	0.5	0.2	0.5	0.3	0.7	2.7
4200.	0.5	1.9	5.7	11.8	5.5	2.2	1.6	1.1	2.8	3.9	2.1	0.5	0.2	0.5	0.2	0.5	2.6
4400.	0.4	1.9	5.4	11.2	5.4	2.2	1.5	1.1	2.7	3.7	2.0	0.5	0.2	0.5	0.2	0.5	2.5
4600.	0.4	1.9	5.3	11.2	5.1	2.1	1.5	1.1	2.7	3.7	2.0	0.5	0.2	0.5	0.2	0.5	2.4
4800.	0.3	1.9	4.8	11.1	5.0	2.1	1.5	1.0	2.6	3.7	2.0	0.5	0.2	0.5	0.2	0.5	2.4
5000.	0.3	1.8	4.6	11.0	4.8	2.0	1.5	1.0	2.6	3.7	1.8	0.5	0.2	0.4	0.2	0.5	2.3
5200.	0.3	1.7	4.4	10.7	4.4	1.8	1.5	1.0	2.4	3.5	1.8	0.5	0.2	0.4	0.2	0.5	2.2
5400.	0.3	1.6	4.2	10.4	4.3	1.8	1.3	1.0	2.4	3.4	1.6	0.5	0.2	0.3	0.2	0.5	2.1
5600.	0.3	1.6	4.1	10.2	4.1	1.8	1.3	1.0	2.4	3.3	1.6	0.5	0.2	0.3	0.1	0.5	2.1
5800.	0.3	1.6	3.9	10.1	4.0	1.8	1.2	1.0	2.4	3.2	1.6	0.5	0.2	0.3	0.1	0.5	2.0
6000.	0.3	1.6	3.9	9.9	3.9	1.7	1.2	1.0	2.4	3.0	1.6	0.5	0.2	0.3	0.1	0.5	2.0
6200.	0.3	1.6	3.8	9.5	3.7	1.7	1.1	1.0	2.3	3.0	1.6	0.4	0.2	0.2	0.1	0.4	1.9
6400.	0.3	1.5	3.8	9.5	3.7	1.6	1.1	0.9	2.3	3.0	1.5	0.4	0.2	0.2	0.1	0.4	1.9
6600.	0.3	1.4	3.7	9.4	3.5	1.6	1.0	0.9	2.2	3.0	1.4	0.4	0.2	0.2	0.1	0.4	1.9
6800.	0.3	1.4	3.7	9.2	3.5	1.6	1.0	0.7	2.2	2.6	1.4	0.4	0.2	0.2	0.1	0.4	1.8
7000.	0.3	1.3	3.6	8.9	3.5	1.6	0.9	0.7	2.2	2.4	1.4	0.4	0.2	0.2	0.1	0.3	1.7
7200.	0.2	1.1	3.5	8.9	3.3	1.6	0.9	0.6	2.1	2.4	1.4	0.4	0.2	0.2	0.1	0.3	1.7
7400.	0.2	0.8	3.4	8.9	3.2	1.5	0.9	0.6	2.1	2.2	1.4	0.4	0.2	0.2	0.1	0.3	1.6
7600.	0.2	0.8	3.4	8.5	3.0	1.5	0.9	0.6	2.1	2.2	1.3	0.4	0.2	0.2	0.1	0.1	1.6
7800.	0.0	0.7	3.3	8.3	3.0	1.5	0.9	0.6	2:0	2.2	1.3	0.4	0.2	0.1	0.1	0.1	1.5
8000.	0.0	0.4	3.1	8.1	3.0	1.5	0.9	0.6	1.8	1.7	1.2	0.4	0.2	0.1	0.1	0.0	1.4

Table 3-35. Percent loss of direct (beam) energy incident on the ground due to plume shadow -- winter season

************************************ PERCENT BEAM ENERGY LOSS TABLE ************************************

NATURAL DRAFT COOLING TOWER EXAMPLE USING CD144 MET TAPE

SEASON=WINTER

DISTANCE FROM TOWER (M)	WIND FROM: N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	AVG
	PLUME HEADED: S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	AVG
200.	38.2	44.7	45.5	45.6	46.1	47.0	46.6	43.3	38.4	34.8	30.5	25.8	23.6	24.4	25.4	35.0	37.2
400.	4.7	13.9	37.9	40.8	43.5	44.4	45.1	43.1	38.4	32.4	24.6	11.7	4.7	2.5	3.2	3.3	24.6
600.	2.7	6.0	31.2	38.1	37.9	36.8	34.3	28.5	26.7	24.5	17.9	5.9	2.5	1.7	1.9	1.7	18.6
800.	1.8	5.0	26.2	35.7	34.7	27.3	21.8	13.5	17.5	18.2	13.5	3.5	1.5	1.4	1.2	1.8	14.0
1000.	1.8	4.7	21.8	34.2	29.4	21.8	13.3	8.4	13.5	14.5	11.4	2.4	1.2	1.4	1.1	1.8	11.4
1200.	1.7	4.3	19.2	32.2	25.2	16.6	9.5	6.8	10.9	12.1	9.5	2.2	1.2	1.1	0.7	1.3	9.7
1400.	1.7	4.1	16.3	31.1	22.7	13.0	6.6	5.0	9.7	10.3	8.4	2.1	1.0	1.1	0.8	1.3	8.4
1600.	1.5	4.0	15.4	30.2	21.3	10.7	5.7	4.3	8.4	9.9	7.8	1.5	1.0	1.0	0.8	1.2	7.8
1800.	1.4	4.0	14.7	29.2	18.8	9.4	4.6	3.6	7.8	8.9	6.7	1.4	0.7	1.0	0.7	1.2	7.1
2000.	1.4	3.8	14.2	27.5	16.6	8.0	4.3	3.3	7.2	8.9	6.0	1.4	0.7	1.0	0.7	1.2	6.6
2200.	1.2	3.7	13.9	26.5	15.7	7.1	4.0	2.8	6.7	8.5	5.4	1.3	0.7	1.0	0.6	1.2	6.3
2400.	1.2	3.6	13.2	25.5	14.7	6.2	3.8	2.8	6.4	8.0	4.9	1.0	0.6	1.0	0.6	1.2	5.9
2600.	1.2	3.4	13.1	24.9	13.1	5.7	3.5	2.8	6.3	7.2	4.6	1.0	0.5	0.9	0.6	1.2	5.6
2800.	1.2	3.3	12.3	24.1	12.0	5.0	3.4	2.8	5.5	7.0	4.5	1.0	0.4	0.8	0.7	1.2	5.3
3000.	1.2	3.3	11.5	23.6	10.8	4.8	3.3	2.3	5.3	7.0	4.4	1.0	0.4	0.7	0.7	1.1	5.1
3200.	1.1	3.3	11.4	23.1	10.6	4.5	3.2	2.3	5.0	6.9	4.2	1.0	0.4	0.7	0.5	1.1	5.0
3400.	0.9	3.1	11.0	22.7	10.2	4.1	3.1	2.1	4.8	6.9	3.7	1.0	0.4	0.7	0.5	1.1	4.8
3600.	0.9	3.1	10.5	21.6	9.7	4.1	2.9	2.0	5.0	6.6	3.6	0.9	0.4	0.7	0.5	1.1	4.6
3800.	1.0	3.1	10.1	20.6	9.3	4.0	2.8	2.0	4.8	6.5	3.6	0.9	0.4	0.7	0.5	1.1	4.5
4000.	0.9	3.1	9.7	19.8	9.2	3.9	2.8	2.0	4.8	6.5	3.6	0.9	0.4	0.7	0.4	1.1	4.4
4200.	0.8	3.1	9.4	19.3	8.9	3.6	2.6	1.9	4.6	6.4	3.4	0.9	0.4	0.7	0.4	0.8	4.2
4400.	0.7	3.1	8.9	18.2	8.7	3.6	2.5	1.8	4.4	6.0	3.2	0.9	0.4	0.7	0.3	0.8	4.0
4600.	0.7	3.1	8.6	18.2	8.4	3.5	2.4	1.8	4.4	6.0	3.2	0.8	0.4	0.7	0.3	0.8	4.0
4800.	0.5	3.1	7.9	18.1	8.2	3.5	2.4	1.7	4.2	6.0	3.3	0.8	0.4	0.7	0.3	0.8	3.9
5000.	0.5	3.0	7.5	17.9	7.9	3.3	2.4	1.7	4.2	6.0	2.9	0.8	0.4	0.6	0.3	0.8	3.8
5200.	0.5	2.8	7.2	17.5	7.2	3.0	2.4	1.6	3.9	5.7	2.9	0.8	0.4	0.6	0.3	0.8	3.6
5400.	0.5	2.7	6.8	17.0	7.0	3.0	2.2	1.6	3.9	5.5	2.6	0.8	0.4	0.6	0.3	0.8	3.5
5600.	0.4	2.7	6.6	16.6	6.8	3.0	2.2	1.6	3.9	5.4	2.6	0.7	0.4	0.5	0.2	0.8	3.4
5800.	0.4	2.7	6.4	16.4	6.5	3.0	1.9	1.6	3.9	5.2	2.6	0.7	0.4	0.5	0.2	0.8	3.3
6000.	0.4	2.7	6.4	16.1	6.4	2.7	1.9	1.6	3.9	5.0	2.6	0.7	0.4	0.5	0.2	0.8	3.3
6200.	0.4	2.6	6.2	15.4	6.0	2.7	1.8	1.6	3.7	5.0	2.6	0.6	0.4	0.3	0.2	0.6	3.1
6400.	0.4	2.5	6.2	15.4	6.0	2.7	1.8	1.5	3.7	5.0	2.5	0.6	0.3	0.3	0.2	0.6	3.1
6600.	0.4	2.4	6.1	15.3	5.7	2.6	1.7	1.4	3.6	4.9	2.3	0.6	0.3	0.3	0.1	0.6	3.0
6800.	0.4	2.4	6.0	15.0	5.7	2.6	1.7	1.1	3.6	4.2	2.3	0.6	0.3	0.3	0.1	0.6	2.9
7000.	0.4	2.0	5.9	14.6	5.7	2.6	1.4	1.1	3.6	3.9	2.3	0.6	0.3	0.3	0.1	0.4	2.8
7200.	0.4	1.7	5.7	14.6	5.4	2.6	1.4	1.0	3.4	3.9	2.3	0.6	0.3	0.3	0.1	0.4	2.8
7400.	0.4	1.2	5.6	14.4	5.2	2.5	1.4	1.0	3.4	3.6	2.3	0.6	0.3	0.3	0.1	0.4	2.7
7600.	0.4	1.2	5.6	13.9	5.0	2.4	1.4	1.0	3.4	3.6	2.1	0.6	0.3	0.3	0.1	0.2	2.6
7800.	0.0	1.1	5.4	13.6	5.0	2.4	1.4	0.9	3.2	3.6	2.1	0.6	0.3	0.2	0.1	0.2	2.5
8000.	0.0	0.6	5.0	13.2	4.8	2.4	1.4	0.9	3.0	2.8	2.0	0.6	0.3	0.2	0.1	0.0	2.3

Table 3-36. Salt drift deposition as a function of distance and direction -- winter season

************************************ PLUME SALT DEPOSITION TABLE (KG./(KM.**2-MO.)) ************************************

NATURAL DRAFT COOLING TOWER EXAMPLE USING CD144 MET TAPE

SEASON=WINTER

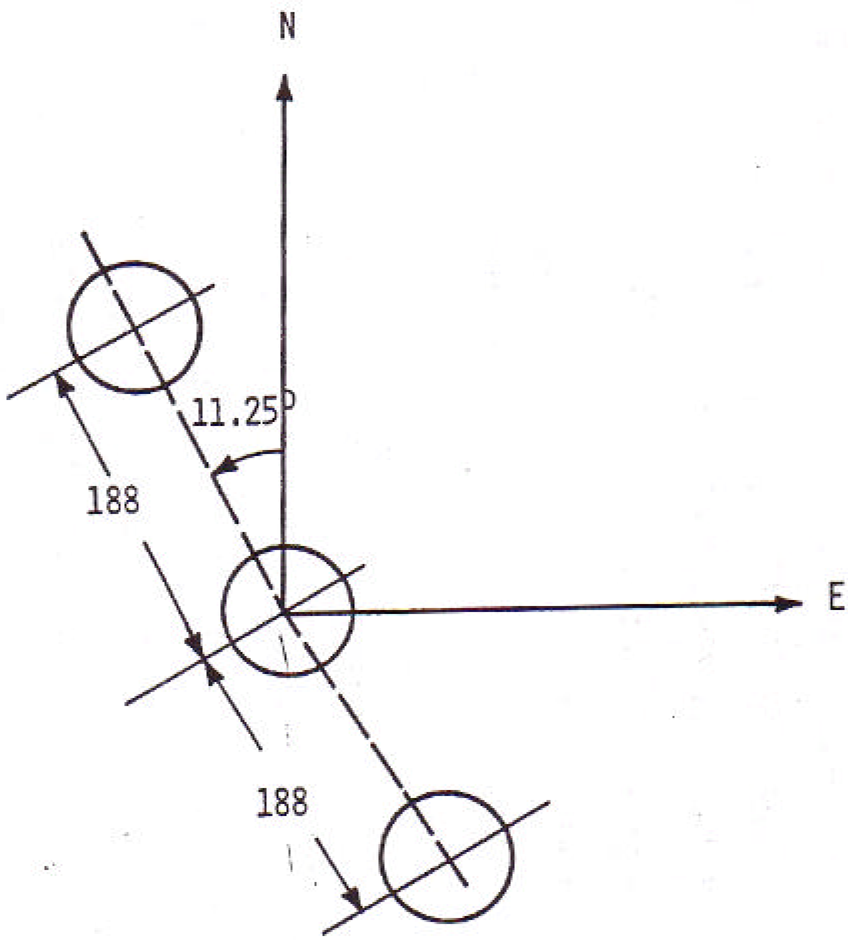
DISTANCE FROM TOWER (M)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	AVG
	WIND FROM																
	PLUME HEADED																
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	AVG
100.	2.11	4.10	10.15	6.36	2.08	1.11	1.33	2.45	3.90	3.38	6.25	2.61	0.87	0.35	0.34	0.41	2.99
200.	2.11	4.10	10.15	6.36	2.08	1.11	1.33	2.45	3.90	3.38	6.25	2.61	0.87	0.35	0.34	0.41	2.99
300.	2.11	4.10	10.15	6.36	2.08	1.11	1.33	2.45	3.90	3.38	6.25	2.61	0.87	0.35	0.34	0.41	2.99
400.	4.83	7.84	18.82	12.21	4.11	1.63	2.37	4.27	6.29	4.20	10.29	4.44	1.20	0.55	0.47	0.63	5.26
500.	21.89	34.07	80.77	52.11	17.34	8.10	10.16	18.31	27.51	17.28	39.28	17.34	4.92	2.53	2.15	3.32	22.32
600.	29.34	55.56	139.47	85.11	28.99	16.24	17.64	34.46	55.40	47.84	87.19	33.85	10.97	5.23	5.19	6.06	41.16
700.	24.54	52.99	144.37	88.86	30.23	15.46	17.20	35.27	55.16	53.35	101.40	38.68	12.72	5.16	4.94	5.81	42.88
800.	12.06	27.92	100.30	59.61	20.28	8.87	9.72	23.25	31.77	30.18	77.31	31.07	10.21	2.73	2.80	3.67	28.23
900.	9.02	22.47	40.81	26.33	8.39	6.32	7.47	14.83	23.38	22.75	41.48	17.73	4.71	1.93	1.85	2.42	15.74
1000.	6.12	12.62	32.47	21.86	6.91	3.44	3.96	11.92	11.91	11.65	31.69	14.44	4.03	1.23	1.09	1.82	11.07
1100.	5.82	12.14	19.59	12.65	3.61	3.24	3.84	10.40	11.53	10.69	18.46	8.69	2.98	1.09	1.09	1.60	7.96
1200.	4.07	9.42	16.99	10.54	2.96	2.78	3.08	7.35	10.06	9.43	16.81	8.26	3.03	0.84	0.91	1.18	6.73
1300.	3.44	8.56	15.48	9.28	2.94	2.57	2.82	3.75	9.31	8.84	15.26	7.67	3.13	0.75	0.79	0.60	5.95
1400.	3.12	8.06	15.00	9.04	2.91	2.45	2.65	3.27	8.53	8.40	13.75	6.60	2.61	0.75	0.75	0.51	5.53
1500.	2.96	7.14	14.97	9.02	2.89	2.08	2.39	3.20	7.39	7.43	13.59	6.55	2.59	0.75	0.69	0.46	5.26
1600.	2.39	6.05	14.29	8.74	2.84	1.70	1.94	2.99	6.16	5.99	11.97	5.73	2.20	0.55	0.60	0.45	4.66
1700.	2.36	5.99	13.75	8.41	2.68	1.68	1.91	2.69	6.07	5.89	10.71	5.11	1.92	0.53	0.60	0.43	4.42
1800.	2.07	5.78	13.03	7.93	2.52	1.56	1.89	2.61	5.67	5.53	9.50	4.37	1.52	0.41	0.49	0.41	4.08
1900.	2.05	5.64	12.25	7.37	2.39	1.51	1.81	2.57	5.44	5.33	8.44	3.86	1.23	0.41	0.45	0.40	3.82
2000.	2.02	5.29	12.18	7.34	2.36	1.42	1.69	2.56	5.13	4.93	8.37	3.82	1.23	0.41	0.41	0.40	3.72
2100.	2.00	5.00	12.14	7.28	2.34	1.37	1.62	2.33	4.84	4.71	8.29	3.79	1.22	0.41	0.40	0.40	3.63
2200.	1.92	4.51	12.04	7.15	2.29	1.29	1.51	2.07	4.58	4.25	8.09	3.74	1.20	0.41	0.38	0.37	3.49
2300.	1.83	4.26	11.62	6.80	2.20	1.19	1.39	1.61	4.20	3.81	7.69	3.58	1.18	0.41	0.35	0.27	3.27
2400.	1.16	3.11	10.94	6.40	2.09	0.87	1.08	1.38	3.07	2.95	6.76	3.23	1.03	0.28	0.31	0.24	2.81
2500.	0.95	2.83	10.39	6.09	1.97	0.77	0.92	1.36	2.71	2.67	6.15	2.98	0.92	0.23	0.24	0.24	2.59
2600.	0.89	2.72	9.39	5.55	1.75	0.71	0.83	1.23	2.66	2.55	5.36	2.66	0.75	0.21	0.24	0.21	2.36
2700.	0.89	2.70	7.81	4.90	1.51	0.71	0.82	1.15	2.62	2.53	4.69	2.39	0.55	0.21	0.24	0.18	2.12
2800.	0.83	2.68	7.08	4.52	1.40	0.69	0.82	1.08	2.56	2.46	4.26	2.21	0.49	0.19	0.22	0.16	1.98
2900.	0.79	2.58	6.07	3.80	1.22	0.64	0.75	1.04	2.35	2.32	4.05	2.00	0.43	0.17	0.20	0.16	1.79
3000.	0.77	2.40	5.76	3.60	1.13	0.60	0.70	1.03	2.22	2.11	3.77	1.81	0.40	0.17	0.17	0.15	1.67
3100.	0.76	2.27	5.43	3.39	1.08	0.56	0.66	1.00	2.04	2.02	3.41	1.68	0.39	0.17	0.17	0.15	1.57
3200.	0.74	2.12	5.00	2.99	0.98	0.47	0.64	0.99	1.85	1.88	3.00	1.52	0.38	0.16	0.16	0.14	1.44
3300.	0.67	1.86	4.83	2.91	0.91	0.42	0.59	0.97	1.76	1.65	2.83	1.47	0.37	0.14	0.15	0.14	1.35
3400.	0.67	1.77	4.72	2.85	0.87	0.40	0.56	0.97	1.67	1.57	2.67	1.43	0.36	0.14	0.15	0.14	1.31
3500.	0.65	1.71	4.44	2.52	0.81	0.38	0.51	0.93	1.54	1.41	2.43	1.36	0.35	0.14	0.14	0.14	1.22
3600.	0.61	1.66	4.09	2.37	0.76	0.35	0.49	0.87	1.44	1.29	2.36	1.22	0.34	0.14	0.13	0.14	1.14
3700.	0.55	1.63	3.82	2.23	0.71	0.32	0.48	0.74	1.36	1.21	2.14	1.16	0.33	0.11	0.10	0.13	1.06
3800.	0.52	1.53	3.66	2.14	0.67	0.28	0.45	0.71	1.19	1.07	2.01	1.14	0.31	0.09	0.10	0.12	1.00
3900.	0.49	1.46	3.64	2.14	0.66	0.27	0.44	0.66	1.08	0.93	1.99	1.12	0.31	0.08	0.10	0.11	0.97
4000.	0.48	1.35	3.62	2.13	0.65	0.27	0.42	0.60	1.02	0.88	1.96	1.11	0.31	0.07	0.10	0.10	0.94
4100.	0.46	1.23	3.44	2.01	0.59	0.25	0.39	0.50	0.94	0.79	1.76	1.02	0.30	0.07	0.09	0.09	0.87
4200.	0.43	1.14	3.32	1.95	0.58	0.22	0.37	0.48	0.86	0.74	1.65	0.98	0.27	0.07	0.09	0.09	0.83
4300.	0.43	1.10	3.06	1.82	0.55	0.21	0.36	0.46	0.80	0.72	1.42	0.90	0.23	0.07	0.09	0.09	0.77
4400.	0.43	1.09	2.96	1.71	0.52	0.21	0.36	0.45	0.80	0.72	1.29	0.86	0.22	0.07	0.09	0.08	0.74
4500.	0.39	1.00	2.92	1.70	0.50	0.20	0.33	0.42	0.72	0.66	1.25	0.84	0.22	0.06	0.06	0.07	0.71
4600.	0.45	1.07	2.83	1.73	0.50	0.21	0.35	0.43	0.74	0.64	1.20	0.76	0.23	0.07	0.06	0.07	0.71
4700.	0.52	1.16	2.73	1.69	0.49	0.22	0.38	0.46	0.78	0.64	1.18	0.72	0.23	0.08	0.07	0.08	0.71
4800.	0.52	1.16	2.67	1.66	0.48	0.22	0.38	0.46	0.78	0.64	1.05	0.64	0.19	0.08	0.07	0.08	0.69
4900.	0.52	1.16	2.54	1.57	0.46	0.22	0.38	0.46	0.78	0.64	1.00	0.61	0.18	0.08	0.07	0.08	0.67
5000.	0.51	1.13	2.50	1.53	0.45	0.21	0.36	0.45	0.75	0.61	0.96	0.61	0.17	0.07	0.07	0.07	0.65

************************************ PLUME SALT DEPOSITION TABLE (KG./(KM.**2-MO.)) ************************************

NATURAL DRAFT COOLING TOWER EXAMPLE USING CD144 MET TAPE

SEASON=WINTER

DISTANCE FROM TOWER (M)	WIND FROM N / PLUME HEADED S	NNE / SSW	NE / SW	ENE / WSW	E / W	ESE / WNW	SE / NW	SSE / NNW	S / N	SSW / NNE	SW / NE	WSW / ENE	W / E	WNW / ESE	NW / SE	NNW / SSE	AVG / AVG
5100.	0.51	1.11	2.40	1.45	0.43	0.20	0.34	0.43	0.73	0.58	0.93	0.59	0.17	0.07	0.07	0.07	0.63
5200.	0.42	0.88	2.22	1.32	0.40	0.18	0.28	0.40	0.65	0.54	0.90	0.56	0.16	0.06	0.06	0.07	0.57
5300.	0.40	0.84	2.15	1.30	0.39	0.17	0.27	0.37	0.61	0.51	0.88	0.55	0.14	0.06	0.06	0.06	0.55
5400.	0.39	0.84	2.10	1.27	0.38	0.17	0.26	0.37	0.59	0.50	0.85	0.54	0.14	0.06	0.06	0.06	0.54
5500.	0.39	0.83	2.10	1.27	0.37	0.17	0.26	0.37	0.59	0.49	0.83	0.54	0.14	0.06	0.06	0.06	0.53
5600.	0.39	0.83	2.07	1.25	0.37	0.17	0.26	0.37	0.59	0.49	0.78	0.53	0.13	0.06	0.06	0.06	0.53
5700.	0.37	0.83	2.06	1.25	0.37	0.16	0.26	0.36	0.57	0.47	0.76	0.53	0.13	0.05	0.05	0.06	0.52
5800.	0.36	0.83	1.96	1.20	0.36	0.16	0.26	0.35	0.56	0.46	0.72	0.49	0.13	0.05	0.04	0.06	0.50
5900.	0.35	0.80	1.68	1.05	0.32	0.15	0.26	0.35	0.55	0.46	0.69	0.41	0.13	0.05	0.04	0.06	0.46
6000.	0.30	0.73	1.63	1.02	0.31	0.14	0.23	0.33	0.51	0.43	0.68	0.39	0.12	0.04	0.04	0.05	0.43
6100.	0.30	0.72	1.70	1.05	0.31	0.14	0.23	0.32	0.49	0.41	0.67	0.39	0.13	0.04	0.04	0.05	0.44
6200.	0.30	0.72	1.69	1.04	0.30	0.14	0.23	0.32	0.49	0.41	0.66	0.39	0.12	0.04	0.04	0.05	0.43
6300.	0.30	0.71	1.69	1.04	0.30	0.14	0.23	0.31	0.48	0.39	0.66	0.39	0.12	0.04	0.04	0.05	0.43
6400.	0.30	0.71	1.68	1.03	0.29	0.14	0.22	0.31	0.48	0.39	0.62	0.39	0.12	0.04	0.04	0.05	0.43
6500.	0.30	0.70	1.68	1.03	0.29	0.13	0.22	0.30	0.47	0.39	0.62	0.39	0.12	0.04	0.03	0.05	0.42
6600.	0.31	0.65	1.75	1.06	0.31	0.14	0.20	0.29	0.47	0.39	0.65	0.40	0.13	0.04	0.03	0.05	0.43
6700.	0.32	0.66	1.76	1.06	0.31	0.14	0.21	0.30	0.48	0.41	0.65	0.40	0.13	0.05	0.03	0.05	0.44
6800.	0.33	0.68	1.73	1.04	0.30	0.15	0.22	0.31	0.48	0.42	0.65	0.39	0.14	0.05	0.03	0.06	0.44
6900.	0.34	0.68	1.70	1.00	0.30	0.15	0.23	0.32	0.51	0.43	0.64	0.39	0.14	0.05	0.04	0.06	0.44
7000.	0.31	0.63	1.65	0.95	0.29	0.14	0.21	0.33	0.48	0.41	0.64	0.38	0.14	0.05	0.04	0.06	0.42
7100.	0.31	0.61	1.69	0.97	0.29	0.14	0.21	0.32	0.48	0.41	0.67	0.39	0.16	0.05	0.04	0.05	0.42
7200.	0.30	0.60	1.67	0.97	0.29	0.14	0.21	0.31	0.48	0.40	0.66	0.39	0.16	0.05	0.04	0.05	0.42
7300.	0.30	0.60	1.67	0.97	0.29	0.14	0.21	0.31	0.48	0.40	0.66	0.39	0.16	0.05	0.04	0.05	0.42
7400.	0.30	0.60	1.67	0.96	0.28	0.14	0.21	0.31	0.48	0.40	0.65	0.38	0.16	0.05	0.04	0.05	0.42
7500.	0.30	0.60	1.66	0.95	0.28	0.14	0.21	0.31	0.48	0.40	0.64	0.38	0.16	0.05	0.04	0.05	0.41
7600.	0.30	0.59	1.60	0.93	0.27	0.14	0.21	0.31	0.46	0.39	0.62	0.37	0.15	0.05	0.04	0.05	0.40
7700.	0.29	0.58	1.60	0.93	0.27	0.13	0.20	0.30	0.45	0.38	0.62	0.37	0.15	0.04	0.04	0.05	0.40
7800.	0.28	0.57	1.57	0.91	0.26	0.13	0.19	0.30	0.45	0.37	0.60	0.36	0.15	0.04	0.04	0.05	0.39
7900.	0.28	0.57	1.52	0.89	0.26	0.13	0.19	0.29	0.45	0.38	0.59	0.36	0.14	0.04	0.04	0.05	0.38
8000.	0.28	0.57	1.54	0.91	0.26	0.13	0.19	0.29	0.45	0.38	0.60	0.36	0.14	0.04	0.04	0.05	0.39
8100.	0.28	0.57	1.51	0.90	0.26	0.13	0.19	0.30	0.45	0.38	0.59	0.36	0.13	0.04	0.04	0.05	0.39
8200.	0.28	0.58	1.52	0.91	0.26	0.13	0.20	0.30	0.46	0.39	0.60	0.37	0.13	0.04	0.04	0.05	0.39
8300.	0.28	0.58	1.49	0.89	0.25	0.13	0.20	0.29	0.46	0.40	0.58	0.36	0.13	0.04	0.04	0.05	0.39
8400.	0.27	0.57	1.48	0.88	0.25	0.13	0.19	0.30	0.46	0.40	0.57	0.36	0.13	0.04	0.04	0.05	0.38
8500.	0.27	0.57	1.48	0.88	0.25	0.12	0.19	0.30	0.45	0.40	0.57	0.36	0.13	0.04	0.04	0.05	0.38
8600.	0.27	0.57	1.48	0.88	0.25	0.12	0.19	0.29	0.45	0.40	0.57	0.36	0.13	0.04	0.04	0.05	0.38
8700.	0.27	0.57	1.48	0.88	0.25	0.12	0.19	0.29	0.45	0.40	0.57	0.36	0.13	0.04	0.04	0.05	0.38
8800.	0.27	0.57	1.48	0.88	0.25	0.12	0.19	0.29	0.45	0.40	0.57	0.36	0.13	0.04	0.04	0.05	0.38
8900.	0.27	0.57	1.42	0.85	0.24	0.12	0.19	0.28	0.45	0.40	0.57	0.34	0.13	0.04	0.04	0.04	0.37
9000.	0.27	0.57	1.39	0.84	0.24	0.13	0.20	0.28	0.46	0.40	0.56	0.33	0.12	0.04	0.04	0.04	0.37
9100.	0.26	0.55	1.35	0.82	0.23	0.12	0.19	0.28	0.45	0.39	0.54	0.32	0.12	0.04	0.04	0.04	0.36
9200.	0.26	0.54	1.32	0.81	0.23	0.12	0.19	0.28	0.44	0.38	0.53	0.31	0.12	0.04	0.04	0.04	0.35
9300.	0.26	0.54	1.30	0.80	0.23	0.12	0.19	0.27	0.44	0.38	0.53	0.31	0.12	0.04	0.04	0.04	0.35
9400.	0.25	0.54	1.27	0.79	0.22	0.12	0.18	0.26	0.43	0.38	0.51	0.30	0.11	0.04	0.03	0.04	0.34
9500.	0.25	0.54	1.27	0.79	0.22	0.12	0.18	0.26	0.43	0.38	0.51	0.30	0.11	0.04	0.03	0.04	0.34
9600.	0.25	0.53	1.28	0.80	0.23	0.12	0.18	0.26	0.42	0.36	0.51	0.31	0.11	0.04	0.03	0.04	0.34
9700.	0.25	0.52	1.22	0.77	0.21	0.11	0.18	0.26	0.39	0.33	0.47	0.29	0.10	0.04	0.03	0.04	0.33
9800.	0.25	0.54	1.18	0.73	0.21	0.12	0.18	0.26	0.40	0.35	0.44	0.28	0.10	0.04	0.03	0.04	0.32
9900.	0.25	0.54	1.15	0.71	0.20	0.12	0.18	0.24	0.40	0.35	0.42	0.27	0.09	0.04	0.03	0.04	0.31
10000.	0.24	0.53	1.11	0.69	0.19	0.11	0.17	0.24	0.37	0.32	0.39	0.26	0.09	0.03	0.03	0.04	0.30



D = Diameter of Top of Each Tower = 65.7 m

H = Height of Each Tower = 126.0 m

d = Distance Between Towers, Center-to-Center = 188 m

Figure 3-10. Sketch of geometry and orientation of natural-draft cooling towers used in Case Study 2.

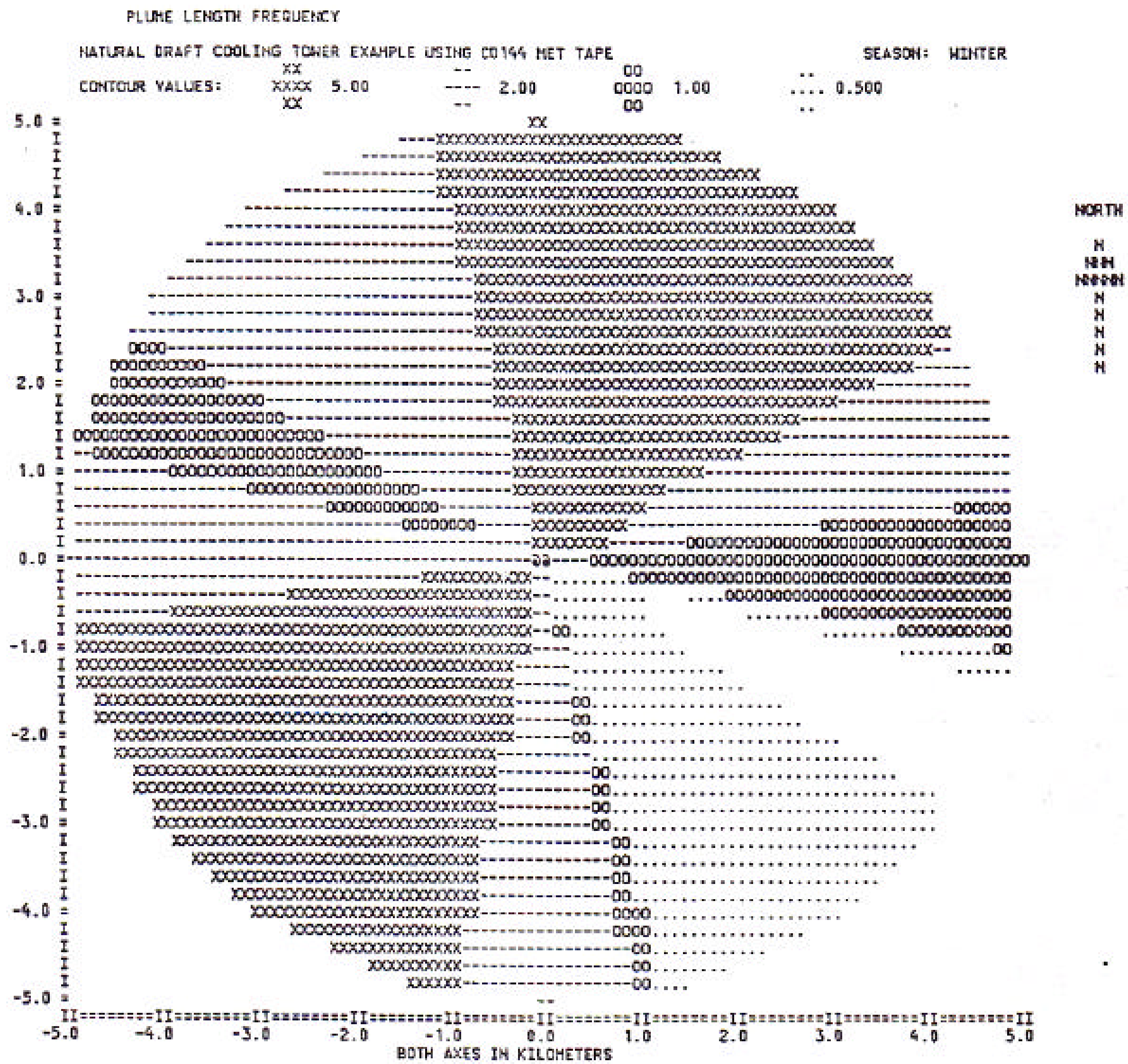


Figure 3-11. Isopleth plot of results presented in Table 3-31 (frequency of occurrence of visible plume).

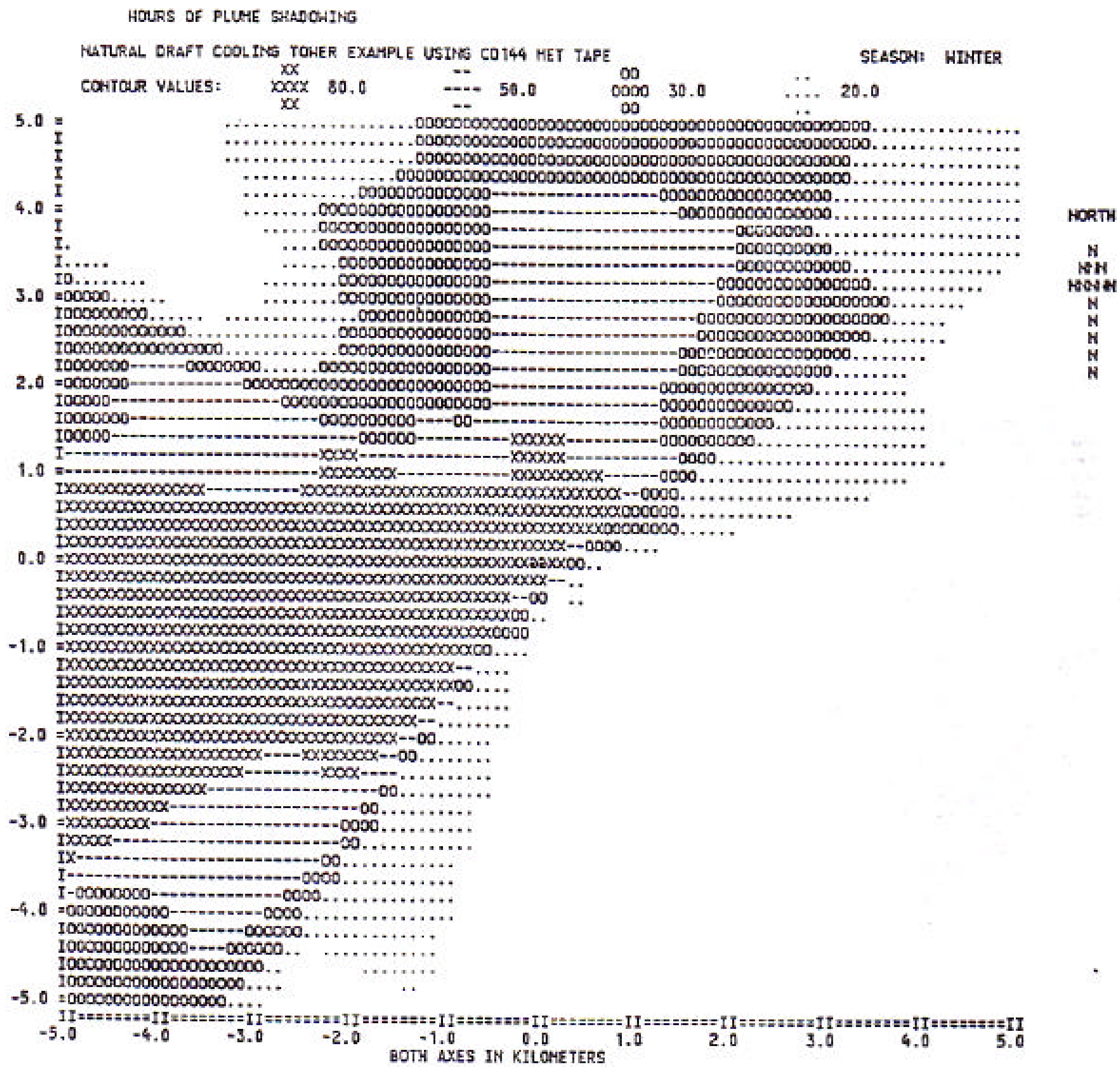


Figure 3-12. Isopleth plot of results presented in Table 3-32 (hours of shadowing)

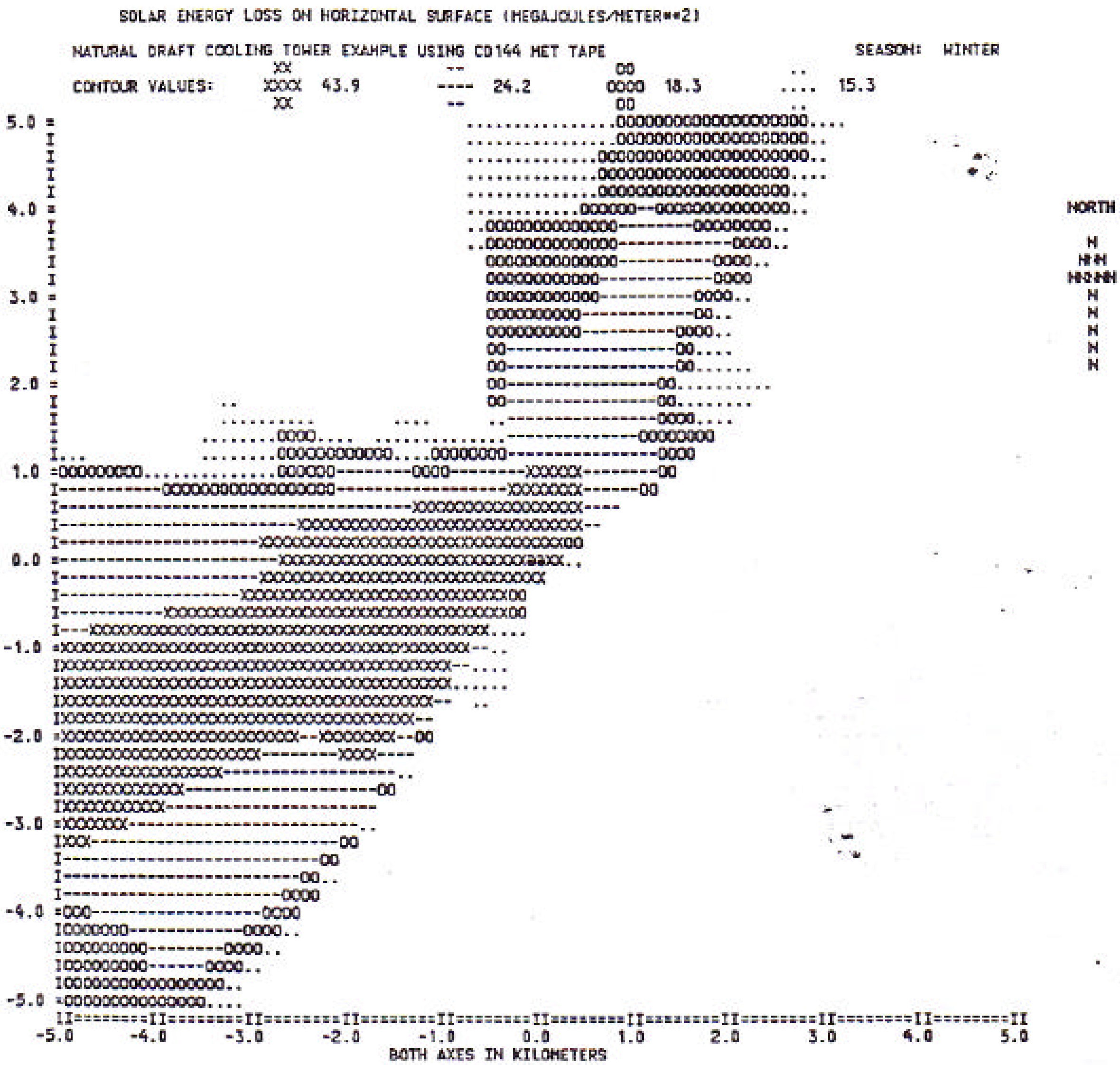


Figure 3-13. Isopleth plot of results presented in Table 3-33 (total solar energy loss due to plume shadowing).

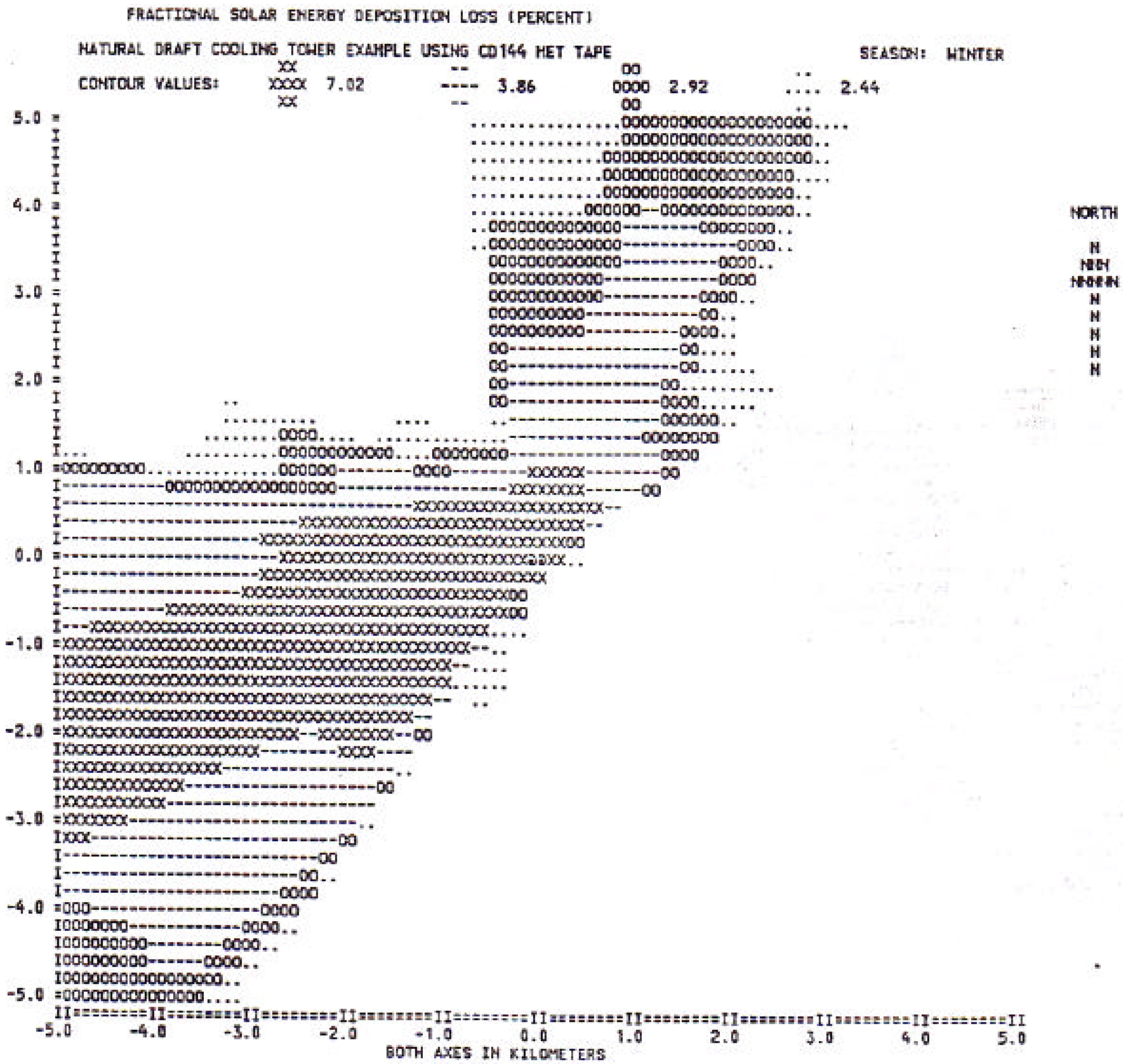


Figure 3-14. Isopleth plot of results presented in Table 3-34 (percent energy loss due to plume shadowing).

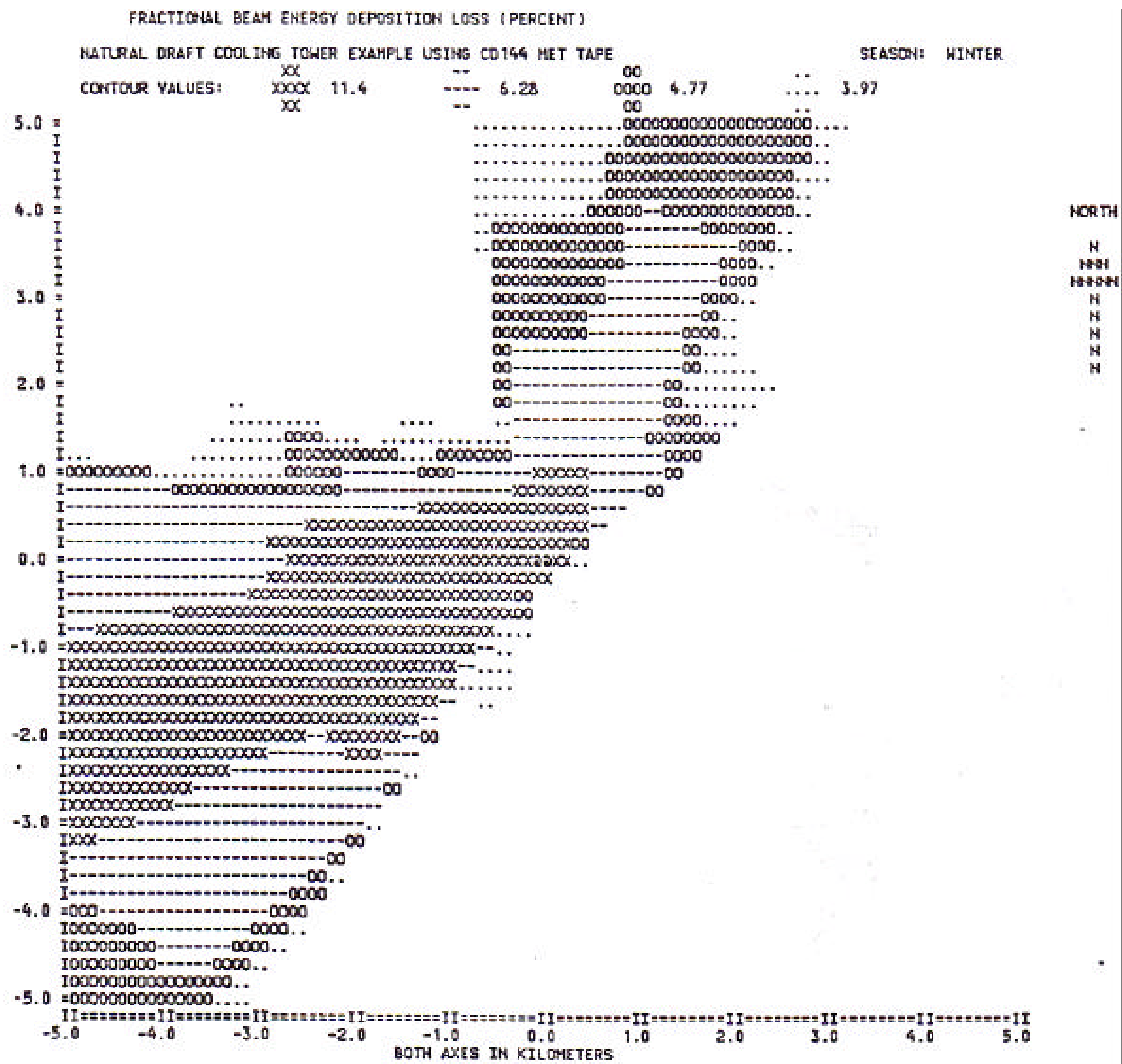


Figure 3-15. Isopleth plot of results presented in Table 3-35 (percent energy loss of direct [beam] energy due to plume shadowing).

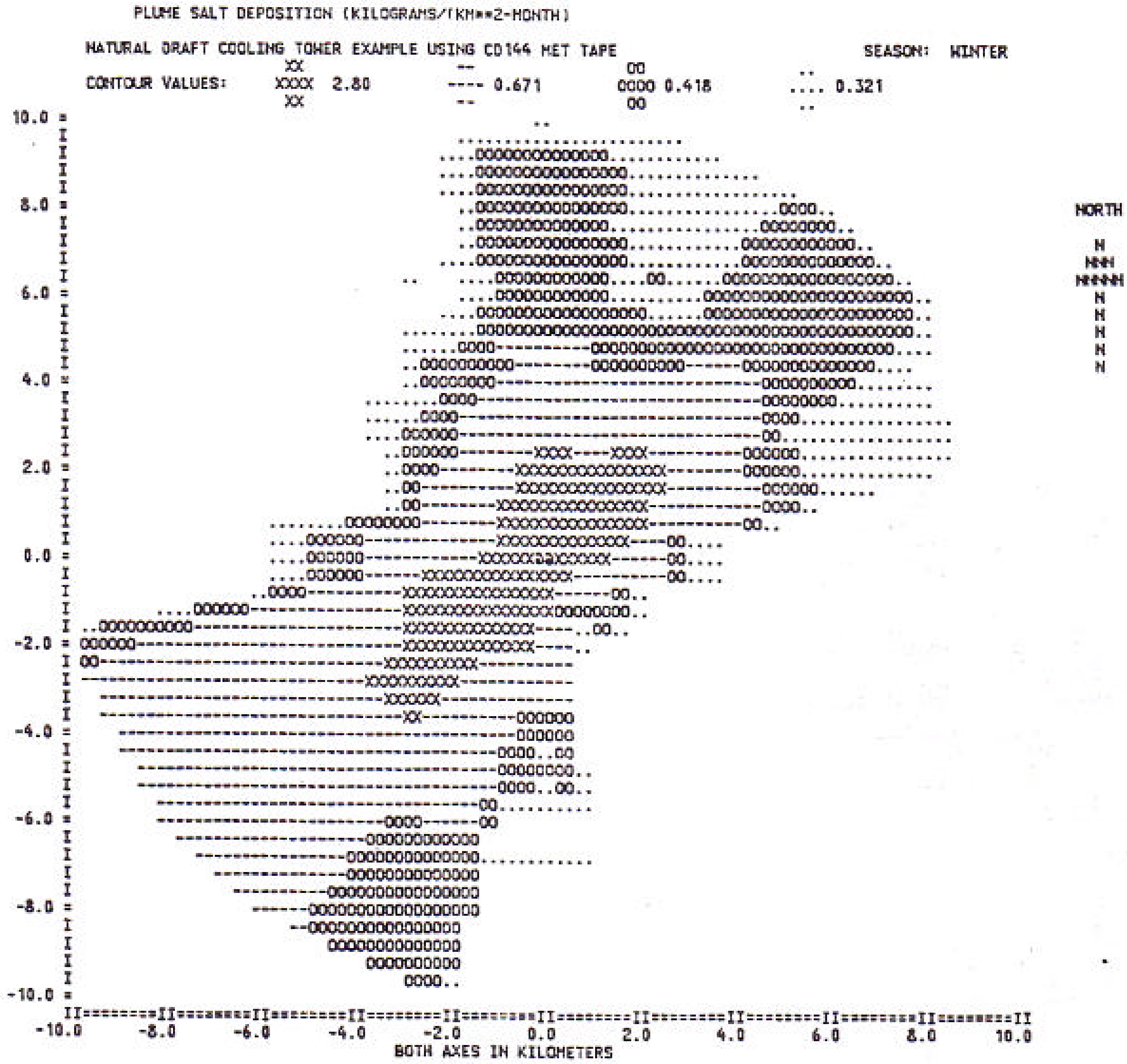


Figure 3-16. Isopleth plot of results presented in Table 3-36 (salt drift deposition).

Appendix A

ANNUAL MIXING HEIGHT DATA FROM HOLZWORTH

APPENDIX A

ALLOWANCE FOR P-, C-, AND M-TYPE MIXING HEIGHTS AND WIND SPEEDS

NCC tabulations of mean mixing heights and wind speeds are given separately for precipitation (P) and non-precipitation (non-P) cases. These tabulations show a distinct tendency for P mixing heights to be higher in the morning and lower in the afternoon than non-P heights. In the calculations, this happens because of the effects of dense cloudiness. Actually, morning and afternoon mixing heights with precipitation may be expected to be higher than without because in the mixing layer above the condensation level the (slower) pseudoadiabatic lapse rate would be more appropriate than the dry adiabatic lapse rate. However, the effectiveness of this consideration is highly dependent on such assumptions as the water vapor content of the initially lifted parcel, the amount of entrainment as the parcel rises, etc. In view of such complexities and the intended climatological use of the derived data, it was decided to allow for all mixing-height and wind-speed cases other than non-P in an arbitrary manner. C cases (Appendix A, Tabulation III) were treated as P cases since marked cold air advection was assumed to be generally indicative of a comparatively deep mixing layer. Wind speeds for P and C cases were assumed faster than otherwise. The number of missing (M) cases was insignificant.

In allowing for P, C, and M cases, it was assumed that the morning and afternoon mixing heights and wind speeds generally were greater than for non-P cases. The allowance was made through use of NCC Tabulation I (see Table A-5), frequencies of mixing-height classes by wind speed classes. One-half of the total P, C, and M frequencies were proportionately redistributed among the non-P frequencies for mixing-height classes above the mean height (for all speed classes). The remaining one-half of P, C, and M frequencies were redistributed among the non-P frequencies for wind speed classes above the mean speed (for all mixing height classes). Thus, the non-P part of each table of mixing-height class by wind-speed class (see Table A-5) was divided into four sections according to the mean height and mean speed. Approximately one-fourth of the P, C, and M frequencies was redistributed in the upper-right section of the frequency table (i.e. in the non-P section with speeds above the mean and heights below the mean); one-fourth was redistributed in the lower left section (i.e., non-P heights above the mean and speeds below); and one-half was redistributed in the lower-right section (i.e., non-P heights and speeds both above the mean). In the redistributions each individual (cell) frequency of non-P mixing height by wind speed was increased in proportion of its frequency to the total non-P frequency of all cells being considered. The total frequencies of all non-P cells above the mean mixing height and above the mean wind speed each was considered separately. Cells with zero non-P frequencies were unaffected by redistributions as were cells below both the mean mixing height and mean wind speed. Due allowance was made for mean heights and wind speeds that fell within a class interval.

Mean mixing heights and wind speeds given in NCC Tabulation III (see Table A-3) are based on averages of the actual values. The means finally arrived at after the redistributions are the NCC Tabulation III means plus the increase in mean value between the mean based on frequency counts by class intervals before (non-P cases only) and after (all cases) the redistributions. Table B-1 gives mean seasonal and annual values of mixing height and wind speed for both before and after allowance for P, C, and M cases. Percentage frequencies of non-P cases are

Table B-1. MEAN SEASONAL AND ANNUAL MORNING AND AFTERNOON MIXING HEIGHTS (U) AND WIND SPEEDS (U) FOR NOP[a] AND ALL[b] CASES.

Station	Time[c]	Winter H, m NOP	Winter H, m All	Winter % NOP	Winter U, m sec^{-1} NOP	Winter U, m sec^{-1} All	Spring H, m NOP	Spring H, m All	Spring % NOP	Spring U, m sec^{-1} NOP	Spring U, m sec^{-1} All	Summer H, m NOP	Summer H, m All	Summer % NOP	Summer U, m sec^{-1} NOP	Summer U, m sec^{-1} All	Autumn H, m NOP	Autumn H, m All	Autumn % NOP	Autumn U, m sec^{-1} NOP	Autumn U, m sec^{-1} All	Annual H, m NOP	Annual H, m All	Annual % NOP	Annual U, m sec^{-1} NOP	Annual U, m sec^{-1} All
Albany, New York	M	576	804	58.0	5.0	6.7	613	786	66.3	5.0	6.1	474	527	83.0	3.7	4.1	491	583	81.1	4.2	4.8	538	675	72.1	4.5	5.4
	A	868	967	60.8	6.9	7.6	1663	1753	69.4	8.3	8.7	1896	1943	79.1	6.8	7.0	1231	1272	80.2	6.9	7.2	1414	1484	72.3	7.2	7.6
Albuquerque, New Mexico	M	345	391	88.9	3.7	4.0	498	553	92.4	4.2	4.5	560	582	93.7	3.6	3.7	377	414	90.3	3.3	3.5	445	485	91.3	3.7	3.9
	A	1402	1464	88.3	5.5	5.8	3426	3452	94.4	8.8	8.9	3902	3941	88.5	5.8	6.0	2247	2295	90.1	5.3	5.5	2744	2788	90.3	6.4	6.5
Amarillo, Texas	M	237	273	83.9	6.5	6.9	311	337	88.7	7.8	8.1	353	379	83.5	7.0	7.4	296	323	87.0	6.5	6.8	299	328	85.7	7.0	7.3
		1101	1171	83.0	8.2	8.5	2447	2507	89.6	9.9	10.1	2475	2520	88.9	7.3	7.4	1648	1693	88.4	7.4	7.6	1917	1973	87.4	8.2	8.4
Athens, Georgia	M	328	407	71.2	5.1	6.0	328	383	78.7	4.7	5.3	363	390	82.6	3.6	3.8	278	314	85.5	4.0	4.4	324	374	79.5	4.4	4.9
	A	970	1042	72.4	6.5	7.0	1707	1754	77.8	6.9	7.2	1876	1918	75.7	4.7	4.9	1428	1455	85.3	5.5	5.7	1495	1542	77.8	5.9	6.2
Bismarck, North Dakota	M	272	380	59.7	5.0	6.5	378	474	68.7	5.5	6.5	239	282	80.2	3.9	4.5	255	301	84.4	4.4	5.0	286	359	73.2	4.7	5.6
	A	528	625	60.8	7.0	7.8	1756	1880	74.6	8.7	9.2	2015	2078	84.4	7.0	7.2	1299	1368	83.5	7.8	8.1	1399	1488	75.8	7.6	8.1
Boise, Idaho	M	327	407	68.1	3.6	4.2	342	424	76.7	4.5	5.0	185	193	90.4	3.3	3.4	224	279	79.8	3.8	4.2	269	326	78.7	3.8	4.2
	A	631	754	67.9	4.3	4.9	2244	2329	78.0	6.4	6.7	2511	2540	92.2	5.8	5.9	1320	1409	81.5	5.0	5.3	1676	1758	79.9	5.4	5.7
Brownsville, Texas	M	365	438	74.6	6.4	7.4	722	746	88.9	8.1	8.3	788	794	96.5	7.1	7.2	530	561	89.2	5.6	5.9	601	635	87.3	6.8	7.2
	A	1043	1084	78.3	8.2	8.6	1113	1127	89.4	9.5	9.6	1533	1540	93.0	8.7	8.7	1369	1385	86.8	7.7	7.8	1264	1284	86.8	8.5	8.7
Buffalo, New York	M	595	869	36.6	6.3	8.2	476	627	62.5	5.4	6.4	391	458	80.7	4.2	4.6	462	571	76.7	4.7	5.3	481	631	64.1	5.1	6.1
	A	727	857	34.4	7.2	8.5	1333	1431	56.8	7.5	8.1	1575	1616	81.0	6.5	6.7	1135	1196	73.1	6.5	6.9	1192	1275	61.3	6.9	7.6
Burrwood, Louisiana	M	535	593	81.6	7.0	7.5	701	720	92.6	6.4	6.6	1282	1300	87.8	4.1	4.2	1090	1113	87.5	6.2	6.4	902	932	87.3	5.9	6.2
	A	637	681	76.1	6.8	7.1	804	816	91.3	6.1	6.2	1238	1252	83.7	4.2	4.3	1053	1073	83.1	6.0	6.2	933	956	83.5	5.8	5.9
Cape Hatteras, North Carolina	M	630	725	73.2	7.8	8.5	643	736	78.3	7.6	8.2	780	848	77.4	6.2	6.7	761	846	78.2	6.6	7.2	703	789	76.7	7.0	7.6
	A	701	769	71.5	7.7	8.2	878	945	77.2	8.5	8.8	988	1021	78.7	7.1	7.3	923	962	78.7	7.0	7.3	872	924	76.5	7.6	7.8
Caribou, Maine	M	447	596	54.0	6.1	7.5	475	610	62.8	5.6	6.7	417	508	68.7	4.4	5.1	472	603	65.5	5.3	6.3	452	579	62.7	5.4	6.4
	A	706	823	49.6	7.8	8.9	1511	1618	62.0	7.7	8.2	1817	1883	69.8	7.6	8.0	1099	1191	62.4	7.7	8.3	1283	1379	60.9	7.7	8.3
Charleston, South Carolina	M	296	363	74.8	4.9	5.8	339	385	82.6	4.8	5.3	411	437	84.4	4.2	4.5	264	297	85.7	4.2	4.6	327	371	81.8	4.5	5.1
	A	951	1004	75.0	6.7	7.1	1519	1562	82.4	7.2	7.4	1447	1510	70.7	5.7	6.0	1222	1243	84.8	6.1	6.3	1284	1330	78.2	6.4	6.7
Columbia, Missouri	M	390	448	74.3	6.0	6.5	409	477	73.9	6.6	7.3	294	321	83.3	4.7	5.0	317	358	83.1	5.5	5.9	352	401	78.6	5.7	6.2
	A	797	872	71.5	7.0	7.5	1523	1599	75.8	8.4	8.8	1689	1723	83.9	5.6	5.8	1349	1395	82.2	6.5	6.7	1339	1397	78.3	6.9	7.2
Dayton, Ohio	M	461	557	58.6	6.2	7.1	462	555	67.2	5.9	6.6	349	375	87.4	3.8	4.0	360	417	82.4	4.5	5.0	408	476	73.9	5.1	5.7
	A	749	836	56.4	7.2	7.9	1570	1670	68.3	7.5	8.0	1661	1685	83.9	5.3	5.5	1315	1346	82.6	6.3	6.5	1323	1384	72.8	6.6	7.0

[a]NOP excludes type P, C, and M cases (see text).
[b]ALL includes all cases, with allowances for types P, C, and M (see text).
[c]M, morning; A, afternoon.

Table B-1 (continued). MEAN SEASONAL AND ANNUAL MORNING AND AFTERNOON MIXING HEIGHTS (H) AND WIND SPEEDS (U) FOR NOP[a] AND ALL[b] CASES.

Station	Time[c]	Winter H, m NOP	Winter H, m All	Winter % NOP	Winter U, m sec⁻¹ NOP	Winter U, m sec⁻¹ All	Spring H, m NOP	Spring H, m All	Spring % NOP	Spring U, m sec⁻¹ NOP	Spring U, m sec⁻¹ All	Summer H, m NOP	Summer H, m All	Summer % NOP	Summer U, m sec⁻¹ NOP	Summer U, m sec⁻¹ All	Autumn H, m NOP	Autumn H, m All	Autumn % NOP	Autumn U, m sec⁻¹ NOP	Autumn U, m sec⁻¹ All	Annual H, m NOP	Annual H, m All	Annual % NOP	Annual U, m sec⁻¹ NOP	Annual U, m sec⁻¹ All
Denver, Colorado	M	178	219	78.5	4.5	4.8	360	423	82.6	4.3	4.6	243	255	92.6	3.6	3.7	163	174	87.0	3.5	3.6	236	268	85.1	4.0	4.2
	A	1357	1482	80.3	5.8	6.3	2951	3070	80.7	7.2	7.6	3358	3458	79.6	5.9	6.1	2085	2161	86.8	5.1	5.3	2437	2543	81.8	6.0	6.3
Dodge City, Kansas	M	224	266	80.5	6.7	7.3	316	354	81.7	7.7	8.2	302	328	79.6	7.1	7.5	255	283	85.5	6.6	7.0	274	308	81.8	7.0	7.5
	A	811	879	81.4	8.0	8.3	1783	1872	82.8	9.6	9.9	2028	2086	86.1	8.3	8.5	1267	1323	87.3	8.2	8.4	1472	1540	84.4	8.5	8.8
El Paso, Texas	M	360	405	90.7	4.2	4.5	660	690	96.1	5.5	5.7	718	758	89.8	4.0	4.2	385	429	90.3	3.3	3.5	530	571	91.7	4.3	4.5
	A	1421	1460	91.6	5.9	6.1	3211	3222	97.0	8.4	8.4	3696	3721	91.7	5.1	5.2	2118	2148	91.9	4.4	4.5	2611	2638	93.0	5.9	6.1
Ely, Nevada	M	157	193	78.8	4.8	5.1	427	489	83.3	4.7	5.1	108	109	95.0	4.2	4.2	146	161	88.8	4.3	4.5	209	238	86.4	4.5	4.7
	A	1020	1072	80.8	5.2	5.5	2630	2708	79.1	7.1	7.4	3583	3624	87.8	6.9	7.0	2116	2179	88.1	5.9	6.1	2337	2396	83.9	6.3	6.5
Flint, Michigan	M	518	674	49.1	6.0	7.2	429	527	69.6	5.3	6.1	280	328	83.5	3.5	4.0	400	494	77.1	4.5	5.2	406	506	69.8	4.8	5.6
	A	762	862	45.6	7.0	7.8	1496	1608	66.1	7.6	8.2	1697	1734	81.1	6.1	6.3	1213	1268	75.6	6.7	7.1	1292	1368	67.1	6.8	7.4
Glasgow, Montana	M	220	283	73.7	4.7	5.5	347	391	82.6	5.9	6.3	277	304	86.5	5.4	5.7	232	262	88.8	5.0	5.3	269	310	82.9	5.3	5.7
	A	428	524	67.3	6.2	6.9	1855	1971	77.6	7.7	8.1	2409	2454	88.0	7.1	7.2	1257	1307	88.6	7.5	7.7	1487	1564	80.3	7.1	7.5
Grand Junction, Colorado	M	276	329	81.9	3.1	3.4	550	628	86.5	5.1	5.4	290	307	90.4	4.6	4.7	239	273	86.6	3.7	3.9	338	384	86.3	4.1	4.3
	A	1075	1160	83.0	3.1	3.4	3087	3166	86.1	6.3	6.6	3895	3940	87.8	5.9	6.1	2048	2133	86.4	4.4	4.6	2526	2600	85.8	4.9	5.2
Great Falls, Montana	M	447	562	73.5	8.8	9.7	527	643	76.7	6.5	7.3	359	399	89.1	4.4	4.7	422	491	84.2	7.0	7.5	438	524	80.8	6.7	7.3
	A	874	1003	70.8	9.9	10.5	2318	2439	72.2	8.4	8.9	2984	3040	83.3	6.9	7.2	1641	1707	83.3	9.0	9.3	1954	2047	77.4	8.6	9.0
Green Bay, Wisconsin	M	442	573	59.7	5.8	6.9	433	534	70.9	5.4	6.2	323	372	81.7	4.0	4.5	465	543	79.6	4.9	5.5	415	506	72.9	5.0	5.8
	A	632	704	59.7	7.3	7.9	1389	1492	73.3	7.8	8.2	1607	1648	84.1	6.5	6.7	1067	1127	78.0	7.1	7.5	1173	1243	73.7	7.2	7.6
Greensboro, North Carolina	M	389	480	74.8	4.7	5.4	402	492	76.1	4.7	5.4	400	445	80.9	3.8	4.2	290	343	82.4	3.8	4.3	370	440	78.5	4.3	4.8
	A	926	992	71.9	6.4	6.8	1708	1765	78.7	7.1	7.4	1674	1710	78.5	4.9	5.1	1306	1334	84.6	5.6	5.8	1403	1450	78.4	6.0	6.3
Huntington, West Virginia	M	482	634	57.9	4.2	5.3	575	721	70.7	4.6	5.5	300	338	83.0	2.4	2.7	332	403	82.1	2.6	3.1	442	524	73.4	3.4	4.2
	A	963	1079	58.3	5.7	6.4	1872	1986	72.5	6.0	6.5	1596	1641	81.9	4.1	4.3	1300	1340	81.7	4.6	4.9	1432	1511	73.6	5.1	5.5
International Falls, Minn.	M	251	347	54.0	4.3	5.6	319	411	66.3	4.6	5.6	266	337	75.2	3.3	4.1	406	513	70.6	5.1	6.0	310	402	66.5	4.3	5.3
	A	584	656	52.7	6.3	7.0	1540	1646	68.3	7.1	7.5	1688	1747	78.9	6.6	6.9	1054	1146	69.9	7.0	7.4	1216	1299	67.4	6.8	7.2
Jackson, Mississippi	M	379	470	68.8	4.0	4.9	417	467	81.3	4.4	4.9	408	421	91.9	3.0	3.1	305	343	83.0	3.2	3.6	377	425	81.2	3.7	4.1
	A	1014	1088	69.1	5.4	5.9	1503	1543	81.8	6.0	6.2	1803	1830	76.4	4.3	4.5	1319	1349	31.3	4.9	5.1	1409	1453	77.1	5.2	5.4
Jacksonville, Florida	M	345	403	79.4	5.2	5.9	447	477	90.4	5.3	5.6	567	583	91.1	4.3	4.4	418	458	85.9	4.7	5.0	444	480	86.7	4.9	5.2
	A	1058	1104	80.1	6.7	7.0	1639	1667	86.1	7.1	7.2	1681	1712	68.0	5.6	5.8	1321	1342	80.4	6.5	6.5	1424	1456	78.6	6.5	6.7
Lake Charles, Louisiana	M	319	394	71.2	5.8	6.7	418	459	87.3	5.3	5.7	493	506	92.4	4.0	4.1	290	308	90.8	4.3	4.5	380	417	85.4	4.9	5.3
	A	822	867	74.5	7.1	7.5	1164	1179	86.2	6.9	7.0	1365	1392	80.4	5.0	5.2	1299	1315	86.5	5.7	5.8	1162	1188	81.9	6.2	6.4

Table B-1 (continued). MEAN SEASONAL AND ANNUAL MORNING AND AFTERNOON MIXING HEIGHTS (H) AND WIND SPEEDS (U) FOR NOP[a] AND ALL[b] CASES.

Station		Winter					Spring					Summer					Autumn					Annual				
		H, m			U, m sec^{-1}		H, m			U, m sec^{-1}		H, m			U, m sec^{-1}		H, m			U, m sec^{-1}		H, m			U, m sec^{-1}	
		NOP	All	% NOP	NOP	All	NOP	All	% NOP	NOP	All	NOP	All	% NOP	NOP	All	NOP	All	% NOP	NOP	All	NOP	All	% NOP	NOP	All
Portland,	M	481	618	70.4	5.6	6.6	533	689	68.5	5.4	6.4	435	501	78.9	4.3	4.8	395	506	74.1	4.7	5.6	461	578	72.9	5.0	5.9
Maine	A	879	945	69.0	7.2	7.8	1384	1479	70.9	8.2	8.7	1414	1476	80.4	7.3	7.6	1083	1141	76.3	7.0	7.4	1190	1260	74.1	7.4	7.8
Rapid City,	M	226	363	65.5	4.7	6.3	362	465	73.7	5.8	6.7	298	330	85.4	4.5	4.8	264	314	86.6	5.0	5.5	287	368	77.8	5.0	5.8
South Dakota	A	848	982	67.7	7.2	7.9	2032	2166	74.6	8.4	8.8	2419	2510	83.5	6.7	6.9	1559	1615	87.0	7.6	7.8	1714	1810	78.2	7.5	7.9
St. Cloud,	M	338	393	74.8	5.4	6.1	404	469	77.6	5.6	6.3	328	351	89.4	3.9	4.2	389	429	87.0	5.1	5.5	364	411	82.2	5.0	5.5
Minnesota	A	537	607	59.7	6.6	7.3	1344	1432	75.7	7.7	8.0	1595	1646	82.8	6.6	6.9	952	1006	80.7	7.4	7.7	1107	1173	74.7	7.1	7.5
Salem,	M	325	431	56.2	3.0	3.8	432	627	55.4	2.3	2.9	379	424	89.1	2.0	2.2	292	404	68.1	2.2	2.8	357	471	67.2	2.4	2.9
Oregon	A	622	787	50.4	3.7	4.5	1614	1733	56.3	4.3	4.8	1655	1632	86.1	4.4	4.5	1115	1212	67.9	4.2	4.6	1251	1354	65.1	4.1	4.6
Salt Lake City,	M	254	329	71.9	3.7	4.3	317	419	73.7	4.8	5.4	198	216	88.9	4.4	4.6	198	238	84.8	4.3	4.6	241	300	79.8	4.3	4.7
Utah	A	808	944	67.9	4.0	4.6	2548	2675	74.8	6.2	6.6	3673	3737	85.9	6.0	6.2	1821	1933	83.7	5.2	5.5	2212	2322	78.0	5.3	5.7
San Antonio,	M	370	459	71.7	5.0	5.8	678	748	78.9	6.0	6.5	897	915	92.0	5.6	5.7	595	654	84.0	5.1	5.5	635	694	81.6	5.4	5.9
Texas	A	1065	1112	79.0	6.5	6.8	1529	1552	88.7	7.1	7.2	2108	2119	91.7	5.9	6.0	1542	1572	87.5	6.0	6.1	1561	1589	86.7	6.4	6.5
San Diego,	M	468	534	88.1	2.0	2.2	807	851	91.1	2.6	2.7	531	538	95.4	2.0	2.0	558	578	95.0	2.0	2.1	591	625	92.4	2.2	2.2
California	A	989	1021	91.4	4.2	4.3	1056	1085	92.6	5.1	5.2	564	566	98.5	4.1	4.1	819	834	95.8	4.3	4.3	857	877	94.5	4.4	4.5
Santa Monica,	M	376	422	85.4	2.8	3.0	651	676	92.6	2.7	2.8	552	562	94.1	1.9	1.9	487	510	91.9	2.3	2.4	516	542	91.0	2.4	2.5
California	A	863	893	91.6	4.4	4.5	946	963	95.0	5.9	6.0	603	603	99.4	5.1	5.1	785	798	95.8	4.8	4.8	799	814	95.4	5.1	5.1
Sault Ste. Marie,	M	386	532	33.9	4.8	6.1	390	493	66.1	4.7	5.5	278	332	76.1	3.7	4.2	519	676	64.2	4.9	5.8	393	508	60.0	4.5	5.4
Michigan	A	582	700	33.4	5.9	7.0	1152	1243	66.3	7.3	7.7	1394	1433	79.1	6.9	7.1	1024	1125	60.7	7.0	7.6	1038	1125	59.8	6.8	7.3
Seattle,	M	626	824	49.8	5.1	6.2	681	838	55.1	4.6	5.5	532	576	85.1	4.0	4.2	476	585	61.5	4.3	5.0	578	705	62.8	4.5	5.2
Washington	A	585	718	45.8	4.7	5.4	1490	1577	56.5	5.7	6.2	1398	1419	89.5	4.8	4.9	898	987	66.3	4.6	5.0	1092	1175	64.5	4.9	5.4
Shreveport,	M	430	508	72.4	5.7	6.3	5.5	566	83.9	6.3	6.7	469	482	92.2	4.7	4.8	391	430	86.2	4.5	4.8	451	497	83.6	5.3	5.7
Louisiana	A	1016	1088	72.8	6.2	6.7	1441	1484	82.4	6.8	7.1	1802	1823	85.4	4.7	4.8	1385	1414	85.3	5.2	5.4	1411	1452	81.4	5.7	6.0
Spokane,	M	336	414	60.2	4.7	5.7	341	401	74.1	5.2	5.8	234	259	88.3	4.1	4.4	218	266	75.0	3.8	4.3	282	335	74.4	4.4	5.1
Washington	A	430	523	56.9	4.8	5.6	1861	1943	72.0	6.1	6.5	2533	2559	87.8	5.2	5.3	1261	1362	74.7	5.0	5.4	1521	1597	72.8	5.3	5.7
Tampa,	M	394	436	85.8	5.8	6.1	503	526	91.7	5.6	5.8	656	674	91.1	4.2	4.3	419	439	89.2	5.4	5.6	493	519	89.4	5.3	5.4
Florida	A	1052	1079	81.4	6.4	6.6	1523	1544	87.8	6.7	6.8	1460	1526	68.9	5.0	5.3	1401	1429	84.4	6.4	6.8	1359	1394	80.6	6.2	6.4
Topeka,	M	381	448	73.7	5.9	6.6	454	529	75.9	7.0	7.8	371	406	80.4	5.2	5.6	317	361	81.3	5.0	5.6	380	436	77.8	5.8	6.4
Kansas	A	801	876	74.6	7.4	7.9	1441	1512	77.2	9.3	9.6	1503	1542	86.1	6.8	7.0	1228	1267	82.2	7.5	7.8	1243	1299	80.0	7.8	8.1
Tucson,	M	216	247	90.7	4.3	4.5	244	260	96.5	4.2	4.3	335	356	90.0	3.8	3.9	225	241	93.0	4.4	4.5	255	276	92.5	4.2	4.3
Arizona	A	1390	1424	88.3	5.0	5.2	2659	2664	97.8	6.8	6.8	3040	3110	82.2	5.3	5.5	2073	2110	89.5	4.9	5.0	2290	2327	89.4	5.5	5.6

Table B-1 (continued). MEAN SEASONAL AND ANNUAL MORNING AND AFTERNOON MIXING HEIGHTS (H) AND WIND SPEEDS (U) FOR NOP[a] AND ALL[b] CASES.

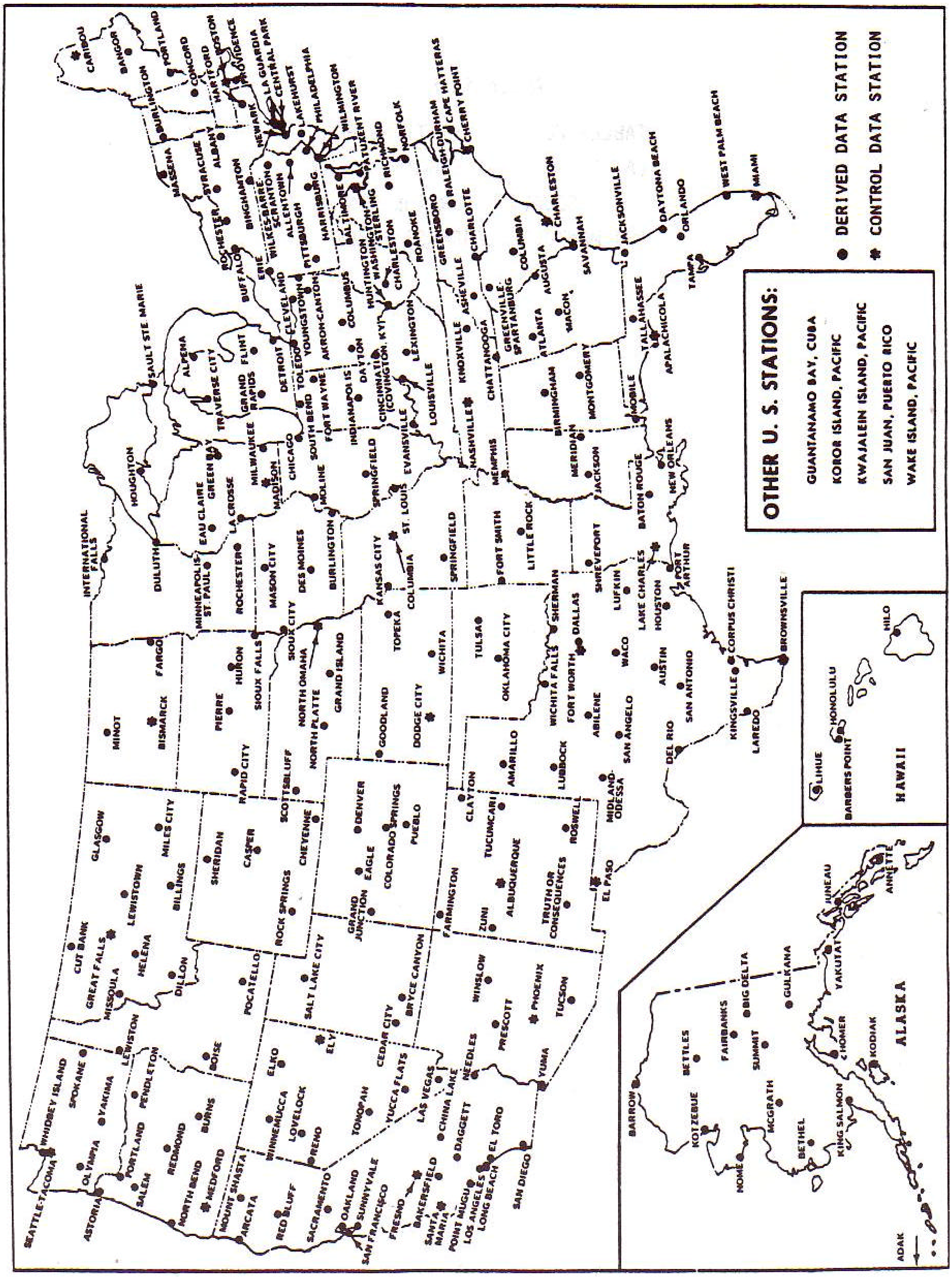
Station	Time[c]	Winter					Spring					Summer					Autumn					Annual				
		H, m			U, m sec^{-1}		H, m			U, m sec^{-1}		H, m			U, m sec^{-1}		H, m			U, m sec^{-1}		H, m			U, m sec^{-1}	
		NOP	All	% NOP	NOP	All	NOP	All	% NOP	NOP	All	NOP	All	% NOP	NOP	All	NOP	All	% NOP	NOP	All	NOP	All	% NOP	NOP	All
Lander,	M	188	223	83.0	2.5	2.8	427	511	81.7	3.3	3.7	326	337	95.4	2.7	2.7	265	322	86.2	2.6	2.9	301	348	86.5	2.8	3.0
Wyoming	A	808	926	82.1	3.6	4.1	2629	2755	79.4	6.4	6.9	3406	3490	84.4	6.3	6.6	1907	2030	85.1	4.6	5.0	2187	2300	82.7	5.2	5.6
Las Vegas,	M	266	321	92.0	4.2	4.5	405	433	95.4	5.4	5.6	283	292	97.2	4.6	4.7	242	276	94.3	4.1	4.3	299	331	94.7	4.6	4.8
Nevada	A	1123	1153	94.0	4.1	4.2	2769	2785	95.2	7.0	7.1	3672	3693	92.0	6.6	6.7	2076	2106	95.6	5.1	5.2	2410	2434	94.2	5.7	5.8
Little Rock,	M	451	541	76.3	4.6	5.2	460	544	77.8	5.0	5.7	355	375	90.0	3.5	3.7	303	342	86.2	3.4	3.8	392	450	82.5	4.1	4.6
Arkansas	A	996	1101	72.1	6.1	6.6	1554	1612	80.0	6.7	7.0	1817	1851	84.1	4.8	4.9	1360	1401	84.6	5.0	5.2	1431	1491	80.2	5.7	5.9
Medford,	M	289	387	60.6	1.5	1.9	392	535	68.0	1.8	2.2	259	285	93.7	1.2	1.3	220	293	75.0	1.1	1.3	290	375	74.3	1.4	1.7
Oregon	A	747	933	65.0	2.2	2.8	2004	2079	67.6	4.5	4.8	2332	2349	92.0	4.6	4.6	1481	1594	77.6	3.2	3.5	1641	1738	75.5	3.6	3.9
Miami,	M	654	707	87.2	5.4	5.7	947	980	91.1	5.7	5.9	1041	1071	88.3	4.3	4.5	872	933	82.4	5.0	5.3	878	923	87.2	5.1	5.3
Florida	A	1208	1221	89.2	6.4	6.5	1440	1459	87.4	6.8	6.9	1360	1383	73.7	5.3	5.5	1315	1341	78.7	6.6	6.9	1330	1351	82.2	6.3	6.5
Midland,	M	249	290	83.4	5.1	5.7	405	429	90.9	7.3	7.5	583	606	90.2	7.0	7.2	388	419	87.9	5.7	6.0	406	436	88.1	6.3	6.6
Texas	A	1222	1276	84.5	7.5	7.8	2408	2449	92.4	8.9	9.0	2716	2744	90.7	6.6	6.7	1849	1887	89.7	6.6	6.7	2048	2089	89.3	7.4	7.5
Montgomery,	M	387	484	72.1	4.2	5.0	382	431	82.6	3.9	4.3	430	444	92.0	3.4	3.5	294	323	86.8	3.3	3.6	373	420	83.3	3.7	4.1
Alabama	A	988	1060	72.1	5.8	6.3	1590	1622	84.4	5.8	6.0	1770	1801	79.6	4.3	4.4	1380	1402	85.7	4.8	4.9	1432	1471	80.4	5.2	5.4
Nantucket,	M	780	905	63.7	8.5	9.5	588	734	66.3	7.5	8.4	389	448	75.9	5.7	6.2	625	739	72.3	6.9	7.6	595	707	69.5	7.1	7.9
Massachusetts	A	791	890	59.7	9.0	9.8	746	827	74.6	8.4	8.8	609	667	77.4	7.1	7.3	765	831	70.8	7.9	8.3	727	804	70.6	8.1	8.6
Nashville,	M	440	563	62.8	4.3	5.2	500	606	73.7	4.8	5.6	417	441	89.4	3.2	3.4	301	357	81.1	3.0	3.5	414	492	76.7	3.8	4.4
Tennessee	A	1035	1123	66.6	6.2	6.8	1713	1783	75.4	6.8	7.1	1845	1874	80.9	4.6	4.8	1438	1473	80.9	5.1	5.3	1507	1563	75.9	5.7	6.0
New York,	M	875	986	71.5	8.3	9.1	788	918	72.0	6.9	7.7	662	711	82.0	5.5	5.8	675	741	82.6	6.6	7.1	750	839	77.0	6.8	7.4
New York	A	901	976	67.5	8.2	8.8	1360	1466	75.4	8.7	9.1	1512	1570	82.0	6.8	7.0	1086	1132	80.7	7.4	7.7	1214	1286	76.4	7.8	8.2
North Platte,	M	209	284	72.1	4.3	5.3	317	383	73.0	5.9	6.8	321	361	80.9	5.4	5.9	238	287	82.0	4.3	4.9	271	329	77.0	5.0	5.7
Nebraska	A	886	986	77.4	7.6	8.1	1778	1894	76.1	8.7	9.1	1717	1756	88.7	7.3	7.4	1356	1400	88.6	7.5	7.7	1434	1509	82.7	7.8	8.1
Oakland,	M	386	453	78.3	2.9	3.3	701	763	84.6	3.9	4.2	515	527	93.3	3.2	3.3	464	508	85.3	2.7	2.9	516	563	85.3	3.2	3.4
California	A	649	709	80.1	4.1	4.4	1087	1121	87.6	6.5	6.6	643	644	98.0	5.9	5.9	745	770	89.5	5.0	5.1	781	811	88.8	5.4	5.5
Oklahoma City,	M	296	342	78.1	6.9	7.5	409	457	82.0	8.7	9.2	344	367	83.5	6.9	7.2	309	343	83.1	6.7	7.2	339	377	81.6	7.3	7.8
Oklahoma	A	804	859	78.8	8.1	8.4	1447	1506	82.0	9.8	10.0	1830	1862	88.5	7.2	7.3	1266	1302	85.5	7.7	7.9	1336	1382	83.7	8.2	8.4
Peoria,	M	327	392	69.3	5.2	5.9	361	431	71.1	5.7	6.4	272	305	83.3	3.8	4.2	273	321	82.2	4.4	4.9	308	362	76.4	4.8	5.4
Illinois	A	533	594	64.2	6.8	7.3	1353	1443	72.2	8.2	8.7	1498	1532	85.0	5.8	6.0	1068	1104	83.7	6.7	6.9	1113	1168	76.2	6.9	7.2
Pittsburgh,	M	419	634	42.3	4.7	6.5	404	536	61.1	4.2	5.1	333	382	82.8	3.1	3.5	404	488	79.3	3.7	4.3	390	510	66.3	3.9	4.9
Pennsylvania	A	811	920	45.1	6.9	7.9	1753	1892	60.9	7.7	8.4	1794	1827	82.2	5.4	5.6	1365	1409	78.7	6.2	6.5	1430	1512	66.7	6.5	7.1

Table B-1 (continued). MEAN SEASONAL AND ANNUAL MORNING AND AFTERNOON MIXING HEIGHTS (H) AND WIND SPEEDS (U) FOR NOP[a] AND ALL[b] CASES.

Station		Winter					Spring					Summer					Autumn					Annual				
		H, m			U, m sec^{-1}		H, m			U, m sec^{-1}		H, m			U, m sec^{-1}		H, m			U, m sec^{-1}		H, m			U, m sec^{-1}	
		NOP	All	% NOP	NOP	All	NOP	All	% NOP	NOP	All	NOP	All	% NOP	NOP	All	NOP	All	% NOP	NOP	All	NOP	All	% NOP	NOP	All
Washington,	M	539	672	74.0	5.3	6.3	481	585	77.5	4.7	5.4	378	421	84.0	3.1	3.4	359	436	83.2	3.7	4.4	439	528	79.6	4.2	4.9
D. C.	A	963	1054	71.5	6.7	7.3	1795	1890	74.5	7.5	7.9	1884	1924	83.4	5.4	5.6	1371	1412	84.3	6.2	6.4	1503	1570	78.4	6.4	6.8
Winnemucca,	M	231	301	83.2	2.8	3.3	343	434	83.0	3.6	4.1	117	129	85.2	2.6	2.7	179	255	82.6	2.9	3.4	217	280	83.5	3.0	3.4
Nevada	A	1001	1067	82.5	4.5	4.9	2699	2756	83.5	6.6	6.8	3627	3656	92.6	6.1	6.2	2095	2150	90.3	5.2	5.4	2355	2407	87.2	5.6	5.8
Winslow,	M	205	223	91.1	2.8	3.0	241	270	94.2	4.0	4.2	221	232	93.8	3.2	3.3	198	213	91.9	2.5	2.6	216	234	92.7	3.1	3.3
Arizona	A	1078	1128	91.5	5.3	5.6	3160	3178	94.6	8.8	8.9	3801	3840	87.3	6.9	7.1	2243	2303	88.3	5.0	5.2	2570	2613	90.4	6.5	6.7

Appendix B

TABLES FOR U.S. STATIONS FOR
(A) TOTAL AVERAGE DAILY SOLAR INSOLATION FOR THE MONTH
(B) MONTHLY CLEARNESS INDEX


OTHER U. S. STATIONS:
GUANTANAMO BAY, CUBA
KOROR ISLAND, PACIFIC
KWAJALEIN ISLAND, PACIFIC
SAN JUAN, PUERTO RICO
WAKE ISLAND, PACIFIC
● DERIVED DATA STATION
✱ CONTROL DATA STATION
HAWAII
LIHUE
BARBERS POINT
HONOLULU
HILO
ALASKA
BARROW
KOTZEBUE
NOME
BETTLES
FAIRBANKS
BIG DELTA
GULKANA
SUMMIT
MCGRATH
BETHEL
KING SALMON
HOMER
KODIAK
YAKUTAT
JUNEAU
ANNETTE
ADAK
SEATTLE-TACOMA
WHIDBEY ISLAND
OLYMPIA
ASTORIA
PORTLAND
SALEM
SPOKANE
YAKIMA
PENDLETON
LEWISTON
REDMOND
BURNS
NORTH BEND
MEDFORD
BOISE
POCATELLO
MOUNT SHASTA
ARCATA
RED BLUFF
SACRAMENTO
OAKLAND
SUNNYVALE
SAN FRANCISCO
FRESNO
BAKERSFIELD
SANTA MARIA
POINT MUGU
LOS ANGELES
LONG BEACH
EL TORO
SAN DIEGO
DAGGETT
CHINA LAKE
LAS VEGAS
YUCCA FLATS
TONOPAH
RENO
LOVELOCK
WINNEMUCCA
ELKO
ELY
CEDAR CITY
BRYCE CANYON
SALT LAKE CITY
NEEDLES
YUMA
PRESCOTT
PHOENIX
TUCSON
WINSLOW
CUT BANK
GREAT FALLS
MISSOULA
HELENA
DILLON
LEWISTOWN
GLASGOW
BILLINGS
MILES CITY
SHERIDAN
CASPER
ROCK SPRINGS
CHEYENNE
SCOTTSBLUFF
RAPID CITY
GRAND JUNCTION
EAGLE
DENVER
COLORADO SPRINGS
PUEBLO
FARMINGTON
ZUNI
ALBUQUERQUE
TRUTH OR CONSEQUENCES
TUCUMCARI
CLAYTON
ROSWELL
EL PASO
MINOT
BISMARCK
FARGO
PIERRE
HURON
SIOUX FALLS
NORTH PLATTE
NORTH OMAHA
GRAND ISLAND
SIOUX CITY
GOODLAND
DODGE CITY
WICHITA
TOPEKA
KANSAS CITY
AMARILLO
LUBBOCK
MIDLAND-ODESSA
SAN ANGELO
ABILENE
WICHITA FALLS
OKLAHOMA CITY
TULSA
FORT WORTH
DALLAS
SHERMAN
WACO
AUSTIN
SAN ANTONIO
DEL RIO
LAREDO
KINGSVILLE
CORPUS CHRISTI
BROWNSVILLE
HOUSTON
LAKE CHARLES
LUFKIN
PORT ARTHUR
SHREVEPORT
INTERNATIONAL FALLS
DULUTH
MINNEAPOLIS-ST. PAUL
ROCHESTER
MASON CITY
DES MOINES
BURLINGTON
COLUMBIA
ST. LOUIS
SPRINGFIELD
FORT SMITH
LITTLE ROCK
HOUGHTON
EAU CLAIRE
GREEN BAY
LA CROSSE
MADISON
MILWAUKEE
CHICAGO
MOLINE
SPRINGFIELD
EVANSVILLE
MEMPHIS
JACKSON
MERIDIAN
BATON ROUGE
NEW ORLEANS
SAULT STE MARIE
ALPENA
TRAVERSE CITY
GRAND RAPIDS
FLINT
DETROIT
TOLEDO
SOUTH BEND
FORT WAYNE
INDIANAPOLIS
DAYTON
CINCINNATI (COVINGTON, KY)
LOUISVILLE
LEXINGTON
NASHVILLE
KNOXVILLE
CHATTANOOGA
BIRMINGHAM
MONTGOMERY
MOBILE
ATLANTA
MACON
GREENVILLE-SPARTANBURG
ASHEVILLE
CHARLOTTE
COLUMBIA
AUGUSTA
SAVANNAH
CHARLESTON
JACKSONVILLE
TALLAHASSEE
APALACHICOLA
TAMPA
ORLANDO
DAYTONA BEACH
WEST PALM BEACH
MIAMI
CLEVELAND
YOUNGSTOWN
AKRON-CANTON
COLUMBUS
HUNTINGTON
CHARLESTON
ROANOKE
GREENSBORO
RALEIGH-DURHAM
CAPE HATTERAS
CHERRY POINT
NORFOLK
RICHMOND
WASHINGTON
STERLING
BALTIMORE
PATUXENT RIVER
WILMINGTON
PHILADELPHIA
HARRISBURG
PITTSBURGH
ERIE
BUFFALO
ROCHESTER
SYRACUSE
MASSENA
BINGHAMTON
WILKES-BARRE-SCRANTON
ALLENTOWN
LAKEHURST
NEWARK
LA GUARDIA
CENTRAL PARK
ALBANY
BURLINGTON
HARTFORD
PROVIDENCE
BOSTON
CONCORD
PORTLAND
BANGOR
CARIBOU

Station	Parameter	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
ABILENE TX (LAT. 32.2)	$\bar{H}$ MJ/m^2	11.47	14.74	18.42	22.11	24.24	27.05	25.41	23.74	20.43	16.24	12.31	10.51
	$\bar{K}_T$	.58	.60	.61	.61	.61	.66	.63	.64	.63	.62	.59	.57
	Ta C	6.0	9.0	12.0	18.0	22.0	27.0	29.0	29.0	24.0	19.0	12.0	8.0
	DD C-DAY	367.	266.	197.	58.	6.	0.	0.	0.	0.	49.	187.	321.
ALBANY NY (LAT. 42.4)	$\bar{H}$ MJ/m^2	5.19	7.65	14.34	15.22	18.44	25.22	22.37	18.65	13.05	10.75	9.20	5.86
	$\bar{K}_T$	.38	.40	.55	.45	.47	.61	.56	.52	.45	.51	.62	.48
	Ta C	-5.0	-4.0	.0	8.0	14.0	19.0	22.0	21.0	17.0	10.0	4.0	-2.0
	DD C-DAY	749.	646.	544.	302.	141.	22.	5.	12.	75.	234.	423.	673.
ALBUQUERQUE NM (LAT. 35.0)	$\bar{H}$ MJ/m^2	12.88	16.31	21.41	26.35	28.77	30.90	28.86	26.60	23.67	18.69	14.13	11.75
	$\bar{K}_T$	.71	.71	.73	.74	.73	.75	.72	.72	.75	.75	.74	.71
	Ta C	1.0	4.0	7.0	12.0	17.0	22.0	25.0	23.0	20.0	13.0	6.0	1.0
	DD C-DAY	513.	389.	331.	157.	32.	0.	0.	0.	4.	121.	342.	496.
AMARILLO TX (LAT. 35.1)	$\bar{H}$ MJ/m^2	11.93	15.24	19.17	23.61	25.83	27.38	26.75	25.12	21.23	16.83	12.98	10.72
	$\bar{K}_T$	.66	.66	.65	.67	.65	.67	.66	.68	.67	.68	.68	.65
	Ta C	2.0	4.0	8.0	14.0	19.0	24.0	26.0	25.0	21.0	15.0	8.0	4.0
	DD C-DAY	499.	393.	334.	153.	45.	6.	0.	0.	11.	114.	312.	457.
AMES IA (LAT. 42.0)	$\bar{H}$ MJ/m^2	7.28	10.58	13.67	16.85	20.07	22.62	22.41	19.24	15.35	11.46	7.82	5.98
	$\bar{K}_T$	.53	.55	.52	.50	.51	.55	.56	.54	.53	.54	.52	.48
	Ta C	-7.0	-4.0	.0	9.0	15.0	20.0	23.0	22.0	17.0	11.0	2.0	-4.0
	DD C-DAY	794.	639.	539.	260.	106.	18.	0.	8.	58.	206.	463.	699.
AMHERST MA (LAT. 42.1)	$\bar{H}$ MJ/m^2	4.85	7.40	12.55	14.51	18.02	21.49	21.58	18.40	13.80	10.45	6.40	5.19
	$\bar{K}_T$	.35	.39	.48	.43	.46	.52	.54	.51	.48	.49	.43	.42
	Ta C	-4.0	-3.0	1.0	8.0	14.0	19.0	21.0	20.0	16.0	11.0	4.0	-2.0
	DD C-DAY	713.	611.	515.	300.	139.	23.	4.	12.	68.	221.	403.	644.
ANNAPOLIS MD (LAT. 38.6)	$\bar{H}$ MJ/m^2	7.33	10.17	14.24	17.54	20.43	23.32	22.69	19.64	16.03	12.31	7.91	6.49
	$\bar{K}_T$	.46	.48	.51	.51	.52	.56	.56	.54	.53	.53	.46	.45
	Ta C	1.0	2.0	6.0	12.0	17.0	22.0	24.0	23.0	20.0	14.0	8.0	2.0
	DD C-DAY	526.	454.	376.	183.	58.	0.	0.	0.	16.	137.	293.	484.
ANNETTE AK (LAT. 55.0)	$\bar{H}$ MJ/m^2	2.64	4.81	9.88	15.24	18.30	18.34	18.34	14.28	10.80	5.11	2.47	1.72
	$\bar{K}_T$	.43	.42	.51	.52	.49	.45	.47	.44	.47	.37	.34	.36
	Ta C	.0	2.0	3.0	5.0	9.0	11.0	15.0	14.0	12.0	8.0	4.0	2.0
	DD C-DAY	527.	465.	468.	381.	281.	187.	143.	124.	196.	315.	410.	499.
APALACHICOLA FL (LAT. 29.4)	$\bar{H}$ MJ/m^2	12.25	15.22	18.44	23.00	25.47	24.71	22.62	21.20	19.24	17.48	13.93	11.04
	$\bar{K}_T$	.57	.59	.59	.63	.64	.61	.57	.56	.58	.63	.62	.55
	Ta C	12.0	13.0	15.0	19.0	23.0	26.0	27.0	27.0	26.0	21.0	16.0	13.0
	DD C-DAY	193.	144.	100.	18.	0.	0.	0.	0.	0.	9.	85.	177.
ASHEVILLE NC (LAT. 35.3)	$\bar{H}$ MJ/m^2	9.21	12.48	16.03	20.51	23.28	23.78	23.24	21.56	18.25	14.86	10.47	8.46
	$\bar{K}_T$	.51	.54	.55	.58	.59	.58	.58	.58	.58	.60	.55	.51
	Ta C	3.0	4.0	8.0	13.0	18.0	21.0	23.0	23.0	19.0	14.0	8.0	4.0
	DD C-DAY	467.	398.	329.	155.	56.	8.	0.	0.	28.	149.	312.	453.
ASTORIA OR (LAT. 46.1)	$\bar{H}$ MJ/m^2	3.85	6.52	11.17	15.51	20.49	20.16	22.37	19.07	15.01	8.82	4.77	3.26
	$\bar{K}_T$	.34	.39	.46	.48	.53	.49	.56	.55	.55	.47	.38	.33
	Ta C	5.0	6.0	6.0	8.0	11.0	13.0	15.0	15.0	14.0	11.0	8.0	5.0
	DD C-DAY	420.	333.	355.	287.	219.	142.	91.	84.	112.	210.	308.	382.
ATLANTA GA (LAT. 33.4)	$\bar{H}$ MJ/m^2	9.53	11.88	15.77	20.24	22.37	23.17	22.50	20.99	17.23	14.64	11.08	8.41
	$\bar{K}_T$	.50	.50	.53	.56	.56	.56	.56	.56	.54	.57	.55	.48
	Ta C	6.0	7.0	11.0	16.0	20.0	24.0	25.0	25.0	22.0	17.0	11.0	7.0
	DD C-DAY	389.	311.	246.	80.	15.	0.	0.	0.	4.	76.	227.	371.

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
ATLANTIC CITY NJ (LAT. 39.3)												
$\bar{H}$ MJ/m^2	7.41	10.68	16.12	18.09	20.64	23.99	23.78	19.97	16.41	12.64	8.83	6.66
$\bar{K}_T$	.48	.51	.59	.52	.52	.58	.59	.55	.55	.56	.53	.47
T_a C	2.0	2.0	5.0	10.0	15.0	21.0	23.0	23.0	20.0	15.0	9.0	3.0
DD C-DAY	520.	461.	407.	242.	100.	8.	0.	0.	13.	111.	277.	470.
BALTIMORE MD (LAT. 39.1)												
$\bar{H}$ MJ/m^2	7.33	10.17	14.24	17.54	20.43	23.32	22.69	19.64	16.03	12.31	7.91	6.49
$\bar{K}_T$	.47	.49	.52	.51	.52	.56	.56	.54	.53	.54	.47	.46
T_a C	1.0	2.0	6.0	12.0	18.0	22.0	25.0	24.0	20.0	14.0	8.0	2.0
DD C-DAY	544.	470.	382.	189.	61.	0.	0.	0.	15.	139.	315.	512.
BARROW AK (LAT. 71.2)												
$\bar{H}$ MJ/m^2	.13	1.67	7.99	16.85	20.95	22.87	17.73	10.62	4.81	1.72	.29	.00
$\bar{K}_T$	.00	.79	.81	.76	.60	.54	.46	.39	.34	.42	.00	.00
T_a C	-25.0	-28.0	-26.0	-18.0	-7.0	.0	3.0	3.0	.0	-9.0	-18.0	-24.0
DD C-DAY	1398.	1296.	1371.	1080.	803.	547.	446.	467.	575.	833.	1095.	1271.
BETHEL AK (LAT. 60.5)												
$\bar{H}$ MJ/m^2	1.55	4.68	11.79	18.57	19.19	18.78	15.47	10.62	8.32	4.89	1.88	.96
$\bar{K}_T$	.49	.57	.72	.69	.53	.46	.40	.35	.41	.47	.44	.47
T_a C	-14.0	-13.0	-11.0	-4.0	4.0	10.0	12.0	11.0	7.0	-1.0	-8.0	-15.0
DD C-DAY	1057.	883.	919.	652.	448.	223.	177.	219.	340.	579.	797.	1037.
BIG SPRING TX (LAT. 32.1)												
$\bar{H}$ MJ/m^2	11.21	14.39	19.49	24.38	23.92	24.80	23.08	19.57	21.87	16.14	12.17	10.87
$\bar{K}_T$	.57	.58	.64	.68	.60	.61	.57	.52	.67	.61	.58	.59
T_a C	6.0	9.0	12.0	18.0	22.0	26.0	28.0	28.0	24.0	18.0	12.0	7.0
DD C-DAY	362.	260.	179.	50.	0.	0.	0.	0.	0.	48.	212.	329.
BILLINGS MT (LAT. 45.5)												
$\bar{H}$ MJ/m^2	6.62	9.92	15.03	19.09	22.65	25.62	26.63	23.32	17.75	10.68	7.24	5.57
$\bar{K}_T$	.56	.58	.61	.58	.58	.62	.67	.67	.65	.55	.56	.54
T_a C	-6.0	-3.0	.0	7.0	12.0	17.0	22.0	21.0	15.0	10.0	2.0	-3.0
DD C-DAY	742.	585.	558.	340.	185.	73.	6.	8.	123.	271.	488.	658.
BINGHAMPTON NY (LAT. 42.1)												
$\bar{H}$ MJ/m^2	5.82	8.54	12.48	15.99	20.39	23.32	22.90	19.72	15.24	10.80	6.03	4.77
$\bar{K}_T$	.42	.45	.48	.47	.52	.56	.57	.55	.53	.51	.40	.39
T_a C	-6.0	-5.0	.0	7.0	13.0	18.0	21.0	20.0	16.0	10.0	3.0	-4.0
DD C-DAY	741.	657.	581.	338.	178.	42.	12.	22.	96.	253.	447.	682.
BIRMINGHAM AL (LAT. 33.3)												
$\bar{H}$ MJ/m^2	8.58	11.85	15.32	20.56	23.40	23.57	22.94	21.18	18.09	15.03	10.38	8.12
$\bar{K}_T$	.45	.49	.51	.57	.59	.57	.57	.57	.56	.58	.51	.46
T_a C	7.0	8.0	12.0	17.0	21.0	25.0	27.0	26.0	23.0	17.0	11.0	7.0
DD C-DAY	363.	287.	216.	64.	11.	0.	0.	0.	3.	76.	217.	341.
BISMARCK ND (LAT. 46.5)												
$\bar{H}$ MJ/m^2	6.61	10.50	14.68	18.78	23.04	24.55	25.59	21.66	15.98	11.42	6.73	5.19
$\bar{K}_T$	.59	.63	.61	.58	.60	.59	.64	.62	.59	.61	.54	.54
T_a C	-13.0	-11.0	-3.0	6.0	12.0	17.0	21.0	20.0	14.0	7.0	-1.0	-9.0
DD C-DAY	978.	801.	687.	367.	188.	68.	10.	19.	140.	313.	602.	851.
BLUE HILL MA (LAT. 42.1)												
$\bar{H}$ MJ/m^2	6.52	8.99	12.71	15.85	19.70	21.62	20.91	18.15	14.72	10.41	6.61	5.39
$\bar{K}_T$	.47	.47	.49	.47	.50	.52	.52	.51	.51	.49	.44	.44
T_a C	-3.0	-3.0	1.0	7.0	13.0	18.0	21.0	20.0	16.0	11.0	5.0	-1.0
DD C-DAY	654.	585.	520.	322.	148.	38.	0.	12.	59.	212.	383.	603.
BOISE ID (LAT. 43.3)												
$\bar{H}$ MJ/m^2	5.94	9.74	14.18	20.32	24.55	26.72	27.98	23.80	19.07	13.13	7.57	5.14
$\bar{K}_T$	.46	.53	.55	.61	.63	.65	.70	.67	.67	.64	.53	.44
T_a C	-1.0	1.0	5.0	9.0	14.0	18.0	23.0	22.0	17.0	11.0	4.0	.0
DD C-DAY	618.	474.	401.	243.	136.	45.	0.	0.	73.	231.	440.	565.
BOSTON MA (LAT. 42.2)												
$\bar{H}$ MJ/m^2	5.81	8.28	12.25	15.22	19.74	20.87	20.74	17.77	14.26	9.95	6.06	4.98
$\bar{K}_T$	.42	.43	.47	.45	.50	.50	.52	.50	.49	.47	.41	.41
T_a C	-1.0	.0	3.0	9.0	15.0	20.0	23.0	22.0	18.0	13.0	7.0	1.0
DD C-DAY	604.	540.	470.	285.	116.	20.	0.	5.	33.	176.	335.	546.

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
BOULDER CO (LAT. 40.0)												
$\bar{H}$ MJ/m^2	8.41	11.22	16.79	19.26	19.26	21.98	21.77	18.38	17.25	12.98	9.29	7.62
$\bar{K}_T$	.56	.55	.62	.56	.49	.53	.54	.51	.58	.58	.57	.56
T_a C	.0	1.0	3.0	9.0	14.0	19.0	23.0	22.0	17.0	12.0	5.0	2.0
DD C-DAY	551.	459.	449.	268.	131.	49.	3.	0.	77.	204.	383.	503.
BROWNSVILLE TX (LAT. 25.5)												
$\bar{H}$ MJ/m^2	12.00	14.05	16.81	19.15	23.25	25.26	25.89	23.21	19.45	16.98	11.88	10.58
$\bar{K}_T$	.51	.50	.51	.52	.59	.63	.65	.61	.57	.58	.48	.47
T_a C	15.0	17.0	20.0	23.0	26.0	28.0	28.0	28.0	27.0	24.0	19.0	16.0
DD C-DAY	125.	84.	49.	0.	0.	0.	0.	0.	0.	3.	19.	81.
CAPE HATTERAS NC (LAT. 35.2)												
$\bar{H}$ MJ/m^2	10.20	13.26	18.07	23.88	26.56	26.97	26.30	23.29	19.74	15.10	11.88	9.03
$\bar{K}_T$	.57	.58	.62	.67	.67	.66	.65	.63	.63	.61	.62	.54
T_a C	8.0	8.0	10.0	14.0	19.0	23.0	25.0	25.0	23.0	18.0	13.0	9.0
DD C-DAY	339.	299.	254.	104.	26.	0.	0.	0.	0.	42.	154.	298.
CARIBOU ME (LAT. 46.5)												
$\bar{H}$ MJ/m^2	5.73	9.62	15.35	16.73	19.82	20.07	21.29	18.82	13.93	8.78	4.60	4.43
$\bar{K}_T$	.52	.58	.64	.52	.51	.49	.53	.54	.52	.47	.37	.46
T_a C	-11.0	-10.0	-4.0	3.0	10.0	15.0	18.0	17.0	12.0	7.0	.0	-8.0
DD C-DAY	939.	817.	727.	477.	260.	102.	43.	64.	187.	379.	580.	853.
CHARLESTON SC (LAT. 32.5)												
$\bar{H}$ MJ/m^2	10.58	12.67	16.39	21.54	23.00	23.42	21.87	20.74	17.06	14.34	11.92	9.03
$\bar{K}_T$	.54	.52	.54	.60	.58	.57	.54	.56	.53	.55	.58	.50
T_a C	10.0	10.0	14.0	18.0	22.0	25.0	27.0	26.0	24.0	19.0	14.0	10.0
DD C-DAY	271.	216.	162.	30.	0.	0.	0.	0.	0.	33.	157.	262.
CHARLOTTE NC (LAT. 35.1)												
$\bar{H}$ MJ/m^2	9.29	12.39	16.20	21.39	23.07	24.45	23.65	21.69	18.21	14.86	10.51	8.54
$\bar{K}_T$	.52	.54	.55	.60	.58	.59	.59	.59	.58	.60	.55	.51
T_a C	6.0	7.0	10.0	16.0	20.0	24.0	26.0	25.0	22.0	16.0	11.0	6.0
DD C-DAY	394.	327.	256.	81.	19.	0.	0.	0.	6.	84.	233.	388.
CHATTANOOGA TN (LAT. 35.0)												
$\bar{H}$ MJ/m^2	8.12	11.35	14.49	19.51	22.57	23.32	22.90	21.02	17.84	13.94	9.46	7.58
$\bar{K}_T$	.45	.49	.49	.55	.57	.57	.57	.57	.57	.56	.49	.45
T_a C	5.0	6.0	10.0	16.0	20.0	24.0	26.0	26.0	22.0	16.0	9.0	5.0
DD C-DAY	427.	347.	268.	92.	28.	0.	0.	0.	5.	101.	268.	410.
CHICAGO IL (LAT. 41.6)												
$\bar{H}$ MJ/m^2	7.15	9.70	13.63	16.31	20.78	23.13	22.04	20.32	16.06	11.08	6.57	5.48
$\bar{K}_T$	.51	.50	.52	.48	.53	.56	.55	.57	.55	.52	.43	.43
T_a C	-3.0	-2.0	3.0	10.0	16.0	21.0	24.0	23.0	19.0	13.0	5.0	-1.0
DD C-DAY	701.	585.	486.	252.	116.	14.	0.	4.	32.	176.	410.	629.
CLEVELAND OH (LAT. 41.2)												
$\bar{H}$ MJ/m^2	5.19	7.53	13.05	15.77	21.87	23.38	23.04	20.62	15.72	11.00	5.90	4.81
$\bar{K}_T$	.36	.38	.49	.46	.56	.57	.57	.57	.54	.51	.38	.37
T_a C	-2.0	-1.0	2.0	9.0	15.0	20.0	22.0	21.0	18.0	12.0	5.0	.0
DD C-DAY	656.	577.	498.	278.	136.	22.	5.	9.	53.	197.	390.	598.
COLUMBIA MO (LAT. 38.6)												
$\bar{H}$ MJ/m^2	7.53	10.45	14.39	18.11	22.21	23.88	24.00	22.00	18.73	13.55	9.28	7.07
$\bar{K}_T$	.47	.49	.52	.52	.56	.58	.60	.60	.62	.59	.54	.49
T_a C	-1.0	.0	6.0	12.0	18.0	23.0	25.0	24.0	20.0	14.0	6.0	.0
DD C-DAY	598.	486.	398.	180.	67.	7.	0.	0.	30.	139.	362.	537.
COLUMBUS OH (LAT. 40.0)												
$\bar{H}$ MJ/m^2	5.39	8.28	12.38	16.43	20.41	23.50	22.67	19.95	17.65	11.96	7.44	5.52
$\bar{K}_T$	.36	.41	.46	.48	.52	.57	.56	.55	.59	.54	.46	.41
T_a C	-1.0	.0	4.0	11.0	16.0	21.0	23.0	22.0	18.0	12.0	5.0	.0
DD C-DAY	604.	527.	449.	237.	95.	15.	0.	3.	47.	193.	397.	577.
CORPUS CHRISTI TX (LAT. 27.5)												
$\bar{H}$ MJ/m^2	10.97	13.82	17.29	19.85	23.49	25.29	26.33	23.36	19.68	17.08	11.93	10.05
$\bar{K}_T$	.49	.51	.54	.54	.59	.63	.66	.62	.58	.60	.51	.47
T_a C	13.0	15.0	18.0	22.0	25.0	27.0	29.0	29.0	27.0	23.0	18.0	15.0
DD C-DAY	169.	111.	67.	0.	0.	0.	0.	0.	0.	4.	45.	122.

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
CORVALLIS OR (LAT. 44.3)												
$\bar{H}$ MJ/m^2	4.22	5.81	11.75	16.89	21.24	24.30	28.02	22.87	16.69	9.83	5.86	3.39
$\bar{K}_T$	.34	.33	.47	.51	.55	.59	.70	.65	.60	.49	.43	.31
T_a C	3.0	6.0	7.0	10.0	13.0	16.0	18.0	18.0	16.0	11.0	7.0	5.0
DD C-DAY	451.	341.	336.	248.	163.	80.	34.	31.	67.	203.	328.	413.
DALLAS TX (LAT. 32.5)												
$\bar{H}$ MJ/m^2	9.67	12.85	16.49	19.01	21.81	24.91	24.62	22.52	19.17	15.20	10.93	9.25
$\bar{K}_T$	.49	.53	.54	.53	.55	.61	.61	.60	.59	.58	.53	.51
T_a C	7.0	10.0	13.0	19.0	23.0	28.0	30.0	30.0	26.0	20.0	13.0	9.0
DD C-DAY	338.	243.	174.	39.	0.	0.	0.	0.	0.	31.	158.	289.
DAVIS CA (LAT. 38.3)												
$\bar{H}$ MJ/m^2	6.61	10.71	16.81	22.08	26.60	29.36	28.86	25.55	20.83	14.55	9.03	6.19
$\bar{K}_T$	.41	.50	.60	.64	.67	.71	.72	.70	.69	.63	.52	.42
T_a C	7.0	9.0	11.0	14.0	17.0	21.0	23.0	22.0	21.0	17.0	11.0	7.0
DD C-DAY	324.	230.	184.	99.	40.	0.	0.	0.	0.	31.	178.	303.
DAYTON OH (LAT. 39.5)												
$\bar{H}$ MJ/m^2	6.78	9.38	13.90	17.46	21.69	24.07	23.61	21.52	17.75	12.94	7.83	6.07
$\bar{K}_T$	.44	.46	.51	.51	.55	.58	.59	.59	.59	.57	.47	.44
T_a C	-2.0	-1.0	4.0	11.0	16.0	22.0	24.0	23.0	19.0	13.0	5.0	-1.0
DD C-DAY	636.	538.	448.	229.	92.	7.	0.	4.	35.	171.	387.	587.
DENVER CO (LAT. 39.4)												
$\bar{H}$ MJ/m^2	10.68	14.15	18.25	21.73	24.37	27.38	26.50	24.79	20.68	15.49	10.97	9.13
$\bar{K}_T$	.69	.69	.67	.63	.62	.66	.66	.68	.69	.69	.66	.65
T_a C	-1.0	.0	3.0	9.0	14.0	19.0	23.0	22.0	17.0	11.0	4.0	.0
DD C-DAY	604.	501.	482.	292.	141.	44.	0.	0.	67.	227.	427.	558.
DES MOINES IA (LAT. 41.3)												
$\bar{H}$ MJ/m^2	7.03	9.92	13.48	17.79	21.52	23.78	23.78	20.93	16.96	12.60	7.91	5.78
$\bar{K}_T$	.49	.51	.51	.52	.55	.57	.59	.58	.58	.58	.51	.45
T_a C	-7.0	-4.0	1.0	10.0	16.0	21.0	24.0	23.0	18.0	12.0	3.0	-4.0
DD C-DAY	786.	634.	536.	258.	103.	14.	0.	7.	52.	194.	453.	689.
DETROIT MI (LAT. 42.1)												
$\bar{H}$ MJ/m^2	5.44	8.33	12.52	16.20	20.89	23.24	23.36	20.26	16.03	11.39	6.20	4.81
$\bar{K}_T$	.40	.44	.48	.48	.53	.56	.58	.57	.56	.54	.41	.39
T_a C	-4.0	-3.0	2.0	9.0	14.0	20.0	22.0	22.0	18.0	12.0	4.0	-2.0
DD C-DAY	696.	597.	512.	288.	136.	20.	3.	9.	53.	209.	415.	629.
DODGE CITY KA (LAT. 37.5)												
$\bar{H}$ $MJ/m2$	10.83	13.67	18.07	22.58	23.54	27.56	27.18	24.38	20.62	15.89	11.71	9.70
$\bar{K}_T$	.65	.63	.64	.65	.60	.67	.67	.67	.67	.67	.66	.64
T_a C	-1.0	1.0	5.0	12.0	17.0	23.0	26.0	25.0	20.0	13.0	5.0	.0
DD C-DAY	589.	463.	410.	191.	64.	12.	0.	0.	23.	137.	370.	544.
DULUTH MN (LAT. 46.5)												
$\bar{H}$ MJ/m^2	5.57	8.83	13.44	16.70	20.22	23.11	23.19	19.55	13.94	9.71	5.32	4.35
$\bar{K}_T$	.50	.53	.56	.52	.52	.56	.58	.56	.52	.52	.43	.45
T_a C	-13.0	-11.0	-5.0	4.0	10.0	15.0	19.0	18.0	12.0	7.0	-2.0	-10.0
DD C-DAY	973.	823.	715.	440.	269.	108.	37.	58.	177.	339.	610.	872.
EAST LANSING MI (LAT. 42.4)												
$\bar{H}$ MJ/m^2	4.81	8.36	12.29	14.18	19.65	21.70	21.37	18.44	14.76	10.12	5.39	4.31
$\bar{K}_T$	.35	.44	.47	.42	.50	.52	.53	.52	.51	.48	.36	.35
T_a C	-5.0	-4.0	.0	8.0	13.0	19.0	21.0	20.0	16.0	10.0	3.0	-2.0
DD C-DAY	730.	638.	553.	308.	156.	27.	5.	15.	74.	234.	443.	653.
EL PASO TX (LAT. 31.5)												
$\bar{H}$ MJ/m^2	13.84	18.07	22.96	27.39	29.90	30.53	28.02	26.72	24.05	19.32	15.35	13.09
$\bar{K}_T$	.69	.72	.75	.76	.75	.75	.70	.71	.74	.73	.72	.70
T_a C	7.0	9.0	13.0	17.0	22.0	27.0	27.0	26.0	23.0	18.0	11.0	7.0
DD C-DAY	381.	247.	177.	58.	0.	0.	0.	0.	0.	47.	230.	360.
ELY NV (LAT. 39.2)												
$\bar{H}$ MJ/m^2	9.95	13.93	19.40	23.59	26.10	29.61	27.10	25.43	21.70	16.43	12.00	9.20
$\bar{K}_T$	.64	.67	.70	.68	.66	.72	.67	.70	.72	.72	.72	.65
T_a C	-4.0	-2.0	.0	5.0	10.0	14.0	19.0	18.0	13.0	7.0	1.0	-3.0
DD C-DAY	727.	597.	543.	373.	253.	125.	16.	24.	130.	329.	522.	658.

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
FAIRBANKS AK (LAT. 64.5)												
$\bar{H}$ MJ/m^2	.80	3.18	9.74	16.10	19.95	22.04	18.57	15.18	7.69	3.60	1.13	.25
$\bar{K}_T$	.61	.55	.70	.64	.56	.54	.49	.52	.43	.45	.51	.49
$\bar{T}_a$ C	-24.0	-19.0	-13.0	-1.0	8.0	14.0	15.0	12.0	6.0	-3.0	-16.0	-22.0
DD C-DAY	1311.	1056.	966.	593.	308.	123.	95.	184.	357.	668.	1018.	1252.
FARGO ND (LAT. 46.5)												
$\bar{H}$ MJ/m^2	5.32	8.92	12.89	17.54	21.10	22.02	23.19	19.89	14.57	10.13	5.48	4.94
$\bar{K}_T$	.48	.54	.54	.54	.55	.53	.58	.57	.54	.54	.44	.51
$\bar{T}_a$ C	-14.0	-12.0	-4.0	6.0	13.0	18.0	21.0	21.0	14.0	8.0	-2.0	-11.0
DD C-DAY	1018.	844.	703.	378.	186.	54.	7.	18.	130.	310.	607.	896.
FORT SMITH AR (LAT. 35.2)												
$\bar{H}$ MJ/m^2	8.25	11.30	15.11	18.80	22.02	23.61	22.86	21.86	18.13	14.19	9.80	7.83
$\bar{K}_T$	.46	.49	.52	.53	.56	.57	.57	.59	.58	.57	.51	.47
$\bar{T}_a$ C	4.0	6.0	10.0	17.0	21.0	26.0	28.0	27.0	23.0	17.0	10.0	5.0
DD C-DAY	448.	338.	262.	73.	9.	0.	0.	0.	0.	75.	243.	405.
FORT WAYNE IN (LAT. 41.0)												
$\bar{H}$ MJ/m^2	6.32	9.08	13.44	17.08	22.06	24.45	23.82	21.10	16.54	12.35	7.07	5.65
$\bar{K}_T$	.44	.46	.50	.50	.56	.59	.59	.59	.56	.57	.45	.43
$\bar{T}_a$ C	-4.0	-2.0	2.0	10.0	15.0	21.0	23.0	22.0	18.0	12.0	5.0	-2.0
DD C-DAY	684.	582.	491.	262.	120.	13.	0.	7.	50.	202.	413.	627.
FORT WORTH TX (LAT. 32.5)												
$\bar{H}$ MJ/m^2	10.54	13.42	17.77	12.25	23.46	26.85	25.59	24.59	20.91	16.48	12.46	10.20
$\bar{K}_T$	.54	.55	.59	.34	.59	.66	.64	.66	.65	.63	.60	.56
$\bar{T}_a$ C	7.0	9.0	13.0	18.0	22.0	27.0	29.0	29.0	25.0	19.0	13.0	8.0
DD C-DAY	341.	249.	177.	55.	0.	0.	0.	0.	0.	36.	180.	298.
FRESNO CA (LAT. 36.5)												
$\bar{H}$ MJ/m^2	7.78	12.38	18.32	22.79	26.64	29.15	27.93	25.34	21.03	15.68	10.08	6.69
$\bar{K}_T$	.45	.55	.64	.65	.67	.71	.69	.69	.68	.65	.55	.42
$\bar{T}_a$ C	7.0	10.0	12.0	16.0	19.0	23.0	27.0	26.0	23.0	18.0	12.0	7.0
DD C-DAY	336.	237.	186.	90.	34.	3.	0.	0.	0.	47.	197.	321.
GAINESVILLE FL (LAT. 29.4)												
$\bar{H}$ MJ/m^2	11.63	15.35	18.61	22.54	24.51	22.75	21.75	21.24	18.57	15.39	13.30	10.62
$\bar{K}_T$	.54	.59	.59	.62	.62	.56	.54	.56	.56	.56	.59	.53
$\bar{T}_a$ C	13.0	14.0	17.0	21.0	24.0	26.0	27.0	27.0	26.0	22.0	17.0	14.0
DD C-DAY	164.	133.	73.	11.	0.	0.	0.	0.	0.	7.	69.	143.
GLASGOW MT (LAT. 48.1)												
$\bar{H}$ MJ/m^2	6.44	10.58	15.77	19.03	23.50	25.63	26.76	22.33	17.15	11.21	6.48	4.94
$\bar{K}_T$	.64	.68	.68	.60	.61	.62	.67	.65	.65	.63	.57	.57
$\bar{T}_a$ C	-12.0	-8.0	-3.0	6.0	12.0	17.0	21.0	21.0	14.0	8.0	-1.0	-7.0
DD C-DAY	951.	799.	659.	360.	186.	83.	17.	26.	150.	338.	613.	814.
GRAND JUNCTION CO (LAT. 39.1)												
$\bar{H}$ MJ/m^2	9.70	13.59	17.98	22.29	25.30	29.61	28.06	24.30	20.95	15.81	11.00	9.03
$\bar{K}_T$	.62	.65	.65	.65	.64	.72	.70	.67	.70	.69	.65	.64
$\bar{T}_a$ C	-3.0	.0	5.0	11.0	16.0	22.0	25.0	24.0	19.0	12.0	4.0	-1.0
DD C-DAY	672.	504.	405.	215.	81.	12.	0.	0.	17.	174.	437.	617.
GRAND LAKE CO (LAT. 40.2)												
$\bar{H}$ MJ/m^2	8.88	13.11	17.71	21.44	23.11	26.46	25.12	21.14	19.93	15.11	9.80	7.70
$\bar{K}_T$	.59	.65	.65	.63	.59	.64	.62	.58	.67	.68	.61	.57
$\bar{T}_a$ C	-9.0	-7.0	-4.0	.0	6.0	10.0	13.0	12.0	8.0	3.0	-3.0	-8.0
DD C-DAY	864.	734.	720.	525.	381.	250.	153.	174.	280.	446.	653.	820.
GREAT FALLS MT (LAT. 47.3)												
$\bar{H}$ MJ/m^2	5.77	9.58	15.14	17.94	21.91	24.71	26.56	22.12	16.89	10.96	6.44	4.68
$\bar{K}_T$	.54	.59	.64	.56	.57	.60	.67	.64	.63	.60	.54	.51
$\bar{T}_a$ C	-5.0	-2.0	.0	6.0	12.0	16.0	21.0	20.0	14.0	9.0	1.0	-2.0
DD C-DAY	749.	641.	591.	357.	213.	103.	16.	29.	143.	302.	512.	649.
GREEN BAY WI (LAT. 44.3)												
$\bar{H}$ MJ/m^2	5.74	8.79	13.10	16.08	20.47	22.69	22.52	19.34	14.78	10.05	5.82	4.60
$\bar{K}_T$	.46	.49	.52	.49	.53	.55	.56	.55	.53	.50	.42	.42
$\bar{T}_a$ C	-9.0	-8.0	-2.0	7.0	12.0	18.0	21.0	20.0	15.0	10.0	1.0	-6.0
DD C-DAY	854.	731.	627.	353.	188.	51.	12.	30.	106.	272.	515.	759.

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
GREENSBORO NC (LAT. 36.0)												
$\bar{H}$ MJ/m^2	8.57	11.37	14.80	19.61	22.29	23.50	22.62	19.86	17.23	13.76	10.16	7.78
$\bar{K}_T$	.49	.50	.51	.56	.56	.57	.56	.54	.55	.56	.55	.48
T_a C	3.0	4.0	8.0	14.0	19.0	23.0	25.0	24.0	21.0	14.0	8.0	4.0
DD C-DAY	453.	379.	302.	113.	33.	0.	0.	0.	13.	116.	278.	437.
GRNVLE-SPTNBRG NC (LAT. 34.5)												
$\bar{H}$ MJ/m^2	9.38	11.30	16.29	21.39	23.15	23.32	23.19	21.48	17.75	14.95	10.76	8.58
$\bar{K}_T$	.51	.48	.55	.60	.58	.57	.58	.58	.56	.60	.55	.51
T_a C	6.0	7.0	10.0	16.0	21.0	24.0	26.0	25.0	22.0	16.0	11.0	6.0
DD C-DAY	391.	321.	250.	80.	16.	0.	0.	0.	5.	81.	233.	381.
GRIFFIN GA (LAT. 33.1)												
$\bar{H}$ MJ/m^2	9.95	12.63	16.23	21.70	24.13	24.25	23.38	21.87	18.27	15.56	12.04	8.78
$\bar{K}_T$	.52	.52	.54	.60	.61	.59	.58	.59	.57	.60	.59	.49
T_a C	6.0	8.0	11.0	16.0	21.0	24.0	25.0	25.0	22.0	17.0	11.0	7.0
DD C-DAY	356.	289.	228.	61.	11.	0.	0.	0.	11.	61.	200.	339.
HARTFORD CT (LAT. 41.6)												
$\bar{H}$ MJ/m^2	6.62	9.46	13.73	16.12	19.85	22.36	22.15	19.22	15.24	11.05	6.91	7.91
$\bar{K}_T$	.47	.49	.52	.48	.51	.54	.55	.54	.52	.51	.45	.62
T_a C	-4.0	-3.0	2.0	9.0	15.0	20.0	23.0	21.0	17.0	11.0	5.0	-2.0
DD C-DAY	692.	594.	506.	288.	126.	13.	0.	7.	59.	213.	395.	634.
HILO HI (LAT. 19.4)												
$\bar{H}$ MJ/m^2	11.71	15.47	18.73	18.02	18.73	24.00	22.33	20.49	18.90	14.18	12.63	11.00
$\bar{K}_T$	.43	.50	.54	.48	.48	.61	.58	.54	.53	.45	.45	.43
T_a C	21.0	21.0	21.0	22.0	22.0	23.0	23.0	24.0	24.0	23.0	22.0	21.0
DD C-DAY	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HONOLULU HI (LAT. 21.2)												
$\bar{H}$ MJ/m^2	15.20	17.67	21.60	23.40	25.83	25.75	25.75	25.62	23.99	21.23	17.84	15.53
$\bar{K}_T$	.58	.59	.63	.62	.66	.65	.66	.68	.68	.68	.66	.63
T_a C	22.0	22.0	22.0	23.0	24.0	25.0	26.0	26.0	26.0	25.0	24.0	23.0
DD C-DAY	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HOUSTON TX (LAT. 29.6)												
$\bar{H}$ MJ/m^2	10.05	12.64	16.37	18.97	23.11	25.08	24.53	21.69	19.09	16.58	11.55	9.50
$\bar{K}_T$	.47	.49	.52	.52	.58	.62	.61	.58	.58	.60	.52	.48
T_a C	11.0	13.0	16.0	21.0	24.0	27.0	28.0	29.0	26.0	22.0	16.0	13.0
DD C-DAY	231.	163.	105.	13.	0.	0.	0.	0.	0.	13.	86.	185.
INDIANAPOLIS IN (LAT. 39.4)												
$\bar{H}$ MJ/m^2	6.15	8.95	13.05	16.43	20.53	22.87	22.67	20.32	16.94	12.25	7.36	5.44
$\bar{K}_T$	.40	.43	.48	.48	.52	.55	.56	.56	.57	.54	.44	.39
T_a C	-1.0	.0	4.0	11.0	17.0	22.0	24.0	23.0	19.0	13.0	5.0	.0
DD C-DAY	639.	533.	436.	215.	88.	6.	0.	3.	35.	168.	388.	587.
INYOKERN CA (LAT. 35.4)												
$\bar{H}$ MJ/m^2	13.05	17.52	24.17	29.32	32.99	34.96	32.79	30.86	27.10	20.24	15.31	12.34
$\bar{K}_T$	.73	.77	.83	.83	.83	.85	.81	.84	.86	.82	.80	.75
T_a C	7.0	11.0	14.0	18.0	23.0	27.0	32.0	31.0	27.0	20.0	13.0	8.0
DD C-DAY	341.	218.	148.	71.	6.	0.	0.	0.	0.	24.	176.	334.
ITHACA NY (LAT. 42.3)												
$\bar{H}$ MJ/m^2	5.10	8.49	11.79	14.55	19.61	22.54	22.37	19.24	14.89	10.37	5.23	4.14
$\bar{K}_T$	.37	.45	.45	.43	.50	.54	.56	.54	.52	.49	.35	.34
T_a C	-5.0	-4.0	.0	7.0	12.0	18.0	20.0	19.0	15.0	10.0	4.0	-2.0
DD C-DAY	723.	646.	562.	332.	176.	39.	11.	22.	87.	243.	423.	654.
JACKSON MS (LAT. 32.2)												
$\bar{H}$ MJ/m^2	8.88	11.72	15.83	20.18	22.94	23.53	22.78	21.39	17.96	15.11	10.42	8.46
$\bar{K}_T$	.45	.48	.52	.56	.58	.57	.57	.57	.55	.58	.50	.46
T_a C	8.0	10.0	13.0	19.0	23.0	26.0	28.0	27.0	24.0	19.0	13.0	9.0
DD C-DAY	316.	246.	174.	41.	3.	0.	0.	0.	0.	51.	167.	280.
JACKSONVILLE FL (LAT. 30.2)												
$\bar{H}$ MJ/m^2	11.18	14.49	17.71	21.52	23.28	21.98	21.86	19.93	16.03	13.86	11.47	9.63
$\bar{K}_T$	.53	.57	.57	.59	.59	.54	.55	.53	.49	.51	.52	.49
T_a C	12.0	13.0	16.0	20.0	23.0	26.0	27.0	27.0	25.0	21.0	16.0	12.0
DD C-DAY	193.	157.	98.	13.	0.	0.	0.	0.	0.	11.	89.	176.

KANSAS CITY MO (LAT. 39.2)

$\bar{H}$ MJ/m^2	7.62	10.55	14.28	18.46	21.81	24.70	24.24	22.02	17.79	13.40	9.00	6.87
$\bar{K}_T$	.49	.51	.52	.54	.55	.60	.60	.61	.59	.59	.54	.49
T_a C	-2.0	1.0	5.0	13.0	18.0	23.0	26.0	25.0	20.0	15.0	6.0	.0
DD C-DAY	641.	496.	414.	174.	62.	7.	0.	0.	23.	131.	357.	563.

KEY WEST FL (LAT. 24.3)

$\bar{H}$ MJ/m^2	13.69	17.10	20.51	23.95	24.24	22.73	22.36	20.97	18.63	16.49	13.90	12.23
$\bar{K}_T$	.56	.60	.62	.64	.62	.57	.57	.55	.54	.55	.55	.53
T_a C	21.0	21.0	23.0	25.0	27.0	28.0	29.0	29.0	28.0	26.0	23.0	21.0
DD C-DAY	9.	14.	3.	0.	0.	0.	0.	0.	0.	0.	0.	10.

LAKE CHARLES LA (LAT. 30.1)

$\bar{H}$ MJ/m^2	10.00	12.71	16.56	20.20	23.17	24.34	21.79	21.08	18.73	16.81	12.38	9.70
$\bar{K}_T$	.48	.50	.53	.55	.58	.60	.54	.56	.57	.62	.56	.49
T_a C	11.0	12.0	15.0	20.0	23.0	27.0	28.0	27.0	25.0	21.0	15.0	12.0
DD C-DAY	212.	152.	108.	22.	0.	0.	0.	0.	0.	11.	117.	189.

LANDER WY (LAT. 42.5)

$\bar{H}$ MJ/m^2	9.62	13.42	18.86	23.13	24.46	28.23	27.10	24.25	19.40	14.89	9.91	8.24
$\bar{K}_T$	.71	.71	.72	.69	.63	.68	.67	.68	.68	.71	.67	.68
T_a C	-6.0	-3.0	.0	6.0	12.0	16.0	21.0	21.0	15.0	8.0	.0	-4.0
DD C-DAY	787.	636.	565.	363.	212.	85.	3.	11.	113.	308.	567.	722.

LANSING MI (LAT. 42.5)

$\bar{H}$ MJ/m^2	5.65	8.92	12.89	14.99	20.89	23.15	22.78	20.14	15.78	10.80	5.86	4.69
$\bar{K}_T$	.42	.47	.50	.45	.53	.56	.57	.56	.55	.51	.40	.39
T_a C	-5.0	-4.0	1.0	8.0	14.0	19.0	22.0	21.0	16.0	11.0	4.0	-3.0
DD C-DAY	730.	638.	553.	308.	156.	27.	5.	15.	74.	234.	443.	653.

LARAMIE WY (LAT. 41.2)

$\bar{H}$ MJ/m^2	9.37	12.46	17.73	20.83	22.92	26.22	24.80	22.00	17.56	13.34	9.49	7.65
$\bar{K}_T$	.65	.63	.67	.61	.58	.63	.62	.61	.60	.62	.61	.59
T_a C	-5.0	-4.0	-2.0	3.0	9.0	14.0	18.0	17.0	12.0	6.0	.0	-4.0
DD C-DAY	763.	650.	653.	453.	296.	143.	39.	56.	192.	374.	577.	715.

LAS VEGAS NV (LAT. 36.0)

$\bar{H}$ MJ/m^2	11.67	16.14	21.12	26.01	29.36	31.20	28.27	26.22	23.29	17.94	13.30	10.87
$\bar{K}_T$	.67	.72	.73	.74	.74	.76	.70	.71	.75	.74	.71	.68
T_a C	6.0	9.0	12.0	17.0	23.0	28.0	31.0	30.0	26.0	19.0	11.0	7.0
DD C-DAY	382.	271.	186.	62.	3.	0.	0.	0.	0.	43.	215.	343.

LEMONT IL (LAT. 41.4)

$\bar{H}$ MJ/m^2	7.15	9.70	13.63	16.31	20.78	23.13	22.04	20.32	16.06	11.08	6.57	5.48
$\bar{K}_T$	.50	.50	.51	.48	.53	.56	.55	.57	.55	.51	.43	.43
T_a C	-3.0	-2.0	3.0	10.0	16.0	21.0	24.0	23.0	19.0	13.0	5.0	-1.0
DD C-DAY	701.	585.	486.	252.	116.	14.	0.	4.	32.	176.	410.	629.

LEXINGTON KY (LAT. 38.0)

$\bar{H}$ MJ/m^2	7.15	10.79	15.22	19.91	24.09	25.97	25.76	23.34	20.53	15.10	9.83	7.15
$\bar{K}_T$	.44	.50	.54	.57	.61	.63	.64	.64	.67	.65	.56	.48
T_a C	.0	2.0	6.0	13.0	18.0	23.0	25.0	24.0	20.0	14.0	7.0	2.0
DD C-DAY	553.	462.	374.	168.	59.	4.	0.	0.	22.	137.	340.	508.

LINCOLN NE (LAT. 40.5)

$\bar{H}$ MJ/m^2	7.95	10.66	14.51	17.73	20.74	22.79	22.46	21.24	17.23	13.59	8.66	7.19
$\bar{K}_T$	.54	.53	.54	.52	.53	.55	.56	.59	.58	.62	.54	.54
T_a C	-4.0	-2.0	3.0	11.0	16.0	22.0	25.0	24.0	19.0	12.0	4.0	-1.0
DD C-DAY	687.	564.	463.	223.	95.	17.	0.	3.	42.	167.	405.	592.

LITTLE ROCK AR (LAT. 34.4)

$\bar{H}$ MJ/m^2	8.28	10.96	14.97	19.03	22.08	23.50	23.34	21.58	18.48	14.47	10.20	7.82
$\bar{K}_T$	.45	.47	.51	.53	.56	.57	.58	.58	.58	.57	.52	.46
T_a C	4.0	6.0	10.0	16.0	21.0	26.0	27.0	27.0	23.0	17.0	10.0	5.0
DD C-DAY	420.	321.	241.	70.	5.	0.	0.	0.	5.	71.	258.	398.

LOS ANGELES CA (LAT. 33.6)

$\bar{H}$ MJ/m^2	10.75	14.39	19.19	21.66	24.09	25.80	27.14	24.63	21.08	15.39	12.25	10.29
$\bar{K}_T$	.57	.60	.64	.61	.61	.63	.67	.66	.66	.60	.61	.59
T_a C	12.0	13.0	13.0	15.0	16.0	18.0	20.0	20.0	20.0	18.0	15.0	13.0
DD C-DAY	184.	150.	148.	108.	63.	39.	11.	8.	13.	43.	88.	155.

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
LOUISVILLE KY (LAT. 38.1)												
$\bar{H}$ MJ/m^2	6.87	9.67	13.61	17.58	21.56	23.45	23.03	20.85	17.08	12.69	7.95	6.28
$\bar{K}_T$	.42	.45	.49	.51	.55	.57	.57	.57	.56	.54	.46	.42
$\bar{T}_a$ C	.0	2.0	6.0	13.0	18.0	22.0	24.0	24.0	20.0	14.0	7.0	1.0
DD C-DAY	546.	454.	367.	159.	58.	0.	0.	0.	19.	134.	333.	506.
LYNN MA (LAT. 42.3)												
$\bar{H}$ MJ/m^2	4.94	8.74	12.55	16.48	18.99	22.50	22.54	17.65	14.22	9.66	5.56	4.18
$\bar{K}_T$	.36	.46	.48	.49	.49	.54	.56	.49	.49	.46	.37	.34
$\bar{T}_a$ C	-1.0	.0	3.0	9.0	15.0	20.0	23.0	22.0	18.0	13.0	7.0	1.0
DD C-DAY	604.	540.	470.	285.	116.	20.	0.	5.	33.	176.	335.	546.
MACON GA (LAT. 32.4)												
$\bar{H}$ MJ/m^2	10.38	12.98	16.41	21.39	23.70	23.95	23.07	21.81	18.13	15.41	11.14	9.08
$\bar{K}_T$	.53	.53	.54	.59	.60	.58	.57	.58	.56	.59	.54	.50
$\bar{T}_a$ C	9.0	10.0	14.0	19.0	23.0	26.0	27.0	27.0	24.0	19.0	13.0	9.0
DD C-DAY	302.	235.	166.	37.	3.	0.	0.	0.	0.	46.	169.	288.
MADISON WI (LAT. 43.1)												
$\bar{H}$ MJ/m^2	6.41	9.22	13.99	16.53	19.82	23.07	23.24	19.76	16.40	11.28	6.31	5.63
$\bar{K}_T$	.49	.50	.54	.49	.51	.56	.58	.56	.58	.55	.44	.48
$\bar{T}_a$ C	-7.0	-6.0	.0	7.0	13.0	19.0	21.0	20.0	15.0	10.0	1.0	-5.0
DD C-DAY	830.	696.	599.	328.	165.	40.	8.	22.	96.	263.	505.	742.
MANHATTAN KA (LAT. 39.1)												
$\bar{H}$ MJ/m^2	8.04	11.05	14.44	18.13	22.06	23.07	22.23	22.02	17.17	12.23	9.50	6.53
$\bar{K}_T$	.52	.53	.52	.53	.56	.56	.55	.61	.57	.54	.57	.46
$\bar{T}_a$ C	-1.0	1.0	5.0	13.0	18.0	23.0	26.0	25.0	20.0	14.0	6.0	.0
DD C-DAY	623.	496.	401.	183.	69.	7.	0.	0.	32.	150.	373.	544.
MATANUSKA AK (LAT. 61.3)												
$\bar{H}$ MJ/m^2	1.34	3.85	10.13	14.90	18.25	19.34	17.12	13.15	8.29	4.18	1.59	.63
$\bar{K}_T$	.49	.50	.64	.56	.51	.48	.45	.43	.42	.42	.42	.37
$\bar{T}_a$ C	-11.0	-7.0	-3.0	2.0	8.0	12.0	14.0	12.0	8.0	1.0	-6.0	-10.0
DD C-DAY	914.	714.	689.	477.	310.	168.	129.	169.	288.	526.	738.	904.
MEDFORD OR (LAT. 42.2)												
$\bar{H}$ MJ/m^2	4.94	8.87	13.88	20.24	24.63	27.31	29.23	25.17	18.78	11.63	6.36	3.85
$\bar{K}_T$	.36	.46	.53	.60	.63	.66	.73	.70	.65	.55	.43	.31
$\bar{T}_a$ C	3.0	5.0	7.0	10.0	14.0	18.0	22.0	21.0	18.0	12.0	6.0	3.0
DD C-DAY	489.	369.	348.	247.	139.	52.	6.	12.	49.	200.	358.	470.
MEMPHIS TN (LAT. 35.0)												
$\bar{H}$ MJ/m^2	8.04	11.18	15.03	19.68	23.19	24.66	24.41	22.40	18.50	14.82	9.96	7.70
$\bar{K}_T$	.44	.48	.51	.55	.59	.60	.61	.61	.59	.60	.52	.46
$\bar{T}_a$ C	5.0	7.0	11.0	17.0	22.0	26.0	28.0	27.0	23.0	17.0	10.0	6.0
DD C-DAY	422.	330.	254.	73.	12.	0.	0.	0.	4.	79.	235.	384.
MIAMI FL (LAT. 25.5)												
$\bar{H}$ MJ/m^2	14.34	17.40	20.53	22.75	23.08	22.21	22.46	21.24	18.69	16.27	14.80	13.34
$\bar{K}_T$	.61	.62	.63	.61	.59	.55	.57	.56	.55	.56	.60	.60
$\bar{T}_a$ C	19.0	19.0	21.0	23.0	25.0	27.0	27.0	28.0	27.0	25.0	22.0	20.0
DD C-DAY	41.	31.	11.	0.	0.	0.	0.	0.	0.	0.	0.	36.
MIDLAND TX (LAT. 31.6)												
$\bar{H}$ MJ/m^2	11.75	15.05	19.95	23.04	25.80	25.72	25.68	24.55	21.37	16.69	13.47	11.37
$\bar{K}_T$	.58	.60	.65	.64	.65	.63	.64	.66	.66	.63	.63	.61
$\bar{T}_a$ C	6.0	8.0	12.0	17.0	22.0	26.0	27.0	27.0	23.0	18.0	11.0	7.0
DD C-DAY	362.	260.	179.	50.	0.	0.	0.	0.	0.	42.	212.	329.
MILWAUKEE WI (LAT. 42.6)												
$\bar{H}$ MJ/m^2	6.24	8.79	13.10	16.83	21.27	23.65	23.57	20.31	16.41	11.18	6.74	5.02
$\bar{K}_T$	.46	.47	.50	.50	.54	.57	.59	.57	.57	.53	.46	.42
$\bar{T}_a$ C	-7.0	-5.0	.0	7.0	12.0	18.0	21.0	21.0	16.0	11.0	2.0	-4.0
DD C-DAY	786.	661.	579.	338.	193.	50.	8.	20.	78.	244.	475.	703.
MINN-ST. PAUL MN (LAT. 44.5)												
$\bar{H}$ MJ/m^2	5.99	9.21	12.81	16.54	20.18	22.44	22.82	19.51	14.99	10.80	6.03	4.69
$\bar{K}_T$	.49	.52	.51	.50	.52	.54	.57	.55	.54	.54	.44	.43
$\bar{T}_a$ C	-11.0	-9.0	-2.0	7.0	14.0	19.0	22.0	21.0	16.0	10.0	.0	-7.0
DD C-DAY	909.	754.	632.	332.	151.	36.	6.	12.	96.	262.	543.	799.

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
MT WEATHER VA (LAT. 39.0)												
$\bar{H}$ MJ/m^2	7.20	11.47	14.15	17.33	21.27	21.98	21.35	18.00	15.70	11.76	8.46	7.03
$\bar{K}_T$	.46	.55	.51	.50	.54	.53	.53	.50	.52	.52	.50	.49
T_a C	-1.0	.0	3.0	10.0	15.0	20.0	22.0	21.0	18.0	12.0	5.0	.0
DD C-DAY	615.	535.	453.	251.	102.	13.	0.	3.	44.	189.	370.	573.
NASHVILLE TN (LAT. 36.1)												
$\bar{H}$ MJ/m^2	6.82	10.04	13.76	18.82	21.62	23.71	23.13	20.66	17.90	13.67	9.07	6.73
$\bar{K}_T$	.39	.45	.48	.53	.55	.58	.57	.56	.57	.56	.49	.42
T_a C	3.0	5.0	9.0	15.0	20.0	24.0	26.0	25.0	22.0	16.0	9.0	5.0
DD C-DAY	460.	373.	291.	98.	25.	0.	0.	0.	6.	100.	277.	424.
NATICK MA (LAT. 42.2)												
$\bar{H}$ MJ/m^2	6.36	9.70	13.63	16.35	20.91	17.10	21.45	19.11	15.01	10.91	6.15	5.60
$\bar{K}_T$	.46	.51	.52	.49	.53	.41	.53	.53	.52	.52	.41	.46
T_a C	-2.0	-2.0	3.0	9.0	15.0	20.0	23.0	22.0	17.0	12.0	6.0	.0
DD C-DAY	672.	585.	487.	282.	123.	17.	0.	6.	56.	203.	375.	608.
NEW ORLEANS LA (LAT. 29.6)												
$\bar{H}$ MJ/m^2	8.96	10.84	14.03	17.25	18.80	18.55	17.46	17.42	16.03	14.95	11.64	8.29
$\bar{K}_T$	.42	.42	.45	.47	.47	.46	.44	.46	.48	.54	.52	.42
T_a C	11.0	13.0	15.0	20.0	23.0	26.0	27.0	27.0	25.0	20.0	15.0	12.0
DD C-DAY	202.	143.	107.	22.	0.	0.	0.	0.	0.	11.	107.	179.
NEWPORT RI (LAT. 41.3)												
$\bar{H}$ MJ/m^2	6.48	9.66	13.80	16.52	20.45	22.50	21.62	18.78	15.89	11.42	7.32	5.90
$\bar{K}_T$	.45	.49	.52	.49	.52	.54	.54	.52	.54	.53	.47	.46
T_a C	.0	.0	3.0	7.0	12.0	17.0	21.0	21.0	18.0	13.0	8.0	2.0
DD C-DAY	567.	531.	487.	340.	191.	55.	0.	9.	43.	171.	330.	501.
NEW YORK NY (LAT. 40.5)												
$\bar{H}$ MJ/m^2	5.44	8.33	12.14	15.45	18.09	19.68	19.22	16.29	13.86	10.13	6.15	4.81
$\bar{K}_T$	.37	.41	.45	.45	.46	.48	.48	.45	.47	.46	.38	.36
T_a C	.0	1.0	5.0	11.0	17.0	22.0	25.0	24.0	20.0	15.0	9.0	2.0
DD C-DAY	541.	488.	417.	230.	69.	3.	0.	0.	15.	124.	293.	493.
NORFOLK VA (LAT. 36.5)												
$\bar{H}$ MJ/m^2	8.71	11.30	15.57	19.97	22.61	23.95	23.03	20.14	16.66	12.98	9.34	7.70
$\bar{K}_T$	.51	.51	.54	.57	.57	.58	.57	.55	.54	.54	.51	.49
T_a C	4.0	5.0	8.0	14.0	19.0	23.0	25.0	24.0	22.0	16.0	10.0	5.0
DD C-DAY	422.	367.	296.	126.	29.	0.	0.	0.	5.	78.	223.	391.
NORTH OMAHA NE (LAT. 41.2)												
$\bar{H}$ MJ/m^2	8.55	11.60	14.90	19.38	21.48	23.57	23.78	21.81	16.58	12.31	8.29	6.95
$\bar{K}_T$	.60	.59	.56	.57	.55	.57	.59	.61	.57	.57	.53	.54
T_a C	-5.0	-3.0	3.0	10.0	17.0	22.0	25.0	23.0	19.0	12.0	4.0	-2.0
DD C-DAY	753.	626.	522.	258.	116.	23.	0.	7.	58.	198.	460.	653.
OAK RIDGE TN (LAT. 36.0)												
$\bar{H}$ MJ/m^2	6.94	9.95	13.63	18.69	21.54	22.79	21.79	19.91	17.44	13.34	8.82	6.73
$\bar{K}_T$	.40	.44	.47	.53	.54	.55	.54	.54	.56	.55	.47	.42
T_a C	3.0	5.0	9.0	15.0	19.0	23.0	25.0	24.0	21.0	15.0	8.0	4.0
DD C-DAY	463.	383.	306.	122.	43.	0.	0.	0.	11.	120.	298.	444.
OKLAHOMA CITY OK (LAT. 35.2)												
$\bar{H}$ MJ/m^2	10.66	13.26	17.02	20.83	22.58	26.35	25.51	24.59	20.24	15.85	11.88	9.91
$\bar{K}_T$	.59	.58	.58	.59	.57	.64	.63	.67	.64	.64	.62	.60
T_a C	2.0	4.0	9.0	15.0	20.0	25.0	27.0	27.0	23.0	16.0	9.0	4.0
DD C-DAY	486.	369.	296.	100.	20.	0.	0.	0.	7.	82.	263.	431.
PAGE AZ (LAT. 36.4)												
$\bar{H}$ MJ/m^2	12.56	15.99	22.02	25.87	29.10	29.60	28.47	24.95	21.60	16.83	12.98	10.17
$\bar{K}_T$	.73	.72	.77	.74	.74	.72	.71	.68	.70	.70	.70	.64
T_a C	.0	2.0	5.0	10.0	15.0	20.0	24.0	22.0	18.0	12.0	5.0	.0
DD C-DAY	591.	447.	396.	240.	107.	21.	0.	6.	41.	189.	390.	562.
PARKERSBURG WV (LAT. 39.2)												
$\bar{H}$ MJ/m^2	5.99	8.46	12.64	15.87	20.39	22.65	22.02	20.26	16.50	11.89	6.99	5.53
$\bar{K}_T$	.38	.41	.46	.46	.52	.55	.55	.56	.55	.52	.42	.39
T_a C	1.0	1.0	6.0	13.0	18.0	22.0	24.0	23.0	20.0	14.0	7.0	2.0
DD C-DAY	553.	471.	381.	178.	67.	4.	0.	0.	26.	149.	333.	515.

PASADENA CA (LAT. 34.1)

$\bar{H}$ MJ/m^2	10.51	13.94	18.38	21.31	23.82	24.28	26.54	25.08	20.18	15.32	11.35	9.88
$\bar{K}_T$	.56	.59	.62	.60	.60	.59	.66	.68	.63	.60	.57	.57
T_a C	12.0	13.0	13.0	15.0	17.0	19.0	23.0	23.0	22.0	19.0	15.0	13.0
DD C-DAY	191.	151.	141.	94.	47.	26.	0.	0.	6.	29.	91.	166.

PENSACOLA FL (LAT. 30.3)

$\bar{H}$ MJ/m^2	10.47	13.44	16.96	21.31	23.53	23.78	22.48	21.31	18.00	16.49	11.64	9.38
$\bar{K}_T$	.50	.53	.54	.59	.59	.58	.56	.57	.55	.61	.53	.48
T_a C	11.0	12.0	15.0	20.0	23.0	26.0	27.0	27.0	25.0	21.0	15.0	12.0
DD C-DAY	237.	179.	117.	21.	0.	0.	0.	0.	0.	18.	105.	199.

PEORIA IL (LAT. 40.4)

$\bar{H}$ MJ/m^2	6.82	9.54	13.48	17.67	21.31	23.99	23.57	21.02	17.04	12.52	7.75	5.82
$\bar{K}_T$	.46	.47	.50	.52	.54	.58	.59	.58	.58	.57	.48	.43
T_a C	-5.0	-2.0	3.0	11.0	16.0	22.0	24.0	23.0	19.0	13.0	4.0	-2.0
DD C-DAY	709.	580.	477.	231.	100.	9.	0.	4.	39.	182.	418.	637.

PHOENIX AZ (LAT. 33.3)

$\bar{H}$ MJ/m^2	12.42	17.06	21.79	26.89	30.28	30.95	27.27	25.59	23.75	18.90	14.18	11.71
$\bar{K}_T$	.65	.71	.73	.75	.76	.75	.68	.69	.74	.73	.70	.66
T_a C	10.0	13.0	15.0	19.0	24.0	29.0	32.0	31.0	28.0	22.0	15.0	11.0
DD C-DAY	238.	162.	103.	33.	0.	0.	0.	0.	0.	9.	101.	216.

PHILADELPHIA PA (LAT. 39.5)

$\bar{H}$ MJ/m^2	7.33	10.13	14.53	17.79	20.64	23.19	22.52	19.47	16.24	12.27	8.00	6.36
$\bar{K}_T$	.48	.49	.53	.52	.52	.56	.56	.54	.54	.54	.48	.46
T_a C	.0	1.0	5.0	11.0	17.0	22.0	24.0	23.0	20.0	14.0	8.0	2.0
DD C-DAY	563.	484.	398.	204.	68.	0.	0.	0.	21.	138.	313.	513.

PITTSBURGH PA (LAT. 40.3)

$\bar{H}$ MJ/m^2	6.62	8.92	13.48	16.75	20.39	23.40	22.90	20.18	17.00	12.31	7.70	5.94
$\bar{K}_T$	.44	.44	.50	.49	.52	.57	.57	.56	.57	.56	.48	.44
T_a C	.0	.0	5.0	11.0	17.0	22.0	24.0	23.0	19.0	13.0	7.0	1.0
DD C-DAY	592.	513.	424.	212.	89.	6.	0.	3.	32.	166.	348.	546.

POCATELLO ID (LAT. 42.5)

$\bar{H}$ MJ/m^2	6.91	10.47	15.28	21.77	24.28	27.42	28.26	24.70	19.89	13.82	8.58	6.49
$\bar{K}_T$	.51	.55	.59	.65	.62	.66	.70	.69	.69	.66	.58	.54
T_a C	-4.0	.0	2.0	7.0	12.0	17.0	22.0	21.0	15.0	9.0	2.0	-2.0
DD C-DAY	720.	554.	510.	328.	187.	77.	0.	11.	107.	286.	488.	656.

PORT ARTHUR TX (LAT. 29.6)

$\bar{H}$ MJ/m^2	9.59	12.35	16.08	18.21	22.44	23.86	22.11	20.47	18.09	15.99	10.76	8.92
$\bar{K}_T$	.45	.48	.51	.50	.57	.59	.55	.54	.55	.58	.48	.45
T_a C	11.0	13.0	16.0	20.0	24.0	27.0	28.0	28.0	26.0	21.0	16.0	12.0
DD C-DAY	233.	168.	112.	18.	0.	0.	0.	0.	0.	19.	102.	190.

PORTLAND ME (LAT. 43.4)

$\bar{H}$ MJ/m^2	6.57	9.91	15.01	16.98	21.45	22.62	23.46	20.16	16.02	11.42	6.57	5.77
$\bar{K}_T$	.51	.54	.59	.51	.55	.55	.58	.57	.56	.56	.46	.50
T_a C	-5.0	-4.0	.0	6.0	11.0	17.0	20.0	19.0	15.0	9.0	4.0	-3.0
DD C-DAY	744.	657.	579.	375.	207.	62.	7.	29.	108.	282.	448.	564.

PORTLAND OR (LAT. 45.4)

$\bar{H}$ MJ/m^2	4.02	6.57	10.05	14.78	17.71	19.80	23.15	18.59	14.36	8.41	4.86	3.47
$\bar{K}_T$	.34	.38	.41	.45	.46	.48	.58	.53	.52	.43	.37	.34
T_a C	3.0	6.0	8.0	10.0	14.0	17.0	19.0	19.0	17.0	12.0	7.0	5.0
DD C-DAY	463.	346.	332.	240.	147.	71.	27.	31.	66.	193.	328.	418.

PROSSER WA (LAT. 46.1)

$\bar{H}$ MJ/m^2	4.90	9.29	14.70	21.81	25.79	28.47	29.60	25.29	19.18	11.47	5.69	4.19
$\bar{K}_T$	.43	.55	.61	.67	.67	.69	.74	.73	.71	.61	.45	.42
T_a C	-1.0	4.0	6.0	10.0	14.0	18.0	21.0	20.0	16.0	10.0	4.0	.0
DD C-DAY	624.	428.	376.	240.	127.	47.	7.	16.	66.	231.	413.	543.

PUEBLO CO (LAT. 38.2)

$\bar{H}$ MJ/m^2	11.39	14.74	18.67	22.78	25.20	28.05	27.13	25.08	21.10	16.50	12.31	10.01
$\bar{K}_T$	.70	.69	.67	.66	.64	.68	.67	.69	.69	.71	.71	.68
T_a C	-1.0	1.0	4.0	11.0	16.0	21.0	25.0	24.0	19.0	12.0	5.0	1.0
DD C-DAY	601.	471.	431.	225.	82.	16.	0.	0.	31.	186.	403.	551.

		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
PULLMAN	WA (LAT. 46.4)												
$\bar{H}$	MJ/m^2	5.14	7.61	12.42	19.07	22.67	28.69	29.52	23.08	17.90	10.71	6.15	4.01
$\bar{K}_T$		.46	.46	.52	.59	.59	.69	.74	.66	.66	.57	.50	.41
T_a	C	-2.0	1.0	3.0	7.0	11.0	15.0	19.0	18.0	15.0	9.0	3.0	.0
DD	C-DAY	637.	481.	460.	317.	204.	105.	26.	42.	114.	271.	452.	572.
PUT-IN-BAY	OH (LAT. 41.4)												
$\bar{H}$	MJ/m^2	5.02	8.32	12.21	15.43	20.66	22.67	23.71	21.58	16.69	12.34	6.57	4.64
$\bar{K}_T$		.35	.43	.46	.46	.53	.55	.59	.60	.57	.57	.43	.36
T_a	C	-2.0	-1.0	2.0	9.0	15.0	21.0	24.0	23.0	19.0	14.0	6.0	.0
DD	C-DAY	661.	576.	501.	283.	122.	13.	0.	0.	22.	154.	367.	589.
RALEIGH	NC (LAT. 35.5)												
$\bar{H}$	MJ/m^2	9.95	12.75	16.81	19.78	20.87	23.84	22.71	20.20	16.14	13.05	10.00	8.45
$\bar{K}_T$		.56	.56	.58	.56	.53	.58	.56	.55	.52	.53	.53	.52
T_a	C	5.0	6.0	10.0	15.0	20.0	24.0	25.0	25.0	22.0	16.0	10.0	5.0
DD	C-DAY	422.	354.	279.	100.	27.	0.	0.	0.	7.	103.	250.	410.
RALEIGH-DURHAM	NC (LAT. 35.5)												
$\bar{H}$	MJ/m^2	9.00	11.85	15.66	20.22	21.64	22.44	23.15	20.14	16.62	13.23	10.05	8.16
$\bar{K}_T$		.51	.52	.54	.57	.55	.54	.57	.55	.53	.54	.53	.50
T_a	C	5.0	6.0	10.0	15.0	20.0	24.0	25.0	25.0	21.0	16.0	10.0	5.0
DD	C-DAY	422.	354.	279.	100.	27.	0.	0.	0.	7.	103.	250.	410.
RAPID CTY	SD (LAT. 44.1)												
$\bar{H}$	MJ/m^2	7.78	11.63	16.69	20.28	22.41	24.76	24.88	22.62	17.98	13.13	8.57	6.61
$\bar{K}_T$		.62	.65	.66	.61	.58	.60	.62	.64	.64	.65	.62	.59
T_a	C	-5.0	-2.0	.0	7.0	13.0	18.0	23.0	22.0	16.0	10.0	2.0	-2.0
DD	C-DAY	741.	636.	584.	342.	181.	70.	12.	7.	92.	267.	498.	651.
RENO	NV (LAT. 39.3)												
$\bar{H}$	MJ/m^2	9.80	13.56	18.80	24.79	27.80	29.89	29.60	27.05	22.27	16.54	11.60	8.75
$\bar{K}_T$		.63	.65	.68	.72	.71	.72	.73	.74	.74	.73	.69	.62
T_a	C	.0	2.0	4.0	8.0	12.0	16.0	20.0	19.0	15.0	10.0	4.0	.0
DD	C-DAY	570.	434.	426.	303.	182.	81.	9.	28.	93.	253.	415.	551.
RICHLAND	WA (LAT. 46.2)												
$\bar{H}$	MJ/m^2	3.60	8.41	13.93	19.53	21.58	27.06	24.09	25.13	16.23	9.58	5.19	4.14
$\bar{K}_T$		.32	.50	.57	.60	.56	.65	.60	.72	.60	.51	.41	.42
T_a	C	.0	4.0	8.0	12.0	17.0	20.0	24.0	22.0	18.0	12.0	6.0	2.0
DD	C-DAY	571.	395.	327.	183.	72.	17.	7.	16.	43.	202.	383.	503.
RICHMOND	VA (LAT. 37.5)												
$\bar{H}$	MJ/m^2	7.91	10.72	15.07	19.34	21.86	23.49	23.40	20.14	16.54	12.64	8.67	7.12
$\bar{K}_T$		.48	.49	.53	.55	.55	.57	.58	.55	.54	.54	.49	.47
T_a	C	3.0	4.0	8.0	14.0	19.0	23.0	25.0	25.0	21.0	15.0	9.0	4.0
DD	C-DAY	474.	398.	316.	126.	36.	0.	0.	0.	12.	113.	267.	448.
RIVERSIDE	CA (LAT. 33.6)												
$\bar{H}$	MJ/m^2	11.51	15.37	20.01	22.65	26.08	28.47	28.18	25.87	22.40	17.04	13.36	11.30
$\bar{K}_T$		.61	.64	.67	.63	.66	.69	.70	.70	.70	.67	.67	.64
T_a	C	11.0	12.0	13.0	15.0	18.0	20.0	24.0	24.0	22.0	18.0	14.0	11.0
DD	C-DAY	226.	173.	157.	93.	41.	12.	0.	0.	3.	34.	118.	208.
ROCHESTER	NY (LAT. 43.1)												
$\bar{H}$	MJ/m^2	5.65	8.41	12.64	16.66	21.52	23.95	24.03	20.51	15.53	10.55	6.03	4.77
$\bar{K}_T$		.43	.45	.49	.50	.55	.58	.60	.58	.55	.51	.42	.41
T_a	C	-4.0	-4.0	1.0	8.0	14.0	19.0	22.0	21.0	17.0	11.0	5.0	-2.0
DD	C-DAY	706.	626.	551.	315.	158.	26.	5.	14.	70.	221.	408.	632.
SACRAMENTO	CA (LAT. 38.3)												
$\bar{H}$	MJ/m^2	6.82	11.10	16.62	22.23	28.39	28.68	28.47	24.37	20.43	15.28	9.42	6.36
$\bar{K}_T$		.42	.52	.60	.64	.72	.69	.71	.67	.67	.66	.54	.43
T_a	C	7.0	10.0	12.0	15.0	18.0	21.0	24.0	23.0	22.0	17.0	12.0	8.0
DD	C-DAY	343.	237.	207.	126.	67.	11.	0.	0.	3.	56.	200.	331.
ST. CLOUD	MN (LAT. 45.3)												
$\bar{H}$	MJ/m^2	7.11	10.50	15.31	17.69	20.87	22.62	23.21	20.53	15.05	10.08	6.11	5.14
$\bar{K}_T$		.60	.61	.62	.54	.54	.55	.58	.59	.55	.52	.47	.50
T_a	C	-12.0	-9.0	-2.0	6.0	13.0	18.0	21.0	20.0	14.0	9.0	.0	-8.0
DD	C-DAY	966.	804.	673.	368.	180.	47.	10.	21.	127.	299.	583.	847.

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
ST. LOUIS MO (LAT. 38.4)												
H MJ/m²	7.37	10.30	14.49	18.00	22.15	23.95	23.78	20.93	17.50	12.89	8.71	6.45
K_T	.46	.49	.52	.52	.56	.58	.59	.57	.58	.56	.51	.44
T_a C	.0	2.0	6.0	14.0	19.0	24.0	26.0	25.0	21.0	15.0	7.0	1.0
DD C-DAY	581.	465.	379.	151.	57.	6.	0.	0.	19.	124.	333.	523.
SALT LAKE CITY UT (LAT. 40.5)												
H MJ/m²	6.82	10.72	14.82	20.06	23.87	26.00	25.96	23.07	18.67	13.23	8.54	6.11
K_T	.46	.53	.55	.59	.61	.63	.64	.64	.63	.60	.53	.46
T_a C	-1.0	1.0	4.0	10.0	15.0	19.0	25.0	24.0	18.0	11.0	4.0	.0
DD C-DAY	637.	492.	437.	263.	132.	49.	0.	3.	58.	223.	432.	598.
SAN ANTONIO TX (LAT. 29.3)												
H MJ/m²	11.58	14.51	17.52	18.82	22.54	25.26	26.14	24.34	20.49	16.52	12.17	10.54
K_T	.54	.56	.56	.51	.57	.62	.65	.65	.62	.60	.54	.52
T_a C	11.0	12.0	16.0	20.0	24.0	27.0	28.0	28.0	26.0	21.0	15.0	12.0
DD C-DAY	238.	159.	108.	22.	0.	0.	0.	0.	0.	17.	113.	202.
SAN DIEGO CA (LAT. 32.4)												
H MJ/m²	11.10	14.36	17.92	19.43	20.64	21.35	22.90	20.89	18.67	15.11	11.89	10.26
K_T	.57	.59	.59	.54	.52	.52	.57	.56	.58	.58	.57	.56
T_a C	12.0	13.0	14.0	15.0	17.0	18.0	20.0	21.0	21.0	18.0	15.0	13.0
DD C-DAY	174.	132.	122.	80.	44.	29.	3.	0.	9.	24.	78.	143.
SAN FRANCISCO CA (LAT. 37.5)												
H MJ/m²	8.16	11.85	17.08	21.44	24.20	24.99	22.61	20.01	17.75	13.90	9.63	7.33
K_T	.49	.54	.60	.61	.61	.61	.56	.55	.58	.59	.54	.48
T_a C	10.0	12.0	12.0	13.0	14.0	15.0	15.0	15.0	17.0	16.0	14.0	11.0
DD C-DAY	243.	181.	184.	162.	143.	108.	112.	98.	57.	71.	129.	224.
SANTA MARIA CA (LAT. 34.5)												
H MJ/m²	11.08	14.64	20.32	23.42	26.64	29.11	28.48	25.59	21.91	17.48	13.01	10.58
K_T	.60	.63	.69	.66	.67	.71	.71	.69	.69	.70	.67	.62
T_a C	10.0	11.0	11.0	12.0	13.0	15.0	16.0	16.0	17.0	15.0	13.0	10.0
DD C-DAY	255.	206.	202.	157.	129.	92.	55.	52.	53.	81.	150.	217.
SAVANNAH GA (LAT. 32.1)												
H MJ/m²	10.30	13.15	16.87	21.64	23.57	23.19	22.44	20.97	16.87	14.57	11.10	8.96
K_T	.52	.53	.55	.60	.59	.57	.56	.56	.52	.55	.53	.49
T_a C	10.0	11.0	14.0	19.0	23.0	26.0	27.0	27.0	25.0	20.0	14.0	10.0
DD C-DAY	268.	211.	142.	35.	0.	0.	0.	0.	0.	33.	141.	254.
SAULT ST. MARIE MI (LAT. 46.3)												
H MJ/m²	5.56	9.45	14.89	17.52	22.00	23.00	23.96	19.95	13.47	9.03	4.39	3.97
K_T	.49	.57	.62	.54	.57	.56	.60	.57	.50	.48	.35	.41
T_a C	-9.0	-10.0	-4.0	3.0	9.0	14.0	17.0	17.0	13.0	7.0	.0	-6.0
DD C-DAY	847.	767.	709.	450.	265.	112.	53.	58.	155.	322.	528.	759.
SCHENECTADY NY (LAT. 42.5)												
H MJ/m²	5.44	8.41	11.46	14.22	17.31	18.78	18.57	16.69	12.55	9.16	5.39	4.35
K_T	.40	.44	.44	.42	.44	.45	.46	.47	.44	.44	.36	.36
T_a C	-5.0	-4.0	1.0	8.0	15.0	20.0	23.0	21.0	17.0	11.0	4.0	-2.0
DD C-DAY	744.	641.	543.	302.	136.	20.	4.	11.	76.	234.	420.	656.
SEATTLE WA (LAT. 47.3)												
H MJ/m²	3.26	5.69	11.04	16.56	20.95	21.79	23.71	19.86	13.72	7.90	4.43	2.68
K_T	.31	.35	.47	.52	.54	.53	.59	.57	.51	.43	.37	.29
T_a C	5.0	7.0	7.0	10.0	13.0	16.0	18.0	18.0	16.0	12.0	8.0	6.0
DD C-DAY	410.	333.	321.	220.	134.	65.	28.	26.	72.	183.	302.	365.
SHREVEPORT LA (LAT. 32.2)												
H MJ/m²	9.45	11.67	15.81	19.53	22.92	22.75	23.50	21.75	17.36	14.47	10.16	8.28
K_T	.48	.48	.52	.54	.58	.56	.58	.58	.54	.55	.49	.45
T_a C	8.0	10.0	14.0	18.0	22.0	26.0	28.0	28.0	25.0	19.0	13.0	9.0
DD C-DAY	307.	237.	169.	45.	0.	0.	0.	0.	0.	26.	165.	265.
SILVER HILL MD (LAT. 38.5)												
H MJ/m²	7.61	10.20	14.22	18.32	21.45	23.21	21.58	19.19	16.60	12.34	8.45	6.82
K_T	.48	.48	.51	.53	.54	.56	.54	.53	.55	.53	.49	.47
T_a C	2.0	3.0	7.0	13.0	18.0	23.0	25.0	24.0	21.0	15.0	9.0	3.0
DD C-DAY	506.	431.	343.	147.	40.	0.	0.	0.	8.	106.	283.	476.

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
SPOKANE	**WA (LAT. 47.4)**											
H MJ/m²	4.94	8.91	13.26	19.53	23.25	25.30	27.73	23.17	17.02	8.62	5.48	3.18
K_T	.47	.56	.56	.61	.60	.61	.70	.67	.64	.47	.46	.35
T_a C	-3.0	.0	3.0	8.0	13.0	16.0	21.0	20.0	15.0	9.0	2.0	-1.0
DD C-DAY	682.	510.	474.	315.	182.	80.	12.	26.	109.	296.	492.	620.
SPRINGFIELD	**MO (LAT. 37.1)**											
H MJ/m²	8.33	11.39	15.41	18.59	22.11	23.91	23.61	22.15	19.01	13.94	99.22	7.54
K_T	.50	.52	.54	.53	.56	.58	.59	.60	.62	.59	5.52	.49
T_a C	1.0	3.0	7.0	14.0	18.0	23.0	25.0	25.0	21.0	15.0	7.0	2.0
DD C-DAY	553.	436.	367.	153.	52.	6.	0.	3.	19.	126.	325.	499.
STATE COLLEGE	**PA (LAT. 40.5)**											
H MJ/m²	5.81	8.45	12.42	15.60	19.53	22.75	22.08	18.99	15.10	11.50	6.48	5.02
K_T	.39	.42	.46	.46	.50	.55	.55	.53	.51	.52	.41	.38
T_a C	-2.0	-2.0	2.0	9.0	15.0	20.0	22.0	21.0	17.0	11.0	5.0	-1.0
DD C-DAY	654.	572.	489.	267.	115.	13.	3.	8.	61.	214.	400.	609.
STILLWATER	**OK (LAT. 36.1)**											
H MJ/m²	8.66	11.96	16.23	19.07	20.99	24.80	24.80	22.67	19.03	14.72	10.75	8.53
K_T	.50	.53	.56	.54	.53	.60	.62	.62	.61	.60	.58	.53
T_a C	2.0	5.0	9.0	16.0	20.0	25.0	27.0	27.0	22.0	17.0	9.0	4.0
DD C-DAY	481.	358.	287.	97.	21.	0.	0.	0.	6.	81.	258.	429.
SUMMIT	**MT (LAT. 48.2)**											
H MJ/m²	5.11	6.78	11.22	17.33	19.34	20.64	23.45	21.35	14.82	9.04	4.27	3.18
K_T	.51	.44	.48	.55	.50	.50	.59	.62	.56	.51	.38	.37
T_a C	-8.0	-5.0	-4.0	1.0	6.0	10.0	14.0	13.0	8.0	4.0	-2.0	-6.0
DD C-DAY	854.	691.	715.	518.	377.	253.	143.	171.	302.	457.	647.	777.
SYRACUSE	**NY (LAT. 43.1)**											
H MJ/m²	5.40	8.08	12.14	15.66	20.26	23.11	23.36	19.72	14.99	10.09	5.19	4.31
K_T	.41	.43	.47	.47	.52	.56	.58	.55	.53	.49	.36	.37
T_a C	-5.0	-4.0	1.0	8.0	14.0	19.0	22.0	21.0	17.0	11.0	5.0	-2.0
DD C-DAY	713.	628.	548.	308.	151.	26.	6.	10.	67.	218.	400.	636.
TALLAHASSEE	**FL (LAT. 30.3)**											
H MJ/m²	10.33	13.01	17.69	20.20	22.92	19.91	22.75	22.46	17.73	14.76	15.22	13.01
K_T	.49	.51	.57	.55	.58	.49	.57	.60	.54	.54	.69	.67
T_a C	11.0	12.0	16.0	19.0	23.0	26.0	27.0	27.0	25.0	20.0	15.0	12.0
DD C-DAY	227.	179.	10[illegible].	19.	0.	0.	0.	0.	0.	17.	113.	209.
TAMPA	**FL (LAT. 27.6)**											
H MJ/m²	13.67	16.35	19.95	22.79	24.88	23.96	22.29	20.70	18.99	16.94	14.93	12.63
K_T	.61	.61	.62	.62	.63	.59	.56	.55	.56	.60	.64	.60
T_a C	16.0	16.0	19.0	21.0	24.0	26.0	27.0	27.0	26.0	23.0	19.0	16.0
DD C-DAY	113.	98.	50.	5.	0.	0.	0.	0.	0.	0.	39.	94.
TRENTON	**NJ (LAT. 40.1)**											
H MJ/m²	7.24	10.22	14.36	17.75	20.56	22.86	22.61	19.64	16.29	12.31	8.16	6.49
K_T	.48	.50	.53	.52	.52	.55	.56	.54	.55	.55	.50	.48
T_a C	.0	.0	5.0	11.0	16.0	21.0	24.0	23.0	19.0	13.0	7.0	1.0
DD C-DAY	567.	492.	410.	213.	75.	0.	0.	0.	22.	140.	312.	518.
TUCSON	**AZ (LAT. 32.1)**											
H MJ/m²	13.09	16.81	22.83	27.85	30.95	29.65	26.26	24.67	24.30	18.69	14.85	12.42
K_T	.66	.68	.75	.77	.78	.72	.65	.66	.75	.71	.71	.67
T_a C	10.0	11.0	14.0	18.0	22.0	27.0	30.0	28.0	26.0	20.0	14.0	10.0
DD C-DAY	262.	191.	134.	42.	3.	0.	0.	0.	0.	14.	128.	226.
TULSA	**OK (LAT. 36.1)**											
H MJ/m²	8.67	11.43	15.45	18.30	21.56	24.41	23.86	22.23	18.34	13.77	9.80	8.16
K_T	.50	.51	.54	.52	.55	.59	.59	.60	.59	.57	.53	.51
T_a C	3.0	5.0	9.0	16.0	20.0	25.0	28.0	27.0	23.0	17.0	10.0	4.0
DD C-DAY	489.	370.	293.	98.	16.	0.	0.	0.	6.	79.	260.	434.
TWIN FALLS	**ID (LAT. 40.3)**											
H MJ/m²	6.82	10.05	14.86	19.34	23.11	24.79	25.20	22.61	18.09	11.97	7.37	5.49
K_T	.46	.50	.55	.57	.59	.60	.63	.63	.61	.54	.46	.41
T_a C	-1.0	1.0	4.0	9.0	13.0	17.0	22.0	21.0	16.0	10.0	4.0	.0
DD C-DAY	644.	490.	454.	290.	161.	73.	0.	12.	99.	260.	442.	589.

		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
WASHINGTON	DC (LAT. 38.5)												
$\bar{H}$	MJ/m^2	6.65	9.62	13.38	16.85	18.69	23.34	22.12	19.32	15.35	11.75	8.82	6.15
$\bar{K}_T$		.42	.45	.48	.49	.47	.56	.55	.53	.51	.51	.51	.42
$\bar{T}_a$	C	2.0	3.0	7.0	13.0	18.0	23.0	25.0	24.0	21.0	15.0	9.0	3.0
DD	C-DAY	484.	423.	348.	160.	41.	0.	0.	0.	18.	121.	288.	463.
WICHITA	KS (LAT. 37.4)												
$\bar{H}$	MJ/m^2	9.29	11.97	15.99	19.76	22.78	25.20	24.41	22.57	18.71	14.40	10.26	8.29
$\bar{K}_T$		.56	.55	.56	.57	.58	.61	.61	.62	.61	.61	.58	.54
$\bar{T}_a$	C	.0	2.0	6.0	14.0	19.0	24.0	27.0	26.0	21.0	15.0	7.0	1.0
DD	C-DAY	581.	447.	373.	153.	50.	4.	0.	0.	18.	117.	337.	526.
YUMA	AZ (LAT. 32.4)												
$\bar{H}$	MJ/m^2	12.77	16.79	21.64	26.50	29.43	29.52	27.30	24.58	22.19	18.50	13.82	11.35
$\bar{K}_T$		.65	.69	.71	.74	.74	.72	.68	.66	.69	.71	.67	.62
$\bar{T}_a$	C	12.0	15.0	17.0	21.0	25.0	29.0	34.0	33.0	30.0	24.0	17.0	13.0
DD	C-DAY	171.	107.	54.	13.	0.	0.	0.	0.	0.	0.	60.	153.
AKLAVIK	NW (LAT. 68.1)												
$\bar{H}$	MJ/m^2	.21	2.09	8.45	16.23	21.54	22.08	18.65	12.42	6.52	2.59	.46	.04
$\bar{K}_T$		1.61	.56	.72	.69	.62	.54	.49	.44	.41	.44	.65	.00
$\bar{T}_a$	C	-28.0	-27.0	-22.0	-12.0	.0	9.0	13.0	10.0	3.0	-7.0	-19.0	-26.0
DD	C-DAY	1462.	1298.	1268.	930.	591.	268.	152.	255.	448.	786.	1147.	1406.
CHURCHILL	MA (LAT. 58.4)												
$\bar{H}$	MJ/m^2	2.72	6.27	12.75	18.61	21.33	22.16	21.12	15.89	9.41	4.81	2.51	1.46
$\bar{K}_T$		.65	.67	.73	.67	.58	.54	.55	.51	.44	.41	.47	.49
$\bar{T}_a$	C	-27.0	-26.0	-19.0	-10.0	-2.0	5.0	11.0	11.0	5.0	-1.0	-11.0	-21.0
DD	C-DAY	1421.	1265.	1183.	872.	641.	375.	200.	208.	378.	601.	900.	1249.
EDMONTON	AT (LAT. 53.3)												
$\bar{H}$	MJ/m^2	3.72	7.36	13.05	17.27	21.29	21.45	22.00	17.10	12.46	7.86	4.64	2.76
$\bar{K}_T$		.53	.59	.64	.58	.57	.52	.56	.52	.52	.53	.56	.48
$\bar{T}_a$	C	-14.0	-11.0	-5.0	4.0	11.0	14.0	16.0	15.0	10.0	5.0	-4.0	-10.0
DD	C-DAY	1006.	844.	739.	425.	222.	123.	41.	100.	228.	410.	675.	891.
KAPUSKASING	OT (LAT. 49.2)												
$\bar{H}$	MJ/m^2	4.60	7.95	12.96	15.47	17.15	20.07	20.07	16.73	11.29	6.69	3.35	3.35
$\bar{K}_T$		.49	.53	.57	.49	.45	.49	.51	.49	.44	.39	.31	.42
$\bar{T}_a$	C	-18.0	-16.0	-9.0	.0	7.0	14.0	16.0	15.0	10.0	4.0	-4.0	-14.0
DD	C-DAY	1132.	964.	868.	543.	322.	123.	41.	95.	225.	420.	692.	1004.
LETHBRIDGE	AT (LAT. 49.4)												
$\bar{H}$	MJ/m^2	5.02	8.78	14.22	17.56	21.75	24.25	25.51	21.75	15.47	10.04	5.86	3.76
$\bar{K}_T$		.54	.59	.63	.56	.57	.59	.64	.64	.60	.59	.55	.47
$\bar{T}_a$	C	-8.0	-7.0	-2.0	5.0	11.0	14.0	17.0	16.0	12.0	7.0	.0	-4.0
DD	C-DAY	832.	717.	644.	387.	224.	118.	31.	62.	177.	339.	562.	709.
MONCTON	NB (LAT. 46.1)												
$\bar{H}$	MJ/m^2	4.18	7.53	12.13	15.89	18.40	18.82	19.65	17.15	12.96	8.78	4.60	3.76
$\bar{K}_T$		.37	.45	.50	.49	.48	.46	.49	.49	.48	.46	.36	.38
$\bar{T}_a$	C	-8.0	-8.0	-3.0	3.0	9.0	15.0	17.0	16.0	13.0	7.0	1.0	-5.0
DD	C-DAY	823.	742.	563.	438.	260.	95.	34.	58.	153.	339.	495.	746.
MONTREAL	QU (LAT. 45.3)												
$\bar{H}$	MJ/m^2	4.60	8.36	13.38	16.73	19.65	20.49	21.33	18.40	12.96	8.36	4.18	3.35
$\bar{K}_T$		.39	.48	.54	.51	.51	.50	.53	.52	.47	.43	.32	.32
$\bar{T}_a$	C	-9.0	-7.0	-2.0	5.0	12.0	17.0	18.0	17.0	15.0	8.0	1.0	-6.0
DD	C-DAY	870.	767.	653.	380.	176.	38.	5.	24.	92.	289.	490.	773.
OTTAWA	OT (LAT. 45.3)												
$\bar{H}$	MJ/m^2	6.02	9.53	14.01	16.85	20.78	23.34	22.87	19.61	14.85	9.24	5.14	4.56
$\bar{K}_T$		.51	.55	.57	.51	.54	.56	.57	.56	.54	.48	.39	.44
$\bar{T}_a$	C	-10.0	-10.0	-3.0	5.0	12.0	16.0	17.0	16.0	14.0	8.0	.0	-8.0
DD	C-DAY	902.	801.	684.	393.	189.	50.	14.	45.	123.	315.	520.	816.
ST.JOHNS	NF (LAT. 47.3)												
$\bar{H}$	MJ/m^2	3.35	6.27	10.04	13.38	16.73	17.98	18.40	14.22	11.71	7.11	3.35	2.93
$\bar{K}_T$		.32	.39	.42	.42	.43	.44	.46	.41	.44	.39	.28	.32
$\bar{T}_a$	C	-4.0	-4.0	-2.0	1.0	5.0	10.0	15.0	15.0	11.0	6.0	2.0	-1.0
DD	C-DAY	701.	650.	659.	515.	394.	240.	103.	100.	190.	362.	462.	618.

		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
TORONTO	OT (LAT. 43.4)												
$\bar{H}$	MJ/m^2	5.06	7.74	12.21	15.56	19.99	21.75	22.04	18.15	14.39	9.37	5.14	3.97
$\bar{K}_T$		.39	.42	.48	.47	.51	.53	.55	.51	.51	.46	.36	.34
T_a	C	-3.0	-3.0	.0	6.0	12.0	17.0	18.0	17.0	15.0	10.0	4.0	-1.0
DD	C-DAY	685.	622.	563.	342.	166.	34.	4.	10.	84.	244.	422.	617.
VANCOUVER	BC (LAT. 48.6)												
$\bar{H}$	MJ/m^2	3.18	4.35	7.82	14.34	19.57	20.16	22.79	16.64	10.54	6.69	3.97	2.34
$\bar{K}_T$		.32	.28	.34	.45	.51	.49	.57	.49	.40	.38	.36	.28
T_a	C	2.0	3.0	6.0	9.0	12.0	15.0	16.0	16.0	14.0	10.0	6.0	4.0
DD	C-DAY	479.	402.	376.	278.	172.	87.	45.	48.	122.	253.	365.	437.
WINNIPEG	MA (LAT. 49.5)												
$\bar{H}$	MJ/m^2	5.48	9.41	15.18	18.36	21.33	21.95	23.75	19.74	13.34	8.57	4.98	3.85
$\bar{K}_T$		.59	.64	.67	.59	.56	.53	.60	.58	.52	.50	.47	.49
T_a	C	-17.0	-15.0	-7.0	3.0	11.0	15.0	17.0	17.0	12.0	6.0	-4.0	-13.0
DD	C-DAY	1116.	955.	814.	452.	225.	82.	21.	39.	179.	379.	695.	976.

APPENDIX C

DETERMINATION OF CHARACTERISTIC WIND DIRECTION FOR INPUT TO THE PLUME MODEL FOR MULTIPLE-TOWER CASES

In this Appendix, we will explain how to select the N standard wind directions (SWDs) for an actual site, and we will discuss some of the practical difficulties involved in their choice and application. The basic philosophy we want to keep in mind is that for a given installation of multiple NDCTs, CMDCTs or LMDCTs, there are usually only a few significantly different wind directions from the viewpoint of plume merging and wake effects. Instead of running the plume code for each of the 16 meteorological wind directions (MWDs), we can usually obtain the uniquely different plume behaviors for a given category of meteorological and tower conditions by running the plume model for only two or three wind directions. For example, in Fig. C-1, we show a set of four NDCTs or CMDCTs arranged in a square (a common geometry when four towers are present such as at the extensively-studied Keystone site in Pennsylvania). The natural choice of user-selected origin for this installation is at the center of the square. It is clear that in the range of wind direction angles between 0 and 360°, only wind directions between 0° and 45° give unique plume behaviors, and any other wind direction gives an identically predicted plume to one in this range. It is also clear for this tower geometry that wind directions of 0° and 45° will yield the most divergent predictions. We would at least want to consider these two SWDs. But if we decide to choose three wind directions, we will include a SWD for every sector -- for every range of MWD. This is the maximum directionality which has meaning when the weather tapes only specify wind directions within 22.5° sectors. Thus, in this case an adequate choice would be the two SWDs (0°, 45°); alternatively, use of the three wind directions (0°, 22.5°, 45°) would give the richest meaningful representation of wind directional effects.

Our first task is to select WD(I), I=1,...,NWD. This array contains the SWDs, and is needed when applying the seasonal/annual system to a site. We will show other examples below, some of which have additional difficulties. But first, let us outline the second necessary step in including directional effects for the above example; namely the selection of the array IWD(N), N=1,...,16. This array indicates which of the SWDs the code should use when calculating effects produced when the wind for a particular hour on the meteorological tape is in any one of the 16 MWDs. Thus, the values of the IWD-array lie between 1 and NWD, the number of SWDs. The correct choice 4 of numbers in the IWD-array, when the three SWDs shown in Fig. C-1 are used, is also indicated in that figure by means of the circled integers. For example, IWD(2) = 2 means that in accumulating environmental effects for sector 2, the results of the detailed case computation for each category representative with a wind direction of 22.5° is used. Clearly, this computation is also appropriate for sectors 4, 6, 8, 10, 12, 14 and 16 if the effects computed are distributed into the corresponding downwind sections on the ground.

The decision is somewhat more difficult when only two SWDs are selected, as shown in Fig. C-2, because one has to decide whether to use the 0° calculation or the 45° calculation for the even-numbered sectors. Since for most environmental effects the predictions will be conservative if the plume mixes rapidly and experiences the maximum wake effects (causing the lowest-rising plume), the use of the 0° SWD seems most desirable. However, this selection will tend to place the drift from the small drops nearer the tower which may not be conservative in sensitive cases. In that case, the pattern 1222122212221222 may be more desirable for the user. In either case, 8 of the 16 sectors are exactly represented by the SWDs.

Next we consider the case of a single LMDCT oriented with its axis along an east-west direction as shown in Fig. C-3. For linear towers, we recommend three SWDs: directions perpendicular to the tower axis, along the tower axis and at 45° to the tower axis. Here a suitable choice for the three SWDs is 0°, 45° and 90°. Clearly sector 1 must have IWD = 1, sector 3 must have IWD = 2, and sector 5 must have IWD = 3. Likewise, the IWD-values for all of the remaining odd-numbered sectors are unambiguously predetermined. But judgment is required to set the IWD-values for the even-numbered sectors because their central angles fall midway between two SWDs. Considering only the first quadrant (which determined all remaining choices by consistency), we have indicated our recommended choices in Fig. C-3. There we choose to use the 0° prediction in sector 2 as well as sector 1, believing from test runs of our plume code that a wind direction of about 22.5° (in the center of sector 2) gives predictions very close to those obtained for a wind direction of 0°. Further, this choice is conservative except for far-field drift, because in the crossflow orientation the plume will rise the least and mix the fastest. The choice of IWD = 3 in sector 4 means that the inline predictions will be used for an average wind direction which lies 22.5° away from inline. Our test calculations again show that the predictions for a wind direction 22.5° away from inline differ little from those for a pure inline wind direction. But if the user wants to follow the conservative philosophy, he may want to specify the IWD-array as 1122322111223221.

In the case of the same linear tower with its axis in a NE-SW orientation, the choice is very similar. As shown in Fig. C-4 the SWDs are chosen as 45°, 0° and 135° is a crossflow orientation (and -45° could also have been selected). The choice of the IWD-array is really identical to that in Fig. C-3, but the pattern is rotated by 45°, and the SWDs are numbered differently. The chosen pattern is 2111233321112333. Again, a choice of 2212233322122333 will appeal to some users as more conservative.

In all of the previous examples, the axes of symmetry of the tower complex lie conveniently along the middle of a MWD sector. In practice, of course, this is not always the case. The final set of complications the user has to face is shown in Figs. C-5 and C-6, for two adjacent LMDCTs with parallel axes. The long axis of the towers is, however, assumed to be 16° east of north. If three SWDs are chosen, they should be taken as inline, 45° to the tower, and crossflow. Here this implies 16°, 61°, and 106°. Since Since each even-numbered sector contains one of the SWDs, the specification of IWD for these sectors is unambiguous. Also, sector 1 should probably be associated with the 16° predictions, because its central angle is only 16° from this wind direction. Likewise, it is clear that sectors 5 and 13 must be associated with the crossflow case, also having central angles that differ by only 16° from that orientation. The sectors for which the choice is not clear are numbers 3, 8, 11 and 16. Our suggestion is to associate these sectors with the 45° predictions, because the effects will be more conservative in this case than if inline results are used for them (except for far-field drift effects). The recommended pattern in this case is, then, 1122332211223322. However, other choices could be defended. If the user wanted to emphasize the inline orientation to increase far-field drift for example (to add conservatism), the choice 1112332111123321 would make sense. When the symmetry lines of the tower complex are not simply related to central angles of sectors, the choice obviously requires more judgment and compromise.

As a final example of our methods of selecting the IWD-array, we present in Fig. C-6 the same tower configuration as in Fig. C-5, but here introduce only two SWDs, corresponding to inline and crossflow. These are 16° and 106°. Now the only sectors for which the choice of IWD is ambiguous are 3, 4, 7, 8, 11, 12, 15 and 16. As shown in Fig. C-6, we have chosen to associate sectors 16 and 3 with the inline wind direction, which means that sectors 8 and 11 will also be so associated by symmetry. Sectors 4 and 7 have been associated with the crossflow dinw direction, which by symmetry also associates sectors 12 and 15 with this direction. The resulting IWD array is 111222211112222l. Another reasonable choice that strongly emphasizes the crossflow results is 1122222211222222. Neither of these selections of IWD is ideal, and here the read advantage of using three SWDs is evident.

The user should remember that in cases with even less symmetry than the examples shown, more than three SWDs can always be used, up to a maximum of 16. For example, if a site has two LMDCTs whose axes are at right angles to one another, a richer set of SWDs may be needed. To us it seems that six wind directions would probably be enough at such a site, but this would depend on where the tower centers are located relative to each other. It would depend particularly on whether either tower lies significantly in the wake of the other tower for certain wind directions. However, for three CMDCTs at the vertices of an equilateral triangle it is clear that three SWDs, the second 30° beyond the first and the third 30° beyond the second will represent fully the directional effects of the complex. But since these angles are incommensurate with the 22.5° sector widths, this configuration poses problems in the selection of IWD.

Finally, a case we have seen in field studies involves a set of NDCTs located approximately along a line. Here we would recommend three SWDs if the plumes from the towers are near enough together to interact. The three should be chosen along the line of towers, perpendicular to the line, and at 45° to the line.

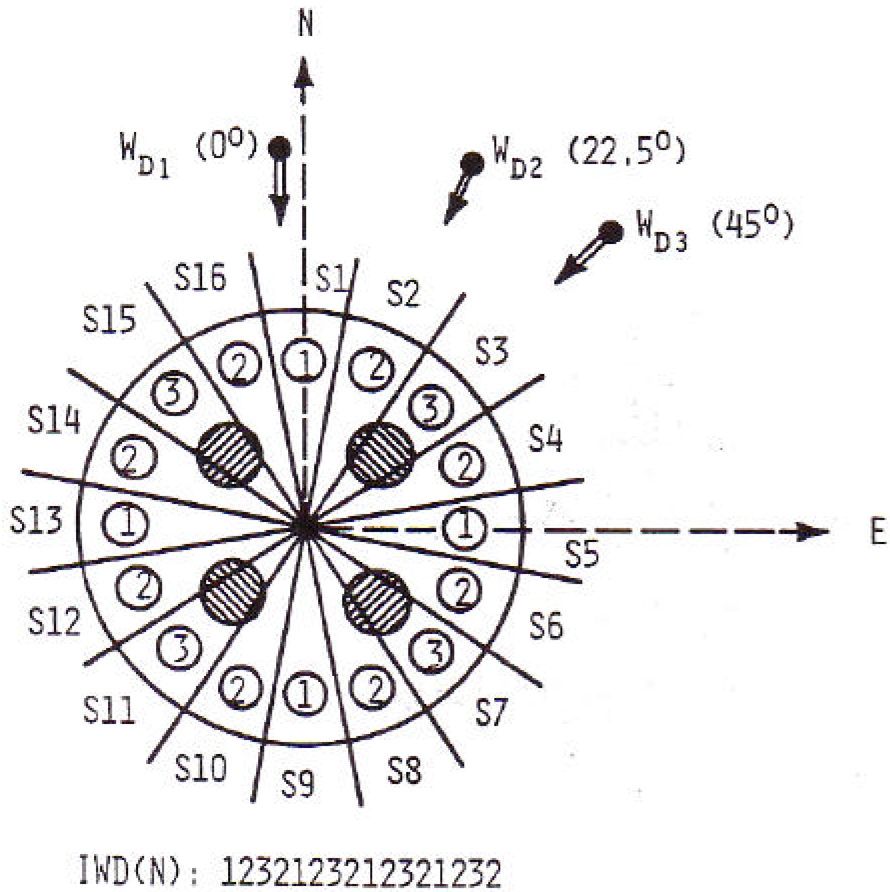
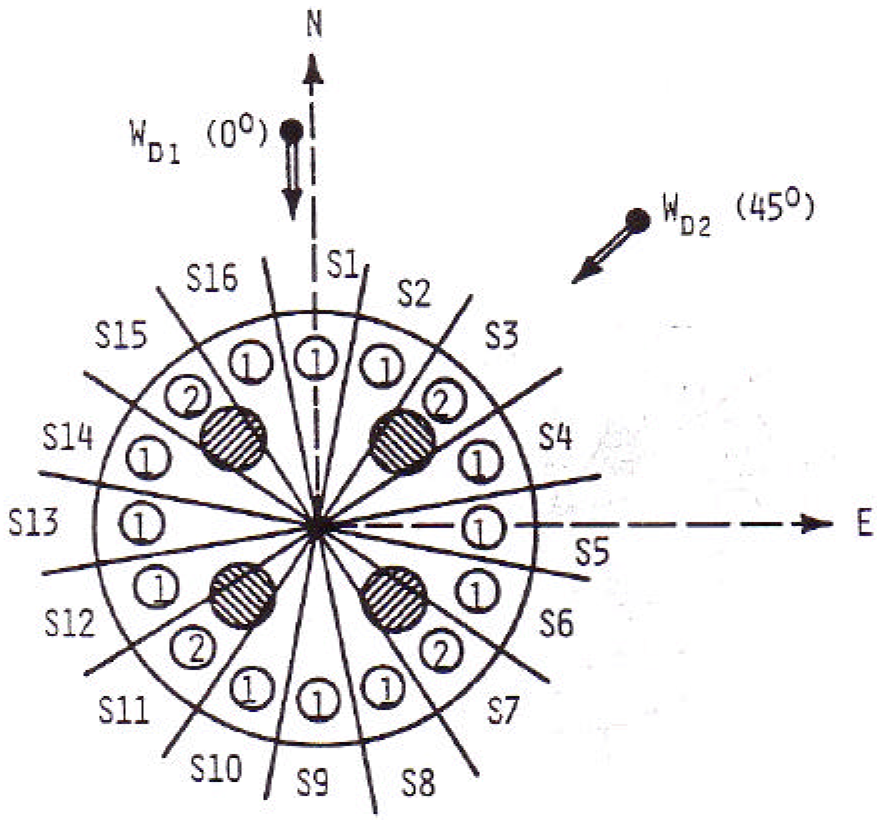


FIGURE C-1. Selection of three standard wind directions and the IWD-array for a site with four NDCTs or CMDCTs arranged in a square with sides oriented north-south and east-west



IWD(N): 1121112111211121

FIGURE C-2. Selection of two standard wind directions and the IWD-array for a site with four NDCTs or CMDCTs arranged in a square with sides oriented north-south and east-west

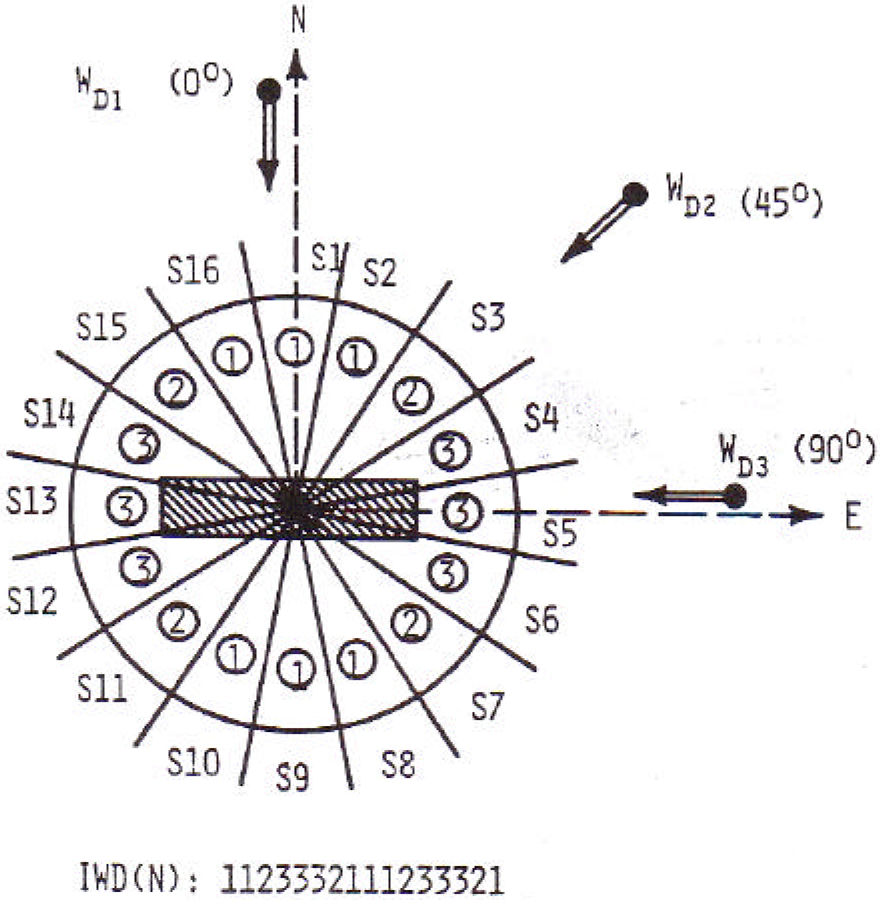
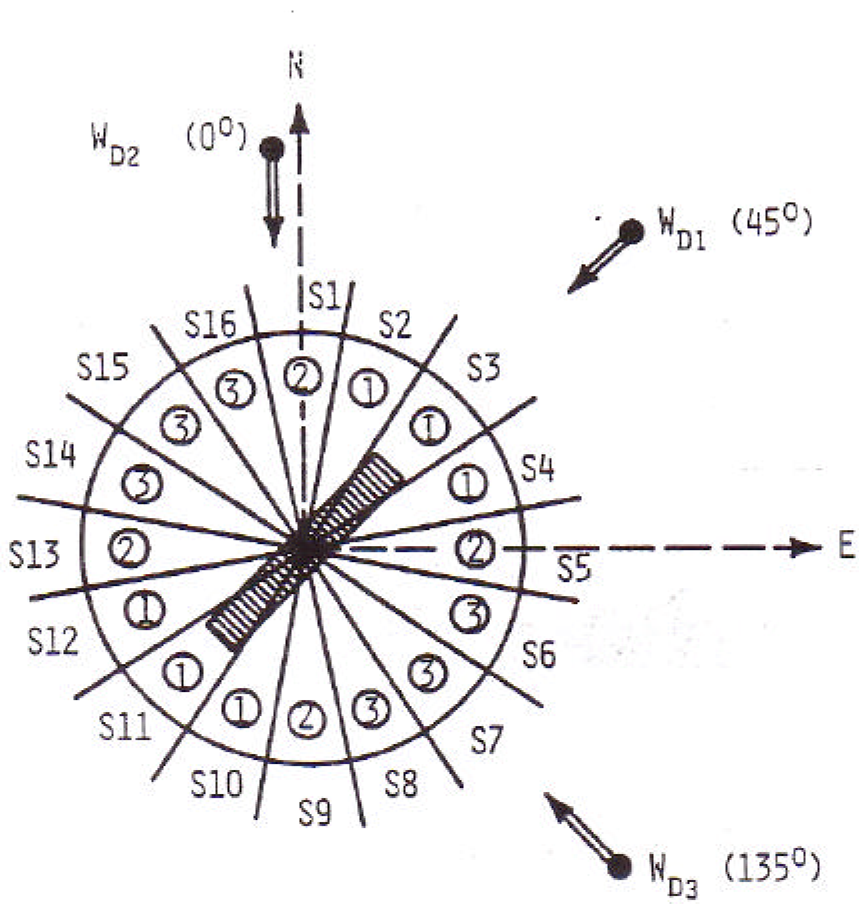
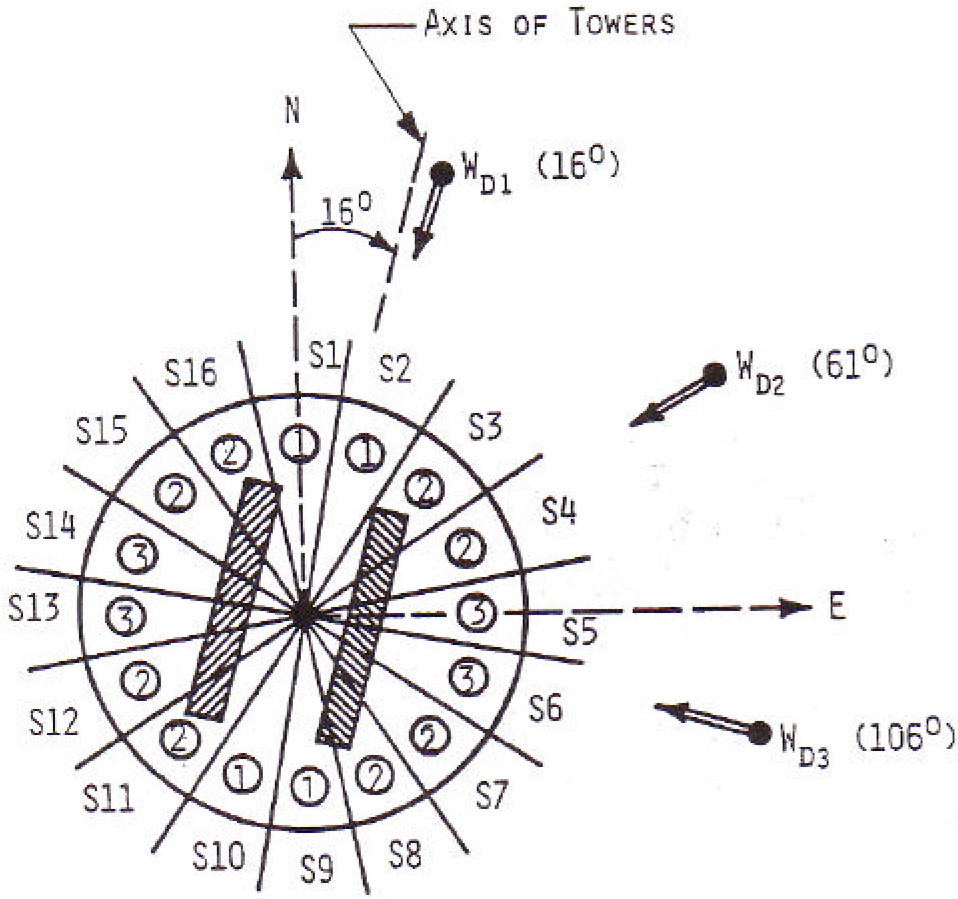


FIGURE C-3. Selection of three standard wind directions and the IWD-array for a single LMDCT oriented with its long axis along an east-west direction



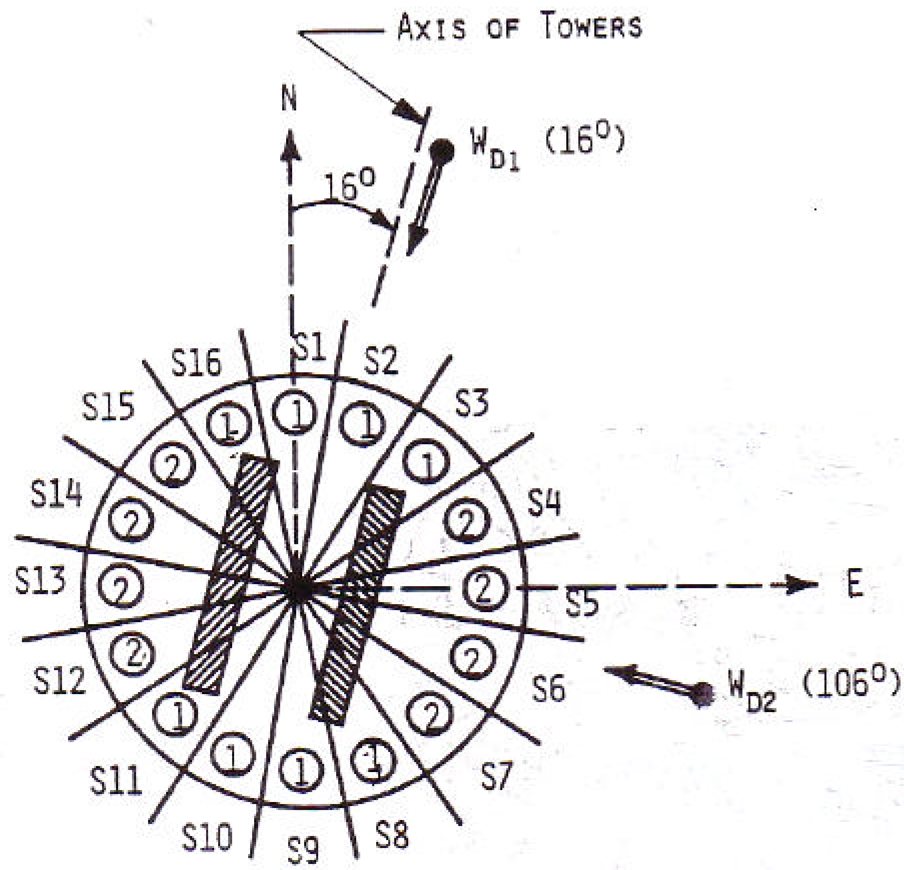
IWD(N): 2111233321112333

FIGURE C-4. Selection of three standard wind directions and the IWD-array for a single LMDCT oriented with its long axis along a NE-SW direction



IWD(N): 1122332211223322

FIGURE C-5. Selection of three standard wind directions and the IWD-array for a site with two parallel LMDCTs oriented with their long axes at an angle of 16° east of north



IWD(N): 1112222111122221

FIGURE C-6. Selection of two standard wind directions and the IWD-array for a site with two parallel LMDCTs with their long axes at an angle of 16° east of north