Justification for the Decommissioning of the Clinton Power Station Back-up Meteorological Monitoring Tower.

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Abstract: The Clinton Power Station is required by the Nuclear Regulatory Commission to monitor instantaneous and time averaged meteorological conditions. The Clinton Power Station currently has a primary meteorological monitoring tower and a back-up meteorological monitoring tower. Clinton is seeking relief to a previous commitment to regulatory quality by seeking the elimination of the back-up meteorological monitoring tower, specifically the abandonment or removal of the 10 meter wind speed and 10 meter wind direction sensors which provide a sigma theta stability classification. Murray and Trettel, Inc., consulting meteorologists, were asked by the Clinton Power Station to justify the decommissioning of the back-up meteorological monitoring tower.

INTRODUCTION: The Amergen, Clinton Power Station, owned and operated by Exelon Nuclear, currently meets it's Nuclear Regulatory Commission requirement to monitor site specific meteorological conditions by utilizing a 60 meter guyed tower located approximately 0.5 miles south-southeast from the plant reactor building.

Site Instrumentation and Data Acquisition:

Wind speed and direction are measured with Climatronics F460 wind sensors. The wind speed sensors have a starting speed of 0.5 mph (0.22 mps), a range of 0 to 100 mph (0 to 44.7 mps), and a system accuracy of ±1.0 mph at 100 mph (±0.45 mps at 44.7 mps). The wind direction sensors have a threshold speed of 0.5 mph (0.22 mps), a range of 0 to 540°, and a system accuracy of ±5°.

Ambient and differential temperatures are measured with the Climatronics 100093 system. Ambient temperature is measured within the range of -20 to 110°F (-28.9 to 43.3°C) with an accuracy of ±0.5°F (+0.3°C). Differential temperature is measured within the range of –5.4 to 12.6°F (-3.0 to 7.0°C) with an accuracy of ±0.18°F (±0.10°C). Dew point temperature is measured with the Climatronics 101197 system. Dew point temperature is measured with the range of -20 to 110°F (-28.9 to 43.3°C) with an accuracy of ±2.7°F (1.5°C).

Precipitation is measured with an MRI model 302 tipping bucket rain gauge and is measured in increments of one one-hundredth of an inch with a system accuracy of ±0.01" (±0.25mm).

Instrument types and locations are summarized in Table 1.

The meteorological data are collected and stored by an ESC 8816 Data Logger. The ESC 8816 measures the analog voltages of the instruments and records the digital equivalent within the range of 0 to +10 volts. Data are obtained from the ESC 8816 by a direct dial telephone hookup to an in-house computer system. Data are sampled every second.

As a backup to the ESC, data are also recorded with a Johnson Yokogawa Corp. digital recorder (JYC DA100 data acquisition unit and Contec IPC-PT/M300(PC)WOU PC). Data are sampled every 10 seconds.

Data loggers are summarized in Table 2

Table 1

Instrument Locations

Measurement	Sensor Type	Location	Elevation
Wind Speed	Climatronics 100075 F460	Tower	60 m
Wind Direction	Climatronics 100076 F460	Tower	60 m
Ambient Temperature	Climatronics 100093	Tower	60 m
Differential Temperature	Climatronics 100093	Tower	60 m
Wind Speed	Climatronics 100075 F460	Tower	10 m
Wind Direction	Climatronics 100076 F460	Tower	10 m
Ambient Temperature	Climatronics 100093	Tower	10 m
Dew Point Temperature	Climatronics 1001197	Tower	10 m
Precipitation	MRI 302 Tipping Bucket	Ground	3 ft.

Table 2

Data Loggers

Measurement	Logger Type	Sampling Frequency
Winds, Temperatures, and Precipitation	ESC 8816 Data Logger	1 sec.
Winds, Temperatures, and Precipitation	Johnson Yokogawa Corp. Digital Recorder (JYC DA100 and Contec IPC-PT/M300(PC)WOU) digital recorder	10 sec.

Data Analysis:

Hourly values of wind speed, wind direction, ambient temperature, differential temperature, dew point temperature, and precipitation are obtained through measurements taken at the site. The standard deviation of wind direction (sigma) is derived. The wind direction variation is described in terms of the standard deviation of the direction about the mean direction. The ESC computes an hourly value of wind sigma by taking the Root-Mean-Square (RMS) of the four quarter-hour wind sigma values. The quarter-hour wind sigma values are calculated directly from the one second wind direction samples during the 15 minute period.

The data base files are edited approximately once a week. Missing ESC values are replaced with digital recorder values, when available. Invalid data are deleted from the data base.

When an hourly value is missing or invalid, the numeral 999 is entered into the computer data file in the appropriate location. When the wind direction changes substantially relative to its short term fluctuations, the numeral 888 can be entered into the wind sigma location to indicate shifting winds. When the wind blows with velocities near the sensing threshold of the instrument, the numeral 777 can be entered into the wind direction, wind speed, and wind sigma locations to indicate light and variable winds.

A back-up meteorological monitoring tower is located closer to the plant than the primary tower. The back-up tower is located 0.3 miles to the Northeast of the plant. The back-up tower measures the following parameters:

10 meter wind speed with a Met One 1564B sensor
10 meter wind direction with a Met One 1565C sensor
10 meter sigma theta

The above sensors are aging and it is becoming more difficult to obtain spare parts.

In the event that data from the primary tower was unavailable to the control room or the Emergency Preparedness Department, the wind speed and wind direction from the backup tower would be utilized to estimate horizontal dispersion and the sigma theta would be utilized to estimate atmospheric stability.

In a memo dated February 21, 1997, the Clinton Power Station sought relief to a previous commitment to regulatory quality by seeking the elimination of the back-up meteorological monitoring tower, specifically focusing on the abandonment or removal of the 10 meter wind speed and 10 meter wind direction sensors, which result in a sigma theta value utilized to estimate atmospheric stability.

The NRC Emergency Preparedness Plan review for Region III was contacted. It was determined that the four (4) criteria below would be required before Clinton could convince the NRC that it was acceptable to delete the function of the Clinton back-up tower.

1. The primary meteorological monitoring tower would have to be evaluated to determine that it is being maintained and calibrated in accordance with ANSI standards. Also, the data retrieved would be proven to be valid and representative of current conditions at the time.
2. Arrangements need to be in place and personnel on shift trained to be able to quickly retrieve a source of backup meteorological data.
3. A statistical study or evaluation would need to be done proving the backup source of meteorological data (National Weather Service data from Lincoln, Bloomington, Decatur and Champaign) is representative of the dispersion meteorology of the 10 miles Emergency Preparedness Zone (EPZ).
4. The change must be shown not to decrease the effectiveness of the Emergency Plan.

The Clinton Power Station requested Murray and Trettel, Inc. focus on item three (3) in performing the statistical study and data gathering evaluation. The study/evaluation was to address the following attributes:

1. Two (2) years of historical data collection for comparison (2005 and 2006) from the Clinton primary meteorological monitoring tower.

2. Data collected should represent National Weather Service data from Lincoln, Bloomington, Decatur and Champaign, Illinois for the years 2005 and 2006. The respective dispersion meteorology for the four locations above should be compared relative to data from the Clinton primary meteorological monitoring tower.
3. A professional position paper summarizing the data collection and the graphic representation resulting in a professional recommendation.

Data is collected from the ESC 8816 data logger each morning via modem. An in house computer program flags data for manual review. Some data that may be flagged includes lower level wind speed exceeding upper level wind speed, a greater than expected increase of wind speed with height, a large variation in wind direction between the upper and lower levels, sigma theta values greater than or equal to 50, temperature values higher or lower than expected based upon time of year, a rapid increase or decrease in temperature between consecutive hours, delta T values higher or lower than expected based upon time of day, etc. At least two meteorologists manually review the data each day as a means of quality assurance. If data are determined to be erroneous, the field services manager is notified and a maintenance team may be dispatched to perform maintenance on the meteorological monitoring system.

Another means of reviewing the data is to compare meteorological trends (temperature, wind speed, wind direction) with a nearby National Weather Service site (or sites).

The meteorological monitoring system on the primary tower at Clinton is calibrated every four months.

The primary meteorological data points from the primary meteorological monitoring tower utilized in the event of an accidental release or in an emergency required to determine atmospheric dispersion are the 10 meter wind speed, 10 meter wind direction and the change in temperature with height (Delta T) between the 60 meter temperature and the 10 meter temperature.

The following are the valid data recovery percentages for the three primary data points for the years 2005, 2006 and year to date 2007 (through July):

Parameter	2005	2006	2007 (through July)
10 meter wind speed	98.5%	99.6%	99.7%
10 meter wind direction	98.6%	99.0%	99.7%
60-10 meter temperature (Delta T)	99.5%	99.3%	98.8%
Joint Frequency	97.4%	98.7%	98.8%

Nuclear Regulatory Commission Regulatory Guide 1.23, Revision 1, dated March 2007 states that “Meteorological instruments should be inspected and serviced at a frequency that will insure data recovery of at least 90 percent on an annual basis. The 90-percent rate applies to the composite of all variables (e.g., the joint frequency distribution of wind speed, wind direction, stability class) needed to model atmospheric dispersion for each potential release pathway.”

The above valid data recovery percentages clearly exceed the NRC requirements as stated in Regulatory Guide 1.23, Revision 1.

Hourly meteorological data for the years 2005 and 2006 were obtained for the following locations:

1. Clinton Power Station, Clinton, Illinois
2. Central Illinois Regional Airport, Bloomington, Illinois
3. Decatur Airport, Decatur, Illinois
4. Logan County Airport, Lincoln, Illinois
5. University of Illinois, Willard Airport, Champaign, Illinois
6. Braidwood Power Station, Braidwood, Braceville, Illinois
7. Dresden Nuclear Power Station, Morris, Illinois
8. LaSalle County Nuclear Power Station, Marseilles, Illinois

Distance From/To

Clinton	Bloomington	22.1
Clinton	Decatur	23.5
Clinton	Lincoln	28.0
Clinton	Champaign	29.1
Clinton	LaSalle	74.3
Clinton	Braidwood	80.4
Clinton	Dresden	88.4

Data from Braidwood, Clinton, Dresden and LaSalle were obtained from databases maintained for Exelon Nuclear by Murray and Trettel, Inc.

Data from Bloomington, Champaign, Decatur and Lincoln were obtained from the Midwestern Regional Climate Center of the Illinois State Water Survey, Champaign, Illinois.

Wind tables were derived from wind speed and wind direction data from all of the above locations with the exception of LaSalle (whose average wind speed exceeds all other location and would produce greater dispersion characteristics). The 10 meter wind speed and wind direction data from Clinton, Braidwood, Dresden and LaSalle were utilized to produce wind tables. Wind is measured at 10 meters at the four airport locations (Bloomington, Champaign, Decatur and Lincoln).

Hourly stability classifications were determined for each of the nuclear facilities (Braidwood, Clinton, Decatur and LaSalle) based upon the change of temperature with height (Delta T). The values stored in the database are actual change in temperature with height (degrees Fahrenheit over the distance between the upper temperature and the lower temperature). In order to determine a stability class, a conversion from degrees Fahrenheit over the distance between temperature sensors to degrees Celsius per 100 meters was performed. Delta T is measured to two levels on the Dresden and LaSalle meteorological monitoring towers and one level at Clinton and Braidwood.

The following are the heights of measurement of the change of temperature with height for each of the nuclear facilities:

	Lower Level	Upper Level	Difference
Clinton	10.0m (32.81 feet)	60m (197 feet)	50.0m (164 feet)
Braidwood	9.15m (30 feet)	61.915m (203 feet)	53.765m (173 feet)
Dresden (Mid)	10.675m (35 feet)	45.75m (150 feet)	35.075m (125 feet)
Dresden (Upper)	10.675m (35 feet)	91.50m (300 feet)	80.825m (265 feet)
LaSalle (Mid)	10.065m (33 feet)	61.00m (200 feet)	50.935m (167 feet)
LaSalle (Upper)	10.065m (33 feet)	114.375m (375 feet)	104.31m (342 feet)

In order to convert the change in temperature (in degrees Fahrenheit) between the upper level and lower (or in the case of Dresden and LaSalle also the mid level) per distance in feet to degrees Celsius per 100 meters, one must find the multiple to convert height to 100 meters. In the case of Clinton, the difference in height between the lower and upper level temperature measurements is 50 meters. 50 meters must be multiplied by 2 to get to 100 meters. The temperature ration of Celsius to Fahrenheit is 5/9 (.5555).

The following are the conversions for the above towers to convert the change in temperature with height (in Fahrenheit and feet) to the Lapse Rate in degrees Celsius per 100 meters:

Clinton:	2 X .5555 = 1.111
Braidwood:	1.895 X .5555 = 1.053
Dresden (Mid):	2.851 X .5555 = 1.584
Dresden (Upper):	1.237 X .5555 = 0.687
LaSalle (Mid):	1.963 X .5555 = 1.090
LaSalle (Upper):	1.043 X .5555 = 0.533

For example, a tower measurement Delta Temperature of -2.0 degrees Fahrenheit between the upper and lower level on the Clinton meteorological monitoring tower (164 foot height differential between levels) would yield the following results:

-2.0 X (2 X .5555) = -2.0 X 1.111 = a lapse rate of -2.22 Celsius per 100 meters which would correspond to a Pasquill Stability Category of A (Extremely Unstable) based upon Table 1, Classification of Atmospheric Stability on page 8 of Revision 1 of Regulatory Guide 1.23, dated March 2007 (see table below).

Table 5

Atmospheric Stability Classes

Class	Differential Temperature Interval (in ^{0}C/100m) (1)	Differential Temperature Interval (in °F over the 60-10 m interval) (2)
Extremely Unstable	$\Delta T \leq -1.9$	$\Delta T \leq -1.8$
Moderately Unstable	$-1.9 < \Delta T \leq -1.7$	$-1.8 < \Delta T \leq -1.6$
Slightly Unstable	$-1.7 < \Delta T \leq -1.5$	$-1.6 < \Delta T \leq -1.4$
Neutral	$-1.5 < \Delta T \leq -0.5$	$-1.4 < \Delta T \leq -0.5$
Slightly Stable	$-0.5 < \Delta T \leq 1.5$	$-0.5 < \Delta T \leq 1.3$
Moderately Stable	$1.5 < \Delta T \leq 4.0$	$1.3 < \Delta T \leq 3.7$
Extremely Stable	$4.0 < \Delta T$	$3.7 < \Delta T$

Hourly stability classes were calculated based upon computed lapse rates for all four nuclear facilities (Braidwood, Clinton, Dresden and LaSalle). Stability classes were determined for both the middle and upper levels at Dresden and LaSalle.

The hourly stability classes for all nuclear plants and all available levels were compared to Clinton. The number of hours that the stability class at a given facility matched that calculated for Clinton were totaled as well as the absolute difference in stability classes between Clinton and the other plants. The hourly stability class for each level at each site was assigned a numeric value as follows:

Stability Classification	Pasquill Stability Category	Numeric Equivalent
Extremely Unstable	A	1
Moderately Unstable	B	2
Slightly Unstable	C	3
Neutral	D	4
Slightly Stable	E	5
Moderately Stable	F	6
Extremely Stable	G	7

Stability Class was also estimated for Clinton based upon the hourly Sigma Theta (standard deviation of horizontal wind direction fluctuation over a period of 15 minutes to 1 hour) values from both the upper and lower level of the tower. Sigma Theta is a parameter that is recorded and archived for each hour as measured on the Clinton primary meteorological monitoring tower.

The following is a classification of atmospheric stability determined by Sigma Theta as found in Table 3 of the Proposed Revision 1 to NRC Regulatory Guide 1.23, dated September, 1980:

CLASSIFICATION OF ATMOSPHERIC STABILITY
BY SIGMA THETA

Stability Classification	Pasquill Categories	Sigma Theta (degrees)
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Extremely unstable	A	Sigma >=22.5
Moderately unstable	B	22.5>Sigma>=17.5
Slightly unstable	C	17.5>Sigma>=12.5
Neutral	D	12.5>Sigma>=7.5
Slightly stable	E	7.5>Sigma>=3.8
Moderately stable	F	3.8>Sigma>=2.1
Extremely stable	G	2.1>Sigma

Hourly stability classes were determined for the primary meteorological monitoring tower based upon the hourly lower and upper sigma theta values. The hourly stability classifications were compared to those derived from the stability classifications determined from the Delta Temperature from the Clinton meteorological monitoring tower.

Hourly observations from the Decatur Airport in Decatur, Illinois and the University of Illinois, Willard Airport in Champaign, Illinois were used to estimate hourly stability class.

The following table provides a means to estimate stability class by utilizing four variables: wind speed, cloud cover, season and time of day. This table is utilized at Clinton in the event that data from the primary meteorological monitoring tower becomes unavailable.

Table 1-1
Stability Class Determination

Surface Wind Speed (mph)	Daytime Solar Radiation				Nighttime Conditions		
	For moderate cloud cover move one column to the right			Heavy Overcast Rain	Thin overcast (>1/2 cloud cover)	< 3/8 cloud cover	Heavy Overcast Rain
	Summer Clear Sky	Spring/Fall Clear Sky	Winter Clear Sky				
< 9.0	A	A-B	B	D	F	G	D
9.0	A-B	B	C	D	E	F	D
to 13.5	B	B-C	C	D	D	E	D
> 13.5	C	C-D	D	D	D	D	D

Only observations that were taken at the top of each hour at each airport were utilized. Special observations recorded between the hours were not considered. The observations included a wind speed and cloud cover for up to three atmospheric cloud base heights. If any of the three cloud base heights indicated OVC (overcast) or VV (vertical visibility, often lowered by obscurations such as fog), the sky was considered overcast. If one, two or all three cloud base heights indicated the sky was clear (CLR), had few (FEW) or scattered (SCT) clouds, the sky was considered clear. If none of the three cloud base sky coverage indicators were overcast but at least one was considered broken (BKN), the cloud cover was considered moderate.

Seasons were broken out as follows:

Winter – December, January, February
Spring – March, April, May
Summer – June, July, August
Fall – September, October, November

Utilizing a sunrise/sunset table generated from the United States Naval Observatory web site, the following conventions were used to define daytime by season:

Winter – 8 a.m. to 4 p.m.
Spring – 6 a.m. to 6 a.m.
Summer – 6 a.m. to 8 p.m.
Fall – 6 a.m. to 5 p.m.

The above times were used to roughly estimate the day/night division on a seasonal basis.

A stability classification was determined for each hour using the above conventions for determining cloud cover, season and whether an hour occurred during the daytime or nighttime, in combination with the wind speed.

Wind Classifications

Hourly wind data from the Braidwood, Clinton, and Dresden nuclear plants as well as the airports in Bloomington, Champaign, Decatur and Lincoln, Illinois were obtained. Only hourly observations from the airports were utilized and special observations (observations taken between hours to indicate changing weather) were eliminated from the databases. Each hourly airport observations provided a wind speed and a wind direction. Wind speed data from the nuclear facilities provides an hourly average wind speed (based upon 3600 one second observations per hour) while the airport data provides an average speed based upon the two minutes prior to the time of the observation.

The airport wind direction data provides direction rounded to tens of degrees (i.e. 360 is north and coded 36, 90 is east and coded 09, 180 is south and coded 18, etc.). Wind direction data from the nuclear facilities is archived in whole degrees.

Wind direction classes are based upon the following:

Wind Direction Classes

IF	348.75°	<	WD	≤	11.25°	THEN	Class is	N
IF	11.25°	<	WD	≤	33.75°	THEN	Class is	NNE
IF	33.75°	<	WD	≤	56.25°	THEN	Class is	NE
IF	56.25°	<	WD	≤	78.75°	THEN	Class is	ENE
IF	78.75°	<	WD	≤	101.25°	THEN	Class is	E
IF	101.25°	<	WD	≤	123.75°	THEN	Class is	ESE
IF	123.75°	<	WD	≤	146.25°	THEN	Class is	SE
IF	146.25°	<	WD	≤	168.75°	THEN	Class is	SSE
IF	168.75°	<	WD	≤	191.25°	THEN	Class is	S
IF	191.25°	<	WD	≤	213.75°	THEN	Class is	SSW
IF	213.75°	<	WD	≤	236.25°	THEN	Class is	SW
IF	236.25°	<	WD	≤	258.75°	THEN	Class is	WSW
IF	258.75°	<	WD	≤	281.25°	THEN	Class is	W
IF	281.25°	<	WD	≤	303.75°	THEN	Class is	WNW
IF	303.75°	<	WD	≤	326.25°	THEN	Class is	NW
IF	326.25°	<	WD	≤	348.75°	THEN	Class is	NNW

Wind tables based upon hourly wind speed and wind direction values were produced for 7 locations (Braidwood, Clinton, Dresden, Bloomington, Champaign, Decatur and Lincoln). See appendix for examples.

CLINTON'S CURRENT STBILITY CLASS DETERMINATION IN AN EMERGENCY:

In the event of an emergency at the Clinton Power Station, the following priority list is used by the facility to determine the atmospheric stability:

1. Primary Meteorological Monitoring Tower (determined from Delta T)
2. Back-up Meteorological Monitoring Tower (determined from Sigma Theta)
3. National Weather Service – Lincoln, Illinois
4. Dresden Nuclear Power Station
5. Local Airports
6. Murray and Trettel

Information obtained from the National Weather Service Forecast Office in Lincoln, Illinois would include wind speed, wind direction and cloud cover. Table 1-1 on the previous page would then be utilized to estimate a stability class.

Delta T would be obtained from the Dresden Nuclear Power Station. The delta T would be utilized to determine a stability class.

Wind speed, wind direction and cloud cover can be obtained from local airports (located in or near Bloomington, Champaign, Decatur and Lincoln. Bloomington is north of the Clinton Power Station, Champaign is east, Decatur is south and Lincoln is west.

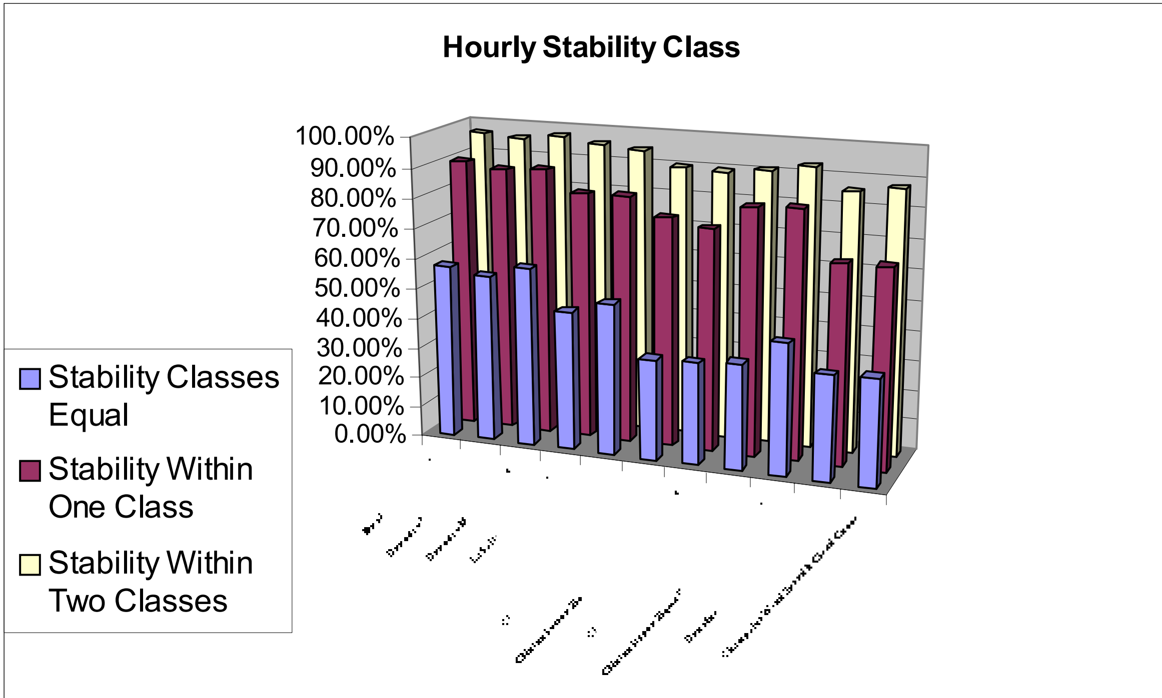
The following automated observation phone numbers could be used in order to retrieve wind speed, wind direction and cloud cover information from the four regional airports:

Champaign	217-352-9118
Decatur	217-429-0052
Bloomington	309-661-9478
Lincoln	217-732-9605

RESULTS:

Stability Class

The stability class determined from the Delta Temperature on the Clinton primary meteorological monitoring tower was compared to several other locations utilizing three separate means of determining stability. The following graph and table provide the percentage of hours from January 2005 through December 2006 when the calculated stability class was equivalent, varied by one stability class or varied by two stability classes from the stability determined from Clinton's Delta Temperature value:



	Braidwood Delta-T	Dresden Lower Delta-T	Dresden Upper Delta-T	LaSalle Lower Delta-T	LaSalle Upper Delta-T	Clinton Lower Sigma Safety Guide 23	Clinton Lower Sigma RG 1.23 Proposed Rev 1	Clinton Upper Sigma Safety Guide 23	Clinton Upper Sigma RG 1.23 Proposed Rev 1	Decatur Wind Speed & Cloud Cover	Champaign Wind Speed & Cloud Cover
Stability Classes Equal	57.50%	55.50%	59.20%	46.30%	50.30%	33.30%	33.90%	34.90%	43.20%	34.60%	35.30%
Stability Within One Class	89.60%	87.80%	88.80%	81.90%	82.00%	76.10%	73.60%	81.60%	82.20%	66.10%	66.10%
Stability Within Two Classes	96.80%	95.70%	97.20%	95.50%	94.30%	89.60%	89.10%	90.60%	92.60%	85.80%	87.70%

The delta T values from the three closest nuclear facilities produced the five highest percentages for matching Clinton's hourly stability class determined from the change in temperature with height (delta T) from Clinton's primary meteorological monitoring tower.

The Clinton primary tower stability class determined from the delta T least frequently matched the stability class determined from the primary tower sigma theta. The stability class that would currently be utilized if the primary meteorological monitoring tower was inoperable is based upon the sigma theta measured at the Clinton back-up meteorological monitoring tower. Sigma theta data from the Clinton back-up tower was not available for this study. The purpose of a back-up tower would be to provide similar meteorological values to the primary tower. Stability values based upon sigma theta do not correlate well with stability values determined from the change in temperature with height (delta T) on the primary tower.

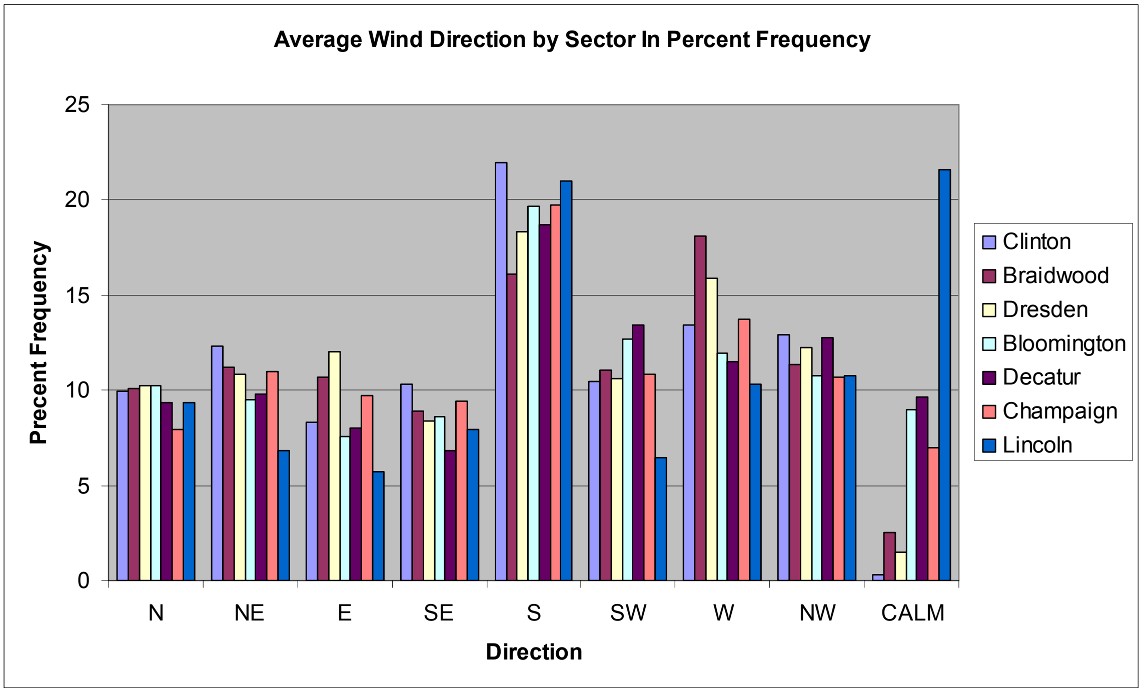
Wind Classification:

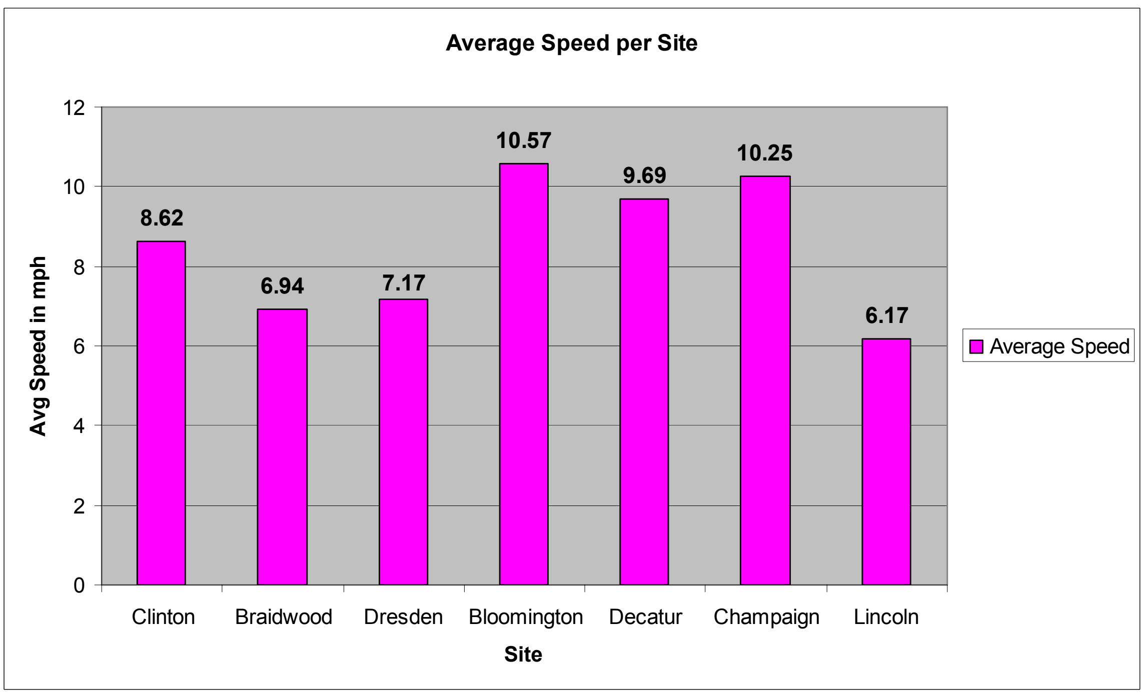
Ten meter wind speed and direction data was obtained from the Clinton, Braidwood and Dresden nuclear power stations. Wind data was also obtained from local airports within 30 miles of the Clinton Power Station. Those airports included the Central Illinois Regional Airport in Bloomington, Illinois, the University of Illinois, Willard Airport, in Champaign, Illinois, the Decatur Airport in Decatur, Illinois and the Logan County Airport in Lincoln, Illinois.

Wind directions were initially put into thirty-six 10 degree categories. From those 36 wind direction categories, the directions were then combined into 8 direction categories. Wind speeds were put into 10 speed categories, one of which was calm.

Average Wind Direction by Sector In Percent Frequency

	Clinton	Braidwood	Dresden	Bloomington	Decatur	Champaign	Lincoln
N	9.95	10.09	10.24	10.25	9.32	7.97	9.35
NE	12.35	11.21	10.86	9.51	9.79	11.01	6.8
E	8.33	10.68	12.01	7.6	8.04	9.71	5.71
SE	10.33	8.9	8.39	8.62	6.83	9.43	7.94
S	21.93	16.07	18.33	19.68	18.67	19.77	21
SW	10.45	11.02	10.61	12.66	13.42	10.83	6.48
W	13.43	18.13	15.84	11.94	11.52	13.69	10.29
NW	12.9	11.33	12.23	10.77	12.76	10.66	10.79
CALM	0.31	2.55	1.45	8.99	9.65	6.94	21.62





In a simplified ranking scheme, the percentage of occurrence for each of the 8 wind direction categories for the six sites (2 nuclear facilities and 4 airports), were ranked by difference in percentage when compared to the percentage of occurrence for those directions from the Clinton primary meteorological monitoring tower. Wind speed was similarly ranked.

The ranking for each direction category was totaled and a final rank was calculated with the lowest total ranking number having the greatest correlation.

Total wind direction ranking had the same weight as the wind speed ranking. The final ranking for each site combined the final direction ranking and the speed ranking.

The table below illustrates each site's ranking.

RANKING ACCORDING TO PERCENTAGE OF OCCURRENCE WHEN COMPARED TO CLINTON

Direction	Braidwood	Dresden	Bloomington	Champaign	Decatur	Lincoln
N	1	2	3	6	5	4
NE	1	3	5	2	4	6
E	4	6	2	3	1	5
SE	2	4	3	1	6	5
S	6	5	3	2	4	1
SW	3	1	4	2	5	6
W	6	4	2	1	3	5
NW	3	2	5	6	1	4
Calm	2	1	4	3	5	6
Total	28	28	31	26	34	42
Rank	T-2	T-2	4	1	5	6
Wind Speed Rank	4	2	5	3	1	6
Sum of Ranks	6	4	9	4	6	12
Final Wind Ranking	T-3	T-1	5	T-1	T-3	6

Based upon the above ranking system, wind data from Dresden and Champaign are the most consistent with that obtained from Clinton. Data from Lincoln is the least consistent with Clinton.

Hourly wind speed and wind direction data from the Clinton back-up tower was not available for this study.

CONCLUSION:

In the event of an emergency at the Clinton Power Station, the following should be used in order of preference in order to estimate wind speed, wind direction and stability (atmospheric dispersion):

1. Clinton Primary Meteorological Monitoring Tower (utilizing stability class based upon delta T plus wind speed and wind direction)
2. Dresden stability class plus the Champaign wind speed and wind direction.
3. Dresden Meteorological Monitoring Tower (utilizing the upper level stability class based upon delta T first, then the middle level stability class if upper level is not available plus wind speed and wind direction from 10 meters)
4. Braidwood Meteorological Monitoring Tower (utilizing stability class based upon delta T plus wind speed and wind direction from 10 meters)
5. Meteorological Consulting (private meteorologist or National Weather Service)

6. Clinton Back-up Meteorological Monitoring Tower (utilizing wind speed, wind direction and sigma theta to determine stability)
7. LaSalle Meteorological Monitoring Tower (utilizing the upper level stability class based upon delta T first then the middle level stability class if the upper level is not available plus wind speed and wind direction from 10 meters)
8. Champaign utilizing wind speed, wind direction and cloud cover
9. Decatur utilizing wind speed, wind direction and cloud cover
10. Bloomington utilizing wind speed, wind direction and cloud cover
11. Lincoln utilizing wind speed, wind direction and cloud cover

Currently, the Clinton back-up tower would be the first data set used if the Clinton primary tower became inoperable. Based upon the above priority list, the Clinton back-up tower is sixth in order of preference and would be lower on the list if only stability class were considered.

Revision 1 of NRC Regulatory Guide 1.23 states that "Vertical temperature difference is the preferred method for determining stability classes at nuclear power plants…" The preferred method for determining wind speeds and directions and stability class in the event of an emergency, if Clinton's primary meteorological monitoring tower is inoperable would be to get wind speed and wind direction information from Champaign and stability class from Dresden. If time is of the essence, wind speed, wind direction and stability class should be obtained from Dresden.

References

American National Standard for Determining Meteorological Information at Nuclear Facilities, ANS-3.11-2005.

NRC Safety Guide 23, Onsite Meteorological Programs, February 1972.

NRC Proposed Revision 1 to Regulatory Guide 1.23, Meteorological Programs in Support of Nuclear Power Plants, September 1980.

NRC Second Proposed Revision 1 to Regulatory Guide 1.23, Meteorological Program for Nuclear Power Plants, April 1986.

NRC Revision 1, Regulatory Guide 1.23, Meteorological Monitoring Programs for Nuclear Power Plants, March 2007.

Appendix

Wind Tables