

Tall Tower Project Final Report

**West Texas A & M University
Alternative Energy Institute**

**Ken Starcher, Director
David Carr, Research Associate**

April 2006

Tall Tower at Washburn:**Logger:**

NRG 9300 collecting 10 minute averages.

Current Status:

Logger is collecting data properly. #6 WS is intermittent.

Data Handling:

Working Computer Systems: 2 dos based systems. 2 pc's running Windows 98, Windows 2000.

Software Involved: Microsoft Excel, NRG Basestation, NRG SDR, and DOS

Backup: Monthly, cd set kept locally in office. 2nd backup kept in Computer Center Vault. Also backed up on 2 computers

Internet: Summaries, maximums, and minimums, as well as site descriptions are available at

<http://www.wtamu.edu/research/aei/data/talltower2/ttpindex.htm> which is linked to our main page at

<http://www.windenergy.org>

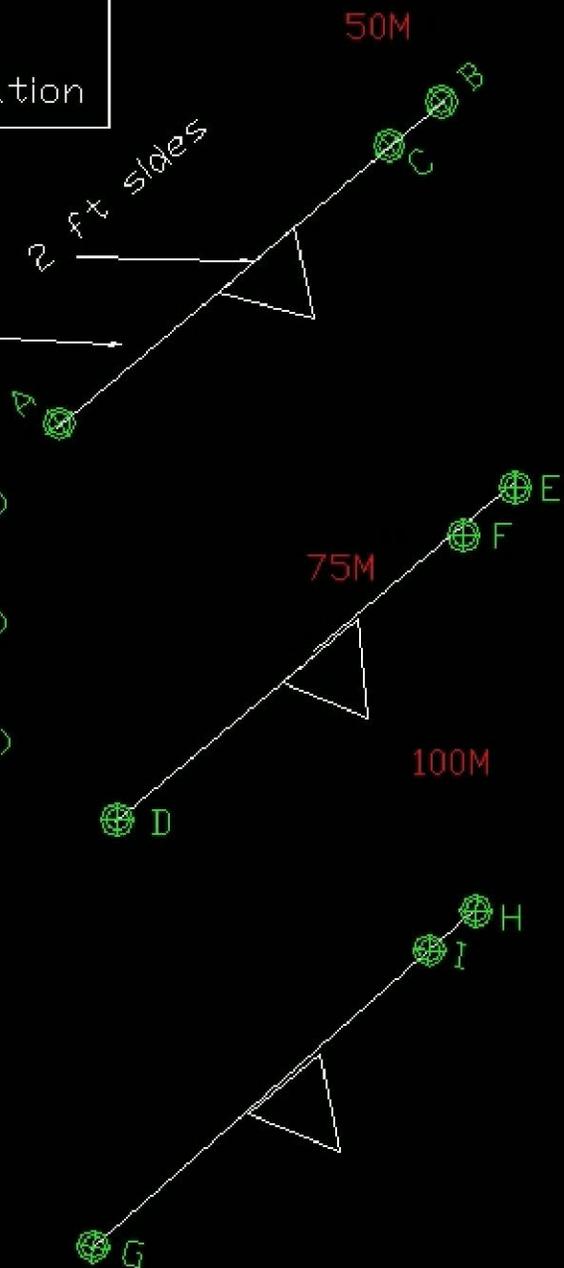
Data Sharing: Currently low detail data is shared publicly via the internet as well as in raw form to NREL in Colorado.

History of site: The Washburn site was installed on a communications tower owned by Gilvin-Terill Inc. They allowed us to utilize their tower free of charge for this research. David Carr, Kevin Hiatt, and Tae Hee Han, AEI employees, completed the installation in a period of 2 days. Anemometers & wind vanes were installed on 10 foot booms. These booms were raised up the tower by rope & pulley, then attached to the tower using hose clamps. Please refer to the installation diagram on the next page for sensor configuration:

Tall Tower North
Near Washburn Texas
Boom and Sensor Configuration

LAT LONG 35° 10.261' 101° 32.410'

Booms approx. 8 ft
from tower to tip.



- A. Calibrated WS#1(cal#49)
- B. Uncalibrated WS#2
- C. WD#1
- D. Calibrated WS#3(cal#51)
- E. Uncalibrated WS#4
- F. WD#2
- G. Calibrated WS#5(cal#50)
- H. Uncalibrated WS#6
- I. WD #3



AEI 2004

Over the two and a half year period, there have been very few repairs or problems. Following is an outline of changes or problems:

9-1-03: Installation of NRG 9300 logger & sensors.

7-8-04: Anemometer #6 was giving problems. We climbed the tower, replaced the anemometer, it seemed to fix the problems.

12-14-04: It was discovered that the 100 meter WD was somehow tracking with the 75 meter WD. A repair trip was made to discover the reason for this. The logger was reset and all connections checked out. After the logger reset, the numbers were logging correctly again. Seemed to be a glitch in the NRG hardware or software internal to the logger. We have watched closely since then and have not seen that issue again.

6-10-05: Data logger suffered a problem with lightning. Unit was checked out and seemed to be functioning correctly, but cell phone part of unit was bad. It was decided to collect the data manually.

12-1-05: After detailed analysis of the data, a problem was discovered. The #6 wind speed sensor has continued to be intermittent. However, the #5 is at the same level and in the predominant wind direction. Our data analysis should reflect winds primarily from ws #5.

Data Analysis: Data is given directly to our graduate student, now Catalina Herrera. The student then downloads the data from the 256k flash card, or from the automated call in. This data is in raw form & must be converted to text form to be used in our data analysis template (refer to appendix). It is converted with NRG software, either NRG basestation or NRG SDR. The text data is processed through the filters designed by Tae Hee Han to eliminate bad data. Then it is placed in the AEI excel template. In the meantime, the raw data is also backed up on 2 pcs in our office. Monthly, it is backup up to cd and stored in the university vault at the Computer Center on campus. Once the data is in the template, it is printed and reviewed by the Research Associate, currently David Carr. The data is then placed on the web in a much-simplified format for easy viewing. The raw data is also distributed to NREL as needed.

Tall Tower at Sweetwater:

Logger:

NRG Symphonie collecting 10 minute averages.

Status:

Calling regularly, emailing data to AEI.

Data Handling:

Working Computer Systems: 1 laptop running Windows 2000. 1 pc running Windows 98. 1 PDA running Palm OS 4, 1 PDA running Pocket PC 2000

Software Involved: Microsoft Excel, NRG Symphonie Data Retriever, Microsoft Outlook, Eudora Light for Palm OS

Backup: Email server(short term). Monthly, cd set kept locally in office. 2nd backup kept in Computer Center Vault. Summaries, maximums, and minimums, as well as site descriptions are available at

<http://www.wtamu.edu/research/aei/data/talltower1/ttpindex.htm>, which is also linked to our main page at <http://www.windenergy.org>.

History of Site: This tower is located near Sweetwater, TX and is an existing lattice tower built for communication equipment. The owner is Enterprise Electronics and through Paul Finch, they donated the space and allowed us access to the tower. David Carr, Kevin Hiatt, and Tae Hee Han installed the wind monitoring equipment on the week of May 12th, 2003. The install was successful and we had data calling in that week.

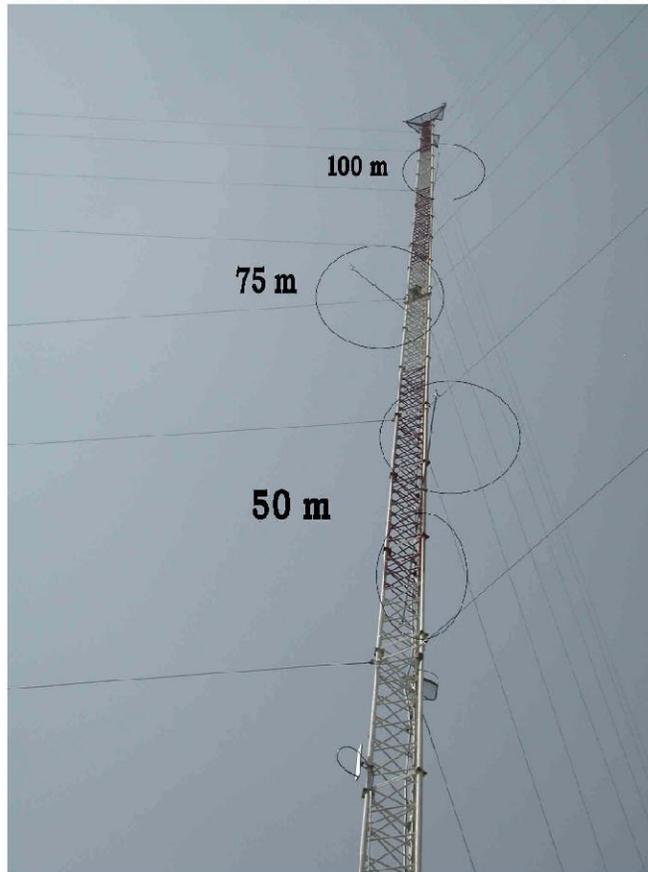


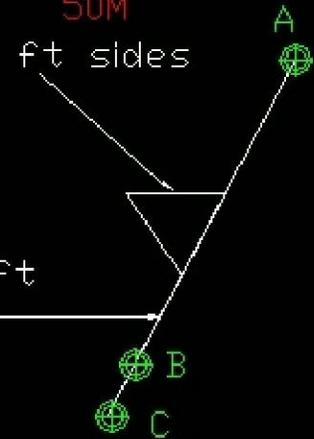
Photo of Sweetwater Booms

Tall Tower South
Near Sweetwater Texas
Boom and Sensor Configuration

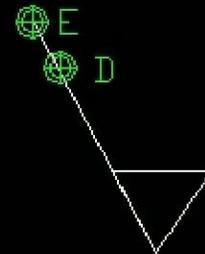
LAT LONG 32°24'42" 100°21'16"

Booms approx. 8 1/2 ft
from tower to tip.

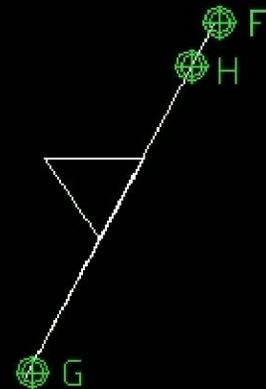
50M
2 1/2 ft sides



75M



100M



- A. Uncalibrated WS#1
- B. Calibrated WS#2(cal#48)
- C. WD#1
- D. Uncalibrated WS#3
- E. Calibrated WS#4(cal#47)
- F. WD#4
- G. Uncalibrated WS#5
- H. Calibrated WS#6(cal#46)

AEI 2004

Boom & Sensor Configuration, Sweetwater Tower

History of revisions & faults:

May 12 th & 13 th , 2003:	Installed equipment
June 1 st , 2003:	Replaced logger, 9300
December 18 th & 19 th , 2003:	Replaced logger with NRG Symphonie
June 04, 2004:	Patched logger to call on weekends
August 25 th , 2004:	Site Inspection
January 10 th , 2005:	ISP problem. Had to go to site to change email settings.
January 19 th , 20 th :	Logger replacement, recall from NRG, leap yr fix.
May 10 th , 2005:	Communications battery failure, replaced Ipack
June 22 nd , 2005:	Patched logger to include height & direction references

Data Analysis: Data is given directly to our graduate student, now Catalina Herrera. The student then downloads the data from the 16 mb mmc chip, or extracts it from the automatic email. This data is in raw form & must be converted to text form to be used in our data analysis template (refer to appendix). It is converted with NRG SDR software. The text data is processed through the filters designed by Tae Hee Han to eliminate bad data. Then it is placed in the AEI excel template. In the meantime, the raw data is also backed up on 2 pcs in our office. Monthly, it is backup up to cd and stored in the university vault at the Computer Center on campus. Once the data is in the template, it is printed and reviewed by the Research Associate, currently David Carr. The data is then placed on the web in a much-simplified format for easy viewing, and in keeping with our contract. The raw data is also distributed to NREL as needed.

Description of the AEI Data Analysis Template:

Following is the data analysis template we offer as a free download on the internet. We are offering this as an open source template.

Format:	Microsoft Excel 2000
Designed for:	Wind data, esp. NRG 9300, any will work.
Useful for:	Trend analysis, error detection, data printing, reports.

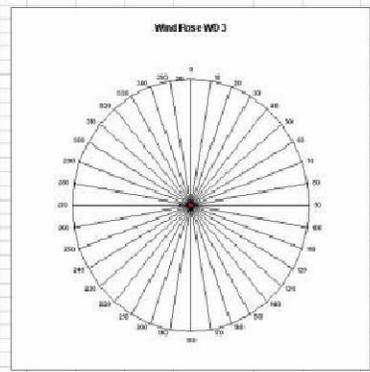
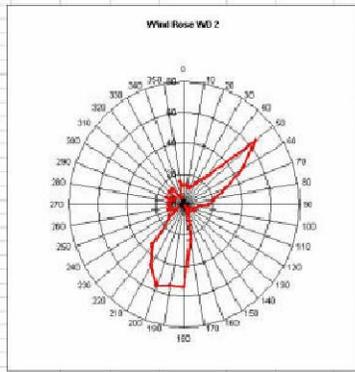
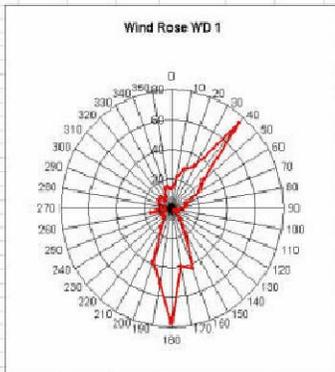
There is first a Site Information summary page. Although this may at first seem unimportant, many of the data calculations are based upon this page.

SITE INFORMATION SUMMARY				AEI-GLO DATA TEMPLATE VERSION 2.0
Enter the name, elevation, and levels of sensors. Data within spreadsheet will be based on this info.				
Site name:				
Elevation in m:				Calculate feet to meters here:
WS LEVEL 1		meters	WS1	Enter Feet <input type="text" value="0"/>
WS LEVEL 1		meters	WS2	Meters = <input type="text" value="0"/>
WS LEVEL 2		meters	WS3	
WS LEVEL 2		meters	WS4	
WS LEVEL 3		meters	WS5	
WS LEVEL 3		meters	WS6	
WS LEVEL 4		meters	WS7	
WS LEVEL 4		meters	WS8	
<i>The number below will be calculated, do not enter the number.</i>				
p for this site	1.23			
WD 1		meters	ALL DATA IN ORANGE MUST BE ENTERED. IT WILL BE UTILIZED THROUGHOUT THE TEMPLATE IN LABELS AND CALCULATIONS	
WD 2		meters		
WD 3		meters		
LAT	LONG			
This Area for notes on site visit dates, etc.				

Normally we use up to 6 anemometers on a tower and 3 wind vanes. This spreadsheet is basically geared for working with those numbers or less. It could easily be modified to

51 Tall Tower Sweetwater

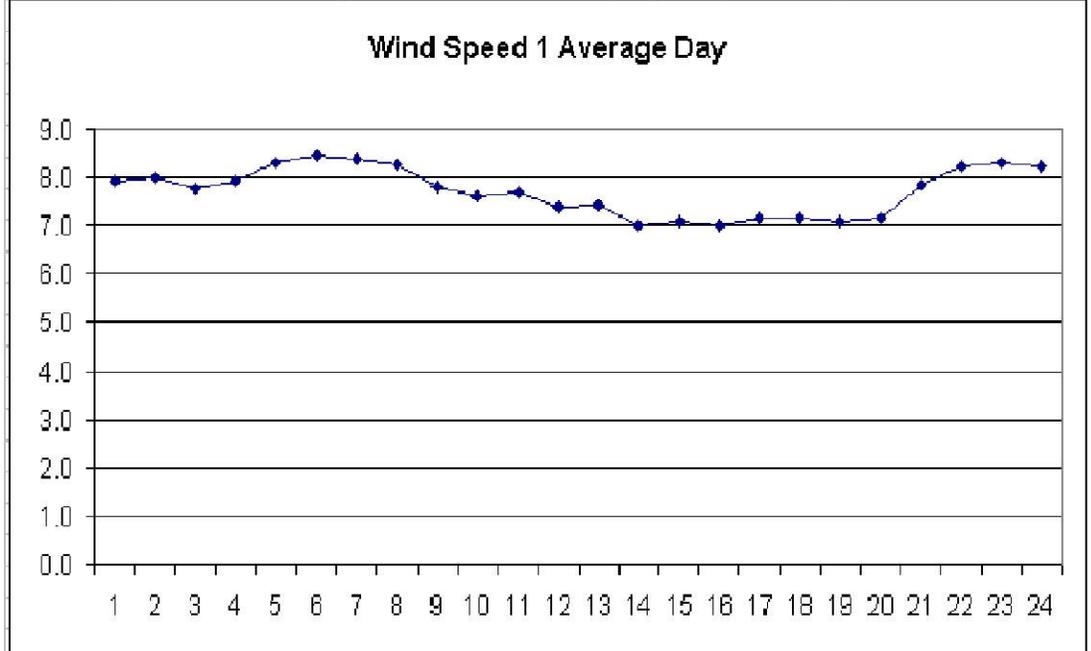
WD 1 50 meters February 04 29 Days Data WD 2 100 meters February 04 29 Days Data WD 3 not installed meters February 04 29 Days Data



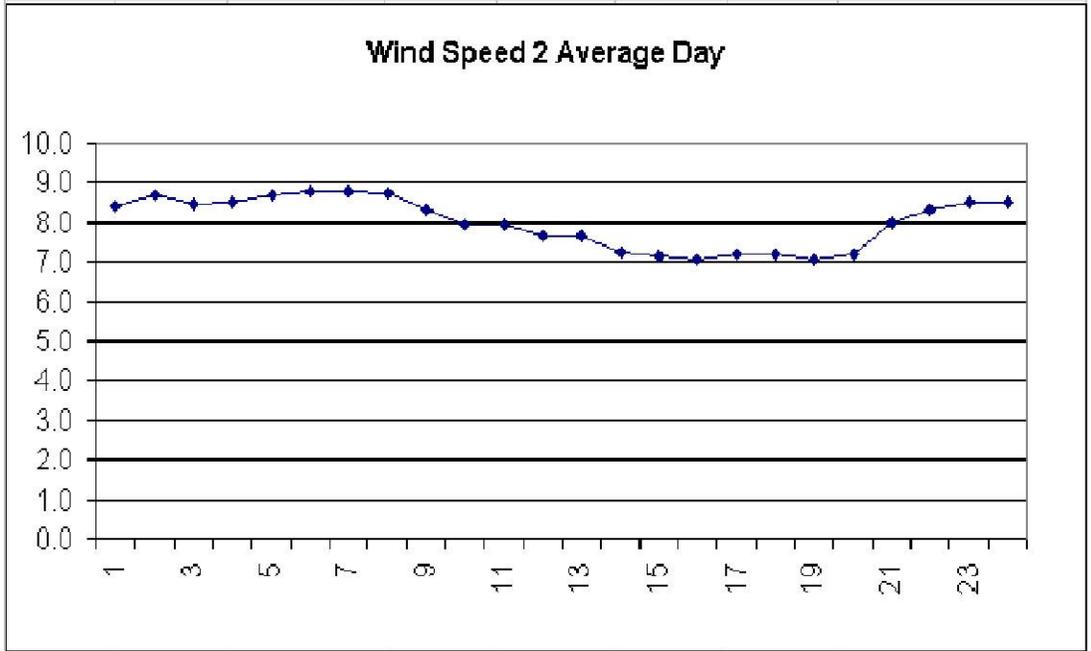
0	13	13	0	12	12	0	0	0
10	22	22	10	13	13	10	0	0
20	50	28	20	24	11	20	0	0
30	85	33	30	40	16	30	0	0
40	158	75	40	64	24	40	0	0
50	186	30	50	129	65	50	0	0
60	211	29	60	176	47	60	0	0
70	223	11	70	206	30	70	0	0
80	232	10	80	228	22	80	0	0
90	241	9	90	245	17	90	0	0
100	245	4	100	255	10	100	0	0
110	250	5	110	263	8	110	0	0
120	256	6	120	271	8	120	0	0
130	267	2	130	273	2	130	0	0
140	267	10	140	279	6	140	0	0
150	286	19	150	281	2	150	0	0
160	329	43	160	292	11	160	0	0
170	368	38	170	316	24	170	0	0
180	445	77	180	370	54	180	0	0
190	496	51	190	434	64	190	0	0
200	534	38	200	480	56	200	0	0
210	545	15	210	526	48	210	0	0
220	558	9	220	560	34	220	0	0
230	565	7	230	572	12	230	0	0
240	573	8	240	577	6	240	0	0
250	578	5	250	588	11	250	0	0
260	593	15	260	597	9	260	0	0
270	601	8	270	608	11	270	0	0
280	606	5	280	616	8	280	0	0
290	616	10	290	620	12	290	0	0
300	627	11	300	635	7	300	0	0
310	636	11	310	647	12	310	0	0
320	645	7	320	659	12	320	0	0
330	663	8	330	666	6	330	0	0
340	666	13	340	669	4	340	0	0
350	681	15	350	684	15	350	0	0
360	694		360	696		360	0	0

I have included pasted in a copy of one of our sites for example. These wind rose graphs above are automatically generated by binning the data that was copied in to the previous data section. Note also the titles at the top of the page as well as the small ones above each chart. Those are automatically generated from the Site Information sheet. This is useful when printed data is needed.

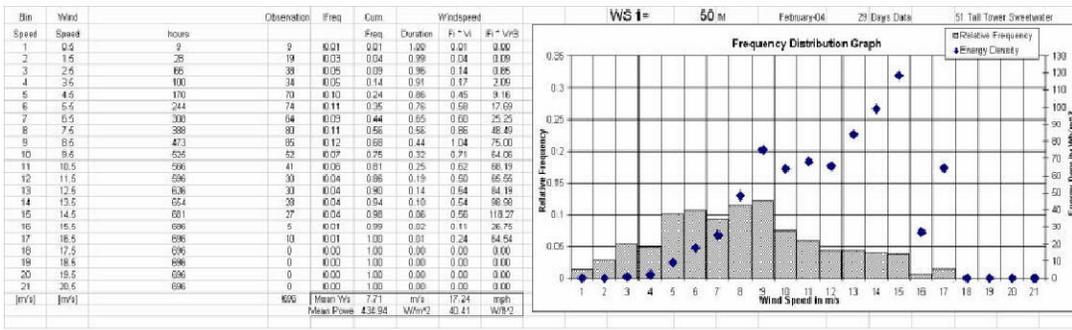
50 meters	February-04	29 Days Data	51 Tall Tower Sweetwater
-----------	-------------	--------------	--------------------------



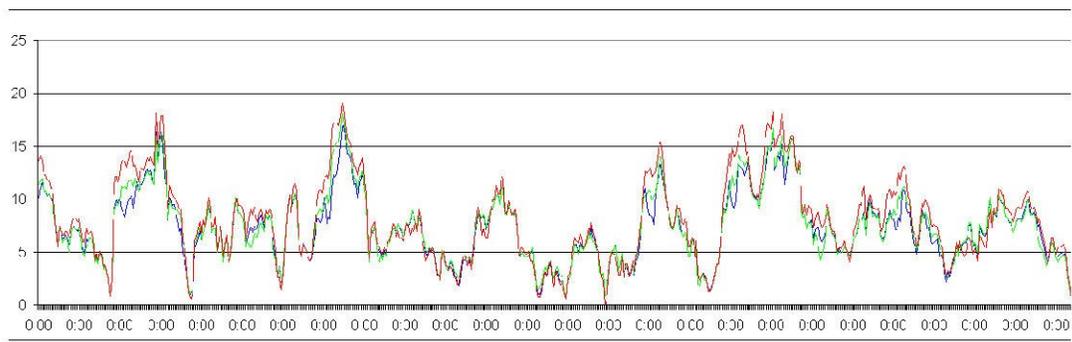
50 meters	February-04	29 Days Data	51 Tall Tower Sweetwater
-----------	-------------	--------------	--------------------------



The charts above show the diurnal patterns of the month which shows the daily trend of each sensor.



This chart on the "chart" page of the month shows wind frequency distribution and power trends for each month.



Below the frequency distribution charts you will find simple time based charts of the wind speeds. These are useful for quickly spotting bad or intermittent sensors.