CLIMATOLOGY OF QUARTERLY METEOROLOGICAL DATA AND IMPLICATIONS FOR INSTRUMENTATION AND DOSE ASSESSMENT

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Introduction

Wind direction, wind speed, and an indication of atmospheric stability are key meteorological parameters for assessing radiological doses from routine operation of nuclear plants in the United States. Utilization of these parameters is discussed in Nuclear Regulatory Commission (NRC) Regulatory Guide 1.21[1] that outlines information to be included in the annual Effluent and Waste Disposal Report to the NRC. Estimation of doses is done on a quarterly basis using hourly meteorological data collected at the nuclear plant.

Routine doses at the Tennessee Valley Authority's Browns Ferry (BFN) and Sequoyah Nuclear Plants (SQN) are estimated using the actual meteorological data and radioactive releases for each quarter. Continuous release throughout the quarter is assumed. The wind speed, wind direction, and stability class (as estimated from the vertical temperature difference) are summarized into joint frequency distributions as outlined in NRC Regulatory Guide 1.23.[2]

For ground-level releases at BFN and SQN, and at the Watts Bar Nuclear Plant (WBN) which is under construction, 10-meter level wind directions and speeds, and the atmospheric temperature differences between 46- and 10-meters are used to represent transport and dispersion conditions. The data are first validated and archived. Then quarterly meteorological data summaries are generated and compared with longer-term quarterly averages for reasonableness. After approval, the data are provided for use in the dose assessment model.[3] Of the meteorological parameters, dose estimates are most sensitive to changes in atmospheric stability.[4] For ground-level releases, doses are inversely proportional to the wind speed.

This paper illustrates techniques for reviewing the quarterly data summaries and highlights characteristics and implications from the review. The intent is to emphasize the importance of (1) analyzing collected meteorological data, (2) selecting appropriate data for assessing doses, and (3) identifying trends in the data.

Approach

BFN is located along the Tennessee River in northern Alabama in gently rolling terrain. SQN and WBN are located in eastern Tennessee, also along the Tennessee River. They are situated in river valleys and surrounded by complex terrain. The river valley lies in a north northeast to south southwest direction.

Quarterly data summaries primarily from January 1987 through June 1994 for BFN, SQN, and WBN are presented. The quarters are defined as January through March (quarter 1), April through June (quarter 2), July through September (quarter 3), and October through December (quarter 4).

The maximum calculated quarterly dispersion values (χ/Q) at the site boundary are also provided. The χ/Q (s/m^3), the sector in which it occurred, and the downwind distance are included. The dispersion value is directly proportional to the estimated dose.

Some longer-term annual and quarterly summaries and dispersion values are included where appropriate. These are indicative of data periods that may be used for plant license applications and for radiation effluent monitor setpoint calculations.

Results

Stability Class

Table 1 shows the quarterly percentage occurrence of stability classes A through G for SQN from 1987 through the second quarter of 1994. Stability class A represents the maximum atmospheric mixing conditions, typical of a sunny day with low to moderate wind speeds. Stability class G represents the poorest mixing conditions, typical of nighttime with a temperature inversion. Substantial variability in frequency of occurrence is evident from quarter to quarter, especially for stability class A. Class D or E was typically the most frequent, however.

Solar insolation and wind pattern changes should cause the stability class distribution to vary by season. Therefore, the average stability class occurrence by quarter for SQN for the same period is shown in Figure 1. Significant differences are seen between quarters. The D class was most frequent in the first quarter, with E the most frequent in the third quarter. The most class A's occurred in the third quarter and the most class G's occurred in the first quarter. Stability classes B, C, and F showed less variability by quarter. Similar patterns are evident in Figures 2 and 3 for BFN and WBN, respectively.

Stability class A variability is examined further in Figure 4. The SQN second quarter class A percentage occurrence is plotted for the 23-year period from 1972 through 1994. Large shifts in the pattern are evident in 1977 and 1991. No sensor calibration problems occurred to account for these pattern swings. Close examination revealed that inconsistent aspirator shielding is suspected to contribute to the temperature uncertainty.[5] Some of the shift may be attributable to the wet periods of the early 70's and early 90's.

Meteorological data for SQN from 1972-75 were used for original setpoint calculations. Consideration is being given to updating the data period to 1972-88. Figure 5 contrasts the stability class frequency distributions for the 1972-75 and 1972-88 data periods. The 1972-75 period shows a lower frequency of unstable classes (A through C) and higher frequency of E classes than for the longer period. The dispersion value implications of this change are discussed later.

Wind Direction

Table 2 includes the quarterly percentage occurrence of the most frequent wind direction sectors for SQN from 1987 through the second quarter of 1994. The river valley influence on the directions is shown by the bimodal peaks in the north northeast (NNE) and south southwest (SSW) directions. The directional characteristics for the six most frequent sectors are summarized in Figure 6 that shows the average wind direction occurrence by quarter for SQN for the same period as Table 2. It shows that the most frequent wind direction in the first, third, and fourth quarters is NNE and the most frequent in the second quarter is SSW. This indicates that the critical sector from a dose standpoint could vary by quarter.

Wind Speed

Table 2 also includes quarterly wind speed information for SQN. In addition to the average wind speed by quarter, the calm frequency and percentage occurrence is included. TVA defines a calm as a wind speed less than 0.6 mi/h. The average wind speed and calm occurrence by quarter for SQN are included at the bottom of Table 2. It shows an average wind speed range from 3.1 mi/h in the third quarter to 4.5 mi/h in the first quarter. The calm occurrence ranges from 1.3 percent in the fourth quarter to 2.0 percent in the second quarter. The average wind speed and calm occurrence by quarter for BFN are shown graphically in Figure 7. It shows that the quarter with the highest average wind speed coincides with the quarter of lowest frequency of calms. The lowest average wind speed and highest calm frequency occur in the third quarter.

Table 3 shows the quarterly wind direction and speed information for WBN. Similar characteristics exist between SQN and WBN, except that WBN has a higher frequency of calms and a trend toward more calms with time. For further review, the annual percentage occurrence of calms was examined for the 20-year period of 1974-93. The results are provided in Figure 8. The trend for more calms is most evident since the mid 80s. Also, the calm frequency shows a marked increase in 1993 to an annual frequency of about 13 percent. No instrumentation modifications or problems have been identified to explain the trend. Examination of National Weather Service data for Chattanooga and Knoxville indicates a regional trend for lower wind speeds during this period. In 1993, several high starting threshold problems with the 10-meter anemometer may account for a portion of the calm occurrence.

Dispersion Values

Table 1 also includes the quarterly highest site boundary dispersion values for SQN. The dispersion values (χ/Qs) range from 1.00E-05 s/m^3 in the second quarter of 1987 to 3.77E-06 s/m^3 in the first quarter of 1988. These compare to dispersion values of 5.12E-06 s/m^3 for the 1972-75 and 4.65E-06 s/m^3 for the 1972-88 periods, both which occurred in the north sector. The Table 1 dispersion values show only four quarterly values less than the worst case for the 1972-88 period. Thus, use of the 1972-88 dispersion values would typically underestimate doses on a quarterly basis.

Several attempts were made to correlate the variation of dispersion values with meteorological parameters, but with little success. One example is included in Figure 9 for SQN stability class G frequency. Little relationship is apparent on this broad level. Since the critical sector varies with quarter, and since both stability class and wind speed affect the dispersion value; a more rigorous comparison is warranted. An example would be comparing only the north sector for first quarter for a low wind speed class.

Conclusions

Analysis of quarterly meteorological data summaries is useful for:

1. Providing a basis for ensuring that the data are reasonable. Generation of data summaries after validation can introduce errors. Some data problems are too subtle to be detected through typical validation procedures,

2. Developing familiarity with the characteristics of data and with changes throughout the year,

3. Explaining unexpected variations in dose estimates.

Examination of these summaries provides a basis for determining the appropriate data base to be used for routine dose estimation. Use of a long-term, historical meteorological data base will likely underestimate doses reported to the NRC on a quarterly basis. Similarly, setpoints are more realistic if based on actual quarterly meteorological data.

Finally, review of quarterly data summaries reveals trends in the data that could indicate climate variability, changes in measurement or processing methodology, changes in exposure around the collection equipment, or equipment problems.

References

1. Nuclear Regulatory Commission (NRC), "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants, Regulatory Guide 1.21, Revision 1, June 1974.

2. Nuclear Regulatory Commission (NRC), " Onsite Meteorological Programs," Regulatory Guide 1.23, Revision 0, February 1972.

3. R. M. Nicoll, Tennessee Valley Authority, "Gaseous Effluent Licensing Code (GELC) Documentation," Revision 1, January 1984.

4. William B. Norris, The University of Alabama in Huntsville, "A Sensitivity Analysis of the Gaseous Effluent Licensing Code (GELC), " October 1991.

5. Stone & Webster Engineering Corporation, "Independent Evaluation of Sequoyah/Browns Ferry Meteorological Monitoring/Assessment Program Issues," July 1993.

Table 1

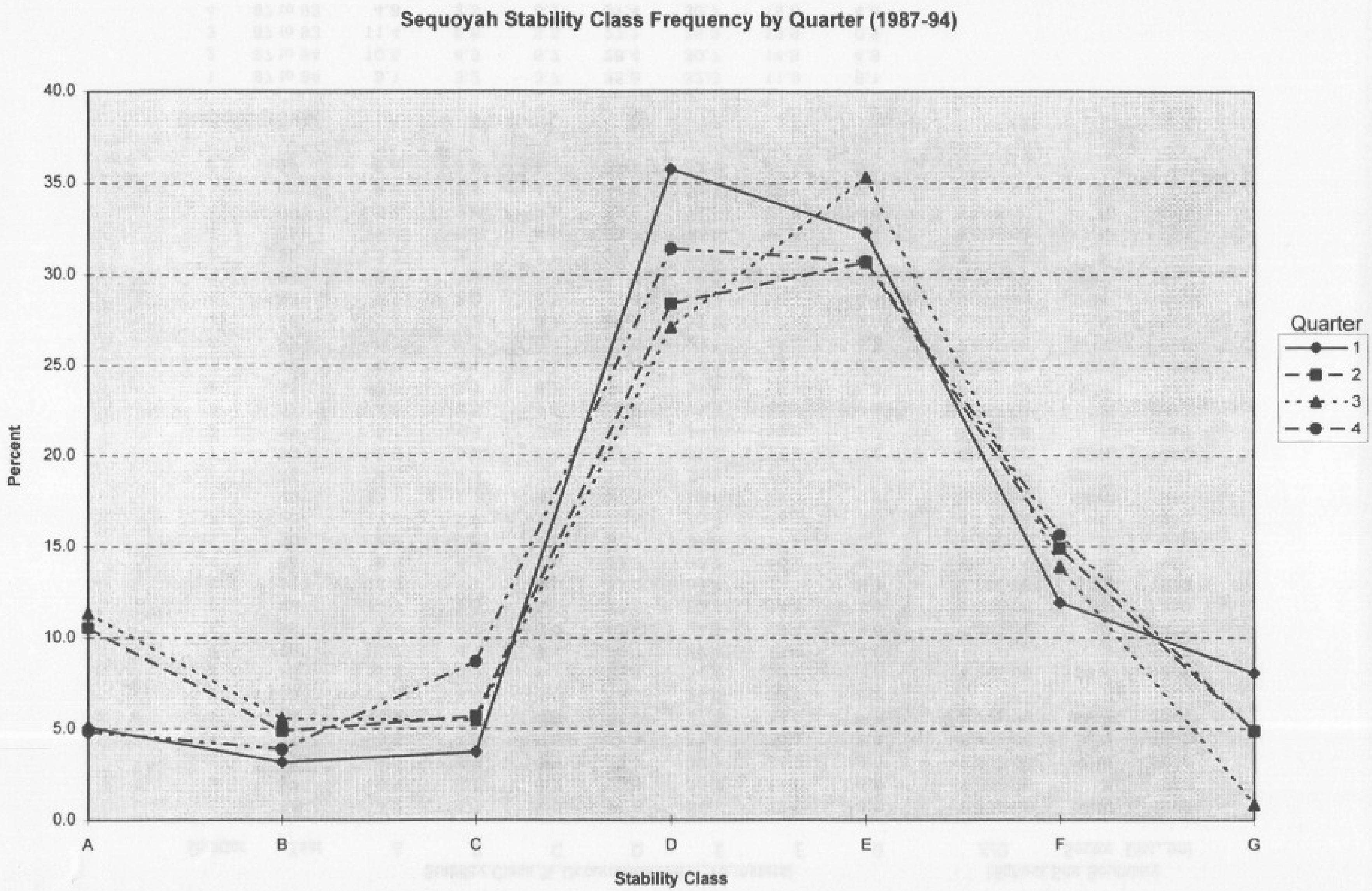
Sequoyah Nuclear Plant
Ground Level

Quarter	Year	A	B	C	D	E	F	G	X/Q	Sector	Dist. (m)
		Stability Class % Occurrence (46 - 10 meters)							Highest Site Boundary		
1	87	4.2	4.1	4.7	41.6	24.3	12.0	9.0	6.87E-06	SSW	1840
2	87	10.5	5.2	7.2	30.9	28.7	11.0	6.4	1.00E-05	N	950
3	87	9.3	6.3	7.7	22.2	32.2	20.2	2.0	6.80E-06	SSW	1840
4	87	6.6	3.7	5.0	24.6	31.6	20.1	8.4	9.45E-06	SSW	1840
1	88	9.3	3.3	3.5	23.0	37.6	16.0	7.3	3.77E-06	SSW	1840
2	88	24.7	4.0	3.0	13.5	24.0	23.6	7.3			
3	88	13.6	6.1	6.1	25.4	34.6	10.1	1.0	4.99E-06	SSW	1840
4	88	6.7	4.7	5.1	24.7	36.4	18.4	4.0			
1	89	6.3	2.7	4.0	43.6	24.5	10.4	8.6	4.26E-06	N	950
2	89	11.3	5.5	5.9	27.5	30.6	14.5	4.6	5.97E-06	N	950
3	89	15.3	5.4	4.0	23.2	38.7	13.1	0.3	7.80E-06	S	1570
4	89	6.9	4.4	3.5	33.9	30.7	16.2	4.4	6.67E-06	N	950
1	90	4.8	3.7	4.0	29.1	36.8	11.4	10.1	5.38E-06	N	950
2	90	17.8	5.8	4.7	22.3	30.3	16.1	3.0	4.47E-06	N	950
3	90	17.1	7.2	4.9	21.1	32.6	16.2	0.8	6.22E-06	SSW	1840
4	90	4.5	4.3	3.7	28.2	33.3	20.8	5.3	6.50E-06	NNW	730
1	91	5.5	3.9	4.4	37.3	31.4	11.7	5.9	4.41E-06	SSW	1840
2	91	5.1	6.5	6.5	34.1	34.6	10.5	2.7	7.63E-06	N	950
3	91	3.5	3.5	4.5	38.9	36.3	12.7	0.6	6.76E-06	S	1570
4	91	3.7	3.7	4.2	30.8	34.5	17.9	5.2	5.91E-06	NNW	730
1	92	6.0	4.1	3.6	31.6	31.9	13.1	9.7	6.83E-06	NW	660
2	92	6.3	4.8	6.7	33.6	29.1	15.2	4.2	7.05E-06	N	950
3	92	3.1	4.2	6.2	38.1	38.9	9.4	0.2	6.37E-06	N	950
4	92	2.1	2.8	3.8	42.3	34.3	12.1	2.6	6.19E-06	SSW	1840
1	93	0.7	1.3	1.7	43.3	38.6	8.6	5.8	9.15E-06	SSW	1840
2	93	3.2	3.4	5.8	32.1	35.3	15.1	5.1	9.59E-06	N	950
3	93	17.6	6.3	4.9	20.7	33.9	15.5	1.1	6.53E-06	N	950
4	93	3.4	3.6	3.6	35.5	35.5	14.4	4.0	5.81E-06	N	950
1	94	3.8	2.4	4.0	36.5	33.3	12.1	8.0			
2	94	5.4	3.9	5.7	33.2	32.9	13.1	5.7			

Quarterly Average		A	B	C	D	E	F	G
1	87 to 94	5.1	3.2	3.7	35.8	32.3	11.9	8.1
2	87 to 94	10.5	4.9	5.7	28.4	30.7	14.9	4.9
3	87 to 93	11.4	5.6	5.5	27.1	35.3	13.9	0.9
4	87 to 93	4.8	3.9	8.7	31.4	30.7	15.6	4.8

10/3/94
SQNSC.XLS

Figure 1



Sequoyah Stability Class Frequency by Quarter (1987-94)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Percent
A
B
C
D
E
F
G
Stability Class
Quarter
1
2
3
4

Figure 2

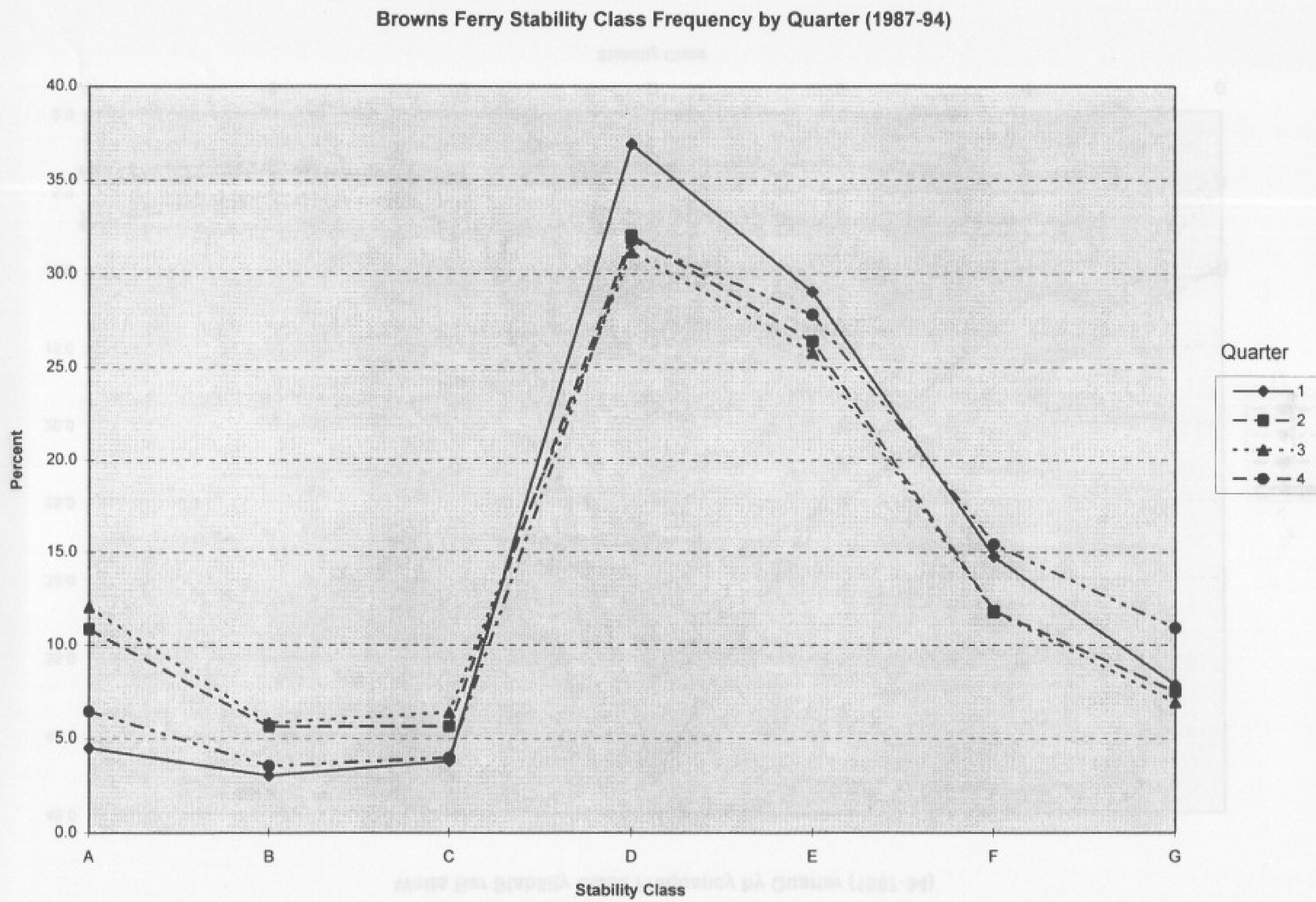

Browns Ferry Stability Class Frequency by Quarter (1987-94)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Percent
A
B
C
D
E
F
G
Stability Class
Quarter
1
2
3
4

Figure 3

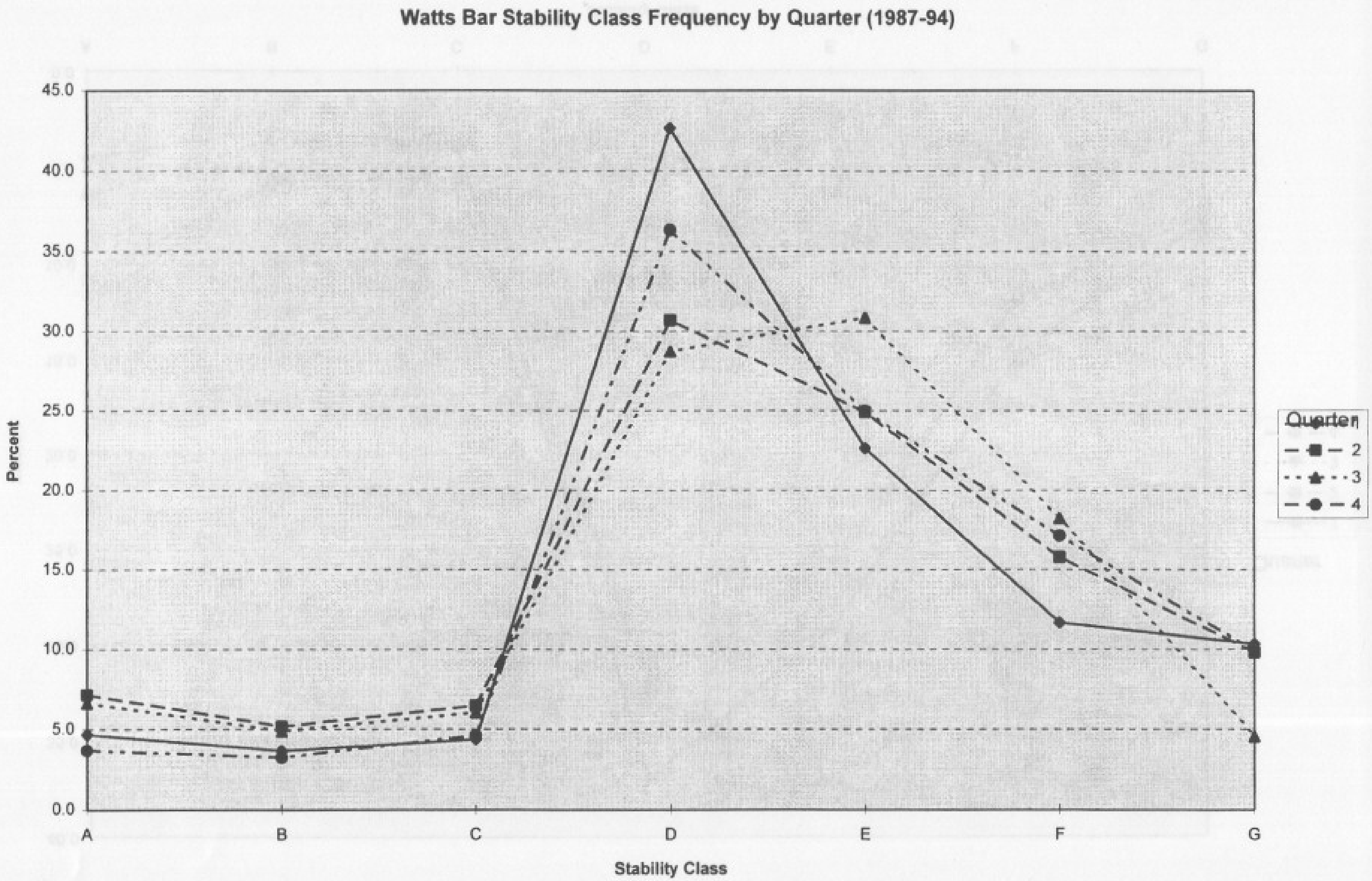

Watts Bar Stability Class Frequency by Quarter (1987-94)
Percent
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
A
B
C
D
E
F
G
Stability Class
Quarter
1
2
3
4

Figure 4

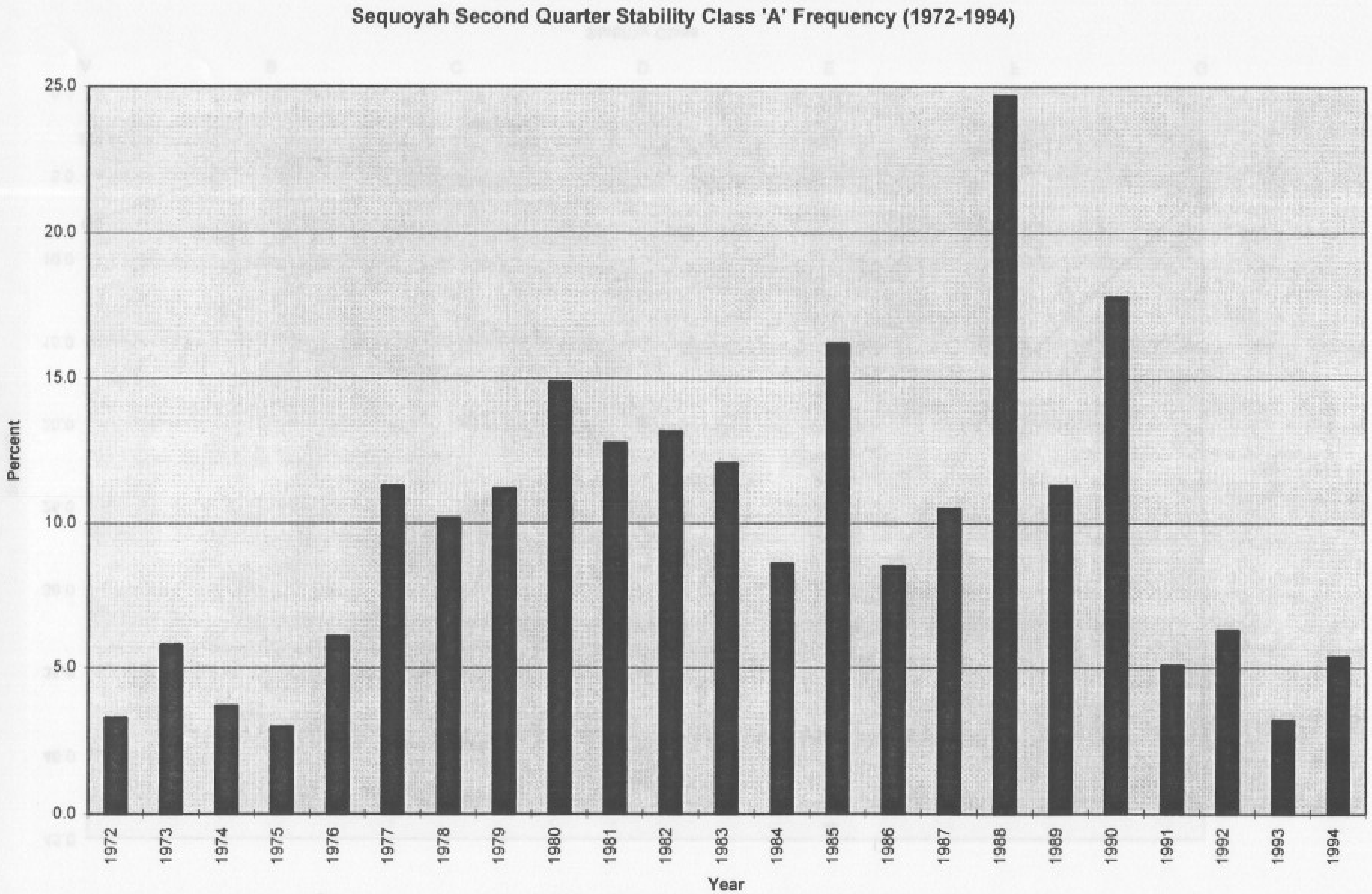
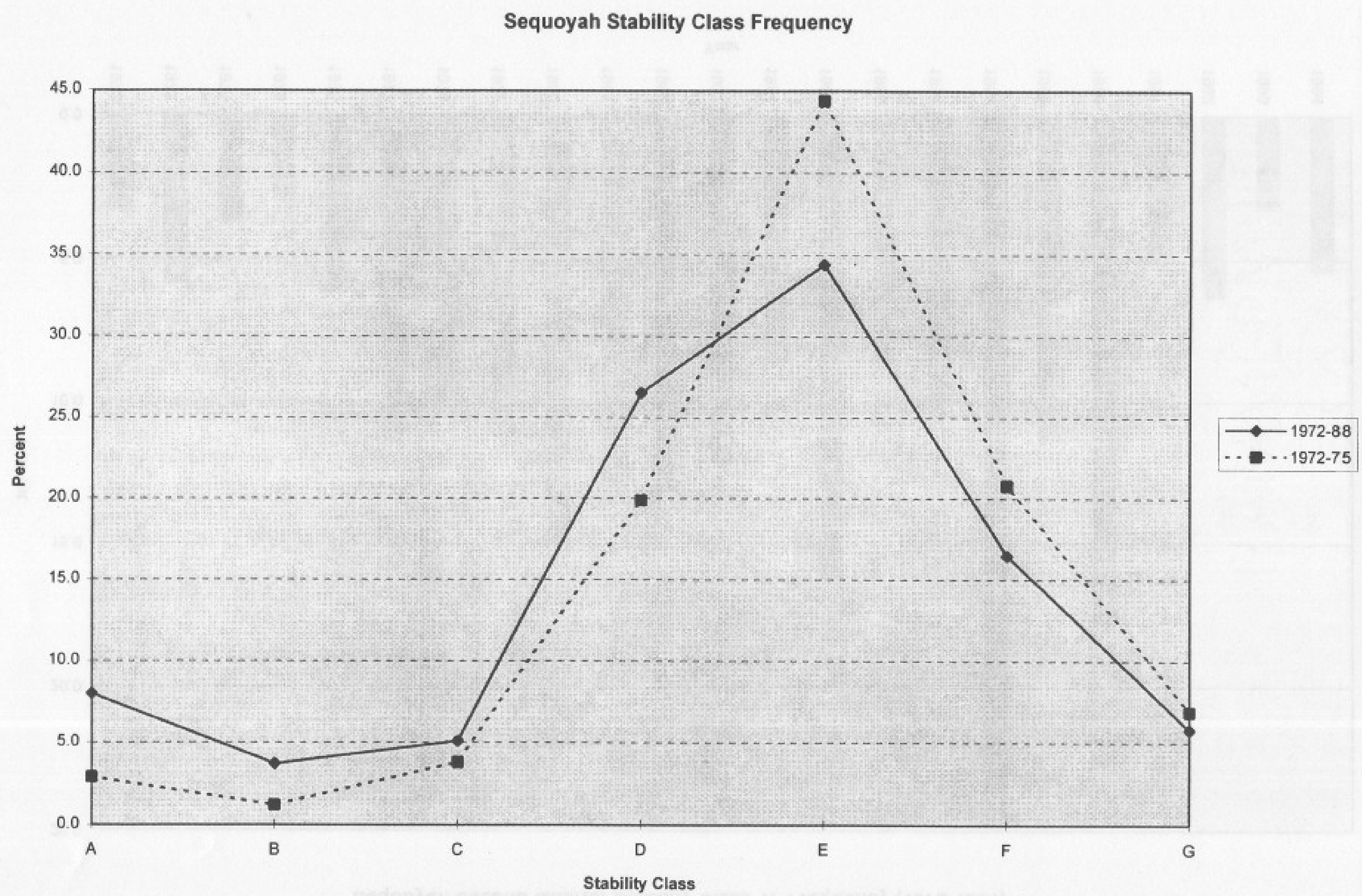

Sequoyah Second Quarter Stability Class 'A' Frequency (1972-1994)
25.0
20.0
15.0
10.0
5.0
0.0
Percent
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
Year

Figure 5



Sequoyah Stability Class Frequency
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Percent
A
B
C
D
E
F
G
Stability Class
1972-88
1972-75

Table 2

Sequoyah Nuclear Plant
Ground Level

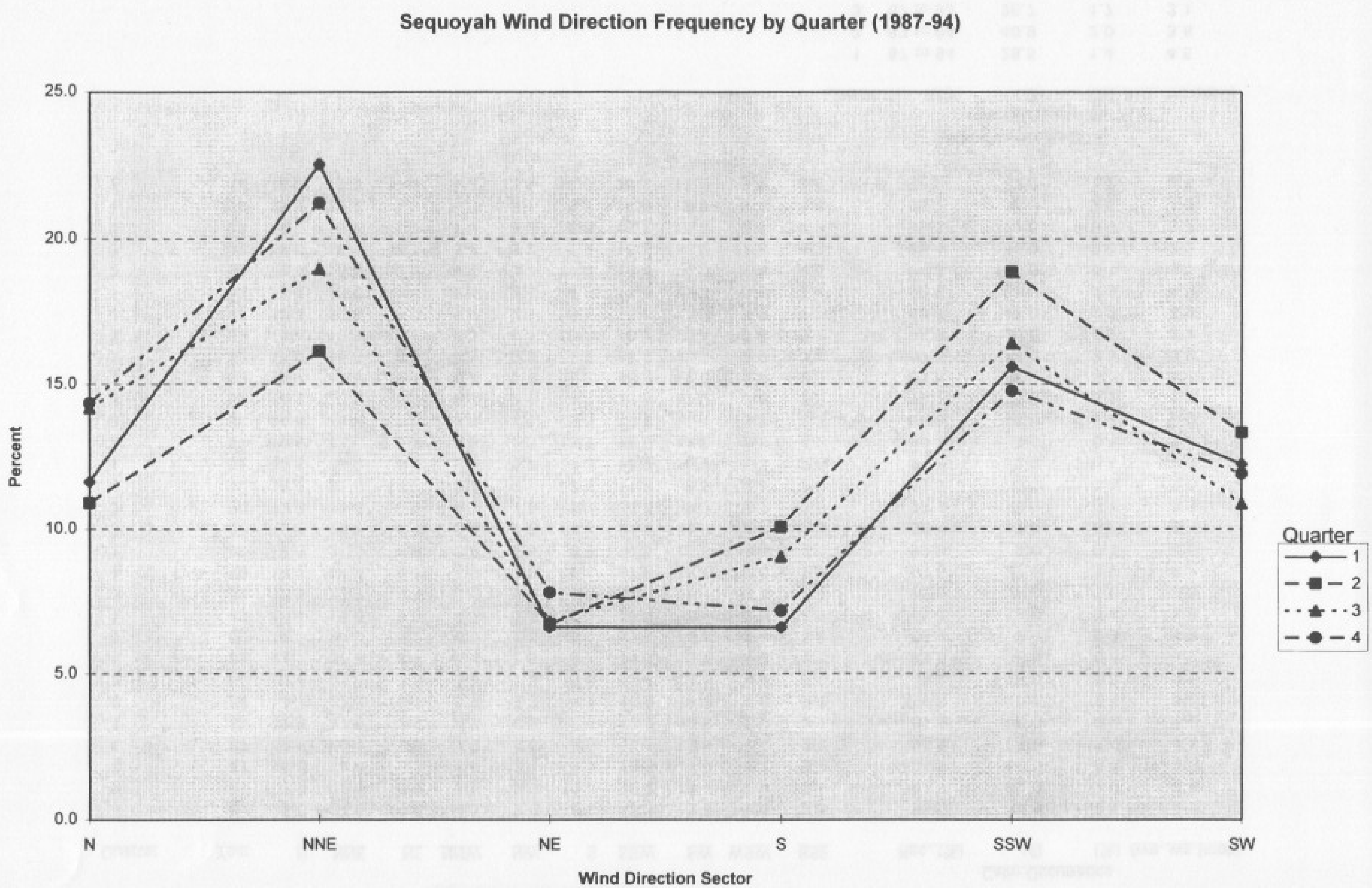
		Wind Direction % Occurrence											Calm Occurrence		
Quarter	Year	N	NNE	NE	NNW	NW	S	SSW	SW	WSW	SSE	Rec. (%)	(#)	(%)	Avg. ws (mph)
1	87	9.0	27.6	10.0	4.1	2.9	5.9	12.5	11.8	2.9	2.5	95.0	44.0	2.1	4.2
2	87	9.7	12.0	6.0	5.8	3.3	12.4	20.2	13.1	2.9	4.5	91.7	82.0	4.0	3.8
3	87	15.3	18.0	6.3	6.6	3.1	9.1	16.8	9.0	3.1	3.4	91.8	65.0	3.2	3.0
4	87	14.9	20.4	5.9	7.3	4.0	5.9	14.5	12.6	1.9	2.7	93.9	58.0	2.8	4.1
1	88	12.6	17.5	3.9	9.2	6.2	7.6	17.2	12.8	2.0	2.1	91.3	6.0	0.3	4.8
2	88	10.4	22.2	10.1	5.1	3.7	7.2	14.9	10.9	2.8	2.1	96.5	10.0	0.5	4.2
3	88	12.4	17.6	7.5	3.7	1.3	9.0	17.4	12.0	4.7	3.0	96.1	18.0	0.8	3.1
4	88	11.7	22.8	8.9	4.4	2.6	6.1	14.3	13.4	4.9	1.7	93.5	8.0	0.4	4.2
1	89	13.1	24.0	5.7	6.0	2.5	5.2	17.1	13.8	2.5	1.9	96.1	7.0	0.3	4.9
2	89	10.4	15.0	5.0	4.3	3.1	11.4	20.5	11.8	2.8	4.7	95.7	13.0	0.6	3.8
3	89	16.9	22.3	5.3	6.0	2.1	9.0	13.0	11.1	3.3	2.8	98.0	38.0	1.8	3.0
4	89	14.7	19.7	6.7	5.9	3.0	6.4	17.6	13.6	2.6	1.8	93.5	37.0	1.7	4.2
1	90	8.5	21.5	6.6	3.8	2.4	8.5	17.5	16.8	3.4	2.0	93.8	2.0	0.1	4.5
2	90	10.8	14.8	5.7	5.4	1.8	8.4	21.3	15.7	4.1	2.3	98.4	17.0	0.8	4.1
3	90	13.3	22.3	10.0	4.1	1.9	6.7	14.3	9.7	3.2	2.6	97.5	9.0	0.4	3.3
4	90	16.2	22.6	10.2	5.2	2.3	7.6	11.8	9.5	2.1	3.9	87.7	9.0	0.5	3.8
1	91	10.6	19.0	6.6	7.1	5.3	7.3	18.2	10.7	2.9	2.0	91.2	2.0	0.1	4.5
2	91	10.6	13.0	6.3	4.5	2.3	13.1	19.3	12.6	2.6	4.2	99.3	3.0	0.1	3.2
3	91	14.8	19.9	5.2	3.9	1.6	9.3	17.8	11.1	3.9	2.7	98.8	35.0	1.6	3.0
4	91	14.1	20.5	8.0	6.7	2.8	9.1	13.8	12.2	2.5	2.5	95.7	25.0	1.2	3.9
1	92	11.7	21.8	8.1	6.4	5.8	6.7	13.3	11.8	2.7	2.0	93.4	36.0	1.7	4.1
2	92	13.0	16.9	6.5	6.6	3.6	7.8	16.1	15.7	3.0	3.6	97.3	74.0	3.5	3.6
3	92	13.6	16.9	6.2	3.7	1.5	10.3	19.1	13.1	3.6	3.1	98.8	26.0	1.2	3.1
4	92	14.4	22.8	9.0	5.2	2.3	6.3	15.6	11.3	4.0	1.1	98.6	42.0	1.9	3.9
1	93	13.7	25.6	6.4	6.4	3.6	4.9	14.1	10.3	3.3	1.4	80.5	81.0	3.9	4.3
2	93	10.4	15.8	6.6	4.1	2.2	10.3	18.4	14.9	2.4	4.5	94.8	106.0	5.1	3.7
3	93	13.0	15.8	7.1	5.2	3.2	9.9	16.5	10.2	2.8	4.2	98.4	66.0	3.0	3.2
4	93	14.5	19.7	5.9	7.7	3.8	8.8	15.8	10.8	2.4	2.3	99.2	19.0	0.9	3.7
1	94	13.9	23.2	5.5	8.9	6.1	6.7	14.8	9.9	2.2	1.4	93.7	50.0	2.5	4.3
2	94	12.0	19.3	7.4	4.2	2.0	10.0	20.2	12.0	2.0	3.8	98.3	22.0	1.0	3.8

Mean Quartly Avgs.

		Calm Occurrence		
Quarter	Year	(#)	(%)	Avg. ws (mph)
1	87 to 94	28.5	1.4	4.5
2	87 to 94	40.9	2.0	3.8
3	87 to 93	36.7	1.7	3.1
4	87 to 93	28.3	1.3	4.0

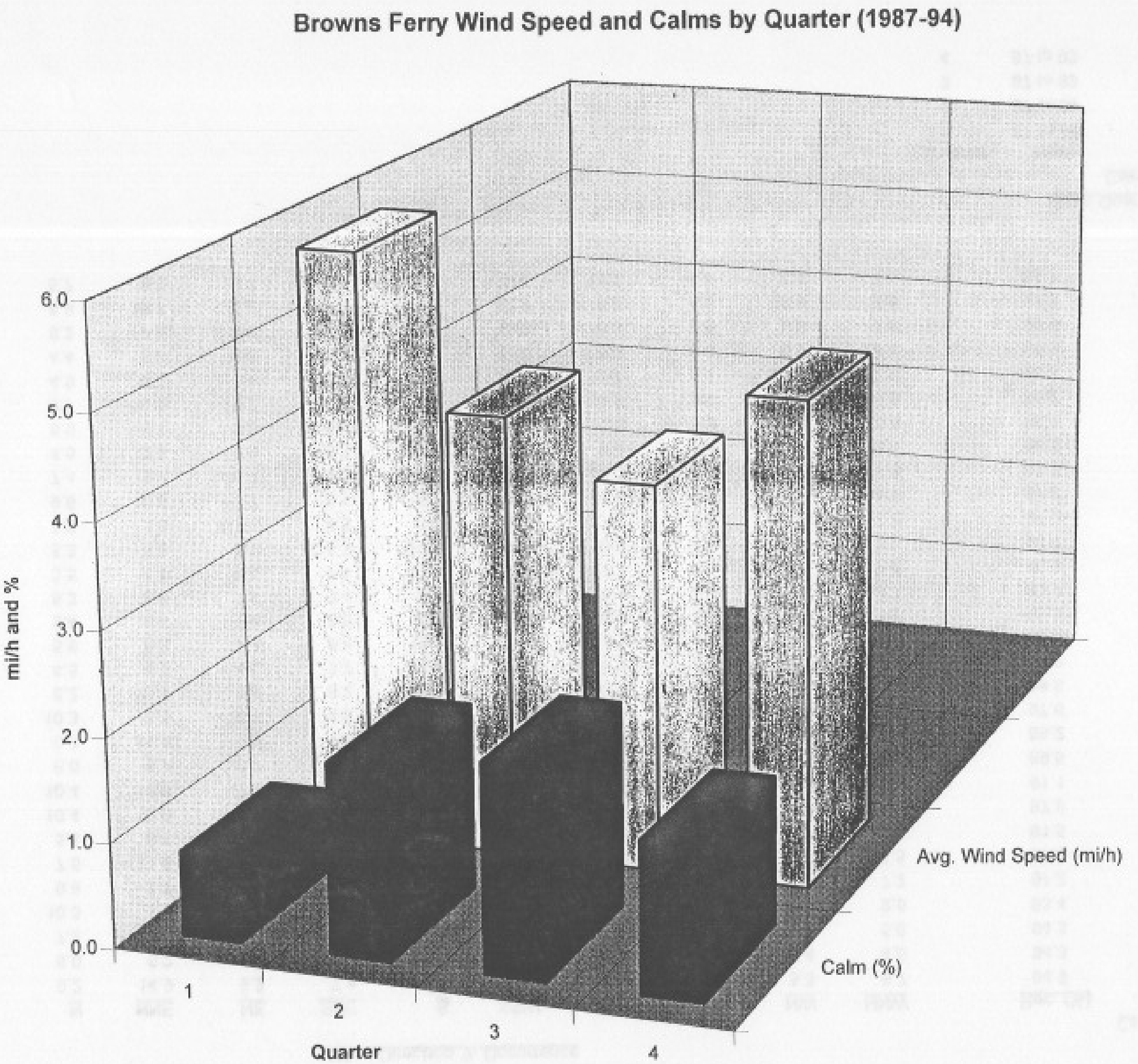
10/3/94
SQNWS.XLS

Figure 6



Sequoyah Wind Direction Frequency by Quarter (1987-94)
25.0
20.0
15.0
10.0
5.0
0.0
Percent
N
NNE
NE
S
SSW
SW
Wind Direction Sector
Quarter
1
2
3
4

Figure 7



Browns Ferry Wind Speed and Calms by Quarter (1987-94)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
mi/h and %
1
2
3
4
Quarter
Avg. Wind Speed (mi/h)
Calm (%)

Table 3

Watts Bar Nuclear Plant
Ground Level

Wind Direction % Occurrence

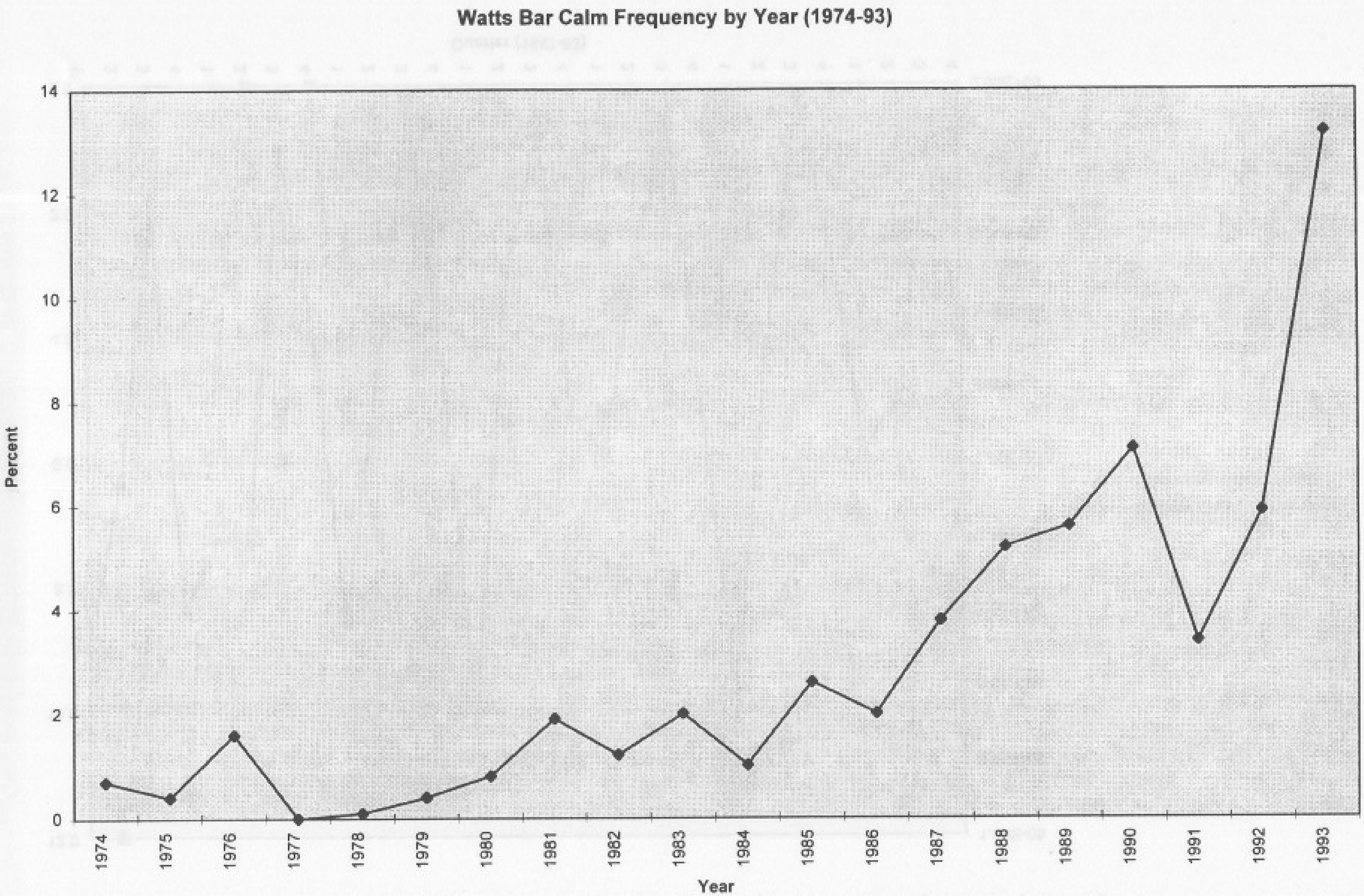
Quarter	Year	N	NNE	NE	ENE	S	SSW	SW	W	NW	NNW	Rec. (%)	Calm Occurrence (#)	(%)	Avg. ws (mph)
1	87	9.2	14.9	9.2	7.4	4.6	13.2	5.3	5.0	5.3	6.7	94.9	38	1.8	4.3
2	87	6.0	6.2	5.8	5.2	11.8	18.8	10.3	4.5	4.4	4.0	94.3	66	3.2	3.7
3	87	7.2	9.9	9.4	6.3	8.0	13.1	6.3	6.4	5.7	5.6	94.5	147	7.0	3.1
4	87	10.3	7.7	7.5	4.5	4.6	10.6	7.0	8.7	7.3	9.5	93.4	67	3.2	4.2
1	88	9.8	7.7	6.6	3.6	8.2	16.7	6.9	6.6	8.4	7.2	97.2	147	6.9	4.5
2	88	7.5	11.0	8.3	6.0	7.8	15.5	7.0	6.1	5.0	4.5	97.5	153	7.1	4.2
3	88	5.1	6.7	7.1	5.8	11.4	16.7	10.0	5.5	3.7	3.0	91.5	70	3.4	2.9
4	88	10.4	10.0	7.7	3.3	6.0	15.7	8.3	6.7	8.0	7.1	97.9	69	3.2	4.1
1	89	10.4	12.5	7.7	6.0	5.7	19.5	6.6	4.6	4.8	6.6	91.1	108	5.3	4.8
2	89	6.0	6.7	6.7	5.0	10.7	21.7	7.7	5.6	5.1	3.5	89.5	139	7.0	3.8
3	89	6.3	11.9	9.8	7.0	9.2	12.2	8.0	3.8	4.6	3.8	89.2	82	4.2	3.2
4	89	10.3	8.5	6.7	4.5	7.0	14.6	7.1	7.5	8.4	7.7	97.6	130	6.0	4.0
1	90	8.2	10.1	6.6	6.2	6.2	17.6	9.0	6.4	4.2	5.3	98.5	30	1.4	4.3
2	90	4.5	4.3	4.6	3.7	11.3	22.2	9.3	6.5	6.4	4.5	94.2	117	5.6	4.0
3	90	5.9	6.8	8.4	8.3	10.1	15.5	7.1	4.8	6.0	4.2	96.6	214	10.0	2.9
4	90	9.4	9.6	7.6	5.6	8.3	13.9	6.0	6.9	8.0	6.2	95.3	239	11.2	3.6
1	91	8.3	8.6	7.7	6.4	6.2	16.4	8.4	5.4	6.8	6.7	93.9	126	5.8	4.4
2	91	3.5	4.4	6.1	7.1	11.6	18.8	11.2	5.1	3.0	2.4	90.5	22	1.0	3.0
3	91	5.3	6.9	6.6	5.3	10.8	16.9	10.6	4.5	3.5	3.7	94.7	91	4.3	2.9
4	91	8.3	7.6	7.1	4.5	6.9	12.5	7.8	8.6	8.0	7.2	97.3	55	2.6	3.6
1	92	9.6	9.5	7.7	6.1	5.2	12.4	7.8	6.9	8.9	6.8	97.2	51	2.4	4.2
2	92	7.4	8.3	6.7	6.5	6.7	15.9	10.2	5.3	6.1	5.3	93.3	80	3.9	3.7
3	92	4.5	7.8	7.9	6.3	11.3	18.8	9.8	5.4	3.5	3.0	96.5	183	8.6	3.0
4	92	8.9	9.7	9.0	5.8	6.6	14.4	6.3	5.2	7.8	8.8	96.7	189	8.8	3.6
1	93	9.7	14.3	10.2	7.1	4.4	11.3	6.5	6.6	5.3	6.5	95.2	174	8.2	4.1
2	93	4.9	6.3	5.4	6.0	10.6	18.7	12.2	5.1	3.4	2.9	96.8	288	13.6	3.5
3	93	4.4	5.0	6.8	8.2	10.2	17.3	8.4	5.0	5.9	4.4	95.8	359	17.0	2.8
4	93	8.2	7.6	8.1	4.8	7.1	15.9	6.3	5.8	9.9	7.5	95.5	290	13.8	3.3
1	94	8.9	10.7	9.0	6.7	4.9	12.9	6.2	4.5	10.6	7.5	97.8	104	4.9	4.1
2	94	5.7	8.7	8.7	6.4	8.1	20.6	10.1	4.5	3.9	4.1	98.7	197	9.1	3.7

Mean Quartly Avgs.

Quarter	Years	Calm Occurrence (#)	(%)	Avg. ws (mph)
1	87 to 94	97	4.6	4.3
2	87 to 94	133	6.3	3.7
3	87 to 93	164	7.8	3.0
4	87 to 93	148	7.0	3.8

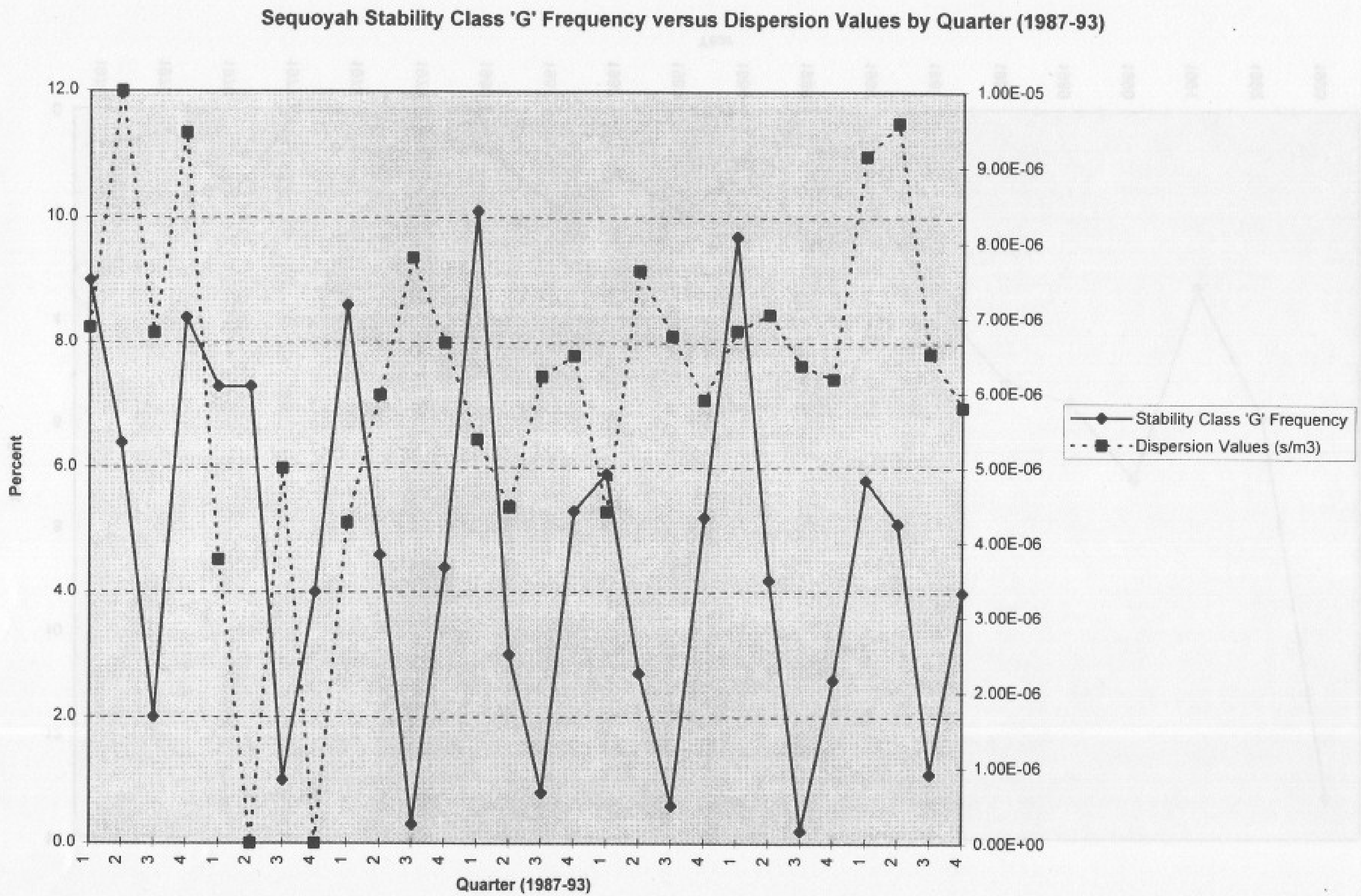
WBNWS.XLS
10/3/94

Figure 8



Calms are wind speeds of less than 0.6 mi/h.

Figure 9



Sequoyah Stability Class 'G' Frequency versus Dispersion Values by Quarter (1987-93)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Percent
1.00E-05
9.00E-06
8.00E-06
7.00E-06
6.00E-06
5.00E-06
4.00E-06
3.00E-06
2.00E-06
1.00E-06
0.00E+00
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
Quarter (1987-93)
Stability Class 'G' Frequency
Dispersion Values (s/m3)