Final Report

Technical Evaluation Report of 1985 Meteorological Data from the Indian Point Nuclear Power Plant

Submitted by: Gregg L. Andrews
Battelle Pacific Northwest Laboratory
P.O. Box 999
Richland, WA 99352

5/87

TABLE OF CONTENTS

1.0 Introduction

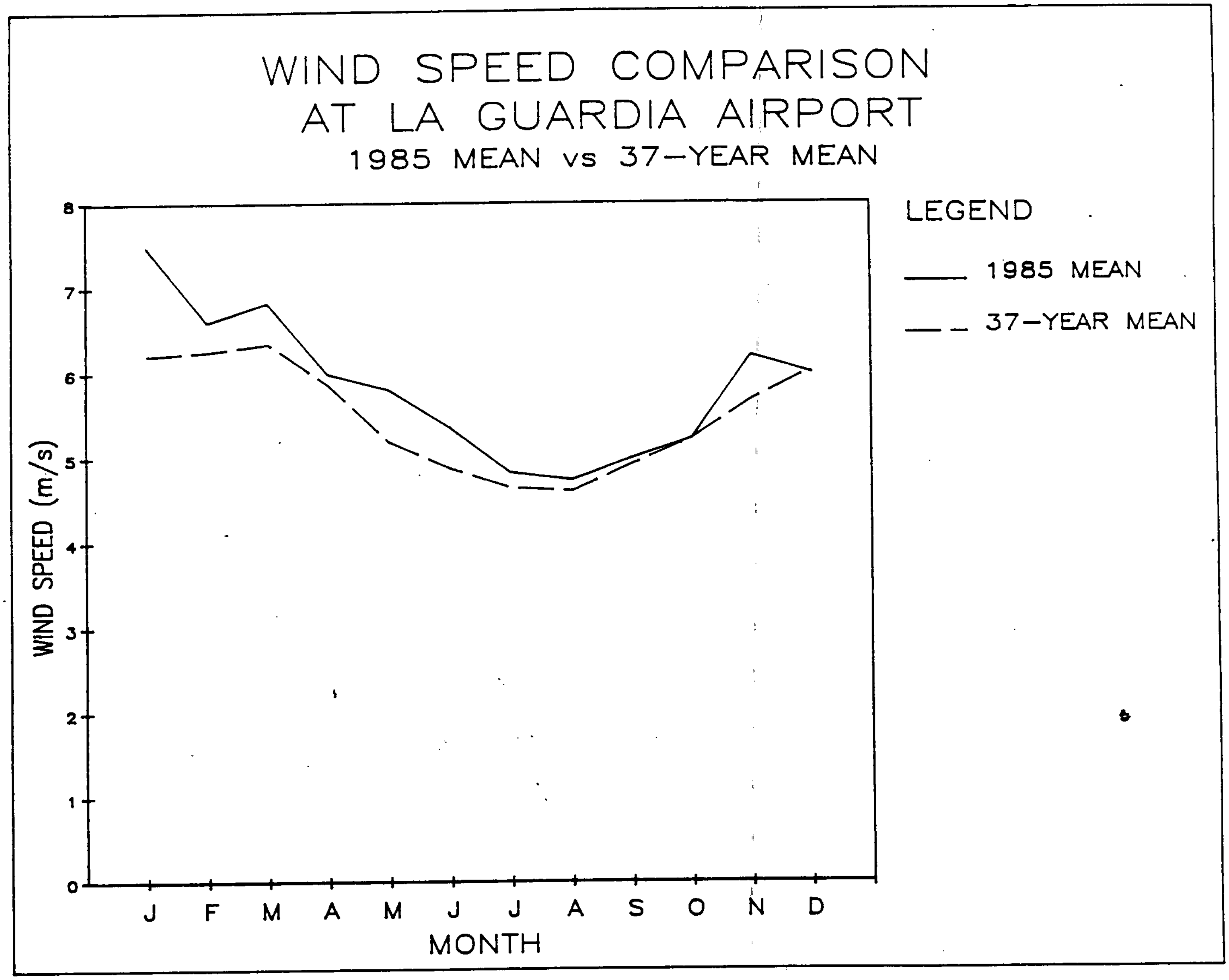
Meteorological data at operating reactor sites must be available for use in emergency response situations as well as to demonstrate that routine releases of radioactive material to the atmosphere result in doses below the guidelines of 10 CFR 50 Appendix I. As discussed in Information Notice No. 84-91 issued by the Office of Inspection and Enforcement, the quality of meteorological data collected at operating reactor sites is important to ensure appropriate integration into emergency response actions and to ensure appropriate assessments of the radiological impacts of routine releases.

This report describes and evaluates the quality, reliability, and representativeness of the 1985 Indian Point meteorological data for use in emergency response and assessments of the radiological impact of routine releases.

The evaluation was performed by processing the 1985 Indian Point data with existing NRC quality assurance computer codes (Snell 1984) and using previous site data (Jan. 1, 1974 through Dec. 31, 1975 and Aug. 1, 1978 through July 31, 1979) in a comparative analysis. Although concurrent and historical hourly meteorological data were available from some nearby National Weather Service (NWS) stations, the data could not be used because the stations were not within close proximity of the Indian Point plant and were influenced by different terrain features. Much of the data in this report are presented in graphical form to facilitate the comparisons between different sets of data for the same parameter.

The closest NWS station to the Indian Point plant that tabulates climatological data is La Guardia Airport. The 1985 La Guardia yearly and monthly averaged meteorological data (e.g., temperature, precipitation, wind speed, etc.) were compared to the long-term (30 years in most cases) climatological means and extremes (NOAA 1985) from La Guardia to determine if 1985 was an anomalous year for the region including the Indian Point site. The records showed that 1985 contained a few climatological extremes. Most were maximum temperatures set in the winter and spring months. Also, the mean monthly wind speeds for 1985 either exceeded or equaled the 37-year mean monthly wind speeds (Fig.1). Thus, it appears that 1985 contained some climatological anomalies. This aspect was taken into account during the comparison between the 1985 Indian Point data and previous site data.

The NRC quality assurance computer programs were developed to assess the quality and reliability of a utility's meteorological data. These codes consist of the following programs: DATE, MISS, JFREQ, and QA. DATE locates adjacent records that are not sequential in date or time, MISS tabulates the number of missing occurrences for each parameter at three different levels, JFREQ creates joint frequency distribution of wind speed, wind direction and stability, and QA flags questionable occurrences of wind speed, wind direction, temperature, dew point, delta-temperature, and precipitation.



WIND SPEED COMPARISON
AT LA GUARDIA AIRPORT
1985 MEAN vs 37-YEAR MEAN
LEGEND
1985 MEAN
37-YEAR MEAN
WIND SPEED (m/s)
0
1
2
3
4
5
6
7
8
J
F
M
A
M
J
J
A
S
O
N
D
MONTH

FIGURE 1

2.0 Data and Measurement Site Description

The New York Power Authority submitted a magnetic tape containing hourly meteorological data from January 1, 1985 through December 31, 1985 for the Indian Point nuclear power plant. The data were recorded at 10.0 meters and 122.0 meters. Table 1 indicates which parameters were recorded at each level.

Table 1

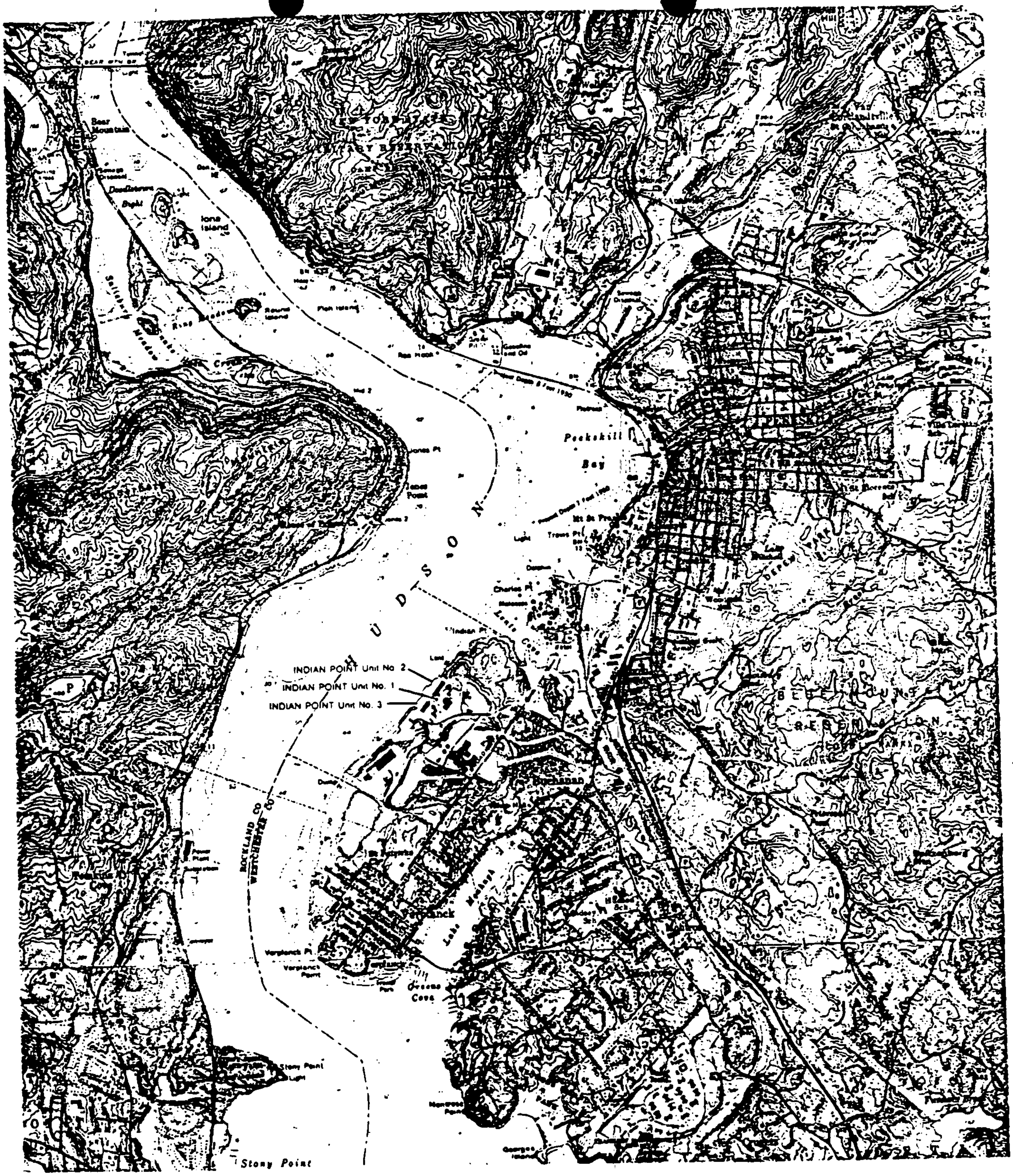
Parameter	Level (Meters)
Delta-Temperature	60.0-10.0
Delta-Temperature	122.0-10.0
Wind Speed and Direction	10.0
Wind Speed and Direction	122.0

The data were not in the format as described in Section 2.3.3 of the Standard Review Plan (NRC 1981), however format specifications were provided. A computer program was developed to reformat the data into the NRC format.

Onsite meteorological data are obtained from a dual tower system that consists of a primary instrumented tower and an emergency back-up instrumented tower. The primary tower is 122 meters high and is located approximately 1150 meters (3750 ft) north of the containment buildings and support buildings and approximately 1680 meters (5500 ft) east from the river (Fig. 2). The base of the primary tower has an elevation of approximately 40 meters MSL and has been in that location since 1973. The parameters measured on the primary tower are the 60.0-10.0 meter delta-temperature, the 122.0-10.0 meter delta-temperature, and 10.0 meter, 38.0 meter, 60.0 meter, and 122.0 meter wind direction and speed. The 38.0 meter and 60.0 meter wind direction and speed are not included in this report. The emergency back-up tower is located approximately 820 meters (2700 ft) southwest from the primary tower. The back-up system provides measurements of 10 meter level wind direction and speed, and an estimate of atmospheric stability (i.e., sigma theta).

The site is located on the east bank of the Hudson River within the Hudson River Valley in southeast New York state (Fig. 3). The river runs northeast to southwest, at this point but turns sharply northwest approximately two miles northeast of the plant. The west bank of the Hudson is flanked by the steep, heavily-wooded slopes of the Dunderberg and West Mountains to the northwest (elevations 331 meters (1086 ft) and 383 meters (1257 ft), respectively, above sea level) and Buckberg Mountain to the west-southwest (elevation 242 meters (793 ft)). These peaks extend to the west and gradually rise to sightly higher peaks (New York Power Authority 1982).

The general orientation of this high ground is northeast to southwest. One mile northwest of the site, Dunderberg bulges to the east. North of Dunderberg and the site, high grounds reach 244 meters (800 ft) from the east bank of the Hudson River. At this location the Hudson River makes a sharp turn to the northwest. To the east of the site, peaks are generally lower than those



CONSOLIDATED EDISON CO.
INDIAN POINT UNIT 2

Topographical Map of Indian Point and Surrounding Area

FIGURE 2

EXISTING AND HISTORICAL METEOROLOGICAL
TOWERS AT INDIAN POINT

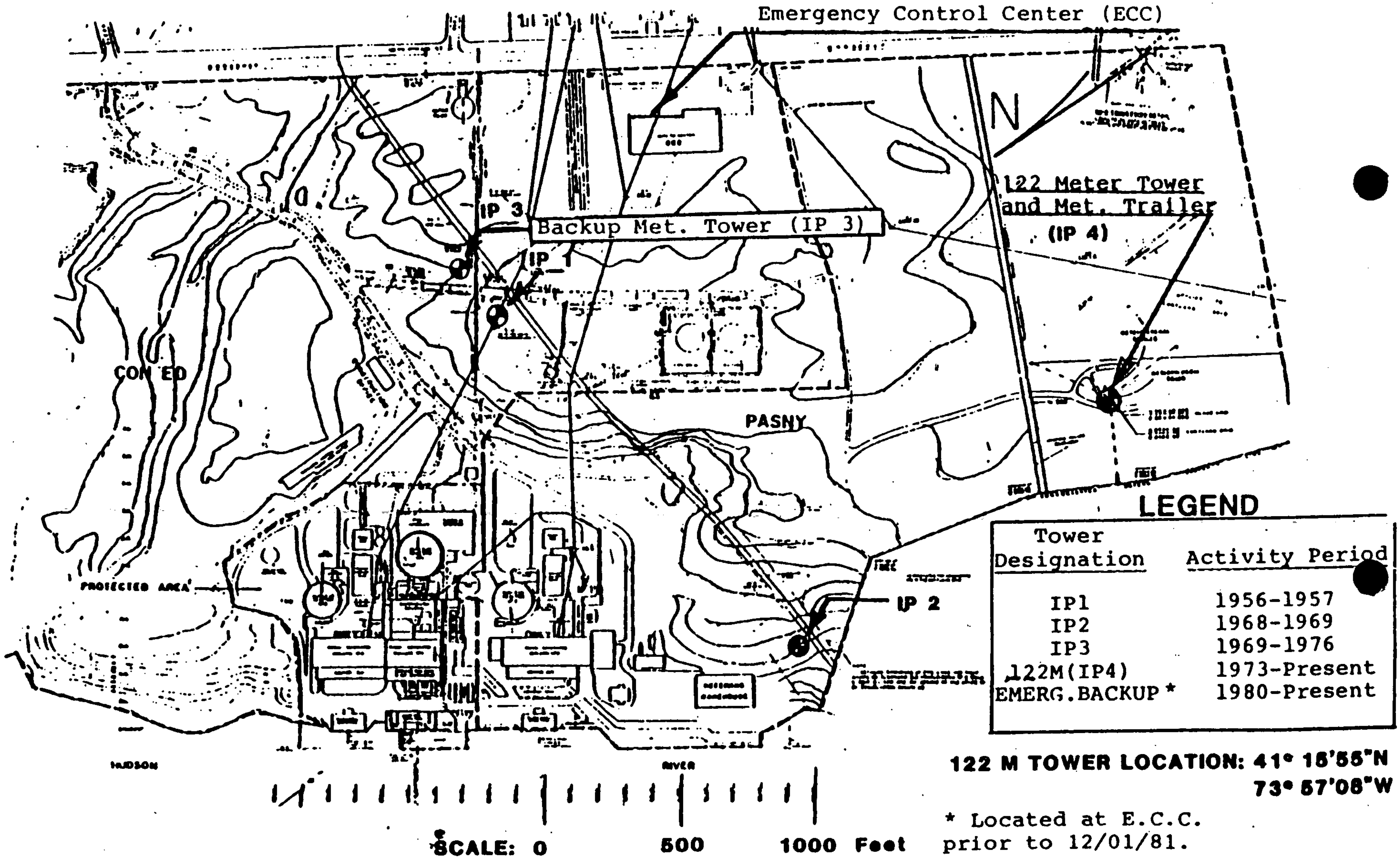


FIGURE 3

to the north and west; the Spitzenberg and Blue Mountains average about 183 meters (600 ft) in height, and there is a weak, poorly-defined series of ridges that run in a north-northwest direction. To the west of the site there are the Timp Mountains at an elevation of 256 meters (846 ft). To the south of the site elevations of 31 meters (100 ft) or less gradually slope towards the city of Verplanck. The river south of the site makes another sharp bend to the southeast and then widens as it flows pass the cities of Croton and Haverstraw (New York Power Authority 1982).

3.0 Definition of Terms

Two terms used throughout this report require some qualification. The use of "climatological representativeness" means data are representative on a short term basis (e.g., one to two years). The use of "data collection system" includes the sensors, maintenance and calibration procedures, and related software and instrumentation needed to record and collect data.

4.0 Limitations of Comparative Analysis

The evaluation was performed by processing the 1985 Indian Point data with existing NRC quality assurance computer codes and using previous site data (Jan. 1, 1974 through Dec. 31, 1975 and Aug. 1, 1978 through July 31, 1979) in a comparative analysis. This kind of comparative analysis provides insight into the quality, representativeness, and reliability of the data set which may reflect problems with the data collection system. However, this is not an absolute evaluation of the data collection system. Such an evaluation would include a thorough examination of the sensors, calibration and maintenance procedures, and related software and instrumentation.

5.0 Data Evaluation

Data reliability and quality of the 1985 Indian Point meteorological data set were assessed using the NRC quality assurance codes (described in Section 1.0). Climatological representativeness was evaluated through comparisons with previous site data.

5.1 Evaluations

The Indian Point meteorological data set consists of parameters measured at 10.0 and 122.0 meters. Evaluations were performed on data recovery, 60.0-10.0 meter delta-temperature, 122.0-10.0 meter delta-temperature, 10.0 meter wind direction and speed, 122.0 meter wind direction and speed.

The following subsections discuss the reliability, quality and climatological representativeness of the 1985 Indian Point meteorological data.

5.1.1 Data Recovery

The MISS program evaluates the reliability of meteorological data by calculating the percentage of data recovery for several parameters. Table 2 shows the percent of data recovery for all parameters analyzed in this report.

Table 2

Parameter	Level (Meters)	Data Recovery (Percent)
Delta-Temperature	60.0-10.0	100.0
Delta-Temperature	122.0-10.0	100.0
Wind Direction	10.0	100.0
Wind Speed	10.0	99.9
Wind Direction	122.0	99.8
Wind Speed	122.0	99.9

Regulatory Guide 1.23 (NRC 1972) states that meteorological instruments should be inspected and serviced at a frequency which will assure at least 90% data recovery. Also, joint frequency distribution of wind speed, wind direction, and delta-temperature should have a data recovery of at least 90%. As Table 2 shows, all of the parameters have data recoveries (i.e., reliability) well above 90%. In addition, joint frequency distributions showed data recoveries well above 90%. Although it appears that all the instruments have been properly maintained throughout the 1985 data collecting period, these high data recoveries (e.g., 100%) remain suspect. If periodic maintenance and calibration procedures are performed throughout the year there should be several hours of "down time", thus yielding a recovery of data lower than 100%. As indicated in Section 2.0 the emergency back-up tower includes a 10 meter level wind direction and speed and an estimate of atmospheric stability (sigma theta). It would appear that during missing periods of 10 meter wind data, data from the primary tower were filled in with 10 meter data from the back-up tower. This is completely legitimate and emphasizes the need for back-up data. However, the delta-temperature data does not appear to be redundant, and should reflect a data recovery lower than 100%. The recovery rate of 100% suggests that the data may be subjected to some method of interpolation, are not periodically maintained and calibrated, or a redundant system has been implemented in recent years (1982-1985).

The DATE program indicated all possible hours (8760) of all parameters were present in the data set.

5.1.2 60.0-10.0 Meter Delta-Temperature

The 1985 Indian Point 60.0-10.0 meter delta-temperature data were compared with previous 60.0-10.0 delta-temperature data (New York Power Authority 1982)

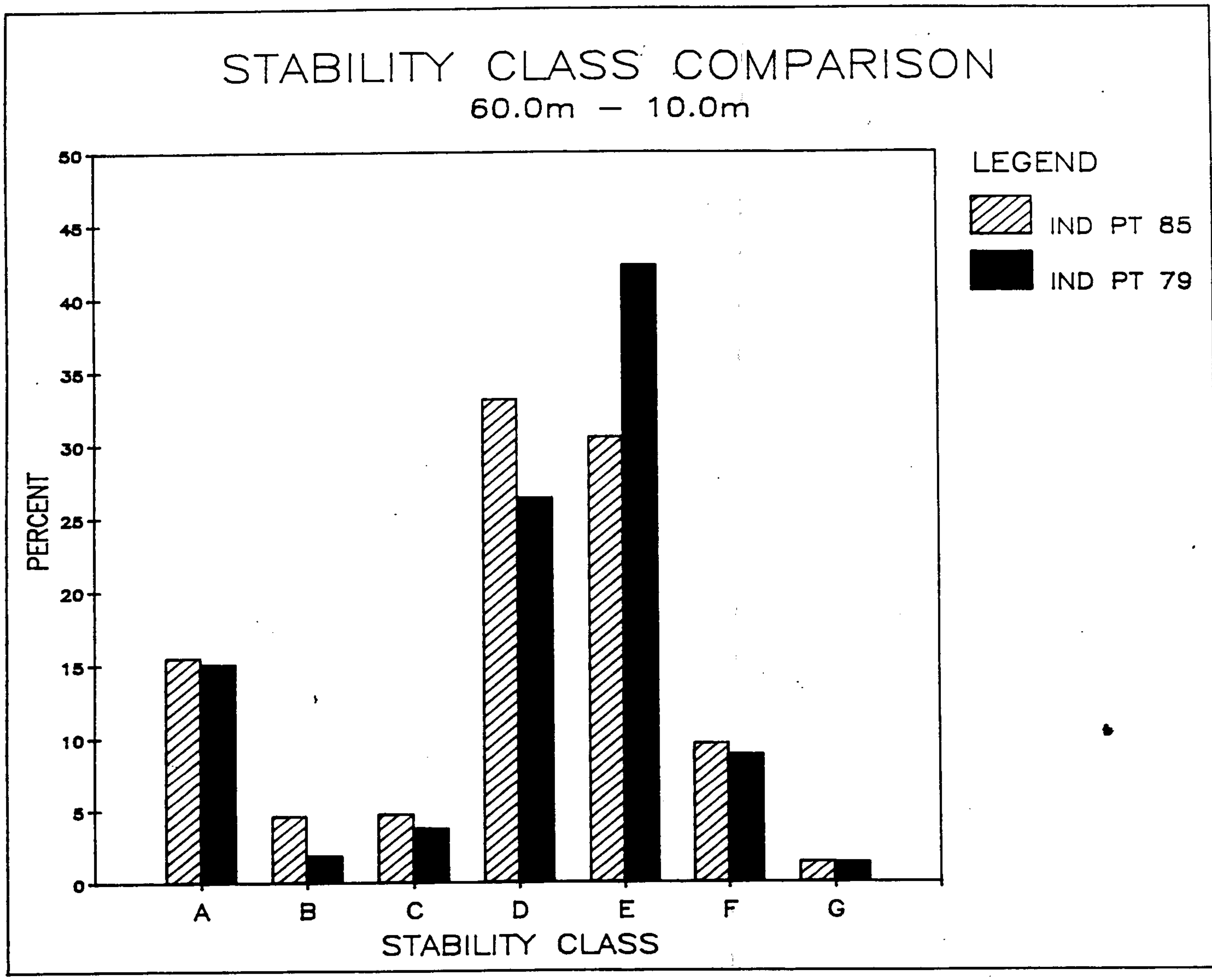

STABILITY CLASS COMPARISON
60.0m — 10.0m
LEGEND
IND PT 85
IND PT 79
PERCENT
50
45
40
35
30
25
20
15
10
5
0
A
B
C
D
E
F
G
STABILITY CLASS

FIGURE 4

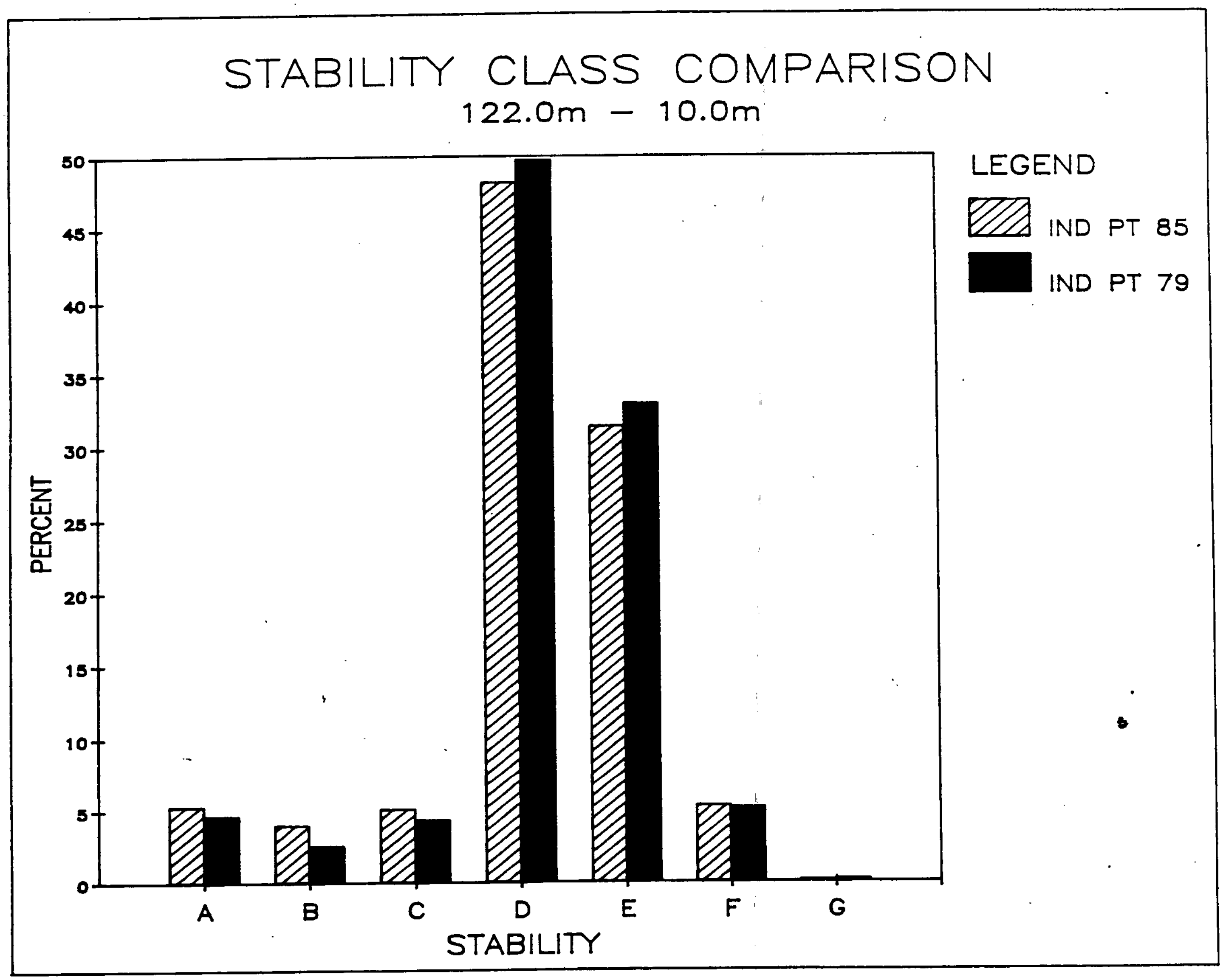

STABILITY CLASS COMPARISON
122.0m – 10.0m
LEGEND
IND PT 85
IND PT 79
PERCENT
50
45
40
35
30
25
20
15
10
5
0
A
B
C
D
E
F
G
STABILITY

FIGURE 5

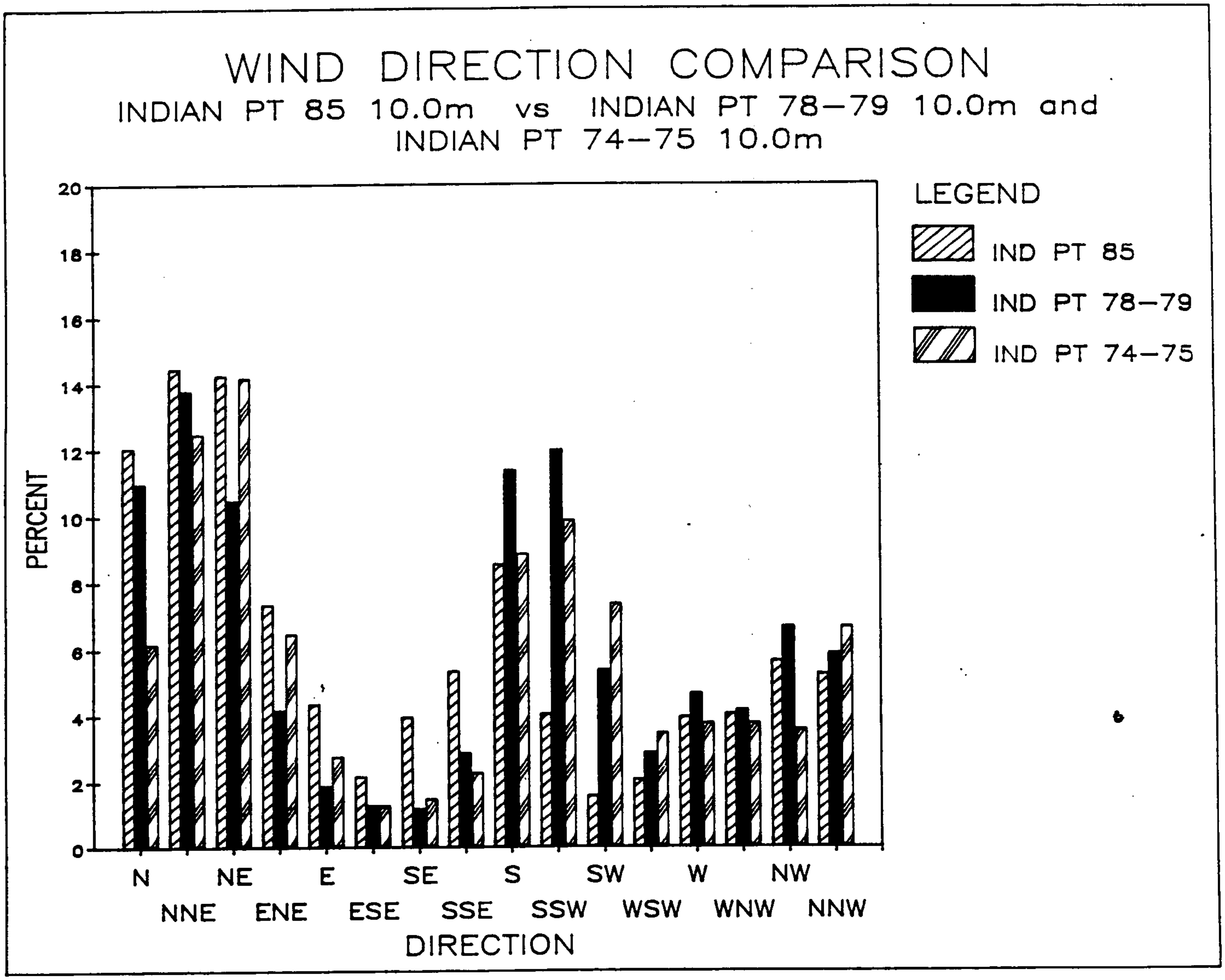

WIND DIRECTION COMPARISON
INDIAN PT 85 10.0m vs INDIAN PT 78–79 10.0m and
INDIAN PT 74–75 10.0m
LEGEND
IND PT 85
IND PT 78–79
IND PT 74–75
PERCENT
0
2
4
6
8
10
12
14
16
18
20
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
DIRECTION

FIGURE 6

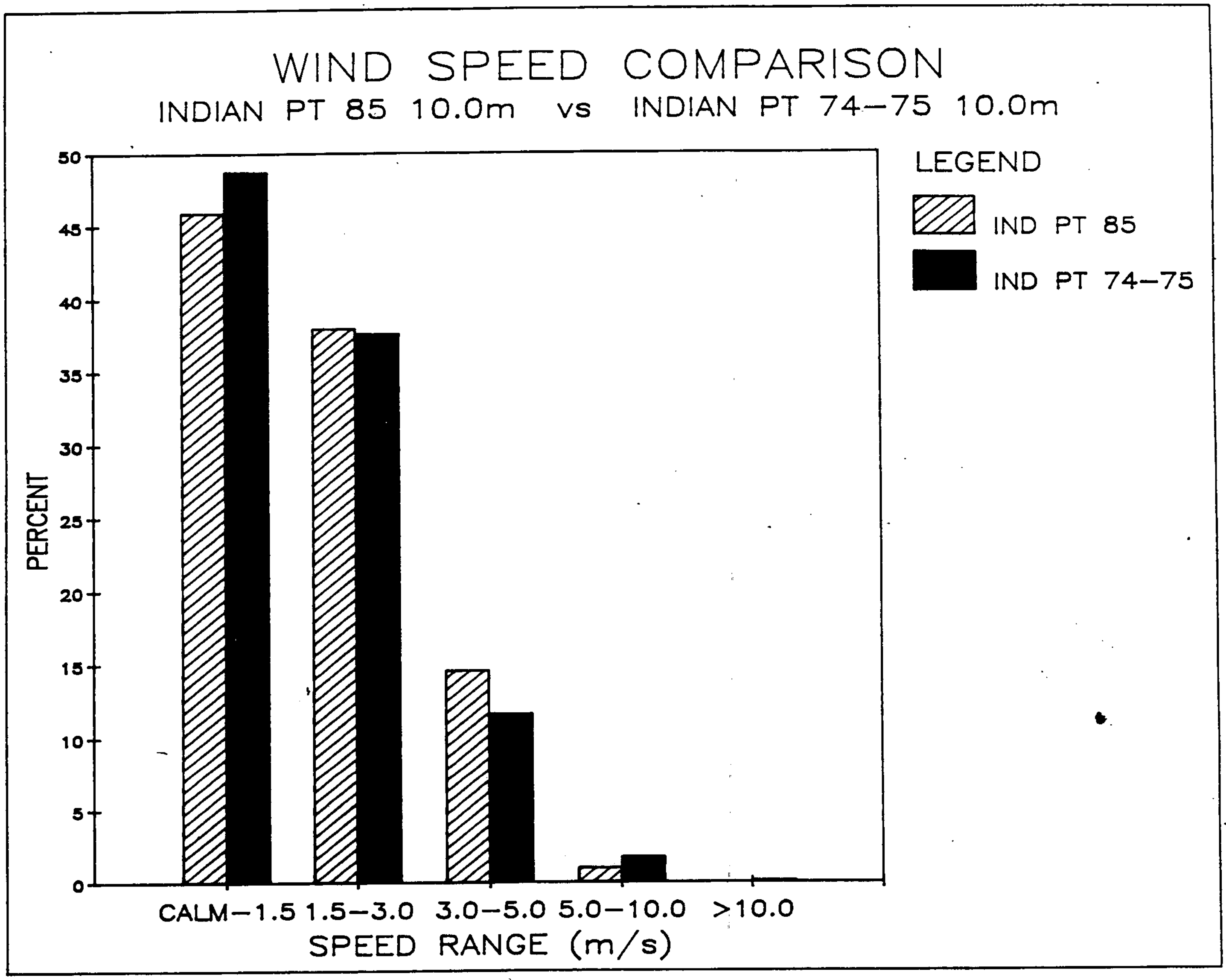

WIND SPEED COMPARISON
INDIAN PT 85 10.0m vs INDIAN PT 74–75 10.0m
LEGEND
IND PT 85
IND PT 74–75
PERCENT
0
5
10
15
20
25
30
35
40
45
50
CALM–1.5
1.5–3.0
3.0–5.0
5.0–10.0
>10.0
SPEED RANGE (m/s)

FIGURE 7

from August 1, 1978 through July 31, 1979 (Fig. 4). The stability classes were determined using the NRC delta-temperature method (Appendix A). The comparison indicates a close relationship between the two data sets. Although there are some discrepancies in the D and E stability classes, it is common to see a shift from one stability class to another on a year-by-year basis.

From examinations of onsite 60.0-10.0 meter delta-temperature distributions it appears that the 1985 60.0-10.0 meter delta-temperature data were climatologically representative, of high quality, and, also, reliable due to their high data recovery (100.0%). It appears that the data would be representative and reliable for use in emergency response actions and routine dose assessments.

5.1.3 122.0-10.0 Meter Delta-Temperature

The 1985 Indian Point 122.0-10.0 meter delta-temperature data were compared with previous 122.0-10.0 delta-temperature data (New York Power Authority 1982) from August 1, 1978 through July 31, 1979 (Fig. 5). The stability classes were determined using the NRC delta-temperature method (Appendix A). The comparison indicates a very close relationship between the two data sets.

From examinations of onsite 122.0-10.0 meter delta-temperature distributions it appears that the 1985 122.0-10.0 meter delta-temperature data were climatologically representative, of high quality, and, also, reliable due to their high data recovery (100.0%). It appears that the data would be representative and reliable for use in emergency response actions and routine dose assessments.

5.1.4 10.0 Meter Wind Direction and Speed

A comparison (Fig. 6) was made between the 1985 Indian Point 10.0 meter wind directions and previous (Aug. 1, 1978 through July 31, 1979 (New York Power Authority 1982) and Jan. 1, 1974 through Dec. 31, 1975 (Verholek 1977)) 10.0 meter wind directions from Indian Point. The comparison shows a reasonably close relationship among the three data sets. The discrepancies that exist between the data sets are more than likely due to the year-by-year change in the weather pattern, and do not necessarily reflect any problems with the data collection system.

A wind speed comparison between the 1985 Indian Point 10.0 meter data and the January 1, 1974 through December 31, 1975 Indian Point 10.0 meter data are shown in Figure 7. The August 1, 1978 through July 31, 1979 wind speed data were omitted due to the difference in wind speed categories. The comparison shows a very close relationship among the two data sets.

From examinations of the 1985 Indian Point 10.0 meter wind direction and speed frequency distributions it appears that the data were climatologically representative, of high quality and, also, reliable because of their high data recovery (100.0% and 99.9%, respectively). It appears the data would be representative and reliable for use in emergency response actions or routine dose assessments.

5.1.5 122.0 Meter Wind Direction and Speed

The 1985 Indian Point 122.0 meter wind direction data were compared with previous (Aug. 1, 1978 through July 31, 1979 (New York Power Authority 1982) and Jan. 1, 1974 through Dec. 31, 1975 (Verholek 1977)) Indian Point 122.0 meter wind direction data (Fig. 8). The comparison indicates a close relationship among the data sets. In addition, the 1985 Indian Point 122.0 meter wind speed data were compared with previous (Jan. 1, 1974 through Dec. 31, 1975) Indian Point 122.0 wind speed data (Fig. 9). The August 1, 1978 through July 31, 1979 wind speed data were omitted due to differences in the wind speed categories. Again, the comparison shows a close relationship between the two data sets.

In conjunction with the above comparisons, an intercomparison was made between the wind directions (Fig. 10) and wind speeds (Fig. 11) from the 1985 Indian Point 10.0 meter and 122.0 meter meteorological data. Although the wind direction comparison shows some large differences between the two data sets, they do display the same basic trend; higher frequencies in the north, south, and northwest sectors. Differences between wind direction distributions are common for measurements made at different levels (e.g., 10.0 meter vs 122.0 meter); especially when the interval between the two levels is large. The lower-level winds tend to turn counter-clockwise during low pressure events and clockwise during high pressure events relative to the upper-level wind direction. Other factors such as terrain, obstructions and vegetation, and/or local mesoscale circulations may also generate different frequency distributions for two different levels of wind direction. The wind speed comparison shows the expected distribution between lower- and upper-level wind speeds; the lower-level winds are skewed more toward the slower wind speeds while the upper-level winds are skewed toward the higher wind speeds.

Examinations of the 122.0 meter wind direction and speed indicate that the data were climatologically representative, of high quality, and, also, are reliable due to their high data recovery (99.8% and 98.9%, respectively). It appears that the data would be representative and reliable for use in emergency response actions or routine dose assessments.

6.0 Conclusion

The quality, reliability, and representativeness of meteorological data collected at operating reactor sites is important to ensure appropriate integration into emergency response actions and to ensure appropriate assessments of the radiological impacts of routine releases.

As discussed in Section 5.1.1, the delta-temperature data had data recoveries of 100%. Because these data do not appear to have been backed-up, data recoveries lower than 100% are expected. A thorough review of the recovery methods for the delta-temperature data ought to be performed to ensure data integrity.

In general, examinations of the Indian Point 1985 data set indicate the data appeared to be climatologically representative, of high quality, and reliable

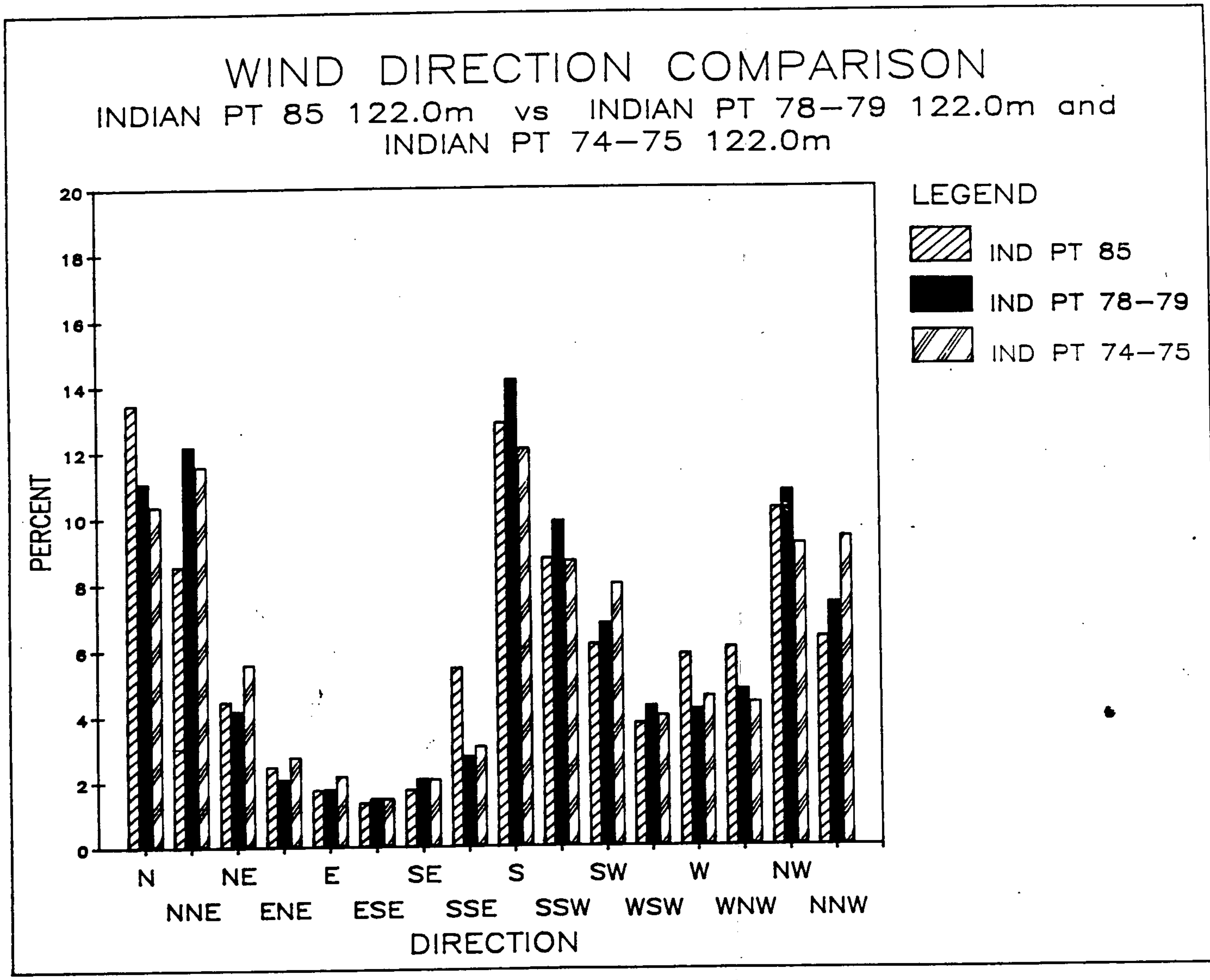

WIND DIRECTION COMPARISON
INDIAN PT 85 122.0m vs INDIAN PT 78-79 122.0m and
INDIAN PT 74-75 122.0m
LEGEND
IND PT 85
IND PT 78-79
IND PT 74-75
PERCENT
20
18
16
14
12
10
8
6
4
2
0
N
NE
E
SE
S
SW
W
NW
NNE
ENE
ESE
SSE
SSW
WSW
WNW
NNW
DIRECTION

FIGURE 8

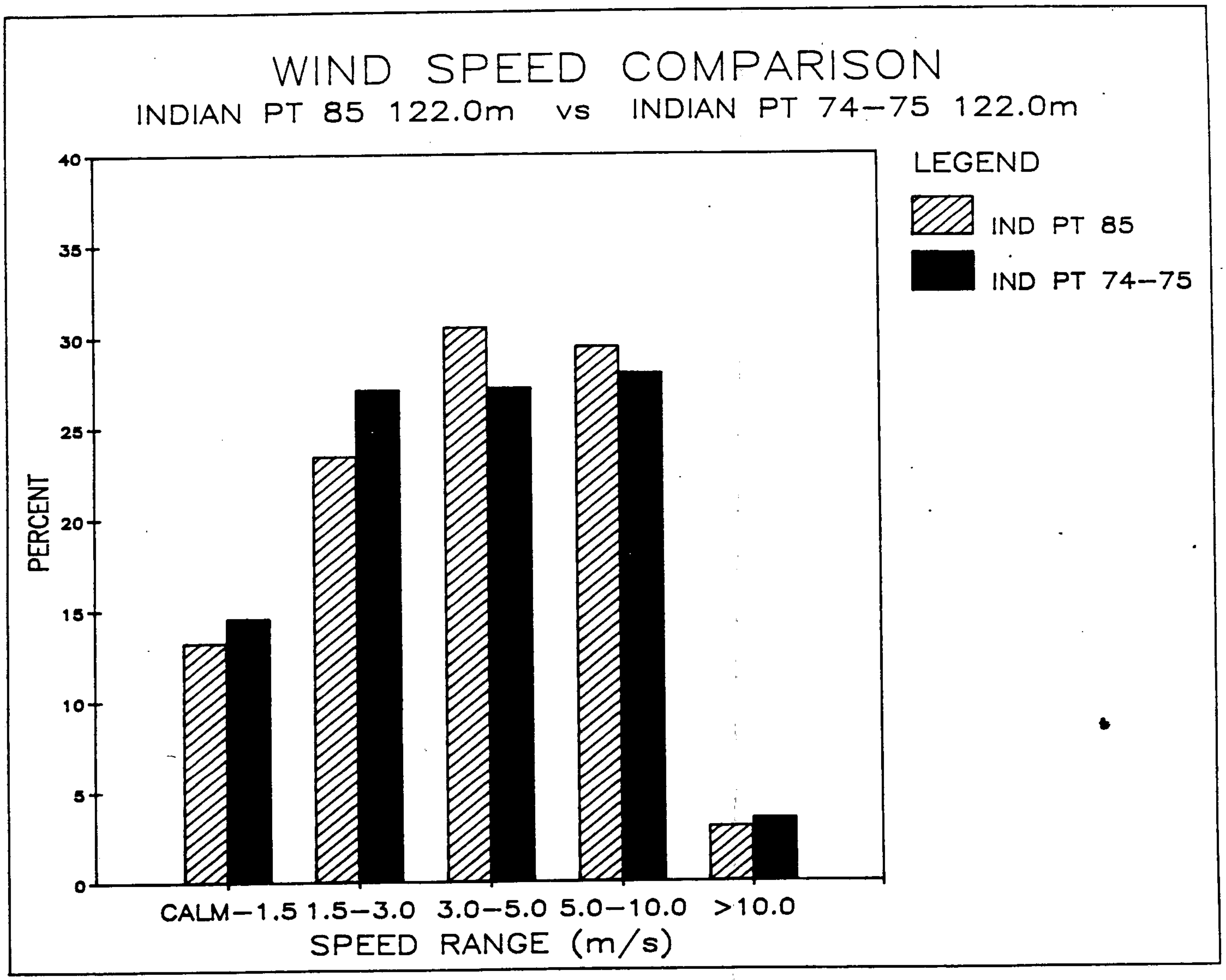

WIND SPEED COMPARISON
INDIAN PT 85 122.0m vs INDIAN PT 74–75 122.0m
LEGEND
IND PT 85
IND PT 74–75
PERCENT
0
5
10
15
20
25
30
35
40
CALM–1.5
1.5–3.0
3.0–5.0
5.0–10.0
>10.0
SPEED RANGE (m/s)

FIGURE 9

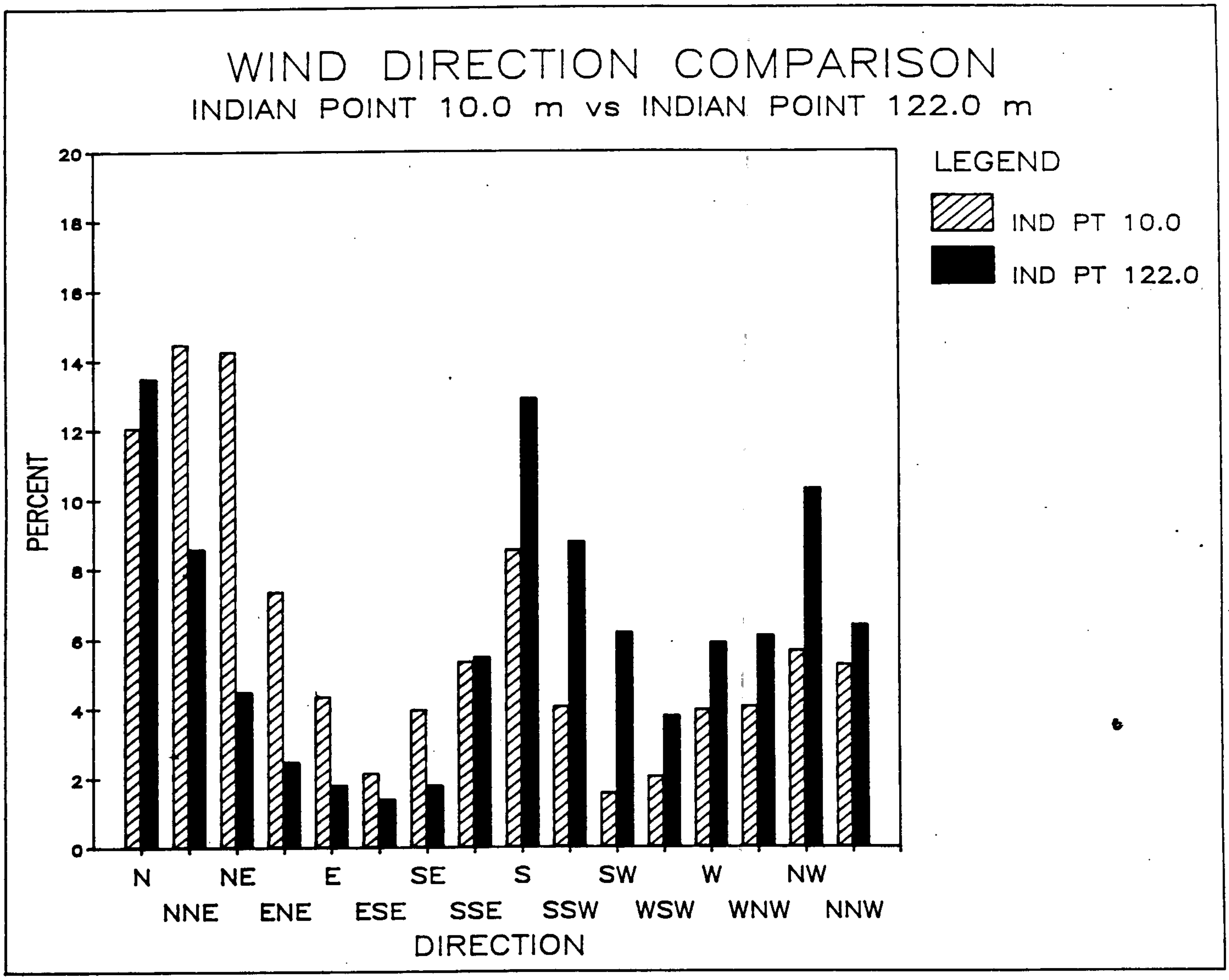
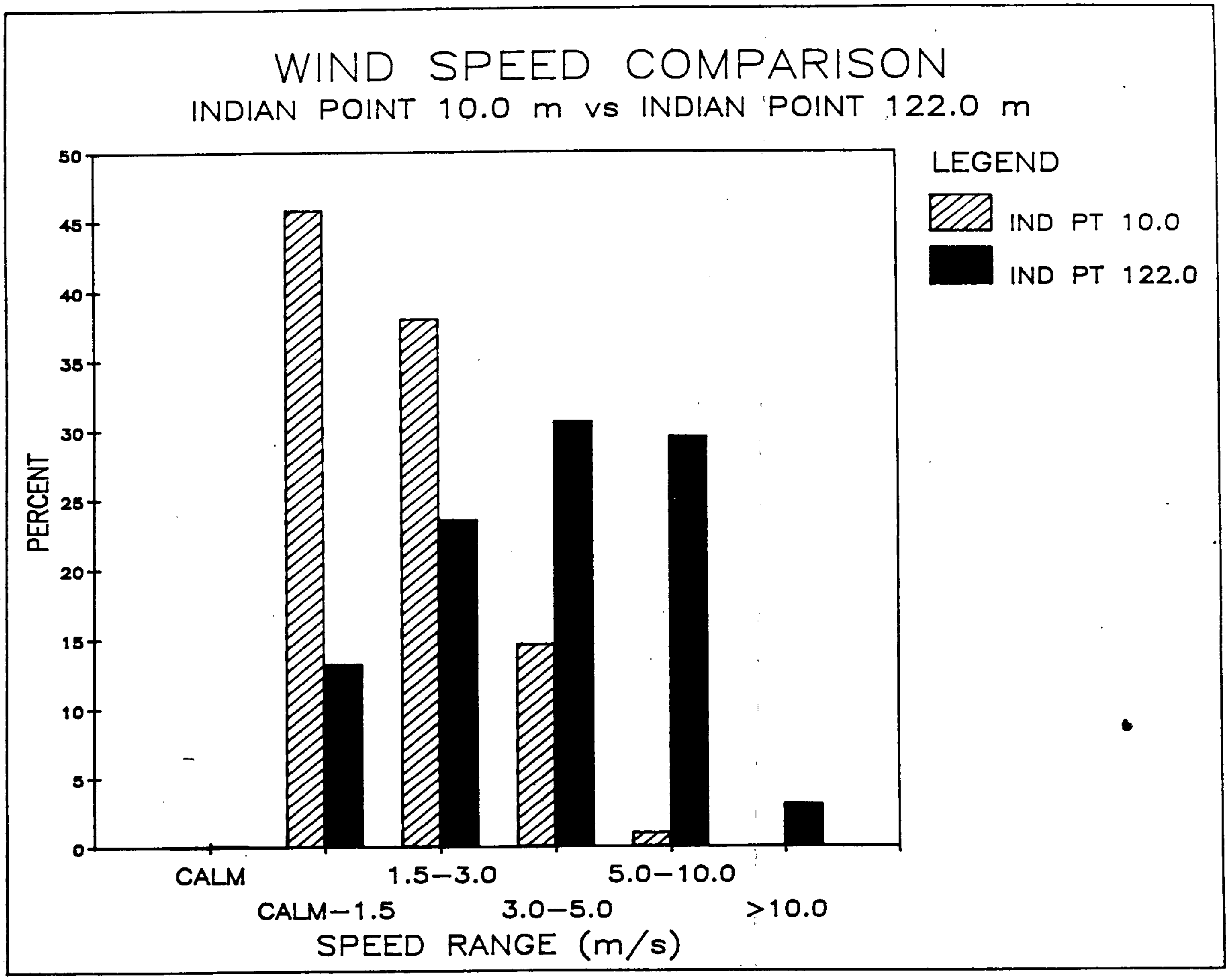

WIND DIRECTION COMPARISON
INDIAN POINT 10.0 m vs INDIAN POINT 122.0 m
LEGEND
IND PT 10.0
IND PT 122.0
PERCENT
0
2
4
6
8
10
12
14
16
18
20
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
DIRECTION

FIGURE 10



WIND SPEED COMPARISON
INDIAN POINT 10.0 m vs INDIAN POINT 122.0 m
LEGEND
IND PT 10.0
IND PT 122.0
PERCENT
50
45
40
35
30
25
20
15
10
5
0
CALM
CALM−1.5
1.5−3.0
3.0−5.0
5.0−10.0
>10.0
SPEED RANGE (m/s)

FIGURE 11

and would not affect NYPA's ability to provide credible dose calculations and recommendations for protective actions in an emergency situation as well as doses calculated to assess the impacts of routine releases of radioactive material to the atmosphere.

7.0 References

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APPENDIX A

ability
Class

A
B
C
D
E
F
G

?PPENDIX A

Indian Point 3

Temperature Scheme

Numeric Category	Stability Class
1	A
2	B
3	C
4	D
5	E
6	F
7	G