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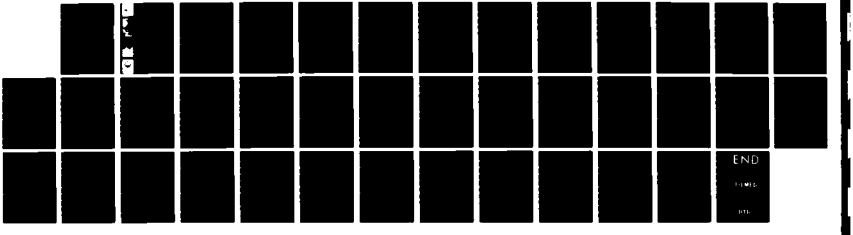

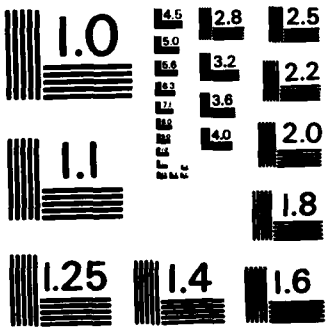

US Army Corps of Engineers

COASTAL ENGINEERING RESEARCH CENTER

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OCEANOGRAPHIC AND METEOROLOGICAL CONDITIONS DURING A SHIP MOORING FORCE STUDY

by

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Coastal Engineering Research Center

DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
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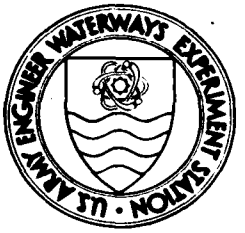

August 1985
Final Report

Prepared for

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Port Hueneme, California 93043

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Wave and current data collected about 3 km from shore at Duck, North Carolina, in connection with a ship mooring force experiment are summarized. Six-hourly wave heights, periods, and spectra; 15-min average values of current speed and direction; and wind speed and direction are presented for the period between 1900 hours 14 November 1983 and 1430 hours 17 November 1983. The response of the coastal wave and current fields to passage of a local wind system is illustrated.

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PREFACE

The study described herein was authorized by the Naval Civil Engineering Laboratory (NCEL), Port Hueneme, California, under the general direction of Mr. Paul Palo.

All elements of the study were conducted by the US Army Engineer Waterways Experiment Station (WES) Field Research Facility (FRF) personnel at Duck, North Carolina, under the direction of Dr. R. W. Whalin, Chief, Coastal Engineering Research Center (CERC); Dr. J. R. Houston, Chief, Research Division, CERC; and Mr. Curtis Mason, Chief, FRF. The report was written by Messrs. Mason, William E. Grogg, Jr., and Eugene W. Bichner.

Commanders and Directors of WES during the investigation were COL Tilford C. Creel, CE, and COL Robert C. Lee, CE; Technical Director was Mr. F. R. Brown. Director of WES at the time of publication of this report was COL Allen F. Grum, USA; Technical Director was Dr. Robert W. Whalin.

CONTENTS

OCEANOGRAPHIC AND METEOROLOGICAL CONDITIONS DURING A SHIP MOORING FORCE STUDY

PART I: INTRODUCTION

Background

1. The Naval Civil Engineering Laboratory (NCEL) is involved in the investigation of ship motions and mooring forces on vessels anchored in coastal waters. A mooring force model was developed by NCEL, but field data are required to verify its accuracy and determine its limitations.

2. To assist NCEL meet these field data requirements, the US Army Engineer Waterways Experiment Station (WES) conducted two field data collection efforts at the Coastal Engineering Research Center (CERC) Field Research Facility (FRF) (Figure 1). The objective of the first effort, conducted between 23 April and 19 May 1983, was to determine the spatial variability in the nearshore (15-m water depth) wave field. Based on the results of this effort, which are documented in a report by Hughes,* a second experiment was designed and conducted between 14 and 17 November 1983. This report discusses the results of the second data collection effort.

Objectives

3. The objectives of ~~the November~~ experiment were to determine mooring loads on cables mooring a ship in the open ocean and to collect data on the environmental forces (waves, currents, and wind) producing these loads. Large variability in the relative magnitude of these forces was desired. Following data analysis, the results were to be compared by NCEL with those from the numerical model to assess the model's capabilities. This report presents a summary and assessment of wave, current, and wind data collected during the experiment.

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* Steven A. Hughes. 1984. "Spatial Variability in the Nearshore Wavefield." Miscellaneous Paper CERC-84-7, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

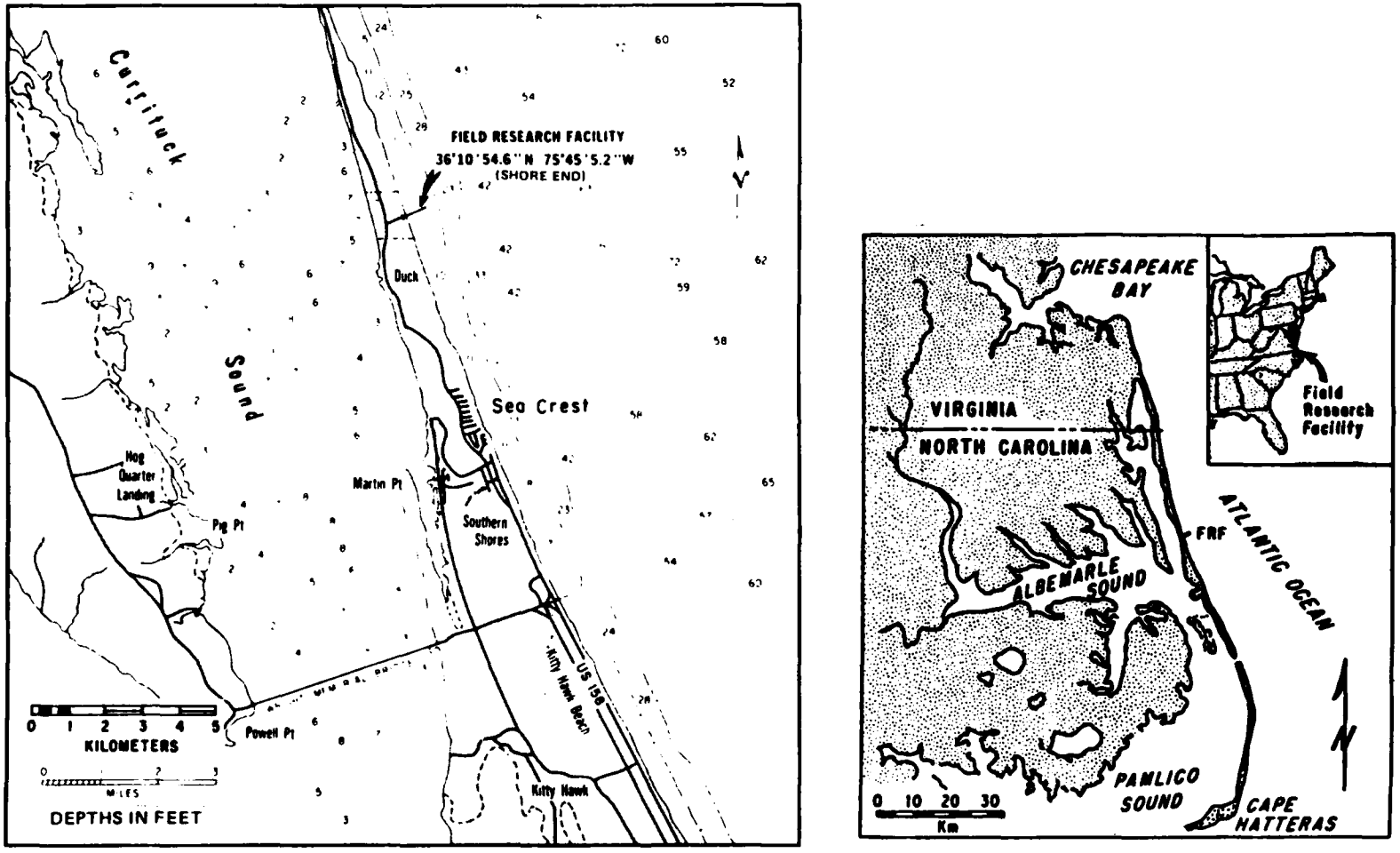

Figure 1. Location of study

PART II: APPROACH

4. To conduct the experiment, the OCP SEACON, a 264-ft-long* naval ocean construction platform ship, was set in a four-point moor in approximately 55 ft of water offshore of the FRF (Figure 2). NCEL instruments were attached to the mooring cables to measure mooring loads, and these data were collected on an onboard NCEL data acquisition system. A number of other instruments were used to measure the forces impinging upon the SEACON during the experiment, as described below.

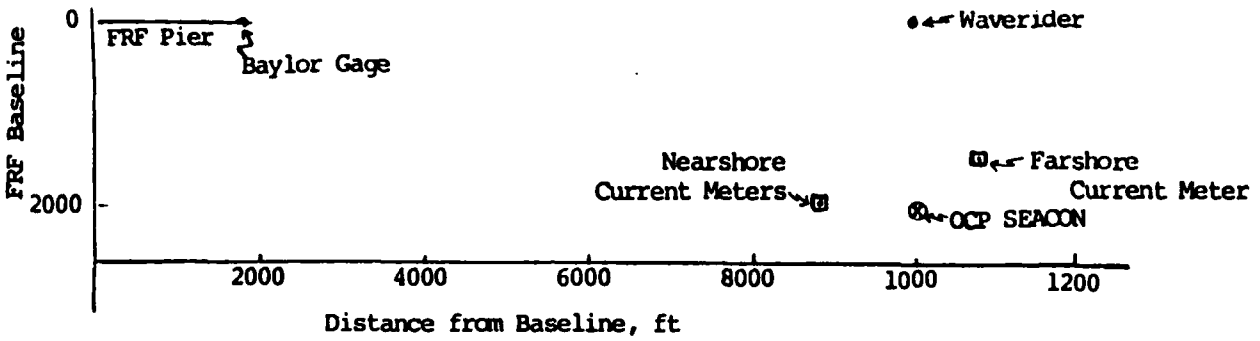

Figure 2. Location of current meters and wave gages

Wave Data Collection

5. An FRF Baylor staff inductance wave gage located at the seaward end of the FRF research pier and an FRF Waverider buoy wave gage located north of the ship (Figure 2) provided wave height and period data throughout the experiment. However, to determine the wave field at the ship's exact position, two other Waveriders were positioned near the ship. Data from these buoys were collected by NCEL aboard the SEACON.

Nearshore Currents

6. Neil Brown acoustic current meters were placed on taut-wire moorings approximately 1,000 ft on either side of the vessel (Figure 2). The FRF Lighter Amphibious Resupply Cargo vessel (LARC-V), an amphibious cargo vessel, was used to deploy the moorings, and a Zeiss electronic total station was used

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* To convert feet to meters use a conversion factor of 0.3048.

for positioning the craft. At the primary (nearshore) mooring (water depth = 54.5 ft National Geodetic Vertical Datum (NGVD)), one meter was positioned at a depth of 14.5 ft NGVD, and a lower one was positioned at a depth of 29 ft NGVD. These meters were designed to sample current speed and direction every second for 15 min, determine the resultant speed and direction for that 15-min sample, and write the data on an internal cassette tape. The farshore meter was placed in 56.4 ft of water at a depth of 10 ft for NGVD.

Other Data

7. An anemometer on the FRF office building provided wind speed and direction data, and visual observations were made of wave direction (including radar-measured waves), currents at the pier end and in the breaker zone, and other oceanographic parameters (water temperature, visibility, etc.).

PART III: DATA REDUCTION AND ANALYSIS

Meteorological Data

8. Figure 3 shows the time-history of hourly values of wind speed and direction.

Wave Data

9. Data from the pier-end Baylor gage and the FRF Waverider were analyzed using a Fast Fourier Transform (FFT) analysis routine which yields the band spectra (frequency vs. percent normalized variance), a wave height parameter (four times the standard deviation of the record), and the period associated with the maximum energy density. Plots of the wave height and period time-histories for both the Baylor and Waverider gages are shown in Figures 4 and 5, and Appendix A summarizes the band spectra from the FRF Waverider during the experiment.

Current Data

10. Cassette tapes from the Neil Brown current meters were sent to a private company for reduction. Plots of the time-histories of current speed and direction at the two nearshore current meters are shown in Figure 6, and Appendix B contains tables of each 15-min value between 14 and 17 November 1983.

11. Upon return of the data printouts to the FRF, it was noticed that directional data from the farshore current meter did not agree with those from the nearshore meters. Questioning of the leasor regarding improper functioning of the equipment revealed that an incorrect circuit card had been placed in the farshore meter by the factory. Although the speeds indicated on each channel were correct, the directional characteristics could not be determined from the data because of uncertainties in the meter's orientation during each sample run. However, if the current direction could be assumed to be identical to that of the nearshore meters and the meter orientation remained constant, then the magnitude could be determined. Such conditions occurred only between 1700 hours on 15 November and 0800 hours on 16 November.

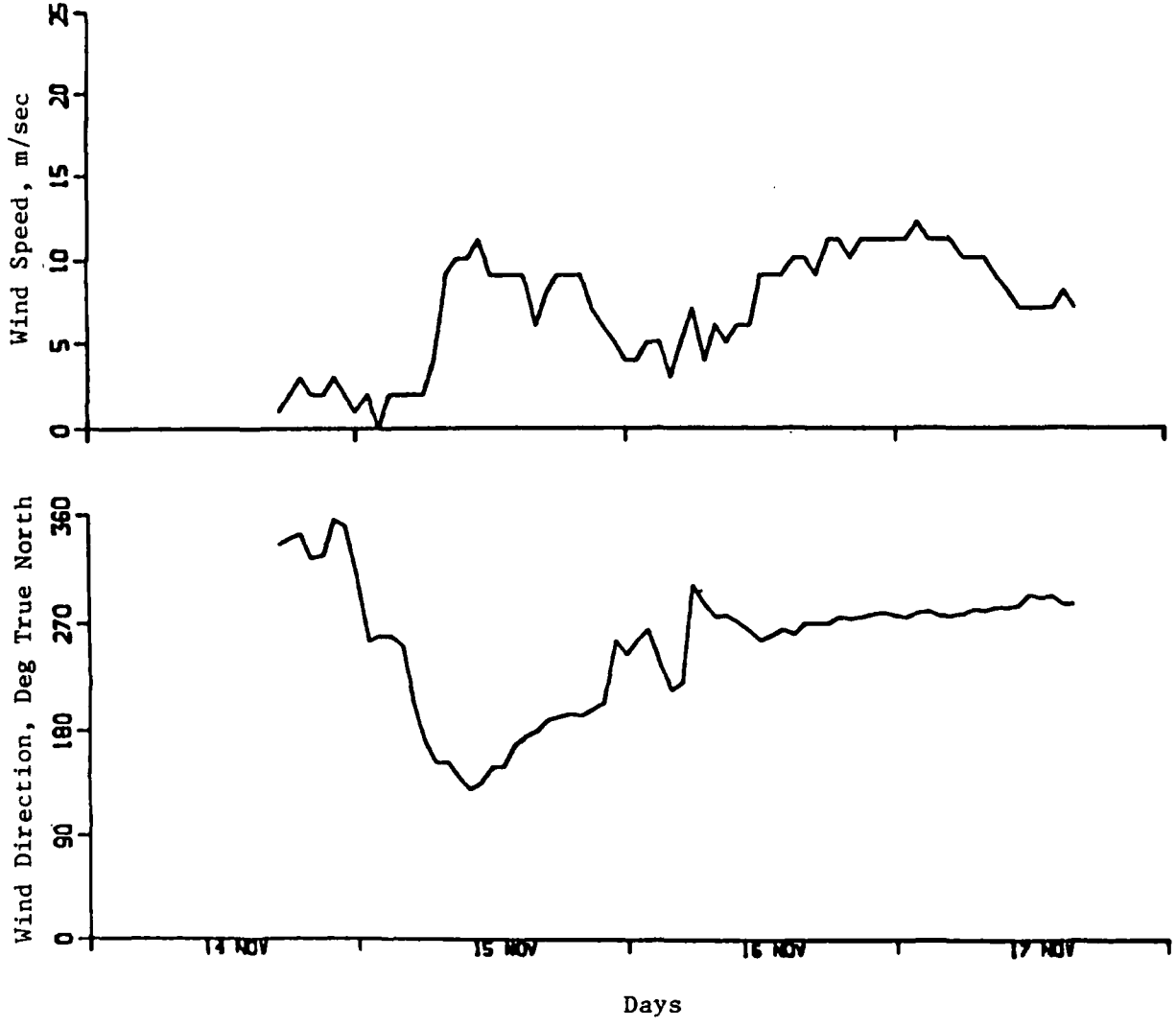

Figure 3. Time-history of wind speed and direction, FRF building anemometer, 14-17 November 1983

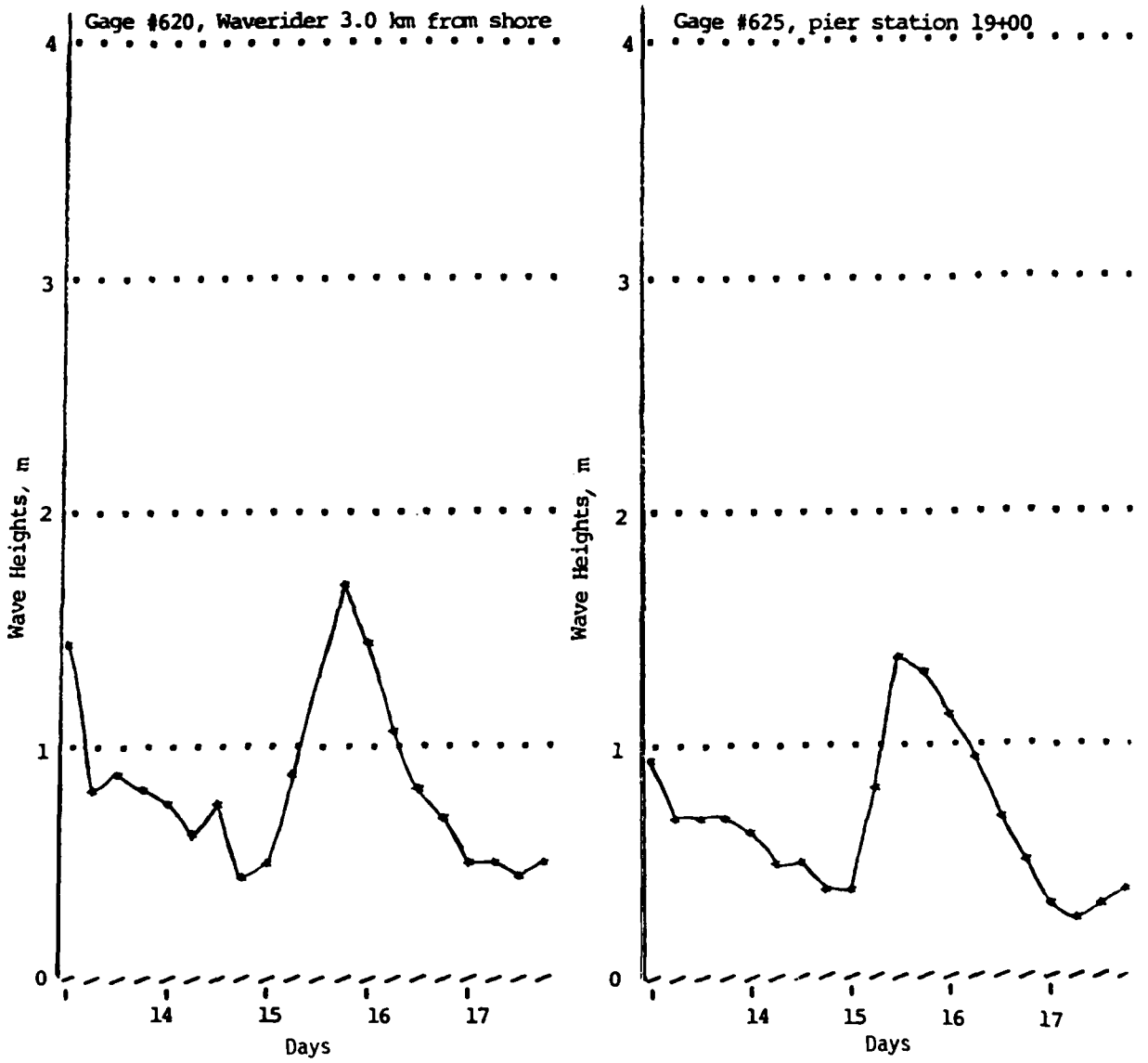

Figure 4. Wave heights, 14-17 November 1983

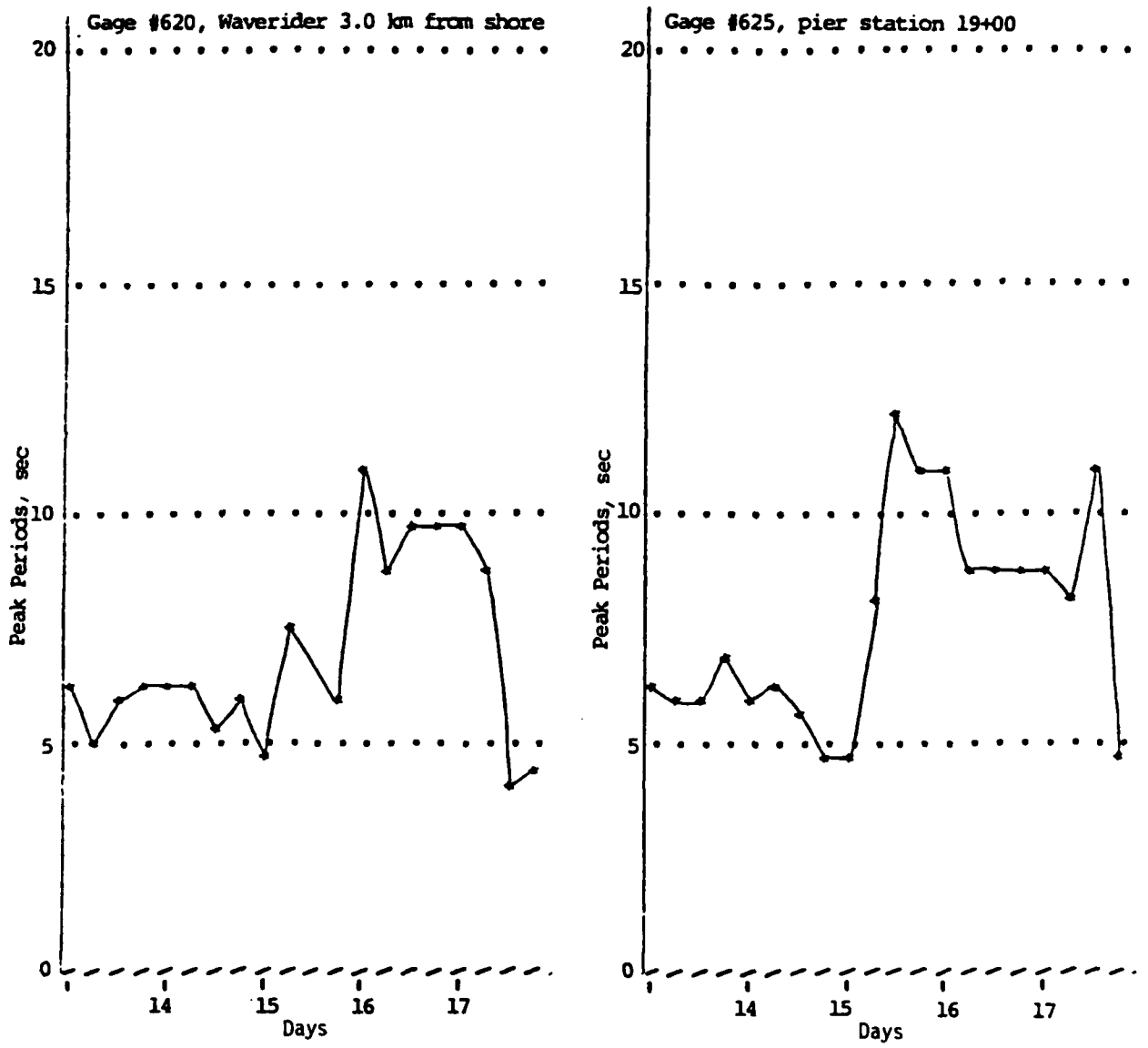

Figure 5. Wave periods, 14-17 November 1983

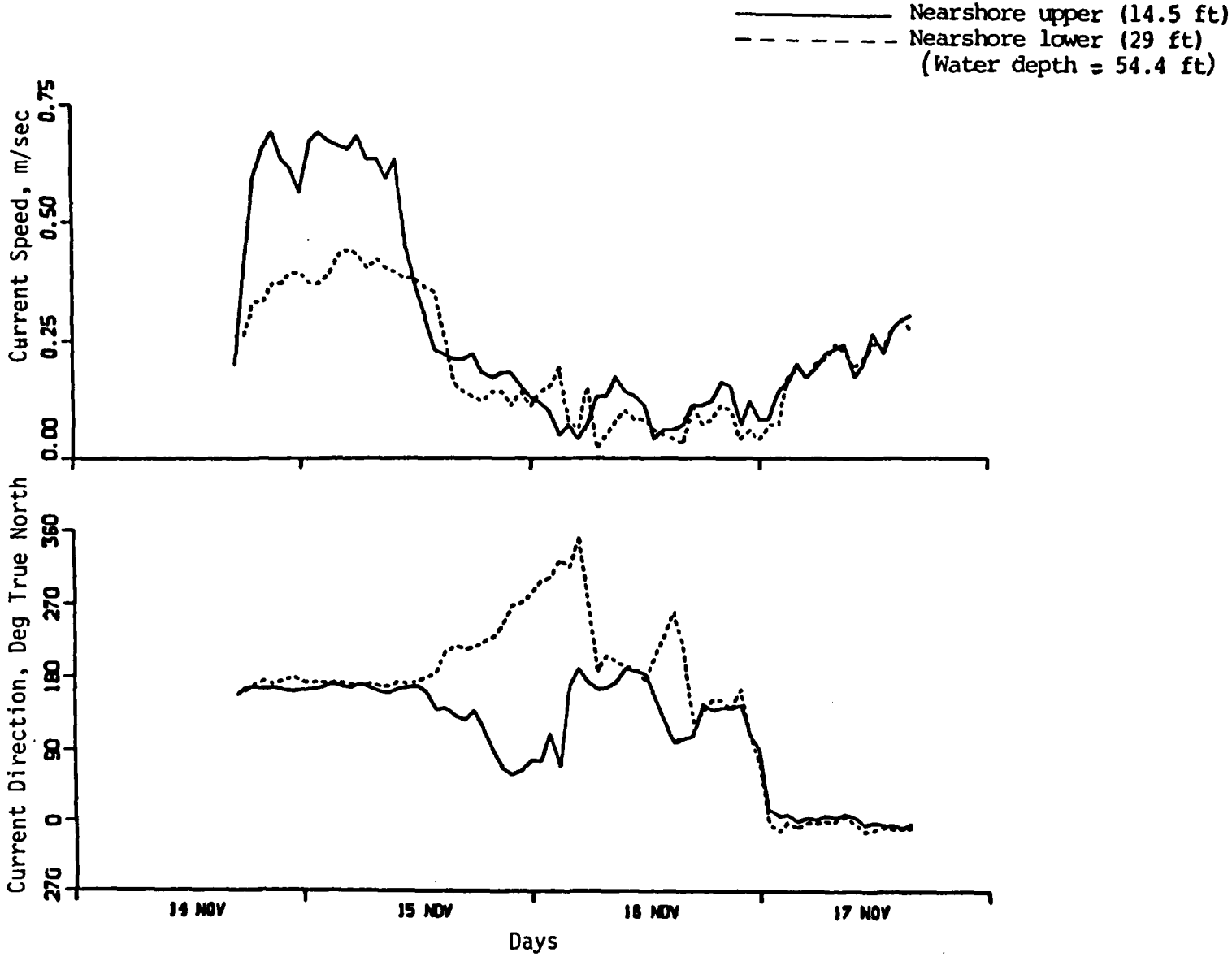

Figure 6. Time-history of current speed and direction, nearshore array, 14-17 November 1983

PART IV: RESULTS

12. The following discussion presents an assessment of the forces affecting the SEACON during its 3-day deployment (1500 hours 14 November through 1700 hours 17 November 1983). Since winds appear to be the primary factor controlling waves and currents during the experiment, their characteristics will be addressed first.

Meteorological Conditions

13. Between 1500 hours 14 November and 0600 hours 15 November, the wind speed remained constant at about 2 m/sec. However, the wind direction gradually rotated counter-clockwise from due north on 14 November to about 135 deg (SE) by 1000 hours on 15 November. Between 0600 hours and 1000 hours the speed increased drastically, reaching a peak value of approximately 12 m/sec at 1000 hours, and remaining at approximately 10 m/sec until 2000 hours. The wind direction slowly changed from 135 deg (SE) to 190 deg (SSW), but this time with a clockwise rotation. This process continued after 2000 hours as the wind speed gradually diminished, reaching a maximum of 300 deg (WNW) at 0600 hours on 16 November. At that time, the wind speed began a gradual increase to about 12 m/sec and, after a relatively rapid shift of direction to about 270 deg (W) at 1100 hours on 16 November, the wind remained out of the WNW for the final 24 hours of the experiment.

Waves

14. Strong winds from the southeast on the morning of 15 November caused rapid development of wind waves, such that by noon the significant wave height had reached a maximum of 1.5 m (Figure 4). As the winds shifted from the southeast to the west, wave heights decreased almost linearly, returning to their pre-storm values of less than 0.5 m by 2400 hours on 16 November. Wave spectra (Appendix A) indicate that at 0700 hours on 15 November, the wave field could be characterized by a single-peaked spectrum (peak period about 7.5 sec). Radar wave direction observations taken at that time indicate an offshore wave approach angle of 45 deg (relative to true north). By 1400 hours, however, two wave trains were evident in the

nearshore zone, one arriving from 75 deg and the other from 105 deg. The 75-deg train appeared to be that with the most energy (about 15 percent of the variance) at a period of about 11 sec, while the 105-deg train contained about 9 percent of the variance at a period of about 5 sec.

15. At 1700 hours, only one train could be identified on the radar image, approaching from an angle of 95 deg. However, the wave data obtained at 1900 hours indicate the continued existence of two wave trains, with peak periods of about 5.5 and 11 sec. By 0100 hours on 16 November, as wave heights began to decrease, only one wave train was evident from the spectral output (T=11 sec), a situation which continued throughout the remainder of the experiment. The visual observations indicate that waves on the morning of 16 November approached from an angle of 85 deg.

Currents

16. The current patterns indicated by this data set are extremely interesting, yet quite complex. Since the ship's mooring system precluded placement of the current meters near the ship, they were moored about 1,000 ft on either side. It was felt that the currents impinging upon the ship could be determined by interpolating between these two data sets.

17. The data summarized in Appendix B and shown in Figure 6 provide current speeds and direction at the nearshore location at depths of 14.5 and 29 ft NGVD. Although most of the data from the farshore meter were not retrievable, reliable estimates of current speeds for the 15-hr period on 15-16 November indicated that the currents affecting the ship should be adequately represented by the data from the nearshore near-surface meter.

18. Between 1800 hours and 2000 hours 14 November, near-surface current speeds increased rapidly to over 0.5 m/sec, remained relatively constant until approximately 0900 hours on 15 November, and then decreased rapidly over the next 6 hr. Throughout most of this period, currents were flowing southward. This agrees well with the 0700 hours 15 November dye measurements at the end of the FRF pier and in the midsurf zone under the pier, both of which indicated a current of about 0.25 m/sec directed southward.

19. The period between noon on 15 November and midnight on 16 November appears to be a transitional one for the currents, apparently in response to the rapidly changing wind regime. The near-surface current speeds were

relatively low, averaging less than 0.1 m/sec. Some indication of tidal forcing is indicated in both meters' speed time-series, with maxima and minima at the expected 12-hr spacing. However, the directional data show peculiar differences during this period. Between noon on 15 November and 0600 hours on 16 November the nearshore current varied between 180 deg and 80 deg at approximately 12-hr intervals.

20. In comparing the near-surface and middepth currents at the nearshore site, note that the middepth speeds were often smaller, while the directions were generally in very good agreement, except during the transitional period of 15 and 16 November.

21. The correlation between winds and currents at this location is rather complex. As the wind speed increased and its direction rotated counter-clockwise early on 15 November, the current direction remained constant with depth (southward). However, between noon and midnight on 15 November, as the wind direction rotated clockwise, currents at the surface changed direction counter-clockwise, while those at the bottom rotated clockwise. Such a difference in current patterns over such a small vertical distance (about 15 ft) is extremely puzzling. A thorough check of data quality shows no questionable data, so it appears that a shear zone existed for approximately 15 hr between 15- and 30-ft depths at the nearshore site.

Summary

22. Between 14 and 17 November, the OCP SEACON was exposed to the following combinations of wind, wave, and current conditions:

Time Period	Winds m/sec	Waves, m	Near-Surface Currents m/sec
1700 hours 14 Nov - 0200 hours 15 Nov	Light (2)	Low (0.4)	Large (0.5)
0200 hours 15 Nov - 2400 hours 15 Nov	High (10)	Medium (1.5)	Large (0.5) to small (0.1)
0000 hours 16 Nov - 1200 hours 16 Nov	Medium (5)	Medium (1)	Small and variable
1200 hours 16 Nov - 1200 hours 17 Nov	High (10)	Low	Medium (0.2)

In light of the objectives of this experiment, such variability in conditions over such a short time period was extremely fortuitous. Caution should be exercised in planning future experiments with the expectation that similar good fortune will prevail.

APPENDIX A: WAVE SPECTRA FROM FRF WAVERIDER

14-17 NOVEMBER 1983

Table A1

Wave Spectra, Waverider (620), 1900 EST, 14 November 1984

Band Spectrum (Band Center Frequency Versus Percentage Normal Variance)

Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %
.00586	.156	.27441	4.428	.54297	.287	.81152	.000
.01660	.033	.28516	3.652	.55371	.264	.82227	.000
.02734	.054	.29590	2.777	.56445	.106	.83301	.000
.03809	.042	.30664	2.539	.57520	.229	.84375	.000
.04883	.109	.31738	2.240	.58594	.316	.85449	.000
.05957	1.137	.32813	.331	.59668	.186	.86523	.000
.07031	1.693	.33887	.660	.60742	.137	.87598	.000
.08105	2.351	.34961	1.108	.61816	.474	.88672	.000
.09180	2.958	.36035	1.090	.62891	.536	.89746	.000
.10254	2.824	.37109	1.717	.63965	.379	.90820	.000
.11328	1.700	.38184	.925	.65039	.314	.91895	.000
.12402	1.480	.39258	.842	.66113	.284	.92969	.000
.13477	2.758	.40332	.310	.67188	.255	.94043	.000
.14551	.839	.41406	.379	.68262	.140	.95117	.000
.15625	1.813	.42480	.619	.69336	.204	.96191	.000
.16699	7.277	.43555	.367	.70410	.238	.97266	.000
.17773	5.848	.44629	.701	.71484	.115	.98340	.000
.18848	5.188	.45703	.445	.72559	.252	.99414	.000
.19922	4.773	.46777	.445	.73633	.144	1.00488	.000
.20996	6.347	.47852	.624	.74707	.224	1.01563	.000
.22070	4.081	.48926	.855	.75781	.164	1.02637	.000
.23145	4.927	.50000	.449	.76855	.124	1.03711	.000
.24219	3.814	.51074	.422	.77930	.119	1.04785	.000
.25293	6.643	.52148	.508	.79004	.000	1.05859	.000
.26367	3.896	.53223	.281	.80078	.000	1.06934	.000

Significant Height = 0.45 m.
Peak Period = 5.99 sec.

Table A2

Wave Spectra, Waverider (620), 0100 EST, 15 November 1983

Band Spectrum (Band Center Frequency Versus Percentage Normal Variance)

Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %
.00586	.059	.27441	2.093	.54297	.057	.81152	.000
.01660	.102	.28516	5.382	.55371	.048	.82227	.000
.02734	.111	.29590	1.013	.56445	.099	.83301	.000
.03809	.162	.30664	.739	.57520	.165	.84375	.000
.04883	.126	.31738	1.446	.58594	.054	.85449	.000
.05957	.330	.32813	.548	.59668	.076	.86523	.000
.07031	1.832	.33887	.807	.60742	.087	.87598	.000
.08105	1.616	.34961	1.096	.61816	.042	.88672	.000
.09180	2.229	.36035	.602	.62891	.058	.89746	.000
.10254	2.914	.37109	.298	.63965	.040	.90820	.000
.11328	7.056	.38184	.137	.65039	.018	.91895	.000
.12402	4.772	.39258	.309	.66113	.057	.92969	.000
.13477	3.158	.40332	.217	.67188	.068	.94043	.000
.14551	2.926	.41406	.469	.68262	.069	.95117	.000
.15625	2.110	.42480	.351	.69336	.061	.96191	.000
.16699	.851	.43555	.177	.70410	.045	.97266	.000
.17773	4.353	.44629	.397	.71484	.069	.98340	.000
.18848	6.193	.45703	.268	.72559	.045	.99414	.000
.19922	4.524	.46777	.065	.73633	.000	1.00488	.000
.20996	10.407	.47852	.152	.74707	.000	1.01563	.000
.22070	4.958	.48926	.110	.75781	.000	1.02637	.000
.23145	7.378	.50000	.152	.76855	.000	1.03711	.000
.24219	8.160	.51074	.075	.77930	.000	1.04785	.000
.25293	3.446	.52148	.186	.79004	.000	1.05859	.000
.26367	3.678	.53223	.127	.80078	.000	1.06934	.000

Significant Height = 0.49 m.
Peak Period = 4.76 sec.

Table A3

Wave Spectra, Waverider (620), 0700 EST, 15 November 1983

Band Spectrum (Band Center Frequency Versus Percentage Normal Variance)

Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %
.00586	.021	.27441	.512	.54297	.039	.81152	.000
.01660	.017	.28516	.449	.55371	.036	.82227	.000
.02734	.089	.29590	.467	.56445	.025	.83301	.000
.03809	.146	.30664	.326	.57520	.013	.84375	.000
.04883	.066	.31738	.183	.58594	.019	.85449	.000
.05957	.104	.32813	.146	.59668	.012	.86523	.000
.07031	.280	.33887	.146	.60742	.010	.87598	.000
.08105	.518	.34961	.135	.61816	.018	.88672	.000
.09180	1.600	.36035	.187	.62891	.013	.89746	.000
.10254	5.420	.37109	.204	.63965	.013	.90820	.000
.11328	15.501	.38184	.136	.65039	.023	.91895	.000
.12402	12.925	.39258	.631	.66113	.010	.92969	.000
.13477	21.997	.40332	.183	.67188	.005	.94043	.000
.14551	15.206	.41406	.238	.68262	.010	.95117	.000
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.19922	1.859	.46777	.028	.73633	.005	1.00488	.000
.20996	1.064	.47852	.068	.74707	.007	1.01563	.000
.22070	1.232	.48926	.043	.75781	.000	1.02637	.000
.23145	1.494	.50000	.082	.76855	.000	1.03711	.000
.24219	.648	.51074	.037	.77930	.000	1.04785	.000
.25293	.670	.52148	.029	.79004	.000	1.05859	.000
.26367	.445	.53223	.020	.80078	.000	1.06934	.000

Significant Height = 0.88 m.
Peak Period = 7.42 sec.

Table A4

Wave Spectra, Waverider (620), 1400 EST, 15 November 1983

Band Spectrum (Band Center Frequency Versus Percentage Normal Variance)

Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %
.00586	.029	.27441	1.133	.54297	.050	.81152	.000
.01660	.033	.28516	.799	.55371	.092	.82227	.000
.02734	.037	.29590	1.433	.56445	.102	.83301	.000
.03809	.071	.30664	1.477	.57520	.123	.84375	.000
.04883	.083	.31738	.400	.58594	.088	.85449	.000
.05957	.085	.32813	.695	.59668	.060	.86523	.000
.07031	1.210	.33887	.559	.60742	.064	.87598	.000
.08105	8.149	.34961	1.126	.61816	.084	.88672	.000
.09180	13.380	.36035	.364	.62891	.042	.89746	.000
.10254	11.743	.37109	.936	.63965	.072	.90820	.000
.11328	7.397	.38184	.312	.65039	.027	.91895	.000
.12402	3.743	.39258	.272	.66113	.081	.92969	.000
.13477	6.572	.40332	.234	.67188	.041	.94043	.000
.14551	2.311	.41406	.232	.68262	.024	.95117	.000
.15625	1.301	.42480	.812	.69336	.019	.96191	.000
.16699	1.958	.43555	.457	.70410	.044	.97266	.000
.17773	1.067	.44629	.383	.71484	.056	.98340	.000
.18848	2.160	.45703	.136	.72559	.000	.99414	.000
.19922	4.410	.46777	.455	.73633	.000	1.00488	.000
.20996	9.064	.47852	.159	.74707	.000	1.01563	.000
.22070	2.617	.48926	.232	.75781	.000	1.02637	.000
.23145	4.029	.50000	.320	.76855	.000	1.03711	.000
.24219	1.722	.51074	.065	.77930	.000	1.04785	.000
.25293	1.916	.52148	.065	.79004	.000	1.05859	.000
.26367	2.086	.53223	.078	.80078	.000	1.06934	.000

Significant Height = 1.60 m.
Peak Period = 10.89 sec.

Table A5

Wave Spectra, Waverider (620), 1900 EST, 15 November 1983

Band Spectrum (Band Center Frequency Versus Percentage Normal Variance)

Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %
.00586	.033	.27441	1.693	.54297	.093	.81152	.000
.01660	.028	.28516	1.011	.55371	.116	.82227	.000
.02734	.113	.29590	2.119	.56445	.098	.83301	.000
.03809	.074	.30664	.485	.57520	.046	.84375	.000
.04883	.055	.31738	.488	.58594	.102	.85449	.000
.05957	.043	.32813	.816	.59668	.088	.86523	.000
.07031	.635	.33887	.847	.60742	.078	.87598	.000
.08105	7.562	.34961	.629	.61816	.065	.88672	.000
.09180	8.574	.36035	.451	.62891	.081	.89746	.000
.10254	3.633	.37109	.393	.63965	.029	.90820	.000
.11328	7.674	.38184	.316	.65039	.027	.91895	.000
.12402	4.871	.39258	.373	.66113	.043	.92969	.000
.13477	2.253	.40332	.385	.67188	.045	.94043	.000
.14551	2.390	.41406	.309	.68262	.062	.95117	.000
.15625	1.345	.42480	.371	.69336	.019	.96191	.000
.16699	12.404	.43555	.233	.70410	.021	.97266	.000
.17773	4.295	.44629	.375	.71484	.012	.98340	.000
.18848	10.096	.45703	.238	.72559	.030	.99414	.000
.19922	2.296	.46777	.254	.73633	.022	1.00488	.000
.20996	3.108	.47852	.157	.74707	.021	1.01563	.000
.22070	3.572	.48926	.212	.75781	.007	1.02637	.000
.23145	3.412	.50000	.120	.76855	.016	1.03711	.000
.24219	4.674	.51074	.159	.77930	.000	1.04785	.000
.25293	1.417	.52148	.121	.79004	.000	1.05859	.000
.26367	3.341	.53223	.252	.80078	.000	1.06934	.000

Significant Height = 1.70 m.
Peak Period = 5.99 sec.

Table A6

Wave Spectra, Waverider (620), 0100 EST, 16 November 1983

Band Spectrum (Band Center Frequency Versus Percentage Normal Variance)

Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %
.00586	.022	.27441	.757	.54297	.023	.81152	.000
.01660	.014	.28516	.262	.55371	.028	.82227	.000
.02734	.056	.29590	.402	.56445	.015	.83301	.000
.03809	.083	.30664	.405	.57520	.019	.84375	.000
.04883	.031	.31738	.390	.58594	.024	.85449	.000
.05957	.085	.32813	.119	.59668	.027	.86523	.000
.07031	.457	.33887	.225	.60742	.015	.87598	.000
.08105	10.552	.34961	.209	.61816	.025	.88672	.000
.09180	17.222	.36035	.268	.62891	.018	.89746	.000
.10254	12.695	.37109	.092	.63965	.012	.90820	.000
.11328	6.353	.38184	.091	.65039	.011	.91895	.000
.12402	6.207	.39258	.157	.66113	.007	.92969	.000
.13477	4.696	.40332	.077	.67188	.014	.94043	.000
.14551	8.101	.41406	.053	.68262	.022	.95117	.000
.15625	7.089	.42480	.114	.69336	.019	.96191	.000
.16699	4.087	.43555	.130	.70410	.012	.97266	.000
.17773	1.638	.44629	.052	.71484	.017	.98340	.000
.18848	1.762	.45703	.069	.72559	.011	.99414	.000
.19922	5.352	.46777	.058	.73633	.005	1.00488	.000
.20996	1.609	.47852	.068	.74707	.012	1.01563	.000
.22070	3.483	.48926	.057	.75781	.014	1.02637	.000
.23145	1.761	.50000	.029	.76855	.006	1.03711	.000
.24219	1.631	.51074	.029	.77930	.005	1.04785	.000
.25293	.796	.52148	.046	.79004	.000	1.05859	.000
.26367	.228	.53223	.024	.80078	.000	1.06934	.000

Significant Height = 1.43 m.
Peak Period = 10.89 sec.

Table A7

Wave Spectra, Waverider (620), 0700 EST, 16 November 1983

Band Spectrum (Band Center Frequency Versus Percentage Normal Variance)

Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %
.00586	.043	.27441	.268	.54297	.049	.81152	.000
.01660	.015	.28516	.144	.55371	.077	.82227	.000
.02734	.044	.29590	.264	.56445	.113	.83301	.000
.03809	.068	.30664	.185	.57520	.082	.84375	.000
.04883	.036	.31738	.077	.58594	.089	.85449	.000
.05957	.074	.32813	.137	.59668	.146	.86523	.000
.07031	2.186	.33887	.090	.60742	.068	.87598	.000
.08105	7.078	.34961	.043	.61816	.118	.88672	.000
.09180	14.391	.36035	.087	.62891	.086	.89746	.000
.10254	13.812	.37109	.163	.63965	.085	.90820	.000
.11328	15.844	.38184	.131	.65039	.046	.91895	.000
.12402	6.470	.39258	.106	.66113	.125	.92969	.000
.13477	9.925	.40332	.130	.67188	.028	.94043	.000
.14551	3.946	.41406	.158	.68262	.049	.95117	.000
.15625	7.602	.42480	.391	.69336	.097	.96191	.000
.16699	3.308	.43555	.125	.70410	.040	.97266	.000
.17773	1.636	.44629	.216	.71484	.057	.98340	.000
.18848	4.048	.45703	.130	.72559	.076	.99414	.000
.19922	.920	.46777	.179	.73633	.047	1.00488	.000
.20996	1.236	.47852	.398	.74707	.048	1.01563	.000
.22070	1.129	.48926	.273	.75781	.000	1.02637	.000
.23145	1.306	.50000	.144	.76855	.000	1.03711	.000
.24219	.481	.51074	.117	.77930	.000	1.04785	.000
.25293	.194	.52148	.218	.79004	.000	1.05859	.000
.26367	.478	.53223	.105	.80078	.000	1.06934	.000

Significant Height = 1.03 m.
Peak Period = 8.83 sec.

Table A8

Wave Spectra, Waverider (620), 1300 EST, 16 November 1983

Band Spectrum (Band Center Frequency Versus Percentage Normal Variance)

Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %
.00586	.020	.27441	.180	.54297	.333	.81152	.000
.01660	.020	.28516	.110	.55371	.269	.82227	.000
.02734	.039	.29590	.172	.56445	.347	.83301	.000
.03809	.091	.30664	.062	.57520	.357	.84375	.000
.04883	.098	.31738	.107	.58594	.259	.85449	.000
.05957	.076	.32813	.096	.59668	.235	.86523	.000
.07031	.140	.33887	.088	.60742	.211	.87598	.000
.08105	5.127	.34961	.103	.61816	.176	.88672	.000
.09180	16.333	.36035	.085	.62891	.197	.89746	.000
.10254	21.560	.37109	.118	.63965	.231	.90820	.000
.11328	8.029	.38184	.178	.65039	.092	.91895	.000
.12402	10.014	.39258	.271	.66113	.179	.92969	.000
.13477	7.038	.40332	.443	.67188	.072	.94043	.000
.14551	6.307	.41406	.647	.68262	.060	.95117	.000
.15625	4.586	.42480	.904	.69336	.172	.96191	.000
.16699	3.211	.43555	1.402	.70410	.121	.97266	.000
.17773	.942	.44629	1.110	.71484	.051	.98340	.000
.18848	.696	.45703	.980	.72559	.073	.99414	.000
.19922	.825	.46777	.900	.73633	.052	1.00488	.000
.20996	.514	.47852	1.853	.74707	.174	1.01562	.000
.22070	1.059	.48926	.759	.75781	.074	1.02637	.000
.23145	.809	.50000	1.361	.76855	.057	1.03711	.000
.24219	.248	.51074	.550	.77930	.000	1.04785	.000
.25293	.140	.52148	.614	.79004	.000	1.05859	.000
.26367	.234	.53223	.559	.80078	.000	1.06934	.000

Significant Height = 0.84 m.
Peak Period = 9.75 sec.

Table A9

Wave Spectra, Waverider (620), 1900 EST, 16 November 1983

Band Spectrum (Band Center Frequency Versus Percentage Normal Variance)

Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %
.00586	.023	.27441	.077	.54297	.752	.81152	.000
.01660	.039	.28516	.071	.55371	.497	.82227	.000
.02734	.027	.29590	.058	.56445	.529	.83301	.000
.03809	.083	.30664	.133	.57520	.422	.84375	.000
.04883	.025	.31738	.162	.58594	.407	.85449	.000
.05957	.061	.32813	.242	.59668	.396	.86523	.000
.07031	.513	.33887	.316	.60742	.507	.87598	.000
.08105	1.353	.34961	.521	.61816	.267	.88672	.000
.09180	7.438	.36035	.748	.62891	.472	.89746	.000
.10254	16.959	.37109	2.623	.63965	.194	.90820	.000
.11328	16.115	.38184	2.018	.65039	.243	.91895	.000
.12402	8.082	.39258	4.435	.66113	.706	.92969	.000
.13477	5.924	.40332	2.081	.67188	.267	.94043	.000
.14551	2.515	.41406	3.760	.68262	.476	.95117	.000
.15625	1.460	.42480	2.109	.69336	.493	.96191	.000
.16699	3.701	.43555	2.595	.70410	.356	.97266	.000
.17773	.785	.44629	2.356	.71484	.294	.98340	.000
.18848	1.526	.45703	2.842	.72559	.175	.99414	.000
.19922	.834	.46777	1.179	.73633	.208	1.00488	.000
.20996	.702	.47852	.682	.74707	.162	1.01563	.000
.22070	.190	.48926	1.402	.75781	.236	1.02637	.000
.23145	.120	.50000	.887	.76855	.000	1.03711	.000
.24219	.136	.51074	.674	.77930	.000	1.04785	.000
.25293	.074	.52148	.855	.79004	.000	1.05859	.000
.26367	.119	.53223	1.085	.80078	.000	1.06934	.000

Significant Height = 0.66 m.
Peak Period = 9.75 sec.

Table A10

Wave Spectra, Waverider (620), 0100 EST, 17 November 1983

Band Spectrum (Band Center Frequency Versus Percentage Normal Variance)

Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %
.00586	.166	.27441	.072	.54297	1.191	.81152	.000
.01660	.042	.28516	.175	.55371	.699	.82227	.000
.02734	.140	.29590	.240	.56445	.908	.83301	.000
.03809	.083	.30664	.195	.57520	2.141	.84375	.000
.04883	.116	.31738	.409	.58594	.679	.85449	.000
.05957	.195	.32813	1.206	.59668	.389	.86523	.000
.07031	.722	.33887	1.231	.60742	.769	.87598	.000
.08105	3.567	.34961	2.389	.61816	.601	.88672	.000
.09180	3.712	.36035	6.539	.62891	.483	.89746	.000
.10254	10.958	.37109	3.377	.63965	.388	.90820	.000
.11328	4.701	.38184	6.411	.65039	.604	.91895	.000
.12402	4.807	.39258	8.274	.66113	.829	.92969	.000
.13477	1.948	.40332	4.452	.67188	.497	.94043	.000
.14551	3.070	.41406	6.306	.68262	.515	.95117	.000
.15625	1.642	.42480	3.880	.69336	.311	.96191	.000
.16699	.421	.43555	3.565	.70410	.247	.97266	.000
.17773	.300	.44629	1.593	.71484	.450	.98340	.000
.18848	.108	.45703	4.029	.72559	.464	.99414	.000
.19922	.392	.46777	3.649	.73633	.212	1.00488	.000
.20996	.227	.47852	.906	.74707	.654	1.01563	.000
.22070	.305	.48926	2.002	.75781	.348	1.02637	.000
.23145	.226	.50000	1.210	.76855	.214	1.03711	.000
.24219	.188	.51074	1.180	.77930	.258	1.04785	.000
.25293	.132	.52148	1.989	.79004	.164	1.05859	.000
.26367	.074	.53223	.862	.80078	.262	1.06934	.000

Significant Height = 0.53 m.
Peak Period = 9.75 sec.

Table A11

Wave Spectra, Waverider (620), 0700 EST, 17 November 1983

Band Spectrum (Band Center Frequency Versus Percentage Normal Variance)

Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %
.00586	.097	.27441	.171	.54297	1.129	.81152	.000
.01660	.044	.28516	.355	.55371	1.146	.82227	.000
.02734	.123	.29590	.365	.56445	.461	.83301	.000
.03809	.083	.30664	.163	.57520	2.281	.84375	.000
.04883	.099	.31738	.264	.58594	.961	.85449	.000
.05957	.468	.32813	.164	.59668	1.007	.86523	.000
.07031	.604	.33887	.582	.60742	.809	.87598	.000
.08105	3.210	.34961	.882	.61816	.579	.88672	.000
.09180	4.413	.36035	.870	.62891	.340	.89746	.000
.10254	6.526	.37109	2.257	.63965	.494	.90820	.000
.11328	11.763	.38184	3.149	.65039	.401	.91895	.000
.12402	4.681	.39258	3.259	.66113	.646	.92969	.000
.13477	1.631	.40332	2.593	.67188	.775	.94043	.000
.14551	2.709	.41406	5.678	.68262	.344	.95117	.000
.15625	1.024	.42480	5.496	.69336	.722	.96191	.000
.16699	1.037	.43555	3.452	.70410	.591	.97266	.000
.17773	2.536	.44629	10.229	.71484	.404	.98340	.000
.18848	.327	.45703	6.706	.72559	.359	.99414	.000
.19922	.520	.46777	2.979	.73633	.381	1.00488	.000
.20996	.536	.47852	3.401	.74707	.380	1.01563	.000
.22070	.302	.48926	1.360	.75781	.221	1.02637	.000
.23145	.410	.50000	1.585	.76855	.000	1.03711	.000
.24219	.340	.51074	1.238	.77930	.000	1.04785	.000
.25293	.547	.52148	1.520	.79004	.000	1.05859	.000
.26367	.273	.53223	.977	.80078	.000	1.06934	.000

Significant Height = 0.47 m.
Peak Period = 8.83 sec.

Table A12

Wave Spectra, Waverider (620), 1300 EST, 17 November 1983

Band Spectrum (Band Center Frequency Versus Percentage Normal Variance)

Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %	Band Center Freq	Normal Var %
.00586	.117	.27441	5.027	.54297	.338	.81152	.048
.01660	.022	.28516	1.667	.55371	.440	.82227	.065
.02734	.134	.29590	7.140	.56445	.400	.83301	.034
.03809	.065	.30664	5.482	.57520	.462	.84375	.000
.04883	.036	.31738	1.960	.58594	.438	.85449	.000
.05957	.155	.32813	2.728	.59668	.516	.86523	.000
.07031	.629	.33887	3.136	.60742	.297	.87598	.000
.08105	.571	.34961	4.306	.61816	.600	.88672	.000
.09180	1.764	.36035	2.276	.62891	.264	.89746	.000
.10254	4.141	.37109	1.159	.63965	.281	.90820	.000
.11328	4.686	.38184	2.137	.65039	.305	.91895	.000
.12402	4.662	.39258	1.200	.66113	.109	.92969	.000
.13477	4.870	.40332	3.237	.67188	.578	.94043	.000
.14551	2.803	.41406	2.496	.68262	.482	.95117	.000
.15625	.656	.42480	2.222	.69336	.215	.96191	.000
.16699	1.276	.43555	1.804	.70410	.198	.97266	.000
.17773	.462	.44629	1.532	.71484	.220	.98340	.000
.18848	.835	.45703	.637	.72559	.371	.99414	.000
.19922	.890	.46777	.962	.73633	.124	1.00488	.000
.20996	.678	.47852	.819	.74707	.284	1.01563	.000
.22070	1.002	.48926	.341	.75781	.243	1.02637	.000
.23145	.812	.50000	.923	.76855	.122	1.03711	.000
.24219	7.567	.51074	.893	.77930	.102	1.04785	.000
.25293	2.997	.52148	.374	.79004	.055	1.05859	.000
.26367	5.254	.53223	.628	.80078	.079	1.06934	.000

Significant Height = 0.47 m.
Peak Period = 4.13 sec.

APPENDIX B: FRF CURRENT METER DATA

14-17 NOVEMBER 1983

Table B1

Nearshore Current Meter Upper (14.5 ft Deep), 15-Minute Average Values

TIME	VN	VE	DIR	SPD	VN	VE	DIR	SPD
14 Nov 1659 1983	-18.41	7.54	157.71	19.89	-30.32	9.20	163.12	31.69
	-31.68	8.45	165.07	32.79	-35.30	8.75	166.08	36.37
	-40.13	8.45	168.11	41.01	-44.81	8.00	169.88	45.51
	-46.62	9.35	168.65	47.55	-50.69	10.86	167.91	51.84
318/1859	-57.97	12.83	167.52	59.37	-60.54	13.59	167.35	62.04
Julian Day / Time	-62.05	12.98	168.18	63.39	-61.74	12.53	168.53	63.00
	-62.[illegible]0	14.79	166.74	64.52	-63.71	16.61	165.39	65.83
	-62.00	14.49	167.01	64.45	-63.10	11.93	169.30	64.22
	-67.63	14.64	167.78	69.20	-65.37	11.93	169.66	66.45
3182129	-65.58	15.98	166.30	67.50	-64.83	13.72	168.05	66.27
	-61.06	15.98	165.33	63.12	-61.06	17.04	164.41	63.39
	-59.55	16.89	164.17	61.90	-56.54	16.13	164.07	58.79
	-58.05	17.79	162.96	60.71	-57.29	17.34	163.16	59.86
	-55.48	16.13	163.79	57.78	-53.37	17.49	161.86	56.16
3182359	-54.01	14.03	165.44	55.80	-57.48	12.22	168.00	58.76
	-59.59	14.94	165.93	61.44	-62.76	14.78	166.74	64.48
	-64.87	15.54	166.53	66.71	-63.21	14.03	167.49	64.75
	-66.98	13.58	168.54	68.35	-69.85	15.69	167.34	71.59
	-67.74	14.78	167.69	69.33	-63.97	11.47	169.84	64.99
3190229	-62.16	9.81	171.03	62.93	-63.51	9.35	171.62	64.20
	-66.23	8.90	172.35	66.83	-62.91	8.00	172.76	63.42
	-63.06	10.11	170.89	63.87	-63.67	12.07	169.27	64.80
	-65.02	11.16	170.26	65.97	-64.12	12.97	168.56	65.42
	-62.01	12.52	168.58	63.26	-62.01	12.07	168.99	63.17
3190459	-63.82	13.58	167.99	65.24	-62.01	14.33	166.98	63.64
	-62.16	12.97	168.21	63.50	-65.48	10.71	170.71	66.35
	-66.83	9.66	171.78	67.53	-68.19	9.05	172.44	68.79
	-63.06	13.58	167.85	64.51	-58.39	13.88	166.63	60.01
	-61.25	13.43	167.64	62.71	-67.29	13.13	168.96	68.55
3190729	-62.98	15.52	166.16	64.86	-58.61	17.03	163.80	61.03
	-60.27	18.38	163.04	63.01	-64.34	16.88	165.30	66.51
	-63.13	17.93	164.14	65.63	-57.86	18.53	162.24	60.75
	-56.35	18.08	162.21	59.18	-56.65	17.03	163.27	59.16
	-61.17	17.18	164.32	63.54	-57.86	14.62	165.82	59.67
3190959	-61.17	14.31	166.83	62.82	-57.71	11.15	169.06	58.77
	-51.53	10.55	168.43	52.60	-47.31	9.19	169.01	48.20
	-43.69	9.19	168.12	44.65	-42.04	8.14	169.05	42.82
	-38.57	7.23	169.38	39.24	-36.01	6.63	169.57	36.62
	-35.41	6.63	169.39	36.02	-33.45	6.78	168.54	34.13
3191229	-31.75	7.22	167.18	32.56	-29.79	7.67	165.56	30.77
	-28.44	9.33	161.84	29.93	-24.53	10.98	155.87	26.87
	-22.42	12.94	150.01	25.89	-21.07	13.69	146.98	25.13
	-17.61	14.60	140.34	22.87	-16.55	13.99	139.79	21.68
	-16.70	12.34	143.55	20.77	-17.00	11.89	145.04	20.75
3191459	-17.00	13.24	142.09	21.55	-18.51	14.75	141.45	23.66
	-17.76	15.50	138.88	23.57	-17.00	15.20	138.21	22.81
	-14.30	15.65	132.41	21.20	-13.99	14.90	133.21	20.44
	-14.45	15.05	133.83	20.86	-13.24	16.40	128.92	21.08
	-13.09	16.85	127.84	21.34	-13.54	16.10	130.07	21.04
3191729	-15.82	16.12	134.46	22.59	-15.52	15.82	134.45	22.16
	-16.27	14.31	138.66	21.67	-13.56	15.37	131.42	20.50
	-12.66	14.92	130.31	19.56	-10.55	14.92	125.26	18.27
	-8.29	16.12	117.20	18.13	-6.33	16.42	111.07	17.60
	-3.62	15.82	102.88	16.23	-1.36	16.12	94.81	16.18

(Continued)

Key:
VN = Current speed, cm/sec, toward (+ = North, - = South).
VE = Current Speed, cm/sec, toward (+ = East, - = West).
DIR = Current direction, degrees.
SPD = Current speed, cm/sec.

Table B1. (Continued)

TIME	VN	VE	DIR	SPD	VN	VE	DIR	SPD
3191959	0.75	17.05	87.47	17.06	1.36	16.14	85.19	16.20
	4.98	17.05	73.72	17.76	4.83	16.44	73.64	17.14
	6.94	16.75	67.49	18.13	6.34	13.43	64.74	14.85
	6.94	12.82	61.58	14.58	9.35	12.07	52.22	15.27
	9.35	14.78	57.68	17.50	9.96	15.69	57.60	18.58
3192229	7.56	13.00	59.83	15.04	6.05	10.88	60.95	12.45
	6.35	13.91	65.46	15.29	4.69	13.00	70.18	13.82
	6.05	12.55	64.27	13.93	3.33	10.88	73.01	11.38
	2.87	13.00	77.54	13.31	5.44	14.36	69.25	15.36
	6.20	12.85	64.25	14.26	4.53	12.70	70.35	13.48
3200059	2.87	11.19	75.60	11.55	0.15	9.52	89.09	9.52
	-0.30	9.83	91.76	9.83	-1.66	8.62	100.92	8.77
	-3.17	9.37	108.71	9.89	-5.14	7.86	123.18	9.39
	-2.27	6.35	109.65	6.74	3.63	8.46	66.80	9.21
	1.97	4.84	67.89	5.22	0.91	4.84	79.38	4.92
3200329	-1.51	3.78	111.80	4.07	-4.08	3.17	142.12	5.17
	-6.65	1.21	169.70	6.76	-2.87	2.87	135.00	4.06
	-3.93	0.91	167.01	4.03	-3.93	0.15	177.80	3.93
	-3.93	-0.76	190.89	4.00	-4.83	-0.60	187.12	4.87
	-5.14	-2.11	202.38	5.55	-4.23	-0.45	186.12	4.25
3200559	-6.50	0.60	174.69	6.52	-7.10	0.30	177.56	7.11
	-8.46	0.0	180.00	8.46	-8.16	1.81	167.47	8.36
	-12.69	3.32	165.32	13.12	-14.65	1.06	175.87	14.69
	-15.41	2.57	170.54	15.62	-15.26	2.57	170.45	15.47
	-13.14	2.72	168.31	13.42	-15.41	2.87	169.45	15.67
3200829	-15.56	1.96	172.81	15.68	-14.35	0.60	177.59	14.36
	-16.62	1.81	173.77	16.72	-18.58	1.36	175.81	18.63
	-17.82	-0.91	182.91	17.85	-16.31	-0.15	180.53	16.32
	-13.44	-2.27	189.57	13.63	-16.16	-3.02	190.59	16.44
	-15.11	-1.81	186.84	15.21	-12.69	-3.17	194.04	13.08
3201059	-12.70	-1.66	187.46	12.81	-10.43	-3.33	197.68	10.95
	-10.58	-1.36	187.33	10.67	-11.94	-0.60	182.90	11.96
	-10.88	-0.76	183.97	10.91	-8.92	-0.91	185.81	8.96
	-6.05	0.30	177.14	6.05	-4.69	0.91	169.05	4.77
	-3.93	1.66	157.07	4.27	-5.14	1.97	159.08	5.50
3201329	-3.02	2.87	136.47	4.17	-2.27	3.78	120.96	4.41
	-3.48	4.53	127.48	5.71	-1.81	5.44	108.43	5.74
	-2.12	7.26	106.26	7.56	-1.21	6.80	100.08	6.91
	-0.91	6.20	98.33	6.26	0.0	7.71	90.00	7.71
	-1.51	6.05	104.04	6.23	-0.91	7.41	96.98	7.46
3201559	-1.51	6.35	103.39	6.53	-3.02	6.80	113.96	7.44
	-2.57	9.37	105.33	9.72	-3.17	9.98	107.65	10.47
	-3.02	10.88	105.52	11.30	-4.08	10.58	111.09	11.34
	-6.20	5.74	137.17	8.45	-6.35	6.35	135.00	8.98
	-8.92	5.90	146.53	10.69	-7.86	8.92	131.39	11.89
3201829	-7.11	9.98	125.46	12.26	-8.47	10.59	128.66	13.56
	-9.38	8.02	139.47	12.34	-9.38	10.59	131.53	14.14
	-9.98	8.77	138.69	13.29	-10.74	8.92	140.27	13.96
	-12.40	9.83	141.60	15.83	-13.16	9.83	143.24	16.43
	-12.55	8.47	145.99	15.14	-11.50	8.62	143.13	14.37
3202059	-11.80	9.38	141.52	15.07	-9.23	7.56	140.66	11.93
	-8.62	7.26	139.90	11.27	-8.62	7.87	137.63	11.67
	-6.05	4.24	145.01	7.39	-4.69	7.26	122.86	8.64
	-5.45	8.62	122.28	10.20	-7.11	9.98	125.46	12.26
	-3.93	11.80	108.43	12.44	-2.57	9.83	104.66	10.16
3202329	-1.81	8.46	102.09	8.66	-0.76	8.92	94.84	8.95
	-0.15	7.86	91.10	7.86	1.97	5.44	70.14	5.79
	2.72	6.80	68.20	7.33	4.84	3.63	36.87	6.05
	7.86	2.12	15.07	8.14	8.46	1.81	12.09	8.66
	8.92	1.36	8.67	9.02	12.39	2.12	8.69	12.57

(Continued)

Table B1. (Concluded)

TIME	VN	VE	DIR	SPD	VN	VE	DIR	SPD
3210159	14.36	1.21	4.81	14.41	14.51	1.36	5.36	14.57
	13.45	0.30	1.29	13.46	16.32	0.45	1.59	16.33
	16.02	1.97	6.99	16.14	16.32	0.60	2.12	16.34
	17.23	1.21	4.01	17.27	18.14	1.06	3.34	18.17
	19.50	-0.45	358.67	19.50	18.74	-3.17	350.39	19.01
3210429	18.58	-1.21	356.28	18.62	18.13	0.15	0.48	18.13
	17.37	1.36	4.47	17.42	16.62	5.29	17.65	17.44
	18.58	1.66	5.11	18.65	17.67	-1.96	353.66	17.78
	19.03	0.76	2.27	19.05	18.13	1.96	6.18	18.23
	21.75	3.32	8.69	22.00	22.05	2.57	6.64	22.20
3210659	22.05	2.87	7.41	22.24	21.00	0.76	2.06	21.01
	23.57	2.87	6.94	23.74	24.92	3.93	8.95	25.23
	22.51	1.06	2.69	22.53	21.90	5.59	14.31	22.61
	24.02	6.34	14.80	24.84	21.90	4.38	11.31	22.34
	23.87	3.17	7.57	24.08	21.15	2.27	6.12	21.27
3210929	21.30	1.36	3.65	21.34	20.09	-1.06	356.99	20.12
	17.37	1.36	4.47	17.42	16.77	1.96	6.68	16.88
	19.94	1.81	5.19	20.02	21.00	1.51	4.11	21.05
	19.64	-2.11	353.85	19.75	18.43	-0.76	357.65	18.44
	24.02	1.51	3.60	24.07	26.74	-0.81	358.06	26.75
3211159	25.51	-1.36	356.95	25.55	27.02	0.60	1.28	27.03
	26.42	-3.32	352.83	26.63	25.06	-2.87	353.47	25.22
	22.04	-2.72	352.97	22.21	22.04	-1.66	355.69	22.10
	26.57	-0.91	358.05	26.58	27.78	-2.57	354.72	27.90
	27.02	-3.47	352.68	27.24	27.32	-4.68	350.28	27.72
3211429	26.12	-6.04	346.98	26.81	26.42	-2.42	354.78	26.53

Table B2

Nearshore Current Meter Lower (29 ft Deep), 15-Minute Average Values

TIME	VN	VE	DIR	SPD	VN	VE	DIR	SPD
14 Nov 1659	-23.89	9.20	159.01	25.69	-17.05	11.01	147.14	20.30
1983	-17.80	10.71	148.96	20.78	-22.18	8.75	158.47	23.84
	-25.19	7.85	162.70	26.39	-26.85	6.34	166.72	27.59
	-28.82	5.43	169.33	29.32	-32.74	3.62	173.69	32.94
3181859	-32.33	4.23	172.55	32.60	-34.89	5.14	171.63	35.27
Julian Time	-32.93	2.42	175.80	33.02	-31.87	1.66	177.02	31.92
Day	-33.08	2.11	176.34	33.15	-35.95	4.38	173.05	36.22
	-35.20	3.63	174.12	35.38	-40.03	4.53	173.54	40.29
	-36.86	4.83	172.53	37.17	-36.10	2.72	175.69	36.21
3182129	-36.68	2.42	176.23	36.76	-36.08	3.17	174.98	36.22
	-36.99	2.42	176.26	37.06	-37.44	2.26	176.54	37.51
	-38.50	1.36	177.98	38.52	-37.89	0.0	180.00	37.89
	-39.40	-0.45	180.66	39.40	-40.61	0.30	179.57	40.61
	-41.67	2.26	176.89	41.73	-38.65	3.62	174.64	38.82
3182359	-38.80	4.38	173.56	39.04	-38.65	3.32	175.09	38.79
	-36.99	3.77	174.17	37.18	-36.38	4.08	173.61	36.61
	-37.14	3.17	175.12	37.27	-36.38	3.77	174.08	36.58
	-35.17	3.47	174.36	35.35	-34.87	4.98	171.87	35.23
	-36.53	3.32	174.81	36.68	-36.83	2.72	175.78	36.93
3190229	-38.37	2.42	176.40	38.45	-38.52	1.66	177.53	38.56
	-38.97	3.47	174.91	39.13	-40.63	2.57	176.38	40.72
	-39.12	4.08	174.05	39.34	-38.67	5.59	171.78	39.07
	-42.30	4.23	174.29	42.51	-42.90	3.63	175.17	43.05
	-44.26	3.78	175.12	44.42	-44.11	4.23	174.52	44.31
3190459	-43.93	5.59	172.75	44.28	-44.23	4.68	173.96	44.48
	-44.08	7.10	170.86	44.65	-44.38	7.85	169.97	45.07
	-42.87	6.79	171.00	43.41	-41.21	5.89	171.87	41.63
	-42.27	4.68	173.68	42.53	-41.36	3.62	174.99	41.52
	-39.85	4.68	173.30	40.13	-42.72	8.00	169.39	43.47
3190729	-41.82	5.59	172.39	42.19	-41.51	6.49	171.11	42.02
	-41.36	8.00	169.05	42.13	-38.80	8.60	167.49	39.74
	-37.59	9.81	165.37	38.85	-39.10	7.40	169.29	39.79
	-39.85	6.79	170.33	40.43	-38.95	6.64	170.32	39.51
	-38.04	6.04	170.98	38.52	-39.40	5.43	172.15	39.77
3190959	-38.34	4.23	173.71	38.58	-37.44	3.77	174.24	37.63
	-36.08	3.93	173.79	36.29	-37.59	5.13	172.22	37.94
	-37.74	4.53	173.16	38.01	-37.74	4.68	172.93	38.03
	-38.95	3.47	174.91	39.10	-37.74	3.17	175.20	37.87
	-37.89	3.47	174.76	38.05	-37.74	2.57	176.11	37.83
3191229	-37.64	1.66	177.47	37.67	-37.18	0.76	178.84	37.19
	-36.43	0.30	179.52	36.43	-36.73	-0.76	181.18	36.74
	-37.03	-2.27	183.50	37.10	-36.28	-3.02	184.76	36.40
	-34.77	-3.02	184.97	34.90	-33.41	-8.01	193.49	34.35
	-29.32	-12.85	203.66	32.02	-24.79	-12.85	207.40	27.92
3191459	-21.93	-13.01	210.67	25.50	-19.21	-12.10	212.21	22.70
	-16.03	-11.50	215.64	19.73	-13.46	-11.50	220.50	17.70
	-12.40	-9.68	217.97	15.73	-11.95	-9.68	219.01	15.38
	-11.34	-7.87	214.73	13.80	-10.89	-8.47	217.87	13.80
	-11.34	-8.02	215.25	13.89	-9.83	-9.08	222.71	13.38

(Continued)

Key:

VN = Current speed toward north (cm/sec).
VE = Current speed toward east (cm/sec).
DIR = Current (heading toward).
SPD = Current speed (cm/sec).

Table B2. (Continued)

TIME	VN	VE	DIR	SPD	VN	VE	DIR	SPD
3191729	-10.29	-8.17	218.45	13.14	-9.99	-7.26	216.03	12.35
	-9.99	-7.57	217.15	12.53	-9.23	-6.81	216.42	11.47
	-9.99	-7.26	216.03	12.35	-9.69	-7.72	218.55	12.39
	-9.08	-8.48	223.02	12.42	-9.08	-8.78	224.03	12.63
	-8.48	-9.38	227.91	12.64	-8.93	-9.84	227.77	13.29
3191959	-9.38	-10.89	229.27	14.37	-8.62	-10.59	230.84	13.65
	-8.02	-11.50	235.11	14.01	-7.56	-12.10	237.99	14.27
	-6.50	-12.55	242.61	14.14	-5.29	-13.01	247.85	14.04
	-2.72	-12.71	257.91	12.99	-0.76	-13.01	266.67	13.03
	-0.30	-11.34	268.47	11.35	0.45	-10.89	272.39	10.90
3192229	-0.15	-13.76	269.37	13.76	0.0	-14.52	270.00	14.52
	0.15	-13.61	270.64	13.61	0.91	-10.89	274.76	10.93
	2.42	-9.38	284.47	9.68	2.57	-11.80	282.30	12.07
	2.27	-10.89	281.77	11.12	6.05	-10.74	299.40	12.33
	7.41	-10.13	306.18	12.55	6.50	-10.13	302.69	12.04
3200059	6.51	-12.71	297.11	14.28	7.26	-13.62	298.07	15.44
	8.93	-13.02	304.45	15.78	7.11	-12.86	298.94	14.70
	7.87	-12.41	302.38	14.70	7.26	-12.26	300.65	14.25
	12.41	-14.68	310.21	19.22	14.98	-10.90	323.97	18.53
	14.98	-11.35	322.85	18.80	13.92	-9.99	324.34	17.14
3200329	11.96	-7.57	327.67	14.15	8.32	-6.05	323.97	10.29
	5.45	-5.60	314.22	7.81	8.48	-3.33	338.55	9.11
	7.42	-3.33	335.82	8.13	6.66	-1.66	345.96	6.86
	6.21	-0.76	353.05	6.25	2.88	-0.15	356.99	2.88
	1.06	-1.36	307.87	1.73	1.66	-1.21	323.97	2.06
3200559	0.0	-0.15	270.00	0.15	-0.45	-1.06	246.80	1.15
	-1.36	-1.06	217.87	1.72	0.60	0.60	45.00	0.85
	-2.11	-0.30	188.13	2.14	-3.93	-0.91	192.99	4.03
	-4.23	-1.96	204.90	4.66	-4.83	0.0	180.00	4.83
	-4.08	-2.11	207.41	4.59	-5.14	-2.72	207.90	5.81
3200829	-6.50	-1.96	196.82	6.79	-5.59	-1.96	199.36	5.92
	-7.40	-2.42	198.08	7.79	-7.40	1.06	171.87	7.48
	-8.76	-0.30	181.97	8.77	-8.46	-0.76	185.10	8.49
	-9.52	-2.42	194.25	9.82	-10.73	-4.23	201.52	11.53
	-10.42	-1.81	189.87	10.58	-9.97	-1.96	191.14	10.16
3201059	-7.71	-1.51	191.09	7.86	-6.95	-2.57	200.28	7.41
	-6.95	-1.06	188.65	7.03	-7.10	0.45	176.35	7.12
	-7.56	0.76	174.29	7.60	-9.37	0.15	179.08	9.37
	-9.37	0.76	175.39	9.40	-6.35	-1.66	194.68	6.56
	-5.74	-2.72	205.35	6.36	-5.59	-2.87	207.18	6.29
3201329	-5.44	-3.63	213.69	6.54	-3.02	-4.38	235.41	5.32
	-3.33	-3.93	229.76	5.15	-3.17	-1.97	211.76	3.73
	-1.36	0.45	161.56	1.43	-0.30	-1.81	260.54	1.84
	-0.76	-4.08	259.51	4.15	-3.17	-5.44	239.74	6.30
	-2.57	-5.14	243.43	5.75	-1.81	-2.72	236.31	3.27
3201559	-2.27	-1.51	213.69	2.73	-5.14	0.76	171.63	5.20
	-3.48	3.93	131.50	5.25	-5.60	5.29	136.59	7.70
	-6.50	9.38	124.74	11.41	-1.82	9.83	100.46	10.00
	-0.91	8.02	96.46	8.07	-2.12	6.50	108.03	6.84
	-4.84	4.69	135.91	6.74	-5.14	4.08	141.55	6.57
3201829	-3.33	3.78	131.35	5.04	-4.99	3.48	145.12	6.08
	-6.96	3.78	151.48	7.92	-6.96	6.20	138.29	9.32
	-8.32	6.05	143.97	10.29	-6.96	3.18	155.46	7.65
	-9.53	4.99	152.35	10.76	-9.68	5.60	149.97	11.18
	-9.23	5.90	147.41	10.95	-8.17	3.78	155.16	9.00
3202059	-8.01	6.65	140.30	10.41	-6.35	3.63	150.25	7.31
	-5.14	0.45	174.96	5.16	-5.44	1.87	160.14	5.79
	-3.93	1.06	164.93	4.07	-4.08	1.51	159.68	4.35
	-2.57	3.33	127.69	4.20	-3.63	3.93	132.71	5.35
	-1.66	5.59	106.56	5.83	-0.76	5.14	98.37	5.19

(Continued)

(Sheet 2 of 3)

Table B2. (Concluded)

TIME	VN	VE	DIR	SPD	VN	VE	DIR	SPD
3202329	1.51	3.93	68.96	4.21	1.51	2.87	62.24	3.25
	1.36	3.93	70.91	4.16	3.17	2.87	42.14	4.28
	3.83	1.81	26.56	4.06	4.53	0.60	7.58	4.57
	7.41	-0.76	354.17	7.45	8.62	-0.30	357.99	8.62
	8.62	-1.21	352.01	8.70	11.03	-1.51	352.20	11.14
3210159	14.66	-3.78	345.55	15.14	14.36	-1.21	355.19	14.41
	13.91	-2.87	348.33	14.20	16.32	-2.72	350.54	16.55
	17.08	-0.60	357.97	17.09	17.08	-0.91	356.86	17.10
	17.23	-1.06	356.49	17.26	16.02	-1.06	356.22	16.06
	18.29	-3.17	350.15	18.56	17.99	-3.33	349.51	18.29
3210429	15.86	-2.72	350.27	16.09	17.98	-2.11	353.29	18.10
	17.37	-1.06	356.52	17.40	16.16	2.57	9.03	16.37
	17.52	-1.51	355.07	17.59	17.82	-2.87	350.85	18.05
	19.94	-1.21	356.53	19.98	19.64	0.15	0.44	19.64
	21.75	1.51	3.97	21.80	21.15	1.21	3.27	21.18
3210659	20.68	-0.30	359.16	20.68	22.48	-0.60	358.46	22.50
	24.61	2.87	6.65	24.77	23.10	2.11	5.23	23.19
	23.70	-0.45	358.91	23.71	22.34	3.32	8.46	22.59
	22.04	2.87	7.41	22.23	20.98	2.42	6.57	21.12
	22.19	1.96	5.05	22.28	20.83	-0.75	357.92	20.85
3210929	20.68	-1.21	356.66	20.72	20.23	-4.23	348.20	20.67
	18.72	-1.66	354.93	18.79	19.17	-0.60	358.20	19.18
	19.02	-1.06	356.82	19.05	20.08	-2.11	353.89	20.19
	20.68	-5.28	345.67	21.35	22.64	-3.17	352.03	22.87
	23.55	-0.75	358.16	23.56	24.76	-5.13	348.29	25.28
3211159	22.95	-5.28	347.03	23.55	23.10	-2.11	354.77	23.19
	25.06	-5.89	346.78	25.74	24.91	-6.19	346.05	25.67
	22.64	-3.77	350.54	22.96	24.61	-0.30	359.30	24.61
	25.21	-3.32	352.50	25.43	26.87	-4.23	351.06	27.20
	26.27	-5.43	348.31	26.82	27.48	-5.43	348.81	28.01
3211429	27.48	-6.49	346.71	28.23	27.78	-2.11	355.65	27.86

END

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