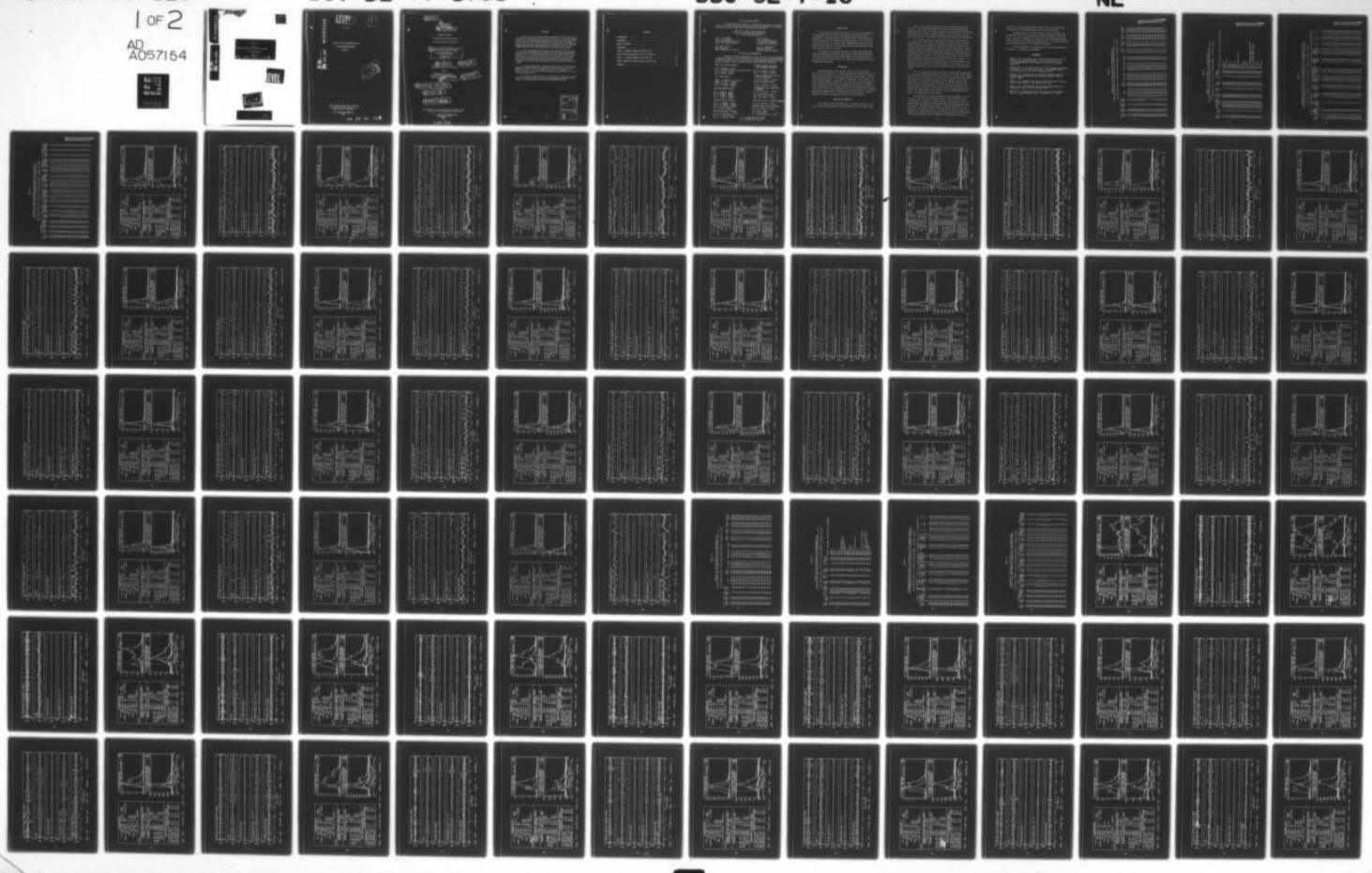
AD-A057 154 STEVENS INST OF TECH HOBOKEN N J DAVIDSON LAB F/G 8/3
RADAR AND TUCKER WAVEMETER DATA FROM SEA-LAND MCLEAN VOYAGE 32.(U)
AUG 78 J F DALZELL N00024-74-C-5451
UNCLASSIFIED SIT-DL-77-1931 SSC-SL-7-16 NL

1 OF 2
AD A057154



LEVEL II

(1)

SL-7-16

RADAR AND TUCKER WAVEMETER DATA FROM SEA-LAND McLEAN VOYAGE 32

SHIP STRUCTURE COMMITTEE
1978

(18) SSC

(19) SL-7-16

(9) TECHNICAL REPORT

on

Project SR-1221

"Correlation and Verification of

Wavemeter Data from the SL-7"

(6) RADAR AND TUCKER WAVEMETER DATA
FROM SEA-LAND McLEAN
VOYAGE 32.

by

(10) J. F. Dalzell

Stevens Institute of Technology

(11) Aug 78

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1978

ABSTRACT

So that more precise correlations between full scale observations and analytical and model results could be carried out, one of the objectives of the instrumentation program for the SL-7 class container ships was the provision of instrumental measures of the wave environment. To this end, two wave meter systems were installed on the S.S. SEA-LAND McLEAN. Raw data was collected from both systems during the second (1973-1974) and third (1974-1975) winter data collecting seasons.

It was the purpose of the present work to reduce this raw data, to develop and implement such corrections as were found necessary and feasible, and to correlate and evaluate the final results from the two wave meters. In carrying out this work it was necessary to at least partly reduce several other channels of recorded data, so that, as a by-product, reduced results were also obtained for midship bending stresses, roll, pitch, and two components of acceleration on the ship's bridge.

As the work progressed it became evident that the volume of documentation required would grow beyond the usual dimensions of a single technical report. For this reason the analyses, the methods, the detailed results, discussions, and conclusions are contained in a series of ten related reports.

This report is one of the six in the series in which the detailed results of the data reduction process are presented. Included in this report is the reduced data from the Second Season Voyage 32.

CONTENTS

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INTRODUCTION

It was one of the objectives of the SL-7 full-scale instrumentation program to provide a direct instrumental measure of the wave environment so that more precise correlations could be made between full-scale observations, and analytical and model results. To this end the ship was fitted with a micro-wave radar relative wave meter and various motion sensing devices. A "Tucker Meter" pressure actuated wave height sensing system was also installed.

The purpose of the present project is to reduce and analyze the resulting radar and Tucker meter data obtained on the SEA-LAND McLEAN in the second (1973-1974) and third (1974-1975) winter recording seasons. The purpose of the present report is to present the reduced data from the Second Season Voyage 32.

BACKGROUND

Since the purpose of the present report is only to document a portion of the reduced data, it should be noted that details of the experiments themselves, and of the analyses leading up to the present results, are contained elsewhere. To be specific, References 1 and 2 contain, for both recording seasons in question, a full account of the instrumentation, basic recording, and the nominal circumstances surrounding the present data. References 3 and 5 contain the detail of the reduction of the original data to digital form. Reference 4 contains the detail of the analyses and of the procedures used in generating the present results. Finally, Reference 6 contains the summary, discussion and conclusions.

NOTES ON THE CONTENTS

Each voyage leg was processed, and is presented, as a unit. The first part of the presentation for each voyage leg is a four-part table.

Parts a and b of each table contain the log-book data extracted from Ref. 1 or 2. With the exception of the first column of each page, the meaning of each entry is that established by Teledyne Materials Research. The first column is the run number assigned to each interval during the digitization at D.L. This number is retained for identification throughout.

Part c of each table is a comparison of results from the present digitization with that at TMR. Five columns are stress results obtained at TMR. Stresses are presented in thousands of pounds per square inch. The columns marked 6 through 8 are from the present digitization. Column 6 "range of recorded extremes" was computed from the first pass analysis by scaling the extremes in each interval and subtracting the smallest extreme from the largest. Column 7 is $2\sqrt{2}$ times the process rms. This estimate should compare with the value given by TMR for "rms P to T stress,". Column 8 is the difference of the sample mean of the interval noted, from the sample mean of the first interval digitized in each voyage leg. The remaining columns are various ratios of present results to those obtained by TMR.

Part d of the tables involves indices of the magnitude of raw radar, roll, pitch, vertical and transverse acceleration, and Tucker meter signals. The first index in each case is 4.0 x the rms. The second and third indices are the positive and negative extremes for each channel. The extremes observed for roll and pitch were corrected for electrical zero on tape before scaling. The extremes for all other items were corrected to the sample mean before scaling. The senses of pitch and Tucker meter are not correct for reasons noted in Ref. 4, and it is to be emphasized that all data is raw (uncorrected for anything).

The second part of the presentation for each voyage leg is a series of charts, a pair of charts for each interval. The first of the pair includes plots of spectra of midship vertical bending stress, roll, corrected radar wave elevation, Tucker meter wave, and the mean dynamic head at frame 119. The "mean dynamic head" is a partial correction of the Tucker meter as detailed in Ref. 4. At the left of the first chart is a tabulation of various data; portions of the log book data from the tables, two indices of midship stress, a summary of the magnitude of motions,

and finally a table summarizing wave height statistics obtained from spectra as well as peak-trough analyses of the time histories.

The second chart of the pair for each interval are sample time histories for five of the channels of information treated in the first chart. As noted in Reference 4, there was at the end of data reduction 16-1/2 minutes of valid radar wave elevation data. To produce the charts an 8-1/2 minute portion of this sample was selected.

A fuller discussion of the background and conventions employed in the charts is presented in the Appendix.

REFERENCES

1. Wheaton, J.W. and Boentgen, R.R., "Second Season Results from Ship Response Instrumentation Aboard the SL-7 Class Containership S.S. SEA-LAND McLEAN in North Atlantic Service," SL-7-9, 1976, AD-A034162.

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3. Dalzell, J.F., "Original Radar and Standard Tucker Wavemeter SL-7 Containership Data Reduction and Correlation Sample," SSC-277, SL-7-14. 1978.

4. Dalzell, J.F., "Wavemeter Data Reduction Method and Initial Data for the SL-7 Containership," SSC-278, SL-7-15. 1978.

5. Dalzell, J.F., "Modified Radar and Standard Tucker Wavemeter SL-7 Containership Data," SSC-279, SL-7-20. 1978 .

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TABLE Ia

SUMMARY OF TMR LOG-BOOK DATA CORRESPONDING TO
INTERVALS SELECTED FOR WAVE METER DATA REDUCTION (PAGE 1 OF 2)

SEA LAND MC LEAN : 1973-1974 WINTER SEASON : VOYAGE 32 EAST

D.L. RUN NO.	TMR TAPE NO.	TMR INDX NO.	TMR INTV NO.	DATE	TIME (GMT)	LATITUDE	LONGITUDE	COURSE	SPEED KT.	PROP RPM	DRAFT FT.	SEA/AIR TEMP
113	139	4	13	12-30-73	2400	40-38 N	68-17 W	079	33.0	133.8	30.00	43/50
117	139	5	17	12-31-73	0400	40-38 N	68-17 W	079	32.7	132.4	30.05	44/50
121	139	6	21	12-31-73	0800	40-38 N	68-17 W	079	32.7	132.4	30.11	48/48
133	139	9	33	12-31-73	2000	42-49 N	52-42 W	078	32.6	132.2	30.28	45/55
137	139	10	37	12-31-73	2400	42-49 N	52-42 W	078	21.1	85.7	30.28	42/42
141	139	11	41	01-01-74	0400	42-49 N	52-42 W	078	21.0	85.1	30.24	46/46
145	139	12	45	01-01-74	0800	42-49 N	52-42 W	078	21.4	86.7	30.20	60/49
149	139	13	49	01-01-74	1200	42-49 N	52-42 W	078	21.3	86.3	30.20	47/48
153	139	14	53	01-01-74	1400	44-39 N	40-31 W	078	21.1	85.5	30.22	47/50
157	139	15	57	01-01-74	1600	44-39 N	40-31 W	090	21.0	85.1	30.01	58/52
161	139	16	61	01-01-74	2000	44-39 N	40-31 W	090	21.9	88.7	30.00	46/50
201	141	17	1	01-01-74	2400	44-39 N	40-31 W	090	20.8	84.5	29.89	52/50
205	141	18	5	01-02-74	0400	44-39 N	40-31 W	090	21.0	85.3	29.81	56/50
209	141	19	9	01-02-74	0800	44-39 N	40-31 W	075	21.4	87.0	29.85	56/52
213	141	20	13	01-02-74	1200	45-00 N	29-29 W	075	22.5	91.2	29.85	55/54
217	141	21	17	01-02-74	1600	45-00 N	29-29 W	090	24.1	97.6	29.63	56/56
221	141	22	21	01-02-74	2000	45-00 N	29-29 W	085	27.2	110.4	29.66	55/51
225	141	23	25	01-02-74	2400	45-00 N	29-29 W	085	27.1	109.9	29.53	55/52
229	141	24	29	01-03-74	0400	45-00 N	29-29 W	070	27.7	112.2	29.45	56/50
233	141	25	33	01-03-74	0800	45-00 N	29-29 W	070	27.7	112.4	29.50	54/50
237	141	26	37	01-03-74	1200	47-10 N	15-26 W	070	27.7	112.3	29.36	55/58
241	141	27	41	01-03-74	1600	47-10 N	15-26 W	070	27.7	112.3	29.33	56/54
245	141	28	45	01-03-74	2000	47-10 N	15-26 W	074	27.7	112.3	29.46	53/
249	141	29	49	01-03-74	2400	47-10 N	15-26 W	075	27.5	111.7	29.39	54/52

TABLE Ib

SUMMARY OF TMR LOG-BOOK DATA CORRESPONDING TO
INTERVALS SELECTED FOR WAVE METER DATA REDUCTION (PAGE 2 OF 2)

SEA LAND MC LEAN : 1973-1974 WINTER SEASON : VOYAGE 32 EAST

D.L. RUN NO.	SEA STATE	<REL WIND> DIR/SPEED /(KT)	REL WAVE DIR	WAVE HT. FT.	REL SWELL DIR	<-SWELL-> HT FT.	LENGTH FT.	VISUAL WEATHER /TMR LOG-BOOK COMMENTS
113	7	169P/30	169P	5	169P	5	300	CLEAR /
117	7	169P/30	169P	6	169P	5	300	CLEAR /
121	6	169P/22	169P	5	169P	5	300	PTLY CLDY /
133	5	123P/20	168P	5	168P	5	300	CLDY /
137	4	168P/20	168P	5	168P	5	250	OCAST /
141	5	168P/20	168P	8	168P	8	250	OCAST /
145	5	123P/20	168P	10	168P	10	200	OCAST /
149	7	123P/28	123P	15	123P	12	200	OCAST /
153	7	123P/30	168P	18	168P	15	200	OCAST /
157	8	157P/35	157P	20	157P	15	200	CLDY /HEAVY ROLLS
161	8	135P/35	135P	20	135P	15	200	CLDY /
201	9	157P/40	157P	20	157P	15	200	CLDY /
205	8	157P/40	157P	12	135P	12	300	PT CLDY /
209	7	120P/40	120P	10	120P	12	300	PT CLDY /
213	9	120P/45	120P	12	120P	15	300	PT CLDY /
217	9	146P/50	157P	15	157P	15	300	CLDY /
221	8	141P/50	141P	12	141P	15	300	CLDY /ROLLING AND PITCHING
225	8	130P/45	130P	12	130P	10	400	PT CLDY /RAIN SQUALLS
229	8	92P/45	115P	12	115P	10	500	CLDY /ROLLING MOD TO HEAVY
233	5	115P/35	115P	8	115P	10	500	CLDY /
237	6	115P/30	115P	10	115P	8	500	PT CLDY /
241	7	155S/30	155S	10	160P	10	500	PT CLDY /
245	6	151S/25	151S	10	151S	8	400	CLDY /
249	6	150S/25	165P	8	165P	8	300	PT CLDY /

TABLE Ic

COMPARISON OF TMR RESULTS FOR MIDSHIP VERTICAL BENDING STRESS
WITH CORRESPONDING RAW DIGITIZATION RESULTS AT DAVIDSON LABORATORY

SEA LAND MC LEAN : 1973-1974 WINTER SEASON : VOYAGE 32 EAST

	<----------TMR RESULTS---------->					<----D.L. DIGITIZATION--->			<--COLUMN RATIOS-->		
D.L. RUN NO.	NO. WAVE INDUCED CYCLES (1)	NO. 1ST MODE BURSTS (2)	MAX P-TO-T STRESS KPSI (3)	RMS P-TO-T STRESS KPSI (4)	MAX 1ST MODE STRESS KPSI (5)	RANGE OF RECORDED EXTREMES KPSI (6)	2.83X (SAMPLE RMS) KPSI (7)	REL MEAN STRESS KPSI (8)	(7) / (4)	(6) / (3+5)	(6) / (3)
113	83	0	3.55	1.63	0.00	4.95	2.06	-0.65	1.27	1.39	1.39
117	66	0	4.23	1.71	0.00	4.85	2.11	-0.82	1.23	1.15	1.15
121	57	0	3.79	1.77	0.00	6.47	2.95	-0.92	1.67	1.70	1.70
133	91	0	3.99	1.74	0.00	4.66	1.89	-0.52	1.09	1.17	1.17
137	105	0	4.26	1.42	0.00	4.62	1.66	-0.96	1.17	1.08	1.08
141	81	0	3.04	1.38	0.00	5.54	1.49	-1.19	1.08	1.82	1.82
145	76	0	5.93	2.98	0.00	6.31	2.97	-1.19	1.00	1.06	1.06
149	65	0	8.50	4.14	0.00	12.50	5.08	-0.17	1.23	1.47	1.47
153	55	1	13.41	6.07	0.58	11.40	5.55	-0.10	0.91	0.81	0.85
157	58	1	14.80	7.18	0.57	15.70	7.02	0.04	0.98	1.02	1.06
161	55	1	12.48	5.96	0.63	13.56	6.40	-0.10	1.07	1.03	1.09
201	57	0	12.30	7.02	0.00	14.60	7.36	-0.12	1.05	1.19	1.19
205	60	1	10.40	5.75	0.69	11.46	5.94	0.11	1.03	1.03	1.10
209	68	17	10.69	5.10	1.64	14.56	6.24	-0.09	1.22	1.18	1.36
213	58	8	12.89	7.61	1.11	15.25	7.91	0.06	1.04	1.09	1.18
217	61	11	15.80	5.93	0.90	18.94	7.10	0.22	1.20	1.13	1.20
221	56	15	11.63	6.32	1.09	15.64	7.11	-0.41	1.12	1.23	1.34
225	44	0	11.43	6.20	0.00	16.19	7.03	-0.59	1.14	1.42	1.42
229	48	7	10.95	6.26	0.83	14.33	6.72	-0.55	1.07	1.22	1.31
233	43	2	10.39	5.26	0.60	10.91	5.31	-0.59	1.01	0.99	1.05
237	44	0	8.01	4.78	0.00	10.26	5.58	-0.41	1.17	1.28	1.28
241	46	0	9.04	4.47	0.00	9.51	4.84	-0.54	1.08	1.05	1.05
245	46	1	13.80	5.18	0.57	13.44	5.68	-0.68	1.10	0.94	0.97
249	62	3	6.98	3.39	0.74	8.78	4.14	-0.94	1.22	1.14	1.26

TABLE Id

SUMMARY OF RAW DIGITIZATION RESULTS FOR RADAR RANGE
ROLL, PITCH, DECK HOUSE ACCELERATIONS, AND TUCKER METER

SEA LAND MC LEAN : 1973-1974 WINTER SEASON : VOYAGE 32 EAST

	<--- RADAR --->			<--- ROLL ---->			<--- PITCH --->			<--VERT ACCEL->			<--LAT ACCEL-->			<-- TUCKER -->		
D.L. RUN NO.	4.0 (RMS) FT	RECORDED EXTREMES FT		4.0 (RMS) DEG	RECORDED EXTREMES DEG		4.0 (RMS) DEG	RECORDED EXTREMES DEG		4.0 (RMS) (G)	RECORDED EXTREMES (G)		4.0 (RMS) (G)	RECORDED EXTREMES (G)		4.0 (RMS) FT	RECORDED EXTREMES FT	
113	24.	24.	-17.	9.9	7.	-11.	0.4	-0.2	-1.1	0.08	0.1	-0.1	0.22	0.2	-0.2	3.	2.	-3.
117	21.	16.	-18.	8.6	6.	-5.	0.4	-0.2	-0.9	0.07	0.1	-0.1	0.19	0.1	-0.1	2.	2.	-2.
121	23.	18.	-16.	9.4	7.	-7.	0.4	-0.1	-0.8	0.07	0.1	-0.1	0.20	0.2	-0.1	2.	2.	-2.
133	17.	17.	-14.	6.2	5.	-5.	0.5	0.1	-0.9	0.10	0.1	-0.1	0.15	0.1	-0.1	3.	2.	-2.
137	16.	14.	-13.	5.2	3.	-5.	0.6	0.0	-0.9	0.11	0.1	-0.1	0.13	0.1	-0.1	2.	2.	-2.
141	16.	14.	-14.	6.6	4.	-6.	0.5	0.1	-0.8	0.10	0.1	-0.1	0.15	0.1	-0.1	2.	2.	-2.
145	20.	15.	-18.	13.6	12.	-12.	0.5	0.1	-0.8	0.09	0.1	-0.1	0.32	0.3	-0.3	4.	3.	-3.
149	28.	21.	-21.	21.7	17.	-15.	0.7	0.3	-0.9	0.10	0.1	-0.1	0.49	0.4	-0.4	5.	5.	-4.
153	30.	27.	-25.	21.3	16.	-14.	0.7	0.2	-0.8	0.08	0.1	-0.1	0.46	0.3	-0.3	5.	5.	-4.
157	33.	28.	-32.	24.7	18.	-18.	0.7	0.2	-0.9	0.12	0.1	-0.1	0.55	0.4	-0.4	7.	6.	-6.
161	32.	28.	-23.	22.2	17.	-17.	0.8	0.3	-0.9	0.11	0.1	-0.1	0.49	0.4	-0.4	7.	6.	-6.
201	35.	30.	-35.	23.1	21.	-16.	0.8	0.5	-0.9	0.11	0.1	-0.1	0.51	0.4	-0.5	8.	7.	-5.
205	33.	35.	-28.	26.4	18.	-18.	0.7	0.2	-0.9	0.12	0.1	-0.1	0.59	0.4	-0.4	9.	8.	-7.
209	29.	24.	-26.	25.0	23.	-14.	0.8	0.5	-0.9	0.18	0.2	-0.1	0.55	0.3	-0.5	9.	7.	-7.
213	32.	31.	-28.	26.8	23.	-16.	0.9	0.4	-0.9	0.17	0.2	-0.2	0.63	0.4	-0.5	10.	9.	-7.
217	30.	24.	-26.	20.3	20.	-12.	0.8	0.5	-1.0	0.17	0.2	-0.1	0.47	0.3	-0.4	9.	7.	-7.
221	33.	26.	-24.	24.1	21.	-13.	0.8	0.5	-1.0	0.16	0.2	-0.1	0.56	0.4	-0.5	8.	7.	-8.
225	31.	25.	-25.	17.0	17.	-11.	0.6	0.4	-0.9	0.11	0.1	-0.1	0.38	0.3	-0.4	6.	5.	-4.
229	26.	24.	-24.	21.4	14.	-12.	0.8	0.3	-1.0	0.12	0.1	-0.1	0.47	0.3	-0.3	7.	6.	-5.
233	24.	18.	-19.	16.1	13.	-12.	0.6	0.2	-0.8	0.10	0.1	-0.1	0.36	0.3	-0.3	6.	4.	-4.
237	23.	24.	-21.	17.4	15.	-12.	0.7	0.6	-0.9	0.10	0.1	-0.1	0.36	0.2	-0.3	5.	5.	-4.
241	25.	20.	-20.	16.6	10.	-14.	0.7	0.2	-0.9	0.11	0.1	-0.1	0.36	0.3	-0.3	5.	3.	-4.
245	26.	21.	-20.	15.0	9.	-16.	0.9	0.5	-1.0	0.11	0.1	-0.1	0.32	0.3	-0.3	5.	4.	-4.
249	31.	34.	-20.	16.1	8.	-19.	0.9	0.2	-1.6	0.11	0.1	-0.1	0.35	0.3	-0.3	4.	3.	-2.

LOG BOOK DATA

DATE AND TIME	12-30-73 2400
POSITION	40-38 N 68-17 W
COURSE AND SPEED	079 , 33.0 KNOTS
SEA STATE	7
WAVE HEIGHT	5 FEET
" REL DIR	169 PORT
SWELL HEIGHT	5 FEET
" REL DIR	169 PORT

---- VISUAL WEATHER / COMMENTS ----

CLEAR /

MIDSHIP VERTICAL BENDING STRESS

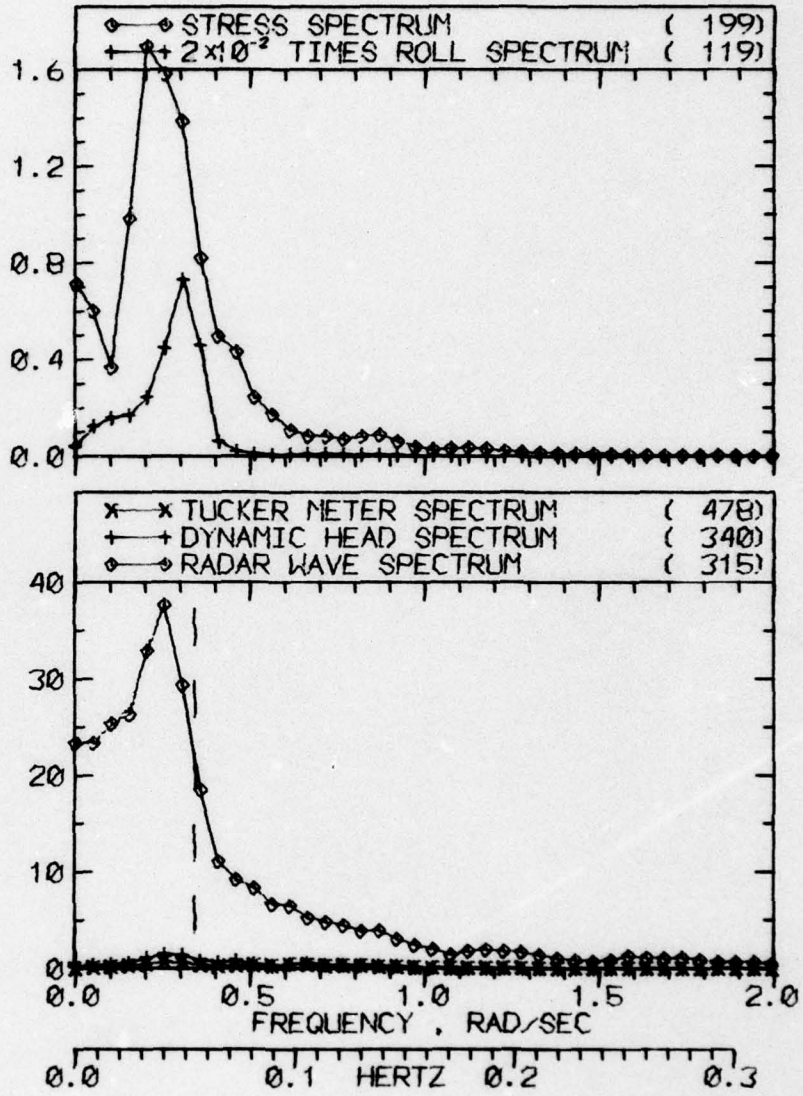
MAXIMUM PK-TR	3.6 KPSI
4.0 X RMS	2.9 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

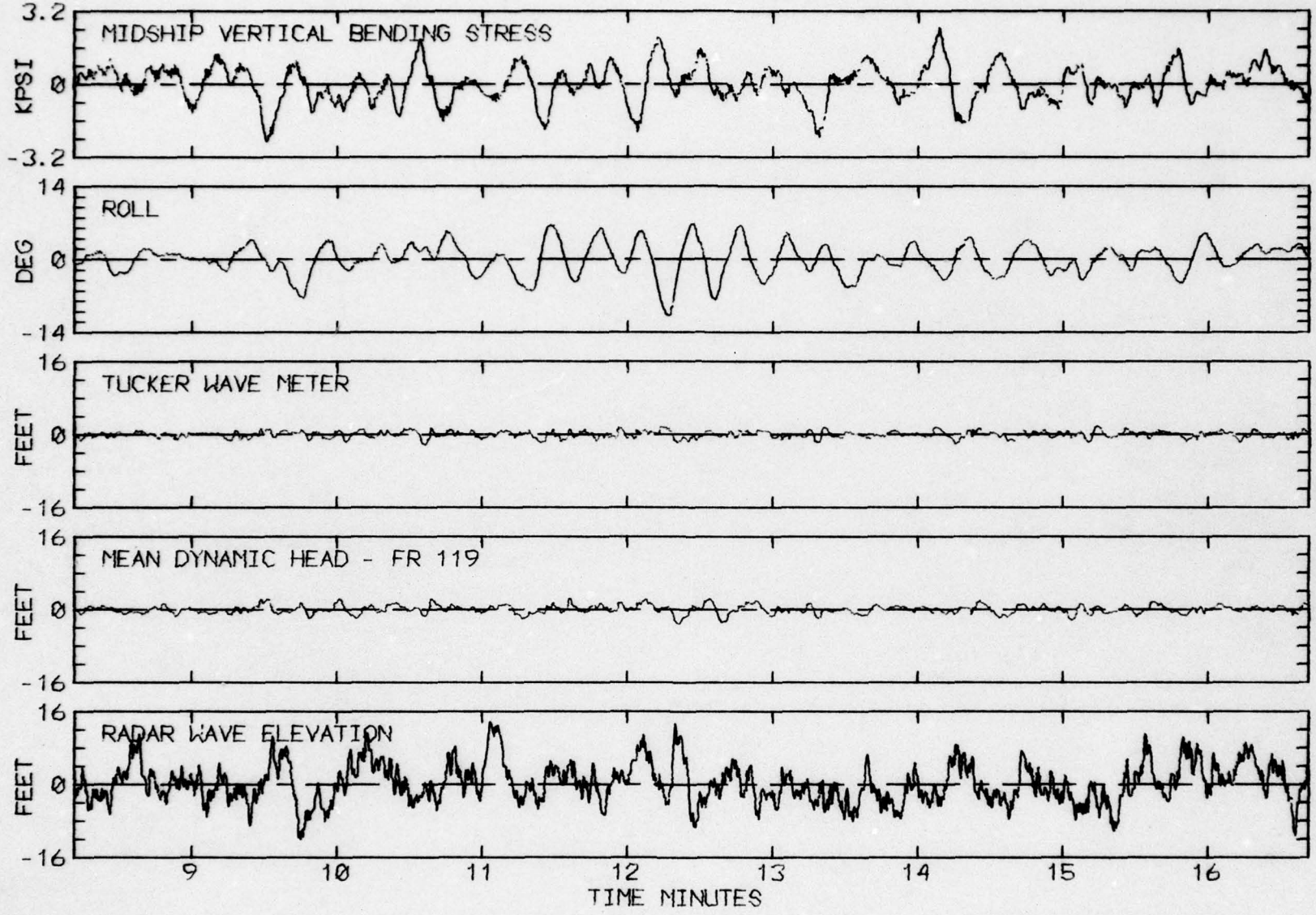
ROLL	10.2 DEG
PITCH	0.43 DEG
DK HSE VERT ACCEL	0.08 G
DK HSE LAT ACCEL	0.22 G
RADAR SLANT RANGE	24.0 FEET
VERTICAL RANGE	16.8 FEET
DISPL AT RADAR	5.1 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	222	172	182
MAXIMUM HEIGHT	3.8	5.4	22.6
10TH HIGHEST HTS	2.7	3.3	14.5
3RD HIGHEST HTS	2.0	2.4	10.8
4.0 RMS(SPECTRA)	2.6	3.2	16.1



RUN 113 -- VOYAGE 32E -- TAPE 139 -- INDEX 4 -- INTERVAL 13



RUN 113 -- VOYAGE 32E -- TAPE 139 -- INDEX 4 -- INTERVAL 13

LOG BOOK DATA

DATE AND TIME	12-31-73 0400
POSITION	40-38 N 68-17 W
COURSE AND SPEED	079 , 32.7 KNOTS
SEA STATE	7
WAVE HEIGHT	6 FEET
" REL DIR	169 PORT
SWELL HEIGHT	5 FEET
" REL DIR	169 PORT

---- VISUAL WEATHER / COMMENTS ----

CLEAR /

MIDSHIP VERTICAL BENDING STRESS

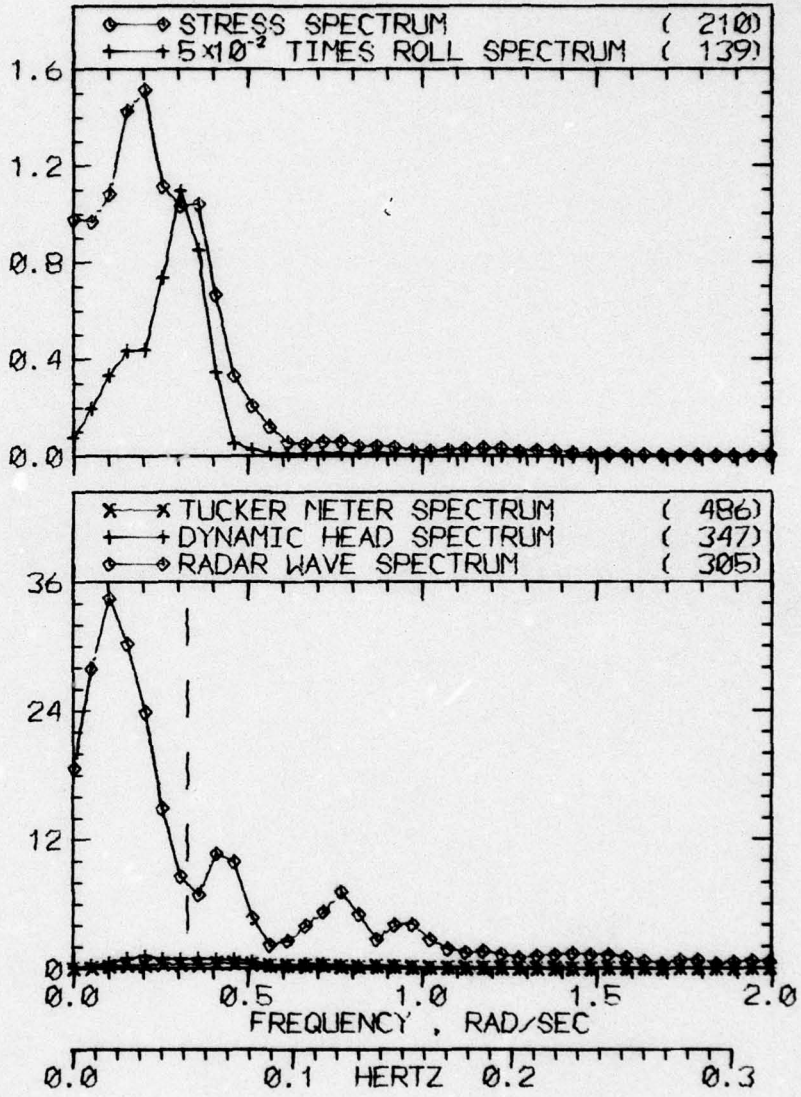
MAXIMUM PK-TR	4.2 KPSI
4.0 X RMS	3.0 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

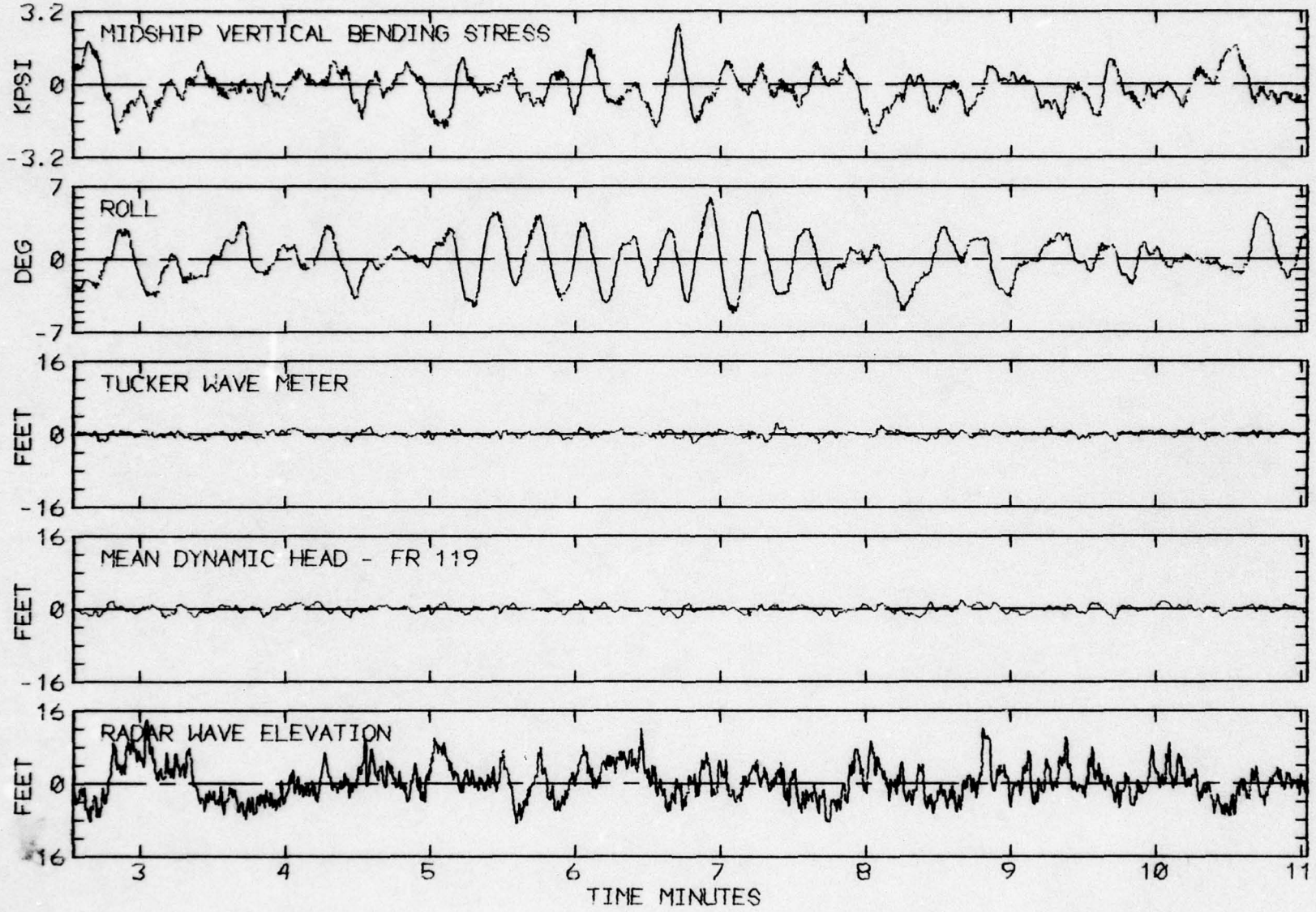
ROLL	8.7 DEG
PITCH	0.36 DEG
DK HSE VERT ACCEL	0.07 G
DK HSE LAT ACCEL	0.19 G
RADAR SLANT RANGE	21.0 FEET
VERTICAL RANGE	15.4 FEET
DISPL AT RADAR	4.6 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	248	162	202
MAXIMUM HEIGHT	3.6	3.9	21.9
10TH HIGHEST HTS	2.3	2.9	12.9
3RD HIGHEST HTS	1.7	2.2	9.9
4.0 RMS(SPECTRA)	2.4	3.1	14.6



RUN 117 -- VOYAGE 32E -- TAPE 139 -- INDEX 5 -- INTERVAL 17



RUN 117 -- VOYAGE 32E -- TAPE 139 -- INDEX 5 -- INTERVAL 17

LOG BOOK DATA

DATE AND TIME	12-31-73 0800
POSITION	40-38 N 68-17 W
COURSE AND SPEED	079 , 32.7 KNOTS
SEA STATE	6
WAVE HEIGHT	5 FEET
" REL DIR	169 PORT
SWELL HEIGHT	5 FEET
" REL DIR	169 PORT

---- VISUAL WEATHER / COMMENTS ----

PTLY CLDY /

MIDSHIP VERTICAL BENDING STRESS

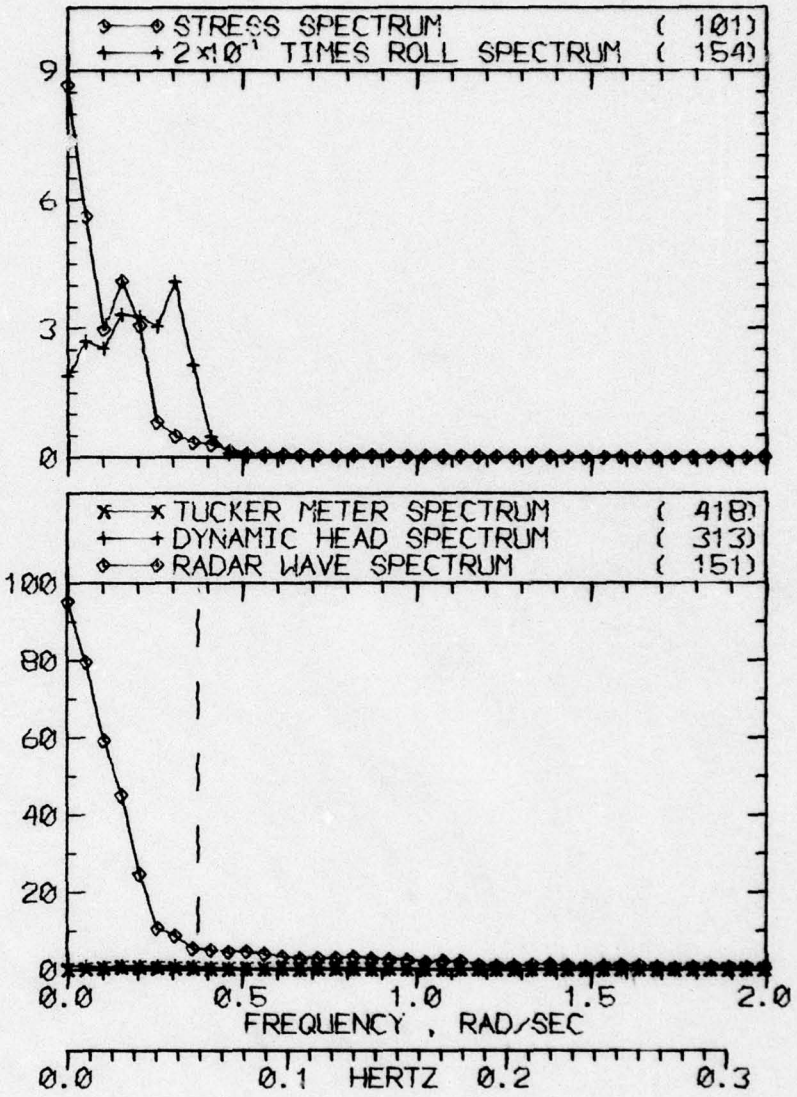
MAXIMUM PK-TR	3.8 KPSI
4.0 X RMS	4.3 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

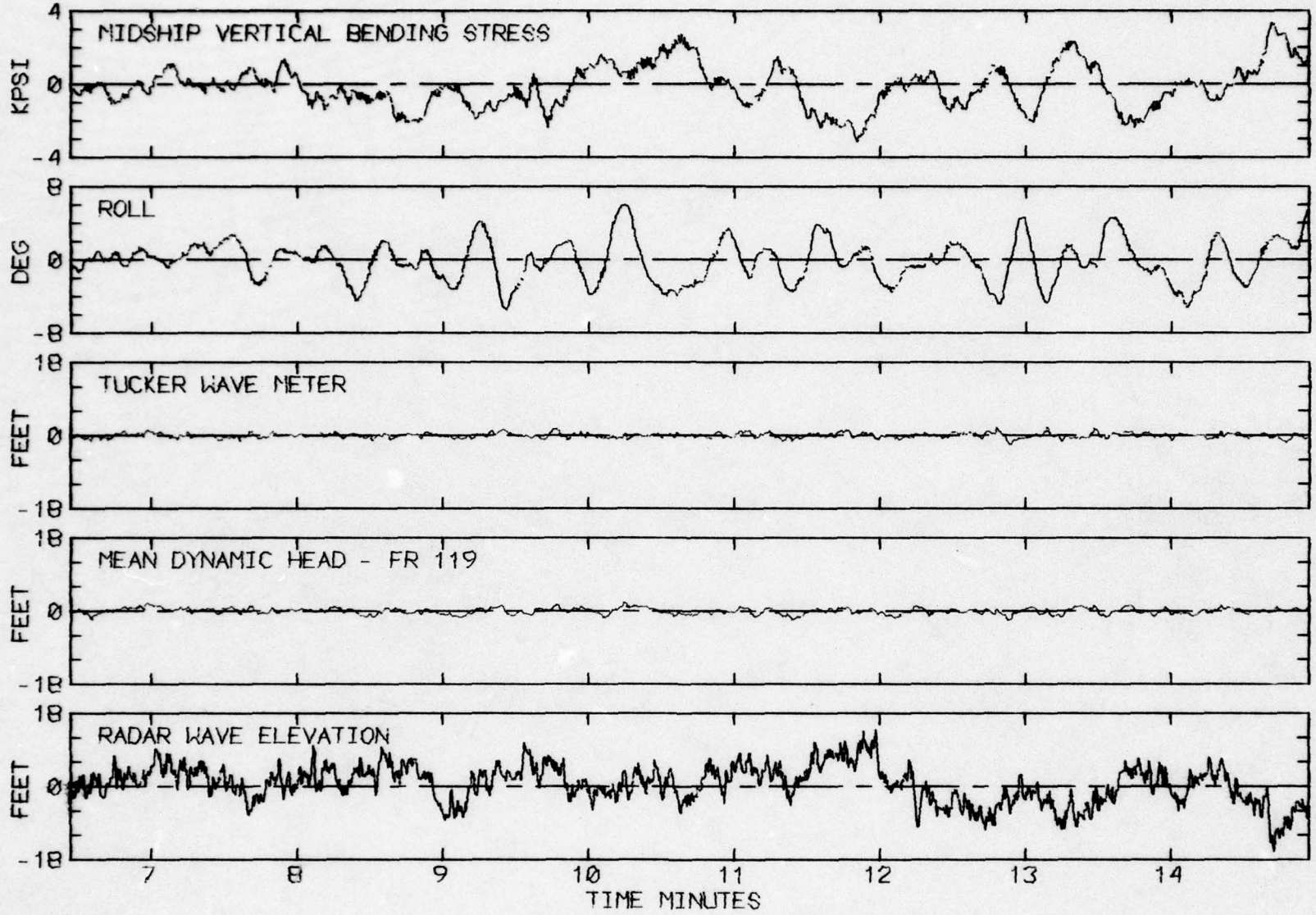
ROLL	9.7 DEG
PITCH	0.39 DEG
DK HSE VERT ACCEL	0.07 G
DK HSE LAT ACCEL	0.20 G
RADAR SLANT RANGE	22.9 FEET
VERTICAL RANGE	17.6 FEET
DISPL AT RADAR	3.5 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	231	164	151
MAXIMUM HEIGHT	3.7	3.0	18.6
10TH HIGHEST HTS	2.3	2.7	12.6
3RD HIGHEST HTS	1.6	2.0	10.2
4.0 RMS(SPECTRA)	2.3	2.8	17.2



RUN 121 -- VOYAGE 32E -- TAPE 139 -- INDEX 6 -- INTERVAL 21



RUN 121 -- VOYAGE 32E -- TAPE 139 -- INDEX 6 -- INTERVAL 21

LOG BOOK DATA

DATE AND TIME	12-31-73 2000
POSITION	42-49 N 52-42 W
COURSE AND SPEED	078 , 32.6 KNOTS
SEA STATE	5
WAVE HEIGHT	5 FEET
" REL DIR	168 PORT
SWELL HEIGHT	5 FEET
" REL DIR	168 PORT

---- VISUAL WEATHER / COMMENTS ----

CLDY /

MIDSHIP VERTICAL BENDING STRESS

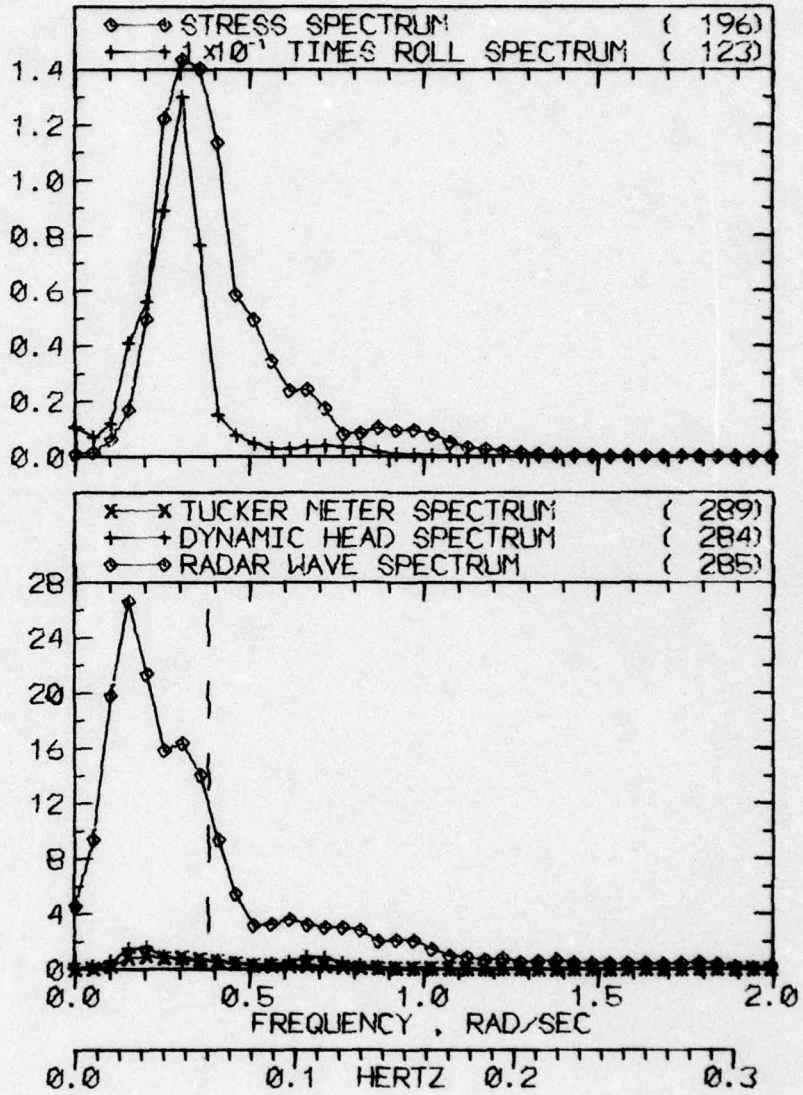
MAXIMUM PK-TR	4.0 KPSI
4.0 X RMS	2.7 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

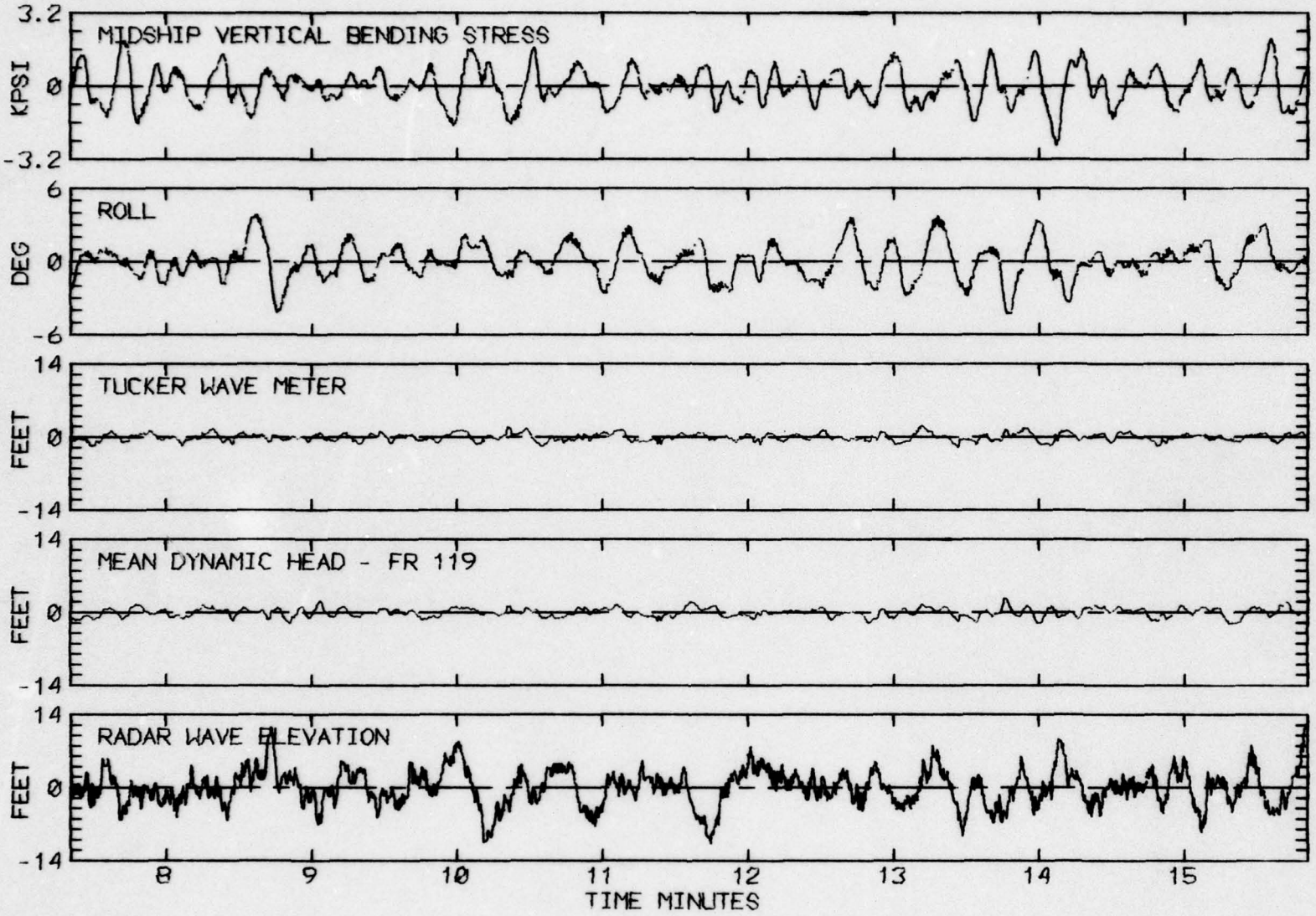
ROLL	6.2 DEG
PITCH	0.51 DEG
DK HSE VERT ACCEL	0.10 G
DK HSE LAT ACCEL	0.15 G
RADAR SLANT RANGE	16.7 FEET
VERTICAL RANGE	14.0 FEET
DISPL AT RADAR	5.9 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN. HEAD/RADAR		
P-T SAMPLE SIZE	180	136	233
MAXIMUM HEIGHT	3.8	3.5	19.5
10TH HIGHEST HTS	2.5	3.1	11.8
3RD HIGHEST HTS	1.7	2.3	7.6
4.0 RMS(SPECTRA)	2.6	3.1	12.5



RUN 133 -- VOYAGE 32E -- TAPE 139 -- INDEX 9 -- INTERVAL 33



RUN 133 -- VOYAGE 32E -- TAPE 139 -- INDEX 9 -- INTERVAL 33

LOG BOOK DATA

DATE AND TIME	12-31-73 2400
POSITION	42-49 N 52-42 W
COURSE AND SPEED	078 , 21.1 KNOTS
SEA STATE	4
WAVE HEIGHT	5 FEET
" REL DIR	168 PORT
SWELL HEIGHT	5 FEET
" REL DIR	168 PORT

---- VISUAL WEATHER / COMMENTS ----

OCAST /

MIDSHIP VERTICAL BENDING STRESS

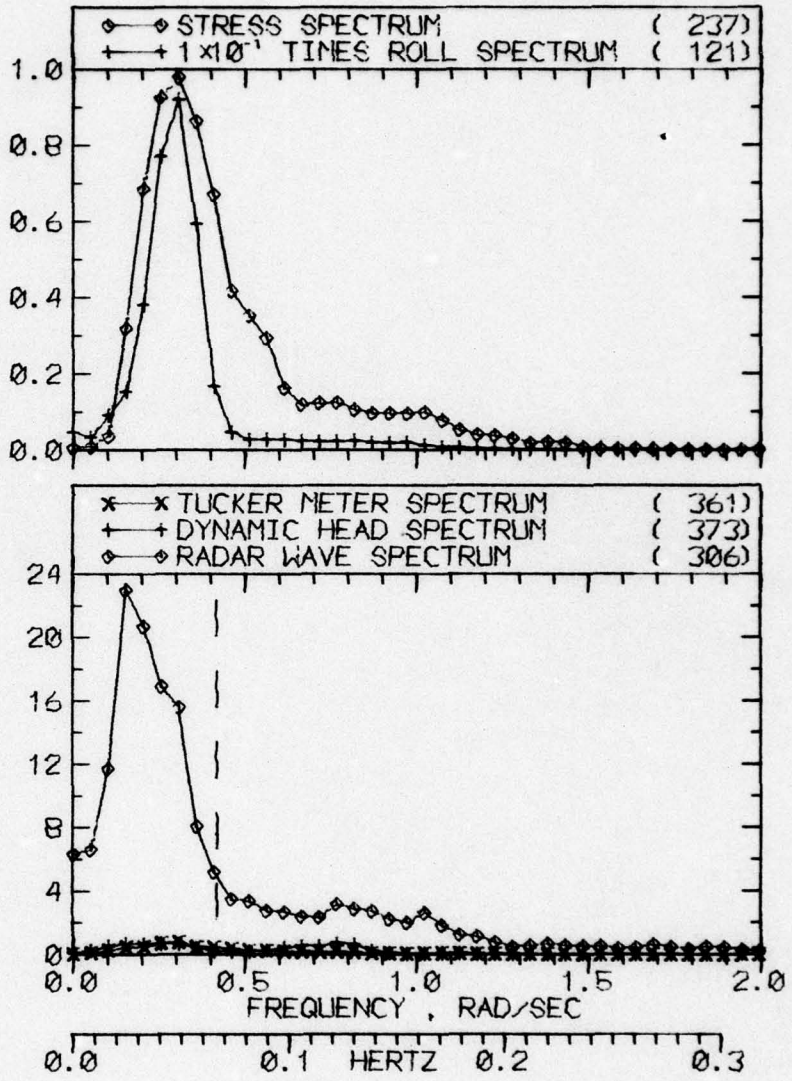
MAXIMUM PK-TR	4.3 KPSI
4.0 X RMS	2.4 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

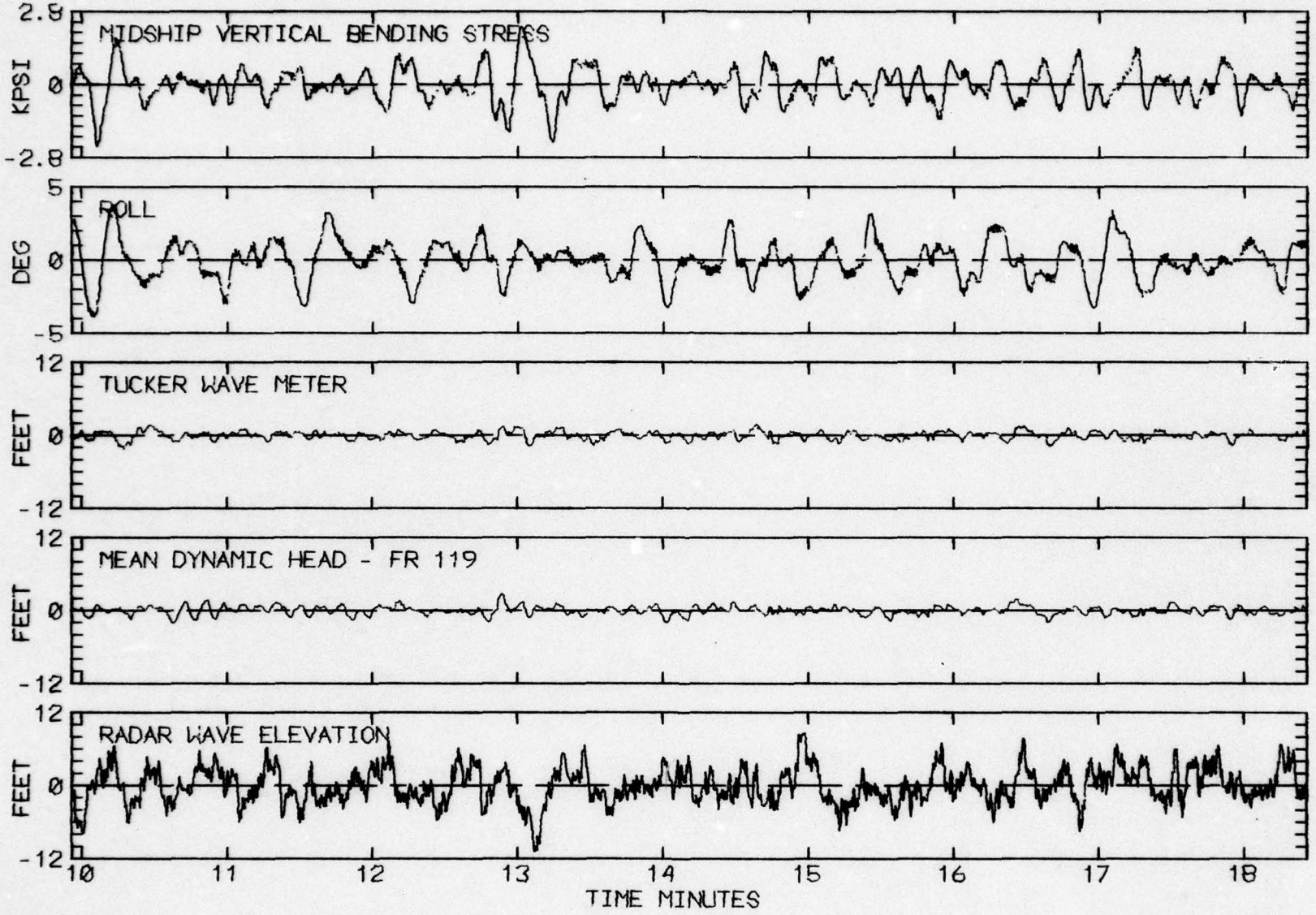
ROLL	5.3 DEG
PITCH	0.55 DEG
DK HSE VERT ACCEL	0.11 G
DK HSE LAT ACCEL	0.13 G
RADAR SLANT RANGE	15.5 FEET
VERTICAL RANGE	13.5 FEET
DISPL AT RADAR	5.7 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	210	159	223
MAXIMUM HEIGHT	3.2	3.8	16.4
10TH HIGHEST HTS	2.3	2.9	11.0
3RD HIGHEST HTS	1.6	2.1	8.1
4.0 RMS(SPECTRA)	2.4	2.7	11.8



RUN 137 -- VOYAGE 32E -- TAPE 139 -- INDEX 10 -- INTERVAL 37



RUN 137 -- VOYAGE 32E -- TAPE 139 -- INDEX 10 -- INTERVAL 37

LOG BOOK DATA

DATE AND TIME	01-01-74 0400
POSITION	42-49 N 52-42 W
COURSE AND SPEED	078 , 21.0 KNOTS
SEA STATE	5
WAVE HEIGHT	8 FEET
" REL DIR	168 PORT
SWELL HEIGHT	8 FEET
" REL DIR	168 PORT

---- VISUAL WEATHER / COMMENTS ----

OCAST /

MIDSHIP VERTICAL BENDING STRESS

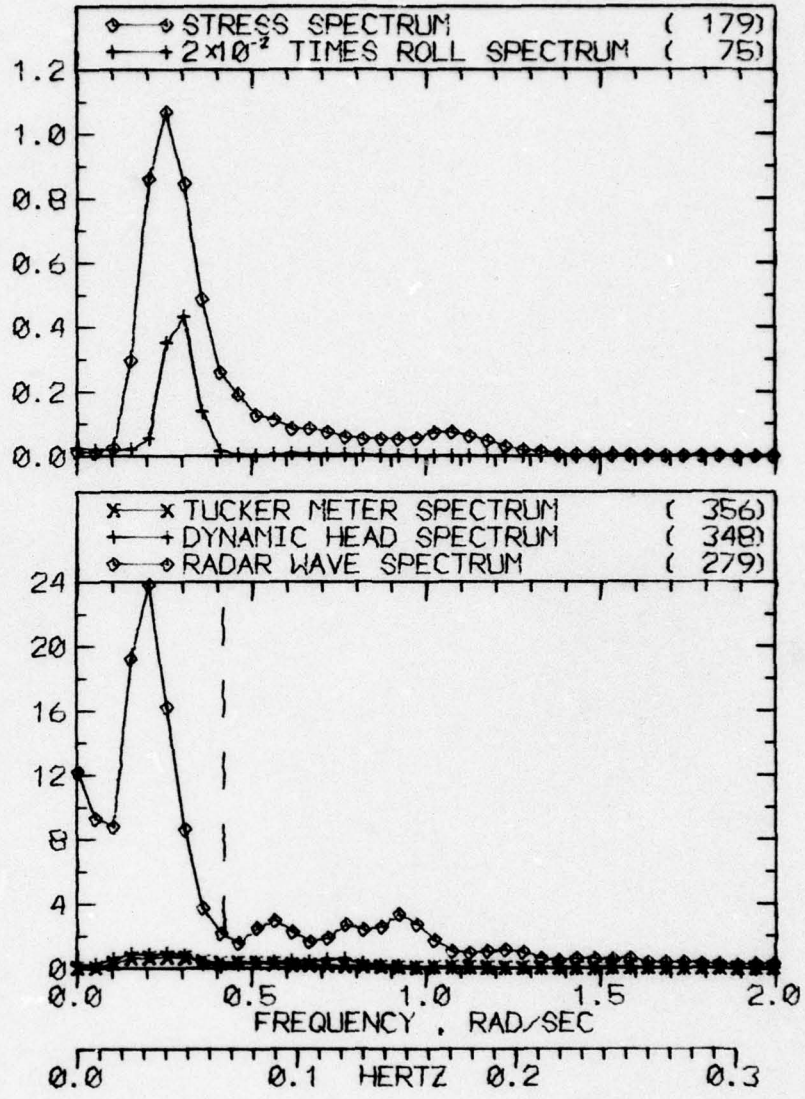
MAXIMUM PK-TR	3.0 KPSI
4.0 X RMS	2.1 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

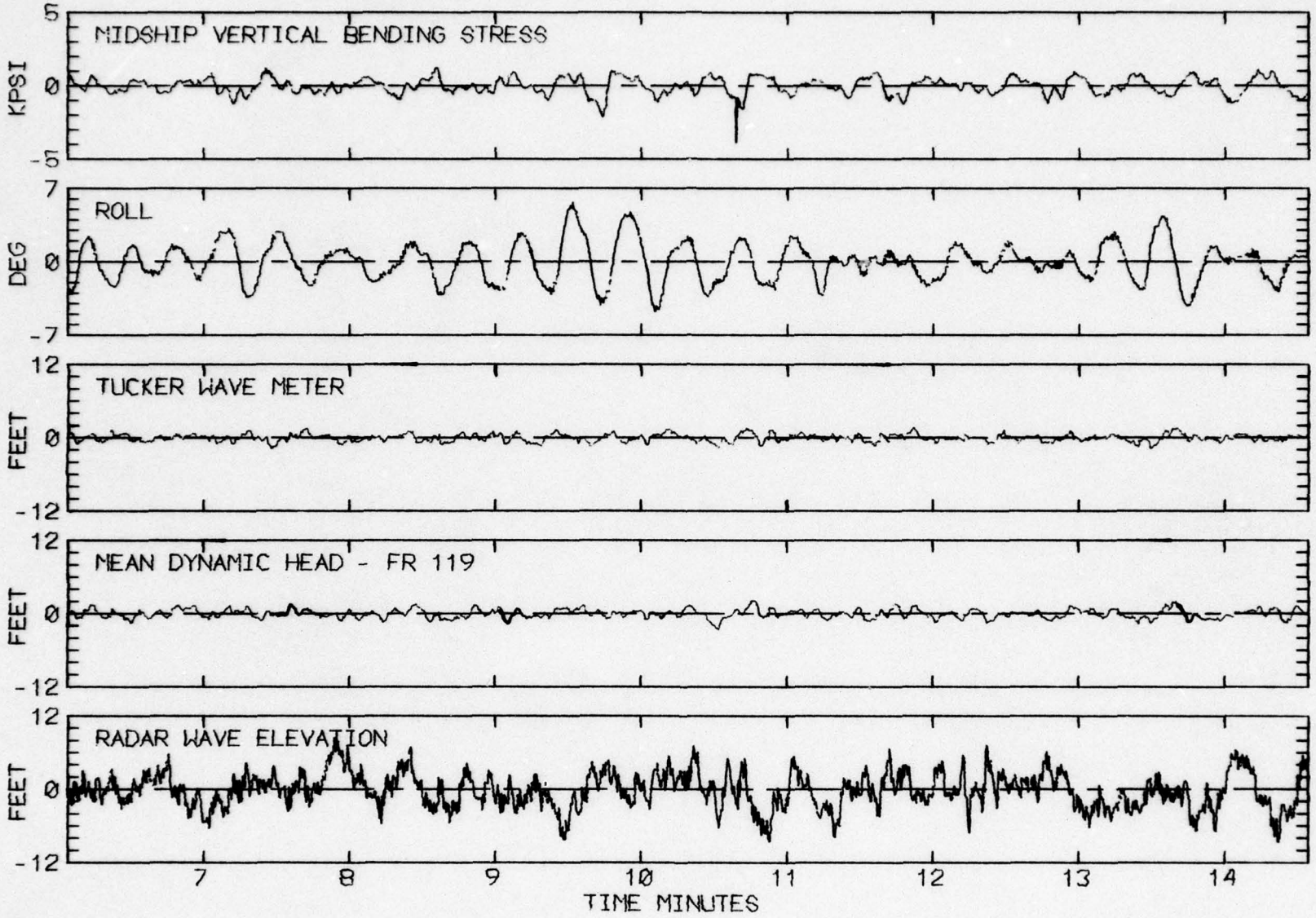
ROLL	6.8 DEG
PITCH	0.51 DEG
DK HSE VERT ACCEL	0.10 G
DK HSE LAT ACCEL	0.15 G
RADAR SLANT RANGE	15.5 FEET
VERTICAL RANGE	12.7 FEET
DISPL AT RADAR	4.9 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN. HEAD/RADAR		
P-T SAMPLE SIZE	204	154	247
MAXIMUM HEIGHT	3.0	4.1	14.9
10TH HIGHEST HTS	2.3	2.9	9.4
3RD HIGHEST HTS	1.7	2.2	7.0
4.0 RMS(SPECTRA)	2.4	2.8	11.1



RUN 141 -- VOYAGE 32E -- TAPE 139 -- INDEX 11 -- INTERVAL 41



RUN 141 -- VOYAGE 32E -- TAPE 139 -- INDEX 11 -- INTERVAL 41

LOG BOOK DATA

DATE AND TIME	01-01-74 0800
POSITION	42-49 N 52-42 W
COURSE AND SPEED	078 , 21.4 KNOTS
SEA STATE	5
WAVE HEIGHT	10 FEET
" REL DIR	168 PORT
SWELL HEIGHT	10 FEET
" REL DIR	168 PORT

---- VISUAL WEATHER / COMMENTS ----

OCAST /

MIDSHIP VERTICAL BENDING STRESS

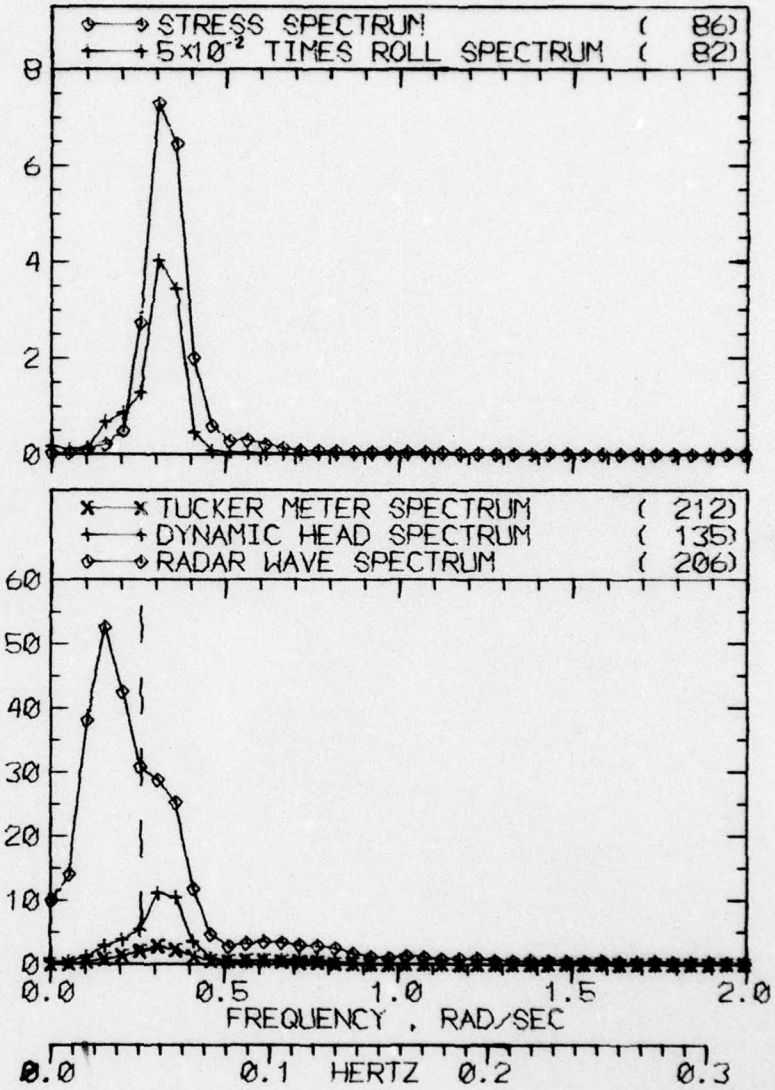
MAXIMUM PK-TR	5.9 KPSI
4.0 X RMS	4.2 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

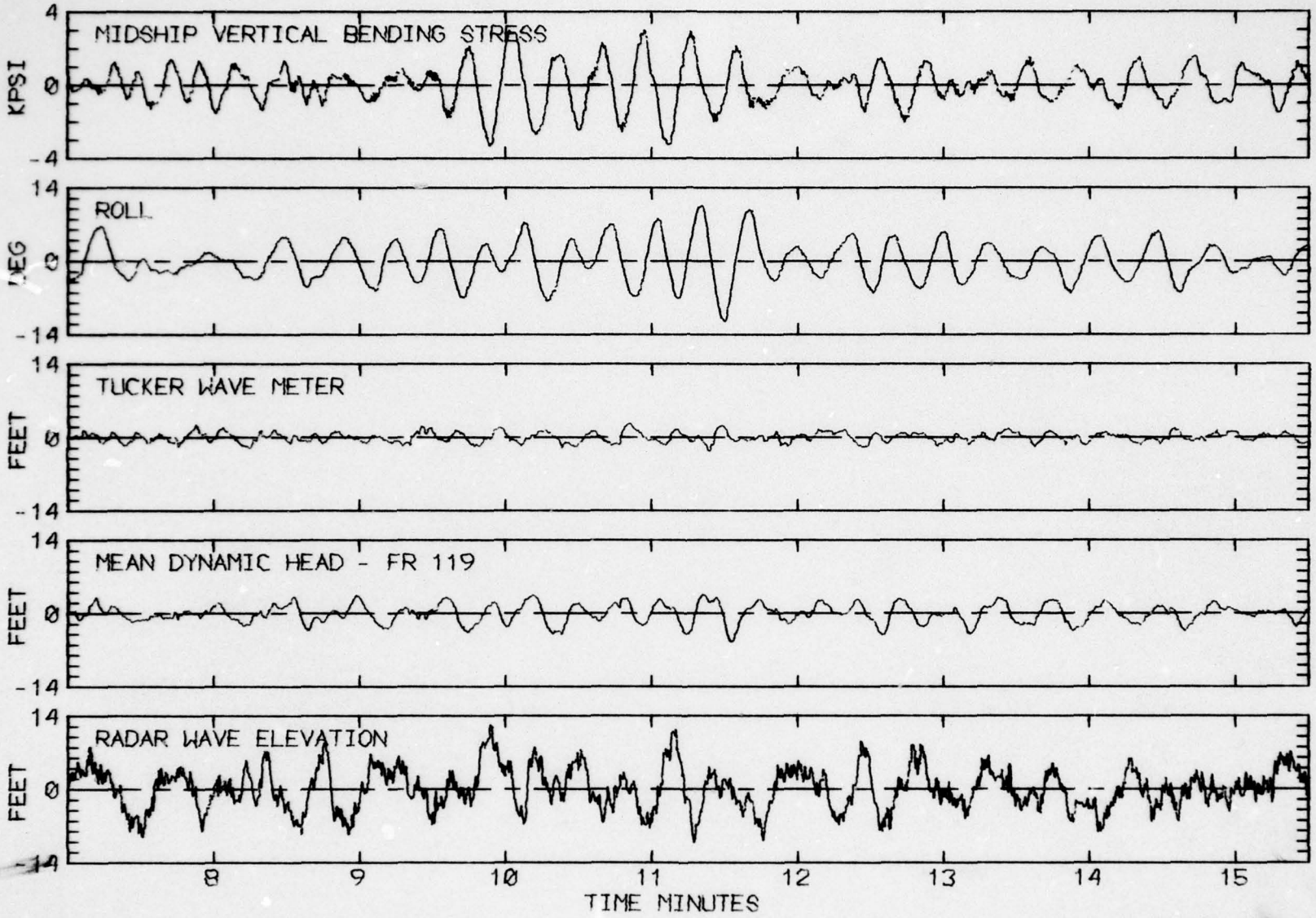
ROLL	13.6 DEG
PITCH	0.53 DEG
DK HSE VERT ACCEL	0.09 G
DK HSE LAT ACCEL	0.32 G
RADAR SLANT RANGE	20.4 FEET
VERTICAL RANGE	17.9 FEET
DISPL AT RADAR	7.4 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	127	91	162
MAXIMUM HEIGHT	4.9	8.9	21.3
10TH HIGHEST HTS	3.5	6.8	14.8
3RD HIGHEST HTS	2.7	5.3	9.9
4.0 RMS(SPECTRA)	3.6	6.1	15.8



RUN 145 -- VOYAGE 32E -- TAPE 139 -- INDEX 12 -- INTERVAL 45



RUN 145 -- VOYAGE 32E -- TAPE 139 -- INDEX 12 -- INTERVAL 45

LOG BOOK DATA

DATE AND TIME	01-01-74 1200
POSITION	42-49 N 52-42 W
COURSE AND SPEED	078 , 21.3 KNOTS
SEA STATE	7
WAVE HEIGHT	15 FEET
" REL DIR	123 PORT
SWELL HEIGHT	12 FEET
" REL DIR	123 PORT

---- VISUAL WEATHER / COMMENTS ----

OCAST /

MIDSHIP VERTICAL BENDING STRESS

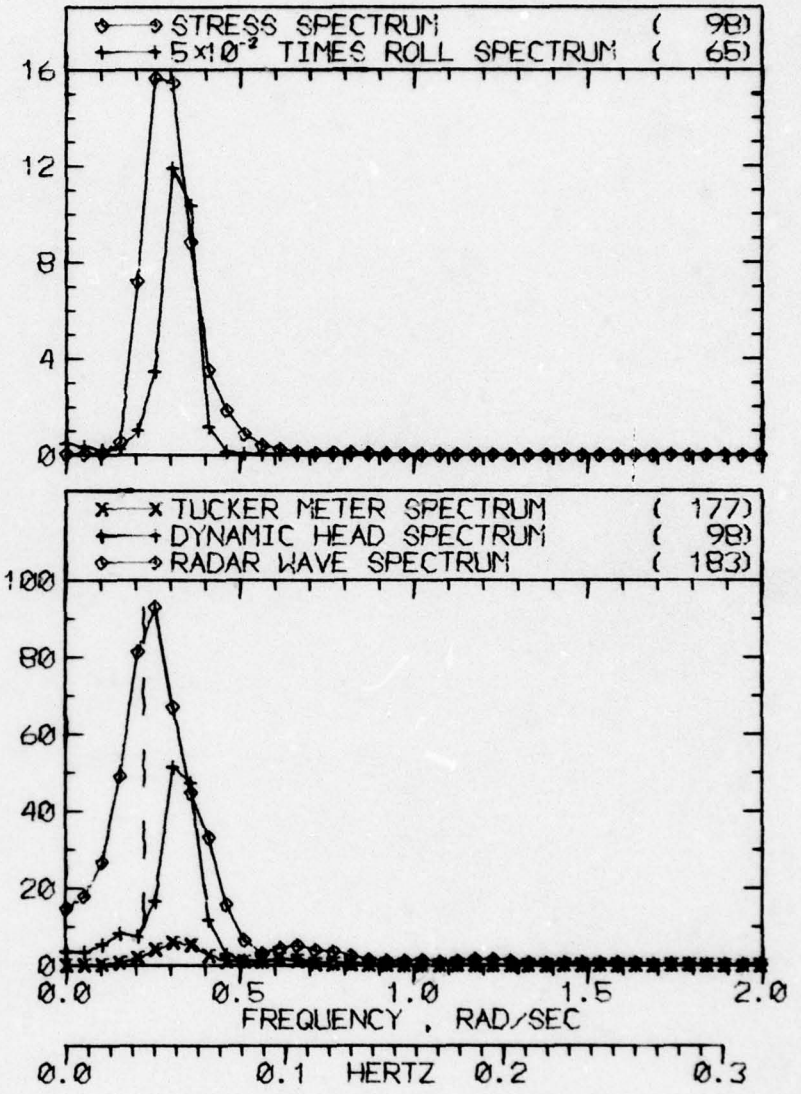
MAXIMUM PK-TR	8.5 KPSI
4.0 X RMS	6.8 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

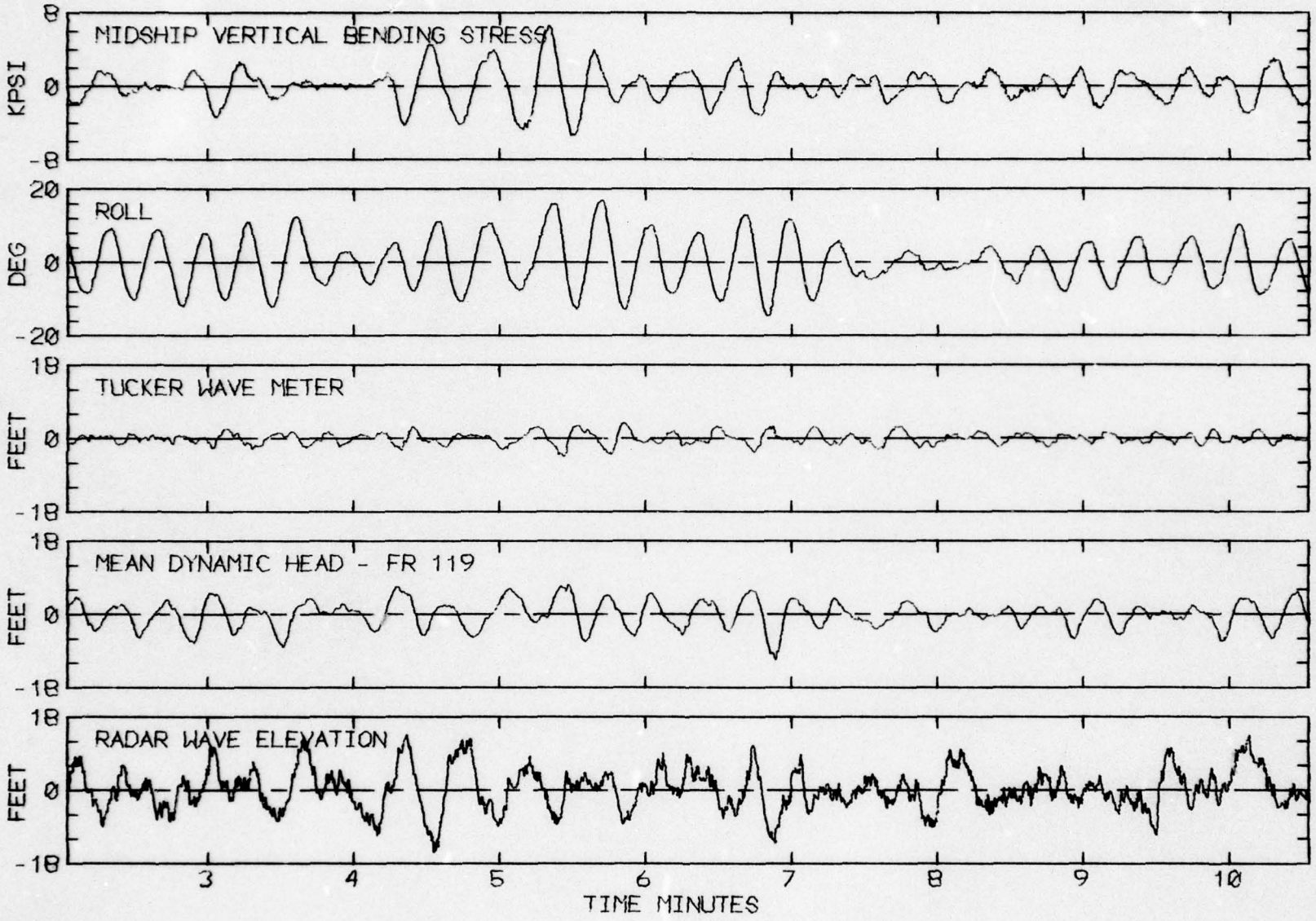
ROLL	21.9 DEG
PITCH	0.69 DEG
DK HSE VERT ACCEL	0.10 G
DK HSE LAT ACCEL	0.49 G
RADAR SLANT RANGE	28.0 FEET
VERTICAL RANGE	22.8 FEET
DISPL AT RADAR	13.6 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	118	60	133
MAXIMUM HEIGHT	7.6	17.0	29.7
10TH HIGHEST HTS	5.0	12.7	20.8
3RD HIGHEST HTS	3.9	10.4	14.3
4.0 RMS(SPECTRA)	4.9	11.6	20.2



RUN 149 -- VOYAGE 32E -- TAPE 139 -- INDEX 13 -- INTERVAL 49



RUN 149 -- VOYAGE 32E -- TAPE 139 -- INDEX 13 -- INTERVAL 49

LOG BOOK DATA

DATE AND TIME	01-01-74 1400
POSITION	44-39 N 40-31 W
COURSE AND SPEED	078 . 21.1 KNOTS
SEA STATE	7
WAVE HEIGHT	18 FEET
" REL DIR	168 PORT
SWELL HEIGHT	15 FEET
" REL DIR	168 PORT

---- VISUAL WEATHER / COMMENTS ----

OCAST /

MIDSHIP VERTICAL BENDING STRESS

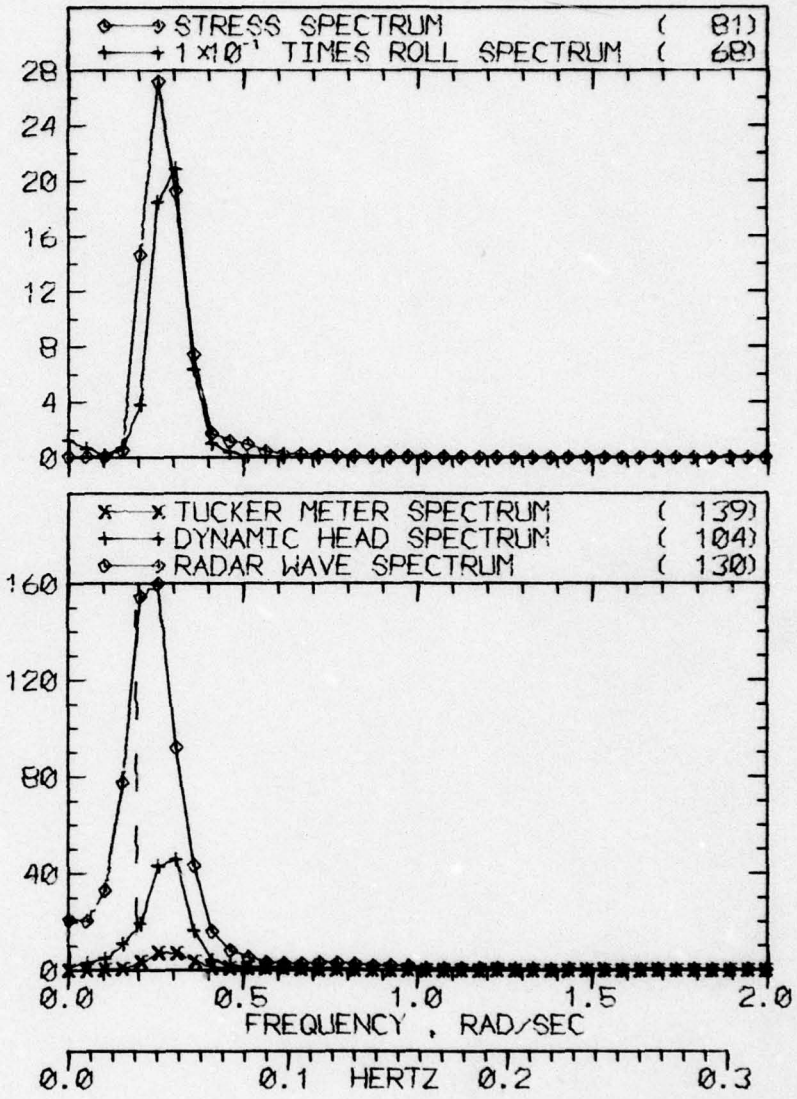
MAXIMUM PK-TR	13.4 KPSI
4.0 X RMS	7.8 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

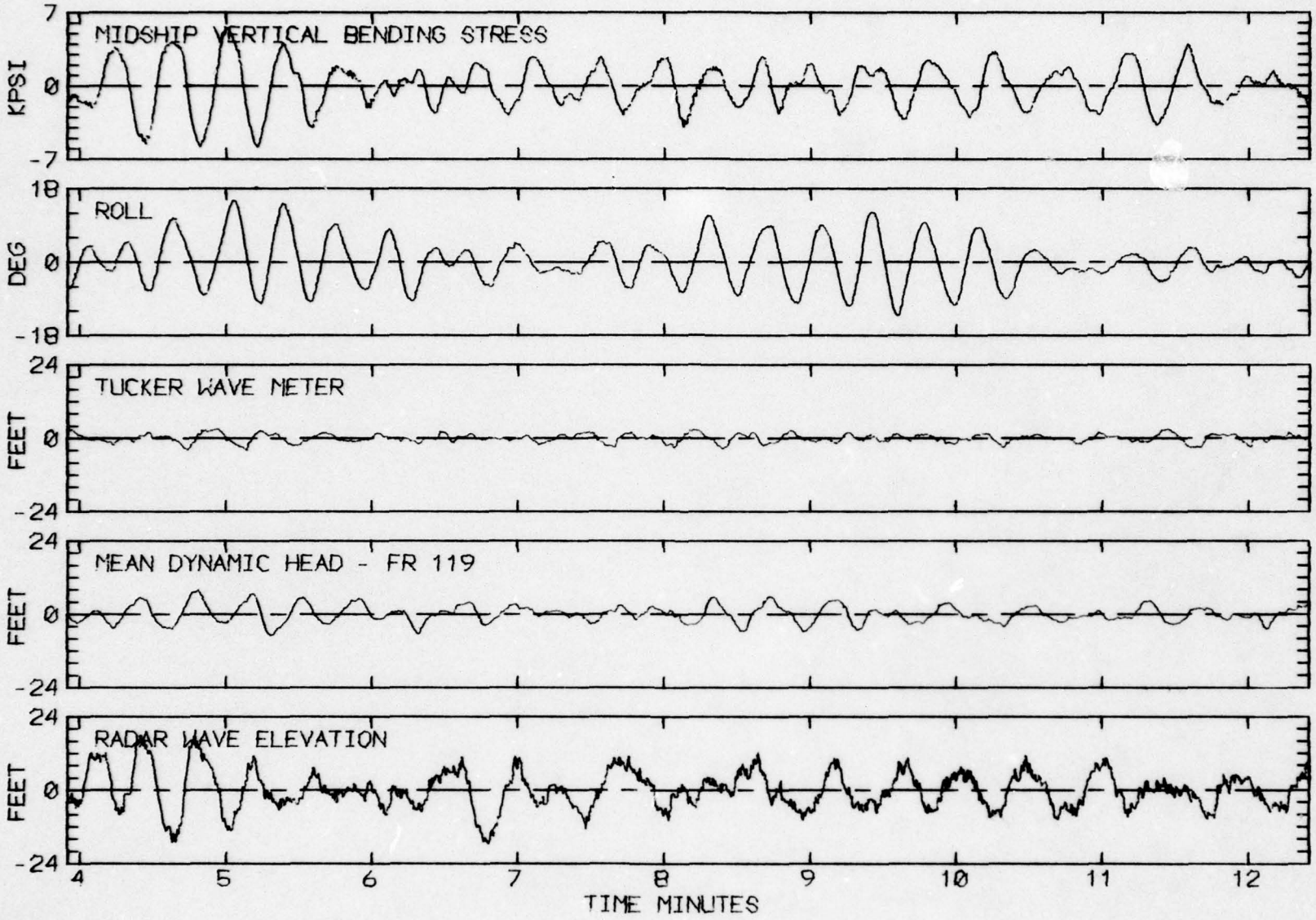
ROLL	20.9 DEG
PITCH	0.70 DEG
DK HSE VERT ACCEL	0.08 G
DK HSE LAT ACCEL	0.46 G
RADAR SLANT RANGE	30.5 FEET
VERTICAL RANGE	25.0 FEET
DISPL AT RADAR	13.5 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	111	56	123
MAXIMUM HEIGHT	7.0	14.4	34.4
10TH HIGHEST HTS	5.6	12.2	23.4
3RD HIGHEST HTS	3.9	10.3	15.4
4.0 RMS(SPECTRA)	5.0	11.4	23.4



RUN 153 -- VOYAGE 32E -- TAPE 139 -- INDEX 14 -- INTERVAL 53



RUN 153 -- VOYAGE 32E -- TAPE 139 -- INDEX 14 -- INTERVAL 53

LOG BOOK DATA

DATE AND TIME	01-01-74 1600
POSITION	44-39 N 40-31 W
COURSE AND SPEED	090 , 21.0 KNOTS
SEA STATE	8
WAVE HEIGHT	20 FEET
" REL DIR	157 PORT
SWELL HEIGHT	15 FEET
" REL DIR	157 PORT

---- VISUAL WEATHER / COMMENTS ----

CLDY /HEAVY ROLLS

MIDSHIP VERTICAL BENDING STRESS

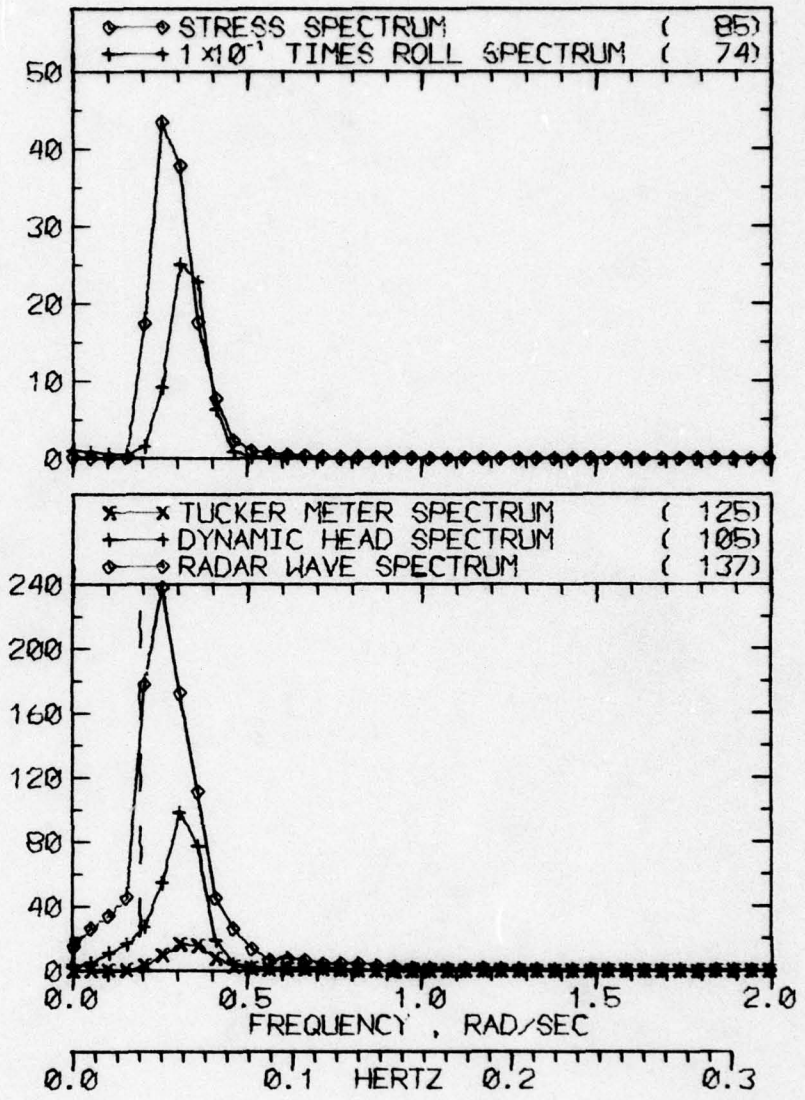
MAXIMUM PK-TR	14.8 KPSI
4.0 X RMS	10.3 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

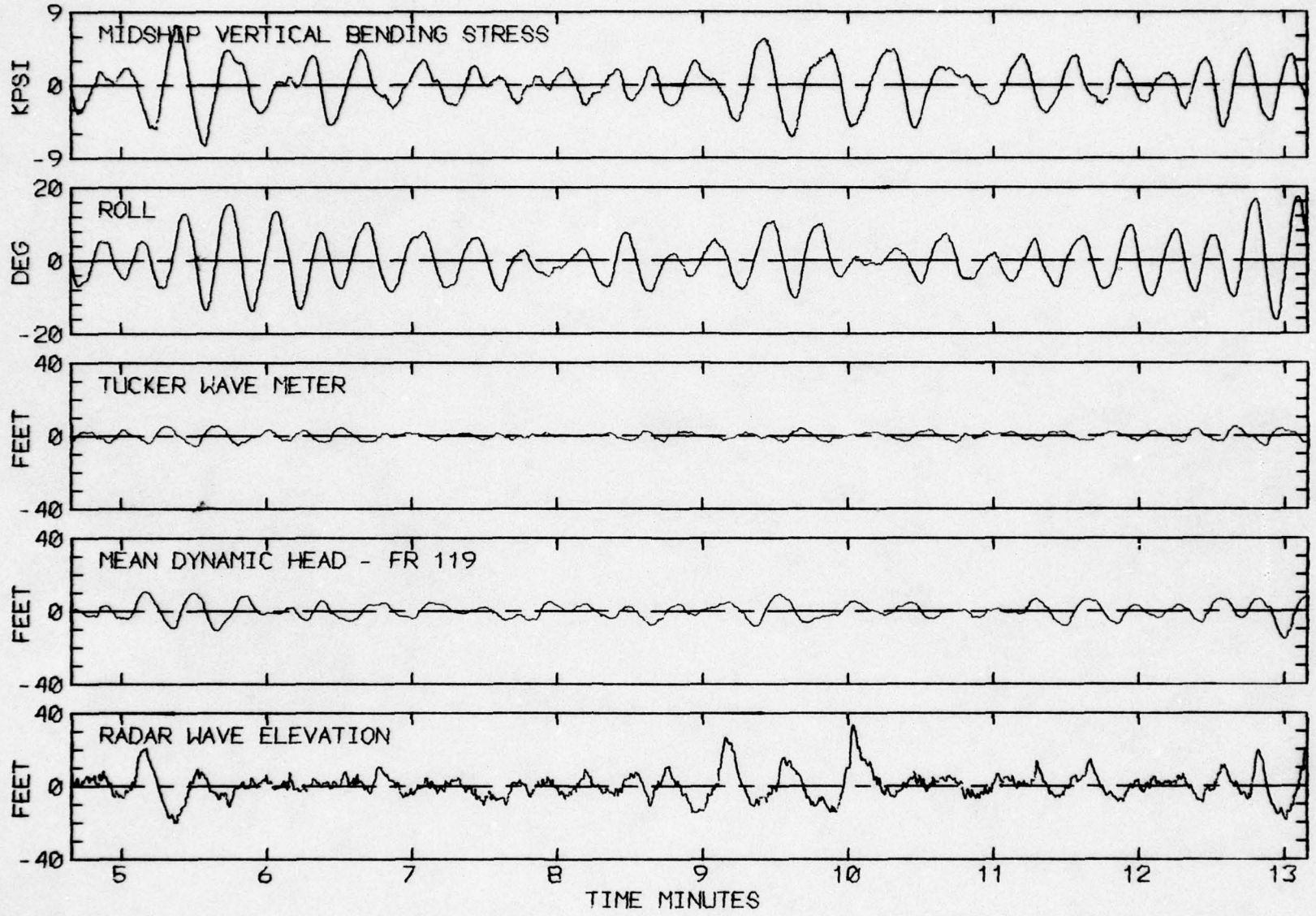
ROLL	23.7 DEG
PITCH	0.73 DEG
DK HSE VERT ACCEL	0.12 G
DK HSE LAT ACCEL	0.55 G
RADAR SLANT RANGE	33.0 FEET
VERTICAL RANGE	30.4 FEET
DISPL AT RADAR	21.4 FEET

WAVE HEIGHT STATISTICS (FEET)

		TUCKER/DYN. HEAD/RADAR	
P-T SAMPLE SIZE	92	54	118
MAXIMUM HEIGHT	10.6	22.0	41.3
10TH HIGHEST HTS	7.9	18.8	31.0
3RD HIGHEST HTS	6.0	15.1	20.2
4.0 RMS(SPECTRA)	7.4	16.3	28.2



RUN 157 -- VOYAGE 32E -- TAPE 139 -- INDEX 15 -- INTERVAL 57



RUN 157 -- VOYAGE 32E -- TAPE 139 -- INDEX 15 -- INTERVAL 57

LOG BOOK DATA

DATE AND TIME	01-01-74 2000
POSITION	44-39 N 40-31 W
COURSE AND SPEED	090 , 21.9 KNOTS
SEA STATE	8
WAVE HEIGHT	20 FEET
" REL DIR	135 PORT
SWELL HEIGHT	15 FEET
" REL DIR	135 PORT

---- VISUAL WEATHER / COMMENTS ----

CLDY /

MIDSHIP VERTICAL BENDING STRESS

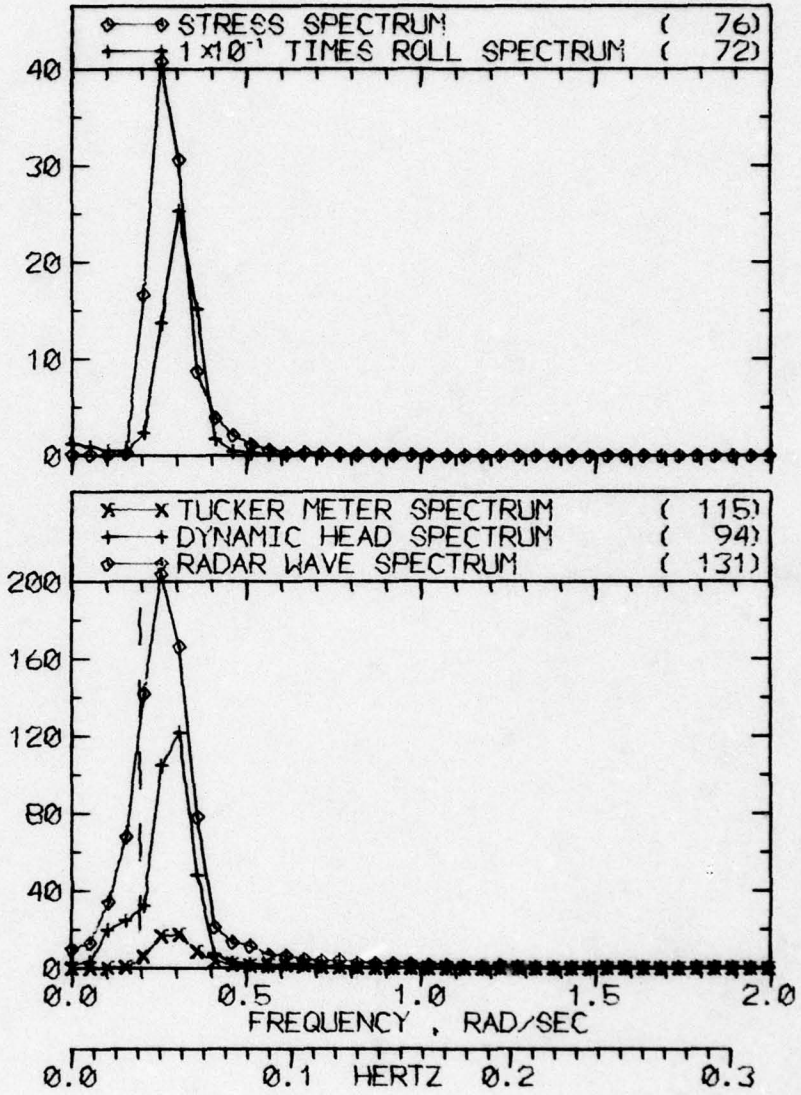
MAXIMUM PK-TR	12.5 KPSI
4.0 X RMS	9.3 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

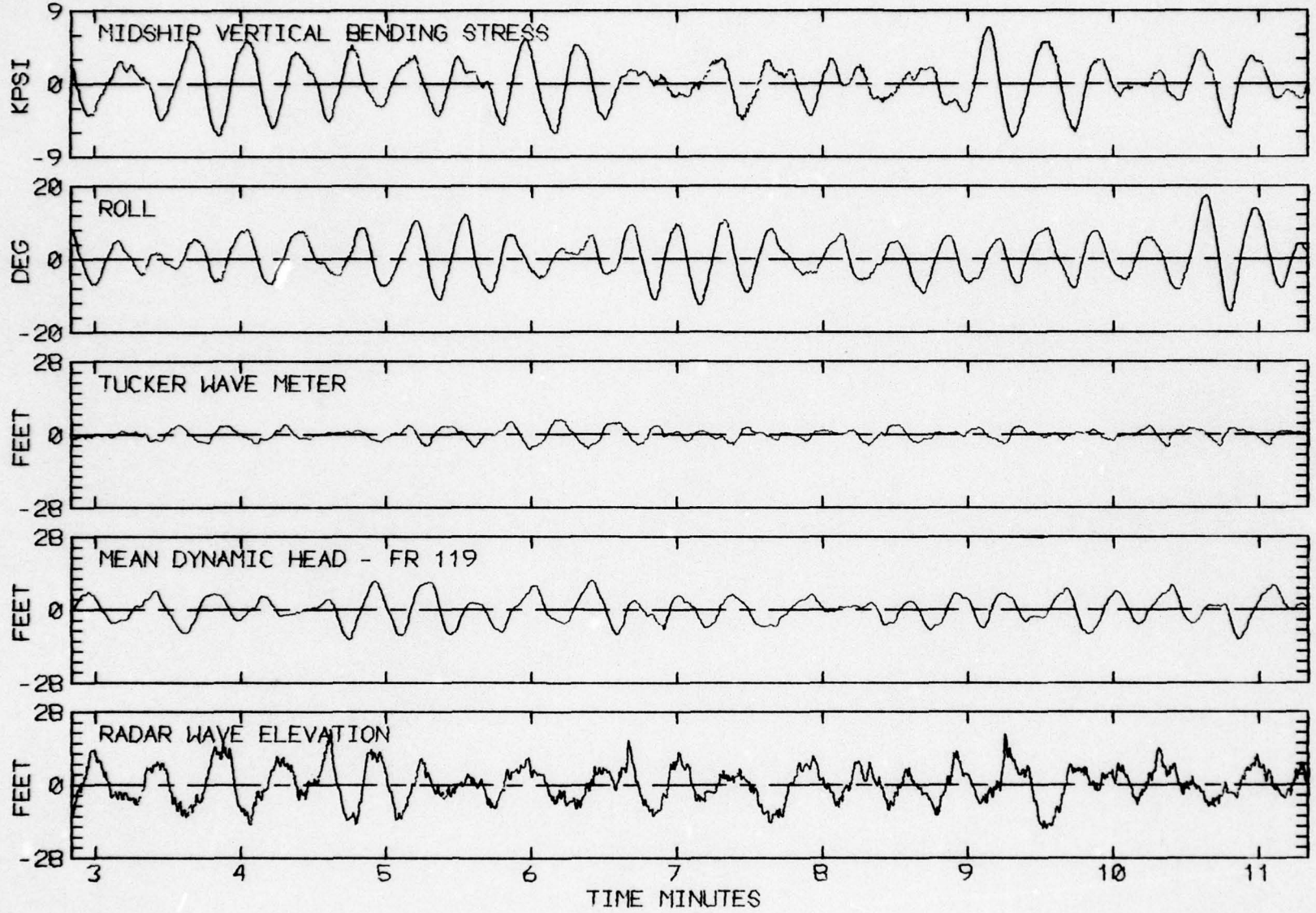
ROLL	22.5 DEG
PITCH	0.76 DEG
DK HSE VERT ACCEL	0.11 G
DK HSE LAT ACCEL	0.49 G
RADAR SLANT RANGE	31.7 FEET
VERTICAL RANGE	26.1 FEET
DISPL AT RADAR	21.2 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	81	48	96
MAXIMUM HEIGHT	11.0	20.7	37.1
10TH HIGHEST HTS	8.4	18.7	28.4
3RD HIGHEST HTS	6.2	15.4	20.3
4.0 RMS(SPECTRA)	7.3	17.6	25.9



RUN 161 -- VOYAGE 32E -- TAPE 139 -- INDEX 16 -- INTERVAL 61



RUN 161 -- VOYAGE 32E -- TAPE 139 -- INDEX 16 -- INTERVAL 61

LOG BOOK DATA

DATE AND TIME	01-01-74 2400
POSITION	44-39 N 40-31 W
COURSE AND SPEED	090 , 20.8 KNOTS
SEA STATE	9
WAVE HEIGHT	20 FEET
" REL DIR	157 PORT
SWELL HEIGHT	15 FEET
" REL DIR	157 PORT

---- VISUAL WEATHER / COMMENTS ----

CLDY /

MIDSHIP VERTICAL BENDING STRESS

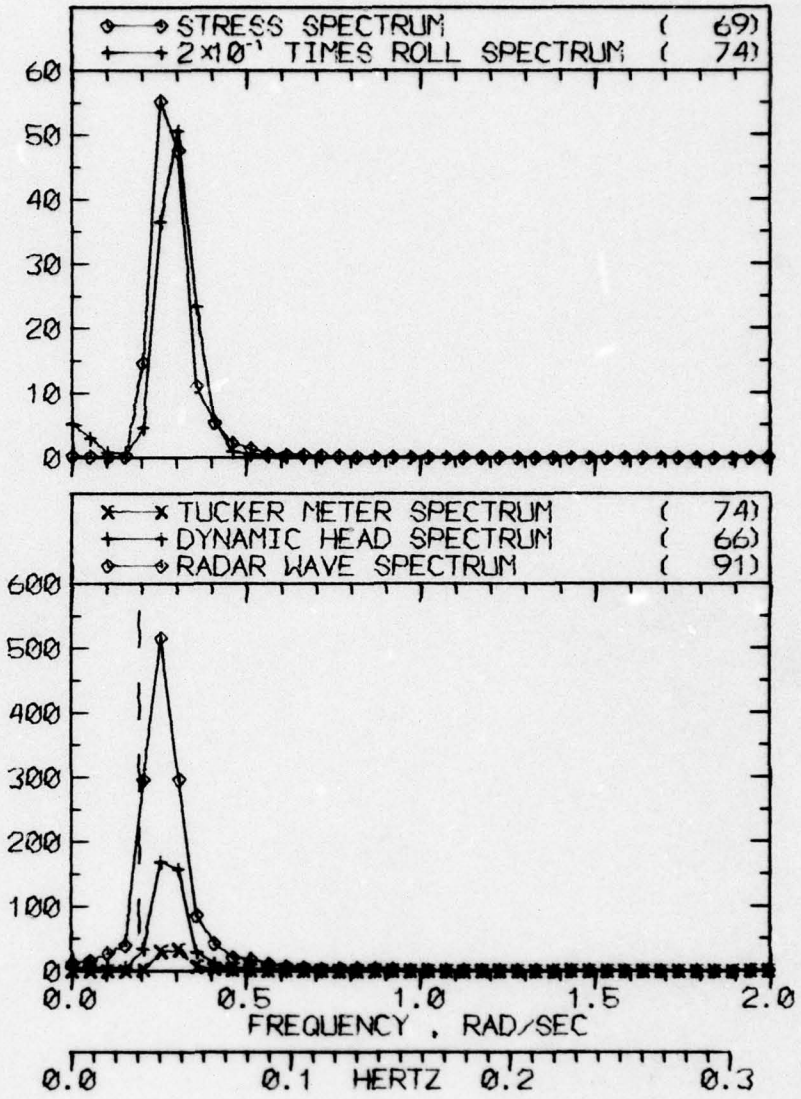
MAXIMUM PK-TR	12.3 KPSI
4.0 X RMS	10.7 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

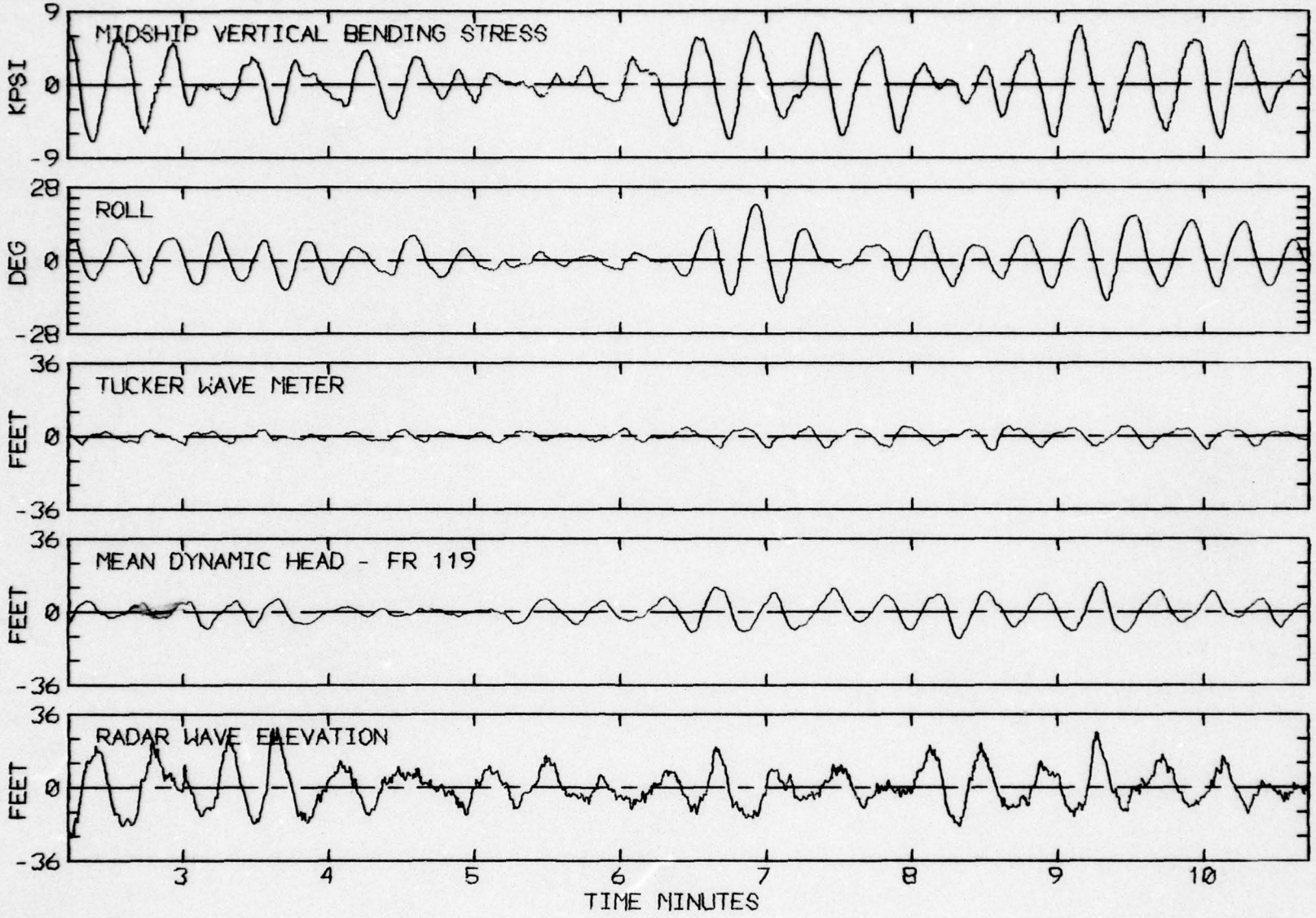
ROLL	23.0 DEG
PITCH	0.76 DEG
DK HSE VERT ACCEL	0.11 G
DK HSE LAT ACCEL	0.51 G
RADAR SLANT RANGE	35.0 FEET
VERTICAL RANGE	33.4 FEET
DISPL AT RADAR	24.8 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	65	52	95
MAXIMUM HEIGHT	10.9	24.5	46.7
10TH HIGHEST HTS	10.2	20.9	38.1
3RD HIGHEST HTS	7.9	17.3	26.2
4.0 RMS(SPECTRA)	8.5	18.8	34.3



RUN 201 -- VOYAGE 32E -- TAPE 141 -- INDEX 17 -- INTERVAL 1



RUN 201 -- VOYAGE 32E -- TAPE 141 -- INDEX 17 -- INTERVAL 1

LOG BOOK DATA

DATE AND TIME	01-02-74 0400
POSITION	44-39 N 40-31 W
COURSE AND SPEED	090 , 21.0 KNOTS
SEA STATE	8
WAVE HEIGHT	12 FEET
" REL DIR	157 PORT
SWELL HEIGHT	12 FEET
" REL DIR	135 PORT

---- VISUAL WEATHER / COMMENTS ----

PT CLDY /

MIDSHIP VERTICAL BENDING STRESS

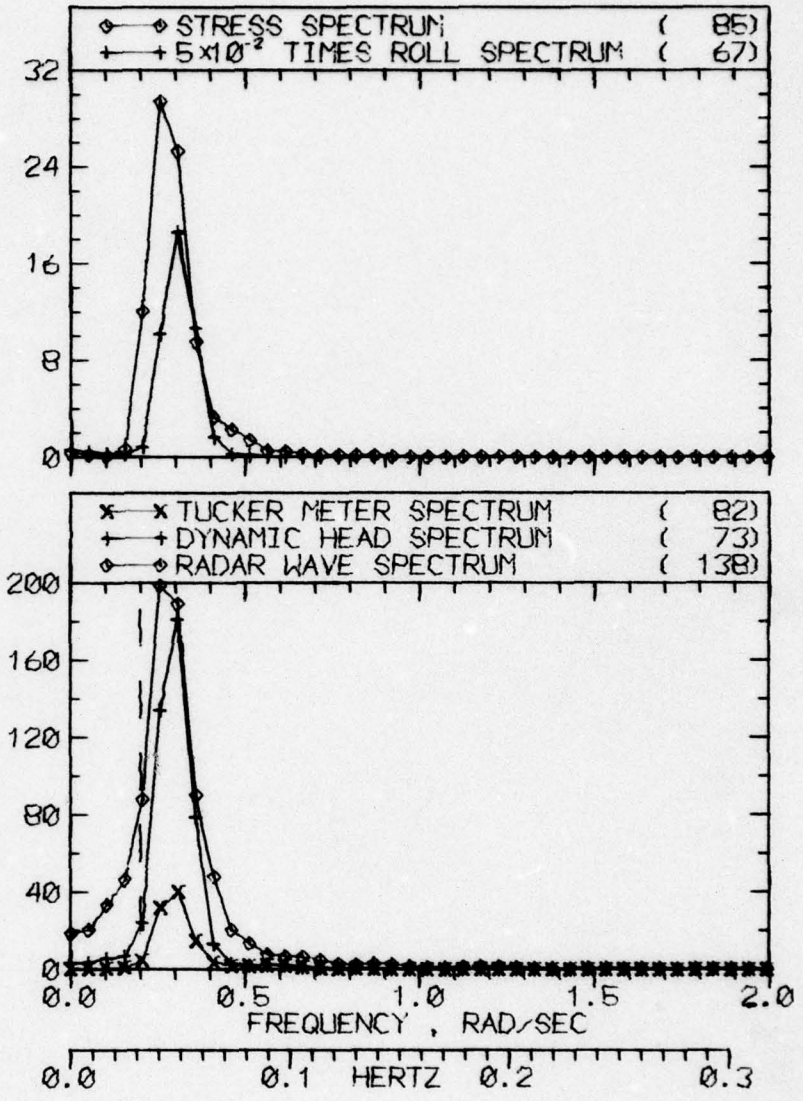
MAXIMUM PK-TR	10.4 KPSI
4.0 X RMS	8.4 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

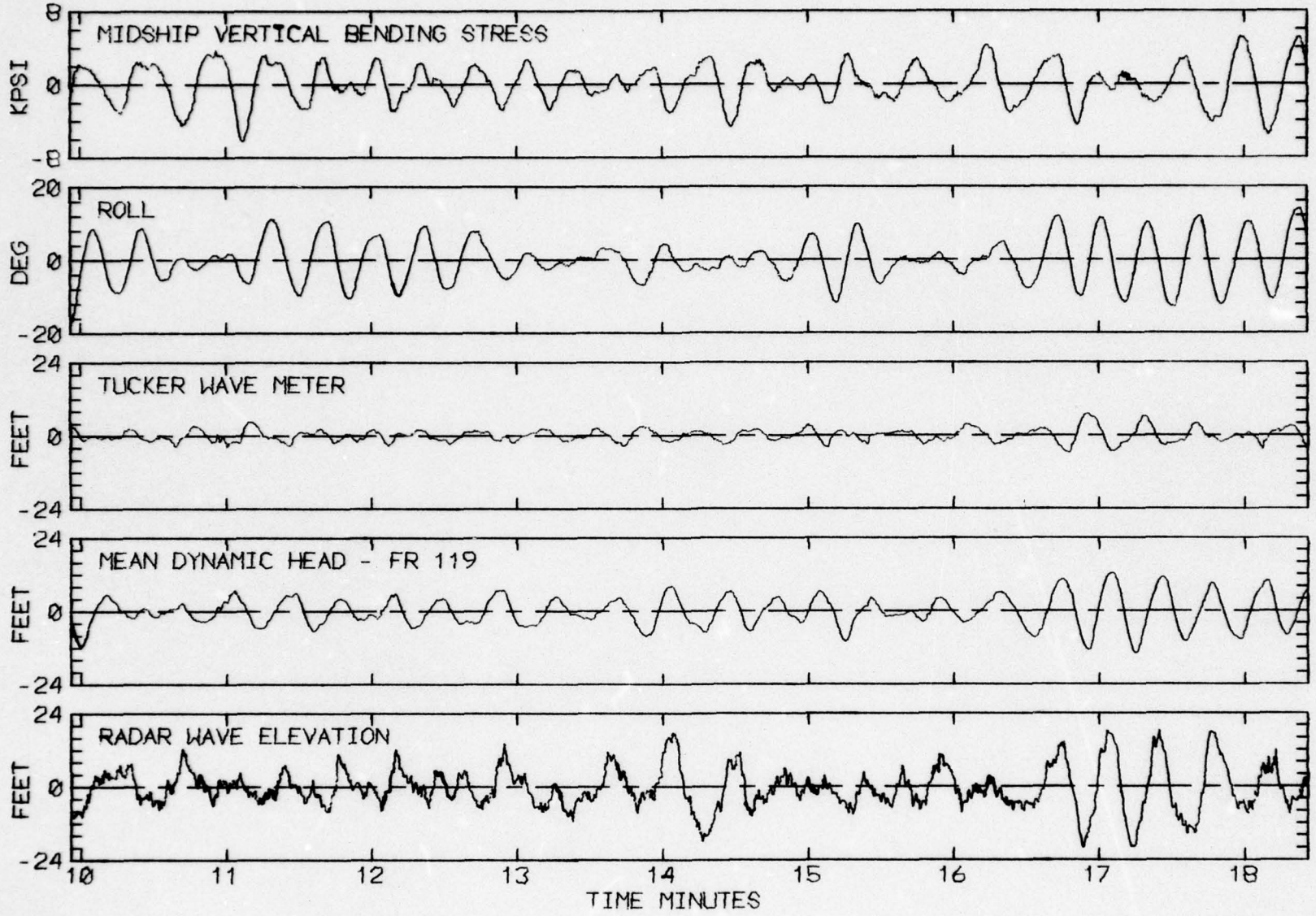
ROLL	26.8 DEG
PITCH	0.74 DEG
DK HSE VERT ACCEL	0.12 G
DK HSE LAT ACCEL	0.59 G
RADAR SLANT RANGE	33.4 FEET
VERTICAL RANGE	25.0 FEET
DISPL AT RADAR	25.3 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN. HEAD/RADAR		
P-T SAMPLE SIZE	69	52	114
MAXIMUM HEIGHT	13.0	26.2	38.1
10TH HIGHEST HTS	10.9	22.0	30.2
3RD HIGHEST HTS	8.3	18.4	19.0
4.0 RMS(SPECTRA)	9.5	19.4	26.0



RUN 205 -- VOYAGE 32E -- TAPE 141 -- INDEX 18 -- INTERVAL 5



RUN 205 -- VOYAGE 32E -- TAPE 141 -- INDEX 18 -- INTERVAL 5

LOG BOOK DATA

DATE AND TIME	01-02-74 0800
POSITION	44-39 N 40-31 W
COURSE AND SPEED	075 , 21.4 KNOTS
SEA STATE	7
WAVE HEIGHT	10 FEET
" REL DIR	120 PORT
SWELL HEIGHT	12 FEET
" REL DIR	120 PORT

---- VISUAL WEATHER / COMMENTS ----

PT CLDY /

MIDSHIP VERTICAL BENDING STRESS

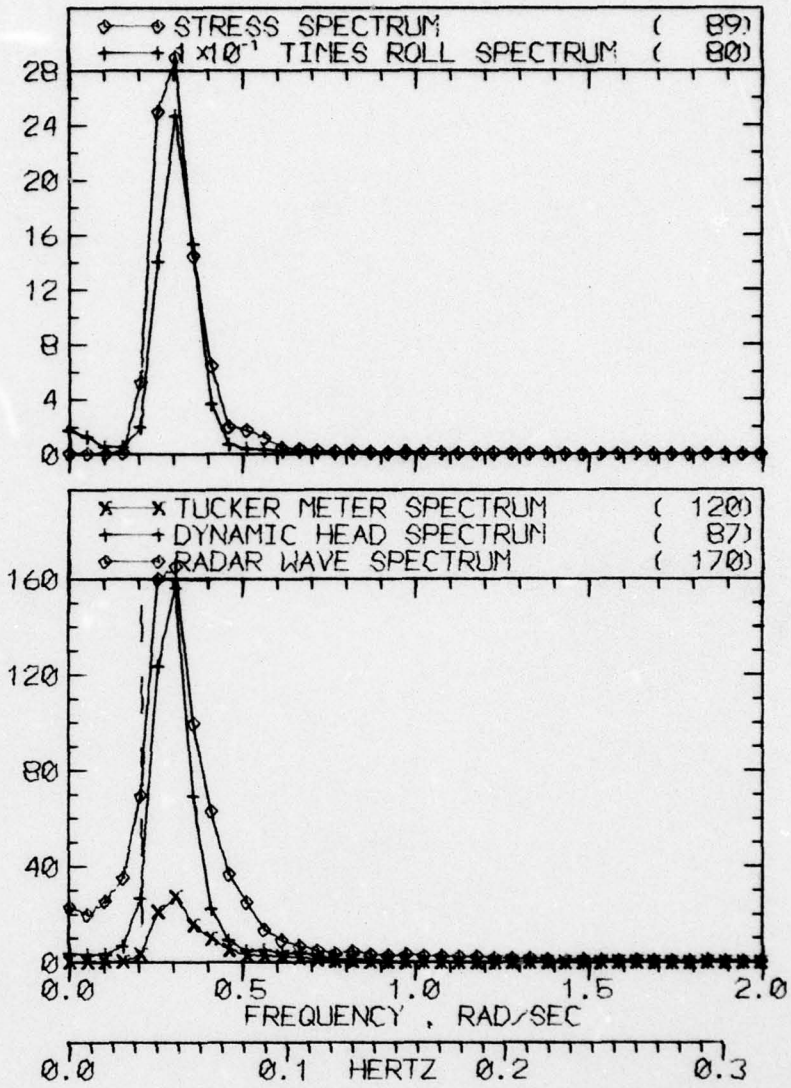
MAXIMUM PK-TR	10.7 KPSI
4.0 X RMS	8.5 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

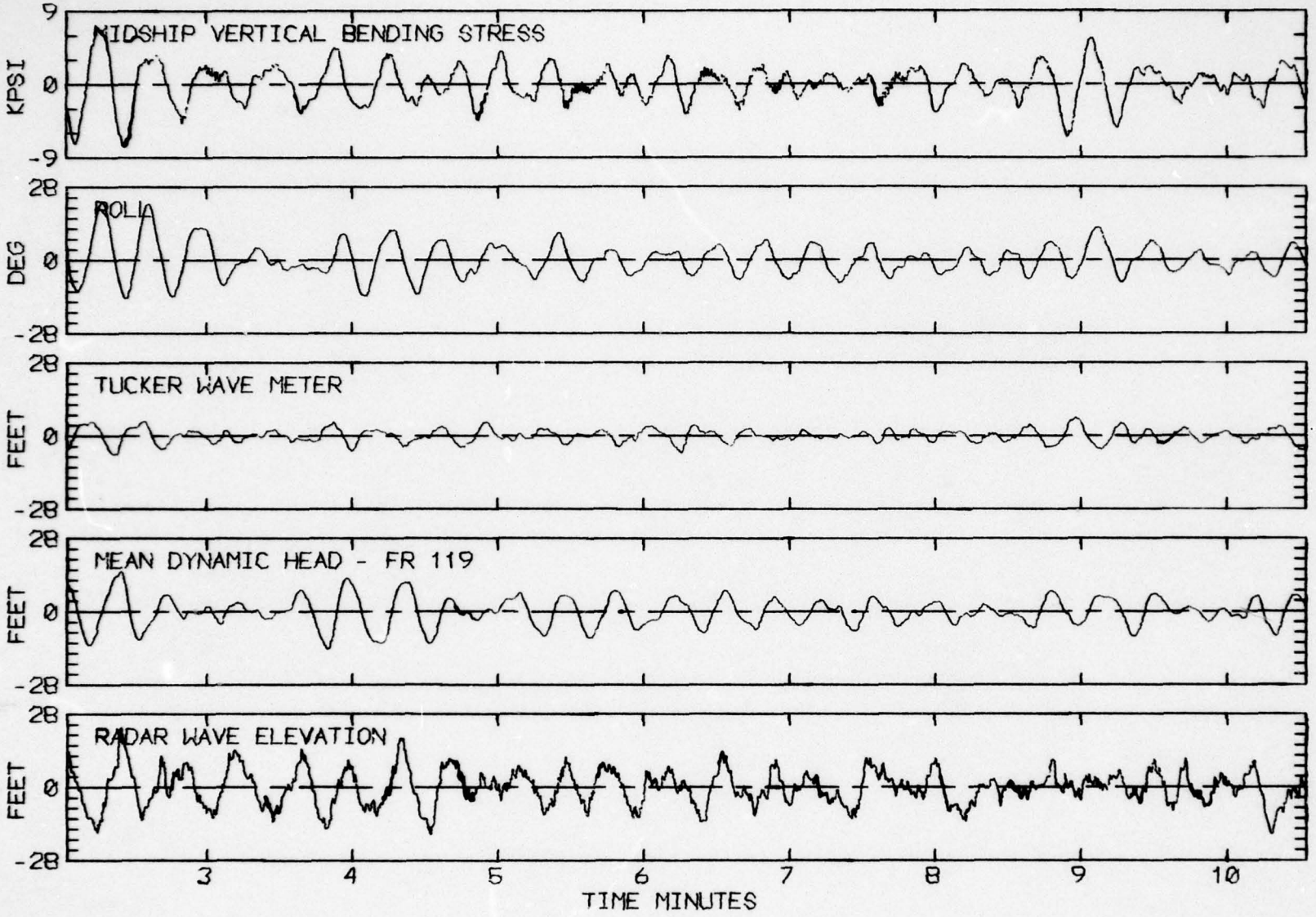
ROLL	23.1 DEG
PITCH	0.77 DEG
DK HSE VERT ACCEL	0.18 G
DK HSE LAT ACCEL	0.55 G
RADAR SLANT RANGE	29.0 FEET
VERTICAL RANGE	25.8 FEET
DISPL AT RADAR	25.5 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	89	55	126
MAXIMUM HEIGHT	12.6	26.1	36.8
10TH HIGHEST HTS	10.5	21.8	26.4
3RD HIGHEST HTS	7.6	17.1	19.4
4.0 RMS(SPECTRA)	9.0	19.1	25.7



RUN 209 -- VOYAGE 32E -- TAPE 141 -- INDEX 19 -- INTERVAL 9



RUN 209 -- VOYAGE 32E -- TAPE 141 -- INDEX 19 -- INTERVAL 9

LOG BOOK DATA

DATE AND TIME	01-02-74 1200
POSITION	45-00 N 29-29 W
COURSE AND SPEED	075 , 22.5 KNOTS
SEA STATE	9
WAVE HEIGHT	12 FEET
" REL DIR	120 PORT
SWELL HEIGHT	15 FEET
" REL DIR	120 PORT

---- VISUAL WEATHER / COMMENTS ----

PT CLDY /

MIDSHIP VERTICAL BENDING STRESS

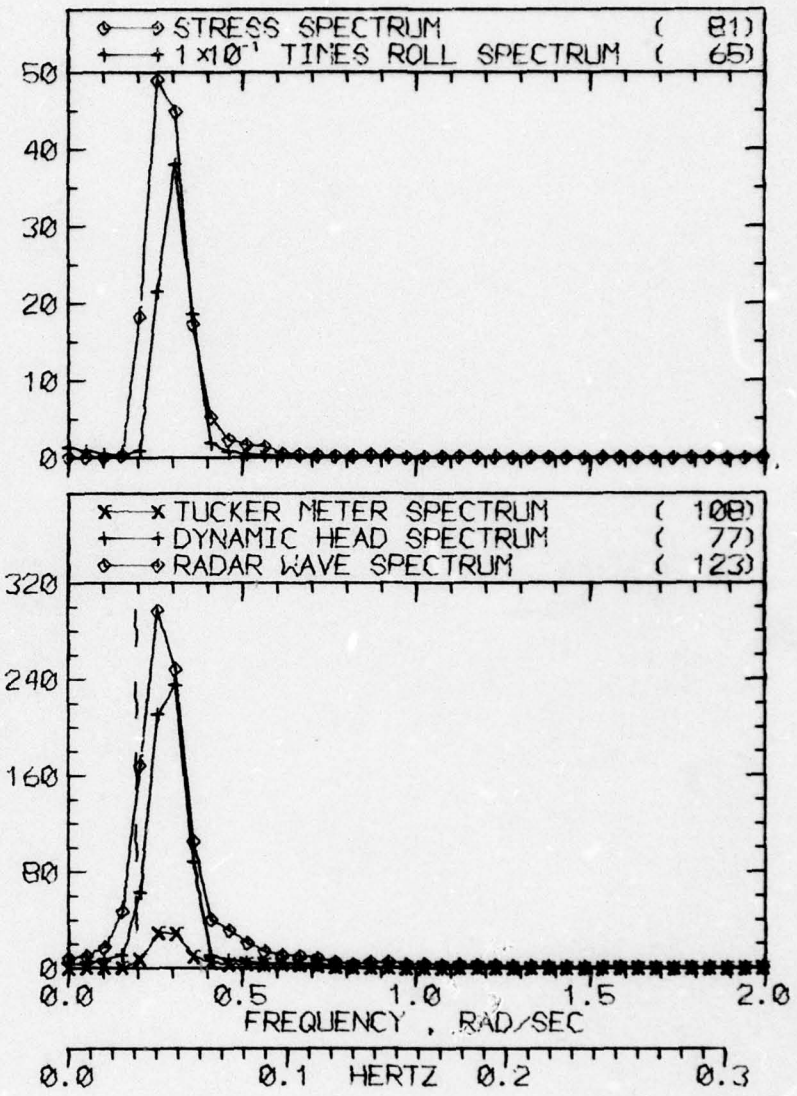
MAXIMUM PK-TR	12.9 KPSI
4.0 X RMS	10.9 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

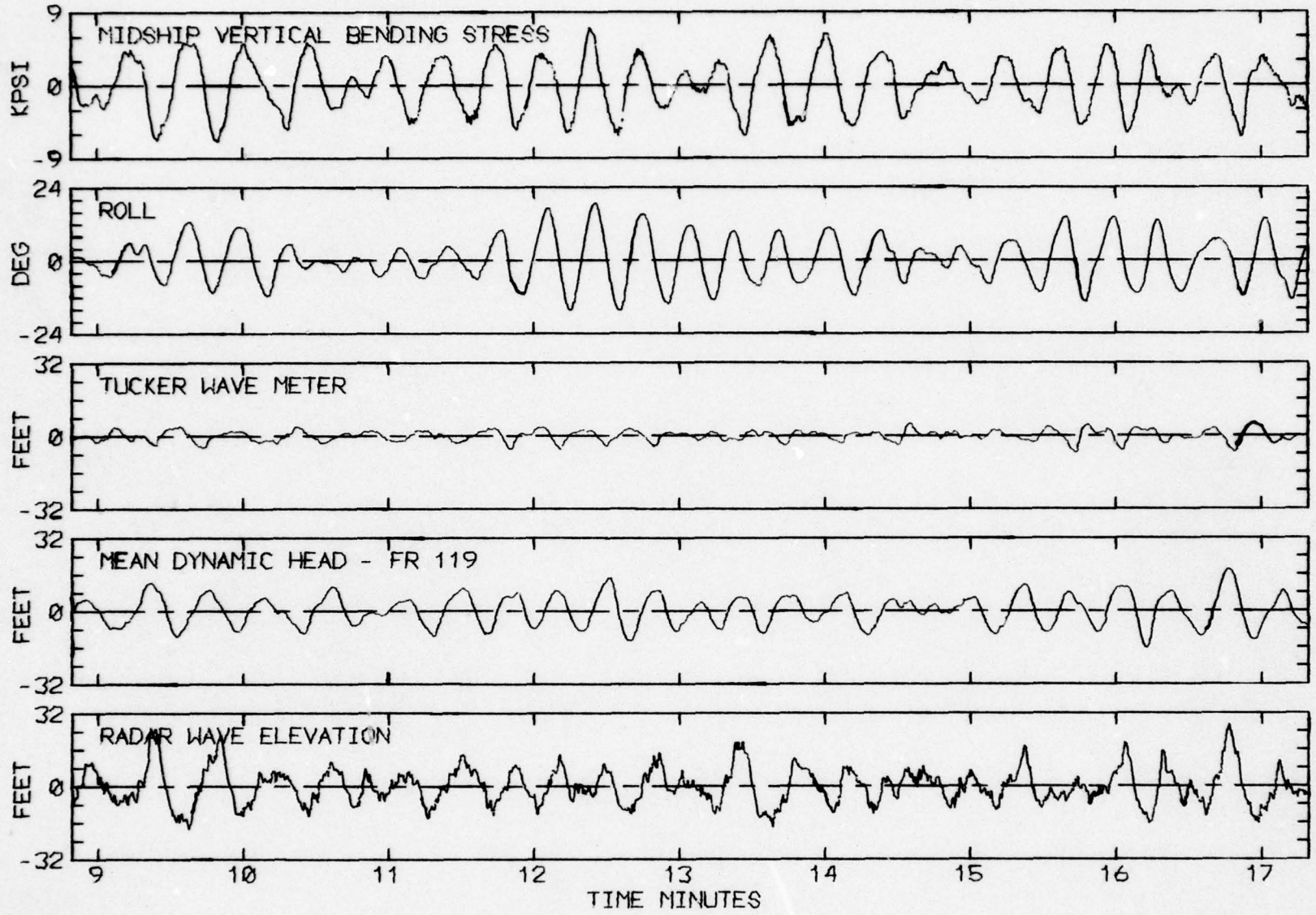
ROLL	26.5 DEG
PITCH	0.87 DEG
DK HSE VERT ACCEL	0.17 G
DK HSE LAT ACCEL	0.63 G
RADAR SLANT RANGE	31.9 FEET
VERTICAL RANGE	29.7 FEET
DISPL AT RADAR	28.9 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN. HEAD/RADAR		
P-T SAMPLE SIZE	97	50	94
MAXIMUM HEIGHT	13.5	30.5	44.1
10TH HIGHEST HTS	10.1	26.4	35.2
3RD HIGHEST HTS	7.1	21.4	25.7
4.0 RMS(SPECTRA)	9.1	23.2	30.0



RUN 213 -- VOYAGE 32E -- TAPE 141 -- INDEX 20 -- INTERVAL 13



RUN 213 -- VOYAGE 32E -- TAPE 141 -- INDEX 20 -- INTERVAL 13

LOG BOOK DATA

DATE AND TIME	01-02-74 1600
POSITION	45-00 N 29-29 W
COURSE AND SPEED	090 , 24.1 KNOTS
SEA STATE	9
WAVE HEIGHT	15 FEET
" REL DIR	157 PORT
SWELL HEIGHT	15 FEET
" REL DIR	157 PORT

---- VISUAL WEATHER / COMMENTS ----

CLDY /

MIDSHIP VERTICAL BENDING STRESS

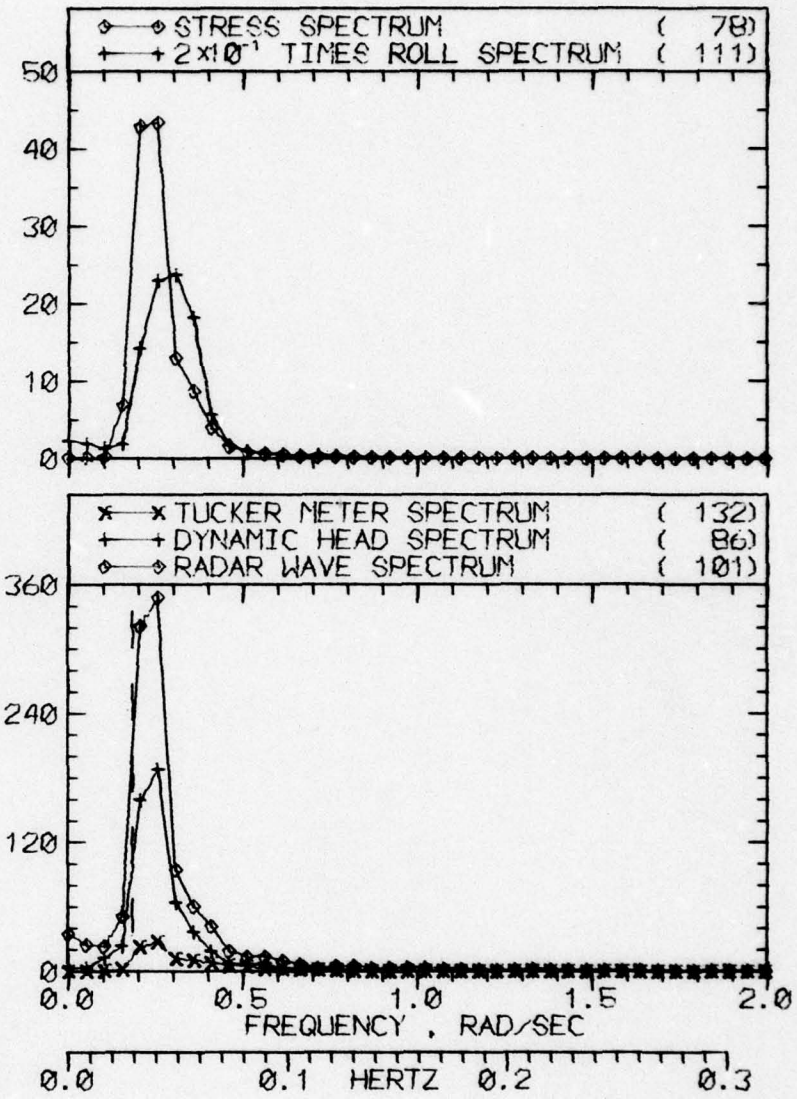
MAXIMUM PK-TR	15.8 KPSI
4.0 X RMS	10.1 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

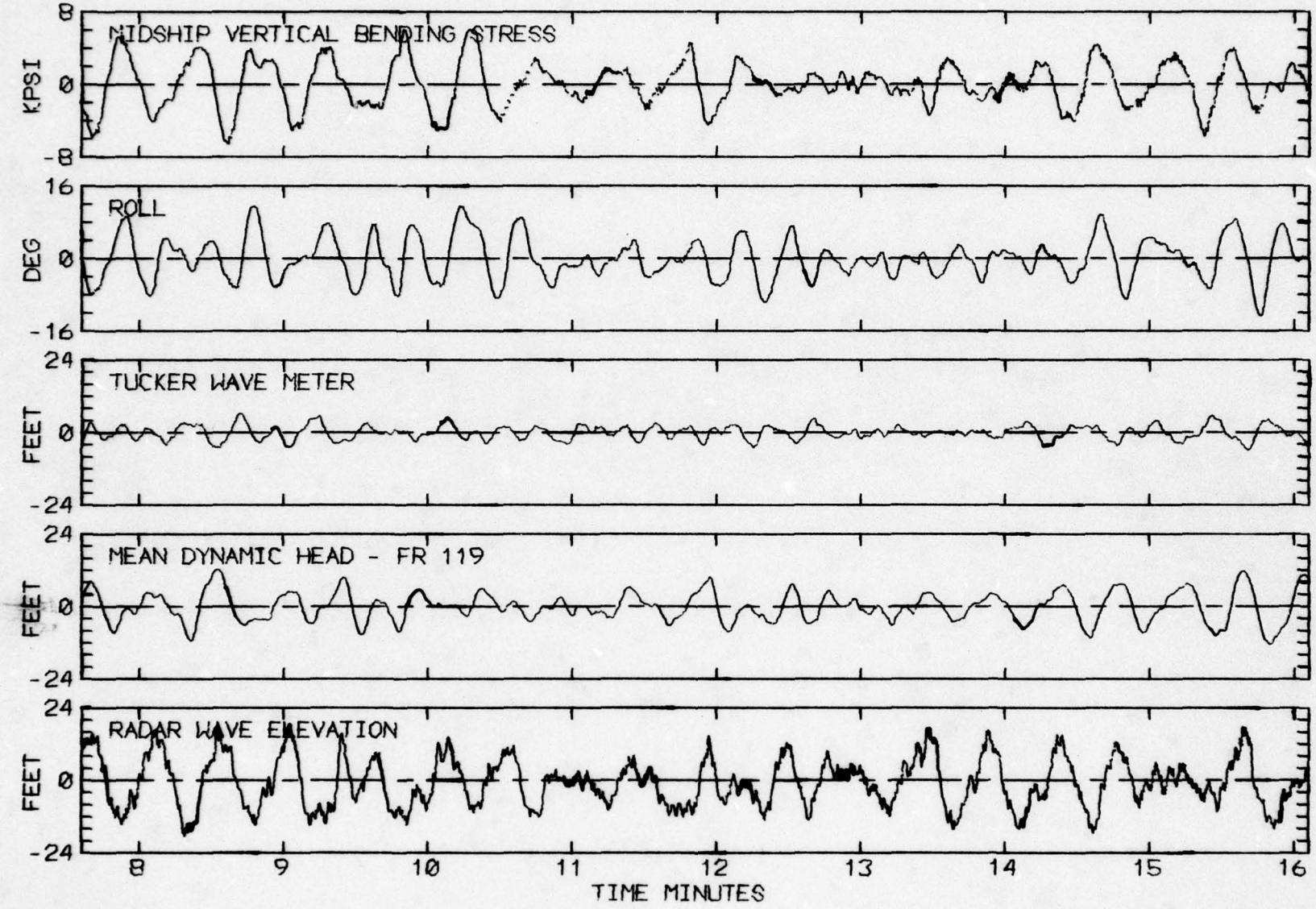
ROLL	19.9 DEG
PITCH	0.81 DEG
DK HSE VERT ACCEL	0.17 G
DK HSE LAT ACCEL	0.47 G
RADAR SLANT RANGE	29.8 FEET
VERTICAL RANGE	29.1 FEET
DISPL AT RADAR	27.4 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN. HEAD/RADAR		
P-T SAMPLE SIZE	77	51	104
MAXIMUM HEIGHT	11.6	24.6	35.4
10TH HIGHEST HTS	9.7	21.8	32.5
3RD HIGHEST HTS	7.9	18.9	22.9
4.0 RMS(SPECTRA)	9.3	21.0	30.2



RUN 217 -- VOYAGE 32E -- TAPE 141 -- INDEX 21 -- INTERVAL 17



RUN 217 -- VOYAGE 32E -- TAPE 141 -- INDEX 21 -- INTERVAL 17

LOG BOOK DATA

DATE AND TIME	01-02-74 2000
POSITION	45-00 N 29-29 W
COURSE AND SPEED	085 . 27.2 KNOTS
SEA STATE	8
WAVE HEIGHT	12 FEET
" REL DIR	141 PORT
SWELL HEIGHT	15 FEET
" REL DIR	141 PORT

---- VISUAL WEATHER / COMMENTS ----

CLDY /ROLLING AND PITCHING

MIDSHIP VERTICAL BENDING STRESS

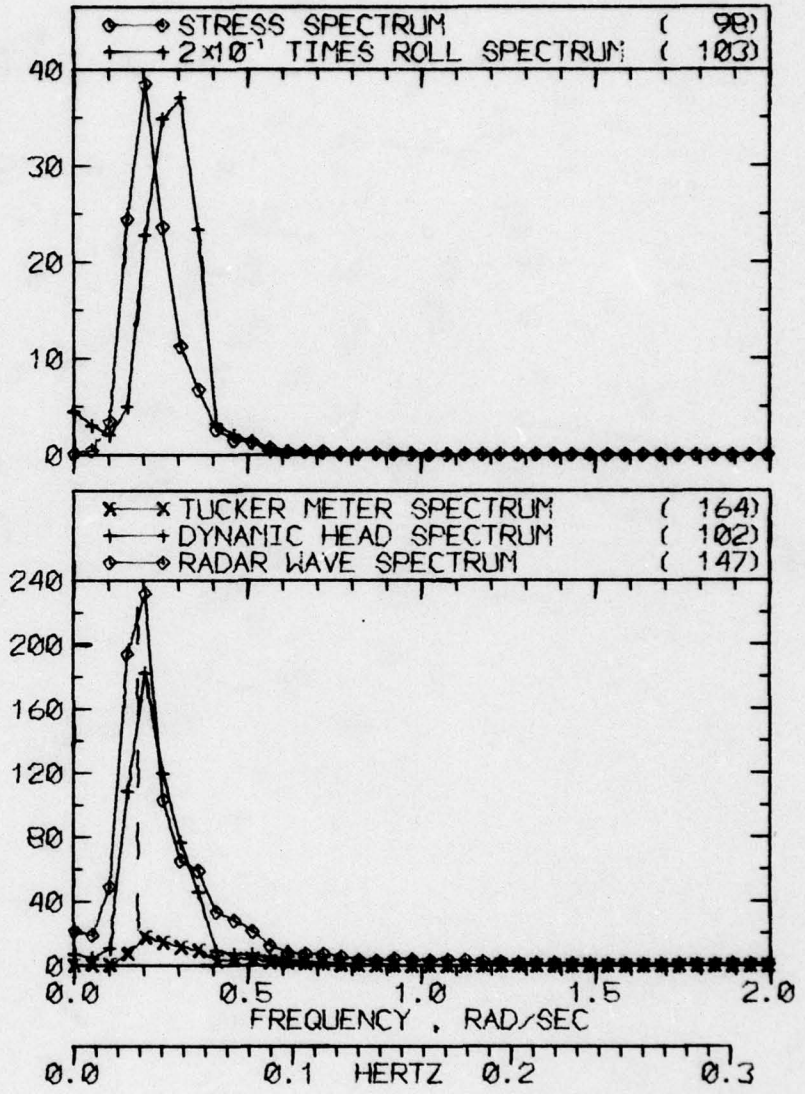
MAXIMUM PK-TR	11.6 KPSI
4.0 X RMS	9.8 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

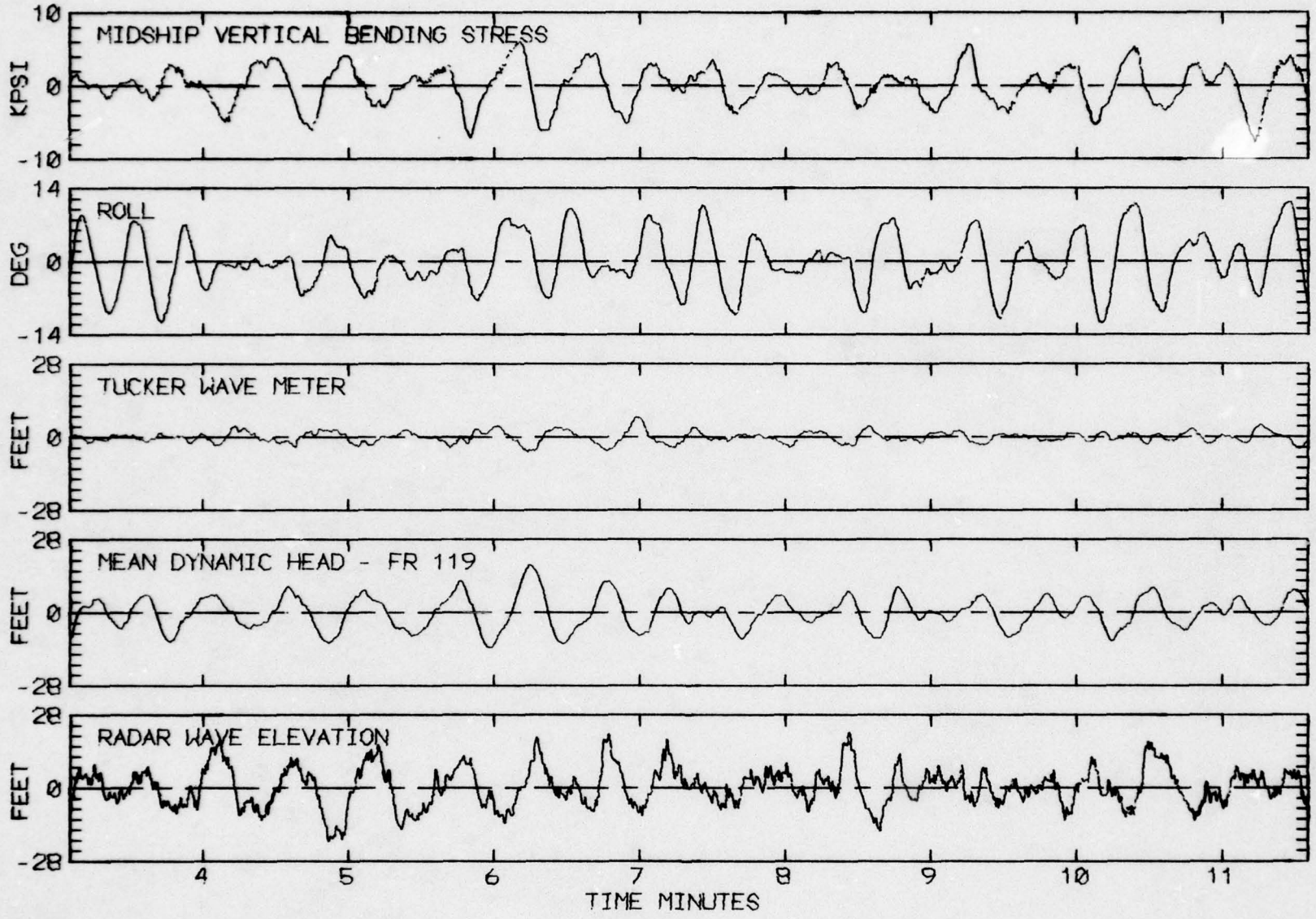
ROLL	23.8 DEG
PITCH	0.84 DEG
DK HSE VERT ACCEL	0.16 G
DK HSE LAT ACCEL	0.56 G
RADAR SLANT RANGE	32.6 FEET
VERTICAL RANGE	29.0 FEET
DISPL AT RADAR	25.9 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	90	50	112
MAXIMUM HEIGHT	12.0	29.9	38.0
10TH HIGHEST HTS	9.2	23.9	29.8
3RD HIGHEST HTS	6.5	19.1	20.3
4.0 RMS(SPECTRA)	8.3	22.0	27.5



RUN 221 -- VOYAGE 32E -- TAPE 141 -- INDEX 22 -- INTERVAL 21



RUN 221 -- VOYAGE 32E -- TAPE 141 -- INDEX 22 -- INTERVAL 21

LOG BOOK DATA

DATE AND TIME	01-02-74 2400
POSITION	45-00 N 29-29 W
COURSE AND SPEED	085 . 27.1 KNOTS
SEA STATE	8
WAVE HEIGHT	12 FEET
" REL DIR	130 PORT
SWELL HEIGHT	10 FEET
" REL DIR	130 PORT

---- VISUAL WEATHER / COMMENTS ----

PT CLDY /RAIN SQUALLS

MIDSHIP VERTICAL BENDING STRESS

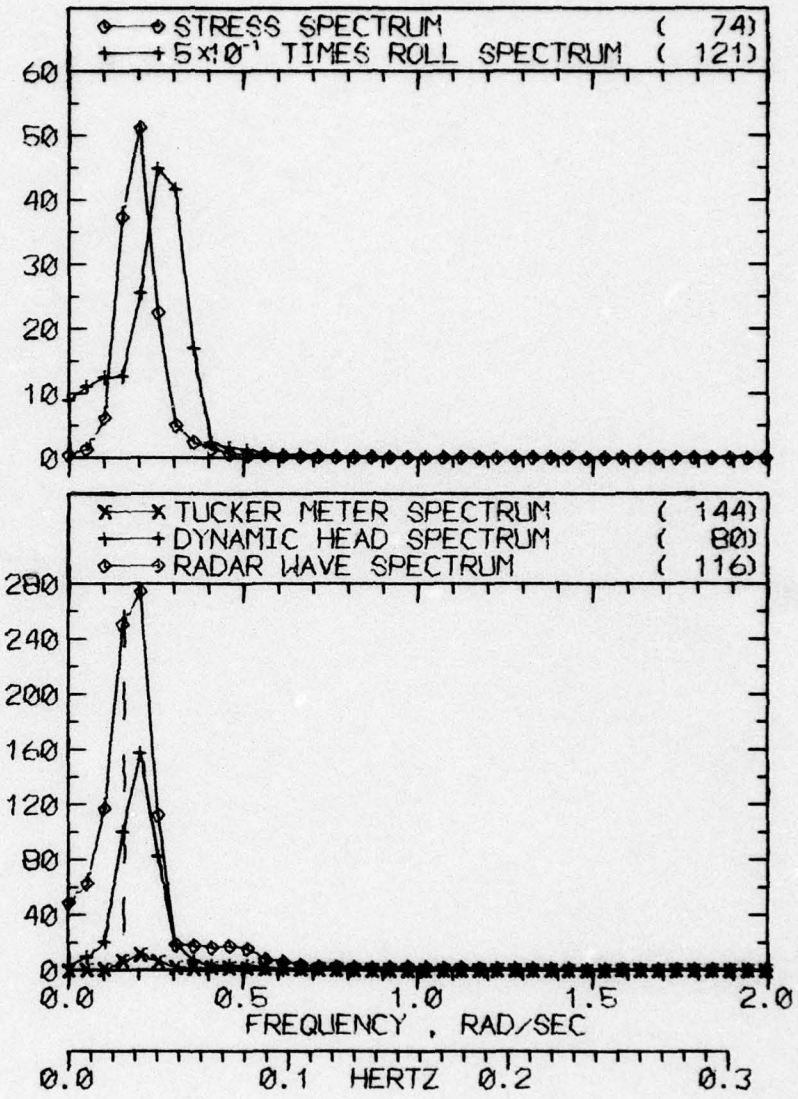
MAXIMUM PK-TR	11.4 KPSI
4.0 X RMS	10.3 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

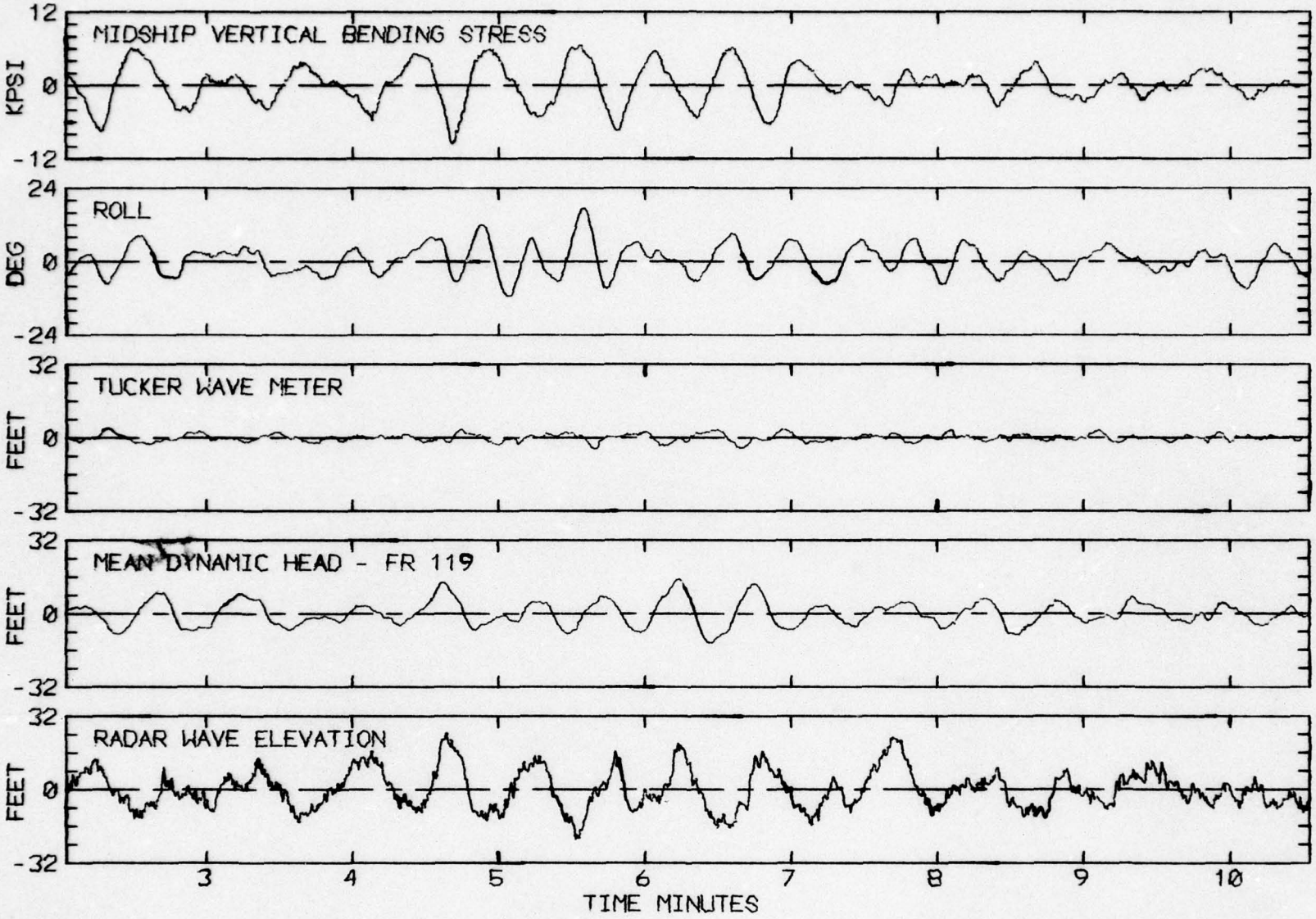
ROLL	17.0 DEG
PITCH	0.64 DEG
DK HSE VERT ACCEL	0.11 G
DK HSE LAT ACCEL	0.38 G
RADAR SLANT RANGE	31.1 FEET
VERTICAL RANGE	29.0 FEET
DISPL AT RADAR	19.8 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	124	39	120
MAXIMUM HEIGHT	8.1	27.7	38.5
10TH HIGHEST HTS	6.2	21.9	26.6
3RD HIGHEST HTS	4.0	17.7	16.7
4.0 RMS(SPECTRA)	5.8	18.4	28.6



RUN 225 -- VOYAGE 32E -- TAPE 141 -- INDEX 23 -- INTERVAL 25



RUN 225 -- VOYAGE 32E -- TAPE 141 -- INDEX 23 -- INTERVAL 25

LOG BOOK DATA

DATE AND TIME	01-03-74 0400
POSITION	45-00 N 29-29 W
COURSE AND SPEED	070 . 27.7 KNOTS
SEA STATE	8
WAVE HEIGHT	12 FEET
" REL DIR	115 PORT
SWELL HEIGHT	10 FEET
" REL DIR	115 PORT

---- VISUAL WEATHER / COMMENTS ----

CLDY /ROLLING MOD TO HEAVY

MIDSHIP VERTICAL BENDING STRESS

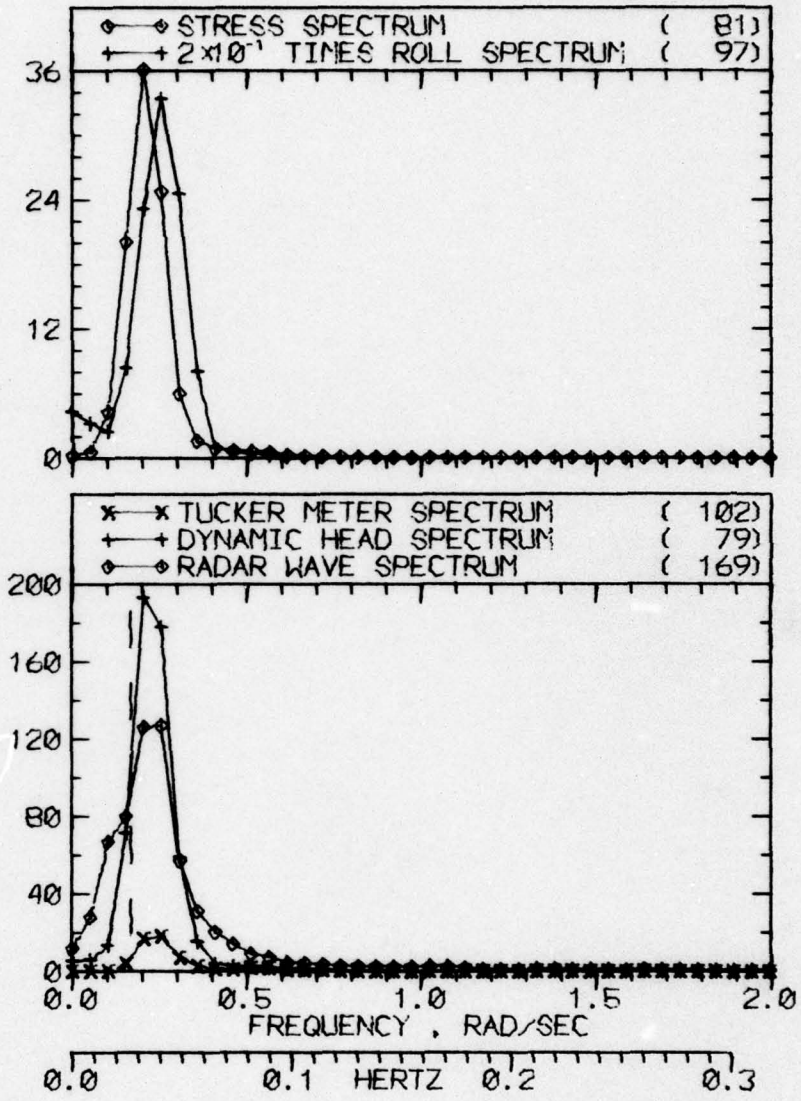
MAXIMUM PK-TR	10.9 KPSI
4.0 X RMS	9.0 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

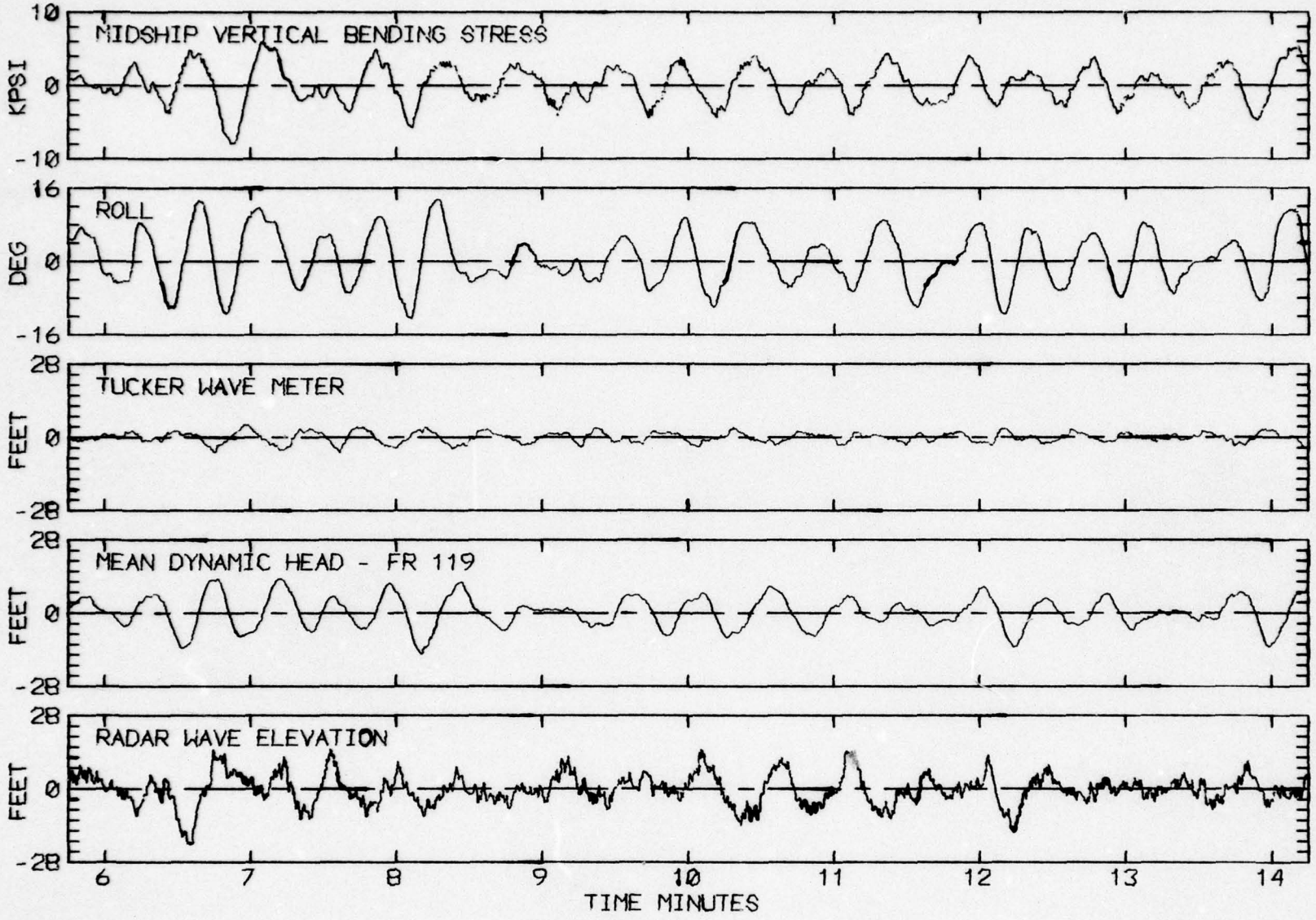
ROLL	21.1 DEG
PITCH	0.83 DEG
DK HSE VERT ACCEL	0.12 G
DK HSE LAT ACCEL	0.47 G
RADAR SLANT RANGE	26.2 FEET
VERTICAL RANGE	24.5 FEET
DISPL AT RADAR	22.8 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	111	45	163
MAXIMUM HEIGHT	8.6	27.2	29.6
10TH HIGHEST HTS	6.1	23.5	19.5
3RD HIGHEST HTS	4.5	20.4	13.4
4.0 RMS(SPECTRA)	7.0	21.3	22.9



RUN 229 -- VOYAGE 32E -- TAPE 141 -- INDEX 24 -- INTERVAL 29



RUN 229 -- VOYAGE 32E -- TAPE 141 -- INDEX 24 -- INTERVAL 29

LOG BOOK DATA

DATE AND TIME	01-03-74 0800
POSITION	45-00 N 29-29 W
COURSE AND SPEED	070 , 27.7 KNOTS
SEA STATE	5
WAVE HEIGHT	8 FEET
" REL DIR	115 PORT
SWELL HEIGHT	10 FEET
" REL DIR	115 PORT

---- VISUAL WEATHER / COMMENTS ----

CLDY /

MIDSHIP VERTICAL BENDING STRESS

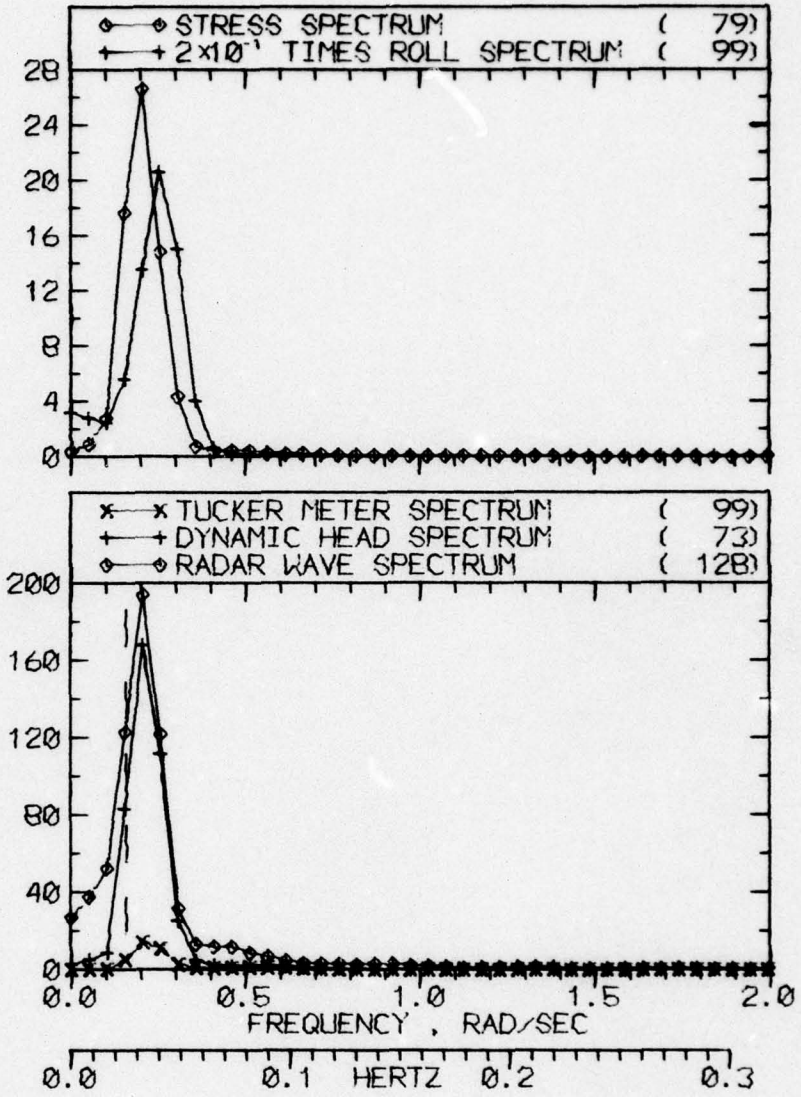
MAXIMUM PK-TR	10.4 KPSI
4.0 X RMS	7.6 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

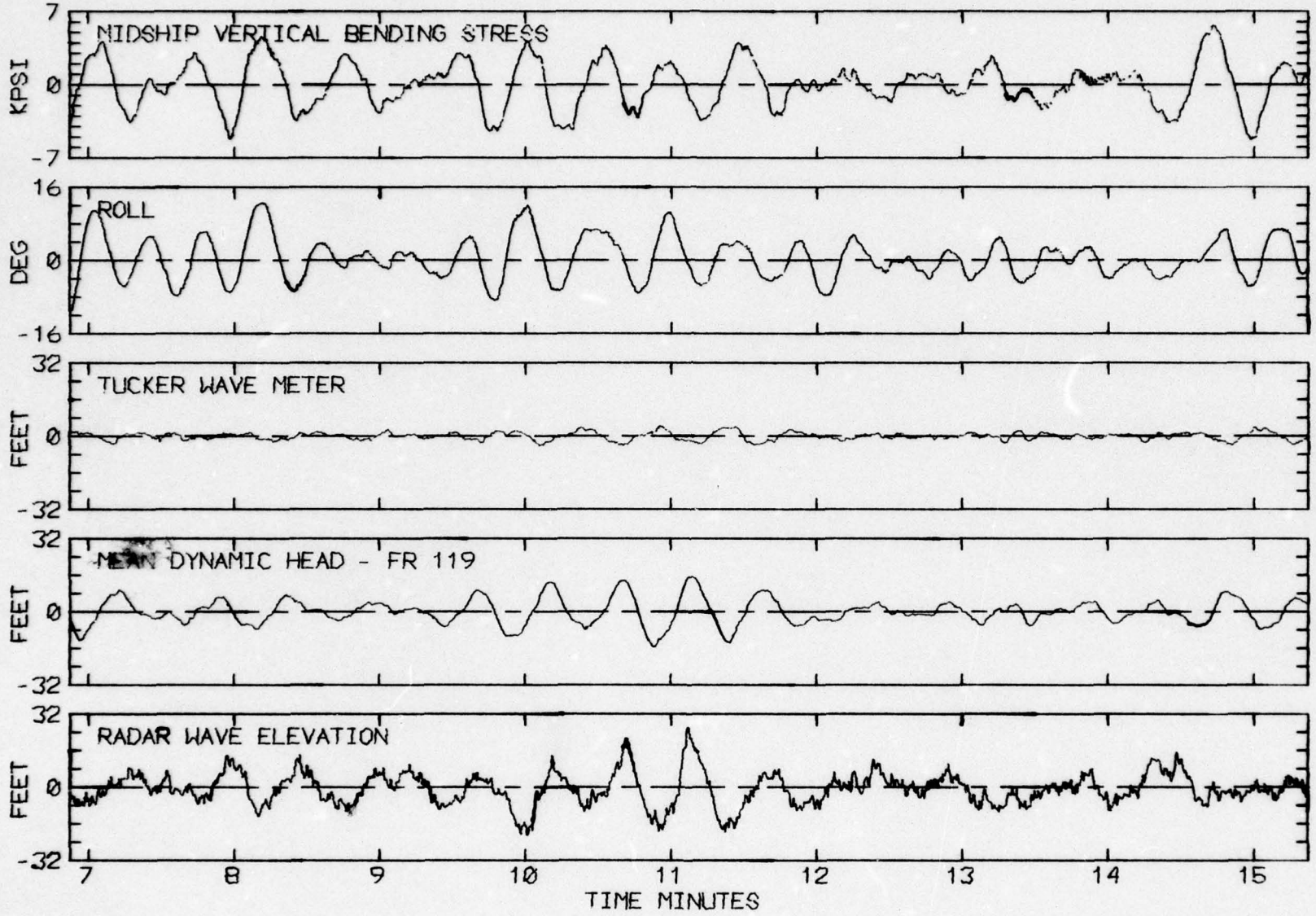
ROLL	16.5 DEG
PITCH	0.65 DEG
DK HSE VERT ACCEL	0.10 G
DK HSE LAT ACCEL	0.36 G
RADAR SLANT RANGE	23.6 FEET
VERTICAL RANGE	22.8 FEET
DISPL AT RADAR	20.1 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	117	42	142
MAXIMUM HEIGHT	7.7	28.8	45.1
10TH HIGHEST HTS	5.6	23.4	24.4
3RD HIGHEST HTS	3.9	18.0	14.5
4.0 RMS(SPECTRA)	5.9	18.6	23.7



RUN 233 -- VOYAGE 32E -- TAPE 141 -- INDEX 25 -- INTERVAL 33



RUN 233 -- VOYAGE 32E -- TAPE 141 -- INDEX 25 -- INTERVAL 33

LOG BOOK DATA

DATE AND TIME	01-03-74 1200
POSITION	47-10 N 15-26 W
COURSE AND SPEED	070 . 27.7 KNOTS
SEA STATE	6
WAVE HEIGHT	10 FEET
" REL DIR	115 PORT
SWELL HEIGHT	8 FEET
" REL DIR	115 PORT

---- VISUAL WEATHER / COMMENTS ----

PT CLDY /

MIDSHIP VERTICAL BENDING STRESS

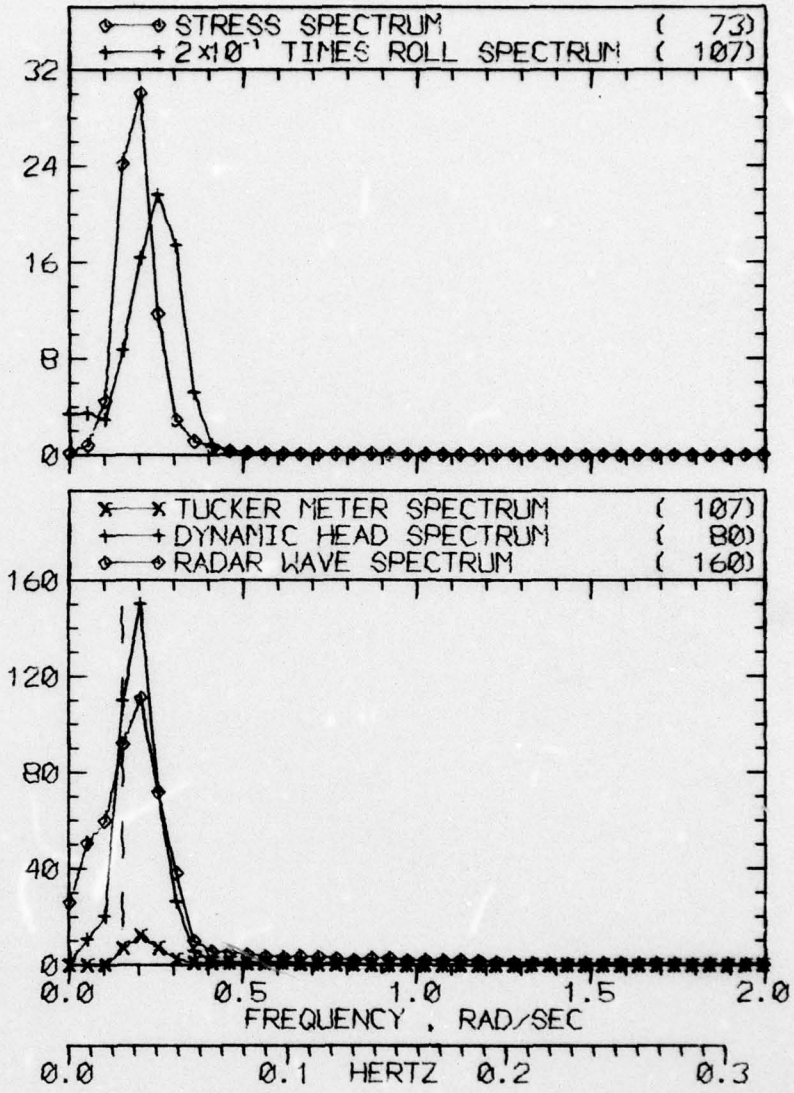
MAXIMUM PK-TR	8.0 KPSI
4.0 X RMS	8.0 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

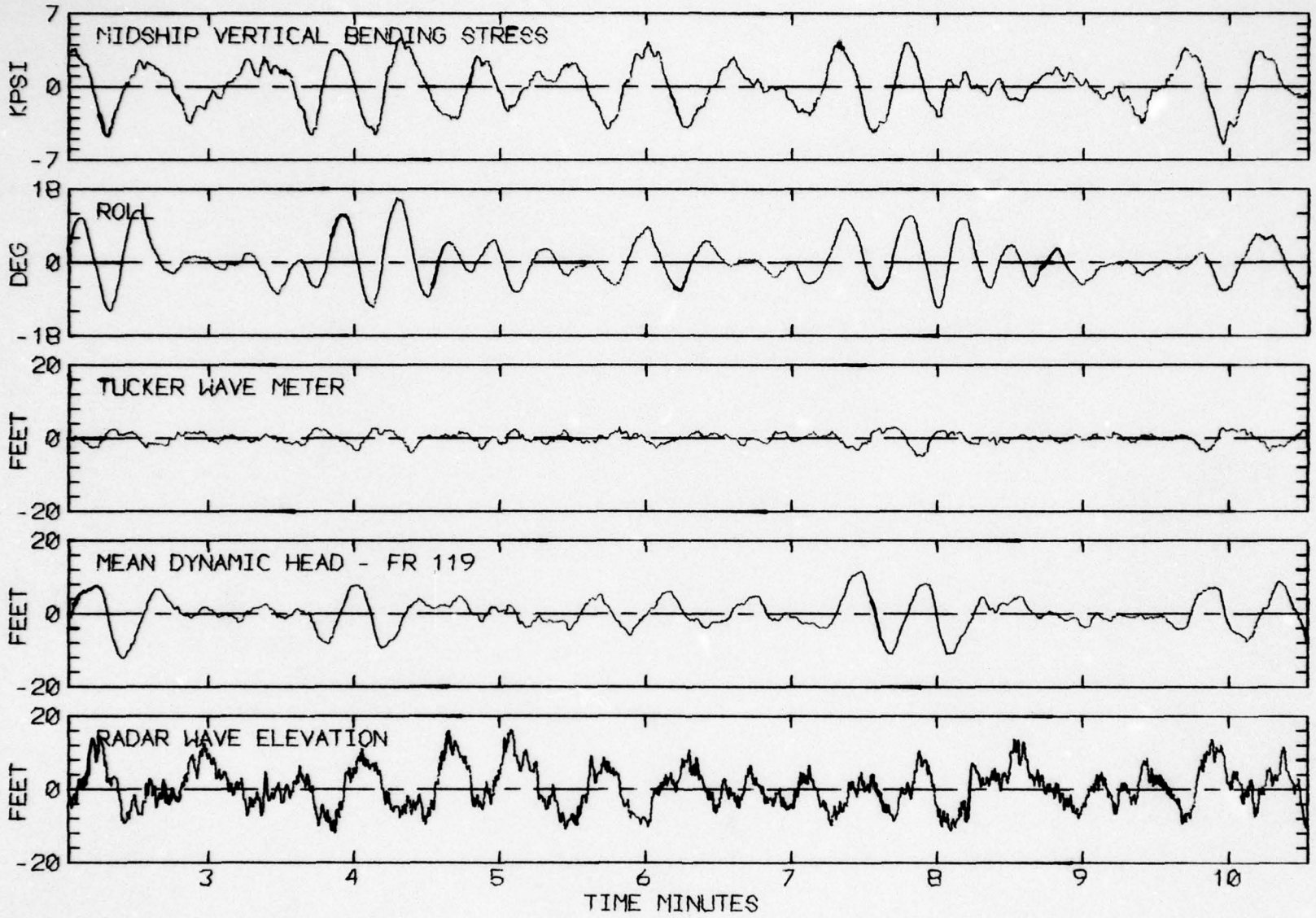
ROLL	18.0 DEG
PITCH	0.71 DEG
DK HSE VERT ACCEL	0.10 G
DK HSE LAT ACCEL	0.36 G
RADAR SLANT RANGE	23.4 FEET
VERTICAL RANGE	22.9 FEET
DISPL AT RADAR	19.0 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	111	38	136
MAXIMUM HEIGHT	8.3	22.7	24.2
10TH HIGHEST HTS	5.8	21.1	17.8
3RD HIGHEST HTS	3.9	17.9	12.7
4.0 RMS(SPECTRA)	5.6	18.2	20.7



RUN 237 -- VOYAGE 32E -- TAPE 141 -- INDEX 26 -- INTERVAL 37



RUN 237 -- VOYAGE 32E -- TAPE 141 -- INDEX 26 -- INTERVAL 37

LOG BOOK DATA

DATE AND TIME	01-03-74 1600
POSITION	47-10 N 15-26 W
COURSE AND SPEED	070 . 27.7 KNOTS
SEA STATE	7
WAVE HEIGHT	10 FEET
" REL DIR	155 STBD
SWELL HEIGHT	10 FEET
" REL DIR	160 PORT

---- VISUAL WEATHER / COMMENTS ----

PT CLDY /

MIDSHIP VERTICAL BENDING STRESS

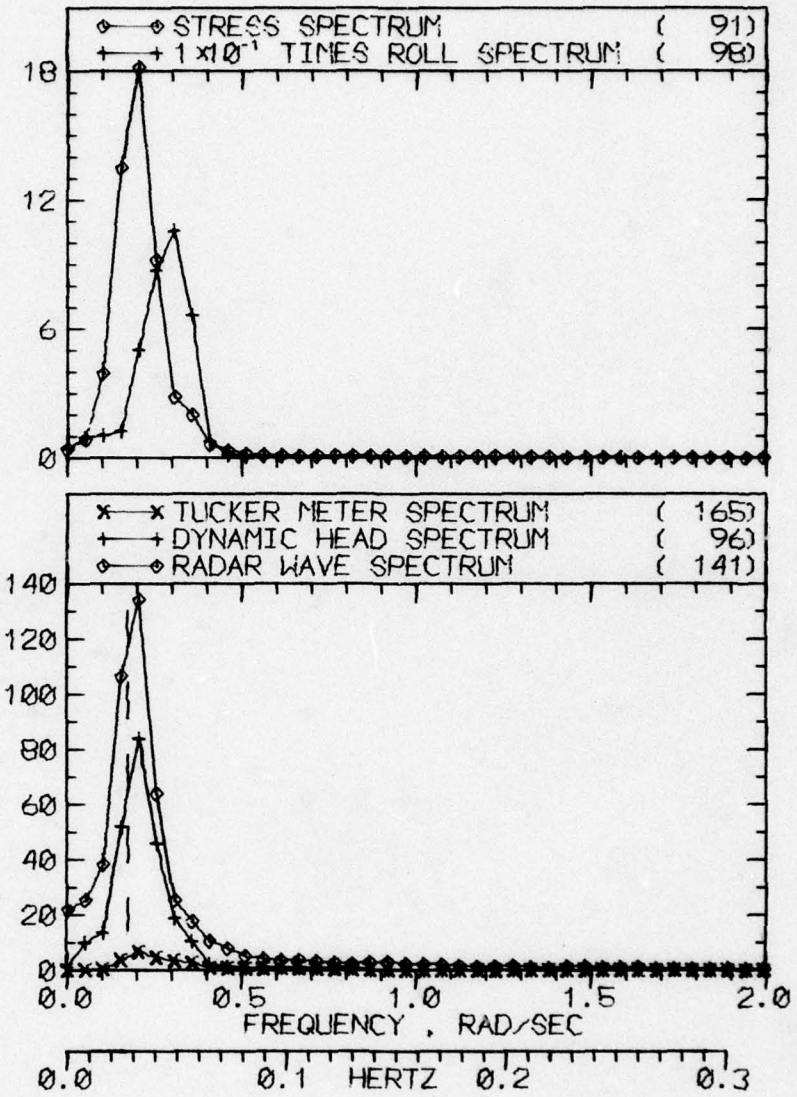
MAXIMUM PK-TR	9.0 KPSI
4.0 X RMS	6.6 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

ROLL	17.1 DEG
PITCH	0.69 DEG
DK HSE VERT ACCEL	0.11 G
DK HSE LAT ACCEL	0.36 G
RADAR SLANT RANGE	25.5 FEET
VERTICAL RANGE	20.3 FEET
DISPL AT RADAR	15.3 FEET

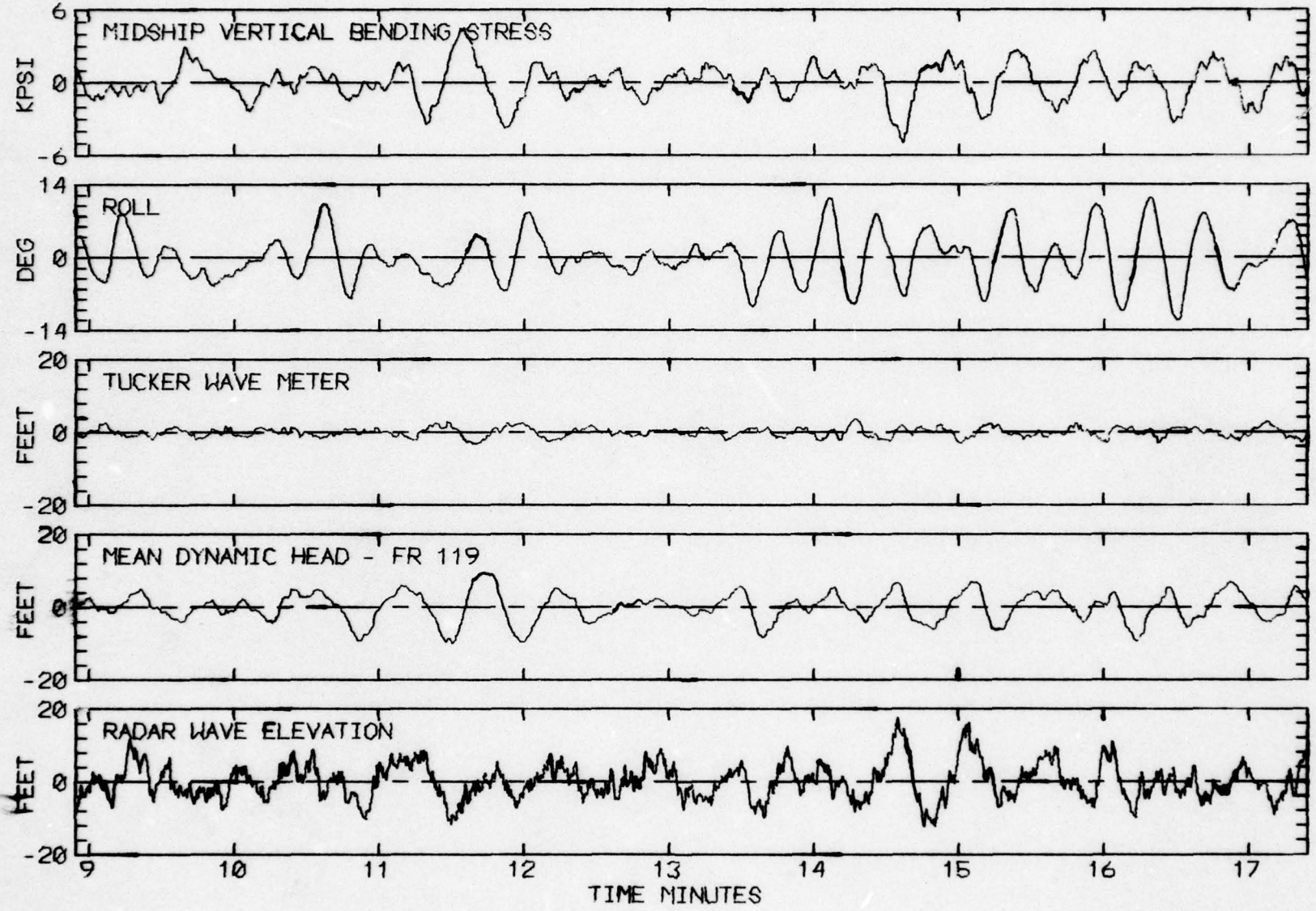
WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN. HEAD/RADAR		
P-T SAMPLE SIZE	118	53	158
MAXIMUM HEIGHT	6.3	19.1	30.7
10TH HIGHEST HTS	4.5	15.3	18.5
3RD HIGHEST HTS	3.4	12.1	12.2
4.0 RMS(SPECTRA)	4.9	14.2	20.5



05

RUN 241 -- VOYAGE 32E -- TAPE 141 -- INDEX 27 -- INTERVAL 41



RUN 241 -- VOYAGE 32E -- TAPE 141 -- INDEX 27 -- INTERVAL 41

LOG BOOK DATA

DATE AND TIME	01-03-74 2000
POSITION	47-10 N 15-26 W
COURSE AND SPEED	074 . 27.7 KNOTS
SEA STATE	6
WAVE HEIGHT	10 FEET
" REL DIR	151 STBD
SWELL HEIGHT	8 FEET
" REL DIR	151 STBD

---- VISUAL WEATHER / COMMENTS ----

CLDY /

MIDSHIP VERTICAL BENDING STRESS

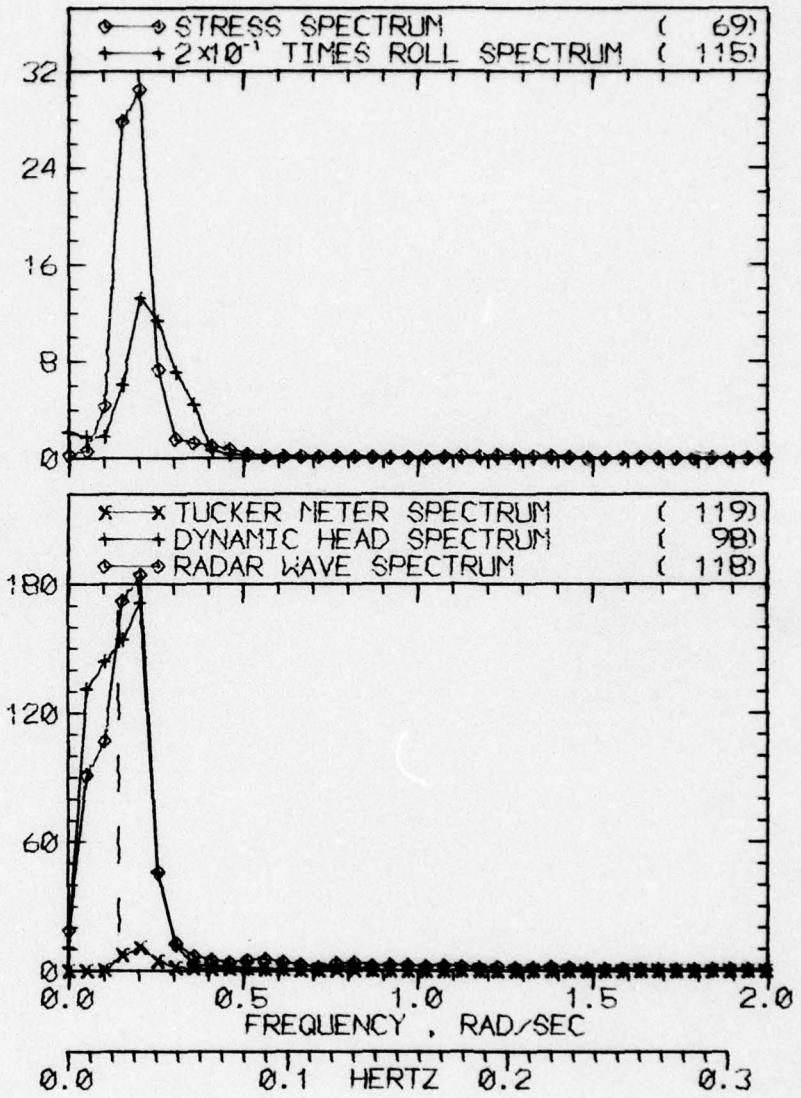
MAXIMUM PK-TR	13.8 KPSI
4.0 X RMS	8.0 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

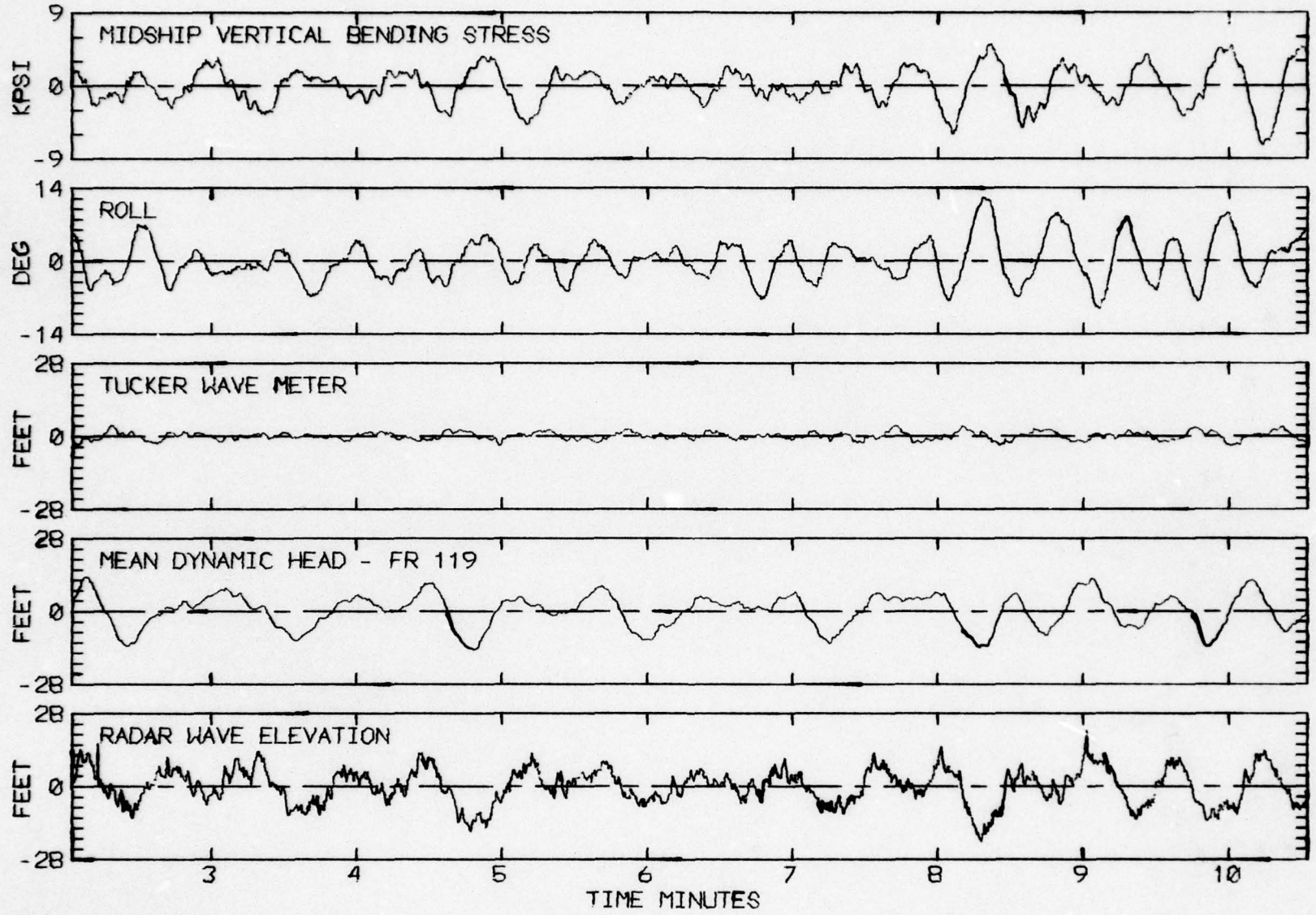
ROLL	14.2 DEG
PITCH	0.92 DEG
DK HSE VERT ACCEL	0.11 G
DK HSE LAT ACCEL	0.32 G
RADAR SLANT RANGE	25.7 FEET
VERTICAL RANGE	22.0 FEET
DISPL AT RADAR	22.6 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	134	29	117
MAXIMUM HEIGHT	6.8	25.8	36.0
10TH HIGHEST HTS	5.0	22.1	20.6
3RD HIGHEST HTS	3.5	20.4	14.6
4.0 RMS(SPECTRA)	5.4	23.6	24.2



RUN 245 -- VOYAGE 32E -- TAPE 141 -- INDEX 28 -- INTERVAL 45



RUN 245 -- VOYAGE 32E -- TAPE 141 -- INDEX 28 -- INTERVAL 45

LOG BOOK DATA

DATE AND TIME	01-03-74 2400
POSITION	47-10 N 15-26 W
COURSE AND SPEED	075 , 27.5 KNOTS
SEA STATE	6
WAVE HEIGHT	8 FEET
" REL DIR	165 PORT
SWELL HEIGHT	8 FEET
" REL DIR	165 PORT

---- VISUAL WEATHER / COMMENTS ----

PT CLDY /

MIDSHIP VERTICAL BENDING STRESS

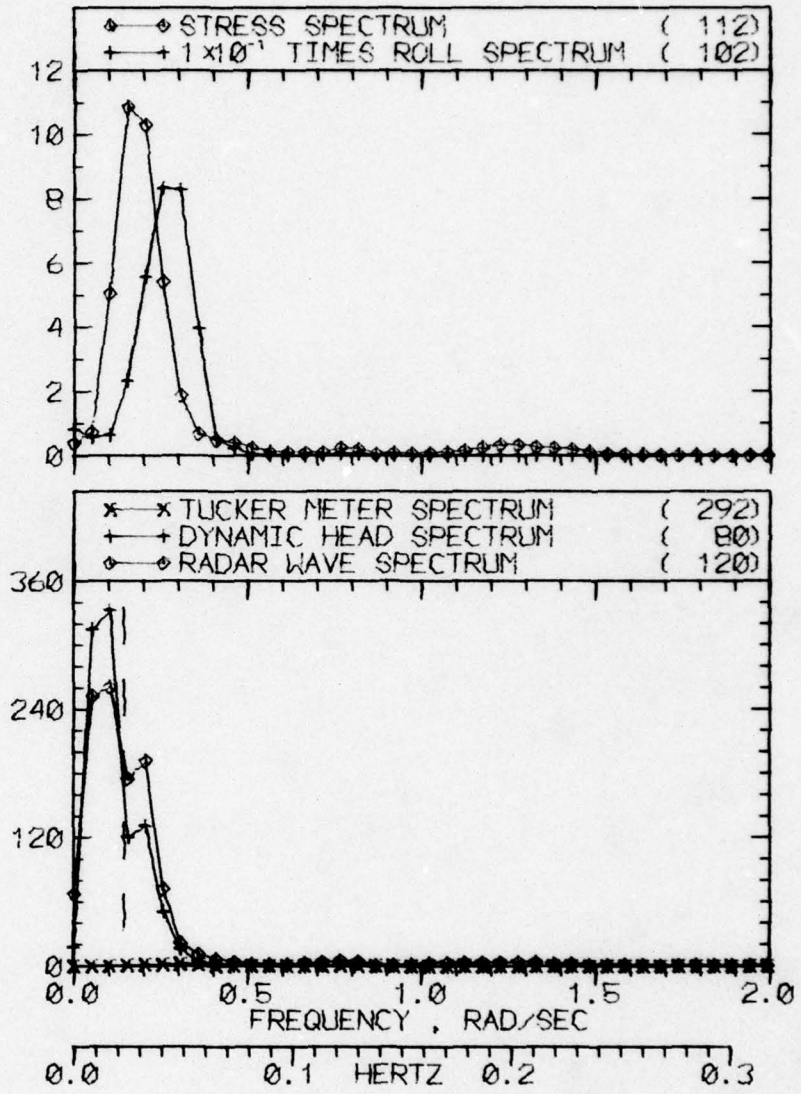
MAXIMUM PK-TR	7.0 KPSI
4.0 X RMS	5.7 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

ROLL	16.0 DEG
PITCH	0.93 DEG
DK HSE VERT ACCEL	0.11 G
DK HSE LAT ACCEL	0.35 G
RADAR SLANT RANGE	31.1 FEET
VERTICAL RANGE	20.6 FEET
DISPL AT RADAR	24.4 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN. HEAD	RADAR
SAMPLE SIZE	241	27	105
MAXIMUM HEIGHT	4.3	32.7	39.9
10TH HIGHEST HTS	3.0	29.6	27.9
3RD HIGHEST HTS	2.2	25.0	17.7
4.0 RMS(SPECTRA)	3.4	28.5	30.2



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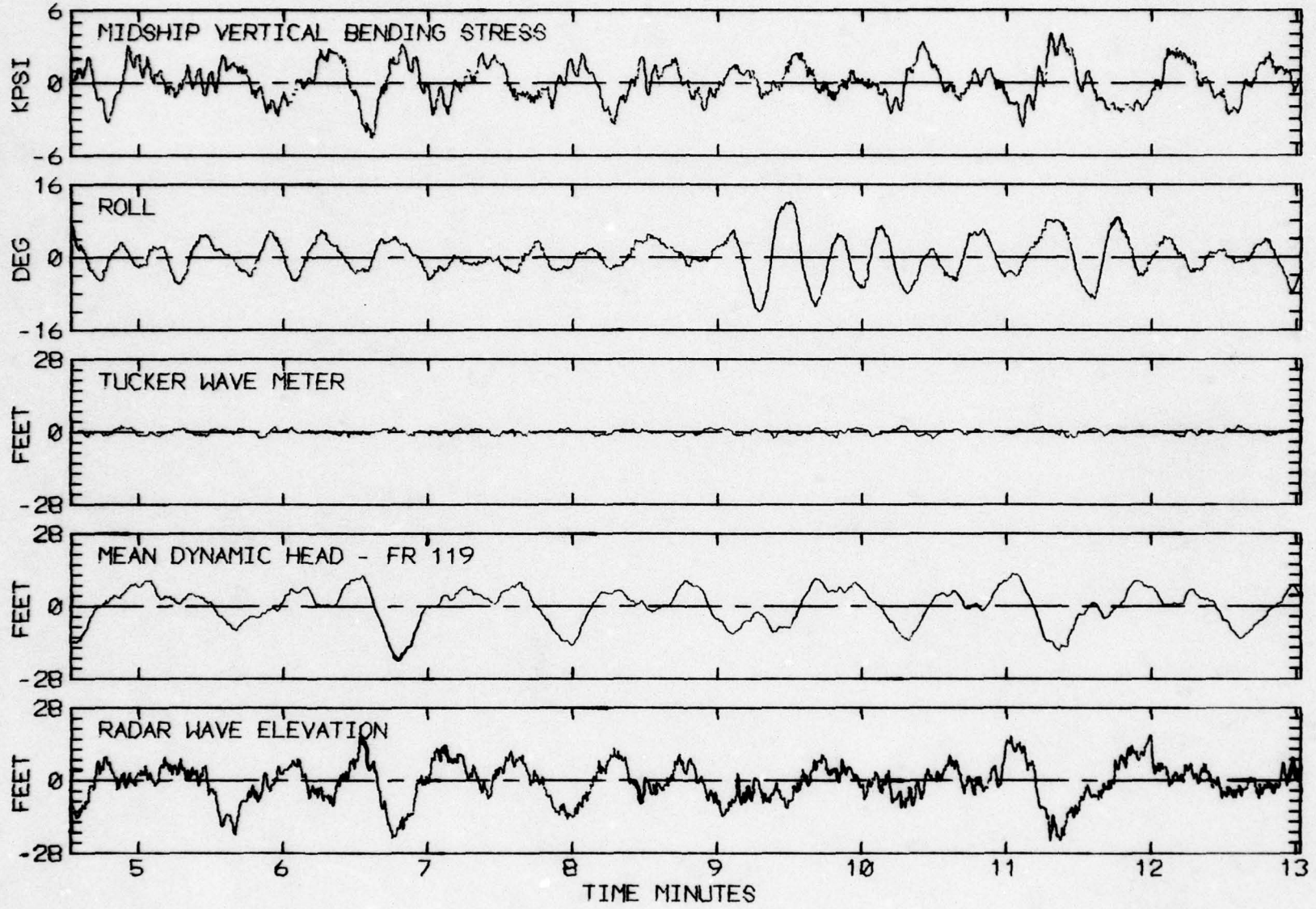
RUN 249 -- VOYAGE 32E -- TAPE 141 -- INDEX 29 -- INTERVAL 49



RUN 249 -- VOYAGE 32E -- TAPE 141 -- INDEX 29 -- INTERVAL 49

TABLE IIa

SUMMARY OF TMR LOG-BOOK DATA CORRESPONDING TO
INTERVALS SELECTED FOR WAVE METER DATA REDUCTION (PAGE 1 OF 2)

SEA LAND MC LEAN : 1973-1974 WINTER SEASON : VOYAGE 32 WEST

D.L. RUN NO.	TMR TAPE NO.	TMR INDX NO.	TMR INTV NO.	DATE	TIME (GMT)	LATITUDE	LONGITUDE	COURSE	SPEED KT.	PROP RPM	DRAFT FT.	SEA/AIR TEMP
309	143	3	9	01-08-74	1500	51-39 N	02-07 E	260	31.5	127.6	29.38	48/44
313	143	4	13	01-08-74	1710	51-39 N	02-07 E	260	31.5	127.6	29.38	48/44
337	143	9	36	01-09-74	1200	45-08 N	13-30 W	233	32.6	132.0	29.87	45/55
341	143	10	40	01-09-74	1600	45-08 N	13-30 W	233	32.7	132.4	29.80	55/58
345	143	11	44	01-09-74	2000	45-08 N	13-30 W	267	32.3	131.0	29.69	55/52
349	143	12	48	01-09-74	2400	45-08 N	13-30 W	266	31.8	129.0	29.40	54/54
359	143	15	58	01-10-74	1200	43-29 N	24-51 W	245	11.0	44.9	29.62	54/54
361	143	15	60	01-10-74	1200	43-29 N	24-51 W	245	11.0	44.9	29.62	54/54
401	145	17	1	01-10-74	2000	43-29 N	24-51 W	250	8.7	35.3	29.84	45/50
405	145	18	5	01-10-74	2400	43-29 N	24-51 W	250	10.9	44.3	29.63	55/48
409	145	19	9	01-11-74	0400	43-29 N	24-51 W	240	26.1	105.9	28.90	55/48
413	145	20	13	01-11-74	0800	43-29 N	24-51 W	240	11.0	44.9	29.46	57/52
421	145	22	21	01-11-74	1600	41-31 N	29-25 W	270	12.4	50.3	29.70	58/51
425	145	23	25	01-11-74	2000	41-31 N	29-25 W	270	16.2	65.7	29.88	56/44
429	145	24	29	01-11-74	2400	41-31 N	29-25 W	270	18.7	75.9	29.89	57/46
437	145	26	37	01-12-74	0800	41-31 N	29-25 W	271	28.4	115.1	29.63	58/52
441	145	27	41	01-12-74	1200	41-07 N	40-08 W	245	32.5	131.9	29.64	58/
450	145	29	50	01-12-74	1630	41-07 N	40-08 W	245	28.1	122.0	29.66	61/53
453	145	30	53	01-12-74	2000	41-07 N	40-08 W	269	32.5	131.8	29.71	59/49
461	145	32	61	01-13-74	0400	41-07 N	40-08 W	272	29.6	119.9	29.40	63/59
465	145	33	65	01-13-74	0800	41-07 N	40-08 W	272	32.6	132.1	29.64	50/50
507	147	36	7	01-13-74	2000	40-17 N	56-29 W	274	31.9	129.3	30.14	61/38
512	147	37	12	01-13-74	2400	40-17 N	56-29 W	272	28.5	115.5	30.30	65/35
513	147	38	13	01-14-74	0400	40-17 N	56-29 W	274	32.8	132.9	30.42	61/31

TABLE IIb

SUMMARY OF TMR LOG-BOOK DATA CORRESPONDING TO
INTERVALS SELECTED FOR WAVE METER DATA REDUCTION (PAGE 2 OF 2)

SEA LAND MC LEAN : 1973-1974 WINTER SEASON : VOYAGE 32 WEST

D.L. RUN NO.	SEA STATE	<REL WIND> DIR/SPEED /(KT)	REL WAVE DIR	WAVE HT. FT.	REL SWELL DIR	<-SWELL-> HT FT.	LENGTH FT.	VISUAL WEATHER /TMR LOG-BOOK COMMENTS
309	10	35P/55	35P	10	35P	8	250	OCAST /
313	10	35P/55	35P	10	35P	10	400	OCAST /
337	9	14S/45	8P	15	8P	10	500	CLDY /
341	7	30P/40	30P	15	8P	10	500	CLDY /
345	8	64P/45	64P	10	64P	10	500	CLDY /
349	9	41P/50	41P	15	41P	10	500	OCAST /
359	9	2S/55	2S	30	25S	15	500	CLDY RAIN SQUALLS /
361	9	2S/55	2S	30	25S	15	500	CLDY RAIN SQUALLS /
401	9	20S/50	20S	25	20S	20	500	OCAST RAIN /
405	7	2P/55	2P	25	2P	20	500	OCAST /
409	12	37P/60	37P	35	37P	20	500	OCAST /
413	11	15P/60	15P	35	30S	20	500	OCAST RAIN /
421	11	45S/60	45S	30	45S	25	400	PT CLDY /
425	10	45S/60	45S	20	45S	25	400	OCAST /
429	10	45S/60	0	20	0	25	500	OCAST RAIN SQUALLS /
437	9	91P/50	91P	15	91P	20	400	OCAST /
441	10	2S/50	2S	25	2S	20	400	OCAST /
450	9	2S/45	2S	25	2S	20	400	OCAST /
453	9	44P/45	44P	15	44P	20	400	OCAST /IN AUTO OPERATION
461	7	47P/40	47P	15	2P	12	500	OCAST /
465	10	43S/50	43S	25	43S	20	500	OCAST /HEAVY RAIN SQUALLS
507	9	41S/45	41S	15	41S	20	400	OCAST /HEAVY HAIL
512	9	43S/45	43S	10	43S	20	400	RAIN SNOW /
513	4	41S/35	41S	4	41S	8	300	OCAST /

TABLE IIc

COMPARISON OF TMR RESULTS FOR MIDSHIP VERTICAL BENDING STRESS WITH CORRESPONDING RAW DIGITIZATION RESULTS AT DAVIDSON LABORATORY

SEA LAND MC LEAN : 1973-1974 WINTER SEASON : VOYAGE 32 WEST

	TMR RESULTS					D.L. DIGITIZATION			COLUMN RATIOS		
D.L. RUN NO.	NO. WAVE INDUCED CYCLES (1)	NO. 1ST MODE BURSTS (2)	MAX P-TO-T STRESS KPSI (3)	RMS P-TO-T STRESS KPSI (4)	MAX 1ST MODE STRESS KPSI (5)	RANGE OF RECORDED EXTREMES KPSI (6)	2.83X (SAMPLE RMS) KPSI (7)	REL MEAN STRESS KPSI (8)	(7) / (4)	(6) / (3+5)	(6) / (3)
309	153	9	3.55	1.76	1.29	6.56	2.11	-0.19	1.20	1.36	1.85
313	212	62	11.02	3.99	7.58	10.98	4.19	-0.10	1.05	0.59	1.00
337	186	34	6.73	2.99	2.66	9.45	3.28	-0.58	1.10	1.01	1.40
341	179	60	8.33	3.43	4.97	13.83	3.53	-0.33	1.03	1.04	1.66
345	199	62	9.83	4.22	3.19	12.79	4.70	-0.24	1.11	0.98	1.30
349	142	65	14.51	7.25	4.16	19.02	7.49	1.52	1.03	1.02	1.31
359	109	49	17.32	10.06	2.33	23.11	10.46	-0.18	1.04	1.18	1.33
361	113	50	19.98	9.46	2.75	21.83	9.56	-0.08	1.01	0.96	1.09
401	113	9	19.36	7.60	3.28	21.07	7.88	-0.23	1.04	0.93	1.09
405	117	6	15.97	6.74	2.31	19.51	6.57	-0.35	0.97	1.07	1.22
409	158	37	13.71	4.70	3.86	16.80	4.96	-1.71	1.05	0.96	1.23
413	135	27	19.15	7.25	3.70	21.18	7.10	-0.48	0.98	0.93	1.11
421	132	28	17.53	7.54	3.61	17.84	7.16	-0.13	0.95	0.84	1.02
425	140	29	16.43	6.77	4.75	21.44	6.60	-0.27	0.97	1.01	1.30
429	150	47	14.39	6.34	4.42	17.49	6.42	-0.96	1.01	0.93	1.22
437	173	43	15.35	5.35	8.98	22.11	5.69	-1.37	1.06	0.91	1.44
441	197	23	6.63	3.30	3.25	11.59	3.93	-1.00	1.19	1.17	1.75
450	183	29	11.34	5.37	4.07	15.90	6.07	-0.10	1.13	1.03	1.40
453	208	23	7.64	3.40	3.43	14.46	4.08	-0.62	1.20	1.31	1.89
461	179	31	12.17	5.03	5.38	17.84	5.25	0.57	1.04	1.02	1.47
465	199	11	7.68	3.55	3.05	11.12	4.09	-0.44	1.15	1.04	1.45
507	210	11	10.09	3.67	3.20	12.44	4.48	-0.36	1.22	0.94	1.23
512	198	23	8.34	4.10	5.35	14.40	4.39	0.34	1.07	1.05	1.73
513	230	6	6.10	2.92	1.84	10.40	3.74	-0.10	1.28	1.31	1.70

TABLE IId

SUMMARY OF RAW DIGITIZATION RESULTS FOR RADAR RANGE
ROLL, PITCH, DECK HOUSE ACCELERATIONS, AND TUCKER METER

SEA LAND MC LEAN : 1973-1974 WINTER SEASON : VOYAGE 32 WEST

	<--- RADAR --->			<--- ROLL ---->			<--- PITCH --->			<--VERT ACCEL->			<--LAT ACCEL-->			<-- TUCKER -->		
D.L. RUN NO.	4.0 (RMS) FT	RECORDED EXTREMES FT	FT	4.0 (RMS) DEG	RECORDED EXTREMES DEG	DEG	4.0 (RMS) DEG	RECORDED EXTREMES DEG	DEG	4.0 (RMS) (G)	RECORDED EXTREMES (G)	(G)	4.0 (RMS) (G)	RECORDED EXTREMES (G)	(G)	4.0 (RMS) FT	RECORDED EXTREMES FT	FT
309	15.	13.	-13.	5.0	7.	-2.	0.6	0.2	-1.2	0.16	0.2	-0.1	0.15	0.2	-0.1	2.	2.	-2.
313	28.	28.	-39.	3.2	4.	-4.	1.3	0.5	-1.7	0.29	0.2	-0.2	0.11	0.2	-0.1	3.	3.	-3.
337	34.	28.	-23.	7.3	6.	-7.	1.7	0.9	-1.8	0.39	0.3	-0.3	0.21	0.2	-0.2	7.	5.	-6.
341	33.	32.	-41.	4.8	4.	-3.	1.8	1.2	-2.1	0.41	0.5	-0.4	0.15	0.1	-0.1	6.	5.	-5.
345	37.	29.	-34.	4.9	8.	-2.	2.1	1.2	-2.1	0.46	0.4	-0.3	0.16	0.1	-0.2	5.	4.	-5.
349	54.	41.	-38.	5.9	7.	-5.	2.2	2.0	-1.9	0.49	0.4	-0.4	0.19	0.2	-0.2	7.	5.	-6.
359	68.	59.	-48.	23.7	19.	-21.	1.9	2.0	-1.6	0.44	0.3	-0.4	0.64	0.6	-0.5	17.	11.	-11.
361	58.	45.	-50.	15.9	12.	-12.	2.0	2.0	-1.8	0.43	0.3	-0.4	0.43	0.3	-0.3	13.	10.	-11.
401	60.	69.	-50.	23.3	15.	-19.	1.7	1.9	-1.5	0.38	0.3	-0.4	0.62	0.5	-0.4	13.	9.	-10.
405	51.	50.	-35.	18.7	18.	-17.	1.7	1.6	-1.6	0.40	0.3	-0.3	0.50	0.5	-0.5	13.	9.	-10.
409	51.	56.	-48.	14.1	15.	-15.	2.4	2.3	-2.1	0.55	0.4	-0.6	0.39	0.4	-0.5	12.	11.	-11.
413	62.	45.	-53.	17.0	13.	-15.	2.0	2.1	-1.8	0.48	0.4	-0.5	0.47	0.4	-0.4	11.	8.	-8.
421	53.	41.	-51.	7.6	5.	-7.	1.9	1.9	-1.8	0.43	0.3	-0.4	0.21	0.2	-0.2	8.	6.	-6.
425	59.	54.	-54.	8.4	6.	-7.	2.2	2.2	-1.9	0.52	0.4	-0.5	0.23	0.3	-0.2	10.	11.	-8.
429	61.	47.	-57.	8.5	6.	-7.	2.6	2.3	-2.2	0.60	0.5	-0.5	0.25	0.2	-0.2	9.	7.	-7.
437	54.	51.	-54.	7.6	7.	-9.	2.6	2.4	-2.3	0.60	0.6	-0.5	0.22	0.3	-0.2	8.	6.	-8.
441	38.	32.	-48.	7.8	6.	-9.	2.0	1.1	-2.1	0.44	0.4	-0.3	0.22	0.2	-0.2	7.	5.	-6.
450	47.	35.	-52.	8.8	6.	-7.	2.4	1.5	-2.2	0.51	0.4	-0.4	0.22	0.2	-0.2	6.	4.	-5.
453	34.	32.	-42.	6.6	7.	-4.	1.8	1.3	-2.0	0.38	0.4	-0.3	0.18	0.2	-0.2	5.	4.	-4.
461	43.	35.	-42.	5.2	4.	-4.	2.3	1.7	-2.1	0.49	0.4	-0.4	0.15	0.2	-0.1	5.	3.	-5.
465	32.	25.	-28.	5.8	3.	-7.	1.8	1.1	-2.2	0.39	0.4	-0.3	0.15	0.1	-0.1	4.	3.	-4.
507	33.	24.	-42.	8.5	5.	-8.	1.6	0.9	-2.0	0.34	0.3	-0.3	0.21	0.2	-0.2	4.	3.	-3.
512	32.	27.	-28.	6.3	3.	-9.	1.9	0.9	-2.1	0.42	0.4	-0.3	0.17	0.1	-0.2	4.	3.	-4.
513	25.	23.	-19.	5.1	2.	-6.	1.1	0.5	-1.4	0.25	0.2	-0.2	0.14	0.1	-0.1	3.	2.	-3.

LOG BOOK DATA	
DATE AND TIME	01-08-74 1500
POSITION	51-39 N 02-07 E
COURSE AND SPEED	260 . 31.5 KNOTS
SEA STATE	10
WAVE HEIGHT	10 FEET
" REL DIR	35 PORT
SWELL HEIGHT	8 FEET
" REL DIR	35 PORT

---- VISUAL WEATHER / COMMENTS ----

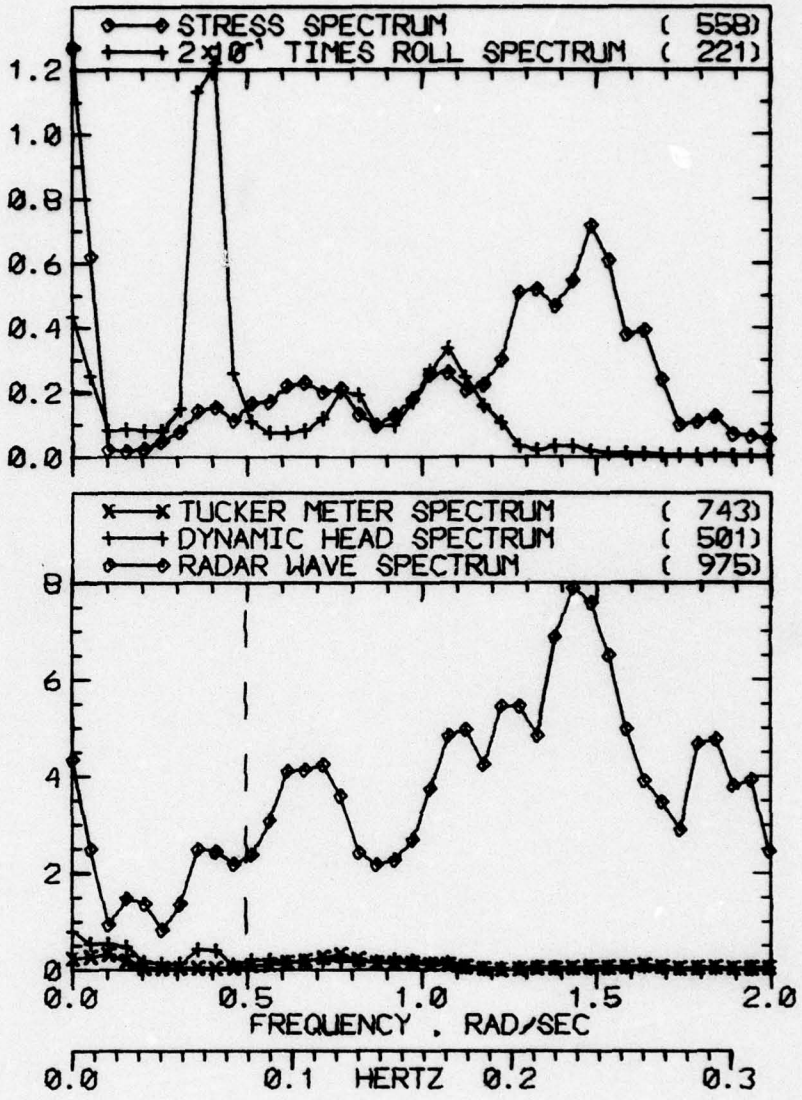
OCAST /

MIDSHIP VERTICAL BENDING STRESS	
MAXIMUM PK-TR	3.6 KPSI
4.0 X RMS	3.0 KPSI

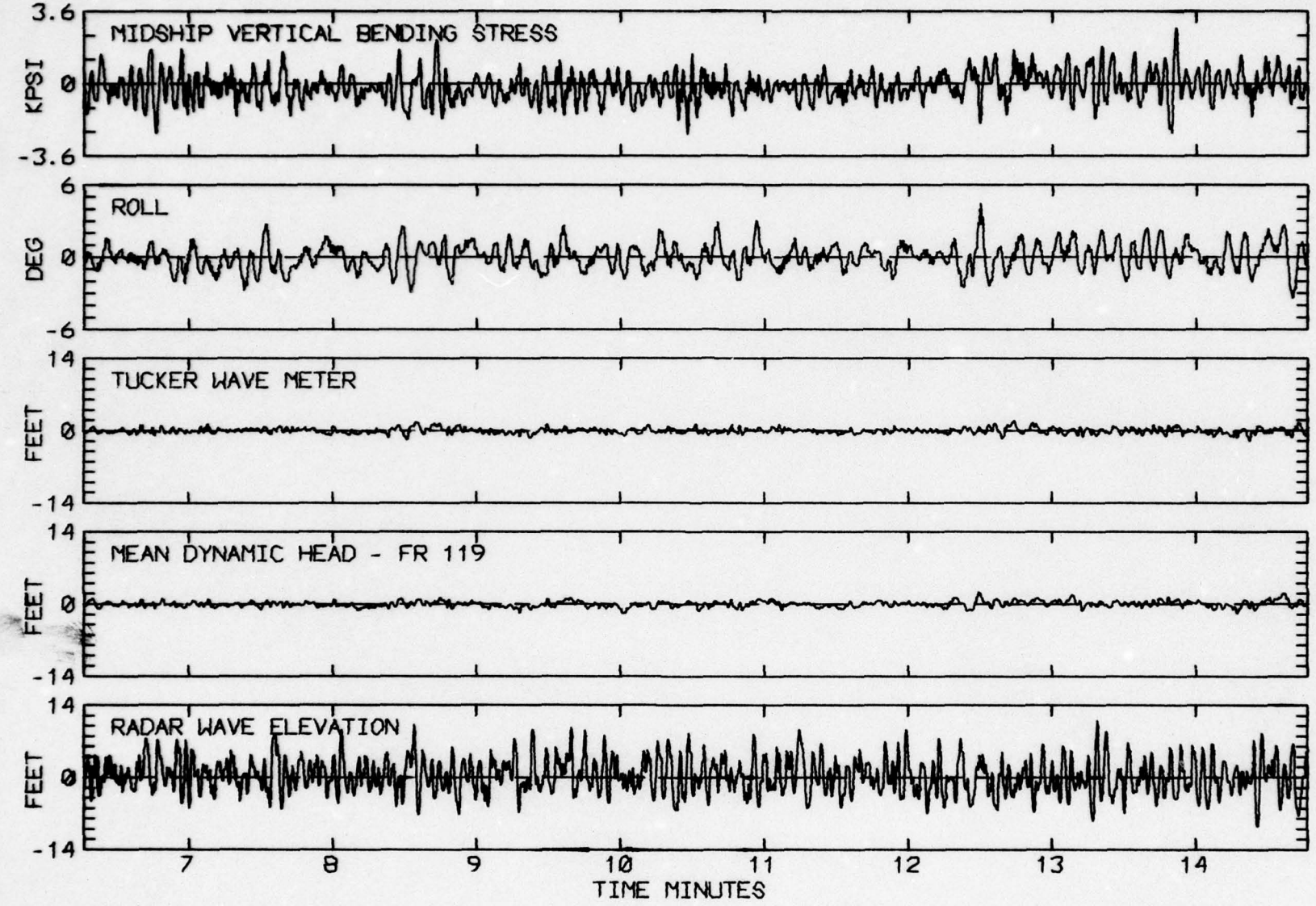
SUMMARY OF MOTIONS (4.0 X RMS)	
ROLL	5.0 DEG
PITCH	0.60 DEG
DK HSE VERT ACCEL	0.16 G
DK HSE LAT ACCEL	0.15 G
RADAR SLANT RANGE	14.5 FEET
VERTICAL RANGE	13.9 FEET
DISPL AT RADAR	5.4 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN. HEAD/RADAR		
P-T SAMPLE SIZE	374	241	317
MAXIMUM HEIGHT	2.8	3.2	17.5
10TH HIGHEST HTS	1.8	2.3	14.0
3RD HIGHEST HTS	1.4	1.8	11.2
4.0 RMS(SPECTRA)	2.0	2.4	12.3



RUN 309 -- VOYAGE 32W -- TAPE 143 -- INDEX 3 -- INTERVAL 9



RUN 309 -- VOYAGE 32W -- TAPE 143 -- INDEX 3 -- INTERVAL 9

LOG BOOK DATA

DATE AND TIME	01-08-74 1710
POSITION	51-39 N 02-07 E
COURSE AND SPEED	260 . 31.5 KNOTS
SEA STATE	10
WAVE HEIGHT	10 FEET
" REL DIR	35 PORT
SWELL HEIGHT	10 FEET
" REL DIR	35 PORT

---- VISUAL WEATHER / COMMENTS ----

OCAST /

MIDSHIP VERTICAL BENDING STRESS

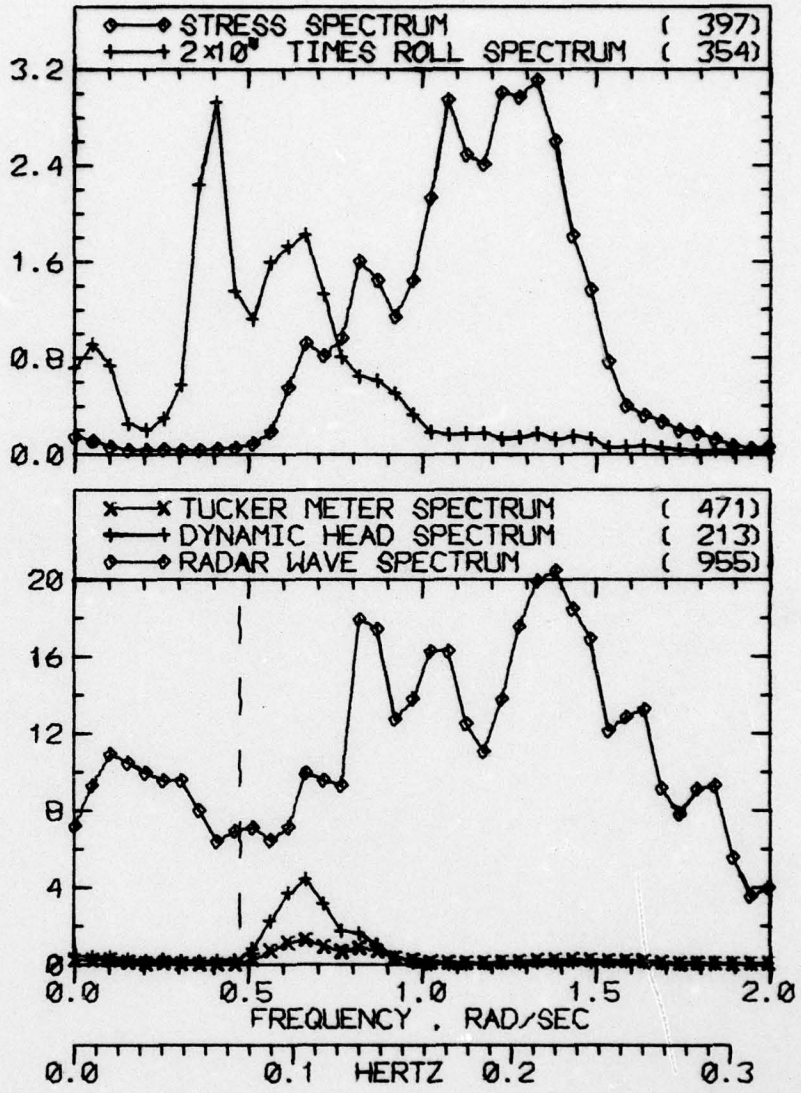
MAXIMUM PK-TR	11.0 KPSI
4.0 X RMS	5.7 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

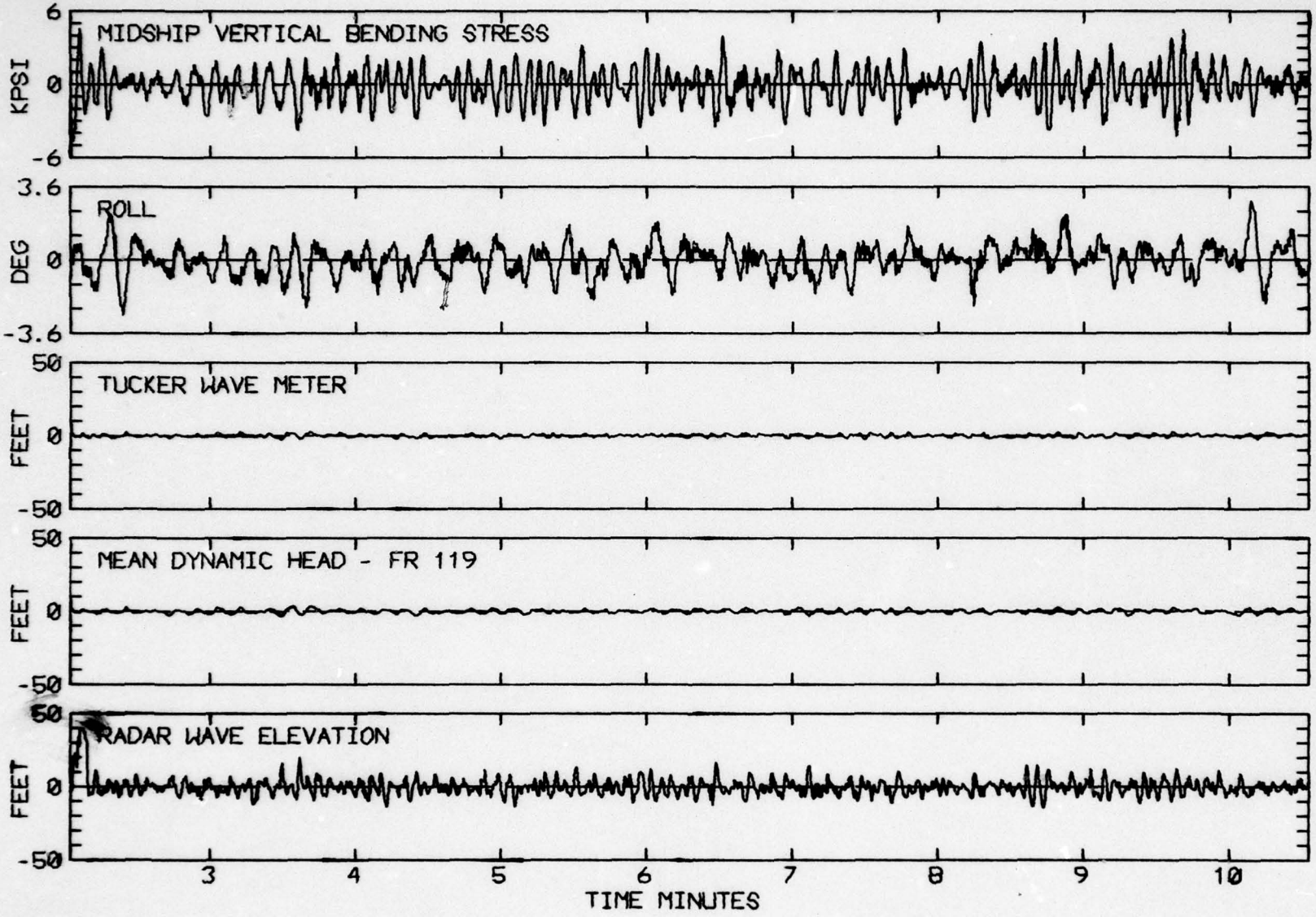
ROLL	3.1 DEG
PITCH	1.32 DEG
DK HSE VERT ACCEL	0.29 G
DK HSE LAT ACCEL	0.11 G
RADAR SLANT RANGE	28.5 FEET
VERTICAL RANGE	26.5 FEET
DISPL AT RADAR	12.9 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	255	181	320
MAXIMUM HEIGHT	4.1	5.8	46.7
10TH HIGHEST HTS	3.4	4.8	22.8
3RD HIGHEST HTS	2.7	3.9	17.7
4.0 RMS(SPECTRA)	3.3	4.5	20.9



RUN 313 -- VOYAGE 32W -- TAPE 143 -- INDEX 4 -- INTERVAL 13



RUN 313 -- VOYAGE 32W -- TAPE 143 -- INDEX 4 -- INTERVAL 13

LOG BOOK DATA

DATE AND TIME	01-09-74 1200
POSITION	45-08 N 13-30 W
COURSE AND SPEED	233 . 32.6 KNOTS
SEA STATE	9
WAVE HEIGHT	15 FEET
" REL DIR	8 PORT
SWELL HEIGHT	10 FEET
" REL DIR	8 PORT

---- VISUAL WEATHER / COMMENTS ----

CLDY /

MIDSHIP VERTICAL BENDING STRESS

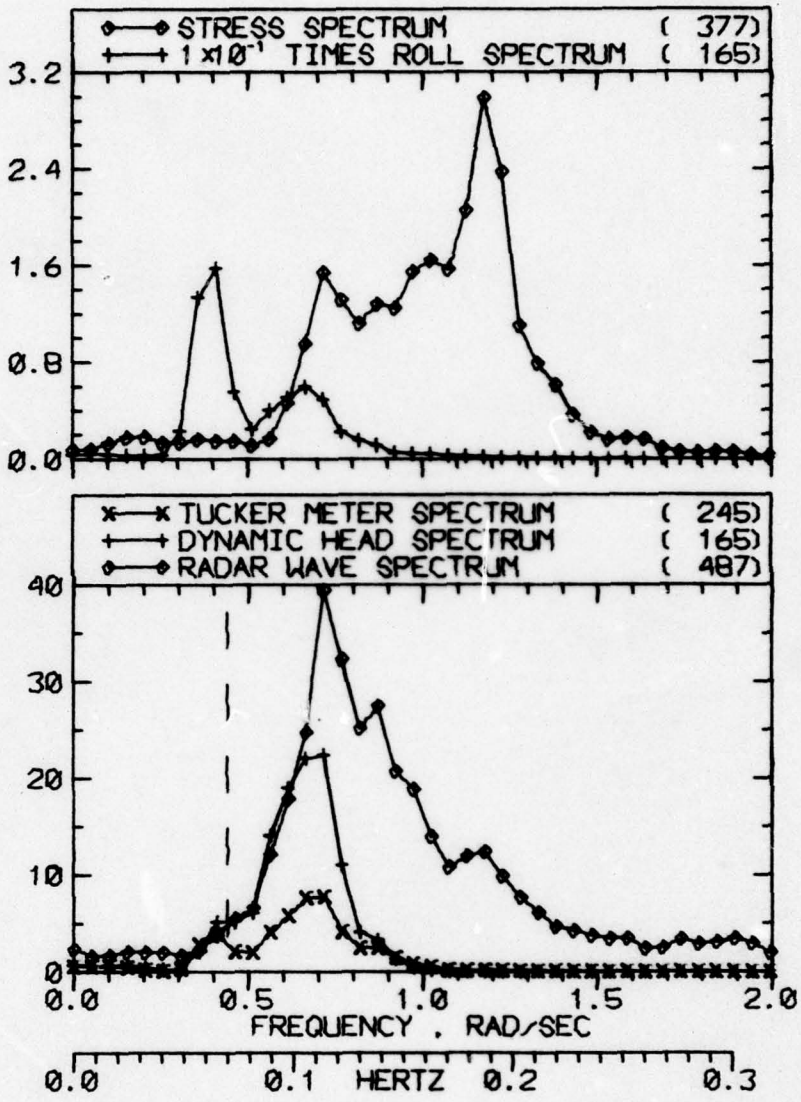
MAXIMUM PK-TR	6.7 KPSI
4.0 X RMS	4.7 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

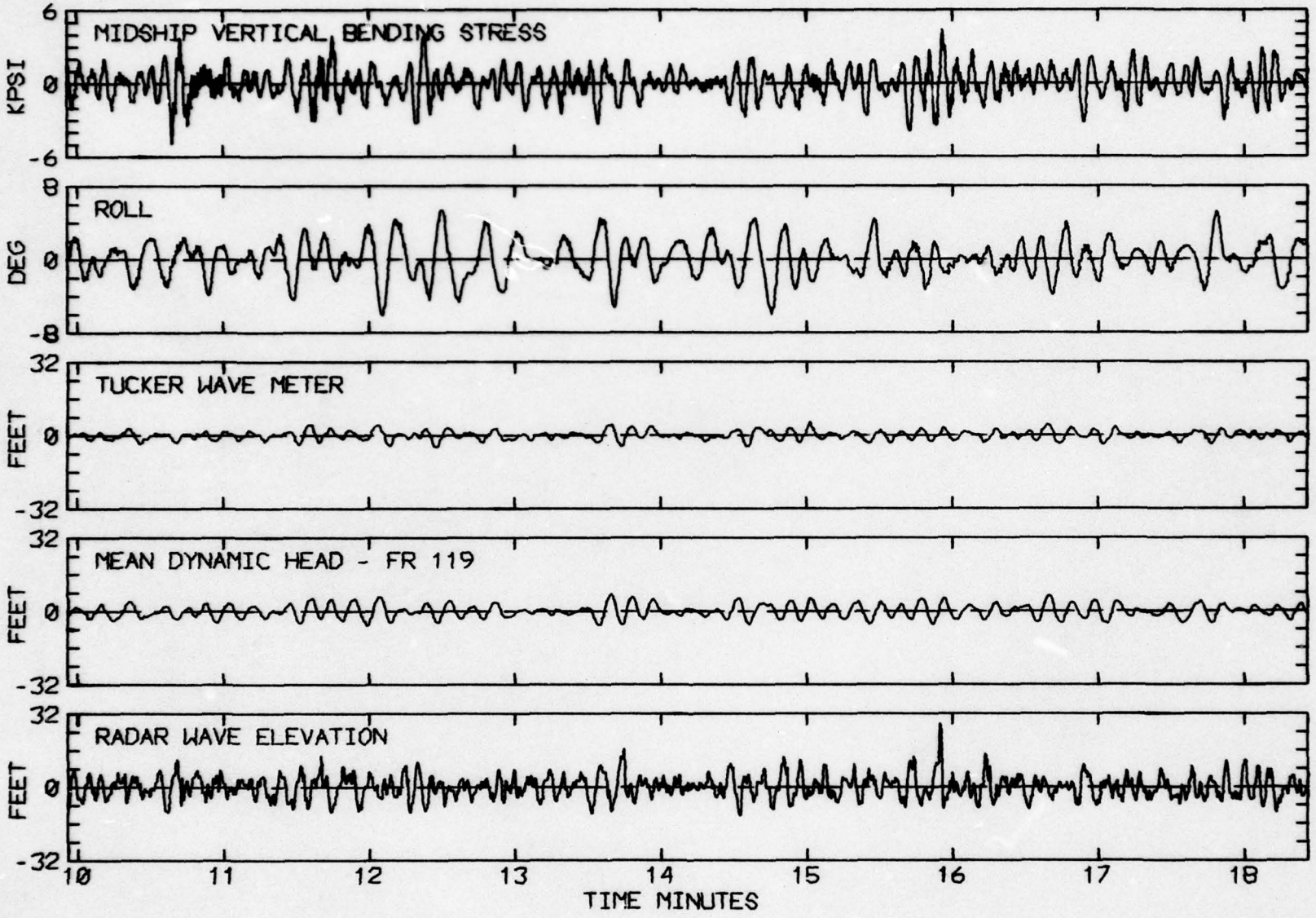
ROLL	7.5 DEG
PITCH	1.70 DEG
DK HSE VERT ACCEL	0.39 G
DK HSE LAT ACCEL	0.21 G
RADAR SLANT RANGE	33.5 FEET
VERTICAL RANGE	31.3 FEET
DISPL AT RADAR	21.6 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	145	109	240
MAXIMUM HEIGHT	9.3	13.2	41.7
10TH HIGHEST HTS	7.9	11.4	22.4
3RD HIGHEST HTS	6.2	9.6	16.8
4.0 RMS(SPECTRA)	6.6	10.0	18.4



RUN 337 -- VOYAGE 32W -- TAPE 143 -- INDEX 9 -- INTERVAL 36



RUN 337 -- VOYAGE 32W -- TAPE 143 -- INDEX 9 -- INTERVAL 36

LOG BOOK DATA

DATE AND TIME	01-09-74 1600
POSITION	45-08 N 13-30 W
COURSE AND SPEED	233 . 32.7 KNOTS
SEA STATE	7
WAVE HEIGHT	15 FEET
" REL DIR	30 PORT
SWELL HEIGHT	10 FEET
" REL DIR	8 PORT

---- VISUAL WEATHER / COMMENTS ----

CLDY /

MIDSHIP VERTICAL BENDING STRESS

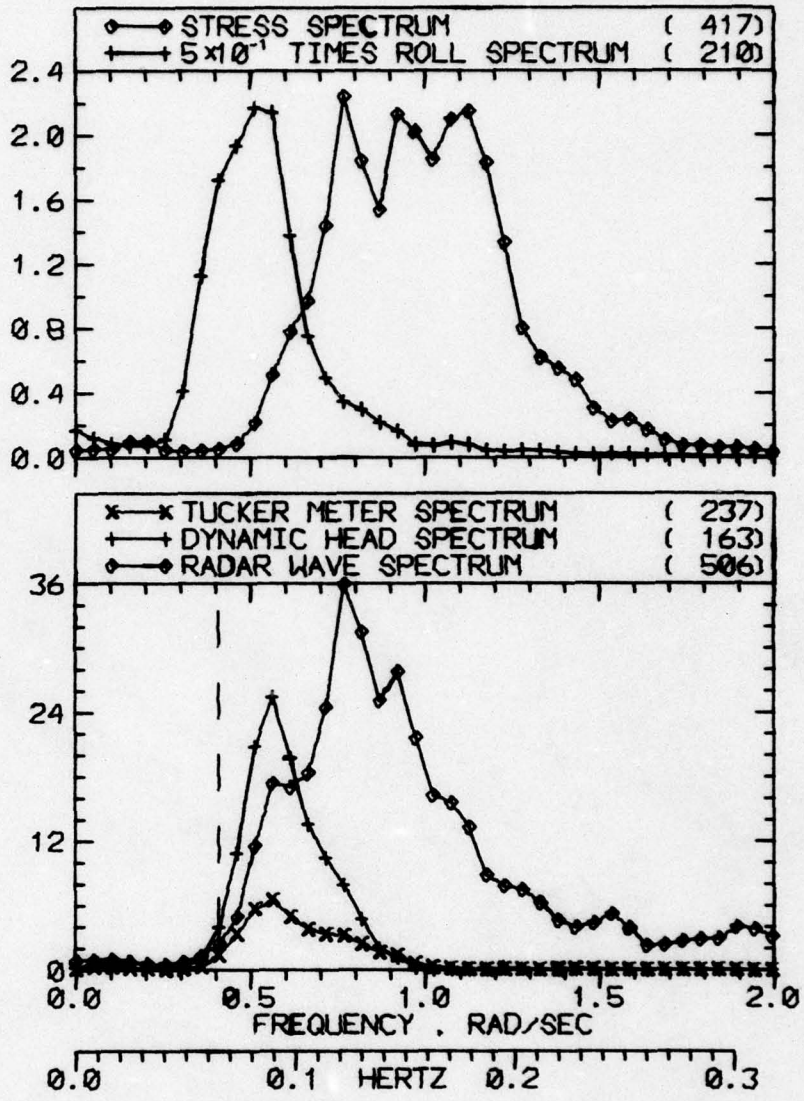
MAXIMUM PK-TR	8.3 KPSI
4.0 X RMS	5.0 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

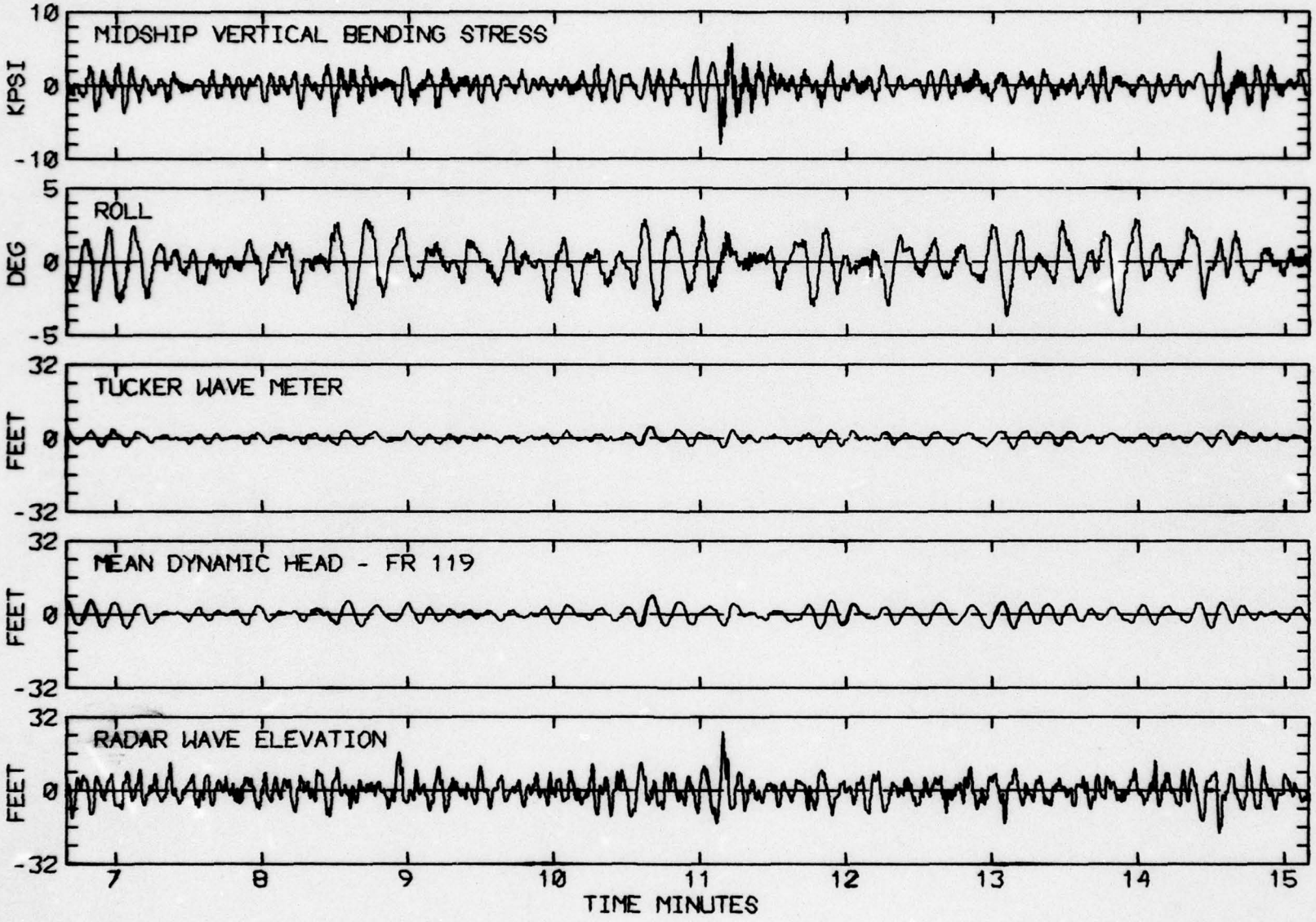
ROLL	4.9 DEG
PITCH	1.85 DEG
DK HSE VERT ACCEL	0.41 G
DK HSE LAT ACCEL	0.15 G
RADAR SLANT RANGE	33.4 FEET
VERTICAL RANGE	32.1 FEET
DISPL AT RADAR	22.5 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	153	104	262
MAXIMUM HEIGHT	7.5	13.2	33.6
10TH HIGHEST HTS	6.5	11.3	20.8
3RD HIGHEST HTS	5.3	9.5	16.1
4.0 RMS(SPECTRA)	6.0	10.2	18.6



RUN 341 -- VOYAGE 32W -- TAPE 143 -- INDEX 10 -- INTERVAL 40



RUN 341 -- VOYAGE 32W -- TAPE 143 -- INDEX 10 -- INTERVAL 40

LOG BOOK DATA

DATE AND TIME	01-09-74 2000
POSITION	45-08 N 13-30 W
COURSE AND SPEED	267 . 32.3 KNOTS
SEA STATE	8
WAVE HEIGHT	10 FEET
" REL DIR	64 PORT
SWELL HEIGHT	10 FEET
" REL DIR	64 PORT

---- VISUAL WEATHER / COMMENTS ----

CLDY /

MIDSHIP VERTICAL BENDING STRESS

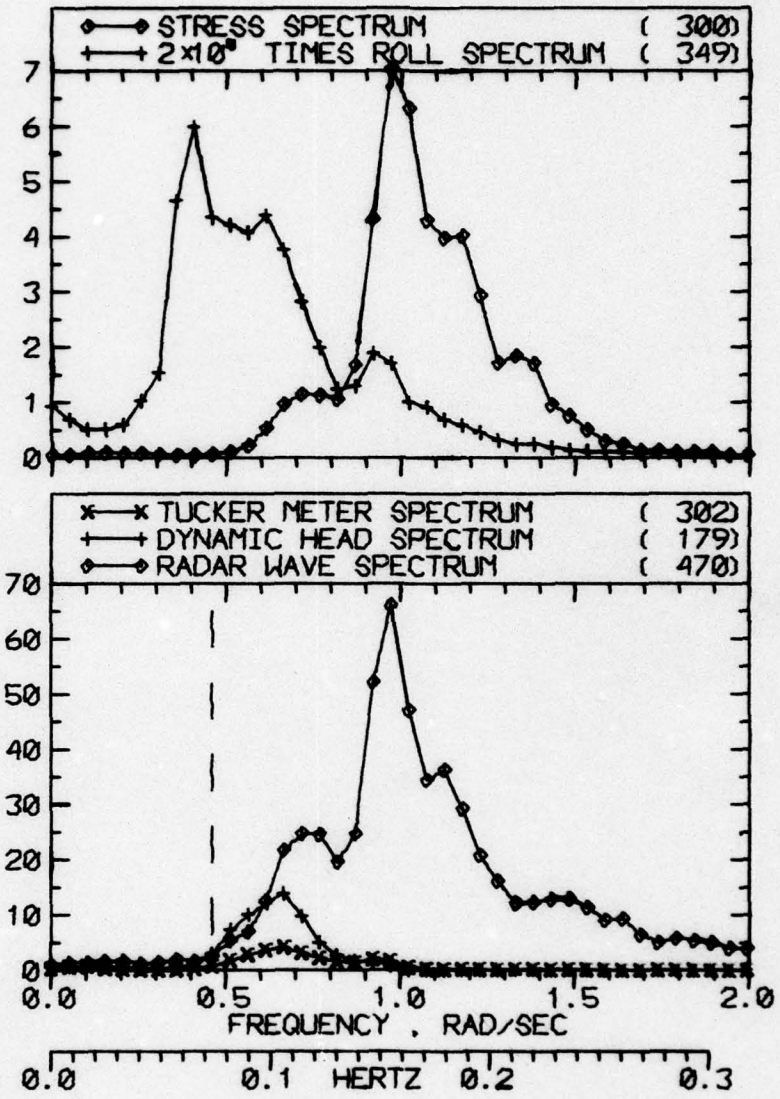
MAXIMUM PK-TR	9.8 KPSI
4.0 X RMS	6.6 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

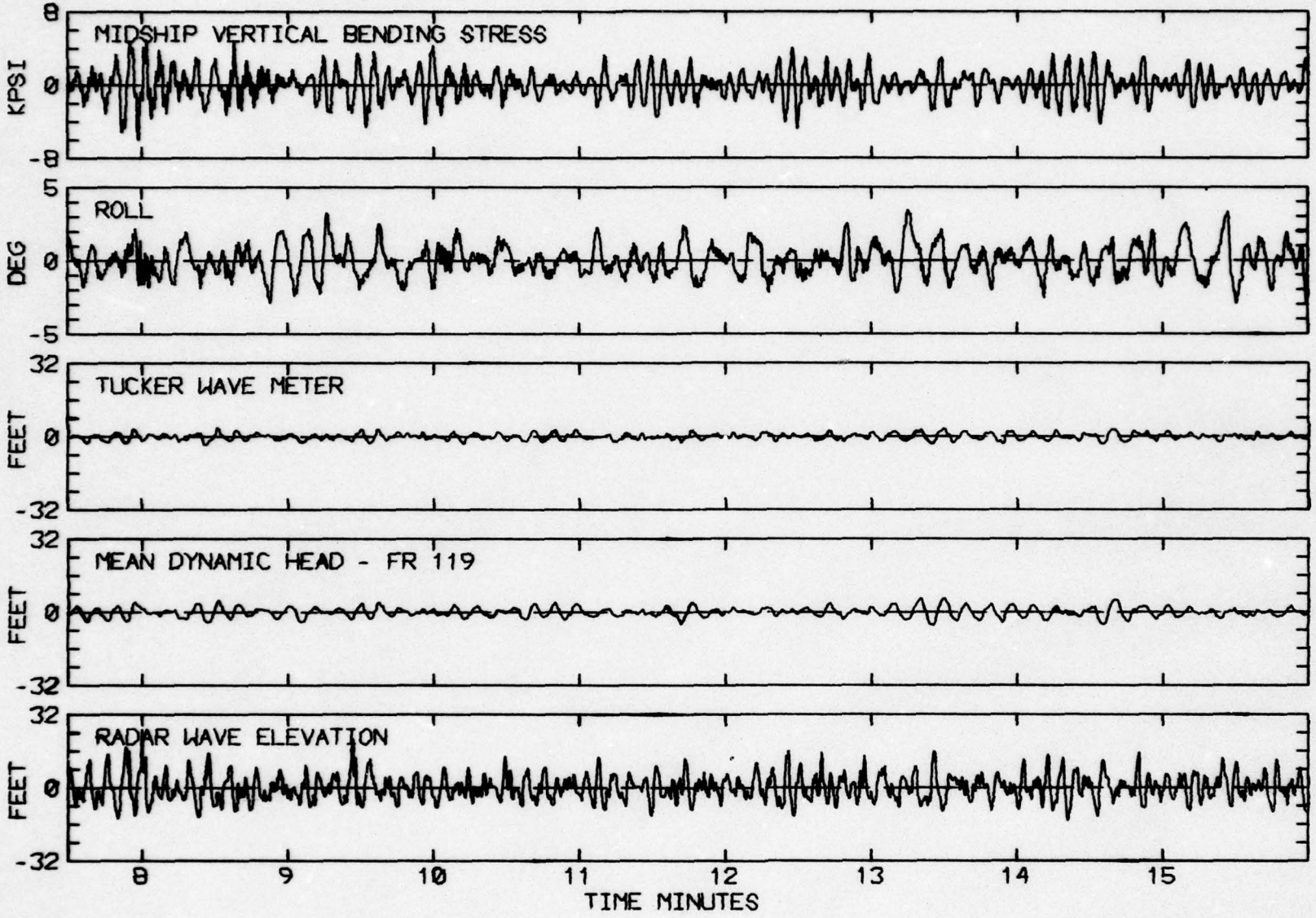
ROLL	4.8 DEG
PITCH	2.09 DEG
DK HSE VERT ACCEL	0.46 G
DK HSE LAT ACCEL	0.16 G
RADAR SLANT RANGE	37.4 FEET
VERTICAL RANGE	35.8 FEET
DISPL AT RADAR	20.8 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN. HEAD/RADAR		
P-T SAMPLE SIZE	201	128	235
MAXIMUM HEIGHT	8.4	13.0	36.4
10TH HIGHEST HTS	6.0	9.4	28.3
3RD HIGHEST HTS	4.5	7.5	21.9
4.0 RMS(SPECTRA)	5.2	7.9	22.9



RUN 345 -- VOYAGE 32W -- TAPE 143 -- INDEX 11 -- INTERVAL 44



RUN 345 -- VOYAGE 32W -- TAPE 143 -- INDEX 11 -- INTERVAL 44

LOG BOOK DATA

DATE AND TIME	01-09-74 2400
POSITION	45-08 N 13-30 W
COURSE AND SPEED	266 . 31.8 KNOTS
SEA STATE	9
WAVE HEIGHT	15 FEET
" REL DIR	41 PORT
SWELL HEIGHT	10 FEET
" REL DIR	41 PORT

---- VISUAL WEATHER / COMMENTS ----

OCAST /

MIDSHIP VERTICAL BENDING STRESS

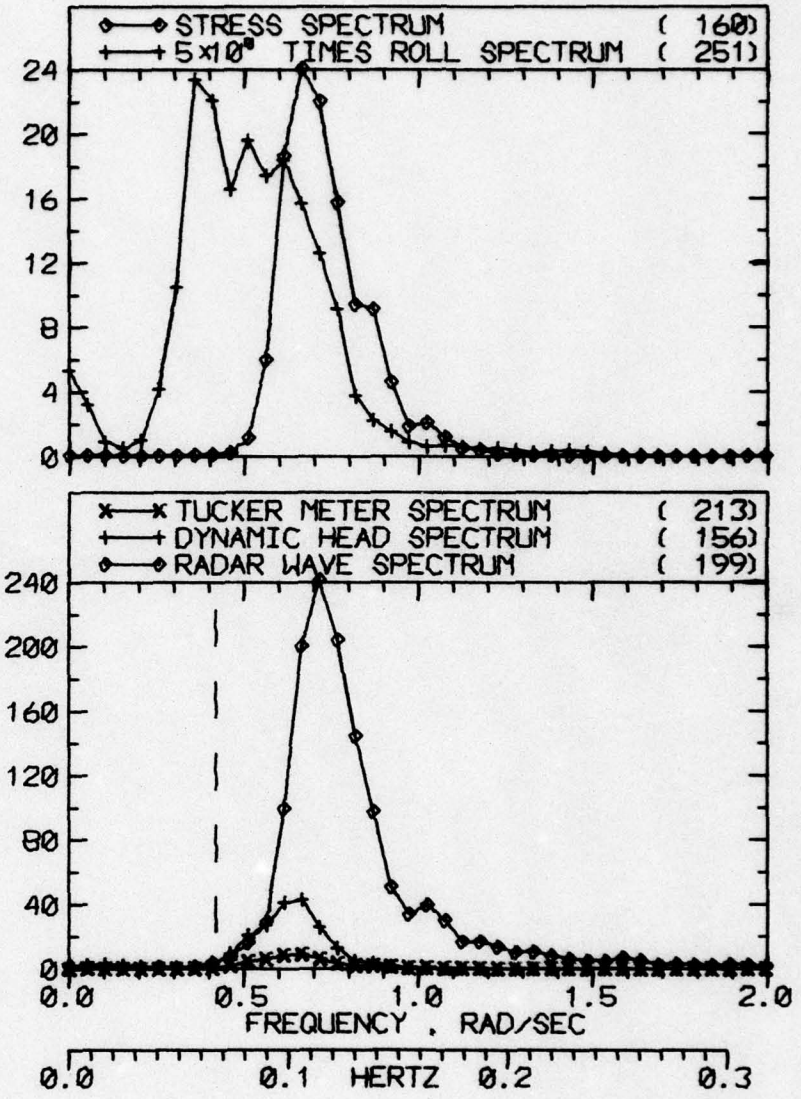
MAXIMUM PK-TR	14.5 KPSI
4.0 X RMS	10.1 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

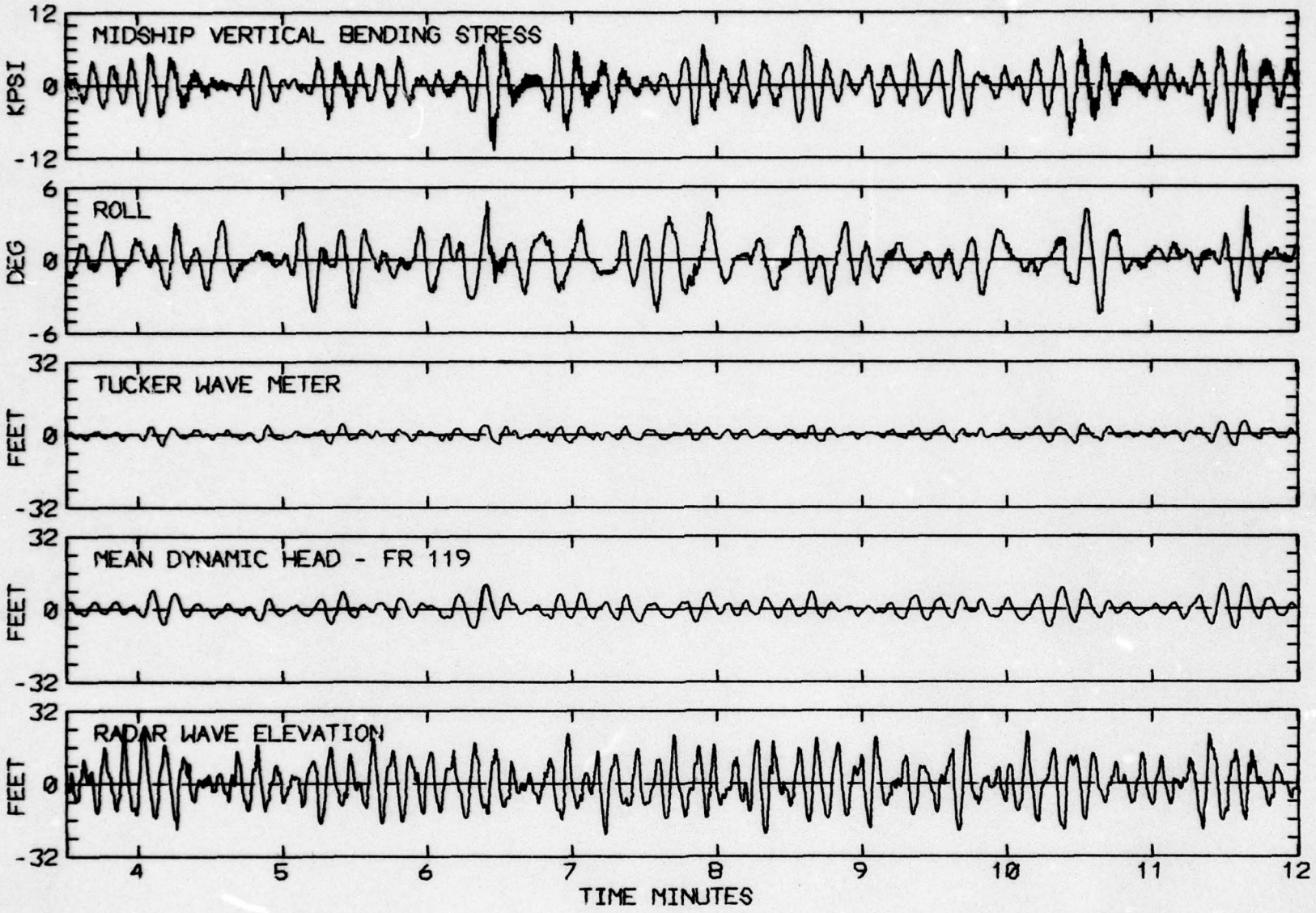
ROLL	5.6 DEG
PITCH	2.17 DEG
DK HSE VERT ACCEL	0.49 G
DK HSE LAT ACCEL	0.19 G
RADAR SLANT RANGE	53.5 FEET
VERTICAL RANGE	50.6 FEET
DISPL AT RADAR	30.1 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN. HEAD/RADAR		
P-T SAMPLE SIZE	137	103	146
MAXIMUM HEIGHT	9.9	19.1	40.7
10TH HIGHEST HTS	7.8	15.1	37.8
3RD HIGHEST HTS	6.3	12.5	33.0
4.0 RMS(SPECTRA)	6.8	13.2	33.5



RUN 349 -- VOYAGE 32W -- TAPE 143 -- INDEX 12 -- INTERVAL 48



RUN 349 -- VOYAGE 32W -- TAPE 143 -- INDEX 12 -- INTERVAL 48

LOG BOOK DATA

DATE AND TIME	01-10-74 1200
POSITION	43-29 N 24-51 W
COURSE AND SPEED	245 . 11.0 KNOTS
SEA STATE	9
WAVE HEIGHT	30 FEET
" REL DIR	2 STBD
SWELL HEIGHT	15 FEET
" REL DIR	25 STBD

---- VISUAL WEATHER / COMMENTS ----

CLDY RAIN SQUALLS /

MIDSHIP VERTICAL BENDING STRESS

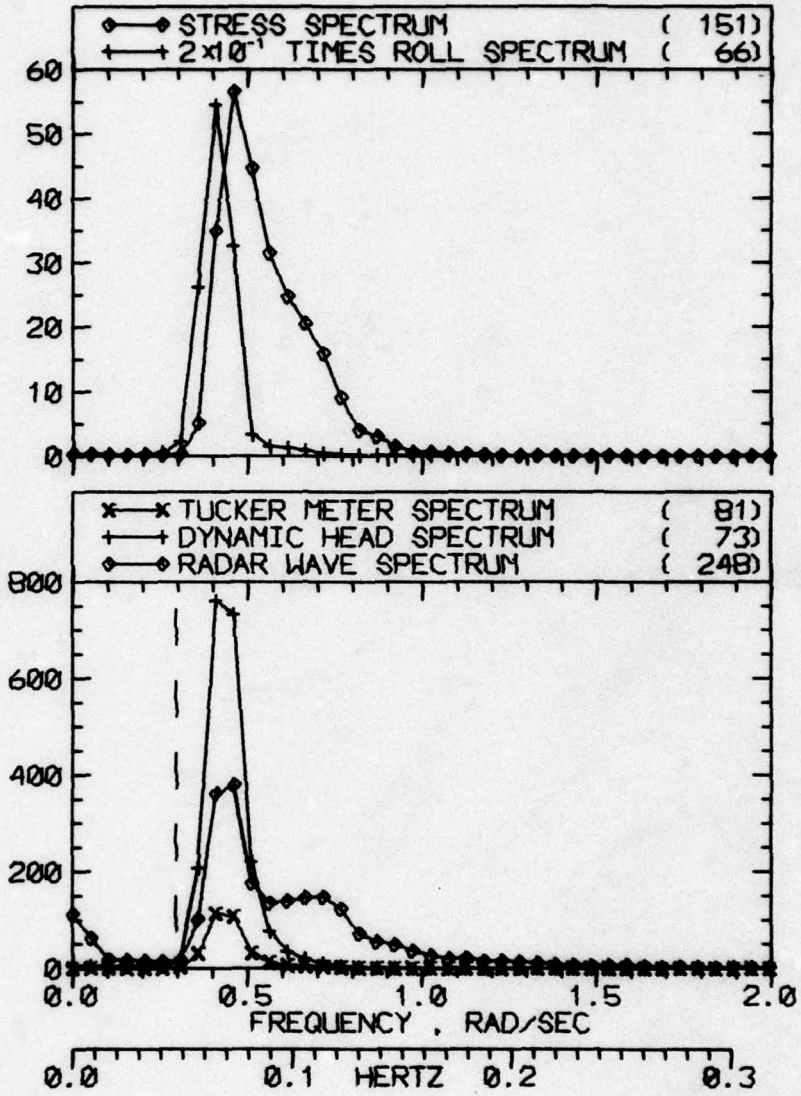
MAXIMUM PK-TR	17.3 KPSI
4.0 X RMS	14.6 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

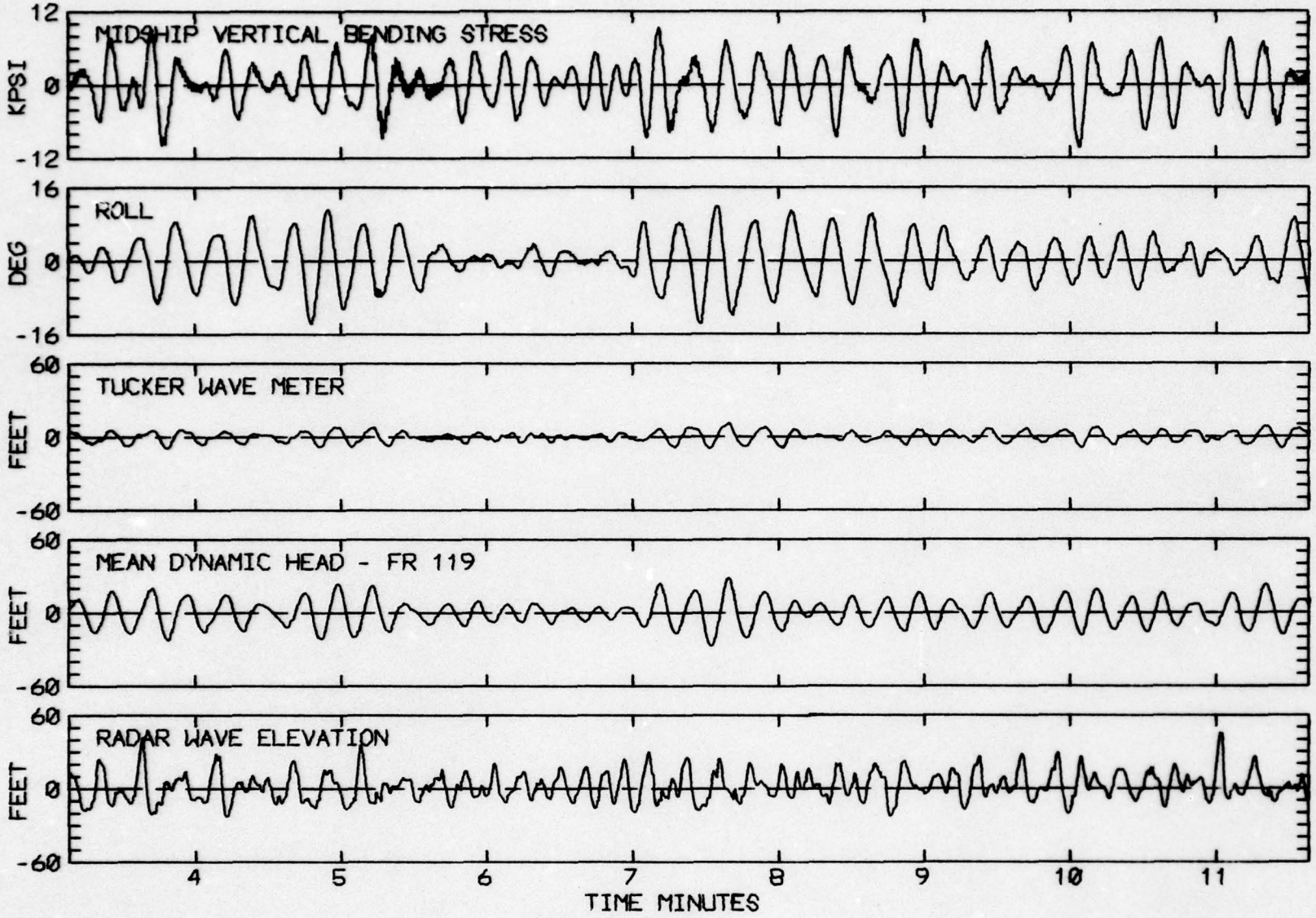
ROLL	22.7 DEG
PITCH	1.93 DEG
DK HSE VERT ACCEL	0.44 G
DK HSE LAT ACCEL	0.64 G
RADAR SLANT RANGE	68.4 FEET
VERTICAL RANGE	57.0 FEET
DISPL AT RADAR	52.3 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	72	67	110
MAXIMUM HEIGHT	19.1	49.1	63.9
10TH HIGHEST HTS	17.7	44.4	51.1
3RD HIGHEST HTS	15.8	39.7	40.6
4.0 RMS(SPECTRA)	16.4	41.6	43.7



RUN 359 -- VOYAGE 32W -- TAPE 143 -- INDEX 15 -- INTERVAL 58



RUN 359 -- VOYAGE 32W -- TAPE 143 -- INDEX 15 -- INTERVAL 58

LOG BOOK DATA

DATE AND TIME	01-10-74 1200
POSITION	43-29 N 24-51 W
COURSE AND SPEED	245 . 11.0 KNOTS
SEA STATE	9
WAVE HEIGHT	30 FEET
" REL DIR	2 STBD
SWELL HEIGHT	15 FEET
" REL DIR	25 STBD

---- VISUAL WEATHER / COMMENTS ----

CLDY RAIN SQUALLS /

MIDSHIP VERTICAL BENDING STRESS

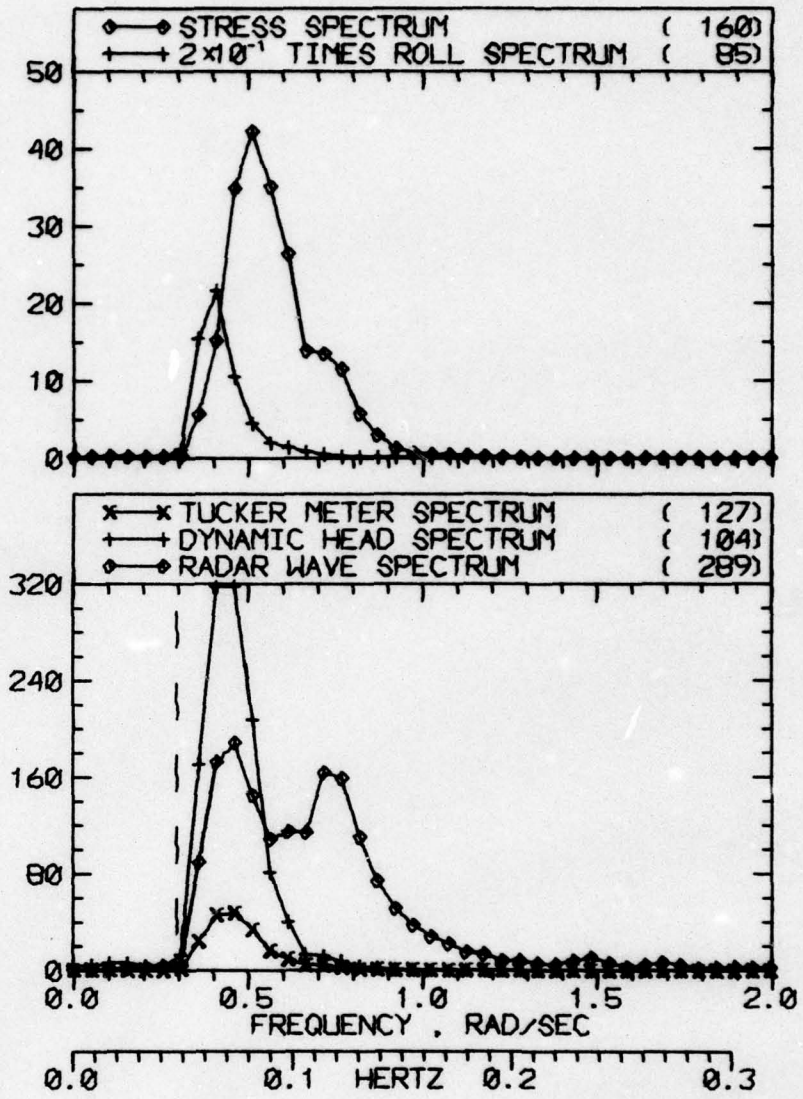
MAXIMUM PK-TR	20.0 KPSI
4.0 X RMS	13.3 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

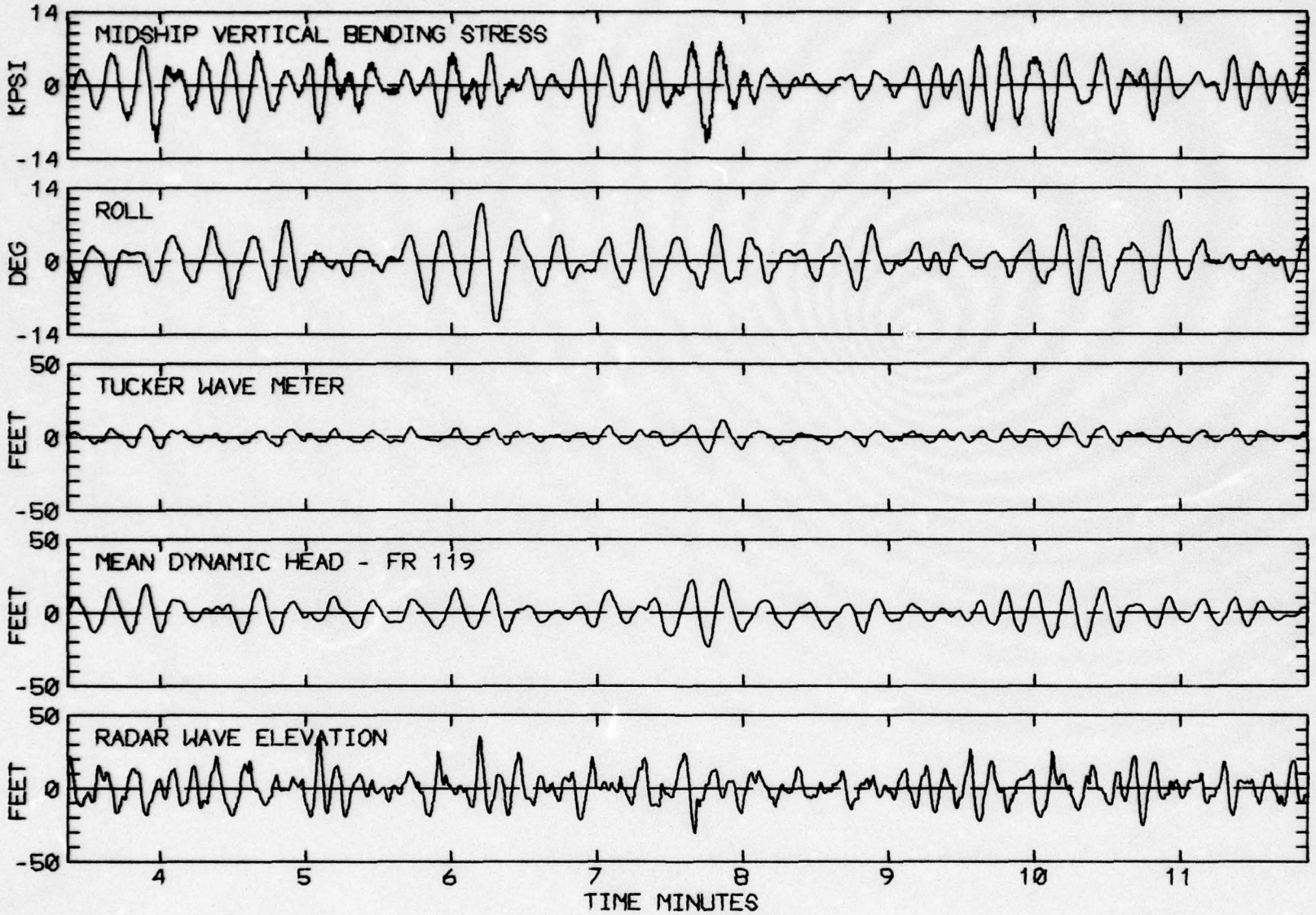
ROLL	15.7 DEG
PITCH	1.99 DEG
DK HSE VERT ACCEL	0.43 G
DK HSE LAT ACCEL	0.43 G
RADAR SLANT RANGE	58.3 FEET
VERTICAL RANGE	54.2 FEET
DISPL AT RADAR	43.0 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN. HEAD/RADAR		
P-T SAMPLE SIZE	82	72	121
MAXIMUM HEIGHT	19.2	45.3	54.7
10TH HIGHEST HTS	15.7	37.5	46.9
3RD HIGHEST HTS	12.5	30.3	36.9
4.0 RMS(SPECTRA)	13.0	31.6	37.7



RUN 361 -- VOYAGE 32W -- TAPE 143 -- INDEX 15 -- INTERVAL 60



RUN 361 -- VOYAGE 32W -- TAPE 143 -- INDEX 15 -- INTERVAL 60

LOG BOOK DATA

DATE AND TIME	01-10-74 2000
POSITION	43-29 N 24-51 W
COURSE AND SPEED	250 . 8.7 KNOTS
SEA STATE	9
WAVE HEIGHT	25 FEET
" REL DIR	20 STBD
SWELL HEIGHT	20 FEET
" REL DIR	20 STBD

---- VISUAL WEATHER / COMMENTS ----

OCAST RAIN /

MIDSHIP VERTICAL BENDING STRESS

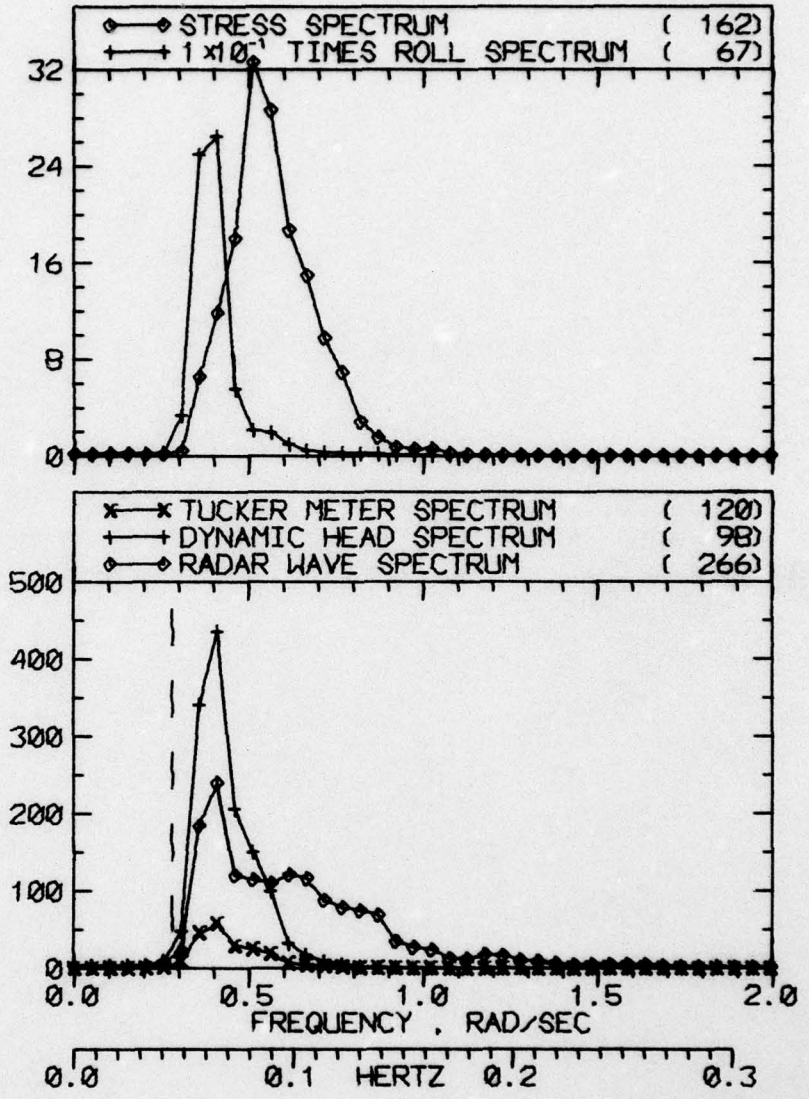
MAXIMUM PK-TR	19.4 KPSI
4.0 X RMS	11.4 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

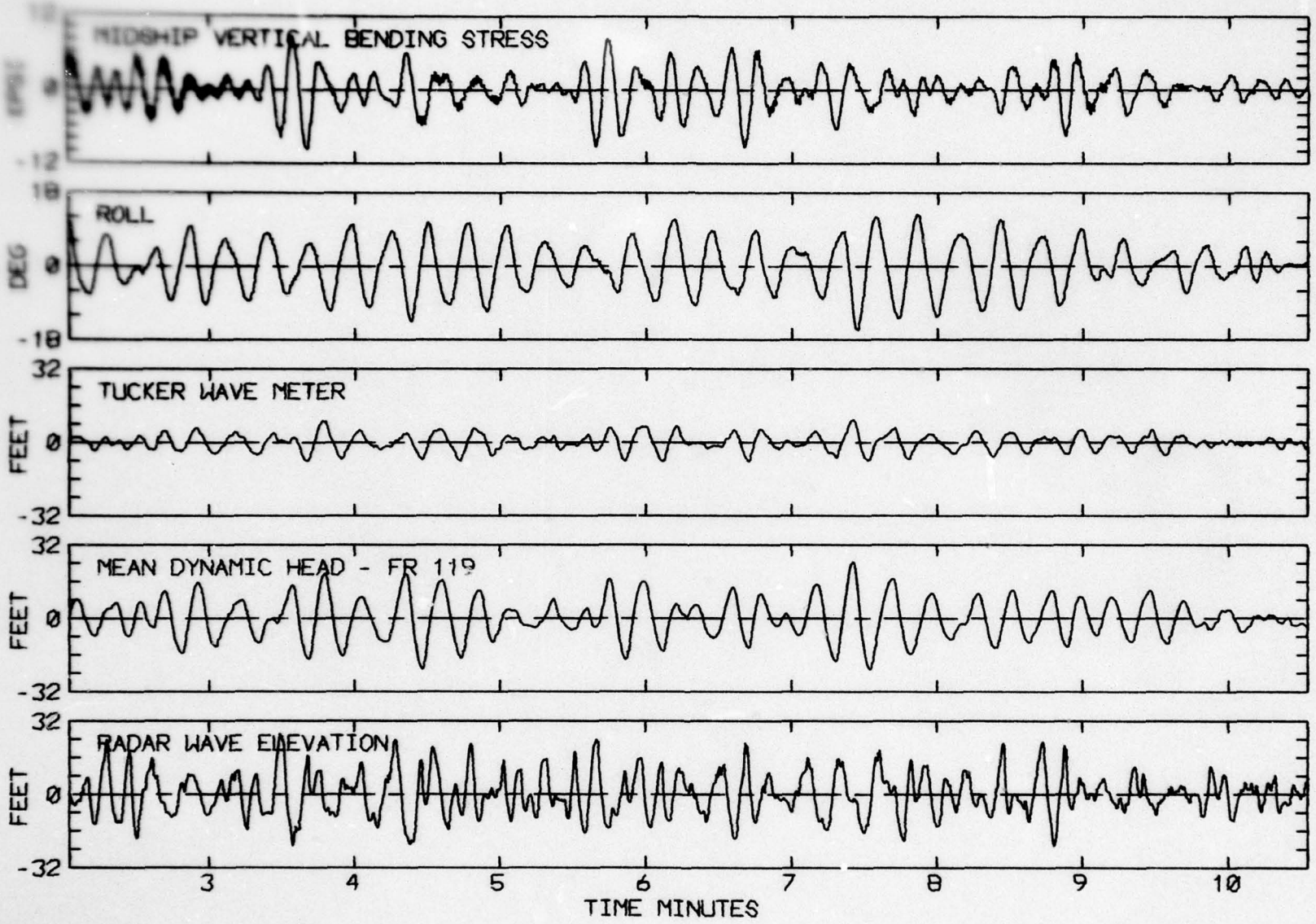
ROLL	23.6 DEG
PITCH	1.67 DEG
DK HSE VERT ACCEL	0.38 G
DK HSE LAT ACCEL	0.62 G
RADAR SLANT RANGE	60.1 FEET
VERTICAL RANGE	50.3 FEET
DISPL AT RADAR	42.8 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	95	70	125
MAXIMUM HEIGHT	17.6	46.8	49.1
10TH HIGHEST HTS	14.7	38.7	41.0
3RD HIGHEST HTS	12.0	31.8	33.4
4.0 RMS(SPECTRA)	13.2	33.5	36.0



RUN 401 -- VOYAGE 32W -- TAPE 145 -- INDEX 17 -- INTERVAL 1



RUN 401 -- VOYAGE 32W -- TAPE 145 -- INDEX 17 -- INTERVAL 1

LOG BOOK DATA

DATE AND TIME	01-10-74 2400
POSITION	43-29 N 24-51 W
COURSE AND SPEED	250 . 10.9 KNOTS
SEA STATE	7
WAVE HEIGHT	25 FEET
" REL DIR	2 PORT
SWELL HEIGHT	20 FEET
" REL DIR	2 PORT

---- VISUAL WEATHER / COMMENTS ----

OCAST /

MIDSHIP VERTICAL BENDING STRESS

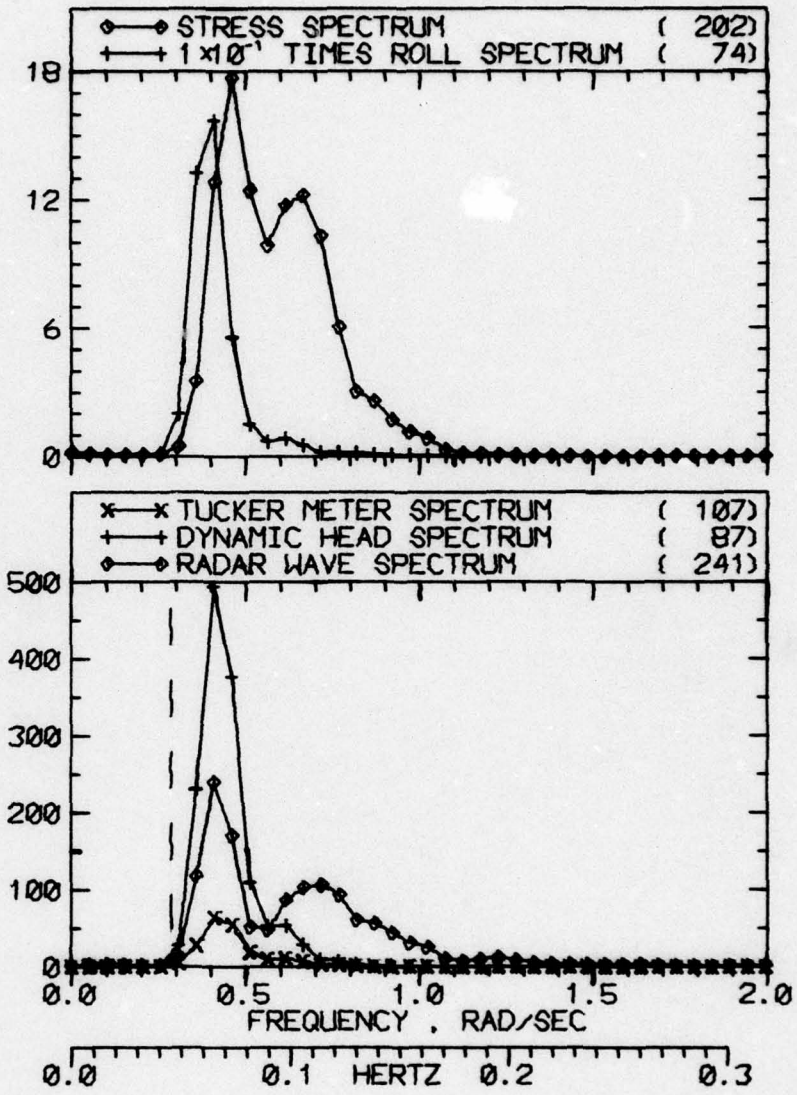
MAXIMUM PK-TR	16.0 KPSI
4.0 X RMS	9.5 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

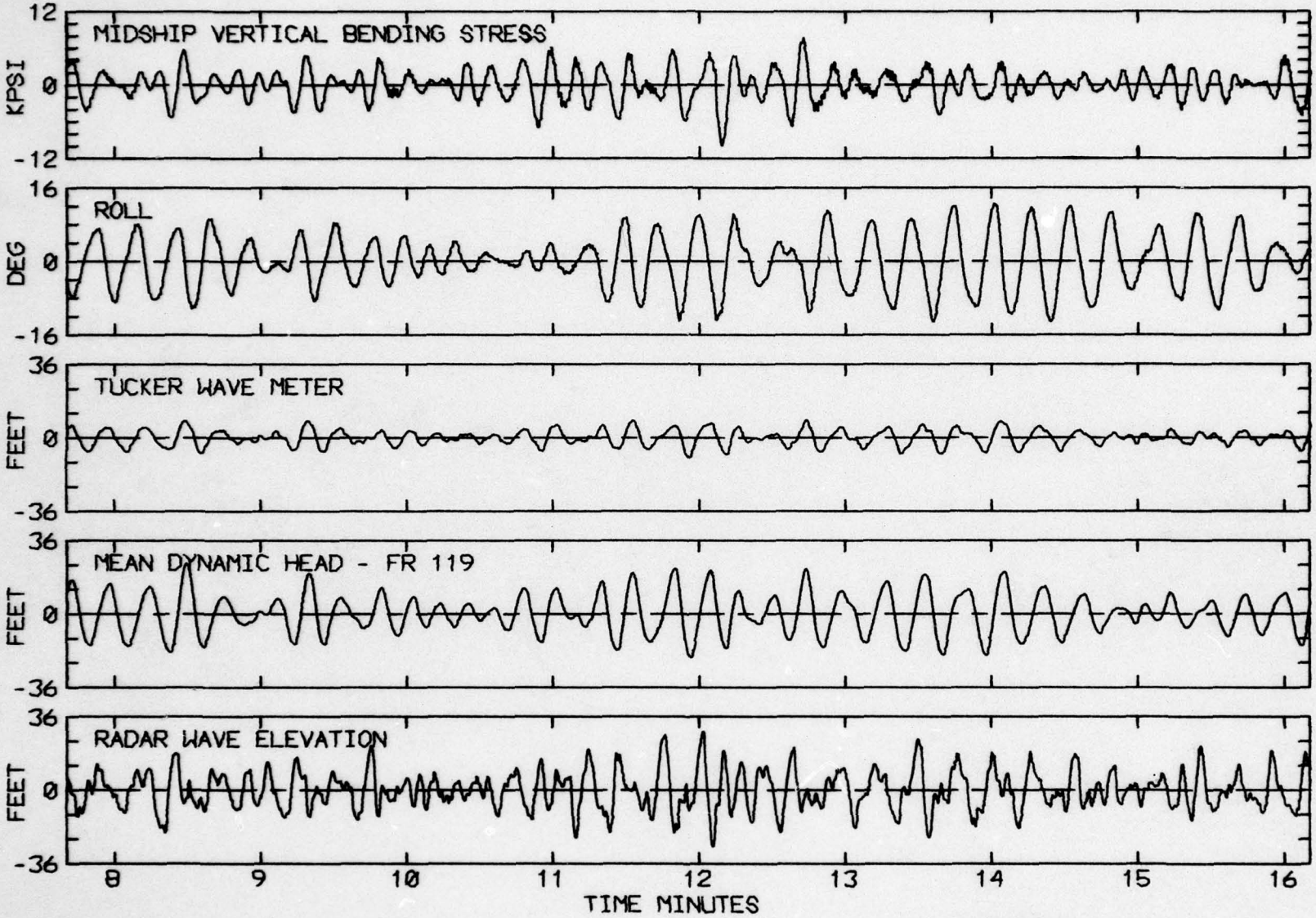
ROLL	18.4 DEG
PITCH	1.68 DEG
DK HSE VERT ACCEL	0.40 G
DK HSE LAT ACCEL	0.50 G
RADAR SLANT RANGE	51.2 FEET
VERTICAL RANGE	47.7 FEET
DISPL AT RADAR	43.4 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN. HEAD/RADAR		
P-T SAMPLE SIZE	90	70	121
MAXIMUM HEIGHT	15.9	43.4	57.2
10TH HIGHEST HTS	15.0	39.0	39.7
3RD HIGHEST HTS	13.0	33.8	32.5
4.0 RMS(SPECTRA)	13.3	34.0	33.5



RUN 405 -- VOYAGE 32W -- TAPE 145 -- INDEX 18 -- INTERVAL 5



RUN 405 -- VOYAGE 32W -- TAPE 145 -- INDEX 18 -- INTERVAL 5

LOG BOOK DATA

DATE AND TIME	01-11-74 0400
POSITION	43-29 N 24-51 W
COURSE AND SPEED	240 . 26.1 KNOTS
SEA STATE	12
WAVE HEIGHT	35 FEET
" REL DIR	37 PORT
SWELL HEIGHT	20 FEET
" REL DIR	37 PORT

---- VISUAL WEATHER / COMMENTS ----

OCAST /

MIDSHIP VERTICAL BENDING STRESS

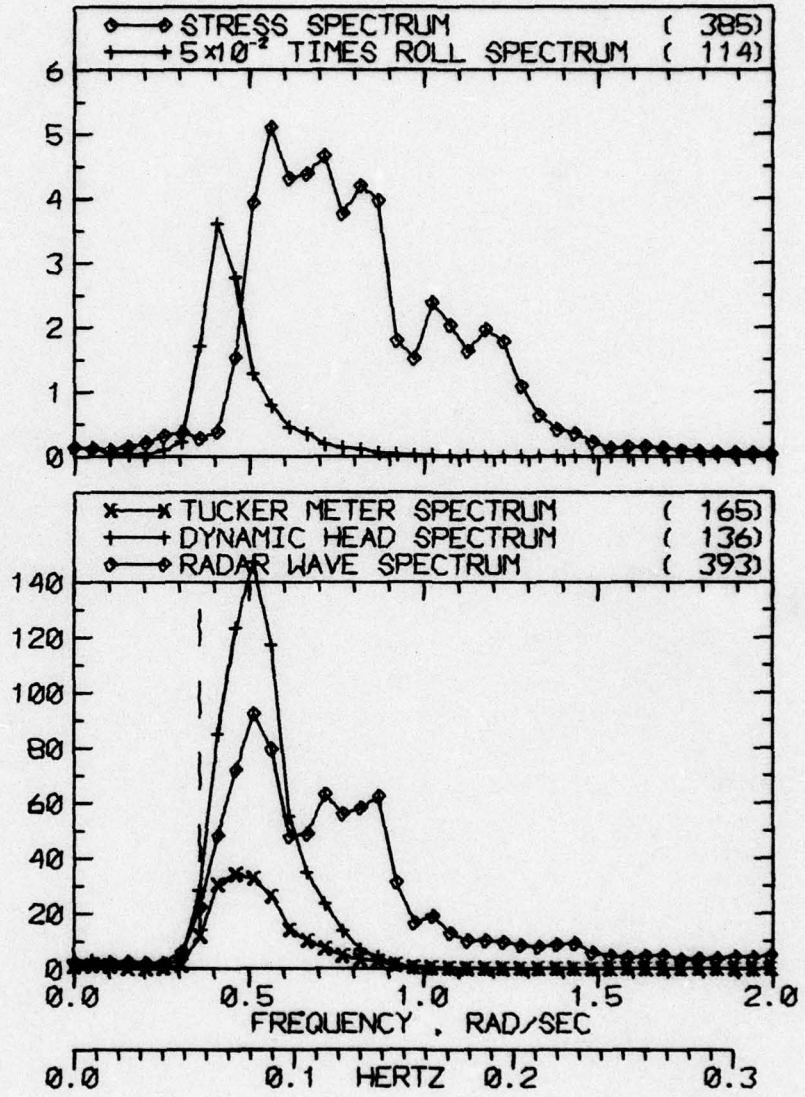
MAXIMUM PK-TR	13.7 KPSI
4.0 X RMS	6.9 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

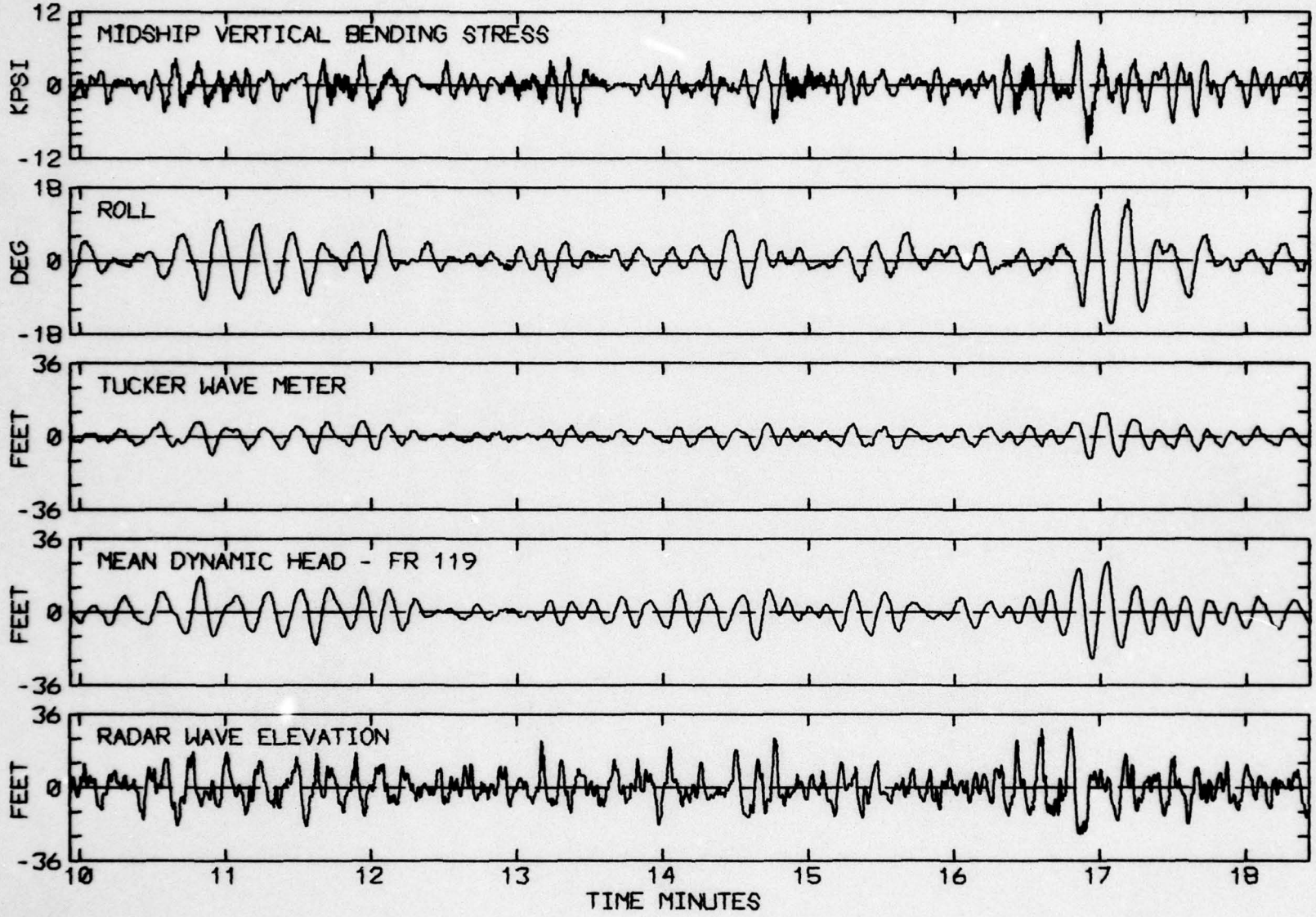
ROLL	14.2 DEG
PITCH	2.37 DEG
DK HSE VERT ACCEL	0.55 G
DK HSE LAT ACCEL	0.39 G
RADAR SLANT RANGE	51.2 FEET
VERTICAL RANGE	44.6 FEET
DISPL AT RADAR	38.7 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN. HEAD/RADAR		
P-T SAMPLE SIZE	119	102	200
MAXIMUM HEIGHT	21.4	44.3	52.8
10TH HIGHEST HTS	14.7	28.4	32.4
3RD HIGHEST HTS	11.1	21.7	24.0
4.0 RMS(SPECTRA)	12.5	23.2	27.7



RUN 409 -- VOYAGE 32W -- TAPE 145 -- INDEX 19 -- INTERVAL 9



RUN 409 -- VOYAGE 32W -- TAPE 145 -- INDEX 19 -- INTERVAL 9

LOG BOOK DATA

DATE AND TIME	01-11-74 0800
POSITION	43-29 N 24-51 W
COURSE AND SPEED	240 . 11.0 KNOTS
SEA STATE	11
WAVE HEIGHT	35 FEET
" REL DIR	15 PORT
SWELL HEIGHT	20 FEET
" REL DIR	30 STBD

---- VISUAL WEATHER / COMMENTS ----

OCAST RAIN /

MIDSHIP VERTICAL BENDING STRESS

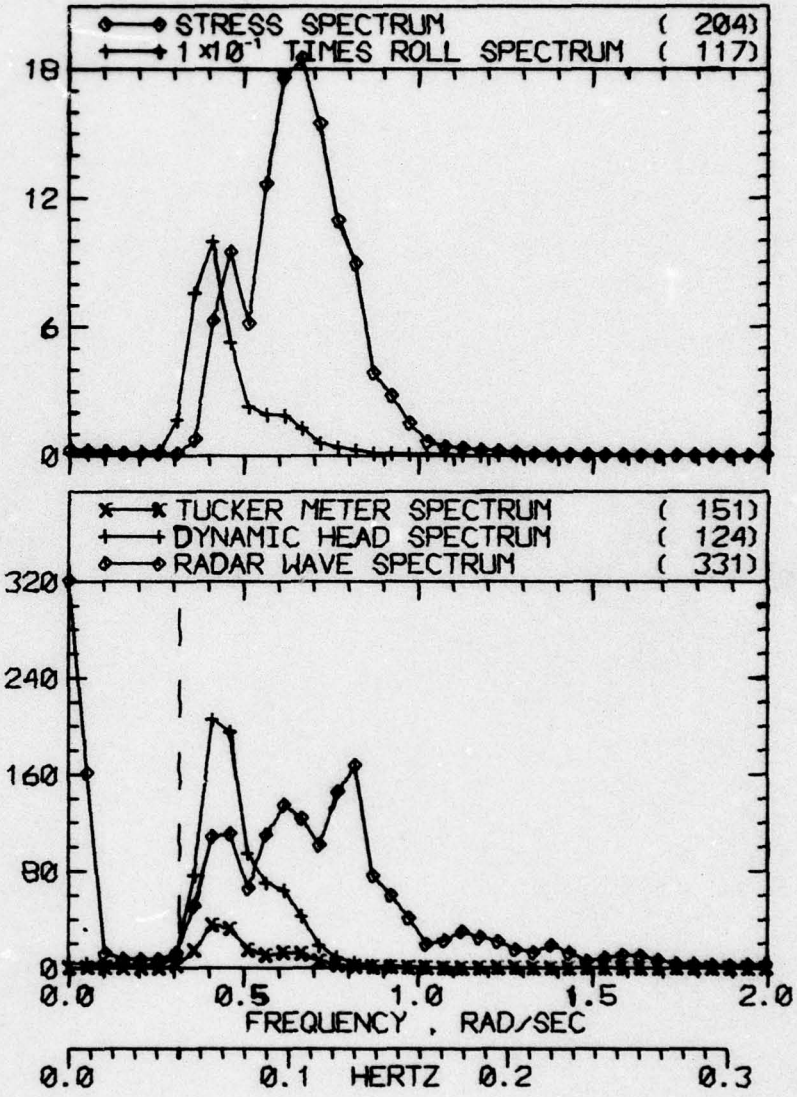
MAXIMUM PK-TR	19.2 KPSI
4.0 X RMS	10.0 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

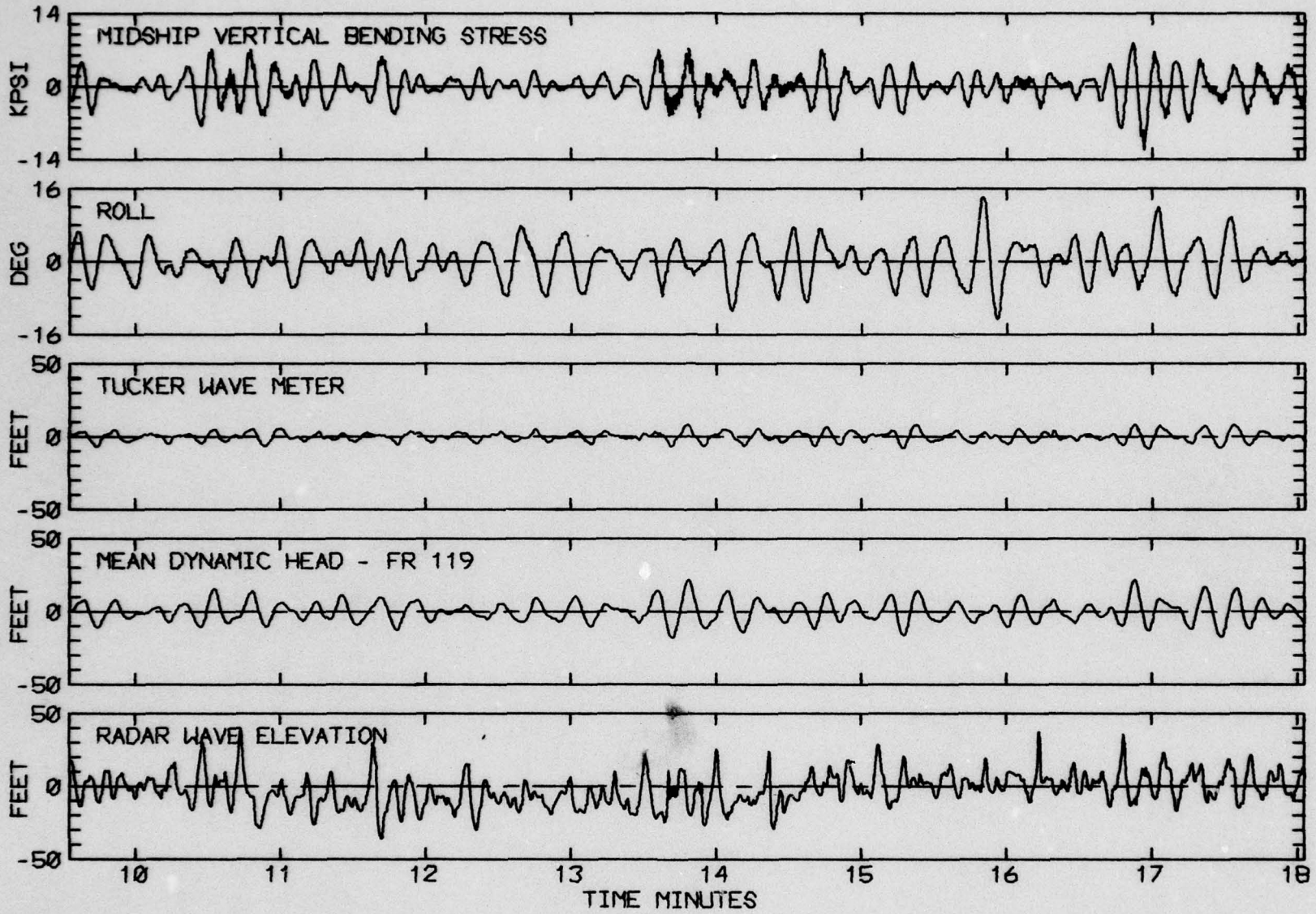
ROLL	16.8 DEG
PITCH	2.03 DEG
DK HSE VERT ACCEL	0.48 G
DK HSE LAT ACCEL	0.47 G
RADAR SLANT RANGE	61.8 FEET
VERTICAL RANGE	56.5 FEET
DISPL AT RADAR	39.5 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN. HEAD/RADAR		
P-T SAMPLE SIZE	107	75	121
MAXIMUM HEIGHT	16.2	35.0	68.7
10TH HIGHEST HTS	12.7	31.4	52.0
3RD HIGHEST HTS	10.4	25.2	38.6
4.0 RMS(SPECTRA)	11.4	25.8	40.0



RUN 413 -- VOYAGE 32W -- TAPE 145 -- INDEX 20 -- INTERVAL 13



RUN 413 -- VOYAGE 32W -- TAPE 145 -- INDEX 20 -- INTERVAL 13

LOG BOOK DATA

DATE AND TIME	01-11-74 1600
POSITION	41-31 N 29-25 W
COURSE AND SPEED	270 . 12.4 KNOTS
SEA STATE	11
WAVE HEIGHT	30 FEET
" REL DIR	45 STBD
SWELL HEIGHT	25 FEET
" REL DIR	45 STBD

---- VISUAL WEATHER / COMMENTS ----

PT CLDY /

MIDSHIP VERTICAL BENDING STRESS

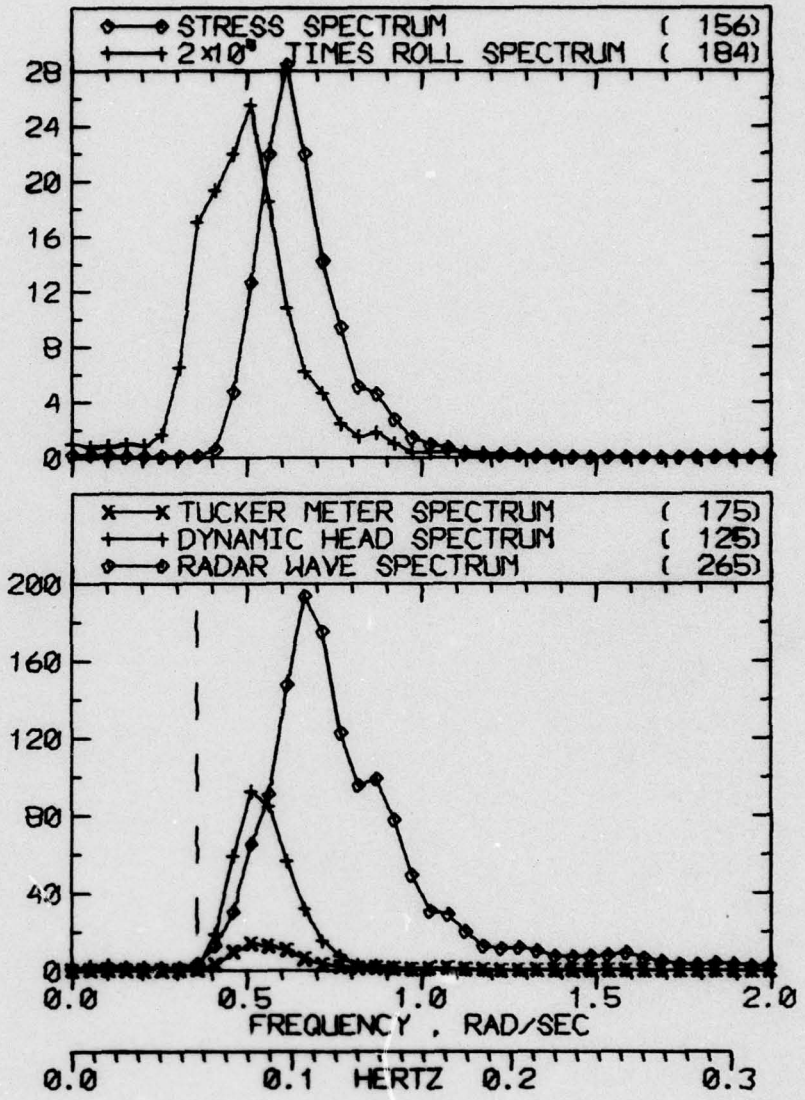
MAXIMUM PK-TR	17.5 KPSI
4.0 X RMS	10.5 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

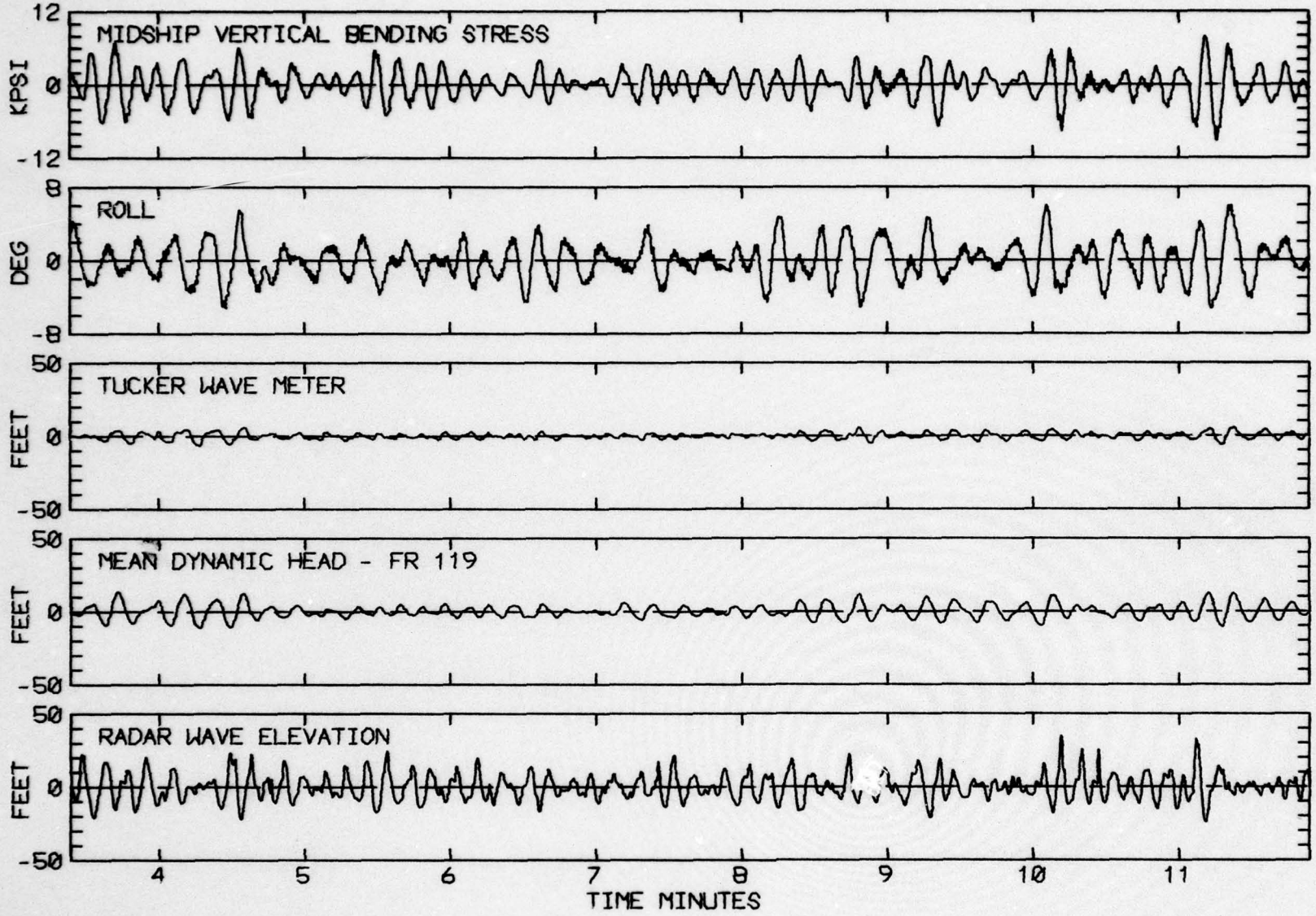
ROLL	7.8 DEG
PITCH	1.88 DEG
DK HSE VERT ACCEL	0.43 G
DK HSE LAT ACCEL	0.21 G
RADAR SLANT RANGE	53.0 FEET
VERTICAL RANGE	54.0 FEET
DISPL AT RADAR	33.4 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	148	93	149
MAXIMUM HEIGHT	11.0	22.8	57.4
10TH HIGHEST HTS	8.8	20.0	42.4
3RD HIGHEST HTS	7.1	17.3	34.4
4.0 RMS(SPECTRA)	7.8	17.9	33.9



RUN 421 -- VOYAGE 32W -- TAPE 145 -- INDEX 22 -- INTERVAL 21



RUN 421 -- VOYAGE 32W -- TAPE 145 -- INDEX 22 -- INTERVAL 21

LOG BOOK DATA

DATE AND TIME	01-11-74 2000
POSITION	41-31 N 29-25 W
COURSE AND SPEED	270 . 16.2 KNOTS
SEA STATE	10
WAVE HEIGHT	20 FEET
" REL DIR	45 STBD
SWELL HEIGHT	25 FEET
" REL DIR	45 STBD

---- VISUAL WEATHER / COMMENTS ----

OCAST /

MIDSHIP VERTICAL BENDING STRESS

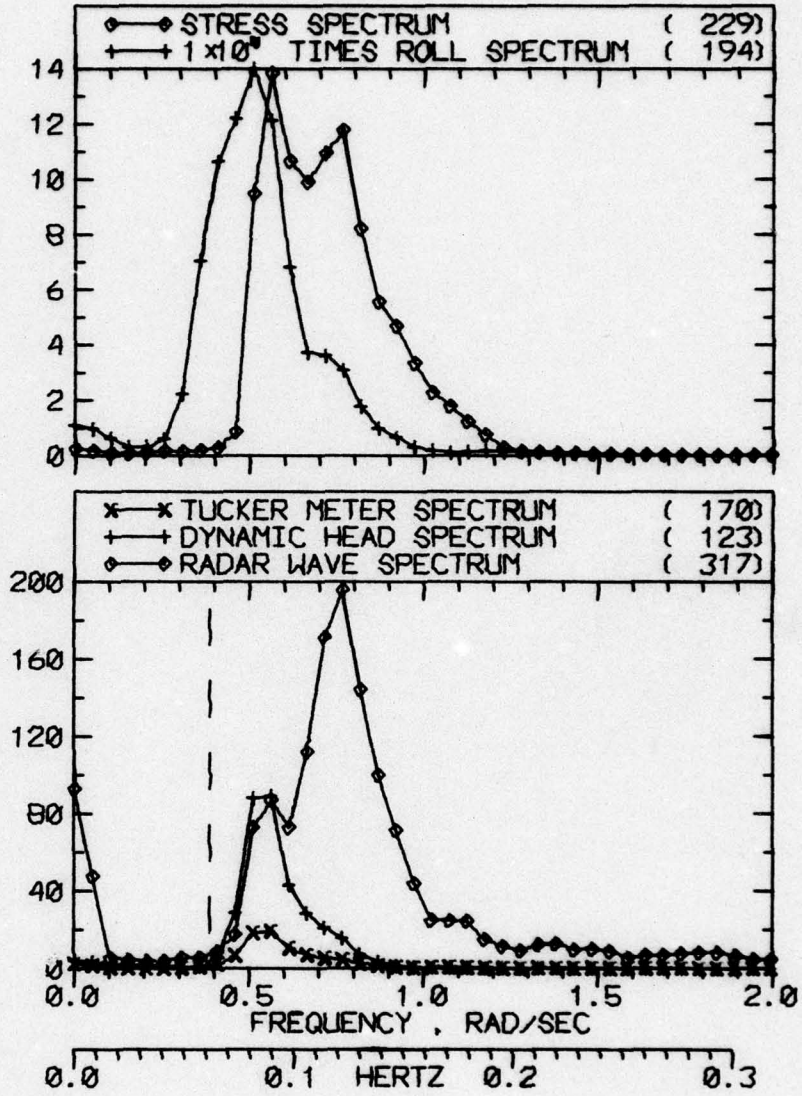
MAXIMUM PK-TR	16.4 KPSI
4.0 X RMS	9.1 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

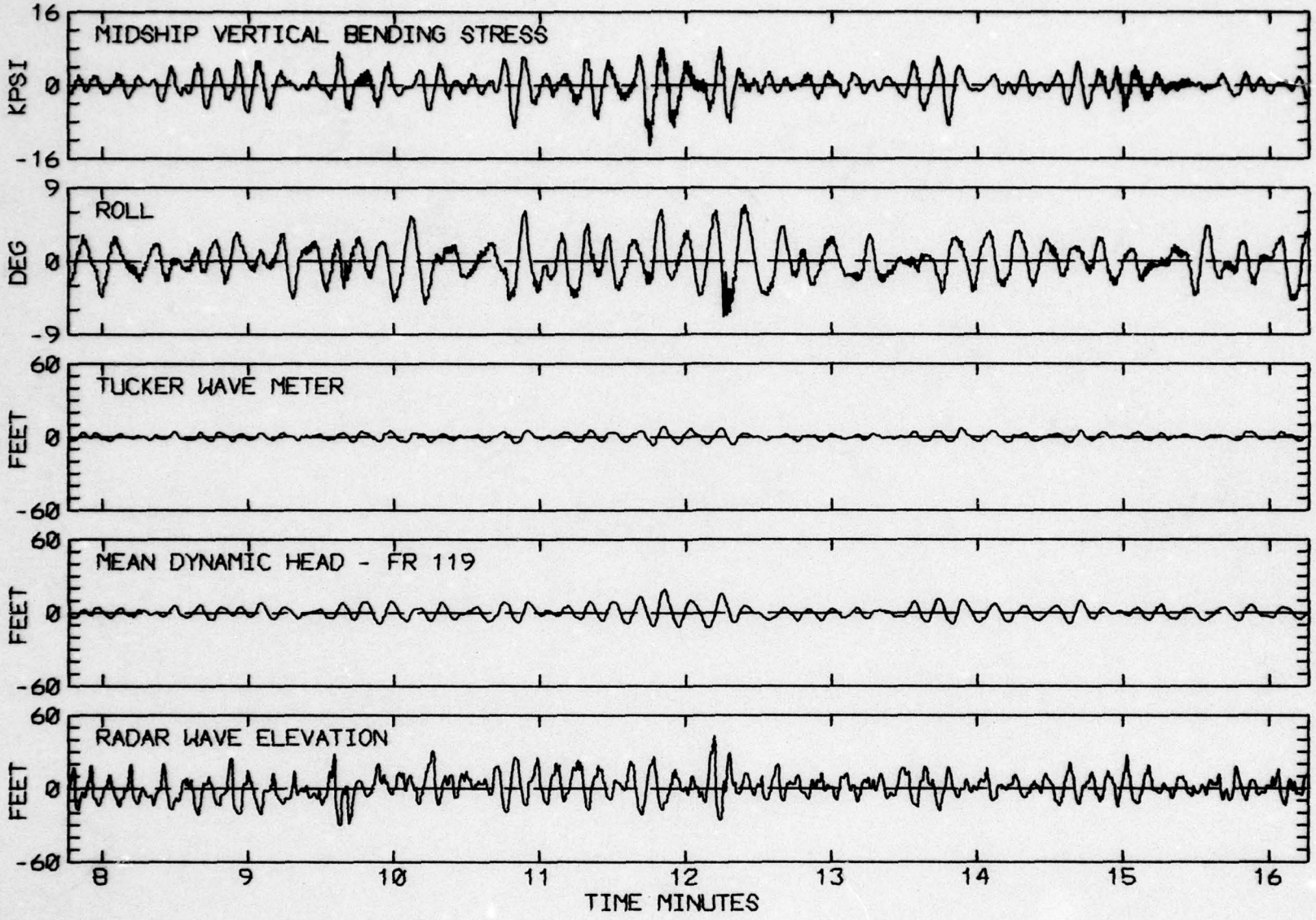
ROLL	8.4 DEG
PITCH	2.25 DEG
DK HSE VERT ACCEL	0.52 G
DK HSE LAT ACCEL	0.23 G
RADAR SLANT RANGE	59.5 FEET
VERTICAL RANGE	55.4 FEET
DEPL AT RADAR	33.4 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	154	102	160
MAXIMUM HEIGHT	13.4	29.8	69.6
10TH HIGHEST HTS	10.1	21.1	45.8
3RD HIGHEST HTS	7.7	16.3	35.0
4.0 RMS(SPECTRA)	8.7	16.9	35.4



RUN 425 -- VOYAGE 32W -- TAPE 145 -- INDEX 23 -- INTERVAL 25



RUN 425 -- VOYAGE 32W -- TAPE 145 -- INDEX 23 -- INTERVAL 25

LOG BOOK DATA

DATE AND TIME	01-11-74 2400
POSITION	41-31 N 29-25 W
COURSE AND SPEED	270 . 18.7 KNOTS
SEA STATE	10
WAVE HEIGHT	20 FEET
" REL DIR	0
SWELL HEIGHT	25 FEET
" REL DIR	0

---- VISUAL WEATHER / COMMENTS ----

OCAST RAIN SQUALLS /

MIDSHIP VERTICAL BENDING STRESS

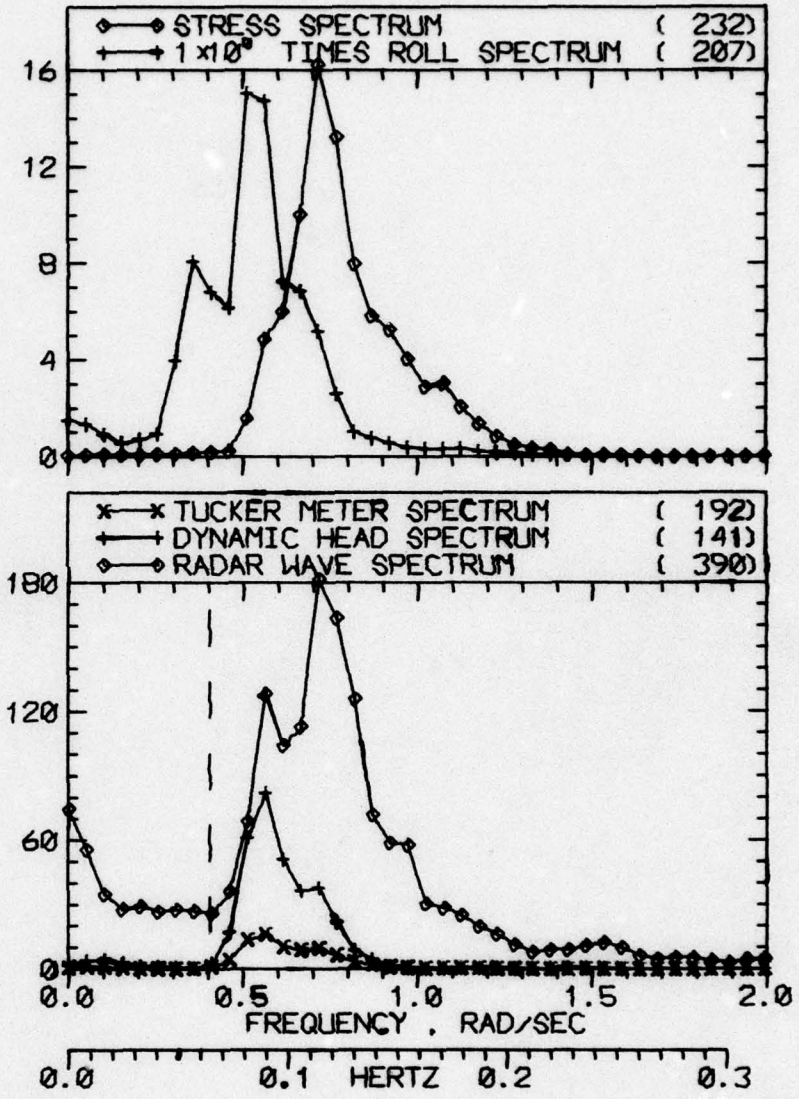
MAXIMUM PK-TR	14.4 KPSI
4.0 X RMS	8.8 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

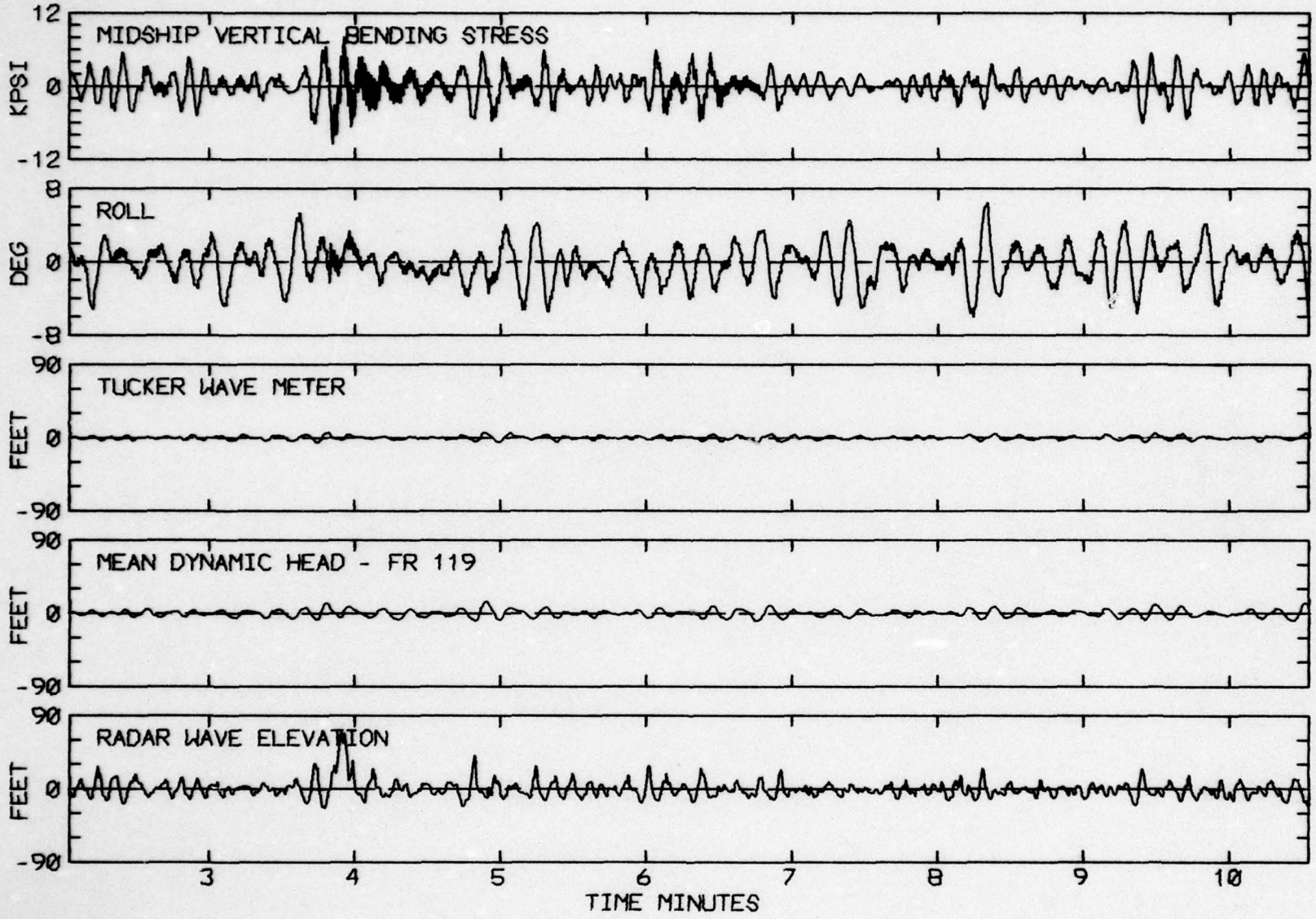
ROLL	8.5 DEG
PITCH	2.57 DEG
DK HSE VERT ACCEL	0.60 G
DK HSE LAT ACCEL	0.25 G
RADAR SLANT RANGE	61.2 FEET
VERTICAL RANGE	57.9 FEET
DISPL AT RADAR	36.6 FEET

WAVE HEIGHT STATISTICS (FEET)

		TUCKER/DYN. HEAD/RADAR	
P-T SAMPLE SIZE	154	105	160
MAXIMUM HEIGHT	11.5	21.9	85.9
10TH HIGHEST HTS	9.1	18.3	47.3
3RD HIGHEST HTS	7.6	15.5	35.4
4.0 RMS(SPECTRA)	8.5	16.8	37.3



RUN 429 -- VOYAGE 32W -- TAPE 145 -- INDEX 24 -- INTERVAL 29



RUN 429 -- VOYAGE 32W -- TAPE 145 -- INDEX 24 -- INTERVAL 29

LOG BOOK DATA

DATE AND TIME	01-12-74 0800
POSITION	41-31 N 29-25 W
COURSE AND SPEED	271 . 28.4 KNOTS
SEA STATE	9
WAVE HEIGHT	15 FEET
" REL DIR	91 PORT
SWELL HEIGHT	20 FEET
" REL DIR	91 PORT

---- VISUAL WEATHER / COMMENTS ----

OCAST /

MIDSHIP VERTICAL BENDING STRESS

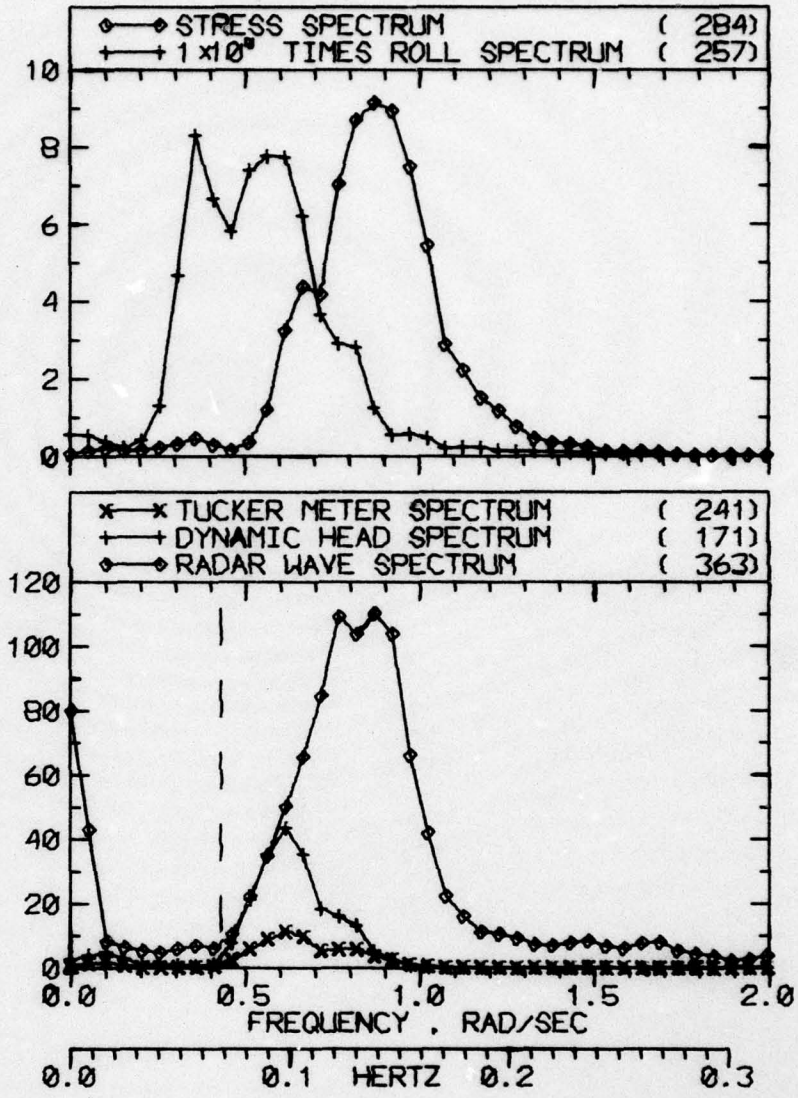
MAXIMUM PK-TR	15.4 KPSI
4.0 X RMS	8.1 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

ROLL	7.7 DEG
PITCH	2.60 DEG
DK HSE VERT ACCEL	0.60 G
DK HSE LAT ACCEL	0.22 G
RADAR SLANT RANGE	54.1 FEET
VERTICAL RANGE	50.5 FEET
DISPL AT RADAR	31.9 FEET

WAVE HEIGHT STATISTICS (FEET)

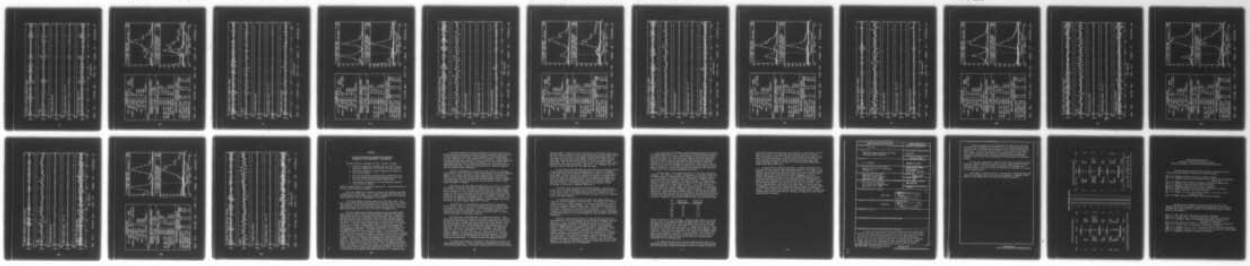
	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	171	117	191
MAXIMUM HEIGHT	14.1	22.8	56.7
10TH HIGHEST HTS	9.5	17.0	38.2
3RD HIGHEST HTS	6.8	13.0	27.8
4.0 RMS(SPECTRA)	7.9	13.5	30.9

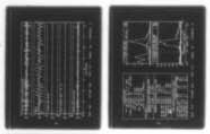


RUN 437 -- VOYAGE 32W -- TAPE 145 -- INDEX 26 -- INTERVAL 37

AD-A057 154 STEVENS INST OF TECH HOBOKEN N J DAVIDSON LAB F/G 8/3
RADAR AND TUCKER WAVEMETER DATA FROM SEA-LAND MCLEAN VOYAGE 32.(U)
AUG 78 J F DALZELL N00024-74-C-5451
UNCLASSIFIED SIT-DL-77-1931 SSC-SL-7-16 NL

2 OF 2
AD A057154





END
DATE FILMED
9-78
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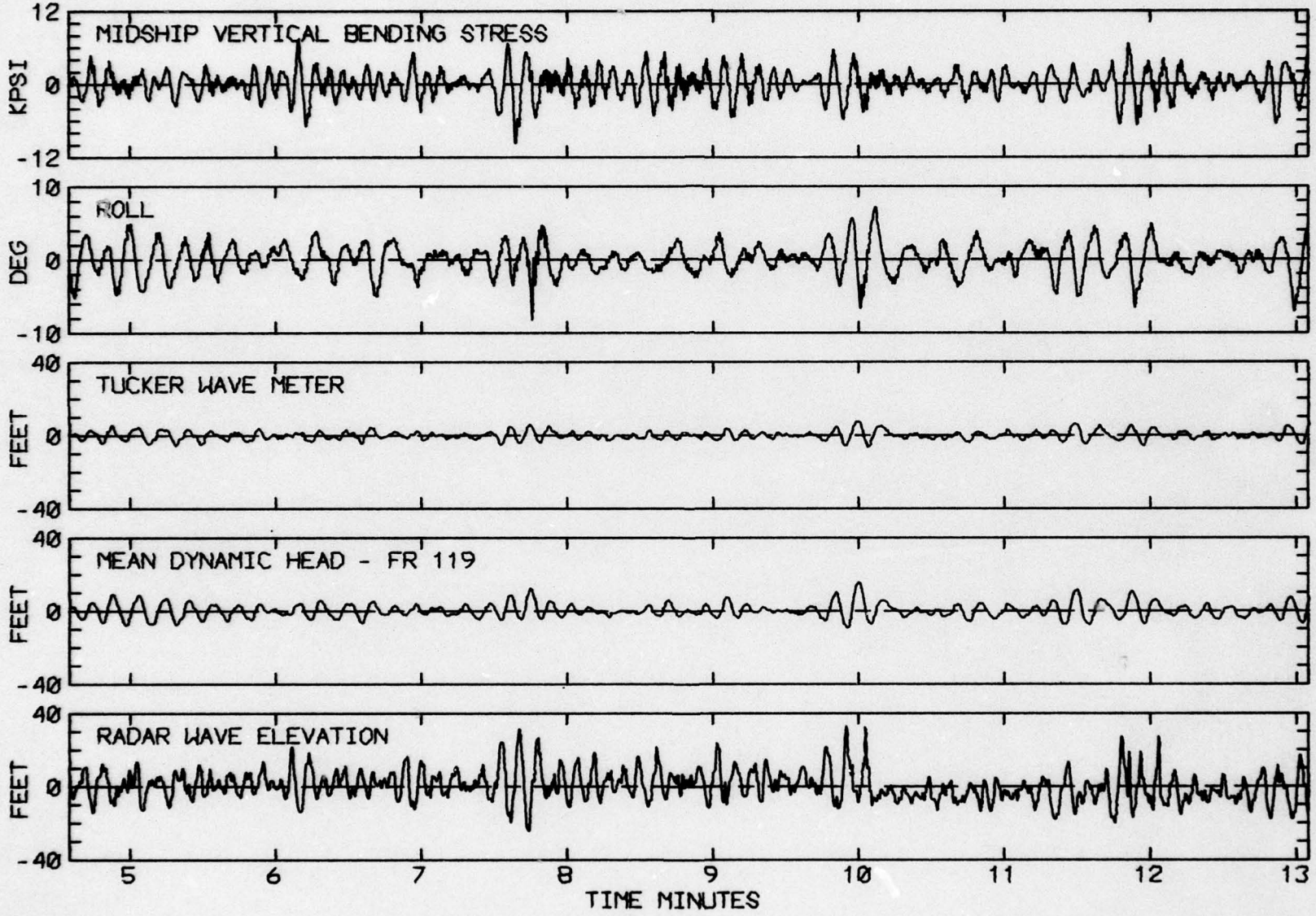


RUN 437 -- VOYAGE 32W -- TAPE 145 -- INDEX 26 -- INTERVAL 37

LOG BOOK DATA

DATE AND TIME	01-12-74 1200
POSITION	41-07 N 40-08 W
COURSE AND SPEED	245 . 32.5 KNOTS
SEA STATE	10
WAVE HEIGHT	25 FEET
" REL DIR	2 STBD
SWELL HEIGHT	20 FEET
" REL DIR	2 STBD

---- VISUAL WEATHER / COMMENTS ----

OCAST /

MIDSHIP VERTICAL BENDING STRESS

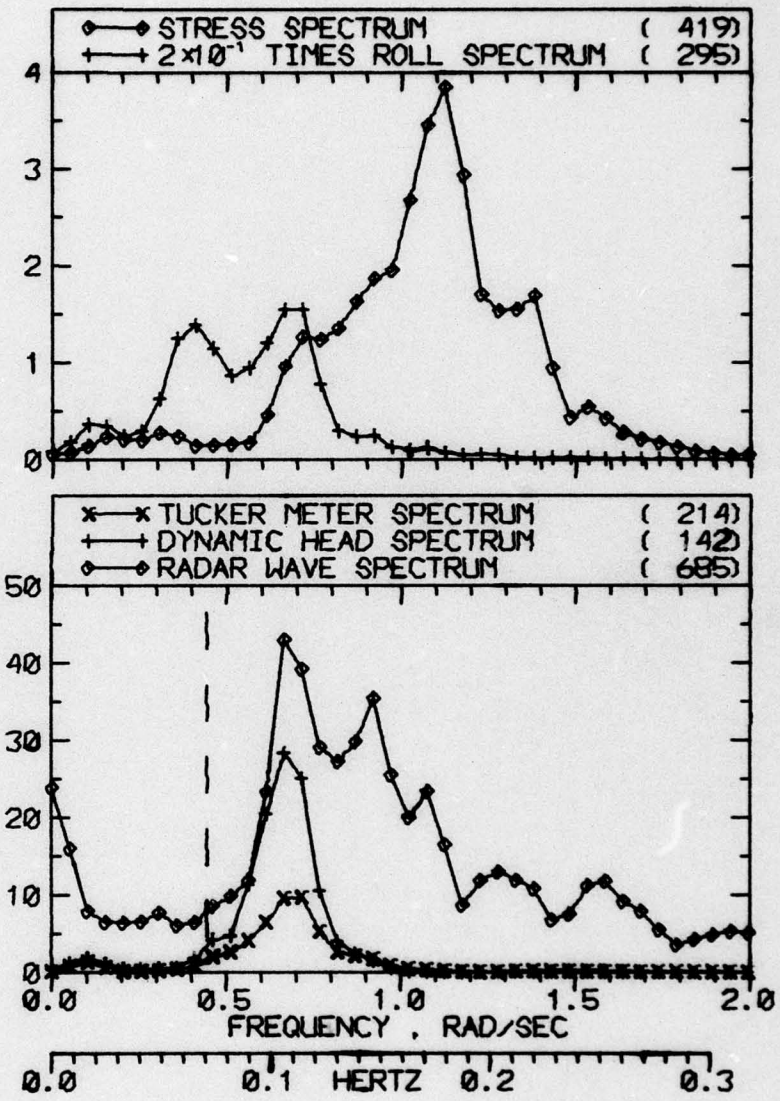
MAXIMUM PK-TR	6.6 KPSI
4.0 X RMS	5.6 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

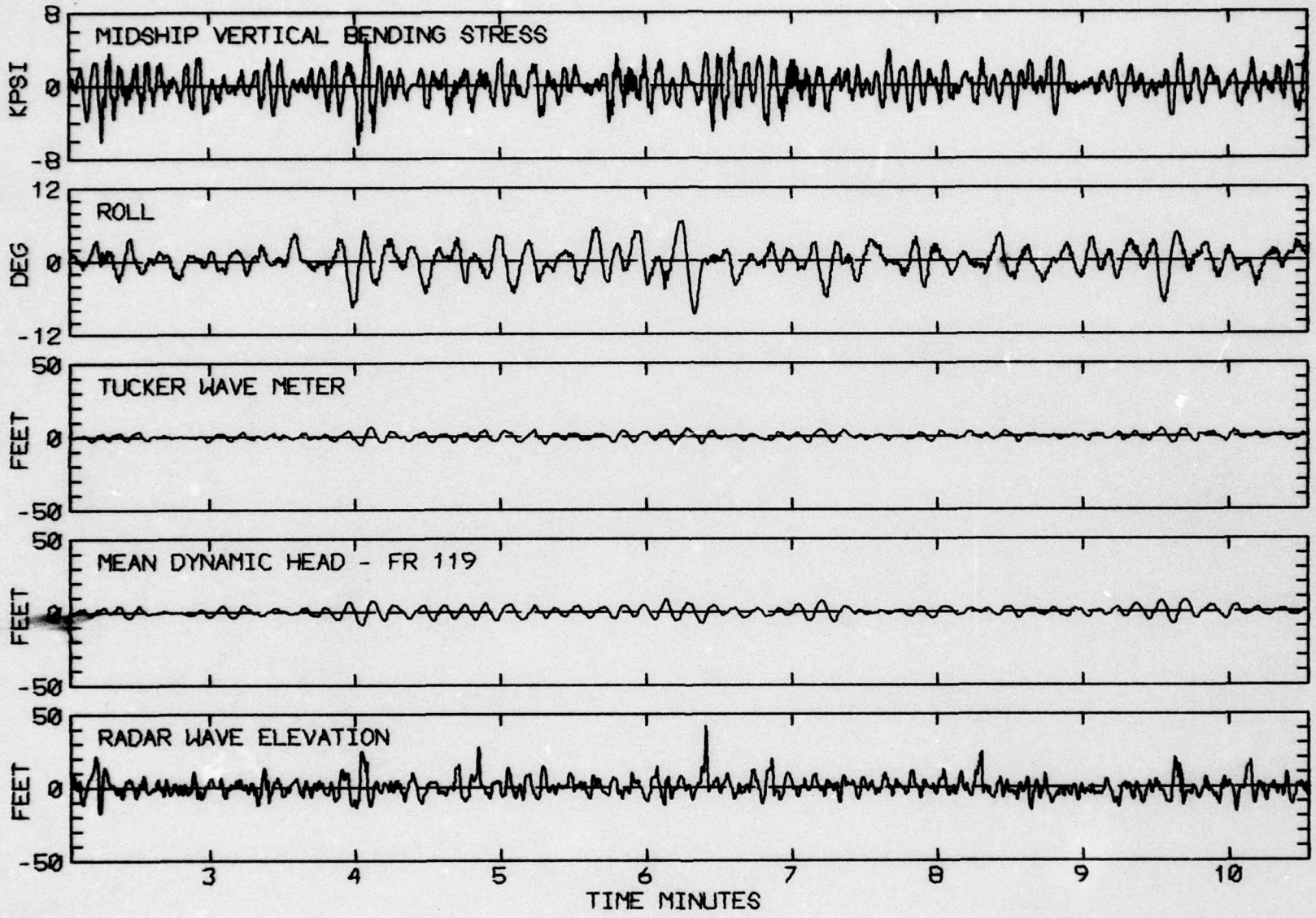
ROLL	7.7 DEG
PITCH	1.96 DEG
DK HSE VERT ACCEL	0.44 G
DK HSE LAT ACCEL	0.22 G
RADAR SLANT RANGE	38.3 FEET
VERTICAL RANGE	34.2 FEET
DISPL AT RADAR	22.3 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN. HEAD/RADAR		
P-T SAMPLE SIZE	200	140	270
MAXIMUM HEIGHT	10.1	15.8	44.9
10TH HIGHEST HTS	8.0	12.2	27.1
3RD HIGHEST HTS	5.8	9.4	19.3
4.0 RMS(SPECTRA)	6.8	10.1	23.0



RUN 441 -- VOYAGE 32W -- TAPE 145 -- INDEX 27 -- INTERVAL 41



RUN 441 -- VOYAGE 32W -- TAPE 145 -- INDEX 27 -- INTERVAL 41

LOG BOOK DATA

DATE AND TIME	01-12-74 1630
POSITION	41-07 N 40-08 W
COURSE AND SPEED	245 . 28.1 KNOTS
SEA STATE	9
WAVE HEIGHT	25 FEET
" REL DIR	2 STBD
SWELL HEIGHT	20 FEET
" REL DIR	2 STBD

---- VISUAL WEATHER / COMMENTS ----

OCAST /

MIDSHIP VERTICAL BENDING STRESS

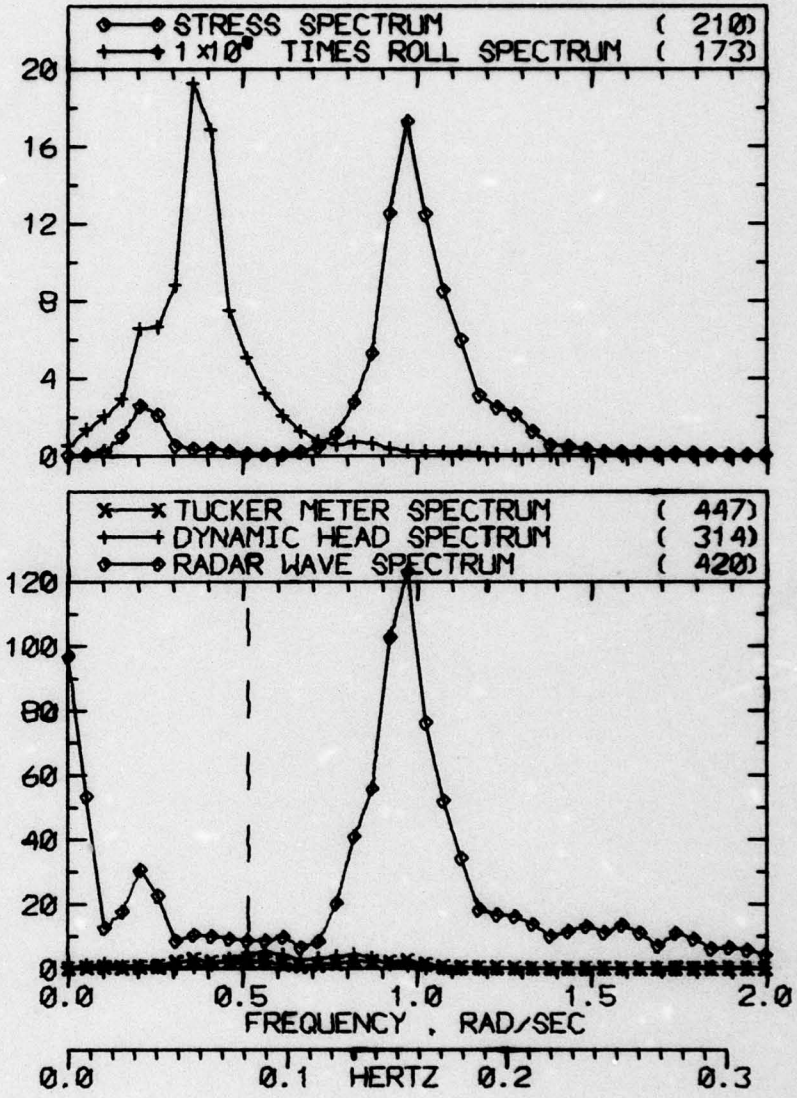
MAXIMUM PK-TR	11.3 KPSI
4.0 X RMS	8.7 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

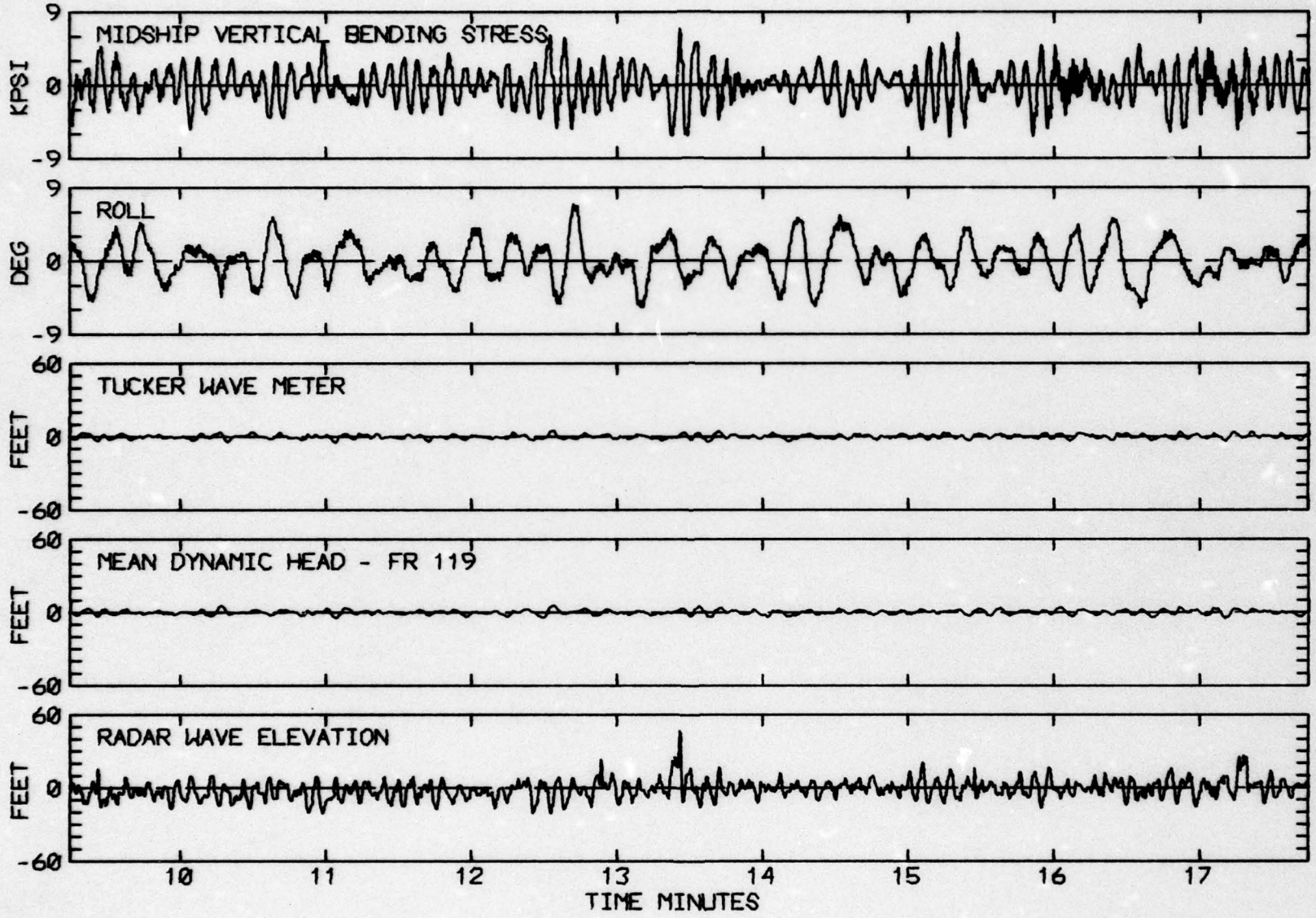
ROLL	8.6 DEG
PITCH	2.36 DEG
DK HSE VERT ACCEL	0.51 G
DK HSE LAT ACCEL	0.22 G
RADAR SLANT RANGE	46.6 FEET
VERTICAL RANGE	43.5 FEET
DISPL AT RADAR	21.1 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	209	179	222
MAXIMUM HEIGHT	8.3	8.9	58.0
10TH HIGHEST HTS	5.9	7.0	33.7
3RD HIGHEST HTS	4.6	5.4	26.4
4.0 RMS(SPECTRA)	5.5	6.3	29.4



RUN 450 -- VOYAGE 32W -- TAPE 145 -- INDEX 29 -- INTERVAL 50



RUN 450 -- VOYAGE 32W -- TAPE 145 -- INDEX 29 -- INTERVAL 50

LOG BOOK DATA

DATE AND TIME	01-12-74 2000
POSITION	41-07 N 40-08 W
COURSE AND SPEED	269 . 32.5 KNOTS
SEA STATE	9
WAVE HEIGHT	15 FEET
" REL DIR	44 PORT
SWELL HEIGHT	20 FEET
" REL DIR	44 PORT

---- VISUAL WEATHER / COMMENTS ----

OCAST /IN AUTO OPERATION

MIDSHIP VERTICAL BENDING STRESS

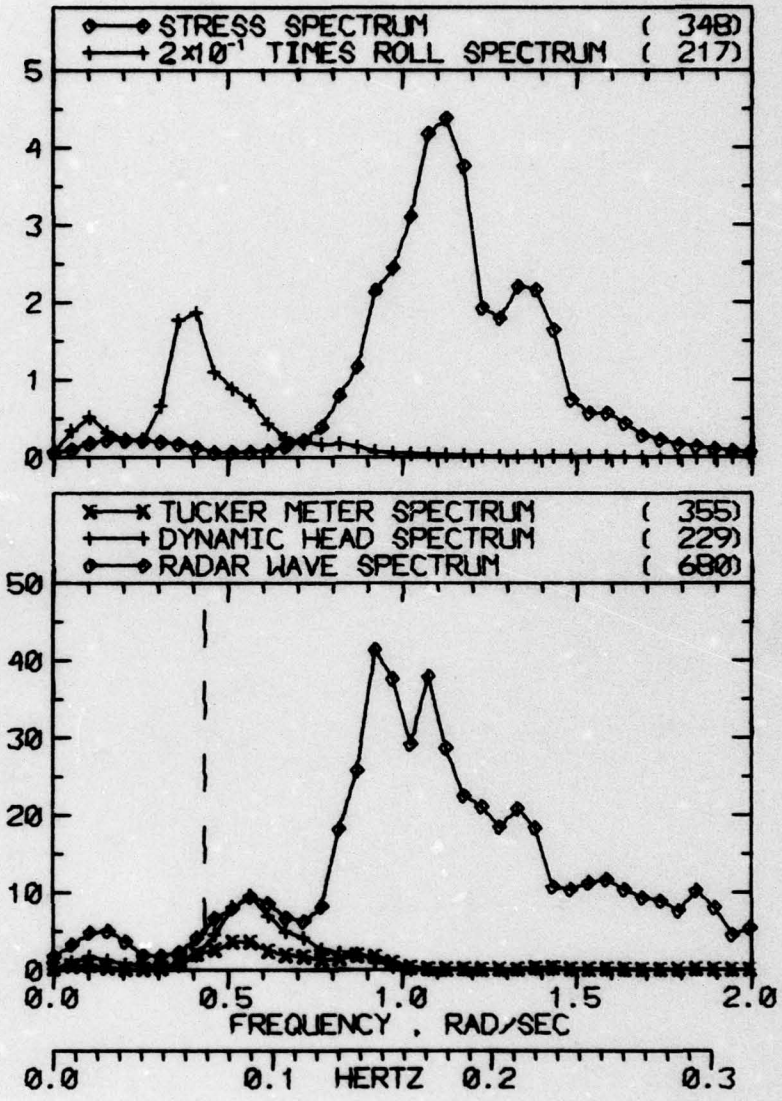
MAXIMUM PK-TR	7.6 KPSI
4.0 X RMS	5.8 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

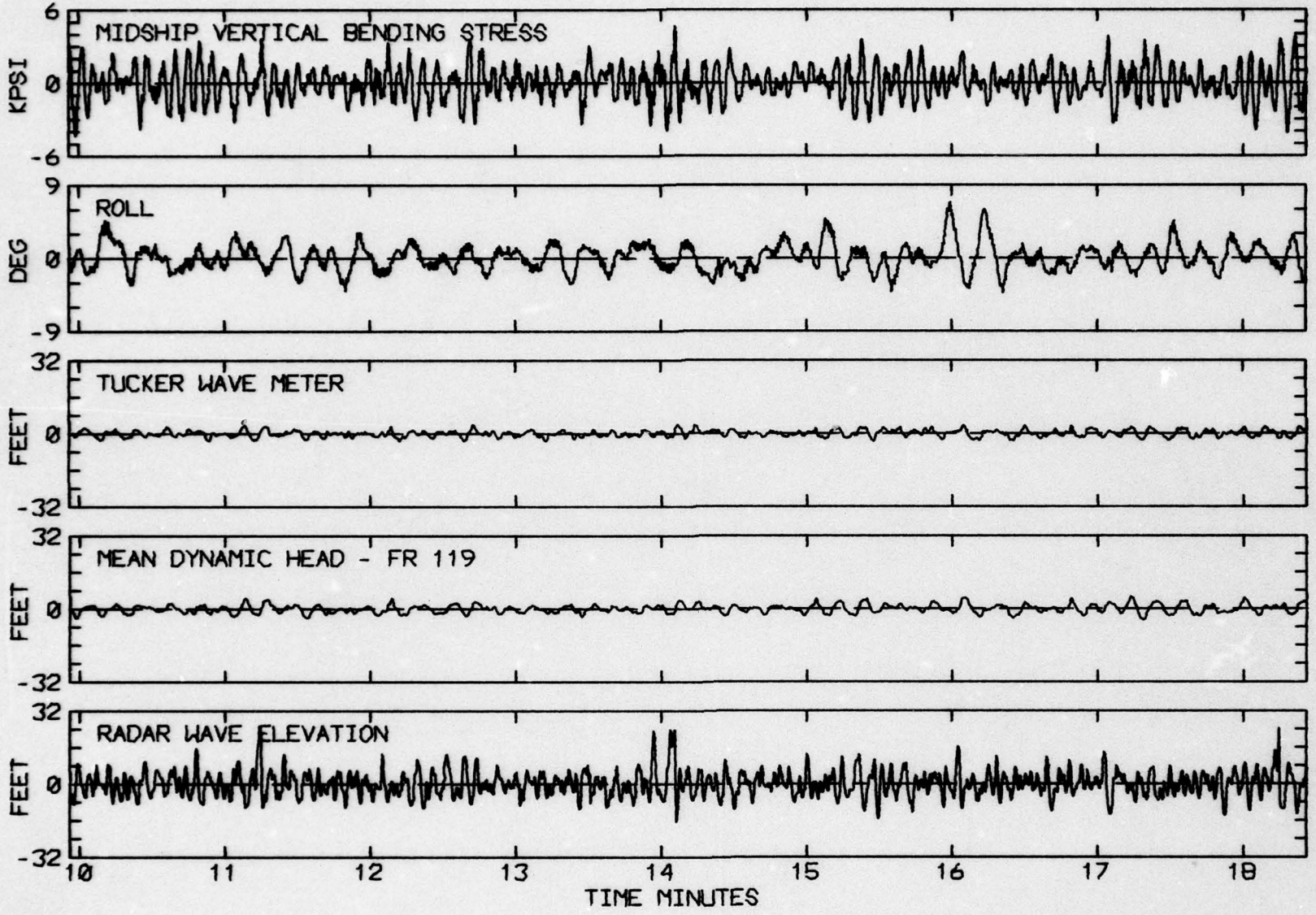
ROLL	6.6 DEG
PITCH	1.76 DEG
DK HSE VERT ACCEL	0.38 G
DK HSE LAT ACCEL	0.18 G
RADAR SLANT RANGE	34.4 FEET
VERTICAL RANGE	31.3 FEET
DISPL AT RADAR	16.2 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN. HEAD/RADAR		
P-T SAMPLE SIZE	228	164	280
MAXIMUM HEIGHT	6.6	10.0	41.5
10TH HIGHEST HTS	5.6	7.8	25.9
3RD HIGHEST HTS	4.1	5.8	19.5
4.0 RMS(SPECTRA)	5.3	6.9	22.5



RUN 453 -- VOYAGE 32W -- TAPE 145 -- INDEX 30 -- INTERVAL 53



RUN 453 -- VOYAGE 32W -- TAPE 145 -- INDEX 30 -- INTERVAL 53

LOG BOOK DATA

DATE AND TIME	01-13-74 0400
POSITION	41-07 N 40-08 W
COURSE AND SPEED	272 . 29.6 KNOTS
SEA STATE	7
WAVE HEIGHT	15 FEET
" REL DIR	47 PORT
SWELL HEIGHT	12 FEET
" REL DIR	2 PORT

---- VISUAL WEATHER / COMMENTS ----

OCAST /

MIDSHIP VERTICAL BENDING STRESS

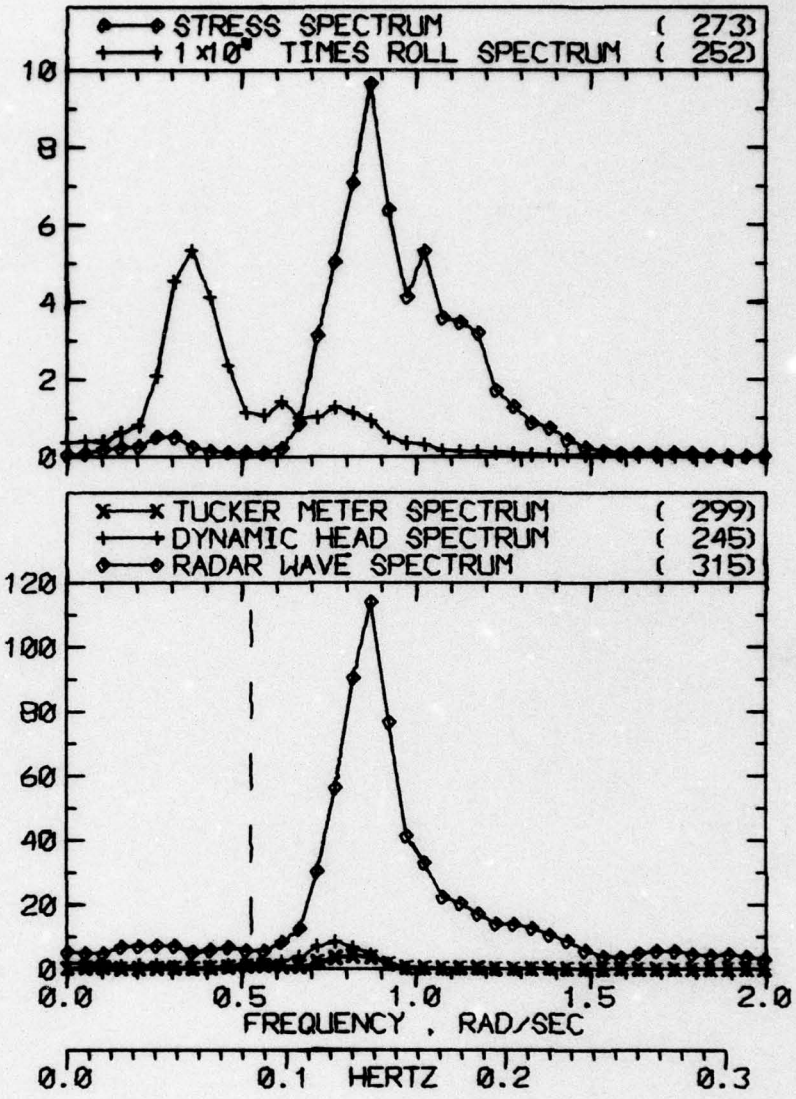
MAXIMUM PK-TR	12.2 KPSI
4.0 X RMS	7.3 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

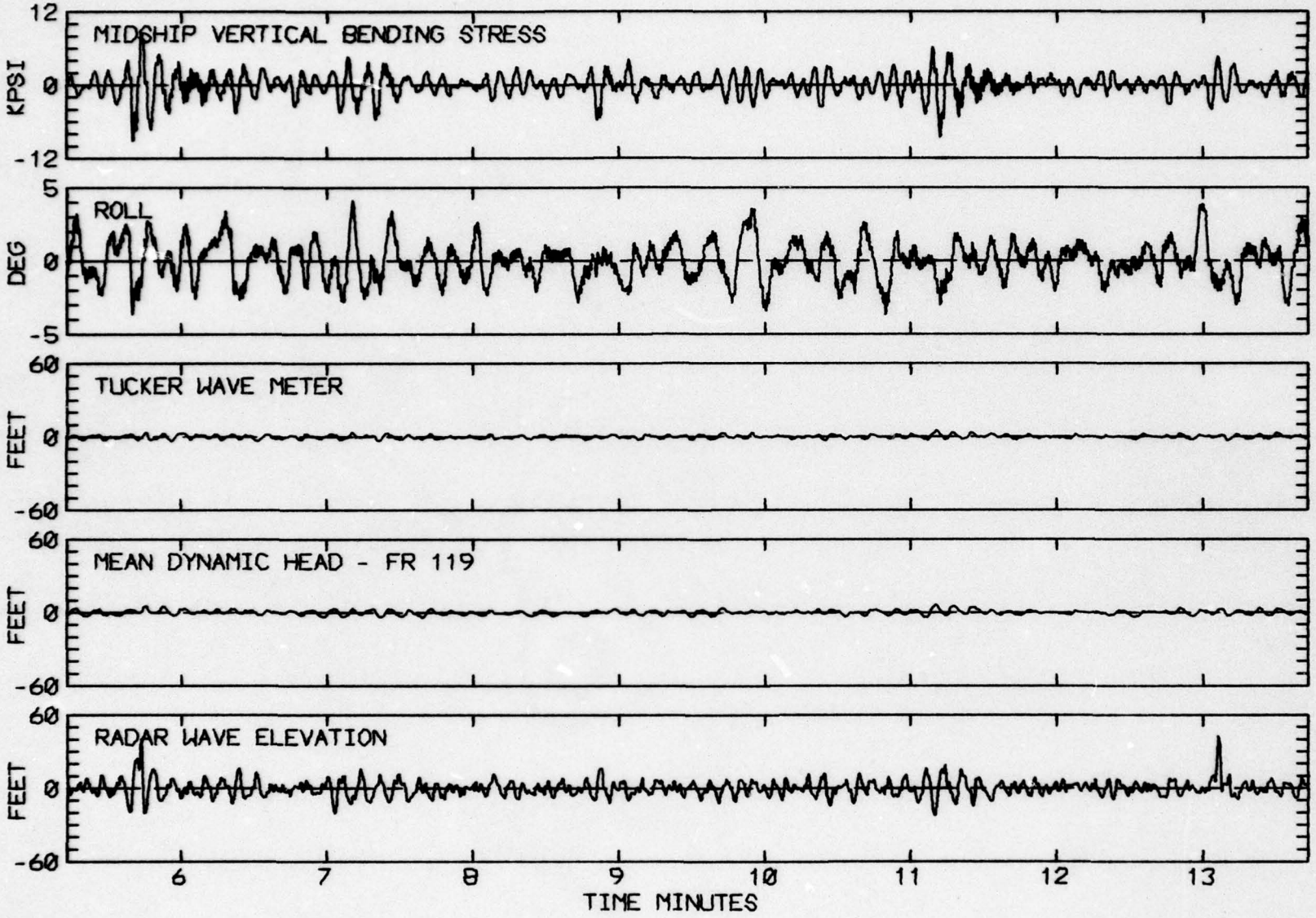
ROLL	5.2 DEG
PITCH	2.31 DEG
DK HSE VERT ACCEL	0.49 G
DK HSE LAT ACCEL	0.15 G
RADAR SLANT RANGE	42.8 FEET
VERTICAL RANGE	41.1 FEET
DISPL AT RADAR	22.9 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN. HEAD/RADAR		
P-T SAMPLE SIZE	221	182	218
MAXIMUM HEIGHT	7.1	10.7	60.3
10TH HIGHEST HTS	5.3	7.2	30.8
3RD HIGHEST HTS	4.1	5.5	22.2
4.0 RMS(SPECTRA)	4.9	6.6	25.0



RUN 461 -- VOYAGE 32W -- TAPE 145 -- INDEX 32 -- INTERVAL 61



RUN 461 -- VOYAGE 32W -- TAPE 145 -- INDEX 32 -- INTERVAL 61

LOG BOOK DATA

DATE AND TIME	01-13-74 0800
POSITION	41-07 N 40-08 W
COURSE AND SPEED	272 . 32.6 KNOTS
SEA STATE	10
WAVE HEIGHT	25 FEET
" REL DIR	43 STBD
SWELL HEIGHT	20 FEET
" REL DIR	43 STBD

---- VISUAL WEATHER / COMMENTS ----

OCAST /HEAVY RAIN SQUALLS

MIDSHIP VERTICAL BENDING STRESS

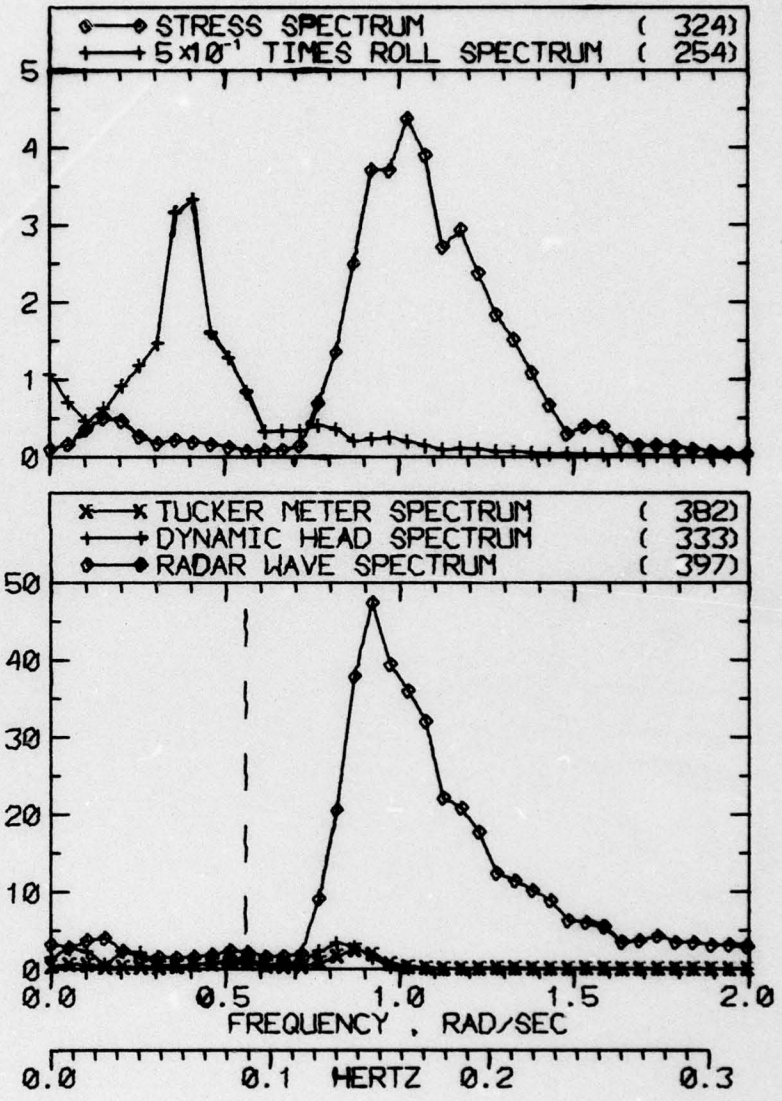
MAXIMUM PK-TR	7.7 KPSI
4.0 X RMS	5.8 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

ROLL	5.8 DEG
PITCH	1.85 DEG
DK HSE VERT ACCEL	0.39 G
DK HSE LAT ACCEL	0.15 G
RADAR SLANT RANGE	31.9 FEET
VERTICAL RANGE	29.7 FEET
DISPL AT RADAR	15.1 FEET

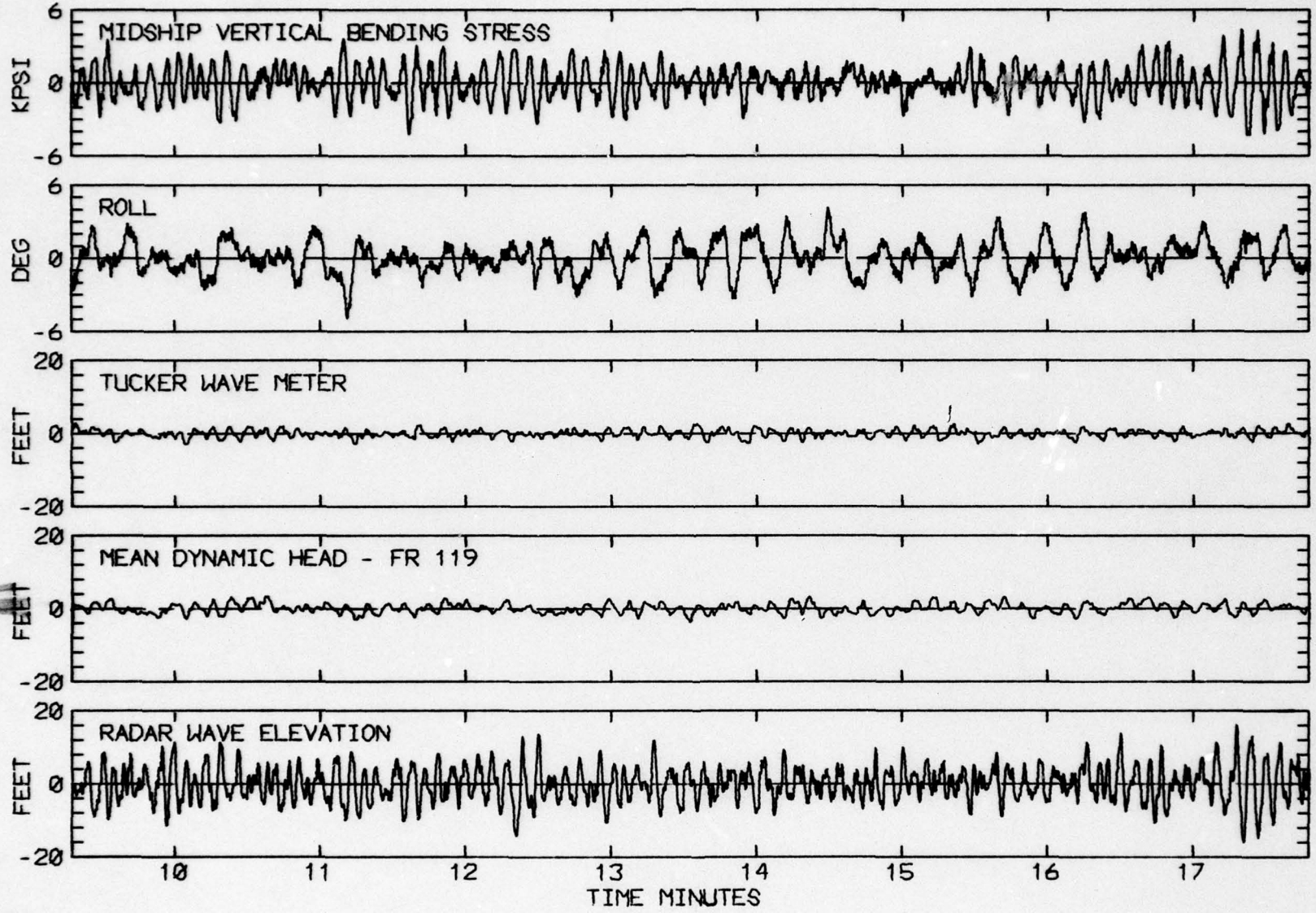
WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	304	179	238
MAXIMUM HEIGHT	5.5	7.0	32.7
10TH HIGHEST HTS	4.2	4.7	22.5
3RD HIGHEST HTS	3.0	3.9	17.8
4.0 RMS(SPECTRA)	4.0	5.0	19.1



RUN 465 -- VOYAGE 32W -- TAPE 145 -- INDEX 33 -- INTERVAL 65

100



RUN 465 -- VOYAGE 32W -- TAPE 145 -- INDEX 33 -- INTERVAL 65

LOG BOOK DATA	
DATE AND TIME	01-13-74 2000
POSITION	40-17 N 56-29 W
COURSE AND SPEED	274 . 31.9 KNOTS
SEA STATE	9
WAVE HEIGHT	15 FEET
" REL DIR	41 STBD
SWELL HEIGHT	20 FEET
" REL DIR	41 STBD

---- VISUAL WEATHER / COMMENTS ----

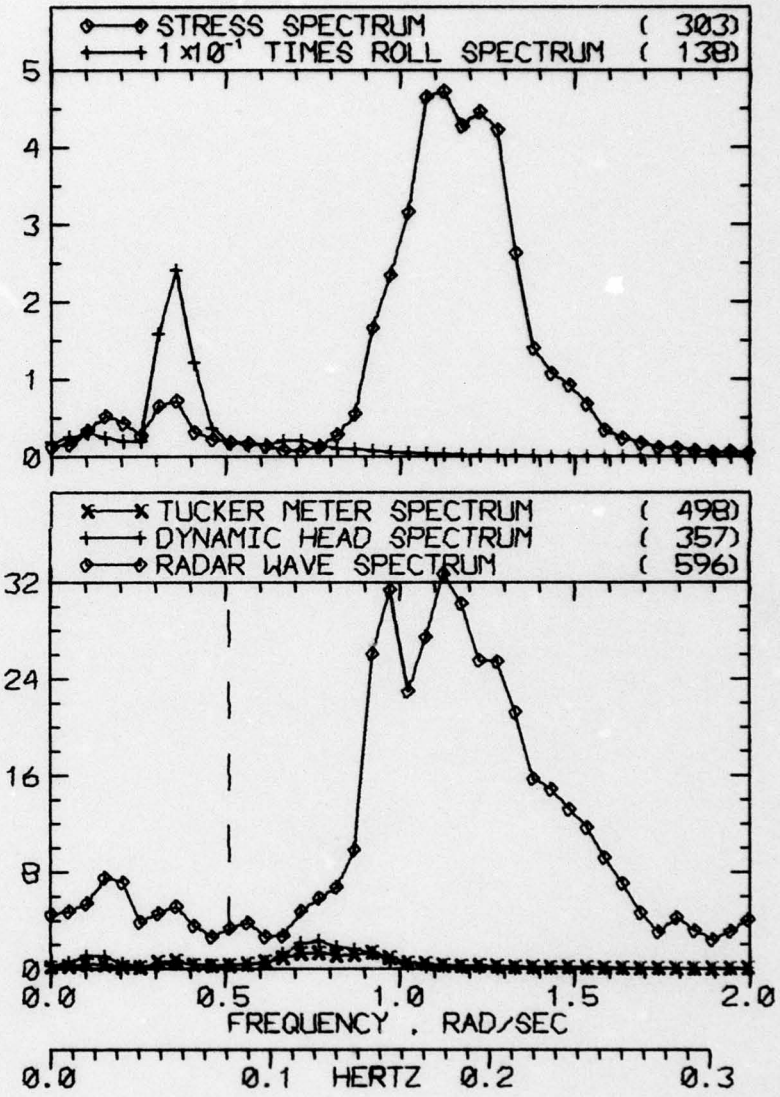
OCAST /HEAVY HAIL

MIDSHIP VERTICAL BENDING STRESS	
MAXIMUM PK-TR	10.1 KPSI
4.0 X RMS	6.1 KPSI

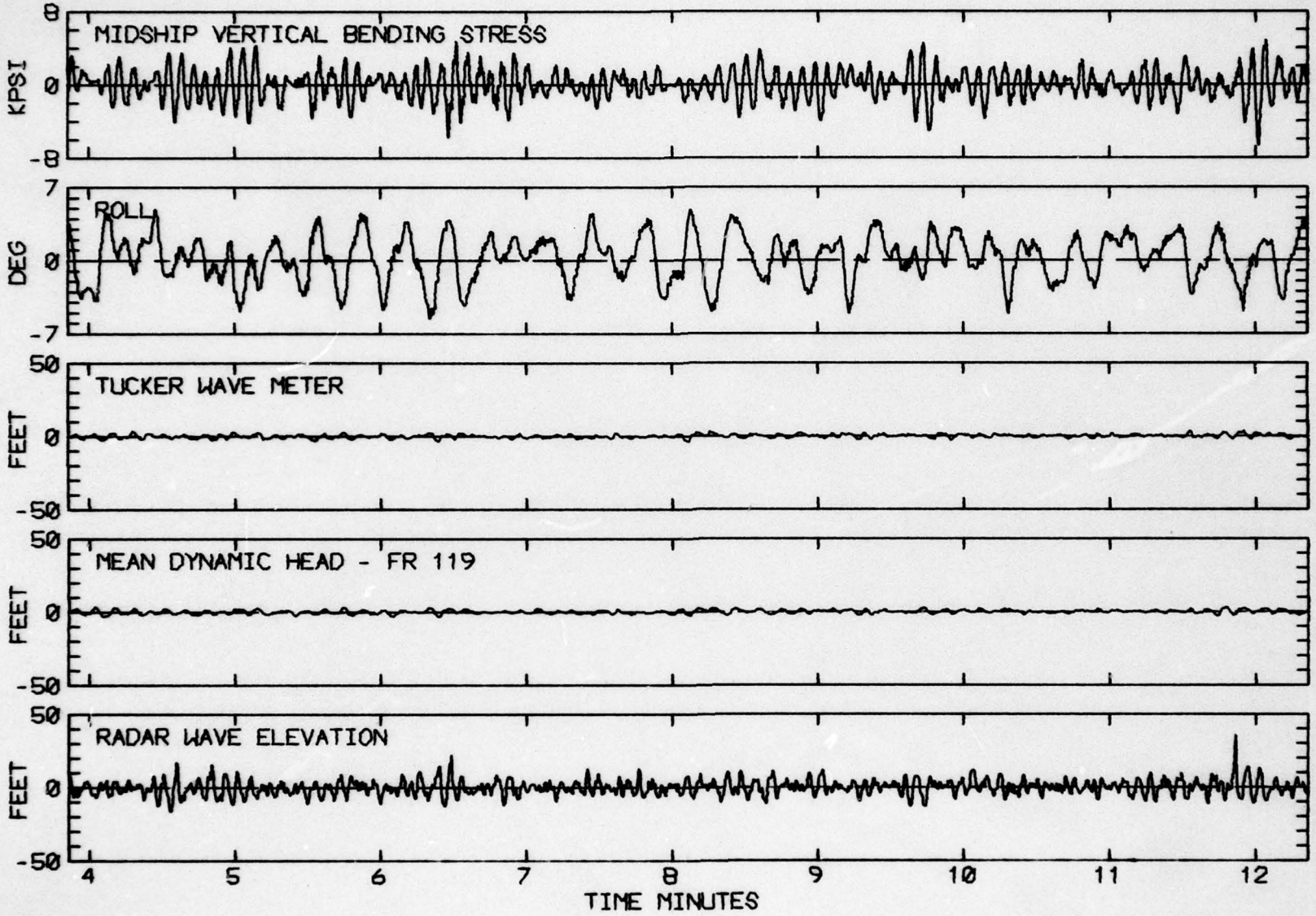
SUMMARY OF MOTIONS (4.0 X RMS)	
ROLL	8.3 DEG
PITCH	1.56 DEG
DK HSE VERT ACCEL	0.34 G
DK HSE LAT ACCEL	0.21 G
RADAR SLANT RANGE	33.1 FEET
VERTICAL RANGE	27.6 FEET
DISPL AT RADAR	12.2 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN. HEAD/RADAR		
P-T SAMPLE SIZE	260	212	287
MAXIMUM HEIGHT	5.9	6.8	44.9
10TH HIGHEST HTS	4.3	4.6	23.3
3RD HIGHEST HTS	3.1	3.4	18.0
4.0 RMS(SPECTRA)	3.8	4.1	20.2



RUN 507 -- VOYAGE 32W -- TAPE 147 -- INDEX 36 -- INTERVAL 7



RUN 507 -- VOYAGE 32W -- TAPE 147 -- INDEX 36 -- INTERVAL 7

LOG BOOK DATA

DATE AND TIME	01-13-74 2400
POSITION	40-17 N 56-29 W
COURSE AND SPEED	272 . 28.5 KNOTS
SEA STATE	9
WAVE HEIGHT	10 FEET
" REL DIR	43 STBD
SWELL HEIGHT	20 FEET
" REL DIR	43 STBD

---- VISUAL WEATHER / COMMENTS ----

RAIN SNOW /

MIDSHIP VERTICAL BENDING STRESS

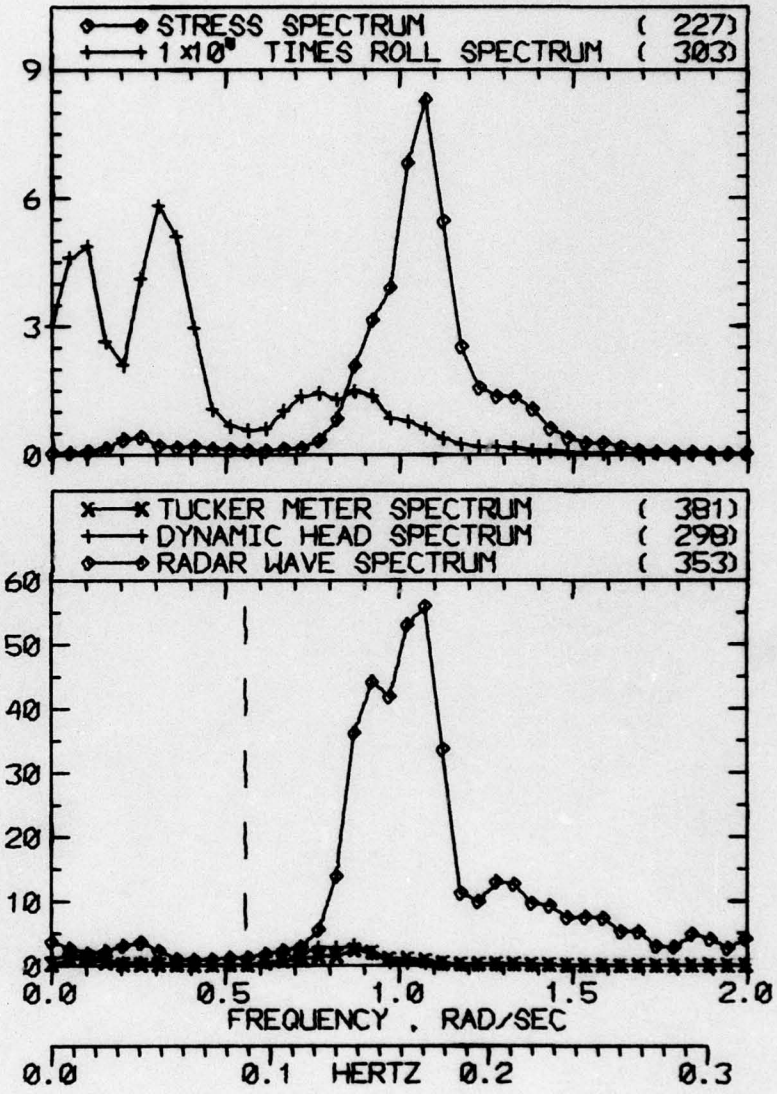
MAXIMUM PK-TR	8.3 KPSI
4.0 X RMS	6.2 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

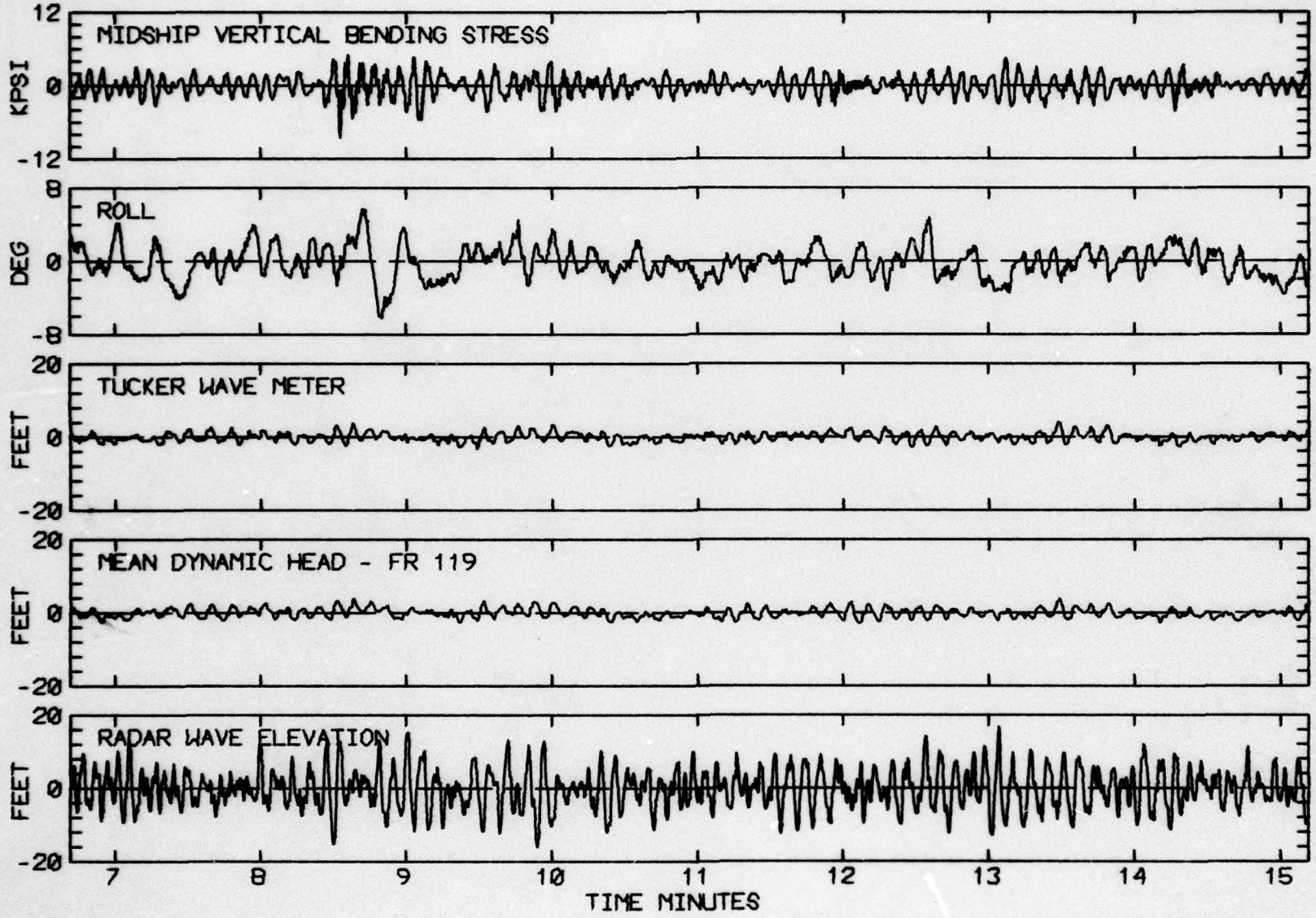
ROLL	6.4 DEG
PITCH	1.88 DEG
DK HSE VERT ACCEL	0.42 G
DK HSE LAT ACCEL	0.17 G
RADAR SLANT RANGE	32.2 FEET
VERTICAL RANGE	31.1 FEET
DEPL AT RADAR	16.1 FEET

WAVE HEIGHT STATISTICS (FEET)

	TUCKER/DYN.	HEAD/RADAR	
P-T SAMPLE SIZE	250	187	253
MAXIMUM HEIGHT	6.2	5.9	28.4
10TH HIGHEST HTS	4.4	4.6	23.3
3RD HIGHEST HTS	3.4	3.8	18.7
4.0 RMS(SPECTRA)	4.1	4.5	20.0



RUN 512 -- VOYAGE 32W -- TAPE 147 -- INDEX 37 -- INTERVAL 12



RUN 512 -- VOYAGE 32W -- TAPE 147 -- INDEX 37 -- INTERVAL 12

LOG BOOK DATA

DATE AND TIME	01-14-74 0400
POSITION	40-17 N 56-29 W
COURSE AND SPEED	274 . 32.8 KNOTS
SEA STATE	4
WAVE HEIGHT	4 FEET
" REL DIR	41 STBD
SWELL HEIGHT	8 FEET
" REL DIR	41 STBD

---- VISUAL WEATHER / COMMENTS ----

OCAST /

MIDSHIP VERTICAL BENDING STRESS

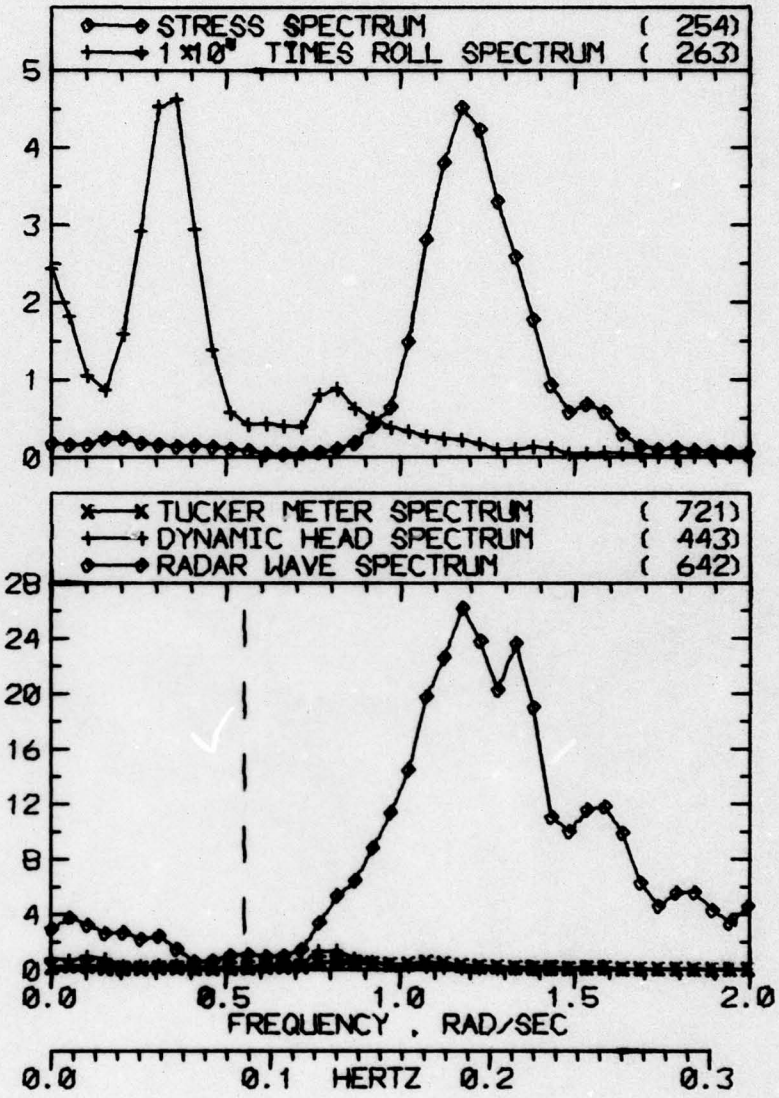
MAXIMUM PK-TR	6.1 KPSI
4.0 X RMS	5.2 KPSI

SUMMARY OF MOTIONS (4.0 X RMS)

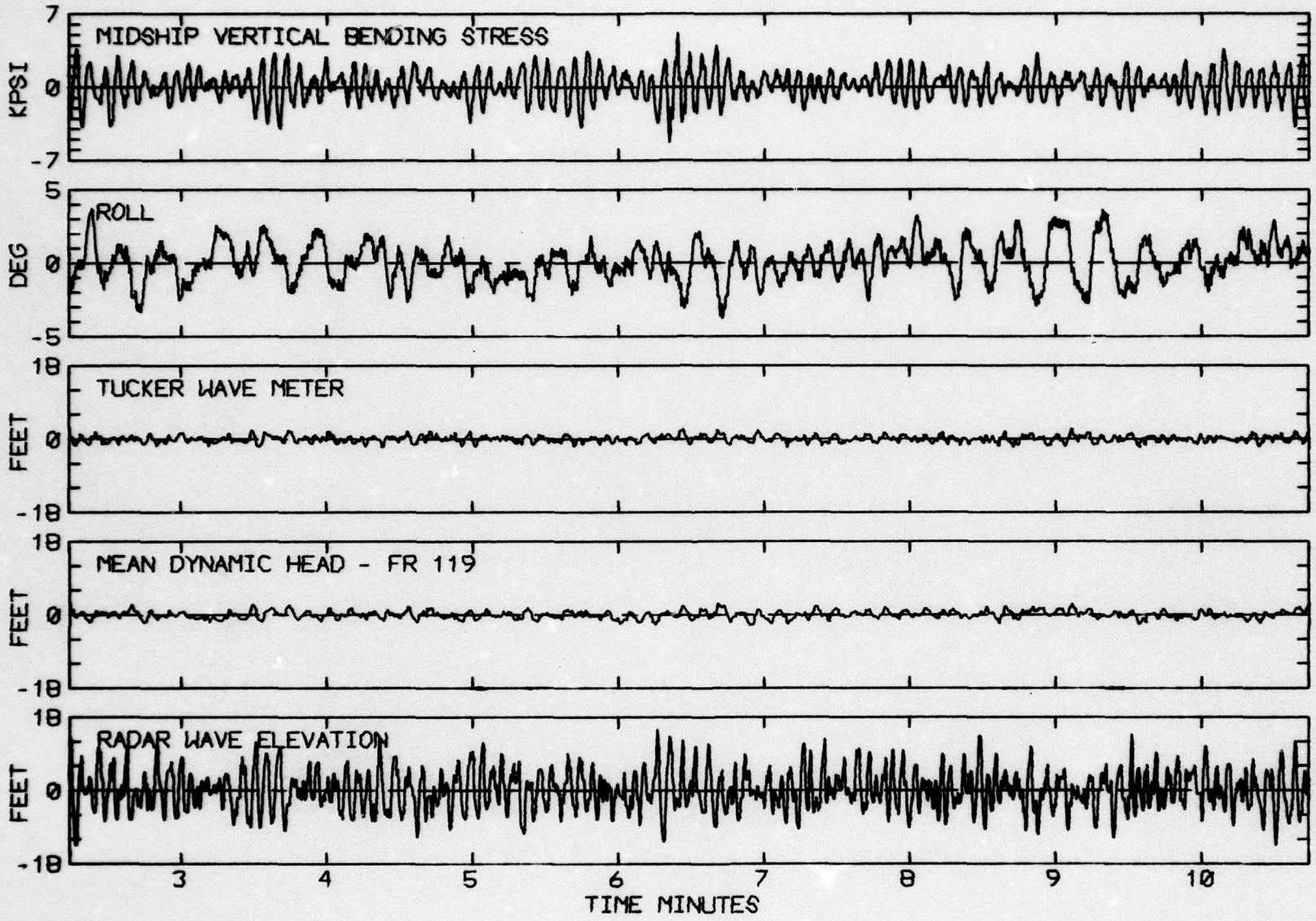
ROLL	5.1 DEG
PITCH	1.11 DEG
DK HSE VERT ACCEL	0.25 G
DK HSE LAT ACCEL	0.14 G
RADAR SLANT RANGE	24.7 FEET
VERTICAL RANGE	22.7 FEET
DISPL AT RADAR	8.5 FEET

WAVE HEIGHT STATISTICS (FEET)

		TUCKER/DYN. HEAD/RADAR	
P-T SAMPLE SIZE	338	243	289
MAXIMUM HEIGHT	4.4	4.3	27.8
10TH HIGHEST HTS	3.2	3.5	20.7
3RD HIGHEST HTS	2.4	2.6	17.1
4.0 RMS(SPECTRA)	2.9	3.3	18.1



RUN 513 -- VOYAGE 32W -- TAPE 147 -- INDEX 38 -- INTERVAL 13



RUN 513 -- VOYAGE 32W -- TAPE 147 -- INDEX 38 -- INTERVAL 13

APPENDIX

THE DATA REDUCTION AND PRESENTATION PROCEDURE ACCORDING TO THE DEVELOPMENT IN REFERENCE 4

The data reduction procedure for each interval involved:

a. Four main computation programs, the last one of which produced a complete file of results for each interval.

b. Two lister programs to supply immediate indications of some of the results.

c. One file consolidation program which produced one file for each voyage leg containing everything but the time histories of radar wave and mean dynamic head.

d. Two programs to generate the final graphical presentations for each interval.

Items b through d amount to bookkeeping operations. The work was done in the four main computation programs.

The first computation program carried out the procedure described in Reference 4 for the radar. At its conclusion the radar wave spectrum and the computed time history were written in temporary files as was the time history of vertical displacement at the radar.

The second program involved reduction of the Tucker data. Both the original data and the displacement file produced by the first program were accessed. The procedure was carried out so that time histories of mean dynamic head and the Tucker Meter signal were available. These were spectrum analyzed, and all results written in a temporary file.

The third computation program accessed the various wave-related time histories (radar, Tucker, and mean dynamic head) and performed a peak-trough analysis on the middle 16-1/2 minutes of each. (Because of the tapering described in Reference 4 both the radar and mean dynamic head data are not valid for the first and last two minutes of sample.) The object of the peak-trough analysis was to produce double amplitude statistics. The zero crossing convention was used; that is, a crest was defined as the largest instantaneous value in an excursion <u>above</u> the sample mean, a trough was the smallest instantaneous value in an excursion <u>below</u> the sample mean. The double amplitude is the difference in elevation between crest and succeeding trough. In this approach small fluctuations are more or less ignored if they are riding on top of large ones. The results resemble the double amplitudes which would be estimated by hand from an oscillograph record except that the hand analyst would probably visually fair through superimposed noise whereas the computer does not. The effect is that while the computer gets about the same number of double amplitudes as the human analyst, the computer's answers tend to be higher if the records are noisy. From the double amplitudes found, the average of 1/3 and 1/10 highest were computed, and the position in the sample of the largest double amplitude was noted. All results, including the actual double amplitudes were written in a temporary file.

The fourth computation program accessed the original data and performed spectrum analyses upon the midship vertical bending stress and roll. It then accessed all previously written temporary files and produced a new file containing all of the results for the interval. These results included log-book data, results of the first analysis of raw data (Ref.3,5), five spectra along with all analysis parameters, all results from the peak-trough analysis, and the two new time histories, the radar wave and the mean dynamic head. These files were meant to be stored on magnetic tape for possible future reference.

The final presentation of results for each interval is contained on two charts. The first type of chart (which appears on the even numbered pages of this report) contains the scalar spectra and a tabulation of results. The second type of chart (odd numbered pages) involves sample time histories. Both are identified at the bottom with the DL run number, the voyage number, the analog tape and interval numbers, and the index number assigned by Teledyne.

Referring to any even page, the tabulation at the left is intended as a summary of the most significant numbers pertaining to the interval. At the top is as much of the original log-book data as it seemed reasonable to squeeze in. This includes date, time, position, and ship speed, as well as the visual estimates of wave and swell heights and directions. Directions are counted from the bow to port or starboard in degrees. The "sea state" is apparently the Beaufort wind. The final line in the first section of the tabulation includes comments on visual weather and, after the slash, any other comment appearing in the log.

The second box in the tabulation involves midship longitudinal stress results. Only two of the many numbers which are available could be included as indices. The first is the maximum peak to trough stress excursion as obtained in Reference 1 or 2. The second index is the significant stress (4 times rms) as derived from the area of the stress spectrum obtained in the present reduction.

The third box in the tabulation is a summary of motions. Again the "significant" motions (4 rms) are indicated. The value for roll was derived from spectrum area, that for pitch and accelerations from the rms of the basic data. (Unless there are significant linear trends in the data the differences are slight between "raw" and "spectrum" rms.) The last three items in the list involve various stages in the radar data reduction. The first is the slant range as recorded. The "vertical range is $R_c(t)$ of the radar analysis. This entry is essentially the vertical component of the range relative to the position of the accelerometer package. The number was derived from the spectrum. The last entry is the significant displacement at the radar (significant doubly integrated acceleration). It too was derived from spectrum analyses.

In a sense, the table at the bottom of the tabulation contains the final numerical answers. Items in the first column pertain to the uncorrected Tucker Meter signal. The second column pertains to the mean dynamic

head developed in conjunction with the analysis of the Tucker meter, and the third column pertains to wave elevations derived from the radar system. The first row in the table is the number of double amplitudes found in the middle 16-1/2 minutes of the sample. Below this are noted the maximum height found and the averages of the 1/10 and 1/3 highest double amplitudes. The final line in the table is the significant (4 rms) height derived from the spectral analyses. Ordinarily it is expected that the last two lines of the table will be about the same.

At the right of any even page are plots of the five computed spectra. It was decided to standardize the frequency scale from 0 to 2 rad/sec. In the great majority of intervals everything of interest is contained in this range. In some intervals one spectrum or another is non-negligible beyond 2 rad/sec but nothing much has been seen beyond 2.5 rad/sec for any of the quantities analyzed except in the stress spectrum where something may often be noticed around the frequency of the first mode of vertical vibration. The folding frequency of the analyses is above 20 rad/sec; no aliasing is expected, Reference 3.

The stress and roll spectra are plotted together. The vertical scale is for the stress spectrum. The roll spectrum has been multiplied by the factor noted in the legend before plotting. Dimensions of the stress spectral density are ($kpsi^2$/rad/sec) and those of the roll spectral density are (deg^2/rad/sec).

All three wave related spectra (Tucker, mean dynamic head, and radar) are plotted together to the same scale. The dimension of the wave spectral density is ($feet^2$/rad/sec). In the wave spectrum plot there is a vertical (slightly joggled) dashed line. This line marks the position of the low frequency cutoff, ω_o, discussed in Reference 4 in conjunction with double integration of the vertical accelerations. It is correct to interpret the position of this line as meaning that the double integration has been done correctly for higher frequencies, and incorrectly for lower frequencies.

There are several details about the spectrum analyses which are not documented in the plots because they are constant throughout the data reduction. First, the normalization of the spectra is such that the spectrum area equals variance. All spectra are derived from a Fast Fourier Transform analysis of an 8192 point sample. The fundamental results is 4096 spectral estimates of 2 degrees of freedom each. These estimates are uniformly spaced in frequency at a delta-frequency of 0.00511 rad/sec. In order to improve statistical reliability, the basic spectral estimates were averaged in blocks of 20 estimates at intervals of 10 estimates. The resulting averages are thus equi-speced on the frequency scale at intervals of $\Delta\omega$ = 0.0511 rad/sec. This also means that adjacent spectral estimates as shown in the plot are not quite independent -- to about the same degree as spectral estimates from the older autocorrelation methods are not independent.

As a result of the averaging, each spectral estimate has 40 degrees of freedom associated with it. Accordingly, the 90% confidence bounds on the spectra shown in the charts may be formed by multiplying the values given by 0.72 and 1.51. Had the process sampled continued indefinitely and a large number of 20.5 minute samples been obtained and analyzed, nine out of ten of these new estimates of spectral density would be expected to lie within the bounds so constructed. The practical implication is simply that the influence of sampling variability upon the given numerical results is roughly the same as that associated with the result of most other full scale wave measurement exercises.

The last detail of the spectrum analysis is the "total degrees of freedom." This number is included in parentheses at the end of each line of legend because it depends upon the shape of each individual spectrum. It is an estimate of the proper number of degrees of freedom to use in constructing confidence bounds on the sample variance. If each of the numbers in the present 8192 point time histories had been picked randomly the "total degrees of freedom" would be 8191. This is not the case -- adjacent members of all the present time series are highly correlated so that the equivalent "random" sample size is much smaller. In the present data set the "total degrees of freedom" (TDF) is expected to vary between 60 and 600. Approximate 90% confidence bounds on the variances assuming a Normal zero mean process, may be constructed by multiplying the estimate by two factors derived from the percentage points of the Chi-square distribution. Examples of the values of these factors are given as follows:

TDF	Factor for Lower Bound	Factor for High Bound
60	.72	1.32
120	.80	1.27
200	.84	1.17
400	.89	1.12
600	.91	1.10

These are factors for the variances. The square root applies to the rms values so that very roughly the 90% confidence bounds on rms range from the sample rms ± 15% for TDF = 60 to the sample rms ± 5% for TDF = 600. The practical implications of these results are quite similar to those mentioned in connection with the confidence bounds on the spectra. There is only so much "precision" obtainable from one 20 minute sample of wave elevation -- that which was attacined in the present work appears comparable to that achieved in the past in similar studies. With respect to comparisons between wave meters or between data and predictions of rms ship responses there can be little justification to a concern about differences of 5 to 15% magnitude.

The sample time histories on the odd numbered pages need little explanation, except perhaps to say that the duration of the sample shown (8-1/2 minutes) was a compromise between a desire to display as much of

the 16-1/2 minutes of derived wave time histories as was possible in one page; and the desire to spread the time scale out so that individual fluctuations were visible for intervals involving high ship speed in head seas. To produce the charts an 8-1/2 minute portion of the available 16-1/2 minutes of sample was chosen such that the largest radar wave double amplitude is shown -- as well as (if possible) the largest mean dynamic head double amplitude.

It may be fairly asked why the effort in producing plotted time histories for each interval was considered worthwhile. The answer to the question is fairly simple. While the present data in its original analog form has been scanned systematically by eye, the process involved oscillograph records with a time scale of about 15 minutes to the inch. At this time compression only a gross idea of what was happening can be formed, no detailed assessment of the believability of the data can be made, and, most importantly, the odd malfunction which is enough to upset the spectrum estimates or the statistics may often go unnoticed. This last is considered most important in the radar data. It was pointed out in References 3 and 5 that an attempt was made to weed out intervals where the radar had evidently lost signal and re-established a new reference range. In this process only the most obvious instances could be identified; no guarantees could be made that all instances of moderate or small magnitude had been eliminated.

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So that more precise correlations between full scale observations and analytical and model results could be carried out, one of the objectives of the instrumentation program for the SL-7 class container ships was the provision of instrumental measures of the wave environment. To this end, two wave meter systems were installed on the S.S. SEA-LAND McLEAN. Raw data was collected from both systems during the second (1973-1974) and third (1974-1975) winter data collecting seasons.

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It was the purpose of the present work to reduce this raw data, to develop and implement such corrections as were found necessary and feasible, and to correlate and evaluate the final results from the two wave meters. In carrying out this work it was necessary to at least partly reduce several other channels of recorded data, so that, as a by-product, reduced results were also obtained for midship bending stresses, roll, pitch, and two components of acceleration on the ship's bridge.

As the work progressed it became evident that the volume of documentation required would grow beyond the usual dimensions of a single technical report. For this reason the analyses, the methods, the detailed results, discussions, and conclusions are contained in a series of ten related reports.

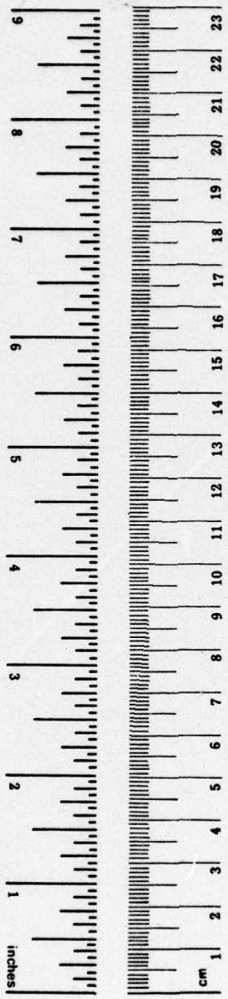
This report is one of the six in the series in which the detailed results of the data reduction process are presented. Included in this report is the reduced data from the Second Season Voyage 32.

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

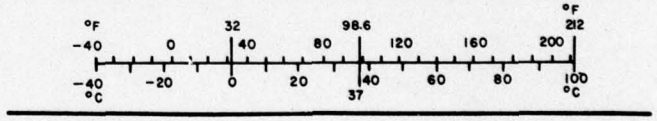
Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square *centi*meters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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