Marine Technology Society

Dynamic Positioning Conference

21 - 22 October, 1997

Session 5

Thrust Required and Holding Capacity

Thrust Required and Holding Capacity

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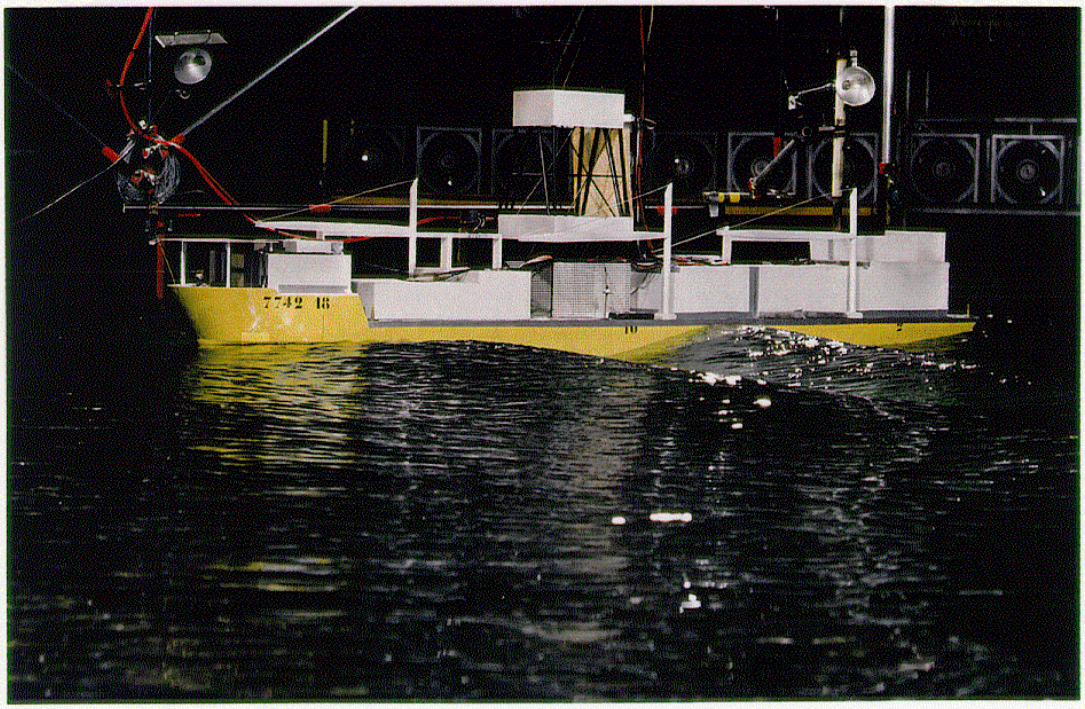
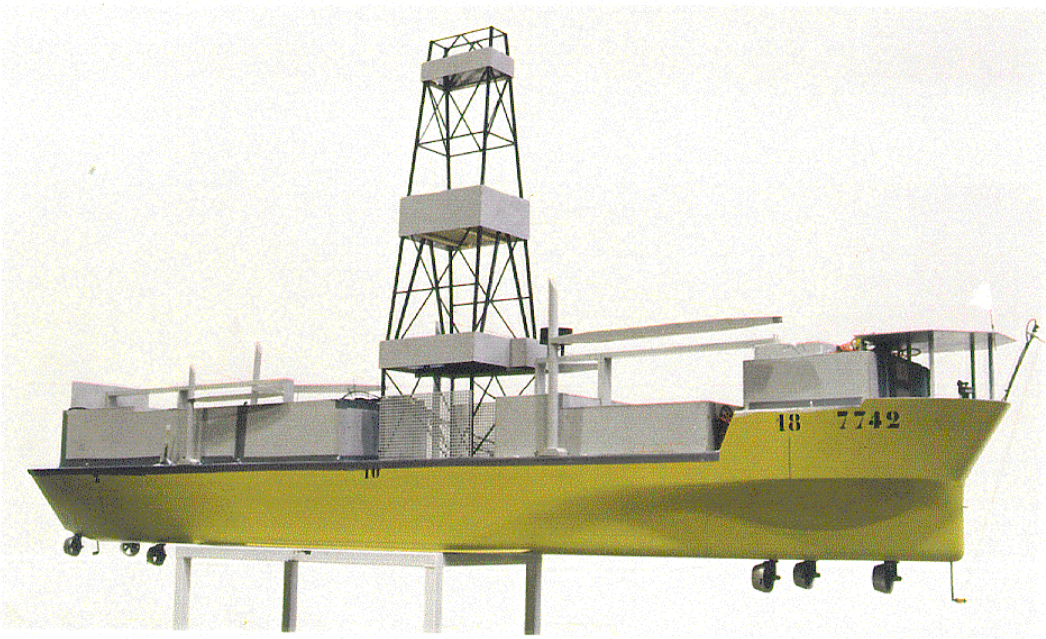
DISCOVERER ENTERPRISE STATIONKEEPING PERFORMANCE
VERIFICATION BY MODEL TESTING

MODEL TESTS FOR THE DISCOVERER ENTERPRISE

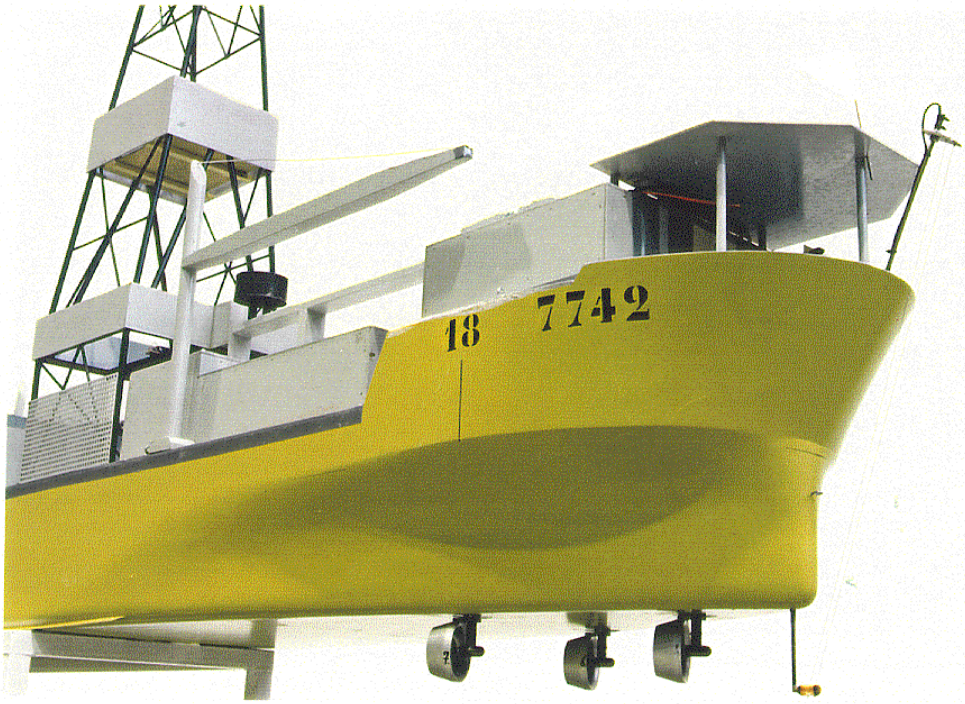


The vessel moored in soft springs
50-year storm condition, stern waves

MODEL TESTS FOR THE DISCOVERER ENTERPRISE

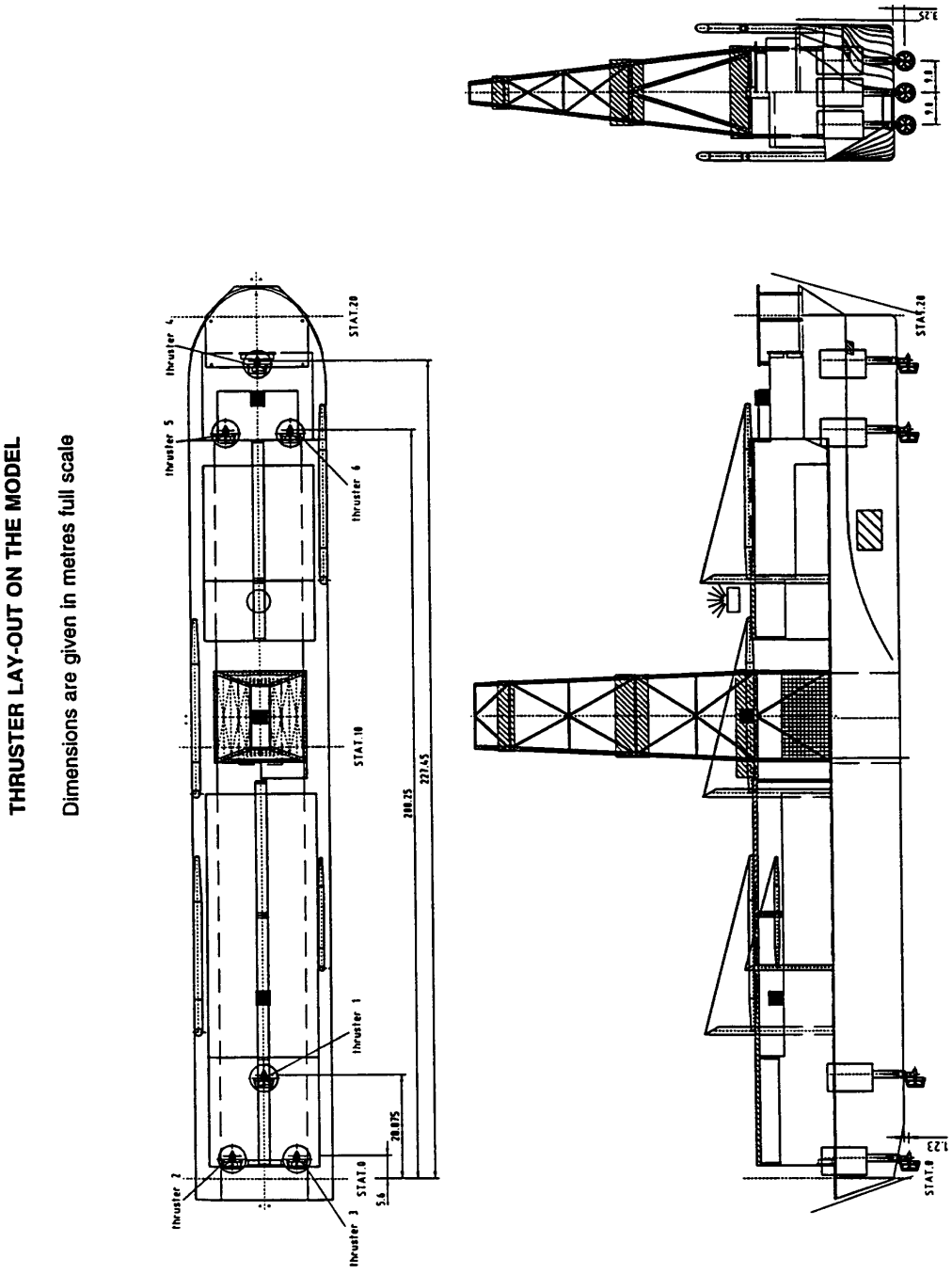


The model



Thruster arrangement

MODEL TESTS FOR THE DISCOVERER ENTERPRISE

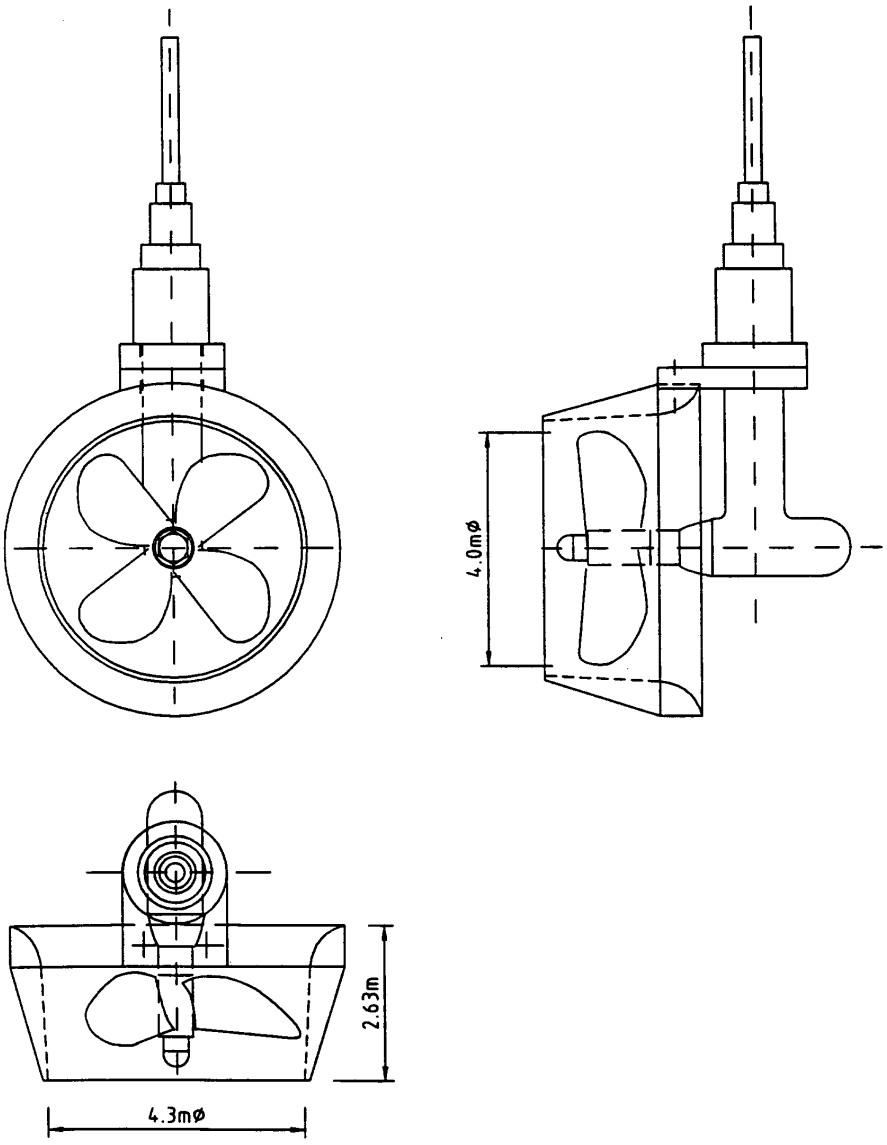


THRUSTER LAY-OUT ON THE MODEL

Dimensions are given in metres full scale

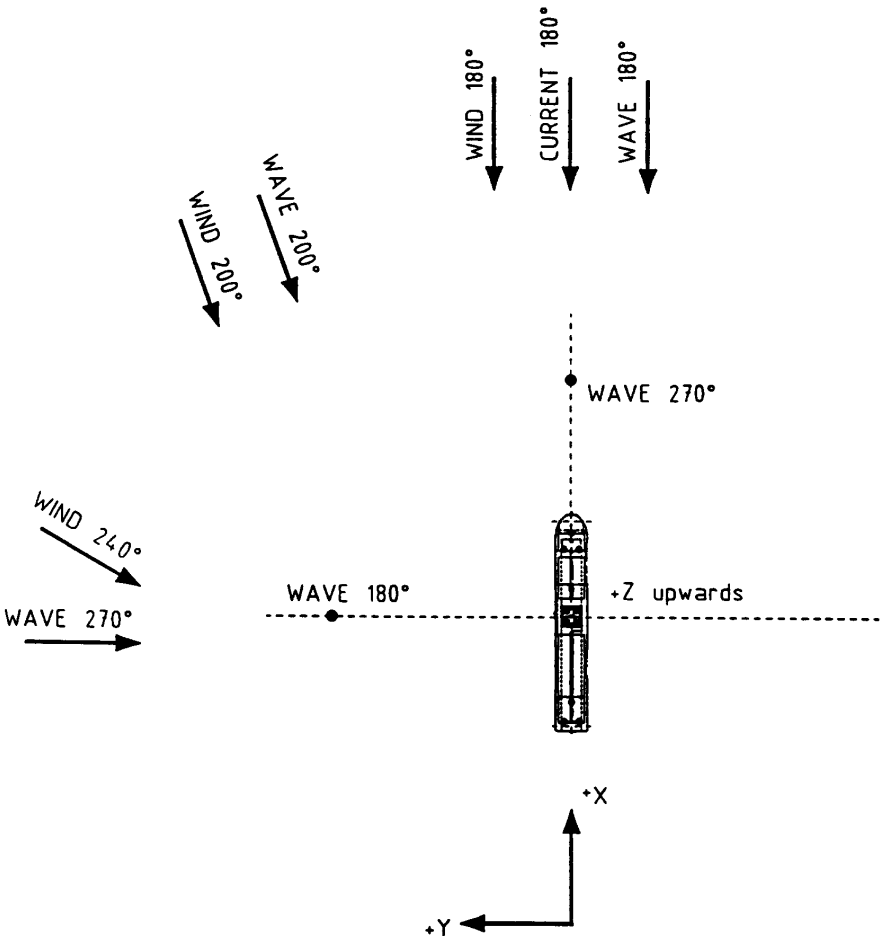
MODEL TESTS FOR THE DISCOVERER ENTERPRISE

THRUSTER MODELS



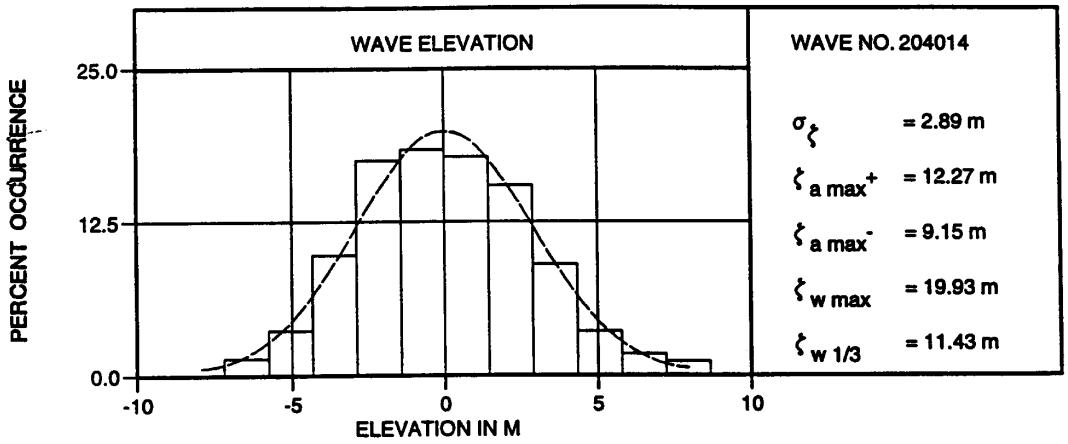
MODEL TESTS FOR THE DISCOVERER ENTERPRISE

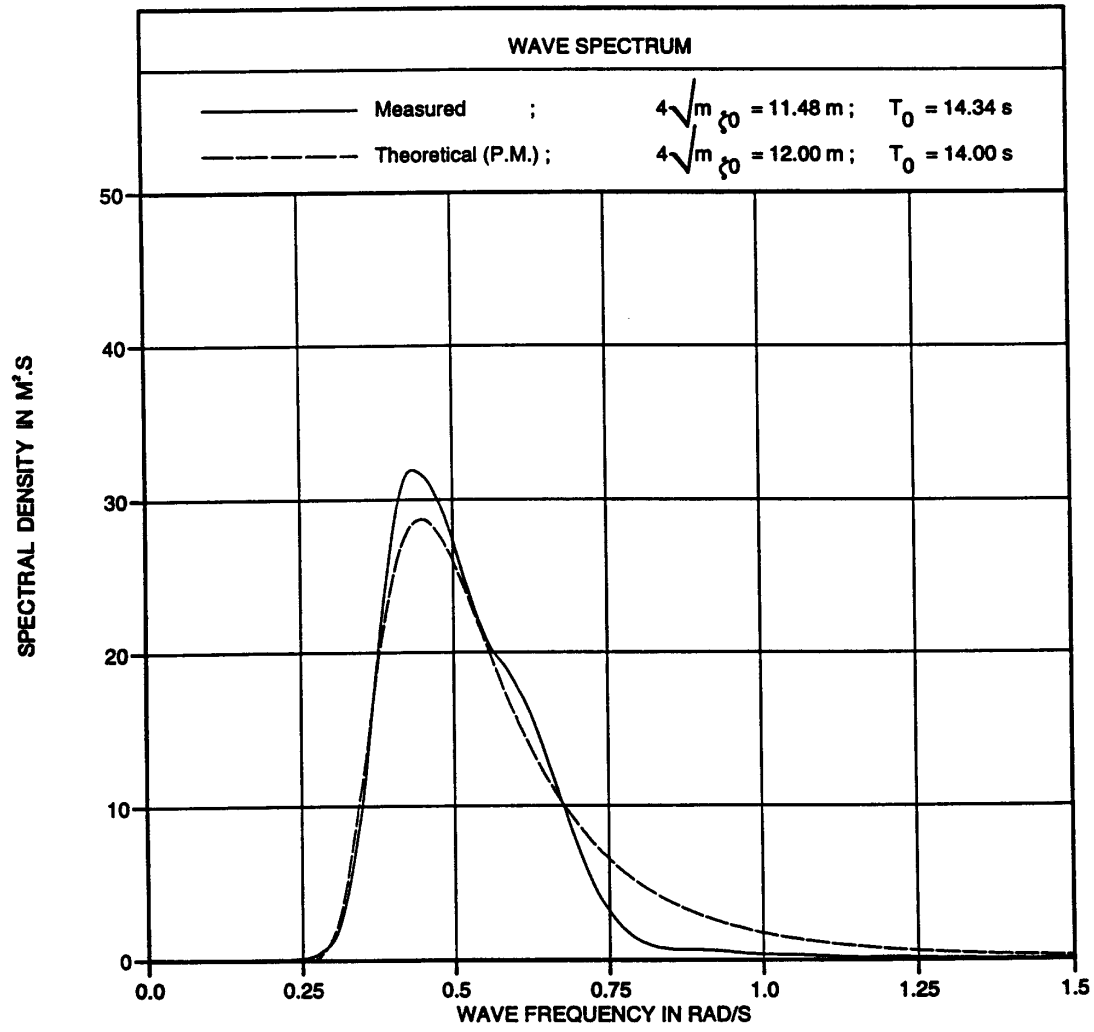
BASIN FIXED SYSTEM OF CO-ORDINATES

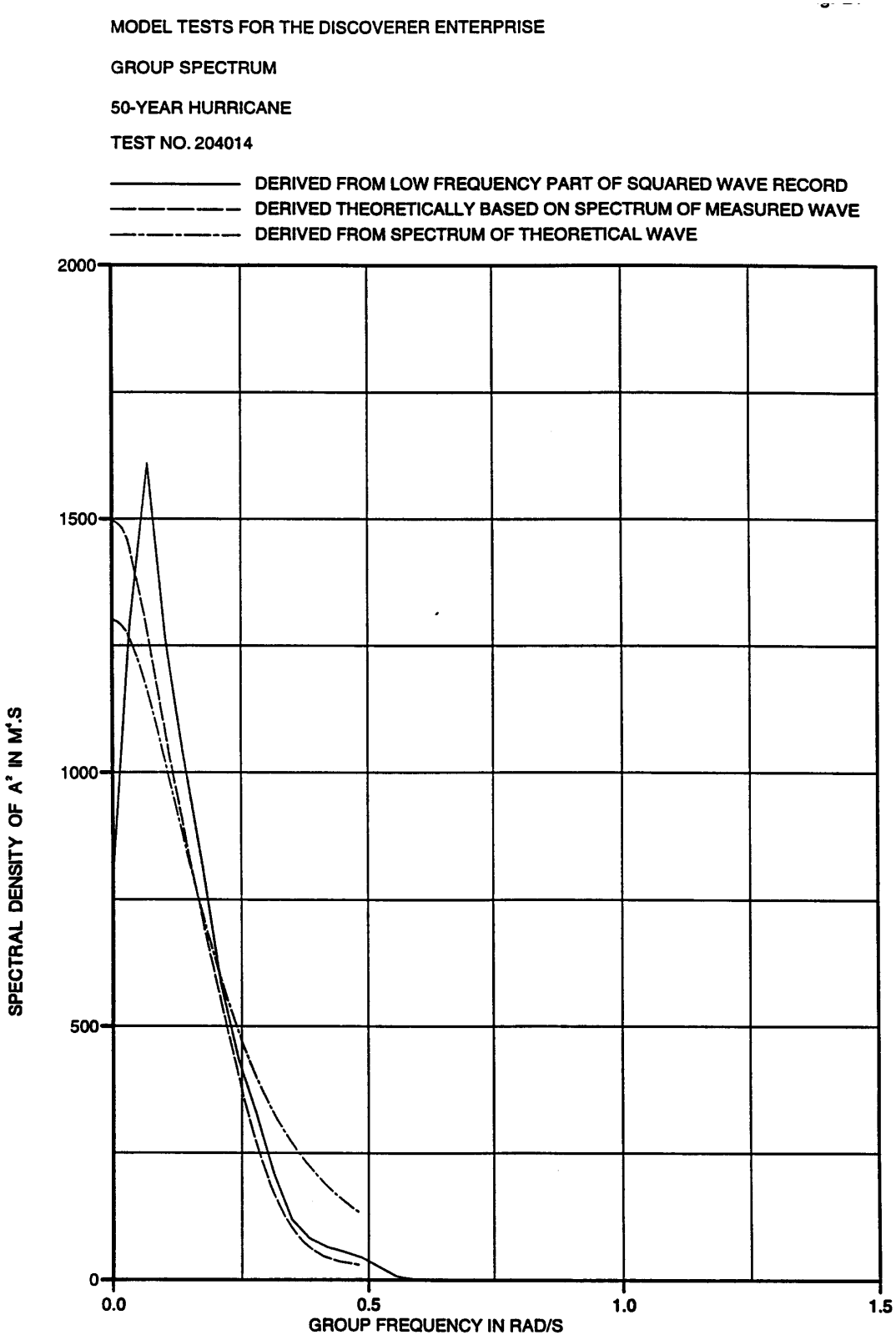


MODEL TESTS FOR THE DISCOVERER ENTERPRISE

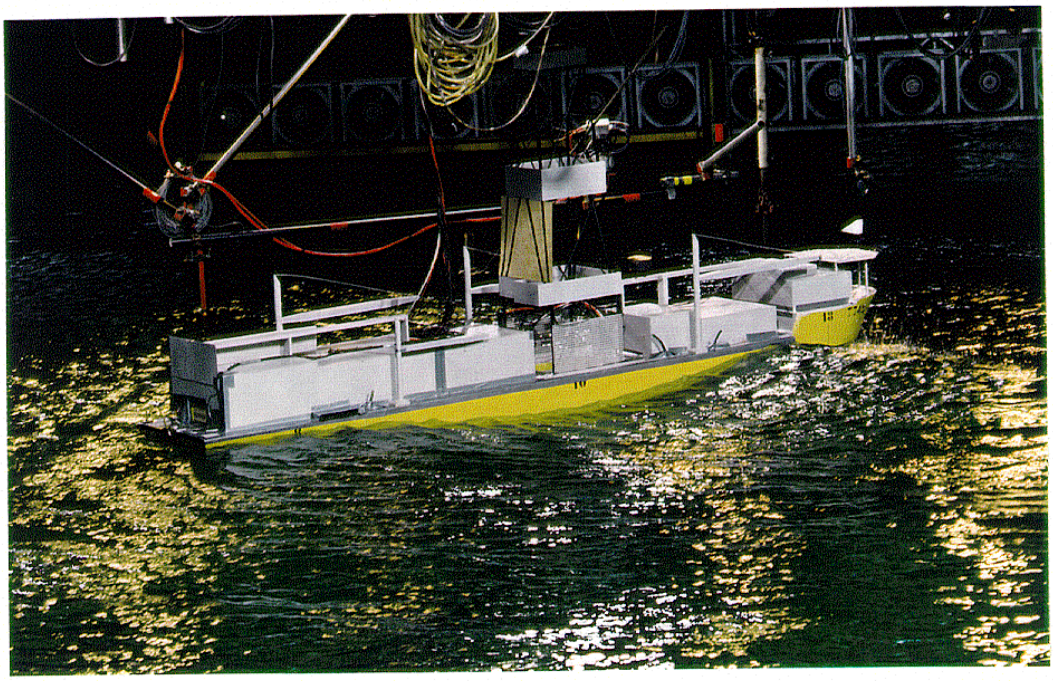
50-YEAR HURRICANE

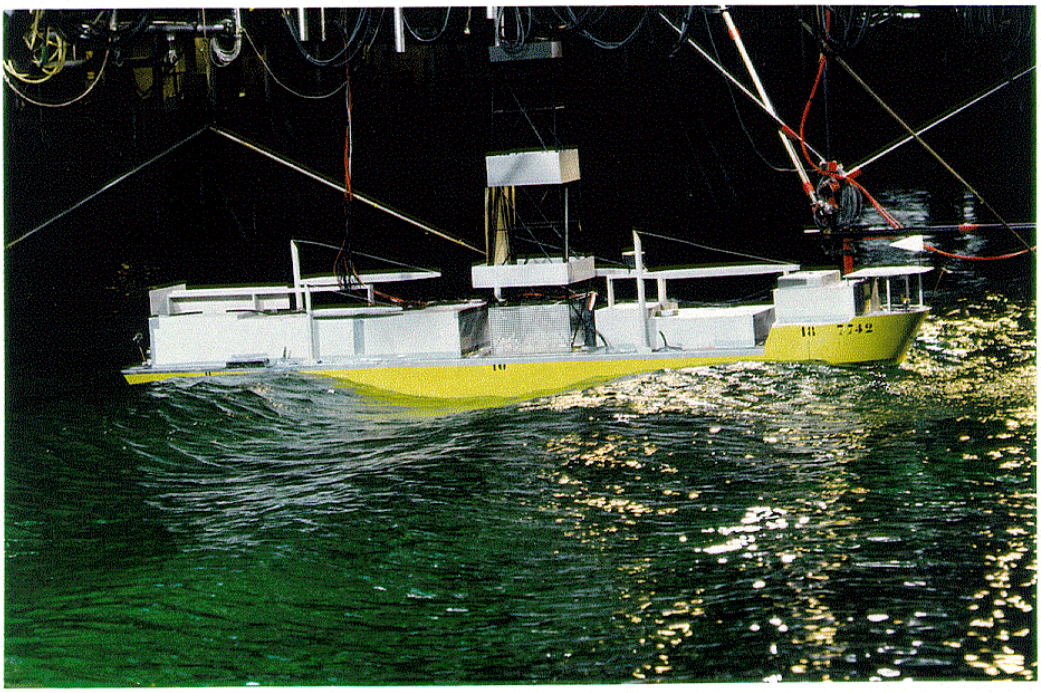





MODEL TESTS FOR THE DISCOVERER ENTERPRISE
GROUP SPECTRUM
50-YEAR HURRICANE
TEST NO. 204014
DERIVED FROM LOW FREQUENCY PART OF SQUARED WAVE RECORD
DERIVED THEORETICALLY BASED ON SPECTRUM OF MEASURED WAVE
DERIVED FROM SPECTRUM OF THEORETICAL WAVE
SPECTRAL DENSITY OF A² IN M².S
2000
1500
1000
500
0
0.0
0.5
1.0
1.5
GROUP FREQUENCY IN RAD/S

MODEL TESTS FOR THE DISCOVERER ENTERPRISE



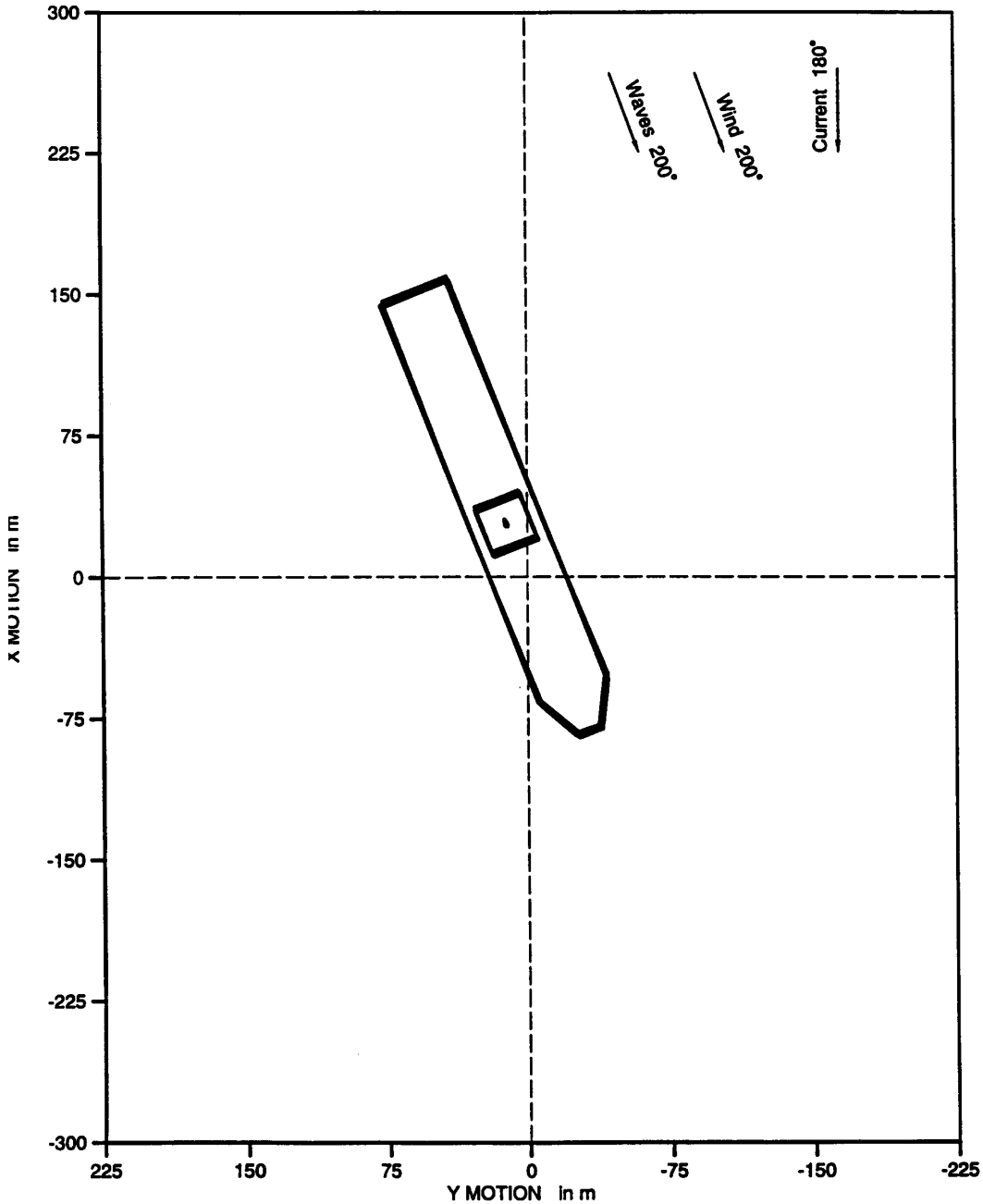


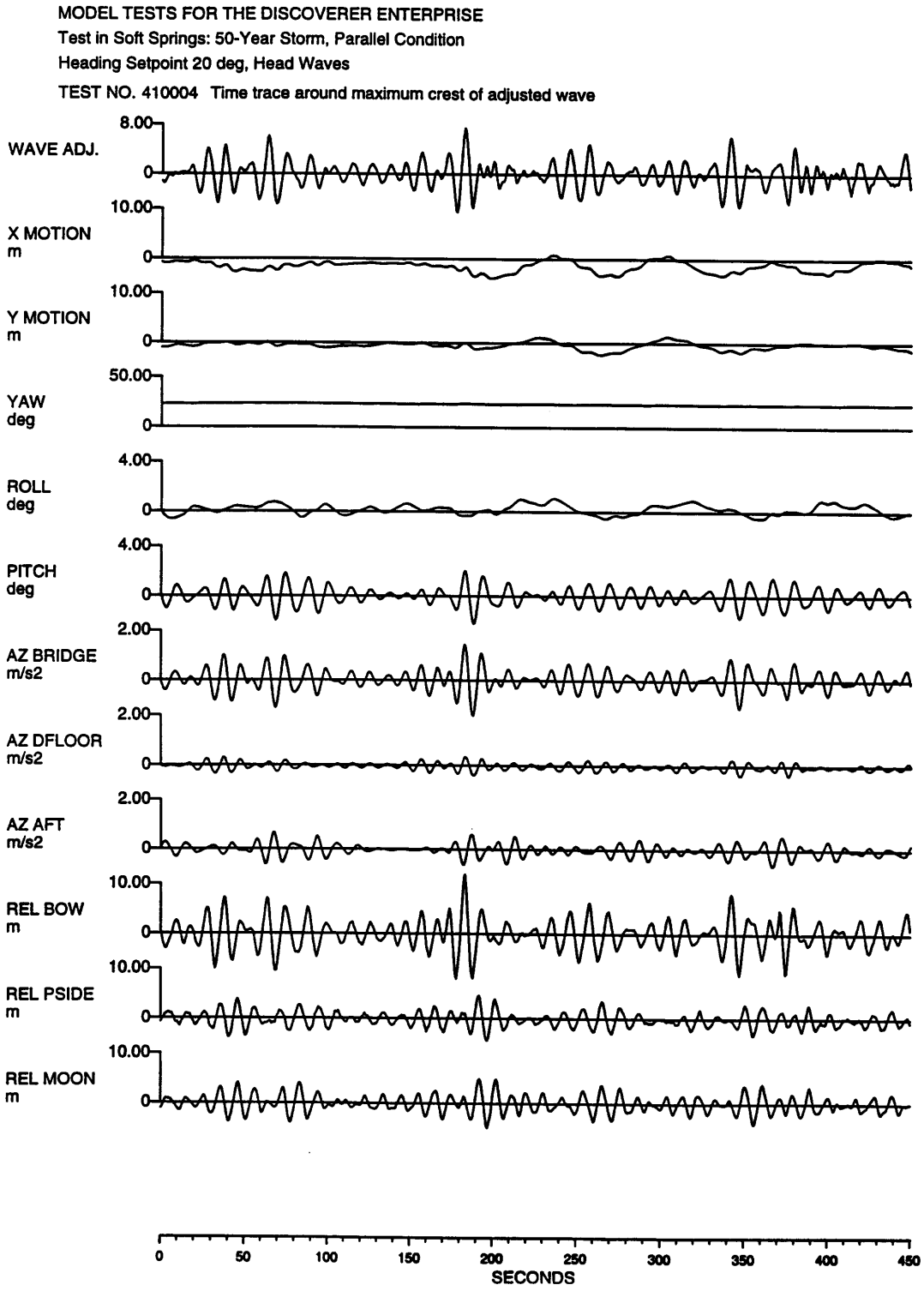
DP Test
50-year hurricane condition, head waves

MODEL TESTS FOR THE DISCOVERER ENTERPRISE

Test in soft springs
50-Year Storm, Parallel - Heading Setpoint 200 deg, Stern Waves

TEST NO. 410009




MODEL TESTS FOR THE DISCOVERER ENTERPRISE
Test in Soft Springs: 50-Year Storm, Parallel Condition
Heading Setpoint 20 deg, Head Waves
TEST NO. 410004 Time trace around maximum crest of adjusted wave
WAVE ADJ.
8.00
0
X MOTION
m
10.00
0
Y MOTION
m
10.00
0
YAW
deg
50.00
0
ROLL
deg
4.00
0
PITCH
deg
4.00
0
AZ BRIDGE
m/s2
2.00
0
AZ DFLOOR
m/s2
2.00
0
AZ AFT
m/s2
2.00
0
REL BOW
m
10.00
0
REL PSIDE
m
10.00
0
REL MOON
m
10.00
0
0
50
100
150
200
250
300
350
400
450
SECONDS

MODEL TESTS FOR THE DISCOVERER ENTERPRISE

RESULTS OF TEST NO. 410004 - TEST IN SOFT SPRINGS

Environmental condition: 50-Year Storm, Parallel Condition
Heading Setpoint : 20 deg, Head Waves

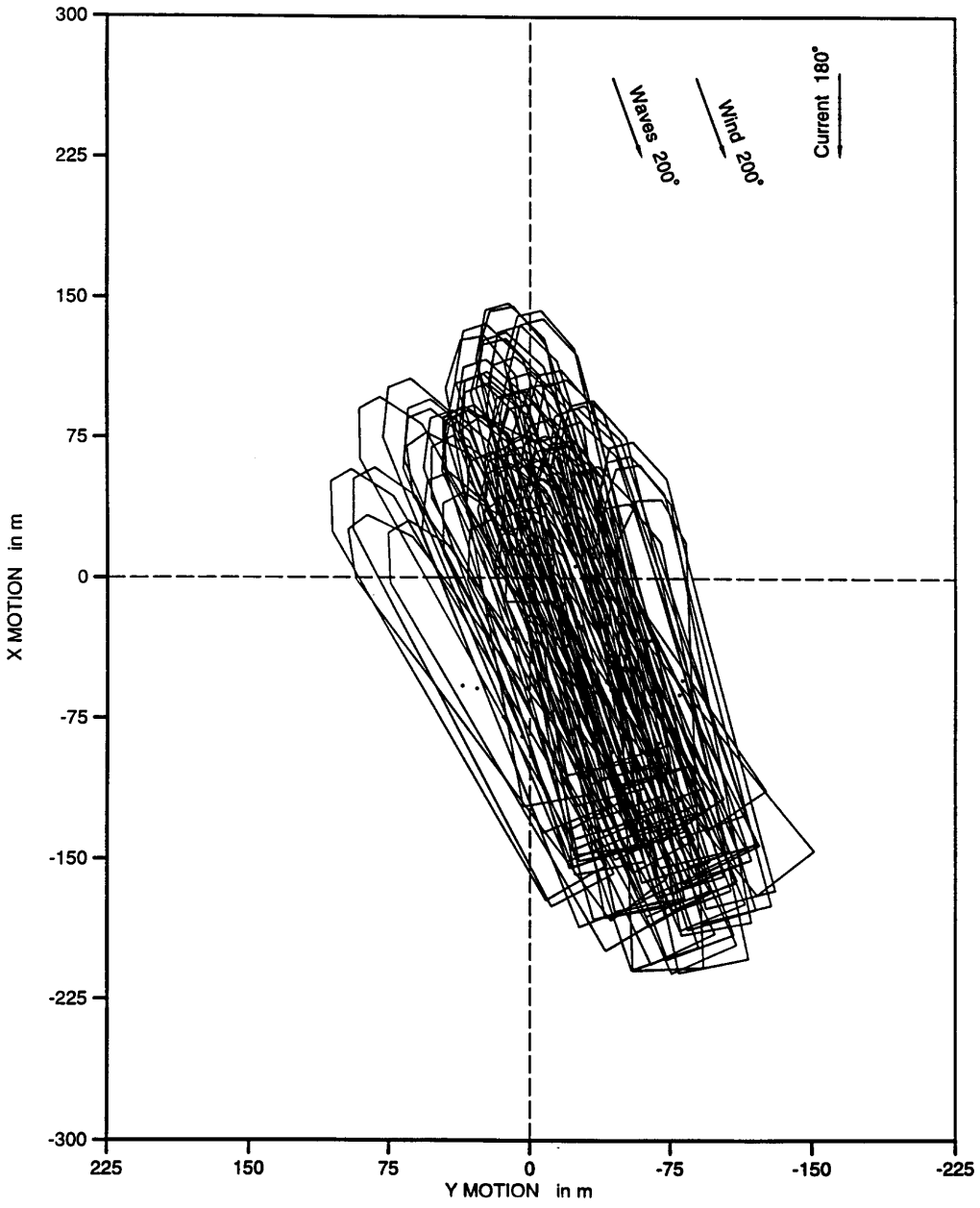
Waves, Wind and Current

STATISTICAL ANALYSIS

NOTATION	DIM.	MEAN	ST. DEV.	A 1/3 +	A 1/3 -	2A 1/3	A MAX. +	A MAX. -	2A MAX.	NO
X MOTION	m	-1.44	0.82	-0.34	-2.73	1.43	1.20	-4.59	4.26	727
Y MOTION	m	-0.54	0.44	0.12	-1.22	0.89	1.41	-2.37	3.15	718
Z MOTION	m	0.03	0.70	1.39	-1.36	2.69	2.55	-2.32	4.55	936
ROLL	deg	0.25	0.27	0.72	-0.19	0.69	1.32	-0.74	1.65	635
PITCH	deg	0.01	0.69	1.40	-1.39	2.72	2.24	-2.39	4.37	911
YAW	deg	23.36	0.23	23.71	22.95	0.51	24.01	22.50	1.04	1198
AX BRIDGE	m/s2	0.01	0.17	0.35	-0.34	0.66	0.62	-0.68	1.16	1004
AX DFLOOR	m/s2	-0.03	0.19	0.34	-0.43	0.74	0.65	-0.80	1.31	1005
AX AFT	m/s2	0.03	0.16	0.34	-0.29	0.60	0.58	-0.61	1.06	1003
AY BRIDGE	m/s2	0.05	0.08	0.20	-0.09	0.25	0.33	-0.27	0.46	1125
AY DFLOOR	m/s2	0.04	0.06	0.14	-0.06	0.15	0.27	-0.18	0.31	944
AY AFT	m/s2	0.02	0.07	0.14	-0.12	0.22	0.28	-0.31	0.41	938
AZ BRIDGE	m/s2	0.02	0.42	0.87	-0.81	1.63	1.63	-1.58	3.13	1011
AZ DFLOOR	m/s2	-0.04	0.14	0.26	-0.32	0.57	0.44	-0.51	0.90	1059
AZ AFT	m/s2	-0.02	0.22	0.43	-0.47	0.88	0.88	-0.83	1.56	1008
REL BOW	m	-0.05	2.99	6.27	-6.14	12.16	12.35	-10.50	22.86	1012
REL PSIDE	m	-0.19	1.58	3.05	-3.33	6.24	5.18	-5.25	10.43	1043
REL MOON	m	-0.07	1.72	3.48	-3.29	6.59	5.72	-4.73	10.32	1093
REL STERN	m	-0.40	2.93	5.40	-6.13	11.32	8.93	-9.57	18.37	682
FX	kN	-1449								
FY	kN	-35								
MZ	kNm	1341								

MODEL TESTS FOR THE DISCOVERER ENTERPRISE
DP Test
Check Hovering Capability
50-Year Hurricane - Heading Setpoint 20 deg, Head Waves
Waves, Wind and Current

TEST NO. 409012



MODEL TESTS FOR THE DISCOVERER ENTERPRISE

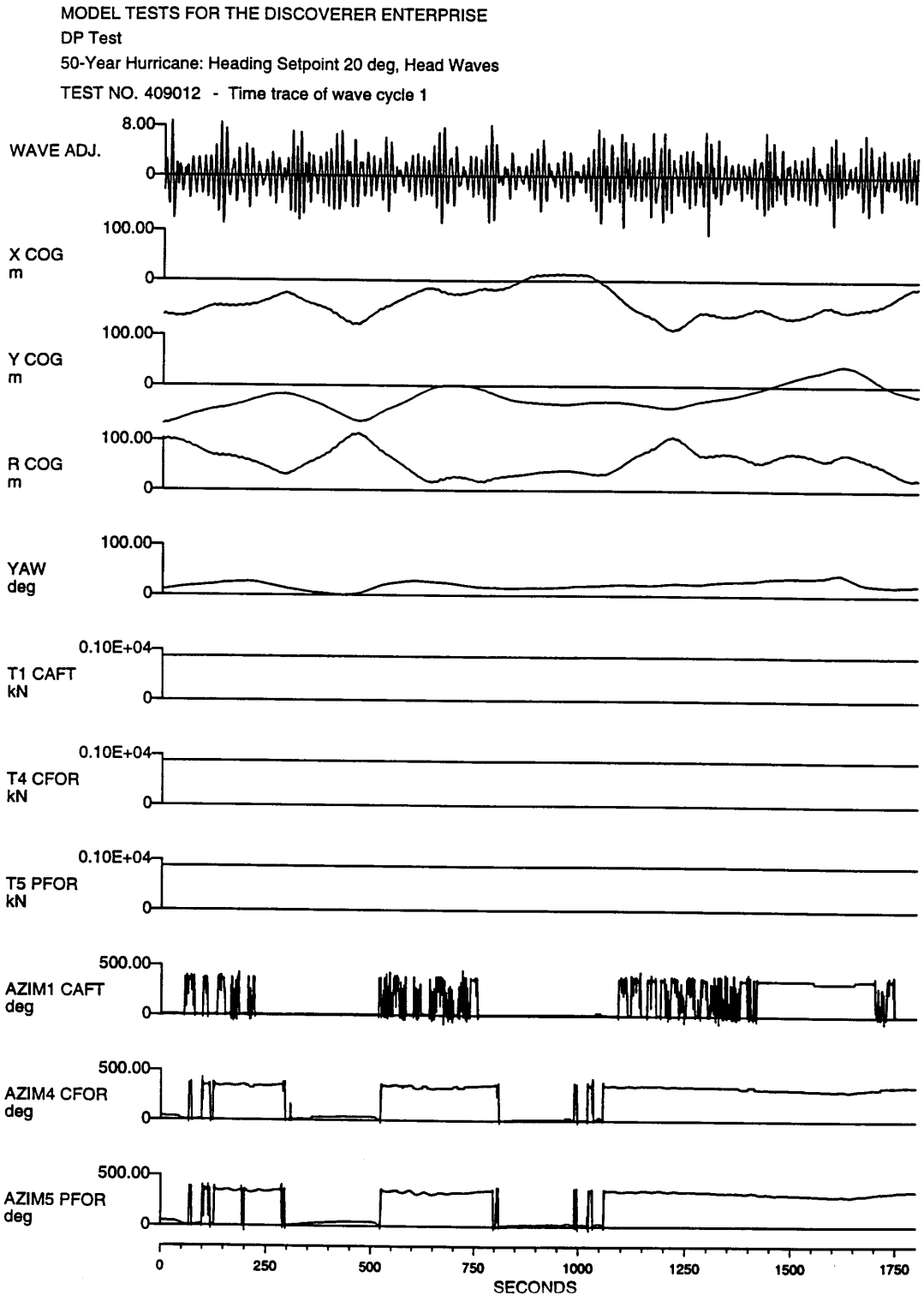
RESULTS OF TEST NO. 409012 - DP TEST

Environmental condition: 50-Year Hurricane
Heading Setpoint : 20 deg, Head Waves

Waves, Wind and Current

STATISTICAL ANALYSIS

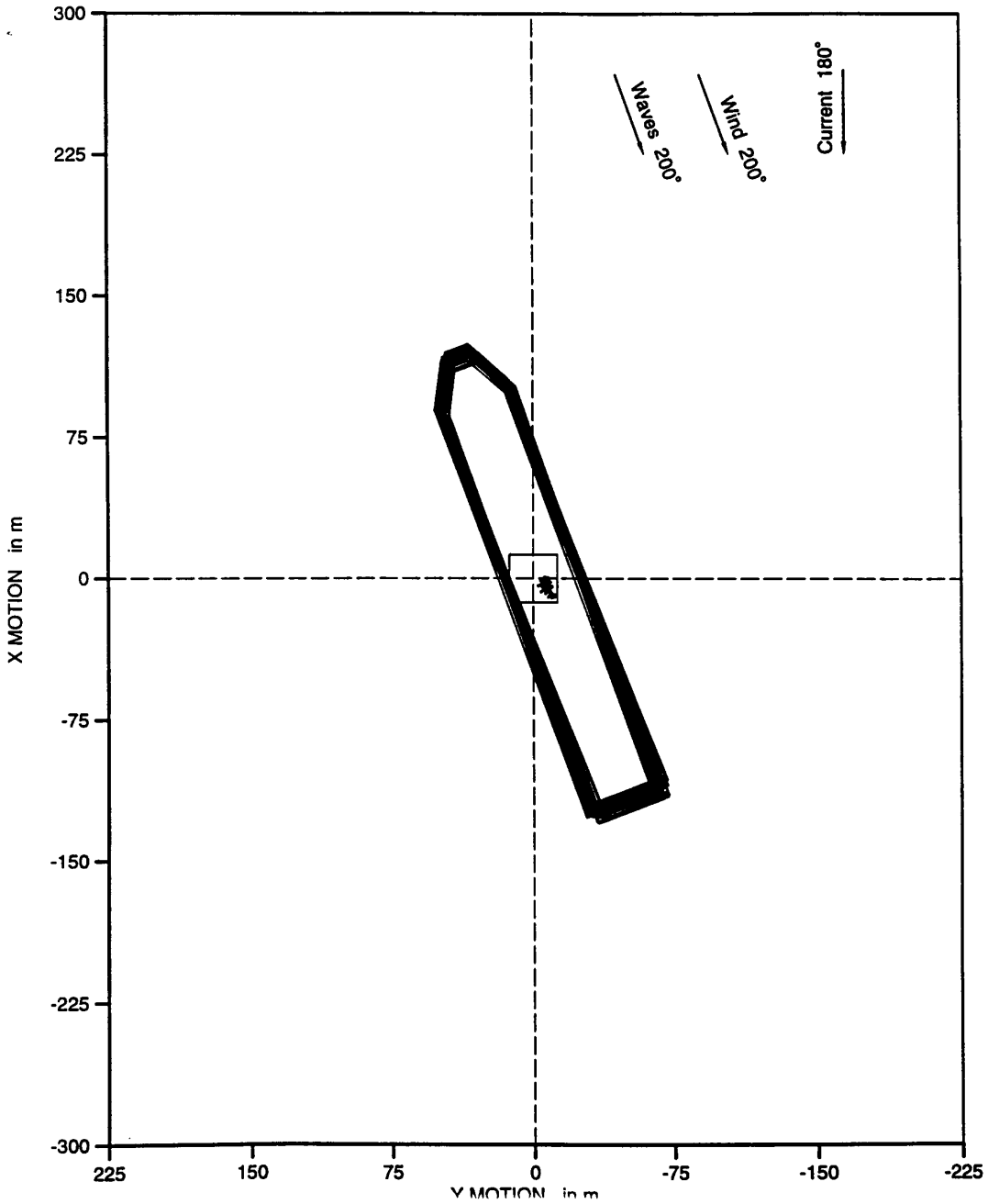
NOTATION	DIM.	MEAN	ST. DEV.	A 1/3 +	A 1/3 -	2A 1/3	A MAX. +	A MAX. -	2A MAX.	NO
X COG	m	-39.70	28.23	-3.46	-71.10	11.51	39.24	-104.00	101.30	416
Y COG	m	-30.00	25.33	-4.98	-61.90	8.71	41.10	-88.60	60.19	309
R COG	m	57.22	25.23	89.02	26.00	12.59	116.40	5.63	96.45	385
Z COG	m	0.00	0.88	1.71	-1.70	3.27	2.88	-2.94	5.48	787
ROLL	deg	2.35	1.68	4.57	-0.04	1.91	10.24	-5.12	12.21	705
PITCH	deg	-0.01	1.47	2.85	-2.89	5.61	4.46	-4.59	9.04	784
YAW	deg	20.50	7.00	30.12	12.67	3.21	45.76	0.13	27.86	462
AX BRIDGE	m/s2	0.03	0.29	0.61	-0.58	1.16	0.96	-1.05	1.87	866
AX DFLOOR	m/s2	-0.02	0.32	0.61	-0.69	1.27	0.99	-1.18	2.03	864
AX AFT	m/s2	0.03	0.26	0.54	-0.54	1.05	0.86	-0.96	1.69	868
AY BRIDGE	m/s2	0.51	0.32	1.00	-0.01	0.63	2.04	-0.99	2.48	883
AY DFLOOR	m/s2	0.40	0.31	0.85	-0.07	0.47	1.95	-0.95	2.48	822
AY AFT	m/s2	0.37	0.30	0.80	-0.11	0.47	1.82	-1.00	2.37	841
AZ BRIDGE	m/s2	0.05	0.71	1.54	-1.39	2.88	2.76	-2.45	4.64	874
AZ DFLOOR	m/s2	-0.03	0.25	0.49	-0.54	1.01	0.98	-0.99	1.76	895
AZ AFT	m/s2	-0.02	0.35	0.68	-0.67	1.31	1.09	-1.01	1.93	843
REL BOW	m	-0.09	4.74	10.21	-10.30	20.20	18.26	-17.70	33.58	898
REL PSIDE	m	-0.99	2.09	3.25	-5.08	7.95	7.09	-10.90	15.83	1081
REL MOON	m	-0.03	2.41	5.04	-4.70	9.52	8.30	-7.07	14.23	1028
T1 CAFT	kN	874.00								
T2 PAFT	kN	874.00								
T3 SAFT	kN	874.00								
T4 CFOR	kN	874.00								
T5 PFOR	kN	874.00								
T6 SFOR	kN	874.00								
AZIM1 CAFT	deg	107.90	152.70							
AZIM2 PAFT	deg	130.20	163.40							
AZIM3 SAFT	deg	137.20	162.00							
AZIM4 CFOR	deg	239.30	154.10							
AZIM5 PFOR	deg	220.10	158.70							
AZIM6 SFOR	deg	170.40	163.50							

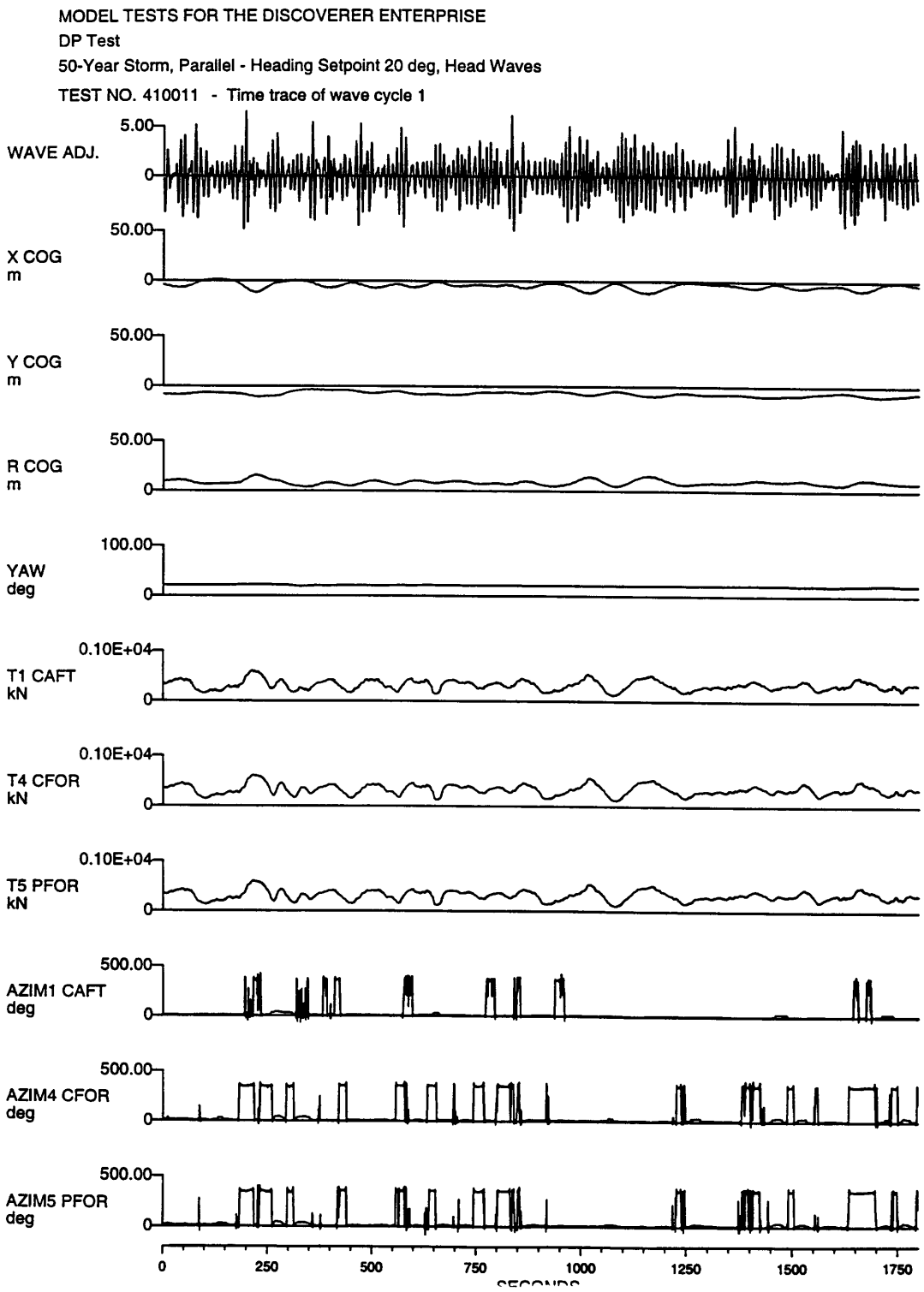

MODEL TESTS FOR THE DISCOVERER ENTERPRISE
DP Test
50-Year Hurricane: Heading Setpoint 20 deg, Head Waves
TEST NO. 409012 - Time trace of wave cycle 1
WAVE ADJ.
8.00
0
X COG
m
100.00
0
Y COG
m
100.00
0
R COG
m
100.00
0
YAW
deg
100.00
0
T1 CAFT
kN
0.10E+04
0
T4 CFOR
kN
0.10E+04
0
T5 PFOR
kN
0.10E+04
0
AZIM1 CAFT
deg
500.00
0
AZIM4 CFOR
deg
500.00
0
AZIM5 PFOR
deg
500.00
0
0
250
500
750
1000
1250
1500
1750
SECONDS

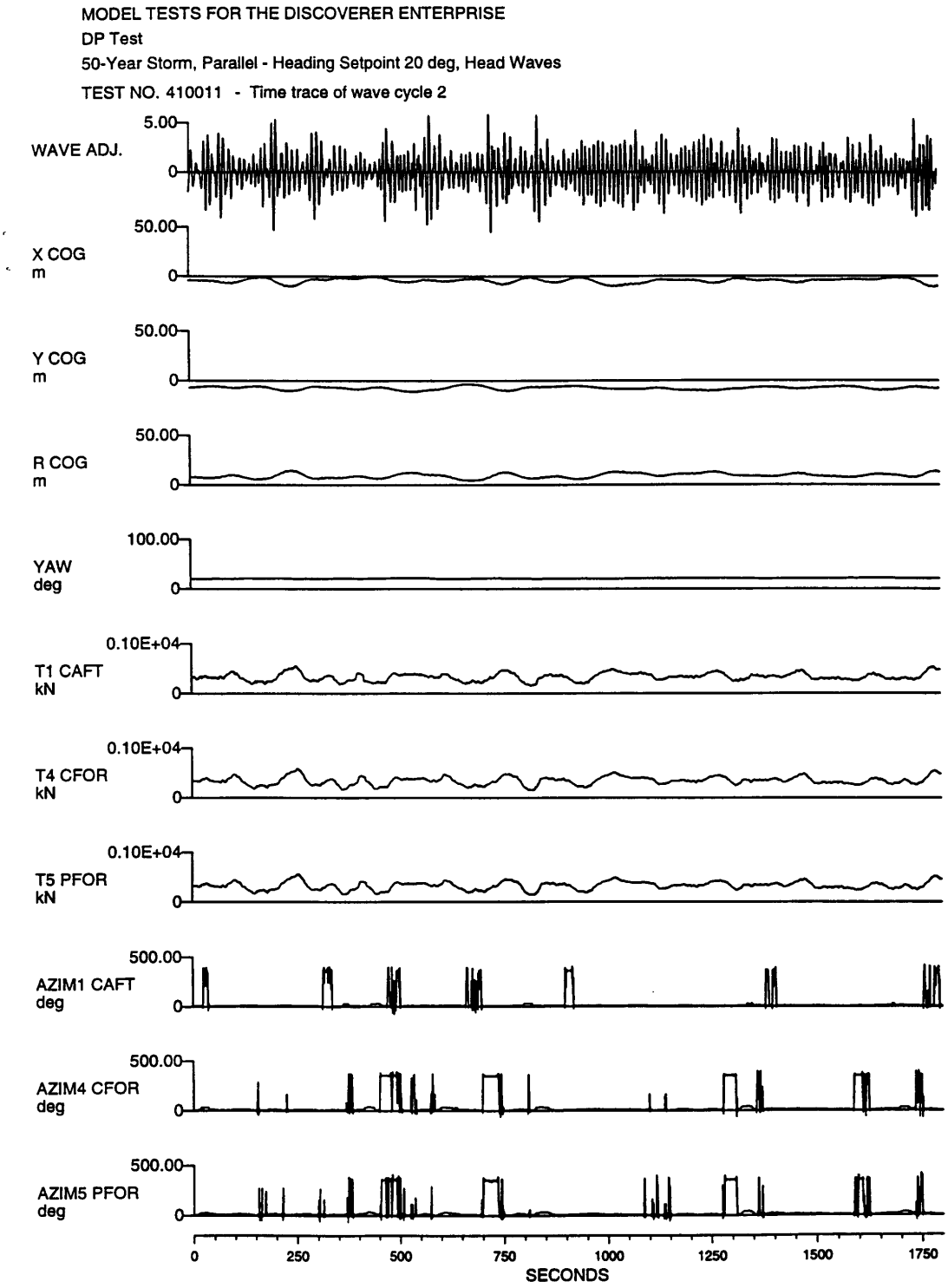
MODEL TESTS FOR THE DISCOVERER ENTERPRISE

DP Test
50-Year Storm, Parallel - Heading Setpoint 20 deg, Head Waves
Waves, Wind and Current

TEST NO. 410011




MODEL TESTS FOR THE DISCOVERER ENTERPRISE
DP Test
50-Year Storm, Parallel - Heading Setpoint 20 deg, Head Waves
TEST NO. 410011 - Time trace of wave cycle 1
WAVE ADJ.
5.00
0
X COG
m
50.00
0
Y COG
m
50.00
0
R COG
m
50.00
0
YAW
deg
100.00
0
T1 CAFT
kN
0.10E+04
0
T4 CFOR
kN
0.10E+04
0
T5 PFOR
kN
0.10E+04
0
AZIM1 CAFT
deg
500.00
0
AZIM4 CFOR
deg
500.00
0
AZIM5 PFOR
deg
500.00
0
0
250
500
750
1000
1250
1500
1750
SECONDS


MODEL TESTS FOR THE DISCOVERER ENTERPRISE
DP Test
50-Year Storm, Parallel - Heading Setpoint 20 deg, Head Waves
TEST NO. 410011 - Time trace of wave cycle 2
WAVE ADJ.
5.00
0
X COG
m
50.00
0
Y COG
m
50.00
0
R COG
m
50.00
0
YAW
deg
100.00
0
T1 CAFT
kN
0.10E+04
0
T4 CFOR
kN
0.10E+04
0
T5 PFOR
kN
0.10E+04
0
AZIM1 CAFT
deg
500.00
0
AZIM4 CFOR
deg
500.00
0
AZIM5 PFOR
deg
500.00
0
0
250
500
750
1000
1250
1500
1750
SECONDS