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Publisher's version / Version de l'éditeur:
https://doi.org/10.4224/18227295
Technical Report, 2009-01-01

National Research Council Canada
Institute for Ocean Technology

Conseil national de recherches Canada
Institut des technologies océaniques

TR-2009-24

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Akinturk, A.; Cumming, D.; Oates, C.; Bass, D.; Millan, J., 2009. Description of Seakeeping Experiments Carried Out on CCGA Roberts Sisters II Model IOT761. St. John's, NL : NRC Institute for Ocean Technology. Technical Report, TR-2009-24.

Canada

DOCUMENTATION PAGE

REPORT NUMBER	NRC REPORT NUMBER	DATE
TR-2009-24		May 2010

REPORT SECURITY CLASSIFICATION	DISTRIBUTION
Unclassified	Unlimited

TITLE

DESCRIPTION OF SEAKEEPING TESTS CARRIED OUT ON CCGA ROBERTS SISTERS II MODEL IOT761

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PUBLICATION

N/A

SPONSORING AGENCY(S)

IOT, SafetyNet

IOT PROJECT NUMBER	NRC FILE NUMBER
42_2374_10	

KEY WORDS	PAGES	FIGS.	TABLES
Fishing Vessel, Seakeeping, Motion Induced Interruptions	ix, 26 App A-J	56	17

SUMMARY

This report describes a set of seakeeping experiments carried out during the summer and into the fall of 2009 as part of the Fishing Vessel Safety Project on a 1:10.67 scale model of the 65 ft (19.81 m) long fishing vessel CCGA Roberts Sisters II, designated IOT761, in the Institute for Ocean Technology (IOT) Offshore Engineering Basin (OEB). The data from these tests was used to correlate with the full-scale data acquired during sea trials carried out off St. John's, NL November 15, 2004. The objective of the experiments was to acquire quality model scale seakeeping data to correlate with full-scale data, as well as to validate numerical prediction software under development at Memorial University of Newfoundland (MUN).

This document describes the model fabrication, instrumentation, data analysis procedure, provides the results of the sea trial /physical model/numerical model correlation exercise and recommendations to improve the overall correlation in future.

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DVD to be included with this report:
DECAY.DIR – all pitch & roll decay results
REG_STAT.XLS – file with regular wave statistics & plots.
IRREG_STAT.XLS – file with irregular wave statistics & plots.
TR-2009-24.PDF – includes test report, figures, tables, appendices.
PHOTOS.DIR – directory of model photos.

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LIST OF ABBREVIATIONS

Accel.	acceleration(s)
AP	aft perpendicular
ART	anti-roll tank
ARTB	anti-roll tank with baffles in place
B	beam, breadth
CD	compact disc
CCGA	Canadian Coast Guard Auxiliary
CCGS	Canadian Coast Guard Ship
CG	center of gravity
cm	centimetre(s)
COG	course over ground
DAS	data acquisition system
DC	direct current
deg.	degree(s)
DOF	degree(s) of freedom
DV	digital video
FFT	Fast Fourier Transform
ft.	feet, foot
FS	full scale
FW	fresh water
g, G	acceleration due to gravity
GDAC	General Data Acquisition and Control

LIST OF ABBREVIATIONS (cont'd.)

GEDAP	General Data Analysis Package
h	water depth
H_{m0}	significant wave height (based on zeroth moment for a narrow banded spectrum)
Ht.	height
H_S	significant wave height (based on zero crossing period)
hw	wave height
Hz	Hertz
IMU	Inertial Measurement Unit
IOT	Institute for Ocean Technology
kg	kilogram(s)
kts.	knots
L	length
LCB	longitudinal center of buoyancy
LCF	longitudinal center of floatation
Lm	model length (LWL)
Lw	wave length
LWL	length water line
m	metre(s)
MII	Motion Induced Interruptions
mm	millimetre(s)
MP	MotionPak
MS	model scale

LIST OF ABBREVIATIONS (cont'd.)

MUN	Memorial University of Newfoundland
NRC	National Research Council
OEB	Offshore Engineering Basin
OMAE	Offshore Mechanics and Arctic Engineering
rad.	radian(s)
RMS	Root Mean Square
rps	revolutions per second
s, sec.	second(s)
SAR	Search And Rescue
S(f)	energy spectrum (function of frequency)
SNAME	Society of Naval Architects and Marine Engineers
SOG	Speed Over Ground
STBD.	starboard
StDev., S.D.	standard deviation
SW	salt water
t	tonne(s), time
T	draft
T1,T2	start/end time
T_{pd}	period of spectral peak calculated by the 'Delft Method'
T_E	wave encounter period
T_Z	zero crossing period
w	circular frequency

LIST OF ABBREVIATIONS (cont'd.)

we	encounter wave frequency
wn	nondimensional wave frequency
ZCA	zero crossing analysis

DESCRIPTION OF SEAKEEPING EXPERIMENTS CARRIED OUT ON CCGA ROBERTS SISTERS II MODEL IOT761

1.0 INTRODUCTION

This report describes a set of seakeeping experiments carried out during the summer and into the fall of 2009 as part of the Fishing Vessel Safety Project on a 1:10.67 scale model of the 65 ft (19.81 m) long fishing vessel CCGA Roberts Sisters II, designated IOT761, in the Institute for Ocean Technology (IOT) Offshore Engineering Basin (OEB). The data from these tests was used to correlate with the full-scale data acquired during sea trials carried out off St. John’s, NL November 15, 2004 - described in Reference 1. The objective of the experiments was to acquire quality model scale seakeeping data to correlate with full-scale data, as well as to validate numerical prediction software under development at Memorial University of Newfoundland (MUN).

This document describes the model fabrication, instrumentation, data analysis procedure, provides the results of the sea trial /physical model/numerical model correlation exercise and recommendations to improve the overall correlation in future.

2.0 BACKGROUND

The Fishing Vessel Safety Project is just a small component of the overall SafetyNet initiative to understand and mitigate the health and safety risks associated with employment in a marine environment. SafetyNet is the first federally funded research program investigating occupational health and safety in historically high risk Atlantic Canada marine, coastal and offshore industries. The Fishing Vessel Safety Project is conducting research on the occupational health and safety of seafood harvesters. Fishing is the most dangerous occupation in Newfoundland and Labrador and is increasingly so: over the past ten years, the rates of reported injuries and fatalities nearly doubled. These trends have the effect of reducing the sustainability of the fishery, increasing health care and compensation costs, and straining the available SAR resources. The development of effective solutions, to prevent or mitigate injury, fatality or SAR events, has been seriously hindered by the scarcity of the research needed to understand the factors that influence seafood harvester occupational health and safety.

The Fishing Vessel Safety Project is a multi-disciplinary, inter-departmental and inter-sectorial research project. The broad-based and multi-factorial approach in investigating the inter-related factors that influence fishing safety including: fishery policy and vessel regulations, vessel safety design and modeling, human relationships on vessels and health and safety program development, implementation and evaluation. The Fishing Vessel Safety Project is composed of six integrated components:

1) Longitudinal Analysis: A statistical analysis of all fishing injuries, fatalities and SAR incidents from 1989 to 2000 to determine trends and influencing factors of seafood harvester occupational health and safety;
2) Perceptions of Risk: An interview-based study, conducted with seafood harvesters, on the perceptions of causes of accidents and near-misses - and the effectiveness of existing accident prevention programs;
3) Motion Induced Interruptions (MII's): Sea trials, physical and numerical modeling of the effects of MIIs, sudden vessel motions induced by wave action, on crew accidents and development of criteria to reduce MIIs;
4) Delayed Return to Work: an interview-based study on the psychological and social factors that delay previously injured seafood harvesters from returning to work;
5) Education Program: The development of an interactive, community-based occupational safety education program for seafood harvesters; and
6) Comparative Analysis: A comparative analysis of accident and fatality rates, and regulatory regimes for fisheries management and fishing vessel safety in Canada, the United States, Iceland, Norway, Denmark, France and Australia.

Several of the project components will yield results that can be directly used by stakeholder organizations for designing and implementing injury and fatality prevention programs. The applied nature of the overall project will be represented by a series of recommendations that will provide accessible and applicable information needed to make informed decisions. Additional information on SafetyNet may be found by visiting their web site (Reference 2).

The effort described in this report is part of Component #3 of the overall Fishing Vessel Research Project. Seakeeping trials on a total of five Newfoundland based fishing vessels ranging in lengths from 35 ft. to 75 ft. (10.67 m to 22.86 m) were completed in 2003/4 (References 1, 3 to 6). Data was acquired on some of the vessels with and without roll damping devices deployed. Standard seakeeping parameters such as ship motions, speed, rudder angle, and heading angle were recorded along with data on the ambient environmental conditions (wave height/direction, wind speed/direction). Free-running physical model experiments on the 35 ft. CCGA Atlantic Swell were carried out early in 2005 (Reference 7) as well as on the 65 ft. CCGA Miss Jacqueline IV in late 2006 (Reference 8). Project participants at the MUN Faculty of Engineering will derive numerical models of all five hull forms and run simulations using their non-linear time domain ship motion prediction codes. Validated simulation tools will then be used to predict the expected level of MIIs for different fishing vessel designs.

Additional information on human factors in ship design is provided in References 9 to 12.

3.0 DESCRIPTION OF THE IOT OFFSHORE ENGINEERING BASIN

The IOT Offshore Engineering Basin (OEB) has a working area of 26 m by 65.8 m with a depth that can be varied from 0.1 m to 2.8 m. Waves are generated using 168 individually computer controlled, hydraulically activated, wet back wavemaker segments fitted around the perimeter of the tank in an 'L' configuration. Each segment can be operated in one of three modes of articulation: flapper mode (± 15º), piston mode (± 400 mm), or a combination of both modes. The wavemakers are capable of generating both regular and irregular waves up to 0.5 m significant wave height. Passive wave absorbers are fitted around the other two sides of the tank. The facility has a recirculating water system based current generation capability with current speed dependent on water depth. The facility also has extensive video coverage and is serviced over its entire working area by a 5 tonne lift capacity crane. Additional information on the OEB can be found in Reference 13.

4.0 DESCRIPTION OF PHYSICAL MODEL IOT761

Model IOT761 is a 1:10.67 scale representation of the CCGA Roberts Sisters II fishing vessel and was fabricated of wood and glass conforming to surfaces generated from 2-D lines/table of offsets constructed according to IOT standard construction procedures described in Reference 14. The hull was made using a Styrofoam™ HI 60 polystyrene foam core with a ¾" plywood floor and Renshape™ was used in areas requiring local reinforcement. IOT's Liné milling machine was used to machine the general geometry of the hull which was then covered with 10 ounce cloth and resin, primed, sanded and painted with three coats of Imron™ Polyurethane 1300U Enamel high gloss yellow paint. A simple superstructure simulating the wheelhouse was included forward.

Model IOT761 was outfitted with six Renshape™ reference blocks located on the gunwales and stern - milled flat to a specified level above the baseline. The hull was reinforced with RENSHAPE™ blocks to provide a secure base for two ¾ inch in diameter 8 inch long (1.905 cm * 20.32 cm) aluminium model launching pins fitted on the sides of the hull forward of Station 5 and well above the waterline. These pins were designed to interface with the model launch system used to restrain the model in waves just prior to each run. A stern eyebolt, anchored to a RENSHAPE™ block, was fitted on the model longitudinal centerline just above the waterline to accommodate a tag line that provided a method to arrest and retrieve the model at the end of each run. Body plan, profile and plan view drawings are provided in Figure 1. Hydrostatics for the ship and physical model are included in Appendix A. Photographs of the completed hull are given in Figure 2.

Since the model was relatively small, very little additional weight was needed to ballast it to the desired draft and trim. The placement of instrumentation (especially batteries) and extra weights was crucial to matching the hydrostatics. A swing test was done, where the nominal locations of the ballast and instrumentation were determined. The model swing results are provided in Appendix B. The model was placed in the small trim tank to set the condition, static and dynamic stability properties - including draft, trim, transverse metacentric height and mass moments of inertia. The results of the inclining experiment are also provided in Appendix B.

Aft of the superstructure, a rectangular passive anti-roll tank (ART) with internal baffles was included with inlet port at the top for convenient filling using 2.88 kg of fresh water dyed blue for enhanced visibility on video and drain plug on one end near the bottom. The period of this tank was matched to the natural roll period of the model as per parameters outlined in Reference 15. A sketch of the model ART is furnished in Figure 3. A plywood plate was fitted over the main deck aft of the ART as a precautionary measure to prevent the electronics from being damaged in the event of water splashing over the deck.

The model was outfit with a propeller shaft and a brass four bladed, right hand stock propeller (propeller 104R, see Figure 4), driven by a Model 1580DC Aerotech brush type rotary DC servo motor. No bilge keels are included in the design. A simple flat plate rudder (Figure 4) was suspended from the hull aft of the propeller. A fixed nozzle encompassing the propeller on the ship and sole piece carried aft to form the lower gudgeon supporting the lower rudder bearing were omitted from the model (Figure 5). Other outfit components included a motor controller; radio control/telemetry electronics, autopilot electronics, model motions measurement instrumentation, cabling and several batteries of different sizes packed in a confined space (Figure 6).

Incorporating an autopilot into the design was desirable to eliminate the heading control variability inherent in using a human operator. In addition, having defined consistent autopilot gain factors incorporated into the numerical model under development by MUN enhances and facilitates the simulation effort. For the ‘Roberts Sisters II’ model, an integrated yaw rate signal was derived from an onboard strapdown inertial measurement unit (IMU) to provide a heading angle feedback signal considered stable enough during the relatively short (< 60 s) runs. As with any closed-loop control signal, the autopilot used the difference between the heading reference signal and the desired heading (the setpoint) to control the rudder angle to mitigate the observed heading difference. Physically, the autopilot control software executes on the shore computer: the IMU feedback signal is telemetered from the model to the shore by radio communications and the rudder command was sent from the autopilot computer back to the model. The autopilot reads the feedback signal, computes a new rudder command and transmits it to the model at a rate of 20 Hz.

An important design consideration was minimizing the influence of the autopilot system on model roll motion by incorporating a Kalman filter-based notch filter programmed to prevent autopilot induced rudder activity at the model natural roll frequency. The procedure adopted for tuning the autopilot for consistent dynamic behaviour was to first categorize the steering attributes of the model for each nominal forward speed as a first order Nomoto equation (identified by system identification techniques from standard zig zag tests performed in calm water in the OEB). The system gain was then computed for each forward speed in order to produce the identical closed-loop steering characteristics, thus ensuring consistent model steering for the entire test program (see table below).

Using these gains, the resulting closed-loop autopilot control bandwidth was 0.544 rad./s and the damping was 0.707. The detailed design of the autopilot system is described in Reference 16.

Forward Speed (m/s MS)	Forward Speed (knots FS)	Nomoto K Parameter	Nomoto T Parameter	Proportional Gain	Differential Gain
0.617	3.92	0.42	2.00	1.2	1.0
1.210	7.68	0.095	1.84	0.48	0.31

A wooden cradle was fabricated to accommodate the model during transit and was fixed to a metal platform to facilitate launching and recovery of the model in the OEB. Four lengths of chain were attached from the base of the platform to the main OEB overhead crane to support the model during launch and recovery (Figure 7). In order to charge the batteries, the model was removed from the OEB after testing at the end of the day and hooked up to a charging facility along side the tank.

5.0 DESCRIPTION OF NUMERICAL PREDICTION PROGRAM 'MOTSIM'

To address some of the deficiencies inherent in standard two dimensional strip theory ship motion prediction programs, researchers from MUN and IOT developed a non-linear time domain code called MOTSIM that simulates six degrees of freedom motion (described in Reference 17). The geometry is defined in terms of a series of sections each described by a set of panels – the more panels, the longer the computation time. At each time step, the code determines the intersection of these panels with the waterline and redefines the paneling describing the ship's waterline. The pressure forces associated with the incident waves are then numerically integrated over the surface, using second order Gaussian Quadrature. The waves are taken as second order Stokes waves. The normal velocity distribution associated with the velocity of the vessel and the incident wave particle velocities is averaged over each panel. A least square fitting of this distribution based on the wetted panels belonging to a particular section is then made such that a unique decomposition of the modal velocities (surge, sway, heave and roll) is obtained that most closely satisfies the body boundary condition on the section. The use of wetted surface to determine modal velocities serves as an approximation to a non-linear body boundary condition. The code permits more general decompositions of the velocity distribution to be made using a higher number of standard or non-standard modes. From this decomposition, the scattering forces and moments are determined for each section based on pre-calculated memory functions. The memory functions for each section are derived using added mass and damping coefficients from zero speed linear theory over a truncated semi-infinite frequency range. Their use allows for arbitrary frequency content in the scattering forces and moments. The added mass and damping coefficients can be either two or three dimensional. Corrections are made for forward speed. Viscous effects associated with roll damping and manoeuvring are determined using semi-empirical formulae or experimentally determined coefficients. The total forces are then used in the non-linear equations of motions to determine the motions of the vessel.

The principle characteristics of this computational intensive software are:

- non-linear Froude-Krylov forces based on the calculated wetted surface of the hull at each time step; and
- radiation and diffraction forces are determined as a single set of scattering forces (based on relative motions) and obtained from memory functions, which are evaluated based on linear theory using a three dimensional panel code.

Thus MOTSIM is considered to be based on a hybrid theory with nonlinear Froude-Krylov terms, but with quasi non-linear three dimensional hydrodynamic terms. Higher amplitude waves can be accommodated and since three dimensional coefficients are calculated, the motions of lower L/B ratio hull forms can be computed with complex end effects included. Over the last several years, MOTSIM has been validated against a number of full scale and model scale data sets, and improvements such as a manoeuvring prediction capability as well as a capability to predict Motion Induced Interruptions (MIIs) have been added. The sea trials on the small fishing vessels involved in this project provided an invaluable opportunity to evaluate the algorithm using a small vessel in a complex multi-directional seaway. Preliminary validation of MOTSIM for predicting full scale motions is provided in Reference 18.

6.0 DESCRIPTION OF INSTRUMENTATION

This section describes the data acquisition, instrumentation and calibration methodology used for each parameter measured:

Several independent systems were used to measure the model motions – a MotionPak II, ADIS motion measurement system, tri-axial accelerometer installation and the QUALISYS system. As these systems are based on different measurement principles, more confidence can be placed in the systems if they achieve similar results.

1) BEI Systron Donner Inertial Division MotionPak II: The MotionPak II is a solid state, six degree of freedom, inertial sensing system used to measure angular rates and linear accelerations. Three orthogonally mounted GyroChip quartz rate gyroscopes are used to measure the three angular velocities: roll, pitch and yaw. Three orthogonally mounted silicon accelerometers measure the three linear accelerations: heave, sway and surge. These accelerations are measured in g's where one g = 9.808 m/s^2. Additional information on the MotionPak II is available in Reference 19.

   Both the angular velocities and linear accelerations were manually calibrated. Angular velocities were calibrated using the turntable that could be rotated at specified angular rates. Accelerations were calibrated in terms of g's, where the maximum measured value is 1 g (9.808 m/s^2). The MotionPak II was placed at different angles such that each individual accelerometer was vertical (positive +1g), vertical (negative –1g) and horizontal (zero g).

MotionPak II was located nominally:
0.8269 m forward of center of gravity full scale
0.2316 m to starboard of center of gravity full scale
1.4557 m above center of gravity full scale

2) Analog Devices, Inc. Model ADIS16405: Motion measurement package that incorporates a tri-axial digital gyroscope angular rate sensor, tri-axial digital linear acceleration sensor as well as built-in signal conditioning, calibration and power management electronics. Factory calibration values were used to calibrate all sensor outputs. Additional Information on the ADIS16405 motions package is provided in Reference 20.

3) QUALISYS: Several infrared emitting bulbs were strategically placed on the model such that the QUALISYS cameras fitted at the east end of the OEB could track its 3D position. The QUALISYS system was used to determine six motions: orthogonal linear displacements (X, Y, Z) in the tank co-ordinate system translated to an origin at the model's center of gravity, the heading angle, and the pitch and roll angle in a body co-ordinate system. X and Y were used to determine model speed. Calibrated during a dedicated exercise when the QUALISYS system was surveyed in. Occasionally it was necessary to move the markers on the model to acquire acceptable data as the model launch position was relocated in the OEB. Additional information on the QUALISYS system is furnished in Reference 21.

4) Bow Accelerometers: Three orthogonally mounted linear accelerometers were installed well forward of the MotionPak II to measure accelerations solely to provide verification of the MotionPak II analysis algorithm. The sensors were calibrated using the same procedure as was used to calibrate the accelerometers in the MotionPak II.

   The bow accelerometers are located nominally from position of MotionPak II:
   3.945 m forward (full scale)
   0.88 m to starboard (full scale)
   2.659 m above (full scale)

Rudder Angle: Rudder angle was measured by installing a rotational potentiometer on the pivot point of the rudder. This parameter was calibrated relative to a protractor fitted adjacent to the linkage. No effort was made to duplicate the ship's rudder slew rate model scale because the slowest rudder rate available on the rudder servo was still much faster than the target value.

Propeller Shaft Rotation: The shaft rotation was measured using a tachometer integral with the propulsion motor. The tachometer provided an analog signal linearly proportional to shaft speed and was calibrated using a laser tachometer aimed at a piece of reflective tape on the shaft.

Wave Elevation: Wave elevation was measured using four capacitance wave probes located at different positions in the OEB. Wave matching was conducted using a separate wave probe nominally located at the OEB's test center – an arbitrary central point in the OEB.

The locations of the four wave probes used during experimentation plus the wave probe installed during wave matching are listed as follows:

WAVE PROBE	**X (m)**	**Y (m)**
South West (Upstream) Probe	15.49	4.77
South East (Downstream) Probe	44.06	4.72
North Beam Probe	30.02	22.69
Calibration Probe	29.65	13.42
South Beam Probe	29.73	4.78

NOTE: the origin (0,0) is the South West corner of the tank.

The wave probes were calibrated using the OEB wave probe calibration facility. A sketch of the OEB layout for these experiments is provided in Figure 8.

Data Acquisition: All analog data was low pass filtered at 10 Hz, amplified as required, and digitized at 50 Hz. All data acquired from the model was conditioned on the model before transfer to onshore data acquisition computer through radio telemetry. The wave and QUALISYS data were conditioned/digitized using a NEFF signal conditioner, transferred to the data acquisition system via cable and stored in parallel with the model data. Synchronization between the NEFF data and telemetry is nominally within 0.2 s.

In addition, an RMS error channel was set up to monitor QUALISYS signal integrity and two signals were acquired to monitor wave board activity. A list of signals acquired is provided in Table 1 while the calibration sheets for each signal (excluding the ADIS motion package which was calibrated using factory calibration factors) are given in Appendix C.

7.0 DESCRIPTION OF THE EXPERIMENTAL SETUP

The OEB was configured for these seakeeping experiments as follows.

Water Depth: The water depth was set at 2.8 meters for the seakeeping experiments.

Blanking Walls: The OEB's blanking walls, that cover the beaches on the north side, were removed for all seakeeping experiments.

Segmented Wave Board Configuration: All boards were adjusted to a height of 1.3 meters as measured from the OEB floor to the bottom of the board, and were set in piston mode.

Wave Generation: Multi-directional irregular waves, corresponding to the 10:57 Newfoundland time waves as measured at sea during the full scale trial using a moored Datawell directional wave buoy (see Figure 9 from Reference 1), were matched with a dominant wave direction of 77.34 degrees relative to the OEB south wall and 88.6 degrees from the OEB west wall. Plots of the target irregular wave spectral density and direction data are presented in Figure 9. Seven 1/50 regular waves over a range of frequencies bracketing the nominal roll natural frequency of the model were matched for each of two dominant wave directions of 25 degrees and 45 degrees from the OEB south wall. See Tables 2 and 3 for details of the regular waves. Two wave directions were used in both the regular and irregular wave cases to provide some flexibility regarding the model direction. A listing of the waves used is provided below:

WAVE NAME	**FULL SCALE WAVE (Buoy, Time)**	**WAVE DIRECTION ** (relative to OEB Orientation)**	**Flipped**
RS2_w1_mds	Datawell, Nov. 15/04, 10:57 NF	77.34 South Wall	Y
RS2_w2_mds	Datawell, Nov. 15/04, 10:57 NF	88.6 South Wall	Y
RS2_w3_mds	Datawell, Nov. 15/04, 10:57 NF	88.6 West Wall	N
RS2_w4_mds	Datawell, Nov. 15/04, 10:57 NF	77.34 West Wall	N
REG65*	Datawell, Nov. 15/04, 10:57 NF	25.0 West Wall	N
REG45*	Datawell, Nov. 15/04, 10:57 NF	45.0 West Wall	N

Wave Generation Summary

* NOTE: The regular waves only had two angles of generation from the OEB west wall listed above, however the varying wave heights and wave periods are listed in Tables 2 & 3.

** NOTE: "Wave Direction" in the table above represents the dominant wave direction.

Where 'Flipped' refers to the waves that had their wave spreading angle characteristics flipped about their dominant axis. This is to ensure that the proper side of the model was receiving the desired wave energy. Wave matching results for both the regular and irregular waves are provided in Appendix D. Information on the standard IOT method of generating waves and computing wave analysis data products can be found in Reference 22.

Video Cameras: Two digital video (DV) cameras were used to record the test runs:

View #1: This camera was mounted in a metal frame on the west wall of the OEB, roughly on the OEB longitudinal centerline, 4.68 m above the OEB floor. This camera was operated remotely from the control station. Images from this camera were recorded on one hour digital video (mini DV) tapes annotated with file name and record time.

View #2: Camera mounted on a mobile tripod and manually directed by an operator with camera location varied along the length of the north and east side of the OEB to derive an optimum view relative to the given model direction. The video recorded by this camera was stored within the camera on a mini DV tape with no annotation. The HD video record was subsequently transferred to a dedicated hard drive unit where each run is stored in separate files with the run number embedded in the file name.

Model Launch System: The OEB has a wood and rope launch system controlled by the overhead crane. The model is held in place by two rubber grips against its hull bottom and a triangular frame of rope on either side (see Figure 10). This frame restrains the model for the first few waves prior to the model's release and angles the model at a predetermined ideal run angle in order to optimize the limited available run length. The model was outfitted with launching pins located port and starboard on the hull, which rest against the rope frame to restrain the model from drifting too far aft. A 200 kg weight at the bottom of the rope launching frame anchors the frame in the tank.

Model Control System: The model's shaft speed and rudder angle were controlled using software installed on an on-shore computer that communicated with the model via wireless modem. Model shaft speed settings were determined iteratively to ensure the desired forward speed in waves, and shaft speed remained constant throughout the run. An autopilot was included in model IOT761 so that the model could move along a set course with respect to the dominant incident wave direction for each run. The model operation, monitoring and data acquisition centre was positioned on the tank walkway directly behind the model when launching from the east end (Figure 11) or on a platform in front of the wavemakers when launching from the west end (Figure 12).

8.0 DESCRIPTION OF SEAKEEPING TEST PROGRAM

The irregular wave test program consisted of performing experiments while transiting at two different forward speeds (nominally trawl speed (2-5 knots full scale) and cruise speed (7 to 8 knots full scale)), and five different headings with respect to the dominant incident waves (head, bow, beam, quartering and following seas). Diagrams of the model launch positions that include the incident wave direction are illustrated in Appendix E. Experiments with the anti-roll tank filled to the operating level were also carried out – bow, beam, quartering and following seas at trawl speed only. In addition, a number of repeat runs were carried out to investigate repeatability as well as uncertainty issues.

The heading angles were derived after careful examination of the directional wave data and ship heading angle data acquired during the 'Roberts Sisters II' full-scale seakeeping sea trials.

Regular wave runs were carried out in beam and quartering seas at two forward speeds (4 and 8 knots full scale) with and without the ART filled over a range of wave frequencies as described in Tables 2 and 3.

Typical Run Sequence:

Carrying out a free running model experiment in the OEB is a labour intensive effort. The following personnel are required:

- Operator of video camera View #2
- Individual operating the model remotely via portable wireless control device.
- Individual attending the model restraining line.
- Individual operating the data acquisition system (DAS), maintaining the run log, initiating video View #1 and wave generator computer.
- Individual carrying out the online data analysis - reviewing the acquired data after each run using a dedicated workstation in the OEB Control Room.

A typical run sequence is provided as follows:

1) All team members take their positions.
2) With model in the start position, the wave generation signal was loaded and wavemaker span set to no (0%) stroke.
3) Data acquisition was triggered which commences (and synchronizes) execution of the wave drive signal. Since the wavemaker stroke is set to 0%, no physical waves were generated. Calm water data is acquired until the delay interval has passed. The delay interval is equal to the sum of all ‘constant speed’ wave data acquired up to that point for a given condition, less a suitable period to allow the irregular wave train to build and traverse the tank to reach the model. Since the entire irregular wave spectrum cannot be covered in a single run, this process is necessary to ensure that seakeeping data for the whole spectrum is acquired in an efficient manner using a series of wave segments.
4) When the required delay interval has passed, the wavemaker span was increased to 100% and physical wave generation begins.
5) Roughly one minute of waves was permitted to pass the model with the model constrained in the launcher.
6) The model shaft speed was adjusted to the desired value however the model was restrained in the launcher by the tag line attached to the stern.
7) Video recording was commenced on the cameras.
8) The model was then released.
9) The model was propelled down the tank with heading angle controlled by the autopilot with some unavoidable lateral drift depending on the wave heading. The model planar (X, Y) position was tracked using QUALISYS. The video camera operator manually tracked the model and zoomed in/out as required, optimizing the image.
10) Within a few metres of the end of the tank, the restraining (tag) line attached to the model stern arrests the model’s forward travel and the shaft speed is cut. Video recording, wave generation and data acquisition were terminated.
11) The model was towed manually back to the starting position using the tag line with the propulsion system and rudder control used to manoeuvre the model stern first into the launching device.

12) A wait time of 12 minutes between runs was required to permit the tank to settle to calm. A varying number of runs dependent on the forward speed and model direction with respect to the incident wave combination was required to complete a given run sequence. A total of 20 minutes of data full scale (367 s model scale) was required to complete each irregular wave run sequence while 2 to 3 runs were carried out to acquire a minimum of 10 wave encounters for regular wave runs.

The zero speed drift runs were executed by merely setting the model heading nominally 90 degrees with respect to the dominant wave direction near the west end of the tank and acquiring data until the model either drifted too close to an obstruction, tank perimeter - or sufficient acquisition time scaled to full scale data matched.

In addition to the runs in waves, a number of dedicated roll decay experiments were carried out in calm water at zero forward speed as well as 4 and 8 knots full scale. The model was manually stimulated in roll by depressing the main deck at the nominal maximum beam. Pitch decay runs were also carried out at zero forward speed in calm water by manually depressing the bow to stimulate the model in pitch.

Photographs of model IOT761 in the OEB during testing are shown in Figures 13 to 15. The Run Log/Video Log is provided in Appendix F.

9.0 DATA ANALYSIS

A description of the data analysis process is provided as follows:

9.1 Online Data Analysis

The data were acquired in GDAC format (*.DAC files) described in References 23, 24. The following online data analysis command procedure was executed on a workstation in the OEB Control Room immediately after each run to verify the integrity of the acquired data:

- All measured channels from instrumentation, south and west wave board monitoring channels, plus signal dropout ‘RMS error’ monitoring channel (QUALISYS) were converted from GDAC to GEDAP format (described in Reference 25) and scaled to full scale units using Froude scaling laws (scale factor 10.67).
- QUALISYS data was de-spiked to remove most of the signal dropouts.
- Dedicated MotionPak II motions analysis software was run generating six degrees of freedom motions at the position of the MotionPak II unit in an earth fixed co-ordinate system using a value for low frequency cut-off (F1) of 0.06 Hz for irregular waves and 0.83 * ($1/T_E$) Hz full scale for regular waves where T_E is the wave encounter period. Since the MotionPak II unit was fitted fairly close to the location of the nominal model CG, it was not necessary to move the computed motions to a new location for this online data review. The following 18 channels were output from the six parameters measured by the MotionPak II: three

orthogonal angular accelerations/rates/angles (roll, pitch and yaw) and three orthogonal linear accelerations/velocities/displacements (surge, sway and heave).

- The QUALISYS linear displacement motions (X, Y, Z) were also deemed to be close enough to the model CG such that it was not necessary to move them.
- A routine was executed to compute two model speed channels (in full scale m/s and knots) from QUALISYS planar position (X, Y) data.
- Five QUALISYS channels were plotted in the time domain (heading angle, forward speed (knots), RMS error and planar (X,Y) position) and time segments for statistical analysis were interactively selected for the initial zero speed segment as well as the steady state speed segment.
- The following entire time series were plotted for review:
    - Plot #1: six QUALISYS acquired model motion channels (3 orthogonal linear displacements, roll, pitch and heading angle)
    - Plot #2: six MotionPak II acquired raw model motion channels (3 orthogonal linear accelerations, 3 orthogonal angular rates)
    - Plot #3: QUALISYS signal integrity channel, south wave board monitoring channel and the four wave probe channels
    - Plot #4: model speed over ground (m/s), rudder angle, shaft speed, bow vertical, lateral and longitudinal acceleration channels
    - Plot #5: six of the computed MotionPak II motion channels in an earth referenced co-ordinate system – (3 orthogonal angles, 3 orthogonal linear accelerations)
    - Plot #6: six acquired ADIS parameters (3 orthogonal angles, 3 orthogonal linear accelerations)
- Basic statistics (minimum, maximum, mean, standard deviation) were computed for all measured and computed channels for the interactively selected zero speed and steady state time segment.
- The user was given the option to plot the six time series plots to a local laser printer in the OEB Control Room.
- A table of basic statistics were output to a local laser printer in the OEB Control Room and statistics were stored in an ASCII format file in the project directory.

The following is a list of parameters examined throughout the course of the online analysis to provide an indication of the quality of the data acquired.

- Verifying the value of the shaft rps, model forward speed, and heading angle as being relatively constant and the correct magnitude.
- Comparing the standard deviation of the motion channels output by QUALISYS, ADIS and MotionPak II.
- Reviewing the QUALISYS signal integrity channel for evidence of signal loss. If significant signal loss was detected during critical segments of the run, the run was normally repeated.
- Plotting and comparing the pitch and roll angle data output from QUALISYS on the same time base as the integrated roll and pitch rate data from the MotionPak II.

An example online data analysis product is provided in Appendix G.

9.2 Offline Data Analysis

The offline data analysis is carried out to merge all irregular (20 minutes full scale) or regular (minimum 10 cycles) runs for a given heading angle/forward speed/ART combination before computing the statistics. The analysis sequence is described as follows:

1) Initial offline data analysis:

- All measured channels from instrumentation plus dropout monitoring channel 'RMS error' (QUALISYS) and wave board monitoring channels were converted from GDAC to GEDAP format (described in Reference 25). The model scale data was converted to full scale using Froude scaling laws. (scaling factor = 10.67).
- The following 13 channels were isolated for further analysis:
    1) South Center Wave Height
    2) MotionPak II Roll Rate
    3) MotionPak II Pitch Rate
    4) MotionPak II Yaw Rate
    5) MotionPak II Surge Acceleration
    6) MotionPak II Sway Acceleration
    7) MotionPak II Heave Acceleration
    8) Shaft Speed
    9) Rudder Angle
    10) QUALISYS X Displacement
    11) QUALISYS Y Displacement
    12) QUALISYS Pitch Angle
    13) QUALISYS Roll Angle
- The rudder angle and shaft speed channels were low pass filtered using a high frequency cut-off value of 3 Hz to remove signal noise.
- Routines were executed to compute a model speed channel (m/s) from the smoothed QUALISYS planar position (X, Y) data.
- A second full scale speed channel was computed from the smoothed QUALISYS planar position (X, Y) data (knots) and output as Channel 14.

2) Select Time Segments

Time segments were selected for all 14 channels – each run starting from 0 s and having a minimum of at least 60 s after the final segment. The segments for each channel start and end at the same time with a 3 s overlap between segments.

3) Merge Data

The data for each channel of each segment was smoothly merged using a 3 s overlap.

4) Analysis of MotionPak II Data

- The sign of MotionPak II Heave Acceleration was changed by multiplying by –1.
- Dedicated FFT based MotionPak II motions data analysis software was run to compute motions at the CG in an earth fixed co-ordinate system using a value for low frequency cut-off (F1) of 0.06 Hz for the irregular waves and 0.83 * ($1/T_E$) Hz full scale for regular waves where T_E is the wave encounter period. Since the MotionPak II unit was not fitted exactly at the location of the nominal model CG, it was necessary to move the computed motions to a new location as follows:
  X = 0.8269 m aft full scale
  Y = 0.2316 m to starboard full scale
  Z = 1.4557 m down full scale
  The following 18 channels were output: three orthogonal angular accelerations/rates/angles (roll, pitch and yaw) and three orthogonal linear accelerations/velocities/displacements (surge, sway and heave).
- The channels are re-ordered and some channels are discarded. The following 18 channels are retained:

CHANNEL DESCRIPTION	UNITS
1) MotionPak II Surge Displacement	m
2) MotionPak II Surge Acceleration	m/s^2
3) MotionPak II Sway Displacement	m
4) MotionPak II Sway Acceleration	m/s^2
5) MotionPak II Heave Displacement	m
6) MotionPak II Heave Acceleration	m/s^2
7) MotionPak II Yaw Angle	deg.
8) MotionPak II Yaw Rate	deg./s
9) MotionPak II Pitch Angle	deg.
10) MotionPak II Pitch Rate	deg./s
11) MotionPak II Roll Angle	deg.
12) MotionPak II Roll Rate	deg./s
13) Shaft Speed	rps
14) Rudder Angle	deg.
15) QUALISYS Pitch Angle	deg.
16) QUALISYS Roll Angle	deg.
17) Forward Speed	knots
18) South Center Wave Probe	m

It is noted that during analysis of the MotionPak II data that 5% of the data is lost off the start and end of each MotionPak II channel.

5) Review Data, Select Final Time Segments

All 18 channels were reviewed in the time domain to ensure there were no anomalies and manually de-spiked as required. For irregular wave runs, the optimum 1200 s (20 minutes full scale) was identified and selected.

6) Basic Statistics Computed

It was noted that there was significant noise on several of the acquired channels probably emanating from RF sources or from local mechanical vibration on the model. To eliminate this noise, a rectangular band pass (normally 0 to 0.4 Hz or 0 to 0.5 Hz) filter was applied. This did not affect the mean value of the data however significantly reduced the standard deviation. An example time series plot of filtered heave acceleration data superimposed on unfiltered data is provided in Figure 16.

A procedure was run to compute the basic statistics (minimum, maximum, mean ands standard deviation) for all 18 channels and the data output in an ASCII format file.

Comparison between QUALISYS and MotionPak II roll and pitch angle data in the time domain was carried out as a final verification. In addition, a few channels of the filtered data were compared to the unfiltered data to ensure the filtering process did not introduce any anomalies.

A zero crossing analysis was performed on MotionPak II heave displacement to count the number of upcrossings and downcrossing using a threshold value of 0.05 m. This value was assumed to be equal to the number of wave encounters. This information was appended to the end of the ASCII statistics file.

A zero crossing analysis was performed on the wave data from the south center wave probe for regular wave runs to determine the average wave height and period using a threshold value of 0.05 m. This information was appended to the end of the ASCII statistics file.

A spectral density analysis using 22 degrees of freedom was executed on the wave data from the south center wave probe for irregular wave runs to estimate the significant wave height ($H_{m0} = 4 * SQRT(M0)$ where M0 is the first spectral moment) as well as the period of the spectral peak (T_{pd}) using the 'Delft Method' (see Reference 22). This information was also appended to the end of the ASCII statistics file.

An example of the ASCII format basic statistics file for a typical regular wave run (CASE5_4) is given in Table 4 while the statistics for a typical irregular wave run (quartering seas, trawl speed) is furnished in Table 5. Example time series plots for each merged channel (excluding the two QUALISYS channels) for a typical regular wave run (CASE5_4) and irregular wave run (quartering seas, trawl speed) is provided in Appendix H.

Summery tables of regular wave standard deviation basic statistics for each run are provided in Table 6. Plots of standard deviation linear accelerations (m/s^2) and angles (deg.) vs. measured average wave period (s) at the south center wave probe are presented in Figures 17 to 26. Plots of standard deviation roll angle (deg.) vs. wave encounter frequency (rad./s) to illustrate the influence of fluid added to the ART on roll response are furnished in Figures 27 to 30.

Summery tables of irregular wave standard deviation basic statistics for each merged run are provided in Table 7. Plots of standard deviation linear accelerations (m/s^2) and angles (deg.) vs. heading with respect to the nominal wave direction are given in Figure 31 (trawl speed, ART empty) and Figure 32 (cruise speed, ART empty). A plot of standard deviation roll angle (deg.) vs. heading with respect to the nominal wave direction (up to bow seas as a head seas run was omitted from the test plan) to illustrate the influence of fluid added to the ART on roll response is furnished in Figure 33.

A DVD with the detailed tables of statistics in EXCEL format[1] is included with this report.

9.3 Roll and Pitch Decay Analysis

The roll and pitch decay runs were analyzed using dedicated software to compute the equivalent viscous damping. Pitch and roll decay runs were carried out in calm water at zero forward speed while roll decay runs were also carried out at 4 knots and 8 knots as described in Section 8.0. QUALISYS roll angle and ADIS roll rate data was used for all the analysis with the exception of the pitch decay runs where the MotionPak II pitch rate and ADIS pitch rate channels were used. Initially, the decay data was reviewed in the time domain and data from each of the excitations was isolated and separated out into individual GEDAP files omitting the first half cycle and all very low amplitude cycles. The data was then low pass filtered prior to carrying out the following analysis procedure:

The decay analysis algorithm computes viscous equivalent damping. Peaks and troughs data were input, and log decrements were computed as the natural logarithm of the ratio of two successive amplitudes. Both crests and troughs were used in calculating log decrements to increase the computational accuracy - especially in cases where only a few decay cycles were available. Damping ratios are calculated from the log decrements whereby the damping ratio for linear damping was estimated as the average of these log decrements. The damping ratio for non-linear damping is modeled in the form:

zeta = B1 + B2 * X

where zeta = damping ratio
B1 = equivalent damping linear term
B2 = equivalent damping non-linear term

If the damping is linear, B2 = 0 and B1 is equal to the damping ratio for linear damping.

The equivalent damping terms were estimated by fitting a linear regression line through the damping ratio versus amplitude values. The equivalent damping linear term is the y intercept of the regression line. The equivalent damping non-linear term is set to be the slope of the regression line. The software uses the equivalent damping linear and equivalent damping non-linear terms to compute the equivalent damping envelope for the decay series.

The following plots were generated:

1) Roll or Pitch Angle vs. Time Plot: illustrating the raw data, the filtered decay series, the equivalent damping curve, the mean value and the detected peaks and troughs.

2) Damping Ratio vs. Amplitude Plot

3) Period vs. Amplitude Plot

The following two tables were also generated for each excitation:

1) Table listing the offset, average period, linear damping coefficient, equivalent damping slope and the equivalent damping offset for the entire selected time segment.

2) Table listing for each half cycle: amplitude, amplitude-offset, damping ratio, and period for each trough and crest in the selected decay time series.

Example data products described above are provided in Figure 34 for a typical pitch decay run, Figure 35 for a zero speed roll decay run and Figure 36 for an 8 knot full scale forward speed run with ART active. The results of the roll and pitch decay analysis are summarized in Table 8. The average full scale roll period without water in the ART is 6.0544 s (zero forward speed), 6.0948 s (4 knots), and 6.1061s (8 knots). The average full scale roll period with water in the ART (no baffles installed) is 7.6005 s (4 knots), and 7.3377 s (8 knots). The average full scale roll period with water in the ART (baffles installed) is 7.4032 s (4 knots), and 7.2679 s (8 knots). The average full scale zero speed pitch period is 3.5409 s. Note the accuracy of the results declines as the forward speed increases due to the reduced number of available cycles.

The entire set of roll and pitch decay results have been scanned in and are included on the DVD accompanying this report.

9.4 Investigation of Autopilot Performance

To investigate the performance of the model autopilot, plots of model/ship roll, yaw and rudder angle vs. heading angle were generated for both the trawl and cruise speeds (Figures 37, 38).

9.5 Seakeeping Data Verification Process

The following efforts were carried out to validate the integrity of the acquired motions data:

Comparison of Basic Statistics from Different Sensors: The following comparison of the minimum, maximum and standard deviation statistics for four typical runs (CBOW_008, THEAD_001, CASE3_3_003 and ART_TBEAM_008) are given in Table 9.

- QUALISYS/MotionPak II Pitch Angle;
- ADIS/MotionPak II Pitch Rate;
- QUALISYS/MotionPak II Roll Angle;
- ADIS/MotionPak II Roll Rate;
- QUALISYS/MotionPak II Heave (Z) Displacement;
- QUALISYS/MotionPak II Yaw (Heading) Angle;
- ADIS/MotionPak II Yaw Rate.

Time Domain Comparison: Time series plots for a typical run (CBOW_008) comparing the following parameters are included in Appendix I.

- Comparison of QUALISYS roll angle to MotionPak II roll angle;
- Comparison of QUALISYS pitch angle to MotionPak II pitch angle;
- Comparison of QUALISYS heading angle to MotionPak II yaw angle;
- Comparison of QUALISYS vertical (heave) displacement to MotionPak II vertical (heave) displacement;
- Comparison of ADIS roll rate to MotionPak II roll rate;
- Comparison of ADIS pitch rate to MotionPak II pitch rate;
- Comparison of ADIS yaw rate to MotionPak II yaw rate.

Additional comparisons of MotionPak II data to ADIS are provided in Reference 26.

Comparison of MotionPak II and Bow Tri-Axial Accelerations: Dedicated software was used to move the orthogonal accelerations as measured by the MotionPak II in a body co-ordinate system to the location of the bow accelerometers. The bow accelerometer package was assumed to be 3.945 m full scale forward of the MotionPak II, 0.88 m full scale to starboard of the MotionPak II and 2.659 m full scale above the MotionPak II. Comparisons were made with both filtered and unfiltered data. Time series plots for a typical run (CBOW_008) comparing filtered and unfiltered orthogonal accelerations are provided in Appendix J. Comparison of the minimum, maximum and standard deviation statistics for four typical runs (CBOW_008, THEAD_001, CASE3_3_003 and ART_TBEAM_008) are given in Table 10. Table 10 also includes the notch filtering frequencies used.

Data Repeatability Analysis Results: A comparison of the basic statistics from the first three time segments of four separate runs for both a following seas, trawl speed, ART empty as well as following seas, trawl speed, ART filled is presented in Table 11.

10.0 COMPARISON OF FULL SCALE, PHYSICAL MODEL AND NUMERICAL MODEL DATA

Based on model tests, sea trials and numerical results, comparisons of all data were made in two separate analyses, regular and irregular waves. There are some factors to consider when reading the comparison and viewing the plots. The model data is intended to reflect that of the sea trials, however there are sources of error in both the model tests as well as sea trials that prevents the results from perfectly correlating. Some of these sources of error are first discussed below:

Model Geometry

The model geometry may have been a factor in the discrepancies between both the sea trial and MOTSIM results. The scale factor is approximate, but the 'Roberts Sisters II' geometry itself has some uncertainty. The keel was estimated on the model as well, which could have impacted the differences in results. Also note that the Roberts Sisters II was fitted with a nozzle encompassing the propeller, however, the nozzle was not present on the model. There are also uncertainties in the results obtained when the anti roll tank was filled. The position of the modelled tank was approximated and its performance could have been altered with regard to materials used and the system in general.

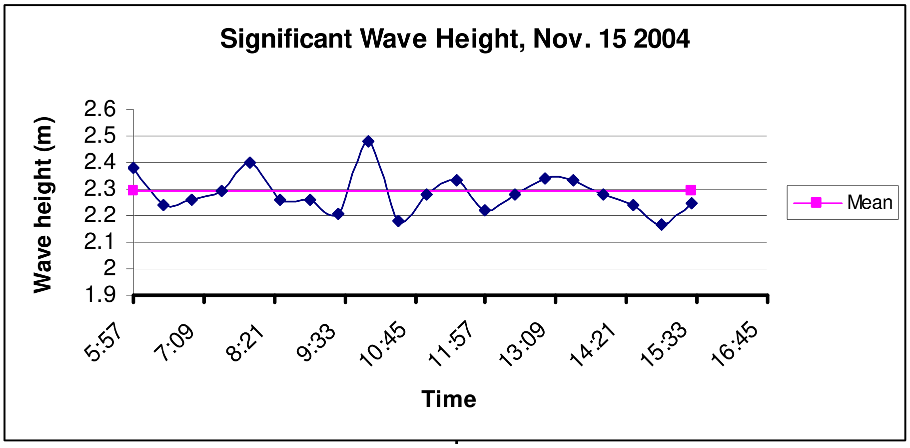
Wave Buoy

It should also be noted that during the sea trials, while the data was being retrieved from the wave buoys, the 'Roberts Sisters II' location was much farther away from the buoy such that the waves at her location could have been different than those experienced at the buoy.

Waves

The waves used in the OEB for the model runs were measured during the sea trial at 11 o'clock on November 15, 2004. Thus only one nominal wave was used. Discrepancies in the model data and MOTSIM data could be due to the fact that the entire wave spectrum was used for MOTSIM. So any changes in significant wave height could be the cause of an excess or lack of energy for the waves in the model runs. The plot below shows that the 11 o'clock significant wave height lies roughly around the mean at about 2.3 m.

During the sea trials, it also would have been optimal if the sea state remained constant, however, sea conditions are constantly changing which makes it impossible to determine an exact sea state at a given time.



Significant Wave Height vs. Time (sea trial data)

Other Factors

Another factor in discrepancies in the results could have been due to the fact that the actual sea trials took place at a distance where it was still possible to have reflections of the waves from the nearby land mass. The size of the OEB was also insufficient for proper model testing and mimicking the desired conditions was difficult.

Irregular Wave Data Comparison

A comparison was made based on the results gathered from the 'Roberts Sisters II' sea trials in 2004, model tests carried out in the OEB and numerical data results obtained from MOTSIM. This comparison is based on irregular wave data.

Experiments were carried out at 4 knots (trawling speed), 8 knots (cruising speed) as well as 4 knots with the anti-roll tank active. All three scenarios were used in the comparison plots. The plots compare each acceleration/angular rate to the heading angle at each speed for all sets of data. The plots are shown in Figures 39 to 56 while the results are listed in Tables 12 to 17.

Trawling Speed (ART empty)

Figures 39 to 44 shows the comparison plots for irregular waves at trawling speed. The model results as well as the numerical result for amot_4ktnp_m165 for shows surge to be over predicted in comparison to the MOTSIM results and sea trials. Although at bow seas all results are consistent. Results for sway and heave were fairly consistent with the model tests being slightly under predicted at following and quartering seas and over predicted at beam, bow and head seas. Both model test and MOTSIM are under predicted at following and quartering seas for roll angle, consistent at beam seas, and over predicted at bow and head seas.

Cruising Speed (ART empty)

Figures 45 to 50 shows the comparison plots for irregular waves at cruising speed. These plots follow a consistent pattern to that of trawling speed. For surge acceleration, all results are consistent at bow seas and slightly over predicted at following, quartering, beam and head seas. Model test results for both sway and heave are under predicted at following and quartering seas and over predicted at beam, bow and head seas. The roll angle data is consistent with results for MOTSIM at beam bow and head seas, while the model test results are over predicted. Both model test and MOTSIM results are under predicted for following and quartering seas.

Trawling speed with ART Active

Figures 51 to 56 shows the comparison plots for irregular waves at trawling speed with the anti-roll tank active. Sea trials were not conducted with the ant-roll tank is use at head seas or following seas, so comparison will only be made for quartering, beam and bow seas. The MOTSIM result for amot_ktnpt_m165 is greatly over predicted for sway, pitch and roll. Roll angle is of main interest in this comparison. Figure 33 shows a comparison of roll angle at trawl speed with and without the anti-roll tank filled. From this plot it is shown that the anti roll tank reduces the roll angle.

11.0 DISCUSSION & RECOMMENDATIONS

Comparisons of motions as measured during the sea trial, model tests and estimated numerically using a number of wave inputs are illustrated in Figures 39 to 56 with the values listed in Tables 12 to 17. The model test results compared to full scale data can generally be described as poor. The primary factors for this poor correlation are assumed to be:

- The challenge in emulating a complex ‘real’ multi-directional wave in a small wave basin that is not optimized for free-running seakeeping tests;
- The fact that the only irregular wave matched was measured by the moored wave buoy at 11 o’clock the day of the trial while the wave conditions are changing throughout the day.
- The yaw angle correlation was particularly poor. Although an autopilot was used during the model experiments, the gain factors were assumed nominal values as the autopilot gain factors on the ship were unknown.
- The lack of a nozzle on the model, while the difference in wetted surface area and lateral profile area are not likely enough to significantly impact on the measured motions per se, the flow over the rudder on the ship would be significantly higher than on the model and thus the ship steering efficiency would be much greater than the model probably resulting in lower yaw angles for the same speed.

Comparison of motions from different sensors (Table 9, Appendix I): Standard deviation statistics computed for motions measured using different sensors generally compared within 3% with the exception when very small deviations were noted.

Comparison of motions measured by MotionPak II transferred and compared to orthogonal accelerometers on bow (Table 10): Standard deviation statistics computed in the body co-ordinate system and moved to the location of the accelerometers at the bow also generally compared within 3% with the exception when very small deviations were noted.

A review of the data repeatability analysis results (Table 11) implies that the data is repeatable with acceptable deviations between primary model motion parameters and incident waves.

Autopilot Performance Issues: Comparisons of the model autopilot performance versus the sea trial autopilot performance showed poor model scale heading keeping. Especially poor model autopilot performance was noted in the following test conditions: following and quartering seas at cruise speed and following, beam and bow seas at trawl speed. A number of factors appear to be contributing to the poor autopilot performance including:

1) Unlike the full scale vessel, the model lacks a nozzle encompassing the propeller directing the flow on the rudder thereby increasing rudder performance even at slow forward speeds.
2) The full-scale autopilot tuning gains are unknown and were not matched by the model scale autopilot.
3) The model scale heading reference may drift during a run.
4) Lack of integral gain in the autopilot controller may contribute to a constant error between the desired heading and the actual course steered.
5) At launch, sometimes the model starts off with an incorrect heading: this can take a considerable amount of the run segment for the autopilot to correct – especially at slow forward speed.

Integral gain is not feasible to add to the controller, since the run durations are not long enough for it to have an effect on the “following error” or offset heading error. This small error should be taken into account during analysis or the operator could account for it by adjusting the heading setpoint of the autopilot prior to launch. Exact matching of headings from run segment to run segment is problematic and is likely to continue to be an issue in the future due to the combined effects of offset heading error and heading initial launch heading errors.

The following recommendations may help to improve model-scale autopilot performance in the future:

1) Match Full-Scale Autopilot Gains: It may be possible to identify the closed-loop gains of the autopilot during the field trials. The procedure would require that some zig-zag runs be conducted in relatively calm water to identify the open-loop

steering model (autopilot off), and closed-loop steering model (autopilot on). It is not clear if step responses or zig-zags could be conducted with the autopilot on. Failing this approach, hand tuning of the autopilot to achieve similar course-keeping at model scale would be a relatively easy task, but would require a number of runs at the various test conditions.

2) Change Heading Reference: In older model-scale autopilots, the Qualisys was used to provide a non-drifting heading reference. During operation in areas of the OEB that have no Qualisys coverage, the inertial system can be used to fill in.

12.0 ACKNOWLEDGEMENTS

The authors would like to thank the technical support staff at IOT for their assistance during this test program. In addition, the assistance of MUN co-op student Elizabeth Charmley with the preliminary experiments (summer 2009) was much appreciated.

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TABLES

CCGA Roberts Sisters II Seakeeping Experiments

Offshore Engineering Basin **July-Oct. 2009**

Model IOT761 **Scale 1:10.67**

Name	Units	Range	Device
shaft speed	rps	+/- 12	tachometer
pitch rate	deg./s	+/- 40	MotionPak II
roll rate	deg./s	+/- 40	MotionPak II
yaw rate	deg./s	+/- 10	MotionPak II
heave acceleration	G	+/- 1	MotionPak II
sway acceleration	G	+/- 1	MotionPak II
surge acceleration	G	+/- 1	MotionPak II
rudder angle	deg.	+/- 24	potentiometer
heading angle	deg.	+/- 185	QUALISYS
roll angle	deg.	+/- 85	QUALISYS
pitch angle	deg.	+/- 85	QUALISYS
bow vertical acceleration	G	+/- 1	linear uni-axial accelerometer
bow lateral acceleration	G	+/- 1	linear uni-axial accelerometer
bow longitudinal acceleration	G	+/- 1	linear uni-axial accelerometer
X Displacement	m	2 - 59	QUALISYS
Y Displacement	m	2 - 23	QUALISYS
Z Displacement	m	-0.5 - +4.5	QUALISYS
heave acceleration	G	+/- 8	ADIS Motion Package
sway acceleration	G	+/- 8	ADIS Motion Package
surge acceleration	G	+/- 8	ADIS Motion Package
pitch rate	deg./s	+/- 400	ADIS Motion Package
roll rate	deg./s	+/- 400	ADIS Motion Package
yaw rate	deg./s	+/- 400	ADIS Motion Package
South East Wave Elevation	m	0 – 0.7	Capacitance Wave Probe
South Center Wave Elevation	m	0 – 0.8	Capacitance Wave Probe
South West Wave Elevation	m	0 – 0.8	Capacitance Wave Probe
North Center Wave Elevation	m	0 – 0.7	Capacitance Wave Probe

NOTE:

1) Model forward speed computed from QUALISYS X and Y planar position.
2) MotionPak II data to be used to compute the following 18 channels:

Roll/Pitch/Yaw Angle/Velocity/Acceleration

Surge/Sway/Heave Displacement/Velocity/Acceleration

MotionPak II motions can be moved to any point on the rigid body and output in either an earth or a body co-ordinate system.

3) Vertical, lateral & longitudinal linear accelerometers to be installed in bow to verify MotionPak II output.
4) An RMS error channel was also acquired to monitor QUALISYS signal integrity.
5) A south and west wave board amplitude signal were also acquired to monitor actual wave board activity.
6) All channels to be sampled at 50 Hz, low pass filtered at 10 Hz.

TABLE 1: List of Signals Measured

Safer Fishing Vessel Seakeeping **CCGA Roberts Sisters II Seakeeping Experiments - July 2009**
Proj. #42_2374_10

CASE 1
Heading: Beam seas — ART is empty
Model speed: 0.630 m/s (4 knots)
distance traveled by model 58.00 m — Transverse distance 24.51 m
Total travelling time at speed 92.06 s

	Non-dim	Full scale	Model scale								
No	wn	w [rad/s]	w [rad/s]	f [Hz]	Period [s]	Wave Length [m]	Wave height (1/50) [m]	Wave height (1/35) [m]	Deep Water Ratio	Encounter wave frequency	No of wave encounters
1	1.1	0.784	2.562	0.408	2.453	9.018	0.180	0.258	0.621	2.562	37.5
2	1.2	0.856	2.795	0.445	2.248	7.726	0.155	0.221	0.725	2.795	40.9
3	1.3	0.927	3.028	0.482	2.075	6.655	0.133	0.190	0.841	3.028	44.4
4	1.4	0.998	3.261	0.519	1.927	5.771	0.115	0.165	0.970	3.261	47.8
5	1.5	1.070	3.493	0.556	1.799	5.040	0.101	0.144	1.111	3.493	51.2
6	1.6	1.141	3.726	0.593	1.686	4.435	0.089	0.127	1.263	3.726	54.6
7	1.8	1.284	4.192	0.667	1.499	3.506	0.070	0.100	1.597	4.192	61.4

CASE 2 CASE 1 with ART fillied

CASE 3
Heading: Beam seas — ART is empty
Model speed: 1.260 m/s (8 knots)
distance traveled by model 58.00 m — Transverse distance 24.51 m
Total travelling time at speed 46.03 s

	Non-dim	Full scale	Model scale								
No	wn	w [rad/s]	w [rad/s]	f [Hz]	Period [s]	Wave length [m]	Wave height (1/50) [m]	Wave height (1/35) [m]	Deep Water Ratio	Encounter wave frequency	No of wave encounters
1	1.1	0.784	2.562	0.408	2.453	9.018	0.180	0.258	0.621	2.562	18.8
2	1.2	0.856	2.795	0.445	2.248	7.726	0.155	0.221	0.725	2.795	20.5
3	1.3	0.927	3.028	0.482	2.075	6.655	0.133	0.190	0.841	3.028	22.2
4	1.4	0.998	3.261	0.519	1.927	5.771	0.115	0.165	0.970	3.261	23.9
5	1.5	1.070	3.493	0.556	1.799	5.040	0.101	0.144	1.111	3.493	25.6
6	1.6	1.141	3.726	0.593	1.686	4.435	0.089	0.127	1.263	3.726	27.3
7	1.8	1.284	4.192	0.667	1.499	3.506	0.070	0.100	1.597	4.192	30.7

CASE 4 CASE 3 with ART fillied

TABLE 2: Regular Wave Details – Beam Seas Runs

Safer Fishing Vessel Seakeeping **CCGA Roberts Sisters II Seakeeping Experiments - July 2009**
Proj. #42_2374_10

CASE 5
Heading: Quartering seas ART is empty
Model speed: 0.630 m/s (4 knots)
distance traveled by model 52.00 m Transverse distance 21.98 m
Total travelling time at speed 82.54 s

	Non-dim	Full scale	Model scale								
No	wn	w [rad/s]	w [rad/s]	f [Hz]	Period [s]	Wave length [m]	Wave height (1/50) [m]	Wave height (1/35) [m]	Deep Water Ratio	Encounter wave frequency	No of wave encounters
1	1.2	0.856	2.795	0.445	2.248	7.726	0.155	0.221	0.725	2.440	32.1
2	1.4	0.998	3.261	0.519	1.927	5.771	0.115	0.165	0.970	2.778	36.5
3	1.6	1.141	3.726	0.593	1.686	4.435	0.089	0.127	1.263	3.096	40.7
4	1.7	1.212	3.959	0.630	1.587	3.930	0.079	0.112	1.425	3.247	42.7
5	1.8	1.284	4.192	0.667	1.499	3.506	0.070	0.100	1.597	3.394	44.6
6	1.9	1.355	4.425	0.704	1.420	3.147	0.063	0.090	1.779	3.536	46.4
7	2.1	1.498	4.891	0.778	1.285	2.576	0.052	0.074	2.174	3.804	50.0

CASE 6 CASE 5 with ART fillied

CASE 7
Heading: Quartering seas ART is empty
Model speed: 1.260 m/s (8 knots)
distance traveled by model 52.00 m Transverse distance 21.98 m
Total travelling time at speed 41.27 s

	Non-dim	Full scale	Model scale								
No	wn	w [rad/s]	w [rad/s]	f [Hz]	Period [s]	Wave length [m]	Wave height (1/50) [m]	Wave height (1/35) [m]	Deep Water Ratio	Encounter wave frequency	No of wave encounters
1	1.2	0.856	2.795	0.445	2.248	7.726	0.155	0.221	0.725	2.085	27.4
2	1.4	0.998	3.261	0.519	1.927	5.771	0.115	0.165	0.970	2.295	30.1
3	1.6	1.141	3.726	0.593	1.686	4.435	0.089	0.127	1.263	2.465	32.4
4	1.7	1.212	3.959	0.630	1.587	3.930	0.079	0.112	1.425	2.535	33.3
5	1.8	1.284	4.192	0.667	1.499	3.506	0.070	0.100	1.597	2.596	34.1
6	1.9	1.355	4.425	0.704	1.420	3.147	0.063	0.090	1.779	2.646	34.8
7	2.1	1.498	4.891	0.778	1.285	2.576	0.052	0.074	2.174	2.718	35.7

CASE 8 CASE 7 with ART fillied

NOTE: Indicates roll natural frequency, or closest to that
ART = anti-roll tank
Deep water assumption h >= Lw/2

f	frequency, Hz	Lw	wave length, m
h	water depth in the OEB, m	LWL	water line length, m
hw	wave height, m	T	period, s
Lm	model length (LWL), m	Te	encounter period, s
		w	circular frequency, rad/s
		we	encounter wave frequency, rad/s
		wn	nondimensional wave frequency, rad/s {w* sqrt(Lm/g)}

TABLE 3: Regular Wave Details – Quartering Seas Runs

CCGA Roberts Sisters II Seakeeping Experiments

Proj #42_2374_10	**Offshore Engineering Basin**	
Quartering Seas	**ART Empty**	**4 knots**
Nominal Wave Period:	**1.5870 s**	

Analysis Date/Time	=	15/10/2009 8:51
Acquired Date/Time	=	25/09/2009 14:28
Input File	=	CASE5_4
Output File	=	CASE5_4_STAT
Number of Samples	=	9914
Segment Start Time	=	230.00 seconds
Segment End Time	=	612.83 seconds

Description	Unit	Min	Max	Mean	St. Dev.	Chan
MP_Surge_Displ	m	-0.42759	0.43765	-0.000962	0.23627	1
MP_Surge_Accel	m/s**2	-0.48758	0.42816	-0.003565	0.24589	2
MP_Sway_Displ	m	-0.43197	0.47601	0.001002	0.21531	3
MP_Sway_Accel	m/s**2	-0.54083	0.57468	0.024213	0.23032	4
MP_Heave_Displ	m	-0.3533	0.35441	-0.000735	0.19188	5
MP_Heave_Accel	m/s**2	-0.67622	0.24307	-0.20568	0.20908	6
MP_Yaw_Angle	deg	-4.4362	4.9328	0.10046	1.9201	7
MP_Yaw_Rate	deg/s	-2.2517	2.5032	0.27131	1.5171	8
MP_Pitch_Angle	deg	-3.5254	1.636	-0.67791	1.4223	9
MP_Pitch_Rate	deg/s	-3.018	2.5414	-0.33137	1.4197	10
MP_Roll_Angle	deg	-19.75	18.581	-0.71702	12.292	11
MP_Roll_Rate	deg/s	-19.536	18.542	-0.079971	12.409	12
Shaft Speed	rps	2.0884	2.2685	2.1838	0.039662	13
Rudder Angle	deg	-0.60523	5.6994	2.6802	1.1093	14
QUAL_Pitch_Angle	deg	-4.8426	2.4387	0.24981	1.3179	15
QUAL_Roll_Angle	deg	-21.315	19.041	0.64519	12.025	16
Forward Speed	knots	3.6046	3.7987	3.6862	0.056957	17
South Center Wave Probe	m	-0.47965	0.45279	-0.024472	0.30435	18

MP_Heave_Displ	m	ZCA_NWU	60
		ZCA_NWD	61
South Center Wave Probe	m	WAV_HAV	0.870108
	s	WAV_TAV	5.17841

NOTE: ZCA_NWU = NO. OF WAVE ENCOUNTER UPCROSSINGS
ZCA_NWD = NO.OF WAVE ENCOUNTER DOWNCROSSINGS
WAV_HAV = AVERAGE WAVE HEIGHT (m) (ZERO CROSSING ANALYSIS)
WAV_TAV = AVERAGE PERIOD (s) (ZERO CROSSING ANALYSIS)

TABLE 4: Typical Regular Wave Basic Statistics File (CASE5_4)

CCGA Roberts Sisters II Seakeeping Experiments

Proj #42_2374_10		**Offshore Engineering Basin**	
Quartering Seas		**ART Empty**	**4 knots**
Nominal Wave Period:		**11.3238**	
Analysis Date/Time	=	28/10/2009 14:50	
Acquired Date/Time	=	24/09/2009 15:19	
Input File	=	TQUART	
Output File	=	TQUART_STAT	
Number of Samples	=	28757	
Segment Start Time	=	182.99 seconds	
Segment End Time	=	1383.0 seconds	

Description	Unit	Min	Max	Mean	St. Dev.	Chan
MP_Surge_Displ	m	-2.095	2.0538	-0.003601	0.71619	1
MP_Surge_Accel	m/s**2	-0.83446	0.82024	-0.003355	0.2799	2
MP_Sway_Displ	m	-1.322	1.3667	0.00091	0.49886	3
MP_Sway_Accel	m/s**2	-0.38267	0.4086	-0.002399	0.14045	4
MP_Heave_Displ	m	-1.4083	1.6403	0.000226	0.50055	5
MP_Heave_Accel	m/s**2	-0.89378	0.38902	-0.2317	0.1898	6
MP_Yaw_Angle	deg	-6.3772	10.052	-0.54453	2.9689	7
MP_Yaw_Rate	deg/s	-2.1026	1.8446	-0.018442	0.64024	8
MP_Pitch_Angle	deg	-5.4765	3.3811	-0.89594	1.6477	9
MP_Pitch_Rate	deg/s	-3.4772	3.9606	-0.18629	1.2213	10
MP_Roll_Angle	deg	-6.1374	3.9023	-0.60607	1.8018	11
MP_Roll_Rate	deg/s	-4.994	5.0298	-0.020368	1.5939	12
Shaft Speed	rps	2.6498	2.9151	2.7584	0.061834	13
Rudder Angle	deg	-6.1511	6.7814	0.52507	2.1955	14
QUAL_Pitch_Angle	deg	-4.3019	4.3074	0.079526	1.5954	15
QUAL_Roll_Angle	deg	-3.5623	5.396	0.82735	1.7585	16
Forward Speed	knots	2.1819	7.1988	5.0152	0.79372	17
South Center Wave Probe	m	-1.4337	1.541	-0.014796	0.54705	18

MP_Heave_Displ	m	ZCA_NWU	105
		ZCA_NWD	106
South Center Wave Probe	m	WAV_HM0	2.18818
	s	SPEC_TPD	11.3238

NOTE: ZCA_NWU = NO. OF WAVE ENCOUNTER UPCROSSINGS
ZCA_NWD = NO.OF WAVE ENCOUNTER DOWNCROSSINGS
WAV_HMO = SIGNIFICANT WAVE HEIGHT (m)
SPEC_TPD = PERIOD OF SPECTRAL PEAK (s)

TABLE 5: Typical Irregular Wave Basic Statistics File (Quartering Seas, Trawl Speed)

CCGA ROBERTS SISTERS II SEAKEEPING EXPERIMENTS RESULTS FOR REGULAR WAVES

Proj #42_2374_10 **Offshore Engineering Basin**
Beam Seas **ART Empty** **4 knots**

	Case 1 Surge Accel. (m/s²)	Sway Accel. (m/s²)	Heave Accel. (m/s²)	Yaw Angle (deg.)	Pitch Angle (deg.)	Roll Angle (deg.)	Wave Period (s)	Encounter Wave Frequency (rad./s)
Case1_1	0.089382	0.47696	0.49933	0.69831	0.52581	5.7513	8.06129	0.784
Case1_2	0.080303	0.42771	0.45243	0.69452	0.40961	6.808	7.34166	0.856
Case1_3	0.087911	0.47078	0.50603	0.86224	0.43834	10.579	6.81324	0.927
Case1_4	0.089823	0.49758	0.61109	1.2969	0.50531	16.151	6.28603	0.998
Case1_5	0.081866	0.31609	0.53492	1.472	0.4539	16.132	5.90481	1.069
Case1_6	0.097591	0.18622	0.49203	0.82259	0.49038	10.767	5.48077	1.141
Case1_7	0.069478	0.2204	0.44842	0.6755	0.42427	2.7771	4.87328	1.284

Proj #42_2374_10 **Offshore Engineering Basin**
Beam Seas **ART Filled, Baffles Installed** **4 knots**

	Case 2B Surge Accel. (m/s²)	Sway Accel. (m/s²)	Heave Accel. (m/s²)	Yaw Angle (deg.)	Pitch Angle (deg.)	Roll Angle (deg.)	Wave Period (s)
Case2B_1	0.10494	0.48926	0.51837	1.0859	0.59075	7.9153	7.95953
Case2B_2	0.080599	0.40363	0.47281	0.99215	0.3832	8.6108	7.39156
Case2B_3	0.084862	0.40355	0.52103	1.3975	0.41765	11.4	6.77752
Case2B_4	0.069929	0.33927	0.54868	0.94558	0.38089	10.139	6.28633
Case2B_5	0.067836	0.27695	0.48324	5.9874	0.35989	4.6732	5.88778

Proj #42_2374_10 **Offshore Engineering Basin**
Beam Seas **ART Filled** **4 knots**

	Case 2 Surge Accel. (m/s²)	Sway Accel. (m/s²)	Heave Accel. (m/s²)	Yaw Angle (deg.)	Pitch Angle (deg.)	Roll Angle (deg.)	Wave Period (s)	Encounter Wave Frequency (rad./s)
Case2_1	0.098224	0.46517	0.51723	2.4936	0.60002	7.1805	8.01989	0.784
Case2_2	0.067768	0.41603	0.46557	2.4241	0.3461	7.8995	7.38765	0.856
Case2_3	0.076099	0.39167	0.51131	1.6697	0.3885	10.44	6.77733	0.927
Case2_4	0.076277	0.34253	0.54927	1.8305	0.38301	10.095	6.28886	0.998
Case2_5	0.072221	0.29184	0.49412	2.1291	0.36437	4.611	5.88319	1.069
Case2_6	0.077486	0.2695	0.49282	1.7212	0.43681	3.3069	5.52077	1.141
Case2_7	0.068604	0.22722	0.45862	2.3286	0.39605	1.6744	4.86001	1.284

TABLE 6 (1 of 4): Regular Wave Motion Statistics

Proj #42_2374_10 **Offshore Engineering Basin**
Beam Seas **ART Empty** **8 knots**

Case 3	Surge Accel. (m/s^2)	Sway Accel. (m/s^2)	Heave Accel. (m/s^2)	Yaw Angle (deg.)	Pitch Angle (deg.)	Roll Angle (deg.)	Wave Period (s)	Encounter Wave Frequency (rad./s)
Case3_1	0.079829	0.49925	0.51176	1.0229	0.41407	6.4012	8.0074	0.784
Case3_2	0.063517	0.42096	0.44998	1.1602	0.34777	6.5165	7.42542	0.856
Case3_3	0.079328	0.43533	0.48032	1.3971	0.41585	9.295	6.82125	0.927
Case3_4	0.21597	0.58359	0.66267	1.0123	0.47044	15.543	6.35296	0.998
Case3_5	0.1008	0.35989	0.57381	0.93783	0.56782	16.183	5.92983	1.069
Case3_6	0.11228	0.27113	0.53403	1.7567	0.58467	11.897	5.46552	1.141
Case3_7	0.077489	0.2881	0.51191	1.9313	0.42916	2.6377	4.90521	1.284

Proj #42_2374_10 **Offshore Engineering Basin**
Beam Seas **ART Filled** **8 knots**

Case 4	Surge Accel. (m/s^2)	Sway Accel. (m/s^2)	Heave Accel. (m/s^2)	Yaw Angle (deg.)	Pitch Angle (deg.)	Roll Angle (deg.)	Wave Period (s)	Encounter Wave Frequency (rad./s)
Case4_1	0.11275	0.47935	0.51905	3.7451	0.59866	7.3913	7.98761	0.784
Case4_2	0.075283	0.38358	0.49097	2.1311	0.34227	7.8763	7.22083	0.856
Case4_3	0.086801	0.37737	0.52408	2.5308	0.45013	10.034	6.91145	0.927
Case4_4	0.089189	0.33506	0.58262	1.9708	0.40396	9.1599	6.26235	0.998
Case4_5	0.090378	0.28464	0.50375	2.5384	0.5114	5.1429	5.92179	1.069
Case4_6	0.098842	0.27746	0.48842	1.4164	0.55039	3.6437	5.47332	1.141
Case4_7	0.0884	0.22932	0.45531	1.9658	0.51859	1.848	4.96894	1.284

Proj #42_2374_10 **Offshore Engineering Basin**
Beam Seas **ART Filled, Baffles Installed** **8 knots**

Case 4B	Surge Accel. (m/s^2)	Sway Accel. (m/s^2)	Heave Accel. (m/s^2)	Yaw Angle (deg.)	Pitch Angle (deg.)	Roll Angle (deg.)	Wave Period (s)	Encounter Wave Frequency (rad./s)
Case4B_1	0.099095	0.45712	0.50761	1.5579	0.52086	7.6122	8.01194	0.784
Case4B_2	0.083041	0.42059	0.47734	1.0883	0.40193	8.6222	7.40001	0.856
Case4B_3	0.091964	0.3662	0.55339	0.95357	0.45579	11.275	6.7451	0.927
Case4B_4	0.085492	0.31363	0.58613	1.8275	0.44969	9.479	6.2415	0.998
Case4B_5	0.077126	0.28309	0.53558	1.099	0.43566	4.5941	5.88563	1.069
Case4B_6	0.083135	0.28975	0.53337	1.3871	0.52129	3.2458	5.46129	1.141
Case4B_7	0.077141	0.2293	0.48118	0.82636	0.46487	1.9484	4.92964	1.284

TABLE 6 (2 of 4): Regular Wave Motion Statistics

Proj #42_2374_10 **Offshore Engineering Basin**
Quartering Seas **ART Empty** **4 knots**

Case 5	Surge Accel. (m/s^2)	Sway Accel. (m/s^2)	Heave Accel. (m/s^2)	Yaw Angle (deg.)	Pitch Angle (deg.)	Roll Angle (deg.)	Wave Period (s)	Encounter Wave Frequency (rad./s)
Case5_1	0.34053	0.30368	0.4038	1.6401	1.9782	4.0823	7.36672	0.747
Case5_2	0.27427	0.24887	0.29007	1.8353	1.5823	4.6786	6.30984	0.851
Case5_3	0.29433	0.31659	0.27238	1.9172	1.6424	10.184	5.49124	0.948
Case5_4	0.24589	0.23032	0.20908	1.9201	1.4223	12.292	5.17841	0.994
Case5_5	0.23445	0.17645	0.23791	1.7873	1.4565	11.524	4.87959	1.039
Case5_6	0.22128	0.080429	0.24444	1.4954	1.4016	7.3883	4.66457	1.083
Case5_7	0.22919	0.067962	0.23218	2.0344	1.4764	3.0861	4.19579	1.165

Proj #42_2374_10 **Offshore Engineering Basin**
Quartering Seas **ART Empty** **4 knots** **Repeat of CASE 5**

Case 5R	Surge Accel. (m/s^2)	Sway Accel. (m/s^2)	Heave Accel. (m/s^2)	Yaw Angle (deg.)	Pitch Angle (deg.)	Roll Angle (deg.)	Wave Period (s)
Case5_1R	0.30951	0.31082	0.34576	1.9095	1.7714	4.2567	7.33877
Case5_3R	0.32583	0.28767	0.27776	1.6832	1.6218	10.075	5.51204
Case5_4R	0.24813	0.22247	0.20639	1.0643	1.5885	14.271	5.18001
Case5_5R	0.24867	0.14632	0.21943	1.6722	1.5055	15.713	4.89966
Case5_7R	0.21996	0.065846	0.21609	1.3947	1.408	3.0366	4.20137

Proj #42_2374_10 **Offshore Engineering Basin**
Quartering Seas **ART Filled** **4 knots**

Case 6	Surge Accel. (m/s^2)	Sway Accel. (m/s^2)	Heave Accel. (m/s^2)	Yaw Angle (deg.)	Pitch Angle (deg.)	Roll Angle (deg.)	Wave Period (s)	Encounter Wave Frequency (rad./s)
Case6_1	0.3494	0.27868	0.34862	2.6712	2.0478	5.263	7.38982	0.747
Case6_2	0.31856	0.12056	0.2662	1.5608	1.8109	4.0996	6.23513	0.851
Case6_3	0.26913	0.16223	0.29256	1.5906	1.6173	5.1101	5.529	0.948
Case6_4	0.24487	0.11868	0.23037	1.4768	1.4573	2.8345	5.16596	0.994
Case6_5	0.24763	0.12698	0.25982	1.4298	1.5043	2.4157	4.94902	1.039
Case6_6	0.23812	0.10364	0.23304	1.5212	1.4772	1.7149	4.6364	1.083
Case6_7	0.23565	0.084864	0.22818	1.4199	1.4829	1.3612	4.21467	1.165

TABLE 6 (3 of 4): Regular Wave Motion Statistics

Proj #42_2374_10 Offshore Engineering Basin
Quartering Seas ART Filled 4 knots Repeat of CASE 6

Case 6R	Surge Accel. (m/s^2)	Sway Accel. (m/s^2)	Heave Accel. (m/s^2)	Yaw Angle (deg.)	Pitch Angle (deg.)	Roll Angle (deg.)	Wave Period (s)	Encounter Wave Frequency (rad./s)
Case6_1R	0.34025	0.29626	0.36032	1.7526	1.9551	5.4838	7.33974	0.747
Case6_2R	0.2587	0.22607	0.26486	1.5553	1.4986	5.5497	6.29244	0.851
Case6_3R	0.2641	0.17248	0.28853	1.4194	1.5461	5.3199	5.51017	0.948
Case6_4R	0.23007	0.13745	0.23217	1.3886	1.3886	3.2547	5.17986	0.994
Case6_5R	0.24394	0.1249	0.25573	1.4076	1.5052	2.3654	4.89938	1.039
Case6_6R	0.23682	0.11546	0.24857	1.5418	1.4672	1.9317	4.64508	1.083
Case6_7R	0.21698	0.093801	0.21997	1.2964	1.3843	1.5283	4.19997	1.165

Proj #42_2374_10 Offshore Engineering Basin
Quartering Seas ART Empty 8 knots

Case 7	Surge Accel. (m/s^2)	Sway Accel. (m/s^2)	Heave Accel. (m/s^2)	Yaw Angle (deg.)	Pitch Angle (deg.)	Roll Angle (deg.)	Wave Period (s)	Encounter Wave Frequency (rad./s)
Case7_1	0.30049	0.26055	0.27948	2.4893	1.7723	3.3437	7.37933	0.638
Case7_2	0.27263	0.18004	0.21821	1.7129	1.5991	2.6151	6.31328	0.703
Case7_3	0.28666	0.1855	0.18778	2.1828	1.6591	3.0769	5.51191	0.755
Case7_4	0.26058	0.13551	0.16991	2.1712	1.533	2.6285	5.16291	0.776
Case7_5	0.26494	0.13293	0.17097	1.8602	1.5603	2.8008	4.85786	0.795
Case7_6	0.25381	0.13196	0.1549	2.2253	1.4384	3.5559	4.60332	0.810
Case7_7	0.2351	0.1022	0.15801	1.5644	1.3632	3.0276	4.21896	0.832

Proj #42_2374_10 Offshore Engineering Basin
Quartering Seas ART Filled 8 knots

Case 8	Surge Accel. (m/s^2)	Sway Accel. (m/s^2)	Heave Accel. (m/s^2)	Yaw Angle (deg.)	Pitch Angle (deg.)	Roll Angle (deg.)	Wave Period (s)	Encounter Wave Frequency (rad./s)
Case8_1	0.30634	0.31699	0.28618	2.8128	1.8405	4.7862	7.04741	0.638
Case8_2	0.26016	0.18825	0.19656	1.8529	1.5274	4.1078	6.36793	0.703
Case8_3	0.27833	0.1653	0.19471	1.8004	1.6418	4.3411	5.4577	0.755
Case8_4	0.25913	0.13116	0.17937	1.9112	1.5014	3.6741	5.21414	0.776
Case8_5	0.26679	0.13619	0.19313	1.7701	1.5912	4.2686	4.96134	0.795
Case8_6	0.23895	0.10578	0.16085	1.5319	1.4128	3.6639	4.59545	0.810
Case8_7	0.22298	0.080329	0.13767	1.6989	1.3175	3.4588	4.15338	0.832

TABLE 6 (4 of 4): Regular Wave Motion Statistics

CCGA Roberts Sisters II Seakeeping Experiments

Proj #42_2374_10 **Offshore Engineering Basin**
Trawl Speed, Nominally 4 knots **ART Empty**

	Surge Accel. (m/s^2)	Sway Accel. (m/s^2)	Heave Accel. (m/s^2)	Yaw Angle (deg.)	Pitch Angle (deg.)	Roll Angle (deg.)	Heading
TFOL	0.25093	0.1404	0.19681	7.3099	1.5039	2.8904	Following
TQUART	0.2799	0.14045	0.1898	2.9689	1.6477	1.8018	Quartering
TBEAM	0.22191	0.30016	0.57776	12.12	1.7306	5.1473	Beam
TBOW	0.21194	0.31802	0.61049	10.298	2.3219	5.7464	Bow
THEAD	0.34654	0.15708	0.5254	1.8979	2.9447	2.8048	Head

Proj #42_2374_10 **Offshore Engineering Basin**
Trawl Speed, Nominally 4 knots **ART Filled**

	Roll Angle (deg.)	Heading
ART_TFOL	1.6932	Following
ART_TQUART	2.0026	Quartering
ART_TBEAM	3.4964	Beam
ART_TBOW	3.5315	Bow
ART_THEAD		Head

Proj #42_2374_10 **Offshore Engineering Basin**
Cruise Speed, Nominally 8 knots **ART Empty**

	Surge Accel. (m/s^2)	Sway Accel. (m/s^2)	Heave Accel. (m/s^2)	Yaw Angle (deg.)	Pitch Angle (deg.)	Roll Angle (deg.)	Heading
CFOL	0.21895	0.14511	0.15971	17.623	1.3217	2.2591	Following
CQUART	0.22508	0.14166	0.1614	10.208	1.3341	1.515	Quartering
CBEAM	0.22198	0.31234	0.72796	4.2104	1.9065	3.9084	Beam
CBOW	0.1925	0.39372	0.77061	3.3107	1.439	6.3207	Bow
CHEAD	0.30503	0.19846	0.78929	6.9198	2.6418	4.1505	Head

NOTE: All angles and accelerations are Standard Deviation values.

TABLE 7: Irregular Wave Motion Statistics

Roll & Pitch Decay Results

CCGA Roberts Sisters II **Proj. 42_2374_10**
Model #IOT761 **Scale 1:10.667**
Offshore Engineering Basin **July 2009**

Pitch Decay Experiments:

File Name	Sensor	Excitation #	Average Period (s)	Linear Damping Coeff.	Equivalent Damping Slope	Equivalent Damping Offset
pitch_decay_001	ADIS Pitch Rate	2nd	3.3764	0.14639	0.00638	0.12721
pitch_decay_001	MP_Pitch_Rate	2nd	3.7040	0.18981	-0.02319	0.29054
pitch_decay_001	ADIS Pitch Rate	3rd	3.2145	0.17017	0.00241	0.16184
pitch_decay_001	MP_Pitch_Rate	3rd	3.6382	0.16186	-0.02535	0.31896
pitch_decay_001	ADIS Pitch Rate	5th	3.6125	0.17731	-0.02669	0.24463
pitch_decay_001	MP_Pitch_Rate	5th	3.6997	0.16378	-0.02545	0.24150

Average Pitch Period (s) 3.5409

Roll Decay Experiments - ART empty- zero forward speed:

File Name	Sensor	Excitation #	Average Period (s)	Linear Damping Coeff.	Equivalent Damping Slope	Equivalent Damping Offset
Roll_decay_001	ADIS Roll Rate	1st	6.0550	0.01107	0.00311	-0.00024
Roll_decay_001	QUALISYS	1st	6.0536	0.01096	0.00363	-0.00191
Roll_decay_002	ADIS Roll Rate	1st	6.0542	0.01137	0.00238	-0.00082
Roll_decay_002	QUALISYS	1st	6.0533	0.01102	0.00248	-0.00115
Roll_decay_002	ADIS Roll Rate	2nd	6.0548	0.01186	0.00153	0.00468
Roll_decay_002	QUALISYS	2nd	6.0508	0.01224	0.00242	0.00128
Roll_decay_002	ADIS Roll Rate	3rd	6.0586	0.01182	0.00116	0.00699
Roll_decay_002	QUALISYS	3rd	6.0546	0.01273	0.00112	0.00776

Average Roll Period (s) 6.0544

Roll Decay Experiments - ART empty - forward speed = 0.6 m/s (~ 4 knots):

File Name	Sensor	Excitation #	Average Period (s)	Linear Damping Coeff.	Equivalent Damping Slope	Equivalent Damping Offset
roll_s0p6_001	ADIS Roll Rate	1st	6.1082	0.02862	0.00163	0.01823
roll_s0p6_001	QUALISYS	1st	6.1071	0.02872	0.00279	0.00837
roll_s0p6_002	ADIS Roll Rate	2nd	6.0861	0.02898	0.00161	0.01868
roll_s0p6_002	QUALISYS	2nd	6.0903	0.02912	0.00180	0.01779
roll_s0p6_003	ADIS Roll Rate	3rd	6.0870	0.03011	0.00131	0.02180
roll_s0p6_003	QUALISYS	3rd	6.0901	0.03071	0.00173	0.02100

Average Roll Period (s) 6.0948

TABLE 8 (1 of 3): Summary of Roll/Pitch Decay Results

Roll Decay Experiments - ART empty - forward speed = 1.2 m/s (~ 8 knots):

File Name	Sensor	Excitation #	Average Period (s)	Linear Damping Coeff.	Equivalent Damping Slope	Equivalent Damping Offset
roll_s1p2_001	ADIS Roll Rate	1st	6.0920	0.03793	0.00132	0.02899
roll_s1p2_001	QUALISYS	1st	6.0771	0.03948	0.00148	0.03036
roll_s1p2_002	ADIS Roll Rate	2nd	6.1075	0.03888	0.00039	0.03685
roll_s1p2_002	QUALISYS	2nd	6.1220	0.03790	0.00132	0.02911
roll_s1p2_003	ADIS Roll Rate	3rd	6.1232	0.04077	-0.00002	0.04090
roll_s1p2_003	QUALISYS	3rd	6.1150	0.03793	0.00113	0.03012

Average Roll Period (s) 6.1061

Roll Decay Experiments - ART filled - forward speed = 0.6 m/s (~ 4 knots):

File Name	Sensor	Excitation #	Average Period (s)	Linear Damping Coeff.	Equivalent Damping Slope	Equivalent Damping Offset
Roll_art_s0p6_001	ADIS Roll Rate	1st	7.6126	0.15336	-0.00117	0.15809
Roll_art_s0p6_001	QUALISYS	1st	7.8029	0.11820	0.01456	0.06650
Roll_art_s0p6_002	ADIS Roll Rate	2nd	7.4513	0.15592	-0.00876	0.20546
Roll_art_s0p6_002	QUALISYS	2nd	7.5617	0.11878	0.00160	0.11065
Roll_art_s0p6_003	ADIS Roll Rate	3rd	7.5359	0.11812	0.00051	0.11536
Roll_art_s0p6_003	QUALISYS	3rd	7.6388	0.10485	0.00392	0.08558

Average Roll Period (s) 7.6005

Roll Decay Experiments - ART filled - forward speed = 1.2 m/s (~ 8 knots):

File Name	Sensor	Excitation #	Average Period (s)	Linear Damping Coeff.	Equivalent Damping Slope	Equivalent Damping Offset
Roll_art_s1p2_001	ADIS Roll Rate	1st	7.3467	0.16120	-0.01316	0.25719
Roll_art_s1p2_001	QUALISYS	1st	7.2186	0.15610	-0.01648	0.27910
Roll_art_s1p2_002	ADIS Roll Rate	2nd	7.3393	0.14218	-0.00681	0.19605
Roll_art_s1p2_002	QUALISYS	2nd	7.3541	0.12693	-0.00395	0.15501
Roll_art_s1p2_003	ADIS Roll Rate	3rd	7.2697	0.13206	-0.00653	0.19397
Roll_art_s1p2_003	QUALISYS	3rd	7.4978	0.11271	0.00136	0.10510

Average Roll Period (s) 7.3377

Roll Decay Experiments - with baffled ART - forward speed = 0.6 m/s (~ 4 knots):

File Name	Sensor	Excitation #	Average Period (s)	Linear Damping Coeff.	Equivalent Damping Slope	Equivalent Damping Offset
Roll_ARTB_s0p6_001	ADIS Roll Rate	1st	7.3613	0.13786	-0.00694	0.18980
Roll_ARTB_s0p6_001	QUALISYS	1st	7.5312	0.11827	-0.00152	0.12759
Roll_ARTB_s0p6_002	ADIS Roll Rate	2nd	7.4195	0.12150	-0.00169	0.13228
Roll_ARTB_s0p6_002	QUALISYS	2nd	7.4655	0.10695	0.00090	0.10165
Roll_ARTB_s0p6_003	ADIS Roll Rate	3rd	7.1756	0.12268	-0.00484	0.17206
Roll_ARTB_s0p6_003	QUALISYS	3rd	7.4658	0.11232	-0.00067	0.11639

Average Roll Period (s) 7.4032

TABLE 8 (2 of 3): Summary of Roll/Pitch Decay Results

Roll Decay Experiments - with baffled ART - forward speed = 1.2 m/s (~ 8 knots):

File Name	Sensor	Excitation #	Average Period (s)	Linear Damping Coeff.	Equivalent Damping Slope	Equivalent Damping Offset
Roll_ARTB_s1p2_001	ADIS Roll Rate	1st	7.0467	0.12030	-0.00467	0.17049
Roll_ARTB_s1p2_001	QUALISYS	1st	7.1677	0.11636	-0.00037	0.11894
Roll_ARTB_s1p2_002	ADIS Roll Rate	2nd	7.2222	0.12611	-0.00615	0.18875
Roll_ARTB_s1p2_002	QUALISYS	2nd	7.5618	0.10413	-0.00022	0.10599
Roll_ARTB_s1p2_003	ADIS Roll Rate	3rd	7.1189	0.12135	-0.00481	0.17313
Roll_ARTB_s1p2_003	QUALISYS	3rd	7.4903	0.10927	-0.00076	0.11454

Average Roll Period (s) 7.2679

NOTES: Pitch decay results derived using the ADIS pitch rate sensor and the MotionPak II pitch rate sensor.
Roll decay results derived using the ADIS roll rate sensor as well as QUALISYS roll angle.
Pitch angle was highly damped with only a few cycles available for analysis.
ART = anti-roll tank - experiments were carried out with and without the tank operational as well as with and without baffles in tank
For experiments with the ART active, the roll angle was highly damped compared to the model with no water in the tank.
There was a lot of scatter in the results when the motions are highly damped.
Due to an error in the DACON file, the zero speed roll & pitch results had to be scaled to full scale (scaling factor = 10.667) using GEDAP Program 'SCALE'.
With no water in the ART, the roll period is constant as the roll angle decays.
With water in the ART, the roll period increases with decreasing roll amplitude.
Roll period at zero forward speed is about 1 to 1.5 s less than that with forward speed.
There is only a minor difference between roll perod at 4 knots and 8 knots.
The ART with water increases the roll period by about 1 s over without water in ART.
Adding baffles to the ART reduces the roll period slightly however this may be due to the small reduction in GM_T due to the addition of the weight of the baffles.

TABLE 8 (3 of 3): Summary of Roll/Pitch Decay Results

COMPARISON OF MOTIONS MEASURED BY DIFFERENT SENSORS

CCGA Roberts Sisters II — Proj. 42_2374_10

Model #IOT761 — **Scale 1:10.667**
Offshore Engineering Basin — **July 2009**

Pitch Angle	File Name	Units	Minimum	Maximum	St. Dev.	% Diff. - St. Dev.
QUALISYS	CBOW_008	deg.	-3.5469	3.0668	1.2864	0.04%
MOTIONPAK II	CBOW_008	deg.	-3.5741	3.1445	1.2859	
QUALISYS	THEAD_001	deg.	-9.8565	6.6944	2.9637	0.90%
MOTIONPAK II	THEAD_001	deg.	-9.9245	6.8012	2.9907	
QUALISYS	CASE3_3_003	deg.	-1.3183	1.0056	0.4886	2.32%
MOTIONPAK II	CASE3_3_003	deg.	-0.95323	1.1349	0.4775	
QUALISYS	ART_TBEAM_008	deg.	-1.7242	1.7854	0.79563	3.27%
MOTIONPAK II	ART_TBEAM_008	deg.	-1.7049	1.7375	0.82253	

Pitch Rate	File Name	Units	Minimum	Maximum	St. Dev.	% Diff. - St. Dev.
ADIS	CBOW_008	deg./s	-5.8334	4.9748	1.983	3.18%
MOTIONPAK II	CBOW_008	deg./s	-5.6749	4.9284	2.0482	
ADIS	THEAD_001	deg./s	-14.773	12.8900	4.6763	1.78%
MOTIONPAK II	THEAD_001	deg./s	-13.301	15.1000	4.7610	
ADIS	CASE3_3_003	deg./s	-1.1693	1.4792	0.5455	2.24%
MOTIONPAK II	CASE3_3_003	deg./s	-1.5184	1.5619	0.5580	
ADIS	ART_TBEAM_008	deg./s	-2.1448	2.6776	1.1195	0.89%
MOTIONPAK II	ART_TBEAM_008	deg./s	-2.7767	2.3371	1.1295	

Roll Angle	File Name	Units	Minimum	Maximum	St. Dev.	% Diff. - St. Dev.
QUALISYS	CBOW_008	deg.	-13.176	12.58	5.5087	0.23%
MOTIONPAK II	CBOW_008	deg.	-12.916	12.891	5.4958	
QUALISYS	THEAD_001	deg.	-8.605	8.6203	4.3666	1.14%
MOTIONPAK II	THEAD_001	deg.	-8.8707	8.5839	4.417	
QUALISYS	CASE3_3_003	deg.	-14.134	12.958	8.3486	1.40%
MOTIONPAK II	CASE3_3_003	deg.	-13.693	12.706	8.4672	
QUALISYS	ART_TBEAM_008	deg.	-7.2867	6.1481	3.1001	1.92%
MOTIONPAK II	ART_TBEAM_008	deg.	-7.6134	5.3262	3.1608	

Roll Rate	File Name	Units	Minimum	Maximum	St. Dev.	% Diff. - St. Dev.
ADIS	CBOW_008	deg./s	-12.778	13.569	5.9192	1.00%
MOTIONPAK II	CBOW_008	deg./s	-13.240	14.190	5.8607	
ADIS	THEAD_001	deg./s	-8.571	8.438	4.4517	2.85%
MOTIONPAK II	THEAD_001	deg./s	-10.192	9.6752	4.5825	
ADIS	CASE3_3_003	deg./s	-11.487	12.059	7.3679	1.68%
MOTIONPAK II	CASE3_3_003	deg./s	-12.321	13.076	7.4941	
ADIS	ART_TBEAM_008	deg./s	-7.1196	7.0107	3.1827	4.16%
MOTIONPAK II	ART_TBEAM_008	deg./s	-8.9776	7.8172	3.3207	

TABLE 9 (1 of 2): Comparison of Motions by Different Sensors

COMPARISON OF MOTIONS MEASURED BY DIFFERENT SENSORS

CCGA Roberts Sisters II — Proj. 42_2374_10

Model #IOT761 — **Scale 1:10.667**
Offshore Engineering Basin — **July 2009**

Heave (Z) Displ.	File Name	Units	Minimum	Maximum	St. Dev.	% Diff. - St. Dev.
QUALISYS	CBOW_008	m	-1.3958	1.0226	0.55049	10.98%
MOTIONPAK II	CBOW_008	m	-1.5516	1.1045	0.61837	
QUALISYS	THEAD_001	m	-1.5199	1.5087	0.56888	7.29%
MOTIONPAK II	THEAD_001	m	-1.4418	1.5399	0.61362	
QUALISYS	CASE3_3_003	m	-0.87461	0.89586	0.50936	0.78%
MOTIONPAK II	CASE3_3_003	m	-0.90188	0.84175	0.51337	
QUALISYS	ART_TBEAM_008	m	-0.99695	0.70428	0.40044	2.44%
MOTIONPAK II	ART_TBEAM_008	m	-0.75106	0.82839	0.39092	

Heading (Yaw) Angle	File Name	Units	Minimum	Maximum	St. Dev.	% Diff. - St. Dev.
QUALISYS	CBOW_008	deg.	-3.5638	4.3841	2.0629	3.11%
MOTIONPAK II	CBOW_008	deg.	-3.5985	3.8917	2.1291	
QUALISYS	THEAD_001	deg.	-2.6665	2.7142	1.2225	9.55%
MOTIONPAK II	THEAD_001	deg.	-2.4204	2.4667	1.1159	
QUALISYS	CASE3_3_003	deg.	-1.2413	1.9121	0.7682	10.77%
MOTIONPAK II	CASE3_3_003	deg.	-1.2018	2.0021	0.69348	
QUALISYS	ART_TBEAM_008	deg.	-2.2282	0.42104	0.65129	6.11%
MOTIONPAK II	ART_TBEAM_008	deg.	-1.7416	1.1145	0.69366	

Yaw Rate	File Name	Units	Minimum	Maximum	St. Dev.	% Diff. - St. Dev.
ADIS	CBOW_008	deg./s	-1.5719	2.3778	0.80696	0.20%
MOTIONPAK II	CBOW_008	deg./s	-1.5786	2.3801	0.80537	
ADIS	THEAD_001	deg./s	-1.9739	1.9605	0.58460	4.13%
MOTIONPAK II	THEAD_001	deg./s	-1.855	1.9044	0.56143	
ADIS	CASE3_3_003	deg./s	-1.0787	0.91145	0.42559	30.01%
MOTIONPAK II	CASE3_3_003	deg./s	-0.73428	0.83123	0.32736	
ADIS	ART_TBEAM_008	deg./s	-1.1143	1.2433	0.53651	0.00%
MOTIONPAK II	ART_TBEAM_008	deg./s	-1.0989	1.1185	0.53649	

NOTE: All channels have been tared.
Parameters compare fairly well other than situations where the magnitude of the parameter is relatively low.
CBOW - irregular waves - bow seas - cruising speed.
THEAD - irregular waves - head seas - trawl speed.
CASE3_3 - regular waves - beam seas, 8 knots, wave period = 2.075 s.
ART_TBEAM - irregular waves - beam seas - trawl speed - with anti-roll tank (ART) active

TABLE 9 (2 of 2): Comparison of Motions by Different Sensors

COMPARISON OF ACCELERATIONS MEASURED BY MOTIONPAK II & BOW ACCELEROMETERS

CCGA Roberts Sisters II — **Proj. 42_2374_10**
Model #IOT761 — **Scale 1:10.667**
Offshore Engineering Basin — **July 2009**

Longitudinal Acceleration	File Name	Units	Filter Freq. F1 (Hz)	Filter Freq. F2 (Hz)	Minimum	Maximum	St. Dev.	% Diff. - St. Dev.
Bow Accelerometer	CBOW_008	m/s^2	0.13	0.53	-1.0192	1.1377	0.41638	0.50%
MotionPak II	CBOW_008	m/s^2	0.13	0.53	-1.0209	1.035	0.41429	
Bow Accelerometer	THEAD_001	m/s^2	0.12	0.5	-2.0227	1.9449	0.71251	2.17%
MotionPak II	THEAD_001	m/s^2	0.12	0.5	-2.0845	2.0206	0.72834	
Bow Accelerometer	CASE3_3_003	m/s^2	0	0.7	-0.16695	0.1884	0.08167	23.40%
MotionPak II	CASE3_3_003	m/s^2	0	0.7	-0.19076	0.26114	0.10662	
Bow Accelerometer	ART_TBEAM_003	m/s^2	0	0.5	-0.57564	0.60173	0.22377	0.60%
MotionPak II	ART_TBEAM_003	m/s^2	0	0.5	-0.60503	0.62337	0.22243	

Lateral Acceleration	File Name	Units	Filter Freq. F1 (Hz)	Filter Freq. F2 (Hz)	Minimum	Maximum	St. Dev.	% Diff. - St. Dev.
Bow Accelerometer	CBOW_008	m/s^2	0	0.48	-3.5838	3.1041	1.4018	5.59%
MotionPak II	CBOW_008	m/s^2	0	0.48	-3.6313	3.1275	1.4848	
Bow Accelerometer	THEAD_001	m/s^2	0.11	0.24	-1.9765	1.9959	0.90657	3.19%
MotionPak II	THEAD_001	m/s^2	0.11	0.24	-2.0325	2.0356	0.9364	
Bow Accelerometer	CASE3_3_003	m/s^2	0	0.5	-2.4092	2.4515	1.5043	2.20%
MotionPak II	CASE3_3_003	m/s^2	0	0.5	-2.469	2.553	1.5381	
Bow Accelerometer	ART_TBEAM_003	m/s^2	0	0.5	-2.9011	1.7834	0.78542	3.21%
MotionPak II	ART_TBEAM_003	m/s^2	0	0.5	-2.9519	1.9086	0.81145	

Vertical Acceleration	File Name	Units	Filter Freq. F1 (Hz)	Filter Freq. F2 (Hz)	Minimum	Maximum	St. Dev.	% Diff. - St. Dev.
Bow Accelerometer	CBOW_008	m/s^2	0.16	0.5	-1.8049	1.8624	0.77943	1.43%
MotionPak II	CBOW_008	m/s^2	0.16	0.5	-1.9214	2.0063	0.76843	
Bow Accelerometer	THEAD_001	m/s^2	0.08	0.5	-2.5657	2.4522	0.83742	2.97%
MotionPak II	THEAD_001	m/s^2	0.08	0.5	-2.2304	2.5437	0.81325	
Bow Accelerometer	CASE3_3_003	m/s^2	0	0.5	-0.87153	0.87551	0.43254	1.95%
MotionPak II	CASE3_3_003	m/s^2	0	0.5	-0.82329	0.83968	0.44116	
Bow Accelerometer	ART_TBEAM_003	m/s^2	0	0.5	-1.9411	1.5525	0.64905	3.79%
MotionPak II	ART_TBEAM_003	m/s^2	0	0.5	-1.8931	1.6053	0.62535	

NOTE: Moved MotionPak II accelerations forward 3.945 m, to stbd. 0.88 m, and vertically up 2.659 m full scale.
MotionPak II accelerations were output in a body fixed co-ordinate system.
Converted bow accelerations from G's to m/s^2 and changed sign where necessary.
All channels have been tared.
Channels were notch filtered using GEDAP Program 'FILT_FFT' using specified filter frequencies.
CBOW - irregular waves - bow seas - cruising speed.
THEAD - irregular waves - head seas - trawl speed.
CASE3_3 - regular waves - beam seas - ART is empty.
ART_TBEAM - irregular waves - beam seas - ART filled.

TABLE 10: Comparison of MotionPak II & Bow Tri-Axial Accelerations

RESULTS OF REPEATABILITY CHECK RUNS

CCGA Roberts Sisters II — Proj. 42_2374_10

Model #IOT761 — **Scale 1:10.667**
Offshore Engineering Basin — **July 2009**
Anti-Roll Tank Empty

File Name	Parameter	Minimum	Maximum	St. Dev.
TFOL_R1A	MP_Surge_Displ (m)	-1.9303	2.2561	0.7686
TFOL_R1B	MP_Surge_Displ (m)	-1.8398	1.7732	0.7254
TFOL_R1C	MP_Surge_Displ (m)	-1.7084	1.7986	0.6816
TFOL_ORIG	MP_Surge_Displ (m)	-1.6330	1.8981	0.6765
TFOL_R1A	MP_Sway_Displ (m)	-0.8354	0.8385	0.2916
TFOL_R1B	MP_Sway_Displ (m)	-0.8978	0.9177	0.3295
TFOL_R1C	MP_Sway_Displ (m)	-0.6464	0.8818	0.3051
TFOL_ORIG	MP_Sway_Displ (m)	-1.0694	0.9472	0.3706
TFOL_R1A	MP_Heave_Displ (m)	-1.4524	1.7122	0.5197
TFOL_R1B	MP_Heave_Displ (m)	-1.3523	1.2934	0.4922
TFOL_R1C	MP_Heave_Displ (m)	-1.2025	1.2723	0.4896
TFOL_ORIG	MP_Heave_Displ (m)	-1.1920	1.5337	0.5176
TFOL_R1A	MP_Yaw_Angle (deg.)	-4.9740	7.0506	2.5305
TFOL_R1B	MP_Yaw_Angle (deg.)	-4.1269	5.9846	1.9574
TFOL_R1C	MP_Yaw_Angle (deg.)	-4.9774	9.1323	2.6172
TFOL_ORIG	MP_Yaw_Angle (deg.)	-5.8396	8.3802	2.2234
TFOL_R1A	MP_Pitch_Angle (deg.)	-4.9795	3.5982	1.5285
TFOL_R1B	MP_Pitch_Angle (deg.)	-5.0453	3.1062	1.5054
TFOL_R1C	MP_Pitch_Angle (deg.)	-5.8789	3.6243	1.5702
TFOL_ORIG	MP_Pitch_Angle (deg.)	-5.0992	3.5328	1.6127
TFOL_R1A	MP_Roll_Angle (deg.)	-6.9344	7.2707	2.5175
TFOL_R1B	MP_Roll_Angle (deg.)	-7.9173	8.0373	2.5778
TFOL_R1C	MP_Roll_Angle (deg.)	-7.9087	6.4862	2.3846
TFOL_ORIG	MP_Roll_Angle (deg.)	-8.4365	6.9723	2.9540
TFOL_R1A	Forward Speed	4.5292	knots	
TFOL_R1B	Forward Speed	4.5508	knots	
TFOL_R1C	Forward Speed	4.4967	knots	
TFOL_ORIG	Forward Speed	4.7496	knots	
TFOL_R1A	South Center Wave Probe	WAV_HM0	2.05515	m
TFOL_R1B	South Center Wave Probe	WAV_HM0	1.92432	m
TFOL_R1C	South Center Wave Probe	WAV_HM0	1.93073	m
TFOL_ORIG	South Center Wave Probe	WAV_HM0	1.93536	m
TFOL_R1A	South Center Wave Probe	SPEC_TPD	10.5053	s
TFOL_R1B	South Center Wave Probe	SPEC_TPD	10.7323	s
TFOL_R1C	South Center Wave Probe	SPEC_TPD	10.7615	s
TFOL_ORIG	South Center Wave Probe	SPEC_TPD	10.5608	s

NOTE: WAV_HM0 = Significant Wave Height (m)
SPEC_TPD = Period of Spectral Peak (s)
TFOL_R1A FILES: TFOL_R1_001, TFOL_R2_001, TFOL_R3_001
TFOL_R1B FILES: TFOL_R1_002, TFOL_R2_002, TFOL_R3_002
TFOL_R1C FILES: TFOL_R1_003, TFOL_R2_003, TFOL_R3_003
TFOL_ORIG FILES: TFOL_002, TFOL_003, TFOL_004

TABLE 11 (1 of 2): Data Repeatability Analysis Results – Following Sea, Trawl Speed

RESULTS OF REPEATABILITY CHECK RUNS

CCGA Roberts Sisters II **Proj. 42_2374_10**
Model #IOT761 **Scale 1:10.667**
Offshore Engineering Basin **July 2009**
Anti-Roll Tank Filled

File Name	Parameter	Minimum	Maximum	St. Dev.
ART_TFOL_R1A	MP_Surge_Displ (m)	-1.5927	2.0741	0.7219
ART_TFOL_R1B	MP_Surge_Displ (m)	-1.8630	1.9444	0.7191
ART_TFOL_R1C	MP_Surge_Displ (m)	-1.7376	1.8381	0.6997
ART_TFOL_ORIG	MP_Surge_Displ (m)	-1.6717	1.9520	0.6957
ART_TFOL_R1A	MP_Sway_Displ (m)	-0.9886	0.8454	0.3295
ART_TFOL_R1B	MP_Sway_Displ (m)	-0.6744	0.6544	0.3035
ART_TFOL_R1C	MP_Sway_Displ (m)	-0.7291	0.8884	0.3342
ART_TFOL_ORIG	MP_Sway_Displ (m)	-0.9237	1.1389	0.3472
ART_TFOL_R1A	MP_Heave_Displ (m)	-1.2358	1.4159	0.4576
ART_TFOL_R1B	MP_Heave_Displ (m)	-1.2383	1.5651	0.4671
ART_TFOL_R1C	MP_Heave_Displ (m)	-1.2740	1.1471	0.4488
ART_TFOL_ORIG	MP_Heave_Displ (m)	-1.2540	1.3224	0.4344
ART_TFOL_R1A	MP_Yaw_Angle (deg.)	-4.4955	7.5986	2.1418
ART_TFOL_R1B	MP_Yaw_Angle (deg.)	-5.4573	6.6108	2.2374
ART_TFOL_R1C	MP_Yaw_Angle (deg.)	-6.1828	6.3890	2.5356
ART_TFOL_ORIG	MP_Yaw_Angle (deg.)	-5.3053	8.4521	2.5047
ART_TFOL_R1A	MP_Pitch_Angle (deg.)	-5.1975	3.4302	1.5812
ART_TFOL_R1B	MP_Pitch_Angle (deg.)	-5.4788	2.9049	1.6078
ART_TFOL_R1C	MP_Pitch_Angle (deg.)	-4.9784	3.6343	1.5865
ART_TFOL_ORIG	MP_Pitch_Angle (deg.)	-4.9277	3.5424	1.6091
ART_TFOL_R1A	MP_Roll_Angle (deg.)	-4.5630	4.0782	1.7381
ART_TFOL_R1B	MP_Roll_Angle (deg.)	-3.9989	3.4328	1.4595
ART_TFOL_R1C	MP_Roll_Angle (deg.)	-4.3403	3.8779	1.5749
ART_TFOL_ORIG	MP_Roll_Angle (deg.)	-4.4299	3.5370	1.5879
ART_TFOL_R1A	Forward Speed	4.7569	knots	
ART_TFOL_R1B	Forward Speed	4.6887	knots	
ART_TFOL_R1C	Forward Speed	4.6242	knots	
ART_TFOL_ORIG	Forward Speed	4.7124	knots	
ART_TFOL_R1A	South Center Wave Probe	WAV_HM0	1.99319	m
ART_TFOL_R1B	South Center Wave Probe	WAV_HM0	1.97737	m
ART_TFOL_R1C	South Center Wave Probe	WAV_HM0	2.01162	m
ART_TFOL_ORIG	South Center Wave Probe	WAV_HM0	1.98619	m
ART_TFOL_R1A	South Center Wave Probe	SPEC_TPD	10.5951	s
ART_TFOL_R1B	South Center Wave Probe	SPEC_TPD	10.3736	s
ART_TFOL_R1C	South Center Wave Probe	SPEC_TPD	10.6325	s
ART_TFOL_ORIG	South Center Wave Probe	SPEC_TPD	10.4892	s

NOTE: WAV_HM0 = Significant Wave Height (m)
SPEC_TPD = Period of Spectral Peak (s)
ART_TFOL_R1A FILES: ART_TFOL_R1_001, ART_TFOL_R2_001, ART_TFOL_R3_001
ART_TFOL_R1B FILES: ART_TFOL_R1_002, ART_TFOL_R2_002, ART_TFOL_R3_002
ART_TFOL_R1C FILES: ART_TFOL_R1_003, ART_TFOL_R2_003, ART_TFOL_R3_003
ART_TFOL_ORIG FILES: ART_TFOL_001, ART_TFOL_002, ART_TFOL_003

TABLE 11 (2 of 2): Data Repeatability Analysis Results – Following Sea, Trawl Speed, Anti-Roll Tank Active

CCGA Roberts Sisters II Seakeeping Experiments

NOTE: All angles and accelerations are Standard Deviation values.

Proj #42_2374_10 Offshore Engineering Basin

SURGE	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	X-Axis
	Model Test	Sea Trials	amot_4ktdw_m165_900	amot_4ktdw_m165_830	amot_4ktdw_m165_800	amot_4ktdw_m165_730	amot_4ktdw_m165_700	amot_4ktdw_m165	amot_4ktnpt_m165	
TFOL	0.25093	0.1993	0.232	0.2175	0.24	0.232	0.222	0.232	0.2125	Following
TQUART	0.2799	0.178	0.2155	0.202	0.2395	0.221	0.2185	0.2155	0.2425	Quartering
TBEAM	0.22191	0.156	0.191	0.1925	0.2105	0.1865	0.1905	0.1925	0.2765	Beam
TBOW	0.21194	0.20768	0.2205	0.213	0.2215	0.2175	0.207	0.2215	0.2445	Bow
THEAD	0.34654	0.193	0.258	0.2535	0.276	0.266	0.2585	0.2585	0.177	Head

	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)
	Model Test	Sea Trials	amot_4ktdw_m165_nrt	amot_4ktdw_m165_900	amot_4ktdw_m165_830	amot_4ktdw_m165_1430	amot_4ktdw_m165_1400	amot_4ktdw_m165_1330	amot_4ktdw_m165	amot_4ktnpt_m165
ART_TFOL	0.32013			0.232	0.2175					
ART_TQUART	0.28128	0.1849	0.2485	0.2155	0.202	0.249	0.241	0.2275	0.249	0.265
ART_TBEAM	0.16347	0.185	0.2095	0.191	0.1925	0.2165	0.2085	0.206	0.2085	0.265
ART_TBOW	0.24662	0.22157	0.2355	0.2205	0.213	0.21	0.221	0.2365	0.2365	0.224
ART_THEAD				0.258	0.2535					

	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)	Surge Accel. (m/s^2)
	Model Test	Sea Trials	mot_8ktnpt_m165_1230	mot_8ktnpt_m165_1200	mot_8ktnpt_m165_1130	mot_8ktnpt_m165_1100	mot_8ktdw_m165	mot_8ktnpt_m165
CFOL	0.21895	0.2007	0.2515	0.235	0.2455	0.245	0.2455	0.1755
CQUART	0.22508	0.18027	0.23	0.222	0.221	0.2165	0.216	0.233
CBEAM	0.22198	0.164	0.207	0.2125	0.202	0.208	0.207	0.242
CBOW	0.1925	0.189	0.2105	0.2005	0.2035	0.2165	0.2005	0.203
CHEAD	0.30503	0.1995	0.2455	0.23	0.243	0.2455	0.2455	0.1685

NOTE: T(heading angle) = Trawl Speed Results (nominally 4 knots) – Anti-Roll Tank Empty
C(heading angle) = Cruise Speed Results (nominally 8 knots) – Anti-Roll Tank Empty
ART-T(heading angle) = Trawl Speed with Anti-Roll Tank Active

TABLE 12: Comparison Table of Surge Accelerations for Model, Sea Trials and Numerical Data

CCGA Roberts Sisters II Seakeeping Experiments

NOTE: All angles and accelerations are Standard Deviation values.

Proj #42_2374_10 Offshore Engineering Basin

SWAY	Sway Accel. (m/s^2) Model Test	Sway Accel. (m/s^2) Sea Trials	Sway Accel. (m/s^2) amot_4ktdw_m165_900	Sway Accel. (m/s^2) amot_4ktdw_m165_830	Sway Accel. (m/s^2) amot_4ktdw_m165_800	Sway Accel. (m/s^2) amot_4ktdw_m165_730	Sway Accel. (m/s^2) amot_4ktdw_m165_700	Sway Accel. (m/s^2) amot_4ktdw_m165	Sway Accel. (m/s^2) amot_4ktnpt_m165	X-Axis
TFOL	0.1404	0.1546	0.1365	0.133	0.1465	0.1365	0.1375	0.1365	0.177	Following
TQUART	0.14045	0.222	0.1695	0.1685	0.176	0.165	0.1645	0.1695	0.1385	Quartering
TBEAM	0.30016	0.2389	0.267	0.2485	0.279	0.254	0.2585	0.2485	0.265	Beam
TBOW	0.31802	0.17647	0.253	0.2485	0.253	0.237	0.2385	0.253	0.2425	Bow
THEAD	0.15708	0.1878	0.1265	0.1225	0.1325	0.122	0.1205	0.1205	0.1925	Head

	Sway Accel. (m/s^2) Model Test	Sway Accel. (m/s^2) Sea Trials	Sway Accel. (m/s^2) amot_4ktdw_m165_nrt	Sway Accel. (m/s^2) amot_4ktdw_m165_900	Sway Accel. (m/s^2) amot_4ktdw_m165_830	Sway Accel. (m/s^2) amot_4ktdw_m165_1430	Sway Accel. (m/s^2) amot_4ktdw_m165_1400	Sway Accel. (m/s^2) amot_4ktdw_m165_1330	Sway Accel. (m/s^2) amot_4ktdw_m165	Sway Accel. (m/s^2) amot_4ktnpt_m165
ART_TFOL	0.30824			0.1365	0.133					
ART_TQUART	0.16684	0.238	0.158	0.1695	0.1685	0.156	0.1635	0.171	0.156	0.386
ART_TBEAM	0.33638	0.263	0.2885	0.267	0.2485	0.2825	0.2885	0.2805	0.2885	0.698
ART_TBOW	0.47077	0.1949	0.2835	0.253	0.2485	0.267	0.2825	0.28	0.28	0.926
ART_THEAD				0.1265	0.1225					

	Sway Accel. (m/s^2) Model Test	Sway Accel. (m/s^2) Sea Trials	Sway Accel. (m/s^2) mot_8ktnpt_m165_1230	Sway Accel. (m/s^2) mot_8ktnpt_m165_1200	Sway Accel. (m/s^2) mot_8ktnpt_m165_1130	Sway Accel. (m/s^2) mot_8ktnpt_m165_1100	Sway Accel. (m/s^2) mot_8ktdw_m165	Sway Accel. (m/s^2) mot_8ktnpt_m165
CFOL	0.14511	0.15766	0.1275	0.13	0.1275	0.1245	0.1275	0.1595
CQUART	0.14166	0.199	0.1675	0.1535	0.163	0.1625	0.168	0.1705
CBEAM	0.31234	0.244	0.3345	0.3185	0.3275	0.33	0.3345	0.2745
CBOW	0.39372	0.20987	0.3045	0.286	0.293	0.2995	0.286	0.2455
CHEAD	0.19846	0.19695	0.165	0.166	0.163	0.175	0.175	0.1605

NOTE: T(heading angle) = Trawl Speed Results (nominally 4 knots) – Anti-Roll Tank Empty
C(heading angle) = Cruise Speed Results (nominally 8 knots) – Anti-Roll Tank Empty
ART-T(heading angle) = Trawl Speed with Anti-Roll Tank Active

TABLE 13: Comparison Table of Sway Accelerations for Model, Sea Trials and Numerical Data

CCGA Roberts Sisters II Seakeeping Experiments
NOTE: All angles and accelerations are Standard Deviation values.
Proj #42_2374_10 Offshore Engineering Basin

HEAVE	Heave Accel. (m/s^2) Model Test	Heave Accel. (m/s^2) Sea Trials	Heave Accel. (m/s^2) amot_4ktdw_m165_900	Heave Accel. (m/s^2) amot_4ktdw_m165_830	Heave Accel. (m/s^2) amot_4ktdw_m165_800	Heave Accel. (m/s^2) amot_4ktdw_m165_730	Heave Accel. (m/s^2) amot_4ktdw_m165_700	Heave Accel. (m/s^2) amot_4ktdw_m165	Heave Accel. (m/s^2) amot_4ktnpt_m165	X-Axis
TFOL	0.19681	0.405	0.349	0.329	0.361	0.3315	0.354	0.3315	0.449	Following
TQUART	0.1898	0.4185	0.355	0.336	0.372	0.3395	0.349	0.355	0.3915	Quartering
TBEAM	0.57776	0.50169	0.4555	0.436	0.4695	0.4195	0.439	0.436	0.444	Beam
TBOW	0.61049	0.482	0.449	0.4195	0.465	0.4205	0.419	0.465	0.4285	Bow
THEAD	0.5254	0.513	0.4825	0.454	0.4805	0.4545	0.45	0.45	0.471	Head

	Heave Accel. (m/s^2) Model Test	Heave Accel. (m/s^2) Sea Trials	Heave Accel. (m/s^2) amot_4ktdw_m165_nrt	Heave Accel. (m/s^2) amot_4ktdw_m165_900	Heave Accel. (m/s^2) amot_4ktdw_m165_830	Heave Accel. (m/s^2) amot_4ktdw_m165_1430	Heave Accel. (m/s^2) amot_4ktdw_m165_1400	Heave Accel. (m/s^2) amot_4ktdw_m165_1330	Heave Accel. (m/s^2) amot_4ktdw_m165	Heave Accel. (m/s^2) amot_4ktnpt_m165
ART_TFOL	0.33739			0.349	0.329					
ART_TQUART	0.23815	0.46085	0.332	0.355	0.336	0.3305	0.3445	0.3475	0.3305	0.4125
ART_TBEAM	0.61257	0.5447	0.484	0.4555	0.436	0.495	0.4805	0.4785	0.4805	0.462
ART_TBOW	0.66058	0.58367	0.469	0.449	0.4195	0.454	0.498	0.482	0.482	0.456
ART_THEAD				0.4825	0.454					

	Heave Accel. (m/s^2) Model Test	Heave Accel. (m/s^2) Sea Trials	Heave Accel. (m/s^2) mot_8ktnpt_m165_1230	Heave Accel. (m/s^2) mot_8ktnpt_m165_1200	Heave Accel. (m/s^2) mot_8ktnpt_m165_1130	Heave Accel. (m/s^2) mot_8ktnpt_m165_1100	Heave Accel. (m/s^2) mot_8ktdw_m165	Heave Accel. (m/s^2) mot_8ktnpt_m165
CFOL	0.15971	0.45896	0.383	0.3715	0.389	0.3685	0.389	0.406
CQUART	0.1614	0.4426	0.375	0.356	0.3745	0.352	0.3545	0.4705
CBEAM	0.72796	0.6205	0.605	0.5955	0.6075	0.603	0.605	0.5365
CBOW	0.77061	0.6435	0.6395	0.5845	0.5905	0.5965	0.5845	0.514
CHEAD	0.78929	0.72846	0.7335	0.6715	0.7115	0.729	0.729	0.523

NOTE: T(heading angle) = Trawl Speed Results (nominally 4 knots) – Anti-Roll Tank Empty
C(heading angle) = Cruise Speed Results (nominally 8 knots) – Anti-Roll Tank Empty
ART-T(heading angle) = Trawl Speed with Anti-Roll Tank Active

TABLE 14: Comparison Table of Heave Accelerations for Model, Sea Trials and Numerical Data

CCGA Roberts Sisters II Seakeeping Experiments

NOTE: All angles and accelerations are Standard Deviation values.

Proj #42_2374_10 Offshore Engineering Basin

ROLL	Roll Angle (deg.) Model Test	Roll Angle (deg.) Sea Trials	Roll Angle (deg.) amot_4ktdw_m165_900	Roll Angle (deg.) amot_4ktdw_m165_830	Roll Angle (deg.) amot_4ktdw_m165_800	Roll Angle (deg.) amot_4ktdw_m165_730	Roll Angle (deg.) amot_4ktdw_m165_700	Roll Angle (deg.) amot_4ktdw_m165	Roll Angle (deg.) amot_4ktnpt_m165	X-Axis
TFOL	2.8904	3.5648	2.0095	1.995	2.4055	2.063	1.824	2.063	2.549	Following
TQUART	2.8904	4.1043	2.413	2.2355	2.5905	2.4345	2.357	2.413	2.5975	Quartering
TBEAM	5.1473	4.6957	5.0765	5.0285	5.506	5.1685	4.9975	5.0285	5.831	Beam
TBOW	5.7464	4.0386	4.563	5.2775	5.931	5.4225	5.677	5.931	4.82	Bow
THEAD	2.8048	3.9223	1.8775	1.9225	5.931	2.1925	2.107	2.107	3.239	Head

	Roll Angle (deg.) Model Test	Roll Angle (deg.) Sea Trials	Roll Angle (deg.) mot_4ktdw_m165_par	Roll Angle (deg.) mot_4ktdw_m165_nrt	Roll Angle (deg.) mot_4ktdw_m165_900	Roll Angle (deg.) mot_4ktdw_m165_830	Roll Angle (deg.) mot_4ktdw_m165_1430	Roll Angle (deg.) mot_4ktdw_m165_1400	Roll Angle (deg.) mot_4ktdw_m165_1330	Roll Angle (deg.) mot_4kdw_m165	Roll Angle (deg.) mot_4ktnpt_m165
ART_TFOL	1.6139				2.0095	1.995					
ART_TQUART	2.0026	2.747	1.728	2.164	2.413	2.2355	1.9685	2.1465	2.3535	1.9685	4.798
ART_TBEAM	3.4964	3.0279	3.218	6.248	5.0765	5.0285	3.2095	3.3585	3.3175	3.3585	6.46
ART_TBOW	3.5315	2.0887	3.366	4.897	4.563	5.2775	2.7925	2.5865	2.694	2.694	8.095
ART_THEAD			0	0	1.8775	1.9225					

	Roll Angle (deg.) Model Test	Roll Angle (deg.) Sea Trials	Roll Angle (deg.) mot_8ktnpt_m165_1230	Roll Angle (deg.) mot_8ktnpt_m165_1200	Roll Angle (deg.) mot_8ktnpt_m165_1130	Roll Angle (deg.) mot_8ktnpt_m165_1100	Roll Angle (deg.) mot_8ktdw_m165	Roll Angle (deg.) mot_8ktnpt_m165
CFOL	2.2591	4.0095	2.566	2.7135	2.697	2.473	2.697	4.0265
CQUART	1.515	4.114	2.808	2.468	2.6545	2.7885	2.8535	2.9805
CBEAM	3.9084	4.7762	5.141	4.8685	4.9895	4.9515	5.141	4.7305
CBOW	6.3207	3.9878	4.544	3.8185	4.133	4.581	3.8185	3.273
CHEAD	4.1505	2.947	2.942	2.6855	2.651	2.5955	2.5955	3.7885

NOTE: T(heading angle) = Trawl Speed Results (nominally 4 knots) – Anti-Roll Tank Empty
C(heading angle) = Cruise Speed Results (nominally 8 knots) – Anti-Roll Tank Empty
ART-T(heading angle) = Trawl Speed with Anti-Roll Tank Active

TABLE 15: Comparison Table of Roll Angles for Model, Sea Trials and Numerical Data

CCGA Roberts Sisters II Seakeeping Experiments
NOTE: All angles and accelerations are Standard Deviation values.
Proj #42_2374_10 Offshore Engineering Basin

PITCH	Pitch Angle (deg.) Model Test	Pitch Angle (deg.) Sea Trials	Pitch Angle (deg.) amot_4ktdw_m165_900	Pitch Angle (deg.) amot_4ktdw_m165_830	Pitch Angle (deg.) amot_4ktdw_m165_800	Pitch Angle (deg.) amot_4ktdw_m165_730	Pitch Angle (deg.) amot_4ktdw_m165_700	Pitch Angle (deg.) amot_4ktdw_m165	Pitch Angle (deg.) amot_4ktnpt_m165	X-Axis
TFOL	1.5039	1.7959	1.753	1.672	1.7705	1.677	1.7195	1.677	1.815	Following
TQUART	1.6477	1.5718	1.6625	1.54	1.8165	1.667	1.682	1.6625	2.0515	Quartering
TBEAM	1.7306	1.607	1.6945	1.6275	1.8115	1.56	1.7025	1.6275	2.253	Beam
TBOW	2.3219	1.826	1.7625	1.66	1.7785	1.724	1.6515	1.7785	1.7785	Bow
THEAD	2.9447	1.9124	2.2305	2.14	1.7785	2.233	2.15	2.15	1.6025	Head

	Pitch Angle (deg.) Model Test	Pitch Angle (deg.) Sea Trials	Pitch Angle (deg.) mot_4ktdw_m165_par	Pitch Angle (deg.) mot_4ktdw_m165_nrt	Pitch Angle (deg.) mot_4ktdw_m165_900	Pitch Angle (deg.) mot_4ktdw_m165_830	Pitch Angle (deg.) mot_4ktdw_m165_1430	Pitch Angle (deg.) mot_4ktdw_m165_1400	Pitch Angle (deg.) mot_4ktdw_m165_1330	Pitch Angle (deg.) mot_4kdw_m165	Pitch Angle (deg.) mot_4ktnpt_m165
ART_TFOL	1.597				1.753	1.672					
ART_TQUART	1.7024	1.645	1.803	1.7945	1.6625	1.54	1.8015	1.77	1.6825	1.8015	4.488
ART_TBEAM	1.065	1.7808	1.696	1.7125	1.6945	1.6275	1.876	1.6925	1.775	1.6925	4.104
ART_TBOW	1.0468	2.3286	1.856	1.8535	1.7625	1.66	1.651	1.812	1.864	1.864	3.184
ART_THEAD					2.2305	2.14					

	Pitch Angle (deg.) Model Test	Pitch Angle (deg.) Sea Trials	Pitch Angle (deg.) mot_8ktnpt_m165_1230	Pitch Angle (deg.) mot_8ktnpt_m165_1200	Pitch Angle (deg.) mot_8ktnpt_m165_1130	Pitch Angle (deg.) mot_8ktnpt_m165_1100	Pitch Angle (deg.) mot_8ktdw_m165	Pitch Angle (deg.) mot_8ktnpt_m165
CFOL	1.3217	1.609	1.8985	1.769	1.8895	1.8245	1.8895	1.634
CQUART	1.3341	1.4655	1.7095	1.6865	1.7215	1.617	1.6115	2.097
CBEAM	1.9065	1.468	1.9705	1.9705	1.898	1.8505	1.9705	2.1105
CBOW	1.439	1.6386	2.0045	1.7705	1.848	1.9295	1.7705	1.907
CHEAD	2.6418	1.7528	2.4655	2.212	2.3755	2.4165	2.4165	1.648

NOTE: T(heading angle) = Trawl Speed Results (nominally 4 knots) – Anti-Roll Tank Empty
C(heading angle) = Cruise Speed Results (nominally 8 knots) – Anti-Roll Tank Empty
ART-T(heading angle) = Trawl Speed with Anti-Roll Tank Active

TABLE 16: Comparison Table of Pitch Angles for Model, Sea Trials and Numerical Data

CCGA Roberts Sisters II Seakeeping Experiments

NOTE: All angles and accelerations are Standard Deviation values.

Proj #42_2374_10 Offshore Engineering Basin

YAW	Yaw Angle (deg.) Model Test	Yaw Angle (deg.) Sea Trials	Yaw Angle (deg.) amot_4ktdw_m165_900	Yaw Angle (deg.) amot_4ktdw_m165_830	Yaw Angle (deg.) amot_4ktdw_m165_800	Yaw Angle (deg.) amot_4ktdw_m165_730	Yaw Angle (deg.) amot_4ktdw_m165_700	Yaw Angle (deg.) amot_4ktdw_m165	Yaw Angle (deg.) amot_4ktnpt_m165	X-Axis
TFOL	7.3099	2.7172	1.161	1.348	1.478	1.187	1.069	1.187	1.618	Following
TQUART	2.9689	2.3965	2.7665	2.467	2.762	2.1265	2.0745	2.7665	1.499	Quartering
TBEAM	12.12	2.376	2.8135	2.531	3.0625	2.483	2.7	2.531	4.2195	Beam
TBOW	10.298	2.261	2.497	2.66	2.249	2.127	2.599	2.249	2.568	Bow
THEAD	1.8979	2.2025	1.102	1.5705	2.249	1.271	1.0285	1.0285	1.724	Head

	Yaw Angle (deg.) Model Test	Yaw Angle (deg.) Sea Trials	Yaw Angle (deg.) mot_4ktdw_m165_par	Yaw Angle (deg.) mot_4ktdw_m165_nrt	Yaw Angle (deg.) mot_4ktdw_m165_900	Yaw Angle (deg.) mot_4ktdw_m165_830	Yaw Angle (deg.) mot_4ktdw_m165_1430	Yaw Angle (deg.) mot_4ktdw_m165_1400	Yaw Angle (deg.) mot_4ktdw_m165_1330	Yaw Angle (deg.) mot_4kdw_m165	Yaw Angle (deg.) mot_4ktnpt_m165
ART_TFOL	2.3837				1.161	1.348					
ART_TQUART	3.5803	2.6235	2.4935	2.846	2.7665	2.467	2.4575	2.7605	2.7805	2.4575	6.589
ART_TBEAM	2.9196	2.8805	2.816	2.979	2.8135	2.531	2.4085	2.603	2.179	2.603	7.112
ART_TBOW	2.8655	1.999	2.412	2.5905	2.497	2.66	2.248	2.65	2.5205	2.5205	8.661
ART_THEAD					1.102	1.5705					

	Yaw Angle (deg.) Model Test	Yaw Angle (deg.) Sea Trials	Yaw Angle (deg.) mot_8ktnpt_m165_1230	Yaw Angle (deg.) mot_8ktnpt_m165_1200	Yaw Angle (deg.) mot_8ktnpt_m165_1130	Yaw Angle (deg.) mot_8ktnpt_m165_1100	Yaw Angle (deg.) mot_8ktdw_m165	Yaw Angle (deg.) mot_8ktnpt_m165
CFOL	17.623	2.3577	1.745	1.745	1.6355	1.8735	1.6355	1.0615
CQUART	10.208	2.1498	2.4185	2.4515	2.3175	2.534	2.2215	2.3435
CBEAM	4.2104	1.5533	2.6165	2.912	2.6845	2.862	2.6165	3.178
CBOW	3.3107	1.1789	2.35	1.7295	2.1465	2.2665	1.7295	1.696
CHEAD	6.9198	1.2668	0.861	0.798	0.8485	0.7675	0.7675	0.668

NOTE: T(heading angle) = Trawl Speed Results (nominally 4 knots) – Anti-Roll Tank Empty
C(heading angle) = Cruise Speed Results (nominally 8 knots) – Anti-Roll Tank Empty
ART-T(heading angle) = Trawl Speed with Anti-Roll Tank Active

TABLE 17: Comparison Table of Yaw Angles for Model, Sea Trials and Numerical Data

FIGURES

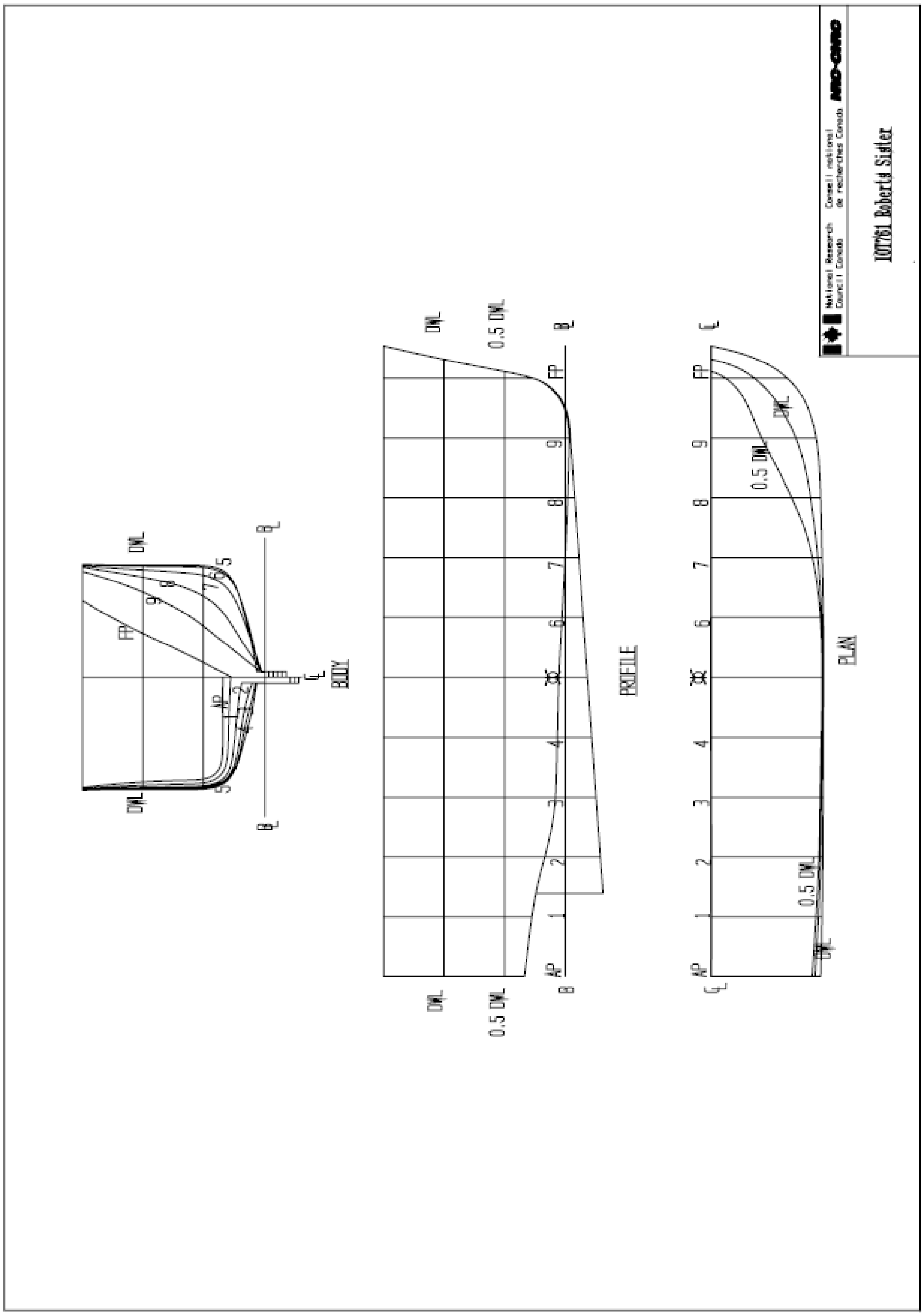


FIGURE 1: Body Plan, Profile & Plan Drawings - Roberts Sisters II Model IOT761

FIGURE 2: CCGA Roberts Sisters II Model IOT761

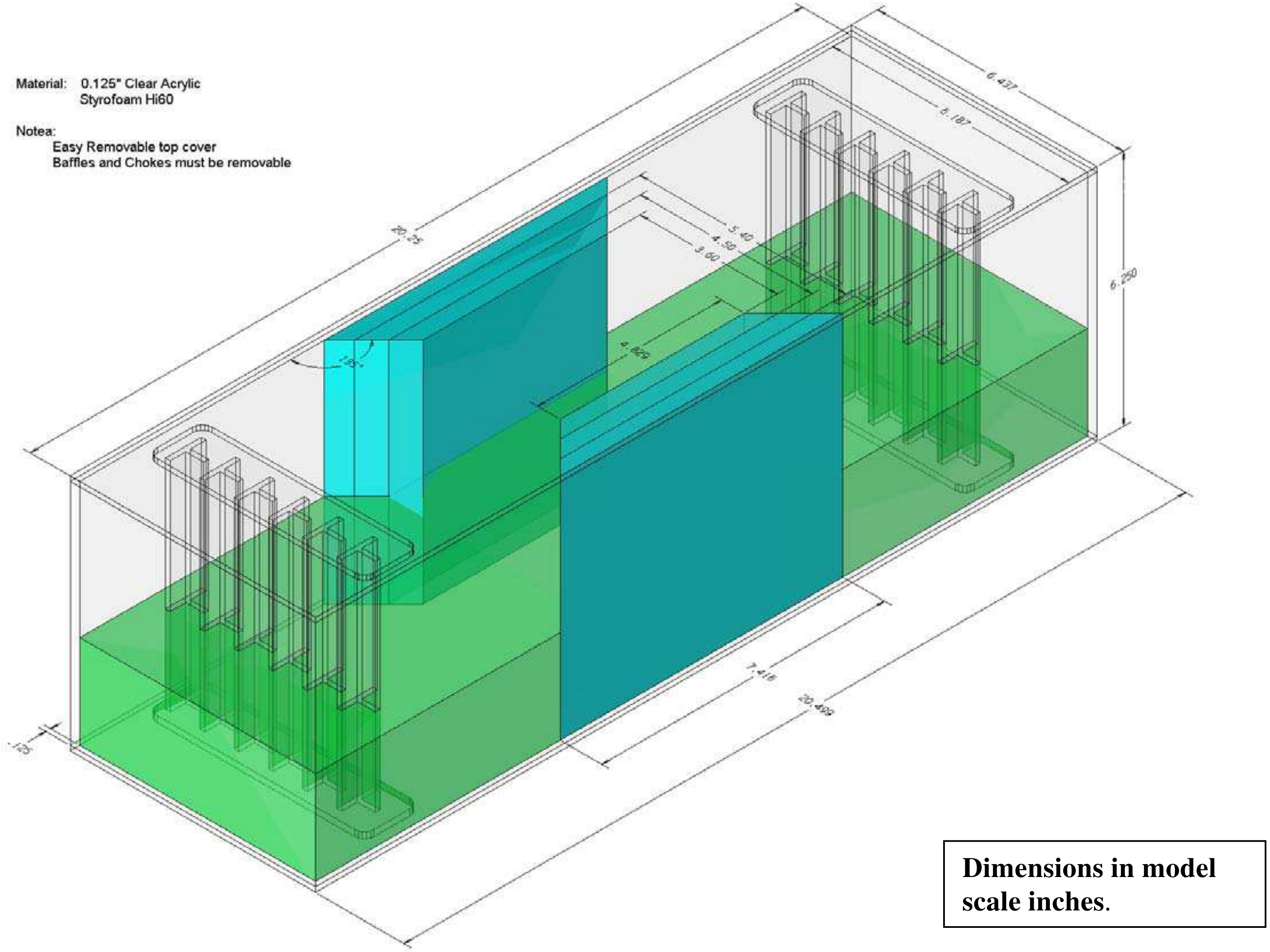


FIGURE 3: CCGA Roberts Sisters II Model Anti-Roll Tank Design

FIGURE 4: Model IOT761 Propeller/Rudder Arrangement

FIGURE 5: CCGA Roberts Sisters II - Propeller/Rudder Arrangement

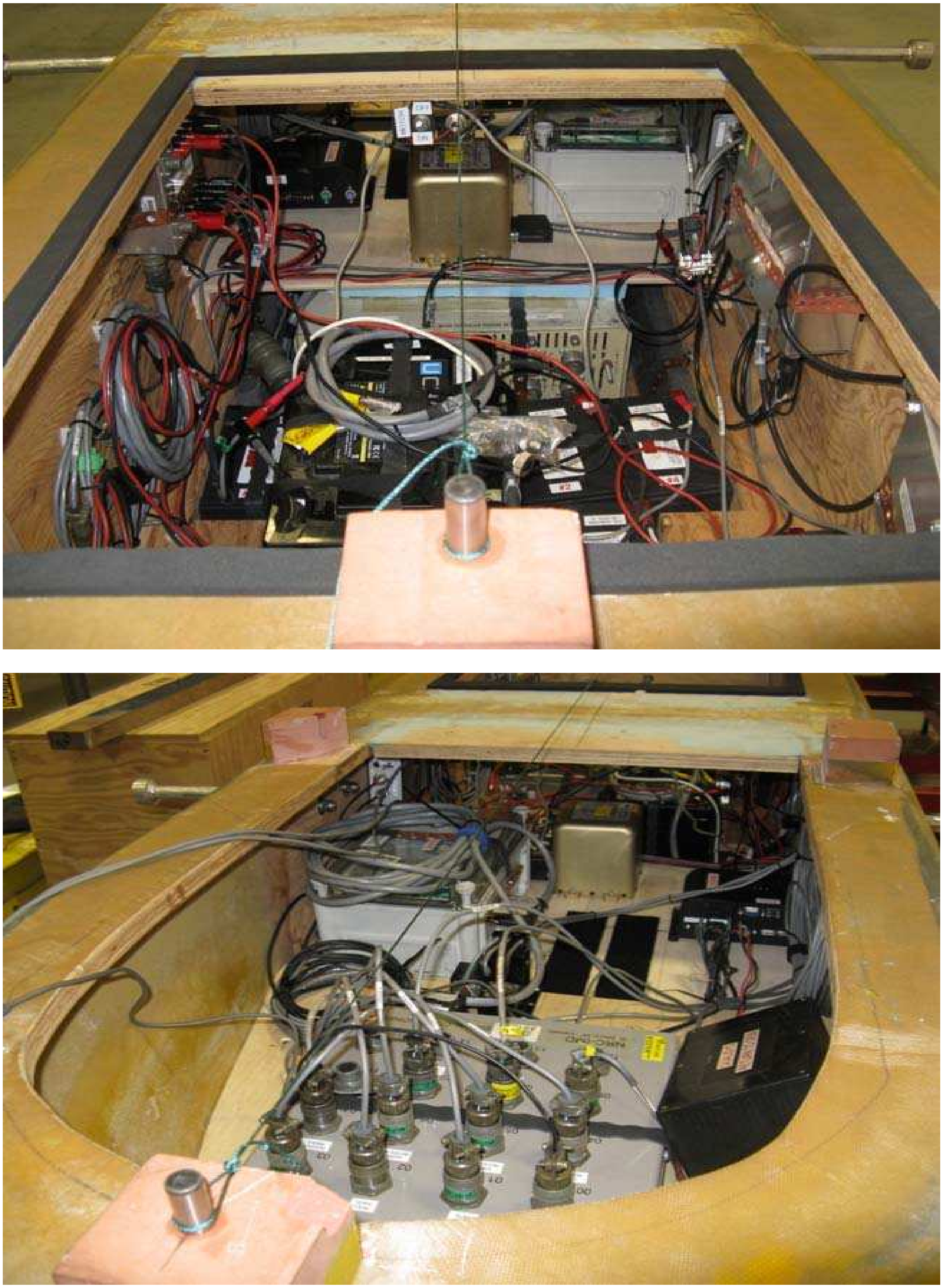


FIGURE 6: Model IOT761 Instrumentation & Battery Layout

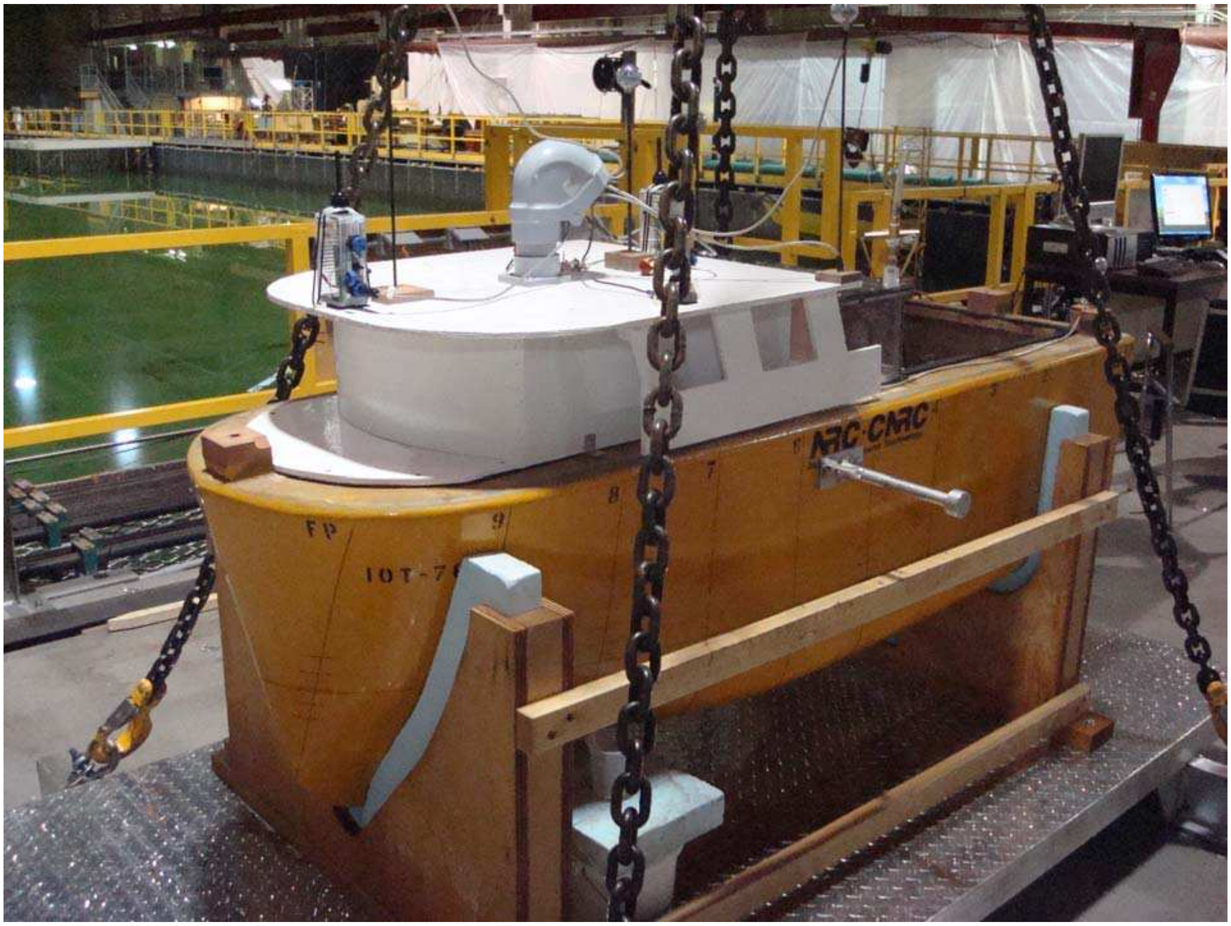


FIGURE 7: Model IOT761 in Cradle with Lifting Chains Attached

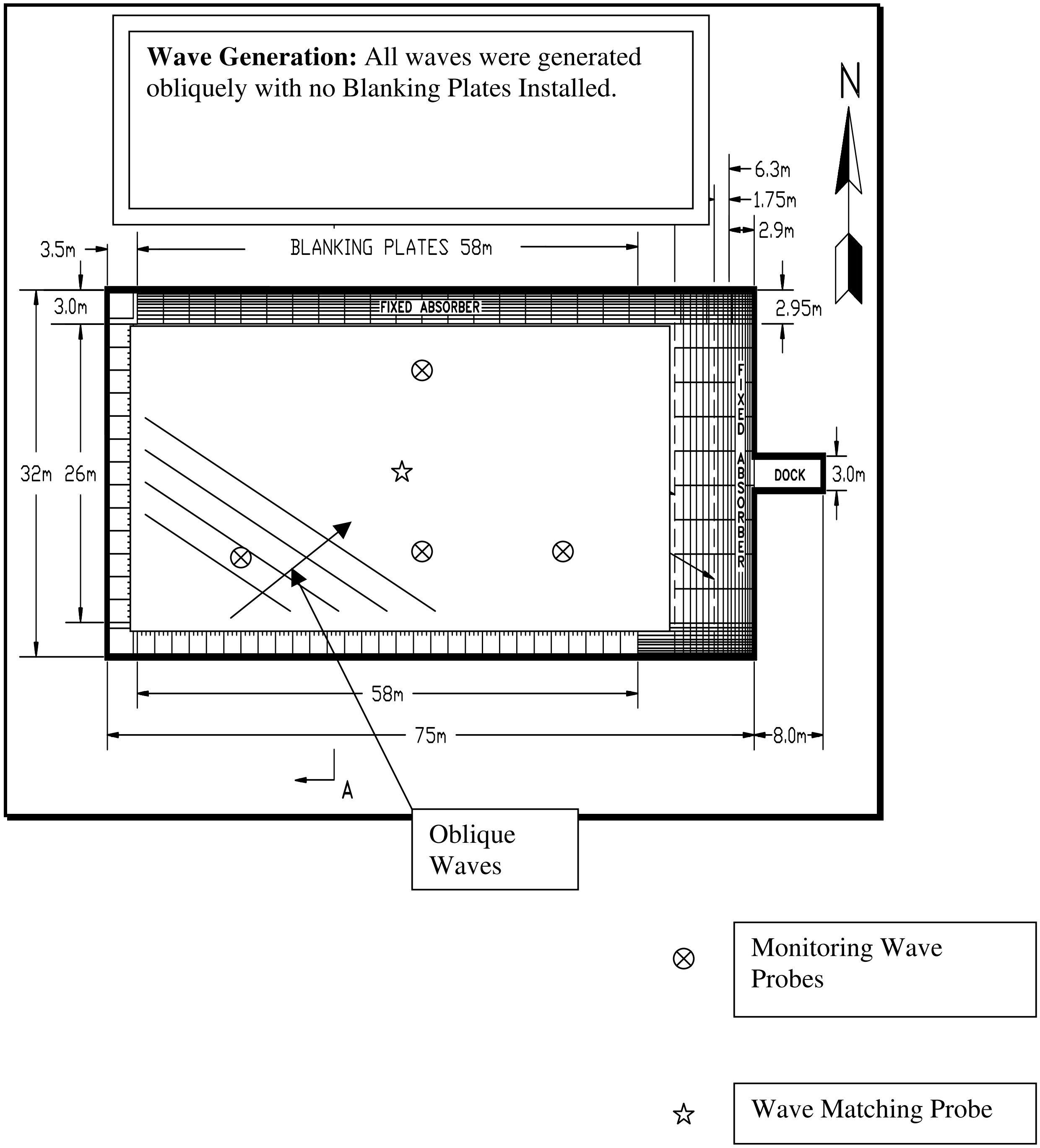
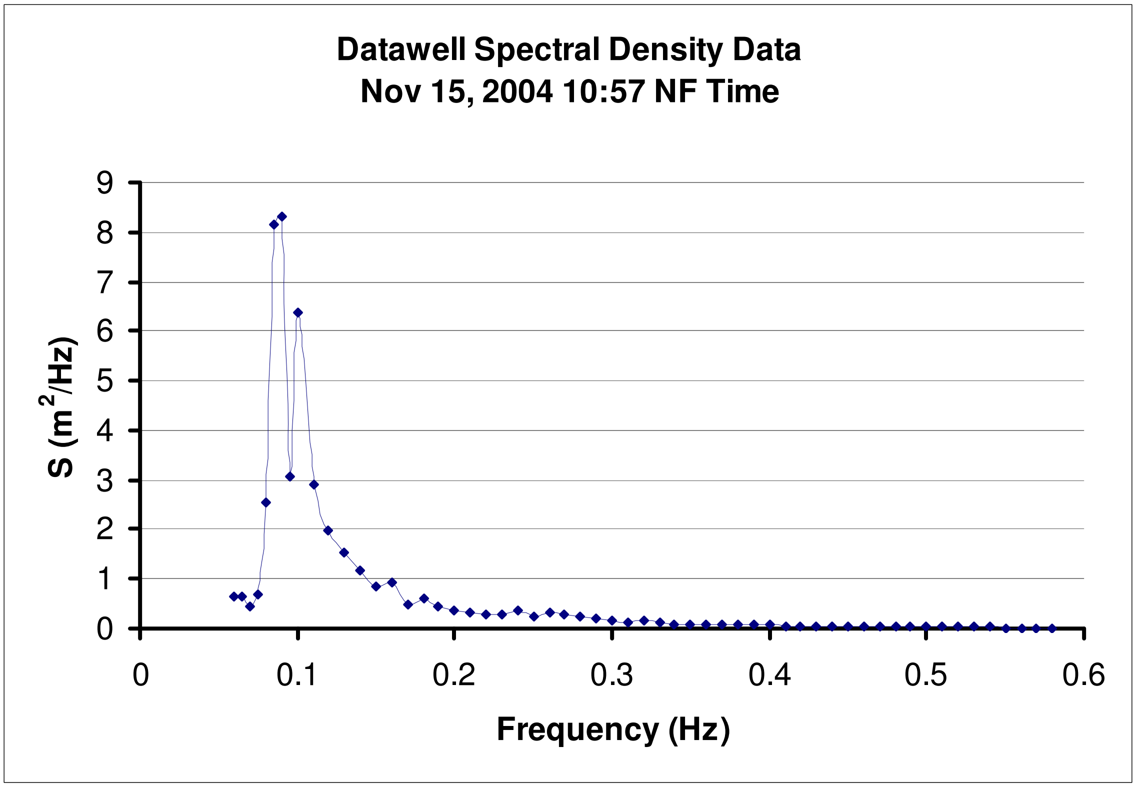


FIGURE 8: Offshore Engineering Basin Layout



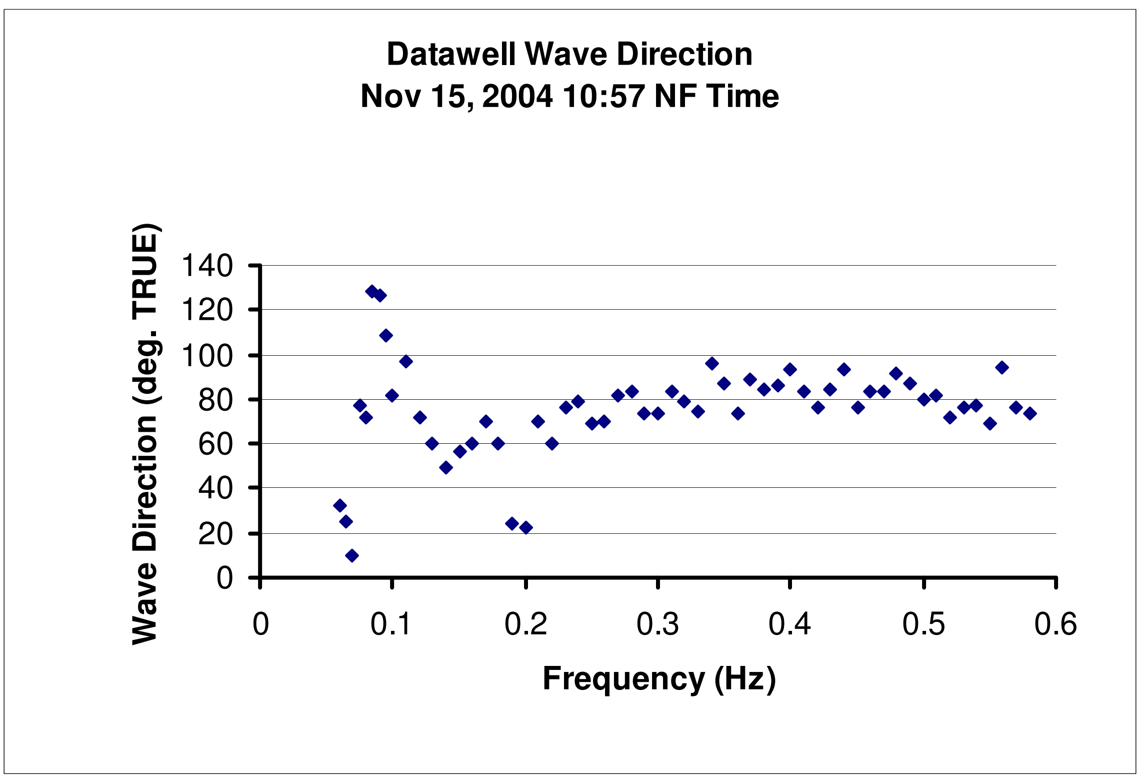


FIGURE 9: Target Irregular Wave Spectral Density and Direction Data

FIGURE 10: Model Launching Arrangement

FIGURE 11: Launching Model from South East Corner

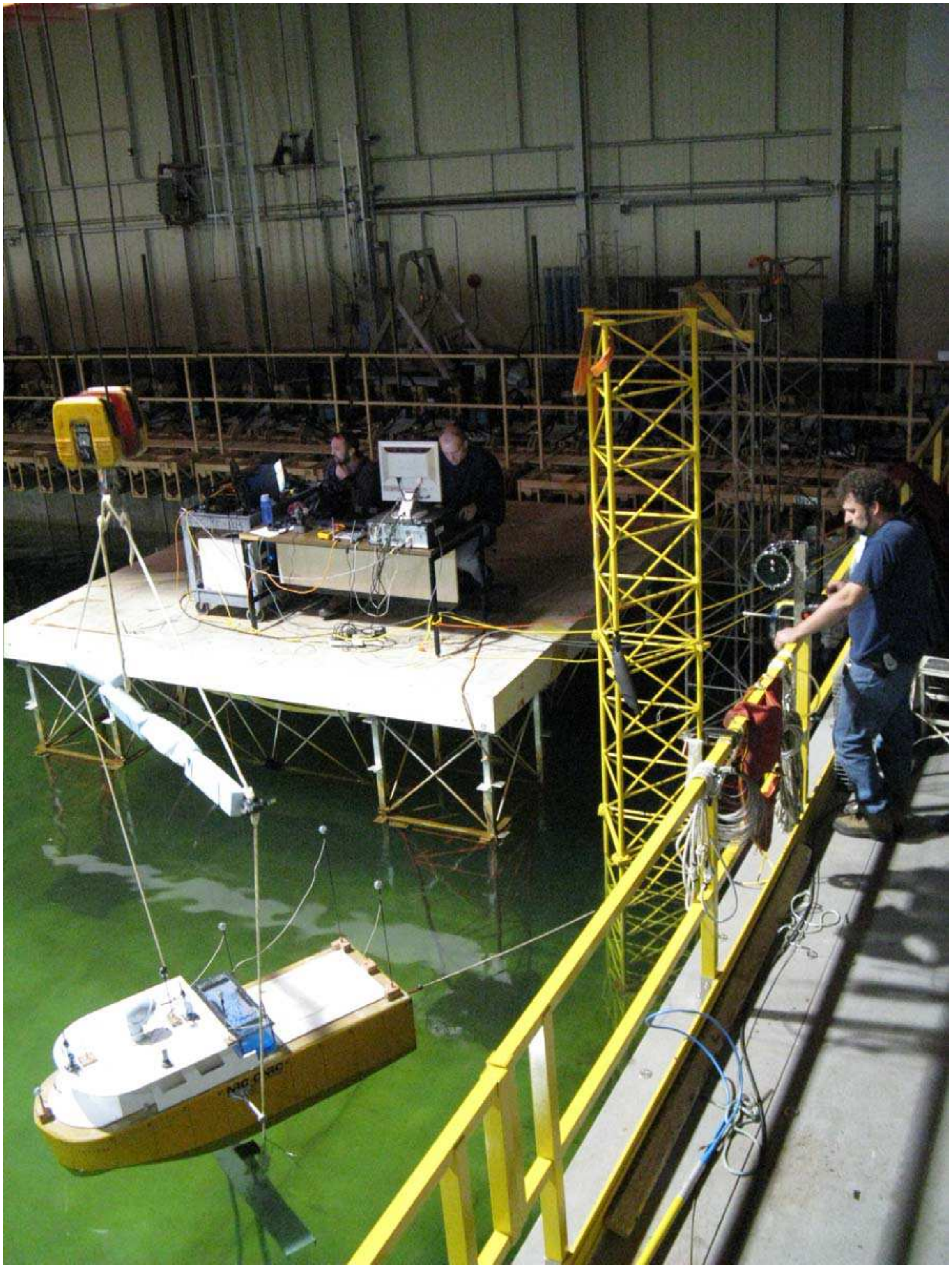


FIGURE 12: Launching Model from North West Corner

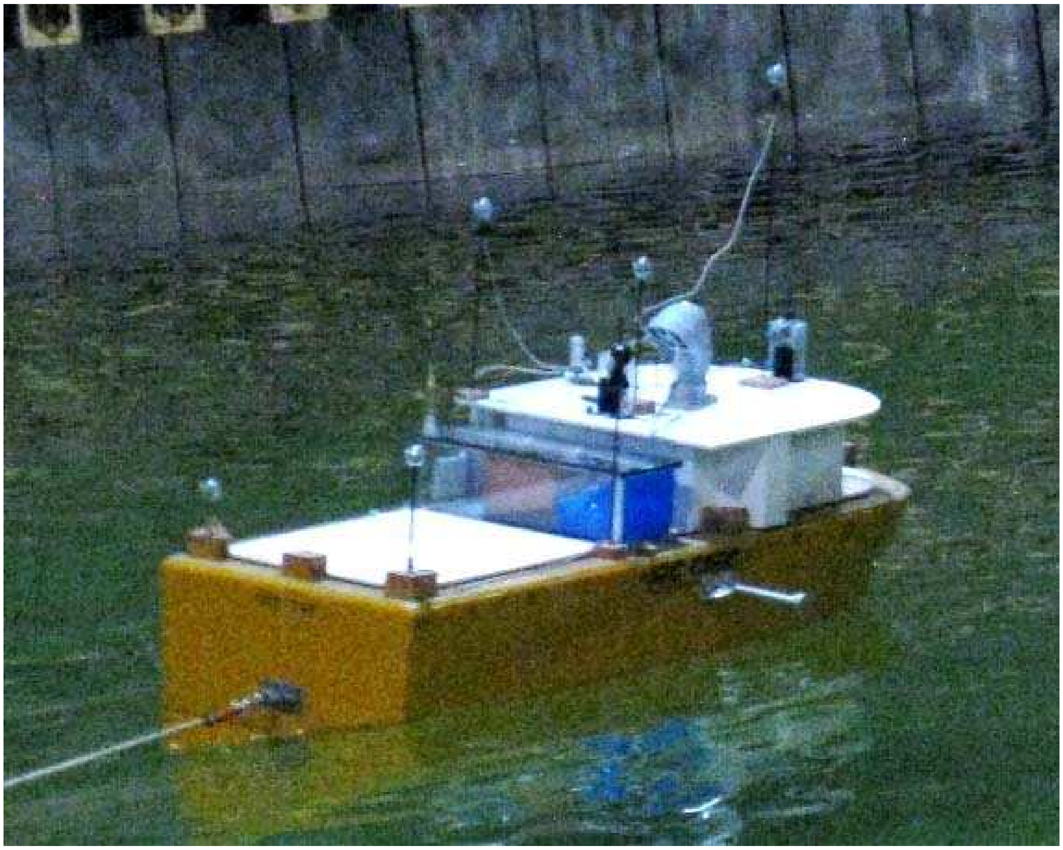


FIGURE 13: Model IOT761 with ART in use (fluid in ART dyed blue)

FIGURE 14: Model IOT761 without ART in use

FIGURE 15: Model IOT761 During Testing – case where the period of the wave matches the natural roll period of model.

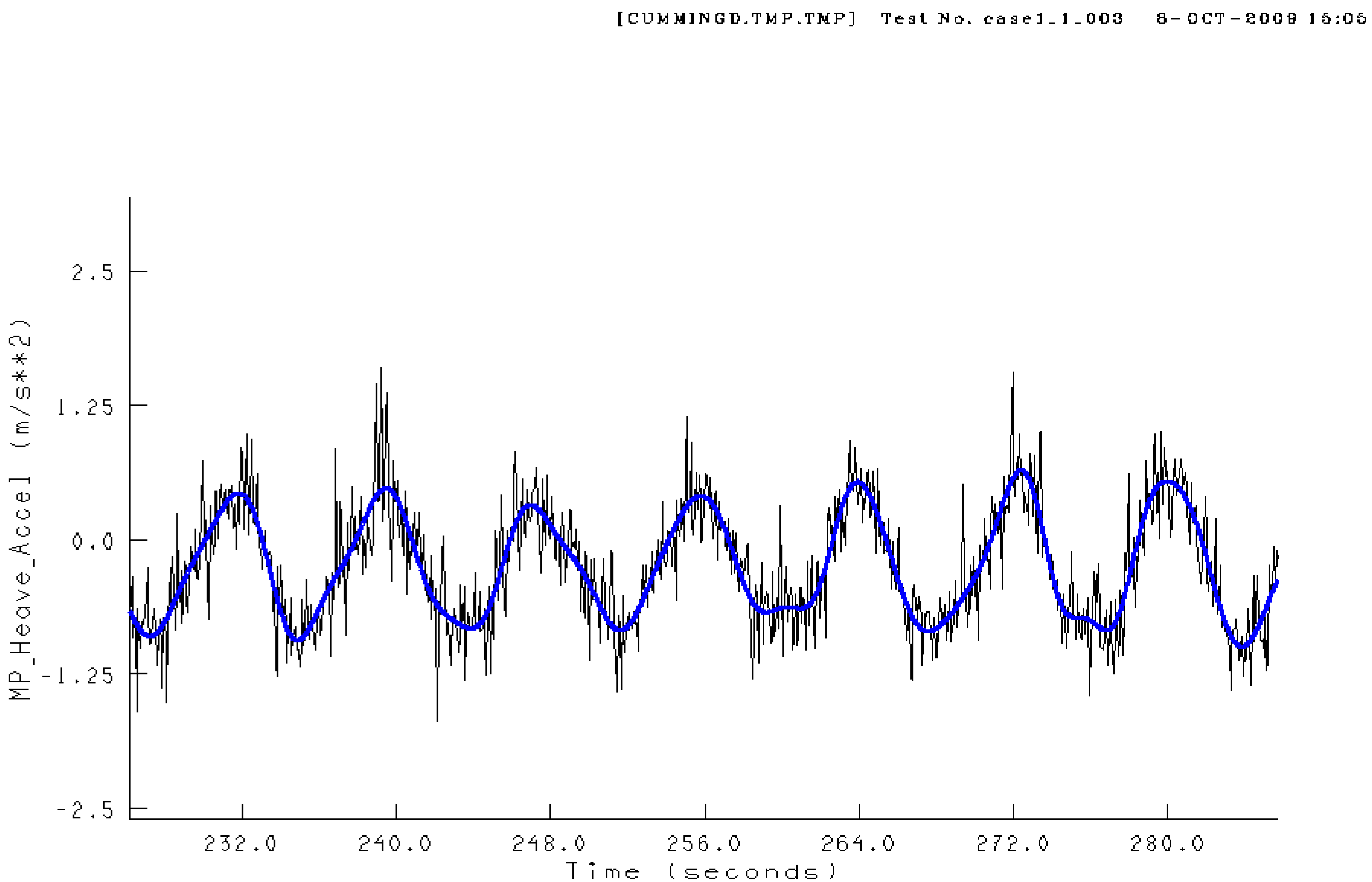


FIGURE 16: Example Time Series Plot of Heave Acceleration With/Without Band Pass Filtering

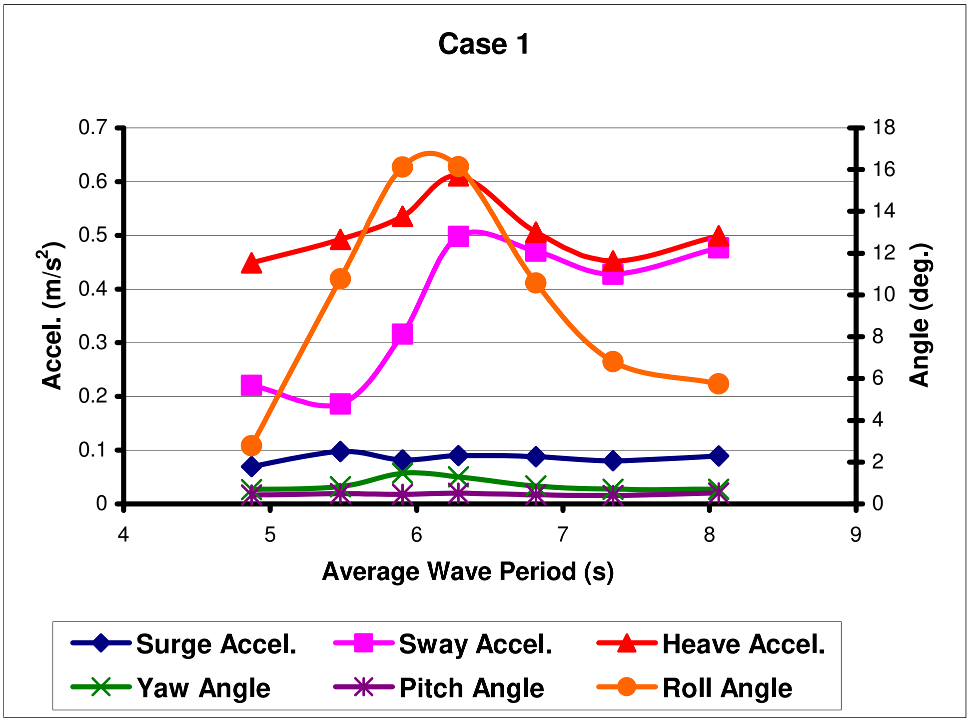


FIGURE 17: Accel./Angle vs. Average Wave Period – Case 1 (Beam Seas, 4 knots, ART Empty)

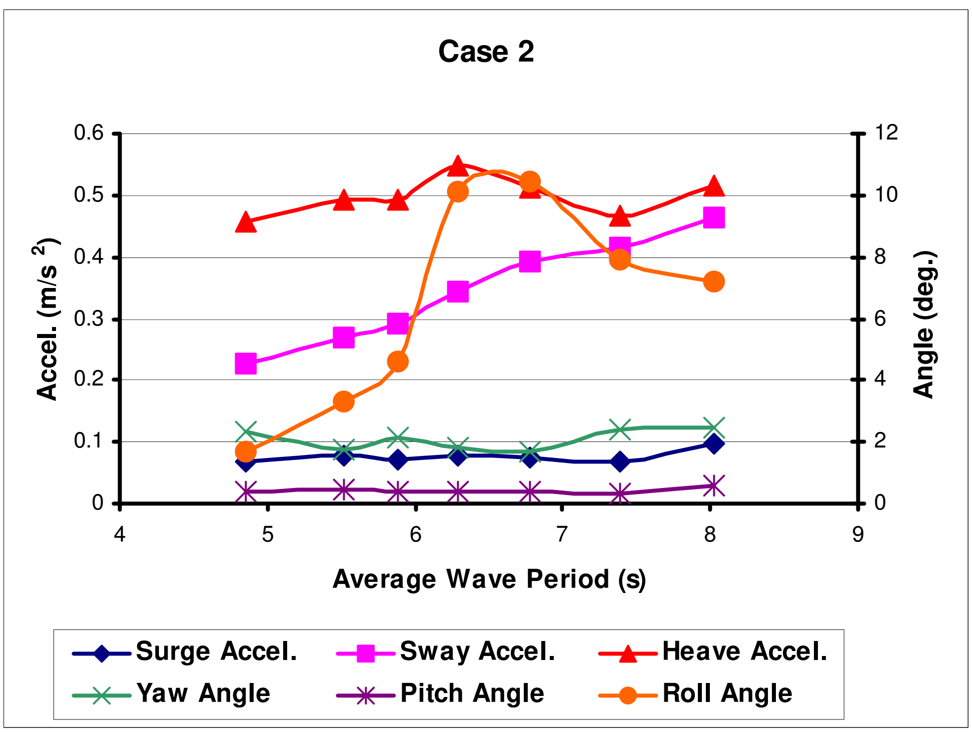


FIGURE 18: Accel./Angle vs. Average Wave Period – Case 2 (Beam Seas, 4 knots, ART Filled)

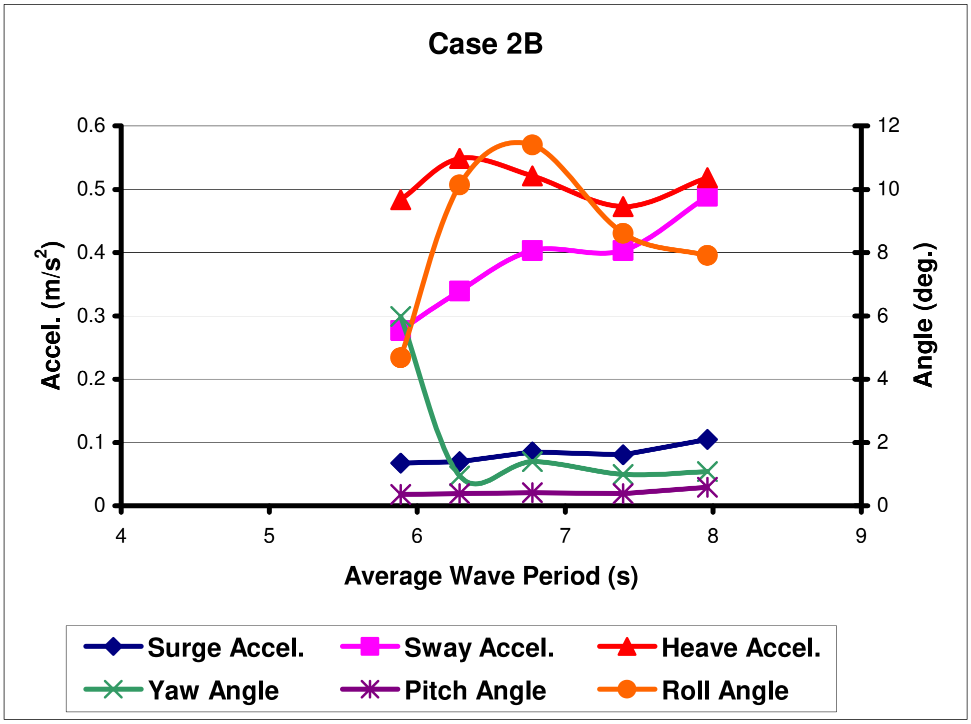


FIGURE 19: Accel./Angle vs. Average Wave Ht. – Case 2B (Beam Seas, 4 knots, ART Filled - fitted with baffles)

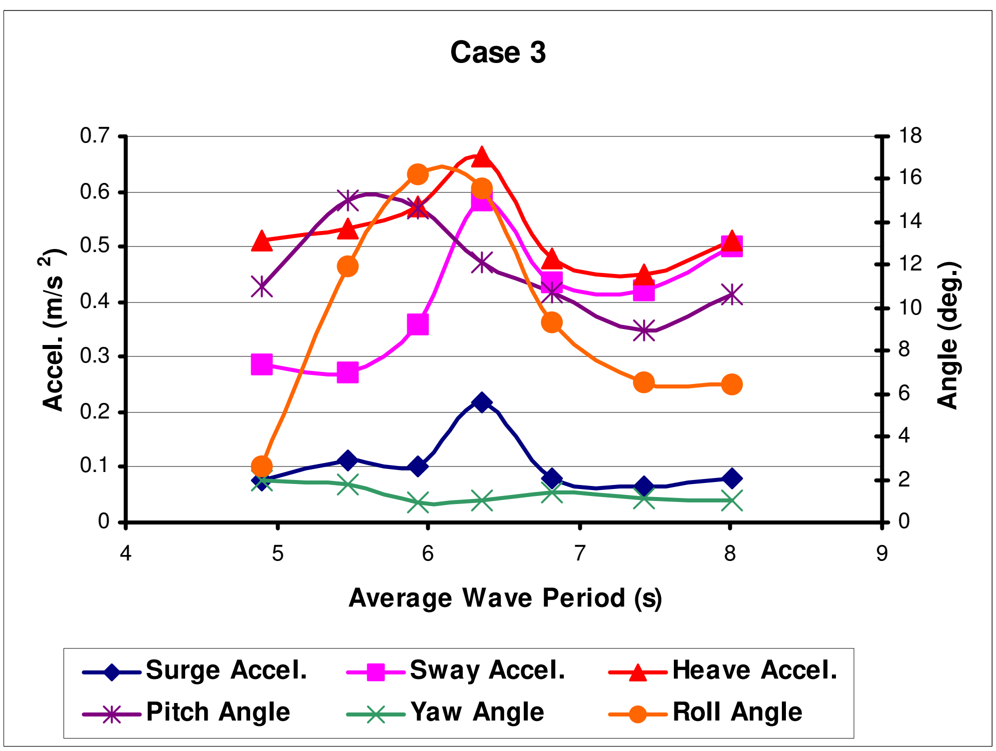


FIGURE 20: Accel./Angle vs. Average Wave Period – Case 3 (Beam Seas, 8 knots, ART Empty)

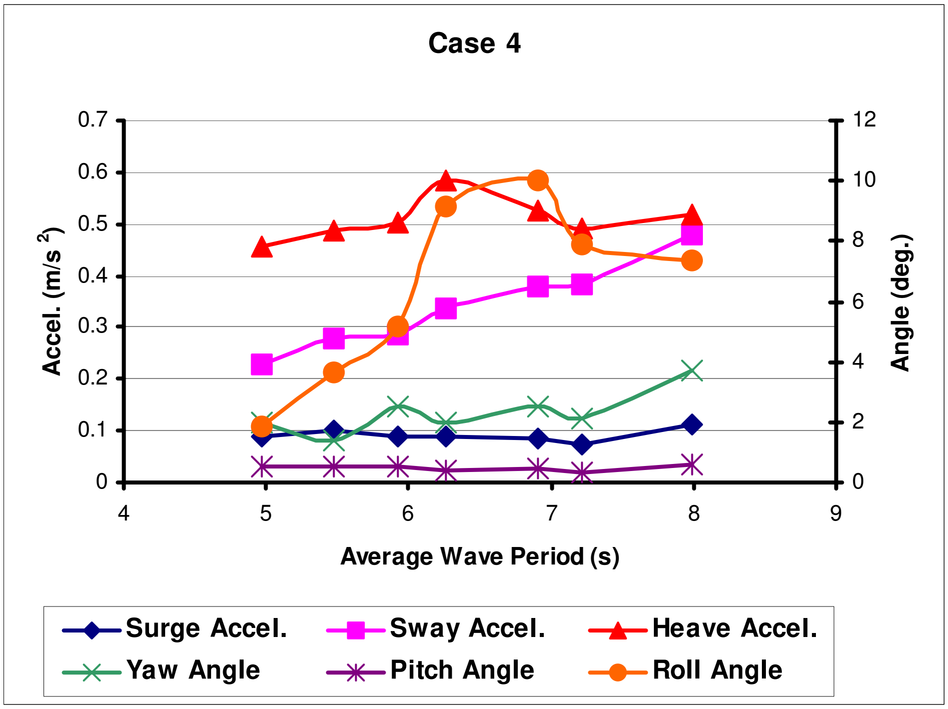


FIGURE 21: Accel./Angle vs. Average Wave Period – Case 4 (Beam Seas, 8 knots, ART Filled)

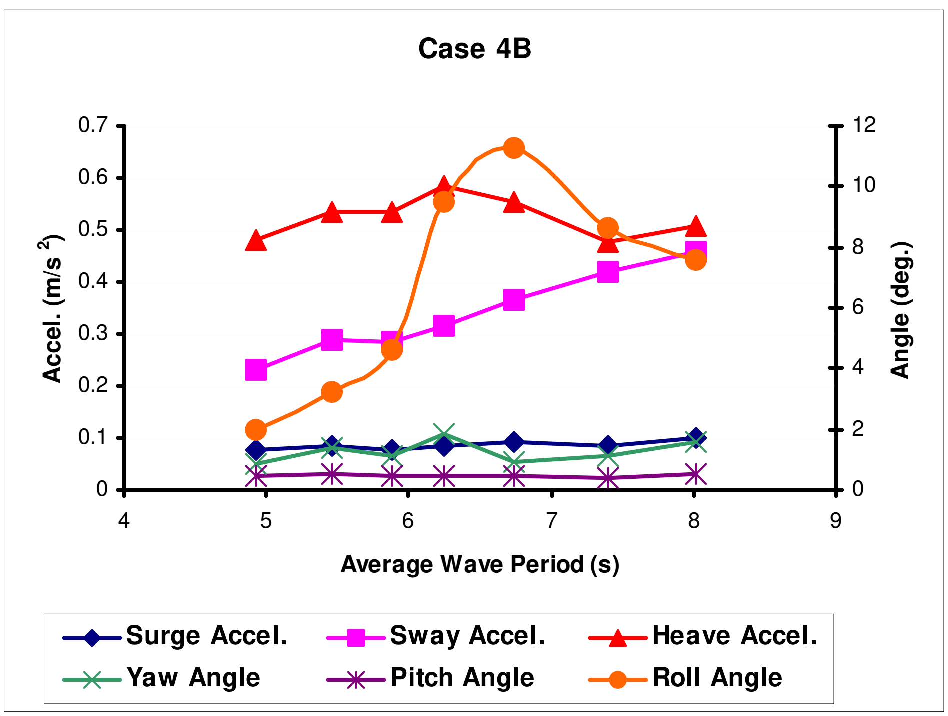


FIGURE 22: Accel./Angle vs. Average Wave Period – Case 4B (Beam Seas, 8 knots, ART Filled - fitted with baffles)

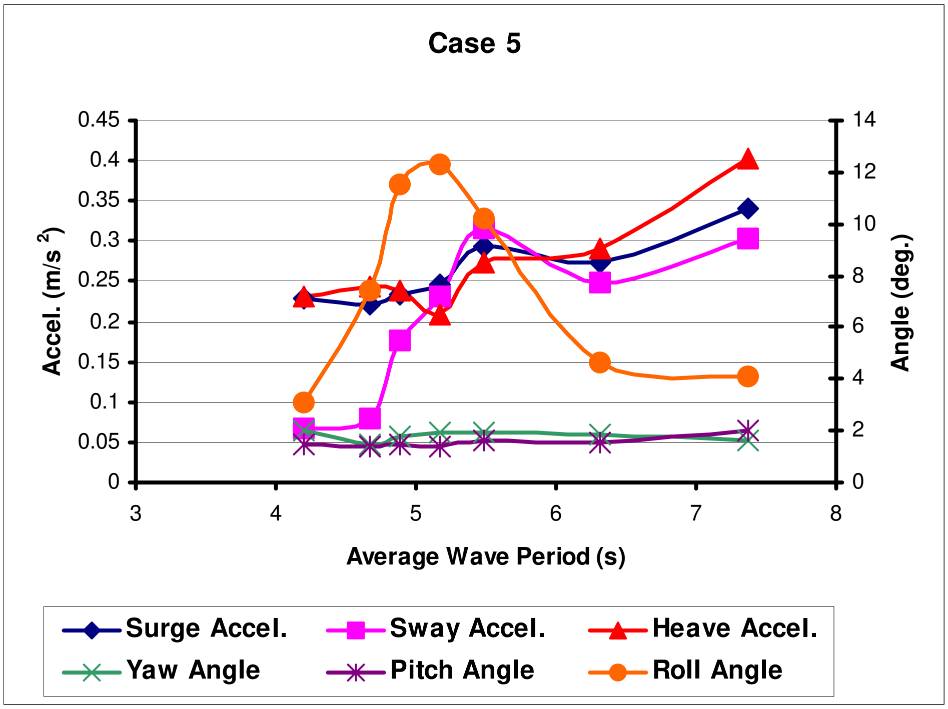


FIGURE 23: Accel./Angle vs. Average Wave Period – Case 5 (Quartering Seas, 4 knots, ART Empty)

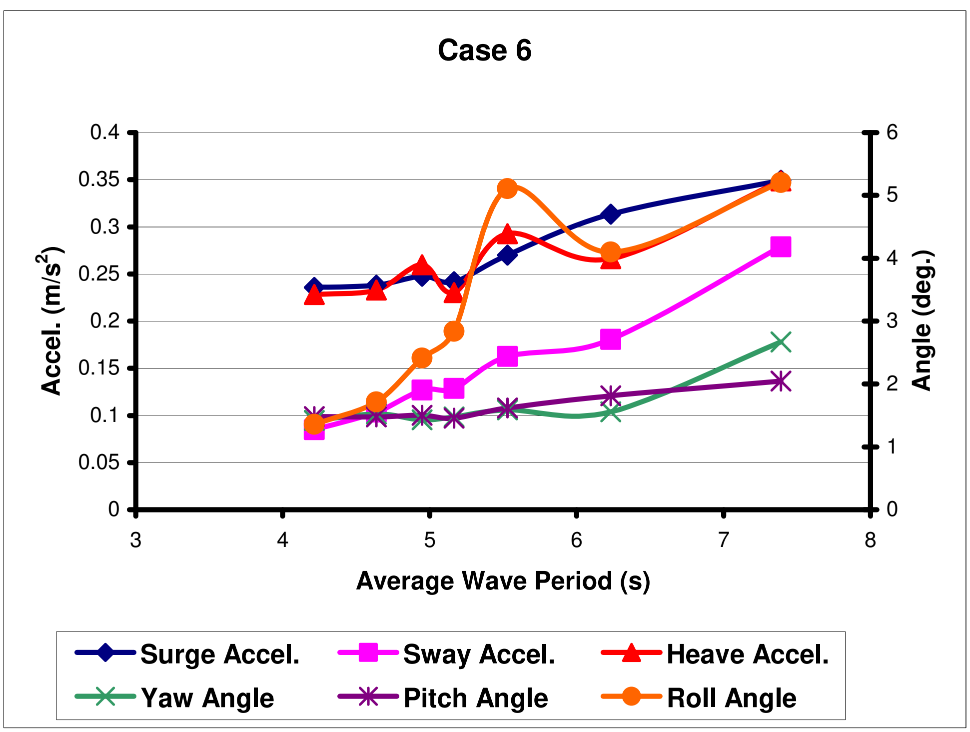


FIGURE 24: Accel./Angle vs. Average Wave Period – Case 6 (Quartering Seas, 4 knots, ART Filled)

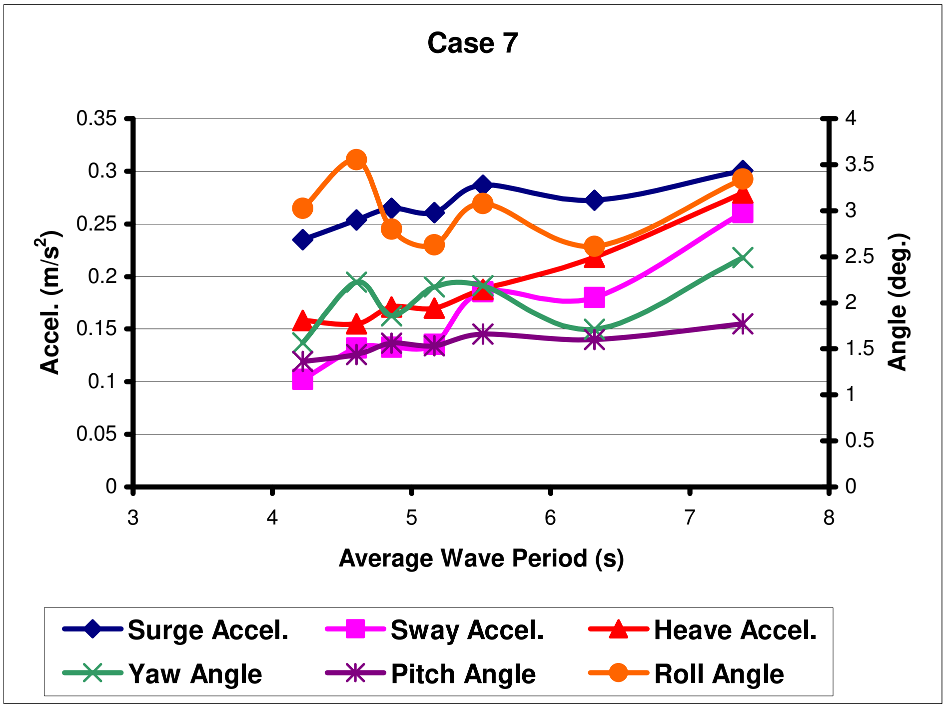


FIGURE 25: Accel./Angle vs. Average Wave Period – Case 7 (Quartering Seas, 8 knots, ART Empty)

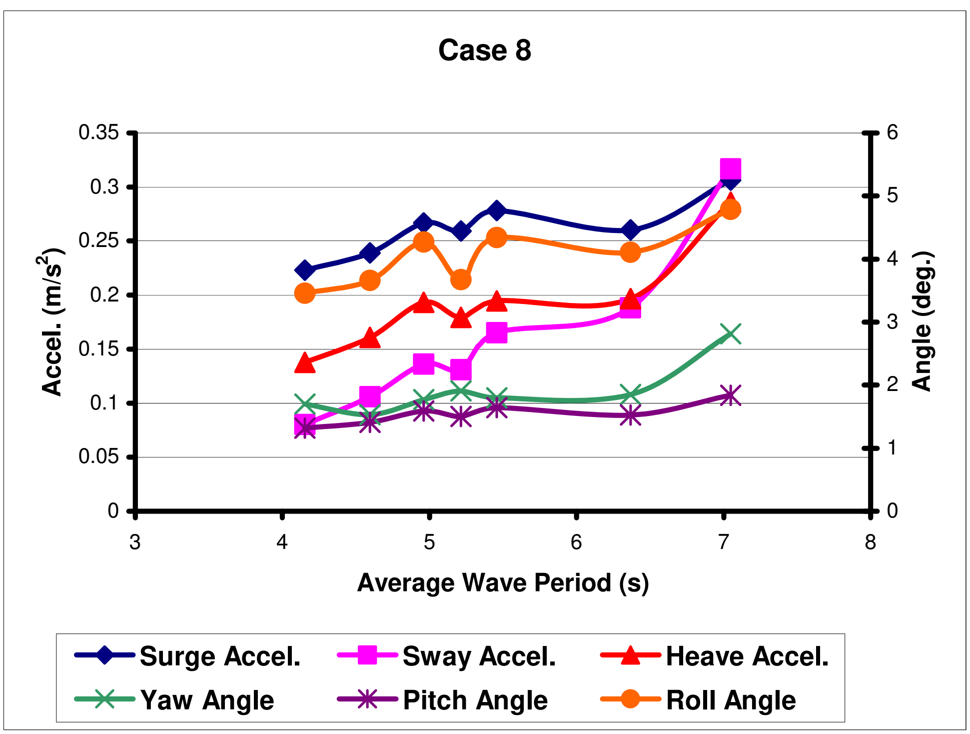


FIGURE 26: Accel./Angle vs. Average Wave Period – Case 8 (Quartering Seas, 8 knots, ART Filled)

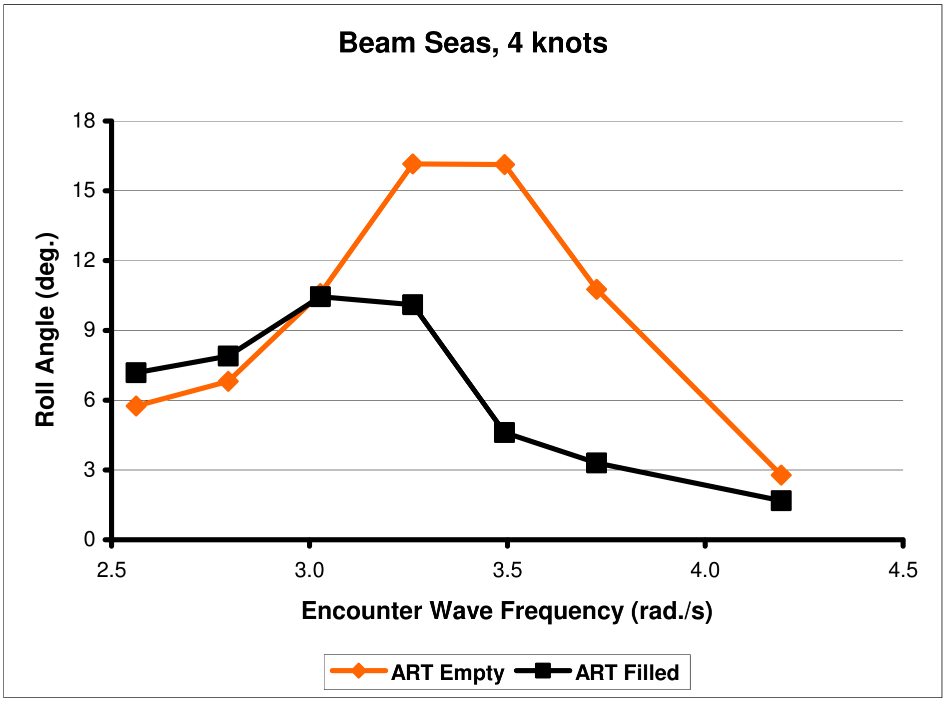


FIGURE 27: Roll Angle vs. Encounter Wave Frequency – Beam Seas, 4 knots, With/Without ART Filled

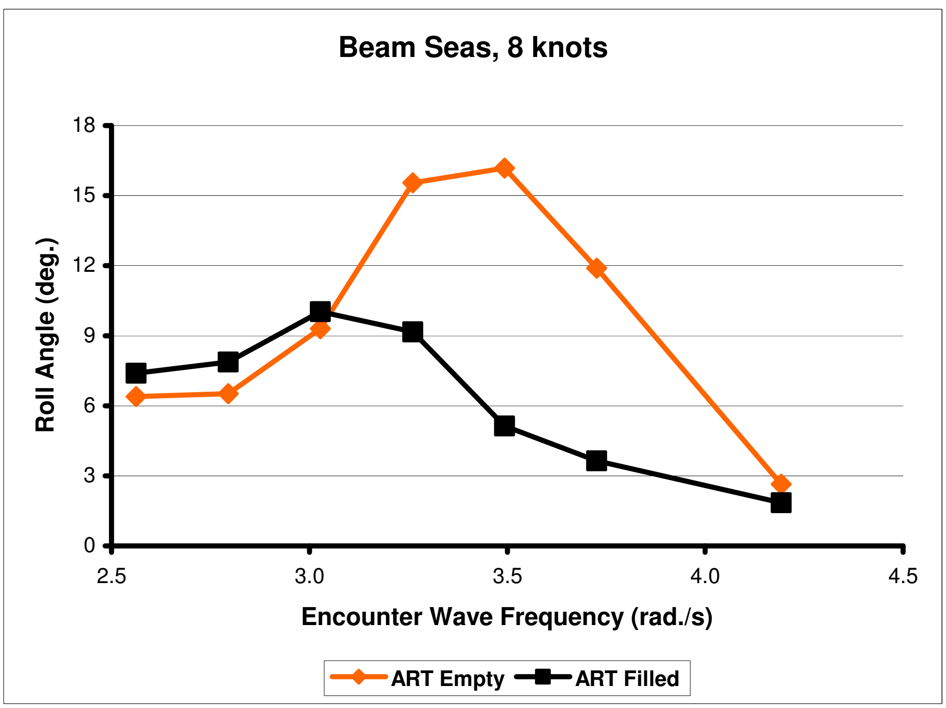


FIGURE 28: Roll Angle vs. Encounter Wave Frequency – Beam Seas, 8 knots, With/Without ART Filled

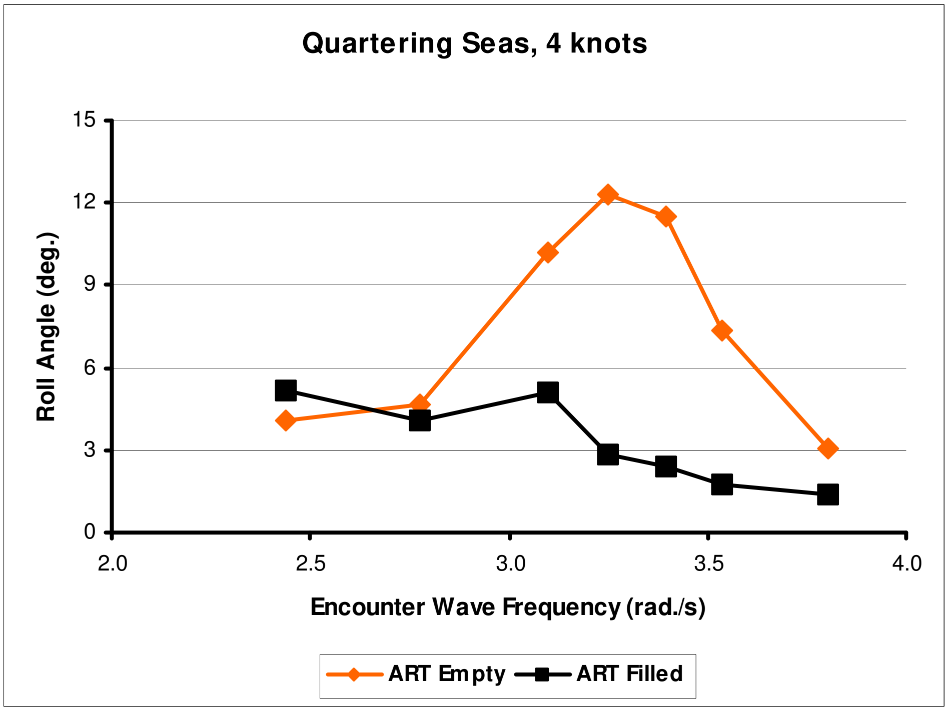


FIGURE 29: Roll Angle vs. Encounter Wave Frequency – Quartering Seas, 4 knots, With/Without ART Filled

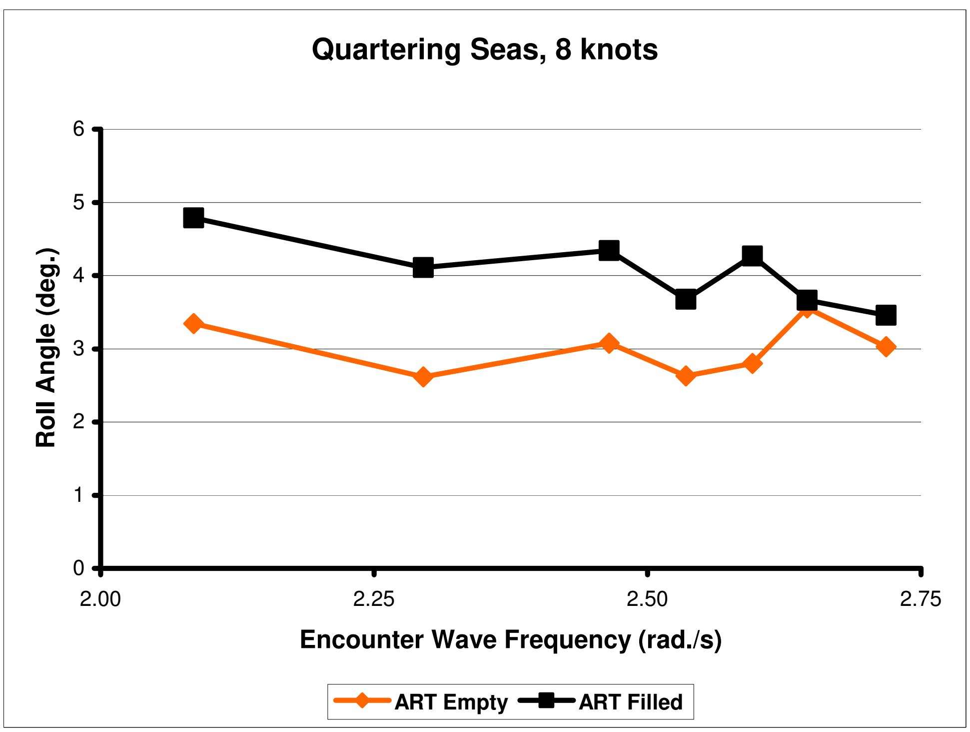


FIGURE 30: Roll Angle vs. Encounter Wave Frequency – Quartering Seas, 8 knots, With/Without ART Filled

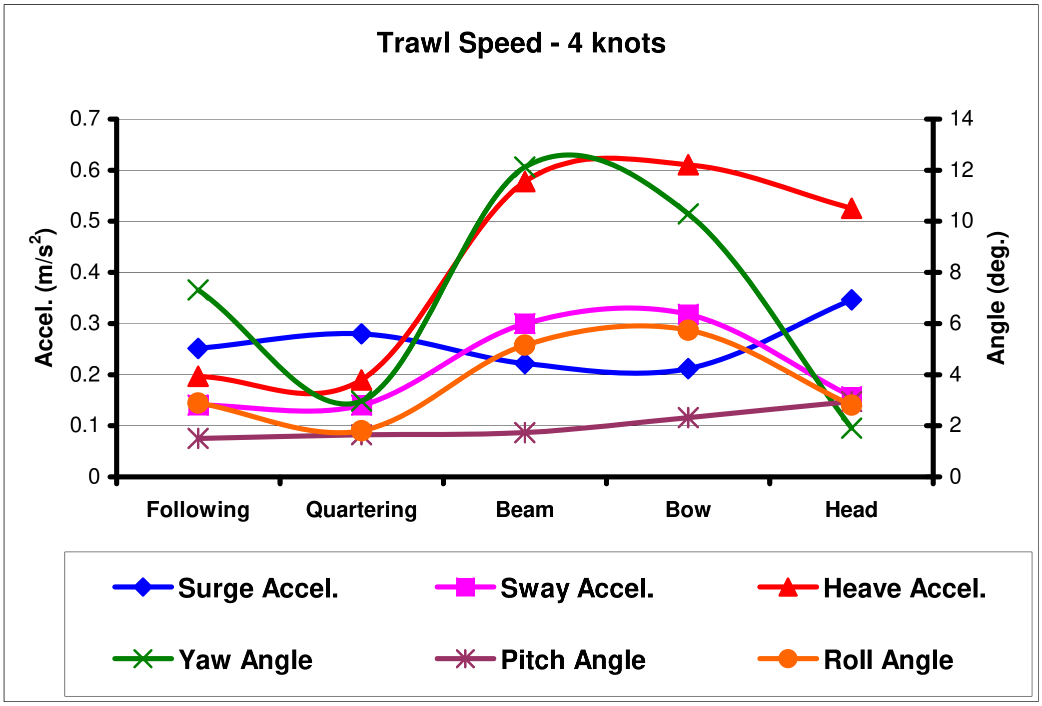


FIGURE 31: Accel./Angle vs. Heading – Trawl Speed, ART Empty

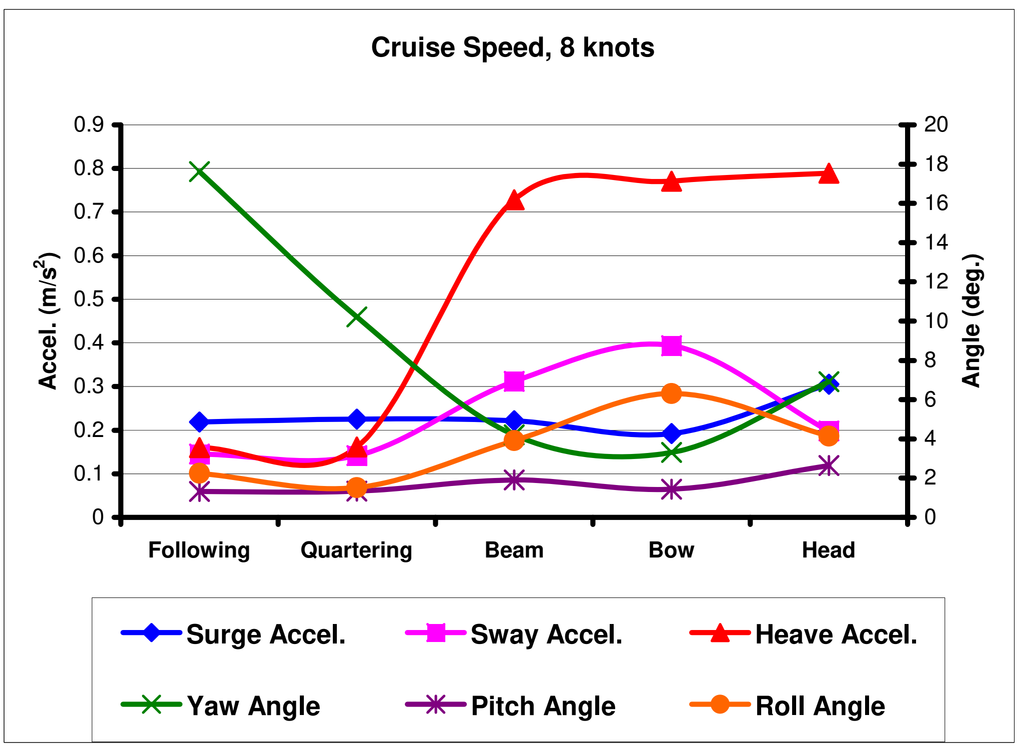


FIGURE 32: Accel./Angle vs. Heading – Cruise Speed, ART Empty

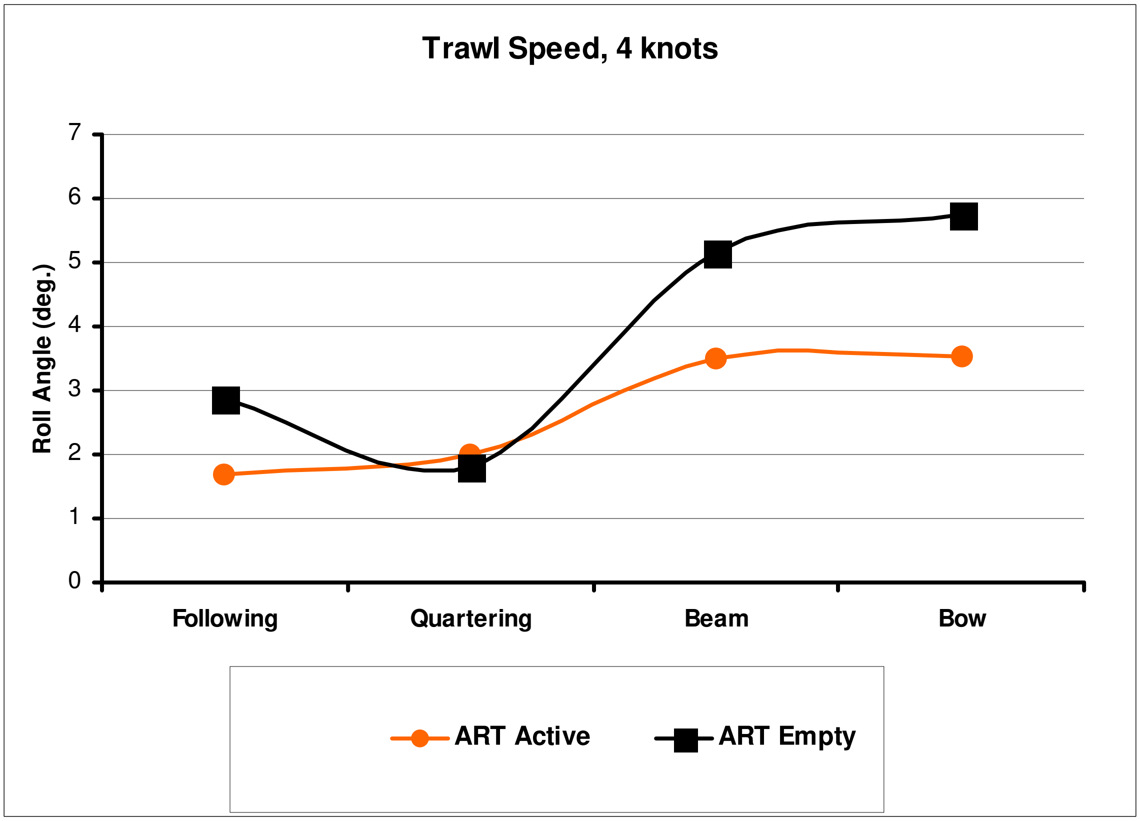


FIGURE 33: Roll Angle vs. Heading – Trawl Speed – With/Without ART Active

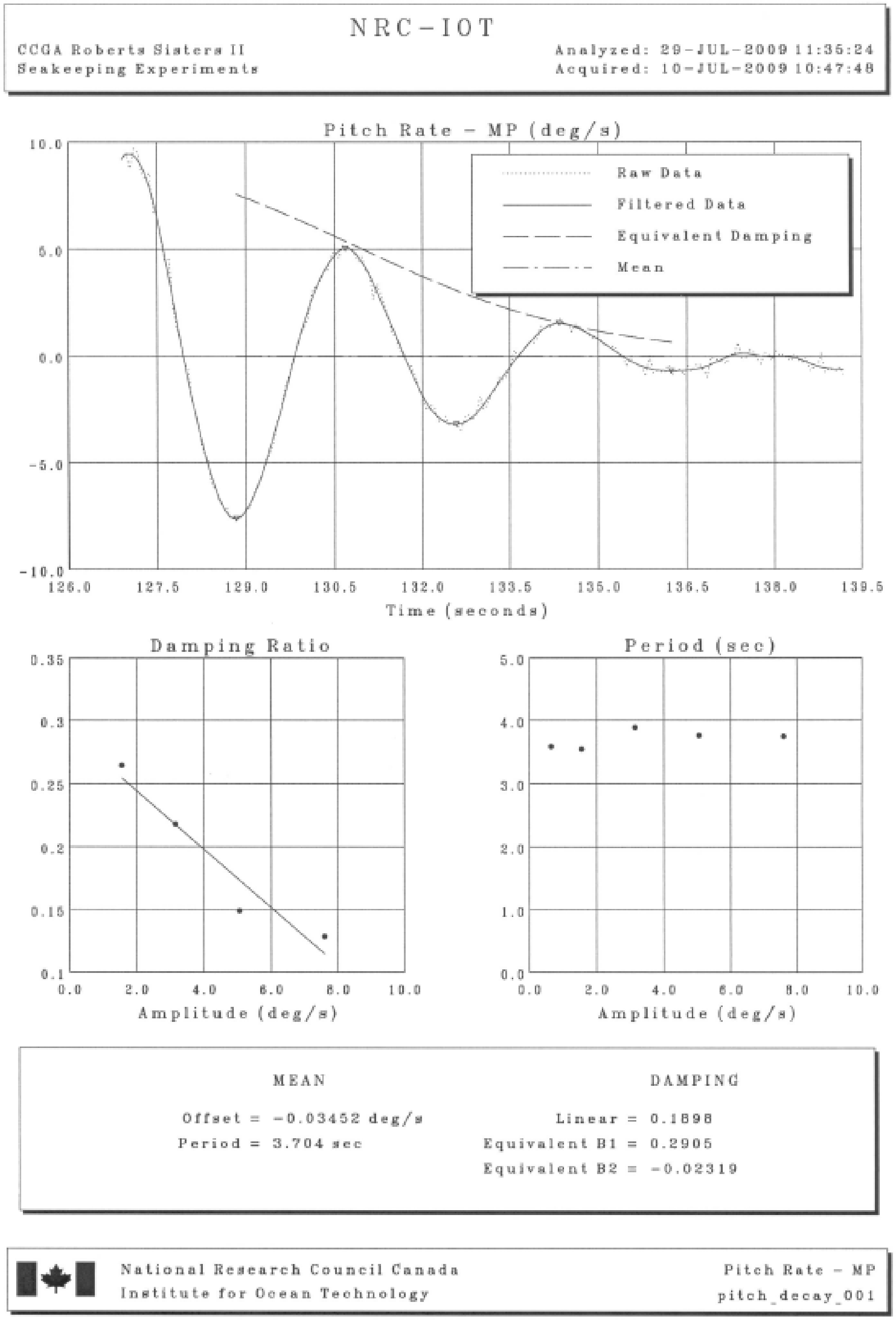


FIGURE 34 (1 of 2): Typical Pitch Decay Run Results

NRC-IOT

CCGA Roberts Sisters II
Seakeeping Experiments

Analyzed: 29-JUL-2009 11:35:24
Acquired: 10-JUL-2009 10:47:48

Pitch Rate - MP (deg/s)

Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
-0.0345	3.7040	0.18981	-0.02319	0.29054

Pitch Rate - MP (deg/s)

Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
-7.6334	7.5989	0.12841	3.7471
5.0247	5.0592	0.14873	3.7566
-3.1887	3.1542	0.21785	3.8872
1.5298	1.5644	0.26425	3.5451
-0.6960	0.6615		3.5838

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Pitch Rate - MP
pitch_decay_001

FIGURE 34 (2 of 2): Typical Pitch Decay Run Results

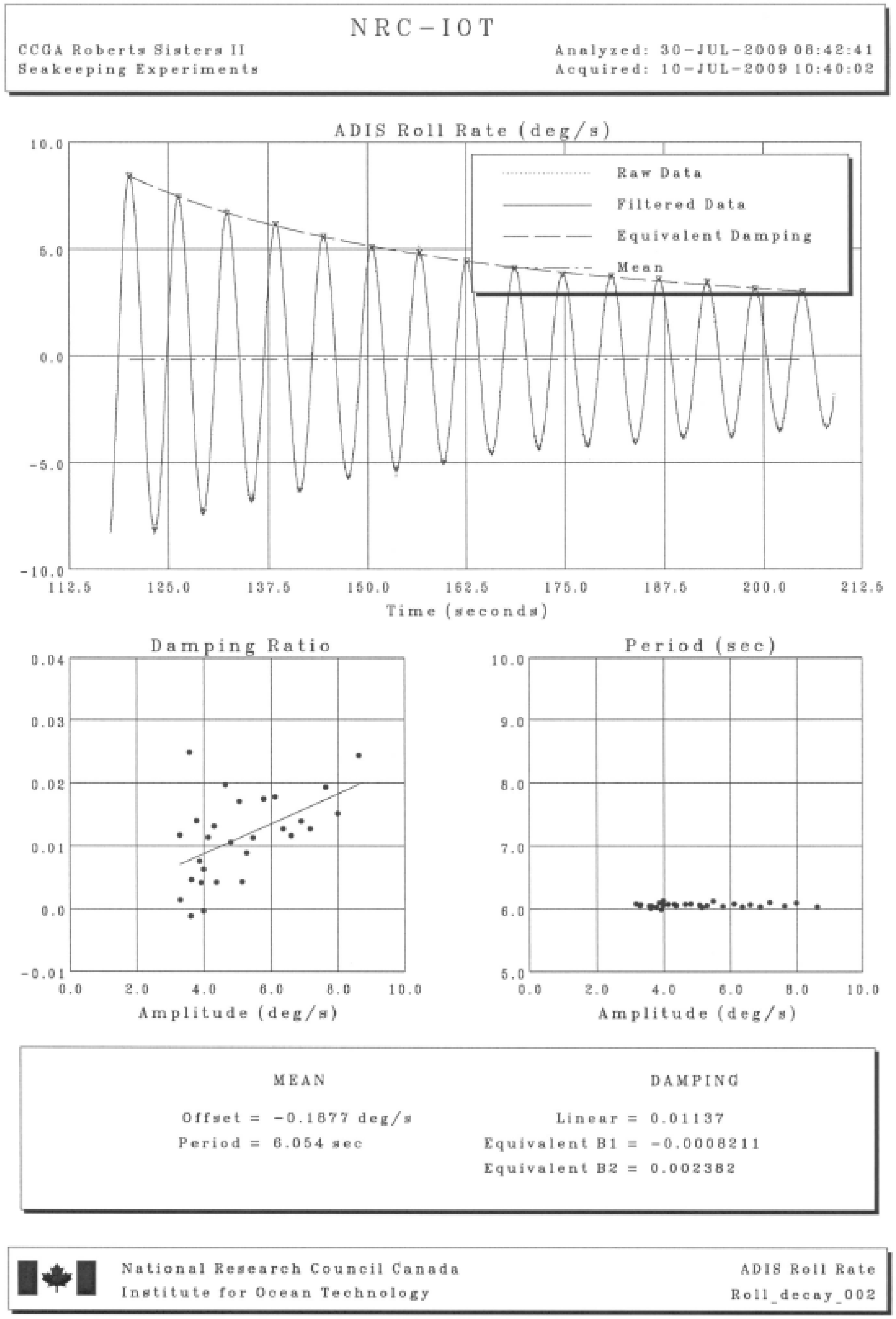

FIGURE 35 (1 of 2): Typical Zero Speed Roll Decay Run Results

NRC-IOT

CCGA Roberts Sisters II
Seakeeping Experiments

Analyzed: 30-JUL-2009 08:42:41
Acquired: 10-JUL-2009 10:40:02

ADIS Roll Rate (deg/s)

Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
-0.1877	6.0542	0.01137	0.00238	-0.00082

ADIS Roll Rate (deg/s)

Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
8.4396	8.6273	0.02435	6.0272
-8.1796	7.9919	0.01511	6.0910
7.4335	7.6212	0.01927	6.0423
-7.3612	7.1734	0.01273	6.0938
6.7045	6.8922	0.01392	6.0277
-6.7850	6.5973	0.01166	6.0596
6.1723	6.3600	0.01274	6.0289
-6.2983	6.1106	0.01775	6.0754
5.5913	5.7791	0.01743	6.0341
-5.6589	5.4711	0.01128	6.1205
5.0929	5.2807	0.00884	6.0497
-5.3237	5.1360	0.00434	6.0154
4.8786	5.0664	0.01707	6.0508
-4.9895	4.8018	0.01052	6.0768
4.4578	4.6456	0.01961	6.0693
-4.5557	4.3680	0.00428	6.0455
4.1219	4.3097	0.01310	6.0685
-4.3236	4.1358	0.01134	6.0649
3.8034	3.9911	-0.00038	6.0545
-4.1836	3.9958	0.00626	6.1251
3.7303	3.9180	0.00416	5.9799
-4.0548	3.8671	0.00757	6.0874
3.5884	3.7762	0.01401	6.0173
-3.8013	3.6135	-0.00115	6.0067
3.4388	3.6265	0.00459	6.0369
-3.7624	3.5746	0.02488	6.0398
3.1181	3.3058	0.00139	6.0621
-3.4792	3.2914	0.01172	6.0488
2.9847	3.1725		6.0721

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ADIS Roll Rate
Roll_decay_002

FIGURE 35 (2 of 2): Typical Zero Speed Roll Decay Run Results

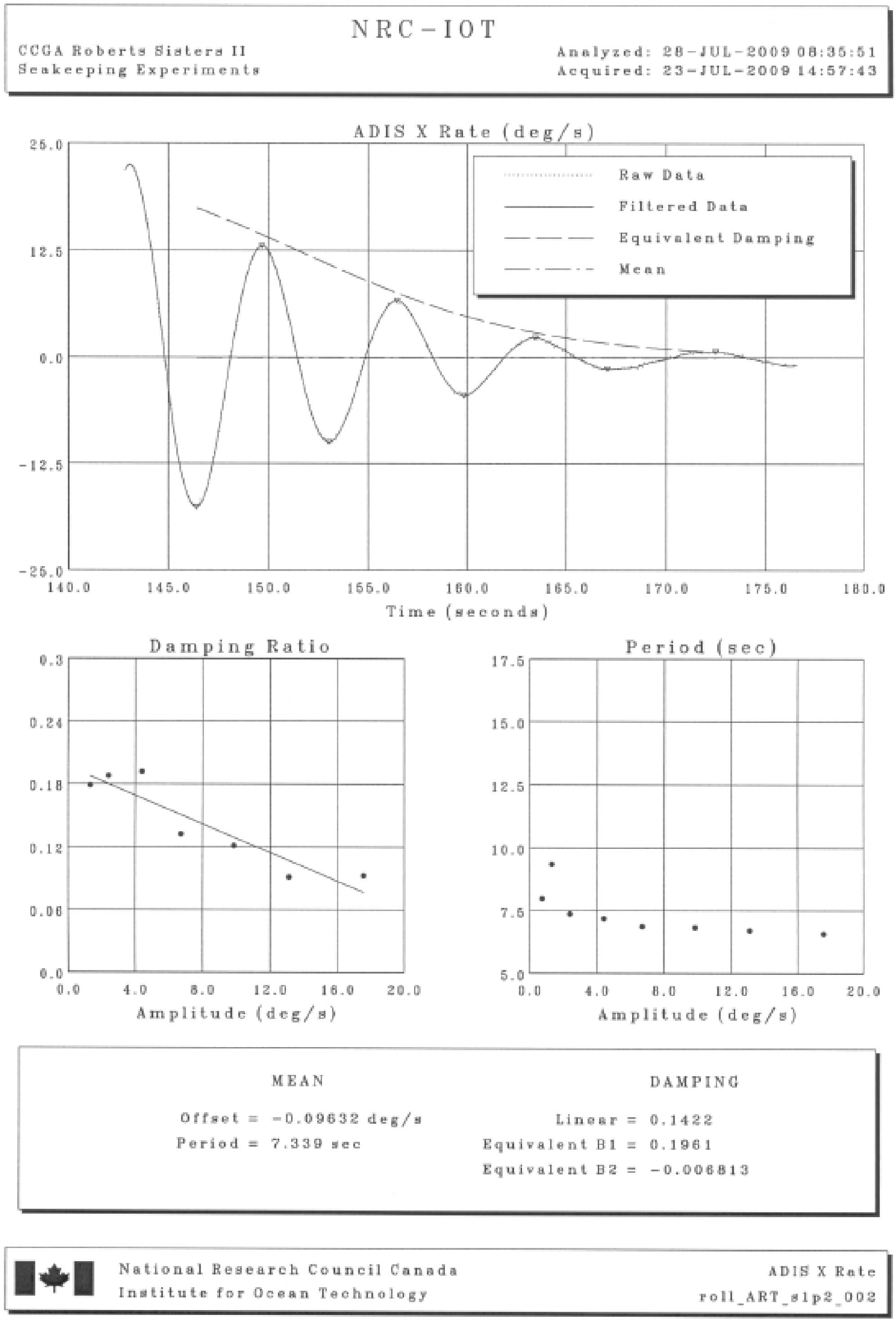

FIGURE 36 (1 of 2): Typical 1.2 m/s (8 knot Full Scale) Roll Decay Run Results With ART Filled

NRC-IOT

CCGA Roberts Sisters II
Seakeeping Experiments

Analyzed: 28-JUL-2009 08:35:51
Acquired: 23-JUL-2009 14:57:43

ADIS X Rate (deg/s)

Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
-0.0963	7.3393	0.14218	-0.00681	0.19605

ADIS X Rate (deg/s)

Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
-17.6593	17.5630	0.09237	6.5608
13.0264	13.1228	0.09102	6.6900
-9.9437	9.8474	0.12107	6.8203
6.6166	6.7129	0.13249	6.8500
-4.5073	4.4109	0.19170	7.1682
2.2917	2.3880	0.18793	7.3442
-1.4055	1.3091	0.17865	9.3261
0.6437	0.7400		7.9548

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ADIS X Rate
roll_ART_s1p2_002

FIGURE 36 (2 of 2): Typical 1.2 m/s (8 knot Full Scale) Roll Decay Run Results With ART Filled

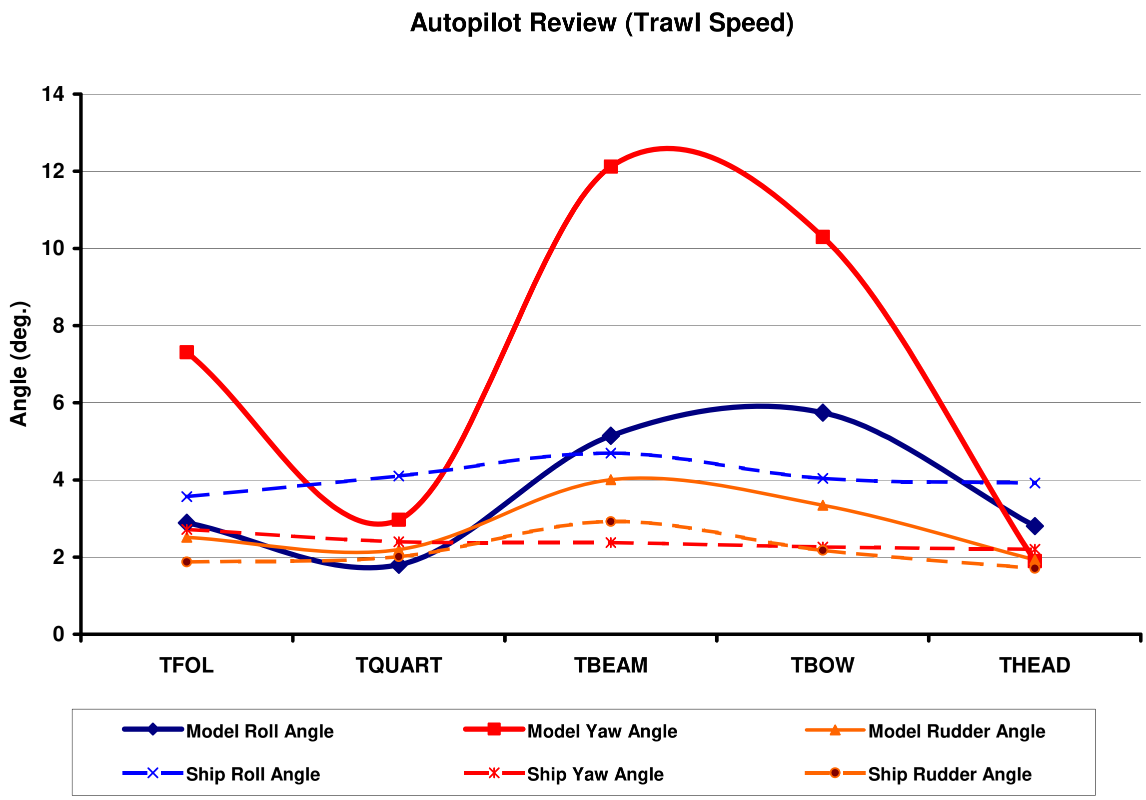


FIGURE 37: Investigation of Autopilot Performance – Trawl Speed

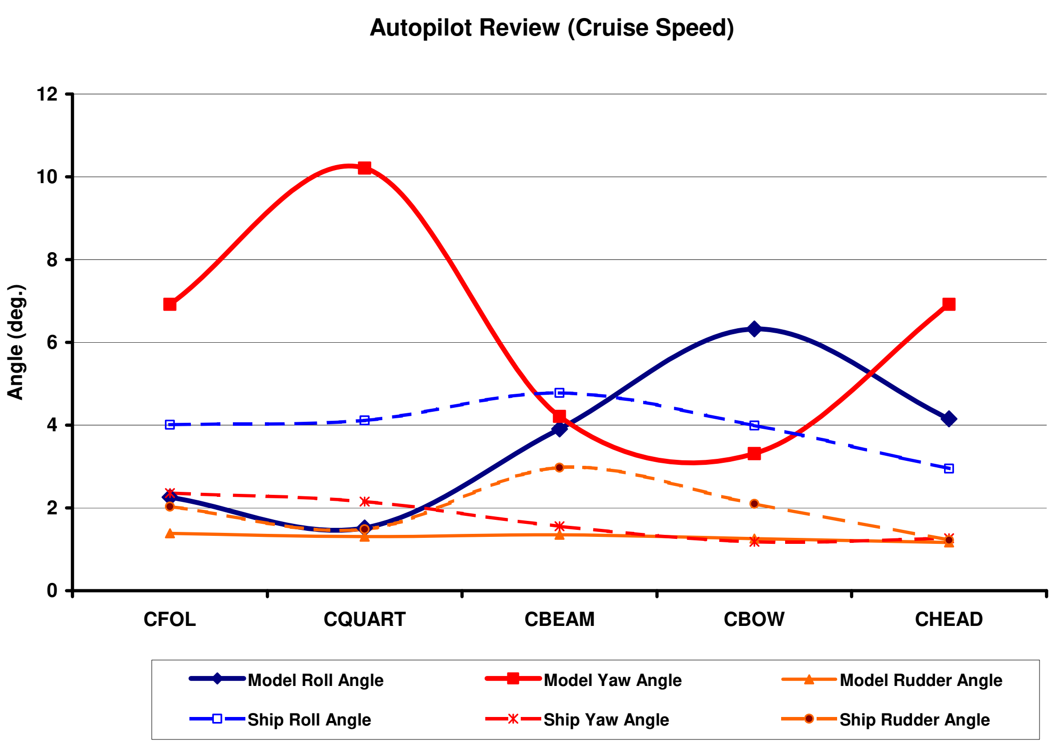


FIGURE 38: Investigation of Autopilot Performance – Cruise Speed

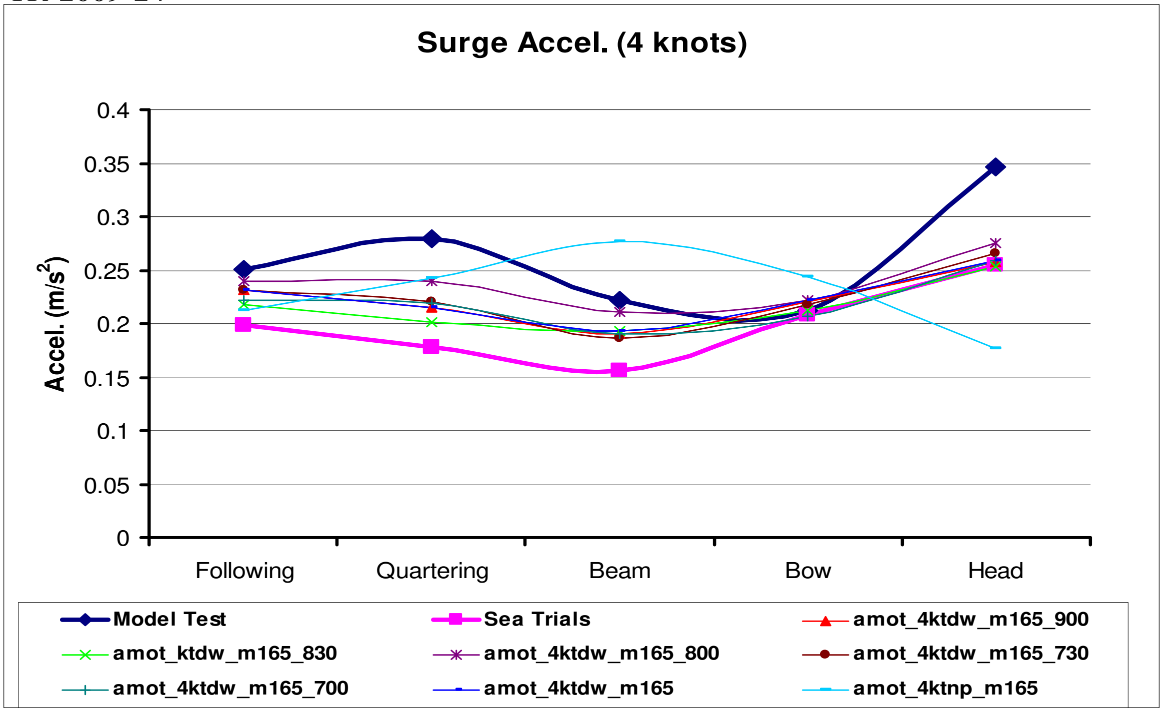


FIGURE 39: Surge Acceleration vs. Heading – Trawl Speed, ART Empty

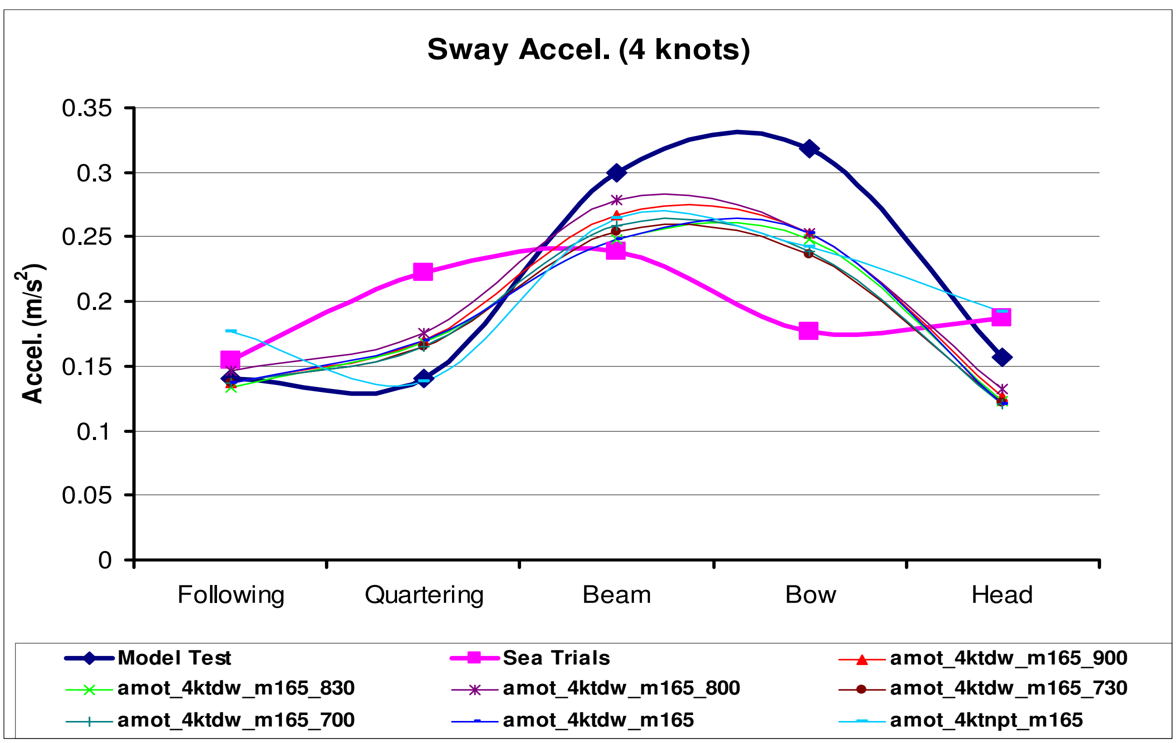


FIGURE 40: Sway Acceleration vs. Heading – Trawl Speed, ART Empty

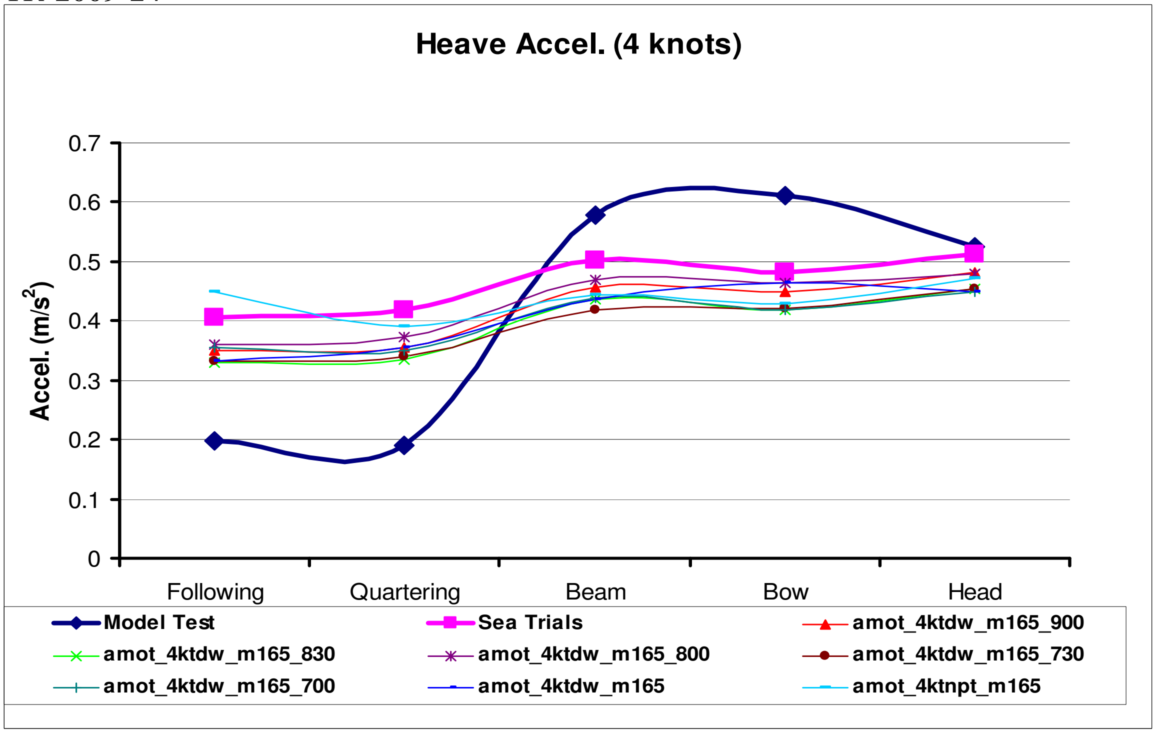


FIGURE 41: Heave Acceleration vs. Heading – Trawl Speed, ART Empty

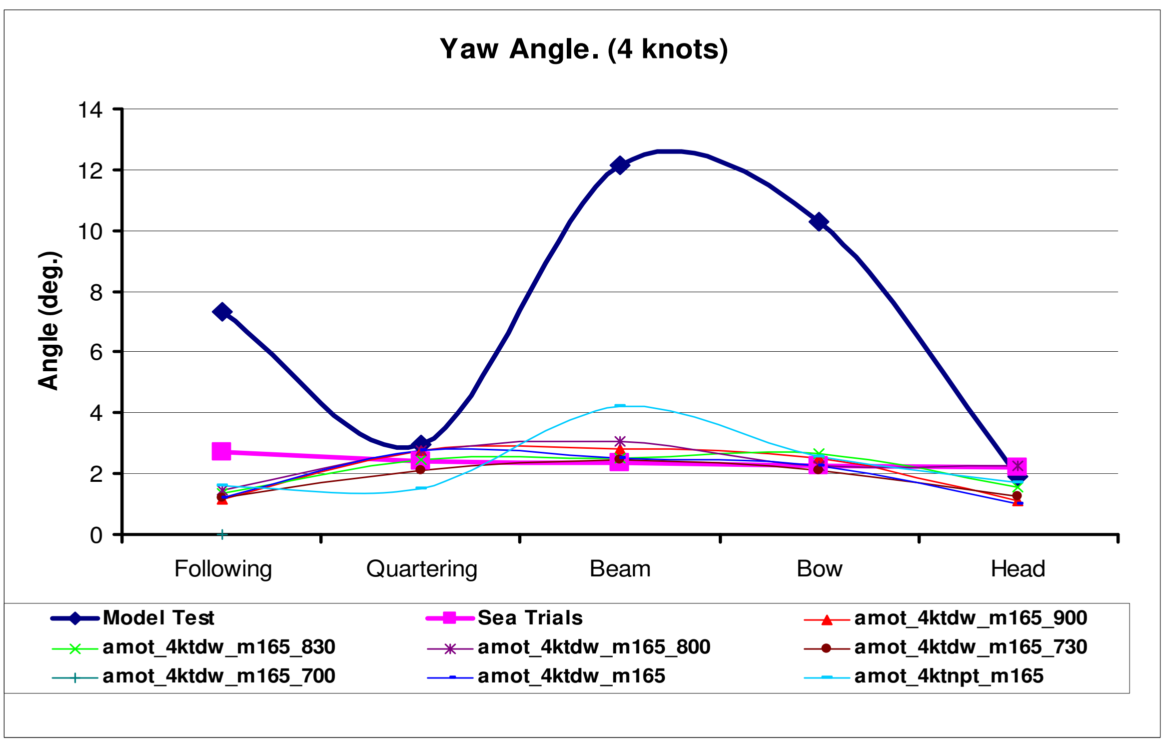


FIGURE 42: Yaw Angle. vs. Heading – Trawl Speed, ART Empty

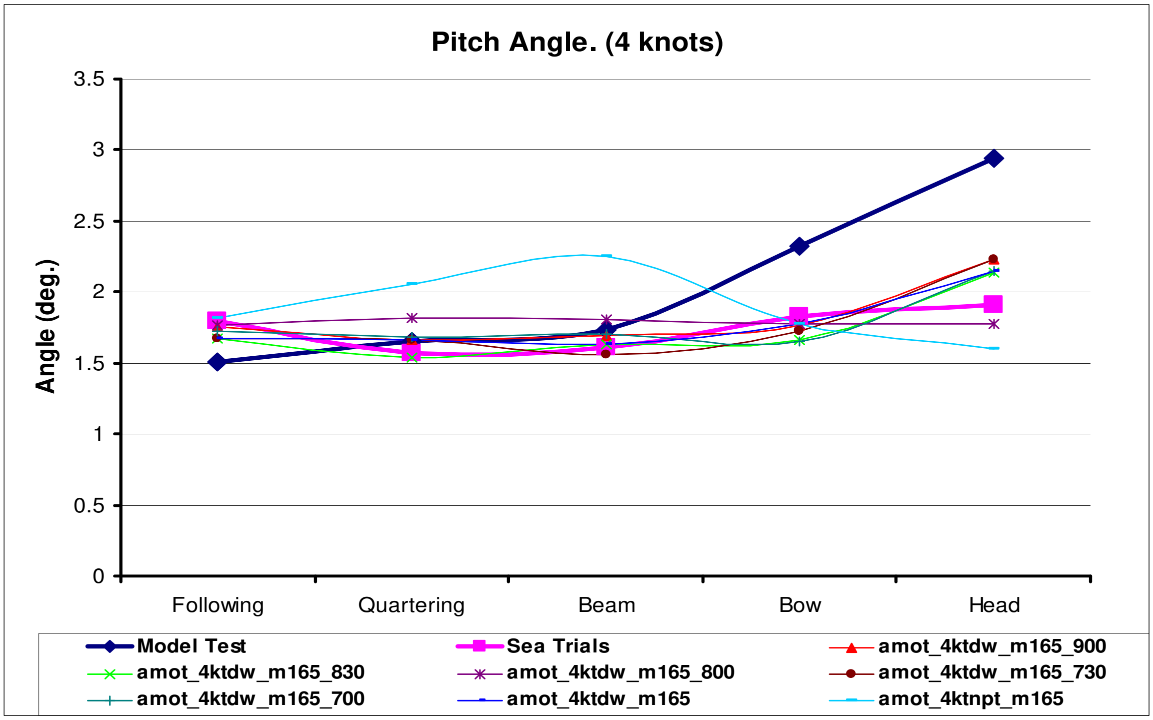


FIGURE 43: Pitch Angle. vs. Heading – Trawl Speed, ART Empty

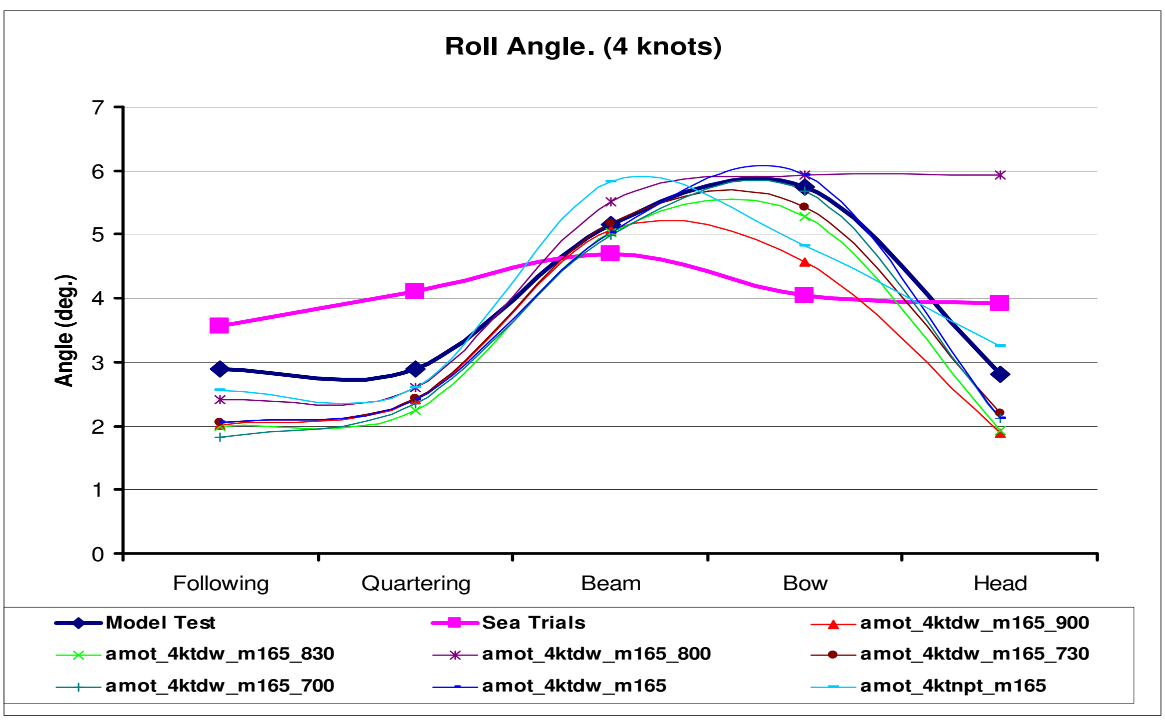


FIGURE 44: Roll Angle. vs. Heading – Trawl Speed, ART Empty

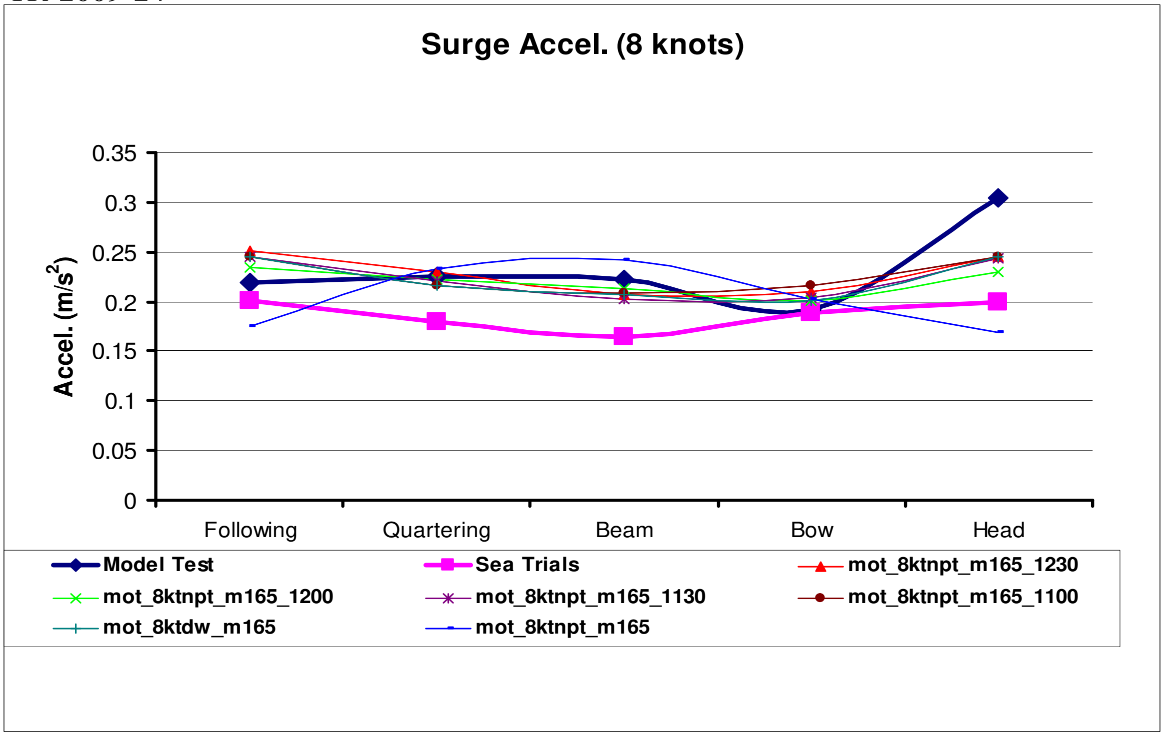


FIGURE 45: Surge Acceleration vs. Heading – Cruising Speed, ART Empty

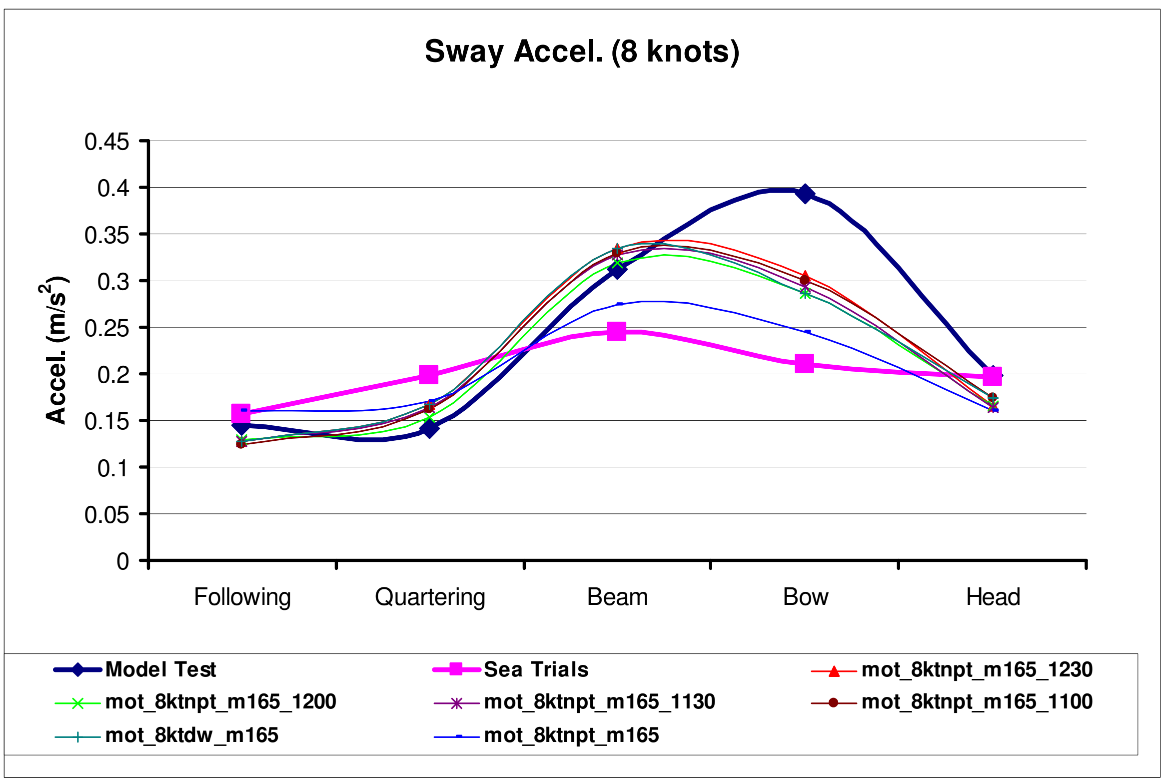


FIGURE 46: Sway Acceleration vs. Heading – Cruising Speed, ART Empty

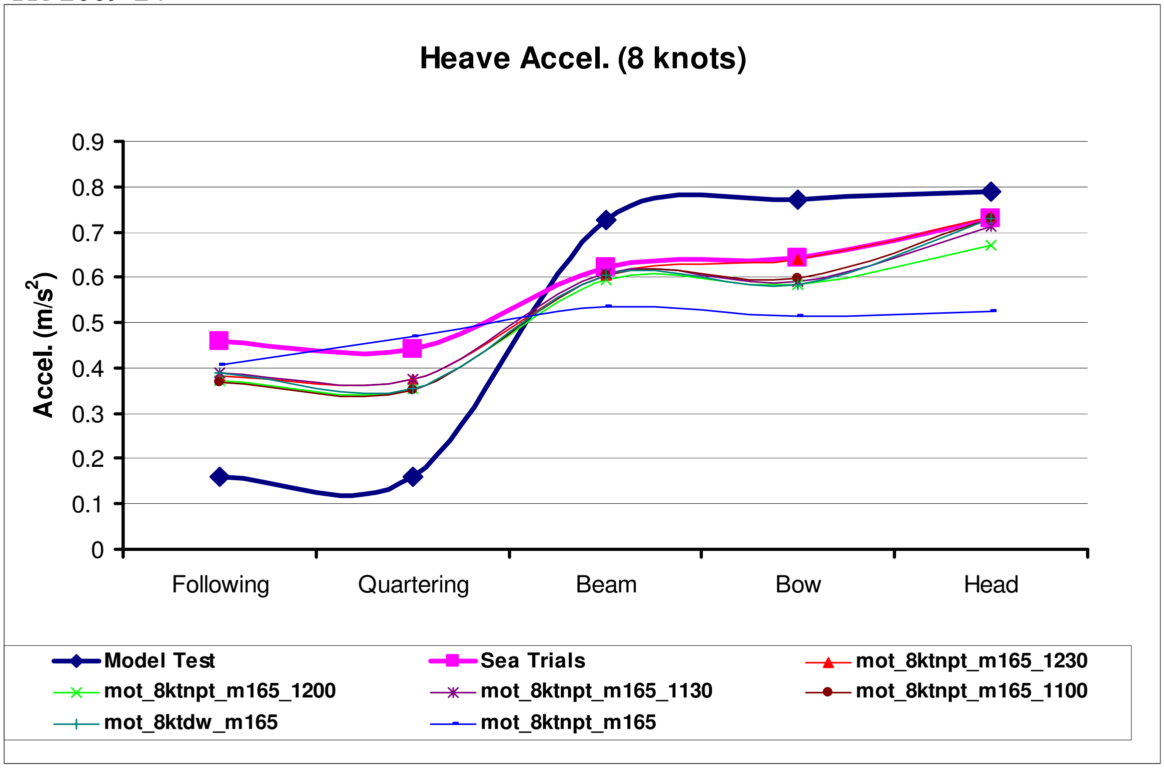


FIGURE 47: Heave Acceleration vs. Heading – Cruising Speed, ART Empty

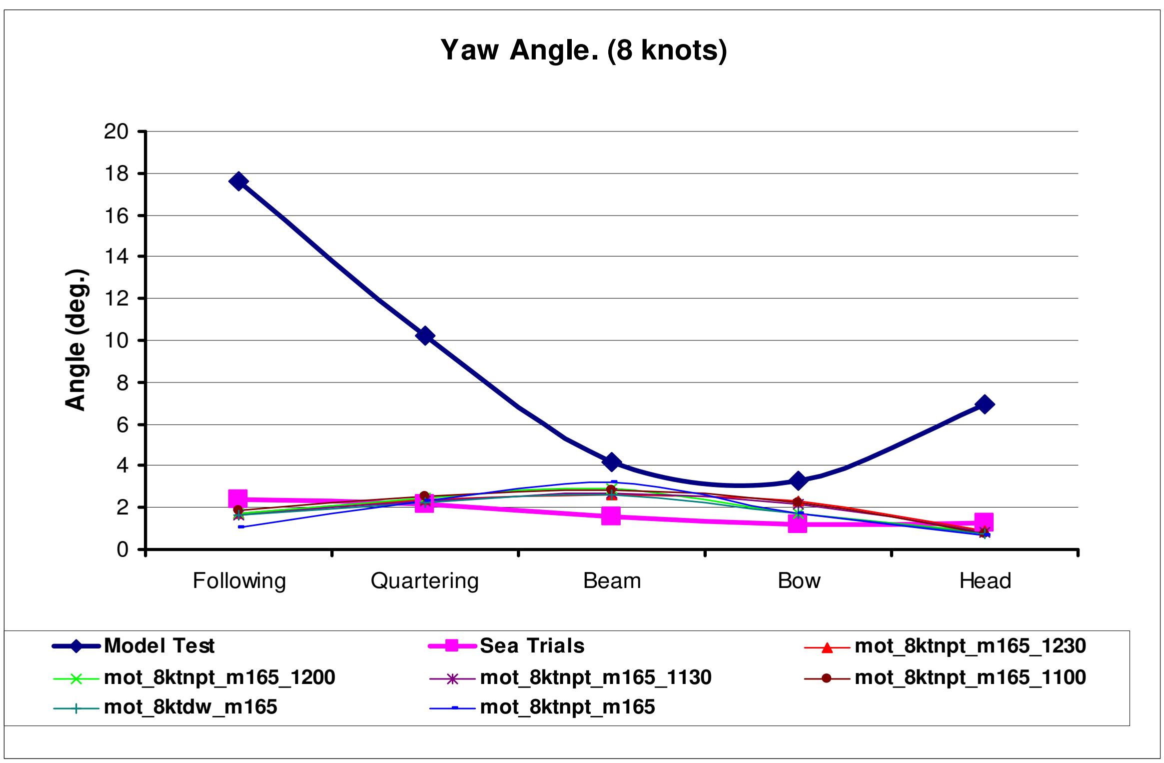


FIGURE 48: Yaw Angle. vs. Heading – Cruising Speed, ART Empty

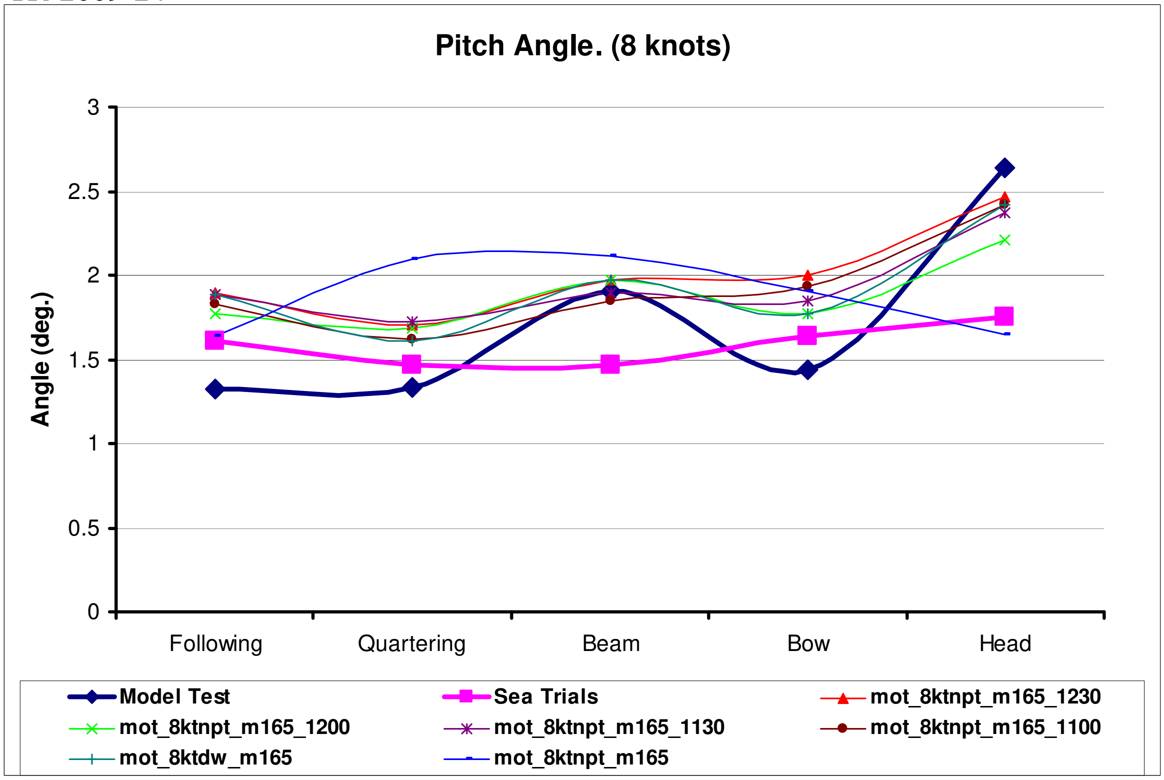


FIGURE 49: Pitch Angle. vs. Heading – Cruising Speed, ART Empty

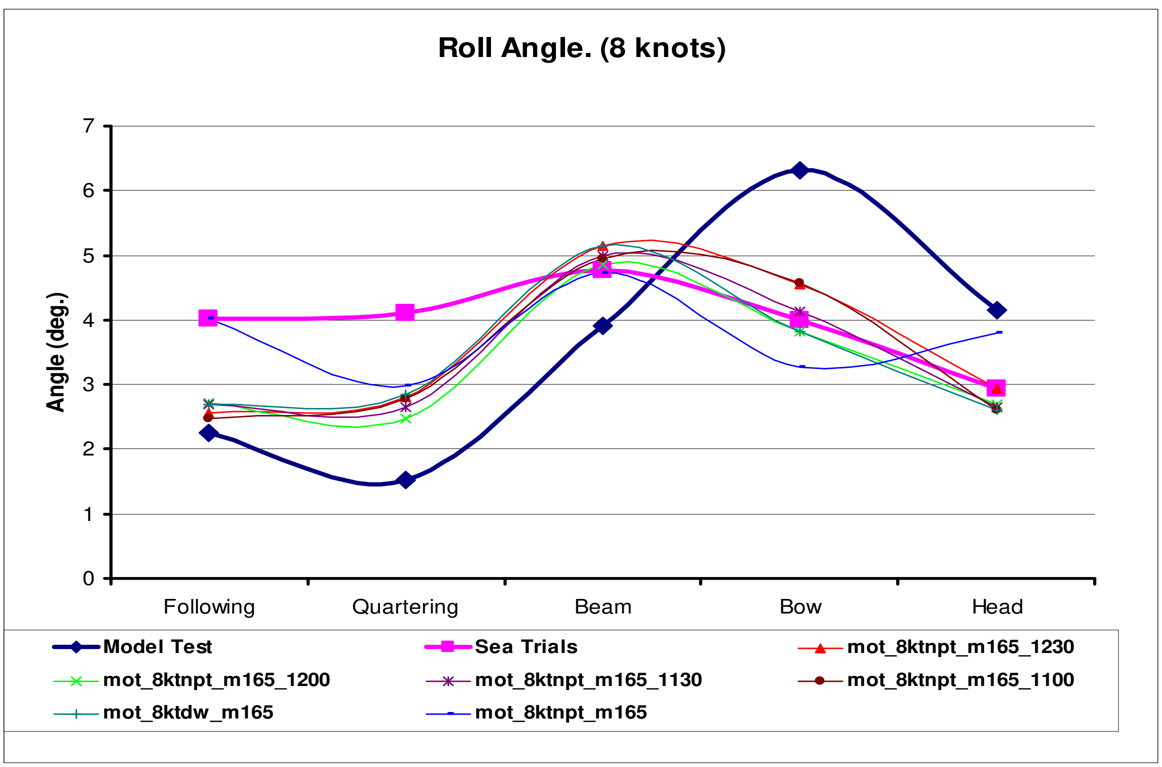


FIGURE 50: Roll Angle. vs. Heading – Cruising Speed, ART Empty

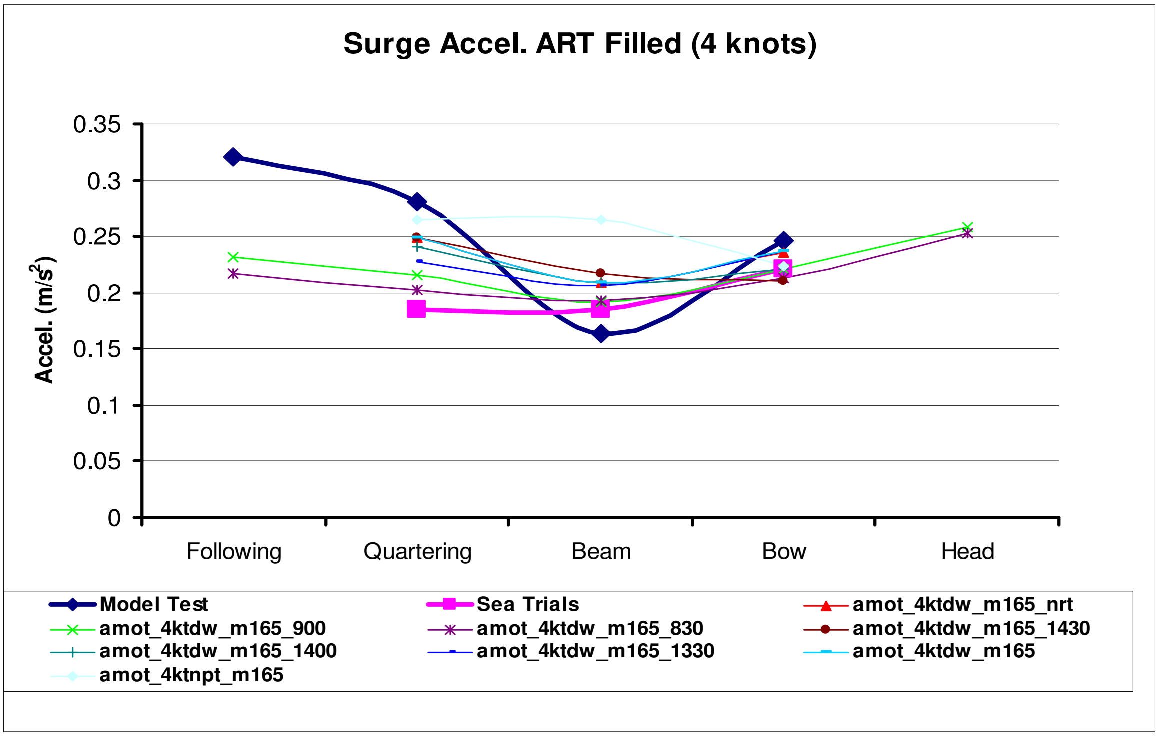


FIGURE 51: Surge Acceleration vs. Heading – Trawl Speed, ART Filled

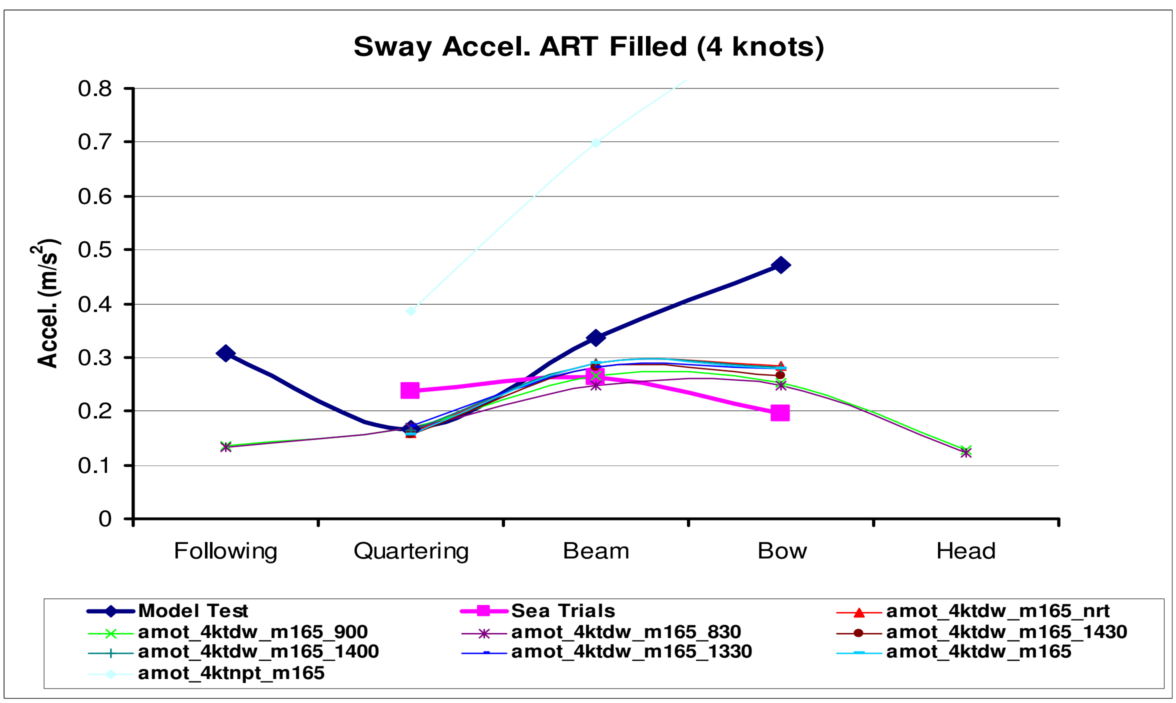


FIGURE 52: Sway Acceleration vs. Heading – Trawl Speed, ART Filled

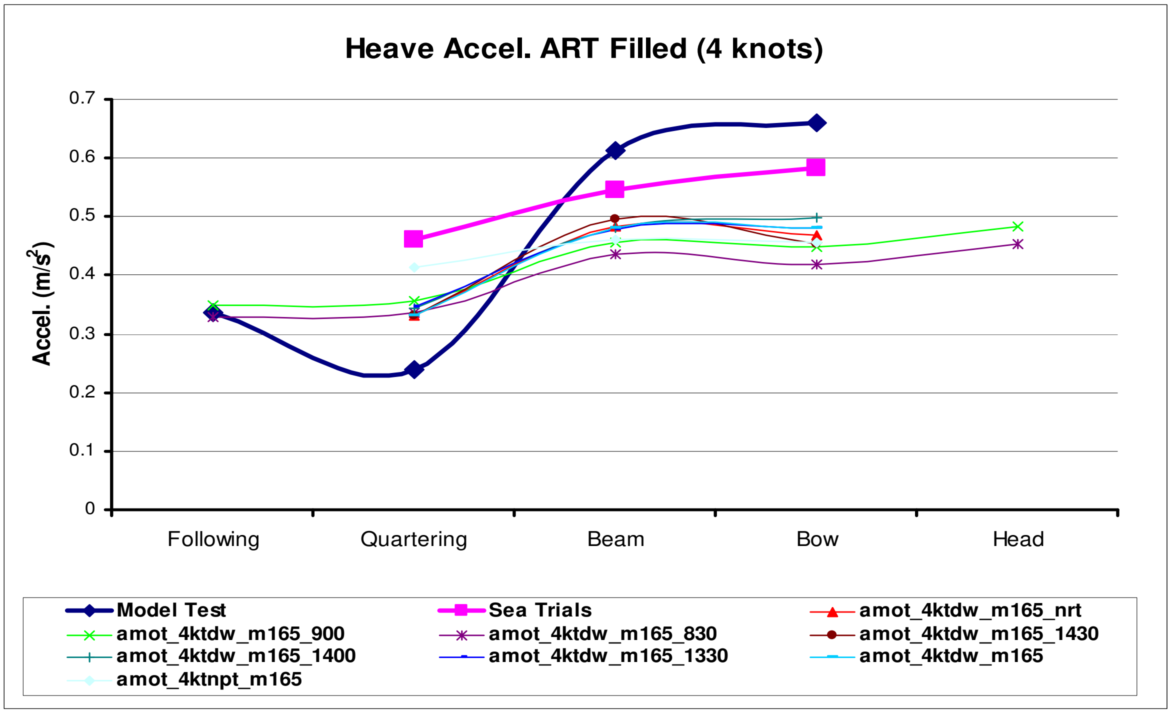


FIGURE 53: Heave Acceleration vs. Heading – Trawl Speed, ART Filled

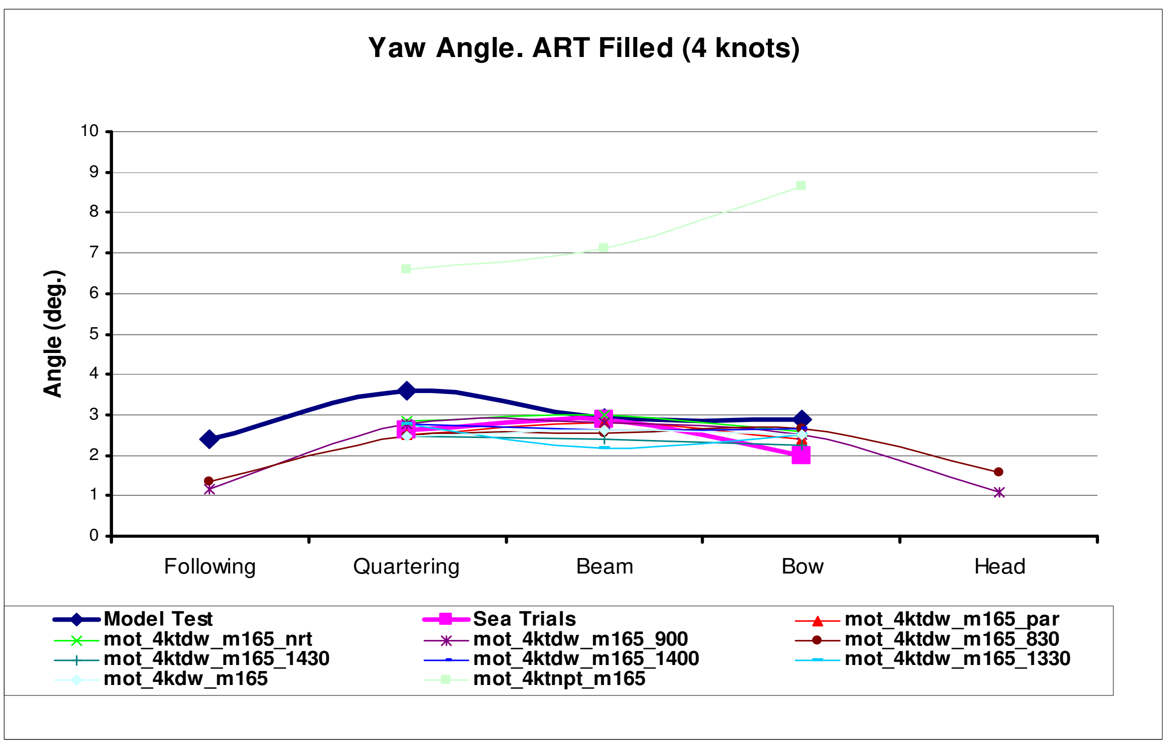


FIGURE 54: Yaw Angle. vs. Heading – Trawl Speed, ART Filled

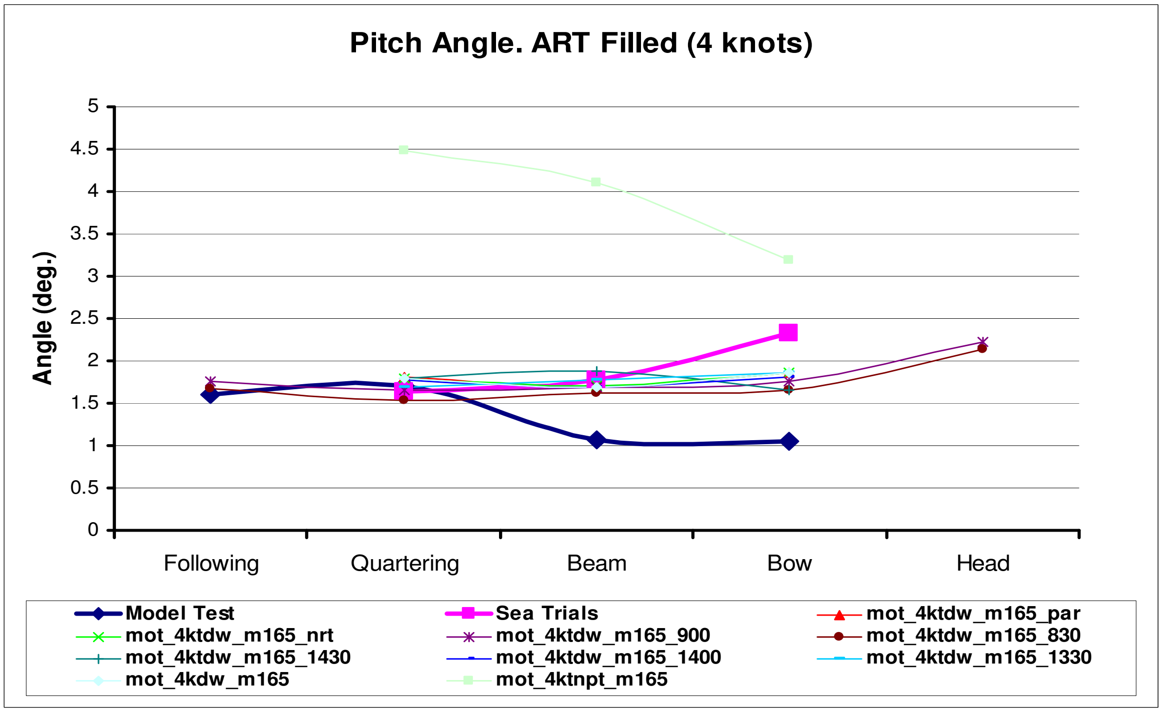


FIGURE 55: Pitch Angle. vs. Heading – Trawl Speed, ART Filled

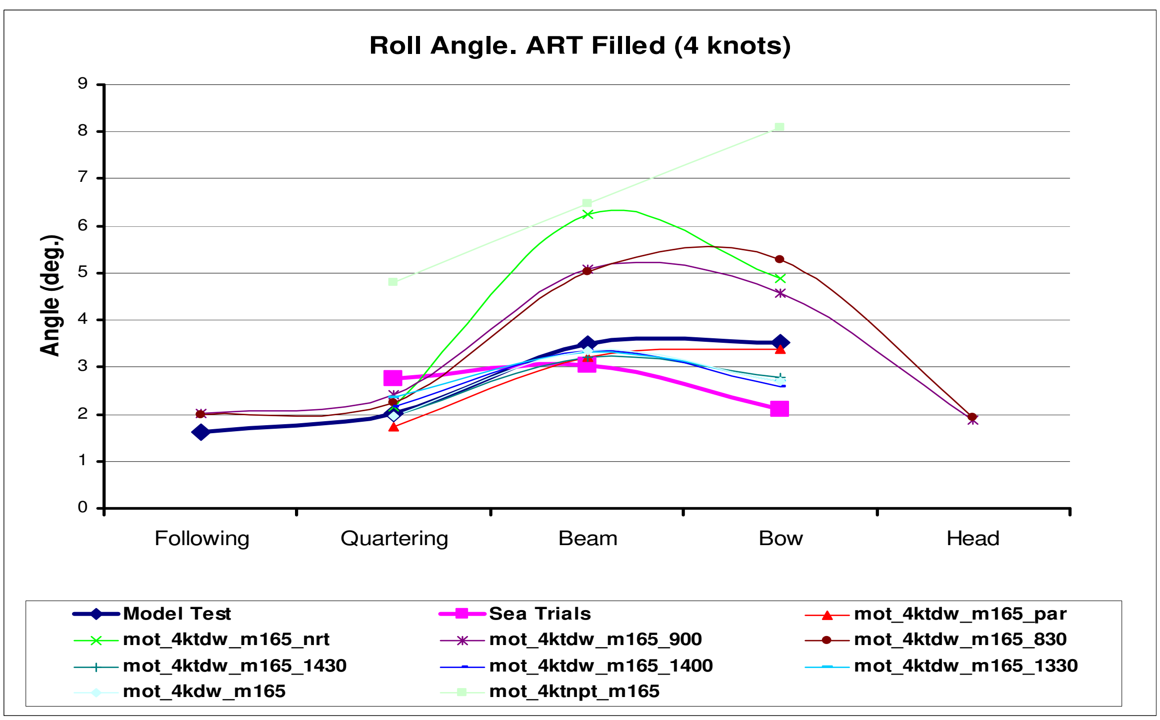


FIGURE 56: Roll Angle. vs. Heading – Trawl Speed, ART Filled

APPENDIX A

HYDROSTATICS FOR SHIP AND PHYSICAL MODEL

HYDROSTATICS WITHOUT APPENDAGES **Scale 1: 10.667**

	Ship	Model
LENGTH BETWEEN PERPENDICULARS, m	18.99	1.780
LENGTH ON THE WATERLINE, m	19.18	1.798
LENGTH OVERALL, m	19.79	1.855
MAXIMUM WATERLINE BEAM, m	7.01	0.657
DRAFT AT MIDSHIPS, m	2.72	0.255
DRAFT ABOVE DATUM AT AFT PERPENDICULAR, m	2.54	0.238
DRAFT ABOVE DATUM AT FWD PERPENDICULAR, m	2.91	0.273
TRIM, deg.	1.13	1.128
EQUIVALENT LEVEL KEEL DRAFT ABOVE BASELINE, m	2.72	0.255
PARALLEL MIDDLE BODY WRT AP, m	NA	NA
TO, m	NA	NA
CENTRE OF BUOYANCY WRT AP, m	8.69	0.814
CENTRE OF BUOYANCY ABOVE BASELINE, m	1.69	0.158
CENTRE OF FLOTATION WRT AP, m	8.43	0.790
WATERPLANE AREA, sq. m	118.76	1.044
WETTED SURFACE AREA, sq.m	209.38	1.840
WETTED SURFACE AREA, (EXCLUDING TRANSOM) sq.m	201.20	1.768
MIDSHIP SECTIONAL AREA, sq.m	15.35	0.135
TRANSVERSE METACENTRIC RADIUS, m	1.90	0.178
LONGITUDINAL METACENTRIC RADIUS, m	13.88	1.301
VOLUME OF DISPLACEMENT, cu. m	223.33	0.184
DISPLACEMENT, (tonnes @ FS in SW)(kg @ MS in FW)	228.91	184.001

MASS PROPERTIES

	Ship	Model
CENTER OF GRAVITY ABOVE BASELINE, m	2.69	0.252
TRANSVERSE METACENTRE HEIGHT, m	0.90	0.084
LONGITUDINAL METACENTRE HEIGHT, m	12.88	1.207

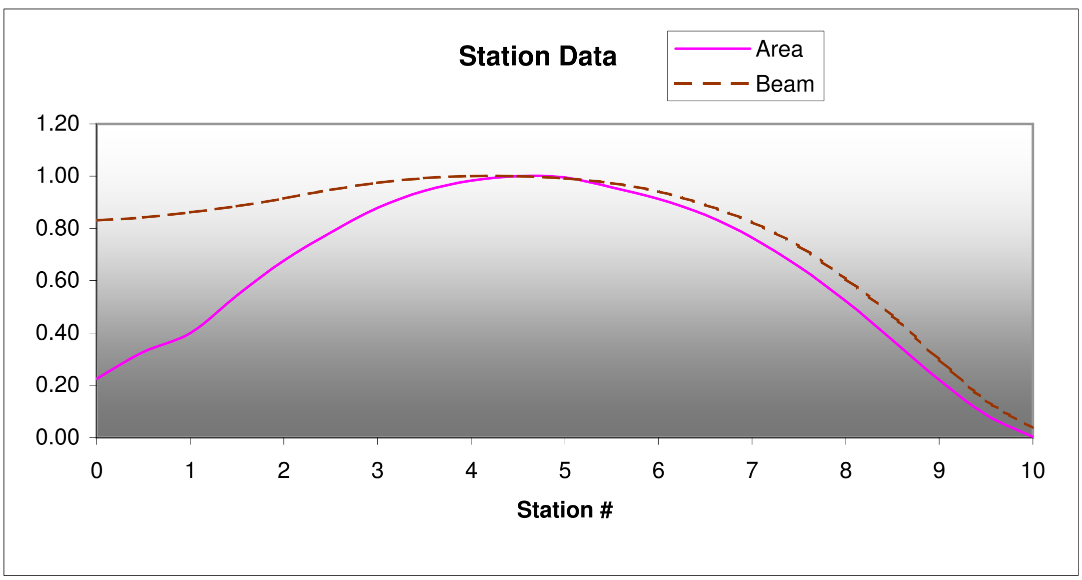
COEFFICIENTS OF FORM FOR NAKED HULL

COEFFICIENTS BASED ON: LENGTH ON WATERLINE
MAXIMUM BEAM
EQUIVALENT LEVEL KEEL DRAFT

L/B	2.709
L/T	6.979
B/T	2.576
LCB %L FORWARD OF AP	45.745
LCF %L FORWARD OF AP	44.387
BLOCK COEFFICIENT	0.611
MIDSHIP COEFFICIENT	0.804
PRISMATIC COEFFICIENT	0.759
WATERPLANE COEFFICIENT	0.883
LONGITUDINAL INERTIA OF WATERPLANE	0.778
TRANSVERSE INERTIA OF WATERPLANE	0.775
BM/B	0.271
BML/L	0.701
BEAM - DISPLACEMENT RATIO	1.155
DRAFT - DISPLACEMENT RATIO	0.449
LENGTH - DISPLACEMENT RATIO	3.131
WETTED SURFACE - DISPLACEMENT RATIO	5.687
BM - DISPLACEMENT RATIO	0.313
BML - DISPLACEMENT RATIO	2.288

SECTIONAL AREA AND BEAM CURVES

Station	Area	Beam
0	0.224	0.831
0.5	0.327	0.842
1	0.400	0.861
1.5	0.545	0.885
2	0.676	0.915
2.5	0.785	0.948
3	0.879	0.975
3.5	0.944	0.992
4	0.984	1.000
4.5	1.000	1.000
5	0.995	0.991
5.5	0.957	0.974
6	0.913	0.941
6.5	0.852	0.890
7	0.764	0.823
7.5	0.654	0.733
8	0.523	0.606
8.5	0.373	0.466
9	0.220	0.300
9.5	0.088	0.141
10	0.002	0.037



Definitions:
Area = Station Area / Max. Sectional Area
Beam = Station Beam / Max. Section Beam

APPENDIX B

MODEL SWING & INCLINING RESULTS

Swing test

In order to match the model scale mass properties to those of the fishing vessel CCGA Roberts Sisters II, a swing test was performed in the Model Preparation Shop at NRC-IOT. The target displacement at the model scale was given as 181.09 kg (note that the scale is 1 : $10^{2/3}$). The bare hull weight was 67.25 kg. After including all outfit such as batteries, cables, sensors, etc., the model weighed 123.35 kg, which left 57.74 kg as ballast. When all of the material was placed into the model but not secured, including the ballast, the total weight was 180.89 kg, which was short by 200 grams from the target value. However, this 0.1% difference was deemed acceptable. A weight breakdown as prepared for the swing test is given in Table 1 below.

Table 1: Weight breakdown for the model in preparation for the swing test

Model Weights	
Description	**Weight (kg)**
Target displacement – model scale	***181.09***
Empty hull weight before swing	67.25
Installed Electronics	22.10
Batteries	34.00
Model weight without ballast (measured)	123.35
Ballast (estimated)	57.74
Final model weight, after swing	***180.89***

The target mass properties and the measured values after the swing test are given in Table 2. The model was first swung in pitch mode (stern to bow sense). The distribution of the weights was adjusted until a difference of 7 mm between the measured and target values for VCG was achieved (Table 2). Next, the model was swung in the port to starboard sense (roll mode). Again, the weights were adjusted until a difference of 6 mm between the measured VCG and target VCG was achieved. Note that the reference point for the VCG during the swing test is taken from the top of the aluminium bar as shown in Figure 2. It should also be noted that swings in both roll and pitch modes were alternately repeated to make sure that both produce the same VCG value, of course, within the experimental error. Theoretically, VCG for a given model should be independent of the way it is measured.

Table 2: Model parameters: the target and the measured values after the swing test

Parameter	Target	Measured	Difference
Displacement (kg)	181.09	180.89	-0.200
VCG (Pitch)* (m)	0.357	0.364	0.007
VCG (Roll)* (m)		0.363	0.006
Radius of Gyration (Pitch) (m)	0.467	0.455	-0.012
Radius of Gyration (Roll) (m)	0.2737	0.255	-0.019
*As measured from the top of the aluminium bar on the swing frame (m) (see Figure 2)			

Some of the possible causes for the observed discrepancies between the target and measured values:

- The location of the model in the swing frame: Prior to swinging the model, the correct position for the model to be mounted in the swing frame was determined. However, in the swing frame instead of the typical support of a piece of High Density 60 Styrofoam (H60) sheet, a combination of an aluminium bar and a wedge shaped piece of the foam was used to support the model at a level height and to accommodate for the rake of the keel and the non-flat of the bottom (see Figures 1 and 2 below). Hence, the model was not at its predetermined position during the swing tests.
- In order to match the roll radius of gyration, it was necessary to move the weights (mass) away from the center of rotation for roll. This posed a problem due to the restrictions on space, hence, most ballast weight was moved to the bottom and sides of the model as much as possible. The 'Roberts Sisters II' model was built with a wooden lining on the inside aiding in moving weight away from the centre of the model, as well as allowing the mounting of equipment on the model's walls and therefore furthering the distribution of weight away from the centre line. This impacted the Roll Radius of Gyration and resulted in a measured value lower than the target Roll Radius of Gyration (see Table 2 above).
- Although theoretically it should not matter, another hindrance encountered during the inclining portion of the swing test was that the weight pan could only be swung from the stern of the swing frame. Mounted at the front of the swing frame, the weight pan did not clear the superstructure and forward deck of the 'Roberts Sisters II' model, however it did clear the transom and all aft appendages when mounted by the stern. This meant that only one direction of incline could be measured.

Inclining Experiment

After the swing test was completed, and all the equipment and wiring had been installed and secured to the model, an inclining experiment was conducted to verify the transverse metacentric height (GM_T), the pitch and the roll periods. The securing of the equipment as well as the addition of cables, Qualisys markers, etc. added 2.91 kg to the final model weight - a final displacement of 184 kg as tested condition.

During the inclining experiment, a weight of 4.9 kg was used to heel the model to an average of 4.33 degrees. The summarized results of this experiment can be seen in Table 3 Inclining Summary below. The measured GM_T and target GM_T have a difference of 2 mm.

Table 3: Inclining summary

Inclining Summary			
	Measured	**Target**	**Difference**
Inclining mass (kg)	4.9949	-	-
Distance (m)	0.2075	-	-
Average angle (deg)	4.3325	-	-
GM_T (m)	0.0879	0.0899	-0.002
KG (VCG) (m)	0.254	0.251	0.003

Final Mass Properties of the Model

The following table gives the as tested condition for the model.

Table 4: Model parameters as tested

Parameter	Target	As Tested	Difference
Displacement (kg)	181.09	184.0	2.91
GM_T (m)	0.0899	0.0879	-0.002
KG (VCG) from B.L. (m)*	0.251	0.254	0.003
Radius of Gyration (Pitch) (m)	0.467	0.455	-0.012
Radius of Gyration (Roll) (m)	0.274	0.255	-0.019
Roll period (s) from decay tests (ART is empty, zero speed)	1.940	1.853	-0.087
Pitch period (s) from decay tests (ART is empty, zero speed)	1.228	1.084	-0.144
* For the definition of the baseline, refer to the drawing file "Roberts Sister Lam.ckd" at NRC-IOT Design Office databases			

Figure 1: 'Roberts Sisters II' Model IOT761 in Swing Frame

Figure 2: 'Roberts Sisters II' Model IOT761 Support Setup

APPENDIX C

INSTRUMENTATION CALIBRATION RESULTS

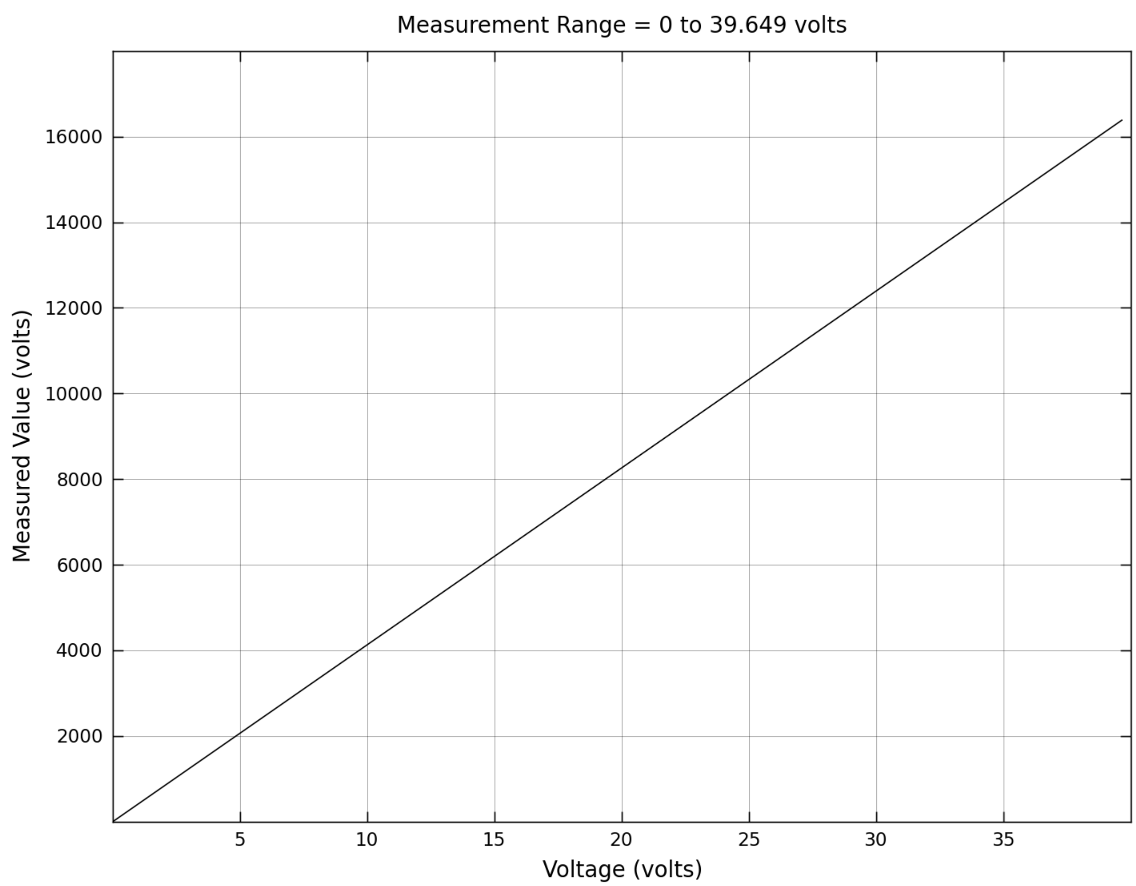
Safer Fishing Vessel Seakeeping Phase 2

Calibration of ADIS Supply

Calibrated 2009-06-24 12:47

Test Facility: OEB	**Serial #:**	**Filter Frequency:**
Data Source: DASPC25 Channel 1	**Programmable Gain:**	**Excitation Voltage:**
Sensor Model:	**Plug-In Gain:**	

Data Point #	**Physical Value** (volts)	**Measured Value** (volts)	**Fitted Curve Value** (volts)	**Error** (volts)	**Definition of Calibration Curve**
					Polynomial Degree = 1 (Linear Fit) $Y = C_0 + C_1 \cdot V$ where $Y(t)$ = Voltage (volts), $V(t)$ = measured value (volts), C_0 = 0 volts, C_1 = 0.00242 volts/volt.



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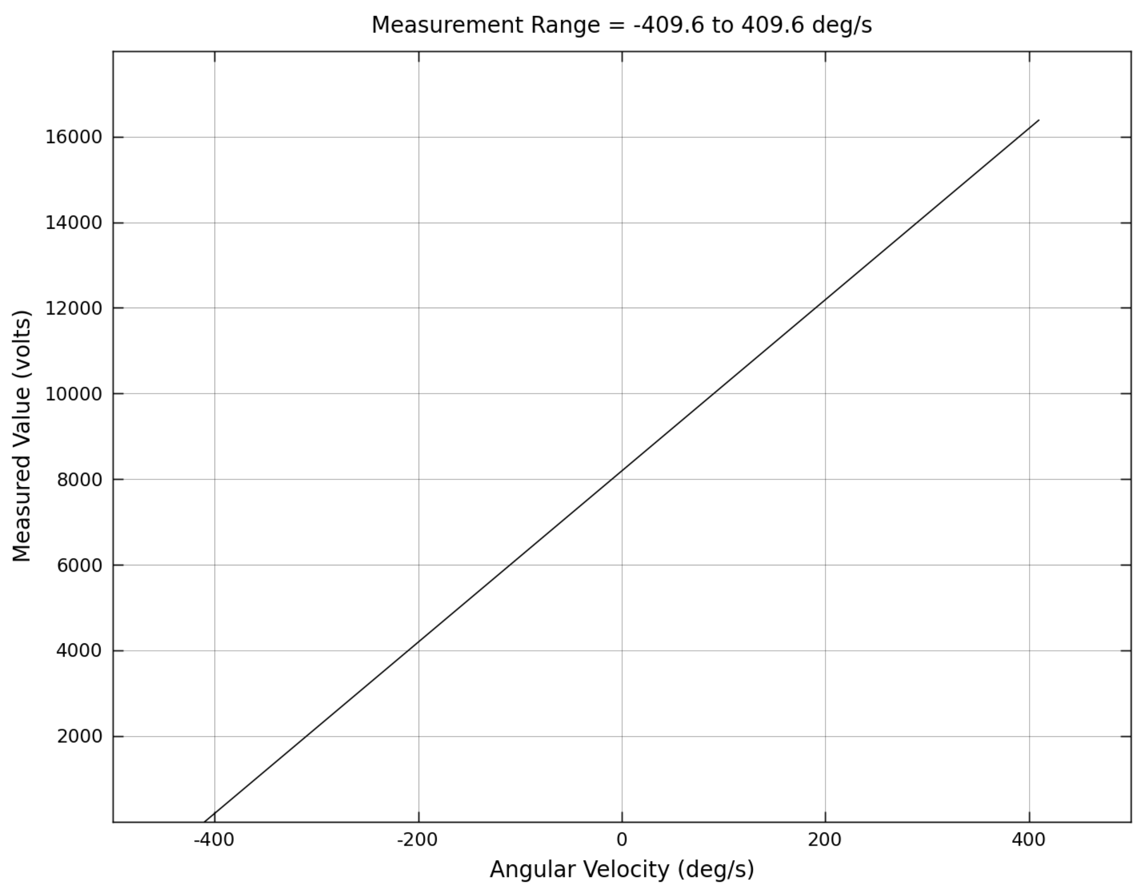
Safer Fishing Vessel Seakeeping Phase 2

Calibration of ADIS X Rate

Calibrated 2009-06-24 12:47

Test Facility: OEB **Data Source:** DASPC25 Channel 2 **Sensor Model:**	**Serial #:** **Programmable Gain:** **Plug-In Gain:**	**Filter Frequency:** **Excitation Voltage:**

Data Point #	Physical Value (deg/s)	Measured Value (volts)	Fitted Curve Value (deg/s)	Error (deg/s)	Definition of Calibration Curve
					Polynomial Degree = 1 (Linear Fit) $Y = C_0 + C_1 \cdot V$ where $Y(t)$ = Angular Velocity (deg/s), $V(t)$ = measured value (volts), C_0 = -409.6 deg/s, C_1 = 0.05 deg/s/volt.



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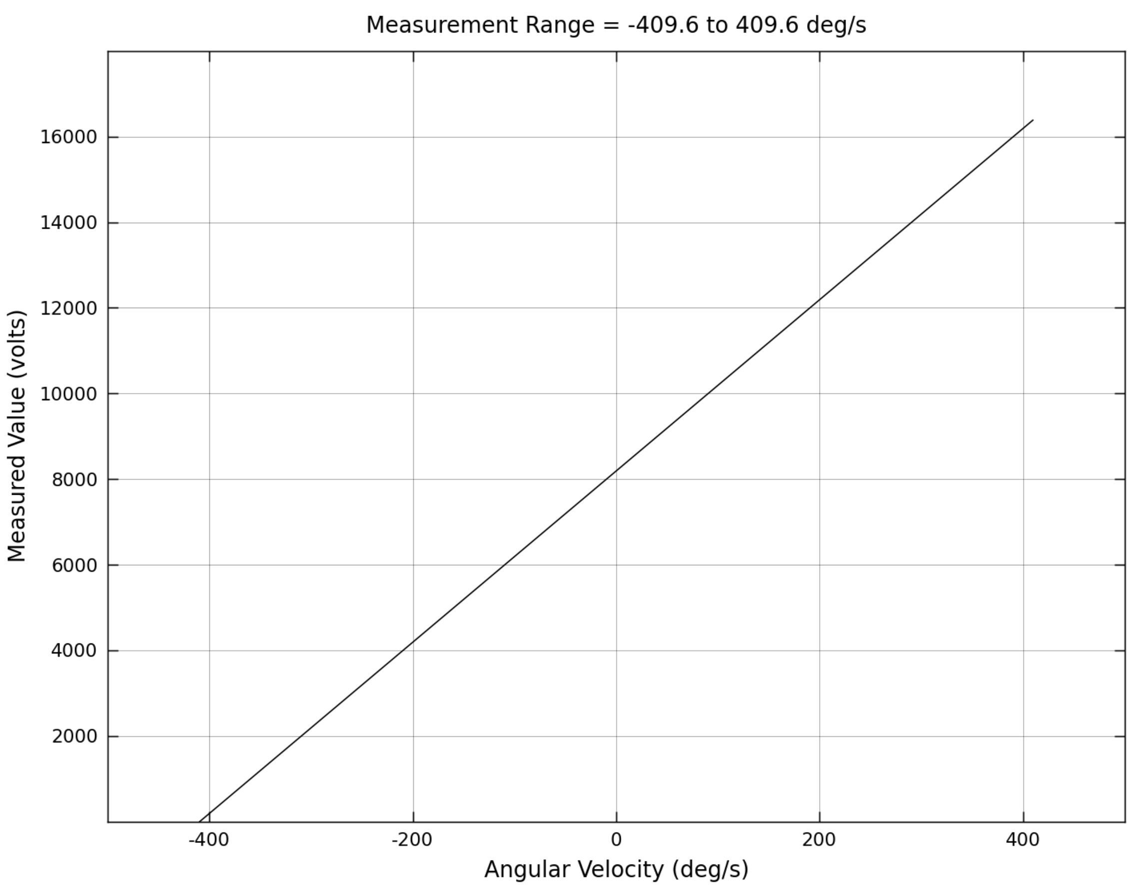
Safer Fishing Vessel Seakeeping Phase 2
Calibration of ADIS Y Rate
Calibrated 2009-06-24 12:48

Test Facility: OEB	**Serial #:**	**Filter Frequency:**
Data Source: DASPC25 Channel 3	**Programmable Gain:**	**Excitation Voltage:**
Sensor Model:	**Plug-In Gain:**	

Data Point #	**Physical Value** (deg/s)	**Measured Value** (volts)	**Fitted Curve Value** (deg/s)	**Error** (deg/s)	**Definition of Calibration Curve**
					Polynomial Degree = 1 (Linear Fit) $Y = C_0 + C_1 \cdot V$ where $Y(t)$ = Angular Velocity (deg/s), $V(t)$ = measured value (volts), C_0 = -409.6 deg/s, C_1 = 0.05 deg/s/volt.



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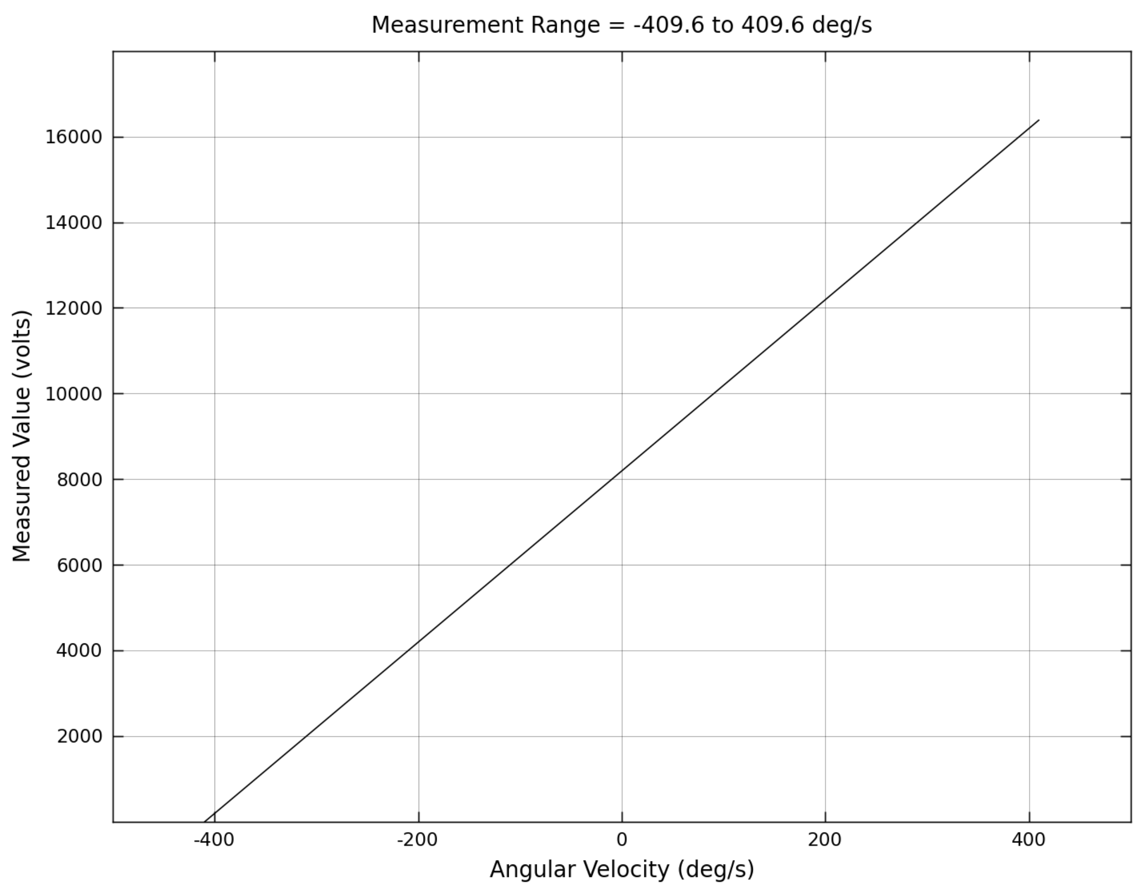
Safer Fishing Vessel Seakeeping Phase 2

Calibration of ADIS Z Rate

Calibrated 2009-06-24 12:48

Test Facility: OEB **Data Source:** DASPC25 Channel 4 **Sensor Model:**	**Serial #:** **Programmable Gain:** **Plug-In Gain:**	**Filter Frequency:** **Excitation Voltage:**

Data Point #	**Physical Value** (deg/s)	**Measured Value** (volts)	**Fitted Curve Value** (deg/s)	**Error** (deg/s)	**Definition of Calibration Curve**
					Polynomial Degree = 1 (Linear Fit) $Y = C_0 + C_1 \cdot V$ where $Y(t)$ = Angular Velocity (deg/s), $V(t)$ = measured value (volts), C_0 = -409.6 deg/s, C_1 = 0.05 deg/s/volt.



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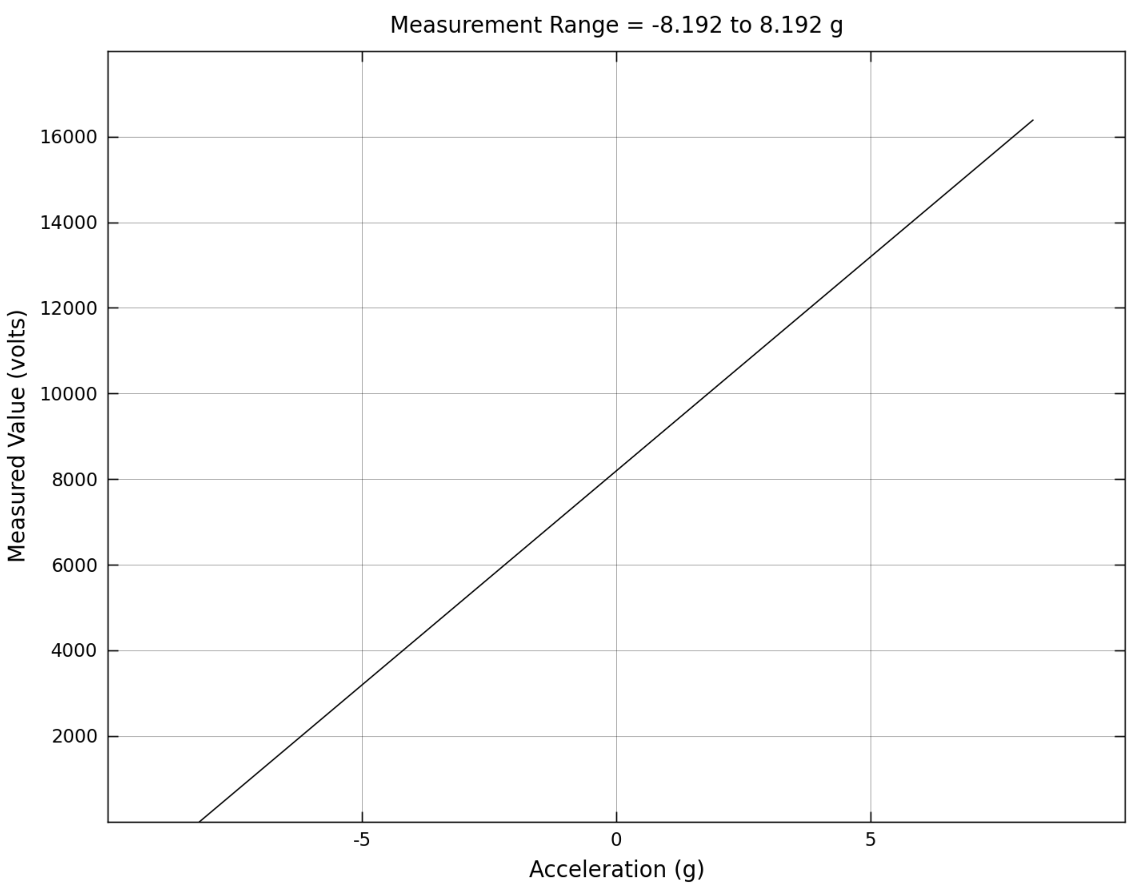
Institute for Ocean Technology

Safer Fishing Vessel Seakeeping Phase 2
Calibration of ADIS X Accel
Calibrated 2009-06-24 12:48

Test Facility: OEB **Data Source:** DASPC25 Channel 5 **Sensor Model:**	**Serial #:** **Programmable Gain:** **Plug-In Gain:**	**Filter Frequency:** **Excitation Voltage:**

Data Point #	**Physical Value** (g)	**Measured Value** (volts)	**Fitted Curve Value** (g)	**Error** (g)	**Definition of Calibration Curve**
					Polynomial Degree = 1 (Linear Fit) $Y = C_0 + C_1 \cdot V$ where $Y(t)$ = Acceleration (g), $V(t)$ = measured value (volts), C_0 = -8.192 g, C_1 = 0.001 g/volt.



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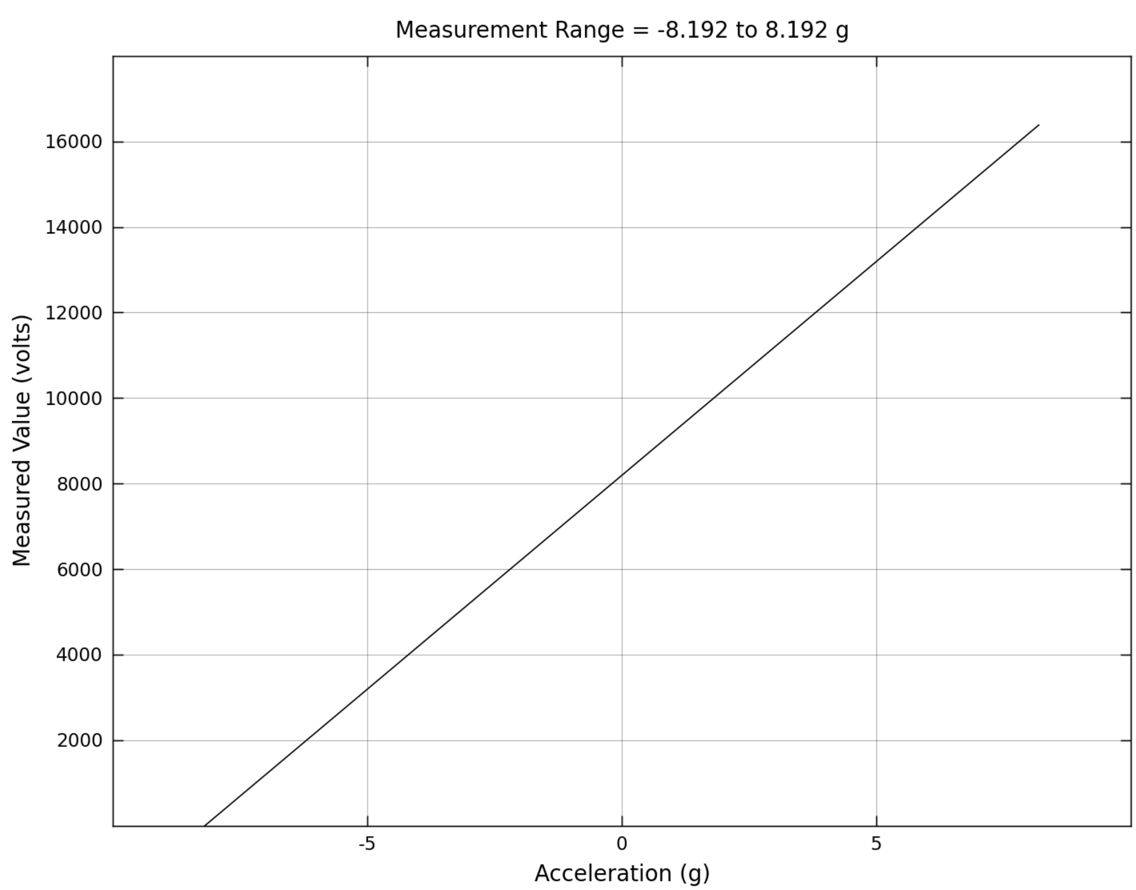
Safer Fishing Vessel Seakeeping Phase 2

Calibration of ADIS Y Accel

Calibrated 2009-06-24 12:48

Test Facility: OEB	**Serial #:**	**Filter Frequency:**
Data Source: DASPC25 Channel 6	**Programmable Gain:**	**Excitation Voltage:**
Sensor Model:	**Plug-In Gain:**	

Data Point #	**Physical Value** (g)	**Measured Value** (volts)	**Fitted Curve Value** (g)	**Error** (g)	**Definition of Calibration Curve**
					Polynomial Degree = 1 (Linear Fit) $Y = C_0 + C_1 \cdot V$ where $Y(t)$ = Acceleration (g), $V(t)$ = measured value (volts), C_0 = -8.192 g, C_1 = 0.001 g/volt.



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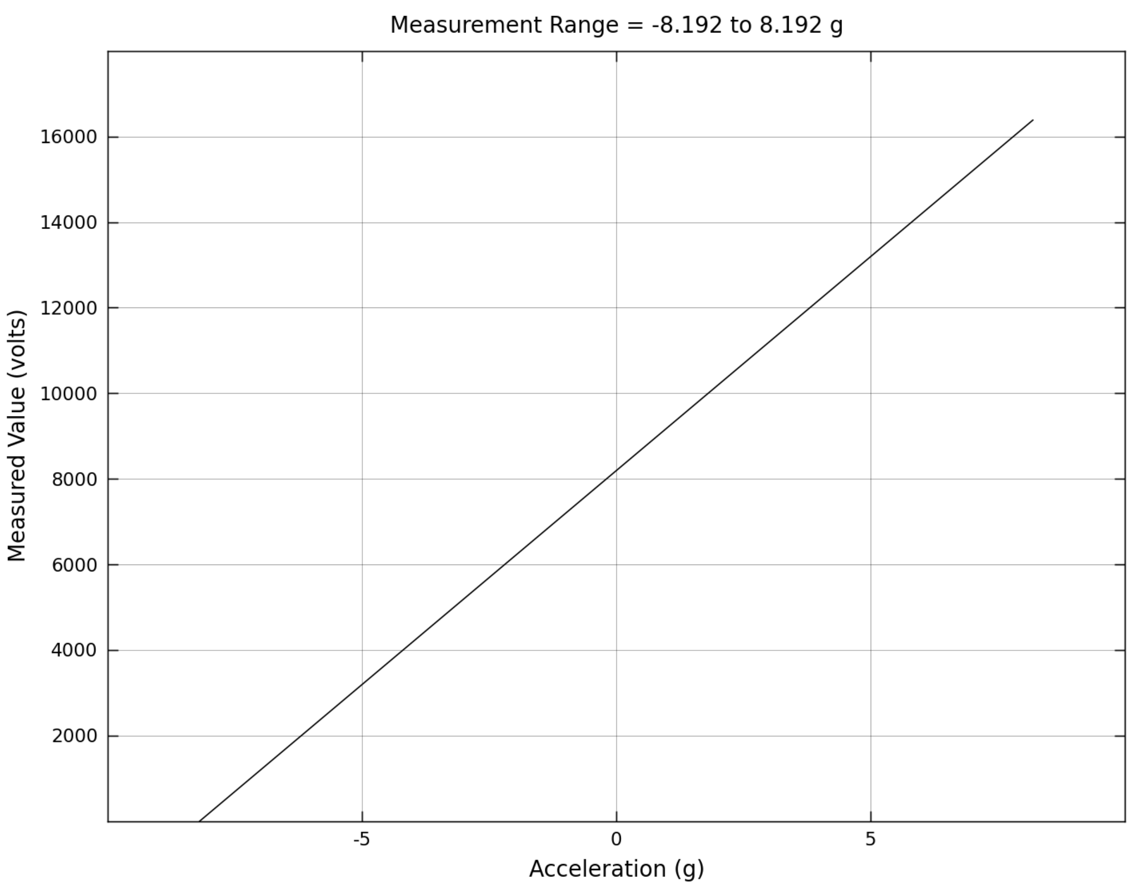
Safer Fishing Vessel Seakeeping Phase 2
Calibration of ADIS Z Accel
Calibrated 2009-06-24 12:49

Test Facility: OEB **Data Source:** DASPC25 Channel 7 **Sensor Model:**	**Serial #:** **Programmable Gain:** **Plug-In Gain:**	**Filter Frequency:** **Excitation Voltage:**

Data Point #	**Physical Value** (g)	**Measured Value** (volts)	**Fitted Curve Value** (g)	**Error** (g)	**Definition of Calibration Curve**
					Polynomial Degree = 1 (Linear Fit) $Y = C_0 + C_1 \cdot V$ where $Y(t)$ = Acceleration (g), $V(t)$ = measured value (volts), C_0 = -8.192 g, C_1 = 0.001 g/volt.



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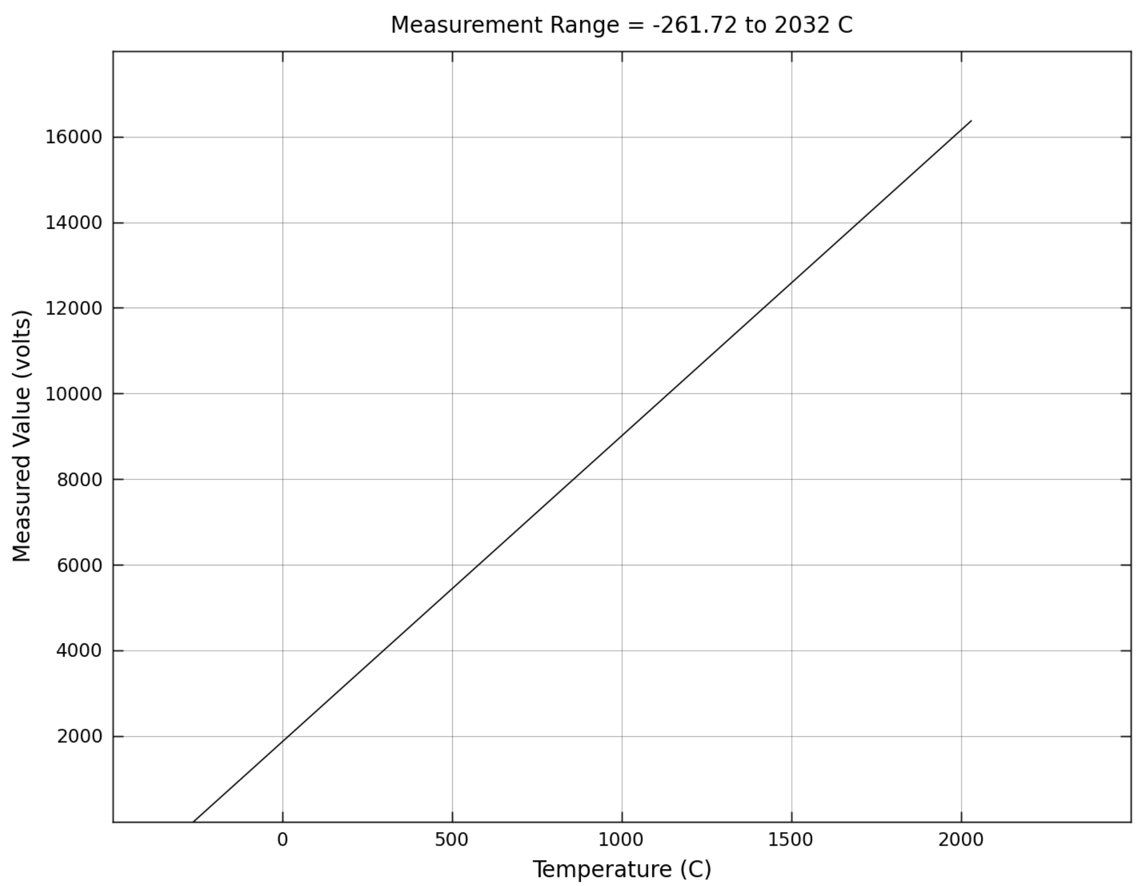
Safer Fishing Vessel Seakeeping Phase 2

Calibration of ADIS X Temp

Calibrated 2009-06-24 12:49

Test Facility: OEB **Data Source:** DASPC25 Channel 8 **Sensor Model:**	**Serial #:** **Programmable Gain:** **Plug-In Gain:**	**Filter Frequency:** **Excitation Voltage:**

Data Point #	**Physical Value** (C)	**Measured Value** (volts)	**Fitted Curve Value** (C)	**Error** (C)	**Definition of Calibration Curve**
					Polynomial Degree = 1 (Linear Fit) $Y = C_0 + C_1 \cdot V$ where $Y(t)$ = Temperature (C), $V(t)$ = measured value (volts), C_0 = -261.72 C, C_1 = 0.14 C/volt.



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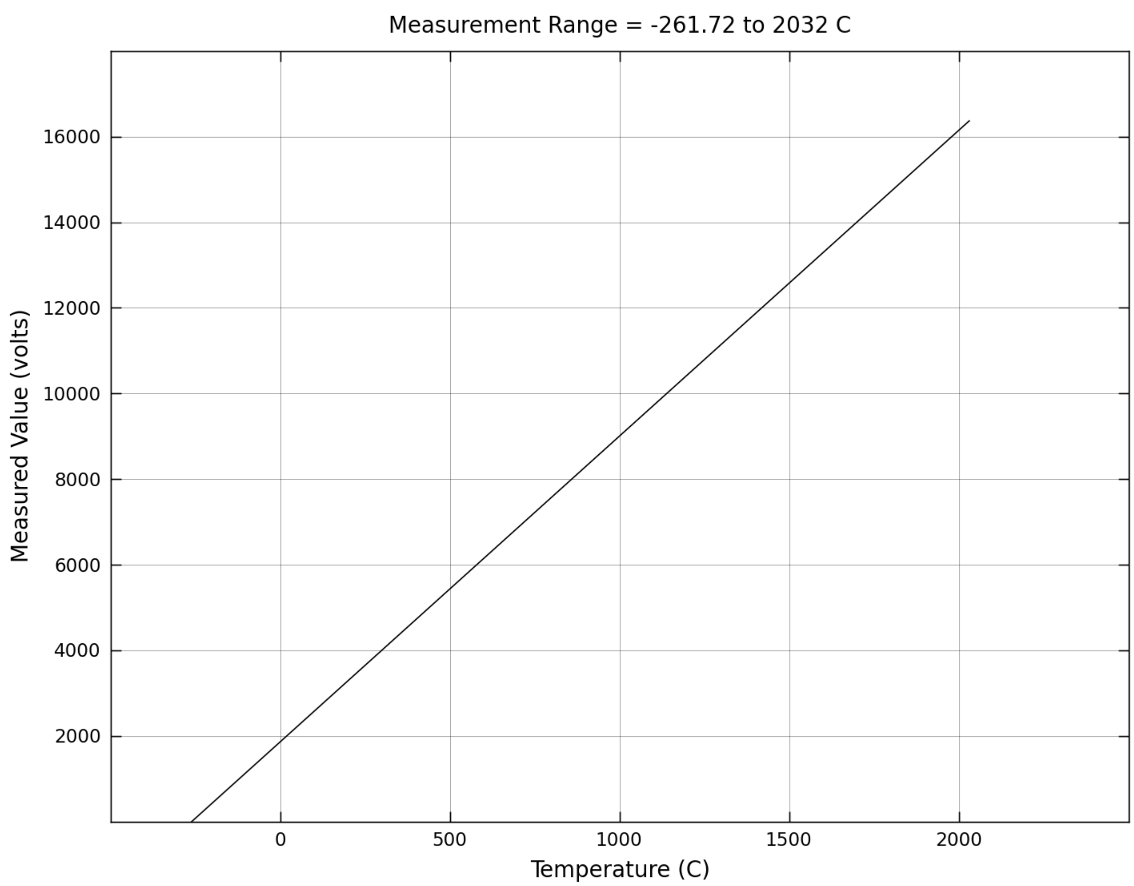
Safer Fishing Vessel Seakeeping Phase 2
Calibration of ADIS Y Temp
Calibrated 2009-06-24 12:50

Test Facility: OEB **Data Source:** DASPC25 Channel 9 **Sensor Model:**	**Serial #:** **Programmable Gain:** **Plug-In Gain:**	**Filter Frequency:** **Excitation Voltage:**

Data Point #	**Physical Value** (C)	**Measured Value** (volts)	**Fitted Curve Value** (C)	**Error** (C)	**Definition of Calibration Curve**
					Polynomial Degree = 1 (Linear Fit) $Y = C_0 + C_1 \cdot V$ where $Y(t)$ = Temperature (C), $V(t)$ = measured value (volts), C_0 = -261.72 C, C_1 = 0.14 C/volt.



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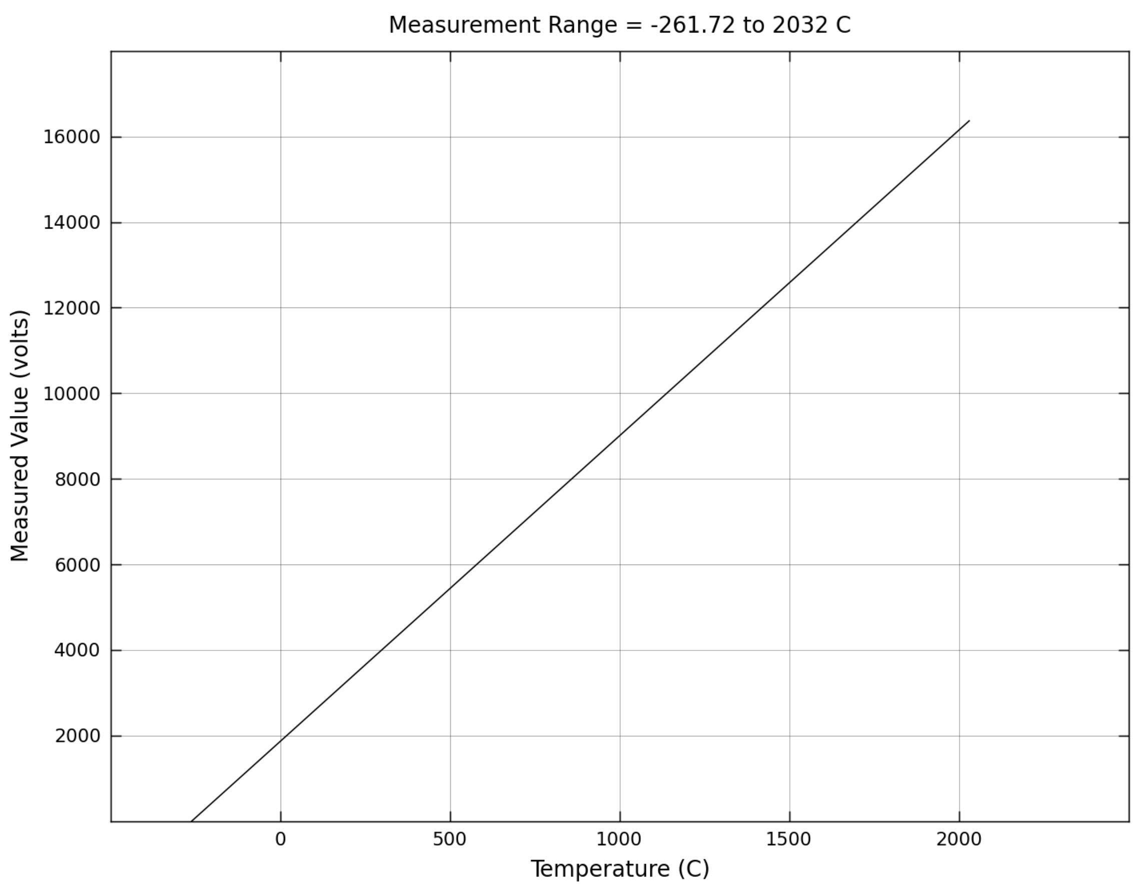
Safer Fishing Vessel Seakeeping Phase 2
Calibration of ADIS Z Temp
Calibrated 2009-06-24 12:50

Test Facility: OEB	**Serial #:**	**Filter Frequency:**
Data Source: DASPC25 Channel 10	**Programmable Gain:**	**Excitation Voltage:**
Sensor Model:	**Plug-In Gain:**	

Data Point #	**Physical Value** (C)	**Measured Value** (volts)	**Fitted Curve Value** (C)	**Error** (C)	**Definition of Calibration Curve**
					Polynomial Degree = 1 (Linear Fit) $Y = C_0 + C_1 \cdot V$ where $Y(t)$ = Temperature (C), $V(t)$ = measured value (volts), C_0 = -261.72 C, C_1 = 0.14 C/volt.



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Safer Fishing Vessel Seakeeping Phase 2

Calibration of Aerotech 1410 tach

Calibrated 2009-07-07 13:47

Test Facility: OEB	**Serial #:**	**Filter Frequency:** 10.0
Data Source: DASPC34 Channel 1	**Programmable Gain:**	**Excitation Voltage:** 10
Sensor Model: 1410	**Plug-In Gain:** 2	

Data Point #	Physical Value (rps)	Measured Value (volts)	Fitted Curve Value (rps)	Error (rps)
1	-12.970	-5.8342	-12.978	-0.0076591
2	-8.7000	-3.9219	-8.6466	0.053425
3	-4.3830	-2.0537	-4.4152	-0.032244
4	4.1500	1.7037	4.0949	-0.055053
5	8.4170	3.6206	8.4366	0.019560
6	12.750	5.5347	12.772	0.021970

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

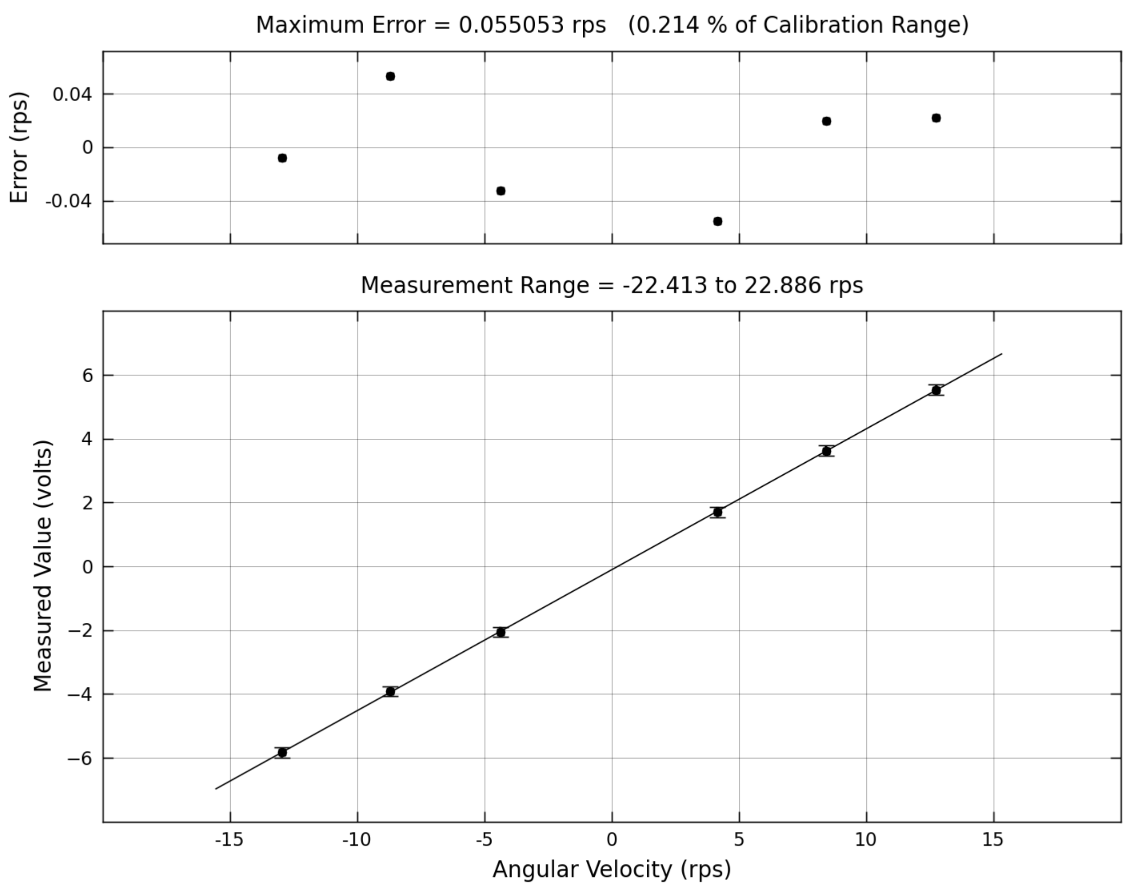
$Y = C_0 + C_1 \cdot V$

where $Y(t)$ = Angular Velocity (rps),

$V(t)$ = measured value (volts),

C_0 = 0.23627 rps,

C_1 = 2.2649 rps/volt.



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Safer Fishing Vessel Seakeeping Phase 2
Calibration of Pitch Rate - MP
Calibrated 2009-06-25 15:49

Test Facility: OEB	**Serial #:** 0205	**Filter Frequency:** 10.0
Data Source: DASPC34 Channel 2	**Programmable Gain:**	**Excitation Voltage:** 15
Sensor Model: Motion Pak II	**Plug-In Gain:**	

Data Point #	Physical Value (deg/s)	Measured Value (volts)	Fitted Curve Value (deg/s)	Error (deg/s)
1	-40.000	-6.7540	-39.968	0.032301
2	-20.000	-3.3978	-19.975	0.025331
3	20.000	3.2789	19.798	-0.20204
4	40.000	6.6944	40.144	0.14440

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

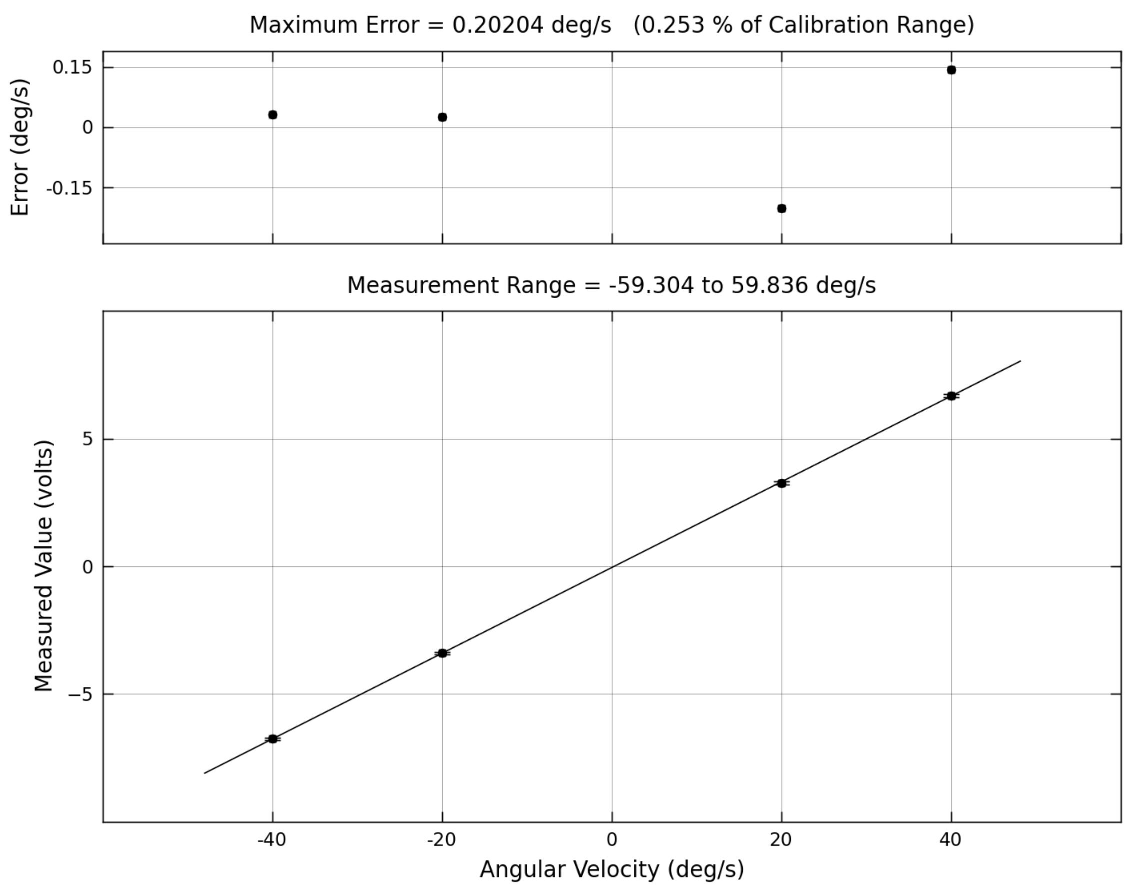
$Y = C_0 + C_1 \cdot V$

where $Y(t)$ = Angular Velocity (deg/s),

$V(t)$ = measured value (volts),

C_0 = 0.26595 deg/s,

C_1 = 5.957 deg/s/volt.



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Safer Fishing Vessel Seakeeping Phase 2

Calibration of Roll Rate - MP

Calibrated 2009-06-26 10:38

Test Facility: OEB	**Serial #:** 0205	**Filter Frequency:** 10.0
Data Source: DASPC34 Channel 3	**Programmable Gain:**	**Excitation Voltage:** 15
Sensor Model: Motion Pak II	**Plug-In Gain:**	

Data Point #	Physical Value (deg/s)	Measured Value (volts)	Fitted Curve Value (deg/s)	Error (deg/s)
1	-40.000	2.6523	-40.240	-0.23979
2	-20.000	1.3005	-19.923	0.077231
3	20.000	-1.3727	20.257	0.25667
4	40.000	-2.6983	40.182	0.18173
5	75.000	-4.9965	74.724	-0.27584

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

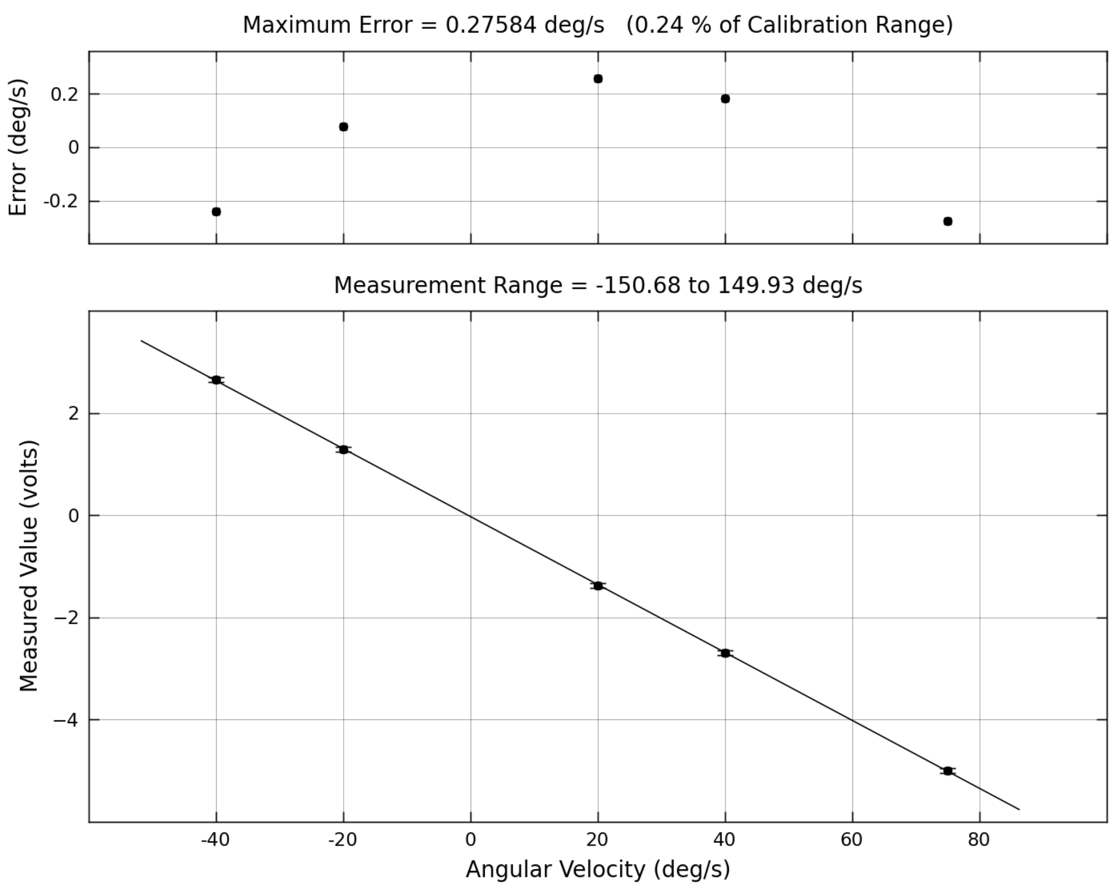
$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Angular Velocity (deg/s),

$V(t)$ = measured value (volts),

C_0 = -0.37507 deg/s,

C_1 = -15.03 deg/s/volt.



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Safer Fishing Vessel Seakeeping Phase 2

Calibration of Yaw Rate - MP

Calibrated 2009-06-25 15:10

Test Facility: OEB	**Serial #:** 0205	**Filter Frequency:** 10.0
Data Source: DASPC34 Channel 4	**Programmable Gain:**	**Excitation Voltage:** 15
Sensor Model: Motion Pak II	**Plug-In Gain:** 5	

Data Point #	Physical Value (deg/s)	Measured Value (volts)	Fitted Curve Value (deg/s)	Error (deg/s)
1	-10.000	6.9026	-9.9676	0.032417
2	-8.0000	5.6375	-8.0492	-0.049208
3	-5.0000	3.6120	-4.9777	0.022277
4	0.00000	0.33092	-0.0024776	-0.0024776
5	5.0000	-2.9531	4.9773	-0.022651
6	8.0000	-4.9618	8.0232	0.023156
7	10.000	-6.2631	9.9965	-0.0035142

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

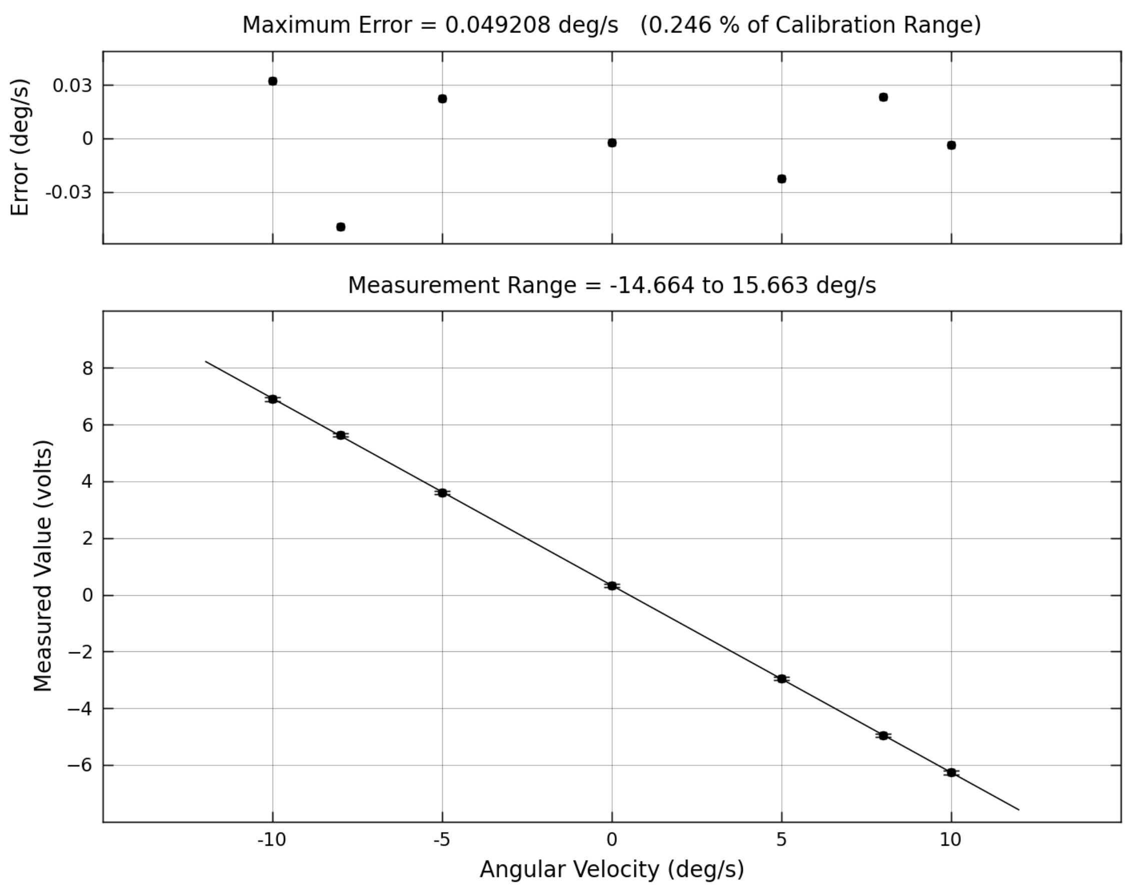
$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Angular Velocity (deg/s),

$V(t)$ = measured value (volts),

C_0 = 0.49931 deg/s,

C_1 = -1.5164 deg/s/volt.



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Safer Fishing Vessel Seakeeping Phase 2

Calibration of Heave Accel - MP

Calibrated 2009-06-26 10:55

Test Facility: OEB	**Serial #:** 0205	**Filter Frequency:** 10.0
Data Source: DASPC34 Channel 5	**Programmable Gain:**	**Excitation Voltage:** 15
Sensor Model: Motion Pak II	**Plug-In Gain:**	

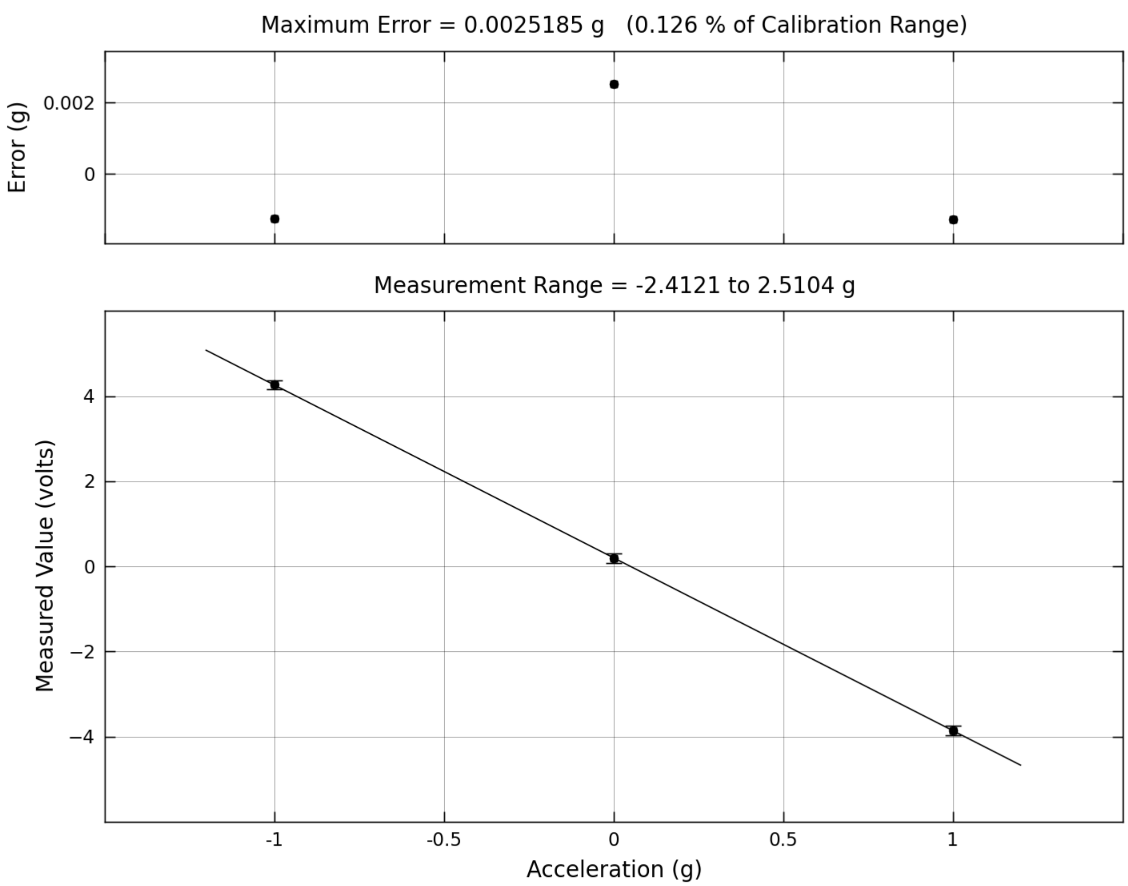
Data Point #	Physical Value (g)	Measured Value (volts)	Fitted Curve Value (g)	Error (g)
1	-1.0000	4.2677	-1.0013	-0.0012545
2	0.00000	0.18936	0.0025185	0.0025185
3	1.0000	-3.8583	0.99874	-0.0012640

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Acceleration (g),
$V(t)$ = measured value (volts),
C_0 = 0.049125 g,
C_1 = -0.24612 g/volt.



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Safer Fishing Vessel Seakeeping Phase 2

Calibration of Sway Accel - MP

Calibrated 2009-06-26 11:10

Test Facility: OEB	**Serial #:** 0205	**Filter Frequency:** 10.0
Data Source: DASPC34 Channel 6	**Programmable Gain:**	**Excitation Voltage:** 15
Sensor Model: Motion Pak II	**Plug-In Gain:** 3	

Data Point #	Physical Value (g)	Measured Value (volts)	Fitted Curve Value (g)	Error (g)
1	-1.0000	6.6217	-1.0004	-0.00038462
2	0.00000	0.032431	0.00077007	0.00077007
3	1.0000	-6.5417	0.99961	-0.00038546

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

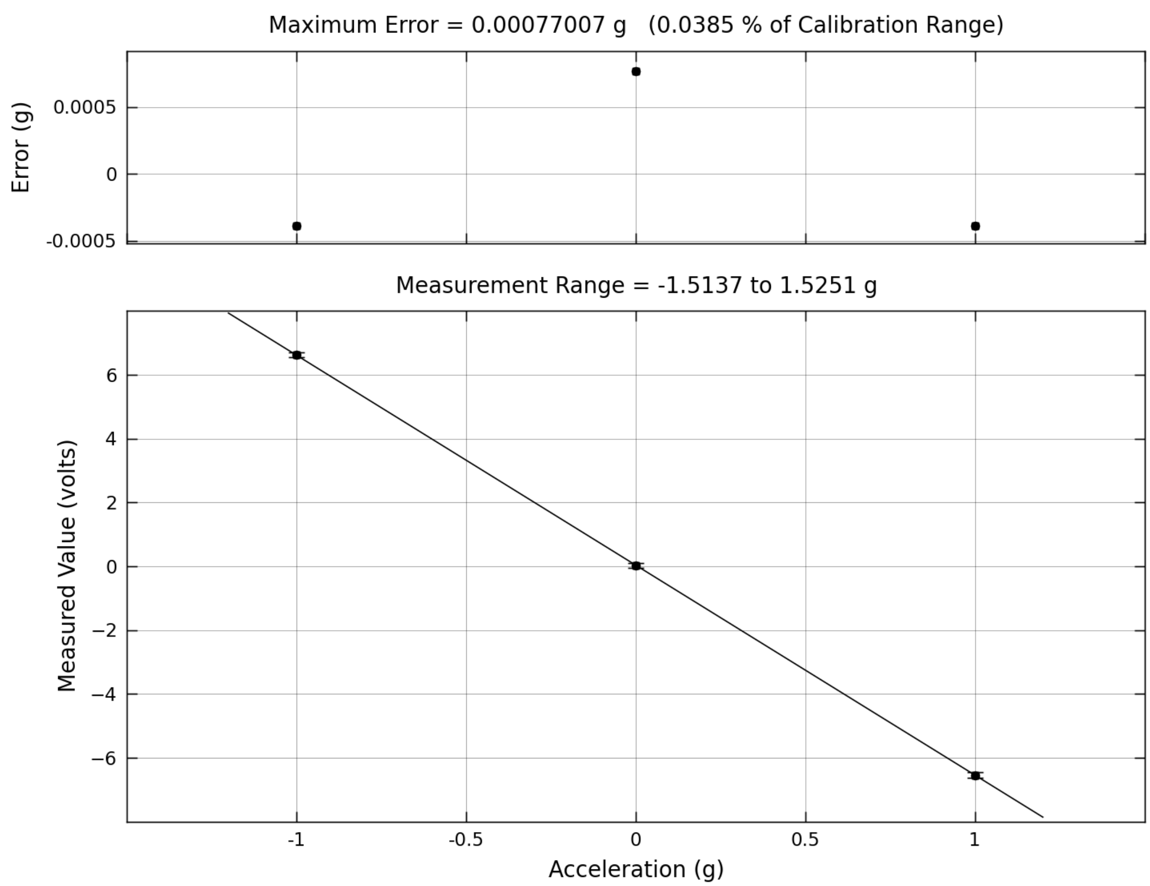
$Y = C_0 + C_1 \cdot V$

where $Y(t)$ = Acceleration (g),

$V(t)$ = measured value (volts),

C_0 = 0.0056976 g,

C_1 = -0.15194 g/volt.



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Safer Fishing Vessel Seakeeping Phase 2

Calibration of Surge Accel - MP

Calibrated 2009-06-26 11:13

Test Facility: OEB	**Serial #:** 0205	**Filter Frequency:** 10.0
Data Source: DASPC34 Channel 7	**Programmable Gain:**	**Excitation Voltage:** 15
Sensor Model: Motion Pak II	**Plug-In Gain:** 3	

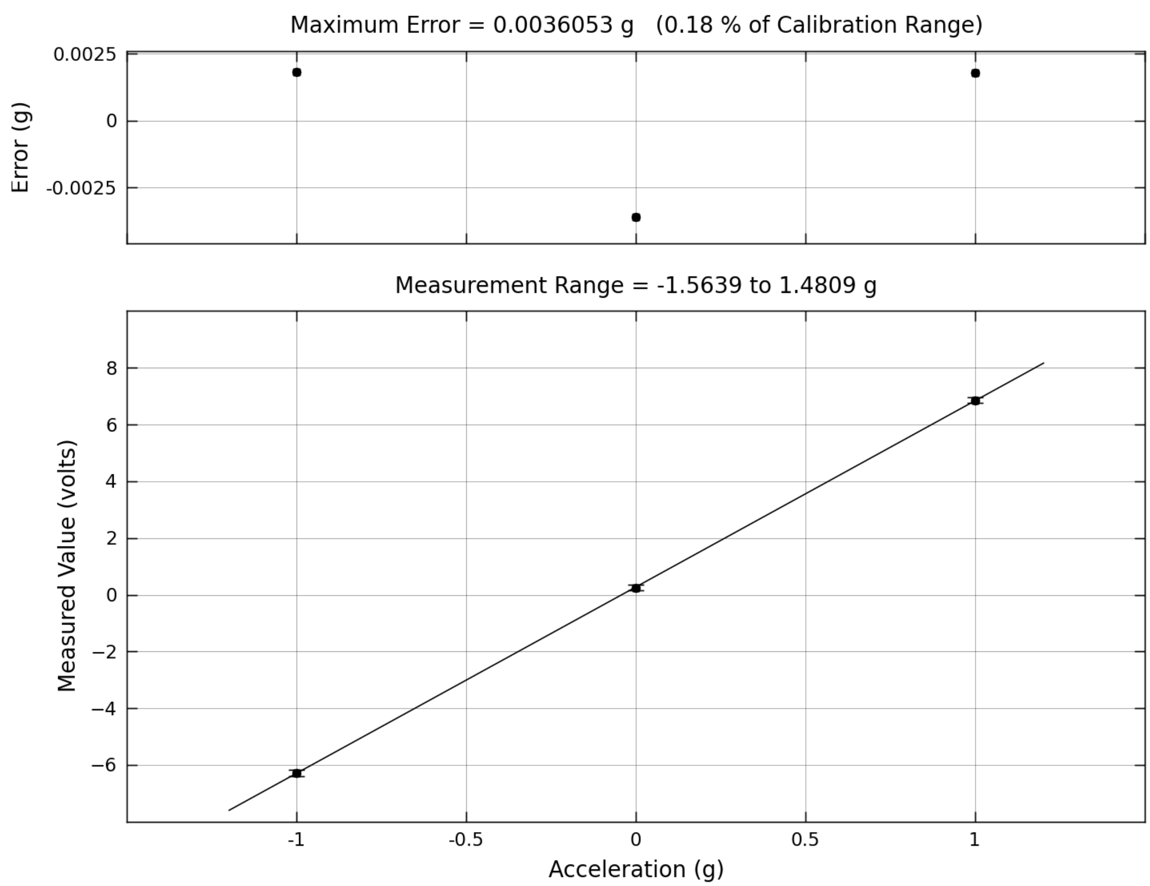
Data Point #	Physical Value (g)	Measured Value (volts)	Fitted Curve Value (g)	Error (g)
1	-1.0000	-6.2838	-0.99819	0.0018125
2	0.00000	0.24915	-0.0036053	-0.0036053
3	1.0000	6.8532	1.0018	0.0017929

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Acceleration (g),
$V(t)$ = measured value (volts),
C_0 = -0.041536 g,
C_1 = 0.15224 g/volt.



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Safer Fishing Vessel Seakeeping Phase 2

Calibration of Rudder Angle

Calibrated 2009-07-07 12:04

Test Facility: OEB	**Serial #:** NA	**Filter Frequency:** 10.0
Data Source: DASPC34 Channel 8	**Programmable Gain:**	**Excitation Voltage:** 15
Sensor Model: Motion Pak II	**Plug-In Gain:** 2	

Data Point #	Physical Value (deg)	Measured Value (volts)	Fitted Curve Value (deg)	Error (deg)
1	-26.500	7.4914	-27.042	-0.54197
2	-11.000	6.1686	-10.942	0.057951
3	1.0000	5.1237	1.7757	0.77567
4	9.9000	4.4036	10.540	0.64007
5	24.700	3.3167	23.768	-0.93173

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

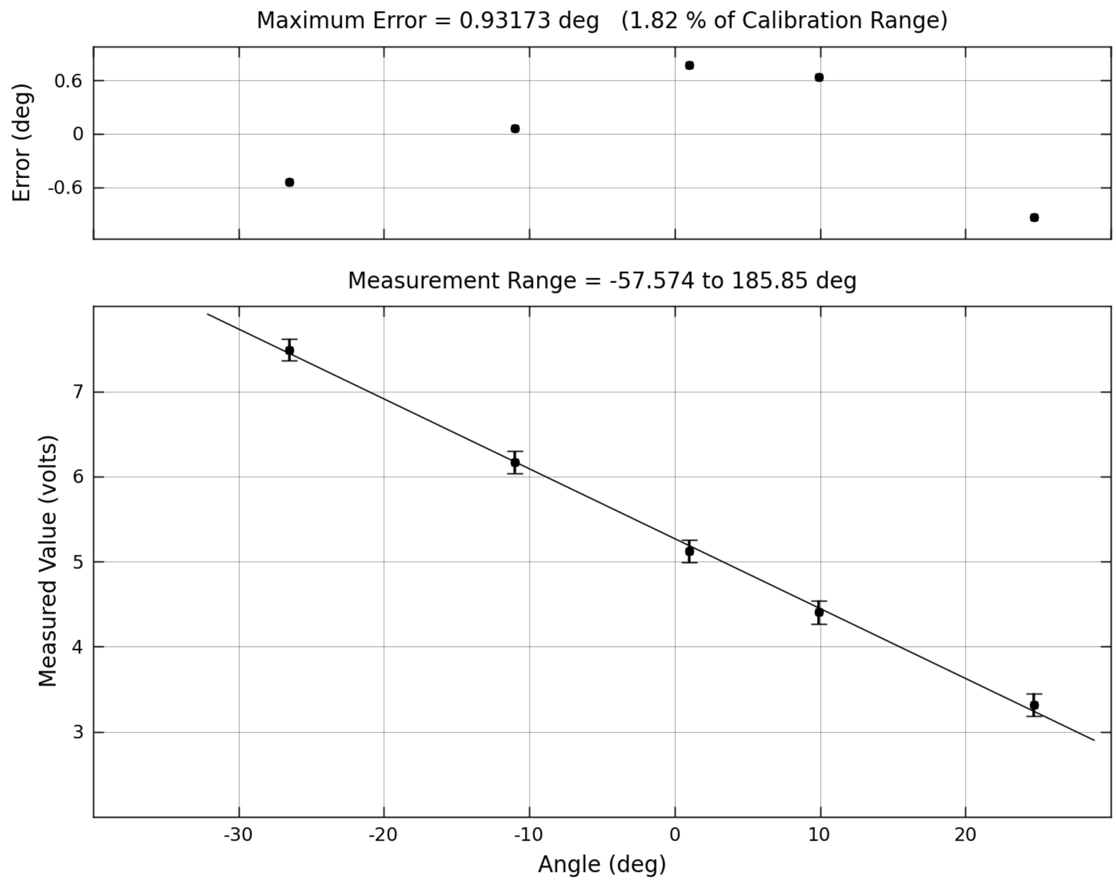
$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Angle (deg),

$V(t)$ = measured value (volts),

C_0 = 64.136 deg,

C_1 = -12.171 deg/volt.



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Safer Fishing Vessel Seakeeping Phase 2
Calibration of Heave Accel
Calibrated 2009-06-26 11:22

Test Facility: OEB	**Serial #:** 1267	**Filter Frequency:** 10.0
Data Source: DASPC34 Channel 9	**Programmable Gain:**	**Excitation Voltage:** 15
Sensor Model: QA900 Accel	**Plug-In Gain:** 2	

Data Point #	Physical Value (g)	Measured Value (volts)	Fitted Curve Value (g)	Error (g)
1	-1.0000	-3.7957	-0.99839	0.0016057
2	0.00000	0.074346	-0.0031961	-0.0031961
3	1.0000	3.9817	1.0016	0.0015904

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

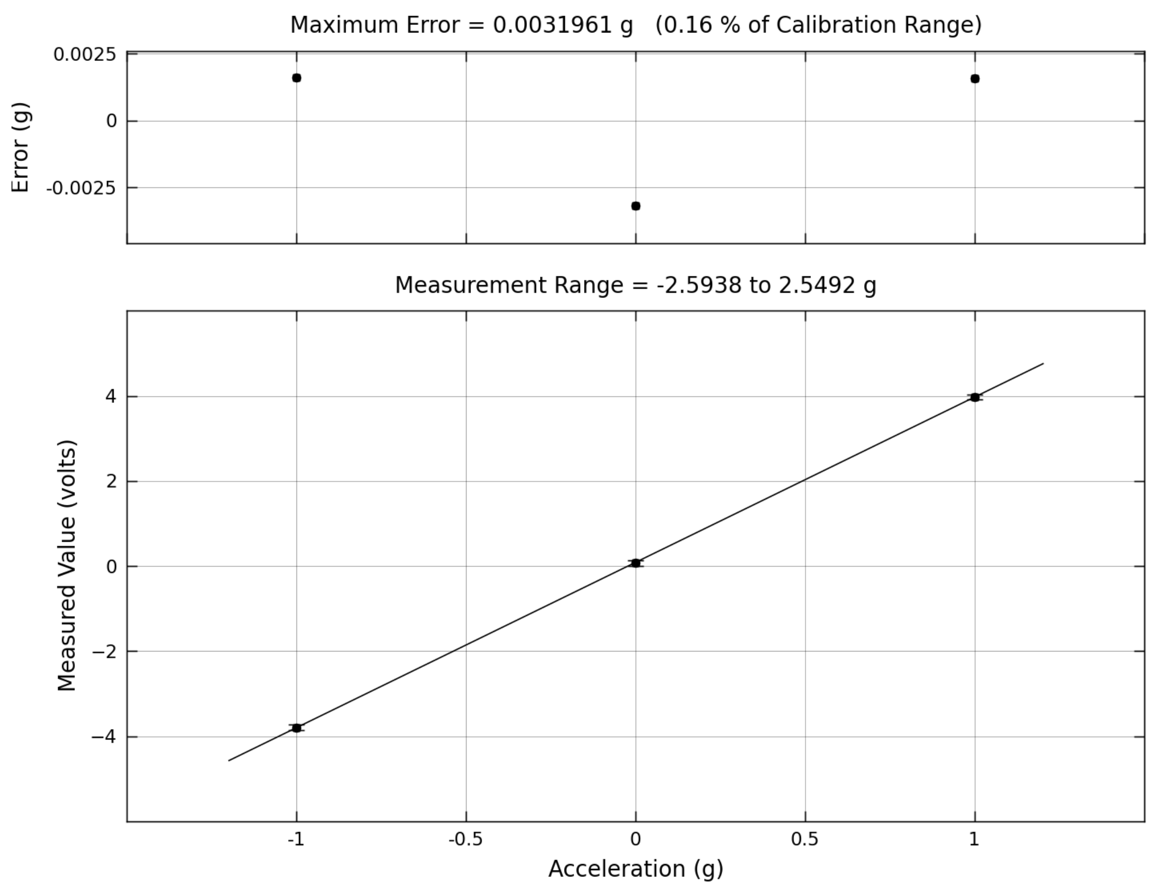
$Y = C_0 + C_1 \cdot V$

where $Y(t)$ = Acceleration (g),

$V(t)$ = measured value (volts),

C_0 = -0.022314 g,

C_1 = 0.25715 g/volt.



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Safer Fishing Vessel Seakeeping Phase 2

Calibration of Sway Accel

Calibrated 2009-06-26 11:27

Test Facility: OEB	**Serial #:** 1251	**Filter Frequency:** 10.0
Data Source: DASPC34 Channel 10	**Programmable Gain:**	**Excitation Voltage:** 15
Sensor Model: QA900 Accel	**Plug-In Gain:** 2	

Data Point #	Physical Value (g)	Measured Value (volts)	Fitted Curve Value (g)	Error (g)
1	-1.0000	6.6652	-1.0016	-0.0016234
2	0.00000	0.057916	0.0032628	0.0032628
3	1.0000	-6.4850	0.99836	-0.0016394

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

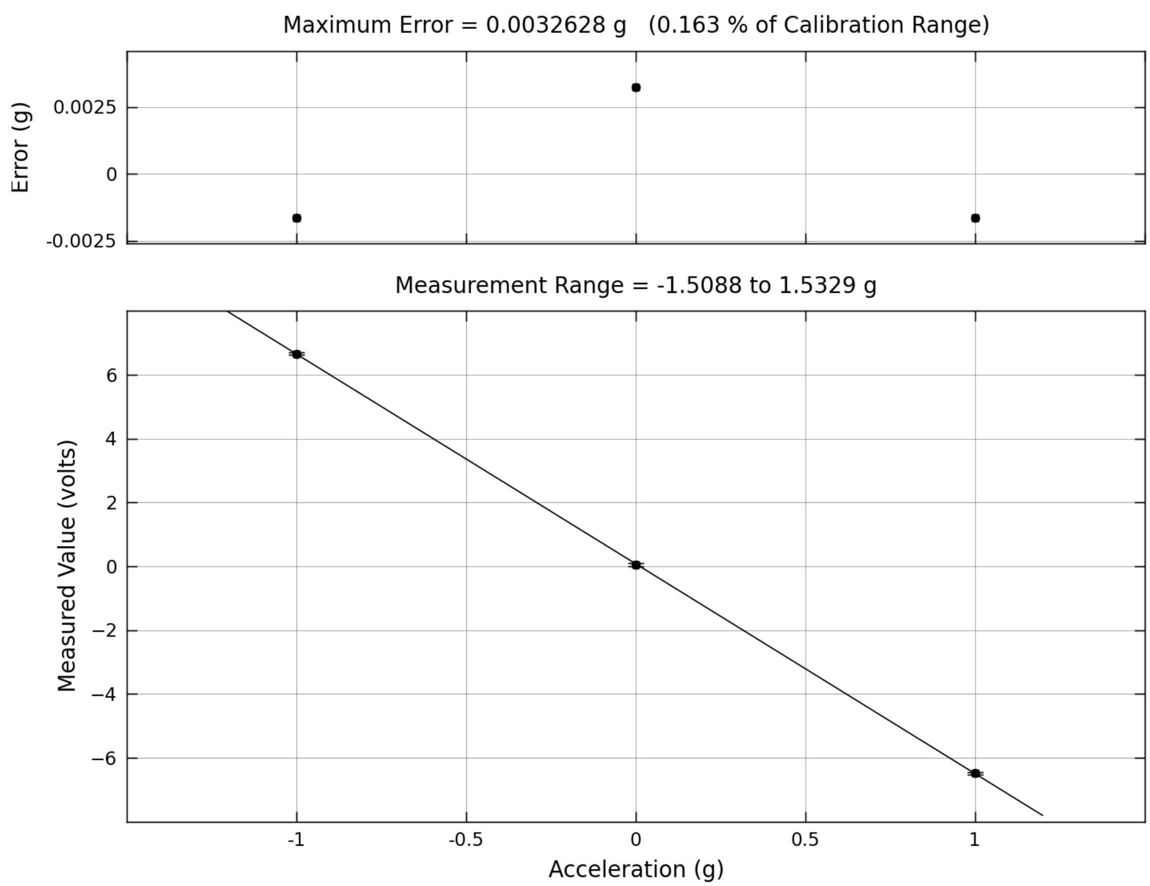
$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Acceleration (g),

$V(t)$ = measured value (volts),

C_0 = 0.012071 g,

C_1 = -0.15209 g/volt.



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Safer Fishing Vessel Seakeeping Phase 2

Calibration of Surge Accel

Calibrated 2009-06-26 11:29

Test Facility: OEB	**Serial #:** 1258	**Filter Frequency:** 10.0
Data Source: DASPC34 Channel 11	**Programmable Gain:**	**Excitation Voltage:** 15
Sensor Model: QA900 Accel	**Plug-In Gain:** 2	

Data Point #	Physical Value (g)	Measured Value (volts)	Fitted Curve Value (g)	Error (g)
1	-1.0000	-6.9536	-1.0021	-0.0020939
2	0.00000	0.11349	0.0042143	0.0042143
3	1.0000	7.0918	0.99788	-0.0021204

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

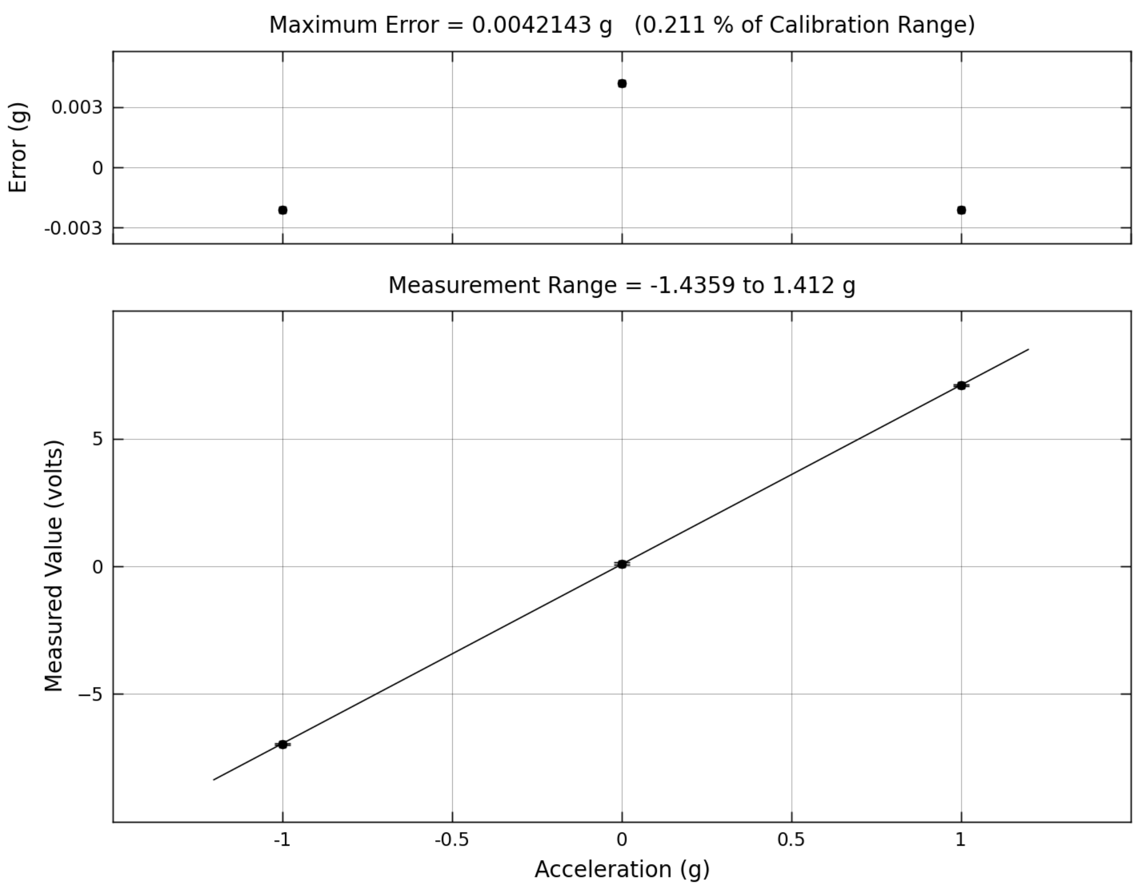
$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Acceleration (g),

$V(t)$ = measured value (volts),

C_0 = -0.011945 g,

C_1 = 0.14239 g/volt.



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Safer Fishing Vessel Seakeeping Phase 2

Calibration of Downstream Wp

Calibrated 2009-06-24 13:17

Test Facility: OEB	**Serial #:** F00	**Filter Frequency:** 15.0
Data Source: OEBDAS Channel 1	**Programmable Gain:**	**Excitation Voltage:** 10
Sensor Model:	**Plug-In Gain:**	

Data Point #	Physical Value (m)	Measured Value (volts)	Fitted Curve Value (m)	Error (m)
1	0.00000	-1.2398	-7.4626e-05	-7.4626e-05
2	0.10000	-0.74078	0.099587	-0.00041263
3	0.20000	-0.23990	0.19961	-0.00038575
4	0.30000	0.26257	0.29996	-4.1246e-05
5	0.40000	0.76715	0.40073	0.00072618
6	0.50000	1.2721	0.50157	0.0015708
7	0.60000	1.7641	0.59982	-0.00017992
8	0.70000	2.2597	0.69880	-0.0012027

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

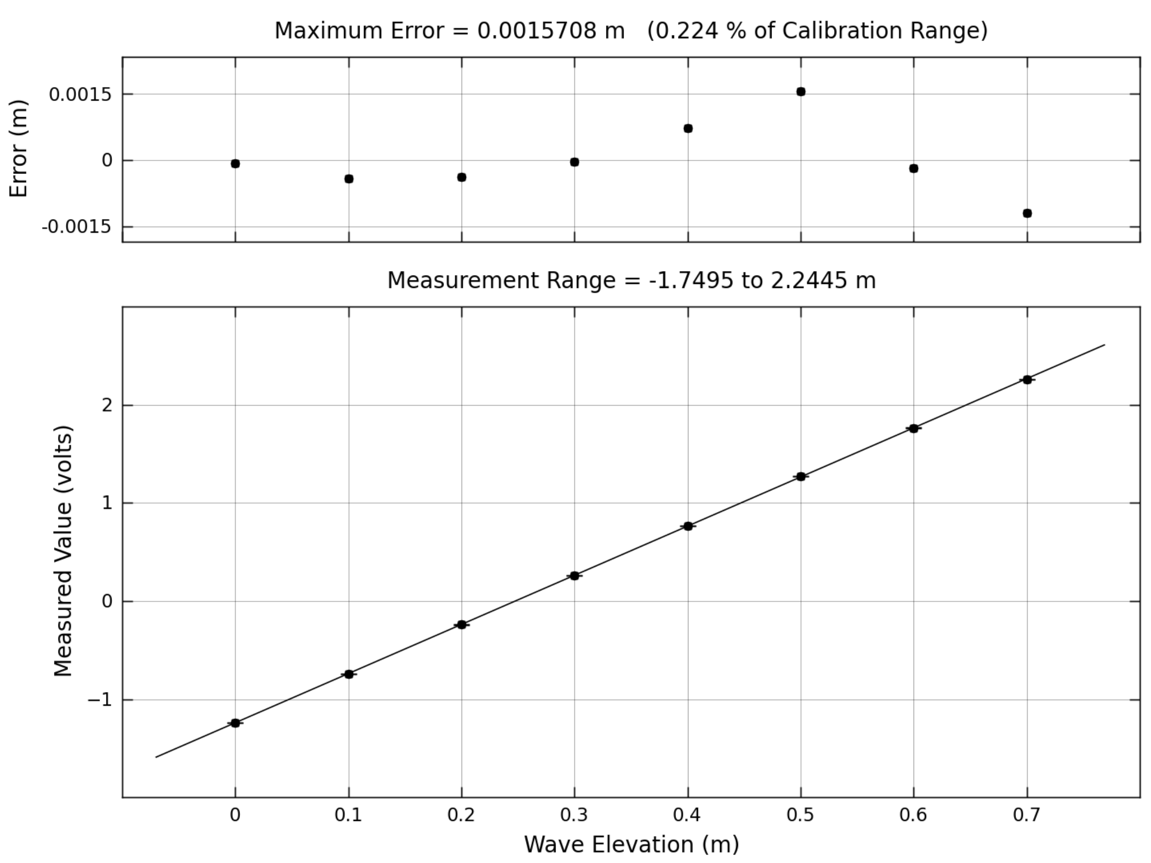
$Y = C_0 + C_1 \cdot V$

where $Y(t)$ = Wave Elevation (m),

$V(t)$ = measured value (volts),

C_0 = 0.24752 m,

C_1 = 0.1997 m/volt.



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Safer Fishing Vessel Seakeeping Phase 2
Calibration of North.C Wp
Calibrated 2009-06-23 13:46

Test Facility: OEB	**Serial #:** F01	**Filter Frequency:** 10.0
Data Source: OEBDAS Channel 2	**Programmable Gain:**	**Excitation Voltage:** 10
Sensor Model:	**Plug-In Gain:**	

Data Point #	Physical Value (m)	Measured Value (volts)	Fitted Curve Value (m)	Error (m)
1	0.00000	-1.9754	0.00018450	0.00018450
2	0.10000	-1.4672	0.099954	-4.6484e-05
3	0.20000	-0.95664	0.20020	0.00019676
4	0.30000	-0.45009	0.29965	-0.00034837
5	0.40000	0.061718	0.40014	0.00013824
6	0.50000	0.56772	0.49948	-0.00051516
7	0.60000	1.0798	0.60002	1.9133e-05
8	0.70000	1.5909	0.70037	0.00037144

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

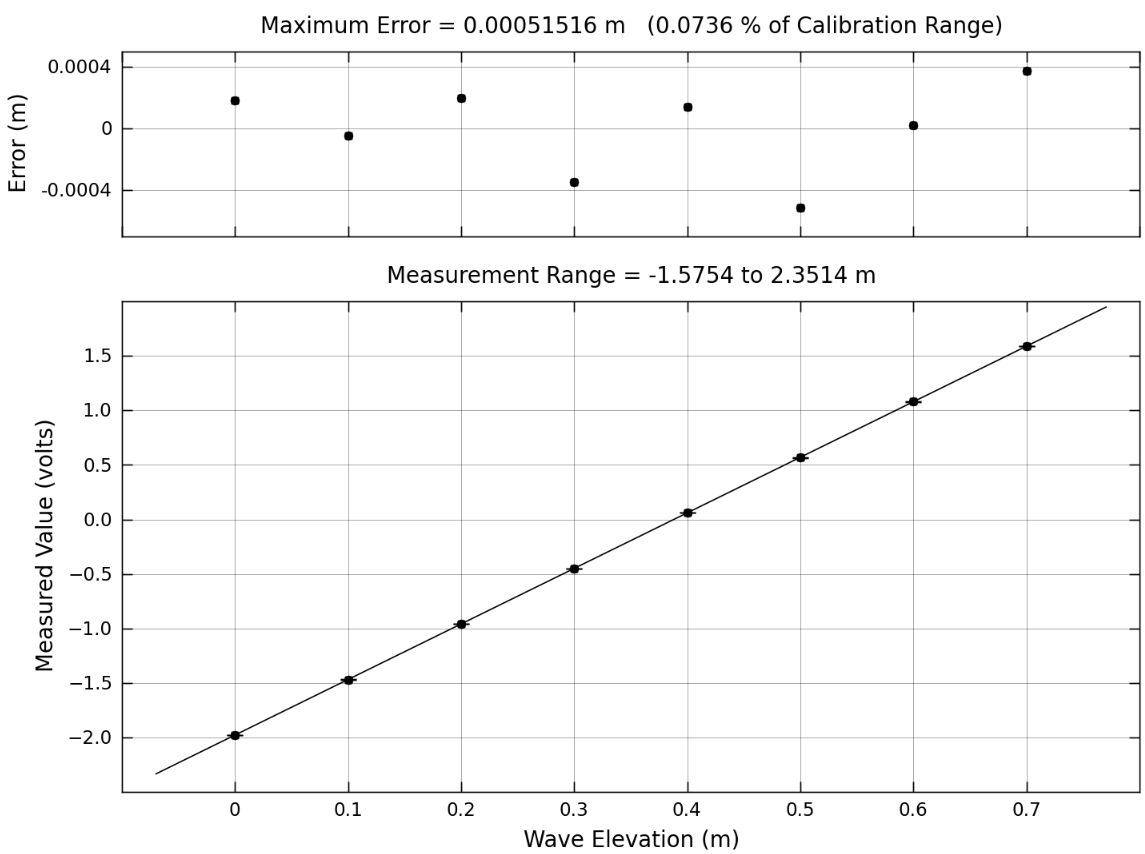
$Y = C_0 + C_1 \cdot V$

where $Y(t)$ = Wave Elevation (m),

$V(t)$ = measured value (volts),

C_0 = 0.38802 m,

C_1 = 0.19634 m/volt.



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Safer Fishing Vessel Seakeeping Phase 2

Calibration of Upstream Wp

Calibrated 2009-06-23 13:57

Test Facility: OEB	**Serial #:** F02	**Filter Frequency:** 10.0
Data Source: OEBDAS Channel 3	**Programmable Gain:**	**Excitation Voltage:** 10
Sensor Model:	**Plug-In Gain:**	

Data Point #	Physical Value (m)	Measured Value (volts)	Fitted Curve Value (m)	Error (m)
1	0.00000	-2.0580	-0.0011617	-0.0011617
2	0.10000	-1.5210	0.10023	0.00022969
3	0.20000	-0.98877	0.20072	0.00071517
4	0.30000	-0.46343	0.29990	-9.6894e-05
5	0.50000	0.60141	0.50095	0.00094969
6	0.60000	1.1273	0.60024	0.00023771
7	0.70000	1.6589	0.70061	0.00060907
8	0.80000	2.1775	0.79852	-0.0014828

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

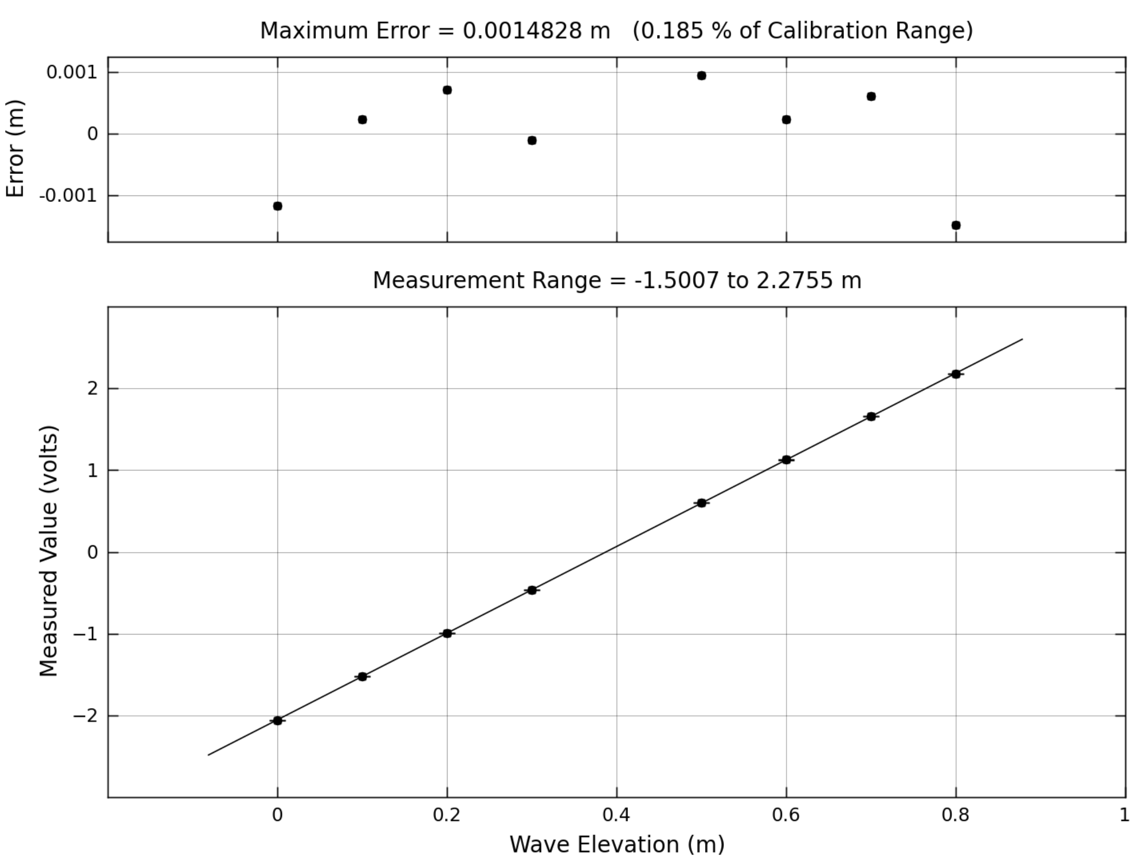
$Y = C_0 + C_1 \cdot V$

where $Y(t)$ = Wave Elevation (m),

$V(t)$ = measured value (volts),

C_0 = 0.3874 m,

C_1 = 0.18881 m/volt.



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Safer Fishing Vessel Seakeeping Phase 2

Calibration of Cal Wp/ South.C WP

Calibrated 2009-06-24 13:56

Test Facility: OEB	**Serial #:** F03	**Filter Frequency:** 10.0
Data Source: OEBDAS Channel 4	**Programmable Gain:**	**Excitation Voltage:** 10
Sensor Model:	**Plug-In Gain:**	

Data Point #	Physical Value (m)	Measured Value (volts)	Fitted Curve Value (m)	Error (m)
1	0.00000	-2.9244	2.8388e-05	2.8388e-05
2	0.10000	-2.0748	0.098891	-0.0011093
3	0.20000	-1.2005	0.20062	0.00062329
4	0.30000	-0.33926	0.30084	0.00084394
5	0.40000	0.51494	0.40024	0.00024064
6	0.50000	1.3663	0.49931	-0.00069374
7	0.60000	2.2348	0.60037	0.00036597
8	0.70000	3.0910	0.70000	-4.6106e-06
9	0.80000	3.9479	0.79971	-0.00029474

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

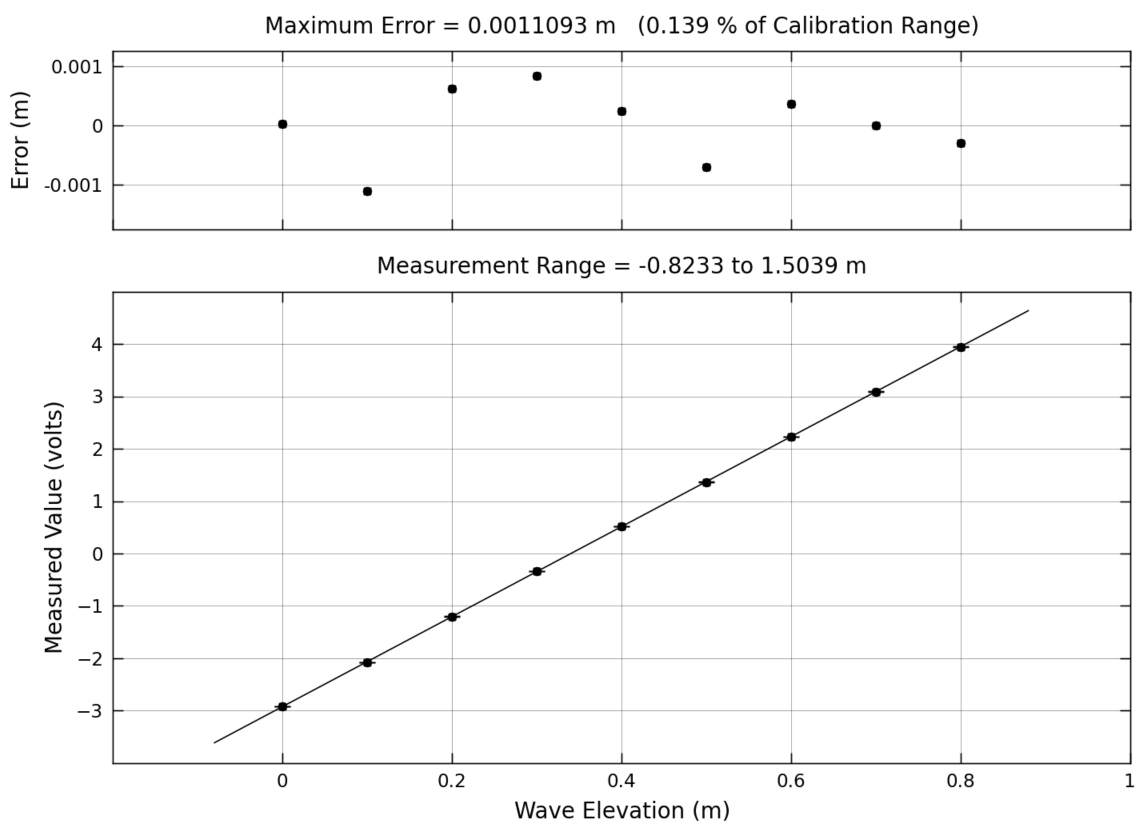
$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Wave Elevation (m),

$V(t)$ = measured value (volts),

C_0 = 0.34032 m,

C_1 = 0.11636 m/volt.



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Safer Fishing Vessel Seakeeping Phase 2

Calibration of X 1

Calibrated 2008-08-14 13:48

Test Facility: OEB	**Serial #:**	**Filter Frequency:**
Data Source: OEBDAS Channel 49	**Programmable Gain:**	**Excitation Voltage:**
Sensor Model: Qualisys Body 1	**Plug-In Gain:**	

Data Point #	Physical Value (m)	Measured Value (volts)	Fitted Curve Value (m)	Error (m)
1	-59.000	-9.5651	-59.000	0.00023153
2	-30.000	0.15683	-30.000	-0.00047562
3	-2.0000	9.5440	-1.9998	0.00024175

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

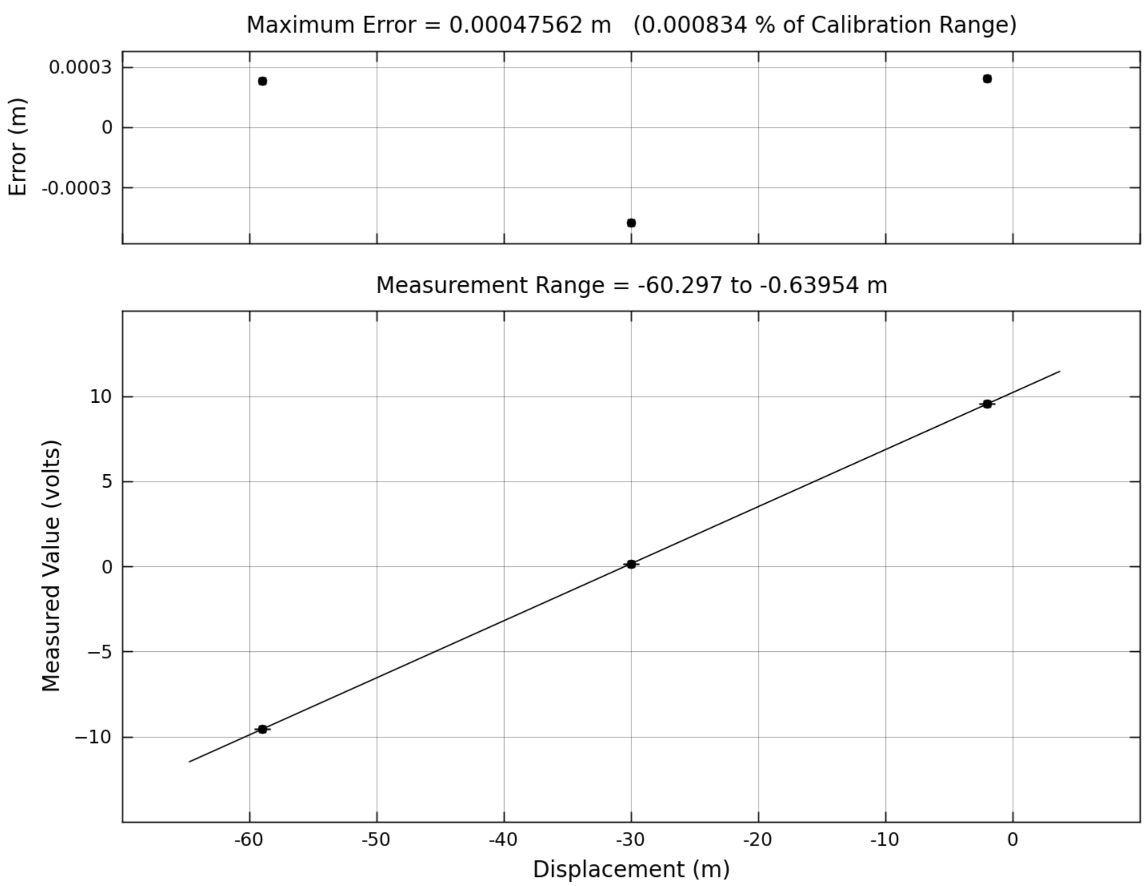
$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Displacement (m),

$V(t)$ = measured value (volts),

C_0 = -30.468 m,

C_1 = 2.9829 m/volt.



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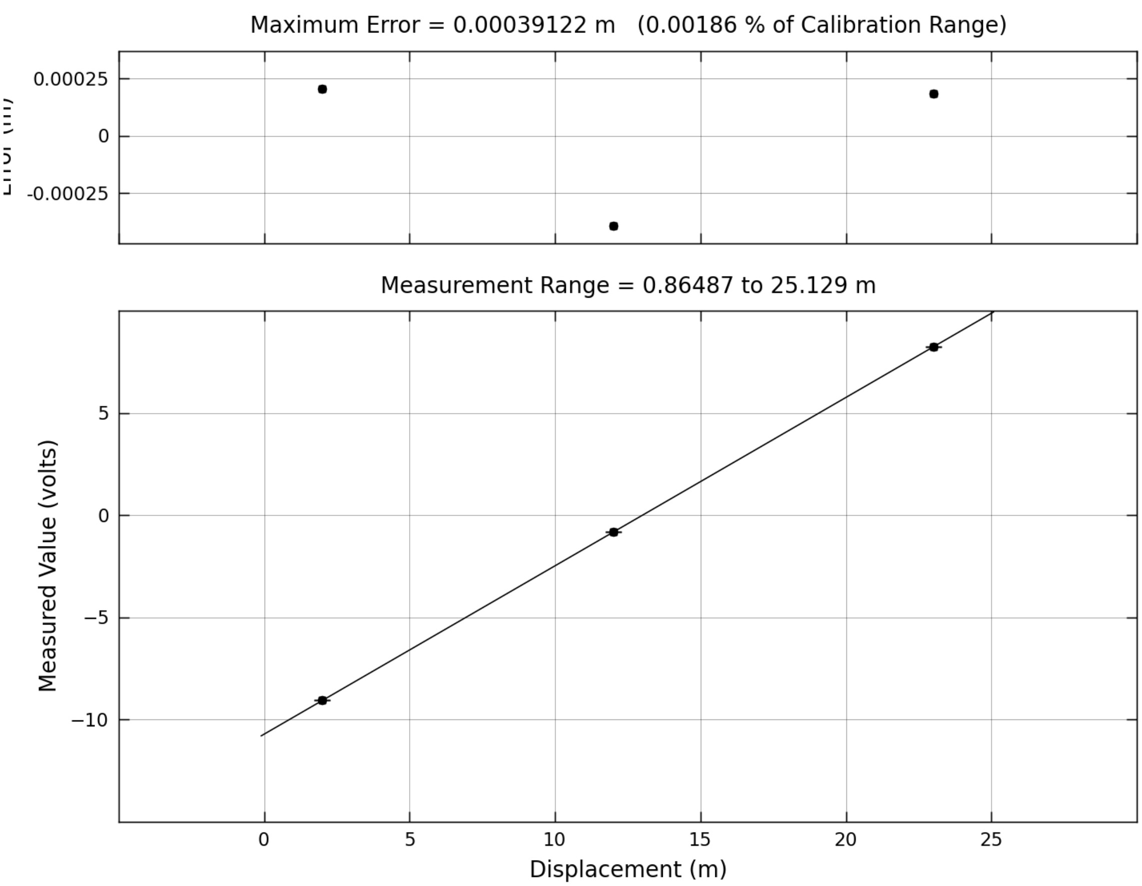
Safer Fishing Vessel Seakeeping Phase 2

Calibration of Y 1

Calibrated 2008-08-14 13:50

Test Facility: OEB **Data Source:** OEBDAS Channel 50 **Sensor Model:** Qualysis Body 1	**Serial #:** **Programmable Gain:** **Plug-In Gain:**	**Filter Frequency:** **Excitation Voltage:**

Data Point #	Physical Value (m)	Measured Value (volts)	Fitted Curve Value (m)	Error (m)	Definition of Calibration Curve
1	2.0000	-9.0642	2.0002	0.00020461	Polynomial Degree = 1 (Linear Fit)
2	12.000	-0.82221	12.000	-0.00039122	$Y = C_0 + C_1 \cdot V$
3	23.000	8.2450	23.000	0.00018577	where $Y(t)$ = Displacement (m),
					$V(t)$ = measured value (volts),
					C_0 = 12.997 m,
					C_1 = 1.2132 m/volt.



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Safer Fishing Vessel Seakeeping Phase 2
Calibration of Z 1
Calibrated 2008-09-09 14:42

Test Facility: OEB	**Serial #:**	**Filter Frequency:**
Data Source: OEBDAS Channel 51	**Programmable Gain:**	**Excitation Voltage:**
Sensor Model: Qualysis Body 1	**Plug-In Gain:**	

Data Point #	Physical Value (m)	Measured Value (volts)	Fitted Curve Value (m)	Error (m)
1	-0.50000	-8.2301	-0.50000	-8.4162e-07
2	2.0000	-0.0019385	2.0000	1.3414e-06
3	4.5000	8.2262	4.5000	-7.2450e-07

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

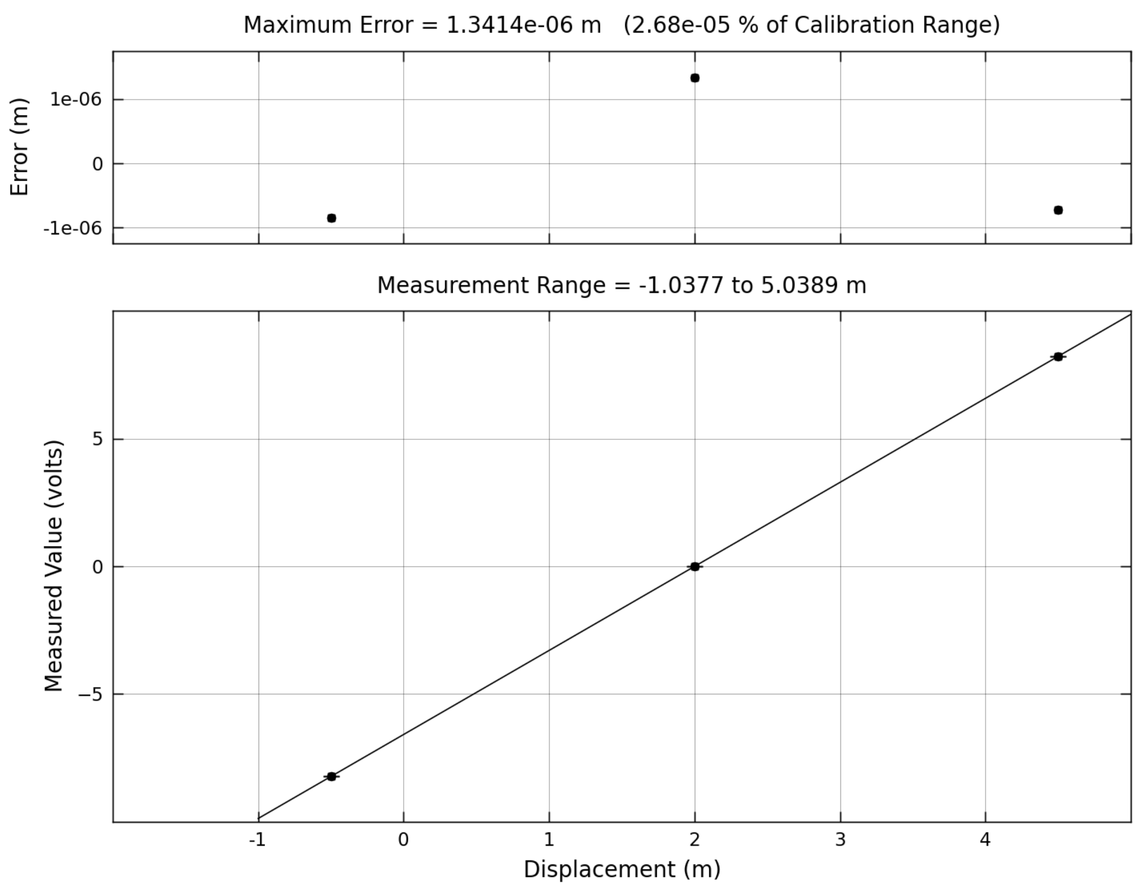
$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Displacement (m),

$V(t)$ = measured value (volts),

C_0 = 2.0006 m,

C_1 = 0.30383 m/volt.



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Safer Fishing Vessel Seakeeping Phase 2

Calibration of Roll 1

Calibrated 2008-08-14 13:57

Test Facility: OEB	**Serial #:**	**Filter Frequency:**
Data Source: OEBDAS Channel 52	**Programmable Gain:**	**Excitation Voltage:**
Sensor Model: Qualysis Body 1	**Plug-In Gain:**	

Data Point #	Physical Value (deg)	Measured Value (volts)	Fitted Curve Value (deg)	Error (deg)
1	-85.000	-9.3355	-84.999	0.0012288
2	0.00000	0.0054835	-0.0024538	-0.0024538
3	85.000	9.3473	85.001	0.0012251

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

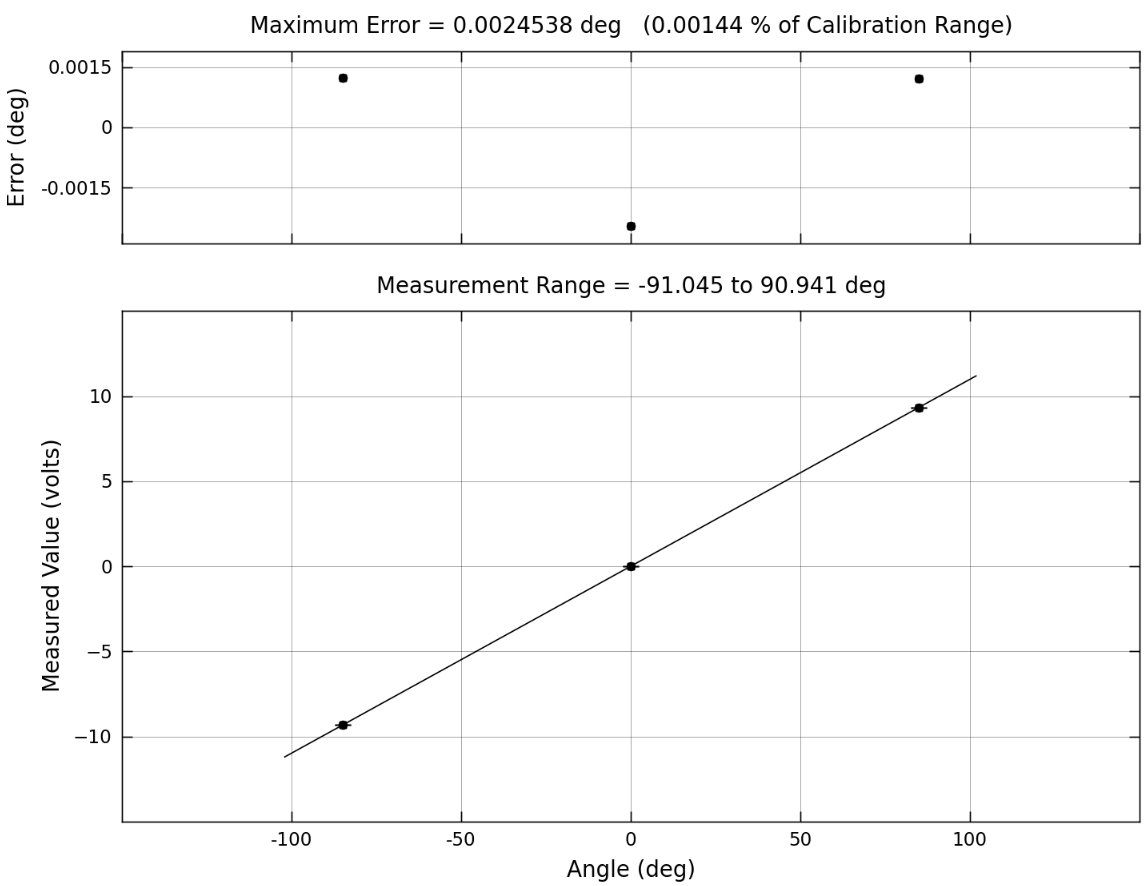
$Y = C_0 + C_1 \cdot V$

where $Y(t)$ = Angle (deg),

$V(t)$ = measured value (volts),

C_0 = -0.05235 deg,

C_1 = 9.0993 deg/volt.



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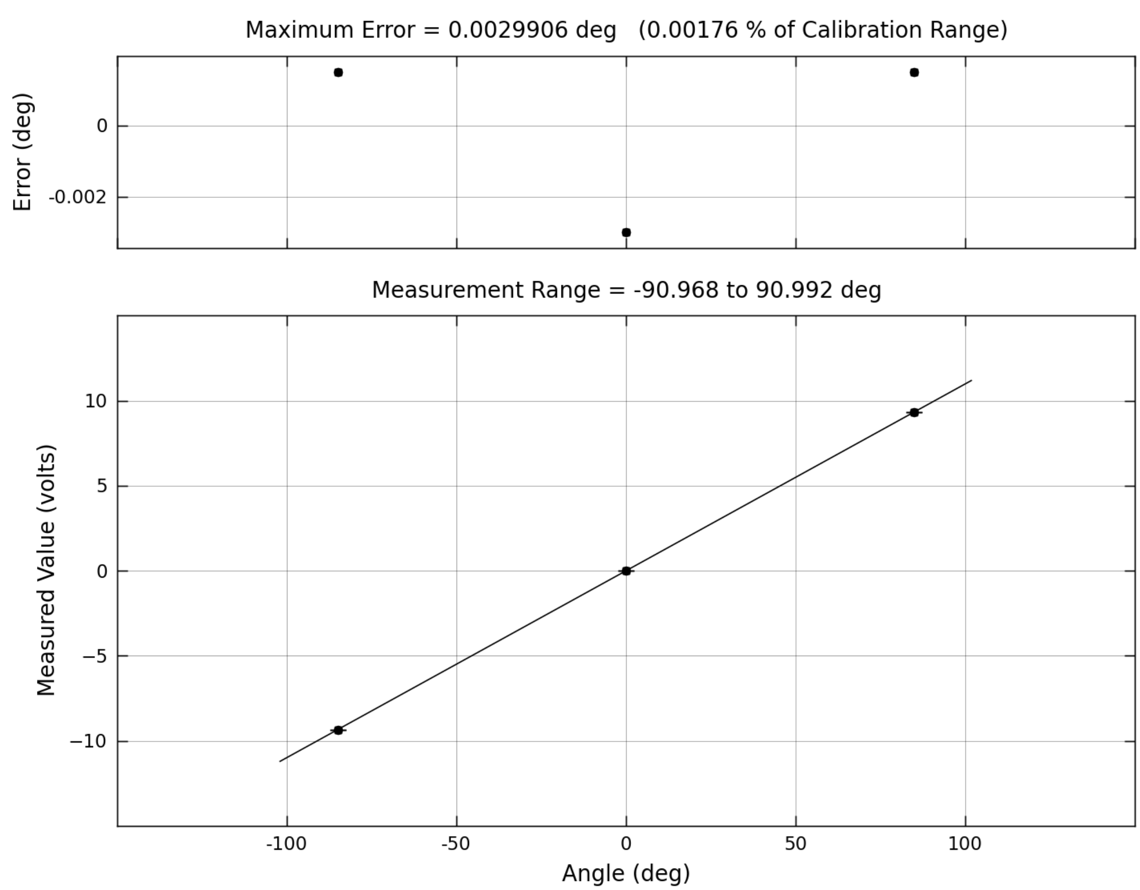
Safer Fishing Vessel Seakeeping Phase 2

Calibration of Pitch 1

Calibrated 2008-08-14 13:59

Test Facility: OEB	**Serial #:**	**Filter Frequency:**
Data Source: OEBDAS Channel 53	**Programmable Gain:**	**Excitation Voltage:**
Sensor Model: Qualysis Body 1	**Plug-In Gain:**	

Data Point #	Physical Value (deg)	Measured Value (volts)	Fitted Curve Value (deg)	Error (deg)	Definition of Calibration Curve
1	-85.000	-9.3439	-84.999	0.0014967	Polynomial Degree = 1 (Linear Fit)
2	0.00000	-0.0016632	-0.0029906	-0.0029906	$Y = C_0 + C_1 \cdot V$
3	85.000	9.3416	85.001	0.0014939	where $Y(t)$ = Angle (deg),
					$V(t)$ = measured value (volts),
					C_0 = 0.012141 deg,
					C_1 = 9.098 deg/volt.



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Safer Fishing Vessel Seakeeping Phase 2

Calibration of Heading 1

Calibrated 2008-08-14 14:00

Test Facility: OEB	**Serial #:**	**Filter Frequency:**
Data Source: OEBDAS Channel 54	**Programmable Gain:**	**Excitation Voltage:**
Sensor Model: Qualysis Body 1	**Plug-In Gain:**	

Data Point #	Physical Value (deg)	Measured Value (volts)	Fitted Curve Value (deg)	Error (deg)
1	-185.00	-9.6330	-185.00	0.00083537
2	0.00000	-0.00063172	-0.0016596	-0.0016596
3	185.00	9.6320	185.00	0.00082419

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

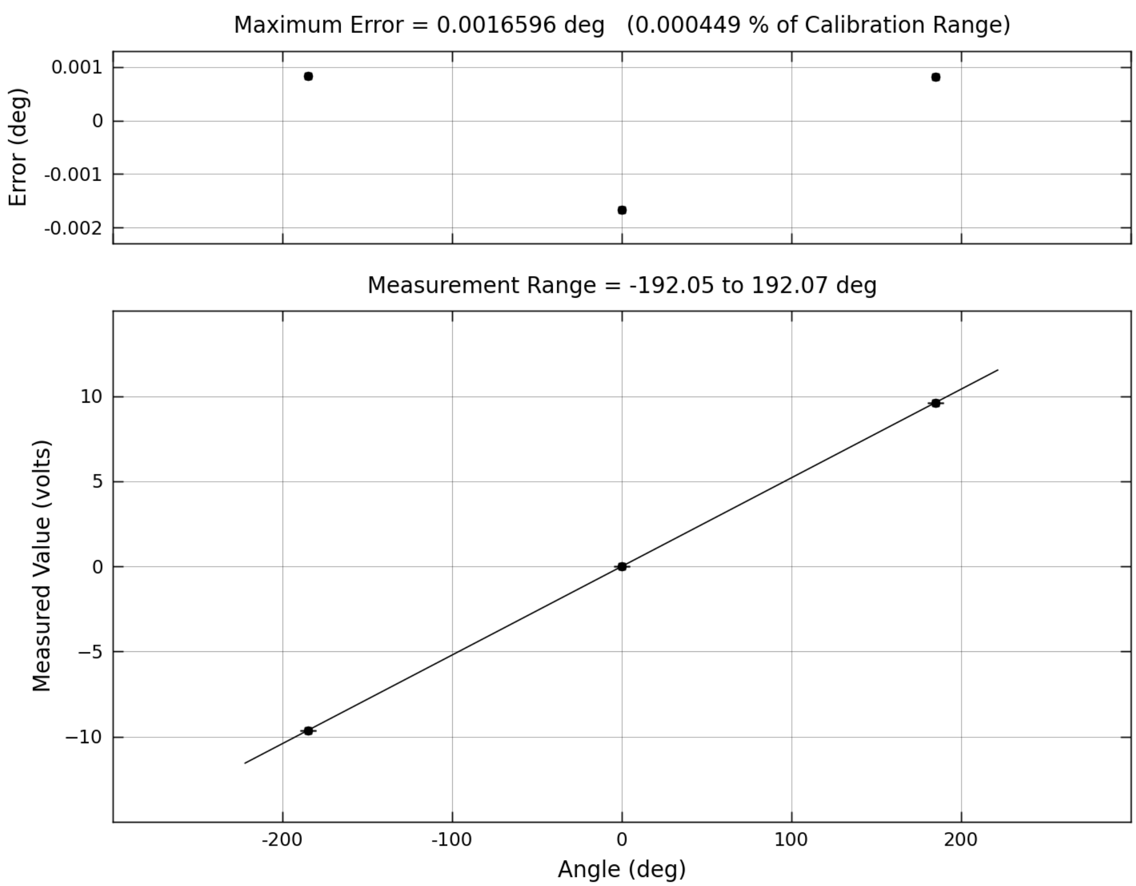
$Y = C_0 + C_1 \cdot V$

where $Y(t)$ = Angle (deg),

$V(t)$ = measured value (volts),

C_0 = 0.010473 deg,

C_1 = 19.206 deg/volt.



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Safer Fishing Vessel Seakeeping Phase 2

Calibration of RMS 1

Calibrated 2008-08-14 14:02

Test Facility: OEB	**Serial #:**	**Filter Frequency:**
Data Source: OEBDAS Channel 55	**Programmable Gain:**	**Excitation Voltage:**
Sensor Model: Qualysis Body 1	**Plug-In Gain:**	

Data Point #	Physical Value (volts)	Measured Value (volts)	Fitted Curve Value (volts)	Error (volts)
1	0.00000	-8.9511	0.0026321	0.0026321
2	100.00	0.46887	99.994	-0.0055601
3	190.00	8.9483	190.00	0.0029222

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

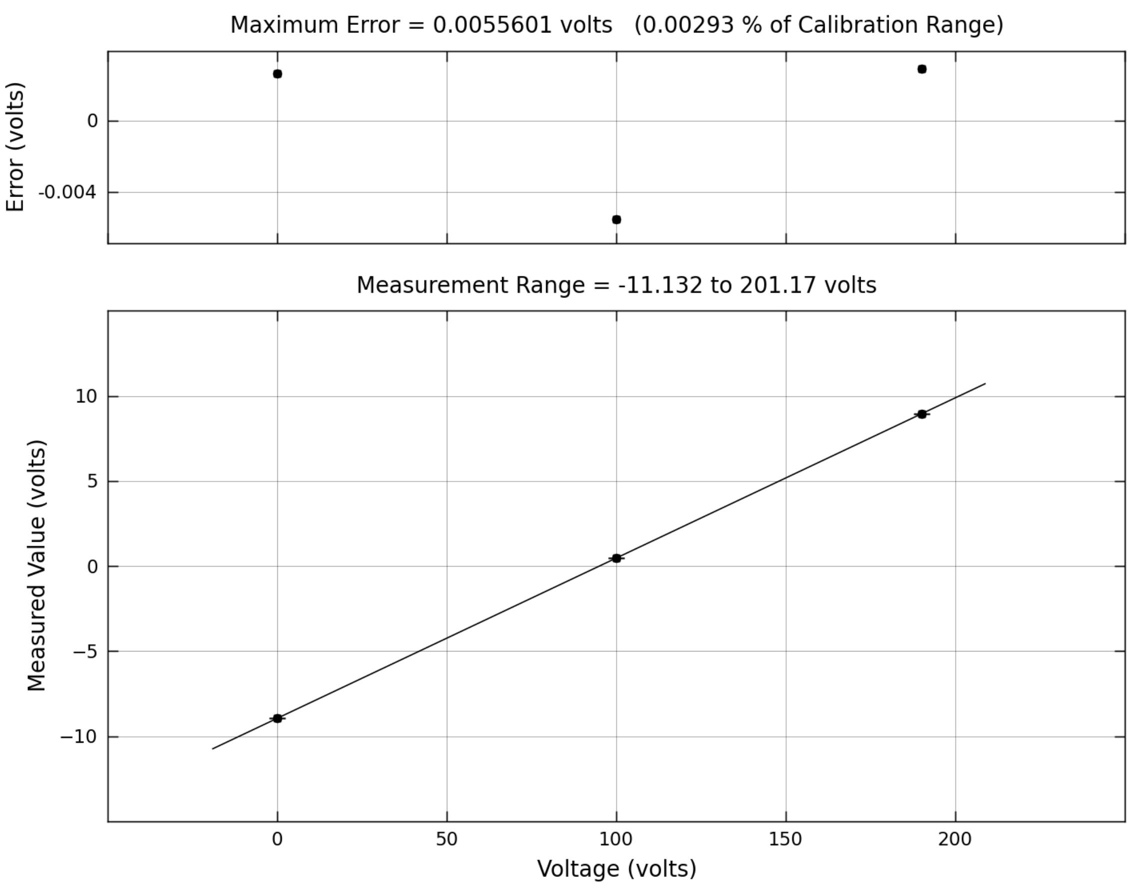
$Y = C_0 + C_1 \cdot V$

where $Y(t)$ = Voltage (volts),

$V(t)$ = measured value (volts),

C_0 = 95.017 volts,

C_1 = 10.615 volts/volt.



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Safer Fishing Vessel Seakeeping Phase 2
Calibration of South_Waveboard
Calibrated 2009-04-16 14:38

Test Facility: OEB	**Serial #:**	**Filter Frequency:**
Data Source: OEBDAS Channel 56	**Programmable Gain:**	**Excitation Voltage:**
Sensor Model: mcu5	**Plug-In Gain:**	

Data Point #	**Physical Value** (deg)	**Measured Value** (volts)	**Fitted Curve Value** (deg)	**Error** (deg)
1	-15.000	5.2037	-14.998	0.0024430
2	0.00000	0.081243	-0.0048838	-0.0048838
3	15.000	-5.0462	15.002	0.0024408

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

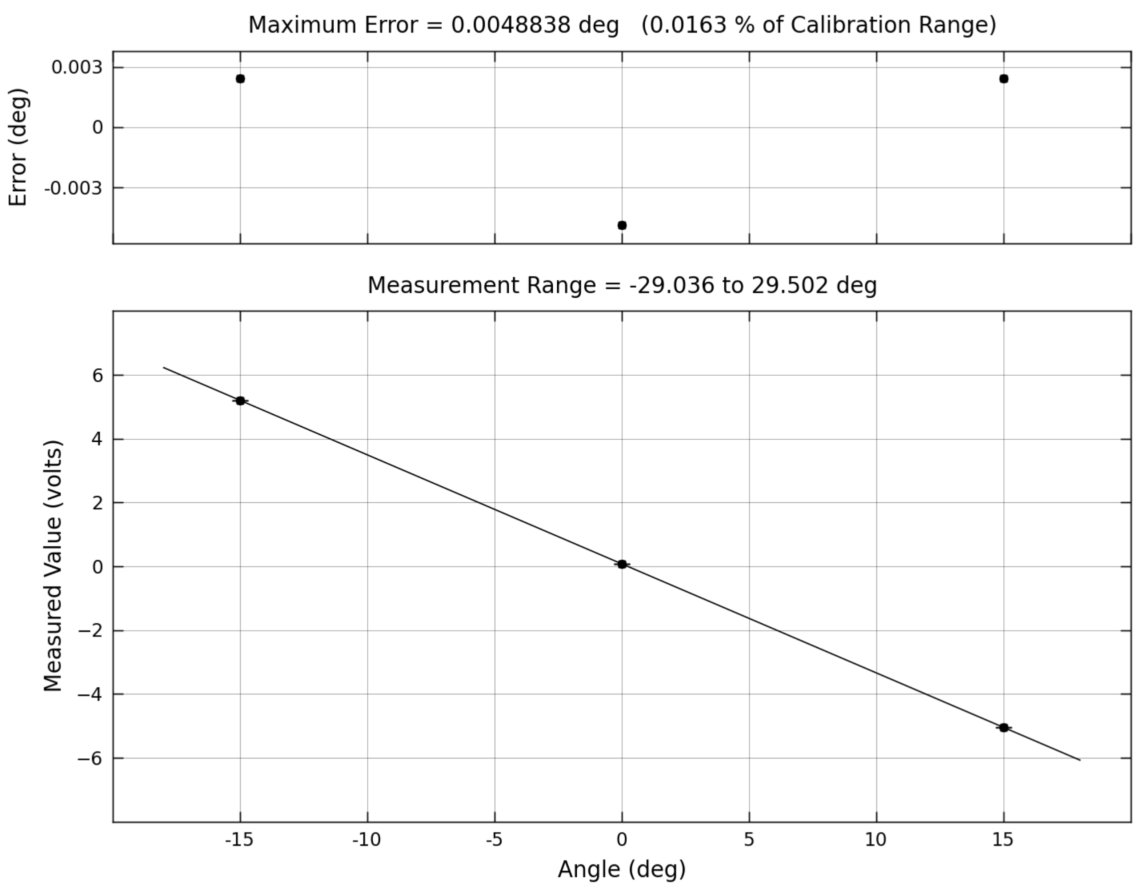
$$Y = C_0 + C_1 \cdot V$$

where $Y(t)$ = Angle (deg),

$V(t)$ = measured value (volts),

C_0 = 0.2329 deg,

C_1 = -2.9269 deg/volt.



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Safer Fishing Vessel Seakeeping Phase 2
Calibration of West_Waveboard
Calibrated 2009-04-16 14:38

Test Facility: OEB **Data Source:** OEBDAS Channel 64 **Sensor Model:** mcu7	**Serial #:** **Programmable Gain:** **Plug-In Gain:**	**Filter Frequency:** **Excitation Voltage:**

Data Point #	Physical Value (deg)	Measured Value (volts)	Fitted Curve Value (deg)	Error (deg)
1	-15.000	4.1135	-15.006	-0.0060035
2	0.00000	-0.0039195	0.012021	0.012021
3	15.000	-4.1115	14.994	-0.0060173

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

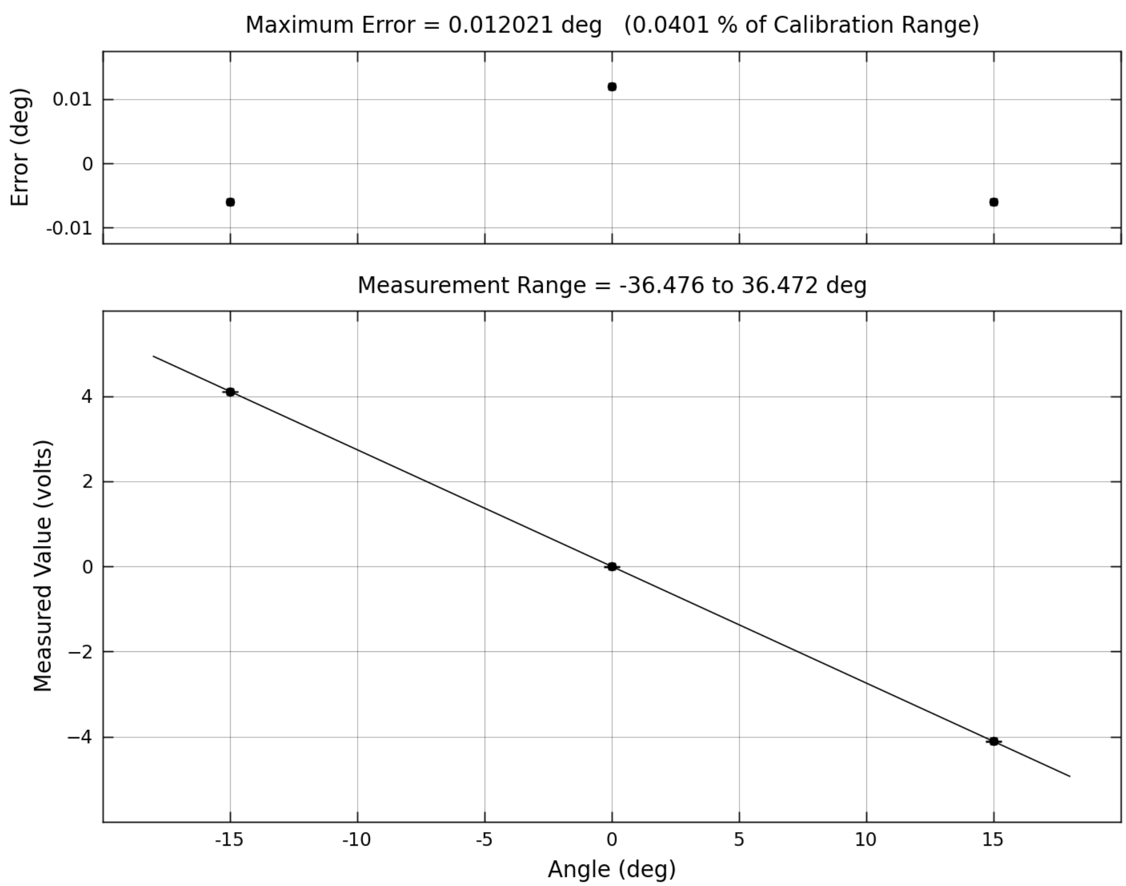
$Y = C_0 + C_1 \cdot V$

where $Y(t)$ = Angle (deg),

$V(t)$ = measured value (volts),

C_0 = -0.0022754 deg,

C_1 = -3.6474 deg/volt.



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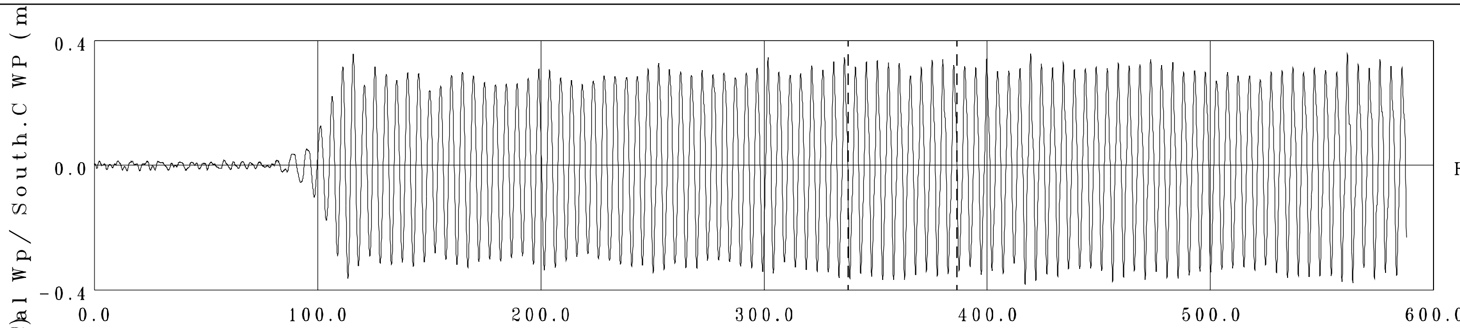
APPENDIX D

WAVE MATCHING RESULTS – REGULAR & IRREGULAR WAVES

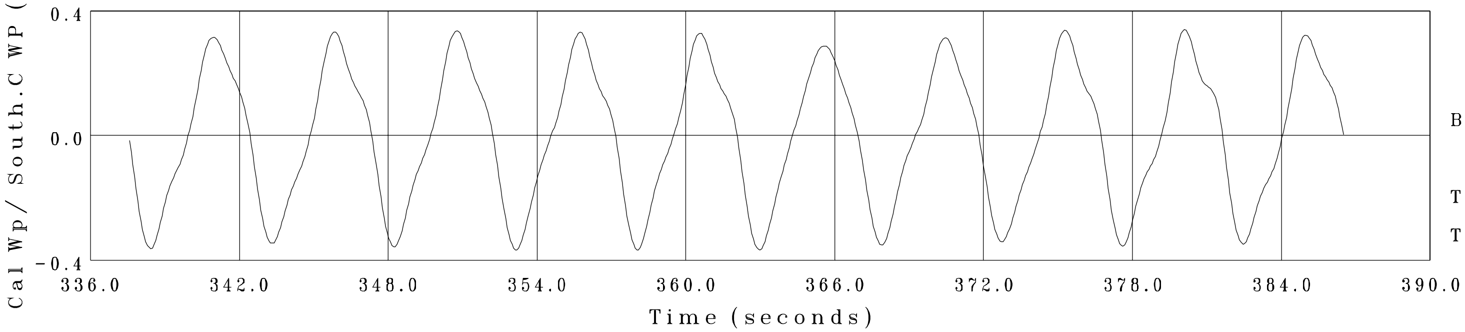
Roberts Sister II
Regular Wave Calib

IOT

Analyzed: 06-OCT-2009 10:18:17
Acquired: 6-OCT-2009 09:43:39



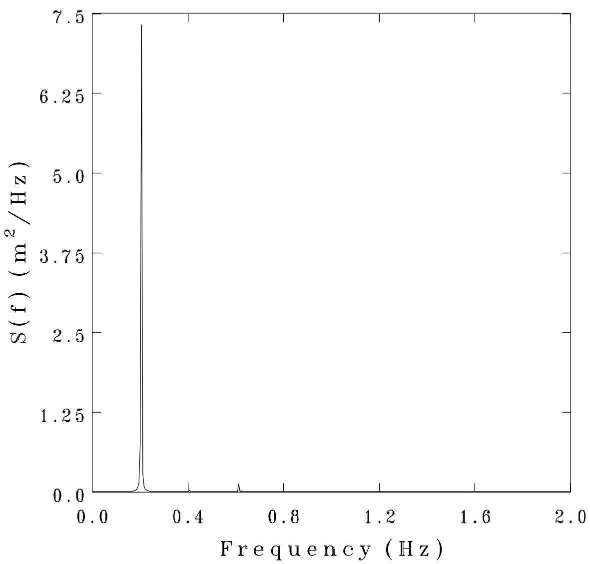
Full record



Best wave cycles

T1 = 337.58 seconds

T2 = 386.50 seconds



Full record wave parameters:			
Average wave height	=	0.669 m	
Average wave period	=	4.898 seconds	
			Target /
Best wave cycles parameters:			(Tolerance):
Average wave height	=	0.683 m	0.750 m
Average wave period	=	4.902 seconds	4.900 seconds
Deviation from target height	=	8.97 %	(5.0 %)
Wave height stability	=	9.48 %	(5.0 %)
Wave crest stability	=	4.36 %	(2.5 %)

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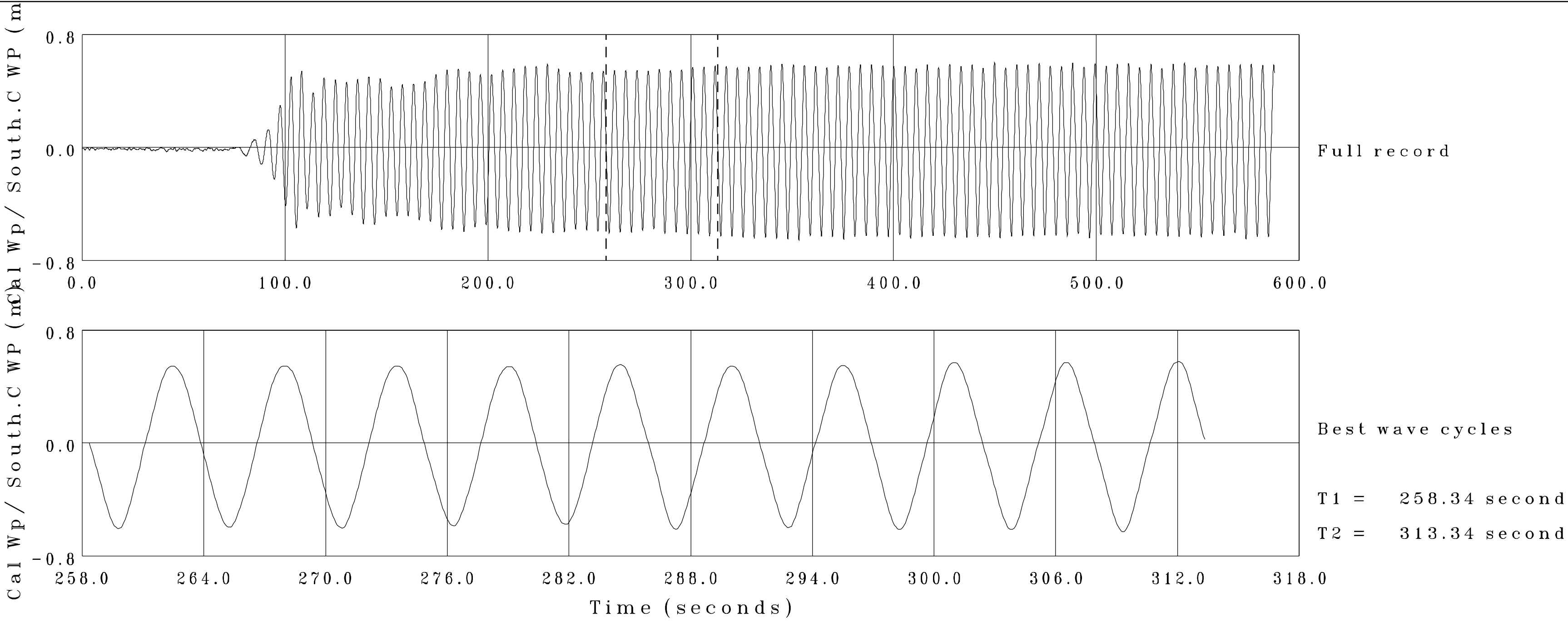
GENERATED BY: NRC/IOT | CHECKED BY: | APPROVED BY:

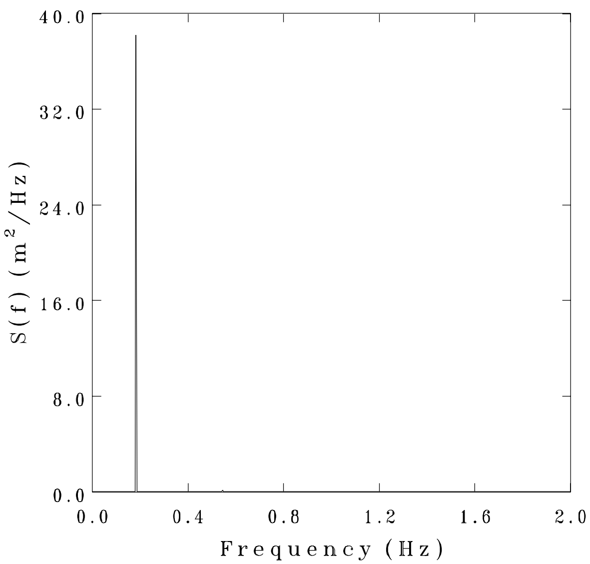
Figure A2 REG65_H0P75_T4P90_DRV2_001

Roberts Sister II
Regular Wave Calib

IOT

Analyzed: 06-OCT-2009 09:30:44
Acquired: 5-OCT-2009 15:21:40





Full record wave parameters:

Average wave height	= 1.198 m	
Average wave period	= 5.510 seconds	

Best wave cycles parameters:

		Target / (Tolerance):
Average wave height	= 1.152 m	0.950 m
Average wave period	= 5.504 seconds	5.510 seconds
Deviation from target height	= 21.31 %	(5.0 %)
Wave height stability	= 5.69 %	(5.0 %)
Wave crest stability	= 3.28 %	(2.5 %)

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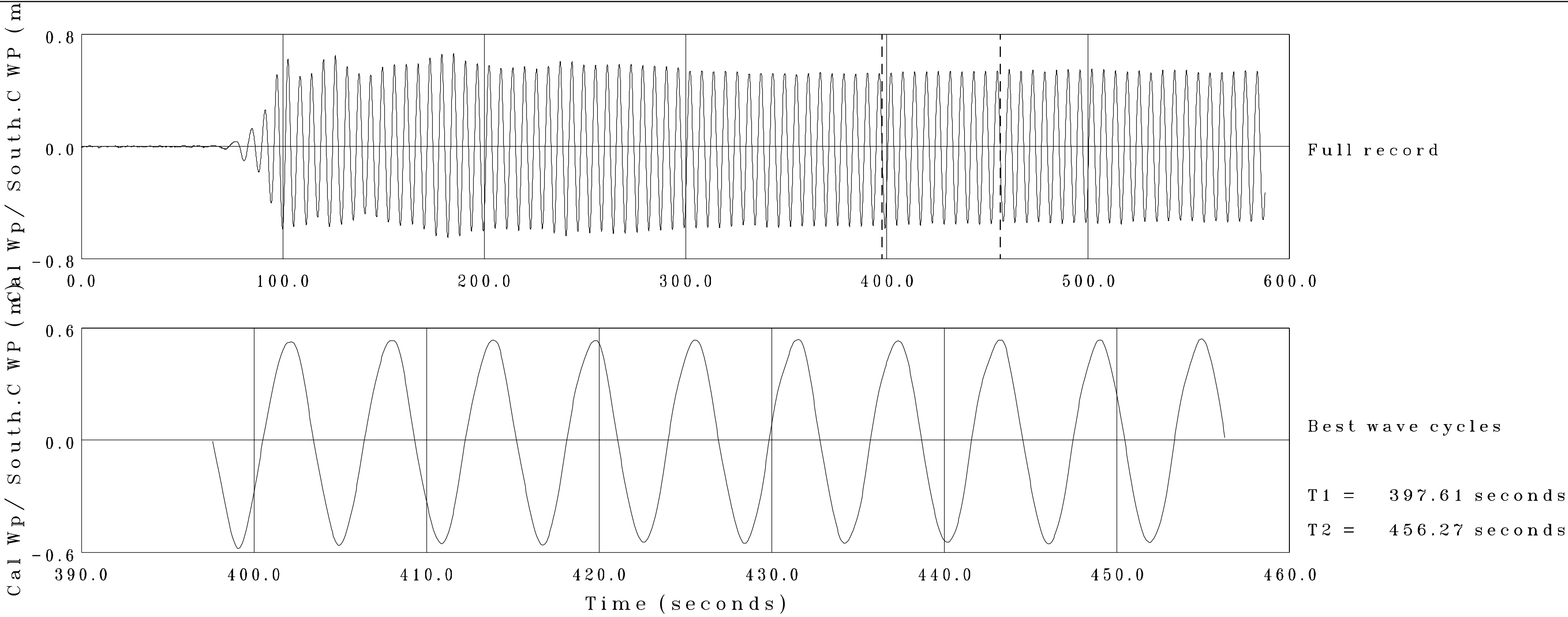
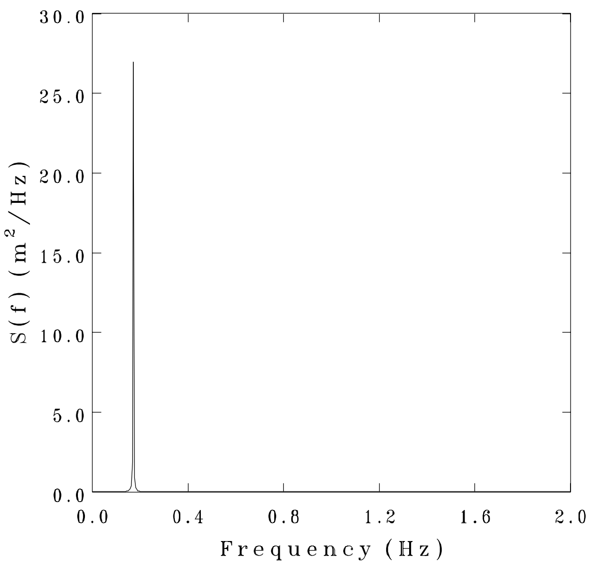
Figure A2 REG65_H0P95_T5P51_DRV2_001

Roberts Sister II
Regular Wave Calib

IOT

Analyzed: 06-OCT-2009 10:19:57
Acquired: 6-OCT-2009 09:54:11





Full record wave parameters:			
Average wave height	=	1.098 m	
Average wave period	=	5.869 seconds	
			Target /
Best wave cycles parameters:			**(Tolerance):**
Average wave height	=	1.088 m	1.080 m
Average wave period	=	5.870 seconds	5.870 seconds
Deviation from target height	=	0.73 %	(5.0 %)
Wave height stability	=	1.64 %	(5.0 %)
Wave crest stability	=	0.44 %	(2.5 %)

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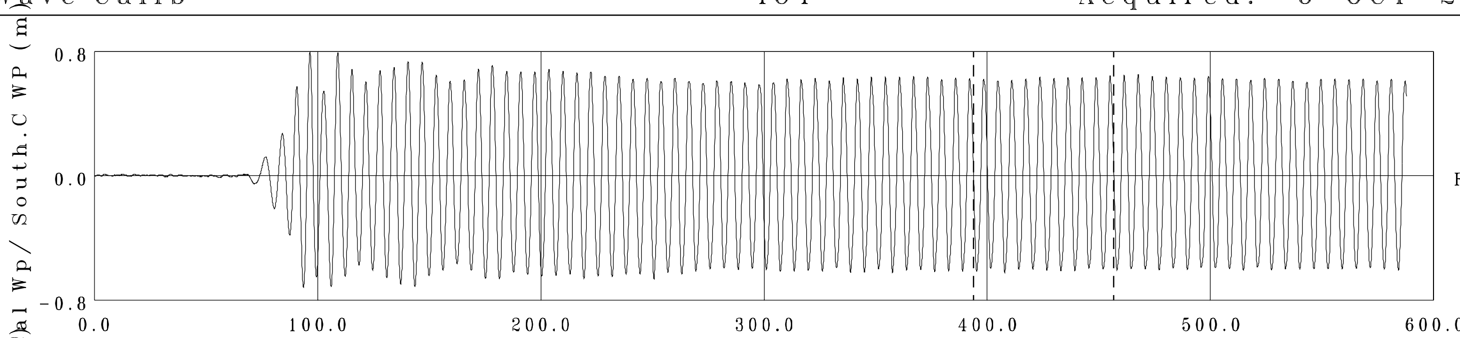
GENERATED BY: NRC/IOT	CHECKED BY:	APPROVED BY:

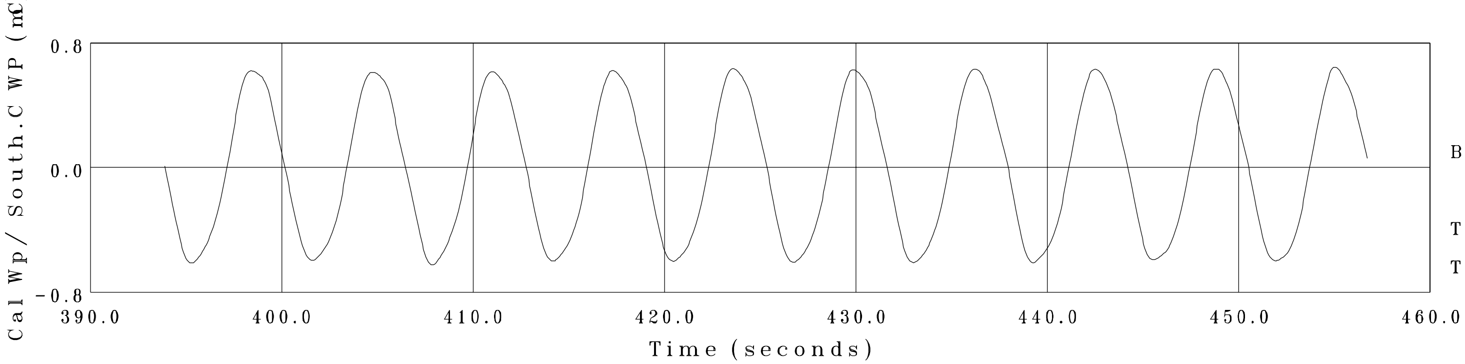
Figure A2 REG65_H1P08_T5P87_DRV2_001

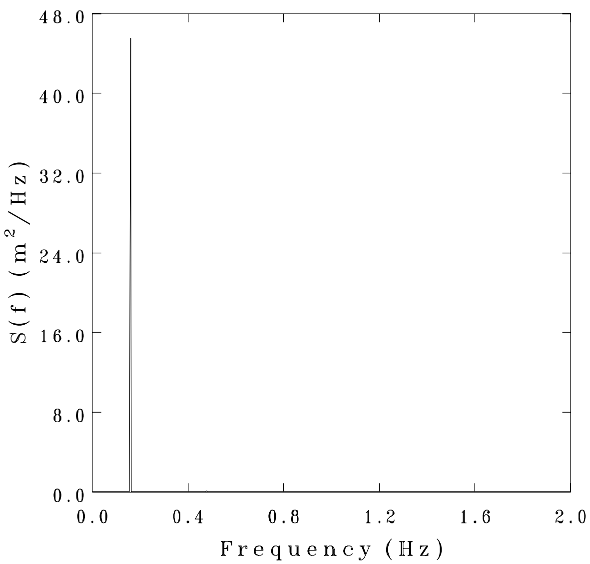
Roberts Sister II
Regular Wave Calib

IOT

Analyzed: 06-OCT-2009 09:36:17
Acquired: 6-OCT-2009 09:15:04







Full record wave parameters:		
Average wave height	= 1.235 m	
Average wave period	= 6.292 seconds	
		Target /
Best wave cycles parameters:		(Tolerance):
Average wave height	= 1.232 m	1.230 m
Average wave period	= 6.293 seconds	6.290 seconds
Deviation from target height	= 0.19 %	(5.0 %)
Wave height stability	= 2.84 %	(5.0 %)
Wave crest stability	= 1.50 %	(2.5 %)

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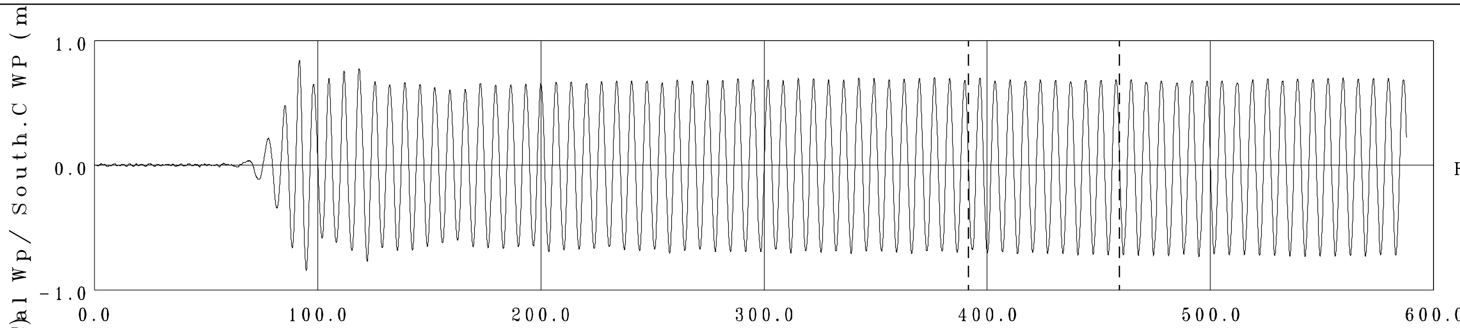
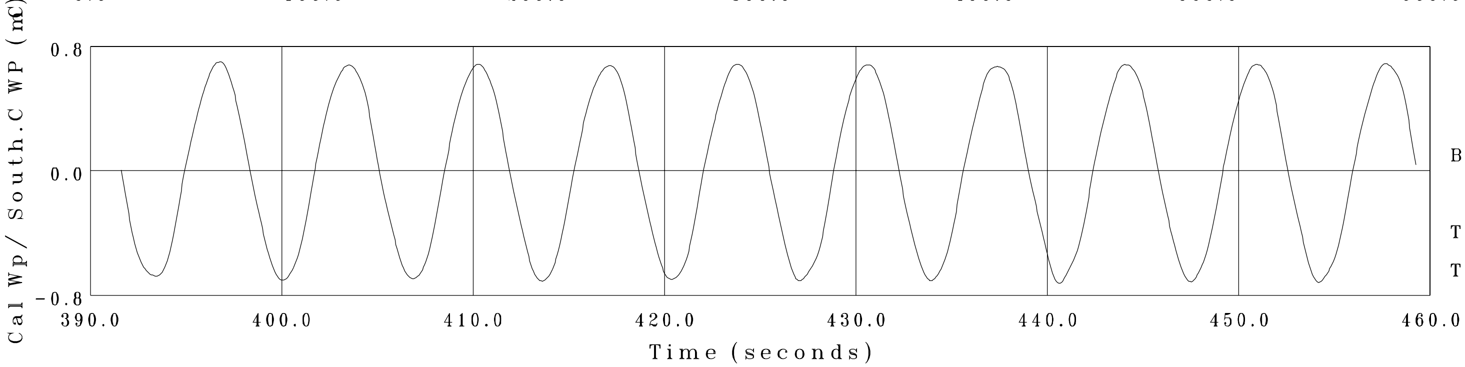
Figure A2 REG65_H1P23_T6P29_DRV2_001

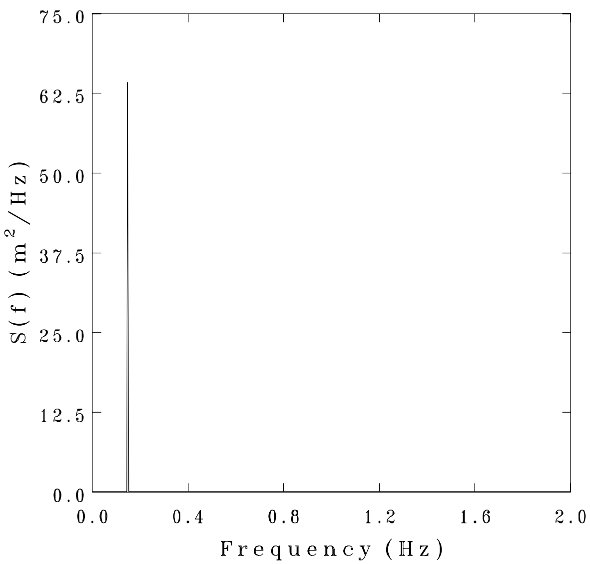
Roberts Sister II
Regular Wave Calib

IOT

Analyzed: 06-OCT-2009 10:21:24
Acquired: 6-OCT-2009 10:04:24







Full record wave parameters:

Average wave height	= 1.374 m	
Average wave period	= 6.779 seconds	
Best wave cycles parameters:		**Target / (Tolerance):**
Average wave height	= 1.388 m	1.420 m
Average wave period	= 6.780 seconds	6.780 seconds
Deviation from target height	= 2.26 %	(5.0 %)
Wave height stability	= 2.44 %	(5.0 %)
Wave crest stability	= 0.81 %	(2.5 %)

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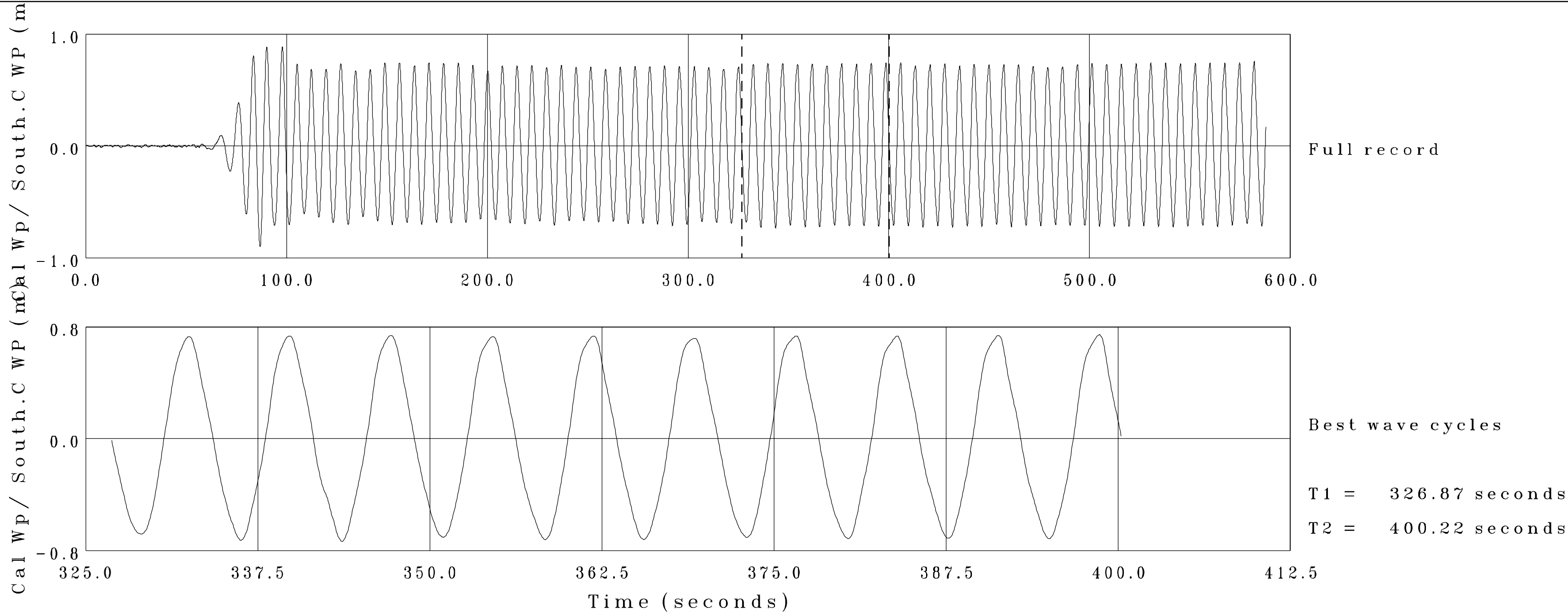
GENERATED BY: NRC/IOT | CHECKED BY: | APPROVED BY:

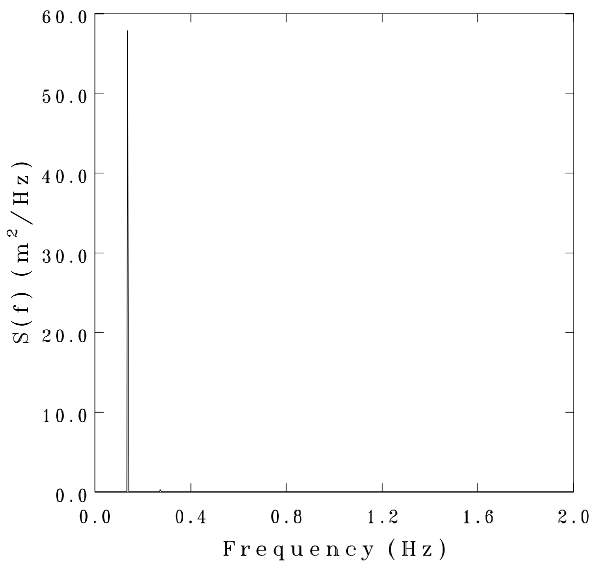
Figure A2 REG65_H1P42_T6P78_DRV2_001

Roberts Sister II
Regular Wave Calib

IOT

Analyzed: 06-OCT-2009 10:16:29
Acquired: 6-OCT-2009 09:33:33





Full record wave parameters:		
Average wave height	= 1.413 m	
Average wave period	= 7.340 seconds	
		Target /
Best wave cycles parameters:		(Tolerance):
Average wave height	= 1.451 m	1.650 m
Average wave period	= 7.336 seconds	7.340 seconds
Deviation from target height	= 12.05 %	(5.0 %)
Wave height stability	= 3.41 %	(5.0 %)
Wave crest stability	= 0.80 %	(2.5 %)

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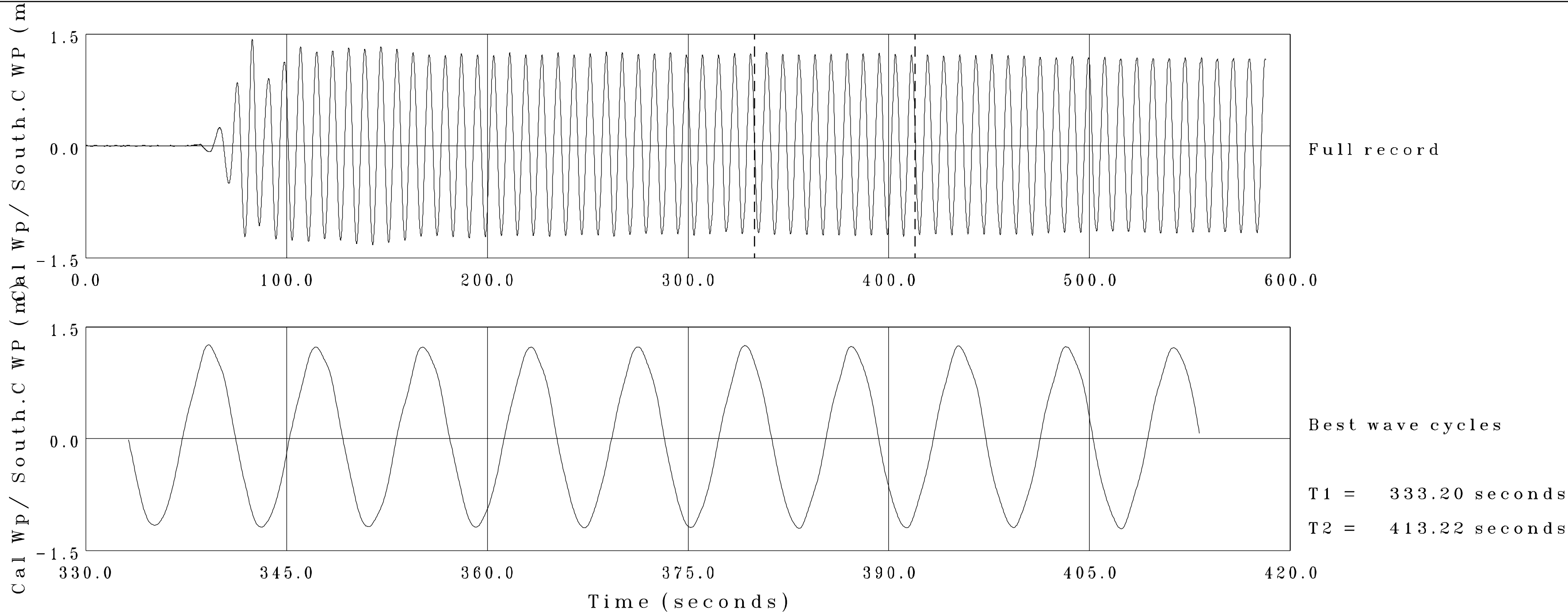
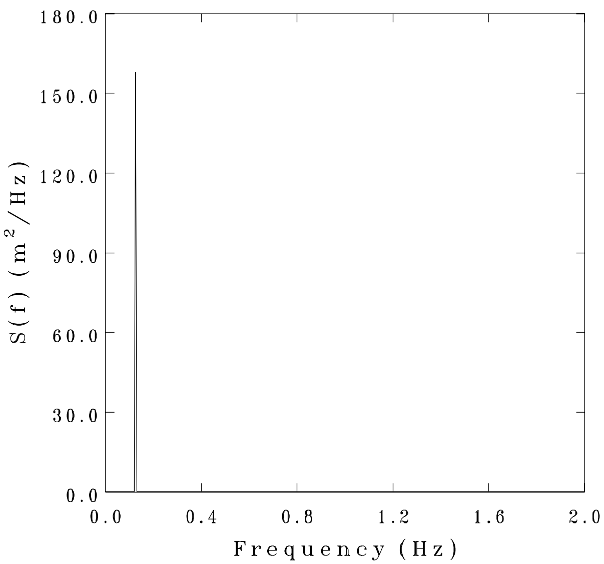
GENERATED BY: NRC/IOT | CHECKED BY: | APPROVED BY:

Figure A2 REG65_H1P65_T7P34_DRV2_001

Roberts Sister II
Regular Wave Calib | IOT | Analyzed: 06-OCT-2009 10:24:12
Acquired: 6-OCT-2009 10:17:28





Full record wave parameters:

Average wave height	= 2.421 m	
Average wave period	= 8.012 seconds	
Best wave cycles parameters:		**Target / (Tolerance):**
Average wave height	= 2.427 m	1.920 m
Average wave period	= 8.012 seconds	8.010 seconds
Deviation from target height	= 26.40 %	(5.0 %)
Wave height stability	= 1.85 %	(5.0 %)
Wave crest stability	= 1.13 %	(2.5 %)

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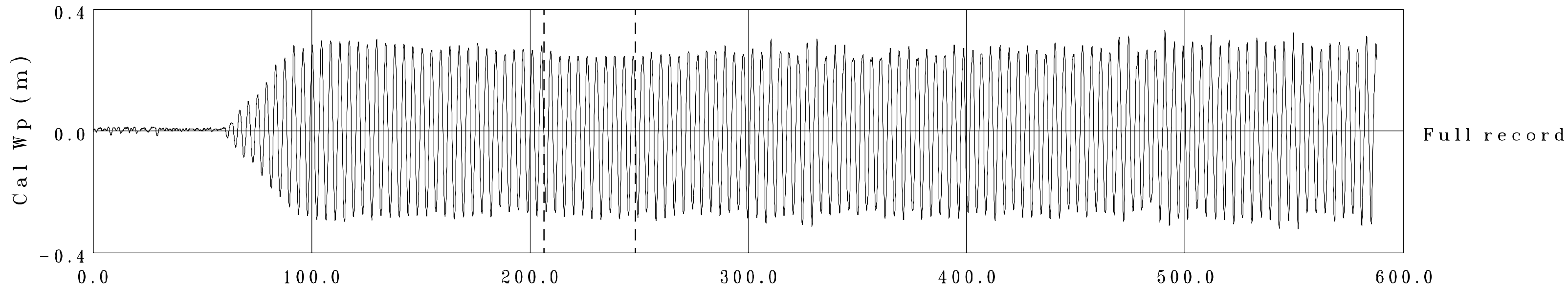
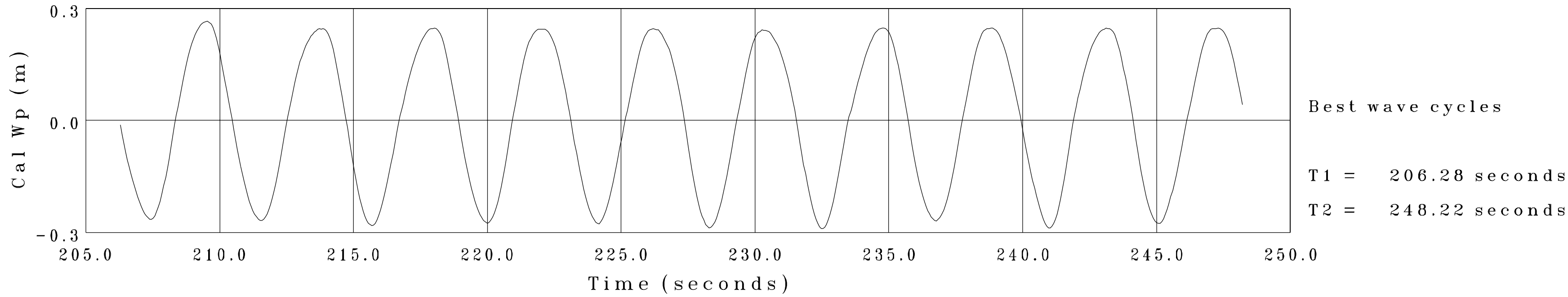
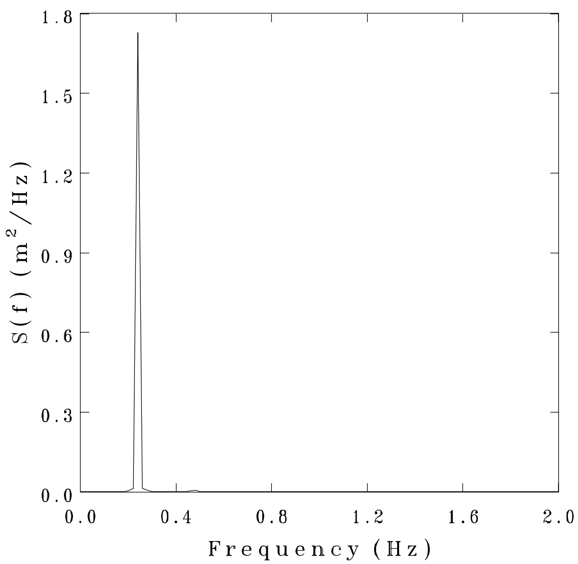
Figure A2 REG65_H1P92_T8P01_DRV2_001







Full record wave parameters:

Average wave height	= 0.529 m	
Average wave period	= 4.199 seconds	

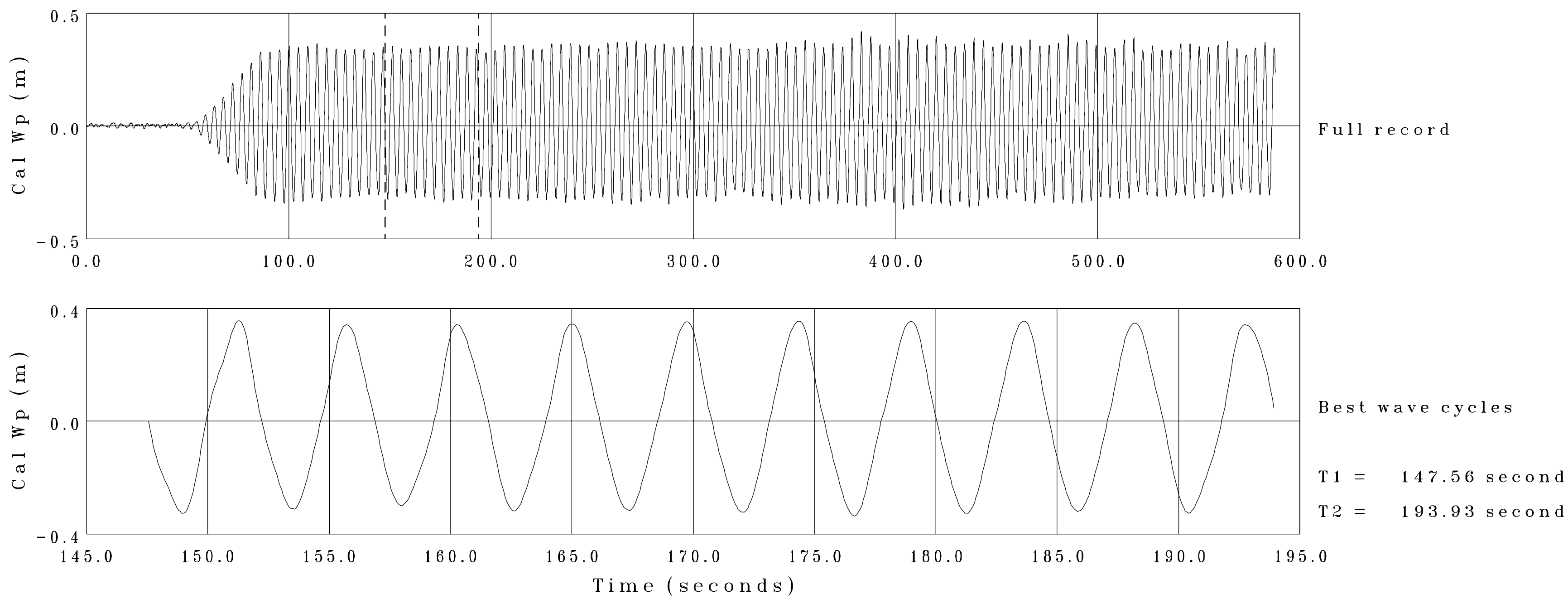
Best wave cycles parameters:

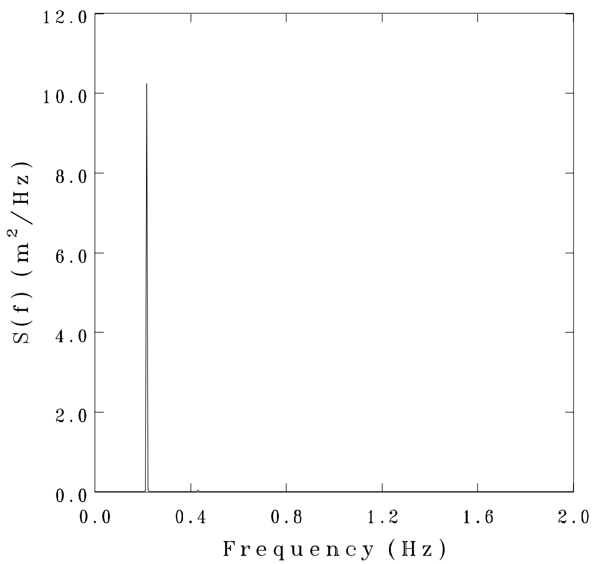
		Target / (Tolerance):
Average wave height	= 0.527 m	0.550 m
Average wave period	= 4.202 seconds	4.200 seconds
Deviation from target height	= 4.26 %	(5.0 %)
Wave height stability	= 4.52 %	(5.0 %)
Wave crest stability	= 0.59 %	(2.5 %)

Roberts Sister II
Regular Wave Calib

IOT

Analyzed: 03-JUL-2009 14:48:57
Acquired: 3-JUL-2009 14:40:28





Full record wave parameters:

Average wave height	= 0.675 m	
Average wave period	= 4.640 seconds	

Best wave cycles parameters:		**Target / (Tolerance):**
Average wave height	= 0.669 m	0.670 m
Average wave period	= 4.638 seconds	4.640 seconds
Deviation from target height	= 0.11 %	(5.0 %)
Wave height stability	= 7.30 %	(5.0 %)
Wave crest stability	= 1.74 %	(2.5 %)

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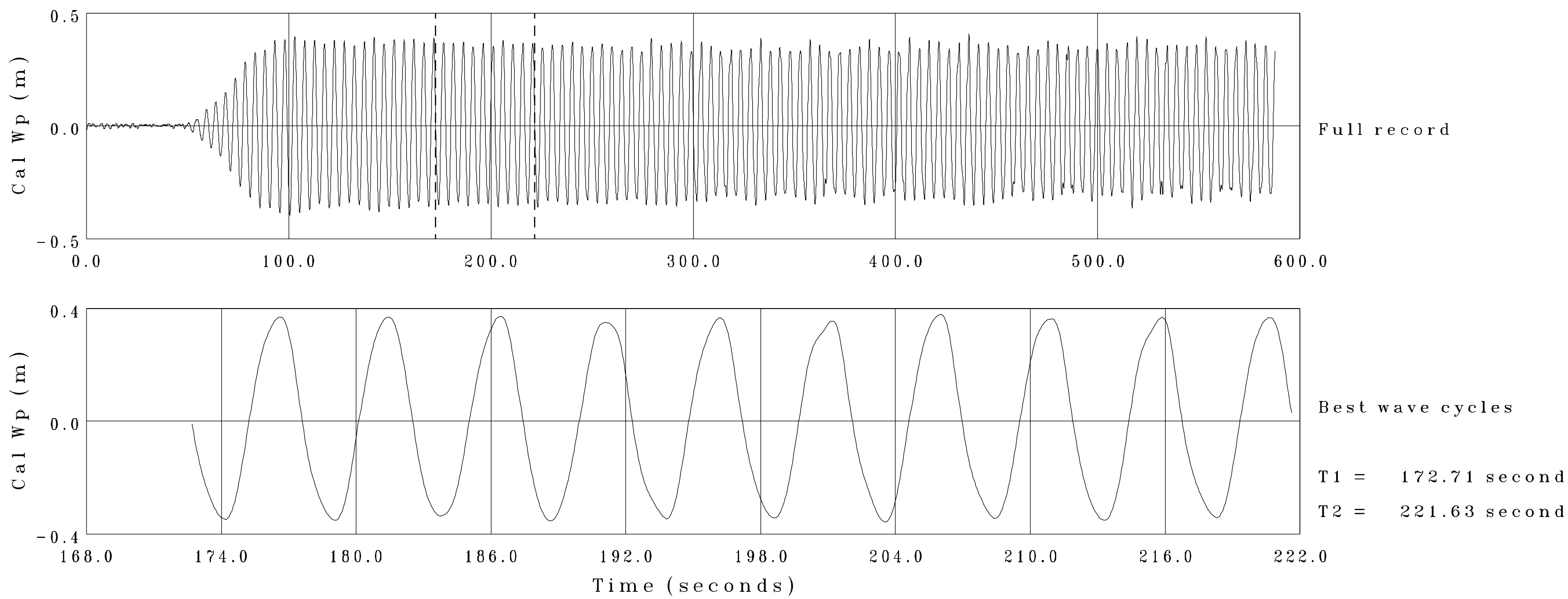
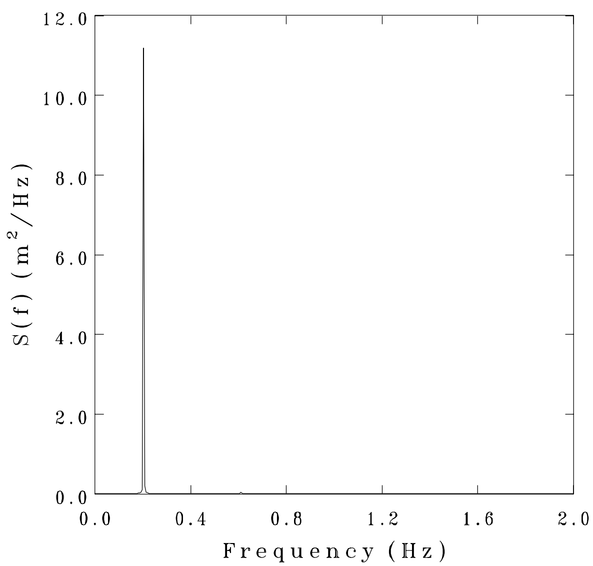
Figure A2 REG45_H0P67_T4P64_001

Roberts Sister II
Regular Wave Calib

IOT

Analyzed: 03-JUL-2009 14:27:50
Acquired: 3-JUL-2009 14:24:14





Full record wave parameters:

Average wave height	= 0.701 m	
Average wave period	= 4.899 seconds	

Best wave cycles parameters:		**Target / (Tolerance):**
Average wave height	= 0.713 m	0.750 m
Average wave period	= 4.895 seconds	4.900 seconds
Deviation from target height	= 4.88 %	(5.0 %)
Wave height stability	= 5.67 %	(5.0 %)
Wave crest stability	= 3.63 %	(2.5 %)

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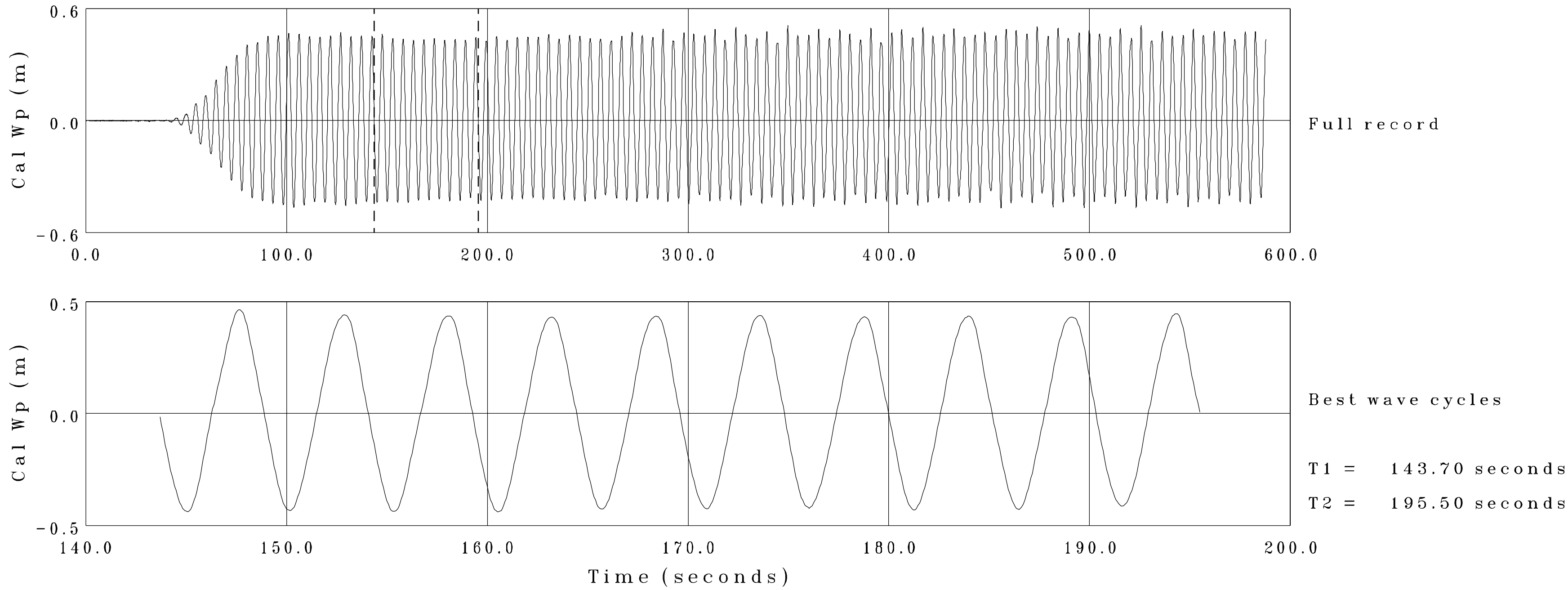
GENERATED BY: NRC/IOT | CHECKED BY: | APPROVED BY:

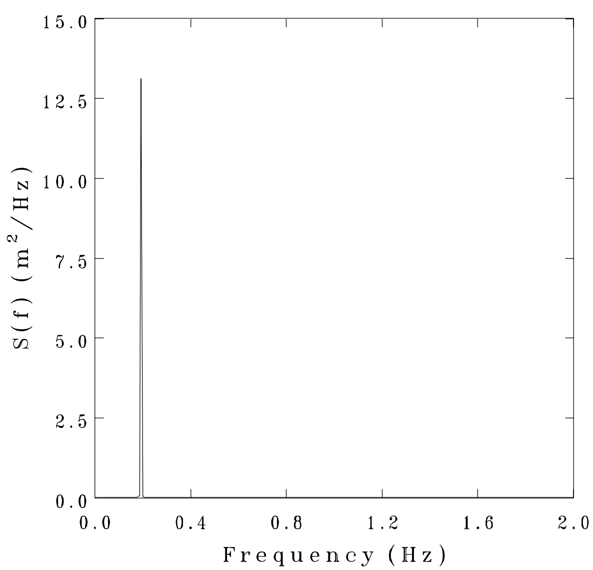
Figure A2 REG45_H0P75_T4P90_001

Roberts Sister II
Regular Wave Calib

IOT

Analyzed: 03-JUL-2009 12:04:21
Acquired: 3-JUL-2009 12:00:36





Full record wave parameters:		
Average wave height	= 0.869 m	
Average wave period	= 5.182 seconds	
Best wave cycles parameters:		**Target / (Tolerance):**
Average wave height	= 0.866 m	0.840 m
Average wave period	= 5.180 seconds	5.180 seconds
Deviation from target height	= 3.11 %	(5.0 %)
Wave height stability	= 2.81 %	(5.0 %)
Wave crest stability	= 1.27 %	(2.5 %)

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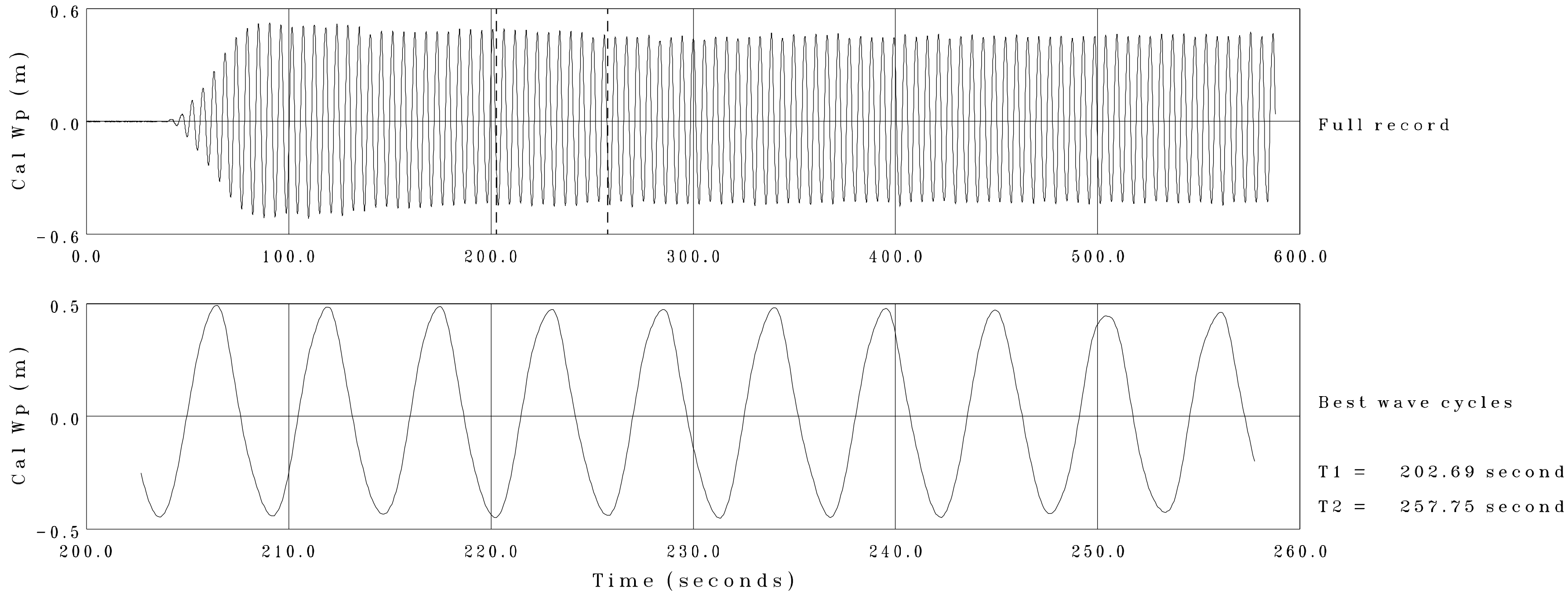
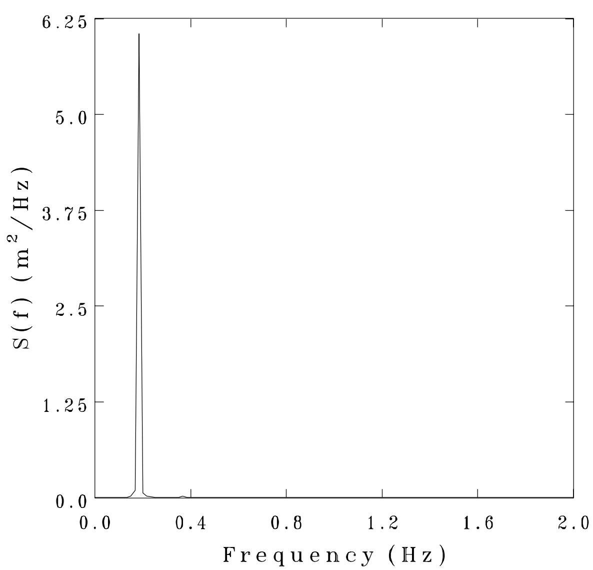
GENERATED BY: NRC/IOT | CHECKED BY: | APPROVED BY:

Figure A2 REG45_H0P84_T5P18_001





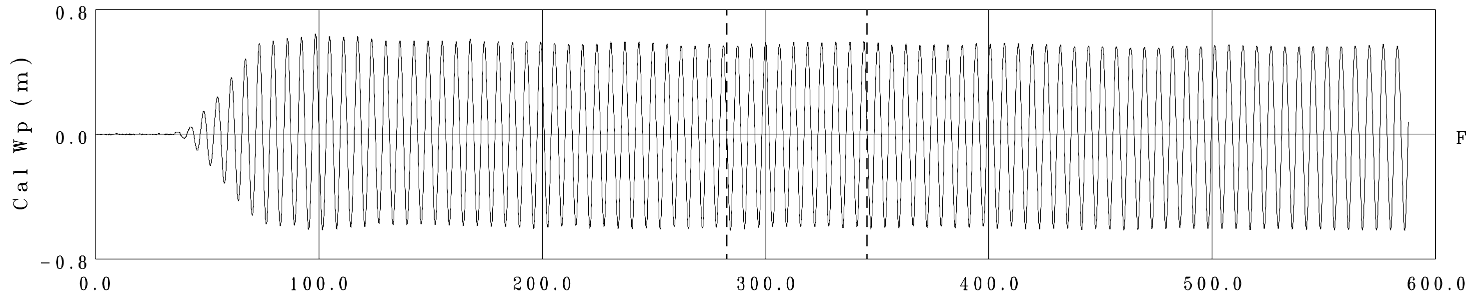
Full record wave parameters:		
Average wave height	= 0.918 m	
Average wave period	= 5.512 seconds	
Best wave cycles parameters:		Target / (Tolerance):
Average wave height	= 0.916 m	0.950 m
Average wave period	= 5.514 seconds	5.510 seconds
Deviation from target height	= 3.57 %	(5.0 %)
Wave height stability	= 7.14 %	(5.0 %)
Wave crest stability	= 2.87 %	(2.5 %)

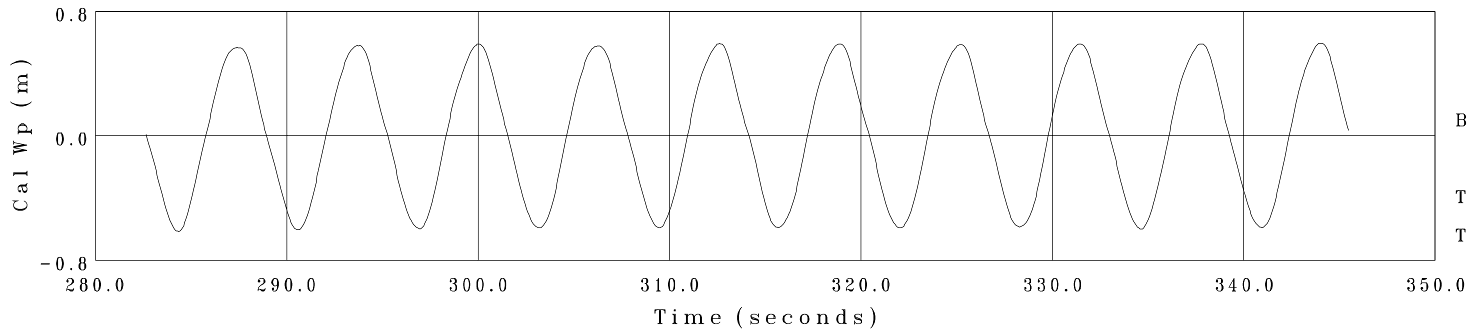
Figure A3 REG45_H0P95_T5P51_002

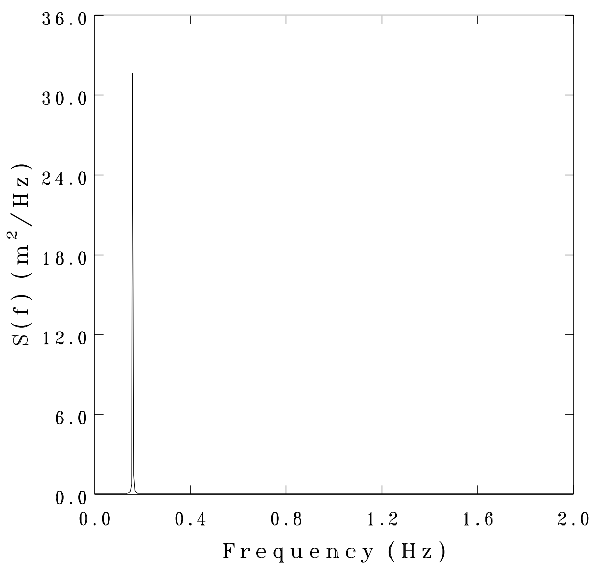
Roberts Sister II
Regular Wave Calib

IOT

Analyzed: 03-JUL-2009 11:19:47
Acquired: 3-JUL-2009 11:15:52







Full record wave parameters:		
Average wave height	= 1.179 m	
Average wave period	= 6.291 seconds	
		Target /
Best wave cycles parameters:		(Tolerance):
Average wave height	= 1.181 m	1.230 m
Average wave period	= 6.290 seconds	6.290 seconds
Deviation from target height	= 3.99 %	(5.0 %)
Wave height stability	= 1.86 %	(5.0 %)
Wave crest stability	= 0.90 %	(2.5 %)

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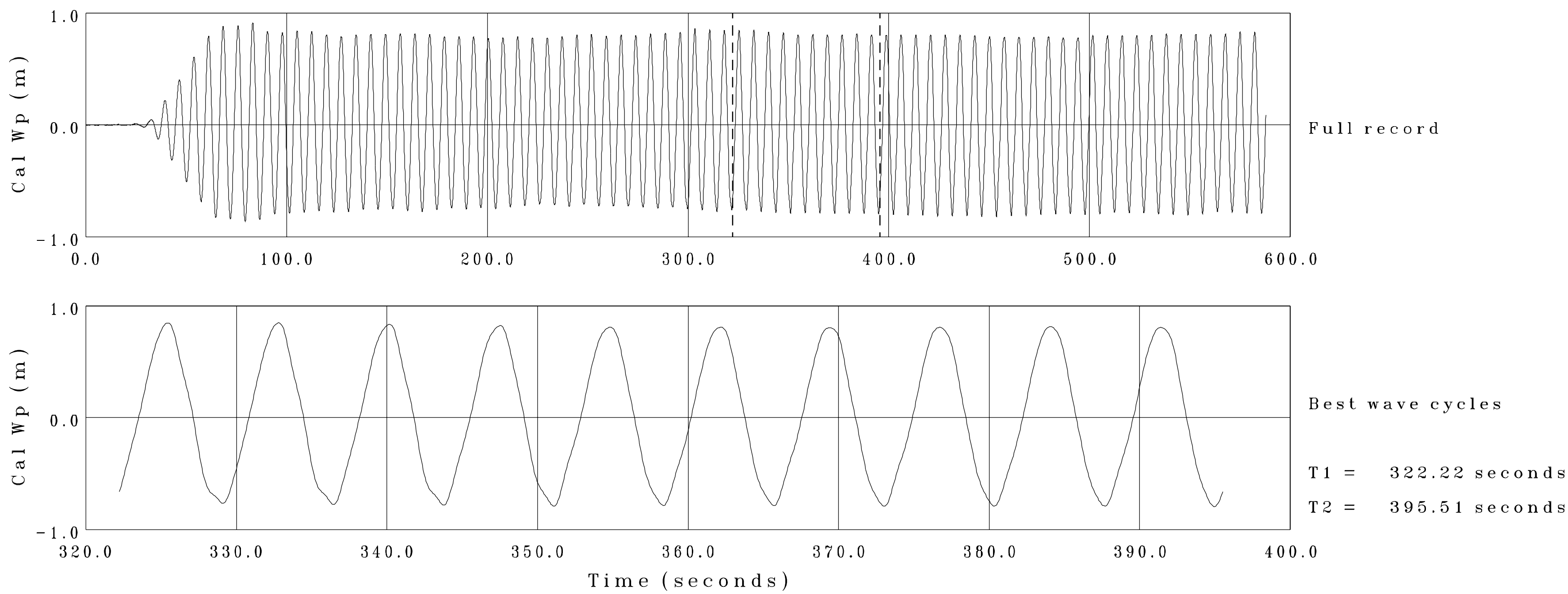
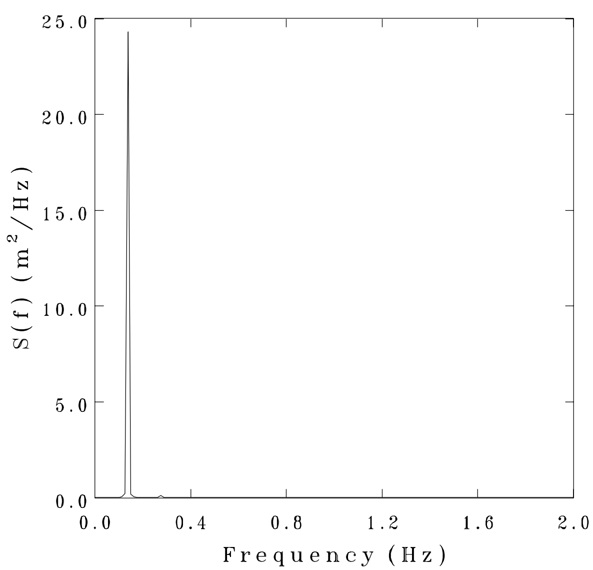
Figure A2 REG45_H1P23_T6P29_001

Roberts Sister II
Regular Wave Calib

IOT

Analyzed: 03-JUL-2009 11:03:59
Acquired: 3-JUL-2009 11:00:27





Full record wave parameters:

Average wave height	= 1.604 m	
Average wave period	= 7.337 seconds	

Best wave cycles parameters:

		Target / (Tolerance):
Average wave height	= 1.604 m	1.650 m
Average wave period	= 7.337 seconds	7.340 seconds
Deviation from target height	= 2.80 %	(5.0 %)
Wave height stability	= 2.19 %	(5.0 %)
Wave crest stability	= 3.92 %	(2.5 %)

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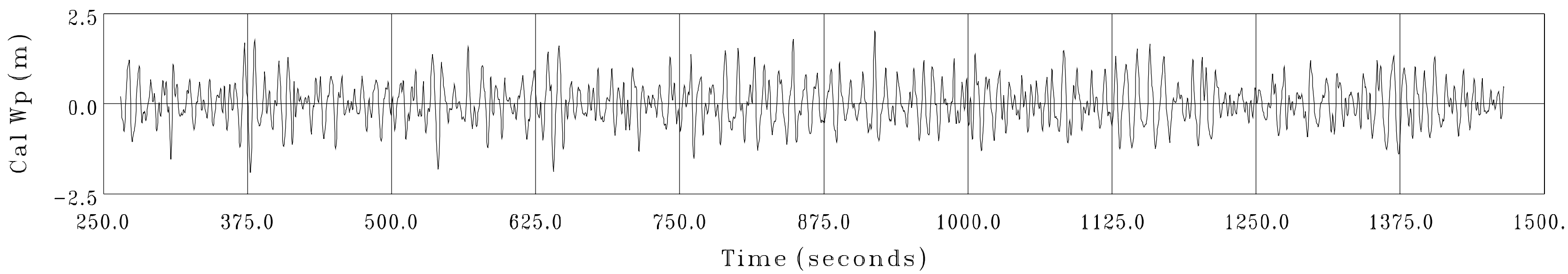
GENERATED BY: NRC/IOT | CHECKED BY: | APPROVED BY:

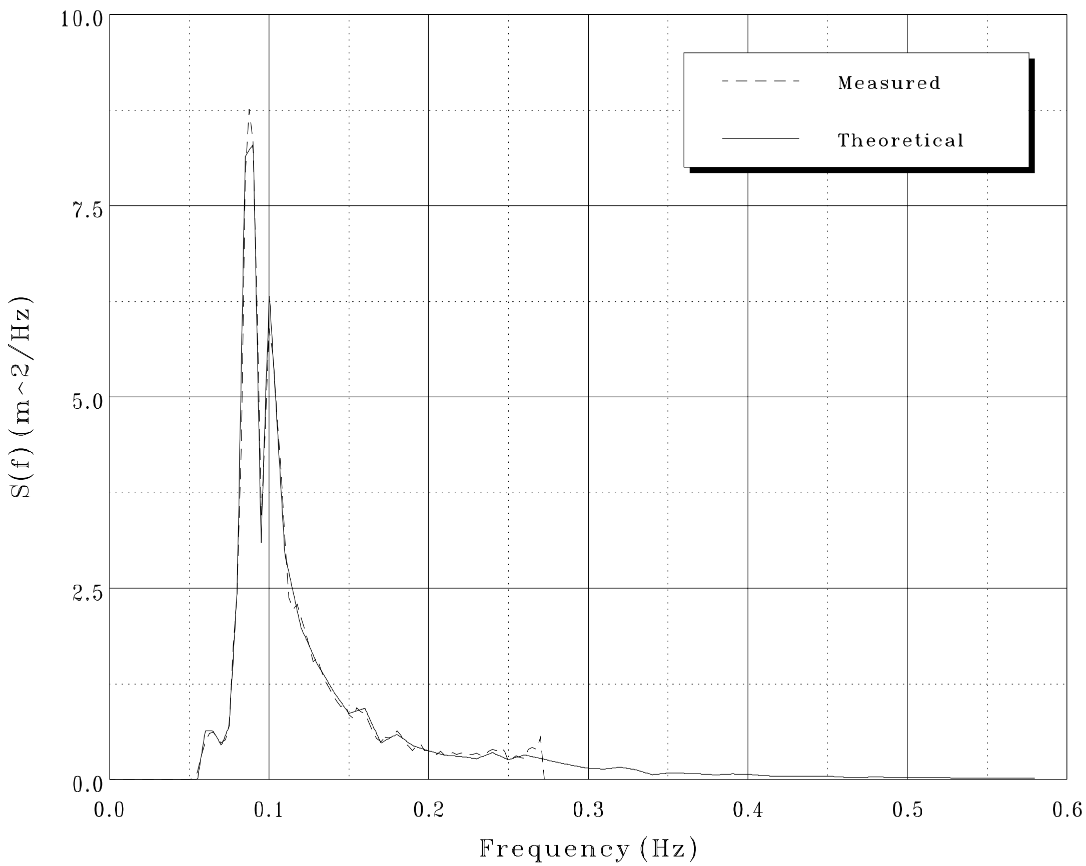
Figure A3 REG45_H1P65_T7P34_002

Roberts Sister II
Irregular Wave Matching

NRC/IOT

Analyzed: 07-JUL-2009 09:44:53
Acquired: 7-JUL-2009 09:36:49





Spectral Analysis:		TARGET / (TOLERANCE)
Hm_0	= 2.2022 m	
T_{pd}	= 11.3807 s	11.1100 s
m_0	= 0.3031	
m_2	= 0.0048	
T_z	= 7.9060 s	
ε_4	= 0.6567	
DOF	= 14.00	
Deviation from target T_p	= 2.436 %	(2.5 %)

Zero-Crossing Analysis:		
H_s	= 2.2301 m	2.2800 m
Deviation from target H_s	= -2.188 %	(5.0 %)

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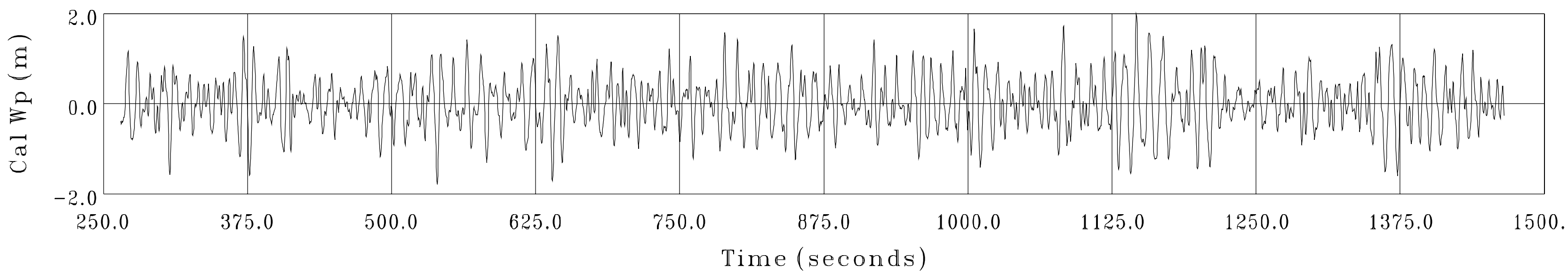
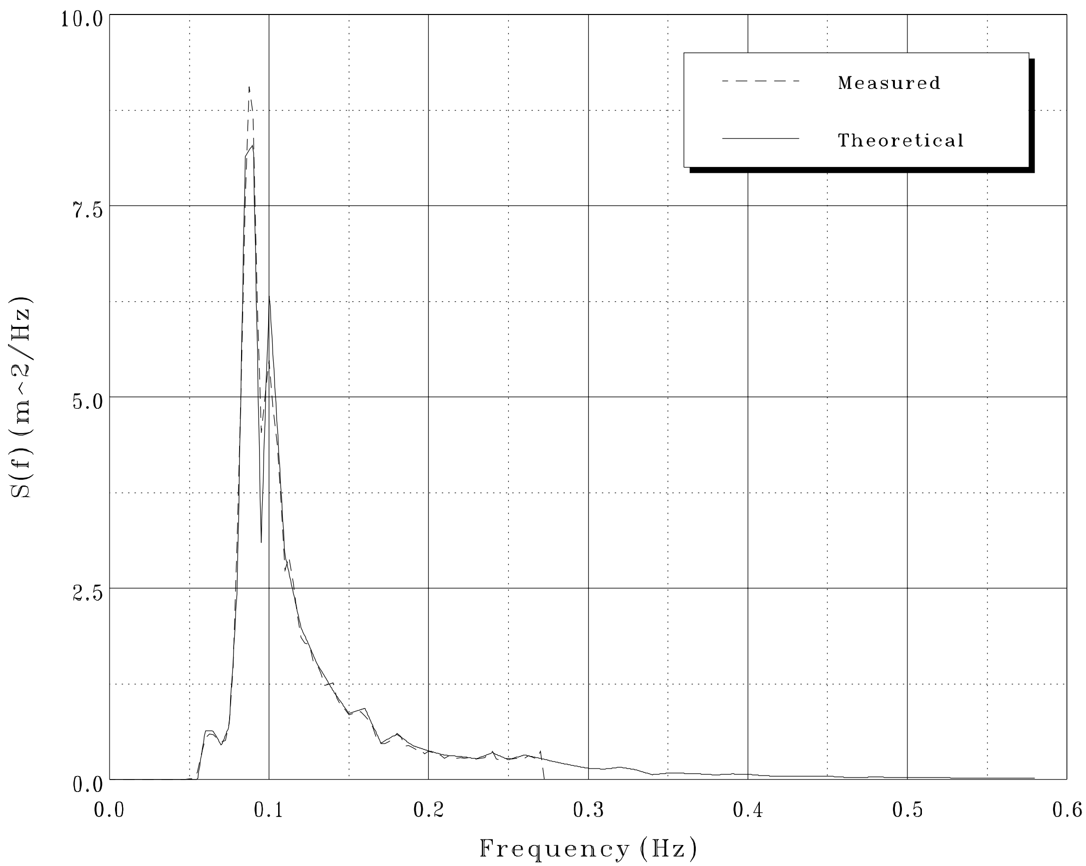
GENERATED BY: NRC/IOT | CHECKED BY: | APPROVED BY:

Figure A17 RS2_W1_MDS_004





Spectral Analysis:		TARGET / (TOLERANCE)
Hm_0	= 2.1993 m	
T_{pd}	= 11.3580 s	11.1100 s
m_0	= 0.3023	
m_2	= 0.0046	
T_Z	= 8.0919 s	
ε_4	= 0.6503	
DOF	= 14.00	
Deviation from target T_p	= 2.232 %	(2.5 %)

Zero-Crossing Analysis:		
H_s	= 2.1980 m	2.2800 m
Deviation from target H_s	= -3.596 %	(5.0 %)

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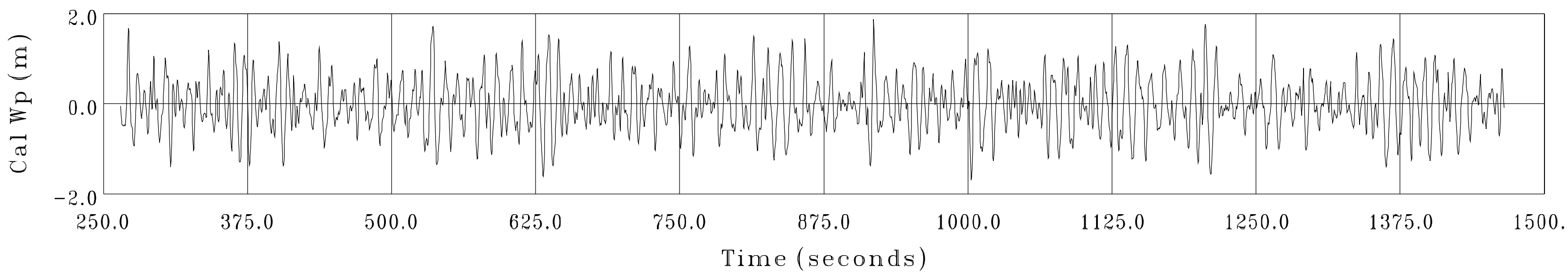
GENERATED BY: NRC/IOT | CHECKED BY: | APPROVED BY:

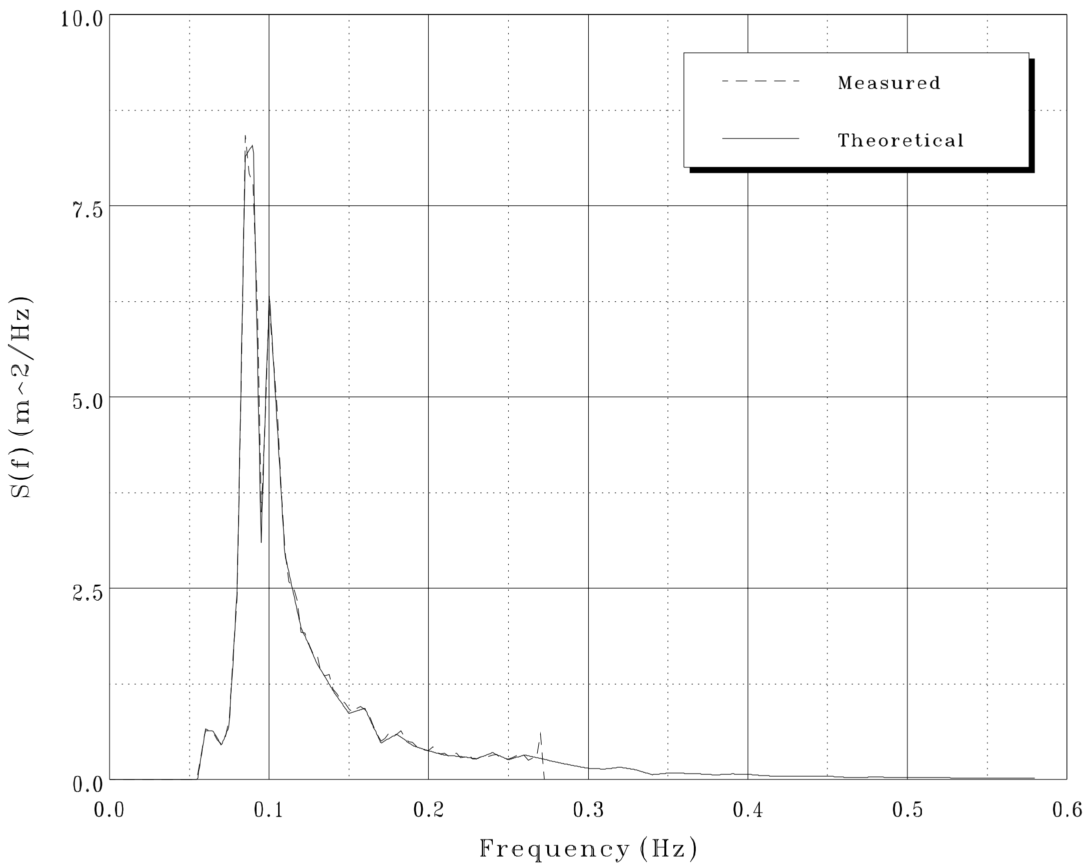
Figure A18 RS2_W2_MDS_004

Roberts Sister II
Irregular Wave Matching

NRC/IOT

Analyzed: 06-JUL-2009 15:43:22
Acquired: 6-JUL-2009 15:35:41





Spectral Analysis:		TARGET / (TOLERANCE)
Hm_0	= 2.2159 m	
T_{pd}	= 11.4215 s	11.1100 s
m_0	= 0.3069	
m_2	= 0.0048	
T_z	= 7.9844 s	
ε_4	= 0.6475	
DOF	= 14.00	
Deviation from target T_p	= 2.803 %	(2.5 %)

Zero-Crossing Analysis:		
H_s	= 2.1635 m	2.2800 m
Deviation from target H_s	= -5.111 %	(5.0 %)

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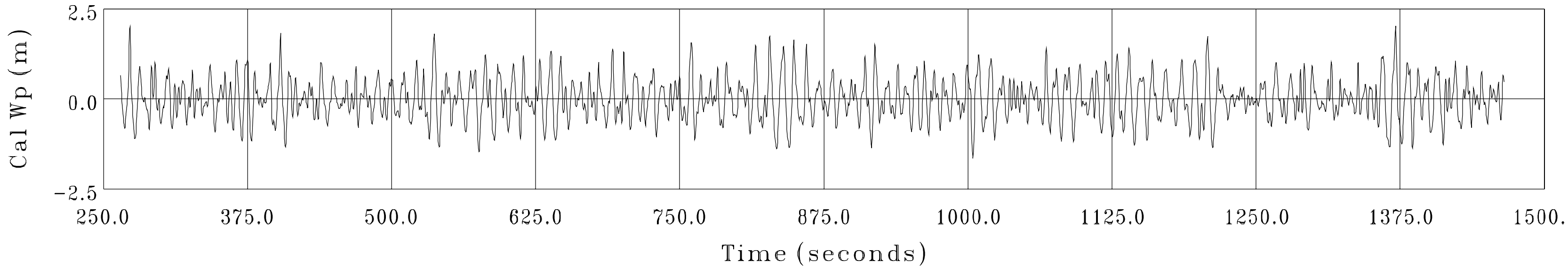
GENERATED BY: NRC/IOT | CHECKED BY: | APPROVED BY:

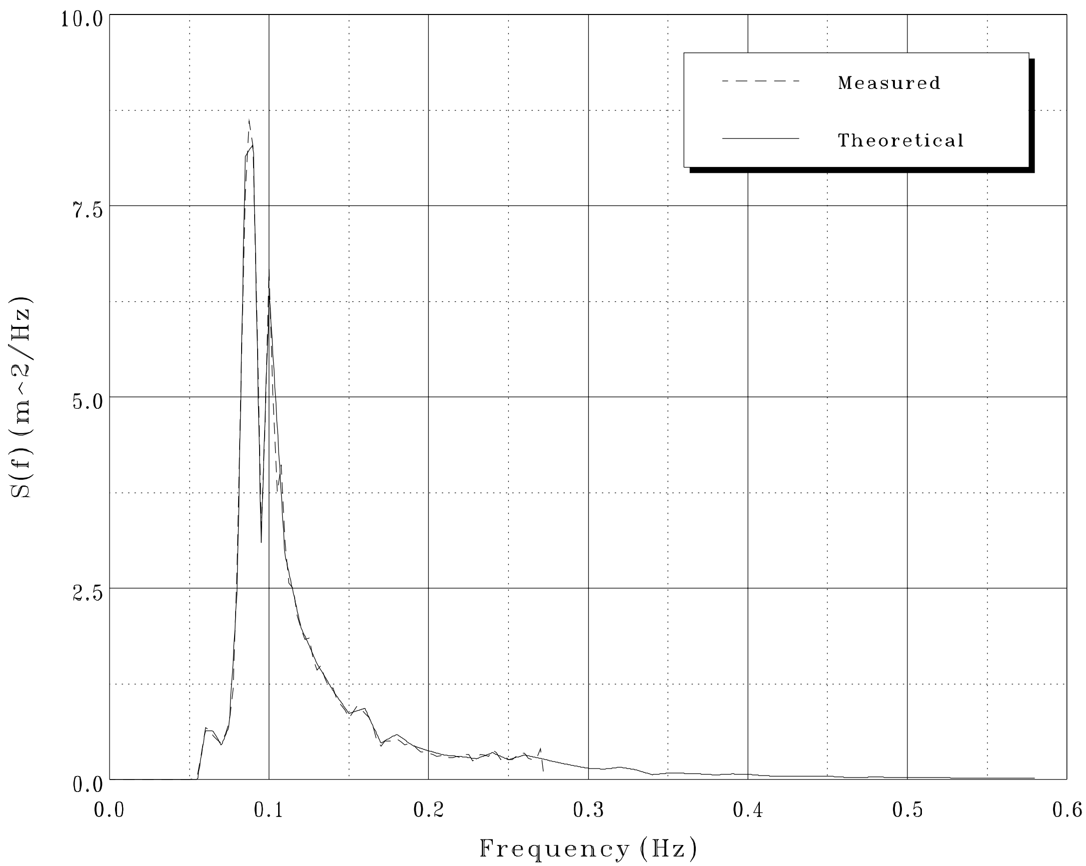
Figure A14 RS2_W3_MDS_003

Roberts Sister II
Irregular Wave Matching

NRC/IOT

Analyzed: 07-JUL-2009 09:05:32
Acquired: 7-JUL-2009 08:56:42





Spectral Analysis:		TARGET / (TOLERANCE)
Hm_0	= 2.1891 m	
T_{pd}	= 11.3955 s	11.1100 s
m_0	= 0.2995	
m_2	= 0.0047	
T_Z	= 8.0245 s	
ε_4	= 0.6512	
DOF	= 14.00	
Deviation from target T_p	= 2.570 %	(2.5 %)

Zero-Crossing Analysis:		
H_s	= 2.1754 m	2.2800 m
Deviation from target H_s	= -4.590 %	(5.0 %)

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GENERATED BY: NRC/IOT | CHECKED BY: | APPROVED BY:

Figure A16 RS2_W4_MDS_002

APPENDIX E

MODEL LAUNCH POSITIONS

Safer Fishing Vessel Seakeeping **CCGA Roberts Sisters II Seakeeping Experiments - July 2009**

Proj. #42_2374_10

CASE 1

Heading:	Beam seas	ART is empty		
Model speed:	0.630	m/s (4 knots)		
distance traveled by model	58.00	m	Transverse distance	24.51 m
Total travelling time at speed	92.06	s		

	Non-dim	Full scale	Model scale								
No	wn	w [rad/s]	w [rad/s]	f [Hz]	Period [s]	Wave Length [m]	Wave height (1/50) [m]	Wave height (1/35) [m]	Deep Water Ratio	Encounter wave frequency	No of wave encounters
1	1.1	0.784	2.562	0.408	2.453	9.018	0.180	0.258	0.621	2.562	37.5
2	1.2	0.856	2.795	0.445	2.248	7.726	0.155	0.221	0.725	2.795	40.9
3	1.3	0.927	3.028	0.482	2.075	6.655	0.133	0.190	0.841	3.028	44.4
4	1.4	0.998	3.261	0.519	1.927	5.771	0.115	0.165	0.970	3.261	47.8
5	1.5	1.070	3.493	0.556	1.799	5.040	0.101	0.144	1.111	3.493	51.2
6	1.6	1.141	3.726	0.593	1.686	4.435	0.089	0.127	1.263	3.726	54.6
7	1.8	1.284	4.192	0.667	1.499	3.506	0.070	0.100	1.597	4.192	61.4

CASE 2 CASE 1 with ART fillied

CASE 3

Heading:	Beam seas	ART is empty		
Model speed:	1.260	m/s (8 knots)		
distance traveled by model	58.00	m	Transverse distance	24.51 m
Total travelling time at speed	46.03	s		

	Non-dim	Full scale	Model scale								
No	wn	w [rad/s]	w [rad/s]	f [Hz]	Period [s]	Wave length [m]	Wave height (1/50) [m]	Wave height (1/35) [m]	Deep Water Ratio	Encounter wave frequency	No of wave encounters
1	1.1	0.784	2.562	0.408	2.453	9.018	0.180	0.258	0.621	2.562	18.8
2	1.2	0.856	2.795	0.445	2.248	7.726	0.155	0.221	0.725	2.795	20.5
3	1.3	0.927	3.028	0.482	2.075	6.655	0.133	0.190	0.841	3.028	22.2
4	1.4	0.998	3.261	0.519	1.927	5.771	0.115	0.165	0.970	3.261	23.9
5	1.5	1.070	3.493	0.556	1.799	5.040	0.101	0.144	1.111	3.493	25.6
6	1.6	1.141	3.726	0.593	1.686	4.435	0.089	0.127	1.263	3.726	27.3
7	1.8	1.284	4.192	0.667	1.499	3.506	0.070	0.100	1.597	4.192	30.7

CASE 4 CASE 3 with ART fillied

Safer Fishing Vessel Seakeeping **CCGA Roberts Sisters II Seakeeping Experiments - July 2009**

Proj. #42_2374_10

CASE 5 Heading: Quartering seas ART is empty
Model speed: 0.630 m/s (4 knots)
distance traveled by model 52.00 m Transverse distance 21.98 m
Total travelling time at speed 82.54 s

	Non-dim	Full scale	Model scale								
No	wn	w [rad/s]	w [rad/s]	f [Hz]	Period [s]	Wave length [m]	Wave height (1/50) [m]	Wave height (1/35) [m]	Deep Water Ratio	Encounter wave frequency	No of wave encounters
1	1.2	0.856	2.795	0.445	2.248	7.726	0.155	0.221	0.725	2.440	32.1
2	1.4	0.998	3.261	0.519	1.927	5.771	0.115	0.165	0.970	2.778	36.5
3	1.6	1.141	3.726	0.593	1.686	4.435	0.089	0.127	1.263	3.096	40.7
4	1.7	1.212	3.959	0.630	1.587	3.930	0.079	0.112	1.425	3.247	42.7
5	1.8	1.284	4.192	0.667	1.499	3.506	0.070	0.100	1.597	3.394	44.6
6	1.9	1.355	4.425	0.704	1.420	3.147	0.063	0.090	1.779	3.536	46.4
7	2.1	1.498	4.891	0.778	1.285	2.576	0.052	0.074	2.174	3.804	50.0

CASE 6 CASE 5 with ART fillied

CASE 7 Heading: Quartering seas ART is empty
Model speed: 1.260 m/s (8 knots)
distance traveled by model 52.00 m Transverse distance 21.98 m
Total travelling time at speed 41.27 s

	Non-dim	Full scale	Model scale								
No	wn	w [rad/s]	w [rad/s]	f [Hz]	Period [s]	Wave length [m]	Wave height (1/50) [m]	Wave height (1/35) [m]	Deep Water Ratio	Encounter wave frequency	No of wave encounters
1	1.2	0.856	2.795	0.445	2.248	7.726	0.155	0.221	0.725	2.085	27.4
2	1.4	0.998	3.261	0.519	1.927	5.771	0.115	0.165	0.970	2.295	30.1
3	1.6	1.141	3.726	0.593	1.686	4.435	0.089	0.127	1.263	2.465	32.4
4	1.7	1.212	3.959	0.630	1.587	3.930	0.079	0.112	1.425	2.535	33.3
5	1.8	1.284	4.192	0.667	1.499	3.506	0.070	0.100	1.597	2.596	34.1
6	1.9	1.355	4.425	0.704	1.420	3.147	0.063	0.090	1.779	2.646	34.8
7	2.1	1.498	4.891	0.778	1.285	2.576	0.052	0.074	2.174	2.718	35.7

CASE 8 CASE 7 with ART fillied

NOTE: (green) Indicates roll natural frequency, or closest to that

ART = anti-roll tank

Deep water assumption h >= Lw/2

f	frequency, Hz
h	water depth in the OEB, m
hw	wave height, m
Lm	model length (LWL), m
Lw	wave length, m
LWL	water line length, m
T	period, s
Te	encounter period, s
w	circular frequency, rad/s
we	encounter wave frequency, rad/s
wn	nondimensional wave frequency, rad/s {w* sqrt(Lm/g)}

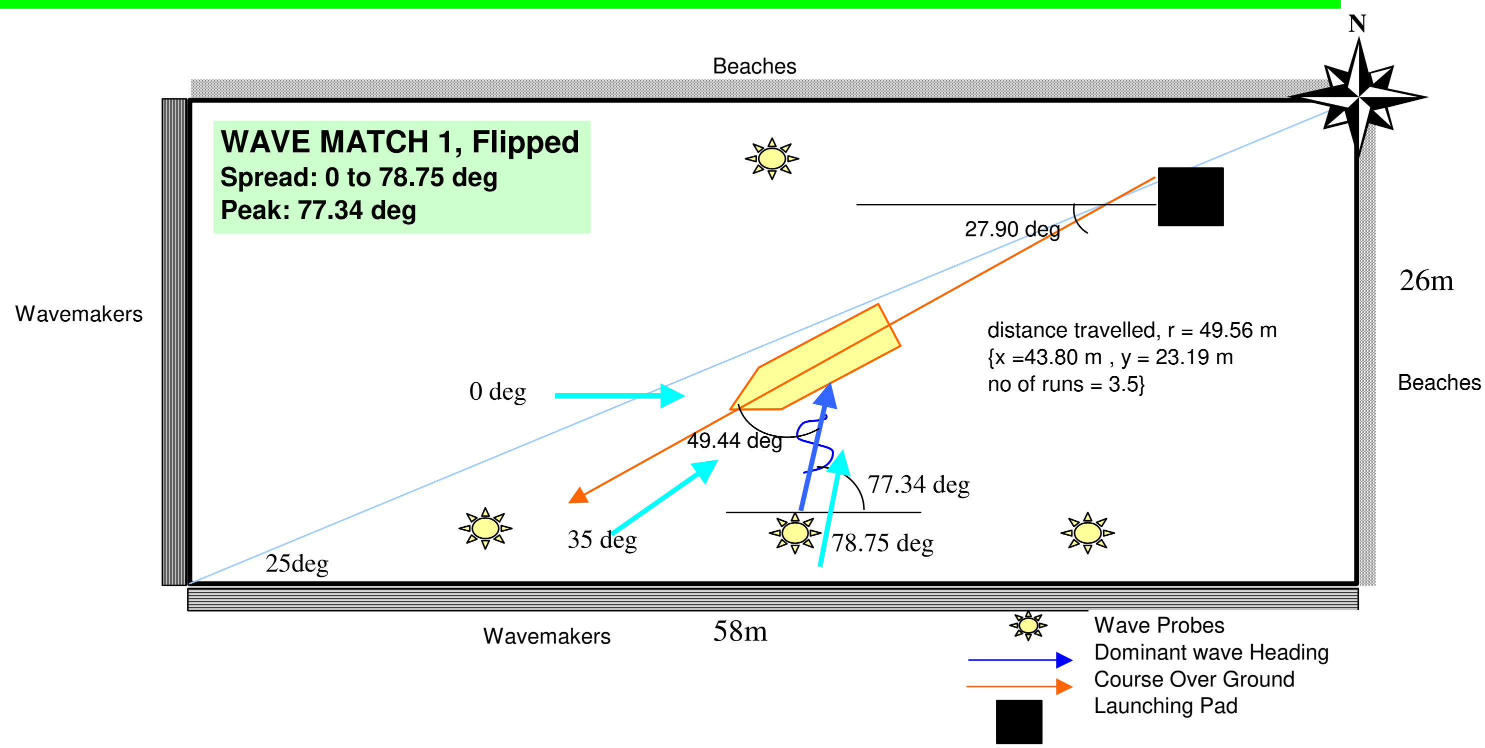
Safer Fishing Vessel Seakeeping **CCGA Roberts Sisters II Seakeeping Experiments - July 2009**
Proj. #42_2374_10

Head Seas, Trawl Speed

Model Speed (m/s)	0.410		time for 20 min of trials in model scale (min) 6.124
SOG	2.6	Knots	
COG	73	Degrees True North (Sea trials)	
Max Wave Direction	122.44	Degrees True North (Sea trials)	
Relative angle	49.44	Degrees (pure head seas is zero degrees)	
	130.56	(Wave heading - COG)	

Acquired Nov. 15, 2004 @ 14:27 UTC, 10:57 NF Time using Datawell directional wave buoy
Max wave direction is 126.6563 Degrees True North (Sea trials)

WAVES ARE FLIPPED: Now the waves coming from the port side



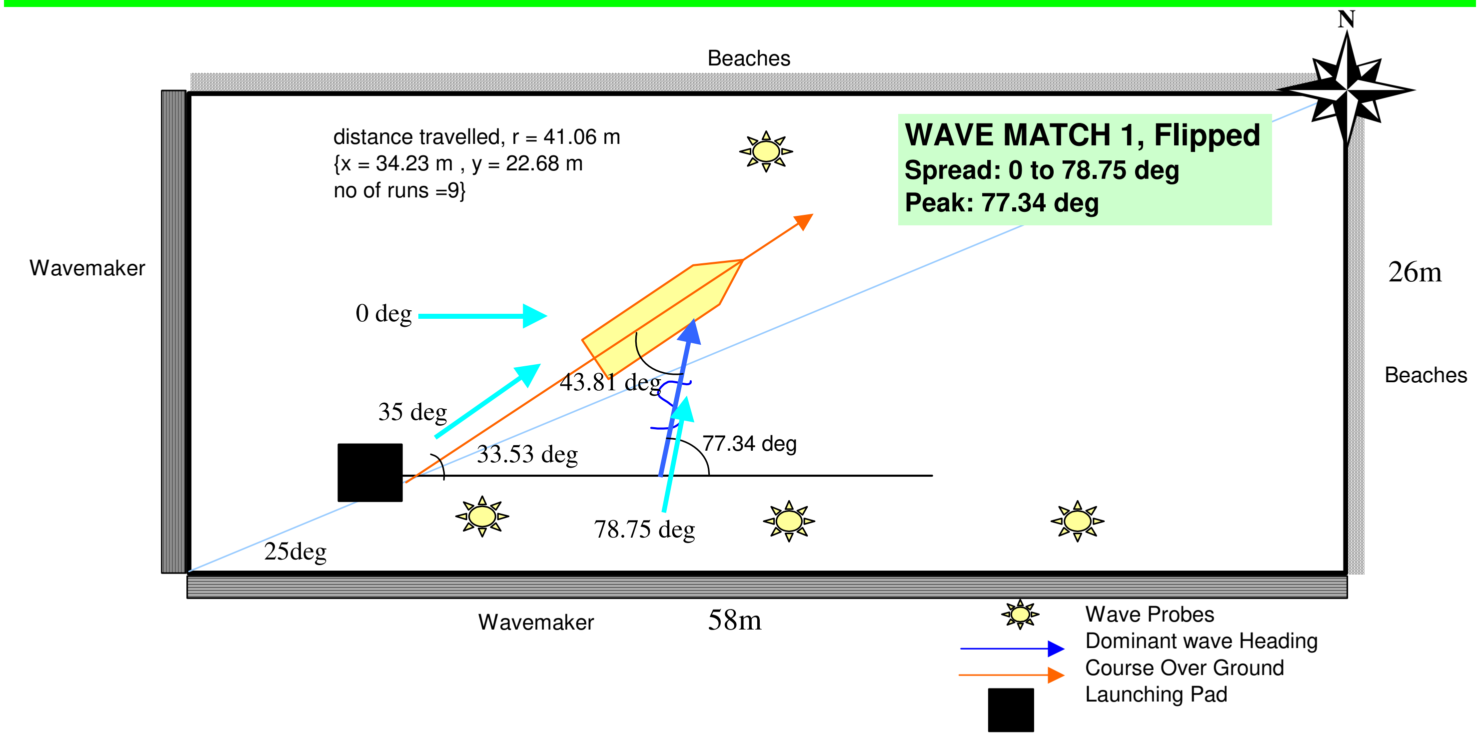
Safer Fishing Vessel Seakeeping **CCGA Roberts Sisters II Seakeeping Experiments - July 2009**
Proj. #42_2374_10
Following Seas, Trawl Speed

Model Speed (m/s)	0.756		time for 20 min of trials in model scale (min) 6.124
SOG	4.8	Knots	
COG	253	Degrees True North (Sea trials)	
Max Wave Direction	116.81	Degrees True North (Sea trials)	

Relative angle	-136.19	Degrees (pure head seas is zero degrees)
	43.81	(Wave heading - COG)

Acquired Nov. 15, 2004 @ 14:27 UTC, 10:57 NF Time using Datawell directional wave buoy
Max wave direction is 126.6563 Degrees True North (Sea trials)

WAVES ARE FLIPPED: Now the waves coming from the starboard side

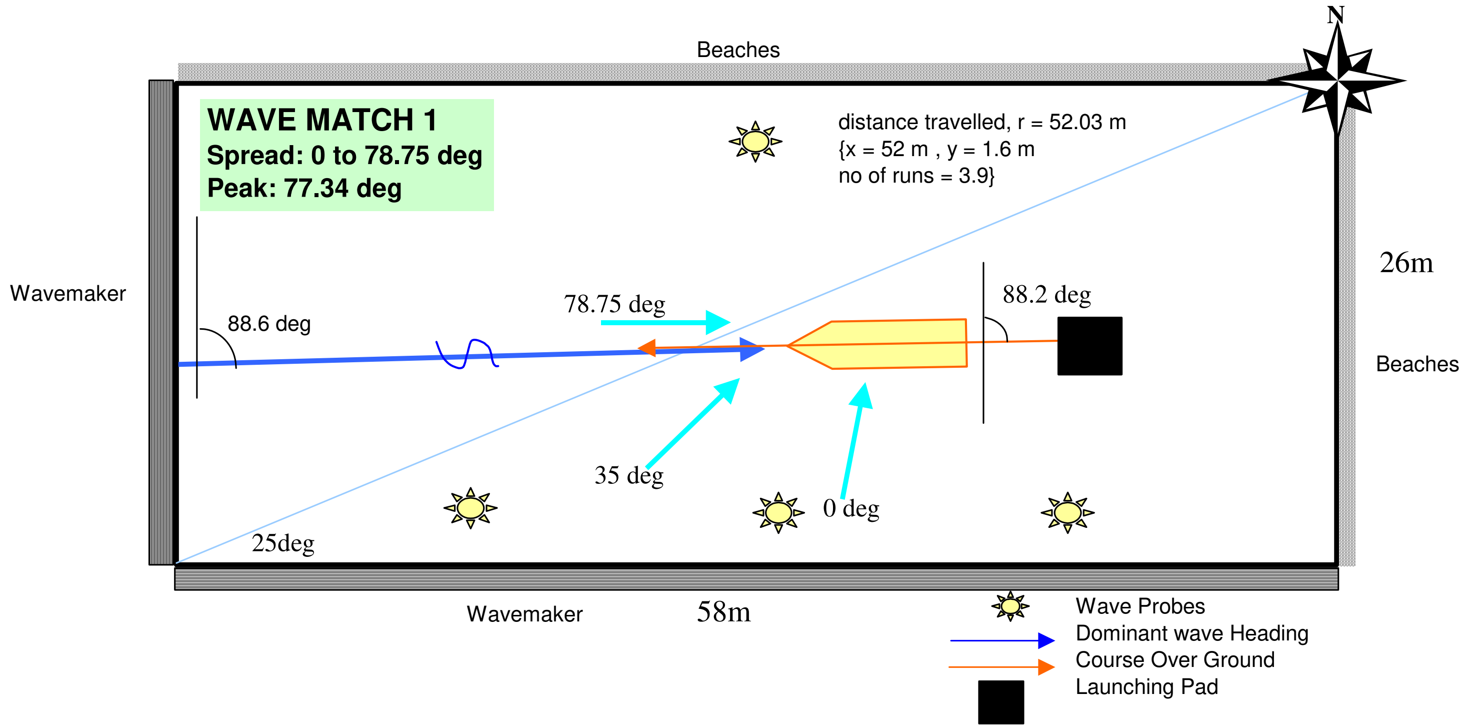


Safer Fishing Vessel Seakeeping **CCGA Roberts Sisters II Seakeeping Experiments - July 2009**
Proj. #42_2374_10
Bow Seas, Trawl Speed

Model Speed (m/s)	0.473		time for 20 min of trials in model scale (min) 6.124
SOG	3	Knots	
COG	120	Degrees True North (Sea trials)	
Max Wave Direction	119.63	Degrees True North (Sea trials)	

Relative angle -0.37 Degrees (pure head seas is zero degrees)
179.63 (Wave heading - COG)

Acquired Nov. 15, 2004 @ 14:27 UTC, 10:57 NF Time using Datawell directional wave buoy
Max wave direction is 126.6563 Degrees True North (Sea trials)



Safer Fishing Vessel Seakeeping **CCGA Roberts Sisters II Seakeeping Experiments - July 2009**

Proj. #42_2374_10

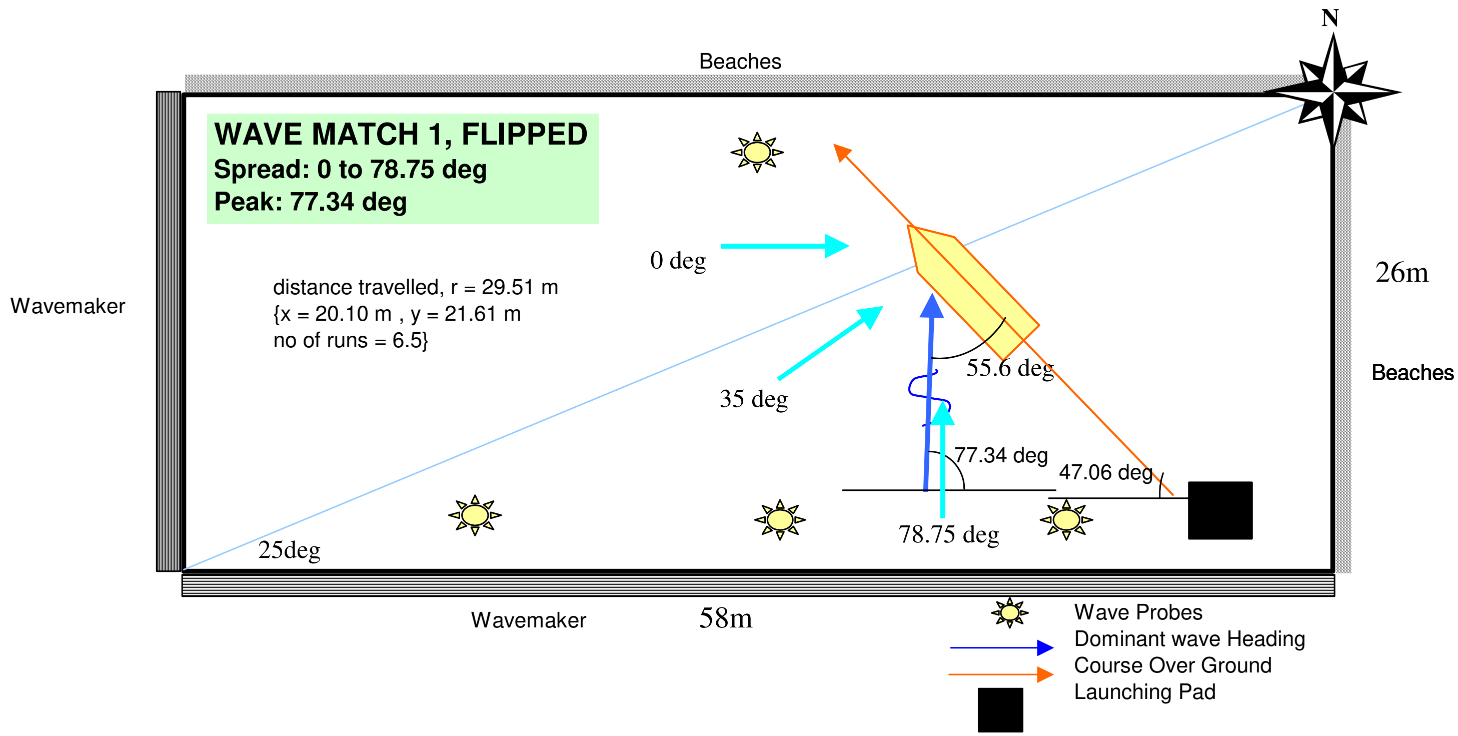
Beam Seas, Trawl Speed

Model Speed (m/s)	0.410		time for 20 min of trials in model scale (min) 6.124
SOG	2.6	Knots	
COG	344	Degrees True North (Sea trials)	
Max Wave Direction	108.38	Degrees True North (Sea trials)	

Relative angle 124.38 Degrees (pure head seas is zero degrees)
55.62 (Wave heading - COG)

Acquired Nov. 15, 2004 @ 14:27 UTC, 10:57 NF Time using Datawell directional wave buoy
Max wave direction is 126.6563 Degrees True North (Sea trials)

WAVES ARE FLIPPED: Now the waves coming from the port side



Safer Fishing Vessel Seakeeping **CCGA Roberts Sisters II Seakeeping Experiments - July 2009**

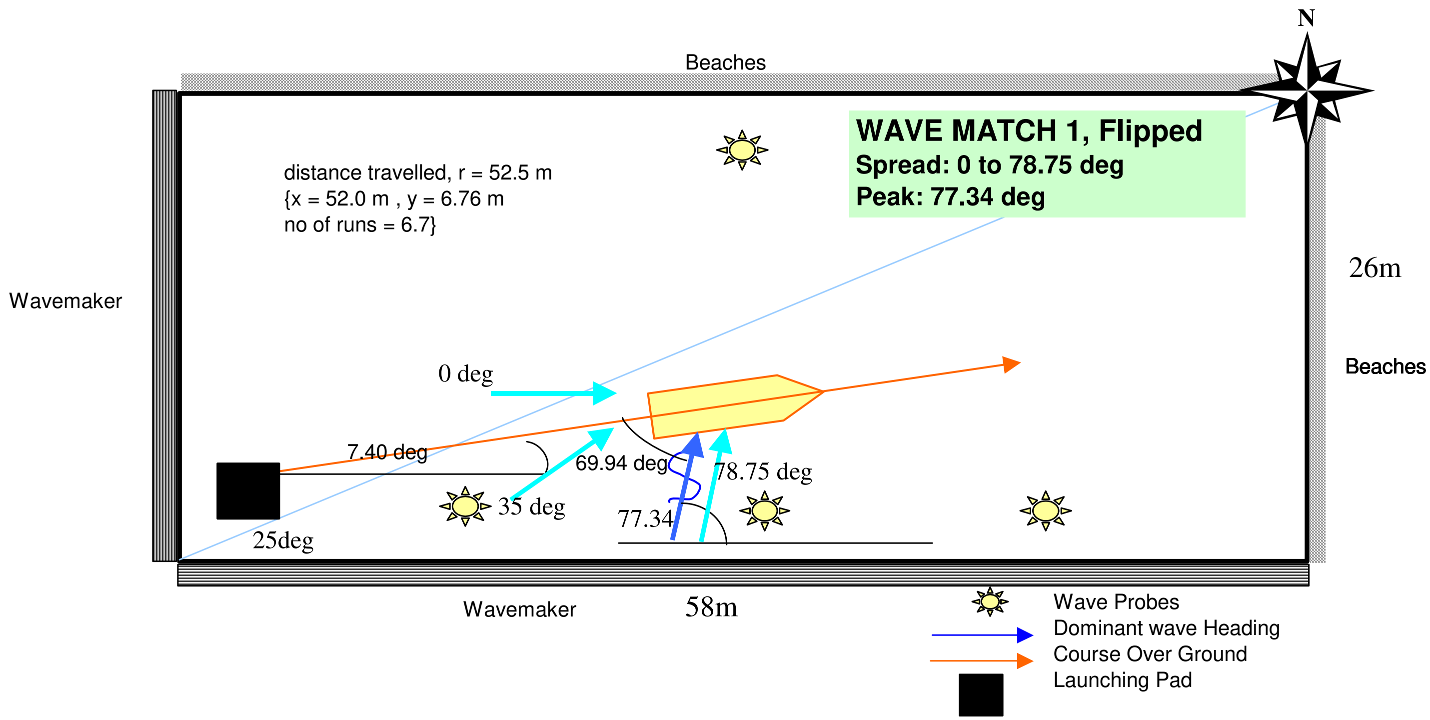
Proj. #42_2374_10

Quartering Seas, Trawl Speed

Model Speed (m/s)	0.756	time for 20 min of trials in model scale (min) 6.124
SOG	4.8	Knots
COG	210	Degrees True North (Sea trials)
Max Wave Direction	99.94	Degrees True North (Sea trials)
Relative angle	-110.06	Degrees (pure head seas is zero degrees)
	69.94	(Wave heading - COG)

Acquired Nov. 15, 2004 @ 14:27 UTC, 10:57 NF Time using Datawell directional wave buoy
Max wave direction is 126.6563 Degrees True North (Sea trials)

WAVES ARE FLIPPED: Now the waves coming from the starboard side



Safer Fishing Vessel Seakeeping **CCGA Roberts Sisters II Seakeeping Experiments - July 2009**

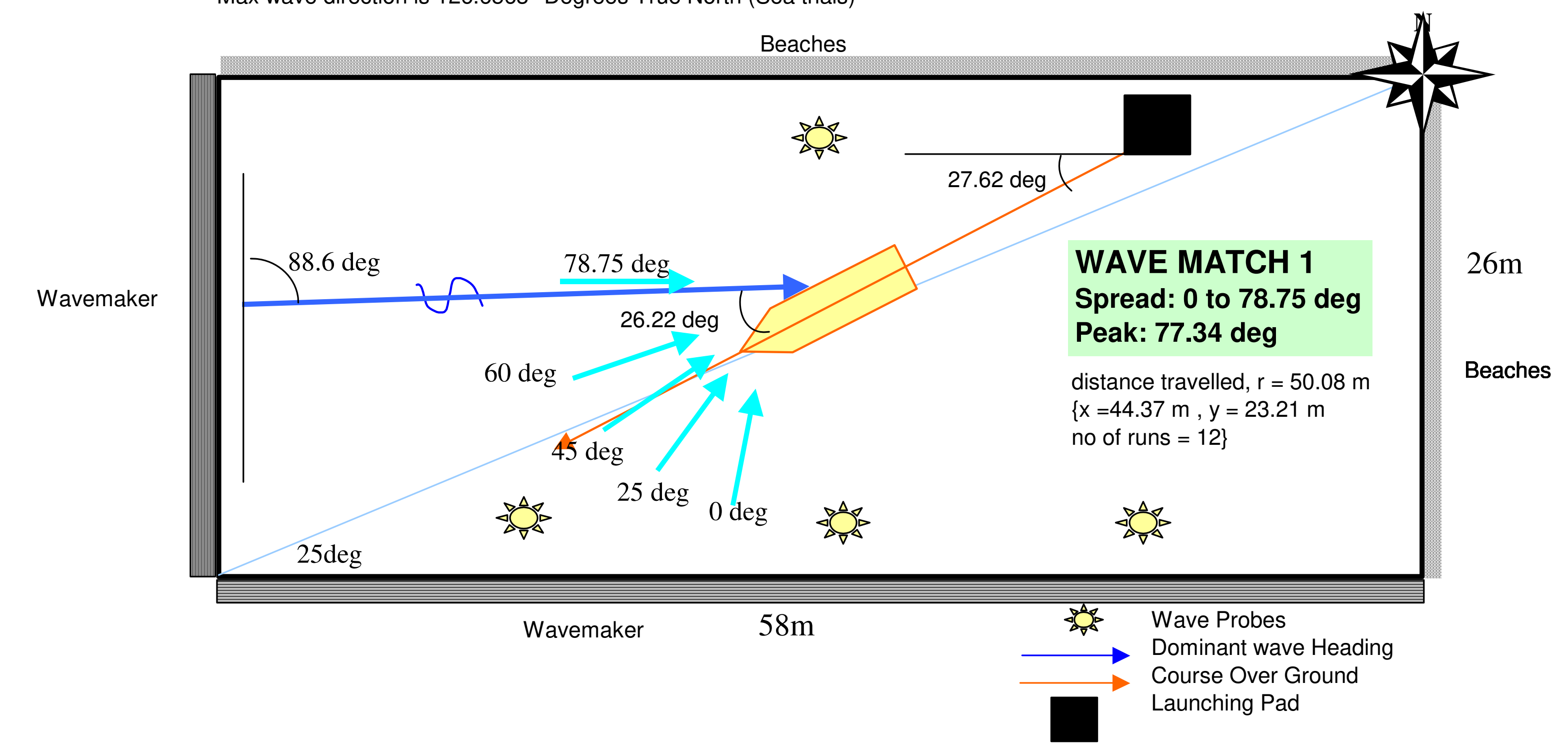
Proj. #42_2374_10

Head Seas, Cruise Speed

Model Speed (m/s)	1.134		time for 20 min of trials in model scale (min) 6.124
SOG	7.2	Knots	
COG	92	Degrees True North (Sea trials)	
Max Wave Direction	118.22	Degrees True North (Sea trials)	

Relative angle 26.22 Degrees (pure head seas is zero degrees)
153.78 (Wave heading - COG)

Acquired Nov. 15, 2004 @ 14:27 UTC, 10:57 NF Time using Datawell directional wave buoy
Max wave direction is 126.6563 Degrees True North (Sea trials)



Safer Fishing Vessel Seakeeping **CCGA Roberts Sisters II Seakeeping Experiments - July 2009**

Proj. #42_2374_10

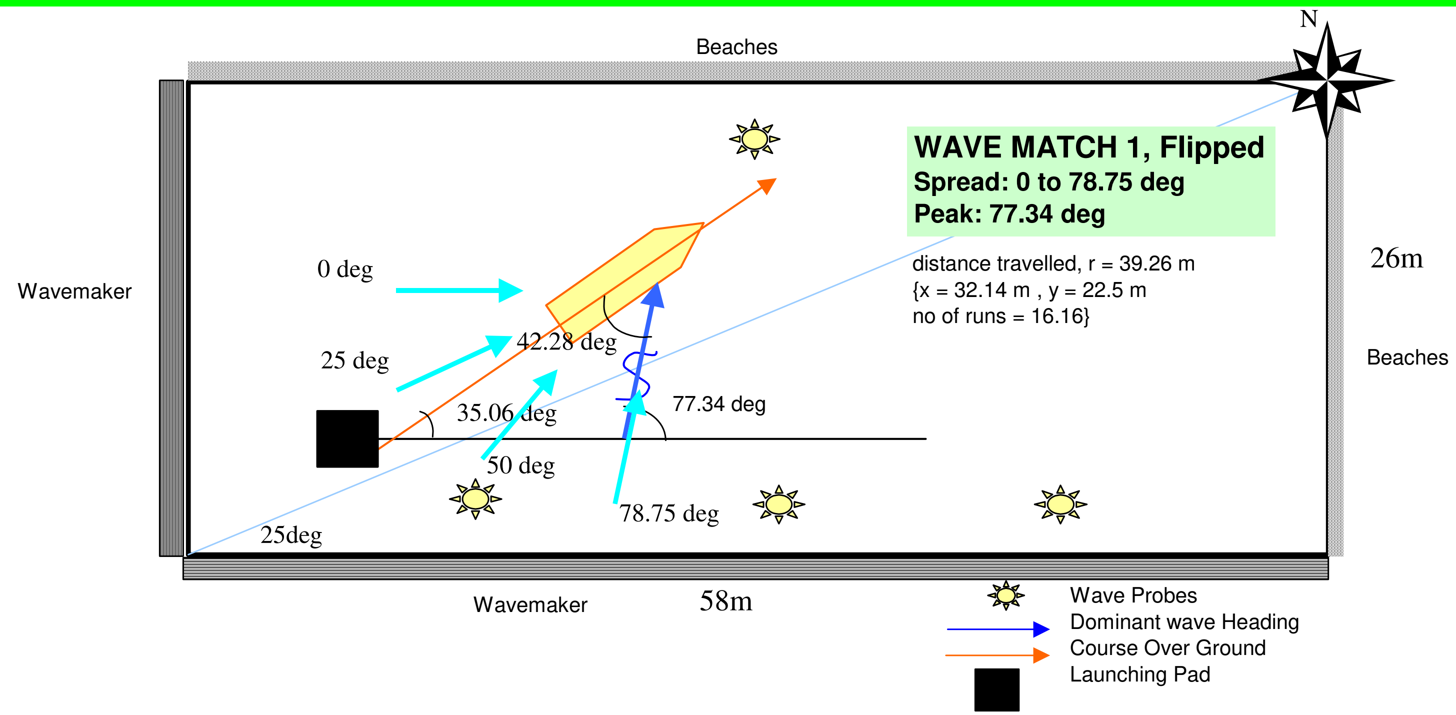
Following Seas, Cruise Speed

Model Speed (m/s)	1.118		time for 20 min of trials in model scale (min) 6.124
SOG	7.1	Knots	
COG	270	Degrees True North (Sea trials)	
Max Wave Direction	132.28	Degrees True North (Sea trials)	

Relative angle -137.72 Degrees (pure head seas is zero degrees)
42.28 (Wave heading - COG)

Acquired Nov. 15, 2004 @ 14:27 UTC, 10:57 NF Time using Datawell directional wave buoy
Max wave direction is 126.6563 Degrees True North (Sea trials)

WAVES ARE FLIPPED: Now the waves coming from the starboard side



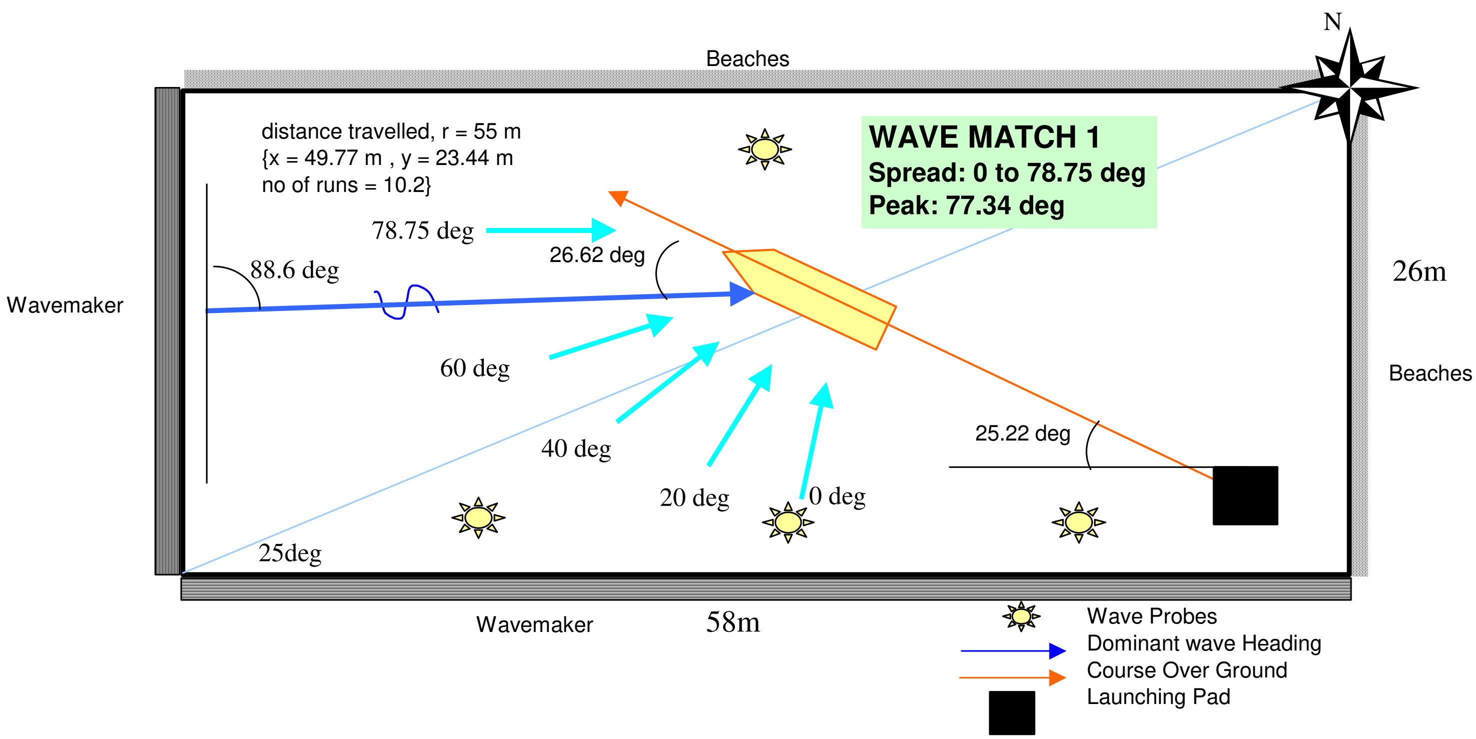
Safer Fishing Vessel Seakeeping **CCGA Roberts Sisters II Seakeeping Experiments - July 2009**

Proj. #42_2374_10

Bow Seas, Cruise Speed

Model Speed (m/s)	1.103		time for 20 min of trials in model scale (min) 6.124
SOG	7	Knots	
COG	135	Degrees True North (Sea trials)	
Max Wave Direction	108.38	Degrees True North (Sea trials)	
Relative angle	-26.62	Degrees (pure head seas is zero degrees)	
	153.38	(Wave heading - COG)	

Acquired Nov. 15, 2004 @ 14:27 UTC, 10:57 NF Time using Datawell directional wave buoy
Max wave direction is 126.6563 Degrees True North (Sea trials)



Safer Fishing Vessel Seakeeping **CCGA Roberts Sisters II Seakeeping Experiments - July 2009**
Proj. #42_2374_10

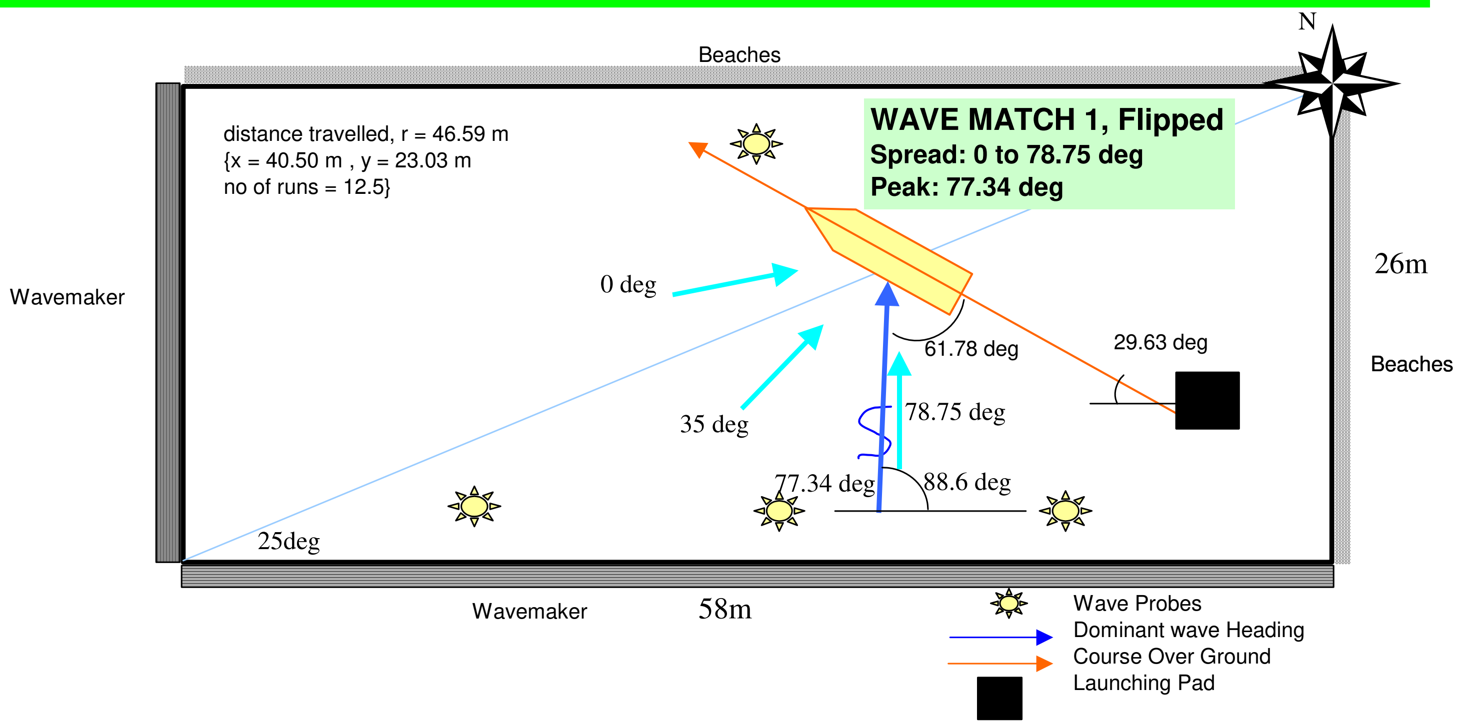
Beam Seas, Cruise Speed

Model Speed (m/s)	1.103		time for 20 min of trials in model scale (min) 6.124
SOG	7	Knots	
COG	0	Degrees True North (Sea trials)	
Max Wave Direction	118.22	Degrees True North (Sea trials)	

Relative angle 118.22 Degrees (pure head seas is zero degrees)
61.78 (Wave heading - COG)

Acquired Nov. 15, 2004 @ 14:27 UTC, 10:57 NF Time using Datawell directional wave buoy
Max wave direction is 126.6563 Degrees True North (Sea trials)

WAVES ARE FLIPPED: Now the waves coming from the port side



Safer Fishing Vessel Seakeeping **CCGA Roberts Sisters II Seakeeping Experiments - July 2009**
Proj. #42_2374_10

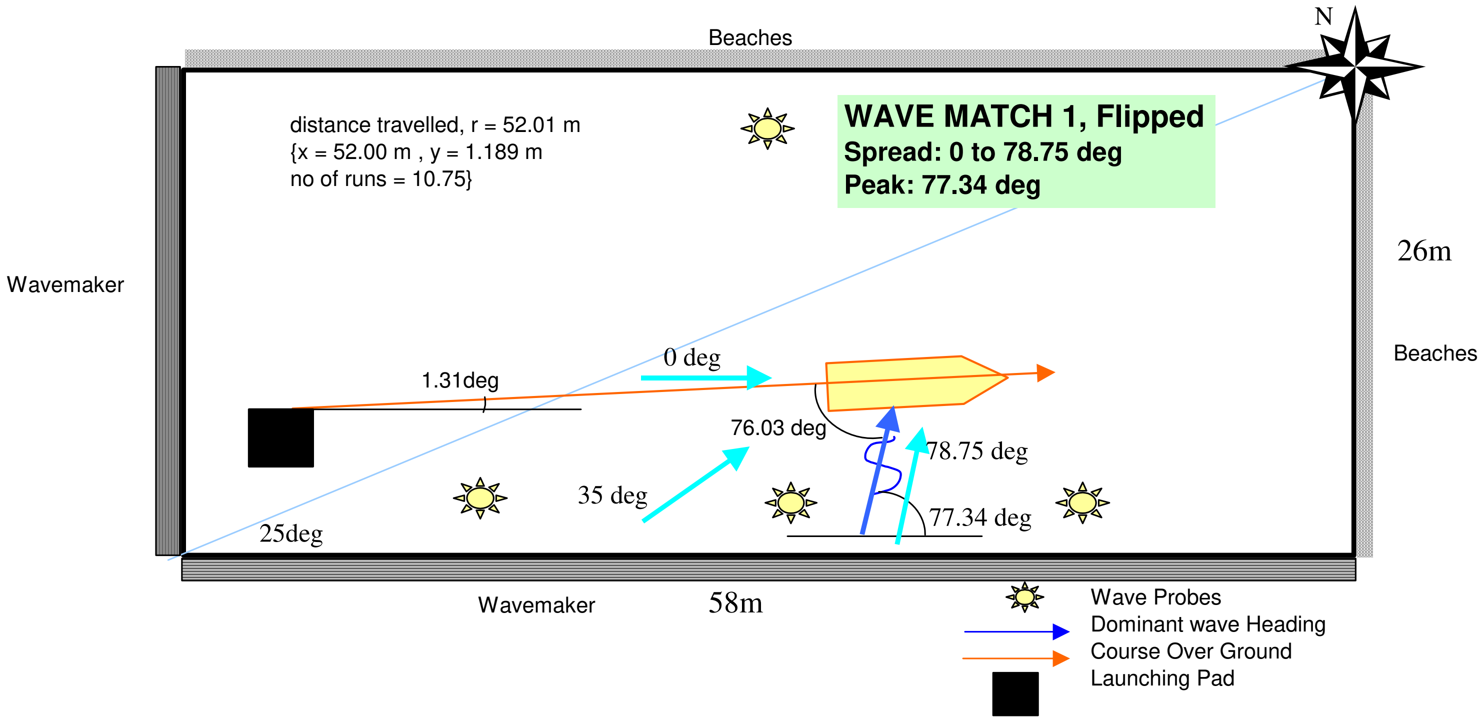
Quartering Seas, Cruise Speed

Model Speed (m/s)	1.103		time for 20 min of trials in model scale (min) 6.124
SOG	7	Knots	
COG	225	Degrees True North (Sea trials)	
Max Wave Direction	121.03	Degrees True North (Sea trials)	

Relative angle -103.97 Degrees (pure head seas is zero degrees)
76.03 (Wave heading - COG)

Acquired Nov. 15, 2004 @ 14:27 UTC, 10:57 NF Time using Datawell directional wave buoy
Max wave direction is 126.6563 Degrees True North (Sea trials)

WAVES ARE FLIPPED: Now the waves coming from the starboard side



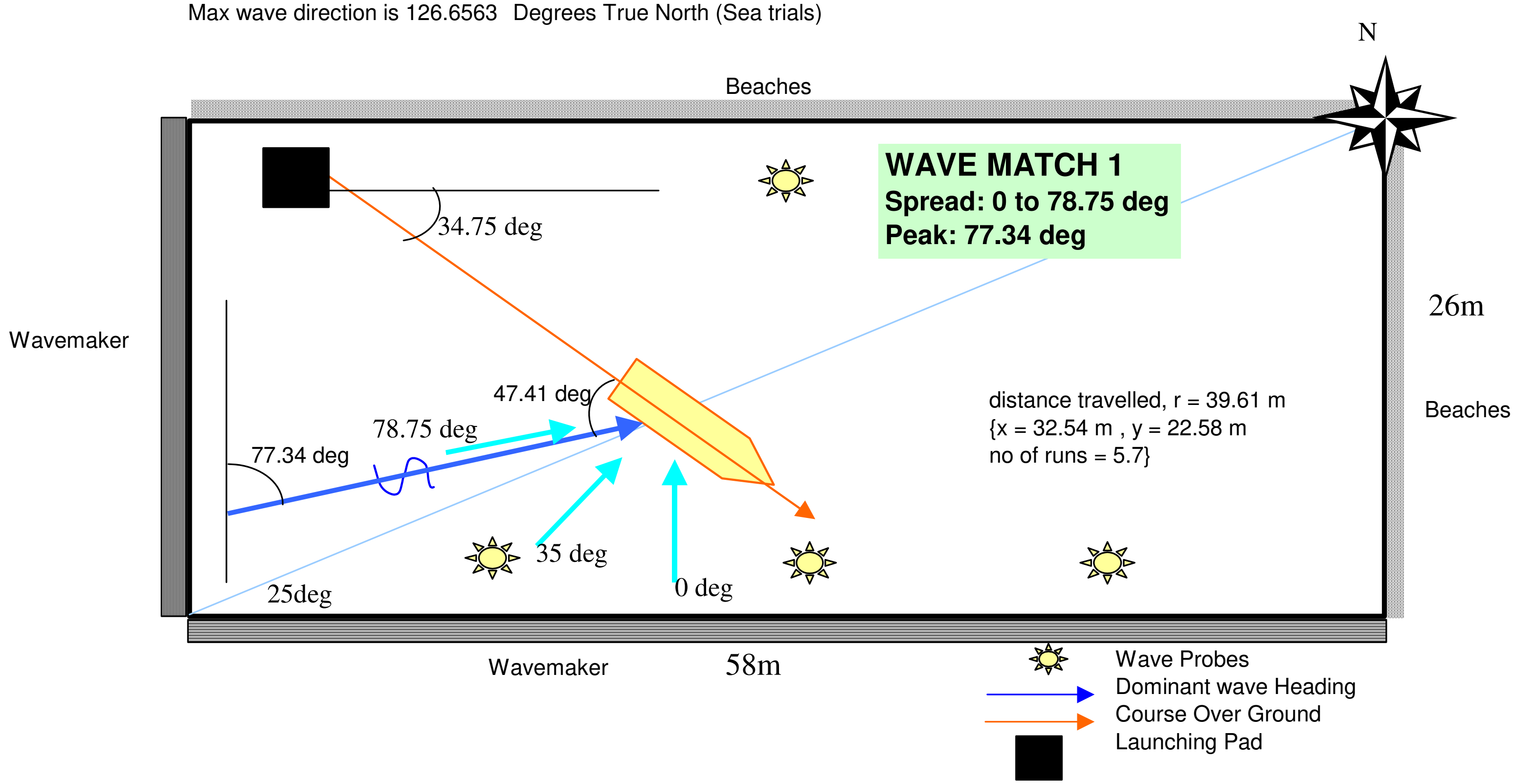
Safer Fishing Vessel Seakeeping **CCGA Roberts Sisters II Seakeeping Experiments - July 2009**

Proj. #42_2374_10

Beam Seas, Trawl Speed with Anti Roll Tanks filled

Model Speed (m/s)	0.504	time for 20 min of trials in model scale (min) 6.124
SOG	3.2	Knots
COG	340	Degrees True North (Sea trials)
Max Wave Direction	112.59	Degrees True North (Sea trials)
Relative angle	-227.41	Degrees (pure head seas is zero degrees)
	-47.41	(Wave heading - COG)

Acquired Nov. 15, 2004 @ 14:27 UTC, 10:57 NF Time using Datawell directional wave buoy
Max wave direction is 126.6563 Degrees True North (Sea trials)



Safer Fishing Vessel Seakeeping **CCGA Roberts Sisters II Seakeeping Experiments - July 2009**
Proj. #42_2374_10

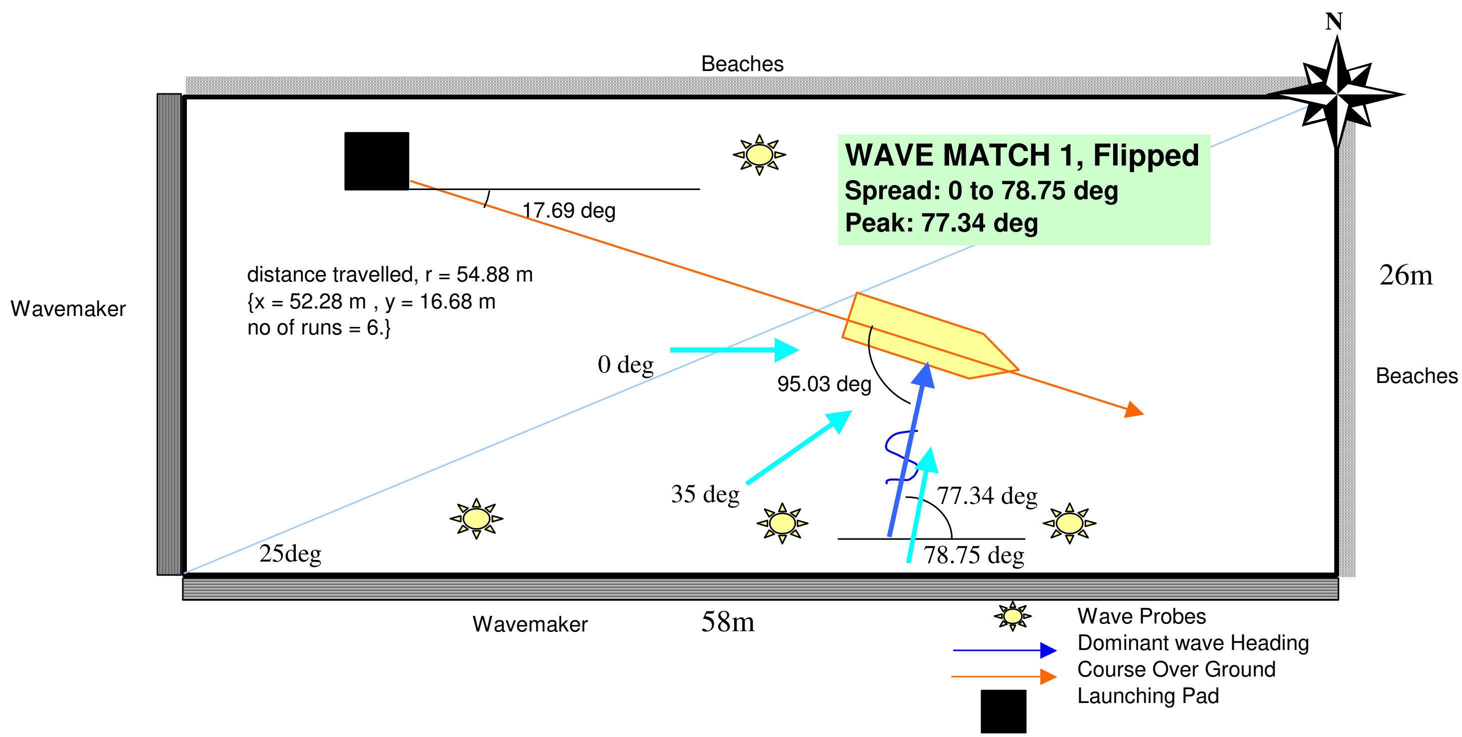
Quartering Seas, Trawl Speed with Anti Roll Tanks filled

Model Speed (m/s)	0.740		time for 20 min of trials in model scale (min) 6.124
SOG	4.7	Knots	
COG	206	Degrees True North (Sea trials)	
Max Wave Direction	121.03	Degrees True North (Sea trials)	

Relative angle	-84.97	Degrees (pure head seas is zero degrees)
	95.03	(Wave heading - COG)

Acquired Nov. 15, 2004 @ 14:27 UTC, 10:57 NF Time using Datawell directional wave buoy
Max wave direction is 126.6563 Degrees True North (Sea trials)

WAVES ARE FLIPPED: Now the waves coming from the starboard side



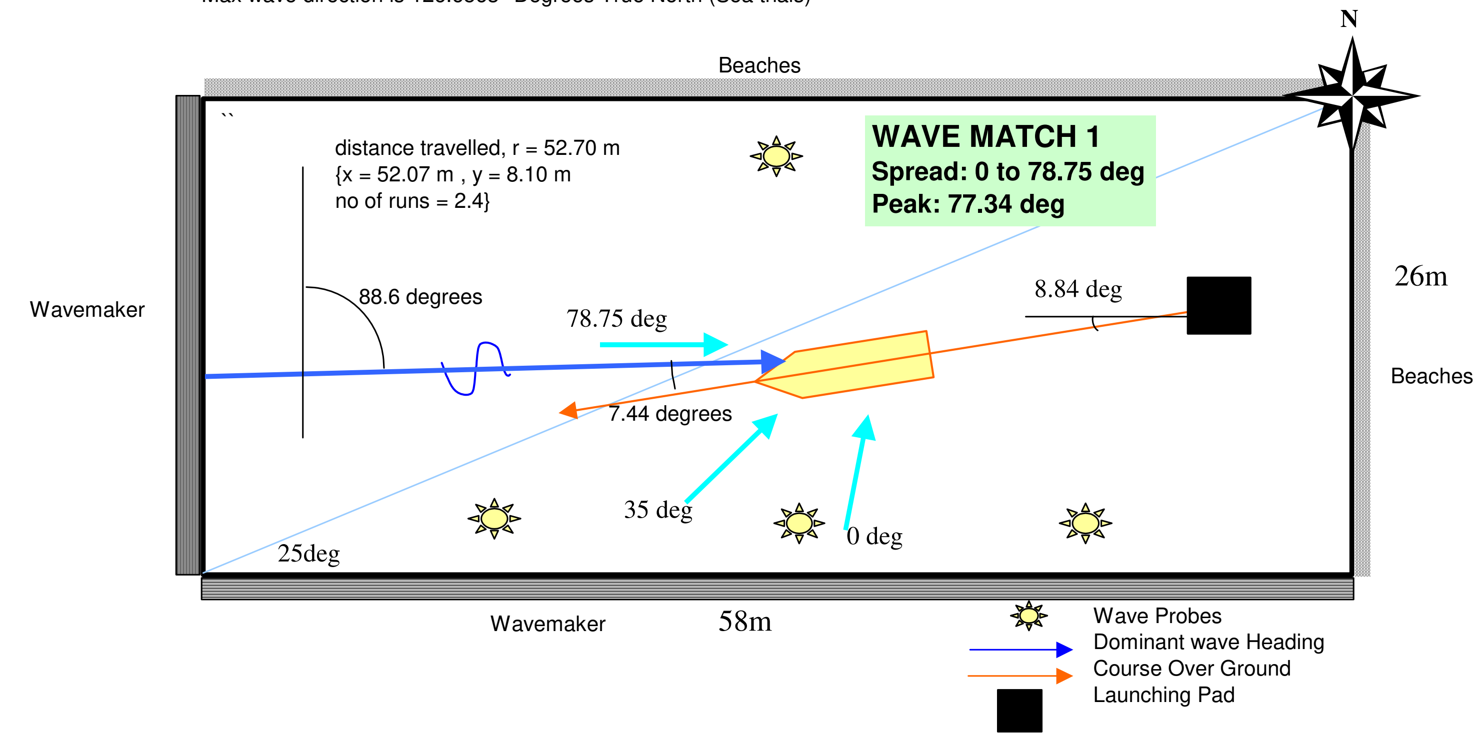
Safer Fishing Vessel Seakeeping **CCGA Roberts Sisters II Seakeeping Experiments - July 2009**

Proj. #42_2374_10

Bow Seas, Trawl Speed with Anti Roll Tanks filled

Model Speed (m/s)	0.315	time for 20 min of trials in model scale (min) 6.124
SOG	2	Knots
COG	115	Degrees True North (Sea trials)
Max Wave Direction	122.44	Degrees True North (Sea trials)
Relative angle	7.44	Degrees (pure head seas is zero degrees)
	172.56	(Wave heading - COG)

Acquired Nov. 15, 2004 @ 14:27 UTC, 10:57 NF Time using Datawell directional wave buoy
Max wave direction is 126.6563 Degrees True North (Sea trials)



APPENDIX F

RUN LOG/VIDEO LOG

CCGA Roberts Sisters II Seakeeping Experiments

Model IOT761		Model Scale 1:10.67	Proj. 42_2374_10			Offshore Engineering Basin
Date	**Time**	**Wave Drive Signal**	**File Name**	**Video Tape #**	**Video Time**	**Comments**
10-Jul-09	10:36:11		roll_decay_001			zero speed roll decay tests
10-Jul-09	10:40:02		roll_decay_002			zero speed roll decay tests
10-Jul-09	10:47:48		pitch_decay_001			Pitch decay test
10-Jul-09	11:04:36		speed_run_001			rps 12.75 Measured Speed= 1.21 m/s
		calm water zig zag manoeuvres carried out to tune model autopilot				
10-Jul-09	11:17:04		Zigzag_001			1.21 m/s 5 deg rudder 5 deg yaw
10-Jul-09	11:23:50		Zigzag_002			1.21 m/s 10 deg rudder 10 deg yaw
10-Jul-09	11:31:46		speed_run_002			rps 6.63 Measured speed = 0.617 m/s
10-Jul-09	13:28:39		Zigzag_003			0.617 m/s, 15 deg Rudder 10 deg yaw
10-Jul-09	13:43:12		Zigzag_004			0.617 m/s, 25 deg Rudder 15 deg yaw
10-Jul-09	13:54:29		Zigzag_005			1.21 m/s 20 deg rudder 10 deg yaw
10-Jul-09	14:10:52	REG25_H0P75_T4P90_DRV	wave_run_001			Speed = 1.21 m/s
10-Jul-09	14:21:46	REG25_H0P75_T4P90_DRV	wave_run_002			Speed = 0.617 m/s
10-Jul-09	14:49:50		Zigzag_006			1.21 m/s 25 deg rudder 5 deg yaw
10-Jul-09	14:55:28		Zigzag_007			1.21 m/s 2 deg rudder 5 deg yaw, aborted
10-Jul-09	15:02:53		Zigzag_008			1.21 m/s 5 deg rudder 5 deg yaw, aborted
13-Jul-09	9:35:46	REG45_H0P55_T4P20_DRV	wave_run_003			rps 12.75
13-Jul-09	9:45:06	REG45_H0P95_T5P51_DRV	wave_run_004			rps 12.75
13-Jul-09	9:55:50	REG45_H0P95_T5P51_DRV	wave_run_005			rps 6.63
13-Jul-09	13:36:28	REG45_H0P95_T5P51_DRV	wave_run_006			rps 6.63 with auto pilot set, run aborted, rudder failure
13-Jul-09						QUALISYS reference point changed to position of MotionPak, Previous location was bow QUALISYS marker (Shift was X= -745.06 mm Z= 1091.63 mm)
13-Jul-09	13:50:37	REG45_H0P95_T5P51_DRV	wave_run_007			rps 6.63 with auto pilot set, run aborted autopilot not working properly
13-Jul-09	13:56:17	REG45_H0P95_T5P51_DRV	wave_run_008			rps 6.63 with auto pilot set, auto pilot tuning
13-Jul-09	14:05:55	REG45_H0P95_T5P51_DRV	wave_run_009			rps 6.63 with auto pilot set, auto pilot tuning
13-Jul-09	14:57:30		wave_run_010			rps 6.63 with auto pilot set, autopilot tuning no wave
13-Jul-09	15:05:42	REG45_H0P95_T5P51_DRV	wave_run_011			rps 6.63 with autopilot set, autopilot tuning with Kalman Filter
13-Jul-09	15:11:58	REG45_H0P95_T5P51_DRV	wave_run_012			rps 6.63 with autopilot set, autopilot tuning without Kalman Filter
14-Jul-09	9:25:00	REG45_H0P95_T5P51_DRV	wave_run_013			rps 6.63 with autopilot set, auto pilot tuning with Kalman Filter, invert rudder on, negative k
14-Jul-09	9:31:42	REG45_H0P95_T5P51_DRV	wave_run_014			rps 6.63 with autopilot set, autopilot tuning with Kalman Filter, turned off invert rudder, negative k
14-Jul-09	9:51:33		sign_check_001			error noted
14-Jul-09	9:52:13		sign_check_002			tipping model to stbd
14-Jul-09	9:53:25		sign_check_003			pushing bow down
14-Jul-09	9:56:48		sign_check_004			push model straight to port, push model straight to stbd, push model straight forward, push model straight back,
14-Jul-09	10:46:32		sign_check_005			weight added to top of roll tank and removed x 2
14-Jul-09	10:51:40		sign_check_006			pulled model to port, model pushed to port from stbd, model pushed to stbd from port, model pulled to stern from winch,
14-Jul-09	11:33:00		sign_check_007			model lowered on OEB overhead crane, heave, while in cradle
14-Jul-09	11:38:45		sign_check_008			Yaw check pull counterclockwise then clockwise
14-Jul-09	11:44:00		sign_check_009			Sway check push from port (Tank south)
14-Jul-09	11:49:54		sign_check_010			Surge west or towards bow the back
14-Jul-09	11:55:17		sign_check_011			push model from stern
14-Jul-09	12:57:53	RS2_w1_mds	0drift_beam_001	1	0:00:00	Drift test model drifting to probe abort and retry
14-Jul-09	13:04:14	RS2_w1_mds	0drift_beam_002	1	0:02:17	Drift test model pointing West Head to sea
14-Jul-09	13:20:53	RS2_w1_mds	0drift_beam_003	1	0:09:40	Drift test model pointing East Following sea Model did not stay on following seas, retry with larger heading
14-Jul-09	13:23:48	RS2_w1_mds	0drift_beam_004	1	0:10	Drift test model pointing East Following sea same as above
14-Jul-09	13:27:00	RS2_w1_mds	0drift_beam_005	1	0:11:41	Drift test model pointing North East Following sea
14-Jul-09						Auto Pilot Angle Setpoint = -1.77 deg
14-Jul-09	14:06:42	RS2_w3_mds	TBow_001	1	0:18:25	Tbow Test 1
14-Jul-09	14:19:07	RS2_w3_mds	TBow_002	1	0:20:39	Span @ 5:50 Rel @ 5:25
14-Jul-09	14:35:23	RS2_w3_mds	TBow_003	1	0:22:06	Span @ 3:54 Rel @ 3:39
14-Jul-09	14:45:38	RS2_w3_mds	TBow_004	1	0:23:54	Span @ 2:09 Rel @ 1:54
14-Jul-09	15:20:09	RS2_w3_mds	TBow_005	1	0:25:45	Span @ 1:15 Rel @ 1:00
						added 2.88 kg of water added to tank, Auto Pilot Angle Setpoint t = -8.84 deg,
15-Jul-09	10:19:59	RS2_w3_mds	ART_TBow_001	1	0:27:25	, Rel @ 7:15
15-Jul-09	10:30:42	RS2_w3_mds	ART_TBow_002	1	0:28:44	Span @ 5:45, Rel @ 5:30
15-Jul-09	10:42:47	RS2_w3_mds	ART_TBow_003	1	0:30:33	Span @ 3:51, Rel @ 3:36
15-Jul-09	10:56:55	RS2_w3_mds	ART_TBow_004	1	0:31:45	Span @ 2:05, Rel @ 1:50
15-Jul-09	11:11:46	RS2_w3_mds	ART_TBow_005	1	0:33:19	Span @ 1:15, Rel @ 1:00
15-Jul-09	12:00:00					Moved control station and launch to north east corner for next set of headings
15-Jul-09	13:40:14		angle_check_001			Run to collect launch angle to be able to in put new setpoint
15-Jul-09						Auto Pilot Angle Setpoint = -3.1 deg
15-Jul-09	13:56:37	RS2_w1_mds	THEAD_001	1	0:35:01	Rel @ 7:07
15-Jul-09						Auto Pilot Angle Setpoint = -5 deg
15-Jul-09	14:06:15	RS2_w1_mds	THEAD_002	1	0:36:58	Span @ 6:03, Rel @ 5:40 bad release repeat with lower transit time
15-Jul-09	14:12:45	RS2_w1_mds	THEAD_003	1	0:37:35	Span @ 5:55, Rel @ 5:40
15-Jul-09	14:23:56	RS2_w1_mds	THEAD_004	1	0:39:18	Span @ 4:28, Rel @ 4:13
15-Jul-09	14:38:36	RS2_w1_mds	THEAD_005	1	0:41:16	Run with new Kalman filter settings OmegaN 3.25, Zeta =0.05

Date	Time	Wave Drive Signal	File Name	Video Tape #	Video Time	Comments
15-Jul-09	14:52:14	RS2_w1_mds	THEAD_006	1	0:42:24	Span @ 3:15, Rel @ 3:00
15-Jul-09	15:04:43	RS2_w1_mds	THEAD_007	1	0:44:26	Span @1:56 , Rel @ 1:41
15-Jul-09	15:15:47	RS2_w1_mds	THEAD_008	1	0:46:21	Last run with more overlap Span @1:15 , Rel @ 1:00
15-Jul-09	15:29:15	RS2_w3_mds	CHEAD_001	1	0:47:41	Rel @ 7:15
15-Jul-09	15:35:59	RS2_w3_mds	CHEAD_002	1	0:48:48	Span @7:04 , Rel @ 6:49
16-Jul-09	8:43:24	RS2_w3_mds	CHEAD_003	1	0:50:04	Span @6:32 , Rel @ 6:17
16-Jul-09	8:51:34	RS2_w3_mds	CHEAD_004	1	0:50:52	Span @6:03 , Rel @ 5:48
16-Jul-09	9:01:52	RS2_w3_mds	CHEAD_005	1	0:51:49	Span @5:28 , Rel @ 5:13
16-Jul-09	9:12:58	RS2_w3_mds	CHEAD_006	1	0:52:54	Repeat Last run (missed data) Span @ 5:29 , Rel @ 5:14
16-Jul-09	9:24:10	RS2_w3_mds	CHEAD_007	1	0:53:37	Span @4:58 , Rel @ 4:43
16-Jul-09	9:34:32	RS2_w3_mds	CHEAD_008	1	0:54:36	Span @4:30 , Rel @ 4:13
16-Jul-09	9:47:23	RS2_w3_mds	CHEAD_009	1	0:55:31	Span @4:01 , Rel @ 3:43
16-Jul-09	9:58:06	RS2_w3_mds	CHEAD_010	1	0:56:27	Span @3:30 , Rel @ 3:12
16-Jul-09	10:07:22	RS2_w3_mds	CHEAD_011	1	0:58:07	Span @2:55, Rel @ 2:37
16-Jul-09	10:18:23	RS2_w3_mds	CHEAD_012	1	0:58:58	Span @2:19, Rel @ 2:01
16-Jul-09	10:29:24	RS2_w3_mds	CHEAD_013	1	0:59:47	Span @1:50, Rel @ 1:32
16-Jul-09	10:39:55	RS2_w3_mds	CHEAD_014	1	1:00:33	Span @1:18, Rel @ 1:00
16-Jul-09	10:49:51	RS2_w3_mds	CHEAD_015	1	1:01:40	Span @ 0:43, Rel @ 0:25
16-Jul-09	11:00:00					Moved control station and launch to South east corner for next set of headings
16-Jul-09	14:23:10	RS2_w3_mds	angle_check_001			Run to collect launch angle to be able to in put new setpoint
17-Jul-09						
17-Jul-09	8:57:51	RS2_w3_mds	CBow_001	1	1:02:54	Rel @ 7:12 Increased RPS to 14.75 rps
17-Jul-09	9:34:00	RS2_w3_mds	CBow_002	1	1:03:26	Rel @ 7:12 Increased rps to 13.5 rps Autopilot Setpoint =-2 deg
17-Jul-09	10:04:20	RS2_w3_mds	CBow_003	1	1:04:17	Span @ 7:03, Rel @ 6:45
17-Jul-09	10:15:21	RS2_w3_mds	CBow_004	1	1:04:58	Span @ 6:35, Rel @ 6:17
17-Jul-09	10:25:35	RS2_w3_mds	CBow_005	1	1:05:57	Span @ 6:05, Rel @ 5:47
17-Jul-09	10:35:13	RS2_w3_mds	CBow_006	1	1:06:43	Span @ 5:33, Rel @ 5:15
17-Jul-09	10:45:07	RS2_w3_mds	CBow_007	1	1:07:36	Span @ 5:02, Rel @ 4:44
17-Jul-09	10:57:46	RS2_w3_mds	CBow_008	1	1:08:53	Span @ 4:32, Rel @ 4:14
17-Jul-09	11:07:08	RS2_w3_mds	CBow_009	1	1:09:47	Span @ 4:03, Rel @ 3:45
17-Jul-09	11:24:12	RS2_w3_mds	CBow_010	1	1:10:28	Span @ 3:32, Rel @ 3:14
17-Jul-09	11:34:03	RS2_w3_mds	CBow_011	1	1:11:23	Span @ 3:02, Rel @ 2:44
17-Jul-09	11:44:04	RS2_w3_mds	CBow_012	1	1:12:21	Span @ 2:35, Rel @ 2:17
17-Jul-09	11:54:04	RS2_w3_mds	CBow_013	1	1:13:10	Span @ 2:07 , Rel @ 1:49
17-Jul-09	12:04:07	RS2_w3_mds	CBow_014	1	1:14:01	Span @ 1:35 , Rel @ 1:17
17-Jul-09	12:14:06	RS2_w3_mds	CBow_015	1	1:14:33	Span @ 1:07 , Rel @ 0:49
17-Jul-09	13:50:44	RS2_w3_mds	CBow_016	1	1:15:25	Span @ 0:38 , Rel @ 0:20
17-Jul-09	14:07:03	RS2_w2_mds	Cbeam_001	1	1:16:02	Rel @ 7:12, Autopilot Setpoint = 2.41deg, RPS = 13.5
17-Jul-09	14:21:09	RS2_w2_mds	Cbeam_002	1	1:16:53	Rel @ 7:12, Autopilot Setpoint = 2.41deg, RPS = 12.75
17-Jul-09	14:32:00	RS2_w2_mds	Cbeam_003	1	1:17:48	Span @ 7:03, Rel @ 6:45
17-Jul-09	14:42:03	RS2_w2_mds	Cbeam_004	1	1:18:54	Span @ 6:35, Rel @ 6:17 Bad Autopilot Setting repeat
17-Jul-09	14:50:04	RS2_w2_mds	Cbeam_005	1	1:20:14	Span @ 6:35, Rel @ 6:17
17-Jul-09	15:00:03	RS2_w2_mds	Cbeam_006	1	1:21:11	Span @ 6:04, Rel @ 5:46
17-Jul-09	15:10:04	RS2_w2_mds	Cbeam_007	1	1:22:10	Span @ 5:33, Rel @ 5:15
17-Jul-09	15:20:04	RS2_w2_mds	Cbeam_008	1	1:23:04	Span @ 5:03, Rel @ 4:45
17-Jul-09	15:30:02	RS2_w2_mds	Cbeam_009	1	1:23:57	Span @ 4:32, Rel @ 4:14
20-Jul-09						**OEB Maintenance day**
21-Jul-09						Rezero Probe
21-Jul-09	8:55:29	RS2_w2_mds	Cbeam_010	1	1:24:43	Span @ 4:05, Rel @ 3:47
21-Jul-09	9:05:23	RS2_w2_mds	Cbeam_011	1	1:25:41	Span @ 3:32, Rel @ 3:14
21-Jul-09	9:15:54	RS2_w2_mds	Cbeam_012	2	0:00:00	Span @ 2:53, Rel @ 2:35
21-Jul-09	9:25:52	RS2_w2_mds	Cbeam_013	2	0:03:45	Span @ 2:23, Rel @ 2:05
21-Jul-09	9:36:20	RS2_w2_mds	Cbeam_014	2	0:06:04	Span @ 1:50, Rel @ 1:32
21-Jul-09	9:45:52	RS2_w2_mds	Cbeam_015	2	0:06:27	Span @ 1:16, Rel @ 0:58
21-Jul-09	9:56:09	RS2_w2_mds	Cbeam_016	2	0:07:25	**Span @ 0:42, Rel @ 0:24**
21-Jul-09						
21-Jul-09	10:33:36	REG25_H1P92_T8P01_DRV2	Case1_1_001	2	0:07:52	Autopilot Setpoint = -2.2 deg, RPS = 6.63
21-Jul-09						wave angle incorrectly spec'd at matching, regen new waves with theta=65
21-Jul-09	10:50:48	REG65_H1P92_T8P01_DRV2	Case1_1_002	2	0:10:07	Autopilot Setpoint = -2.2 deg, RPS = 6.63
21-Jul-09	11:02:17	REG65_H1P92_T8P01_DRV2	Case1_1_003	2	0:16:40	Autopilot Setpoint = -2.2 deg, RPS = 6.63
21-Jul-09						
21-Jul-09	11:10:42	REG65_H1P65_T7P34_DRV2	Case1_2_001	2	0:18:29	Autopilot Setpoint = -2.2 deg, RPS = 6.63
21-Jul-09	11:20:41	REG65_H1P65_T7P34_DRV2	Case1_2_002	2	0:20:03	Autopilot Setpoint = -2.2 deg, RPS = 6.63
21-Jul-09						
21-Jul-09	11:30:44	REG65_H1P42_T6P78_DRV2	Case1_3_001	2	0:21:42	Autopilot Setpoint = -2.2 deg, RPS = 6.63
21-Jul-09	11:40:51	REG65_H1P42_T6P78_DRV2	Case1_3_002	2	0:23:45	Autopilot Setpoint = -2.2 deg, RPS = 6.63
21-Jul-09						
21-Jul-09	11:52:21	REG65_H1P23_T6P29_DRV2	Case1_4_001	2	0:25:29	Autopilot Setpoint = -2.2 deg, RPS = 6.63
21-Jul-09	12:03:55	REG65_H1P23_T6P29_DRV2	Case1_4_002	2	0:27:27	Autopilot Setpoint = -2.2 deg, RPS = 6.63
21-Jul-09	13:01:24	REG65_H1P23_T6P29_DRV2	Case1_4_003	2	n/a	Autopilot Setpoint = 4 deg, RPS = 8.6
21-Jul-09	13:12:27	REG65_H1P23_T6P29_DRV2	Case1_4_004	2	0:29:34	Autopilot Setpoint = 0 deg, RPS = 7.6
21-Jul-09	13:22:39	REG65_H1P23_T6P29_DRV2	Case1_4_005	2	0:30:53	Autopilot Setpoint = 0 deg, RPS = 7.6
21-Jul-09						
21-Jul-09	13:33:18	REG65_H1P08_T5P87_DRV2	Case1_5_001	2	0:32:52	Autopilot Setpoint = 0 deg, RPS = 7.6
21-Jul-09	13:44:08	REG65_H1P08_T5P87_DRV2	Case1_5_002	2	0:34:58	Autopilot Setpoint = 0 deg, RPS = 7.6
21-Jul-09						
21-Jul-09	13:54:00	REG65_H0P95_T5P51_DRV2	Case1_6_001	2	0:36:14	Autopilot Setpoint = 0 deg, RPS = 7.6
21-Jul-09	14:04:00	REG65_H0P95_T5P51_DRV2	Case1_6_002	2	0:38:00	Autopilot Setpoint = 0 deg, RPS = 7.6

Date	Time	Wave Drive Signal	File Name	Video Tape #	Video Time	Comments
21-Jul-09						
21-Jul-09	14:14:00	REG65_H0P75_T4P90_DRV2	Case1_7_001	2	0:39:25	Run aborted - would not take heading.
21-Jul-09	14:23:00	REG65_H0P75_T4P90_DRV2	Case1_7_002	2	0:39:40	Autopilot Setpoint = 0 deg, RPS = 7.6
21-Jul-09	14:34:00	REG65_H0P75_T4P90_DRV2	Case1_7_003	2	0:40:38	Autopilot Setpoint = 0 deg, RPS = 7.6
21-Jul-09						
21-Jul-09	14:45:00	REG25_H1P92_T8P01_DRV2	case3_1_001	2	0:41:29	Autopilot Setpoint = 0 deg, RPS = 7.6 video late starting
21-Jul-09	14:54:00	REG65_H1P92_T8P01_DRV2	case3_1_002	2	0:42:05	Autopilot Setpoint = 0d eg, RPS = 7.6
21-Jul-09						
21-Jul-09	15:04:17	REG65_H1P65_T7P34_DRV2	case3_2_001	2	0:42:05	Autopilot Setpoint = 0 deg, RPS = 12.75
21-Jul-09	15:15:20	REG65_H1P65_T7P34_DRV2	case3_2_002	2	0:42:47	Autopilot Setpoint = 0 deg, RPS = 12.75
21-Jul-09	15:25:06	REG65_H1P65_T7P34_DRV2	case3_2_003	2	0:44:06	Autopilot Setpoint = 0 deg, RPS = 12.75
21-Jul-09						
21-Jul-09	15:35:41	REG65_H1P42_T6P78_DRV2	case3_3_001	2	0:44:56	Autopilot Setpoint = 0 deg, RPS = 13.5
22-Jul-09	9:00:07	REG65_H1P42_T6P78_DRV2	case3_3_002	2	0:45:26	Autopilot Setpoint = 0 deg, RPS = 13.5, no QUALISYS, repeat follows.
22-Jul-09	9:11:20	REG65_H1P42_T6P78_DRV2	case3_3_003	2	0:46:02	Autopilot Setpoint = 0 deg, RPS = 13.5
22-Jul-09	9:21:24	REG65_H1P42_T6P78_DRV2	case3_3_004	2	n/a	Autopilot Setpoint = -3 deg, RPS = 13.5
22-Jul-09						
22-Jul-09	9:32:59	REG65_H1P23_T6P29_DRV2	case3_4_001	2	0:47:19	Autopilot Setpoint = 0 deg, RPS = 13.5
22-Jul-09	9:42:47	REG65_H1P23_T6P29_DRV2	case3_4_002	2	n/a	Autopilot Setpoint = 0 deg, RPS = 14.8
22-Jul-09	10:04:09	REG65_H1P23_T6P29_DRV2	case3_4_003	2	0:48:09	Autopilot Setpoint = 0 deg, RPS = 15.0
22-Jul-09	10:14:39	REG65_H1P23_T6P29_DRV2	case3_4_004	2	n/a	Autopilot Setpoint = 0 deg, RPS = 15.0
22-Jul-09						
22-Jul-09	10:24:54	REG65_H1P08_T5P87_DRV2	case3_5_001	2	0:48:51	Autopilot Setpoint = 0 deg, RPS = 15.0
22-Jul-09	10:34:51	REG65_H1P08_T5P87_DRV2	case3_5_002	2	0:50:06	Autopilot Setpoint = 0 deg, RPS = 15.3
22-Jul-09	10:44:51	REG65_H1P08_T5P87_DRV2	case3_5_003	2	0:50:50	Autopilot Setpoint = 0 deg, RPS = 15.3
22-Jul-09						
22-Jul-09	10:54:51	REG65_H0P95_T5P51_DRV2	case3_6_001	2	n/a	Autopilot Setpoint = 0 deg, RPS = 15.3
22-Jul-09	11:04:51	REG65_H0P95_T5P51_DRV2	case3_6_002	2	0:51:24	Autopilot Setpoint = -1 deg, RPS = 15.3
22-Jul-09	11:14:52	REG65_H0P95_T5P51_DRV2	case3_6_003	2	0:52:14	Autopilot Setpoint = -3 deg, RPS = 15.3
22-Jul-09						
22-Jul-09	11:24:59	REG65_H0P75_T4P90_DRV2	case3_7_001	2	0:52:57	Autopilot Setpoint = 0 deg, RPS = 13.5
22-Jul-09	11:35:01	REG65_H0P75_T4P90_DRV2	case3_7_002	2	0:53:56	Autopilot Setpoint = 2 deg, RPS = 13.5
22-Jul-09	11:45:01	REG65_H0P75_T4P90_DRV2	case3_7_003	2	0:54:38	Autopilot Setpoint = 2 deg, RPS = 13.5
22-Jul-09						
22-Jul-09						Add Water to ART
22-Jul-09	12:58:02	REG65_H1P92_T8P01_DRV2	case2_1_001	2	0:55:08	Autopilot Setpoint = 0 deg, RPS = 6.63
22-Jul-09	13:08:12	REG65_H1P92_T8P01_DRV2	case2_1_002	2	0:58:34	Autopilot Setpoint = 0 deg, RPS = 6.63
22-Jul-09						
22-Jul-09	13:19:01	REG65_H1P65_T7P34_DRV2	case2_2_001	2	0:59:53	Autopilot Setpoint = 0 deg, RPS = 6.63
22-Jul-09	13:28:46	REG65_H1P65_T7P34_DRV2	case2_2_002	2	1:01:22	Autopilot Setpoint = 0 deg, RPS = 6.63
22-Jul-09						
22-Jul-09	13:38:48	REG65_H1P42_T6P78_DRV2	case2_3_001	2	1:02:56	Autopilot Setpoint = 0 deg, RPS = 6.63
22-Jul-09	13:48:48	REG65_H1P42_T6P78_DRV2	case2_3_002	2	1:04:24	Autopilot Setpoint = 0 deg, RPS = 6.63
22-Jul-09						
22-Jul-09	13:58:57	REG65_H1P23_T6P29_DRV2	case2_4_001	2	1:05:49	Autopilot Setpoint = 0 deg, RPS = 7.6
22-Jul-09	14:08:20	REG65_H1P23_T6P29_DRV2	case2_4_002	2	1:07:17	Autopilot Setpoint = 0 deg, RPS = 7.6
22-Jul-09						
22-Jul-09	14:18:24	REG65_H1P08_T5P87_DRV2	case2_5_001	2	1:08:44	Autopilot Setpoint = 0 deg, RPS = 7.6
22-Jul-09	14:29:11	REG65_H1P08_T5P87_DRV2	case2_5_002	2	1:10:09	Autopilot Setpoint = 0 deg, RPS = 7.6
22-Jul-09						
22-Jul-09	14:39:21	REG65_H0P95_T5P51_DRV2	case2_6_001	2	1:11:23	Autopilot Setpoint = 0 deg, RPS = 7.6
22-Jul-09	14:50:43	REG65_H0P95_T5P51_DRV2	case2_6_002	2	1:11:56	Autopilot Setpoint = 0 deg, RPS = 7.6
22-Jul-09						
22-Jul-09	15:00:41	REG65_H0P75_T4P90_DRV2	case2_7_001	2	1:13:11	Autopilot Setpoint = 0 deg, RPS = 7.6
22-Jul-09	15:11:50	REG65_H0P75_T4P90_DRV2	case2_7_002	2	1:14:14	Autopilot Setpoint = 0 deg, RPS = 7.6
22-Jul-09						
22-Jul-09	15:21:20	REG65_H1P92_T8P01_DRV2	case4_1_001	2	n/a	Autopilot Setpoint = 0 deg, RPS = 12.75
22-Jul-09	15:31:34	REG65_H1P92_T8P01_DRV2	case4_1_002	2	n/a	Autopilot Setpoint =2 deg, RPS = 12.75
22-Jul-09	15:41:31	REG65_H1P92_T8P01_DRV2	case4_1_003	2	1:14:33	Autopilot Setpoint =2 deg, RPS = 12.75
23-Jul-09	8:37:27	REG65_H1P65_T7P34_DRV2	case4_2_001	2	1:15:40	Autopilot Setpoint = 2 deg, RPS = 12.75
23-Jul-09	8:47:30	REG65_H1P65_T7P34_DRV2	case4_2_002	2	1:16:34	Autopilot Setpoint = 2 deg, RPS = 12.75
23-Jul-09	8:58:07	REG65_H1P65_T7P34_DRV2	case4_2_003	2	1:17:24	Autopilot Setpoint = 2 deg, RPS = 12.75
23-Jul-09						
23-Jul-09	9:07:49	REG65_H1P42_T6P78_DRV2	case4_3_001	2	1:18:21	Autopilot Setpoint = 2 deg, RPS = 13.5
23-Jul-09	9:17:31	REG65_H1P42_T6P78_DRV2	case4_3_002	2	1:19:19	Autopilot Setpoint = 2 deg, RPS = 13.5
23-Jul-09	9:27:30	REG65_H1P42_T6P78_DRV2	case4_3_003	2	1:20:19	Autopilot Setpoint = 2 deg, RPS = 13.5
23-Jul-09						
23-Jul-09	9:37:23	REG65_H1P23_T6P29_DRV2	case4_4_001	2	1:21:15	Autopilot Setpoint = 2 deg, RPS = 15.0
23-Jul-09	9:47:32	REG65_H1P23_T6P29_DRV2	case4_4_002	2	1:22:07	Autopilot Setpoint = 3 deg, RPS = 15.0
23-Jul-09	10:02:23	REG65_H1P23_T6P29_DRV2	case4_4_003	2	1:23:09	Autopilot Setpoint = 4 deg, RPS = 15.0
23-Jul-09						
23-Jul-09	10:12:27	REG65_H1P08_T5P87_DRV2	case4_5_001	2	1:23:37	Autopilot Setpoint = 4 deg, RPS = 15.0
23-Jul-09	10:22:40	REG65_H1P08_T5P87_DRV2	case4_5_002	2	1:24:44	Autopilot Setpoint = 4 deg, RPS = 15.0
23-Jul-09	10:33:11	REG65_H1P08_T5P87_DRV2	case4_5_003	2	1:25:36	Autopilot Setpoint = 4 deg, RPS = 15.0
23-Jul-09						
23-Jul-09	10:43:05	REG65_H0P95_T5P51_DRV2	case4_6_001	2	1:26:34	Autopilot Setpoint = 4 deg, RPS = 15.0
23-Jul-09	10:53:16	REG65_H0P95_T5P51_DRV2	case4_6_002	2	1:27:21	Autopilot Setpoint = 4 deg, RPS = 15.0
23-Jul-09	11:03:42	REG65_H0P95_T5P51_DRV2	case4_6_003	2	1:28:17	Autopilot Setpoint = 4 deg, RPS = 15.0
23-Jul-09						
23-Jul-09	11:13:34	REG65_H0P75_T4P90_DRV2	case4_7_001	2	1:28:46	Autopilot Setpoint = 4 deg, RPS = 15.0
23-Jul-09	11:23:30	REG65_H0P75_T4P90_DRV2	case4_7_002	2	1:29:26	Autopilot Setpoint = 4 deg, RPS = 15.0
23-Jul-09	11:33:31	REG65_H0P75_T4P90_DRV2	case4_7_003	2	1:29:48	Autopilot Setpoint = 4 deg, RPS = 15.0

Date	Time	Wave Drive Signal	File Name	Video Tape #	Video Time	Comments
23-Jul-09						set up for dynamic roll decays with ART filled
23-Jul-09	12:46:54		Roll_ART_s0p6_001	NA	NA	Low speed roll decay with ART filled
23-Jul-09	14:11:29		Roll_ART_s0p6_002	NA	NA	Low speed roll decay with ART filled
23-Jul-09	14:15:19		Roll_ART_s0p6_003	NA	NA	Low speed roll decay with ART filled
23-Jul-09						Remove water from ART
23-Jul-09	14:24:21		Roll_s0p6_001	NA	NA	Low speed roll decay
23-Jul-09	14:28:23		Roll_s0p6_002	NA	NA	Low speed roll decay
23-Jul-09	14:33:24		Roll_s0p6_003	NA	NA	Low speed roll decay
23-Jul-09	14:37:12		Roll_s1p2_001	NA	NA	High speed roll decay
23-Jul-09	14:40:43		Roll_s1p2_002	NA	NA	High speed roll decay
23-Jul-09	14:43:52		Roll_s1p2_003	NA	NA	High speed roll decay
						Added water to ART
23-Jul-09	14:52:58		Roll_ART_s1p2_001	NA	NA	High speed roll decay with ART filled
23-Jul-09	14:57:43		Roll_ART_s1p2_002	NA	NA	High speed roll decay with ART filled
23-Jul-09	15:00:48		Roll_ART_s1p2_003	NA	NA	High speed roll decay with ART filled
23-Jul-09						Install Baffles to ART
23-Jul-09	15:25:24		Roll_ARTB_s0p6_001	NA	NA	Low speed roll decay with ART filled, baffles fitted
23-Jul-09	15:29:02		Roll_ARTB_s0p6_002	NA	NA	Low speed roll decay with ART filled, baffles fitted
23-Jul-09	15:32:18		Roll_ARTB_s0p6_003	NA	NA	Low speed roll decay with ART filled, baffles fitted
23-Jul-09	15:36:03		Roll_ARTB_s1p2_001	NA	NA	High speed roll decay with ART filled, baffles fitted
23-Jul-09	15:38:48		Roll_ARTB_s1p2_002	NA	NA	High speed roll decay with ART filled, baffles fitted
23-Jul-09	15:43:02		Roll_ARTB_s1p2_003	NA	NA	High speed roll decay with ART filled, baffles fitted
24-Jul-09	8:51:18	REG65_H1P23_T6P29_DRV2	Case2B_4_001	3		Autopilot Setpoint = 0 deg, RPS = 7.6 Aborted due to bad heading
24-Jul-09	9:01:15	REG65_H1P23_T6P29_DRV2	Case2B_4_002	3	0:00:00	Autopilot Setpoint = 0 deg, RPS = 7.6 With ART and Baffles
24-Jul-09	9:11:15	REG65_H1P23_T6P29_DRV2	Case2B_4_003	3	0:01:12	Autopilot Setpoint = 0 deg, RPS = 7.6With ART and Baffles
24-Jul-09						
24-Jul-09	9:21:16	REG65_H1P08_T5P87_DRV2	Case2B_5_001	3	0:02:27	Autopilot Setpoint = 0 deg, RPS = 7.6 With ART and Baffles
24-Jul-09	9:31:34	REG65_H1P08_T5P87_DRV2	Case2B_5_002	3	0:03:55	Autopilot Setpoint = 0 deg, RPS = 7.6 With ART and Baffles
24-Jul-09						
24-Jul-09	9:41:57	REG65_H1P23_T6P29_DRV2	Case4B_4_001	3	0:05:15	Autopilot Setpoint = 0 deg, RPS = 15.0 With ART and Baffles
24-Jul-09	9:51:57	REG65_H1P23_T6P29_DRV2	Case4B_4_002	3	0:05:47	Autopilot Setpoint = 0 deg, RPS = 15.0 With ART and Baffles
24-Jul-09	10:02:00	REG65_H1P23_T6P29_DRV2	Case4B_4_003	3	0:06:33	Autopilot Setpoint = 0 deg, RPS = 15.0 With ART and Baffles
24-Jul-09						
24-Jul-09	10:11:59	REG65_H1P08_T5P87_DRV2	Case4B_5_001	3	0:07:27	Autopilot Setpoint = 0 deg, RPS = 15.0 With ART and Baffles
24-Jul-09	10:22:00	REG65_H1P08_T5P87_DRV2	Case4B_5_002	3	0:08:23	Autopilot Setpoint = 0 deg, RPS = 15.0 With ART and Baffles
24-Jul-09	10:32:01	REG65_H1P08_T5P87_DRV2	Case4B_5_003	3	0:08:55	Autopilot Setpoint = 0 deg, RPS = 15.0 With ART and Baffles
24-Jul-09						
24-Jul-09	10:42:16	REG65_H1P42_T6P78_DRV2	case4B_3_001	3	0:09:39	Autopilot Setpoint = 0 deg, RPS = 13.5 With ART and Baffles
24-Jul-09	10:52:15	REG65_H1P42_T6P78_DRV2	case4B_3_002	3	0:10:21	Autopilot Setpoint = 0 deg, RPS = 13.5 With ART and Baffles
24-Jul-09	11:07:03	REG65_H1P42_T6P78_DRV2	case4B_3_003	3	0:11:05	Autopilot Setpoint = 0 deg, RPS = 13.5 With ART and Baffles
24-Jul-09						
24-Jul-09	11:17:04	REG65_H1P42_T6P78_DRV2	case2B_3_001	3	0:11:50	Autopilot Setpoint = 0 deg, RPS = 6.63 With ART and Baffles
24-Jul-09	11:27:04	REG65_H1P42_T6P78_DRV2	case2B_3_002	3	0:13:23	Autopilot Setpoint = 0 deg, RPS = 6.63 With ART and Baffles
24-Jul-09						
24-Jul-09	11:35:41		Roll_ARTB_001			zero speed roll decay with ART and Baffles
						Water removed from ART
24-Jul-09	11:49:24		Roll_B_001			zero speed roll decay - no water in ART
24-Jul-09						
	13:00:50	n/a	TBEAM_check_001	n/a	n/a	Autopilot Setpoint = 22 deg, RPS = 6.63 Baffles left in ART, heading check run, no waves
24-Jul-09	13:08:25	RS2_W1_mds	TBEAM_001	3	0:00:00	Rel 7:12 Autopilot Setpoint = 25 deg, RPS = 6.63 Baffles left in
24-Jul-09	13:18:23	RS2_W1_mds	TBEAM_002	3	0:15:58	Rel 7:12 Autopilot Setpoint = 30 deg, RPS = 5.2 Baffles left in
24-Jul-09	13:28:09	RS2_W1_mds	TBEAM_003	3	0:16:45	Rel 7:12 Autopilot Setpoint = 30 deg, RPS = 5.2 Baffles left in
24-Jul-09	13:47:35	RS2_W1_mds	TBEAM_004	3	0:17:48	Rel 7:12 Autopilot Setpoint = 22 deg, RPS = 5.2 Baffles left in
24-Jul-09	13:57:14	RS2_W1_mds	TBEAM_005	3	0:18:41	Rel 7:12 Autopilot Setpoint = 22 deg, RPS = 5.2 Baffles left in
24-Jul-09	14:10:09	RS2_W1_mds	TBEAM_006	3	0:19:42	aborted run
24-Jul-09	14:20:06	RS2_W1_mds	TBEAM_007	3	0:19:48	aborted run
24-Jul-09	14:30:14	RS2_W1_mds	TBEAM_008	3	0:20:01	Span @ 6:55, Rel @ 6:37
24-Jul-09	14:40:07	RS2_W1_mds	TBEAM_009	3	0:20:57	Span @ 6:25, Rel @ 6:07
24-Jul-09	14:50:05	RS2_W1_mds	TBEAM_010	3	0:22:00	model heading off, repeat follows
24-Jul-09	15:00:23	RS2_W1_mds	TBEAM_011	3	0:22:49	Span @ 5:59, Rel @ 5:41
24-Jul-09	15:10:52	RS2_W1_mds	TBEAM_012	3	0:23:43	Span @ 5:33, Rel @ 5:15
24-Jul-09	15:20:31	RS2_W1_mds	TBEAM_013	3	0:24:44	Span @ 5:02, Rel @ 4:44
24-Jul-09	15:33:42	RS2_W1_mds	TBEAM_014	3	0:25:40	Span @ 5:02, Rel @ 4:44
27-Jul-09	8:25:00					Waveprobes rezeroed
27-Jul-09	8:54:29	RS2_W1_mds	TBEAM_015	3	0:26:36	Span @ 4:34, Rel @ 4:16
27-Jul-09	9:04:52	RS2_W1_mds	TBEAM_016	3	0:27:26	Span @ 4:01, Rel @ 3:43
27-Jul-09	9:14:23	RS2_W1_mds	TBEAM_017	3	0:28:17	Span @ 3:21, Rel @ 3:03
27-Jul-09	9:24:52	RS2_W1_mds	TBEAM_018	3	0:29:15	Span @ 2:58, Rel @ 2:40
27-Jul-09	9:34:52	RS2_W1_mds	TBEAM_019	3	0:30:04	Span @ 2:27, Rel @ 2:09
27-Jul-09	9:44:52	RS2_W1_mds	TBEAM_020	3	0:30:56	Span @ 1:51, Rel @ 1:33
27-Jul-09	9:54:52	RS2_W1_mds	TBEAM_021	3	0:31:44	Span @ 1:20 Rel @ 1:02
27-Jul-09	10:05:53	RS2_W1_mds	TBEAM_022	3	0:32:53	Span @ 0:49 Rel @ 0:31

Date	Time	Wave Drive Signal	File Name	Video Tape #	Video Time	Comments
27-Jul-09						Add water to ART Baffles installed
27-Jul-09	10:55:08	REG65_H1P92_T8P01_DRV2	case2B_1_001	3	0:33:14	Autopilot Setpoint = 0 deg, RPS = 6.63
27-Jul-09	11:05:28	REG65_H1P92_T8P01_DRV2	case2B_1_002	3	0:34:43	Autopilot Setpoint = 2 deg, RPS = 6.63
27-Jul-09						
27-Jul-09	11:15:44	REG65_H1P92_T8P01_DRV2	case2B_2_001	3	0:36:12	Autopilot Setpoint = 2 deg, RPS = 6.63 Wrong wave, repeat run
27-Jul-09	11:25:21	REG65_H1P65_T7P34_DRV2	case2B_2_002	3	0:37:53	Autopilot Setpoint = 2 deg, RPS = 6.63
27-Jul-09	11:35:32	REG65_H1P65_T7P34_DRV2	case2B_2_003	3	0:39:07	Autopilot Setpoint = 2 deg, RPS = 6.63
27-Jul-09						
27-Jul-09	11:45:42	REG65_H1P92_T8P01_DRV2	case4B_1_001	3	0:40:36	Autopilot Setpoint =2 deg, RPS = 12.75
27-Jul-09	11:55:33	REG65_H1P92_T8P01_DRV2	case4B_1_002	3	0:41:12	Autopilot Setpoint =2 deg, RPS = 12.75
27-Jul-09	12:05:41	REG65_H1P92_T8P01_DRV2	case4B_1_003	3	0:41:53	Autopilot Setpoint =2 deg, RPS = 12.75
27-Jul-09						
27-Jul-09	13:04:47	REG65_H1P65_T7P34_DRV2	case4B_2_001	3	0:42:40	Autopilot Setpoint =2 deg, RPS = 12.75
27-Jul-09	13:14:37	REG65_H1P65_T7P34_DRV2	case4B_2_002	3	0:43:21	Autopilot Setpoint =2 deg, RPS = 12.75
27-Jul-09	13:24:15	REG65_H1P65_T7P34_DRV2	case4B_2_003	3	0:44:11	Autopilot Setpoint =2 deg, RPS = 12.75
27-Jul-09						
27-Jul-09	13:34:10	REG65_H0P95_T5P51_DRV2	case4B_6_001	3	n/a	Autopilot Setpoint =2 deg, RPS = 15.00
27-Jul-09	13:44:16	REG65_H0P95_T5P51_DRV2	case4B_6_002	3	n/a	failed model launch, repeat run follows
27-Jul-09	13:55:48	REG65_H0P95_T5P51_DRV2	case4B_6_003	3	0:45:01	Autopilot Setpoint =2 deg, RPS = 15.00
27-Jul-09	14:05:19	REG65_H0P95_T5P51_DRV2	case4B_6_004	3	0:45:54	Autopilot Setpoint =2 deg, RPS = 15.00
27-Jul-09						
27-Jul-09	14:15:28	REG65_H0P75_T4P90_DRV2	case4B_7_001	3	0:46:35	Autopilot Setpoint =2 deg, RPS = 15.00
27-Jul-09	14:25:12	REG65_H0P75_T4P90_DRV2	case4B_7_002	3	0:47:00	Autopilot Setpoint =2 deg, RPS = 15.00
27-Jul-09	14:41:06	REG65_H0P75_T4P90_DRV2	case4B_7_003	3	0:47:43	Autopilot Setpoint =2 deg, RPS = 15.00
27-Jul-09						
27-Jul-09	14:51:03	REG65_H0P95_T5P51_DRV2	case2B_6_001	3	0:48:11	Autopilot Setpoint =2 deg, RPS = 7.6
27-Jul-09	15:02:43	REG65_H0P95_T5P51_DRV2	case2B_6_002	3	0:49:16	Autopilot Setpoint =2 deg, RPS = 7.6
27-Jul-09						
27-Jul-09	15:11:24	REG65_H0P75_T4P90_DRV2	case2B_7_001	3	0:50:37	Autopilot Setpoint =2 deg, RPS = 7.6
27-Jul-09						
27-Jul-09	15:20:31	REG65_H1P08_T5P87_DRV2	Case2B_5_003	3	na	Autopilot Setpoint = 2 deg, RPS = 7.6 With ART and Baffles. Extra run carried out for demo for visiting Governors.
27-Jul-09						
27-Jul-09	15:29:53	REG65_H0P75_T4P90_DRV2	case2B_7_002	3	0:51:45	Autopilot Setpoint =2 deg, RPS = 7.6
17-Sep-09						OEB setup to continue testing after long break
17-Sep-09	13:22:12		Check_run_012			
17-Sep-09	14:06:47	RS2_w3_mds	TBow_006	4	0:00:00	RPS = 6.63
17-Sep-09	14:23:03	RS2_w3_mds	TBow_007	4	0:13:10	RPS = 8.28 Run Aborted
17-Sep-09	14:27:54	RS2_w3_mds	TBow_008	4	0:15:45	RPS = 8.28
17-Sep-09	14:41:04	RS2_w3_mds	TBow_009	4	0:17:40	Span @ 6:28, Rel @ 6:10
17-Sep-09	14:50:13	RS2_w3_mds	TBow_010	4	0:23:24	Span @ 5:27, Rel @ 5:09 Bad yaw Repeat
17-Sep-09	14:59:54	RS2_w3_mds	TBow_011	4	0:25:16	Span @ 5:24, Rel @ 5:06
17-Sep-09	15:10:08	RS2_w3_mds	TBow_012	4	0:26:45	Span @ 4:19, Rel @ 4:01 Re do at lower RPS
17-Sep-09	15:20:41	RS2_w3_mds	TBow_013	4	0:28:22	Span @ 3:18, Rel @ 3:00
17-Sep-09	15:32:21	RS2_w3_mds	TBow_014	4	0:30:15	Span @ 4:19, Rel @ 4:01 RPS = 7.9
17-Sep-09	15:46:17	RS2_w3_mds	TBow_015	4	0:31:56	Span @ 3:18, Rel @ 3:00 RPS = 7.7
17-Sep-09	15:58:47		roll_decay_003			Roll decay test
18-Sep-09	8:40:00					Start pumps and go to High Pressure
18-Sep-09	9:02:09	RS2_w3_mds	TBow_016	4	0:33:23	Span @ 2:02, Rel @ 1:44
18-Sep-09	9:12:35	RS2_w3_mds	TBow_017	4	0:33:56	Span @ 0:50, Rel @ 0:32
18-Sep-09						2.88 kg of water added to tank, Auto Pilot Angle Setpoint t = -8.84 deg,
18-Sep-09	9:50:58	RS2_w3_mds	ART_Tbow_006	4	0:34:53	RPS = 7.4
18-Sep-09	10:08:13	RS2_w3_mds	ART_Tbow_007	4	0:37:16	Span @ 6:02, Rel @ 5:44 Auto Pilot Angle Setpoint t= -8.0 deg, Repeat run due to heading track
18-Sep-09	10:19:47	RS2_w3_mds	ART_Tbow_008	4	0:39:40	Span @ 6:02, Rel @ 5:44 Auto Pilot Angle Setpoint t= -8.8 deg,
18-Sep-09	10:37:08	RS2_w3_mds	ART_Tbow_009	4	0:42:09	Span @ 4:18, Rel @ 4:00
18-Sep-09	10:48:03	RS2_w3_mds	ART_Tbow_010	4	0:44:11	Span @ 2:44, Rel @ 2:26
18-Sep-09	10:58:42	RS2_w3_mds	ART_Tbow_011	4	0:46:17	Span @ 1:12, Rel @ 0:54
18-Sep-09						Moved to North position removed water from ART
18-Sep-09	13:15:39	RS2_w1_mds	THEAD_009	4	0:47:33	RPS = 7.4
18-Sep-09	13:29:10	RS2_w1_mds	THEAD_010	4	0:49:46	Autopilot set point -3 deg
18-Sep-09	13:39:23	RS2_w1_mds	THEAD_011	4	0:51:56	Span @ 6:05, Rel @ 5:45 Autopilot set point -2 deg repeat to get overlap
18-Sep-09	13:49:05	RS2_w1_mds	THEAD_012	4		Span @ 6:08, Rel @ 5:48 Autopilot set point -2 deg
18-Sep-09	13:59:16	RS2_w1_mds	THEAD_013	4	0:53:33	Span @ 4:58, Rel @ 4:38 RPS= 7.0
18-Sep-09	14:09:11	RS2_w1_mds	THEAD_014	4	0:55:39	Span @ 3:36, Rel @ 3:16
18-Sep-09	14:19:35	RS2_w1_mds	THEAD_015	4	0:57:06	Span @ 2:27, Rel @ 2:07
18-Sep-09	14:30:19	RS2_w1_mds	THEAD_016	4	0:58:54	Span @ 1:22, Rel @ 1:02
18-Sep-09	14:43:09	RS2_w1_mds	THEAD_017	4	1:00:53	Span @ 2:27, Rel @ 2:07 RPS = 6.7
18-Sep-09	14:53:00	RS2_w1_mds	THEAD_018	4	1:02:47	Span @ 1:22, Rel @ 1:02
22-Sep-09						used hand tach to verify shaft rps settings, all ok.
22-Sep-09						launch model and start hydraulics
22-Sep-09						calm water speed check runs.
22-Sep-09	9:33:26		speed_run_003			RPS 6.63 Measured speed = 3.94 knots FS, 0.632 m/s MS.
22-Sep-09	9:50:13		speed_run_004			RPS 12.75 Measured speed = 1.21 m/s MS.
22-Sep-09	11:23:16		speed_run_005			RPS 6.63 checking QUALISYS

Date	Time	Wave Drive Signal	File Name	Video Tape #	Video Time	Comments
22-Sep-09						set up art_tquart wave runs for further QUALISYS and speed check.
22-Sep-09	11:37:53	RS2_w1_mds	ART_Tquart_001	4	1:04:08	QUALISYS bad, cover stbd fwd marker and repeat below.
22-Sep-09	11:50:41	RS2_w1_mds	ART_Tquart_002	4	1:06:03	Rel Autopilot Setpoint = -11.36 deg, RPS = 6.63 Baffles left in, tank filled
22-Sep-09	12:15:39	RS2_w1_mds	ART_Tquart_003	4	1:08:18	Rel Autopilot Setpoint = -16.0 deg, RPS = 7.5 Baffles left in, tank filled, still poor QUALISYS, cover port fwd marker, repeat run follows.
22-Sep-09	12:37:25	RS2_w1_mds	ART_Tquart_004	4	1:28:38	Rel Autopilot Setpoint = -16.0 deg, RPS = 8.4 Baffles left in, tank filled, QUALISYS still rough at mid tank, re-acquire body file and check as follows below.
22-Sep-09	13:56:47		check_run_013	n/a	n/a	QUALISYS check run in waves, still dropping out thru middle of tank, uncover all markers, reposition port fwd marker to just aft of bow marker and re-acquire body file with model at mid-tank.
22-Sep-09	14:47:57		check_run_014	5	0:01:42	QUALISYS check run in waves.
22-Sep-09	14:54:29		check_run_015	n/a	n/a	QUALISYS check run, no waves., still dropping out, cover centerline marker aft of stack and re-try.
22-Sep-09						
22-Sep-09	15:05:37		check_run_016	n/a	n/a	QUALISYS check run, no waves.
22-Sep-09	15:09:11	RS2_w1_mds	check_run_017	n/a	n/a	QUALISYS check run in waves,same configuration as above. Slightly better tracking, cover centerline marker on fwd wheelhouse roof and re-try as follows.
22-Sep-09	15:18:01	RS2_w1_mds	check_run_018	n/a	n/a	QUALISYS check run in waves,still poor, uncover both centerline markers and cover stbd midships marker, re-check in waves.
22-Sep-09	15:31:13	RS2_w1_mds	check_run_019	n/a	n/a	QUALISYS check run in waves, no significant improvement
22-Sep-09						remove model, shut down wavemaker hydraulics
23-Sep-09						launch model, all QUALISYS markers uncovered.
23-Sep-09						
23-Sep-09	9:20:31		check_run_020	n/a	n/a	QUALISYS check run, no waves.
23-Sep-09	9:24:18		check_run_021	n/a	n/a	QUALISYS check run, no waves.
23-Sep-09	9:30:06		check_run_022	n/a	n/a	QUALISYS check run, no waves.
23-Sep-09						shorten port fwd marker
23-Sep-09	9:46:20		check_run_023	n/a	n/a	QUALISYS check run, no waves.
23-Sep-09						cover marker aft of stack
23-Sep-09	10:05:27		check_run_024	n/a	n/a	QUALISYS check run, no waves.
23-Sep-09	10:09:02		check_run_025	n/a	n/a	QUALISYS check run, no waves.
23-Sep-09	10:32:44	RS2_w1_mds	check_run_026	n/a	n/a	QUALISYS check run, no waves.
23-Sep-09	10:50:16	RS2_w1_mds	ART_Tquart_005	5	0:01:42	Rel Autopilot Setpoint = -16.0 deg, RPS = 8.4 Baffles left in, tank full, data from 103 to 295
23-Sep-09	11:05:44	RS2_w1_mds	ART_Tquart_006	5	0:03:08	Span @6:40 , Rel @ 6:20 data from 262 to 461
23-Sep-09	11:17:48	RS2_w1_mds	ART_Tquart_007	5	0:04:57	Span @5:44 , Rel @5:24 data from 443 to 645
23-Sep-09	11:33:59	RS2_w1_mds	ART_Tquart_008	5	0:06:17	Span @4:48 , Rel @4:28 data from 634 to 826
23-Sep-09	11:43:39	RS2_w1_mds	ART_Tquart_009	5	0:07:36	Span @ 3:52, Rel @3:42 data from 805 to 1003
23-Sep-09	11:54:15	RS2_w1_mds	ART_Tquart_010	5	0:09:01	Span @2:53 , Rel @2:33 data from 996 to 1203
23-Sep-09	12:04:29	RS2_w1_mds	ART_Tquart_011	5	0:10:17	stuck in launch, repeat follows
23-Sep-09						following two time segments in reverse sequence.
23-Sep-09	12:16:34	RS2_w1_mds	ART_Tquart_012	5	0:10:28	Span @1:52 , Rel @1:32 data from 1290 to 1470
23-Sep-09	13:27:49	RS2_w1_mds	ART_Tquart_013	5	0:11:39	Span @2:02 , Rel @1:42 data from 1188 to 1379
23-Sep-09	13:44:32	RS2_w4_mds	ART_Tbeam_001	5	0:12:50	Rel Autopilot Setpoint = 1 deg, RPS = 6.63 Baffles left in, ART active, data from 126 to 398
23-Sep-09	13:54:31	RS2_w4_mds	ART_Tbeam_002	5	0:14:37	Rel Autopilot Setpoint = 5 deg, RPS = 6.63 Baffles left in, ART active, data from 154 to 360
23-Sep-09	14:05:32	RS2_w4_mds	ART_Tbeam_003	5	0:16:37	Rel Autopilot Setpoint = 6 deg, Span @6:30 , Rel @5:55 data from 350 to 515
23-Sep-09	14:15:44	RS2_w4_mds	ART_Tbeam_004	5	0:18:06	Rel Autopilot Setpoint = 5 deg Span @5:42 , Rel @5:07 data from 502 to 725
23-Sep-09	14:47:02	RS2_w4_mds	ART_Tbeam_005	5	0:19:42	Span @4:38 , Rel @4:03 data from 725 to 950
23-Sep-09	15:00:28	RS2_w4_mds	ART_Tbeam_006	5	0:21:31	Span @ 3:29, Rel @2:54 data from 950 to 1170
23-Sep-09	15:10:27	RS2_w4_mds	ART_Tbeam_007	5	0:23:13	Span @2:27 , Rel @1:52 data from 1149 to 1382
23-Sep-09	15:21:16	RS2_w4_mds	ART_Tbeam_008	5	0:24:53	Span @1:22 , Rel @0:47 data from 1362 to 1470
23-Sep-09						remove model, shut down wavemaker hydraulics
24-Sep-09						relocate launch platform to approx middle of west wavemaker
24-Sep-09	11:25:19		check_run_027	n/a	n/a	QUALISYS check run Rel Autopilot Setpoint = -7.0 deg, RPS = 8.4
24-Sep-09						uncover marker aft of stack
24-Sep-09	11:35:56		check_run_028	n/a	n/a	QUALISYS check run Rel Autopilot Setpoint = -9.4 deg, RPS = 8.4
24-Sep-09						cover marker port fwd
24-Sep-09	11:42:37		check_run_029	n/a	n/a	QUALISYS check run Rel Autopilot Setpoint = -9.4 deg, RPS = 8.4
24-Sep-09	13:16:28	RS2_w1_mds	Tquart_001	n/a	n/a	Rel Autopilot Setpoint = -9.4 deg, RPS = 8.4, no autopilot, repeat run follows.
24-Sep-09	13:27:55	RS2_w1_mds	Tquart_002	5	0:27:24	Rel Autopilot Setpoint = -9.4 deg, RPS = 8.4 data from 139 to 337
24-Sep-09	13:39:02	RS2_w1_mds	Tquart_003	5	0:29:04	Rel Autopilot Setpoint = -14.4 deg, RPS = 9.4 data from 133 to 280
24-Sep-09	13:48:47	RS2_w1_mds	Tquart_004	5	n/a	Rel Autopilot Setpoint = -12.4 deg, Span @6:54 , Rel @6:24 data from 257 to 440
24-Sep-09	13:59:21	RS2_w1_mds	Tquart_005	5	0:30:19	Span @6:05 , Rel @5:35 data from 403 to 571
24-Sep-09	14:10:03	RS2_w1_mds	Tquart_006	5	0:31:53	RPS = 9.0 Span @5:20 , Rel @4:50 data from 550 to 724
24-Sep-09	14:23:10	RS2_w1_mds	Tquart_007	5	0:33:14	Span @4:33 , Rel @4:03 data from 702 to 880
24-Sep-09	14:36:25	RS2_w1_mds	Tquart_008	5	0:34:41	Span @3:46 , Rel @3:16 data from 855 to 1035
24-Sep-09	14:53:51	RS2_w1_mds	Tquart_009	5	0:36:05	Span @2:58 , Rel @2:28 data from 1012 to 1195
24-Sep-09	15:04:23	RS2_w1_mds	Tquart_010	5	0:37:29	Span @2:09 , Rel @1:39 data from 1180 to 1345

Date	Time	Wave Drive Signal	File Name	Video Tape #	Video Time	Comments
24-Sep-09	15:19:54	RS2_w1_mds	Tquart_011	5	0:39:12	Span @1:23 , Rel @0:53 data from 1328 to 1470
24-Sep-09						remove model, shut down wavemaker hydraulics
25-Sep-09						model launched, start wavemaker hydraulics.
25-Sep-09						autopilot setting changed to reflect higher speed.
25-Sep-09	9:20:58	RS2_w1_mds	Cquart_001	5	0:40:37	Rel Autopilot Setpoint = 0 deg, RPS = 12.75 ignore this run??
25-Sep-09						QUALISYS noisy, uncover portside forward marker and remove marker aft of stack, height prior to removal 274 mm from mounting block to middle ball seam.
25-Sep-09	9:35:19	RS2_w1_mds	Cquart_002	5	0:41:42	Rel Autopilot Setpoint = -3 deg, RPS = 12.0 data from 145 to 272
25-Sep-09	9:46:46	RS2_w1_mds	Cquart_003	5	0:42:59	Span @6:55 , Rel @6:22 Rel Autopilot Setpoint = -5 deg, RPS = 12.3 data from 246 to 368
25-Sep-09	9:56:23	RS2_w1_mds	Cquart_004	5	n/a	aborted test
25-Sep-09	10:05:22	RS2_w1_mds	Cquart_005	5	0:44:05	Span @6:25 , Rel @5:52 data from 345 to 483 prop contacted rubber launcher pads at release.
25-Sep-09	10:15:08	RS2_w1_mds	Cquart_006	5	0:45:19	Span @5:50 , Rel @5:17 data from 460 to 575
25-Sep-09	10:25:58	RS2_w1_mds	Cquart_007	5	0:46:02	Span @5:22 , Rel @4:49 data from 556 to 680
25-Sep-09	10:36:18	RS2_w1_mds	Cquart_008	5	0:47:03	Span @4:50 , Rel @4:17 data from 655 to 780
25-Sep-09	10:46:34	RS2_w1_mds	Cquart_009	5	0:48:09	Span @4:19 , Rel @3:46 data from 764 to 890
25-Sep-09	10:57:07	RS2_w1_mds	Cquart_010	5	0:49:12	Span @3:45 , Rel @3:12 data from 865 to 983
25-Sep-09	11:12:11	RS2_w1_mds	Cquart_011	5	0:51:15	Span @3:17 , Rel @2:44 data from 955 to 1078
25-Sep-09	11:25:19	RS2_w1_mds	Cquart_012	5	0:52:21	Span @2:48 , Rel @2:15 data from 1060 to 1182
25-Sep-09	11:36:45	RS2_w1_mds	Cquart_013	5	0:53:17	Span @2:16 , Rel @1:43 data from 1160 to 1284
25-Sep-09	12:00:12	RS2_w1_mds	Cquart_014	5	0:54:44	Span @1:45 , Rel @1:12 data from 1260 to 1386
25-Sep-09	12:10:16	RS2_w1_mds	Cquart_015	5	0:55:53	Span @1:14 , Rel @0:41 data from 1365 to 1470
25-Sep-09						
25-Sep-09						autopilot settings changed for low speed
25-Sep-09	13:17:00	REG45_H1P65_T7P34_DRV2	Case5_1_001	5	0:56:59	Autopilot Setpoint = 0deg, RPS = 6.7
25-Sep-09	13:27:07	REG45_H1P65_T7P34_DRV2	Case5_1_002	5	0:58:42	Autopilot Setpoint = -3 deg, RPS = 7.0
25-Sep-09	13:37:49	REG45_H1P23_T6P29_DRV2	Case5_2_001	5	1:00:28	Autopilot Setpoint = -3 deg, RPS = 7.0
25-Sep-09	13:48:20	REG45_H1P23_T6P29_DRV2	Case5_2_002	5	1:02:05	Autopilot Setpoint = -3 deg, RPS = 7.0
25-Sep-09	13:58:09	REG45_H0P95_T5P51_DRV2	Case5_3_001	5	1:03:28	Autopilot Setpoint = -3 deg, RPS = 7.2
25-Sep-09	14:07:42	REG45_H0P95_T5P51_DRV2	Case5_3_002	5	1:05:23	Autopilot Setpoint = -3 deg, RPS = 7.2
25-Sep-09	14:17:57	REG45_H0P84_T5P18_DRV2	Case5_4_001	5	1:07:09	Autopilot Setpoint = -3 deg, RPS = 7.2
25-Sep-09	14:28:28	REG45_H0P84_T5P18_DRV2	Case5_4_002	5	1:09:11	Autopilot Setpoint = -3 deg, RPS = 7.4
25-Sep-09	14:39:05	REG45_H0P75_T4P90_DRV2	Case5_5_001	5	1:11:11	Autopilot Setpoint = -3 deg, RPS = 7.4
25-Sep-09	15:06:14	REG45_H0P75_T4P90_DRV2	Case5_5_002	5	1:13:06	Autopilot Setpoint = -3 deg, RPS = 7.4
25-Sep-09	15:17:46	REG45_H0P67_T4P64_DRV2	Case5_6_001	5	1:15:03	Autopilot Setpoint = -3 deg, RPS = 7.4
25-Sep-09	15:27:47	REG45_H0P67_T4P64_DRV2	Case5_6_002	5	1:16:54	Autopilot Setpoint = -3 deg, RPS = 7.4
25-Sep-09						remove model, shut down wavemaker hydraulics
					1:18:45	
28-Sep-09	9:00:00					Wavemaker hydraulic pumps started
28-Sep-09	9:39:56	REG45_H0P55_T4P20_DRV2	Case5_7_001	6	0:00:00	Autopilot Setpoint = 0 deg, RPS = 7.4
28-Sep-09	10:00:05	REG45_H0P55_T4P20_DRV2	Case5_7_002	6	0:01:57	Autopilot Setpoint = -3 deg, RPS = 7.4
28-Sep-09	10:15:24	REG45_H1P65_T7P34_DRV2	Case7_1_001	6	0:04:06	Autopilot Setpoint = -3 deg, RPS = 12.3, not analyzed
28-Sep-09	10:25:24	REG45_H1P65_T7P34_DRV2	Case7_1_002	6	0:05:27	Autopilot Setpoint = -3 deg, RPS = 13, not analyzed
28-Sep-09	10:38:09	REG45_H1P65_T7P34_DRV2	Case7_1_003	6	0:06:46	Autopilot Setpoint = -3 deg, RPS = 13.6
28-Sep-09	10:54:46	REG45_H1P65_T7P34_DRV2	Case7_1_004	6	0:07:51	Autopilot Setpoint = -3 deg, RPS = 13.6
28-Sep-09	11:06:09	REG45_H1P65_T7P34_DRV2	Case7_1_005	6	0:09:03	Autopilot Setpoint = -3 deg, RPS = 13.6
28-Sep-09	11:16:07	REG45_H1P23_T6P29_DRV2	Case7_2_001	6	0:10:10	Autopilot Setpoint = -3 deg, RPS = 13.6
28-Sep-09	13:13:07	REG45_H1P23_T6P29_DRV2	Case7_2_002	6	0:11:15	Autopilot Setpoint = -3 deg, RPS = 13.6
28-Sep-09	13:23:30	REG45_H1P23_T6P29_DRV2	Case7_2_003	6	0:12:58	Autopilot Setpoint = -3 deg, RPS = 13.6
28-Sep-09	13:33:45	REG45_H0P95_T5P51_DRV2	Case7_3_001	6	0:14:14	Autopilot Setpoint = -3 deg, RPS = 13.6
28-Sep-09	13:55:57	REG45_H0P95_T5P51_DRV2	Case7_3_002	6	0:15:28	Autopilot Setpoint = -3 deg, RPS = 13.6
28-Sep-09	14:06:03	REG45_H0P84_T5P18_DRV2	Case7_4_001	6	0:16:45	Autopilot Setpoint = -3 deg, RPS = 13.6
28-Sep-09	14:16:11	REG45_H0P84_T5P18_DRV2	Case7_4_002	6	0:18:06	Autopilot Setpoint = -3 deg, RPS = 13.6
28-Sep-09	14:26:09	REG45_H0P75_T4P90_DRV2	Case7_5_001	6	0:19:22	Autopilot Setpoint = -3 deg, RPS = 13.6
28-Sep-09	14:36:15	REG45_H0P75_T4P90_DRV2	Case7_5_002	6	0:20:42	Autopilot Setpoint = -3 deg, RPS = 13.6
28-Sep-09	14:46:08	REG45_H0P67_T4P64_DRV2	Case7_6_001	6	0:21:59	Autopilot Setpoint = -3 deg, RPS = 13.6
28-Sep-09	14:56:12	REG45_H0P67_T4P64_DRV2	Case7_6_002	6	0:23:20	Autopilot Setpoint = -3 deg, RPS = 13.6
28-Sep-09	15:06:12	REG45_H0P55_T4P20_DRV2	Case7_7_001	6	0:24:41	Autopilot Setpoint = -3 deg, RPS = 13.6 Aborted tag line reel jammed
28-Sep-09	15:16:02	REG45_H0P55_T4P20_DRV2	Case7_7_002	6	0:26:34	Autopilot Setpoint = -3 deg, RPS = 13.6
28-Sep-09	15:26:08	REG45_H0P55_T4P20_DRV2	Case7_7_003	6	0:27:44	Autopilot Setpoint = -3 deg, RPS = 13.6
28-Sep-09						Wavemaker hydraulic pumps off
29-Sep-09	8:30:00					Water added to ART model
29-Sep-09	8:40:00					Wavemaker hydraulic pumps started
29-Sep-09	9:09:41	REG45_H1P65_T7P34_DRV2	Case6_1_001	6		Autopilot Setpoint = -3 deg, RPS = 7.0 no run
29-Sep-09	9:14:13	REG45_H1P65_T7P34_DRV2	Case6_1_002	6	0:29:03	Autopilot Setpoint = -3 deg, RPS = 7.0
29-Sep-09	9:24:10	REG45_H1P65_T7P34_DRV2	Case6_1_003	6	0:30:51	Autopilot Setpoint = -1 deg, RPS = 7.4
29-Sep-09	9:34:12	REG45_H1P23_T6P29_DRV2	Case6_2_001	6	0:32:40	Autopilot Setpoint = -1 deg, RPS = 7.2
29-Sep-09	9:45:04	REG45_H1P23_T6P29_DRV2	Case6_2_002	6	0:34:26	Autopilot Setpoint = -1 deg, RPS = 7.2
29-Sep-09	9:55:07	REG45_H0P95_T5P51_DRV2	Case6_3_001	6	0:36:11	Autopilot Setpoint = 2 deg, RPS = 7.2
29-Sep-09	10:05:07	REG45_H0P95_T5P51_DRV2	Case6_3_002	6	0:38:01	Autopilot Setpoint = 0 deg, RPS = 7.2
29-Sep-09	10:36:03	REG45_H0P84_T5P18_DRV2	Case6_4_001	6	0:39:46	Autopilot Setpoint = 0 deg, RPS = 7.2
29-Sep-09	10:46:09	REG45_H0P84_T5P18_DRV2	Case6_4_002	6	0:41:37	Autopilot Setpoint = 0 deg, RPS = 7.2
29-Sep-09	10:56:12	REG45_H0P75_T4P90_DRV2	Case6_5_001	6	0:43:29	Autopilot Setpoint = 0 deg, RPS = 7.2
29-Sep-09	11:06:10	REG45_H0P75_T4P90_DRV2	Case6_5_002	6	0:45:22	Autopilot Setpoint = 0 deg, RPS = 7.2

Date	Time	Wave Drive Signal	File Name	Video Tape #	Video Time	Comments
29-Sep-09	11:18:17	REG45_H0P67_T4P64_DRV2	Case6_6_001	6	0:47:17	Autopilot Setpoint = 0 deg, RPS = 7.2
29-Sep-09	11:28:21	REG45_H0P67_T4P64_DRV2	Case6_6_002	6	0:49:12	Autopilot Setpoint = 0 deg, RPS = 7.2
29-Sep-09	11:38:10	REG45_H0P55_T4P20_DRV2	Case6_7_001	6	0:49:39	Autopilot Setpoint = 0 deg, RPS = 7.2
29-Sep-09	11:48:19	REG45_H0P55_T4P20_DRV2	Case6_7_002	6	0:51:34	Autopilot Setpoint = 0 deg, RPS = 7.2
29-Sep-09	13:02:03	REG45_H1P65_T7P34_DRV2	Case8_1_001	6	0:53:29	Autopilot Setpoint = 0 deg, RPS = 13.6
29-Sep-09	13:12:07	REG45_H1P65_T7P34_DRV2	Case8_1_002	6	0:54:26	Autopilot Setpoint = 0 deg, RPS = 13.6
29-Sep-09	13:22:06	REG45_H1P65_T7P34_DRV2	Case8_1_003	6	0:55:23	Autopilot Setpoint = 0 deg, RPS = 13.6
29-Sep-09	13:32:27	REG45_H1P23_T6P29_DRV2	Case8_2_001	6	0:56:29	Autopilot Setpoint = 0 deg, RPS = 13.8
29-Sep-09	13:42:23	REG45_H1P23_T6P29_DRV2	Case8_2_002	6	0:57:46	Autopilot Setpoint = 0 deg, RPS = 13.8
29-Sep-09	13:52:13	REG45_H0P95_T5P51_DRV2	Case8_3_001	6	0:58:54	Autopilot Setpoint = 0 deg, RPS = 13.8
29-Sep-09	14:02:09	REG45_H0P95_T5P51_DRV2	Case8_3_002	6	1:00:16	Autopilot Setpoint = 0 deg, RPS = 13.8
29-Sep-09	14:12:10	REG45_H0P84_T5P18_DRV2	Case8_4_001	6	1:01:33	Autopilot Setpoint = 0 deg, RPS = 13.8
29-Sep-09	14:22:07	REG45_H0P84_T5P18_DRV2	Case8_4_002	6	1:02:45	Autopilot Setpoint = 0 deg, RPS = 13.8
29-Sep-09	14:32:10	REG45_H0P75_T4P90_DRV2	Case8_5_001	6	1:03:57	Autopilot Setpoint = 0 deg, RPS = 13.8
29-Sep-09	14:42:11	REG45_H0P75_T4P90_DRV2	Case8_5_002	6	1:05:06	Autopilot Setpoint = 0 deg, RPS = 13.8
29-Sep-09	14:52:05	REG45_H0P67_T4P64_DRV2	Case8_6_001	6	1:06:24	Autopilot Setpoint = 0 deg, RPS = 13.8
29-Sep-09	15:02:06	REG45_H0P67_T4P64_DRV2	Case8_6_002	6	1:07:41	Autopilot Setpoint = 0 deg, RPS = 13.8
29-Sep-09	15:12:07	REG45_H0P55_T4P20_DRV2	Case8_7_001	6	1:09:05	Autopilot Setpoint = 0 deg, RPS = 13.8
29-Sep-09	15:22:03	REG45_H0P55_T4P20_DRV2	Case8_7_002	6	1:10:23	Autopilot Setpoint = 0 deg, RPS = 13.8
29-Sep-09	15:30:00					Wavemaker hydraulic pumps off
30-Sep-09	8:45:00		**Repeat Runs**			Wavemaker hydraulic pumps started
30-Sep-09	9:30:09	REG45_H1P65_T7P34_DRV2	Case6_1r_001	6	1:11:44	Autopilot Setpoint = -1 deg, RPS = 7.4
30-Sep-09	9:40:05	REG45_H1P23_T6P29_DRV2	Case6_2r_001	6	1:13:20	Autopilot Setpoint = -1 deg, RPS = 7.2
30-Sep-09	9:50:06	REG45_H0P95_T5P51_DRV2	Case6_3r_001	6	1:14:57	Autopilot Setpoint = 0 deg, RPS = 7.2
30-Sep-09	10:00:08	REG45_H0P84_T5P18_DRV2	Case6_4r_001	6	1:16:48	Autopilot Setpoint = 0 deg, RPS = 7.2
30-Sep-09	10:10:08	REG45_H0P75_T4P90_DRV2	Case6_5r_001	6	1:18:36	Autopilot Setpoint = 0 deg, RPS = 7.2
30-Sep-09	10:20:13	REG45_H0P67_T4P64_DRV2	Case6_6r_001	6	1:20:31	Autopilot Setpoint = 0 deg, RPS = 7.2
30-Sep-09	10:30:04	REG45_H0P55_T4P20_DRV2	Case6_7r_001	6	1:22:33	Autopilot Setpoint = 0 deg, RPS = 7.2
30-Sep-09						
30-Sep-09	10:54:04	REG45_H1P65_T7P34_DRV2	Case5_1r_001	7	0:00:00	Autopilot Setpoint = -3 deg, RPS = 7.0
30-Sep-09	11:04:08	REG45_H0P95_T5P51_DRV2	Case5_3r_001	7	0:01:41	Autopilot Setpoint = -3 deg, RPS = 7.0
30-Sep-09	11:14:08	REG45_H0P84_T5P18_DRV2	Case5_4r_001	7	0:03:35	Autopilot Setpoint = -3 deg, RPS = 7.4
30-Sep-09	11:24:05	REG45_H0P75_T4P90_DRV2	Case5_5r_001	7	0:05:25	Autopilot Setpoint = -3 deg, RPS = 7.4
30-Sep-09	11:34:04	REG45_H0P55_T4P20_DRV2	Case5_7r_001	7	0:07:19	Autopilot Setpoint = -3 deg, RPS = 7.4
						Wavemaker hydraulic pumps off
01-Oct-09						Wavemaker hydraulic pumps started
01-Oct-09						Heading target 146.47 deg
01-Oct-09	9:18:31	RS2_w1_mds	Tfol_001	7	0:09:13	Rel Autopilot Setpoint = 0 deg, RPS = 9.0, not analyzed
01-Oct-09	9:30:22	RS2_w1_mds	Tfol_002	7	0:10:51	Rel Autopilot Setpoint = -3.5 deg, RPS = 8.7
01-Oct-09	9:40:14	RS2_w1_mds	Tfol_003	7	0:12:12	Span @ 6:54 , Rel @ 6:24 data end 266 Autopilot Setpoint = -2.5 deg data end 366
01-Oct-09	9:50:10	RS2_w1_mds	Tfol_004	7	0:13:22	Span @ 6:18 , Rel @ 5:48 data end 518
01-Oct-09	10:00:11	RS2_w1_mds	Tfol_005	7	0:14:40	Span @ 5:32 , Rel @ 5:02 data end 661
01-Oct-09	10:10:20	RS2_w1_mds	Tfol_006	7	0:16:02	Span @ 4:48 , Rel @ 4:18 data end 808
01-Oct-09	10:20:19	RS2_w1_mds	Tfol_007	7	0:17:26	Span @ 4:03 , Rel @ 3:33 data end 943
01-Oct-09	10:30:14	RS2_w1_mds	Tfol_008	7	0:18:39	Span @ 3:21 , Rel @ 2:51 data end 1096
01-Oct-09	10:40:30	RS2_w1_mds	Tfol_009	7	0:20:00	Span @ 2:34 , Rel @ 2:04 data end 1242
01-Oct-09	10:50:07	RS2_w1_mds	Tfol_010	7	0:21:21	Span @ 1:52 , Rel @ 1:22 data end 1364
01-Oct-09	11:00:05	RS2_w1_mds	Tfol_011	7	0:22:42	Span @ 1:14 , Rel @ 0:44 data end 1468
01-Oct-09						Heading target 144.94 deg
01-Oct-09	11:21:13	RS2_w1_mds	Cfol_001	7	0:23:32	Rel Autopilot Setpoint = -4.0 deg, RPS = 12.8, not analyzed
01-Oct-09	11:30:30	RS2_w1_mds	Cfol_002	7	0:24:33	Rel Autopilot Setpoint = -4.0 deg, RPS = 13 data end 209
01-Oct-09	11:40:01	RS2_w1_mds	Cfol_003	7	0:25:29	Span @ 7:12 , Rel @ 6:40 data end 261
01-Oct-09	13:14:50	RS2_w1_mds	Cfol_004	7	0:26:25	Span @ 6:52 , Rel @ 6:20 data end 331
01-Oct-09						Fire alarm, smoke in OEB pump room. Oil leak from failed O-ring in wavemaker hydraulics. Repairs made, oil cleaned up.
						Wavemaker hydraulic pumps started
02-Oct-09	9:00:41	RS2_w1_mds	Cfol_005	7	0:27:22	Span @ 6:30 , Rel @ 5:58 data end 414
02-Oct-09	9:10:22	RS2_w1_mds	Cfol_006	7	0:28:12	Span @ 6:04 , Rel @ 5:32 data end 505
02-Oct-09	9:20:04	RS2_w1_mds	Cfol_007	7	0:29:15	Span @ 5:36 , Rel @ 5:04 data end 598 speed slow repeat
02-Oct-09	9:30:04	RS2_w1_mds	Cfol_008	7	0:30:23	Rel Autopilot Setpoint = -6.0 deg Span @ 5:36 , Rel @ 5:04 data end 595
02-Oct-09	9:40:10	RS2_w1_mds	Cfol_009	7	0:31:32	Rel Autopilot Setpoint = -7.0 deg, Span @ 5:09 , Rel @ 4:37 data end 668
02-Oct-09	9:50:07	RS2_w1_mds	Cfol_010	7	0:32:31	Span @ 4:46 , Rel @ 4:14 data end 754
02-Oct-09	10:00:08	RS2_w1_mds	Cfol_011	7	0:33:28	Span @ 4:20 , Rel @ 3:48 data end 833
02-Oct-09	10:10:09	RS2_w1_mds	Cfol_012	7	0:34:24	Span @ 3:57 , Rel @ 3:25 data end 908
02-Oct-09	10:20:09	RS2_w1_mds	Cfol_013	7	0:35:22	Span @ 3:34 , Rel @ 3:02 data end 987
02-Oct-09	10:30:48	RS2_w1_mds	Cfol_014	7	0:36:23	Span @ 3:10 , Rel @ 2:38 data end 1068
02-Oct-09	10:40:14	RS2_w1_mds	Cfol_015	7	0:37:29	Span @ 2:45 , Rel @ 2:13 data end 1140
02-Oct-09	10:50:12	RS2_w1_mds	Cfol_016	7	0:38:26	Span @ 2:23 , Rel @ 1:51 data end 1218
02-Oct-09	11:00:04	RS2_w1_mds	Cfol_017	7	0:39:31	Span @ 1:59 , Rel @ 1:27 data end 1295
02-Oct-09	11:10:04	RS2_w1_mds	Cfol_018	7	0:40:35	Span @ 1:35 , Rel @ 1:03 data end 1376
02-Oct-09	11:20:04	RS2_w1_mds	Cfol_019	7	0:41:38	Span @ 1:11 , Rel @ 0:39 data end

Date	Time	Wave Drive Signal	File Name	Video Tape #	Video Time	Comments
02-Oct-09	13:00:00					Add 2.88 Kg water to ART
02-Oct-09						Heading target 146.47 deg
02-Oct-09	13:15:54	RS2_w1_mds	ART_Tfol_001	7	0:42:36	Rel Autopilot Setpoint = -5 deg, RPS = 8.7 Data end 278
02-Oct-09	13:25:12	RS2_w1_mds	ART_Tfol_002	7	0:43:55	Span @ 6:47 , Rel @ 6:17 data end 406, wrong rps ~ 6.40
02-Oct-09	13:35:08	RS2_w1_mds	ART_Tfol_003	7	0:44:48	Span @ 6:10 , Rel @ 5:40 data end 541
02-Oct-09	13:45:12	RS2_w1_mds	ART_Tfol_004	7	0:46:05	Span @ 5:28 , Rel @ 4:58 data end 670
02-Oct-09	13:55:10	RS2_w1_mds	ART_Tfol_005	7	0:47:52	Span @ 4:49 , Rel @ 4:19 data end 810
02-Oct-09	14:05:03	RS2_w1_mds	ART_Tfol_006	7	0:48:21	Span @ 4:06 , Rel @ 3:36 data end 935
02-Oct-09	14:15:21	RS2_w1_mds	ART_Tfol_007	7	0:49:38	Span @ 3:28 , Rel @ 2:58 data end 1064
02-Oct-09	14:25:32	RS2_w1_mds	ART_Tfol_008	7	0:51:02	Span @ 2:48 , Rel @ 2:18 data end 1196
02-Oct-09	14:35:32	RS2_w1_mds	ART_Tfol_009	7	0:52:21	Span @ 2:08 , Rel @ 1:38 data end 1320
02-Oct-09	14:45:07	RS2_w1_mds	ART_Tfol_010	7	0:53:38	Span @ 1:30 , Rel @ 1:00 data end 1430
02-Oct-09	14:55:47	RS2_w1_mds	ART_Tfol_011	7	0:54:54	Span @ 1:00 , Rel @ 0:30 data end
02-Oct-09						Wavemaker hydraulic pumps off
05-Oct-09	8:45:00					Wavemaker hydraulic pumps started
05-Oct-09	9:10:27	RS2_w1_mds	ART_Tfol_R1_001	7	0:56:38	Rel Autopilot Setpoint = -5 deg, RPS = 8.7
05-Oct-09	9:20:10	RS2_w1_mds	ART_Tfol_R1_002	7	0:57:59	Repeat of above run
05-Oct-09	9:30:13	RS2_w1_mds	ART_Tfol_R1_003	7	0:59:32	Repeat of above run
05-Oct-09	9:40:09	RS2_w1_mds	ART_Tfol_R2_001	7	1:01:02	Span @ 6:47 , Rel @ 6:17
05-Oct-09	9:50:05	RS2_w1_mds	ART_Tfol_R2_002	7	1:02:19	Repeat of above run
05-Oct-09	10:04:32	RS2_w1_mds	ART_Tfol_R2_003	7	1:03:37	Repeat of above run
05-Oct-09	10:14:04	RS2_w1_mds	ART_Tfol_R3_001	7	1:05:08	Span @ 6:10 , Rel @ 5:40
05-Oct-09	10:24:04	RS2_w1_mds	ART_Tfol_R3_002	7	1:06:31	Repeat of above run
05-Oct-09	10:34:08	RS2_w1_mds	ART_Tfol_R3_003	7	1:07:53	Repeat of above run
05-Oct-09			**Repeat Runs**			Remove water from ART
05-Oct-09	10:53:41	RS2_w1_mds	Tfol_R1_001	7	1:09:14	Rel Autopilot Setpoint = -3.5 deg, RPS = 8.7
05-Oct-09	11:03:13	RS2_w1_mds	Tfol_R1_002	7	1:11:15	Repeat of above run
05-Oct-09	11:13:12	RS2_w1_mds	Tfol_R1_003	7	1:12:45	Repeat of above run
05-Oct-09	11:23:07	RS2_w1_mds	Tfol_R2_001	7	1:14:18	Span @ 6:54 , Rel @ 6:24 Autopilot Setpoint = -2.5 deg
05-Oct-09	11:33:02	RS2_w1_mds	Tfol_R2_002	7	1:15:52	Repeat of above run
05-Oct-09	11:43:02	RS2_w1_mds	Tfol_R2_003	7	1:17:23	Repeat of above run
05-Oct-09	11:53:02	RS2_w1_mds	Tfol_R3_001	7	1:18:59	**Span @ 6:18 , Rel @ 5:48**
05-Oct-09	12:03:03	RS2_w1_mds	Tfol_R3_002	7	1:20:26	Repeat of above run
05-Oct-09	12:13:02	RS2_w1_mds	Tfol_R3_003	7	1:21:29	Repeat of above run
05-Oct-09	12:23:56	RS2_w1_mds	0drift_beam_R_001	7	1:22:56	Drift test model pointing North East Following sea run stopped heading for probe
05-Oct-09	12:31:19	RS2_w1_mds	0drift_beam_R_002	7	1:26:01	Drift test model pointing North East Following sea
						Wavemaker hydraulic pumps off
06-Oct-09	13:30:00					Wavemaker hydraulic pumps started
06-Oct-09						Add water to ART
06-Oct-09	13:47:41	RS2_w1_mds	ART_0drift_beam_001	8	0:00:00	Drift test model pointing North West to start
06-Oct-09	14:01:55	RS2_w1_mds	ART_0drift_beam_002	8	0:07:32	Drift test model pointing Sorth East to start
06-Oct-09						Wavemaker hydraulic pumps off
NOTE:	ART - anti-roll tank		ARTB - anti-roll tank with baffles fitted			
	MS - model scale					
	FS - full scale					
	File Name = C(hdg)_* = high speed at cruise (~ 8 knots FS)			Irregular waves		
	File Name = T(hdg)_* = low speed at trawl (~ 4 knots FS)			Irregular waves		
	File Name = CASE* = regular waves					

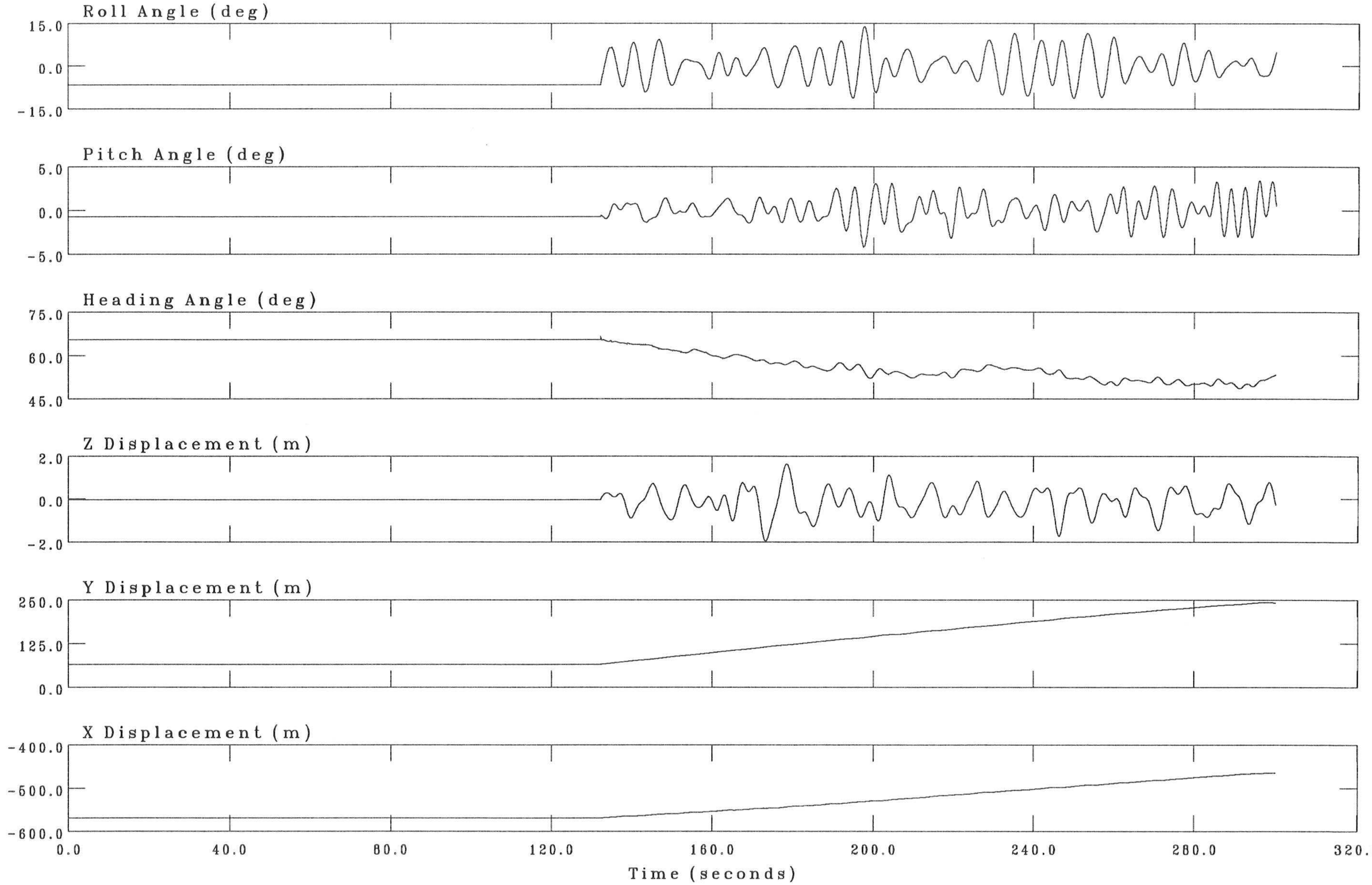
APPENDIX G

EXAMPLE ONLINE ANALYSIS DATA PRODUCT

Safer Fishing Vessel Seakeeping Phase 2
CCGA Roberts Sisters II Seakeeping Tests

NRC-IOT

Analyzed: 16-NOV-2009 16:46:47
Acquired: 24-JUL-2009 13:28:09



National Research Council Canada
Institute for Ocean Technology

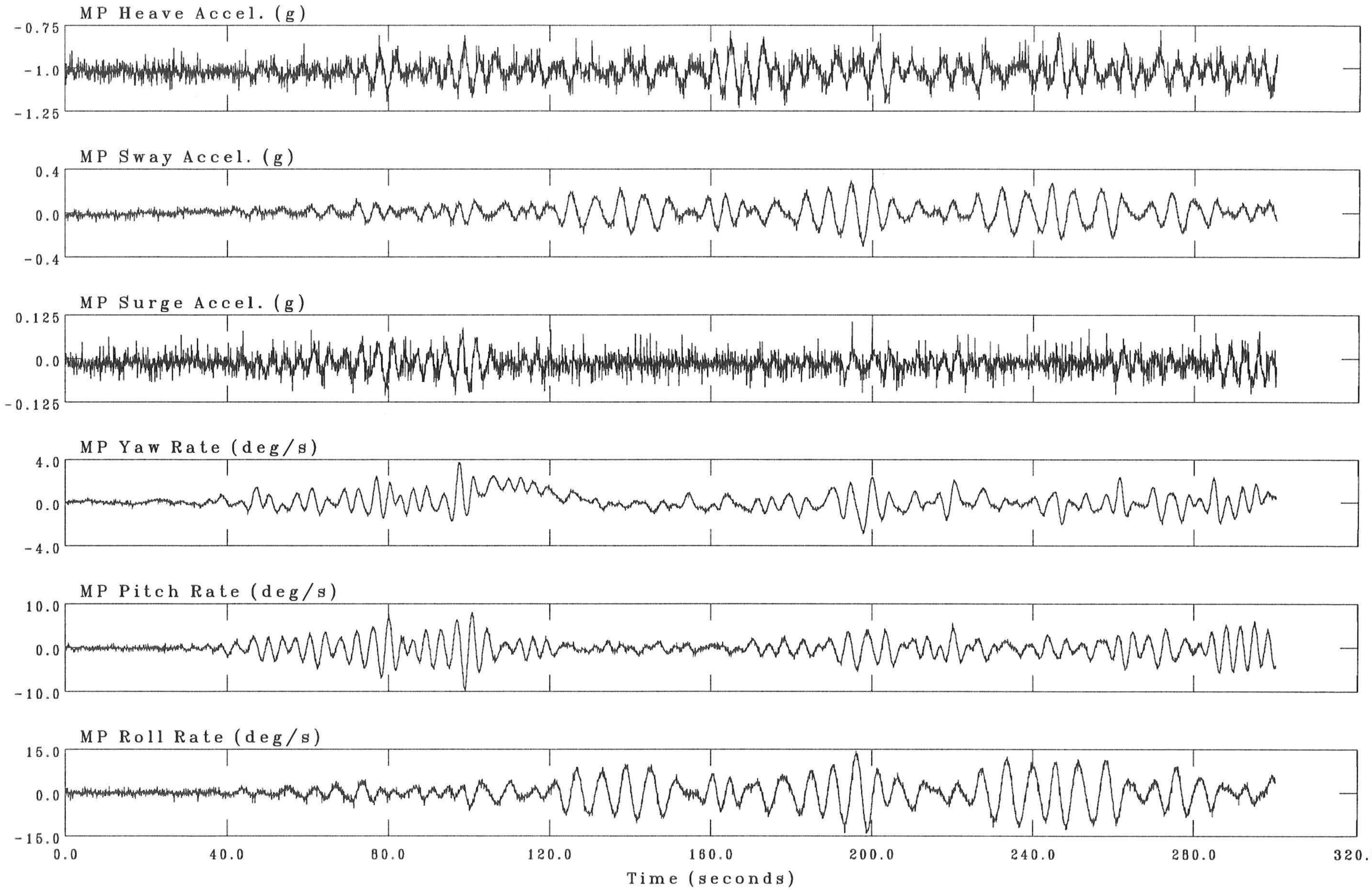
GENERATED BY: CUMMINGD	CHECKED BY:	APPROVED BY:

Figure 1 TBEAM_003

Safer Fishing Vessel Seakeeping Phase 2
CCGA Roberts Sisters II Seakeeping Tests

NRC-IOT

Analyzed: 16-NOV-2009 16:46:58
Acquired: 24-JUL-2009 13:28:09



National Research Council Canada
Institute for Ocean Technology

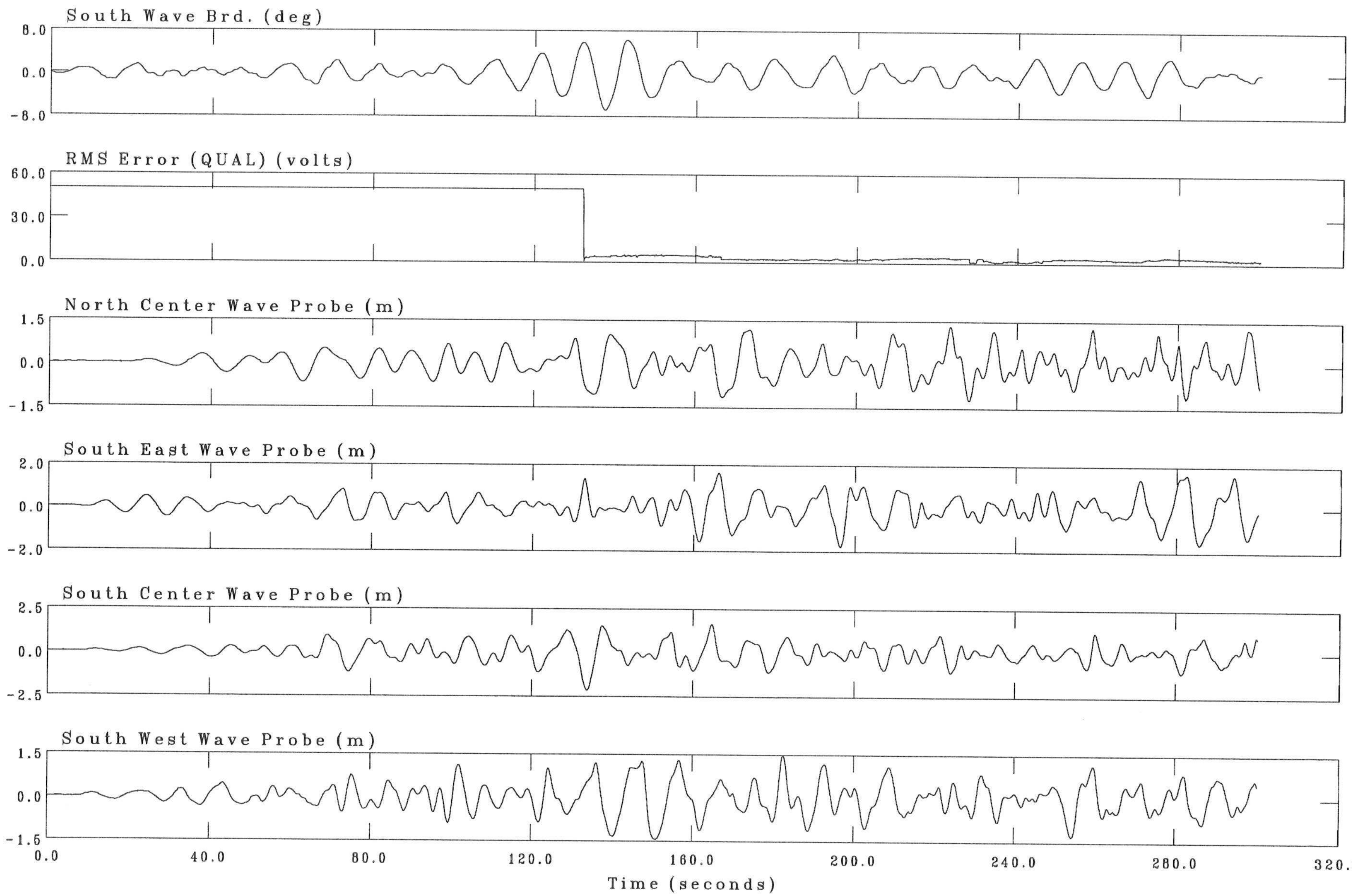
GENERATED BY: CUMMINGD	CHECKED BY:	APPROVED BY:

Figure 2 TBEAM_003

Safer Fishing Vessel Seakeeping Phase 2
CCGA Roberts Sisters II Seakeeping Tests

NRC-IOT

Analyzed: 16-NOV-2009 16:47:06
Acquired: 24-JUL-2009 13:28:09



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Institute for Ocean Technology

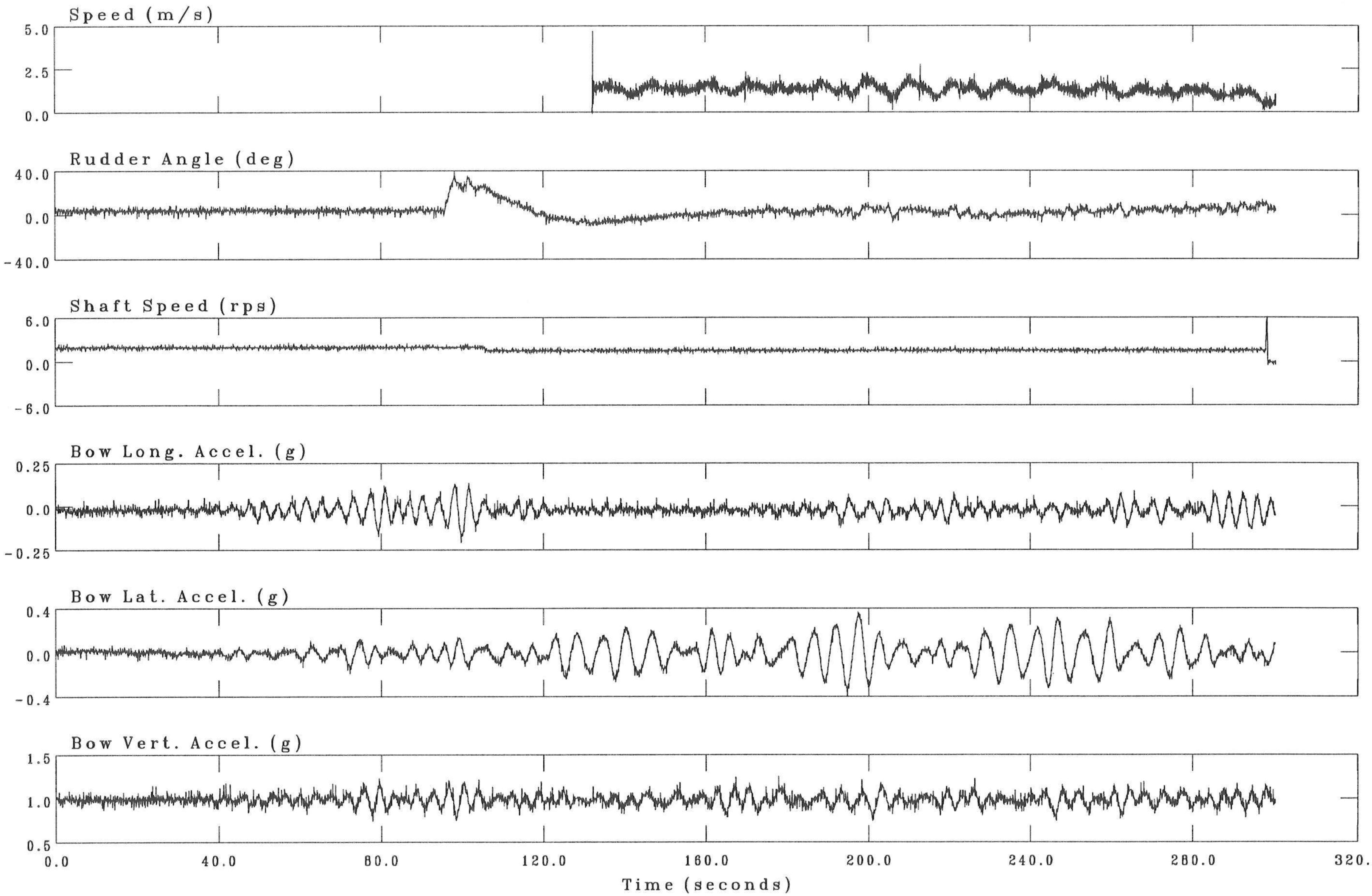
GENERATED BY: CUMMINGD	CHECKED BY:	APPROVED BY:

Figure 3 TBEAM_003

Safer Fishing Vessel Seakeeping Phase 2
CCGA Roberts Sisters II Seakeeping Tests

NRC-IOT

Analyzed: 16-NOV-2009 16:47:13
Acquired: 24-JUL-2009 13:28:09

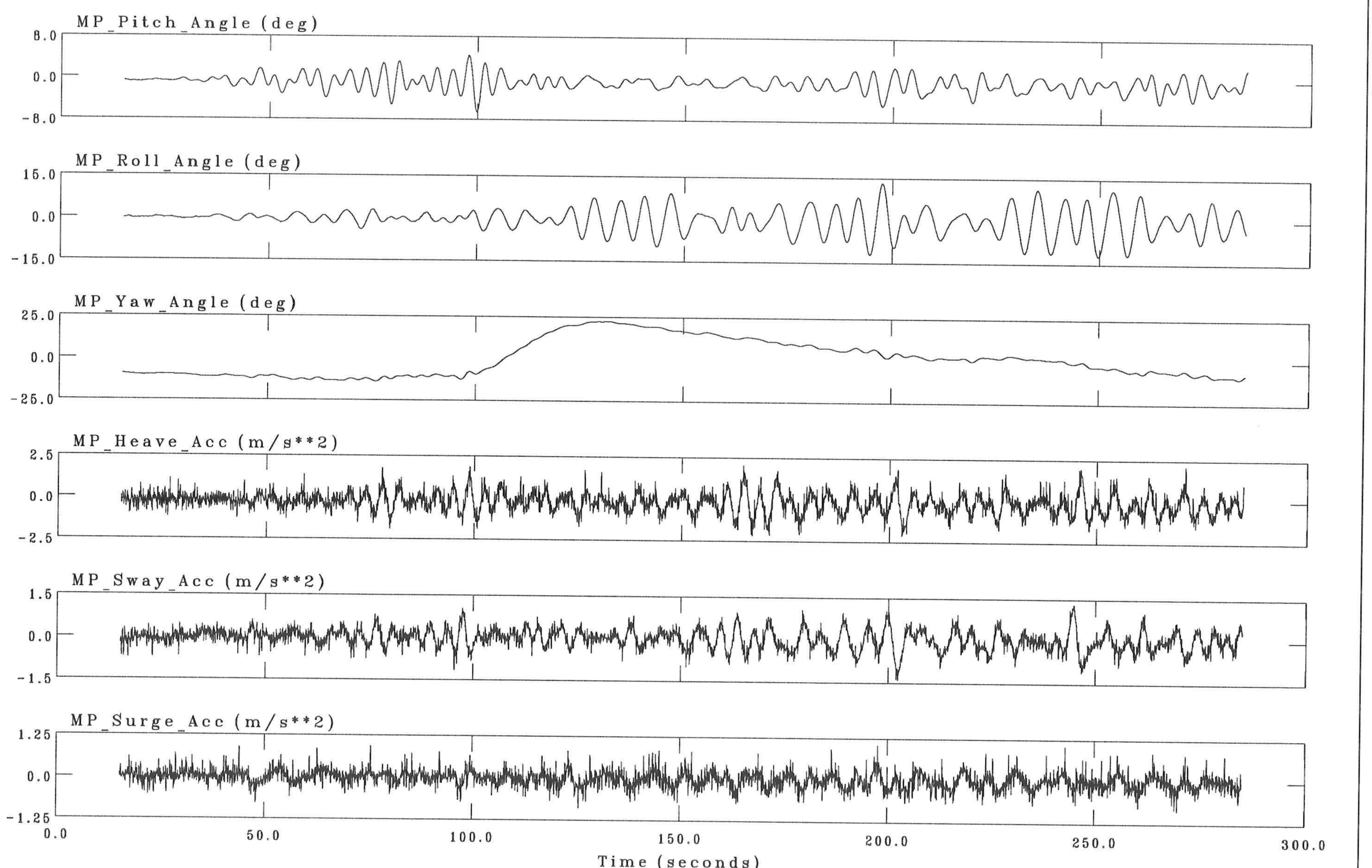


National Research Council Canada Institute for Ocean Technology	GENERATED BY: CUMMINGD	CHECKED BY:	APPROVED BY:
	Figure 4 TBEAM_003		

Safer Fishing Vessel Seakeeping Phase 2
CCGA Roberts Sisters II Seakeeping Tests

NRC-IOT

Analyzed: 16-NOV-2009 16:47:21
Acquired: 24-JUL-2009 13:28:09



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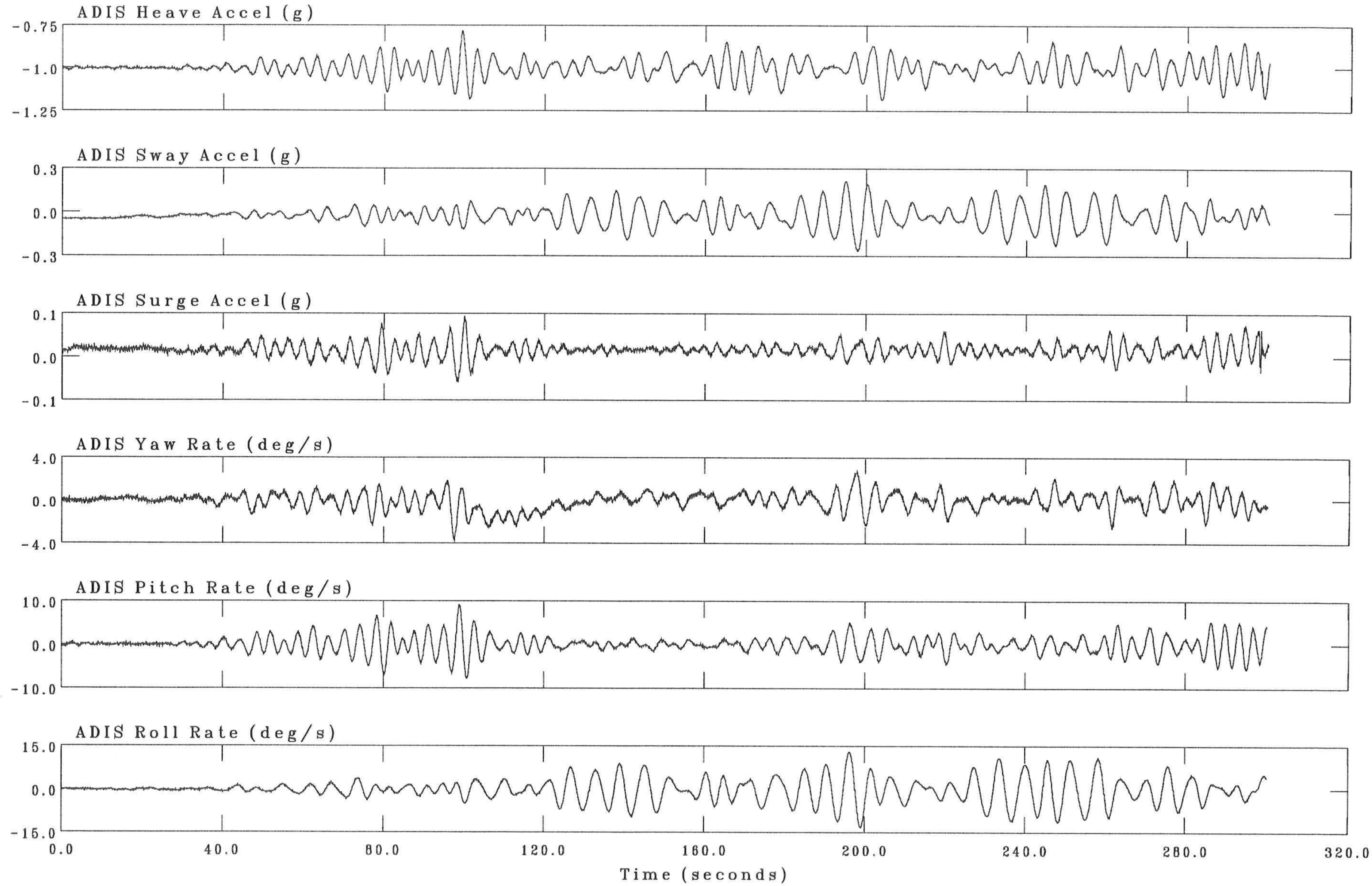
GENERATED BY: CUMMINGD | CHECKED BY: | APPROVED BY:

Figure 5 TBEAM_003

Safer Fishing Vessel Seakeeping Phase 2
CCGA Roberts Sisters II Seakeeping Tests

NRC-IOT

Analyzed: 16-NOV-2009 16:47:30
Acquired: 24-JUL-2009 13:28:09



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Institute for Ocean Technology

GENERATED BY: CUMMINGD	CHECKED BY:	APPROVED BY:

Figure 6 TBEAM_003

---- Z Displ Tare Only ----

```
Analysis Date/Time = 16-NOV-2009 16:47:38
Acquired Date/Time = 24-JUL-2009 13:28:09
Input File         =  CH_S1
Output File        =  TBEAM_003_STAT
Number of Samples  =  1602
Segment Start Time =  10.778 seconds
Segment End Time   =  115.36 seconds
```

Description	Unit	Min	Max	Mean	S.D.	Chan
South West Wave Probe	m	-0.87856	1.1270	0.010321	0.30663	1
South Center Wave Probe	m	-1.1445	0.96165	0.0074154	0.38645	2
South East Wave Probe	m	-0.78462	0.82698	0.013268	0.33220	3
North Center Wave Probe	m	-0.65472	0.71370	0.020233	0.29695	4
MP Roll Rate	deg/s	-6.1034	4.6912	-0.023574	1.5270	5
MP Pitch Rate	deg/s	-9.6828	8.0356	-0.16482	2.3931	6
MP Yaw Rate	deg/s	-1.7008	3.7133	0.30866	0.87460	7
MP Surge Accel.	g	-0.10598	0.088647	-0.011715	0.027698	8
MP Sway Accel.	g	-0.12135	0.13284	0.0066781	0.036707	9
MP Heave Accel.	g	-1.1927	-0.80926	-1.0190	0.048466	10
Bow Vert. Accel.	g	0.74112	1.2347	0.99330	0.064453	11
Bow Lat. Accel.	g	-0.19261	0.13214	-0.0078938	0.043272	12
Bow Long. Accel.	g	-0.20776	0.13485	-0.018822	0.043780	13
Shaft Speed	rps	1.1976	2.4346	1.9304	0.16694	14
Rudder Angle	deg	-3.1830	37.389	6.8549	7.2783	15
X Displacement	m	-568.87	-568.87	-568.87	0.0	16
Y Displacement	m	65.085	65.085	65.085	0.0	17
Z Displacement	m	-0.039488	-0.039488	-0.039488	0.0	18
Heading Angle	deg	65.598	65.598	65.598	0.0	19
Pitch Angle	deg	-0.71808	-0.71808	-0.71808	0.0	20
Roll Angle	deg	-6.6725	-6.6725	-6.6725	0.0	21
RMS Error (QUAL)	volts	49.986	50.005	49.995	0.0034367	22
South Wave Brd.	deg	-3.1470	2.5240	-0.059299	1.0635	23
X_Disp_CG	m	-568.87	-568.87	-568.87	0.0	24
Y_Disp_CG	m	65.085	65.085	65.085	0.0	25
Z_Disp_CG	m	-0.039488	-0.039488	-0.039488	0.0	26
MP_Surge_Displ	m	-0.67599	0.61500	-0.0026257	0.22842	27
MP_Surge_Acc	m/s**2	-0.77378	0.92945	0.017581	0.17767	28
MP_Surge_Vel	m/s	-0.37289	0.40241	-0.000048049	0.13925	29
MP_Sway_Displ	m	-0.55060	0.55974	-0.0044687	0.21406	30
MP_Sway_Acc	m/s**2	-1.1531	1.0389	0.0076029	0.24720	31
MP_Sway_Vel	m/s	-0.49839	0.62974	-0.0038959	0.16754	32
MP_Heave_Displ	m	-0.84622	0.72950	0.0077120	0.30775	33
MP_Heave_Acc	m/s**2	-1.8834	1.8272	-0.19514	0.46270	34
MP_Heave_Vel	m/s	-0.77378	0.99471	-0.0041676	0.28521	35
MP_Yaw_Angle	deg	-13.899	12.800	-9.4295	5.3788	36
MP_Yaw_Acc	deg/sec**2	-6.4780	7.8290	0.018381	1.7241	37
MP_Yaw_Vel	deg/sec	-1.7047	3.7162	0.32339	0.88935	38
MP_Pitch_Angle	deg	-6.5428	4.3467	-0.73958	1.5554	39
MP_Pitch_Acc	deg/sec**2	-31.964	31.417	0.017028	6.7174	40
MP_Pitch_Vel	deg/sec	-9.6838	8.0475	-0.16641	2.4401	41
MP_Roll_Angle	deg	-4.7326	3.3367	-0.35820	1.4220	42
MP_Roll_Acc	deg/sec**2	-55.895	78.601	-0.0010537	13.680	43
MP_Roll_Vel	deg/sec	-6.0744	4.6733	-0.026574	1.5301	44
Speed	m/s	0.0	0.00094891	0.00016818	0.00024931	45
Speed	knots	0.0	0.0018445	0.00032690	0.00048461	46

West Wave Brd.	deg	-5.9118	6.0687	-0.039630	2.5827	47
ADIS Roll Rate	deg/s	-5.0673	3.7660	-0.22405	1.4011	48
ADIS Pitch Rate	deg/s	-7.8382	9.0936	-0.032654	2.3605	49
ADIS Yaw Rate	deg/s	-3.7048	1.8524	-0.25550	0.85617	50
ADIS Surge Accel	g	-0.057000	0.091000	0.014318	0.019395	51
ADIS Sway Accel	g	-0.11900	0.076000	-0.026046	0.030310	52
ADIS Heave Accel	g	-1.1820	-0.78400	-1.0031	0.051708	53

---- Z Displ Tare Only ----

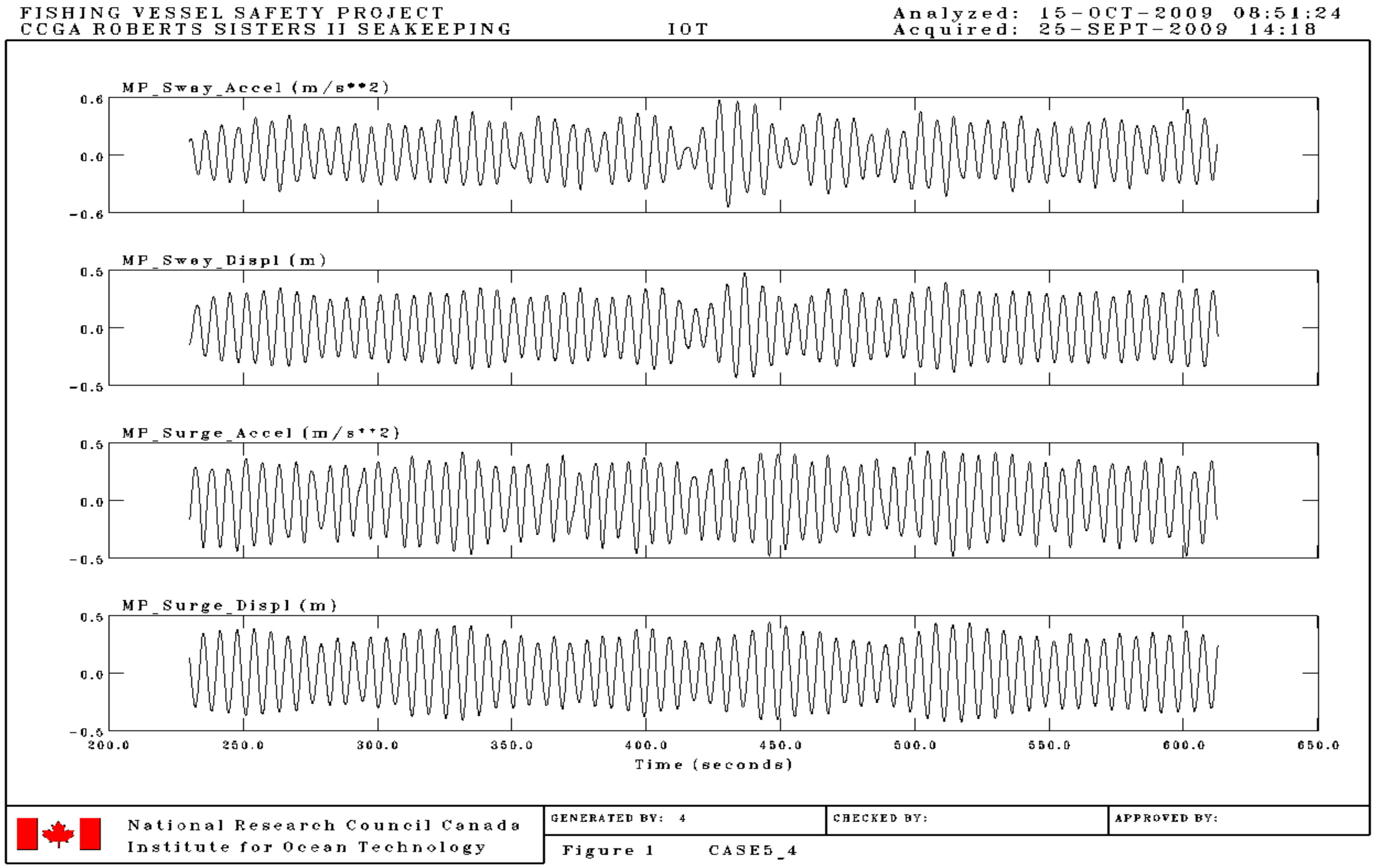
Analysis Date/Time = 16-NOV-2009 16:47:47
Acquired Date/Time = 24-JUL-2009 13:28:09
Input File = CH_S2
Output File = TBEAM_003_STAT
Number of Samples = 2394
Segment Start Time = 137.83 seconds
Segment End Time = 294.14 seconds

Description	Unit	Min	Max	Mean	S.D.	Chan
South West Wave Probe	m	-1.4317	1.4816	0.00073514	0.59439	1
South Center Wave Probe	m	-1.1202	1.6306	0.0063313	0.50826	2
South East Wave Probe	m	-1.7669	1.6403	0.023977	0.66241	3
North Center Wave Probe	m	-1.2236	1.3375	0.026808	0.52156	4
MP Roll Rate	deg/s	-14.040	14.394	0.057836	5.3662	5
MP Pitch Rate	deg/s	-5.6779	5.2936	-0.19120	1.8311	6
MP Yaw Rate	deg/s	-2.8719	2.3630	-0.083378	0.77256	7
MP Surge Accel.	g	-0.10254	0.10667	-0.013733	0.023741	8
MP Sway Accel.	g	-0.30427	0.27931	0.0070961	0.10641	9
MP Heave Accel.	g	-1.2303	-0.77711	-1.0157	0.067584	10
Bow Vert. Accel.	g	0.75344	1.2543	0.98456	0.071590	11
Bow Lat. Accel.	g	-0.39906	0.35423	-0.0070367	0.13079	12
Bow Long. Accel.	g	-0.13167	0.090915	-0.022068	0.032063	13
Shaft Speed	rps	1.2016	1.9955	1.5202	0.098786	14
Rudder Angle	deg	-9.9172	11.834	2.2224	3.3385	15
X Displacement	m	-565.00	-465.99	-517.51	29.541	16
Y Displacement	m	72.155	240.60	160.80	49.234	17
Z Displacement	m	-1.9474	1.6410	-0.16956	0.61139	18
Heading Angle	deg	48.688	64.332	55.268	3.9845	19
Pitch Angle	deg	-4.1637	3.3023	0.0021325	1.3670	20
Roll Angle	deg	-11.266	13.849	0.17987	5.1682	21
RMS Error (QUAL)	volts	0.53860	5.1224	3.0516	0.98277	22
South Wave Brd.	deg	-6.4145	6.1907	-0.028841	2.0752	23
X_Disp_CG	m	-565.00	-465.99	-517.51	29.541	24
Y_Disp_CG	m	72.155	240.60	160.80	49.234	25
Z_Disp_CG	m	-1.9474	1.6410	-0.16956	0.61139	26
MP_Surge_Displ	m	-0.73549	0.63932	0.0040719	0.34534	27
MP_Surge_Acc	m/s**2	-0.85764	1.0537	-0.0050817	0.23725	28
MP_Surge_Vel	m/s	-0.48608	0.53449	-0.0021176	0.21948	29
MP_Sway_Displ	m	-1.2696	1.4932	-0.00058332	0.50607	30
MP_Sway_Acc	m/s**2	-1.4006	1.3174	-0.0018245	0.38753	31
MP_Sway_Vel	m/s	-0.94219	1.2465	0.0033012	0.37743	32
MP_Heave_Displ	m	-1.8469	1.7106	-0.015296	0.61960	33
MP_Heave_Acc	m/s**2	-2.1633	2.1192	-0.20646	0.64445	34
MP_Heave_Vel	m/s	-1.5708	1.3330	-0.0039683	0.52108	35
MP_Yaw_Angle	deg	-9.4456	20.882	4.2745	8.0533	36
MP_Yaw_Acc	deg/sec**2	-7.4691	7.6674	0.010186	1.7015	37
MP_Yaw_Vel	deg/sec	-2.8401	2.3825	-0.072026	0.76196	38

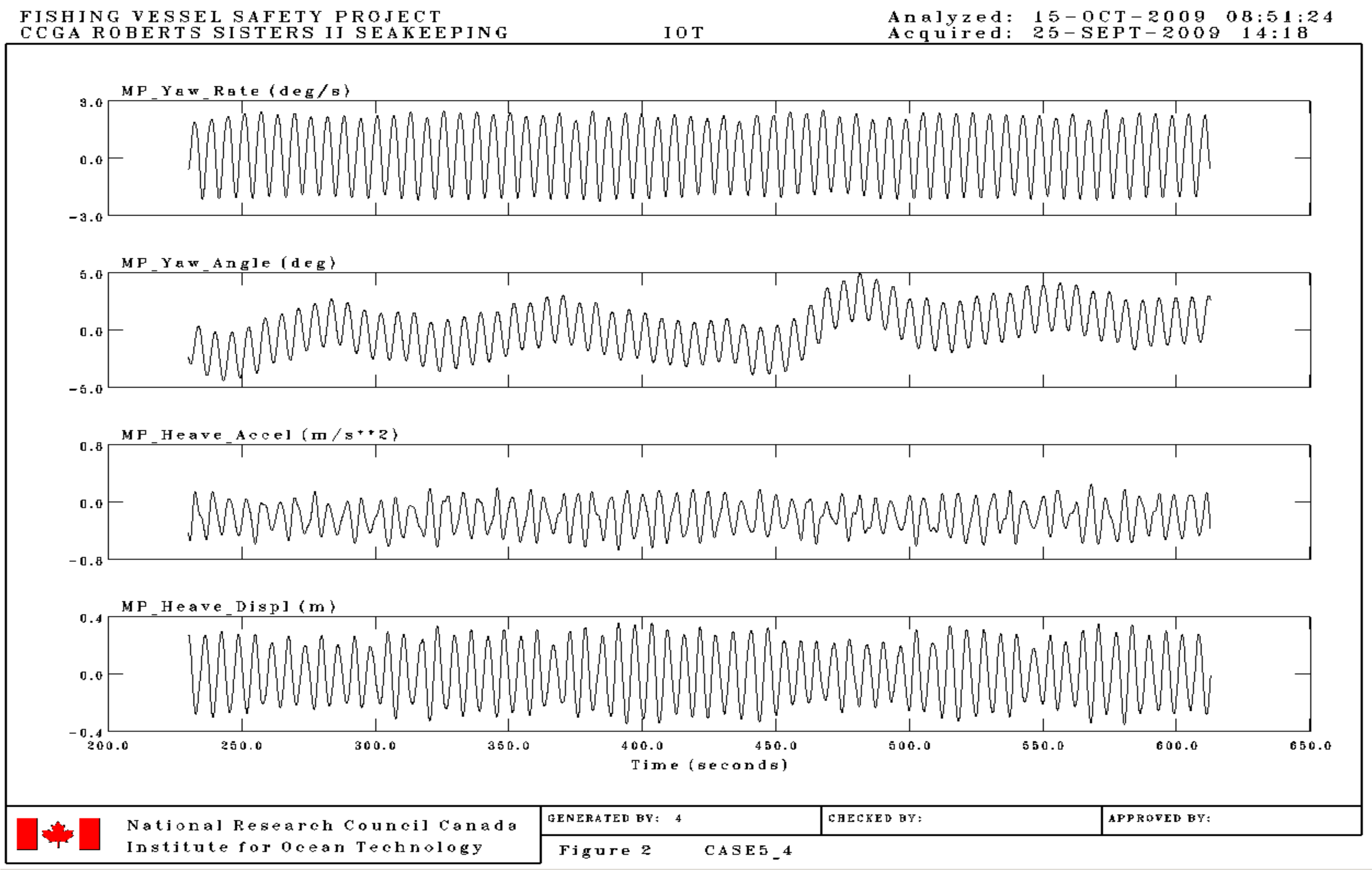
MP_Pitch_Angle	deg	-4.9704	2.4146	-0.72375	1.3350	39
MP_Pitch_Acc	deg/sec**2	-28.843	29.557	-0.0087781	6.1768	40
MP_Pitch_Vel	deg/sec	-5.3523	5.2889	-0.15077	1.6577	41
MP_Roll_Angle	deg	-12.205	13.357	-0.33142	5.3815	42
MP_Roll_Acc	deg/sec**2	-75.547	79.200	-0.029797	15.944	43
MP_Roll_Vel	deg/sec	-14.226	14.148	0.016741	5.5003	44
Speed	m/s	0.14210	2.7595	1.3179	0.28502	45
Speed	knots	0.27621	5.3640	2.5618	0.55402	46
West Wave Brd.	deg	-5.4098	5.8628	-0.058451	2.1798	47
ADIS Roll Rate	deg/s	-13.227	13.059	-0.14093	5.2306	48
ADIS Pitch Rate	deg/s	-5.2663	5.3735	0.0051669	1.8060	49
ADIS Yaw Rate	deg/s	-2.5872	2.7403	0.12357	0.76123	50
ADIS Surge Accel	g	-0.031000	0.064000	0.017117	0.014049	51
ADIS Sway Accel	g	-0.26400	0.21400	-0.026398	0.091375	52
ADIS Heave Accel	g	-1.1860	-0.84500	-0.99978	0.062456	53

APPENDIX H

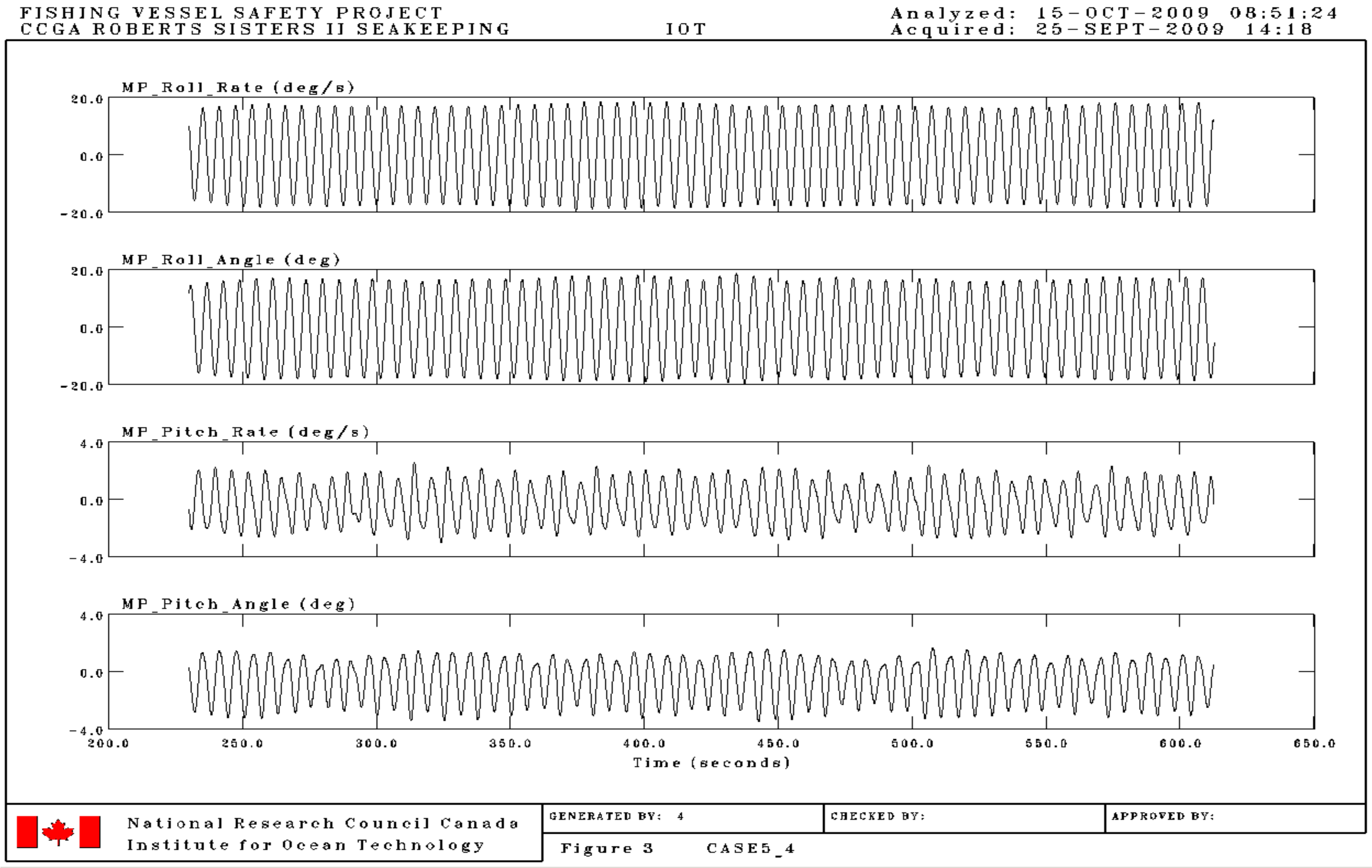
EXAMPLE TIME SERIES PLOTS



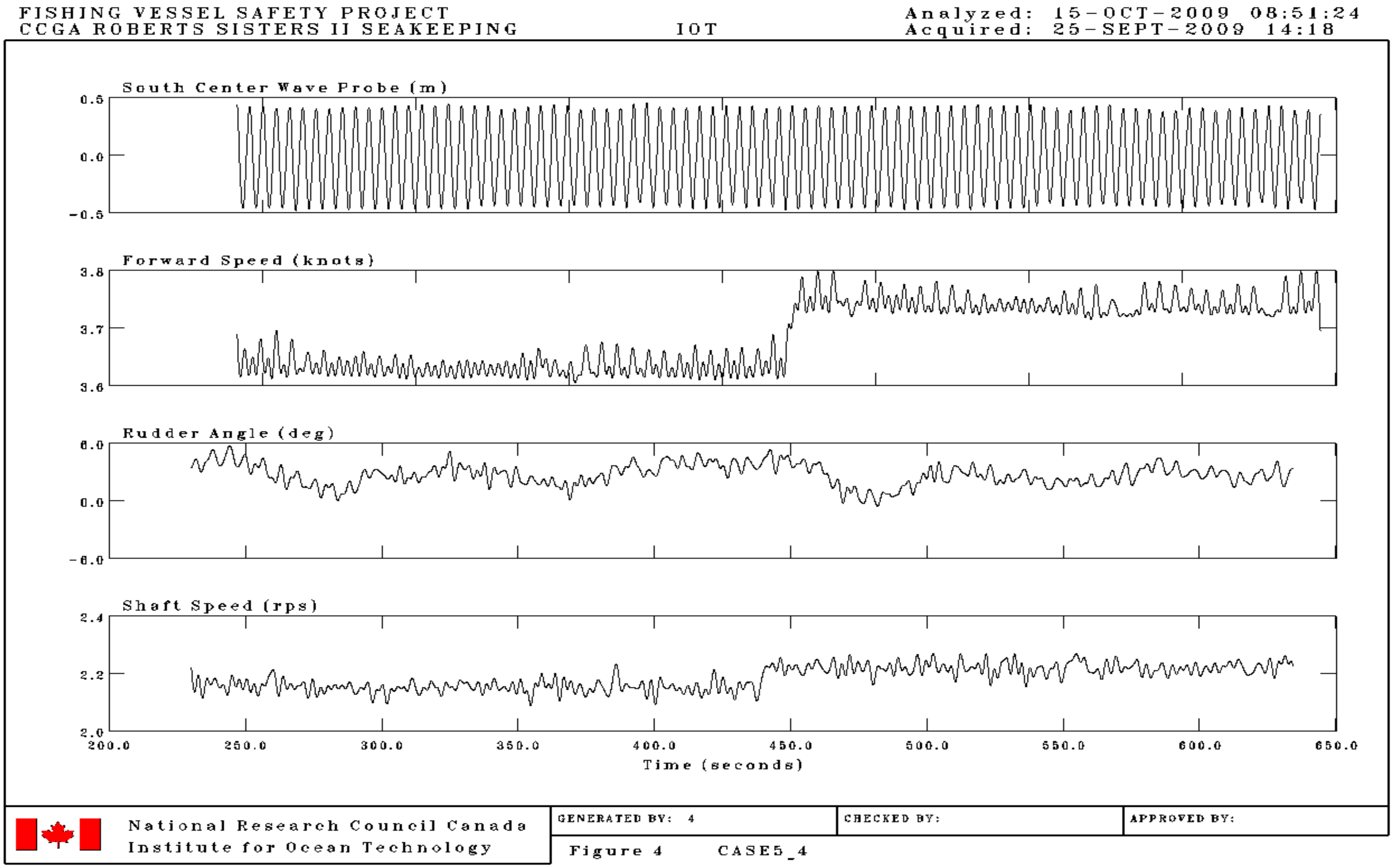
Typical Time Series Plots – for Regular Wave Run CASE5_4, Quartering Seas, 4 knots, ART Empty



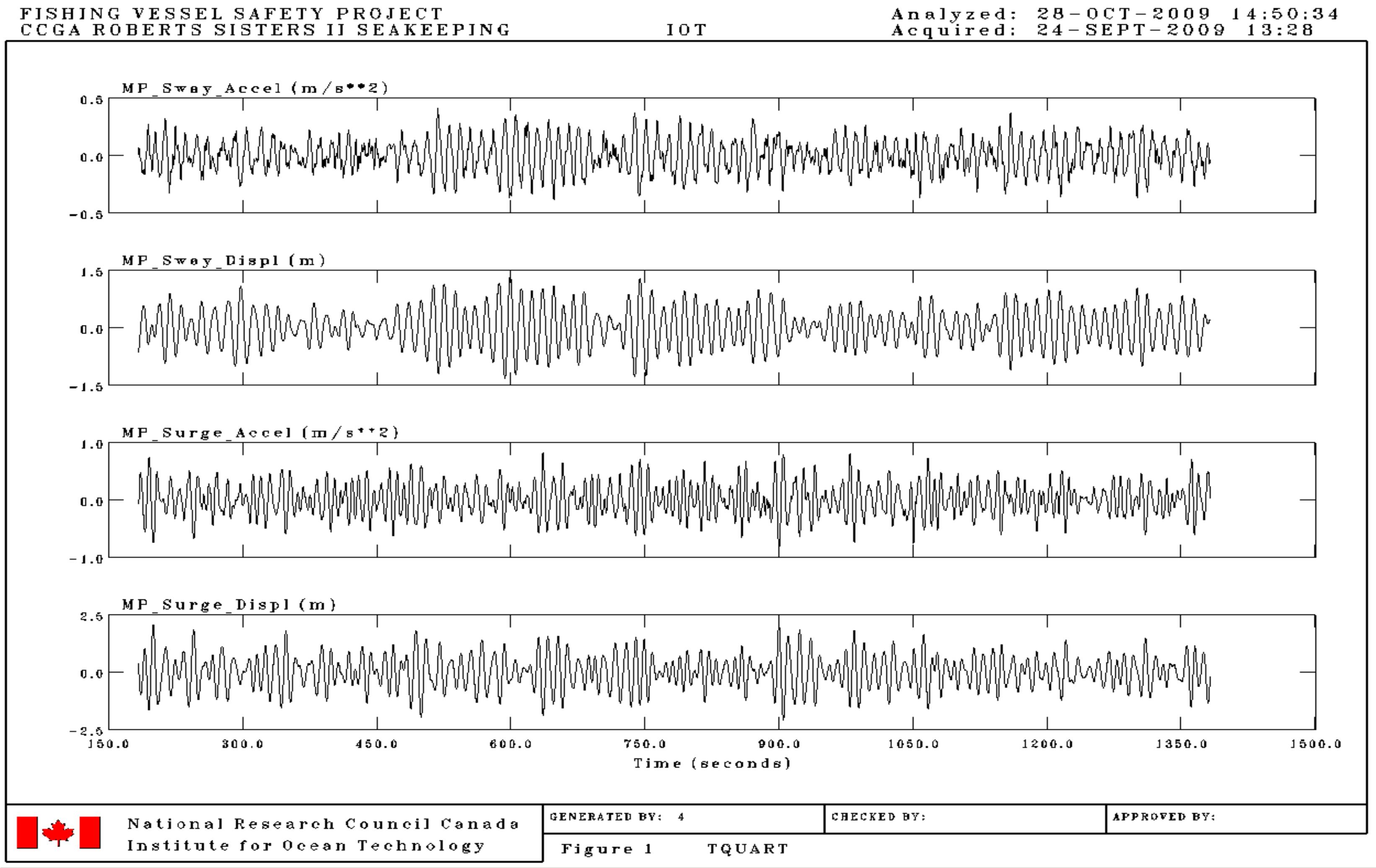
Typical Time Series Plots – for Regular Wave Run CASE5_4, Quartering Seas, 4 knots, ART Empty



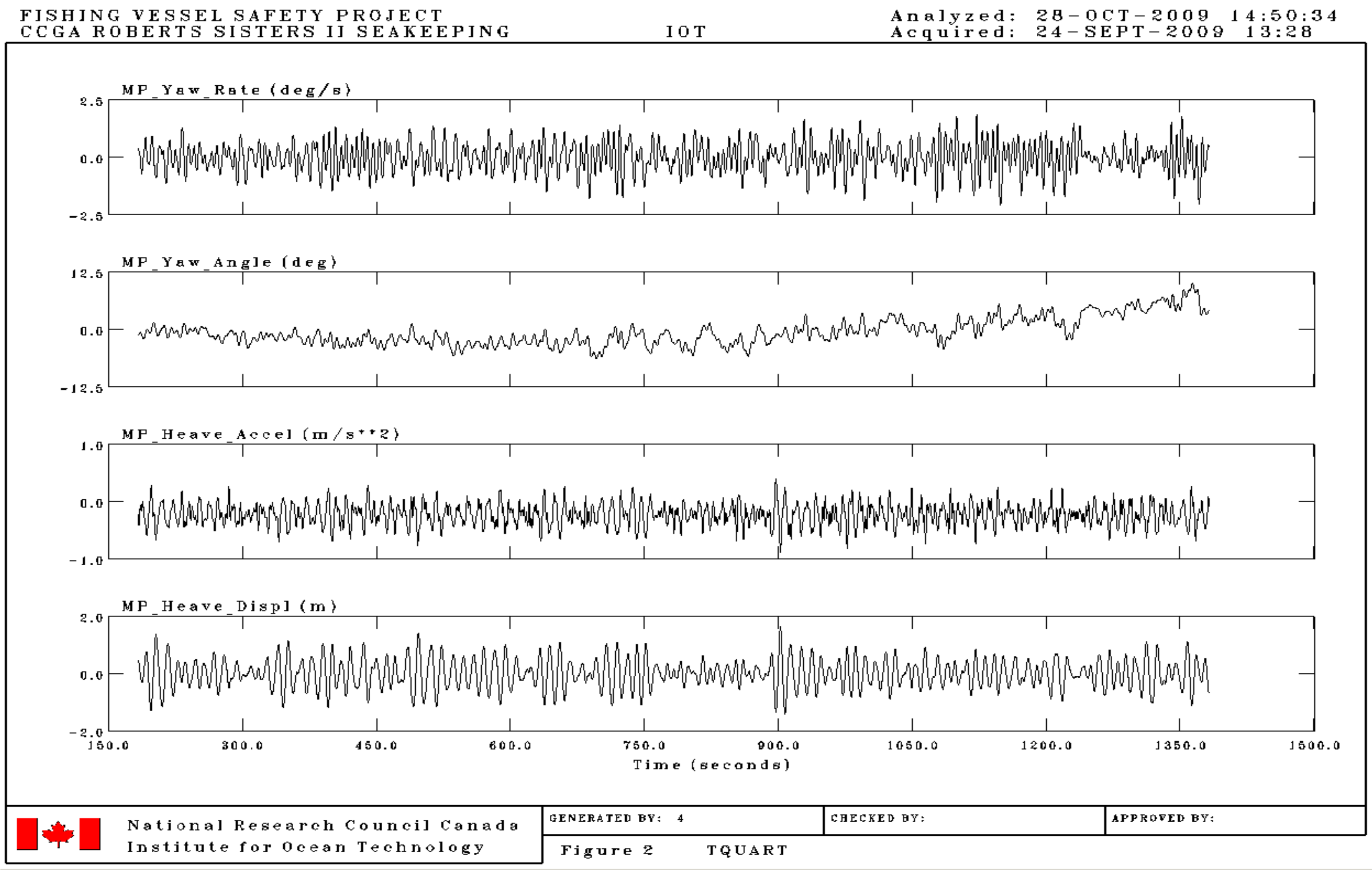
Typical Time Series Plots – for Regular Wave Run CASE5_4, Quartering Seas, 4 knots, ART Empty



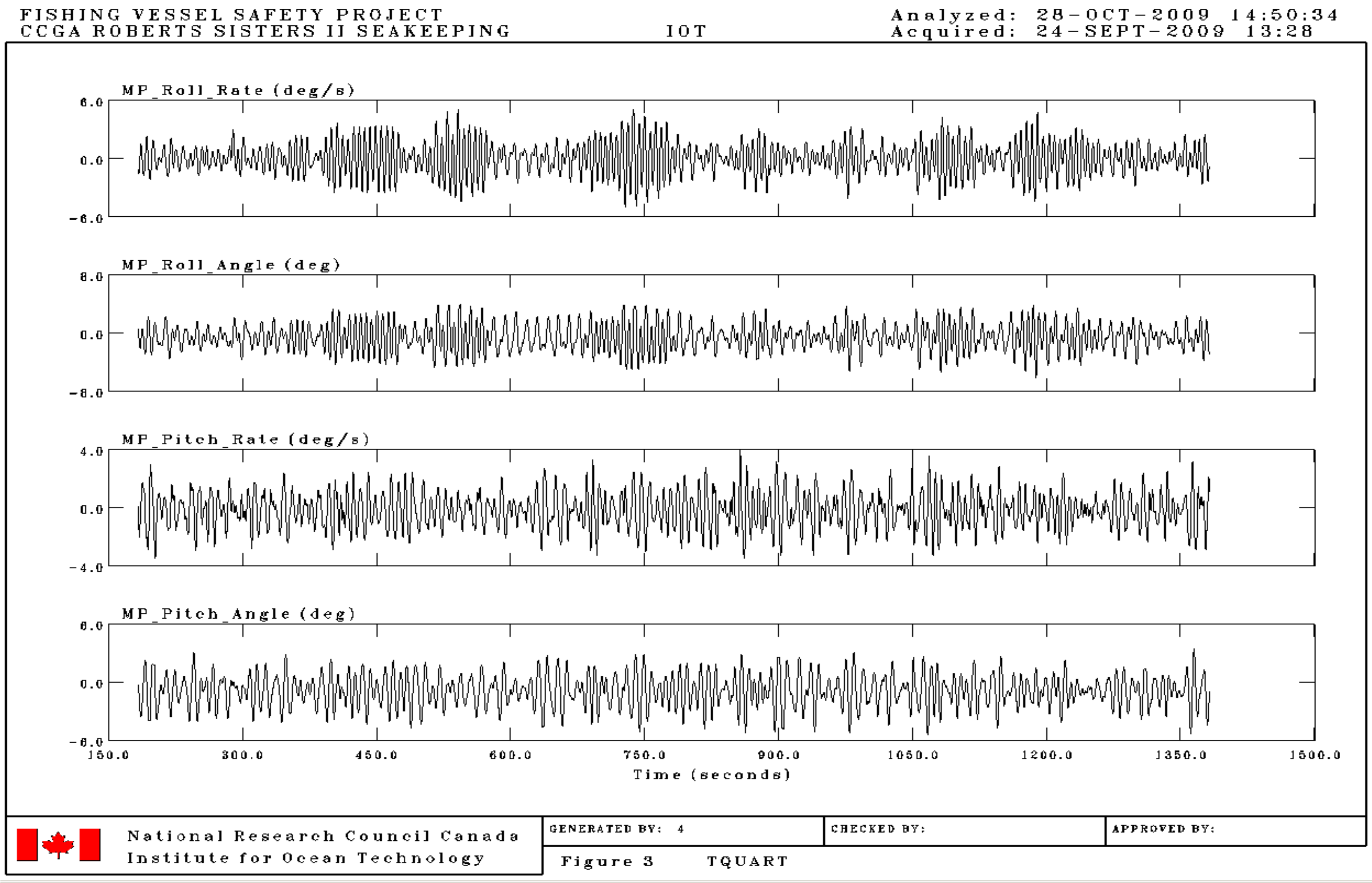
Typical Time Series Plots – for Regular Wave Run CASE5_4, Quartering Seas, 4 knots, ART Empty



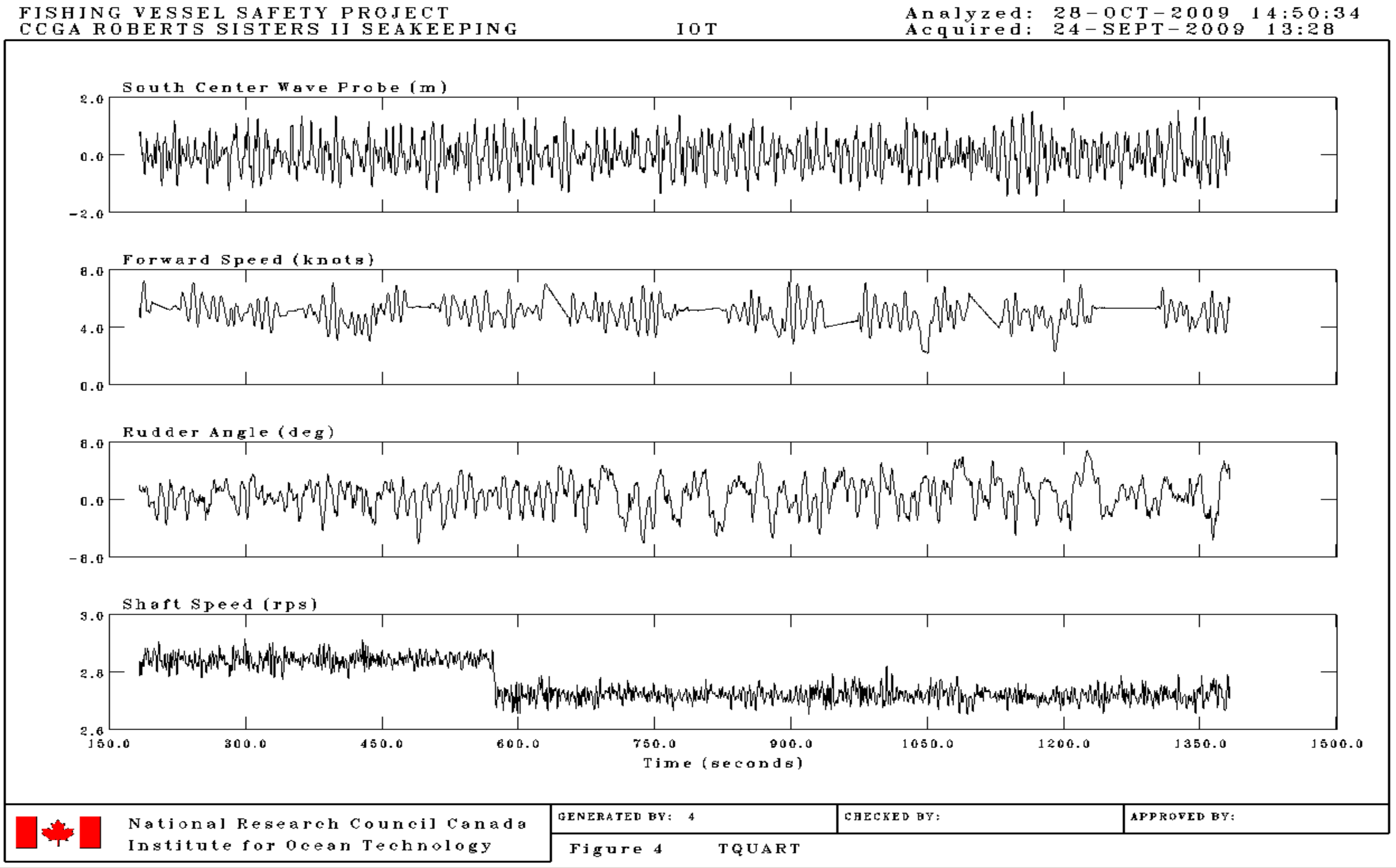
Typical Time Series Plots – for Irregular Wave Run TQUART, Quartering Seas, Trawl Speed, ART Empty



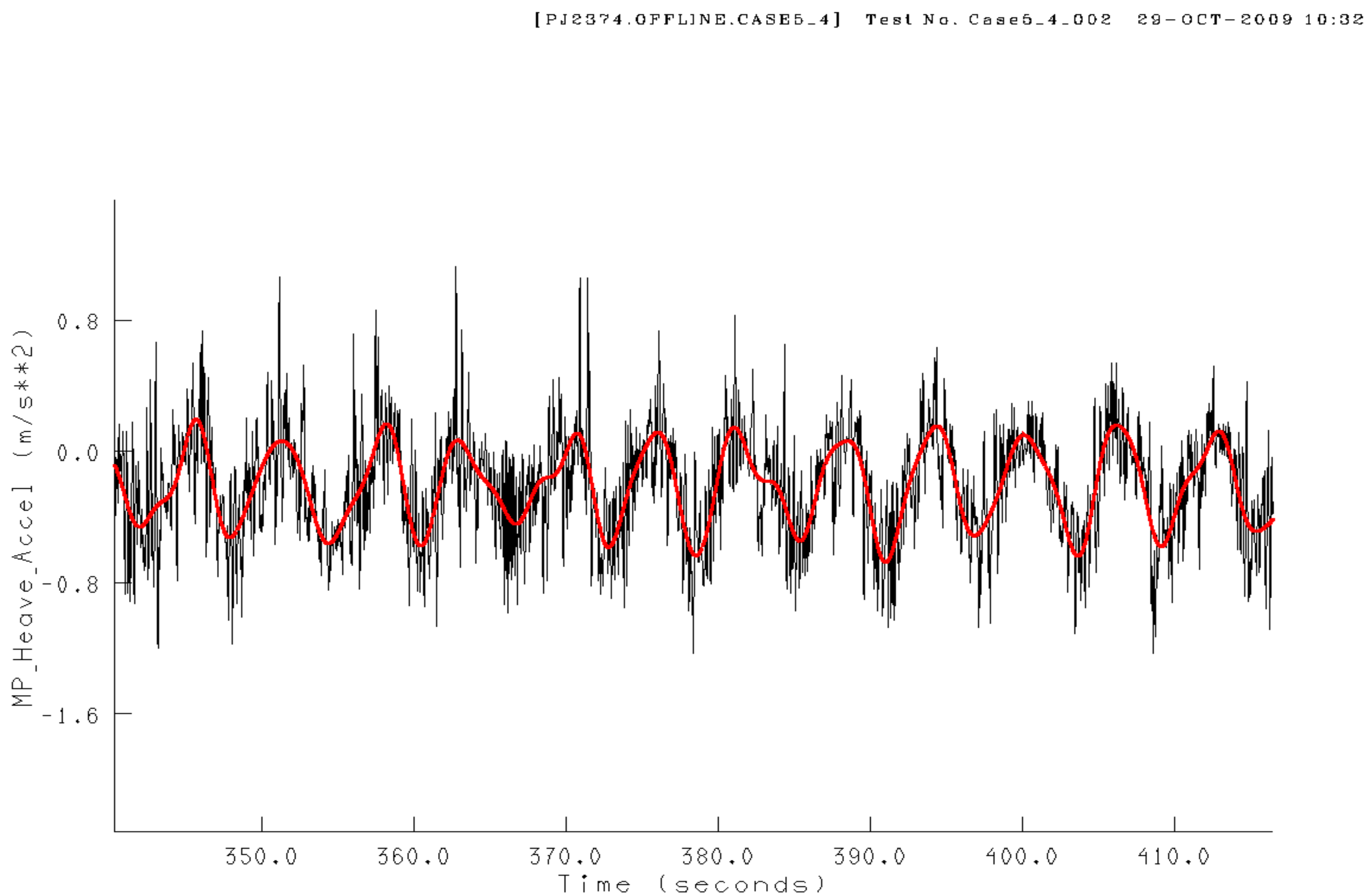
Typical Time Series Plots – for Irregular Wave Run TQUART, Quartering Seas, Trawl Speed, ART Empty



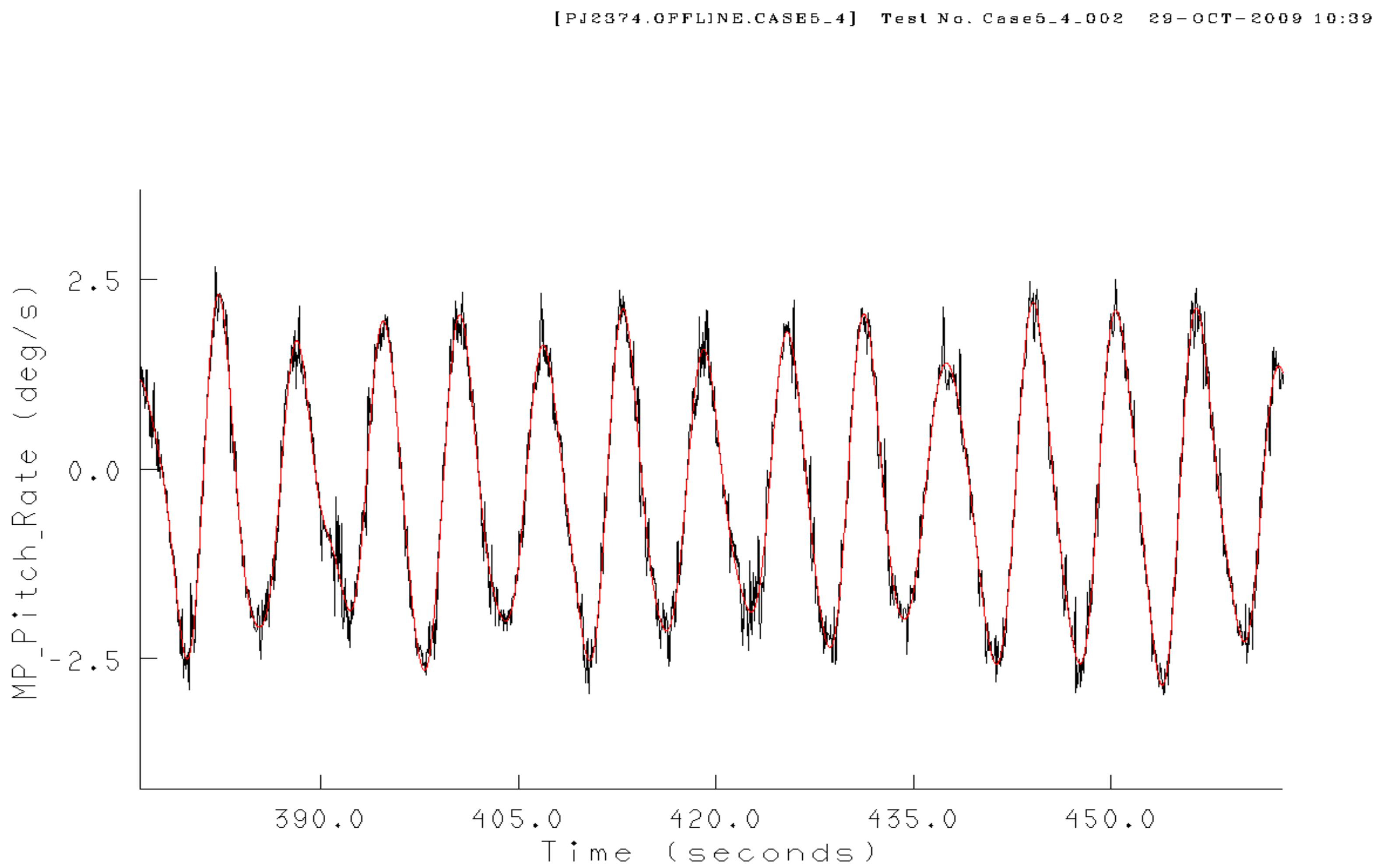
Typical Time Series Plots – for Irregular Wave Run TQUART, Quartering Seas, Trawl Speed, ART Empty



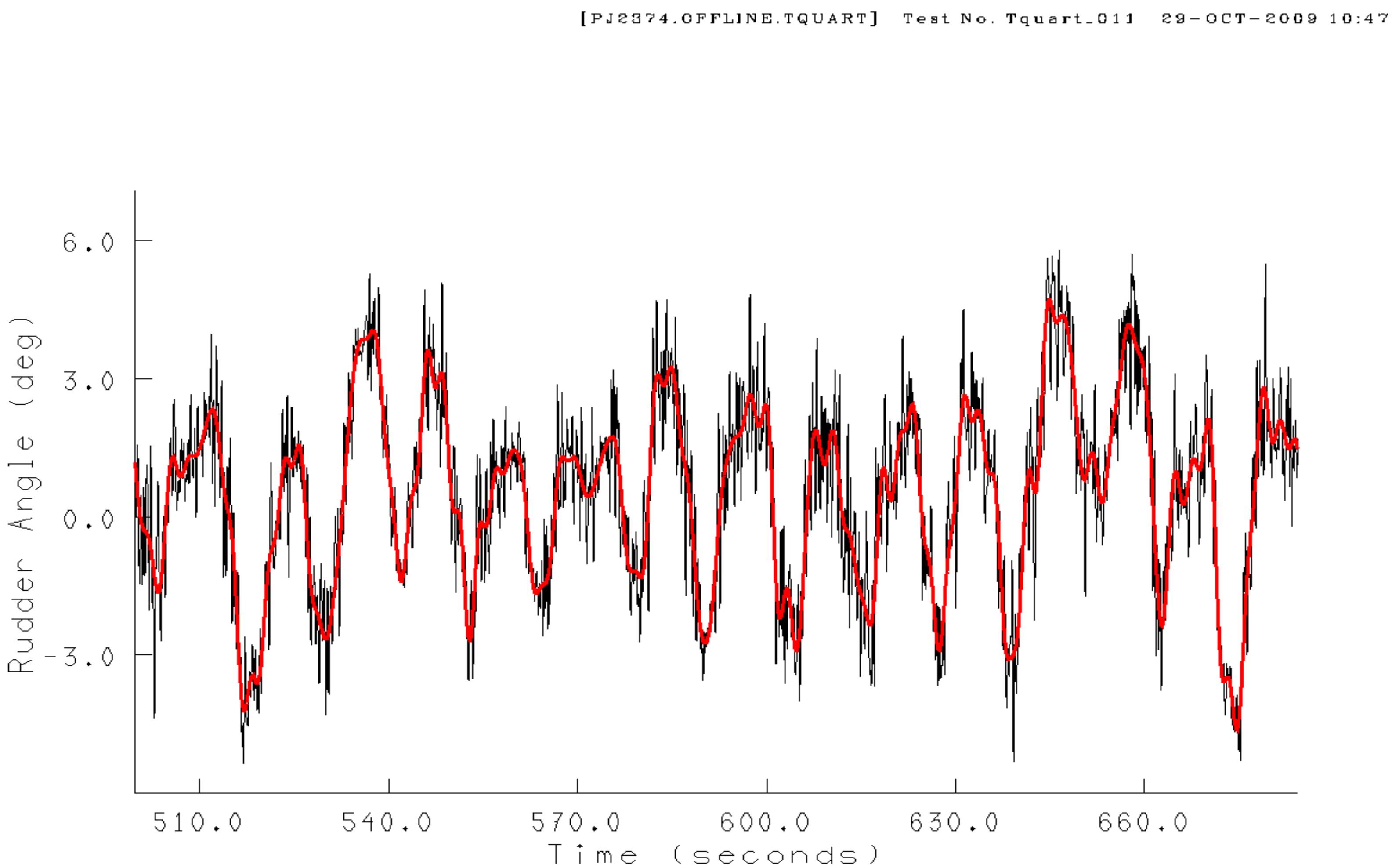
Typical Time Series Plots – for Irregular Wave Run TQUART, Quartering Seas, Trawl Speed, ART Empty



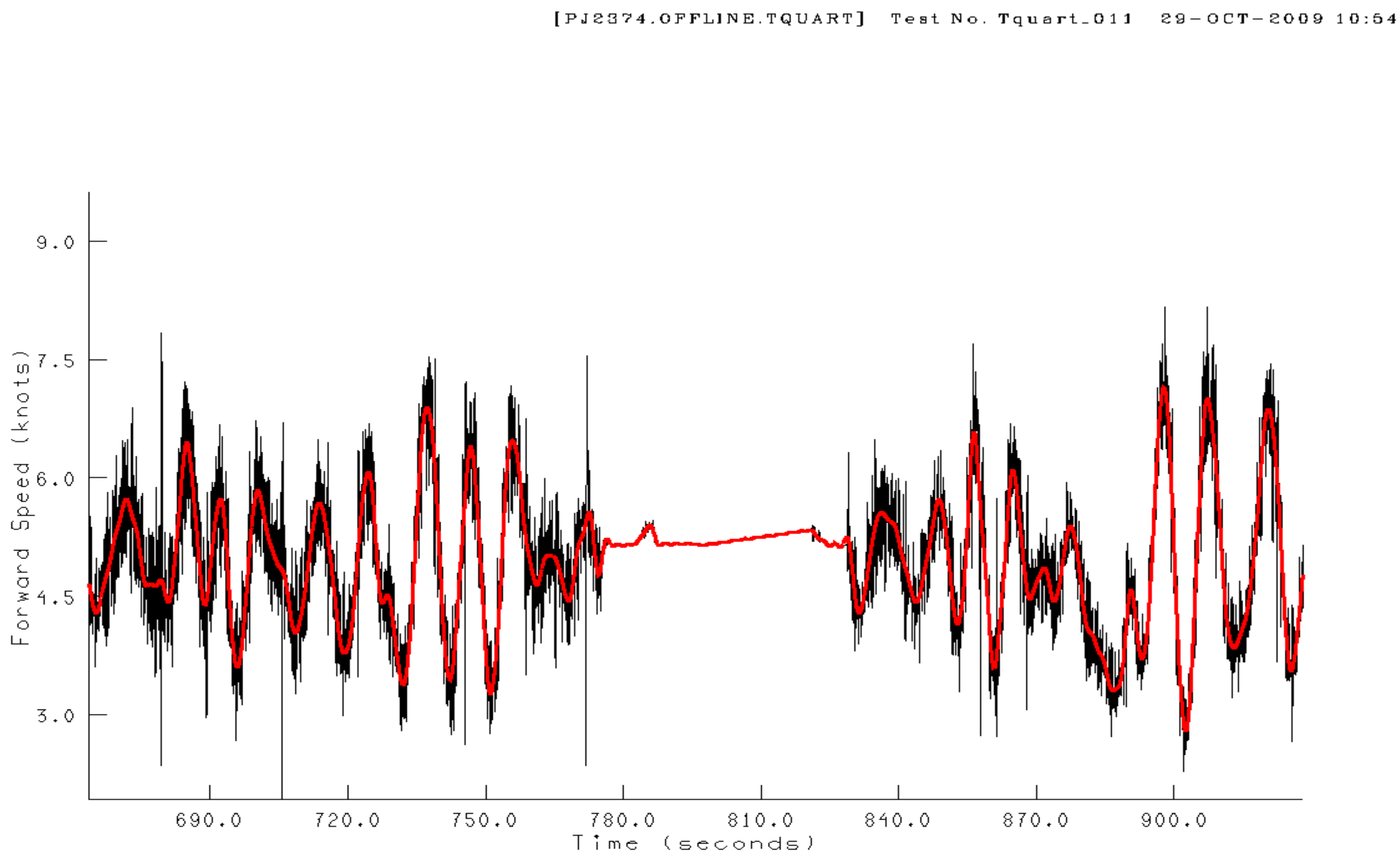
Typical Time Series Comparison of Filtered/Unfiltered Heave Acceleration Data – for Regular Wave Run CASE5_4, Quartering Seas, 4 knots, ART Empty



Typical Time Series Comparison of Filtered/Unfiltered Pitch Rate Data – for Regular Wave Run CASE5_4, Quartering Seas, 4 knots, ART Empty



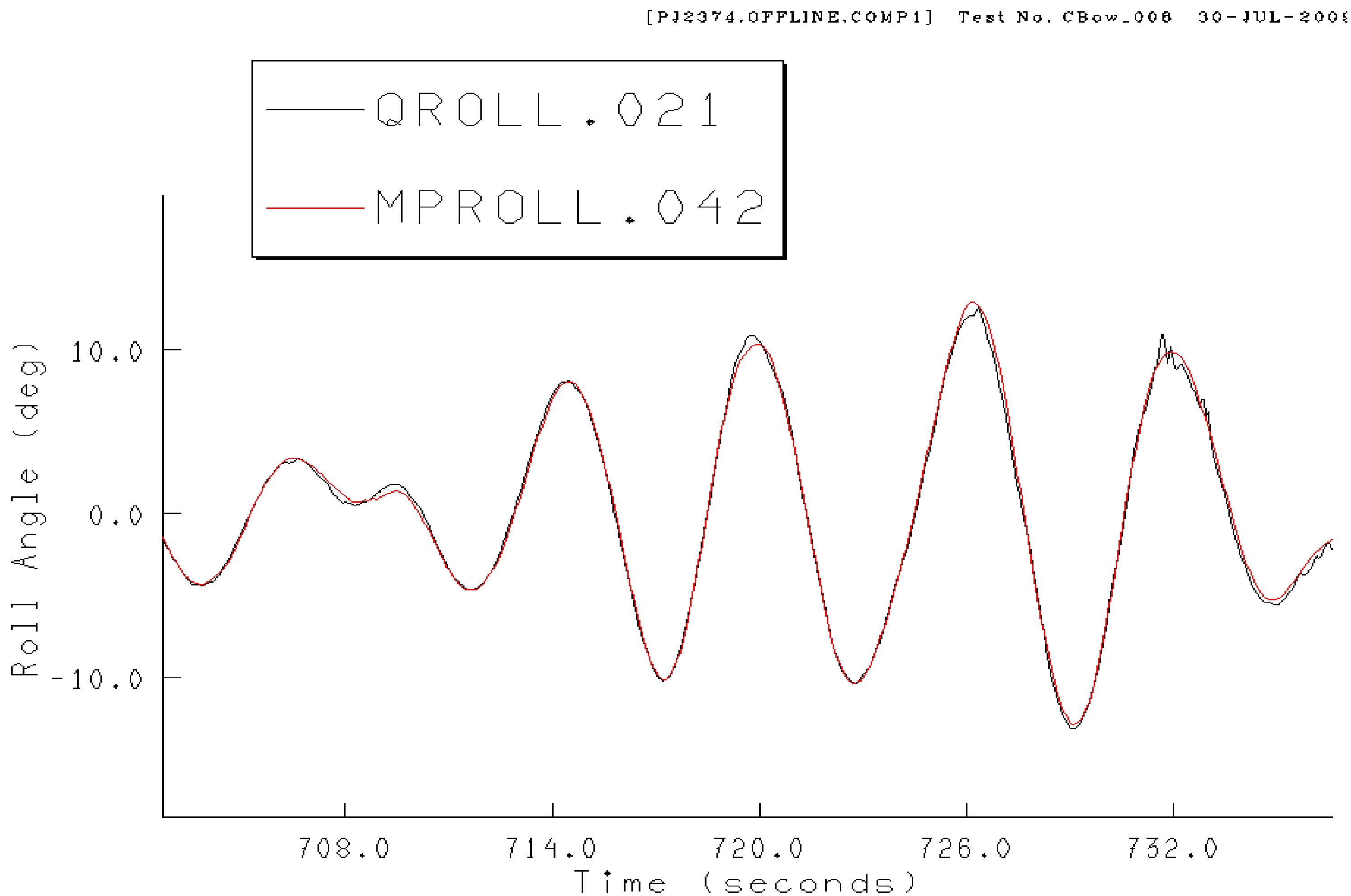
Typical Time Series Comparison of Filtered/Unfiltered Rudder Angle Data – for Irregular Wave Run TQUART, Quartering Seas, Trawl Speed, ART Empty



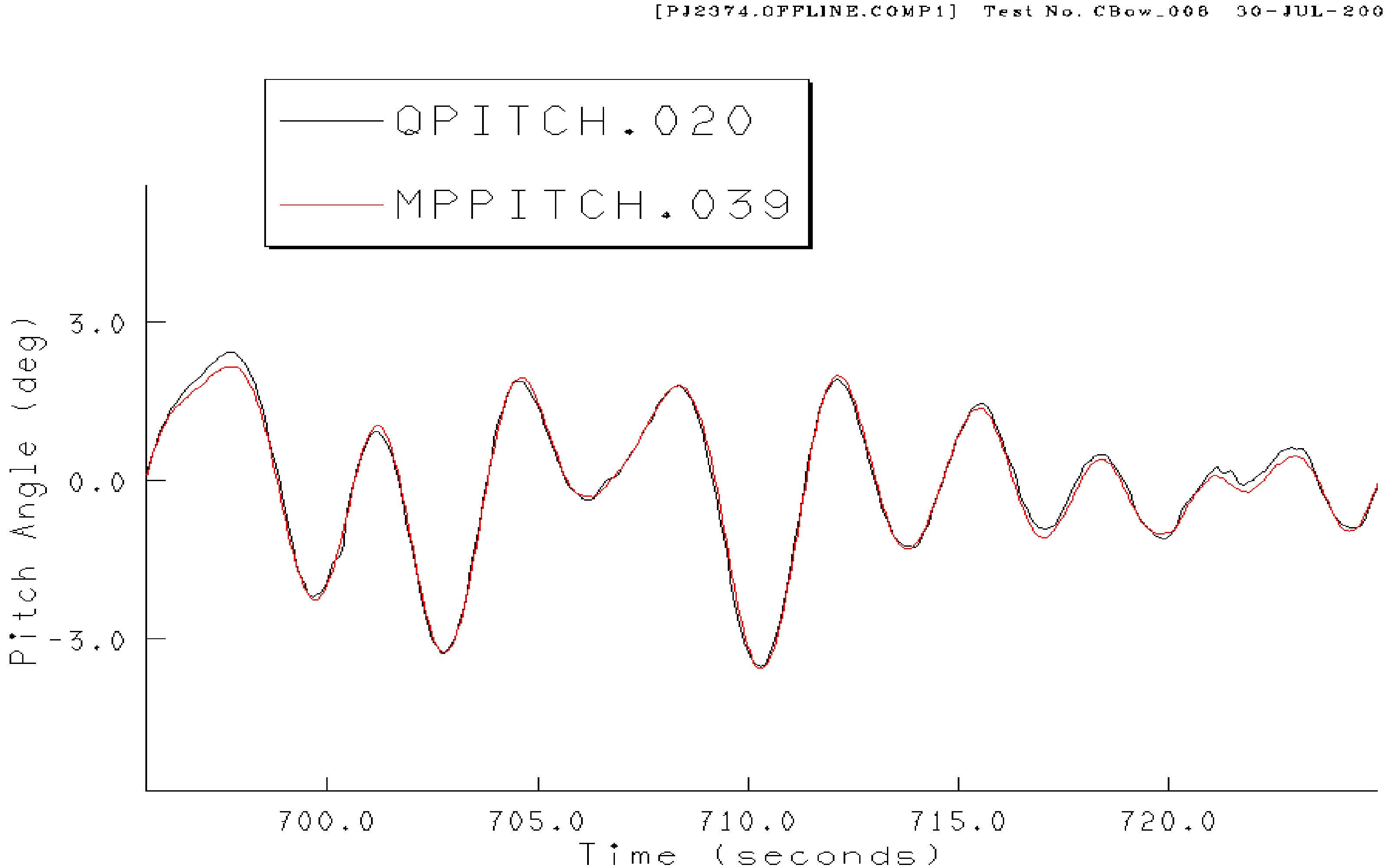
Typical Time Series Comparison of Filtered/Unfiltered Forward Speed Data – for Irregular Wave Run TQUART, Quartering Seas, Trawl Speed, ART Empty

APPENDIX I

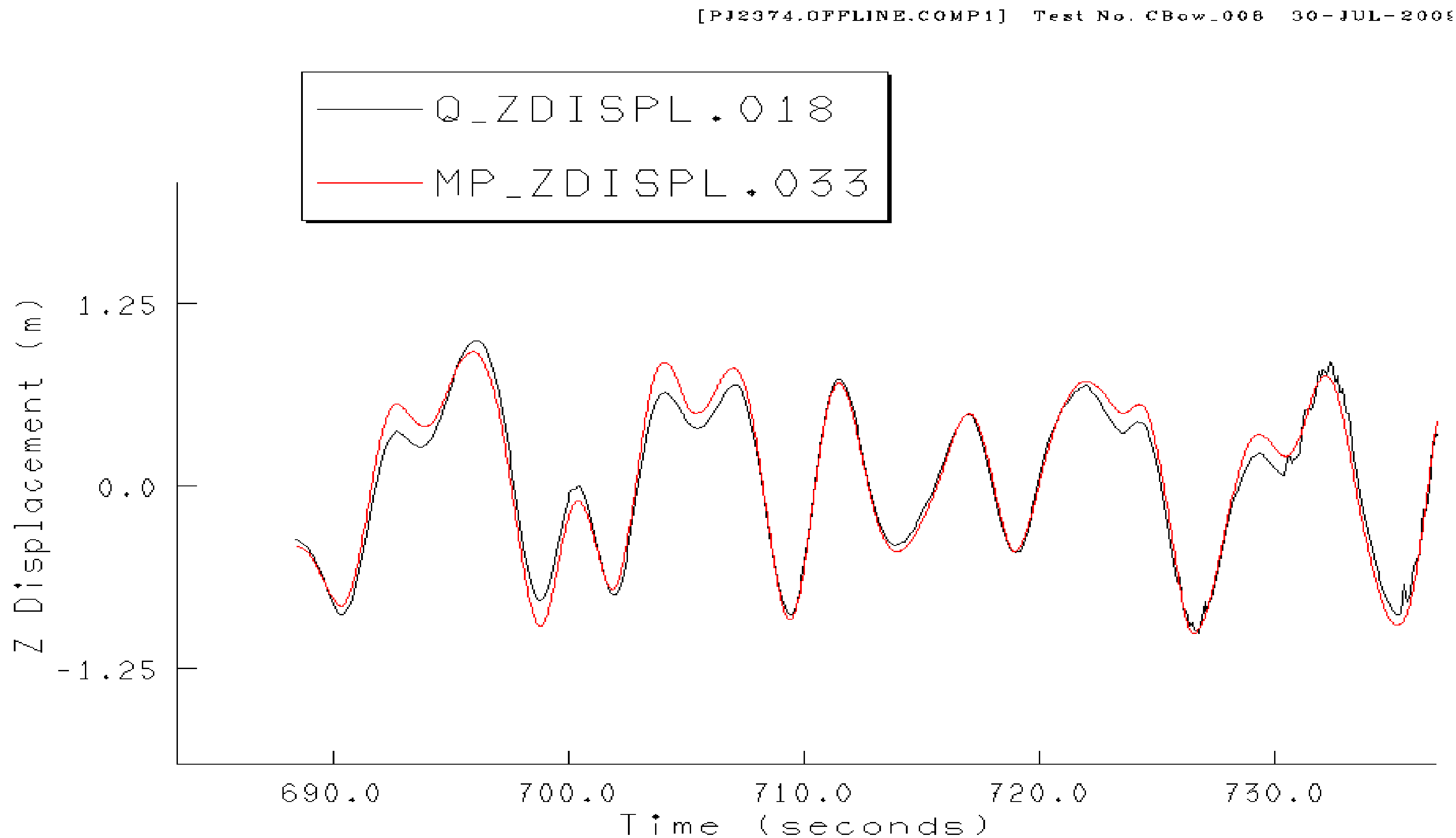
EXAMPLE TIME SERIES PLOTS COMPARING MOTIONS FROM DIFFERENT SENSORS



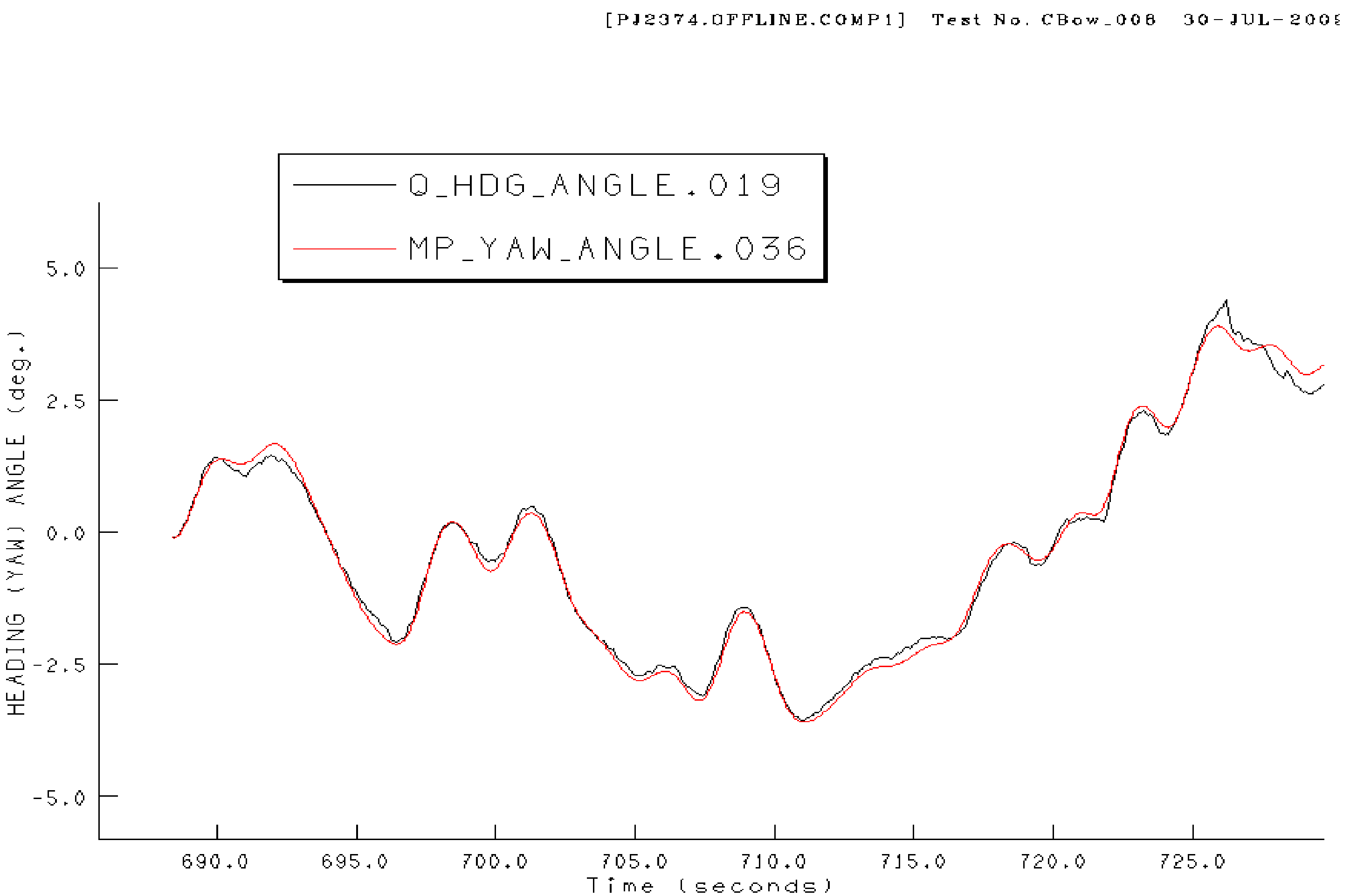
Comparison of QUALISYS Roll Angle and MotionPak II Roll Angle for Run CBOW_008



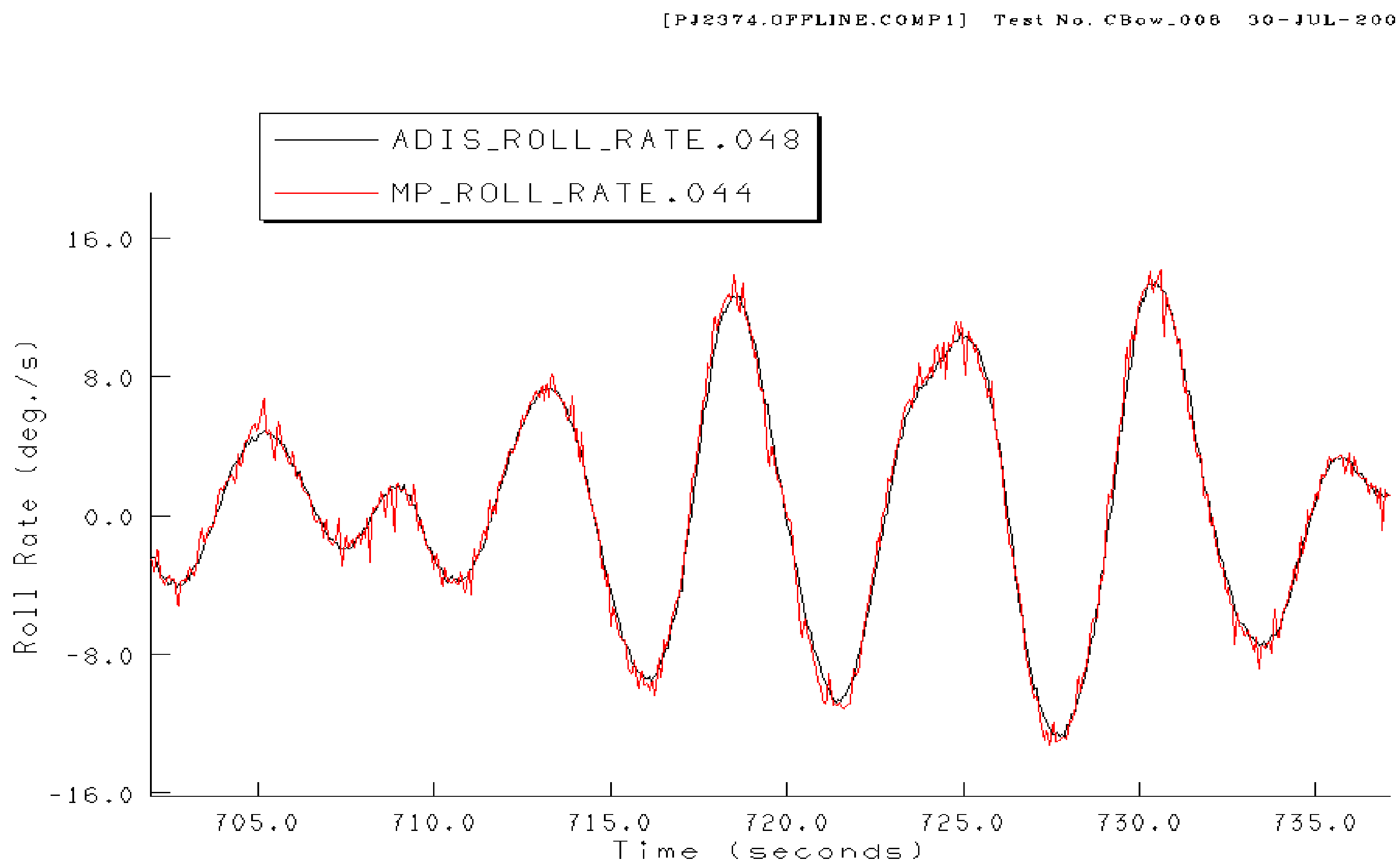
Comparison of QUALISYS Pitch Angle and MotionPak II Pitch Angle for Run CBOW_008



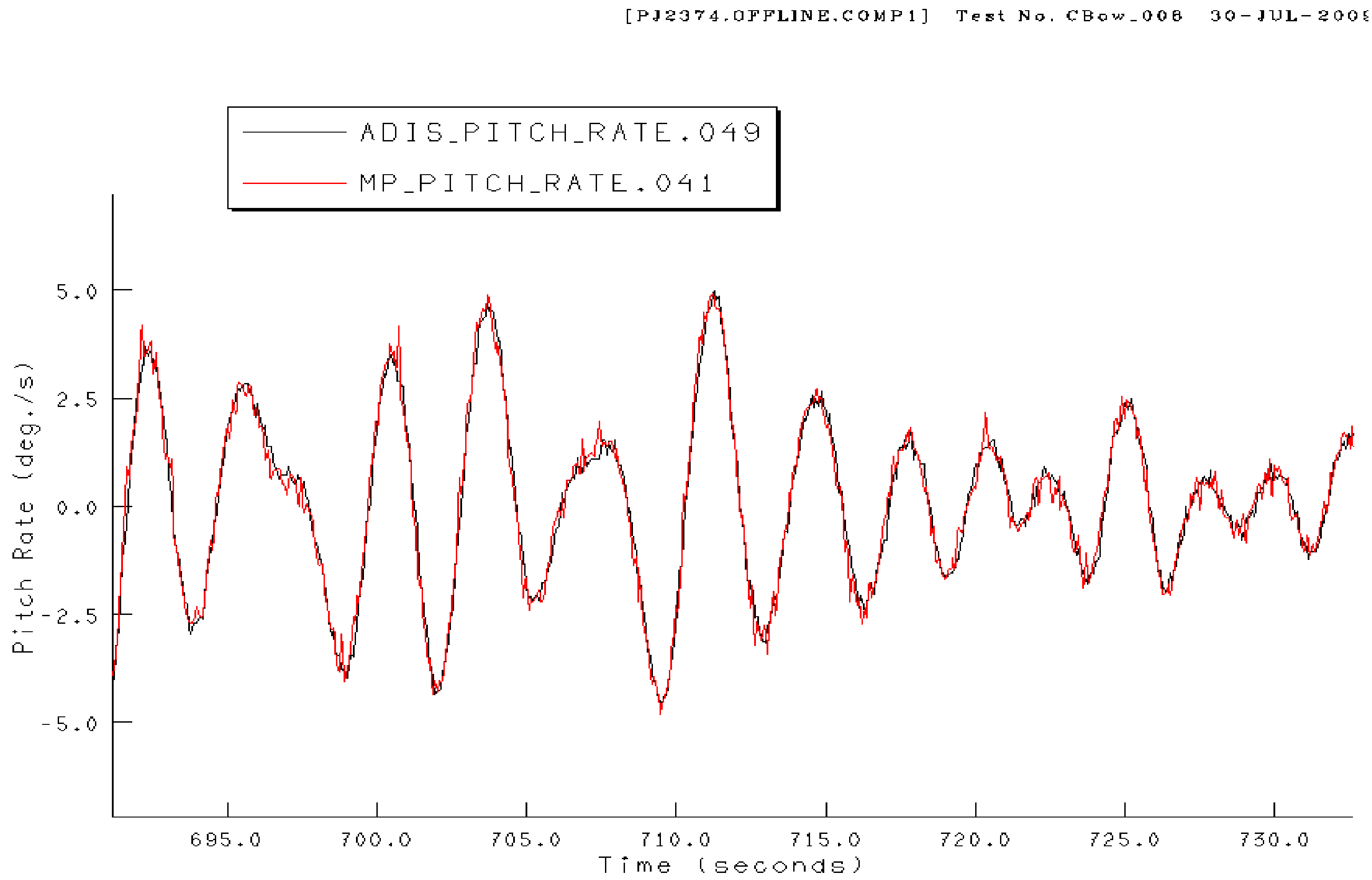
Comparison of QUALISYS Z (Heave) Displacement and MotionPak II Z (Heave) Displacement for Run CBOW_008



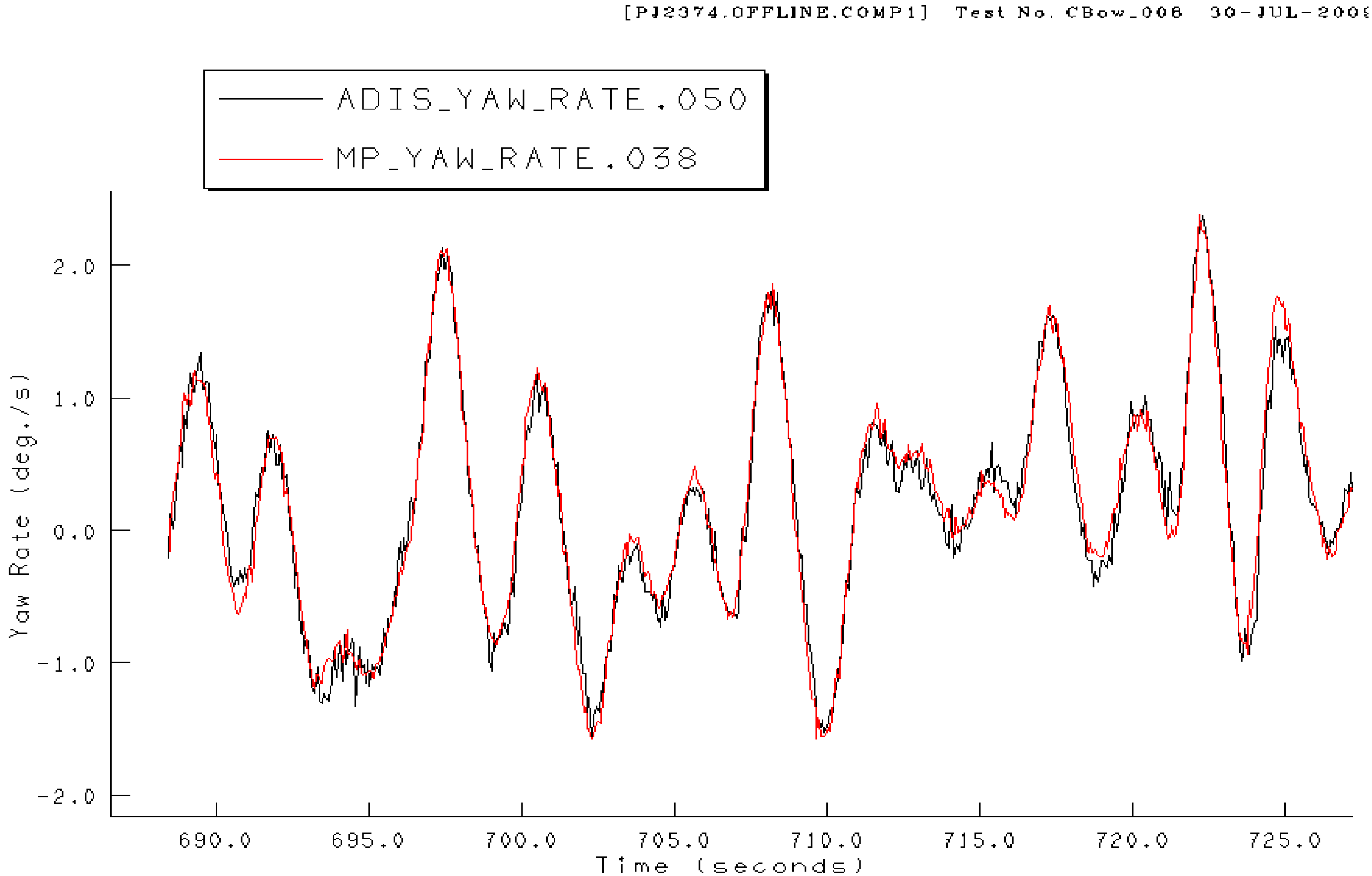
Comparison of QUALISYS Heading Angle and MotionPak II Yaw Angle for Run CBOW_008



Comparison of ADIS Roll Rate and MotionPak II Roll Rate for Run CBOW_008



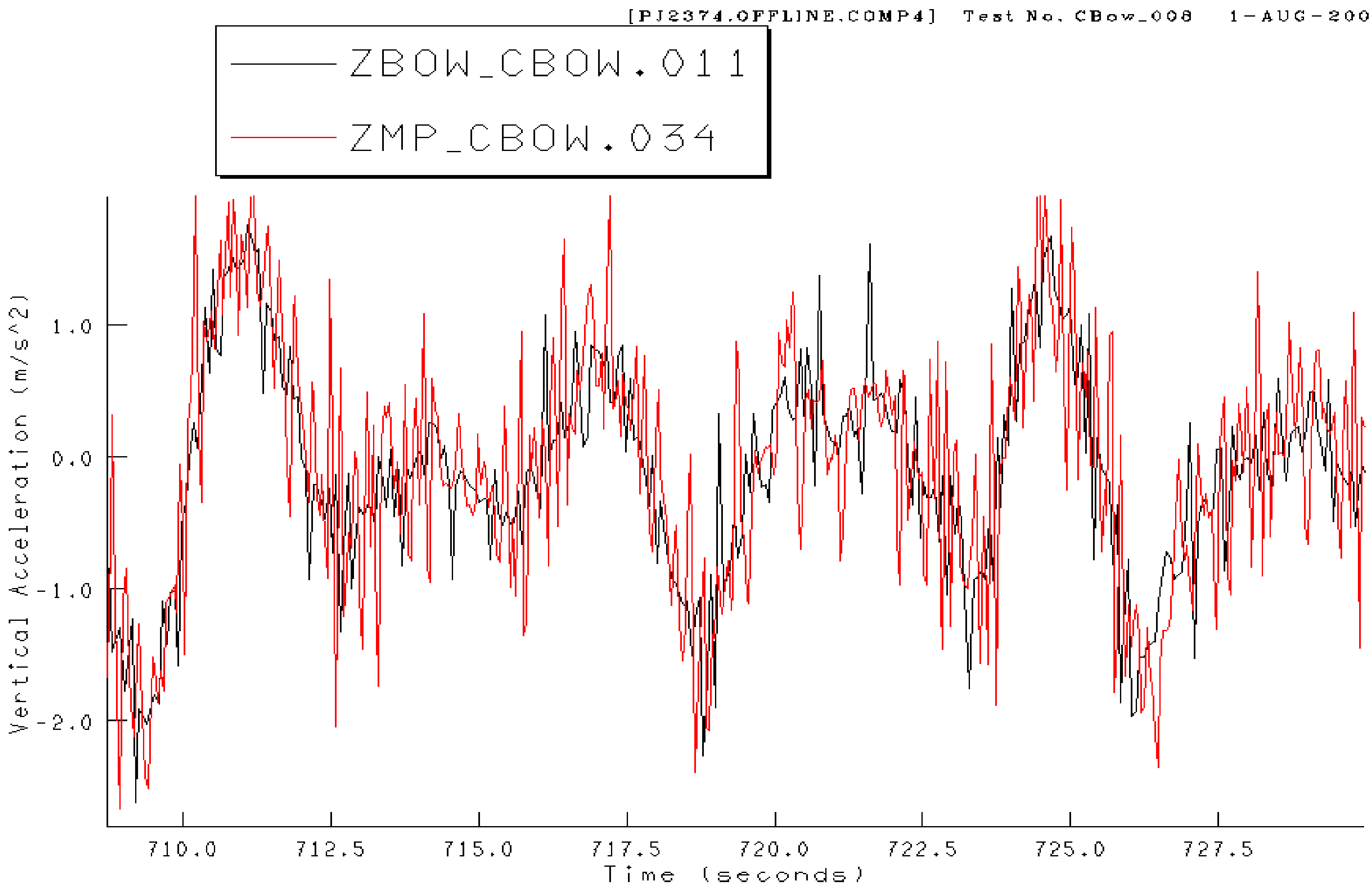
Comparison of ADIS Pitch Rate and MotionPak II Pitch Rate for Run CBOW_008



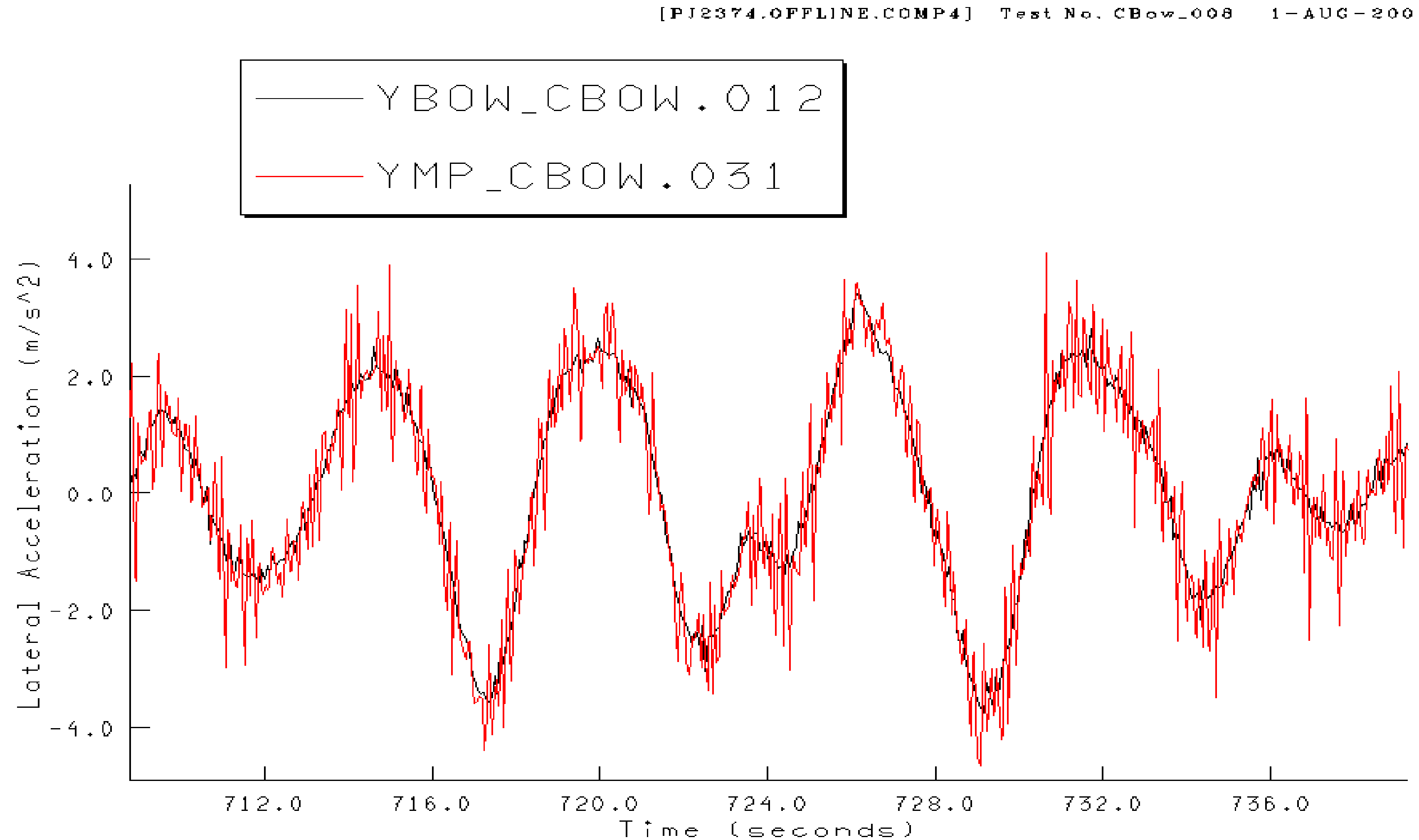
Comparison of ADIS Yaw Rate and MotionPak II Yaw Rate for Run CBOW_008

APPENDIX J

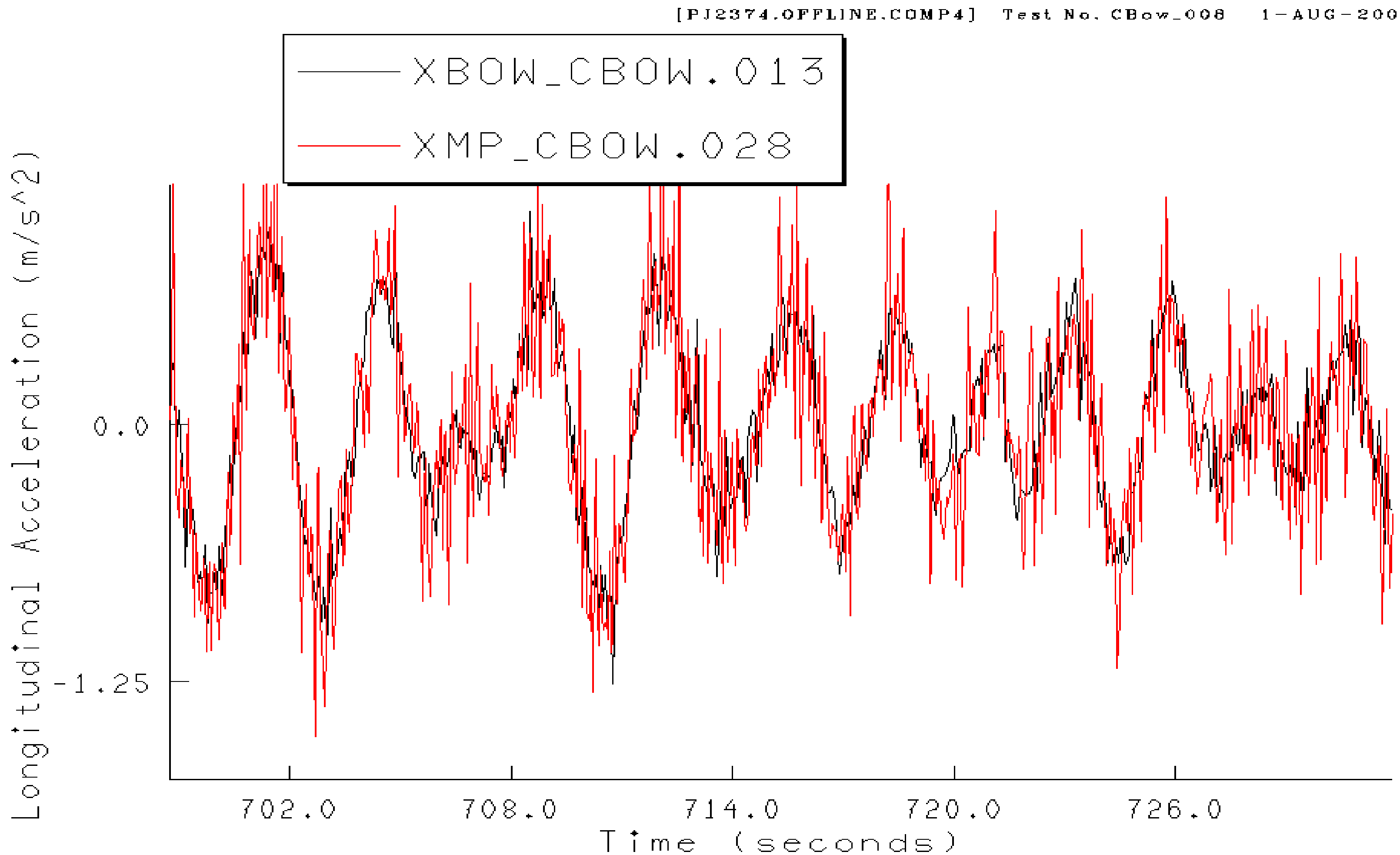
EXAMPLE TIME SERIES PLOTS COMPARING FILTERED/UNFILTERED DATA



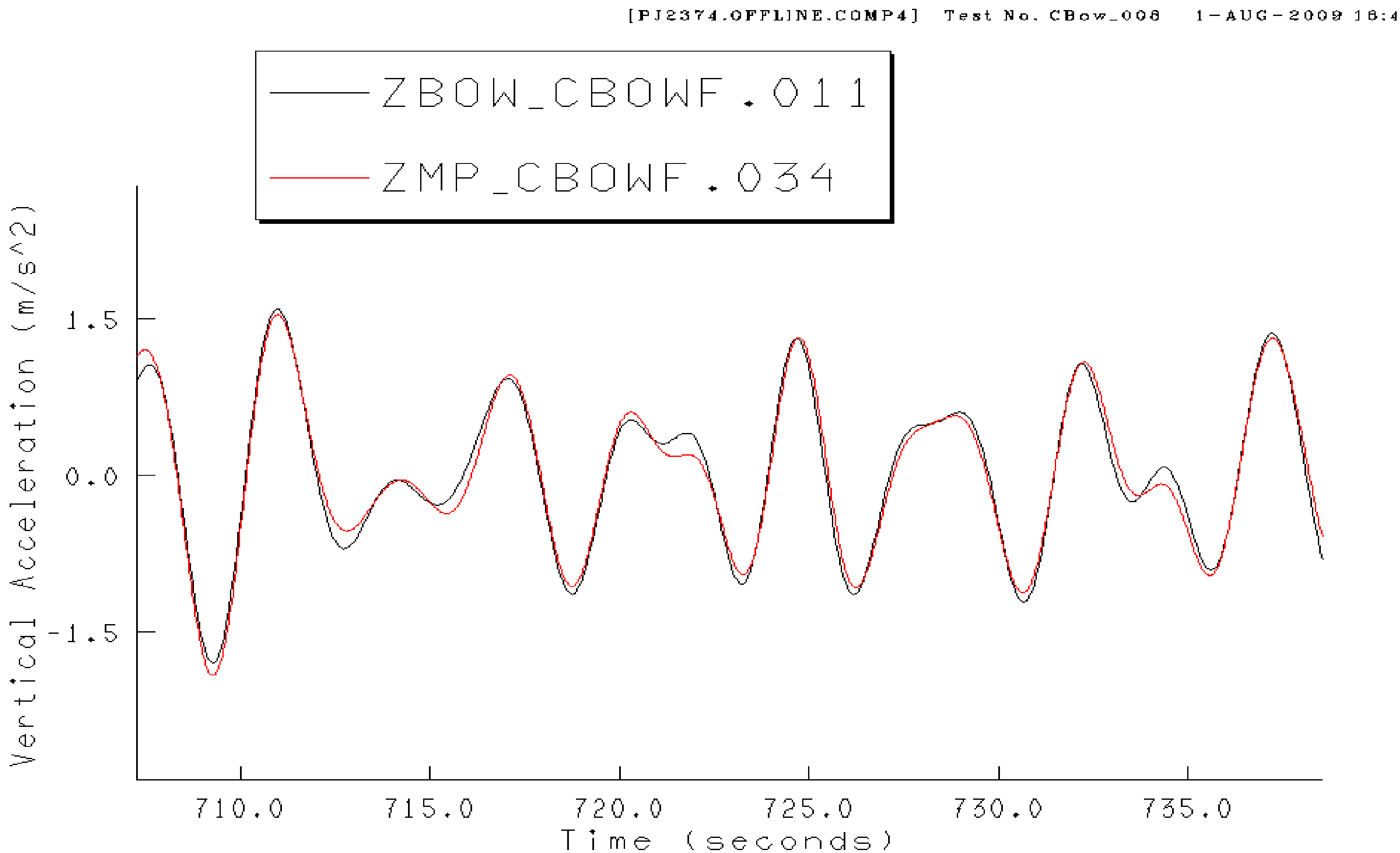
Comparison Between Bow Vertical Acceleration and MotionPak II Vertical Acceleration for Run CBOW_008 (no filtering)



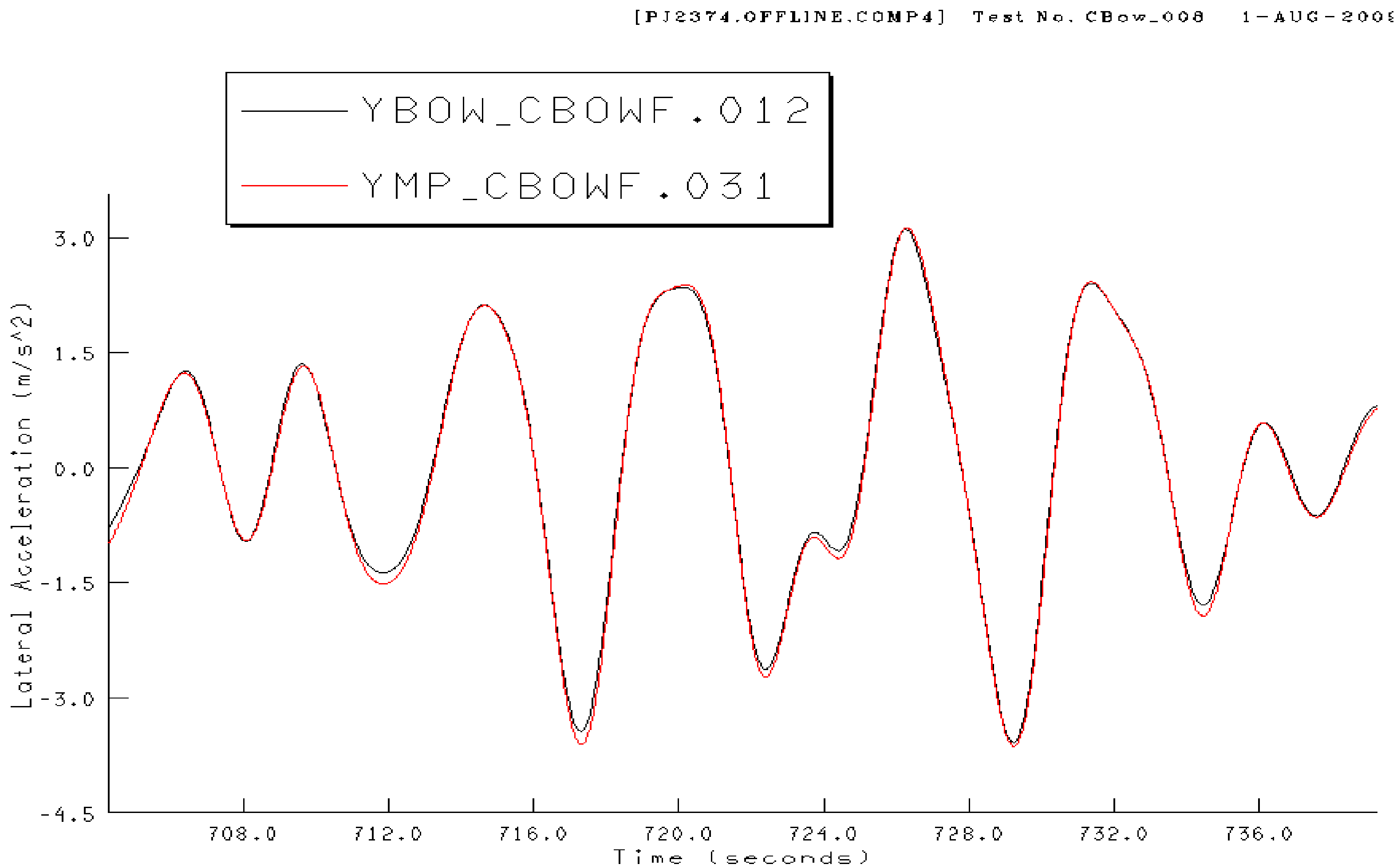
Comparison Between Bow Lateral Acceleration and MotionPak II Lateral Acceleration for Run CBOW_008 (no filtering)



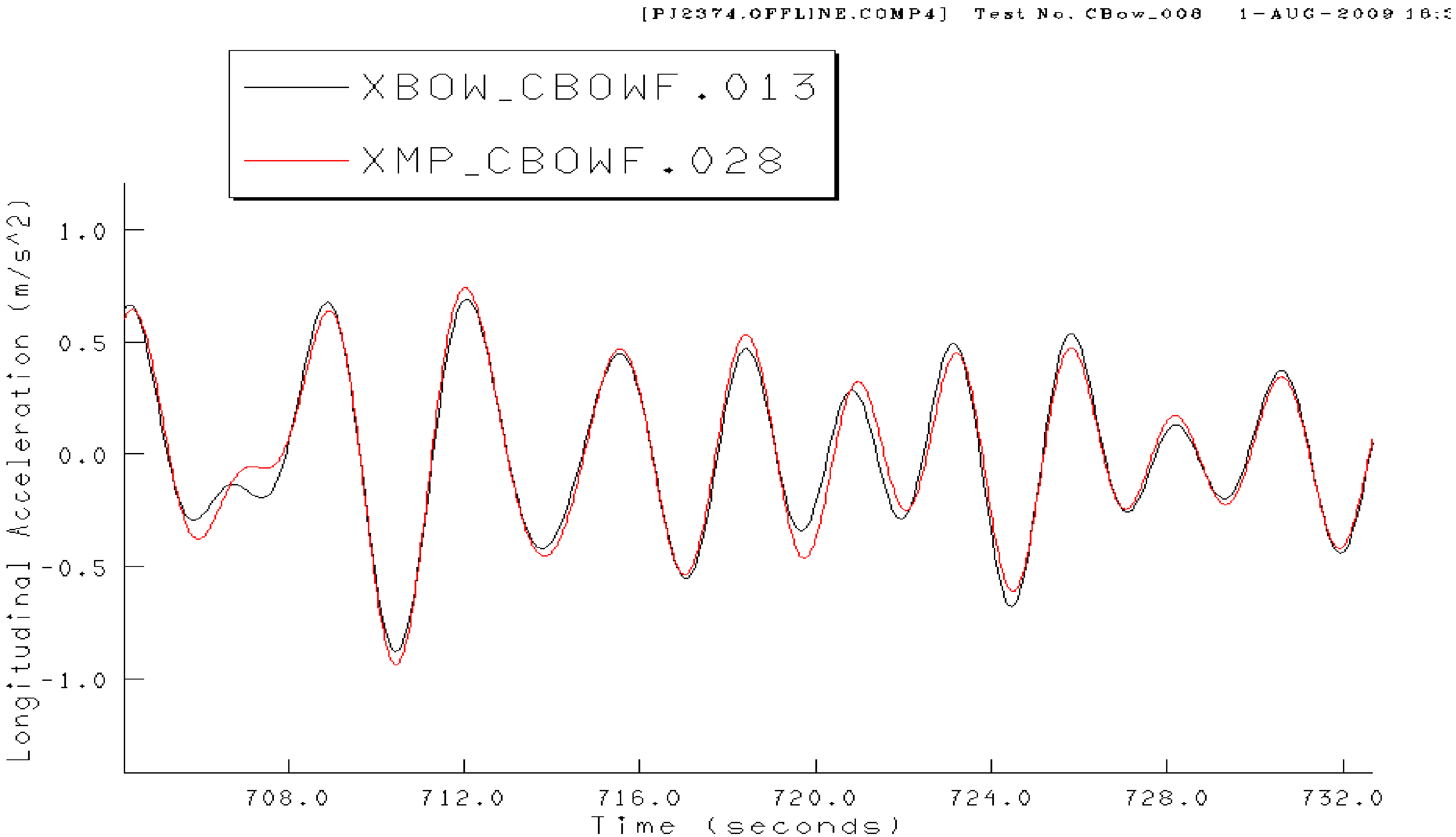
Comparison Between Bow Longitudinal Acceleration and MotionPak II Longitudinal Acceleration for Run CBOW_008 (no filtering)



Comparison Between Bow Vertical Acceleration and MotionPak II Vertical Acceleration for Run CBOW_008 (after filtering)



Comparison Between Bow Lateral Acceleration and MotionPak II Lateral Acceleration for Run CBOW_008 (after filtering)



Comparison Between Bow Longitudinal Acceleration and MotionPak II Longitudinal Acceleration for Run CBOW_008 (after filtering)