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Ocean, Coastal and River Engineering
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Seakeeping, Slamming, Propeller Emergence, Added Power in Waves, Propeller P106R, Model 907, Joint Support Ship	x, 31, App A-J	11	21

SUMMARY
This report describes the experiments carried out on a 1:29.69 scale fully appended model of the Preliminary Design of the Joint Support Ship (JSS) in the Oceans, Coastal and River Engineering (OCRE) Towing Tank in November - December 2011. The purpose of these experiments was to evaluate the performance of this design of the JSS in terms of its sea-keeping and added power in waves. Experiments were done at the End of Life (8.2 m draft) condition.
Seakeeping tests in head seas were done at 12, 15 and 18 knots in sea state 5H, 18 knots in sea state 5 and in following seas at 15 knots in sea state 5. Added power experiments were done in head seas at 15 and 20 knots in sea state 3.
Probability of slamming and propeller emergence was assessed at 18 knots in sea state 5 head seas. Roll, pitch and heave decay experiments were done to characterize the viscous damping of the ship.

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LIST OF ABBREVIATIONS

AC	alternating current
Accel	acceleration
AP	aft perpendicular
BMT	BMT Fleet Technology
CG	center of gravity
CL	centerline
cm	centimetre(s)
DC	direct current
deg.	degree(s)
deg. C	degrees Centigrade
DND	Department of National Defence
DVD	Digital Video Disc
DWL	design water line
ELMS	Engineering, Logistics and Management Services
FP	forward perpendicular
FS	full scale
FW	fresh water
G, g	acceleration due to gravity, (9.808 m/s^2)
GDAC	General Data Acquisition and Control
GEDAP	General Data Analysis Package
GM_t	Transverse metacentric height
H	Wave heading – H0 is following seas, H180 is head seas
HMCS	Her Majesty's Canadian Ship
H_S	Significant wave height
Hz	Hertz
IOT	Institute for Ocean Technology
ITTC	International Towing Tank Conference
JSS	Joint Support Ship
JSS-PMO	Joint Support Ship Project Management Office
kg	kilogram(s)
k_{XX}	Roll gyradius
k_{YY}	Pitch gyradius
k_{ZZ}	Yaw gyradius
LBP	length between perpendiculars
LCB	longitudinal center of buoyancy
LCG	longitudinal center of gravity
LOA	length overall
LWL	length waterline
m	metre(s)
min	minute
mm	millimetre(s)
MP	MotionPak measurement system

MS	model scale
N	Newton(s)
NACA	National Advisory Committee for Aeronautics
NI	National Instruments
NRC	National Research Council
NRCSJS	National Research Council – St. John's
OCRE	Oceans, Coastal and River Engineering
PC	Personal Computer
Prop	Propeller
QA	quality assurance
QUAL	Qualysis optical measurement system
RAS	Replenishment at Sea
relmo	Relative Motion
RMS	Root mean square
rpm	revolutions per minute
rps	revolutions per second
s	second(s)
SD,sd, StDev	standard deviation
SOW	Statement of Work
SRD	Systems Requirements Document
SS	Sea state
Stbd	starboard
SW	salt water
SWEET	**S**oft**W**are **E**nvironement for **E**xperimental **T**echnologies
t	tonne(s)
T1, T2	start, end time
T_P	modal period of sea state
UHMW	Ultra high molecular weight polyethylene
VCG	vertical center of gravity
VS	ship speed

LIST OF SYMBOLS

Symbol	Definition	unit
	Wave Spectrum Symbols	
H_S	Significant wave height	m
T_P	Modal period of wave spectrum	s
	Decay Symbols	
δ	Log decrement	
ζ	Non-dimensional damping ratio	
φ	phase lag of sine wave	deg
τ	damping time constant	s
A	amplitude of sine wave	
c	Linear velocity damping factor	c
f	frequency of sine wave	Hz
$F(t)$	External force	
k	Linear restoring force constant	
m	mass	
$Y(t)$	Linear displacement of mass , m	
$Y0$	Mean value of sine wave	
	Probability of Slamming/Deck Wetness, Propeller Emergence Symbols	
h_D	Deck height above waterline	21 m
h	Depth of propeller	3.21 m.
H	Ship draught	8.2 m
m_0	Variance (relative motion or relative velocity), area under relative motion or relative velocity spectrum	
m_2	Second moment of area under relative motion spectrum	
	Added Power in Waves Symbols	
ρ_M	Density of water, model	kg/m^3
ρ_S	Density of water, ship	kg/m^3
χ_{AW}	non-dimensional added torque	[-]
ν_{AW}	non-dimensional increase in shaft speed due to waves	[-]
η_{AW}	non-dimensional added thrust	[-]
ξ_A	Wave amplitude, model	m
ρ_M	Density of water, model	kg/m^3
ρ_S	Density of water, ship	kg/m^3
B_M	Beam, model	m
D_M	Propeller diameter, model	m
g	Acceleration due to gravity, 9.808 m/s^2	9.808 m/s^2
L_M	Length, model	m
L_S	Length, ship	m

Symbol	Definition	unit
n_{AW}	Increase in shaft speed due to waves, model	1/s
n_{AWS}	Mean increase in ship shaft rotation rate in waves	1/s
n_S	Shaft rotation rate at ship propulsion point	1/s
P_{EW}	Effective power of ship in waves	watt
P_D	Delivered power of ship in calm water	watt
P_{DAW}	Increase in delivered power	watt
P_{DAWS}	Increase in delivered power, ship	watt
P_{DW}	Predicted ship power in waves	watt
Q_{AW}	Added Torque in waves, model	Nm
Q_{AWS}	Mean increase in ship torque in water	Nm
Q_S	Calm water torque at ship propulsion point	Nm
R_{AWS}	Increase in ship resistance due to waves	N
R_{TS}	Ship Resistance in calm water	N
T_{AW}	Added thrust in waves, model	N
T_{AWS}	Thrust increase due to waves	N
V_M	Speed, model	m/s
V_S	Speed, ship	m/s

EXECUTIVE SUMMARY

This report describes experiments carried out on a 1:29.69 scale fully appended model of the Preliminary Design of the Joint Support Ship (JSS) in the Oceans, Coastal and River Engineering (OCRE) Towing Tank in November 2011. The purpose of these experiments was to evaluate performance of this design of the JSS in terms of its resistance, propulsion and wake survey characteristics as a means of assessing the analytical tools that were used in its design. This report documents the sea-keeping and added power in wave experiments.

Seakeeping Tests: The ship responses at various speeds and sea states - pitch angle, and pitch, heave and surge acceleration at the CG - of this design are summarized in the table below. The responses are characterized by the standard deviation of the motion or acceleration.

DataSet	Ship Speed [knots]	Sea State	H_S [m]	QUAL Pitch STD (deg)	MP Surge Accel. STD (g)	MP Heave Accel. STD (g)	MP Pitch Accel. STD (deg/sec**2)
VS20_SS3	20.2	3	1.18	0.046	0.001	0.004	0.077
VS15_SS3	15.4	3	1.20	0.058	0.001	0.004	0.086
VS18_SS5	17.5	5	3.47	0.511	0.004	0.024	0.406
VS18_SS5H	17.1	5H	4.16	0.789	0.007	0.032	0.545
VS15_SS5H_R11_8	15.2	5H	4.27	0.778	0.007	0.029	0.504
VS15_SS5H_R10_6	13.8	5H	4.15	0.778	0.007	0.027	0.474
VS12_SS5H	12.3	5H	4.26	0.721	0.007	0.025	0.436
VS15_H0_SS5	14.7	5	3.46	0.251	0.002	0.002	0.054

The responses predicted at the bridge and at the helicopter deck are less than the limit set for the criterion in SRD Table 4954 as shown in the table below.

Performance Limitations	Location	Bridge		Condition	Helicopter Landing Spot	
Motion	Units	Limit	Measured		Limit	Measured
Slamming Index	Occurrences/hr	20	0.07	VS18_SS5H		
Wetness Index	Occurrences/hr	30	0			
RMS Pitch Amplitude	degrees	1.5	0.79	VS18_SS5H	1.5	0.79
RMS Vertical Velocity	m/s		1.1	VS18_SS5H	1	0.67
RMS Vertical Acceleration	m/s^2	2	0.95	VS18_SS5H	1.2	0.58
Propeller Tip Emergence	Occurrences/hr	90	0.23	VS12_SS5H		

Added Power: The Statement of Work (SOW) required added power experiments in sea state 3 only at 15 and 20 knots. There was no significant increase in the power required to propel the ship in sea state 3. The data for tests at sea state5 and 5H were also analyzed to assess added power. In sea state 5H at 18 knots, delivered power is estimated to be 14.1 MW

Probability of Slamming and Propeller Emergence This assessment was done at 18 knots in sea state 5. The analysis indicates a very small probability of either slamming at Station 1.5 or propeller emergence.

SEAKEEPING AND ADDED POWER TESTS OF THE PRELIMINARY DESIGN (Model IOT907) OF DND JOINT SUPPORT SHIP

1.0 INTRODUCTION

This report describes experiments carried out on a 1:29.69 scale model of the Preliminary Design for a Department of National Defence (DND) Joint Support Ship (JSS), designated IOT907, in the National Research Council St. John's (NRCSJS) Ocean, Coastal and River Engineering (OCRE) Towing Tank in December 2011. The proposed ship has length of 189 m overall, beam of 24 m and design draught of 8 m.

The Systems Requirements Document (SRD) for the JSS specifies that the design comply with several performance requirements regarding speed, sea-keeping and manoeuvrability. The purpose of these experiments was to confirm the analytical assessments of the power needed and the sea-keeping performance of the Preliminary Design of the JSS.

This document includes background information on the project, a description of the instrumentation, facilities used, test program, data analysis procedure and discussion of the results. This report describes the sea-keeping experiments conducted in the Towing Tank between November 14 and December 2, 2011. This report is a contractual deliverable to the DND published in partial fulfillment of the NRCSJS obligations included in the Letter of Agreement between DND and the National Research Council (NRC) dated September 1, 2011.

2.0 BACKGROUND

BMT Fleet Technology (BMT) is developing the design of this vessel for the JSS Project Office. BMT is the project's Engineering, Logistics and Management Services (ELMS) contractor. The construction of up to three new vessels is planned and they are intended to replace the following existing ships: HMCS Protector, HMCS Provider and HMCS Preserver

For this series of the experiments, the full scale test displacement was increased by 837 tonnes over the conditions described in Reference 1. This new displacement of 24,563 tonnes is the current estimate for the end-of-life condition and corresponds to a level trim draught of 8.2 m.

The following series of tests were carried out to satisfy the goals of this phase of the project:

- Appended resistance experiments over a speed range of 3 to 22 knots full scale for the end-of-life test condition to provide an estimate of the effective power needed to propel the ship.
- Flow visualization was carried out to define the wave profile along the hull at speeds of 15 and 20 knots full scale.
- Self-propelled experiments using a stock propeller to assess the delivered power necessary to propel the ship at full scale speeds of 5, 8, 10, 15, 18, 20 and 21 knots. In addition, tests to assess the overload performance at these speeds were also done.
- Wake survey experiments were done at speeds corresponding to 15 and 20 knots full scale.

- Added power experiments in sea state 3 head seas at speeds corresponding to 15 and 20 knots full scale.
- Sea-keeping experiments in sea state 5 head seas at a speed corresponding to 15 knots full scale to investigate slamming, water on deck and propeller emergence.
- Sea-keeping experiments in sea state 5H head seas at speeds corresponding to 12, 15 and 18 knots.
- Sea-keeping experiments in sea state 5 following seas at a speed corresponding to 15 knots full scale.

3.0 DESCRIPTION OF THE NRCSJS TOWING TANK

The NRCSJS Towing Tank has dimensions of 200 m by 12 m by 7 m. Flexible side absorbers can also be deployed along the entire length of the tank to minimize the time between runs. The 85 t tow carriage capable of speeds up to 10 m/s is used to accommodate models for a wide range of test types carried out in calm water and waves. A 4,000 kg lift capacity moveable overhead crane is available over half of the tank length.
At the west end of the tank is a dual flap hydraulic wave board capable of generating regular waves up to 1 m. in height and irregular waves with a signification wave height of 0.5 m. Waves are absorbed by a parabolic corrugated surface beach with transverse slats at the east end of the tank.

Additional information on the Towing Tank is provided in Appendix A.

4.0 DESCRIPTION OF PHYSICAL MODEL IOT907

Model IOT907 is a 1:29.69 scale, nominally 6 m long, representation of the Joint Support Ship fabricated using a polystyrene foam core with ¾" plywood and Renshape™ for areas requiring reinforcement as described in NRCSJS's model fabrication standard provided in Reference 2. The foam was milled to conform to the desired hull geometry using NRCSJS's Liné milling machine. For this series of experiments, the model was complete up to the deck at 15.25 m full scale. This height corresponds to the Replenishment at Sea (RAS) deck. The forecastle was completed up to 21 m full scale and was designed to be removable to simplify access to the model for the resistance and self-propulsion phase of the tests. Coamings and covers were fitted to the three main cockpit openings of the model in anticipation of the possibility of bad weather during the outdoor phase of the test and overtopping waves during the sea-keeping portion of the test. The model was then painted with three coats of polyurethane yellow.

Renshape™ inserts were included in the hull to add reinforcement in way of the hull penetrations and in the anticipated location of the bilge keels. A removable rudder was fabricated. A lateral bow tunnel thruster was included in the model. A rudder post and stern tube were embedded in the hull. After review of the flow visualization imagery, bilge keels were designed by BMT Fleet and fitted to the model prior to the manoeuvring experiments.

A pull point, consisting of an eye bolt fixed to the transom on the longitudinal centerline, was designed to accommodate a longitudinal force nominally 3 cm above the base of the transom for daily verification of the integrity of the resistance load cell. A total of 14 milled surfaces capable

of accommodating trim hooks were included along the main deck provide flexibility when verifying the model attitude in the tank. The forward three milled surfaces on the main deck were used to ensure that the removable forecastle was properly aligned. Inserts were placed in the deck to ensure that the mechanical fastening of the forecastle was consistent and repeatable. The forecastle deck has three milled surfaces that can be used to help set the model condition during the sea-keeping experiments. Lifting lugs were included on the model to avoid using lifting straps and thereby potentially defacing the marking scheme or damaging the bilge keels and to provide attachment points for the bi-filar suspension used to verify the yaw gyradius of the model. The body plan, profile drawing and plan view are provided in Figures 1 and 2.

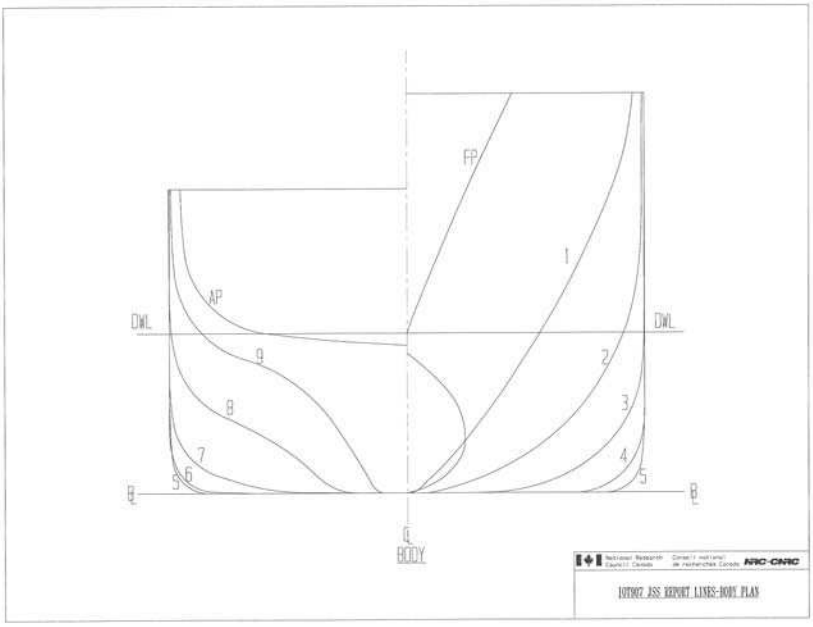

Figure 1 – IOT 907 Body Plan

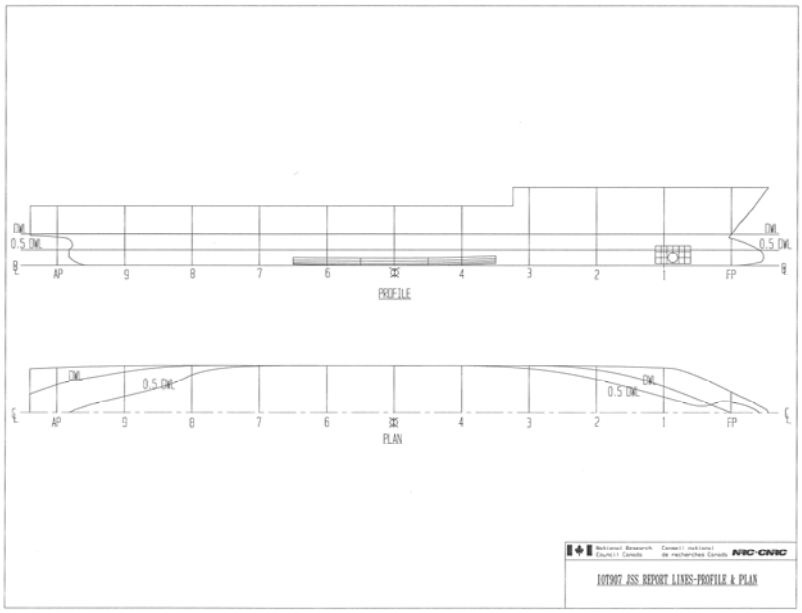

Figure 2 – IOT 907 Profile and Plan

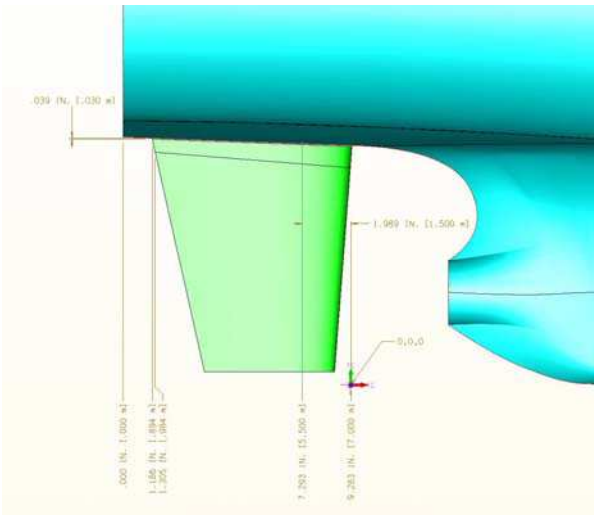

Figure 3 – IOT907 Rudder Arrangement

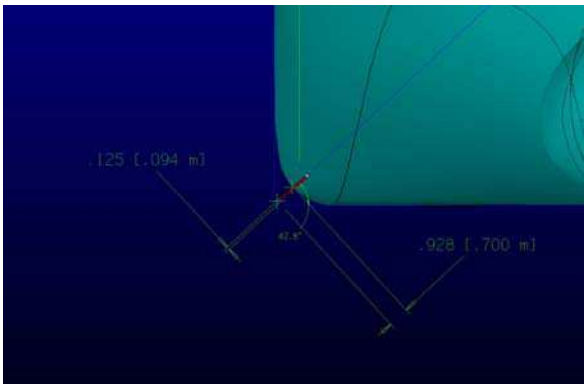

Figure 4 – IOT907 – Bilge Keel in Body Plan

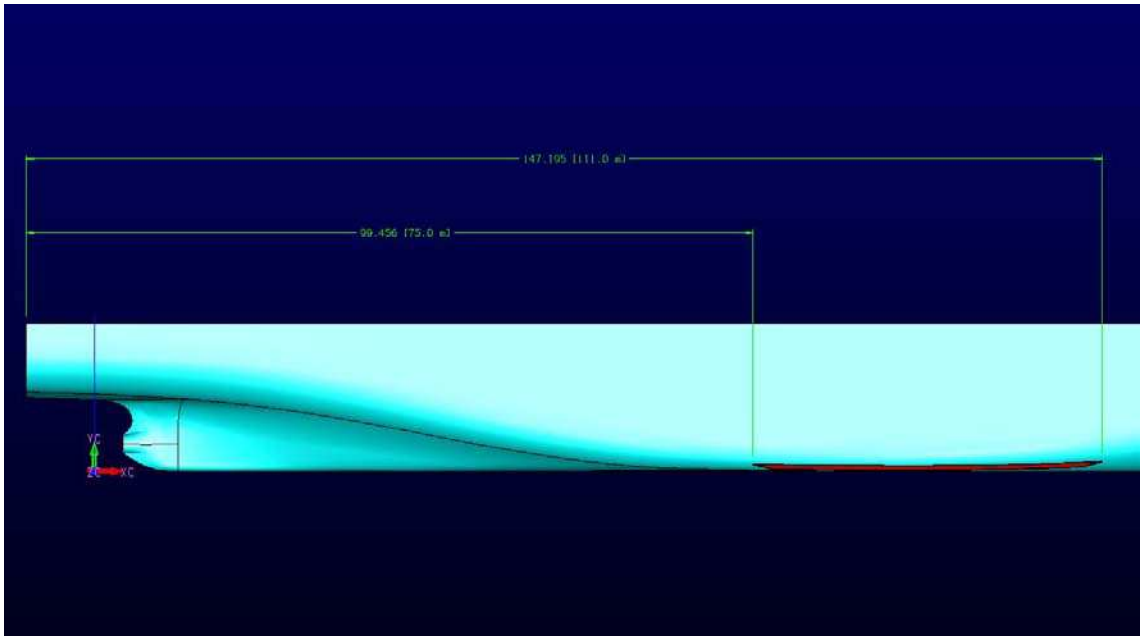

Figure 5 – IOT907 Bilge Keel Longitudinal Extent

Sketches of the rudder and bilge keels, as fitted, are included as Figures 3, 4 and 5. Cylindrical stud turbulence stimulators were fitted to the bow and bulb as per NRCSJS Standard (Reference 2) and shown in Figure 6. Appendage dimensions are given in Table 1.

Standard markings were included on the model as described in NRCSJS model construction standard (Reference 2). The following additional marking was included to accommodate the flow visualization experiment requirement. To assess the wave profile on the hull, tick marks corresponding to 0.5 m waterline spacing were placed at each station marked on the hull. Four tick marks were drawn above the 8 m waterline and two below as shown in Figure 7.

Figure 6 - IOT907 Turbulence Stimulation

Table 1 – Appendage Dimensions

Appendage Dimensions

Rudder	Model Scale				Full Scale	
Tip Chord	5.304	in.	0.135	m	4.01	m
Root Chord Along Hull	8.148	in.	0.207	m	6.16	m
Span	9.298	in.	0.236	m	7.03	m
Shaft CL Fwd of Transom	7.271	in.	0.185	m	5.50	m
Leading Edge Slope	4	deg.				
Section profile	NACA0015					

Bilge Keel	Model Scale				Full Scale	
Aft end of bilge keel wrt to transom	98.831	in.	2.510	m	74.75	m
Fwd end of bilge keel wrt to transom	146.43	in.	3.719	m	110.76	m
Bilge Keel Span	0.925	in.	0.023	m	0.700	m
Angle to Baseline	42.8	deg.				

The model was tested at the following displacement condition - nominally 23963 m^3 volume displacement, level trim, draught is 8.2 m. This is the End Of Life condition. The hydrostatics for the ship and model at this condition can be found in Appendix B.

For the added power and sea-keeping experiments, rectangular guider frames were mounted on the model at Stations 2 and 8. These frames were about 200 mm wider that the maximum beam

of the model and were fitted with UHMW polyethylene strips to reduce friction between the frames and the alignment rails mounted on the carriage. This arrangement permits the model freedom to pitch, heave and surge. Photographs of the model as setup for sea-keeping are given in Figures 7 and 8.

Figure 7 – IOT907 Seakeeping Setup – Bow View

Figure 8 – IOT907 Seakeeping Setup – Stern View

5.0 DESCRIPTION OF INSTRUMENTATION / DATA ACQUISITION SYSTEM

This section describes the instrumentation and calibration methodology used for each parameter measured on model IOT907. The standard NRCSJS sign convention described in Reference 3 was followed where:

Trim Angle – positive bow up
Sinkage – positive down
Roll Angle – positive starboard down
Tow Force – positive forward

5.1 Model Test Instrumentation

5.1.1 Propulsion/Rudder System

The propulsion system consisted of the following components:

- an Aerotech motor controlled by a Soloist CP single-axis digital servo controller powered by 120 v AC supplied from carriage;
- a spline shaft connecting the motor and dynamometer to minimize axial loadings due to vibration;
- an R-250 Kempf & Remmers thrust-torque dynamometer was fitted to inboard end of the shaft to measure the propeller thrust and torque;
- an Allegro A3422 Hall-Effect, Direction-Detection Sensor combined with a Maxim 525 digital-to-analog converter to measure propeller shaft speed; and
- an NRC 5-blade stock propeller, designated P106R, Pitch/Diameter = 0.946, right hand rotation, clockwise when viewed from stern, blade area ratio = 0.59.

The rudder system consisted of the following components:

- a geosim of the design rudder;
- an SSPS-105 precision electro-mechanical servo programmed to give a slew rate of 7.5 deg/second, full scale (40.9 deg/s model scale);
- a pair of 12v Li-ion batteries to power the servo, its controller and a personal computer.
- a Vishay Spectrol Model 132 Single Turn Precision Potentiometer, mounted to the aft coaming and attached to the rudder shaft with a flexible coupling, to measure rudder angle;
- a protractor/pointer system, concentric with rudder shaft, to facilitate calibration and alignment of the system.

Both of these systems were operated by a remote control system consisting of a carriage-based component and a model-based component connected using an RS-232 link. The carriage-based component was a personal computer (PC) equipped with software that permitted the operator to control shaft speed and rudder angles using a mouse to adjust the respective sliders. The software has a number of programmable buttons that can be programmed to set a specific shaft speed and rudder angle. The command stream used a proprietary packet protocol developed by NRCSJS.

The model-based component of remote control consisted of a microcontroller computer with embedded firmware, which received the command stream and translated it into the necessary signals to articulate the model. This microcontroller unit was designed and fabricated at NRCSJS.

5.1.2 Sea-keeping Instrumentation

The following instrumentation systems were fitted to the model:

- a BEI MotionPak II solid state MEMS six degree of freedom inertial sensing system to measure three orthogonal model linear accelerations (surge, sway and heave) and three orthogonal angular rates (pitch, roll and yaw) in order to calculate 18 linear and angular displacements, velocities and accelerations in a body fixed co-ordinate system. For this test, only 12 of the 18 available outputs were used. The device was mounted near the model CG. This is the primary motion measurement system in the model and can be used to predict the motions at any other location in the model.
- a Qualysis optical tracking system consisting of a tree with several infra-red emitters mounted on the model and a pair of cameras fitted to the carriage. Dedicated software calculate the six degrees of freedom displacements (X, Y and Z) and rotations (pitch, roll and yaw) and the residual error in position. This system is used to directly measure the displacements (X,Y and Z) and pitch of the model and the low frequency motions like surge. When combined with carriage speed, it gives the actual model speed. It also acts a backup to the motions measured by the MotionPak II device.
- A strap-down tri-axial accelerometer array was fitted at the center of the helicopter landing deck to directly measure accelerations at this location.
- Relative motion probes were fitted at five locations on the model. A capacitance-type probe was fitted at the stem on centerline and a pair of capacitance-type probes were fitted, port and starboard, at station 1.5. Acoustic-type probes were mounted on the port side of the model deck at the forward RAS location and at the center line of the propeller.
- A vertical accelerometer was fitted in the bottom of the model at Station 1.5.
- Two Schaevitz LSOC high precision gravity referenced tilt sensor oriented to measure model trim and heel were fitted to the same deck as the MotionPak II.

  Detailed information of the instrumentation can be found in Reference 1. Instrumentation locations are given in Table 2.

In addition, an encounter wave probe was fitted to the north side of the carriage approximately 3 meters forward of the bow of the model and off tank centerline. A fixed far field wave probe was fitted to a cantilever beam 1.5 meters from the tank wall and approximately 30 meters from the wave maker.

Carriage speed was measured using the onboard systems of the carriage. A waterproofed S-type load cell was used for bollard thrust verification tests. Water temperature was periodically measured using a hand-held digital thermometer submerged at the nominal mean draft depth of the model.

Table 2 – Location of Seakeeping Instrumentation

Device	Full Scale			Model Scale		
	X from transom [m]	Y from centerline [m]	Z from baseline [m]	X from transom [m]	Y from centerline [m]	Z from baseline [m]
MotionPak II	92.4	0.0	9.7	3.11	0.00	0.33
Qualisys	107.2	0.0	19.3	3.61	0.00	0.65
Accel Z Slam	147.0	0.0	3.1	4.95	0.00	0.10
Accel Triaxial (Helicopter Deck)	12.0	0.0	15.3	0.40	0.00	0.51
Relmo Prop Acoustic	9.2	13.1	16.9	0.31	0.44	0.57
Relmo RAS Acoustic	112.0	13.1	16.9	3.77	0.44	0.57
Relmo Bow	189.2	0.0	22.0	6.37	0.00	0.74
Relmo Port/Stbd	147.1	13.4	22.0	4.95	0.45	0.74
for MotionPak translation						
Helicopter Landing Dk	12	0	15.5	0.404	0	0.522
Bridge	165.9	0	28.3	5.588	0	0.953

5.2 Instrumentation Calibration

All instrumentation was calibrated prior to the commencement of testing. Typically, physical calibrations are done for most instruments. For some instruments, the factory calibration information is used in conjunction with a Hewlett-Packard Precision Voltage Source. Physical calibrations involve setting the device to several known positions, angles, loads or torques, recording the corresponding voltage and fitting a curve (usually first order) to the data. Physical calibrations should cover the range expected for the device during the course of the test.

MotionPakII: The channels used for this device were calibrated using the manufacturer's calibration information.
Qualisys: This system is calibrated by placing a machined emitter array in the measurement field. Dedicated software then solves the calibration system of equations. The validity and extent of the solution is verified by moving a probe within the measurement field. One of the emitters on the tree is chosen as the reference emitter. Its position with respect to the model CG is used to translate the motions of the Qualisys tree to the model CG.
Accelerometers: These devices require physical calibration achieved by setting the accelerometer to different known angles. The resultant acceleration in G's is equal to the cosine of the applied angle.
Capacitance Wave and Relative Motion Probes: All capacitance-type probes were physically calibrated by moving them up and down known distances in a water tank.
Acoustic Relative Motion Probes: These devices are calibrated by varying their position with respect to a reflecting surface.
Load cells: These instruments (verification pull and thrust) were calibrated by applying a series of static weights over desired measuring range. Torque was calibrated using static weights applied to the end of a torque arm.
Inclinometers: The output of these instruments was calibrated against a digital inclinometer.
Shaft Speed: This instrument was calibrated using an external tachometer.

Rudder Angle: The output of the Vishay Potentiometer was calibrated using the protractor system described in section 5.1.1 above.

Table 3 – List of Signals

Signal	Device	Calibrated Range		Measurement Range		Units	Test Type Req'd
		min	max	min	max		
Inline Load	S-Type Load Cell	98	392	-776	676	N	SKP
Carriage Speed	carriage instrumentation	-0.625	6.125	-1	6.5	m/s	SKP H180
Carriage Speed	carriage instrumentation	-1.8	1.8	-2.000	2.001	m/s	SKP H0
Shaft Speed	Allegro A3422 Hall-Effect Senson	4.71	20.82	-33.3	33.2	rps	SP,SKP
Dyno Thrust	Kempf&Remmers R250	0	146	-305	223	N	SP,SKP
Dyno Torque	Kempf&Remmers R250	-7.36	7.36	-12.2	12.4	Nm	SP,SKP
Model Roll	LSOC-14.5 Inclinometer	-14.8	14.9	-19.6	19.1	deg	SKP
Model Pitch	LSOC-14.5 Inclinometer	-4.6	4.6	-7.2	7.2	deg	SKP
X Rate MP1	MotionPak II	-52.2	53.8	-57.3	56.7	deg/s	SKP
Y Rate MP1	MotionPak II	-52.1	48.3	-57.1	56.4	deg/s	SKP
Yaw Rate, Z MP1	MotionPak II	-49.8	48.4	-57.1	56.7	deg/s	SKP
X Accel MP1	MotionPak II	-1	1	-2.1	2.1	g	SKP
Y Accel MP1	MotionPak II	-1	1	-2.1	2.1	g	SKP
Z Accel MP1	MotionPak II	-1	1	-3.2	3.2	g	SKP
X (Body 1)	Qualisys					m	SKP
Y (Body 1)	Qualisys					m	SKP
Z (Body 1)	Qualisys					m	SKP
Roll (Body 1)	Qualisys					deg	SKP
Pitch (Body 1)	Qualisys					deg	SKP
Yaw (Body 1)	Qualisys					deg	SKP
Upstream Wave Probe	Capacitance probe	0	0.65	-1.67	2.17	m	SKP
Encounter Probe	Capacitance probe	0	0.4	-7.4	6.1	m	SKP
Relmo Bow	Capacitance probe	0.694	0.968	-2.67	4.35	m	SKP
Relmo Port	Capacitance probe	0.694	0.968	-2.79	4.57	m	SKP
Relmo Stbd	Capacitance probe	0.694	0.968	-2.75	4.43	m	SKP
Relmo RAS acoustic	Ultrasonic Probe	0.091	0.353	-23	0.36	m	SKP
Relmo Prop acoustic	Ultrasonic Probe	0.076	0.338	-0.24	0.36	m	SKP
Accel Z Slam	Servo Accelerometer	-1	1	-2	2	g	SKP
Accel X tri-axial	Servo Accelerometer	-0.14	0.2	-0.24	0.24	g	SKP
Accel Y tri-axial	Servo Accelerometer	-1	1	-1	1	g	SKP
Accel Z tri-axial	Servo Accelerometer	-1	1	-2.1	2.1	g	SKP

Carriage Speed: Carriage speed is verified periodically by setting up two proximity switches on the towing tank rails at a measured distance apart with companion switches on the tow carriage linked by cable to the carriage data acquisition system. Tow carriage is operated at a constant speed between the two switches and time between activating the switches recorded on the carriage data acquisition system - thus providing an accurate measure of the mean towing carriage speed. For the head sea tests (H180), carriage speed calibration range was -1 to 6.5 m/s. For the following sea tests (H0), carriage speed calibration range was -2 to 2 m/s.

The list of channels is given in Table 3. Details of the calibrations can be found in Appendix C.

5.3 Data Acquisition System

The model based acquisition system consisted of two NOTUS signal conditioning boxes to provide amplification and filtering of the analog signals. Digitization of the analog signals was done using a National Instruments 32-channel NI USB-6218 multifunction data acquisition module and a computer running NRCSJS's standard data acquisition system and software described in References 4-6. Carriage-based signals were acquired using hardware and software described in References 4-6. All acquired analog DC signals were low pass filtered at 10 Hz, amplified as required and digitized at 50 Hz.

6.0 DESCRIPTION OF THE EXPERIMENTAL SET UP

All experiments were carried out in the National Research Council Towing Tank in St. John's, NL. The towing tank was configured as follows for these experiments:

Water Depth: The water depth is fixed at nominally 7 m.

Pull Point: The pull point apparatus used to carry out daily verification of the propulsion system was installed on the outboard edge at the east end of the towing carriage. For these tests, the pull point line was secured and the tow force measured using a waterproof in-line load cell.

Seakeeping and Added Power Setup: For the tests in waves and the associated calm water baseline runs, the test frame spacing was increased and aluminum guiders installed to the lower part of the test frame longitudinal beams. The test frame spacing was adjusted so that there was about 3 mm of free play between the guiders and the model frames. This arrangement restricts model sway, roll and yaw but permits the model freedom to surge, heave and pitch.
The model was fully appended with bilge keels, propeller shaft, propeller, and rudder. For all forward speed experiments the model was self-propelled, manually driven by an operator, but not directionally controlled. For some sets of experiments, the model shaft speed was held constant and carriage speed varied to chase the model and maintain it within the Qualisys field of view. For other sets of experiments, carriage speed was held constant and the operator varied shaft speed to chase the carriage and keep it within the Qualisys field of view.

AC Power , Ethernet and RS-232 cables connecting the model with the carriage were arranged not to affect initial position of the model and its responses due to wave disturbance at speed.

Light ropes, not affecting model responses, were secured to the bow and stern of the model and used by test operators to accelerate the model to the target speed, maintain its position within the guidance system during test runs and restrain the model during deceleration at the end of a run. Video of bow, midship and stern view of the model during all test runs was recorded on a hard drive. A copy of the video with an annotated and hyperlinked copy of the run log is included as a deliverable on a hard drive sent under separate cover.

7.0 DESCRIPTION OF THE TEST PROGRAM

7.1 Wave Spectra

Upon completion of the calm water tests, the model was removed from the tank to be re-configured and instrumented for the seakeeping experiments. While the necessary changes were being made to the instrumentation of the model, the towing tank was re-configured for tests in waves. Matching of the four wave spectra required for these tests was done at this time. Details of the spectra are listed below:

Table 4 – Summary of Wave Spectra Matching

SeaState	Target		Duration [min]	Achieved	
	H_S [m]	T_P [s]		H_S [m]	T_P [s]
3	0.88	7.5	20	0.83	7.79
5	3.25	9.7	20	3.27	9.52
5	3.25	9.7	60	3.20	9.78
5H	4.00	11.0	20	4.00	11.43

7.2 Scope of Work

The Statement of Work (SOW) (Reference 7) required that tests be done at the speeds, sea states and headings listed in Table 5 below. In the SOW, the tests in sea state 3 were included in the resistance and powering section. Because the resistance and propulsion apparatus is not suitable for tests in waves, these tests were moved into the seakeeping section of the test.

Table 5 - Scope of Sea-keeping Tests from Statement of Work

Sea state	Heading [deg]	Speed [kts]	Comment
3	180	15	Added Power
3	180	20	Added Power
5	180	18	SKP/Slam
5H	180	12	SKP
5H	180	15	SKP
5H	180	18	SKP
5	0	0	Original option
5	0	15	Option done

All spectra were synthesized with a 20-minute repeat cycle that gives approximately 100 to 150 wave encounters in head seas. Since slamming incidence was a criterion of interest in sea state 5 head seas, that spectrum was also synthesized with a 60-minute repeat cycle.

For the following sea test, the encounter period of the model with the wave specified in the SOW would be 9.42 sec and would require 17 runs to obtain 100 encounters. There was a large risk that the model would spend a large part of any given run seemingly "frozen" on the wave. Three speed/sea state combinations were proposed as an option to the test specified in the SOW – 15 knots at SS5 or SS5H or 18 knots at SS5H. JSS-PMO selected 15 knots at SS5 as the most suitable operating condition to test in following seas.
For the purpose of wave matching, the encounter wave probe on the carriage was used with the carriage located at the 95-meter mark of the Towing Tank. Details of wave matching can be found in Appendix D.

Table 6 – As Tested Condition

Parameter	Target		Achieved	
	FS	MS	FS	MS
LOA [m] LWL [m] LBP [m] Displacement [t SW, kg FW]	189.2 18015 173 25587	6.374 6.068 5.827 915	24605	915.7
Draught [m]	8.2	0.276	8.2	0.276
Trim [m. by stern]	0	0	0	0
LCG from AP [m]	85.74	2.888	85.7	2.89
VCG from baseline [m]	9.668	0.3256	9.67	0.326
GMt [m]	1.366	0.0461	1.37	0.046
Kxx [m]	8.16	0.327	8.3	0.28
Kyy [m]	37	1.246	36.8	1.24

7.3 Model Setup

After model outfit for sea-keeping was completed, the model without ballast was swung in the large aluminum swing frame to determine its roll and pitch inertia and model CG. A ballast plan was generated to guide the location of the ballast needed to bring the model to the test displacement. The model was installed in the towing tank trim dock, ballast added according to the ballast plan and adjustment of the location of some of the smaller pieces of ballast was made to set the model pitch and trim. An inclining experiment was done to confirm the model GMt and the final location of all the ballast verified to update the ballast plan. Details of the swinging and inclining experiment can be found in Appendix B. Principal particulars of the model as configured for the seakeeping tests are given in Table 6.

7.4 Decay Tests

Roll, pitch and heave decay experiments were conducted to determine roll, pitch and heave

damping properties for the JSS Preliminary Design. The experiments included decay tests in calm water and for a range of forward speeds. Roll decay tests were attempted at 18 knots but were unsuccessful because the model would veer to one side or the other during initiation. Roll decay tests were not attempted at 20 knots. The decay test plan is shown in Table 7.

Table 7 – Decay Test Plan

DECAY TESTS				
FS Speed [kts]	MS Speed [m/s]	Roll	Pitch	Heave
0	0	Y	Y	Y
12	1.133	Y	Y	Y
15	1.416	Y	Y	Y
18	1.699		Y	Y
20	1.888		Y	Y

Each decay test was repeated at least twice. The model was offset to an initial off balance heel or pitch angle or heave displacement and then released. Data was recorded until oscillations ceased. To reduce effect of coupled motions, the roll decays were initiated by pushing down at the LCG on starboard side of model. Pitch decays were initiated by pushing down at the FP on centerline and heave decays were initiated by pushing down at the LCG on centerline.

7.5 Shaft Frictions, Bollards and Calm Water Baseline

As part of the added power experiments, shaft friction tests and in-situ bollard tests were performed at the start and end of each test day. For the shaft friction test, the propeller was removed and replaced with a cylindrical hub of the same mass. Shaft (Dyno) torque and shaft speed were measured as shaft speed was increased in discrete steps from 7 to 16 rps. For the in-situ bollard tests, the inline load cell was attached to the transom of the model and fixed to the pull point to measure tow force. Inline load, thrust, torque and shaft speed were measured as shaft speed was increased in discrete steps from 7 to 15 rps. Details of the shaft friction tests and in-situ bollard tests can be found in Appendix E.

At least two calm water baseline runs were done before and after each speed/sea state combination to determine the baseline thrust, torque and shaft speed for the model as configured.

7.6 Tank Length and Spectrum Segmentation

The limits imposed by the towing tank length required that each spectrum be broken into multiple segments. Starting the wave maker at different points within the drive signal creates segments of the spectrum. The number of segments required is dependent on the model speed, wave repeat cycle, segment overlap and wave heading as shown in Table 8.

A random selection of runs was repeated for QA purposes. Details of the test sequence can be found in the Annotated Run Log in Appendix F.

Table 8 – Spectrum Segmentation

Spectrum	FS Speed [kts]	MS Speed [m/s]	FS Repeat Period [min]	MS Repeat Period [s]	Segments	MS Overlap Average [s]	Heading [deg]	MS Increment [s]
SS3	15	1.416	20	220.23	4	15.3	180	55
SS3	20	1.888	20	220.23	6	17.5	180	37
SS5	18	1.699	60	660.70	13	14.1	180	51
SS5	18	1.699	20	220.23	10	38.9	0	22
SS5H	12	1.133	20	220.23	3	18.3	180	73
SS5H	15	1.416	20	220.23	4	20.5	180	55
SS5H	18	1.699	20	220.23	5	15.8	180	44

8.0 ANALYSIS PROCEDURE

Data collected during experimentation need to be properly analyzed to obtain correct experimental information. Analysis is typically conducted in two phases. Online analysis is conducted during experimentation and offline analysis is normally carried out after testing is completed. Command procedures for each type of experiments are compiled using the GEDAP (Reference 8) and SWEET (Reference 9) suite of programs.

8.1 Online Data Analysis

Online analysis is conducted immediately after a test run is finished. Main goal of this analysis is quality assurance and verification of integrity of the acquired data, i.e., check for proper functioning of sensors, noisiness of recorded data, dropouts in the Qualisys system signals and suitability of used filters. All recorder channels plots are physically examined and malfunctions identified. Preliminary statistical analysis of all channels is done and inspected to determine whether, or not, the run may need to be repeated. Typically, the most likely cause of a repeat run is an excessive number of dropouts in Qualisys usually due to model not reaching steady state or low voltage to the emitter array.

Instrumentation channels are labeled category 1, 2 or 3. Malfunction of a category 1 channel must be repaired before proceeding with the test. Malfunction of a category 2 channel is repaired at the next interruption in testing. Malfunction of a category 3 channel is repaired if the opportunity presents itself.

8.2 Offline Data Analysis

Separate command procedures were prepared and used for analyzing different type of experiments. The command procedures are based on the methods described in the IOT Seakeeping Standard Test Method (Reference 10). However, the common part of analysis included application of calibration constants and conversion to physical units, translation of model scale values to full-scale values, assuring proper units and sign convention, numerical and

manual data de-spiking, and calculation of linear and angular displacements from MotionPak II and Qualisys measurements.

Command procedures for each type of experiment were compiled using the SWEET and GEDAP suite of programs. The following data analysis was carried out after completion of the experimental program to generate the final data products.

8.2.1 Roll Decay Tests

The roll, pitch and heave decay runs were analyzed using dedicated software to compute the equivalent viscous damping. To investigate roll damping, several runs were carried out in calm water at zero forward speed, 12 knots, 15 knots and maximum speed of 18 knots. The roll decay tests on model without appendages that were carried out as part of bare hull tests conducted in the Ice Tank (Reference 1) and are also included in this report for comparison purposes. The results of the roll decay analysis are shown in Table 9.

For the roll decay analysis where more than five cycles are available, each motion excitation segment was analyzed 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 are input, and log decrements are computed as the natural logarithm of the ratio of two successive amplitudes. Both crest and trough amplitudes (x_n, x_{n+1}) are used in calculating log decrements (δ) to increase the computational accuracy - especially in cases where only a few decay cycles can be measured.

$$\delta = \ln\left(\frac{|x_n|}{|x_{n+1}|}\right) \tag{1}$$

From log decrements damping ratios (ζ) are calculated for all measured amplitudes.

$$\zeta = \frac{\delta}{\sqrt{4\pi^2 + \delta^2}} \tag{2}$$

The damping ratio for linear damping is estimated as the average of all log decrements.

Table 9 – Roll Period and Damping

Test	VS [knots]	Segment	Mean		Damping
			Offset [deg]	Period [sec]	Linear
Roll_Decay_VS0_001	0	1	-0.12	15.6	0.0280
	0	2	-0.11	15.6	0.0246
	0	3	-0.12	15.6	0.0231
	0	4	-0.12	15.6	0.0261
Average				15.6	0.0254
Roll_Decay_VS12_VS15_002	12	1	0.46	15.1	0.0584
Roll_Decay_VS12_VS15_002	15	1	0.52	14.9	0.0719
UNAPPENDED (from Reference 1)					
Roll_Decay_040	0	1	0.11	19.5	0.0107
Gmt = 1.31 m.	0	2	0.11	19.6	0.0044
	0	3	0.10	19.5	0.0052
Average				19.5	0.0068
Roll_Decay_038	0	1	0.00	16.7	0.0147
Gmt = 1.93 m.	0	2	0.00	16.5	0.0157
	0	3	0.01	16.9	0.0151
Average				16.7	0.0151

8.2.2 Pitch and Heave Decay Tests

Pitch and heave decay experiments were done at 0, 12, 15, 18 and 20 knots. For the pitch and heave decay experiments where less than five cycles are available, the following alternative data analysis procedure is followed:

A damped sine wave is fitted to the time series of measured data using the least-squares criterion. The fitted curve is defined as follows:

$$Y2(t)=Y0+A\sin(2\pi ft-\varphi)\exp(-t/\tau) \qquad (3)$$

where $Y0$ = mean value of sine wave,
A = amplitude of sine wave,
f = frequency of sine wave in Hz
φ = phase lag of sine wave
τ = damping time constant in seconds.

The non-dimensional damping ratio $\zeta = 1/(2\pi f\tau)$ is also calculated which defines the damping for a second order system of the following form:

$$m\frac{d}{dt}\left(\frac{dY}{dt}\right)+c\frac{dY}{dt}+kY=F(t) \tag{4}$$

where m = mass,
c = linear velocity damping factor,
k = linear restoring force constant (spring constant)
Y(t) = linear displacement of mass m
F(t) = external force.

ζ= r/p where r = c/(2m) and p = $(k/m)^{1/2}$ = natural frequency in radians per second.

Initial values of the parameters Y0, A, f, φand τ are estimated from a zero-crossing analysis of the input time series. The initial estimate for φ is obtained by integrating Y1(t)sin(2πft) and Y1(t)cos(2π ft) over an integer number of zero-crossing cycles where Y1(t) is the input time series. The final values of Y0, A, f, φ and τ are obtained by using the Downhill Simplex Method to minimize the mean square deviation between the measured time series and the damped sine wave. Thus, the five parameters Y0, A, f, φ and τ are chosen to minimize H where:

$$H=\sum_{j=1}^{j=N}\left[Y2(t(j))-Y1(t(j))\right]^2 \tag{5}$$

and N is the number of points in the input time series Y1. This analysis technique has been verified for relatively short records containing as few as one or two cycles of the measured response (Reference 11, 12). Tables 10 and 11 summarize the analysis of the pitch and heave decay experiments, respectively.

Table 10 – Pitch Decay Results

VS [knots]	Segment	τ [sec]	ζ [-]	Y0 [deg]	A [deg]	f [Hz]	φ [deg]	RMS Error [deg]
0	1	4.27	0.28	0.07	2.08	0.13	109	0.05
12	1	3.79	0.29	0.02	2.12	0.15	114	0.02
12	2	3.08	0.34	0.09	2.40	0.15	119	0.03
15	1	3.61	0.29	-0.02	1.77	0.15	102	0.02
15	2	3.27	0.32	-0.01	2.36	0.15	113	0.02
18	1	3.57	0.30	-0.10	2.15	0.15	108	0.01
18	2	3.84	0.29	-0.14	2.00	0.14	117	0.03
20	1	4.06	0.27	-0.15	1.74	0.15	116	0.02
20	2	3.99	0.27	-0.17	1.75	0.15	104	0.01

Table 11 – Heave Decay Results

VS [knots]	Segment	τ [sec]	ζ [-]	Y0 [m]	A [m]	f [Hz]	φ [deg]	RMS Error [m]
0	1	5.42	0.23	-0.59	1.44	0.13	-67	0.04
0	2	4.27	0.29	-0.64	1.56	0.13	-70	0.03
12	1	4.25	0.27	-0.37	1.01	0.14	-72	0.01
12	2	4.22	0.31	-0.36	0.99	0.12	-64	0.04
15	1	4.70	0.26	-0.32	1.05	0.13	-86	0.02
15	2	5.67	0.23	-0.31	0.89	0.12	-84	0.05
18	1	5.19	0.22	-0.22	1.11	0.14	-78	0.02
18	2	4.97	0.23	-0.22	1.20	0.14	-77	0.02
20	1	5.65	0.20	-0.12	1.04	0.14	-75	0.04
20	2	3.99	0.27	-0.17	1.75	0.15	104	0.01

The output plots from all decay analyses are shown in Appendix G.

8.2.3 Seakeeping

The seakeeping offline data analysis require several individual test runs to be merged to obtain the target 20 or 60 minute full-scale time segment before computing the statistics. The number of test runs required to obtain the necessary time segment depends on model speed, heading and spectrum duration as shown in Table 7 above.

The seakeeping offline data analysis procedure was performed three times. The first iteration produced the statistics for the motions and accelerations at the center of gravity of the ship. The second iteration translated the MotionPak data to the center of the Helicopter Landing Deck. The third iteration translated the MotionPak data to the center of the Bridge. Reference dimensions used for the translations are shown in Table 2.

Statistics from a typical merged dataset at the CG, VS 18_SS5H, are shown in Table 12.

An example of the plots of the merged time history for VS18_SS5H (reference location: Ship CG) and statistics for all the merged runs at the three locations can be found in Appendix H

Table 12 – Statistics from a Merged Dataset

VS18_SS5H Merged					
Channel	**Units**	**Min**	**Max**	**Mean**	**SD**
Accel X Triaxial	g	-0.051418	0.047933	0.0018553	0.016066
Accel Z Slam	g	-0.25136	0.25073	-0.00075002	0.083038
Accel Z Slam Vel	m/s	-2.5461	2.5526	0.0015849	0.82019
Accel Z Triaxial	g	-0.19021	0.18925	-9.1182e-05	0.055367
Dyno Thrust	N	1.3620e+06	1.9108e+06	1.6252e+06	66650.
Dyno Torque	Nm	-1.6060e+06	-1.1789e+06	-1.4172e+06	45267.
MP Heave Acc	g	-0.091377	0.11280	0.0014046	0.031655
MP Heave Vel	m/s	-1.2459	1.2782	0.00030907	0.35982
MP Pitch Acc	deg/s**2	-2.0408	1.7691	-0.00071869	0.54491
MP Pitch Vel	deg/s	-2.0275	1.9962	-0.034505	0.62905
MP Surge Acc	g	-0.023519	0.021732	-0.00071558	0.0065899
QUAL Pitch	deg	-2.7020	2.5749	-0.030475	0.78942
QUAL Ship Speed	m/s	8.0303	9.9587	8.7964	0.21962
QUAL X	m	-41.871	-25.383	-32.844	3.3399
QUAL Z	m	7.4530	9.9439	8.8035	0.34964
Relmo Bow	m	-6.8723	8.3230	1.0242	2.1358
Relmo Port	m	-6.5217	6.6041	0.58164	2.2648
Relmo Port Vel DERIV	m/s	-13.201	19.111	0.0042855	2.7735
Relmo Port Vel DIFFT	m/s	-12.102	16.212	0.0044454	2.6926
Relmo Prop Acoustic	m	-2.8052	2.3154	-0.22228	0.77784
Relmo RAS Acoustic	m	-1.9544	1.7375	-0.15043	0.48090
Relmo Stbd	m	-6.2368	5.8586	0.43761	2.1684
Relmo Stbd Vel DERIV	m/s	-11.160	18.555	0.0038731	2.6388
Relmo Stbd Vel DIFFT	m/s	-10.102	16.632	0.0043283	2.5662
Shaft Speed	rpm	142.23	142.61	142.40	0.044113
Upstream Wave Probe	m	-2.8867	3.6113	0.014375	1.0413

A summary of the motions at the CG for all conditions tested is shown in Table 13.

Table 13 – Motions and Accelerations at CG

DataSet	Ship Speed [knots]	Sea State	Hs [m]	QUAL Pitch STD (deg)	QUAL Heave STD (m)	MP Surge Accel. STD (g)	MP Heave Accel. STD (g)	MP Pitch Accel. STD (deg/sec**2)
VS20_SS3	20.2	3	1.18	0.046	.034	0.001	0.004	0.077
VS15_SS3	15.4	3	1.20	0.058	.068	0.001	0.004	0.086
VS18_SS5	17.5	5	3.47	0.511	.188	0.004	0.024	0.406
VS18_SS5H	17.1	5H	4.16	0.789	.350	0.007	0.032	0.545
VS15_SS5H_R11_8	15.2	5H	4.27	0.778	.345	0.007	0.029	0.504
VS15_SS5H_R10_6	13.8	5H	4.15	0.778	.355	0.007	0.027	0.474
VS12_SS5H	12.3	5H	4.26	0.721	.332	0.007	0.025	0.436
VS15_H0_SS5	14.7	5	3.46	0.251	.139	0.002	0.002	0.054

8.2.4 Slamming, Deck Wetness and Propeller Emergence

The probability of slamming (bottom slamming) at Station 1.5, deck wetness at the bow, and probability of propeller emergence are calculated based on measurements of relative motions and accelerations at specified locations, calculated relative velocities (from relative motions or accelerations) and the assumption that the histogram of motions follows a Rayleigh distribution (Reference 13, 14).

The primary environmental and operational conditions for evaluation of slamming, deck wetness and propeller emergence probabilities and occurrence are Sea State 5 and full scale ship speed of 18 knots (VS18_SS5). The repeat period of the Sea State 5 spectrum was 60 minute full scale. The experiment was conducted for model heading of 180 degree (head sea). Results are shown in Table 14 and Table 15.

Tables 14 and 15 also include probabilities and occurrence of slamming, deck wetness and propeller emergence for other tested sea and operational conditions. These experiments were conducted in 20 minutes full scale repeat period spectra. The results are presented for exploratory purpose only as we are not totally confident in accuracy of the results due to reduced sample duration.

The probability of these events was assessed as follows:

Probability of slamming

$$\Pr(slamimpact) = e\left\{-\left(\frac{H^2}{2m_0(relmot)} + \frac{(3.83)^2}{2m_0(relvelocity)}\right)\right\} \tag{6}$$

H – ship draft at location, in m, 8.2 m
3.83 m/s threshold velocity at impact

m_0 variance of relative motion, area under the relative motion spectrum
m_0 variance of relative velocity area under the relative velocity spectrum

Number of slams in T hrs

$$N(T) = (3.6 \cdot 10^3)\frac{T}{2\pi}\sqrt{\frac{2m_0(relvelocity)}{2m_0(relmot)}}\Pr(slammimpact) \tag{7}$$

T ship operation time (1 hr)

Probability of deck wetness

$$\Pr(deckwetness) = e\left\{-\left(\frac{h_D{}^2}{2m_0(relmot)}\right)\right\} \tag{8}$$

h_D deck height above WL, 21 m

No of deck wetness events in 1 hr

$$N(T) = (3.6 \cdot 10^3) \frac{T}{2\pi} \sqrt{\frac{2m_0(relmot)}{2m_2(relmot)}} \Pr(deckwetness) \tag{9}$$

m_2 second moment of area under the relative motion spectrum

Probability of propeller emergence

$$\Pr(propemergence) = e\left\{-\left(\frac{h^2}{2m_0(relmot)}\right)\right\} \tag{10}$$

h depth of the prop, 3.21 m

No of prop emergence events in 1 hr

$$N(T) = (3.6 \cdot 10^3) \frac{T}{2\pi} \sqrt{\frac{2m_0(relmot)}{2m_2(relmot)}} \Pr(propemergence) \tag{11}$$

Probability of slamming, deck wetness and propeller emergence are summarized in Tables 14 and 15.

Table 14 – Probability of Slamming at Station 1.5

Data Set	Ship Speed [knots]	Sea State	H_S [m]	Slamming Index Probability (Z slam) [%]	Slamming occurrence (Z slam) 1/hr	Slamming Index Probability (Relmot) [%]	Slamming occurrence (Relmot) 1/hr
VS20_SS3	20.2	3	1.18	0.0000	0.0E+00	0.00000	1.9E-118
VS15_SS3	15.4	3	1.20	0.0000	0.0E+00	0.00000	2.7E-171
VS18_SS5	17.5	5	3.47	0.0000	3.5E-12	0.00001	1.6E-03
VS18_SS5H	17.1	5H	4.16	0.0000	4.1E-06	0.00038	6.7E-02
VS15_SS5H_R11_8	15.2	5H	4.27	0.0000	1.1E-07	0.00003	5.8E-03
VS15_SS5H_R10_6	13.8	5H	4.15	0.0000	4.3E-09	0.00000	9.1E-04
VS12_SS5H	12.3	5H	4.26	0.0000	3.3E-11	0.00000	6.7E-05
VS15_H0_SS5	14.7	5	3.46	0.0000	0.0E+00	0.00000	3.2E-223

Table 15 – Probability of Deck Wetness and Propeller Emergence

Dataset	Ship Speed [knots]	Sea State	H_S [m]	Deck Wetness Probability BOW [%]	Deck Wetness BOW 1/hr	Deck Wetness Probability RAS [%]	Deck Wetness RAS 1/hr	Propeller Tip Emergence Probability [%]	Propeller Tip Emergence 1/hr
VS20_SS3	20.2	3	1.18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.56E-148	5.91E-145
VS15_SS3	15.4	3	1.20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.23E-193	4.16E-190
VS18_SS5	17.5	5	3.47	6.16E-45	2.03E-41	5.32E-252	1.08E-248	7.40E-08	1.98E-04
VS18_SS5H	17.1	5H	4.16	1.01E-21	3.62E-18	4.08E-219	7.89E-216	1.98E-04	6.02E-01
VS15_SS5H_R11_8	15.2	5H	4.27	1.47E-23	5.59E-20	2.40E-198	5.12E-195	1.78E-04	5.55E-01
VS15_SS5H_R10_6	13.8	5H	4.15	3.23E-24	1.25E-20	1.05E-207	2.32E-204	1.11E-04	3.66E-01
VS12_SS5H	12.3	5H	4.26	5.67E-27	2.22E-23	6.78E-183	1.57E-179	6.90E-05	2.27E-01
VS15_H0_SS5	14.7	5	3.46	2.13E-100	2.19E-96	0.00E+00	0.00E+00	5.36E-14	4.10E-10

8.2.5 Added Power

Surge speed, the speed of the model with respect to the carriage, is calculated by differentiating with respect to time the X (Body 1) signal obtained from Qualisys. Model speed is the vector sum of carriage speed and surge speed.

For some of the test sets, the shaft speed used was the same the speed used for the calm water baseline. This becomes a good measure of the speed lost due to waves but in order to obtain the increases due to waves of torque, thrust and shaft revolutions, it was necessary to plot the mean values of the calm water baseline shaft speed, thrust and corrected torque against model speed for all the baseline runs and interpolate this data at the average speed in waves for a particular run. This also showed that the data variability from one test set to the next was quite small as shown in Table 16 and Figure 9 below.

The increases due to waves in torque, Q_{AW}, thrust, T_{AW} and shaft revolutions n_{AW} are computed by deducting the mean values measured in calm water from the mean values of these parameters measured at the same forward speed in waves.

Table 16 – Calm Water Baseline Power Parameters

Test Set	Model Speed (m/s)	Shaft Speed (rps)	Dyno Thrust (N)	Thrust SD/Mean	Torque Corrected [Nm]	Torque SD/Mean
VS12_ss5H	1.1334	8.50	26.43	1.7%	0.7572	1.7%
Vs15_h0_ss5	1.4147	10.63	41.00	1.4%	1.1698	1.1%
VS15_ss5H	1.4166	10.62	40.92	1.3%	1.1796	1.3%
VS15_ss3	1.4166	10.63	40.49	1.1%	1.1776	1.0%
VS18_ss5H	1.6987	12.93	59.80	0.2%	1.7274	0.3%
VS18_ss5	1.6988	12.93	59.72	0.3%	1.7225	0.9%
Vs20_ss3	1.8891	14.61	77.65	2.9%	2.2193	2.1%

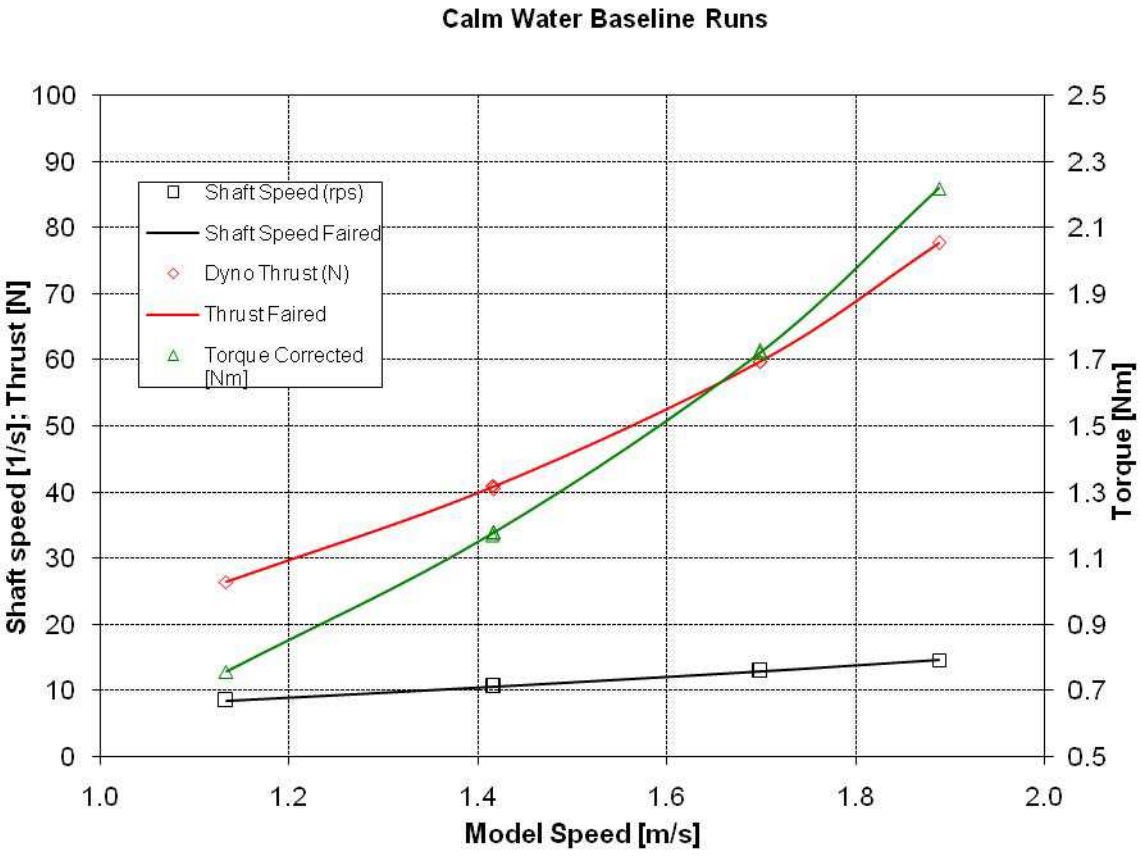

Figure 9 – Calm Water Baseline Summary

Non-dimensional coefficients are computed as follows:

added torque, χ_{AW}

$$\chi_{AW} = Q_{AW} / \left(\rho_M g \xi_A^2 D_M \left(B_M^2 / L_M \right) \right) \tag{12}$$

increase in shaft speed due to waves, ν_{AW}

$$\nu_{AW} = \left(n_{AW} D_M^3 V_M \right) / \left(g \xi_A^2 \left(B_M^2 / L_M \right) \right) \tag{13}$$

added thrust, η_{AW}

$$\eta_{AW} = T_{AW} / \left(\rho_M g \xi_A^2 \left(B_M^2 / L_M \right) \right) \tag{14}$$

where D_M is the propeller diameter and V_M the model speed

The effective power of the ship in waves, P_{EW} is predicted by adding the increase in ship resistance due to waves to the ship resistance in calm water.

$$P_{EW} = \left(R_{TS} + R_{AWS} \right) V_S \tag{15}$$

where R_{TS} is the ship resistance in calm water calculated from standard calm water resistance experiments using the ITTC 1957 method, Reference 15.

Power increase: The increases due to waves in torque, Q_{AW}*, thrust,* T_{AW} *and shaft revolutions* n_{AW} *are computed by deducting the mean values measured in calm water from the mean values of these parameters measured at the same forward speed in waves.*

The increase in delivered power the full size ship P_{DAW} *is predicted by the Torque and Revolution per Minute Method (Reference 16)*

$$P_{DAW} = 2\pi \{ (Q_S + Q_{AWS})(n_S + n_{AWS}) - Q_S n_S \} \tag{16}$$

where Q_S *and* n_S *are the calm water torque and shaft rotation rate at ship propulsion point, predicted from propulsion experiments in calm water by the 1957 Method, (Reference 17) and* Q_{AWS} *and* n_{AWS} *are the mean increases in ship torque and ship shaft rotation rate in waves calculated from the mean increases for the model scaled to full size by Froude scaling:*

$$Q_{AWS} = \rho_S L_S^4 Q_{AW} / \left(\rho_M L_M^4 \right) \tag{17}$$

and

$$n_{AWS} = n_{AW} \sqrt{L_M L_S} \tag{18}$$

The predicted ship power in waves is, P_{DW} *is obtained by adding the increase in delivered power*

due to waves to the delivered power predicted for the ship in calm water, P_D., using the ITTC'57 methodology. (Reference 17)

$$P_{DW} = P_D + P_{DAW} \tag{19}$$

The thrust increase due to waves, T_{AW} *is also predicted for the ship*

$$T_{AWS} = \rho_S L_S^3 T_{AW} / \left(\rho_M L_M^3\right) \tag{20}$$

At 18 knots in sea state 5H, shaft speed was not increased over the baseline calm water value but an estimate of the added power parameters at this condition was made by extrapolating the mean shaft speed and torque. Shaft speed was extrapolated using the TREND function within EXCEL. Torque and thrust were extrapolated using the INTERPOLATE function, part of the XLXTRFUN add-in for EXCEL (Reference 18)

Figure 10 shows a plot of the added power parameters for the merged dataset for sea state 5H including the extrapolation from 16.8 to 18 knots. A summary of the added power for all conditions tested is given in Table 17.

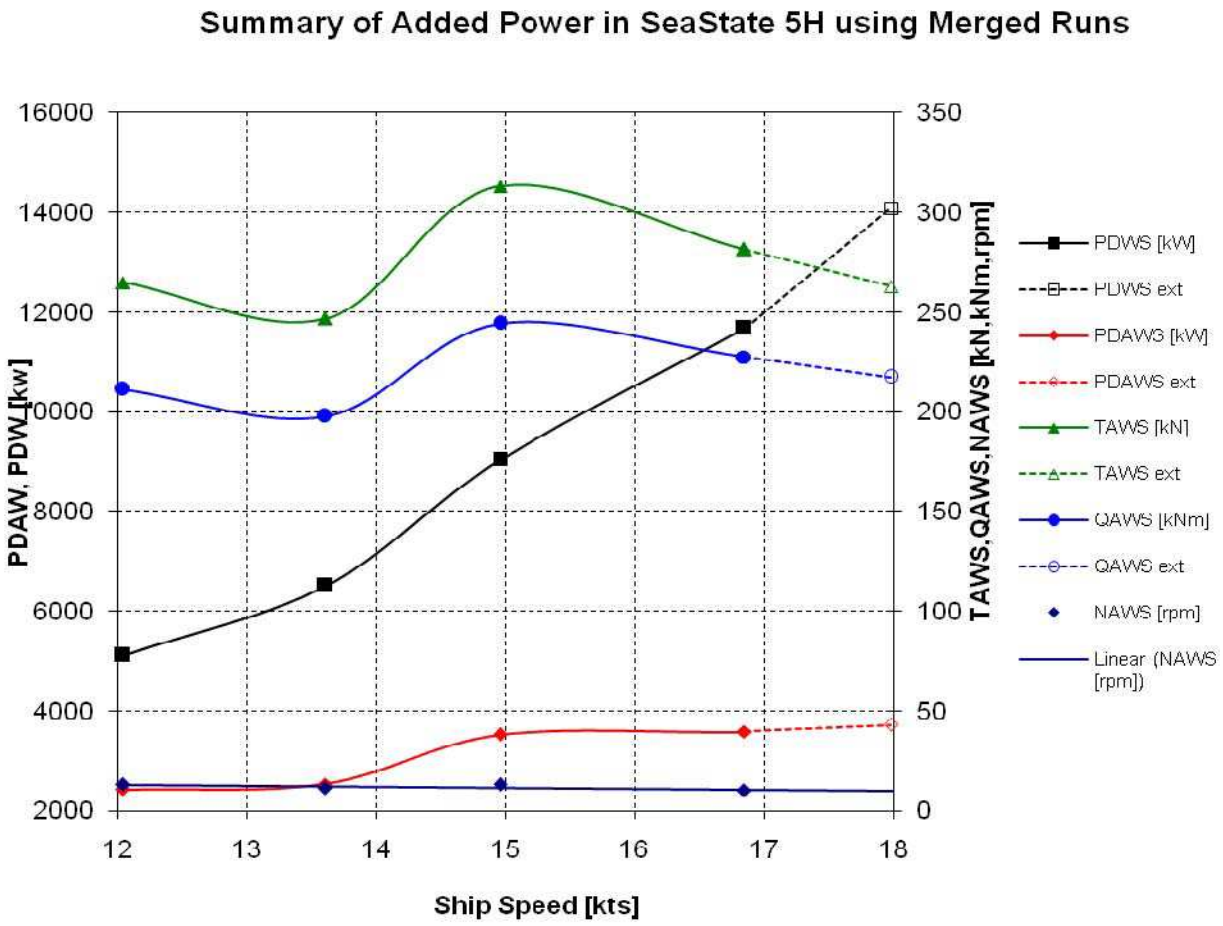

Figure 10 – Added Power in Sea State 5H

Table 17 - Added Power Prediction using Merged Datasets

Sea State	Ship Speed [kts]	NAWS [rpm]	TAWS [kN]	QAWS [kNm]	PDAWS [kW]	PDWS [kW]
SS3	15.1	-0.7	-27.2	-17.4	-217	5455
SS3	20.0	-0.1	-13.7	-7.7	-93	16323
SS5	17.2	6.6	195.4	158.8	2496	11262
SS5H	12.1	13.1	264.5	211.0	2421	5111
SS5H	13.6	11.2	246.6	197.7	2535	6510
SS5H	15.0	12.9	312.9	244.1	3526	9030
SS5H	16.8	10.0	281.5	227.2	3579	11666
SS5H*	18.0	8.5	262.7	217.1	3722	14082

* extrapolated

Tables and statistics for the added power experiments can be found in Appendix I.

8.3 Data Quality

8.3.1 Propulsion in-situ tests

Table 18 summarizes the results of the in-situ tests done at the start and end of each of the four test days. No in-situ test was done at the end of the fourth test day. There was a problem with the first in-situ test, INSITU_004, caused by the restraining lines absorbing some of the tow force. This was corrected for subsequent tests but this defect does not affect the checks of the thrust and torque against shaft speed.

The variation in performance over the course of the test, expressed as the standard deviation divided by the mean, was less than 1% for the bollard test (tow force against thrust) and less than 0.5% for thrust and torque against shaft. The average variation in thrust and torque during the calm water baseline runs was about 1% as shown in Table 16. The calm water runs at 20 knots show the most variation.

Table 18 – Summary of In-Situ Check Runs

Tow Force versus Thrust						
Test	Date	Time	Slope	Intercept [N]	R^2	SD Res [N]
Insitu_004*	29-Nov-11	12:06:34 PM	0.03075	-0.32	0.96863	0.21
Insitu_005	29-Nov-11	6:15:25 PM	0.95601	-2.47	0.99993	0.31
Insitu_006	30-Nov-11	8:43:10 AM	0.97717	-5.68	0.99976	0.58
Insitu_007	30-Nov-11	6:46:25 PM	0.95168	-2.31	0.99995	0.26
Insitu_008	1-Dec-11	8:37:47 AM	0.95543	-2.97	0.99999	0.13
Insitu_009	1-Dec-11	7:28:15 PM	0.95616	-4.20	0.99998	0.15
Insitu_010	2-Dec-11	8:37:03 AM	0.95402	-3.96	0.99998	0.17
		Mean	**0.95841**	**SD/Mean**	0.99993	0.259
* Restraining ropes tight		St Dev'n	**0.00934**	**0.97%**		0.155

Thrust versus rps^2						
Test			Slope	Intercept [N]	R^2	SD Res [N]
Insitu_004			0.61905	-1.13	0.99998	0.19
Insitu_005			0.62406	-1.13	0.99999	0.11
Insitu_006			0.62573	-1.38	0.99996	0.23
Insitu_007			0.62079	-1.61	0.99999	0.10
Insitu_008			0.62282	-1.60	0.99995	0.26
Insitu_009			0.62319	-1.41	0.99993	0.30
Insitu_010			0.62647	-1.25	0.99998	0.15
		Mean	**0.62316**	**SD/Mean**	0.99997	0.190
		St Dev'n	**0.00261**	**0.42%**		0.077
Torque versus rps^2						
Test			Slope	Intercept [Nm]	R^2	SD Res [Nm]
Insitu_004			-0.0157	-0.0560	0.99998	0.0039
Insitu_005			-0.0158	-0.0550	0.99999	0.0028
Insitu_006			-0.0158	-0.0519	0.99997	0.0052
Insitu_007			-0.0158	-0.0400	0.99999	0.0025
Insitu_008			-0.0158	-0.0507	0.99998	0.0041
Insitu_009			-0.0158	-0.0440	0.99997	0.0052
Insitu_010			-0.0158	-0.0576	0.99999	0.0033
		Mean	**-0.01576**	**SD/Mean**	0.99998	0.004
		St Dev'n	**0.00005**	**0.29%**		0.001

8.3.2 Seakeeping Repeat Runs

There were six pairs of repeat runs scheduled during the course of this test program as shown in Table 19. There were other runs repeated because of setup or data issues but the following runs were done to quantify the repeatability of a number of the measurements.

Table 19 – Scheduled Repeat Runs

Core Name	Original Test	Repeat Test
VS18_SS5H	_001	_006
VS15_SS5H	_001	_005
VS12_SS5H	_001	_004
VS18_SS5	_013	_014
VS15_SS3	_001	_005
VS15_H0_SS5	_001	_011

Table 20 summarizes the repeatability of a subset of the data for these six pairs of repeat runs. Please note that the values reported are the RMS at full scale. Details for all the parameters can be found in Appendix J. Repeatability is generally within +/- 3%. This repeatability assessment is

very limited. Ideally, repeatability assessments involve at least ten repeats of a test case and this sort of assessment was beyond the scope of this test.

The worst cases usually involve the acoustic probes used to measure relative motion at the forward RAS location and propeller. This may be related to the type of instrument used as its signal is noisy and the local steepness of irregular waves can cause problems with measurement accuracy. The wave pattern in these two regions is more complex than at the bow or Station 1.5 so the variability noted with these instruments may be representative of what is actually happening.

The Z acceleration at the Helicopter Landing Deck also showed higher than expected variation. Ringing of the mount for the tri-axial accelerometer array used for this measurement is a possible cause. Translation of the MotionPak data to the Helicopter Landing Deck compared well with the values measured with the strapdown tri-axial accelerometer array.

Repeatability in following seas is not as good as in head seas, due mainly to the necessity to let a large portion of the spectrum propagate past the model before starting the carriage.

Table 20 – Summary of Repeatability of Sea-keeping Data

Dataset	VS12_SS5H				VS15_SS5H				VS18_SS5H			
Test	Original	Repeat	Delta (Repeat-Original)	Ratio (Repeat/Original)	Original	Repeat	Delta (Repeat-Original)	Ratio (Repeat/Original)	Original	Repeat	Delta (Repeat-Original)	Ratio (Repeat/Original)
Parameter (RMS)												
Upstream Wave Probe [m]	1.060	1.094	0.035	1.03	1.059	1.073	0.014	1.01	1.156	1.132	-0.023	0.98
Encounter Probe [m]	0.860	0.851	-0.009	0.99	0.928	0.907	-0.021	0.98	0.876	0.929	0.053	1.06
Ship Speed [kts]	12.36	12.38	0.02	1.00	13.69	13.77	0.08	1.01	17.27	17.20	-0.07	1.00
Torque [Nm]	813861	807936	-7925	0.99	963884	955576	-8309	0.99	1381378	1377289	-4089	1.00
MP Heave [m]	0.363	0.366	0.003	1.01	0.385	0.388	0.003	1.01	0.396	0.386	-0.011	0.97
MP Pitch [deg]	0.66	0.67	0.01	1.01	0.71	0.70	-0.01	0.99	0.71	0.72	0.01	1.02
MP Z Accel [g]	0.9989	0.9987	-0.0002	1.00	0.9989	0.9990	0.0001	1.00	0.9989	0.9991	0.0002	1.00
Qualysis Pitch [deg]	0.68	0.69	0.00	1.01	0.73	0.72	-0.01	0.99	0.72	0.73	0.01	1.01
Qualisys Z [m]	8.764	8.759	-0.004	1.00	8.717	8.700	-0.017	1.00	8.831	8.805	-0.027	1.00
Relmo Bow [m]	1.903	1.932	0.029	1.02	2.090	2.074	-0.016	0.99	2.220	2.264	0.044	1.02
Relmo Port [m]	1.556	1.556	0.000	1.00	1.796	1.819	0.023	1.01	2.142	2.170	0.028	1.01
Relmo Prop [m]	0.679	0.739	0.060	1.09	0.720	0.766	0.046	1.06	0.684	0.763	0.079	1.12
Relmo RAS [m]	0.473	0.543	0.070	1.15	0.484	0.541	0.057	1.12	0.418	0.477	0.059	1.14
Accel Z HeliDeck [g]	0.0438	0.0457	0.0019	1.04	0.0472	0.0487	0.0015	1.03	0.0494	0.0523	0.0028	1.06
Accel Z St 1.5 Vel [m/s]	0.618	0.630	0.012	1.02	0.684	0.682	-0.002	1.00	0.764	0.774	0.010	1.01

Dataset	VS15_SS3				VS15_H0_SS5				VS18_SS5			
Test	Original	Repeat	Delta (Repeat-Original)	Ratio (Repeat/Original)	Original	Repeat	Delta (Repeat-Original)	Ratio (Repeat/Original)	Original	Repeat	Delta (Repeat-Original)	Ratio (Repeat/Original)
Parameter (RMS)												
Upstream Wave Probe [m]	0.293	0.287	-0.006	0.98	0.812	0.835	0.023	1.03	0.859	0.875	0.016	1.02
Encounter Probe [m]	0.373	0.365	-0.008	0.98	0.779	0.663	-0.115	0.85	0.804	0.812	0.008	1.01
Ship Speed [kts]	15.52	15.21	-0.31	0.98	14.82	14.78	-0.05	1.00	17.43	17.64	0.21	1.01
Torque [Nm]	906362	924108	17746	1.02	915791	898145	-17645	0.98	1388712	1385691	-3022	1.00
MP Heave [m]	0.035	0.036	0.002	1.05	0.050	0.044	-0.007	0.87	0.274	0.285	0.012	1.04
MP Pitch [deg]	0.08	0.07	0.00	0.96	0.11	0.11	0.00	1.03	0.51	0.53	0.02	1.05
MP Z Accel [g]	0.9985	0.9985	0.0000	1.00	0.9985	0.9985	0.0000	1.00	0.9989	0.9987	-0.0002	1.00
Qualysis Pitch [deg]	0.08	0.08	0.00	1.03	0.40	0.42	0.02	1.05	0.53	0.55	0.03	1.05
Qualisys Z [m]	8.770	8.735	-0.034	1.00	8.639	8.593	-0.046	0.99	8.758	8.762	0.004	1.00
Relmo Bow [m]	1.001	0.979	-0.022	0.98	1.213	1.191	-0.022	0.98	1.819	1.897	0.078	1.04
Relmo Port [m]	0.639	0.650	0.011	1.02	0.590	0.532	-0.058	0.90	1.849	2.056	0.207	1.11
Relmo Prop [m]	0.156	0.176	0.020	1.13	0.300	0.279	-0.021	0.93	0.601	0.635	0.034	1.06
Relmo RAS [m]	0.158	0.165	0.006	1.04	0.391	0.372	-0.019	0.95	0.428	0.461	0.033	1.08
Accel Z HeliDeck [g]	0.0063	0.0068	0.0005	1.09	0.0033	0.0037	0.0004	1.11	0.0399	0.0438	0.0039	1.10
Accel Z St 1.5 Vel [m/s]	0.070	0.073	0.002	1.03	0.040	0.040	0.001	1.01	0.579	0.632	0.053	1.09

Legend: Ratio <=0.9 or >=1.1 | Ratio <=0.95 or >=1.05

9.0 DISCUSSION

9.1 Decay Experiments

9.1.1 Roll Decay

With reference to Table 9, roll period decreases with speed for the fully appended ship. At zero speed, the mean roll period is 15.6 seconds. At 12 and 15 knots, period decreases to 15.1 and 14.9 seconds, respectively. The linear damping term increases from 0.025 at zero speed to 0.058 and 0.072 at 12 and 15 knots.

For comparison, the bare hull roll decay results are included. These results show an increase in period and a decrease in damping for the unappended hull. Roll decays were done at two values of GM_t and show that roll period decreases with an increase in GM_t.

9.1.2 Pitch and Heave Decay

With reference to Tables 10 and 11, τ, the damping time constant, increases with speed between 12 and 20 knots. The non-dimensional damping ratio, ζ, decreases with speed over the same range. There is, however, much variability in the values regressed by the analysis technique as shown in Figure 11.

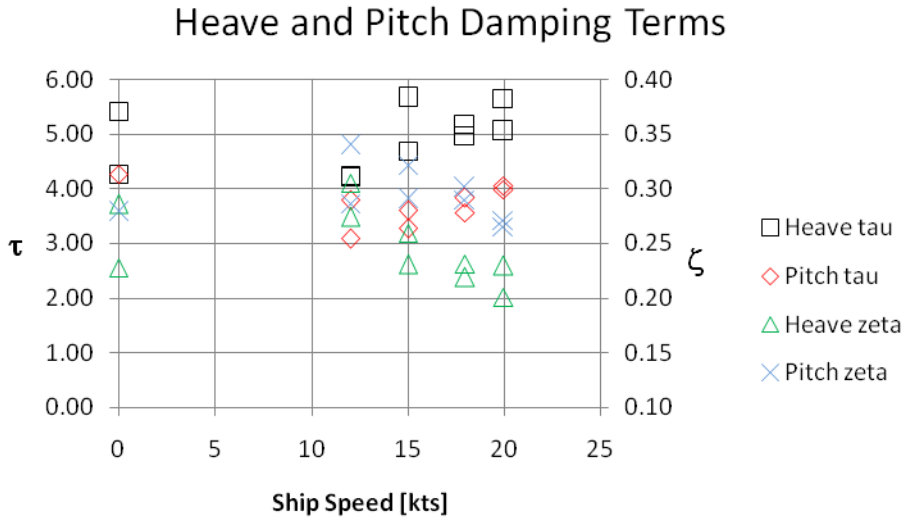

Figure 11 – Heave and Pitch Damping Terms

9.2 Sea-keeping Experiments

The seakeeping criteria limits used for comparison were extracted from the summary of SRD Table 4954 in Reference 7 and are compared to the applicable measured response in Table 21 below. For this comparison, only the responses due to head seas were considered. Typically, the worst case for the responses was at 18 knots in sea state 5H, the only exception being Propeller Tip Emergence which was worst at 12 knots in sea state 5H. It should be noted that the difference

across speed in sea state 5H are negligible. The measured responses are, in general, about ½ of the performance criteria.

Table 21 – Comparison of Measured Responses with Performance Criteria

Performance Limitations	Location	Bridge		Condition	Helicopter Landing Spot	
Motion	Units	Limit	Measured		Limit	Measured
Slamming Index	Occurrences/hr	20	0.07	VS18_SS5H		
Wetness Index	Occurrences/hr	30	0			
RMS Pitch Amplitude	degrees	1.5	0.79	VS18_SS5H	1.5	0.79
RMS Vertical Velocity	m/s		1.1	VS18_SS5H	1	0.67
RMS Vertical Acceleration	m/s^2	2	0.95	VS18_SS5H	1.2	0.58
Propeller Tip Emergence	Occurrences/hr	90	0.23	VS12_SS5H		

9.3 Probability of Slamming and Propeller Emergence

In general, the results indicate very low probability and occurrence frequency of slamming, deck wetness and propeller emergence at tested conditions. The tests in higher sea states were also analyzed to assess probability but while Table 14 and 15 show low probability of slamming in these conditions, it must be remembered that these spectra were too short to be certain that these events would not occur. If further model tests of this model or its successor are contemplated, consideration should be given to increasing the sea state used for this assessment.

9.4 Added Power in Waves

The SOW required tests to determine added power in waves to be conducted in sea state 3 at 15 and 20 knots. This test showed that operating in sea state 3 does not require additional power – at 15 knots, P_{DAWS} was 217 kW (3.8%) less than the calm water prediction of P_D and at 20 knots, P_{DAWS} was 93 kW (0.6%) less than the calm water prediction. These differences are not significant.

While not required by the SOW, the experiments in head sea state 5 and 5H were analyzed to assess added power in those conditions. Using the 18 knot calm water power, the ship will lose 0.8 knots of speed in sea state 5 and 1.2 knots in sea state 5H. Adder power in waves at 18 knots in sea state 5H is estimated to be 3.7 MW. Table 17 contains the complete summary of added power in waves.

10.0 ACKNOWLEDGEMENTS

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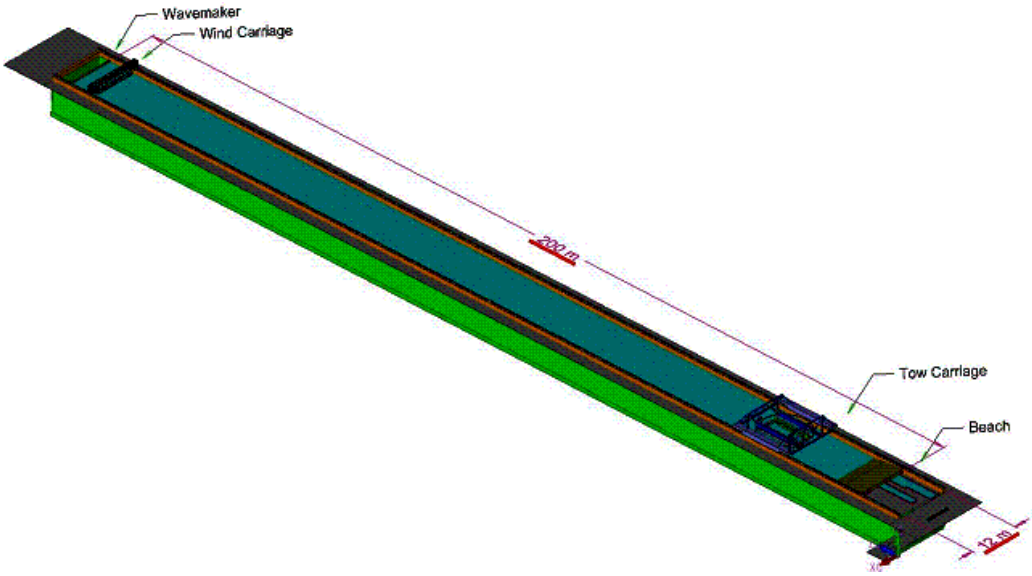
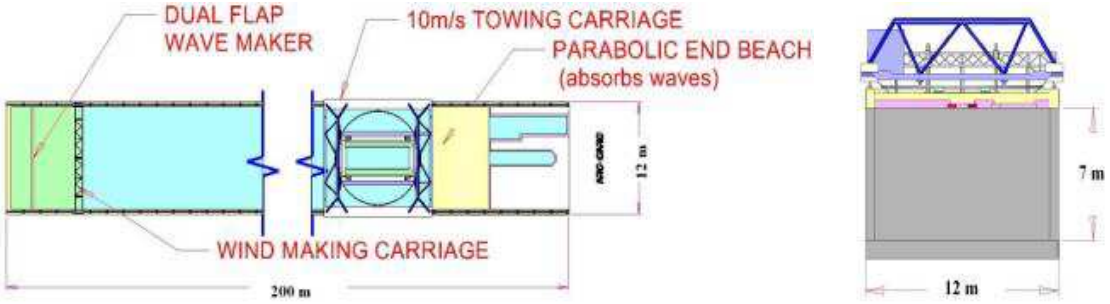
APPENDIX A

DESCRIPTION OF NRC-OCRE TOWING TANK

Towing Tank





DESCRIPTION OF CARRIAGE: Single manned carriage with 8 wheel synchronous motor drive, 85,000 kg, 746 Kw power, 0.001 m/s – 10 m/s speed range. Test frame adjustable for model size. Manual wind carriage for wind generation. Wind carriage can be coupled to main carriage.

WAVE GENERATOR: Dual flap hydraulic wave board with digital computer control, program controlled regular or irregular waves. Maximum wave height of 1m for regular waves and 0.5m significant for irregular waves.

WAVE ABSORBER: Parabolic corrugated surface beach with transverse slats, 20m long slope with 10.5 slope at the waterline, flexible side absorbers.

WIND GENERATION: 8 fan bank, maximum wind speed of 10 m/s @ 10 m from fans.

TEST EQUIPMENT: Planar Motion Mechanism (PMM), Marine Dynamics Test Facility (MDTF), Yacht Dynamometer, Vortex Induced Vibration (VIV) apparatus, capacitance and sonic wave probes, Qualisys optical tracking for model position, propulsion control systems for free-running models, under and above water video (Line-scanning camera).

DATA ACQUISITION: A VMS and Windows NT based distributed client/server system using one or more IOtech DaqBoards, each with 256 channel capability at 100kHz aggregate.

MODEL SIZE RANGE: Ship models up to12m in length, floating structures 0.5m – 4 m in diameter.

TESTS PERFORMED: Resistance and propulsion, wake survey, flow visualization, propeller open water, seakeeping, manoeuvring (PMM), loads due to waves, wind and current on floating and moored structures, lift and drag, dynamics of underwater vehicles (MDTF).

APPENDIX B

HYDROSTATICS

CONDITION 1

JSS IOT907

End of Life - 8.2 m Draft Level Trim

HYDROSTATICS WITHOUT APPENDAGES Scale 1: 29.68905

	Ship	Model
LENGTH BETWEEN PERPENDICULARS, m	173.00	5.827
LENGTH ON THE WATERLINE, m	180.15	6.068
LENGTH OVERALL, m	189.23	6.374
MAXIMUM WATERLINE BEAM, m	24.01	0.809
DRAFT AT MIDSHIPS, m	8.200	0.276
DRAFT ABOVE DATUM AT AFT PERPENDICULAR, m	8.200	0.276
DRAFT ABOVE DATUM AT FWD PERPENDICULAR, m	8.200	0.276
TRIM, deg.	0.000	0.000
EQUIVALENT LEVEL KEEL DRAFT ABOVE BASELINE, m	8.200	0.276
PARALLEL MIDDLE BODY WRT AP, m	NA	NA
TO, m	NA	NA
CENTRE OF BUOYANCY WRT AP, m	85.38	2.876
CENTRE OF BUOYANCY ABOVE BASELINE, m	4.48	0.151
CENTRE OF FLOTATION WRT AP, m	78.43	2.642
WATERPLANE AREA, sq. m	3741.06	4.244
WETTED SURFACE AREA, sq.m	5658.10	6.419
WETTED SURFACE AREA, (EXCLUDING TRANSOM) sq.m	5654.10	6.415
MIDSHIP SECTIONAL AREA, sq.m	194.51	0.221
TRANSVERSE METACENTRIC RADIUS, m	6.55	0.221
LONGITUDINAL METACENTRIC RADIUS, m	332.19	11.189
VOLUME OF DISPLACEMENT, cu. m	23963.59	0.916
DISPLACEMENT, (tonnes @ FS in SW)(kg @ MS in FW)	24562.68	915.721
MASS PROPERTIES		
CENTER OF GRAVITY ABOVE BASELINE, m	9.67	0.326
TRANSVERSE METACENTRE HEIGHT, m	1.37	0.046
LONGITUDINAL METACENTRE HEIGHT, m	327.29	11.024
APPENDAGES		
Bilge Keels		
CENTRE OF BUOYANCY WRT AP, m	86.00	2.897
VOLUME OF DISPLACEMENT, cu. m	4.52	0.0002
WETTED SURFACE AREA, sq.m	111.84	0.127
Rudder		
CENTRE OF BUOYANCY WRT AP, m	-2.42	-0.082
VOLUME OF DISPLACEMENT, cu. m	19.21	0.0007
WETTED SURFACE AREA, sq.m	79.42	0.090
Appended Displacement		
Appended Resistance/Wake Survey		
VOLUME OF DISPLACEMENT, cu. m	23968.11	0.9159
DISPLACEMENT, (tonnes @ FS in SW)(kg @ MS in FW)	24567.31	914.291
Self Propulsion / Seakeeping		
VOLUME OF DISPLACEMENT, cu. m	23987.33	0.9166
DISPLACEMENT, (tonnes @ FS in SW)(kg @ MS in FW)	24587.01	915.024

JSS IOT907

End of Life - 8.2 m Draft Level Trim

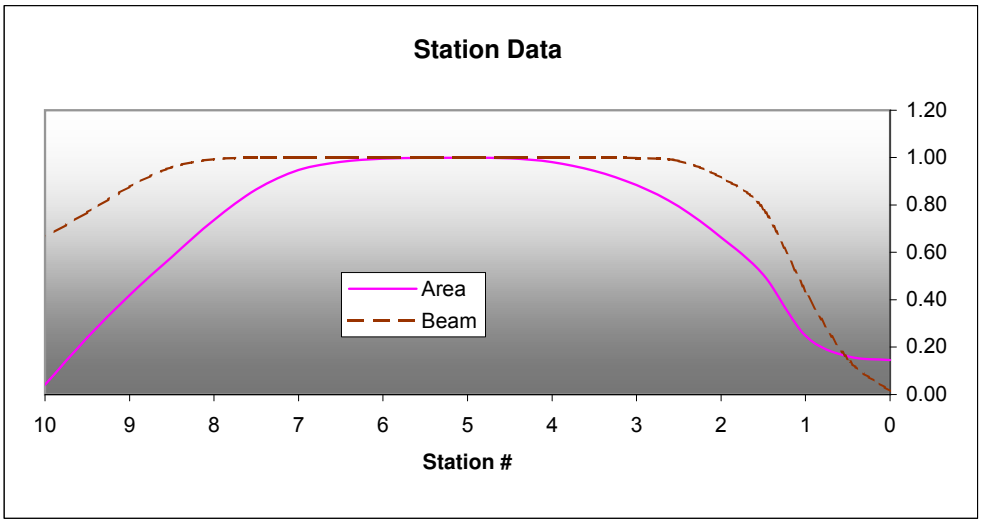
COEFFICIENTS BASED ON: LENGTH WATERLINE
MAXIMUM BEAM AT WATERLINE
EQUIVALENT LEVEL KEEL DRAFT

L/B	7.504
L/T	21.969
B/T	2.928
LCB %L FORWARD OF AP	47.393
LCF %L FORWARD OF AP	43.535
BLOCK COEFFICIENT	0.676
MIDSHIP COEFFICIENT	0.988
PRISMATIC COEFFICIENT	0.684
WATERPLANE COEFFICIENT	0.865
CIX Transverse Inertia of waterplane	0.756
CIY Longitudinal Inertia of waterplane	0.681
BM/B	0.273
BML/L	1.844
BEAM - DISPLACEMENT RATIO (CIRCB)	0.833
DRAFT - DISPLACEMENT RATIO (CIRCT)	0.285
LENGTH - DISPLACEMENT RATIO (CIRCM)	6.251
WETTED SURFACE - DISPLACEMENT RATIO (CIRCS)	6.805
BM - DISPLACEMENT RATIO	0.227
BML - DISPLACEMENT RATIO	11.526

JSS IOT907

End of Life - 8.2 m Draft Level Trim

Station	Area	Beam
0	0.145	0.015
0.5	0.161	0.151
1	0.248	0.436
1.5	0.505	0.783
2	0.663	0.916
2.5	0.793	0.986
3	0.885	0.998
3.5	0.945	0.999
4	0.981	1.000
4.5	0.997	1.000
5	1.000	1.000
5.5	1.000	1.000
6	0.996	1.000
6.5	0.982	1.000
7	0.948	1.000
7.5	0.866	1.000
8	0.737	0.994
8.5	0.580	0.959
9	0.420	0.877
9.5	0.241	0.770
10	0.042	0.666



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

SWINGING/BALLASTING

Model:	IOT907		Note: Frame in roll orientation
Description:	Hull Outfitted - Pitch Gyradius		
Condition:	prep for EOL Condition		Frame used: Aluminum Frame
Date:	25-Nov-11		Frame code:
Model Length:	6.390	m	
Mass of model as swung:	545.770	kg	**Frame Constants Used:**
Model Beam	0.809	m	G0B0t (Nm) 235.014
Supports (if not used enter 0.0 for mass):			G0b0l (Nm) 235.130
Mass:	0	kg	l1 (m) 0.750
Length:	0.05	m	l2 (m) 0.750
Width	1.2	m	a (m) 0.188
Thickness:	0.046482	m	d (m) 1.197
			J0t (kg-m^2) 82.864
INCLINOMETER			J0l(kg-m^2) 83.045
Mass:	0.3	kg	
Height above KE	0.15	m	**Frame Constants Corrected for Support**
			G0B0t (Nm) 235.014
			G0b0l (Nm) 235.130
			J0t (kg-m^2) 82.864
			J0l (kg-m^2) 83.045
			d (m) 1.197

Pitch Gyradius Only

					Chauvenet 4 1.54
Inclining Angles (degrees)					
Pitch		Theta (deg)	Mass (kg)	G1b1 (Nm)	
Initial	0.0100				
Weight 1 port	-4.3200	4.3300	47.724	4723.96	0.604
Initial	0.0000	4.3200	47.724	4734.74	1.093
Weight 1 stbd	4.3600	4.3600	47.724	4691.94	0.849
Initial	0.0000	4.3600	47.724	4691.94	0.849
Restoring moment (mean)		4.3425		4710.65	
Restoring moment (stdev)				22.04	

		+1 sd	-1sd
	Pitch		
TRIMMING MASS (kg)	0	0	0
DISTANCE FROM KE (X) (m, + fwd)	1.8	1.8	1.8
DISTANCE FROM KE (Y) (m, + stbd)	0	0	0
DISTANCE FROM KE (Z) (m, + down)	0.633	0.633	0.633
Correction to Inertia of System (kg-m^2):	0.000	0.000	0.000
Restoring Moment of System (G1b1) (Nm):	4710.65	4732.69	4688.61
Restoring Moment of Frame (G0b0) (Nm):	235.13	235.13	235.13
Restoring Moment of Inclinometer (Gibi) (Nm):	-0.44	-0.44	-0.44
Restoring Moment of Model + Levelling Wt (Gb) (Nm):	4475.96	4498.00	4453.92
Restoring Moment of Model (Nm):	4467.05	#REF!	#REF!
CG of Model and Trim Weight from KE (m):	0.836	0.840	0.832
VCG of Model and Trim Weight from Baseline (m):	0.361	0.357	0.365

Inertia of model

ROLL IN AIR				Chauvenet 3 1.65
Cycles	WAV_TAV	Period (sec)	J1x (kg-m^2)	
20	42.07	2.104	527.97	0.55
20	42.01	2.101	526.46	1.15
25	52.59	2.104	528.02	0.61
	MEAN	**2.1025**	**527.481**	
	STDEV	**0.0018**	**0.8837**	+1 sd / -1sd

CG correction from inclining **0.0000** m.

ROLL		+1 sd	-1sd	+1 sd	-1sd
Inertia of Entire System about KE (kg-m^2)	527.48	528.36	528.36	526.60	526.60
Inertia of Frame about KE (kg-m^2)	83.05	83.05	83.05	83.05	83.05
Inertia of Model+level weight about KE (kg-m^2)	444.44	445.32	445.32	443.55	443.55
Parallel Axis Correction (kg-m^2)	381.44	385.20	377.69	385.20	377.69
Inertia of Model+LevelWt about own CG (kg-m^2)	63.00	60.12	67.63	58.35	65.86
Radius of Gyration (m)	0.340	0.332	0.352	0.327	0.347
Radius of Gyration/Beam	**0.4200**	**0.4102**	**0.4351**	**0.4042**	**0.4294**

Inertia of model

PITCH IN AIR				Chauvenet 4 1.54
Cycles	WAV_TAV	Period (sec)	1Y (kg-m^2)	
10	40.15	4.015	1923.50	0.39
10	40.22	4.022	1930.21	1.16
10	40.01	4.001	1910.11	1.16
10	40.08	4.008	1916.80	0.39
	MEAN	**4.0115**	**1920.154**	
	STDEV	**0.0090**	**8.6513**	+1 sd / -1sd

PITCH		+1 sd	-1sd	+1 sd	-1sd
Inertia of Entire System about KE (kg-m^	1920.15	1928.80	1928.80	1911.50	1911.50
Inertia of Frame about KE (kg-m^2)	83.05	83.05	83.05	83.05	83.05
Inertia of Model+level weight about KE (	1837.10	1845.75	1845.75	1828.45	1828.45
Parallel Axis Correction (kg-m^2)	381.44	385.20	377.69	385.20	377.69
Inertia of Model+LevelWt about own CG	1455.66	1460.55	1468.06	1443.25	1450.76
Radius of Gyration (m)	1.633	1.636	1.640	1.626	1.630
Radius of Gyration/Length	**0.2556**	**0.2560**	**0.2567**	**0.2545**	**0.2551**

Summary

Item	Mass	XCG (st0)	VCG	TCG	Ixx	Iyy	Izz	xmom	zmom	ymom	Parallel axis zz	Parallel axis yy	Parallel axis zz	Jxx	Jyy	Jzz
System																
Model as Swung	545.770	2.75	0.339	0.000	63.00	1455.66	1216.71	1500.87	185.01	0.00	62.72	4190.11	4127.39	125.72	5645.77	5344.10
Inclinometer	-0.3	0	1.405	0				0.00	-0.42	0.00	-0.59	-0.59	0.00	-0.59	-0.59	0.00
Lightship																
Kidney Mass 1	120.88	3.2935	0.2597	-0.0010	0.87	3.09	3.79	398.12	31.39	-0.12	8.15	1319.35	1311.20	9.02	1322.45	1314.99
Kidney Mass 2	117.75	3.4435	0.2597	0.0400	0.85	3.01	3.69	405.47	30.57	4.71	8.13	1404.18	1396.43	8.98	1407.20	1400.12
Kidney Mass 3	117.07	2.6630	0.3803	-0.0075	3.00	0.85	3.67	311.76	44.52	-0.88	16.94	847.14	830.22	19.94	847.99	833.88
	-22.71	0.8000	0.5530	-0.3400	0.00	0.00	0.00	-18.17	-12.56	7.72	-9.57	-21.48	-17.16	-9.57	-21.48	-17.16
	22.71	1.3000	0.5530	-0.3400	0.00	0.00	0.00	29.52	12.56	-7.72	9.57	45.32	41.01	9.57	45.32	41.01
	-25	0.7000	0.5530	0.3400	0.00	0.00	0.00	-17.50	-13.83	-8.50	-10.54	-19.90	-15.14	-10.54	-19.90	-15.14
	25	1.3000	0.5530	0.3400	0.00	0.00	0.00	32.50	13.83	8.50	10.54	49.90	45.14	10.54	49.90	45.14
Rudder	0.73	0.0000	0.2000	0.0000				0.00	0.15	0.00	0.03	0.03	0.00	0.03	0.03	0.00
Ballast1	-20	4.6850	0.1000	0.0000				-93.70	-2.00	0.00	-0.20	-439.18	-438.98	-0.20	-439.18	-438.98
Ballast2	20.00	2.2000	0.1000	0.0000				44.00	2.00	0.00	0.20	97.00	96.80	0.20	97.00	96.80
Ballast3	0	2.1740	0.2076	-0.1				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ballast4	5	3.1000	0.553	0.335				15.50	2.77	1.68	2.09	49.58	48.61	2.09	49.58	48.61
Ballast5	5	3.1000	0.553	-0.335				15.50	2.77	-1.68	2.09	49.58	48.61	2.09	49.58	48.61
Ballast6		2.5000	0.070	-0.200				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5kg - incline wt	0	2.242	0.553	-0.335				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5kg - incline wt	0	2.352	0.553	0.335				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hook Gage 1	0.66	5.816	0.5788	-0.02				3.84	0.38	-0.01	0.22	22.55	22.33	0.22	22.55	22.33
Hook Gage 2	0.66	5.816	0.5788	0.02				3.84	0.38	0.01	0.22	22.55	22.33	0.22	22.55	22.33
Hook Gage 3	0.66	2.914	0.5788	-0.3302				1.92	0.38	-0.22	0.29	5.83	5.68	0.29	5.83	5.68
Hook Gage 4	0.66	2.914	0.5788	0.3302				1.92	0.38	0.22	0.29	5.83	5.68	0.29	5.83	5.68
Hook Gage 5	0.58	0.00635	0.5788	-0.3302				0.00	0.34	-0.19	0.26	0.19	0.06	0.26	0.19	0.06
Hook Gage 6	0.58	0.00635	0.5788	0.3302				0.00	0.34	0.19	0.26	0.19	0.06	0.26	0.19	0.06
Mpak plate	0	2.879	0.2692	0				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fuel	0	4	0.75	0				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Foam 1	0	3.9970	0.1322	-0.0010				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Foam 2	0	3.4620	0.1322	0.0400				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Foam 3	0	2.1740	0.1068	-0.1000				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Displacement	915.70	2.8780	0.3265	0.004052741	71.20	1408.45	1173.35	2635.40	298.95	3.71	101.10	7628.17	7530.25	168.82	9090.79	8758.10
Target	915.00	2.8760	0.3257	0	69.121	1421.124	1421.124	2677.93	306.68	3.71						
Delta	-0.70	0.00	0.00	0.00	-2.08			42.53	7.73	0.00						
				KMt	0.371											
				Kxx (model)	**0.279**	**1.240**	**1.132**									
	24562.128			Kxx (ship)	**8.28**	**36.82**	**33.61**									
						0.204559008										

INCLINING EXPERIMENT

Test Name	Acquisition Time	Model Roll MEAN (deg)	Model Roll STD (deg)	theta	sin(theta)	w	d	displ	915 GMt
INCLINE_001	28/11/2011 16:46	-0.28488	0.037828						
INCLINE_001	28/11/2011 16:46	-4.76702	0.079229	4.482141	0.078148	5	0.643		0.044961
INCLINE_CONTD_001	28/11/2011 16:48	-0.28877	0.042591	4.478246	0.078081	5	0.643		0.045
INCLINE_CONTD_001	28/11/2011 16:48	4.304304	0.016151	4.593076	0.080078	5	0.643		0.043878
INCLINE_CONTD_001	28/11/2011 16:48	-0.26481	0.007605	4.569113	0.079662	5	0.643		0.044107

	MS	FS
Initial GMt [m]	0.0445	1.321
Move 5 kg dn 0.3 m	0.0016	
Final GMt [m]	0.0461	1.369

Flotation QA

Standard_Hydro_IOT907_RES3.xlsFloatQA (4) JSS 16/08/201212:35 PM

Date:	29-Nov-11		g	9.8082	
Condition:	Seakeeping	SKP			
Temp					
rho	998.25	kg/m^3	Temp	18.5	
Volume:	0.9166	m^3			
Displacement:	915.02	kg FW			
Model Weight	548.85	kg FW			
Target Ballast:	366.17	kg FW			
Difference	**0.73**	kg FW			
Actual Ballast:	366.90	kg FW			
Actual Displacement	915.75	kg FW			

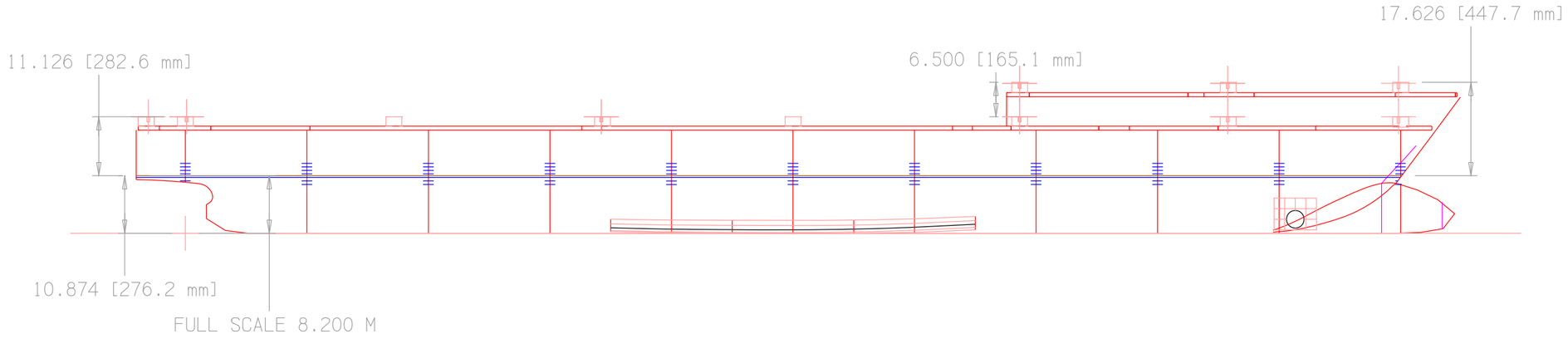
Hook Gages		Actual			Delta		
	Target [mm]	Port	Stbd	Average	Port	Stbd	Average
Fwd	447.7	448	448	448	0.3	0.3	0.3
Mid	282.6	282.5	282.5	282.5	-0.1	-0.1	-0.1
Aft	282.6	282.5	283	282.75	-0.1	0.4	0.15

REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED

Notes:

Target volume =915.72M^3
Target Weight 915.72 Kgs
Target GM =???

Full Scale KMT-GM=VCG
11.034M-??M=??M
(??m/29.68905=)??n



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Artic Avenue , P.O. Box 12093
St. John's, Newfoundland A1B 3T5

TOLERANCES (unless specified)	0.X ± 0.03 0.XX ± 0.015 0.XXX ± 0.005 Angle +/- .5 deg. Fabrication +/- .04 Fraction < 6 inch +/- 1/64 > 6 inch +/- 1/32
Material	NA
FINISH	
DIMENSIONS IN:	INCHES ☒ MILLIMETERS ☐
THIRD ANGLE	
42 2517 16	
DRAWN	T. Hall
APPROVED	
Quantity	NA
TITLE	IOT907 Trim Hook Heights 8.2M DRAFT
A3	NUMBER / REV
SCALE	NA
DATE	Nov 3-2011
SHEET	1 OF 1

APPENDIX C

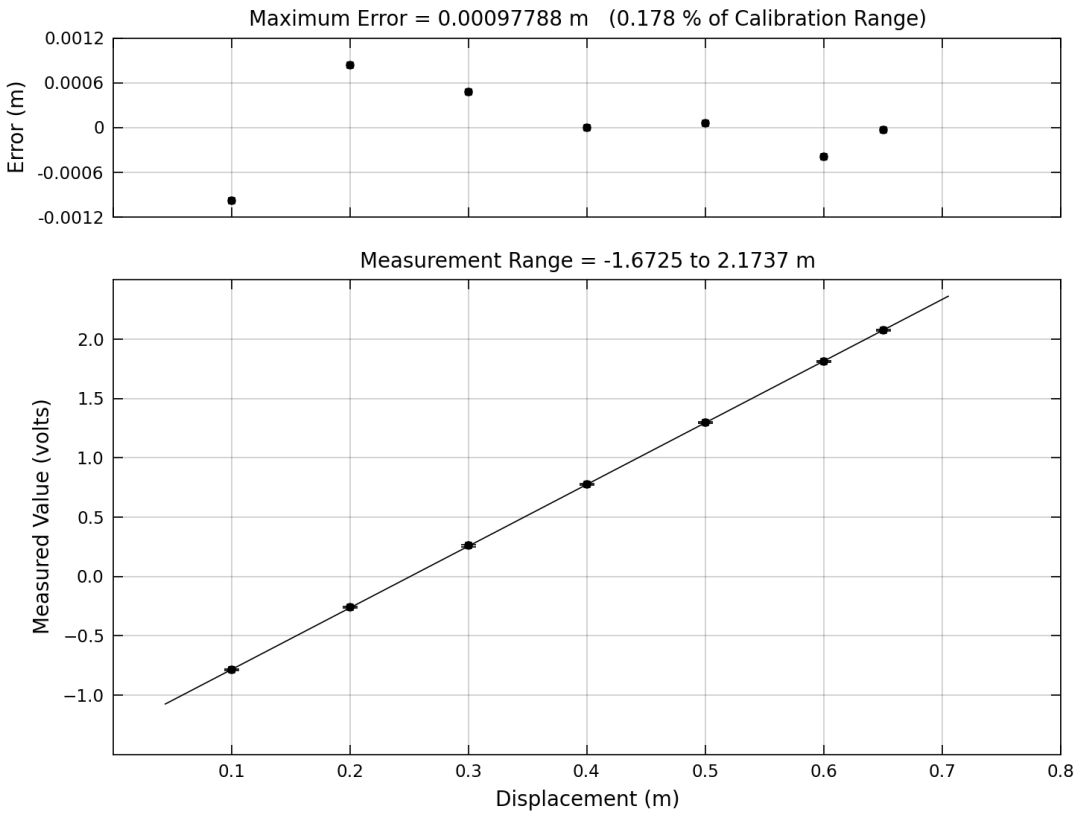
INSTRUMENT CALIBRATIONS

SEA-KEEPING

JSS-Preliminary Design Model Tests
Calibration of Upstream Wave Probe
Calibrated 2011-11-22 18:15Z

Test Facility: CWT	**Serial #:**	**Filter Frequency:** 10.0
Data Source: CAVDAS:50001 Channel 27	**Programmable Gain:** 1	**Excitation:** 10
Sensor Model:	**Plug-In Gain:** 1	

Data Point #	Physical Value (m)	Measured Value (volts)	Fitted Curve Value (m)	Error (m)	Definition of Calibration Curve
1	0.10000	-0.78833	0.099022	-0.00097788	Polynomial Degree = 1 (Linear Fit)
2	0.20000	-0.25888	0.20084	0.00084236	$Y = C_0 + C_1 \cdot V$
3	0.30000	0.25925	0.30048	0.00048437	where $Y(t)$ = Displacement (m),
4	0.40000	0.77674	0.40000	4.5503e-06	$V(t)$ = measured value (volts),
5	0.50000	1.2970	0.50006	6.4732e-05	C_0 = 0.25063 m,
6	0.60000	1.8147	0.59961	-0.00039097	C_1 = 0.19231 m/volt,
7	0.65000	2.0765	0.64997	-2.7167e-05	



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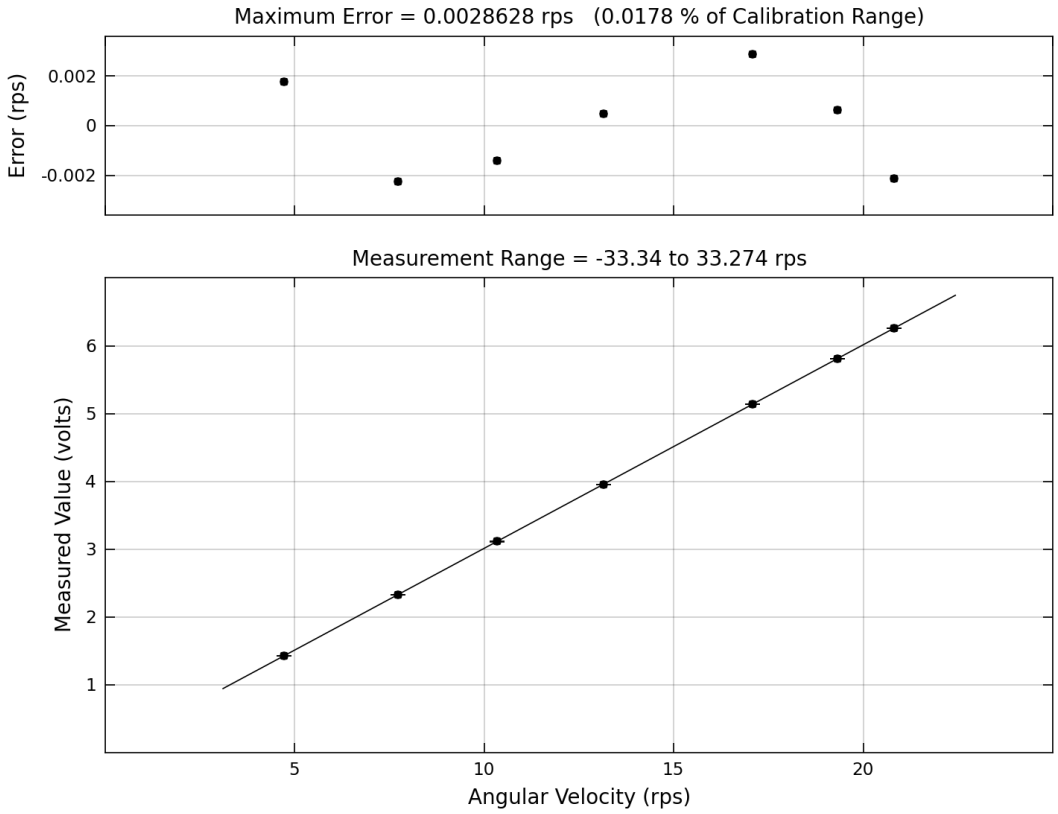
JSS-Preliminary Design Model Tests
Calibration of Shaft Speed
Calibrated 2011-10-12 19:58Z

Test Facility: CWT	**Serial #:**	**Filter Frequency:**
Data Source: DASPC49:50001 Channel 2	**Programmable Gain:**	**Excitation:**
Sensor Model:	**Plug-In Gain:**	

Data Point #	Physical Value (rps)	Measured Value (volts)	Fitted Curve Value (rps)	Error (rps)	Definition of Calibration Curve
1	4.7150	1.4260	4.7168	0.0017749	Polynomial Degree = 1 (Linear Fit)
2	7.7150	2.3255	7.7128	-0.0022402	$Y = C_0 + C_1 \cdot V$
3	10.335	3.1124	10.334	-0.0013955	where $Y(t)$ = Angular Velocity (rps),
4	13.142	3.9557	13.142	0.00048480	$V(t)$ = measured value (volts),
5	17.072	5.1363	17.075	0.0028628	C_0 = -0.032757 rps,
6	19.315	5.8091	19.316	0.00064541	C_1 = 3.3307 rps/volt,
7	20.822	6.2607	20.820	-0.0021322	



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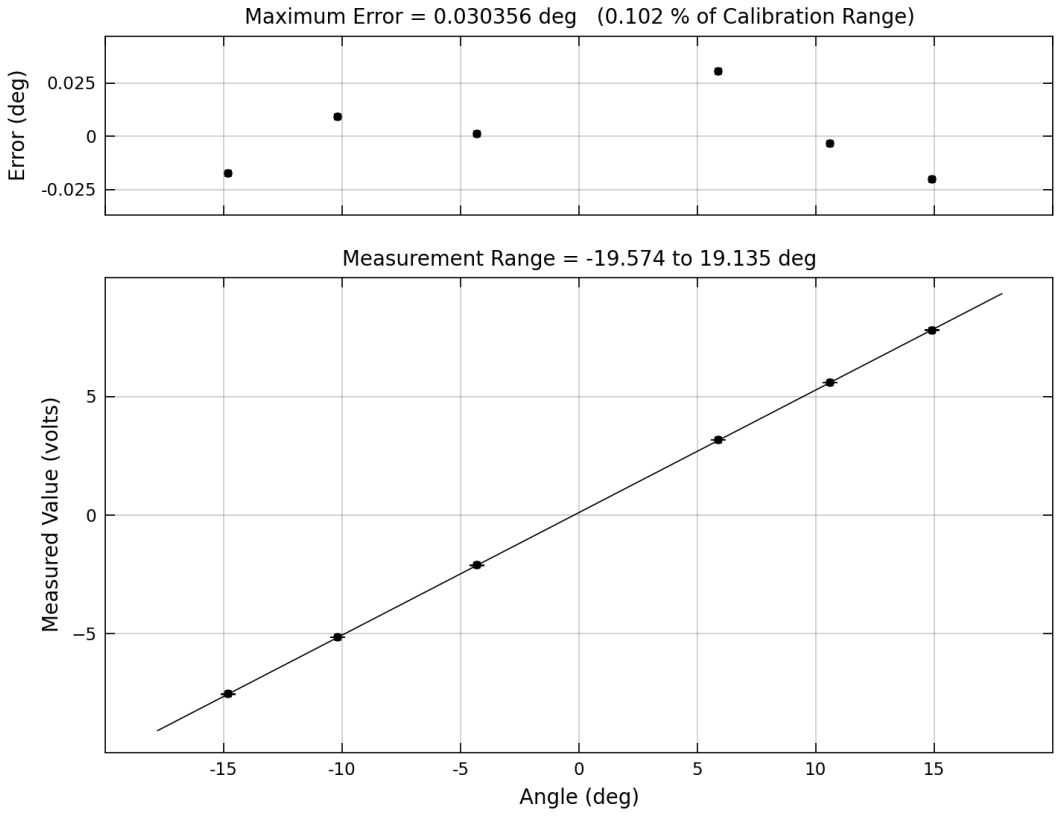
JSS-Preliminary Design Model Tests
Calibration of Model Roll
Calibrated 2011-09-22 17:22Z

Test Facility: CWT	**Serial #:**	**Filter Frequency:** 10
Data Source: DASPC49:50001 Channel 3	**Programmable Gain:**	**Excitation:** +/-15V
Sensor Model:	**Plug-In Gain:**	

Data Point #	Physical Value (deg)	Measured Value (volts)	Fitted Curve Value (deg)	Error (deg)	Definition of Calibration Curve
1	-14.800	-7.5424	-14.817	-0.017380	Polynomial Degree = 1 (Linear Fit)
2	-10.200	-5.1518	-10.191	0.0093574	$Y = C_0 + C_1 \cdot V$
3	-4.3100	-2.1128	-4.3088	0.0012289	where $Y(t)$ = Angle (deg),
4	5.8900	3.1724	5.9204	0.030356	$V(t)$ = measured value (volts),
5	10.600	5.5886	10.597	-0.0032738	C_0 = -0.21962 deg,
6	14.900	7.8016	14.880	-0.020289	C_1 = 1.9354 deg/volt,



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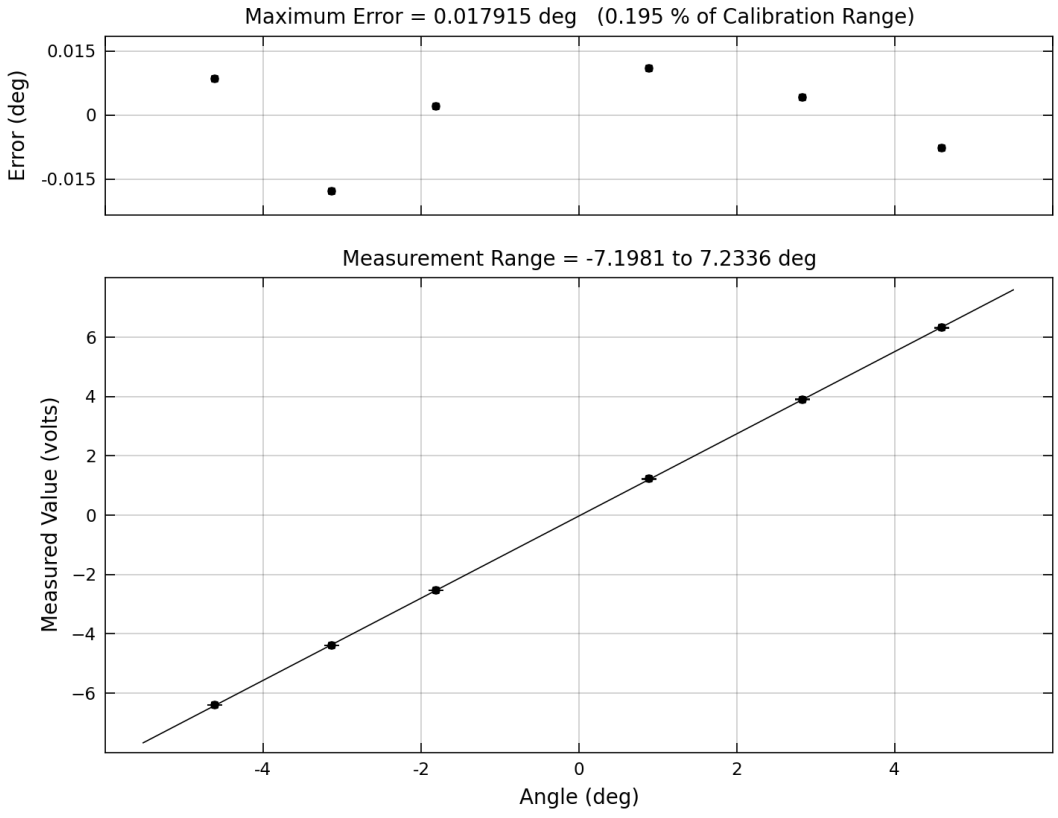
JSS-Preliminary Design Model Tests
Calibration of Model Pitch
Calibrated 2011-09-22 17:35Z

Test Facility: CWT	**Serial #:**	**Filter Frequency:** 10
Data Source: DASPC49:50001 Channel 4	**Programmable Gain:**	**Excitation:** +/-15V
Sensor Model:	**Plug-In Gain:**	

Data Point #	Physical Value (deg)	Measured Value (volts)	Fitted Curve Value (deg)	Error (deg)	Definition of Calibration Curve
1	-4.6100	-6.4017	-4.6016	0.0084318	Polynomial Degree = 1 (Linear Fit)
2	-3.1300	-4.3871	-3.1479	-0.017915	$Y = C_0 + C_1 \cdot V$
3	-1.8100	-2.5301	-1.8079	0.0020712	where $Y(t)$ = Angle (deg),
4	0.89000	1.2241	0.90104	0.011039	$V(t)$ = measured value (volts),
5	2.8300	3.9030	2.8341	0.0041060	C_0 = 0.017771 deg,
6	4.5900	6.3257	4.5823	-0.0077328	C_1 = 0.72159 deg/volt,



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JSS-Preliminary Design Model Tests
Calibration of Yaw Rate, Z MP1
Calibrated 2011-10-12 19:49Z

Test Facility: CWT	**Serial #:**	**Filter Frequency:**
Data Source: DASPC49:50001 Channel 8	**Programmable Gain:**	**Excitation:**
Sensor Model:	**Plug-In Gain:**	

Data Point #	Physical Value (deg/s)	Measured Value (volts)	Fitted Curve Value (deg/s)	Error (deg/s)
1	-49.822	-8.7166	-49.810	0.012270
2	-39.857	-6.9674	-39.855	0.0016698
3	-29.893	-5.2175	-29.898	-0.0046581
4	-19.929	-3.4690	-19.947	-0.018263
5	-7.1740	-1.2300	-7.2061	-0.032123
6	8.5690	1.5556	8.6454	0.076419
7	20.726	3.6687	20.670	-0.055741
8	28.498	5.0542	28.555	0.056980
9	40.654	7.1674	40.581	-0.073395
10	48.427	8.5528	48.464	0.036843

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

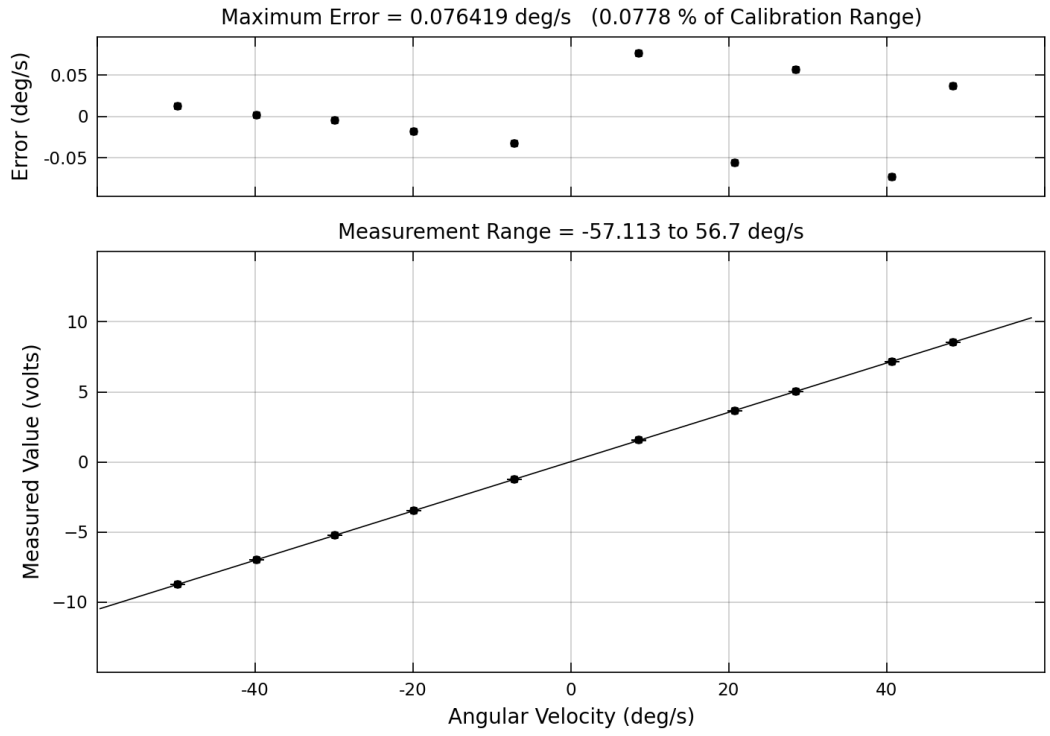
$Y = C_0 + C_1 \cdot V$

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

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

C_0 = -0.2067 deg/s,

C_1 = 5.6906 deg/s/volt,



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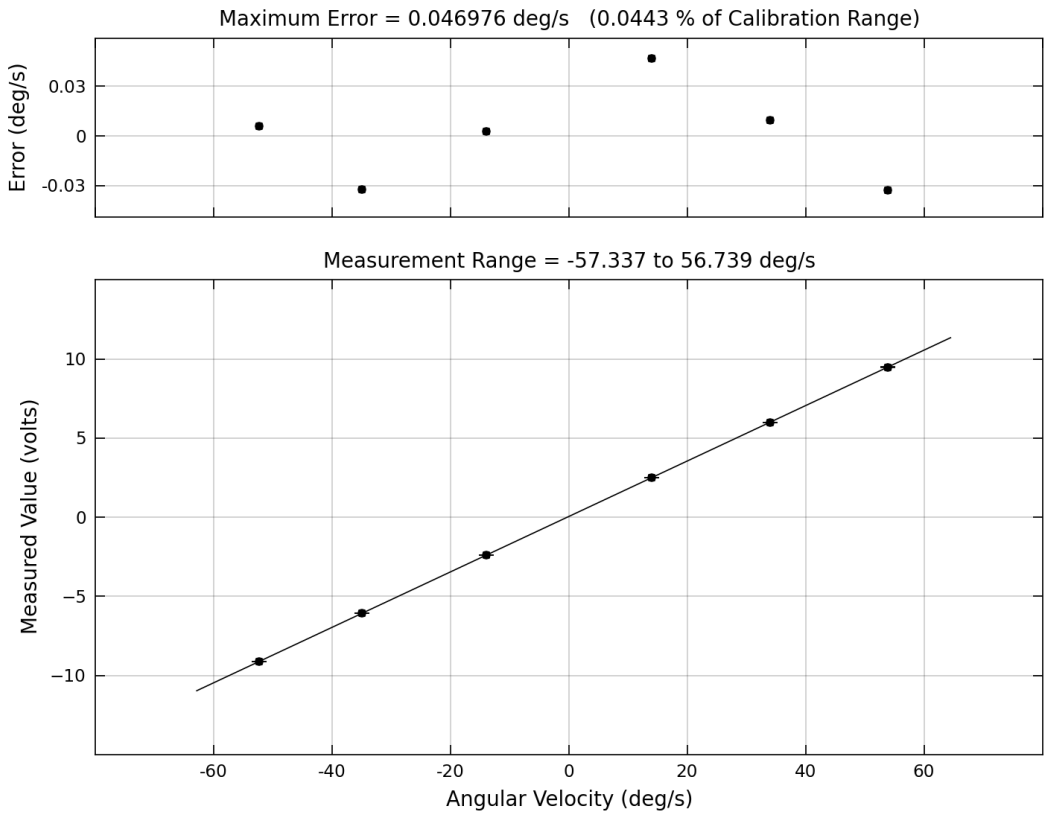
JSS-Preliminary Design Model Tests
Calibration of X Rate MP1
Calibrated 2011-10-12 19:31Z

Test Facility: CWT	**Serial #:**	**Filter Frequency:**
Data Source: DASPC49:50001 Channel 9	**Programmable Gain:**	**Excitation:**
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
1	-52.265	-9.1098	-52.259	0.0059973	Polynomial Degree = 1 (Linear Fit)
2	-34.910	-6.0738	-34.942	-0.032444	$Y = C_0 + C_1 \cdot V$
3	-13.964	-2.3953	-13.961	0.0026673	where $Y(t)$ = Angular Velocity (deg/s),
4	13.964	2.5088	14.011	0.046976	$V(t)$ = measured value (volts),
5	33.913	5.9998	33.923	0.0096750	C_0 = -0.29883 deg/s,
6	53.861	9.4897	53.828	-0.032871	C_1 = 5.7038 deg/s/volt,



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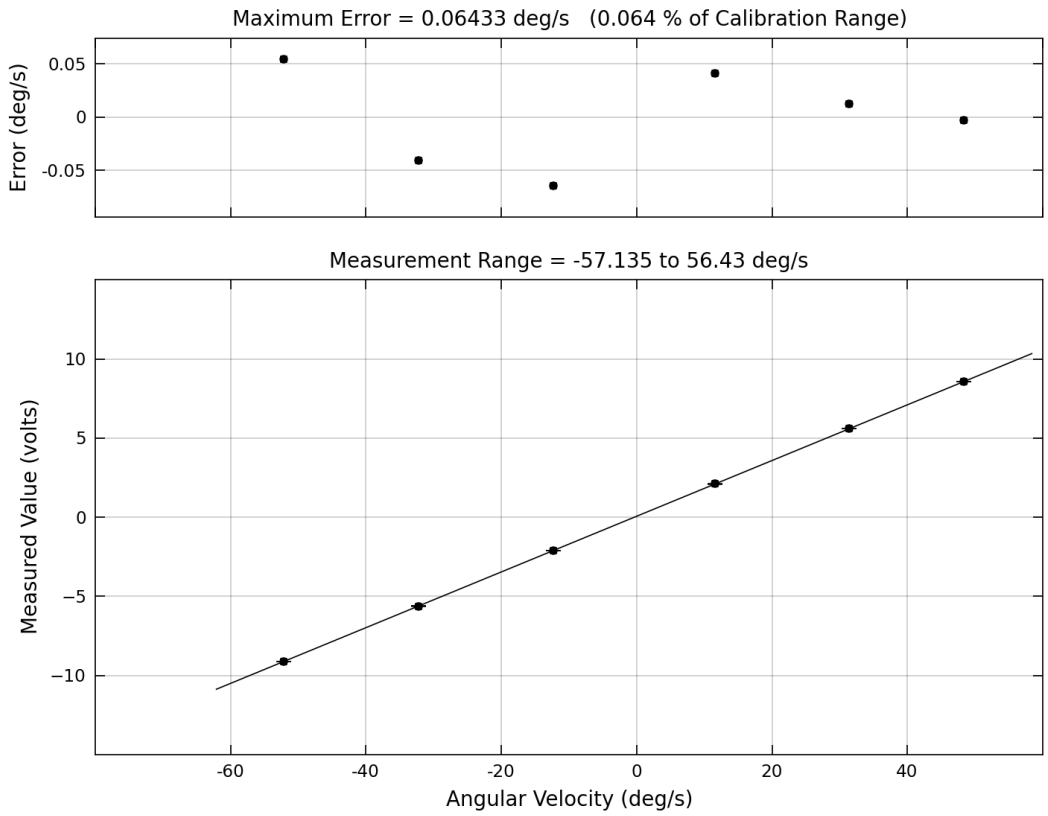
JSS-Preliminary Design Model Tests
Calibration of Y Rate MP1
Calibrated 2011-10-12 19:41Z

Test Facility: CWT	**Serial #:**	**Filter Frequency:**
Data Source: DASPC49:50001 Channel 10	**Programmable Gain:**	**Excitation:**
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
1	-52.122	-9.1075	-52.067	0.054527	Polynomial Degree = 1 (Linear Fit)
2	-32.227	-5.6206	-32.268	-0.040890	$Y = C_0 + C_1 \cdot V$
3	-12.334	-2.1214	-12.398	-0.064330	where $Y(t)$ = Angular Velocity (deg/s),
4	11.538	2.1013	11.579	0.041231	$V(t)$ = measured value (volts),
5	31.432	5.5998	31.445	0.012591	C_0 = -0.35259 deg/s,
6	48.342	8.5751	48.339	-0.0031291	C_1 = 5.6783 deg/s/volt,



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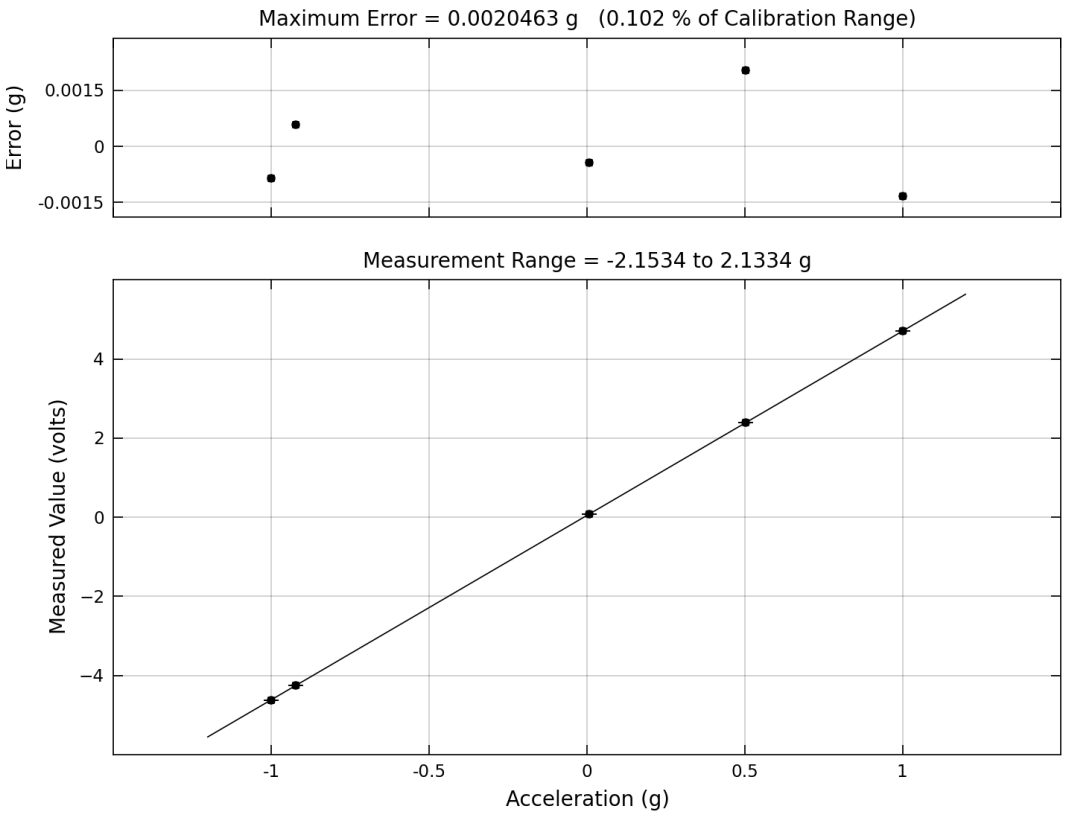
JSS-Preliminary Design Model Tests
Calibration of X Accel MP1
Calibrated 2011-09-23 18:36Z

Test Facility: CWT	**Serial #:**	**Filter Frequency:**
Data Source: DASPC49:50001 Channel 11	**Programmable Gain:**	**Excitation:**
Sensor Model:	**Plug-In Gain:**	

Data Point #	Physical Value (g)	Measured Value (volts)	Fitted Curve Value (g)	Error (g)	Definition of Calibration Curve
1	-0.99996	-4.6228	-1.0008	-0.00085371	Polynomial Degree = 1 (Linear Fit)
2	-0.92321	-4.2580	-0.92262	0.00058743	$Y = C_0 + C_1 \cdot V$
3	0.0066300	0.075388	0.0061921	-0.00043794	where $Y(t)$ = Acceleration (g),
4	0.50151	2.3959	0.50356	0.0020463	$V(t)$ = measured value (volts),
5	0.99990	4.7053	0.99856	-0.0013421	C_0 = -0.0099665 g,
					C_1 = 0.21434 g/volt,



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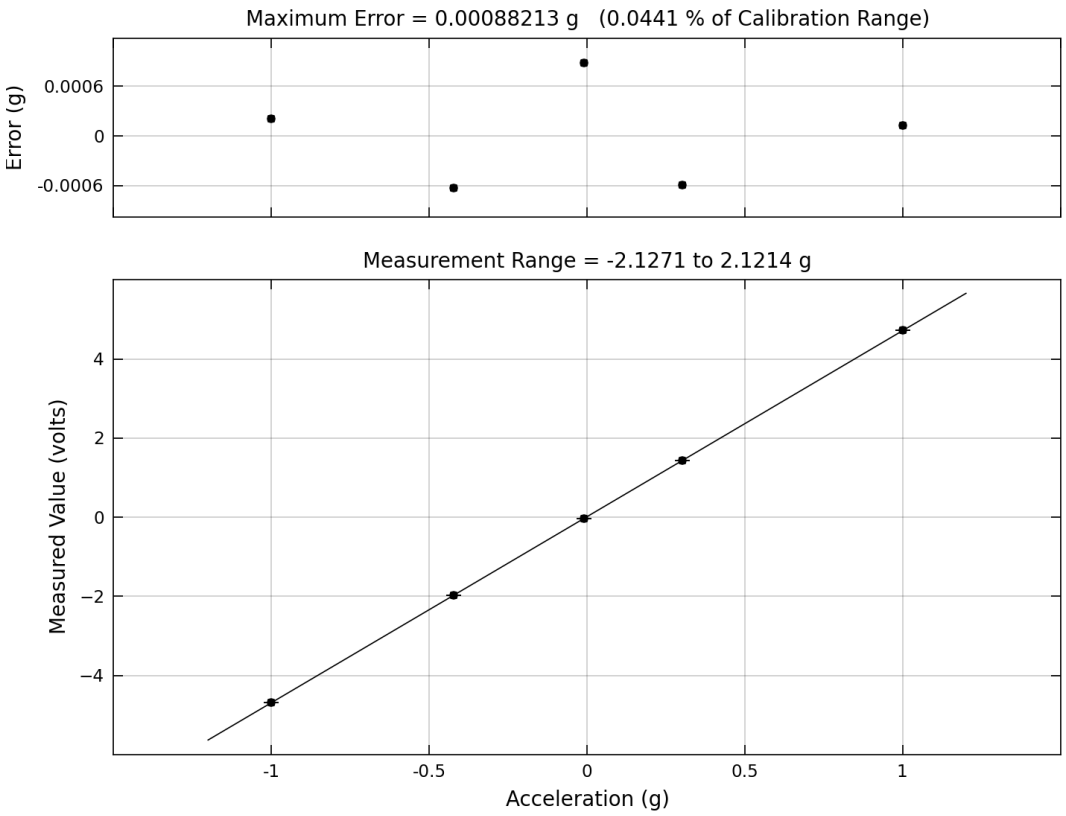
JSS-Preliminary Design Model Tests

Calibration of Y Accel MP1

Calibrated 2011-09-23 18:54Z

Test Facility: CWT	**Serial #:**	**Filter Frequency:**
Data Source: DASPC49:50001 Channel 12	**Programmable Gain:**	**Excitation:**
Sensor Model:	**Plug-In Gain:**	

Data Point #	Physical Value (g)	Measured Value (volts)	Fitted Curve Value (g)	Error (g)	Definition of Calibration Curve
1	-0.99999	-4.6930	-0.99978	0.00020898	Polynomial Degree = 1 (Linear Fit)
2	-0.42262	-1.9790	-0.42325	-0.00062966	$Y = C_0 + C_1 \cdot V$
3	-0.0099482	-0.029235	-0.0090661	0.00088213	where $Y(t)$ = Acceleration (g),
4	0.30237	1.4341	0.30178	-0.00058989	$V(t)$ = measured value (volts),
5	0.99990	4.7211	1.0000	0.00012844	C_0 = -0.0028557 g,
					C_1 = 0.21243 g/volt,



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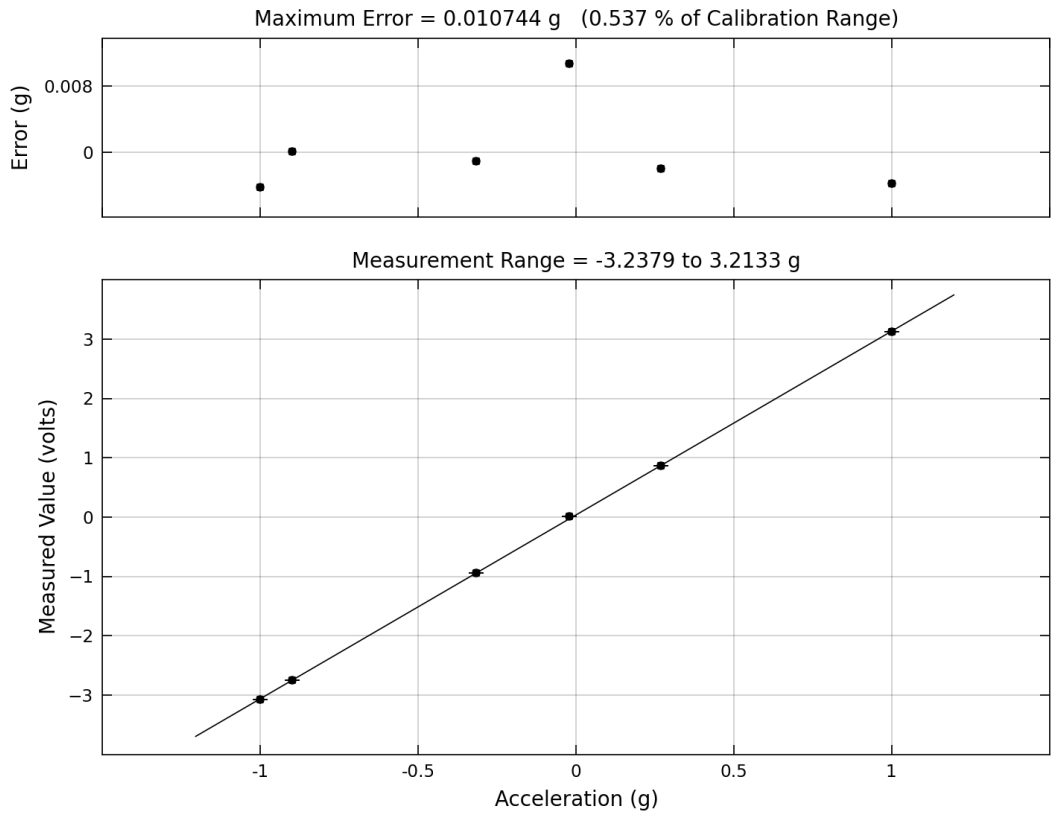
JSS-Preliminary Design Model Tests
Calibration of Z Accel MP1
Calibrated 2011-09-23 19:30Z

Test Facility: CWT	**Serial #:**	**Filter Frequency:**
Data Source: DASPC49:50001 Channel 13	**Programmable Gain:**	**Excitation:**
Sensor Model:	**Plug-In Gain:**	

Data Point #	Physical Value (g)	Measured Value (volts)	Fitted Curve Value (g)	Error (g)	Definition of Calibration Curve
1	-0.99999	-3.0749	-1.0041	-0.0041482	Polynomial Degree = 1 (Linear Fit)
2	-0.89879	-2.7478	-0.89865	0.00014656	$Y = C_0 + C_1 \cdot V$
3	-0.31565	-0.94361	-0.31669	-0.0010373	where $Y(t)$ = Acceleration (g),
4	-0.020070	0.0092750	-0.0093260	0.010744	$V(t)$ = measured value (volts),
5	0.26892	0.86586	0.26697	-0.0019495	C_0 = -0.012318 g,
6	0.99999	3.1267	0.99623	-0.0037556	C_1 = 0.32256 g/volt,



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JSS-Preliminary Design Model Tests
Calibration of Dyno Thrust
Calibrated 2011-11-16 19:59Z

Test Facility: CWT	**Serial #:** 209	**Filter Frequency:** 10
Data Source: DASPC49:50001 Channel 15	**Programmable Gain:**	**Excitation:** 6.008
Sensor Model: K&R R25 Nr.308	**Plug-In Gain:**	

Data Point #	Physical Value (N)	Measured Value (volts)	Fitted Curve Value (N)	Error (N)
1	0.00000	-1.5409	0.016522	0.016522
2	9.8080	-1.9115	9.8081	0.00012513
3	19.616	-2.2828	19.616	-0.00040673
4	29.424	-2.6544	29.431	0.0074343
5	39.232	-3.0257	39.238	0.0058491
6	49.040	-3.3966	49.036	-0.0038833
7	58.848	-3.7679	58.842	-0.0057909
8	68.656	-4.1393	68.654	-0.0015935
9	78.464	-4.5105	78.459	-0.0049414
10	88.272	-4.8812	88.249	-0.022719
11	98.080	-5.2528	98.065	-0.014878
12	107.89	-5.6242	107.88	-0.011599
13	117.70	-5.9956	117.69	-0.0081760
14	127.50	-6.3673	127.51	0.0011322
15	137.31	-6.7393	137.33	0.020049

Table truncated (1 points not displayed).

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

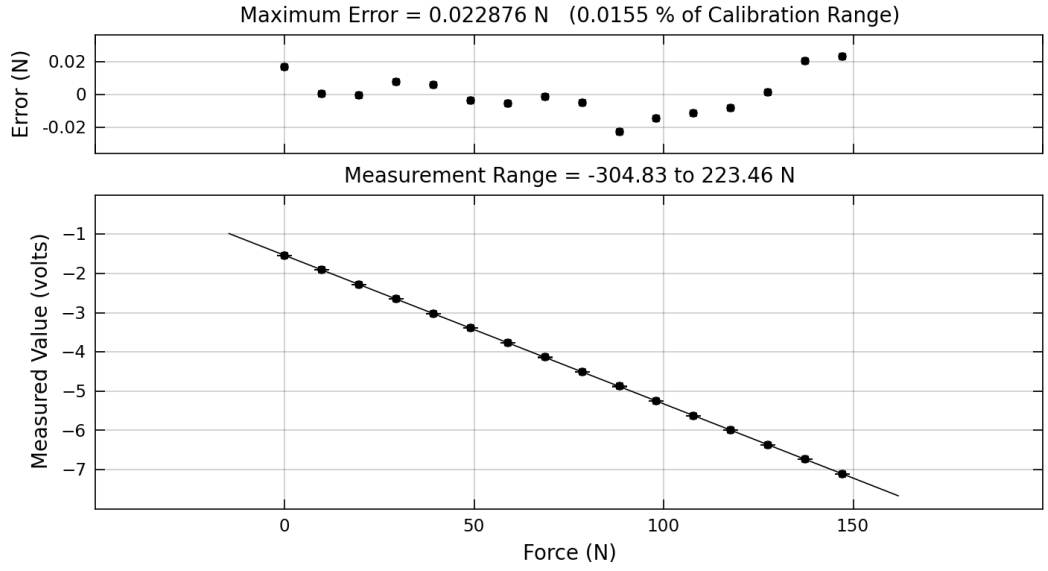
$Y = C_0 + C_1 \cdot V$

where $Y(t)$ = Force (N),

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

C_0 = -40.685 N,

C_1 = -26.415 N/volt,



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JSS-Preliminary Design Model Tests
Calibration of Dyno Torque
Calibrated 2011-11-16 20:21Z

Test Facility: CWT	**Serial #:** 209	**Filter Frequency:** 10
Data Source: DASPC49:50001 Channel 16	**Programmable Gain:**	**Excitation:** 6.001
Sensor Model: K&R R25 Nr. 308	**Plug-In Gain:**	

Data Point #	Physical Value (Nm)	Measured Value (volts)	Fitted Curve Value (Nm)	Error (Nm)
1	-7.3560	6.0600	-7.3249	0.031136
2	-6.1300	5.0727	-6.1135	0.016477
3	-4.9040	4.0838	-4.9003	0.0036695
4	-3.6780	3.0911	-3.6823	-0.0043041
5	-2.4520	2.1032	-2.4703	-0.018260
6	-1.2260	1.1067	-1.2477	-0.021680
7	0.00000	0.10875	-0.023295	-0.023295
8	1.2260	-0.89434	1.2074	-0.018604
9	2.4520	-1.8993	2.4404	-0.011600
10	3.6780	-2.9077	3.6776	-0.00041021
11	4.9040	-3.9127	4.9106	0.0066164
12	6.1300	-4.9192	6.1455	0.015451
13	7.3560	-5.9261	7.3808	0.024802

Definition of Calibration Curve

Polynomial Degree = 1 (Linear Fit)

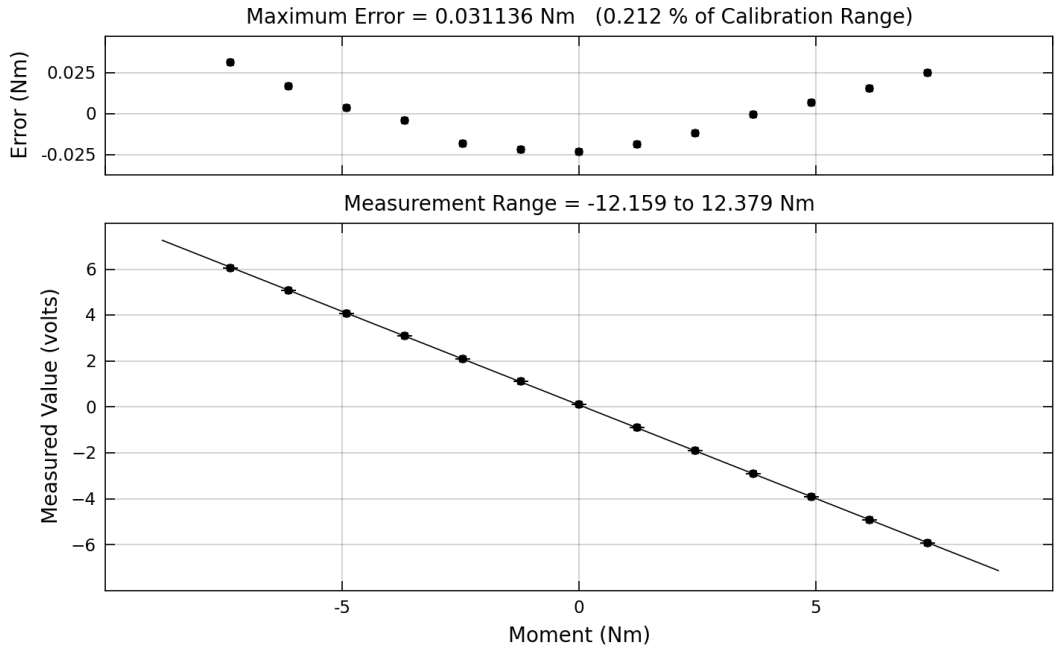
$Y = C_0 + C_1 \cdot V$

where $Y(t)$ = Moment (Nm),

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

C_0 = 0.11014 Nm,

C_1 = -1.2269 Nm/volt,



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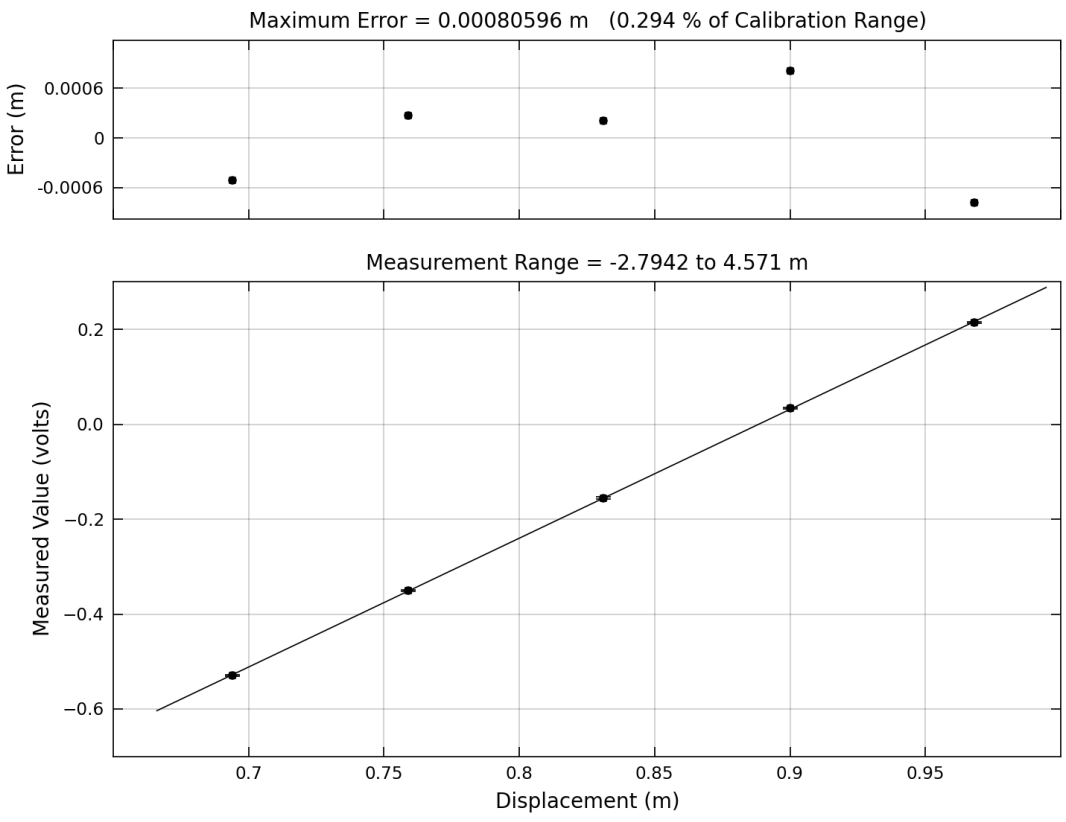
JSS-Preliminary Design Model Tests
Calibration of Relmo Port
Calibrated 2011-11-28 20:23Z

Test Facility: CWT	**Serial #:**	**Filter Frequency:**
Data Source: DASPC49:50001 Channel 17	**Programmable Gain:**	**Excitation:**
Sensor Model:	**Plug-In Gain:**	

Data Point #	Physical Value (m)	Measured Value (volts)	Fitted Curve Value (m)	Error (m)	Definition of Calibration Curve
1	0.69400	-0.52918	0.69349	-0.00050580	Polynomial Degree = 1 (Linear Fit)
2	0.75900	-0.35055	0.75927	0.00027494	$Y = C_0 + C_1 \cdot V$
3	0.83100	-0.15523	0.83120	0.00020402	where $Y(t)$ = Displacement (m),
4	0.90000	0.033771	0.90081	0.00080596	$V(t)$ = measured value (volts),
5	0.96800	0.21412	0.96722	-0.00077912	C_0 = 0.88837 m,
					C_1 = 0.36826 m/volt,



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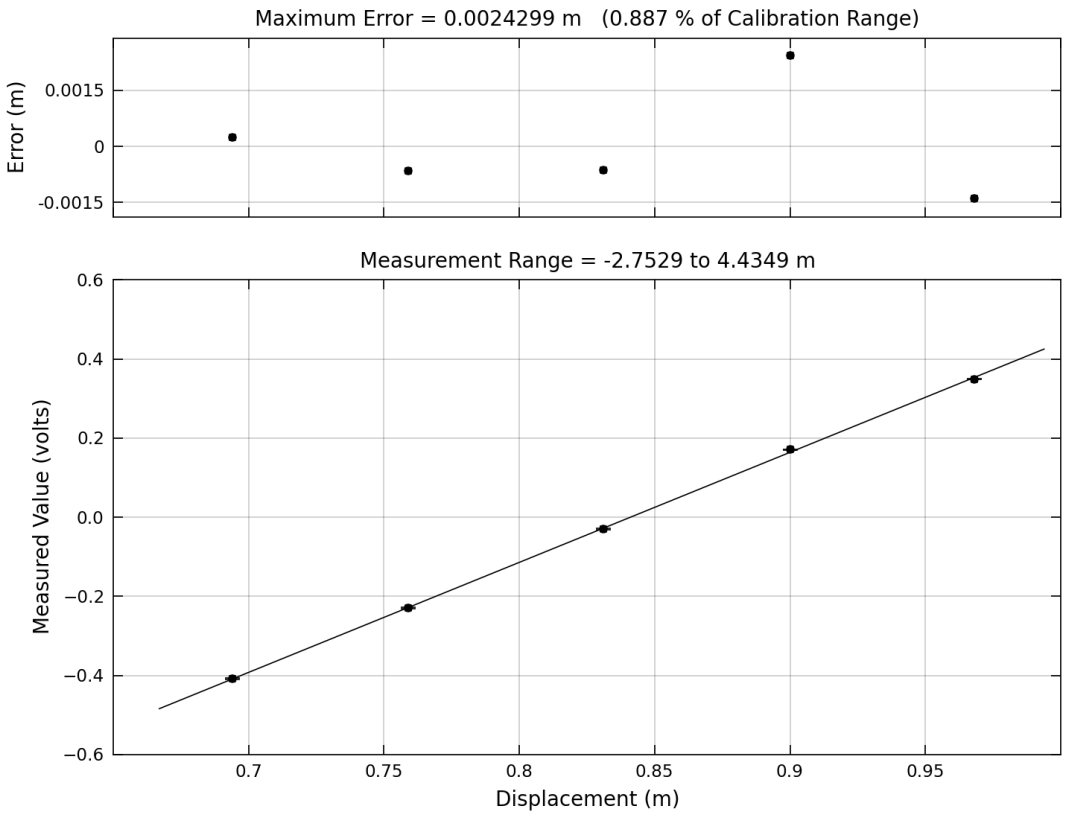
JSS-Preliminary Design Model Tests
Calibration of Relmo Stbd
Calibrated 2011-11-28 20:23Z

Test Facility: CWT	**Serial #:**	**Filter Frequency:**
Data Source: DASPC49:50001 Channel 18	**Programmable Gain:**	**Excitation:**
Sensor Model:	**Plug-In Gain:**	

Data Point #	Physical Value (m)	Measured Value (volts)	Fitted Curve Value (m)	Error (m)	Definition of Calibration Curve
1	0.69400	-0.40842	0.69425	0.00025112	Polynomial Degree = 1 (Linear Fit)
2	0.75900	-0.23010	0.75833	-0.00066552	$Y = C_0 + C_1 \cdot V$
3	0.83100	-0.029662	0.83037	-0.00062933	where $Y(t)$ = Displacement (m),
4	0.90000	0.17084	0.90243	0.0024299	$V(t)$ = measured value (volts),
5	0.96800	0.34944	0.96661	-0.0013862	C_0 = 0.84103 m,
					C_1 = 0.35939 m/volt,



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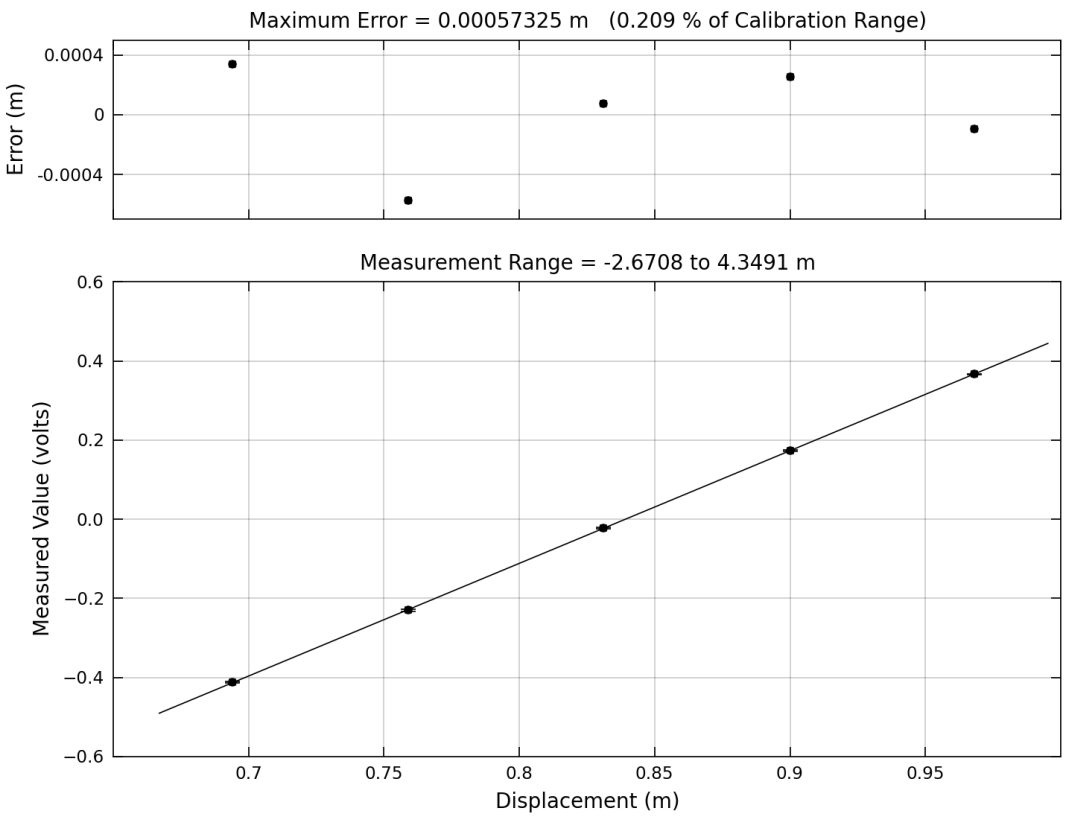
JSS-Preliminary Design Model Tests
Calibration of Relmo Bow
Calibrated 2011-11-28 20:23Z

Test Facility: CWT	**Serial #:**	**Filter Frequency:**
Data Source: DASPC49:50001 Channel 19	**Programmable Gain:**	**Excitation:**
Sensor Model:	**Plug-In Gain:**	

Data Point #	Physical Value (m)	Measured Value (volts)	Fitted Curve Value (m)	Error (m)	Definition of Calibration Curve
1	0.69400	-0.41265	0.69434	0.00034012	Polynomial Degree = 1 (Linear Fit)
2	0.75900	-0.23006	0.75843	-0.00057325	$Y = C_0 + C_1 \cdot V$
3	0.83100	-0.023092	0.83107	7.2615e-05	where $Y(t)$ = Displacement (m),
4	0.90000	0.17400	0.90025	0.00025277	$V(t)$ = measured value (volts),
5	0.96800	0.36676	0.96791	-9.2265e-05	C_0 = 0.83918 m,
					C_1 = 0.351 m/volt,



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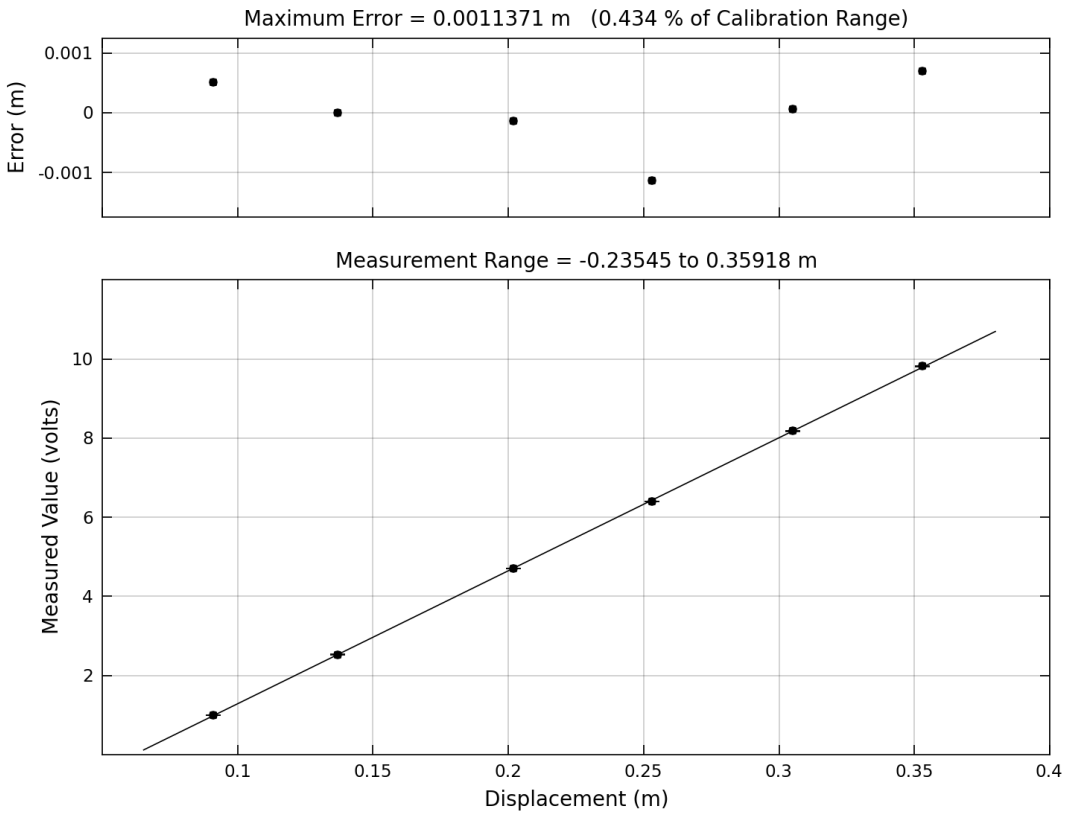
JSS-Preliminary Design Model Tests
Calibration of Relmo RAS acoustic
Calibrated 2011-11-09 17:59Z

Test Facility: CWT	**Serial #:**	**Filter Frequency:**
Data Source: DASPC49:50001 Channel 20	**Programmable Gain:**	**Excitation:**
Sensor Model:	**Plug-In Gain:**	

Data Point #	Physical Value (m)	Measured Value (volts)	Fitted Curve Value (m)	Error (m)	Definition of Calibration Curve
1	0.091000	0.99712	0.091508	0.00050756	Polynomial Degree = 1 (Linear Fit)
2	0.13700	2.5273	0.13700	1.0227e-06	$Y = C_0 + C_1 \cdot V$
3	0.20200	4.7089	0.20187	-0.00013471	where $Y(t)$ = Displacement (m),
4	0.25300	6.3906	0.25186	-0.0011371	$V(t)$ = measured value (volts),
5	0.30500	8.1799	0.30506	6.0752e-05	C_0 = 0.061862 m,
6	0.35300	9.8159	0.35370	0.00070248	C_1 = 0.029731 m/volt,



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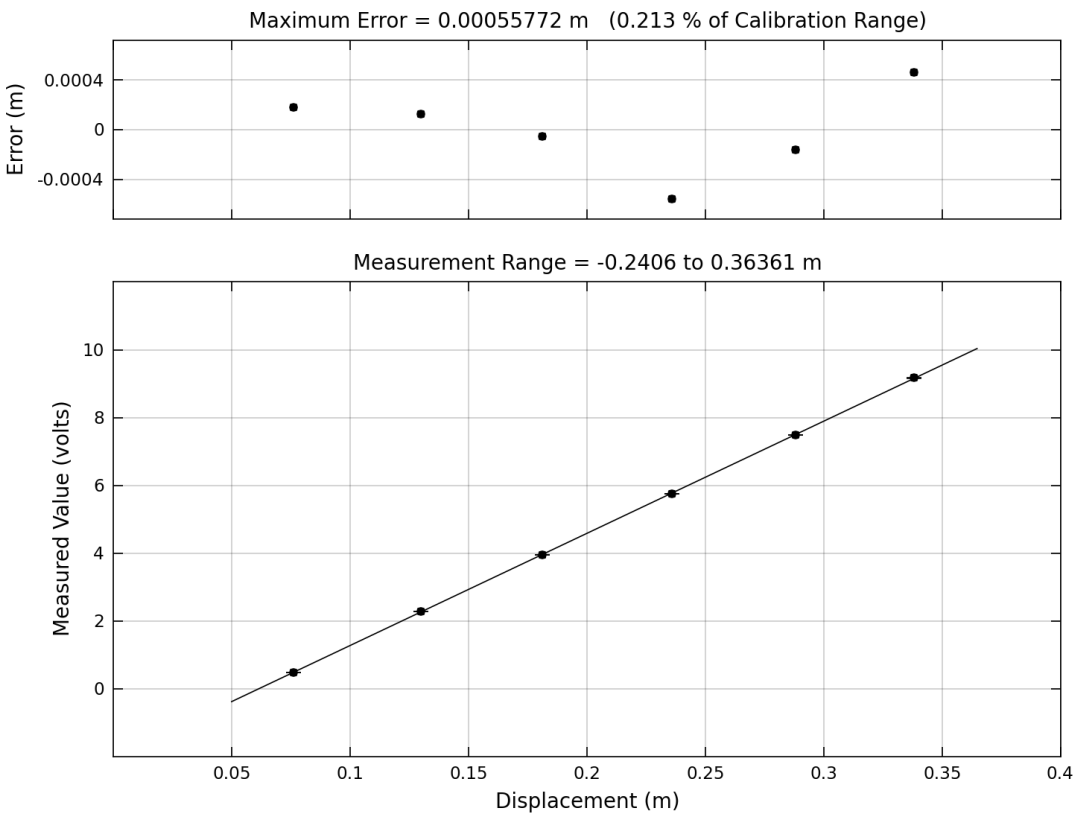
JSS-Preliminary Design Model Tests
Calibration of Relmo Prop acoustic
Calibrated 2011-11-09 18:10Z

Test Facility: CWT	**Serial #:**	**Filter Frequency:**
Data Source: DASPC49:50001 Channel 21	**Programmable Gain:**	**Excitation:**
Sensor Model:	**Plug-In Gain:**	

Data Point #	Physical Value (m)	Measured Value (volts)	Fitted Curve Value (m)	Error (m)	Definition of Calibration Curve
1	0.076000	0.48584	0.076180	0.00018017	Polynomial Degree = 1 (Linear Fit)
2	0.13000	2.2715	0.13013	0.00012712	$Y = C_0 + C_1 \cdot V$
3	0.18100	3.9537	0.18095	-5.2102e-05	where $Y(t)$ = Displacement (m),
4	0.23600	5.7575	0.23544	-0.00055772	$V(t)$ = measured value (volts),
5	0.28800	7.4920	0.28784	-0.00015952	C_0 = 0.061502 m,
6	0.33800	9.1676	0.33846	0.00046206	C_1 = 0.030211 m/volt,



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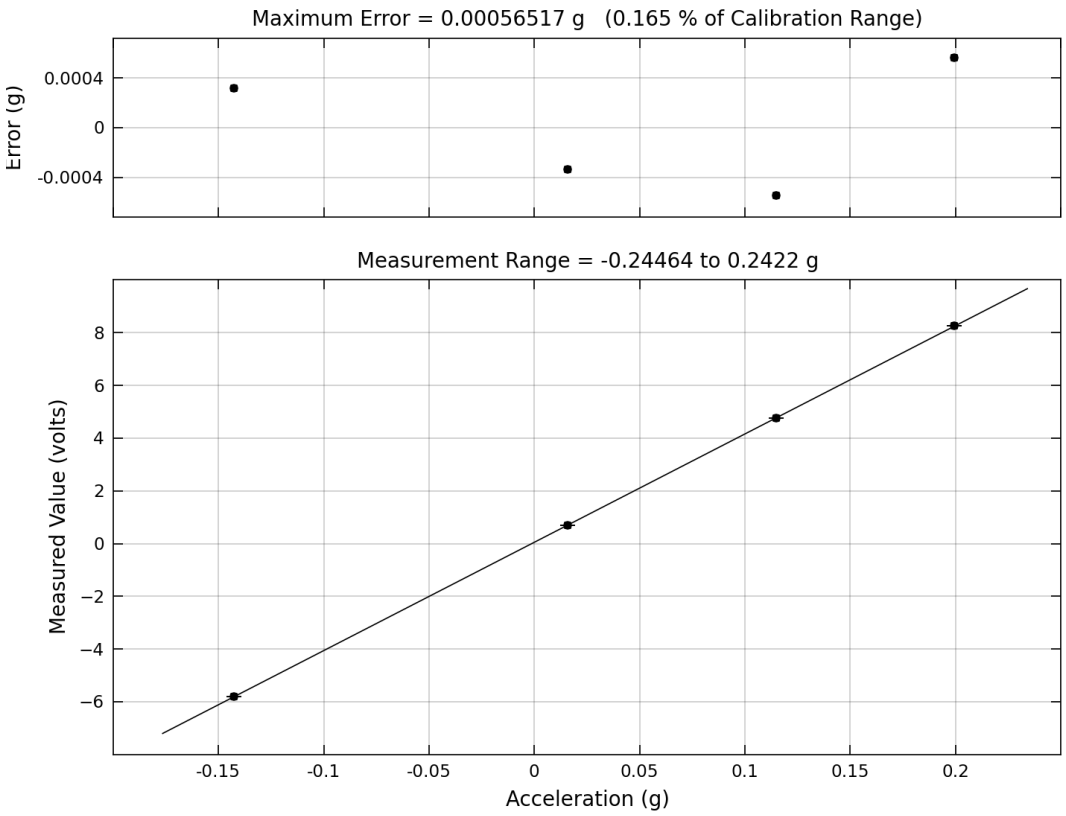
JSS-Preliminary Design Model Tests
Calibration of Accel X tri-axial
Calibrated 2011-11-08 14:25Z

Test Facility: CWT	**Serial #:**	**Filter Frequency:**
Data Source: DASPC49:50001 Channel 22	**Programmable Gain:**	**Excitation:**
Sensor Model:	**Plug-In Gain:**	

Data Point #	Physical Value (g)	Measured Value (volts)	Fitted Curve Value (g)	Error (g)	Definition of Calibration Curve
1	-0.14263	-5.7960	-0.14231	0.00031831	Polynomial Degree = 1 (Linear Fit)
2	0.015707	0.68166	0.015370	-0.00033694	$Y = C_0 + C_1 \cdot V$
3	0.11494	4.7495	0.11439	-0.00054654	where $Y(t)$ = Acceleration (g),
4	0.19937	8.2637	0.19993	0.00056517	$V(t)$ = measured value (volts),
					C_0 = -0.0012231 g,
					C_1 = 0.024342 g/volt,



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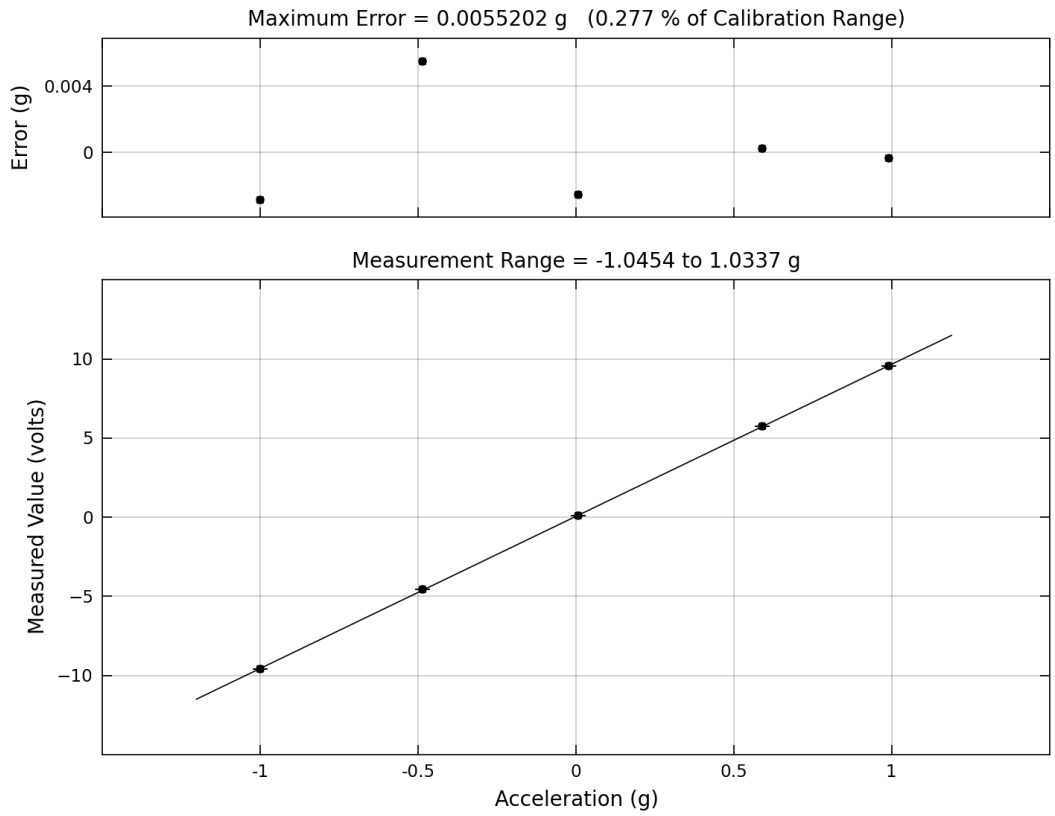
JSS-Preliminary Design Model Tests
Calibration of Accel Y tri-axial
Calibrated 2011-11-08 14:09Z

Test Facility: CWT	**Serial #:**	**Filter Frequency:**
Data Source: DASPC49:50001 Channel 23	**Programmable Gain:**	**Excitation:**
Sensor Model:	**Plug-In Gain:**	

Data Point #	Physical Value (g)	Measured Value (volts)	Fitted Curve Value (g)	Error (g)	Definition of Calibration Curve
1	-0.99973	-9.5886	-1.0026	-0.0028675	Polynomial Degree = 1 (Linear Fit)
2	-0.48481	-4.5544	-0.47929	0.0055202	$Y = C_0 + C_1 \cdot V$
3	0.0069810	0.099148	0.0044556	-0.0025254	where $Y(t)$ = Acceleration (g),
4	0.59061	5.7401	0.59084	0.00023017	$V(t)$ = measured value (volts),
5	0.99027	9.5791	0.98991	-0.00035749	C_0 = -0.005851 g,
					C_1 = 0.10395 g/volt,



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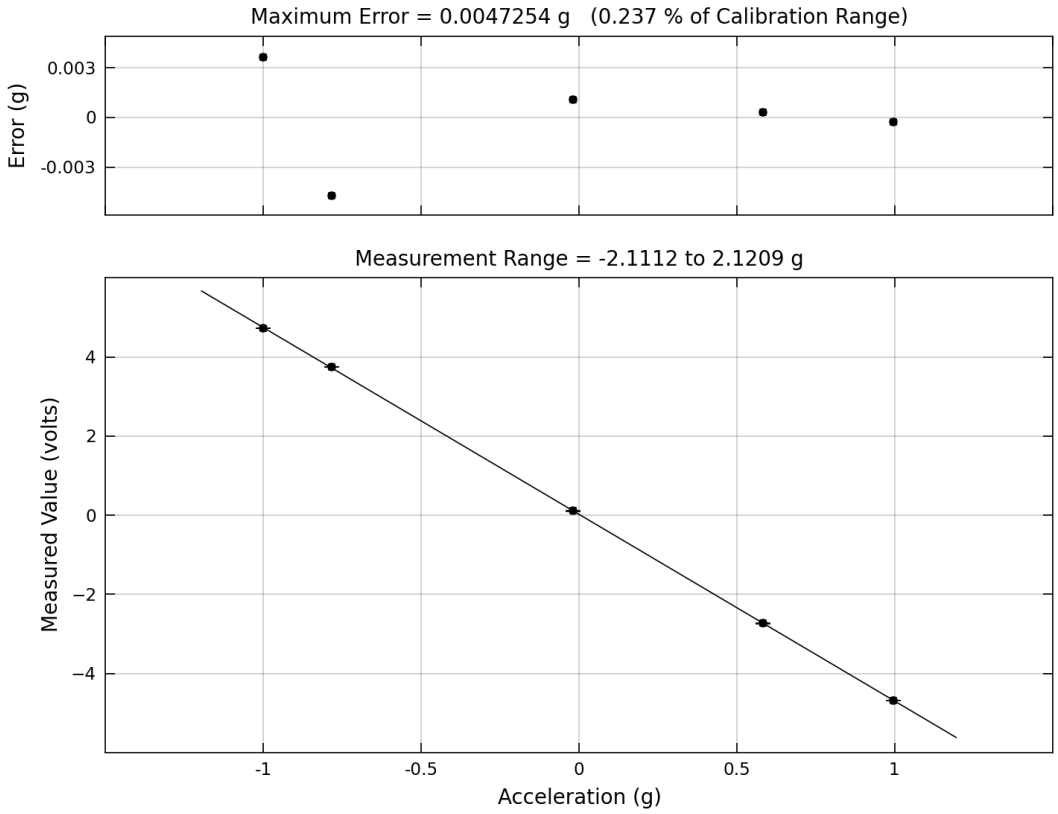
JSS-Preliminary Design Model Tests
Calibration of Accel Z tri-axial
Calibrated 2011-11-08 13:12Z

Test Facility: CWT	**Serial #:**	**Filter Frequency:**
Data Source: DASPC49:50001 Channel 24	**Programmable Gain:**	**Excitation:**
Sensor Model:	**Plug-In Gain:**	

Data Point #	Physical Value (g)	Measured Value (volts)	Fitted Curve Value (g)	Error (g)	Definition of Calibration Curve
1	-0.99974	4.7304	-0.99612	0.0036199	Polynomial Degree = 1 (Linear Fit)
2	-0.78229	3.7422	-0.78702	-0.0047254	$Y = C_0 + C_1 \cdot V$
3	-0.019197	0.10866	-0.018122	0.0010747	where $Y(t)$ = Acceleration (g),
4	0.58354	-2.7361	0.58384	0.00030215	$V(t)$ = measured value (volts),
5	0.99506	-4.6781	0.99478	-0.00027139	C_0 = 0.0048706 g,
					C_1 = -0.21161 g/volt,



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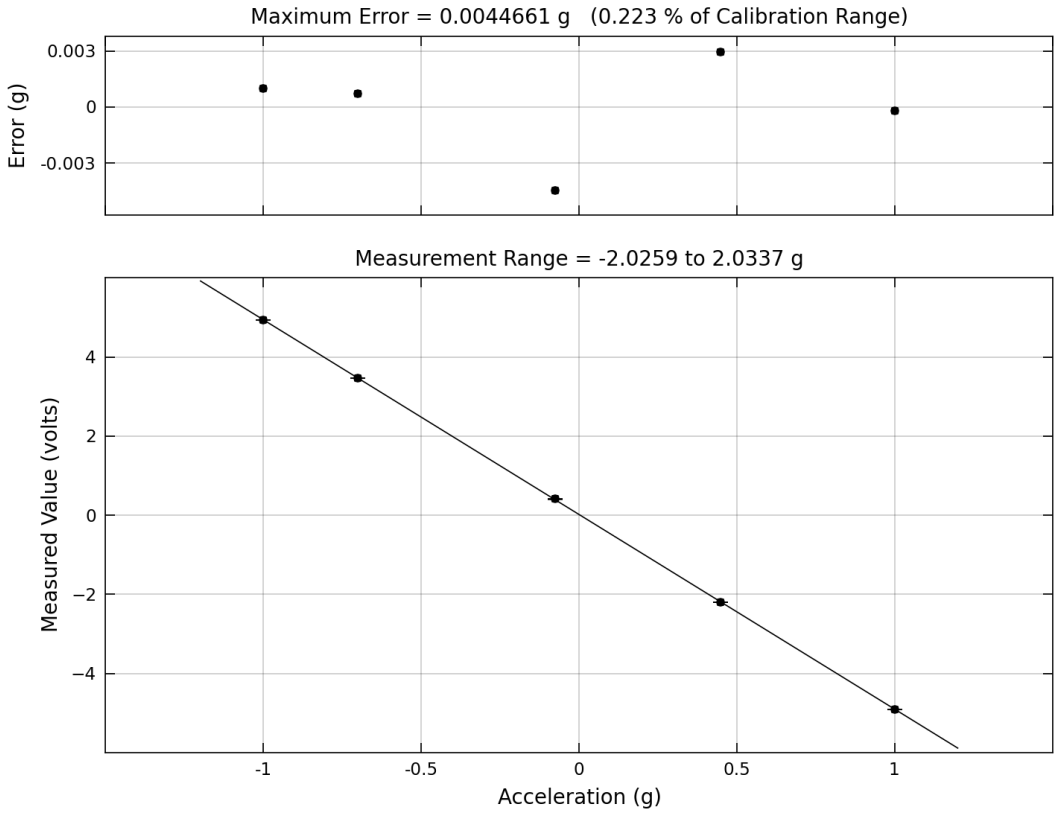
JSS-Preliminary Design Model Tests
Calibration of Accel Z Slam
Calibrated 2011-11-08 12:51Z

Test Facility: CWT	**Serial #:**	**Filter Frequency:**
Data Source: DASPC49:50001 Channel 25	**Programmable Gain:**	**Excitation:**
Sensor Model:	**Plug-In Gain:**	

Data Point #	Physical Value (g)	Measured Value (volts)	Fitted Curve Value (g)	Error (g)	Definition of Calibration Curve
1	-0.99961	4.9388	-0.99861	0.0010018	Polynomial Degree = 1 (Linear Fit)
2	-0.70091	3.4686	-0.70020	0.00070911	$Y = C_0 + C_1 \cdot V$
3	-0.075327	0.41212	-0.079793	-0.0044661	where $Y(t)$ = Acceleration (g),
4	0.44776	-2.2014	0.45070	0.0029396	$V(t)$ = measured value (volts),
5	0.99961	-4.9048	0.99943	-0.00018440	C_0 = 0.0038597 g,
					C_1 = -0.20298 g/volt,



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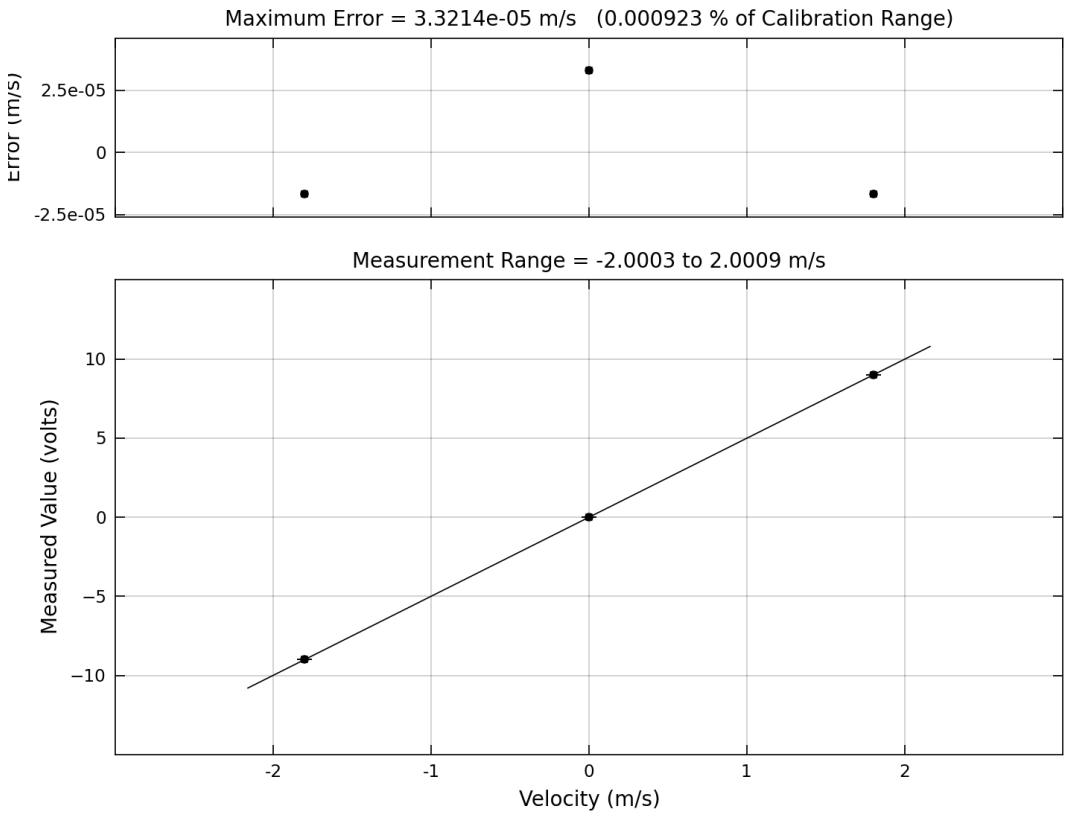
JSS-Preliminary Design Model Tests
Calibration of Carriage Speed
Calibrated 2011-12-02 13:43Z

Test Facility: CWT	**Serial #:**	**Filter Frequency:** 10
Data Source: TOWDAS:50001 Channel 2	**Programmable Gain:** 1	**Excitation:**
Sensor Model:	**Plug-In Gain:** 1	

Data Point #	Physical Value (m/s)	Measured Value (volts)	Fitted Curve Value (m/s)	Error (m/s)	Definition of Calibration Curve
1	-1.8000	-8.9988	-1.8000	-1.6606e-05	Polynomial Degree = 1 (Linear Fit)
2	0.00000	-0.0012213	3.3214e-05	3.3214e-05	$Y = C_0 + C_1 \cdot V$
3	1.8000	8.9958	1.8000	-1.6607e-05	where $Y(t)$ = Velocity (m/s),
					$V(t)$ = measured value (volts),
					C_0 = 0.00027755 m/s,
					C_1 = 0.20006 m/s/volt,



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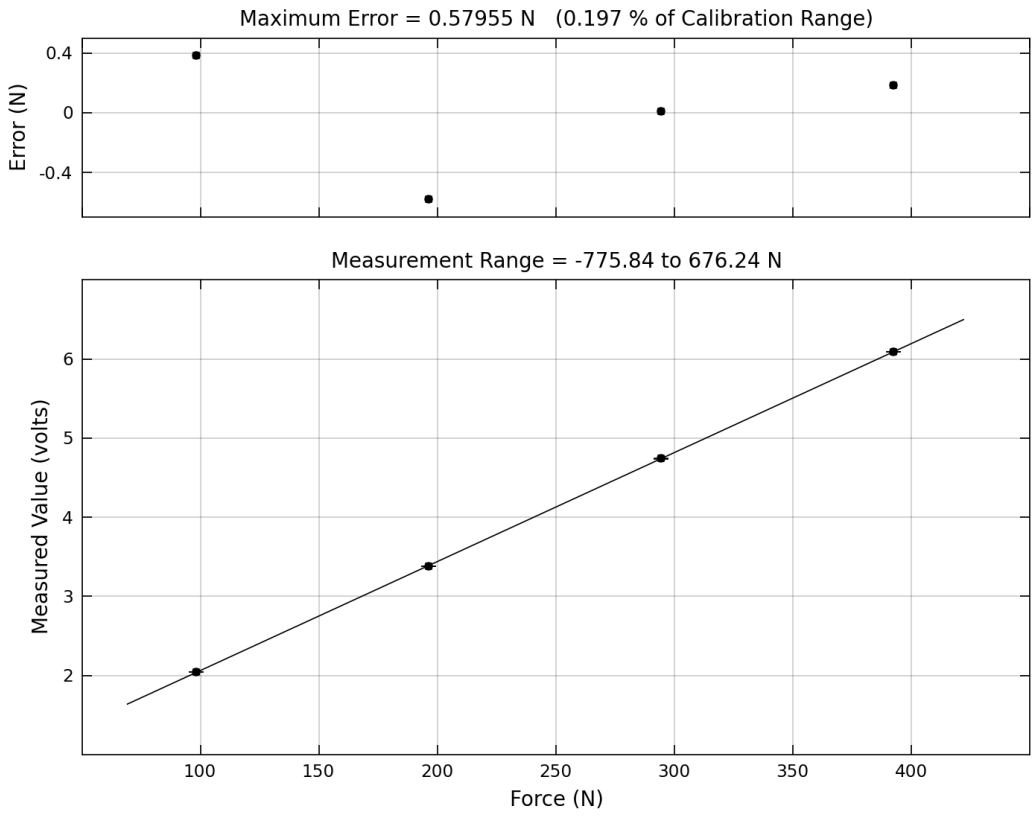
JSS-Preliminary Design Model Tests
Calibration of Inline load
Calibrated 2011-11-14 16:36Z

Test Facility: CWT	**Serial #:** A10642	**Filter Frequency:** 10
Data Source: TOWDAS:50001 Channel 5	**Programmable Gain:** 1	**Excitation:** 10v
Sensor Model: 100 lb s type	**Plug-In Gain:** 200	

Data Point #	Physical Value (N)	Measured Value (volts)	Fitted Curve Value (N)	Error (N)	Definition of Calibration Curve
1	98.080	2.0421	98.465	0.38546	Polynomial Degree = 1 (Linear Fit)
2	196.16	3.3797	195.58	-0.57955	$Y = C_0 + C_1 \cdot V$
3	294.38	4.7407	294.39	0.0082977	where $Y(t)$ = Force (N),
4	392.46	6.0940	392.65	0.18579	$V(t)$ = measured value (volts),
					C_0 = -49.799 N,
					C_1 = 72.604 N/volt,



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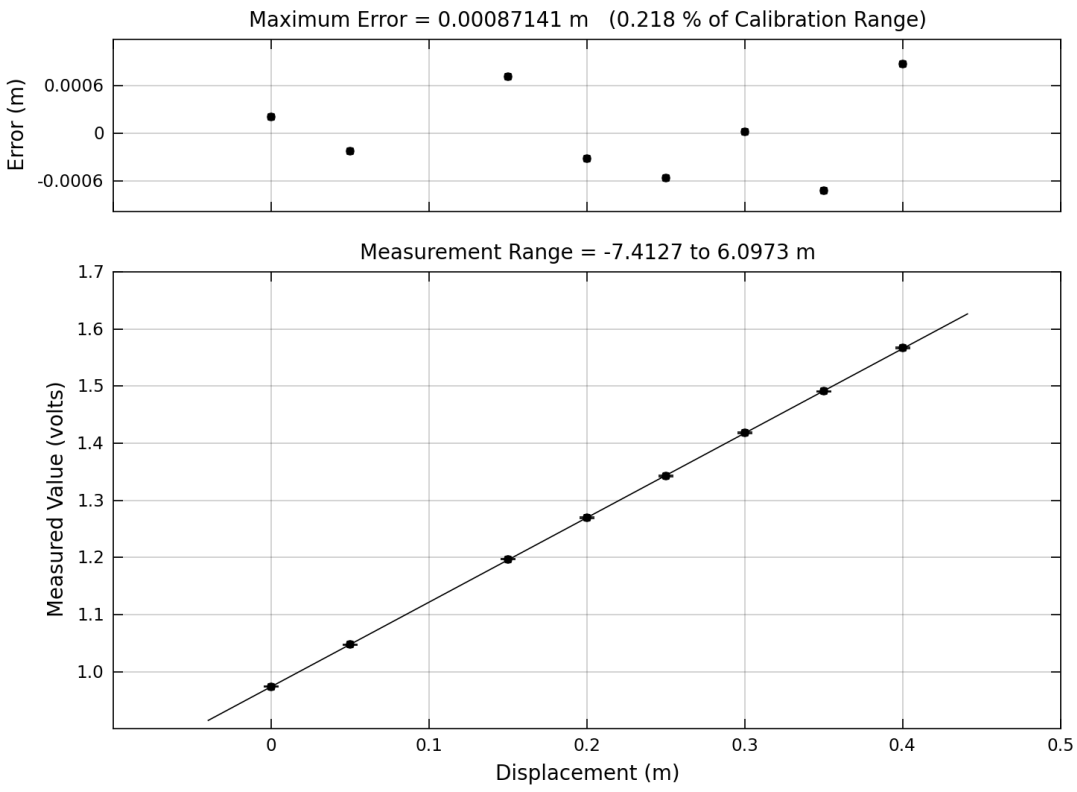
JSS-Preliminary Design Model Tests
Calibration of Encounter probe
Calibrated 2011-11-23 16:12Z

Test Facility: CWT	**Serial #:**	**Filter Frequency:** 10
Data Source: TOWDAS:50001 Channel 19	**Programmable Gain:** 1	**Excitation:** 10v
Sensor Model:	**Plug-In Gain:** 1	

Data Point #	Physical Value (m)	Measured Value (volts)	Fitted Curve Value (m)	Error (m)	Definition of Calibration Curve
1	0.00000	0.97400	0.00020316	0.00020316	Polynomial Degree = 1 (Linear Fit)
2	0.050000	1.0474	0.049781	-0.00021898	$Y = C_0 + C_1 \cdot V$
3	0.15000	1.1968	0.15071	0.00071032	where $Y(t)$ = Displacement (m),
4	0.20000	1.2693	0.19969	-0.00031338	$V(t)$ = measured value (volts),
5	0.25000	1.3430	0.24945	-0.00055499	C_0 = -0.65773 m,
6	0.30000	1.4178	0.30002	1.7400e-05	C_1 = 0.6755 m/volt,
7	0.35000	1.4908	0.34929	-0.00071494	
8	0.40000	1.5671	0.40087	0.00087141	



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APPENDIX D

WAVE MATCHING

Sea State 3

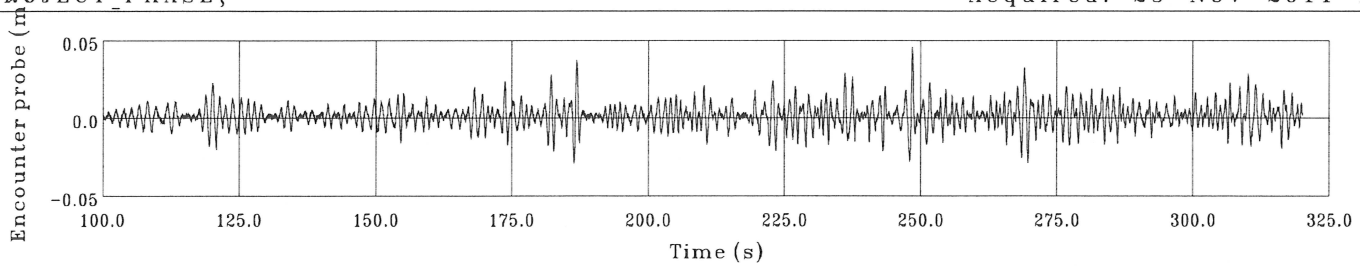
H_S = 0.88 m – T_P = 7.5 s

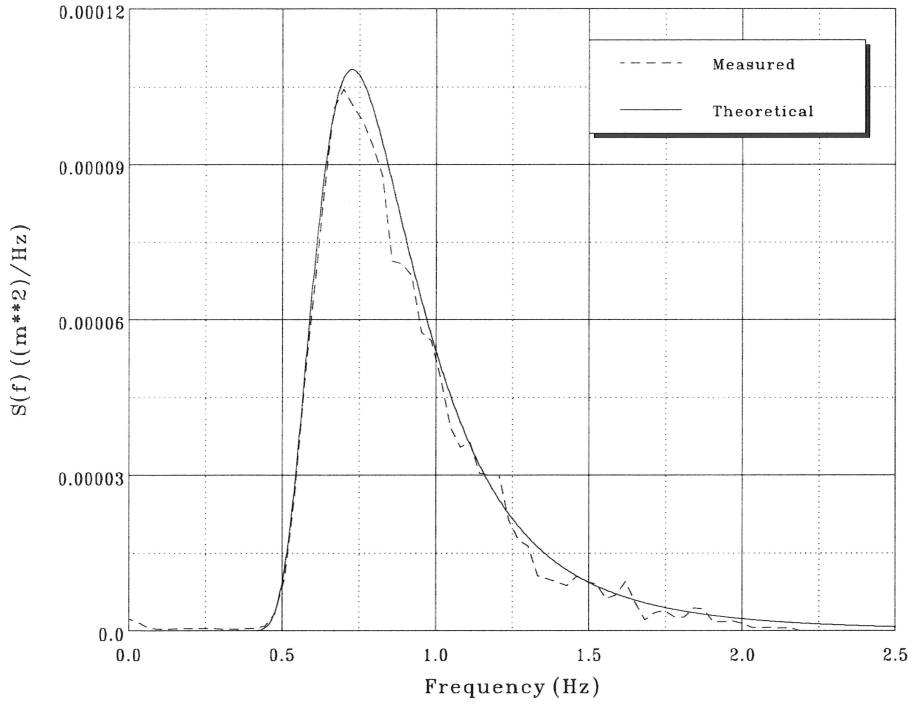
Spectrum repeat period = 20 minutes

Final iteration is first plot shown

JSS-Preliminary Design Model Tests
{PROJECT_PHASE}

Analyzed: {ANA_DATE} {ANA_TIME}
Acquired: 25-NOV-2011 17:25:44





Spectral Analysis:		TARGET / (TOLERANCE)
Hm_0	= 0.0284 m	
T_p	= 1.4303 s	1.3760 s
m_0	= 0.0001	
m_2	= 0.0000	
T_Z	= 1.0640 s	
ε_4	= 0.5715	
DOF	= 30.00	
Deviation from target T_p	= 3.943 %	(7.5 %)

Zero-Crossing Analysis:		
H_s	= 0.0279 m	0.0296 m
Deviation from target H_s	= -5.695 %	(2.5 %)

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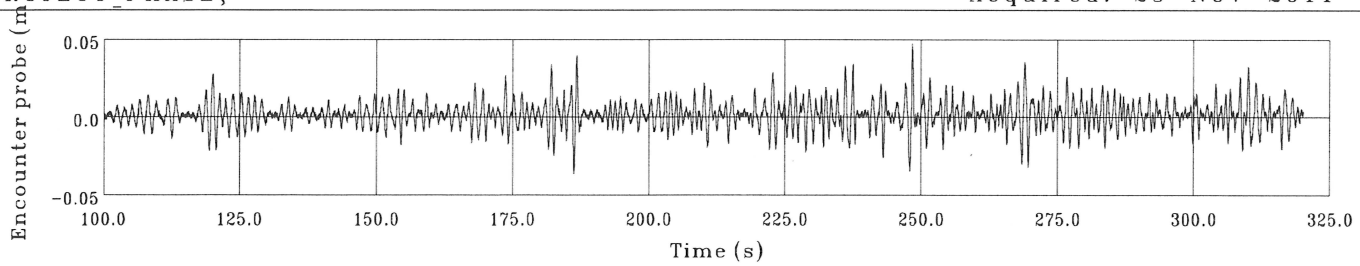
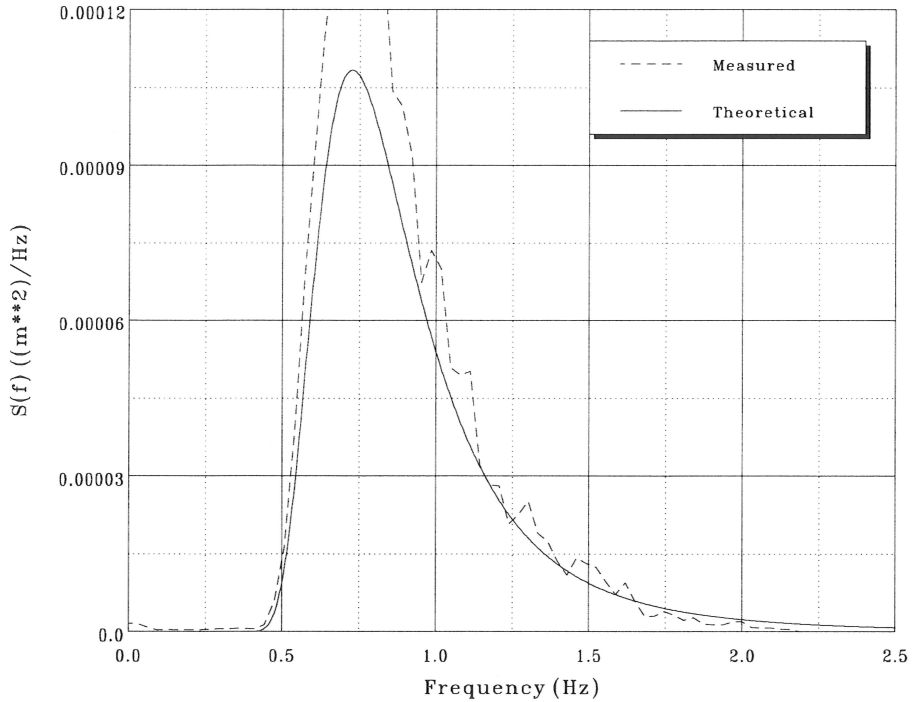
GENERATED BY:	CHECKED BY:	APPROVED BY:

Figure {FIGURE_NUMBER} HS0P88_T7P5_005

JSS-Preliminary Design Model Tests
{PROJECT_PHASE}

Analyzed: {ANA_DATE} {ANA_TIME}
Acquired: 25-NOV-2011 17:04:04





Spectral Analysis:		TARGET / (TOLERANCE)
Hm_0	= 0.0331 m	
T_p	= 1.3111 s	1.3760 s
m_0	= 0.0001	
m_2	= 0.0001	
T_z	= 1.0873 s	
ε_4	= 0.5564	
DOF	= 30.00	
Deviation from target T_p	= 4.719 %	(7.5 %)

Zero-Crossing Analysis:		
H_s	= 0.0329 m	0.0296 m
Deviation from target H_s	= 11.11 %	(2.5 %)

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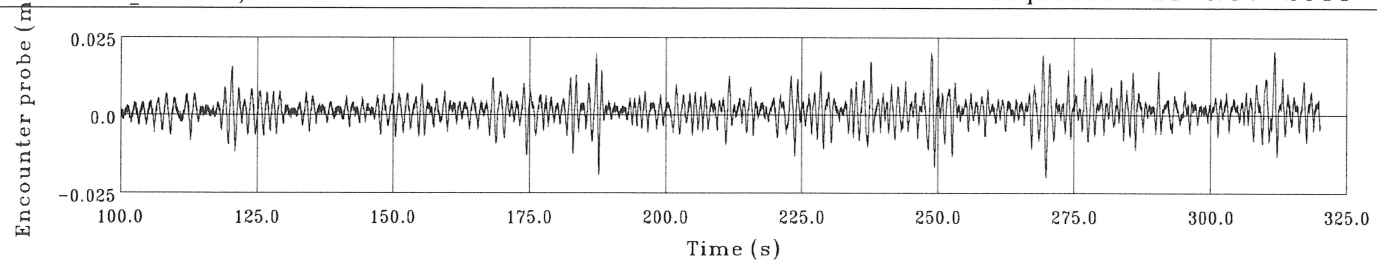
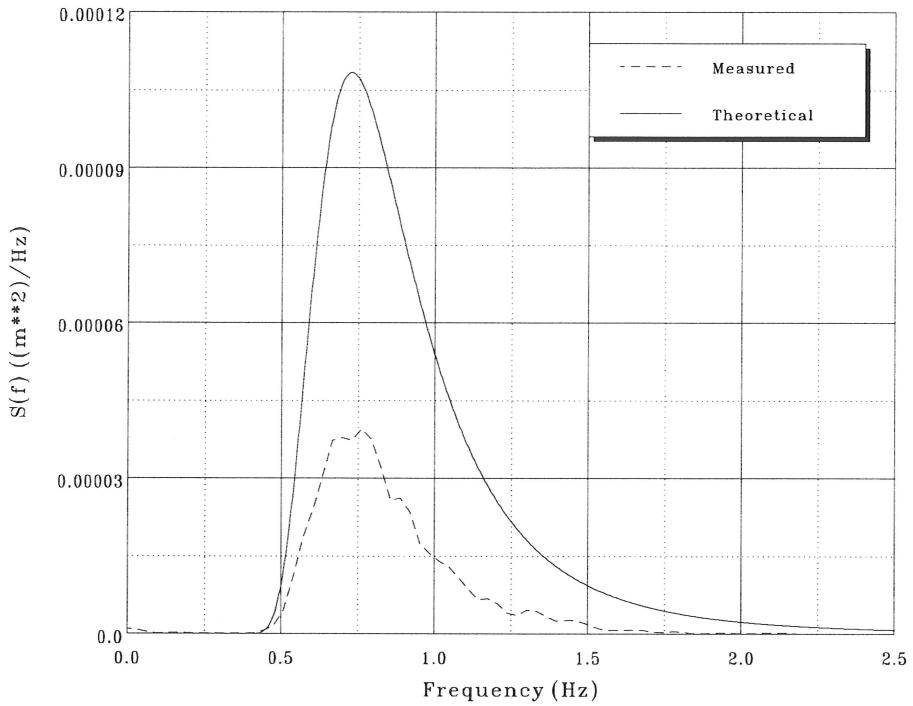
Figure {FIGURE_NUMBER} HS0P88_T7P5_004

JSS-Preliminary Design Model Tests
{PROJECT_PHASE}

Analyzed: {ANA_DATE} {ANA_TIME}
Acquired: 25-NOV-2011 16:25:36





Spectral Analysis:		TARGET / (TOLERANCE)
Hm_0	= 0.0164 m	
T_p	= 1.3111 s	1.3760 s
m_0	= 0.0000	
m_2	= 0.0000	
T_Z	= 1.1399 s	
ε_4	= 0.5391	
DOF	= 30.00	
Deviation from target T_p	= 4.719 %	(7.5 %)

Zero-Crossing Analysis:		
H_s	= 0.0155 m	0.0296 m
Deviation from target H_s	= -47.62 %	(2.5 %)

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GENERATED BY:	CHECKED BY:	APPROVED BY:

Figure {FIGURE_NUMBER} HS0P88_T7P5_003

Sea State 5

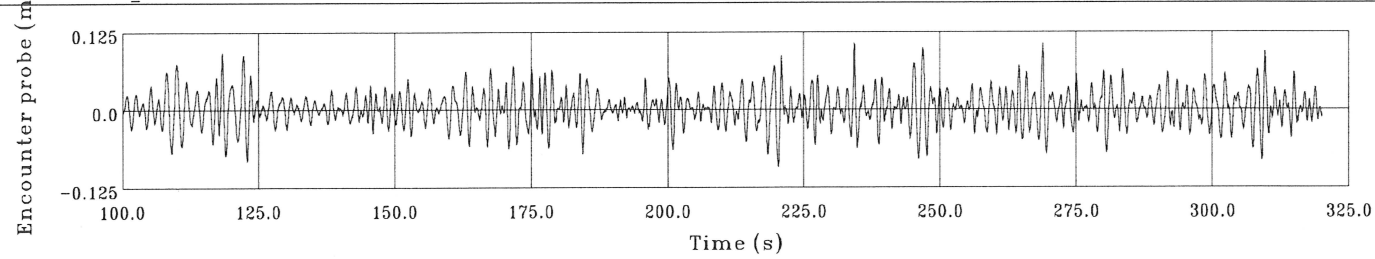
H_S = 3.25 m – T_P = 9.7 s

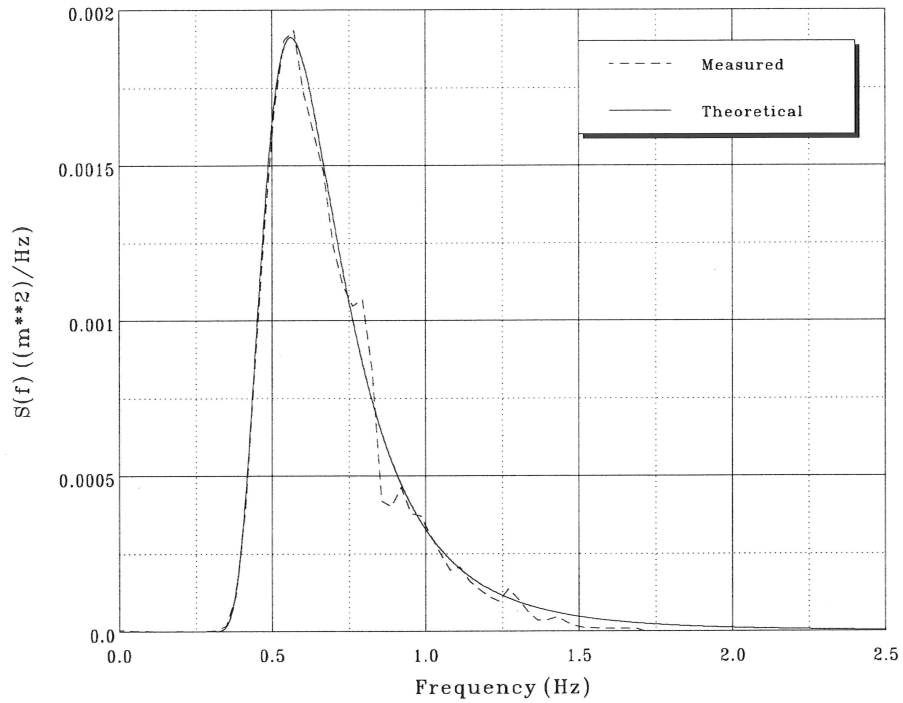
Spectrum repeat period = 20 minutes

Final iteration is first plot shown

JSS-Preliminary Design Model Tests
{PROJECT_PHASE}

Analyzed: {ANA_DATE} {ANA_TIME}
Acquired: 25-NOV-2011 17:44:41





Spectral Analysis:		TARGET / (TOLERANCE)
Hm_0	= 0.1068 m	
T_p	= 1.7481 s	1.7800 s
m_0	= 0.0007	
m_2	= 0.0004	
T_Z	= 1.3850 s	
ε_4	= 0.5519	
DOF	= 30.00	
Deviation from target T_p	= 1.792 %	(7.5 %)

Zero-Crossing Analysis:		
H_s	= 0.1102 m	0.1095 m
Deviation from target H_s	= 0.6383 %	(2.5 %)

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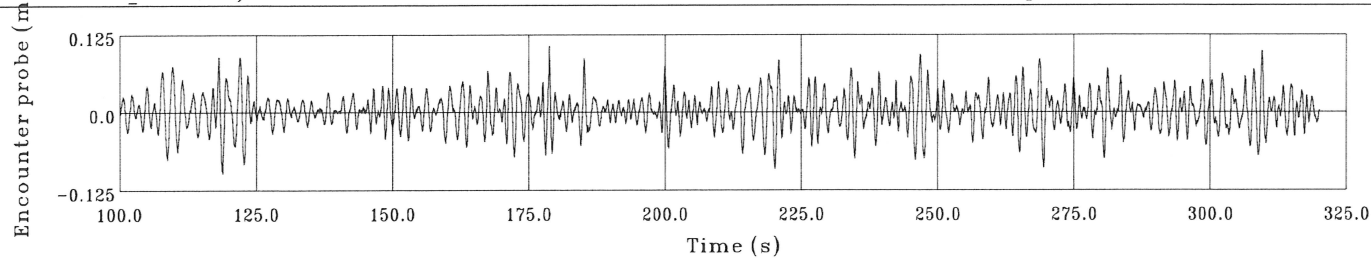
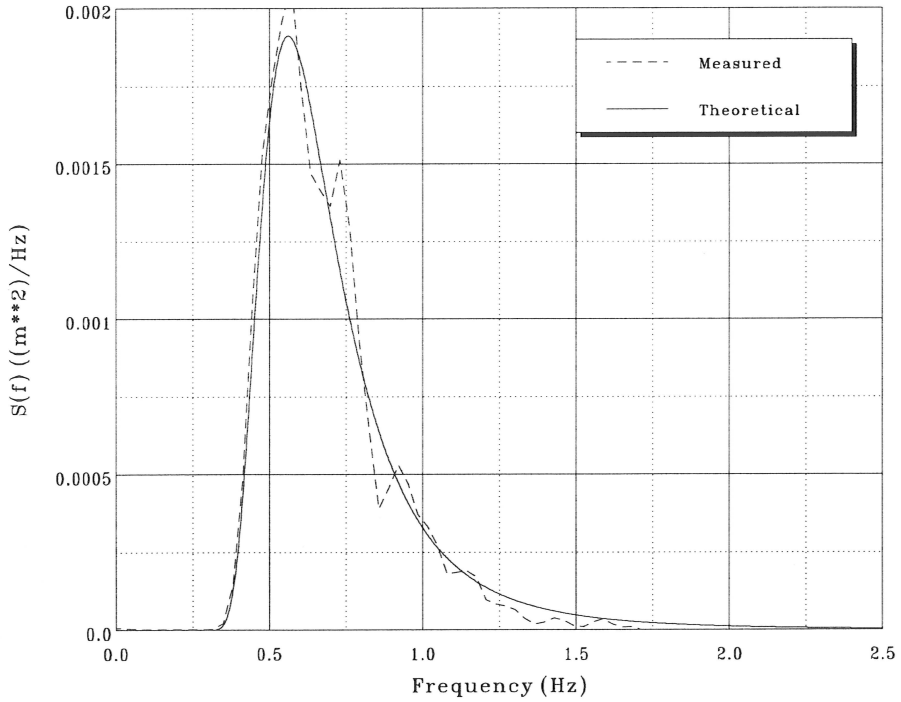
GENERATED BY:	CHECKED BY:	APPROVED BY:

Figure {FIGURE_NUMBER} S_HS3P25_T9P7_003

JSS-Preliminary Design Model Tests
{PROJECT_PHASE}

Analyzed: {ANA_DATE} {ANA_TIME}
Acquired: 25-NOV-2011 15:39:21





		TARGET / (TOLERANCE)
Spectral Analysis:		
Hm_0	= 0.1095 m	
T_p	= 1.7481 s	1.7800 s
m_0	= 0.0007	
m_2	= 0.0004	
T_Z	= 1.3991 s	
ε_4	= 0.5546	
DOF	= 30.00	
Deviation from target T_p	= 1.792 %	(7.5 %)
Zero-Crossing Analysis:		
H_s	= 0.1112 m	0.1095 m
Deviation from target H_s	= 1.517 %	(2.5 %)

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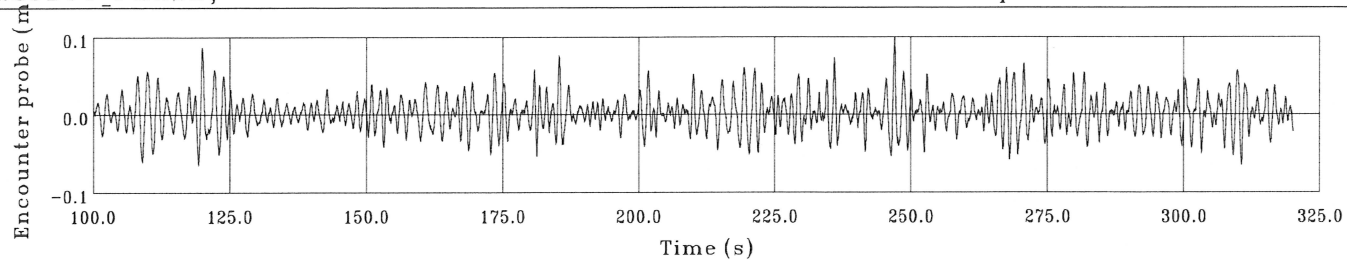
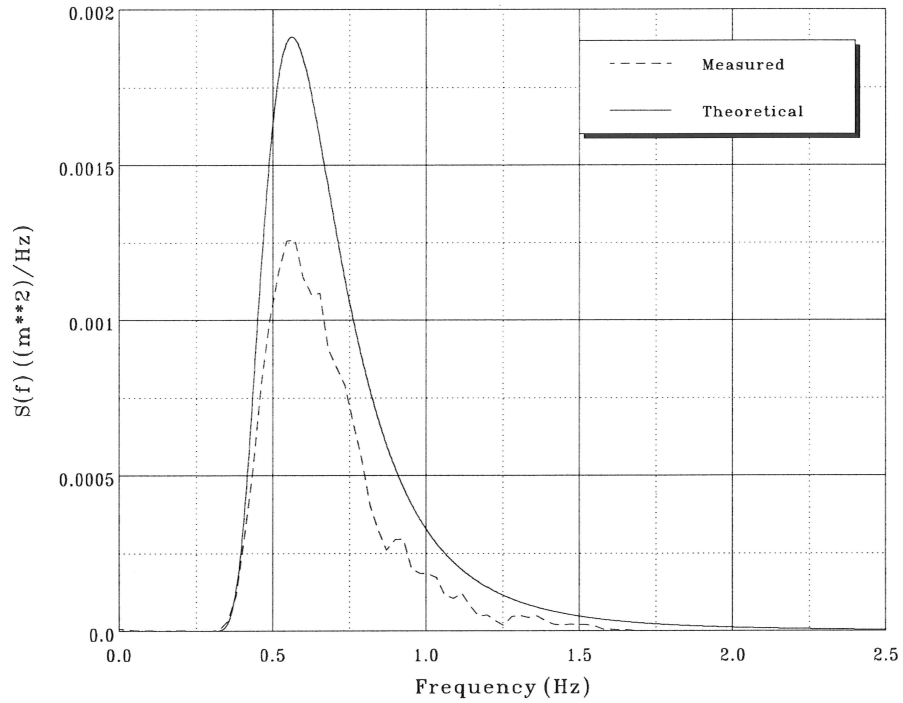
GENERATED BY:	CHECKED BY:	APPROVED BY:

Figure {FIGURE_NUMBER} S_HS3P25_T9P7_002

JSS-Preliminary Design Model Tests
{PROJECT_PHASE}

Analyzed: {ANA_DATE} {ANA_TIME}
Acquired: 25-NOV-2011 15:19:07





Spectral Analysis:		TARGET / (TOLERANCE)
Hm_0	= 0.0856 m	
T_p	= 1.7481 s	1.7800 s
m_0	= 0.0005	
m_2	= 0.0002	
T_z	= 1.4174 s	
ε_4	= 0.5590	
DOF	= 26.00	
Deviation from target T_p	= 1.792 %	(7.5 %)

Zero-Crossing Analysis:		
H_s	= 0.0889 m	0.1095 m
Deviation from target H_s	= −18.82 %	(2.5 %)

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GENERATED BY:	CHECKED BY:	APPROVED BY:

Figure {FIGURE_NUMBER} S_HS3P25_T9P7_001

Sea State 5

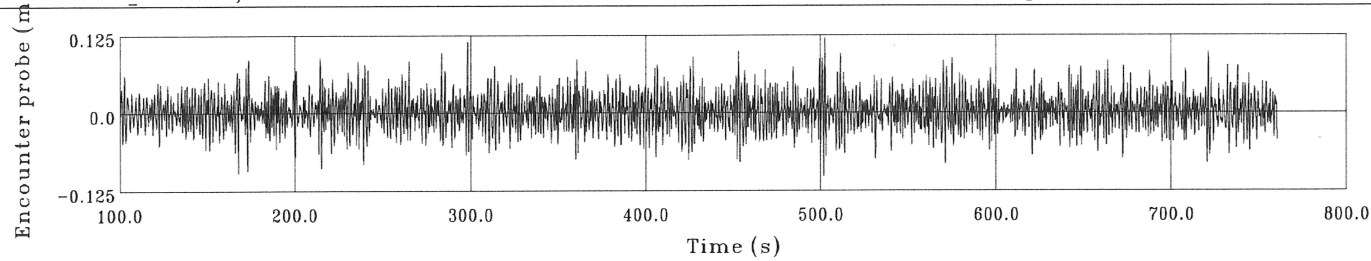
H_S = 3.25 m – T_P = 9.7 s

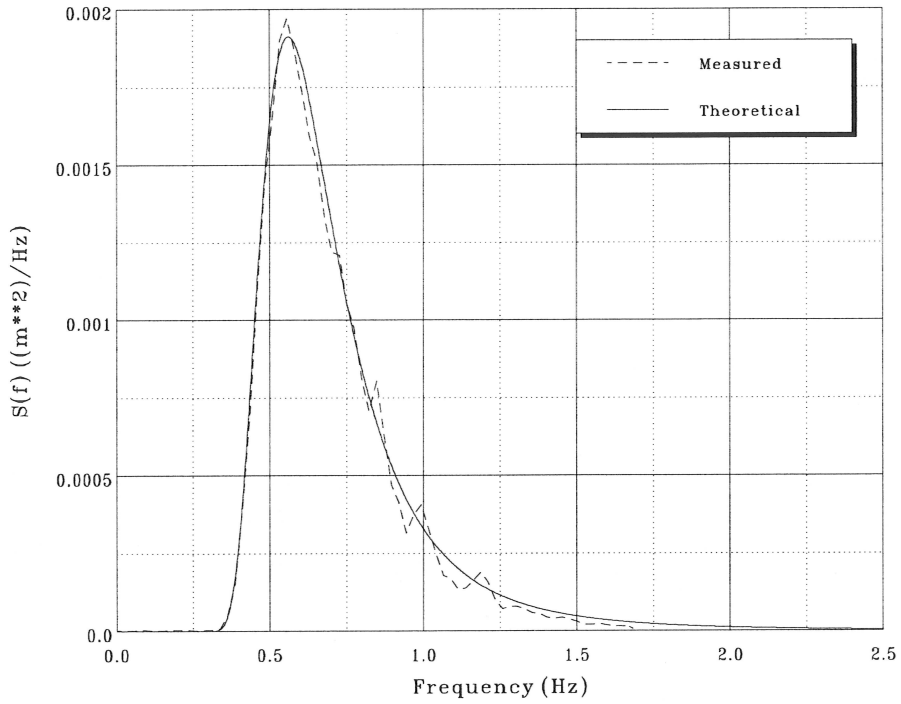
Spectrum repeat period = 60 minutes

Final iteration is first plot shown

JSS-Preliminary Design Model Tests
{PROJECT_PHASE}

Analyzed: {ANA_DATE} {ANA_TIME}
Acquired: 25-NOV-2011 18:38:40





Spectral Analysis:		TARGET / (TOLERANCE)
Hm_0	= 0.1067 m	
T_p	= 1.7954 s	1.7800 s
m_0	= 0.0007	
m_2	= 0.0004	
T_z	= 1.3783 s	
ε_4	= 0.5655	
DOF	= 66.00	
Deviation from target T_p	= 0.8671 %	(7.5 %)

Zero-Crossing Analysis:		
H_s	= 0.1078 m	0.1095 m
Deviation from target H_s	= -1.508 %	(2.5 %)

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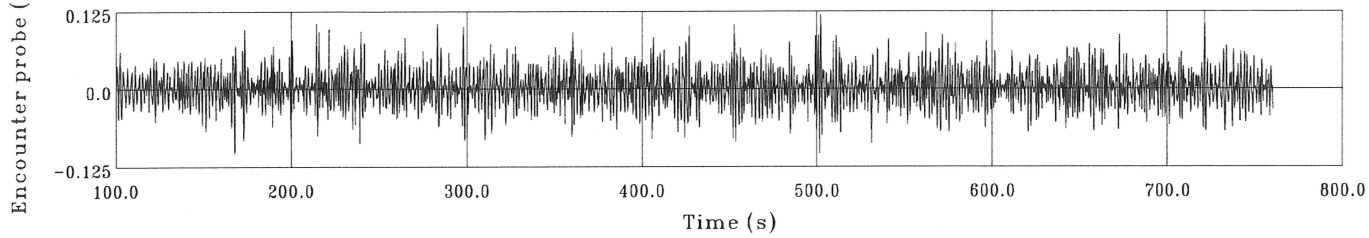
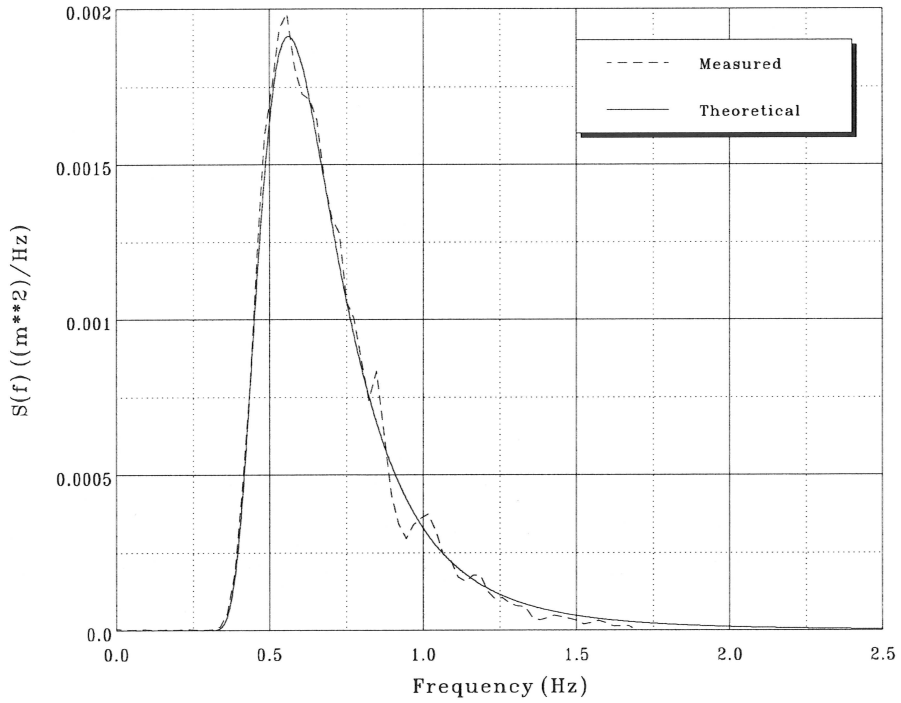
Figure {FIGURE_NUMBER} HS3P25_T9P7_003

JSS-Preliminary Design Model Tests
{PROJECT_PHASE}

Analyzed: {ANA_DATE} {ANA_TIME}
Acquired: 25-NOV-2011 14:46:43





Spectral Analysis:		TARGET / (TOLERANCE)
Hm_0	= 0.1091 m	
T_p	= 1.7954 s	1.7800 s
m_0	= 0.0007	
m_2	= 0.0004	
T_z	= 1.3810 s	
ε_4	= 0.5674	
DOF	= 66.00	
Deviation from target T_p	= 0.8671 %	(7.5 %)

Zero-Crossing Analysis:		
H_s	= 0.1105 m	0.1095 m
Deviation from target H_s	= 0.9501 %	(2.5 %)

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Figure {FIGURE_NUMBER} HS3P25_T9P7_002

JSS-Preliminary Design Model Tests
{PROJECT_PHASE}

Analyzed: {ANA_DATE} {ANA_TIME}
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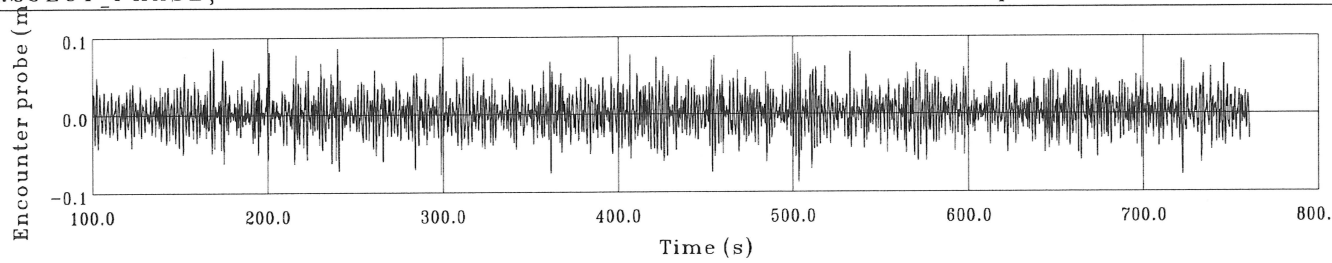

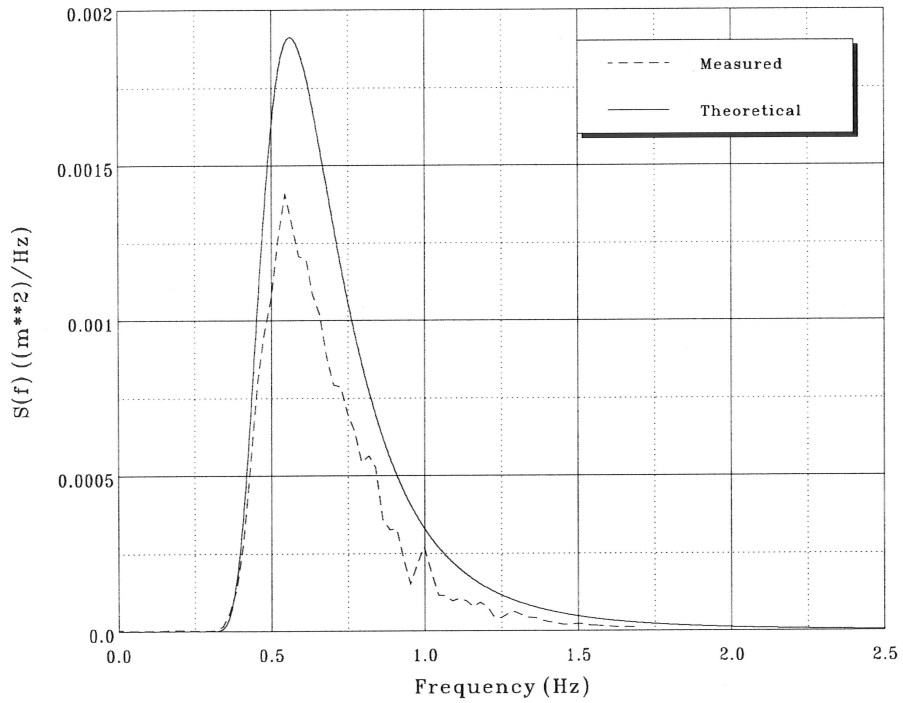

Spectral Analysis:		TARGET / (TOLERANCE)
Hm_0	= 0.0880 m	
T_p	= 1.8353 s	1.7800 s
m_0	= 0.0005	
m_2	= 0.0002	
T_Z	= 1.4029 s	
ε_4	= 0.5743	
DOF	= 62.00	
Deviation from target T_p	= 3.109 %	(7.5 %)

Zero-Crossing Analysis:		
H_s	= 0.0890 m	0.1095 m
Deviation from target H_s	= −18.72 %	(2.5 %)

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Figure {FIGURE_NUMBER} HS3P25_T9P7_001

Sea State 5H

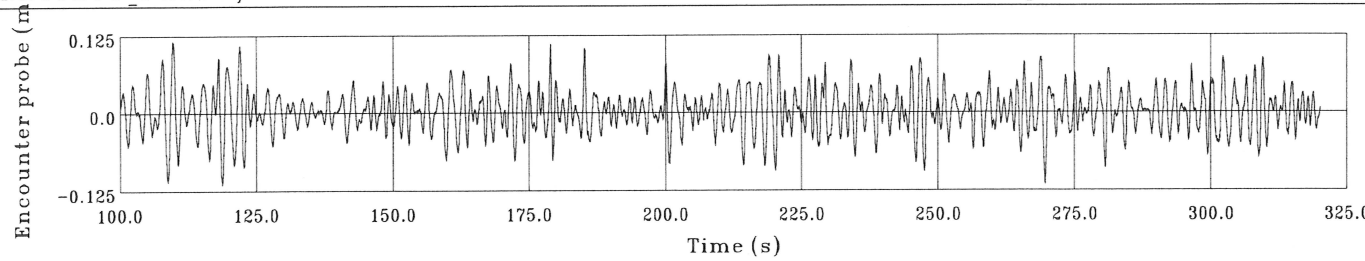
H_S = 4.0 m – T_P = 9.7 s

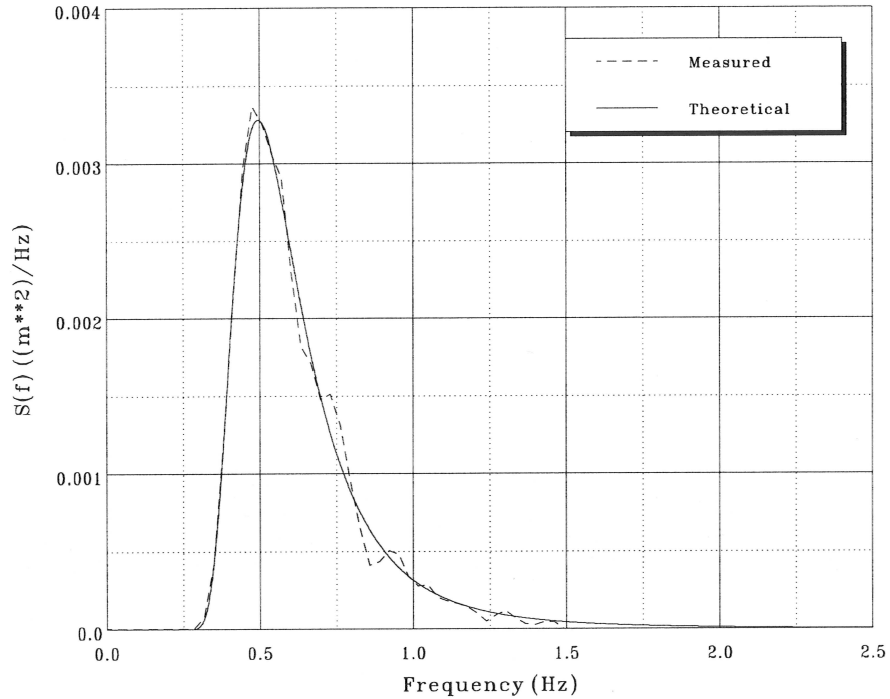
Spectrum repeat period = 20 minutes

Final iteration is first plot shown

JSS-Preliminary Design Model Tests
{PROJECT_PHASE}

Analyzed: {ANA_DATE} {ANA_TIME}
Acquired: 25-NOV-2011 13:38:39





Spectral Analysis:		TARGET / (TOLERANCE)
Hm_0	= 0.1338 m	
T_p	= 2.0977 s	2.0190 s
m_0	= 0.0011	
m_2	= 0.0005	
T_z	= 1.5500 s	
ε_4	= 0.5761	
DOF	= 30.00	
Deviation from target T_p	= 3.899 %	(7.5 %)

Zero-Crossing Analysis:		
H_s	= 0.1346 m	0.1347 m
Deviation from target H_s	= -0.04185 %	(2.5 %)

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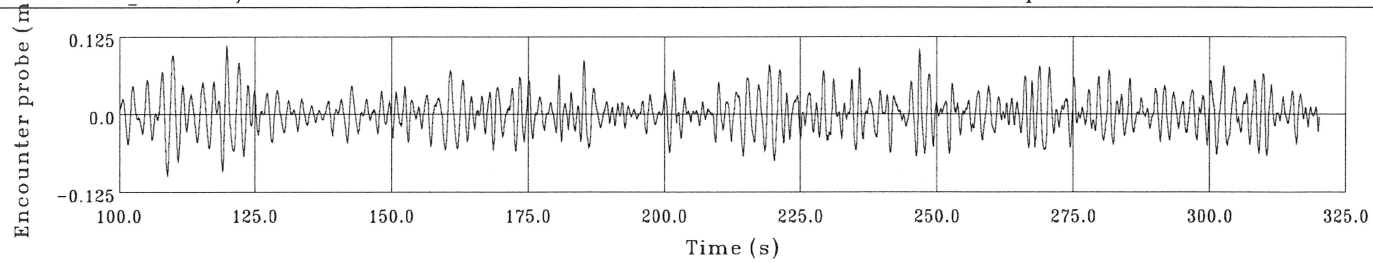
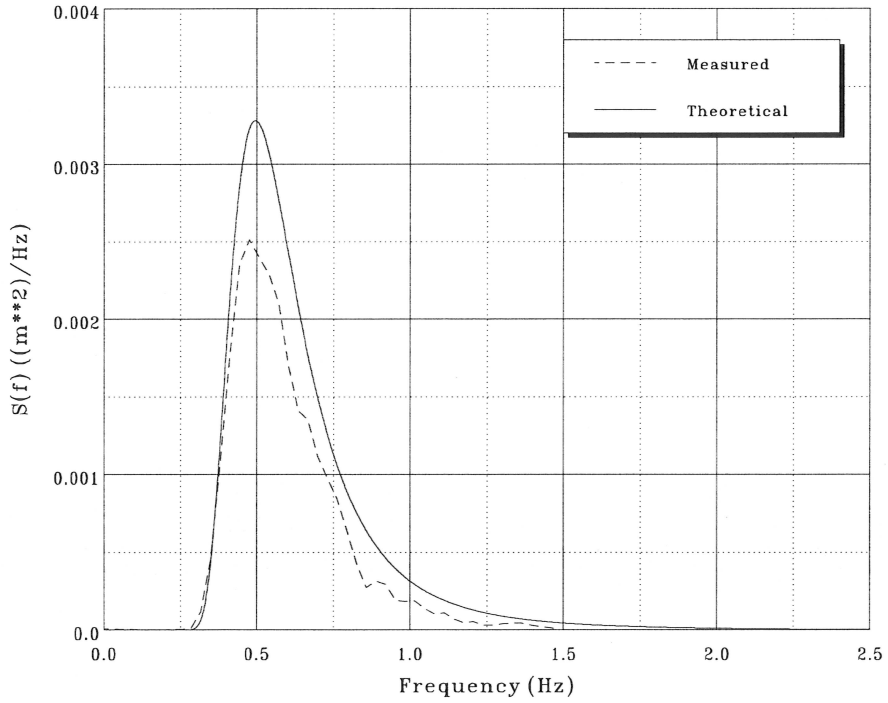
Figure {FIGURE_NUMBER} HS4P0_T11P0_002

JSS-Preliminary Design Model Tests
{PROJECT_PHASE}

Analyzed: {ANA_DATE} {ANA_TIME}
Acquired: 25-NOV-2011 13:16:49





Spectral Analysis:		TARGET / (TOLERANCE)
Hm_0	= 0.1146 m	
T_p	= 2.0977 s	2.0190 s
m_0	= 0.0008	
m_2	= 0.0003	
T_z	= 1.6111 s	
ε_4	= 0.5647	
DOF	= 30.00	
Deviation from target T_p	= 3.899 %	(7.5 %)

Zero-Crossing Analysis:		
H_s	= 0.1136 m	0.1347 m
Deviation from target H_s	= -15.65 %	(2.5 %)

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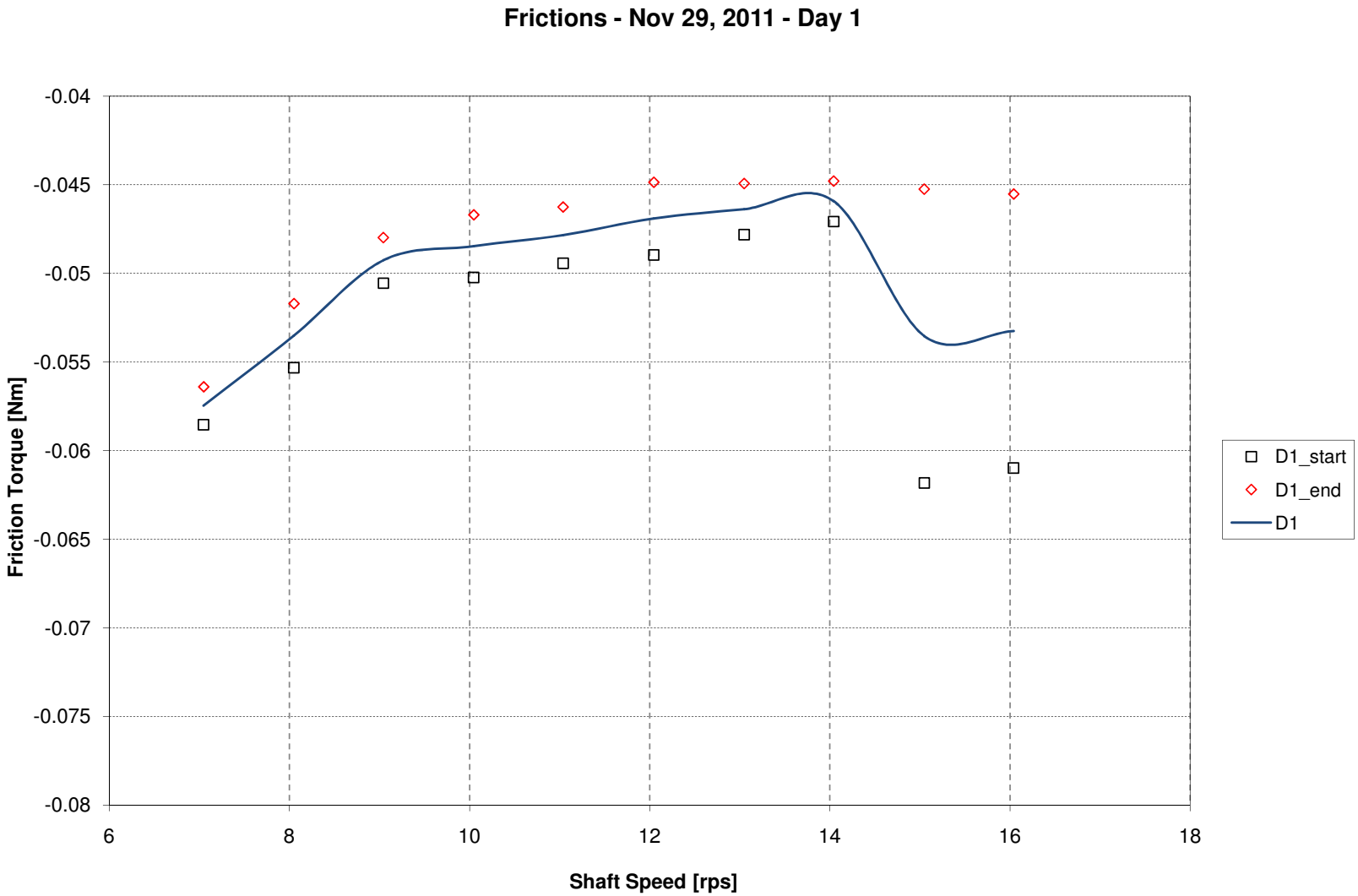
Figure {FIGURE_NUMBER} HS4P0_T11P0_001

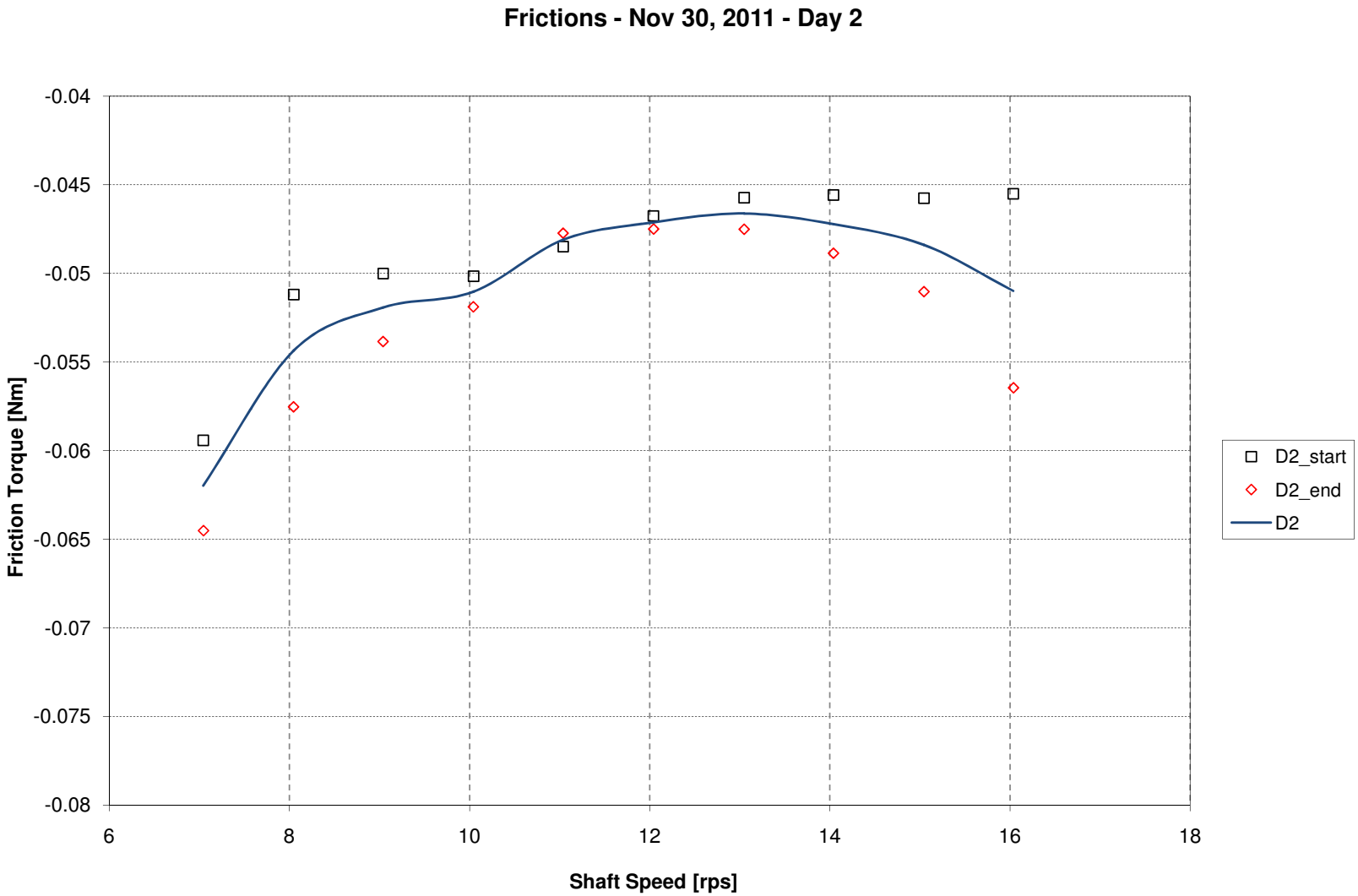
APPENDIX E

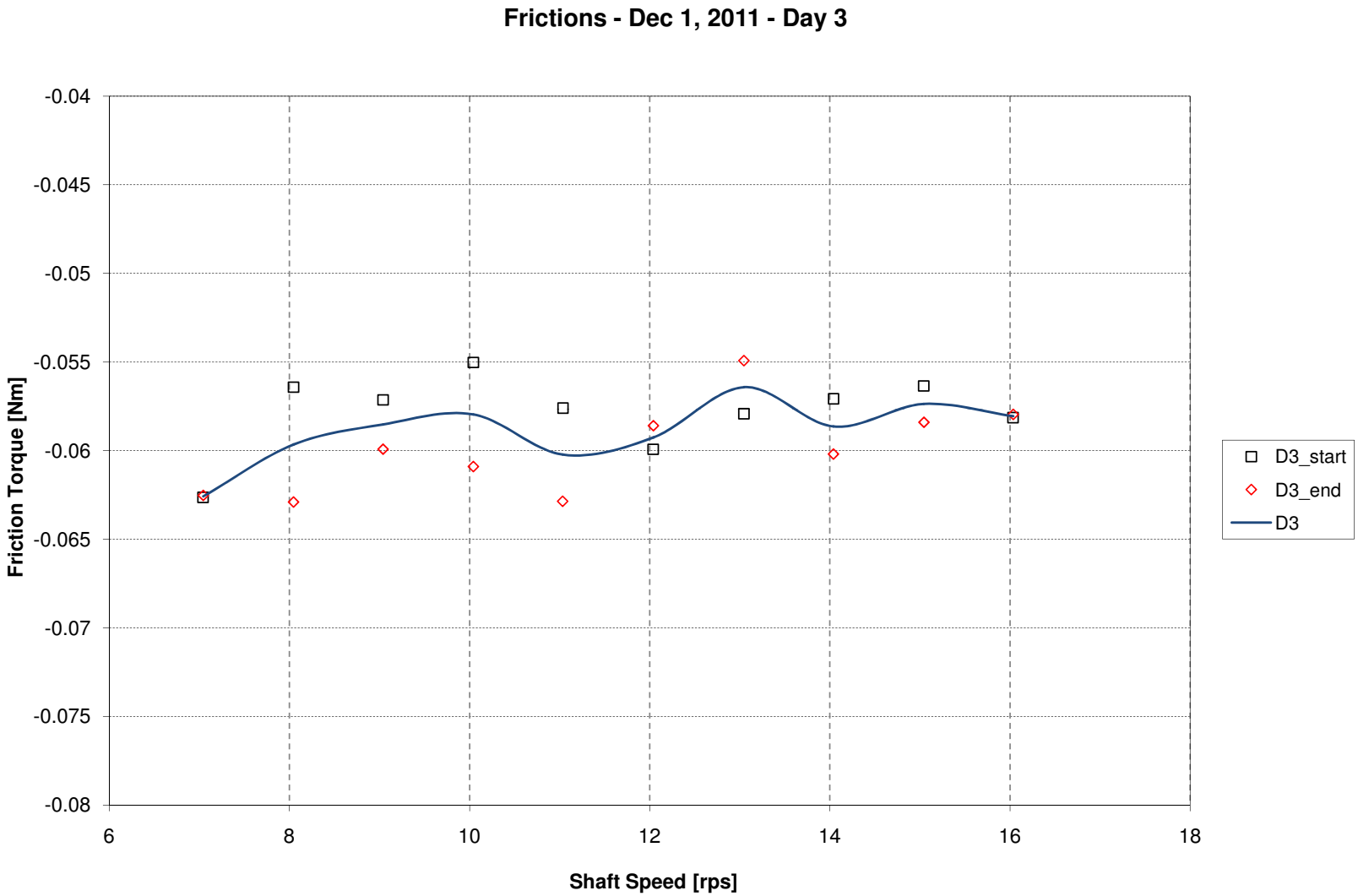
SHAFT FRICTIONS and IN-SITU PROPULSION SYSTEM CHECKS

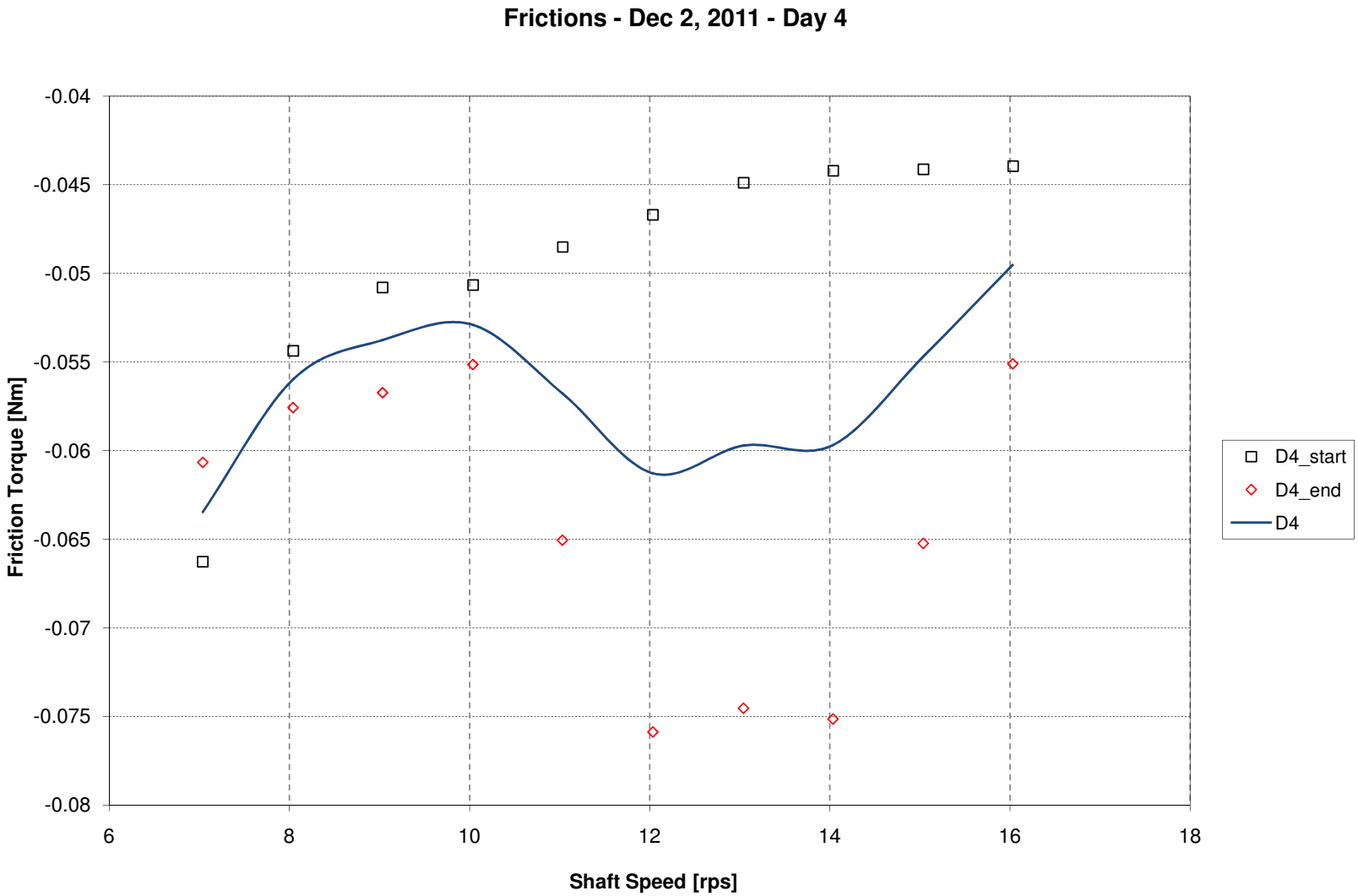
Test Name	Acquisition Time	Segment Start Time (s)	Segment End Time (s)	Shaft Speed (rps)	Dyno Torque (Nm)	Mean Shaft Speed [rps]	Mean Torque [Nm]
					D1_start		D1
FRICTION_009	29/11/2011 14:58	146.8522	160.5558	7.047025	-0.05854	7.04799	-0.05747
FRICTION_009	29/11/2011 14:58	169.0743	181.2964	8.049811	-0.05533	8.050143	-0.05352
FRICTION_009	29/11/2011 14:58	188.7038	200.7407	9.042357	-0.05055	9.042559	-0.04926
FRICTION_009	29/11/2011 14:58	207.4074	220.1851	10.04626	-0.05024	10.04659	-0.04847
FRICTION_009	29/11/2011 14:58	227.4072	239.6294	11.03989	-0.04943	11.04004	-0.04784
FRICTION_009	29/11/2011 14:58	247.7775	259.4441	12.0432	-0.04896	12.04434	-0.04691
FRICTION_009	29/11/2011 14:58	266.2959	280.7403	13.04985	-0.04782	13.04978	-0.04638
FRICTION_009	29/11/2011 14:58	289.0735	301.2957	14.04275	-0.04707	14.04313	-0.04593
FRICTION_009	29/11/2011 14:58	308.7031	321.2956	15.04634	-0.06183	15.04733	-0.05354
FRICTION_009	29/11/2011 14:58	327.9622	343.888	16.03894	-0.06098	16.03995	-0.05325
					D1_end		
FRICTION_010	29/11/2011 22:00	70.52269	92.24479	7.048955	-0.0564		
FRICTION_010	29/11/2011 22:00	100.4225	114.7335	8.050476	-0.05171		
FRICTION_010	29/11/2011 22:00	121.1224	132.3668	9.04276	-0.04798		
FRICTION_010	29/11/2011 22:00	139.2667	153.3222	10.04691	-0.04669		
FRICTION_010	29/11/2011 22:00	157.4111	172.7443	11.04019	-0.04625		
FRICTION_010	29/11/2011 22:00	179.6443	192.6775	12.04547	-0.04486		
FRICTION_010	29/11/2011 22:00	200.3441	213.633	13.0497	-0.04494		
FRICTION_010	29/11/2011 22:00	221.5551	234.0773	14.0435	-0.04479		
FRICTION_010	29/11/2011 22:00	243.2772	254.5216	15.04831	-0.04525		
FRICTION_010	29/11/2011 22:00	261.4216	284.677	16.04096	-0.04552		
					D2_start		D2
FRICTION_011	30/11/2011 11:45	57.74499	75.63377	7.043743	-0.05943	7.045195	-0.06197
FRICTION_011	30/11/2011 11:45	88.15592	110.9002	8.04895	-0.0512	8.048275	-0.05436
FRICTION_011	30/11/2011 11:45	119.5891	137.7334	9.039183	-0.05001	9.03997	-0.05193
FRICTION_011	30/11/2011 11:45	144.3778	158.1777	10.04535	-0.05017	10.04438	-0.05103
FRICTION_011	30/11/2011 11:45	167.8888	182.7109	11.03813	-0.04849	11.03797	-0.04811
FRICTION_011	30/11/2011 11:45	189.8664	203.4108	12.04091	-0.04675	12.04194	-0.04713
FRICTION_011	30/11/2011 11:45	210.8219	222.0662	13.0488	-0.04573	13.0484	-0.04662
FRICTION_011	30/11/2011 11:45	228.9662	245.0661	14.03963	-0.04558	14.04033	-0.04722
FRICTION_011	30/11/2011 11:45	249.4105	262.9549	15.04462	-0.04576	15.0451	-0.0484
FRICTION_011	30/11/2011 11:45	272.4104	292.3436	16.03635	-0.04551	16.0371	-0.05099
					D2_end		
FRICTION_012	30/11/2011 22:30	4.845305	27.07851	0.080659	-0.03404		
FRICTION_012	30/11/2011 22:30	40.87842	53.65613	7.046647	-0.06452		
FRICTION_012	30/11/2011 22:30	61.32275	74.61156	8.047601	-0.05753		
FRICTION_012	30/11/2011 22:30	82.27818	103.4892	9.040758	-0.05384		
FRICTION_012	30/11/2011 22:30	111.1558	127.0001	10.04342	-0.05189		
FRICTION_012	30/11/2011 22:30	138.7556	160.7333	11.03781	-0.04773		
FRICTION_012	30/11/2011 22:30	165.8444	186.2887	12.04298	-0.0475		
FRICTION_012	30/11/2011 22:30	191.9109	210.3108	13.048	-0.04751		
FRICTION_012	30/11/2011 22:30	214.3996	233.3106	14.04103	-0.04886		
FRICTION_012	30/11/2011 22:30	237.655	254.7772	15.04557	-0.05103		
FRICTION_012	30/11/2011 22:30	259.6327	281.8659	16.03786	-0.05646		

Test Name	Acquisition Time	Segment Start Time (s)	Segment End Time (s)	Shaft Speed (rps)	Dyno Torque (Nm)	Mean Shaft Speed [rps]	Mean Torque [Nm]
					D3_start		D3
FRICTION_013	01/12/2011 11:43	34.48957	47.01172	7.042442	-0.06264	7.043735	-0.06258
FRICTION_013	01/12/2011 11:43	54.42279	67.45604	8.047464	-0.05641	8.046513	-0.05966
FRICTION_013	01/12/2011 11:43	74.356	87.13371	9.039855	-0.05713	9.039472	-0.05852
FRICTION_013	01/12/2011 11:43	94.03366	107.578	10.04308	-0.05502	10.0426	-0.05796
FRICTION_013	01/12/2011 11:43	113.4558	128.0224	11.0358	-0.0576	11.03503	-0.06023
FRICTION_013	01/12/2011 11:43	135.1779	146.4222	12.03807	-0.05991	12.03973	-0.05925
FRICTION_013	01/12/2011 11:43	153.8333	167.3777	13.04603	-0.05792	13.04578	-0.05642
FRICTION_013	01/12/2011 11:43	174.2776	188.0776	14.03886	-0.05708	14.03878	-0.05864
FRICTION_013	01/12/2011 11:43	194.2108	207.7552	15.04168	-0.05634	15.04281	-0.05737
FRICTION_013	01/12/2011 11:43	214.6552	229.9884	16.0338	-0.05814	16.03491	-0.05805
					D3_end		
FRICTION_014	01/12/2011 23:08	6.593294	23.41727	7.045029	-0.06252		
FRICTION_014	01/12/2011 23:08	30.23204	43.00975	8.045562	-0.06291		
FRICTION_014	01/12/2011 23:08	48.97267	63.24111	9.039089	-0.05992		
FRICTION_014	01/12/2011 23:08	69.417	83.47247	10.04213	-0.0609		
FRICTION_014	01/12/2011 23:08	89.64836	102.852	11.03425	-0.06286		
FRICTION_014	01/12/2011 23:08	109.6668	122.8704	12.04138	-0.05859		
FRICTION_014	01/12/2011 23:08	129.2592	142.8888	13.04553	-0.05493		
FRICTION_014	01/12/2011 23:08	149.0647	162.6942	14.03869	-0.0602		
FRICTION_014	01/12/2011 23:08	169.9349	187.1848	15.04395	-0.0584		
FRICTION_014	01/12/2011 23:08	196.7681	222.7494	16.03602	-0.05796		
					D4_start		D4
FRICTION_015	02/12/2011 11:46	50.07837	63.87829	7.039359	-0.06627	7.038855	-0.06347
FRICTION_015	02/12/2011 11:46	71.28936	85.08927	8.044347	-0.05438	8.043033	-0.05597
FRICTION_015	02/12/2011 11:46	94.80033	109.878	9.035625	-0.0508	9.034873	-0.05376
FRICTION_015	02/12/2011 11:46	115.5002	130.0668	10.03927	-0.05066	10.03782	-0.0529
FRICTION_015	02/12/2011 11:46	135.9445	148.2111	11.03303	-0.0485	11.03181	-0.05678
FRICTION_015	02/12/2011 11:46	152.3	167.1221	12.03638	-0.0467	12.03536	-0.06129
FRICTION_015	02/12/2011 11:46	174.0221	187.0553	13.04409	-0.04489	13.04206	-0.05972
FRICTION_015	02/12/2011 11:46	195.4886	208.7774	14.03629	-0.04422	14.03511	-0.05968
FRICTION_015	02/12/2011 11:46	216.6996	230.244	15.03953	-0.04413	15.03847	-0.05469
FRICTION_015	02/12/2011 11:46	241.2328	257.5883	16.0321	-0.04395	16.03119	-0.04952
					D4_end		
FRICTION_016	02/12/2011 19:50	116.0264	137.9581	7.038351	-0.06066		
FRICTION_016	02/12/2011 19:50	145.0166	163.419	8.041718	-0.05757		
FRICTION_016	02/12/2011 19:50	171.7379	187.8716	9.034122	-0.05673		
FRICTION_016	02/12/2011 19:50	197.1989	214.845	10.03637	-0.05515		
FRICTION_016	02/12/2011 19:50	223.9202	242.8269	11.0306	-0.06505		
FRICTION_016	02/12/2011 19:50	253.6667	277.615	12.03434	-0.07588		
FRICTION_016	02/12/2011 19:50	289.4632	307.6136	13.04003	-0.07454		
FRICTION_016	02/12/2011 19:50	313.1595	333.8308	14.03394	-0.07515		
FRICTION_016	02/12/2011 19:50	340.3851	356.5187	15.0374	-0.06524		
FRICTION_016	02/12/2011 19:50	365.0897	388.5339	16.03027	-0.0551		

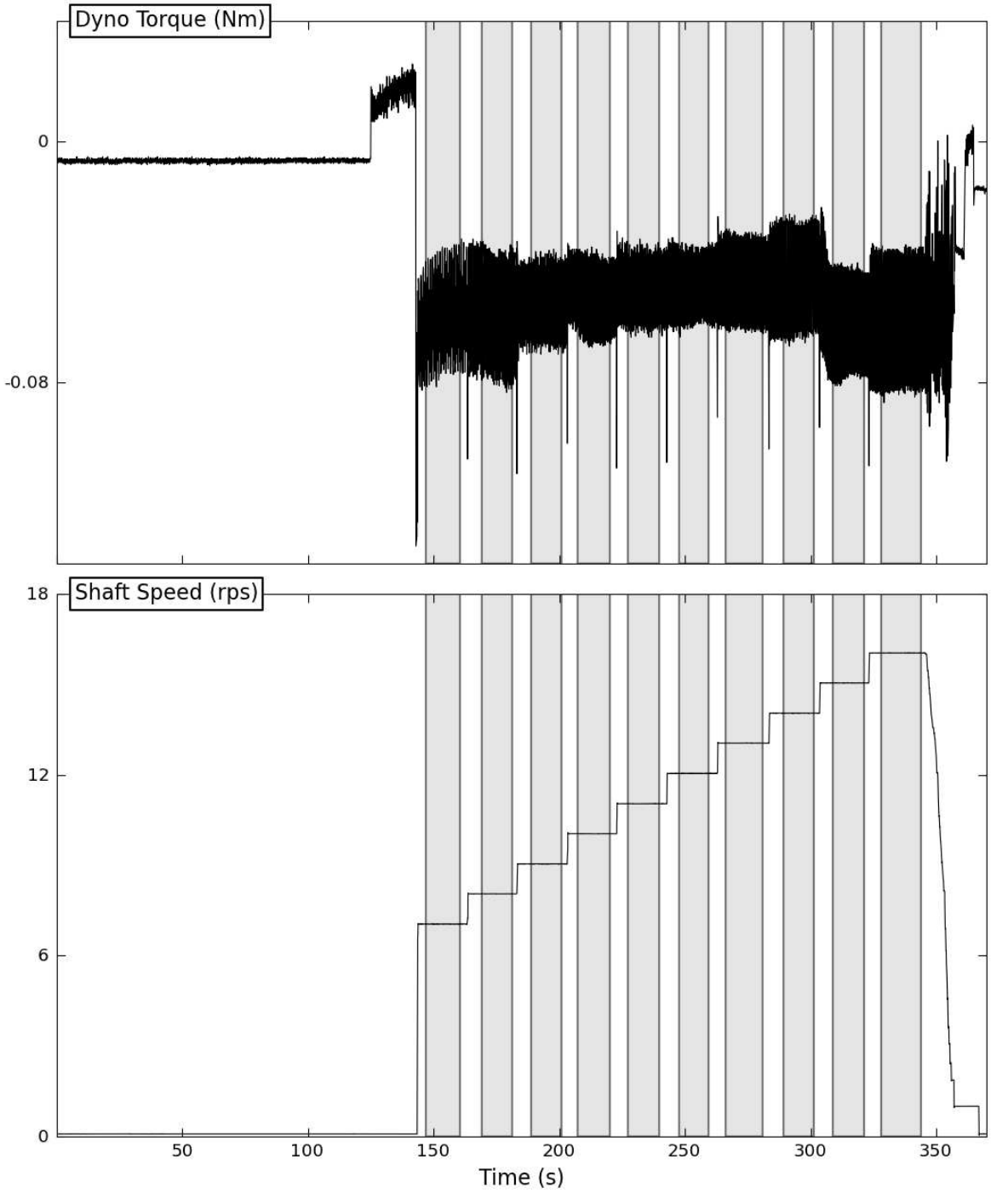

Frictions - Nov 29, 2011 - Day 1
Friction Torque [Nm]
-0.04
-0.045
-0.05
-0.055
-0.06
-0.065
-0.07
-0.075
-0.08
6
8
10
12
14
16
18
Shaft Speed [rps]
D1_start
D1_end
D1


Frictions - Nov 30, 2011 - Day 2
Friction Torque [Nm]
-0.04
-0.045
-0.05
-0.055
-0.06
-0.065
-0.07
-0.075
-0.08
6
8
10
12
14
16
18
Shaft Speed [rps]
D2_start
D2_end
D2


Frictions - Dec 1, 2011 - Day 3
Friction Torque [Nm]
-0.04
-0.045
-0.05
-0.055
-0.06
-0.065
-0.07
-0.075
-0.08
6
8
10
12
14
16
18
Shaft Speed [rps]
D3_start
D3_end
D3


Frictions - Dec 2, 2011 - Day 4
Friction Torque [Nm]
-0.04
-0.045
-0.05
-0.055
-0.06
-0.065
-0.07
-0.075
-0.08
6
8
10
12
14
16
18
Shaft Speed [rps]
D4_start
D4_end
D4

JSS-Preliminary Design Model Tests
FRICTION_009



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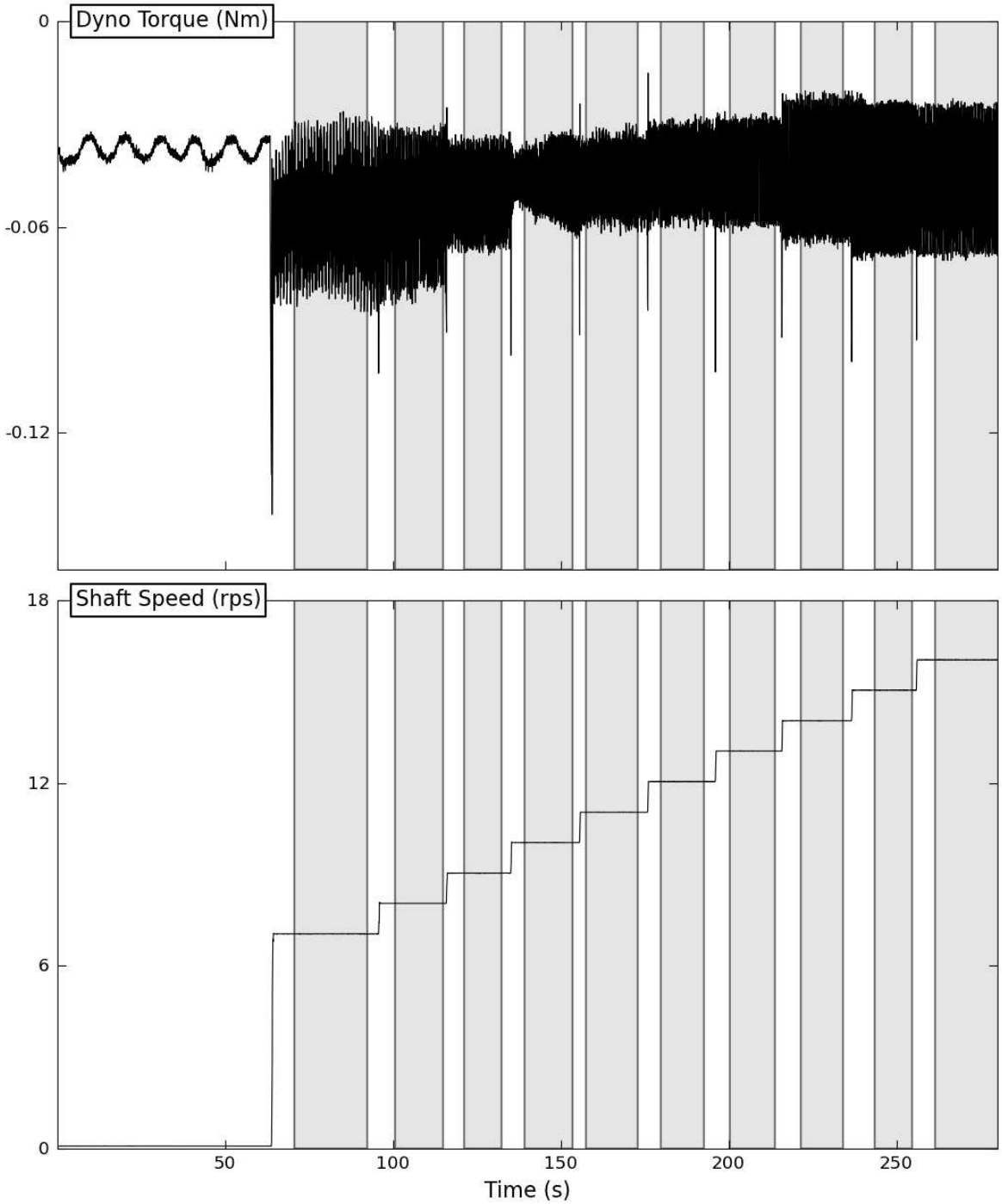
Acquired: 2011-11-29 14:58Z
Analyzed: 2011-11-29 11:42

1

JSS-Preliminary Design Model Tests
FRICTION_010



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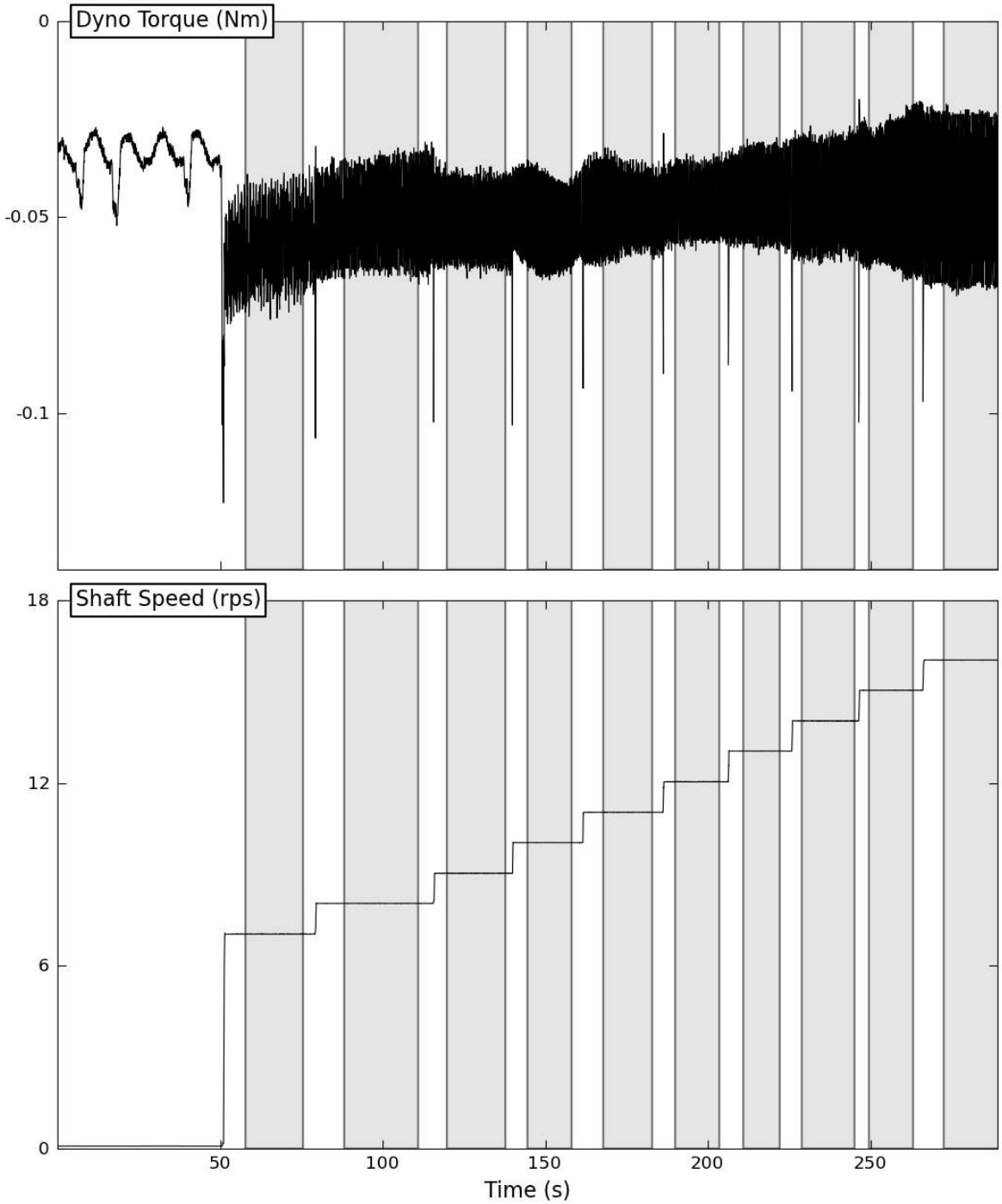
Acquired: 2011-11-29 22:00Z
Analyzed: 2011-11-29 18:45

1

JSS-Preliminary Design Model Tests
FRICTION_011



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Acquired: 2011-11-30 11:45Z
Analyzed: 2011-11-30 08:22

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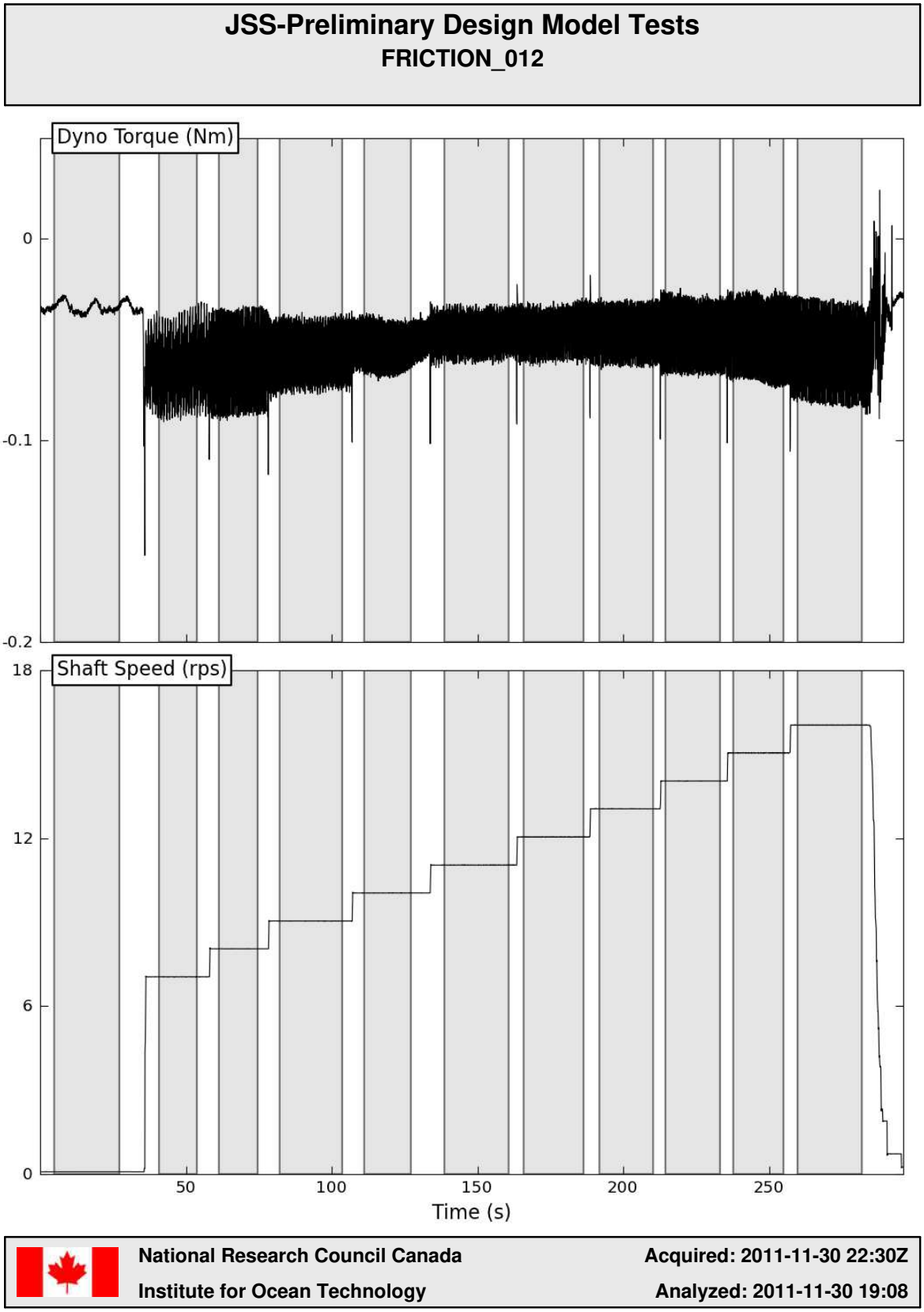
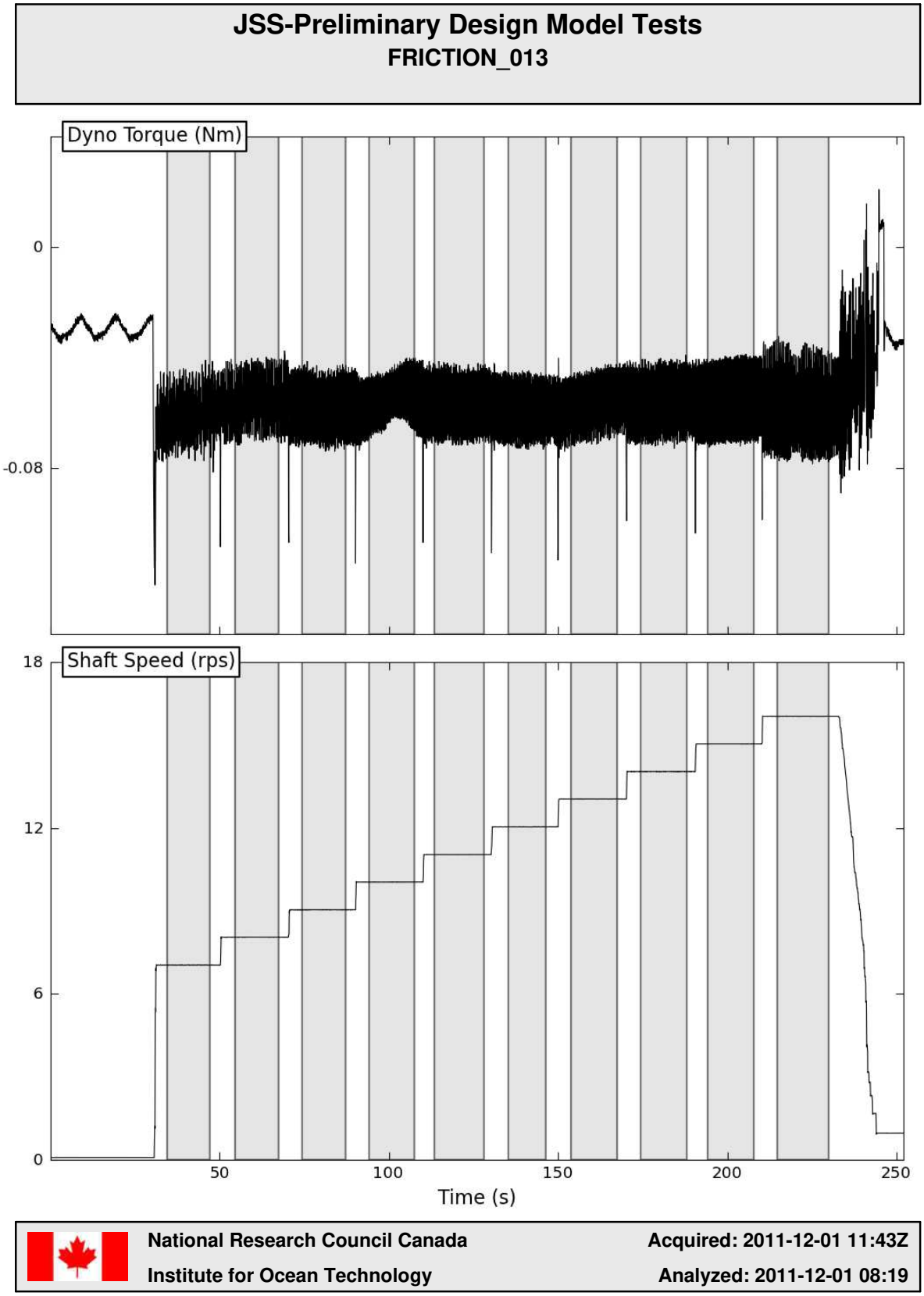
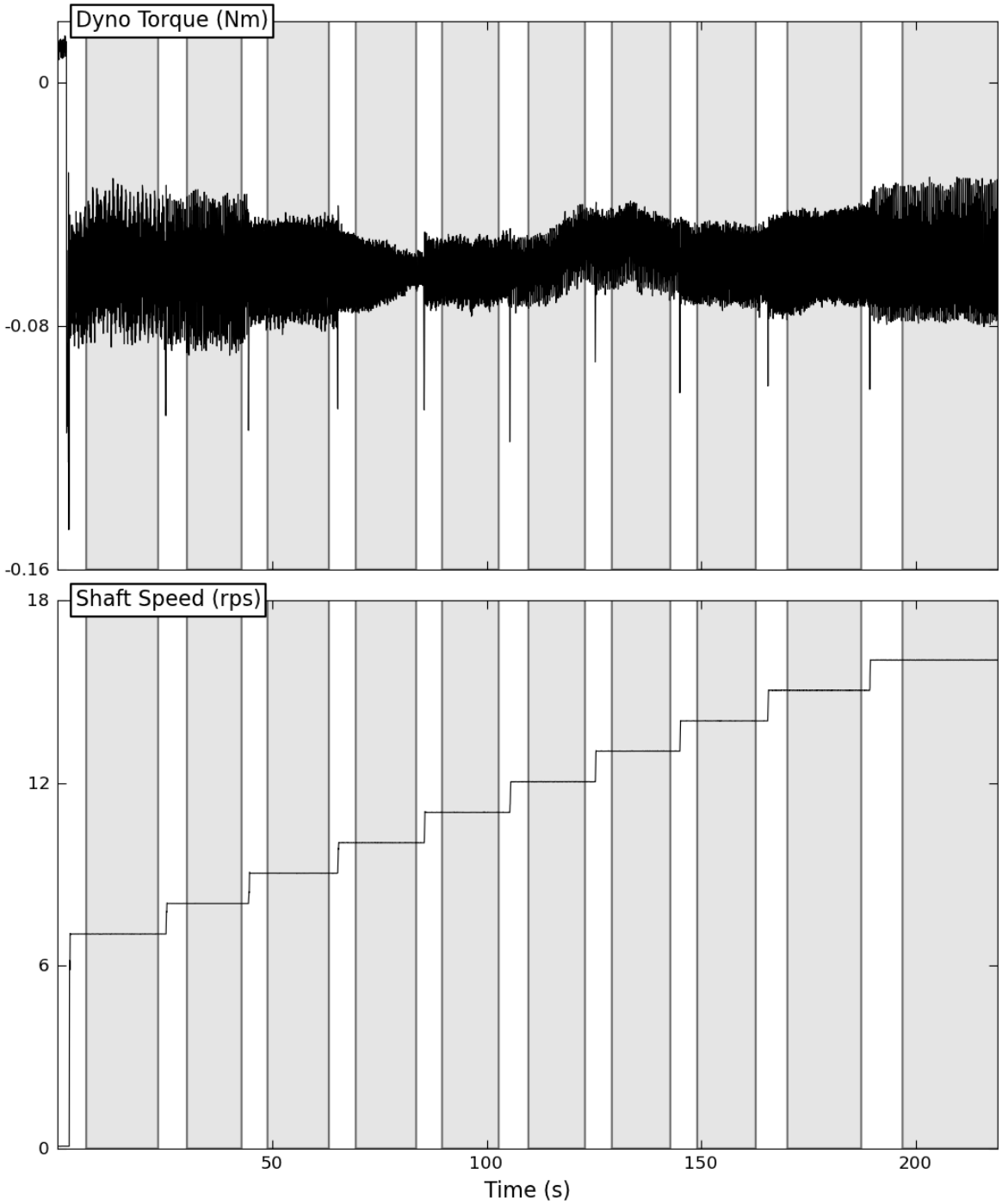

JSS-Preliminary Design Model Tests
FRICTION_012
Dyno Torque (Nm)
0
-0.1
-0.2
Shaft Speed (rps)
18
12
6
0
50
100
150
200
250
Time (s)
National Research Council Canada
Institute for Ocean Technology
Acquired: 2011-11-30 22:30Z
Analyzed: 2011-11-30 19:08

1


JSS-Preliminary Design Model Tests
FRICTION_013
Dyno Torque (Nm)
0
-0.08
Shaft Speed (rps)
18
12
6
0
50
100
150
200
250
Time (s)
National Research Council Canada
Institute for Ocean Technology
Acquired: 2011-12-01 11:43Z
Analyzed: 2011-12-01 08:19

JSS-Preliminary Design Model Tests
FRICTION_014



National Research Council Canada
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Acquired: 2011-12-01 23:08Z
Analyzed: 2011-12-01 19:43

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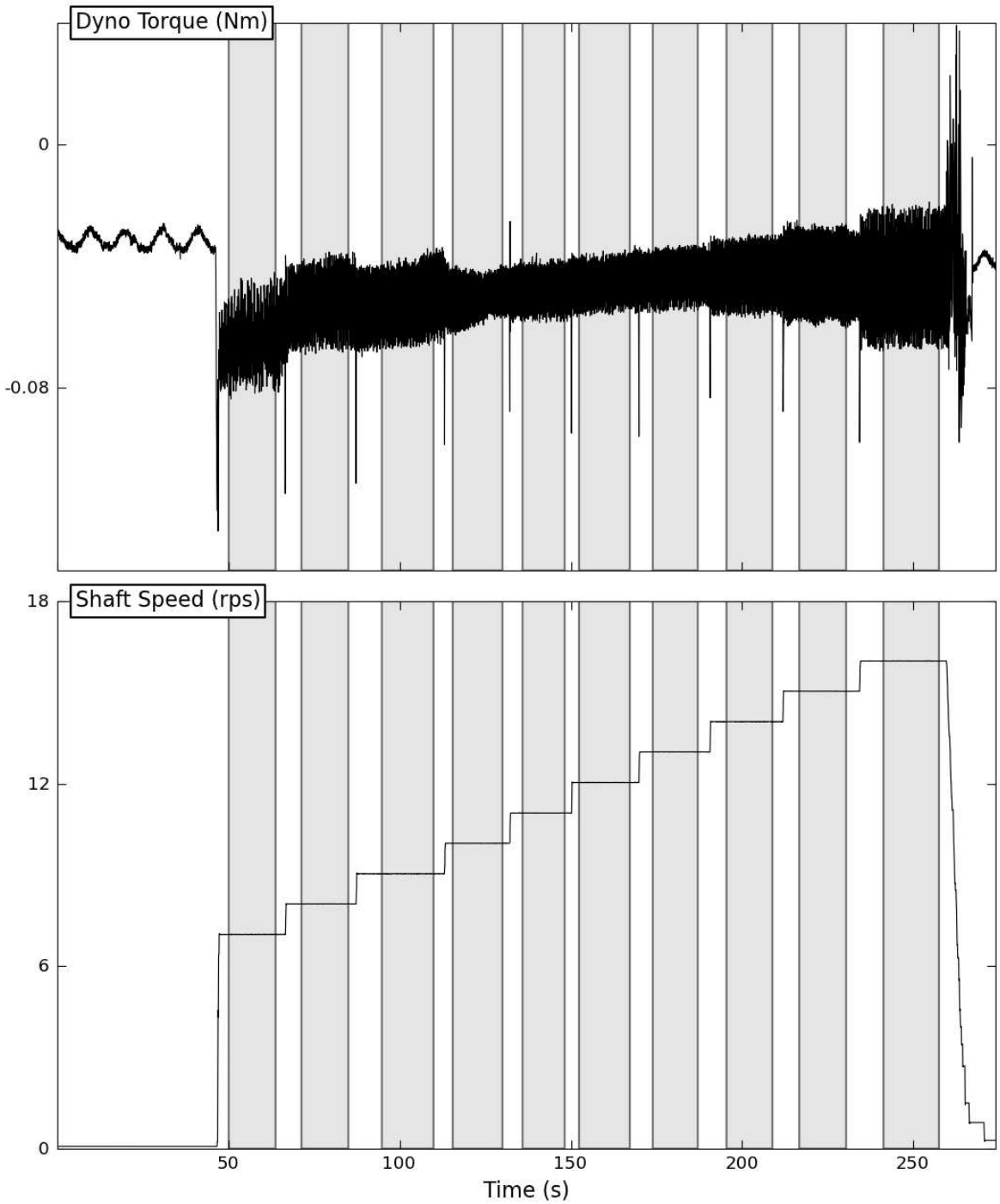
JSS-Preliminary Design Model Tests
FRICTION_015



National Research Council Canada
Institute for Ocean Technology

Acquired: 2011-12-02 11:46Z
Analyzed: 2011-12-02 08:23

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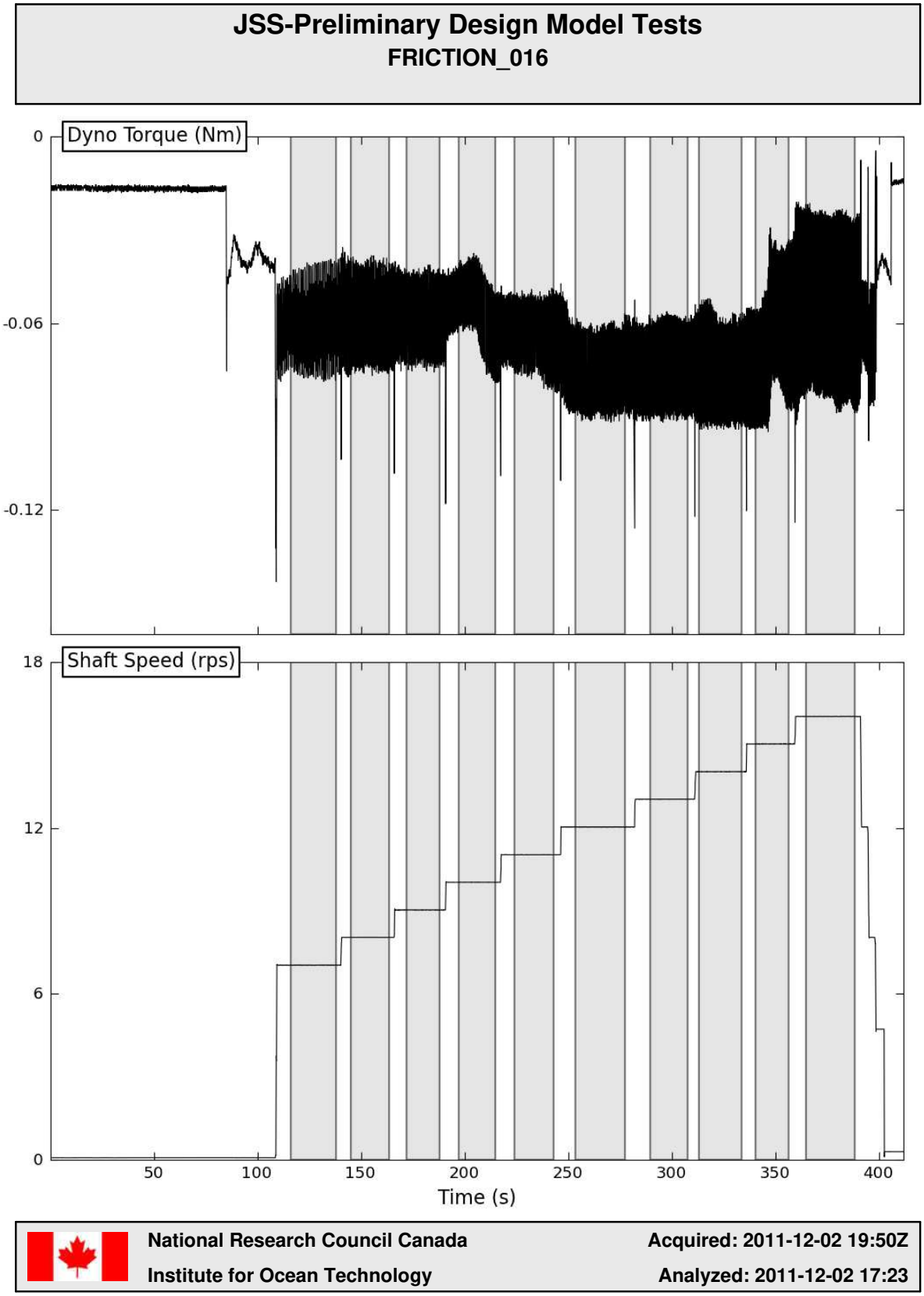

JSS-Preliminary Design Model Tests
FRICTION_016
Dyno Torque (Nm)
0
-0.06
-0.12
Shaft Speed (rps)
18
12
6
0
50
100
150
200
250
300
350
400
Time (s)
National Research Council Canada
Institute for Ocean Technology
Acquired: 2011-12-02 19:50Z
Analyzed: 2011-12-02 17:23

1

IN-SITU PROPULSION SYSTEM CHECKS

TowForce vs Thrust

Test	Date	Time	Slope	Intercept [N]	R^2	sd Res [N]
Insitu_005	29-Nov-11	6:15:25 PM	0.95601	-2.47	0.99993	0.31
Insitu_006	30-Nov-11	8:43:10 AM	0.97717	-5.68	0.99976	0.58
Insitu_007	30-Nov-11	6:46:25 PM	0.95168	-2.31	0.99995	0.26
Insitu_008	1-Dec-11	8:37:47 AM	0.95543	-2.97	0.99999	0.13
Insitu_009	1-Dec-11	7:28:15 PM	0.95616	-4.20	0.99998	0.15
Insitu_010	2-Dec-11	8:37:03 AM	0.95402	-3.96	0.99998	0.17
		Mean	0.95841		0.99993	0.268
		St Dev'n	0.00934			0.168

Thrust vs n^2

Test	Slope	Intercept [N]	R^2	sd Res [N]
Insitu_005	0.62406	-1.13	0.99999	0.11
Insitu_006	0.62573	-1.38	0.99996	0.23
Insitu_007	0.62079	-1.61	0.99999	0.10
Insitu_008	0.62282	-1.60	0.99995	0.26
Insitu_009	0.62319	-1.41	0.99993	0.30
Insitu_010	0.62647	-1.25	0.99998	0.15
Mean	0.62384		0.99997	0.191
St Dev'n	0.00207			0.084

Torque vs n^2

Test	Slope	Intercept [Nm]	R^2	sd Res [Nm]
Insitu_005	-0.0158	-0.0550	0.99999	0.0028
Insitu_006	-0.0158	-0.0519	0.99997	0.0052
Insitu_007	-0.0158	-0.0400	0.99999	0.0025
Insitu_008	-0.0158	-0.0507	0.99998	0.0041
Insitu_009	-0.0158	-0.0440	0.99997	0.0052
Insitu_010	-0.0158	-0.0576	0.99999	0.0033
Mean	-0.01578		0.99998	0.004
St Dev'n	0.00002			0.001

	Maximum		ABS Max
Test	TowForce [N]	Thrust [N]	Torque [Nm]
Insitu_005	131.72	140.01	3.6269
Insitu_006	131.34	140.57	3.6339
Insitu_007	129.95	138.95	3.6065
Insitu_008	130.54	139.62	3.6216
Insitu_009	129.49	139.92	3.6136
Insitu_010	130.48	140.64	3.6337

Summary

0	0	11	1	2									Slope	0.956005		0.624065	-0.0158	
-999	0	0	0	0	0	0	2011.333			29-Nov-11			Intercept	-2.46597		-1.13093	-0.05497	
0	0	0	0	0	0	0	0						R^2	0.999927		0.999992	0.999992	

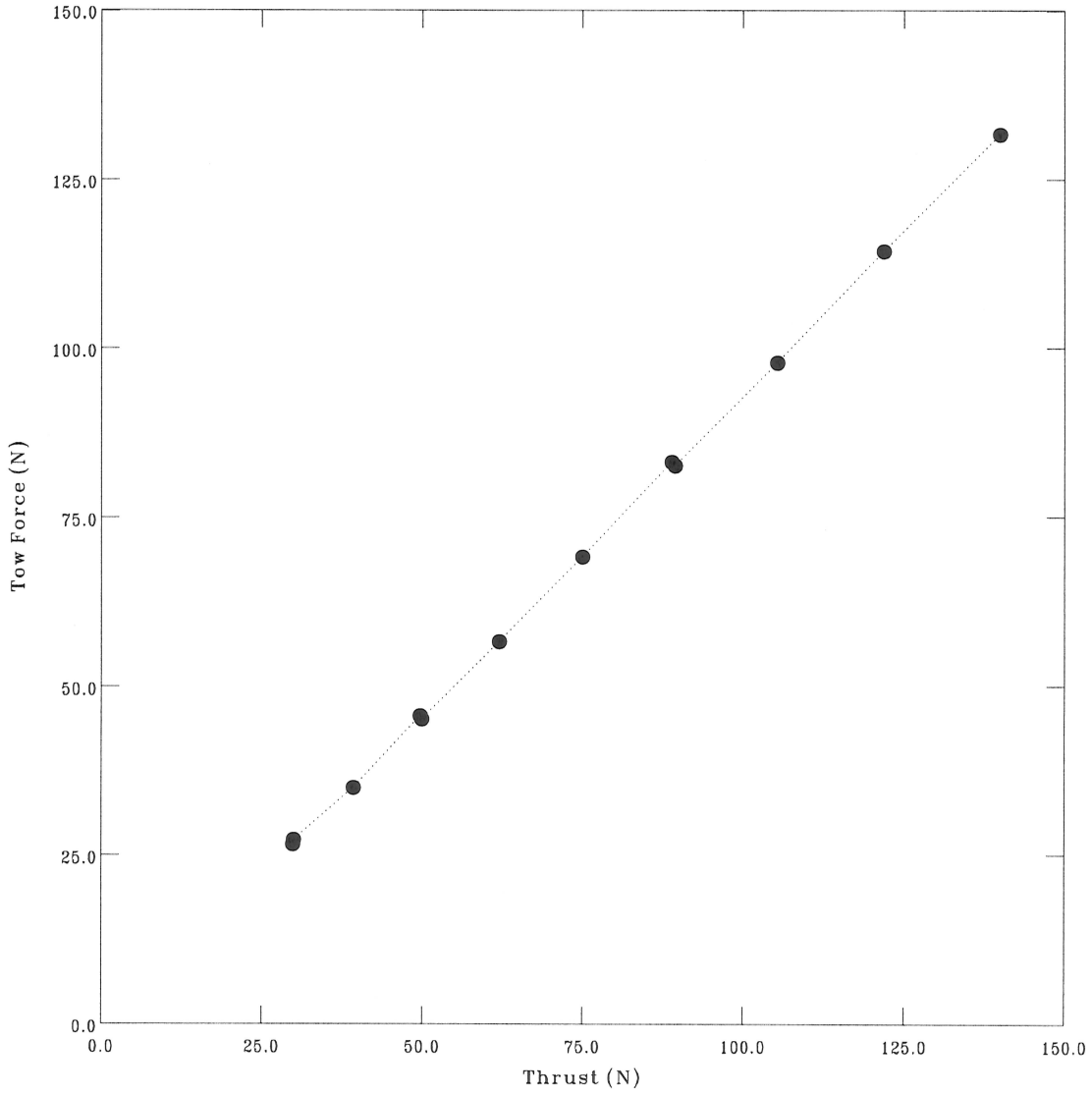
PJ2517SP.INF

Record Number	Tare Segment	RSP Date	RSP Time	Segment Start Time	Segment End Time	Carriage Speed	Tow Force	Shaft Speed	Thrust	Torque	Thrust	Tow Force	Residual	(Shaft Speed)^2	Thrust	Torque	Residual	Residual
		yyyy.ddd	Second of day	Seconds	Seconds	m/s	N	rps	N	Nm	N	N	N		N	Nm	N	Nm
1	1	2011.333	78240.5	59.5	75.34	0	26.54	7.05	29.83	-0.841	29.83	26.54	0.49	49.70	29.83	-0.841	-0.06	-0.001
2	1	2011.333	78265.44	84.44	97.88	0	35.02	8.05	39.23	-1.075	39.23	35.02	-0.02	64.81	39.23	-1.075	-0.09	0.003
3	1	2011.333	78286.4	105.4	117.28	0	45.16	9.04	49.85	-1.345	49.85	45.16	-0.04	81.80	49.85	-1.345	-0.06	0.002
4	1	2011.333	78305	124	137.46	0	56.58	10.05	61.97	-1.651	61.97	56.58	-0.20	100.94	61.97	-1.651	0.11	-0.002
5	1	2011.333	78325.98	144.98	156.84	0	69.14	11.04	74.99	-1.981	74.99	69.14	-0.09	121.89	74.99	-1.981	0.06	-0.001
6	1	2011.333	78344.18	163.18	177.82	0	82.64	12.04	89.45	-2.348	89.45	82.64	-0.41	145.06	89.45	-2.348	0.05	-0.002
7	1	2011.333	78366.34	185.34	196.42	0	97.86	13.05	105.32	-2.749	105.32	97.86	-0.36	170.30	105.32	-2.749	0.17	-0.004
8	1	2011.333	78384.54	203.54	217	0	114.36	14.04	121.91	-3.170	121.91	114.36	0.28	197.21	121.91	-3.170	-0.03	0.000
9	1	2011.333	78409.46	228.46	251.82	0	131.72	15.05	140.01	-3.627	140.01	131.72	0.33	226.42	140.01	-3.627	-0.16	0.004
10	1	2011.333	78444.68	263.68	278.32	0	83.23	12.05	88.90	-2.340								
11	1	2011.333	78468.82	287.82	299.3	0	45.64	9.04	49.67	-1.34								
12	1	2011.333	78490.2	309.2	318.68	0	27.28	7.05	29.92	-0.84								
%																		
											Mean		-2.9E-14				2.92E-14	-9.9E-17
											St. Dev.		0.3107				0.105626	0.002754

INSITU_005

Single Screw Thrust Insitu Check

Model:	907	Test Date:	29-Nov-2011
Description:	Joint Support Ship	Analysis Date:	29-Nov-2011
Condition:	Deep Departure	Project Number:	2517
Tank:	Towing Tank		
Propeller:	P106R		
Description:	MCDV B-Screw		
Condition:	Deep Departure		
Rotation:	RIGHT		



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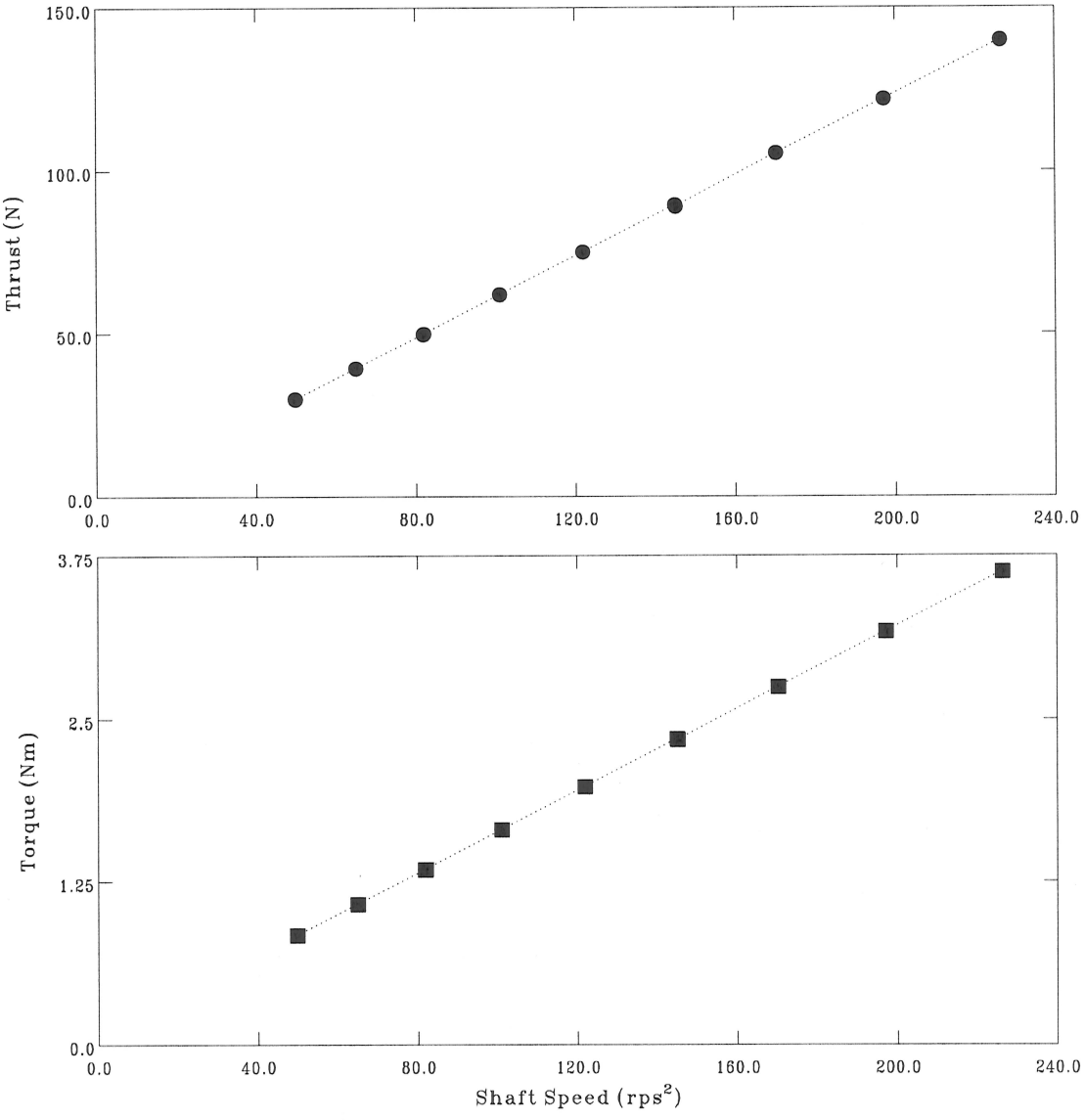
Single Screw Torque and Thrust Insitu Check

Model:	907	Test Date:	29-Nov-2011
Description:	Joint Support Ship	Analysis Date:	29-Nov-2011
Condition:	Deep Departure	Project Number:	2517
Tank:	Towing Tank		
Propeller:	P106R		
Description:	MCDV B-Screw		
Condition:	Deep Departure		
Rotation:	RIGHT		



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0	0	11	10									Slope	0.977169		0.625726	-0.01579		
-999	0	0	0	0	0	0	2011.334			30-Nov-11		Intercept	-5.6766		-1.38085	-0.05193		
0	0	0	0	0	0	0	0					R^2	0.999755		0.999962	0.999971		

PJ2517SP.INF

Record Number	Tare Segment	RSP Date	RSP Time	Segment Start Time	Segment End Time	Carriage Speed	Tow Force	Shaft Speed	Thrust	Torque	Thrust	Tow Force	Residual	(Shaft Speed)^2	Thrust	Torque	Residual	Residual
		yyyy.ddd	Second of day	Seconds	Seconds	m/s	N	rps	N	Nm	N	N	N		N	Nm	N	Nm
1	2	2011.334	43906	52	65.14	0	23.59	7.05	29.97	-0.842	29.97	23.59	-0.02	49.63	29.97	-0.842	0.29	-0.006
2	2	2011.334	43924.62	70.62	84.68	0	31.89	8.05	39.33	-1.078	39.33	31.89	-0.87	64.78	39.33	-1.078	0.18	-0.004
3	2	2011.334	43947.52	93.52	108.78	0	42.43	9.04	49.72	-1.342	49.72	42.43	-0.48	81.70	49.72	-1.342	-0.02	0.000
4	2	2011.334	43968.58	114.58	127.72	0	55.48	10.04	61.49	-1.640	61.49	55.48	1.07	100.89	61.49	-1.640	-0.26	0.005
5	2	2011.334	43989.34	135.34	148.16	0	67.76	11.04	74.57	-1.969	74.57	67.76	0.57	121.82	74.57	-1.969	-0.27	0.007
6	2	2011.334	44011.02	157.02	170.76	0	81.82	12.04	89.26	-2.340	89.26	81.82	0.27	144.95	89.26	-2.340	-0.06	0.001
7	2	2011.334	44030.86	176.86	192.74	0	96.89	13.05	104.89	-2.734	104.89	96.89	0.07	170.21	104.89	-2.734	-0.24	0.006
8	2	2011.334	44054.06	200.06	213.48	0	113.24	14.04	121.97	-3.165	121.97	113.24	-0.27	197.10	121.97	-3.165	0.03	0.000
9	2	2011.334	44078.18	224.18	241.88	0	131.34	15.04	140.57	-3.634	140.57	131.34	-0.34	226.30	140.57	-3.634	0.34	-0.008
10	2	2011.334	44078.48	224.48	242.8	0	131.34	15.04	140.57	-3.634								

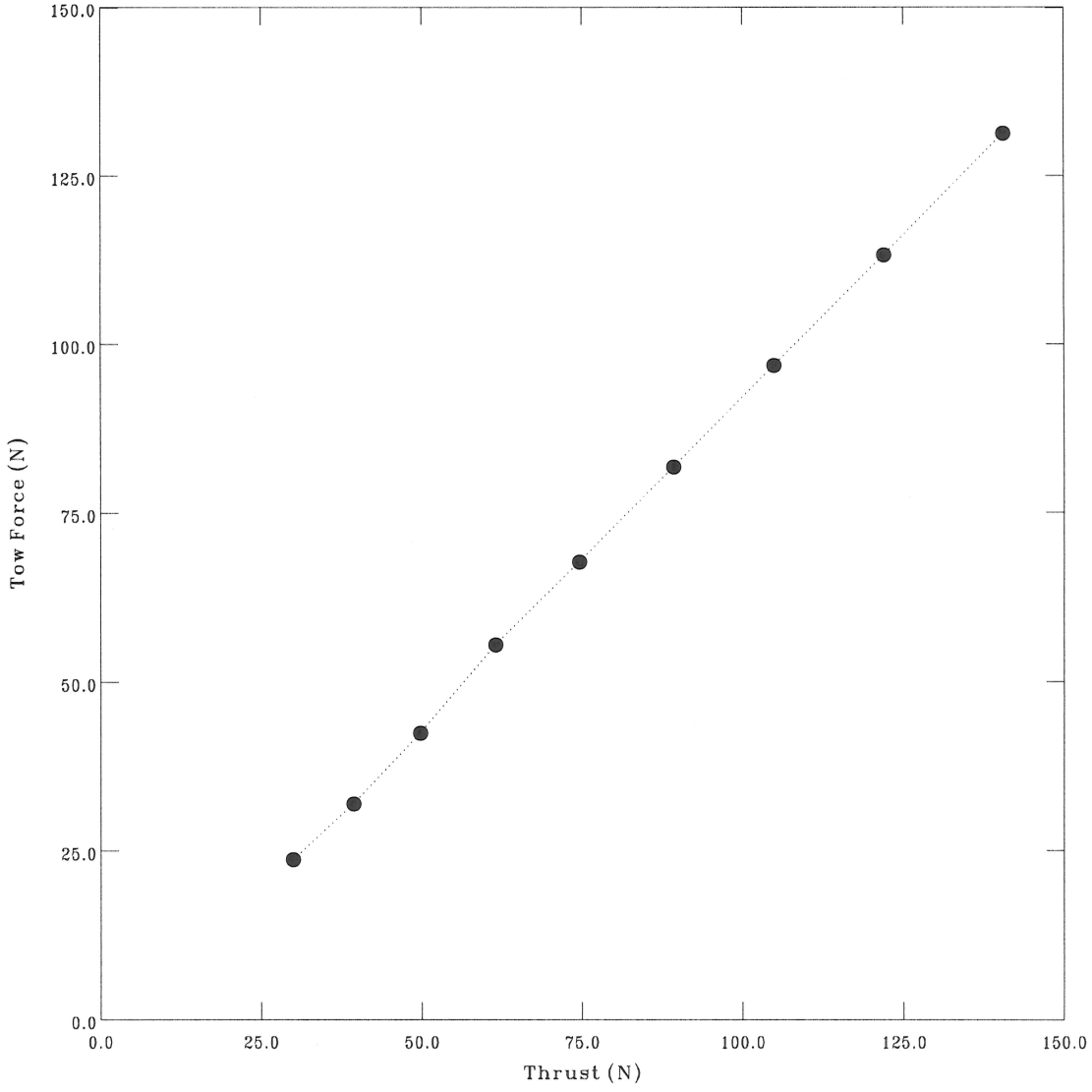
%

Mean	9.47E-15			-1.7E-14	1.23E-16
St. Dev.	0.581806			0.233399	0.0052

INSITU_006

Single Screw Thrust Insitu Check

Model:	907	Test Date:	30-Nov-2011
Description:	Joint Support Ship	Analysis Date:	30-Nov-2011
Condition:	Deep Departure	Project Number:	2517
Tank:	Towing Tank		
Propeller:	P106R		
Description:	MCDV B-Screw		
Condition:	Deep Departure		
Rotation:	RIGHT		



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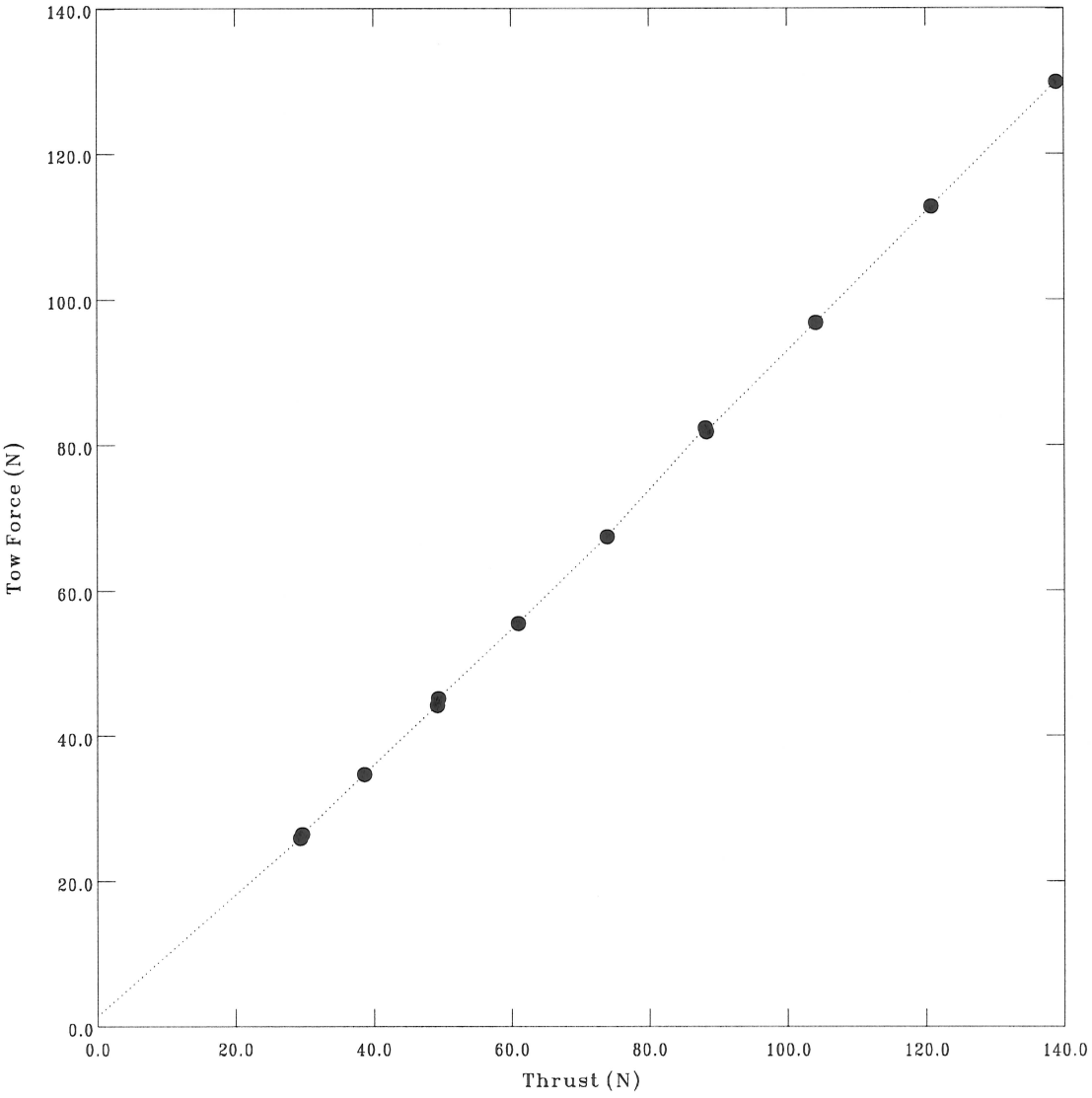
Single Screw Thrust Insitu Check

Model:	907	Test Date:	30-Nov-2011
Description:	Joint Support Ship	Analysis Date:	1-Dec-2011
Condition:	Deep Departure	Project Number:	2517
Tank:	Towing Tank		
Propeller:	P106R		
Description:	MCDV B-Screw		
Condition:	Deep Departure		
Rotation:	RIGHT		



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0	0	11	1	3								Slope	0.951682		0.620787	-0.01576		
-999	0	0	0	0	0	0	2011.334			30-Nov-11		Intercept	-2.31189		-1.61442	-0.04001		
0	0	0	0	0	0	0	0					R^2	0.999949		0.999993	0.999993		

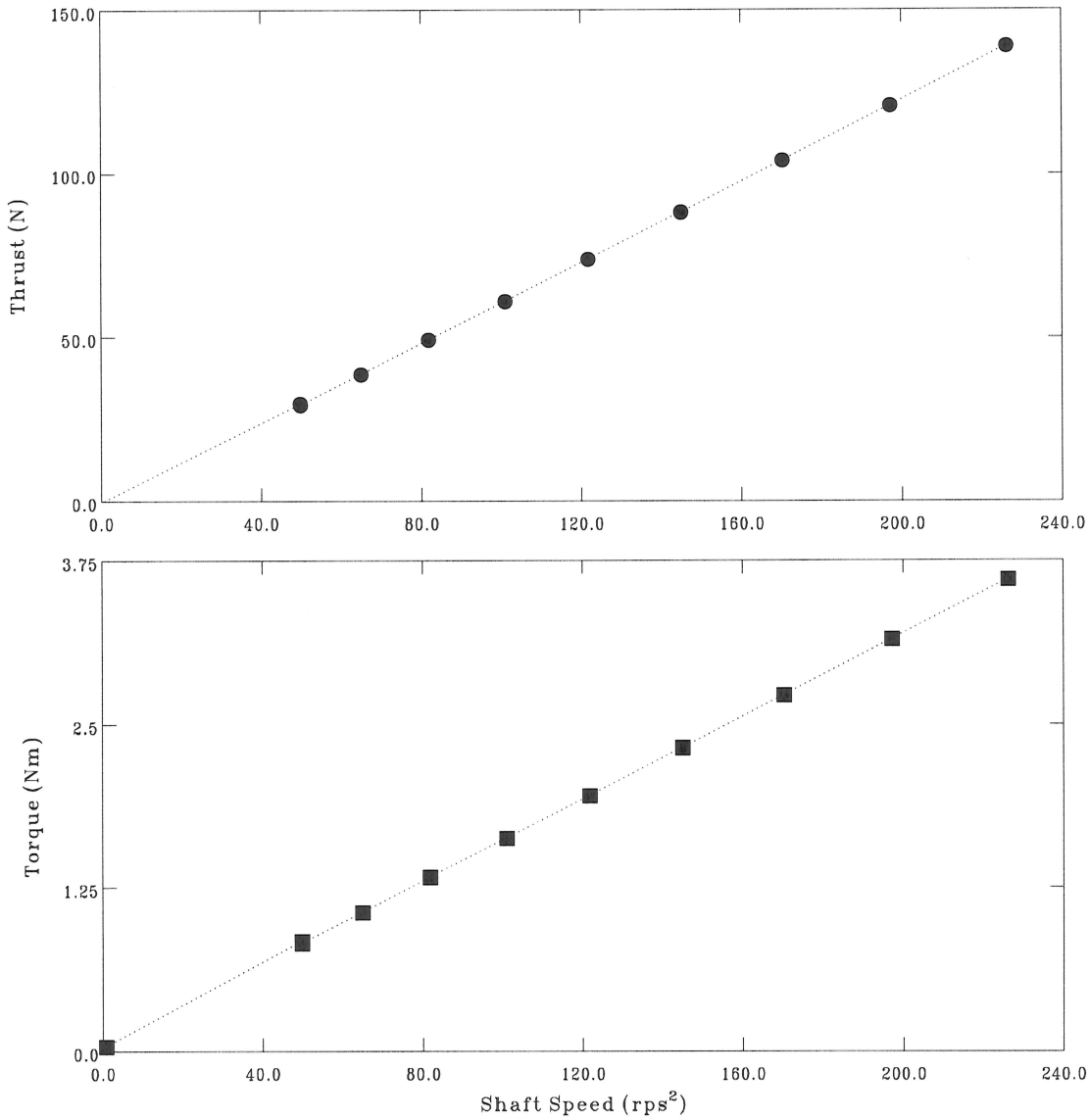
PJ2517SP.INF

Record Number	Tare Segment	RSP Date	RSP Time	Segment Start Time	Segment End Time	Carriage Speed	Tow Force	Shaft Speed	Thrust	Torque	Thrust	Tow Force	Residual	(Shaft Speed)^2	Thrust	Torque	Residual	Residual
		yyyy.ddd	Second of day	Seconds	Seconds	m/s	N	rps	N	Nm	N	N	N		N	Nm	N	Nm
1	2	2011.334	80101.5	59.5	76.92	0	25.89	7.05	29.37	-0.827	29.37	25.89	0.25	49.67	29.37	-0.827	0.15	-0.004
2	2	2011.334	80125.64	83.64	97.88	0	34.71	8.05	38.60	-1.061	38.60	34.71	0.29	64.77	38.60	-1.061	0.01	0.000
3	2	2011.334	80146.62	104.62	118.46	0	44.24	9.04	49.15	-1.327	49.15	44.24	-0.23	81.74	49.15	-1.327	0.02	0.001
4	2	2011.334	80167.58	125.58	137.06	0	55.47	10.04	60.93	-1.628	60.93	55.47	-0.20	100.87	60.93	-1.628	-0.08	0.002
5	2	2011.334	80186.58	144.58	156.84	0	67.45	11.04	73.82	-1.955	73.82	67.45	-0.49	121.80	73.82	-1.955	-0.18	0.005
6	2	2011.334	80205.96	163.96	177.02	0	81.86	12.04	88.31	-2.324	88.31	81.86	0.13	144.97	88.31	-2.324	-0.08	0.001
7	2	2011.334	80223.78	181.78	197.2	0	96.81	13.05	104.09	-2.724	104.09	96.81	0.06	170.23	104.09	-2.724	0.03	-0.002
8	2	2011.334	80245.94	203.94	217	0	112.83	14.04	120.82	-3.149	120.82	112.83	0.16	197.14	120.82	-3.149	0.05	-0.002
9	2	2011.334	80265.32	223.32	237.18	0	129.95	15.04	138.95	-3.606	138.95	129.95	0.02	226.32	138.95	-3.606	0.07	0.000
10	2	2011.334	80288.28	246.28	256.96	0	82.34	12.04	88.14	-2.321								
11	2	2011.334	80313.2	271.2	280.3	0	45.16	9.04	49.29	-1.33								
12	2	2011.334	80334.18	292.18	305.24	0	26.49	7.05	29.64	-0.84								
13	2	2011.334	80356.74	314.74	330.98	0	1.38	0.81	-0.09	-0.03								
%											Mean		-4.3E-15				-7.9E-16	6.17E-17
											St. Dev.		0.255863				0.09865	0.002511

INSITU_007

Single Screw Torque and Thrust Insitu Check

Model:	907	Test Date:	30-Nov-2011
Description:	Joint Support Ship	Analysis Date:	1-Dec-2011
Condition:	Deep Departure	Project Number:	2517
Tank:	Towing Tank		
Propeller:	P106R		
Description:	MCDV B-Screw		
Condition:	Deep Departure		
Rotation:	RIGHT		



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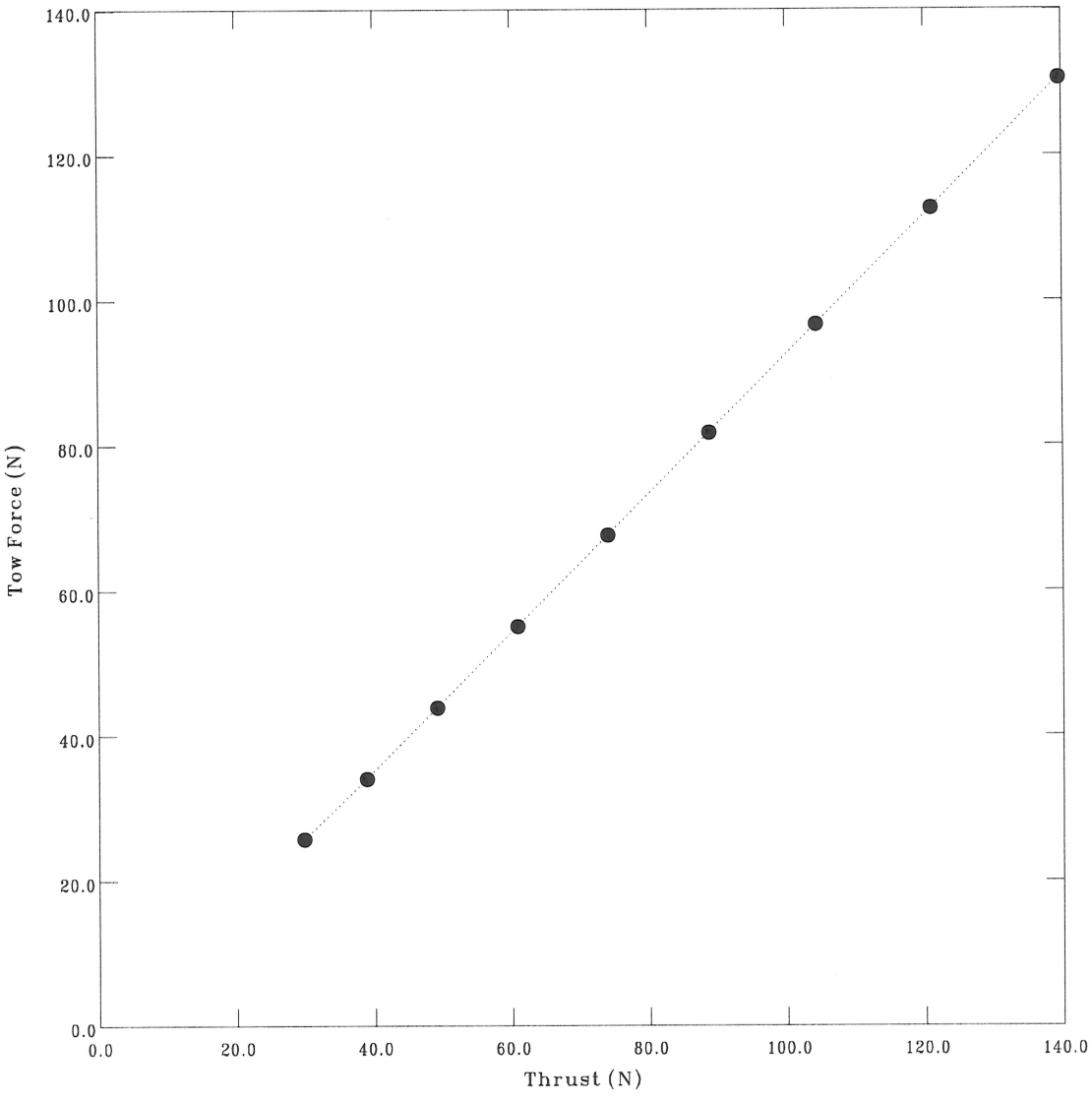
Institute for Ocean Technology

Single Screw Thrust Insitu Check

Model:	907	Test Date:	01-Dec-2011
Description:	Joint Support Ship	Analysis Date:	1-Dec-2011
Condition:	Deep Departure	Project Number:	2517
Tank:	Towing Tank		
Propeller:	P106R		
Description:	MCDV B-Screw		
Condition:	Deep Departure		
Rotation:	RIGHT		



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0	0	11	9									Slope	0.955427			0.622818	-0.01576	
-999	0	0	0	0	0	0	2011.335			1-Dec-11		Intercept	-2.97263			-1.59911	-0.0507	
0	0	0	0	0	0	0	0					R^2	0.999986			0.999953	0.999981	

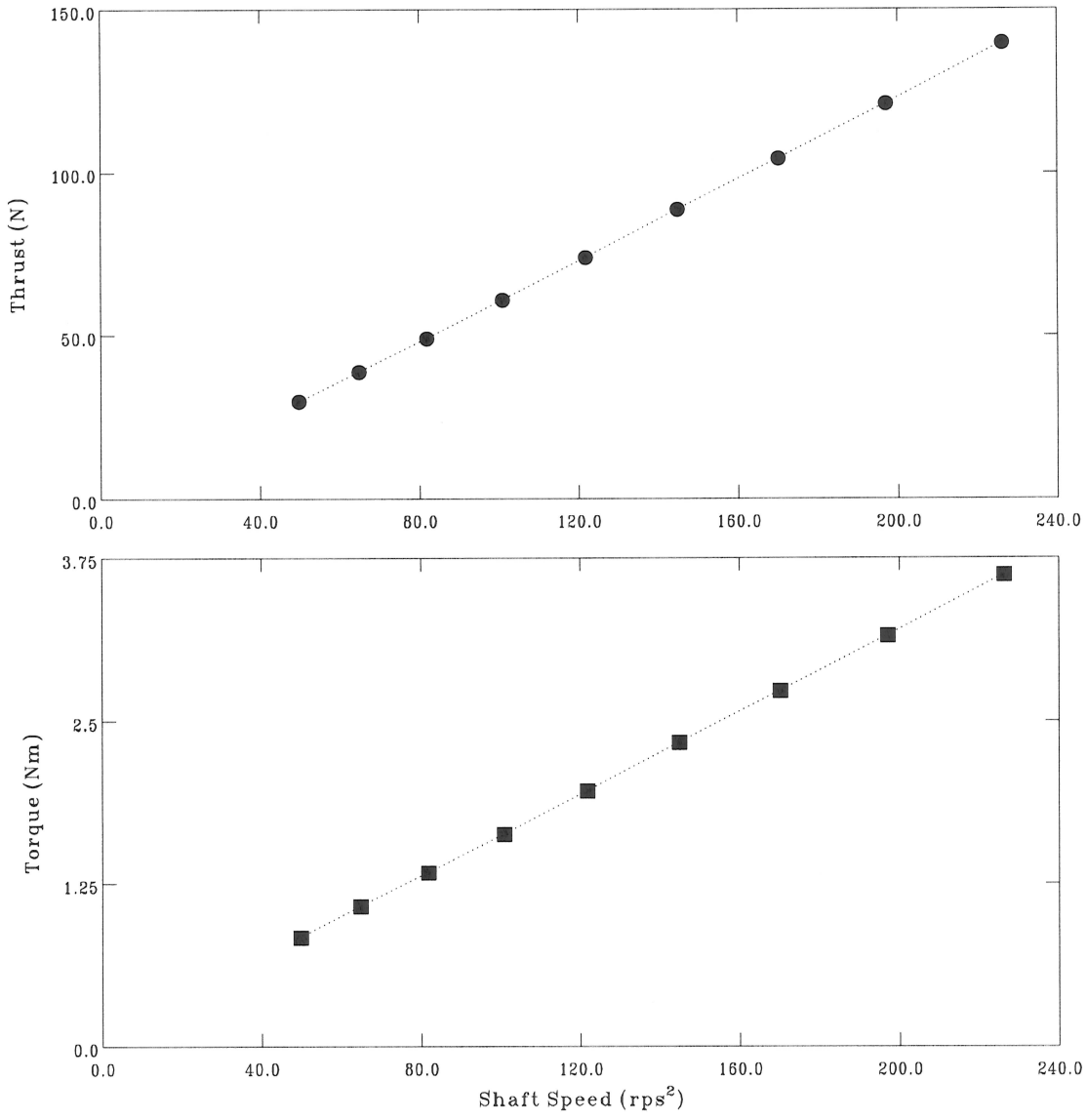
PJ2517SP.INF

Record Number	Tare Segment	RSP Date	RSP Time	Segment Start Time	Segment End Time	Carriage Speed	Tow Force	Shaft Speed	Thrust	Torque	Thrust	Tow Force	Residual	(Shaft Speed)^2	Thrust	Torque	Residual	Residual
		yyyy.ddd	Second of day	Seconds	Seconds	m/s	N	rps	N	Nm	N	N	N		N	Nm	N	Nm
1	1	2011.335	43584.78	75.78	90.34	0	25.72	7.04	29.74	-0.837	29.74	25.72	0.28	49.61	29.74	-0.837	0.44	-0.004
2	1	2011.335	43608.52	99.52	110.28	0	34.09	8.05	38.83	-1.075	38.83	34.09	-0.03	64.74	38.83	-1.075	0.10	-0.004
3	1	2011.335	43628.46	119.46	129.6	0	43.88	9.04	49.12	-1.336	49.12	43.88	-0.07	81.67	49.12	-1.336	-0.15	0.002
4	1	2011.335	43647.14	138.14	148.26	0	55.02	10.04	60.87	-1.634	60.87	55.02	-0.16	100.84	60.87	-1.634	-0.34	0.006
5	1	2011.335	43666.76	157.76	169.16	0	67.66	11.04	73.98	-1.966	73.98	67.66	-0.05	121.78	73.98	-1.966	-0.27	0.004
6	1	2011.335	43686.7	177.7	188.48	0	81.69	12.04	88.73	-2.338	88.73	81.69	-0.11	144.90	88.73	-2.338	0.08	-0.003
7	1	2011.335	43705.7	196.7	209.04	0	96.66	13.05	104.32	-2.731	104.32	96.66	-0.04	170.20	104.32	-2.731	-0.08	0.002
8	1	2011.335	43726.92	217.92	229.3	0	112.75	14.04	121.06	-3.154	121.06	112.75	0.06	197.08	121.06	-3.154	-0.08	0.002
9	1	2011.335	43747.8	238.8	255.26	0	130.54	15.04	139.62	-3.622	139.62	130.54	0.11	226.24	139.62	-3.622	0.31	-0.005
%																		
											Mean		1.58E-14				7.5E-15	-7.4E-17
											St. Dev.		0.134434				0.258583	0.004134

INSITU_008

Single Screw Torque and Thrust Insitu Check

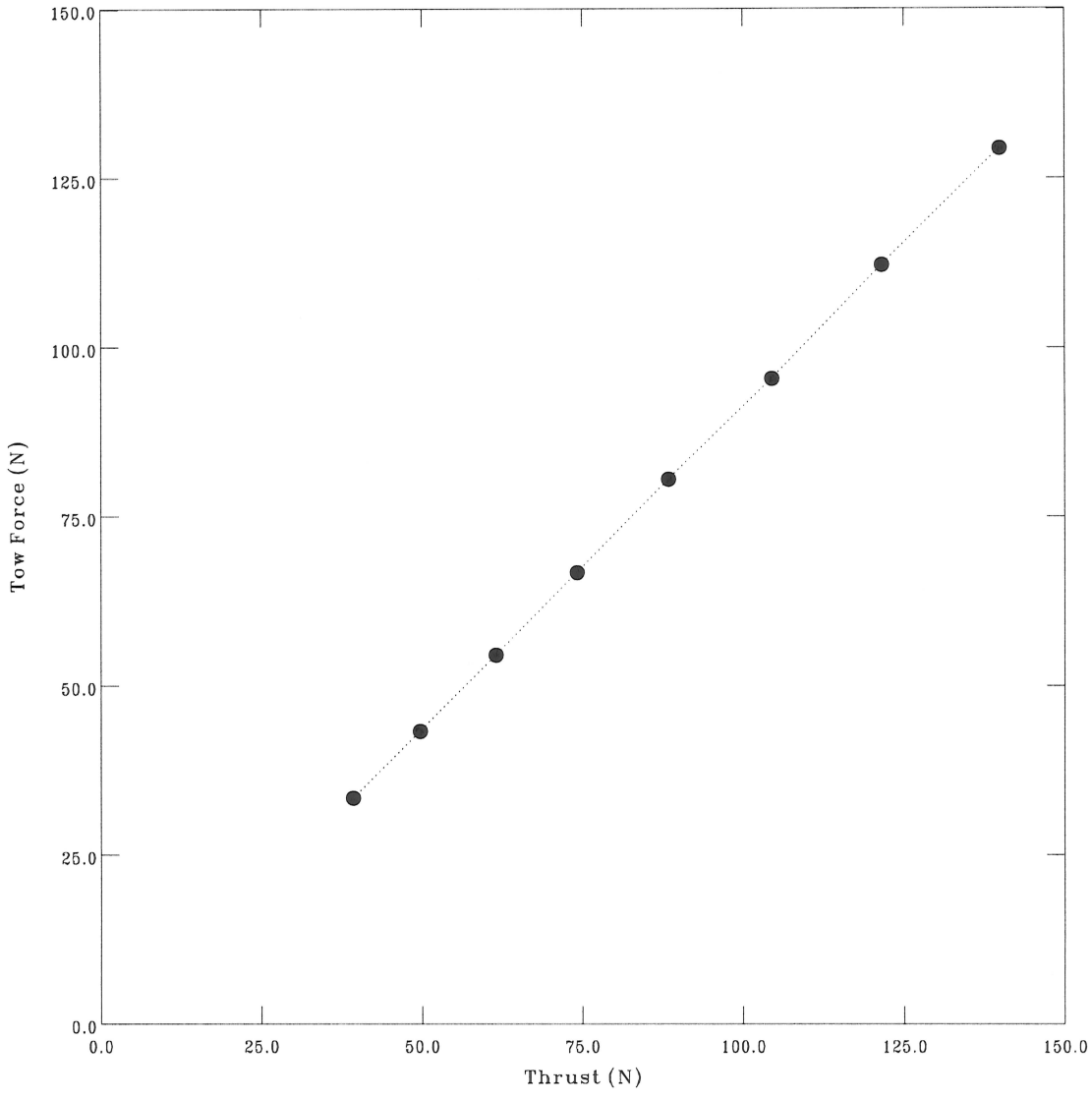
Model:	907	Test Date:	01-Dec-2011
Description:	Joint Support Ship	Analysis Date:	1-Dec-2011
Condition:	Deep Departure	Project Number:	2517
Tank:	Towing Tank		
Propeller:	P106R		
Description:	MCDV B-Screw		
Condition:	Deep Departure		
Rotation:	RIGHT		



National Research Council Canada
Institute for Ocean Technology

Single Screw Thrust Insitu Check

Model:	907	Test Date:	01-Dec-2011
Description:	Joint Support Ship	Analysis Date:	1-Dec-2011
Condition:	Deep Departure	Project Number:	2517
Tank:	Towing Tank		
Propeller:	P106R		
Description:	MCDV B-Screw		
Condition:	Deep Departure		
Rotation:	RIGHT		



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0	0	11	8								Slope	0.956157			0.623187	-0.01577		
-999	0	0	0	0	0	0	2011.335			1-Dec-11	Intercept	-4.1983			-1.40835	-0.04396		
0	0	0	0	0	0	0	0				R^2	0.999979			0.999929	0.999967		

PJ2517SP.INF

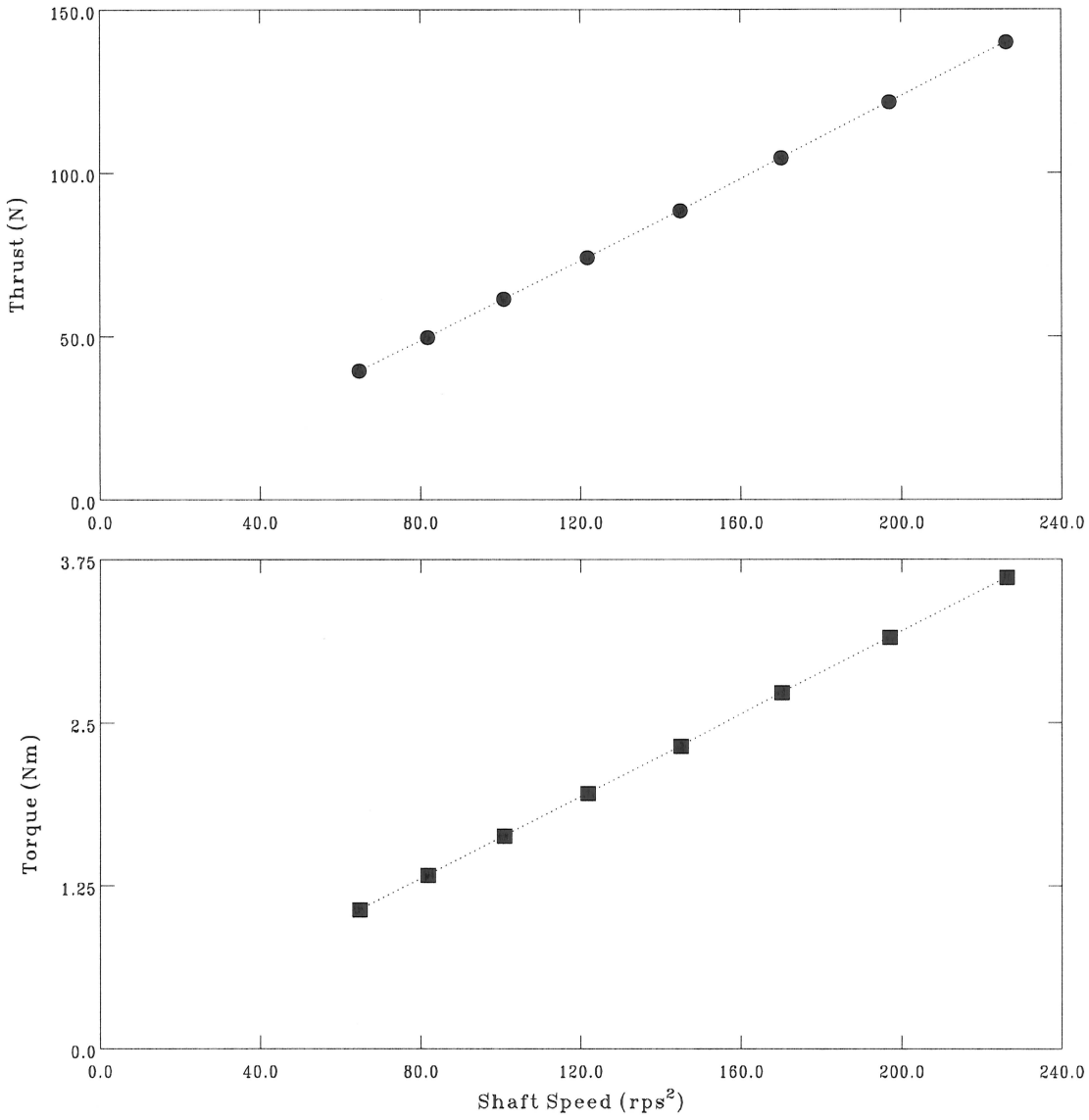
Record Number	Tare Segment	RSP Date	RSP Time	Segment Start Time	Segment End Time	Carriage Speed	Tow Force	Shaft Speed	Thrust	Torque	Thrust	Tow Force	Residual	(Shaft Speed)^2	Thrust	Torque	Residual	Residual
		yyyy.ddd	Second of day	Seconds	Seconds	m/s	N	rps	N	Nm	N	N	N		N	Nm	N	Nm
1	1	2011.335	82625.18	96.18	109.82	0	33.35	8.05	39.26	-1.071	39.26	33.35	0.01	64.73	39.26	-1.071	0.33	-0.006
2	1	2011.335	82646.02	117.02	129.38	0	43.26	9.04	49.64	-1.333	49.64	43.26	0.00	81.71	49.64	-1.333	0.12	0.000
3	1	2011.335	82666.1	137.1	149.96	0	54.57	10.04	61.49	-1.634	61.49	54.57	-0.02	100.83	61.49	-1.634	0.06	0.000
4	1	2011.335	82685.14	156.14	169.52	0	66.70	11.04	74.17	-1.959	74.17	66.70	-0.02	121.78	74.17	-1.959	-0.32	0.005
5	1	2011.335	82703.4	174.4	188.82	0	80.50	12.04	88.44	-2.320	88.44	80.50	0.14	144.97	88.44	-2.320	-0.50	0.010
6	1	2011.335	82724.5	195.5	209.92	0	95.45	13.05	104.50	-2.733	104.50	95.45	-0.27	170.21	104.50	-2.733	-0.16	-0.006
7	1	2011.335	82744.32	215.32	229.22	0	112.28	14.04	121.54	-3.153	121.54	112.28	0.26	197.07	121.54	-3.153	0.14	-0.001
8	1	2011.335	82764.66	235.66	249.04	0	129.49	15.04	139.92	-3.614	139.92	129.49	-0.09	226.26	139.92	-3.614	0.32	-0.002
%																		

Mean	9.77E-15	-9.8E-15	0
St. Dev.	0.1547	0.298694	0.005176

INSITU_009

Single Screw Torque and Thrust Insitu Check

Model:	907	Test Date:	01-Dec-2011
Description:	Joint Support Ship	Analysis Date:	1-Dec-2011
Condition:	Deep Departure	Project Number:	2517
Tank:	Towing Tank		
Propeller:	P106R		
Description:	MCDV B-Screw		
Condition:	Deep Departure		
Rotation:	RIGHT		



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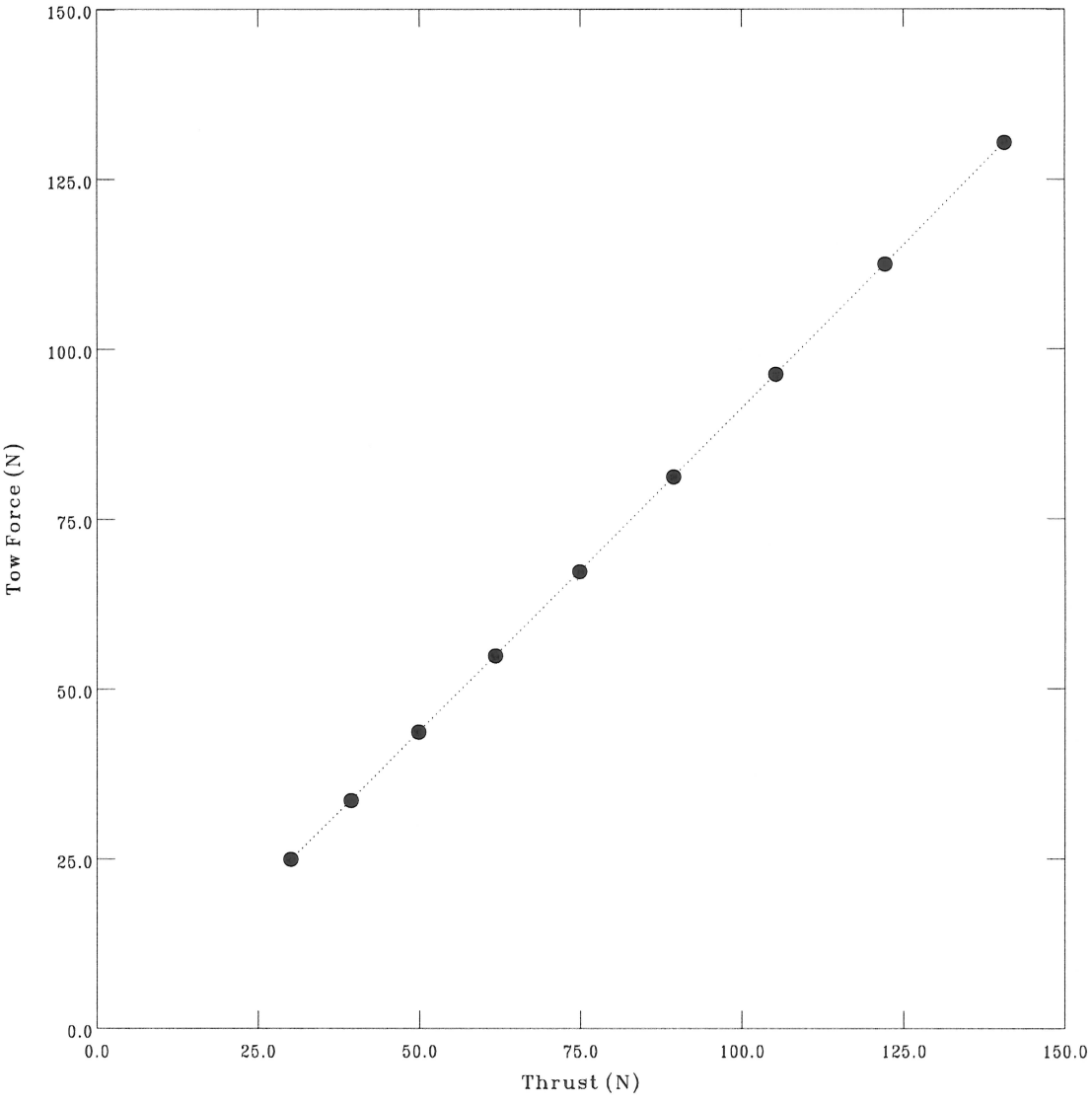
Single Screw Thrust Insitu Check

Model:	907	Test Date:	02-Dec-2011
Description:	Joint Support Ship	Analysis Date:	2-Dec-2011
Condition:	Deep Departure	Project Number:	2517
Tank:	Towing Tank		
Propeller:	P106R		
Description:	MCDV B-Screw		
Condition:	Deep Departure		
Rotation:	RIGHT		



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0	0	11	9									Slope	0.954017		0.626475	-0.01579		
-999	0	0	0	0	0	0	2011.3361			2-Dec-11		Intercept	-3.95971		-1.25473	-0.05762		
0	0	0	0	0	0	0	0					R^2	0.999978		0.999985	0.999988		

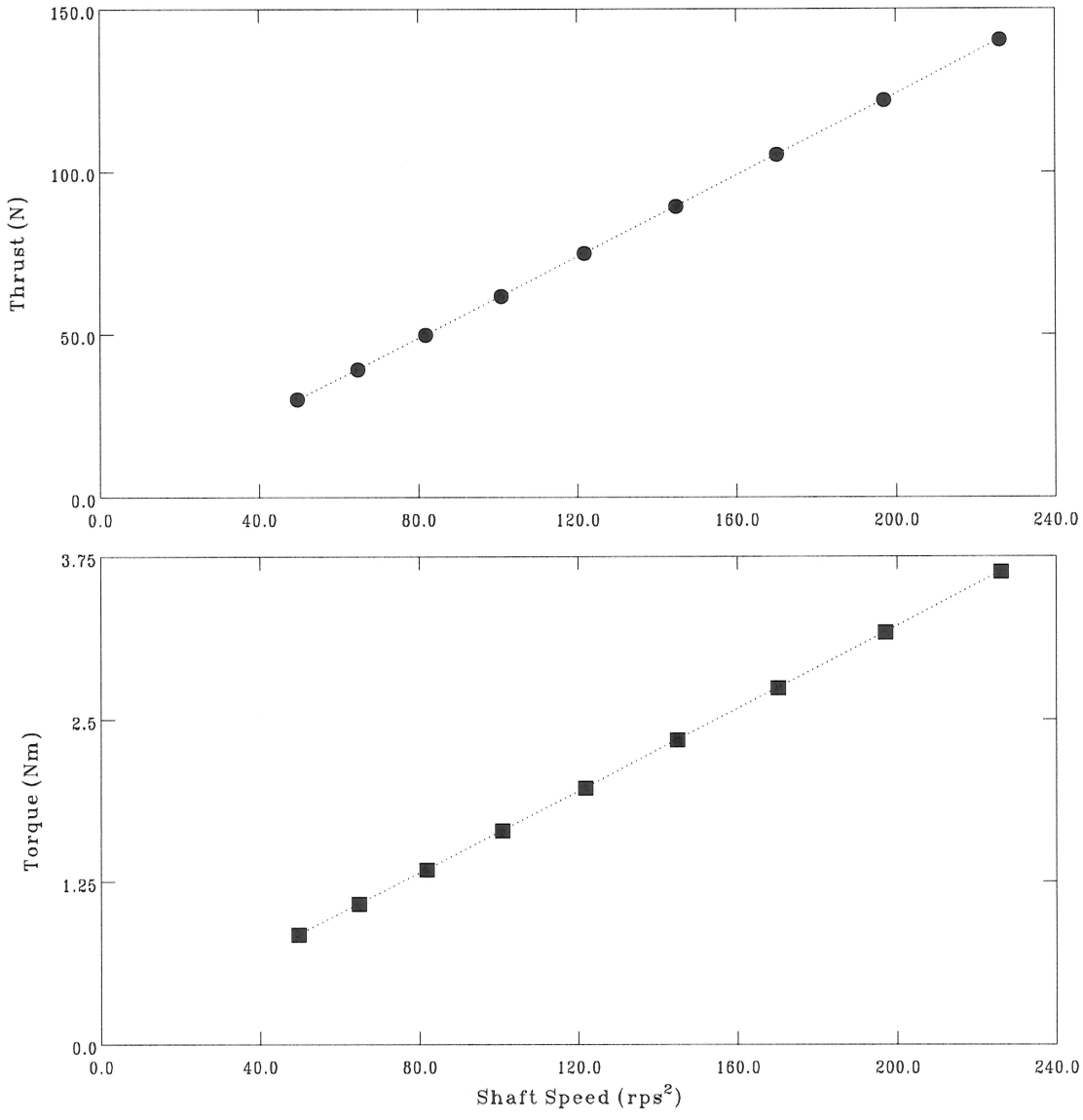
PJ2517SP.INF

Record Number	Tare Segment	RSP Date	RSP Time	Segment Start Time	Segment End Time	Carriage Speed	Tow Force	Shaft Speed	Thrust	Torque	Thrust	Tow Force	Residual	(Shaft Speed)^2	Thrust	Torque	Residual	Residual
		yyyy.ddd	Second of day	Seconds	Seconds	m/s	N	rps	N	Nm	N	N	N		N	Nm	N	Nm
1	1	2011.336	43523.24	67.24	99.52	0	24.93	7.04	30.03	-0.847	30.03	24.93	0.24	49.56	30.03	-0.847	0.24	-0.006
2	1	2011.336	43564.06	108.06	123.26	0	33.56	8.04	39.37	-1.080	39.37	33.56	-0.04	64.70	39.37	-1.080	0.09	-0.001
3	1	2011.336	43584	128	143.2	0	43.65	9.04	49.83	-1.345	49.83	43.65	0.07	81.65	49.83	-1.345	-0.07	0.002
4	1	2011.336	43604.58	148.58	161.88	0	54.88	10.04	61.70	-1.646	61.70	54.88	-0.02	100.79	61.70	-1.646	-0.19	0.003
5	1	2011.336	43624.84	168.84	181.82	0	67.24	11.03	74.84	-1.976	74.84	67.24	-0.20	121.73	74.84	-1.976	-0.16	0.004
6	1	2011.336	43647	191	202.08	0	81.22	12.04	89.46	-2.345	89.46	81.22	-0.16	144.84	89.46	-2.345	-0.03	0.000
7	1	2011.336	43667.26	211.26	221.72	0	96.31	13.04	105.28	-2.744	105.28	96.31	-0.17	170.15	105.28	-2.744	-0.06	0.001
8	1	2011.336	43685.94	229.94	243.24	0	112.58	14.04	122.14	-3.169	122.14	112.58	0.02	197.00	122.14	-3.169	-0.03	0.000
9	1	2011.336	43708.42	252.42	264.14	0	130.48	15.04	140.64	-3.634	140.64	130.48	0.27	226.18	140.64	-3.634	0.20	-0.004
%																		
											Mean		2.53E-14				7.11E-15	-1.5E-16
											St. Dev.		0.169465				0.149457	0.003296

INSITU_010

Single Screw Torque and Thrust Insitu Check

Model:	907	Test Date:	02-Dec-2011
Description:	Joint Support Ship	Analysis Date:	2-Dec-2011
Condition:	Deep Departure	Project Number:	2517
Tank:	Towing Tank		
Propeller:	P106R		
Description:	MCDV B-Screw		
Condition:	Deep Departure		
Rotation:	RIGHT		



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APPENDIX F

TEST RUN LOG

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TEST LOG

Clearwater Towing Tank(CWT)

INSTITUTE FOR OCEAN TECHNOLOGY - PJ2517

JSS - PRELIMINARY DESIGN MODEL TESTS

DATE	TIME	WAIT TIME ACTUAL	Speed (m/s)	FILENAME(.DAQ)	RUN DESCRIPTION	Drive Signal	Video Track #	Bow	Mid	Stn	COMMENTS
23-Nov-11											Set up for seakeeping
"				HS0P88_T7P5_001	Seastate 3 - HS 0.88 - Period 7.5 sec (first attempt)	hs0p88_T7p5_drv					START OF WAVE MATCHING
"											Carriage at 93700
24-Nov-11											Storm closure
25-Nov-11	9:00	0:46									Start Hydraulics. Bring up waveboard
	9:46	0:21		Hs4p0_T11p0_001	Seastate 5H - HS 4m - Period 11 sec (first attempt)	Hs4p0_T11p0_DRV					
	10:08	0:37		Hs4p0_T11p0_002	Seastate 5H - HS 4m - Period 11 sec (second attempt)	Hs4p0_T11p0_DRV2					
	10:46	0:30		Hs3p25_T9p7_001	Seastate 5 - HS 3.25m - Period 9.7 sec (first attempt)	Hs3p25_T9p7_DRV					Duration 60 min full scale
"	11:16	0:32		Hs3p25_T9p7_002	Seastate 5 - HS 3.25m - Period 9.7 sec (Second attempt)	Hs3p25_T9p7_DRV2					Duration 60 min full scale
"	11:49	0:20		S_Hs3p25_T9p7_001	Seastate 5 - HS 3.25m - Period 9.7 sec (first attempt)	S_Hs3p25_T9p7_DRV					Duration 20 min full scale
"	12:09	0:46		S_Hs3p25_T9p7_002	Seastate 5 - HS 3.25m - Period 9.7 sec (Second attempt)	S_Hs3p25_T9p7_DRV2					Duration 20 min full scale
"	12:55	0:38		HS0P88_T7P5_003	Seastate 3 - HS 0.88 - Period 7.5 sec (third attempt)	hs0p88_T7p5_drv					Lower board fixed
"	13:34	0:21		HS0P88_T7P5_004	Seastate 3 - HS 0.88 - Period 7.5 sec (Fourth attempt)	hs0p88_T7p5_drv2					Lower board fixed
"	13:55	0:18		HS0P88_T7P5_005	Seastate 3 - HS 0.88 - Period 7.5 sec (fifth attempt)	hs0p88_T7p5_drv3					Lower board fixed
"	14:14	0:53		S_Hs3p25_T9p7_003	Seastate 5 - HS 3.25m - Period 9.7 sec (Third attempt)	S_Hs3p25_T9p7_DRV3					Duration 20 min full scale
"	15:08	0:21		Hs3p25_T9p7_003	Seastate 5 - HS 3.25m - Period 9.7 sec (third attempt)	Hs3p25_T9p7_DRV3					Duration 60 min full scale
"	15:30	#########									Set up carriage rails for seakeeping
28-Nov-11											
"	8:00										Set up for seakeeping, qualisys, install model, trim and ballast
"	to										
"	19:30										
"	19:51			Pitch_decay_001	zero speed pitch decay						
"											
29-Nov-11											

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TEST LOG

Clearwater Towing Tank(CWT)

INSTITUTE FOR OCEAN TECHNOLOGY - PJ2517

JSS - PRELIMINARY DESIGN MODEL TESTS

DATE	TIME	WAIT TIME ACTUAL	Speed (m/s)	FILENAME(.DAQ)	RUN DESCRIPTION	Drive Signal	Video Track #	Bow	Mid	Stn	COMMENTS
	8:00										Install qualisys battery
"											Set up for seakeeping
"											All new video for seakeeping start at 57, fwd, beam, and aft video
"	9:48		1.133	Speed_chk_12kts_001	carriage at constant speed, varying prop speed		57	B	M	S	rps = 8.43, 8.53, 8.63
"	9:59		1.133	Decay_Vs12_001	Pitch and heave decay at speed		58	B	M	S	rps = 8.53
"	10:17		1.416	Speed_chk_15kts_001	carriage at constant speed, varying prop speed		59	B	M	S	rps = 10.66, 10.76, 10.86
"	10:26		1.416	Decay_Vs15_001	Pitch and heave decay at speed		60	B	M	S	rps = 10.66
"	10:40		1.699	Speed_chk_18kts_001	carriage at constant speed, varying prop speed		61	B	M	S	rps = 12.77, 12.87, 12.97
"	10:53		1.699	Decay_Vs18_001	Pitch and heave decay at speed		62	B	M	S	rps = 12.97
"	11:00										Start hydraulics
"	11:00		1.888	Speed_chk_20kts_001	carriage at constant speed, varying prop speed		63	B	M	S	rps = 14.55, 14.65, 14.75
"	11:10		1.888	Decay_Vs20_001	Pitch and heave decay at speed		64	B	M	S	rps = 14.75
"											Change over to friction hub and set up for frictions
"	11:28			Friction_009	shaft friction test						7,8,9,10,11,12,13,14,15,16 rps
"	12:00										Rezero thrust, and roll and pitch inclinometers
"				Insitu_004	bollard test with inline load attached						carriage at 90m, rps at 7-15 rps, 1 rps increments
"	12:15										Bring up waveboard
"	13:00										rezero wave probes, and relmos
"	13:17		1.133	Calm_12kts_001	open water 12kt constant speed run		65	B	M	S	rps = 8.53 rps
"											
"	13:30		1.416	Calm_15kts_001	open water 12kt constant speed run		66	B	M	S	
"	13:39		1.416	Calm_15kts_002	open water 12kt constant speed run		67	B	M	S	
"	13:45										Waveboard not responding, troubleshooting system operation
"	15:00										translated qualisys body to CG position of model
"	15:17	0:16	1.888	Calm_20kts_001	open water 20kt constant speed run		68	B	M	S	constant carriage speed, rps = 14.75
"	15:33	0:17	1.888	Calm_20kts_002	open water 20kt constant speed run		69	B	M	S	rps = 14.65
"											
"	15:50	0:19	1.888	VS20_SS3_001	SS3 wave tests @ 20kts	hs0p88_T7p5_drv3	70	B	M	S	wave offset at 0 seconds
"	16:09	0:18	1.888	VS20_SS3_002	SS3 wave tests @ 20kts	hs0p88_T7p5_drv3	71	B	M	S	wave offset at 37 seconds
"	16:28	0:18	1.888	VS20_SS3_003	SS3 wave tests @ 20kts	hs0p88_T7p5_drv3	72	B	M	S	wave offset at 73 seconds
"	16:47	0:19	1.888	VS20_SS3_004	SS3 wave tests @ 20kts	hs0p88_T7p5_drv3	73	B	M	S	wave offset at 110 seconds
"	17:06	0:18	1.888	VS20_SS3_005	SS3 wave tests @ 20kts	hs0p88_T7p5_drv3	74	B	M	S	wave offset at 147 seconds
"	17:25	0:18	1.888	VS20_SS3_006	SS3 wave tests @ 20kts	hs0p88_T7p5_drv3	75	B	M	S	wave offset at 184 seconds
"											
"	17:44	0:17	1.888	Calm_20kts_003	open water 20kt constant speed run		76	B	M	S	
"	18:01	#########	1.888	Calm_20kts_004	open water 20kt constant speed run		77	B	M	S	
"											
"	18:13			Insitu_005	bollard test with inline load attached						carriage at 90m, rps at 7-15 rps, 1 rps increments

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TEST LOG

Clearwater Towing Tank(CWT)

INSTITUTE FOR OCEAN - PJ2517 TECHNOLOGY

JSS - PRELIMINARY DESIGN MODEL TESTS

DATE	TIME	WAIT TIME ACTUAL	Speed (m/s)	FILENAME(.DAQ)	RUN DESCRIPTION	Drive Signal	Video Track #	Bow	Mid	Stn	COMMENTS
"	18:20										Shut down hydraulics
"	18:30			Friction_010	shaft friction test						7,8,9,10,11,12,13,14,15,16 rps
30-Nov-11	8:00										Start hydraulics
"	8:15			Friction_011	shaft friction test						7,8,9,10,11,12,13,14,15,16 rps
"	8:40			Insitu_006	bollard test with inline load attached						carriage at 90m, rps at 7-15 rps, 1 rps increments
"	9:00										Bring up waveboard
"	9:27										rezero waveprobes
"	9:34	0:15	1.699	Calm_18kts_001	open water 18kt constant speed run		78	B	M	S	constant carriage speed, rps = 12.97
"	9:49	0:22	1.699	Calm_18kts_002	open water 18kt constant speed run		79	B	M	S	rps = 12.97
"	10:11	0:20	Chase mode	VS18_SS5_001	SS5 wave tests @ 18kts, constant rps = 12.97	Hs3p25_T9p7_DRV2	80	B	M	S	wave offset at 0 seconds
"	10:32	0:19	Chase mode	VS18_SS5_002	SS5 wave tests @ 18kts, constant rps = 12.97	Hs3p25_T9p7_DRV2	81	B	M	S	wave offset at 51 seconds
"	10:52	0:20	Chase mode	VS18_SS5_003	SS5 wave tests @ 18kts, constant rps = 12.97	Hs3p25_T9p7_DRV2	82	B	M	S	wave offset at 102 seconds
"	11:12	0:19	Chase mode	VS18_SS5_004	SS5 wave tests @ 18kts, constant rps = 12.97	Hs3p25_T9p7_DRV2	83	B	M	S	wave offset at 153 seconds
"	11:32	0:19	Chase mode	VS18_SS5_005	SS5 wave tests @ 18kts, constant rps = 12.97	Hs3p25_T9p7_DRV2	84	B	M	S	wave offset at 204 seconds
"	11:52	0:42	Chase mode	VS18_SS5_006	SS5 wave tests @ 18kts, constant rps = 12.97	Hs3p25_T9p7_DRV2	85	B	M	S	wave offset at 255 seconds
"	12:34	0:23	Chase mode	VS18_SS5_007	SS5 wave tests @ 18kts, constant rps = 12.97	Hs3p25_T9p7_DRV2	86	B	M	S	wave offset at 306 seconds
"	12:58	0:19	Chase mode	VS18_SS5_008	SS5 wave tests @ 18kts, constant rps = 12.97	Hs3p25_T9p7_DRV2	87	B	M	S	wave offset at 357 seconds
"	13:18	0:20	Chase mode	VS18_SS5_009	SS5 wave tests @ 18kts, constant rps = 12.97	Hs3p25_T9p7_DRV2	88	B	M	S	wave offset at 408 seconds
"	13:38	0:20	Chase mode	VS18_SS5_010	SS5 wave tests @ 18kts, constant rps = 12.97	Hs3p25_T9p7_DRV2	89	B	M	S	wave offset at 459 seconds
"	13:58	0:20	Chase mode	VS18_SS5_011	SS5 wave tests @ 18kts, constant rps = 12.97	Hs3p25_T9p7_DRV2	90	B	M	S	wave offset at 510 seconds
"	14:19	0:20	Chase mode	VS18_SS5_012	SS5 wave tests @ 18kts, constant rps = 12.97	Hs3p25_T9p7_DRV2	91	B	M	S	wave offset at 561 seconds. Did not update annotator
"	14:39	0:19	Chase mode	VS18_SS5_013	SS5 wave tests @ 18kts, constant rps = 12.97	Hs3p25_T9p7_DRV2	92	B	M	S	wave offset at 612 seconds
"	14:59	0:20	Chase mode	VS18_SS5_014	SS5 wave tests @ 18kts, constant rps = 12.97	Hs3p25_T9p7_DRV2	93	B	M	S	repeat check.
"	15:20	0:15	1.699	Calm_18kts_003	open water 18kt constant speed run		94	B	M	S	constant carriage speed, rps = 12.97
"	15:35	0:35	1.699	Calm_18kts_004	open water 18kt constant speed run		95	B	M	S	prop not activated
"	16:10	0:15	1.699	Calm_18kts_005	open water 18kt constant speed run		n/a				rps = 12.97
"											
"	16:25	0:19	Chase mode	VS18_SS5H_001	SS5H wave tests @ 18kts, constant rps = 12.97	Hs4p0_T11p0_DRV2	96	B	M	S	wave offset at 0 seconds
"	16:44	0:18	Chase mode	VS18_SS5H_002	SS5H wave tests @ 18kts, constant rps = 12.97	Hs4p0_T11p0_DRV2	97	B	M	S	wave offset at 44 seconds
"	17:03	0:19	Chase mode	VS18_SS5H_003	SS5H wave tests @ 18kts, constant rps = 12.97	Hs4p0_T11p0_DRV2	98	B	M	S	wave offset at 88 seconds
"											HDT-320-025 to 027 harddrives installed
"	17:23	0:19	Chase mode	VS18_SS5H_004	SS5H wave tests @ 18kts, constant rps = 12.97	Hs4p0_T11p0_DRV2	1	B	M	S	wave offset at 132 seconds
"	17:42	0:19	Chase mode	VS18_SS5H_005	SS5H wave tests @ 18kts, constant rps = 12.97	Hs4p0_T11p0_DRV2	2	B	M	S	wave offset at 176 seconds
"	18:01	0:19	Chase mode	VS18_SS5H_006	SS5H wave tests @ 18kts, constant rps = 12.97	Hs4p0_T11p0_DRV2	3	B	M	S	wave offset at 0 seconds, repeat of 1st run
"	18:21	#########	1.699	Calm_18kts_006	open water 18kt constant speed run		4	B	M	S	constant carriage speed, rps = 12.97
"		0:00	1.699	Calm_18kts_007	open water 18kt constant speed run		5	B	M	S	rps = 12.97

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TEST LOG

Clearwater Towing Tank(CWT)

INSTITUTE FOR OCEAN TECHNOLOGY - PJ2517

JSS - PRELIMINARY DESIGN MODEL TESTS

DATE	TIME	WAIT TIME ACTUAL	Speed (m/s)	FILENAME(.DAQ)	RUN DESCRIPTION	Drive Signal	Video Track #	Bow	Mid	Stn	COMMENTS
"											
"	18:45			Insitu_007	bollard test with inline load attached						carriage at 90m, rps at 7-15 rps, 1 rps increments
"				Friction_012	shaft friction test						7,8,9,10,11,12,13,14,15,16 rps
"	19:00										Shutdown waveboard
"											
01-Dec-11	8:00										Start hydraulics
"	8:13			Friction_013	shaft friction test						7,8,9,10,11,12,13,14,15,16 rps
"	8:35			Insitu_008	bollard test with inline load attached						carriage at 90m, rps at 7-15 rps, 1 rps increments
"	8:45										Bring up waveboard
"	9:03										rezero waveprobes
"	9:12	0:14	1.416	Calm_15kts_003	open water 15kt constant speed run		6	B	M	S	rps = 10.66
"	9:26	0:13	1.416	Calm_15kts_004	open water 15kt constant speed run		7	B	M	S	rps = 10.66
"	9:40	0:19	Chase mode	VS15_SS3_001	SS3 wave tests @ 15kts, constant rps = 10.66	hs0p88_T7p5_drv3	8	B	M	S	wave offset at 0 seconds
"	10:00	0:22	Chase mode	VS15_SS3_002	SS3 wave tests @ 15kts, constant rps = 10.66	hs0p88_T7p5_drv3	9	B	M	S	wave offset at 55 seconds
"	10:22	0:19	Chase mode	VS15_SS3_003	SS3 wave tests @ 15kts, constant rps = 10.66	hs0p88_T7p5_drv3	10	B	M	S	wave offset at 110 seconds
"	10:42	0:19	Chase mode	VS15_SS3_004	SS3 wave tests @ 15kts, constant rps = 10.66	hs0p88_T7p5_drv3	11	B	M	S	wave offset at 165 seconds
"	11:01	0:31	Chase mode	VS15_SS3_005	SS3 wave tests @ 15kts, constant rps = 10.66	hs0p88_T7p5_drv3	12	B	M	S	wave offset at 0 seconds, repeat run
"											
"	11:33	0:15	1.416	Calm_15kts_005	open water 15kt constant speed run		13	B	M	S	rps = 10.66
"	11:48	0:15	1.416	Calm_15kts_006	open water 15kt constant speed run		14	B	M	S	rps = 10.66
"											
"	12:03	0:50	Chase mode	VS15_SS5H_001	SS5H wave tests @ 15kts, constant rps = 10.66	Hs4p0_T11p0_DRV2	15	B	M	S	wave offset at 0 seconds
"	12:53	0:15	1.416	Calm_15kts_007	open water 15kt constant speed run		16	B	M	S	rps = 10.66
"	13:09	0:18	Chase mode	VS15_SS5H_002	SS5H wave tests @ 15kts, constant rps = 10.66	Hs4p0_T11p0_DRV2	17	B	M	S	wave offset at 55 seconds
"	13:28	0:19	Chase mode	VS15_SS5H_003	SS5H wave tests @ 15kts, constant rps = 10.66	Hs4p0_T11p0_DRV2	18	B	M	S	wave offset at 110 seconds
"	13:48	0:20	Chase mode	VS15_SS5H_004	SS5H wave tests @ 15kts, constant rps = 10.66	Hs4p0_T11p0_DRV2	19	B	M	S	wave offset at 165 seconds
"	14:08	0:25	Chase mode	VS15_SS5H_005	SS5H wave tests @ 15kts, constant rps = 10.66	Hs4p0_T11p0_DRV2	20	B	M	S	wave offset at 0 seconds, repeat run
"											Repeat SS5H at 15kts again with a higher shaft speed of 11.2 rps
"	14:33	0:26	Chase mode	VS15_SS5H_006	SS5H wave tests @ 15kts, constant rps = 11.2	Hs4p0_T11p0_DRV2	21	B	M	S	wave offset at 0 seconds
"	15:00	0:19	Chase mode	VS15_SS5H_007	SS5H wave tests @ 15kts, constant rps = 11.8	Hs4p0_T11p0_DRV2	22	B	M	S	wave offset at 0 seconds, 11.2 rps not high enough
"	15:19	0:19	Chase mode	VS15_SS5H_008	SS5H wave tests @ 15kts, constant rps = 11.8	Hs4p0_T11p0_DRV2	23	B	M	S	wave offset at 55 seconds
"	15:39	0:19	Chase mode	VS15_SS5H_009	SS5H wave tests @ 15kts, constant rps = 11.8	Hs4p0_T11p0_DRV2	24	B	M	S	wave offset at 110 seconds
"	15:58	0:19	Chase mode	VS15_SS5H_010	SS5H wave tests @ 15kts, constant rps = 11.8	Hs4p0_T11p0_DRV2	25	B	M	S	wave offset at 165 seconds
"	16:17	0:19	Chase mode	VS15_SS5H_011	SS5H wave tests @ 15kts, constant rps = 11.8	Hs4p0_T11p0_DRV2	26	B	M	S	wave offset at 165 seconds, repeat run, qualisys dropouts
"	16:37	0:15	1.416	Calm_15kts_008	open water 15kt constant speed run	n/a	27	B	M	S	rps = 10.66, annotator says _007
"	16:52	0:15	1.416	Calm_15kts_009	open water 15kt constant speed run	n/a	n/a				rps = 10.66

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TEST LOG

Clearwater Towing Tank(CWT)

INSTITUTE FOR OCEAN TECHNOLOGY - PJ2517

JSS - PRELIMINARY DESIGN MODEL TESTS

DATE	TIME	WAIT TIME ACTUAL	Speed (m/s)	FILENAME(.DAQ)	RUN DESCRIPTION	Drive Signal	Video Track #	Bow	Mid	Stn	COMMENTS
"	17:08	0:15	1.133	Calm_12kts_002	open water 12kt constant speed run	n/a	28	B	M	S	rps = 8.53
"	17:23	0:15	1.133	Calm_12kts_003	open water 12kt constant speed run	n/a	29	B	M	S	rps = 8.53
"	17:38	0:20	Chase mode	VS12_SS5H_001	SS5H wave tests @ 12kts, constant rps = 9.76	Hs4p0_T11p0_DRV2	30	B	M	S	wave offset at 0 seconds.
"	17:58	0:19	Chase mode	VS12_SS5H_002	SS5H wave tests @ 12kts, constant rps = 9.76	Hs4p0_T11p0_DRV2	31	B	M	S	wave offset at 73 seconds.
"	18:18	0:21	Chase mode	VS12_SS5H_003	SS5H wave tests @ 12kts, constant rps = 9.76	Hs4p0_T11p0_DRV2	32	B	M	S	wave offset at 146 seconds.
"	18:39	0:21	Chase mode	VS12_SS5H_004	SS5H wave tests @ 12kts, constant rps = 9.76	Hs4p0_T11p0_DRV2	33	B	M	S	wave offset at 0 seconds.
"	19:00	0:14	1.133	Calm_12kts_004	open water 12kt constant speed run	n/a	34	B	M	S	rps = 8.53
"	19:15	#########	1.133	Calm_12kts_005	open water 12kt constant speed run	n/a	35	B	M	S	rps = 8.53
"											
"	19:25			Insitu_009	bollard test with inline load attached						carriage at 90m, rps at 7-15 rps, 1 rps increments
"				Friction_014	shaft friction test						7,8,9,10,11,12,13,14,15,16 rps
"											
"											Shut down waveboard

02-Dec-11	8:00										Start hydraulics
"	8:15			Friction_015	shaft friction test						7,8,9,10,11,12,13,14,15,16 rps
"	8:34			Insitu_010	bollard test with inline load attached						carriage at 90m, rps at 7-15 rps, 1 rps increments
"	8:45										Rotate model and move encounter waveprobe
"	9:30										bring up waveboard
"	9:45										rezero waveprobes
"	9:54	0:22	Chase mode	Calm_H0_15kts_001	open water 15kt constant speed run, following seas		36	B	M	S	rps = 10.66
"											recal carriage speed to -2 to +2 m/s for following seas, and repeat calm runs
"	10:16	0:15	Chase mode	Calm_H0_15kts_002	open water 15kt constant speed run, following seas		37	B	M	S	rps = 10.66
"	10:32	0:15	Chase mode	Calm_H0_15kts_003	open water 15kt constant speed run, following seas		38	B	M	S	rps = 10.66
"											
"	10:47	0:21	Chase mode	VS15_H0_SS5_001	SS5H wave tests @ 15kts, constant rps = 10.66	S_Hs3p25_T9p7_DRV3	39	B	M	S	wave offset at 0 seconds. Wrong annotation, says Calm_H0_15kts_003
"	11:08	0:20	Chase mode	VS15_H0_SS5_002	SS5H wave tests @ 15kts, constant rps = 10.66	S_Hs3p25_T9p7_DRV3	40	B	M	S	wave offset at 22 seconds
"	11:28	0:19	Chase mode	VS15_H0_SS5_003	SS5H wave tests @ 15kts, constant rps = 10.66	S_Hs3p25_T9p7_DRV3	41	B	M	S	wave offset at 44 seconds
"	11:48	0:19	Chase mode	VS15_H0_SS5_004	SS5H wave tests @ 15kts, constant rps = 10.66	S_Hs3p25_T9p7_DRV3	42	B	M	S	wave offset at 66 seconds
"	12:07	0:20	Chase mode	VS15_H0_SS5_005	SS5H wave tests @ 15kts, constant rps = 10.66	S_Hs3p25_T9p7_DRV3	43	B	M	S	wave offset at 88 seconds
"	12:27	0:46	Chase mode	VS15_H0_SS5_006	SS5H wave tests @ 15kts, constant rps = 10.66	S_Hs3p25_T9p7_DRV3	44	B	M	S	wave offset at 110 seconds
"	13:14	0:19	Chase mode	VS15_H0_SS5_007	SS5H wave tests @ 15kts, constant rps = 10.66	S_Hs3p25_T9p7_DRV3	45	B	M	S	wave offset at 132 seconds
"	13:34	0:19	Chase mode	VS15_H0_SS5_008	SS5H wave tests @ 15kts, constant rps = 10.66	S_Hs3p25_T9p7_DRV3	46	B	M	S	wave offset at 154 seconds

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NRC·CNRC

TEST LOG

Clearwater Towing Tank(CWT)

INSTITUTE FOR OCEAN TECHNOLOGY - PJ2517

JSS - PRELIMINARY DESIGN MODEL TESTS

DATE	TIME	WAIT TIME ACTUAL	Speed (m/s)	FILENAME(.DAQ)	RUN DESCRIPTION	Drive Signal	Video Track #	Bow	Mid	Stn	COMMENTS
"	13:53	0:21	Chase mode	VS15_H0_SS5_009	SS5H wave tests @ 15kts, constant rps = 10.66	S_Hs3p25_T9p7_DRV3	47	B	M	S	wave offset at 176 seconds
"	14:15	0:19	Chase mode	VS15_H0_SS5_010	SS5H wave tests @ 15kts, constant rps = 10.66	S_Hs3p25_T9p7_DRV3	48	B	M	S	wave offset at 198 seconds
"	14:35	0:17	Chase mode	VS15_H0_SS5_011	SS5H wave tests @ 15kts, constant rps = 10.66	S_Hs3p25_T9p7_DRV3	49	B	M	S	wave offset at 0 seconds
"											
"	14:53	0:16	Chase mode	Calm_H0_15kts_004	open water 15kt constant speed run, following seas		50	B	M	S	rps = 10.66
"	15:09	0:23	Chase mode	Calm_H0_15kts_005	open water 15kt constant speed run, following seas		51	B	M	S	rps = 10.66
"											Removed relmo probes from model and opened test frame to complete some roll decays
"	15:33		1.133, 1.416	roll_decay_Vs12_Vs15_001	roll decay at 12 and 15 kts		52	B	M	S	
"	15:40		1.133, 1.416	roll_decay_Vs12_Vs15_002	roll decay at 12 and 15 kts		53	B	M	S	
"	15:47		1.699	roll_decay_Vs18_001	roll decay at 18 kts		54	B	M	S	
"	15:54		1.699	roll_decay_Vs18_002	roll decay at 18 kts, no prop speed		55	B	M	S	
"	16:05		n/a	roll_decay_Vs0_001	roll decay at zero speed						carriage at 60m position
"											
"				Friction_016	shaft friction test						7,8,9,10,11,12,13,14,15,16 rps

APPENDIX G

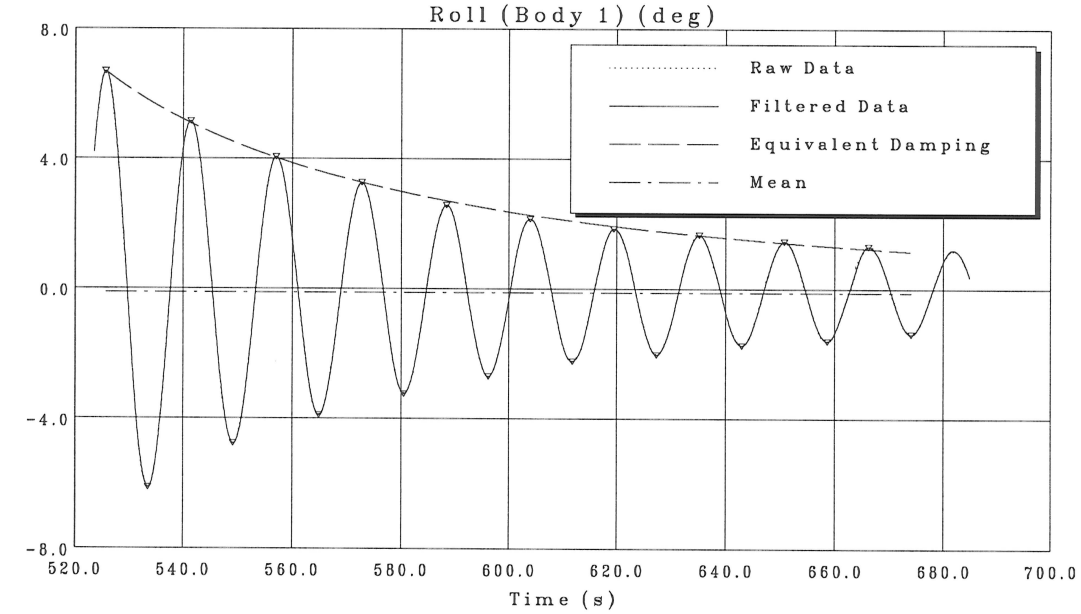
DECAY ANALYSIS

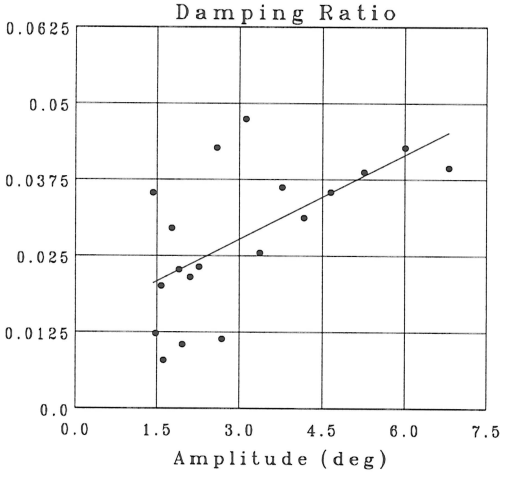
Roll Decay at VS = 0 knots

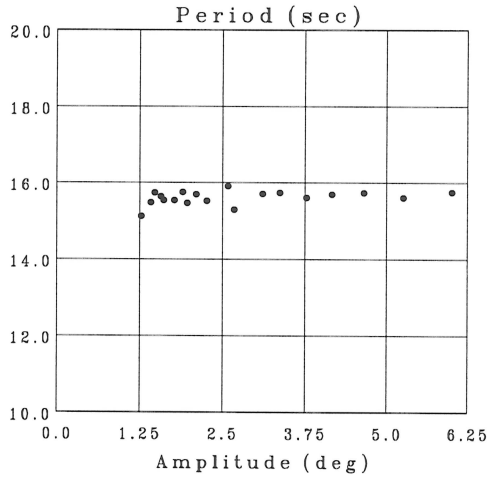
Calm Water

JSS-Preliminary Design Model Tests
{PROJECT_PHASE}

Analyzed: 09-DEC-2011 09:40:53
Acquired: 02-DEC-2011 19:34:03







MEAN		DAMPING	
Offset =	-0.1183 deg	Linear =	0.02803
Period =	15.60 sec	Equivalent B1 =	0.01388
		Equivalent B2 =	0.004593

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Roll (Body 1)
ROLL_DECAY_VS0_001

JSS-Preliminary Design Model Tes

Analyzed: 09-DEC-2011 09:40:53
Acquired: 02-DEC-2011 19:34:03

Roll (Body 1) (deg)

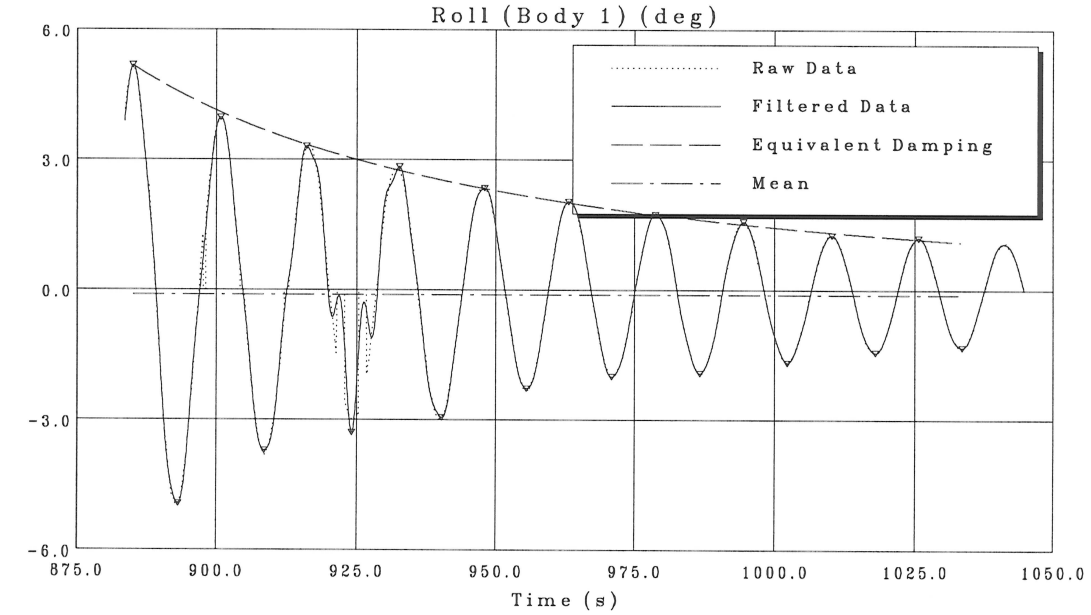
Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
-0.1183	15.5972	0.02803	0.00459	0.01388

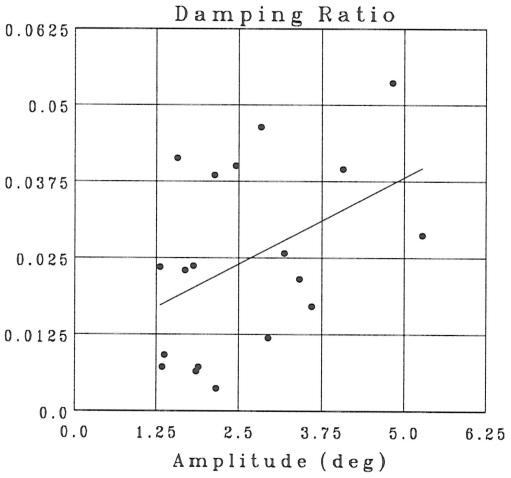
Roll (Body 1) (deg)

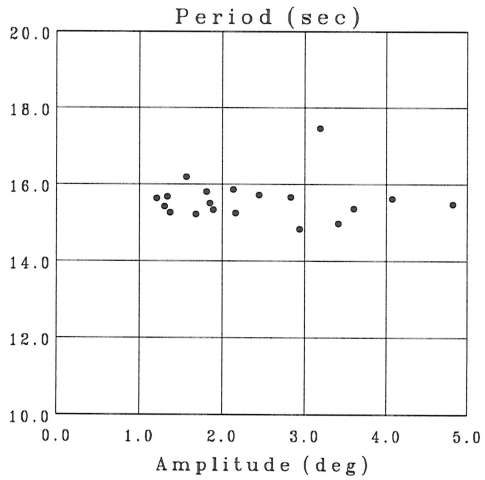
Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
6.6901	6.8085	0.03942	
-6.1332	6.0149	0.04271	15.7439
5.1406	5.2590	0.03869	15.5947
-4.7749	4.6566	0.03535	15.7227
4.0485	4.1668	0.03119	15.6886
-3.8960	3.7777	0.03619	15.5985
3.2532	3.3715	0.02542	15.7336
-3.2310	3.1127	0.04739	15.7023
2.5633	2.6816	0.01131	15.2827
-2.7063	2.5880	0.04272	15.9003
2.1444	2.2627	0.02313	15.5083
-2.2224	2.1040	0.02136	15.6890
1.8491	1.9674	0.01040	15.4528
-2.0225	1.9042	0.02267	15.7383
1.6549	1.7733	0.02947	15.5309
-1.7347	1.6164	0.00779	15.5282
1.4590	1.5773	0.01999	15.6215
-1.5996	1.4813	0.01217	15.7307
1.3074	1.4257	0.03529	15.4729
-1.3943	1.2760		15.1075

JSS-Preliminary Design Model Tests
{PROJECT_PHASE}

Analyzed: 09-DEC-2011 09:44:59
Acquired: 02-DEC-2011 19:34:03







MEAN		DAMPING	
Offset =	-0.1122 deg	Linear =	0.02459
Period =	15.59 sec	Equivalent B1 =	0.009800
		Equivalent B2 =	0.005649

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Roll (Body 1)
ROLL_DECAY_VS0_001

JSS-Preliminary Design Model Tes

Analyzed: 09-DEC-2011 09:44:59
Acquired: 02-DEC-2011 19:34:03

Roll (Body 1) (deg)

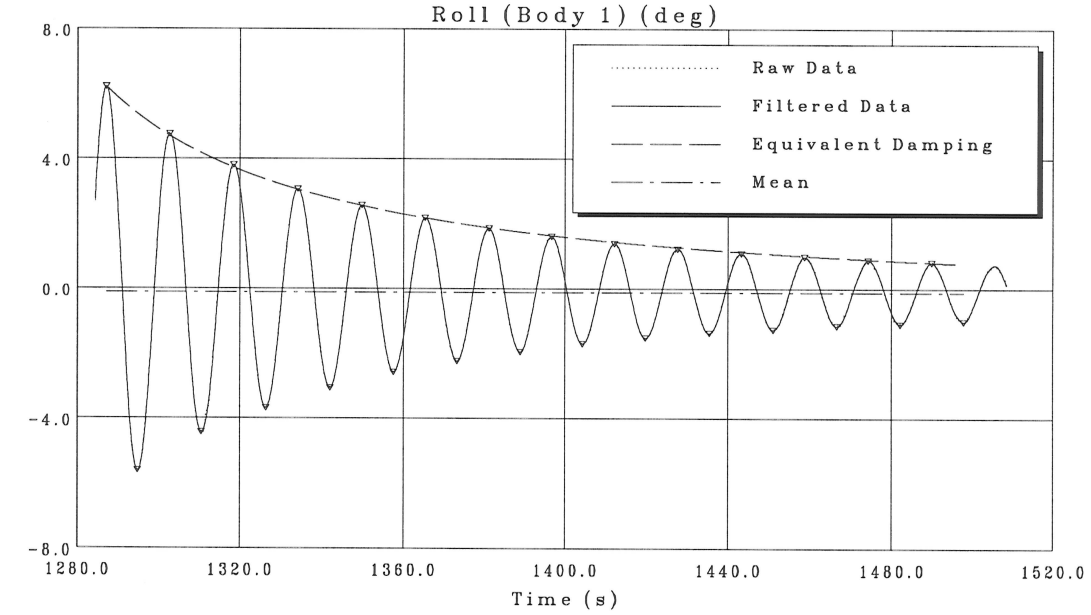
Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
-0.1122	15.5886	0.02459	0.00565	0.00980

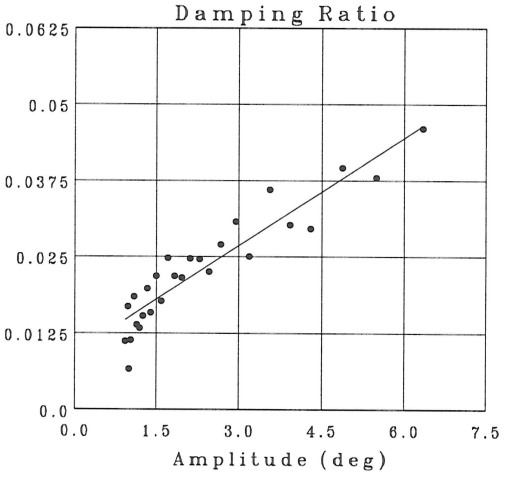
Roll (Body 1) (deg)

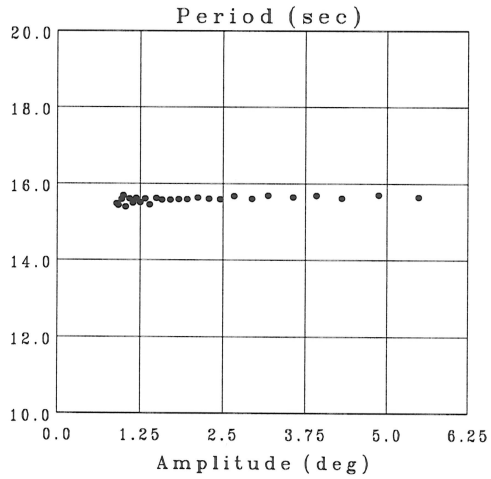
Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
5.1675	5.2797	0.02865	
-4.9373	4.8251	0.05359	15.4703
3.9642	4.0764	0.03947	15.6140
-3.7128	3.6006	0.01703	15.3579
3.3008	3.4130	0.02146	14.9670
-3.3026	3.1904	0.02571	17.4559
2.8306	2.9428	0.01182	14.8328
-2.9477	2.8355	0.04639	15.6576
2.3384	2.4506	0.04000	15.7208
-2.2732	2.1610	0.00362	15.2460
2.0244	2.1366	0.03853	15.8521
-2.0050	1.8928	0.00710	15.3207
1.7388	1.8510	0.00638	15.5040
-1.9265	1.8143	0.02367	15.7999
1.5720	1.6842	0.02295	15.2185
-1.6792	1.5670	0.04124	16.1862
1.2643	1.3765	0.00905	15.2612
-1.4500	1.3378	0.00707	15.6775
1.1963	1.3085	0.02350	15.4167
-1.3275	1.2153		15.6240

JSS-Preliminary Design Model Tests
{PROJECT_PHASE}

Analyzed: 09-DEC-2011 09:50:15
Acquired: 02-DEC-2011 19:34:03







MEAN		DAMPING	
Offset =	-0.1226 deg	Linear =	0.02307
Period =	15.58 sec	Equivalent B1 =	0.009105
		Equivalent B2 =	0.005879

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Roll (Body 1)
ROLL_DECAY_VS0_001

JSS-Preliminary Design Model Tes

Analyzed: 09-DEC-2011 09:50:15
Acquired: 02-DEC-2011 19:34:03

Roll (Body 1) (deg)

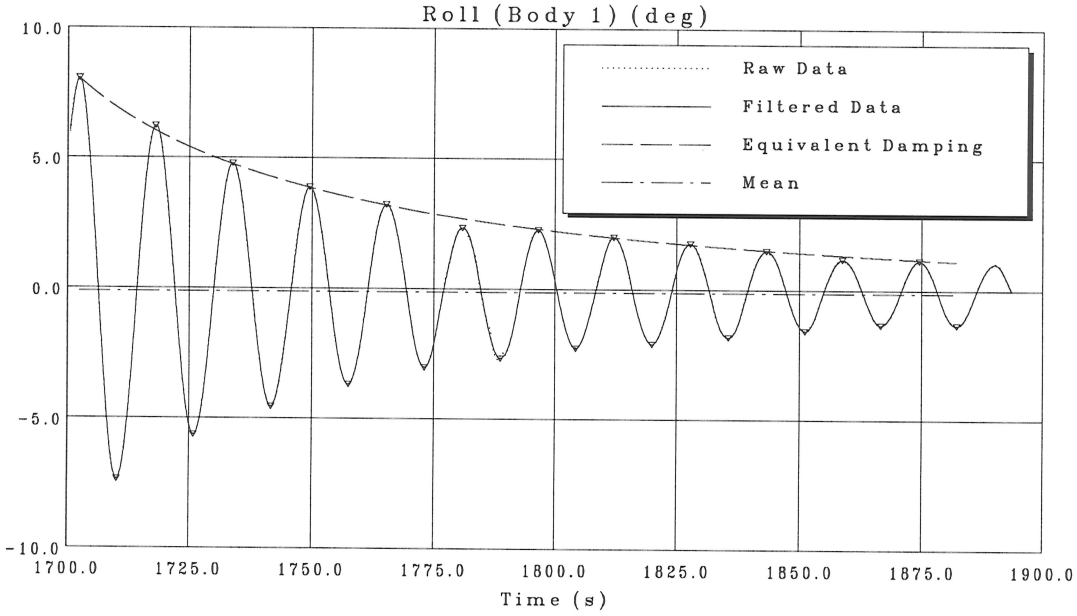
Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
-0.1226	15.5839	0.02307	0.00588	0.00910

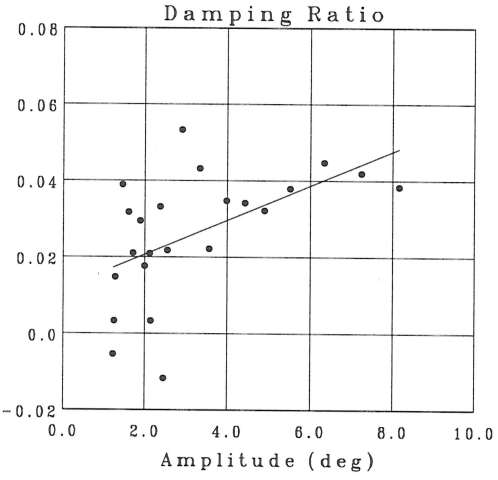
Roll (Body 1) (deg)

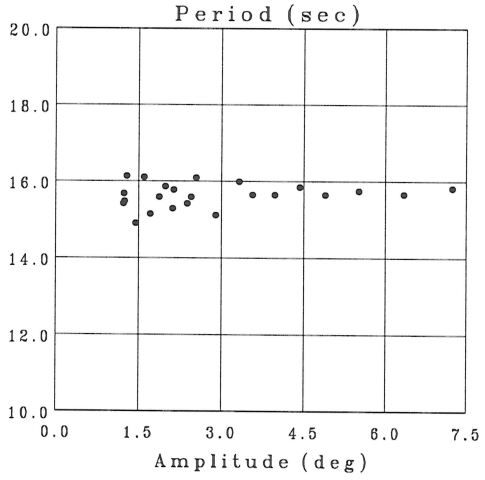
Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
6.2250	6.3476	0.04597	
-5.6159	5.4933	0.03798	15.6426
4.7524	4.8750	0.03957	15.7014
-4.4273	4.3047	0.02958	15.6187
3.7999	3.9225	0.03016	15.6895
-3.6903	3.5677	0.03599	15.6387
3.0635	3.1861	0.02500	15.6917
-3.0679	2.9453	0.03072	15.6038
2.5516	2.6742	0.02696	15.6682
-2.5795	2.4569	0.02243	15.5852
2.1671	2.2897	0.02458	15.6013
-2.2421	2.1195	0.02459	15.6233
1.8392	1.9618	0.02154	15.5811
-1.9561	1.8335	0.02177	15.5796
1.5896	1.7122	0.02471	15.5686
-1.7069	1.5843	0.01761	15.5684
1.3764	1.4990	0.02178	15.6133
-1.5224	1.3998	0.01576	15.4424
1.2096	1.3322	0.01970	15.6042
-1.3748	1.2522	0.01527	15.4958
1.0709	1.1935	0.01329	15.6147
-1.2673	1.1447	0.01383	15.4897
0.9734	1.0960	0.01838	15.6025
-1.1571	1.0345	0.01128	15.3855
0.8759	0.9985	0.00656	15.6807
-1.1007	0.9781	0.01671	15.5837
0.8055	0.9281	0.01113	15.4233
-1.0188	0.8962		15.4675

JSS-Preliminary Design Model Tests
{PROJECT_PHASE}

Analyzed: 09-DEC-2011 09:54:23
Acquired: 02-DEC-2011 19:34:03







MEAN		DAMPING	
Offset =	-0.1240 deg	Linear =	0.02610
Period =	15.63 sec	Equivalent B1 =	0.01152
		Equivalent B2 =	0.004502

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Roll (Body 1)
ROLL_DECAY_VS0_001

JSS-Preliminary Design Model Tes

Analyzed: 09-DEC-2011 09:54:23
Acquired: 02-DEC-2011 19:34:03

Roll (Body 1) (deg)

Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
-0.1240	15.6291	0.02610	0.00450	0.01152

Roll (Body 1) (deg)

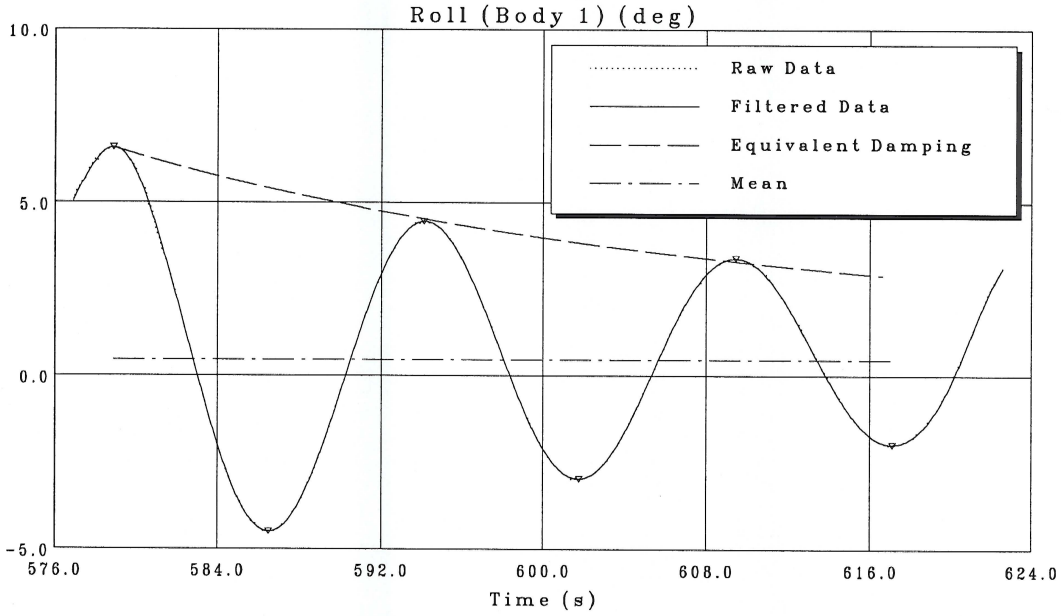
Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
8.0444	8.1684	0.03825	
-7.3668	7.2429	0.04188	15.8113
6.2253	6.3493	0.04467	15.6509
-5.6411	5.5171	0.03779	15.7454
4.7751	4.8991	0.03211	15.6489
-4.5527	4.4288	0.03409	15.8464
3.8548	3.9788	0.03470	15.6409
-3.6916	3.5676	0.02215	15.6479
3.2038	3.3278	0.04319	15.9836
-3.0291	2.9052	0.05330	15.1064
2.3327	2.4566	-0.01174	15.5820
-2.6729	2.5489	0.02168	16.0825
2.2571	2.3811	0.03308	15.4133
-2.2699	2.1459	0.00325	15.7747
2.0002	2.1241	0.02076	15.2820
-2.1139	1.9900	0.01749	15.8538
1.7596	1.8835	0.02942	15.5864
-1.8411	1.7172	0.02104	15.1440
1.4834	1.6073	0.03168	16.0959
-1.5789	1.4550	0.03892	14.9023
1.1634	1.2874	0.01471	16.1270
-1.3532	1.2292	-0.00545	15.4111
1.1265	1.2505	0.00326	15.4663
-1.3617	1.2377		15.6658

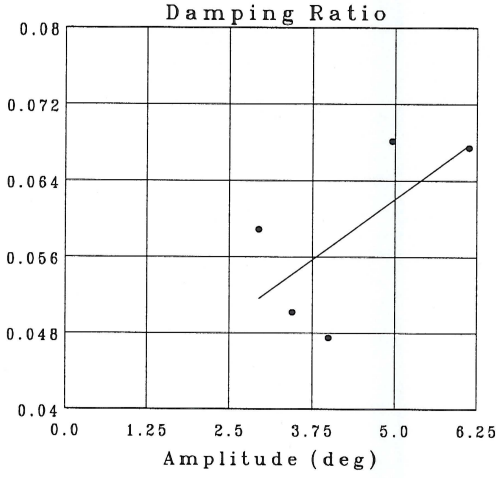
Roll Decay at VS = 12 knots

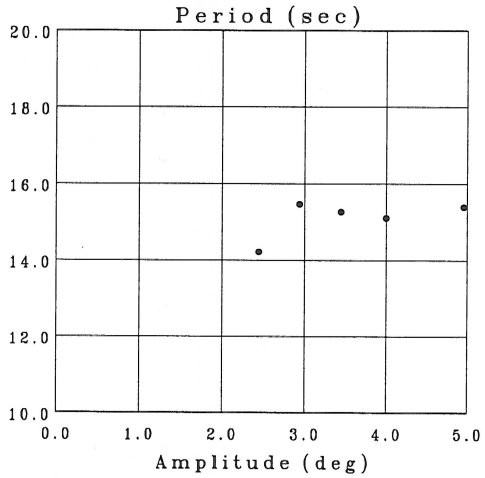
Calm Water

JSS-Preliminary Design Model Tests
{PROJECT_PHASE}

Analyzed: 09-DEC-2011 10:19:01
Acquired: 02-DEC-2011 19:09:43







MEAN		DAMPING	
Offset =	0.4600 deg	Linear =	0.05841
Period =	15.08 sec	Equivalent B1 =	0.03665
		Equivalent B2 =	0.005064

National Research Council Canada
Institute for Ocean Technology

Roll (Body 1)
ROLL_DECAY_VS12_VS15_002

JSS-Preliminary Design Model Tes

Analyzed: 09-DEC-2011 10:19:01
Acquired: 02-DEC-2011 19:09:43

Roll (Body 1) (deg)

Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
0.4600	15.0848	0.05841	0.00506	0.03665

Roll (Body 1) (deg)

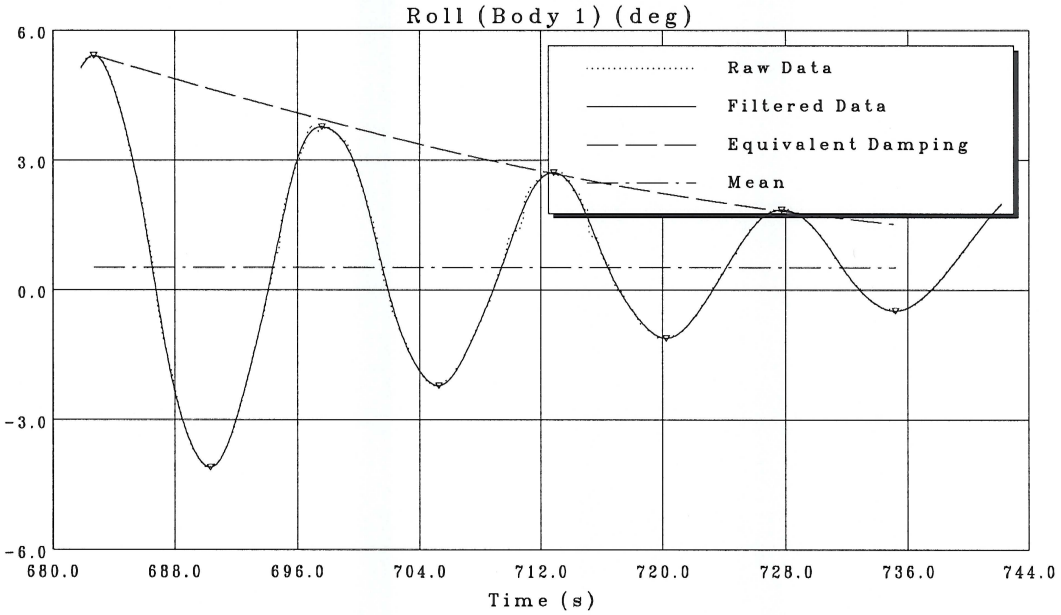
Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
6.5930	6.1330	0.06746	
-4.4993	4.9593	0.06810	15.3916
4.4621	4.0021	0.04748	15.0985
-2.9869	3.4469	0.05017	15.2593
3.4037	2.9437	0.05885	15.4583
-1.9860	2.4460		14.2162

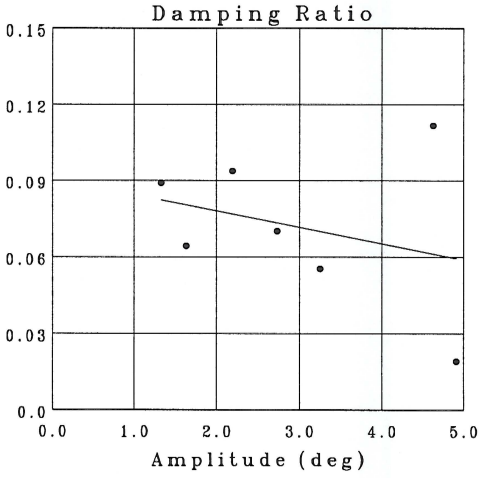
Roll Decay at VS=15 knots

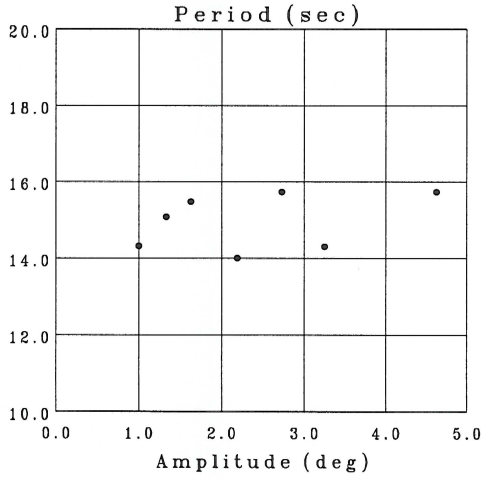
Calm Water

JSS-Preliminary Design Model Tests
{PROJECT_PHASE}

Analyzed: 09-DEC-2011 10:25:13
Acquired: 02-DEC-2011 19:09:43







MEAN		DAMPING	
Offset =	0.5184 deg	Linear =	0.07187
Period =	14.94 sec	Equivalent B1 =	0.09095
		Equivalent B2 =	-0.006460

National Research Council Canada
Institute for Ocean Technology

Roll (Body 1)
ROLL_DECAY_VS12_VS15_002

JSS-Preliminary Design Model Tes

Analyzed: 09-DEC-2011 10:25:13
Acquired: 02-DEC-2011 19:09:43

Roll (Body 1) (deg)

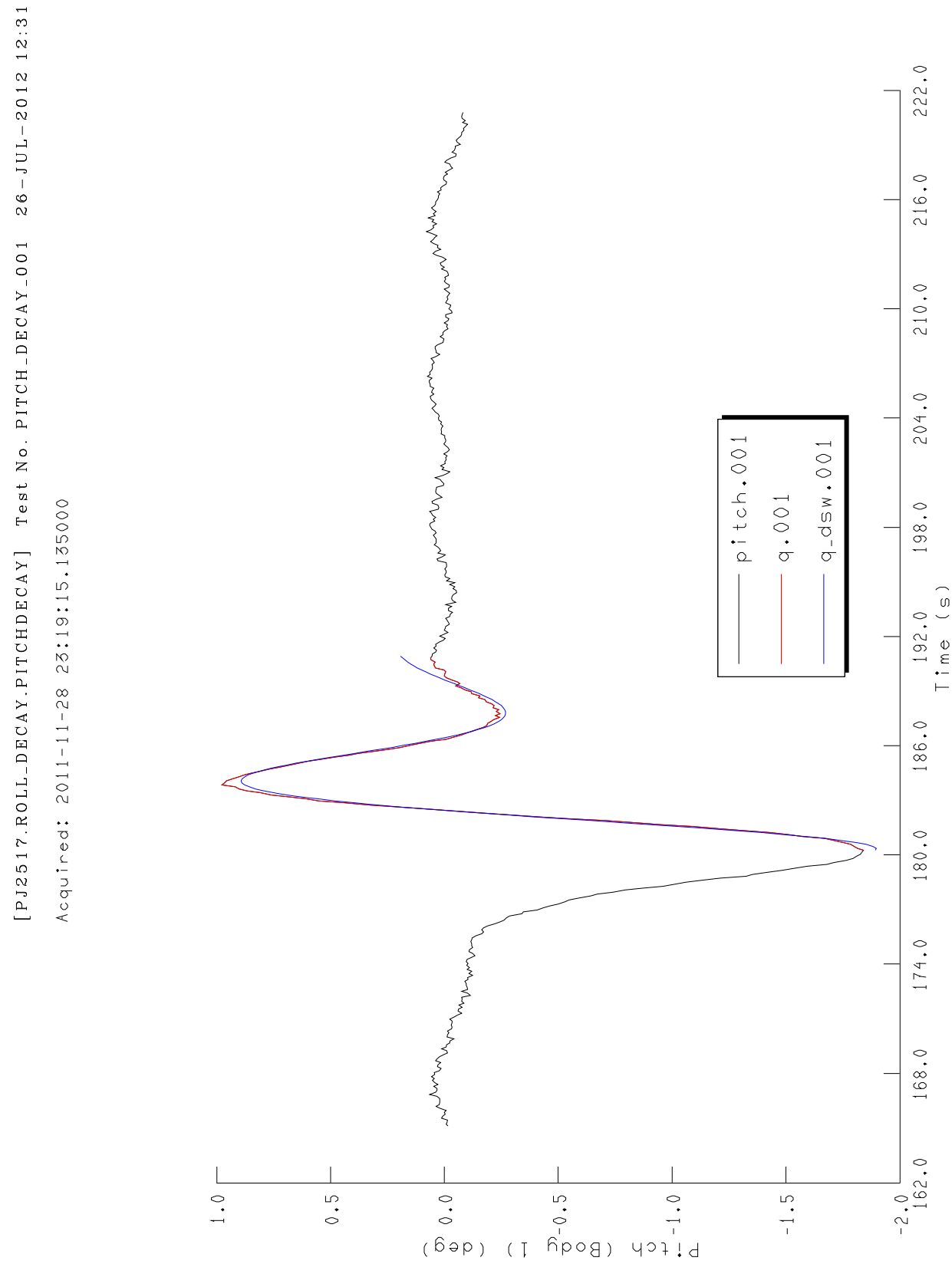
Offset	Average Period	Linear Damping Coefficient	Equivalent Damping Slope	Equivalent Damping Offset
0.5184	14.9434	0.07187	-0.00646	0.09095

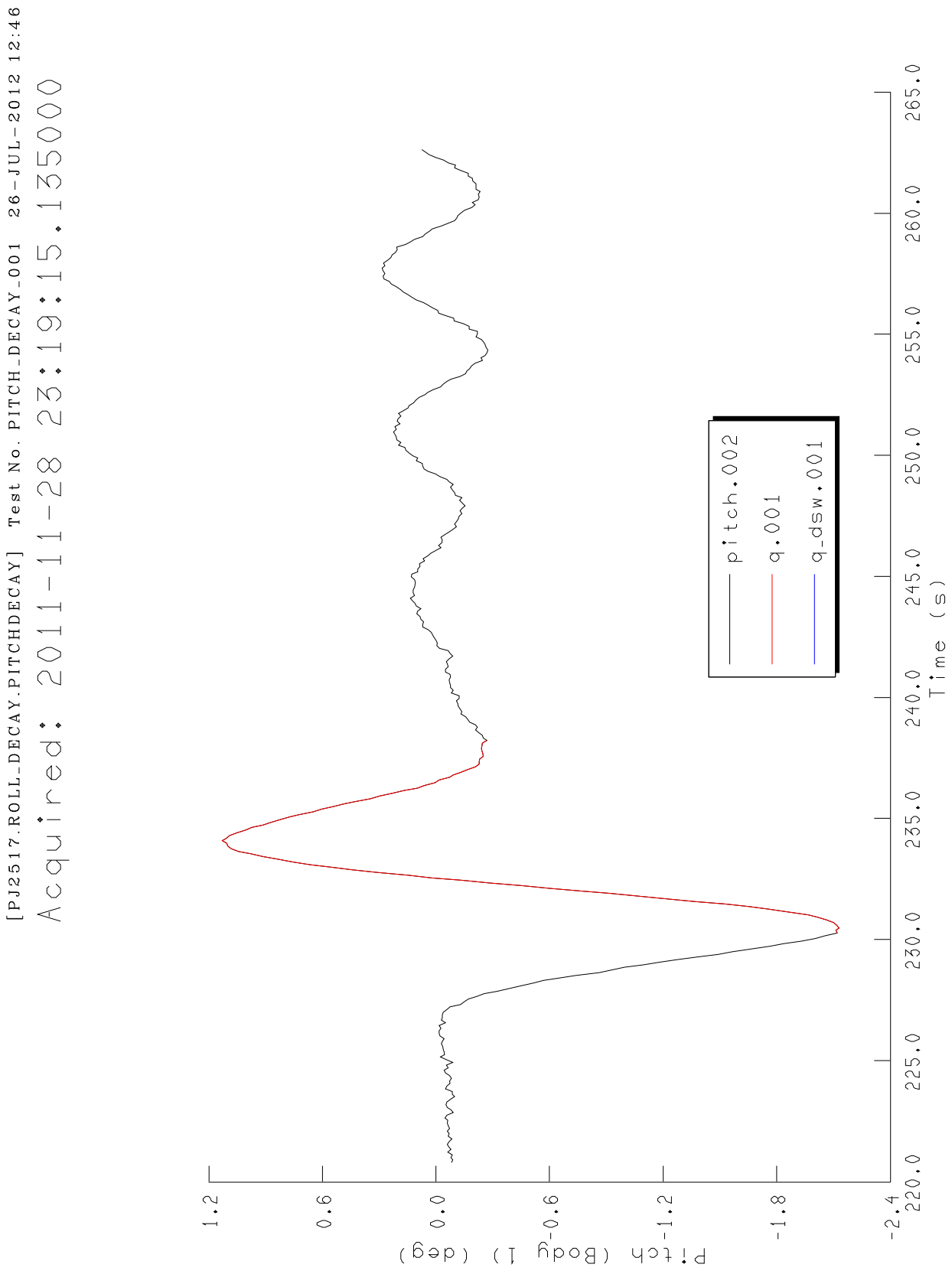
Roll (Body 1) (deg)

Amplitude	ABS(Amplitude-Offset)	Damping Ratio	Period
5.4311	4.9127	0.01901	
-4.1095	4.6279	0.11173	15.7217
3.7691	3.2507	0.05518	14.2910
-2.2142	2.7326	0.07010	15.7303
2.7096	2.1913	0.09375	13.9995
-1.1117	1.6301	0.06428	15.4769
1.8498	1.3315	0.08903	15.0663
-0.4871	1.0055		14.3179

PITCH DECAY TIME HISTORY AND FIT

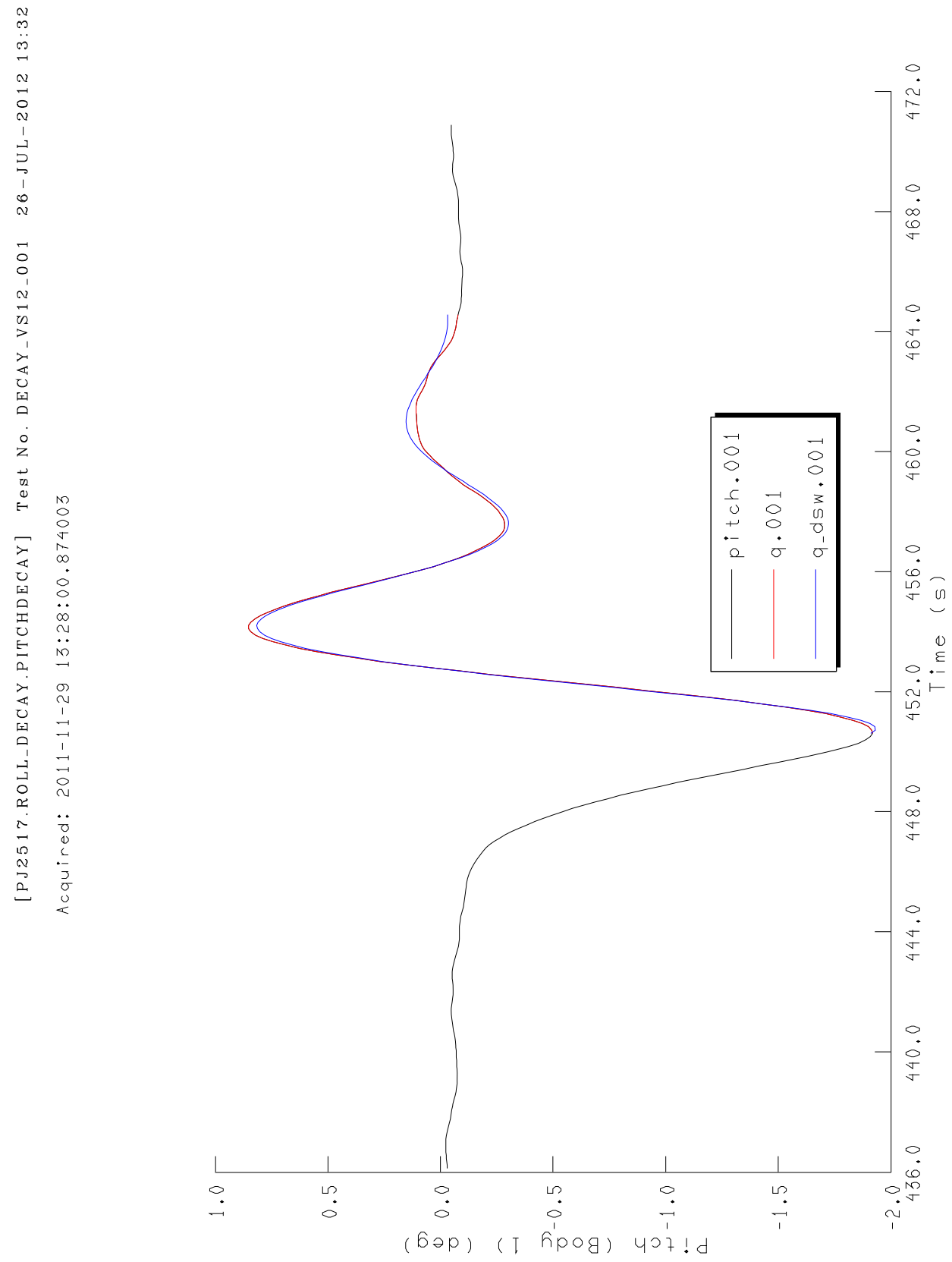
VS = 0 knots

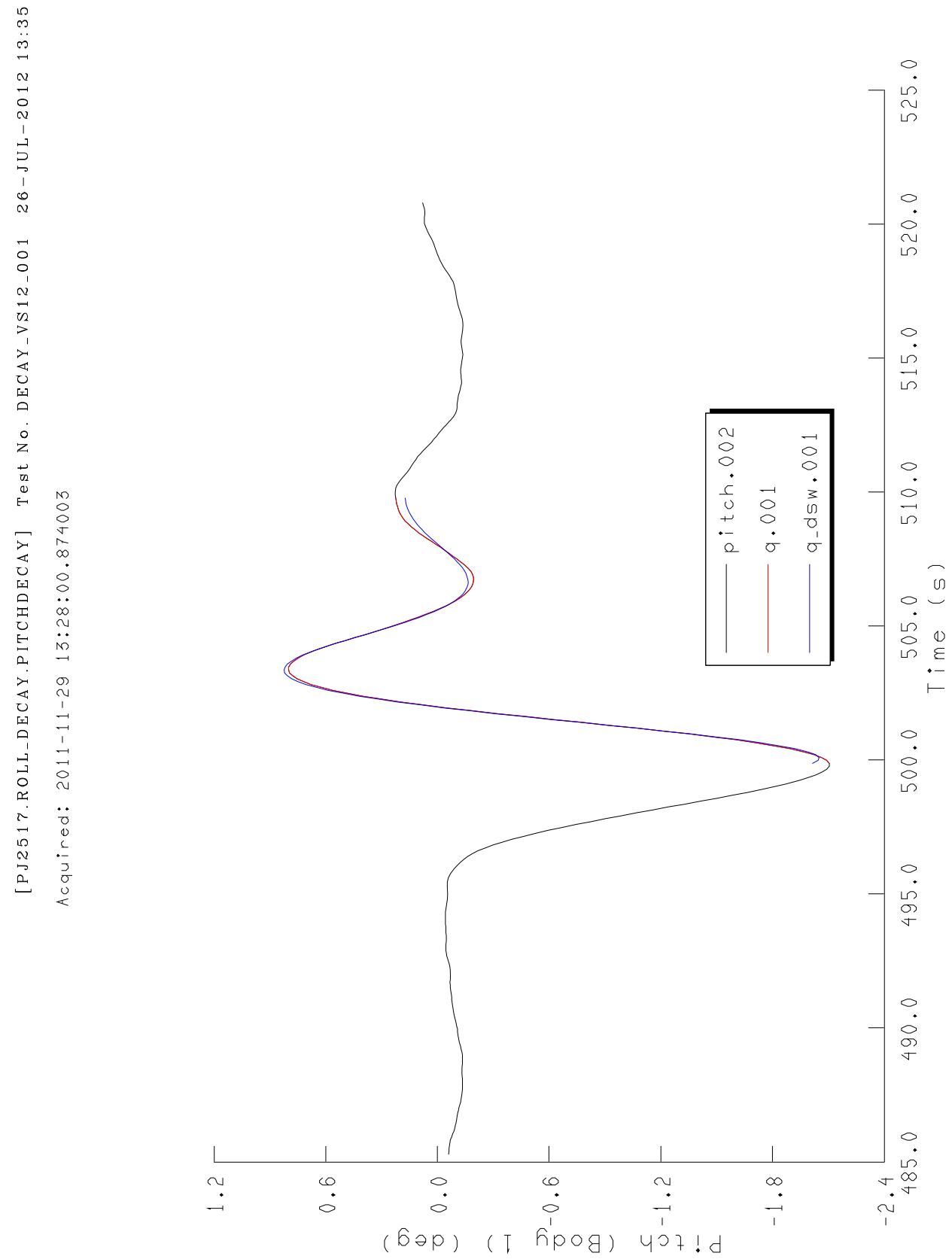

[PJ2517.ROLL_DECAY.PITCHDECAY] Test No. PITCH_DECAY_001 26-JUL-2012 12:31
Acquired: 2011-11-28 23:19:15.135000
pitch.001
q.001
q_dsw.001
Pitch (Body 1) (deg)
Time (s)
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
162.0
168.0
174.0
180.0
186.0
192.0
198.0
204.0
210.0
216.0
222.0


[PJ2517.ROLL_DECAY.PITCHDECAY] Test No. PITCH_DECAY_001 26-JUL-2012 12:46
Acquired: 2011-11-28 23:19:15.135000
pitch.002
q.001
q_dsw.001
Pitch (Body 1) (deg)
Time (s)
1.2
0.6
0.0
-0.6
-1.2
-1.8
-2.4
220.0
225.0
230.0
235.0
240.0
245.0
250.0
255.0
260.0
265.0

PITCH DECAY TIME HISTORY AND FIT

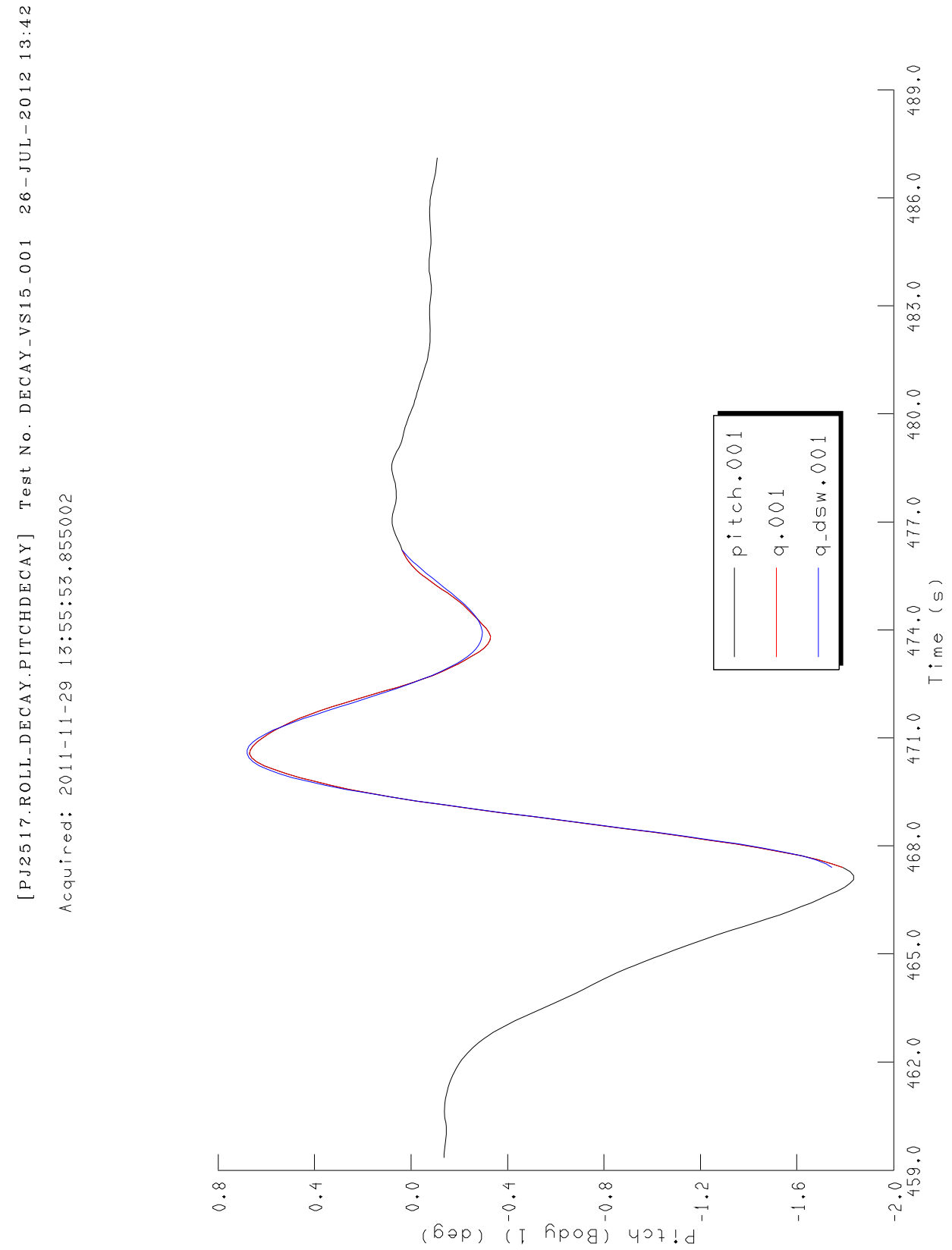
VS = 12 knots

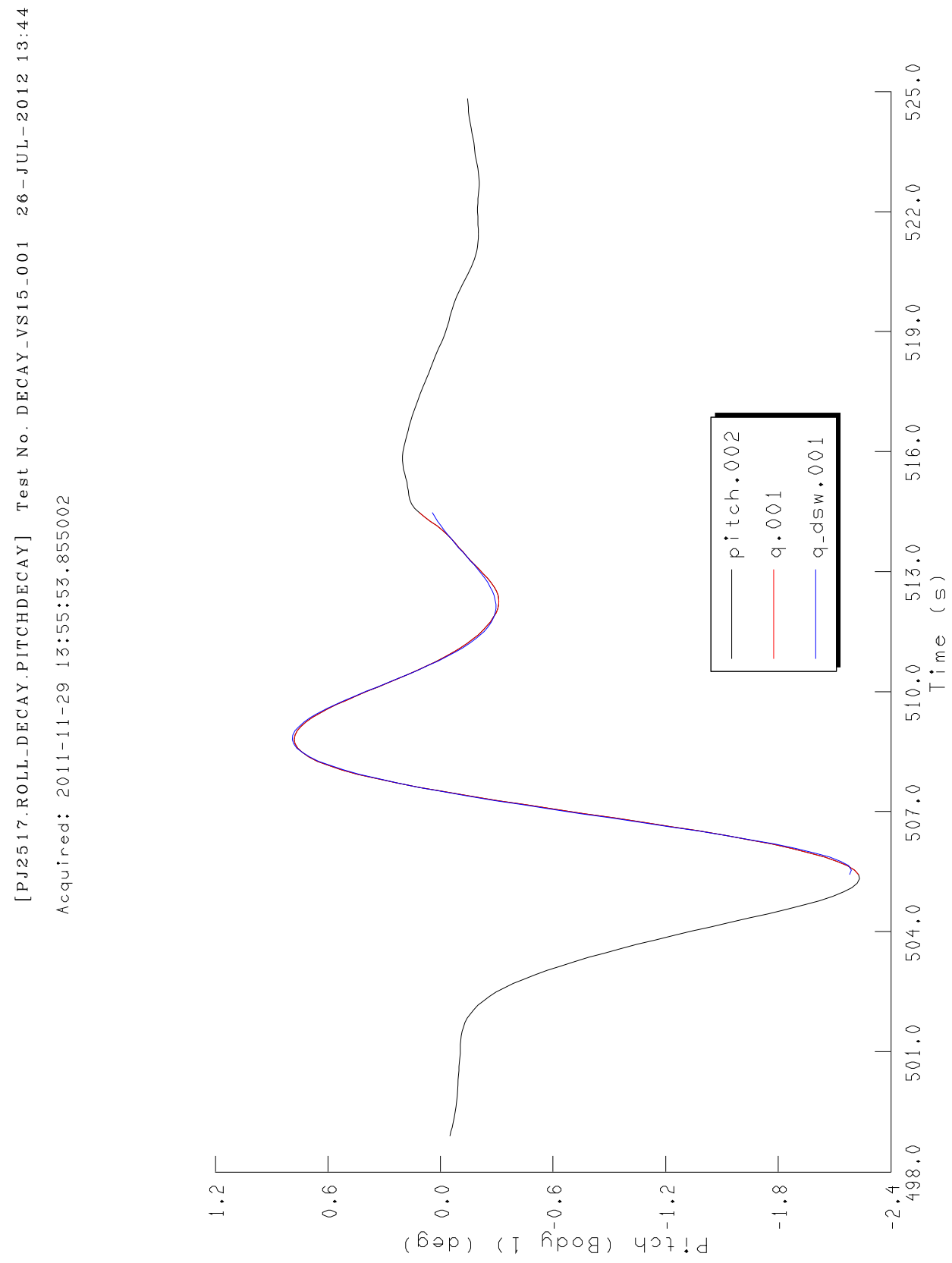

[PJ2517.ROLL_DECAY.PITCHDECAY] Test No. DECAY_VS12_001 26-JUL-2012 13:32
Acquired: 2011-11-29 13:28:00.874003
pitch.001
q.001
q_dsw.001
Pitch (Body 1) (deg)
Time (s)
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
436.0
440.0
444.0
448.0
452.0
456.0
460.0
464.0
468.0
472.0


[PJ2517.ROLL_DECAY.PITCHDECAY] Test No. DECAY_VS12_001 26-JUL-2012 13:35
Acquired: 2011-11-29 13:28:00.874003
Pitch (Body 1) (deg)
1.2
0.6
0.0
-0.6
-1.2
-1.8
-2.4
485.0
490.0
495.0
500.0
505.0
510.0
515.0
520.0
525.0
Time (s)
pitch.002
q.001
q_dsw.001

PITCH DECAY TIME HISTORY AND FIT

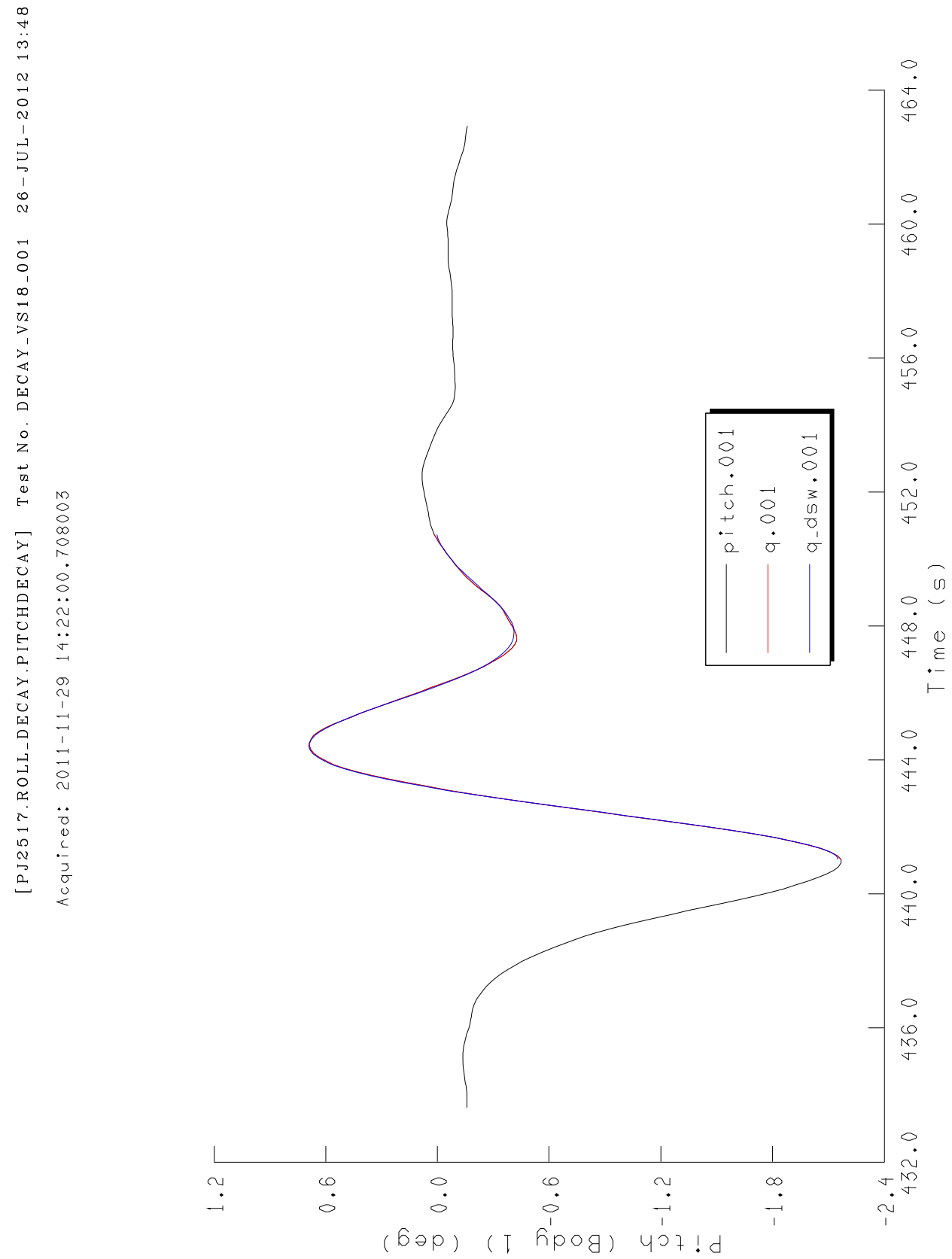
VS = 15 knots

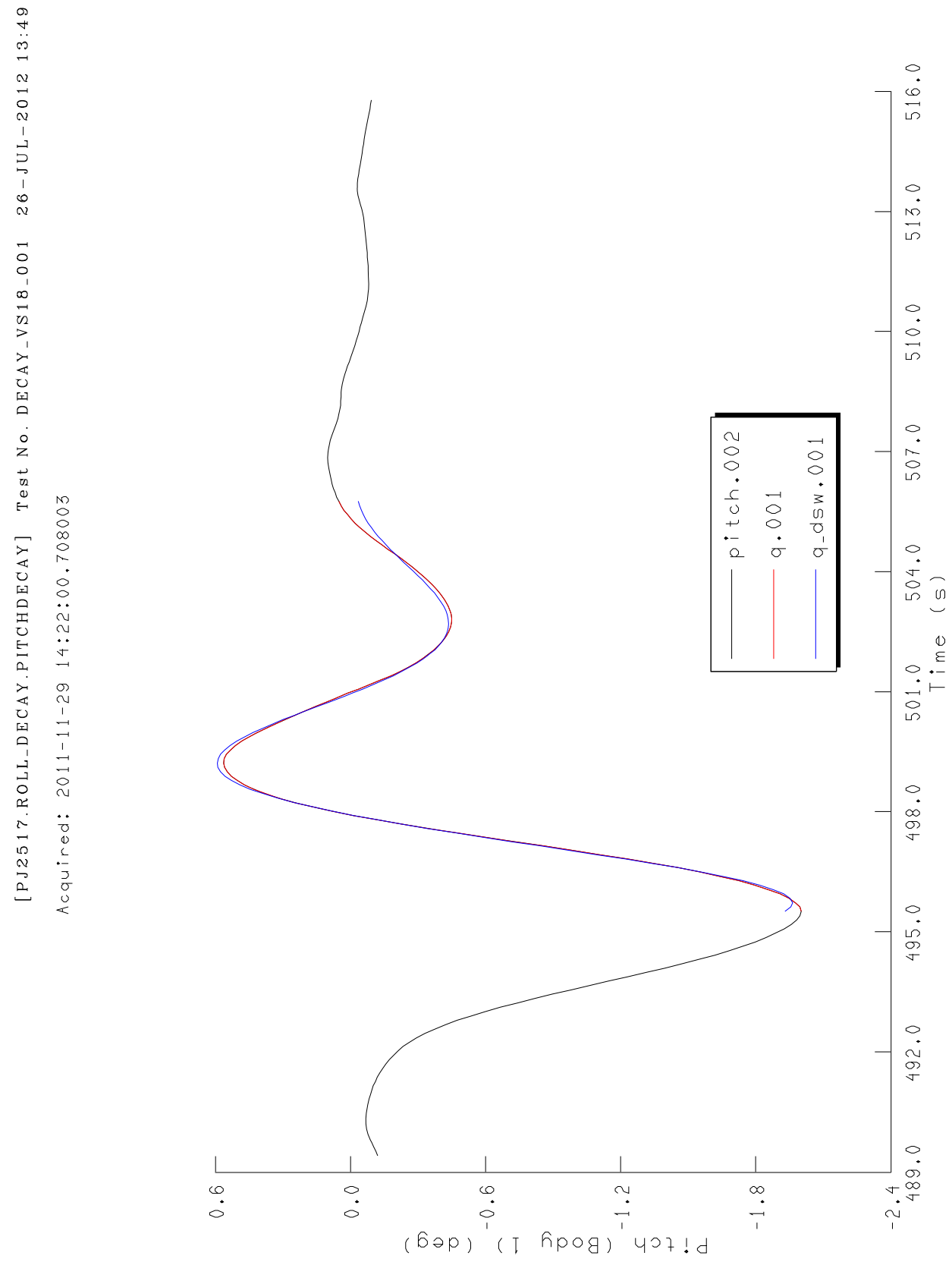

[PJ2517.ROLL_DECAY.PITCHDECAY] Test No. DECAY_VS15_001 26-JUL-2012 13:42
Acquired: 2011-11-29 13:55:53.855002
pitch.001
q.001
q_dsw.001
Pitch (Body 1) (deg)
Time (s)
0.8
0.4
0.0
-0.4
-0.8
-1.2
-1.6
-2.0
459.0
462.0
465.0
468.0
471.0
474.0
477.0
480.0
483.0
486.0
489.0


[PJ2517.ROLL_DECAY.PITCHDECAY] Test No. DECAY_VS15_001 26-JUL-2012 13:44
Acquired: 2011-11-29 13:55:53.855002
pitch.002
q.001
q_dsw.001
Pitch (Body 1) (deg)
Time (s)
1.2
0.6
0.0
-0.6
-1.2
-1.8
-2.4
498.0
501.0
504.0
507.0
510.0
513.0
516.0
519.0
522.0
525.0

PITCH DECAY TIME HISTORY AND FIT

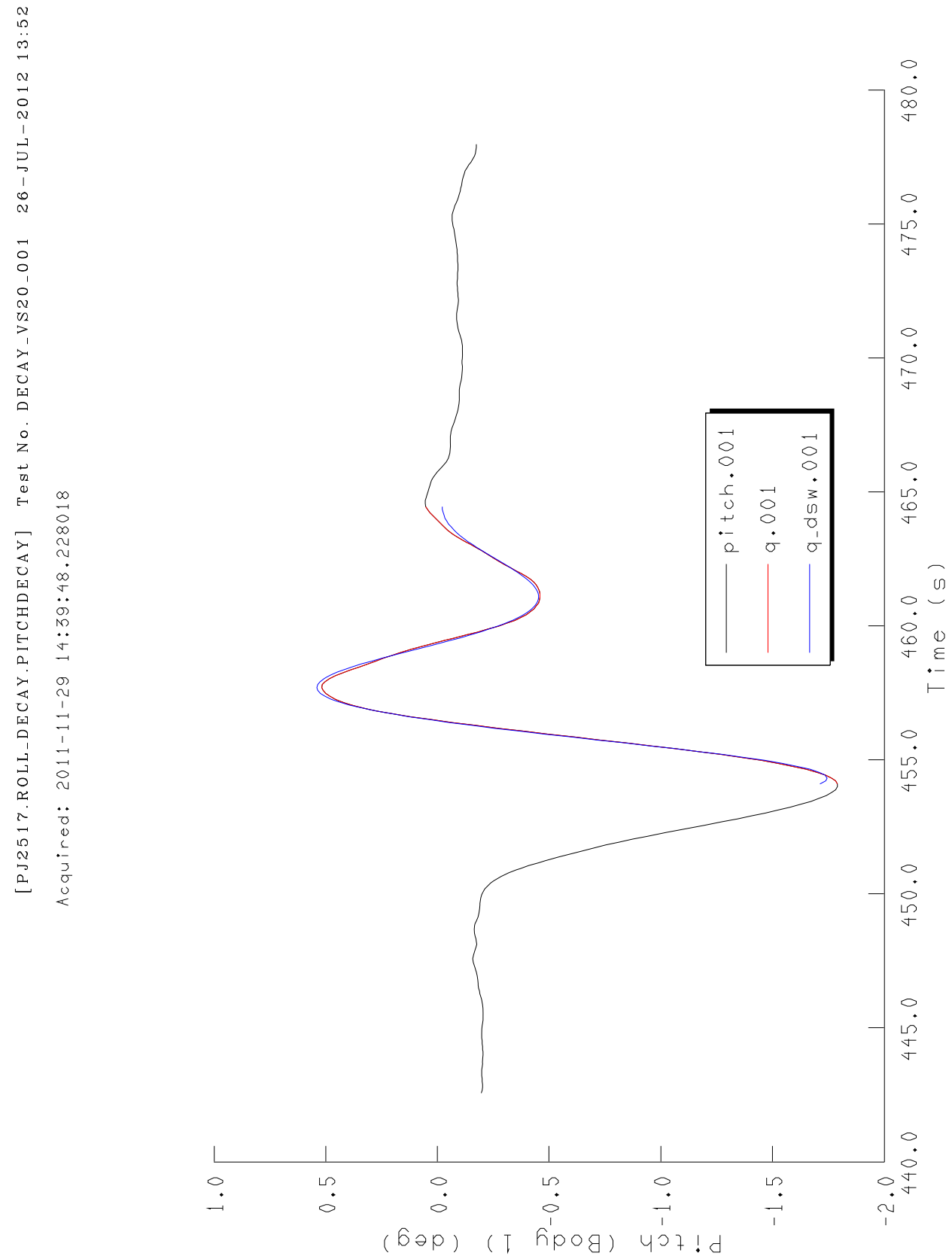
VS = 18 knots

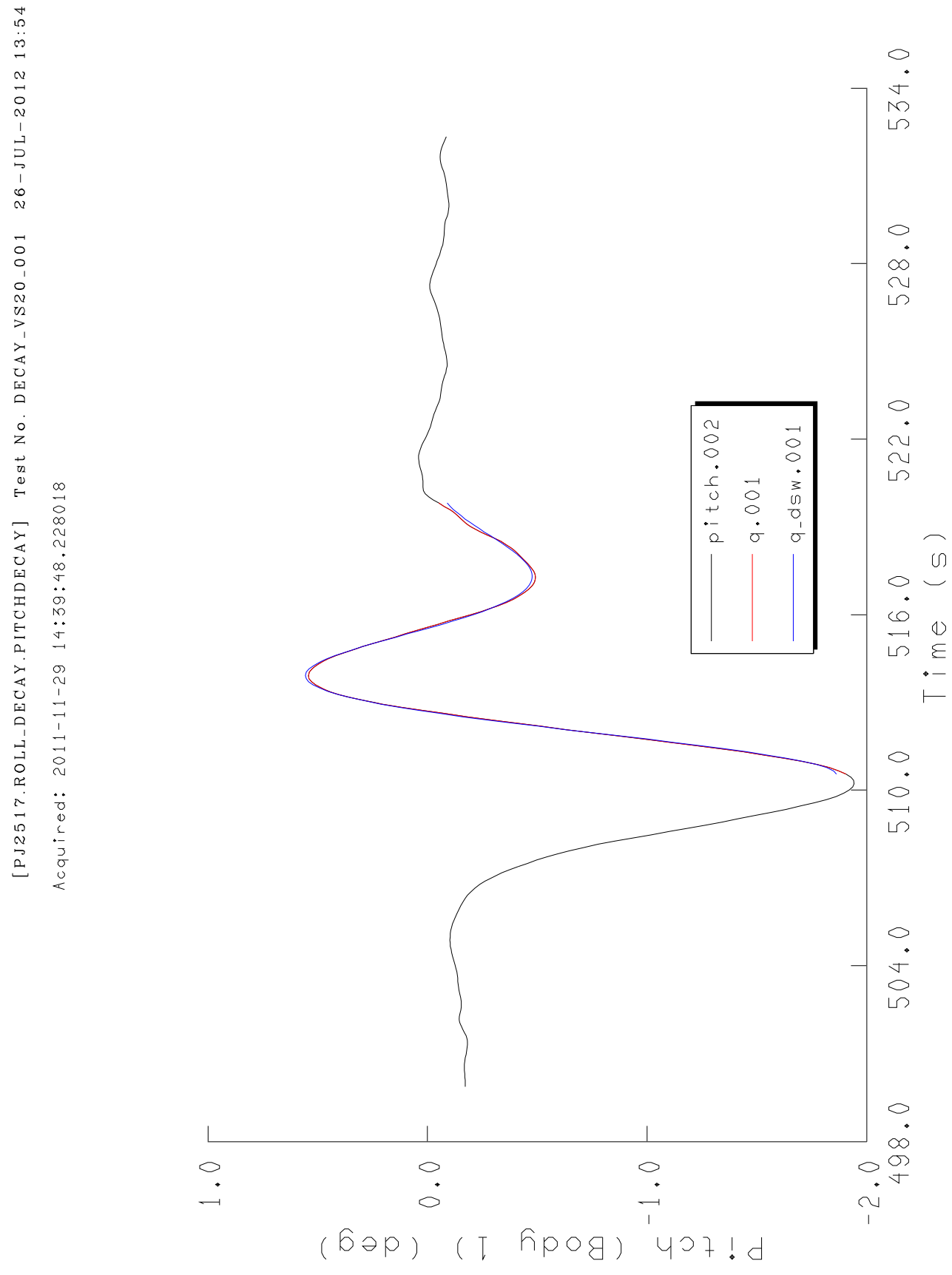

[PJ2517.ROLL_DECAY.PITCHDECAY] Test No. DECAY_VS18_001 26-JUL-2012 13:48
Acquired: 2011-11-29 14:22:00.708003
pitch.001
q.001
q_dsw.001
Pitch (Body 1) (deg)
Time (s)
1.2
0.6
0.0
-0.6
-1.2
-1.8
-2.4
432.0
436.0
440.0
444.0
448.0
452.0
456.0
460.0
464.0


[PJ2517.ROLL_DECAY.PITCHDECAY] Test No. DECAY_VS18_001 26-JUL-2012 13:49
Acquired: 2011-11-29 14:22:00.708003
pitch.002
q.001
q_dsw.001
Pitch (Body 1) (deg)
Time (s)
0.6
0.0
-0.6
-1.2
-1.8
-2.4
489.0
492.0
495.0
498.0
501.0
504.0
507.0
510.0
513.0
516.0

PITCH DECAY TIME HISTORY AND FIT

VS = 20 knots


[PJ2517.ROLL_DECAY.PITCHDECAY] Test No. DECAY_VS20_001 26-JUL-2012 13:52
Acquired: 2011-11-29 14:39:48.228018
pitch.001
q.001
q_dsw.001
Pitch (Body 1) (deg)
Time (s)
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
440.0
445.0
450.0
455.0
460.0
465.0
470.0
475.0
480.0

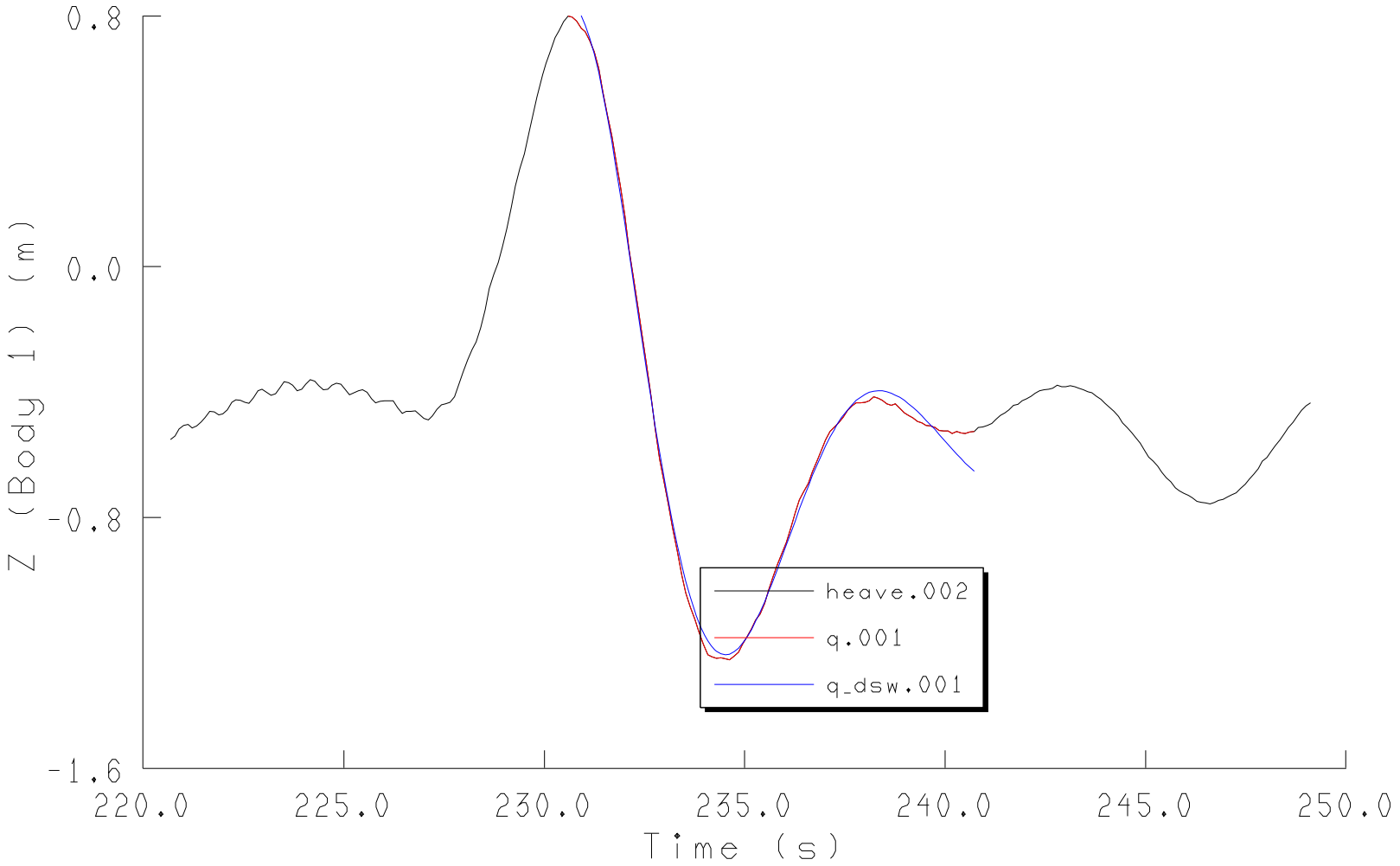

[PJ2517.ROLL_DECAY.PITCHDECAY] Test No. DECAY_VS20_001 26-JUL-2012 13:54
Acquired: 2011-11-29 14:39:48.228018
Pitch (Body 1) (deg)
1.0
0.0
-1.0
-2.0
498.0
504.0
510.0
516.0
522.0
528.0
534.0
Time (s)
pitch.002
q.001
q_dsw.001

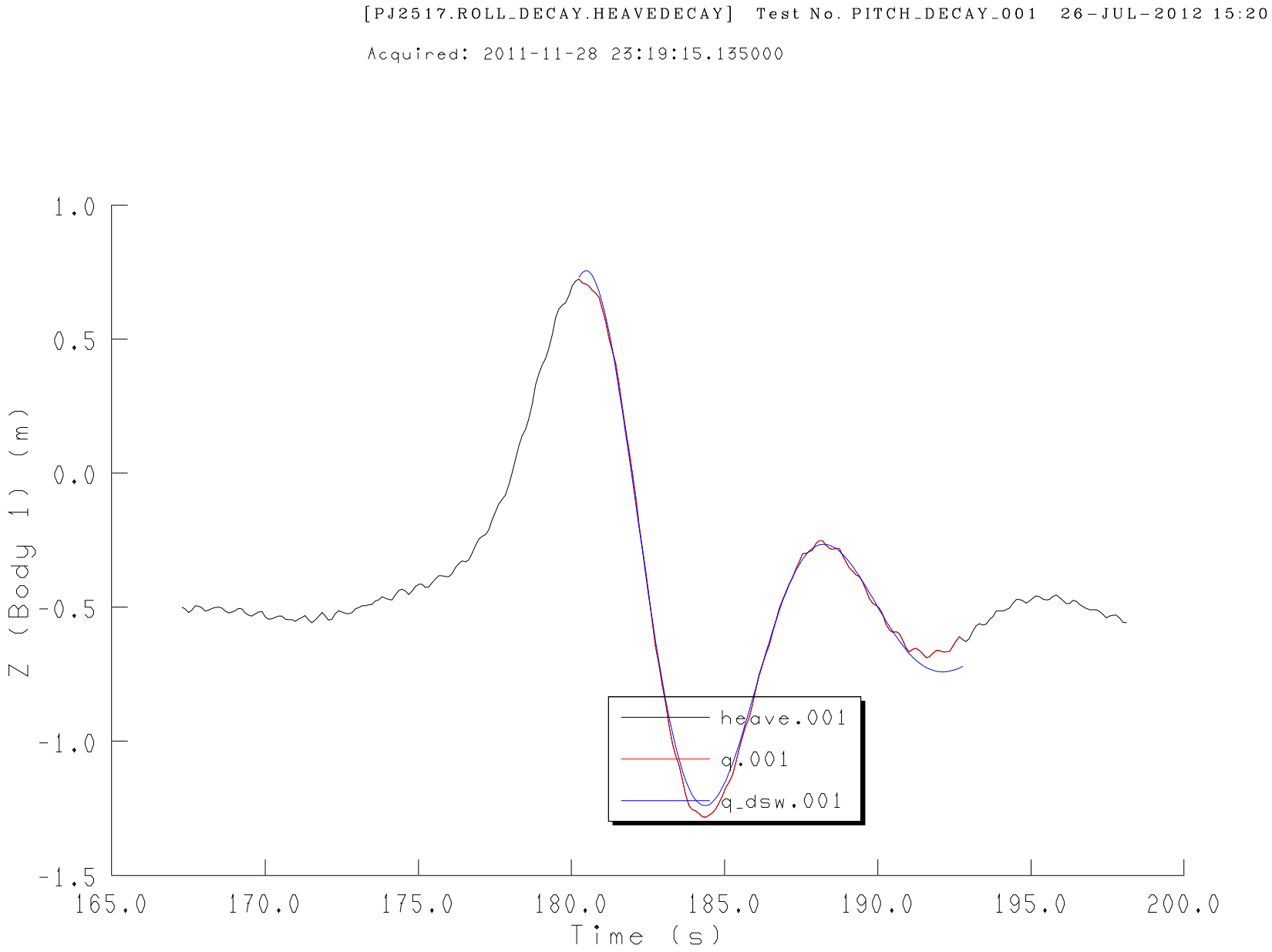
HEAVE DECAY TIME HISTORY AND FIT

VS = 0 knots

[PJ2517.ROLL_DECAY.HEAVEDECAY] Test No. PITCH_DECAY_001 26-JUL-2012 15:22

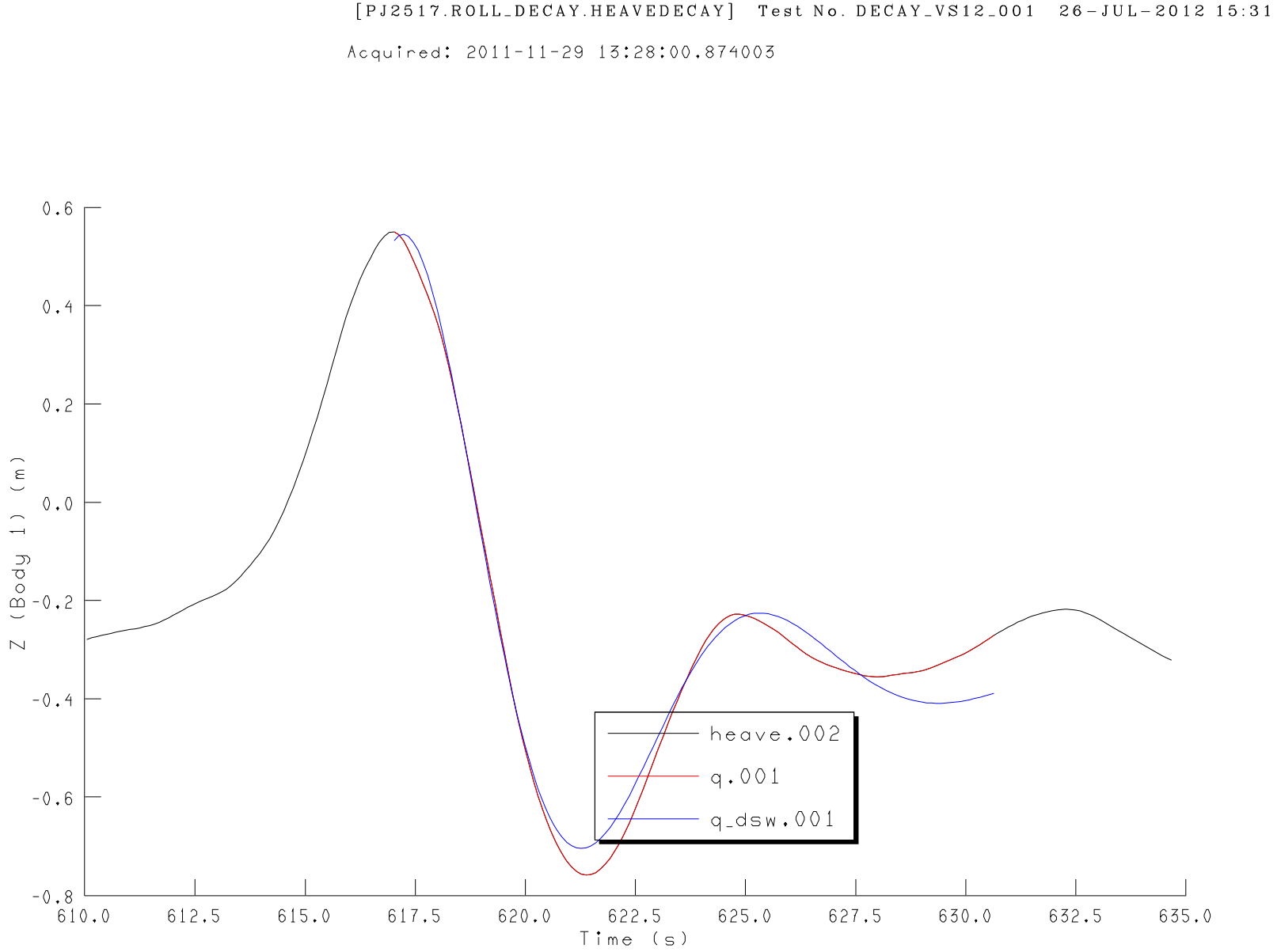
Acquired: 2011-11-28 23:19:15.135000

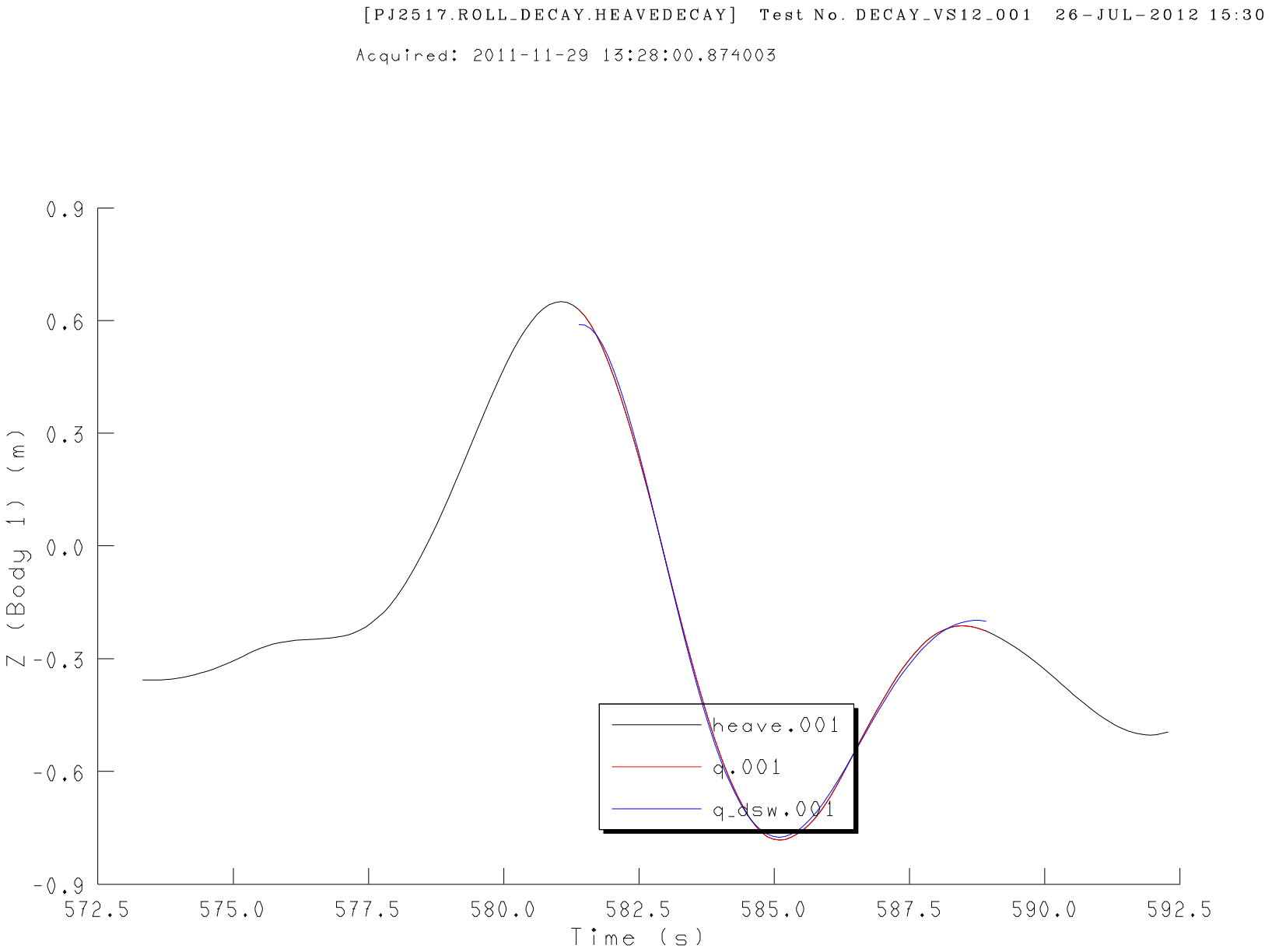



[PJ2517.ROLL_DECAY.HEAVEDECAY] Test No. PITCH_DECAY_001 26-JUL-2012 15:20
Acquired: 2011-11-28 23:19:15.135000
1.0
0.5
0.0
-0.5
-1.0
-1.5
Z (Body 1) (m)
165.0
170.0
175.0
180.0
185.0
190.0
195.0
200.0
Time (s)
heave.001
q.001
q_dsw.001

HEAVE DECAY TIME HISTORY AND FIT

VS = 12 knots


[PJ2517.ROLL_DECAY.HEAVEDECAY] Test No. DECAY_VS12_001 26-JUL-2012 15:31
Acquired: 2011-11-29 13:28:00.874003
Z (Body 1) (m)
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
610.0
612.5
615.0
617.5
620.0
622.5
625.0
627.5
630.0
632.5
635.0
Time (s)
heave.002
q.001
q_dsw.001

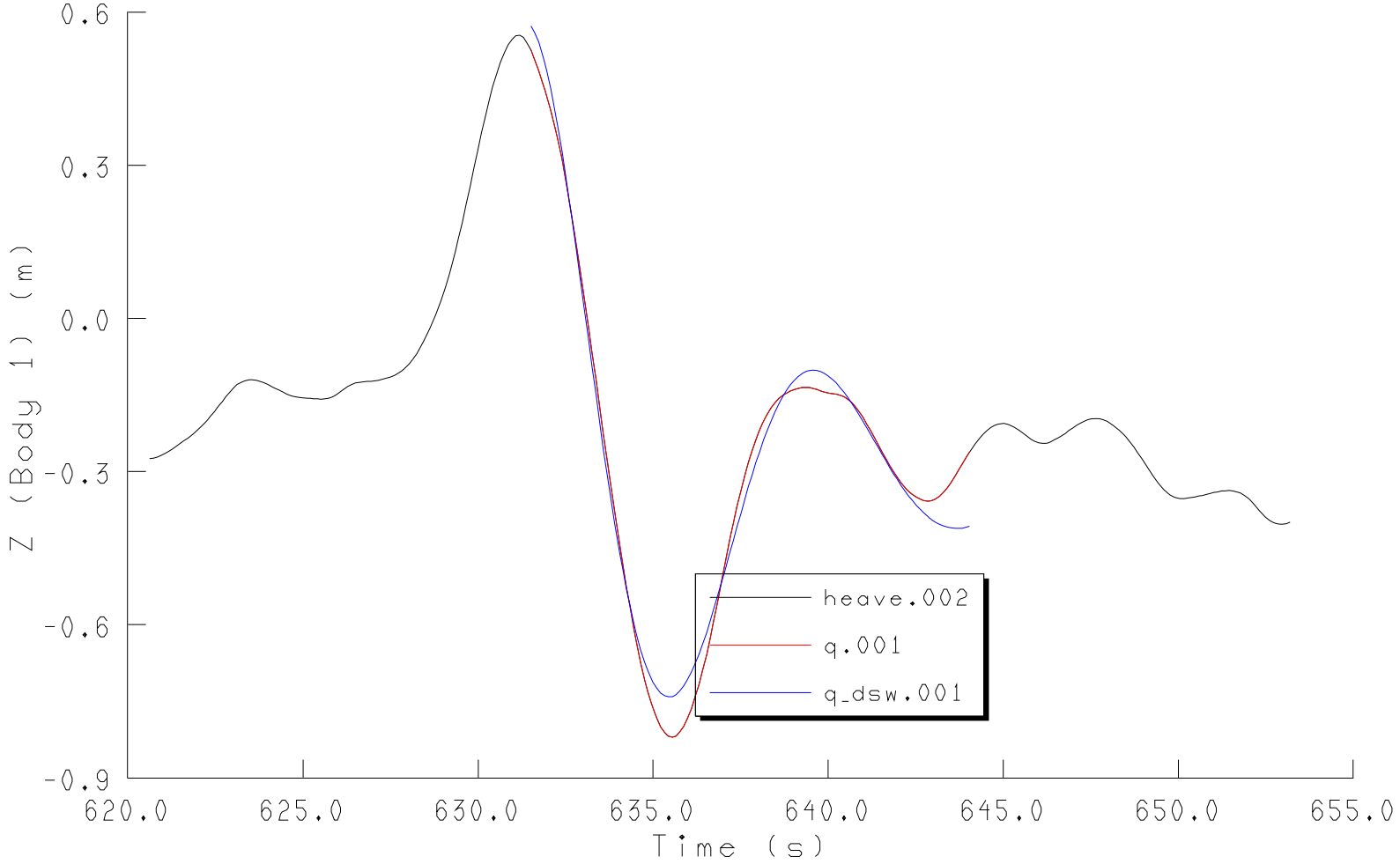

[PJ2517.ROLL_DECAY.HEAVEDECAY] Test No. DECAY_VS12_001 26-JUL-2012 15:30
Acquired: 2011-11-29 13:28:00.874003
Z (Body 1) (m)
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
572.5
575.0
577.5
580.0
582.5
585.0
587.5
590.0
592.5
Time (s)
heave.001
q.001
q_dsw.001

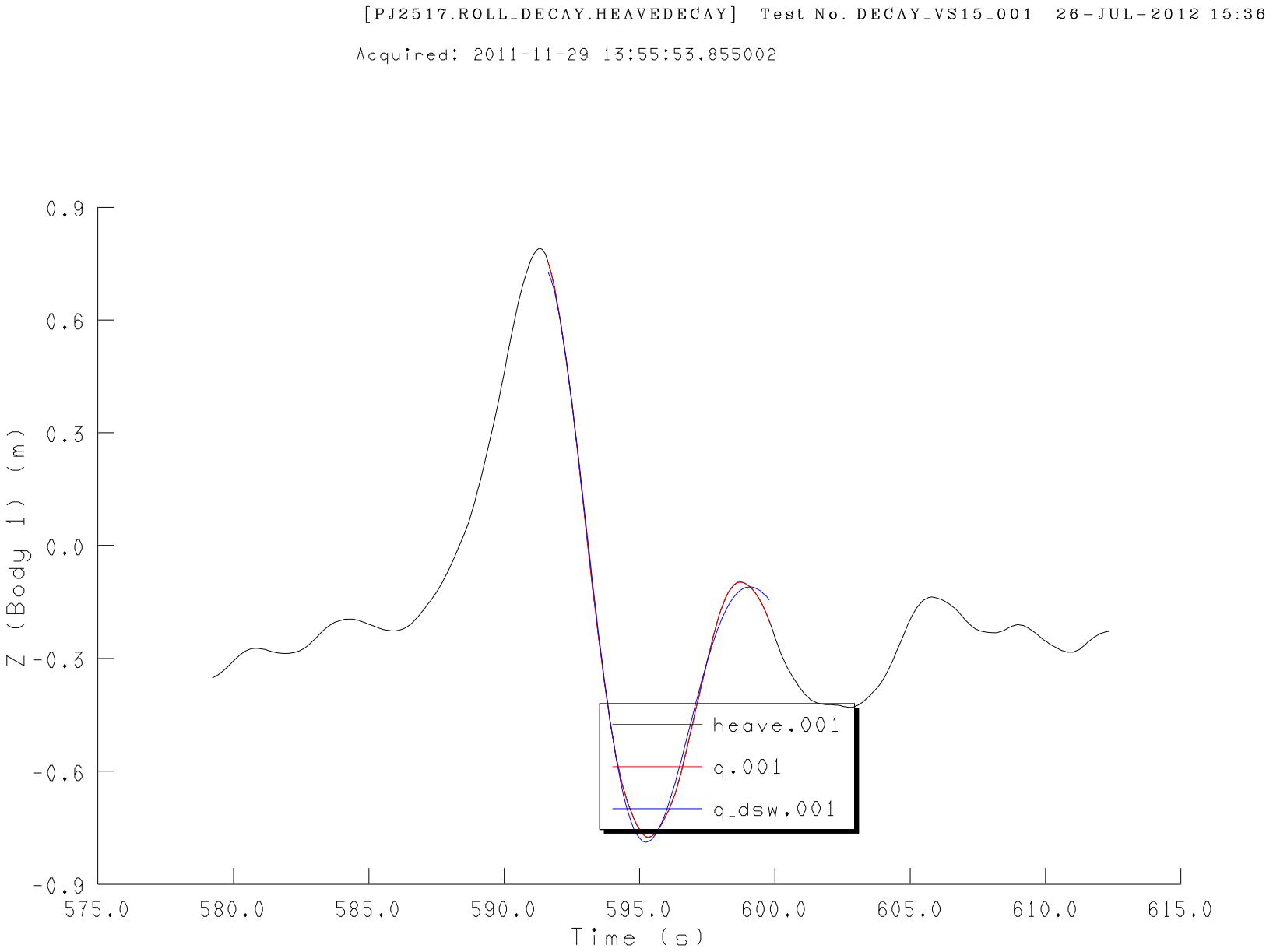
HEAVE DECAY TIME HISTORY AND FIT

VS = 15 knots

[PJ2517.ROLL_DECAY.HEAVEDECAY] Test No. DECAY_VS15_001 26-JUL-2012 15:49

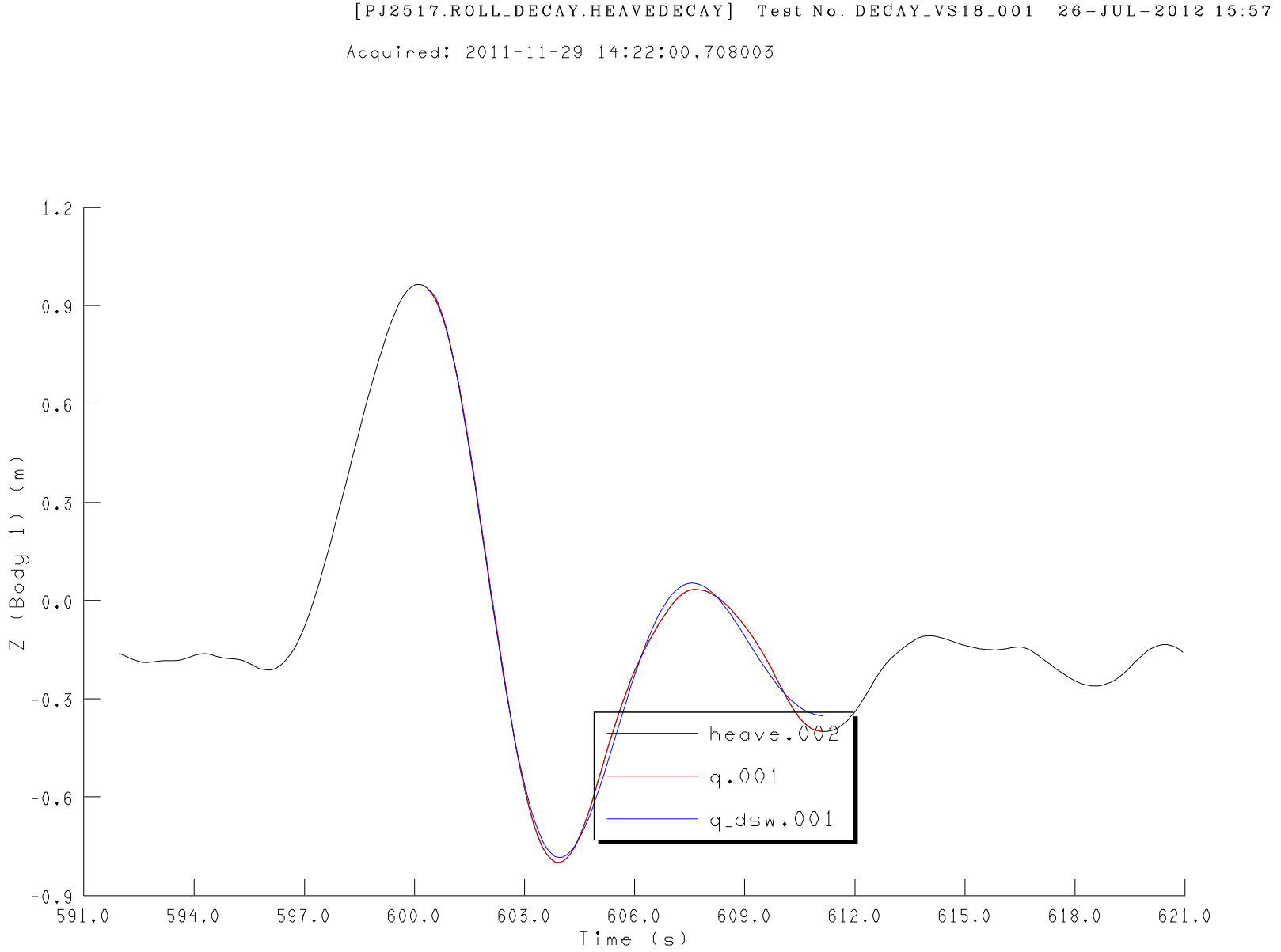
Acquired: 2011-11-29 13:55:53.855002

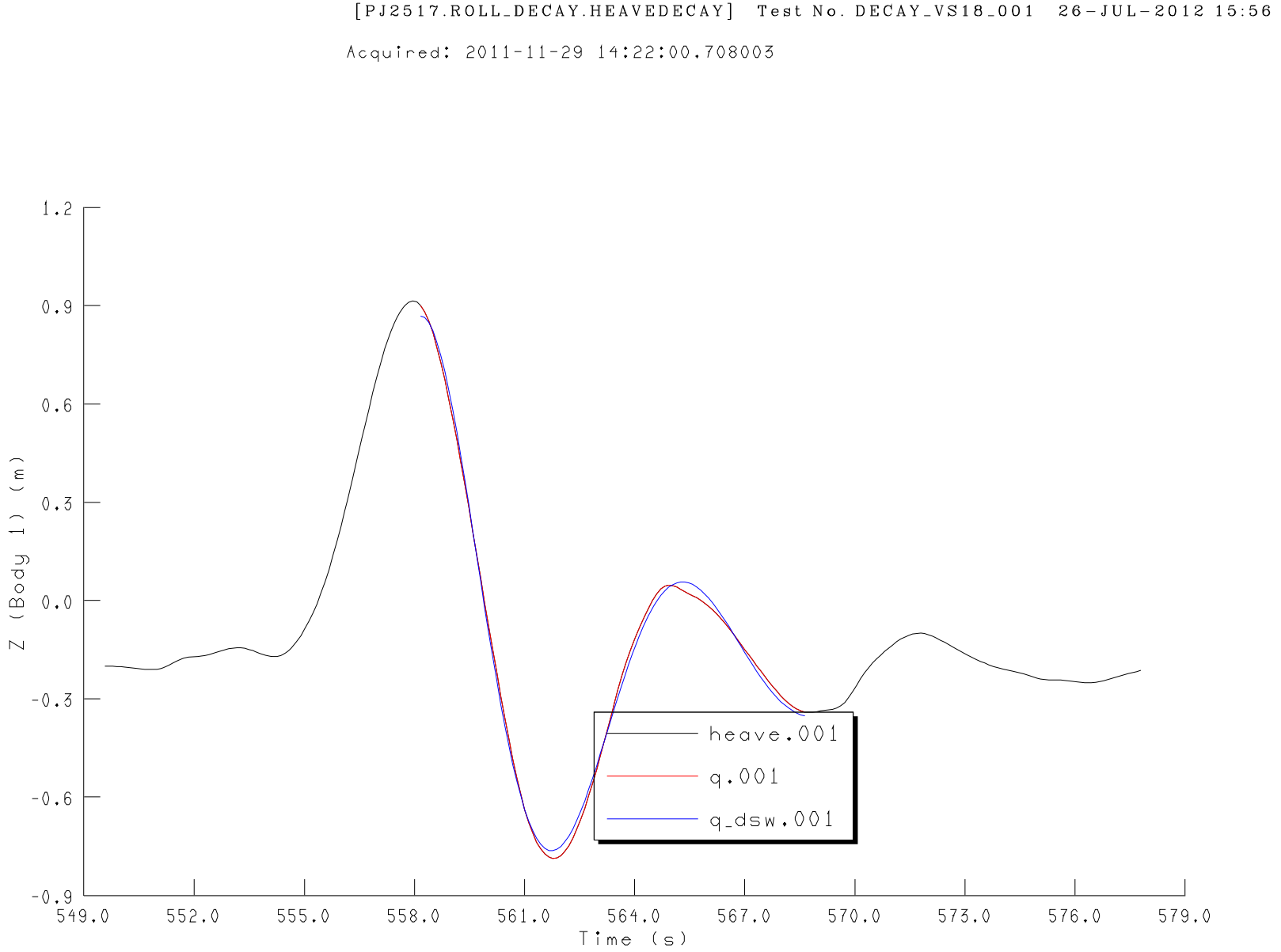



[PJ2517.ROLL_DECAY.HEAVEDECAY] Test No. DECAY_VS15_001 26-JUL-2012 15:36
Acquired: 2011-11-29 13:55:53.855002
Z (Body 1) (m)
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
575.0
580.0
585.0
590.0
595.0
600.0
605.0
610.0
615.0
Time (s)
heave.001
q.001
q_dsw.001

HEAVE DECAY TIME HISTORY AND FIT

VS = 18 knots


[PJ2517.ROLL_DECAY.HEAVEDECAY] Test No. DECAY_VS18_001 26-JUL-2012 15:57
Acquired: 2011-11-29 14:22:00.708003
Z (Body 1) (m)
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
591.0
594.0
597.0
600.0
603.0
606.0
609.0
612.0
615.0
618.0
621.0
Time (s)
heave.002
q.001
q_dsw.001

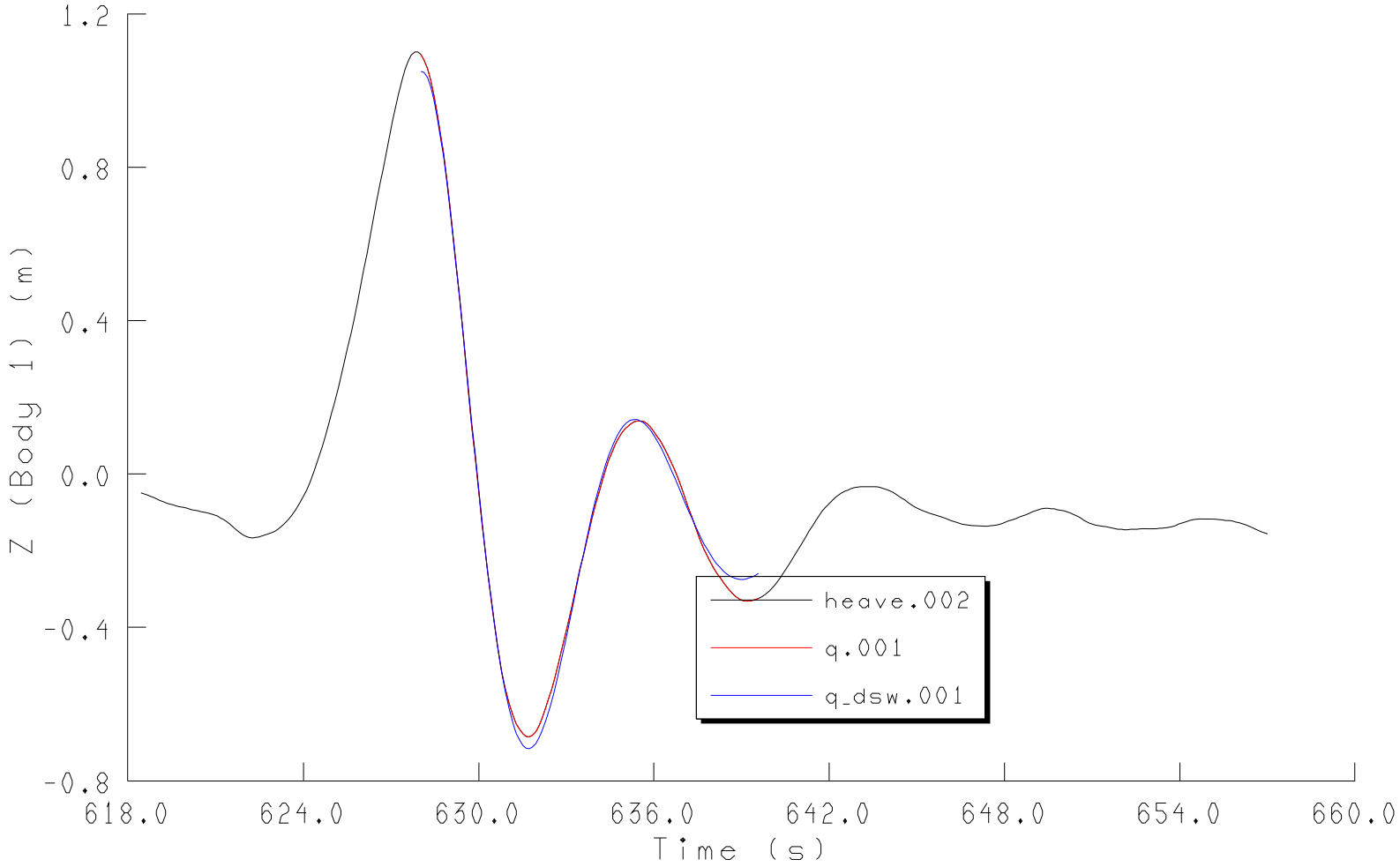

[PJ2517.ROLL_DECAY.HEAVEDECAY] Test No. DECAY_VS18_001 26-JUL-2012 15:56
Acquired: 2011-11-29 14:22:00.708003
Z (Body 1) (m)
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
549.0
552.0
555.0
558.0
561.0
564.0
567.0
570.0
573.0
576.0
579.0
Time (s)
heave.001
q.001
q_dsw.001

HEAVE DECAY TIME HISTORY AND FIT

VS = 20 knots

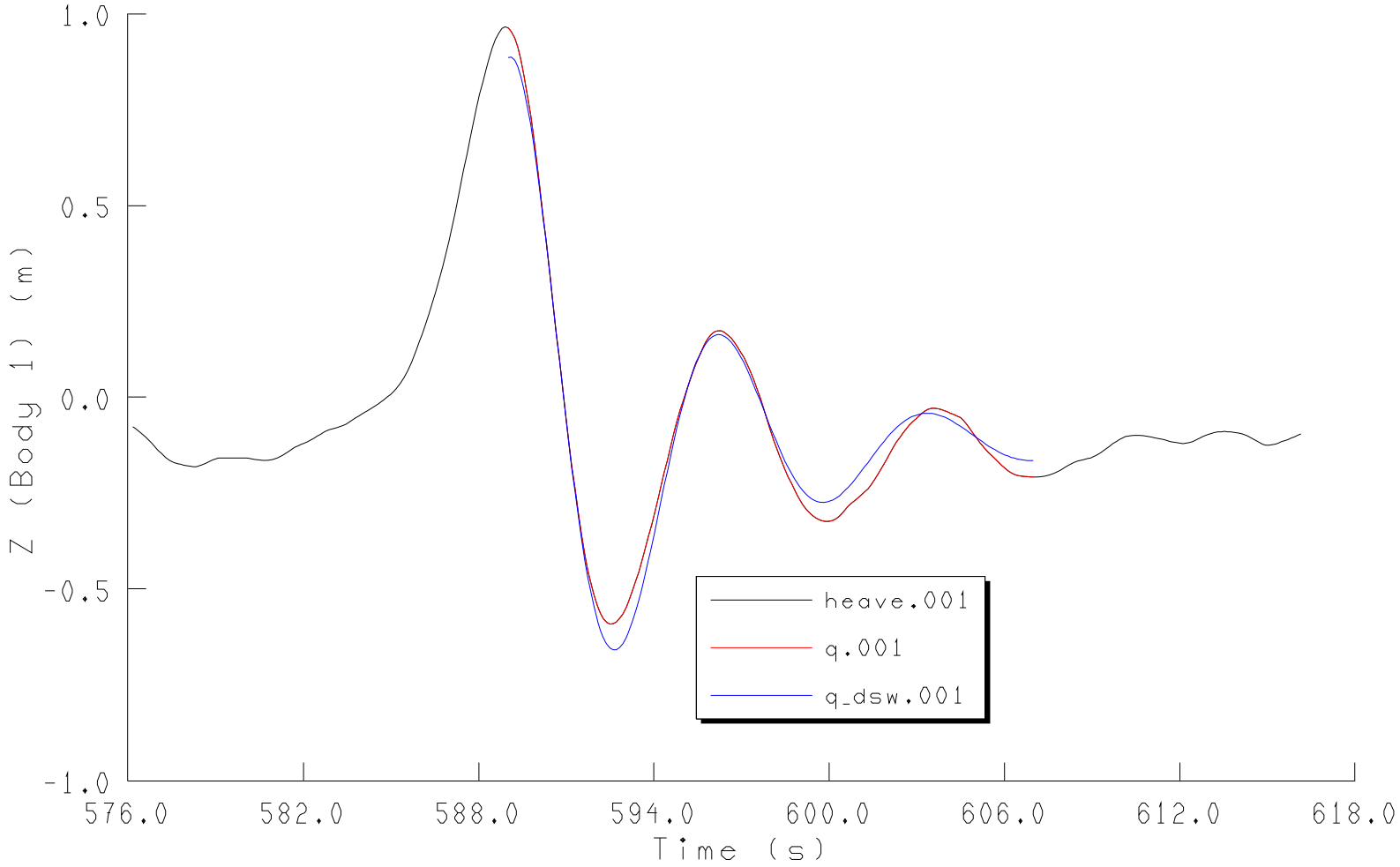
[PJ2517.ROLL_DECAY.HEAVEDECAY] Test No. DECAY_VS20_001 26-JUL-2012 16:03

Acquired: 2011-11-29 14:39:48.228018



[PJ2517.ROLL_DECAY.HEAVEDECAY] Test No. DECAY_VS20_001 26-JUL-2012 16:02

Acquired: 2011-11-29 14:39:48.228018

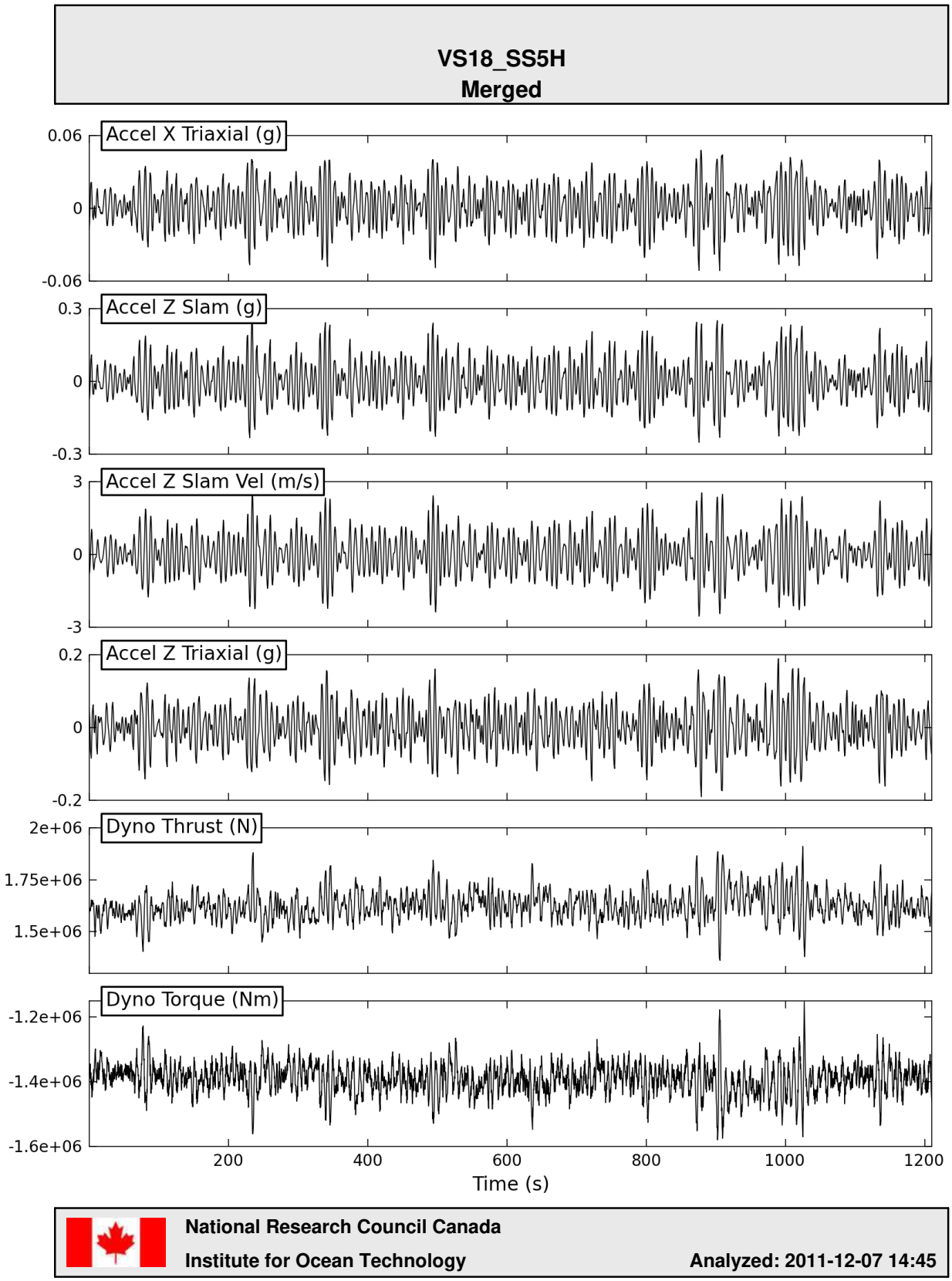


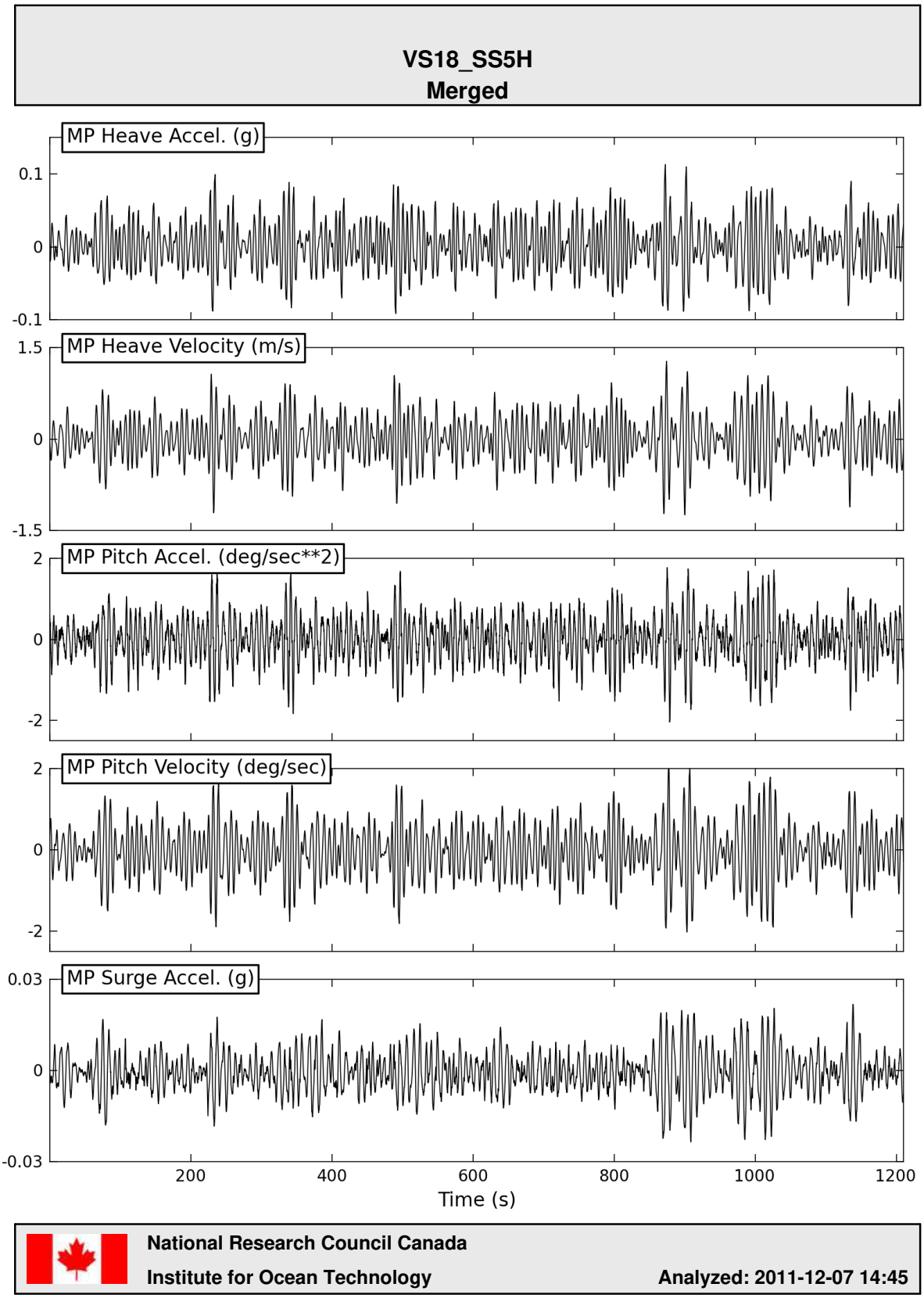
APPENDIX H

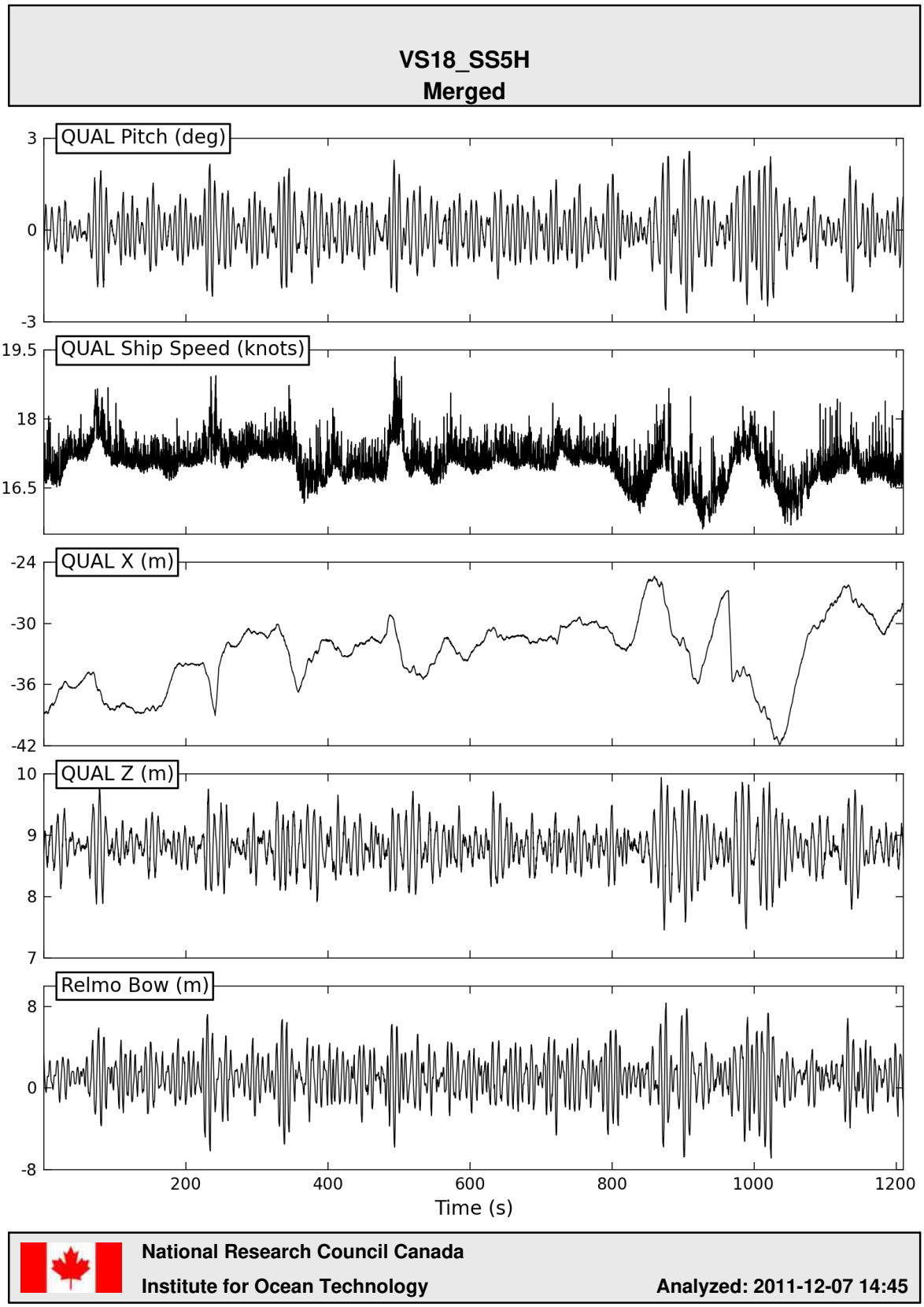
SEAKEEPING OFFLINE ANALYSIS

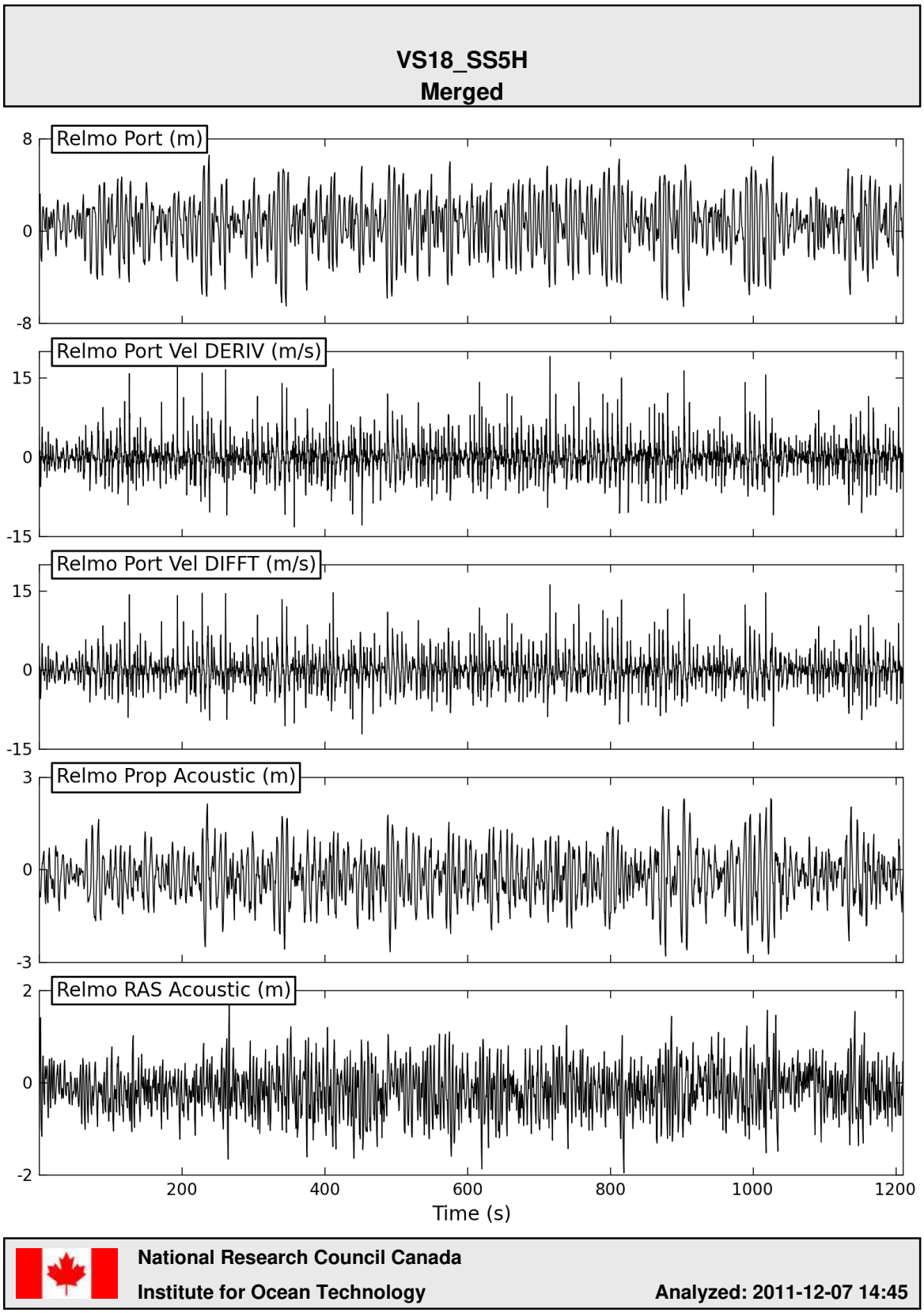
EXAMPLE MERGED TIME HISTORY

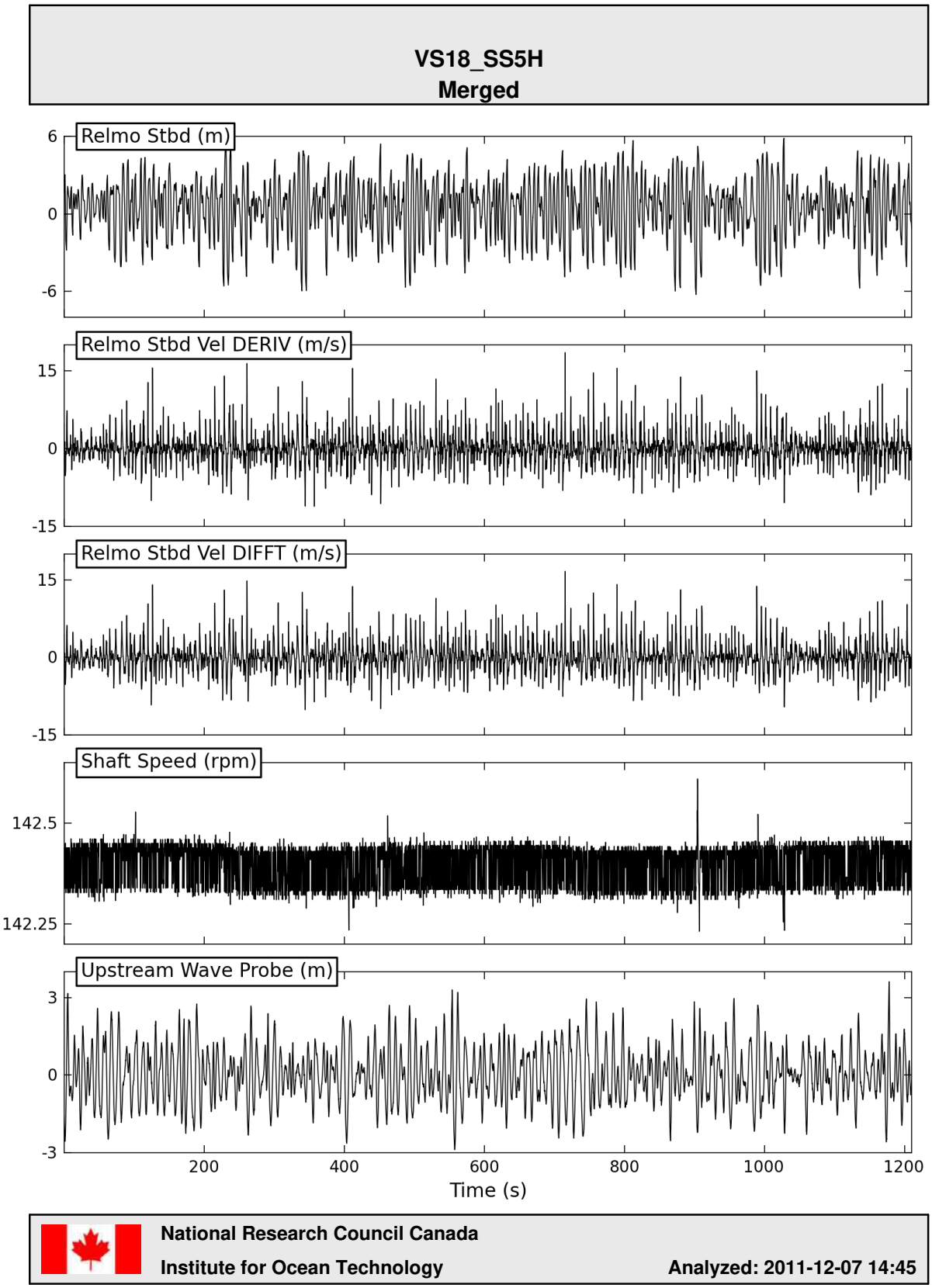
VS18_SS5H


VS18_SS5H
Merged
Accel X Triaxial (g)
0.06
0
-0.06
Accel Z Slam (g)
0.3
0
-0.3
Accel Z Slam Vel (m/s)
3
0
-3
Accel Z Triaxial (g)
0.2
0
-0.2
Dyno Thrust (N)
2e+06
1.75e+06
1.5e+06
Dyno Torque (Nm)
-1.2e+06
-1.4e+06
-1.6e+06
200
400
600
800
1000
1200
Time (s)
National Research Council Canada
Institute for Ocean Technology
Analyzed: 2011-12-07 14:45


VS18_SS5H
Merged
MP Heave Accel. (g)
0.1
0
-0.1
MP Heave Velocity (m/s)
1.5
0
-1.5
MP Pitch Accel. (deg/sec**2)
2
0
-2
MP Pitch Velocity (deg/sec)
2
0
-2
MP Surge Accel. (g)
0.03
0
-0.03
200
400
600
800
1000
1200
Time (s)
National Research Council Canada
Institute for Ocean Technology
Analyzed: 2011-12-07 14:45


VS18_SS5H
Merged
QUAL Pitch (deg)
3
0
-3
QUAL Ship Speed (knots)
19.5
18
16.5
QUAL X (m)
-24
-30
-36
-42
QUAL Z (m)
10
9
8
7
Relmo Bow (m)
8
0
-8
200
400
600
800
1000
1200
Time (s)
National Research Council Canada
Institute for Ocean Technology
Analyzed: 2011-12-07 14:45


VS18_SS5H
Merged
Relmo Port (m)
8
0
-8
Relmo Port Vel DERIV (m/s)
15
0
-15
Relmo Port Vel DIFFT (m/s)
15
0
-15
Relmo Prop Acoustic (m)
3
0
-3
Relmo RAS Acoustic (m)
2
0
-2
200
400
600
800
1000
1200
Time (s)
National Research Council Canada
Institute for Ocean Technology
Analyzed: 2011-12-07 14:45


VS18_SS5H
Merged
Relmo Stbd (m)
6
0
-6
Relmo Stbd Vel DERIV (m/s)
15
0
-15
Relmo Stbd Vel DIFFT (m/s)
15
0
-15
Shaft Speed (rpm)
142.5
142.25
Upstream Wave Probe (m)
3
0
-3
200
400
600
800
1000
1200
Time (s)
National Research Council Canada
Institute for Ocean Technology
Analyzed: 2011-12-07 14:45

STATISTICS FOR MERGED TIME HISTORY

REFERENCE LOCATION: SHIP CG

VS12_SS5H
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.046627	0.040790	0.0024653	0.012780
Accel Z Slam	g	-0.21223	0.22822	-0.00053902	0.065828
Accel Z Slam Vel	m/s	-2.1973	2.2809	0.00023125	0.66397
Accel Z Triaxial	g	-0.16207	0.15415	4.3790e-05	0.046793
Dyno Thrust	N	8.0963e+05	1.1796e+06	9.5469e+05	49221.
Dyno Torque	Nm	-9.6253e+05	-6.8431e+05	-8.1269e+05	35777.
MP Heave Accel.	g	-0.069341	0.086120	0.0013972	0.025174
MP Heave Velocity	m/s	-0.89110	1.0352	6.4603e-05	0.29451
MP Pitch Accel.	deg/sec**2	-1.7892	1.5817	0.00020817	0.43574
MP Pitch Velocity	deg/sec	-1.9337	1.6507	-0.037393	0.53375
MP Surge Accel.	g	-0.024012	0.024783	-0.00028458	0.0067072
QUAL Pitch	deg	-2.5011	2.4384	0.0011087	0.72145
QUAL Ship Speed	knots	10.894	14.818	12.313	0.44705
QUAL X	m	-31.507	-23.937	-27.646	1.5120
QUAL Z	m	7.3025	9.8083	8.7598	0.33243
Relmo Bow	m	-6.6117	7.2821	0.68602	1.9102
Relmo Port	m	-5.6774	4.4932	0.28080	1.6232
Relmo Port Vel DERIV	m/s	-9.5050	15.207	0.00078883	1.9595
Relmo Port Vel DIFFT	m/s	-8.9399	13.974	0.00084727	1.9209
Relmo Prop Acoustic	m	-2.9735	2.3034	-0.17317	0.73388
Relmo RAS Acoustic	m	-1.8331	1.9276	0.061514	0.52654
Relmo Stbd	m	-5.4183	4.3128	0.19295	1.6013
Relmo Stbd Vel DERIV	m/s	-9.8698	14.893	0.00095429	1.9536
Relmo Stbd Vel DIFFT	m/s	-8.4777	13.434	0.0010297	1.9132
Shaft Speed	rpm	106.97	107.15	107.02	0.017613
Upstream Wave Probe	m	-2.8170	3.6657	0.016571	1.0663

VS15_H0_SS5
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.0044901	0.0065271	0.00093218	0.0016368
Accel Z Slam	g	-0.017311	0.017594	-2.2097e-05	0.0047591
Accel Z Slam Vel	m/s	-0.17985	0.15430	-0.00020952	0.044237
Accel Z Triaxial	g	-0.014828	0.021993	0.00010853	0.0048901
Dyno Thrust	N	9.3214e+05	1.1857e+06	1.0546e+06	41116.
Dyno Torque	Nm	-1.0171e+06	-7.7488e+05	-9.0058e+05	32841.
MP Heave Accel.	g	-0.0051669	0.0093771	0.0014069	0.0019835
MP Heave Velocity	m/s	-0.086690	0.080794	9.0765e-05	0.025729
MP Pitch Accel.	deg/sec**2	-0.21134	0.24125	0.00031269	0.054455
MP Pitch Velocity	deg/sec	-0.31273	0.19625	-0.035332	0.085915
MP Surge Accel.	g	-0.0056583	0.0046754	-0.00067294	0.0016679
QUAL Pitch	deg	-1.2284	0.30432	-0.38260	0.25064
QUAL Ship Speed	knots	13.539	15.183	14.709	0.21086
QUAL X	m	30.713	39.328	34.713	1.9655
QUAL Z	m	8.0406	9.0094	8.6182	0.13885
Relmo Bow	m	-2.4235	4.6960	0.94563	0.98023
Relmo Port	m	-0.74460	1.5630	0.43074	0.35534
Relmo Port Vel DERIV	m/s	-0.95433	2.2337	-0.0015785	0.18522
Relmo Port Vel DIFFT	m/s	-0.87287	1.7462	-0.0015565	0.17086
Relmo Prop Acoustic	m	-1.4332	1.0440	-0.20041	0.41093
Relmo RAS Acoustic	m	-1.3313	1.2857	-0.020365	0.39576
Relmo Stbd	m	-0.71503	1.4832	0.45246	0.33764
Relmo Stbd Vel DERIV	m/s	-1.3195	1.9857	-0.0014101	0.18057
Relmo Stbd Vel DIFFT	m/s	-1.1478	1.7451	-0.0014110	0.16714
Shaft Speed	rpm	116.93	117.09	117.00	0.036628
Upstream Wave Probe	m	-2.9022	2.9856	0.00043572	0.86433

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VS15_SS5H
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.054706	0.043797	0.0023202	0.013874
Accel Z Slam	g	-0.23883	0.25363	-0.00051283	0.071658
Accel Z Slam Vel	m/s	-2.5742	2.2538	0.00073850	0.72259
Accel Z Triaxial	g	-0.17235	0.17011	1.8028e-05	0.049658
Dyno Thrust	N	7.1049e+05	1.3273e+06	1.1183e+06	58800.
Dyno Torque	Nm	-1.1239e+06	-6.4734e+05	-9.5430e+05	42982.
MP Heave Accel.	g	-0.077679	0.099810	0.0014092	0.027178
MP Heave Velocity	m/s	-1.1488	1.1187	-0.00030016	0.31959
MP Pitch Accel.	deg/sec**2	-1.8626	1.8005	-0.00058431	0.47375
MP Pitch Velocity	deg/sec	-2.2225	1.9592	-0.036370	0.57937
MP Surge Accel.	g	-0.025568	0.025595	-0.00035022	0.0071792
QUAL Pitch	deg	-2.9412	2.7099	-0.030335	0.77772
QUAL Ship Speed	knots	12.243	16.296	13.790	0.50801
QUAL X	m	-37.624	-16.018	-27.278	4.4998
QUAL Z	m	7.5375	9.8718	8.7190	0.35456
Relmo Bow	m	-7.5207	7.4520	0.83199	2.0192
Relmo Port	m	-6.9681	5.5474	0.36019	1.7966
Relmo Port Vel DERIV	m/s	-12.127	15.343	0.00051607	2.1915
Relmo Port Vel DIFFT	m/s	-11.121	14.150	0.00047599	2.1291
Relmo Prop Acoustic	m	-2.8876	2.3160	-0.19500	0.75292
Relmo RAS Acoustic	m	-1.9725	2.0136	0.072266	0.49397
Relmo Stbd	m	-6.8360	4.9681	0.29782	1.7550
Relmo Stbd Vel DERIV	m/s	-11.265	16.314	0.00032106	2.1409
Relmo Stbd Vel DIFFT	m/s	-9.6612	14.130	0.00031578	2.0805
Shaft Speed	rpm	116.87	117.12	117.04	0.047431
Upstream Wave Probe	m	-2.9127	3.7165	0.019200	1.0380

VS15_SS5H
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.048674	0.045008	0.0022097	0.014779
Accel Z Slam	g	-0.23999	0.24807	-0.00037565	0.076796
Accel Z Slam Vel	m/s	-2.3582	2.6608	0.0011985	0.76838
Accel Z Triaxial	g	-0.18161	0.17909	-0.00017686	0.052395
Dyno Thrust	N	1.1820e+06	1.6123e+06	1.3662e+06	56953.
Dyno Torque	Nm	-1.3486e+06	-9.9177e+05	-1.1555e+06	48632.
MP Heave Accel.	g	-0.093502	0.097528	0.0013849	0.028869
MP Heave Velocity	m/s	-1.1695	1.2878	-3.9693e-05	0.33327
MP Pitch Accel.	deg/sec**2	-1.8629	1.6315	-0.00098220	0.50367
MP Pitch Velocity	deg/sec	-1.9966	2.0105	-0.036976	0.59962
MP Surge Accel.	g	-0.025432	0.022456	-0.00053569	0.0068245
QUAL Pitch	deg	-2.6721	2.7524	-0.074963	0.77760
QUAL Ship Speed	knots	13.928	16.933	15.236	0.39168
QUAL X	m	-30.236	-17.076	-23.389	2.6503
QUAL Z	m	7.4353	9.7887	8.7158	0.34487
Relmo Bow	m	-6.3113	8.2042	0.91614	2.0481
Relmo Port	m	-6.5321	6.2829	0.65178	1.9558
Relmo Port Vel DERIV	m/s	-14.868	18.309	-0.0010623	2.3596
Relmo Port Vel DIFFT	m/s	-13.891	15.257	-0.0012891	2.2973
Relmo Prop Acoustic	m	-3.1458	2.3188	-0.20191	0.77316
Relmo RAS Acoustic	m	-1.6295	2.0681	0.12216	0.50554
Relmo Stbd	m	-6.1536	5.6711	0.51572	1.9060
Relmo Stbd Vel DERIV	m/s	-16.484	16.598	-0.00081718	2.2943
Relmo Stbd Vel DIFFT	m/s	-13.271	15.064	-0.00091679	2.2362
Shaft Speed	rpm	127.04	129.68	129.59	0.083866
Upstream Wave Probe	m	-2.9386	3.7823	0.023208	1.0674

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Institute for Ocean Technology **Analyzed: 2011-12-07 14:52**

VS18_SS5
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.043967	0.036271	0.0011568	0.012082
Accel Z Slam	g	-0.20205	0.19799	-0.0012136	0.061296
Accel Z Slam Vel	m/s	-2.0108	2.0180	-0.00010576	0.58399
Accel Z Triaxial	g	-0.13721	0.12784	-9.0098e-05	0.039951
Dyno Thrust	N	1.4304e+06	1.8267e+06	1.6089e+06	51643.
Dyno Torque	Nm	-1.5425e+06	-1.2200e+06	-1.3788e+06	36821.
MP Heave Accel.	g	-0.074801	0.078075	0.0012923	0.023584
MP Heave Velocity	m/s	-0.88548	0.86484	-3.9319e-05	0.24586
MP Pitch Accel.	deg/sec**2	-1.5573	1.3440	6.9509e-06	0.40563
MP Pitch Velocity	deg/sec	-1.4878	1.3133	-0.034189	0.43579
MP Surge Accel.	g	-0.014599	0.015008	-0.0010929	0.0037455
QUAL Pitch	deg	-1.8093	1.6119	-0.076733	0.51075
QUAL Ship Speed	knots	16.271	19.363	17.468	0.33988
QUAL X	m	-37.449	-24.254	-28.233	2.3541
QUAL Z	m	7.9914	9.4506	8.7766	0.18769
Relmo Bow	m	-5.3077	5.9618	1.1013	1.4718
Relmo Port	m	-5.6193	6.2848	0.53340	1.8527
Relmo Port Vel DERIV	m/s	-11.422	16.714	-0.00070348	2.4430
Relmo Port Vel DIFFT	m/s	-10.403	14.302	-0.00086879	2.3791
Relmo Prop Acoustic	m	-2.3395	1.8913	-0.24256	0.56059
Relmo RAS Acoustic	m	-1.8594	1.7961	0.011331	0.44831
Relmo Stbd	m	-5.6961	5.8044	0.23712	1.8054
Relmo Stbd Vel DERIV	m/s	-10.123	16.772	-0.00062093	2.3529
Relmo Stbd Vel DIFFT	m/s	-9.0765	15.675	-0.00084434	2.2951
Shaft Speed	rpm	142.22	142.54	142.39	0.042517
Upstream Wave Probe	m	-3.4120	3.1801	0.022105	0.86718

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Institute for Ocean Technology **Analyzed: 2011-12-07 14:41**

VS18_SS5H
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.051418	0.047933	0.0018553	0.016066
Accel Z Slam	g	-0.25136	0.25073	-0.00075002	0.083038
Accel Z Slam Vel	m/s	-2.5461	2.5526	0.0015849	0.82019
Accel Z Triaxial	g	-0.19021	0.18925	-9.1185e-05	0.055367
Dyno Thrust	N	1.3620e+06	1.9108e+06	1.6252e+06	66650.
Dyno Torque	Nm	-1.5799e+06	-1.1527e+06	-1.3909e+06	45262.
MP Heave Accel.	g	-0.091377	0.11280	0.0014046	0.031655
MP Heave Velocity	m/s	-1.2459	1.2782	0.00030904	0.35982
MP Pitch Accel.	deg/sec**2	-2.0396	1.7696	-0.00071897	0.54491
MP Pitch Velocity	deg/sec	-2.0275	1.9962	-0.034505	0.62905
MP Surge Accel.	g	-0.023519	0.021732	-0.00071557	0.0065899
QUAL Pitch	deg	-2.7020	2.5749	-0.030475	0.78942
QUAL Ship Speed	knots	15.610	19.358	17.099	0.42687
QUAL X	m	-41.871	-25.383	-32.844	3.3399
QUAL Z	m	7.4530	9.9439	8.8036	0.34959
Relmo Bow	m	-6.8723	8.3230	1.0242	2.1358
Relmo Port	m	-6.5217	6.6041	0.58164	2.2648
Relmo Port Vel DERIV	m/s	-13.201	19.111	0.0042885	2.7735
Relmo Port Vel DIFFT	m/s	-12.104	16.212	0.0044479	2.6926
Relmo Prop Acoustic	m	-2.8052	2.3154	-0.22228	0.77784
Relmo RAS Acoustic	m	-1.9544	1.7375	-0.15043	0.48090
Relmo Stbd	m	-6.2368	5.8586	0.43761	2.1684
Relmo Stbd Vel DERIV	m/s	-11.160	18.555	0.0038732	2.6388
Relmo Stbd Vel DIFFT	m/s	-10.102	16.632	0.0043290	2.5662
Shaft Speed	rpm	142.23	142.61	142.40	0.044113
Upstream Wave Probe	m	-2.8867	3.6113	0.014375	1.0413

VS20_SS3
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.0065551	0.0068615	-9.5050e-05	0.0018172
Accel Z Slam	g	-0.027661	0.030567	-0.00020834	0.0084207
Accel Z Slam Vel	m/s	-0.20403	0.22924	0.0000	0.065478
Accel Z Triaxial	g	-0.023278	0.017979	4.7521e-05	0.0063450
Dyno Thrust	N	1.8775e+06	2.1932e+06	2.0146e+06	60117.
Dyno Torque	Nm	-1.8551e+06	-1.6073e+06	-1.7190e+06	38371.
MP Heave Accel.	g	-0.010759	0.013228	0.0015566	0.0038221
MP Heave Velocity	m/s	-0.10466	0.099500	-1.0597e-05	0.031099
MP Pitch Accel.	deg/sec**2	-0.33881	0.31345	0.0000	0.076607
MP Pitch Velocity	deg/sec	-0.20854	0.13185	-0.035747	0.049049
MP Surge Accel.	g	-0.0044153	0.0010218	-0.0017513	0.00079221
QUAL Pitch	deg	-0.26277	0.066625	-0.10796	0.046030
QUAL Ship Speed	knots	19.985	21.010	20.222	0.12469
QUAL X	m	-32.248	-19.175	-25.391	4.7620
QUAL Z	m	8.7498	8.9799	8.8597	0.034208
Relmo Bow	m	0.67254	2.2168	1.3472	0.19554
Relmo Port	m	-1.1547	1.3747	0.15897	0.36553
Relmo Port Vel DERIV	m/s	-4.1124	4.7969	-0.00041496	0.67756
Relmo Port Vel DIFFT	m/s	-3.8887	4.6053	-0.00041965	0.66349
Relmo Prop Acoustic	m	-0.77818	0.15811	-0.25380	0.12328
Relmo RAS Acoustic	m	-0.88531	0.42438	-0.19138	0.19179
Relmo Stbd	m	-1.3632	1.0830	0.015221	0.35632
Relmo Stbd Vel DERIV	m/s	-4.6100	4.9679	-0.00041191	0.65071
Relmo Stbd Vel DIFFT	m/s	-4.4076	4.6733	-0.00045561	0.63727
Shaft Speed	rpm	160.68	161.02	160.87	0.048528
Upstream Wave Probe	m	-1.0935	1.0565	0.0056091	0.29594

STATISTICS FOR MERGED TIME HISTORY

REFERENCE LOCATION: SHIP BRIDGE

VS12_SS5H
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.046628	0.040790	0.0024653	0.012780
Accel Z Slam	g	-0.21223	0.22821	-0.00053903	0.065828
Accel Z Slam Vel	m/s	-2.1973	2.2809	0.00023097	0.66397
Accel Z Triaxial	g	-0.16207	0.15414	4.3790e-05	0.046793
Dyno Thrust	N	8.0965e+05	1.1796e+06	9.5469e+05	49221.
Dyno Torque	Nm	-9.9853e+05	-7.1850e+05	-8.4331e+05	35653.
MP Heave Acc	g	-0.26205	0.28972	0.0013720	0.076334
MP Heave Vel	m/s	-2.9090	3.0685	0.00040212	0.90909
MP Pitch Acc	deg/s**2	-1.7880	1.5815	0.00020805	0.43574
MP Pitch Vel	deg/s	-1.9337	1.6507	-0.037393	0.53375
MP Surge Acc	g	-0.038747	0.049005	-0.00029684	0.011860
QUAL Pitch	deg	-2.5011	2.4384	0.0011086	0.72145
QUAL Ship Speed	m/s	5.6047	7.6221	6.3345	0.22997
QUAL X	m	-31.507	-23.937	-27.646	1.5120
QUAL Z	m	7.3025	9.8083	8.7598	0.33243
Relmo Bow	m	-6.6115	7.2820	0.68602	1.9102
Relmo Port	m	-5.6774	4.4932	0.28080	1.6232
Relmo Port Vel DERIV	m/s	-9.5056	15.210	0.00078727	1.9595
Relmo Port Vel DIFFT	m/s	-8.9385	13.976	0.00084866	1.9209
Relmo Prop Acoustic	m	-2.9735	2.3034	-0.17317	0.73388
Relmo RAS Acoustic	m	-1.8334	1.9275	0.061514	0.52654
Relmo Stbd	m	-5.4183	4.3128	0.19295	1.6013
Relmo Stbd Vel DERIV	m/s	-9.8703	14.896	0.00095478	1.9536
Relmo Stbd Vel DIFFT	m/s	-8.4784	13.436	0.0010315	1.9131
Shaft Speed	rpm	106.97	107.15	107.02	0.017612
Upstream Wave Probe	m	-2.8168	3.6657	0.016571	1.0663

VS15_H0_SS5
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.0044901	0.0065271	0.00093218	0.0016368
Accel Z Slam	g	-0.017311	0.017594	-2.2097e-05	0.0047591
Accel Z Slam Vel	m/s	-0.17985	0.15430	-0.00020950	0.044237
Accel Z Triaxial	g	-0.014828	0.021993	0.00010853	0.0048901
Dyno Thrust	N	9.3214e+05	1.1857e+06	1.0546e+06	41116.
Dyno Torque	Nm	-1.0529e+06	-8.1064e+05	-9.3497e+05	32924.
MP Heave Acc	g	-0.027715	0.029926	0.0013704	0.0077061
MP Heave Vel	m/s	-0.20009	0.21439	-0.00021147	0.063262
MP Pitch Acc	deg/s**2	-0.21131	0.24120	0.00031262	0.054449
MP Pitch Vel	deg/s	-0.31273	0.19625	-0.035332	0.085915
MP Surge Acc	g	-0.010182	0.0090707	-0.00069978	0.0025125
QUAL Pitch	deg	-1.2284	0.30432	-0.38260	0.25064
QUAL Ship Speed	m/s	6.9651	7.8106	7.5669	0.10847
QUAL X	m	30.713	39.328	34.713	1.9655
QUAL Z	m	8.0406	9.0094	8.6182	0.13885
Relmo Bow	m	-2.4235	4.6960	0.94563	0.98023
Relmo Port	m	-0.74460	1.5630	0.43074	0.35534
Relmo Port Vel DERIV	m/s	-0.95420	2.2337	-0.0015789	0.18520
Relmo Port Vel DIFFT	m/s	-0.87276	1.7462	-0.0015569	0.17085
Relmo Prop Acoustic	m	-1.4332	1.0440	-0.20041	0.41093
Relmo RAS Acoustic	m	-1.3313	1.2857	-0.020365	0.39576
Relmo Stbd	m	-0.71503	1.4832	0.45246	0.33764
Relmo Stbd Vel DERIV	m/s	-1.3197	1.9857	-0.0014092	0.18056
Relmo Stbd Vel DIFFT	m/s	-1.1479	1.7451	-0.0014103	0.16713
Shaft Speed	rpm	116.93	117.09	117.00	0.036626
Upstream Wave Probe	m	-2.9021	2.9856	0.00043587	0.86433

VS15_SS3
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.0051157	0.0080613	0.00092361	0.0018155
Accel Z Slam	g	-0.029046	0.033745	-8.7984e-05	0.0089651
Accel Z Slam Vel	m/s	-0.24906	0.28669	-1.0917e-05	0.075600
Accel Z Triaxial	g	-0.024780	0.022060	3.1849e-05	0.0069860
Dyno Thrust	N	9.7114e+05	1.1264e+06	1.0541e+06	23270.
Dyno Torque	Nm	-1.0265e+06	-8.6639e+05	-9.4573e+05	25601.
MP Heave Acc	g	-0.046649	0.056362	0.0014738	0.013400
MP Heave Vel	m/s	-0.33915	0.33594	-2.9532e-05	0.097486
MP Pitch Acc	deg/s**2	-0.32811	0.32816	6.6817e-05	0.086299
MP Pitch Vel	deg/s	-0.22357	0.17035	-0.035685	0.055112
MP Surge Acc	g	-0.012849	0.010816	-0.00092127	0.0031842
QUAL Pitch	deg	-0.26406	0.16913	-0.061706	0.058363
QUAL Ship Speed	m/s	7.5331	8.6399	7.9111	0.14605
QUAL X	m	-30.711	-14.703	-22.947	4.3424
QUAL Z	m	8.5048	9.0279	8.7450	0.068124
Relmo Bow	m	0.26003	1.8222	0.97424	0.18082
Relmo Port	m	-0.47211	1.7433	0.59387	0.31126
Relmo Port Vel DERIV	m/s	-4.4807	4.7529	0.00046010	0.59891
Relmo Port Vel DIFFT	m/s	-4.0302	4.2028	0.00048909	0.57954
Relmo Prop Acoustic	m	-0.54879	0.34992	-0.15771	0.10785
Relmo RAS Acoustic	m	-0.53741	0.92057	0.10766	0.17862
Relmo Stbd	m	-0.64235	1.7329	0.55964	0.28857
Relmo Stbd Vel DERIV	m/s	-5.2717	4.9082	0.00042974	0.54303
Relmo Stbd Vel DIFFT	m/s	-4.7400	4.5104	0.00047178	0.52483
Shaft Speed	rpm	116.93	117.13	117.01	0.042609
Upstream Wave Probe	m	-1.1236	0.98543	0.0089048	0.30040

VS15_SS5H
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.054706	0.043797	0.0023202	0.013874
Accel Z Slam	g	-0.23883	0.25363	-0.00051285	0.071658
Accel Z Slam Vel	m/s	-2.5742	2.2538	0.00073829	0.72259
Accel Z Triaxial	g	-0.17235	0.17011	1.8042e-05	0.049658
Dyno Thrust	N	7.1049e+05	1.3273e+06	1.1183e+06	58799.
Dyno Torque	Nm	-1.1605e+06	-6.8400e+05	-9.8839e+05	42747.
MP Heave Acc	g	-0.29215	0.32817	0.0014874	0.083373
MP Heave Vel	m/s	-3.2014	3.9402	-0.00019308	0.99037
MP Pitch Acc	deg/s**2	-1.8637	1.7998	-0.00058379	0.47375
MP Pitch Vel	deg/s	-2.2225	1.9592	-0.036369	0.57937
MP Surge Acc	g	-0.045569	0.053457	-0.00033538	0.012896
QUAL Pitch	deg	-2.9412	2.7099	-0.030335	0.77772
QUAL Ship Speed	m/s	6.2985	8.3841	7.0942	0.26134
QUAL X	m	-37.624	-16.018	-27.278	4.4998
QUAL Z	m	7.5376	9.8718	8.7190	0.35456
Relmo Bow	m	-7.5207	7.4520	0.83199	2.0192
Relmo Port	m	-6.9681	5.5474	0.36019	1.7966
Relmo Port Vel DERIV	m/s	-12.127	15.343	0.00051335	2.1914
Relmo Port Vel DIFFT	m/s	-11.121	14.145	0.00047410	2.1291
Relmo Prop Acoustic	m	-2.8876	2.3160	-0.19500	0.75291
Relmo RAS Acoustic	m	-1.9725	2.0136	0.072266	0.49397
Relmo Stbd	m	-6.8360	4.9681	0.29782	1.7550
Relmo Stbd Vel DERIV	m/s	-11.265	16.314	0.00031776	2.1409
Relmo Stbd Vel DIFFT	m/s	-9.6612	14.130	0.00031349	2.0805
Shaft Speed	rpm	116.87	117.12	117.04	0.047431
Upstream Wave Probe	m	-2.9127	3.7164	0.019200	1.0380

VS15_SS5H
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.048673	0.045008	0.0022097	0.014779
Accel Z Slam	g	-0.23999	0.24807	-0.00037565	0.076796
Accel Z Slam Vel	m/s	-2.3582	2.6608	0.0011984	0.76838
Accel Z Triaxial	g	-0.18161	0.17909	-0.00017688	0.052395
Dyno Thrust	N	1.1820e+06	1.6123e+06	1.3662e+06	56953.
Dyno Torque	Nm	-1.3853e+06	-1.0294e+06	-1.1921e+06	48654.
MP Heave Acc	g	-0.29033	0.32707	0.0015148	0.088917
MP Heave Vel	m/s	-3.7336	3.4365	0.00026360	1.0317
MP Pitch Acc	deg/s**2	-1.8627	1.6325	-0.00098167	0.50367
MP Pitch Vel	deg/s	-1.9966	2.0105	-0.036975	0.59962
MP Surge Acc	g	-0.044630	0.059092	-0.00050806	0.014064
QUAL Pitch	deg	-2.6720	2.7524	-0.074963	0.77760
QUAL Ship Speed	m/s	7.1653	8.7111	7.8381	0.20149
QUAL X	m	-30.236	-17.076	-23.389	2.6503
QUAL Z	m	7.4353	9.7887	8.7158	0.34487
Relmo Bow	m	-6.3113	8.2038	0.91614	2.0481
Relmo Port	m	-6.5321	6.2829	0.65178	1.9558
Relmo Port Vel DERIV	m/s	-14.868	18.311	-0.0010607	2.3596
Relmo Port Vel DIFFT	m/s	-13.891	15.258	-0.0012886	2.2973
Relmo Prop Acoustic	m	-3.1458	2.3188	-0.20191	0.77316
Relmo RAS Acoustic	m	-1.6295	2.0681	0.12216	0.50554
Relmo Stbd	m	-6.1537	5.6711	0.51572	1.9060
Relmo Stbd Vel DERIV	m/s	-16.485	16.592	-0.00081557	2.2943
Relmo Stbd Vel DIFFT	m/s	-13.271	15.059	-0.00091574	2.2362
Shaft Speed	rpm	127.04	129.68	129.59	0.083863
Upstream Wave Probe	m	-2.9386	3.7824	0.023208	1.0674

VS18_SS5
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.043966	0.036271	0.0011568	0.012082
Accel Z Slam	g	-0.20205	0.19798	-0.0012136	0.061296
Accel Z Slam Vel	m/s	-2.0107	2.0180	-0.00010586	0.58399
Accel Z Triaxial	g	-0.13719	0.12784	-9.0098e-05	0.039951
Dyno Thrust	N	1.4304e+06	1.8267e+06	1.6089e+06	51642.
Dyno Torque	Nm	-1.5804e+06	-1.2605e+06	-1.4086e+06	36726.
MP Heave Acc	g	-0.23987	0.26038	0.0012924	0.072209
MP Heave Vel	m/s	-2.5746	2.6895	-0.00010214	0.76481
MP Pitch Acc	deg/s**2	-1.5573	1.3436	6.9965e-06	0.40562
MP Pitch Vel	deg/s	-1.4878	1.3133	-0.034189	0.43579
MP Surge Acc	g	-0.038651	0.048109	-0.0010966	0.012999
QUAL Pitch	deg	-1.8092	1.6119	-0.076734	0.51074
QUAL Ship Speed	m/s	8.3707	9.9611	8.9863	0.17484
QUAL X	m	-37.449	-24.254	-28.233	2.3541
QUAL Z	m	7.9914	9.4506	8.7766	0.18769
Relmo Bow	m	-5.3077	5.9618	1.1013	1.4718
Relmo Port	m	-5.6191	6.2848	0.53340	1.8527
Relmo Port Vel DERIV	m/s	-11.438	16.714	-0.00069845	2.4428
Relmo Port Vel DIFFT	m/s	-10.403	14.295	-0.00086539	2.3790
Relmo Prop Acoustic	m	-2.3395	1.8913	-0.24256	0.56058
Relmo RAS Acoustic	m	-1.8594	1.7961	0.011331	0.44831
Relmo Stbd	m	-5.6959	5.8043	0.23712	1.8053
Relmo Stbd Vel DERIV	m/s	-10.123	16.772	-0.00061432	2.3527
Relmo Stbd Vel DIFFT	m/s	-9.0765	15.675	-0.00083958	2.2950
Shaft Speed	rpm	142.22	142.54	142.39	0.042511
Upstream Wave Probe	m	-3.4118	3.1801	0.022105	0.86717

VS18_SS5H
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.051418	0.047933	0.0018553	0.016066
Accel Z Slam	g	-0.25136	0.25073	-0.00075002	0.083038
Accel Z Slam Vel	m/s	-2.5461	2.5526	0.0015849	0.82019
Accel Z Triaxial	g	-0.19021	0.18925	-9.1182e-05	0.055367
Dyno Thrust	N	1.3620e+06	1.9108e+06	1.6252e+06	66650.
Dyno Torque	Nm	-1.6060e+06	-1.1789e+06	-1.4172e+06	45267.
MP Heave Acc	g	-0.30932	0.32253	0.0014999	0.096702
MP Heave Vel	m/s	-3.5303	3.6361	0.0013697	1.0928
MP Pitch Acc	deg/s**2	-2.0408	1.7691	-0.00071869	0.54491
MP Pitch Vel	deg/s	-2.0275	1.9962	-0.034505	0.62905
MP Surge Acc	g	-0.046867	0.059042	-0.00069572	0.015819
QUAL Pitch	deg	-2.7020	2.5749	-0.030475	0.78942
QUAL Ship Speed	m/s	8.0303	9.9587	8.7964	0.21962
QUAL X	m	-41.871	-25.383	-32.844	3.3399
QUAL Z	m	7.4530	9.9439	8.8035	0.34964
Relmo Bow	m	-6.8723	8.3230	1.0242	2.1358
Relmo Port	m	-6.5217	6.6041	0.58164	2.2648
Relmo Port Vel DERIV	m/s	-13.201	19.111	0.0042855	2.7735
Relmo Port Vel DIFFT	m/s	-12.102	16.212	0.0044454	2.6926
Relmo Prop Acoustic	m	-2.8052	2.3154	-0.22228	0.77784
Relmo RAS Acoustic	m	-1.9544	1.7375	-0.15043	0.48090
Relmo Stbd	m	-6.2368	5.8586	0.43761	2.1684
Relmo Stbd Vel DERIV	m/s	-11.160	18.555	0.0038731	2.6388
Relmo Stbd Vel DIFFT	m/s	-10.102	16.632	0.0043283	2.5662
Shaft Speed	rpm	142.23	142.61	142.40	0.044113
Upstream Wave Probe	m	-2.8867	3.6113	0.014375	1.0413

VS20_SS3
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.0065550	0.0068619	-9.5049e-05	0.0018172
Accel Z Slam	g	-0.027661	0.030567	-0.00020834	0.0084208
Accel Z Slam Vel	m/s	-0.20403	0.22924	0.0000	0.065478
Accel Z Triaxial	g	-0.023278	0.017979	4.7521e-05	0.0063450
Dyno Thrust	N	1.8775e+06	2.1932e+06	2.0146e+06	60117.
Dyno Torque	Nm	-1.8964e+06	-1.6421e+06	-1.7527e+06	40292.
MP Heave Acc	g	-0.043168	0.053947	0.0015574	0.012091
MP Heave Vel	m/s	-0.29163	0.26773	-0.00014773	0.085049
MP Pitch Acc	deg/s**2	-0.33879	0.31340	0.0000	0.076611
MP Pitch Vel	deg/s	-0.20854	0.13185	-0.035747	0.049049
MP Surge Acc	g	-0.012646	0.011212	-0.0017547	0.0029657
QUAL Pitch	deg	-0.26277	0.066625	-0.10796	0.046030
QUAL Ship Speed	m/s	10.281	10.809	10.403	0.064151
QUAL X	m	-32.248	-19.175	-25.391	4.7620
QUAL Z	m	8.7498	8.9799	8.8597	0.034208
Relmo Bow	m	0.67249	2.2169	1.3472	0.19554
Relmo Port	m	-1.1547	1.3747	0.15897	0.36554
Relmo Port Vel DERIV	m/s	-4.1124	4.7993	-0.00041591	0.67758
Relmo Port Vel DIFFT	m/s	-3.8887	4.6061	-0.00042030	0.66351
Relmo Prop Acoustic	m	-0.77818	0.15810	-0.25380	0.12328
Relmo RAS Acoustic	m	-0.88531	0.42437	-0.19138	0.19179
Relmo Stbd	m	-1.3632	1.0832	0.015221	0.35632
Relmo Stbd Vel DERIV	m/s	-4.6100	4.9686	-0.00041186	0.65073
Relmo Stbd Vel DIFFT	m/s	-4.4076	4.6738	-0.00045556	0.63729
Shaft Speed	rpm	160.68	161.02	160.87	0.048530
Upstream Wave Probe	m	-1.0935	1.0565	0.0056089	0.29594

STATISTICS FOR MERGED TIME HISTORY

REFERENCE LOCATION: HELICOPTER LANDING DECK

VS12_SS5H
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.046602	0.041184	0.0024562	0.012656
Accel Z Slam	g	-0.21218	0.24037	-0.00052328	0.065084
Accel Z Slam Vel	m/s	-2.1973	2.2807	-0.00029066	0.65606
Accel Z Triaxial	g	-0.16429	0.15414	6.5136e-05	0.046534
Dyno Thrust	N	7.9865e+05	1.1795e+06	9.5461e+05	48484.
Dyno Torque	Nm	-9.9848e+05	-7.1859e+05	-8.4276e+05	35097.
MP Heave Acc	g	-0.19801	0.18573	0.0014808	0.048585
MP Heave Vel	m/s	-2.2850	1.9607	0.00062922	0.58435
MP Pitch Acc	deg/s**2	-1.8278	1.5813	0.00046798	0.43138
MP Pitch Vel	deg/s	-1.9402	1.6507	-0.036985	0.52783
MP Surge Acc	g	-0.021410	0.020767	-0.00025664	0.0056669
QUAL Pitch	deg	-2.5007	2.4361	-0.00077019	0.71347
QUAL Ship Speed	m/s	5.6053	7.6093	6.3432	0.22353
QUAL X	m	-31.507	-22.992	-27.312	1.6283
QUAL Z	m	7.3043	9.8072	8.7579	0.32882
Relmo Bow	m	-7.1437	7.2713	0.68986	1.8862
Relmo Port	m	-6.0611	5.5783	0.27275	1.6018
Relmo Port Vel DERIV	m/s	-9.4874	15.176	0.00068650	1.9376
Relmo Port Vel DIFFT	m/s	-8.9031	13.951	0.00071954	1.8951
Relmo Prop Acoustic	m	-2.9699	2.3070	-0.17873	0.72864
Relmo RAS Acoustic	m	-1.8288	1.9439	0.061428	0.52713
Relmo Stbd	m	-5.6920	5.0212	0.18514	1.5769
Relmo Stbd Vel DERIV	m/s	-9.8537	14.867	0.00054673	1.9236
Relmo Stbd Vel DIFFT	m/s	-8.4657	13.417	0.00060229	1.8805
Shaft Speed	rpm	106.97	107.15	107.02	0.018218
Upstream Wave Probe	m	-2.9056	3.6655	0.015921	1.0715

VS15_H0_SS5
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.0044475	0.0065180	0.00094701	0.0015833
Accel Z Slam	g	-0.017297	0.017573	6.9512e-06	0.0046702
Accel Z Slam Vel	m/s	-0.17981	0.15427	-4.3311e-05	0.043784
Accel Z Triaxial	g	-0.014825	0.015211	6.7411e-05	0.0047113
Dyno Thrust	N	9.3263e+05	1.1854e+06	1.0538e+06	40022.
Dyno Torque	Nm	-1.0524e+06	-8.1388e+05	-9.3473e+05	32529.
MP Heave Acc	g	-0.029653	0.033850	0.0014160	0.0076057
MP Heave Vel	m/s	-0.17520	0.17580	0.00025466	0.056356
MP Pitch Acc	deg/s**2	-0.20585	0.21455	3.2200e-05	0.053781
MP Pitch Vel	deg/s	-0.31262	0.19563	-0.035250	0.083219
MP Surge Acc	g	-0.0066184	0.0049963	-0.00065231	0.0017500
QUAL Pitch	deg	-1.0193	0.30350	-0.38272	0.23902
QUAL Ship Speed	m/s	7.0146	7.8098	7.5704	0.10623
QUAL X	m	30.713	39.325	34.766	1.8712
QUAL Z	m	8.2383	9.0092	8.6164	0.13288
Relmo Bow	m	-2.4223	4.6959	0.93947	0.96090
Relmo Port	m	-0.74440	1.5629	0.42421	0.35914
Relmo Port Vel DERIV	m/s	-0.93535	2.1912	-0.0015356	0.18156
Relmo Port Vel DIFFT	m/s	-0.85678	1.7281	-0.0014846	0.16811
Relmo Prop Acoustic	m	-1.4330	1.0438	-0.20287	0.39307
Relmo RAS Acoustic	m	-1.3299	1.2846	-0.019844	0.39336
Relmo Stbd	m	-0.71497	1.4823	0.45334	0.34184
Relmo Stbd Vel DERIV	m/s	-1.3120	1.9183	-0.0013444	0.17827
Relmo Stbd Vel DIFFT	m/s	-1.1423	1.6960	-0.0013150	0.16547
Shaft Speed	rpm	116.93	117.10	117.00	0.037018
Upstream Wave Probe	m	-2.8998	3.1226	0.0013094	0.86154

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VS15_SS3
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.0051108	0.0080534	0.00091374	0.0017980
Accel Z Slam	g	-0.029028	0.033707	-7.6205e-05	0.0089133
Accel Z Slam Vel	m/s	-0.24903	0.28668	-9.8810e-06	0.075068
Accel Z Triaxial	g	-0.024740	0.026178	5.2252e-05	0.0069546
Dyno Thrust	N	9.7114e+05	1.1263e+06	1.0527e+06	22815.
Dyno Torque	Nm	-1.0255e+06	-8.6684e+05	-9.4681e+05	24013.
MP Heave Acc	g	-0.043824	0.044835	0.0014916	0.011462
MP Heave Vel	m/s	-0.21960	0.21880	0.00019158	0.062157
MP Pitch Acc	deg/s**2	-0.32173	0.32469	7.0676e-05	0.085913
MP Pitch Vel	deg/s	-0.22351	0.17032	-0.035709	0.054363
MP Surge Acc	g	-0.0057744	0.0037379	-0.00091935	0.0013400
QUAL Pitch	deg	-0.26385	0.16895	-0.061367	0.057126
QUAL Ship Speed	m/s	7.5334	8.6393	7.8934	0.14058
QUAL X	m	-30.711	-14.703	-23.075	3.9026
QUAL Z	m	8.5050	9.0277	8.7430	0.064015
Relmo Bow	m	0.26005	1.8197	0.97132	0.18334
Relmo Port	m	-0.46995	1.8231	0.58611	0.31582
Relmo Port Vel DERIV	m/s	-5.7349	4.2180	0.00048584	0.60986
Relmo Port Vel DIFFT	m/s	-5.3367	3.7536	0.00048579	0.59108
Relmo Prop Acoustic	m	-0.60199	0.34931	-0.15331	0.10904
Relmo RAS Acoustic	m	-0.53727	0.91933	0.089182	0.17951
Relmo Stbd	m	-0.63846	1.8915	0.55351	0.29358
Relmo Stbd Vel DERIV	m/s	-5.3815	4.8578	0.00031222	0.55270
Relmo Stbd Vel DIFFT	m/s	-5.0074	4.4672	0.00032572	0.53525
Shaft Speed	rpm	116.93	117.12	117.01	0.043166
Upstream Wave Probe	m	-1.1235	0.99422	0.0068530	0.29690

VS15_SS5H
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.054706	0.043797	0.0023202	0.013874
Accel Z Slam	g	-0.23883	0.25363	-0.00051285	0.071658
Accel Z Slam Vel	m/s	-2.5742	2.2538	0.00073829	0.72259
Accel Z Triaxial	g	-0.17235	0.17011	1.8042e-05	0.049658
Dyno Thrust	N	7.1049e+05	1.3273e+06	1.1183e+06	58799.
Dyno Torque	Nm	-1.1605e+06	-6.8400e+05	-9.8839e+05	42747.
MP Heave Acc	g	-0.18880	0.21555	0.0013258	0.052316
MP Heave Vel	m/s	-2.1709	2.3325	-0.00041855	0.63623
MP Pitch Acc	deg/s**2	-1.8637	1.7998	-0.00058379	0.47375
MP Pitch Vel	deg/s	-2.2225	1.9592	-0.036369	0.57937
MP Surge Acc	g	-0.019502	0.031123	-0.00033932	0.0061004
QUAL Pitch	deg	-2.9412	2.7099	-0.030335	0.77772
QUAL Ship Speed	m/s	6.2985	8.3841	7.0942	0.26134
QUAL X	m	-37.624	-16.018	-27.278	4.4998
QUAL Z	m	7.5376	9.8718	8.7190	0.35456
Relmo Bow	m	-7.5207	7.4520	0.83199	2.0192
Relmo Port	m	-6.9681	5.5474	0.36019	1.7966
Relmo Port Vel DERIV	m/s	-12.127	15.343	0.00051335	2.1914
Relmo Port Vel DIFFT	m/s	-11.121	14.145	0.00047410	2.1291
Relmo Prop Acoustic	m	-2.8876	2.3160	-0.19500	0.75291
Relmo RAS Acoustic	m	-1.9725	2.0136	0.072266	0.49397
Relmo Stbd	m	-6.8360	4.9681	0.29782	1.7550
Relmo Stbd Vel DERIV	m/s	-11.265	16.314	0.00031776	2.1409
Relmo Stbd Vel DIFFT	m/s	-9.6612	14.130	0.00031349	2.0805
Shaft Speed	rpm	116.87	117.12	117.04	0.047431
Upstream Wave Probe	m	-2.9127	3.7164	0.019200	1.0380

VS15_SS5H
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.048673	0.045008	0.0022097	0.014779
Accel Z Slam	g	-0.23999	0.24807	-0.00037565	0.076796
Accel Z Slam Vel	m/s	-2.3582	2.6608	0.0011984	0.76838
Accel Z Triaxial	g	-0.18161	0.17909	-0.00017688	0.052395
Dyno Thrust	N	1.1820e+06	1.6123e+06	1.3662e+06	56953.
Dyno Torque	Nm	-1.3853e+06	-1.0294e+06	-1.1921e+06	48654.
MP Heave Acc	g	-0.19383	0.19536	0.0012448	0.055126
MP Heave Vel	m/s	-2.3294	2.1485	-0.00037442	0.65030
MP Pitch Acc	deg/s**2	-1.8627	1.6325	-0.00098167	0.50367
MP Pitch Vel	deg/s	-1.9966	2.0105	-0.036975	0.59962
MP Surge Acc	g	-0.023144	0.029299	-0.00052025	0.0062159
QUAL Pitch	deg	-2.6720	2.7524	-0.074963	0.77760
QUAL Ship Speed	m/s	7.1653	8.7111	7.8381	0.20149
QUAL X	m	-30.236	-17.076	-23.389	2.6503
QUAL Z	m	7.4353	9.7887	8.7158	0.34487
Relmo Bow	m	-6.3113	8.2038	0.91614	2.0481
Relmo Port	m	-6.5321	6.2829	0.65178	1.9558
Relmo Port Vel DERIV	m/s	-14.868	18.311	-0.0010607	2.3596
Relmo Port Vel DIFFT	m/s	-13.891	15.258	-0.0012886	2.2973
Relmo Prop Acoustic	m	-3.1458	2.3188	-0.20191	0.77316
Relmo RAS Acoustic	m	-1.6295	2.0681	0.12216	0.50554
Relmo Stbd	m	-6.1537	5.6711	0.51572	1.9060
Relmo Stbd Vel DERIV	m/s	-16.485	16.592	-0.00081557	2.2943
Relmo Stbd Vel DIFFT	m/s	-13.271	15.059	-0.00091574	2.2362
Shaft Speed	rpm	127.04	129.68	129.59	0.083863
Upstream Wave Probe	m	-2.9386	3.7824	0.023208	1.0674

VS18_SS5
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.043959	0.036190	0.0011586	0.012146
Accel Z Slam	g	-0.20188	0.19763	-0.0011746	0.061650
Accel Z Slam Vel	m/s	-2.0075	2.0134	0.00032162	0.58705
Accel Z Triaxial	g	-0.13694	0.12760	-8.3009e-05	0.040194
Dyno Thrust	N	1.4324e+06	1.8259e+06	1.6096e+06	51319.
Dyno Torque	Nm	-1.5800e+06	-1.2607e+06	-1.4089e+06	36124.
MP Heave Acc	g	-0.16513	0.16395	0.0012801	0.043838
MP Heave Vel	m/s	-1.6864	1.3981	-0.00014937	0.45113
MP Pitch Acc	deg/s**2	-1.5546	1.3317	-0.00023660	0.40749
MP Pitch Vel	deg/s	-1.4871	1.3126	-0.034412	0.43786
MP Surge Acc	g	-0.017948	0.016659	-0.0010950	0.0050565
QUAL Pitch	deg	-1.8015	1.6112	-0.077076	0.51295
QUAL Ship Speed	m/s	8.3833	9.9610	8.9923	0.17409
QUAL X	m	-37.447	-24.534	-28.289	2.2903
QUAL Z	m	7.9928	9.4497	8.7754	0.18758
Relmo Bow	m	-5.2854	5.9442	1.0997	1.4759
Relmo Port	m	-5.6115	6.2758	0.53313	1.8591
Relmo Port Vel DERIV	m/s	-12.747	20.409	-0.00041799	2.4251
Relmo Port Vel DIFFT	m/s	-10.868	16.982	-0.00064962	2.3692
Relmo Prop Acoustic	m	-2.3363	1.8746	-0.24395	0.56119
Relmo RAS Acoustic	m	-1.8410	1.8977	0.013434	0.44778
Relmo Stbd	m	-5.6805	5.7881	0.23123	1.8083
Relmo Stbd Vel DERIV	m/s	-10.889	16.119	-0.00044308	2.3348
Relmo Stbd Vel DIFFT	m/s	-9.5578	14.355	-0.00066231	2.2836
Shaft Speed	rpm	142.22	142.54	142.39	0.041431
Upstream Wave Probe	m	-3.3932	3.1792	0.023658	0.86539

VS18_SS5H
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.050746	0.048506	0.0018364	0.015962
Accel Z Slam	g	-0.24932	0.26561	-0.00073167	0.082270
Accel Z Slam Vel	m/s	-2.5424	2.6176	0.0017975	0.81206
Accel Z Triaxial	g	-0.18861	0.18841	-7.4690e-05	0.054836
Dyno Thrust	N	1.3626e+06	1.9045e+06	1.6217e+06	65569.
Dyno Torque	Nm	-1.6041e+06	-1.1826e+06	-1.4149e+06	44570.
MP Heave Acc	g	-0.23314	0.21912	0.0012864	0.058581
MP Heave Vel	m/s	-2.1549	2.3074	-0.00095039	0.66707
MP Pitch Acc	deg/s**2	-2.0109	1.7589	-0.00082243	0.54084
MP Pitch Vel	deg/s	-2.0152	1.9948	-0.034917	0.62349
MP Surge Acc	g	-0.023713	0.023902	-0.00072377	0.0064499
QUAL Pitch	deg	-2.6687	2.5742	-0.032126	0.77848
QUAL Ship Speed	m/s	8.0665	9.9157	8.8050	0.21094
QUAL X	m	-41.868	-25.393	-32.335	3.3517
QUAL Z	m	7.4680	9.9306	8.8028	0.33914
Relmo Bow	m	-6.7940	8.2792	1.0278	2.1131
Relmo Port	m	-6.8654	6.5968	0.57477	2.2374
Relmo Port Vel DERIV	m/s	-13.087	18.153	0.0046878	2.7182
Relmo Port Vel DIFFT	m/s	-12.584	16.636	0.0048781	2.6526
Relmo Prop Acoustic	m	-3.1633	2.3107	-0.22045	0.76969
Relmo RAS Acoustic	m	-1.9250	1.7281	-0.14485	0.47666
Relmo Stbd	m	-6.8719	5.8336	0.42623	2.1563
Relmo Stbd Vel DERIV	m/s	-11.545	17.368	0.0040965	2.6009
Relmo Stbd Vel DIFFT	m/s	-10.466	16.493	0.0044730	2.5409
Shaft Speed	rpm	142.23	142.61	142.39	0.042894
Upstream Wave Probe	m	-2.8770	3.5812	0.017757	1.0550

VS20_SS3
Merged

Channel	Units	Min	Max	Mean	SD
Accel X Triaxial	g	-0.0065550	0.0068619	-9.5049e-05	0.0018172
Accel Z Slam	g	-0.027661	0.030567	-0.00020834	0.0084208
Accel Z Slam Vel	m/s	-0.20403	0.22924	0.0000	0.065478
Accel Z Triaxial	g	-0.023278	0.017979	4.7521e-05	0.0063450
Dyno Thrust	N	1.8775e+06	2.1932e+06	2.0146e+06	60117.
Dyno Torque	Nm	-1.8964e+06	-1.6421e+06	-1.7527e+06	40292.
MP Heave Acc	g	-0.039272	0.045595	0.0015569	0.010032
MP Heave Vel	m/s	-0.20416	0.18869	0.00013958	0.056284
MP Pitch Acc	deg/s**2	-0.33879	0.31340	0.0000	0.076611
MP Pitch Vel	deg/s	-0.20854	0.13185	-0.035747	0.049049
MP Surge Acc	g	-0.0062404	0.0034465	-0.0017476	0.0013544
QUAL Pitch	deg	-0.26277	0.066625	-0.10796	0.046030
QUAL Ship Speed	m/s	10.281	10.809	10.403	0.064151
QUAL X	m	-32.248	-19.175	-25.391	4.7620
QUAL Z	m	8.7498	8.9799	8.8597	0.034208
Relmo Bow	m	0.67249	2.2169	1.3472	0.19554
Relmo Port	m	-1.1547	1.3747	0.15897	0.36554
Relmo Port Vel DERIV	m/s	-4.1124	4.7993	-0.00041591	0.67758
Relmo Port Vel DIFFT	m/s	-3.8887	4.6061	-0.00042030	0.66351
Relmo Prop Acoustic	m	-0.77818	0.15810	-0.25380	0.12328
Relmo RAS Acoustic	m	-0.88531	0.42437	-0.19138	0.19179
Relmo Stbd	m	-1.3632	1.0832	0.015221	0.35632
Relmo Stbd Vel DERIV	m/s	-4.6100	4.9686	-0.00041186	0.65073
Relmo Stbd Vel DIFFT	m/s	-4.4076	4.6738	-0.00045556	0.63729
Shaft Speed	rpm	160.68	161.02	160.87	0.048530
Upstream Wave Probe	m	-1.0935	1.0565	0.0056089	0.29594

APPENDIX I

ADDED POWER OFFLINE ANALYSIS

Comment: Added Power Analysis for Seakeeping Tests

Baseline Calm Water Runs

Test Name	Acquisition Time	Carriage Speed (m/s)	Surge Speed (m/s)	Model Speed (m/s)	Encounter probe (m)	Shaft Speed (rps)	Dyno Thrust (N)	Dyno Torque (Nm)	Friction Torque [Nm]	Torque Corr [Nm]
CALM_20KTS_001	29/11/2011 18:46	1.8866	0.0049	1.8915	0.00844	14.721	80.61	-2.3465	-0.05155	2.2949
CALM_20KTS_002	29/11/2011 19:02	1.8865	0.0010	1.8875	0.00802	14.609	78.85	-2.2951	-0.05056	2.2445
CALM_20KTS_003	29/11/2011 21:14	1.8866	0.0021	1.8887	0.00779	14.610	75.09	-2.2155	-0.05057	2.1649
CALM_20KTS_004	29/11/2011 21:30	1.8866	0.0021	1.8887	0.00815	14.611	79.02	-2.2990	-0.05057	2.2484
	Average			1.8883		14.610	77.65			2.2193
	St Dev			0.0007		0.001	2.22	2.9%		0.0471

Test Name	Acquisition Time	Carriage Speed (m/s)	Surge Speed (m/s)	Model Speed (m/s)	Encounter probe (m)	Shaft Speed (rps)	Dyno Thrust (N)	Dyno Torque (Nm)	Friction Torque [Nm]	Torque Corr [Nm]
VS20_SS3_001	29/11/2011 19:19	1.8865	0.0014	1.8879	0.01040	14.609	78.70	-2.2864	-0.05056	2.2358
VS20_SS3_002	29/11/2011 19:38	1.8866	-0.0008	1.8857	0.01113	14.609	75.07	-2.2115	-0.05056	2.1610
VS20_SS3_003	29/11/2011 19:57	1.8866	0.0012	1.8878	0.01094	14.610	78.95	-2.2962	-0.05056	2.2457
VS20_SS3_004	29/11/2011 20:16	1.8866	0.0011	1.8876	0.01071	14.611	78.47	-2.2893	-0.05057	2.2387
VS20_SS3_005	29/11/2011 20:35	1.8865	-0.0011	1.8855	0.01105	14.610	75.00	-2.2170	-0.05056	2.1664
VS20_SS3_006	29/11/2011 20:54	1.8865	-0.0003	1.8862	0.01084	14.610	75.29	-2.2233	-0.05056	2.1728

Merged Spectrum VS20_ss3				1.887		14.60949	76.98374	-2.255941	-0.05056	2.2054

From ITTC57

Test Name		Ship Speed [m/s]	Ship Speed [kts]	QS [kNm]	TS [kN]	NS [rpm]	PD [kW]
CALM_20KTS_001	outlier	10.306	20.03	1154.4	1305.0	137.2	16587.3
CALM_20KTS_002		10.285	19.99	1147.6	1296.8	136.8	16441.9
CALM_20KTS_003		10.291	20.00	1149.7	1299.3	136.9	16485.8
CALM_20KTS_004		10.291	20.00	1149.6	1299.2	136.9	16485.1
		10.293	20.01	1150.3	1300.1	137.0	16500.0
	2.1%	0.009	0.02	2.9	3.5	0.2	61.7

Interpolated Calm Water

Test Name	N [1/s]	T [N]	Q [Nm]	NAW [1/s]	TAW [N]	QAW [Nm]	Ship Speed [m/s]	Ship Speed [kts]	NAWS [rpm]	TAWS [kN]	QAWS [kNm]	PDAWS [kW]	PDWS [kW]
VS20_SS3_001	14.6066	77.6106	2.2182	0.003	1.09	0.0176	10.287	20.00	0.028	29.33	14.07	204.95	16662.2
VS20_SS3_002	14.5863	77.3771	2.2119	0.023	-2.30	-0.0509	10.275	19.97	0.254	-61.92	-40.64	-552.04	15823.7
VS20_SS3_003	14.6058	77.6020	2.2180	0.004	1.35	0.0277	10.286	20.00	0.042	36.18	22.09	321.65	16775.9
VS20_SS3_004	14.6040	77.5811	2.2174	0.007	0.89	0.0213	10.285	19.99	0.074	23.86	17.02	252.91	16699.9
VS20_SS3_005	14.5840	77.3503	2.2111	0.026	-2.35	-0.0447	10.273	19.97	0.282	-63.18	-35.70	-477.91	15888.4
VS20_SS3_006	14.5911	77.4323	2.2134	0.019	-2.14	-0.0406	10.278	19.98	0.207	-57.56	-32.42	-439.95	15955.1
						Average		19.98	0.148	-15.55	-9.26	-115.07	16300.9
						St Dev		0.01	0.113	49.85	29.79	413.93	454.5
VS20_ss3	14.5963	77.4922	2.2150	0.013	-0.51	-0.0096	10.281	19.98	0.145	-13.67	-7.67	-92.57	16323.4

Comment: Added Power Analysis for Seakeeping Tests

Baseline Calm Water Runs

Test Name	Acquisition Time	Carriage Speed (m/s)	Surge Speed (m/s)	Model Speed (m/s)	Encounter probe (m)	Shaft Speed (rps)	Dyno Thrust (N)	Dyno Torque (Nm)	Friction Torque [Nm]	Torque Corr [Nm]
CALM_15KTS_003	01/12/2011 12:41	1.4149	0.0007	1.4155	0.00501	10.625	40.33	-1.2265	-0.05945	1.1670
CALM_15KTS_004	01/12/2011 12:55	1.4149	0.0014	1.4163	0.00548	10.625	41.12	-1.2387	-0.05945	1.1792
CALM_15KTS_005	01/12/2011 15:03	1.4149	0.0038	1.4187	0.00473	10.627	40.10	-1.2334	-0.05946	1.1739
CALM_15KTS_006	01/12/2011 15:17	1.4149	0.0010	1.4159	0.00472	10.626	40.41	-1.2499	-0.05945	1.1904
	Average			1.4166		10.626	40.49			1.1776
	St Dev			0.0014		0.001	0.44	1.1%		0.0099

	Test Name	Acquisition Time	Carriage Speed (m/s)	Surge Speed (m/s)	Model Speed (m/s)	Encounter probe (m)	Shaft Speed (rps)	Dyno Thrust (N)	Dyno Torque (Nm)	Friction Torque [Nm]	Torque Corr [Nm]
	VS15_SS3_001	01/12/2011 13:09	1.4358	-0.0011	1.4347	0.01151	10.626	39.68	-1.2051	-0.05945	1.1457
	VS15_SS3_002	01/12/2011 13:29	1.4022	0.0013	1.4035	0.01090	10.626	40.65	-1.2295	-0.05945	1.1700
	VS15_SS3_003	01/12/2011 13:51	1.4284	-0.0036	1.4248	0.01135	10.627	40.01	-1.2092	-0.05946	1.1497
	VS15_SS3_004	01/12/2011 14:11	1.4347	-0.0006	1.4341	0.01118	10.627	40.91	-1.2315	-0.05946	1.1720
Repeat of _001	VS15_SS3_005	01/12/2011 14:30	1.4188	-0.0006	1.4182	0.01134	10.626	40.05	-1.2225	-0.05945	1.1630

Merged Spectrum

VS15_SS3					1.424		10.62625	40.28053	-1.217254	-0.04923	1.1680

From ITTC57

Test Name	Ship Speed [m/s]	Ship Speed [kts]	QS [kNm]	TS [kN]	NS [rpm]	PD [kW]
CALM_15KTS_003	7.713	14.99	550.4	615.9	96.3	5551.8
CALM_15KTS_004	7.717	15.00	551.1	616.7	96.3	5562.8
CALM_15KTS_005	7.730	15.03	553.2	619.1	96.5	5595.2
CALM_15KTS_006	7.715	15.00	550.7	616.2	96.3	5557.1
	7.719	15.00	551.3	617.0	96.4	5566.7
0.8%	0.008	0.02	1.3	1.5	0.1	19.5

Interpolated Calm Water

Test Name	N [1/s]	T [N]	Q [Nm]	NAW [1/s]	TAW [N]	QAW [Nm]	Ship Speed [m/s]	Ship Speed [kts]	NAWS [rpm]	TAWS [kN]	QAWS [kNm]	PDAWS [kW]	PDWS [kW]
VS15_SS3_001	10.7721	41.9071	1.2078	-0.147	-2.23	-0.0621	7.817	15.20	-1.614	-60.02	-49.58	-594.76	5218.2
VS15_SS3_002	10.5275	40.0729	1.1544	0.099	0.57	0.0156	7.647	14.87	1.085	15.45	12.45	187.14	5575.0
VS15_SS3_003	10.6940	41.3207	1.1907	-0.067	-1.31	-0.0409	7.763	15.09	-0.741	-35.32	-32.70	-372.82	5305.3
VS15_SS3_004	10.7674	41.8721	1.2068	-0.141	-0.96	-0.0347	7.814	15.19	-1.551	-25.80	-27.73	-371.17	5433.8
VS15_SS3_005	10.6422	40.9319	1.1794	-0.016	-0.88	-0.0164	7.727	15.02	-0.177	-23.69	-13.07	-142.08	5445.9
						Average		15.09	-0.705	-26.42	-24.39	-287.90	5383.1
						St Dev		0.15	1.258	31.42	26.28	333.65	155.6
VS15_SS3	10.6901	41.2919	1.1899	-0.064	-1.01	-0.0218	7.761	15.09	-0.703	-27.20	-17.43	-216.78	5454.7

Comment: Added Power Analysis for Seakeeping Tests

Baseline Calm Water Runs

Test Name	Acquisition Time	Carriage Speed (m/s)	Surge Speed (m/s)	Model Speed (m/s)	Encounter probe (m)	Shaft Speed (rps)	Dyno Thrust (N)	Dyno Torque (Nm)	Friction Torque [Nm]	Torque Corr [Nm]
CALM_18KTS_001	30/11/2011 13:02	1.6976	0.0035	1.7011	0.00840	12.929	59.75	-1.7661	-0.04663	1.7195
CALM_18KTS_002	30/11/2011 13:18	1.6974	-0.0004	1.6970	0.00722	12.929	59.51	-1.7577	-0.04663	1.7111
CALM_18KTS_003	30/11/2011 18:49	1.6975	0.0009	1.6984	0.01007	12.932	59.91	-1.7786	-0.04663	1.7319
CALM_18KTS_005	30/11/2011 19:38	1.6974	0.0013	1.6987	0.00632	12.929	59.73	-1.7742	-0.04663	1.7276
	Average			1.6988		12.930	59.72			1.7225
	St Dev			0.0017		0.001	0.16	0.3%		0.0092

	Test Name	Acquisition Time	Carriage Speed (m/s)	Surge Speed (m/s)	Model Speed (m/s)	Encounter probe (m)	Shaft Speed (rps)	Dyno Thrust (N)	Dyno Torque (Nm)	Friction Torque [Nm]	Torque Corr [Nm]
	VS18_SS5_001	30/11/2011 13:40	1.6334	0.0005	1.6339	0.01241	12.928	60.24	-1.7836	-0.04663	1.7370
	VS18_SS5_002	30/11/2011 14:01	1.6353	-0.0021	1.6332	0.01261	12.930	60.28	-1.7945	-0.04663	1.7478
	VS18_SS5_003	30/11/2011 14:21	1.5976	0.0029	1.6005	0.01280	12.930	62.58	-1.8387	-0.04663	1.7920
	VS18_SS5_004	30/11/2011 14:41	1.6208	-0.0017	1.6191	0.01249	12.930	62.20	-1.8269	-0.04663	1.7803
	VS18_SS5_005	30/11/2011 15:01	1.6180	-0.0004	1.6176	0.01377	12.930	60.86	-1.8010	-0.04663	1.7544
	VS18_SS5_006	30/11/2011 15:21	1.6148	-0.0007	1.6142	0.01307	12.930	61.63	-1.8173	-0.04663	1.7707
	VS18_SS5_007	30/11/2011 16:03	1.6063	0.0006	1.6070	0.01327	12.932	61.34	-1.8113	-0.04663	1.7647
	VS18_SS5_008	30/11/2011 16:27	1.6266	0.0020	1.6286	0.01341	12.931	60.84	-1.8004	-0.04663	1.7537
	VS18_SS5_009	30/11/2011 16:47	1.6426	0.0004	1.6431	0.01350	12.930	61.71	-1.8189	-0.04663	1.7723
	VS18_SS5_010	30/11/2011 17:07	1.6382	0.0010	1.6393	0.01303	12.930	60.50	-1.7919	-0.04663	1.7452
	VS18_SS5_011	30/11/2011 17:27	1.6553	-0.0007	1.6545	0.01296	12.932	61.16	-1.8074	-0.04663	1.7608
	VS18_SS5_012	30/11/2011 17:48	1.6414	0.0016	1.6429	0.01381	12.931	61.92	-1.8240	-0.04663	1.7773
	VS18_SS5_013	30/11/2011 18:08	1.6210	0.0019	1.6229	0.01431	12.931	61.93	-1.8223	-0.04663	1.7757
REPEAT of _013	VS18_SS5_014	30/11/2011 18:28	1.6427	0.0002	1.6429	0.01298	12.931	61.54	-1.8126	-0.04663	1.7660
					1.627						
					0.016						
Merged Spectrum VS18_ss5					1.627		12.93044	61.48229	-1.812988	-0.04663	1.7664

From ITTC57

Test Name	Ship Speed [m/s]	Ship Speed [kts]	QS [kNm]	TS [kN]	NS [rpm]	PD [kW]
CALM_18KTS_001	9.269	18.02	842.4	958.9	118.4	10452.2
CALM_18KTS_002	9.247	17.97	836.7	952.5	118.0	10345.2
CALM_18KTS_003	9.254	17.99	838.7	954.7	118.2	10382.0
CALM_18KTS_005	9.256	17.99	839.1	955.2	118.2	10389.2
	9.256	17.99	839.2	955.3	118.2	10392.1
0.5%	0.009	0.02	2.4	2.7	0.2	44.4

Interpolated Calm Water

Test Name	N [1/s]	T [N]	Q [Nm]	NAW [1/s]	TAW [N]	QAW [Nm]	Ship Speed [m/s]	Ship Speed [kts]	NAWS [rpm]	TAWS [kN]	QAWS [kNm]	PDAWS [kW]	PDWS [kW]
VS18_SS5_001	12.3816	54.6877	1.5810	0.547	5.55	0.1560	8.903	17.31	6.019	149.27	124.55	2025.09	10920.5
VS18_SS5_002	12.3761	54.6395	1.5796	0.553	5.64	0.1683	8.899	17.30	6.094	151.66	134.34	2152.57	11034.7
VS18_SS5_003	12.1047	52.3080	1.5123	0.825	10.27	0.2797	8.721	16.95	9.088	276.18	223.34	3470.69	11729.5
VS18_SS5_004	12.2583	53.6145	1.5501	0.672	8.59	0.2302	8.822	17.15	7.395	230.91	183.80	2860.96	11464.3
VS18_SS5_005	12.2462	53.5103	1.5471	0.684	7.35	0.2073	8.814	17.13	7.529	197.76	165.53	2643.01	11218.4
VS18_SS5_006	12.2177	53.2658	1.5400	0.713	8.36	0.2307	8.795	17.10	7.848	224.86	184.17	2897.53	11407.7
VS18_SS5_007	12.1582	52.7593	1.5254	0.774	8.58	0.2393	8.756	17.02	8.521	230.72	191.05	3030.18	11406.7
VS18_SS5_008	12.3373	54.2993	1.5698	0.593	6.54	0.1839	8.874	17.25	6.533	175.92	146.86	2340.21	11128.9
VS18_SS5_009	12.4585	55.3686	1.6005	0.472	6.34	0.1718	8.953	17.40	5.196	170.63	137.16	2121.32	11206.4
VS18_SS5_010	12.4267	55.0857	1.5924	0.504	5.42	0.1529	8.932	17.36	5.546	145.65	122.05	1959.63	10965.5
VS18_SS5_011	12.5548	56.2339	1.6252	0.377	4.92	0.1356	9.015	17.52	4.151	132.43	108.26	1683.26	11014.4
VS18_SS5_012	12.4575	55.3593	1.6002	0.473	6.56	0.1771	8.952	17.40	5.210	176.44	141.40	2175.13	11257.6
VS18_SS5_013	12.2905	53.8926	1.5581	0.640	8.04	0.2175	8.843	17.19	7.053	216.19	173.70	2711.37	11389.6
VS18_SS5_014	12.4569	55.3535	1.6001	0.474	6.18	0.1660	8.952	17.40	5.216	166.32	132.50	2065.06	11145.9
						Average		17.24	6.629	190.66	156.63	2467.00	11241.9
						St Dev		0.17	1.436	42.70	33.25	511.73	233.3
VS18_ss5	12.3280	54.2180	1.5675	0.602	7.26	0.1989	8.868	17.24	6.634	195.36	158.80	2495.96	11262.5

Comment: Added Power Analysis for Seakeeping Tests

Baseline Calm Water Runs

	Test Name	Acquisition Time	Carriage Speed (m/s)	Surge Speed (m/s)	Model Speed (m/s)	Encounter probe (m)	Shaft Speed (rps)	Dyno Thrust (N)	Dyno Torque (Nm)		Friction Torque [Nm]	Torque Corr [Nm]
	CALM_18KTS_003	30/11/2011 18:49	1.6975	0.0009	1.6984	0.01007	12.932	59.91	-1.7786		-0.04663	1.7319
	CALM_18KTS_005	30/11/2011 19:38	1.6974	0.0013	1.6987	0.00632	12.929	59.73	-1.7742		-0.04663	1.7276
	CALM_18KTS_006	30/11/2011 21:50	1.6975	0.0006	1.6981	0.01167	12.932	59.69	-1.7703		-0.04663	1.7237
	CALM_18KTS_007	30/11/2011 22:04	1.6974	0.0021	1.6995	0.00698	12.931	59.87	-1.7732		-0.04663	1.7266
		Average			1.6987		12.931	59.80				1.7274
		St Dev			0.0006		0.001	0.11	0.2%			0.0034
					1.591		12.0246	51.63896				1.492885

	Test Name	Acquisition Time	Carriage Speed (m/s)	Surge Speed (m/s)	Model Speed (m/s)	Encounter probe (m)	Shaft Speed (rps)	Dyno Thrust (N)	Dyno Torque (Nm)		Friction Torque [Nm]	Torque Corr [Nm]
	VS18_SS5H_001	30/11/2011 19:54	1.6015	-0.0018	1.5997	0.01343	12.932	61.25	-1.8081		-0.04663	1.7615
	VS18_SS5H_002	30/11/2011 20:13	1.6053	-0.0012	1.6040	0.01322	12.931	61.75	-1.8174		-0.04663	1.7708
	VS18_SS5H_003	30/11/2011 20:32	1.6005	-0.0044	1.5960	0.01314	12.931	62.32	-1.8306		-0.04663	1.7840
	VS18_SS5H_004	30/11/2011 20:52	1.5728	-0.0001	1.5727	0.01289	12.931	62.09	-1.8234		-0.04663	1.7768
	VS18_SS5H_005	30/11/2011 21:11	1.5822	-0.0008	1.5813	0.01308	12.931	61.80	-1.8172		-0.04663	1.7706
REPEAT of _001	VS18_SS5H_006	30/11/2011 21:30	1.5973	-0.0025	1.5948	0.01357	12.931	61.20	-1.8045		-0.04663	1.7579
					1.591							
					0.013							
Merged Spectrum												
VS18_SS5H					1.591		12.93136	62.10539	-1.82403		-0.04663	1.7774

From ITTC57

Test Name	Ship Speed [m/s]	Ship Speed [kts]	QS [kNm]	TS [kN]	NS [rpm]	PD [kW]
CALM_18KTS_003	9.254	17.99	838.7	954.7	118.2	10382.0
CALM_18KTS_005	9.256	17.99	839.1	955.2	118.2	10389.2
CALM_18KTS_006	9.253	17.99	838.3	954.3	118.2	10374.6
CALM_18KTS_007	9.260	18.00	840.2	956.4	118.3	10410.6
	9.256	17.99	839.1	955.1	118.2	10389.1
0.2%	0.003	0.01	0.8	0.9	0.1	15.5
	8.668	16.85	710.1	806.1	109.2	8087.0

Interpolated Calm Water

Test Name	N [1/s]	T [N]	Q [Nm]	NAW [1/s]	TAW [N]	QAW [Nm]	Ship Speed [m/s]	Ship Speed [kts]	NAWS [rpm]	TAWS [kN]	QAWS [kNm]	PDAWS [kW]	PDWS [kW]
VS18_SS5H_001	12.0984	52.2548	1.5108	0.834	8.99	0.2507	8.717	16.94	9.181	241.78	200.16	3188.50	11433.6
VS18_SS5H_002	12.1339	52.5538	1.5194	0.797	9.20	0.2513	8.740	16.99	8.774	247.42	200.68	3167.09	11489.8
VS18_SS5H_003	12.0681	52.0012	1.5034	0.863	10.32	0.2806	8.696	16.90	9.505	277.61	224.03	3507.71	11687.4
VS18_SS5H_004	11.8765	50.4229	1.4575	1.054	11.67	0.3193	8.569	16.66	11.609	313.84	254.94	4030.42	11812.6
VS18_SS5H_005	11.9471	50.9993	1.4743	0.984	10.80	0.2963	8.616	16.75	10.838	290.38	236.56	3751.66	11677.2
VS18_SS5H_006	12.0580	51.9166	1.5010	0.873	9.29	0.2569	8.690	16.89	9.609	249.72	205.13	3278.51	11436.5
						Average		16.85	9.981	274.21	223.27	3529.08	11620.1
						St Dev		0.14	1.195	30.05	23.58	370.26	155.4
VS18_SS5H	12.0246	51.6390	1.4929	0.907	10.47	0.2845	8.668	16.85	9.985	281.48	227.17	3578.81	11665.8

Comment	Added Power Analysis for Seakeeping Tests										
	Baseline Calm Water Runs										
	Test Name	Acquisition Time	Carriage Speed (m/s)	Surge Speed (m/s)	Model Speed (m/s)	Encounter probe (m)	Shaft Speed (rps)	Dyno Thrust (N)	Dyno Torque (Nm)	Friction Torque [Nm]	Torque Corr [Nm]
	CALM_15KTS_006	01/12/2011 15:17	1.4149	0.0010	1.4159	0.00472	10.626	40.41	-1.2499	-0.05945	1.1904
	CALM_15KTS_007	01/12/2011 16:22	1.4150	0.0038	1.4188	0.00417	10.612	41.43	-1.2471	-0.05941	1.1877
	CALM_15KTS_008	01/12/2011 20:06	1.4149	0.0007	1.4156	0.00607	10.629	40.48	-1.2219	-0.05946	1.1625
	CALM_15KTS_009	01/12/2011 20:21	1.4150	0.0012	1.4162	0.00399	10.628	41.36	-1.2371	-0.05946	1.1776
		Average			1.4166		10.624	40.92			1.1796
		St Dev			0.0015		0.008	0.55	1.3%		0.0126
					1.285		9.615257	33.56358			0.965136
	Test Name	Acquisition Time	Carriage Speed (m/s)	Surge Speed (m/s)	Model Speed (m/s)	Encounter probe (m)	Shaft Speed (rps)	Dyno Thrust (N)	Dyno Torque (Nm)	Friction Torque [Nm]	Torque Corr [Nm]
	VS15_SS5H_001	01/12/2011 15:32	1.2770	0.0009	1.2779	0.01088	10.627	42.23	-1.2705	-0.05946	1.2110
	VS15_SS5H_002	01/12/2011 16:38	1.3263	-0.0041	1.3222	0.01101	10.630	41.37	-1.2451	-0.05947	1.1856
	VS15_SS5H_003	01/12/2011 16:57	1.2734	-0.0018	1.2716	0.01063	10.628	42.49	-1.2686	-0.05946	1.2092
	VS15_SS5H_004	01/12/2011 17:17	1.2658	0.0017	1.2675	0.01124	10.629	43.22	-1.2700	-0.05946	1.2106
Repeat of _001	VS15_SS5H_005	01/12/2011 17:37	1.2649	0.0019	1.2667	0.01129	10.629	42.61	-1.2729	-0.05946	1.2135
					1.285						
					0.023						
Merged Spectrum											
VS15_ss5h_r1					1.285		10.62845	42.73303	-1.272167	-0.05946	1.2127

From ITTC57

Test Name							Ship Speed [m/s]	Ship Speed [kts]	QS [kNm]	TS [kN]	NS [rpm]	PD [kW]	
CALM_15KTS_006							7.715	15.00	550.7	616.2	96.3	5557.1	
CALM_15KTS_007							7.731	15.03	553.2	619.2	96.5	5596.5	
CALM_15KTS_008							7.713	14.99	550.4	615.9	96.3	5552.1	
CALM_15KTS_009							7.717	15.00	551.0	616.5	96.3	5560.8	
0													
0							7.719	15.00	551.3	617.0	96.4	5566.6	
0	1.1%						0.008	0.02	1.3	1.5	0.1	20.2	
0							7.001	13.61	441.2	491.7	86.4	3974.7	
0	Interpolated Calm Water												

Test Name	N [1/s]	T [N]	Q [Nm]	NAW [1/s]	TAW [N]	QAW [Nm]	Ship Speed [m/s]	Ship Speed [kts]	NAWS [rpm]	TAWS [kN]	QAWS [kNm]	PDAWS [kW]	PDWS [kW]
VS15_SS5H_001	9.5633	33.2110	0.9549	1.064	9.02	0.2562	6.963	13.54	11.712	242.58	204.52	2625.14	6528.8
VS15_SS5H_002	9.8993	35.5275	1.0223	0.731	5.84	0.1633	7.204	14.00	8.044	157.09	130.38	1725.35	6106.3
VS15_SS5H_003	9.5158	32.8901	0.9455	1.112	9.60	0.2637	6.929	13.47	12.244	258.05	210.52	2705.66	6545.1
VS15_SS5H_004	9.4847	32.6808	0.9394	1.144	10.54	0.2711	6.906	13.42	12.598	283.52	216.49	2779.45	6577.3
VS15_SS5H_005	9.4792	32.6444	0.9384	1.149	9.97	0.2751	6.902	13.42	12.656	268.10	219.65	2813.74	6604.4
						Average		13.61	11.149	235.31	190.48	2458.90	6439.4
						St Dev		0.27	2.102	54.81	40.36	493.08	222.9
VS15_ss5h_r1	9.6153	33.5636	0.9651	1.013	9.17	0.2476	7.001	13.61	11.157	246.60	197.67	2535.32	6510.0

Comment: Added Power Analysis for Seakeeping Tests

Baseline Calm Water Runs

Test Name	Acquisition Time	Carriage Speed (m/s)	Surge Speed (m/s)	Model Speed (m/s)	Encounter probe (m)	Shaft Speed (rps)	Dyno Thrust (N)	Dyno Torque (Nm)	Friction Torque [Nm]	Torque Corr [Nm]
CALM_15KTS_006	01/12/2011 15:17	1.4149	0.0010	1.4159	0.00472	10.626	40.41	-1.2499	-0.05945	1.1904
CALM_15KTS_007	01/12/2011 16:22	1.4150	0.0038	1.4188	0.00417	10.612	41.43	-1.2471	-0.05941	1.1877
CALM_15KTS_008	01/12/2011 20:06	1.4149	0.0007	1.4156	0.00607	10.629	40.48	-1.2219	-0.05946	1.1625
CALM_15KTS_009	01/12/2011 20:21	1.4150	0.0012	1.4162	0.00399	10.628	41.36	-1.2371	-0.05946	1.1776
	Average			1.4166		10.624	40.92			1.1796
	St Dev			0.0015		0.008	0.55	1.3%		0.0126

Test Name	Acquisition Time	Carriage Speed (m/s)	Surge Speed (m/s)	Model Speed (m/s)	Encounter probe (m)	Shaft Speed (rps)	Dyno Thrust (N)	Dyno Torque (Nm)	Friction Torque [Nm]	Torque Corr [Nm]
VS15_SS5H_007	01/12/2011 18:29	1.4208	-0.0034	1.4173	0.01198	11.769	51.69	-1.5244	-0.05973	1.4647
VS15_SS5H_008	01/12/2011 18:48	1.4137	0.0002	1.4138	0.01194	11.769	51.78	-1.5316	-0.05973	1.4719
VS15_SS5H_009	01/12/2011 19:08	1.3983	-0.0033	1.3950	0.01094	11.769	52.36	-1.5367	-0.05973	1.4770
VS15_SS5H_011	01/12/2011 19:46	1.4216	0.0004	1.4220	0.01161	11.752	52.38	-1.5352	-0.05976	1.4754

Merged Spectrum VS15_ss5h_r2				1.4121		11.76846	52.20777	-1.534331	-0.05974	1.4746

From ITTC57

Test Name	Ship Speed [m/s]	Ship Speed [kts]	QS [kNm]	TS [kN]	NS [rpm]	PD [kW]
CALM_15KTS_006	7.715	15.00	550.7	616.2	96.3	5557.1
CALM_15KTS_007	7.731	15.03	553.2	619.2	96.5	5596.5
CALM_15KTS_008	7.713	14.99	550.4	615.9	96.3	5552.1
CALM_15KTS_009	7.717	15.00	551.0	616.5	96.3	5560.8
	7.719	15.00	551.3	617.0	96.4	5566.6
1.1%	0.008	0.02	1.3	1.5	0.1	20.2

Interpolated Calm Water

Test Name	N [1/s]	T [N]	Q [Nm]	NAW [1/s]	TAW [N]	QAW [Nm]	Ship Speed [m/s]	Ship Speed [kts]	NAWS [rpm]	TAWS [kN]	QAWS [kNm]	PDAWS [kW]	PDWS [kW]
VS15_SS5H_007	10.6355	40.8818	1.1779	1.133	10.81	0.2867	7.723	15.01	12.481	290.78	228.93	3332.20	8908.5
VS15_SS5H_008	10.6082	40.6768	1.1720	1.161	11.10	0.2999	7.704	14.97	12.779	298.54	239.45	3466.33	8994.8
VS15_SS5H_009	10.4611	39.5796	1.1401	1.308	12.78	0.3369	7.601	14.78	14.399	343.62	268.97	3877.41	9151.6
VS15_SS5H_011	10.6725	41.1597	1.1860	1.079	11.22	0.2894	7.748	15.06	11.885	301.76	231.09	3321.56	8962.4
						Average		14.96	12.886	308.67	242.11	3499.38	9004.3
						St Dev		0.13	1.075	23.75	18.47	260.49	104.4
VS15_ss5h_r2	10.5942	40.5717	1.1689	1.174	11.64	0.3057	7.694	14.96	12.930	312.93	244.06	3525.92	9029.8

Comment: Added Power Analysis for Seakeeping Tests

Baseline Calm Water Runs

Test Name	Acquisition Time	Carriage Speed (m/s)	Surge Speed (m/s)	Model Speed (m/s)	Encounter probe (m)	Shaft Speed (rps)	Dyno Thrust (N)	Dyno Torque (Nm)	Friction Torque [Nm]	Torque Corr [Nm]
CALM_12KTS_002	01/12/2011 20:37	1.1321	0.0013	1.1335	0.00157	8.497	26.61	-0.8356	-0.05901	0.7766
CALM_12KTS_003	01/12/2011 20:52	1.1327	-0.0007	1.1321	0.00190	8.497	26.60	-0.8155	-0.05901	0.7564
CALM_12KTS_004_avg	01/12/2011 22:29	1.1321	0.0012	1.1333	0.00379	8.498	25.77	-0.7952	-0.05901	0.7362
CALM_12KTS_005	01/12/2011 22:44	1.1321	0.0025	1.1346	0.00251	8.496	26.75	-0.8184	-0.05901	0.7594
	Average			1.1334		8.497	26.43			0.7572
	St Dev			0.0010		0.000	0.45	1.7%		0.0166

	Test Name	Acquisition Time	Carriage Speed (m/s)	Surge Speed (m/s)	Model Speed (m/s)	Encounter probe (m)	Shaft Speed (rps)	Dyno Thrust (N)	Dyno Torque (Nm)	Friction Torque [Nm]	Torque Corr [Nm]
	VS12_SS5H_001	01/12/2011 21:07	1.1332	-0.0008	1.1324	0.01003	9.719	36.32	-1.0830	-0.05788	1.0251
	VS12_SS5H_002	01/12/2011 21:27	1.1443	0.0006	1.1450	0.00987	9.719	36.46	-1.0864	-0.05788	1.0285
	VS12_SS5H_003	01/12/2011 21:47	1.1373	0.0001	1.1375	0.00982	9.720	36.47	-1.0814	-0.05788	1.0236
Repeat of _001	VS12_SS5H_004	01/12/2011 22:08	1.1343	0.0003	1.1345	0.00964	9.719	36.63	-1.0873	-0.05788	1.0294

Merged Spectrum VS12_ss5h					1.1383		9.719185	36.48165	-1.085426	-0.05788	1.0275

From ITTC57

Test Name	Ship Speed [m/s]	Ship Speed [kts]	QS [kNm]	TS [kN]	NS [rpm]	PD [kW]
CALM_12KTS_002	6.176	12.01	334.5	373.8	75.3	2654.7
CALM_12KTS_003	6.168	11.99	333.6	372.9	75.2	2644.7
CALM_12KTS_004	6.175	12.00	334.4	373.7	75.3	2653.6
CALM_12KTS_005	6.182	12.02	335.2	374.6	75.4	2662.9
	6.175	12.00	334.4	373.8	75.3	2654.0
2.2%	0.006	0.01	0.6	0.7	0.1	7.5

Interpolated Calm Water

Test Name	N [1/s]	T [N]	Q [Nm]	NAW [1/s]	TAW [N]	QAW [Nm]	Ship Speed [m/s]	Ship Speed [kts]	NAWS [rpm]	TAWS [kN]	QAWS [kNm]	PDAWS [kW]	PDWS [kW]
VS12_SS5H_001	8.4901	26.3935	0.7559	1.229	9.93	0.2692	6.170	11.99	13.535	267.07	214.93	2470.73	5117.8
VS12_SS5H_002	8.5810	26.9349	0.7718	1.138	9.52	0.2567	6.239	12.13	12.528	256.14	204.98	2350.74	5089.2
VS12_SS5H_003	8.5265	26.6097	0.7623	1.193	9.86	0.2613	6.198	12.05	13.137	265.14	208.63	2401.61	5085.0
VS12_SS5H_004	8.5054	26.4844	0.7586	1.214	10.14	0.2708	6.182	12.02	13.367	272.79	216.20	2478.03	5140.4
						Average		12.05	13.142	265.29	211.18	2425.28	5108.1
						St Dev		0.06	0.440	6.91	5.30	60.46	26.0
VS12_ss5h	8.5325	26.6453	0.7633	1.187	9.84	0.2642	6.202	12.06	13.067	264.53	210.98	2421.43	5110.8

Comment: Added Power Analysis for Seakeeping Tests — Following Seas
Model Speed needs to have sign changed when calculating ship speed

Baseline Calm Water Runs

Test Name	Acquisition Time	Carriage Speed (m/s)	Surge Speed (m/s)	Model Speed (m/s)	Encounter probe (m)	Shaft Speed (rps)	Dyno Thrust (N)	Dyno Torque (Nm)	Friction Torque [Nm]	Torque Corr [Nm]
CALM_H0_15KTS_002	02/12/2011 13:45	-1.4277	-0.0001	-1.4278	0.00612	10.625	40.40	-1.2134	-0.05496	1.1584
CALM_H0_15KTS_003	02/12/2011 14:02	-1.4116	0.0000	-1.4116	0.00548	10.625	41.58	-1.2371	-0.05496	1.1821
CALM_H0_15KTS_004	02/12/2011 18:23	-1.4126	-0.0001	-1.4127	0.00458	10.626	40.67	-1.2184	-0.05496	1.1634
CALM_H0_15KTS_005	02/12/2011 18:36	-1.4069	-0.0001	-1.4069	0.00483	10.626	41.36	-1.2301	-0.05496	1.1752
		Average		-1.4147		10.626	41.00			1.1698
		St Dev		0.0090		0.000	0.56	1.4%		0.0108

	Test Name	Acquisition Time	Carriage Speed (m/s)	Surge Speed (m/s)	Model Speed (m/s)	Encounter probe (m)	Shaft Speed (rps)	Dyno Thrust (N)	Dyno Torque (Nm)	Friction Torque [Nm]	Torque Corr [Nm]
	VS15_H0_SS5_001	02/12/2011 14:16	-1.4210	0.0003	-1.4207	0.00795	10.625	41.16	-1.2293	-0.05496	1.1743
	VS15_H0_SS5_002	02/12/2011 14:37	-1.4246	0.0001	-1.4245	0.00827	10.625	40.31	-1.2071	-0.05496	1.1521
	VS15_H0_SS5_003	02/12/2011 14:57	-1.4225	0.0010	-1.4215	0.01048	10.625	40.25	-1.2084	-0.05496	1.1534
	VS15_H0_SS5_004	02/12/2011 15:17	-1.4319	0.0000	-1.4318	0.00799	10.624	39.76	-1.1976	-0.05495	1.1426
	VS15_H0_SS5_005	02/12/2011 15:36	-1.3917	0.0000	-1.3917	0.00783	10.625	40.54	-1.2147	-0.05496	1.1598
	VS15_H0_SS5_006	02/12/2011 15:56	-1.4167	-0.0015	-1.4182	0.00880	10.625	40.93	-1.2219	-0.05496	1.1669
	VS15_H0_SS5_007	02/12/2011 16:43	-1.4215	0.0020	-1.4195	0.01017	10.625	39.85	-1.1985	-0.05496	1.1436
	VS15_H0_SS5_008	02/12/2011 17:03	-1.4347	-0.0015	-1.4361	0.01110	10.625	40.66	-1.2169	-0.05496	1.1619
	VS15_H0_SS5_009	02/12/2011 17:22	-1.4141	0.0002	-1.4139	0.00997	10.626	40.35	-1.2100	-0.05496	1.1551
	VS15_H0_SS5_010	02/12/2011 17:44	-1.4192	0.0008	-1.4184	0.01000	10.626	40.07	-1.2028	-0.05496	1.1478
REPEAT of _001	VS15_H0_SS5_011	02/12/2011 18:04	-1.4176	-0.0007	-1.4183	0.00659	10.626	40.26	-1.2058	-0.05496	1.1508

Merged Spectrum VS15_H0_ss5					-1.4196		10.62506	40.30115	-1.20341	-0.05496	1.1485

From ITTC57

Test Name	Ship Speed [m/s]	Ship Speed [kts]	QS [kNm]	TS [kN]	NS [rpm]	PD [kW]
CALM_H0_15KTS_002	7.780	15.12	561.1	628.4	97.2	5719.1
CALM_H0_15KTS_003	7.691	14.95	546.9	611.8	96.0	5497.6
CALM_H0_15KTS_004	7.697	14.96	547.8	612.9	96.1	5512.1
CALM_H0_15KTS_005	7.666	14.90	542.8	607.1	95.7	5434.1
	7.709	14.98	549.7	615.0	96.2	5540.7
0.9%	0.049	0.10	7.9	9.2	0.7	123.7

Interpolated Calm Water

Test Name	N [1/s]	T [N]	Q [Nm]	NAW [1/s]	TAW [N]	QAW [Nm]	Ship Speed [m/s]	Ship Speed [kts]	NAWS [rpm]	TAWS [kN]	QAWS [kNm]	PDAWS [kW]	PDWS [kW]
VS15_H0_SS5_001	10.6621	41.0815	1.1837	-0.037	0.08	-0.0094	7.741	15.05	-0.408	2.25	-7.52	-99.50	5523.2
VS15_H0_SS5_002	10.6916	41.3033	1.1902	-0.067	-0.99	-0.0380	7.762	15.09	-0.733	-26.72	-30.37	-348.87	5325.2
VS15_H0_SS5_003	10.6686	41.1302	1.1852	-0.044	-0.88	-0.0317	7.746	15.06	-0.484	-23.74	-25.31	-283.34	5350.7
VS15_H0_SS5_004	10.7495	41.7378	1.2028	-0.125	-1.98	-0.0602	7.802	15.17	-1.381	-53.14	-48.10	-565.81	5208.4
VS15_H0_SS5_005	10.4353	39.3887	1.1346	0.190	1.16	0.0252	7.583	14.74	2.088	31.09	20.13	319.43	5549.9
VS15_H0_SS5_006	10.6427	40.9360	1.1795	-0.018	-0.01	-0.0126	7.728	15.02	-0.195	-0.21	-10.05	-112.65	5476.3
VS15_H0_SS5_007	10.6524	41.0085	1.1816	-0.027	-1.16	-0.0381	7.734	15.03	-0.301	-31.17	-30.38	-323.78	5282.0
VS15_H0_SS5_008	10.7833	41.9908	1.2102	-0.158	-1.33	-0.0483	7.825	15.21	-1.745	-35.89	-38.58	-491.96	5340.2
VS15_H0_SS5_009	10.6087	40.6805	1.1721	0.017	-0.33	-0.0170	7.704	14.98	0.185	-8.85	-13.59	-126.45	5402.9
VS15_H0_SS5_010	10.6439	40.9447	1.1798	-0.018	-0.87	-0.0320	7.728	15.02	-0.199	-23.40	-25.52	-268.89	5322.1
VS15_H0_SS5_011	10.6431	40.9389	1.1796	-0.017	-0.68	-0.0288	7.728	15.02	-0.191	-18.31	-22.97	-242.75	5346.8
						Average		15.04	-0.306	-17.10	-21.12	-231.32	5375.2
						St Dev		0.12	0.973	22.53	18.20	234.99	103.9
VS15_H0_ss5	10.6537	41.0184	1.1819	-0.029	-0.72	-0.0335	7.735	15.04	-0.315	-19.29	-26.71	-287.57	5320.5

APPENDIX J

DATA QUALITY AND REPEATABILITY

VS12_SS5H

	Delta (Repeat-Orig))	Percent Diff	Ratio (repeat/orig)
Mean		3.0%	
SD		10.4%	
Min		-19.4%	
Max		40.6%	

		VS12_SS5H_001					VS12_SS5H_004							
Channel	Units	Min	Max	Mean	SD	RMS	Min	Max	Mean	SD	RMS			
Accel X Triaxial	g	-0.0468	0.0383	0.0024	0.0119	0.0121	-0.0398	0.0412	0.0025	0.0123	0.0125	0.0004	3.1%	1.03159
Accel Y Triaxial	g	0.0014	0.0210	0.0131	0.0027	0.0134	-0.0047	0.0286	0.0121	0.0042	0.0128	-0.0006	-4.6%	0.95525
Accel Z Slam	g	-0.2126	0.2188	-0.0008	0.0613	0.0613	-0.2021	0.2405	0.0000	0.0627	0.0627	0.0014	2.2%	1.02223
Accel Z Slam Vel	m/s	-2.198	2.282	-0.002	0.618	0.618	-2.170	2.239	0.003	0.630	0.630	0.012	2.0%	1.02016
Accel Z Triaxial	g	-0.1403	0.1390	0.0001	0.0438	0.0438	-0.1644	0.1543	-0.0002	0.0457	0.0457	0.0019	4.2%	1.04327
Carriage Speed	m/s	5.794	6.494	6.206	0.161	6.208	5.856	6.546	6.224	0.175	6.227	0.018	0.3%	1.00296
Dyno Thrust	N	815300	1113700	947760	46370	948894	798390	1112900	954750	46333	955874	6980	0.7%	1.00736
Dyno Torque	Nm	-939810	-692250	-815200	32843	815861	-932900	-692320	-807230	33772	807936	-7925	-1.0%	0.99029
Encounter Probe	m	-2.8278	2.6193	0.2628	0.8193	0.8604	-2.7221	3.0739	0.2586	0.8111	0.8513	-0.0091	-1.1%	0.98937
MP Heave	m	-1.0596	0.9687	-0.0016	0.3634	0.3634	-0.9859	0.9907	-0.0020	0.3664	0.3664	0.0030	0.8%	1.00837
MP Heave Accel.	m/s**2	-0.659	0.713	0.014	0.226	0.227	-0.634	0.739	0.015	0.235	0.236	0.009	3.8%	1.03885
MP Heave Velocity	m/s	-0.791	0.860	-0.001	0.273	0.273	-0.785	0.795	0.000	0.280	0.280	0.006	2.3%	1.02330
MP Pitch	deg	-2.262	2.092	-0.028	0.664	0.664	-2.098	2.279	-0.038	0.669	0.670	0.006	0.9%	1.00904
MP Pitch Accel.	deg/sec**2	-1.722	1.583	-0.002	0.411	0.411	-1.831	1.529	-0.002	0.418	0.418	0.007	1.6%	1.01609
MP Pitch Velocity	deg/sec	-1.643	1.653	-0.037	0.502	0.503	-1.942	1.548	-0.036	0.508	0.510	0.007	1.3%	1.01294
MP Roll	deg	-0.579	-0.262	-0.415	0.050	0.418	-0.646	-0.087	-0.384	0.079	0.392	-0.026	-6.5%	0.93718
MP Roll Accel.	deg/sec**2	-0.410	0.448	0.000	0.093	0.093	-0.631	0.594	0.000	0.140	0.140	0.047	40.2%	1.50291
MP Roll Velocity	deg/sec	-0.174	0.172	-0.001	0.056	0.056	-0.262	0.273	-0.001	0.083	0.083	0.027	39.5%	1.49285
MP Surge	m	-0.4383	0.4246	0.0001	0.1452	0.1452	-0.4403	0.4210	0.0013	0.1542	0.1542	0.0089	6.0%	1.06153
MP Surge Accel.	m/s**2	-0.180	0.193	-0.004	0.062	0.062	-0.198	0.177	-0.002	0.062	0.062	0.000	-0.3%	0.99697
MP Surge Velocity	m/s	-0.272	0.273	0.000	0.092	0.092	-0.272	0.292	-0.001	0.095	0.095	0.002	2.6%	1.02611
MP Sway	m	-0.192	0.193	0.000	0.056	0.056	-0.241	0.300	0.000	0.059	0.059	0.004	6.3%	1.06484
MP Sway Accel.	m/s**2	-0.405	0.423	0.012	0.114	0.115	-0.410	0.512	0.011	0.110	0.111	-0.004	-3.7%	0.96387
MP Sway Velocity	m/s	-0.217	0.166	-0.001	0.042	0.042	-0.225	0.211	0.000	0.040	0.040	-0.001	-3.4%	0.96631
MP Yaw	deg	-0.173	0.081	-0.049	0.062	0.079	-0.144	0.140	-0.025	0.060	0.065	-0.014	-19.4%	0.82323
MP Yaw Accel.	deg/sec**2	-0.255	0.173	0.000	0.049	0.049	-0.217	0.191	0.000	0.049	0.049	0.000	-0.7%	0.99278
MP Yaw Velocity	deg/sec	-0.066	0.033	-0.014	0.014	0.020	-0.083	0.043	-0.014	0.019	0.024	0.004	17.4%	1.19075
Model Pitch	deg	-1.891	0.866	-0.031	0.397	0.399	-1.602	0.966	-0.031	0.409	0.410	0.011	2.8%	1.02828
Model Roll	deg	-0.471	0.438	0.158	0.135	0.208	-0.464	0.534	0.116	0.172	0.207	-0.001	-0.3%	0.99678
QUAL Pitch	deg	-2.228	2.231	-0.003	0.684	0.684	-2.086	2.090	-0.001	0.687	0.687	0.004	0.6%	1.00564
QUAL Residual	mm	2.12	21.99	7.80	2.53	8.20	1.77	20.79	7.68	2.44	8.05	-0.15	-1.9%	0.98164
QUAL Roll	deg	-0.429	0.486	-0.078	0.137	0.158	-0.446	0.552	-0.014	0.172	0.172	0.015	8.9%	1.09338
QUAL Ship Speed	knots	11.39	13.91	12.36	0.37	12.36	11.48	14.36	12.38	0.40	12.38	0.02	0.2%	1.00153
QUAL Speed wrt Carriage	m/s	0.002	0.936	0.151	0.112	0.188	0.002	0.851	0.142	0.102	0.175	-0.013	-7.4%	0.92888
QUAL X	m	-31.331	-24.362	-27.307	1.382	27.342	-30.093	-22.990	-26.307	1.542	26.352	-0.990	-3.7%	0.96380
QUAL Y	m	-8.147	-7.898	-8.010	0.042	8.010	-8.217	-7.912	-8.031	0.051	8.031	0.020	0.3%	1.00254
QUAL Yaw	deg	-0.198	0.009	-0.100	0.047	0.110	-0.219	0.020	-0.104	0.048	0.114	0.004	3.6%	1.03664
QUAL Z	m	7.733	9.696	8.758	0.315	8.764	7.741	9.780	8.754	0.317	8.759	-0.004	-0.1%	0.99950

VS12_SS5H

												Delta (Repeat-Orig))	Percent Diff	Ratio (repeat/ orig)
												Mean	3.0%	
												SD	10.4%	
												Min	-19.4%	
												Max	40.6%	
		VS12_SS5H_001					**VS12_SS5H_004**							
Channel	Units	Min	Max	Mean	SD	RMS	Min	Max	Mean	SD	RMS			
Relmo Bow	m	-6.2470	6.4261	0.6951	1.7715	1.9030	-7.1474	6.7978	0.6943	1.8034	1.9324	0.0295	1.5%	1.01548
Relmo Port	m	-5.6871	4.4996	0.3233	1.5220	1.5560	-6.0633	5.5815	0.2375	1.5382	1.5564	0.0005	0.0%	1.00031
Relmo Port Vel DERIV	m/s	-9.662	15.470	0.003	1.866	1.866	-9.201	14.128	0.000	1.889	1.889	0.023	1.2%	1.01216
Relmo Port Vel DIFFT	m/s	-8.079	14.161	0.003	1.812	1.812	-6.744	12.211	-0.001	1.830	1.830	0.019	1.0%	1.01027
Relmo Prop Acoustic	m	-2.0851	1.9025	-0.1728	0.6562	0.6786	-2.8042	2.3084	-0.1941	0.7129	0.7388	0.0603	8.5%	1.08881
Relmo RAS Acoustic	m	-1.5063	1.6831	0.0692	0.4677	0.4727	-1.5075	1.9441	0.0553	0.5400	0.5428	0.0701	13.8%	1.14823
Relmo Stbd	m	-5.4182	4.3180	0.2117	1.5080	1.5228	-5.6942	5.0221	0.1510	1.5036	1.5112	-0.0116	-0.8%	0.99237
Relmo Stbd Vel DERIV	m/s	-10.010	15.110	0.003	1.871	1.871	-8.108	13.825	-0.002	1.847	1.847	-0.024	-1.3%	0.98723
Relmo Stbd Vel DIFFT	m/s	-8.431	13.576	0.004	1.814	1.814	-6.880	11.844	-0.002	1.792	1.792	-0.022	-1.2%	0.98809
Shaft Speed	rps	1.7828	1.7858	1.7838	0.0003	1.7838	1.7828	1.7858	1.7838	0.0003	1.7838	0.0000	0.0%	1.00000
Upstream Wave Probe	m	-2.7178	2.7814	0.0164	1.0595	1.0596	-2.9060	2.8389	0.0206	1.0943	1.0945	0.0349	3.2%	1.03290
X Accel MP1	g	-0.0379	0.0180	-0.0011	0.0076	0.0077	-0.0300	0.0184	-0.0010	0.0076	0.0077	0.0000	0.2%	1.00229
X Rate MP1	deg/s	-0.1745	0.1715	-0.0006	0.0551	0.0551	-0.2659	0.2792	-0.0013	0.0831	0.0832	0.0281	40.6%	1.50930
X Speed	m/s	-0.842	0.936	-0.005	0.182	0.182	-0.851	0.643	0.002	0.167	0.167	-0.016	-9.1%	0.91339
Y Accel MP1	g	-0.0367	0.0515	0.0086	0.0134	0.0159	-0.0413	0.0604	0.0078	0.0133	0.0154	-0.0005	-3.1%	0.96908
Y Rate MP1	deg/s	-1.647	1.654	-0.038	0.506	0.508	-1.964	1.549	-0.036	0.509	0.510	0.002	0.5%	1.00472
Y Speed	m/s	-0.151	0.176	0.000	0.045	0.045	-0.218	0.207	0.000	0.052	0.052	0.007	14.0%	1.15064
Z Accel MP1	g	-1.0672	-0.9269	-0.9986	0.0234	0.9989	-1.0643	-0.9242	-0.9984	0.0240	0.9987	-0.0002	0.0%	0.99977

VS15_H0_SS5

												Delta (Repeat-Orig))	Percent Diff	Ratio (repeat/orig)
												Mean	4.7%	
												SD	26.7%	
												Min	-64.5%	
												Max	165.2%	
		VS15_H0_SS5_001					**VS15_H0_SS5_011**							
Channel	Units	Min	Max	Mean	SD	RMS	Min	Max	Mean	SD	RMS			
Accel X Triaxial	g	-0.0018	0.0042	0.0010	0.0011	0.0015	-0.0033	0.0037	0.0010	0.0012	0.0015	0.0000	2.7%	1.02687
Accel Y Triaxial	g	0.0129	0.0203	0.0159	0.0012	0.0159	0.0128	0.0226	0.0170	0.0014	0.0171	0.0011	7.0%	1.07212
Accel Z Slam	g	-0.0112	0.0087	0.0000	0.0041	0.0041	-0.0102	0.0104	0.0001	0.0040	0.0040	0.0000	-0.5%	0.99490
Accel Z Slam Vel	m/s	-0.109	0.078	-0.001	0.040	0.040	-0.084	0.121	0.000	0.040	0.040	0.001	1.4%	1.01458
Accel Z Triaxial	g	-0.0095	0.0087	0.0001	0.0033	0.0033	-0.0083	0.0104	0.0000	0.0037	0.0037	0.0004	10.7%	1.11289
Carriage Speed	m/s	-7.776	-7.759	-7.768	0.003	7.768	-7.767	-7.738	-7.747	0.003	7.747	-0.021	-0.3%	0.99726
Dyno Thrust	N	1011200	1143100	1074500	23481	1074757	956230	1167700	1047200	28287	1047582	-27175	-2.6%	0.97472
Dyno Torque	Nm	-992400	-841430	-915390	27082	915791	-1017500	-815080	-897590	31579	898145	-17645	-1.9%	0.98073
Encounter Probe	m	-1.8609	2.1573	0.2406	0.7407	0.7788	-0.8567	1.6220	0.2767	0.6029	0.6634	-0.1155	-16.0%	0.85176
MP Heave	m	-0.0944	0.1032	0.0001	0.0502	0.0502	-0.0845	0.0819	0.0006	0.0437	0.0437	-0.0065	-13.9%	0.86970
MP Heave Accel.	m/s**2	-0.031	0.057	0.014	0.016	0.022	-0.030	0.076	0.014	0.018	0.023	0.001	5.5%	1.05641
MP Heave Velocity	m/s	-0.053	0.051	-0.001	0.025	0.025	-0.049	0.056	0.000	0.024	0.024	-0.001	-4.3%	0.95802
MP Pitch	deg	-0.247	0.061	-0.080	0.072	0.108	-0.300	0.132	-0.073	0.083	0.110	0.003	2.7%	1.02727
MP Pitch Accel.	deg/sec**2	-0.208	0.212	0.000	0.061	0.061	-0.208	0.200	-0.001	0.061	0.061	0.000	0.6%	1.00641
MP Pitch Velocity	deg/sec	-0.199	0.085	-0.037	0.059	0.070	-0.161	0.120	-0.034	0.055	0.065	-0.005	-6.8%	0.93408
MP Roll	deg	-0.675	-0.548	-0.615	0.028	0.615	-0.721	-0.554	-0.633	0.032	0.633	0.018	2.9%	1.02951
MP Roll Accel.	deg/sec**2	-0.221	0.276	0.000	0.080	0.080	-0.303	0.227	0.001	0.084	0.084	0.004	4.5%	1.04637
MP Roll Velocity	deg/sec	-0.088	0.105	0.001	0.032	0.032	-0.127	0.095	0.004	0.031	0.031	-0.001	-1.6%	0.98368
MP Surge	m	-0.1304	0.1231	-0.0031	0.0699	0.0700	-0.2124	0.3121	0.0003	0.0973	0.0973	0.0274	32.7%	1.39121
MP Surge Accel.	m/s**2	-0.039	0.028	-0.006	0.015	0.016	-0.042	0.025	-0.006	0.014	0.015	-0.001	-5.0%	0.95152
MP Surge Velocity	m/s	-0.063	0.053	0.000	0.032	0.032	-0.084	0.112	0.003	0.044	0.044	0.012	31.3%	1.37064
MP Sway	m	-0.334	0.278	0.001	0.112	0.112	-0.308	0.318	-0.001	0.135	0.135	0.023	18.7%	1.20680
MP Sway Accel.	m/s**2	-0.476	0.553	0.006	0.152	0.153	-0.474	0.469	0.010	0.144	0.145	-0.008	-5.3%	0.94855
MP Sway Velocity	m/s	-0.260	0.306	0.000	0.099	0.099	-0.227	0.257	0.000	0.090	0.090	-0.009	-9.0%	0.91370
MP Yaw	deg	-0.017	0.016	-0.003	0.008	0.008	-0.115	-0.058	-0.087	0.013	0.088	0.079	165.2%	10.48946
MP Yaw Accel.	deg/sec**2	-0.160	0.152	0.000	0.053	0.053	-0.179	0.162	0.000	0.051	0.051	-0.001	-2.7%	0.97311
MP Yaw Velocity	deg/sec	-0.027	0.006	-0.012	0.006	0.013	-0.034	0.010	-0.012	0.007	0.014	0.000	1.5%	1.01490
Model Pitch	deg	-0.189	0.084	-0.069	0.053	0.087	-0.230	0.055	-0.067	0.052	0.085	-0.002	-2.6%	0.97401
Model Roll	deg	-0.056	0.205	0.060	0.052	0.080	0.026	0.343	0.133	0.055	0.144	0.064	57.5%	1.80633
QUAL Pitch	deg	-0.721	-0.059	-0.369	0.150	0.399	-0.706	-0.118	-0.396	0.135	0.418	0.020	4.8%	1.04924
QUAL Residual	mm	12.86	25.77	19.91	1.90	20.00	12.22	25.48	18.63	2.30	18.77	-1.23	-6.3%	0.93855
QUAL Roll	deg	-0.069	0.286	0.122	0.071	0.141	-0.217	0.162	0.026	0.067	0.072	-0.069	-64.5%	0.51205
QUAL Ship Speed	knots	13.98	15.10	14.82	0.19	14.82	13.84	15.05	14.78	0.18	14.78	-0.05	-0.3%	0.99689
QUAL Speed wrt Carriage	m/s	0.002	0.576	0.143	0.097	0.173	0.005	0.632	0.145	0.094	0.173	0.000	0.1%	1.00131
QUAL X	m	30.708	31.675	31.187	0.211	31.188	34.835	35.731	35.323	0.154	35.323	4.136	12.4%	1.13260
QUAL Y	m	-7.536	-7.420	-7.477	0.022	7.477	-7.583	-7.458	-7.515	0.019	7.515	0.038	0.5%	1.00508
QUAL Yaw	deg	179.810	179.890	179.850	0.014	179.850	179.800	179.870	179.840	0.011	179.840	-0.010	0.0%	0.99994
QUAL Z	m	8.410	8.914	8.638	0.092	8.639	8.326	8.848	8.592	0.085	8.593	-0.046	-0.5%	0.99467

VS15_H0_SS5

												Delta (Repeat-Orig))	Percent Diff	Ratio (repeat/ orig)
												Mean		4.7%	
												SD		26.7%	
												Min		-64.5%	
												Max		165.2%	
		VS15_H0_SS5_001					**VS15_H0_SS5_011**							
Channel	Units	Min	Max	Mean	SD	RMS	Min	Max	Mean	SD	RMS			
Relmo Bow	m	-0.0399	2.7524	0.9074	0.8045	1.2127	-0.4655	2.6066	0.8995	0.7805	1.1909	-0.0218	-1.8%	0.98201
Relmo Port	m	-0.1927	1.2588	0.4675	0.3599	0.5900	-0.3051	1.3665	0.3685	0.3838	0.5320	-0.0579	-10.3%	0.90179
Relmo Port Vel DERIV	m/s	-0.750	0.900	-0.001	0.182	0.182	-0.565	0.927	-0.001	0.179	0.179	-0.002	-1.2%	0.98844
Relmo Port Vel DIFFT	m/s	-0.664	0.788	-0.001	0.158	0.158	-0.498	0.833	-0.001	0.161	0.161	0.004	2.3%	1.02323
Relmo Prop Acoustic	m	-0.6281	0.3455	-0.2218	0.2015	0.2997	-0.6063	0.2053	-0.2121	0.1815	0.2792	-0.0205	-7.1%	0.93152
Relmo RAS Acoustic	m	-0.7997	0.8726	0.0094	0.3909	0.3910	-0.9138	0.8615	-0.0034	0.3716	0.3716	-0.0194	-5.1%	0.95047
Relmo Stbd	m	-0.2136	1.1345	0.3820	0.3189	0.4976	-0.2940	1.4774	0.4672	0.3752	0.5993	0.1017	18.5%	1.20436
Relmo Stbd Vel DERIV	m/s	-0.573	0.879	-0.002	0.157	0.157	-0.681	1.050	-0.001	0.184	0.184	0.028	16.2%	1.17585
Relmo Stbd Vel DIFFT	m/s	-0.520	0.710	-0.002	0.134	0.134	-0.602	0.858	-0.001	0.166	0.166	0.032	21.1%	1.23558
Shaft Speed	rps	1.9486	1.9516	1.9499	0.0006	1.9499	1.9490	1.9516	1.9502	0.0007	1.9502	0.0003	0.0%	1.00015
Upstream Wave Probe	m	-2.3523	3.0058	0.0131	0.8115	0.8116	-2.2542	3.1230	0.0104	0.8349	0.8349	0.0233	2.8%	1.02877
X Accel MP1	g	-0.0040	0.0010	-0.0020	0.0009	0.0022	-0.0051	0.0004	-0.0019	0.0009	0.0021	0.0000	-1.0%	0.98957
X Rate MP1	deg/s	-0.0873	0.1060	0.0010	0.0319	0.0319	-0.1275	0.0955	0.0042	0.0311	0.0314	-0.0006	-1.7%	0.98274
X Speed	m/s	-0.570	0.569	-0.002	0.160	0.160	-0.630	0.559	-0.001	0.151	0.151	-0.010	-6.2%	0.94017
Y Accel MP1	g	-0.0395	0.0694	0.0113	0.0160	0.0196	-0.0372	0.0596	0.0120	0.0150	0.0192	-0.0003	-1.7%	0.98341
Y Rate MP1	deg/s	-0.202	0.087	-0.037	0.059	0.070	-0.163	0.120	-0.034	0.056	0.065	-0.005	-6.8%	0.93393
Y Speed	m/s	-0.210	0.198	0.000	0.064	0.064	-0.292	0.245	-0.001	0.085	0.085	0.021	27.5%	1.31858
Z Accel MP1	g	-1.0031	-0.9937	-0.9985	0.0017	0.9985	-1.0034	-0.9920	-0.9985	0.0018	0.9985	0.0000	0.0%	0.99999

VS15_SS3

												Delta (Repeat-Orig))	Percent Diff	Ratio (repeat/orig)
												Mean	0.0%	
												SD	17.8%	
												Min	-51.3%	
												Max	59.0%	
		VS15_SS3_001					**VS15_SS3_005**							
Channel	Units	Min	Max	Mean	SD	RMS	Min	Max	Mean	SD	RMS			
Accel X Triaxial	g	-0.0044	0.0058	0.0008	0.0017	0.0019	-0.0042	0.0060	0.0009	0.0017	0.0019	0.0000	1.1%	1.01144
Accel Y Triaxial	g	0.0133	0.0198	0.0160	0.0009	0.0160	0.0118	0.0196	0.0157	0.0012	0.0158	-0.0003	-1.6%	0.98429
Accel Z Slam	g	-0.0250	0.0252	-0.0001	0.0084	0.0084	-0.0227	0.0248	-0.0001	0.0087	0.0087	0.0003	3.6%	1.03702
Accel Z Slam Vel	m/s	-0.213	0.216	0.000	0.070	0.070	-0.191	0.207	0.000	0.073	0.073	0.002	3.1%	1.03185
Accel Z Triaxial	g	-0.0218	0.0222	0.0001	0.0063	0.0063	-0.0206	0.0262	0.0002	0.0068	0.0068	0.0005	8.2%	1.08510
Carriage Speed	m/s	7.670	7.861	7.830	0.044	7.830	7.622	7.764	7.714	0.040	7.715	-0.115	-1.5%	0.98526
Dyno Thrust	N	971100	1101500	1038600	19500	1038783	981410	1113200	1047100	19958	1047290	8507	0.8%	1.00819
Dyno Torque	Nm	-970040	-836220	-906080	22589	906362	-971850	-863950	-923960	16514	924108	17746	1.9%	1.01958
Encounter Probe	m	-0.0658	1.0848	0.3346	0.1640	0.3726	-0.1539	1.0335	0.3258	0.1645	0.3649	-0.0077	-2.1%	0.97938
MP Heave	m	-0.0947	0.0943	0.0000	0.0346	0.0346	-0.0931	0.0909	0.0000	0.0364	0.0364	0.0018	5.1%	1.05273
MP Heave Accel.	m/s**2	-0.087	0.121	0.014	0.040	0.043	-0.093	0.119	0.014	0.042	0.044	0.002	3.9%	1.04004
MP Heave Velocity	m/s	-0.094	0.105	0.000	0.036	0.036	-0.092	0.100	0.000	0.038	0.038	0.002	4.7%	1.04802
MP Pitch	deg	-0.227	0.075	-0.058	0.049	0.076	-0.193	0.075	-0.055	0.048	0.073	-0.003	-4.4%	0.95738
MP Pitch Accel.	deg/sec**2	-0.290	0.283	0.000	0.083	0.083	-0.319	0.271	0.000	0.089	0.089	0.006	6.5%	1.06690
MP Pitch Velocity	deg/sec	-0.174	0.118	-0.035	0.051	0.062	-0.172	0.113	-0.036	0.051	0.062	0.001	1.4%	1.01387
MP Roll	deg	-0.503	-0.388	-0.447	0.018	0.448	-0.515	-0.382	-0.449	0.020	0.450	0.002	0.4%	1.00435
MP Roll Accel.	deg/sec**2	-0.243	0.299	0.000	0.071	0.071	-0.273	0.313	0.000	0.078	0.078	0.006	8.2%	1.08602
MP Roll Velocity	deg/sec	-0.071	0.062	-0.001	0.020	0.020	-0.081	0.069	-0.001	0.024	0.024	0.004	16.4%	1.17823
MP Surge	m	-0.1293	0.1490	-0.0005	0.0252	0.0252	-0.1195	0.0883	-0.0008	0.0241	0.0241	-0.0011	-4.4%	0.95657
MP Surge Accel.	m/s**2	-0.032	0.016	-0.010	0.007	0.012	-0.035	0.012	-0.009	0.007	0.012	0.000	-2.4%	0.97585
MP Surge Velocity	m/s	-0.056	0.080	0.000	0.013	0.013	-0.057	0.045	0.000	0.011	0.011	-0.002	-15.2%	0.85910
MP Sway	m	-0.294	0.259	0.001	0.098	0.098	-0.269	0.159	0.000	0.061	0.061	-0.037	-46.7%	0.62150
MP Sway Accel.	m/s**2	-0.297	0.528	0.045	0.118	0.126	-0.506	0.503	0.036	0.140	0.145	0.019	13.8%	1.14835
MP Sway Velocity	m/s	-0.192	0.234	0.001	0.067	0.067	-0.202	0.156	0.000	0.045	0.045	-0.023	-40.4%	0.66362
MP Yaw	deg	-0.097	0.115	0.031	0.052	0.061	-0.133	0.085	-0.048	0.057	0.075	0.014	20.4%	1.22686
MP Yaw Accel.	deg/sec**2	-0.199	0.221	0.000	0.055	0.055	-0.246	0.201	0.000	0.064	0.064	0.009	15.1%	1.16382
MP Yaw Velocity	deg/sec	-0.036	0.015	-0.012	0.007	0.014	-0.041	0.014	-0.012	0.008	0.015	0.001	7.1%	1.07350
Model Pitch	deg	-0.277	0.096	-0.078	0.063	0.101	-0.251	0.096	-0.075	0.062	0.097	-0.003	-3.3%	0.96712
Model Roll	deg	0.225	0.432	0.333	0.035	0.334	0.130	0.464	0.312	0.057	0.317	-0.018	-5.5%	0.94692
QUAL Pitch	deg	-0.217	0.131	-0.050	0.059	0.077	-0.215	0.100	-0.060	0.052	0.079	0.002	3.0%	1.03004
QUAL Residual	mm	3.76	22.43	12.12	3.64	12.65	1.55	17.32	7.88	2.54	8.27	-4.38	-41.8%	0.65394
QUAL Roll	deg	-0.377	-0.152	-0.268	0.038	0.271	-0.351	-0.057	-0.244	0.059	0.250	-0.020	-7.7%	0.92581
QUAL Ship Speed	knots	14.94	16.81	15.51	0.29	15.52	14.85	16.18	15.21	0.17	15.21	-0.31	-2.0%	0.98010
QUAL Speed wrt Carriage	m/s	0.002	0.797	0.151	0.145	0.209	0.001	0.566	0.108	0.077	0.133	-0.076	-44.3%	0.63755
QUAL X	m	-30.712	-26.747	-28.839	1.011	28.857	-25.048	-22.852	-23.600	0.554	23.607	-5.250	-20.0%	0.81806
QUAL Y	m	-7.971	-7.856	-7.904	0.022	7.904	-8.014	-7.879	-7.950	0.027	7.950	0.046	0.6%	1.00580
QUAL Yaw	deg	-0.207	0.002	-0.070	0.043	0.082	-0.210	-0.018	-0.143	0.047	0.150	0.068	59.0%	1.83678
QUAL Z	m	8.503	9.030	8.769	0.097	8.770	8.564	8.890	8.735	0.043	8.735	-0.034	-0.4%	0.99609

VS15_SS3

												Delta (Repeat-Orig))	Percent Diff	Ratio (repeat/ orig)
												Mean		0.0%	
												SD		17.8%	
												Min		-51.3%	
												Max		59.0%	
		VS15_SS3_001					**VS15_SS3_005**								
Channel	Units	Min	Max	Mean	SD	RMS	Min	Max	Mean	SD	RMS				
Relmo Bow	m	0.5650	1.5795	0.9869	0.1683	1.0011	0.3097	1.6135	0.9600	0.1940	0.9794	-0.0217	-2.2%	0.97830	
Relmo Port	m	-0.4108	1.6946	0.5576	0.3120	0.6389	-0.4244	1.8245	0.5573	0.3338	0.6497	0.0107	1.7%	1.01677	
Relmo Port Vel DERIV	m/s	-4.775	3.105	0.001	0.617	0.617	-5.739	2.973	0.002	0.667	0.667	0.049	7.7%	1.07983	
Relmo Port Vel DIFFT	m/s	-4.430	2.945	0.001	0.597	0.597	-5.340	2.841	0.002	0.647	0.647	0.050	8.1%	1.08430	
Relmo Prop Acoustic	m	-0.4192	0.3587	-0.1167	0.1034	0.1559	-0.6025	0.3298	-0.1359	0.1118	0.1760	0.0201	12.1%	1.12908	
Relmo RAS Acoustic	m	-0.5394	0.4372	-0.0550	0.1485	0.1584	-0.4467	0.6564	0.0154	0.1640	0.1647	0.0063	3.9%	1.04002	
Relmo Stbd	m	-0.2481	1.6079	0.5134	0.2615	0.5761	-0.4197	1.8923	0.5300	0.3123	0.6151	0.0390	6.5%	1.06767	
Relmo Stbd Vel DERIV	m/s	-3.813	3.284	0.001	0.503	0.503	-5.386	3.360	0.001	0.603	0.603	0.100	18.0%	1.19798	
Relmo Stbd Vel DIFFT	m/s	-3.663	3.113	0.001	0.486	0.486	-5.011	3.226	0.001	0.586	0.586	0.100	18.7%	1.20571	
Shaft Speed	rps	1.9488	1.9520	1.9501	0.0006	1.9501	1.9490	1.9518	1.9503	0.0008	1.9503	0.0002	0.0%	1.00010	
Upstream Wave Probe	m	-1.1251	0.8595	0.0112	0.2931	0.2934	-1.0933	0.9959	0.0008	0.2874	0.2874	-0.0060	-2.1%	0.97971	
X Accel MP1	g	-0.0060	0.0019	-0.0020	0.0013	0.0024	-0.0057	0.0018	-0.0019	0.0013	0.0023	-0.0001	-3.3%	0.96712	
X Rate MP1	deg/s	-0.0710	0.0642	-0.0010	0.0206	0.0206	-0.0818	0.0709	-0.0006	0.0243	0.0243	0.0037	16.3%	1.17699	
X Speed	m/s	-0.793	0.782	-0.004	0.202	0.202	-0.566	0.544	0.000	0.119	0.119	-0.082	-51.3%	0.59161	
Y Accel MP1	g	-0.0240	0.0631	0.0124	0.0126	0.0176	-0.0472	0.0702	0.0115	0.0163	0.0199	0.0023	12.2%	1.12959	
Y Rate MP1	deg/s	-0.176	0.120	-0.035	0.051	0.062	-0.172	0.115	-0.036	0.051	0.063	0.001	1.4%	1.01387	
Y Speed	m/s	-0.209	0.214	0.000	0.054	0.054	-0.213	0.222	0.000	0.059	0.059	0.005	9.1%	1.09509	
Z Accel MP1	g	-1.0090	-0.9876	-0.9985	0.0041	0.9985	-1.0095	-0.9878	-0.9985	0.0043	0.9985	0.0000	0.0%	0.99996	

VS15_SS5H

												Delta (Repeat-Orig))	Percent Diff	Ratio (repeat/orig)
												Mean	6.1%	
												SD	14.5%	
												Min	-15.7%	
												Max	67.1%	
		VS15_SS5H_001					**VS15_SS5H_005**							
Channel	Units	Min	Max	Mean	SD	RMS	Min	Max	Mean	SD	RMS			
Accel X Triaxial	g	-0.0362	0.0439	0.0022	0.0133	0.0135	-0.0451	0.0419	0.0021	0.0134	0.0135	0.0001	0.6%	1.00608
Accel Y Triaxial	g	0.0062	0.0234	0.0144	0.0023	0.0146	-0.0037	0.0244	0.0135	0.0037	0.0140	-0.0006	-4.3%	0.95787
Accel Z Slam	g	-0.1982	0.2324	-0.0008	0.0682	0.0682	-0.2133	0.2381	-0.0011	0.0681	0.0681	-0.0001	-0.2%	0.99850
Accel Z Slam Vel	m/s	-2.105	2.254	-0.002	0.684	0.684	-2.262	2.252	-0.005	0.682	0.682	-0.002	-0.3%	0.99728
Accel Z Triaxial	g	-0.1537	0.1358	0.0002	0.0472	0.0472	-0.1687	0.1713	0.0005	0.0487	0.0487	0.0015	3.1%	1.03189
Carriage Speed	m/s	6.552	7.311	6.882	0.219	6.885	6.460	7.103	6.893	0.172	6.895	0.010	0.1%	1.00148
Dyno Thrust	N	988980	1292200	1113600	50937	1114764	979450	1303300	1121600	48655	1122655	7890	0.7%	1.00708
Dyno Torque	Nm	-1082000	-847540	-963290	33838	963884	-1089500	-832080	-954740	39952	955576	-8309	-0.9%	0.99138
Encounter Probe	m	-3.1722	2.6183	0.3045	0.8765	0.9278	-2.4260	3.2537	0.3181	0.8496	0.9072	-0.0206	-2.2%	0.97778
MP Heave	m	-1.2392	1.0885	0.0014	0.3846	0.3846	-1.3446	1.1067	0.0016	0.3879	0.3879	0.0033	0.9%	1.00858
MP Heave Accel.	m/s**2	-0.655	0.919	0.014	0.252	0.253	-0.851	0.964	0.013	0.258	0.258	0.005	2.1%	1.02095
MP Heave Velocity	m/s	-0.980	0.940	-0.001	0.299	0.299	-0.972	1.079	0.001	0.303	0.303	0.003	1.1%	1.01083
MP Pitch	deg	-2.153	2.264	-0.049	0.711	0.712	-2.299	2.230	-0.053	0.700	0.702	-0.010	-1.4%	0.98607
MP Pitch Accel.	deg/sec**2	-1.866	1.407	0.000	0.459	0.459	-1.901	1.588	0.003	0.454	0.454	-0.005	-1.0%	0.98961
MP Pitch Velocity	deg/sec	-1.838	1.555	-0.031	0.552	0.553	-2.043	1.529	-0.035	0.546	0.547	-0.006	-1.0%	0.98975
MP Roll	deg	-0.549	-0.309	-0.444	0.040	0.446	-0.561	-0.243	-0.410	0.057	0.414	-0.032	-7.4%	0.92856
MP Roll Accel.	deg/sec**2	-0.357	0.451	0.000	0.089	0.089	-0.506	0.694	0.000	0.120	0.120	0.031	29.5%	1.34535
MP Roll Velocity	deg/sec	-0.146	0.135	-0.001	0.046	0.046	-0.206	0.166	-0.001	0.068	0.068	0.022	37.9%	1.46780
MP Surge	m	-0.4367	0.4517	0.0014	0.1449	0.1449	-0.4086	0.3880	-0.0010	0.1392	0.1392	-0.0057	-4.0%	0.96044
MP Surge Accel.	m/s**2	-0.181	0.181	-0.004	0.064	0.064	-0.185	0.194	-0.003	0.063	0.063	0.000	-0.6%	0.99355
MP Surge Velocity	m/s	-0.289	0.291	0.001	0.092	0.092	-0.281	0.247	0.001	0.091	0.091	-0.001	-1.3%	0.98720
MP Sway	m	-0.189	0.139	0.000	0.056	0.056	-0.221	0.272	0.000	0.080	0.080	0.024	34.6%	1.41898
MP Sway Accel.	m/s**2	-0.314	0.477	0.026	0.116	0.119	-0.445	0.457	0.028	0.138	0.140	0.022	16.6%	1.18147
MP Sway Velocity	m/s	-0.163	0.151	0.000	0.041	0.041	-0.175	0.300	0.000	0.060	0.060	0.018	36.4%	1.44507
MP Yaw	deg	-0.124	0.089	-0.029	0.047	0.055	-0.111	0.082	-0.029	0.037	0.047	-0.008	-15.7%	0.85409
MP Yaw Accel.	deg/sec**2	-0.161	0.163	0.000	0.048	0.048	-0.178	0.223	0.000	0.050	0.050	0.002	4.4%	1.04550
MP Yaw Velocity	deg/sec	-0.051	0.031	-0.012	0.012	0.017	-0.057	0.036	-0.012	0.014	0.019	0.002	10.6%	1.11176
Model Pitch	deg	-1.493	0.976	-0.049	0.443	0.446	-1.716	1.034	-0.053	0.447	0.450	0.004	0.9%	1.00884
Model Roll	deg	-0.082	0.451	0.234	0.103	0.255	-0.342	0.553	0.224	0.147	0.268	0.012	4.7%	1.04835
QUAL Pitch	deg	-2.223	2.336	-0.031	0.725	0.726	-2.241	2.194	-0.060	0.715	0.717	-0.008	-1.2%	0.98837
QUAL Residual	mm	1.67	19.28	8.39	2.61	8.78	5.60	31.20	17.23	3.81	17.65	8.86	67.1%	2.00898
QUAL Roll	deg	-0.426	0.100	-0.158	0.101	0.187	-0.403	0.367	-0.104	0.143	0.177	-0.010	-5.6%	0.94582
QUAL Ship Speed	knots	12.76	15.54	13.69	0.47	13.69	12.61	16.43	13.77	0.43	13.77	0.08	0.6%	1.00582
QUAL Speed wrt Carriage	m/s	0.002	1.073	0.158	0.118	0.198	0.002	1.431	0.189	0.136	0.233	0.035	16.3%	1.17720
QUAL X	m	-27.021	-19.475	-23.454	2.088	23.547	-29.441	-20.617	-25.000	2.584	25.133	1.586	6.5%	1.06737
QUAL Y	m	-8.056	-7.863	-7.971	0.033	7.971	-8.140	-7.863	-7.985	0.044	7.986	0.015	0.2%	1.00184
QUAL Yaw	deg	-0.213	-0.010	-0.120	0.042	0.127	-0.207	0.011	-0.121	0.041	0.128	0.001	0.7%	1.00730
QUAL Z	m	7.772	9.750	8.711	0.316	8.717	7.677	9.701	8.694	0.327	8.700	-0.017	-0.2%	0.99809

VS15_SS5H

	Delta (Repeat-Orig))	Percent Diff	Ratio (repeat/ orig)
Mean		6.1%	
SD		14.5%	
Min		-15.7%	
Max		67.1%	

		VS15_SS5H_001					**VS15_SS5H_005**							
Channel	Units	Min	Max	Mean	SD	RMS	Min	Max	Mean	SD	RMS			
Relmo Bow	m	-5.8557	6.9574	0.8385	1.9146	2.0902	-6.5648	7.0115	0.8285	1.9013	2.0740	-0.0162	-0.8%	0.99226
Relmo Port	m	-6.9957	4.8059	0.3654	1.7585	1.7961	-6.9258	5.6199	0.3407	1.7870	1.8192	0.0231	1.3%	1.01288
Relmo Port Vel DERIV	m/s	-12.198	15.132	-0.009	2.230	2.230	-9.134	14.117	0.002	2.241	2.241	0.011	0.5%	1.00506
Relmo Port Vel DIFFT	m/s	-11.176	13.557	-0.010	2.155	2.155	-8.731	13.131	0.002	2.175	2.175	0.020	0.9%	1.00941
Relmo Prop Acoustic	m	-1.8661	2.1404	-0.1948	0.6929	0.7197	-3.1831	2.3037	-0.1953	0.7408	0.7661	0.0464	6.3%	1.06452
Relmo RAS Acoustic	m	-1.3072	1.3642	0.1066	0.4725	0.4843	-1.3965	1.7369	0.0847	0.5343	0.5410	0.0566	11.0%	1.11691
Relmo Stbd	m	-6.8660	4.1466	0.3128	1.7117	1.7400	-6.8471	5.0642	0.2447	1.7319	1.7491	0.0091	0.5%	1.00521
Relmo Stbd Vel DERIV	m/s	-11.398	16.673	-0.010	2.183	2.183	-8.923	14.093	0.003	2.167	2.167	-0.016	-0.8%	0.99248
Relmo Stbd Vel DIFFT	m/s	-9.748	14.345	-0.011	2.109	2.109	-8.767	12.775	0.002	2.102	2.102	-0.007	-0.3%	0.99667
Shaft Speed	rps	1.9489	1.9518	1.9504	0.0008	1.9504	1.9492	1.9522	1.9507	0.0008	1.9507	0.0003	0.0%	1.00015
Upstream Wave Probe	m	-2.4901	2.7826	0.0335	1.0581	1.0586	-2.5521	2.7937	0.0445	1.0718	1.0727	0.0141	1.3%	1.01331
X Accel MP1	g	-0.0297	0.0188	-0.0015	0.0084	0.0085	-0.0337	0.0182	-0.0015	0.0083	0.0084	-0.0001	-0.6%	0.99400
X Rate MP1	deg/s	-0.1483	0.1357	-0.0014	0.0464	0.0464	-0.2061	0.1680	-0.0008	0.0680	0.0680	0.0216	37.8%	1.46536
X Speed	m/s	-1.070	0.620	0.004	0.193	0.193	-1.430	1.180	-0.008	0.224	0.224	0.031	15.0%	1.16262
Y Accel MP1	g	-0.0319	0.0593	0.0104	0.0138	0.0173	-0.0415	0.0604	0.0100	0.0158	0.0187	0.0014	8.0%	1.08387
Y Rate MP1	deg/s	-1.840	1.556	-0.031	0.552	0.553	-2.063	1.529	-0.035	0.546	0.547	-0.006	-1.0%	0.98970
Y Speed	m/s	-0.151	0.159	0.000	0.044	0.044	-0.221	0.264	0.000	0.062	0.062	0.019	35.5%	1.43129
Z Accel MP1	g	-1.0673	-0.9055	-0.9986	0.0257	0.9989	-1.0867	-0.9008	-0.9986	0.0263	0.9990	0.0001	0.0%	1.00007

VS18_SS5

	Delta (Repeat-Orig))	Percent Diff	Ratio (repeat/orig)
Mean		7.9%	
SD		7.3%	
Min		-0.8%	
Max		38.9%	

		VS18_SS5_013					VS18_SS5_014							
Channel	Units	Min	Max	Mean	SD	RMS	Min	Max	Mean	SD	RMS			
Accel X Triaxial	g	-0.0343	0.0300	0.0011	0.0121	0.0121	-0.0304	0.0314	0.0011	0.0131	0.0132	0.0010	8.2%	1.08585
Accel Y Triaxial	g	0.0011	0.0233	0.0144	0.0031	0.0147	-0.0049	0.0280	0.0141	0.0036	0.0146	-0.0001	-0.8%	0.99155
Accel Z Slam	g	-0.1624	0.1532	-0.0013	0.0606	0.0606	-0.1426	0.1701	-0.0011	0.0669	0.0669	0.0063	9.8%	1.10345
Accel Z Slam Vel	m/s	-1.653	1.577	-0.002	0.579	0.579	-1.424	1.604	0.004	0.632	0.632	0.053	8.7%	1.09138
Accel Z Triaxial	g	-0.1013	0.1185	0.0003	0.0399	0.0399	-0.1307	0.1044	0.0003	0.0438	0.0438	0.0039	9.2%	1.09665
Carriage Speed	m/s	8.571	9.046	8.829	0.126	8.830	8.633	9.198	8.907	0.139	8.908	0.078	0.9%	1.00883
Dyno Thrust	N	1430300	1762500	1623800	48293	1624518	1482800	1768400	1617600	47478	1618297	-6221	-0.4%	0.99617
Dyno Torque	Nm	-1497800	-1274400	-1388300	33845	1388712	-1502500	-1280900	-1385300	32896	1385691	-3022	-0.2%	0.99782
Encounter Probe	m	-1.7855	2.3274	0.4136	0.6896	0.8041	-2.0750	2.3317	0.3767	0.7192	0.8119	0.0078	1.0%	1.00967
MP Heave	m	-0.7877	0.8549	0.0011	0.2735	0.2735	-0.6569	0.6738	-0.0017	0.2853	0.2853	0.0117	4.2%	1.04293
MP Heave Accel.	m/s**2	-0.621	0.631	0.013	0.223	0.224	-0.525	0.587	0.015	0.241	0.241	0.017	7.5%	1.07788
MP Heave Velocity	m/s	-0.706	0.735	0.000	0.240	0.240	-0.656	0.574	0.001	0.255	0.255	0.015	6.1%	1.06299
MP Pitch	deg	-1.517	1.318	-0.058	0.505	0.508	-1.261	1.288	-0.049	0.529	0.531	0.023	4.4%	1.04516
MP Pitch Accel.	deg/sec**2	-1.264	1.224	0.001	0.404	0.404	-1.329	1.131	-0.001	0.443	0.443	0.039	9.2%	1.09646
MP Pitch Velocity	deg/sec	-1.200	1.204	-0.035	0.437	0.439	-1.219	1.114	-0.039	0.468	0.469	0.031	6.7%	1.06978
MP Roll	deg	-0.605	-0.246	-0.406	0.055	0.410	-0.680	-0.191	-0.430	0.074	0.436	0.027	6.3%	1.06518
MP Roll Accel.	deg/sec**2	-0.435	0.606	0.000	0.120	0.120	-0.729	0.703	0.000	0.128	0.128	0.008	6.4%	1.06594
MP Roll Velocity	deg/sec	-0.195	0.203	0.000	0.062	0.062	-0.293	0.293	-0.002	0.075	0.076	0.013	19.2%	1.21298
MP Surge	m	-0.1742	0.1373	0.0005	0.0607	0.0607	-0.2008	0.1709	-0.0015	0.0717	0.0717	0.0111	16.7%	1.18250
MP Surge Accel.	m/s**2	-0.104	0.080	-0.008	0.037	0.038	-0.115	0.101	-0.012	0.038	0.040	0.002	5.3%	1.05398
MP Surge Velocity	m/s	-0.121	0.115	0.000	0.045	0.045	-0.117	0.148	0.000	0.048	0.048	0.003	6.7%	1.06892
MP Sway	m	-0.368	0.381	0.001	0.137	0.137	-0.527	0.607	0.003	0.184	0.184	0.048	29.7%	1.34918
MP Sway Accel.	m/s**2	-0.652	0.559	0.004	0.155	0.155	-0.507	0.673	0.038	0.154	0.158	0.003	2.1%	1.02136
MP Sway Velocity	m/s	-0.307	0.297	0.000	0.099	0.099	-0.475	0.328	0.000	0.119	0.119	0.019	17.8%	1.19488
MP Yaw	deg	-0.103	0.048	-0.051	0.027	0.057	-0.116	0.106	-0.032	0.048	0.058	0.000	0.5%	1.00494
MP Yaw Accel.	deg/sec**2	-0.155	0.210	0.000	0.050	0.050	-0.184	0.190	0.000	0.052	0.052	0.002	4.1%	1.04140
MP Yaw Velocity	deg/sec	-0.062	0.039	-0.012	0.015	0.019	-0.083	0.056	-0.012	0.017	0.021	0.002	9.3%	1.09770
Model Pitch	deg	-1.307	0.800	-0.086	0.403	0.412	-1.268	0.839	-0.092	0.443	0.452	0.040	9.3%	1.09790
Model Roll	deg	-0.107	0.636	0.265	0.125	0.293	-0.633	0.640	0.249	0.162	0.297	0.004	1.2%	1.01199
QUAL Pitch	deg	-1.493	1.261	-0.095	0.517	0.525	-1.284	1.365	-0.086	0.546	0.553	0.027	5.1%	1.05223
QUAL Residual	mm	9.88	36.26	22.23	4.07	22.60	11.98	39.75	24.94	4.09	25.27	2.67	11.2%	1.11816
QUAL Roll	deg	-0.534	0.185	-0.159	0.130	0.205	-0.476	0.698	-0.142	0.168	0.220	0.015	7.1%	1.07406
QUAL Ship Speed	knots	16.72	18.86	17.43	0.31	17.43	16.97	19.07	17.63	0.34	17.64	0.21	1.2%	1.01185
QUAL Speed wrt Carriage	m/s	0.002	0.690	0.137	0.091	0.164	0.006	0.719	0.165	0.103	0.194	0.030	16.9%	1.18451
QUAL X	m	-29.160	-24.254	-26.979	1.207	27.006	-32.051	-26.898	-28.974	1.029	28.992	1.986	7.1%	1.07355
QUAL Y	m	-8.075	-7.878	-7.974	0.036	7.974	-8.163	-7.814	-7.953	0.051	7.953	-0.021	-0.3%	0.99740
QUAL Yaw	deg	-0.211	-0.005	-0.145	0.029	0.147	-0.253	0.010	-0.150	0.045	0.157	0.009	6.1%	1.06256
QUAL Z	m	8.064	9.329	8.756	0.195	8.758	8.198	9.269	8.760	0.188	8.762	0.004	0.0%	1.00042

VS18_SS5

		VS18_SS5_013					VS18_SS5_014					Delta (Repeat-Orig))	Percent Diff	Ratio (repeat/ orig)
												Mean	7.9%	
												SD	7.3%	
												Min	-0.8%	
												Max	38.9%	
Channel	Units	Min	Max	Mean	SD	RMS	Min	Max	Mean	SD	RMS			
Relmo Bow	m	-3.2909	5.4165	1.1174	1.4350	1.8187	-2.9777	4.5848	1.0911	1.5517	1.8969	0.0782	4.2%	1.04298
Relmo Port	m	-4.8610	5.4992	0.5671	1.7598	1.8489	-4.7617	5.5518	0.5366	1.9851	2.0563	0.2074	10.6%	1.11218
Relmo Port Vel DERIV	m/s	-11.501	16.929	-0.003	2.345	2.345	-12.802	20.491	0.009	2.615	2.615	0.270	10.9%	1.11492
Relmo Port Vel DIFFT	m/s	-10.405	14.144	-0.002	2.253	2.253	-10.906	17.036	0.008	2.528	2.528	0.276	11.5%	1.12239
Relmo Prop Acoustic	m	-2.3399	1.1391	-0.2597	0.5425	0.6014	-1.7466	1.2058	-0.2600	0.5794	0.6351	0.0337	5.4%	1.05595
Relmo RAS Acoustic	m	-1.3351	1.2898	0.0502	0.4248	0.4277	-1.2783	1.9028	0.0416	0.4590	0.4609	0.0332	7.5%	1.07755
Relmo Stbd	m	-4.7657	4.9248	0.1909	1.6988	1.7095	-4.6955	4.7313	0.1598	1.8886	1.8953	0.1859	10.3%	1.10872
Relmo Stbd Vel DERIV	m/s	-9.177	15.398	-0.002	2.261	2.261	-10.940	16.179	0.008	2.483	2.483	0.222	9.4%	1.09816
Relmo Stbd Vel DIFFT	m/s	-8.841	14.057	-0.001	2.178	2.178	-9.592	13.410	0.008	2.402	2.402	0.223	9.8%	1.10252
Shaft Speed	rps	2.3703	2.3743	2.3732	0.0007	2.3732	2.3715	2.3752	2.3731	0.0007	2.3731	-0.0001	0.0%	0.99996
Upstream Wave Probe	m	-2.0434	2.6316	0.0098	0.8590	0.8590	-2.4283	2.4401	0.0364	0.8741	0.8748	0.0158	1.8%	1.01837
X Accel MP1	g	-0.0228	0.0151	-0.0020	0.0075	0.0078	-0.0230	0.0155	-0.0022	0.0083	0.0086	0.0008	9.8%	1.10304
X Rate MP1	deg/s	-0.1984	0.2044	-0.0003	0.0625	0.0625	-0.2949	0.2961	-0.0021	0.0757	0.0757	0.0132	19.1%	1.21164
X Speed	m/s	-0.690	0.531	0.010	0.153	0.154	-0.715	0.642	-0.004	0.174	0.174	0.021	12.7%	1.13573
Y Accel MP1	g	-0.0621	0.0693	0.0075	0.0161	0.0178	-0.0487	0.0792	0.0114	0.0160	0.0196	0.0018	9.7%	1.10247
Y Rate MP1	deg/s	-1.202	1.205	-0.035	0.438	0.439	-1.219	1.127	-0.039	0.468	0.470	0.031	6.7%	1.06955
Y Speed	m/s	-0.200	0.196	0.000	0.058	0.058	-0.322	0.405	0.000	0.086	0.086	0.028	38.9%	1.48230
Z Accel MP1	g	-1.0635	-0.9347	-0.9986	0.0228	0.9989	-1.0535	-0.9393	-0.9984	0.0245	0.9987	-0.0002	0.0%	0.99983

VS18_SS5H

												Delta (Repeat-Orig))	Percent Diff	Ratio (repeat/orig)
												Mean	4.8%	
												SD	12.1%	
												Min	-20.9%	
												Max	44.9%	
		VS18_SS5H_001					**VS18_SS5H_006**							
Channel	Units	Min	Max	Mean	SD	RMS	Min	Max	Mean	SD	RMS			
Accel X Triaxial	g	-0.0469	0.0404	0.0016	0.0148	0.0149	-0.0456	0.0485	0.0017	0.0155	0.0156	0.0007	4.5%	1.04644
Accel Y Triaxial	g	0.0074	0.0211	0.0151	0.0020	0.0152	0.0006	0.0251	0.0148	0.0034	0.0152	-0.0001	-0.5%	0.99465
Accel Z Slam	g	-0.2332	0.2481	-0.0010	0.0773	0.0773	-0.2296	0.2658	-0.0008	0.0786	0.0786	0.0013	1.7%	1.01708
Accel Z Slam Vel	m/s	-2.240	2.553	-0.003	0.764	0.764	-2.291	2.618	-0.001	0.774	0.774	0.010	1.2%	1.01244
Accel Z Triaxial	g	-0.1418	0.1370	0.0003	0.0494	0.0494	-0.1656	0.1587	-0.0001	0.0523	0.0523	0.0028	5.6%	1.05744
Carriage Speed	m/s	8.478	9.024	8.702	0.117	8.703	8.233	8.914	8.655	0.142	8.656	-0.047	-0.5%	0.99464
Dyno Thrust	N	1404900	1882500	1607100	56903	1608107	1433700	1870900	1603500	57298	1604523	-3584	-0.2%	0.99777
Dyno Torque	Nm	-1561700	-1226900	-1380800	39958	1381378	-1558900	-1255300	-1376700	40268	1377289	-4089	-0.3%	0.99704
Encounter Probe	m	-2.5133	3.0501	0.3796	0.7895	0.8760	-2.4331	2.9650	0.3714	0.8519	0.9293	0.0533	5.9%	1.06088
MP Heave	m	-1.3064	1.3845	0.0016	0.3962	0.3962	-1.1658	1.4070	0.0019	0.3857	0.3857	-0.0106	-2.7%	0.97328
MP Heave Accel.	m/s**2	-0.864	0.974	0.014	0.278	0.279	-0.960	0.977	0.012	0.276	0.276	-0.003	-1.0%	0.99036
MP Heave Velocity	m/s	-1.213	1.067	-0.001	0.322	0.322	-1.092	1.167	-0.002	0.315	0.315	-0.007	-2.2%	0.97820
MP Pitch	deg	-2.167	2.238	-0.053	0.709	0.710	-2.154	2.326	-0.057	0.722	0.724	0.013	1.9%	1.01880
MP Pitch Accel.	deg/sec**2	-1.539	1.646	0.002	0.515	0.515	-1.953	1.639	-0.001	0.526	0.526	0.011	2.1%	1.02154
MP Pitch Velocity	deg/sec	-1.904	1.637	-0.032	0.587	0.588	-1.989	1.733	-0.031	0.596	0.597	0.009	1.5%	1.01493
MP Roll	deg	-0.562	-0.257	-0.394	0.050	0.397	-0.600	-0.160	-0.388	0.070	0.394	-0.003	-0.8%	0.99222
MP Roll Accel.	deg/sec**2	-0.275	0.403	0.000	0.095	0.095	-0.364	0.483	0.000	0.132	0.132	0.037	32.4%	1.38702
MP Roll Velocity	deg/sec	-0.118	0.183	-0.001	0.046	0.046	-0.229	0.182	-0.002	0.073	0.073	0.027	44.9%	1.57922
MP Surge	m	-0.3699	0.3510	0.0007	0.1112	0.1112	-0.4054	0.3275	0.0005	0.1048	0.1048	-0.0064	-5.9%	0.94234
MP Surge Accel.	m/s**2	-0.180	0.172	-0.008	0.057	0.057	-0.175	0.197	-0.008	0.055	0.055	-0.002	-3.3%	0.96725
MP Surge Velocity	m/s	-0.226	0.262	0.000	0.076	0.076	-0.259	0.249	0.001	0.072	0.072	-0.004	-6.0%	0.94143
MP Sway	m	-0.428	0.680	-0.001	0.156	0.156	-0.397	0.520	-0.001	0.166	0.166	0.009	5.8%	1.06010
MP Sway Accel.	m/s**2	-1.109	0.617	0.035	0.160	0.164	-0.602	0.524	0.037	0.141	0.145	-0.018	-12.0%	0.88717
MP Sway Velocity	m/s	-0.641	0.305	0.001	0.111	0.111	-0.291	0.381	0.000	0.110	0.110	-0.001	-1.2%	0.98829
MP Yaw	deg	-0.034	0.136	0.060	0.041	0.073	-0.178	0.041	-0.065	0.052	0.084	0.011	14.3%	1.15407
MP Yaw Accel.	deg/sec**2	-0.163	0.162	0.000	0.049	0.049	-0.186	0.168	0.000	0.050	0.050	0.001	2.5%	1.02490
MP Yaw Velocity	deg/sec	-0.053	0.021	-0.012	0.011	0.017	-0.061	0.044	-0.013	0.016	0.020	0.004	20.7%	1.23034
Model Pitch	deg	-1.891	1.010	-0.087	0.491	0.499	-2.021	1.073	-0.088	0.522	0.529	0.030	5.9%	1.06063
Model Roll	deg	-0.045	0.486	0.293	0.077	0.303	-0.172	0.649	0.326	0.136	0.353	0.049	15.1%	1.16281
QUAL Pitch	deg	-2.168	2.166	-0.030	0.719	0.720	-2.085	2.351	-0.042	0.728	0.729	0.009	1.3%	1.01283
QUAL Residual	mm	1.65	23.99	9.07	3.82	9.84	1.22	25.88	8.99	3.23	9.56	-0.29	-3.0%	0.97078
QUAL Roll	deg	-0.384	0.075	-0.209	0.083	0.225	-0.538	0.197	-0.209	0.136	0.250	0.024	10.2%	1.10709
QUAL Ship Speed	knots	16.52	19.45	17.27	0.36	17.27	16.06	19.28	17.20	0.38	17.20	-0.07	-0.4%	0.99609
QUAL Speed wrt Carriage	m/s	0.003	1.281	0.180	0.141	0.229	0.004	1.251	0.192	0.141	0.238	0.010	4.1%	1.04153
QUAL X	m	-40.976	-33.814	-36.720	1.740	36.761	-33.777	-26.655	-29.756	1.929	29.818	-6.943	-20.9%	0.81114
QUAL Y	m	-8.030	-7.854	-7.922	0.030	7.922	-8.053	-7.821	-7.936	0.042	7.936	0.014	0.2%	1.00176
QUAL Yaw	deg	-0.160	0.036	-0.063	0.046	0.078	-0.209	0.007	-0.112	0.046	0.121	0.043	43.1%	1.54996
QUAL Z	m	7.875	9.777	8.827	0.292	8.831	7.876	9.896	8.800	0.283	8.805	-0.027	-0.3%	0.99698

VS18_SS5H

												Delta (Repeat-Orig))	Percent Diff	Ratio (repeat/ orig)
												Mean		4.8%	
												SD		12.1%	
												Min		-20.9%	
												Max		44.9%	
		VS18_SS5H_001					**VS18_SS5H_006**								
Channel	Units	Min	Max	Mean	SD	RMS	Min	Max	Mean	SD	RMS				
Relmo Bow	m	-6.2031	7.2206	1.0861	1.9360	2.2198	-5.8132	7.0571	1.0563	2.0020	2.2636		0.0437	2.0%	1.01970
Relmo Port	m	-5.6619	6.6402	0.5599	2.0680	2.1424	-6.8700	6.1995	0.5462	2.1001	2.1700		0.0275	1.3%	1.01284
Relmo Port Vel DERIV	m/s	-10.842	18.040	0.000	2.554	2.554	-13.090	18.171	-0.005	2.651	2.651		0.097	3.7%	1.03786
Relmo Port Vel DIFFT	m/s	-9.797	14.769	0.000	2.467	2.467	-12.590	16.642	-0.005	2.569	2.569		0.102	4.0%	1.04114
Relmo Prop Acoustic	m	-2.5142	2.1777	-0.2036	0.6527	0.6837	-3.1677	1.8784	-0.2175	0.7311	0.7628		0.0791	10.9%	1.11565
Relmo RAS Acoustic	m	-1.4750	1.4109	-0.1514	0.3896	0.4180	-1.5330	1.2562	-0.1167	0.4622	0.4767		0.0587	13.1%	1.14055
Relmo Stbd	m	-5.6200	5.3796	0.5366	2.0118	2.0821	-6.8755	5.5080	0.3762	2.0983	2.1318		0.0496	2.4%	1.02383
Relmo Stbd Vel DERIV	m/s	-10.239	15.809	0.001	2.452	2.452	-11.705	17.378	-0.008	2.598	2.598		0.146	5.8%	1.05968
Relmo Stbd Vel DIFFT	m/s	-9.338	14.185	0.001	2.374	2.374	-10.588	16.499	-0.008	2.521	2.521		0.147	6.0%	1.06205
Shaft Speed	rps	2.3716	2.3755	2.3734	0.0007	2.3734	2.3718	2.3746	2.3731	0.0007	2.3731		-0.0003	0.0%	0.99987
Upstream Wave Probe	m	-2.5590	3.1580	-0.0019	1.1556	1.1556	-2.4660	2.8084	0.0204	1.1322	1.1324		-0.0232	-2.0%	0.97991
X Accel MP1	g	-0.0323	0.0193	-0.0020	0.0091	0.0093	-0.0352	0.0221	-0.0021	0.0096	0.0099		0.0006	6.1%	1.06344
X Rate MP1	deg/s	-0.1211	0.1856	-0.0010	0.0465	0.0465	-0.2307	0.1849	-0.0018	0.0734	0.0734		0.0269	44.8%	1.57784
X Speed	m/s	-1.279	0.796	-0.009	0.222	0.222	-1.251	0.867	-0.012	0.231	0.231		0.008	3.7%	1.03745
Y Accel MP1	g	-0.1089	0.0711	0.0104	0.0166	0.0196	-0.0560	0.0633	0.0106	0.0147	0.0181		-0.0015	-8.0%	0.92354
Y Rate MP1	deg/s	-1.923	1.647	-0.032	0.587	0.588	-1.998	1.737	-0.031	0.596	0.597		0.009	1.5%	1.01486
Y Speed	m/s	-0.206	0.153	0.000	0.054	0.054	-0.222	0.216	0.000	0.059	0.059		0.006	10.4%	1.10998
Z Accel MP1	g	-1.0880	-0.9006	-0.9985	0.0284	0.9989	-1.0978	-0.8996	-0.9987	0.0281	0.9991		0.0002	0.0%	1.00016