



FLOODSTAND-deliverable:

**Benchmark data on time to capsize.
Part 3: Towing**

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Revision	2.0
Deliverable No.	D4.1c

Date	20 January 2011
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Document identification sheet	
FLOODSTAND	Integrated Flooding Control and Standard for Stability and Crises Management
FP7-RTD- 218532	
Title: Benchmark data on time to capsize	Other report identifications:
Investigating partner(s): SSPA	SSPA Report No.: 4007 4581-3 rev. 2
Author(s): Ingvar Rask	
Reviewed by: Peter Grundevik & Björn Allenström	
<input type="checkbox"/> Outline <input checked="" type="checkbox"/> Draft <input type="checkbox"/> Final Version number: 2.0 Revision date: 20 January 2011 Next version due: Number of pages: 122	<input type="checkbox"/> A deliverable <input checked="" type="checkbox"/> Part of a deliverable <input type="checkbox"/> Cover document for a part of a deliverable <input type="checkbox"/> Deliverable cover document <input type="checkbox"/> Other Deliverable number: D4.1c Work Package: WP4 Deliverable due at month: 12
Accessibility: <input checked="" type="checkbox"/> Public <input type="checkbox"/> Restricted <input type="checkbox"/> Confidential (consortium only) <input type="checkbox"/> Internal (accessibility defined for the final version)	Available from: SSPA Sweden AB Distributed to: Disclosees when restricted: Comments: This deliverable, D4.1c, presents the third and last part of results obtained in model tests at SSPA in Task 4.1. The first and the second part of results are given in 4.1a and 4.1b respectively.
Abstract: A set of physical model experiments aiming at characterizing stochastic process of the time it takes for the vessel to capsize/sink after a hull breach event has been carried out at SSPA Sweden AB in the Maritime Dynamics Laboratory. A RoPax vessel model in scale 1:40 was used. A two compartment damage was modelled and a series of tests at stationary and at 1 and 2 knots towing speed in head-on waves was performed.	

EXECUTIVE SUMMARY

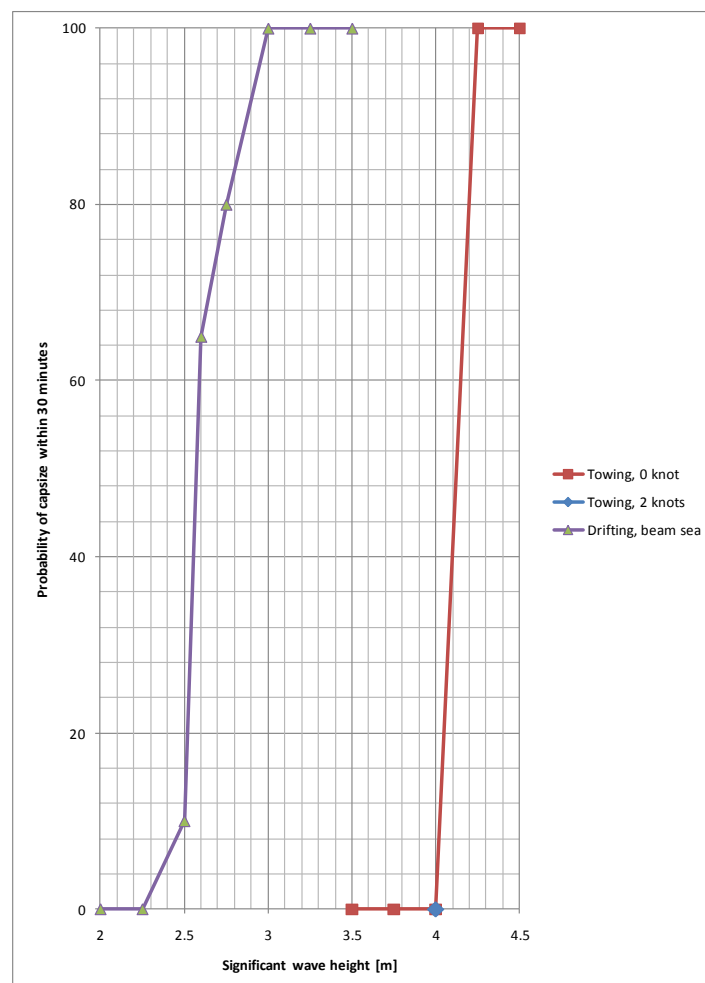
A set of physical model experiments aiming at characterising stochastic process of the time it takes for the vessel to capsize/sink after a hull breach event has been carried out at SSPA Sweden AB in the Maritime Dynamics Laboratory. A RoPax vessel model in scale 1:40 was used. A two compartment damage was modelled.

A series of tests at stationary and at 2 knots towing speed in head-on waves was performed. A total of 32 tests were performed.

In previous tests (83 tests) the model was free drifting in beam waves for a maximum of 30 minutes. The results are given in SSPA Report no. 40094581-1 (Deliverable D4.1a).

Aiming at getting more information about the time to capsize, up to 3 hours, for the lower wave heights, 2 m and below, a second set of tests (6 tests) were carried out. In those tests the model was kept in position by means of a soft mooring system. The results are given in SSPA Report no. 40094581-2 (Deliverable D4.1b).

The probability of capsizing within half an hour as function of significant wave height in free drifting and towing tests is shown in the figure.





REPORT

Date:
2011-01-20

SSPA Report No.:
4007 4581-3

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FLOODSTAND

Integrated flooding and standard for stability and crises management
FP7-RTD- 218532

Benchmark data on time to capsizes

Capsizing tests at SSPA

Part 3: Towing

SSPA Sweden AB

A handwritten signature in blue ink, appearing to read "Peter Grundevik".

Peter Grundevik
*Head of Department
Research*

SSPA Sweden AB

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Björn Allenström
*Project Manager
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Summary

A set of physical model experiments aiming at characterising stochastic process of the time it takes for the vessel to capsize/sink after a hull breach event has been carried out at SSPA Sweden AB in the Maritime Dynamics Laboratory. A RoPax vessel model in scale 1:40 was used. A two compartment damage was modelled and a series of tests at stationary and at 2 knots towing speed in head-on waves was performed. The series of tests comprised repetitions in order to create sufficiently consistent relative frequency distribution of time to capsize. A total of 32 tests were performed.

The probability of capsizing within half an hour as function of significant wave height is shown in the figure.

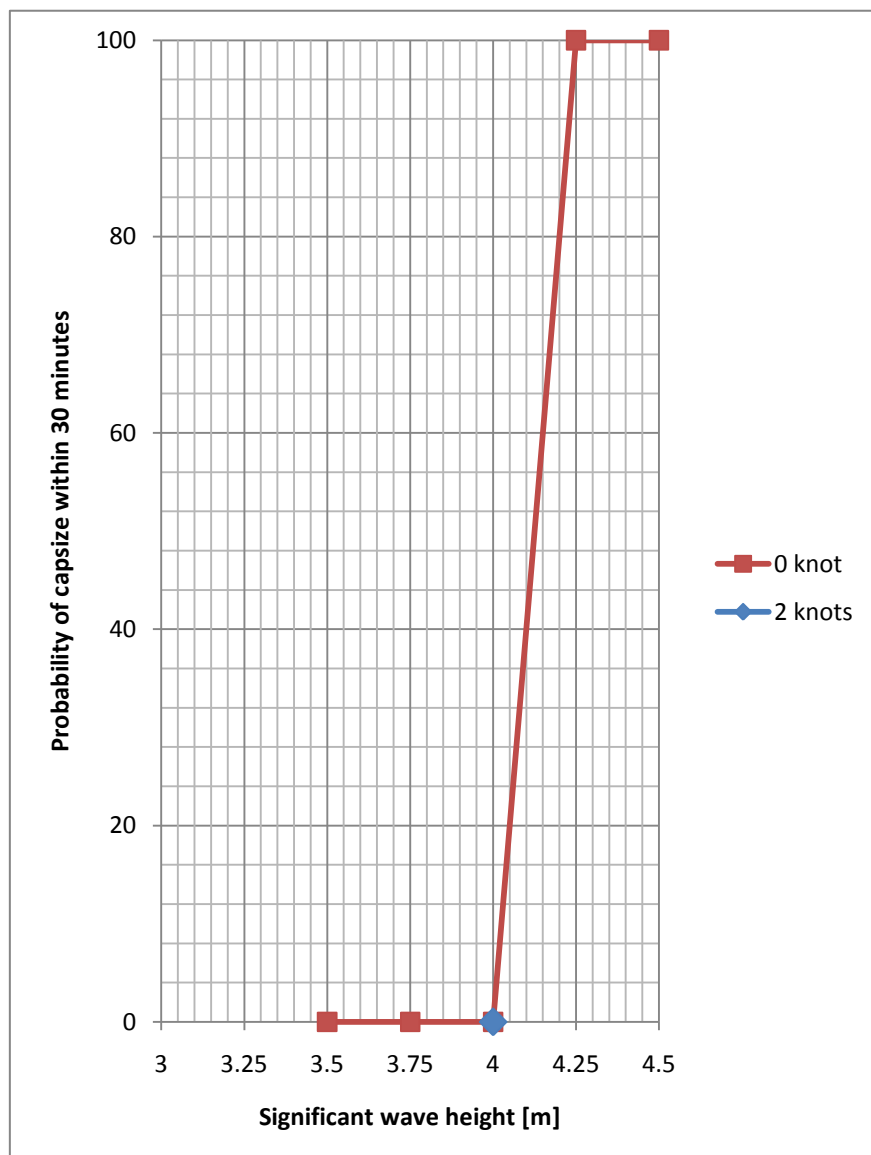


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1 Introduction

A set of physical model experiments aiming at characterising stochastic process of the time it takes for the vessel to capsize/sink after a hull breach event has been carried out at SSPA Sweden AB in the Maritime Dynamics Laboratory. A RoPax vessel model in scale 1:40 was used. A two compartment damage was modelled and a series of tests at stationary and at 2 knots towing speed in head-on waves was performed. The series of tests comprised repetitions in order to create sufficiently consistent relative frequency distribution of time to capsize.

2 Ship data

The tests were carried out with a model of a RoPax vessel. The main data of the ship at the intact loading condition are given in Table 1:

Table 1 Main data of the intact ship

Parameter	Unit	Value	
Length, Lpp	[m]	137.4	
Breadth, moulded	[m]	24.2	
Draft, aft	[m]	5.61	
Draft, forward	[m]	5.17	
Displacement	[m ³]	12 046	
Block coefficient	[-]	0.683	
LCG (fwd of Lpp/2)	[m]	-4.66	
VCG (above BL)	[m]	10.62	
GM _T (measured)	[m]	Intact cond.	Damage cond.
		1.17	1.04
Radii of gyration in air, roll	[m]	8.954 (0.37*B)	
Radii of gyration in air, pitch	[m]	37.1 (0.27*Lbp)	

The SSPA ship model 3191-A was used in the tests. The body plan is shown in Figure 1. The model was manufactured in scale 1:40.

The model was equipped with two fixed rudders, SSPA stock propellers and bilge keels.

Table 2 Main data of the rudders

Parameter	Unit	Value
Area (one rudder), movable	[m ²]	8.75
Area (one rudder), total	[m ²]	10.85
Rudder height	[m]	4.00
% of Lbp · T per rudder	[%]	2.93

Table 3 Main data of the propellers

Parameter	Unit	Value
Diameter (full scale)	[m]	4.18
No of blades, Z	[-]	4
Pitch P/D at 0.7R	[-]	0.806
Blade area ratio	[-]	0.611

The length of the forward bilge keels is 35.2 m (#7.95 to #13.07) and the aft bilge keels 13.6 m (#5.38 to #7.36). The height of the bilge keels is 0.6 m

The design water line was marked on the model as well as marks for every other meter vertical distance.

2.1 The hull damage

Damage was caused to the model according to SOLAS damage opening standard by means of a V-cut in the hull from bottom to top. The depth of the cut is $B/5 = 4.84$ m and the length is $0.03L+3$ m = 7.12 m. The position of the centre of the damage is 37.8 m forward of AP, see Figure 2.

The flooded compartments below the car deck are R511, R512, R519, R521 and R611 as shown in Figure 3. The total gross volume of the flooded compartments is 3 246 m³. The net volume was measured to 2 418 m³. The volume of the intact side tanks on the starboard side R513, R514 and R515 is 16.3, 25.5 and 21.2 m³ respectively.

The trim angle of the damaged ship was measured to 0.45 deg relative to the intact ship and the heel angle was 4.00 deg towards the port.

Photos of the model are shown in Figure 4.

3 Model tests

3.1 Test facility and procedure

The tests were carried out with a free model in the Maritime Dynamics Laboratory (MDL). MDL has a basin with the dimensions 88 m x 39 m and variable water depth between 0 and 3.0 m.

Wave generators for producing regular waves and irregular long-crested waves are installed on two perpendicular sides of the basin. A multi-motion carriage, used for data logging and model control, spans the whole basin.

Measurement signals from the model are transferred to the carriage via a lightweight measuring arm, which does not influence the motions of the model. Control signals from the measuring arm are directly linked to the carriage control computer and data logging system.

3.1.1 Wind force

Wind forces were applied on the model in order to get a realistic pretension in the towing wire. The forces were applied by means of a propeller on the upper deck of the model. For each wave height a wind force was calibrated according to the relation between wind speed and wave height recommended by ITTC (see Fig 5a)

3.1.2 Towage system

The length of the towing wire is 800 m and the weight in air is 10 kg/m corresponding to 8.6 kg/m in water for a steel wire. The selection of these data was based on a discussion with tug boat officers from the towage service company Svitzer. Due to limitation in the model basin a truncated model towing wire system has to be designed. The configuration of the system is shown in Fig 5b. The system was calibrated and compared with the corresponding full scale catenary characteristics. In the working range of the wire the model system agrees well with the full scale system as can be seen in Fig 5c.

3.1.3 Test procedure

A test starts with the model secured to the carriage by means of stretched cords at a position 20 m from the wave generators. The air propeller is started and the model is released. The position of the towing point is adjusted in such a way that the model will be kept in a position within the measuring range of the device for measuring the 6 DOF of the model (the position depends on the actual wind force). When the model is in a stable position the wave generators are started. The different wave components are successively sent away

towards the model; with the shortest waves first, in such a way that the wave spectrum will be fully developed when all wave components reach the position of the model. Shortly before this the data logging system and the carriage (in the cases there is a forward speed) are started.

A test is interrupted when the average heel angle exceeds 20 deg or when the duration of the test exceeds 30 min full scale time.

The model is then secured to the carriage and drained from water. In order to be sure that there is no water left in the model before the next test the trim and heel are checked in a static measurement.

Photos of the test arrangement can be seen in Figure 5d.

3.2 Measurements

The following parameters were measured at a sampling frequency of 50 Hz in model scale corresponding to 7.91 Hz in full scale.

Table 4 Measured parameters

Parameter	Unit
Wave height	m
Wave heading	deg
Tow line force	kN
Surge	m
Sway	m
Heave	m
Roll	deg.
Pitch	deg.
Yaw	deg.
Pull point position	m

A definition of coordinate system is given in Enclosure 1.

Video recordings of all tests were made. Video cameras were positioned at bow and side perspective on the port side.

Photos from some of the tests are shown in Figure 6.

3.3 Capzising tests

The test programme according to the table below was carried out in head sea.

Table 5 Test programme

$H_{1/3}$ [m]	T_p [sec.]	Tow speed [knots]	No. of tests
3.50	7.48	0	1
3.75	7.75	0	1
4.00	8.00	0	10
4.25	8.25	0	10
4.00	8.00	2.00	10

The wave spectra were generated according to the Jonswap formulation with $\gamma = 3.3$.

The waves were calibrated at a fixed position in the basin before the tests. The position was the same as the model's starting position i.e. 20 m from the wave generators.

4 Results

The results of the wave calibration are given in Appendix 01.

In Appendix 02 time series plots of all tests are given. The plotted parameters are Wave height, low pass filtered and unfiltered Roll and Pitch, Surge and Tow force. The low pass filter was a digital filter of the order of 256 with a cut-off frequency of 0.01 Hz.

In Appendix 03 statistical tables of each test are given.

An overview of the capsizing tests is shown in Figure 7.

In Appendix 04 the roll decay test in intact condition is plotted and analysed. The used analysis method is described in Enclosure 2.

The results from the static measuring that preceded each test are given in tables in Appendix 05.

The filename of the video records are given in Appendix 06.

Time series of all tests and static measuring are stored in file folder Timeseries and TimeseriesSM respectively. A specification is given in Appendix 07.

5 Figures, enclosures and appendices

Table of figures

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Figure 2	Hull damage
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Figure 6	Photos from tests
Figure 7	Summary of test results

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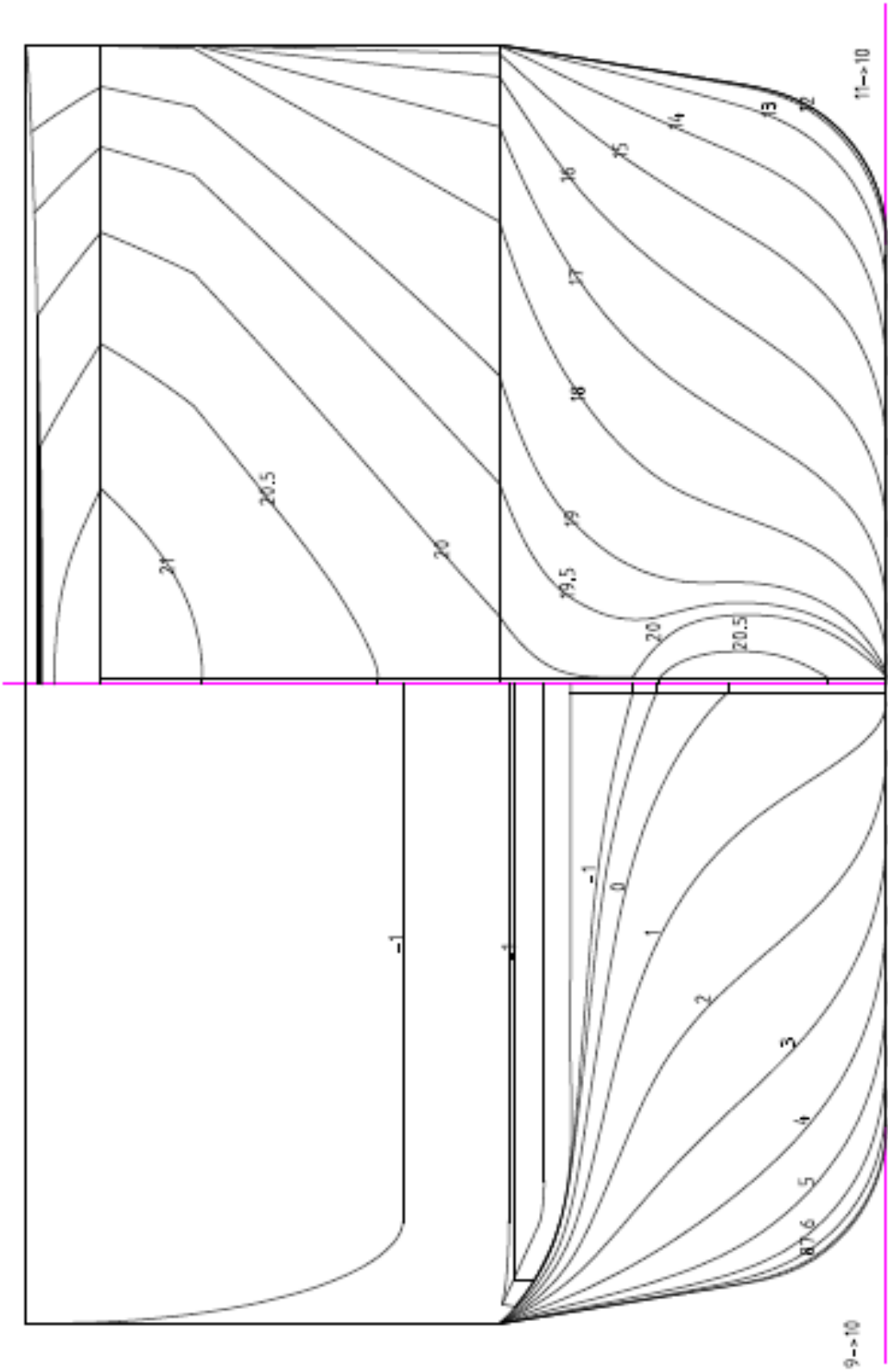
Enclosure 1	Definitions
Enclosure 2	Decay tests

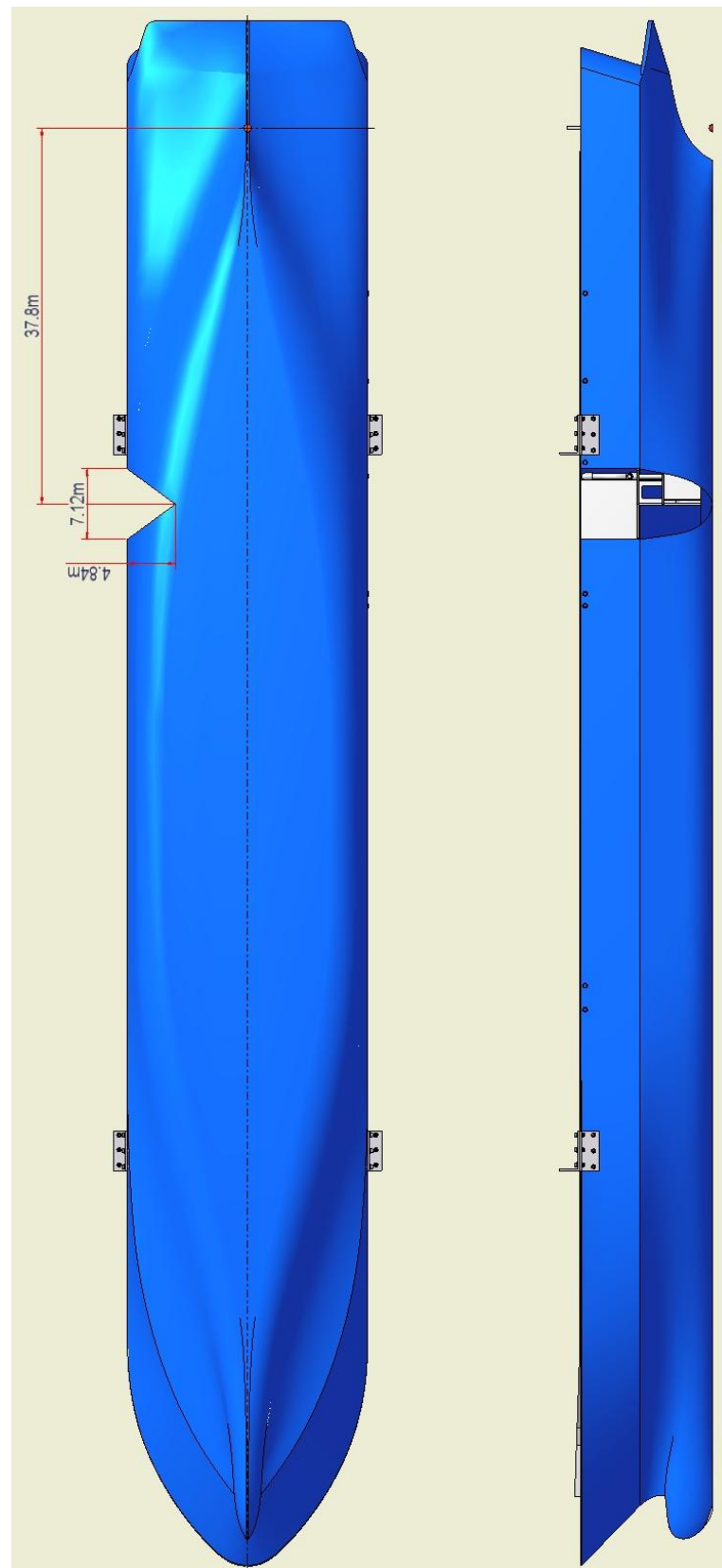
Table of appendices

Appendix 01	Wave calibrations
Appendix 02	Plots of time series
Appendix 03	Statistical tables
Appendix 04	Roll decay results
Appendix 05	Static measuring before each test
Appendix 06	Video recordings from wave tests
Appendix 07	CD with time series from decay tests capsizing tests and static measuring

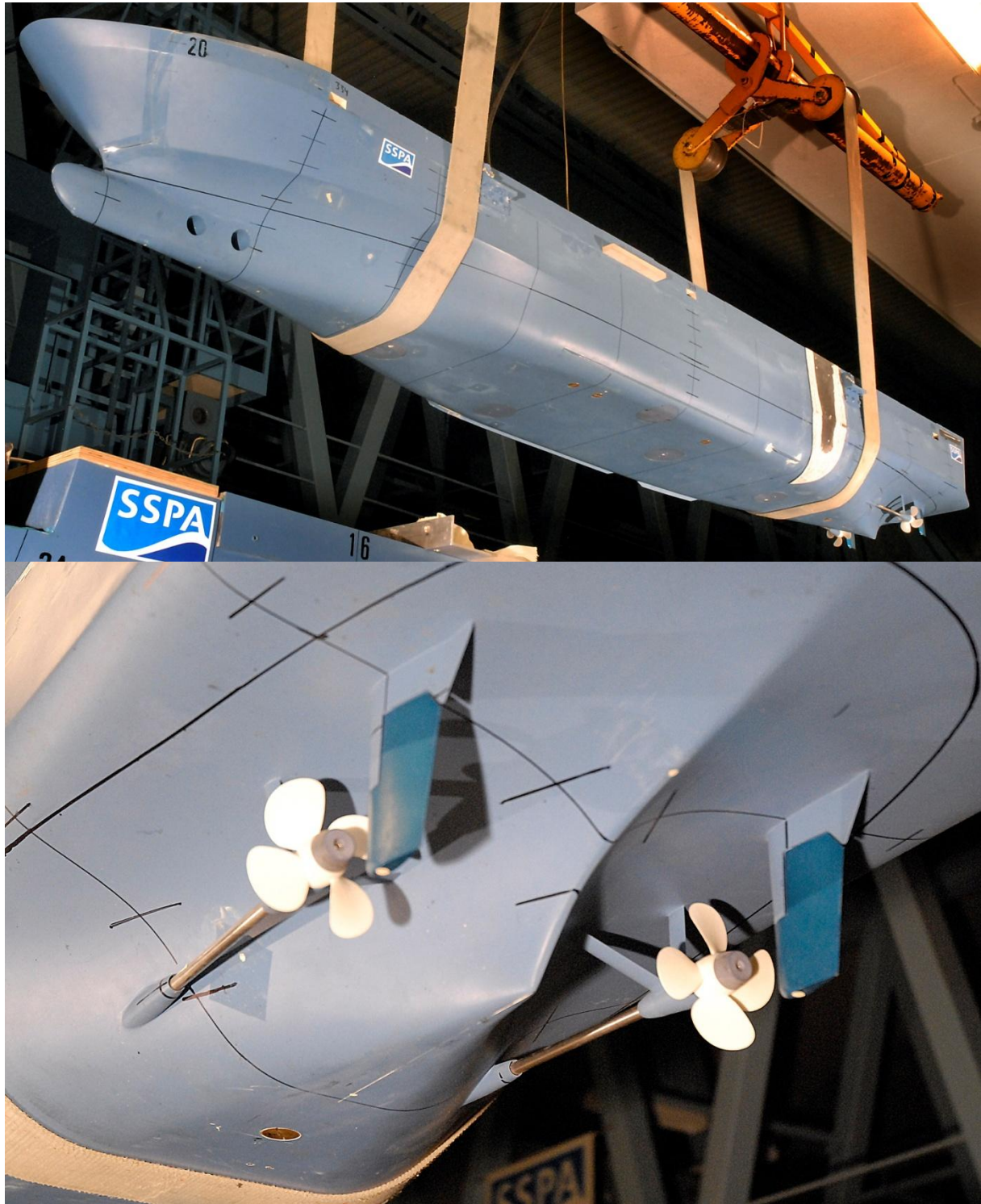
Body plan

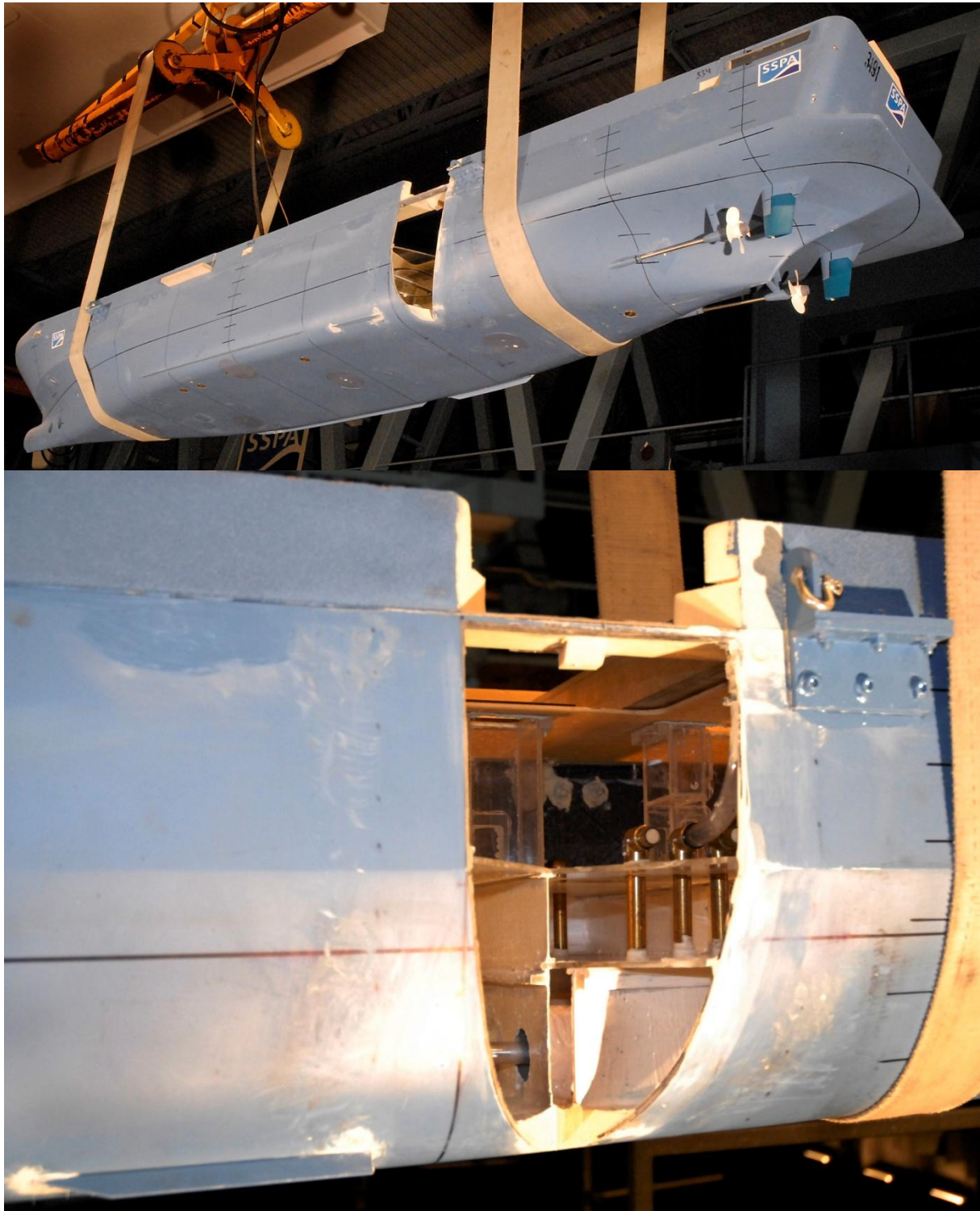
Figure: 1

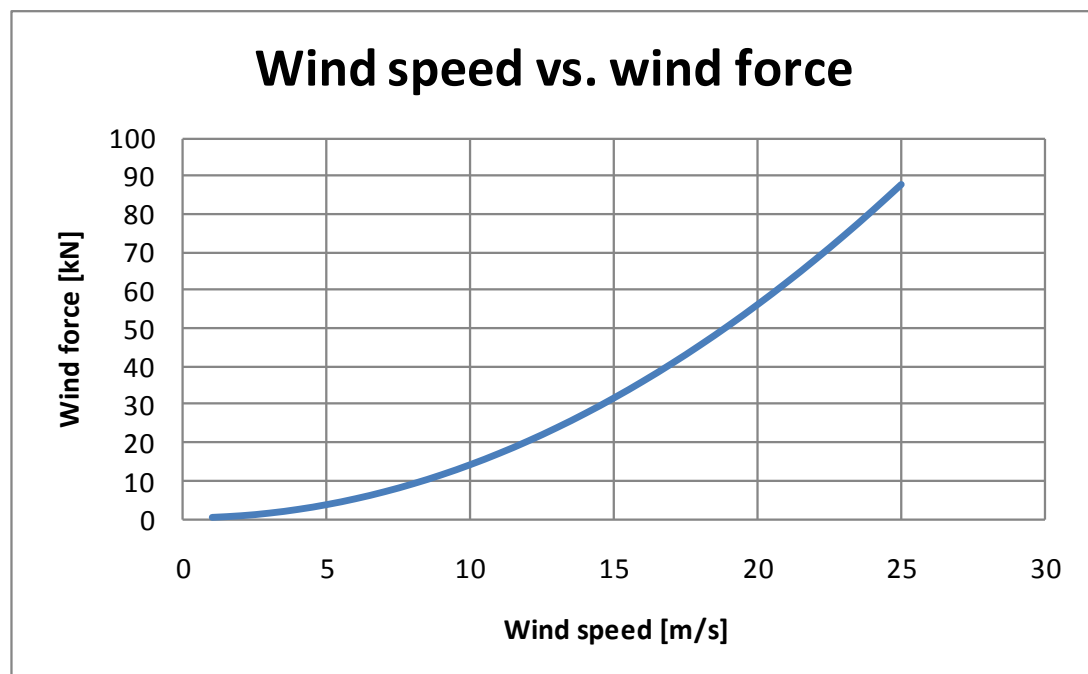
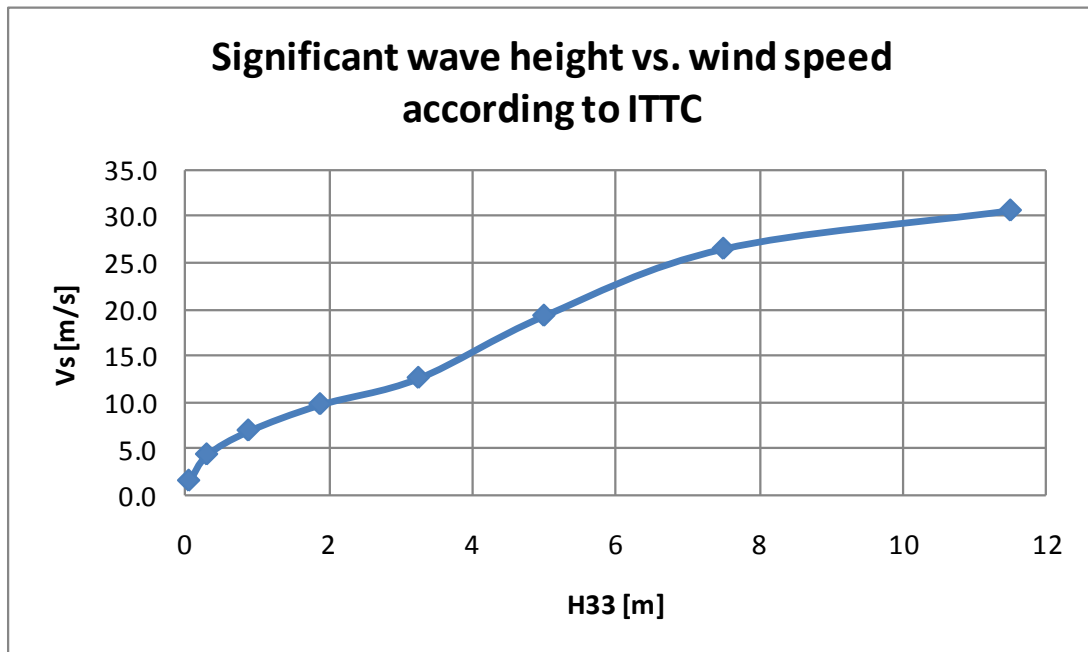










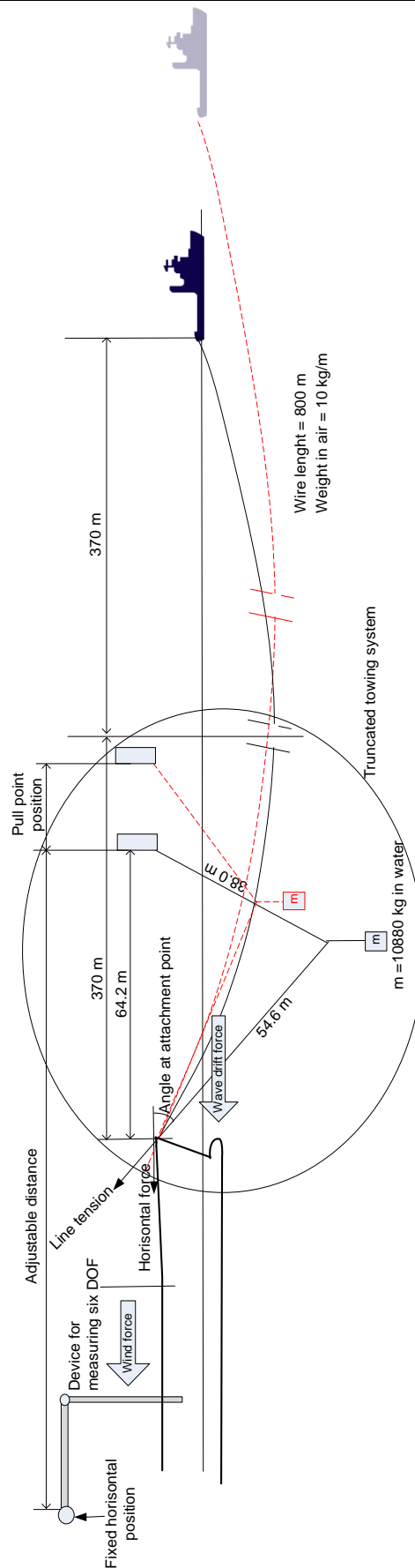


$$\text{Wind force} = \frac{1}{2} P C_x A_T V_s^2$$

where Front area $A_T = 571 \text{ m}^2$

$$P = 1.23 \text{ kg/m}^3$$

$C_x = 0.4$ (ref. Maneuvring Technical Manual
Shiff & Hafen, Heft 2-3/1990)



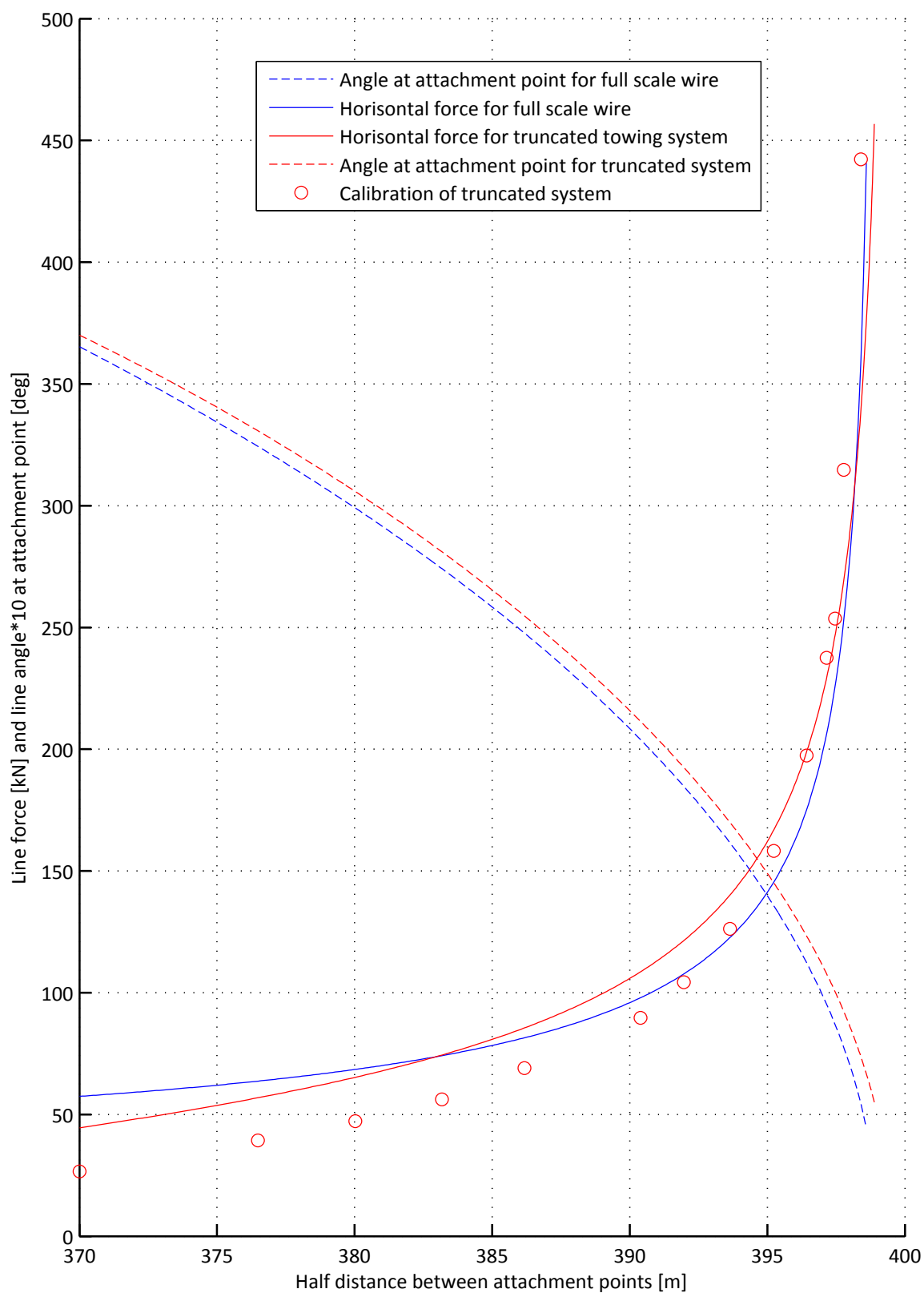
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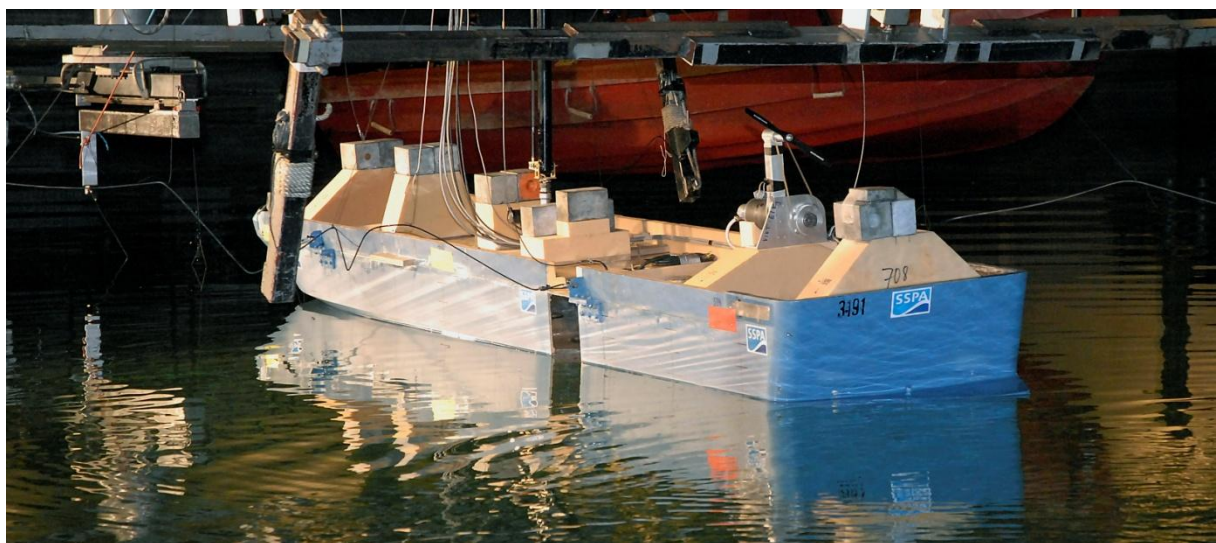
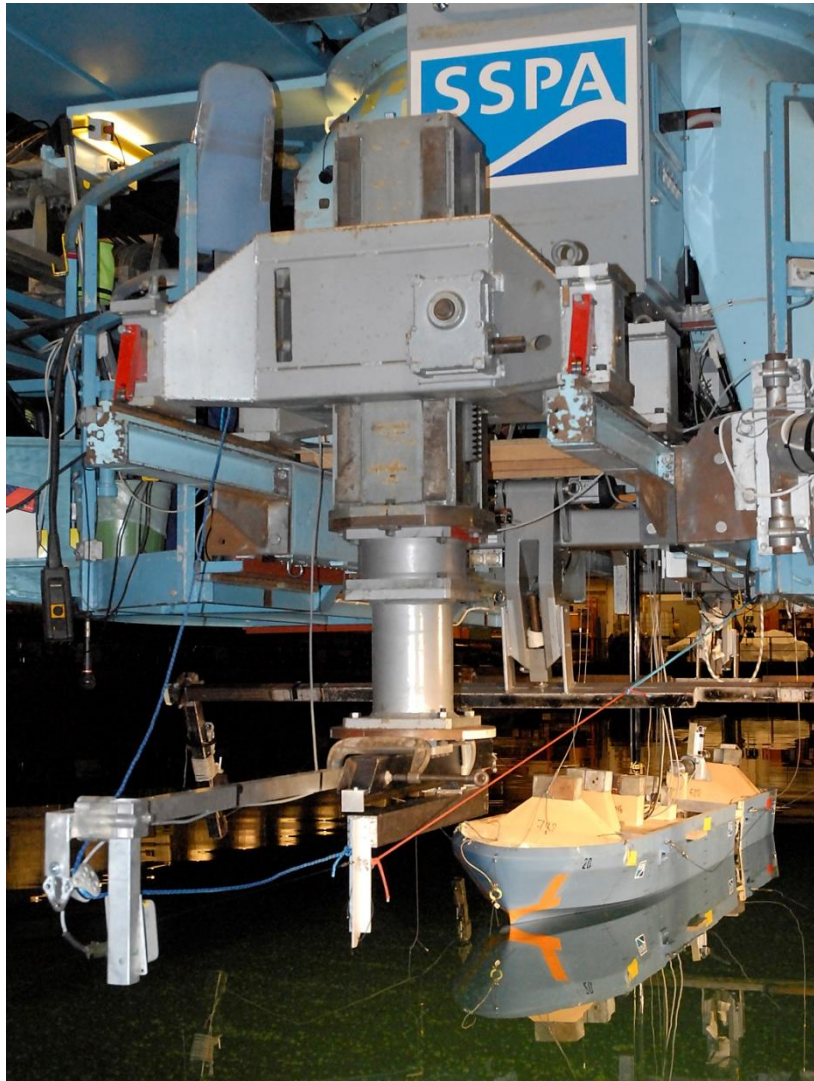
Towing wire characteristics

Length ~ 800 m, Weight(in air)= 10 kg/m

Test procedure and setup

Figure: 5c







Run 50

Hs= 4.0 m Tp= 8.0 s V= 0 kn



Run 66

Hs= 4.25 m Tp= 8.25 s V= 0 kn

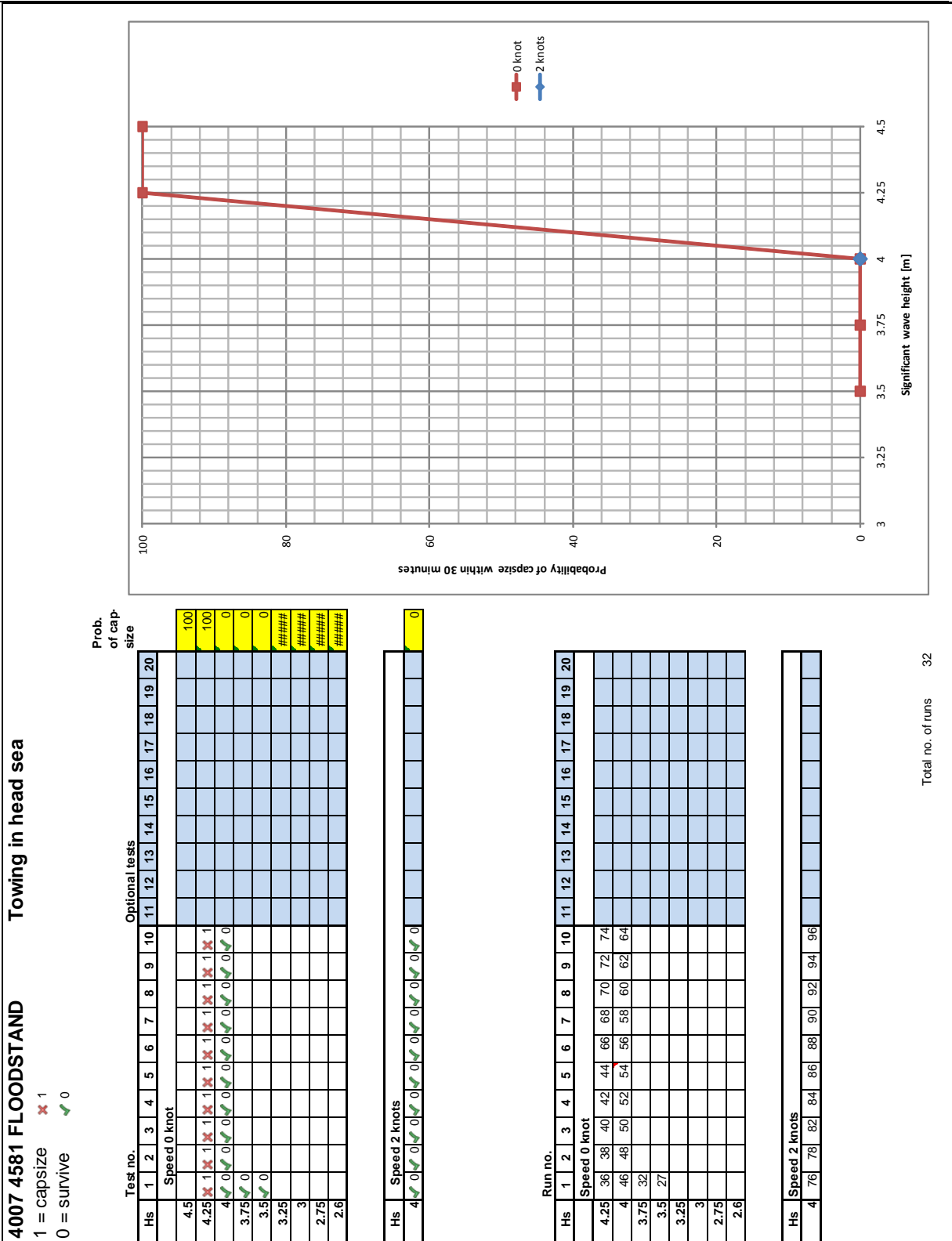


Run 90

Hs= 4.0 m Tp= 8.0 s V= 2 kn

Summary of test results

Figure: 7



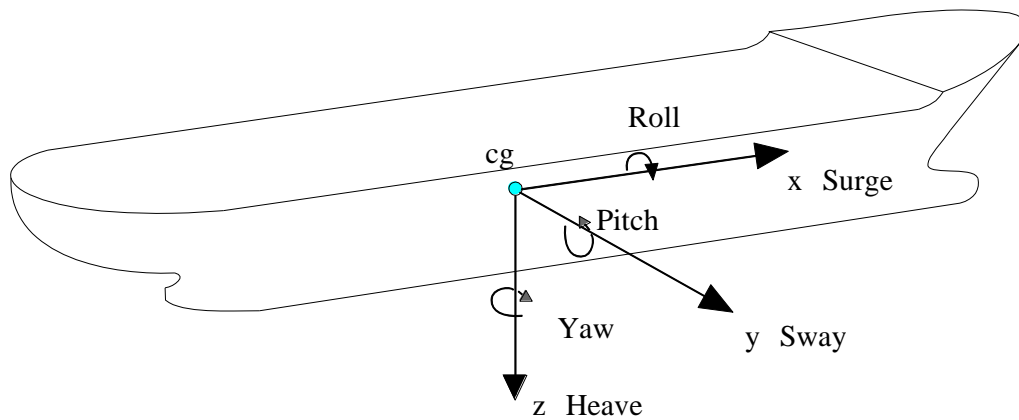
Probability of capsized within 30 minutes

Significant wave height [m]

0 knot

2 knots

Total no. of runs32

BEAM SEA, 90° FOLLOWING SEA, 0° HEAD SEA, 180° **Sign convention according to ITTC**

- heading angle and yaw rate are positive for a turn to starboard
- rudder angle is negative for a turn to starboard
- longitudinal rudder force is positive pointing forward
- lateral rudder force is positive pointing starboard
 - rudder stock torque is positive clockwise seen from above
 - wave height is positive downwards
 - relative motion is positive for increasing freeboard
 - lateral acceleration is positive to starboard (gravity component included)

All results given in this report are presented in full scale using Froude scaling.

A decay test is performed by giving the model a slight offset from its equilibrium where after the model is allowed to oscillate. Due to damping the amplitudes will successively decay

From the recorded decay curves the damping coefficients may be derived from the decrease of motion amplitude for the successive oscillations. Also natural period may be derived from these tests.

The decay may be described by:

$$\ddot{\phi} + 2\zeta\omega_0\dot{\phi} + \omega_0^2\phi + d\dot{\phi}|\dot{\phi}| = 0$$

Where: ζ is the linear damping
 ω_0 is the natural frequency
 d is the non-linear damping

At the evaluation of a decay test the non-linear damping (d) is assumed to be 0. The damping factor may then be derived according to the expression below.

$$\xi = \ln(\phi_0/\phi_n)/2\pi n$$

Where:

ξ = damping factor
 ϕ_0 = amplitude at first oscillation
 ϕ_n = amplitude at n:th oscillation
 n = number of oscillations
 \ln = natural logarithm

An example of a decay test is shown in the figure.

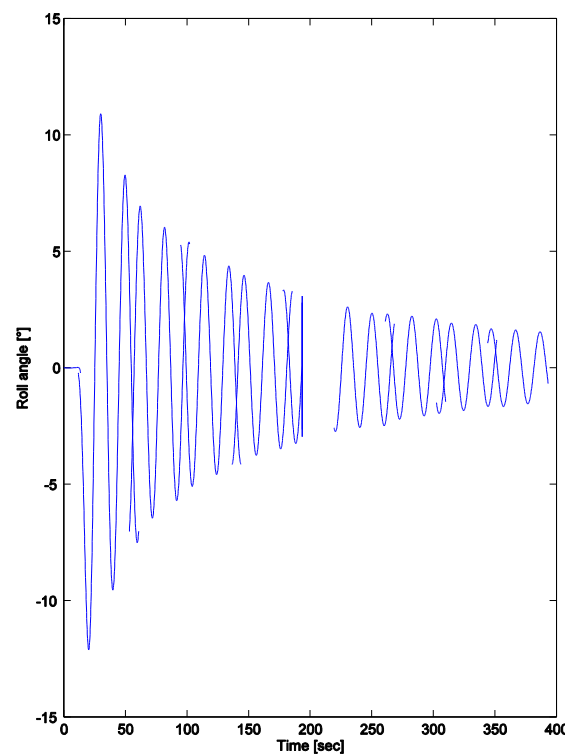


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Figure [no.]	Wave height [m]	Spectral peak period [sec]	Serie [no.]	Run [no.]
1	3.50	7.48	0	6
2	3.75	7.75	0	5
3	4.00	8.00	0	4
4	4.25	8.25	0	3

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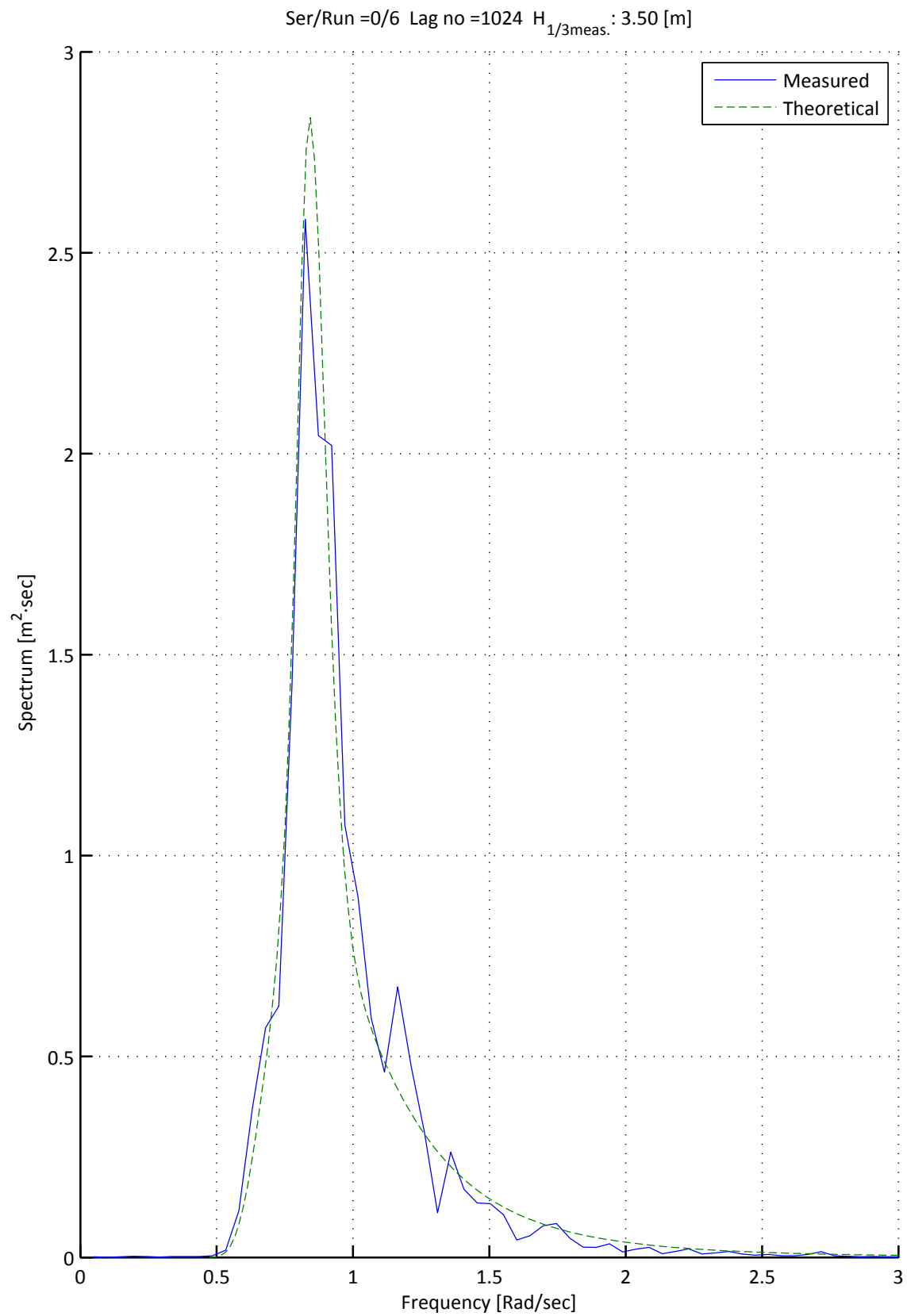
Wave calibration

$H_{1/3} = 3.5 \text{ m}$ $T_p = 7.48 \text{ sec}$ $\gamma = 3.3$

Jonswap spectrum

Appendix: 01

Figure: 1



FLOODSTAND

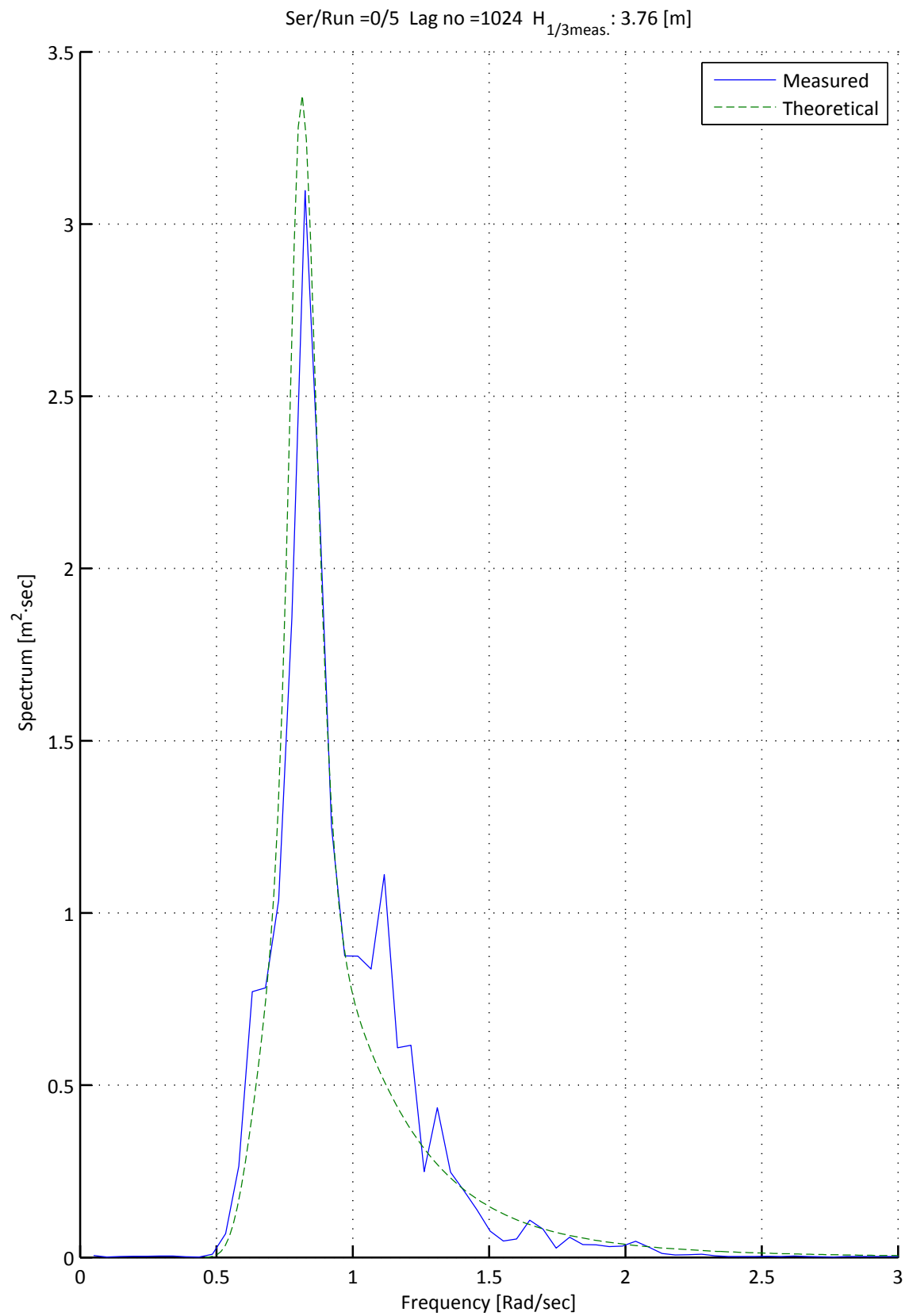
Wave calibration

$H_{1/3} = 3.75 \text{ m}$ $T_p = 7.75 \text{ sec}$ $\gamma = 3.3$

Jonswap spectrum

Appendix: 01

Figure: 2



FLOODSTAND

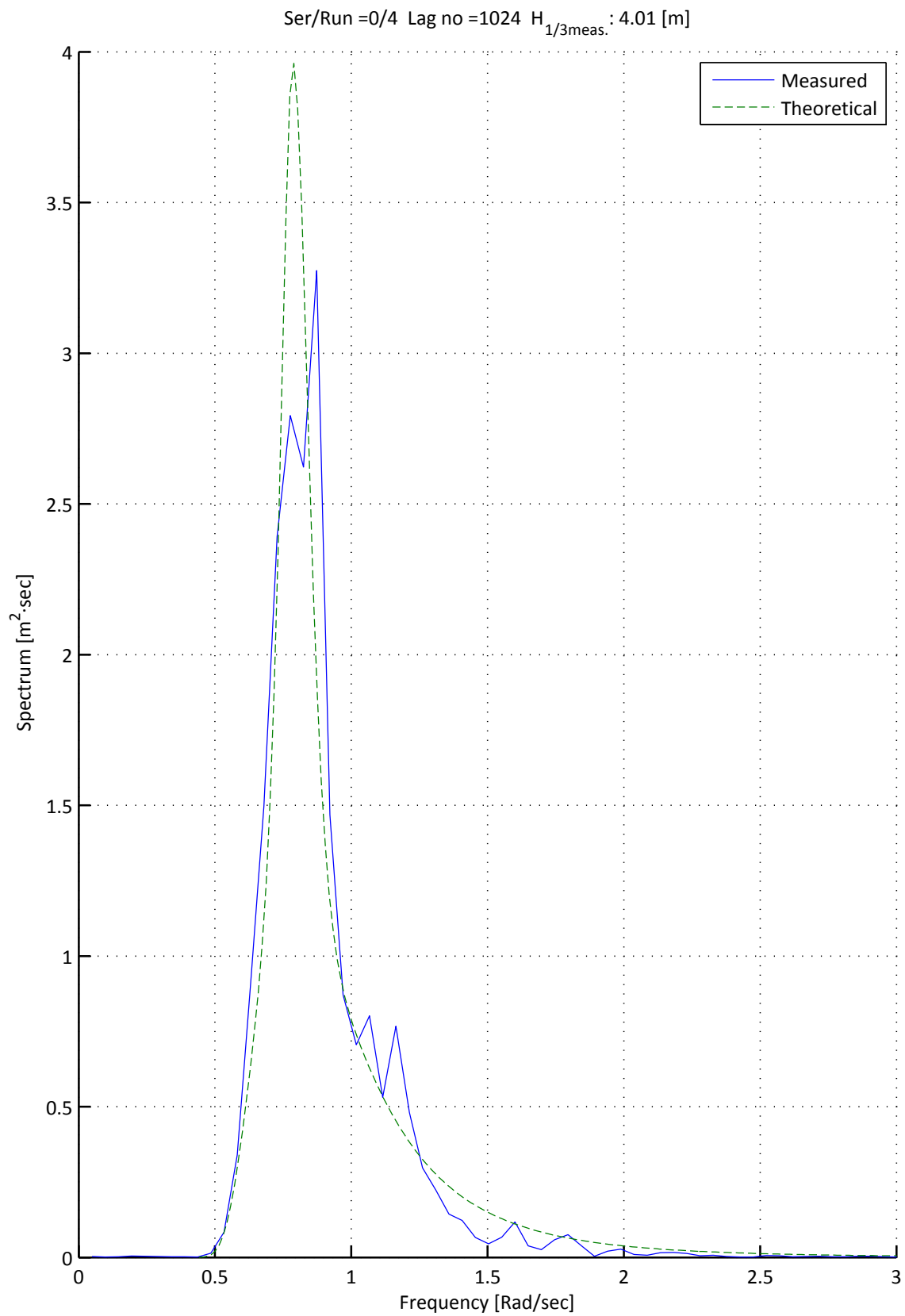
Wave calibration

$H_{1/3} = 4 \text{ m}$ $T_p = 8.00 \text{ sec}$ $\gamma = 3.3$

Jonswap spectrum

Appendix: 01

Figure: 3



FLOODSTAND

Wave calibration

$H_{1/3} = 4.25 \text{ m}$ $T_p = 8.25 \text{ sec}$ $\gamma = 3.3$

Jonswap spectrum

Appendix: 01

Figure: 4

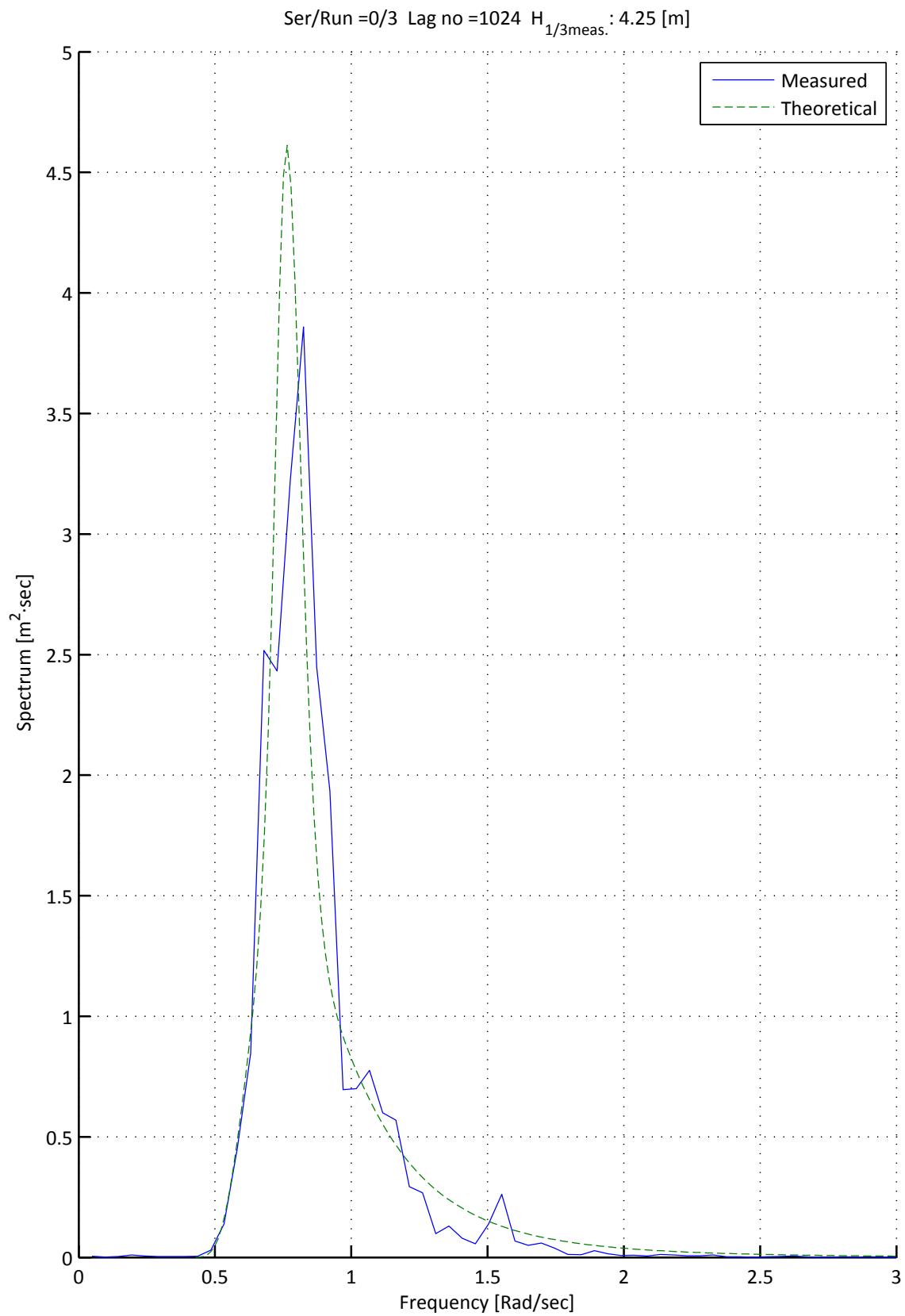


Table of contents

Figure [no.]	Wave height [m]	Spectral peak period [sec]	Tow speed [knots]	Serie [no.]	Run [no.]
1	3.50	7.48	0	5	27
2	3.75	7.75	0	5	32
3	4.00	8.00	0	5	46
4	4.00	8.00	0	5	48
5	4.00	8.00	0	5	50
6	4.00	8.00	0	5	52
7	4.00	8.00	0	5	54
8	4.00	8.00	0	5	56
9	4.00	8.00	0	5	58
10	4.00	8.00	0	5	60
11	4.00	8.00	0	5	62
12	4.00	8.00	0	5	64
13	4.25	8.25	0	5	36
14	4.25	8.25	0	5	38
15	4.25	8.25	0	5	40
16	4.25	8.25	0	5	42
17	4.25	8.25	0	5	44
18	4.25	8.25	0	5	66
19	4.25	8.25	0	5	68
20	4.25	8.25	0	5	70
21	4.25	8.25	0	5	72
22	4.25	8.25	0	5	74

Figure [no.]	Wave height [m]	Spectral peak period [sec]	Tow speed [knots]	Serie [no.]	Run [no.]
23	4.00	8.00	2.00	5	76
24	4.00	8.00	2.00	5	78
25	4.00	8.00	2.00	5	82
26	4.00	8.00	2.00	5	84
27	4.00	8.00	2.00	5	86
28	4.00	8.00	2.00	5	88
29	4.00	8.00	2.00	5	90
30	4.00	8.00	2.00	5	92
31	4.00	8.00	2.00	5	94
32	4.00	8.00	2.00	5	96

FLOODSTAND

Jonswap spectrum

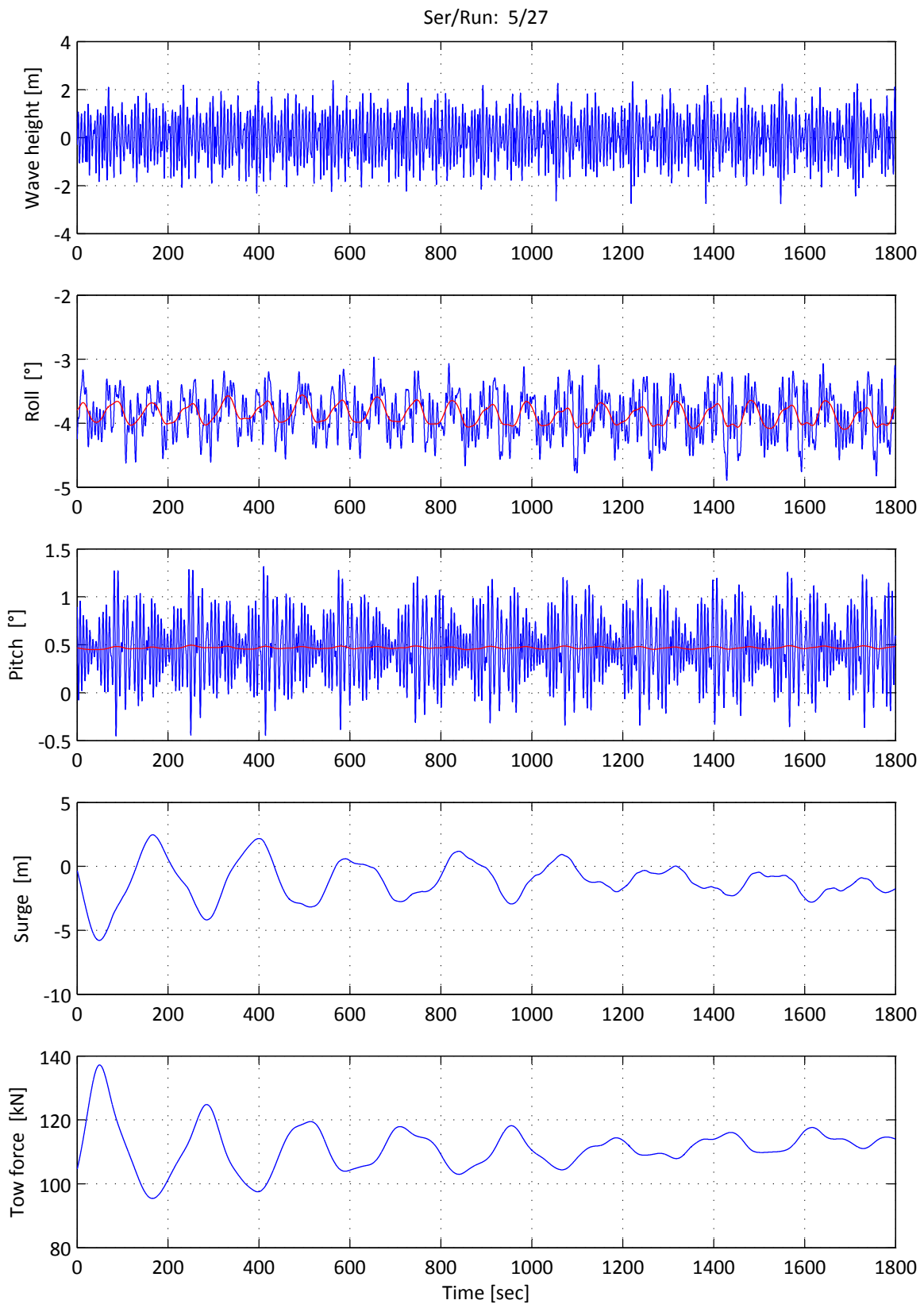
$H_{1/3} = 3.5$ m $T_p = 7.48$ sec $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 1



FLOODSTAND

Jonswap spectrum

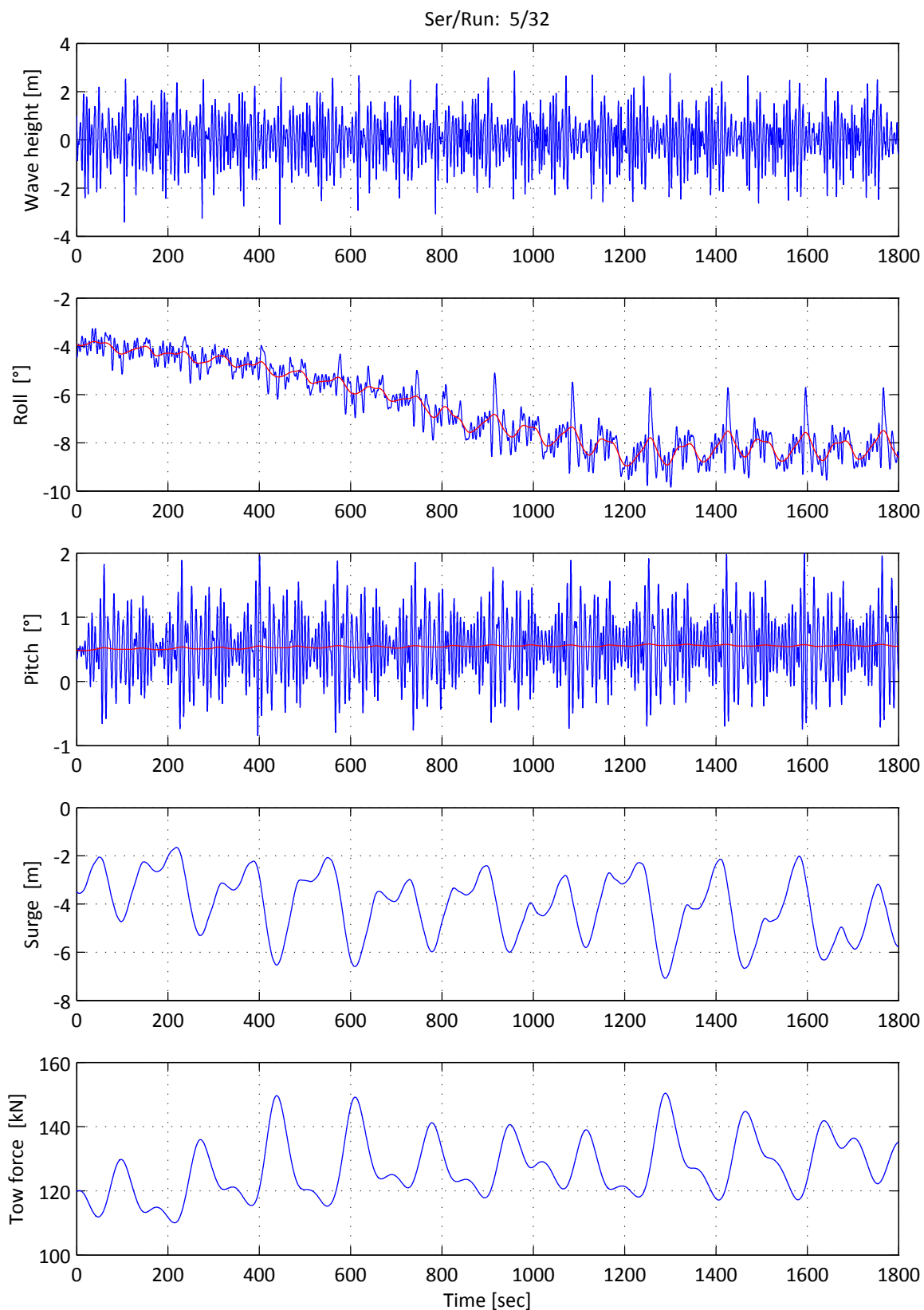
$H_{1/3} = 3.75 \text{ m}$ $T_p = 7.75 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 2



FLOODSTAND

Jonswap spectrum

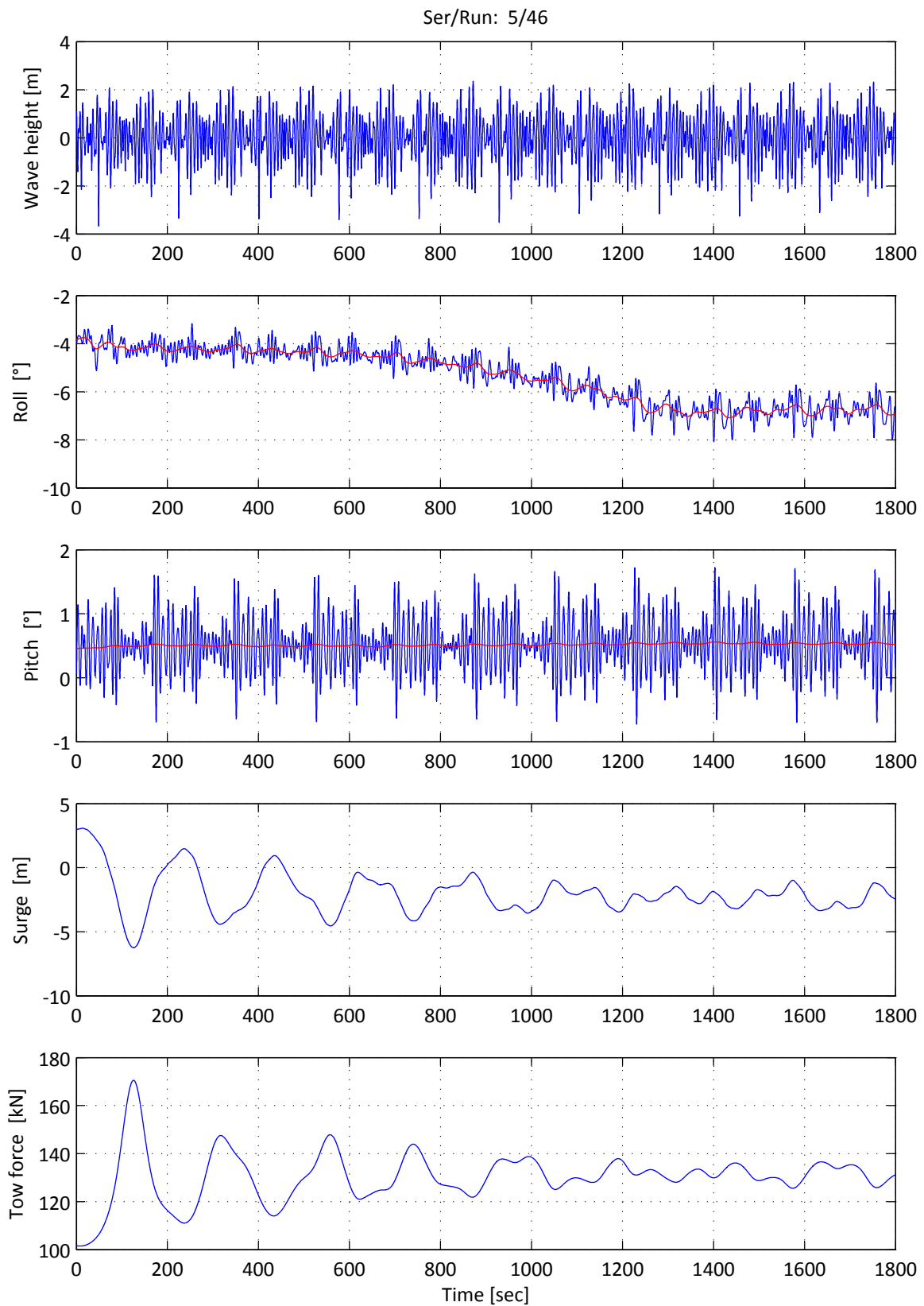
$H_{1/3} = 4 \text{ m}$ $T_p = 8.00 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 3



FLOODSTAND

Jonswap spectrum

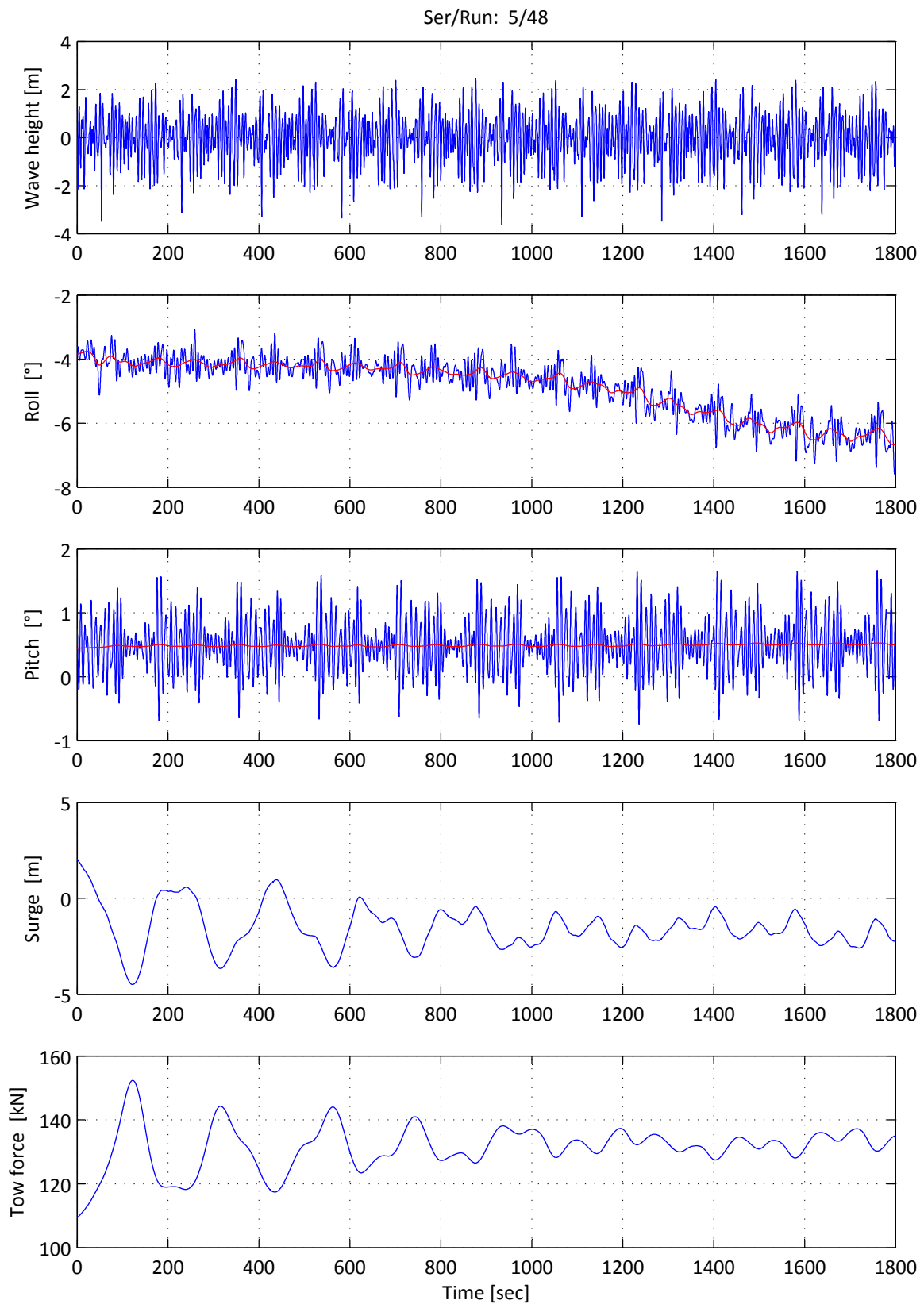
$H_{1/3} = 4 \text{ m}$ $T_p = 8.00 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 4



FLOODSTAND

Jonswap spectrum

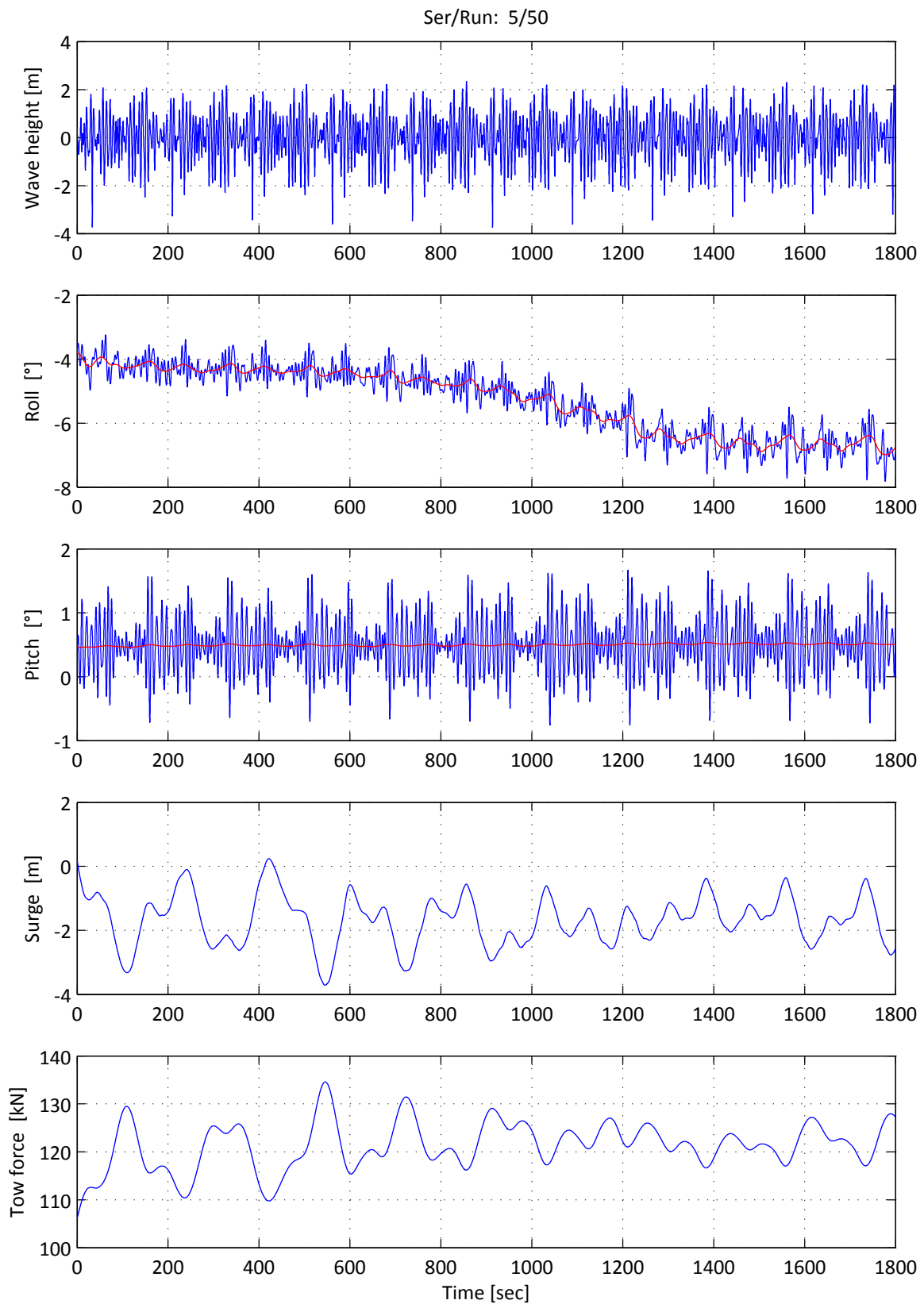
$H_{1/3} = 4 \text{ m}$ $T_p = 8.00 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 5



FLOODSTAND

Jonswap spectrum

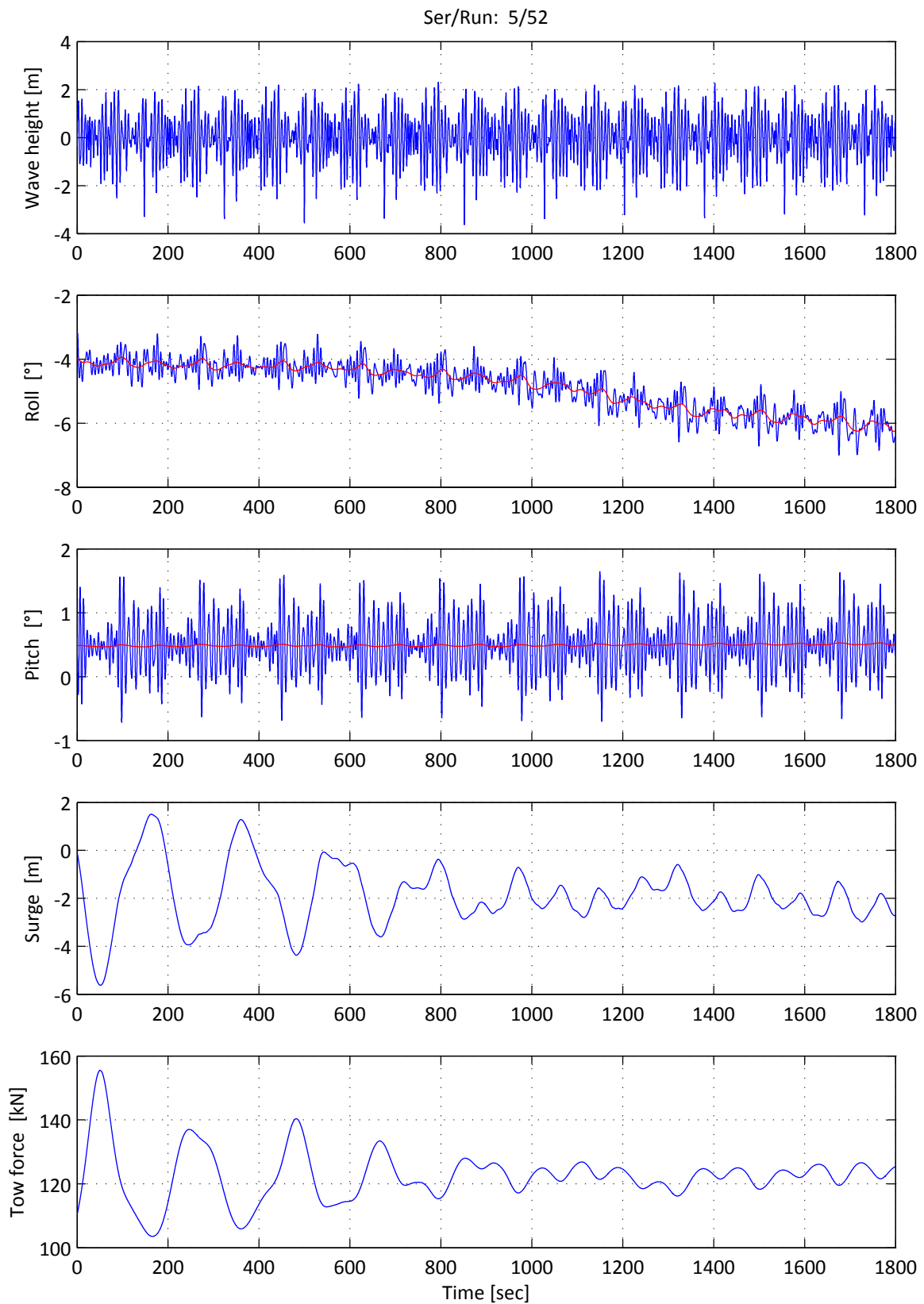
$H_{1/3} = 4 \text{ m}$ $T_p = 8.00 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 6



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Jonswap spectrum

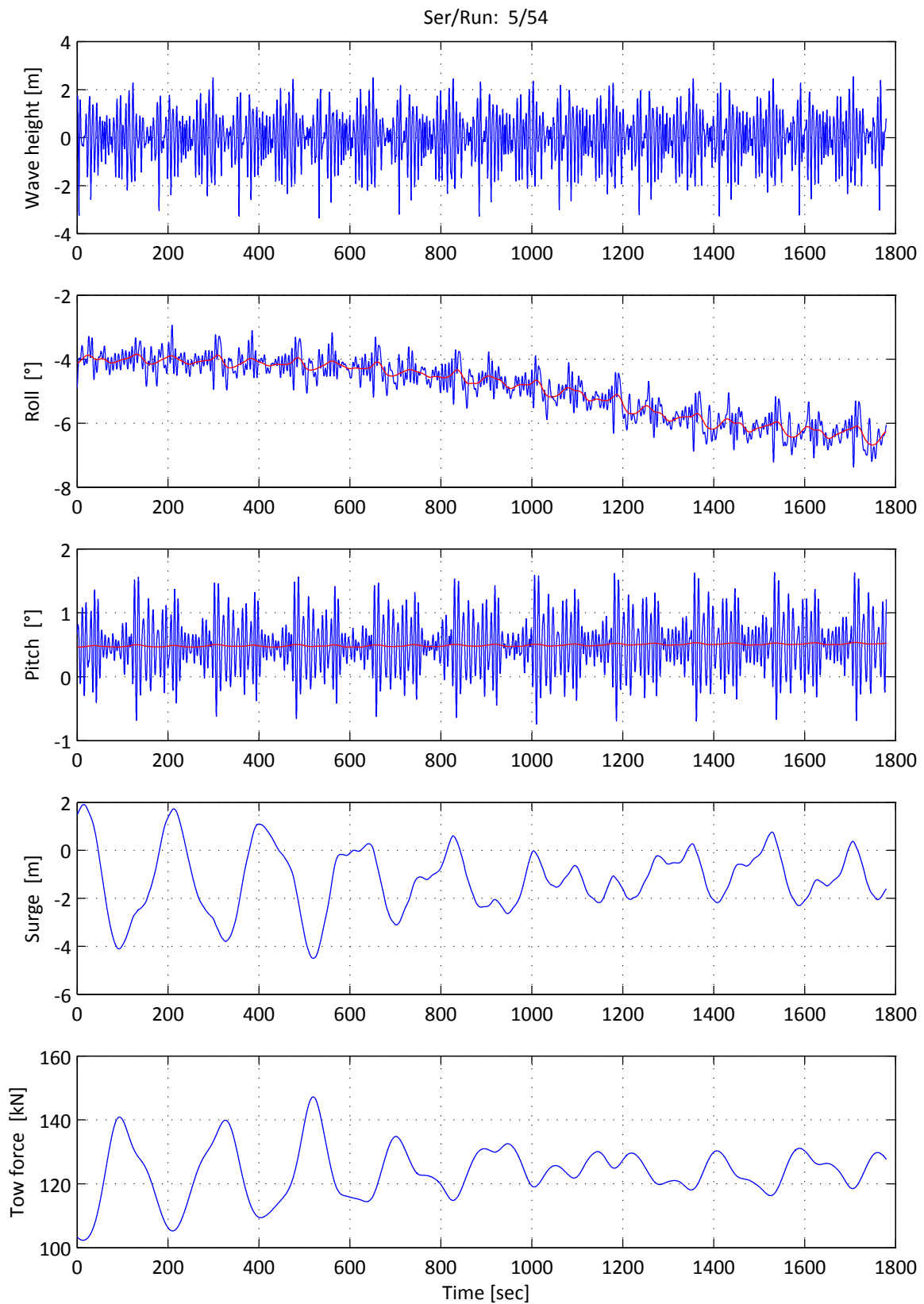
$H_{1/3} = 4 \text{ m}$ $T_p = 8.00 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 7



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Jonswap spectrum

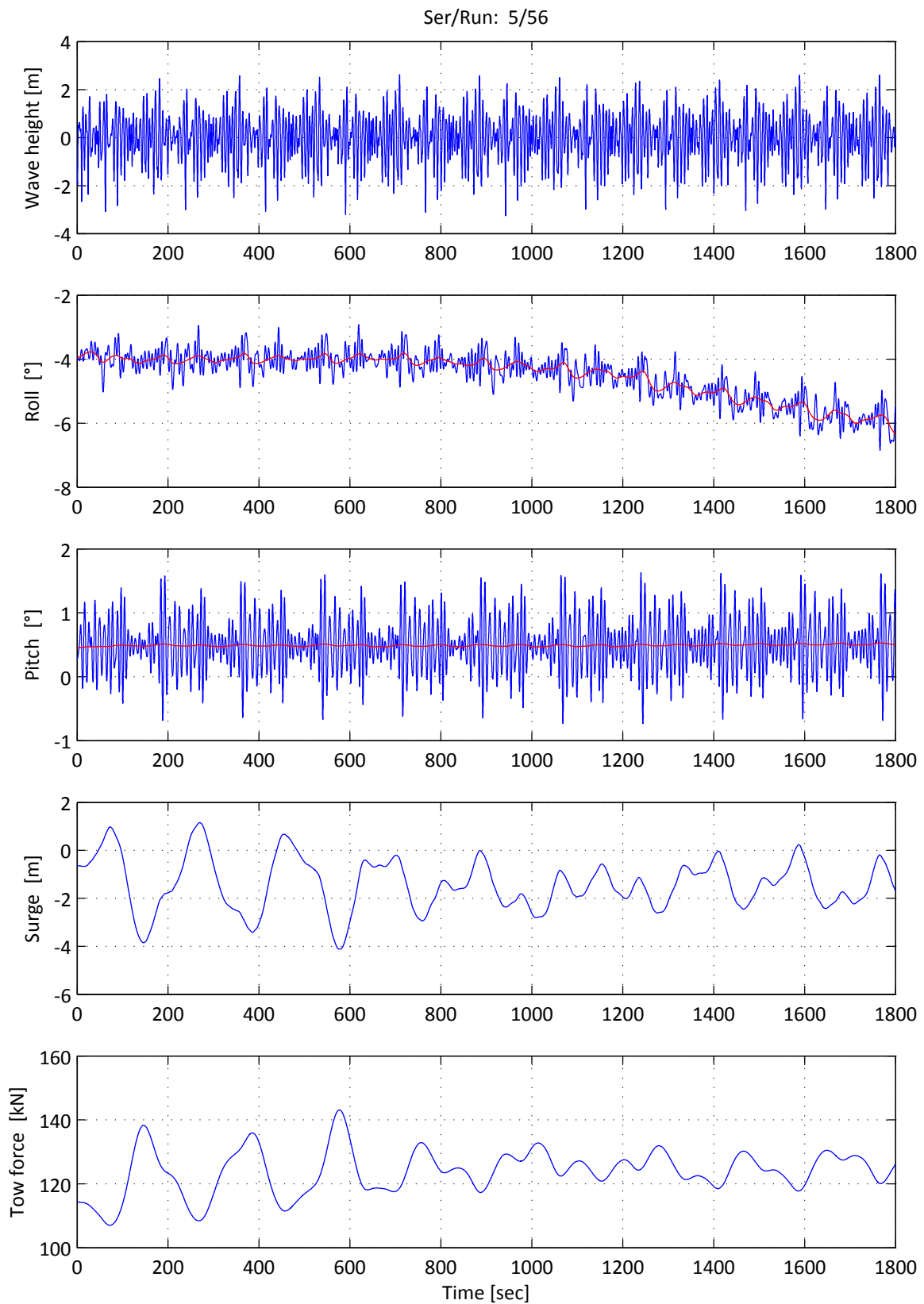
$H_{1/3} = 4 \text{ m}$ $T_p = 8.00 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 8



FLOODSTAND

Jonswap spectrum

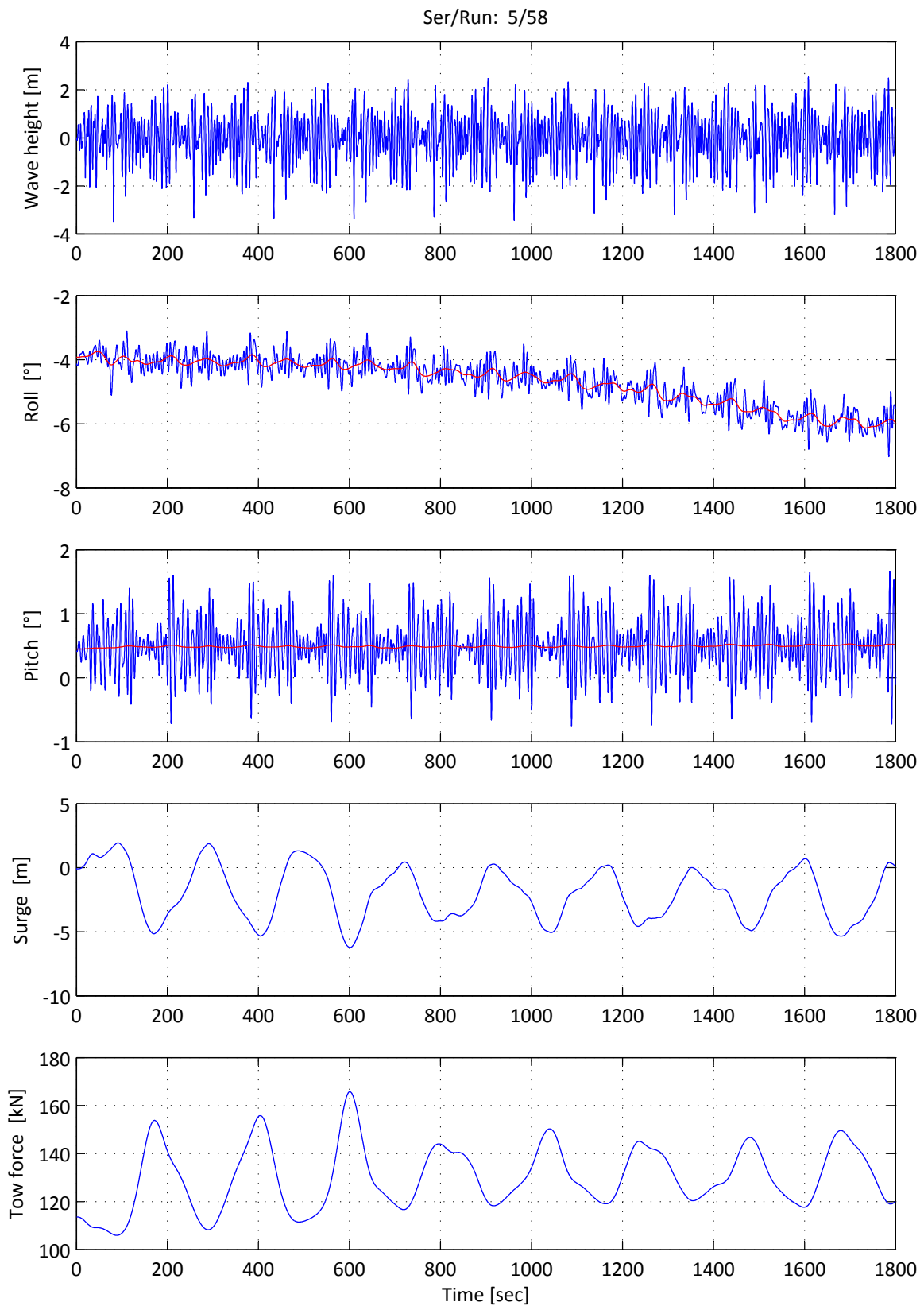
$H_{1/3} = 4 \text{ m}$ $T_p = 8.00 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 9



FLOODSTAND

Jonswap spectrum

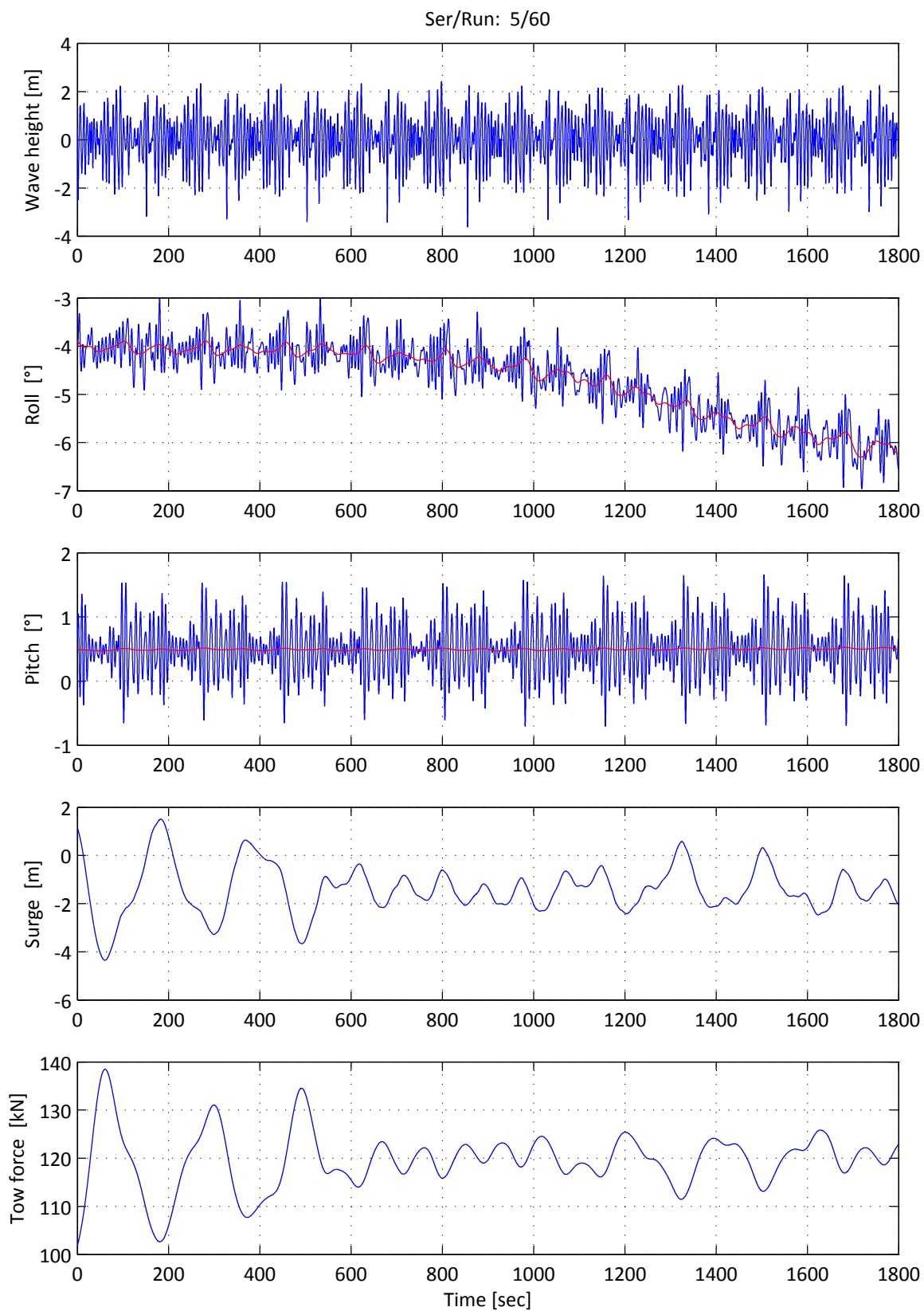
$H_{1/3} = 4 \text{ m}$ $T_p = 8.00 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 10



FLOODSTAND

Jonswap spectrum

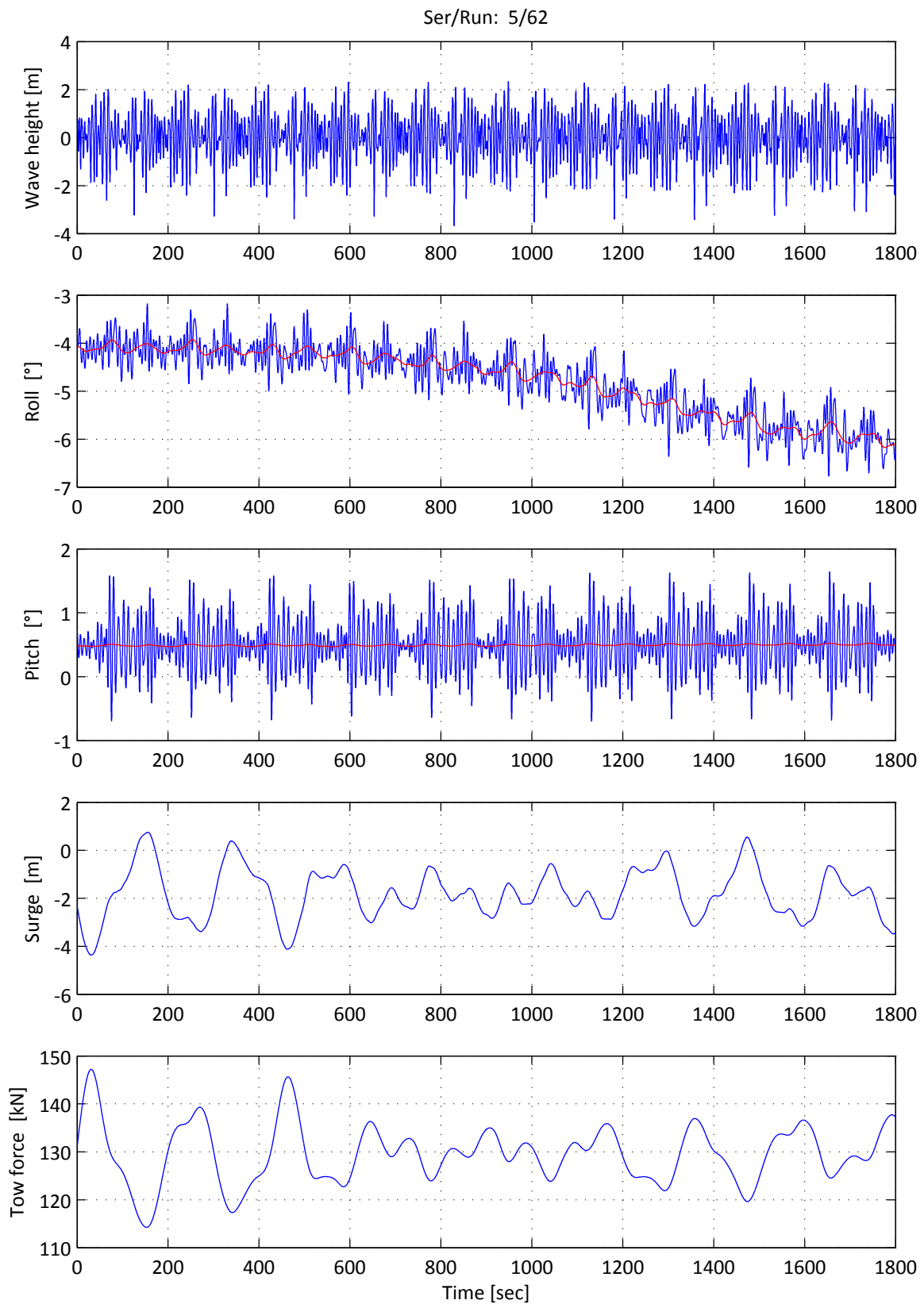
$H_{1/3} = 4 \text{ m}$ $T_p = 8.00 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 11



FLOODSTAND

Jonswap spectrum

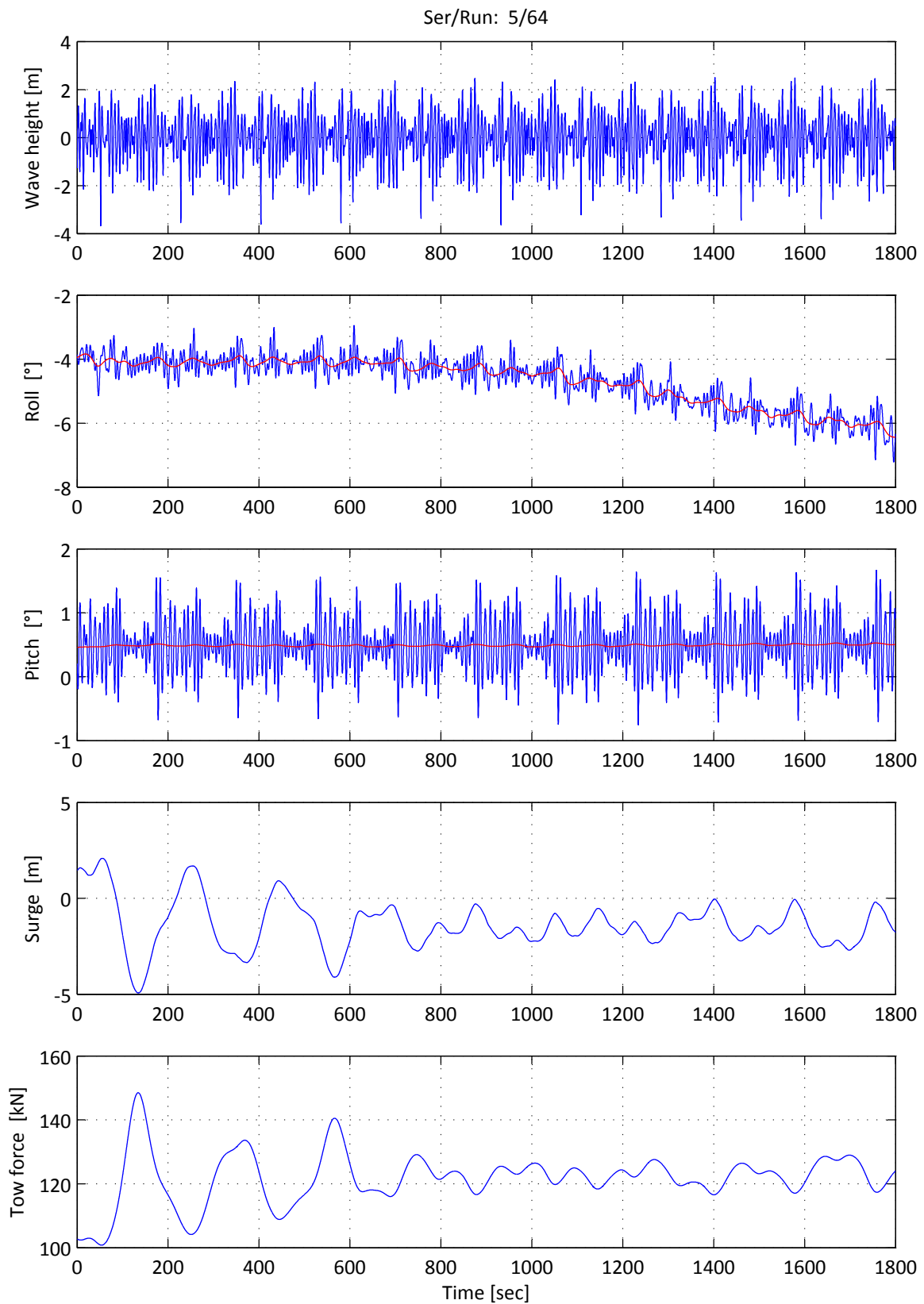
$H_{1/3} = 4 \text{ m}$ $T_p = 8.00 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 12



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Jonswap spectrum

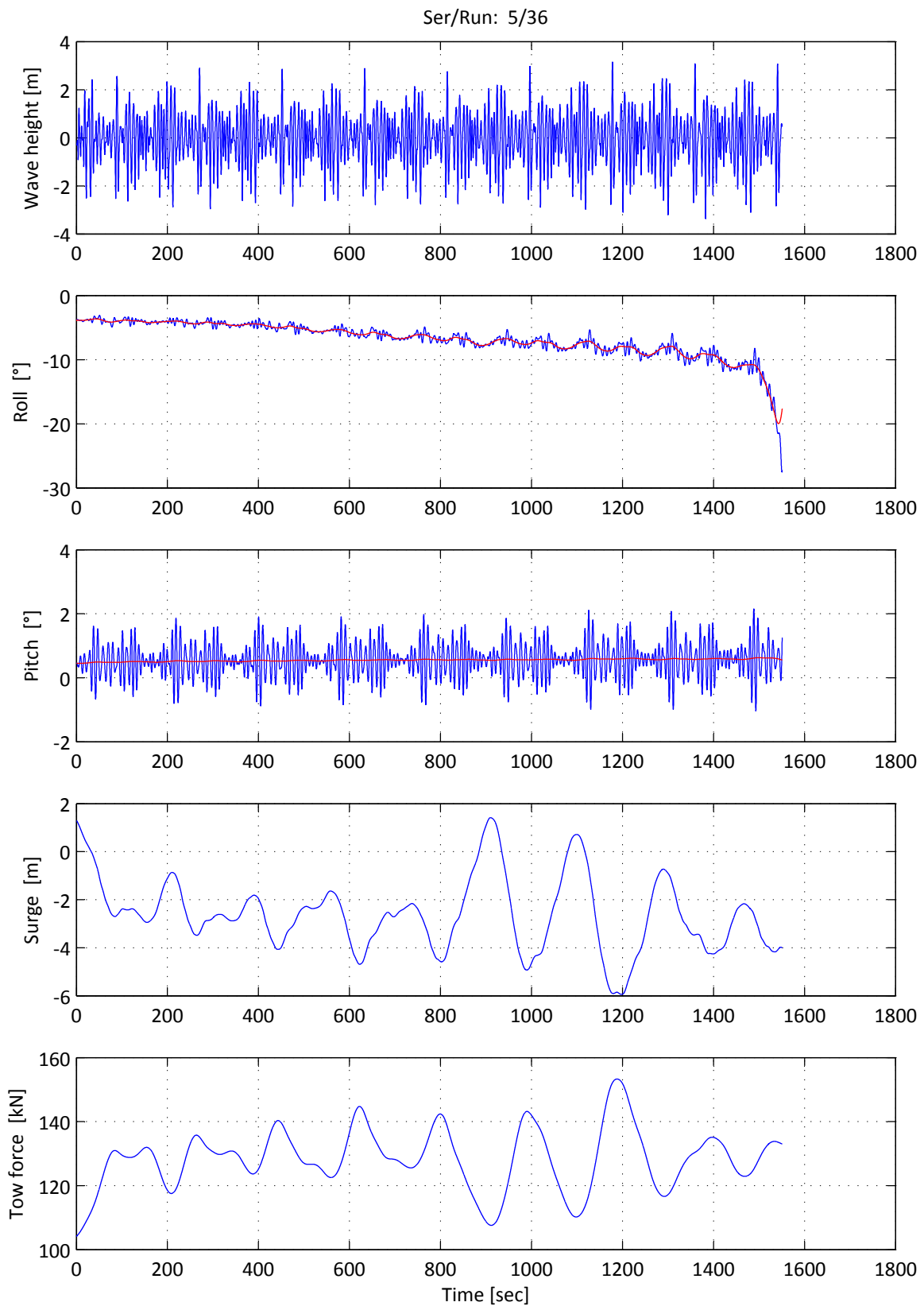
$H_{1/3} = 4.25$ m $T_p = 8.25$ sec $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 13



FLOODSTAND

Jonswap spectrum

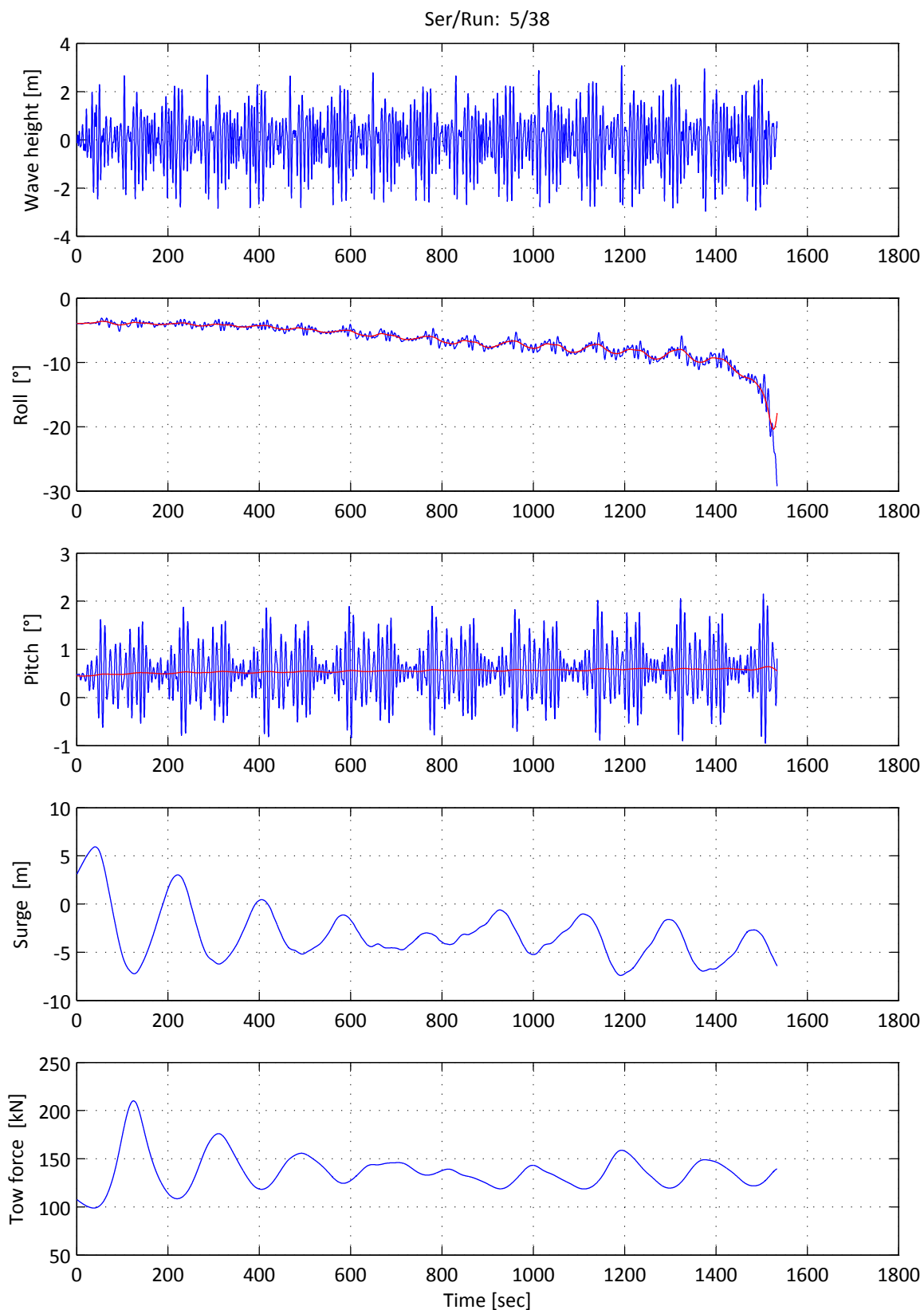
$H_{1/3} = 4.25 \text{ m}$ $T_p = 8.25 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 14



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Jonswap spectrum

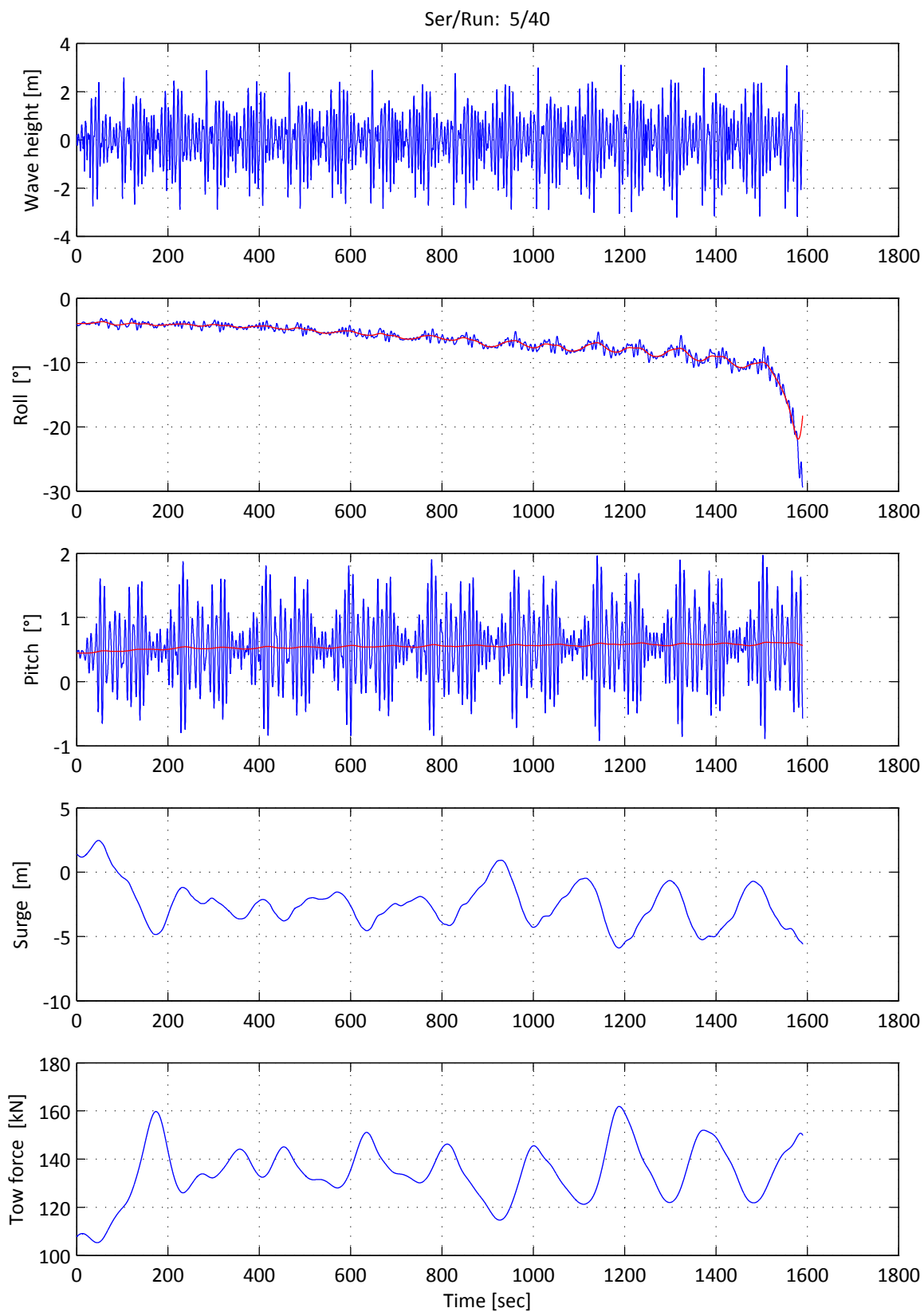
$H_{1/3} = 4.25$ m $T_p = 8.25$ sec $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 15



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Jonswap spectrum

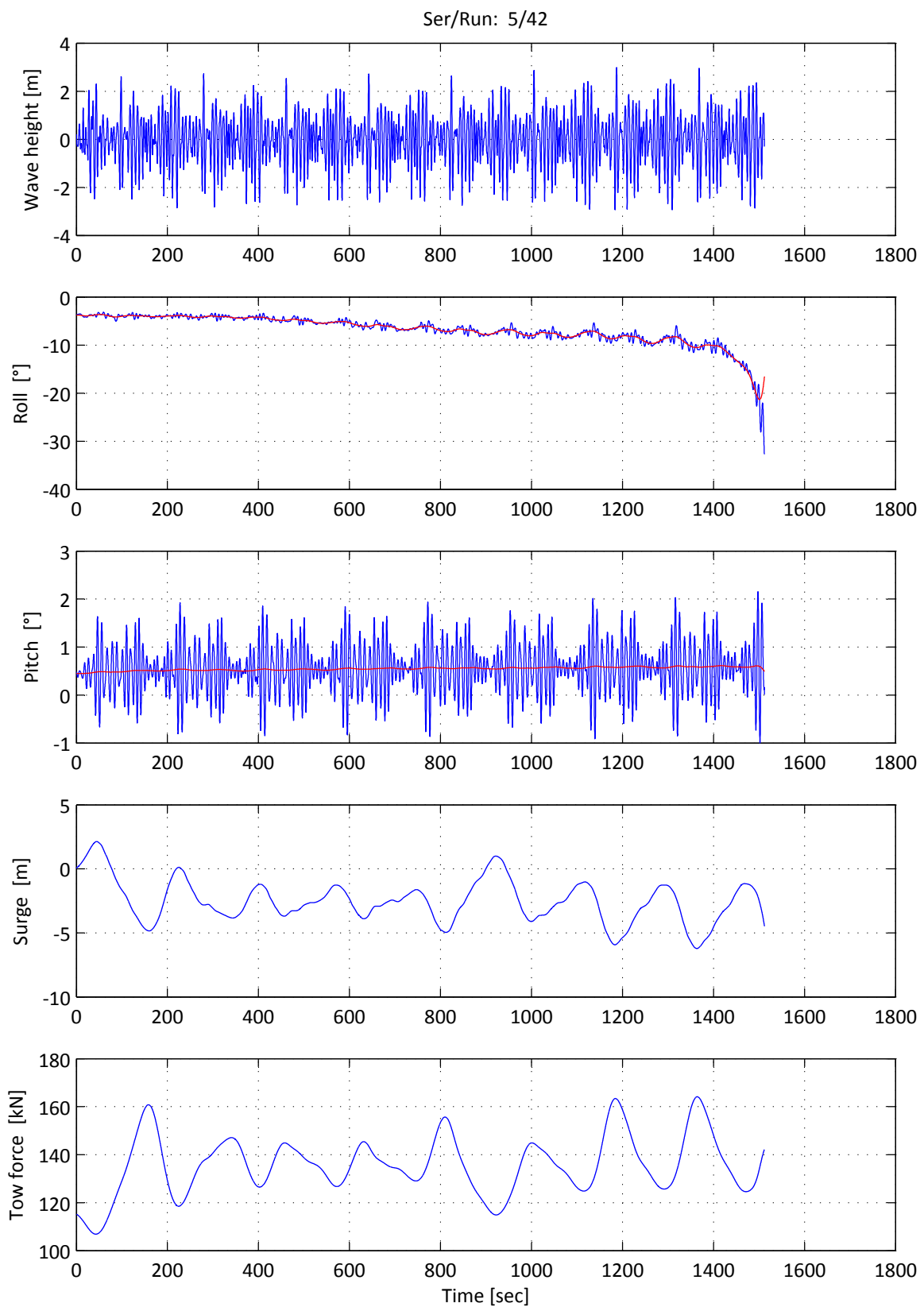
$H_{1/3} = 4.25 \text{ m}$ $T_p = 8.25 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 16



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Jonswap spectrum

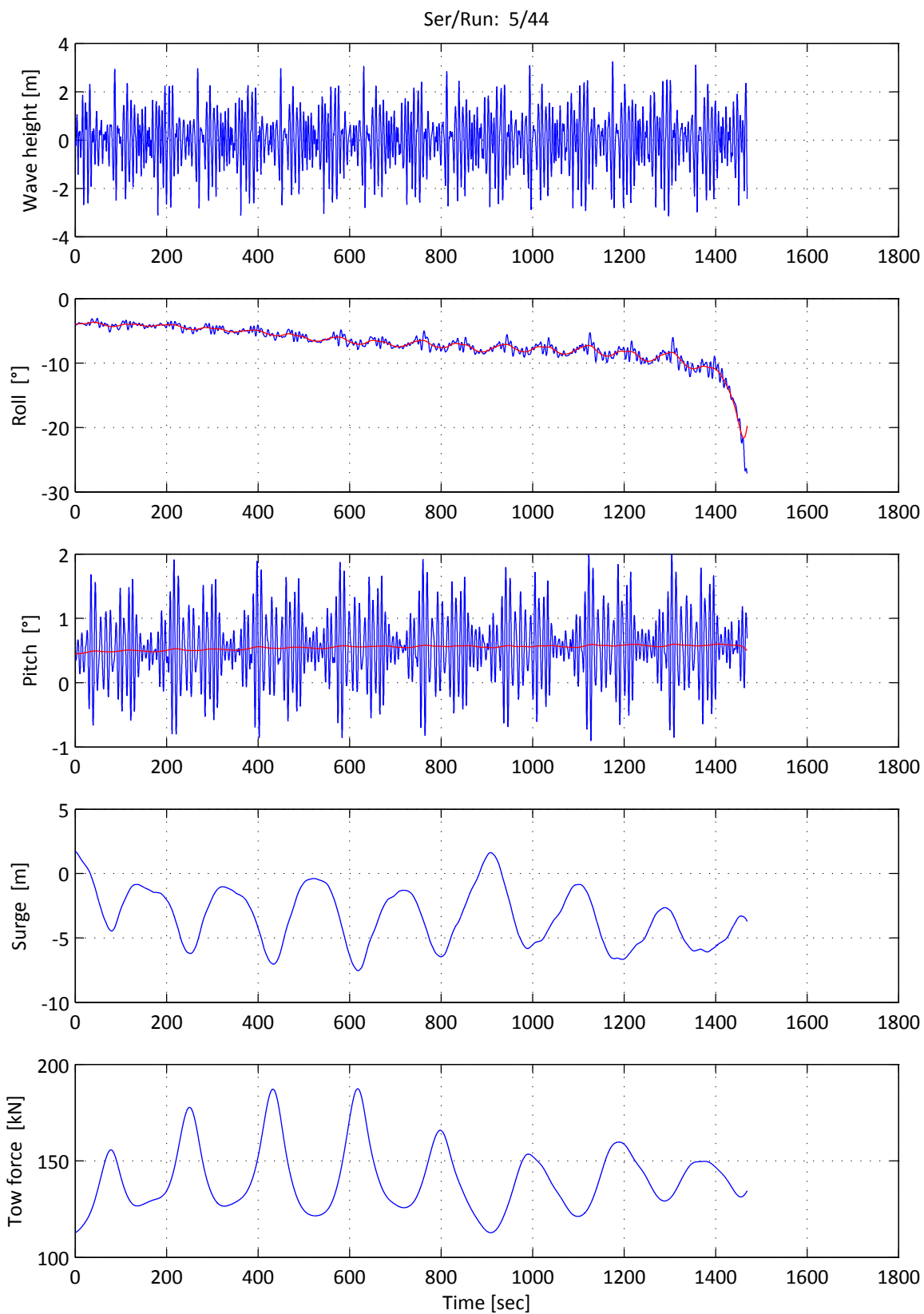
$H_{1/3} = 4.25 \text{ m}$ $T_p = 8.25 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 17



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Jonswap spectrum

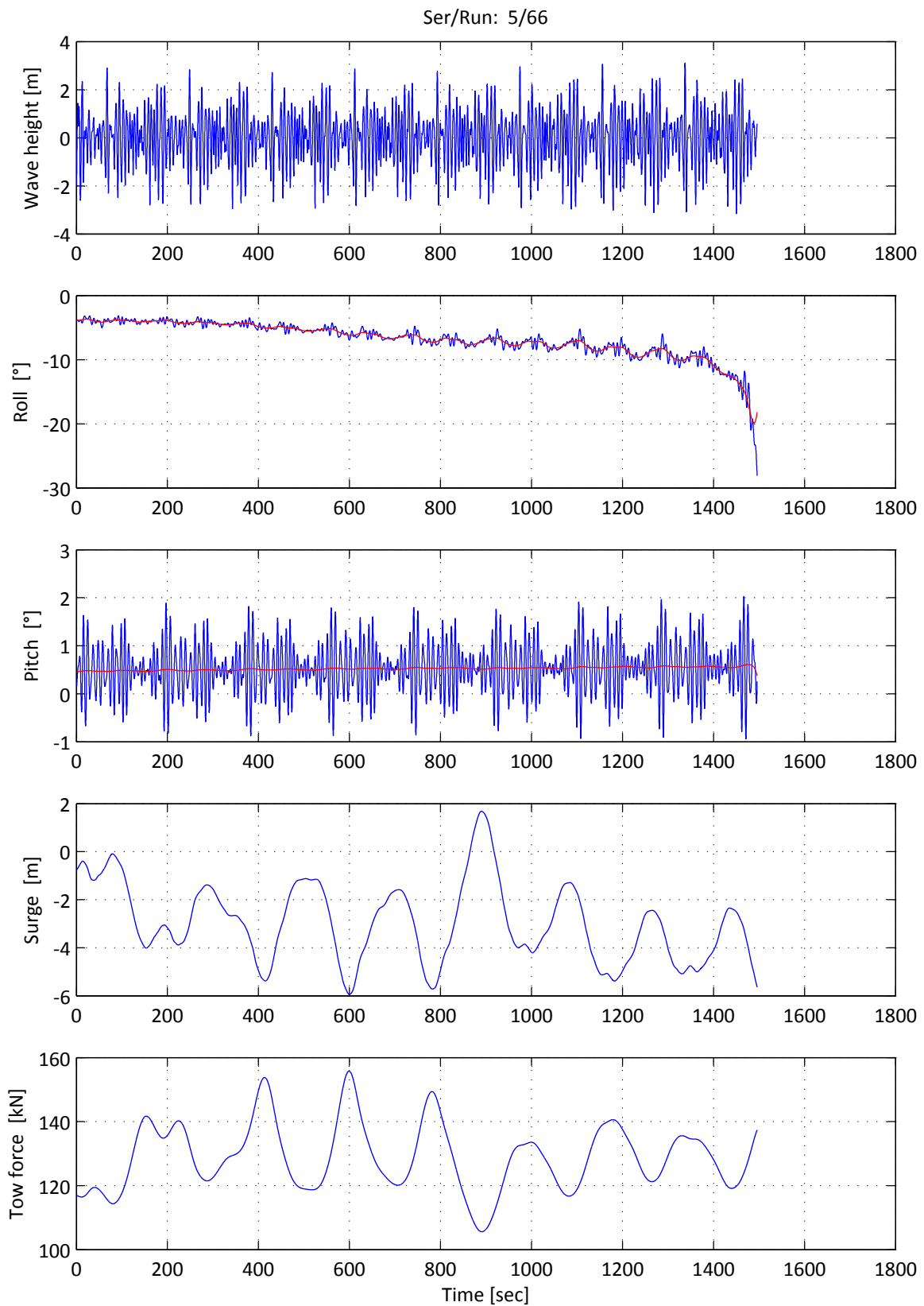
$H_{1/3} = 4.25$ m $T_p = 8.25$ sec $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 18



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Jonswap spectrum

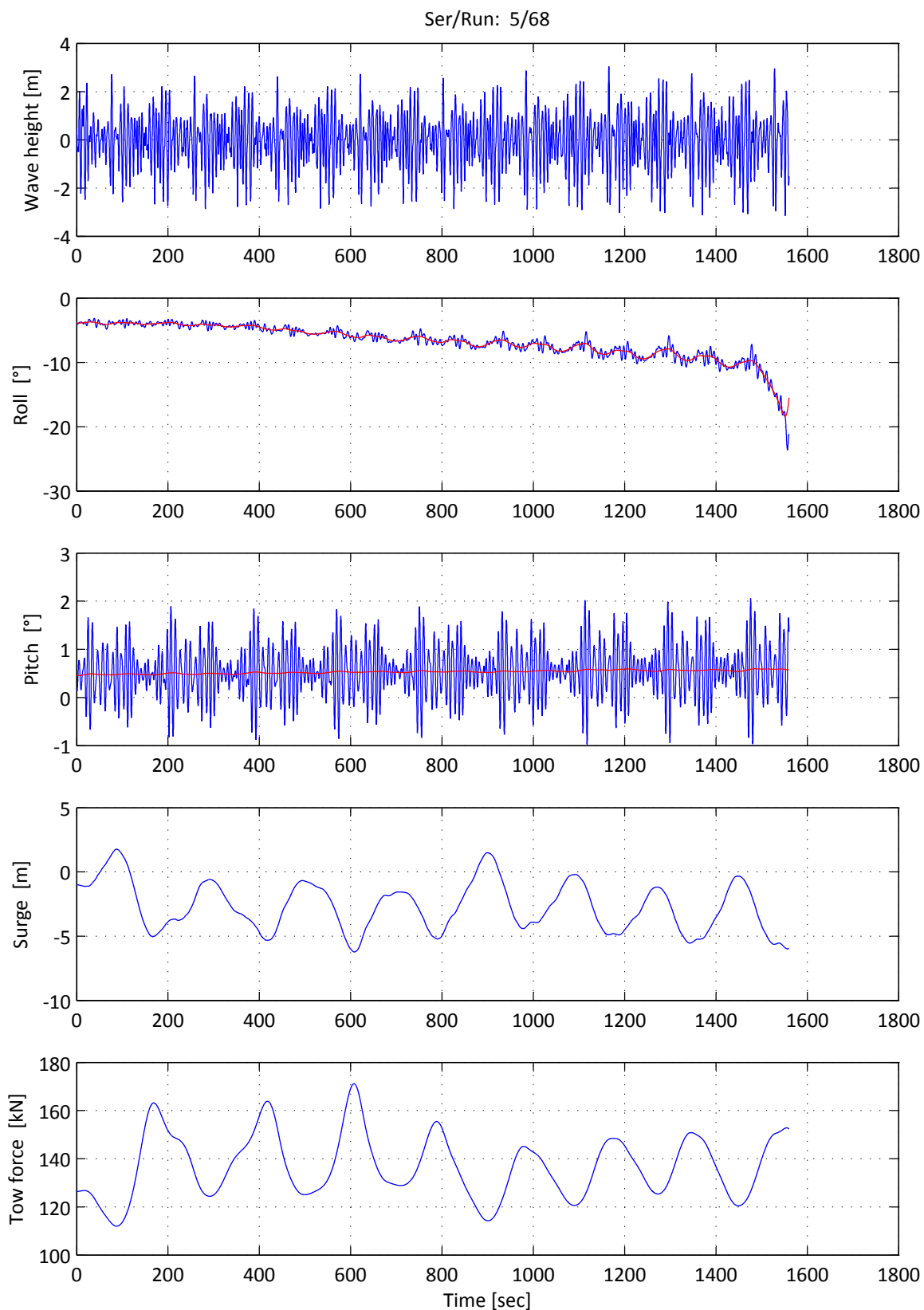
$H_{1/3} = 4.25$ m $T_p = 8.25$ sec $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 19



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Jonswap spectrum

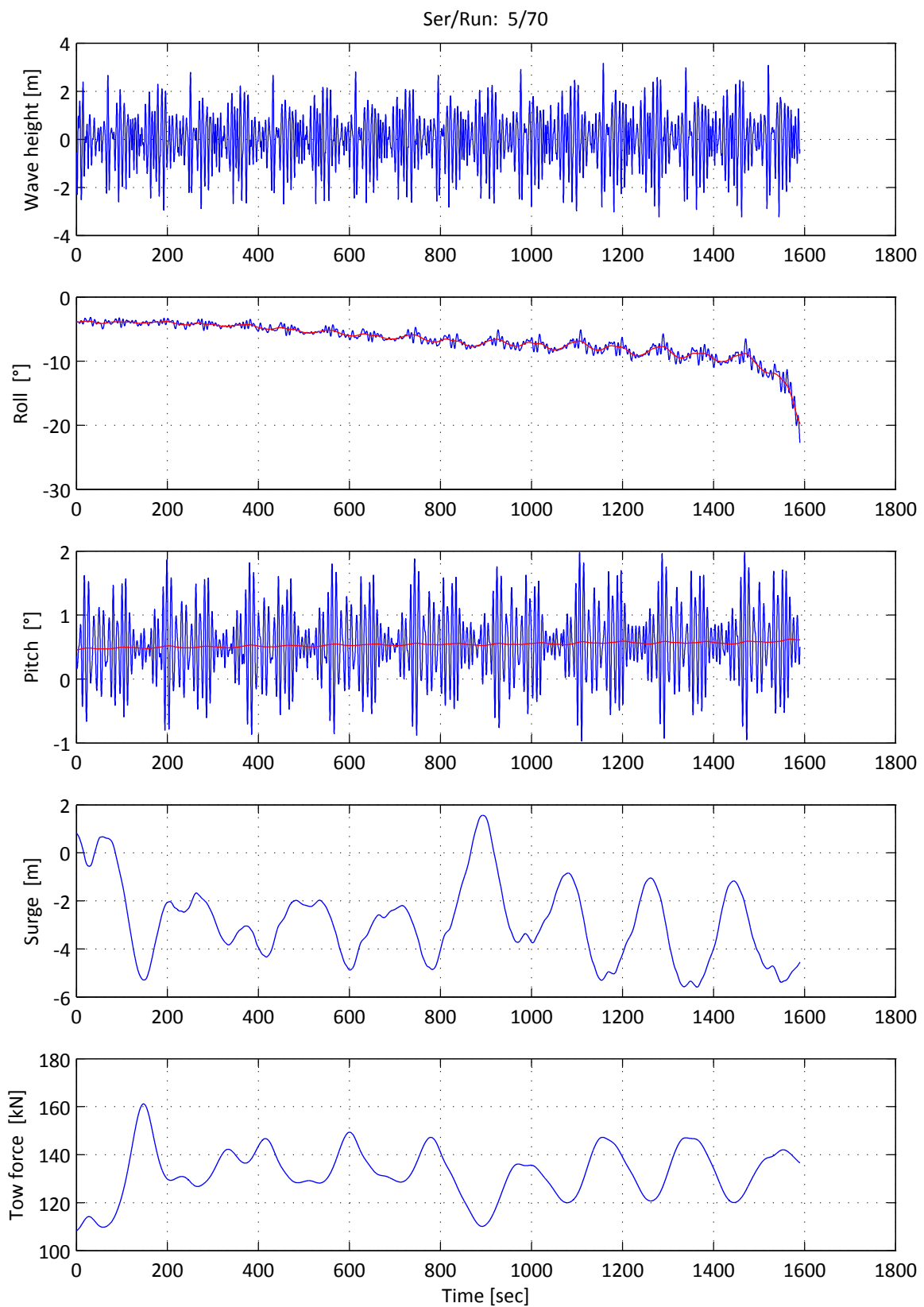
$H_{1/3} = 4.25$ m $T_p = 8.25$ sec $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 20



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Jonswap spectrum

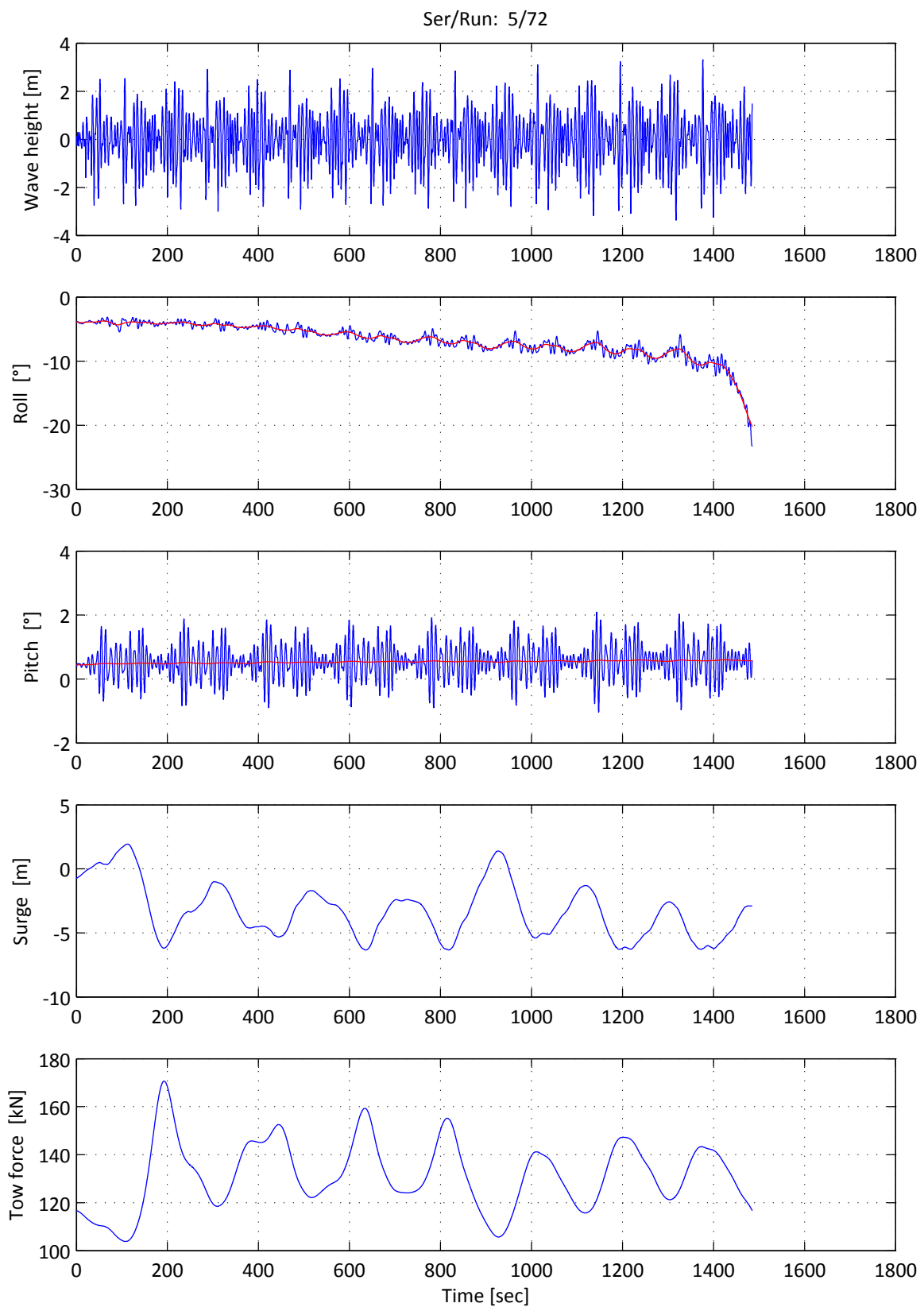
$H_{1/3} = 4.25$ m $T_p = 8.25$ sec $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 21



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Jonswap spectrum

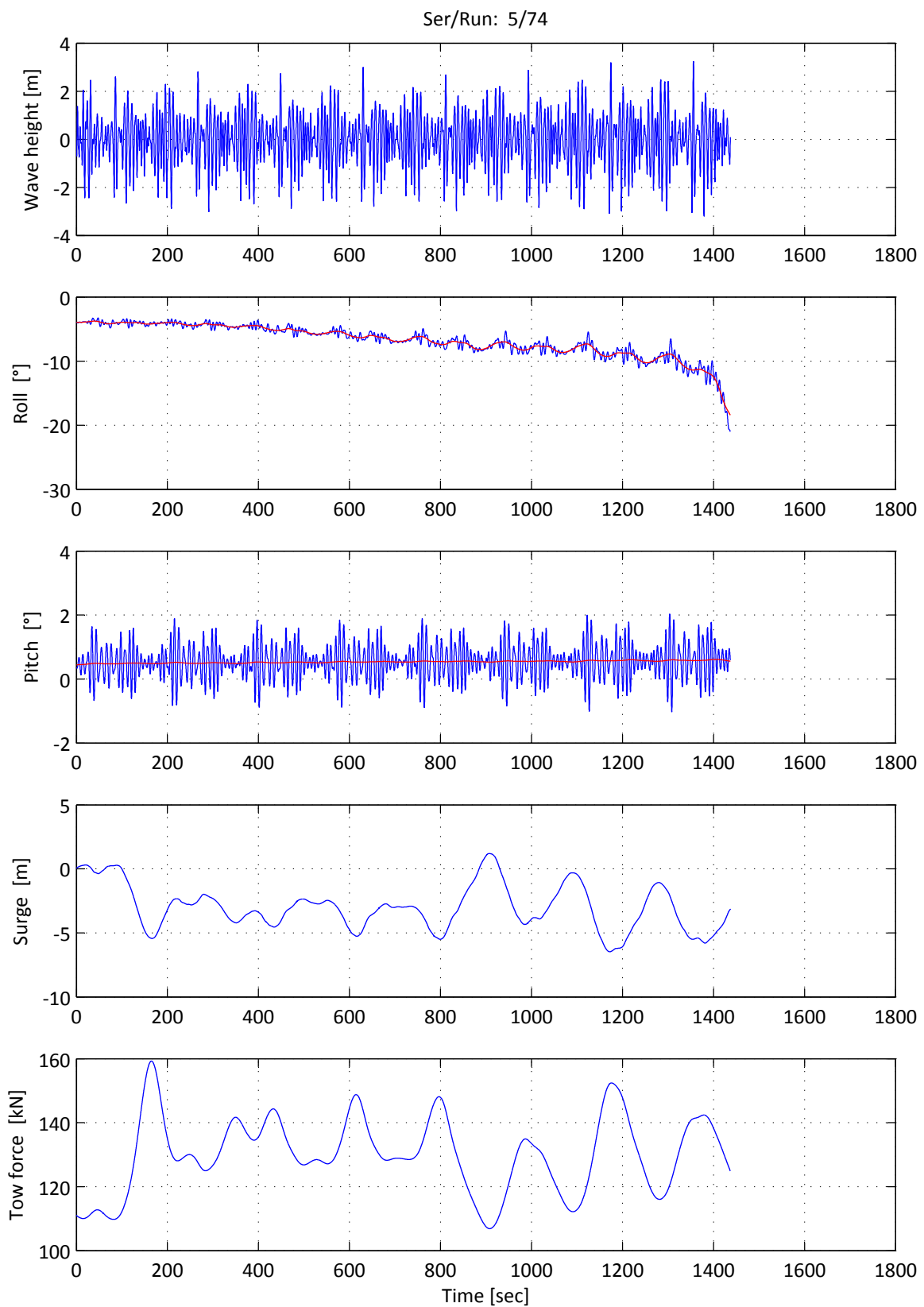
$H_{1/3} = 4.25$ m $T_p = 8.25$ sec $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 0.0 knot

Appendix: 02

Figure: 22



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Jonswap spectrum

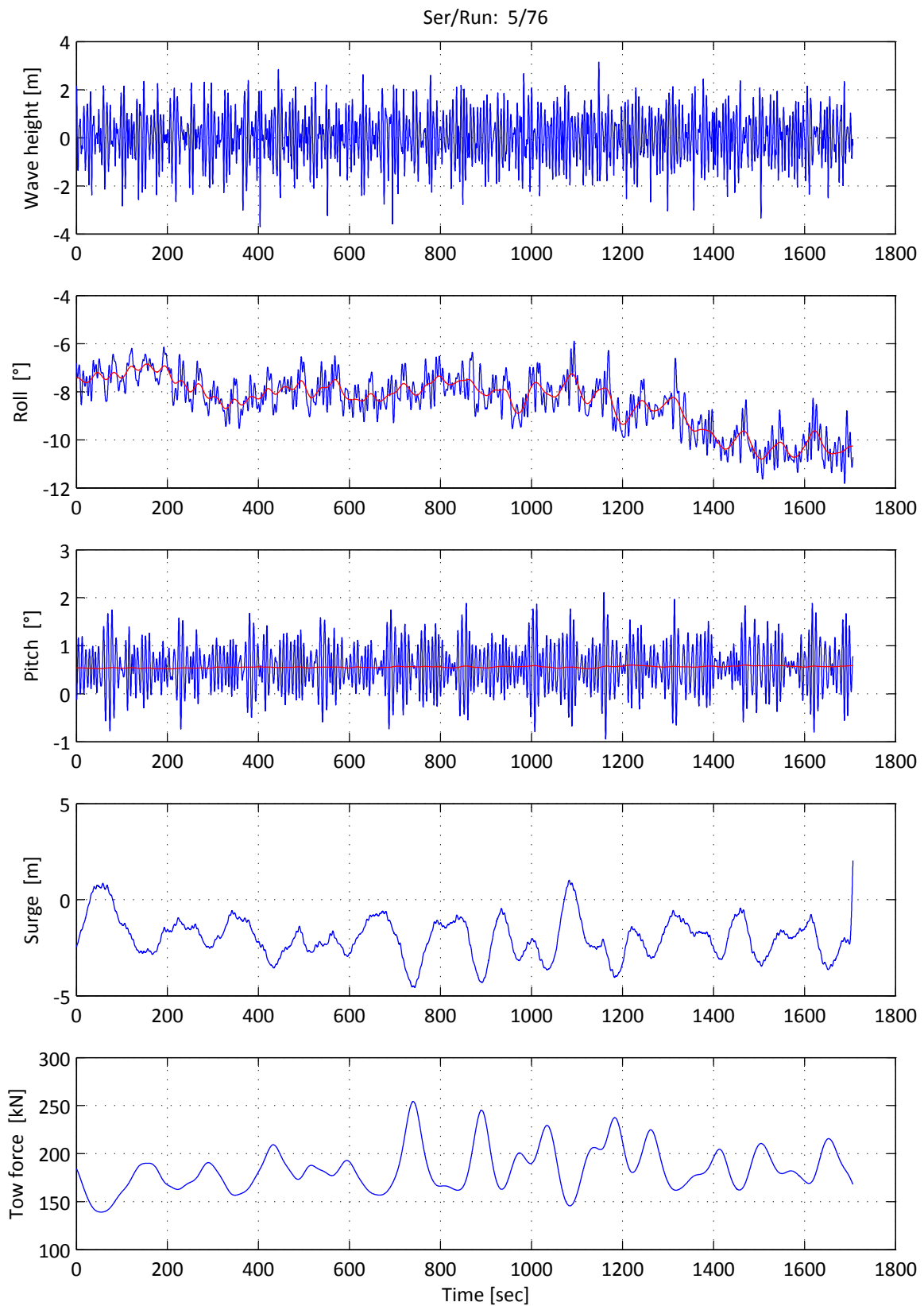
$H_{1/3} = 4 \text{ m}$ $T_p = 8.00 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 2.0 knots

Appendix: 02

Figure: 23



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Jonswap spectrum

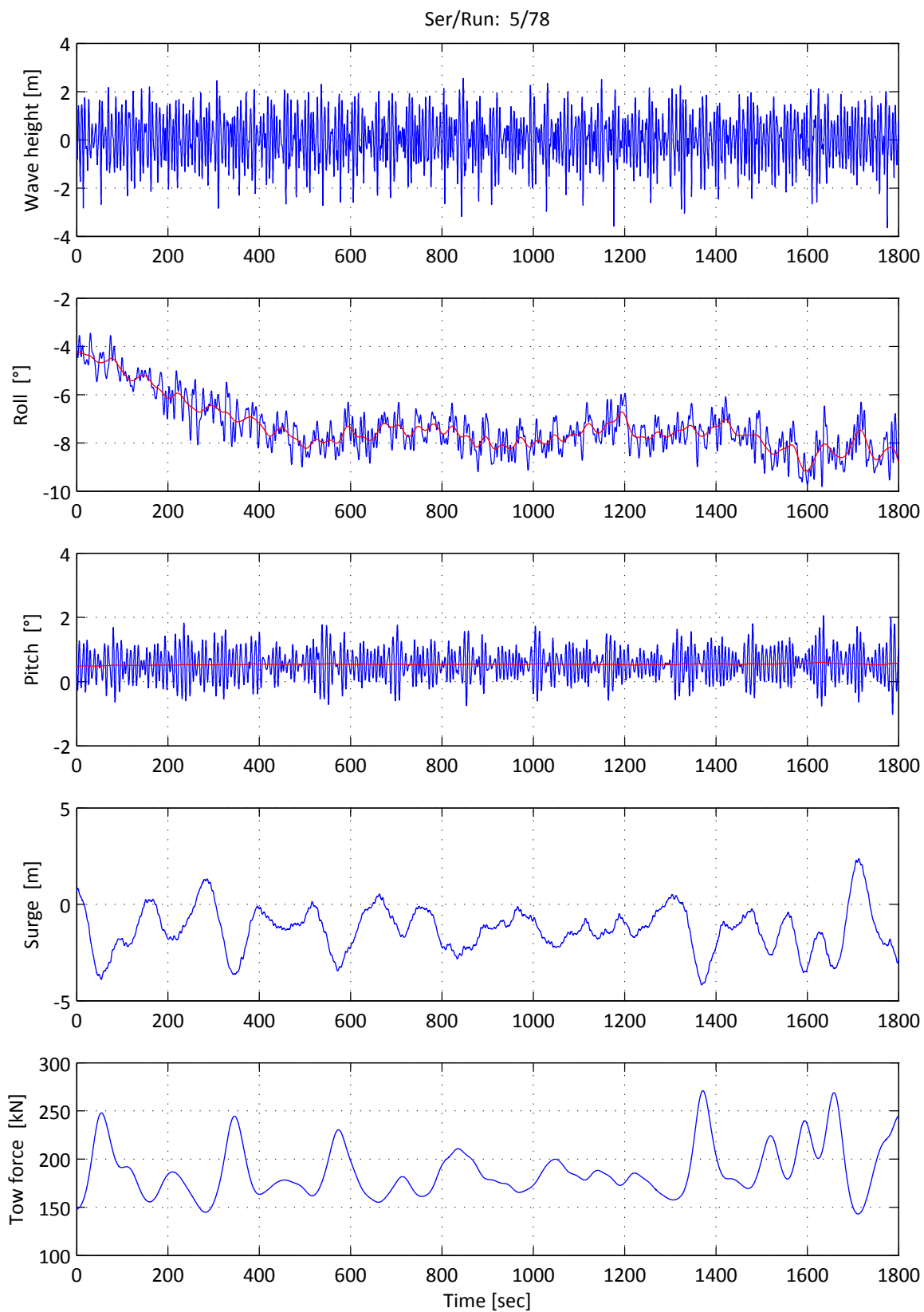
$H_{1/3} = 4 \text{ m}$ $T_p = 8.00 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 2.0 knots

Appendix: 02

Figure: 24



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Jonswap spectrum

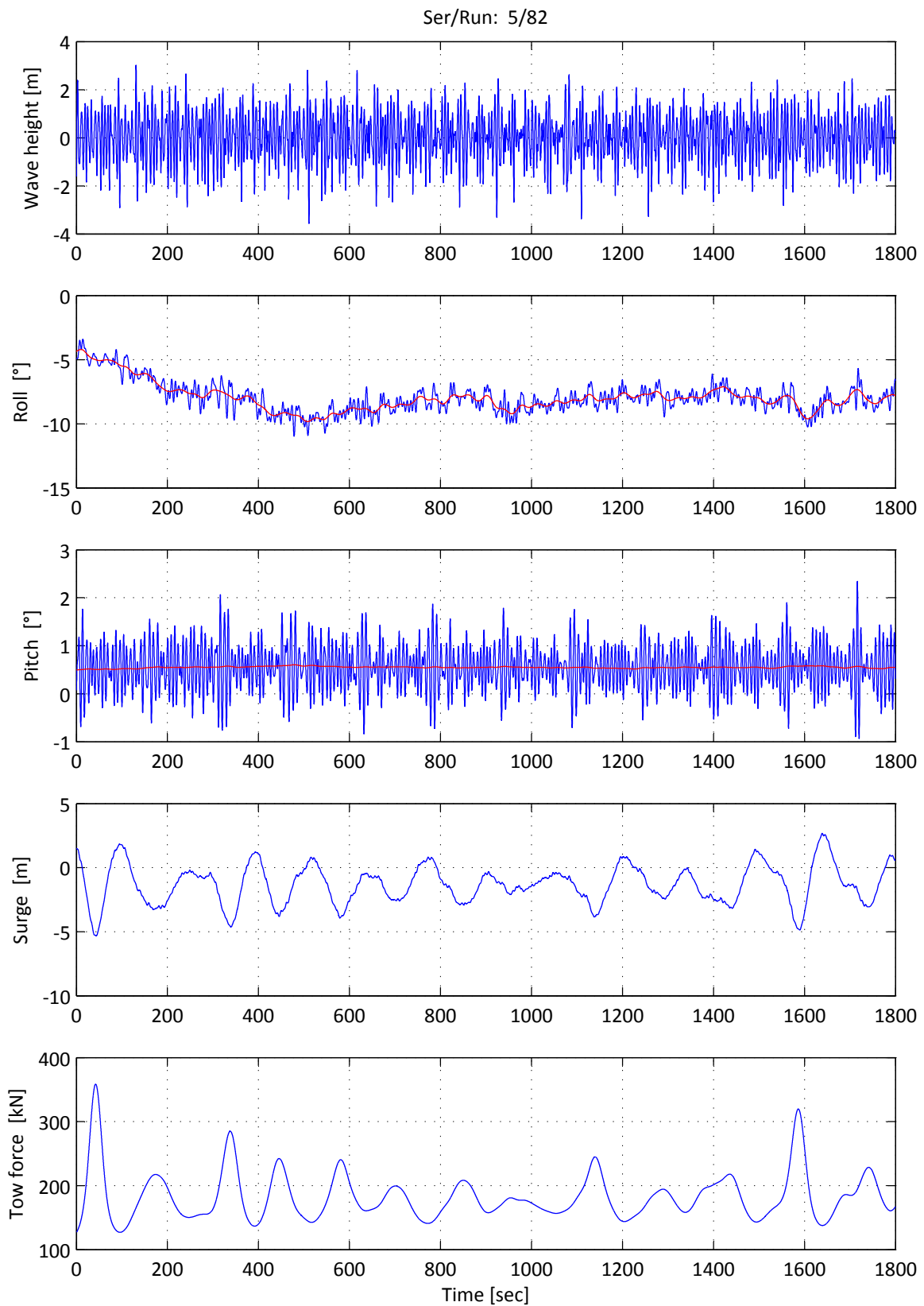
$H_{1/3} = 4 \text{ m}$ $T_p = 8.00 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 2.0 knots

Appendix: 02

Figure: 25



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Jonswap spectrum

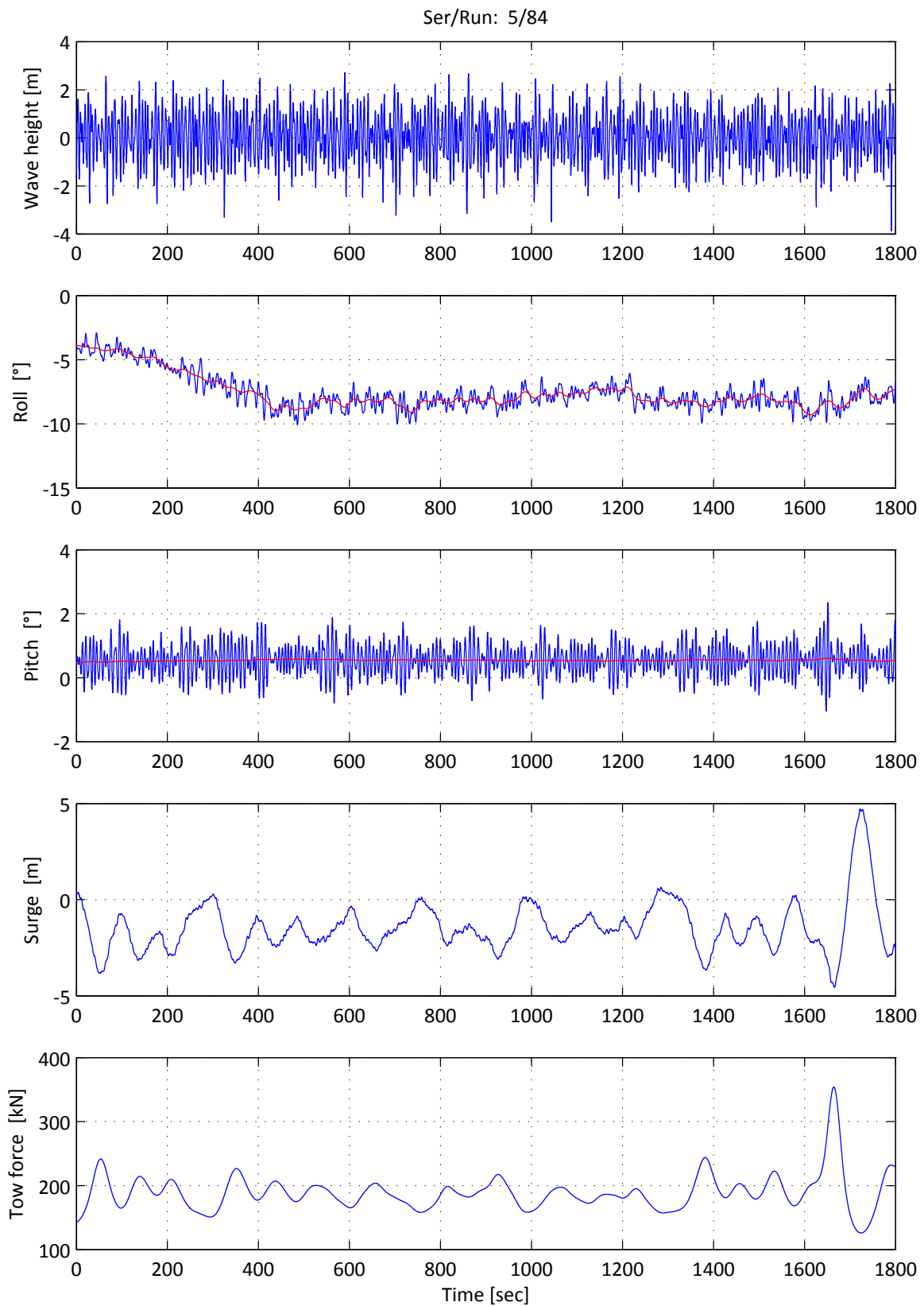
$H_{1/3} = 4 \text{ m}$ $T_p = 8.00 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 2.0 knots

Appendix: 02

Figure: 26



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Jonswap spectrum

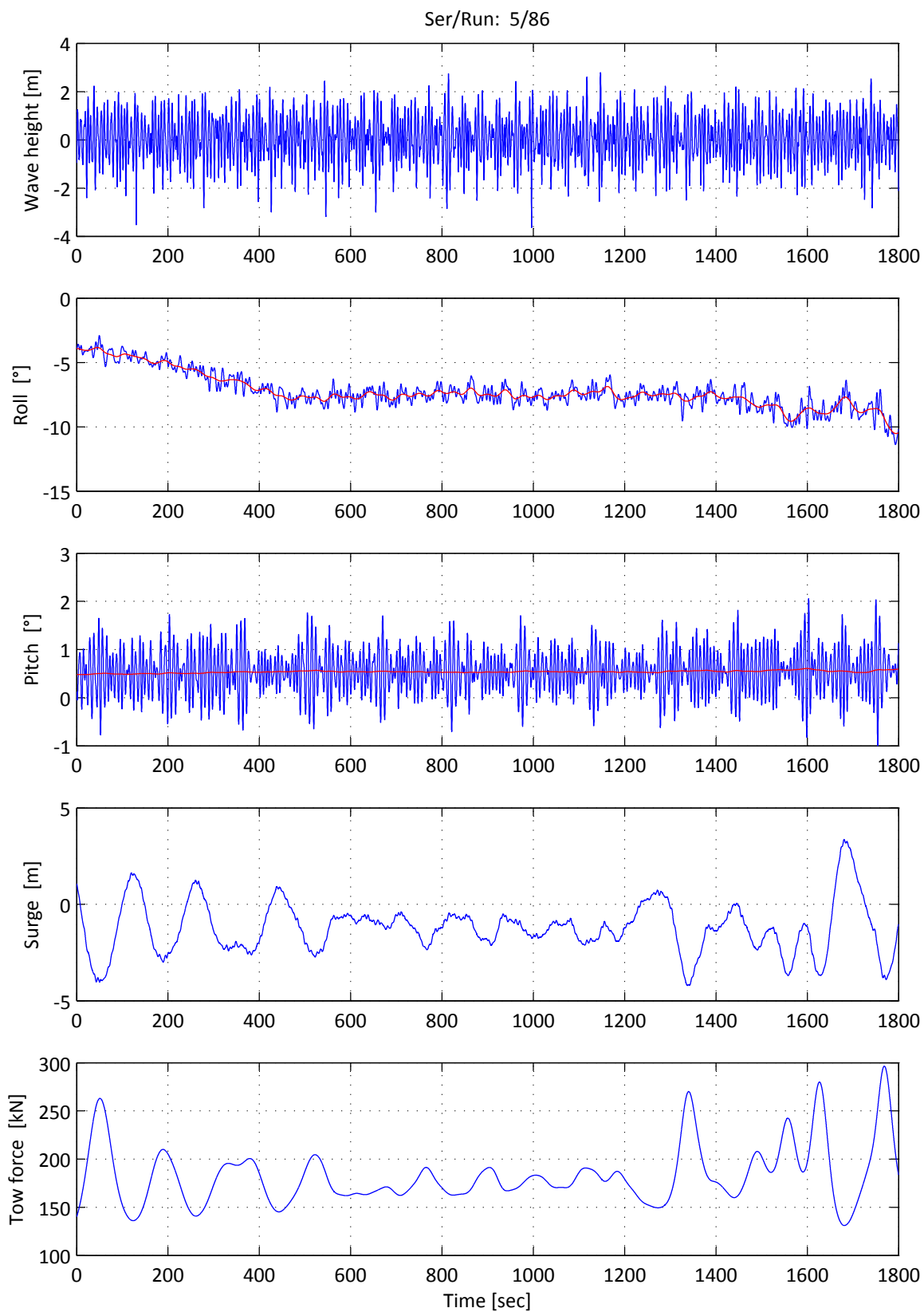
$H_{1/3} = 4 \text{ m}$ $T_p = 8.00 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 2.0 knots

Appendix: 02

Figure: 27



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Jonswap spectrum

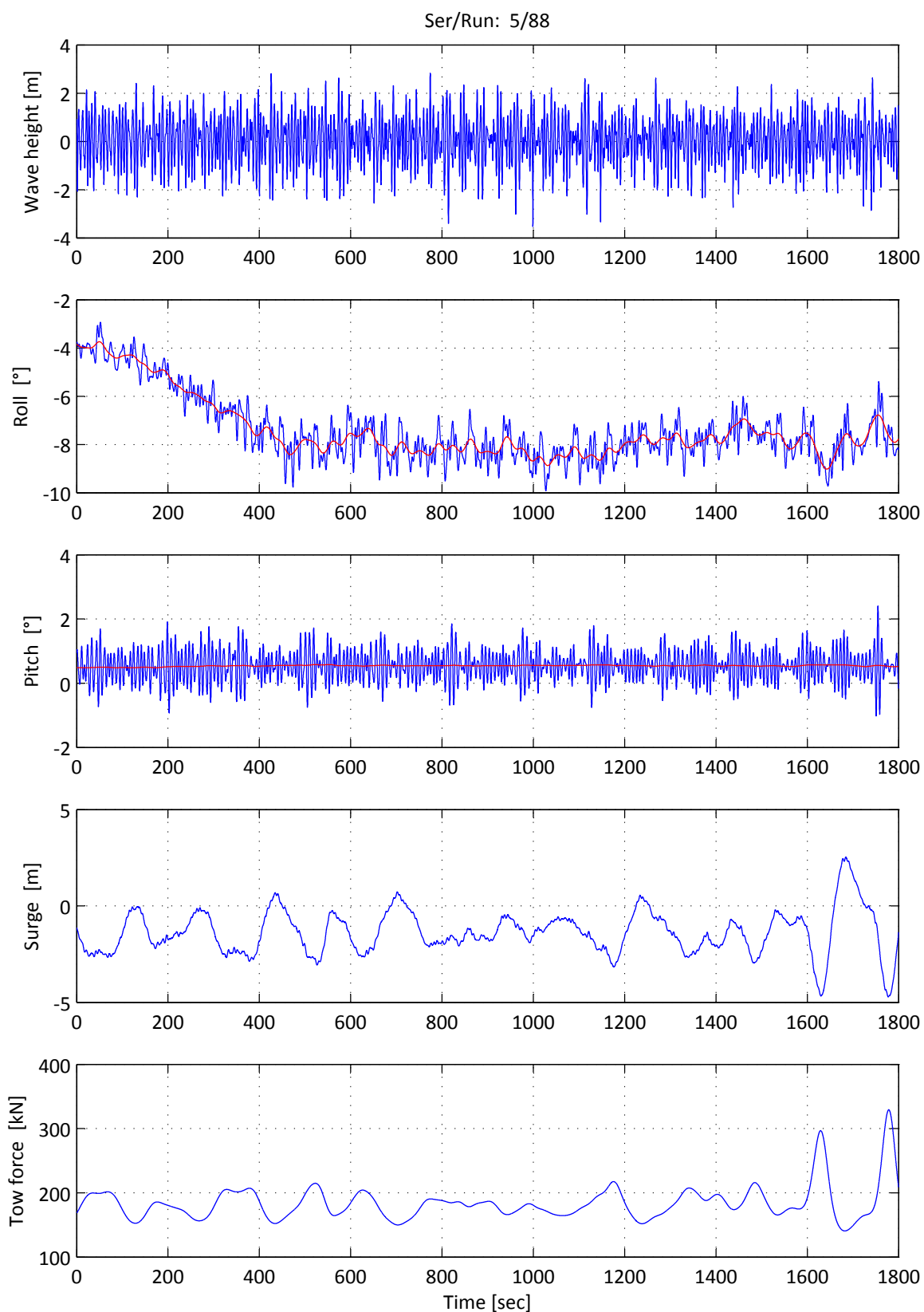
$H_{1/3} = 4 \text{ m}$ $T_p = 8.00 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 2.0 knots

Appendix: 02

Figure: 28



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Jonswap spectrum

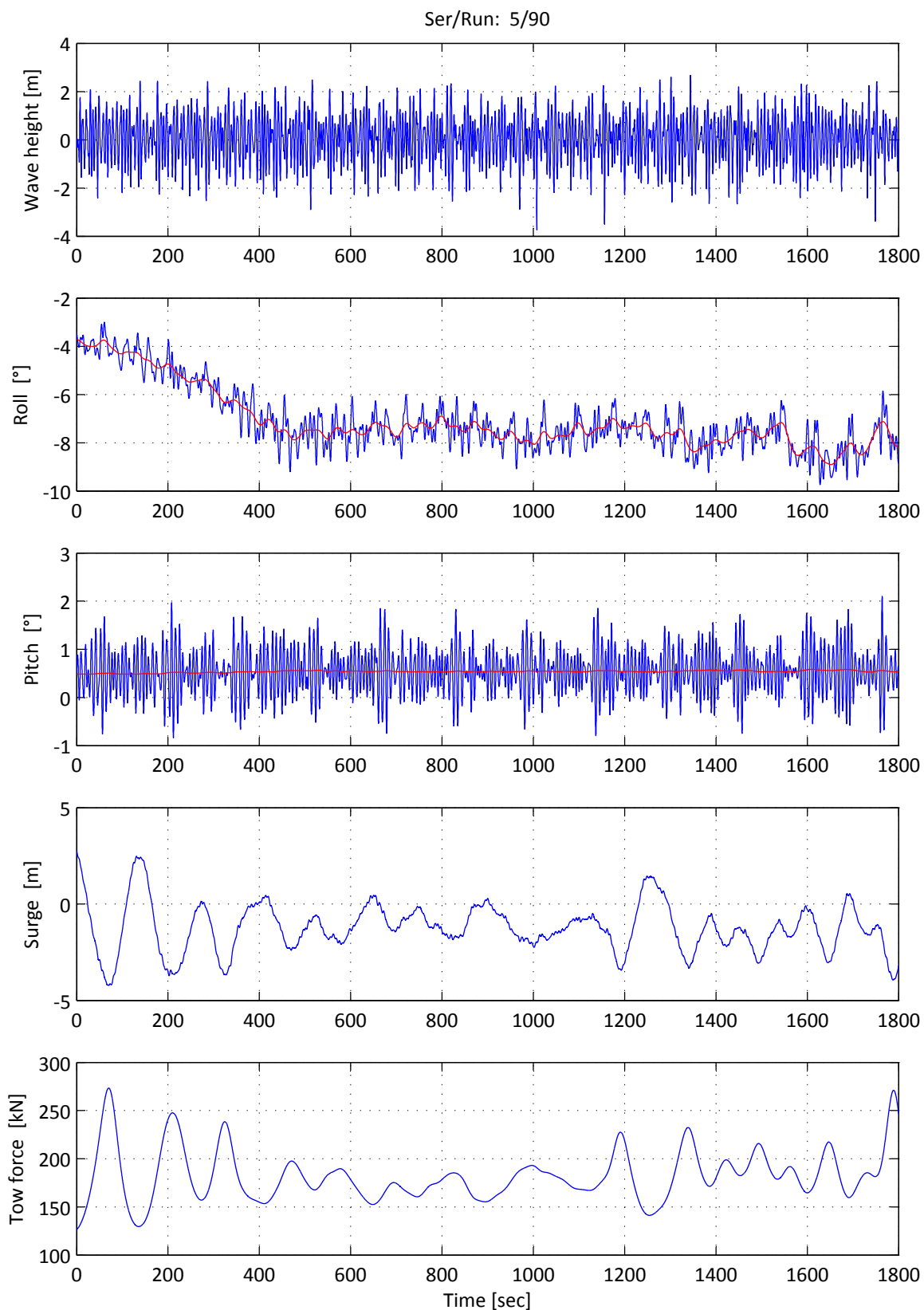
$H_{1/3} = 4 \text{ m}$ $T_p = 8.00 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 2.0 knots

Appendix: 02

Figure: 29



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Jonswap spectrum

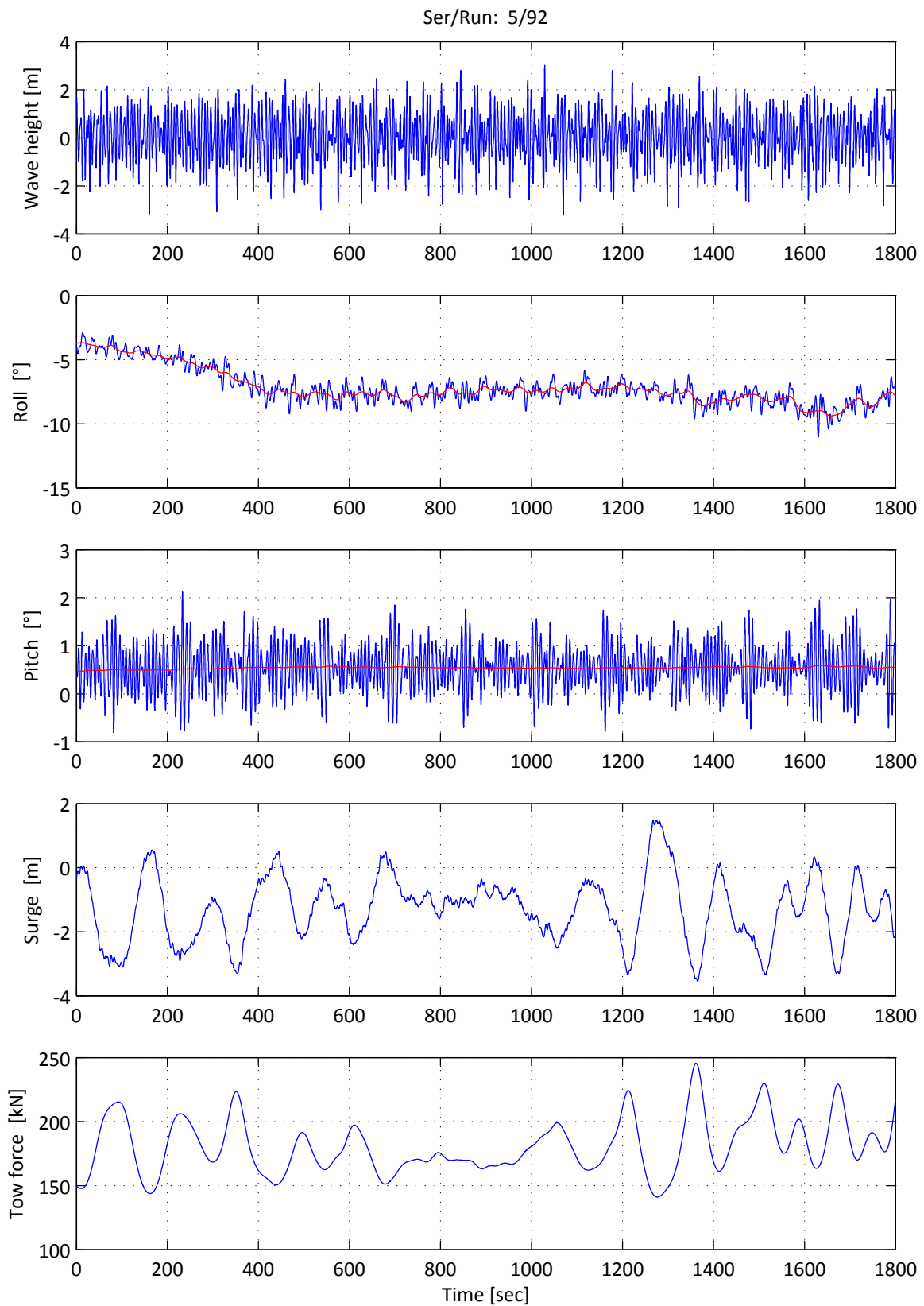
$H_{1/3} = 4 \text{ m}$ $T_p = 8.00 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 2.0 knots

Appendix: 02

Figure: 30



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Jonswap spectrum

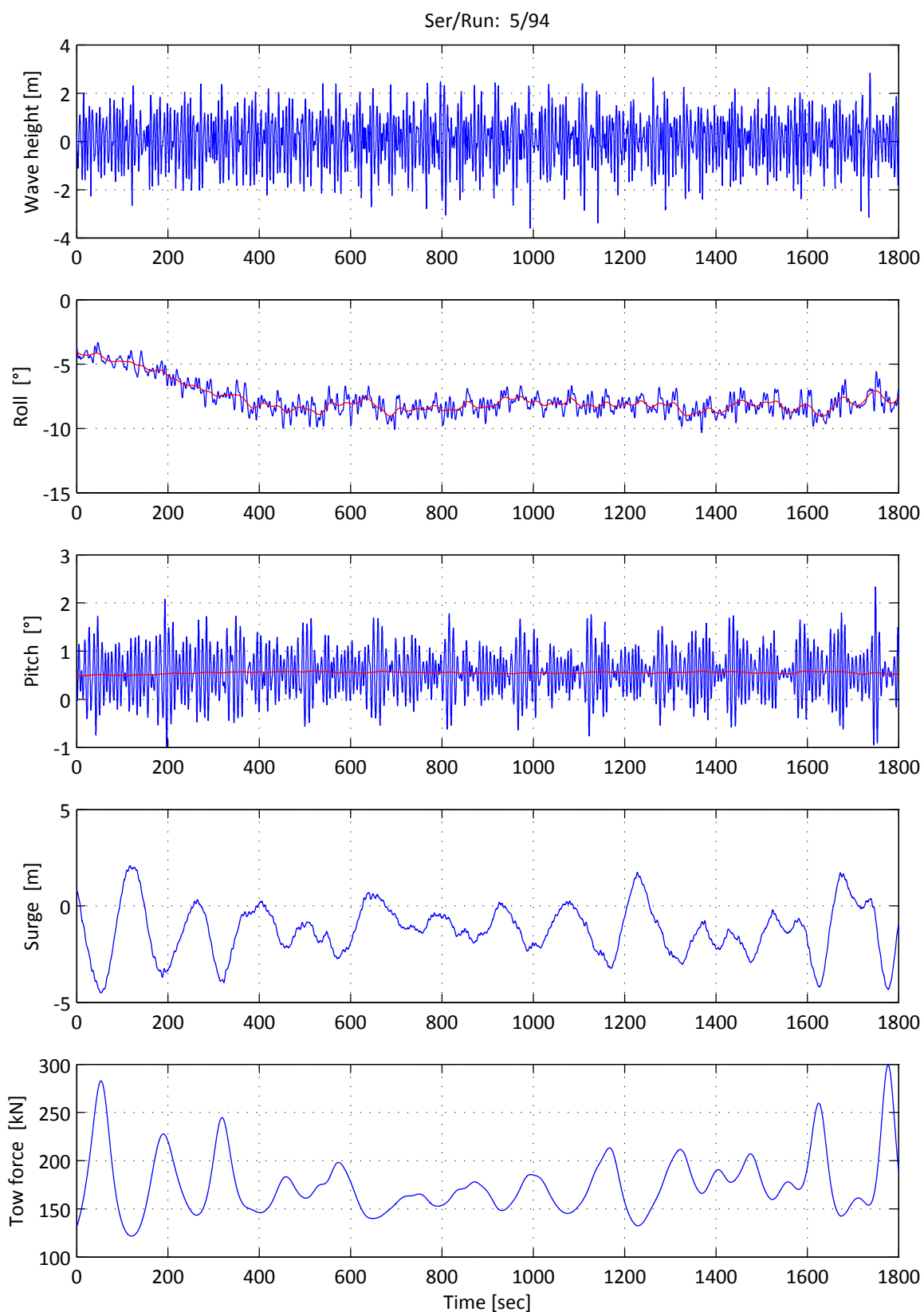
$H_{1/3} = 4 \text{ m}$ $T_p = 8.00 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 2.0 knots

Appendix: 02

Figure: 31



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Jonswap spectrum

$H_{1/3} = 4 \text{ m}$ $T_p = 8.00 \text{ sec}$ $\gamma = 3.3$

Water depth: 102.0 m

Tow speed: 2.0 knots

Appendix: 02

Figure: 32

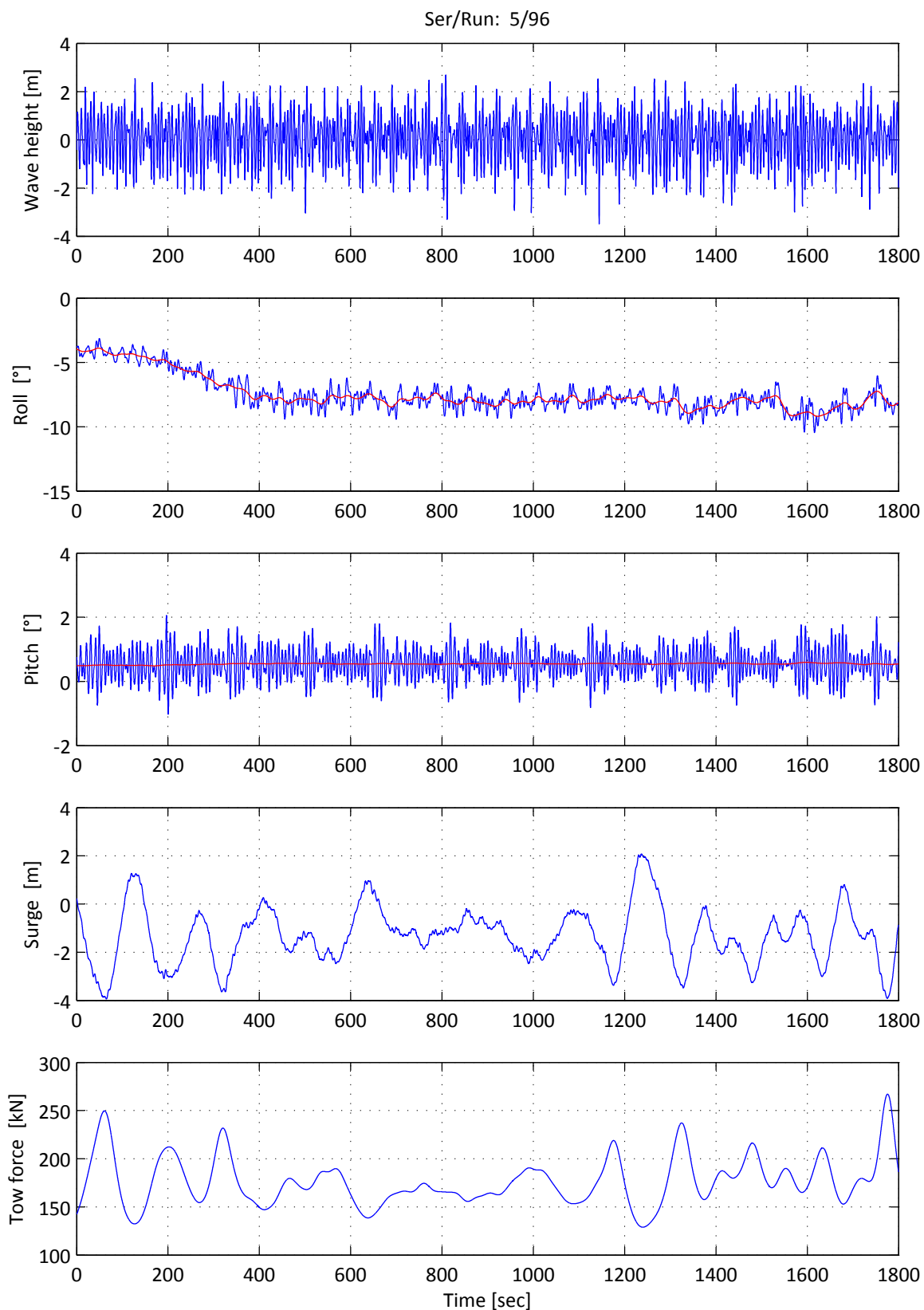


Table of contents

Figure [no.]	Wave height [m]	Spectral peak period [sec]	Tow speed [knots]	Serie [no.]	Run [no.]
1	3.50	7.48	0	5	27
2	3.75	7.75	0	5	32
3	4.00	8.00	0	5	46
4	4.00	8.00	0	5	48
5	4.00	8.00	0	5	50
6	4.00	8.00	0	5	52
7	4.00	8.00	0	5	54
8	4.00	8.00	0	5	56
9	4.00	8.00	0	5	58
10	4.00	8.00	0	5	60
11	4.00	8.00	0	5	62
12	4.00	8.00	0	5	64
13	4.25	8.25	0	5	36
14	4.25	8.25	0	5	38
15	4.25	8.25	0	5	40
16	4.25	8.25	0	5	42
17	4.25	8.25	0	5	44
18	4.25	8.25	0	5	66
19	4.25	8.25	0	5	68
20	4.25	8.25	0	5	70
21	4.25	8.25	0	5	72
22	4.25	8.25	0	5	74

Figure [no.]	Wave height [m]	Spectral peak period [sec]	Tow speed [knots]	Serie [no.]	Run [no.]
23	4.00	8.00	2.00	5	76
24	4.00	8.00	2.00	5	78
25	4.00	8.00	2.00	5	82
26	4.00	8.00	2.00	5	84
27	4.00	8.00	2.00	5	86
28	4.00	8.00	2.00	5	88
29	4.00	8.00	2.00	5	90
30	4.00	8.00	2.00	5	92
31	4.00	8.00	2.00	5	94
32	4.00	8.00	2.00	5	96

Definitions

Statistical analysis of all measured signals includes min, mean, max and significant values according to:

Minimum value =

$$x_{\min} < x_i \quad (i = 1, 2, 3 \dots N)$$

Mean value =

$$\bar{x} = \frac{1}{N} \sum_{i=1}^N x_i$$

Maximum value =

$$x_{\max} > x_i \quad (i = 1, 2, 3 \dots N)$$

Where: $x_i \quad (i = 1, 2, 3 \dots N)$ = measured signal

N = Number of samples (measurement time) \times (sampling frequency)

Significant single amplitude = $2 \cdot \sigma$

Significant double amplitude = $4 \cdot \sigma$

Where:

$$\sigma^2 = \frac{1}{N} \sum_{i=1}^N (x_i - \bar{x})^2$$

All significant values of measured signals are given as significant single amplitudes except wave height, which is given as significant double amplitude.

Zero crossing period

Suppose the total number of zero up crossings is $nc+1 = t_0, t_1 \dots t_{nc}$ then the zero crossing period, T_z is estimated according to:

$$T_z = (t_{nc} - t_0) / nc$$

Note that: Nominal wave height = Total significant wave height

Nominal wave period = Spectral peak period for Jonswap spectrum

```

Ser no           :      5
Run no          :     27
Scale factor     :    40.000
Measuring time   :   29 min 58 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    0.00 knots
Ship length      :   137.40 m
Wave heading     :   180.00 deg
Water depth      :   102.00 m
Nominal wave height :    3.50 m
Nominal wave period :    7.48 sec

```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-2.76	0.02	2.37	3.61*	6.73
Wave heading	[deg]	-182.10	-180.00	-178.48	1.51	55.28
Tow line force	[kN]	95.42	111.28	137.16	13.55	230.23
Surge	[m]	-5.79	-1.17	2.47	3.03	217.53
Sway	[m]	-4.75	-0.92	0.25	1.81	436.96
Heave	[m]	0.24	0.65	1.06	0.24	7.77
Roll	[deg]	-4.90	-3.87	-2.97	0.69	12.30
Pitch	[deg]	-0.45	0.47	1.31	0.63	7.73
Yaw	[deg]	-0.18	0.00	0.20	0.14	7.83
Roll(filt)	[deg]	-4.10	-3.87	-3.56	0.27	81.89
Pitch(filt)	[deg]	0.45	0.47	0.50	0.02	82.42
Pull point position	[m]	16.40	16.41	16.42	0.01	0.54

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

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Statistical tables from wave tests

Appendix: 03

Figure: 2

```
Ser no          :      5
Run no          :     32
Scale factor    :   40.000
Measuring time  : 29 min 58 sec
Sampling frequency :   7.906 Hz
Ship speed (Nominal) :   0.00 knots
Ship length     :  137.40 m
Wave heading    :  180.00 deg
Water depth     :  102.00 m
Nominal wave height :   3.75 m
Nominal wave period :   7.75 sec
```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.50	0.05	2.85	3.79*	6.56
Wave heading	[deg]	177.00	179.75	182.98	2.88	170.76
Tow line force	[kN]	110.05	127.14	150.41	18.29	180.56
Surge	[m]	-7.09	-4.03	-1.65	2.60	140.80
Sway	[m]	-2.15	-0.18	2.68	2.48	341.21
Heave	[m]	0.07	0.69	1.31	0.41	7.49
Roll	[deg]	-9.85	-6.67	-3.26	3.41	62.20
Pitch	[deg]	-0.84	0.54	2.00	0.94	8.10
Yaw	[deg]	-0.29	-0.00	0.22	0.16	8.07
Roll(filt)	[deg]	-8.96	-6.67	-3.80	3.25	48.83
Pitch(filt)	[deg]	0.48	0.54	0.58	0.04	190.47
Pull point position	[m]	17.49	17.50	17.52	0.01	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

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Statistical tables from wave tests

Appendix: 03

Figure: 3

```
Ser no      :      5
Run no      :      46
Scale factor :    40.000
Measuring time : 29 min 58 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    0.00 knots
Ship length :   137.40 m
Wave heading :   180.00 deg
Water depth  :   102.00 m
Nominal wave height :    4.00 m
Nominal wave period :    8.00 sec
```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.66	0.01	2.35	3.91*	6.73
Wave heading	[deg]	178.25	180.75	184.92	2.66	63.65
Tow line force	[kN]	101.53	130.30	170.55	20.59	196.20
Surge	[m]	-6.25	-2.01	3.08	3.18	154.19
Sway	[m]	-2.62	0.39	3.18	1.98	226.61
Heave	[m]	0.24	0.68	1.12	0.35	8.00
Roll	[deg]	-8.07	-5.38	-3.17	2.32	18.85
Pitch	[deg]	-0.72	0.52	1.72	0.81	8.65
Yaw	[deg]	-0.19	0.00	0.21	0.14	7.96
Roll(filt)	[deg]	-7.08	-5.38	-3.75	2.21	0.00
Pitch(filt)	[deg]	0.46	0.51	0.56	0.04	91.04
Pull point position	[m]	18.15	18.17	18.19	0.01	0.58

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

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Statistical tables from wave tests

Appendix: 03

Figure: 4

```
Ser no          :      5
Run no          :      48
Scale factor    :    40.000
Measuring time  :   29 min 58 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    0.00 knots
Ship length     :   137.40 m
Wave heading    :   180.00 deg
Water depth     :   102.00 m
Nominal wave height :    4.00 m
Nominal wave period :    8.00 sec
```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.63	0.01	2.46	3.94*	6.71
Wave heading	[deg]	178.07	180.73	183.51	2.29	97.67
Tow line force	[kN]	109.33	131.41	152.36	13.67	159.06
Surge	[m]	-4.49	-1.54	2.04	2.21	141.71
Sway	[m]	-1.97	0.21	1.85	1.53	237.87
Heave	[m]	0.21	0.68	1.12	0.35	7.72
Roll	[deg]	-7.57	-4.85	-3.07	1.79	29.64
Pitch	[deg]	-0.74	0.49	1.66	0.80	8.53
Yaw	[deg]	-0.18	0.00	0.20	0.14	8.02
Roll(filt)	[deg]	-6.68	-4.85	-3.76	1.66	77.67
Pitch(filt)	[deg]	0.44	0.49	0.53	0.03	88.29
Pull point position	[m]	18.15	18.17	18.19	0.01	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

```

Ser no           :      5
Run no          :     50
Scale factor     :   40.000
Measuring time   : 29 min 58 sec
Sampling frequency : 7.906 Hz
Ship speed (Nominal) : 0.00 knots
Ship length      : 137.40 m
Wave heading     : 180.00 deg
Water depth      : 102.00 m
Nominal wave height : 4.00 m
Nominal wave period : 8.00 sec

```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.75	0.02	2.33	3.91*	6.71
Wave heading	[deg]	178.15	180.24	182.90	2.43	88.84
Tow line force	[kN]	106.13	121.27	134.59	9.83	142.52
Surge	[m]	-3.72	-1.68	0.24	1.55	140.53
Sway	[m]	-2.33	-0.25	2.37	2.19	197.93
Heave	[m]	0.23	0.69	1.12	0.36	7.79
Roll	[deg]	-7.82	-5.29	-3.24	2.11	22.58
Pitch	[deg]	-0.76	0.50	1.67	0.81	8.70
Yaw	[deg]	-0.18	0.00	0.20	0.14	7.76
Roll(filt)	[deg]	-6.99	-5.29	-3.80	2.00	74.25
Pitch(filt)	[deg]	0.46	0.50	0.53	0.03	88.92
Pull point position	[m]	18.15	18.17	18.19	0.01	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

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Statistical tables from wave tests

Appendix: 03

Figure: 6

```
Ser no          :      5
Run no          :     52
Scale factor    :   40.000
Measuring time  : 29 min 58 sec
Sampling frequency :   7.906 Hz
Ship speed (Nominal) :   0.00 knots
Ship length     :  137.40 m
Wave heading    :  180.00 deg
Water depth     :  102.00 m
Nominal wave height :   4.00 m
Nominal wave period :   8.00 sec
```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.63	0.01	2.30	3.90*	6.68
Wave heading	[deg]	179.19	180.68	182.57	1.54	67.26
Tow line force	[kN]	103.55	122.51	155.50	16.04	138.68
Surge	[m]	-5.63	-1.88	1.50	2.48	135.36
Sway	[m]	-1.01	0.24	1.47	1.07	351.14
Heave	[m]	0.20	0.68	1.12	0.35	7.72
Roll	[deg]	-7.00	-4.87	-3.18	1.52	30.27
Pitch	[deg]	-0.71	0.49	1.65	0.79	8.56
Yaw	[deg]	-0.20	-0.00	0.22	0.14	8.08
Roll(filt)	[deg]	-6.26	-4.87	-3.94	1.38	82.35
Pitch(filt)	[deg]	0.46	0.49	0.53	0.03	95.06
Pull point position	[m]	18.15	18.17	18.19	0.01	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

```

Ser no           :      5
Run no          :     54
Scale factor     :   40.000
Measuring time   : 29 min 38 sec
Sampling frequency : 7.906 Hz
Ship speed (Nominal) : 0.00 knots
Ship length      : 137.40 m
Wave heading     : 180.00 deg
Water depth      : 102.00 m
Nominal wave height : 4.00 m
Nominal wave period : 8.00 sec

```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.35	0.02	2.52	3.90*	6.86
Wave heading	[deg]	179.23	180.55	181.78	1.15	64.67
Tow line force	[kN]	102.32	123.70	147.20	16.35	190.26
Surge	[m]	-4.50	-1.20	1.91	2.61	152.66
Sway	[m]	-1.37	-0.29	1.35	1.13	371.79
Heave	[m]	0.24	0.68	1.11	0.35	7.69
Roll	[deg]	-7.38	-4.94	-2.94	1.86	26.62
Pitch	[deg]	-0.74	0.49	1.63	0.79	8.59
Yaw	[deg]	-0.18	-0.00	0.20	0.14	7.70
Roll(filt)	[deg]	-6.68	-4.94	-3.85	1.73	64.26
Pitch(filt)	[deg]	0.46	0.49	0.53	0.04	96.97
Pull point position	[m]	18.15	18.17	18.19	0.01	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

```

Ser no           :      5
Run no          :     56
Scale factor     :    40.000
Measuring time   :   29 min 58 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    0.00 knots
Ship length      :   137.40 m
Wave heading     :   180.00 deg
Water depth      :   102.00 m
Nominal wave height :    4.00 m
Nominal wave period :    8.00 sec

```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.25	0.01	2.62	3.92*	6.85
Wave heading	[deg]	178.74	181.04	183.56	2.28	4.43
Tow line force	[kN]	107.01	123.84	143.12	13.74	172.53
Surge	[m]	-4.12	-1.41	1.15	2.15	140.25
Sway	[m]	-0.70	0.74	2.81	1.74	193.66
Heave	[m]	0.21	0.68	1.11	0.36	7.79
Roll	[deg]	-6.84	-4.49	-2.92	1.46	26.13
Pitch	[deg]	-0.73	0.49	1.63	0.79	8.65
Yaw	[deg]	-0.20	0.00	0.21	0.13	7.47
Roll(filt)	[deg]	-6.30	-4.49	-3.77	1.30	82.09
Pitch(filt)	[deg]	0.45	0.49	0.53	0.03	88.78
Pull point position	[m]	18.15	18.17	18.19	0.01	0.58

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

FLOODSTAND

Statistical tables from wave tests

Appendix: 03

Figure: 9

```
Ser no      :      5
Run no      :      58
Scale factor :    40.000
Measuring time : 29 min 58 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    0.00 knots
Ship length :   137.40 m
Wave heading :   180.00 deg
Water depth  :   102.00 m
Nominal wave height :    4.00 m
Nominal wave period :    8.00 sec
```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.49	0.01	2.53	3.91*	6.77
Wave heading	[deg]	177.94	180.41	182.55	2.14	57.60
Tow line force	[kN]	105.96	130.05	165.79	26.27	217.76
Surge	[m]	-6.24	-1.99	1.93	4.13	213.90
Sway	[m]	-1.98	-0.72	0.87	1.47	356.45
Heave	[m]	0.21	0.68	1.14	0.35	7.85
Roll	[deg]	-7.03	-4.69	-3.11	1.50	24.35
Pitch	[deg]	-0.75	0.49	1.66	0.80	8.61
Yaw	[deg]	-0.21	-0.00	0.20	0.14	7.61
Roll(filt)	[deg]	-6.14	-4.69	-3.75	1.36	79.18
Pitch(filt)	[deg]	0.45	0.49	0.53	0.03	94.61
Pull point position	[m]	18.15	18.17	18.18	0.01	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

FLOODSTAND

Statistical tables from wave tests

Appendix: 03

Figure: 10

```
Ser no      :      5
Run no      :      60
Scale factor :    40.000
Measuring time : 29 min 58 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    0.00 knots
Ship length :   137.40 m
Wave heading :   180.00 deg
Water depth  :   102.00 m
Nominal wave height :    4.00 m
Nominal wave period :    8.00 sec
```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.62	0.01	2.42	3.95*	6.61
Wave heading	[deg]	178.91	181.13	183.92	2.98	89.14
Tow line force	[kN]	101.88	119.59	138.48	11.99	148.67
Surge	[m]	-4.35	-1.40	1.51	2.03	146.71
Sway	[m]	-1.18	0.28	2.51	2.13	0.00
Heave	[m]	0.21	0.68	1.12	0.35	7.89
Roll	[deg]	-6.96	-4.70	-3.02	1.55	27.89
Pitch	[deg]	-0.70	0.49	1.66	0.79	8.52
Yaw	[deg]	-0.21	-0.00	0.22	0.14	7.41
Roll(filt)	[deg]	-6.30	-4.70	-3.89	1.42	53.72
Pitch(filt)	[deg]	0.47	0.49	0.53	0.03	88.20
Pull point position	[m]	18.15	18.17	18.18	0.01	0.60

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

```

Ser no           :      5
Run no          :      62
Scale factor     :    40.000
Measuring time   :    29 min 58 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    0.00 knots
Ship length      :    137.40 m
Wave heading     :    180.00 deg
Water depth      :    102.00 m
Nominal wave height :    4.00 m
Nominal wave period :    8.00 sec

```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.68	0.02	2.33	3.95*	6.59
Wave heading	[deg]	179.08	180.76	183.08	2.09	0.93
Tow line force	[kN]	114.25	129.56	147.21	12.19	155.99
Surge	[m]	-4.37	-1.80	0.75	2.09	129.66
Sway	[m]	-1.38	0.48	2.16	1.81	80.07
Heave	[m]	0.21	0.70	1.16	0.35	7.82
Roll	[deg]	-6.77	-4.79	-3.18	1.47	29.46
Pitch	[deg]	-0.69	0.49	1.64	0.78	8.57
Yaw	[deg]	-0.17	-0.00	0.20	0.13	7.83
Roll(filt)	[deg]	-6.17	-4.79	-3.93	1.34	78.99
Pitch(filt)	[deg]	0.47	0.49	0.53	0.03	94.44
Pull point position	[m]	18.15	18.17	18.18	0.01	0.60

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

FLOODSTAND

Statistical tables from wave tests

Appendix: 03

Figure: 12

```
Ser no      :      5
Run no      :      64
Scale factor :    40.000
Measuring time : 29 min 58 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    0.00 knots
Ship length :   137.40 m
Wave heading :   180.00 deg
Water depth  :   102.00 m
Nominal wave height :    4.00 m
Nominal wave period :    8.00 sec
```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.68	0.02	2.49	3.98*	6.73
Wave heading	[deg]	178.80	180.86	183.72	2.60	22.72
Tow line force	[kN]	100.80	121.73	148.50	16.05	173.00
Surge	[m]	-4.93	-1.38	2.09	2.55	153.82
Sway	[m]	-1.38	0.35	3.29	2.26	83.06
Heave	[m]	0.23	0.69	1.11	0.35	7.89
Roll	[deg]	-7.22	-4.68	-2.95	1.56	29.94
Pitch	[deg]	-0.75	0.49	1.66	0.80	8.69
Yaw	[deg]	-0.20	-0.00	0.21	0.14	7.82
Roll(filt)	[deg]	-6.44	-4.68	-3.84	1.41	80.57
Pitch(filt)	[deg]	0.46	0.49	0.53	0.03	88.68
Pull point position	[m]	18.15	18.17	18.18	0.01	0.61

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

```

Ser no          :      5
Run no          :     36
Scale factor    :   40.000
Measuring time  : 25 min 49 sec
Sampling frequency :   7.906 Hz
Ship speed (Nominal) :   0.00 knots
Ship length     : 137.40 m
Wave heading    : 180.00 deg
Water depth     : 102.00 m
Nominal wave height :   4.25 m
Nominal wave period :   8.25 sec

```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.37	0.00	3.15	4.22*	7.34
Wave heading	[deg]	176.86	181.40	183.70	2.87	115.21
Tow line force	[kN]	104.15	128.41	153.30	18.89	180.48
Surge	[m]	-5.94	-2.61	1.41	3.03	141.11
Sway	[m]	-3.99	1.08	3.71	3.78	0.00
Heave	[m]	0.02	0.69	1.25	0.43	8.13
Roll	[deg]	-25.43	-6.82	-3.09	5.46	22.38
Pitch	[deg]	-1.04	0.55	2.15	1.01	9.30
Yaw	[deg]	-0.43	-0.00	0.44	0.22	8.52
Roll(filt)	[deg]	-19.98	-6.81	-3.64	5.26	80.70
Pitch(filt)	[deg]	0.45	0.55	0.63	0.07	120.36
Pull point position	[m]	19.18	19.20	19.22	0.02	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

Ser no : 5
 Run no : 38
 Scale factor : 40.000
 Measuring time : 25 min 32 sec
 Sampling frequency : 7.906 Hz
 Ship speed (Nominal) : 0.00 knots
 Ship length : 137.40 m
 Wave heading : 180.00 deg
 Water depth : 102.00 m
 Nominal wave height : 4.25 m
 Nominal wave period : 8.25 sec

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-2.96	0.01	3.07	4.20*	7.19
Wave heading	[deg]	177.77	181.83	183.74	2.88	71.46
Tow line force	[kN]	98.87	136.63	210.08	37.17	180.00
Surge	[m]	-7.41	-3.14	5.94	5.42	156.67
Sway	[m]	-3.88	2.22	5.53	4.74	159.63
Heave	[m]	0.07	0.70	1.25	0.42	8.19
Roll	[deg]	-26.00	-6.71	-3.10	5.72	33.75
Pitch	[deg]	-0.95	0.55	2.15	0.99	9.22
Yaw	[deg]	-0.42	0.00	0.45	0.20	8.40
Roll(filt)	[deg]	-20.41	-6.70	-3.62	5.49	81.52
Pitch(filt)	[deg]	0.45	0.55	0.64	0.07	139.69
Pull point position	[m]	19.17	19.19	19.22	0.02	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

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Statistical tables from wave tests

Appendix: 03

Figure: 15

```
Ser no          :      5
Run no          :      40
Scale factor     :    40.000
Measuring time   :    26 min 28 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    0.00 knots
Ship length      :    137.40 m
Wave heading     :    180.00 deg
Water depth      :    102.00 m
Nominal wave height :    4.25 m
Nominal wave period :    8.25 sec
```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.21	0.01	3.10	4.23*	7.30
Wave heading	[deg]	176.34	181.90	184.14	3.72	0.00
Tow line force	[kN]	105.30	134.41	161.87	23.25	175.99
Surge	[m]	-5.90	-2.47	2.47	3.39	153.35
Sway	[m]	-3.89	1.34	4.08	4.85	0.00
Heave	[m]	0.08	0.70	1.30	0.43	8.00
Roll	[deg]	-27.97	-6.79	-3.15	6.07	27.61
Pitch	[deg]	-0.92	0.55	1.97	1.00	9.14
Yaw	[deg]	-0.72	-0.00	0.37	0.20	8.48
Roll(filt)	[deg]	-21.94	-6.77	-3.67	5.75	89.68
Pitch(filt)	[deg]	0.44	0.55	0.61	0.07	121.65
Pull point position	[m]	19.17	19.19	19.21	0.02	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

```

Ser no          :      5
Run no          :      42
Scale factor    :    40.000
Measuring time  :   25 min 10 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    0.00 knots
Ship length     :   137.40 m
Wave heading    :   180.00 deg
Water depth     :   102.00 m
Nominal wave height :    4.25 m
Nominal wave period :    8.25 sec

```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-2.94	0.00	2.99	4.17*	7.30
Wave heading	[deg]	177.68	181.69	183.64	2.56	79.15
Tow line force	[kN]	106.88	135.67	164.13	24.51	176.49
Surge	[m]	-6.23	-2.51	2.14	3.35	154.05
Sway	[m]	-4.27	0.97	3.98	3.82	159.25
Heave	[m]	0.04	0.70	1.41	0.44	8.19
Roll	[deg]	-28.12	-6.83	-3.15	6.20	26.00
Pitch	[deg]	-0.99	0.55	2.15	1.01	9.14
Yaw	[deg]	-0.84	0.00	0.35	0.20	8.68
Roll(filt)	[deg]	-21.34	-6.81	-3.65	5.92	78.72
Pitch(filt)	[deg]	0.45	0.55	0.61	0.07	298.14
Pull point position	[m]	19.17	19.19	19.21	0.02	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

```

Ser no          :      5
Run no          :      44
Scale factor    :    40.000
Measuring time  :    24 min 27 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    0.00 knots
Ship length     :    137.40 m
Wave heading    :    180.00 deg
Water depth     :    102.00 m
Nominal wave height :    4.25 m
Nominal wave period :    8.25 sec

```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.14	0.02	3.23	4.35*	7.00
Wave heading	[deg]	177.53	181.38	183.97	3.10	140.09
Tow line force	[kN]	112.74	140.62	187.37	33.14	188.96
Surge	[m]	-7.55	-3.32	1.75	4.40	174.67
Sway	[m]	-6.87	-0.14	2.90	4.40	84.31
Heave	[m]	0.08	0.71	1.25	0.43	8.08
Roll	[deg]	-26.75	-7.12	-3.10	5.69	24.45
Pitch	[deg]	-0.90	0.55	2.00	0.99	9.20
Yaw	[deg]	-0.26	0.00	0.38	0.20	8.55
Roll(filt)	[deg]	-21.65	-7.11	-3.67	5.44	84.83
Pitch(filt)	[deg]	0.45	0.55	0.60	0.07	209.19
Pull point position	[m]	19.17	19.19	19.22	0.02	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

Ser no : 5
 Run no : 66
 Scale factor : 40.000
 Measuring time : 24 min 54 sec
 Sampling frequency : 7.906 Hz
 Ship speed (Nominal) : 0.00 knots
 Ship length : 137.40 m
 Wave heading : 180.00 deg
 Water depth : 102.00 m
 Nominal wave height : 4.25 m
 Nominal wave period : 8.25 sec

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.16	0.02	3.11	4.32*	7.17
Wave heading	[deg]	179.33	181.63	183.47	1.70	51.17
Tow line force	[kN]	105.61	128.91	155.77	20.69	190.28
Surge	[m]	-5.95	-2.95	1.68	3.27	190.39
Sway	[m]	-6.04	-0.11	2.40	3.60	0.00
Heave	[m]	0.10	0.72	1.24	0.42	8.05
Roll	[deg]	-24.27	-6.82	-3.13	5.57	24.68
Pitch	[deg]	-0.94	0.52	2.02	1.00	9.15
Yaw	[deg]	-0.57	-0.00	0.45	0.19	8.29
Roll(filt)	[deg]	-19.89	-6.82	-3.69	5.36	85.13
Pitch(filt)	[deg]	0.45	0.52	0.61	0.06	220.42
Pull point position	[m]	19.14	19.17	19.19	0.02	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

Ser no : 5
 Run no : 68
 Scale factor : 40.000
 Measuring time : 25 min 58 sec
 Sampling frequency : 7.906 Hz
 Ship speed (Nominal) : 0.00 knots
 Ship length : 137.40 m
 Wave heading : 180.00 deg
 Water depth : 102.00 m
 Nominal wave height : 4.25 m
 Nominal wave period : 8.25 sec

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.14	0.00	3.03	4.28*	7.14
Wave heading	[deg]	178.24	181.63	183.39	1.99	94.53
Tow line force	[kN]	111.99	136.89	171.14	26.13	191.00
Surge	[m]	-6.23	-2.68	1.78	3.80	192.81
Sway	[m]	-4.30	0.49	2.50	3.20	517.73
Heave	[m]	0.06	0.70	1.22	0.43	8.30
Roll	[deg]	-23.63	-6.80	-3.17	5.35	24.69
Pitch	[deg]	-0.97	0.53	2.06	1.02	9.14
Yaw	[deg]	-0.33	-0.00	0.39	0.20	8.45
Roll(filt)	[deg]	-18.38	-6.79	-3.71	5.14	78.55
Pitch(filt)	[deg]	0.45	0.53	0.60	0.07	91.96
Pull point position	[m]	19.15	19.17	19.19	0.02	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

Ser no : 5
 Run no : 70
 Scale factor : 40.000
 Measuring time : 26 min 28 sec
 Sampling frequency : 7.906 Hz
 Ship speed (Nominal) : 0.00 knots
 Ship length : 137.40 m
 Wave heading : 180.00 deg
 Water depth : 102.00 m
 Nominal wave height : 4.25 m
 Nominal wave period : 8.25 sec

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.24	0.03	3.16	4.23*	7.25
Wave heading	[deg]	179.19	182.10	183.93	2.09	112.21
Tow line force	[kN]	108.16	132.60	161.17	21.15	202.26
Surge	[m]	-5.60	-2.86	1.56	3.27	194.72
Sway	[m]	-3.87	0.70	3.09	3.53	123.20
Heave	[m]	0.11	0.72	1.26	0.44	8.32
Roll	[deg]	-20.09	-6.80	-3.18	5.00	30.74
Pitch	[deg]	-0.97	0.54	1.98	1.02	9.16
Yaw	[deg]	-0.35	0.00	0.39	0.20	8.56
Roll(filt)	[deg]	-19.33	-6.80	-3.76	4.90	81.40
Pitch(filt)	[deg]	0.45	0.54	0.62	0.07	121.02
Pull point position	[m]	19.15	19.17	19.19	0.02	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

```

Ser no           :      5
Run no          :      72
Scale factor     :    40.000
Measuring time   :    24 min 43 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    0.00 knots
Ship length      :    137.40 m
Wave heading     :    180.00 deg
Water depth      :    102.00 m
Nominal wave height :    4.25 m
Nominal wave period :    8.25 sec

```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.37	0.02	3.31	4.20*	7.22
Wave heading	[deg]	178.95	181.88	183.57	2.20	63.08
Tow line force	[kN]	103.83	131.41	170.65	28.46	195.03
Surge	[m]	-6.34	-3.29	1.93	4.25	193.78
Sway	[m]	-4.19	1.00	2.93	3.03	219.46
Heave	[m]	0.09	0.72	1.26	0.43	8.35
Roll	[deg]	-21.42	-6.75	-3.17	5.15	31.46
Pitch	[deg]	-1.04	0.54	2.09	1.01	9.08
Yaw	[deg]	-0.20	0.00	0.44	0.20	8.47
Roll(filt)	[deg]	-19.79	-6.75	-3.73	5.04	89.43
Pitch(filt)	[deg]	0.44	0.54	0.60	0.07	161.74
Pull point position	[m]	19.15	19.17	19.19	0.02	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation


```

Ser no           :      5
Run no          :      74
Scale factor     :    40.000
Measuring time   :    23 min 55 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    0.00 knots
Ship length      :    137.40 m
Wave heading     :    180.00 deg
Water depth      :    102.00 m
Nominal wave height :    4.25 m
Nominal wave period :    8.25 sec

```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.20	0.02	3.23	4.22*	7.25
Wave heading	[deg]	179.79	182.10	183.74	1.66	48.17
Tow line force	[kN]	106.89	130.14	159.25	23.52	202.24
Surge	[m]	-6.48	-3.02	1.19	3.52	168.67
Sway	[m]	-3.65	1.05	2.91	2.31	0.00
Heave	[m]	0.10	0.71	1.27	0.43	8.28
Roll	[deg]	-20.69	-6.81	-3.25	5.15	38.35
Pitch	[deg]	-1.02	0.54	2.04	1.02	9.18
Yaw	[deg]	-0.23	-0.00	0.45	0.20	8.50
Roll(filt)	[deg]	-18.12	-6.81	-3.77	4.99	82.85
Pitch(filt)	[deg]	0.45	0.54	0.61	0.07	160.77
Pull point position	[m]	19.15	19.17	19.19	0.02	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

```

Ser no           :      5
Run no          :      76
Scale factor     :    40.000
Measuring time   :    28 min 24 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    2.00 knots
Ship length      :    137.40 m
Wave heading     :    180.00 deg
Water depth      :    102.00 m
Nominal wave height :    4.00 m
Nominal wave period :    8.00 sec

```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.71	0.05	3.15	3.94*	6.54
Wave heading	[deg]	174.43	180.51	187.66	5.15	183.90
Tow line force	[kN]	139.12	183.79	254.20	44.34	129.85
Surge	[m]	-4.56	-1.96	1.02	2.08	100.41
Sway	[m]	2.73	11.26	19.37	8.51	0.00
Heave	[m]	0.09	0.74	1.34	0.46	7.50
Roll	[deg]	-11.82	-8.43	-5.90	2.33	24.39
Pitch	[deg]	-0.94	0.56	2.11	0.91	8.03
Yaw	[deg]	-0.42	0.00	0.41	0.24	10.38
Roll(filt)	[deg]	-10.80	-8.43	-6.85	2.05	167.66
Pitch(filt)	[deg]	0.52	0.56	0.60	0.03	125.18
Pull point position	[m]	22.14	22.17	22.20	0.03	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

```

Ser no          :      5
Run no          :      78
Scale factor    :    40.000
Measuring time  :   29 min 58 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    2.00 knots
Ship length     :   137.40 m
Wave heading    :   180.00 deg
Water depth     :   102.00 m
Nominal wave height :    4.00 m
Nominal wave period :    8.00 sec

```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.65	0.05	2.55	3.85*	6.67
Wave heading	[deg]	174.25	180.20	187.12	3.92	89.20
Tow line force	[kN]	143.03	186.96	270.97	51.96	195.38
Surge	[m]	-4.17	-1.29	2.37	2.28	74.94
Sway	[m]	-1.01	7.45	17.37	9.04	0.00
Heave	[m]	0.13	0.73	1.33	0.45	7.53
Roll	[deg]	-9.81	-7.35	-3.46	2.26	20.09
Pitch	[deg]	-1.01	0.54	2.06	0.91	8.04
Yaw	[deg]	-0.54	0.00	0.40	0.22	9.64
Roll(filt)	[deg]	-9.16	-7.35	-4.24	2.01	114.02
Pitch(filt)	[deg]	0.47	0.54	0.60	0.04	99.60
Pull point position	[m]	23.07	23.10	23.14	0.03	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

```

Ser no           :      5
Run no          :      82
Scale factor     :    40.000
Measuring time   :    29 min 58 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    2.00 knots
Ship length      :    137.40 m
Wave heading     :    180.00 deg
Water depth      :    102.00 m
Nominal wave height :    4.00 m
Nominal wave period :    8.00 sec

```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.57	0.04	3.03	4.00*	6.73
Wave heading	[deg]	174.28	180.19	186.48	4.32	196.44
Tow line force	[kN]	126.77	182.77	358.56	74.26	154.71
Surge	[m]	-5.31	-1.32	2.69	2.98	105.52
Sway	[m]	-0.24	6.40	14.13	6.87	554.41
Heave	[m]	0.07	0.74	1.36	0.46	7.55
Roll	[deg]	-10.99	-7.98	-3.40	2.39	20.35
Pitch	[deg]	-0.94	0.55	2.34	0.92	8.04
Yaw	[deg]	-0.39	-0.00	0.39	0.21	8.73
Roll(filt)	[deg]	-9.83	-7.98	-4.21	2.11	126.47
Pitch(filt)	[deg]	0.50	0.55	0.60	0.04	118.54
Pull point position	[m]	23.07	23.10	23.13	0.03	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

FLOODSTAND

Statistical tables from wave tests

Appendix: 03

Figure: 26

```
Ser no      :      5
Run no      :      84
Scale factor :    40.000
Measuring time : 29 min 58 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    2.00 knots
Ship length :   137.40 m
Wave heading :   180.00 deg
Water depth  :   102.00 m
Nominal wave height :    4.00 m
Nominal wave period :    8.00 sec
```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.88	0.05	2.70	3.95*	6.56
Wave heading	[deg]	175.80	179.88	186.54	4.43	235.40
Tow line force	[kN]	126.02	188.78	354.13	56.41	115.22
Surge	[m]	-4.57	-1.44	4.70	2.58	96.72
Sway	[m]	-1.88	0.99	4.93	3.18	297.71
Heave	[m]	0.07	0.74	1.41	0.47	7.52
Roll	[deg]	-10.10	-7.58	-2.90	2.77	21.86
Pitch	[deg]	-1.04	0.54	2.35	0.91	7.95
Yaw	[deg]	-0.52	-0.00	0.29	0.21	10.68
Roll(filt)	[deg]	-9.31	-7.58	-3.86	2.56	269.96
Pitch(filt)	[deg]	0.47	0.54	0.61	0.04	106.86
Pull point position	[m]	23.07	23.10	23.13	0.03	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

```

Ser no           :      5
Run no          :      86
Scale factor     :    40.000
Measuring time   :   29 min 58 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    2.00 knots
Ship length      :   137.40 m
Wave heading     :   180.00 deg
Water depth      :   102.00 m
Nominal wave height :    4.00 m
Nominal wave period :    8.00 sec

```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.64	0.06	2.78	3.86*	6.62
Wave heading	[deg]	172.69	179.94	186.56	4.09	95.08
Tow line force	[kN]	131.09	182.78	296.54	60.63	156.72
Surge	[m]	-4.21	-1.22	3.37	2.63	82.21
Sway	[m]	-1.73	0.88	4.98	3.06	544.35
Heave	[m]	0.15	0.74	1.31	0.45	7.55
Roll	[deg]	-11.39	-7.26	-2.90	2.78	21.42
Pitch	[deg]	-0.99	0.54	2.06	0.89	7.97
Yaw	[deg]	-0.55	0.00	0.51	0.21	9.59
Roll(filt)	[deg]	-10.53	-7.26	-3.83	2.57	124.66
Pitch(filt)	[deg]	0.48	0.54	0.61	0.05	110.14
Pull point position	[m]	23.07	23.10	23.13	0.03	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

```

Ser no          :      5
Run no          :      88
Scale factor    :    40.000
Measuring time  :   29 min 58 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    2.00 knots
Ship length     :   137.40 m
Wave heading    :   180.00 deg
Water depth     :   102.00 m
Nominal wave height :    4.00 m
Nominal wave period :    8.00 sec

```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.53	0.06	2.82	3.90*	6.62
Wave heading	[deg]	175.54	180.30	186.15	4.25	146.07
Tow line force	[kN]	140.65	184.05	329.33	53.50	156.23
Surge	[m]	-4.71	-1.38	2.53	2.26	109.43
Sway	[m]	-1.79	4.39	10.39	5.82	0.00
Heave	[m]	0.06	0.74	1.35	0.46	7.42
Roll	[deg]	-9.93	-7.40	-2.94	2.74	23.05
Pitch	[deg]	-1.02	0.54	2.41	0.92	8.08
Yaw	[deg]	-0.34	-0.00	0.40	0.22	9.43
Roll(filt)	[deg]	-9.02	-7.39	-3.74	2.52	347.41
Pitch(filt)	[deg]	0.48	0.54	0.58	0.04	132.93
Pull point position	[m]	23.07	23.10	23.14	0.03	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

FLOODSTAND

Statistical tables from wave tests

Appendix: 03

Figure: 29

```

Ser no           :      5
Run no          :      90
Scale factor     :    40.000
Measuring time   :   29 min 58 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    2.00 knots
Ship length      :   137.40 m
Wave heading     :   180.00 deg
Water depth      :   102.00 m
Nominal wave height :    4.00 m
Nominal wave period :    8.00 sec
  
```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.74	0.06	2.67	3.84*	6.70
Wave heading	[deg]	176.07	180.47	184.42	3.48	134.73
Tow line force	[kN]	126.36	182.22	273.34	52.93	137.11
Surge	[m]	-4.22	-1.23	2.75	2.50	71.96
Sway	[m]	0.16	6.75	12.92	7.44	0.00
Heave	[m]	0.11	0.74	1.31	0.45	7.43
Roll	[deg]	-9.74	-7.08	-3.00	2.65	21.47
Pitch	[deg]	-0.84	0.54	2.10	0.91	8.14
Yaw	[deg]	-0.28	-0.00	0.35	0.20	10.43
Roll(filt)	[deg]	-8.90	-7.08	-3.71	2.44	262.60
Pitch(filt)	[deg]	0.48	0.54	0.58	0.04	96.43
Pull point position	[m]	23.08	23.10	23.14	0.03	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation


```

Ser no          :      5
Run no          :      92
Scale factor    :    40.000
Measuring time  :    29 min 58 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    2.00 knots
Ship length     :    137.40 m
Wave heading    :    180.00 deg
Water depth     :    102.00 m
Nominal wave height :    4.00 m
Nominal wave period :    8.00 sec

```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.22	0.07	3.01	3.93*	6.56
Wave heading	[deg]	173.83	180.69	184.74	3.59	110.44
Tow line force	[kN]	141.11	180.46	245.54	42.12	149.39
Surge	[m]	-3.54	-1.29	1.48	2.03	134.73
Sway	[m]	-1.44	6.78	13.40	6.50	198.34
Heave	[m]	0.11	0.75	1.36	0.46	7.46
Roll	[deg]	-11.05	-7.17	-2.90	2.84	23.40
Pitch	[deg]	-0.81	0.54	2.13	0.92	8.00
Yaw	[deg]	-0.27	-0.00	0.40	0.20	9.61
Roll(filt)	[deg]	-9.39	-7.17	-3.67	2.64	202.39
Pitch(filt)	[deg]	0.45	0.54	0.59	0.05	83.94
Pull point position	[m]	23.07	23.10	23.14	0.03	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

FLOODSTAND

Statistical tables from wave tests

Appendix: 03

Figure: 31

```

Ser no          :      5
Run no         :     94
Scale factor    :   40.000
Measuring time  : 29 min 58 sec
Sampling frequency : 7.906 Hz
Ship speed (Nominal) : 2.00 knots
Ship length     : 137.40 m
Wave heading    : 180.00 deg
Water depth     : 102.00 m
Nominal wave height : 4.00 m
Nominal wave period : 8.00 sec
  
```

		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.59	0.08	2.83	3.88*	6.60
Wave heading	[deg]	174.50	180.58	186.73	4.00	142.79
Tow line force	[kN]	121.76	175.28	299.41	61.53	142.60
Surge	[m]	-4.52	-1.25	2.09	2.63	115.72
Sway	[m]	-0.33	6.49	13.40	5.63	244.38
Heave	[m]	0.12	0.78	1.40	0.46	7.45
Roll	[deg]	-10.34	-7.74	-3.32	2.55	21.75
Pitch	[deg]	-0.98	0.55	2.33	0.92	8.08
Yaw	[deg]	-0.35	0.00	0.42	0.22	8.42
Roll(filt)	[deg]	-9.05	-7.74	-4.04	2.31	233.82
Pitch(filt)	[deg]	0.49	0.55	0.58	0.04	144.41
Pull point position	[m]	23.07	23.10	23.13	0.03	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

```

Ser no          :      5
Run no          :      96
Scale factor    :    40.000
Measuring time  :    29 min 58 sec
Sampling frequency :    7.906 Hz
Ship speed (Nominal) :    2.00 knots
Ship length     :    137.40 m
Wave heading    :    180.00 deg
Water depth     :    102.00 m
Nominal wave height :    4.00 m
Nominal wave period :    8.00 sec

```

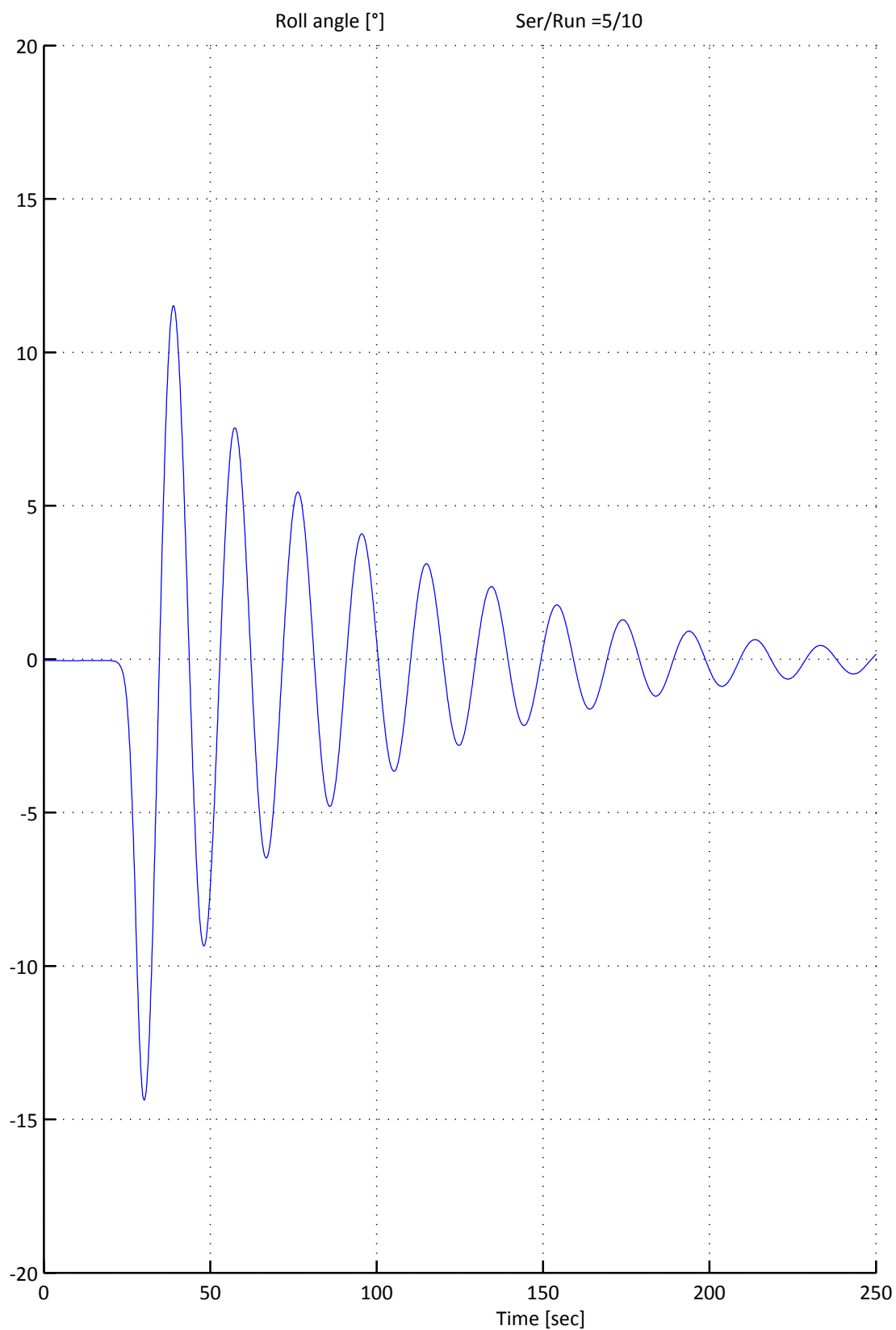
		Minimum Value	Mean Value	Maximum Value	Signif. single ampli- tude	Period of enc. (s)
Wave height	[m]	-3.49	0.07	2.68	3.91*	6.67
Wave heading	[deg]	174.95	180.44	185.07	4.05	172.52
Tow line force	[kN]	128.94	176.62	267.14	50.57	149.28
Surge	[m]	-3.94	-1.33	2.09	2.33	101.95
Sway	[m]	1.32	6.80	13.53	6.24	0.00
Heave	[m]	0.12	0.76	1.33	0.46	7.48
Roll	[deg]	-10.46	-7.47	-3.13	2.79	20.84
Pitch	[deg]	-1.01	0.54	2.06	0.91	8.11
Yaw	[deg]	-0.27	0.00	0.37	0.21	9.42
Roll(filt)	[deg]	-9.20	-7.47	-3.90	2.58	461.90
Pitch(filt)	[deg]	0.49	0.55	0.60	0.04	108.61
Pull point position	[m]	23.07	23.10	23.13	0.03	0.59

Significant single amplitude = 2*standard deviation

* Significant wave height = 4*standard deviation

Table of contents

Figure [no.]	Condition	Content	Speed [knots]	Serie [no.]	Run [no.]
1a	Intact	Plot	0	5	10
1b	Intact	Table	0	5	10



FLOODSTAND

Roll decay tests

Intact condition

Appendix: 04

Figure 1b

Ser no : 5
Run no : 10
Scale factor : 40.000
Sampling frequency : 7.906 Hz
Ship length : 137.40 m
Water depth : 102.00 m
Mean decay period : 19.44 sec
Mean damping, zeta : 0.0487 -

No	Minima (deg)	Maxima (deg)	Double amplitude (deg)	Damping (-)	Period (sec)
1	-9.35	7.54	16.89		18.59
2	-6.48	5.45	11.93	0.0554	18.97
3	-4.80	4.09	8.88	0.0511	19.23
4	-3.65	3.11	6.76	0.0485	19.35
5	-2.81	2.36	5.17	0.0471	19.61
6	-2.16	1.77	3.93	0.0464	19.73
7	-1.63	1.28	2.91	0.0466	19.73
8	-1.21	0.91	2.12	0.0472	19.86
9	-0.88	0.64	1.52	0.0479	19.73
10	-0.65	0.45	1.10	0.0484	19.61

Table of contents

Figure [no.]	Wave height [m]	Spectral peak period [sec]	Tow speed [knots]	Serie [no.]	Run [no.]	Static measuring Run no.
1	3.50	7.48	0	5	27	26
	3.75	7.75	0	5	32	31
	4.00	8.00	0	5	46	45
2	4.00	8.00	0	5	48	47
	4.00	8.00	0	5	50	49
	4.00	8.00	0	5	52	51
3	4.00	8.00	0	5	54	53
	4.00	8.00	0	5	56	55
	4.00	8.00	0	5	58	57
4	4.00	8.00	0	5	60	59
	4.00	8.00	0	5	62	61
	4.00	8.00	0	5	64	63
5	4.25	8.25	0	5	36	35
	4.25	8.25	0	5	38	37
	4.25	8.25	0	5	40	39
6	4.25	8.25	0	5	42	41
	4.25	8.25	0	5	44	43
	4.25	8.25	0	5	66	65
7	4.25	8.25	0	5	68	67
	4.25	8.25	0	5	70	69
	4.25	8.25	0	5	72	71
8	4.25	8.25	0	5	74	73

Figure [no.]	Wave height [m]	Spectral peak period [sec]	Tow speed [knots]	Serie [no.]	Run [no.]	Static measuring Run no.
8	4.00	8.00	2.00	5	76	75
	4.00	8.00	2.00	5	78	77
9	4.00	8.00	2.00	5	82	81
	4.00	8.00	2.00	5	84	83
	4.00	8.00	2.00	5	86	85
10	4.00	8.00	2.00	5	88	87
	4.00	8.00	2.00	5	90	89
	4.00	8.00	2.00	5	92	91
11	4.00	8.00	2.00	5	94	93
	4.00	8.00	2.00	5	96	95

FLOODSTAND

Static measuring before wave test

Appendix: 05

Figure: 1

Ser no : 5
Run no : 26
Measuring time : 6 min 21 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.13	-4.06	-3.98
Pitch	[deg]	0.41	0.43	0.46

Ser no : 5
Run no : 31
Measuring time : 3 min 19 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-3.97	-3.95	-3.93
Pitch	[deg]	0.47	0.49	0.50

Ser no : 5
Run no : 45
Measuring time : 6 min 21 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.10	-3.98	-3.84
Pitch	[deg]	0.42	0.45	0.49

FLOODSTAND

Static measuring before wave test

Appendix: 05

Figure: 2

Ser no : 5
Run no : 47
Measuring time : 6 min 13 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.03	-3.99	-3.94
Pitch	[deg]	0.42	0.45	0.47

Ser no : 5
Run no : 49
Measuring time : 6 min 20 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.02	-3.97	-3.92
Pitch	[deg]	0.44	0.46	0.49

Ser no : 5
Run no : 51
Measuring time : 8 min 2 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.00	-3.93	-3.87
Pitch	[deg]	0.43	0.45	0.47

FLOODSTAND

Static measuring before wave test

Appendix: 05

Figure: 3

Ser no : 5
Run no : 53
Measuring time : 6 min 26 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.00	-3.93	-3.88
Pitch	[deg]	0.41	0.45	0.47

Ser no : 5
Run no : 55
Measuring time : 6 min 30 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.00	-3.94	-3.88
Pitch	[deg]	0.42	0.46	0.49

Ser no : 5
Run no : 57
Measuring time : 6 min 21 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-3.97	-3.92	-3.85
Pitch	[deg]	0.43	0.45	0.47

FLOODSTAND

Static measuring before wave test

Appendix: 05

Figure: 4

Ser no : 5
Run no : 59
Measuring time : 7 min 54 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-3.93	-3.90	-3.86
Pitch	[deg]	0.44	0.46	0.47

Ser no : 5
Run no : 60
Measuring time : 6 min 26 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-3.95	-3.89	-3.79
Pitch	[deg]	0.42	0.45	0.47

Ser no : 5
Run no : 63
Measuring time : 8 min 54 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.09	-4.04	-3.97
Pitch	[deg]	0.42	0.45	0.47

FLOODSTAND

Static measuring before wave test

Appendix: 05

Figure: 5

Ser no : 5
Run no : 35
Measuring time : 5 min 56 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-3.96	-3.95	-3.95
Pitch	[deg]	0.46	0.46	0.47

Ser no : 5
Run no : 37
Measuring time : 5 min 50 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.03	-4.01	-4.00
Pitch	[deg]	0.46	0.46	0.47

Ser no : 5
Run no : 39
Measuring time : 6 min 7 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.02	-4.00	-3.97
Pitch	[deg]	0.45	0.46	0.47

FLOODSTAND

Static measuring before wave test

Appendix: 05

Figure: 6

Ser no : 5
Run no : 41
Measuring time : 6 min 21 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.08	-4.01	-3.96
Pitch	[deg]	0.45	0.47	0.50

Ser no : 5
Run no : 43
Measuring time : 6 min 53 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.10	-4.06	-4.03
Pitch	[deg]	0.44	0.45	0.47

Ser no : 5
Run no : 65
Measuring time : 6 min 40 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.05	-4.00	-3.94
Pitch	[deg]	0.41	0.44	0.46

FLOODSTAND

Static measuring before wave test

Appendix: 05

Figure: 7

Ser no : 5
Run no : 67
Measuring time : 6 min 58 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-3.97	-3.97	-3.95
Pitch	[deg]	0.44	0.44	0.44

Ser no : 5
Run no : 69
Measuring time : 6 min 23 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.11	-4.03	-3.96
Pitch	[deg]	0.42	0.45	0.47

Ser no : 5
Run no : 71
Measuring time : 6 min 59 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.03	-3.96	-3.88
Pitch	[deg]	0.43	0.45	0.47

FLOODSTAND

Static measuring before wave test

Appendix: 05

Figure: 8

Ser no : 5
Run no : 73
Measuring time : 6 min 28 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value

Roll	[deg]	-4.09	-4.03	-3.99
Pitch	[deg]	0.44	0.46	0.47

Ser no : 5
Run no : 75
Measuring time : 6 min 27 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value

Roll	[deg]	-4.12	-4.04	-3.99
Pitch	[deg]	0.42	0.44	0.46

Ser no : 5
Run no : 77
Measuring time : 6 min 45 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value

Roll	[deg]	-4.10	-4.04	-3.99
Pitch	[deg]	0.42	0.45	0.47

FLOODSTAND

Static measuring before wave test

Appendix: 05

Figure: 9

Ser no : 5
Run no : 81
Measuring time : 6 min 27 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.03	-4.00	-3.97
Pitch	[deg]	0.43	0.44	0.46

Ser no : 5
Run no : 83
Measuring time : 6 min 27 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.02	-3.97	-3.92
Pitch	[deg]	0.42	0.45	0.47

Ser no : 5
Run no : 85
Measuring time : 6 min 59 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.07	-4.04	-4.00
Pitch	[deg]	0.41	0.44	0.46

FLOODSTAND

Static measuring before wave test

Appendix: 05

Figure: 10

Ser no : 5
Run no : 87
Measuring time : 6 min 27 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.02	-3.98	-3.92
Pitch	[deg]	0.44	0.46	0.48

Ser no : 5
Run no : 89
Measuring time : 6 min 29 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.05	-4.01	-3.96
Pitch	[deg]	0.41	0.44	0.46

Ser no : 5
Run no : 91
Measuring time : 6 min 16 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-3.97	-3.95	-3.93
Pitch	[deg]	0.43	0.44	0.46

FLOODSTAND

Static measuring before wave test

Appendix: 05

Figure: 11

Ser no : 5
Run no : 93
Measuring time : 6 min 33 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.05	-4.03	-4.00
Pitch	[deg]	0.42	0.45	0.47

Ser no : 5
Run no : 95
Measuring time : 6 min 30 sec
Sampling frequency : 7.906 Hz
Static measuring before test

		Minimum Value	Mean Value	Maximum Value
Roll	[deg]	-4.06	-4.02	-3.97
Pitch	[deg]	0.42	0.44	0.46

Table of contents

Wave height [m]	Spectral peak period [sec]	Tow speed [knots]	Serie [no.]	Run [no.]	Bow view Folder File name	Side view Folder File name
3.50	7.48	0	5	27	5-27 bow	5-27 side
3.75	7.75	0	5	32	5-32 bow	5-32 side
4.00	8.00	0	5	46	5-46 bow	5-46 side
4.00	8.00	0	5	48	5-48 bow	5-48 side
4.00	8.00	0	5	50	5-50 bow	5-50 side
4.00	8.00	0	5	52	5-52 bow	5-52 side
4.00	8.00	0	5	54	5-54 bow	5-54 side
4.00	8.00	0	5	56	5-56 bow	5-56 side
4.00	8.00	0	5	58	5-58 bow	5-58 side
4.00	8.00	0	5	60	5-60 bow	5-60 side
4.00	8.00	0	5	62	5-62 bow	5-62 side
4.00	8.00	0	5	64	5-64 bow	5-64 side
4.25	8.25	0	5	36	5-36 bow	5-36 side
4.25	8.25	0	5	38	5-38 bow	5-38 side
4.25	8.25	0	5	40	5-40 bow	5-40 side
4.25	8.25	0	5	42	5-42 bow	5-42 side
4.25	8.25	0	5	44	5-44 bow	5-44 side
4.25	8.25	0	5	66	5-66 bow	5-66 side
4.25	8.25	0	5	68	5-68 bow	5-68 side
4.25	8.25	0	5	70	5-70 bow	5-70 side
4.25	8.25	0	5	72	5-72 bow	5-72 side
4.25	8.25	0	5	74	5-74 bow	5-74 side

Wave height [m]	Spectral peak period [sec]	Tow speed [knots]	Serie [no.]	Run [no.]	Bow view Folder File name	Side view Folder File name
4.00	8.00	2.00	5	76	5-76 bow	5-76 side
4.00	8.00	2.00	5	78	5-78 bow	5-78 side
4.00	8.00	2.00	5	82	5-82 bow	5-82 side
4.00	8.00	2.00	5	84	5-84 bow	5-84 side
4.00	8.00	2.00	5	86	5-86 bow	5-86 side
4.00	8.00	2.00	5	88	5-88 bow	5-88 side
4.00	8.00	2.00	5	90	5-90 bow	5-90 side
4.00	8.00	2.00	5	92	5-92 bow	5-92 side
4.00	8.00	2.00	5	94	5-94 bow	5-94 side
4.00	8.00	2.00	5	96	5-96 bow	5-96 side

Sampling rate (model scale): 50 Hz

Sampling rate (full scale = $50/\sqrt{40}$) : 7.906 Hz

All variables are stored in full scale units in the *.asc files with time step $\sqrt{40}/50$ sec.

Ordinary capsizing tests are stored in the folder **Timeseries** in columns according to below:

Column no	Channel	Unit
1	Wave height	[m]
2	Wave heading	[deg]
3	Tow line force	[kN]
4	Surge	[m]
5	Sway	[m]
6	Heave	[m]
7	Roll	[deg]
8	Pitch	[deg]
9	Yaw	[deg]
10	Roll(filt)	[deg]
11	Pitch(filt)	[deg]
12	Pull point position	[m]

Static measuring tests are stored in the folder **TimeseriesSM** in columns according to below:

Column no	Channel	Unit
1	Roll	[deg]
2	Pitch	[deg]