



POSISJONERINGSBEREGNING

FOR

KYSTFORSKNINGSFARTØY

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TABLE OF CONTENTS

1.	SAMMENDRAG	2
1.1	FORKORTELSER	2
2.	BASIS FOR ANALYSEN	3
2.1	DATAPROGRAM	3
2.2	VÆRFORHOLD	3
3.	BESKRIVELSE AV FARTØYET	4
3.1	HOVEDDIMENSJONER	4
3.2	KONFIGURASJON AV TRUSTERE	4
3.2.1	TRUSTTAP	5
3.3	FARTØYSKOEFFISIENTER	5
4.	RESULTATER	6
4.1	UTEN BØLGER	6
4.2	MED BØLGER	7
4.3	DEFINERT SJØTILSTAND	8
5.	REFERANSER	9
6.	APPENDIKS A	10



Document revision list	
Rev	Description of changes
01	Første revisjon
02	Oppdatert med en kapasitetsvurdering for Hs = 1m og Curr = 2 knop
03	Oppdatert i forbindelse med anbud.
04	
05	



1. SAMMENDRAG

Formålet med denne rapporten er å vise kapasiteten til kystforskningsfartøyet i dynamisk posisjonering (DP). En analyse er gjennomført der resultatene viser grensene for hvilken vindstyrke fartøyet greier å holde posisjonen.

Fartøyet er utstyrt med en senterpropell og to tunnel-trustere, en akter og en i baugen.

Beregningene viser at fartøyet klarer å holde posisjonen for alle vindretninger opp til en vindstyrke på 17,6 m/s ved 1 knop strøm.

Dersom bølger er inkludert vil holdekapasiteten være 10,3 m/s vind i en sjøtilstand med signifikant bølgehøyde (H_s) på 3,3m og spektral topperiode (T_p) på 8,5s.

I en sjøtilstand med $H_s = 1\text{m}$ og $T_p = 7.5\text{s}$ med 2 knop strøm vil fartøyet kunne holde posisjonen for $\pm 50^\circ$ i forhold til baugen og $\pm 80^\circ$ i forhold til hekken.

1.1 FORKORTELSER

AP	Aktre perpendikulær
BL	Baselinjen
CL	Senterlinjen
DP	Dynamisk posisjonering
Hs	Signifikant bølgehøyde
Tp	Spektral topperiode



2. BASIS FOR ANALYSEN

2.1 DATAPROGRAM

Analysen er gjort ved bruk av programmet ShipX, utviklet av Sintef Ocean (tidligere MARINTEK), ref. /1/. Input er konfigurasjon av trustere, ikke-dimensjonale koeffisienter for skipet og værforhold.

2.2 VÆRFORHOLD

I analysen er det kjørt tre caser med forskjellige værforhold. I alle casene er vind inkludert. For den ene casen er det antatt at det er en strøm på 1 knop som virker på fartøyet, men ingen bølger. For den andre casen er det antatt 1 knop strøm og bølger. For den siste casen er det satt en sjøtilstand med $H_s = 1\text{m}$ og $T_p = 7.5\text{s}$, i tillegg til en strøm på 2 knop. Alt vær antas å komme fra samme retning.

Data for vind er ikke gitt som input siden analysen går ut på å finne grensen for hvor mye vind (og bølger for den ene casen) man kan håndtere i en DP-operasjon. Sammenhengen mellom vind og bølger er gitt av IMCA M 140, ref. /2/.

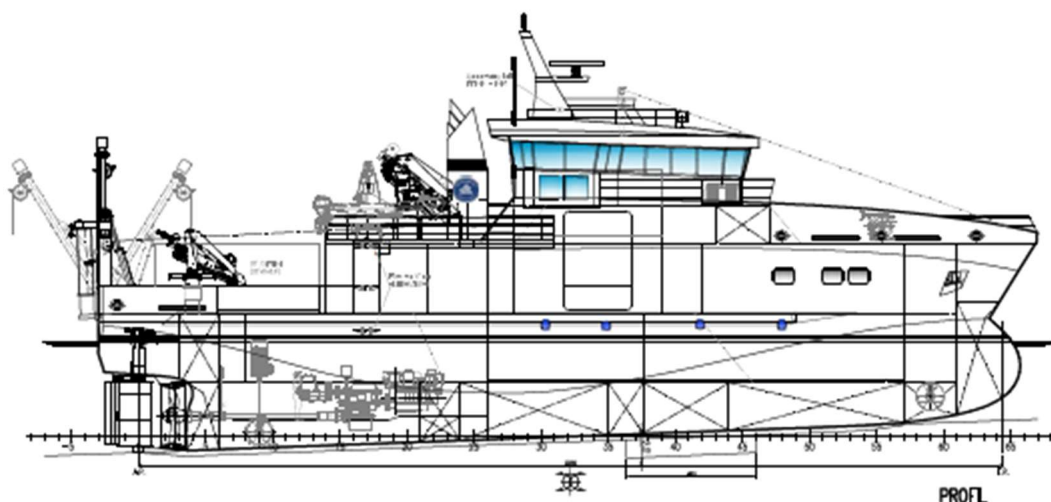
3. BESKRIVELSE AV FARTØYET

3.1 HOVEDDIMENSJONER

Tabell 3-1 Hoveddimensjoner

Karakteristikk	Symbol	Dimensjon	Verdi
Lengde over alt	Loa	m	35.0
Lengde mellom perpendikulærer	Lpp	m	32.2
Dybde I riss	D	m	4.6
Bredde på spant	B	m	10.0
Deplasement	Δ	tonne	443.4
Maks dypgang	T	m	3.5
Transvers vindareal	A_T	m ²	96.0
Langsgående vindareal	A_L	m ²	195.0

Profil av skipet er vist i figuren under.



Figur 3-1 Profil av fartøyet

3.2 KONFIGURASJON AV TRUSTERE

Fartøyet er utstyrt med en senterpropell og to tunnel-trustere, en akter og en i baugen. Lokasjonen av disse relatert til AP, CL og BL, i tillegg til effekt og trust, er gitt i tabellen under.

Table 3-2 Konfigurasjon av trustere

Beskrivelse	X [m]	Y [m]	Effekt [kW]	Max trust [kN]	Min trust [kN]
Senterpropell	1.3	0	700.0	119.7	-83.8
Tunnel Truster Akter	4.5	0	150.0	25.6	-25.6
Tunnel Truster Fremme	29.5	0	250.0	42.7	-42.7



3.2.1 TRUSTTAP

Trusttap på grunn av dynamiske effekter, truster-truster interaksjon, truster-skrog interaksjon osv. er ikke implementert i analysen. For å ta hensyn til dette i analysen er maksimal utnyttelse av trusterne satt til 90%.

3.3 FARTØYSKOEFFISIENTER

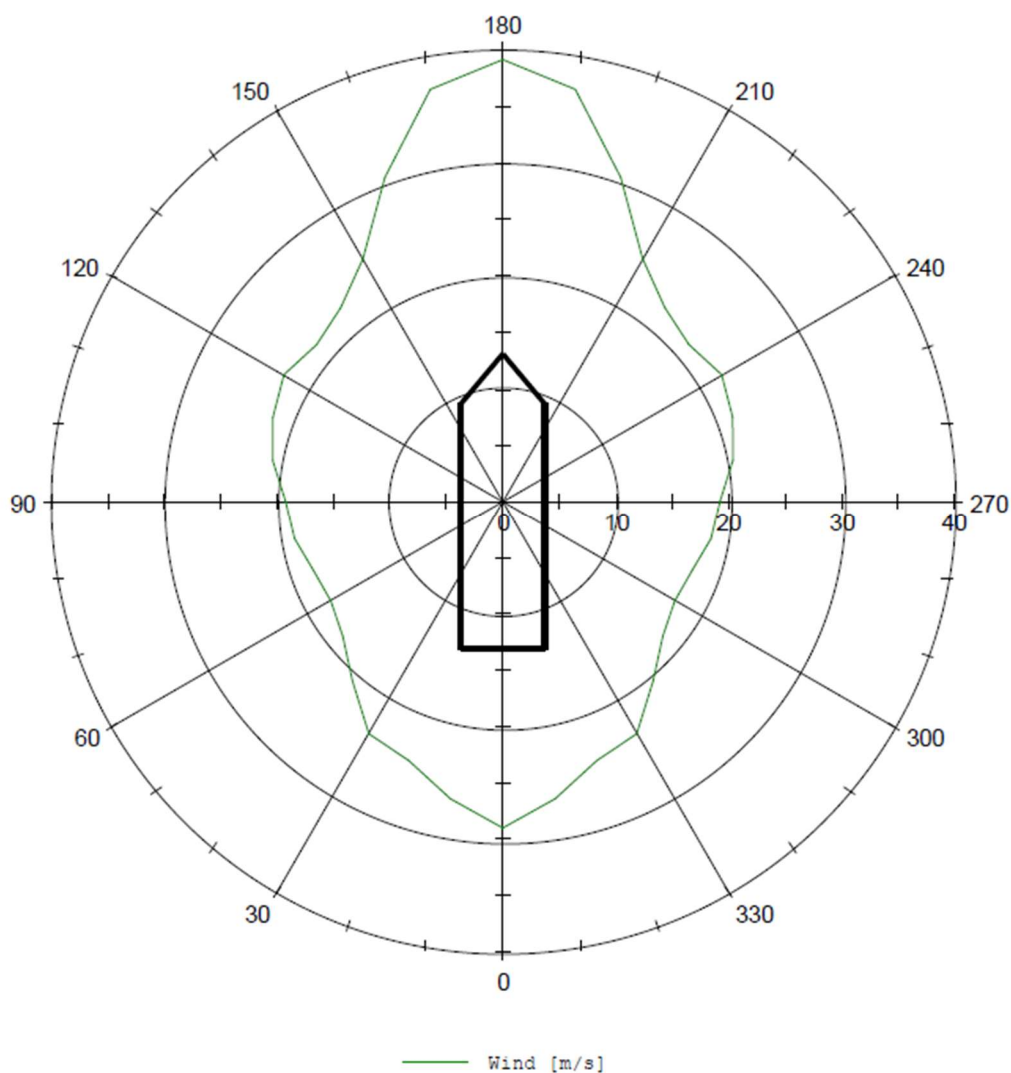
Vind-, strøm- og bølgedriftskoeffisientene er hentet fra sammenligningsskip i ShipX sin database. Strøm- og bølgedriftskoeffisientene er tatt fra et supplyskip, mens vindkoeffisientene er hentet fra et forskningsskip.

4. RESULTATER

Detaljerte resultater finnes i appendiks, ref. kapittel 6.

4.1 UTEN BØLGER

Ship: Kystforskningsfartøy
Run : Dynamisk posisjonering



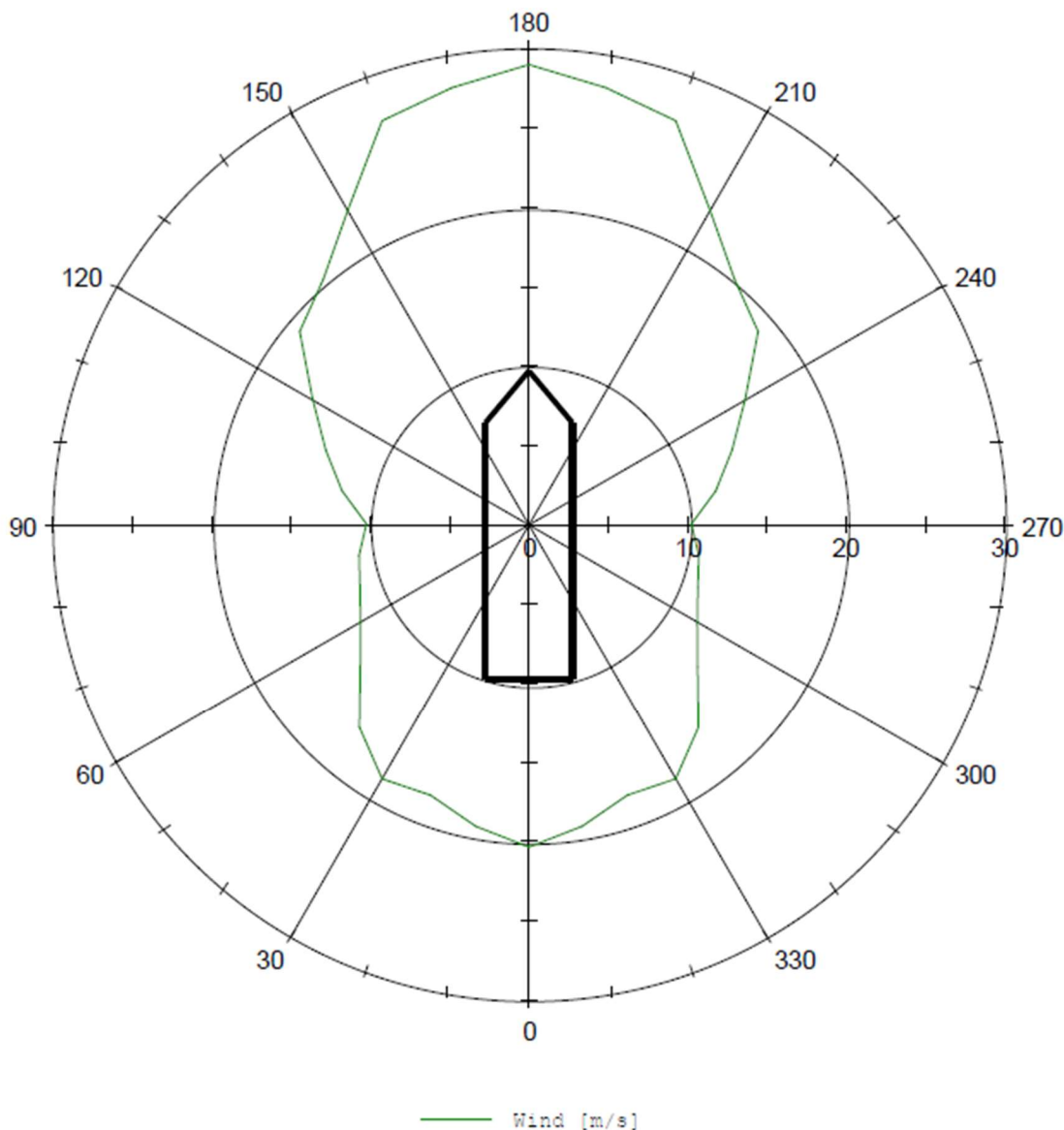
External:
Variable wind velocity rotating 360 deg
0.51 m/s wind generated current rotating 360 deg (0.0 deg offset)

Figur 4-1 Holdekapasitet med vind og strøm

Holdekapasiteten i en DP-operasjon når vind og en strøm på 1 knop virker på fartøyet er minst 17,6 m/s for alle vindretninger.

4.2 MED BØLGER

Ship: Kystforskningsfartøy Run : Dynamisk posisjonering



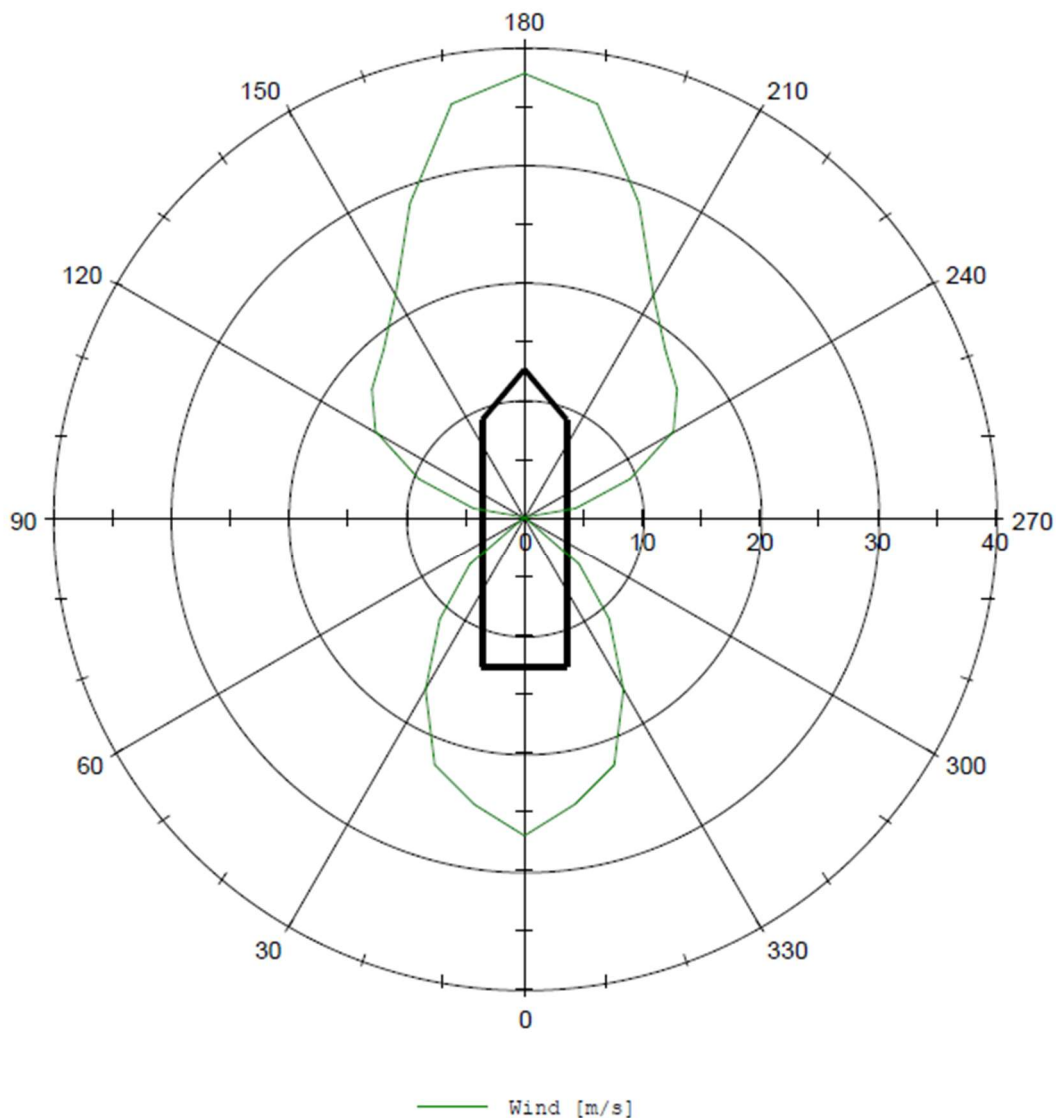
External:
Variable wind velocity rotating 360 deg
0.51 m/s wind generated current rotating 360 deg (0.0 deg offset)
Variable wave height rotating 360 deg (0.0 deg offset)

Figur 4-2 Holdekapasitet med vind, strøm og bølger

Holdekapasiteten i en DP-operasjon når vind, bølger og en strøm på 1 knop virker på fartøyet er minst 10,3 m/s for alle vindretninger. Tilsvarende sjøtilstand har en signifikant bølgehøyde på 3,3m og en spektral topperiode på 8,5s.

4.3 DEFINERT SJØTILSTAND

Ship: Kystforskningsfartøy Run : Dynamisk posisjonering (Bølger)



External:
Variable wind velocity rotating 360 deg
1.03 m/s wind generated current rotating 360 deg (0.0 deg offset)
1.0 m waves rotating 360 deg (0.0 deg offset)

Figure 4-3 Holdekapasitet med vind, Hs=1m, Tp=7.5s og strøm på 2 knop

Fartøyet klarer å holde posisjonen i en DP-operasjon når vind, Hs=1m, Tp=7.5s og strøm på 2 knop virker på fartøyet for innkommende retninger $\pm 50^\circ$ i forhold til baugen og $\pm 80^\circ$ i forhold til hekken.



5. REFERANSER

	Document number	Document title	Rev.
/1/		ShipX Station Keeping User Manual	Apr 2018
/2/		Specification for DP Capability Plots, IMCA M 140	Jun 2000



6. APPENDIKS A



PRINCIPAL HULL DATA

ENCL.	A.1
REPORT	
DATE	07.03.2019
REF.	

SHIP: **Kystforskningsfartøy**
 Loading condition: Design WL
 Draught AP/FP: 3.500 / 3.500 [m]

	Symbol	Unit	
<hr/>			
Length overall	L_{OA}	[m]	35.000
Length on designed waterline	L_{WL}	[m]	25.242
Length betw. perp.	L_{PP}	[m]	32.200
Breadth moulded	B	[m]	9.653
Breadth waterline	B_{WL}	[m]	9.653
Depth to 1 st deck	D	[m]	4.600
Draught at $L_{PP}/2$	T	[m]	3.500
Draught at FP	T_{FP}	[m]	3.500
Draught at AP	T_{AP}	[m]	3.500
Trim (pos. aft)	t	[m]	0.000
Rake of keel		[m]	0.000
Rise of floor		[m]	0.000
Bilge radius		[m]	0.000
<hr/>			
Sea water density	ρ_s	[kg/m ³]	1025.00
Shell plating thickness		[mm]	2
Shell plating in % of displ.		[%]	0.40
<hr/>			
Volume displacement	∇	[m ³]	430.9
Displacement	Δ	[t]	443.4
Prismatic coefficient*	C_P	[-]	0.4253
Block coefficient*	C_B	[-]	0.3961
Midship section coefficient	C_M	[-]	0.9312
Longitudinal C.B. from $L_{PP}/2$	LCB	[m]	1.261
Longitudinal C.B. from $L_{PP}/2^*$	LCB	[% L_{PP}]	3.915
Longitudinal C.B. from AP	LCB	[m]	17.361
Wetted surface	S	[m ²]	1096.75
Wetted surface of transom stern	A_T	[m ²]	10.36
<hr/>			

Remarks: *Refers to L_{PP}
 Hydrostatic corrections not included



FORCE GENERATOR 1

ENCL.	A.2
REPORT	
DATE	07.03.2019
REF.	

Ship: Kystforskningsfartøy
Run : Dynamisk posisjonering
Ship Heading: 0.0 deg
Name: Senterpropell

Env. [deg]	Force [kN]	Dir. [deg]	Thrust [kN]	Rudder [deg]	Revs [rpm]	Power [kW]
0.0	-30.5	0.0	-30.5	-0.0	-113.8	255
10.0	-30.5	0.0	-30.5	0.0	-113.8	255
20.0	-30.5	0.0	-30.5	-0.0	-113.8	255
30.0	-28.7	0.0	-28.7	-0.0	-110.3	240
40.0	-16.9	0.0	-16.9	0.0	-84.8	142
50.0	-8.8	0.0	-8.8	0.0	-61.1	74
60.0	-3.2	0.0	-3.2	-0.0	-37.1	27
70.0	0.2	-0.0	0.2	-0.0	10.0	1
80.0	2.6	0.0	2.6	0.0	33.0	15
90.0	4.0	-0.0	4.1	-0.0	41.2	24
100.0	5.4	0.0	5.6	0.0	48.1	33
110.0	8.7	-0.0	9.0	-0.0	61.0	53
120.0	12.8	0.0	13.2	0.0	73.9	77
130.0	14.1	0.0	14.5	0.0	77.5	85
140.0	16.3	-0.0	16.7	-0.0	83.3	98
150.0	22.5	-0.0	23.1	-0.0	97.8	135
160.0	36.6	0.0	37.6	0.0	124.9	220
170.0	47.5	0.0	48.9	0.0	142.3	286
180.0	47.5	0.0	48.9	0.0	142.3	286
190.0	47.5	0.0	48.9	0.0	142.3	286
200.0	36.6	-0.0	37.6	-0.0	124.9	220
210.0	22.5	0.0	23.1	0.0	97.8	135
220.0	16.3	-0.0	16.7	-0.0	83.3	98
230.0	14.1	0.0	14.5	0.0	77.5	85
240.0	12.8	-0.0	13.2	-0.0	73.9	77
250.0	8.7	0.0	9.0	0.0	61.0	53
260.0	5.4	-0.0	5.6	-0.0	48.1	33
270.0	4.0	-0.0	4.1	-0.0	41.2	24
280.0	2.6	0.0	2.6	0.0	33.0	15
290.0	0.2	-0.0	0.2	-0.0	10.0	1
300.0	-3.2	0.0	-3.2	0.0	-37.1	27
310.0	-8.8	0.0	-8.8	0.0	-61.1	74
320.0	-16.9	0.0	-16.9	-0.0	-84.8	142
330.0	-28.7	0.0	-28.7	-0.0	-110.3	240
340.0	-30.5	0.0	-30.5	0.0	-113.8	255
350.0	-30.5	0.0	-30.5	0.0	-113.8	255



FORCE GENERATOR 2

ENCL.	A.3
REPORT	
DATE	07.03.2019
REF.	

Ship: Kystforskningsfartøy
Run : Dynamisk posisjonering
Ship Heading: 0.0 deg
Name: Tunnel truster bak

Env. [deg]	Force [kN]	Dir. [deg]	Power [kW]
0.0	0.0	90.0	0
10.0	-6.8	90.0	21
20.0	-14.9	90.0	67
30.0	-23.0	90.0	128
40.0	-23.0	90.0	128
50.0	-23.0	90.0	128
60.0	-23.0	90.0	128
70.0	-23.0	90.0	128
80.0	-23.0	90.0	128
90.0	-23.0	90.0	128
100.0	-23.0	90.0	128
110.0	-23.0	90.0	128
120.0	-21.8	90.0	118
130.0	-17.3	90.0	84
140.0	-15.4	90.0	70
150.0	-12.8	90.0	53
160.0	-9.6	90.0	34
170.0	-8.1	90.0	27
180.0	0.0	90.0	0
190.0	8.1	90.0	27
200.0	9.6	90.0	34
210.0	12.8	90.0	53
220.0	15.4	90.0	70
230.0	17.3	90.0	84
240.0	21.8	90.0	118
250.0	23.0	90.0	128
260.0	23.0	90.0	128
270.0	23.0	90.0	128
280.0	23.0	90.0	128
290.0	23.0	90.0	128
300.0	23.0	90.0	128
310.0	23.0	90.0	128
320.0	23.0	90.0	128
330.0	23.0	90.0	128
340.0	14.9	90.0	67
350.0	6.8	90.0	21



FORCE GENERATOR 3

ENCL.	A.4
REPORT	
DATE	07.03.2019
REF.	

Ship: Kystforskningsfartøy
Run : Dynamisk posisjonering
Ship Heading: 0.0 deg
Name: Tunnel truster foran

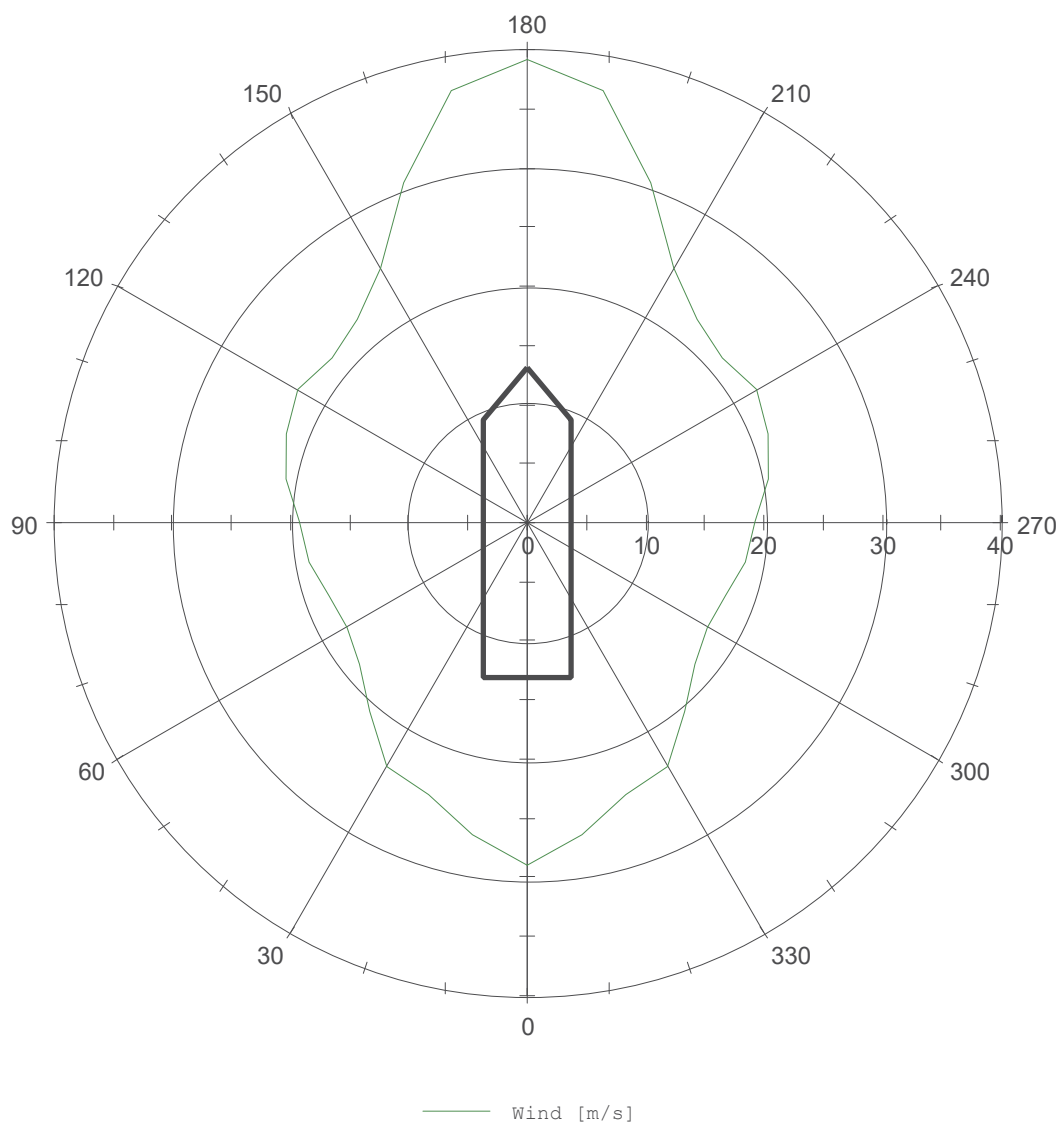
Env. [deg]	Force [kN]	Dir. [deg]	Power [kW]
0.0	0.0	90.0	0
10.0	-1.8	90.0	2
20.0	-5.7	90.0	12
30.0	-10.5	90.0	30
40.0	-10.9	90.0	32
50.0	-12.7	90.0	40
60.0	-14.2	90.0	48
70.0	-16.6	90.0	61
80.0	-21.3	90.0	88
90.0	-24.4	90.0	108
100.0	-30.5	90.0	151
110.0	-34.8	90.0	184
120.0	-38.4	90.0	213
130.0	-38.4	90.0	213
140.0	-38.4	90.0	213
150.0	-38.4	90.0	213
160.0	-38.4	90.0	213
170.0	-28.9	90.0	140
180.0	0.0	90.0	0
190.0	28.9	90.0	140
200.0	38.4	90.0	213
210.0	38.4	90.0	213
220.0	38.4	90.0	213
230.0	38.4	90.0	213
240.0	38.4	90.0	213
250.0	34.8	90.0	184
260.0	30.5	90.0	151
270.0	24.4	90.0	108
280.0	21.3	90.0	88
290.0	16.6	90.0	61
300.0	14.2	90.0	48
310.0	12.7	90.0	40
320.0	10.9	90.0	32
330.0	10.5	90.0	30
340.0	5.7	90.0	12
350.0	1.8	90.0	2



CAPABILITY

ENCL.	A.5
REPORT	
DATE	07.03.2019
REF.	

Ship: Kystforskningsfartøy
Run : Dynamisk posisjonering



External:
Variable wind velocity rotating 360 deg
0.51 m/s wind generated current rotating 360 deg (0.0 deg offset)



CAPABILITY

ENCL.	A.6
REPORT	
DATE	07.03.2019
REF.	

Ship: Kystforskningsfartøy
Run : Dynamisk posisjonering
Ship Heading: 0.0 deg

Env. [deg]	Wind [m/s]	Wave Hs [m]	Wave Tp [s]	Current [m/s]
0.0	28.9	0.0	0.0	0.51
10.0	26.8	0.0	0.0	0.51
20.0	24.4	0.0	0.0	0.51
30.0	23.8	0.0	0.0	0.51
40.0	20.8	0.0	0.0	0.51
50.0	18.5	0.0	0.0	0.51
60.0	17.6	0.0	0.0	0.51
70.0	17.9	0.0	0.0	0.51
80.0	18.8	0.0	0.0	0.51
90.0	19.3	0.0	0.0	0.51
100.0	20.7	0.0	0.0	0.51
110.0	21.7	0.0	0.0	0.51
120.0	22.4	0.0	0.0	0.51
130.0	21.6	0.0	0.0	0.51
140.0	22.4	0.0	0.0	0.51
150.0	24.8	0.0	0.0	0.51
160.0	30.6	0.0	0.0	0.51
170.0	37.1	0.0	0.0	0.51
180.0	39.1	0.0	0.0	0.51
190.0	37.1	0.0	0.0	0.51
200.0	30.6	0.0	0.0	0.51
210.0	24.8	0.0	0.0	0.51
220.0	22.4	0.0	0.0	0.51
230.0	21.6	0.0	0.0	0.51
240.0	22.4	0.0	0.0	0.51
250.0	21.7	0.0	0.0	0.51
260.0	20.7	0.0	0.0	0.51
270.0	19.3	0.0	0.0	0.51
280.0	18.8	0.0	0.0	0.51
290.0	17.9	0.0	0.0	0.51
300.0	17.6	0.0	0.0	0.51
310.0	18.5	0.0	0.0	0.51
320.0	20.8	0.0	0.0	0.51
330.0	23.8	0.0	0.0	0.51
340.0	24.4	0.0	0.0	0.51
350.0	26.8	0.0	0.0	0.51



FORCE GENERATOR 1

ENCL.	A.7
REPORT	
DATE	07.03.2019
REF.	

Ship: Kystforskningsfartøy
Run : Dynamisk posisjonering
Ship Heading: 0.0 deg
Name: Senterpropell

Env. [deg]	Force [kN]	Dir. [deg]	Thrust [kN]	Rudder [deg]	Revs [rpm]	Power [kW]
0.0	-30.5	0.0	-30.5	-0.0	-113.8	255
10.0	-30.5	0.0	-30.5	0.0	-113.8	255
20.0	-30.5	0.0	-30.5	0.0	-113.8	255
30.0	-30.5	0.0	-30.5	0.0	-113.8	255
40.0	-22.8	0.0	-22.8	-0.0	-98.3	190
50.0	-14.6	0.0	-14.6	0.0	-78.8	122
60.0	-9.9	0.0	-9.9	-0.0	-64.8	83
70.0	-5.1	0.0	-5.1	-0.0	-46.4	42
80.0	-1.5	0.0	-1.5	0.0	-24.9	12
90.0	1.6	-0.0	1.7	-0.0	26.2	10
100.0	4.8	0.0	5.0	0.0	45.3	29
110.0	9.5	0.0	9.8	0.0	63.6	57
120.0	16.0	0.0	16.4	0.0	82.5	96
130.0	22.5	-0.0	23.1	-0.0	97.9	135
140.0	26.6	0.0	27.4	0.0	106.5	160
150.0	35.4	0.0	36.4	0.0	122.7	213
160.0	47.5	-0.0	48.9	-0.0	142.3	286
170.0	47.5	0.0	48.9	0.0	142.3	286
180.0	47.5	0.0	48.9	0.0	142.3	286
190.0	47.5	0.0	48.9	0.0	142.3	286
200.0	47.5	0.0	48.9	0.0	142.3	286
210.0	35.4	-0.0	36.4	-0.0	122.7	213
220.0	26.6	0.0	27.4	0.0	106.5	160
230.0	22.5	-0.0	23.1	-0.0	97.9	135
240.0	16.0	0.0	16.4	0.0	82.5	96
250.0	9.5	0.0	9.8	0.0	63.6	57
260.0	4.8	0.0	5.0	0.0	45.3	29
270.0	1.6	-0.0	1.7	-0.0	26.2	10
280.0	-1.5	0.0	-1.5	-0.0	-24.9	12
290.0	-5.1	0.0	-5.1	-0.0	-46.4	42
300.0	-9.9	0.0	-9.9	-0.0	-64.8	83
310.0	-14.6	0.0	-14.6	0.0	-78.8	122
320.0	-22.8	0.0	-22.8	-0.0	-98.3	190
330.0	-30.5	0.0	-30.5	0.0	-113.8	255
340.0	-30.5	0.0	-30.5	0.0	-113.8	255
350.0	-30.5	0.0	-30.5	0.0	-113.8	255



FORCE GENERATOR 2

ENCL.	A.8
REPORT	
DATE	07.03.2019
REF.	

Ship: Kystforskningsfartøy
Run : Dynamisk posisjonering
Ship Heading: 0.0 deg
Name: Tunnel truster bak

Env. [deg]	Force [kN]	Dir. [deg]	Power [kW]
0.0	0.0	90.0	0
10.0	-5.9	90.0	17
20.0	-12.7	90.0	52
30.0	-20.9	90.0	111
40.0	-23.0	90.0	128
50.0	-23.0	90.0	128
60.0	-23.0	90.0	128
70.0	-23.0	90.0	128
80.0	-23.0	90.0	128
90.0	-23.0	90.0	128
100.0	-23.0	90.0	128
110.0	-23.0	90.0	128
120.0	-23.0	90.0	128
130.0	-23.0	90.0	128
140.0	-19.8	90.0	102
150.0	-16.0	90.0	74
160.0	-11.7	90.0	47
170.0	-6.5	90.0	19
180.0	0.0	90.0	0
190.0	6.5	90.0	19
200.0	11.7	90.0	47
210.0	16.0	90.0	74
220.0	19.8	90.0	102
230.0	23.0	90.0	128
240.0	23.0	90.0	128
250.0	23.0	90.0	128
260.0	23.0	90.0	128
270.0	23.0	90.0	128
280.0	23.0	90.0	128
290.0	23.0	90.0	128
300.0	23.0	90.0	128
310.0	23.0	90.0	128
320.0	23.0	90.0	128
330.0	20.9	90.0	111
340.0	12.7	90.0	52
350.0	5.9	90.0	17

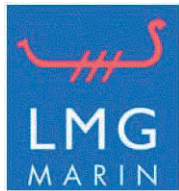


FORCE GENERATOR 3

ENCL.	A.9
REPORT	
DATE	07.03.2019
REF.	

Ship: Kystforskningsfartøy
Run : Dynamisk posisjonering
Ship Heading: 0.0 deg
Name: Tunnel truster foran

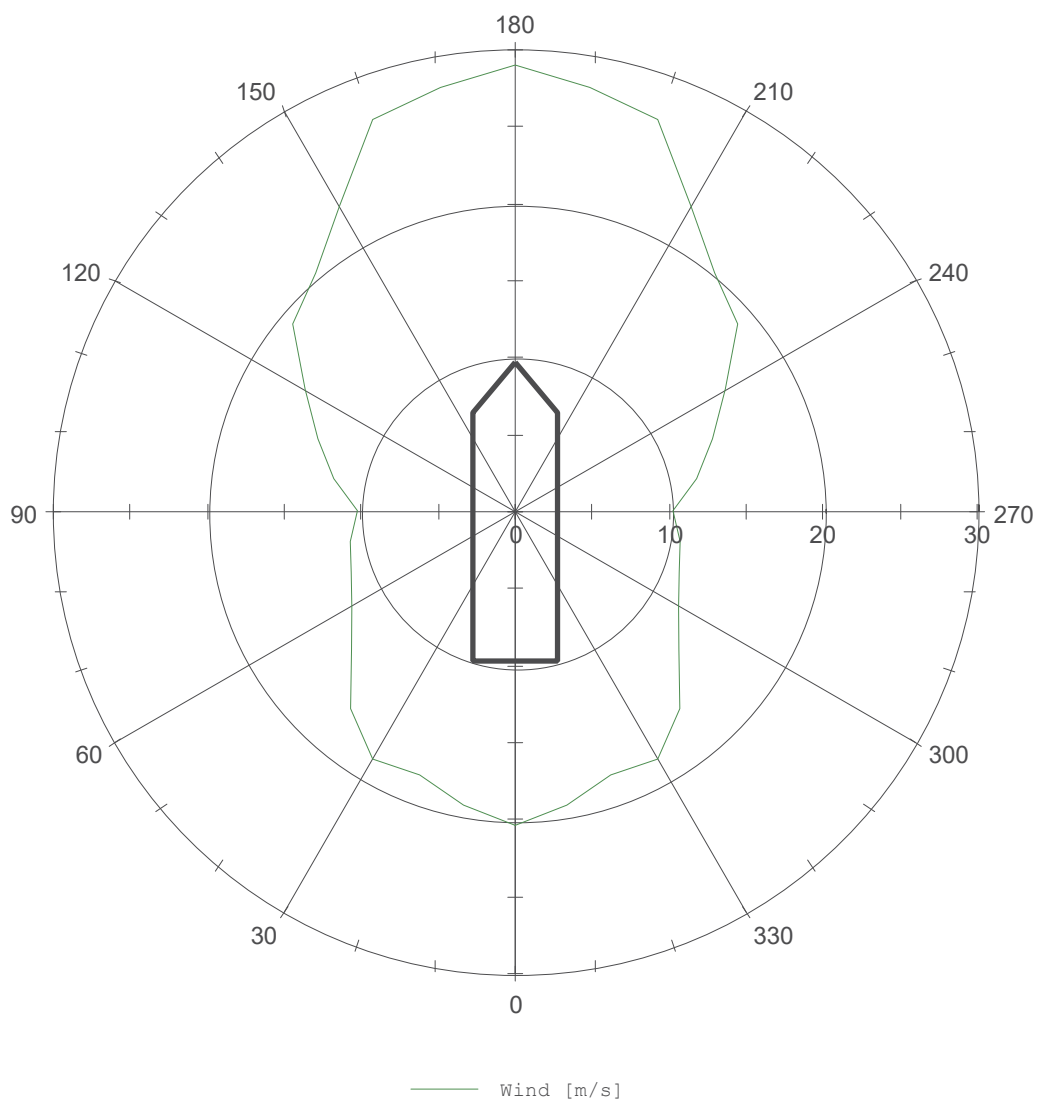
Env. [deg]	Force [kN]	Dir. [deg]	Power [kW]
0.0	0.0	90.0	0
10.0	-1.9	90.0	2
20.0	-5.1	90.0	10
30.0	-10.0	90.0	28
40.0	-11.7	90.0	36
50.0	-13.2	90.0	43
60.0	-14.6	90.0	50
70.0	-15.9	90.0	57
80.0	-18.2	90.0	69
90.0	-19.4	90.0	76
100.0	-22.4	90.0	95
110.0	-25.4	90.0	115
120.0	-29.7	90.0	145
130.0	-38.2	90.0	211
140.0	-38.4	90.0	213
150.0	-38.4	90.0	213
160.0	-34.9	90.0	184
170.0	-18.8	90.0	73
180.0	0.0	90.0	0
190.0	18.8	90.0	73
200.0	34.9	90.0	184
210.0	38.4	90.0	213
220.0	38.4	90.0	213
230.0	38.2	90.0	211
240.0	29.7	90.0	145
250.0	25.4	90.0	115
260.0	22.4	90.0	95
270.0	19.4	90.0	76
280.0	18.2	90.0	69
290.0	15.9	90.0	57
300.0	14.6	90.0	50
310.0	13.2	90.0	43
320.0	11.7	90.0	36
330.0	10.0	90.0	28
340.0	5.1	90.0	10
350.0	1.9	90.0	2



CAPABILITY

ENCL.	A.10
REPORT	
DATE	07.03.2019
REF.	

Ship: Kystforskningsfartøy
Run : Dynamisk posisjonering



External:
Variable wind velocity rotating 360 deg
0.51 m/s wind generated current rotating 360 deg (0.0 deg offset)
Variable wave height rotating 360 deg (0.0 deg offset)



CAPABILITY

ENCL.	A.11
REPORT	
DATE	07.03.2019
REF.	

Ship: Kystforskningsfartøy
Run : Dynamisk posisjonering
Ship Heading: 0.0 deg

Env. [deg]	Wind [m/s]	Wave Hs [m]	Wave Tp [s]	Current [m/s]
0.0	20.4	7.4	12.8	0.51
10.0	19.3	7.0	12.4	0.51
20.0	18.2	6.4	11.9	0.51
30.0	18.5	6.6	12.0	0.51
40.0	16.7	5.8	11.3	0.51
50.0	13.9	4.6	10.1	0.51
60.0	12.3	4.0	9.4	0.51
70.0	11.4	3.7	9.0	0.51
80.0	10.9	3.5	8.8	0.51
90.0	10.3	3.3	8.5	0.51
100.0	12.0	3.9	9.3	0.51
110.0	13.7	4.5	10.0	0.51
120.0	15.8	5.4	10.9	0.51
130.0	18.9	6.8	12.2	0.51
140.0	20.2	7.4	12.7	0.51
150.0	22.9	8.7	13.8	0.51
160.0	27.1	10.9	15.5	0.51
170.0	28.0	11.3	15.8	0.51
180.0	29.0	11.9	16.2	0.51
190.0	28.0	11.3	15.8	0.51
200.0	27.1	10.9	15.5	0.51
210.0	22.9	8.7	13.8	0.51
220.0	20.2	7.4	12.7	0.51
230.0	18.9	6.8	12.2	0.51
240.0	15.8	5.4	10.9	0.51
250.0	13.7	4.5	10.0	0.51
260.0	12.0	3.9	9.3	0.51
270.0	10.3	3.3	8.5	0.51
280.0	10.9	3.5	8.8	0.51
290.0	11.4	3.7	9.0	0.51
300.0	12.3	4.0	9.4	0.51
310.0	13.9	4.6	10.1	0.51
320.0	16.7	5.8	11.3	0.51
330.0	18.5	6.6	12.0	0.51
340.0	18.2	6.4	11.9	0.51
350.0	19.3	7.0	12.4	0.51



FORCE GENERATOR 1

ENCL.	A.12
REPORT	
DATE	20.03.2019
REF.	

Ship: Kystforskningsfartøy
Run : Dynamisk posisjonering (Bølger)
Ship Heading: 0.0 deg
Name: Senterpropell

Env. [deg]	Force [kN]	Dir. [deg]	Thrust [kN]	Rudder [deg]	Revs [rpm]	Power [kW]
0.0	-30.5	0.0	-30.5	0.0	-113.8	255
10.0	-30.5	0.0	-30.5	0.0	-113.8	255
20.0	-30.5	0.0	-30.5	0.0	-113.8	255
30.0	-20.5	0.0	-20.5	-0.0	-93.2	171
40.0	-11.2	0.0	-11.2	0.0	-69.1	94
50.0	-7.0	0.0	-7.0	-0.0	-54.6	59
60.0	Unable to keep station					
70.0	Unable to keep station					
80.0	Unable to keep station					
90.0	Unable to keep station					
100.0	2.0	-0.0	2.1	-0.0	29.4	12
110.0	5.0	0.0	5.1	0.0	46.0	30
120.0	9.9	-0.0	10.2	-0.0	65.0	60
130.0	13.7	0.0	14.1	0.0	76.4	82
140.0	16.3	-0.0	16.8	-0.0	83.4	98
150.0	21.9	-0.0	22.5	-0.0	96.6	132
160.0	35.4	0.0	36.4	0.0	122.9	213
170.0	47.5	0.0	48.9	0.0	142.3	286
180.0	47.5	-0.0	48.9	-0.0	142.3	286
190.0	47.5	-0.0	48.9	-0.0	142.3	286
200.0	35.4	-0.0	36.4	-0.0	122.9	213
210.0	21.9	0.0	22.5	0.0	96.6	132
220.0	16.3	0.0	16.8	0.0	83.4	98
230.0	13.7	0.0	14.1	0.0	76.4	82
240.0	9.9	0.0	10.2	0.0	65.0	60
250.0	5.0	-0.0	5.1	-0.0	46.0	30
260.0	2.0	-0.0	2.1	-0.0	29.4	12
270.0	Unable to keep station					
280.0	Unable to keep station					
290.0	Unable to keep station					
300.0	Unable to keep station					
310.0	-7.0	0.0	-7.0	-0.0	-54.6	59
320.0	-11.2	0.0	-11.2	-0.0	-69.1	94
330.0	-20.5	0.0	-20.5	-0.0	-93.2	171
340.0	-30.5	0.0	-30.5	0.0	-113.8	255
350.0	-30.5	0.0	-30.5	0.0	-113.8	255



FORCE GENERATOR 2

ENCL.	A.13
REPORT	
DATE	20.03.2019
REF.	

Ship: Kystforskningsfartøy
Run : Dynamisk posisjonering (Bølger)
Ship Heading: 0.0 deg
Name: Tunnel truster bak

Env. [deg]	Force [kN]	Dir. [deg]	Power [kW]
0.0	0.0	90.0	0
10.0	-9.3	90.0	33
20.0	-19.5	90.0	100
30.0	-23.0	90.0	128
40.0	-23.0	90.0	128
50.0	-23.0	90.0	128
60.0	Unable to keep station		
70.0	Unable to keep station		
80.0	Unable to keep station		
90.0	Unable to keep station		
100.0	-23.0	90.0	128
110.0	-23.0	90.0	128
120.0	-23.0	90.0	128
130.0	-20.0	90.0	104
140.0	-17.1	90.0	82
150.0	-14.0	90.0	61
160.0	-10.4	90.0	39
170.0	-8.3	90.0	27
180.0	0.0	90.0	0
190.0	8.3	90.0	27
200.0	10.4	90.0	39
210.0	14.0	90.0	61
220.0	17.1	90.0	82
230.0	20.0	90.0	104
240.0	23.0	90.0	128
250.0	23.0	90.0	128
260.0	23.0	90.0	128
270.0	Unable to keep station		
280.0	Unable to keep station		
290.0	Unable to keep station		
300.0	Unable to keep station		
310.0	23.0	90.0	128
320.0	23.0	90.0	128
330.0	23.0	90.0	128
340.0	19.5	90.0	100
350.0	9.3	90.0	33



FORCE GENERATOR 3

ENCL.	A.14
REPORT	
DATE	20.03.2019
REF.	

Ship: Kystforskningsfartøy
Run : Dynamisk posisjonering (Bølger)
Ship Heading: 0.0 deg
Name: Tunnel truster foran

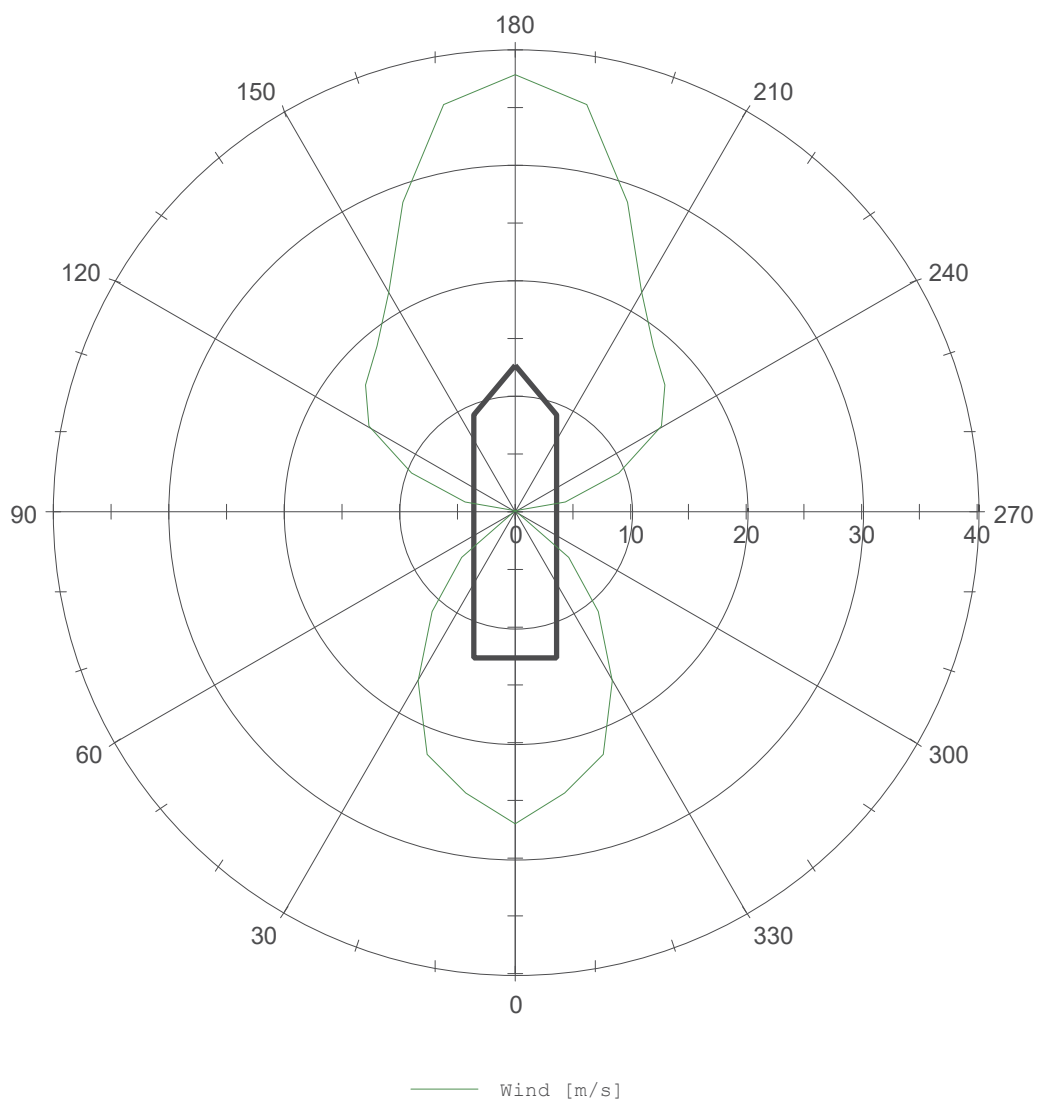
Env. [deg]	Force [kN]	Dir. [deg]	Power [kW]
0.0	0.0	90.0	0
10.0	-1.1	90.0	1
20.0	-5.0	90.0	10
30.0	-6.4	90.0	14
40.0	-6.0	90.0	13
50.0	-7.6	90.0	19
60.0	Unable to keep station		
70.0	Unable to keep station		
80.0	Unable to keep station		
90.0	Unable to keep station		
100.0	-22.3	90.0	94
110.0	-27.1	90.0	126
120.0	-34.3	90.0	180
130.0	-38.4	90.0	213
140.0	-38.4	90.0	213
150.0	-38.4	90.0	213
160.0	-38.4	90.0	213
170.0	-29.3	90.0	142
180.0	0.0	90.0	0
190.0	29.3	90.0	142
200.0	38.4	90.0	213
210.0	38.4	90.0	213
220.0	38.4	90.0	213
230.0	38.4	90.0	213
240.0	34.3	90.0	180
250.0	27.1	90.0	126
260.0	22.3	90.0	94
270.0	Unable to keep station		
280.0	Unable to keep station		
290.0	Unable to keep station		
300.0	Unable to keep station		
310.0	7.6	90.0	19
320.0	6.0	90.0	13
330.0	6.4	90.0	14
340.0	5.0	90.0	10
350.0	1.1	90.0	1



CAPABILITY

ENCL.	A.15
REPORT	
DATE	20.03.2019
REF.	

Ship: Kystforskningsfartøy
Run : Dynamisk posisjonering (Bølger)



External:
Variable wind velocity rotating 360 deg
1.03 m/s wind generated current rotating 360 deg (0.0 deg offset)
1.0 m waves rotating 360 deg (0.0 deg offset)



CAPABILITY

ENCL.	A.16
REPORT	
DATE	20.03.2019
REF.	

Ship: Kystforskningsfartøy
Run : Dynamisk posisjonering (Bølger)
Ship Heading: 0.0 deg

Env. [deg]	Wind [m/s]	Wave Hs [m]	Wave Tp [s]	Current [m/s]
0.0	27.0	1.0	7.5	1.03
10.0	24.7	1.0	7.5	1.03
20.0	22.3	1.0	7.5	1.03
30.0	16.9	1.0	7.5	1.03
40.0	11.2	1.0	7.5	1.03
50.0	6.0	1.0	7.5	1.03
60.0	Unable to keep station			
70.0	Unable to keep station			
80.0	Unable to keep station			
90.0	Unable to keep station			
100.0	4.4	1.0	7.5	1.03
110.0	9.6	1.0	7.5	1.03
120.0	14.7	1.0	7.5	1.03
130.0	17.0	1.0	7.5	1.03
140.0	18.6	1.0	7.5	1.03
150.0	22.0	1.0	7.5	1.03
160.0	28.5	1.0	7.5	1.03
170.0	35.8	1.0	7.5	1.03
180.0	37.8	1.0	7.5	1.03
190.0	35.8	1.0	7.5	1.03
200.0	28.5	1.0	7.5	1.03
210.0	22.0	1.0	7.5	1.03
220.0	18.6	1.0	7.5	1.03
230.0	17.0	1.0	7.5	1.03
240.0	14.7	1.0	7.5	1.03
250.0	9.6	1.0	7.5	1.03
260.0	4.4	1.0	7.5	1.03
270.0	Unable to keep station			
280.0	Unable to keep station			
290.0	Unable to keep station			
300.0	Unable to keep station			
310.0	6.0	1.0	7.5	1.03
320.0	11.2	1.0	7.5	1.03
330.0	16.9	1.0	7.5	1.03
340.0	22.3	1.0	7.5	1.03
350.0	24.7	1.0	7.5	1.03