



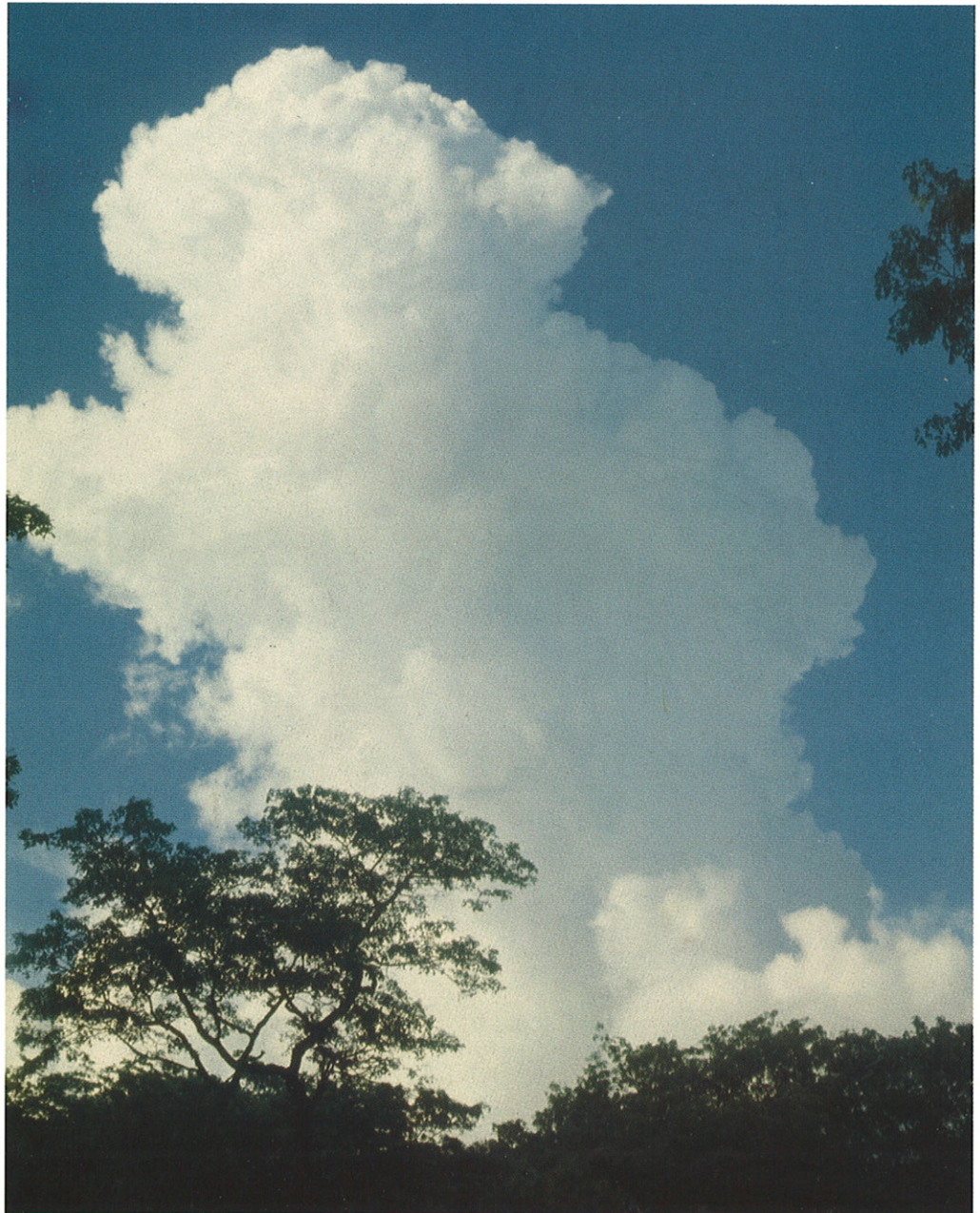
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Mooring sites at Stolsfjorden and Hidrasundet. Extreme wind climate

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TITLE

MOORING SITES AT STOLSFJORDEN AND HIDRASUNDET EXTREME WIND CLIMATE

PREPARED BY

Knut Harstveit

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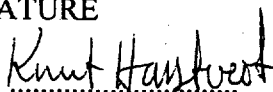
SUMMARY

Extreme wind conditions and turbulence parameters for the two mooring site alternatives at Lauvnes, Hidrasundet, and inner part of the Stolsfjorden are given, using data from Lista, and general knowledge of shielding effects in Norwegian fjords.

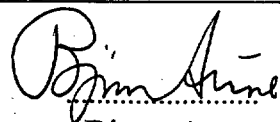
Extreme values are given for 10, 50 and 100 years return periods. Longitudinal turbulence intensity, gust factors, and height profiles are also given.

The highest wind speeds are found in the western sector in the Hidrasundet.

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Summary

Extreme wind conditions and turbulence parameters for the two mooring site alternatives inside Lista are given, using data from Lista, and general knowledge of shielding effects in Norwegian fjords. Extreme values are given for 10, 50 and 100 years return periods. Longitudinal turbulence intensity, gust factors, and height profiles are also given. The tables give a view of the results at the 10 m level. The highest wind speeds are found in the western sector in the Hidrasundet (Lauvnes).

Stolsfjorden	N	NE	E	SE	S	SW	W	NW
U_{10min} [m/s], 10 år, 10m	12.2	16.2	12.4	19.9	21.0	17.4	16.6	19.7
U_{10min} [m/s], 50 år, 10m	13.5	18.0	13.8	22.1	23.3	19.3	18.4	21.9
U_{10min} [m/s], 100 år, 10m	14.0	18.6	14.3	22.9	24.2	20.1	19.1	22.7
$n(U_{10min})$	0.30	0.25	0.25	0.15	0.15	0.25	0.25	0.20
I_u	0.40	0.32	0.32	0.20	0.20	0.32	0.32	0.24
U_{3-5s} [m/s], 10 år, 10m	24.3	29.1	22.4	29.9	31.5	31.4	29.9	31.5
U_{3-5s} [m/s], 50 år, 10m	27.0	32.3	24.9	33.2	35.0	34.8	33.2	35.0
U_{3-5s} [m/s], 100 år, 10m	28.0	33.6	25.8	34.4	36.3	36.1	34.4	36.3
$n(U_{3-5s})$	0.17	0.15	0.15	0.10	0.10	0.15	0.15	0.13

Lauvnes	N	NE	E	SE	S	SW	W	NW
U_{10min} [m/s], 10 år, 10m	10.6	12.6	18.7	19.9	15.8	14.9	24.9	21.0
U_{10min} [m/s], 50 år, 10m	11.8	14.0	20.7	22.1	17.5	16.6	27.6	23.3
U_{10min} [m/s], 100 år, 10m	12.3	14.5	21.5	22.9	18.2	17.2	28.7	24.2
$n(U_{10min})$	0.30	0.18	0.18	0.18	0.25	0.18	0.18	0.25
I_u	0.40	0.24	0.24	0.24	0.40	0.24	0.24	0.40
U_{3-5s} [m/s], 10 år, 10m	21.3	20.1	29.9	31.9	31.5	23.9	39.8	42.0
U_{3-5s} [m/s], 50 år, 10m	23.6	22.3	33.2	35.4	35.0	26.5	44.2	46.7
U_{3-5s} [m/s], 100 år, 10m	24.5	23.2	34.4	36.7	36.3	27.5	45.9	48.4
$n(U_{3-5s})$	0.17	0.12	0.12	0.12	0.14	0.12	0.12	0.14

1. Introduction

The background for this report is a request from Aker Maritime concerning the project of Siri Jack-up: Temporary Winter Mooring in Flekkefjorden. A preliminary answer is given in our letter 321.3/2337/98, enclosed. The positions of the requested areas are slightly different from the sites discussed in this letter.

2. Site description and general wind conditions

The mooring site at Stolsfjorden is situated in the inner part of the fjord, between Olsøya and Langenesodden, south-east of Djupvika. The direction of the fjord is SE-S / NW-N with the direction of SE-S as the most open one. Correspondingly, the highest wind speeds should be expected from that direction. Northerly winds are shielded by Hestedalodden, but so is most of the coast around Lista. Locally, wind speeds during easterly, south-westerly and westerly winds are significantly reduced due to fjord crossing. North-easterly winds are somewhat less shielded due to the local valley to the NE, but winds from that direction are generally not very high west of Lindesnes, except in Fedafjorden.

An area between Lauvnes and Vardnes in Hidasundet is exposed to the strong westerly winds. The wind speed through this sound is partly accelerated due to the narrow sound, and partly retarded due to surface friction from both sides of the sound. The friction effects are probably slightly higher than the sound acceleration. Also wind from east is strong through the sound, while the site is shielded against southerly and northerly winds.

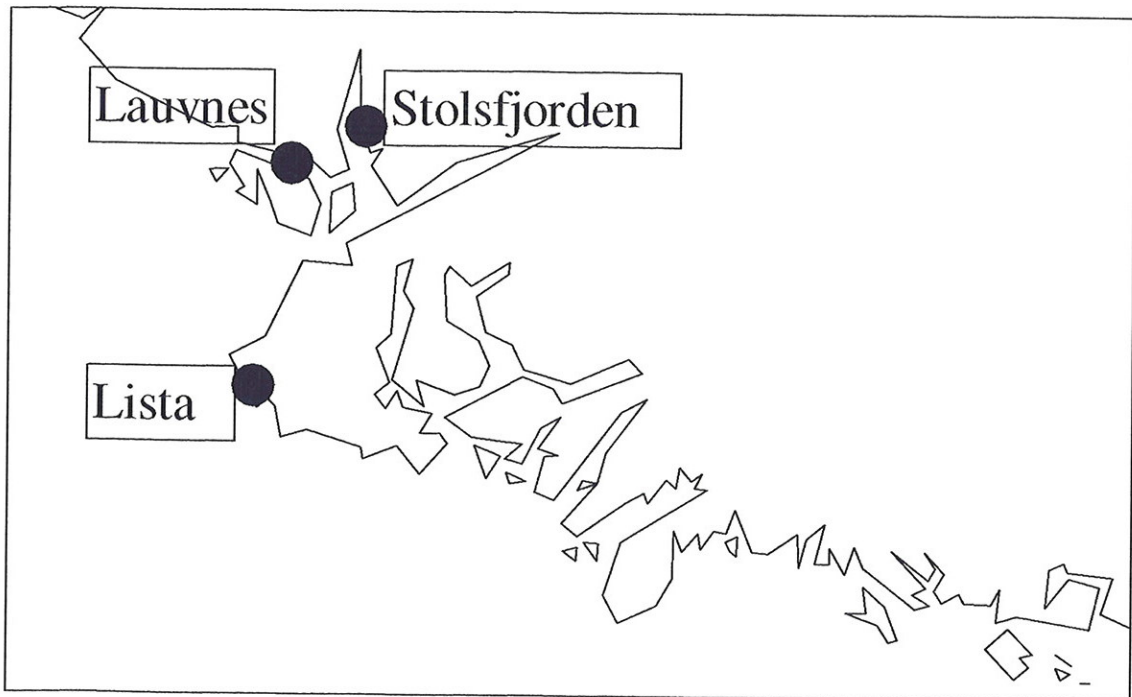
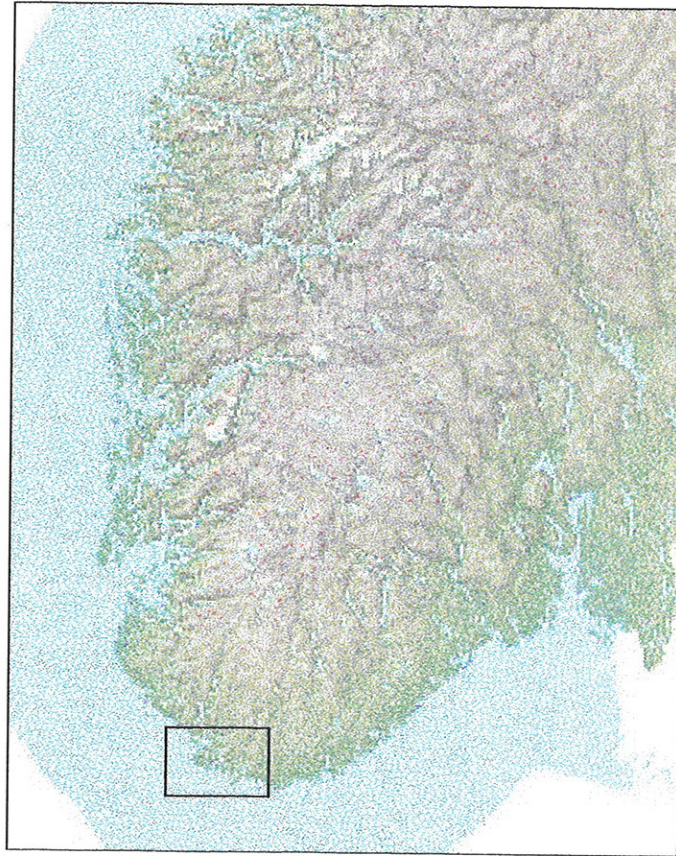


Fig 1. Map of the sites. For more detail, see the enclosed documents.

3. Extreme wind climate

3.1. *Calculating extreme wind climate at the mooring site alternatives.*

50 year values of 10 minutes mean wind is calculated at Lista lighthouse, giving 32 m/s as overall value and 17 - 31 m/s for the 8 sectors N, NE, ... when taken separately. Data from 1982 - 97 are used in the calculations. The values at Lista are assumed to be representative for the values 10 m above sea level, just outside the shore. The results clearly show that the strongest wind comes from west, but the strong winds occur in the whole sector from south-east to north-west. On the other side, this part of the coast is shielded to strong northerly, and partly also north-westerly winds, due to the large scale topography of Southern Norway (Fig. 1).

There are no wind records from the mooring site alternatives in the fjords inside Lista. However, measurements from other fjords (Frierfjorden, Vats/Yrkjesfjorden, Byfjorden close to Bergen, Hardangerfjorden, Sognefjorden, several fjords from Møre and Romsdal) clearly show a general trend of wind shielding when moving into the fjords. The reason for this is the increasing surface friction from the landscape. Only when mountain leewave conditions occur, the mean wind can be stronger than at the coast. Also some special topographic small scale effects close to steep terrain and special geometric forms may result in wind gusts comparable with the coastal gusts. Neither of these two phenomena are expected to occur in the fjord inside Lista. However, the air stream in a fjord may sometimes be only slightly reduced, or perhaps not reduced at all. This is when the air has to pass through a sound or near a headland, and there are open sea at both sites of the sound. Such conditions are found in the Hidrasundet, though some reduction due to the higher landscape east of the sound is expected. Generally, reductions to 70-80% may be expected for wind along relatively open fjords, and 50 - 70 % when crossing such fjords.

The relation between 10, 50, and 100 year extreme values are relatively good known from analysis of more the 30 Norwegian stations. 0.901 and 1.038 are used as average values when calculating the 10 and 100 years extreme values from the 50 - year values.

To do the detailed analysis, we are using a calculating scheme for 8 sectors where known extreme values at Lista are given, and transfer coefficients from Lista to the mooring site alternatives are estimated by educated guesses.

3.2. Gust extremes, turbulence parameters and height profiles.

When surface friction reduces the wind mean wind speed, the turbulence and the gust factor increases, and the wind profile changes, giving more reduction the closer the surface. The 3-5 s gust factors are typically 1.5 - 1.6 along the fjord, and 1.8 - 2.0 across the fjord, and the corresponding values of the exponent of the wind profile equation for the mean wind speed is 0.15 - 0.20 and 0.25 - 0.30, see eq. 1 to 4 and the tables.

The height profile is found by the equations 1 - 3.

$$\frac{U(z)}{U(10m)} = \left(\frac{z}{10m} \right)^n \quad \text{eq. 1}$$

$$\frac{I_u(z)}{I_u(10m)} = \left(\frac{z}{10m} \right)^{-n} \quad \text{eq. 2}$$

$$\frac{Gf(z) - 1}{Gf(10m) - 1} = \left(\frac{z}{10m} \right)^{-n} \quad \text{eq. 3}$$

The relation between the turbulence intensity along the wind direction, and the gust factors are given by

$$I_u = \frac{Gf_{3-5s} - 1}{2.5} = \frac{Gf_{1min} - 1}{1.15} \quad \text{eq. 4}$$

Eq.2 and 4 also give the basic information for calculating the exponent n in eq.1 for wind gusts of 3-5 s, U_{3-5s} and 1min, U_{1min} . $n(I_u)$ is then assumed identical to $n(U_{10min})$.

3.3. Results

The results are given in table 1 and 2a - 2e (Stolsfjorden) and table 3 and 4a - 4e (Lauvnes, Hidasundet).

Table 1

Basic information for calculating extreme wind conditions and turbulence parameters for Stolsfjorden

	N	NE	E	SE	S	SW	W	NW
$U_{10min,Lista}$ [m/s], 50 år	16.9	20.0	23.0	27.6	29.2	27.6	30.7	29.2
Transfer coeff., Lista - 10m asl	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Transfer coeff., 10masl - Stolsfj. (10m)	0.80	0.90	0.60	0.80	0.80	0.70	0.60	0.75
Transfer coeff., Lista - 10m, Stolsfj.	0.80	0.90	0.60	0.80	0.80	0.70	0.60	0.75
U_{10min} [m/s], 50 år, 10m	13.5	18.0	13.8	22.1	23.3	19.3	18.4	21.9
$n(U_{10min})$	0.30	0.25	0.25	0.15	0.15	0.25	0.25	0.20
Gf_{3-5s} (10m)	2.0	1.8	1.8	1.5	1.5	1.8	1.8	1.6

Table 2a

Extreme wind conditions and turbulence parameters during northerly winds.

N	U_{10min} [m/s]			U_{1min} [m/s]			U_{3-5s} [m/s]			Turbulence parameters		
	10 år	50 år	100 år	10 år	50 år	100 år	10 år	50 år	100 år	I_u	Gf_{3-5s}	Gf_{1min}
z [m]												
10	12.2	13.5	14.0	17.8	19.7	20.5	24.3	27.0	28.0	0.40	2.00	1.46
20	15.0	16.6	17.3	20.6	22.8	23.7	27.2	30.1	31.3	0.32	1.81	1.37
30	16.9	18.8	19.5	22.5	25.0	25.9	29.1	32.3	33.5	0.29	1.72	1.33
40	18.4	20.5	21.3	24.0	26.7	27.7	30.6	34.0	35.3	0.26	1.66	1.30
50	19.7	21.9	22.7	25.3	28.1	29.2	31.9	35.4	36.7	0.25	1.62	1.28
n	0.30	0.30	0.30	0.22	0.22	0.22	0.17	0.17	0.17	0.30		

Table 2b

Extreme wind conditions and turbulence parameters during northeasterly winds.

NE	U_{10min} [m/s]			U_{1min} [m/s]			U_{3-5s} [m/s]			Turbulence parameters		
	10 år	50 år	100 år	10 år	50 år	100 år	10 år	50 år	100 år	I_u	Gf_{3-5s}	Gf_{1min}
z [m]												
10	16.2	18.0	18.6	22.1	24.6	25.5	29.1	32.3	33.6	0.32	1.80	1.37
20	19.2	21.4	22.2	25.2	28.0	29.0	32.2	35.7	37.1	0.27	1.67	1.31
30	21.3	23.6	24.5	27.3	30.2	31.4	34.2	38.0	39.4	0.24	1.61	1.28
40	22.9	25.4	26.4	28.8	32.0	33.2	35.8	39.8	41.3	0.23	1.57	1.26
50	24.2	26.9	27.9	30.2	33.5	34.7	37.1	41.2	42.8	0.21	1.53	1.25
n	0.25	0.25	0.25	0.19	0.19	0.19	0.15	0.15	0.15	0.25		

Table 2c

Extreme wind conditions and turbulence parameters during easterly winds.

E	$U_{10\min}$ [m/s]			$U_{1\min}$ [m/s]			U_{3-5s} [m/s]			Turbulence parameters		
	10 år	50 år	100 år	10 år	50 år	100 år	10 år	50 år	100 år	I_u	Gf_{3-5s}	$Gf_{1\min}$
10	12.4	13.8	14.3	17.0	18.9	19.6	22.4	24.9	25.8	0.32	1.80	1.37
20	14.8	16.4	17.1	19.4	21.5	22.3	24.8	27.5	28.5	0.27	1.67	1.31
30	16.4	18.2	18.9	21.0	23.3	24.1	26.3	29.2	30.3	0.24	1.61	1.28
40	17.6	19.5	20.3	22.2	24.6	25.6	27.6	30.6	31.8	0.23	1.57	1.26
50	18.6	20.7	21.4	23.2	25.7	26.7	28.6	31.7	32.9	0.21	1.53	1.25
n	0.25	0.25	0.25	0.19	0.19	0.19	0.15	0.15	0.15	0.25		

Table 2d

Extreme wind conditions and turbulence parameters during southeasterly winds.

SE	$U_{10\min}$ [m/s]			$U_{1\min}$ [m/s]			U_{3-5s} [m/s]			Turbulence parameters		
	10 år	50 år	100 år	10 år	50 år	100 år	10 år	50 år	100 år	I_u	Gf_{3-5s}	$Gf_{1\min}$
10	19.9	22.1	22.9	24.5	27.2	28.2	29.9	33.2	34.4	0.20	1.50	1.23
20	22.1	24.5	25.5	26.7	29.6	30.7	32.1	35.6	36.9	0.18	1.45	1.21
30	23.5	26.1	27.1	28.1	31.1	32.3	33.4	37.1	38.5	0.17	1.42	1.20
40	24.5	27.2	28.2	29.1	32.3	33.5	34.5	38.3	39.7	0.16	1.41	1.19
50	25.4	28.1	29.2	29.9	33.2	34.5	35.3	39.2	40.7	0.16	1.39	1.18
n	0.15	0.15	0.15	0.12	0.12	0.12	0.10	0.10	0.10	0.15		

Table 2e

Extreme wind conditions and turbulence parameters during southerly winds.

S	$U_{10\min}$ [m/s]			$U_{1\min}$ [m/s]			U_{3-5s} [m/s]			Turbulence parameters		
	10 år	50 år	100 år	10 år	50 år	100 år	10 år	50 år	100 år	I_u	Gf_{3-5s}	$Gf_{1\min}$
10	21.0	23.3	24.2	25.9	28.7	29.8	31.5	35.0	36.3	0.20	1.50	1.23
20	23.3	25.9	26.9	28.2	31.3	32.4	33.8	37.6	39.0	0.18	1.45	1.21
30	24.8	27.5	28.6	29.6	32.9	34.1	35.3	39.2	40.7	0.17	1.42	1.20
40	25.9	28.7	29.8	30.7	34.1	35.4	36.4	40.4	41.9	0.16	1.41	1.19
50	26.8	29.7	30.8	31.6	35.1	36.4	37.3	41.4	42.9	0.16	1.39	1.18
n	0.15	0.15	0.15	0.12	0.12	0.12	0.10	0.10	0.10	0.15		

Table 2f

Extreme wind conditions and turbulence parameters during southwesterly winds.

SW	U_{10min} [m/s]			U_{1min} [m/s]			U_{3-5s} [m/s]			Turbulence parameters		
	10 år	50 år	100 år	10 år	50 år	100 år	10 år	50 år	100 år	I_u	Gf_{3-5s}	Gf_{1min}
10	17.4	19.3	20.1	23.8	26.5	27.5	31.4	34.8	36.1	0.32	1.80	1.37
20	20.7	23.0	23.9	27.1	30.1	31.3	34.7	38.5	39.9	0.27	1.67	1.31
30	22.9	25.5	26.4	29.3	32.6	33.8	36.9	40.9	42.5	0.24	1.61	1.28
40	24.6	27.4	28.4	31.1	34.5	35.8	38.6	42.8	44.5	0.23	1.57	1.26
50	26.1	28.9	30.0	32.5	36.0	37.4	40.0	44.4	46.1	0.21	1.53	1.25
n	0.25	0.25	0.25	0.19	0.19	0.19	0.15	0.15	0.15	0.25		

Table 2g

Extreme wind conditions and turbulence parameters during westerly winds.

W	U_{10min} [m/s]			U_{1min} [m/s]			U_{3-5s} [m/s]			Turbulence parameters		
	10 år	50 år	100 år	10 år	50 år	100 år	10 år	50 år	100 år	I_u	Gf_{3-5s}	Gf_{1min}
10	16.6	18.4	19.1	22.7	25.2	26.2	29.9	33.2	34.4	0.32	1.80	1.37
20	19.7	21.9	22.7	25.8	28.7	29.8	33.0	36.6	38.0	0.27	1.67	1.31
30	21.8	24.2	25.2	27.9	31.0	32.2	35.1	39.0	40.5	0.24	1.61	1.28
40	23.5	26.0	27.0	29.6	32.8	34.1	36.7	40.8	42.3	0.23	1.57	1.26
50	24.8	27.5	28.6	30.9	34.3	35.6	38.1	42.3	43.9	0.21	1.53	1.25
n	0.25	0.25	0.25	0.19	0.19	0.19	0.15	0.15	0.15	0.25		

Table 2h

Extreme wind conditions and turbulence parameters during northwesterly winds.

NW	U_{10min} [m/s]			U_{1min} [m/s]			U_{3-5s} [m/s]			Turbulence parameters		
	10 år	50 år	100 år	10 år	50 år	100 år	10 år	50 år	100 år	I_u	Gf_{3-5s}	Gf_{1min}
10	19.7	21.9	22.7	25.1	27.9	29.0	31.5	35.0	36.3	0.24	1.60	1.28
20	22.6	25.1	26.1	28.1	31.2	32.3	34.5	38.3	39.7	0.21	1.52	1.24
30	24.6	27.2	28.3	30.0	33.3	34.6	36.4	40.4	41.9	0.19	1.48	1.22
40	26.0	28.9	30.0	31.4	34.9	36.2	37.8	42.0	43.6	0.18	1.45	1.21
50	27.2	30.2	31.3	32.6	36.2	37.6	39.0	43.3	44.9	0.17	1.43	1.20
n	0.20	0.20	0.20	0.16	0.16	0.16	0.13	0.13	0.13	0.20		

Table 3

Basic information for calculating extreme wind conditions and turbulence parameters for Stolsfjorden

	N	NE	E	SE	S	SW	W	NW
$U_{10min,Lista}$ [m/s], 50 år	16.9	20.0	23.0	27.6	29.2	27.6	30.7	29.2
Transfer coeff., Lista - 10m asl	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Transfer coeff., 10masl - Lauvnes (10m)	0.70	0.70	0.90	0.80	0.60	0.60	0.90	0.80
Transfer coeff., Lista - 10m, Lauvnes	0.70	0.70	0.90	0.80	0.60	0.60	0.90	0.80
U_{10min} [m/s], 50 år, 10m	11.8	14.0	20.7	22.1	17.5	16.6	27.6	23.3
$n(U_{10min})$	0.30	0.18	0.18	0.18	0.25	0.18	0.18	0.25
Gf_{3-5s} (10m)	2.0	1.6	1.6	1.6	2.0	1.6	1.6	2.0

Table 4a

Extreme wind conditions and turbulence parameters during northerly winds.

N	U_{10min} [m/s]			U_{1min} [m/s]			U_{3-5s} [m/s]			Turbulence parameters		
	10 år	50 år	100 år	10 år	50 år	100 år	10 år	50 år	100 år	I_u	Gf_{3-5s}	Gf_{1min}
z [m]												
10	10.6	11.8	12.3	15.5	17.3	17.9	21.3	23.6	24.5	0.40	2.00	1.46
20	13.1	14.6	15.1	18.0	20.0	20.7	23.8	26.4	27.4	0.32	1.81	1.37
30	14.8	16.4	17.1	19.7	21.9	22.7	25.5	28.3	29.3	0.29	1.72	1.33
40	16.1	17.9	18.6	21.0	23.4	24.2	26.8	29.7	30.9	0.26	1.66	1.30
50	17.3	19.2	19.9	22.2	24.6	25.5	27.9	31.0	32.2	0.25	1.62	1.28
n	0.30	0.30	0.30	0.22	0.22	0.22	0.17	0.17	0.17	0.30		

Table 4b

Extreme wind conditions and turbulence parameters during northeasterly winds.

NE	U_{10min} [m/s]			U_{1min} [m/s]			U_{3-5s} [m/s]			Turbulence parameters		
	10 år	50 år	100 år	10 år	50 år	100 år	10 år	50 år	100 år	I_u	Gf_{3-5s}	Gf_{1min}
z [m]												
10	12.6	14.0	14.5	16.1	17.8	18.5	20.1	22.3	23.2	0.24	1.60	1.28
20	14.3	15.8	16.4	17.7	19.7	20.4	21.8	24.2	25.1	0.21	1.53	1.24
30	15.3	17.0	17.7	18.8	20.9	21.7	22.9	25.4	26.4	0.20	1.49	1.23
40	16.2	17.9	18.6	19.6	21.8	22.6	23.7	26.3	27.3	0.19	1.47	1.22
50	16.8	18.7	19.4	20.3	22.5	23.4	24.4	27.0	28.1	0.18	1.45	1.21
n	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.12	0.18		

Table 4c

Extreme wind conditions and turbulence parameters during easterly winds.

E	U _{10min} [m/s]			U _{1min} [m/s]			U _{3-5s} [m/s]			Turbulence parameters		
	10 år	50 år	100 år	10 år	50 år	100 år	10 år	50 år	100 år	I _u	Gf _{3-5s}	Gf _{1min}
10	18.7	20.7	21.5	23.8	26.4	27.4	29.9	33.2	34.4	0.24	1.60	1.28
20	21.2	23.5	24.4	26.3	29.2	30.3	32.4	35.9	37.3	0.21	1.53	1.24
30	22.8	25.3	26.2	27.9	31.0	32.2	34.0	37.7	39.1	0.20	1.49	1.23
40	24.0	26.6	27.6	29.1	32.3	33.5	35.2	39.0	40.5	0.19	1.47	1.22
50	24.9	27.7	28.7	30.1	33.4	34.7	36.1	40.1	41.6	0.18	1.45	1.21
n	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.12	0.18		

Table 4d

Extreme wind conditions and turbulence parameters during southeasterly winds.

SE	U _{10min} [m/s]			U _{1min} [m/s]			U _{3-5s} [m/s]			Turbulence parameters		
	10 år	50 år	100 år	10 år	50 år	100 år	10 år	50 år	100 år	I _u	Gf _{3-5s}	Gf _{1min}
10	19.9	22.1	22.9	25.4	28.2	29.3	31.9	35.4	36.7	0.24	1.60	1.28
20	22.6	25.0	26.0	28.1	31.1	32.3	34.5	38.3	39.8	0.21	1.53	1.24
30	24.3	26.9	28.0	29.8	33.0	34.3	36.2	40.2	41.7	0.20	1.49	1.23
40	25.6	28.4	29.4	31.1	34.5	35.8	37.5	41.6	43.2	0.19	1.47	1.22
50	26.6	29.5	30.7	32.1	35.6	37.0	38.6	42.8	44.4	0.18	1.45	1.21
n	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.12	0.18		

Table 4e

Extreme wind conditions and turbulence parameters during southerly winds.

S	U _{10min} [m/s]			U _{1min} [m/s]			U _{3-5s} [m/s]			Turbulence parameters		
	10 år	50 år	100 år	10 år	50 år	100 år	10 år	50 år	100 år	I _u	Gf _{3-5s}	Gf _{1min}
10	15.8	17.5	18.2	23.0	25.5	26.5	31.5	35.0	36.3	0.40	2.00	1.46
20	18.7	20.8	21.6	26.0	28.9	30.0	34.5	38.3	39.8	0.34	1.84	1.39
30	20.8	23.0	23.9	28.0	31.1	32.3	36.5	40.5	42.1	0.30	1.76	1.35
40	22.3	24.7	25.7	29.5	32.8	34.0	38.1	42.2	43.9	0.28	1.71	1.33
50	23.6	26.2	27.2	30.8	34.2	35.5	39.3	43.7	45.3	0.27	1.67	1.31
n	0.25	0.25	0.25	0.18	0.18	0.18	0.14	0.14	0.14	0.25		

Table 4f

Extreme wind conditions and turbulence parameters during southwesterly winds.

SW	U_{10min} [m/s]			U_{1min} [m/s]			U_{3-5s} [m/s]			Turbulence parameters		
	10 år	50 år	100 år	10 år	50 år	100 år	10 år	50 år	100 år	I_u	Gf_{3-5s}	Gf_{1min}
10	14.9	16.6	17.2	19.1	21.2	22.0	23.9	26.5	27.5	0.24	1.60	1.28
20	16.9	18.8	19.5	21.0	23.4	24.2	25.9	28.7	29.8	0.21	1.53	1.24
30	18.2	20.2	21.0	22.3	24.8	25.7	27.2	30.1	31.3	0.20	1.49	1.23
40	19.2	21.3	22.1	23.3	25.9	26.8	28.1	31.2	32.4	0.19	1.47	1.22
50	20.0	22.1	23.0	24.1	26.7	27.7	28.9	32.1	33.3	0.18	1.45	1.21
n	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.12	0.18		

Table 4g

Extreme wind conditions and turbulence parameters during westerly winds.

W	U_{10min} [m/s]			U_{1min} [m/s]			U_{3-5s} [m/s]			Turbulence parameters		
	10 år	50 år	100 år	10 år	50 år	100 år	10 år	50 år	100 år	I_u	Gf_{3-5s}	Gf_{1min}
10	24.9	27.6	28.7	31.8	35.3	36.6	39.8	44.2	45.9	0.24	1.60	1.28
20	28.2	31.3	32.5	35.1	38.9	40.4	43.1	47.9	49.7	0.21	1.53	1.24
30	30.3	33.7	35.0	37.2	41.3	42.9	45.3	50.2	52.2	0.20	1.49	1.23
40	32.0	35.5	36.8	38.8	43.1	44.7	46.9	52.0	54.0	0.19	1.47	1.22
50	33.3	36.9	38.3	40.1	44.5	46.2	48.2	53.5	55.5	0.18	1.45	1.21
n	0.18	0.18	0.18	0.15	0.15	0.15	0.12	0.12	0.12	0.18		

Table 4h

Extreme wind conditions and turbulence parameters during northwesterly winds.

NW	U_{10min} [m/s]			U_{1min} [m/s]			U_{3-5s} [m/s]			Turbulence parameters		
	10 år	50 år	100 år	10 år	50 år	100 år	10 år	50 år	100 år	I_u	Gf_{3-5s}	Gf_{1min}
10	21.0	23.3	24.2	30.7	34.1	35.4	42.0	46.7	48.4	0.40	2.00	1.46
20	25.0	27.7	28.8	34.7	38.5	39.9	46.0	51.1	53.0	0.34	1.84	1.39
30	27.7	30.7	31.9	37.3	41.4	43.0	48.7	54.0	56.1	0.30	1.76	1.35
40	29.7	33.0	34.3	39.4	43.7	45.4	50.8	56.3	58.5	0.28	1.71	1.33
50	31.4	34.9	36.2	41.1	45.6	47.4	52.5	58.2	60.4	0.27	1.67	1.31
n	0.25	0.25	0.25	0.18	0.18	0.18	0.14	0.14	0.14	0.25		

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From (Name/Department): Danielle Loiselle/Marine
 Date: 12.10.98
 Total No of Pages: 2 (incl. this)

Telefax

**Sri Jack-up: Temporary Winter Mooring in Flekkefjorden
Weather Data**

Knut,


Jan Skjong and I had a discussion concerning weather data for the Flekkefjord area. He said that I need to send you a map that shows where in the fjord we need the weather data. A copy of map number 478 is attached. The platform will be moored just south of Hestedalsodden. It will be protected on the N, E, and W sides. (See X mark on the map.)

I wonder if you could take a look at the map and call me on Wednesday at 22 94 53 85 so we can talk about price and how long it will take you to complete the calculations. I have been in contact with the Bergen DNMI office. They didn't have the capacity to complete the work for another two weeks or so.

I have available to me a copy of the report you wrote for DNMI for the Yrkefjord area. Can I expect the Flekkefjord weather data to be similar to that of the Yrkefjord area?

If you need to contact me before Wednesday, I will be on a ship in Flekkefjord. The mobile number is: 945 767 08.

Thank you,



Danielle Loiselle
 Marine Technology
 Aker Marine Contractors as

P.S.: The design basis is: 100 year storm
 10 min mean wind speed.



DNMI
Norwegian Meteorological Institute

Aker Maritime Contractors
Pb. 1358 Vika
0113 OSLO

Attn.: Danielle Loisel

Your ref.:
Fax of 13/10, several phones

Our ref.:
321.3/2337/98KnH

Date
16. October 1998

Siri Jack-up: Temporary Winter Mooring in Flekkefjorden Weather Data

Three alternative mooring areas in the Lista - Flekkefjord area are examined.

Djupvika is situated in the Stolsfjord close to Hestedalodden. The fjord is situated SE-S to NW-N, but most open to SE - S. Correspondingly the highest wind speeds should be expected from that direction. Locally, northerly winds are shielded by Hestedalodden. Easterly, south-westerly and westerly winds are significantly reduced due to crossing the fjord. North-easterly winds are somewhat less reduced due to the local valley to NE, but winds from that direction are generally not very high west of Lindesnes, except in Fedafjorden.

An area between Lauvnes and Abelnnes in Hidrasundet are exposed to the strong westerly winds. The wind through this sound are partly accelerated due to the narrow sound, and partly retarded due to surface friction from both sides of the sound. The friction effects are probably slightly higher than the sound acceleration, but the westerly wind speed is probably close up to the wind speed at Lista. Also wind from east is strong through the sound, while southerly and northerly winds are reduced.

An area at Strandafjorden, between Hidra and Andabeløya, south of the fjord-cross Hidrasundet /Strandsfjorden, are exposed to strong winds from south and south-west, partly also north-west. The south and south-westerly winds in the region, however, are slightly weaker than the westerly winds.

This make the following table. Please note that the numbers may be slightly conservative.

U_{10min} [m/s], 100 yrs, 10m	N	NE	E	SE	S	SW	W	NW
Djupvika	15	20	18	25	25	22	20	24
Lauvnes	14	16	25	22	20	20	30	25
Strandsfjord	20	20	18	25	28	28	20	25

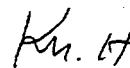
The full analysis will be ready at November 5. We then use a standard procedure with input values of educated guess of transfer-coefficients from Lista, together with wind-profiles and gust-factor. Then the output will be 8 tables pr. station, where the more sophisticated values of the 100 years 10 minutes values at 10 m level will be given, together with values at 10, 20, 30, 50 m height, 10, 50, and 100 years return period, and 3-5 sec, 1 minute and 10 minute wind speed. Please give us a word if other heights should be included. The results will be presented in a report to a price of maximum NOK 20.000,-.

The cost of this work is NOK 3500,-. This should only be paid if there is no more work to be done. We are now of the opinion that we shall do the full analysis. Anyway, please send a formal request.

Your sincerely



Bjørn Aune e.f.
Head of Climatic Division



Knut Harstveit

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Til:	Det norske meteorologiske institutt
Ved:	Knut Harstveit
Telefaksnummer:	22963050

Fra (navn/avdeling):	Tormod Reppe/Marine
Dato:	19.10.98
Antall sider (inkl. denne):	3

Telefaks**Vindstudie**

Det refereres til telefonsamtale av 15.10.98, samt Deres brev datert 16.10.98.
For ordens skyld bekreftes det av vi bestiller full analyse slik det går fram av
Deres brev – med leveranse ikke senere enn 05.11.98.

Områdene vi er interessert i fremgår av vedlagte merkede utsnitt fra sjøkart nr.
478.

Vennlig hilsen
for Aker Marine Contractors AS



Tormod Reppe

