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ENVIRONMENTAL CONDITIONS

UTARBEIDET AV

LARS ANDRESEN

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OPPDRAGSGIVER

PECONOR A/S

OPPDRAGSNR.

SAMMENDRAG

Extreme values of 1 minute wind speed with return periods 2, 10, 50, and 100 years for Osnes, Ålfjorden are given for all-year, summer, and spring conditions. The extremes are given for the 8 main directions. The 100 years all-year value is calculated to 32 m/s, the direction being south-westerly.
Also given is the probability of exceeding the threshold values of 10 and 15 m/s for the 8 directions for each month.
When doing the calculations we have used the reference weather station Utsira together with results from the temporary stations in the Stord and Vats area.

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S U M M A R Y

The extreme values of 1 minute wind speed (m/s) with return periods 2, 10, 50, and 100 years for Osnes, Ålfjorden for the whole year (Y), the months March (M) and April (A), and the period May - August (S) are calculated to:

SECT.	2 YEARS				10 YEARS				50 YEARS				100 YEARS			
	Y	M	A	S	Y	M	A	S	Y	M	A	S	Y	M	A	S
N	18	17	16	14	23	22	21	19	26	25	24	22	27	26	25	23
NE	14	12	11	7	17	16	16	14	19	18	18	17	20	19	19	18
E	11	10	10	8	13	12	12	11	16	15	15	14	17	17	17	16
SE	19	17	16	12	21	20	19	16	23	22	21	18	25	24	23	20
S	22	20	19	16	26	25	25	24	29	29	29	29	30	30	30	30
SW	23	21	19	14	27	26	26	24	30	29	29	28	32	32	32	31
W	17	15	14	10	20	19	18	17	22	21	20	20	24	23	23	21
NW	22	20	19	15	26	24	23	20	29	27	26	23	30	29	28	25
ALL	23	21	19	16	27	26	26	24	30	29	29	29	32	32	32	31

The frequencies of 1 minute mean wind speed above 10 and 15 m/s at Osnes, Ålfjorden, the annual values distributed on directions (left) and the all direction values (total) distributed on months (right).

OSNES, ÅL-FJORD	YEAR	
	>10	>15
360°	1.0	0.0
030°	0.1	-
060°	0.1	-
090°	0.0	-
120°	0.1	-
150°	1.1	0.0
180°	1.1	0.2
210°	1.4	0.3
240°	0.2	0.0
270°	0.1	0.0
300°	1.3	0.2
330°	0.1	0.0
TOTAL	6.6	0.7

OSNES, ÅL-FJORD	TOTAL	
	>10	>15
JAN.	10.4	1.5
FEB.	3.9	0.1
MAR.	6.0	0.3
APR.	3.0	0.1
MAY	1.8	-
JUNE	2.8	0.1
JULY	4.0	0.1
AUG.	1.2	-
SEP.	7.4	0.5
OCT.	10.6	1.6
NOV.	15.8	2.9
DEC.	10.9	1.1
YEAR	6.6	0.7

CONTENTS

1. INTRODUCTION

The background of this report is a request by Peconor Ekofisk AF. This firm wanted a climatic description of the site Osnes, Ålfjorden in Sunnhordland, in connection with building of large constructions for the oil industry in the North Sea.

A contract between DNMI and Peconor were established. DNMI already have given standard tables considering visibility, temperature, humidity, and precipitation for the station Nedre Vats, between Vatsfjord and Ålfjord.

A report (1) considering the wind conditions in Ålfjorden is already published by DNMI. In that report data from the weather stations Slåtterøy and Flesland were used to give extreme wind estimates. The 100 year 1 minute wind speed extreme value was thus estimated to 34 m/s, occurring in the sector SE - SW (see Appendix 1).

Since then, however, much is learned of the wind conditions in the Sunnhordland area. Extreme wind speeds were thus estimated by use of the ordinary weather station Utsira and the temporary wind stations at Digernessundet (Aker Stord), and Vats-/Yrkefjord (Norwegian Contractors). A preliminary version of these results is delivered Peconor. The present report documents the methods used. Tables concerning the occurrences of wind speed above threshold levels are also given.

2. SITE AND TOPOGRAPHY

Ålfjorden is situated in Sunnhordland 25 km north-east of Haugesund and some 20 km inside the coast line. The fjord is about 20 km long, running mostly N - S. The fjord is 1 - 2 km wide, but near the southern end it narrows and turns SW. In the northern part it turns slightly to NE and ends in a larger fjord basin south-east of the island Stord.

The terrain east of the fjord rises up to heights above 500 m asl.. The terrain south and west of the fjord are lower, mostly below 200 m asl..

The actual site, Osnes is situated at the eastern side of Ålfjorden. The site is flat and rises only 10 - 30 m above the fjord, forming a land nose out in the fjord (Figure 2). The eastern side of the fjord are rather steep just inside the land nose.

3. DATA BASIS

Data from the temporary wind stations Digernessundet, Stord (2) and Vats-/Yrkefjord (3) are connected to the long data series from the weather station Utsira. Utsira is a freely exposed little island, 15 km west of Karmøy.

We should here stress that since no measurements has been carried out at Osnes, we still have to use "an educated guess method" at some steps in the calculation process.

Utsira had a break of homogeneity in 1978, when the station was equipped with a Fuess 90z anemometer. During the period 1962-1978 the wind speed at Utsira were recorded systematically too low. It was, however, easy to homogenize the data series of extreme winds by using data from the weather station Sola.

It would be a rather time-consuming task to homogenize the data to give representative values of more frequent wind speeds. However, data from Sola show that there is only minor differences between the frequencies of the 1978-87 period and the common used reference period of 1961-1975. We therefore have choosen data from Utsira for only a 10 years period, 1978-87, when giving frequencies of wind speeds above threshold values.

Due to the free exposition, Utsira is a very good reference wind station for the southern part of the Norwegian Western Coast. An extreme wind speed analysis is carried out for the data, for 10 min mean wind speed as well as 3-5 s wind gusts (2). This is done for winter as well as summer conditions and for the eight 45^0 directions. Extreme values for the mean wind speed are given in Appendix 2.

At Digernessundet a temporary wind station was operated for more than 2 years (2). The measuring site was situated at the southern part of the Stord island, 20 km north-north-west of Osnes. Transfer coefficients from Utsira to Digernes were etablished for all directions, and extreme wind speeds were calculated.

At the Vats area, 20 km south-south-east of Osnes, two wind station has been operated for several years. Transfer coefficients are established using the same technique as for Digernes. Besides, wind tunnel tests carried out by Danish Maritime Institute (4) made for Vats-/Yrkefjord are tested against full scale data (3) and data from the wind tunnel test are found valuable in describing areal wind

distributions, together with gust speeds (3-5 s, 1 min) in relation to 10 min wind speeds.

4. CALCULATION METHOD

4.1 Establishing directional transfer coefficients for 10 minute mean wind speed.

The transfer coefficient, kf, from a reference wind site, R, to an actual site, A, is given by the equation

$$kf(A,R)=U(A)/U(R) \qquad (4.1)$$

where U is the 10 min mean wind speed during strong wind conditions. Generally, kf will be wind direction dependent.

In table 4.1 we have written the wind direction and the transfer coefficients at Digernes and the Vats-/Yrkefjord for all directions at Utsira. These data are taken from (2) and (3). Valuable information considering backing of the wind direction due to surface friction, and channelling due to the fjords and topography are found from the data. From this we have interpolated the values at Osnes, Ålfjorden. When doing the interpolation, local effects, like channelling, surface friction and shielding effects at Osnes are taken into account. The table is valid only for strong wind conditions, and not when local wind systems dominate, such as sea breeze or other thermal wind systems.

The wind speed at Osnes is found by multiplying the wind speed at Utsira by the kf-value. It is clearly that the highest transfer coefficients (kf) from Utsira to Osnes occurs for southerly to south-westerly wind ($180\text{-}220^0$) at Osnes. Such a wind will occur for south-westerly ($200\text{-}250^0$) at Utsira. The wind blows over low heights when coming in from the sea, and is locally channelled by topography and low surface friction in the fjord. It is reasonable to use kf = 0.8 since this kf-value were found at Digernes for similiar conditions. At the Vats area, kf-values for southerly wind along the fjord (site D) were found to 0.7, but some larger friction effects probably occur there.

At the Vats area high transfer coefficients are found for easterly wind. Osnes is most probably shielded to such winds. It will locally be turned north-east.

Southerly wind at the coast will due to surface friction be turned to south-east. Such a wind will be weakened due to land effects at Osnes.

North-westerly wind blows over somewhat less rough terrain than do the westerly wind, and therefore will be less decreased.

UTSIRA	DIGERNES		VATS/YRKEFJORD SITE C		SITE D		SITE K		OSNES, ÅLFJORDEN	
DD	DD	kf	DD	kf	DD	kf	DD	kf	DD	kf
350-20°	NW-N	0.4	N	0.4	NNW-N	0.5	NW	0.57	N	0.6
30-80°	N-NE	0.5	ENE	1.0	NNE	0.7	ENE	1.27	NNE	0.6
90-100°	NE	0.7	ENE	1.0	E	0.7	ENE	1.27	NE-ENE	0.6
110-130	E	0.7	ENE	0.9	E	0.6	E	1.09	ENE	0.5
140-150	E	0.7	E	0.7	ESE	0.5	E	0.84	ENE-E	0.4
160-190	SE-S	0.8	E	0.5	S	0.7	E	0.68	SE-SSE	0.6
							SSE	0.54		
200-220	S-SW	0.8	SSW	0.5	S	0.5	SSW	0.67	S	0.8
230-290	SW	0.8	WSW	0.5	SSW	0.2	WSW	0.67	SSW-W	0.5-0.8
230-250*									SSW-SW	0.8
260-280*									SW-WSW	0.5
300-330	W	0.6	W	0.4	WNW	0.6	WNW	0.71	W-NW	0.55-0.65
290-310*									W	0.5
									W-WNW	0.55
320-340*									WNW-NW	0.65

Table 4.1
Wind direction (DD) and transfer coefficients (kf) at Digernes, Vats/Yrkefjord and Ålfjorden for all of the wind directions at Utsira. *:In the sectors 230 -290° and 300 -330° a finer dividing was needed for Osnes than what can directly be taken from the Vats - Digernes data.

Northerly wind blow along the fjord. Such a wind will, however, be decreased at Osnes due to land friction at Korsnes - Børkjenes. It will be considerably stronger in the middle and western part of the fjord.

We assume that typical inaccuracies of kf at Osnes are $\pm$ 0.1.

4.2. Method for calculating 1 minute extreme wind speeds.

The method of 4.1 establishes transfer coefficients from Utsira to Osnes. The method, however, are valid for 10 min mean wind speed. To get values of the 1 min wind speed, gust factors, GF like

$$GF(1min)=u(max,1min)/u(10min) \qquad (4.2)$$

need to be determined. Here u(max,1min) is the the maximum wind speed of 1 min average occurring in the 10 minute period where the mean wind speed is u(10min).

We now state that wind reducing effects are mainly due to surface friction. Very local phenomena making the wind field inhomogenous are supposed not to occur at the actual site. Further on, large scale shielding or strengthening effects either do not occur, or the effects occur as well at the reference station as at the actual site. We then think that the higher the transfer coefficient between the actual wind speed and the wind speed at a freely exposed reference station, or the gradient wind speed, the lower the gust factor.

To find such a relation, we use data from the wind tunnel experiment at Vats-/Yrkefjord. In Figure 3 the 1 min gust factor is plotted against the transfer coefficient from the approach wind of the model (an estimate for the gradient wind). This is done for the sites A,C,D, and E, and for the directions 90, 165, 180, and 260^0. The GF(1min) data is taken from the measured turbulence intensities, I, by use of the converting formulae

$$GF(1min) = 1+1.15*I \qquad (4.3)$$

found in (3) for a smaller sample of the wind tunnel data. If we look away from 90^0 - wind at site D, the points fit the

curve

$$GF(1min) = A*kf^{-B} \qquad (4.4)$$

where the constants A = 0.99 and B = 0.25. The correlation coefficient between recorded and estimated data also is r=0.99.

We may state that the wind speed at Utsira is approximately 2/3 of the gradient wind speed. When using Utsira data, the constants then should be altered to A=1.10 and B=0.25.

As seen, point D in 90^0 - wind does not fit the curve. This is due to a sharp corner effect, making inhomogeneities to the local wind field. The turbulence, or the gust factors, are getting higher than the rather strong wind should indicate.

UTSIRA	OSNES, ÅLFJORDEN			
DIRECTION	DIRECTION	kf(U)	GF(1min)	kf*GF
N	N	0.6	1.25	0.75
NE	NE	0.6	1.25	0.75
E	NE	0.6	1.25	0.75
SE(ESE)	NE	0.5	1.31	0.66
SE(SSE)	NE	0.4	1.38	0.55
SE(ESE)	E	0.4	1.38	0.55
SE(SSE)	E	0.3	1.49	0.45
S	SE	0.6	1.25	0.75
SW	S	0.8	1.16	0.93
W(WSW)	SW	0.8	1.16	0.93
W	SW	0.5	1.31	0.66
W(WNW)	W	0.5	1.31	0.66
NW	NW	0.65	1.23	0.80

Table 4.2
Transfer coefficients, kf(U) from Utsira to Osnes, Ålfjorden together with 1 min gust factors at Ålfjorden, GF(1min), and the total coefficient, kf(U)*GF(1min) for transferring 10 min mean wind speed at Utsira to 1 min wind gusts at Osnes.

We should here stress that the data used are the wind tunnel data. The full scale data of easterly wind would at all not fit the model due to strong mountain downstream effects making the wind blow much harder in the inner district than should be expected from the Utsira data, if only surface friction were taken into account. However, Osnes is shielded to strong easterly winds.

In table 4.2 the 1 min gust factors calculated for Ålfjorden are given. The gust factors are relative uncertain for north-easterly to easterly wind. Generally, we have from the eqs. 4.1 and 4.4 that if the transfer coefficient should be given too high, the gust factor will be given too low. Inaccuracies originating in the determination of the transfer coefficients therefore have a tendency of being lowered when applying the gust factors. This is reflected in the commonly known rule that the wind gusts are less decreased inshore than is the mean wind speed.

Straight easterly and westerly directions will only exceptionally occur. The coefficients should show minimum for these sectors.

4.3. Method for calculating frequencies of mean wind speed above the treshold values 10 and 15 m/s.

Without observations from the construction site in Ålfjorden, it is impossible to give exact frequencies of all wind speed values (0-30 m/s) distributed on directions. Much of the difficulties refer to the lower values, which are of minor interest in this relation.

The task is therefore defined to give frequencies of mean wind speed greater than 10 and 15 m/s. This can be done to a high degree of reliability, because we know by experience from other projects ((2),(3)), on the basis of wind measurements, how the general wind conditions behave in the fjord areas, some 10 kilometers from the coast in the southern part of Western Norway.

From Table 4.1 we get the transfer coefficients from Utsira to Ålfjorden for each sector. We then calculate the wind speed at Utsira which corresponds to 10 and 15 m/s, respectively, at Osnes in Ålfjorden. We have found it suitable to use the knot values in these calculations. The Beaufort values are rounded off to the nearest fourth. See Table 4.3.

Frequencies of wind speed above 10 and 15 m/s will be given

in sectors of 30 degrees, like the frequency tables for Utsira (Appendix 3). This gives a grouping of twelve 30^0 sectors instead of eigth 45^0 sectors. See Table 4.3.

In the sector $030\text{-}080^0$ at Utsira the wind is blowing from NNE in Vatsfjord, the fjord running N-S like Ålfjord. Towards Osnes the air stream will penetrate the area between Vardåsen/Alnaåsen and Dyraskardfjellet and naturally fall into the $020\text{-}040^0$ sector.

When $090\text{-}150^0$ at Utsira the wind is blowing from ENE and E in the fjord district some 10 km from the coast. At Vikebygd, 2 km north of Osnes, the air stream will come from the east along the small valley south of Trollafjellet. At Osnes, however, we expect the wind to back and blow along the hills of Vikefjellet from the direction 060^0. Wind from E and ESE will be a very seldom event at Osnes, because of the high mountain area, Vikefjellet, close to the operation site.

UTSIRA/OSNES TRANSFER			UTSIRA TRESHOLD VALUES			
UTSIRA WIND DIRECT.	OSNES, ÅLFJORD WIND DIRECT.	kf(Å,U)	OSNES ≥ 10 m/s		OSNES ≥ 15 m/s	
			kt	B	kt	B
360^0	360^0	0.6	32.4	7 3/4	48.6	10
030^0	030^0	0.6	32.4	7 3/4	48.6	10
060^0	030^0	0.6	32.4	7 3/4	48.6	10
090^0	060^0	0.6	32.4	7 3/4	48.6	10
120^0	060^0	0.5	38.9	8 3/4	58.3	11 1/4
150^0	060^0	0.4	48.6	10	72.9	12
180^0	150^0	0.6	32.4	7 3/4	48.6	10
210^0	180^0	0.8	24.3	6 1/2	36.4	8 1/4
240^0	210^0	0.8	24.3	6 1/2	36.4	8 1/4
270^0	240^0	0.5	38.9	8 3/4	58.3	11 1/4
300^0	300^0	0.55	35.3	8 1/4	53.0	10 1/2
330^0	300^0	0.65	29.9	7 1/4	44.9	9 1/2

Table 4.3 Directional transfer coefficients kf(Å,U) from Utsira to Osnes, Ålfjorden for 10 minute mean wind speed. Using the coefficient kf(Å,U) and the treshold values 10 and 15 m/s at Osnes, Ålfjorden, the corresponding treshold values are calculated at Utsira in knots (kt) and Beaufort (B).

Vikefjellet will also separate the air stream from the west, into a WSW and a WNW direction. Therefore a W direction will be unfrequent at Osnes. Wind from NW at Utsira will probably be blowing from WNW at Osnes.

Due to the high landscape towards NNW, wind from that direction will be separated and blow WNW or N.

5.RESULTS

5.1. Extreme 1 minute wind speeds.

The extreme wind speeds conditions can now be transferred from the values at Utsira (Appendix 2) to Osnes by using Table 4.2. When doing those calculations, we notice that the south-easterly and westerly sectors at Utsira are somewhat wider than desirable. We have in (3) argued for that the 100 years extreme wind speed is 30 m/s for ESE (120^0) and 36 m/s for SSE (150^0). A corresponding interpolation should be done for all return periods.

For westerly wind, the strongest winds probably occur for $280\text{-}290^0$ (WNW), while for $250\text{-}260^0$ (WSW), 34 m/s should be used.

SECT.	2 YEARS				10 YEARS				50 YEARS				100 YEARS			
	Y	M	A	S	Y	M	A	S	Y	M	A	S	Y	M	A	S
N	18	17	16	14	23	22	21	19	26	25	24	22	27	26	25	23
NE	14	12	11	7	17	16	16	14	19	18	18	17	20	19	19	18
E	11	10	10	8	13	12	12	11	16	15	15	14	17	17	17	16
SE	19	17	16	12	21	20	19	16	23	22	21	18	25	24	23	20
S	22	20	19	16	26	25	25	24	29	29	29	29	30	30	30	30
SW	23	21	19	14	27	26	26	24	30	29	29	28	32	32	32	31
W	17	15	14	10	20	19	18	17	22	21	20	20	24	23	23	21
NW	22	20	19	15	26	24	23	20	29	27	26	23	30	29	28	25
ALL	23	21	19	16	27	26	26	24	30	29	29	29	32	32	32	31

Table 5.1.
Directional extreme values of 1 minute wind speed (m/s) with return periods 2, 10, 50, and 100 years for Osnes, Ålfjorden for the whole year (Y), the months March (M) and April (A), and the period May - August (S).

For Utsira we have given all-year conditions which will occur in the winter period, defined as September to April. The four months period, May to August, is defined as the summer period. This is due to the fact that the wind in the months September, March and April may be considerably stronger than in the summer months. The strongest wind, however do occur in December - January.

We now try to interpolate between the winter and summer values to give more accurate values for March and April. We then state that the wind speed in each sector in April should lie in between summer and winter values, but never closest to the summer values. The March values should then be between the April and the winter values, but never closest to the winter values. We will then find that the April and March values are well defined and the values are given in Table 5.1.

The highest inaccuracy probably lies in the transfer coefficient from Utsira to Osnes, since the determination of this coefficient includes moments of areal interpolation. Most probably, inaccuracies of ±0.1 should be used for the kf-values. This will introduce a ±0.1 inaccuracy in the transfer coefficient kf*GF(1min) from 10 min wind speed at Utsira to the 1 min gust wind at Osnes. This corresponds to ±2 - ±3 m/s of the 1 min values of Table 5.1.

From Table 5.1 it is seen that the 100 years summer values are only slightly lower than the all-year values, while the 2 years summer values are considerably lower. This is due to the fact that strong wind occur frequently in the winter season, but in the summer season strong wind appear more seldom. For the Ålfjorden area, uncommon southerly to south-westerly summer storms may be almost as strong as uncommon winter storms from those sectors.

5.2. Frequencies of mean wind speed above the treshold values 10 and 15 m/s.

From Table 4.3 it is possible to construct the frequencies of 10 minute mean wind speeds above 10 and 15 m/s at Osnes, Ålfjorden on the basis of monthly frequency tables from Utsira (Appendix 3).

However the task is to determine the frequencies of 1 minute mean wind speed (the "1-min frequencies"). The 1 min gust factor used for the extreme value calculations, cannot be used in the calculations of the 1-min frequencies. In a 10 minute period the ten 1 minute mean values will group with

just as many values above the 10 min mean value as below this value, on the average. When choosing high wind speed values like 10 and 15 m/s, there is a little higher frequency of wind speeds just below these values than just above. Then there will be a few more cases when a 1 min value exceeds the limit value from the underside than from above. But the conversion factor between the 1 min mean and the 10 min mean wind speed will probably be only insignificant higher than 1.0. In this report we let the 10-min frequencies be equal to the 1-min ones.

We do not expect long-lasting wind speeds above 10 m/s from the directions 090, 120, 270, and 330^0, but we cannot rule out this possibility for shorter periods. As to the tables we have decided to give these directions 0.1 % for wind speeds above 10 m/s if the neighbouring directions have above 1.0 %, otherwise 0.0 %. Correspondingly we give these directions 0.0 % for wind speeds above 15 m/s, if the neighbouring directions have above 0.2 %, otherwise -.

The decimal values in the tables do not express such a high degree of accuracy. This is done because of separating the different directions and months. If the frequency tables indicate higher values than do the extreme value tables, 0.0 % is used. This is the case for only two monthly sector values, 0.1 % in May and 0.2 % in July for 060^0-sector wind. The discrepancy is due to the rather short period of time as basis for the frequency tables as distinct from the long data series for the extreme value calculations.

This procedure ends up with Table 5.2a,b.

From Table 5.2 it is seen that wind speed above 10 m/s is most frequent from the sector $350\text{-}010^0$, $140\text{-}220^0$, and $290\text{-}310^0$. Wind speed above 15 m/s is seldom from the north. From September to January south and south-south-west are the most frequent directions. Otherwise north, south-south-east and west-north-west are frequent directions.

November is the month when to expect most cases with wind above 10 m/s at Osnes, but also January, October, and December have relatively high frequency.

OSNES, ÅLFJORDEN 1978-87									
	JANUARY		FEBRUARY		MARCH		APRIL		
	>10	>15	>10	>15	>10	>15	>10	>15	
36	1.0	-	0.6	-	0.6	-	1.9	0.1	36
03	0.3	-	0.0	-	-	-	0.2	-	03
06	0.3	-	0.2	-	0.1	-	0.0	-	06
09	0.0	-	0.0	-	0.0	-	0.0	-	09
12	0.1	-	0.1	-	0.1	-	0.0	-	12
15	1.7	-	1.5	0.1	1.7	-	0.2	-	15
18	1.2	0.1	0.2	-	0.8	0.1	0.3	-	18
21	3.0	1.0	0.4	-	1.3	0.1	-	-	21
24	0.5	-	0.2	-	0.1	-	-	-	24
27	0.1	0.0	0.0	-	0.1	-	0.0	-	27
30	2.1	0.4	0.7	-	1.1	0.1	0.3	-	30
33	0.1	0.0	0.0	-	0.1	-	0.1	-	33
	10.4	1.5	3.9	0.1	6.0	0.3	3.0	0.1	

	MAY		JUNE		JULY		AUGUST		
	>10	>15	>10	>15	>10	>15	>10	>15	
36	0.7	-	1.0	-	1.6	0.1	0.4	-	36
03	-	-	-	-	-	-	-	-	03
06	0.0	-	-	-	0.0	-	-	-	06
09	0.0	-	0.0	-	0.0	-	0.0	-	09
12	0.0	-	0.0	-	0.0	-	0.0	-	12
15	0.2	-	0.2	-	0.6	-	0.1	-	15
18	0.4	-	0.1	-	0.2	-	0.1	-	18
21	0.1	-	0.3	0.1	0.2	-	0.1	-	21
24	0.0	-	-	-	0.1	-	-	-	24
27	0.0	-	0.1	-	0.1	-	0.0	-	27
30	0.3	-	1.0	-	1.9	-	0.5	-	30
33	0.0	-	0.1	-	0.1	-	0.0	-	33
	1.8	-	2.8	0.1	4.0	0.1	1.2	-	

Table 5.2a.
Calculated frequencies (%) of mean wind speed greater than 10 and 15 m/s at Osnes in Ålfjorden, distributed on directions. The calculations are based on wind statistics from Utsira lighthouse for the period 1978-87. "0.0" means a frequency less than 0.05 %. "-" means an improbable or extreme event.

OSNES, ÅLFJORDEN 1978-87									
	SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER		
	>10	>15	>10	>15	>10	>15	>10	>15	
36	1.2	-	0.4	-	1.6	0.2	1.5	-	36
03	0.1	-	-	-	0.2	-	0.3	-	03
06	0.1	-	0.3	-	0.3	-	0.7	-	06
09	0.0	-	0.0	-	0.0	-	0.0	-	09
12	0.0	-	0.1	0.0	0.1	0.0	0.1	-	12
15	0.9	-	1.5	0.2	2.5	0.2	1.8	-	15
18	1.9	0.2	2.7	0.6	3.1	0.6	1.7	0.2	18
21	1.5	0.1	2.6	0.5	4.5	1.2	2.7	0.7	21
24	0.1	-	0.4	0.1	0.3	-	0.4	-	24
27	0.1	-	0.1	0.0	0.1	0.0	0.1	0.0	27
30	1.4	0.2	2.4	0.2	3.0	0.7	1.5	0.2	30
33	0.1	-	0.1	0.0	0.1	0.0	0.1	0.0	33
	7.4	0.5	10.6	1.6	15.8	2.9	10.9	1.1	

	YEAR		
	>10	>15	
36	1.0	0.0	36
03	0.1	-	03
06	0.1	-	06
09	0.0	-	09
12	0.1	-	12
15	1.1	0.0	15
18	1.1	0.2	18
21	1.4	0.3	21
24	0.2	0.0	24
27	0.1	0.0	27
30	1.3	0.2	30
33	0.1	0.0	33
	6.6	0.7	

Table 5.2b.
Calculated frequencies (%) of mean wind speed greater than 10 and 15 m/s at Osnes in Ålfjorden, distributed on directions. The calculations are based on wind statistics from Utsira lighthouse for the period 1978-87. "0.0" means a frequency less than 0.05 %. "-" means an improbable or extreme event.

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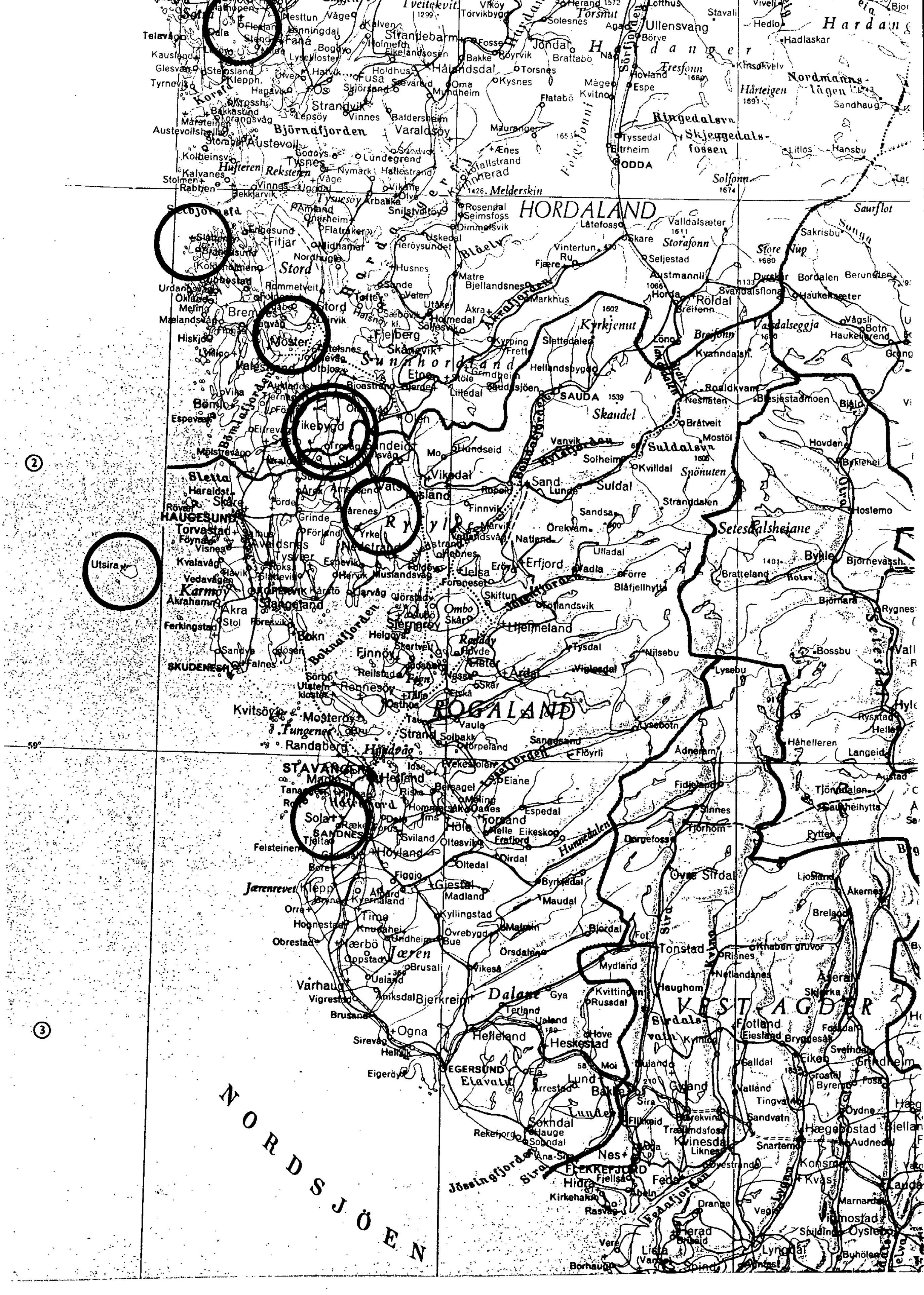

Figure 1.
Map showing the location of the Ålfjorden area and the neigbouring districts, Vats-/Yrkefjord and Digernessundet, with the weather stations Utsira, Sola, Slåtterøy and Flesland.

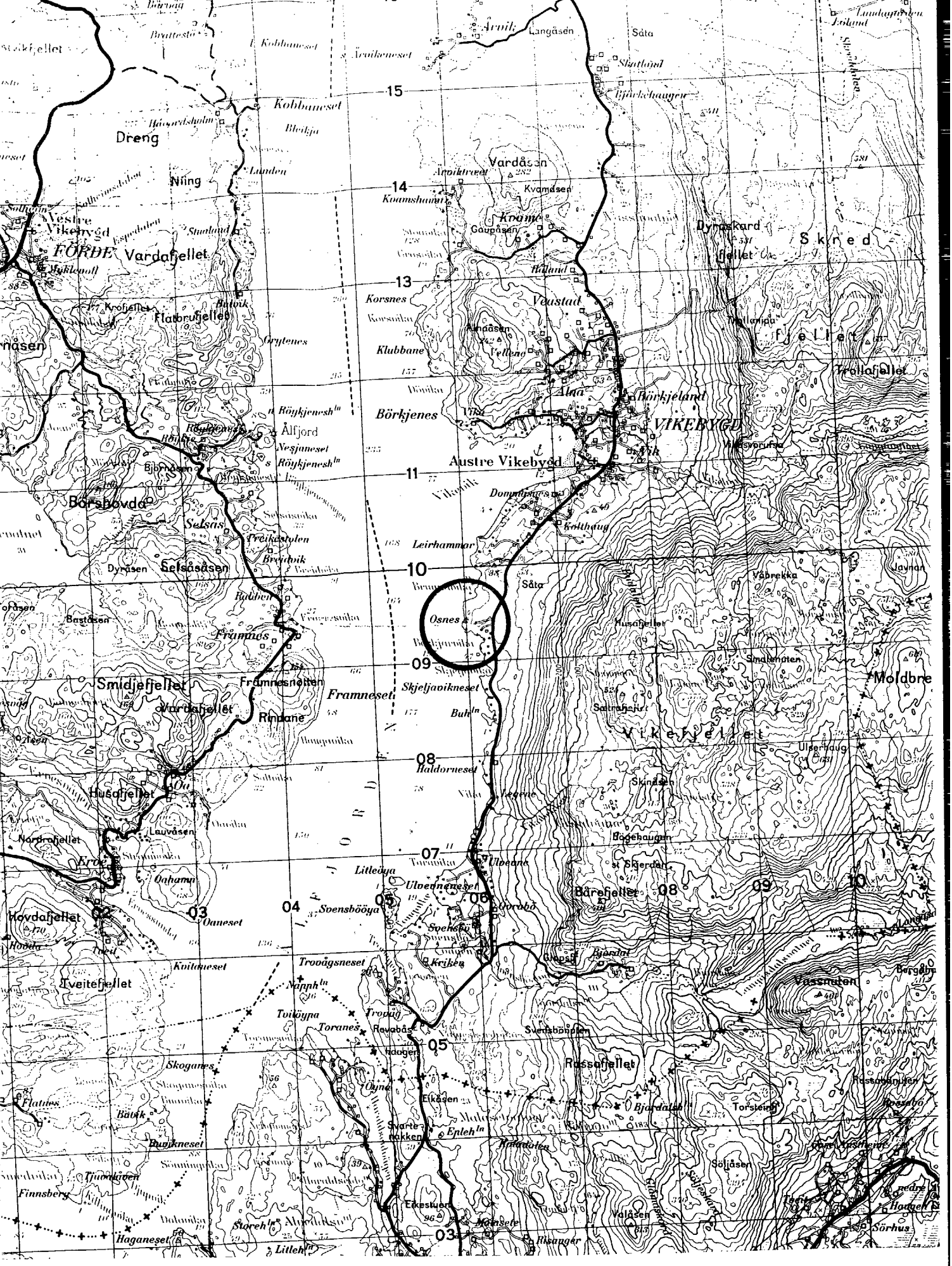

Figure 2.
Map of the Ålfjorden area with Osnes about 2 km south-south-west of Vikebygd.

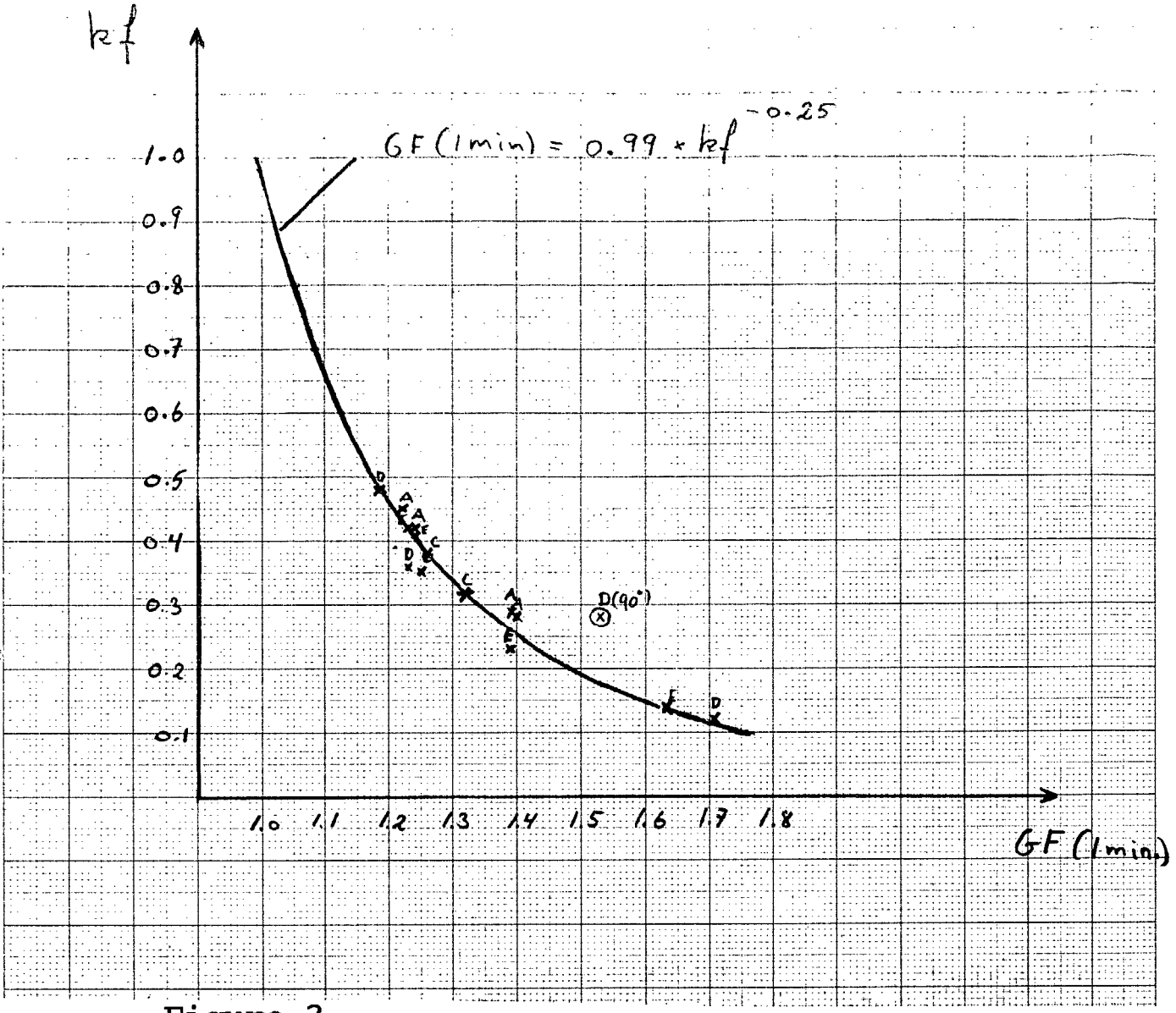

Figure 3.
1 minute gust factor, GF(1min), plotted against the transfer coefficient, kf, from the approach wind of the wind tunnel experiment of Vats-/Yrkefjord (4).

Previous estimates of extreme wind speeds for Ålfjorden (1).

Extreme vind speeds 10 m asl
for the "Gullfaks B"- area in Alfjorden.
The speeds are given in m/s.

Sector	Time average	10 years	100 years
SE-SW	1 min.	28	34
and NW-N	10 min.	25	30
SW-NW	1 min.	25	30
	10 min.	22	27
N-SE	1 min.	20	24
	10 min.	18	22

Extreme wind speeds for Utsira lighthouse.

The extremes for the 8 different sectors are calculated according to the following procedure:

Return period 2 and 5 years - 50 and 20 percentiles of 23 years of data.
Return periods 10 years or more - the extreme value for all directions calculated according to Gumbels 1. distributions of extremes are fixed to the most wind exposed sector. For the other sectors, this value are weighted after the average of the 5 highest recorded speeds of each sector.

Unit: m/s.

Return periode (years)	SEPTEMBER - APRIL								MAY - AUGUST								All directions	
	N	NE	E	SE	S	SW	W	NW	N	NE	E	SE	S	SW	W	NW	Winter	Summer
	10 MIN. MEAN WINDSPEEDS																	
2	24	17	18	25	25	23	26	27	18	8	12	16	18	14	15	18	29	21
5	29	19	21	28	27	26	29	31	21	12	16	18	21	20	19	21	32	23
10	31	21	23	31	28	28	31	33	25	17	20	23	26	25	25	25	33	26
50	34	23	26	34	31	31	34	37	29	20	24	27	31	29	30	29	37	31
100	36	24	27	36	33	32	36	38	31	21	25	29	33	31	32	31	38	33
	3-5s GUSTWIND SPEEDS																	
2	33	22	25	36	33	31	36	35	23	10	16	20	23	17	21	24	39	28
5	41	28	29	38	36	35	39	39	26	15	22	26	29	25	26	28	42	31
10	44	32	33	42	40	40	43	44	30	19	25	31	34	32	32	32	44	34
50	49	35	36	46	44	44	48	49	34	22	29	36	39	37	37	37	49	39
100	50	37	38	48	46	45	49	51	36	23	31	38	41	39	39	39	51	41

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4730 UTSIRA FYR

JANUARY 1978-1987

HRS. 00,06,12,18 GMT N= 1240 C= 0.8 % VM= 9.2 M/S FM=4.7 B

DD	F: 1	2	3	4	5	6	7	8	9	10	11	12	ND	FDM
36N		0.2	0.6	0.8	1.3	1.8	1.1	0.4	0.3				6.6	5.6
03	0.1	0.4	1.5	1.4	1.0	0.6	0.5	0.2					5.5	4.3
06	0.4	1.3	1.9	1.1		0.2							4.9	2.9
09E	0.4	1.5	1.6	1.2	0.5	0.5	0.2						5.9	3.4
12	0.8	1.4	2.3	2.8	1.9	1.1	0.8	0.1					11.3	4.0
15	0.4	1.0	2.8	3.0	2.8	2.8	1.9	1.1	0.4	0.2			16.5	4.9
18S	0.1	0.4	1.6	3.8	3.7	3.9	1.9	1.2					16.5	5.2
21	0.2	0.2	0.8	2.0	0.9	1.3	0.4	0.1					5.9	4.5
24	0.2	0.2	1.0	1.6	1.3	1.7	0.9	1.0	0.2				8.1	5.3
27W	0.2	0.3	1.0	1.3	1.5	1.5	0.8	1.0	0.2				7.7	5.3
30	0.1	0.1	0.4	1.3	0.9	1.5	1.1	0.2	0.1	0.1			5.7	5.4
33		0.2	0.4	0.6	0.8	0.6	0.7	0.8	0.2	0.1	0.1		4.5	6.0
NF	2.8	7.2	16.0	21.0	16.5	17.3	10.4	6.2	1.4	0.3	0.1			

FREQUENCY OF MAX WIND FORCE BETWEEN THE HOURS OF OBSERVATION

											C
19-01		2.3	9.4	20.0	14.2	20.0	15.8	10.6	6.5	1.0	0.3
01-07		2.3	7.4	23.2	13.2	19.0	18.1	9.7	4.5	2.3	0.3
07-13	0.6	0.6	10.6	17.4	16.1	22.6	14.8	11.6	3.2	1.6	0.6
13-19	1.0	2.3	10.0	17.7	12.6	21.0	20.6	7.7	4.8	1.9	0.3

4730 UTSIRA FYR

FEBRUARY 1978-1987

HRS. 00,06,12,18 GMT N= 1128 C= 2.6 % VM= 7.5 M/S FM=4.1 B

DD	F: 1	2	3	4	5	6	7	8	9	10	11	12	ND	FDM
36N	0.3	0.7	0.4	1.2	1.1	1.5	0.5	0.4	0.1				6.2	4.8
03	0.3	0.8	1.3	1.5	0.7	0.2	0.1						4.9	3.5
06	0.9	0.7	0.9	0.8	0.3	0.1							3.6	2.8
09E	0.7	0.9	1.5	2.3	0.4	0.1	0.2	0.1					6.2	3.4
12	0.4	2.4	3.0	2.6	1.3	1.2	0.6						11.5	3.7
15	0.4	1.7	2.9	3.6	2.9	1.9	1.3	1.1					15.9	4.5
18S	1.0	1.2	3.1	5.9	5.5	5.2	2.3	0.7	0.1	0.1			25.1	4.7
21	0.4	0.6	1.5	1.8	1.0	0.4							5.8	3.6
24	0.5	0.4	0.9	1.2	1.0	0.3	0.2						4.4	3.7
27W	0.4	0.2	1.2	1.2	1.2	0.6	0.4	0.3	0.1				5.4	4.4
30		0.5	0.8	2.0	0.6	0.4	0.3	0.3					4.8	4.3
33	0.1	0.3	0.4	0.8	0.9	0.5	0.4	0.2					3.6	4.8
NF	5.3	10.5	18.1	24.7	16.8	12.4	6.3	2.9	0.3	0.1				

FREQUENCY OF MAX WIND FORCE BETWEEN THE HOURS OF OBSERVATION

											C
19-01	2.1	3.5	14.9	23.0	20.9	15.6	11.3	6.4	1.8	0.4	
01-07	1.8	4.6	12.4	26.2	15.6	21.3	9.9	5.0	2.1	0.7	0.4
07-13	1.4	4.6	14.5	25.9	16.0	18.8	10.3	6.7	1.4		0.4
13-19	0.7	5.0	14.9	25.5	19.5	15.6	12.1	5.0	1.4		0.4

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4730 UTSIRA FYR

MARCH 1978-1987

HRS. 00,06,12,18 GMT N= 1240 C= 1.4 % VM= 8.1 M/S FM=4.3 B

DD	F: 1	2	3	4	5	6	7	8	9	10	11	12	ND	FDM
36N	0.5	0.7	1.6	1.8	1.5	0.7	1.0	0.2	0.1				8.1	4.3
03	0.1	0.8	1.8	0.5	0.2								3.4	3.0
06	0.3	0.8	0.8	0.5	0.1	0.1							2.6	2.8
09E	0.7	1.0	1.5	1.2	0.2	0.2							4.9	2.9
12	0.4	1.0	2.4	4.0	2.2	1.8	0.5	0.2					12.4	4.2
15	0.2	1.5	2.3	3.0	3.2	3.4	3.3	1.0	0.3				18.3	5.1
18S	0.2	1.5	2.5	4.8	4.6	4.8	2.2	1.0	0.1				21.8	4.9
21	0.3	0.7	1.2	1.5	1.3	1.0	0.2	0.1					6.2	4.1
24	0.1	1.2	1.4	1.3	0.9	1.2	0.6	0.1					6.7	4.2
27W	0.2	0.7	0.9	1.3	0.9	1.0	0.2	0.2					5.6	4.3
30	0.1	0.3	0.6	0.8	0.7	0.5	0.5	0.1					3.6	4.5
33	0.3	0.6	0.7	1.0	0.5	0.8	0.6	0.4	0.1				5.1	4.6
NF	3.5	11.0	17.8	21.5	16.3	15.5	9.0	3.4	0.6					

FREQUENCY OF MAX WIND FORCE BETWEEN THE HOURS OF OBSERVATION

C

19-01	0.6	4.8	10.6	20.3	20.0	16.8	17.1	6.5	2.6	0.6
01-07	0.6	2.9	13.2	23.9	13.9	21.3	16.5	6.1	1.3	0.3
07-13	0.6	3.5	13.2	20.0	15.2	21.0	16.8	7.4	1.9	0.3
13-19	1.0	3.9	13.9	21.0	16.5	19.0	13.9	7.7	2.6	0.6

4730 UTSIRA FYR

APRIL 1978-1987

HRS. 00,06,12,18 GMT N= 1200 C= 0.9 % VM= 6.6 M/S FM=3.8 B

DD	F: 1	2	3	4	5	6	7	8	9	10	11	12	ND	FDM
36N	0.6	1.3	4.0	6.3	4.2	2.7	2.2	1.0	0.2	0.1			22.3	4.6
03	0.4	1.0	2.2	2.7	0.4	0.2	0.3	0.1					7.2	3.5
06	0.3	0.6	2.1	0.7									3.6	2.9
09E	0.1	0.8	1.1	0.9	0.3	0.2							3.4	3.3
12	0.4	0.8	1.8	1.8	1.0	0.3	0.1						6.2	3.5
15	0.5	1.0	1.9	2.8	2.3	1.2	0.3						10.0	4.0
18S	0.3	1.4	2.7	6.1	4.7	1.7	0.4	0.1					17.3	4.2
21	0.4	1.9	1.8	1.6	1.1	0.6							7.4	3.4
24	0.3	1.3	1.5	1.0	0.3								4.4	2.9
27W	0.6	1.7	1.2	1.6	0.9	0.2	0.1						6.2	3.2
30	0.2	1.0	1.0	1.2	0.5	0.3							4.1	3.4
33	0.2	1.2	1.5	2.5	0.6	0.6	0.2	0.1					7.0	3.8
NF	4.3	14.0	22.7	29.1	16.4	7.7	3.4	1.3	0.2	0.1				

FREQUENCY OF MAX WIND FORCE BETWEEN THE HOURS OF OBSERVATION

C

19-01	0.3	4.3	16.7	31.0	22.7	13.0	7.0	3.3	1.7	
01-07	0.7	6.3	15.0	35.3	18.0	14.7	5.7	3.0	0.3	1.0
07-13	0.7	6.0	19.7	27.3	21.0	15.7	6.0	3.0	0.3	0.3
13-19		4.0	20.0	26.0	24.0	15.0	6.7	3.3	1.0	

4730 UTSIRA FYR

MAY 1978-1987

HRS. 00,06,12,18 GMT N= 1240 C= 1.6 % VM= 6.3 M/S FM=3.7 B

DD	F: 1	2	3	4	5	6	7	8	9	10	11	12	ND	FDM
36N	1.6	1.8	5.2	4.8	3.5	1.5	0.7	0.5					19.8	3.9
03	0.3	1.6	3.0	0.6	0.5								6.0	2.9
06	0.2	1.6	1.2	0.4	0.2								3.6	2.6
09E	0.3	0.9	1.2	1.2	0.2								3.9	3.0
12	0.5	0.6	1.7	1.3	1.1	0.5	0.1	0.1	0.1				6.0	3.8
15	0.3	1.1	1.0	2.1	2.2	1.4	0.6	0.2					9.0	4.4
18S	0.3	1.0	2.8	5.2	5.1	2.6	0.5	0.1					17.5	4.4
21	0.2	1.5	2.7	1.5	0.9	0.7							7.7	3.5
24	0.5	1.2	1.9	1.0	0.6	0.2							5.5	3.2
27W	0.2	1.2	1.5	1.0	0.3	0.3	0.1	0.1					4.8	3.3
30	0.4	1.5	1.5	0.6	0.3		0.3		0.1				4.8	3.2
33	0.3	1.1	2.9	2.9	1.8	0.7	0.2						10.0	3.8
NF	5.3	15.2	26.6	22.7	16.8	8.0	2.6	1.0	0.2					

FREQUENCY OF MAX WIND FORCE BETWEEN THE HOURS OF OBSERVATION

C

19-01	1.0	7.7	20.3	24.8	22.3	16.1	4.8	2.6	0.3
01-07	0.6	8.4	22.3	28.7	17.1	14.5	5.5	1.6	1.3
07-13		8.1	25.5	26.5	16.8	13.9	5.8	2.6	1.0
13-19	1.3	4.8	21.6	24.2	23.2	14.5	7.4	1.9	1.0

4730 UTSIRA FYR

JUNE 1978-1987

HRS. 00,06,12,18 GMT N= 1200 C= 2.1 % VM= 6.6 M/S FM=3.8 B

DD	F: 1	2	3	4	5	6	7	8	9	10	11	12	ND	FDM
36N	0.3	1.1	4.1	6.1	4.9	5.1	2.0	0.5					24.1	4.7
03	0.5	1.3	1.7	0.8		0.1							4.3	2.7
06	0.5	0.6	0.6	0.3	0.3								2.2	2.6
09E	0.3	0.9	0.6	0.3	0.1								2.3	2.5
12	0.4	0.2	0.8	0.9	0.4	0.1	0.1						2.8	3.5
15	0.6	0.5	2.0	1.8	0.4	0.3	0.3						5.8	3.5
18S	0.5	1.3	3.6	5.2	2.2	0.6	0.3	0.1					13.7	3.8
21	0.7	1.3	2.8	2.3	0.6	0.1							7.7	3.1
24	0.5	0.7	1.2	0.6	0.6		0.2	0.1					3.8	3.3
27W	0.3	1.3	1.1	1.4	1.2	0.1							5.4	3.4
30	0.1	1.3	2.2	2.2	0.4	0.6	0.1	0.1					6.9	3.6
33	0.3	1.8	3.8	5.8	3.5	2.7	1.0	0.1					19.0	4.2
NF	5.1	12.1	24.3	27.6	14.5	9.6	3.9	0.8						

FREQUENCY OF MAX WIND FORCE BETWEEN THE HOURS OF OBSERVATION

C

19-01	1.0	5.0	19.7	28.3	21.7	14.0	6.7	3.3	0.3
01-07	2.3	5.7	19.7	28.0	19.0	16.7	7.3	1.3	
07-13	1.3	6.0	18.7	35.0	18.3	14.0	4.7	2.0	
13-19	1.0	4.0	20.3	26.7	23.3	14.0	7.7	3.0	

4730 UTSIRA FYR

JULY 1978-1987

HRS. 00,06,12,18 GMT N= 1240 C= 2.4 % VM= 6.3 M/S FM=3.7 B

DD	F: 1	2	3	4	5	6	7	8	9	10	11	12	ND	FDM
36N	0.5	1.9	3.7	6.1	3.6	2.7	0.7	0.2					19.4	4.2
03	0.2	0.9	1.5	0.6									3.1	2.7
06	0.7	0.7	0.5										1.9	1.9
09E	0.4	0.2	0.4	0.2	0.2								1.5	2.8
12	0.2	0.4	0.7	1.0	0.4	0.3	0.2						3.2	3.8
15	0.7	0.5	1.0	2.2	1.3	0.2							5.9	3.6
18S	0.6	1.0	1.8	5.3	3.5	1.5	0.2						14.0	4.1
21	0.2	0.9	2.3	2.3	0.6	0.2							6.5	3.4
24	0.4	1.0	1.1	1.0	0.2	0.2							3.9	3.0
27W	0.8	1.0	1.7	1.5	0.2	0.2	0.1						5.6	3.1
30	0.9	1.9	2.6	3.1	1.0	1.0							10.4	3.4
33	0.6	2.2	4.4	6.2	5.7	2.5	0.6						22.2	4.1
NF	6.4	12.5	21.7	29.4	16.8	8.9	1.8	0.2						

FREQUENCY OF MAX WIND FORCE BETWEEN THE HOURS OF OBSERVATION

									C
19-01	2.3	6.1	17.7	29.4	21.3	15.8	6.5	1.0	
01-07	2.3	6.8	18.4	29.4	21.9	13.9	6.5	0.3	0.6
07-13	2.3	7.7	19.4	26.8	23.2	15.2	4.5	0.6	0.3
13-19	0.6	2.9	19.0	33.5	22.3	15.5	5.2	1.0	

4730 UTSIRA FYR

AUGUST 1978-1987

HRS. 00,06,12,18 GMT N= 1240 C= 1.2 % VM= 6.9 M/S FM=3.9 B

DD	F: 1	2	3	4	5	6	7	8	9	10	11	12	ND	FDM
36N	0.6	1.9	4.0	5.7	3.9	2.7	1.3	0.7					20.8	4.3
03	0.3	1.0	1.2	1.5	0.1	0.3	0.2						4.7	3.4
06	0.1	0.9	0.5	0.3	0.2	0.2							2.2	3.1
09E	0.3	0.6	0.7	0.6	0.3	0.1							2.7	3.1
12	0.4	0.5	1.0	0.8	0.6	0.2							3.5	3.4
15	0.3	1.0	1.7	1.8	0.9	1.5	0.6						7.7	4.1
18S	0.2	0.8	2.3	4.5	3.0	1.8	0.7	0.2	0.1				13.5	4.4
21	0.2	0.9	1.7	1.6	1.5	0.9	0.2	0.1					7.0	4.0
24	0.5	1.2	1.5	1.3	0.9	1.0	0.2	0.1					6.8	3.8
27W	0.6	0.7	1.2	2.3	1.1	0.4	0.3						6.6	3.8
30	0.7	1.9	1.9	2.7	1.0	0.5							8.6	3.3
33	0.3	2.0	3.1	4.4	3.1	1.0	0.4	0.2					14.6	3.9
NF	4.6	13.3	20.7	27.6	16.6	10.6	4.0	1.2	0.1					

FREQUENCY OF MAX WIND FORCE BETWEEN THE HOURS OF OBSERVATION

									C
19-01	1.0	4.8	19.4	23.9	19.7	18.7	8.4	4.2	
01-07	0.6	6.5	18.1	26.8	20.6	16.1	8.7	2.3	0.3
07-13	1.0	7.1	15.2	28.7	21.6	17.1	6.1	2.9	0.3
13-19	0.3	3.9	17.7	29.0	17.7	19.4	7.7	3.5	0.6

DET NORSKE METEOROLOGISKE INSTITUTT - KLIMAAVDELINGEN

4730 UTSIRA FYR

SEPTEMBER1978-1987

HRS. 00,06,12,18 GMT N= 1200 C= 0.8 % VM= 8.6 M/S FM=4.6 B

DD	F: 1	2	3	4	5	6	7	8	9	10	11	12	ND	FDM
36N	0.3	0.7	1.1	2.9	1.8	2.6	1.3	0.8	0.1				11.6	4.9
03	0.3	0.9	1.1	0.8	0.8	0.3	0.2						4.3	3.5
06	0.2	0.4	1.1	0.4	0.3								2.3	3.1
09E	0.1	0.3	0.2	0.4	0.4								1.3	3.6
12	0.2	0.7	1.1	2.5	0.5	0.7			0.1				5.7	3.9
15	0.3	0.8	0.8	2.1	2.0	2.1	1.5	0.7					10.1	5.0
18S	0.5	0.7	1.6	3.8	4.3	4.0	2.2	0.3					17.3	4.9
21	0.3	0.8	1.7	2.4	1.9	1.6	0.8	0.3					9.7	4.4
24	0.5	0.8	1.3	1.6	1.3	1.8	0.5	0.1					7.8	4.3
27W	0.4	0.6	0.8	2.3	1.5	2.0	1.2	0.1	0.1				8.9	4.7
30	0.1	0.6	1.1	2.3	2.2	2.3	0.5	0.3		0.1			9.3	4.8
33	0.2	0.8	1.4	2.5	2.0	2.8	1.0	0.1	0.2				10.9	4.7
NF	3.3	7.9	13.2	23.9	19.0	19.9	9.1	2.5	0.4	0.1				

FREQUENCY OF MAX WIND FORCE BETWEEN THE HOURS OF OBSERVATION

C

19-01	0.3	4.3	8.7	15.0	22.7	22.7	18.0	6.7	1.7		
01-07	0.3	2.0	11.0	18.3	20.3	26.3	14.3	5.7	1.3	0.3	
07-13	0.3	0.7	11.0	15.3	19.3	25.3	18.3	7.7	1.7		0.3
13-19	0.3	2.0	7.3	20.0	18.7	24.7	16.3	9.0	1.0	0.3	0.3

4730 UTSIRA FYR

OCTOBER 1978-1987

HRS. 00,06,12,18 GMT N= 1240 C= 0.2 % VM= 9.6 M/S FM=4.9 B

DD	F: 1	2	3	4	5	6	7	8	9	10	11	12	ND	FDM
36N	0.2	0.4	0.9	1.8	0.6	0.8	0.3	0.2	0.1				5.3	4.5
03	0.4	0.4	0.6	1.0	0.6	0.2							3.1	3.4
06	0.5	0.7	0.8	0.8	0.3								3.1	2.9
09E	0.2	0.7	0.5	0.9	0.2	0.2	0.1						2.7	3.3
12	0.2	0.7	1.4	1.7	1.0	0.9	0.7	0.4	0.1				7.0	4.5
15	0.2	0.5	1.5	2.7	2.7	4.1	3.1	1.0	0.5	0.1			16.4	5.5
18S	0.1	0.4	1.1	2.7	5.2	5.2	1.9	0.6	0.2	0.1	0.1		17.4	5.3
21	0.4	0.6	1.0	2.3	1.8	1.9	1.1	0.2	0.4				9.8	4.8
24	0.5	0.4	1.2	3.3	1.9	1.4	1.3	0.3	0.3				10.6	4.8
27W	0.1	0.5	0.8	2.3	1.3	2.7	1.3	0.4	0.1	0.1	0.1		9.7	5.2
30	0.1	0.4	1.0	1.5	1.3	1.5	0.8	0.7	0.2				7.3	5.1
33	0.2	0.1	0.9	1.6	1.0	1.6	1.0	0.6	0.2	0.1			7.2	5.3
NF	2.9	5.9	11.8	22.5	17.9	20.4	11.5	4.4	1.9	0.3	0.2			

FREQUENCY OF MAX WIND FORCE BETWEEN THE HOURS OF OBSERVATION

C

19-01		0.6	6.8	17.4	18.4	24.2	17.1	9.7	3.9	1.9	
01-07		1.3	6.5	19.0	17.4	21.0	19.0	11.0	3.2	1.3	0.3
07-13	0.6	1.3	5.2	15.2	17.1	26.1	18.7	9.0	4.2	1.9	0.6
13-19	0.6	1.6	6.8	16.5	17.1	23.5	19.0	9.7	4.5		0.6

DET NORSKE METEOROLOGISKE INSTITUTT - KLIMAAVDELINGEN

4730 UTSIRA FYR

NOVEMBER 1978-1987

HRS. 00,06,12,18 GMT N= 1200 C= 1.0 % VM= 9.8 M/S FM=5.0 B

DD	F: 1	2	3	4	5	6	7	8	9	10	11	12	ND	FDM
36N	0.3	0.2	0.8	1.6	0.8	1.3	1.4	0.7	0.3	0.1	0.1		7.5	5.5
03	0.5	0.4	1.0	1.3	0.8	0.5	0.3		0.1				4.8	3.9
06	0.5	0.5	1.0	1.2	0.5	0.1	0.1						3.8	3.3
09E	0.9	0.5	1.3	0.8	0.3	0.3	0.2	0.2					4.4	3.3
12	0.4	0.6	1.3	1.5	1.1	0.6	0.5	0.1					6.1	4.1
15	0.5	0.6	2.3	1.8	1.7	3.8	1.8	1.6					14.0	5.1
18S	0.4	0.5	1.4	2.1	2.8	3.6	2.3	1.2	0.5	0.2			15.0	5.4
21	0.1	0.3	0.6	1.3	2.6	1.7	1.5	0.5	0.2				8.7	5.4
24		0.2	1.3	2.3	1.6	3.0	1.6	0.9	0.5				11.3	5.5
27W	0.3	0.3	0.9	2.0	2.8	1.1	1.1	0.4	0.1	0.1			9.1	4.9
30	0.2	0.7	0.8	1.5	1.7	1.8	0.9	0.8	0.2				8.4	5.1
33	0.2	0.1	0.5	1.3	0.8	0.8	0.6	0.8	0.4	0.3	0.2		5.9	5.9
NF	4.3	4.8	13.3	18.6	17.4	18.3	12.3	7.0	2.3	0.7	0.3			

FREQUENCY OF MAX WIND FORCE BETWEEN THE HOURS OF OBSERVATION

C

19-01	1.0	1.3	4.7	17.0	17.0	17.7	20.0	11.3	6.3	3.0	0.3	0.3
01-07	2.3	0.3	6.0	14.7	17.0	20.3	17.0	15.3	4.0	2.3	0.7	
07-13	1.7	2.3	6.0	13.0	16.7	18.7	19.0	12.7	6.3	2.7	1.0	
13-19	2.0	1.7	6.7	14.7	13.7	21.0	18.0	14.0	6.7	1.3		0.3

4730 UTSIRA FYR

DECEMBER 1978-1987

HRS. 00,06,12,18 GMT N= 1240 C= 1.2 % VM= 9.8 M/S FM=5.0 B

DD	F: 1	2	3	4	5	6	7	8	9	10	11	12	ND	FDM
36N	0.2	0.3	0.7	1.0	1.5	0.7	1.0	1.0	0.2				6.6	5.4
03	0.1	0.5	1.0	1.2	0.8	0.3	0.2	0.1					4.2	4.1
06	0.2	0.4	0.6	0.6	0.2			0.1					2.0	3.3
09E	0.3	0.9	1.1	1.7	1.5	0.5	0.1	0.2					6.3	4.0
12	0.3	1.2	1.5	2.9	2.6	2.2	1.0	0.3		0.2			12.2	4.6
15	0.2	1.0	1.9	2.3	2.6	3.6	3.1	1.1	0.6	0.2			16.7	5.4
18S	0.2	0.8	1.3	2.7	3.4	4.0	2.4	1.0	0.2				16.0	5.2
21	0.2	0.3	0.9	1.8	1.4	2.0	0.5	0.2					7.3	4.8
24	0.1	0.2	0.6	1.9	1.3	1.7	1.0	0.6	0.2				7.6	5.3
27W	0.1	0.2	0.5	1.0	2.3	2.1	1.4	0.6	0.2				8.4	5.5
30	0.1	0.2	0.3	1.5	1.3	1.9	1.5	0.5	0.2	0.1			7.5	5.6
33	0.1	0.2	0.7	0.5	0.8	0.8	0.6	0.2		0.1			4.0	5.0
NF	1.9	6.4	11.2	19.0	19.4	19.9	12.9	5.9	1.6	0.5				

FREQUENCY OF MAX WIND FORCE BETWEEN THE HOURS OF OBSERVATION

C

19-01	1.0	1.6	6.5	15.2	12.3	22.9	22.3	12.3	3.2	2.9		
01-07	1.0	1.9	6.8	11.3	17.4	23.9	19.0	12.9	5.2	0.6		
07-13	1.0	1.3	6.8	13.5	14.2	24.5	18.4	13.9	5.5	0.6	0.3	
13-19	0.6	3.5	5.5	13.9	15.5	22.3	18.1	14.8	4.2	1.6		

DET NORSKE METEOROLOGISKE INSTITUTT - KLIMAAVDELINGEN

4730 UTSIRA FYR

YEAR 1978-1987

HRS. 00,06,12,18 GMT N=14608 C= 1.3 % VM= 7.9 M/S FM=4.3 B

DD	F:	1	2	3	4	5	6	7	8	9	10	11	12	ND	FDM
36N		0.5	0.9	2.3	3.3	2.4	2.0	1.1	0.5	0.1	0.0	0.0		13.2	4.5
03		0.3	0.8	1.5	1.2	0.5	0.2	0.1	0.0	0.0				4.6	3.5
06		0.4	0.8	1.0	0.6	0.2	0.1	0.0	0.0					3.0	2.9
09E		0.4	0.8	1.0	1.0	0.4	0.2	0.1	0.0					3.8	3.3
12		0.4	0.9	1.6	2.0	1.2	0.8	0.4	0.1	0.0	0.0			7.3	4.0
15		0.4	0.9	1.8	2.4	2.1	2.2	1.5	0.7	0.2	0.0			12.2	4.8
18S		0.4	0.9	2.1	4.3	4.0	3.2	1.4	0.5	0.1	0.0	0.0		17.1	4.7
21		0.3	0.8	1.6	1.9	1.3	1.0	0.4	0.1	0.0				7.5	4.1
24		0.3	0.7	1.2	1.5	1.0	1.0	0.5	0.3	0.1				6.8	4.4
27W		0.3	0.7	1.1	1.6	1.3	1.0	0.6	0.3	0.1	0.0	0.0		6.9	4.4
30		0.2	0.9	1.2	1.7	1.0	1.0	0.5	0.2	0.1	0.0	0.0		6.8	4.3
33		0.2	0.9	1.7	2.5	1.8	1.3	0.6	0.3	0.1	0.0	0.0		9.5	4.4
NF		4.1	10.1	18.1	24.0	17.0	14.1	7.3	3.1	0.7	0.2	0.0			

FREQUENCY OF MAX WIND FORCE BETWEEN THE HOURS OF OBSERVATION

													C
19-01	0.9	3.9	12.9	22.1	19.4	18.2	12.9	6.5	2.4	0.8	0.1	0.0	
01-07	1.0	4.1	13.1	23.7	17.6	19.1	12.3	6.2	2.0	0.7	0.1		0.1
07-13	1.0	4.1	13.8	22.0	18.0	19.4	12.0	6.7	2.2	0.6	0.2	0.0	0.0
13-19	0.8	3.3	13.6	22.4	18.6	18.8	12.7	6.7	2.3	0.5	0.1	0.0	0.0