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**BLOCK 15/12 IN THE NORTH SEA, NORWEGIAN SECTOR.
NUMBER OF OCCURRENCES OF SPECIFIED WEATHER CONDITIONS
IN APRIL, JUNE, OCTOBER AND OCTOBER.1 - NOVEMBER.15.**

Helle Tønnessen and Knut A. Iden

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TITLE

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IN APRIL, JUNE, OCTOBER AND OCTOBER.1 - NOVEMBER.15.**

PREPARED BY

Helle Tønnessen and Knut A. Iden

ORDERED BY

**KVÆRNER CONCRETE CONSTRUCTION
Project No.: 570**

SUMMARY

6 hourly values of significant wave heights from the point 1411 (1955-1993) in the Norwegian hindcast archive are analysed with regard to 4 specified weather conditions during a 72 hours period. The number of occurrences are plotted against the different years together with the average waiting time.

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Contingency tables of wave height/period (H_{M0}/TP) for Hindcast point 1411 for the months April, June, October and November.

APPENDIX 2

The specification of cases given by Kværner in telefax of 25.8.95 and 1.9.95.

Summary

6 hourly values of significant wave heights from the point 1411 (1955-1993) in the Norwegian hindcast archive are analyzed with regard to 4 specified weather conditions during a 72 hours period. The number of occurrences are plotted against the different years together with the average waiting time.

1. Introduction

Statistical Weather information are very helpful when a feasible plan for conducting an installation offshore is made. However, meteorological and oceanographic observations offshore are not plentiful. For the actual position at block 15/12, the nearest location with such data is Sleipner A. Here the measurements started in 1993. This data series is too short for the analysis in question. Our nearest locations with data series of some length is Ekofisk and Frigg dating back to 1980. Missing data may occur in both data series. This makes these data series unsuitable for the analysis needed.

2. About the data used

The data used is time series of waves (HM0) from the Norwegian hindcast archive. This is data generated from 6 hourly pressure fields for the period 1955-1993. The source of the pressure fields are until 1981 digitized weather maps and thereafter the numerical weather prediction system. From the pressure maps wind speed and direction are modelled. Through a hindcast technique, the wave fields are computed from the wind fields by our wave model WINCH 2.

The grid of the model is 75 km. The nearest grid point is the point 1411 (58.4°N, 1.3°E) UTM coordinates for the block 15/12 where the weather information is sought is :

N 6438063 m
E 434553 m.

This location is about 50 km SE of the grid point 1411. The general tendency going southwards in this part of the North Sea is on the average towards lower wave heights. This means that the results probably are slightly worse than for the actual point. However, it is assumed that the effect of this is low compared to the accuracy of the hindcast data themselves.

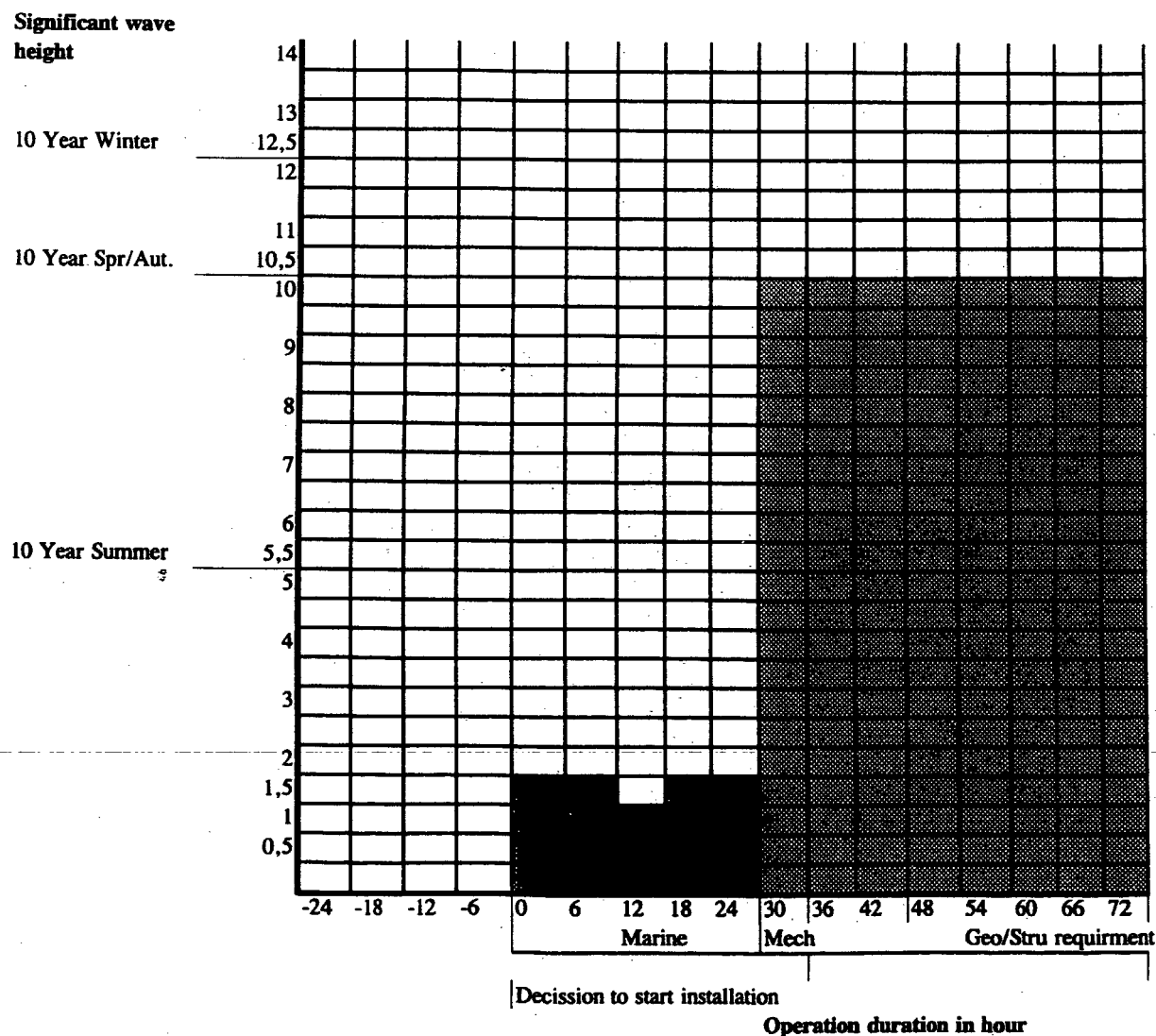
3. Results

For each weather window defined below four periods of the year is analyzed. This is April, June, October and October - 15 November. Thus, for each weather window definition four sets of figures are presented. The figures should be self-explanatory.

The counting of the weather windows is done discrete. This means, a 72 hour period fulfilling the criterions will only appear once in the counting. Each wave height is given a duration of 6 hour.

The waiting time for the first occurrence of an individual month is computed from the starting point of the month. The waiting time for the second occurrence is computed from the end of the first and so on. No occurrence will give the number of days in the month or in the period analyzed (Oct.-Nov.) as the waiting time.

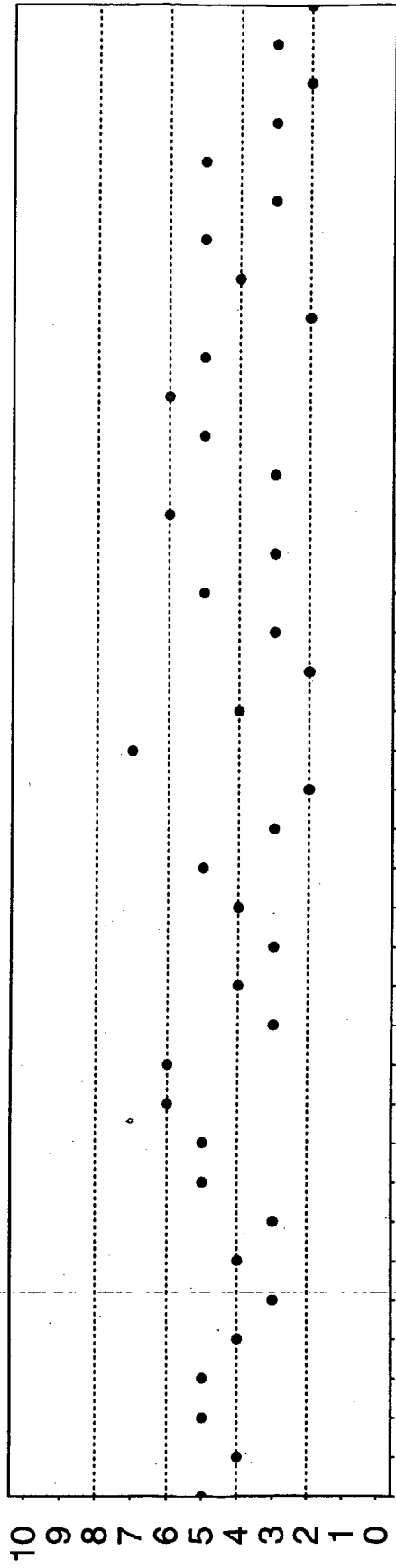
3.1.1 Definition of weather window 1 (Case 1)



3.1.2 Number of occurrences - window 1

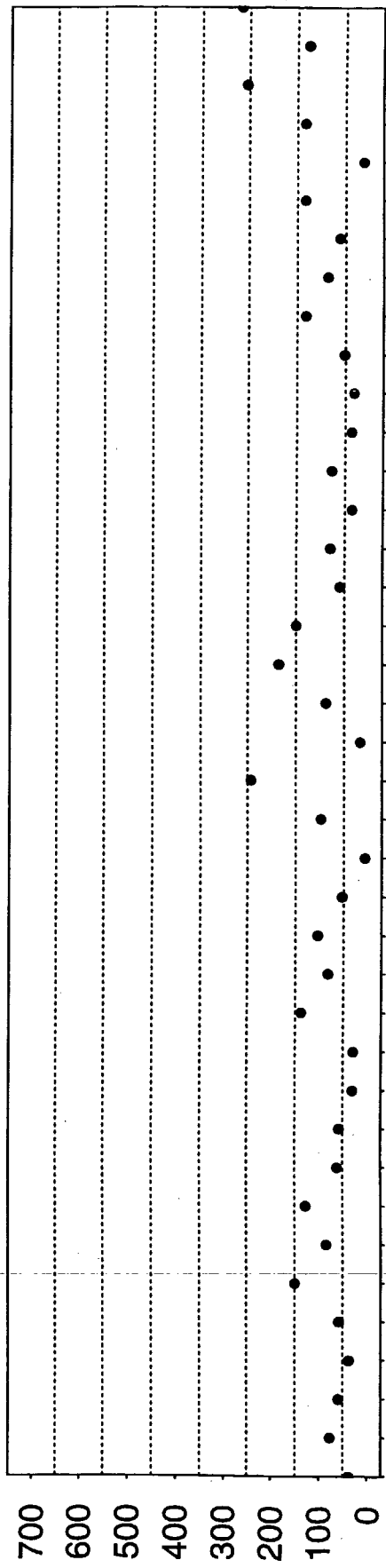


number of cases



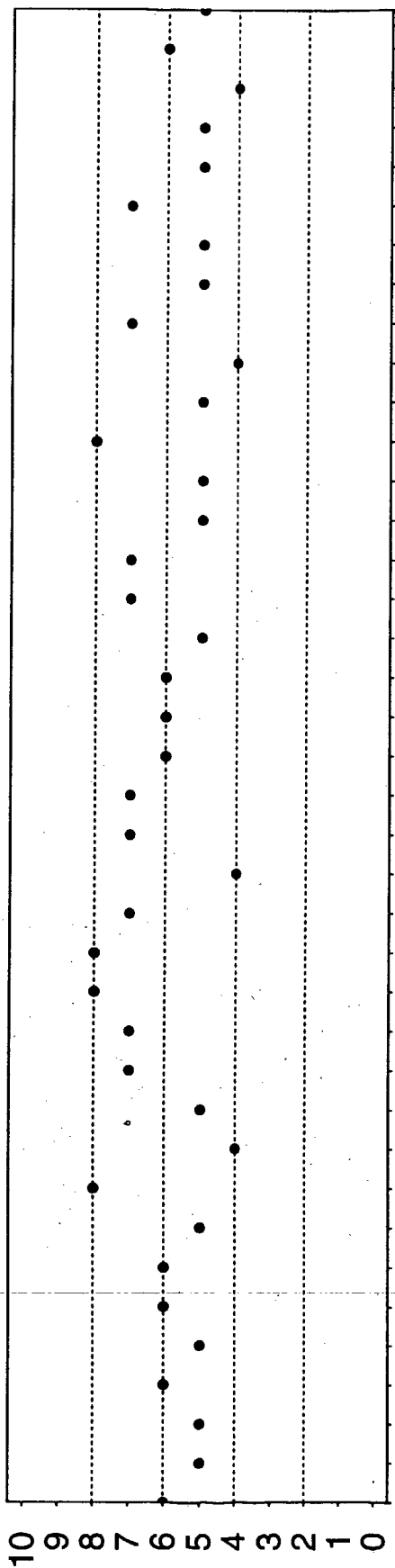
year

mean waiting hours



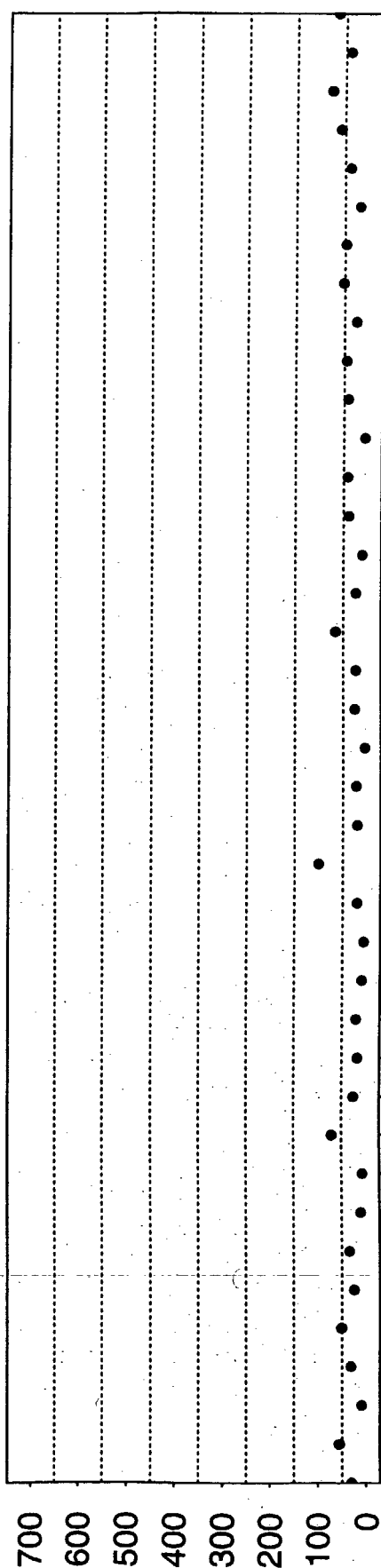
year

number of cases



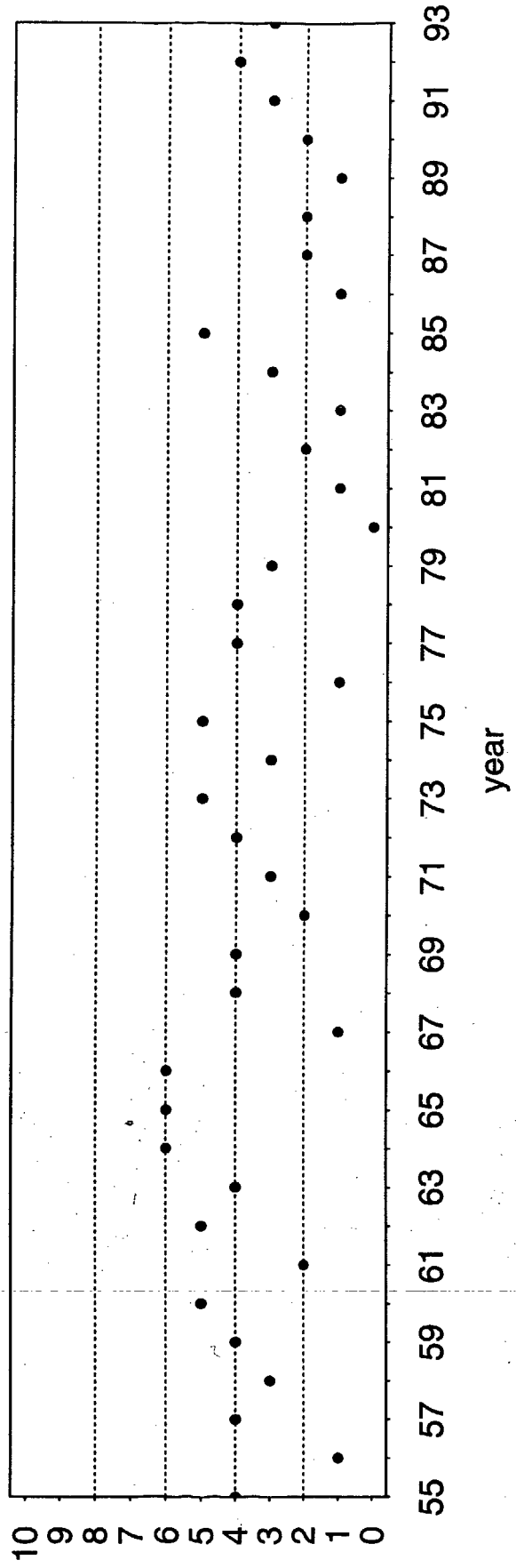
year

mean waiting hours

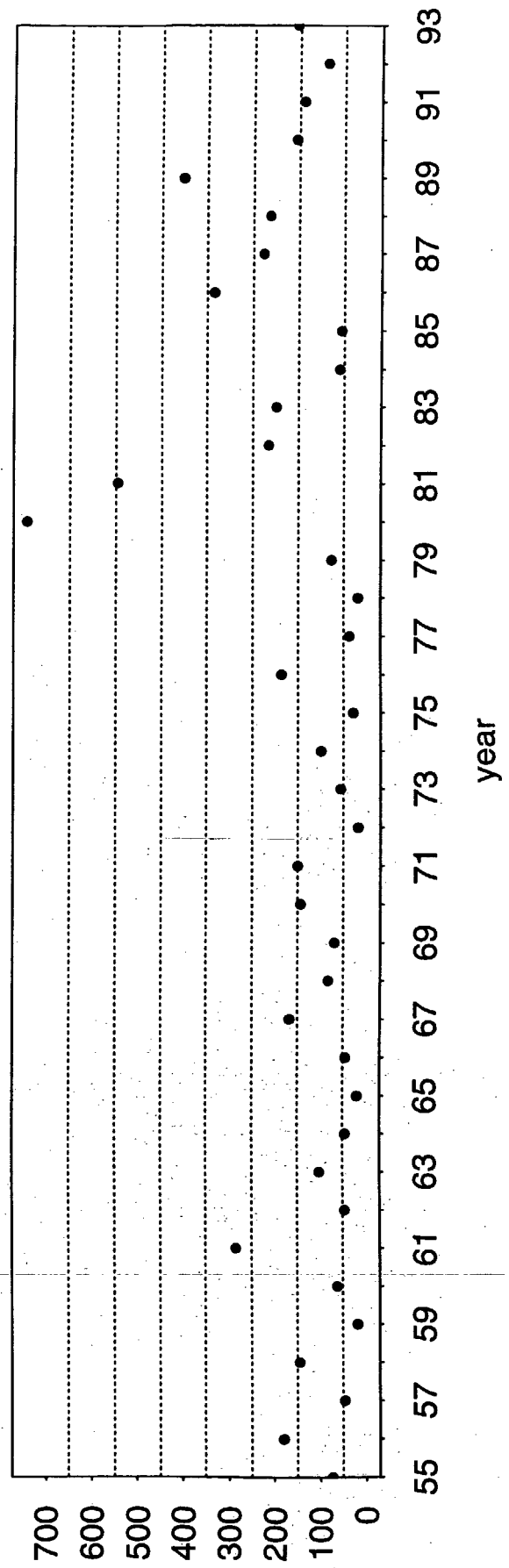


year

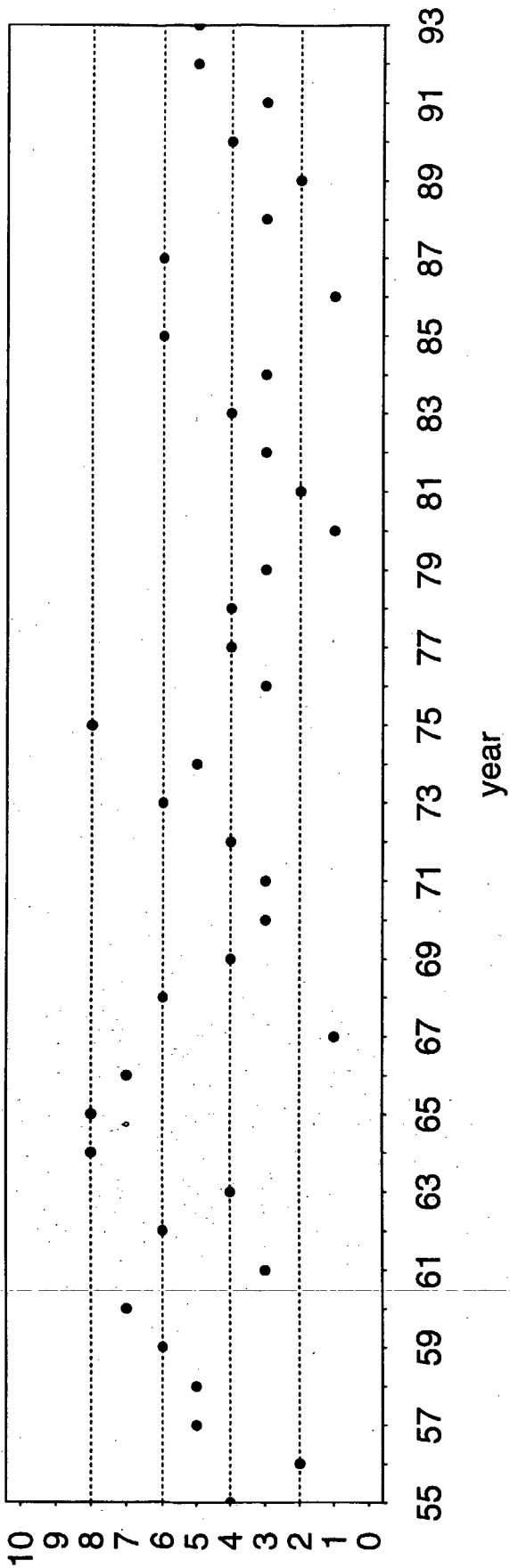
number of cases



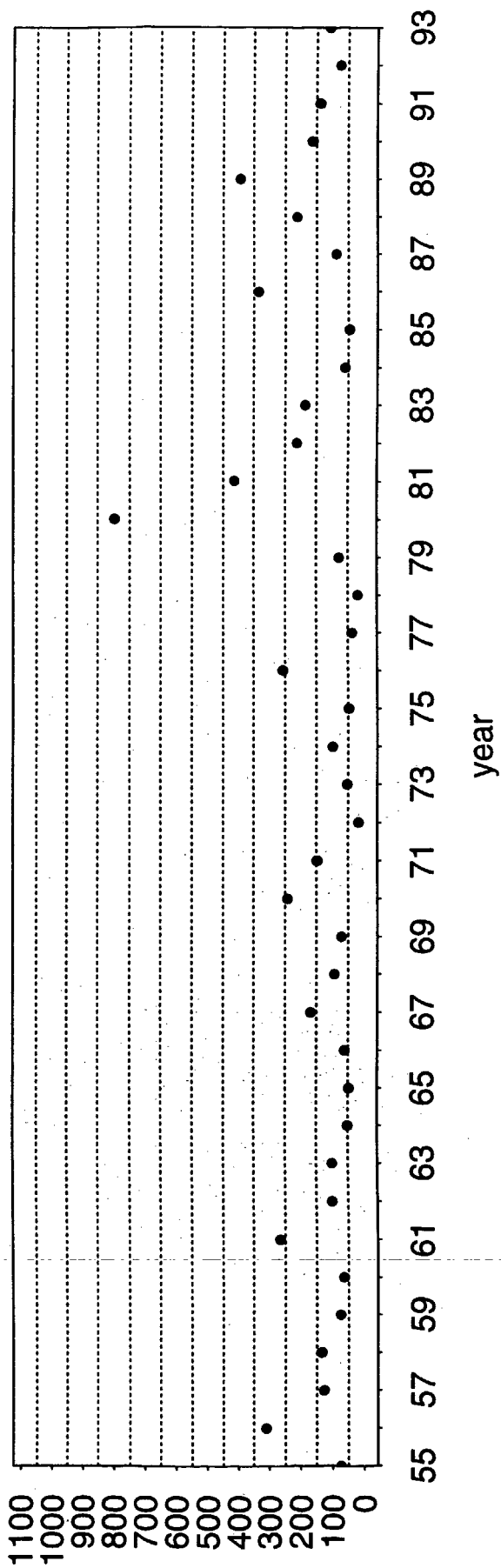
mean waiting hours



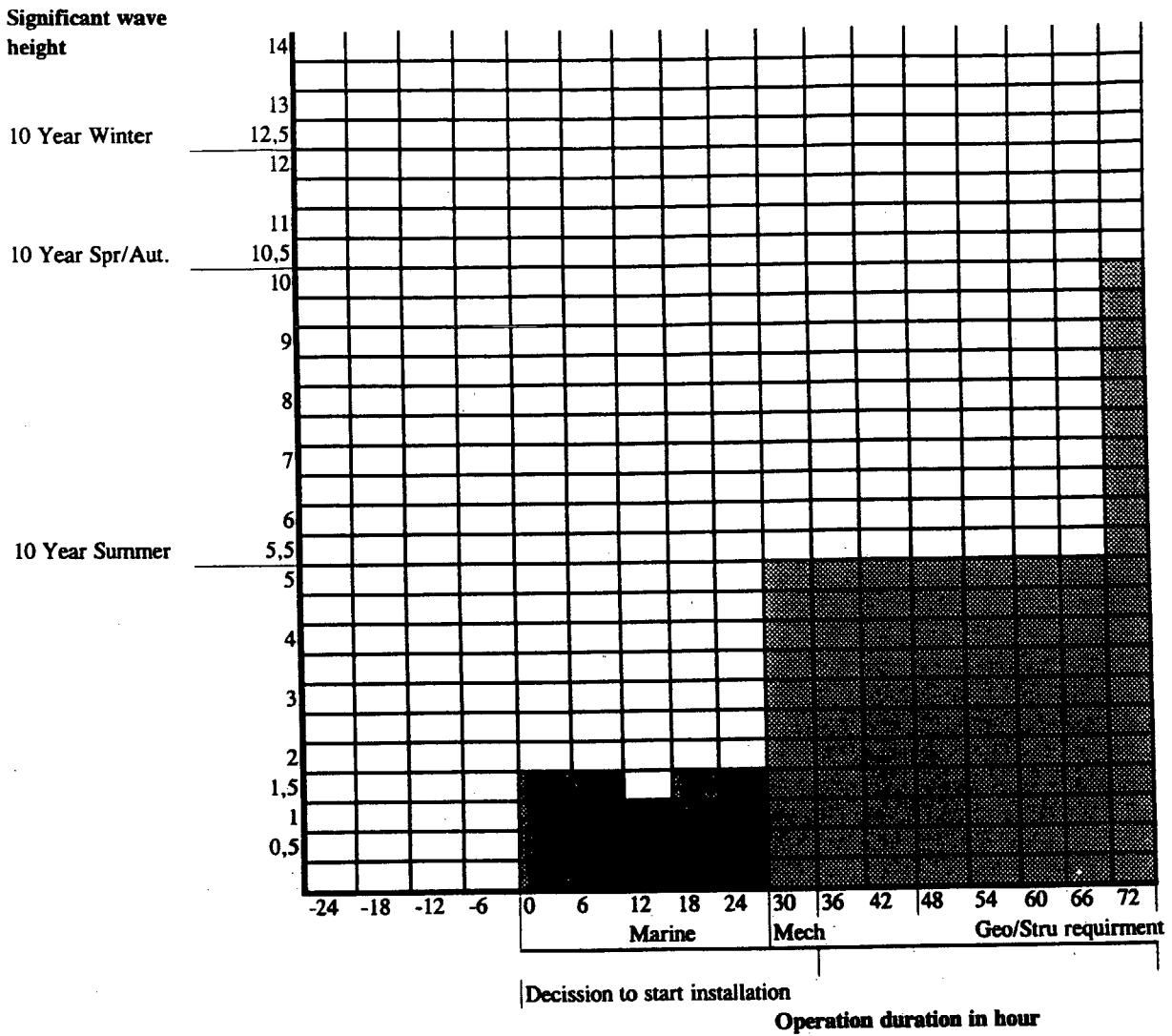
number of cases



mean waiting hours



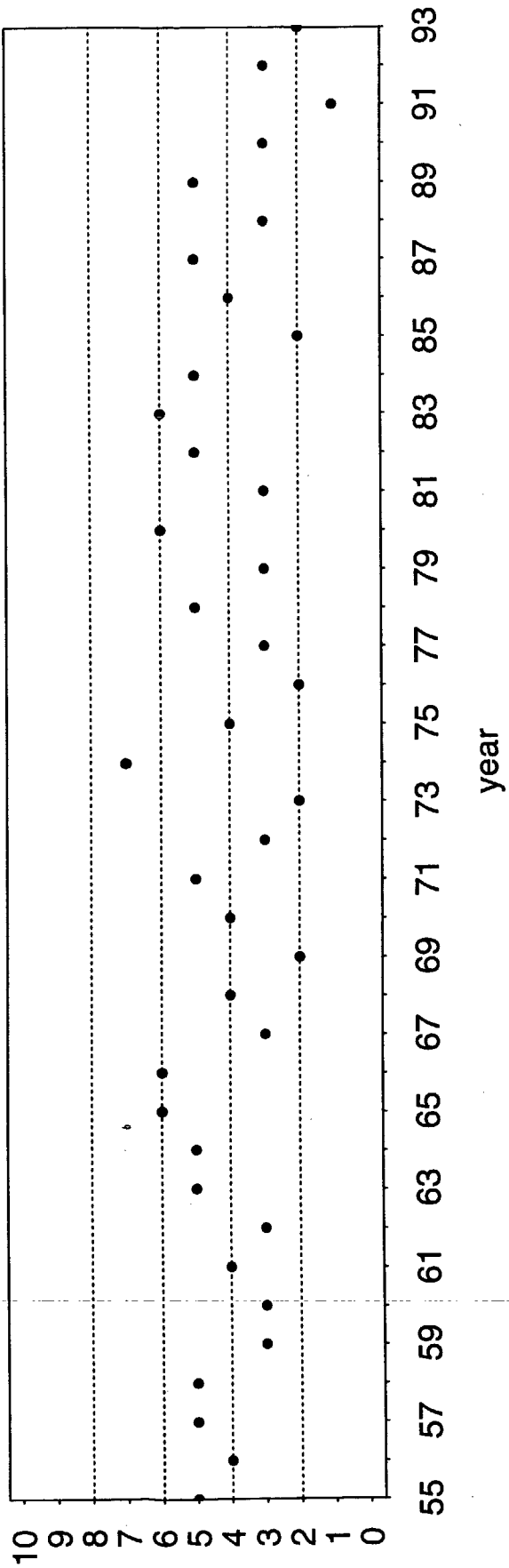
3.2.1 Definition of weather window 2 (Case 2)



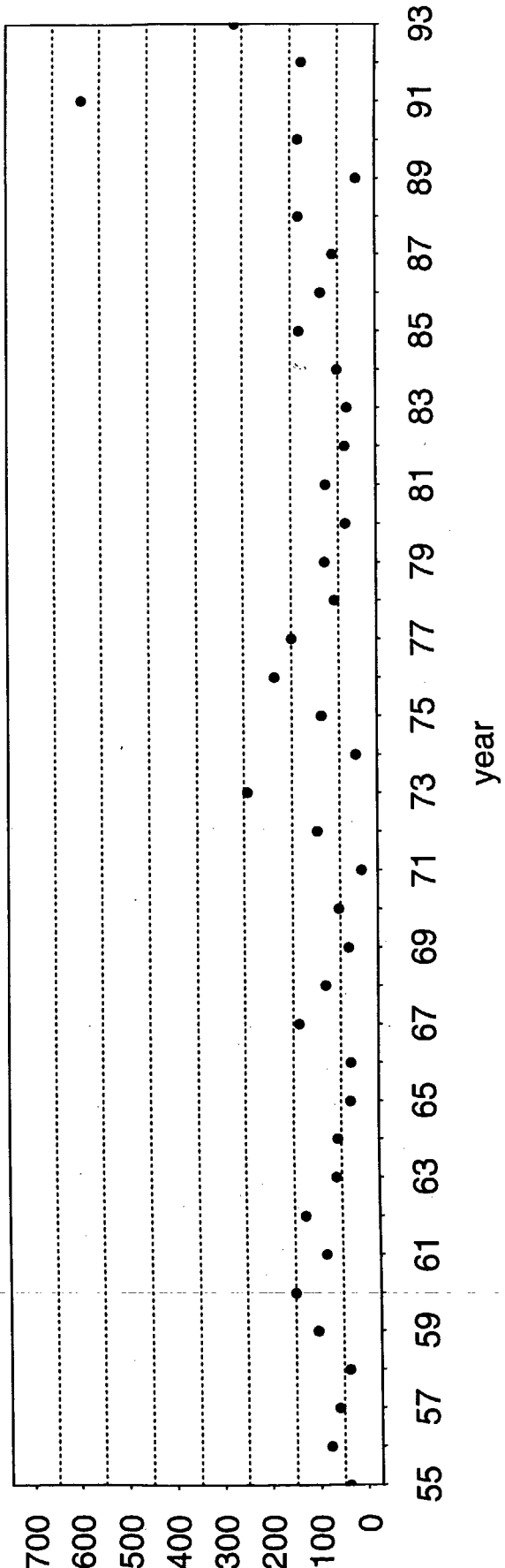
CASE 2

3.2.2 Number of occurrences - window 2

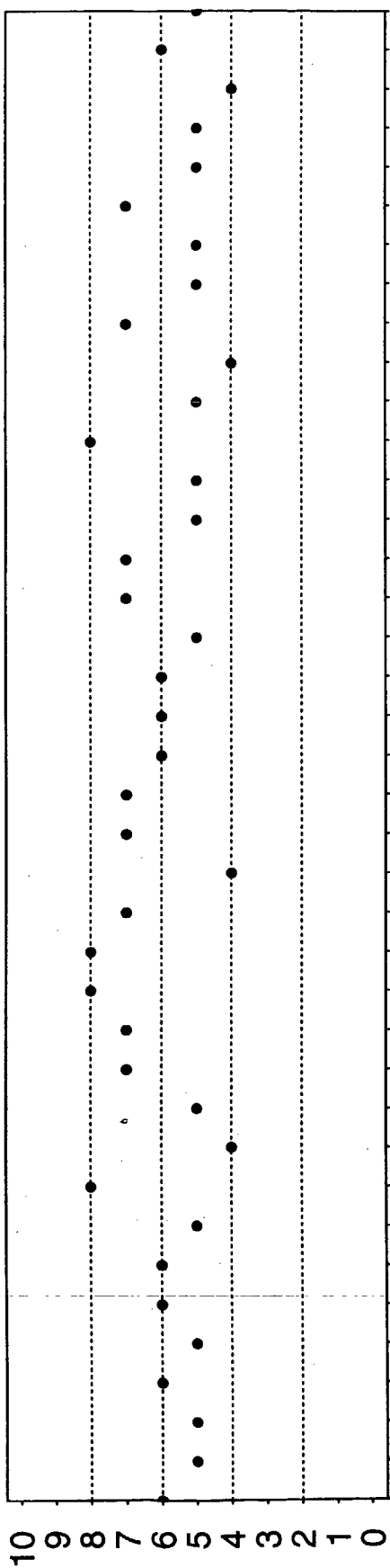
number of cases



mean waiting hours

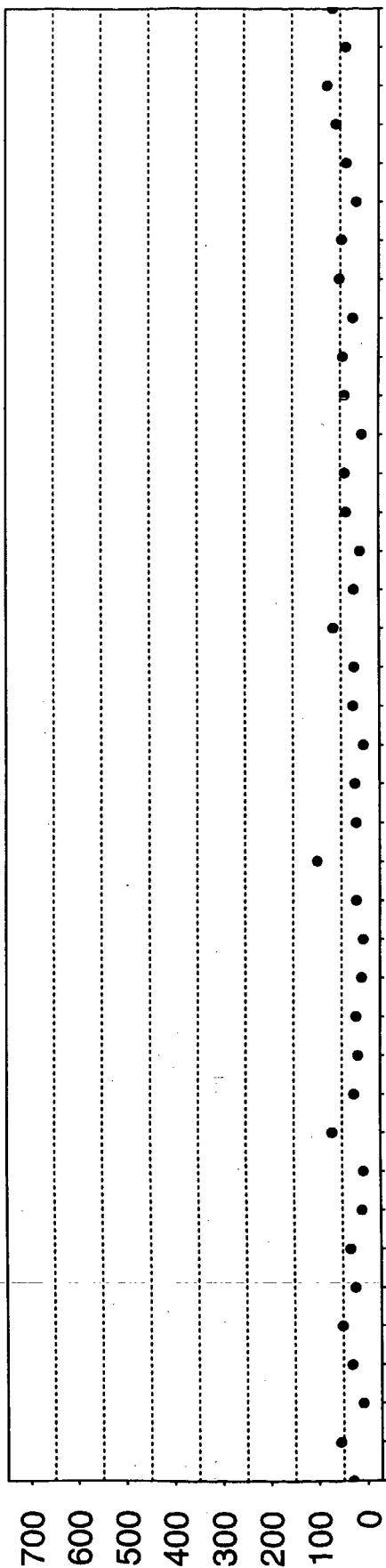


number of cases



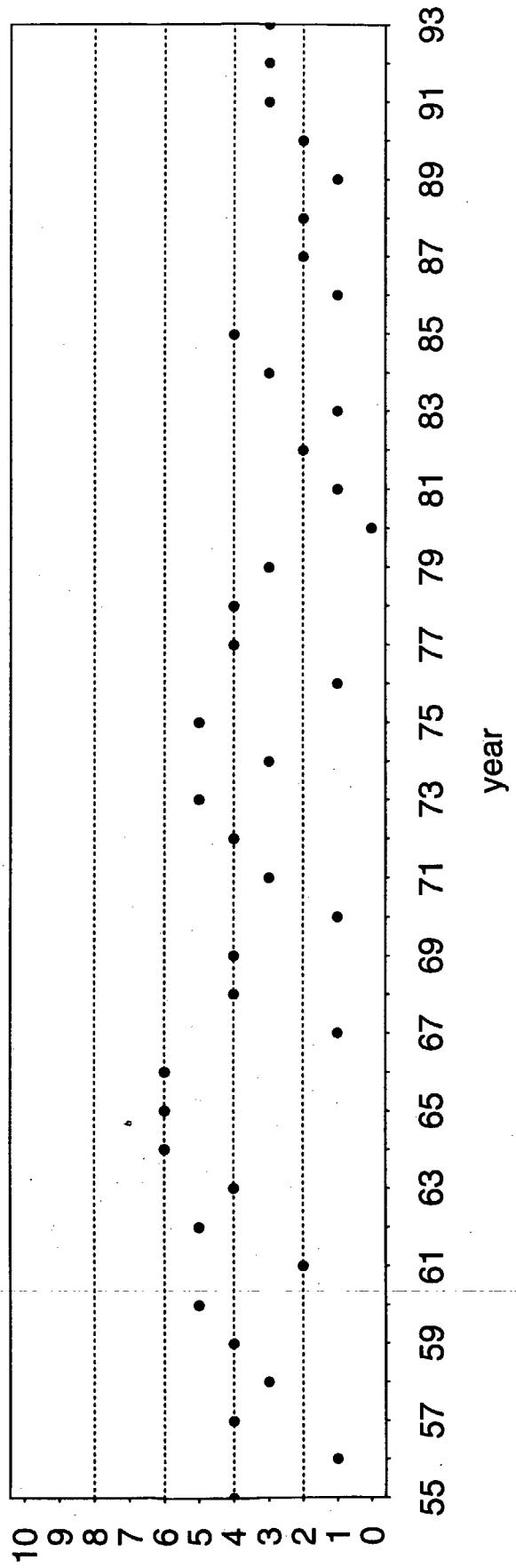
year

mean waiting hours

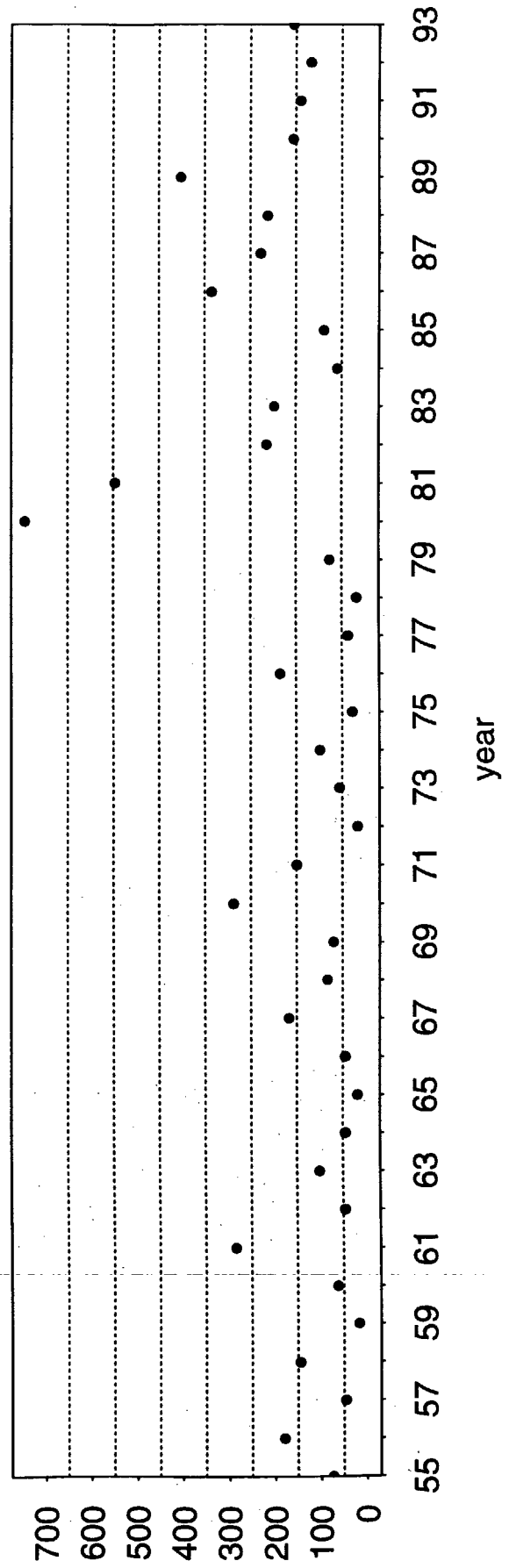


year

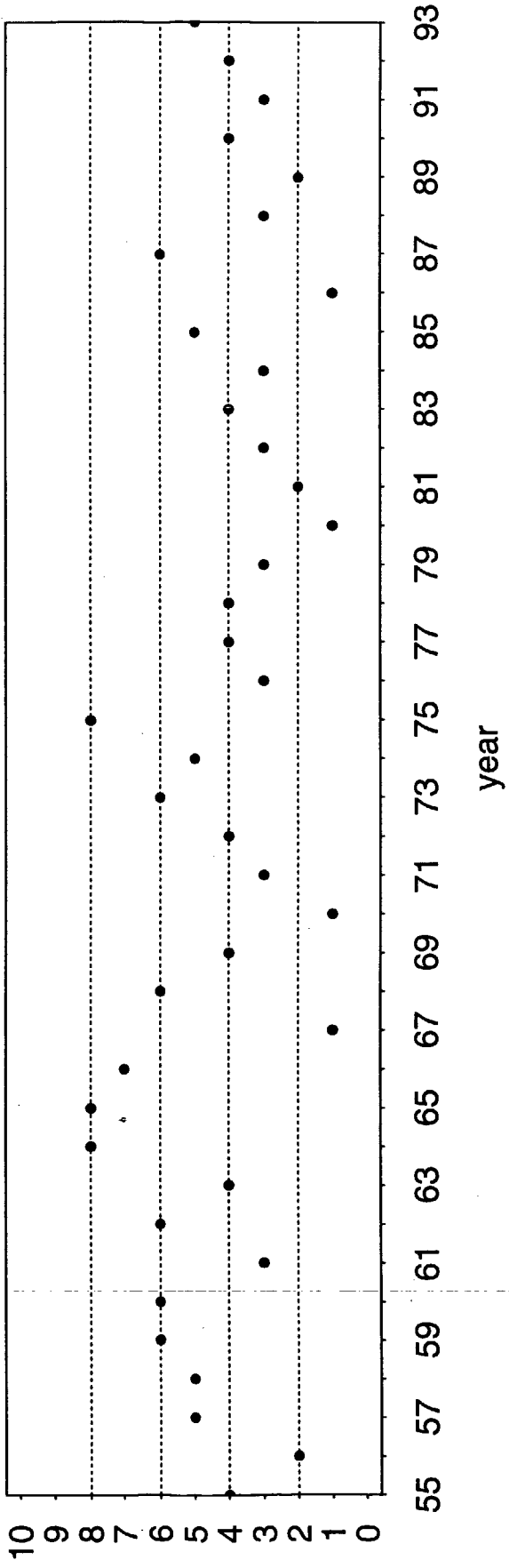
number of cases



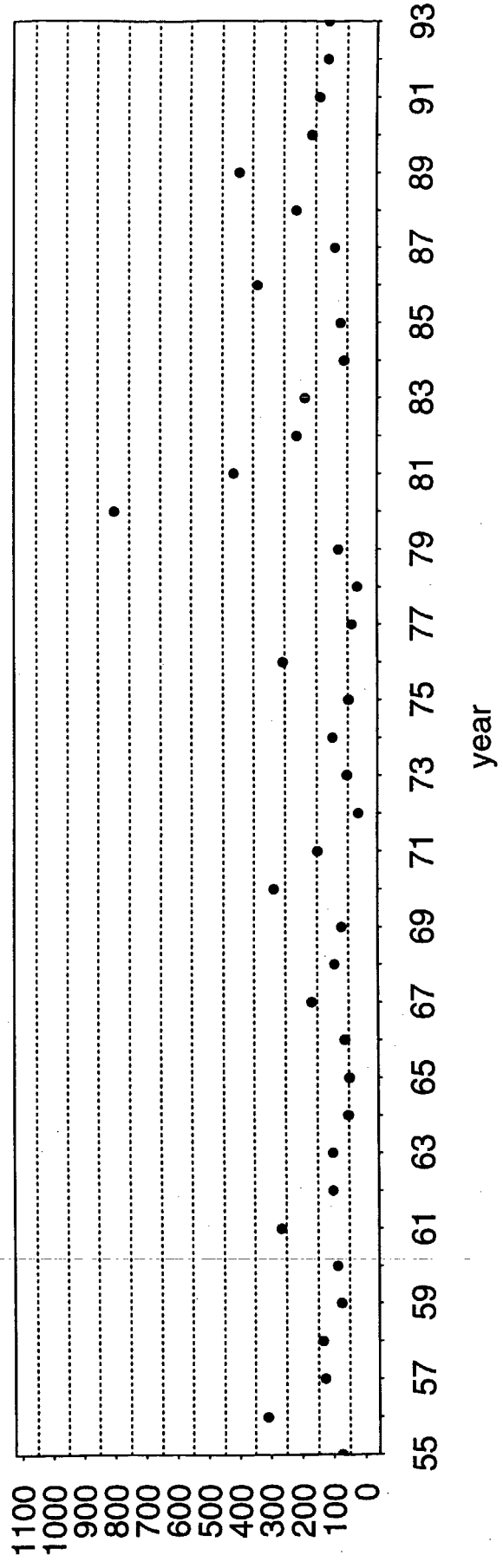
mean waiting hours



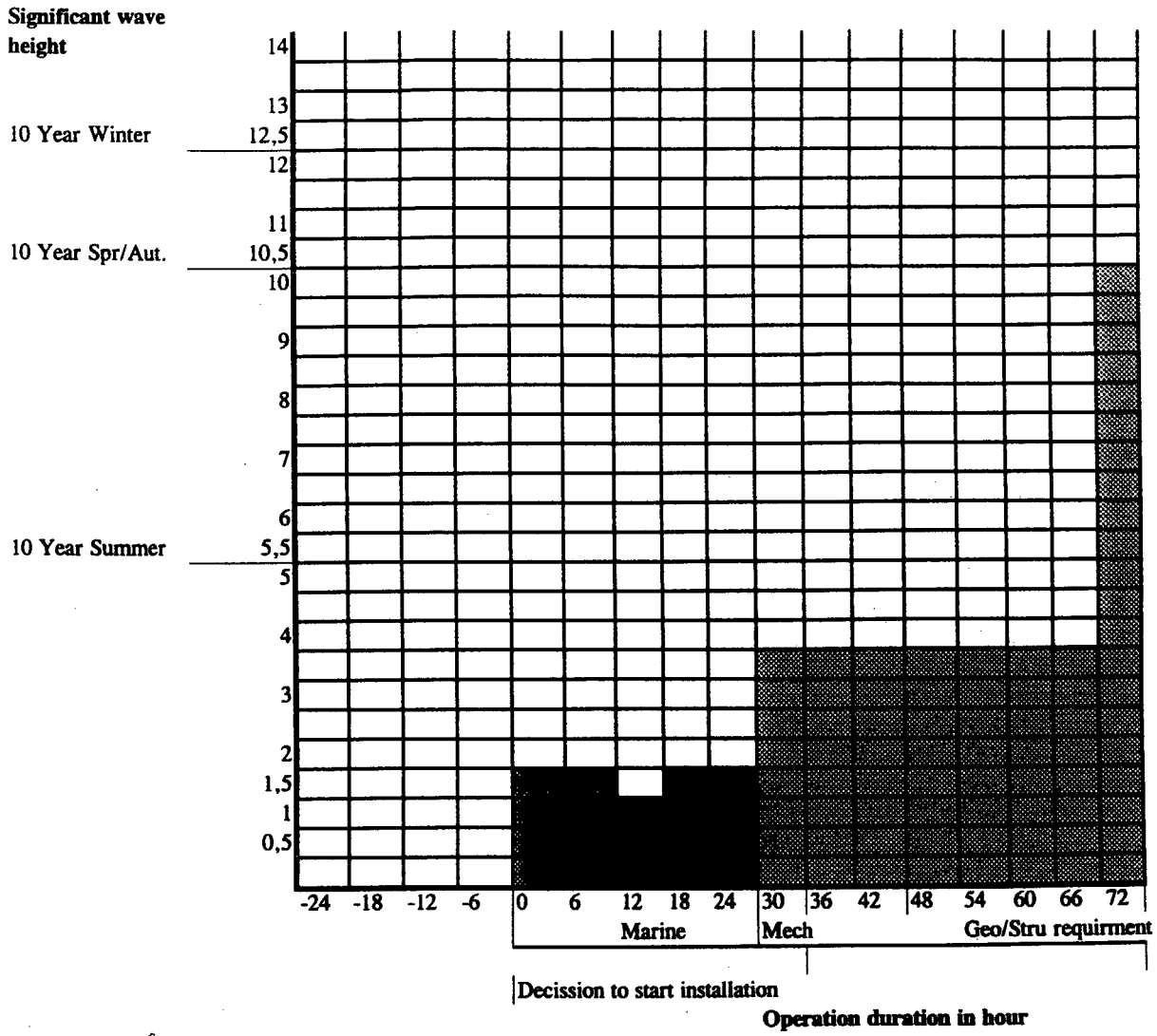
number of cases



mean waiting hours



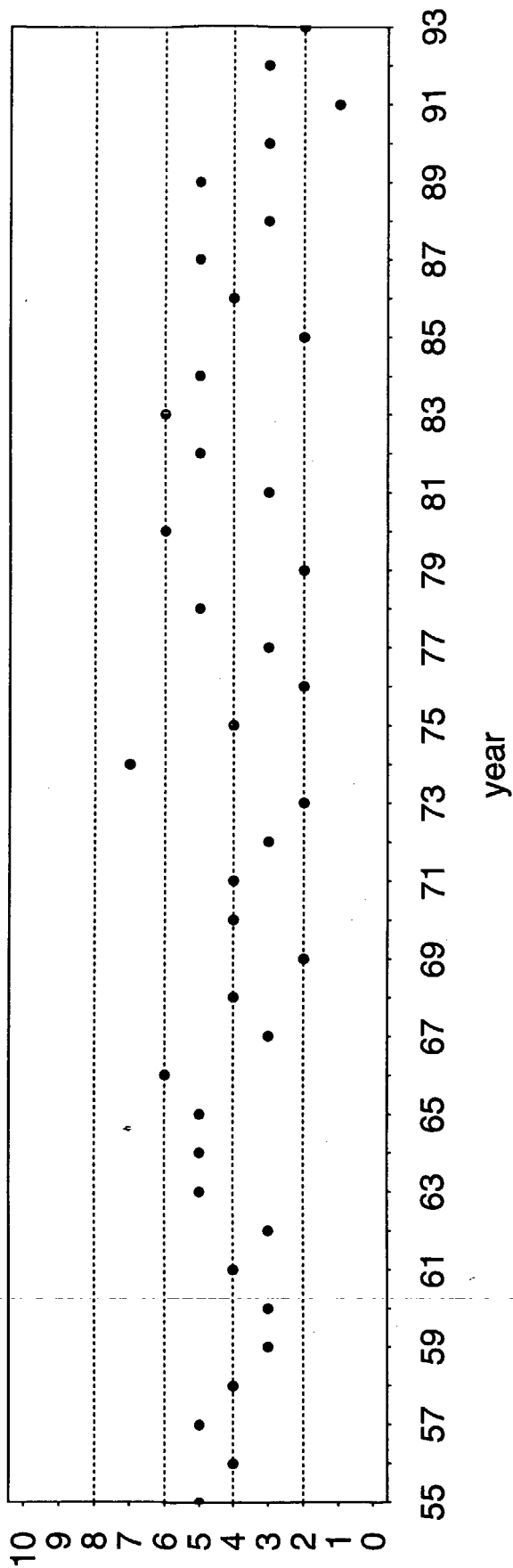
3.3.1 Definition of weather window 3 (Case 3)



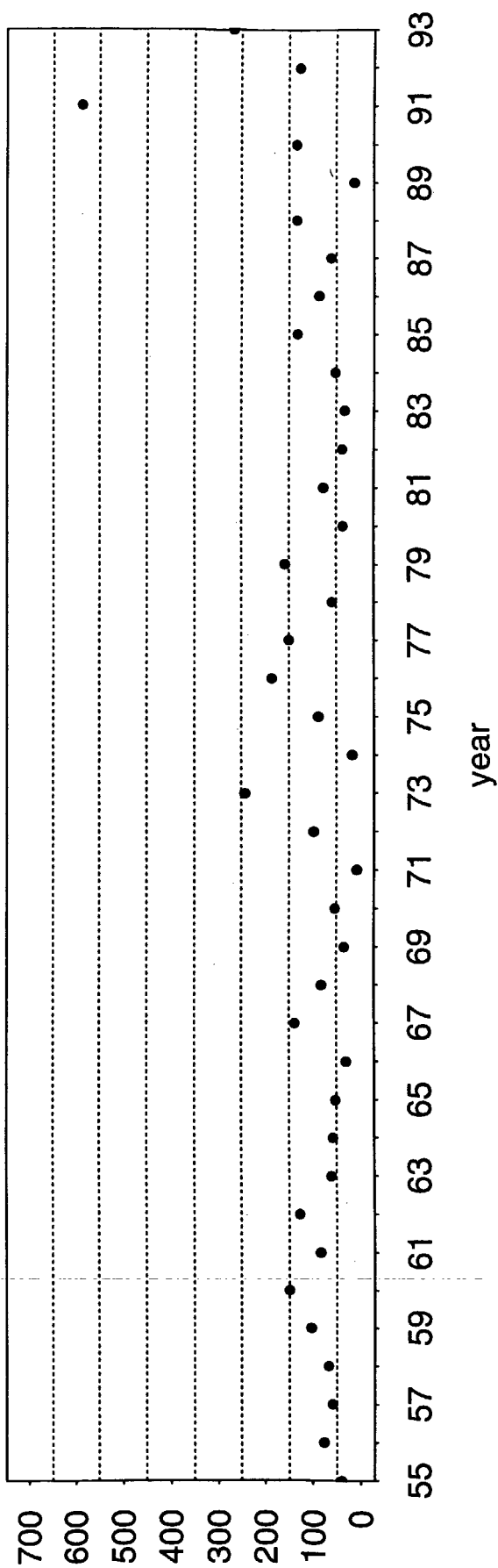
CASE 3

3.3.2 Number of occurrences - window 3

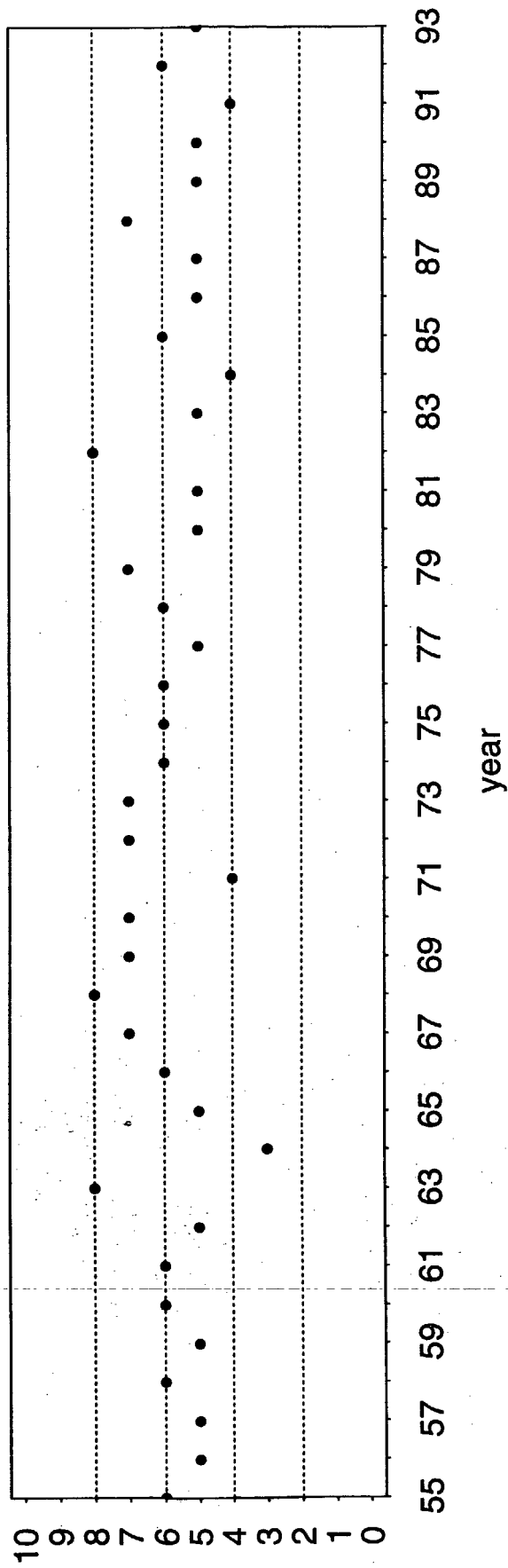
number of cases



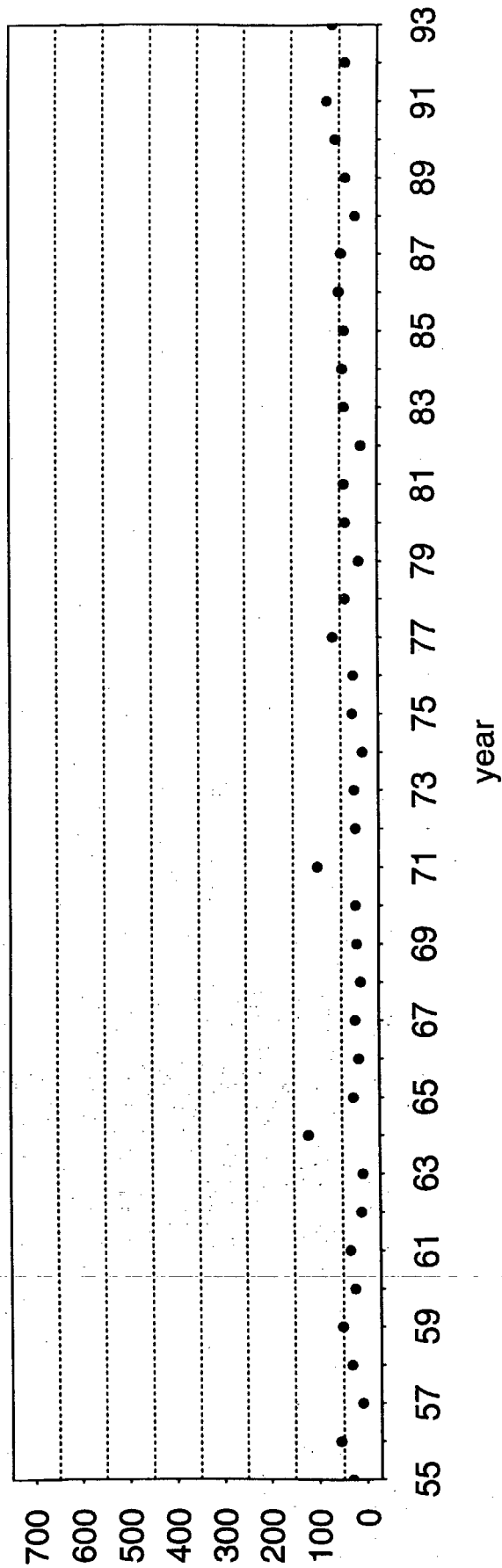
mean waiting hours



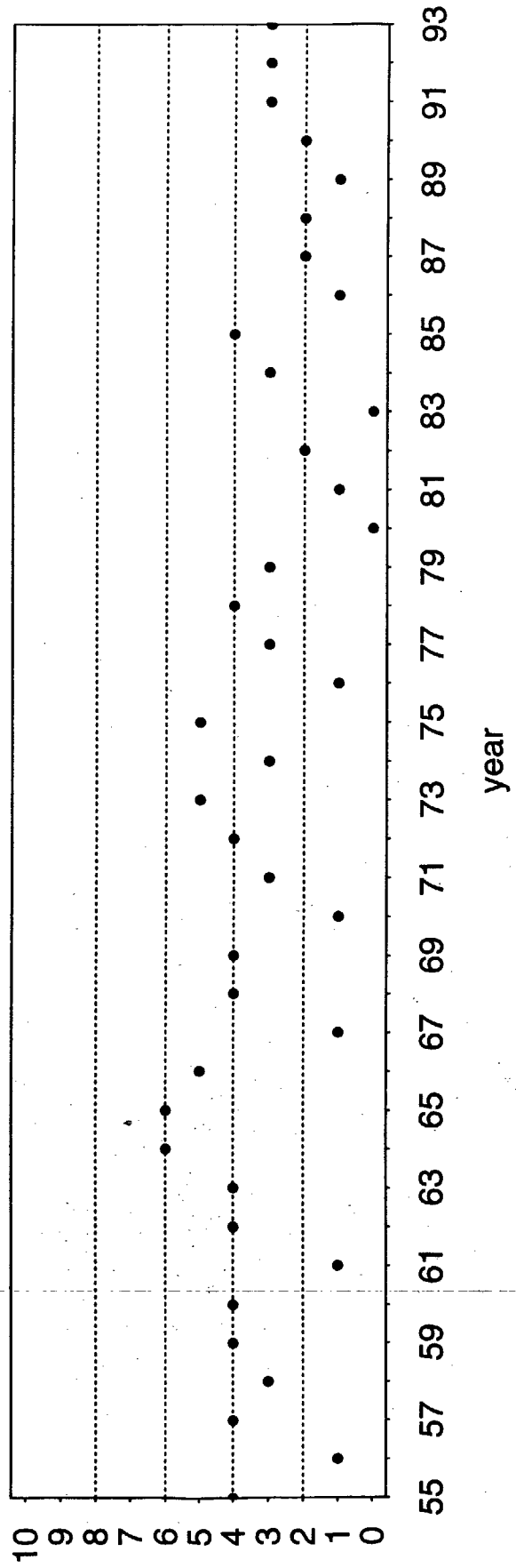
number of cases



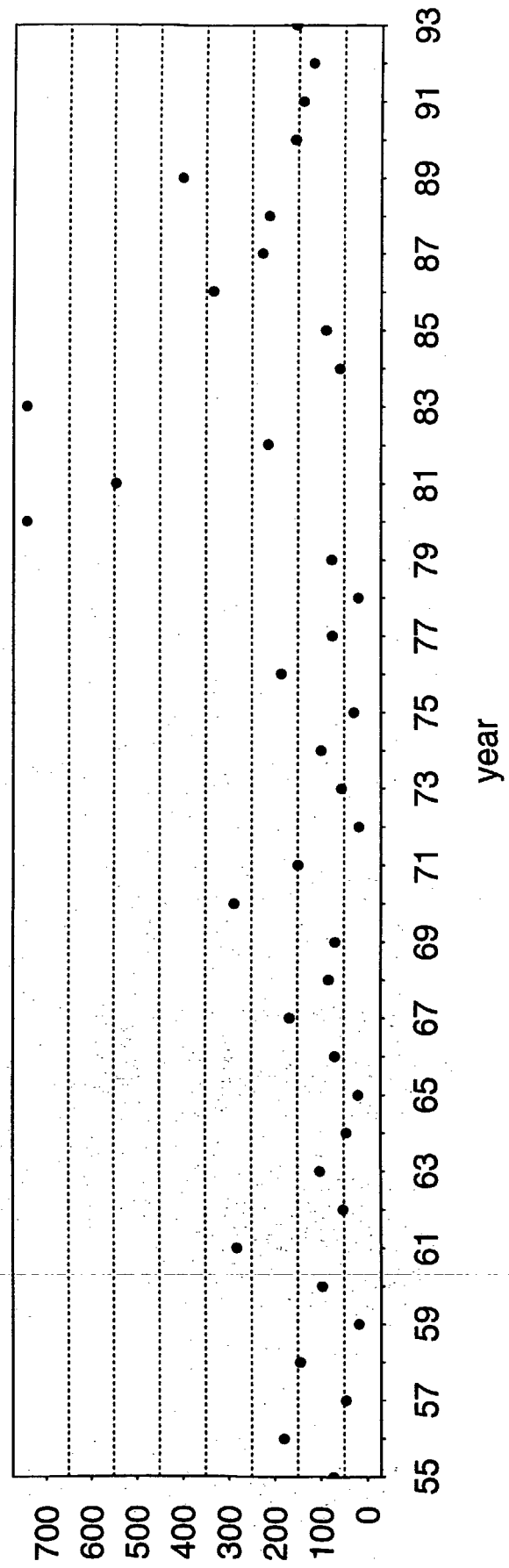
mean waiting hours



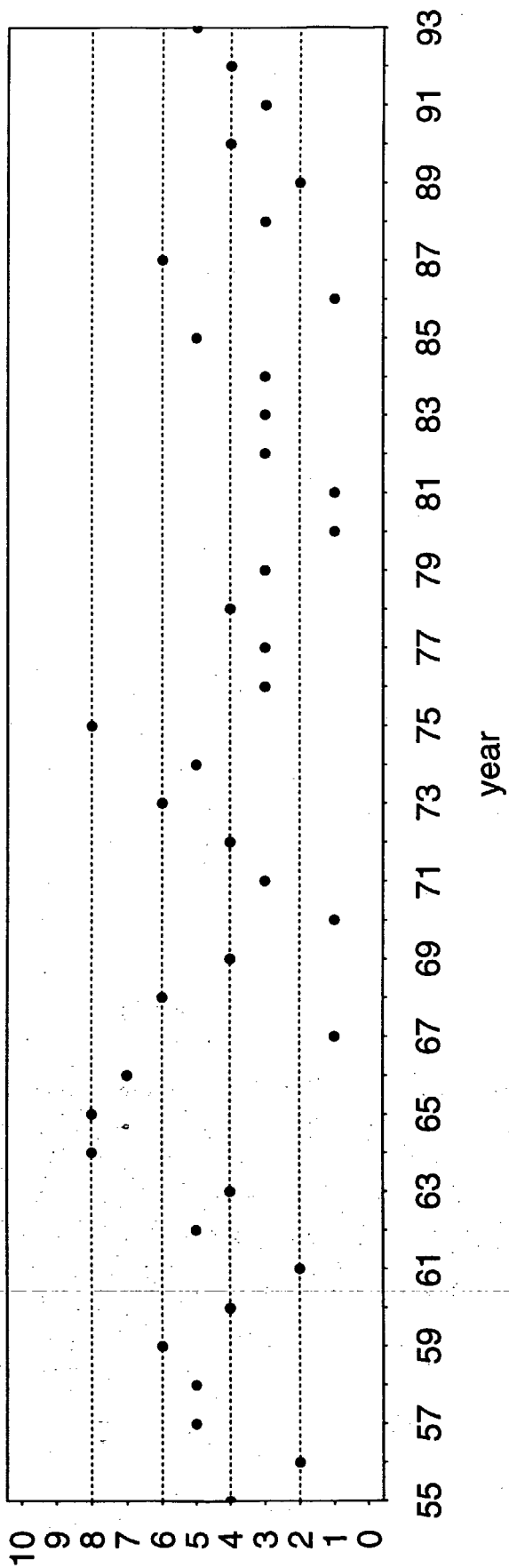
number of cases



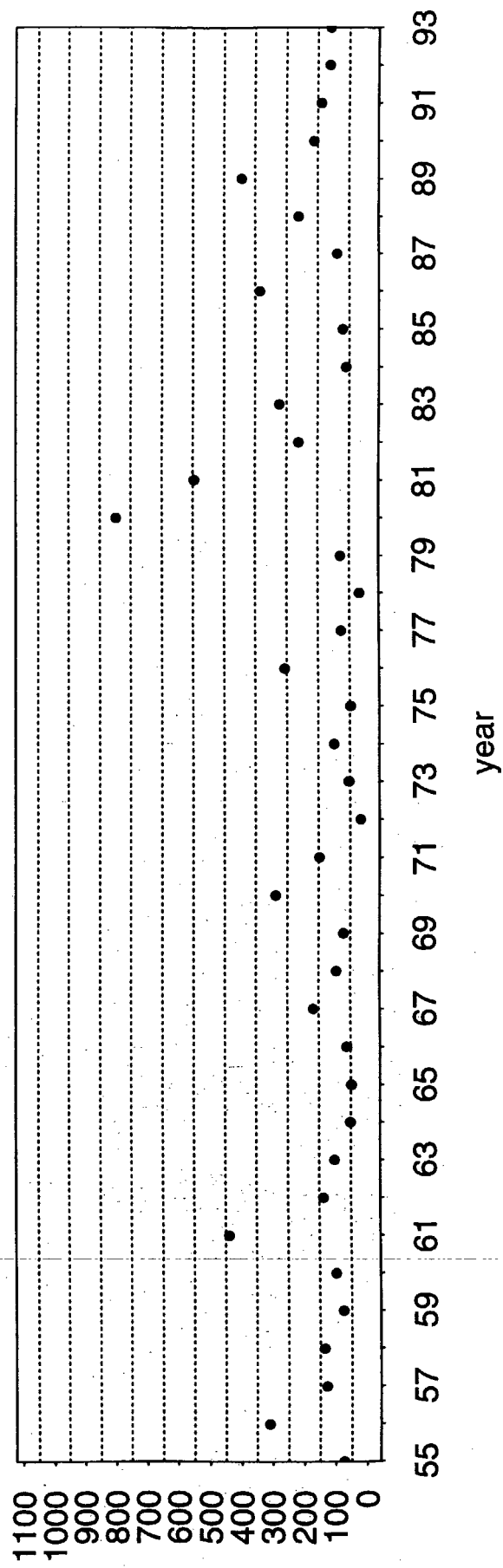
mean waiting hours



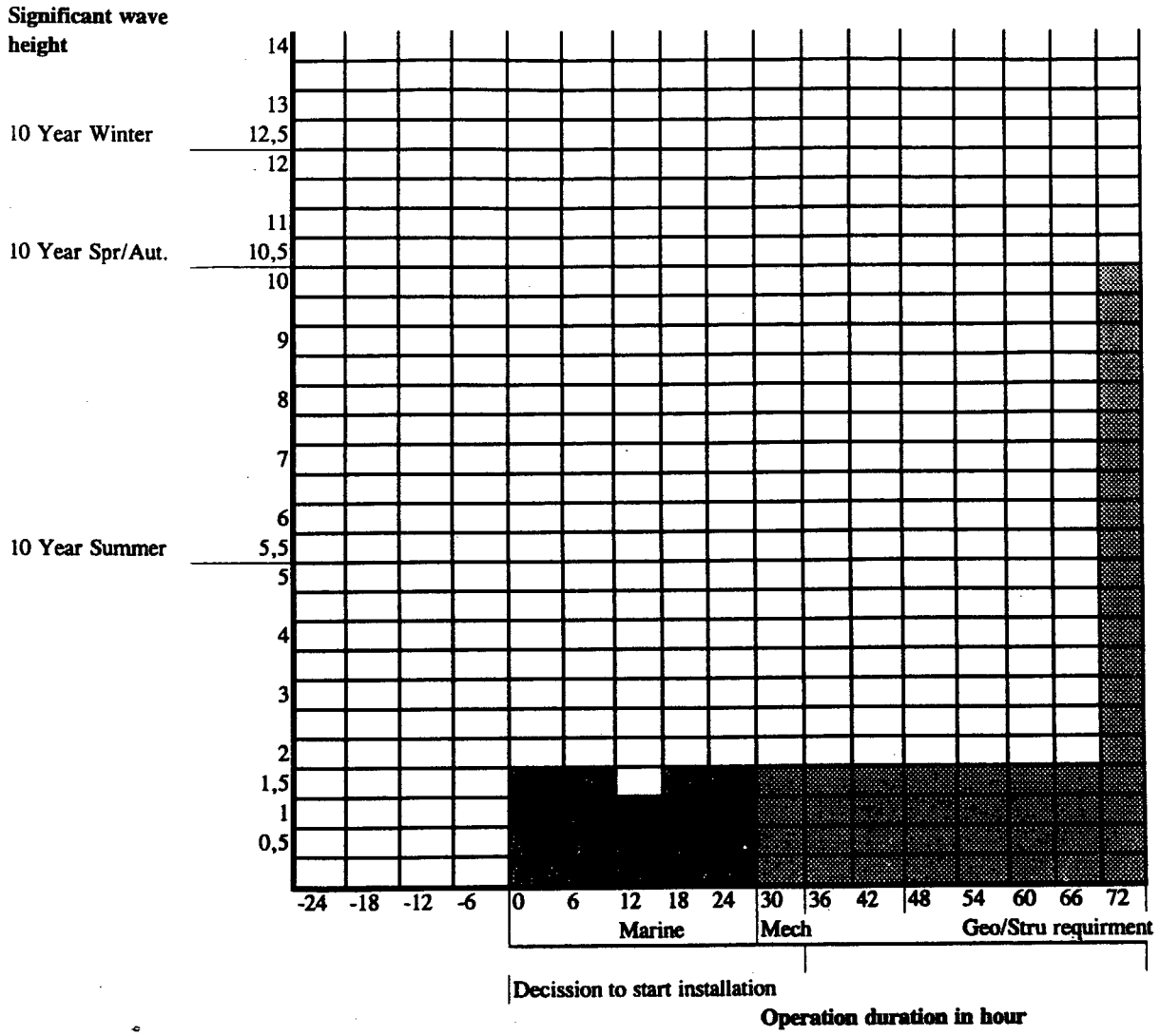
number of cases



mean waiting hours



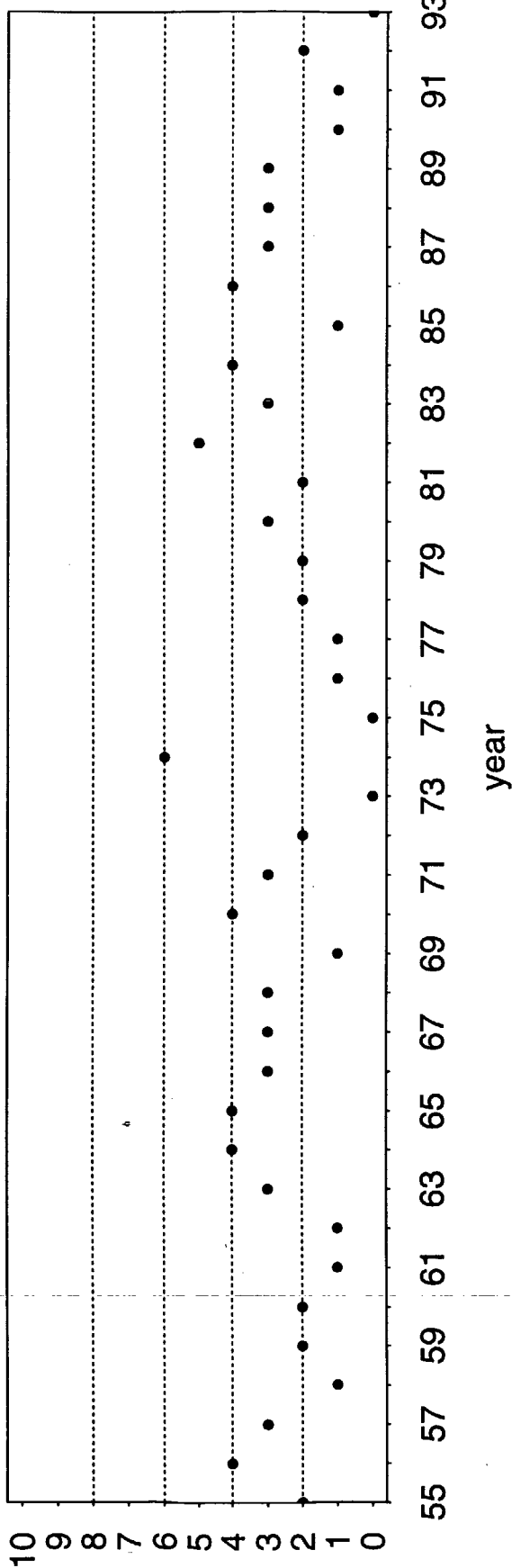
3.4.1 Definition of weather window 4 (Case 4)



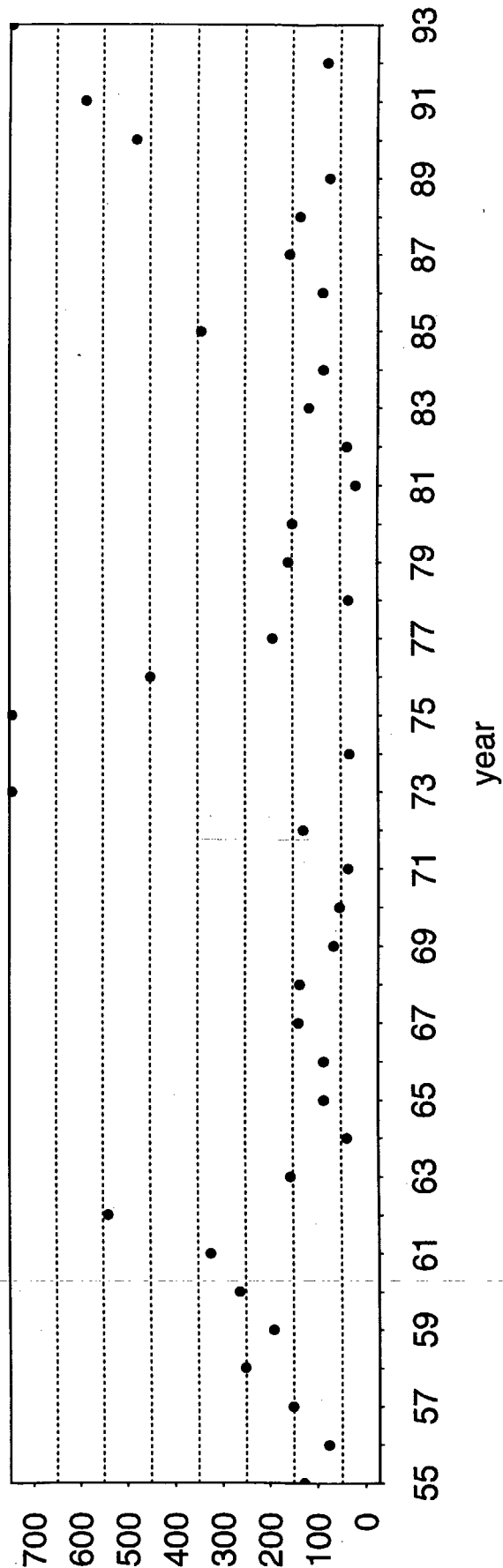
CASE 4

3.4.2 Number of occurrences - window 4

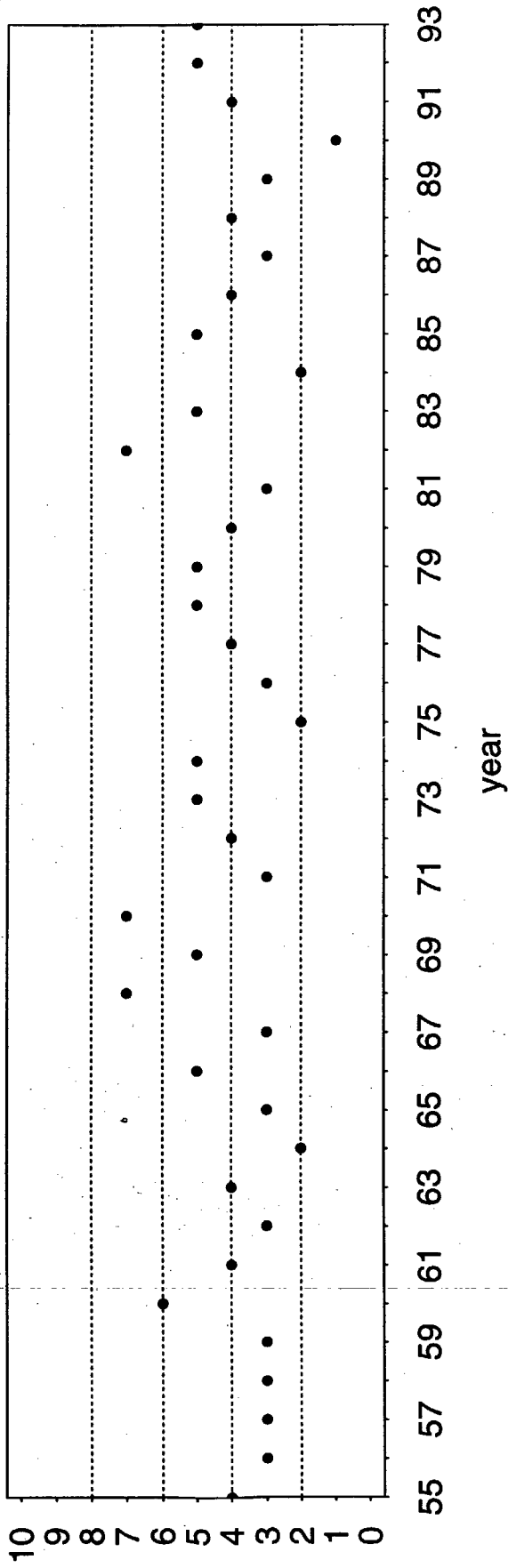
number of cases



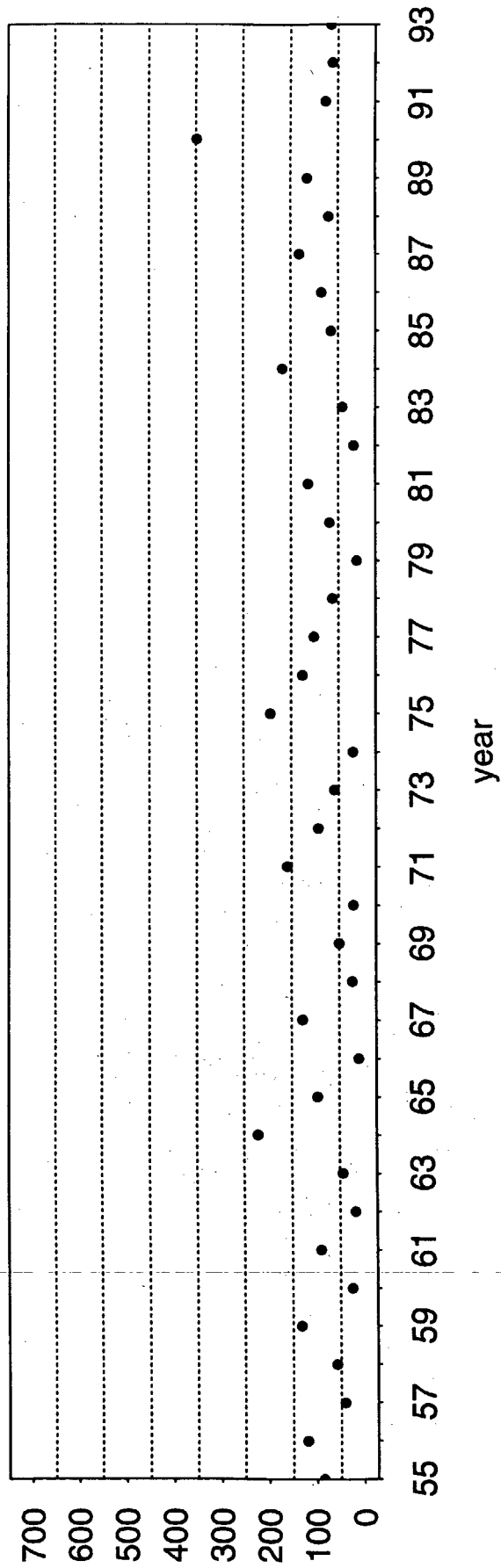
mean waiting hours



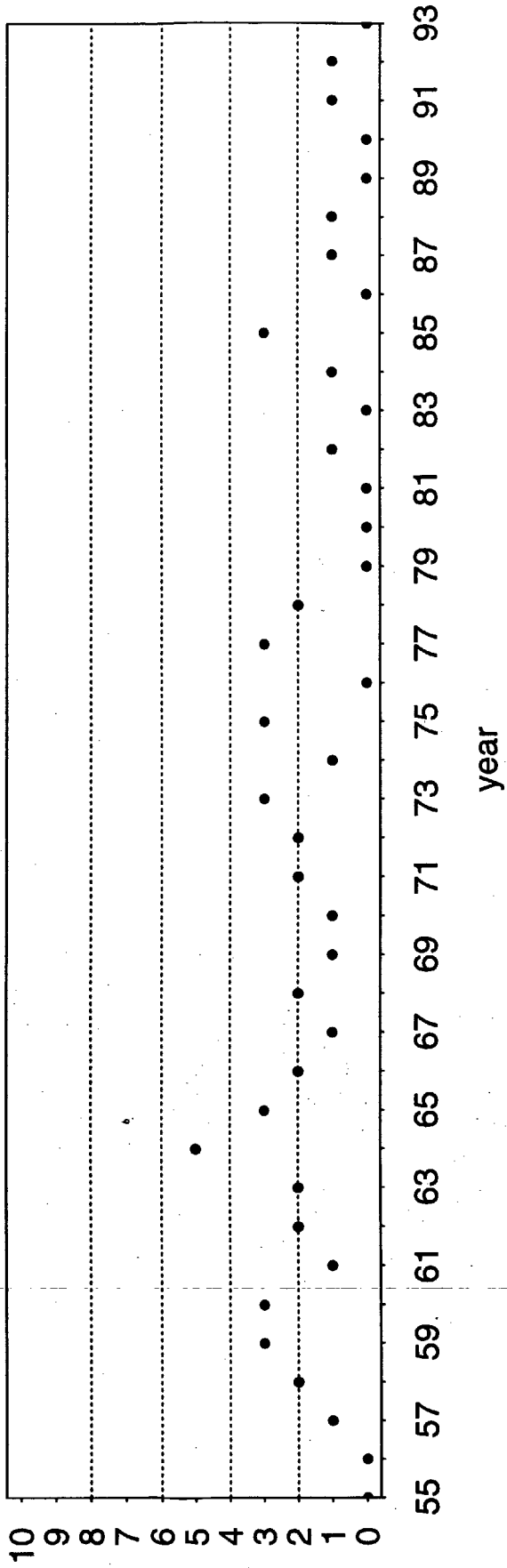
number of cases



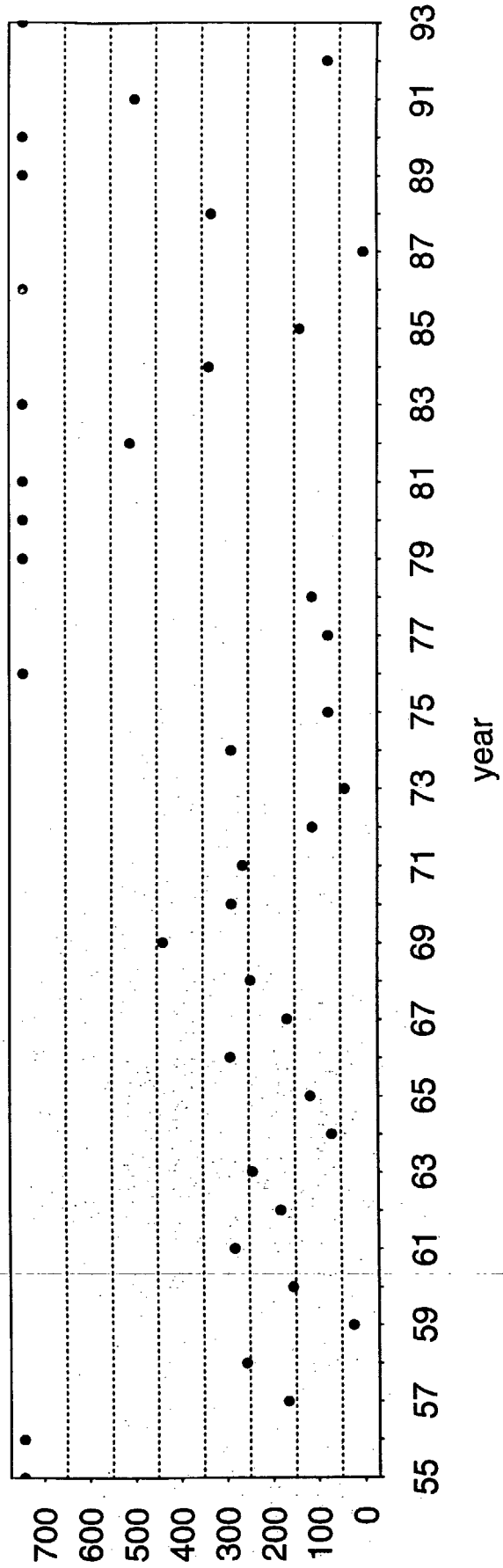
mean waiting hours



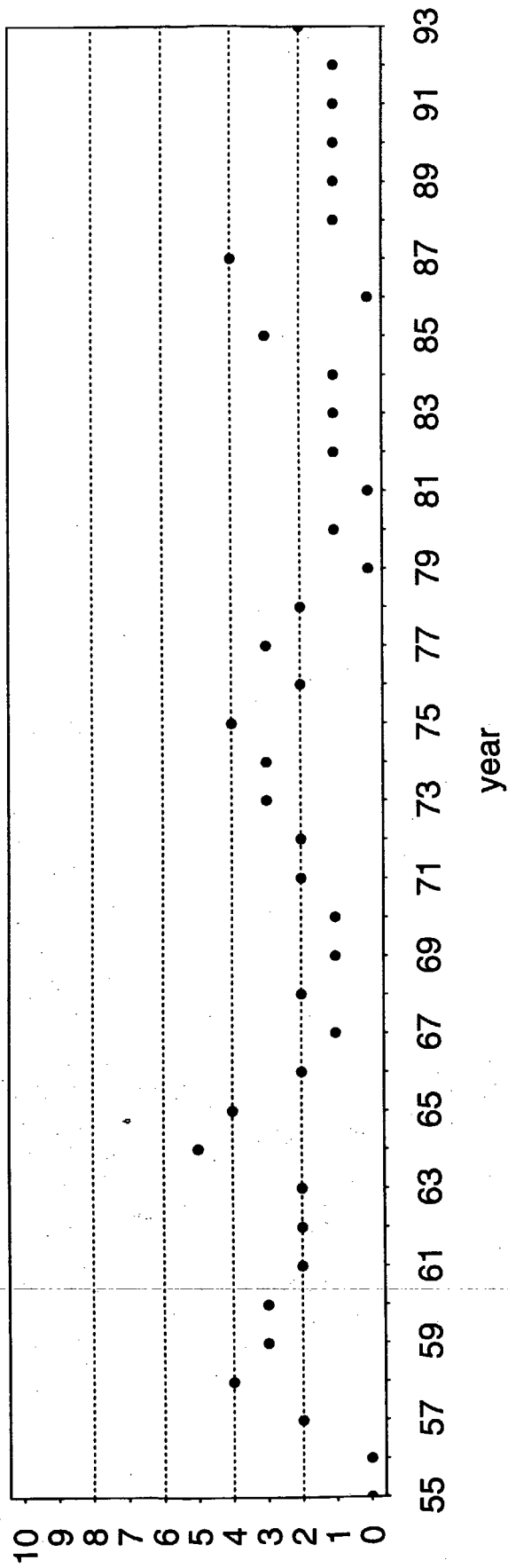
number of cases



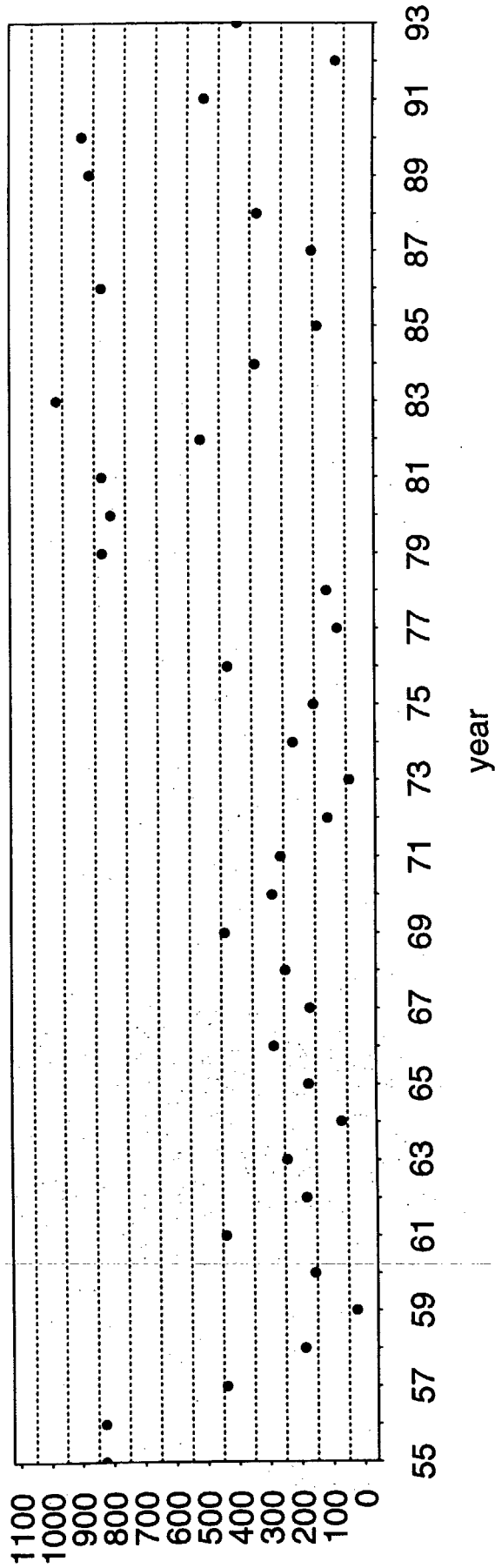
mean waiting hours



number of cases



mean waiting hours



APPENDIX 1

Contingency tables of wave height/period (H_{M0}/TP) for Hindcast point 1411 for the months of April, June, October and November.

FREQUENCY TABLE FOR TOTAL SEA HMO/TP
 HINDCAST DATA POINT : 1411
 POSITION: 58.4 N 1.3 E

APRIL 1955 - 1993

TP(s) HMO m	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	>=14	SUM	MARG. PROB.	CUM. PROB.	MEAN	STDEV.
0.0- 0.9	7	9	33	74	149	39	70	70	53	34	11	21	18	25	6	619	13.23	13.2265	6.43	3.10	
1.0- 1.9				151	309	430	301	208	101	70	50	50	46	80	23	1769	37.80	51.0256	7.56	2.39	
2.0- 2.9					20	238	436	253	161	103	48	48	24	29	15	1327	28.35	79.3803	8.36	1.78	
3.0- 3.9						1	93	165	120	83	46	46	41	22	11	582	12.44	91.8162	9.62	1.76	
4.0- 4.9								28	52	51	38	38	23	16	9	217	4.64	96.4530	10.73	1.65	
5.0- 5.9									10	36	21	21	11	6	3	97	2.07	98.5256	11.31	1.27	
6.0- 6.9										6	16	16	11	11	3	47	1.00	99.5299	12.24	1.18	
7.0- 7.9											3	3	6	1	3	13	0.28	99.8077	12.82	1.09	
8.0- 8.9											2	2	2	1	2	5	0.11	99.9145	13.56	0.95	
9.0- 9.9														2	1	3	0.06	99.9786	13.77	1.24	
10.0-10.9															1	1	0.02	100.0000	14.50	0.00	
11.0-11.9																0	0.00	100.0000			
>=12.0																0	0.00	100.0000			

SUM	7	9	33	74	300	368	739	900	707	478	360	243	192	193	77	4680
MARG. PROB.	0.15	0.19	0.71	1.58	6.41	7.86	15.79	19.23	15.11	10.21	7.69	5.19	4.10	4.12	1.65	
CUM. PROB.	0.15	0.34	1.05	2.63	9.04	16.90	32.69	51.92	67.03	77.24	84.94	90.13	94.23	98.35	100.00	
MEAN	0.00	0.11	0.26	0.50	0.98	1.37	1.69	2.07	2.31	2.65	3.07	3.16	3.21	2.50	3.20	
STDV.	0.00	0.03	0.05	0.08	0.26	0.36	0.53	0.72	0.94	1.12	1.36	1.75	1.90	1.82	2.21	

MEAN HMO = 2.15m MEAN TP = 8.19s
 ST. DEV. HMO = 1.24m ST. DEV. TP = 2.55s
 MAX. HMO = 10.5m, 68 4 4 6, TP = 14.5s
 MAX. TP = 18.3s, 60 4 23 0, HMO = 3.1m

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FREQUENCY TABLE FOR TOTAL SEA HMO/TP
 HINDCAST DATA POINT : 1411
 POSITION: 58.4 N 1.3 E

JUNE 1955 - 1993

TP(s) HMO m	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	>=14	SUM	MARG. PROB.	CUM. PROB.	MEAN	STDEV.
0.0- 0.9	16	24	113	263	276	139	131	55	40	34	24	22	16	33	11	1197	25.58	25.5769	5.37	2.82	
1.0- 1.9					202	431	632	356	207	106	44	26	29	32	7	2072	44.27	69.8504	6.95	1.84	
2.0- 2.9						10	203	362	229	75	39	27	6	7	2	960	20.51	90.3633	7.96	1.37	
3.0- 3.9								77	142	70	26	16	1	9		341	7.29	97.6496	8.92	1.23	
4.0- 4.9								1	9	39	20	9	1			79	1.69	99.3376	9.77	0.84	
5.0- 5.9										5	12	3				20	0.43	99.7650	10.38	0.59	
6.0- 6.9											2	5				7	0.15	99.9145	11.00	0.50	
7.0- 7.9												3	1			4	0.09	100.0000	11.85	0.17	
8.0- 8.9																0	0.00	100.0000			
9.0- 9.9																0	0.00	100.0000			
10.0-10.9																0	0.00	100.0000			
11.0-11.9																0	0.00	100.0000			
>=12.0																0	0.00	100.0000			

SUM	16	24	113	263	478	580	966	851	627	329	167	111	54	81	20	4680
MARG. PROB.	0.34	0.51	2.41	5.62	10.21	12.39	20.64	18.18	13.40	7.03	3.57	2.37	1.15	1.73	0.43	
CUM. PROB.	0.34	0.85	3.27	8.89	19.10	31.50	52.14	70.32	83.72	90.75	94.32	96.69	97.84	99.57	100.00	
MEAN	0.00	0.10	0.26	0.49	0.94	1.22	1.50	1.98	2.23	2.42	2.56	2.57	1.39	1.33	0.99	
STDV.	0.00	0.03	0.05	0.08	0.24	0.39	0.50	0.70	0.91	1.22	1.45	1.81	1.16	0.88	0.60	

MEAN HMO = 1.62m MEAN TP = 6.97s
 ST. DEV. HMO = 0.97m ST. DEV. TP = 2.33s
 MAX. HMO = 7.7m, 60 6 29 12, TP = 12.0s
 MAX. TP = 15.9s, 86 6 15 0, HMO = 0.6m

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FREQUENCY TABLE FOR TOTAL SEA HMO/TP
 HINCAST DATA POINT : 1411
 POSITION: 58.4 N 1.3 E

OCTOBER 1955 - 1993

TP(s)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	>=14	SUM PROB.	MARG. PROB.	CUM. PROB.	MEAN	STDEV.
0.0-0.9	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14		308	6.37	6.3689	6.90	3.66
1.0-1.9	1	2	3	4	5	6	7	8	9	10	11	12	13	14		29	1533	31.70	38.0687	7.70	2.51
2.0-2.9						17	339	455	237	155	114	82	40	62	35	1536	31.76	69.8304	8.57	2.12	
3.0-3.9				44	77	23	3	168	250	127	82	88	53	26	29	826	17.08	86.9107	9.57	1.95	
4.0-4.9			18					65		106	59	48	32	31	22	363	7.51	94.4169	10.62	1.84	
5.0-5.9										25	48	28	19	18	14	152	3.14	97.5600	11.42	1.59	
6.0-6.9											25	15	9	9	7	65	1.34	98.9041	11.82	1.34	
7.0-7.9											1	10	5	6	4	31	0.64	99.5451	12.54	1.11	
8.0-8.9														3	3	11	0.23	99.7726	13.34	1.13	
9.0-9.9															5	5	0.10	99.8759	15.40	1.23	
10.0-10.9															1	5	6	0.12100	0.0000	15.50	1.09
11.0-11.9																0	0	0.00100	0.0000		
>=12.0																0	0	0.00100	0.0000		

SUM	0	3	18	44	184	331	751	843	733	546	408	337	238	238	162	4836
MARG. PROB.	0.00	0.06	0.37	0.91	3.80	6.84	15.53	17.43	15.16	11.29	8.44	6.97	4.92	4.92	3.35	
CUM. PROB.	0.00	0.06	0.43	1.34	5.15	11.99	27.52	44.95	60.11	71.40	79.84	86.81	91.73	96.65	100.00	
MEAN		0.13	0.26	0.50	1.04	1.44	1.88	2.35	2.68	2.95	3.31	3.35	3.28	3.01	3.76	
STDV.		0.06	0.05	0.08	0.26	0.32	0.44	0.68	0.95	1.17	1.50	1.58	1.88	1.85	2.37	

MEAN HMO = 2.53m MEAN TP = 8.70s
 ST.DEV. HMO = 1.35m ST.DEV.TP = 2.61s
 MAX. HMO = 10.7m, 91 10 18 12, TP = 16.1s
 MAX. TP = 19.6s, 85 10 17 6, HMO = 0.4m
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SEQUENCE TABLE FOR TOTAL SEA HMO/TP
 HINDCAST DATA POINT : 1411
 POSITION: 58.4 N 1.3 E

NOVEMBER 1955 - 1993

TP (s)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	>=14	SUM	MARG. PROB.	CUM. PROB.	MEAN	STDEV.	
HMO	1	2	3	4	5	6	7	8	9	10	11	12	13	14								
m																						
0.0-0.9	1	8	28	49	78	153	205	36	10	22	19	16	4	5	3	3	240	5.13	5.1282	6.90	2.95	
1.0-1.9									125	92	60	57	46	93	35	35	1102	23.55	28.6752	8.38	2.83	
2.0-2.9						24	240	430	285	131	130	93	60	60	46	46	1499	32.03	60.7051	8.82	2.24	
3.0-3.9							7	160	328	183	118	97	56	40	36	36	1025	21.90	82.6068	9.62	1.88	
4.0-4.9								3	92	142	93	75	44	27	16	16	492	10.51	93.1197	10.39	1.60	
5.0-5.9									30	67	67	35	23	18	10	10	183	3.91	97.0299	11.22	1.48	
6.0-6.9										22	22	13	12	15	15	15	77	1.65	98.6752	12.40	1.73	
7.0-7.9												5	2	5	8	8	30	0.64	99.3162	13.00	1.12	
8.0-8.9													2	6	9	17	17	0.36	99.6795	13.96	1.16	
9.0-9.9														5	3	8	8	0.17	99.8504	13.78	0.68	
10.0-10.9														2	2	4	4	0.09	99.9359	14.13	0.86	
11.0-11.9															3	3	3	0.06	100.0000	14.47	0.06	
>=12.0																0	0	0.00	100.0000	14.47	0.06	

SUM	0	1	8	28	127	191	488	776	840	600	509	391	259	276	186	4680
MARG. PROB.	0.00	0.02	0.17	0.60	2.71	4.08	10.43	16.58	17.95	12.82	10.88	8.35	5.53	5.90	3.97	
CUM. PROB.	0.00	0.02	0.19	0.79	3.50	7.59	18.01	34.59	52.54	65.36	76.24	84.59	90.13	96.03	100.00	
MEAN	0.10	0.29	0.50	1.07	1.53	1.91	2.39	2.87	3.15	3.41	3.35	3.35	3.51	3.25	3.95	
STDV.	0.00	0.04	0.07	0.27	0.39	0.55	0.68	0.87	1.18	1.44	1.49	1.74	2.07	2.42		

MEAN HMO = 2.80m MEAN TP = 9.17s
 ST.DEV. HMO = 1.40m ST.DEV.TP = 2.52s
 MAX. HMO = 11.7m, 81 11 24 6, TP = 14.5s
 MAX. TP = 18.4s, 64 11 4 18, HMO = 1.4m
 THE NORWEGIAN METEOROLOGICAL INSTITUTE,
 THE ENVIRONMENTAL DATA CENTER, P.O. BOX 43 BLINDERN,
 N 0313 OSLO, NORWAY.

APPENDIX 2

The specification of cases given by Kværner in telefax of 25.8.95 and 1.9.95.

Head Office
Lysaker torg 8
P.O.Box 344
1324 Lysaker, Norway
Tel. +47 67 52 70 00
Telefax +47 67 52 70 10

Hanøytangen Yard
P.O.Box C
N-5310 Hauglandshella, Norway
Tel. +47 56 15 72 00
Telefax +47 56 15 72 10

TELEFAX

Til/To Company
DNMI

Attention
Knut A. Iden

Dato/Date
25.08.95

Til Telefax nr./To no.
22 96 30 50

Fra/From
Jan Skjong

Fra Telefax Nr./From Telefax
67 52 70 10

Vedr./Subject
Wave occurrence investigation for block 15/12

Side/Page
6

Godkj./Approval
M. Østrem / HANØY TANGEN

Prosj.nr./Project No.
570

Tid/Time
15:00

Utg.nr./Outgoing No. **5289**

Sendt av/Sent by *JWH*

Order for : Wave occurrence investigation for block 15/12 on the Norwegian sector:

Based on our fax 22/8-95 no 5277 and your fax dated 23/8-95 ref. 343.2/2018/1995-we want an analysis performed in order to give occurrence of specified wave conditions over the years from 1955-1993.

The wave conditions are given as a significant wave height with 6 hours interval for a total of 72 hours.

Four different wave cases shall be investigated

- Case 1
- Case 2
- Case 3
- Case 4

Idem

METEOROLOGISK INSTITUTT	
Saknr.: <i>2018</i>	Dok.nr.: <i>2</i>
Saksb.: <i>KL</i>	A <i>343.2</i>
Innk.: <i>26/8-95</i>	Eksp.:

Two months shall be considered : June , October.

NB. The definition of the Cases ^{are} included in the text.
G.A.S.

Reporting : Reporting language is English
The results shall be presented as a DNMI report with a short introduction for the basis of the calculations.
The results shall be presented in graphs/tables for June and October

with :

- Number of occurrence from 1955 to 1994.
- Expected waiting before occurrence 1955 to 1994

Lump sum for the work :

- Soft ware preparation kr 5880,-
- 4 Cases kr 8000,-
- Total Lump sum kr 13880,-

Invoice: Kværner Concrete Construction a.s.
Lysaker torg 8
P.O.Box 344
1324 Lysaker, Norway
Project no 570

Delivery of report : Week 35

Before start of the work a kick off meeting is required. Pls contact undersigned for arrangement of meeting at your earliest convinience (28/8 ?). We look forward for the results from analysis.

If any clarification is required please contact under signed on 67 52 70 78.

Best regards



Jan Skjong

KVÆRNER

Kværner Concrete Construction a.s

Head Office
Lysaker torg 8
P.O.Box 344
1324 Lysaker, Norway
Tel. +47 67 52 70 00
Telefax +47 67 52 70 10

Hanøytangen Yard
P.O.Box C
N-5310 Hauglandshella, Norway
Tel. +47 56 15 72 00
Telefax +47 56 15 72 10

TELEFAX

Til/To Company
D N M I

Date/Date
01.09.95

Attention
Knut A. Iden

Til Telefax nr./To no.
22 96 30 50

Fra/From
Jan Skjong

Fra Telefax Nr./From Telefax
67 52 70 10

Vedr./Subject
Værstatistikk for Blokk 15/12

Godkj./Approved


Prosj.nr./Project No.
570

Side/Page
1

Utg.nr./Outgoing No.
5320

Sendt av/Sent by
Jew H

Tid/Time
10:00

Takk for draft rapporten oversendt pr fax 31/8-95.

Den var i henhold til det vi ønsket å opnå ved vår undersøkelse.

Vår eneste kommentar går på å angi i teksten avstanden fra beregningspunktet til block 15/ 12. Vil avstanden være neglisjerbar på resultatet eller være av betydning ?

UTM koordinater på 15/12

Nord 6438063 m
Øst 434553 m

Vi oversender pr. brev originalene til Case 1 , 2 , 3 , 4 for bedre kopier i rapporten.

I tillegg til de dataene som er utregnet ønsker vi å inkludere i den samme analysen resultater for april måned med basis i de casene som er gitt.

Vi ser frem til endelig rapport og takker for arbeidet så langt.

Med vennlig hilsen


Jan Skjong