

VERIFICATION OF METER PERFORMANCE AND WELL ALLOCATION
BY DATA ANALYSIS.

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SUMMARY:

The Statfjord field is now past peak production. Sub-sea tie-in of satellite fields to the Statfjord C platform requires the use of well allocation by test separator for ownership allocation between fields.

The fiscal metering station is for oil transfer from platform storage to shuttle tanker.

The paper will show how, by data acquisition and analysis, the oil to storage flow measurement can be verified to fiscal standard, and well and field allocations can be verified to the standards specified by the Department of Trade and Industry (DTI) and the Norwegian Petroleum Directorate (NPD).

1. INTRODUCTION

Traditional fiscal flow measurement requirements are clearly specified and set stringent requirements for measurement uncertainty. These in turn set stringent requirements with regard to equipment, installation and the product to be measured.

With today's requirements for cheaper, faster, and simpler field developments, with use of existing infrastructure, we rarely have the luxury of a fiscal quality stream to be measured. This is reflected in the emphasis on multi-phase metering at this workshop.

DTI and NPD have also demonstrated their willingness to approve alternative field developments where measurement to fiscal standards is not economically justified by the cost of reducing the measurement uncertainty.

At the 1995 workshop Lewis Philp from the DTI included the following list of typical uncertainties by category in his presentation:

- | | | |
|--------------------------------|--------------|--------------|
| i) Fiscal: | 0.25% oil | 1.0% gas |
| ii) Allocation (continuous) | 0.5-1.0% oil | 2.0-3.0% gas |
| iii) Allocation (intermittent) | 5% oil | 5% gas |

These have been used as a guideline when evaluating performance on Statfjord.

2. THE STATFJORD FIELD DEVELOPMENT

The Statfjord field lies to the north of the Brend field and extends into the UK sector.

The UK share is currently 14.5% pending the results of the final redetermination. The metering system therefore has to meet the requirements of both the NPD and the DTI.

The field development consists of three concrete gravity basis production platforms. Each platform has separate crude oil storage capacity, offshore loading system, and fiscal metering stations for oil and gas export.

Production start was in November 1979 from Statfjord A and the field development was completed in 1985 when Statfjord C came on stream and gas export started. Plateau production rates of 700,000 barrels/day were maintained until 1992 when the Snorre field was tied in to Statfjord A at the end of the year. The current development was completed at the end of 1994 when the Statfjord Nord and Oest satellites were tied into the Statfjord C platform.

The Snorre field extends over two licences with the current split of 70.3/29.7 between the PL089 and PL057 groups.

The Statfjord Oest field also extends over two licences with the current split of 50/50 between PL089/PL037 groups. The Statfjord Nord field lies 100% within the PL037 license which is the norwegian license for the main Statfjord field.

The fiscaly metered export quantities of oil and gas must therefore be allocated between 4 fields, 7 license shares, and 15 participating companies where the majority have participating interests in more than one field.

3. THE METERING SYSTEM

The metering system shown in figure 1 represents the original configuration for all 3 platforms.

- i) Fiscal oil export metering station consisting of 5 turbine meters and a meter prover.
- ii) Oil inventory measurement by DP measurement of the oil/water interface in the storage cells.
- iii) Oil to storage metering by 2 turbine meters.
- iv) Gas export metering station consisting of orifice meters, samplers, and online gas chromatographs. (Statfjord B has an additional gas export metering station for UK gas export.
- v) Gas injection metering.
- vi) Fuel gas metering
(both fuel and injection gas are of export quality).
- vii) Flare gas metering.
- viii) Test seperator measurement of well streams for reservoir management.

The oil to storage meters used for daily production reporting are verified to fiscal standard on a monthly basis by comparing the metered inventory (opening inventory plus oil to storage minus oil export) to the DP measurement of inventory levels at the end of each day. The difference between the two inventory levels is plotted as shown in figure 2.

If the oil to storage meters are consistent with the fiscal meters the difference will fluctuate plus minus zero due to the uncertainty of the DP measurement.

As the output is metered to fiscal standard the slightest systematic variation in the metered input will accumulate as a difference between the two inventory figures.

An end of month adjustment is made to the monthly production figure to correct for the accumulated difference.

As there was no provision for online proving of the oil to storage meters the original procedure was to change out the meters at six month intervals for onshore proving. The meters are now only replaced when they no longer measure correctly.

The uncertainty of the method is +/- 2000 Sm³ which would seem to be high. For a daily production rate of 25000 Sm³ this would represent +/- 8%. However on a monthly basis, at the same production rate, the uncertainty is reduced to +/- 0.27% and the cumulative uncertainty is insignificant.

This means that a non-fiscal standard metering station can be used as the fiscal metering point for field allocation.

4. THE STATFJORD C METERING AND ALLOCATION SYSTEM

The development of the Nord and Oest satellite fields required an additional inlet separator for the satellite fields to provide sufficient processing capacity. Production reaches the platform through 4 flow lines from 4 subsea templates (2 for each field) with 4 well slots on each template. Fully developed each field will have 6 production wells with an additional 4 well template for water injection on each field.

The original metering and allocation concept was for a fiscal standard metering station on the oil and gas streams from the satellite inlet separator with proportional sampling in order to establish the total mass per component of hydrocarbons produced during the month. Proportional sampling was also added to the oil to storage metering station in order to establish the total mass per component of hydrocarbons processed on the platform (the gas composition is already available from the gas export metering station). No additional metering station was added to the oil and gas streams from the original inlet separator to establish the total hydrocarbons produced by the main field. This was calculated as the difference between the total processed hydrocarbons and the total satellite production on a mass per component basis. The C₆+ component oil recovery factor for the platform was then used to allocated this component to oil and gas produced from

each field. Light end components in the processed oil were then allocated to each field in proportion to the C6+ component

Finally the remaining mass per component was allocated as the gas stream for each field.

Allocation between the satellite fields is in proportion to the theoretical production per flowline established via the test separator. When a flowline is routed through the test separator this bypasses the new inlet separator metering station. The mass flow from the test separator therefore has to be added to the total mass from this metering station before the allocation can be made.

The disadvantages of this metering and allocation concept are obvious. No direct metering of oil production from any of the fields. No mass balance over the platform to enable verification of the meters. Dependency on the oil recovery factor being representative for all fields. Allocation by difference for the main field which therefore bears the total measurement and allocation uncertainty (plus or minus).

Some of the reasons for the choice are just as obvious.

First and foremost cost. Multiphase meters on the flowlines were proposed in addition to the new inlet separator metering station in order to allocate production between the satellite fields and reduce the requirement for well testing. The reduction in uncertainty did not justify the cost. A metering station on the original inlet separator was rejected for the same reason.

The allocation based on the new metering station, instead of well allocation for all 3 fields, was chosen because this concept was already approved and in operation for the tie-in of the Snorre field to Statfjord A. There, after two stages of separation and dehydration of the gas, the gas and live crude streams are fiscally measured on the Snorre platform before transfer to Statfjord A. (The oil stream is connected to the existing process trains upstream of the 2nd stage separator for two further stages of commingled separation upstream of the oil to storage meters. The gas stream enters a new gas separator for pressure reduction prior to entering the existing process trains together with the gas from the Statfjord A inlet separators).

For the well allocation alternative there were problems in reaching agreement as to the relative uncertainty of a well allocation where the satellite fields have two wells (flowlines) each and the main field has 22. On the one hand each well from the main field makes a smaller contribution to the overall uncertainty while on the other it is harder to pinpoint changes to individual wells due to increasing GOR or water cut. The shrinkage factor to be applied to the well test measurements in order to find the stock tank production rate was also a significant contributor to the overall uncertainty, and is still the most likely source of systematic error between the satellite fields.

The preliminary daily production figures after start up were based on the well allocation performed on the platform where the metered volume from the satellite metering station, with an average shrinkage factor for the two satellite field reservoirs applied, was used as the basis for calculating the daily production for the Nord and Oest fields while the oil to storage volume less the satellite volume was used for the main field well allocation.

In order to verify the shrinkage factors a comparison was made between the allocated and theoretical volumes.

The results for the first two months were as follows:

	TOTAL		SFC		SAT.		OEST		NORD	
	Diff.	vol.	Diff.	vol.	Diff.	vol.	Diff.	vol.	Diff.	vol.
1	0.46	100	0.49	62	0.42	38	0.19	20	0.69	18
2	0.39	100	0.51	63	0.18	37	0.33	20	-0.01	17
cum2	0.42	100	0.50	62.5	0.30	37.5	0.27	20	0.34	17.5

Where: Diff. = Percentage variation between measured/allocated production.

Vol. = Percentage of total production volume for each stream.

Daily variations of +/- 5% or more between allocated and theoretical production for individual streams were registered. However, this can be expected under well testing, or after a production shut in when wells have to be beamed up to a stable production rate. The above table would however indicate that these variations even out over the monthly allocation period. The results also indicate the following:

- Total theoretical production has less than 0.5% variance from metered total production.
- Theoretical production from the satellites has less than 0.5% variance from metered satellite production (with shrinkage factor).
- No significant difference between the percentage variance for total platform or the individual fields.

- The shrinkage factors used for the individual reservoir fluids are correctly calculated and do not represent a source of systematic error for the allocation.

This may seem a rather small amount of data on which to base such sweeping conclusions, however two months data is the result of 60 daily allocations. For a monthly allocation it takes 5 years to collect a similar amount of data!

The result for months 3 and 4 were as follows:

	TOTAL		SFC		SAT		OEST		NORD	
	Diff.	vol.	Diff.	vol.	Diff.	vol.	Diff.	vol.	Diff.	vol.
3	-1.98	100	-3.17	61	-0.10	39	-0.03	20	-0.17	19
4	-1.62	100	-2.54	61	0.19	39	-0.12	20	0.58	19
Cum2	-1.80	100	-2.85	61	0.03	39	-0.07	20	0.15	19
Cum4	-0.66	100	-1.55	63	0.17	37	0.10	20	0.25	17

At first glance the results would seem to be less promising than the first two months; however the larger difference between theoretical and allocated production is entirely due to water break through in some wells from the main field reservoir. This could be confirmed by the increase in water produced and by subsequent well tests. The variances for the satellite fields remain well within the required tolerances. In month 3 there was also water breakthrough in both of the satellite fields resulting in a difference of -5.61% between metered satellite production (with shrinkage factor) and theoretical satellite production.

When revised rates were applied after well testing the variance was reduced to -0.23%. As this could affect the field allocation between Oest and Nord a reallocation of the first 24 days in the month was carried out using the revised theoretical production rates after water breakthrough. It is the results from the reallocation which are shown in the table.

All other figures in the tables are based on the original data as collected. No effort has been made to improve the results by excluding unrepresentative data.

CONCLUSION:

Based on the result of the first two months one could conclude that a well allocation for all three fields, without an intermediate measurement of the satellite fields, would give a representative field allocation.

Subsequent results have shown that the volume metering of oil and water produced by the satellite fields has enabled us to provide an accurate allocation of the satellite fields despite increasing water production in the main field. Increasing GOR in the main field due to reproduction of injected gas would have also caused problems without the intermediate metering. On the other hand, increasing GOR on the main field, would have a significant effect on the oil recovery factor required for a mass allocation.

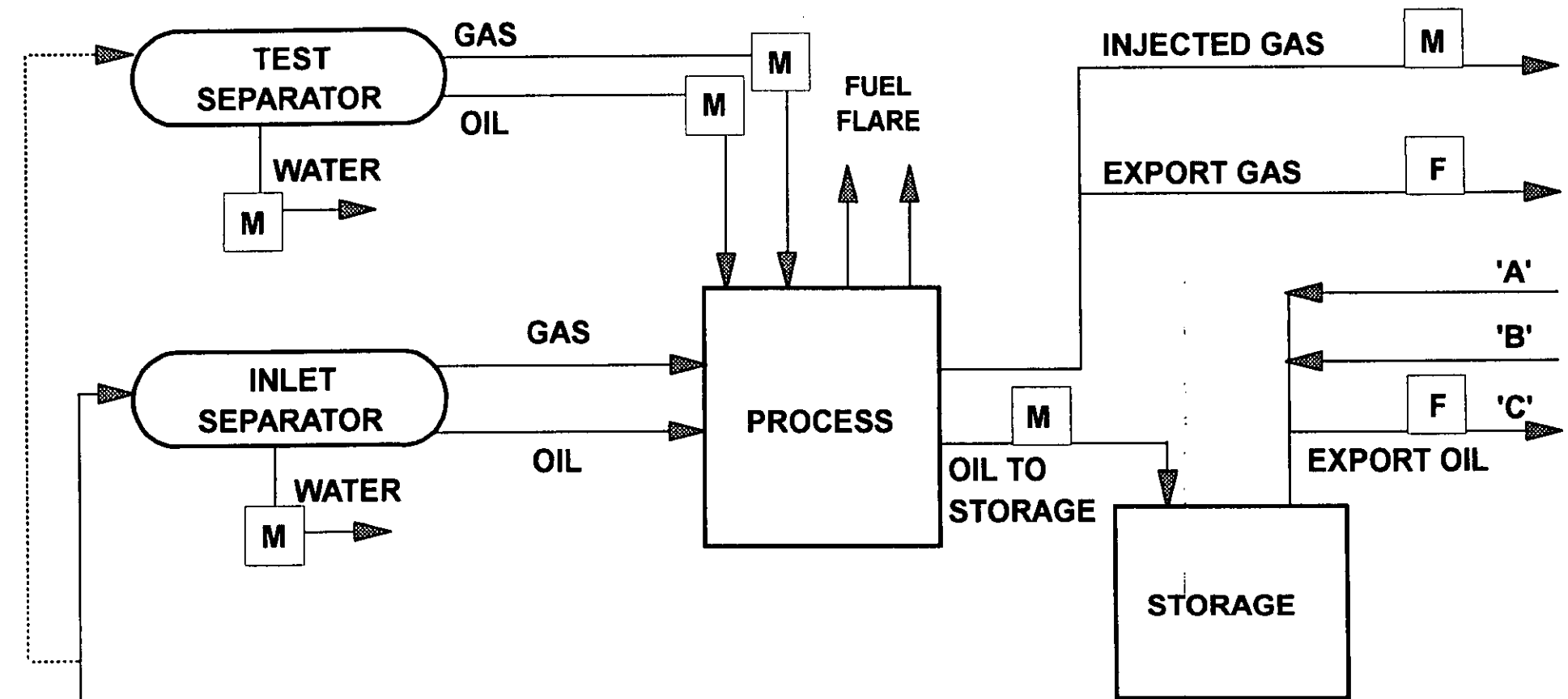
The overall conclusion is therefore:

Well allocation, based on theoretical production rates per flowline, of the Oest and Nord fields using the metered volume (with shrinkage factor) from the satellite metering station provides the most equitable allocation of production between the three fields.

The recommendation to the field owners was therefore to ammend the agreements accordingly to reflect the change from a mass to a volume based allocation for all fields.

STATFJORD PLATFORM

METERING AND SAMPLING

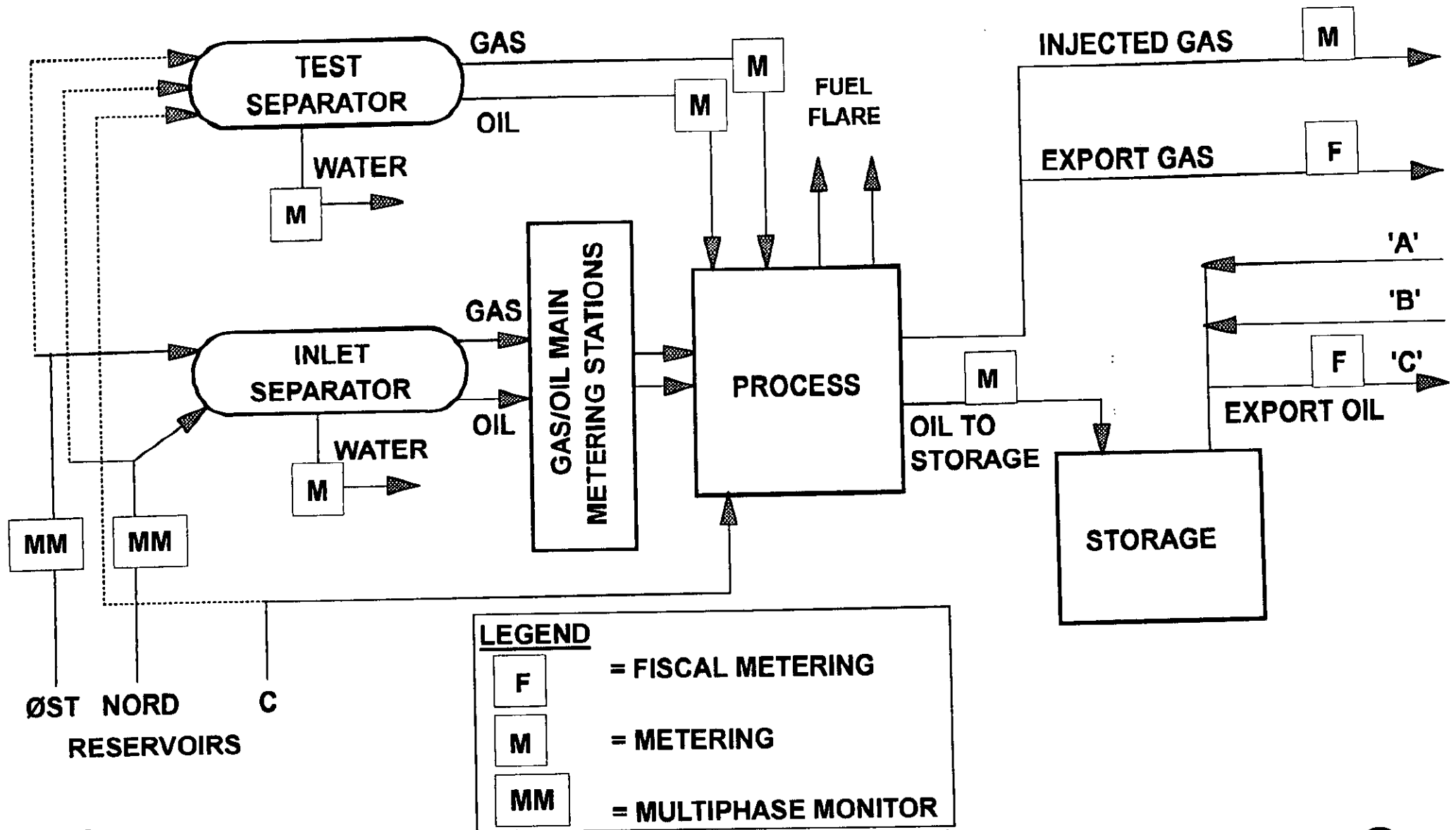


LEGEND

- F** = FISCAL METERING
- M** = METERING

STATFJORD ØST/NORD TIE-IN STATFJORD 'C' PLATFORM

METERING AND SAMPLING



	total				statfjord C				satellites				oest				nord			
	prod.	diff.	diff.%	vol.%	prod.	diff.	diff.%	vol.%	prod.	diff.	diff.%	vol.%	prod.	diff.	diff.%	vol.%	prod.	diff.	diff.%	vol.%
nov.	1459789	6737	0,46	100	904728	4395	0,49	62,0	555048	2342	0,42	38,0	293488	543	0,19	32,4	261560	1799	0,69	17,9
dec.	1579789	6108	0,39	100	1002306	5085	0,51	63,4	577483	1023	0,18	36,6	320761	1085	0,34	32,0	256722	-35	-0,01	16,3
cum. 1	3039578	12845	0,42	100	1907034	9480	0,50	62,7	1132531	3365	0,30	37,3	614249	1628	0,27	32,2	518282	1764	0,34	17,1
jan.	1490001	-29436	-1,98	100	908891	-28853	-3,17	61,0	581110	-583	-0,10	39,0	300517	-93	-0,03	33,1	280593	-490	-0,17	18,8
feb.	1396842	-22602	-1,62	100	926326	-23497	-2,54	66,3	470516	895	0,19	33,7	261505	-317	-0,12	28,2	209011	1212	0,58	15,0
cum. 2	2886843	-52038	-1,80	100	1835217	-52350	-2,85	63,6	1051626	312	0,03	36,4	562022	-410	-0,07	30,6	489604	722	0,15	17,0
cum. 3	5926421	-39193	-0,66	100	3742251	-42870	-1,15	63,1	2184157	3677	0,17	36,9	1176271	1218	0,10	31,4	1007886	2486	0,25	17,0

NOVEMBER 1995					NOVEMBER 1995				
STATFJORD C + SATELLITES					STATFJORD C				
	ALLOK	TEOR	DIFF	DIFF		ALLOK	TEOR	DIFF	DIFF
DAY	SM3	SM3	SM3	%	DAY	SM3	SM3	SM3	%
2	39.490	39.377	113	0,29	2	25.672	25.835	-163	-0,63
3	52.074	52.416	-342	-0,66	3	34.372	33.406	966	2,81
4	49.093	49.267	-174	-0,35	4	31.399	31.308	91	0,29
5	50.804	50.031	773	1,52	5	31.852	30.970	882	2,77
6	51.138	51.458	-320	-0,63	6	29.783	30.175	-392	-1,32
7	51.789	50.762	1.027	1,98	7	30.865	30.275	590	1,91
8	48.840	48.588	252	0,52	8	30.795	30.399	396	1,29
9	50.469	49.917	552	1,09	9	34.303	33.706	597	1,74
10	51.453	51.320	133	0,26	10	32.789	33.009	-220	-0,67
11	50.524	50.496	28	0,06	11	30.819	31.287	-468	-1,52
12	48.263	49.208	-945	-1,96	12	27.590	28.690	-1.100	-3,99
13	52.058	50.771	1.287	2,47	13	33.244	32.419	825	2,48
14	51.211	50.227	984	1,92	14	32.332	31.913	419	1,30
15	52.078	51.391	687	1,32	15	31.611	31.209	402	1,27
16	51.522	51.588	-66	-0,13	16	30.683	31.061	-378	-1,23
17	52.048	51.889	159	0,31	17	31.300	31.364	-64	-0,20
18	51.159	50.821	338	0,66	18	30.461	30.302	159	0,52
19	52.080	52.128	-48	-0,09	19	31.420	31.687	-267	-0,85
20	52.041	52.077	-36	-0,07	20	31.417	31.686	-269	-0,86
21	51.851	51.728	123	0,24	21	31.273	31.401	-128	-0,41
22	47.835	48.537	-702	-1,47	22	33.677	33.462	215	0,64
23	51.175	50.496	679	1,33	23	30.834	30.213	621	2,01
24	52.039	51.550	489	0,94	24	31.787	31.508	279	0,88
25	49.356	50.310	-954	-1,93	25	30.144	30.890	-746	-2,47
26	52.027	51.155	872	1,68	26	33.351	32.438	913	2,74
27	52.017	51.297	720	1,38	27	31.556	31.256	300	0,95
28	42.359	43.596	-1.237	-2,92	28	27.076	27.560	-484	-1,79
29	51.661	50.091	1.570	3,04	29	31.464	30.437	1.027	3,26
30	51.322	50.547	775	1,51	30	30.859	30.467	392	1,27
	1.459.776	1.453.039	6.737	0,46		904.728	900.333	4.395	0,49

NOVEMBER 1995					NOVEMBER 1995					NOVEMBER 1995				
SATELLITES					ØST					NORD				
	ALLOK	TEOR	DIFF	DIFF		ALLOK	TEOR	DIFF	DIFF		ALLOK	TEOR	DIFF	DIFF
DAY	SM3	SM3	SM3	%	DAY	SM3	SM3	SM3	%	DAY	SM3	SM3	SM3	%
2	13.818	13.542	276	2.00	2	10.927	10.751	176	1,61	2	2.891	2.791	100	3,46
3	17.702	19.010	-1.308	-7,39	3	10.825	10.701	124	1,15	3	6.877	8.309	-1.432	-20,82
4	17.694	17.959	-265	-1,50	4	10.685	10.663	22	0,21	4	7.009	7.296	-287	-4,09
5	18.952	19.061	-109	-0,58	5	10.569	11.056	-487	-4,61	5	8.383	8.005	378	4,51
6	21.355	21.283	72	0,34	6	10.585	10.566	19	0,18	6	10.770	10.717	53	0,49
7	20.924	20.487	437	2,09	7	10.667	10.505	162	1,52	7	10.257	9.982	275	2,68
8	18.045	18.189	-144	-0,80	8	7.947	8.322	-375	-4,72	8	10.098	9.867	231	2,29
9	16.166	16.211	-45	-0,28	9	6.540	6.344	196	3,00	9	9.626	9.867	-241	-2,50
10	18.664	18.311	353	1,89	10	8.459	8.444	15	0,18	10	10.205	9.867	338	3,31
11	19.705	19.209	496	2,52	11	9.565	9.342	223	2,33	11	10.140	9.867	273	2,69
12	20.673	20.518	155	0,75	12	10.837	10.658	179	1,65	12	9.836	9.860	-24	-0,24
13	18.814	18.352	462	2,46	13	10.807	10.658	149	1,38	13	8.007	7.694	313	3,91
14	18.879	18.314	565	2,99	14	10.718	10.658	60	0,56	14	8.161	7.656	505	6,19
15	20.467	20.182	285	1,39	15	10.808	10.658	150	1,39	15	9.659	9.524	135	1,40
16	20.839	20.527	312	1,50	16	10.820	10.660	160	1,48	16	10.019	9.867	152	1,52
17	20.748	20.525	223	1,07	17	10.774	10.658	116	1,08	17	9.974	9.867	107	1,07
18	20.698	20.519	179	0,86	18	10.743	10.652	91	0,85	18	9.955	9.867	88	0,88
19	20.660	20.441	219	1,06	19	10.609	10.574	35	0,33	19	10.051	9.867	184	1,83
20	20.624	20.391	233	1,13	20	10.534	10.516	18	0,17	20	10.090	9.875	215	2,13
21	20.578	20.327	251	1,22	21	10.581	10.452	129	1,22	21	9.997	9.875	122	1,22
22	14.158	15.075	-917	-6,48	22	8.023	8.748	-725	-9,04	22	6.135	6.327	-192	-3,13
23	20.341	20.283	58	0,29	23	10.540	10.435	105	1,00	23	9.801	9.848	-47	-0,48
24	20.252	20.042	210	1,04	24	10.463	10.925	-462	-4,42	24	9.789	9.117	672	6,86
25	19.212	19.420	-208	-1,08	25	10.211	10.317	-106	-1,04	25	9.001	9.103	-102	-1,13
26	18.676	18.717	-41	-0,22	26	10.355	10.339	16	0,15	26	8.321	8.378	-57	-0,69
27	20.461	20.041	420	2,05	27	10.642	10.288	354	3,33	27	9.819	9.753	66	0,67
28	15.283	16.036	-753	-4,93	28	8.110	8.597	-487	-6,00	28	7.173	7.439	-266	-3,71
29	20.197	19.654	543	2,69	29	10.516	10.133	383	3,64	29	9.681	9.521	160	1,65
30	20.463	20.080	383	1,87	30	10.628	10.325	303	2,85	30	9.835	9.755	80	0,81
	555.048	552.706	2.342	0,42		293.488	292.945	543	0,19		261.560	259.761	1.799	0,69

DECEMBER 1995					DECEMBER 1995				
STATFJORD C + SATELLITES					STATFJORD C				
	ALLOK	TEOR	DIFF	DIFF		ALLOK	TEOR	DIFF	DIFF
DAY	SM3	SM3	SM3	%	DAY	SM3	SM3	SM3	%
1	38.714	37.297	1.417	3,66	1	18.162	17.235	927	5,10
2	52.114	50.572	1.542	2,96	2	31.461	30.492	969	3,08
3	51.692	50.973	719	1,39	3	31.090	30.861	229	0,74
4	52.187	51.174	1.013	1,94	4	31.639	31.039	600	1,90
5	52.358	51.717	641	1,22	5	31.912	31.602	310	0,97
6	51.914	51.835	79	0,15	6	31.535	31.720	-185	-0,59
7	51.137	50.402	735	1,44	7	30.744	30.279	465	1,51
8	51.880	51.800	80	0,15	8	31.536	31.677	-141	-0,45
9	51.897	51.690	207	0,40	9	31.530	31.572	-42	-0,13
10	51.876	51.774	102	0,20	10	31.587	31.656	-69	-0,22
11	51.980	52.292	-312	-0,60	11	31.923	32.140	-217	-0,68
12	51.550	52.429	-879	-1,71	12	34.310	34.247	63	0,18
13	40.562	40.670	-108	-0,27	13	21.023	20.854	169	0,80
14	48.890	48.332	558	1,14	14	28.698	28.185	513	1,79
15	52.250	52.290	-40	-0,08	15	32.978	32.727	251	0,76
16	52.065	51.932	133	0,26	16	32.939	32.704	235	0,71
17	52.068	52.149	-81	-0,16	17	31.815	31.800	15	0,05
18	52.275	52.369	-94	-0,18	18	32.758	32.795	-37	-0,11
19	52.647	52.516	131	0,25	19	36.281	35.326	955	2,63
20	51.658	50.901	757	1,47	20	35.413	34.817	596	1,68
21	52.748	51.953	795	1,51	21	36.517	35.872	645	1,77
22	52.159	51.666	493	0,95	22	35.946	35.592	354	0,98
23	50.823	49.567	1.256	2,47	23	34.629	33.493	1.136	3,28
24	51.609	51.505	104	0,20	24	35.436	35.424	12	0,03
25	52.597	52.647	-50	-0,10	25	36.428	36.563	-135	-0,37
26	52.252	52.002	250	0,48	26	36.095	35.905	190	0,53
27	50.841	51.904	-1.063	-2,09	27	35.464	35.990	-526	-1,48
28	51.216	52.061	-845	-1,65	28	33.795	34.465	-670	-1,98
29	50.316	51.592	-1.276	-2,54	29	32.998	33.996	-998	-3,02
30	51.311	51.267	44	0,09	30	34.086	33.882	204	0,60
31	52.203	52.403	-200	-0,38	31	31.578	32.311	-733	-2,32
	1.579.789	1.573.681	6.108	0,39		1.002.306	997.221	5.085	0,51

DECEMBER 1995					DECEMBER 1995					DECEMBER 1995				
SATELLITES					ØST					NORD				
DAY	ALLOK	TEOR	DIFF	DIFF	DAY	ALLOK	TEOR	DIFF	DIFF	DAY	ALLOK	TEOR	DIFF	DIFF
	SM3	SM3	SM3	%		SM3	SM3	SM3	%		SM3	SM3	SM3	%
1	20.552	20.062	490	2,38	1	10.619	10.325	294	2,77	1	9.933	9.737	196	1,97
2	20.653	20.080	573	2,77	2	10.619	10.325	294	2,77	2	10.034	9.755	279	2,78
3	20.602	20.112	490	2,38	3	10.577	10.325	252	2,38	3	10.025	9.787	238	2,37
4	20.548	20.135	413	2,01	4	10.537	10.325	212	2,01	4	10.011	9.810	201	2,01
5	20.446	20.115	331	1,62	5	10.495	10.325	170	1,62	5	9.951	9.790	161	1,62
6	20.379	20.115	264	1,30	6	10.461	10.325	136	1,30	6	9.918	9.790	128	1,29
7	20.393	20.123	270	1,32	7	10.464	10.325	139	1,33	7	9.929	9.798	131	1,32
8	20.344	20.123	221	1,09	8	10.438	10.325	113	1,08	8	9.906	9.798	108	1,09
9	20.367	20.118	249	1,22	9	10.455	10.328	127	1,21	9	9.912	9.790	122	1,23
10	20.289	20.118	171	0,84	10	10.416	10.328	88	0,84	10	9.873	9.790	83	0,84
11	20.057	20.152	-95	-0,47	11	10.381	10.354	27	0,26	11	9.676	9.798	-122	-1,26
12	17.240	18.182	-942	-5,46	12	7.801	8.384	-583	-7,47	12	9.439	9.798	-359	-3,80
13	19.539	19.816	-277	-1,42	13	9.886	10.026	-140	-1,42	13	9.653	9.790	-137	-1,42
14	20.192	20.147	45	0,22	14	10.361	10.349	12	0,12	14	9.831	9.798	33	0,34
15	19.272	19.563	-291	-1,51	15	9.410	9.773	-363	-3,86	15	9.862	9.790	72	0,73
16	19.126	19.228	-102	-0,53	16	9.292	9.430	-138	-1,49	16	9.834	9.798	36	0,37
17	20.253	20.349	-96	-0,47	17	10.619	10.559	60	0,57	17	9.634	9.790	-156	-1,62
18	19.517	19.574	-57	-0,29	18	10.676	10.543	133	1,25	18	8.841	9.031	-190	-2,15
19	16.366	17.190	-824	-5,03	19	10.654	10.543	111	1,04	19	5.712	6.647	-935	-16,37
20	16.245	16.084	161	0,99	20	10.648	10.543	105	0,99	20	5.597	5.541	56	1,00
21	16.231	16.081	150	0,92	21	10.638	10.540	98	0,92	21	5.593	5.541	52	0,93
22	16.213	16.074	139	0,86	22	10.631	10.540	91	0,86	22	5.582	5.534	48	0,86
23	16.194	16.074	120	0,74	23	10.619	10.540	79	0,74	23	5.575	5.534	41	0,74
24	16.173	16.081	92	0,57	24	10.600	10.540	60	0,57	24	5.573	5.541	32	0,57
25	16.169	16.084	85	0,53	25	10.599	10.543	56	0,53	25	5.570	5.541	29	0,52
26	16.157	16.097	60	0,37	26	10.590	10.540	50	0,47	26	5.567	5.557	10	0,18
27	15.377	15.914	-537	-3,49	27	10.302	10.540	-238	-2,31	27	5.075	5.374	-299	-5,89
28	17.421	17.596	-175	-1,00	28	10.582	10.540	42	0,40	28	6.839	7.056	-217	-3,17
29	17.318	17.596	-278	-1,61	29	10.374	10.540	-166	-1,60	29	6.944	7.056	-112	-1,61
30	17.225	17.385	-160	-0,93	30	10.432	10.540	-108	-1,04	30	6.793	6.845	-52	-0,77
31	20.625	20.092	533	2,58	31	10.585	10.540	45	0,43	31	10.040	9.552	488	4,86
	577.483	576.460	1.023	0,18		320.761	319.703	1.058	0,33		256.722	256.757	-35	-0,01

JANUARY 1996 REVISED					JANUARY 1996 REVISED				
STATFJORD C + SATELLITES					STATFJORD C				
	ALLOK	TEOR	DIFF	DIFF		ALLOK	TEOR	DIFF	DIFF
DAY	SM3	SM3	SM3	%	DAY	SM3	SM3	SM3	%
1	51.607	51.612	-5	-0,01	1	32.867	33.786	-919	-2,80
2	51.308	51.195	113	0,22	2	33.718	34.332	-614	-1,82
3	49.603	50.519	-916	-1,85	3	28.775	30.413	-1.638	-5,69
4	51.116	52.322	-1.206	-2,36	4	31.583	32.535	-952	-3,01
5	52.675	51.904	771	1,46	5	34.609	34.038	571	1,65
6	32.750	31.716	1.034	3,16	6	15.956	14.276	1.080	7,03
7	21.352	22.672	-1.320	-6,18	7	7.894	8.702	-808	-10,24
8	47.985	46.427	1.558	3,25	8	29.591	28.152	1.439	4,86
9	52.175	51.723	452	0,87	9	33.711	33.448	263	0,78
10	51.034	50.991	43	0,08	10	32.799	32.716	83	0,25
11	47.201	47.165	36	0,08	11	29.016	28.890	126	0,43
12	52.514	51.657	857	1,63	12	34.334	33.385	949	2,76
13	52.405	51.355	1.050	2,00	13	34.205	33.061	1.144	3,34
14	47.165	49.668	-2.503	-5,31	14	29.848	32.342	-2.494	-8,36
15	45.831	51.293	-5.462	-11,92	15	25.269	30.987	-5.718	-22,63
16	49.794	52.187	-2.393	-4,81	16	29.236	31.809	-2.573	-8,80
17	51.956	52.204	-248	-0,48	17	31.467	31.828	-361	-1,15
18	51.621	52.320	-699	-1,35	18	31.188	31.945	-757	-2,43
19	51.691	52.573	-882	-1,71	19	31.289	32.196	-907	-2,90
20	52.472	53.719	-1.247	-2,38	20	32.108	33.344	-1.236	-3,85
21	52.518	54.313	-1.795	-3,42	21	32.243	33.938	-1.695	-5,26
22	44.253	45.663	-1.410	-3,19	22	24.040	25.288	-1.248	-5,19
23	52.368	53.843	-1.475	-2,82	23	32.191	33.471	-1.280	-3,98
24	51.656	54.181	-2.525	-4,89	24	31.509	33.840	-2.331	-7,40
25	51.784	54.153	-2.369	-4,57	25	31.892	34.216	-2.324	-7,29
26	50.675	52.733	-2.058	-4,06	26	30.828	32.796	-1.968	-6,38
27	51.944	52.341	-397	-0,76	27	32.144	32.404	-260	-0,81
28	52.043	52.898	-855	-1,64	28	32.295	32.961	-666	-2,06
29	52.038	52.792	-754	-1,45	29	32.288	33.078	-790	-2,45
30	50.597	52.404	-1.807	-3,57	30	30.889	32.467	-1.578	-5,11
31	15.870	18.894	-3.024	-19,05	31	9.709	11.100	-1.391	-14,33
	1.490.001	1.519.437	-29.436	-1,98		908.891	937.744	-28.853	-3,17

JANUARY 1996 REVISED					JANUARY 1996 REVISED					JANUARY 1996 REVISED				
SATELLITES					ØST					NORD				
DAY	ALLOK SM3	TEOR SM3	DIFF SM3	DIFF %	DAY	ALLOK SM3	TEOR SM3	DIFF SM3	DIFF %	DAY	ALLOK SM3	TEOR SM3	DIFF SM3	DIFF %
1	18.740	17.826	914	4,88	1	10.502	9.991	511	4,87	1	8.238	7.835	403	4,89
2	17.590	16.863	727	4,13	2	10.419	9.991	428	4,11	2	7.171	6.872	299	4,17
3	20.828	20.106	722	3,47	3	10.348	9.991	357	3,45	3	10.480	10.115	365	3,48
4	19.533	19.787	-254	-1,30	4	9.861	9.991	-130	-1,32	4	9.672	9.796	-124	-1,28
5	18.066	17.866	200	1,11	5	10.102	9.991	111	1,10	5	7.964	7.875	89	1,12
6	17.394	17.440	-46	-0,26	6	9.555	9.582	-27	-0,28	6	7.839	7.858	-19	-0,24
7	13.458	13.970	-512	-3,80	7	7.698	7.992	-294	-3,82	7	5.760	5.978	-218	-3,78
8	18.394	18.275	119	0,65	8	10.052	9.988	64	0,64	8	8.342	8.287	55	0,66
9	18.464	18.275	189	1,02	9	10.090	9.988	102	1,01	9	8.374	8.287	87	1,04
10	18.235	18.275	-40	-0,22	10	9.966	9.988	-22	-0,22	10	8.269	8.287	-18	-0,22
11	18.185	18.275	-90	-0,49	11	9.937	9.988	-51	-0,51	11	8.248	8.287	-39	-0,47
12	18.180	18.272	-92	-0,51	12	9.947	9.998	-51	-0,51	12	8.233	8.274	-41	-0,50
13	18.200	18.294	-94	-0,52	13	9.955	10.007	-52	-0,52	13	8.245	8.287	-42	-0,51
14	17.317	17.326	-9	-0,05	14	10.000	10.007	-7	-0,07	14	7.317	7.319	-2	-0,03
15	20.562	20.306	256	1,25	15	10.132	10.007	125	1,23	15	10.430	10.299	131	1,26
16	20.558	20.378	180	0,88	16	10.094	10.007	87	0,86	16	10.464	10.371	93	0,89
17	20.489	20.376	113	0,55	17	10.059	10.005	54	0,54	17	10.430	10.371	59	0,57
18	20.433	20.375	58	0,28	18	10.031	10.004	27	0,27	18	10.402	10.371	31	0,30
19	20.402	20.377	25	0,12	19	10.015	10.004	11	0,11	19	10.387	10.373	14	0,13
20	20.364	20.375	-11	-0,05	20	9.997	10.004	-7	-0,07	20	10.367	10.371	-4	-0,04
21	20.275	20.375	-100	-0,49	21	9.953	10.004	-51	-0,51	21	10.322	10.371	-49	-0,47
22	20.213	20.375	-162	-0,80	22	9.923	10.004	-81	-0,82	22	10.290	10.371	-81	-0,79
23	20.177	20.372	-195	-0,97	23	9.903	10.001	-98	-0,99	23	10.274	10.371	-97	-0,94
24	20.147	20.341	-194	-0,96	24	9.903	10.000	-97	-0,98	24	10.244	10.341	-97	-0,95
25	19.892	19.937	-45	-0,23	25	9.971	10.000	-29	-0,29	25	9.921	9.937	-16	-0,16
26	19.847	19.937	-90	-0,45	26	9.955	10.000	-45	-0,45	26	9.892	9.937	-45	-0,45
27	19.800	19.937	-137	-0,69	27	9.931	10.000	-69	-0,69	27	9.869	9.937	-68	-0,69
28	19.748	19.937	-189	-0,96	28	9.905	10.000	-95	-0,96	28	9.843	9.937	-94	-0,95
29	19.750	19.714	36	0,18	29	9.820	9.777	43	0,44	29	9.930	9.937	-7	-0,07
30	19.708	19.937	-229	-1,16	30	9.885	10.000	-115	-1,16	30	9.823	9.937	-114	-1,16
31	6.161	7.794	-1.633	-26,51	31	2.608	3.300	-692	-26,53	31	3.553	4.494	-941	-26,48
	581.110	581.693	-583	-0,10		300.517	300.610	-93	-0,03		280.593	281.083	-490	-0,17

FEBRUARY 1996					FEBRUARY 1996				
STATFJORD C + SATELLITES					STATFJORD C				
DAY	ALLOK SM3	TEOR SM3	DIFF SM3	DIFF %	DAY	ALLOK SM3	TEOR SM3	DIFF SM3	DIFF %
1	2.070	1.968	102	4,93	1	2.070	1.968	102	4,93
2	40.566	41.141	-575	-1,42	2	35.541	35.374	167	0,47
3	50.667	50.505	162	0,32	3	30.793	31.805	-1.012	-3,29
4	51.808	50.640	1.168	2,25	4	32.044	31.458	586	1,83
5	49.671	50.669	-998	-2,01	5	31.867	32.870	-1.003	-3,15
6	51.966	52.075	-109	-0,21	6	34.297	34.305	-8	-0,02
7	50.413	51.373	-960	-1,90	7	32.815	33.603	-788	-2,40
8	51.576	51.808	-232	-0,45	8	34.001	34.038	-37	-0,11
9	51.201	51.776	-575	-1,12	9	34.416	35.209	-793	-2,30
10	51.547	51.727	-180	-0,35	10	34.047	34.410	-363	-1,07
11	50.820	51.745	-925	-1,82	11	32.503	33.910	-1.407	-4,33
12	49.161	50.857	-1.696	-3,45	12	29.873	31.800	-1.927	-6,45
13	50.080	52.796	-2.716	-5,42	13	30.906	33.766	-2.860	-9,25
14	52.901	53.175	-274	-0,52	14	33.698	34.140	-442	-1,31
15	51.683	53.042	-1.359	-2,63	15	34.240	35.094	-854	-2,49
16	50.481	51.096	-615	-1,22	16	34.441	35.249	-808	-2,35
17	39.844	39.888	-44	-0,11	17	23.750	24.025	-275	-1,16
18	49.934	51.106	-1.172	-2,35	18	33.570	34.646	-1.076	-3,21
19	50.805	51.952	-1.147	-2,26	19	34.568	35.637	-1.069	-3,09
20	50.571	51.983	-1.412	-2,79	20	34.356	35.673	-1.317	-3,83
21	50.747	51.900	-1.153	-2,27	21	34.493	35.709	-1.216	-3,53
22	49.168	53.247	-4.079	-8,30	22	32.828	36.862	-4.034	-12,29
23	49.915	51.366	-1.451	-2,91	23	33.608	34.981	-1.373	-4,09
24	51.893	50.814	1.079	2,08	24	35.598	34.429	1.169	3,28
25	50.122	49.890	232	0,46	25	33.848	33.505	343	1,01
26	51.069	51.019	50	0,10	26	34.790	34.632	158	0,45
27	50.851	50.836	15	0,03	27	34.571	34.449	122	0,35
28	49.434	49.122	312	0,63	28	33.166	32.735	431	1,30
29	49.878	49.928	-50	-0,10	29	33.628	33.541	87	0,26
	-4.000					-4.000			
	1.396.842	1.419.444	-22.602	-1,62		926.326	949.823	-23.497	-2,54

FEBRUARY 1996					FEBRUARY 1996					FEBRUARY 1996				
SATELLITES					ØST					NORD				
ALLOK	TEOR	DIFF	DIFF		ALLOK	TEOR	DIFF	DIFF		ALLOK	TEOR	DIFF	DIFF	
DAY	SM3	SM3	SM3	%	DAY	SM3	SM3	SM3	%	DAY	SM3	SM3	SM3	%
1	0	0	0	#DIV/0!	1	0	0	0	#DIV/0!	1	0	0	0	#DIV/0!
2	5.025	5.767	-742	-14,77	2	2.803	3.600	-797	-28,43	2	2.222	2.167	55	2,48
3	19.874	18.700	1.174	5,91	3	10.274	9.841	433	4,21	3	9.600	8.859	741	7,72
4	19.764	19.182	582	2,94	4	9.813	9.524	289	2,95	4	9.951	9.658	293	2,94
5	17.804	17.799	5	0,03	5	9.527	9.524	3	0,03	5	8.277	8.275	2	0,02
6	17.669	17.770	-101	-0,57	6	9.470	9.524	-54	-0,57	6	8.199	8.246	-47	-0,57
7	17.598	17.770	-172	-0,98	7	9.431	9.524	-93	-0,99	7	8.167	8.246	-79	-0,97
8	17.575	17.770	-195	-1,11	8	9.420	9.524	-104	-1,10	8	8.155	8.246	-91	-1,12
9	16.785	16.567	218	1,30	9	9.649	9.524	125	1,30	9	7.136	7.043	93	1,30
10	17.500	17.317	183	1,05	10	9.625	9.524	101	1,05	10	7.875	7.793	82	1,04
11	18.317	17.835	482	2,63	11	9.781	9.524	257	2,63	11	8.536	8.311	225	2,64
12	19.288	19.057	231	1,20	12	9.529	9.415	114	1,20	12	9.759	9.642	117	1,20
13	19.174	19.030	144	0,75	13	9.455	9.384	71	0,75	13	9.719	9.646	73	0,75
14	19.203	19.035	168	0,87	14	9.448	9.366	82	0,87	14	9.755	9.669	86	0,88
15	17.443	17.948	-505	-2,90	15	9.097	9.360	-263	-2,89	15	8.346	8.588	-242	-2,90
16	16.040	15.847	193	1,20	16	9.460	9.360	100	1,06	16	6.580	6.487	93	1,41
17	16.094	15.863	231	1,44	17	9.371	9.360	11	0,12	17	6.723	6.503	220	3,27
18	16.364	16.460	-96	-0,59	18	9.886	9.957	-71	-0,72	18	6.478	6.503	-25	-0,39
19	16.237	16.315	-78	-0,48	19	9.767	9.812	-45	-0,46	19	6.470	6.503	-33	-0,51
20	16.215	16.310	-95	-0,59	20	9.754	9.811	-57	-0,58	20	6.461	6.499	-38	-0,59
21	16.254	16.191	63	0,39	21	9.636	9.596	40	0,42	21	6.618	6.595	23	0,35
22	16.340	16.385	-45	-0,28	22	9.569	9.596	-27	-0,28	22	6.771	6.789	-18	-0,27
23	16.307	16.385	-78	-0,48	23	9.553	9.596	-43	-0,45	23	6.754	6.789	-35	-0,52
24	16.295	16.385	-90	-0,55	24	9.544	9.596	-52	-0,54	24	6.751	6.789	-38	-0,56
25	16.274	16.385	-111	-0,68	25	9.534	9.596	-62	-0,65	25	6.740	6.789	-49	-0,73
26	16.279	16.387	-108	-0,66	26	9.533	9.596	-63	-0,66	26	6.746	6.791	-45	-0,67
27	16.280	16.387	-107	-0,66	27	9.533	9.596	-63	-0,66	27	6.747	6.791	-44	-0,65
28	16.268	16.387	-119	-0,73	28	9.526	9.596	-70	-0,73	28	6.742	6.791	-49	-0,73
29	16.250	16.387	-137	-0,84	29	9.517	9.596	-79	-0,83	29	6.733	6.791	-58	-0,86
	470.516	469.621	895	0,19		261.505	261.822	-317	-0,12		209.011	207.799	1.212	0,58

References

[1] Paper presented at the North Sea Flow Measurement Workshop, a workshop arranged by NFOGM & TUV-NEL

Note that this reference was not part of the original paper, but has been added subsequently to make the paper searchable in Google Scholar.