



PL-054 Technical Subcommittee Members

Denne rapport
tilhører



UND DOK.SENTER

L.NR. 12381140081

KODE Well 31/2-5 nr 54

Returneres etter bruk

Your Ref:

Our Ref:

EPV/am

Dear Sirs,

NOTE ON 31/2-5 OIL ZONE TEST

As promised at the Technical Committee meeting on 10th March,
we submit a note on the above subject prepared by our reservoir
engineering department.

Yours faithfully
A/S NORSKE SHELL

D. Provan
J.V. Liaison

Enclosure

NOTE ON 31/2-5 OIL ZONE TEST

In the initial 31/2-2 model test match exercise an error has been detected in the input of layer thicknesses in the water zone. This caused the tight zone to become too close to the OWC. Having corrected this, other restrictions to flow below the OWC had to be found in order to achieve a match. Cores recovered from this interval bled oil and the logs indicate the presence of a 15 - 25% residual oil saturation in the upper 15 metres of the water leg. Only with the acceptance of a reduction in relative permeability to water due to the presence of this oil saturation was a match obtained.

The same type of residual oil saturation below the OWC is also present in well 31/2-5. Inclusion of this phenomenon in the well model results in a reduced water cut development in practical test periods. (See Figs. 1 & 2).

Expanding the perforations upwards by 3 metres (8 metres in total) does not have the desired effect of significantly increasing the GOR within the time frame of a test. Figs. 3 and 4 show the effects when the residual oil below the OWC is respectively included and excluded. The modest GOR increase is explained by the increased kh of the perforated interval and the reduced drawdown that results at expected rates i.e. 5000 B/D. Hence to have a marked effect, higher rates, that may not be realized, will be required to restore drawdown and hence propensity to cone gas.

In spite of the simulation results not being overly sensitive to perforation interval we consider that:

- a) lowering the base of the perforations may, in case of the model being optimistic, result in rapid development of high water cut.
- b) lifting the upper perforated level may in case of optimism in the model promote rapid uncontrollable GOR increase.

Further it is believed that the development of a water cut will provide the most sensitive overall test of the model and its uncertainties. Any development of increase in GOR must be accurately monitored in order to be used for model calibration.

We are therefore considering testing the 31/2-5 oil zone in two stages in a mechanically similar fashion to 31/2-2, firstly without gas lift and secondly introducing gas lift if productivity suggests that this is desirable. This procedure is now being compared with our earlier suggestion of a simultaneous gravel pack of both zones and our conclusion will be formalized in the final well test programme.

The operator believes that the optimum single test of the oil zone in well 31/2-5 that will permit calibration of the simulation model will be realized by the perforation of the interval 1589 - 95 m BDF.

WELL 31/2-5

COMPLETION 5M ABOVE OWC
RESIDUAL OIL BELOW OWC INCLUDED
PERFORMANCE AT VARIOUS RATE LEVELS

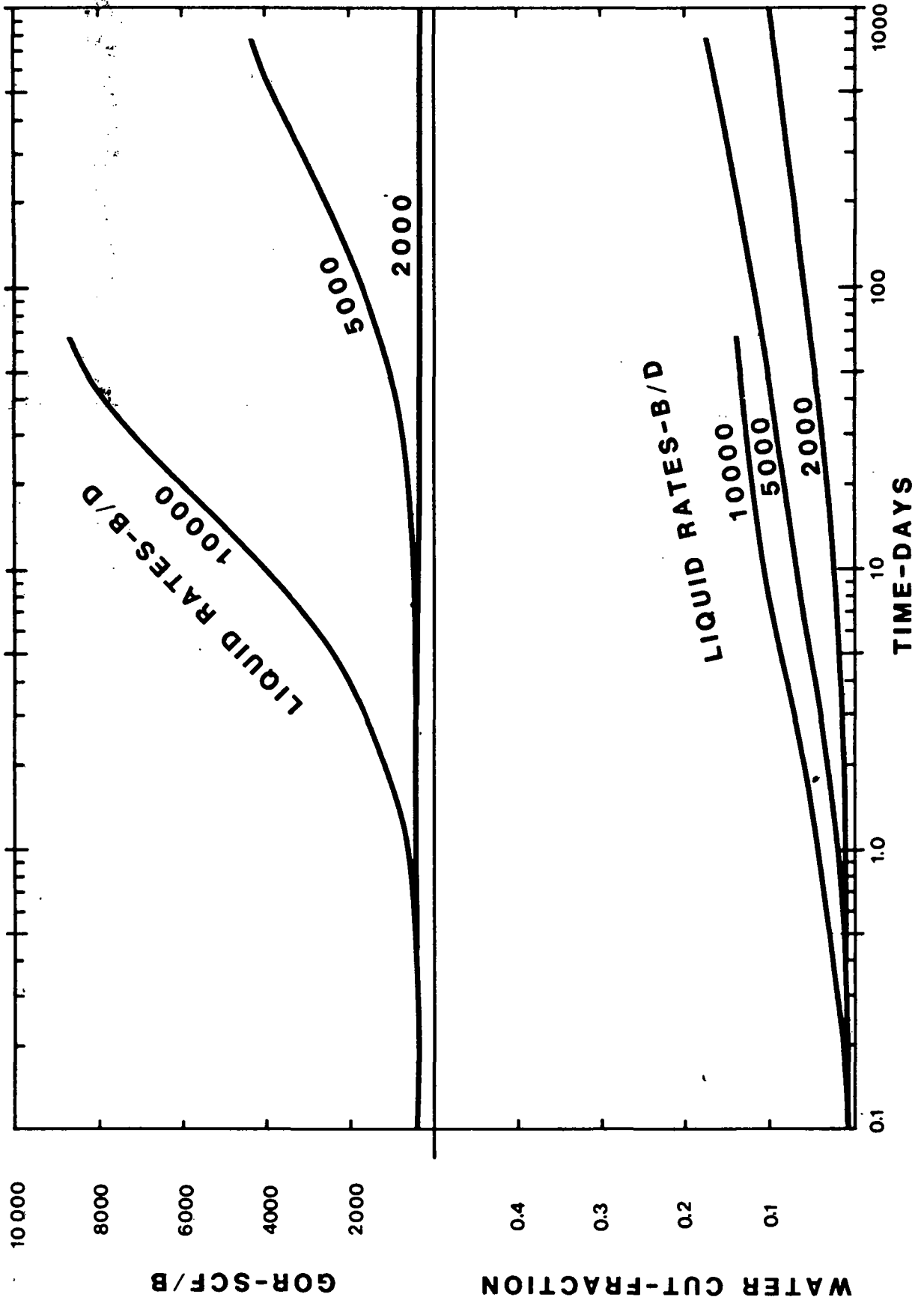


Fig. 1

WELL 31/2-5
 COMPLETION 5M ABOVE OWC
 EFFECT OF RESIDUAL OIL BELOW OWC
 5000 B/D LIQUID RATE

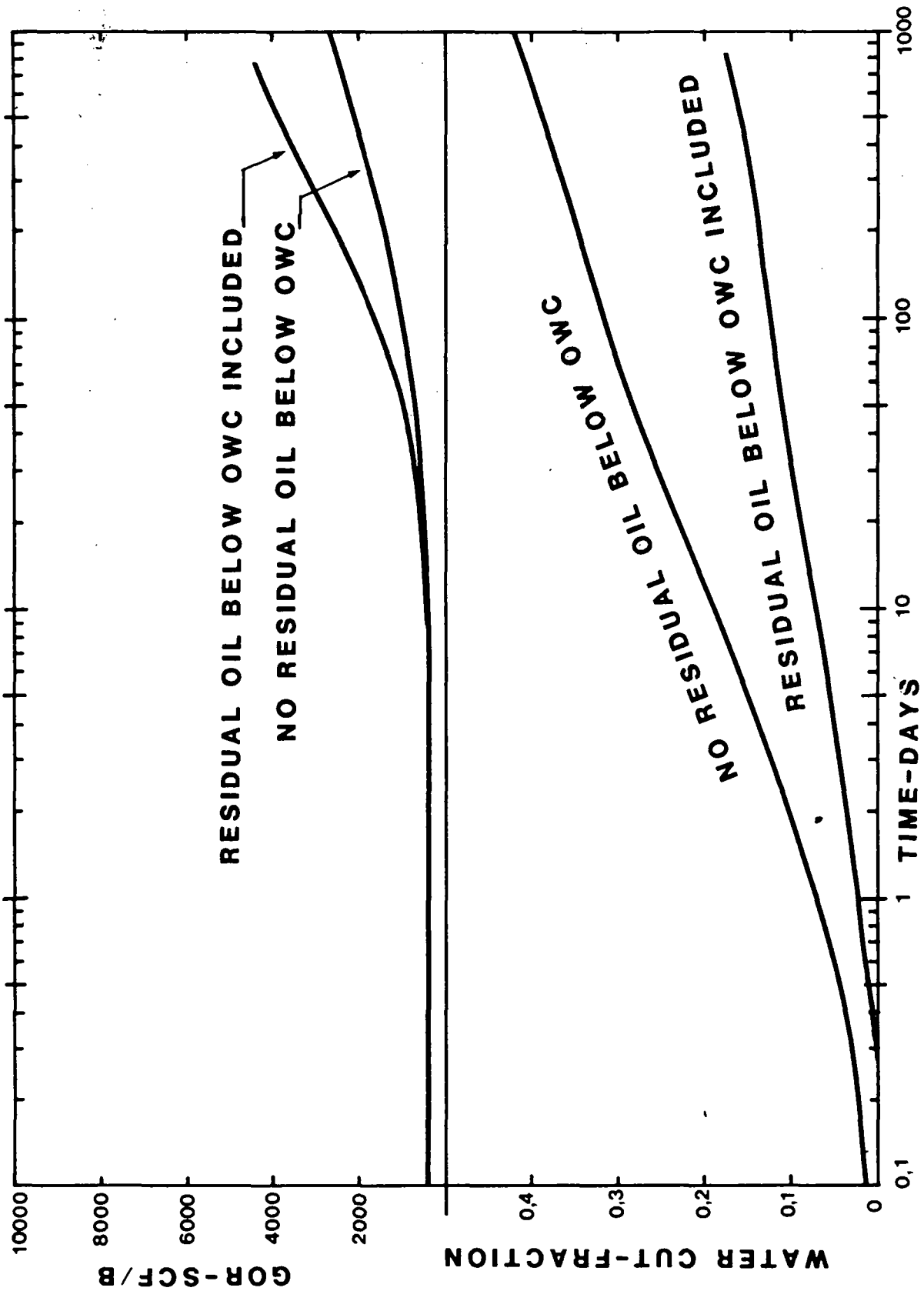


Fig. 2

WELL 31/2-5
PERFORMANCE OF VARIOUS COMPLETION INTERVALS
RESIDUAL OIL BELOW OWC INCLUDED
5000 B/D-LIQUID RATE

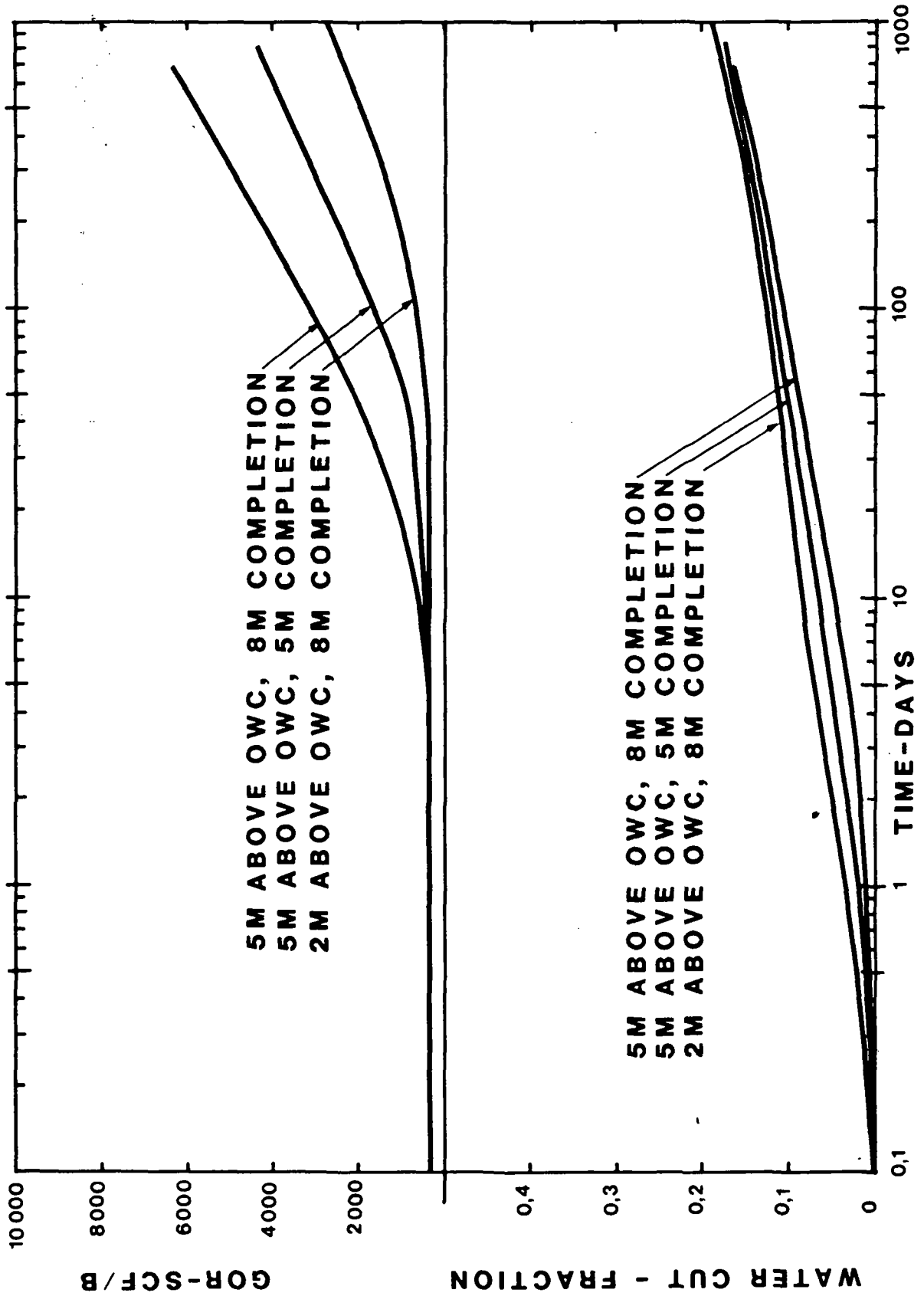


Fig. 3

WELL 31/2-5
PERFORMANCE OF VARIOUS COMPLETION INTERVALS
NO RESIDUAL OIL BELOW OWC
5000 B/D LIQUID RATE

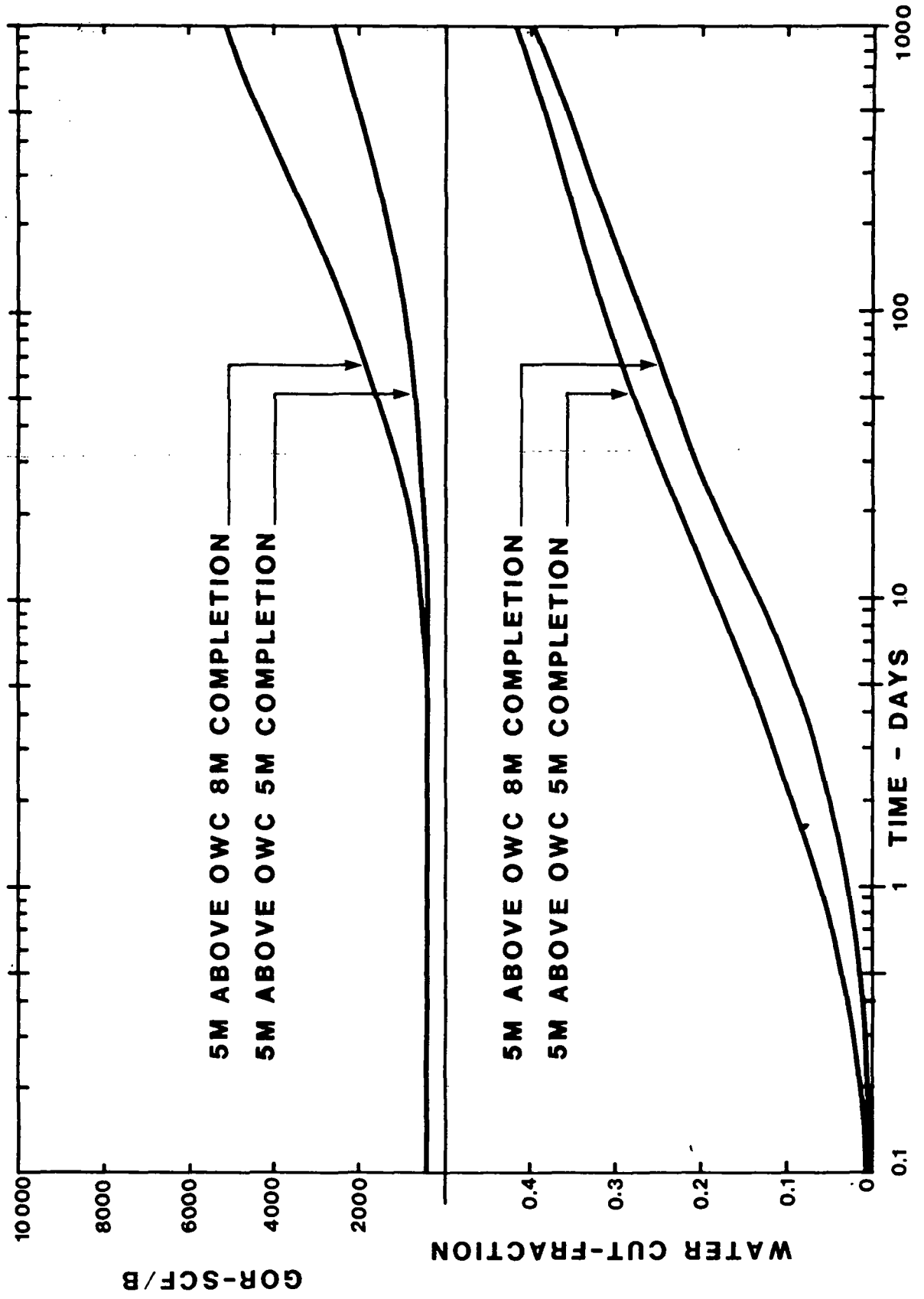


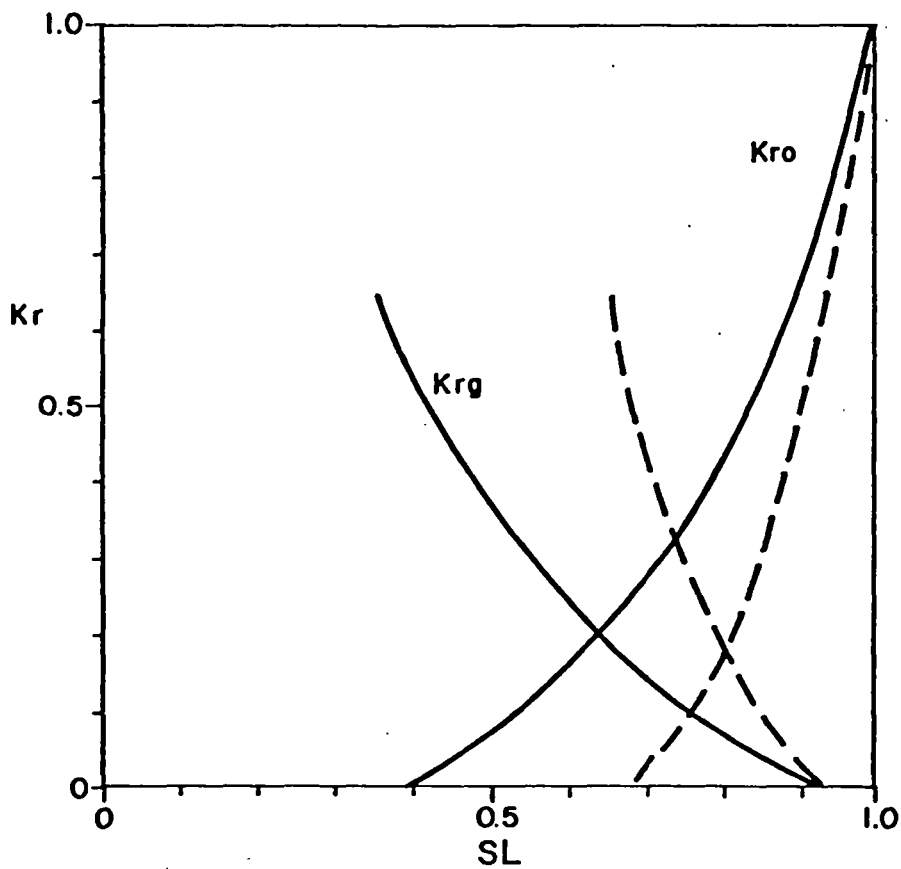
Fig. 4

LAYER No.	LAYER DEPTH TOP - BASE (m BDF)	LAYER THICKNESS (m)	POROSITY (%)	PERMEABILITY (md)		ROCK TYPE	ZONE	SATURATIONS (%)		REMARKS	
				K _H	K _V			GAS	OIL		WATER
1	1544.11 - 1547.16	3.05	32	400	175	2	Gas	75	0	25	
2	1547.16 - 1552.04	4.88	28	90	32	2	"	75	0	25	
3	1552.04 - 1562.10	10.06	32	4000	2500	1	"	90	0	10	
4	1562.10 - 1579.16	17.07	31	700	392	1	"	90	0	10	
5	1579.16 - 1584.04	4.88	32	3600	2250	1	oil	0	90	10	
6	1584.04 - 1587.09	3.05	30	405	175	2	"	0	75	25	
7	1587.09 - 1589.22	2.13	32	5700	3800	1	"	0	90	10	Completion interval
8	1589.22 - 1591.36	2.13	32	5700	3600	1	"	0	90	10	
9	1591.36 - 1593.49	2.13	31	314	146	2	WATER	0	0	100	
10	1593.49 - 1597.45	3.96	25	6	2	2	"	0	0	100	
11	1597.45 - 1606.60	9.14	30	2000	1400	1	"	0	0	100	
12	1606.60 - 1791.31	184.71	30	1000	600	1	"	0	0	100	

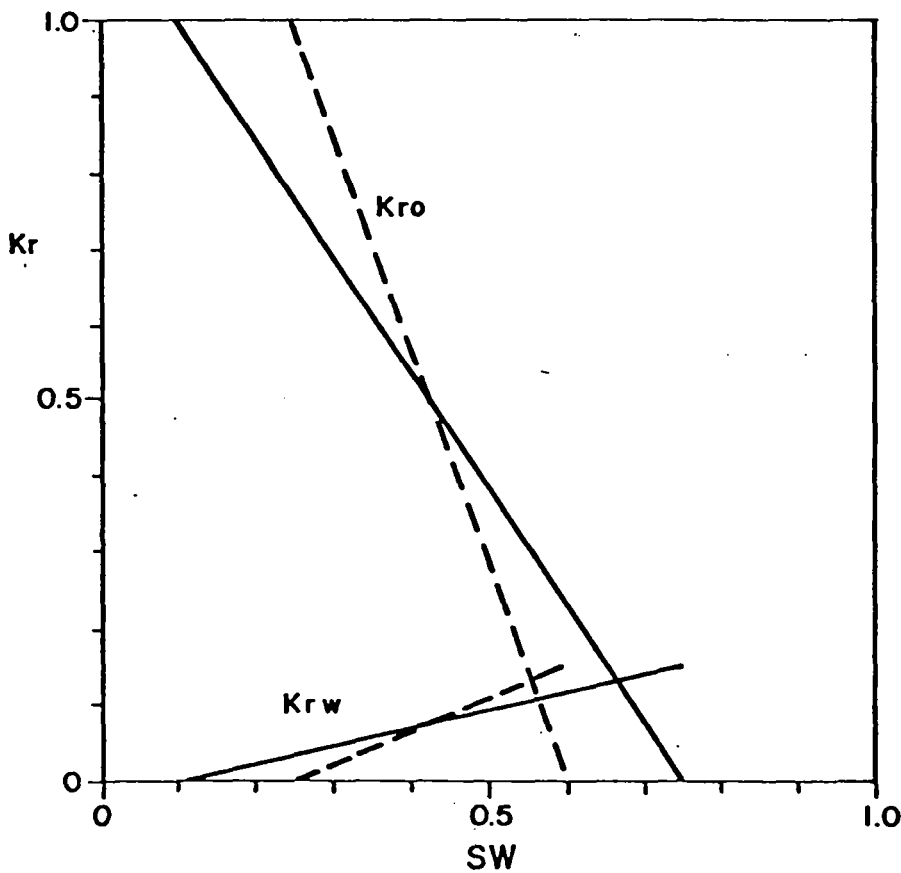
GRID MESH IN R - DIRECTION (m) :

I=1	I=2	I=3	I=4	I=5	I=6	I=7	I=8	I=9	I=10
2.03	3.96	7.92	15.85	32.00	64.01	128.02	256.03	512.06	1416.41

RELATIVE PERMEABILITIES

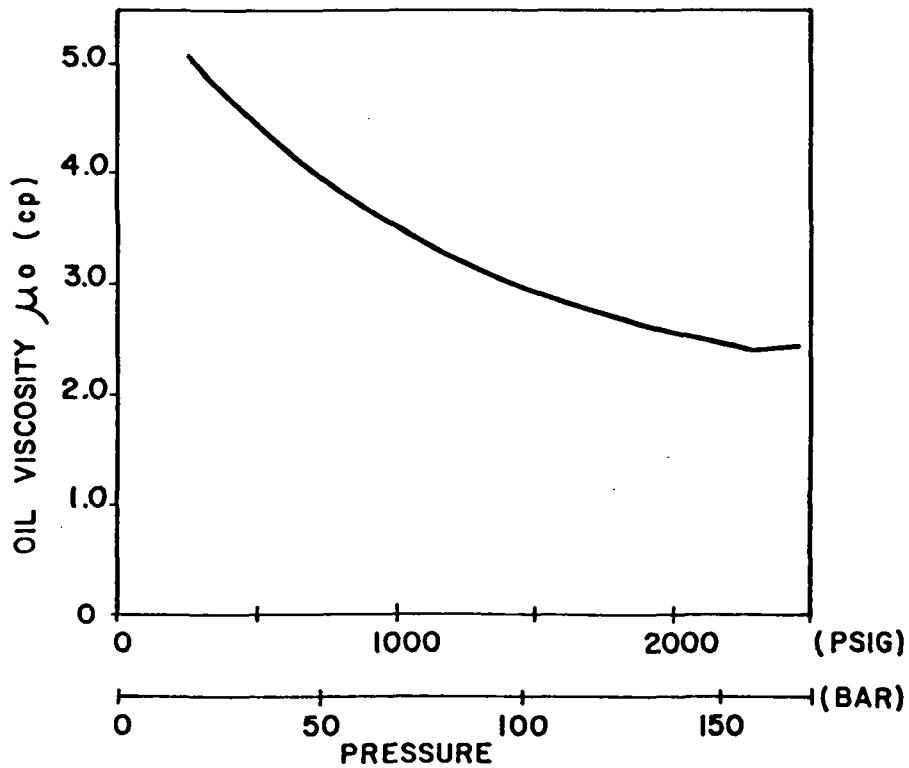
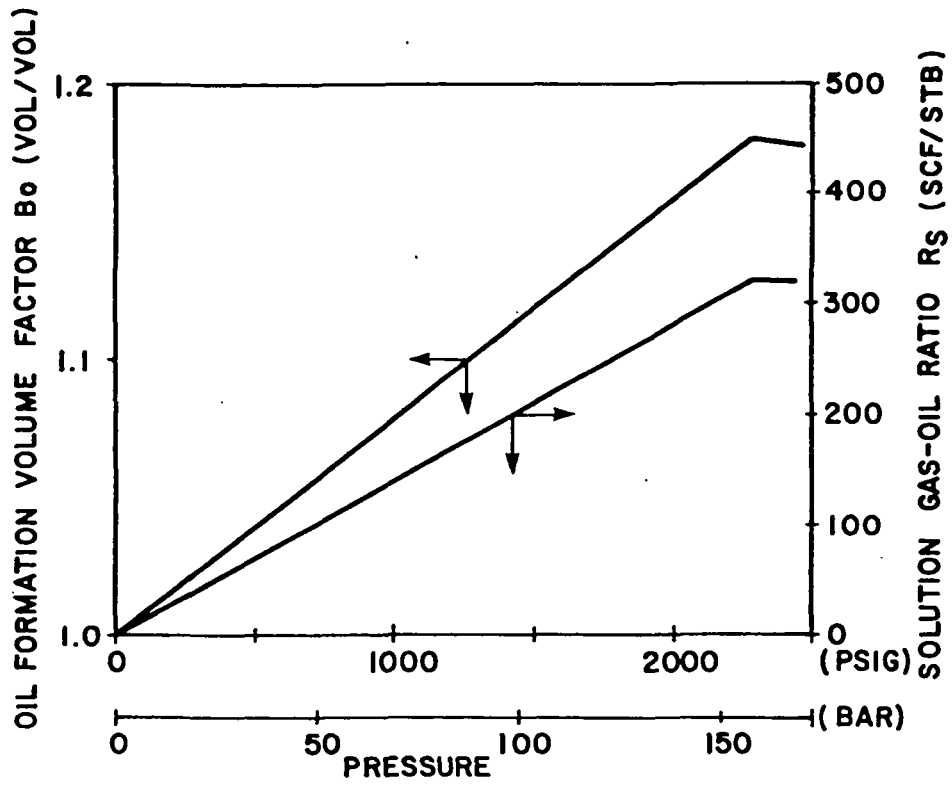


	<u>TYPE 1</u>	<u>TYPE 2</u>
Sorw :	.25	.40
Sorg :	.25	.40
Swc :	.10	.25
Sgcrit :	.03	.05



a-s Norske Shell		
EXPLORATION & PRODUCTION FORUS		
31/2- AREA OIL ZONE STUDIES		
WELL 31/2-2 MODEL		
REL. PERM.		
AUTHOR: EPPP/22	FIG:	DATE:
REPORT NO:		DRAW NO: G 819/

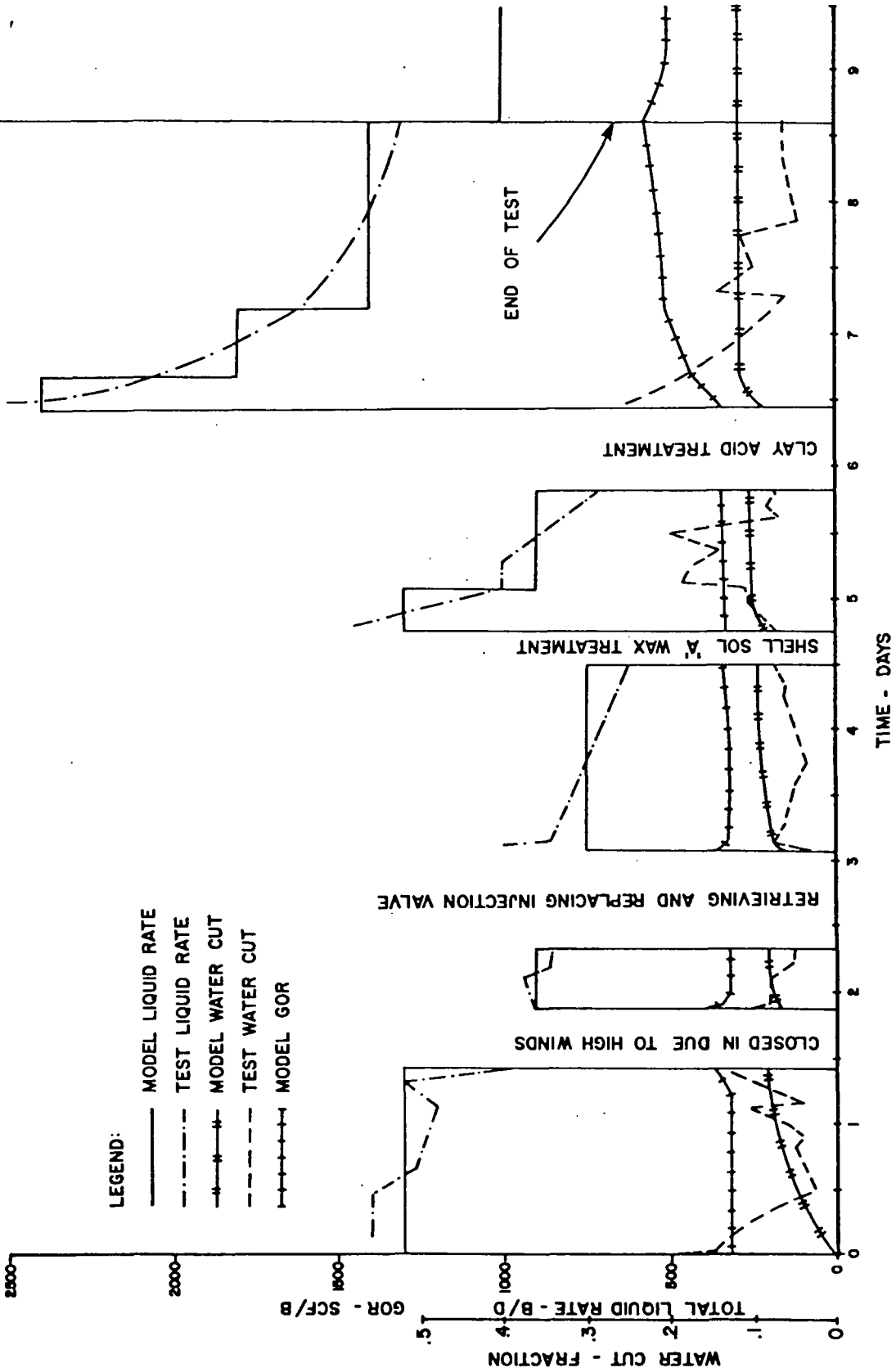
OIL PROPERTIES USED IN THE 31/2-2 STUDY.



a-s Norske Shell EXPLORATION & PRODUCTION FORUS		
31/2-AREA OIL ZONE STUDIES WELL 31/2-2 MODEL OIL PROPERTIES		
AUTHOR	EPPP/22	FIG. DATE
REPORT NO.		DRAW NO G 819/

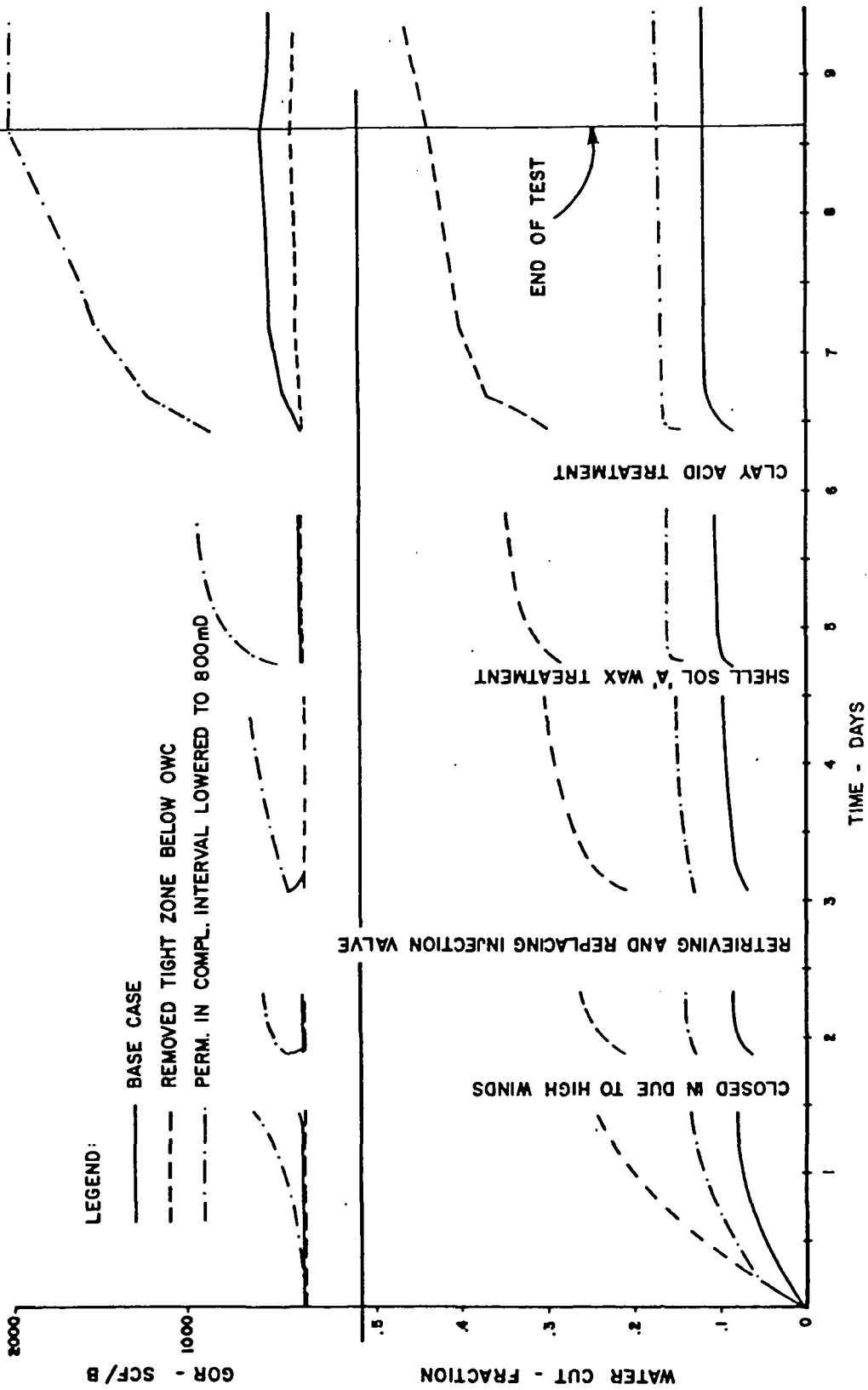
TEST MATCH WELL 31/2 - 2

GAS LIFT PHASE

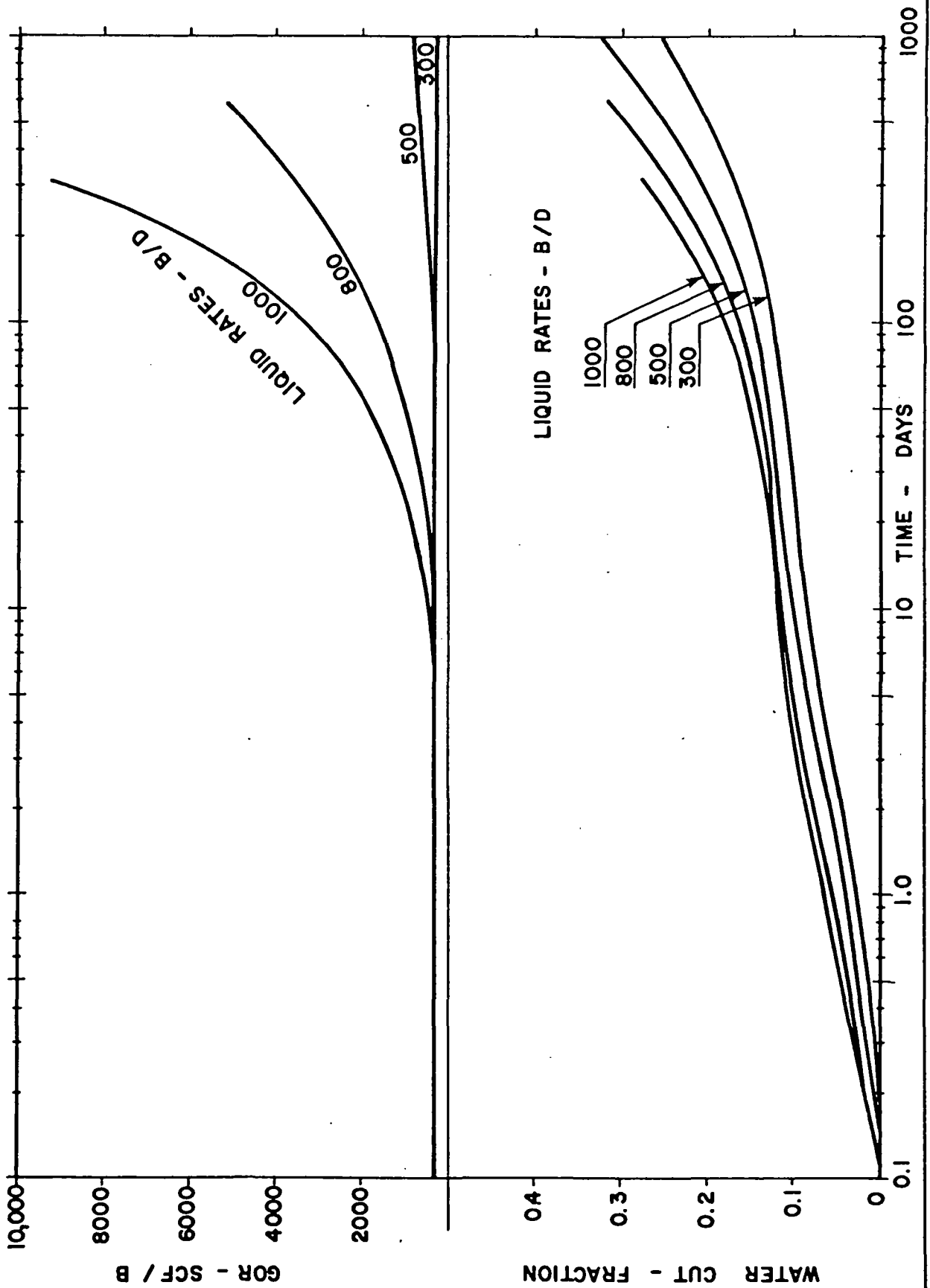


31/2-2 TEST MATCH

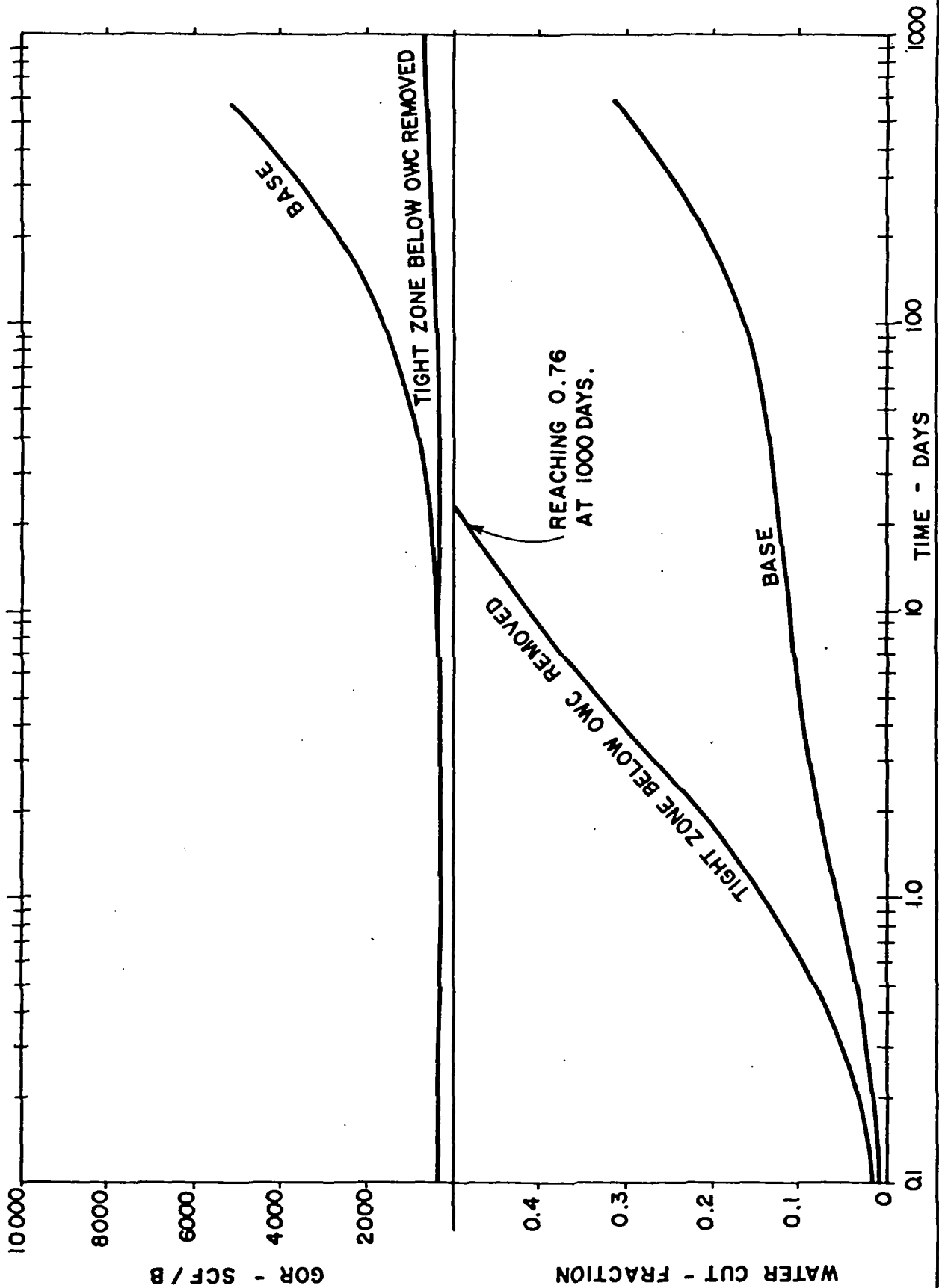
SENSITIVITIES ON RESERVOIR PARAMETERS



WELL 31/2 - 2
 PERFORMANCE AT VARIOUS RATE LEVELS

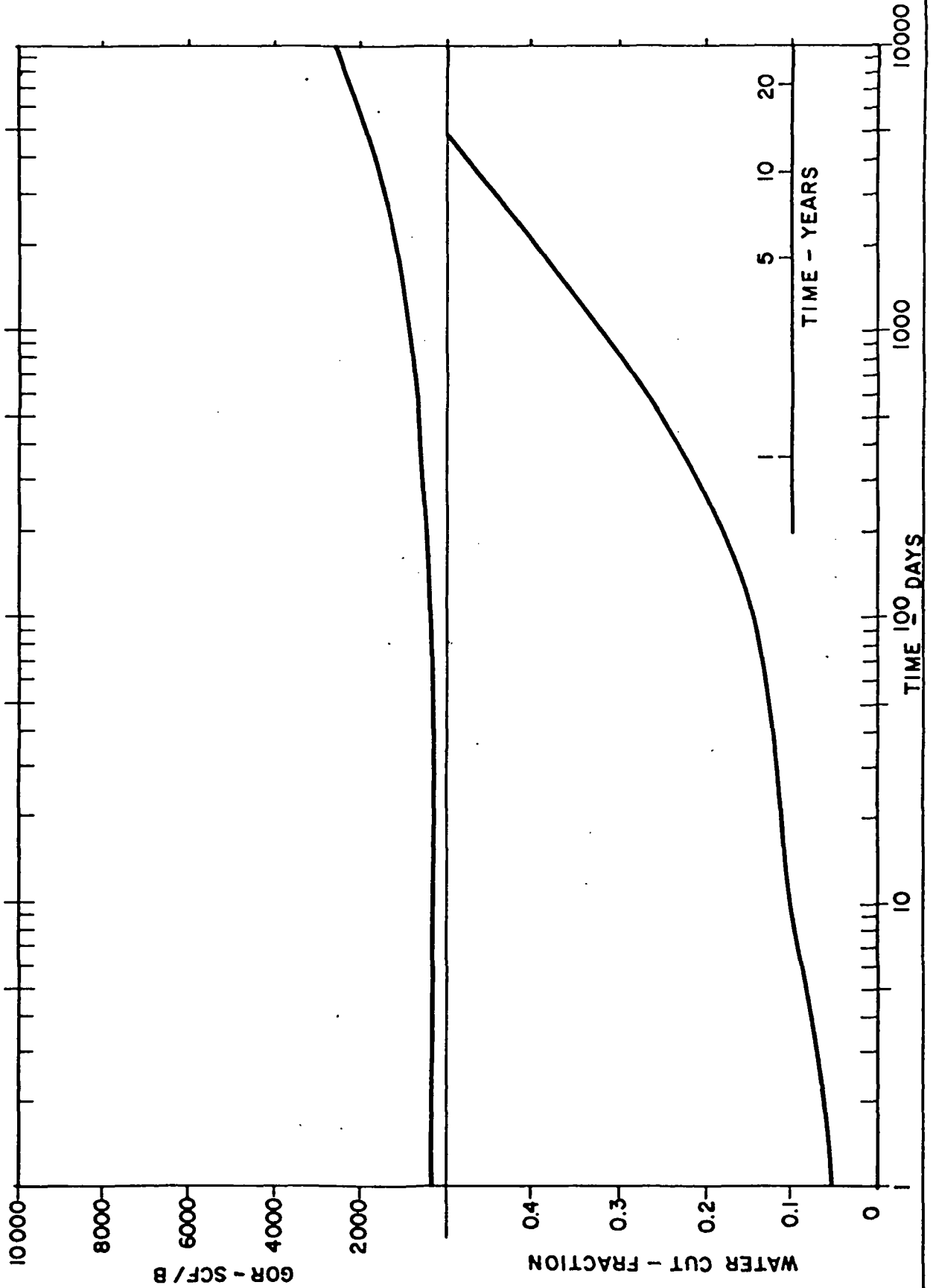


WELL 31/2-2
 EFFECT OF TIGHT ZONE BELOW OWC
 800 B/D LIQUID RATE



a-s Norske Shell EXPLORATION & PRODUCTION FORUS		
31/2-AREA OIL ZONE STUDIES WELL 31/2-2 MODEL EFFECT OF TIGHT ZONE BELOW OWC		
AUTHOR: EPPP/22	FIG.	DATE
REPORT NO.		DRAW NO G 819/

WELL 31/2-2
500 B/D LIQUID RATE



a-s Norske Shell			
EXPLORATION & PRODUCTION FORUS			
31/2-AREA OIL ZONE STUDIES			
WELL 31/2-2 MODEL			
LONG TERM PREDICTION			
AUTHOR: EPPP/22	FIG:	DATE:	
REPORT NO:		DRAW NO: 6 819/	

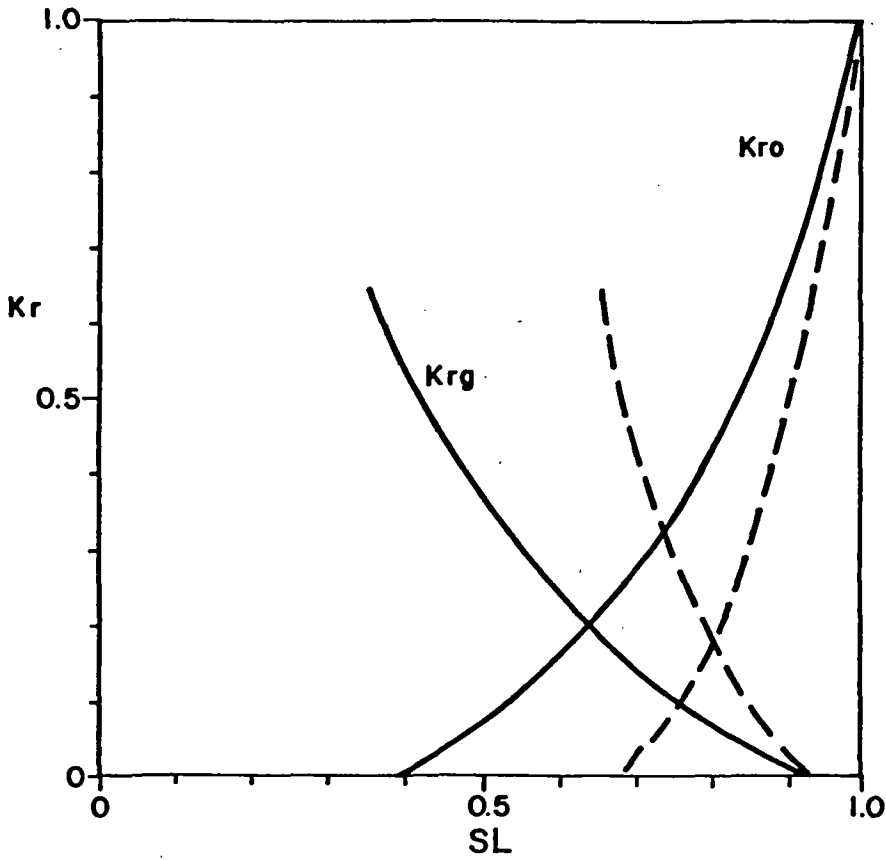
Interval no.

3 1/2 - 5 MODEL DATA

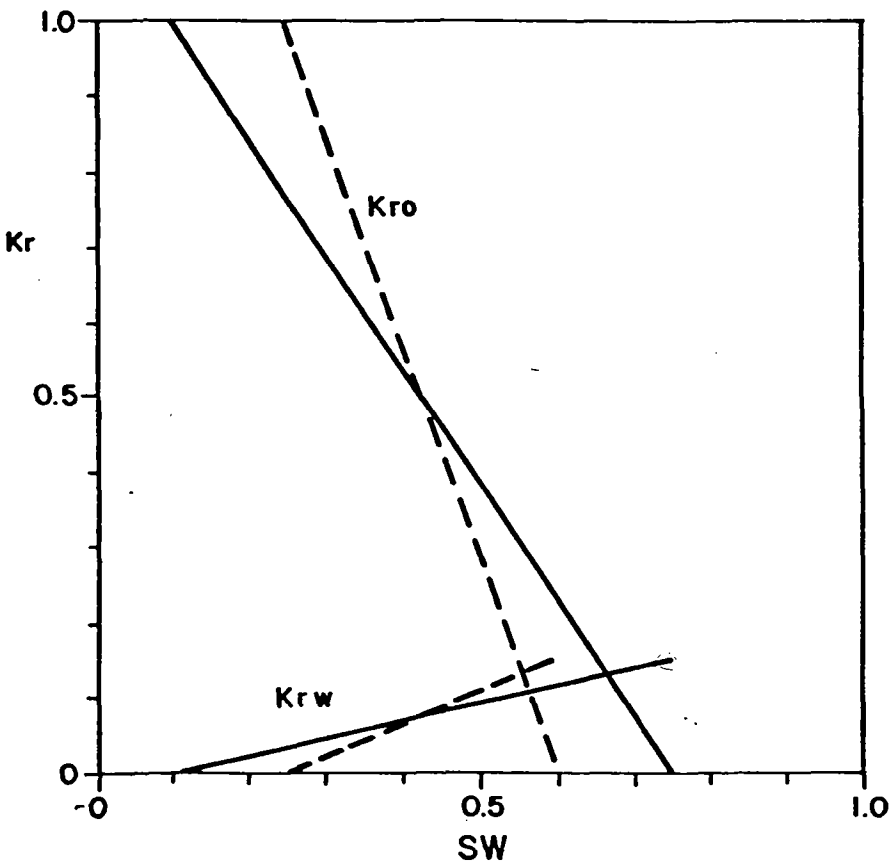
Interval no.	Log-Depth		Interval		φ		k _H		k _v	
	M	ft	Lab	Corrected	Lab	Corrected	Lab	Corrected	Lab	Corrected
1	36.5	120	35.1	32.5	4445 (2.5)	4445	1925 (7)	1925	1925 (7)	1925
2	4.5	5	1.17 (3)	1.17	0.032 (3)	0.003	0.006	0.003	0.006	0.000
3	4.5	15								
4	7	23								
5	5	16								
6	5	16	32.3 (7)	29.9	9615 (2)	9615				6500
7	5	17								
8	4.5	15								
9	7	23								
10	2.5	8	25.7 (1)	24.4	23 (1)	11	8.5 (1)	8.5	8.5	3
11	3	10	25.7 (1)	24.4	23 (1)	11	8.5 (1)	8.5	8.5	3
12	200	656	35.2	32.6	57 (5) (1)	511	115 (1)	115	115	80

* Used plugs at core depths 1555.9, 1555.6 and 1566.9 as typical
 ** From Gamma-Ray assumed similar to 1562 - 1564 m
 *** Assumed same as layer 9
 **** From Correlation well 31/2-2

RELATIVE PERMEABILITIES



	<u>TYPE 1</u>	<u>TYPE 2</u>
Sorw :	.25	.40
Sorg :	.25	.40
Swc :	.10	.25
Sgcrit :	.03	.05

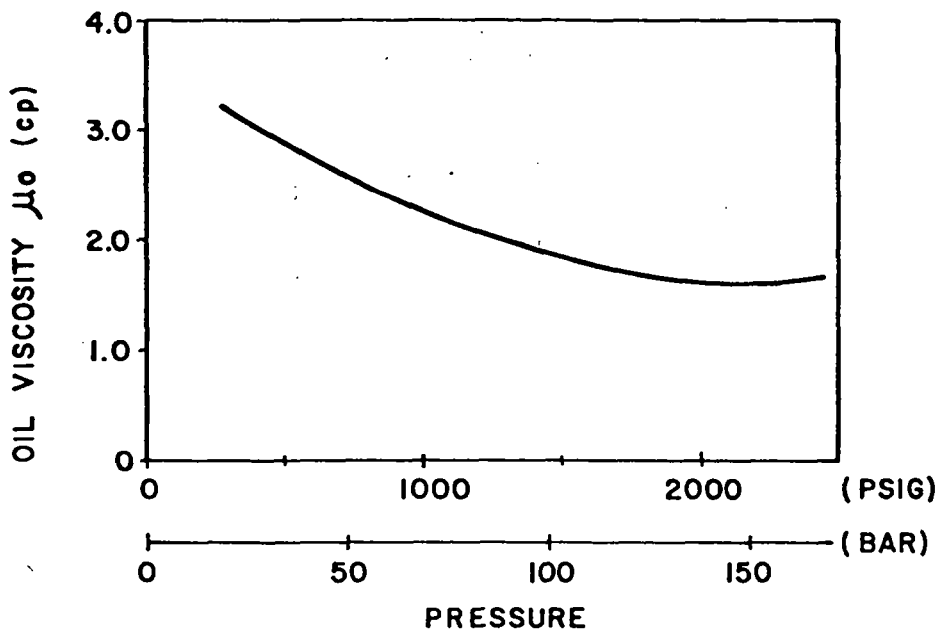
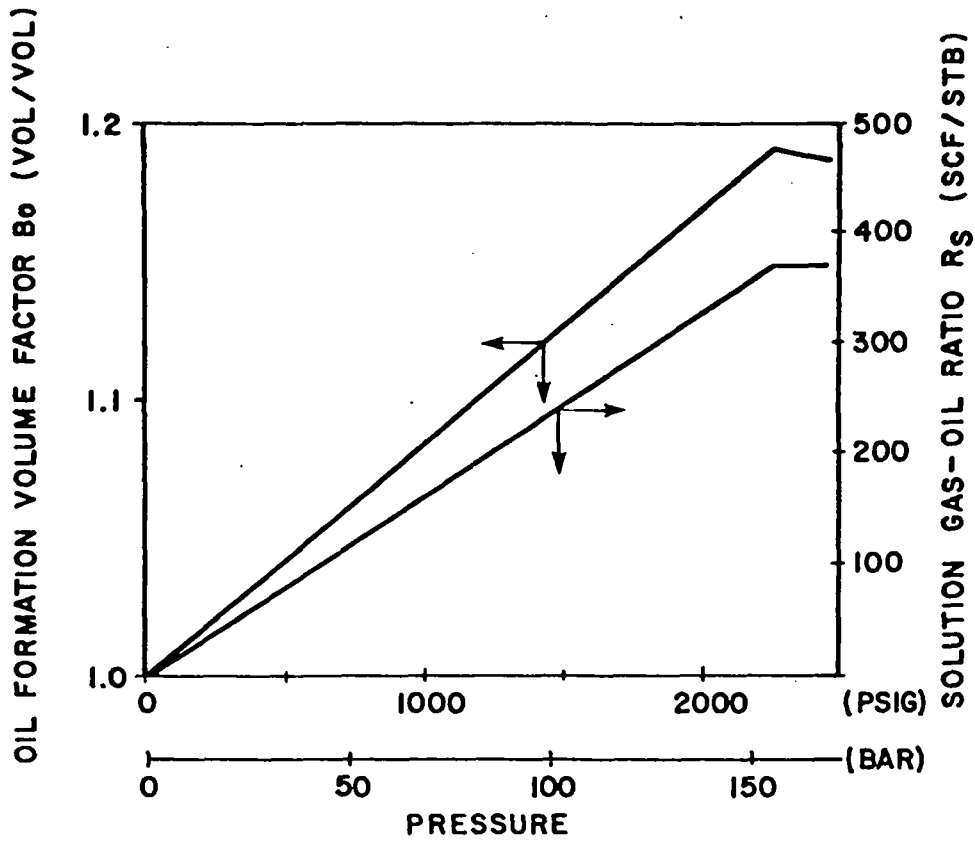


a.s. Norske Shell
EXPLORATION & PRODUCTION FORUS

3 1/2 - AREA OIL ZONE STUDIES
WELL 3 1/2 - 2 MODEL
REL. PERM.

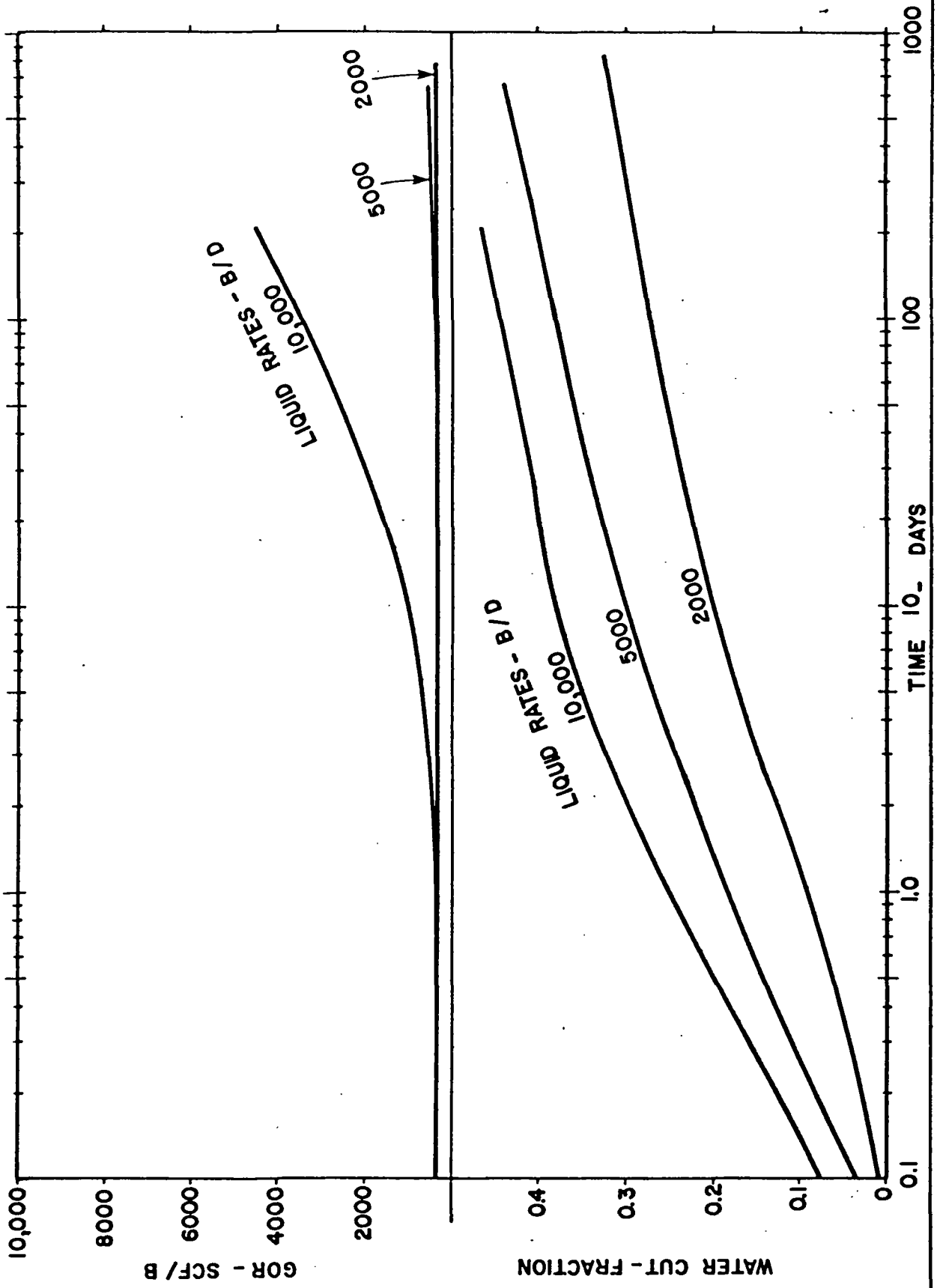
AUTHOR EPPP/22	FIG:	DATE:
REPORT NO.	DRAW NO G 819/	


OIL PROPERTIES USED IN THE 31/2-5 STUDY



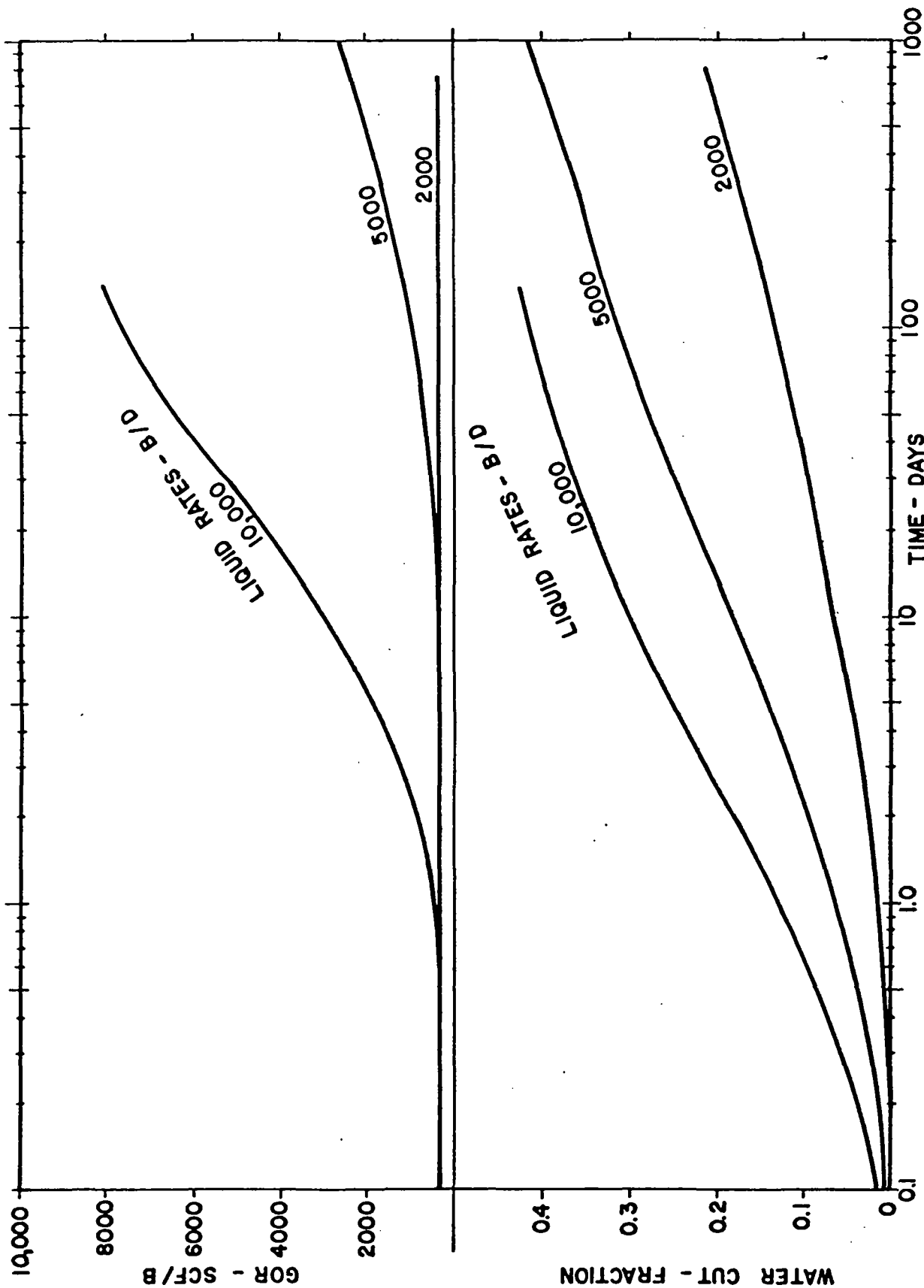
a-s Norske Shell EXPLORATION & PRODUCTION FORUS		
31/2-AREA OIL ZONE STUDIES WELL 31/2-5 MODEL OIL PROPERTIES		
AUTHOR EPPP/22	FIG.	DATE
REPORT NO	DRAW NO G819/	


WELL 31/2-5
 PERFORMANCE AT VARIOUS RATE LEVELS
 COMPLETION 2m ABOVE OWC



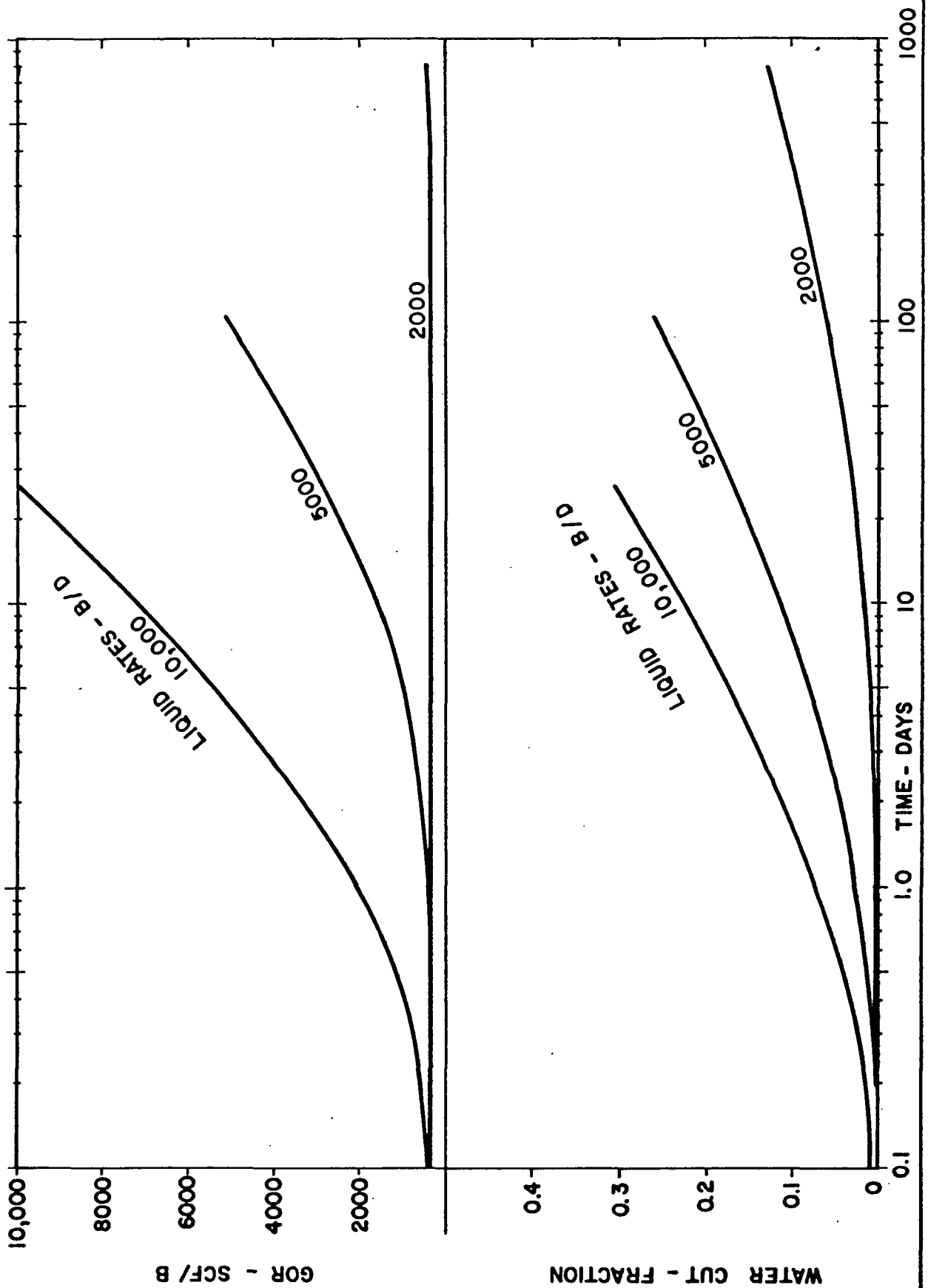
a-s Norske Shell
 EXPLORATION & PRODUCTION FORUS 
 FLATHEAD OIL ZONE STUDIES
 WELL 31/2-5 MODEL
 COMPLETION 2m ABOVE OWC
 PMPR DEC. '80 - JAN. '81 FIG. 6


WELL 31/2-5
 PERFORMANCE AT VARIOUS RATE LEVELS
 COMPLETION 5 m ABOVE OWC



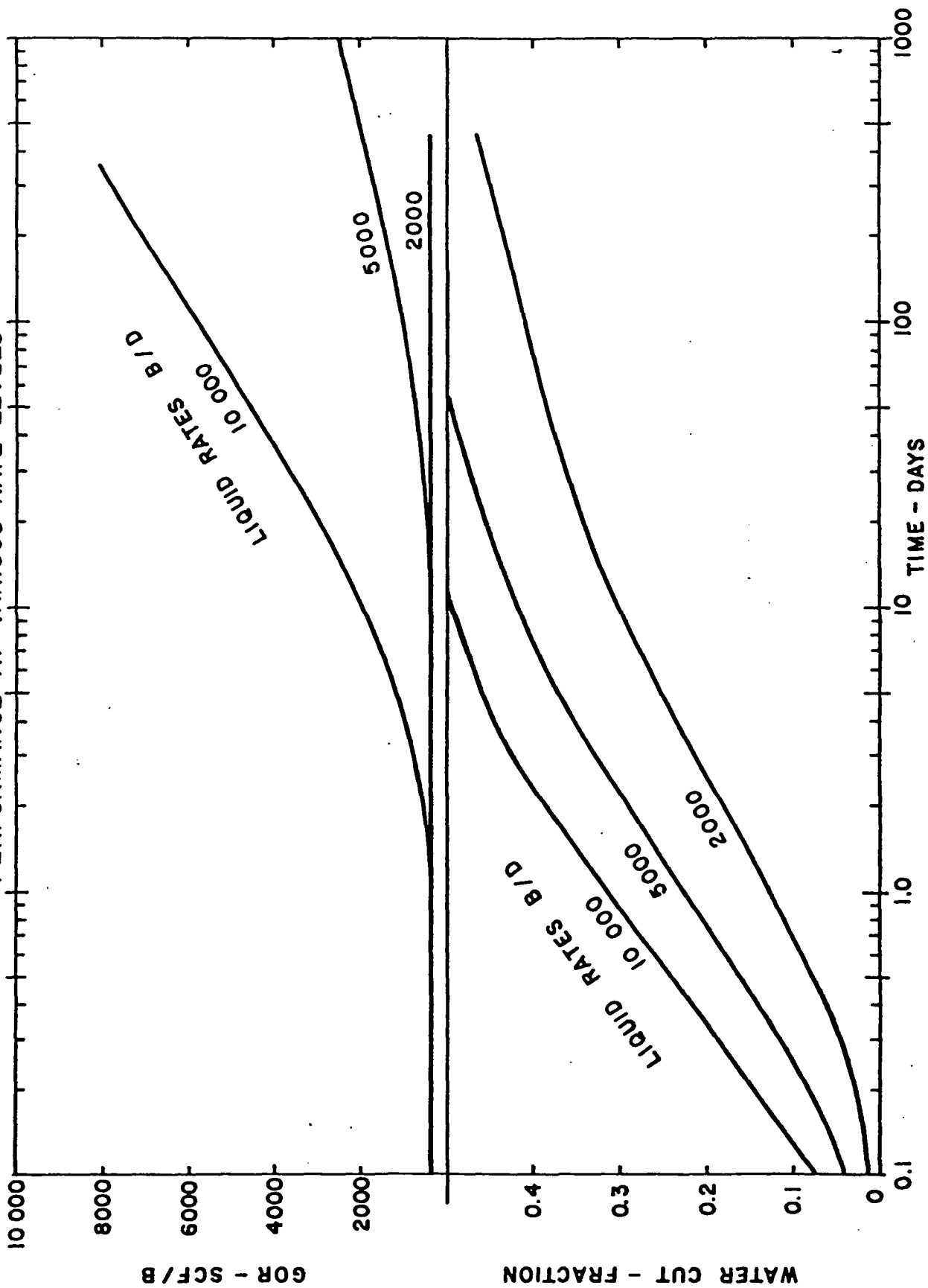

 a.s. Norske Shell
 EXPLORATION & PRODUCTION FORUS
 FLATHEAD OIL ZONE STUDIES
 WELL 31/2-5 MODEL
 COMPLETION 5 m ABOVE OWC
 PMPR DEC. '80 - JAN. '81 FIG. 5

WELL 31/2-5
 PERFORMANCE AT VARIOUS RATE LEVELS
 COMPLETION 8 m ABOVE OWC



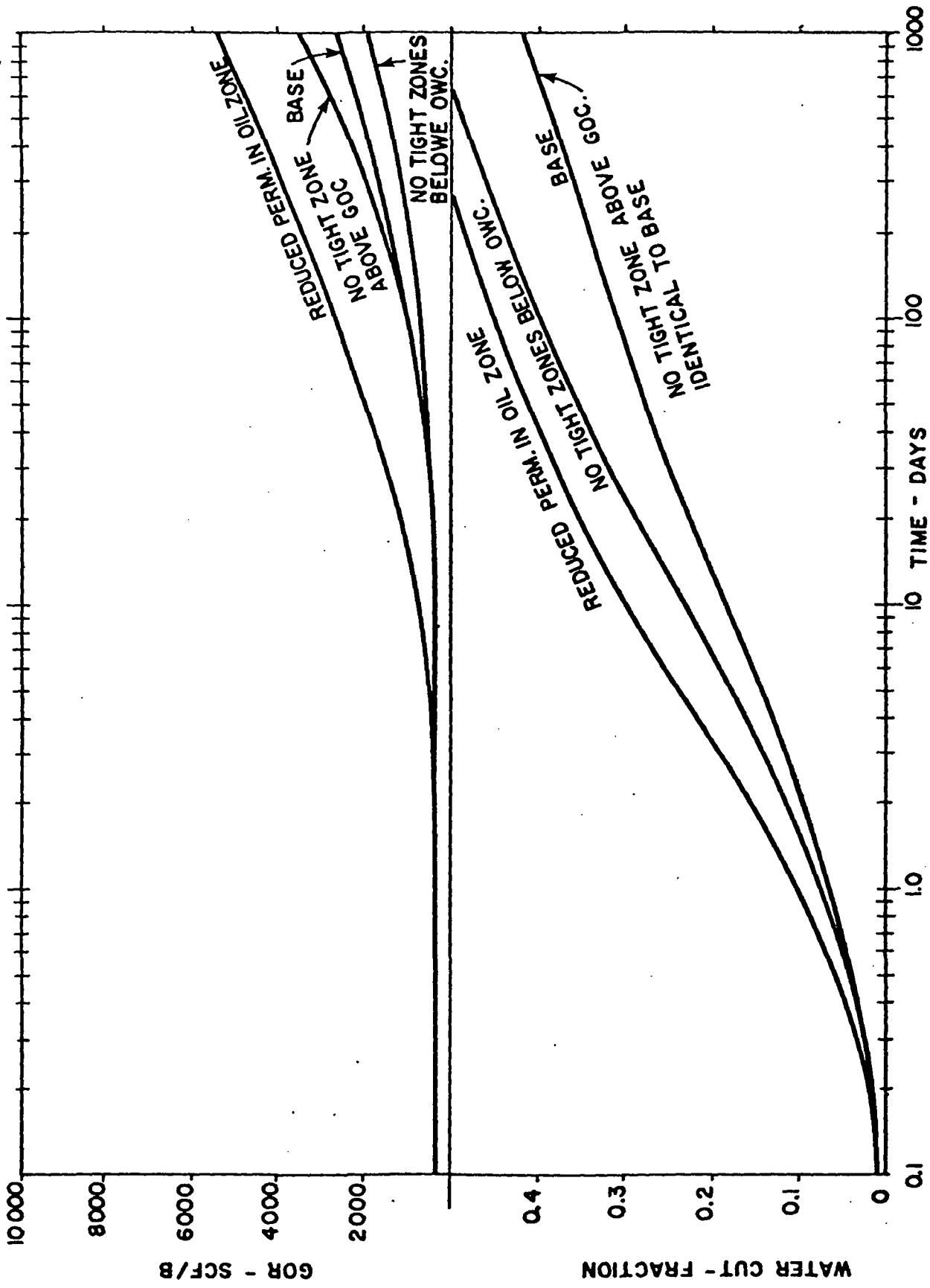
a-s Norske Shell
 EXPLORATION & PRODUCTION FORUS 
 FLATHEAD OIL ZONE STUDIES
 WELL 31/2-5 MODEL
 COMPLETION 8 m ABOVE OWC
 PMPR DEC. '80 - JAN. '81 FIG. 4

WELL 31/2-5
 REDUCED PERMEABILITY IN OIL ZONE
 COMPLETION 2m ABOVE OWC.
 PERFORMANCE AT VARIOUS RATE LEVELS

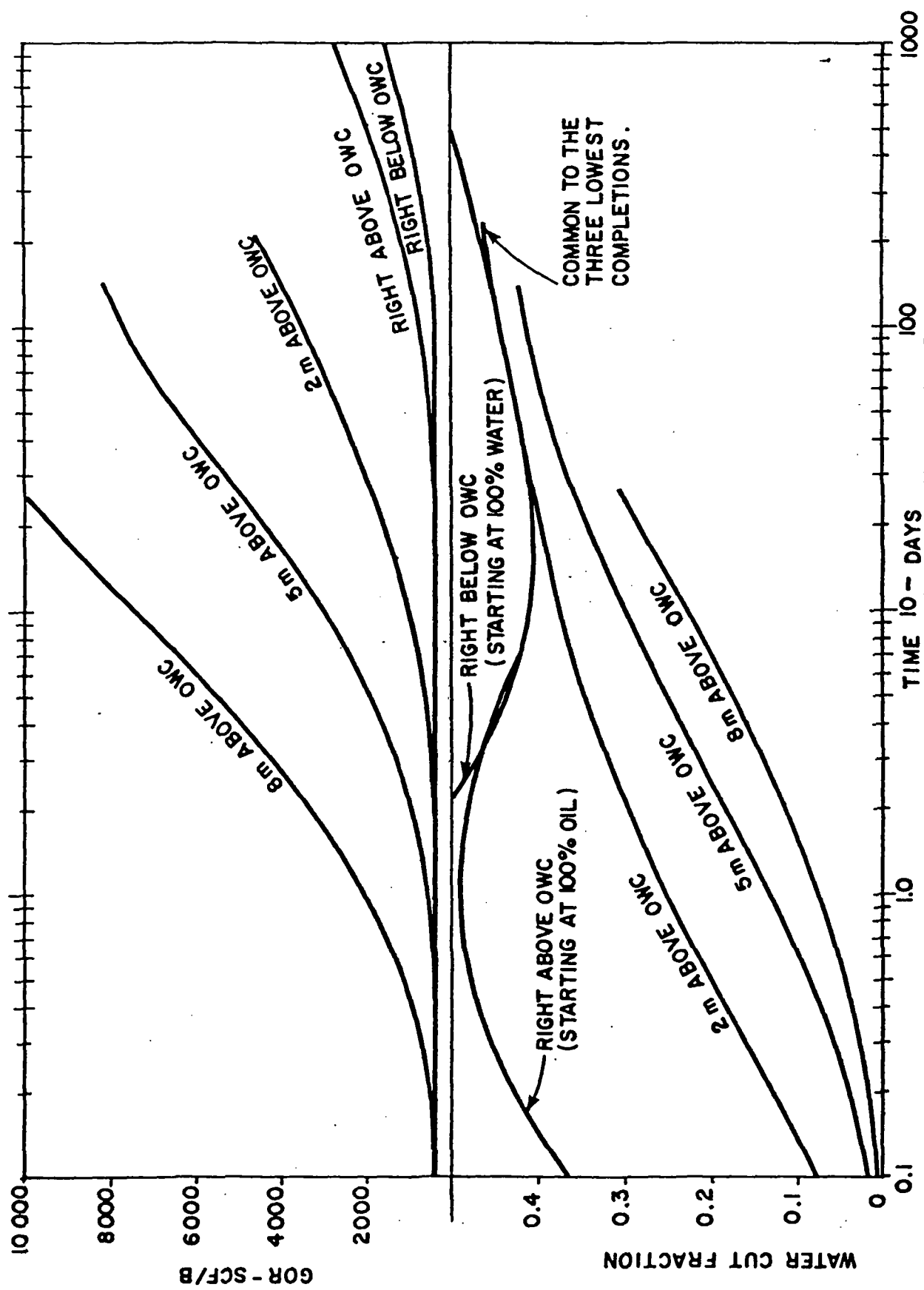


a-s Norske Shell		
EXPLORATION & PRODUCTION FORUM		
31/2-AREA OIL ZONE STUDIES WELL 31/2-5 MODEL SENSITIVITY OF REDUCED PERMEABILITY IN OIL ZONE		
AUTHOR EPPP/22	FIG.	DATE
REPORT NO		DRAW NO 0819/

WELL 31/2-5
 SENSITIVITIES ON RESERVOIR PARAMETERS
 COMPLETION 5m ABOVE OWC. 5000 B/D LIQUID RATE



WELL 31/2-5
 PERFORMANCE OF VARIOUS COMPLETION INTERVALS
 10000 B/D LIQUID RATE

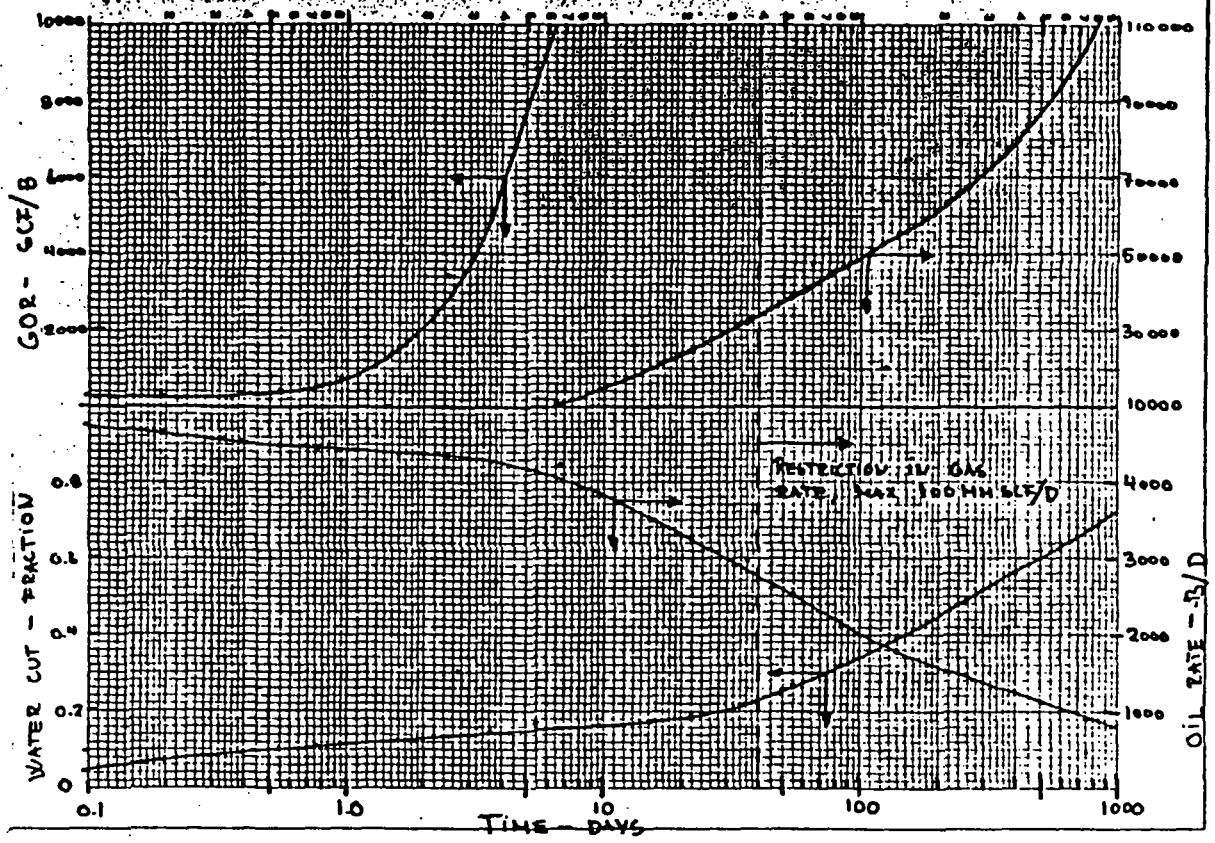


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 EXPLORATION & PRODUCTION FORUS

31/2 - AREA OIL ZONE STUDIES
 WELL 31/2-5 MODEL
 PERFORMANCE OF VARIOUS
 COMPLETION INTERVALS

AUTHOR EPPP/22	FIG.	DATE
REPORT NO	DRAW NO G 819/	

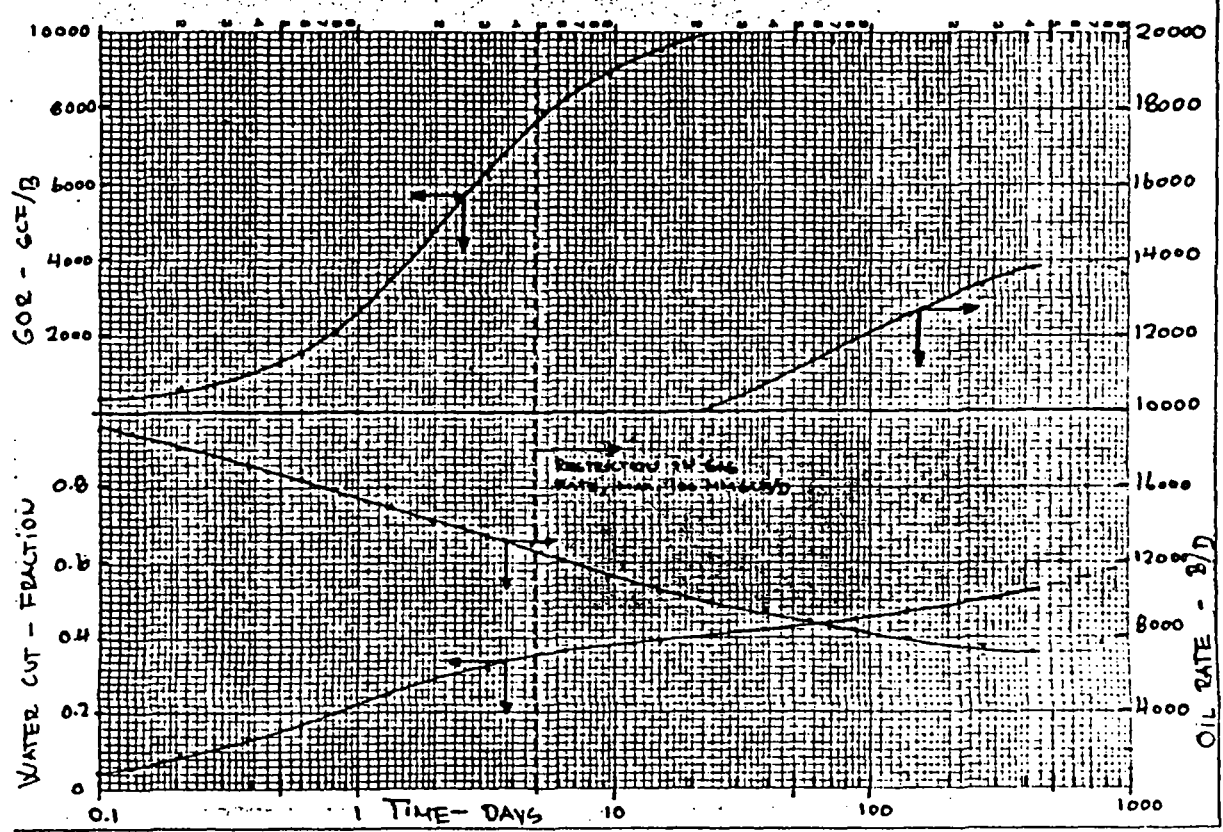
WELL 3 1/2 - 2
 5000 B/D LIQUID RATE, MAX GAS RATE 100 MM SCF/D



3 1/2 - AREA OIL ZONE STUDIES
 WELL 3 1/2 - 2 MODEL
 PERFORMANCE AT 5000 B/D LIQUID RATE

AUTUMN 1977/78

WELL 3 1/2 - 5
 COMPLETION 5 M. ABOVE OWC
 20000 B/D LIQUID RATE, MAX GAS RATE 100 MM SCF/D



3 1/2 - AREA OIL ZONE STUDIES
 WELL 3 1/2 - 5 MODEL
 PERFORMANCE AT 20000 B/D LIQUID RATE

AUTUMN 1977/78