1R - 279

REPORTS

DATE:

1986

VACUUM FIELD WATERFLOW TECHNICAL COMMITTEE

RESPONSE TO MANAGEMENT COMMITTEES CHARGES

OCTOBER 2, 1986

Enclosed is the response to the charges set forth by the Management Committee during the meeting held September 4, 1986. A copy of these charges is attached.

One important aspect which should be mentioned in the forefront is the legal aspect of drilling or recompleting monitor wells. These wells are being completed outside of the unitized intervals and, in some cases, on property not leased to the unit operators. It was felt this was beyond the scope of the Technical Committee and would have to be handled on an individual company basis.

The Technical Committee recommends any information obtained as a result of the following report be fully shared, interpreted as a group and the Technical Committee Chair keep a complete file. Individual company responses to the Management Committees charges are attached.

PHILLIPS PETROLEUM COMPANY
ODESSA, TEXAS 79762
4001 PENBROOK

EXPLORATION AND PRODUCTION GROUP

September 5, 1986

Vacuum Field Waterflow
Management Committee
September 4, 1986, Meeting Minutes

Vacuum Field Waterflow
Management Committee Members

Attached are the minutes from the committee meeting held on September 4, 1986, in Odessa, Texas.

A joint meeting with the Technical and Geological - Geophysical Committees is scheduled for Thursday, October 2, 1986, at 9:00 A.M. CDLST. It will be held in the 2nd floor Conference Room of the Phillips Building, 4001 Penbrook, Odessa, Texas.

Very truly yours,

W. J. Mueller, Chairman
Management Committee

WJM:ko

Attachment

cc: Technical Committee Members

Vacuum Field Waterflow Committee
Management Committee Meeting Minutes
September 4, 1986

The fourth meeting of the Vacuum Field Waterflow Management Committee was held September 4, 1986, at the Phillips Petroleum Company building in Odessa, Texas. An attendance list is attached.

Bill Mueller opened by stating that the main purposes of the meeting were to review Mr. R. L. Stamets' letter received subsequent to the meeting with the N.M.O.C.D. on August 19, 1986, and to determine charges to the Technical Committee. The minutes of the above meeting were reviewed and then the requests contained in Mr. Stamets' letter were discussed. All operators expressed their desire and willingness to proceed with a positive action program to locate the source or sources of injected fluid movement into the salt section. A program will be approved and actual work commenced prior to Mr. Stamets' requested December, 1986, meeting.

All operations will immediately proceed to verify the mechanical integrity of every injection well they operate. This to include a complete surface inspection of all wellhead equipment including any below - ground - level valves. An annulus and bradenhead pressure survey should also be conducted at this time. These data are to be forwarded to the Technical Committee for compilation and report presentation to the N.M.O.C.D.

The charges to the Technical Committee are as follows:

1. Select "Hot Spot" locations for the drilling of nine monitor wells through the salt section.

   Locations to be as follows:

   1 - Phillips' M. E. Hale Lease
   2 - Phillips' East Vacuum G-SA Unit
   1 - Texaco's Central Vacuum Unit
   1 - Texaco's Vacuum G-SA Unit
   1 - Texaco's West Vacuum Unit
   2 - Mobil's Bridges State Lease
   1 - Arco's SWD Well Offset
   9 TOTAL

   If a field-wide tracer survey program is approved, each operator will handle his own drilling, completion and disposal procedures and costs.

2. Design tracer and pressure pulse testing programs between each of the current monitor wells in addition to the above wells and their directly offsetting injection wells.

3. Design detailed channel check well survey programs for both Graybury-San Andres and Abo injection wells with a wellhead injection pressure of 900 psi or greater. Investigate both commercial and any R & D tools available. High resolution is important.

It is requested that the above charges be completed and presented to the Management Committee at a joint meeting scheduled for Thursday, October 2, 1986, at 9:00 A.M. It will be held in the 2nd floor Conference Room of the Phillips Building, 4001 Penbrook, Odessa, Texas.

Mobil will form and chair a Geological - Geophysical Committee for a detailed description of the Vacuum Field area. Names of individual company representatives are to be sent to Matt Sweeney. The charges to the Geological - Geophysical Committee are as follows:

1. Prepare a detailed Geological description of all formations.

   1st priority - Interval from surface to base of salt
   2nd priority - Interval below base of salt

2. Investigate possible use of seismic data to locate fluid pockets, solution caverns, fractures, etc. in the salt section.

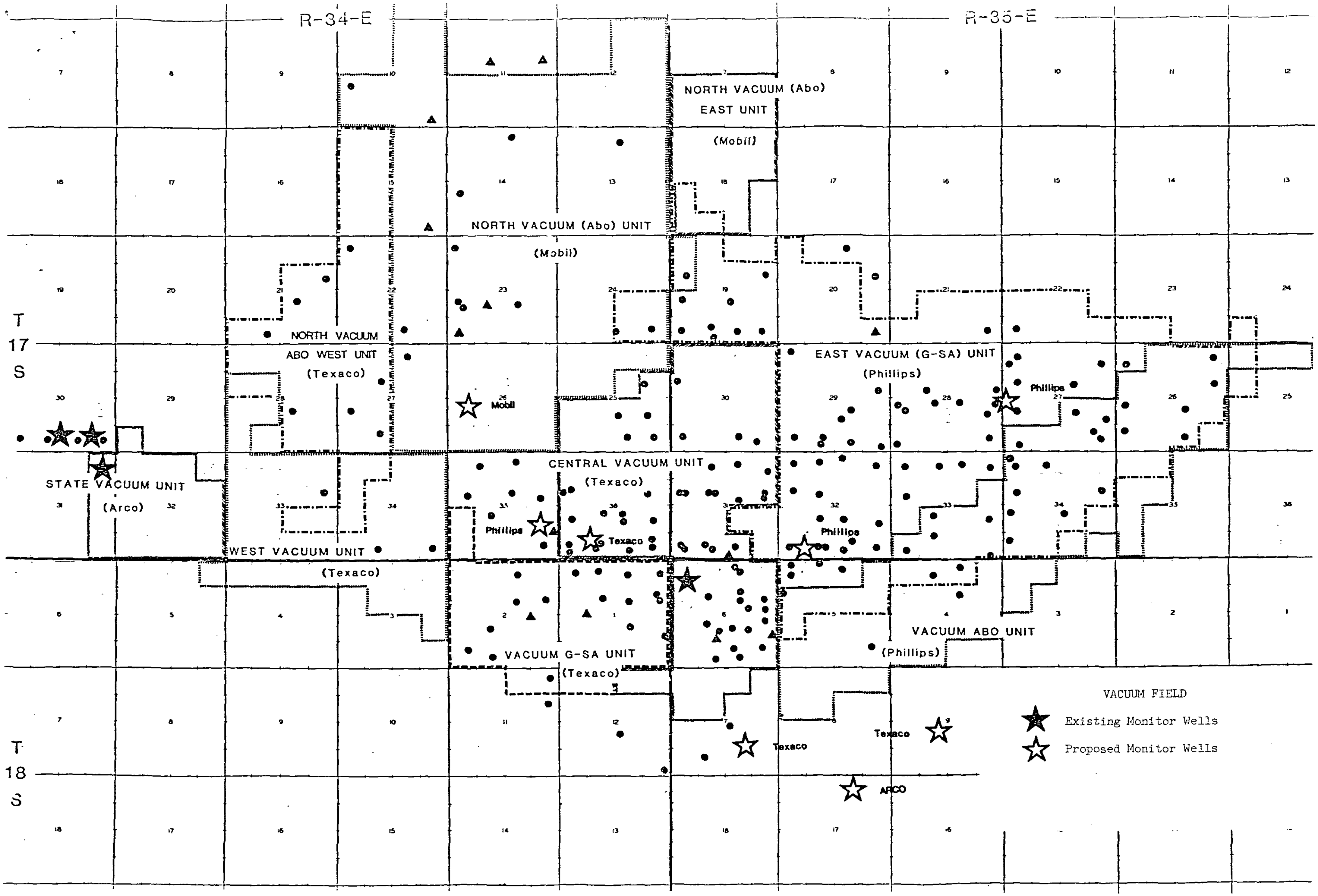
3. Formulate the "most likely" condition that would occur with subsidence in the area due to salt dissolution.

It is requested that a report on the above charges be presented to the Management Committee at the joint meeting scheduled for October 2, 1986.

DRILLING OF MONITOR WELLS - Charge No. 1

In order to interpret the charge, "HOT SPOT" was defined as an area where waterflows in the salt section were encountered during drilling or a known area where bradenhead flows have occurred. The committee agreed the most economical method of pressure monitoring the salt section was by recompletion of existing wellbores where available. This involves less risk since the characteristics of flow through salt are relatively unknown and the guarantee of hitting a flow is unsure. For a monitor well to be of any value, it would have to encounter a flow in the salt section. The following map represents proposed locations should the need for monitor wells arise. ARCO, Mobil, and Texaco propose conversion for their respective locations. Locations were picked by updating bradenhead maps and wellbore availability.

The consensus of the Technical Committee is that should a field wide tracer program be approved, the proposed conversions will not suffice. Texaco is not in favor of drilling or the extended flowing of any monitoring system. In conjunction, any water sample obtained from a well flowing from the salt should still be submitted for chemical and isotope analysis.



R-34-E
R-35-E
T 17 S
T 18 S
NORTH VACUUM (Abo) EAST UNIT (Mobil)
NORTH VACUUM (Abo) UNIT (Mobil)
NORTH VACUUM ABO WEST UNIT (Texaco)
EAST VACUUM (G-SA) UNIT (Phillips)
STATE VACUUM UNIT (Arco)
CENTRAL VACUUM UNIT (Texaco)
WEST VACUUM UNIT (Texaco)
VACUUM G-SA UNIT (Texaco)
VACUUM ABO UNIT (Phillips)
Mobil
Phillips
Texaco
ARCO
VACUUM FIELD
Existing Monitor Wells
Proposed Monitor Wells

PROPOSED MONITOR WELL LOCATIONS

ARCO	Lea 403 State No. 6	660' FNL, 1980' FEL 17-18-35
Mobil	Bridges State No. 39	1980' FSL, 660' FWL 26-17-34
Phillips	M. E. Hale Mon. Well No. 1	1310' FSL, 660' FEL 35-17-34
Phillips	EVGSAU Mon. Well No. 1	660' FSL, 1310' FWL 32-17-35
Phillips	EVGSAU Mon. Well No. 2	1980' FSL, 10' FEL 28-17-35
Texaco	CVU No. 91	660' FSL, 1980' FWL 36-17-34
Texaco	State AP No. 2	2310' FSL, 1650' FWL 9-18-35
Texaco	State AN No. 6	990' FSL, 2310' FEL 7-18-35

<u>PRESSURE AND TRACER TESTING</u> - Charge No. 2

The charge as stated read pulse testing. The Technical Committee took this to mean interference testing. The major goals to be determined by pressure testing the salt section are areal extent, communication, and flow characteristics. The following procedure developed by Phillips' research was accepted by the Technical Committee.

INTERFERENCE TESTING BETWEEN MONITOR WELLS

Objectives:

1. Determine if the two monitor wells are in communication.
2. Develop a better understanding of the characteristics of flow in salt zones.
3. Determine depth(s) of flow(s).
4. Develop refined procedures for subsequent tests.

Procedure:

1. Approximately two weeks before drilling into the salt in Supplemental Monitor Well No. 1, begin opening up Texaco's Central Vacuum Unit (CVU) Monitor Well No. 1 with fresh water. Install surface pressure gauge with automatic pressure sampling and continuous digital recording capabilities.

2. One week before drilling into the salt, shut in CVU Monitor Well No. 1 and begin recording hourly pressure readings.

3. Prepare equipment for surface pressure measurement on Supplemental Monitor Well No. 1 (automatic sampling and digital recording capabilities). Prepare equipment for flow rate measurement and salt water disposal.

4. Drill through salt section.

5. If a significant flow occurs at Supplemental Monitor Well No. 1, begin recording pressures and flow rates at new well at 15 minute intervals.

6. Response time for an observable pressure response at CVU Monitor Well No. 1 may vary from a few hours to several days or more depending on flow rate, storage and flow characteristics in salt "conduits". If no response occurs after 72 hours, continue recording pressures hourly for another 72 hours, then begin recording pressures daily. If a response does occur, continue recording pressures hourly until all drawdown/buildup testing on Supplemental Monitor Well No. 1 is completed.

7. If no response at CVU Monitor Well No. 1 occurs after 144 hours of flow at Supplemental Monitor Well No. 1, shut in Supplemental Monitor Well No. 1. If a response does occur, shut in Supplemental Monitor Well No. 1 72 hours after initial response. Record

buildup pressures at Supplemental Monitor Well No. 1 at 4 minute intervals for 2 hours, continue at 15 minute intervals for 2 additional hours, then continue hourly for a total of 10 days.

8. Leave surface pressure equipment in place in both Supplemental Monitor Well No. 1 and CVU Monitor Well No. 1. Record pressures daily for an indefinite period at both wells.

9. A modification of this procedure may be used to conduct tests on subsequent monitor wells whether newly drilled or recompleted. For each new interference test run, all existing monitor wells should be included.

A procedure to test between injection wells and monitor wells was not provided. Lack of information such as characteristics of flow through salt and unknown effects such as interference of pressure transients in existing operations precluded the ability to design such a test. Once the information from interference testing between monitor wells has been concluded, tests between injection and monitor wells should be addressed.

If these tests prove inconclusive, a tracer program should be evaluated for confirmation. Information from pressure testing would be necessary in designing a tracer program. A tracer program would require extended flowing of monitor wells and the subsidence problem should be evaluated prior to inception.

Phillips' Research Department, in designing the interference testing procedure, conceived the idea of evaluating falloff tests for abnormally high wellbore storage to detect channels or possible caverns. The Technical Committee recommends re-evaluating any available falloffs and scheduling of new tests to help identify suspect wells. Conventional testing procedures utilizing sensitive recording devices to measure early time data is absolutely necessary. A review of old tests data should aid in this design. Mapping of bottom hole pressures acquired from these tests may be helpful in identifying suspect areas.

LOGGING PROGRAM - Charge No. 3

The charge set forth by the Management Committee classified suspect wells as any well with greater than 900 psi wellhead pressure. A list of these wells by operators and units is identified in the suspect well section. A full consensus of the Technical Committee agreed to run radioactive injection profiles using scintillation detectors in conjunction with temperature surveys in a limited number of suspect wells throughout the field to detect channeling behind pipe and look for anomalies which can verify the validity of the various techniques available.

The following information was collected by Phillips' research on available logging techniques and are listed in preferential order.

1. Radioactive Tracer survey. These can be run through tubing. Only tools having multiple scintillation detectors should be run, as Geiger-Mueller tubes are too inefficient to track the slug through high density material (casing and cement). The tools that utilize the Geiger-Mueller detectors were designed to trace the slug as it moves inside the casing and is useful to determine where flow is leaving the pipe. All four of the major wireline companies recommended the tracer survey using

scintillation detectors as the most reliable technique for detecting channeling of injected fluid.

2. Nuclear decay time log (TDT, PDK100, TMD) set to monitor the activated oxygen. This is the same principle as the Texaco log, but is much less sensitive (would require larger fluid volume flow) and would be strictly qualitative. This survey can be run in tubing. This should be tried as it would be among the fastest methods for surveying all injection wells.

3. Texaco neutron activation tool. This tool was developed by Texaco specifically for measuring the rate of flow of fluids behind casing. The principle is similar to the radioactive tracer log except that this tool is much more complex and it creates the radioactive tracer material by nuclear processes everywhere in the proximity of the neutron generator instead of just releasing a slug inside the casing. This is the only tool that can be used to calculate the volume of fluid flow, although others may give some information about fluid flow velocity. This tool is run at stations in depth. The size of the tool, 3-5/8" diameter, requires tubing to be removed from the well. Fluid flow must be occurring

in the channels during the measurement, which requires that the fluid be pumped down into the casing. How much pressure can be safely put on the casing is a question that must be considered. Although Dresser-ATlas has licensed this tool, the one that is operated by Texaco is the only one that has been calibrated for quantative measurements.

4. Radial Differential Temperature survey. Only Gearhart offers this service. Due to signal-to-noise problems, it can't log inside tubing, but can be lowered through the tubing and run in the casing between the top perforations and bottom of the tubing string. The tool is stopped at a depth point and the two temperature probes extended outward at 180 degrees to contact the casing. The tool is rotated (usually about 4-6 times and averaged) and the difference in temperatures between opposite sides of the borehole plotted versus angle. The tool can measure temperature differences of 0.01 degree Fahrenheit. About 15 minutes/station is required for the tool. The tool has rotating parts and extension arms, so it has some maintenance and reliability problems, but usually is pretty reliable in 5-1/2" and smaller casing. The tool can usually be repaired rapidly at wellsite. Uniform flow (the same in all directions around the

pipe) cannot be detected; fluid has to be preferentially moving upward on one side of the well to cause the temperature difference across the hole. A very good use of this tool is to combine it with a perforating gun to direct the perforations into the channels. The usual method is to perforate in a 60 degree angular spread in the direction selected by the radial temperature tool.

The following logs have some potential, but are judged to have a much lower probability of success.

5. Standard slim-hole gamma ray log. This would be run to establish a base log. A radioactive substance would then be injected at the surface and pumped down. The log would be run following the injection of the radioactive tracer and a sufficient volume of water to purge the tubing. Any tracer in the annular region would show up as an increase compared to the base log. This technique was suggested by Dresser-Atlas and they further recommended using material such as fertilizer with high potassium content of KCl as the tracer, as no permit would be required for this substance. The effect would not be large enough to detect reliably, especially as the background would likely be altered by the injection process.

6. TDT (PDK100 or TMD) run in standard mode to determine sigma, the capture cross-section. This would require running about 4-6 passes and averaging them to obtain a base log, the injection of large amounts of boron, and then running several additional passes of the tool to obtain a comparison log. If boron is present in a channel after injection, it should show up as a shift toward higher sigma on the log. This is a technique Schlumberger has suggested before, but still has not been tried.

Two other logs were suggested, but are judged to be virtually of no value for this project, the differential temperature log (vertical differential) and the noise log. Each of these logs might be of use in downward flowing channels, but is usually not of any help for detection of upward channel flow.

A more indirect approach to the problem would be to examine the salt adjacent to the injection wells and assume that if the well is leaking along vertical channels, the leaching of the salt would have caused a cavern to develop. The three logs that could be of use in locating caverns are the neutron log (including the cased hole version), the waveform sonic log, and the high frequency cement evaluation log. It is my opinion that the more direct methods should be tried first and these techniques run in holes found to have severe channeling to look for caverns that might allow subsidence to occur.

After the first round of wells have been logged, any suspicious wells should be re-evaluated by one or more of the above methods. The Geologic Committee may detect a possible logging method to aid in their report. Coordination between the committees should be maintained in order to minimize costs.

Methods to prioritize the list of wells to log included proximity to hot spots, injection volumes, rates and pressures. Texaco has identified 13 wells as preliminary candidates for injection profiles and 16 wells for pressure falloff tests. Falloff tests are being run in conjunction with injection profiles to evaluate their usefulness as a fairly inexpensive method to exonerate suspect wells. Phillips has assigned a priority of testing by proximity to the known problem areas. Basically starting from the west edge of the East Vacuum Grayburg San Andres Unit and working eastward. Mobil has proposed 15 San Andres and 20 Abo water injection wells for radioactive tracer and temperature surveys as a first pass. Results of these runs will help determine the need for additional activity such as falloff tests, TDT logging, etc.

VACUUM FIELD - ARCO OPERATED
WATER INJECTION FOR JUNE, 1986

Well No.	Surface P	No. Days Injected	Avg Daily Rate-BWPD	Monthly Inj-BW	Cumulative Inj-BW
State Vacuum Unit					
1	1485	2	3	5	14666
2	1463	25	54	1344	206908
4	1473	26	17	439	47692
7	1474	30	211	6326	938492
9	1462	30	514	15420	1928392
11	1464	30	312	9373	828602
13	1464	30	137	4116	376444
15	1464	30	332	9966	1523370
17	1465	30	64	1932	164596
19	1464	30	97	2897	463647
21	1460	1	1	1	6716
	TOTAL		1742	51819	6499525
Sinclair Vacuum SWDS					
1	2150	30	2221	66624	9828061

MOBIL BRIDGES STATE (SAN ANDRES) WATERFLOOD

INJECTION WELL DATA AS OF JULY 31, 1986

WIW NO.	INJ. RATE (BWPD)	CUM. INJ. (MBW)	WHP (PSIG)
2*	368	2211	2100
3*	435	1427	2150
5*	64	551	2131
6*	616	1786	2125
7*	66	2523	2125
20*	33	2467	2125
21*	389	1431	2113
24*	135	869	2192
30*	257	1472	2075
31*	34	2886	2163
32	236	824	2075
35	473	1777	2031
37*	244	2203	2193
42	29	482	2150
43*	464	1385	2106
47	128	2129	2081
48*	29	1571	2100
52	40	533	2100
56	100	1799	2150
62	488	2510	2150
63	304	906	2238
64*	359	1824	2250
105	179	1023	2113
127	33	832	2112
132	383	1108	2150
State "G" 3	258	1002	2100
State "J" 1*	157	1138	2088
State "J" 4	165	811	2200

* Planned for Tracer and Temp. Surveys

KKSingh
9/24/86

A:M626744B.KKS

NORTH VACUUM ABO FIELD

INJECTION WELL DATA AS OF JULY 1986

NORTH VACUUM ABO UNIT

WIW NO.	INJ. RATE (BWPD)	CUM. INJ. (MBW)
96	230	1257
98	63	4
109*	260	1445
112	153	7
117*	415	2249
118*	345	1789
119*	314	1623
124*	108	610
128	133	755
129	74	6
130	158	778
140*	261	1078
143	201	6
144	81	435
145	77	562
147*	245	1022
148*	291	1103
150*	356	1664
151	3	121
153	99	757
155	245	8
156	148	8
157*	231	1486
159*	222	1080
161	193	1044
166	156	903
169	185	976
171*	79	493
172	166	930

NORTH VACUUM ABO FIELD

INJECTION WELL DATA AS OF JULY 1986

WIW NO.	INJ. RATE (BWPD)	CUM. INJ. (MBW)
173	158	536
175	224	700
202*	280	1472
203	169	5
204	87	3
205	191	11
207*	312	2296
208*	55	267
209	194	6
211	107	8
212*	170	1283
213	25	788
216*	314	1702
217	235	1000
218	178	898
219	149	758
220	125	564
228	123	547
231	215	938
302	19	1
NORTH VACUUM ABO EAST UNIT		
1	73	23
2	47	23
3*	32	283
4*	40	312
5	46	16
6	46	23
7*	53	442
8	27	164
9	69	26
10	44	19
11	27	145

* Wells for Radioactive Tracer/Temperature Surveys

NOTE: All wells have WHP greater than 900 psig.

Date: September 16, 1986
Number: 00000034

To: M. H. Brownlee
From: M. V. Navarrette
Subject: Vacuum Field Injection

The following is a list of all injection wells in the Vacuum Field with WH pressures equal to or greater than 900 psi operated by Phillips Petroleum Company.

Lease & Well No.	July Inj. Press.	July Inj. Rate	Cum Inj to 7/1/86
M. E. Hale #14	1825	27,807	955,467
M. E. Hale #15	1800	59,051	2,417,424
M. E. Hale #16	1800	60,744	2,775,714
M. E. Hale #17	1850	27,584	1,190,597
M. E. Hale #18	1700	105,190	3,884,904
M. E. Hale #19	2100	81,382	2,242,097
Mable #4	2150	17,286	466,051
Mable #5	1950	13,076	415,113
EVGSAU #2721C001	1400	54,586	359,749
EVGSAU #2913C007	1575	19,977	78,648
EVGSAU #2913C009	1000	3,541	93
EVGSAU #2941C001	1525	11,316	11,034
EVGSAU #2947C001	1050	7,485	17,330
EVGSAU #2980C003	1650	6,463	18,474
EVGSAU #3202C009	1350	45,227	64,500
EVGSAU #3202C011	1600	37,881	23,064
EVGSAU #3229C006	1100	32,935	0
EVGSAU #3236C006	1100	105,989	97,188
EVGSAU #2059W003	1250	919	295,091
EVGSAU #1911W002	1250	3,925	209,965
EVGSAU #1910W003	1225	0	100,770
EVGSAU #2923W003	1250	1,931	295,147
EVGSAU #1952W002	1200	2,064	175,371
EVGSAU #2060W001	1225	5,201	503,527
EVGSAU #1903W004	1250	918	62,725
EVGSAU #2416W002	1250	3,155	355,600
EVGSAU #1978W002	1250	870	11,090
EVGSAU #2437W002	1250	4,729	208,662
EVGSAU #1825W002	1200	3,034	19,308
EVGSAU #2054W003	1250	1,813	173,869
EVGSAU #2418W002	1250	103	92,293
EVGSAU #1912W004	1200	436	53,761
EVGSAU #1953W002	1200	2,568	192,488

EVGSAU #1904W003	1200	2,134	147,095
EVGSAU #1910W004	1250	1,176	203,774
EVGSAU #2801W005	1250	8,088	2,433,397
EVGSAU #2864W002	1250	4,431	469,276
EVGSAU #2944W001	1250	2,568	163,089
EVGSAU #2923W002	1250	100	310,911
EVGSAU #2957W002	1250	9,849	620,501
EVGSAU #2963W005	1250	12,936	933,063
EVGSAU #2801W012	1300	12,583	1,743,168
EVGSAU #2944W002	1250	2,943	237,827
EVGSAU #2060W014	1200	3,723	108,742
EVGSAU #3127W005	1150	16,726	2,244,478
EVGSAU #3127W006	1050	18,213	2,939,294
EVGSAU #3236W008	1075	49,701	3,352,055
EVGSAU #0524W005	1175	3,507	474,957
EVGSAU #0449W002	1200	4,705	317,906
EVGSAU #0524W004	1220	1,594	131,875
EVGSAU #0546W002	1200	1,762	78,553
EVGSAU #3229W006	900	31,955	254,012
EVGSAU #3127W004	1200	53,086	191,557
EVGSAU #2738W004	1200	30,321	2,702,442
EVGSAU #2801W006	1200	13,513	2,381,005
EVGSAU #2738W006	1000	17,840	1,049,408
EVGSAU #2230W003	1000	4,348	563,707
EVGSAU #2801W015	1000	17,138	1,766,129
EVGSAU #2721W001	1200	3,053	1,907,994
EVGSAU #2721W002	1200	3,210	3,666,528
EVGSAU #2738W008	1000	13,514	1,862,178
EVGSAU #2150W001	1200	6,495	670,947
EVGSAU #2150W002	1200	0	409,973
EVGSAU #2851W002	1200	11,022	582,396
EVGSAU #2865W001	1200	21,204	819,034
EVGSAU #2230W004	900	12,136	764,176
EVGSAU #2155W001	1250	5,301	392,110
EVGSAU #2720W008	1000	3,940	238,740
EVGSAU #2622W004	1000	16,015	4,057,563
EVGSAU #2717W005	1200	46,564	3,835,113
EVGSAU #2717W003	1350	25,437	3,268,495
EVGSAU #2622W003	1200	1	246,027
EVGSAU #2271W003	1100	538	26,508
EVGSAU #2622W007	1200	368	29,830
EVGSAU #3333W006	1150	13,781	3,053,721
EVGSAU #0449W001	1225	2,747	236,638
EVGSAU #3315W007	1150	2,616	1,167,076
EVGSAU #3315W009	1275	7,530	826,969
EVGSAU #3440W006	1200	9,808	579,704
Lea #W04	1700	493	23,980
Lea #W06	1700	1,557	46,264
Vacuum Abo #15W03	150*	5,111	79,522
Vacuum Abo #13W18	150*	34,612	426,114
Vacuum Abo #13W07	150*	254	51,142
Vacuum Abo #12W02	150*	15,995	315,114

*Operating at 1800# pressure in September, 1986.

TEXACO OPERATED

NORTH VACUUM ABO WEST UNIT

AS OF 8-1-86

Well No.	Average Pressure	Rate (BPD)	Cumulative
2	3300	8	7,203
4	3250	107	103,693
7	3200	100	33,943
10	3400	3	2,412
11	3400	6	3,362
12	3300	11	5,925
16	3300	20	57,864
17	2700	336	158,225
18	3200	115	124,527
21	3200	152	163,614
22	3200	89	73,116
25	3200	37	114,916

* Injection profiles only.

** Injection profiles and pressure falloff tests.

*** Pressure falloff tests only.

TEXACO OPERATED

WEST VACUUM UNIT

AS OF 8-1-86

Well No.	Average Pressure	Rate (BPD)	Cumulative
4	1550	35	307,066
5	1600	0	251,519
7	1550	16	417,538
9	1600	0	411,947
11	1600	31	932,051
16	1600	117	968,112
18	1550	164	1,788,616
20	1625	112	1,934,426
23	1550	262	2,378,709
* 25	1700	624	3,196,686
* 27	1300	449	5,151,219
30	900	15	134,363
32	1600	173	1,502,035
34	1600	275	1,451,982
* 36	1300	814	4,901,616
40	1600	83	541,084
42	1600	87	1,060,879
44	1500	70	1,061,655
48	1500	88	1,149,763
55	900	235	396,037

* Injection profiles only.

** Injection profiles and pressure falloff tests.

*** Pressure falloff tests only.

TEXACO OPERATED

VACUUM GRAYBURG SAN ANDRES UNIT

AS OF 8-1-86

Well No.	Average Pressure	Rate (BPD)	Cumulative
4	1075	1	7,409
14	1150	207	190,221
15	1800	725	5,707,366
16	1200	140	242,246
17	1725	790	7,112,933
19	754	125	5,769,195
29	1800	372	2,829,000
* 31	1500	2383	7,974,483
33	1700	2167	6,035,667
** 35	1325	973	2,363,458
45	1900	751	5,326,758
* 47	1900	1021	6,537,787
** 49	1300	1922	9,132,711
65	1320	211	94,468

* Injection profiles only.

** Injection profiles and pressure falloff tests.

*** Pressure falloff tests only.

TEXACO OPERATED

CENTRAL VACUUM UNIT

AS OF 8-1-86

Well No.	Average Pressure	Rate (BPD)	Cumulative
5	1020	51	473,251
7	900	33	344,565
15	1050	93	618,928
*** 25	900	887	2,813,482
* 27	900	668	2,664,976
31	1270	468	1,692,414
41	1120	584	2,581,840
* 45	1100	791	2,282,017
* 56	1020	738	2,904,341
*** 57	850	764	3,242,216
*** 58	870	905	3,250,631
60	900	685	2,025,811
*** 72	865	453	3,710,945
*** 73	860	1794	3,596,915
** 100	1000	454	1,587,786
108	1380	23	235,739
***113	1000	21	319,577
115	912	14	271,906
***120	850	48	240,220
121	960	0	161,300
122	930	17	245,022
129	900	28	198,301
***134	860	4	955,847
***135	840	103	958,277
** 138	925	925	3,133,288
144	950	364	867,253
** 145	1260	1029	1,725,593
149	1360	4	114,406
150	1040	14	304,721
154	950	34	286,077
***156	880	744	1,111,687
***157	875	732	907,005

* Injection profiles only.

** Injection profiles and pressure falloff tests.

*** Pressure falloff tests only.

Technical Committee on Vacuum Field Water Flow

ARCO Oil and Gas Company's Response to Management Committee Charges

ARCO Oil and Gas Company plans to actively pursue a program to locate the source or sources of fluid entry in the salt section. Further, AOGC will establish programs to monitor "Hot Spot" locations for water flow indications and for localized subsidence. AOGC will fully support other unit operators in their efforts to solve these problems. AOGC's response to the Management Committee charges are as follows:

1. AOGC has selected a location to drill a monitor well at 1980' FNL and 660' FEL in Section 17-T18S-R35E. As an alternative to drilling this monitor well, AOGC recommends re-entering the Lea 403 State No. 6 (660' FNL and 1980' FEL, Section 17) and completing it as a monitor well. Several factors support this alternative. The cost to re-enter the Lea 403 State No. 6 will be substantially less than drilling a new well. A strong chance exists due to the nature of fluid flow in salts that neither a new well nor a recompleted well will encounter water flows in the salt section. If a water flow is encountered, the mechanical completion of the No. 6 well will suffice for all test purposes other than a long-term tracer test.

2. AOGC concurs with the interference test procedure as proposed by Phillips. The interference test between monitor wells will help determine the extent of communication within the salt section and provide information to determine the flow characteristics of the salt section. With this information, interference testing between select injection wells and the monitor wells should be pursued. If interference tests establish that communication exists between particular wells, then the merits of a RA tracer program for confirmation will be evaluated.

3. AOGC plans to run RA tracer surveys in injection wells using tools with multiple scintillation detectors to detect behind pipe fluid movement. All wells with surface injection pressures greater than 900 psi will be surveyed. Other tools if proven to be more efficient or if needed for verification purposes will be used. To supplement these tests, AOGC supports plans to re-analyze existing pressure falloff tests and possibly schedule new pressure tests to determine wells with large storage volumes. Other tools to detect washouts or caverns behind pipe also will be evaluated.

Mobil Producing Texas & New Mexico Inc.

P O BOX 633
MIDLAND, TEXAS 79702

MIDLAND DIVISION

September 25, 1986

Vacuum Field Waterflow
Technical Committee Members

VACUUM FIELD SALADO WATERFLOW
MOBIL'S PLAN OF ACTION

Several methods have been proposed and discussed in the Technical Committee meetings on the subject matter. All of these may have some value in certain parts of the Vacuum Field in the San Andres reservoir. Mobil is in agreement with the Committee that annulus and bradenhead pressure surveys be run and the mechanical integrity of every injection well be checked. The following comments are made as our contribution to the committee as far as Mobil's operations are concerned.

Pulse Testing

In our opinion, the suggested testing between Texaco's monitor well and new wells drilled in the salt section (and completed open hole) will be time consuming. The fluid flow behavior in the salt formations is not well understood. Parameters required to design a pulse test program are unknown at best. Further, leaving the sensitive pressure gauges required to detect the extremely small ΔP's, in the borehole for long period of time poses operational risks. The whole exercise may end up in just a waste of time and resources.

Interference Testing

Even though this test does not require highly sensitive pressure gauges (as does the pulse testing), the reasons that it may not prove very successful are the same as noted under pulse testing.

In our opinion, a better and simpler way to prove whether or not there is communication is to monitor pressure by perforating the salt section and measuring pressure change with time. This does not require drilling new monitor wells and can be easily accomplished by using already available TA'd or SI wells, and thus reducing the cost of drilling new wells. Mobil has identified one well to run this type of testing. This TA'd well is close to the single identified "Hot Spot" on Mobil's lease. Since the magnitude of problem in Mobil leases is relatively insignificant, this test should be adequate.

A:M626744A.KKS

Mobil

Profile Survey Program

In our opinion, most useful information can still be gained by running injection profiles in the injection wells. Since no single survey can be 100% diagnostic by itself, Mobil recommends running combination surveys. Mobil plans to run radioactive tracer and temperature survey in about fifteen San Andres and twenty Abo water injection wells fairly distributed over our leases.

Pressure Fall-Off Tests

If the planned study by Phillips of the earlier fall-off tests proves useful, Mobil will run such tests in selected San Andres injection wells, in addition to the tests already described.

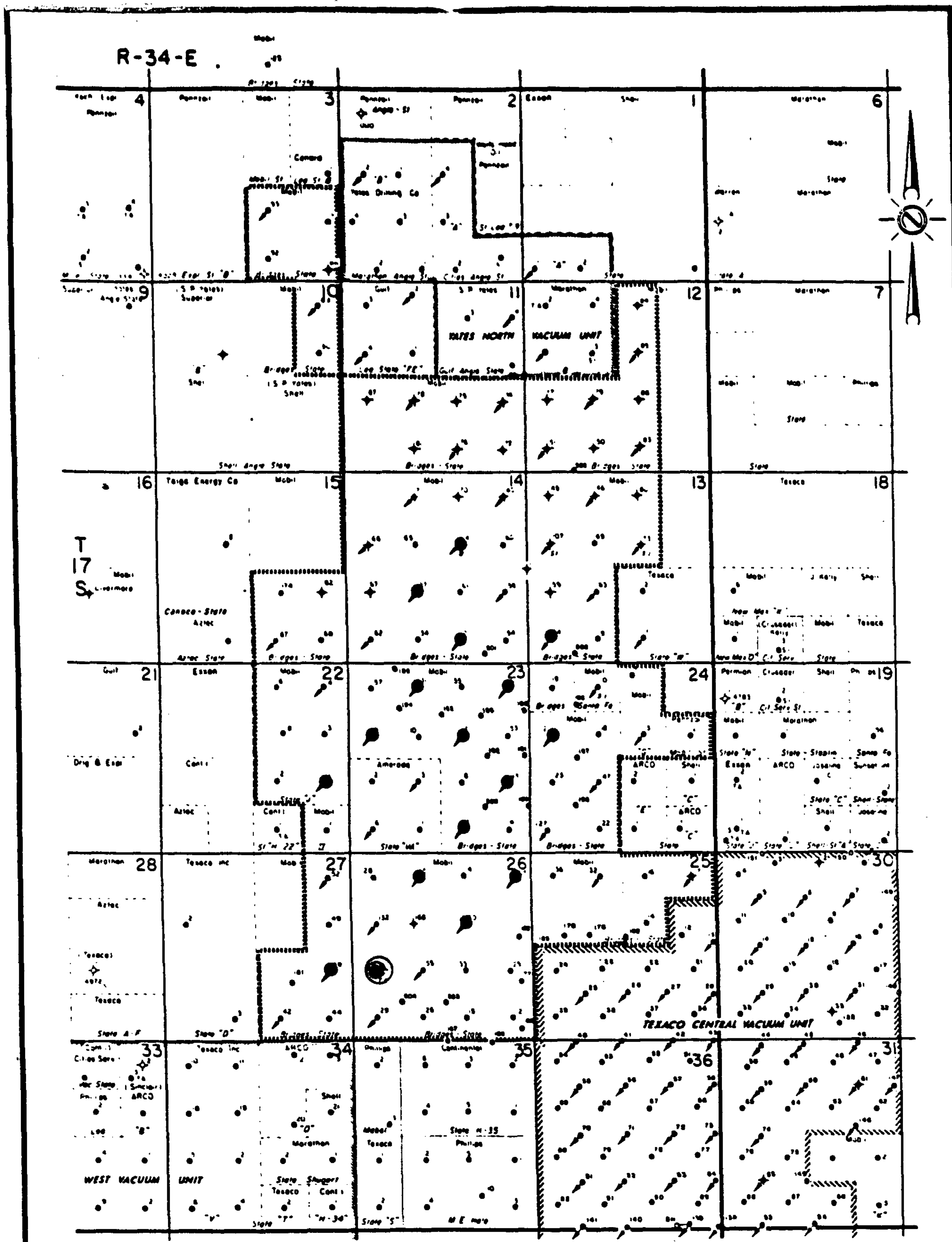
Additional Tests

In the event Geological/Geophysical Committee's work indicates the need for any new tests or use of new tools, we will consider their recommendations in our testing program.

Mobil intends to fully cooperate with the Technical Committee if any other viable and useful methods are proposed.

cc: Environmental and Regulatory
Reservoir Engineering

A:M626744A.KKS



● TRACER/TEMP (OTHER APPROPRIATE TOOLS)

● PRESS. MONITORING SALT SECTION

LEGEND

- • OIL WELL
- TEMPORARILY ABANDONED OIL WELL
- DRY HOLE
- PLUGGED & ABANDONED WELL
- WATER INJECTION WELL
- ABANDONED INJECTION WELL
- UNIT BOUNDARY
- FLOOD AREA

Mobil Producing Texas & New Mexico Inc.
Midland Division

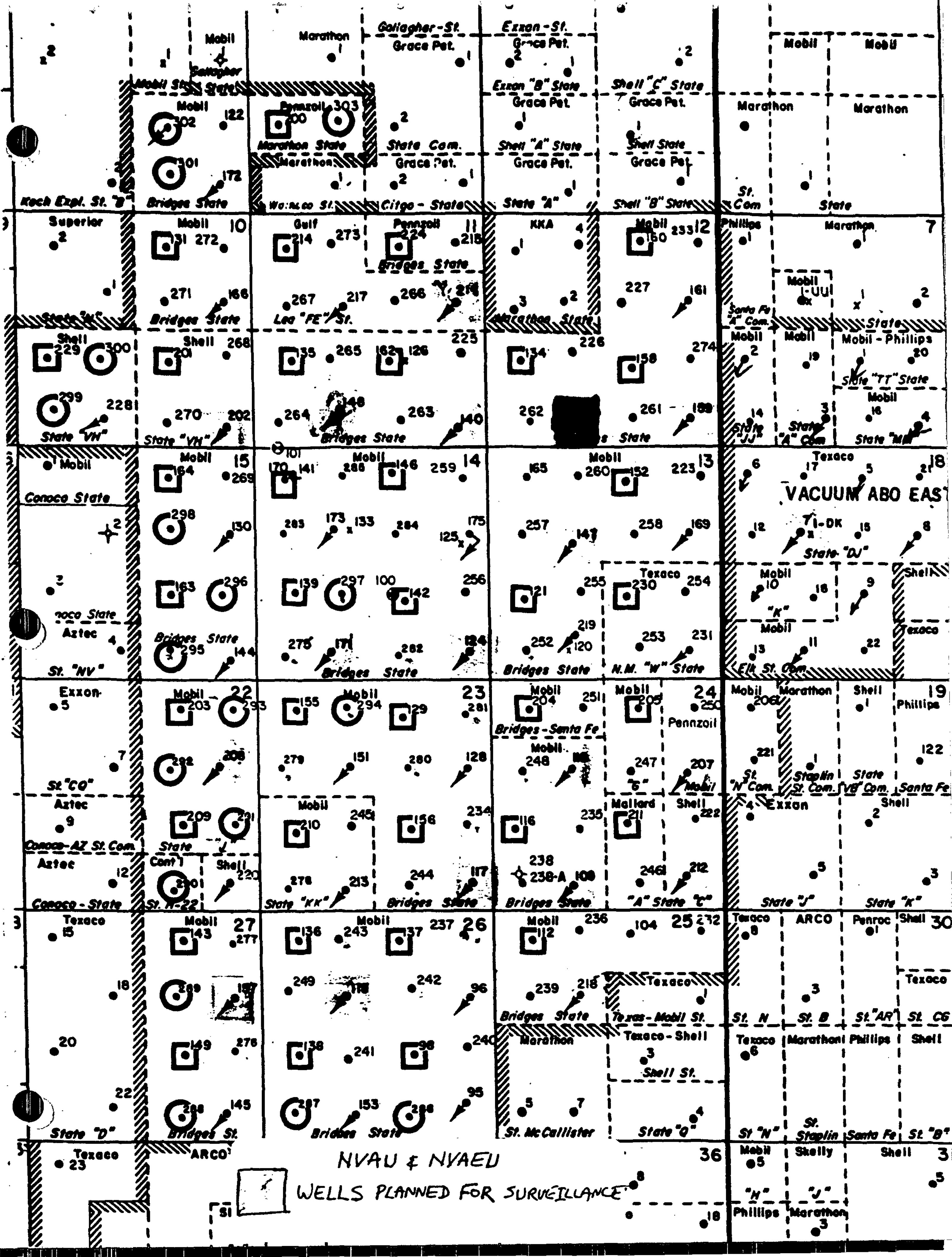
VACUUM (GRAYBURG-SAN ANDRES) POOL

BRIDGES-STATE LEASES

Lea County, New Mexico

K K SINGH

11/85


VACUUM ABO EAST
NVAU & NVAEU
WELLS PLANNED FOR SURVEILLANCE
Mobil
Marathon
Gallagher-St.
Exxon-St.
Grace Pet.
Mobil State
Marathon State
State Com.
Exxon "B" State
Shell "C" State
Shell "A" State
Shell State
Koch Expl. St. "B"
Bridges State
Citgo - State
State "A"
Shell "B" State
Superior
Gulf
Pennzoil
KKA
Phillips
Lea "FE" St.
Marathon State
Santa Fe "A" Com.
Shell
Mobil - Phillips
State "TT" State
State "VH"
State "JJ"
State "A" Com
State "MM"
Conoco State
Texaco
State "DJ"
Aztec
St. "NV"
N.M. "W" State
Elk St. Com.
Exxon
Bridges - Santa Fe
Pennzoil
St "CO"
Conoco-AZ St. Com.
Conoco - State
St. N-22
State "KK"
Mallard
"A" State "C"
State "J"
State "K"
Penroc
ARCO
Texas - Mobil St.
Texaco - Shell
Shell St.
St. McCallister
State "Q"
State "D"
Bridges St.
Staplin Santa Fe
St. "B"
Skelly
Phillips
36

VACUUM FIELD WATERFLOW TECHNICAL COMMITTEE
Phillips' Response to Management Committee Charges to the Technical Committee
September 24, 1986

Charge No. 1. Drilling of monitor wells

The names and locations of the three possible wells to be drilled by Phillips are as follows.

- M. E. Hale Monitor Well #1 -- 1310' FSL & 660' FEL, Sec. 35, Unit P, T-17-S, R-34-E, Lea County, New Mexico.
- EVGSAU Monitor Well #1 -- 660' FSL & 1310' FWL, Sec. 32, Unit M, T-17-s, R-35-E, Lea County, New Mexico.
- EVGSAU Monitor Well #2 -- 1980' FSL & 10' FEL, Sec. 28, Unit I, T-17-s, R-35-E, Lea County, New Mexico.

We recommend that the bradenhead waterflow maps be updated in order to show that the locations of the monitor wells are indeed in "hot spots".

Charge No. 2. Pressure testing programs

Phillips' recommendation for interference testing between monitor wells is attached. We feel that the major goals to be gained by this program are as follows.

1. Determine if monitor wells are in communication.
2. Define some properties of the salt formation.
3. Determine areal extent of the problem.
4. Discover depth of flows.
5. Define information necessary to refine procedures for subsequent tests.

The monitor wells should be drilled in sequence in order to minimize complications in testing.

We further recommend that falloff tests be run in all injection wells with a wellhead pressure of 900 psi or higher. These tests can be used to identify storage. Abnormally high storage volumes may be indicative of cavities (possibly in the salt section) near the wellbore. This data can then be used to prioritize the well sequence for logging.

Tracer testing is still a possibility somewhere in the distant future. Its problems and inconclusiveness however make its use somewhat remote.

Charge No. 3. Injection well logging program

Phillips' evaluation of logging tools that can be used to check for channel flow behind pipe is attached. It is our opinion that more than one tool be used initially to confirm readings in the field. Wells whose falloff tests show high storage volumes could serve as good candidates for this logging program.

We recommend the use of radioactive tracer surveys (using only tools with multiple scintillation detectors) run in conjunction with a continuous reading temperature tool. Cement evaluation tools should also be run to check for good bonding. Phillips also has no objection to pulling the tubing in order to run a log in the casing if such an effort will give better results.

Texaco USA

P O Box 728
Hobbs NM 88240
505 393 7191

October 8, 1986

Vacuum Field Waterflow
Technical Committee

RE: TEXACO RESPONSE TO MANAGEMENT COMMITTEE CHARGES

Charge No. 1 - Drilling of Monitor Wells

Texaco is of the firm opinion the extended flowing of a monitor well or system is an extreme risk. If the monitoring program is for the purpose of pressure testing, the recompletion of available wellbores will suffice. Experience dictates such a completion would be of little benefit should a tracer program be implemented. The following wells have been designated for recompletion purposes:

Central Vacuum Unit No. 91	660' FSL,	1980'	FWL,	36-17-34
State AP No. 2	2310' FSL,	1650'	FWL,	9-18-35
State AN No. 6	990' FSL,	2310'	FEL,	7-18-35

Charge No. 2 - Pressure Testing and Tracers

Texaco concurs with Phillips' proposed interference testing procedure. Adaption of this procedure to recompletions rather than newly drilled wells should be easily manageable. Information learned from pressure testing such as establishing communication and flow behavior through salt is essential prior to designing a tracer program. Should future work indicate a tracer program to be beneficial, the subsidence question will have to be addressed.

Charge No. 3 - Well Survey Program

Texaco agrees with Phillips' evaluation of available logging techniques and supports falloff testing as a viable means of identifying areas suspect for out of zone injection. Injection profiles, run in conjunction with falloff tests in a representative sampling of wells, should determine which of these methods is the most viable to delineate channeling. Anomalies detected by these methods will be investigated by other techniques as recommended by Phillips' evaluation. Once a technique has proven more successful, it will be expanded to encompass the entire field. Mapping pressures will identify areas of suspicion. Once injection wells have been exonerated, suspect producing wells should be investigated.

DCC:jss

VACUUM FIELD WATERFLOW
MANAGEMENT COMMITTEE MEMBERS

ARCO Oil & Gas Company
Mr. John Roam
P. O. Box 1610
Midland, Texas 79702

Conoco, Inc.
Mr. Hugh Ingram
P. O. Box 460
Hobbs, New Mexico 88240

Mobil Producing Texas & New Mexico, Inc.
Mr. Matt Sweeney
P. O. Box 633
Midland, Texas 79702

Phillips Petroleum Company
Mr. Bill Mueller
4001 Penbrook
Odessa, Texas 79762

Texaco Inc.
Mr. Bancker Cade
P. O. Box 728
Hobbs, New Mexico 88240

VACUUM FIELD WATERFLOW
TECHNICAL COMMITTEE MEMBERS

ARCO Oil and Gas Company
Mr. David Douglas
P. O. Box 1610
Midland, Texas 79702

Conoco Inc.
Mr. Brian Horanoff
P. O. Box 460
Hobbs, New Mexico 88240

Marathon Oil Company
Mr. Dan Taimuty
P. O. Box 552
Midland, Texas 79702

Mobil Producing Texas and New Mexico, Inc.
Mr. Bill Hermance
P. O. Box 633
Midland, Texas 79702

Mobil Producing Texas and New Mexico, Inc.
Mr. Kris Singh
P. O. Box 633
Midland, Texas 79702

Phillips Petroleum Company
Mr. Mike Brownlee
4001 Penbrook
Odessa, Texas 79762

Phillips Petroleum Company
Mr. Charley Lord
233 APL
Bartlesville, Oklahoma 74004

Phillips Petroleum Company
Ms. Arlene Pollin
335 Frank Phillips Bldg.
Bartlesville, Oklahoma 74004

Texaco Inc.
Mr. David Cain
P. O. Box 728
Hobbs, New Mexico 88240

Texaco Inc.
HRC (Briar Park)
Mr. Jim Varnon
P. O. Box 770070
Houston, TX 77215-0070

VACUUM FIELD WATERFLOW
GEOLOGICAL-GEOPHYSICAL COMMITTEE MEMBERS

ARCO Oil and Gas Company
Mr. Robert Orlando
2300 West Plano Parkway, PAL 508
Plano, Texas 75075

Mobil Producing Texas and New Mexico, Inc.
Mr. William Hermance
P. O. Box 633
Midland, Texas 79702

Phillips Petroleum Company
Mr. David White
4001 Penbrook
Odessa, Texas 79762

Texaco Inc.
Mr. Ed. Horvath
P. O. Box 3109
Midland, Texas 79702