ESE and ASSOCIATES INC.

DST Interpretation - Pressure Transient - Deliverability Analysis
Material Balance Determinations

SAMUEL GARY, Jr. & ASSOCIATES, INC.

GARY Herd 34-14

330fsl 1650fwl Sec.34 Twp.32s Rge.19w
(Mississippian Chert, gas)
Comanche County, Kansas

Trilobite Testing LLC
TWO HOUR DRAWDOWN PLUS BUILDUP
1998 October 16-20

MODEL ANALYSIS
and
TRANSIGAStm PROJECTIONS

Prepared
1998 October 31
K. Glen Morrison

FEKETE, F.A.S.T.tm and SYNtm software systems.

ESE and ASSOCIATES INC.

1998 October 20

Thomas G. Fertal, Petroleum Geologist
SAMUEL GARY, Jr. & ASSOCIATES, INC.
1670 Broadway, Suite 3300
Denver, CO 80202

Re: SAM GARY Herd 34-14
Mississippian Chert- gas
330 fsl 1650fwl Sec.34 Twp.32s. Rge.19w
Comanche County, Kansas

Dear Tom:
I have reviewed the October 16-20, 1998, test data made available to me by Trilobite Testing, LLC, as well as the logging, completion records and geological information that was forwarded to me by your office.

This well was perforated at 5098-5101 and 5107-13 feet (for a net of nine feet) on October 15, 1998, followed by a mud acid treated of 1000 gallons of 7.5% HCL. Subsequent swabbing and flowing of the well for five hours that day, and another four hours the following day, recovered approximately 85 % of the load and treating liquid. Electronic recorders were run in the hole and the well flowed for a 1.87 hour period prior to shutting it in for a pressure buildup of 90.592 hours.

As the amount of drawdown did not activate the reservoir sufficiently to create a clear radial flow condition (reservoir representative) the data has been treated somewhat like a drill-stem test with a long buildup. A reservoir model has been created and production projections made on a theoretic 160 acre reservoir basis.

GAS RESERVE ESTIMATE (SYNtm-thesized 160 acre model)*:

Initial Gas In Place	IGIP	450	MMcf
Initial Recoverable Gas in Place	IRGIP	427	MMcf
Initial Marketable Gas in Place	**IMGIP**	**396**	**MMcf**

* Simulated Model

TESTED RESERVOIR REGION

• **SYNtm-thesized reservoir interpretation:**			
• Synthesized initial pressure (assumed)	p	1,677.90	psi
• Effective permeability (gas)	k1	0.29	md
• **Measured skin effect**	**s**	**+ 2.01**	
• Wellbore Storage factor	CD	155.48	
• Equivalent Test radius	r1	10.80	ft.
• **Effective permeability (gas)**	**k2**	**0.11**	**md**
• Equivalent Test radius	r2	455.61	ft.

RESERVOIR CHARACTERISTICS:

Assumptions and other data:

Net formation thickness	h	10.0	ft.
Average porosity	Φ	20.0	%
Mineral water saturation	Sw	40.0	%
Oil Saturation	So	0.0	%
Gas saturation	Sg	60.0	%
Abandonment pressure	Pr_2	100.0	psia
Formation Temperature	T	134.0	0 F
Drainage Area (assumed)	A	160.0	Acres

For TRANSIGAStm projections (assumed 160 acres):

Effective permeability (gas)	k1	0.60	md
Measured skin effect	s	-4.50	
Equivalent radius	r1	300.00	ft.
Effective permeability (gas)	k2	0.11	md
Equivalent Drainage radius (160 acres)	r2	1,490.00	ft.

Deliverability:

	Treated 160 acre Model	
Time	**Annual**	**Production**
Year	**MMcf**	**Gas rate Mcf/d**
one	87.093	238.45
two	63.268	173.22
three	53.320	145.98
four	46.359	126.92
five	40.426	110.68

Deliverability (cont'd):

Time Year	Annual MMcf	Production Gas rate Mcf/d
six	35.263	96.54
seven	30.760	84.22
eight	26.831	73.46
nine	23.404	64.08
ten	20.415	55.89

COMMENTS:

After the recorders were in the well for approximately two and one-half days they fell free from the wireline and into the un-recovered liquid. In order to correct the data a pressure of 8.6 psi was subtracted from all readings after 63.1 hour. All recorded readings were also corrected for absolute pressure by adding 13.0 psi.

A view of the temperature graph during buildup on the VALIDATAtm plot shows the influence of the swabbing, along with the short flow period, prior to the well being shut in. The combination of the **swabbing, un-recovered liquids and short drawdown** all had an impact on the quality of the buildup data and reduced the amount of analysis that could be performed. However, the **immediate wellbore** buildup analysis allowed us to identify that the well, in its current condition, has some **positive skin effect (damage)** and the test allowed us to establish a value for the permeability of the virgin state reservoir.

The SYNtm-thesized **Composite Model** shows the best interpretation of the test and allowed me to simulate the results of a moderate sand fracture treatment. This model is then used to project the production from a well draining a 160 acre reservoir.

The same model has been used in our Test Design Program to show how an after treatment test would perform and the time period required for each step of the test. In this case we have built in the Kansas Corporation Commission Four Point (G-1), the Twenty-four hour Deliverability Test (G-2) and the extended drawdown period that would allow a full scale evaluation of the reservoir.

RECOMMENDATIONS:

- Conduct a small acid treatment using a Halliburton (or equivalent) PPI tool.
- Perform a sand fracture treatment.
- Flow the well to cleanup all treating and load liquids.
- Shut-in for 72 hours to stabilize the reservoir.
- Using electronic recorders perform the Four Point KCC G-1 test to establish the 'n' slope of the Deliverability test. Tubing flow rates at approximately 95, 90, 85 and 80 % of surface shut-in casing pressure.
- Extend the fourth rate for an additional twenty-four hour period for the KCC G-2 One Point Deliverability Test.
- Continue the drawdown period for another forty-eight hours (total 72 hours) for the pressure drawdown test at a constant flow rate and shut in for the 160 hour buildup for transient analysis. The well should draw-down to about 75% of SI.
- Record casing buildup using a surface recording chart and periodic dead weight readings.
- Have the service company report daily activities and data from the field to ESE and Associates Inc. and make changes in the program as the actual well performance takes place.

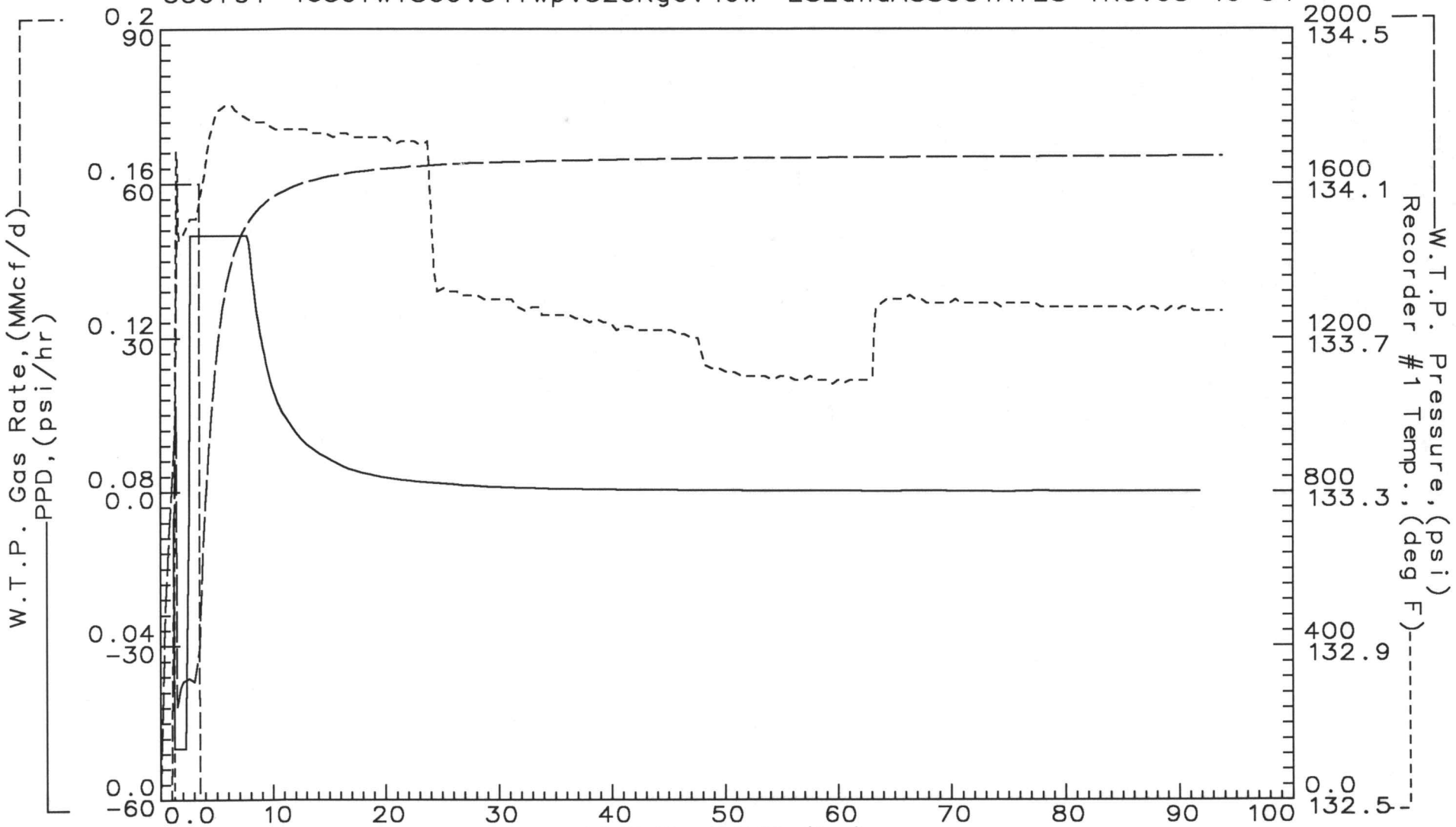
Thank you for this opportunity to assist you in evaluating this well. If you have any questions concerning the data or the interpretations, please contact me.

Yours very truly,

K. Glen Morrison
Encl. (1)

VALIDATA

SAM GARY Herd 34-14,Comanche KS Chert.Trilobite 98-10-16,20
330fsl 1650fwlSec.34Twp.32sRge.19w ESEandASSOCIATES INC.98-10-31



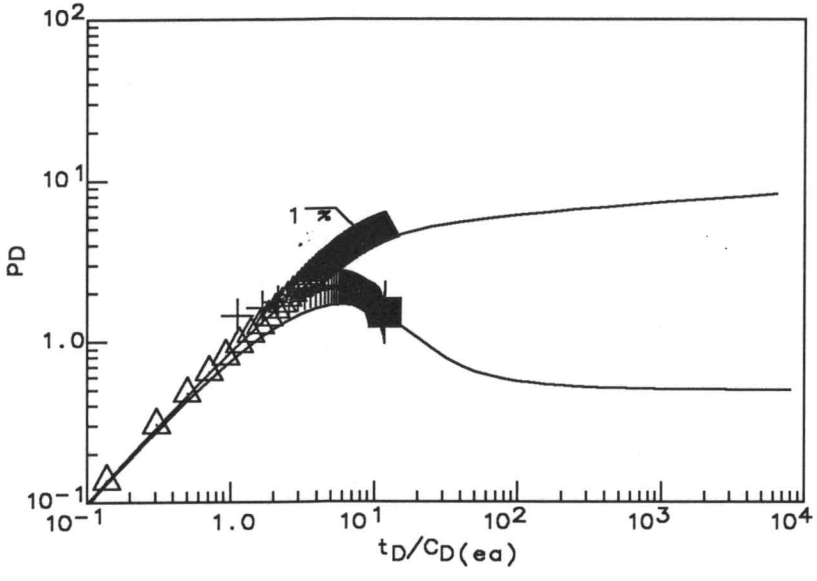
INITIAL = 490
DELETED = 0
REMAINING = 490

CUM GAS PRODUCED = 0.013 MMcf
From 0.00 To 94.10 Hrs.

M.R.D.
PRESSURE BUILDUP PLOT

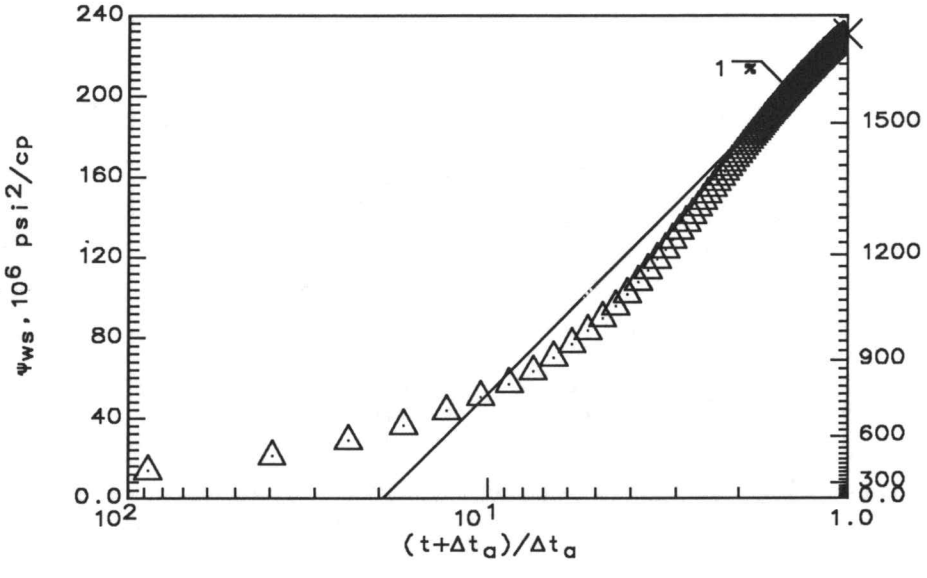
SAM GARY Herd 34-14,Comanche KS
330fsl 1650fwlSec.34Twp.32sRge.19w

$[k_1/u]_t$=19.30 k_1=0.31 C_D=146 s=1.0

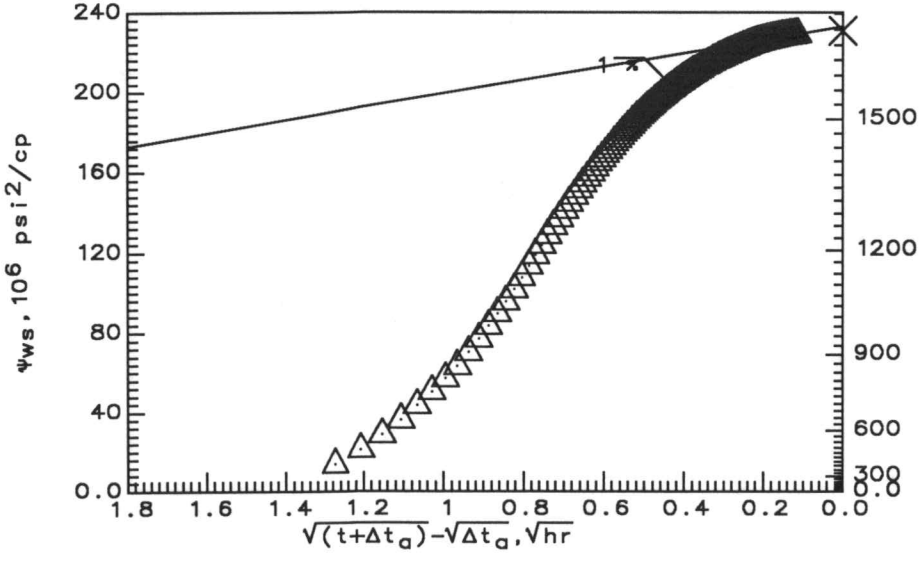


Chert.Trilobite 98-10-16,20
ESEandASSOCIATES INC.98-10-31

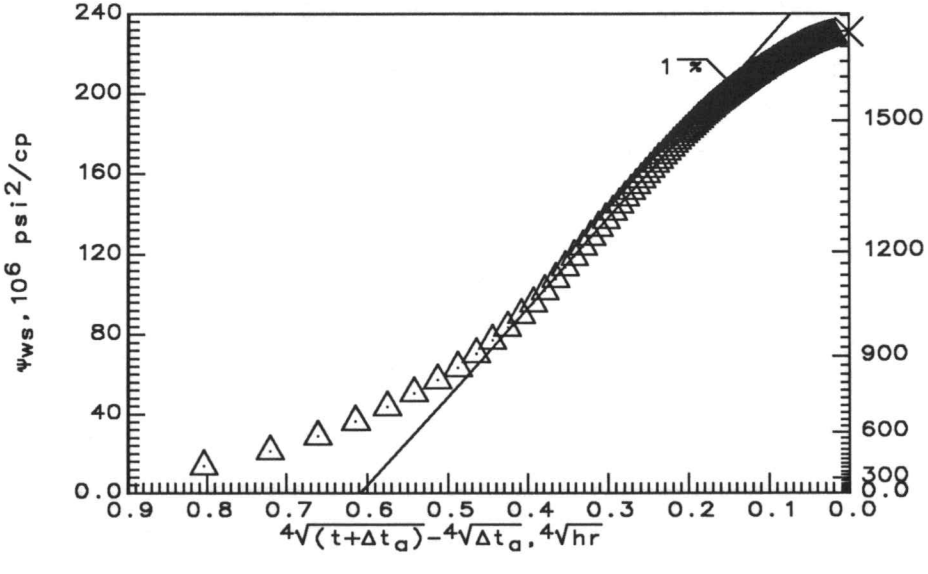
$[k_1/u]$=5.42 k_1=0.09 md s=-2.1 p*=1683.4



$X_f*(k/u)^{1/2}$ =92 X_f=39.4 ft p*=1686.0 psi

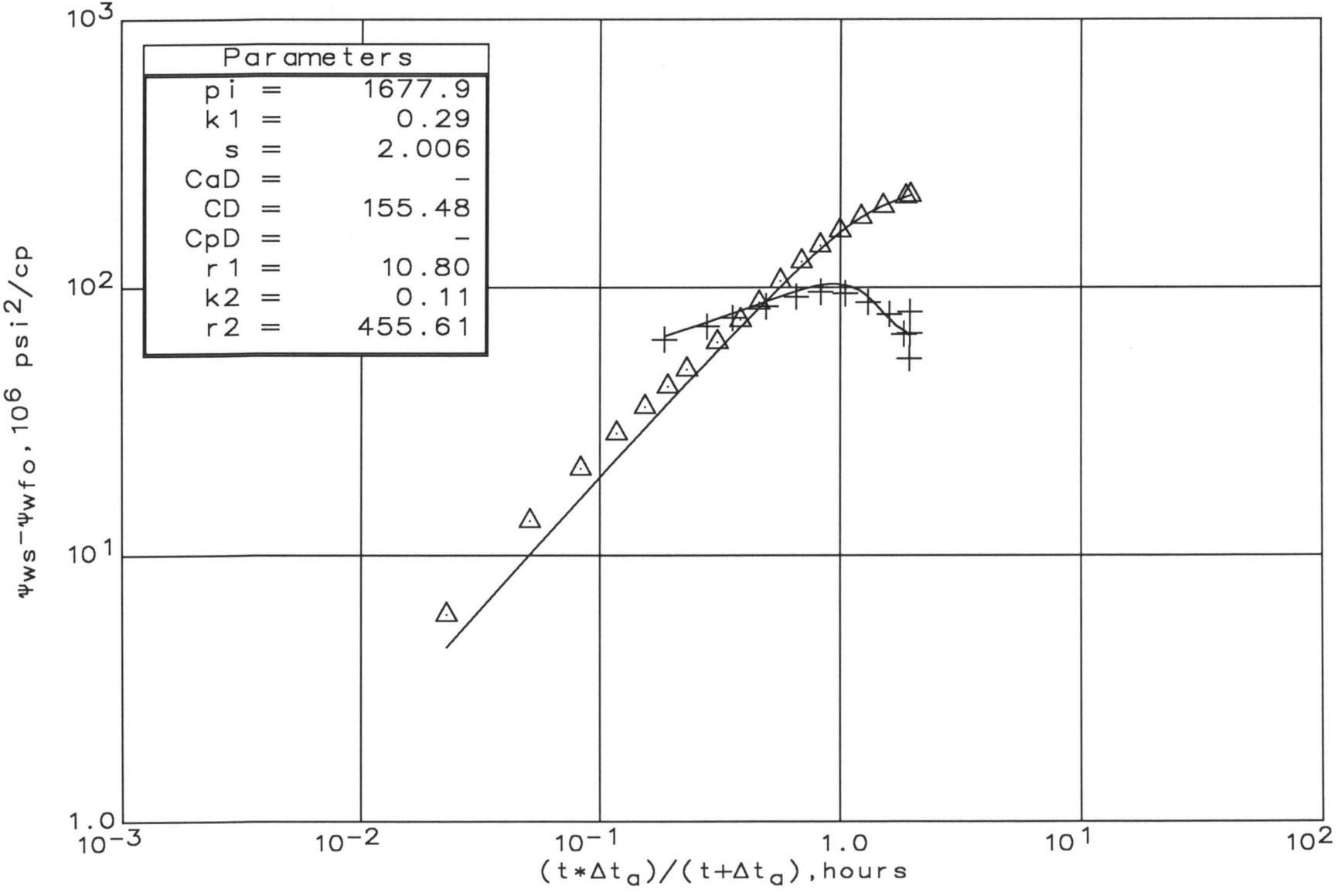


k_fw=0.2 md.ft p*=1832.6 psi



COMPOSITE MODEL

SAM GARY Herd 34-14,Comanche KS
330fsl 1650fwlSec.34Twp.32sRge.19w
Chert.Trilobite 98-10-16,20
ESEandASSOCIATES INC.98-10-31



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DST Interpretation - Pressure Transient - Deliverability Analysis
Material Balance Determinations

SAMUEL GARY, Jr. & ASSOCIATES, INC.

GARY Herd 34-14

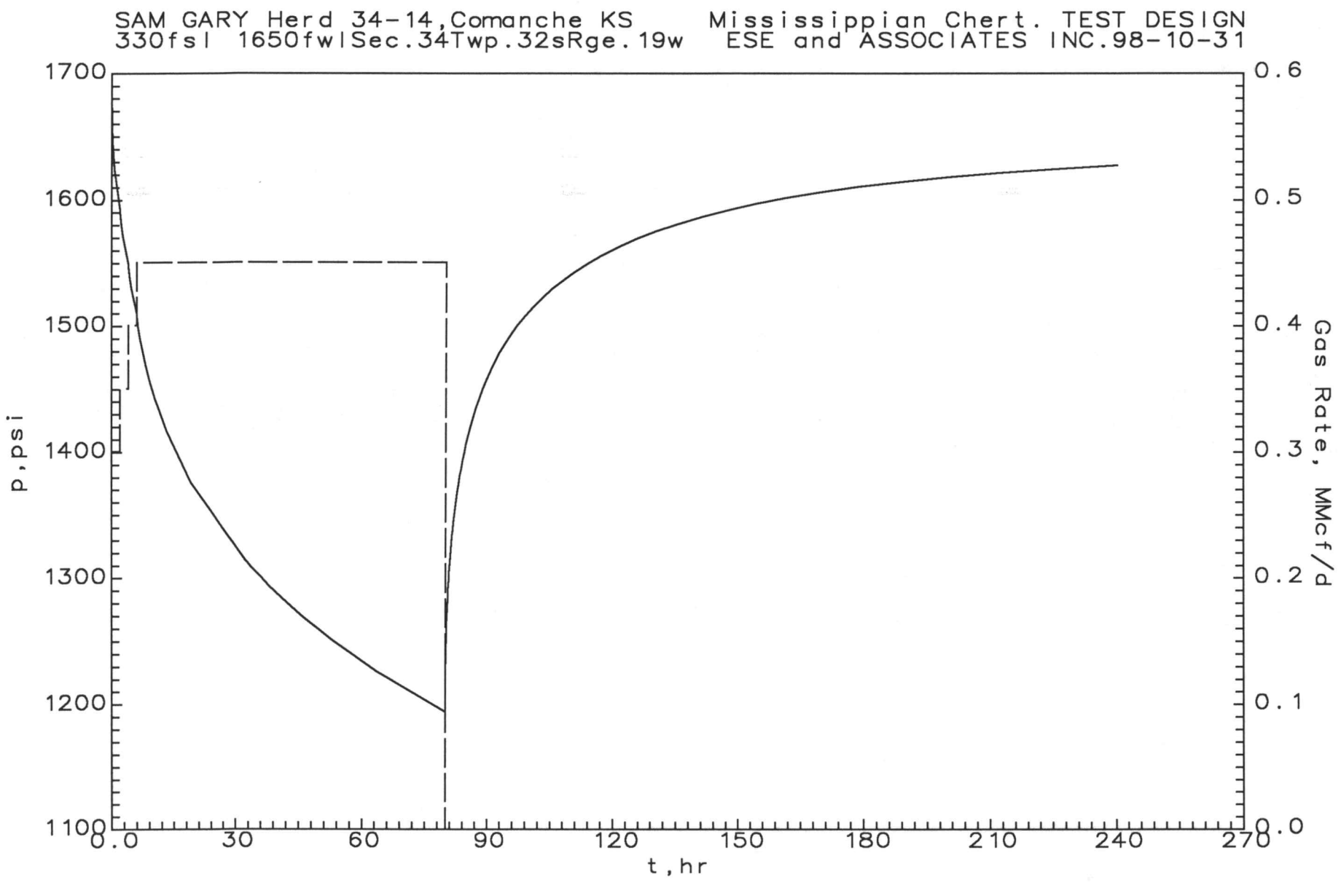
330 fsl 1650 fwl Sec.34 Twp.32s Rge.19w
(Mississippian Chert - gas)
Comanche County, Kansas

TEST DESIGN
for
Kansas Corporation Commission
Four Point Test (G-1)
Deliverability Test (G-2)
Pressure Transient Drawdown - Buildup Reservoir Evaluation

Prepared
1998 October 31
K. Glen Morrison

FEKETE, F.A.S.T.tm and SYNtm software systems.

COMPOSITE MODEL



Gas Test Design

Pressure Forecast

Composite Model

SAM GARY Herd 34-14,Comanche KS Mississippian Chert. TEST DESIGN
330fsl 1650fwlSec.34Twp.32sRge.19w ESE and ASSOCIATES INC.98-10-31

Time hr	Cumulative Time hr	Pressure psi	Gas Rate MMcf/d
0.000	0.000	1677.9	0.300
0.029	0.029	1667.8	0.300
0.083	0.083	1659.5	-
0.240	0.240	1645.9	-
0.693	0.693	1624.5	-
2.000	2.000	1592.3	-
2.029	2.029	1590.0	0.350
2.083	2.083	1587.6	-
2.240	2.240	1582.5	-
2.693	2.693	1571.6	-
4.000	4.000	1549.2	-
4.029	4.029	1547.0	0.400
4.083	4.083	1544.7	-
4.240	4.240	1540.1	-
4.693	4.693	1530.3	-
6.000	6.000	1509.6	-
6.029	6.029	1507.3	0.450
6.083	6.083	1505.1	-
6.240	6.240	1500.6	-
6.693	6.693	1491.0	-
8.000	8.000	1470.4	-
8.022	8.022	1470.1	0.450
8.047	8.047	1469.7	-
8.103	8.103	1469.0	-
8.225	8.225	1467.3	-
8.490	8.490	1463.9	-
9.067	9.067	1456.8	-
10.324	10.324	1442.9	-
13.060	13.060	1417.7	-
19.020	19.020	1376.2	-
32.000	32.000	1315.0	-
32.015	32.015	1314.9	0.450
32.023	32.023	1314.9	-
32.036	32.036	1314.8	-
32.054	32.054	1314.8	-
32.083	32.083	1314.7	-
32.127	32.127	1314.5	-
32.194	32.194	1314.2	-
32.297	32.297	1313.8	-
32.453	32.453	1313.3	-

Gas Test Design

Pressure Forecast

Composite Model

SAM GARY Herd 34-14,Comanche KS Mississippian Chert. TEST DESIGN
330fsl 1650fwlSec.34Twp.32sRge.19w ESE and ASSOCIATES INC.98-10-31

Time hr	Cumulative Time hr	Pressure psi	Gas Rate MMcf/d
32.693	32.693	1312.3	-
33.058	33.058	1311.0	-
33.617	33.617	1308.9	-
34.471	34.471	1305.8	-
35.775	35.775	1301.2	-
37.767	37.767	1294.4	-
40.810	40.810	1284.6	-
45.460	45.460	1270.7	-
52.564	52.564	1251.7	-
63.418	63.418	1226.4	-
80.000	80.000	1194.0	-
80.011	80.011	1204.9	0.000
80.012	80.012	1205.6	-
80.013	80.013	1206.4	-
80.015	80.015	1207.2	-
80.016	80.016	1208.0	-
80.018	80.018	1208.8	-
80.020	80.020	1209.7	-
80.022	80.022	1210.7	-
80.024	80.024	1211.7	-
80.026	80.026	1212.7	-
80.029	80.029	1213.8	-
80.032	80.032	1215.0	-
80.035	80.035	1216.2	-
80.039	80.039	1217.5	-
80.043	80.043	1218.8	-
80.047	80.047	1220.2	-
80.052	80.052	1221.6	-
80.057	80.057	1223.1	-
80.063	80.063	1224.7	-
80.069	80.069	1226.4	-
80.076	80.076	1228.1	-
80.084	80.084	1229.9	-
80.093	80.093	1231.8	-
80.102	80.102	1233.7	-
80.112	80.112	1235.8	-
80.124	80.124	1238.0	-
80.136	80.136	1240.2	-
80.150	80.150	1242.5	-
80.166	80.166	1244.9	-

Gas Test Design

Pressure Forecast

Composite Model

SAM GARY Herd 34-14,Comanche KS
330fsl 1650fwlSec.34Twp.32sRge.19w

Mississippian Chert. TEST DESIGN
ESE and ASSOCIATES INC.98-10-31

Time hr	Cumulative Time hr	Pressure psi	Gas Rate MMcf/d
80.182	80.182	1247.4	-
80.201	80.201	1250.0	-
80.221	80.221	1252.8	-
80.244	80.244	1255.6	-
80.269	80.269	1258.6	-
80.296	80.296	1261.6	-
80.326	80.326	1264.8	-
80.359	80.359	1268.1	-
80.396	80.396	1271.5	-
80.436	80.436	1275.0	-
80.480	80.480	1278.7	-
80.529	80.529	1282.5	-
80.583	80.583	1286.4	-
80.642	80.642	1290.4	-
80.708	80.708	1294.6	-
80.780	80.780	1299.0	-
80.859	80.859	1303.4	-
80.946	80.946	1308.0	-
81.042	81.042	1312.8	-
81.148	81.148	1317.7	-
81.265	81.265	1322.7	-
81.393	81.393	1327.9	-
81.535	81.535	1333.2	-
81.691	81.691	1338.6	-
81.863	81.863	1344.2	-
82.052	82.052	1349.9	-
82.261	82.261	1355.8	-
82.491	82.491	1361.8	-
82.744	82.744	1367.9	-
83.023	83.023	1374.1	-
83.330	83.330	1380.5	-
83.669	83.669	1387.0	-
84.042	84.042	1393.6	-
84.452	84.452	1400.3	-
84.905	84.905	1407.1	-
85.404	85.404	1414.0	-
85.953	85.953	1421.0	-
86.558	86.558	1428.1	-
87.224	87.224	1435.2	-
87.959	87.959	1442.4	-

Gas Test Design

Pressure Forecast

Composite Model

SAM GARY Herd 34-14,Comanche KS Mississippian Chert. TEST DESIGN
330fsl 1650fwlSec.34Twp.32sRge.19w ESE and ASSOCIATES INC.98-10-31

Time hr	Cumulative Time hr	Pressure psi	Gas Rate MMcf/d
88.768	88.768	1449.7	-
89.659	89.659	1457.0	-
90.641	90.641	1464.3	-
91.722	91.722	1471.7	-
92.914	92.914	1479.1	-
94.226	94.226	1486.4	-
95.672	95.672	1493.7	-
97.265	97.265	1501.0	-
99.020	99.020	1508.3	-
100.953	100.953	1515.5	-
103.083	103.083	1522.6	-
105.429	105.429	1529.6	-
108.014	108.014	1536.6	-
110.862	110.862	1543.4	-
113.999	113.999	1550.1	-
117.454	117.454	1556.6	-
121.261	121.261	1563.0	-
125.455	125.455	1569.1	-
130.076	130.076	1575.1	-
135.165	135.165	1580.9	-
140.773	140.773	1586.5	-
146.950	146.950	1591.8	-
153.755	153.755	1596.9	-
161.252	161.252	1601.7	-
169.510	169.510	1606.2	-
178.608	178.608	1610.4	-
188.631	188.631	1614.4	-
199.673	199.673	1618.1	-
211.837	211.837	1621.4	-
225.238	225.238	1624.5	-
240.000	240.000	1627.3	-