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Well Test Interpretation

Report Date 8/23/00

Company:	**Bellwether Exploration Company**	Test Date:	**Aug 13, 2000**
Well:	**Wishbone Fed Com #1, DST #2**	Report No:	**6537808-MV**

Test Type	**MFE Openhole DST, Test #2**	Location	**Sec 6/ T19s/ R30e**
Field		County	**Eddy**
Formation	**Morrow**	State	**New Mexico**
Test Interval, ft	**11380 to 11436**	Field Service Order No.	**6537808**

Reservoir Model	**Heterogeneous**
Initial Reservoir Pressure, psia	**4846 (at 11430 ft)**
Transmissibility, md-ft/cp	**1017.80**
Effective Permeability to GAS, md	**1.93 (based on h= 24 ft)**
Total Skin Factor	**13.72**
Delta P Due to Skin, psi	**2744**
Storativity Ratio, omega	**0.13**
Interporosity Flow Coefficient, lambda	**9.13 E-5**
Boundary Type	**Decrease in mobility (k/u)**
Distance to Boundaries, ft	**56**
Radius of Investigation, ft	**179**

This is a Model Verified™ Interpretation of DST #2 started on Aug 13, 2000 in the Morrow formation. The interval produced gas and condensate during the test. Inspection of the flow regime identification plots (page #5) indicates wellbore storage at early time, changing storage and non-homogeneous behavior during transition and no well-defined infinite acting region.

The data is modeled as being in an infinite radial composite system with skin and variable wellbore storage. The radial composite system assumes a decrease in mobility (decrease in the effective permeability or an increase in the total fluid viscosity) away from the wellbore. A dual porosity system model is also used in the solution to account for the three distinct porosity layers within the tested interval. The mobility decrease is believed to be due to condensate "dropout" in the formation.

Semi-log (Horner and superposition) plots are included in the report, but neither shutin was long enough for a completely reliable pressure extrapolation. The difference between the initial shutin extrapolation (4901 psia) and the initial pressure reported above (4846 psia) is believed to be due to insufficient initial flow time and not an indication of depletion.

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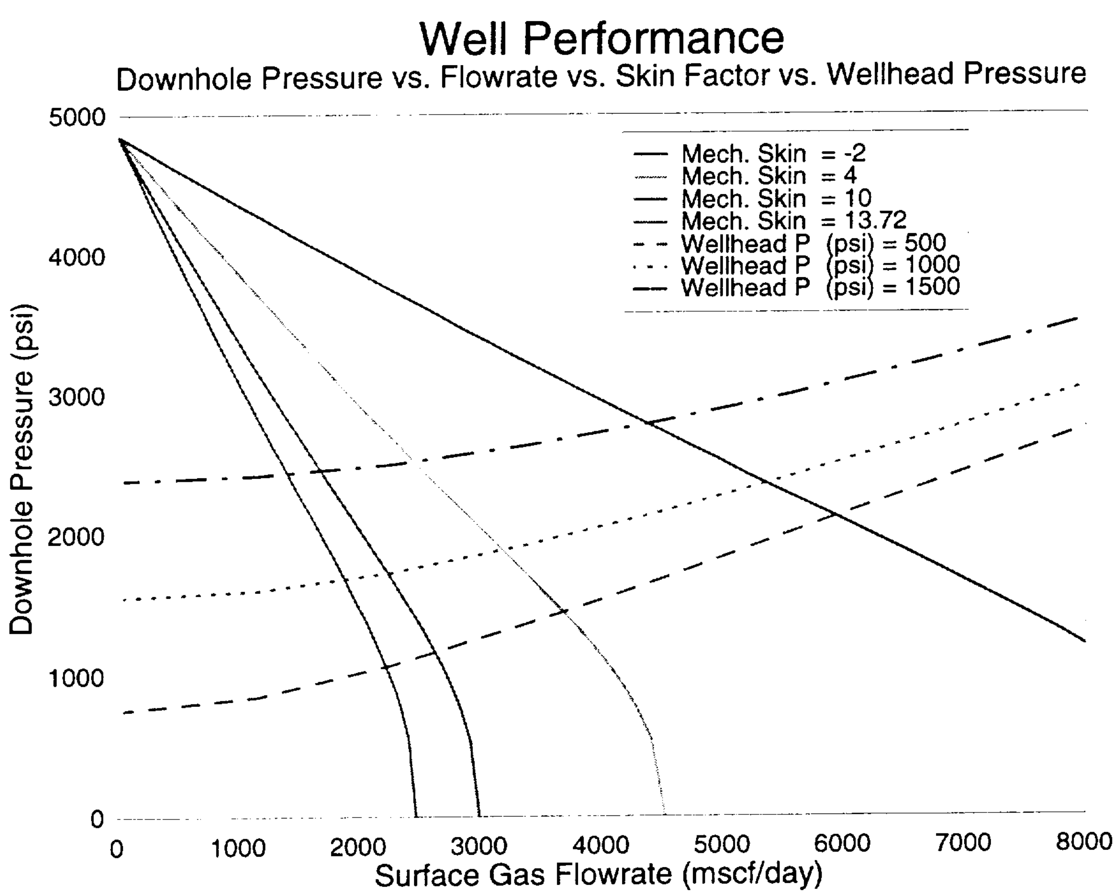
The plot below shows the possible production from the tested interval, if all of the conditions of the projection are met. The plot is based on the results of this interpretation and assumes the well is completed with 2 3/8 tubing. The plot also assumes no change in the G.L.R. water cut and reservoir parameters.

Thank you for using Schlumberger Oilfield Services. Questions concerning this report should be directed to Dick Simper at (915) 684-0700.



2 3/8 Tubing, Flow Correlation : Cullender & Smith

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ROCK / WELLBORE DESCRIPTION

Porosity, %	**8.2**	Water Saturation, %	**30 (estimated)**
Net Thickness, ft	**24 (3 distinct layers)**	Wellbore Radius, ft	**0.33 (7 7/8" bit)**

FLUID DESCRIPTION

Gas Liquid Ratio, scf/bbl	**7052**	Reference Pressure, psia	**4668**
Liquid Gas Ratio, bbl/mmscf	**141.80**	Oil Viscosity, cp	**--**
Water Cut, %	**0.0**	Gas Viscosity, cp	**0.04551**
Oil Gravity, deg API @ 60 F	**52**	Water Viscosity, cp	**--**
Gas Gravity	**0.65 (est) (wet= 1.032)**	Total Form.Vol.Factor, rvb/scf	**0.0006204**
N2/CO2/H2S, mole %	**--**	Total Compressibility, 1/psi	**1.016 E-04**
Water Salinity, ppm	**--**		

COMPLETION CONFIGURATION

Total Depth, ft	**11436**	Packer Depths, ft	**11371. 11380**
Casing Size, in / WT, lbs/ft	**8.625 set at 3005 ft**	Shot Density / Dia, in	**Openhole**
Drill Pipe Length, ft / ID, in	**10402 / 3.826**	Perforated Intervals, ft	**Openhole**
Drill Collar Length, ft / I.D., in	**932 / 2.25**	Cushion Type / Length, ft	**None**

TEST CONDITIONS

Wellhead Pressure, psig	**380 (final flow period)**	Instrument Depth, ft / No.	**11430 / SLSR-1185**
Bottomhole Pressure, psia	**4668 (end of final shutin)**	Max. Temperature, deg F	**174**
Final GAS Rate, mscf/d	**2324**	Initial Hydrostatic, psia	**6023**
Final OIL Rate, stb/d	**330 (calculated from G.L.R.**	Final Hydrostatic, psia	**6034**
Final WATER Rate, stb/d	**--**		

COMMENTS

Test conducted by the Midland Testing District, Mr. James Daugherty. A complete listing of the data collected can be found in field data report #6537808.

Pipe recovery was 7.25 bbls of condensate and 0.50 bbls of mud. Sample chamber recovery was 4.44 scf of gas and 100 cc of condensate.There was gas to surface 12 minutes into the initial flow period.

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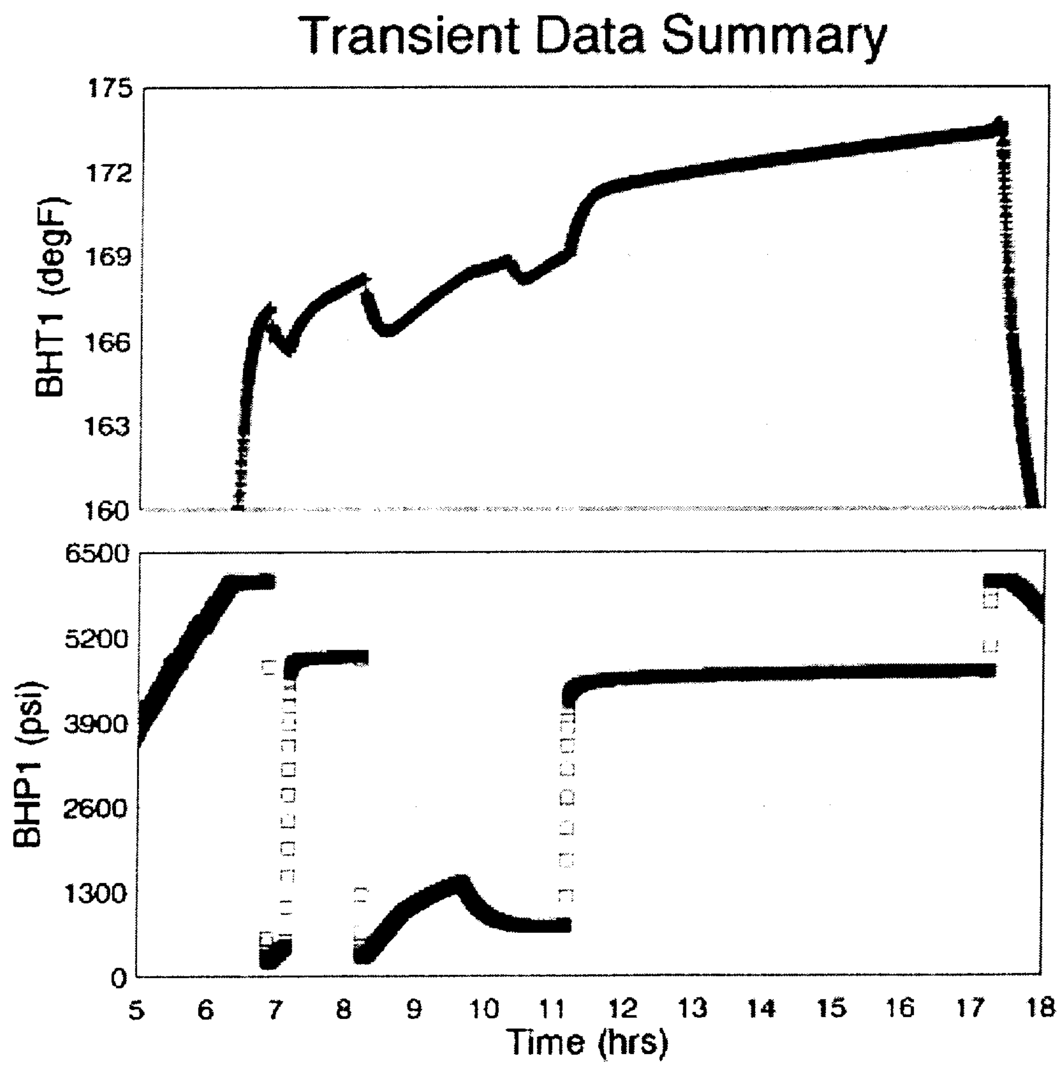
Data and Interpretation Plots

Transient Data Summary, Time Reference= Instrument start time (Aug 13, 2000 at 00:37:00)



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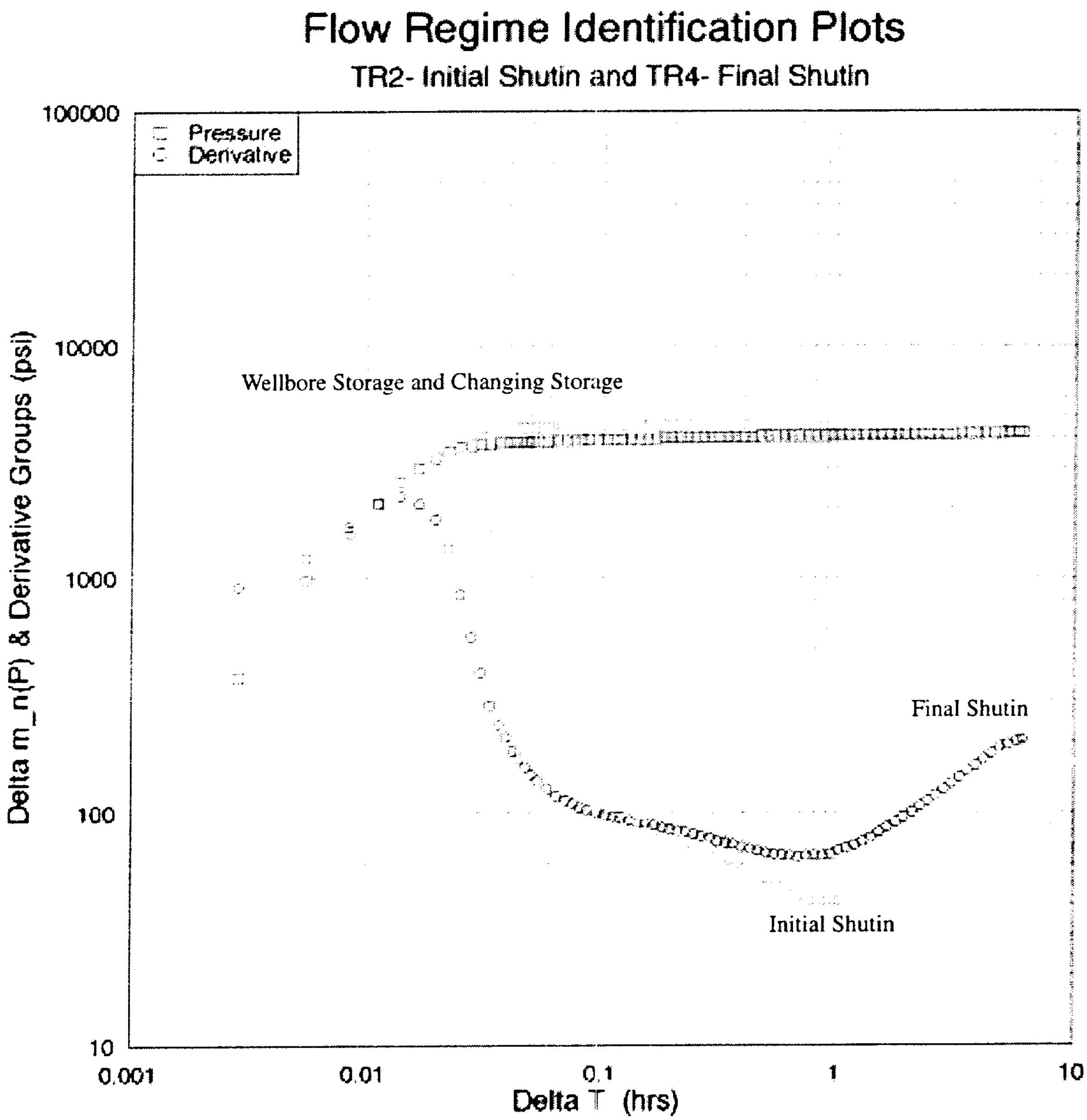
FRID Plots, Smoothing Factor, L= 0.050



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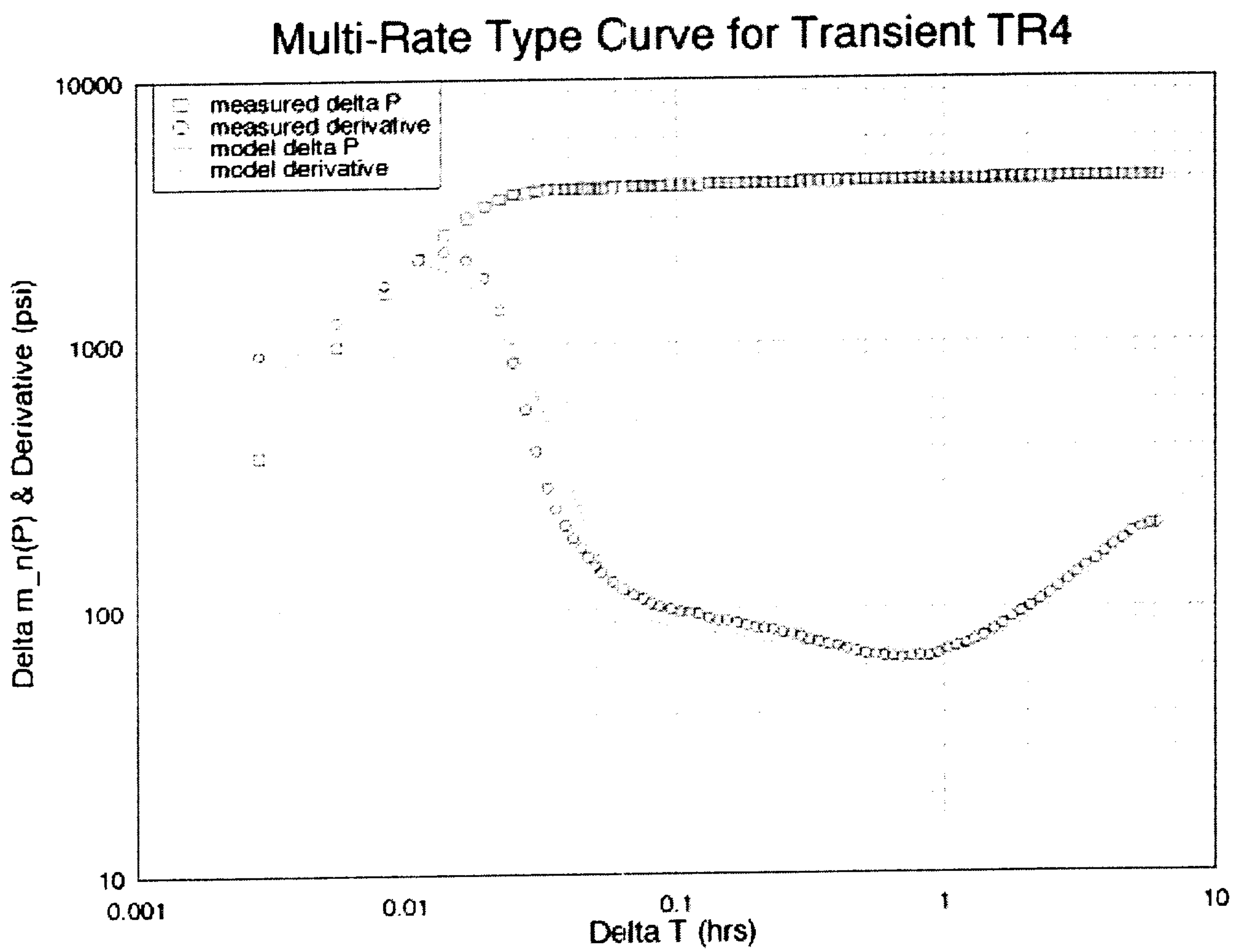
Multi-Rate Type Curve for Transient TR4- Final Shutin

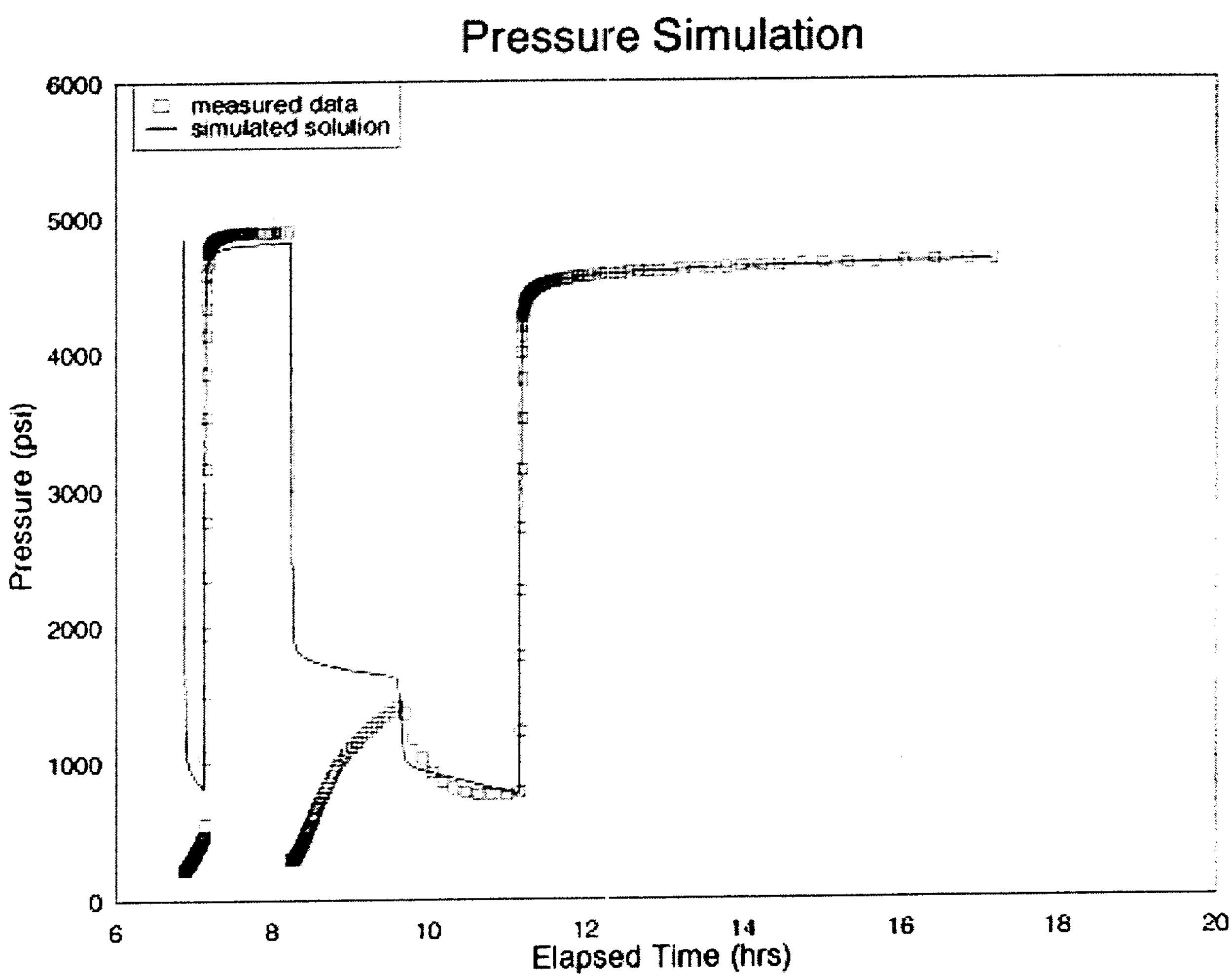


Fully Completed - Radial Composite w/2-Phi (tr-slabs) - Infinite

k = 1.93, Total Skin = 13.72, mr = 6.03, sr = 3.71, omega = 0.13, lambda = 9.13e-05, L1 = 55.68

Variable Wellbore Storage (Exp): C[wb] (bbl/psi) = 8.715e-05, Ca/C[wb] = 143, CphiD[wb] = 17.44

Pressure Simulation



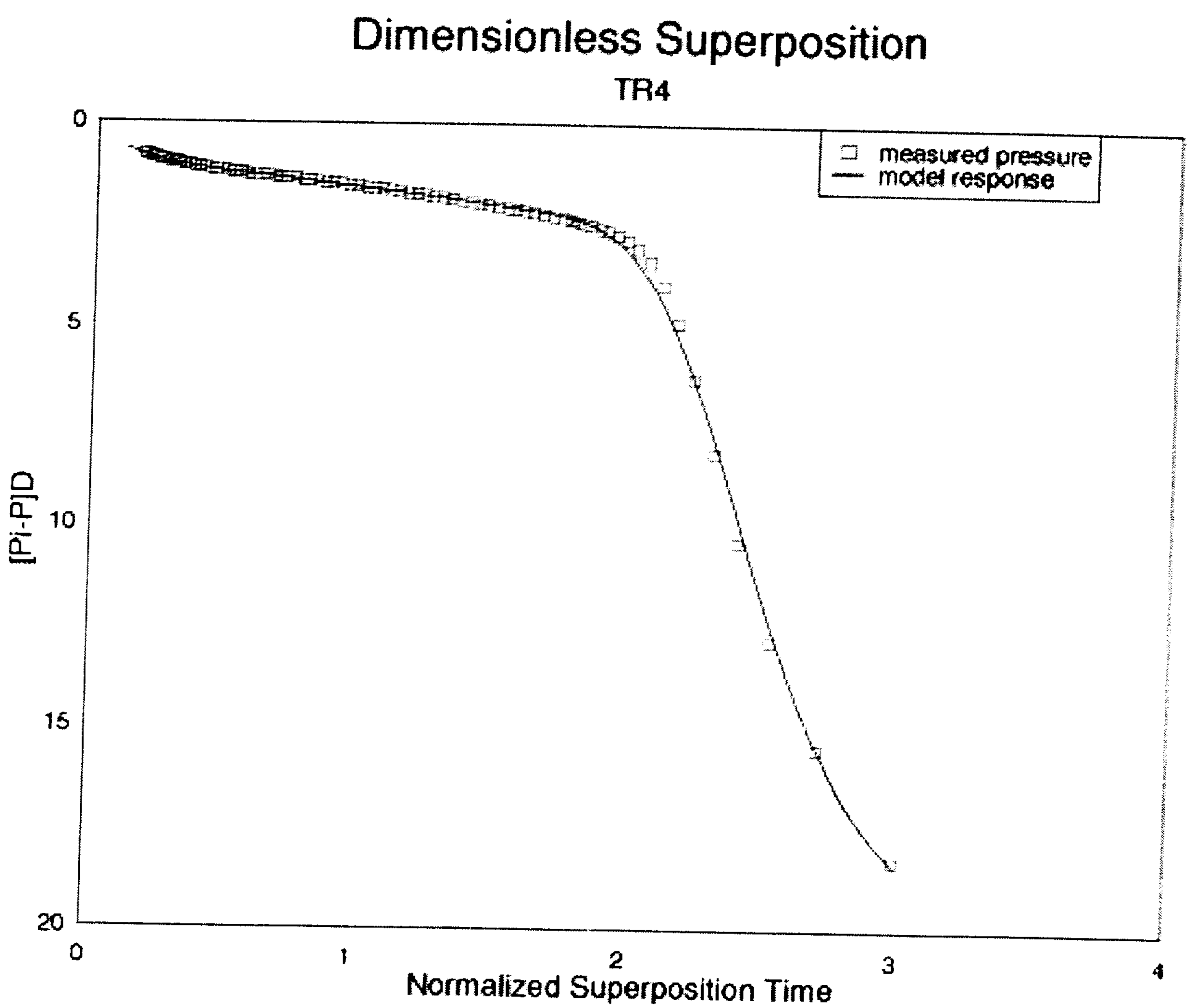
Fully Completed - Radial Composite w/2-Phi (tr-slabs) - Infinite

Pi = 4846, k = 1.93, Total Skin = 13.72, mr = 6.03, sr = 3.71, omega = 0.13, lambda = 9.13e-05, L1 = 55.68

Variable Wellbore Storage (Exp): C[wb] (bbl/psi) = 8.715e-05, Ca/C[wb] = 143, CphiD[wb] = 17.44

Company:	**Bellwether Exploration Company**	Test Date:	[redacted]
Well:	**Wishbone Fed Com #1, DST #2**	Report No:	[redacted]

Dimensionless Superposition Plot, TR4- Final Shutin



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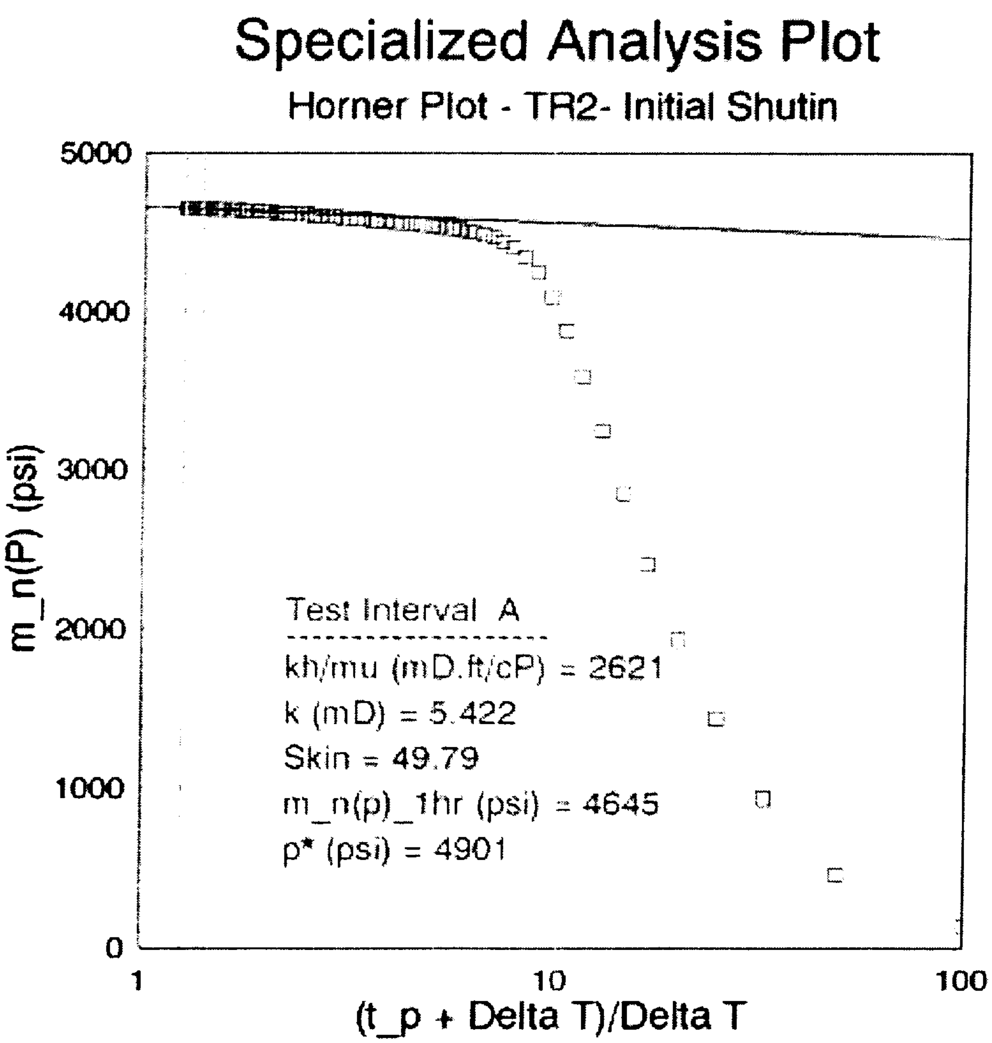
ISI Semi-log Specialized Analysis Plot. Use for general reference ONLY. This is NOT considered to be a valid infinite acting solution.



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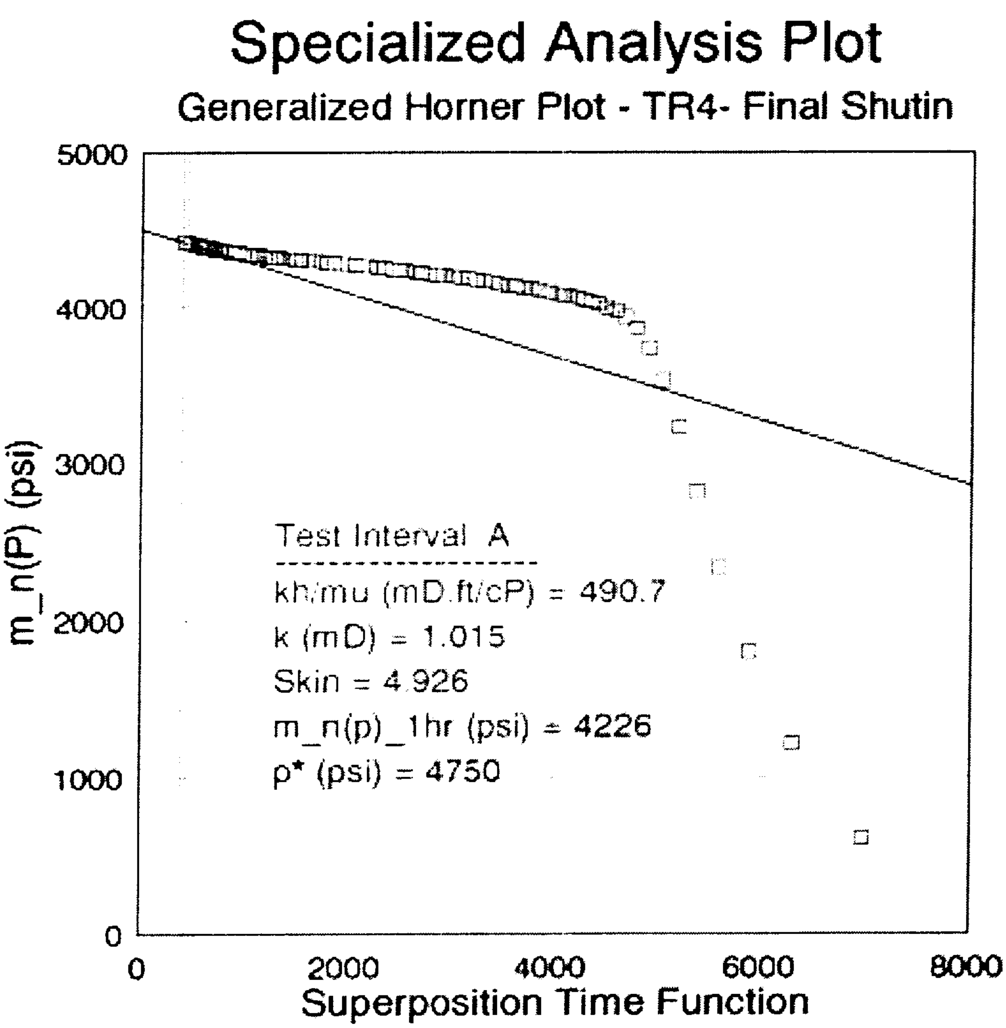
FSI Semi-log Specialized Analysis Plot. Use for general reference ONLY. This is NOT considered to be a valid infinite acting solution.



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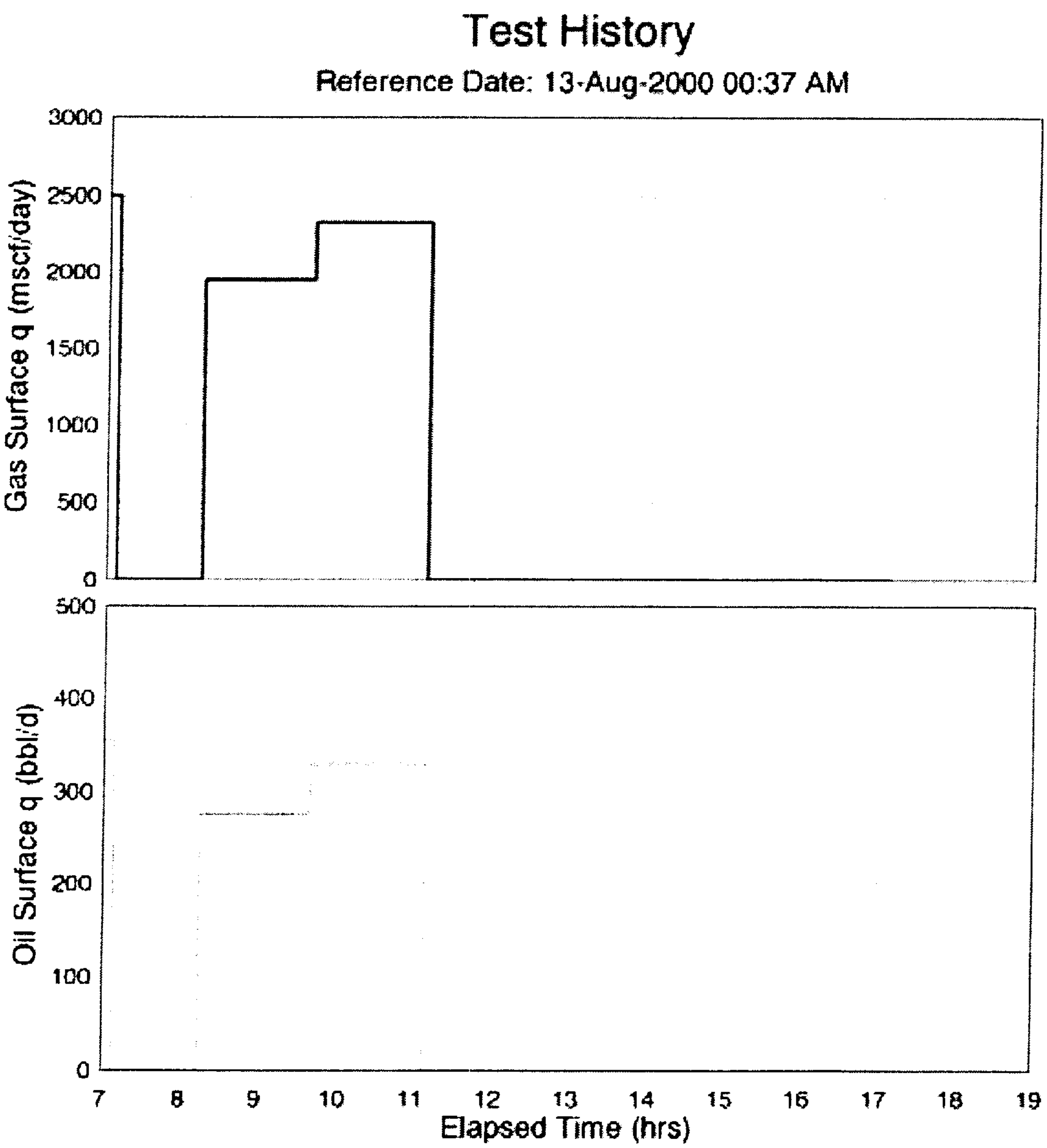
Test Flowrate History. Gas rates are estimated from the final reported surface rate and the measured downhole flowing pressures. Oil (condensate) rates are calculated from the gas rates and the sample chamber G.O.R. (7052 scf/bbl).



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Test History Reference Date 13-Aug-2000 00:37 AM

TEST HISTORY

Start (hrs)	Duration (hrs)	Qo (bbl/d)	Qw (bbl/d)	Qg (1000 ft3/d)
6.87133	0.264	354.64	0	2501
7.13533	1.10267	0	0	0
8.238	1.42	275.94	0	1946
9.658	1.4912	329.54	0	2324
11.1492	6.01383	0	0	0

Table 1: Sequence of Events

Date	Time	Description	Instrument Et, hrs	BHP, psia	BHT, deg F
Aug 13, 2000	07:29	Start Initial Flow	6.871	213	166
	07:45	End Flow, Start Shutin	7.135	462	166
	08:48	End Shutin	8.182	4888	168
	08:51	Start Second Flow	8.230	304	168
	11:46	End Flow, Start Shutin	11.149	769	169
	17:47	End Shutin	17.169	4668	173

Generalized Interpretation Procedure

The Model Verified™ Interpretation technique is a methodology that uses as much of the recorded pressure data as possible, not just those data points that fall on a single straight line. The goal of the interpretation is to define the model type and the specific model parameters that give the best match of the entire test pressure data set. The interpretation will generally include the following distinct steps:

1. Collect the required input data: raw pressure data, rock and wellbore properties, completion and test configuration, production history, and fluid description.
2. Construct a flowrate history. This may be as simple as the final reported rate and an equivalent producing time based on total volume produced, or as complex as actual daily production values. If more than one rate is reported, superposition is used to modify the interpretation plots (log-log and semi-log) in order to give the most accurate results.
3. Determine fluid properties. Liquid: the viscosity and formation volume factor are evaluated at final flowing pressure and maximum temperature; total compressibility is evaluated at the average pressure during the buildup. Gas: all fluid properties are evaluated at the maximum shutin pressure and maximum temperature.
4. Construct the Flow Regime Identification Plot (log-log plot of delta pressure and pressure derivative versus delta time). In gas wells the plotting parameter will be either pseudo pressure or normalized pseudo pressure to account for the way the gas fluid properties change with pressure. There may also be a smoothing factor applied to the pressure derivative to improve the presentation quality of the data. A smoothing factor (L) of 0.0 is no smoothing and a factor of 0.10 is quite a lot of smoothing.
5. Inspect the Flow Regime Identification Plot to identify inner boundary conditions, basic reservoir model, and outer boundary behavior types. This plot also evaluates the validity of specialized plots such as the early time cartesian or the middle time semi-log that can give good initial estimates of reservoir parameters.
6. Construct a total system model and compare the actual pressure behavior to the model predicted behavior. Fine tune the model parameters until an acceptable match is obtained. The final match is presented in three different formats: Log-log, Semi-log, and Cartesian plots.

The output of the process can be specific reservoir model parameters such as effective permeability, skin factor, hydraulic fracture half-length, and distance to boundaries. The process can also provide one or two of the following:

P^*, the extrapolated pressure from the infinite acting portion of the semi-log specialized plot, this value is equal to P_i in an infinite system, and is related to P_{ave} in a closed system.

P_i, the reservoir pressure at the start of the production history.

P_{ave}, the current reservoir pressure, in a closed system.

The reservoir model description can be used in the Nodal™ Analysis program to predict future flowrates, and/or evaluate the possible effect of different completion or stimulation designs.

Interpretation Models

The total system reservoir model that is used to match the test data is made from specific inner boundary conditions, a basic reservoir model, and specific outer boundary conditions. The model parameters for each component (such as wellbore storage factor, effective permeability, wellbore skin condition, distance to a boundary) are adjusted until the best match of the test data set is found. The following is a partial list of the model components available to the Schlumberger GeoQuest Analyst.

Inner Boundary Conditions

- Constant Wellbore Storage
- Variable Wellbore Storage
- Partial Penetration with/without Gas Cap or Water Drive
- Horizontal Wellbore with/without Gas Cap or Water Drive
- Finite Conductivity Vertical Fracture
- Infinite Conductivity Vertical Fracture
- Horizontal Fracture

Basic Reservoir Models

- Homogeneous
- Dual Porosity, pseudo steady state or transient interporosity flow
- Triple Porosity
- Dual Permeability
- Radial Composite

Outer Boundary Conditions

- Infinite System
- Single Sealing Fault
- Partially Sealing Fault
- Single Constant Pressure Boundary
- Two Intersecting Faults (wedge geometry)
- Parallel Sealing Faults (channel geometry)
- Closed Circle
- Constant Pressure Circle
- Closed Rectangle
- Mixed Boundary (closed and constant pressure) Rectangle
- Interwell Interference (observation well active or passive)

It is possible that more than one combination of behavior types will match the test data. Information from other evaluation techniques (logs, cores, etc.) should be used to identify the best solution for a given data set.

For some applications, such as horizontal wellbore and dual permeability system, all of the possible combinations are not available. Detailed references on most model components can be found in the SPE technical literature.

DISTRIBUTION OF REPORTS

Schlumberger GeoQuest has sent copies of this report to the following:

Bellwether Exploration Company
Mr. Russell Macaw (2 copies)
1331 Lamar St.
Suite 1455
Houston, TX 77010

Torch Operating Company
(1 copy)
1221 Lamar St.
Suite 1600
Houston, TX 77010