The New Normal for the Normalization of “Type Well Profiles”

&

a bit about using allocated production data from public sources

OKC-SPEE
October 25, 2018
Problems associated with using allocated production data
Green = DI Allocated Oil  
Red = IHS Allocated Oil
Green = DI Allocated Oil
Red = IHS Allocated Oil
**Green = DI Allocated Oil**

**Red = IHS Allocated Oil**

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**Monday, September 17, 2015**

11:21 AM

EUR 1/2 lift = 80% NPV = 31 mo.

TC EUR 1/2 lift = 80% NPV = 44 mo.

Prepared by: David F. Yattendon PE

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**CONCHO RESOURCES INC.**

**CROSS BAR RANCH 1811 WB**

**Well 3 of 127 Wells Tested**

**Sample Size for Wolfcamp B Type Curve = 124 wells of 127 total**

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**Years Modelled (5y)**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Oil Phase</th>
<th>Gas Phase</th>
<th>NGL Phase</th>
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<tr>
<td>BO (bbls/M)</td>
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<tr>
<td>Diss Akin</td>
<td>7%</td>
<td>7%</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
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<td>8%</td>
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GCR = 1000 SCF/MMBtu

Most Likely - Volatile Oil
Green = DI Allocated Oil  Red = IHS Allocated Oil

Sample Size for Wolfcamp B Type Curve = 1/3 of 177 wells of 177 total

ARE YOU SURE THE DATA YOU GAVE ME IS CORRECT?
I'VE BEEN GIVING YOU INCORRECT DATA FOR YEARS. THIS IS THE FIRST TIME YOU'VE ASKED.
WHAT?
I SAID THE DATA IS TOTALLY ACCURATE.
Green = DI Allocated Oil
Red = IHS Allocated Oil
Green = DI Allocated Oil  Red = IHS Allocated Oil
It makes me CRAZY!
Moving on to normalizing type well profiles
Definition

Type Well Profiles (TWP)

“average monthly” performance in a developmental program over time
• Type Well Profiles are just another tool for the purpose of solving CRITICAL TASKS in the oil and gas industry.

• Help in forecasting economics on new wells.

• Planning a development program
Building Type Well Profiles the Hard Way

• This method is laborious and time consuming, but
  • It will certainly be the most accurate if you can get through the next few pages
Construction of a Type Well Profile

• Type Well Profiles must be representative of the pre-determined purpose using pre-determined goals.

• Choose formation of interest
• Choose well type
  • Horizontal
  • Vertical
• Choose fluid type
  • Dead oil
  • Volatile oil
  • Condensate
  • Wet gas
  • Dry gas
• Do traditional decline curve analysis on each well used in the Type Well Profile.
• Do Statistical Distribution of all individual well results
  • Oil IP
  • Gas IP
  • Oil EUR
  • Gas EUR
• Average monthly forecasts of all wells
  • Type Well Profile EUR equals average of the underlying well EURs
Survivor Bias?

Survivor bias is the tendency to give more weight to the longest surviving wells when averaging production.

Solving the problem;
• Forecast all wells first
Normalization Methods

• Normalize to date of first production or the primary phase
  • When summing all forecasts together this will give a valuable look at the ramp up period that can be expected and should give more reasonable economic results when entering monthly data into your economic model.

• Normalize to month of high production of the primary phase
  • When summing all forecasts together this will yield results that are much easier to enter into an economic model.
    • Initial Rates, Declines, b-factors, etc.

• Normalize by.
  • Lateral Length
  • Completion Practices
    • Stages
    • Clusters
    • Proppant
    • Frac Fluids
    • Etc.

We solve this problem by doing “vintage” normalization

“No, I'm afraid we can't 'just make the data up'—this is business, not politics...”
The only way you can make this work is if you use only wells with modern completion practices...usually HZ wells newer than mid-2015

I used 129 WCA wells (total data set was 207 wells) building this initial type well profile
Sample Size for Wolfcamp A Type Curve = 129 wells of 207 total

API #: 42227388400000

PERFORATED INTERVAL, FT.
7,999

Oil Phase
- IP (30), BOPD: 812
- br: 1.30
- Dil: 75%
- Exp: 6%
- Abd: 0.1
- Prior Cum, Bbls: 40,891
- Rem Oil, Bbls: 541,796
- OIL EUR, Bbls: 582,687

Gas Phase
- IP (30), MCFD: 383
- br: 1.30
- Dil: 38%
- Exp: 6%
- Abd: 0.1
- Prior Cum, MCF: 28,523
- Rem Gas, MCF: 779,567
- Gas EUR, MCF (NO NGLs): 809,090

NGL Phase
- NGL Yield, Bbls/MMcfd: 0
- Gas Shrink: 100%
- NGL EUR, Bbls: 0

BOE EUR, Bbls: 717,530
TC BOE EUR, Bbls: 609,622

GOR = 483 SCF/Bbl
Most likely - Volatile Oil
Sample Size for Wolfcamp A Type Curve = 129 wells of 207 total

PERFORATED INTERVAL, FT: 9,495

API #: 4222794060000

CALLON PETROLEUM COMPANY
PLAYERS A3 6AH
Wolfcamp A
Well # 19 of 272 Wells Posted

Years Modelled: 30

- Oil Phase
  - IP (30), BOEPD: No Forecast
  - bbls: No Forecast
  - Dil: No Forecast
  - Exp: No Forecast
  - Ab: No Forecast
  - Prior Cum, Bbls: No Forecast
  - Rem Oil, Bbls: No Forecast
  - OIL EUR, Bbls: No Forecast

- Gas Phase
  - IP (30), MCFD: No Forecast
  - bbls: No Forecast
  - Dil: No Forecast
  - Exp: No Forecast
  - Ab: No Forecast
  - Prior Cum, MCF: No Forecast
  - Rem Gas, MCF: No Forecast
  - Gas EUR, MCF (NO NGLs): No Forecast

- NGL Phase
  - NGL Yield, Bbls/MMcF: 0
  - Gas Shrink: 100%
  - NGL EUR, Bbls: No Forecast

BOE EUR, Bbls: 723,691

GOR = 1000 SCF/Bbl
Results of the 129 WCA well set

**TYPE WELL**

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**Wolfcamp A**

- **Years Modeled (30)**
- **Oil Phase**
  - IP [30], BOPD: 785
  - b: 1.30
  - DI: 72%
  - Exp: 6%
  - Abn: 0.1
  - Prior Cum, Bbls: 7.096
  - Rem Oil, Bbls: 598,748
  - OIL EUR, Bbls: 605,844

- **Gas Phase**
  - IP [30], MCFD: 674
  - b: 1.30
  - DI: 53%
  - Exp: 6%
  - Abn: 0.1
  - Prior Cum, MCF: 20,786
  - Rem Gas, MCF: 916,763
  - Gas EUR, MCF (NO NGLs): 937,555

- **NGL Phase**
  - NGL Yield, Bbls/MMCF: 0
  - Gas Shrink: 100%
  - NGL EUR, Bbls: 0

- **BOE EUR, Bbls**: 762,104

**GOR = 856 SCF/Bbl**

Most likely - Volatile Oil
DATA is the new OIL
Building Statistical Type Well Profiles

I didn't have any accurate numbers so I just made up this one.

Studies have shown that accurate numbers aren't any more useful than the ones you make up.

How many studies showed that?

Eighty-seven.

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<th>First Prod Date</th>
<th>Perf Interval</th>
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Drilling Info has created algorithms to calculate EURs for every well in America with greater than 6 months of analyzable data.

I have scrutinized their algorithms and believe they are among the best I have seen.

I have developed in-house algorithm to do the same and we are consistently within 10% or so of each other.

Manual history matches will also be within that range of accuracy.

However, allocated data is the biggest problem and it can only be fixed by the TXRRC and other State Agencies.

"The boss wants me to create a computer algorithm that converts hindsight into foresight."
Vintage Normalization

Average by year of 1st production

Resulting normalized annual averages should produce a straight line
With this method of creating “Type Well Profiles” we can quickly and easily produce curves;

1. By County
2. By Twn-Rng
3. By 9-Section area
4. By varying the radius around any Lat/Long in any basin.

<table>
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<th>Oil IP</th>
<th>Oil Di</th>
<th>b factor</th>
<th>Min De</th>
<th>Gas IP</th>
<th>Gas Di</th>
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<td>65.7%</td>
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