SIZING FOR THE WELL LIFE CYCLE IN UNCONVENTIONAL PLAYS
INTRODUCTION: THE NEED FOR ARTIFICIAL LIFT

Almost every person depends on the downstream products produced by the petroleum industry. This ranges from the energy needed to power our lives and the crayons our children play with, to the plastics used to create solar panels. To meet the ever-growing demand for these resources, operators are drawing more production from mature assets and drilling deeper, more complex wells in hotter and harsher environments.

Improving operator asset recovery under such dynamic conditions requires more than lifting technology, it requires a system design which has the ability to look at the production ranges over the lifetime of the well. Providing operators sizing options based on changing well conditions from first production to abandonment empowers them to make a decision which supports their production plans.

The energy to power the world comes from miles below the surface in some of the most challenging places on Earth. Downhole oil wells can contain high levels of gas entrained in the production fluid, solids, scale, asphaltenes, paraffin, metals, and temperatures hot enough to melt Tin. Naturally flowing wells have enough downhole pressure to produce the fluid column a mile or more to the surface wellhead. However, most producing wells are mature wells and have insufficient downhole pressure to lift the fluid column in the production tubing.

To enhance the downhole pressure and raise the fluid column to the surface wellhead, an Artificial Lift Solution must be implemented in the well.
Electric Submersible Pumps offer high production rates and can be designed to handle most downhole conditions. Gas handlers, gas separators, and tapered or shrouded configurations enhance performance in wells with high gas-to-oil ratios by reducing interference from entrained gas. In sandy or abrasive conditions, abrasion-resistant designs and coatings can be used to improve run life by preventing excessive wear on the equipment.

At the surface, variable speed drives offer dynamic programming, alarming, and controlling options to support continuous operation while preventing failures due to gas slugging. While these advancements are critical to ensuring operators achieve expected field performance, the software used to design the downhole system ultimately determines how the technology can be applied most effectively to deliver the desired results.

When it comes to sizing and application, the role of the service company is to analyze the downhole data provided by the operator and design a system which maximizes production while satisfying run life expectations. During equipment selection, the service company is careful not to under- or over-design the system. An undersized configuration will not achieve the expected production, and an oversized configuration will incur unrequested costs in a very price-competitive service industry.

In an ideal world, the motor horsepower would match the pump horsepower demand in order to produce the fluid to the surface, however, downhole conditions are rarely ideal.
OVERCOMING THE UNCONVENTIONAL DILEMMA

A mile underground, conditions can change rapidly. Oil-to-water ratios can change during the lifecycle of the downhole system, resulting in different horsepower demands. A variable speed drive can change frequency to compensate; however, the system will begin to operate to the left or right of the Best Efficiency Point (BEP).
This can affect run life in many ways, all of which result in decreased operator production or uptime. To limit the impact of changing downhole fluid properties, Valiant Artificial Lift Solutions has designed its industry-leading Zone™ Sizing Software, which allows engineers to create equipment sizing models based on changing conditions or fluid properties.

Unconventional wells are unique in that their initial production is significantly higher and declines rapidly. Consequently, a lot of operators prefer to size their equipment at the higher rates to remove frac fluids and maximize oil recovery.

Since the pump may be sized to produce the very high initial fluid rates, and therefore not support the declining production as seen in unconventional plays, it’s unattractive for the operator to have to change out to a lower production pump shortly after the first installation. However, the ability to perform comparative case analysis with Zone Artificial Lift Sizing software provides a single ESP system that supports production across the life of the well, from initial production to abandonment.

By working together during the initial sizing, service companies and operators can dispel misconceptions and identify solutions that would otherwise be overlooked.
ZONE™ CASE COMPARE: HOW IT WORKS

As Valiant begins equipment sizing, we complete a case compare which examines different water cuts, gas-to-oil ratios (GOR), and pump intake pressures (PIP) ranging from 0 to 100 percent water. Water has a specific gravity of 1 and is a measure of the weight of a fluid, which tells the software how much horsepower is required to lift a given fluid to the surface.

By looking at the different water cuts or specific fluid gravity, we can see how the equipment design changes and ultimately how this will affect the producer’s system efficiency.

Go to the next page for an example of a case comparison analysis we use to test students on in our Applications Engineering class.
Student Problem 6: Unconventional Well

Well Data

<table>
<thead>
<tr>
<th>Type</th>
<th>Start MD (ft)</th>
<th>End MD (ft)</th>
<th>OD (in)</th>
<th>weight (lb/ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casing</td>
<td>0</td>
<td>5600’</td>
<td>5.5”</td>
<td>17</td>
</tr>
<tr>
<td>Tubing</td>
<td>0</td>
<td>5300’</td>
<td>2.875”(EU)</td>
<td>6.5</td>
</tr>
<tr>
<td>Top Prod interval</td>
<td>5400’</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Well Survey Data: none

Temperature Information
Fluid temperature at the well head = 90 deg F
Reservoir temperature = 144 deg F

Fluid Properties
API = 35
Gas Gravity = 0.77
Water Gravity = 1.02
Rsb, GOR = see data below
Pb = 2100 Psig
WC = see data below

Well Test Data

<table>
<thead>
<tr>
<th>Month</th>
<th>Qt BPD</th>
<th>WC%</th>
<th>Mscfpd</th>
<th>GOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1000</td>
<td>30</td>
<td>735</td>
<td>1050</td>
</tr>
<tr>
<td>6</td>
<td>700</td>
<td>60</td>
<td>900</td>
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<td>12</td>
<td>500</td>
<td>80</td>
<td>1030</td>
<td>10300</td>
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<tr>
<td>24</td>
<td>300</td>
<td>90</td>
<td>840</td>
<td>28000</td>
</tr>
</tbody>
</table>

Prod Pressure = 200
Initial Static Pressure >= 2000
Datum MD (ft) = 5300’

P_t=P_c=125 Psig

1. Size a complete ESP system using a separator. Do not allow the Dunbar PHI to be greater than one.
2. The well is expected to decline 30% within 6 months.
3. Design the system so that the initial production rate and the production rate in 6, 12, and 24 months can be accommodated with a VSD as close as possible.
4. For each case what is the lift per stage and how does it compare to the lift per stage at the BEP at 60 Hz. It should be less.
5. To check the sensitivity of the design to static pressure variations, Run cases for Pr=1500 and Pr=2500 for each of the 4 cases (12 cases total) and do a case compare for each initial case.
   i.e. Month 1, Pr =1500, Pr =2000, Pr =2500.
THE RESULT: DATA-DRIVEN INSIGHTS FOR SMARTER PRODUCTION

Understanding how equipment is affected by changes in water cut not only allows us to see the impact on one piece of equipment, but also how the entire downhole solution is affected. For example, if we increase the water cut from 30 to 80 percent, we may find that another motor is required to support the horsepower demand. This can affect the total kVA of the drive and transformer, which in turn, impacts the cost of the entire system.

Ultimately, providing operators the choice to select equipment based on case comparison data allows them to make the most informed decision possible. If you would like to learn more about how Valiant’s Zone™ sizing capabilities can improve the run life of your downhole ESP system or would like to request sizing recommendations from one of our expert applications engineers, please visit www.valiant-als.com/contact, or reach out to a Valiant representative.

AUTHORS:

Robert Culverhouse, Marketing Manager
Jamal DaneshFar, Petroleum/Reservoir Engineer
OWN YOUR OPERATIONS

At Valiant, we have the experience and the technology to design solutions that transfer seamlessly from the engineering lab to the field. From sizing and design to installation and operation, we are committed to helping you optimize production and reduce your cost of ownership in dynamic applications. Contact us today to learn how we can help you leverage your artificial lift stack with turnkey ESP configurations.

www.valiant-als.com
405.605.4567

LOCATIONS:

Oklahoma City, Oklahoma
Norman, Oklahoma
Midland, Texas
Bogotá, Colombia

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