

Technology for Water Injection Wells

Variable Orifice Injection Valve or VOi™



Patents Issued & Pending

Tom Hill – July 2019

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2 Minute Intro...

Introduction

What Tejas does

- Rapid Product Development
- API Monogrammed Downhole Products
 - Primarily "Flow Control"
 - Subsurface Safety Valves
 - Packers and Locks
- Testing uHPHT up to 60,000 psi and 1,000°F

What will you see today?

- Wireline Retrievable Variable Orifice Injection (VOi™) Valve for gas and liquid injection
- Variable response to flow it opens more with more flow!
- Prevents backflow when injection is stopped mitigates hammer

Investment Opportunity

- Injector Wells are 25-33% of all completions world-wide
- Increasingly employed in "brown-field" applications
- Application:
 - Water Disposal
 - Water Flood / Pressure Maintenance
- Total DHSV market size for injector wells exceeds \$250 million/ year
 - What does this mean for you?





Status Quo

- Currently, Injection Wells use existing Production Well technology
- The VOi is tailored <u>specifically</u> for injectors
- Technical hurdles have been cleared
 - Conception
 - Design
 - Qualification API 14-A 12th Edition, V3
 - First Deployment Tech is at TRL-6 (TRL-7 before years end)
- So what is this thing?





Innovative solutions - Reliable tools





Variable Orifice Insert, VOi





VOi Insert Valve

VOi Landing Nipple

A CONCERNMENT OF CALL

- Replacement for Injection WL Flapper Safety Valves
- Wireline Retrievable with standard recovery tools
- High Efficiency alternative to conventional valves

COLOR MAN

- "Transparent" and robust well protection
- Low Differential "Surge Protection"



VOi Insert Valve

Operational Flow Cycles Wireline Retrievable VOi™

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Current VOi Multi-Zone Design & Testing

- Prevents "Back-Flow" during Multi-Zone Injection operations that could pull sand from one zone into another – killing the well
- Low back-pressure
- Highly reliable
- Fully qualified
- TRL-6 Deep-Water, GOM
- 42 Deployments

VOi Project Development and Testing

- Robust VOi Validation Testing
 Program 30 Year Equivalent Life
 - Pressure Profile Testing
 - Erosional Endurance Test
 - Chatter Window Test
 - Pressure Integrity Test
 - Flow Surge Test
 - Thermal Cycle Test
 - Cycle Endurance Test
 - Cracking Pressure Test
 - System Debris & Solids Passage Test
 - Drogue Release Test



Technical Advantages – VOi

Current Technical Benefits

- Completely eliminates "Flow Back" when injection stops
 - Protects adjacent completion zones
 - Prevents sand incursion into wellbore
- Unlimited setting depth
- Eliminates "Water Hammer" effect
- Higher injection efficiencies
- Longer life by design
 - Ceramic wear components
 - Low velocities below 100 fps @ 50,000 bbl/day





Financial Benefits

Lower Operating Costs

- Less injection horsepower needed
- VOi is good for all injection rates -> no adjustments for the life of the well
- Better Injection Strategy
 - Prevents formation pressure loss from back-flow
 - Safer well design







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