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IAPG INSTITUTO ARGENTINO DEL PETROLEO Y DEL GAS

2” VELOCITY STRING RIG LESS COMPLETION TECHNIQUE USING A SPECIALLY DESIGNED CT HANGER SYSTEM

A NEW WAY TO STABILIZE AND RECOVER GAS/OIL PRODUCTION IN DEPLETED WELLS

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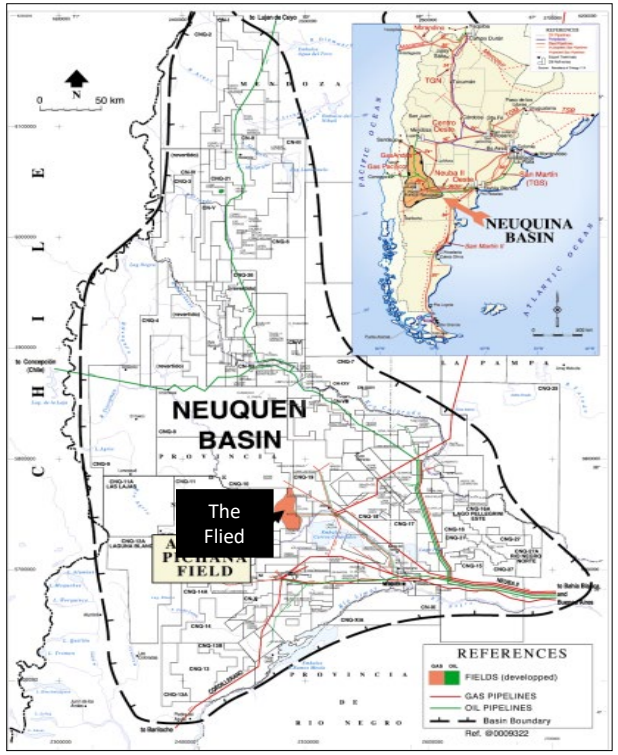
Introduction – Location

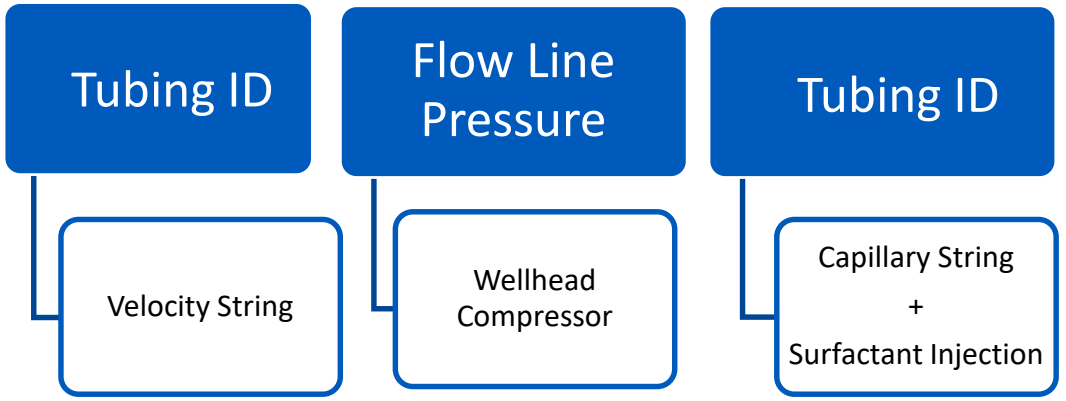


- The field is located in the Neuquén Basin, center-west Argentin
- The gas is produced from sandstones (mainly fractured) of the Mulichinco formation at +/- 1650 m BRT
- + 300 gas wells
- Production line pressure in MP = 508 psi or LP = 290 psi
- No water injection assistance
- Well Completions 4-1/2”, 3-1/2” & 2-7/8”

Problematic and Solution

- Wells with 50% of initial production
- Liquid load
  - Critical Rate = lowest gas rate to remove liquids from the wellbore in linear flow (with 290 psi flowing pressure).
  - 4-1/2” = 60,000 m3/day,
  - 3-1/2” = 40,000 m3/day,
  - 2” = 12,000 m3/day
- Intermittently production

Proposed solutions:



Defined solution:

ID Tubing Reduction : Velocity String Applications

Velocity String Candidates

- VS string well candidates were defined accordance intermittently production

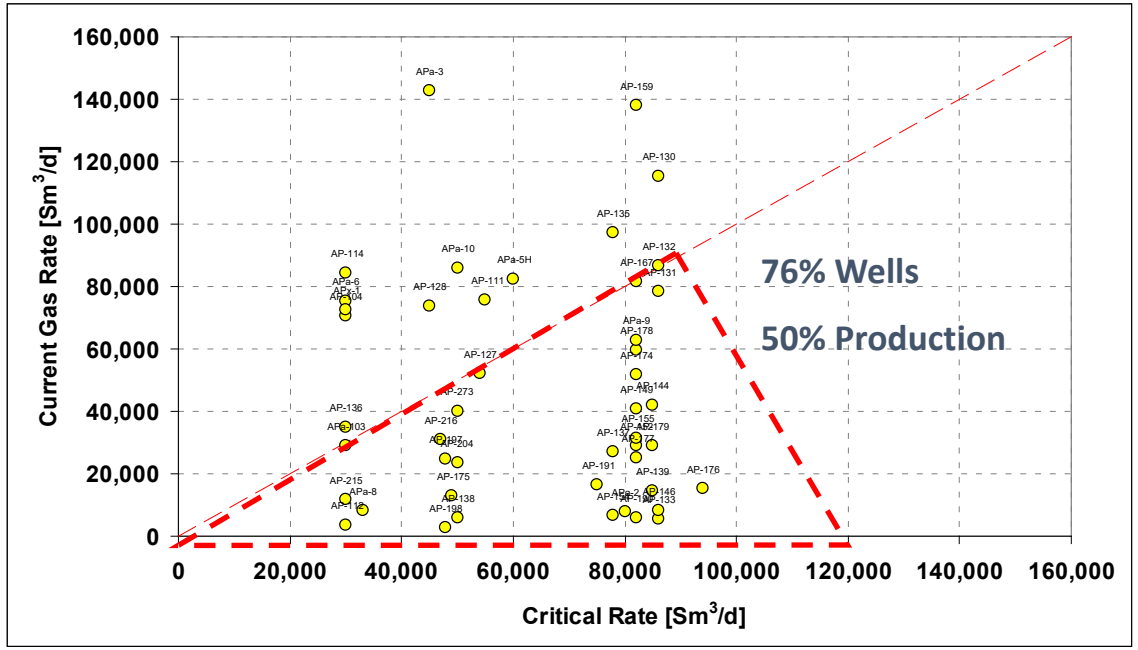


Figure shows that 76% of total wells need VS string installations because they have liquid load and your production is 50% of initial gas rate production

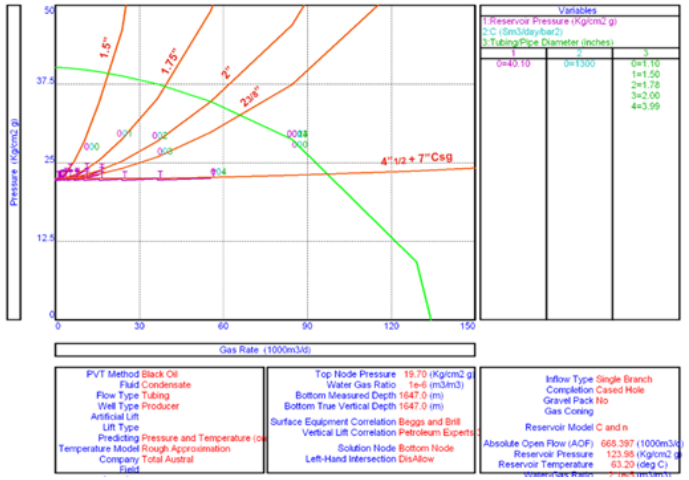
Velocity String Selection

- **OD: 2” Wall Thickness = 0.109”**

- Compatible to be run in 4-1/2” and 3-1/2” ID completions

- Bottom hole intervention possible with 1-1/4” slickline (CT drifted at 1.5”)

- The chosen diameter of the Velocity string has to fit with future production conditions

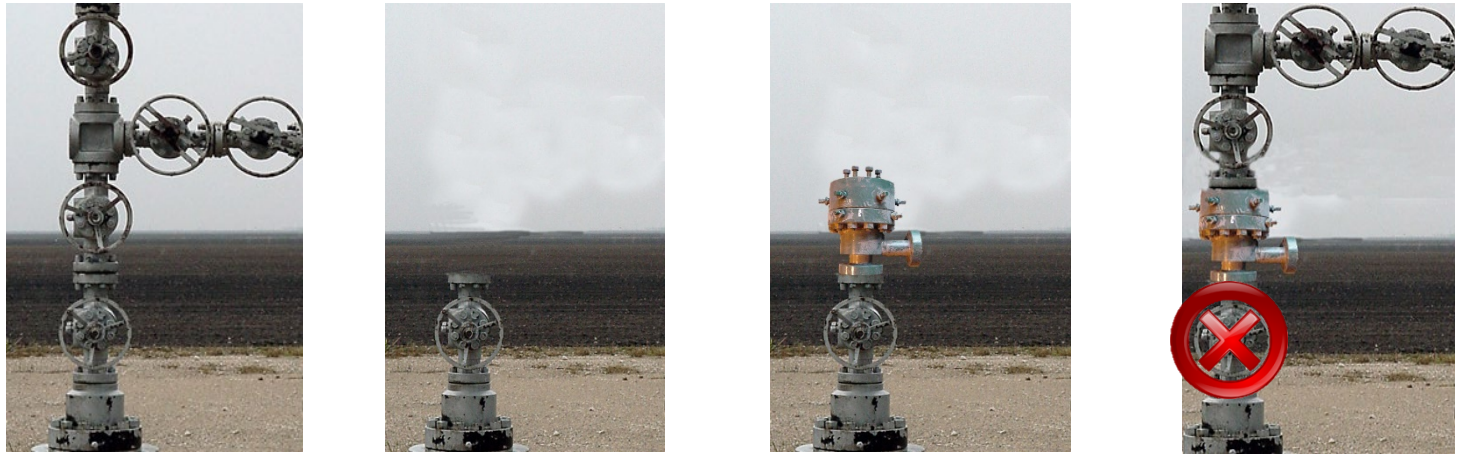


- A too small tubing diameter (e.g. 1.5”) has the advantage of significantly lowering critical rate, but may penalize day by day production profit.

- A too large diameter (e.g. 2-7/8”) may have more instantaneous production but will reach quickly at instable regimen.

Operational Challenges

➢"Conventional CT hanger" does not meet safety customer double barrier policy during production phase



➢**A special CT hanger was designed <u>to hangs the VS "downhole" instead "of surface"</u>** in order to comply with company rules and HSE matters (maintain double safety barriers) and avoid surface facilities modifications.

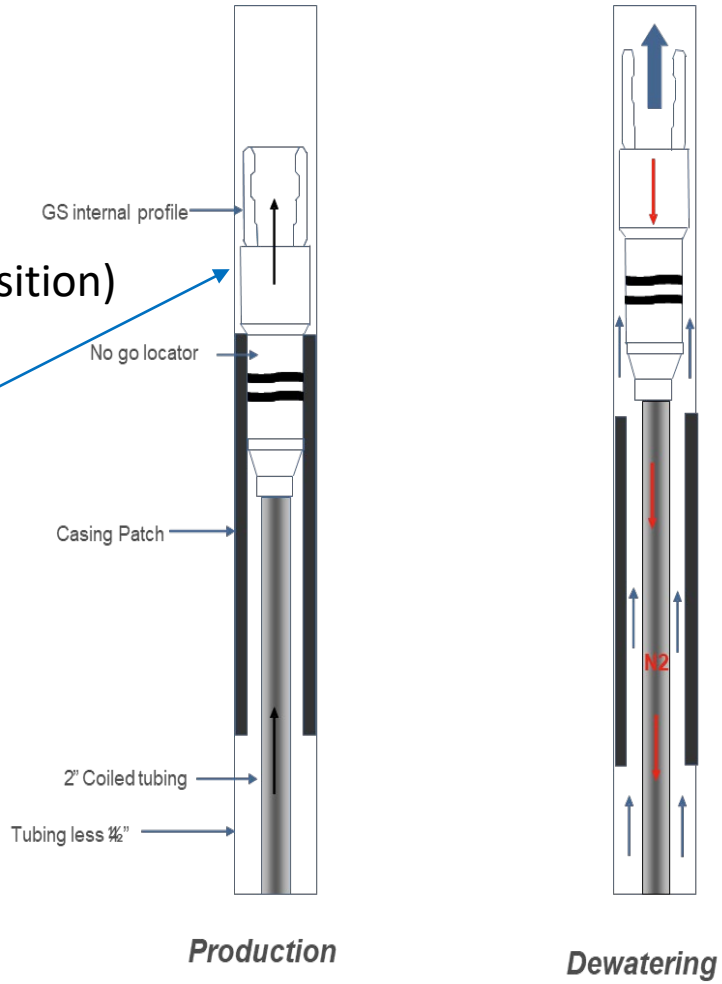
CT Velocity String Hanger features

- Easy set /unset , for the following reasons:

- Easy to lift with coiled tubing unit or a special designed jack system (tree saver design extension) until the seal assembly is out of seal bore, to circulate a water foot out with nitrogen if needed. (see “Dewatering” position)

- Easy and cheap recovery for another well apps.

- Permit to abandon the well at end of production



CT Velocity String Hanger Safety Issues

Special features of CT Hanger system are the Safety Issues while production time and during installation:

While producing

- The design permits to keep integrity of X-tree valves and back pressure valve profile access
- Set a plug in nipple fit in VS hanger as 2nd barrier if need to repair X-tree valves

During installation

- While cutting coiled tubing, the 2 annulus barriers are the 2 sets of BOP pipe rams and the 2 tubing barriers (2” CT is empty) are bottom pump out sub + 2 BOP shear rams.
- GS release just “setting weight down and adding internal pressure higher than 1000 psi” .

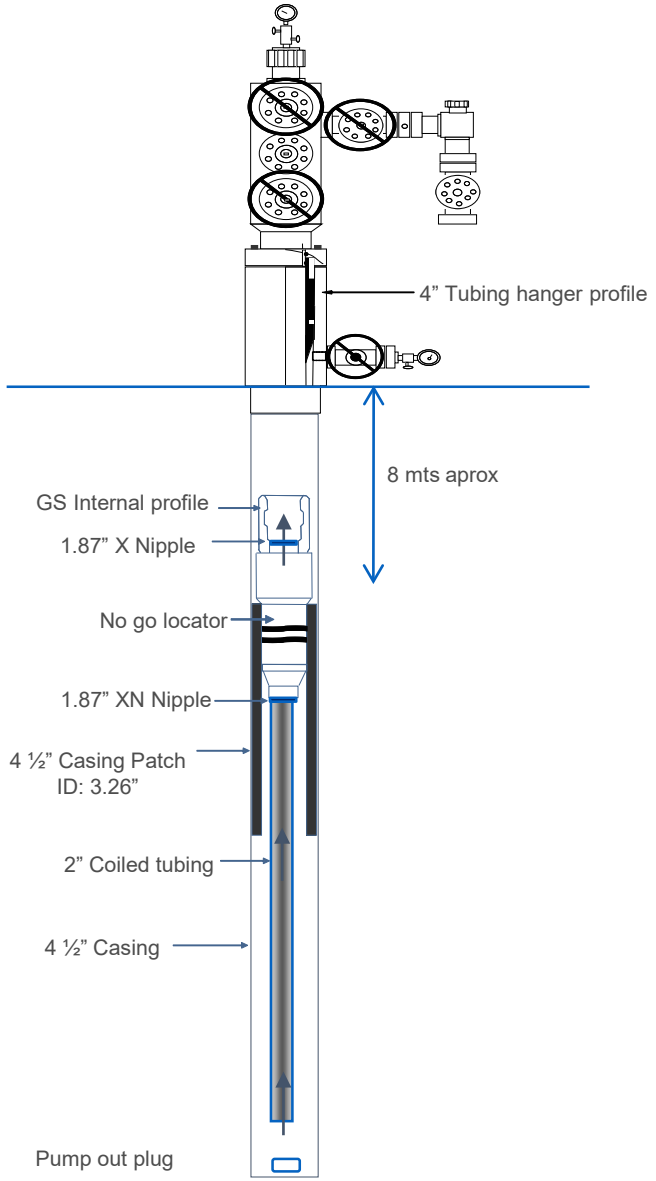
The Technique

Part A:

Metal Metal casing patch Setting ➔ Wire Line deployed at +/- 10 meter under x-mas tree

Part B:

GS internal profile ➔ for running with GS hydraulic setting tool
X nipple ➔ to ensure setting tool / locator sealing while running and to isolate well (plug) as a second barrier
No go locator with seals ➔ to work like a packer of annular fluids
XN nipple ➔ to isolate well (plug) as a first barrier
2 inches" coiled tubing ➔ velocity string
Pump out plug ➔ allows to run the CT empty and acts as a CT internal barriers



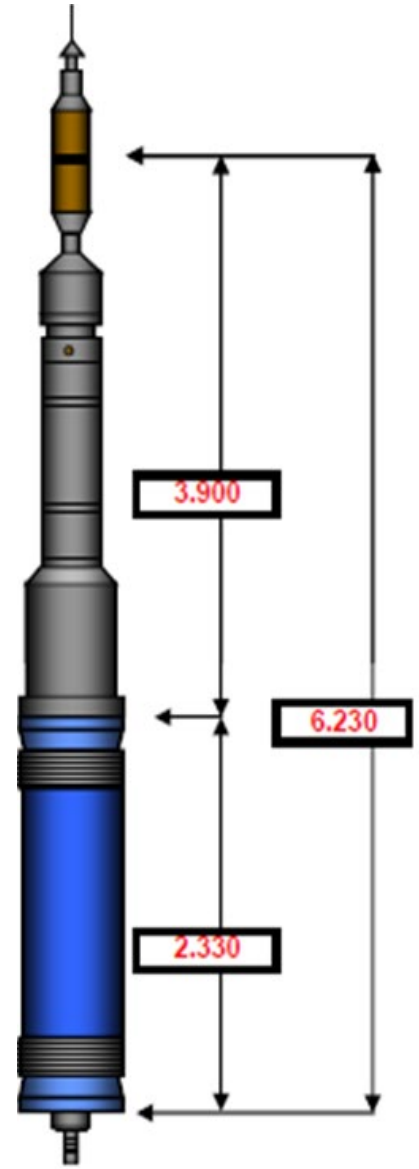
Casing Patch Installation

First phase of operation: Pre CT intervention

- 1st WL run: Rig up WL to remove the DHSV.
- 2nd WL run: Caliper run using 3.87" OD GC from surface till 100 meters * To reaffirm Casing patch deployment run clearance
- 3rd WL run: Caliper run to check ToS w/ 2.95" OD GC*

If Top of Sediments (ToS)>>desired depth, CT clean out operation required.

- 4rd WL run: Set 4 1/2 casing patch using WL and 3 1/4" MSST (Multiple Stage Setting Tool) at +/- 10 meters under x-mas tree.



Velocity String Hanger Installations – Operations

- Rig Up Coiled Tubing Set and test the CT integrity with fluid. *pressure test
- Displace the string with N2.
- Niple Up bottom hole assembly 2” CT Connector, Pump out plug with 4 shear pins.
- Run in hole 2” CT to desired depth less than (+/- 10 mts + altura x-tree + altura BOP’s + Part B).
- Close pipe and slip BOP RAMs. (Qty:2 BOP’s create 2 annulus barrier)
- With 0 psi at stack up over BOP, disassembly over upper BOP.
- Install extra CT clamps.
- Cut the 2” CT 2” Length; 100 cm from upper BOP.

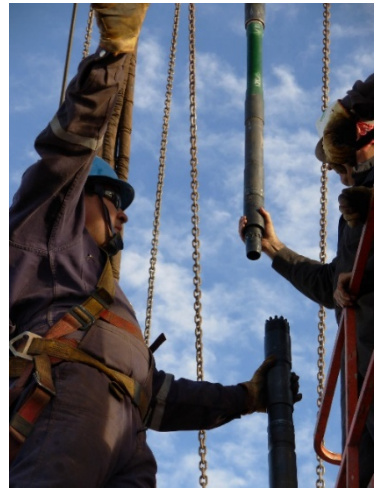
Velocity String Hanger Installations – Operations

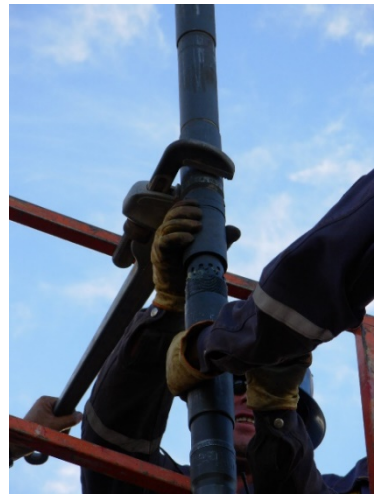
From carrier CT side :

- Assembly 2” Connector coiled tubing + MHA + upper side of Quick connector.
- Perform Pull test to CT connector Pull Force: 15000 lbs higher than BHA and VS string weight.

From completions side:

- Install required part B.
- Assembly setting tool GS with lower side Quick connector and Rig down extra CT clamp.
- Pressurize stack up over the BOP and Open Slip and Pipe BOP.





Velocity String Hanger Installations – Operations

- Run in hole CT (+- 20 m) tagging the Casing Patch.
- Set weight down (-2000 lbs) to set the No Go locator into a Patch.
- Aplly 1000 psi using N2 for GS releasing.
- Pull out of hole to recovery the setting tool.
- Eject Pump out plug with N2 and Open the well and test production

Economics

- 2 alternatives were economically analized (Table 1)

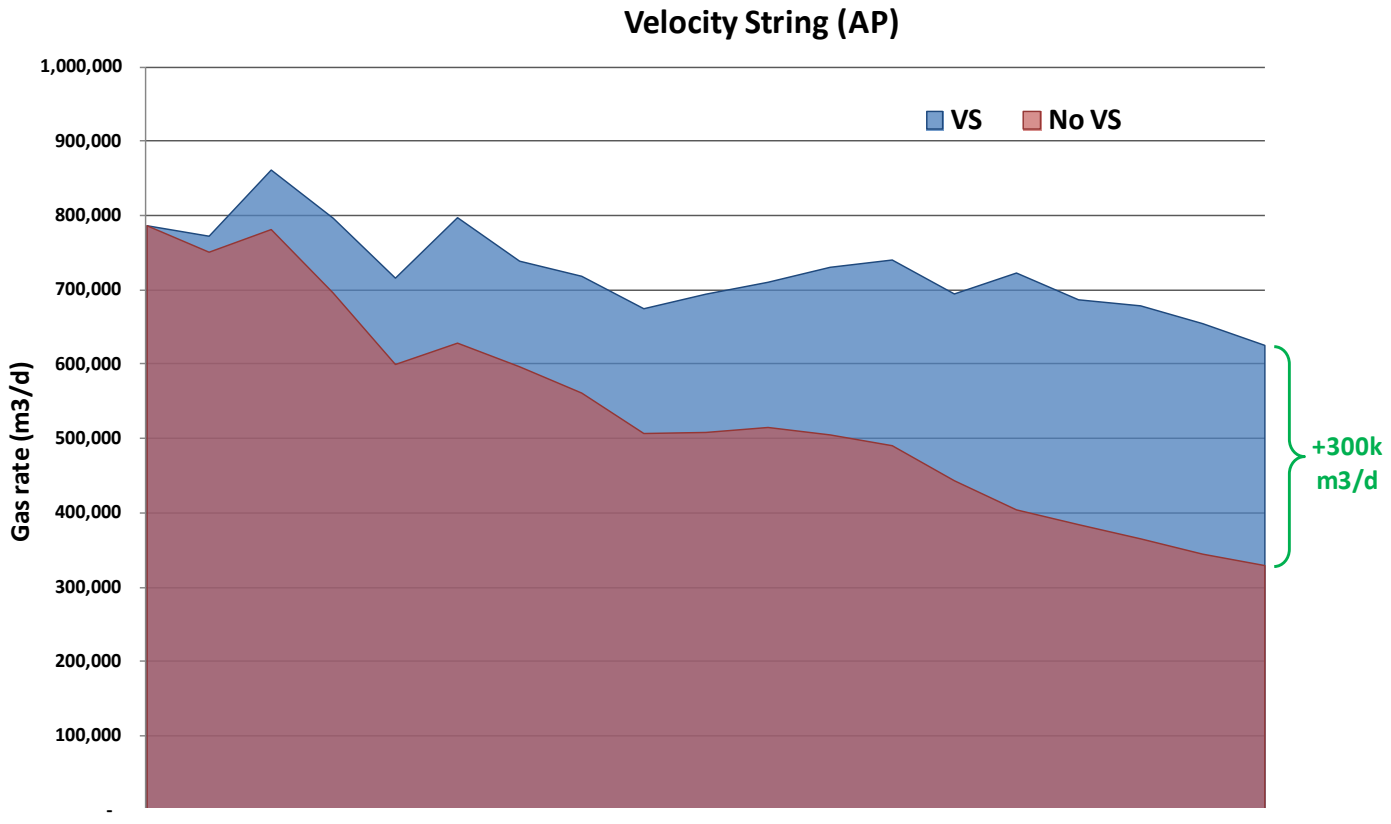
1) Alternative A: Installation of 2 3/8" production tubing using workover rigs
2) Alternative B: Installation of 2" CT Velocity Strings

Table 1 – Economical Analysis	
Alternative A	
Description	**Price (USD/well)**
Rig (Mov and De Mov and Operation)	xx
Services (Slick Line, Coiled Tubing)	xx
Materials(2 3/8" Tibing, Niples, Packers, Well head)	xx
Total Cost per Well Alternative A	**600000**
Alternative B	
Description	**Price (USD/well)**
Coiled Tubing Unit operation	xx
Services (Slick Line, Wire Line)	xx
Materials(2" HS 70 string, Casing Patch, Niples,)	xx
Total Cost per Well Alternative B	**155000**

2" VS Coiled Tubing is 3 times cheaper than 2 3/8" production tbg and WO installation!!!

Results

- During the first 4 months of the project, 20 VS were safely installed.
- Gas production increase of 300 Km3 /d. Average gas increase per well was +/- 15,000 sm^3/d.
- Pay out of 60 days.
- This solution was so successful that more than 100 wells were installed in the following years.



Conclusions

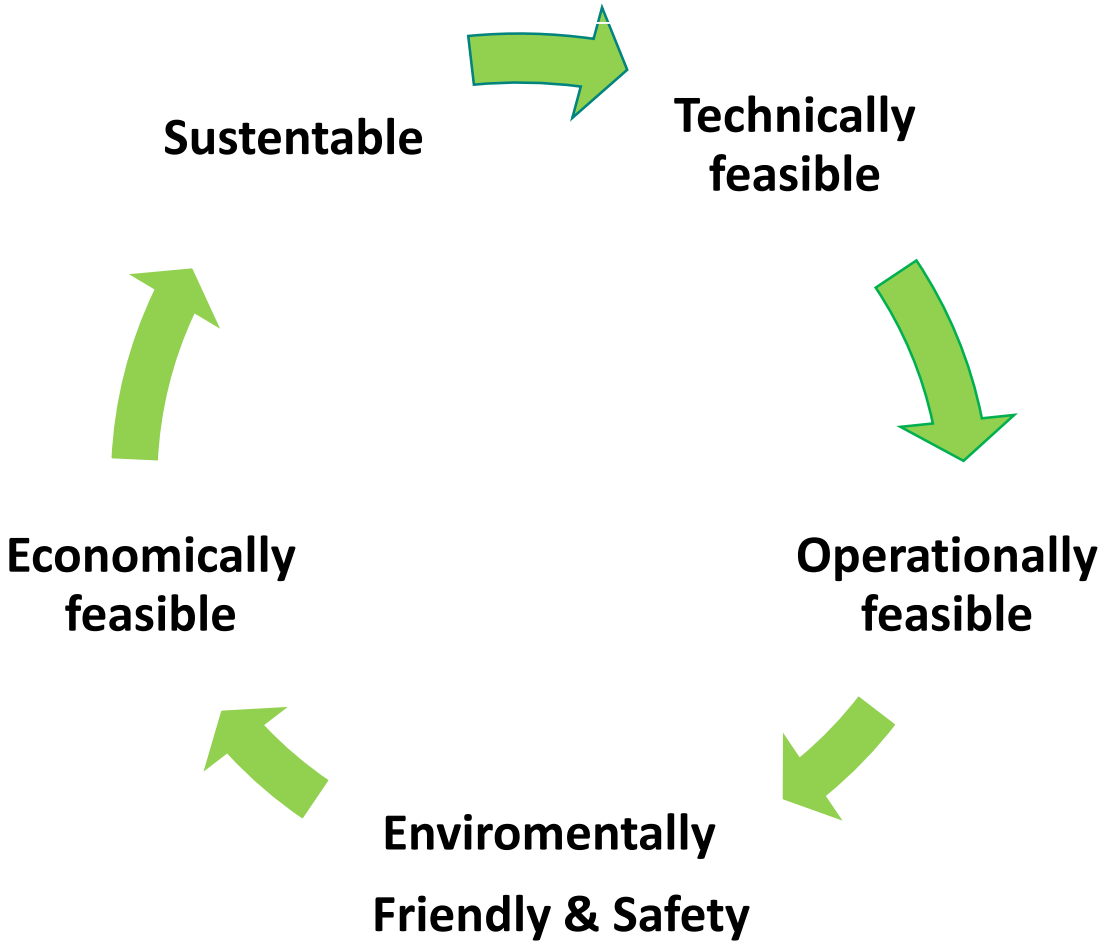
From the production point of view,

- This system stabilizes the gas and condensate production/ increased gas production/ 60 days of pay out
- Possibility to use another technique in parallel: well head compressor – surfactant with capillary string

From an operations stand point,

- This system allows us to set and unset rigless the VS as many times as required to restore the production (ref: dewatering)
- Underbalance installation using Coiled Tubing was identified to be crucial in preventing formation damage.
- The use of this system prevents X-tree and surface line modification keeping surface safety barriers on the well-head versus the use of an additional conventional hanger.
- Logistical cost optimization through rigless intervention versus other work over alternatives (ref:Economics)

Global Project Vision Summary



Acknowledgments

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Thank you!!

Questions!!