2025 GAS LIFT WORKSHOP

High-Pressure Gas Lift in Unconventional Assets – A Journey from Pioneer to Practice

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Agenda

- ExxonMobil HPGL Highlights
- Criteria for Application
- Pilot Downhole Designs Two Configurations
- Downhole Design Test with SPMs
- Surface Facility Design
- First HPGL Well (Shallower Formation) Performance Analysis
- Integrated Surveillance and Monitoring
- In-depth Well Performance Analyses
- Well Model to Support HPGL Conversion: HPGL, CGL, or ESP?
- Lessons Learned
- Path Forward

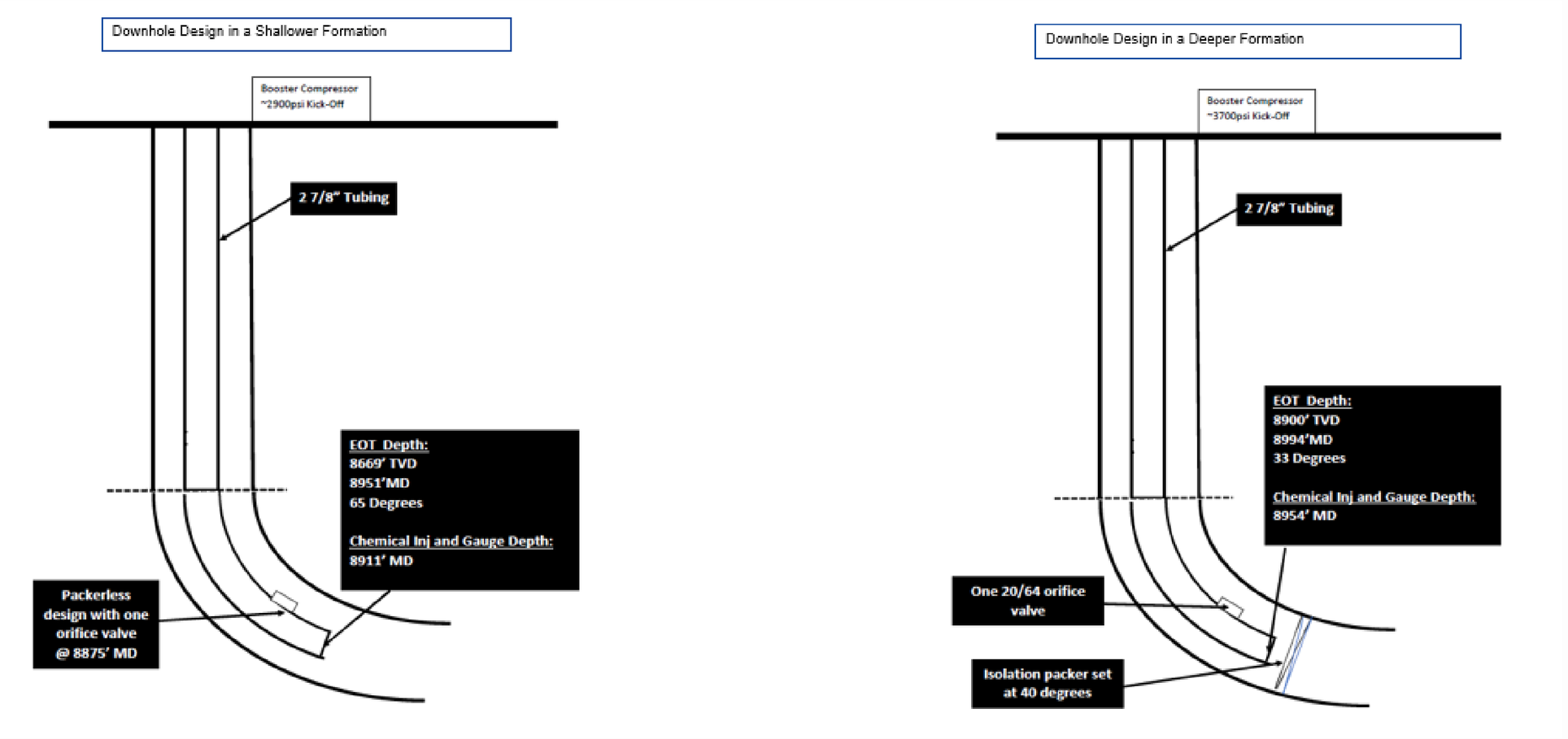
ExxonMobil HPGL Highlights

- First pilot HPGL was executed May 2021 with successful performance
- Current HPGL program with ~ 100 wells
- Pilot and early applications featured simple downhole configurations
- Side Packet Mandrels (SPMs) added in the newer designs
- While programs have consistently delivered desired business values, yet they did encounter operational challenges
- HPGL has become an integral part of Permian field development strategy

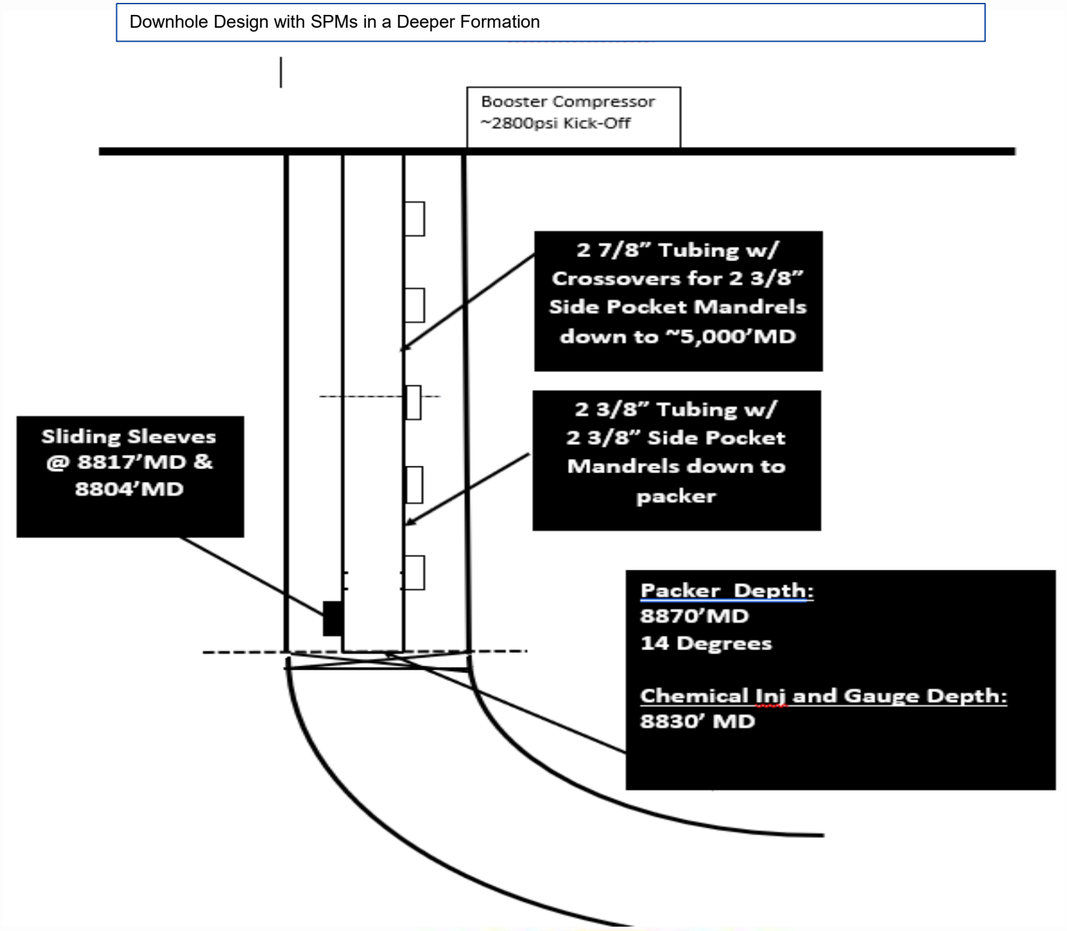
Criteria for Application

- Above grade
- Schedule 3+ months out for F&C electrical installation (electric compressor only)
- Need at least 1100 MCFD for annular injection
- Dehy installed on centralized compression system preferred
- Wolfcamp A or deeper
- Prefer to limit (“Normal” injection + production gas) to 3 MMCFD going through pad tester due to erosional rates (can go over without major concern)
- Battery constraints do not factor in unless Wolfcamp A well was scoped as CGL and changed to HPGL

Pilot Downhole Designs – Two Configurations

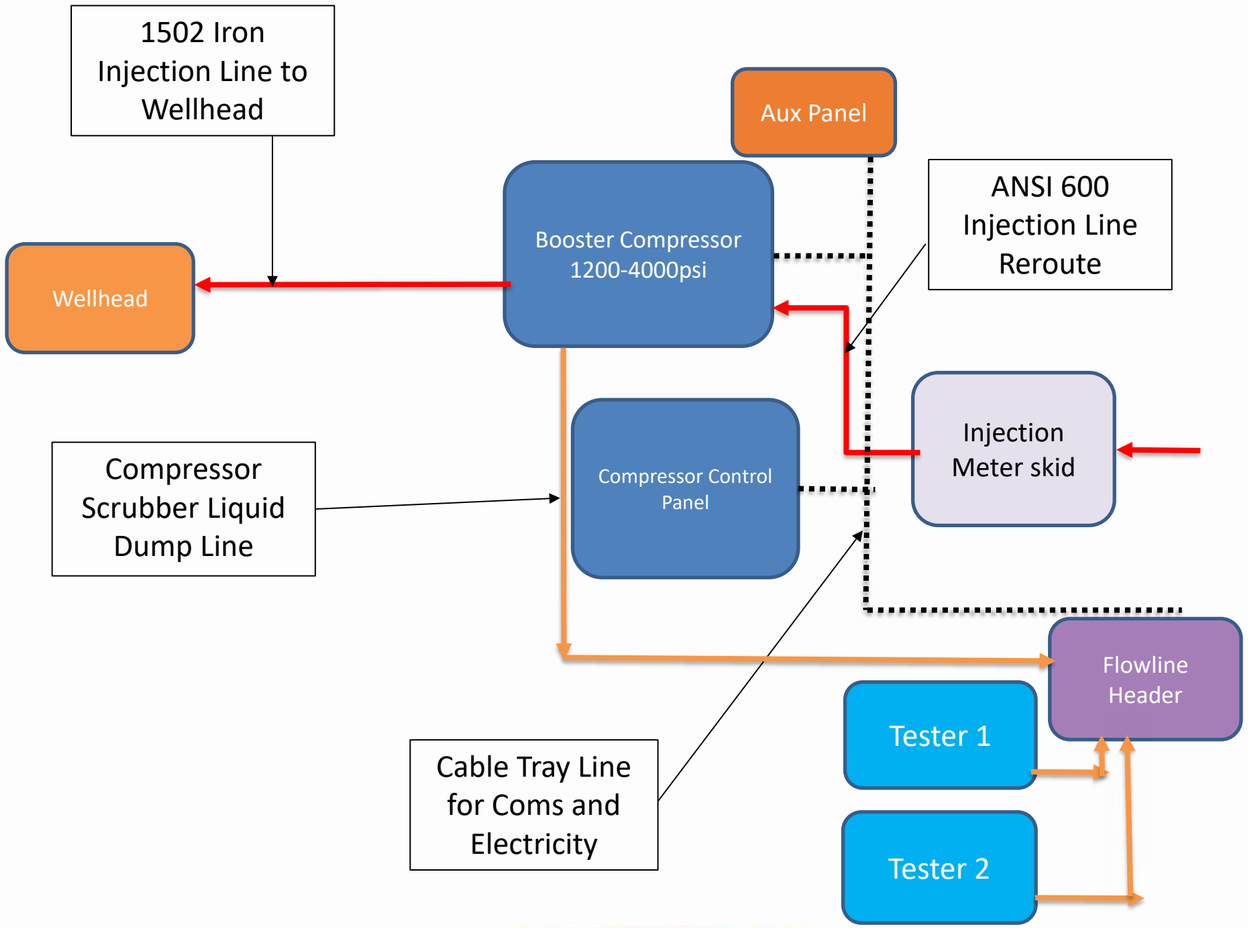


Downhole Design – Test with SPMs



- Annular design
- Configured to run HPGL first, then go CGL directly once HPGL booster moves to other well in ~ 9 months to 1 year
- Save a W/O job with Side Pocket Mandrels (SPMs)
- Many model runs were made to confirm the advantages of tapered tubing string for both HPGL first and when operation is switched to CGL later
- Hybrid tubing w/ 2 7/8" for top 5,000' and 2 3/8" for rest of string
- Side pocket mandrels for all valves
- Use cross-overs in 2 7/8" section for SPMs
- Only live valve is orifice
- EOT has packer
- Sliding sleeves above packer

Surface Facility Design



- Injection
  - Normal injection line is blinded, and temporary surface injection line is built from injection meter skid to booster compressor
  - Booster sends high pressure gas through 1502 injection line to wellhead
- Liquids
  - Temporary surface scrubber line installed between compressor skid and flowline header
- I&E
  - Permissives are added on the flowline header, compressor discharge line, and wellhead casing to shutdown compressor and ESD well

Compressor

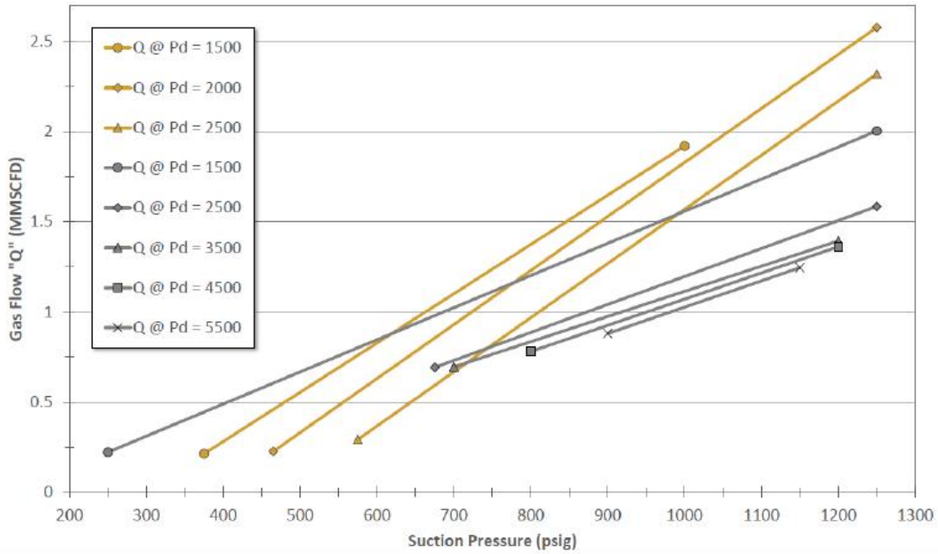
COMPRESSION (booster)

Booster)/ 150 Hp EL)

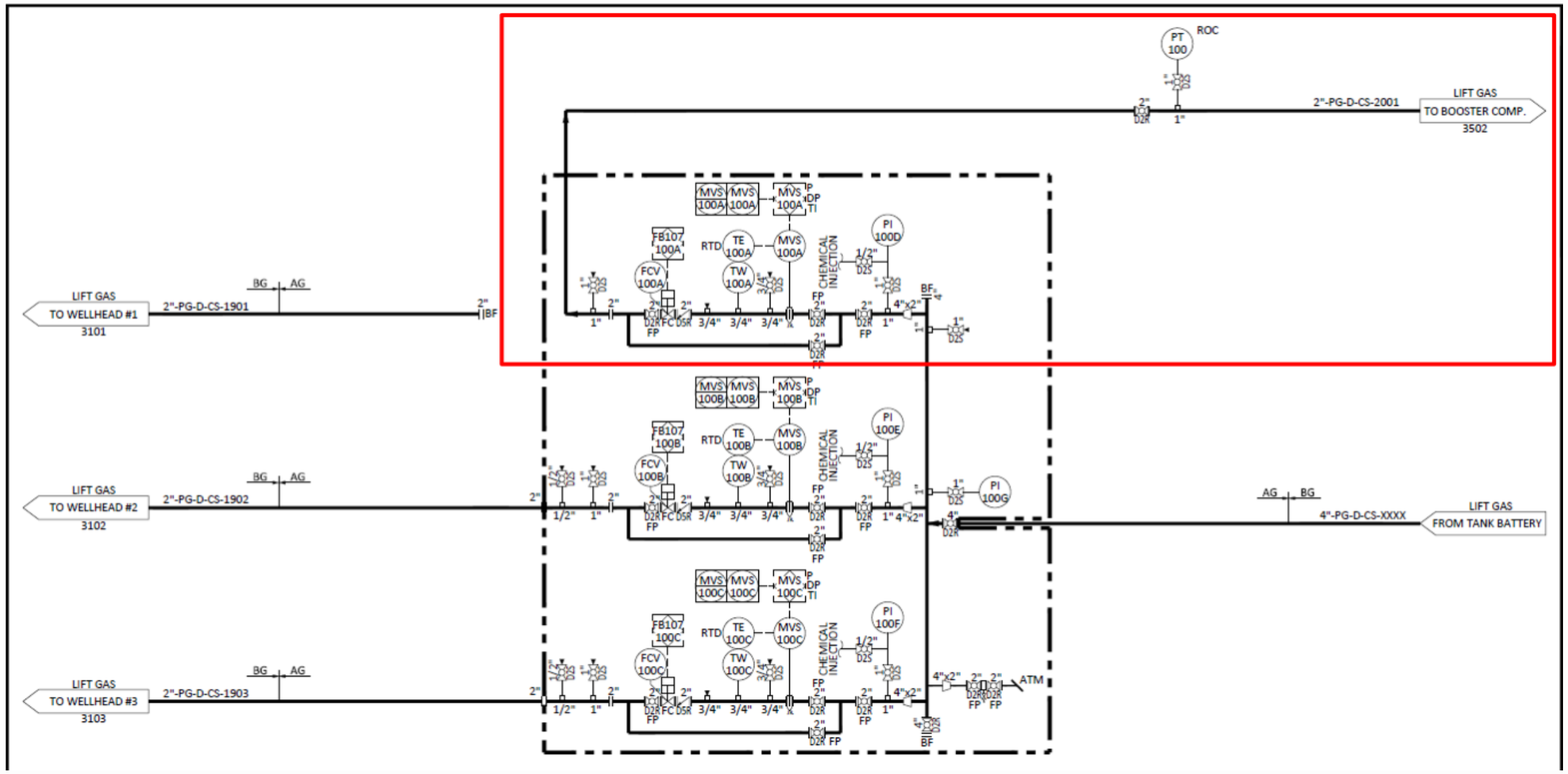
- CAT G3306B NA Engine/ TECO 150 Electric
- Ariel JGQ/2
- 145 BHP X 1800 RPM
- 1ST STAGE CYLINDER - 2-3/4" RJ - 2500 psig
- 2ND STAGE CYLINDER - 1-5/8" RJ - 5500 psig

Booster Compressor Performance

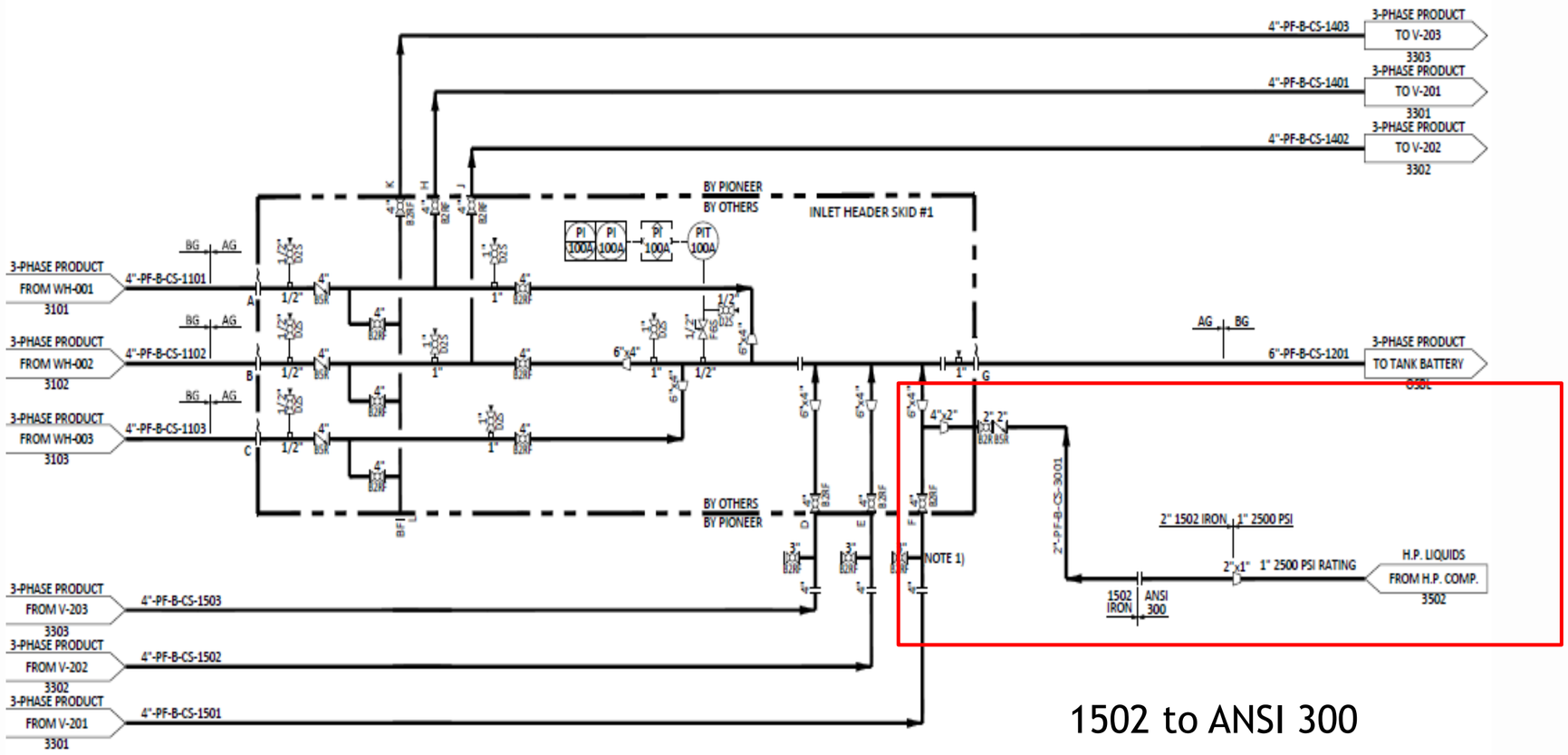
Single Stage - Two Stage



Injection Meter Skid P&ID



Compressor Liquid Dump Line to Commingled Flowline

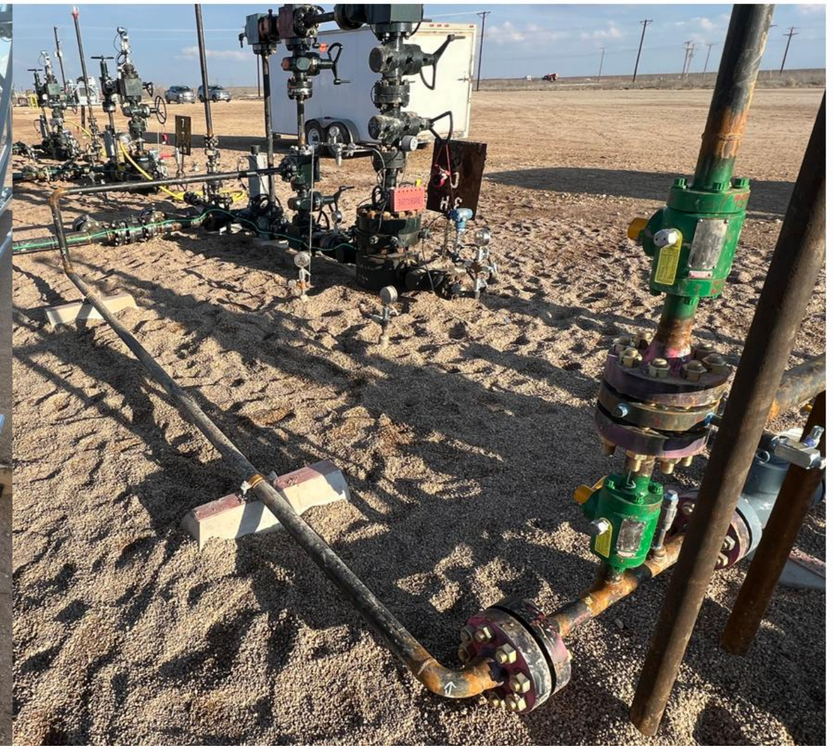


1502 to ANSI 300

Surface Facility

Injection Meter Skid Connection to ANSI 600 Flanged Injection Line

Injection Line Connection to Compressor



Injection Line to Wellhead

Surface Facility (Cont'd)

High Pressure Connection to WH

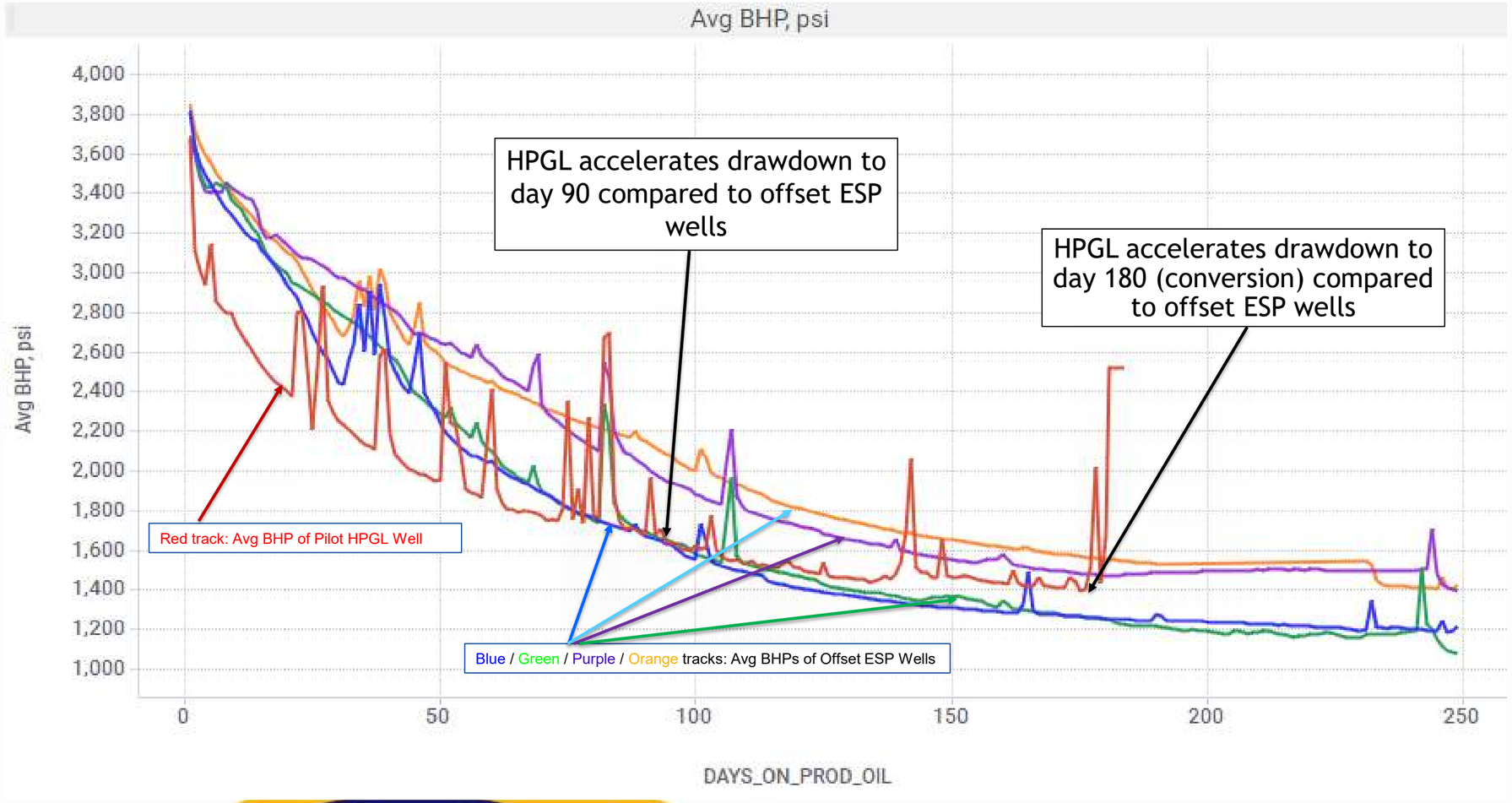
Liquid Scrubber Line to Flowline Header

Liquid Dump Line to Flowline

First HPGL Well (Shallower Formation) Analysis

- Formation: XYZ
- POP on AFL: 5/29/2021
- HPGL Injection Start: 5/29/2021
- Downtime: Multiple days of DT due to electrical PME issues between June and September
- Injection Rates:
  - Initial: 1100 MCFD
  - 7/15-10/18: 1400 MCFD
  - 10/19-11/29: 1300 MCFD
- HPGL End: 12/1/2021
- CGL Start: 12/14/2021
  - CGL injection rate: 550 MCFD
  - CGL continued well decline trend where HPGL ended

First Pilot HPGL Well Compared to Closest ESPS



First Pilot Well HPGL Performance Compared to CGL

- Well models were created and calibrated to selected representative dates for HPGL operating conditions
- Calibrated models were used to simulate typical AGL & CGL performance & compared with HPGL for the same dates and conditions
- HPGL would outperform AGL by ~ 22% on average for all the dates examined, or an average gain of ~ 90 BOPD for HPGL over AGL
- HPGL would outperform CGL by ~ 55% on average for all the dates examined, or an average gain of ~ 180 BOPD for HPGL over CGL
- The net profit from HPGL is significantly more than CGL for 180 days

First Pilot Well HPGL Comparison to AGL & CGL

Date	HGPL, BOPD	AGL, BOPD	Diff over AGL BOPD	% over AGL	CGL, BOPD	Diff over CGL BOPD	% over CGL
5/31/2021	471	379	92	24%	267	204	76%
6/14/2021	559	427	132	31%	331	228	69%
7/9/2021	583	472	111	24%	375	208	55%
8/9/2021	494	418	76	18%	341	153	45%
10/3/2021	398	356	42	12%	304	94	31%
Average	501	410	91	22%	324	177	55%

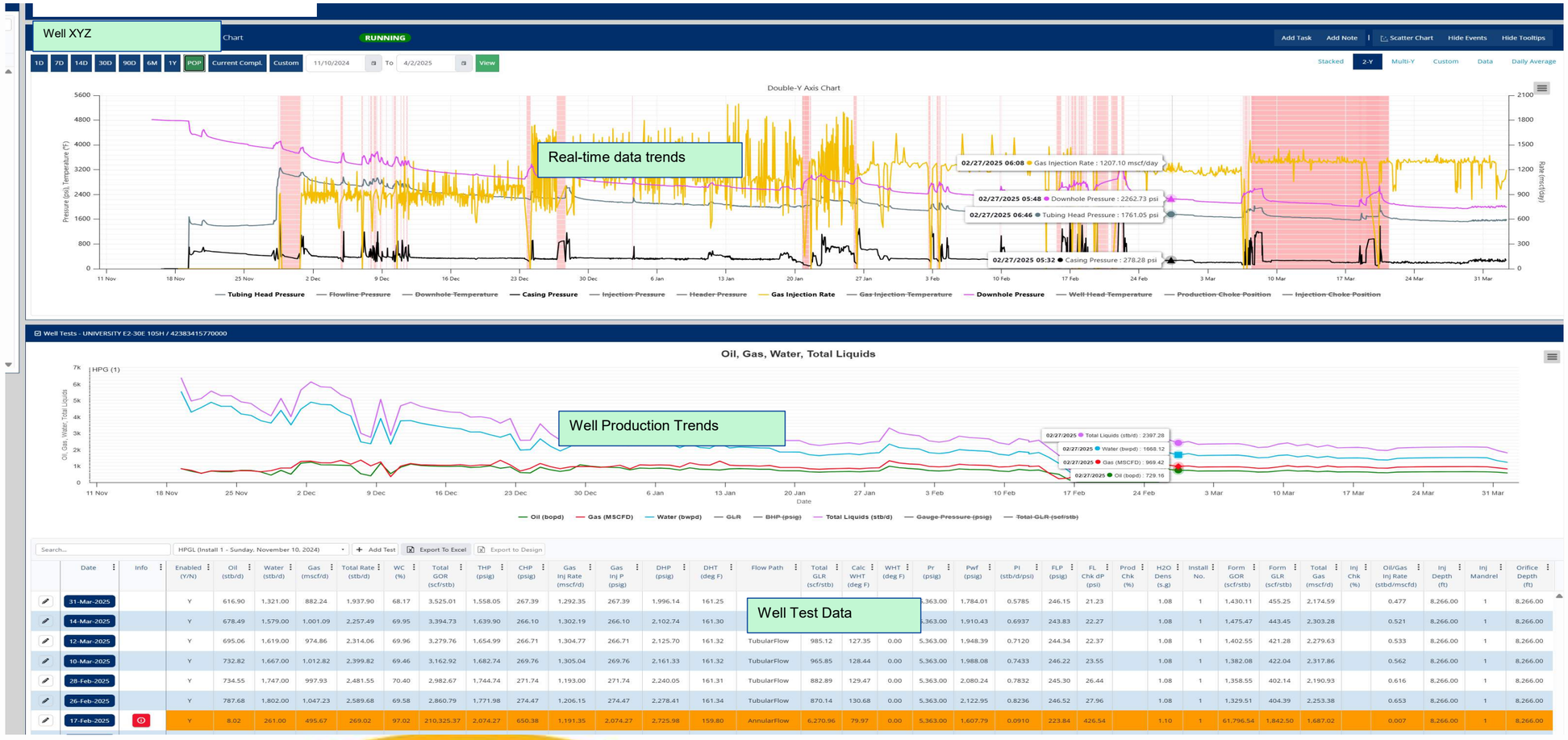
HPGL Ended	HPGL Days	BO over CGL
11/26/2021	179	xyz

Assumptions:

AGL: Pinj=1050 psi, deltaP valve=100 psi, QGI=1200 MCFD, optimum injection depth. Most optimistic case.

CGL: Pinj=1050 psi, deltaP valve=100 psi, QGI=600 MCFD, optimum injection depth. Most optimistic case.

HPGL Integrated Well Surveillance and Monitoring



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In-depth HPGL Well Performance Analyses

Gas Lift Diagnosis | Well Name | with Test Date: 21-May-2025

< | Recommend this well | Recommendations | Test History | Test Graphs | Workover Economics

Optimization Comment for Current Test in Well RAY-WINKLEMAN C43C 103H - Gas Lift Runlife: 354 days - Contact: Walker, William

Optimization Comment...

Gas Lift Recommendations

Injected Gas Rate (mscf/d)	New Injected Gas Rate(mscf/d)	Additional Oil (stb / d)
1,300	2000	5.9

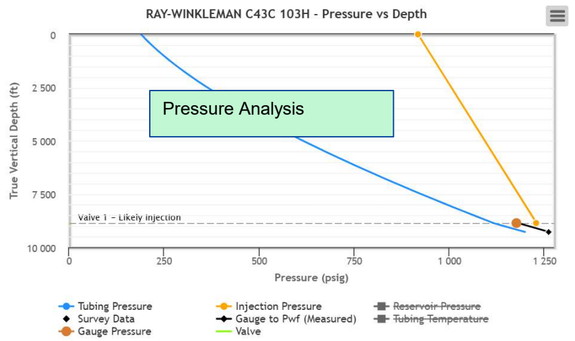
Well Test Data

Oil (stb/d)	Water (stb/d)	Gas (mscf/d)	Liq Rate (stb/d)	WC (%)	Total GOR (scf/stb)
490	830	1249	1320	62.9	5199

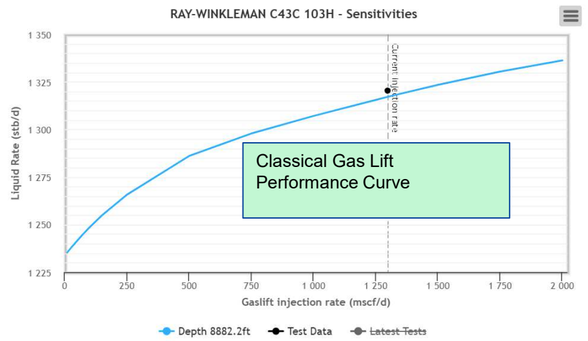
Prod Pressure (psig)	Calc WHT (deg F)	WHT (deg F)	Gas Inj Rate (mscf/d)	Gas Inj P (psig)	Form GOR (scf/stb)
189.5	113.4	0.0	1300	917.4	2548

PI (stb/d/psi)	Pwf (psig)	Pr (psig)	Drdn (%)	Min Stable Inj Rate (mscf/d)
0.3846	1199	5539	78	10

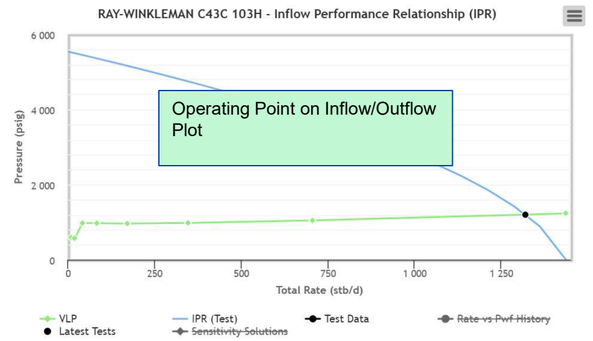
Gradient Traverse Plot



Injection Sensitivity | **WHP Sensitivity**



Validated IPR



Results

	Calculated	Measured	Difference
Downhole Pressure (psig)	1114	1177	63
Downhole Temperature (deg F)	173	166	-7
Gauge Depth TVD (ft)		8848	
Injection Depth TVD (ft)		8882	
Injection Mandrel (Determined)		1	
Injection Mandrel (Forced)			
Deepest Possible Injection (ft)		8882	
Flow Correlation		ALP	

Injection at current injection point

Depth TV (ft)	Gas Inj Rate (mscf/d)	Liq Rate (stb/d)	Oil Rate (bopd)	Add. Oil (bopd)
8882	500	1286	478	-13
8882	750	1298	482	-8
8882	1000	1307	485	-5
8882	1250	1316	489	-2
8882	1300	1317	489	-1
8882	1500	1323	492	1
8882	1750	1330	494	4
8882	2000	1336	496	6

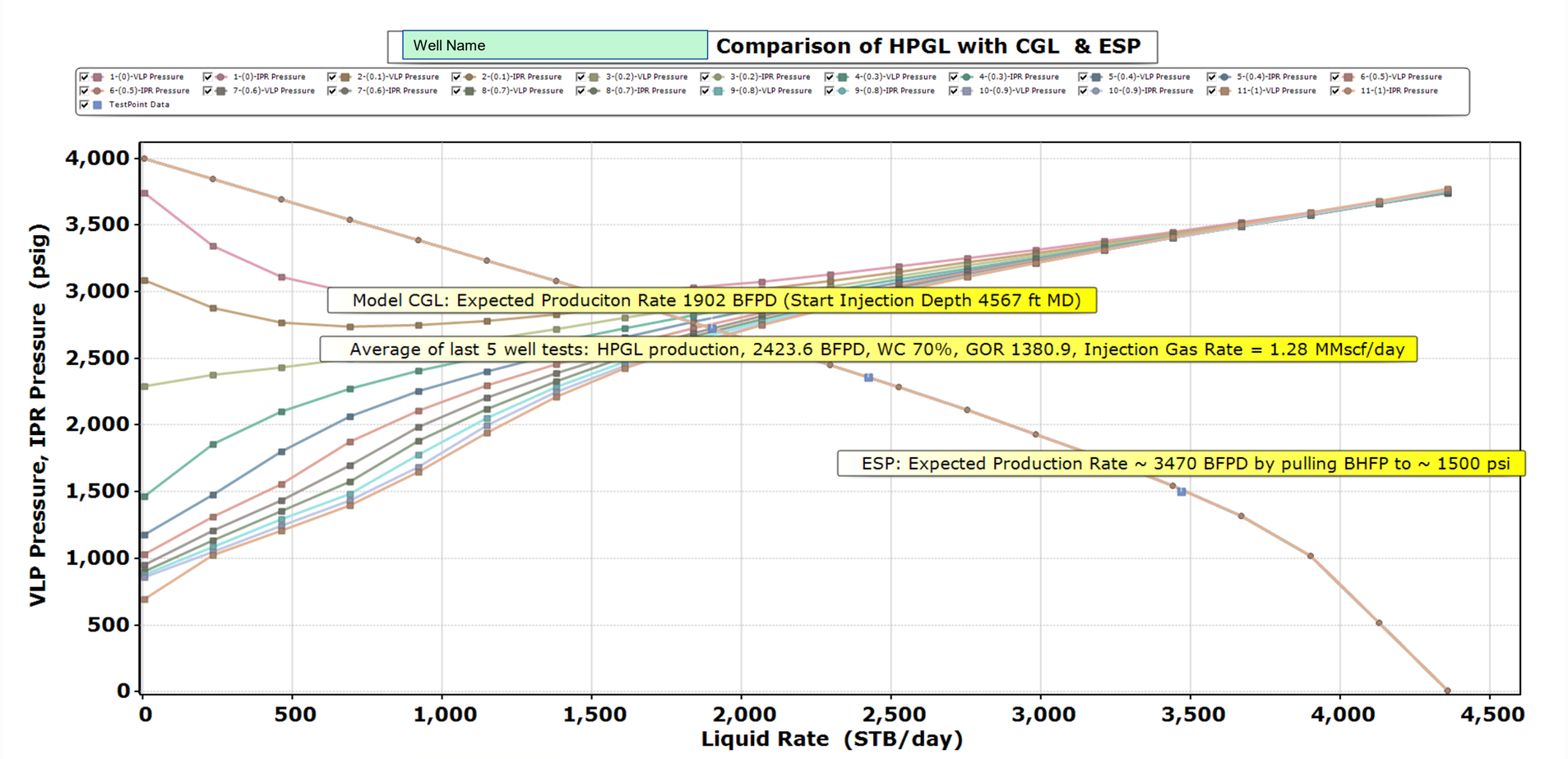
Table for Production Impact with change in gas injection rates

Injection at deepest mandrel

Depth TV (ft)	Gas Inj Rate (mscf/d)	Liq Rate (stb/d)	Oil Rate (bopd)	Add. Oil (bopd)	Oil Gain/Add. Inj (bo/mscf)
8882	500	1286			
8882	750	1298			
8882	1000	1307			
8882	1250	1316			
8882	1300	1317	489	-1	0
8882	1500	1323	492	1	0.006
8882	1750	1330	494	4	0.008
8882	2000	1336	496	6	0.008

Effects of Injection Depth

Well Model to Support HPGL Conversion: HPGL, CGL, or ESP?



Lesson Learned

- Liquid Dump Line/Scrubber System
  - ✓ Issue: Compressor would consistently go down on low suction pressure due to scrubber dump hanging open
  - ✓ Solution: Insulated and heat traced dump valve/back pressure valve and dump line on skid to prevent freezing during winter
- ESD Function
  - ✓ Issue: Injection pressure is too high and 1502 will not allow for steel line to pull gas for ESD
  - ✓ Solution: Run steel line from wellhead next to HPGL to run ESD or just run off of nitrogen
- Injection Rates
  - ✓ Issue: No data for optimal injection set point
  - ✓ Solution: 900mcf and 1100mcf used for testing but bumping injection up to 1300mcf+ has shown increased drawdown and higher production
- Compressor Controls
  - ✓ Issue: Three ways to run compressor 1) Set cyclonic for a set volume and match Hz on compressor for volume 2) Set cyclonic to hold set suction pressure and set Hz on compressor to run at set volume 3) Set suction control valve on inlet of compressor
  - ✓ Solution: Option 2 allows compressor to run smoother and less headache with low suction. This option also utilizes what we already have by using the cyclonic for the suction control

HPGL Path Forward

- Well Selection
  - ✓ Work with reservoir group to select wells for application
  - ✓ List sent out for OPS engineering group to evaluate compression
- F&C Scope of Work
  - ✓ Meet with F&C on location to walk through build
  - ✓ Add to F&C scope of work pre-PSSR
- Field Operations
  - ✓ Meet with representative on location from each field office to walk through operations
- Capital Efficiency
  - ✓ Establish program for moving of equipment to reuse and working with supply chain group on transferring charges (just like ESP surface equipment)
- Execution Strategy
  - ✓ Program manages changes to development strategy and evaluation from ops/reservoir on forecasting for compression

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Question Time

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