2024 GAS LIFT WORKSHOP

Real-Time Surveillance System for Gas Lift Troubleshooting

Irina Sokolova IPCOS

Ilnur Mustafin ConocoPhillips

ALRDC.COM

Agenda

- Real-Time Gas Lift Surveillance system
  - Objectives & Opportunities
  - Challenges
- Real-Time Surveillance System Components
- Data and Modelling Approach
- High-Level System Architecture
- Use case: field in Alaska
- Conclusions

Real-Time Gas Lift Surveillance Objectives and Opportunities

Objectives

- Optimize gas lift operations in Real Time to
  - Increase production and reduce downtime
  - Increase lifting efficiency
- Reduce engineering hours spent on Gas Lift Analysis
- Make gas lift optimization a part of routine engineering practice and promote advanced engineering skillset to wider audience

Opportunities

- Best practices for Gas Lift Surveillance are well-developed and often present in-house and can be used to solve asset-specific challenges
- Most of the Gas Lift Surveillance and Optimization routines can be automated and used to highlight ongoing issues and potential
- Commercial Gas Lift modelling applications are available and can be enhanced by external calculations in case of modelling limitations

Real-Time Gas Lift Surveillance Challenges

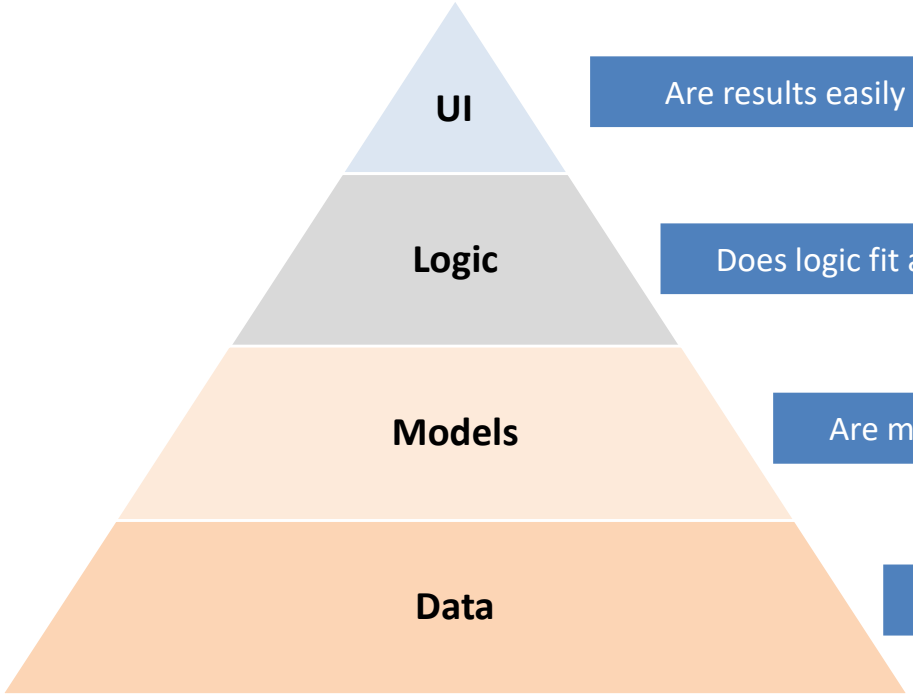
Any Artificial Lift Surveillance is an advanced data- and modelling-intensive routine that requires significant pre-work, including

- Data mining
- Model-building
- Consolidation of gas lift expertise and best practices into automated workflows
- Overcoming limitations of the available commercial modelling tools

Requires maintenance effort to keep the data and models evergreen

May require advanced engineering skillset

Real-Time Surveillance System Components



Are results easily interpretable?

- Highlights issues
- Presents solutions
- Provides guidelines

Does logic fit asset-specific needs?

- Best practice
- Operations by exception
- Overcomes modelling limitations

Are models maintained and reliable?

- Model quality
- Model update & tuning
- Modelling limitations

Can data be used for automation?

- Data availability
- Data quality
- Data structure

Data and Modelling Approach

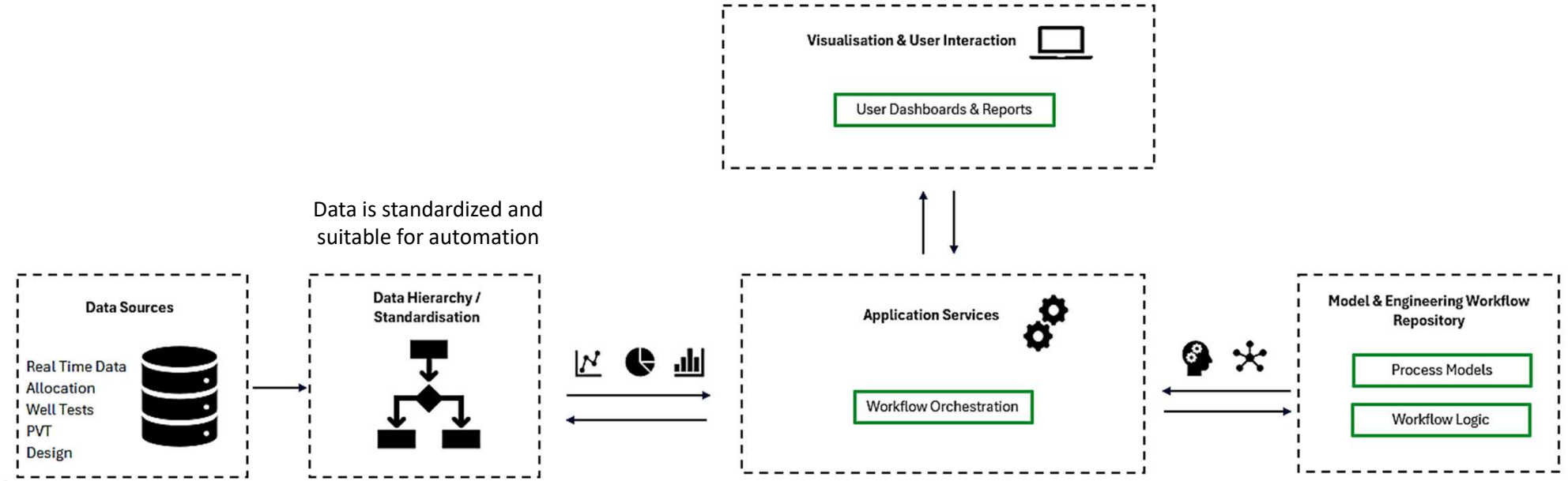
Data

- Data used for automation must be standardized and QC-ed
  - Outside of Real-Time Application
  - Within Real-Time Application data model if one exists
- Required data includes
  - Design data, PVT, Real Time, Well Tests, etc., depending on the models used and required calculations

Models

- Physical
  - Actual physical models
  - Surrogate models
  - Data Driven
  - Hybrid

Real-Time Surveillance System High-Level Architecture



Workflows are scheduled and executed, results are reported

Models: Well/Network/Reservoir, etc.
Workflows: pre-processing workflows, gas lift surveillance logic, etc.

Use case: Digital Oilfield System for a field in Alaska

Alaska Digital Oilfield System

Facts

- Conventional Oil Field
- 600+ active producers, including ~500 Gas Lifted wells
- Physical well models are used
- DOF Development driven by IT security, requirement to replace obsolete & unsupported in-house applications and provide remote engineering support

Workflows

DOF Model Maintenance:
- Automatic Well Addition
- Prosper Model Update

Network Suite:
- Real-Time GAP Update
- Heater tuning
- Pipeline tuning
- What-If Scenario
- Backout Calculations

Well Test Suite:
- Well Model Validation
- Well Test Matching
- Perf. Curves generation
- VLP Generation

Surveillance:
- **Gas Lift Troubleshooting**
- Pump Lift Surveillance
- Flow Assurance

Deployment Phase #1 Phase #2 Phase #3

2024 GAS LIFT WORKSHOP

Road to Gas Lift Surveillance Gains

Data

- Design data, PVT, Well Tests, Real Time data, etc. collected from multiple sources via queries that structure the data and provide first level of data QC

Model building and tuning

- Models are automatically built and updated
- Models are automatically validated and tuned to the new well tests
- This allow reliable well rate estimation for Real Time surveillance

Gas Lift Surveillance

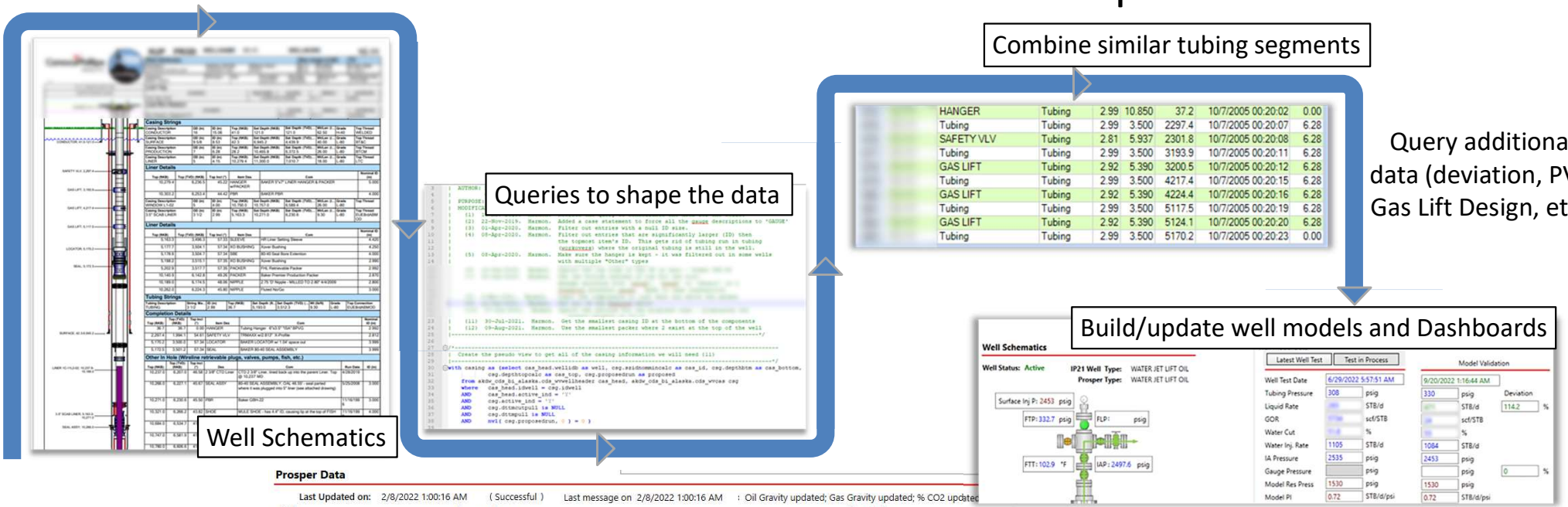
- Gas Lift Surveillance workflow are running on Well Test and Real Time data
- Gas Lift Surveillance is enhanced by valve performance calculations using VPC catalogue

Operations by Exceptions

- Highest producers with issues and opportunities are highlighted for engineers
- Troubleshooting tools are provided to analyze and resolve issues

2024 GAS LIFT WORKSHOP

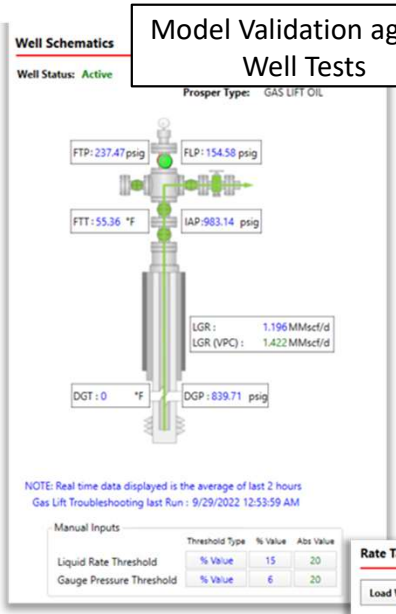
Automatic Well Model Creation and Update



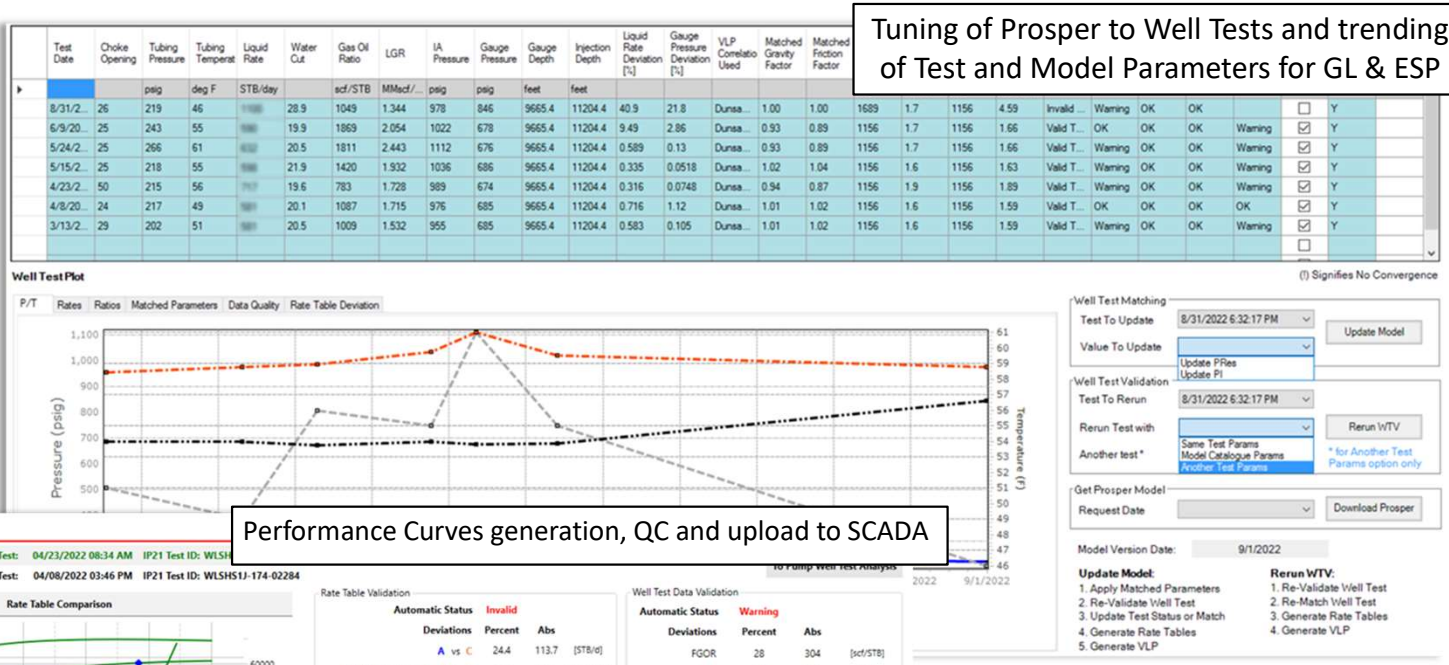
2024 GAS LIFT WORKSHOP

Model Tuning via Well Test Suite

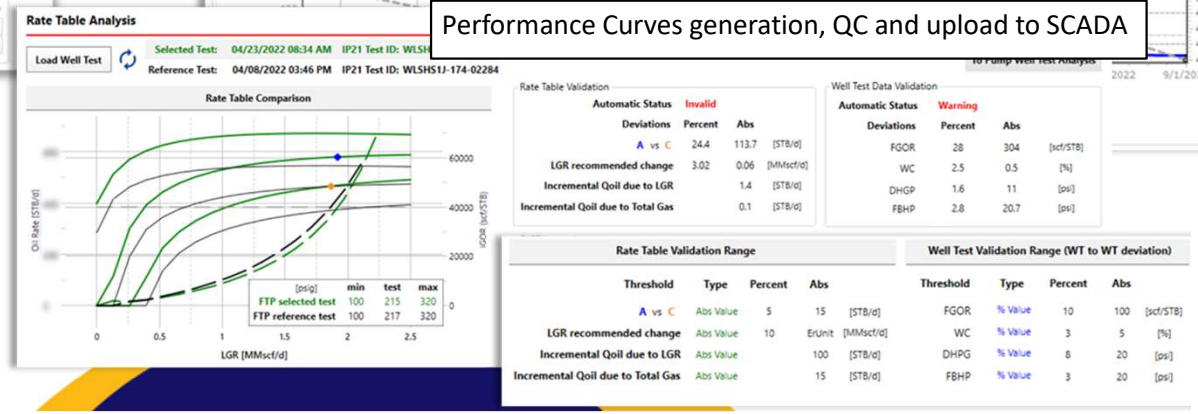
Model Validation against Well Tests



Tuning of Prosper to Well Tests and trending of Test and Model Parameters for GL & ESP



Performance Curves generation, QC and upload to SCADA



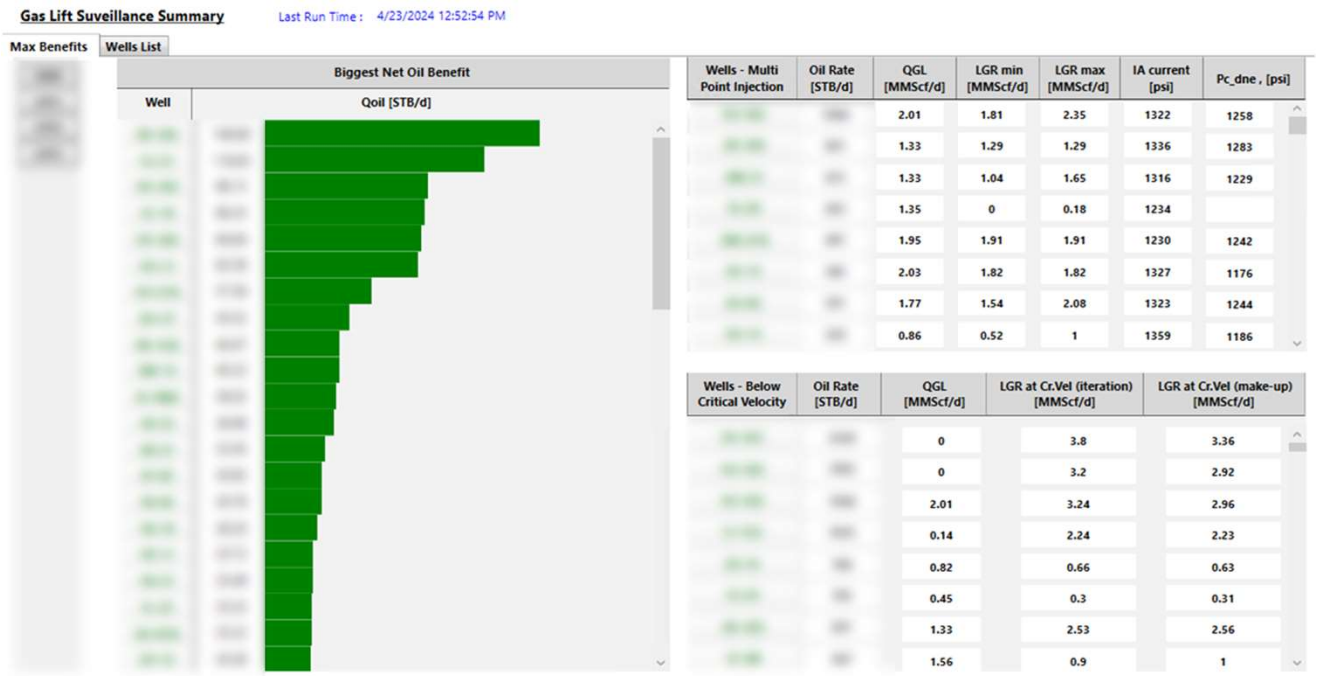
Several levels of QC:

- Raw test data applying ML algorithms
- Changes in Model Parameters
- Changes in Performance Curves

Real-Time Gas Lift Troubleshooting

Central Processing Facility (CPF) Level

- Top wells for oil benefit from lifting from deepest available mandrel
- Summary of multi-point injection wells with guidelines on Gas Lift Gas Rate and Injection Pressure
- Summary of wells with gas lift velocity below critical lift velocity with guidelines on minimum required Gas Lift Gas Rate
- List of wells where lifting OV depth in models are different from WellView



Wells - Multi Point Injection	Oil Rate [STB/d]	QGL [MMScf/d]	LGR min [MMScf/d]	LGR max [MMScf/d]	IA current [psi]	Pc_dne , [psi]
		2.01	1.81	2.35	1322	1258
		1.33	1.29	1.29	1336	1283
		1.33	1.04	1.65	1316	1229
		1.35	0	0.18	1234	
		1.95	1.91	1.91	1230	1242
		2.03	1.82	1.82	1327	1176
		1.77	1.54	2.08	1323	1244
		0.86	0.52	1	1359	1186

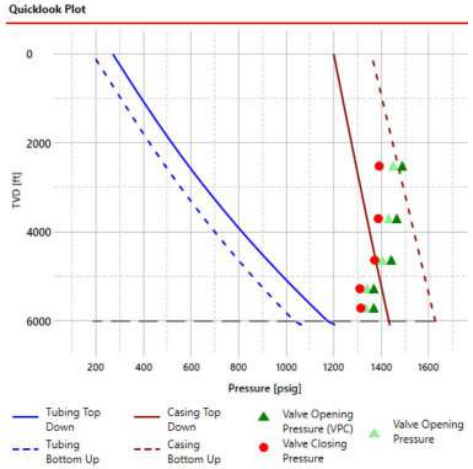
Wells - Below Critical Velocity	Oil Rate [STB/d]	QGL [MMScf/d]	LGR at Cr.Vel (iteration) [MMScf/d]	LGR at Cr.Vel (make-up) [MMScf/d]
		0	3.8	3.36
		0	3.2	2.92
		2.01	3.24	2.96
		0.14	2.24	2.23
		0.82	0.66	0.63
		0.45	0.3	0.31
		1.33	2.53	2.56
		1.56	0.9	1

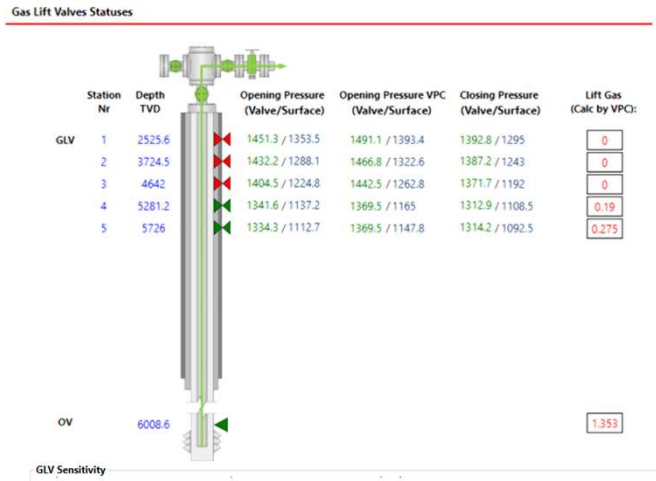
2024 GAS LIFT WORKSHOP

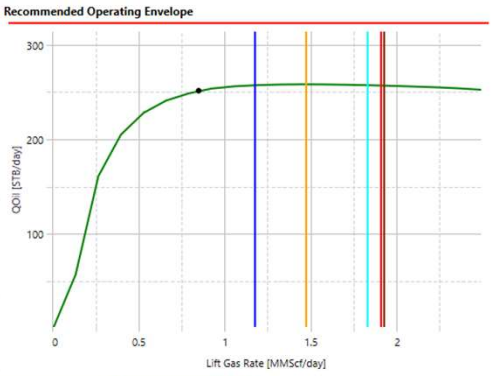
Real-Time Gas Lift Troubleshooting

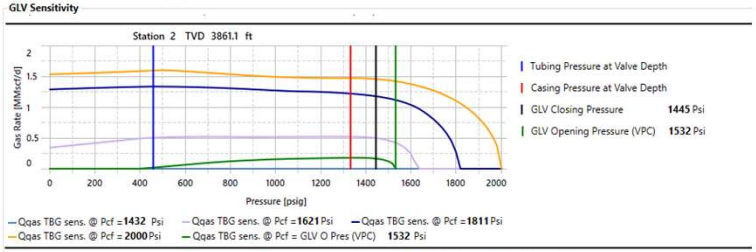
Well Level

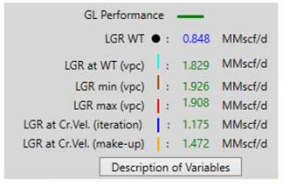
- Valves Opening/Closing Pressure overlayed on Tubing/Casing gradients
- Valve Open/Close Status
- OV and Valve Sensitivity Curves using VPC
- Oil Benefit potential from lifting deeper
- Critical Lift Velocity & Well Stability
- Operating guidelines for avoiding Multipoint Injection and Liquid Loading

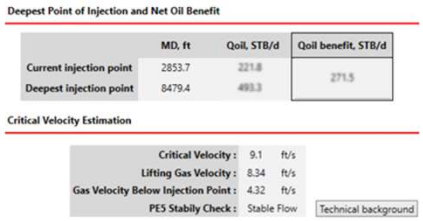












ALRDC.COM

Conclusions

- Gas Lift Surveillance and Optimization challenge can be tackled by monitoring operations in Real-Time
- Operations by exception, along with promoting advanced engineering skillset hold a promise to enhance the practice of gas lift operations
- Gas Lift Surveillance is an advanced step that can be achieved after the major data, modelling, automation and engineering design work has been done
- Implementation tools must be selected to fulfill major technical requirements, however, if limitations are encountered, can be enhanced by additional analysis and logic

2024 GAS LIFT WORKSHOP

Question Time

Copyright

Disclaimer

The following disclaimer shall be included as the last page of a Technical Presentation or Continuing Education Course. A similar disclaimer is included on the Gas Lift Workshop webpage.

The Artificial Lift Research and Development Council and its officers and trustees, and the Gas Lift Workshop Steering Committee members, and their supporting organizations and companies (here-in-after referred to as the Sponsoring Organizations), and the author(s) of this Technical Presentation or Continuing Education Course and their company(ies), provide this presentation and/or training material at the Gas Lift Workshop "as is" without any warranty of any kind, express or implied, as to the accuracy of the information or the products or services referred to by any presenter (in so far as such warranties may be excluded under any relevant law) and these members and their companies will not be liable for unlawful actions and any losses or damage that may result from use of any presentation as a consequence of any inaccuracies in, or any omission from, the information which therein may be contained.

The views, opinions, and conclusions expressed in these presentations and/or training materials are those of the author and not necessarily those of the Sponsoring Organizations. The author is solely responsible for the content of the materials.

The Sponsoring Organizations cannot and do not warrant the accuracy of these documents beyond the source documents, although we do make every attempt to work from authoritative sources. The Sponsoring Organizations provide these presentations and/or training materials as a service. The Sponsoring Organizations make no representations or warranties, express or implied, with respect to the presentations and/or training materials, or any part thereof, including any warrantees of title, non-infringement of copyright or patent rights of others, merchantability, or fitness or suitability for any purpose.