



2024 GAS LIFT WORKSHOP

Real-Time Surveillance System for Gas Lift Troubleshooting

Irina Sokolova



Ilnur Mustafin



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



2024 GAS LIFT WORKSHOP

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



2024 GAS LIFT WORKSHOP

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

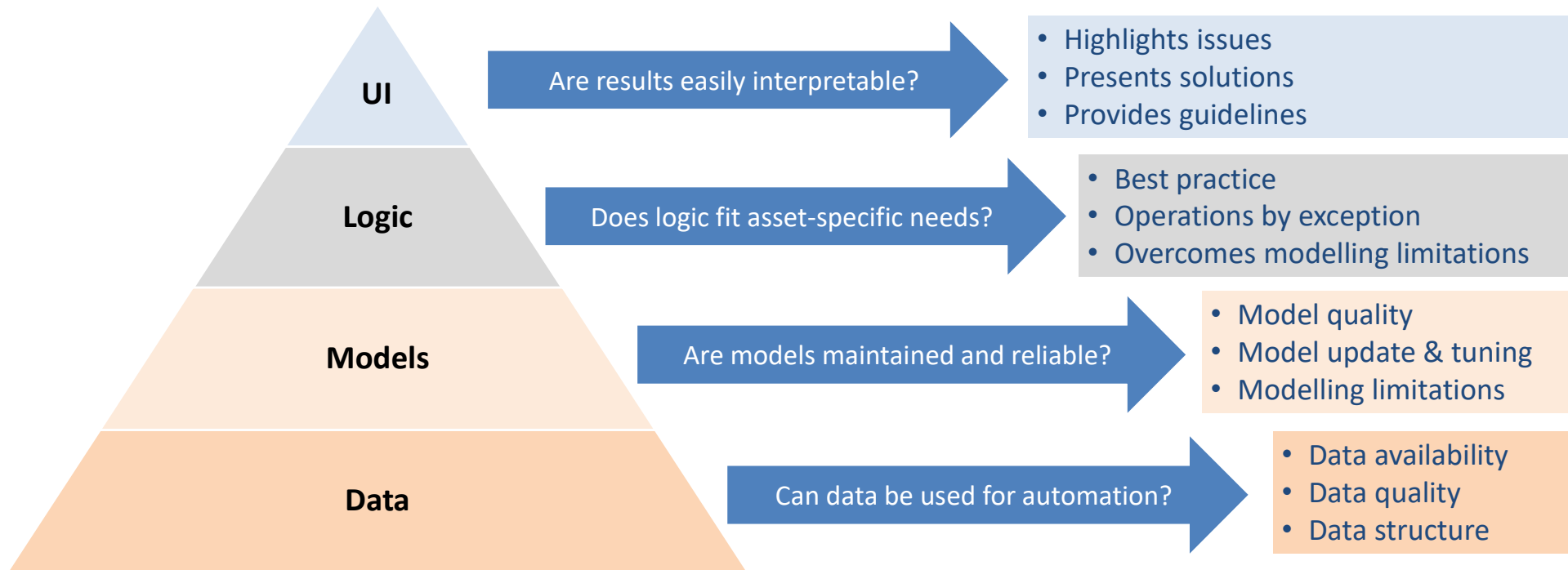
Requires maintenance effort to keep the data and models evergreen

May require advanced engineering skillset



2024 GAS LIFT WORKSHOP

Real-Time Surveillance System Components





2024 GAS LIFT WORKSHOP

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

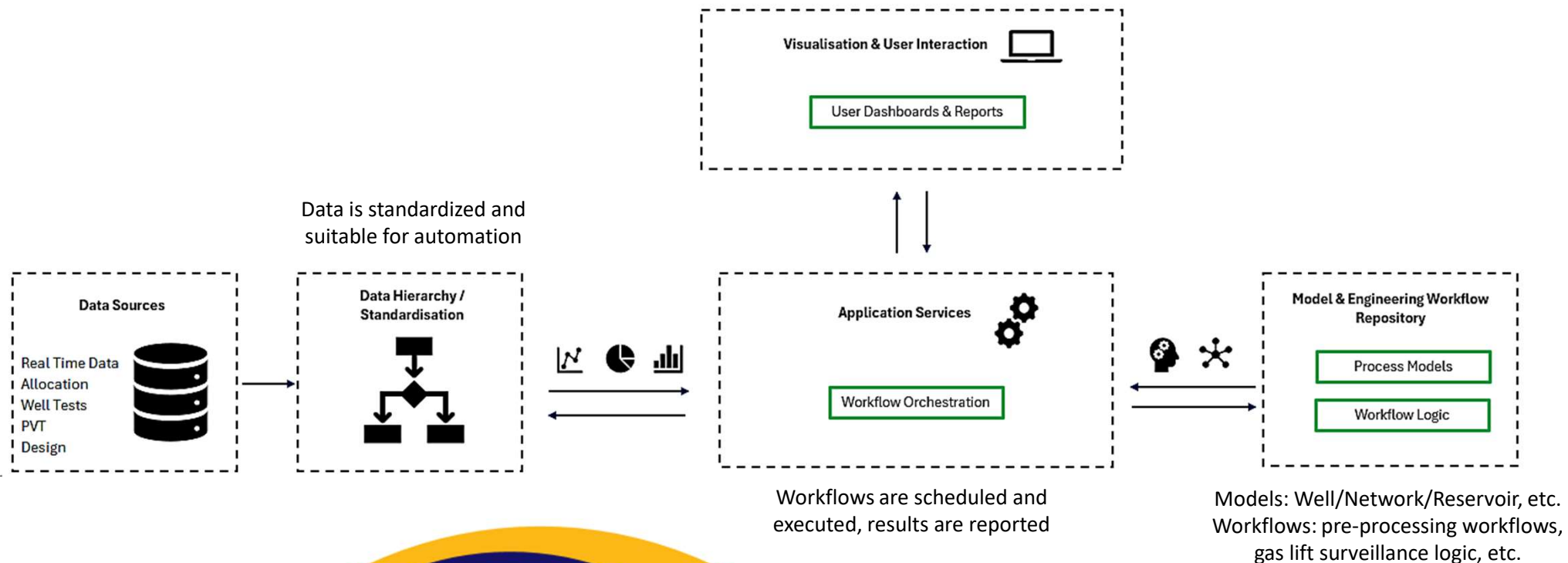
Models

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



2024 GAS LIFT WORKSHOP

Real-Time Surveillance System High-Level Architecture





2024 GAS LIFT WORKSHOP

Use case: Digital Oilfield System for a field in Alaska



ALRDC.COM



2024 GAS LIFT WORKSHOP

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

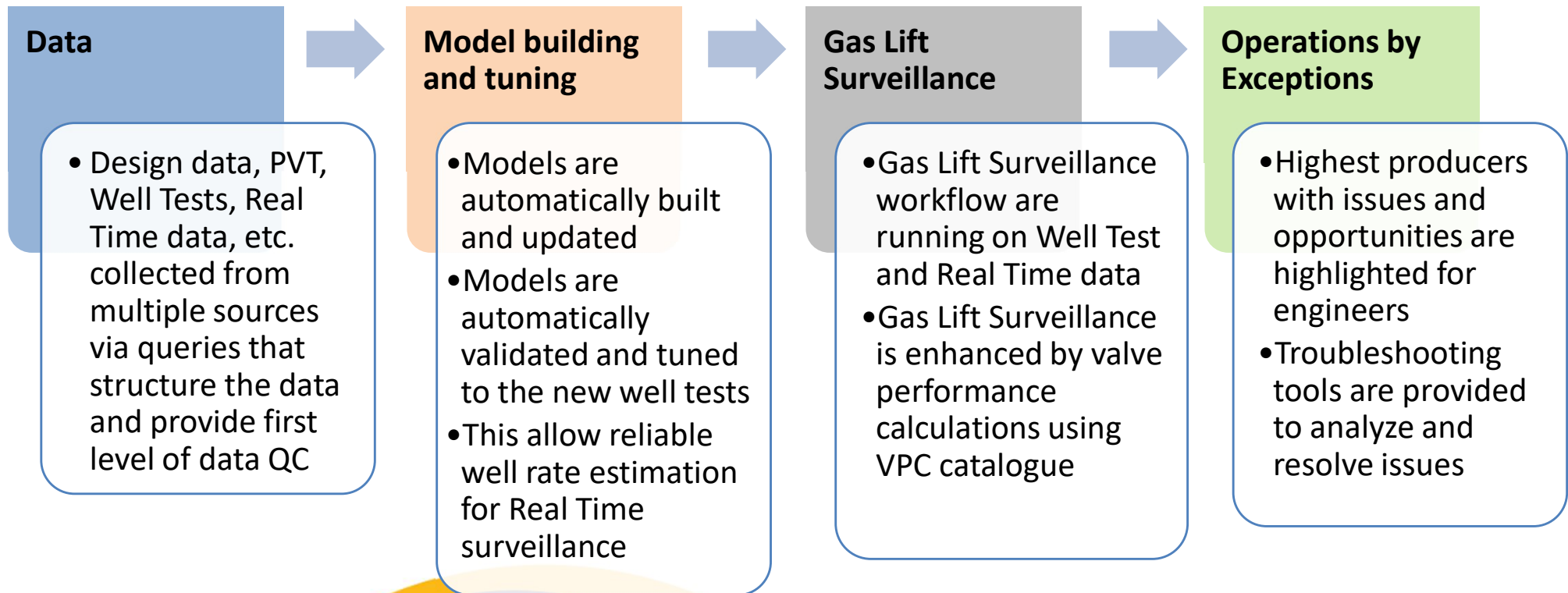
Phase #3

ALRDC.COM



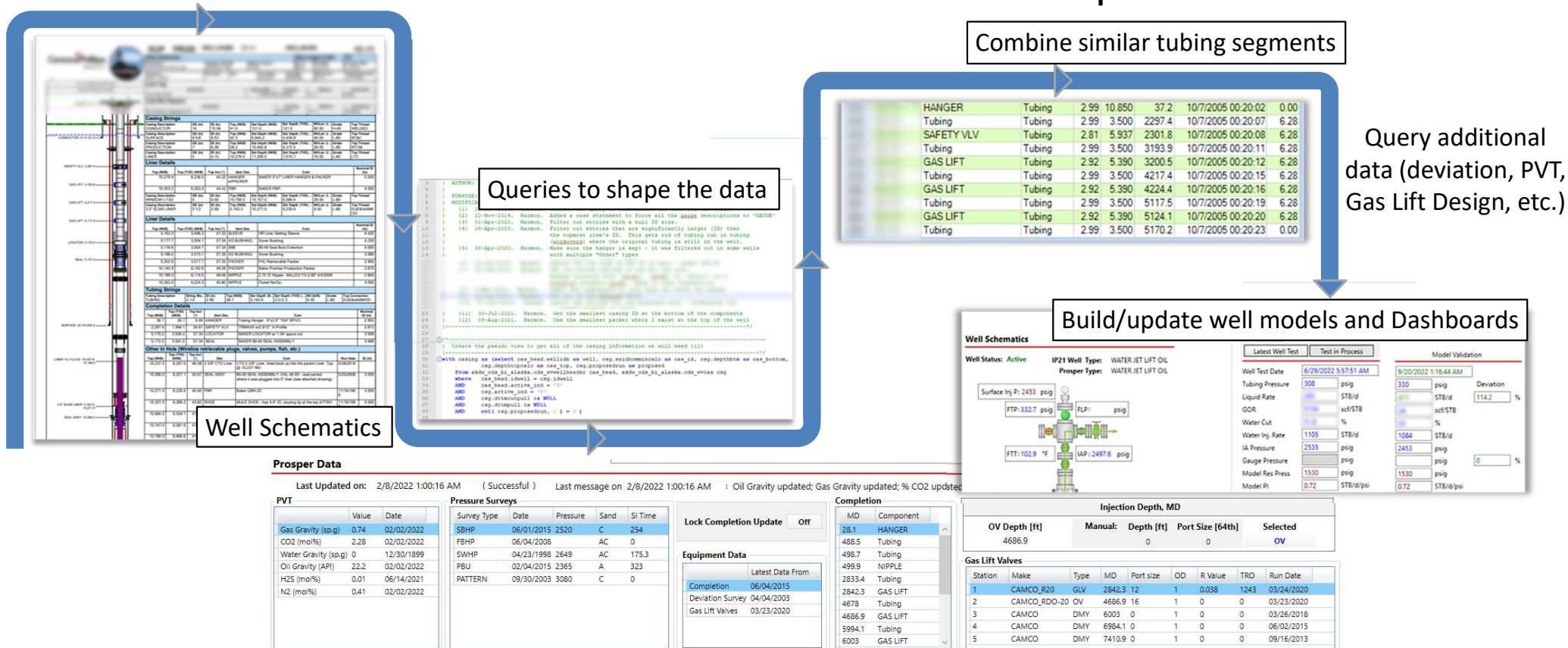
2024 GAS LIFT WORKSHOP

Road to Gas Lift Surveillance Gains



ALRDC.COM

Automatic Well Model Creation and Update

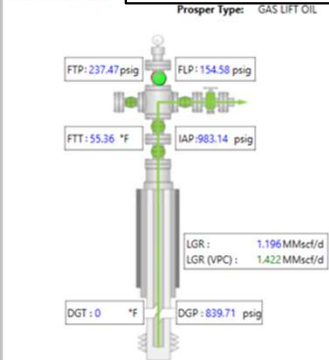




2024 GAS LIFT WORKSHOP

Model Tuning via Well Test Suite

Well Schematics
Well Status: Active
Model Validation against Well Tests

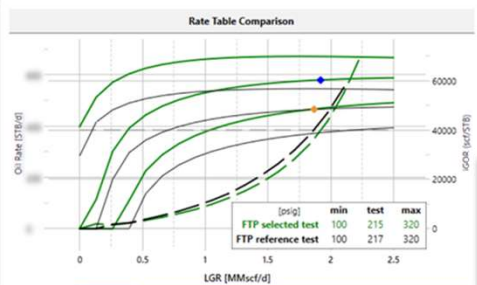


NOTE: Real time data displayed is the average of last 2 hours
Gas Lift Troubleshooting last Run: 9/29/2022 12:53:59 AM

Manual Inputs	Threshold Type	% Value	Abs Value
Liquid Rate Threshold	% Value	15	20
Gauge Pressure Threshold	% Value	6	20

Rate Table Analysis

Load Well Test
Selected Test: 04/23/2022 08:34 AM IP21 Test ID: WLSH511-174-02284
Reference Test: 04/08/2022 03:46 PM IP21 Test ID: WLSH511-174-02284



Performance Curves generation, QC and upload to SCADA

Rate Table Validation				Well Test Data Validation			
Automatic Status	Invalid	Percent	Abs	Automatic Status	Warning	Percent	Abs
Deviations	A vs C	24.4	113.7 [STB/d]	Deviations	FGOR	28	304 [scf/STB]
LGR recommended change		3.02	0.06 [MMscf/d]	WC	2.5	0.5	[%]
Incremental Quill due to LGR			1.4 [STB/d]	DHGP	1.6	11	[psi]
Incremental Quill due to Total Gas			0.1 [STB/d]	FBHP	2.8	20.7	[psi]

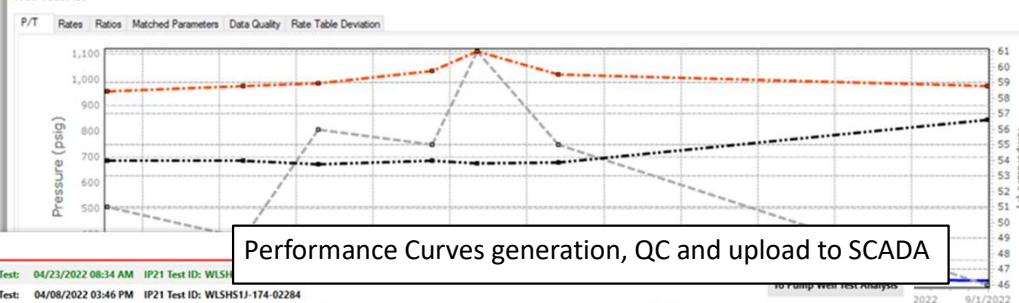
Rate Table Validation Range				Well Test Validation Range (WT to WT deviation)			
Threshold	Type	Percent	Abs	Threshold	Type	Percent	Abs
A vs C	Abs Value	5	15 [STB/d]	FGOR	% Value	10	100 [scf/STB]
LGR recommended change	Abs Value	10	ErUnit [MMscf/d]	WC	% Value	3	5 [%]
Incremental Quill due to LGR	Abs Value		100 [STB/d]	DHGP	% Value	8	20 [psi]
Incremental Quill due to Total Gas	Abs Value		15 [STB/d]	FBHP	% Value	3	20 [psi]

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

Test Date	Choke Opening	Tubing Pressure	Tubing Temp	Liquid Rate	Water Cut	Gas Oil Ratio	LGR	IA Pressure	Gauge Pressure	Gauge Depth	Injection Depth	Liquid Rate Deviation [%]	Gauge Pressure Deviation [%]	VLP Correlatio Used	Matched Gravity Factor	Matched Friction Factor	1689	1.7	1156	4.59	Invalid	Warning	OK	OK				
8/31/2...	26	219	46	1108	28.9	1049	1.344	978	846	9665.4	11204.4	40.9	21.8	Dunsa...	1.00	1.00	1689	1.7	1156	4.59	Invalid	Warning	OK	OK				
6/9/20...	25	243	55	1108	19.9	1869	2.054	1022	678	9665.4	11204.4	9.49	2.86	Dunsa...	0.93	0.89	1156	1.7	1156	1.66	Valid T...	OK	OK	OK	Warning	Y		
5/24/2...	25	266	61	1108	20.5	1811	2.443	1112	676	9665.4	11204.4	0.589	0.13	Dunsa...	0.93	0.89	1156	1.7	1156	1.66	Valid T...	Warning	OK	OK	Warning	Y		
5/15/2...	25	218	55	1108	21.9	1420	1.932	1036	686	9665.4	11204.4	0.335	0.0518	Dunsa...	1.02	1.04	1156	1.6	1156	1.63	Valid T...	Warning	OK	OK	Warning	Y		
4/23/2...	50	215	56	1108	19.6	783	1.728	989	674	9665.4	11204.4	0.316	0.0748	Dunsa...	0.94	0.87	1156	1.9	1156	1.89	Valid T...	Warning	OK	OK	Warning	Y		
4/8/20...	24	217	49	1108	20.1	1087	1.715	976	685	9665.4	11204.4	0.716	1.12	Dunsa...	1.01	1.02	1156	1.6	1156	1.59	Valid T...	OK	OK	OK	OK	Y		
3/13/2...	29	202	51	1108	20.5	1009	1.532	955	685	9665.4	11204.4	0.583	0.105	Dunsa...	1.01	1.02	1156	1.6	1156	1.59	Valid T...	Warning	OK	OK	Warning	Y		

(!) Signifies No Convergence

Well Test Plot



Well Test Matching
Test To Update: 8/31/2022 6:32:17 PM
Value To Update: Update P/Fies, Update PI
Update Model

Well Test Validation
Test To Rerun: 8/31/2022 6:32:17 PM
Rerun Test with: Same Test Params, Model Catalogue Params, Known Well Params
Rerun WTV
Another test *
* for Another Test Params option only

Get Prosper Model
Request Date:
Download Prosper

Model Version Date: 9/1/2022

Update Model:
1. Apply Matched Parameters
2. Re-Validate Well Test
3. Update Test Status or Match
4. Generate Rate Tables
5. Generate VLP

Rerun WTV:
1. Re-Validate Well Test
2. Re-Match Well Test
3. Generate Rate Tables
4. Generate VLP

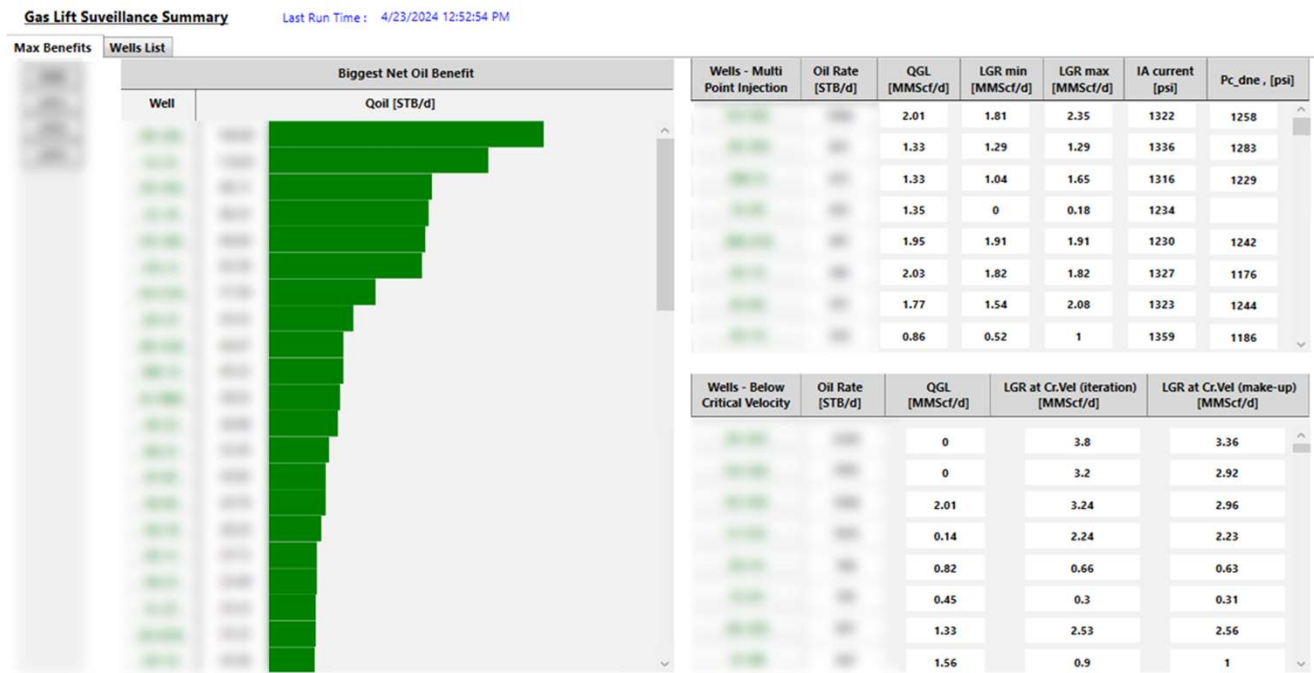
Several levels of QC:

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



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





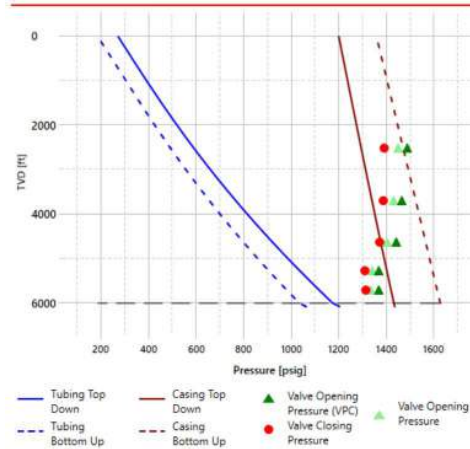
2024 GAS LIFT WORKSHOP

Real-Time Gas Lift Troubleshooting

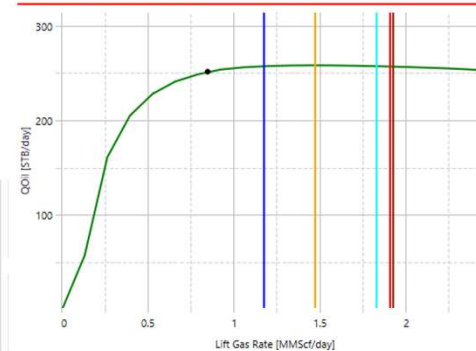
Well Level

- 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

Quicklook Plot

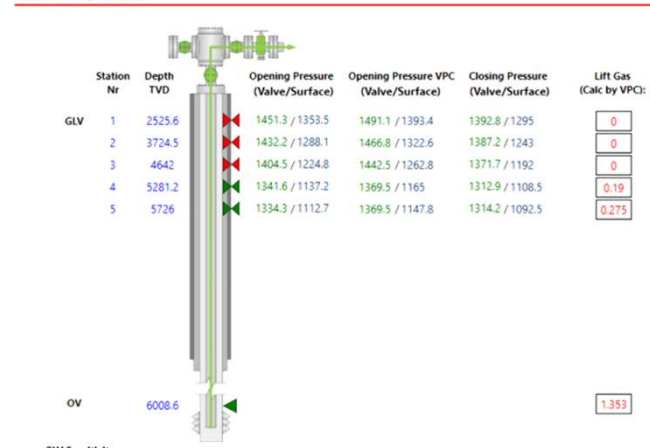


Recommended Operating Envelope

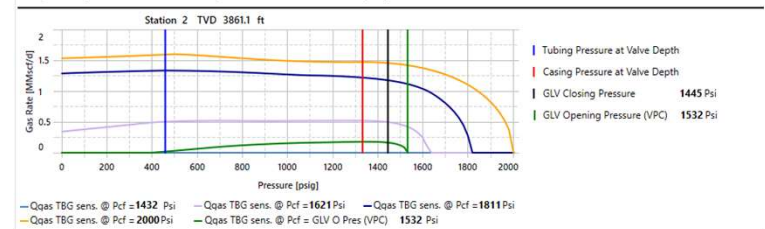


GL Performance	
LGR WT	0.848 MMscf/d
LGR at WT (vpc)	1.829 MMscf/d
LGR min (vpc)	1.926 MMscf/d
LGR max (vpc)	1.908 MMscf/d
LGR at Cr.Vel. (iteration)	1.175 MMscf/d
LGR at Cr.Vel. (make-up)	1.472 MMscf/d
Description of Variables	

Gas Lift Valves Statuses



GLV Sensitivity



Deepest Point of Injection and Net Oil Benefit

	MD, ft	Qoil, STB/d	Qoil benefit, STB/d
Current injection point	2853.7	221.8	
Deepest injection point	8479.4	489.3	271.5

Critical Velocity Estimation

Critical Velocity	9.1	ft/s
Lifting Gas Velocity	8.34	ft/s
Gas Velocity Below Injection Point	4.32	ft/s
PES Stability Check	Stable Flow	Technical background

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



ALRDC.COM



Copyright

- Rights to this presentation are owned by the company(ies) and/or author(s) listed on the title page. By submitting this presentation to the Gas Lift Workshop, they grant to the Workshop, and the Artificial Lift Research and Development Council (ALRDC) rights to:
 - Display the presentation at the Workshop.
 - Place the presentation on the www.alrdc.com web site, with access to the site to be as directed by the Workshop Steering Committee.
 - Place the presentation for distribution and/or sale as directed by the Workshop Steering Committee.
- Other uses of this presentation are prohibited without the expressed written permission of the company(ies) and/or author(s).



ALRDC.COM



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 warranties of title, non-infringement of copyright or patent rights of others, merchantability, or fitness or suitability for any purpose.