

A Day in the Life of a Gas-Lift Well Analyst

ASME/API/ISO Spring 2016 Gas-Lift Workshop

As presented by Ruben Cruz and Larry Peacock With
Special Thanks to our other guest stars



AppSmiths, Inc.
Houston, Texas
USA

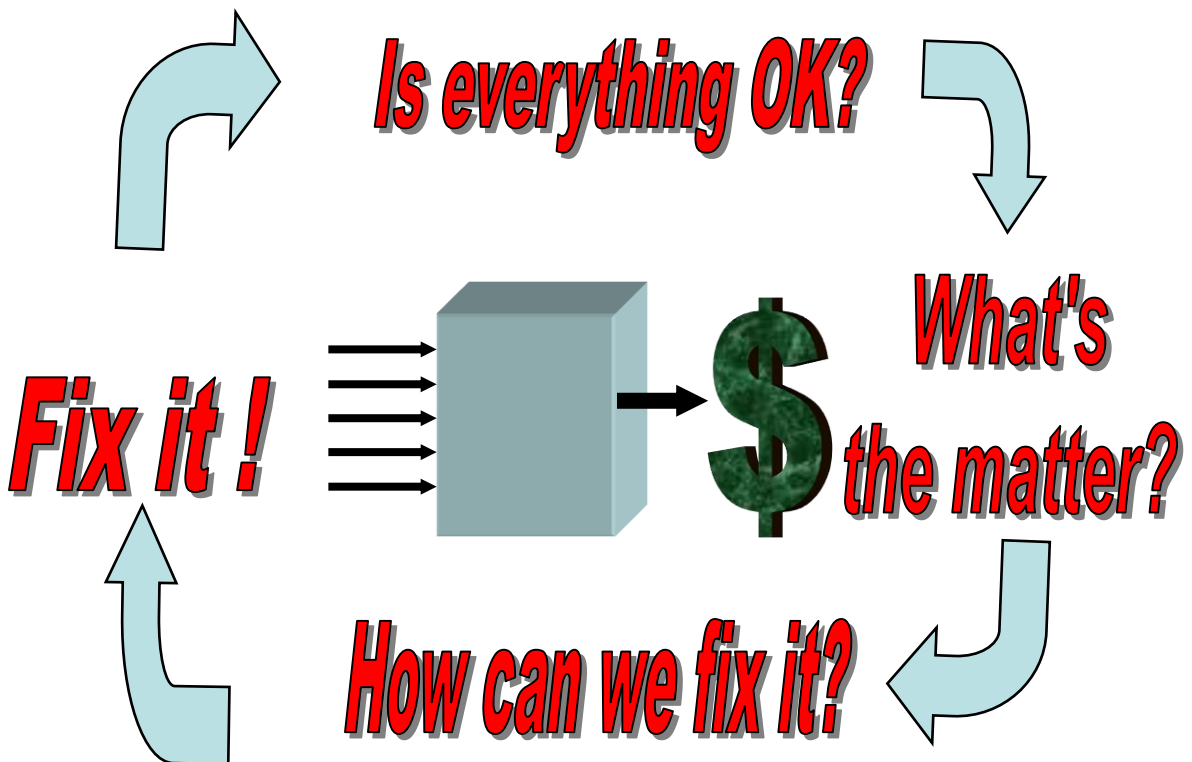
In Association with
Bongo Productions



SURVEILLANCE PROCESS

How do we turn this information into profit?

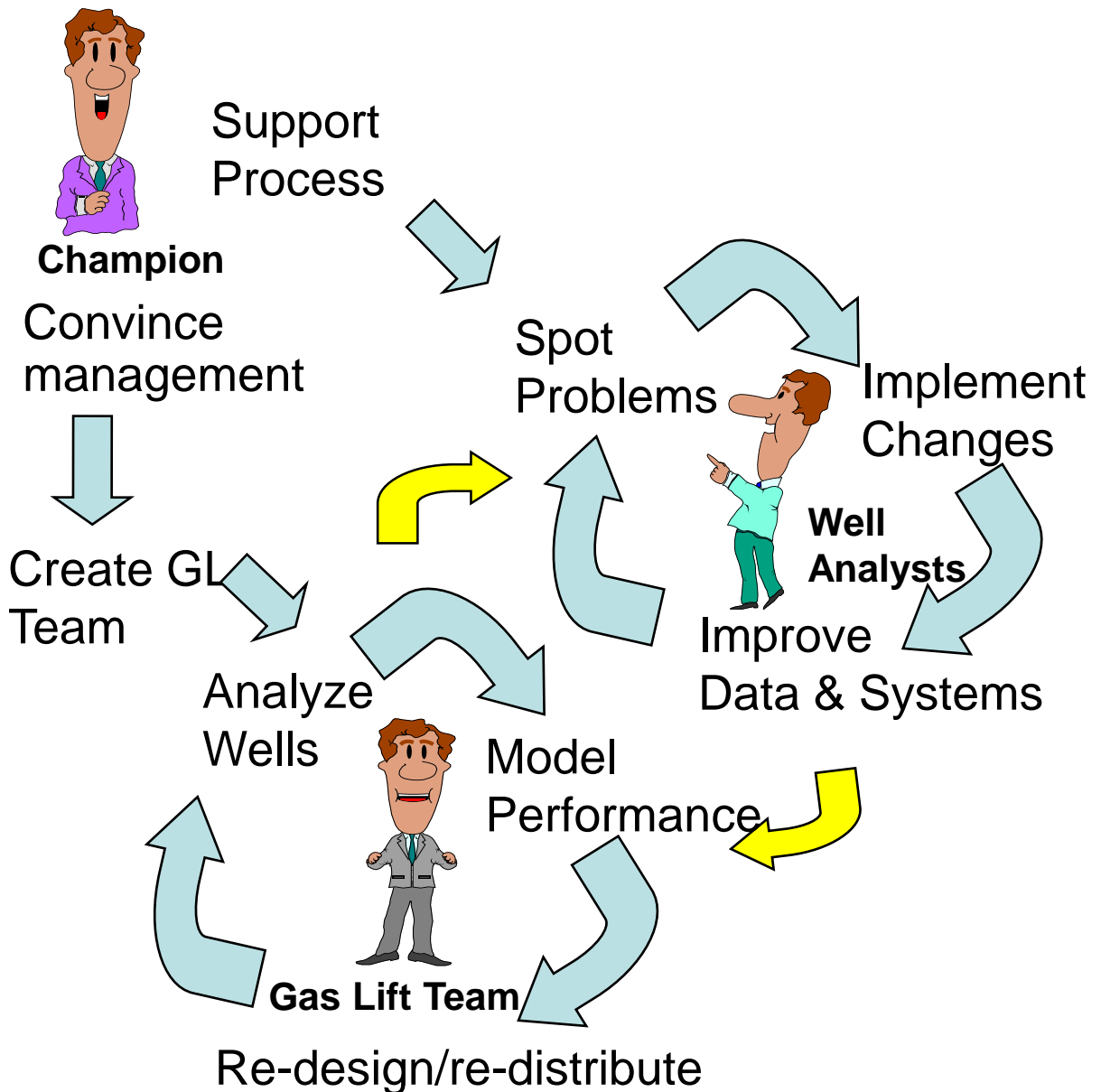
Basic Surveillance:



Surveillance is a **Process**, not a **Project**

TEAM CONCEPT

Recommended Surveillance Strategy:



Our Focus: The Gas-Lift Well Analyst

- **ACCURATE & COMPLETE WELL DATA**
- **SURFACE PRESSURE RECORDER CHARTS, REAL-TIME SCADA**
- **ACCURATE WELL TESTS**
- **SUBSURFACE PRESSURE & TEMPERATURE SURVEYS**
- **PROPER SURVEILLANCE TOOLS**
- **TRAINING**

It's Gallant the Super Analyst!



Vs. Goofus the Barely Analyst



GETTING STARTED

- REVIEW MORNING REPORTS FROM SCADA

Gas Lift GO Group Status Report

Group:

Well	Highest Priority Alarm:	Hours In Alarm	Nbr Alarms	State	Reason Code	Inj Press Min	Inj Press Cnt	Inj Press Max	Inj Rate SP
Y325	FCV Failed To Move	23.5	2	Prod		3680	3907	3960	18405
Y327	Injection Frozen	23.5	4	Frozen		0	0	0	26901
Y332	Setpoint Low	22.8	4	Prod		4955	5032	5087	0
Y339	Setpoint Low	23.0	3	Prod		5233	5289	5310	0
Y345	Diff Pressure Low	23.5	1	Prod		3776	3902	4013	21237
Y352	Prod. Pressure High	23.5	2	Prod		4169	4554	4556	21237
Y353	Setpoint Low	23.0	3	Prod		5490	5490	5490	0
Y374	Injection Rate Deviation Low	3.0	2	Prod		5129	5195	5216	18405
Y383	Injection Frozen	23.5	4	Frozen		2608	2608	2608	25485
Y384	Down Alarm	6.5	5	Down		4710	4983	5038	0
Y385	Setpoint Low	23.0	3	Prod		2825	2832	2853	0
Y391	Out Of Service	0.5	4	Out	FCLC	0	0	0	0
Y393	Out Of Service	0.5	4	Out	FCLC	0	0	0	0
Total: 19			81						230777

Select Well Print Refresh

GETTING STARTED

- **ANALYZES WELLS INDIVIDUALLY**
- **DIAGNOSES PROBLEMS TO DETERMINE MOST LIKELY CAUSE**
- **PRIORITIZES PROBLEMS BASED ON PRODUCTION OF WELL AND SEVERITY OF THE PROBLEM AS WELL AS AMOUNT TO BE GAINED OR THE COST OF THE PROBLEM**
- **DETERMINES ALTERNATIVES TO ADDRESS THE PROBLEMS**
- **PREDICTS IMPACTS OF CHANGES TO WELLS' OPERATION**



NEW WELL TESTS

- RECEIVES NEW DATA AUTOMATICALLY FROM COMPANY DATA STORE INTO ANALYSIS SOFTWARE
- REVIEWS NEW WELL TEST DATA THAT HAS COME IN; CONDUCTING A MINI-WELL REVIEW
- DETERMINES VALIDITY OF NEW DATA
- CONFIRMS TEST CONDITIONS
- IF CONSISTENT WITH PREVIOUS TESTS
 - UPDATE ANALYSIS PROGRAM
 - CALCULATE THE DOWNHOLE PERFORMANCE
 - PLOT CURRENT WELL TEST ON PERFORMANCE CURVE
- IF NOT CONSISTENT WITH PREVIOUS TESTS
 - MAY REORDER NEW WELL TEST
 - MAY ORDER PRESSURE SURVEY
 - MAY NEED TO REDO OPTIMIZATION

FLOWING PRESSURE/TEMPERATURE GRADIENT SURVEYS

- LOAD THE NEW SURVEY THAT HAS ARRIVED ALONG WITH THE WELL TEST
- FLOWING PRESSURE SURVEY DATA IS EXTREMELY USEFUL IN CALIBRATING TWO-PHASE PRESSURE MODELS TO COMPENSATE FOR INSTRUMENT DEFICIENCIES IN WELL TEST DATA
- FLOWING TEMPERATURE SURVEY DATA CAN BE USEFUL IN DETERMINING THE WELL LIFT DEPTH BY SEEING SUDDEN TEMPERATURE CHANGES IN THE WELL

WELLTEST RESERVOIR RESULTS

Well Test

Date:
 Information Only

Enter new date, Edit/New Record to create. Select date, Edit/Delete Record to delete.

Original

Test Length:
 Test Sep. Press.:
 Man. Pressure:

Calculated

FBHP:

IPR Qmax:

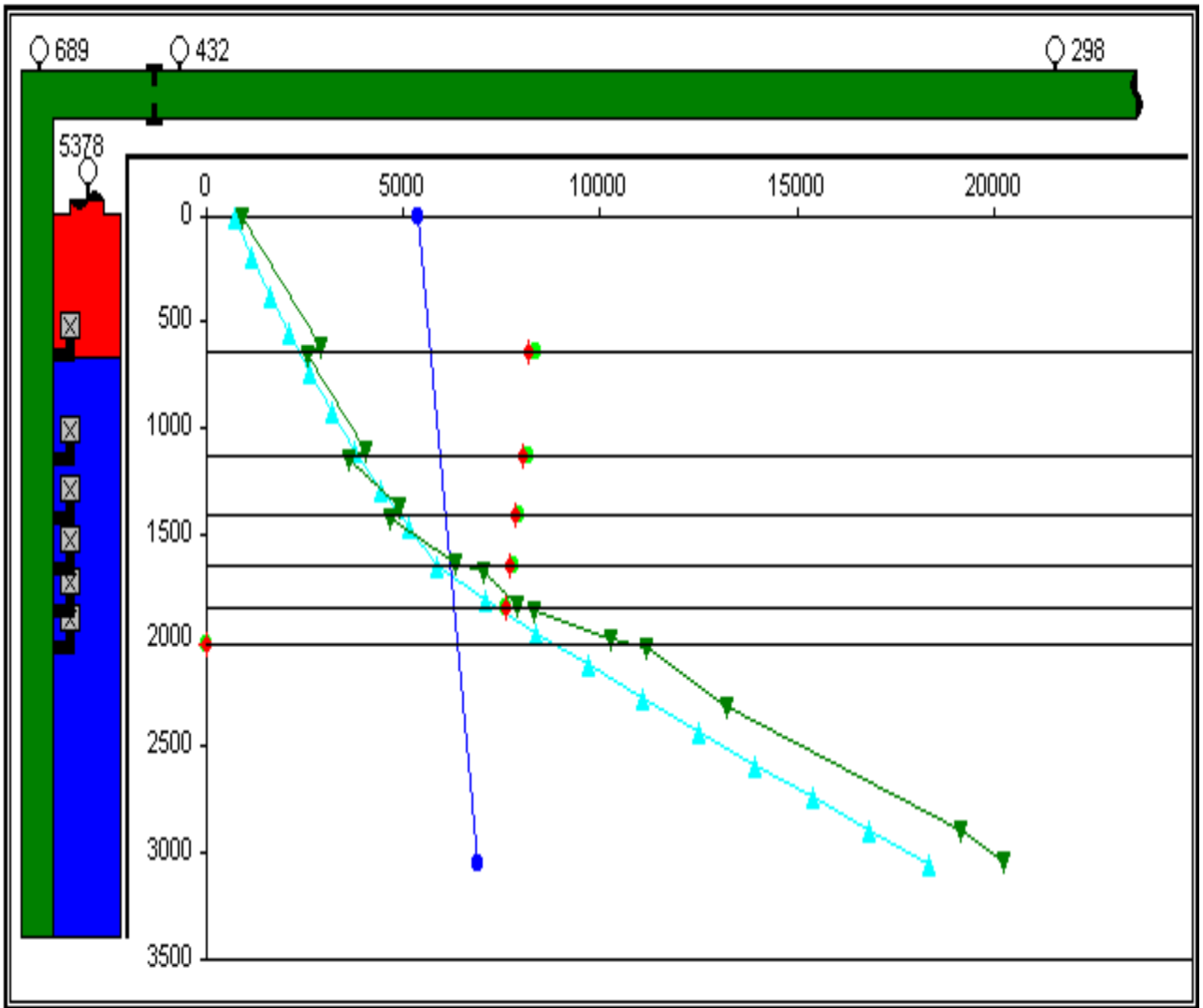
PI:

Lift Depth:

Description	Original	Factor	Calib. Value
Oil Rate	19.1	1.000	19.1
Water Rate	94.5	1.000	94.5
Form. Gas Rate	4,630.7	1.000	4,630.7
LG Rate	11,793.08	1.000	11,793.08
Production Press.	689.0	1.000	689.0
Injection Press.	5,378.0	1.000	5,378.0
Choke Size	25.4	1.000	<input style="border: 2px solid black;" type="text" value="25.4"/>

Well Test Description:

DEPTH vs. PRESSURE GRAPH w/FLOWING SURVEY



MODEL CALIBRATION & WELLTEST BEFORE CALIBRATION

Model Calibration

Description	Value
Production Pressure	689.000
Injection Pressure	5,378.000
Manifold Pressure	297.385
Liquid	113.561
Total Gas	16,423.773
Oil	19.078
Water Cut	83.200

Update IPR

Hold Constant:

Liquid Gas

OK Apply Cancel

Well Test

Date: 12-Oct-1994 Information Only

Enter new date, Edit/New Record to create. Select date, Edit/Delete Record to delete.

Original

Test Length: 8.00 Test Sep. Press.: 689.0 Man. Pressure: 298.0

Calculated

FBHP: 18,297.0
IPR Qmax: 292.3
PI: 0.019
Lift Depth: 1,645.923

Description	Original	Factor	Calib. Value
Oil Rate	19.1	1.000	19.1
Water Rate	94.5	1.000	94.5
Form. Gas Rate	4,630.7	1.000	4,630.7
LG Rate	11,793.08	1.000	11,793.08
Production Press.	689.0	1.000	689.0
Injection Press.	5,378.0	1.000	5,378.0
Choke Size	25.4	1.000	25.4

Well Test Description:

OK Apply Cancel

MODEL CALIBRATION & WELLTEST AFTER CALIBRATION

Model Calibration

Description	Value
Liquid	113.561
Total Gas	16,423.773
Oil	19.078
Water Cut	83.200
Formation Gas	3,681.190
Lift Gas	12,742.582
GOR	192.955

Hold Constant
 Liquid
 Gas

Well Test

Date: 12-Oct-1994 Information Only

Enter new date, Edit/New Record to create. Select date, Edit/Delete Record to delete.

Original

Test Length: 8.00 Test Sep. Press.: 689.0 Man. Pressure: 619.0

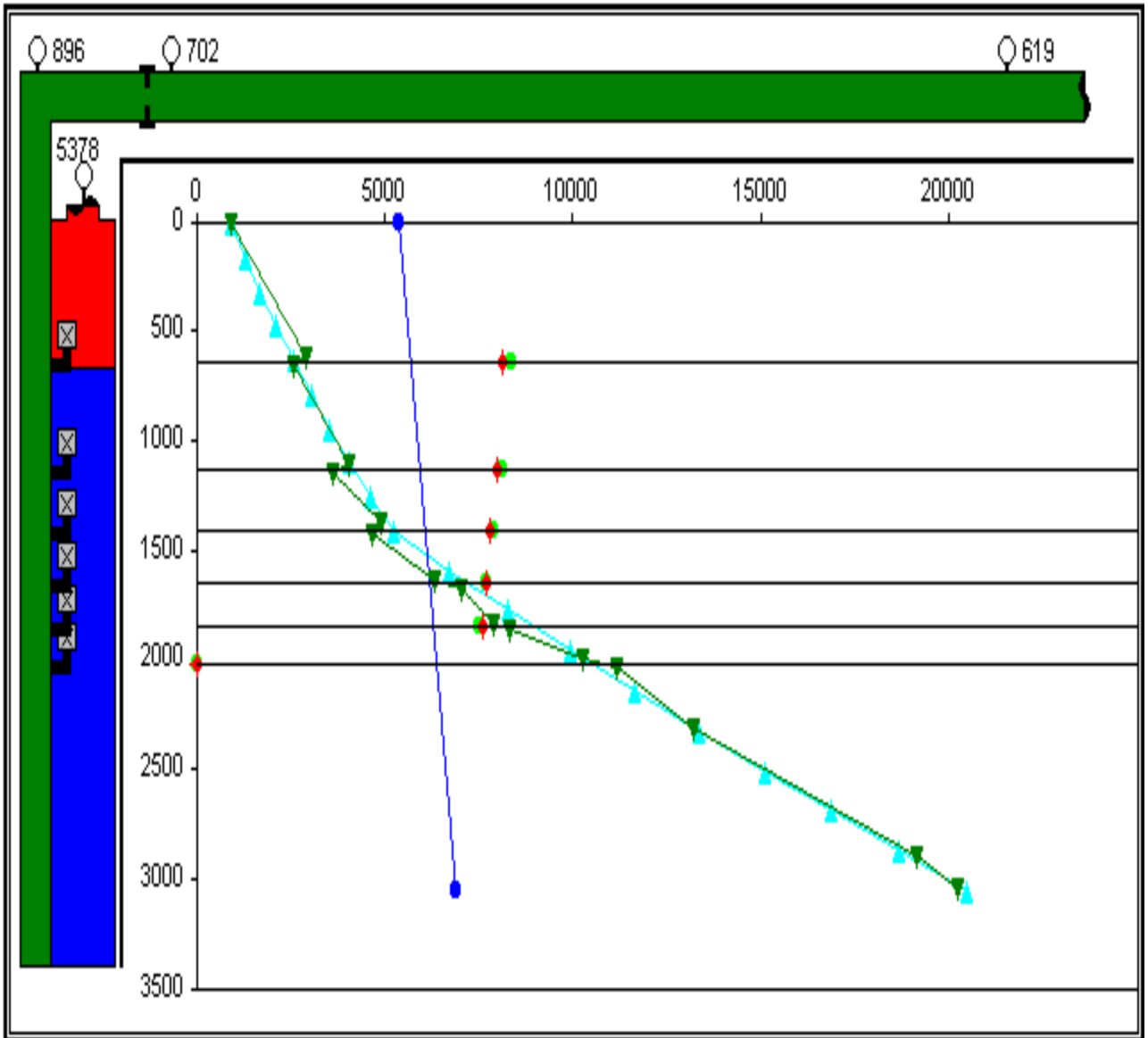
Calculated

FBHP: 20,438.0
 IPR Qmax: 442.3
 PI: 0.031
 Lift Depth: 1,402.083

Description	Original	Factor	Calib. Value
Oil Rate	19.1	1.000	19.1
Water Rate	94.5	1.000	94.5
Form. Gas Rate	4,630.7	0.795	3,681.2
LG Rate	11,793.08	1.081	12,742.58
Production Press.	689.0	1.300	896.0
Injection Press.	5,378.0	1.000	5,378.0
Choke Size	25.4	1.000	25.4

Well Test Description:

CALIBRATED PRODUCTION PRESSURE MODEL

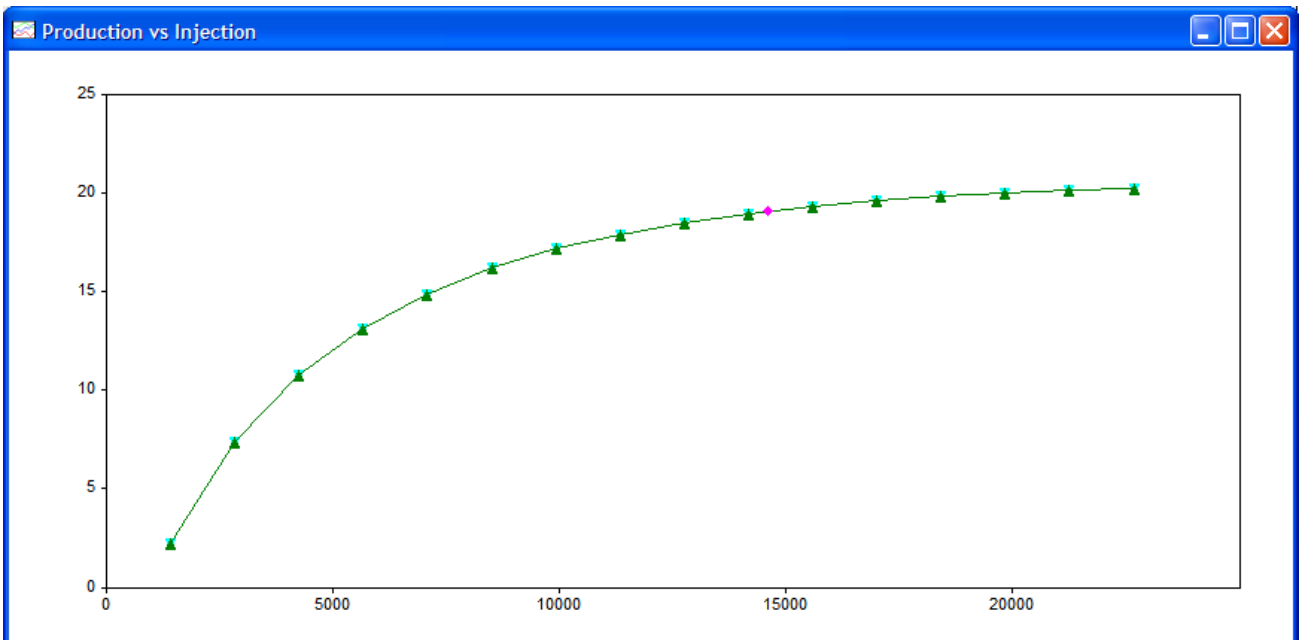
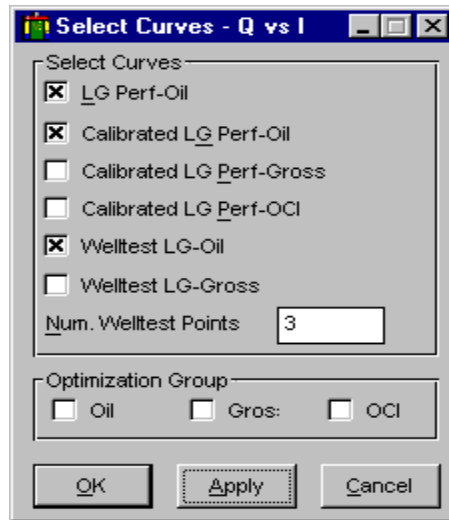


UPDATING RESERVOIR INFO BASED ON WELLTEST & FLOWING SURVEY

The screenshot shows a software window titled "Reservoir" with a blue title bar and standard window controls (minimize, maximize, close). The window contains several input fields and buttons. On the left, there are four input fields: "Resv. Press." (24,132.0), "Bubble Point" (31,771.0), "IPR Qmax" (442.3), and "MD Top Perf." (3,048.0). Below these is a button labeled "Inflow Calculator>>". On the right, there are two sections: "Specific Gravity" with fields for "Form. Gas" (0.700), "Water" (1.070), and "Oil (API)" (34.0); and "Temperatures" with fields for "Static Surf." (26.7) and "Bottomhole" (65.6). At the bottom of the window are three buttons: "OK", "Apply", and "Cancel".

Parameter	Value
Resv. Press.	24,132.0
Bubble Point	31,771.0
IPR Qmax	442.3
MD Top Perf.	3,048.0
Form. Gas	0.700
Water	1.070
Oil (API)	34.0
Static Surf.	26.7
Bottomhole	65.6

LIFT GAS PERFORMANCE CURVE



OPTIMIZATION

- REVIEW WELL CHANGES
- FINALIZE ANALYSIS OF WELLS
- DETERMINE NEED FOR NEW OPTIMIZATION RUN
- CREATE AND DOWNLOAD NEW OPTIMIZATION TABLE TO REAL TIME SYSTEM IF NECESSARY

KA-BOOM!!!!!!!



RUN AN OPTIMISATION MANAGEMENT REPORT

10-Feb-2005

Opt. Management
Field YIBAL

Well	Lease Strg	Date	Test		==== LG Perf ====		diff	% diff
			LG Rate m3/day	Oil m3/day	LG Rate m3/day	Oil m3/day		
Y275	A	1 30-Jul-2002	21100.00	49.00	21237.64	54.28	-5.28	-10.78
Y284	A	1 30-Jul-2002	21100.00	49.00	21237.64	54.28	-5.28	-10.78
Y293	A	1 07-Apr-2001	20500.00	215.00	19821.79	218.37	-3.37	-1.57
Y252	A	1 07-Jan-2003	25000.00	42.00	25485.16	42.60	-0.60	-1.43
Y263	A	1 01-Mar-2004	20000.00	53.00	19821.79	53.04	-0.04	-0.07
Y253	A	1 14-Oct-2002	22710.11	52.94	22653.48	52.91	0.03	0.06

WELL TEST AND THEN SOME

- LOCATE ANY WELLS WITH OLD WELL TEST
- REVIEW STATUS OF WELL TEST VS. PERFORMANCE CURVE PREDICTION
- REVIEW WELLS WITH DEVIATIONS GREATER THAN 20%
- CHECK TEST TO SEE IF IT MATCHES THE CURRENT MODEL USING AN OLD SURVEY
- IF NOT, CALIBRATE AND THEN CHECK FACTORS TO SEE IF CALIBRATED FACTORS FOR THE LAST FEW TESTS ARE REPEATABLE
- IF REPEATABLE AND GAS RATES ARE INVOLVED, CONTACT FIELD TO ASK FOR CHECK OF LIFT GAS AND TEST SEPARATOR GAS METERS
- CHECK TO SEE IF WELL TEST FALLS ON THE PERFORMANCE CURVE WITH OTHER TESTS
- IF NOT NEAR PERFORMANCE CURVE, MAY CHECK WITH RESERVOIR ENGINEER TO SEE IF IT IS POSSIBLE THAT THE RESERVOIR PRESSURE OR PI MAY HAVE CHANGED

UNDERSTANDING ROOT CAUSE OF PROBLEMS

- FOR PROBLEMS, CAN THEY BE SOLVED AT THE SURFACE
 - CLEANING FLOW LINE
 - FIXING LEAK
 - CHANGING INJECTION RATE
- OR DOWNHOLE
 - CHANGING A LEAKING VALVE OR A VALVE THAT IS NOT SET CORRECTLY
 - REDESIGN OF THE STRING

PROBLEM IDENTIFICATION

- TO EVALUATE SOME PROBLEMS, MAY NEED TO ORDER PRESSURE SURVEY TO
 - CONFIRM WHERE WE ARE LIFTING
 - DETERMINE IF MULTIPOINTING
 - DETERMINE INFLOW PERFORMANCE OF WELL
- BUT DUE TO COST, TIME, RISK, DEFERRED PRODUCTION MIGHT USE ALTERNATIVE APPROACH
 - NON-INVASIVE CO2 TRACE TO HELP DETERMINE LEAKS, LIFTING POINT, AND WHETHER MULTIPOINTING IS OCCURRING

VALVE ISSUES

- DETERMINE IF THERE IS A VALVE PROBLEM
 - REVIEW THE VALVE PERFORMANCE DATA FOR THAT VALVE
 - CALL THE GAS-LIFT SHOP TO FIND OUT ABOUT THE SPECIFIC VALE IN THAT MANDREL
 - WHAT IS ITS HISTORY?
- FOR NEW VALVES, RUN THEM THROUGH A GASLIFT VALVE PERFORMANCE TESTER
- FOR OLD VALVES REMOVED, EXAMINE BELLOWS, SEATS, SIGNS OF PLUGGING DUE TO SALT, SAND OR PARAFFIN

	MD	TRO	Choke	GLV Desc.	Mandrel Desc.
1	640.0	7,446.0	3.2	CAMCO R20 3/16	2 7/8" D-SO
2	1,128.0	7,239.0	3.2	CAMCO R20 3/16	2 7/8" D-SO
3	1,402.0	7,033.0	3.2	CAMCO R20 3/16	2 7/8" D-SO
4	1,646.0	6,895.0	3.6	CAMCO R20 3/16	2 7/8" D-SO
5	1,844.0	6,757.0	4.0	CAMCO R20 3/16	2 7/8" D-SO
6	2,012.0	0.0	4.4	CAMCO RDO 3/16	2 7/8" D-SO

SOFTWARE – WHAT IS IT GOOD FOR?

- GOOD CONNECTIONS BETWEEN SCADA AND SURVEILLANCE/DESIGN TOOLS
- CHECKS FOR NEW UPDATES TO SOFTWARE TOOLS IN USE
- PERFORMS RESEARCH ON THE INTERNET FOR LATEST NEWS
- PROVIDES FEEDBACK FOR FUTURE MODIFICATIONS OF TOOLS IN USE

THAT AIN'T ALL THE SUPER ANALYST DOES

- CONSULTS WITH OTHER TEAM MEMBERS AS REQUIRED
 - FIELD OPERATORS
 - EXPLORATION STAFF
 - GAS-LIFT ENGINEERS
- READS LOTS A LITERATURE TO IMPROVE HIS SKILLS
- KEEPS CURRENT ON ALL FIELD ASPECTS FOR HIS AREA
- DETERMINES WHEN AND HOLDS WELL REVIEWS WITH PEERS
- ENJOYS SHARING NEWFOUND KNOWLEDGE WITH COLLEAGUES AND INTERNS
- TAKES PAPERWORK HOME TO REVIEW

CHARACTERISTICS OF A GOOD ANALYST

- HANDS ON WITH WELL PROBLEMS
- WILLING TO BE CLOSE TO THE FIELD
- INTERACTS WITH FIELD STAFF
 - WELL SERVICING
 - WELL TESTING
- DOCUMENTS ACTIONS
- COMMUNICATES ACTIVITIES TO PERTINENT STAFF
- WILLING TO TRAIN OTHERS
- BECOMES A DOCTOR OF WELLS TO BE ABLE TO OBSERVE SYMPTOMS AND QUICKLY PRESCRIBE CORRECTIVE ACTIONS

ANALYST REACTIONS

- EATS AT HIS DESK
- CARES ABOUT MISSING OPPORTUNITIES TO SAVE MONEY OR INCREASE PRODUCTION
- DREAMS OF REACHING FULL POTENTIAL

END OF THE DAY

- DETERMINES WHAT WORK IS TO BE DONE ON WHICH WELLS
 - SCHEDULES FUTURE EFFORTS WITH APPROPRIATE PERSONNEL
 - PROVIDES A PROGNOSIS FOR EACH ACTION
 - TELLS WHY THE ACTION IS BEING PERFORMED

A GAS-LIFT ANALYSTS REWARD

- TRAINING
- WORKSHOP ATTENDANCE
- BIG RAISE AFTER HE IS RECOGNIZED FOR HIS CONTRIBUTION
- RECEIVE NEWLY CREATED NOBEL PRIZE IN GAS-LIFT