

Gas Lift Intermittent Program





CMS Prodex have

developed the integrated

intermittent lift software (*GLIP*) which models the complex intermittent wells operation including simulation of dynamic and highly unsteady – state conditions.

The GLIP program is a powerful and flexible tool used by petroleum engineers to analyze fluid flow in the reservoir and well bore, and to design and optimize intermittent lift operation of oil and gas wells.

Numerous information and data were collected to calibrate developed model and to modify known solutions and to get a model to fit purposes- efficient simulator of intermittent operation.

Application of the model was proved on the fields (*Mexico, Venezuela, Serbia, Hungary etc.*). Information/data were collected and used improved known and applied solutions.

GLIP structure

DES - Data Entry System

Fluid, reservoir and well data base (DB), Equipment - tubing, casing and GLV data base, Injection system, Plunger data.

Tools

PVT package, IPR model, Turner analysis, Reservoir pressure estimation depending on available data.

Intermittent gas lift design and optimization

Automatic valve spacing and testing using various models, Optimized cycles

Trouble analysis

Operating valve depth, cycle simulation (number/day, Qginj, Qliq.)

Plunger design and simulation

Cycle, slug height simulation, pressure buildup, final operating parameters



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Key features

The primary objective of software/suit development was to enable comprehensive analysis of complex well behavior operating intermittently by integrating two apparently separated subsystems into unique model (reservoir/well- hydrodynamic and equipment /mechanic). Model can operate with limited number of information of the reservoir and has ability to predict the performance of well (IPR) if only one test data are available without knowing the reservoir pressure. An intermittent gas lift installation should not considered properly until a two-pen pressures recording instrument has been installed to make daily recording of the tubing and casing pressure.

A control, regulation and problem diagnosis of wells operating intermittently is possible only if measured data are available (surface and bottom). By careful analysis of the tubing and casing pressures, many troubles can be interpreted and corrected without an expense bottom-hole pressures surveys.

Additional features include the detailed analysis of the well and evaluation if the well good candidate for plunger lift application or not (Turner analysis – minimum gas velocity to lift accumulated liquid).

A multitude of design and optimization options offered in GLIP provide you with a great flexibility to analyze or design a system that matches best to yours.





The options include:

- Designing, optimization, simulation of future conditions and problem analysis of intermittent wells operations
- Simulating pressure buildup during by numerical solution of fluid inflow performance model
- Defining optimal well operating parameters
- Increasing well production efficiency.
- Eliminating requests for downhole pressure survey
- Troubleshooting analysis (Qualitative and Quantitative)
- Comprehensiveness- application in analysis of intermittent gas lift wells at given operating conditions
- Comparison of data on pressure buildup with simulated data
- Simulation of well conditions using minimal number of data (two-pen chart)



Features details

Data Entry System (DES) 📑

GLIP uses hierarchical representation that may be visualized in the data browser. **DES** is generating data base where all data and information are organized in well-defined hierarchy with the **Data Browser**. At the top of this hierarchy structure is the system for entering, editing and deleting field, reservoir and well data.

Well data are classified to:

- General well information
- Well Geometry
- Completion data
- Fluid Properties
- Reservoir properties
- General information about surface conditions
- Measurements (production tests, trajectory and surface pressure test, downhole P&T)



Gas Lift Intermittent Program



Field Name	MSB
Reservoir Name	MZ-D
Well Name	MSBExample6
Designer / Analyst	GLIP
Created	3 / 4 /2007
Last Change	8 /25/2007
Comment	
	e at the depth of GLV is available.

	Well Geome	try				
ſ	General Data	Trajectory				
	Calculated Valu	e	Angle	•	Trajectory	1
	Measurment Depth (m)	Vertical Depth (m)	Angle (deg)	Horizontal Distance (m)	200	
	100.00	100.00	5.126	0.00		
	200.00	199.60	5.126	8.94		
	300.00	299.20	2.563	17.87		Н
	400.00	399.10	2.563	22.34	(u) 1000-	Н
	500.00	499.00	8.110	26.81		Н
	600.00	598.00	3.624	40.92		Н
	700.00	697.80	2.563	47.24	1400	Н
	800.00	797.70	4.439	51.71		Н
	900.00	897.40	4.439	59.45	1000	Н
	1000.00	997.10	1.812	67.19	1800 MD Performen Charl 2009.00	
	1100.00	1097.05	1.812	70.35	200	1
	1200.00	1197.00	2.563	73.52		
	1300.00	1296.90	5.126	77.99	2000	Н
	1400.00	1396.50	2.563	86.92 💌	0 20 40 60 60 100 120 Herizenni Disance (m)	-

Completion data

l	Completion		
ſ	General Data Casing Data T	ubing Data	
	Well Bottomhole Completion	Cased/Perforated	•
	Monobore		
	Packer	$\overline{\mathbf{v}}$	
	Packer Depth	2070.00 m	
	Gravel Pack		
	Gravel Permeability	0.00 mD	
	Outside Screen Diameter	0.000 mm	





📣 Reservoir			à	Fluid Pro
Fluid Type	Oil		ſ	General Data
Drive Mehanism	Solution Gas	_	L L	
Initial Reservoir Pressure	210.00	bar		Bubblepoint I
Reservoir Pressure	113.00	bar		
Reservoir Temperature	112.00	*C		Pressure (ba
Permeability	3.70	mD		208.
Vertical Permeability	0.00	mD		200.
Horizontal Permeability	0.00	mD		190.
Porosity	0.164			188.
Total System Compressibility	0.00054	1/bar		170.
Oil Relative Permeability	0.3			160.
Total Thickness	4.00			150.
Fotal Enickness	4.00	m		









Production tests



	D	ownhole	e P&T ≷	1	
Production	Test				
Bottomhole	Liquid	Oil production	Water	Water Cut	Gas

ቅ Productio

flowing pressure (bar)	production (m3/day)	(m3/day)	production (m3/day)	(frac)	(m3/day)
64.00	2.90	2.32	0.58	0.2000	920.00
					_
Water Cut		0.20	000 frac	Input Type	Liquid
			OK	Cance	el Help





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Tools

Static pressure estimation



In the case when static pressure is not known, the developed tool is able to determine a probable value of static pressure by using measurement data. If only one test is available (rate/pressure), model is resolving the set of IPR equations trying to find for which assumed flow exponent or laminar flow coefficients, the difference between two various methods is minimum. The process of calculation can be completely under control of system, or user can give the best estimation, and program will calculate the most probably static pressure.

If two or more test rates are known the accuracy of static pressure estimation is higher and very close to the real reservoir pressure.

Unknown inflow parameters (flow exponent, flow coefficients) can be calculated and determine uniquely.



Fluid Physical Characteristics and PVT 🛛 👗



The program establishes the valid black oil PVT correlations for oil, gas, condensates and water.

Correlations can be automatically matched with measured data. Since gas evaluation in the tubing is a constant composition process, flash data, not differential liberation, should be used for matching. The temperature and bubble point should be entered to match the data given in table.



Reservoir S Iuid Properties		tion PVT Oil-L	.ab				
Bubblepoint Pre	ssure	121	.00 bar				
Pressure (bar)	Solution Gas (m3/m3)		Gas Formation Volume Factor (m3/m3)		Gas Viscosity (mPa.s)	Gas Compresibility	•
110.32	35.00000	1.16000		18.300000			
93.08	29.00000	1.13000		19.400000			
75.84	24.00000	1.11000		21.400000			
58.60	21.00000	1.09000		22.300000			
44.13	18.00000	1.08000		23.500000			
24.00	12.00000	1.06000		23.900000			
10.96	6.50000	1.05000		24.300000			
1.10	1.00000	1.04000		25.100000			-



Correlations used for oil bubble pressure (**Pb**), solution gas (Rs) and oil formation factor (Bo) are: Standing, Lasater, Vasquez-Beggs, Glaso, MECO (Middle East Crude Oils).

PVT module calculates live and dead oil viscosity using Beggs-Robinson, Beal and Chew Connelly correlations. Calculations of density of live and dead oil are included, also.

Reservoir water 💦





Gas / Condesate 🔀 🐴



The necessary calculation properties of reservoir and dry injection gases are applied. When gas is selected as the PVT option, it is requested to enter composition either reservoir or dry injection gas, as is displayed on the input data screen.

To simulate gas behavior at various P &T conditions the analytical **Standing** and Brill - Beggs correlation user can select, or use solution of EOS, proposed by Hall and Yarborough (OGJ, June, 1973).

Fluid Physical Characteristics and PVT						
e Data PVT-Gas PVT-Oil PVT-Condensate PVT-Water Customize Win	dow Help					
N_L/L_28/VEN_LExample3						
🕈 PVT Gas Graphics						
Select Graph Gas Compresibility	Pressure Temperature					
Gas Compresibility	🛠 PVT Gas					
	Gas Molecular Weight Gas Compresibility Gas Density Gas Formation Volume Factor Gas Viscosity	21.23 g/mol 0.87034 60.18 kg/m3 0.00265 m3/m3 0.022608 mPa.s	E.O.S Empirical Empirical			
30.09 0.05 0.21	Graph	_	Close Help			
0,00 0,00 0 10 20 30 40 50 60 70 80 50 Press the (bad)	100 110					

General Data Reservoir Surface Fluid Properties Gas Composition PVT Oil-Lab Molarity (%) Component Name Methane (CH4) 83.3000 Ethane (C2H6) 5,7000 2.6000 Propane (C3H8) 2.0000 i-Buthane (i-C4H10) 2.3000 n-Buthane (n-C4H10) i-Penthane (i-C5H12) 1.2000 n-Penthane (n-C5H12) 1.3000 Carbon dioxid (CO2) 1.6000 Ŧ Close Help 👯 PVT Gas 21.23 g/mol Gas Molecular Weight Gas Compresibility 0.87034 E.O.S • Standing 60.18 kg/m3 Gas Density Brill Beggs 0.00265 m3/m3 Gas Formation Volume Factor Lab.Value 0.022608 mPa.s Empirical Gas Viscosity • Graph Close Help

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Inflow performance relationship



The Inflow Performance Relationship (IPR) is the production engineer's shorthand description of the performance of a well at a given reservoir pressure. IPR is the relationship between the bottomhole flowing pressure and flow rates, and it is the starting point in the analysis of a well's behavior. IPR includes the effects of both reservoir and completion efficiency. The shape of the IPR curve and the method that will be used to establish the relation between the flowing bottomhole pressures and flow rates depend on many factors, like relation between reservoir and saturation pressures (single or two-phase flow), physical characteristics of the reservoir and fluids etc. When the flowing pressure in the formation falls below the bubble point (Pb), gas comes out of solution, reduces the permeability to the oil phase, decreases the productivity index, and reduces the oil flow rate within formation. At increased production rates, Pwf decreases and more gas comes out of solution within reservoir, and the relative permeability to oil decreases.



Other factors such as increased oil viscosity, rock compressibility, and turbulence can add to these effects as wellbore pressures fall and rates increase. The IPR evaluation method selection depending on the flow type and regime as well as well geometry (vertical / slant / horizontal).

Selection of the IPR method is strongly depending on data entered in DES and data required only for IPR modeling. GLIP is controlling the availability of data, as well as the data quality. As results of such checking, the system will select only that models for which there are enough information. If there is not needed information for particular model, on report screen it can be seen that calculated AOFP is 0.

Future IPR performance can be used to design intermittent operation for expected conditions.



If trajectory data have been entered, then system is analyzing information and using build-in rules will decide which type of well was drilled through productive zone. According to results of checking and analyzes, system will recognized the well geometry and will choose the corresponding IPR models (vertical, slant or horizontal). To continue with design program is asking to select IPR method that will be used for all other purposes (design, trouble analysis and optimization).



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Critical gas velocity analysis 🛛 💓



One of the most important aspects in the investigations of the liquidloading phenomena in the gas wells has been focused on how predict the critical gas flow rate or production parameters under which liquid entrainment is impossible.

Program calculates the critical /minimum gas velocity required to keep well with liquid accumulation. Two methods are used:

Turner

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Modified Turner method (SPE 75455)

As results of calculation program gives the dependence of critical gas velocity for various tubing size for cases, wellhead and bottomhole.

urner New Method						
Select Graph	Critical Gas Flow Rate		Solution		At Wellhead	•
	Critical Gas Flow Rate		Pressure	Gas Velocity	Gas Producti	on (m3/day)
	Solution At Wellhead (Turner)		(bar)	(m/s)	59.004 mm	66.091 mm
25 - 59.004 mm (Well is k	aaded) 66.091 mm (Nell Is loaded) 150.400 mm (Nell Is loaded)		13.80	3.2139	10187.52	12781.75
E		1	14.42	3.1399	10411.58	13062.86
25 E		1	15.04	3.0704	10630.80	13337.9
24		1	15.65	3.0049	10845.47	13607.2
E		1.	16.27	2.9432	11055.85	13871.2
23		1	16.89	2.8847	11262.19	14130.0
22	1		17.51	2.8293	11464.70	14384.1
out ()			18.13	2.7767	11663.58	14633.69
Gas production 2831 m380	f		18.74	2.7267	11859.02	14878.8
Gas production 2631 m3/d	ay		19.36	2.6789	12051.18	15119.9
Gas production 2831 m380	/		19.98	2.6334	12240.20	15357.1
ă E			20.60	2.5898	12426.25	15590.56
18 E			21.21	2.5481	12609.43	15820.3
n E			21.83	2.5081	12789.89	16046.8
16			22.45	2.4698	12967.72	16269.9
E 1 1 1			23.07	2.4329	13143.04	16489.8
15	1		23.69	2.3974	13315.94	16706.8
14	and the second		24.30	2.3633	13486.51	16920.8
			24.92	2.3303	13654.84	17132.0
0 10000 2000	a sadaa 4adaa sadaa cadaa 7adaa sadaa	90000	25.54	2.2985	13821.01	17340.4



Intermittent gas lift design

Intermittent gas lift design includes the evaluation of the following parameters: valves setting depth and characteristics of gas lift valves. The setting depths and characteristics of gaslift valves can be evaluated graphically and analytically.

There are various methods for designing intermittent lift installations. Most of them fall into two basic categories:

- Design based on Intermittent Spacing Factor (constant and decrease gas lift valve surface closing pressure).
- Design based on ratio tubing and casing pressure ("Percent Load" and "Opti-flow" methods)

The spacing factor method is recommended for the wells with known inflow characteristics. This method requires the largest number of input data. The depth of the operating valve is automatically evaluated as the explicit function of the reservoir and flowing bottom-hole pressures and the static and flowing gradients.

The tubing / injection pressure method requires minimum information on the reservoir. The designer designates the operating valve taking into account the tubing / injection pressure at valve opening.



Intermittent gas lift optimization



The most important dynamic parameters that should be determined are in order to optimize the well operation are:

- The gas flow rate flowing through gas lift valve,
- The velocity of the liquid slug lifted with gas,
- The liquid volume surfacing in slug form,
- The dispersed liquid volume,
- Cycle per day
- The changes of the flowing bottom-hole pressure.

An important part of dynamic parameters consideration is evaluation of the velocity with which a gas bubble penetrates liquid above in tubing.



Intermittent Gas Lift Optimization

Expected Production Rate	25.89	m3/day			
Max. Liquid Fallback	3.00	%			
Tubing Pressure Increment	1.00	bar			
Gas Injection Time	8.0	sec			
Adiabatic Exponent	1.29				
Change Tubing Pressure at Ope	arating Valve (bar)			0.00	
Change Average Tubing Pressu	re (bar)			0.01	_
Change Tubing Gas Volume at 9	Standard Cond. (m	3/day)		49143.46	
Liquid Slug Flow Velocity (m/s)				5.8561	
Critical Ratio				0.54754	
Relation Tub Press/Gas Casing	Press.			0.54754	
Gas Passage Trough Operating	Valve (m3/day)			90214.27	
Gas Injection Time per Cycle (se	cl			73.4	
Slug Lift Period (sec)				156.7	
Time to Complete Slug Lifting an	id Gas Inj. During I	Dine Cycle	(sec)	230.1	
Required Gas Rate per Cycle (m	3)			76.6362	
Fluid Production per Cycles (m3)				0.3823	
Cycles Frequency				68	-
Optimized Valve	📕 Valve is not	optimized			
Optimization			Close	Hel	lp

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Trouble Analysis



An intermittent gas lift installation should not considered properly until a two-pen pressures recording instrument has been installed to make daily recording of the tubing and casing pressure. By careful study of the tubing and casing pressures, many troubles may be interpreted and corrected without the expense of pressures surveys or tubing jobs.

The knowledge of well operation regulation and control in intermittent gas lift is possible only if the data for measuring tubing / casing pressures and for measuring bottom hole flowing pressure are available; this was the basis for acquiring the sufficient number of data which were the foundation of a intermittent gas lift well performance study.

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Two Pen Analysis							
ielect Graph	Simulated Well Performance	•		Operating V	alve	4	
	Simulated Well Performance			Maximum Sp	bacing Factor		0.0058 bar/m
140			Current Conditions Historical Conditions Expected Condition	Surface Clo: Bottom	sing Pressure at		44.60 bar
120			Future Conditions Future Conditions		ening Pressure a	t j	48.11 bar
Bottomhole Flowing Pressure (bar)					Based on Liquid per Cycle	I	114.05 m
				Tubing Pres Operating V	sure under		36.90 bar
	(6:00.70.00)				e of Injection Ga	is 1	3.4927 m3
				Injection Ga	s Volume per Cy	icle 1	7.0478 m3
	98.90 (S.R.31.6)			Daily Gas In	jection Volume	204	4.5740 m3
	(5.11,2000)			Initial Slug L Operating V	ength above alve		423.66 m
20-		\setminus		Initial Slug V Operating V	'olume above alve		0.8544 m3
°timini		لىيرى		Liquid Produ	action per Cycle		0.2300 m3
0 1 2	Oll Production (m.3ktay)	10		Liquid Fallba	ack		73.08 %
/alve Number		1	2	3	4	5	6
/alve Manufacturer				SLB (Camco)			SLB (Camco)
àas Lift Valve Type 👘					Bellows with n		Bellows with n
/alve Outside Diameter	r (mm)	38.100	38.100				38.100
/alve Name		J-20m	J-20m	J-20m	J-20m		J-20m
Port Inside Diameter (m	m)	6.350	6.350	6.350		6.350	9.525
Seat/Bellow Area		0.067	0.067	0.067		0.067	0.148
) ischarge Coefficient		0.850	0.850	0.850		0.850	0.900
Valve Depth (m)		442.55	824.38	1178.33	1505.07	1811.44	1950.00

The main objectives of intermittent well trouble analysis are:

- Depth of operating gas lift valve
- Simulation of well conditions using minimal number of data
- Surface opening and closing pressure
- Gas injection data
- Eliminating requests for downhole pressure survey
- Defining optimal well operating parameters
- Comparison of data on pressure build-up with simulated data
- Increasing well production efficiency in intermittent gas lift wells.



5000

10000

15000 Time (sec) 20000

25000

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Plunger design and simulation 📗 🚺 🏠



The installations of the plungers not only increase the production, but sustain this increase over a long period. It has been observed in many cases, the rate of decline has actually changed, extending the life of the well dramatically. The basic questions that petroleum production engineers are faced when they intend to apply the plunger lift are:

1 - Is it possible makes a good well selection and where it should be applied?

2 - Is there enough pressure and gas volume?

3 - Will it run under a packer?

4 - Is sales line pressure too high?

5 - What are operating and maintenance costs?

6 - How long will it be effective?

7 - Will eventually need a pumping unit?

Knowing the answers to these questions give possibilities to identify the best candidates, operating cost and economics.





Gas Lift Intermittent Program Preassure Buildup at Surface Casing pressure buildup simulation 28.5 28.4-28.3 a²28.2) 228.1 228.1 1 228.0 27.9 27.8 27.7 -10000 acco Time (sec) 6000 Well Flowline shut-in time 300.0 sec Total required gas volume per 108.7977 m3 cycle Average liquid production per 0.3926 m3 cycle Time for slug surfacing 387.0 sec Tubing Plunger fall time 393.0 sec 15180.0 sec Cycle Time 2 4 5 4

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🖡 Design Casing 0.3934 m3 Corrected gas pressure under 20.87 bar Corrected gas 📤 Slug buildup Assumed slug volume Casing Pressure slug Time (sec) during shut-in volume per Increment pressure (bar 37.62 bar Pressure to lift initial fluid volume 1.45 bar (m) cycle Corrected gas frction pressure (bar) 940.0 0.0 27.63 73.88 146 Liquid frictional pressure loss per 1.45 bar Arrival slug velocity 4.9613 m/s 1880.0 0.13 27.70 74.18 146.271 unit volume 27.77 Bottomhole flowing pressure at 2820.0 0.20 74.48 146 541 24.78 bar 74.80 bar Pressure under slug stoper depth 3760.0 0.27 27.83 74.78 146.81 4700.0 0.33 27.90 75.08 147.079 **Gas Friction Factor** 6495.95 New Pressure under slug 24.65 bar 5640.0 0.40 27.97 75.37 147 347 Gas loss under plunger through 6580.0 0.46 28.03 75.67 147.614 Dynamic correction factor 1.32087 0.2596 m3 clearance 7520.0 0.53 28.10 75.97 147.881 Total required gas volume per Average casing pressure during 36.52 bar 108.7977 m3 8460.0 0.60 28.17 76.27 148 147 cycle cycle 9400.0 0.66 28.23 76.57 148.413 Average liquid production per Minimum casing pressure during 32.73 bar 0.3926 m3 10340.0 0.73 28.30 76.86 148.677 Slug Height Buildup Analysis he for slug surfacing 387.0 sec 393.0 sec inger fall time Assumed Cycles Frequance • IE Time for liquid buildup vs Gas production, Slug height , Bottomhole flowing pressure 15180.0 sec cle Time 45 1450 1100 14100.0 sec Selected Time for liquid buildup ble per day 6 1440 40 1000 -195.07 m 1430 -Selected slug height tal required gas rate per day 652.79 m3/day 900-E36. 1420 -Clearance between Plunger and 2.36 m3/day 12 uid Production ▼ mm 1410quired GLR for liquid 543.18851 m3/m3 4.9613 m/s ** Average slug rise velocity 1400 cumulation in tubing mment 1390 -Average slug rise velocity (m/s) Assumed 1390 me liquid will be accumulated in the annulus ₩Ę8 8 (mm) 12 (mm) 14 (mm) Cycles 1370 300-Ē 3.2411 3.7102 3.9058 ₩. 8.0 1360 3.6175 4.1411 4.3594 200-Ē 3 3.8653 4.4247 4.6580 5 1350 Close 100 E Help 4.0529 4.6394 4.8840 elected Time for liquid buildup Į. 1340 30000 40000 50000 60000 70000 80000 4.2052 4.8137 5.0675 👻 10000 20000 sorioo F Time for liquid buildup (sec) Average dug rice velocit Assumed Bottomhole 🔺 Bottomhole Gas Cycles Time for liquid Slug height flowing production flowing Freguanc buildup (sec) (m) pressure at (m3/day) pressure (bar) stoper depth 86100.0 1115.35 1342.47 41.21 46.14 42900.0 576.90 1411.80 29.98 25.05 28500.0 387.69 24.31 1428.57 19.38 21300.0 21.43 16.50 291.75 1435.66 4 5 16980.0 233.82 1439.49 19.69 14.76 14100.0 195.07 18.53 13.60 1441.86 12042.9 167.32 1443.47 17.70 12.77 10500.0 146.49 1444.63 17.07 12.14 9300.0 130.26 1445.51 16.59 11.66 9 10 8340.0 117.27 1446.19 16.20 11.27 11 7554.5 106.64 1446.73 15.88 10.95 🔻

Plunger and slug velocity simulation / Slug buildup and cycles

Detailed plunger design

Casing pressure buildup simulation

Additional features

Unit conversion system



The built flexibility of the units system enables you to select any group of parameters and to select and define the unit of measurement. You can customize the units to suit your own personal preferences. By making selections from different categories, you can work in the units you prefer and save results in the units required by company police. GLIP offers a guick and simple conversion tool (API, SI, or customized).

If you do change units while running a session, they will remain changed permanently until you decide to change them back again.

Languages



GLIP is a multilingual program. The working language (English, Spanish, and Serbian) can be changed on-line without any additional requirements. Also, every required report will be generated in selected language without interrupting the work with program.

Reports



The flexible architecture of software enables you to customize your request and to select which information and data you want to have in report. In each GLIP module you can customize report and generate it in HTML format. As already explained above, report(s) will be generated in the currently active language.

Unit System Custom	•
Unit GrAPI Custom	Unit
Area	m2
Compresibility	1/bar
Density	kg/m3
Depth, Length	m
Diameter	mm
Formation Factor	m3/m3
Gas Rate	m3/day
Oil Rate	m3/day
Permeability	mD
Pressure	bar







What is coming next?

• Include pattern recognition and neural network modeling

As intermittent operation is fully unsteady state process using predictive features of neural network tools, diagnosis capabilities of the model could be significantly improved. Recognition of typical two-pen chart shapes (casing and tubing pressures at surface)

• New research and test data to include slippage effect and fallback

Operating depth of gas entering, liquid fallback, plunger rising and falling velocity should be deeper investigated and include in model.

Build physical model with real time monitoring to simulate different conditions on field.

• Software modifications

Connect real time data with expert model.

Include new improved IPR model for gas condensate wells.

Liquid loading prediction using decline analysis

Simulation of chemicals injection for solving liquid loading

Pumping systems (sucker road, progressive cavity and electrical submersible pumps)