WINS

Wireless Instrumentation Systems

wiGL™

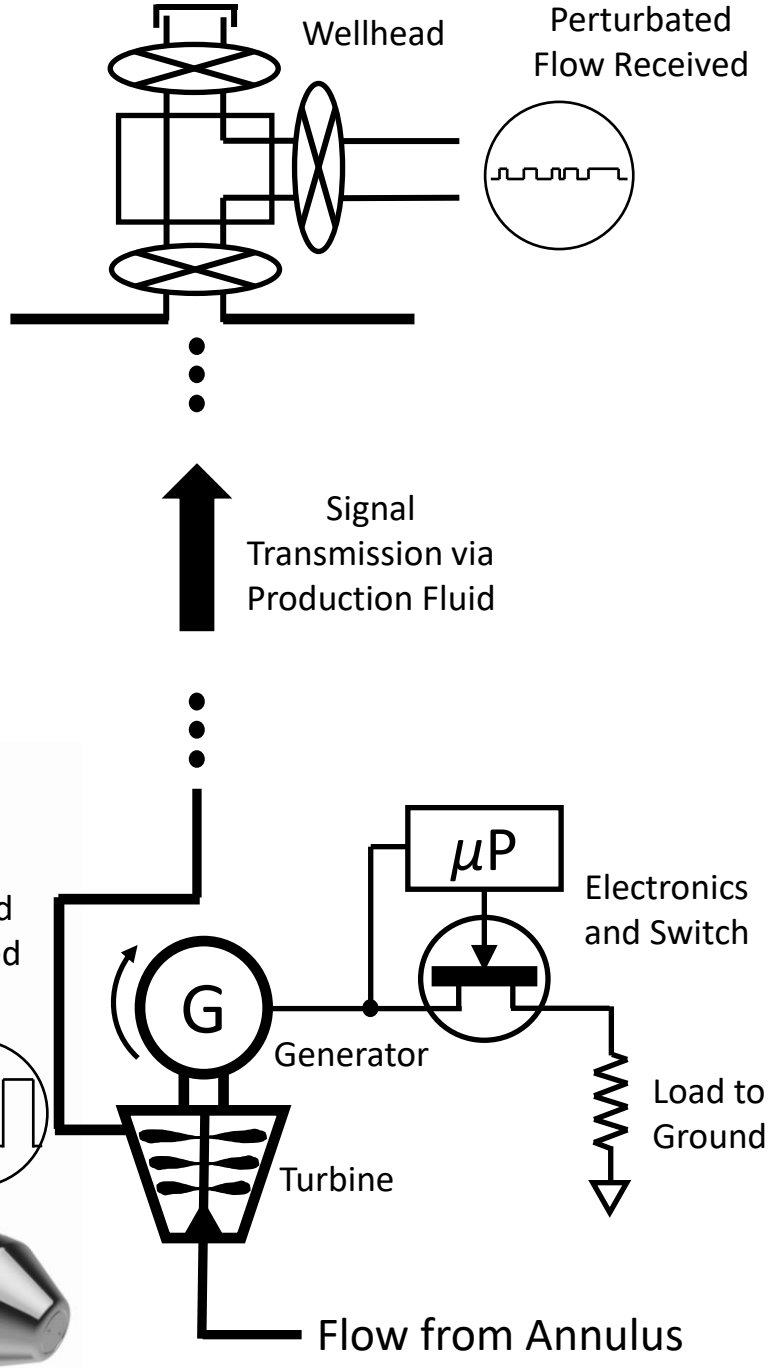
Wireless Gas Lift Valve

The Problem

- Normally, Side Pocket Mandrels (SPM) and Gas Lift Valves permit cheap and easy intervention to maintain and repair Gas Lift systems.
- Highly deviated wells present problems to kickover tools for gravitation, manipulation, and to lift GLVs into upward oriented pockets
- Tubing-conveyed Gas Lift must have a workover for any repair or adjustment
- Electric Gas Lift can minimize interventions and increase optimization (SilverWell and Shell Gasmer Road [John Hirsch et al, circa 2001])
- wiGL Wireless GLV combines the best of all worlds:
  - Interventions are minimized but repair and maintenance are preserved
  - Fits existing SPM infrastructure
  - Electro-mechanical Kickover Tools improve operations at high deviations

WINS Can Build on What We Have

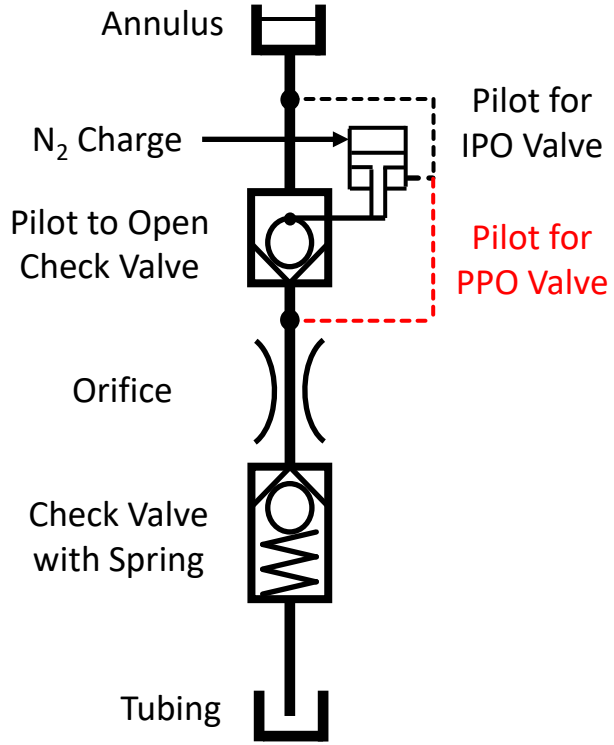
- Downhole turbine coupled to a generator converts flow into electricity
- When a load is added to the generator, it slows down, which causes a pressure change in the flow (signal)
- The pressure signals can be read at the surface, with no repeaters required
- The signals are so small that they will not be detected by existing surface equipment, i.e. no operator impact



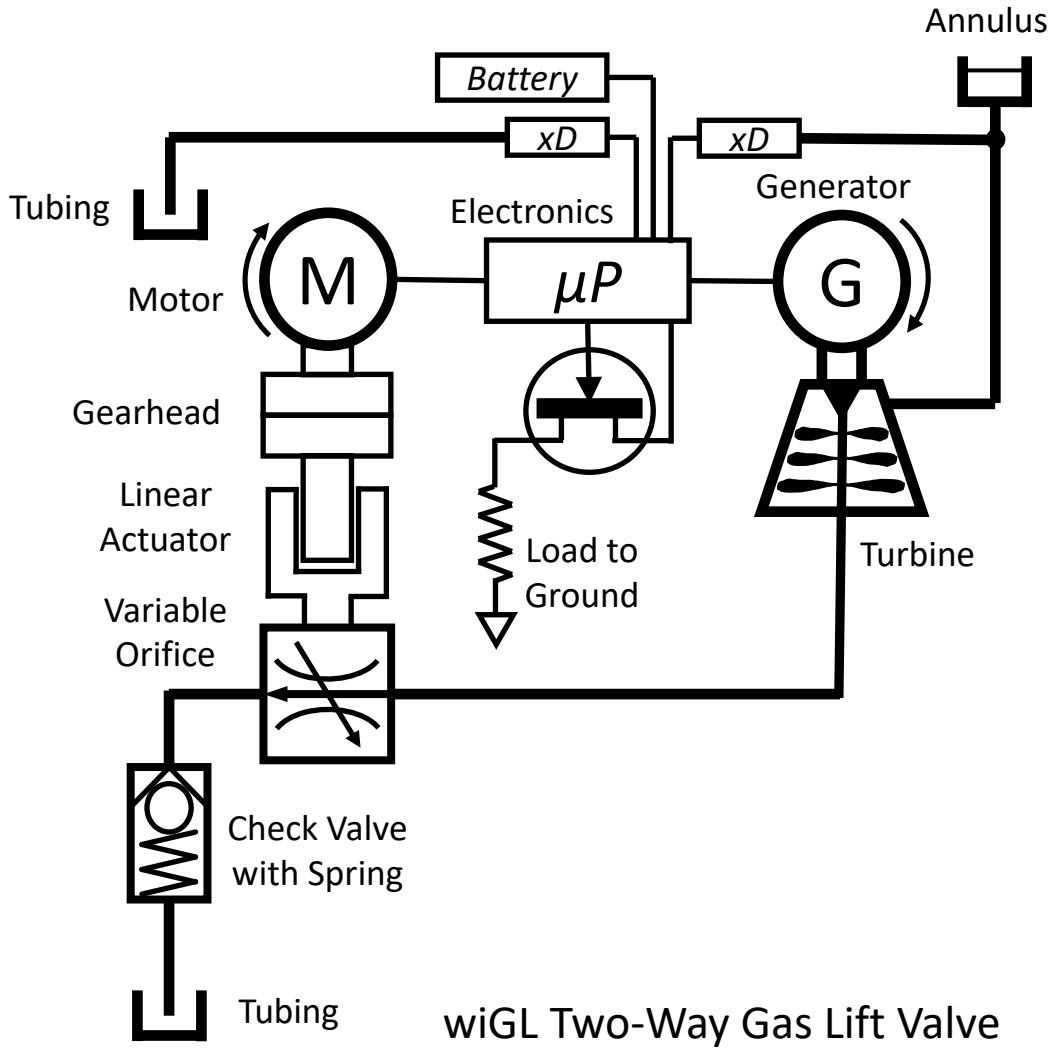
The Solution

- A Turbine-Generator combines many features into one system:
  - Downhole Power Generation replaces or minimizes battery pack
  - Variable load on the generator is the wireless telemetry, lots of power available
  - Turbine is also a mass flow meter
- wiGL **MUST** fit the standard GLV envelope so that existing SPM infrastructure would be convertible to wiGL
- Battery Packs, Electronics, Actuators and Valves are not space efficient.
- Miniaturize / Eliminate all systems possible

Gas Lift Valve Schematics

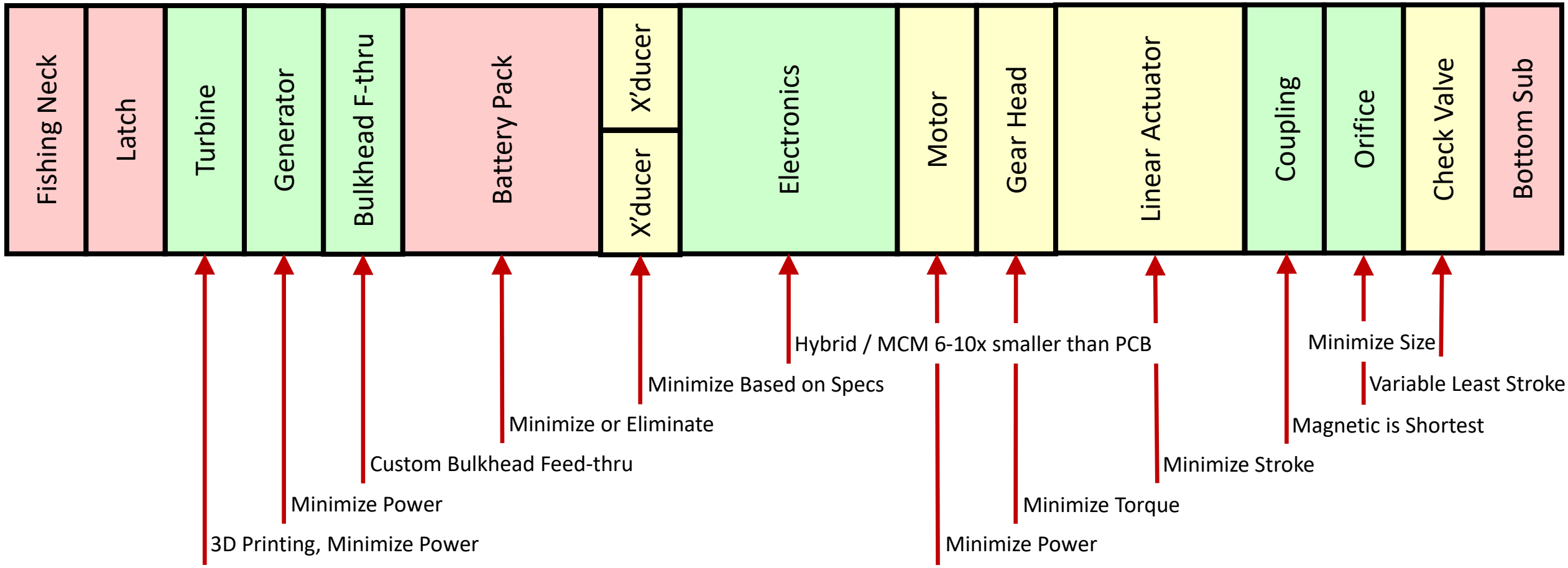


Standard Gas
Lift Valve



wiGL Two-Way Gas Lift Valve

Opportunities for Miniaturization

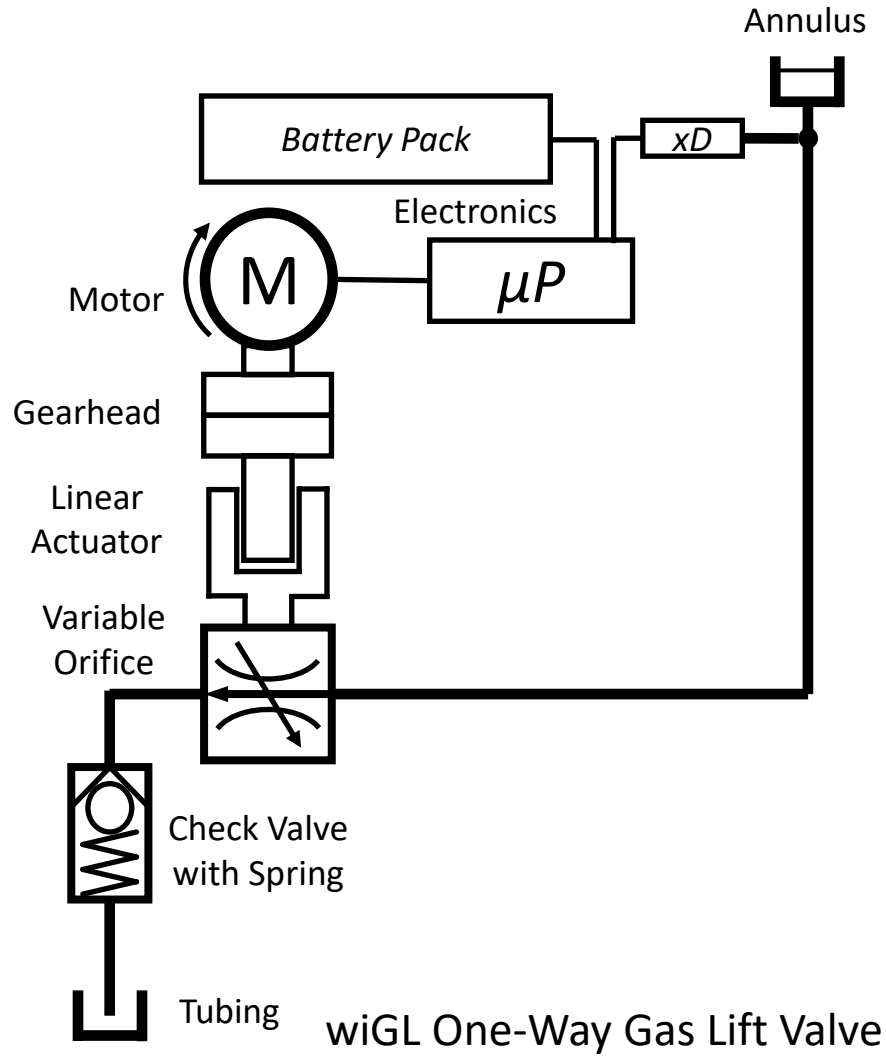


No Opportunity for Miniaturization
Some Opportunity for Miniaturization
Great Opportunity for Miniaturization

15 Systems Needed

Current Design: 1.5”-1W

- 1.5” OD One-Way Comms
- 10,000 psi, 125°C, 2-4 years
- Battery powered
- Adjusts orifice on command
- Conceptual design completed (see below)



wiGL One-Way Gas Lift Valve

Four Options for WINS Solution

wiGL Configuration	1.0” OD wiGL	1.5” OD wiGL
One-Way Communications (Surface to Downhole Only)	Option 2 • Design appears feasible • To be used in existing wells • To be used in restricted envelopes where 1” pocket is the only choice	Option 1 • Conceptual Design Completed • Fewest features
Two-Way Communications (Turbine-Generator Req’d)	Option 3 • Very difficult envelope to fit • Not feasible at present	Option 4 • Design appears feasible • Preferred package with many features. • New wells should be designed for this config.

Requirements

Operator:	A	B	C	D
Location:			Global	
Depth (TVD):	10,800 ft	1500-8000 ft	5-11,000 ft	8500-9520
SIWHP:	8400 psi	70-300 psi	0-2500 psi	400-2000 psi
Annulus Pressure:	3800 psi	725-870 psi	500-3500 psi	1800 psi
Tubing Pressure at Operating Valve:	10,646 psi	290-850 psi	500-1500 psi	1500-1850 psi
Annulus Pressure at Operating Valve:	5578 psi	700-950 psi	500-3500 psi	1600-2000 psi
Circulating Valve Orifice Area:	0.186 in^2	0.186 in^2	0.196 in^2	0.186 in^2
Circulating Direction:	Both	Ann to Tbg	Both	Ann to Tbg
Gas Lift Orifice Diameters Used (in):	0.016, 0.156, 0.188, 0.250, 0.438”	0.016” to .438”	.156-.500” in .032” inc	.156-.500” in .032” inc
Gas Lift Direction:	Ann to Tbg Only	Ann to Tbg Only	Both	Ann to Tbg Only
Unloading Flow Rate:		“Slowly”	1 bpm spec 3 bpm accident	

Requirements

Operator:	A	B	C	D
Gas Lift Valve Size (Initial):	1”	1”	1-1/2”	1-1/2”
GLV Comms (Initial):	One-way	One-way	One-way	One-way
Gas Lift Size (final):	1-1/2”	1-1/2”	1-1/2”	1-1/2”
Gas Lift Comms (Final):	Two-way	Two-way	Two-way	Two-way
Max Temp (°C):	80-132°C	50-100°C	125°C	125°C
Check Valve Needed:	Yes	Yes	Yes	Yes
Check Valve Type:	Barrier Rated (need spec)	Barrier Rated	Barrier Rated	Barrier Rated
Valve Pressure Rating:	5000 psi	5000 psi	5000 psi	5000 psi
Dummy Pressure Rating:	6500 psi (screen out)	5000 psi	5000 psi	
Lifetime (Desired):	3 years	3 years	5 years	5 years
Lifetime (Minimum)	3 years	3 years	3 years	3 years
SPM Metallurgy:	L-80 and P-110 at HT	L-80 Some 13Cr L-80	P-110 and 13Cr L-80	L-80 and 13Cr L-80
Max SPM Deviation (deg):	80+	60 max	80-90	65 (was 70-80)

Requirements

Operator:	A	B	C	D
SPM Size 2.375” x 1.0				
SPM Size 2.875” x 1.0		**X**		
SPM Size 3.5” x 1.0	**X** (inj also)	**X**		
SPM Size 4.5” x 1.0	**X** (inj also)			
SPM Size 3.5” x 1.5	**X**	**X**		**X**
SPM Size 4.5” x 1.5	**X** (low demand)		**X**	**X**
SPM Size 5.0” x 1.5				
SPM Size 5.5” x 1.5			**X**	
SPM Size 7” x 1.5			**X**	
SPM Size 7” x 1.5 x 1.5” (dbl)			**X**	

Requirements

Operator:	A	B	C	D
Experience with Standard Kickover Tool	Can't lift 1.5" GLV at 80^0+ Deviation, 15 misruns of 1" GLV on 1 job. Intend to run calipers to determine SPM orientation	No problems.	Probs with 7" dbl pocket in vertical hole, dropped GLVs after release	
Experience with Ratchet Kickover Tool	Worked in lab, problems in field	None	Worked in lab, no field exp, think it is fine for their needs	
KOT Extra Features	Want GR/CCL with pip tag in GLV for position	None needed		None needed at 65^o. Still looking at higher deviations
Experience with SW:	Not run yet, planning SPMs for backup	Looking…	Not run yet	Yes
General Comments:	EM-KOT and -KOR separate from wiGL	Could gradually change from 1" to 1.5" GLVs		

Project Definitions and Features

Project		Features
1	wiGL 1.0” (option 2)	• wiGL 1.0” dia, standard length • One-way comms (surface to downhole) • Closed, circulate, one orifice flow position (perhaps more) • Battery powered, 2-4 year life based on temp and use
2	wiGL 1.5” (option 4)	• wiGL 1.5” dia, standard length • Two-way comms based on turbine-generator using perturbated flow • Closed, circulate, and variable orifice flow positions • Pressure, temperature, and flow sensors • 3-5 year lifetime based on turbine and electronics reliability
3	Electromechanical Kickover Tool Size 1.0” (EM-KOT)	• Several 1” sizes: 2-3/8 x 1”, 2-7/8 x 1”, 3-1/2 x 1”, etc. • Orientation vs. torque, axial force vs. deflection, kickover force vs. pos, latch grip and release • Interface to one or two tractor manufacturers • Developed first and trialed early to get experience with 1” GLVs in the field.
4	Electromechanical Kickover Robot Size 1.5” (EM-KOR)	• EM-KOR with several sizes: 3-1/2 x 1.5”, 4-1/2 x 1.5”, 5-1/2 x 1.5”, etc. • Multiple operations on a single run • Interface to several tractor manufacturers • Future versions to include pocket maintenance tools

Project Schedule

Projects		Year 1				Year 2					
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		
1	1.0x1W wiGL									wiGL Joint Industry Project	B
2	1.5x2W wiGL										
3	1.0 EM-KOT									EM-KOT/R Joint Industry Project	C
4	1.5 EM-KOR										
		Feasibility Study									
		A									

Legend			
	Design		Test
	Detail		Field Trial
	Manufacture		

Structure of Feasibility Study and JIP

Project Name		Project Scope

A	Feasibility Study
	(6 months)
		• wiGL 1.0” one-way comms feasibility
		  ○ Conceptual and Detailed Design
		• wiGL 1.5” two-way comms feasibility
		  ○ Conceptual Design
		  ○ Select and test miniaturization subsystems
		  ○ Iterate to improve
		• 1.0” EM-KOT feasibility
		  ○ Conceptual Design
		• 1.5” EM-KOR feasibility
		  ○ Conceptual Design

B	wiGL
	Joint Industry Program
	(18 months)
		• wiGL 1.0” with one-way communications
		  ○ Develop, test, and field trial
		• wiGL 1.5” with two-way communications
		  ○ Further develop refining miniaturization
		  ○ Test and field trial

C	Electromechanical
	Kickover Tool
	Joint Industry Program
	(18 months)
		• 1” EM-KOT
		  ○ Develop, test, and field trial
		• 1.5” EM-KOR
		  ○ Develop, test, and field trial

Questions?