

PetroDAQ

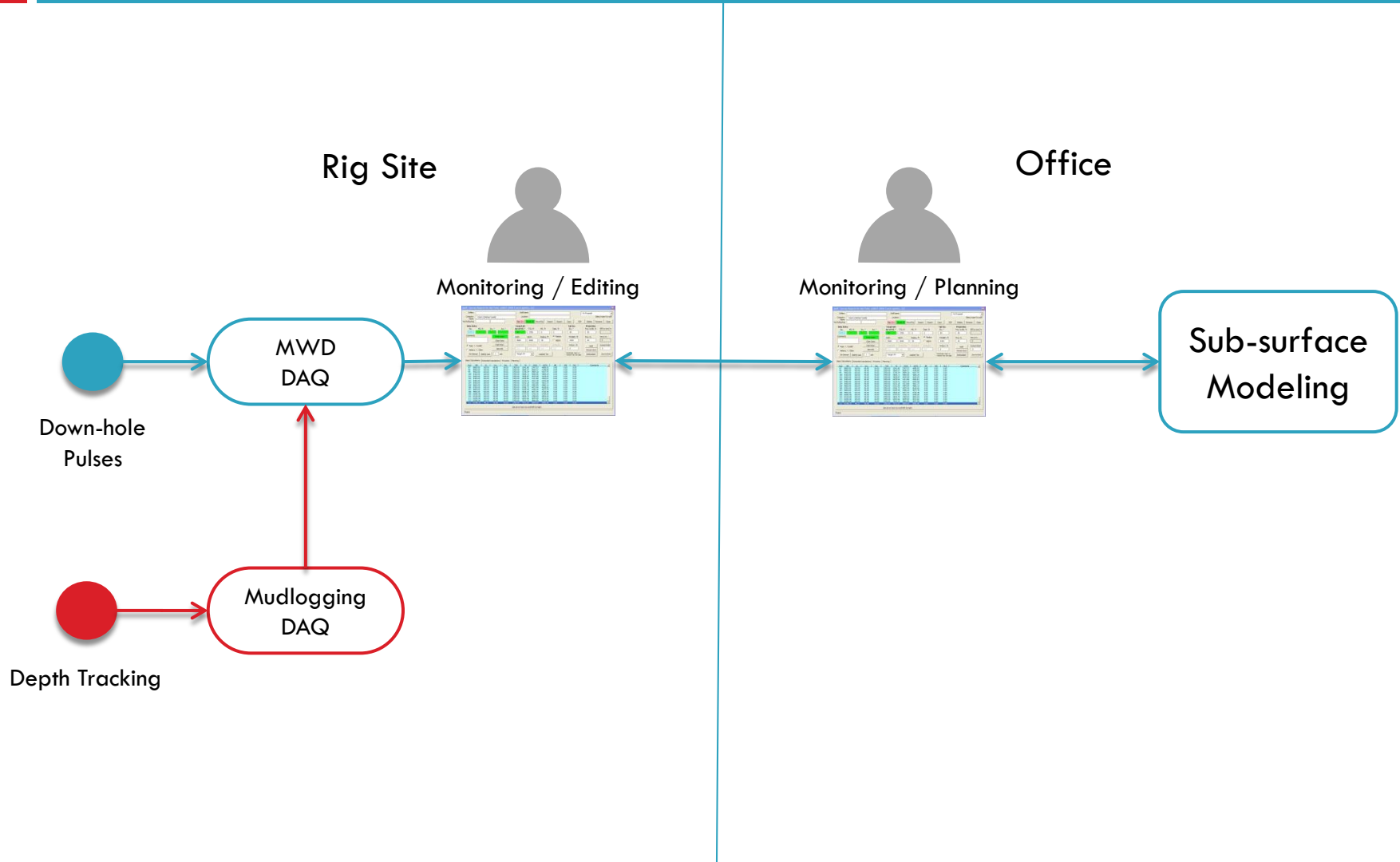


Universal Data Acquisition

DIRECTIONAL GUIDANCE CLOSED LOOP USING AN OPEN STANDARD

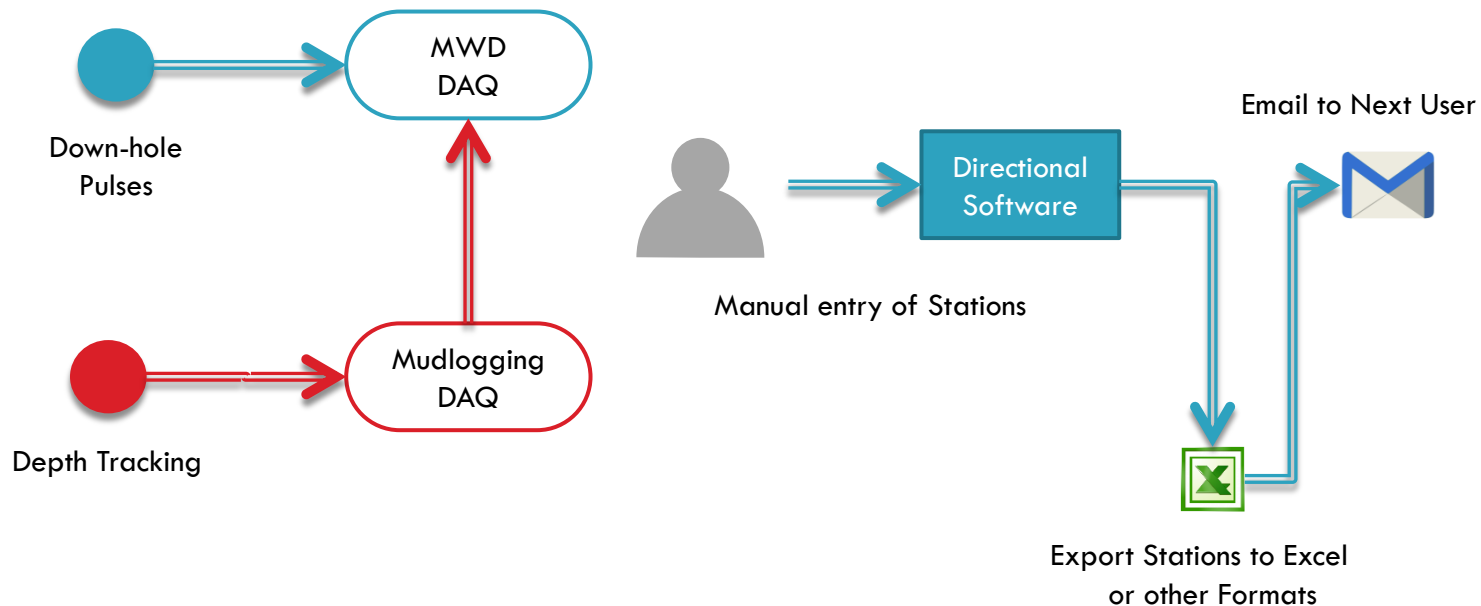
2/8/2013

Ideal Workflow



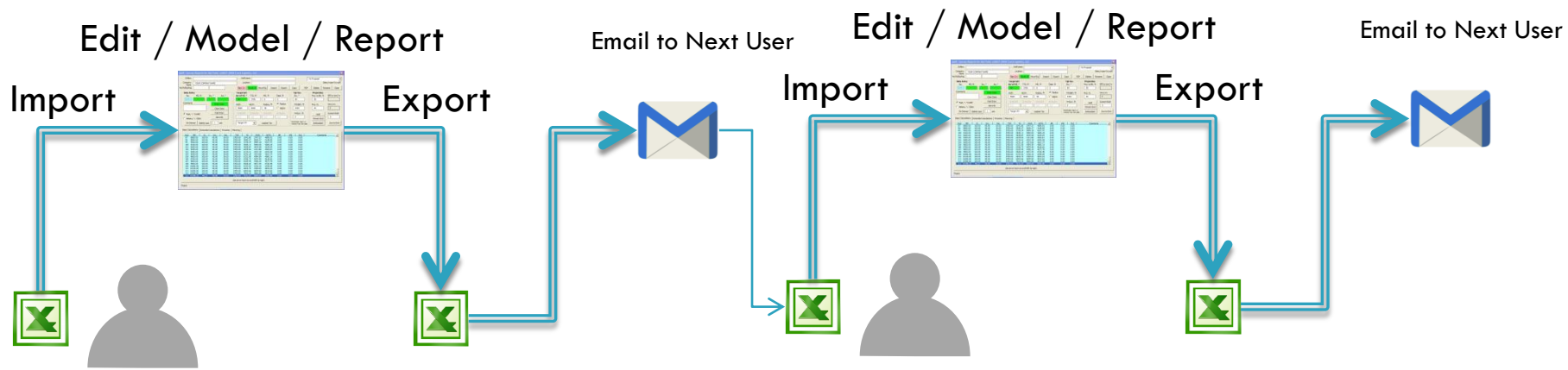
Current Data Collection at the Rig

- Semi-Automatic Entry
- Manual Edits
- Email delivery



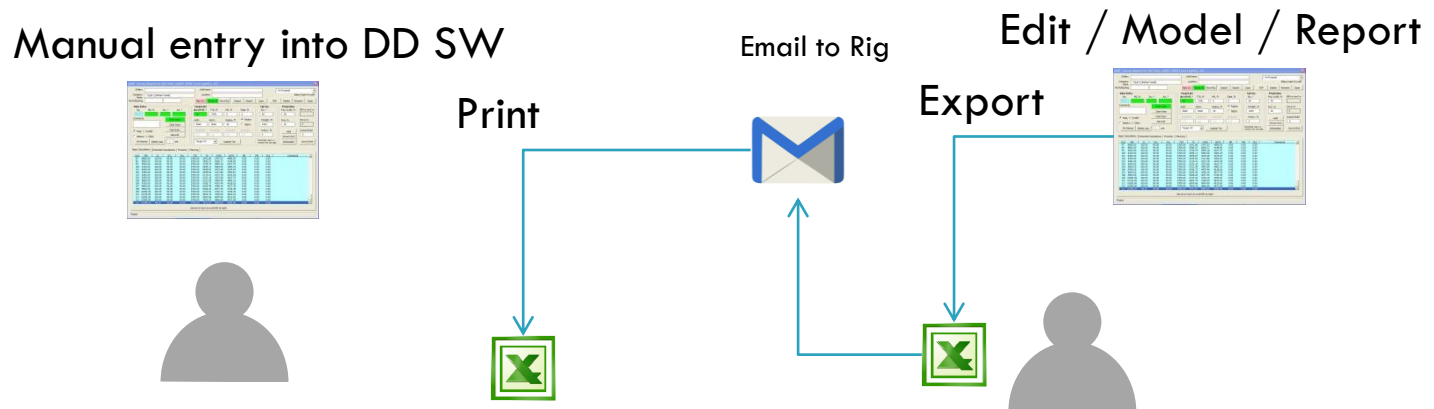
Current Rig to Office

- More Manual Edits
- Email delivery



At the Well Planning Desk

- Batch Data – if process is in place
- Snapshot view of the process
- Manual delivery of the proposed plans



Barriers for a closed loop

- Manual operations at the Directional Drilling DAQ
- No standards in use for interoperability
- Ad-hoc solutions abound, incompatibility increases

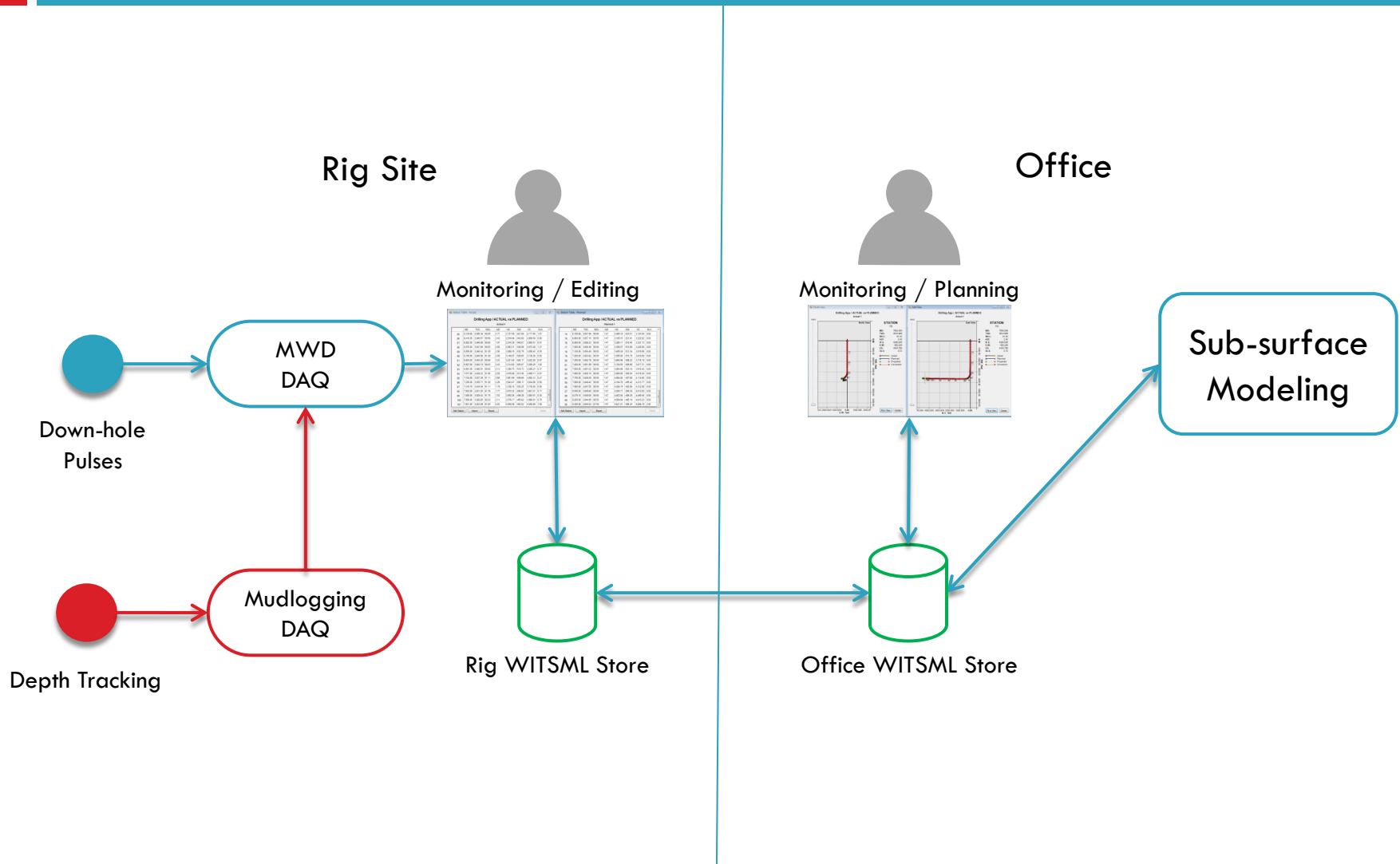
Criteria for better solutions

- ❑ Real-time transfer from the MWD DAQ
- ❑ No manual input
- ❑ Allow corrections with easy Q.C.
- ❑ Real-time monitoring
- ❑ Real-time changes to well plans
- ❑ Integrate Rig operations and Well Planning

A solutions based on WITSML

- Integration with MWD Units via existing data-streams
- Data transfer using open standard
- Interoperability using monitoring and modeling tools from any vendor
- Mature standard, real-life use, gaining acceptance

Implemented Workflow



On-Screen Editing

Station Table - Actual

Drilling App / ACTUAL vs PLANNED

Actual 1

	MD	TVD	INCL	AZI	NS	EW	VS	DLS
85	6,319.00	3,650.38	90.09	2.71	2,727.55	-547.68	2,717.58	1.67
86	6,410.00	3,649.87	90.56	2.43	2,818.46	-543.60	2,808.54	0.60
87	6,502.00	3,648.89	90.65	1.97	2,910.38	-540.07	2,900.51	0.51
88	6,575.00	3,647.95	90.83	2.88	2,983.31	-536.98	2,973.48	1.27
89	6,658.00	3,646.42	91.29	2.90	3,066.19	-532.79	3,056.42	0.55
90	6,740.00	3,644.56	91.29	2.89	3,148.07	-528.65	3,138.36	0.02
91	6,824.00	3,643.20	90.56	3.23	3,231.93	-524.17	3,222.29	0.97
92	6,907.00	3,642.19	90.83	2.43	3,314.83	-520.07	3,305.25	1.02
93	6,991.00	3,640.91	90.92	2.13	3,398.75	-516.73	3,389.21	0.37
94	7,071.00	3,639.23	91.48	2.55	3,478.66	-513.46	3,469.17	0.87
95	7,154.00	3,637.36	91.11	2.66	3,561.56	-509.69	3,552.12	0.47
96	7,236.00	3,635.71	91.20	2.26	3,643.47	-506.17	3,634.08	0.50
97	7,318.78	3,634.04	91.11	1.79	3,726.18	-503.25	3,716.83	0.58
98	7,403.00	3,631.93	91.76	1.77	3,810.33	-500.63	3,801.01	0.77
99	7,485.00	3,629.42	91.75	1.52	3,892.26	-498.28	3,882.97	0.30
100	7,569.00	3,626.65	92.03	2.11	3,976.17	-495.62	3,966.91	0.78
101	7,651.00	3,623.88	91.84	0.83	4,058.09	-493.52	4,048.86	1.58

Add Station Import Export Delete

Station Table - Planned

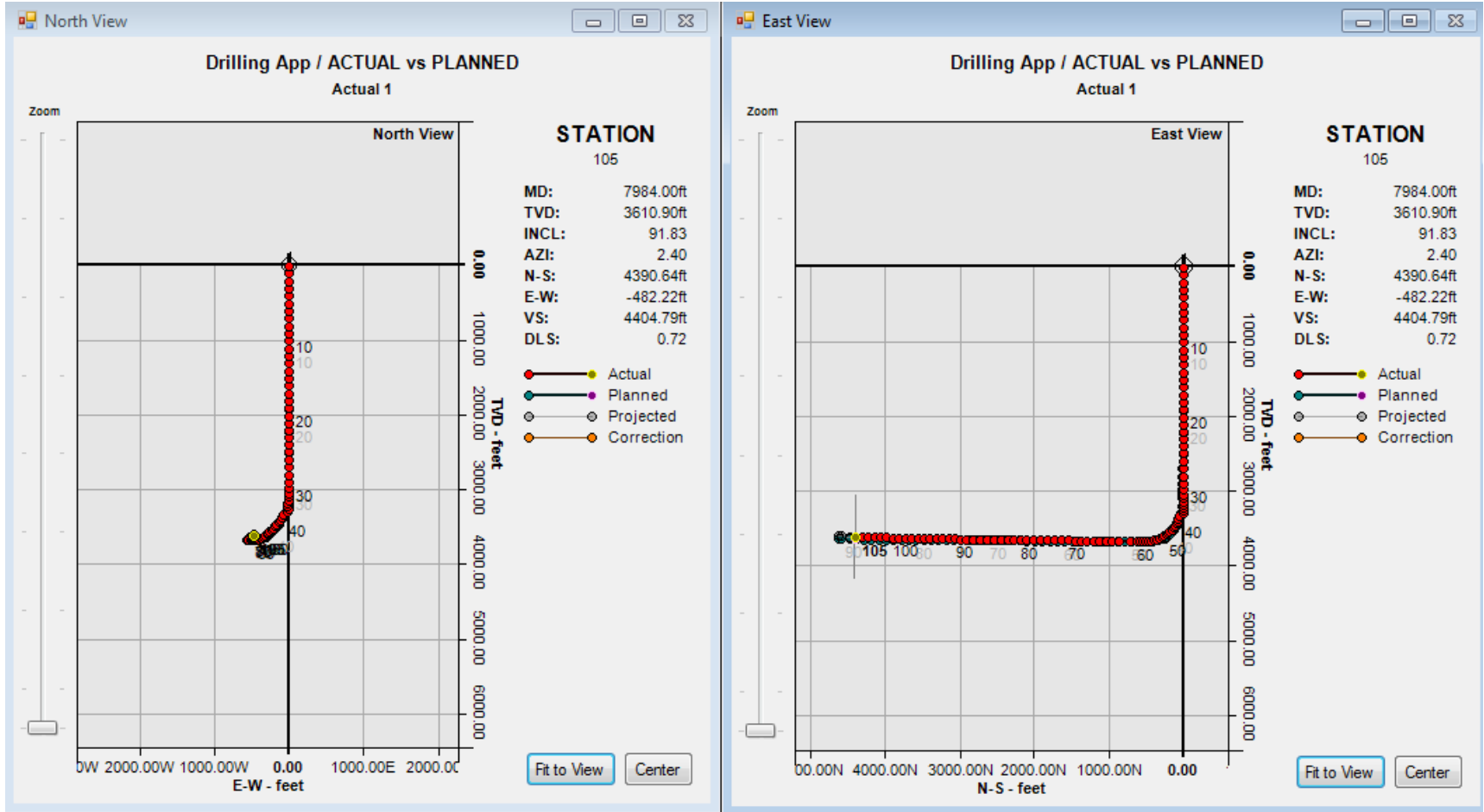
Drilling App / ACTUAL vs PLANNED

Planned 1

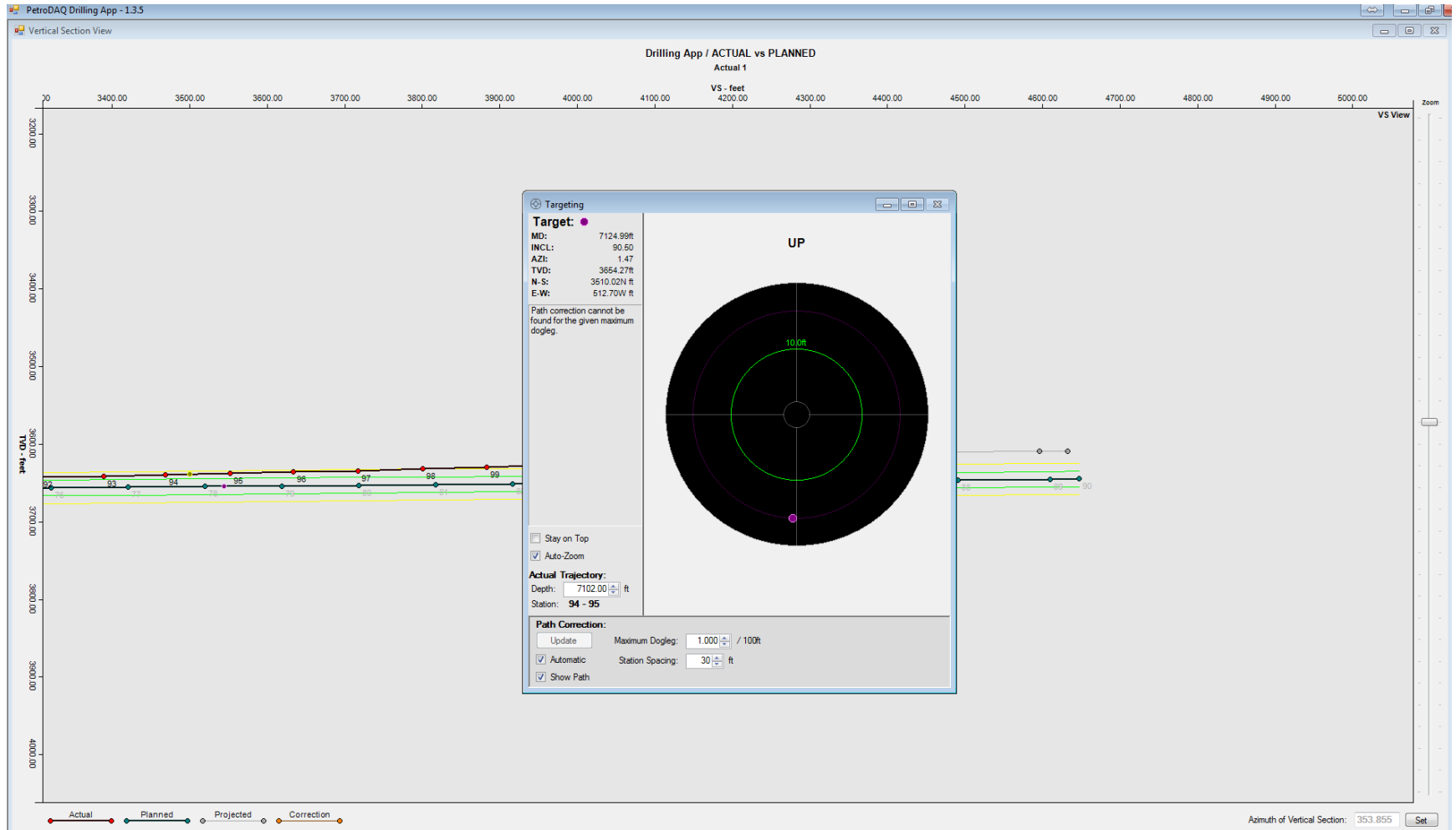
	MD	TVD	INCL	AZI	NS	EW	VS	DLS
74	6,700.00	3,657.96	90.50	1.47	3,085.18	-523.57	3,123.50	0.00
75	6,800.00	3,657.10	90.50	1.47	3,185.15	-521.01	3,222.62	0.00
76	6,900.00	3,656.23	90.50	1.47	3,285.11	-518.45	3,321.73	0.00
77	7,000.00	3,655.36	90.50	1.47	3,385.07	-515.89	3,420.85	0.00
78	7,100.00	3,654.49	90.50	1.47	3,485.04	-513.34	3,519.96	0.00
79	7,200.00	3,653.62	90.50	1.47	3,585.00	-510.78	3,619.08	0.00
80	7,300.00	3,652.76	90.50	1.47	3,684.96	-508.22	3,718.19	0.00
81	7,400.00	3,651.89	90.50	1.47	3,784.93	-505.66	3,817.31	0.00
82	7,500.00	3,651.02	90.50	1.47	3,884.89	-503.10	3,916.42	0.00
83	7,600.00	3,650.15	90.50	1.47	3,984.85	-500.54	4,015.54	0.00
84	7,700.00	3,649.29	90.50	1.47	4,084.82	-497.98	4,114.65	0.00
85	7,800.00	3,648.42	90.50	1.47	4,184.78	-495.42	4,213.77	0.00
86	7,900.00	3,647.55	90.50	1.47	4,284.74	-492.86	4,312.88	0.00
87	8,000.00	3,646.69	90.50	1.47	4,384.71	-490.30	4,412.00	0.00
88	8,079.16	3,646.00	90.50	1.47	4,463.84	-488.28	4,490.46	0.00
89	8,200.00	3,644.95	90.50	1.47	4,584.64	-485.18	4,610.23	0.00
90	8,300.00	3,644.63	87.00	1.47	4,621.51	-484.24	4,646.79	3.50

Add Station Import Export Delete

Visual QC

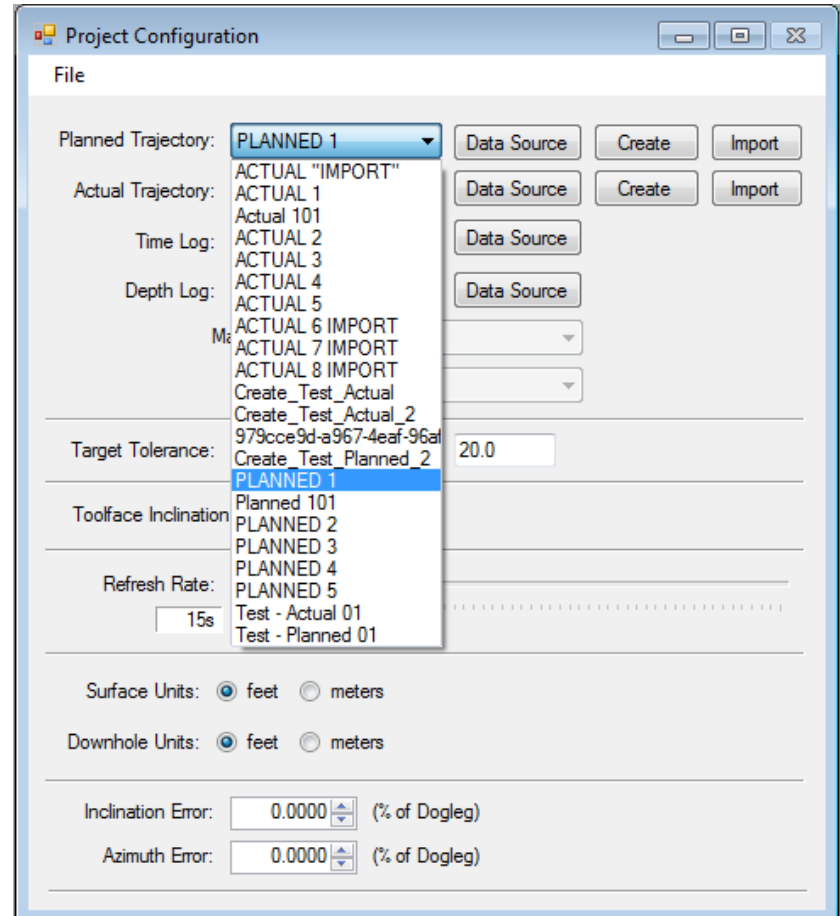


Dynamic Targeting and Planning



Real-time integration

- Unlimited # of Plan revisions
- New plans from the modeling tools are immediately available at the rig



Summary of Benefits

- ❑ Closed loop solution
- ❑ Solution is based on open Standard, allows inter-operability
- ❑ Minimizes chances for fat-fingering
- ❑ On-screen Q.C. aids in prompt detection of errors
- ❑ Drop-in replacement for manual editing/exporting

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