



Looking Forward While Looking Back

10 years of Automated Clearance Scans
Ahead-of the Bit while Drilling

Carol Mann – Dynamic Graphics, Inc
Gary Skinner – Baker Hughes

Looking Forward While Looking Back





A quick look back on 2011

- Fukushima (9.1), Christchurch (6.3), and eastern Turkey (7.1) suffer severe earthquakes
- Wikileaks occurs
- World population reaches 7 billion
- iPhone 4s and Siri debuts



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- Fukushima (9.1), Christchurch (6.3), and eastern Turkey (7.1) suffer severe earthquakes
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- ISCWSA 33 Copenhagen
- ISCWSA 34 Denver
- Education Subcommittee Formed: Plans Hits and Misses ATW
- ISCWSA MWD model rev. 3
- **Human Factors** highlighted in official reports following 3 oil-field incidents in 8 months (2009-2010)



Human Factors in while-drilling clearances

- The ISCWSA, “Current Common Practice in Collision Avoidance Calculations” document states:
“[An MASD] rule, no matter how conservative, does not ensure acceptably low probability of collision. Many other factors contribute, including the level of compliance by office and rig personnel with collision avoidance procedures...”

<https://www.iscwsa.net/articles/collision-avoidance-calculations-current-common-practice/>

- “Spot focus on offshore safety: the human factor”, Offshore Technology.
Elisabeth Fischer, 25 Mar 2012:

“The recognition of human factors in the oil and gas industry is not widespread.... Studies have shown that up to 90% of accidents are attributable to some degree to human failures. ... The prevention of major accidents depends to a large degree upon human reliability at all sites, no matter how automated. ... The topics range from broad, high-level issues such as staff competence, to those covering specific subjects like fatigue risks and alarm handling.”

<https://www.offshore-technology.com/features/featurespot-focus-offshore-safety-the-human-factor>

Pathway to Automated Clearance Calculations

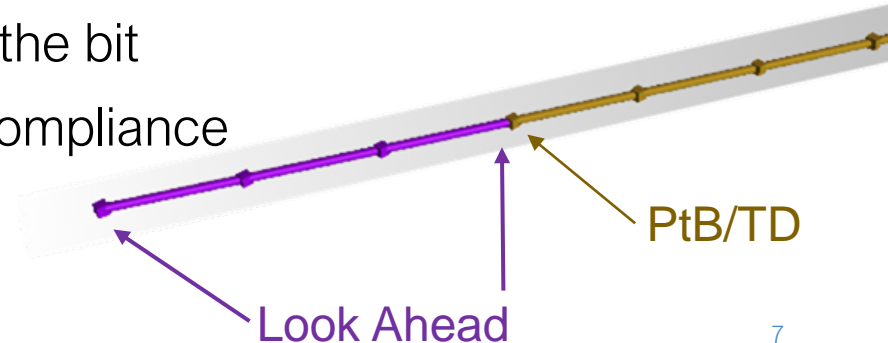
- Digitisation of Directional Surveying and Collision Avoidance started over 40 years ago
- Improvements made to calculation methods, models and management practices
- While-drilling collision avoidance calculations typically remained mirrors of planning process
- Difficult to validate adherence to procedures without reams of paperwork



Design philosophy for auto-clearances

Goal: To aid the DD while drilling

- Be invisible until necessary
- Alert with time to react
- Ensure (and encourage) policy AND procedures are followed
- Assures scans are done at and ahead of the bit
- Eliminate busywork through automated compliance
- Clear, concise, unambiguous results





Revisions and Refinements

Business Evolution

- Feedback and lessons learned implemented in software and procedures
- While-Drilling Collision Management
 - Procedures and training re-written
 - Greater focus on DDs compliance
- Well Planning
 - Make the plan drillable with additional planning functions and rules to cater for off-plan situations
 - Distance from plan / risk assessment rule
- Remote Operations Ready



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Software Evolution

- Distance from plan warning – pre 2011



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Software Evolution

- Distance from plan warning – pre 2011
 - ❖ Auto-clearances ahead of the bit
 - ❖ Primary and Secondary ACR rules
 - ❖ Actuals only
 - ❖ “Look Ahead” options: Ptb-method or trend



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Software Evolution

- Distance from plan warning – pre 2011
 - ❖ Actuals only / 2 rules / Ptb-method or trend
 - More flexibility for defining look ahead path
 - Accommodate incoming WITSML surveys
 - Copy results
 - Plans optionally included



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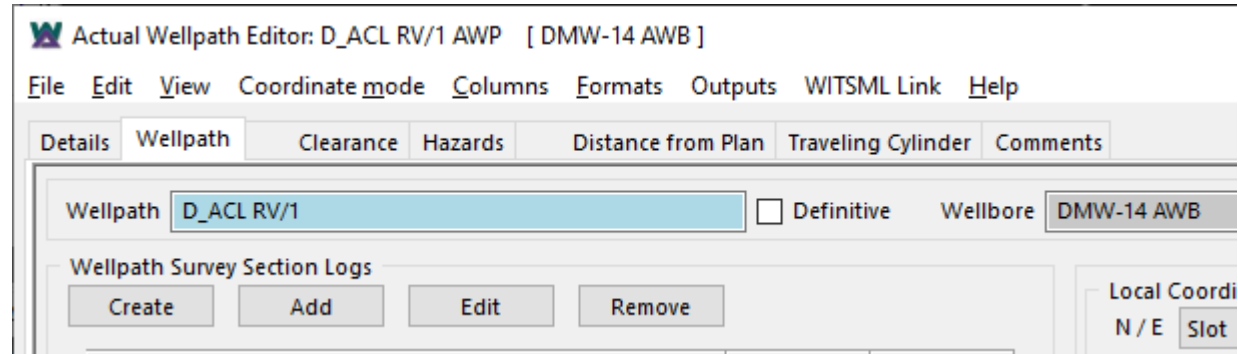
Software Evolution

- Distance from plan warning – pre 2011
- ❖ Actuals only / 2 rules / Ptb-method or trend
 - More flexibility for defining look ahead path
 - Accommodate incoming WITSML surveys
 - Copy results
- ✓ Plans **optionally** included by default
- ✓ Automated logging & Reporting
- ✓ Warning limits added
- ✓ Simultaneous drilling
- ✓ Ability to silence alert
- ✓ Look Ahead “distance from plan” & 3D collision shapes



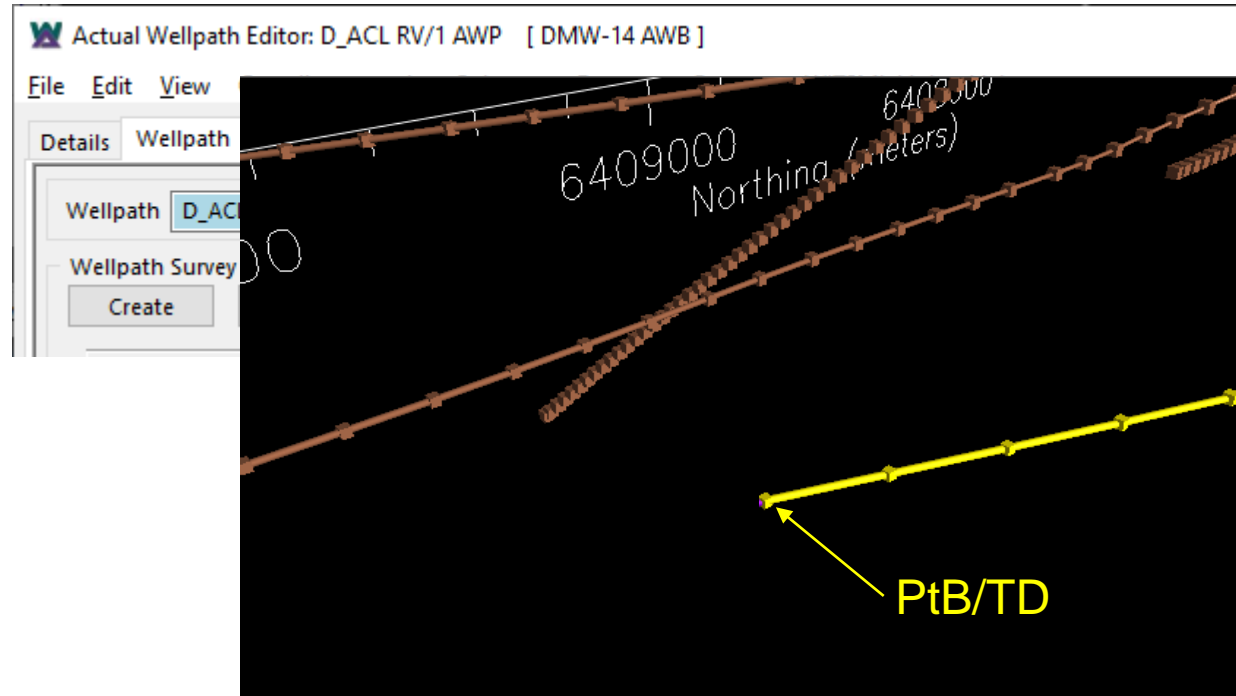
Auto-clearances in Practice

- Invisible, silent partner
- Alert with sufficient time
- Silent until necessary



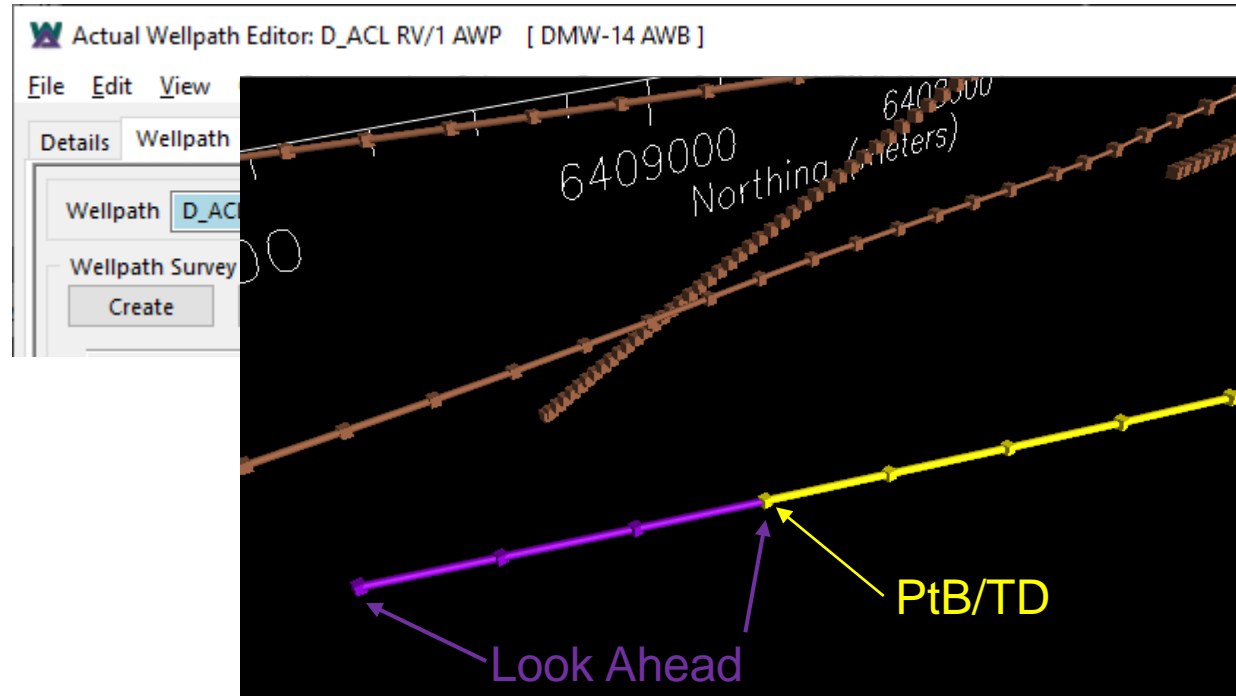
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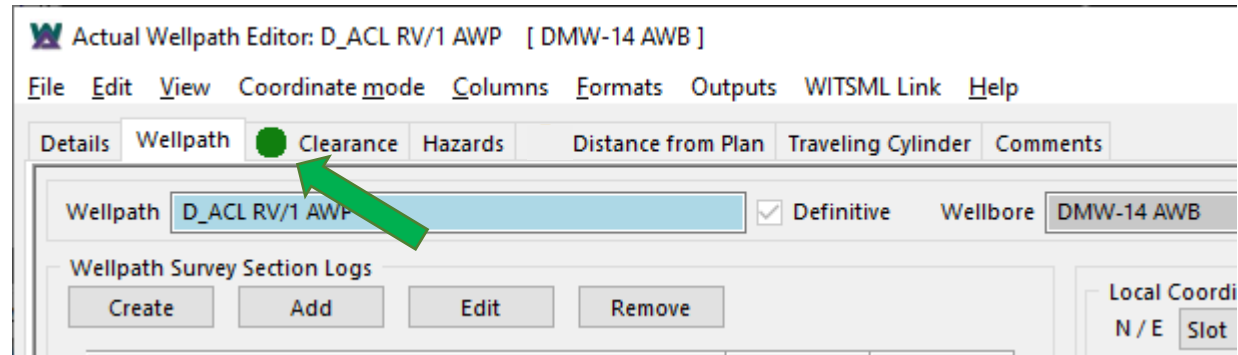
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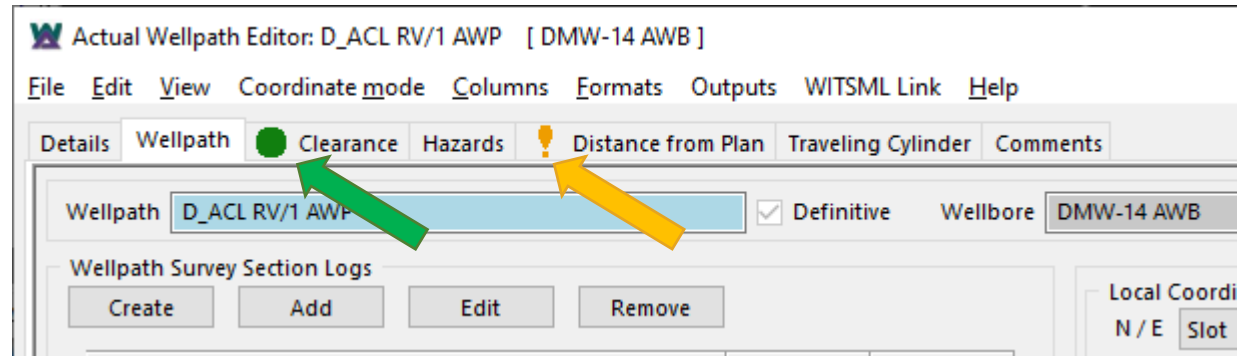
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- Survey 1 added

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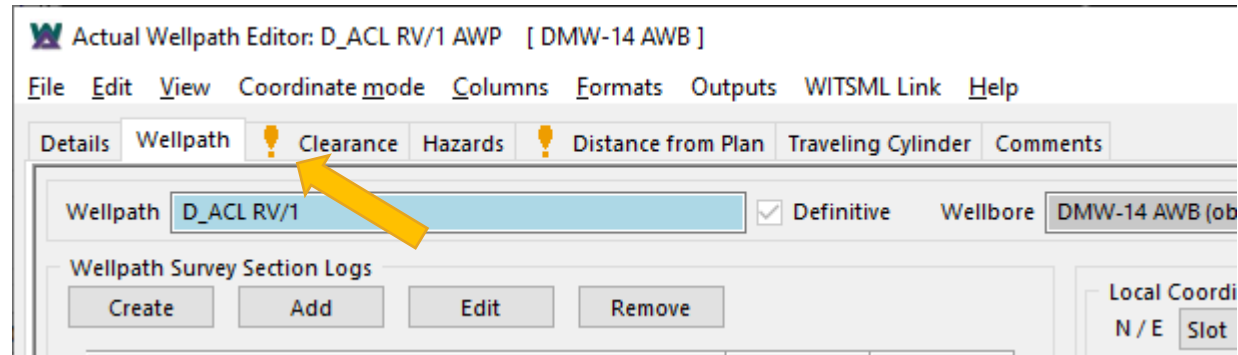
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- Survey 1 added
- Survey 20 added

Auto-clearances in Practice

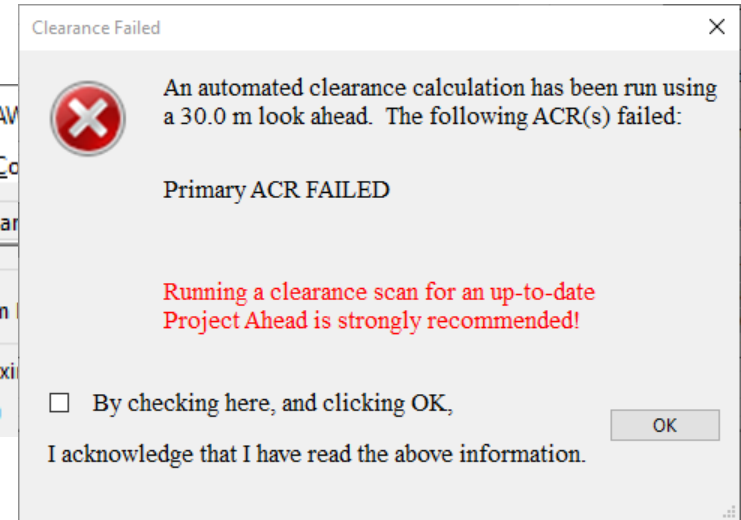
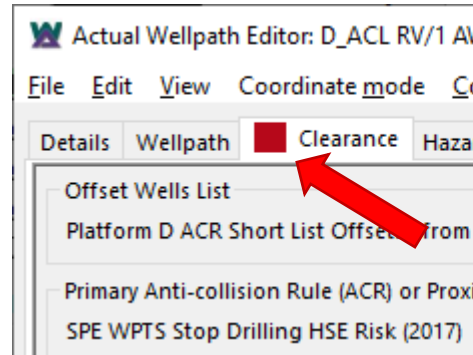
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- Survey 1 added
- Survey 20 added
- Survey 25 added – ACR warning limit

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- Survey 1 added
- Survey 20 added
- Survey 25 added – ACR warning limit
- Survey 27 added – ACR failure limit



Auto-clearances in Practice

Paths to List in Table

Failing paths

All paths

Include warnings

Notes and Warnings

ACR needs casing but error found with anti-collision diameters for reference path:
Fewer than 1 interval given
All used offset paths passed for the specified ACR

Offset Wellpath Name as "Wellpath [Wellbore]" (Left click name to highlight in viewer)	Status	Last Survey Point at MD 2490.0 m		Projection to Bit at MD 2498.0 m		Look Ahead 100.0 m from 2498.0 to 2598.0 m									
		ACR Available Space	Alt ACR Available Space	ACR Available Space	Alt ACR Available Space	ACR Min Sep Ratio: 1.0 (1.1)			Alt ACR Min Sep Ratio: 1.0 (N/A)						
						Ref MD	Available Space	Sep Ratio	Ref MD	Available Space	Sep Ratio				

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→



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		ACR Available Space	Alt ACR Available Space	ACR Available Space	Alt ACR Available Space	ACR Min Sep Ratio: 1.0 (1.1)			Alt ACR Min Sep Ratio: 1.0 (N/A)		
						Ref MD	Available Space	Sep Ratio	Ref MD	Available Space	Sep Ratio
130/60A-D04Z [130/60A-D04Z]	FAIL	24.52	15.82	19.40	10.17	2584.25	-14.71	0.78	2584.30	-28.66	0.65



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		ACR Available Space	Alt ACR Available Space	ACR Available Space	Alt ACR Available Space	ACR Min Sep Ratio: 1.0 (1.1)			Alt ACR Min Sep Ratio: 1.0 (N/A)		
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		ACR Available Space	Alt ACR Available Space	ACR Available Space	Alt ACR Available Space	ACR Min Sep Ratio: 1.0 (1.1)			Alt ACR Min Sep Ratio: 1.0 (N/A)		
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		ACR Available Space	Alt ACR Available Space	ACR Available Space	Alt ACR Available Space	ACR Min Sep Ratio: 1.0 (1.1)			Alt ACR Min Sep Ratio: 1.0 (N/A)		
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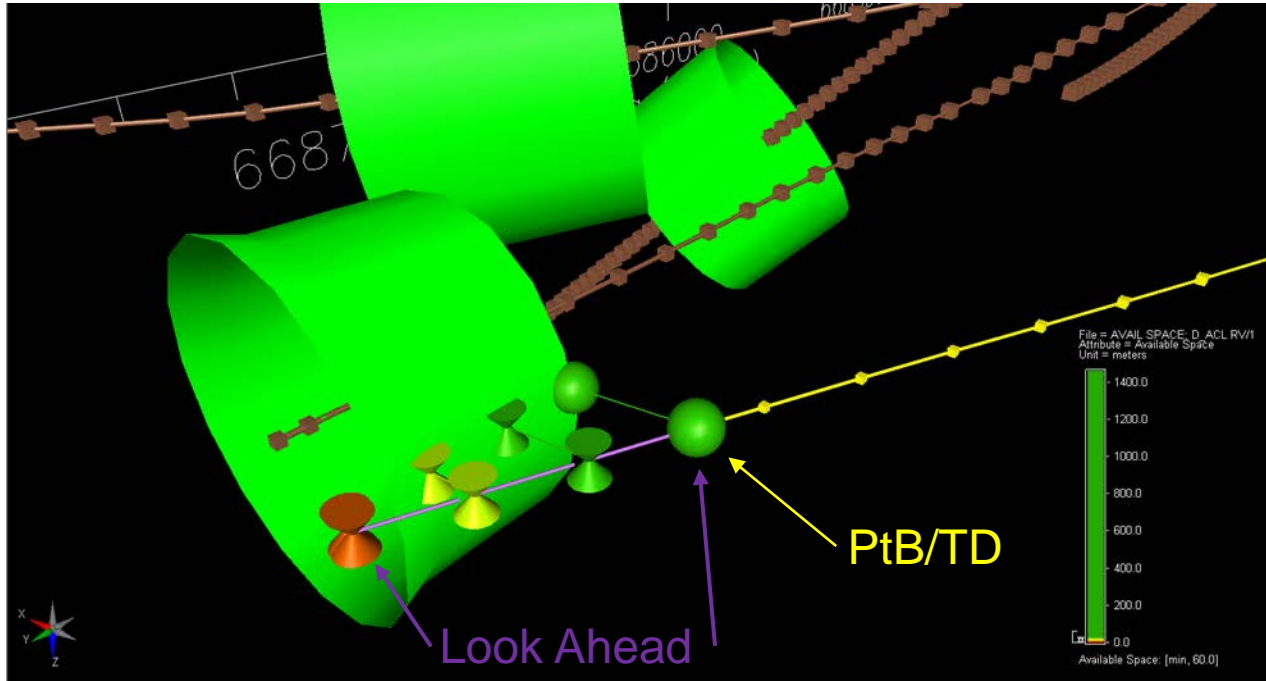
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		ACR Available Space	Alt ACR Available Space	ACR Available Space	Alt ACR Available Space	ACR Min Sep Ratio: 1.0 (1.1)			Alt ACR Min Sep Ratio: 1.0 (N/A)		
						Ref MD	Available Space	Sep Ratio	Ref MD	Available Space	Sep Ratio
130/60A-D04Z [130/60A-D04Z]	FAIL	24.52	15.82	19.40	10.17	2584.25	-14.71	0.78	2584.30	-28.66	0.65
130/60A-D06Z [130/60A-D06Z]	PASS	98.11	92.36	93.39	87.31	2588.00	62.17	2.25	2588.00	52.12	1.87
130/60A-D04 [130/60A-D04]	PASS	237.03	228.22	238.22	229.31	2588.00	251.65	6.18	2588.00	241.76	5.12
130/60A-D06 [130/60A-D06]	PASS	480.84	474.87	484.88	478.93	2498.00	484.88	15.59	2498.00	478.93	13.13
130/60A-D01 [130/60A-D01]	PASS	1167.69	1165.63	1175.07	1173.01	2498.00	1175.07	89.32	2498.00	1173.01	75.88
130/60A-D02 [130/60A-D02]	PASS	1306.74	1306.38	1314.37	1314.01	2498.00	1314.37	134.15	2498.00	1314.01	125.78
130/60A-D08 [130/60A-D08]	PASS	1322.19	1322.22	1329.99	1330.02	2498.00	1329.99	155.59	2498.00	1330.02	150.83
130/60A-D03 [130/60A-D03]	PASS	1328.49	1327.93	1336.16	1335.59	2498.00	1336.16	120.42	2498.00	1335.59	111.80

Visualizing Look-Ahead Collision Avoidance





Silencing Alerts

- Drilling in tight quarters
- Alerting on expected failures could cause missed unexpected failures

Offset Wellpath Name as "Wellpath [Wellbore]" (Left click name to highlight in viewer)	Status	Last Survey Point at MD 2730.0 m		Projection to Bit at MD 2750.0 m		Look Ahead 100.0 m from 2750.0 to 2850.0 m					
		ACR Available Space	Alt ACR Available Space	ACR Available Space	Alt ACR Available Space	ACR Min Sep Ratio: 1.0 (N/A)			Alt ACR Min Sep Dist: 30.0 (N/A)		
						Ref MD	Available Space	Sep Ratio	Ref MD	Available Space	Sep Dist
130/60A-D06Z [130/60A-D06Z]	FAIL	59.00	82.59	48.60	73.46	2850.00	-3.22	0.95	2850.00	33.43	63.43
130/60A-D04Z [130/60A-D04Z]	PASS					2750.00	116.08	2.95	2750.00	145.54	175.54
130/60A-D04 [130/60A-D04]	PASS					2750.00	253.79	5.33	2750.00	282.46	312.46
130/60A-D06 [130/60A-D06]	PASS					2750.00	469.88	12.49	2750.00	480.78	510.78
130/60A-D01 [130/60A-D01]	PASS	1118.99	1102.98	1137.95	1121.96	2750.00	1137.95	82.23	2750.00	1121.96	1151.96

130/60A-D06Z [130/60A-D06Z]
Suspend failure notifications for this path



Logging and Reporting

Records clearance statistics for each survey/iteration to each offset for:

- survey depth, projection to bit, closest approach in look ahead
- ++ Date/Time, ACRs, offset list, warnings generated, converging/diverging



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Reports:

- Pretty report for **proof of clearance calculations being done**



Auto-clearance log status summary report

Test-WMLFeed_awp

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REFERENCE WELLPATH IDENTIFICATION

Operator	ISCWSA	Well	ISCWSA No1
Field	North Sea Example	API	API MMS
Facility	North Sea Facility	Wellbore	Test-WMLFeed
Slot	1		

AUTO-CLEARANCE LOG STATUS SUMMARY * = User suspended failure-notifications on one or more offset wellpath.

Scan		Survey			Bit			Look Ahead			Offset List	Primary ACR	Secondary ACR	Failing Offsets
Time	Status	MD	ACR	Alt ACR	MD	ACR	Alt ACR	MD	ACR	Alt ACR				
2021-06-17 08:24:57	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offsets2 (4)	SPE WPTS Stop Drilling HSE Risk (2017)		
2021-06-17 08:27:32	Pass	1948.89	Pass	-	1974.89	Pass	-	1974.89	Pass	-	Offsets2 (4)	SPE WPTS Stop Drilling HSE Risk (2017)		
2021-06-17 08:29:25	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offsets2 (4)	SPE WPTS Stop Drilling HSE Risk (2017)		
2021-06-17 08:30:13	Pass	1948.89	Pass	-	1974.89	Pass	-	1974.89	Pass	-	Offsets2 (4)	SPE WPTS Stop Drilling HSE Risk (2017)		
2021-06-18 15:48:56	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offsets2 (4)	SPE WPTS Stop Drilling HSE Risk (2017)		
2021-06-18 15:49:20	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offsets2 (4)	SPE WPTS Stop Drilling HSE Risk (2017)		
2021-09-21 13:24:54	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offsets2 (4)	SPE WPTS Stop Drilling HSE Risk (2017)		
2021-09-21 13:25:18	Fail	138.48	Pass	-	138.48	Fail	-	138.48	Fail	-	Offsets2 (3)	SPE WPTS Stop Drilling HSE Risk (2017)		Backwards_pwp , Test SAG only model_awp
2021-09-21 13:26:44	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offsets2 (4)	SPE WPTS Stop Drilling HSE Risk (2017)		



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- CSV reports with summary and detailed results, XML for archive and future re-use

Auto-clearance log status summary report
Test-WMLFeed_aws
Page 1 of 2

REFERENCE WELLPATH IDENTIFICATION										ISCWSA Well				
Wellname	TESTWML									Well	TESTWML			
FACE	North-Tee Exchange									API	API WML			
Offset	North-Tee Facility									Radius	Test-WML-Feed			
Log														
AUTO-CLEARANCE LOG STATUS SUMMARY <small>* User suspended before verification on one or more offset wells</small>														
Time	Status	MO	ACR	AY ACR	MO	ACR	AY ACR	MO	ACR	AY ACR	Offset List	Primary ACR	Secondary ACR	Failing Offsets
2021-05-17 09:24:57	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offset2 (4)	SPE WBPIS Stop During HSE Risk S2171		
2021-05-17 09:27:32	Pass	1948.80	Pass	-	1074.80	Pass	-	1074.80	Pass	-	Offset2 (4)	SPE WBPIS Stop During HSE Risk S2171		
2021-05-17 09:29:21	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offset2 (4)	SPE WBPIS Stop During HSE Risk S2171		
2021-05-17 09:30:13	Pass	1948.80	Pass	-	1074.80	Pass	-	1074.80	Pass	-	Offset2 (4)	SPE WBPIS Stop During HSE Risk S2171		
2021-05-18 09:48:59	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offset2 (4)	SPE WBPIS Stop During HSE Risk S2171		
2021-05-18 11:48:20	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offset2 (4)	SPE WBPIS Stop During HSE Risk S2171		
2021-05-21 13:24:19	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offset2 (4)	SPE WBPIS Stop During HSE Risk S2171		
2021-05-21 13:25:18	Fail	138.40	Pass	-	138.40	Fail	-	138.40	Fail	-	Offset2 (2)	SPE WBPIS Stop During HSE Risk S2171		Backwards over - Test S&D into model_aws
2021-05-21 13:26:44	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offset2 (4)	SPE WBPIS Stop During HSE Risk S2171		



Wellbore Positioning Technical Section

Scan date,	21/09/2021 14:15																
Distance to plan																	
	MD	Distance to plan															
Survey	138.48	0.01															
Bit	138.48	0.32															
Look ahead	238.48	0.32															
Clearance																	
Primary AC rule	SPE WPTS Stop Drilling HSE Risk (2017)																
Alternate AC rule	BH Risk Assessment Required (2019)																
Offset	Survey	Primary	Alternate						Bit	Primary	Alternate						L
Wellpath	MD	Status	Available	ACR value	Status	Available	ACR value	MD	Status	Trend	Available	ACR value	Status	Trend	Available	ACR value	R
Backwards_pwp [B	138.48	pass	-3.7	-	pass	-13.7	-	138.48	fail	diverging	-3.23	-0.598	fail	diverging	-13.23	-5.55172	
Test SAG only mode	138.48	pass	-3.36	-	pass	-13.36	-	138.48	fail	diverging	-3.16	-0.61787	fail	diverging	-13.16	-5.73619	
ISCWSA No. 2 US_p	138.48	pass	457.84	126.213	pass	447.84	123.478	138.48	pass	CONVERG	457.8	124.757	pass	CONVERG	447.8	122.054	
Scan date,	21/09/2021 14:28																
Distance to plan																	
	MD	Distance to plan															
Survey	138.48	0.01															
Bit	164.48	16.59															
Look ahead	264.48	102.07															
Clearance																	
Primary AC rule	SPE WPTS Stop Drilling HSE Risk (2017)																
Alternate AC rule	BH Risk Assessment Required (2019)																
Offset	Survey	Primary	Alternate						Bit	Primary	Alternate						L
Wellpath	MD	Status	Available	ACR value	Status	Available	ACR value	MD	Status	Trend	Available	ACR value	Status	Trend	Available	ACR value	R
Backwards_pwp [B	138.48	fail	-3.23	-0.598	fail	-13.23	-5.55172	164.48	pass	diverging	13.13	6.84805	pass	diverging	3.13	2.39491	
Test SAG only mode	138.48	fail	-3.16	-0.61787	fail	-13.16	-5.73619	164.48	pass	diverging	13.21	7.07859	pass	diverging	3.21	2.47554	
ISCWSA No. 2 US_p	138.48	pass	457.8	124.757	pass	447.8	122.054	164.48	pass	diverging	473.97	124.394	pass	diverging	463.97	121.791	



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Auto-clearance log status summary report
Test-WM2Feed_wpp
Page 2 of 2

REFERENCE WELLPATH IDENTIFICATION														
Wellname	WELL1			Date	ISCWSA 011									
FACE	North-Tee-Example			API	API 0001									
Offset	North-Tee-Example			Wellbore	Test-WM2-Feed									
Log														
AUTO-CLEARANCE LOG STATUS SUMMARY <small>++ User suspended before configuration on one or more other wellbore</small>														
Time	Status	MD	ACR	AV ACR	MD	ACR	AV ACR	MD	ACR	AV ACR	Offset List	Primary ACR	Secondary ACR	Falling Offsets
2021-08-17 09:24:57	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offset2 (4)	SPE WPPTS Stop Drilling HSE Risk 00171		
2021-08-17 09:27:52	Pass	1948.80	Pass	-	1074.80	Pass	-	1074.80	Pass	-	Offset2 (4)	SPE WPPTS Stop Drilling HSE Risk 00171		
2021-08-17 09:29:01	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offset2 (4)	SPE WPPTS Stop Drilling HSE Risk 00171		
2021-08-17 09:30:13	Pass	1948.80	Pass	-	1074.80	Pass	-	1074.80	Pass	-	Offset2 (4)	SPE WPPTS Stop Drilling HSE Risk 00171		
2021-08-18 09:48:59	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offset2 (4)	SPE WPPTS Stop Drilling HSE Risk 00171		
2021-08-18 11:48:20	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offset2 (4)	SPE WPPTS Stop Drilling HSE Risk 00171		
2021-08-21 13:24:59	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offset2 (4)	SPE WPPTS Stop Drilling HSE Risk 00171		
2021-08-21 13:25:18	Fail	138.48	Pass	-	138.48	Fail	-	138.48	Fail	-	Offset2 (2)	SPE WPPTS Stop Drilling HSE Risk 00171		Backwards over - Test SAG only model_wpp
2021-08-21 13:26:44	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offset2 (4)	SPE WPPTS Stop Drilling HSE Risk 00171		

Scan date,	21/09/2021 14:28	
Distance to plan	MD	Distance to plan
Survey	138.48	0.01
Bit	164.48	16.59
Look ahead	264.48	102.07

Clearance										
Primary AC rule	SPE WPPTS Stop Drilling HSE Risk (2017)									
Alternate AC rule	BH Risk Assessment Required (2019)									
Offset	Survey	Primary	Alternate	Bit	Primary	Trend				
Wellpath	MD	Status	Available	ACR value	Status	Available	ACR value	MD	Status	Trend
Backwards_gwp [8	138.48	fail	-3.23	-0.598 fail	-13.23	-5.55172	164.48	pass	diverging	
Test SAG only mod1	138.48	fail	-3.16	-0.61787 fail	-13.16	-5.73619	164.48	pass	diverging	
ISCWSA No. 2 US_g1	138.48	pass	457.8	124.757 pass	447.8	122.054	164.48	pass	diverging	



Logging and Reporting

Records clearance statistics for each survey/iteration to each offset for:

- survey depth, projection to bit, closest approach in look ahead
- ++ Date/Time, ACRs, offset list, warnings generated, converging/diverging

Reports:

- Pretty report for **proof of clearance calculations being done**
- CSV reports with summary and detailed results, XML for archive and future re-use

Invaluable in service failure investigations to understand what the DD was thinking and trying to do at the time

- Enables evaluation of minor incidents before you get to major incidents
- Helps identify degradation factors in bow-tie analysis of processes
- Allows improvement of software and/or procedures to prevent reoccurrence

Auto-clearance log status summary report
Test-WMFeed_awp
Page 1 of 1

REFERENCE WELLPATH IDENTIFICATION

Wellname	WELBPA	Date	ISCWSA 011
FACE	North Sea Exempt	API	API 001
Offset	North Sea Exempt	Wellbore	Test-WMFeed
Log	1		

AUTO-CLEARANCE LOG STATUS SUMMARY ++ User suspended before configuration on one or more other wellbore

Time	Status	MD	ACR	ACR	MD	ACR	ACR	MD	ACR	ACR	Offset List	Primary ACR	Secondary ACR	Falling Offsets
2021-05-17 09:24:57	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offset2 (4)	SPE WPTS Stop Drilling HSE Risk (2017)		
2021-05-17 09:27:32	Pass	1948.80	Pass	-	1074.80	Pass	-	1074.80	Pass	-	Offset2 (4)	SPE WPTS Stop Drilling HSE Risk (2017)		
2021-05-17 09:29:25	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offset2 (4)	SPE WPTS Stop Drilling HSE Risk (2017)		
2021-05-17 09:30:13	Pass	1948.80	Pass	-	1074.80	Pass	-	1074.80	Pass	-	Offset2 (4)	SPE WPTS Stop Drilling HSE Risk (2017)		
2021-05-18 10:48:55	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offset2 (4)	SPE WPTS Stop Drilling HSE Risk (2017)		
2021-05-18 11:48:20	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offset2 (4)	SPE WPTS Stop Drilling HSE Risk (2017)		
2021-05-21 10:24:59	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offset2 (4)	SPE WPTS Stop Drilling HSE Risk (2017)		
2021-05-21 13:25:18	Fail	138.40	Fail	-	138.40	Fail	-	138.40	Fail	-	Offset2 (2)	SPE WPTS Stop Drilling HSE Risk (2017)		Backwards over - Test SAG only model_awp
2021-05-21 13:26:44	Pass	4712.20	Pass	-	4738.20	Pass	-	4738.20	Pass	-	Offset2 (4)	SPE WPTS Stop Drilling HSE Risk (2017)		

Scan date, 21/09/2021 14:28

Distance to plan	MD	Distance to plan
Survey	138.48	0.01
Bit	164.48	16.59
Look ahead	264.48	102.07

Clearance

Primary AC rule	SPE WPTS Stop Drilling HSE Risk (2017)
Alternate AC rule	BH Risk Assessment Required (2019)
Offset	Survey Primary Alternate
Wellpath	MD Status Available ACR value Status Available ACR value MD Status Trend
Backwards_awp [B	138.48 fail -3.23 -0.598 fail -13.23 -5.55172 164.48 pass diverging
Test SAG only modi	138.48 fail -3.16 -0.61787 fail -13.16 -5.73619 164.48 pass diverging
ISCWSA No. 2 US_gp	138.48 pass 457.8 124.757 pass 447.8 122.054 164.48 pass diverging



And for our next version

- Re-design look ahead to allow DD to model next 3 moves (stands)
- More flexible in tightly packed zones
- Can also follow current curve where design is simpler
- Links with Automation
- Automated drilling systems have a forward modelled well path
- Uses WITSML to populate look ahead from forward model
- Defined safeguards to ensure that modelled path relates to current survey depth



And after that? Are we done?

- We don't know
- Sharing of clearance data isn't defined by industry standards
 - The auto-clearance log could be transmitted and used in remote operations displays/monitoring systems, automation platforms and proof of clearances
- Can't make changes too quickly, because you don't know what's working
 - Feedback from operations takes time
 - The better it works the less chance there is for feedback
- But keep re-evaluating and keep up with changing needs



Thanks for listening

Questions?