TAM Software Features for Liquid Level Analysis

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Download the Session 15 PDF Bundle and TAM Example Data from
https://echometer.com/Support/AskEchometer

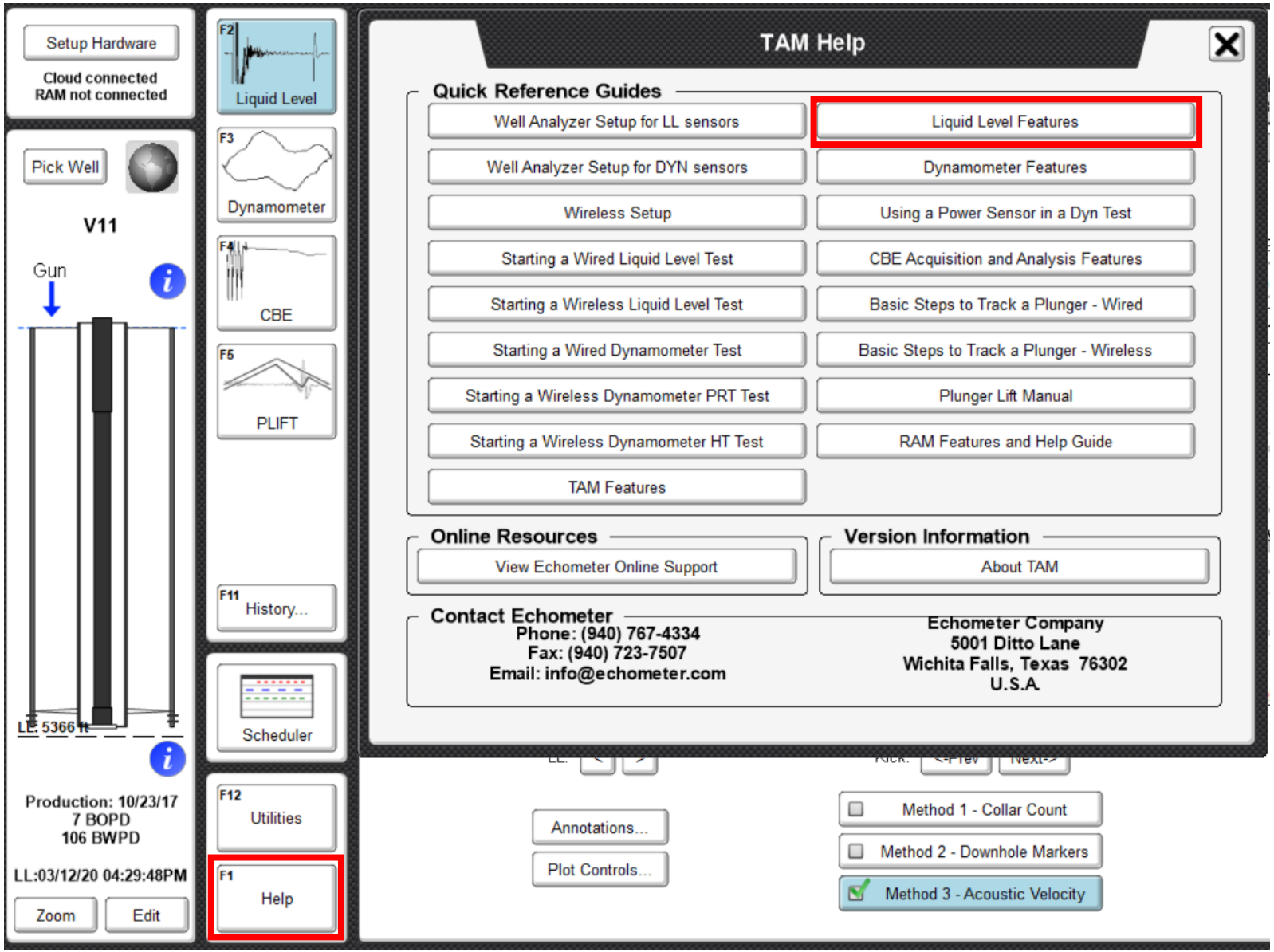
Objective

- To show users the several features/tools available in TAM software to perform a Liquid Level Analysis.

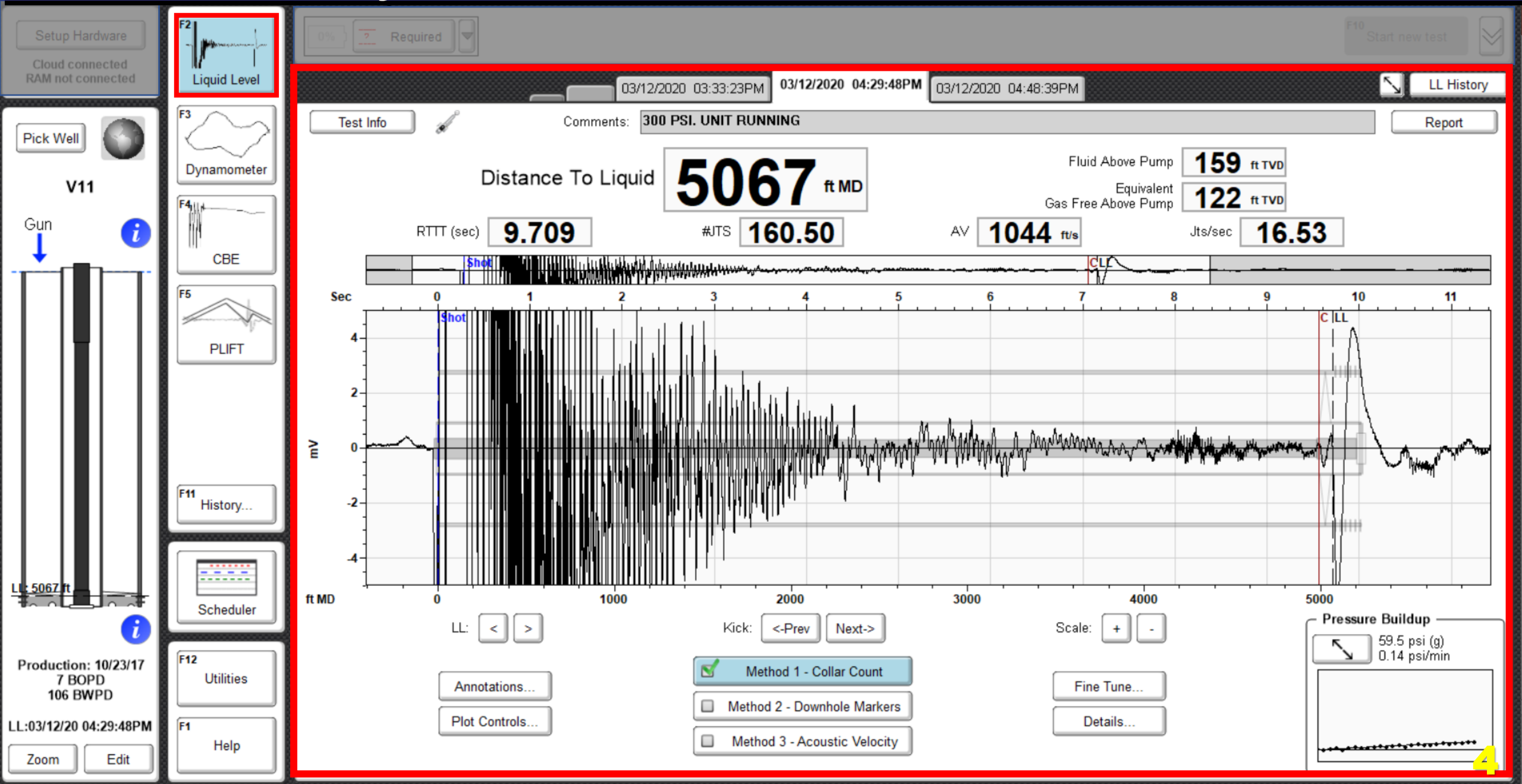
TAM Software version

- TAM 1.7.41 Release
- TAM 1.8 Development to include RAM support. Available soon.

Liquid Level Features document available in TAM Help



Main LL Analysis Window



Main LL Analysis Window

The primary ***Liquid Level (LL)*** analysis screen shows:

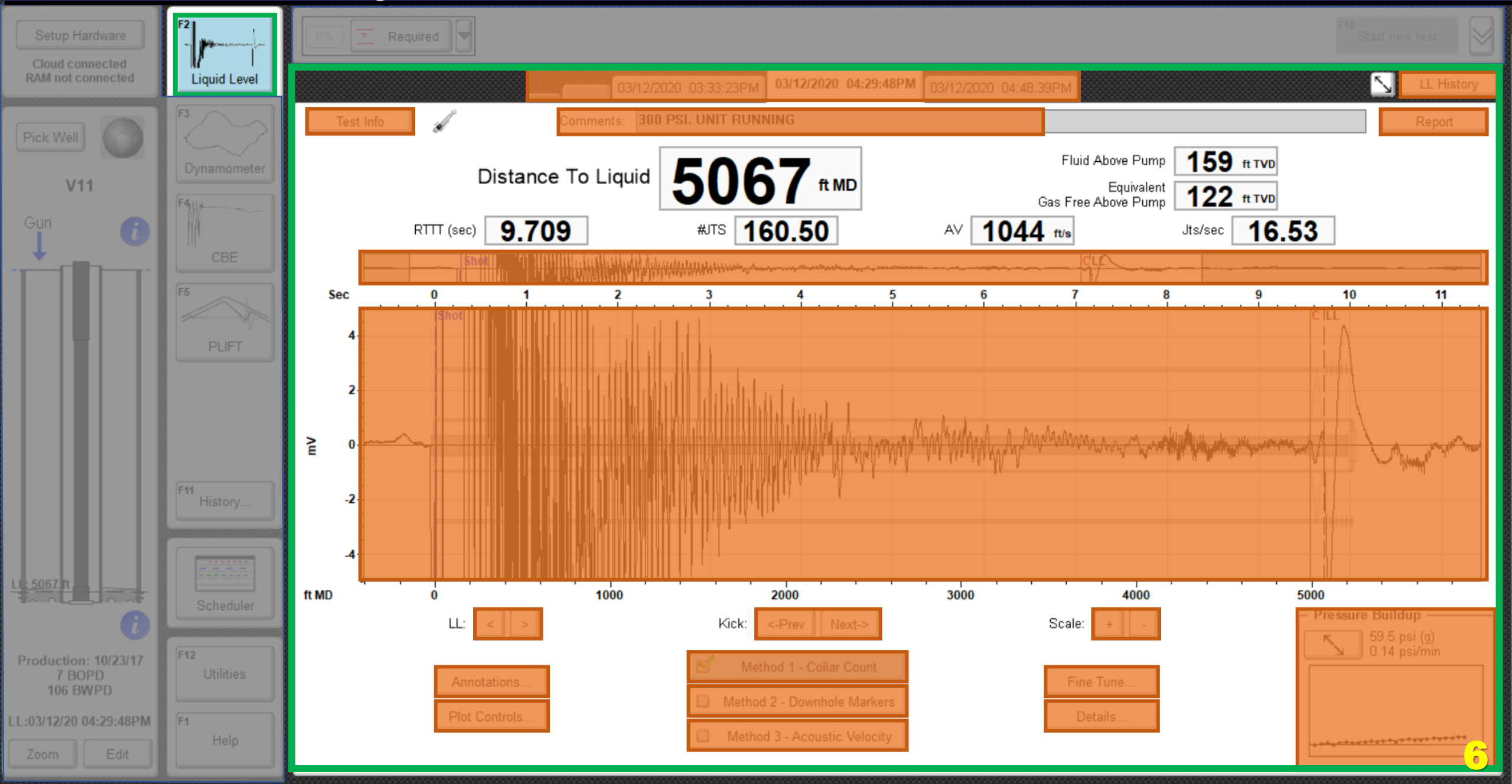
1. Top of the screen:

- History options, test information, and Liquid Level report
- Results
  - Distance to liquid
  - RTTT
  - Acoustic velocity
  - Fluid above pump
- Acoustic trace

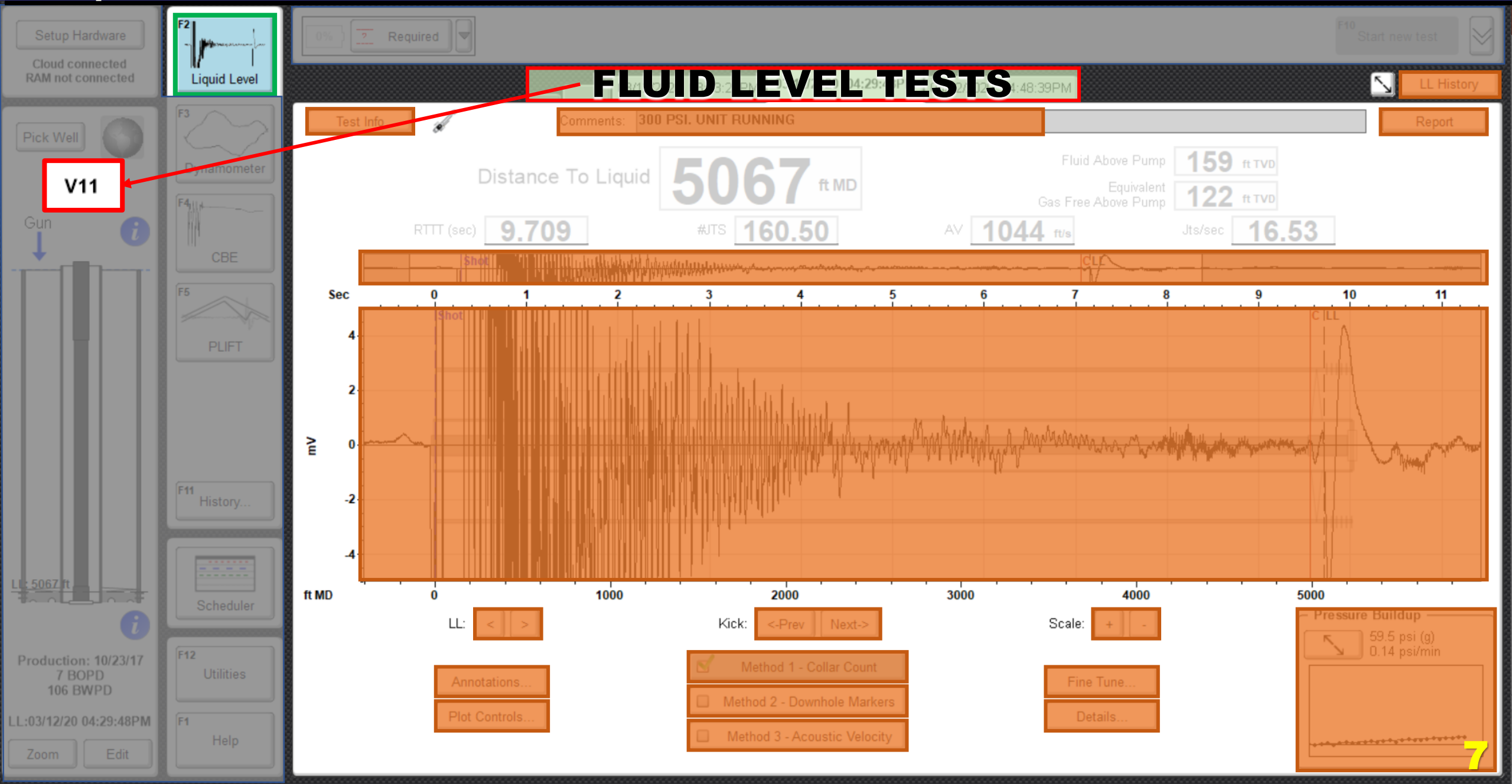
2. Left of the screen: a detailed wellbore schematic with the corresponding fluid distribution.

3. At the bottom of the screen: ***buttons used for plot modification and analysis updates.***

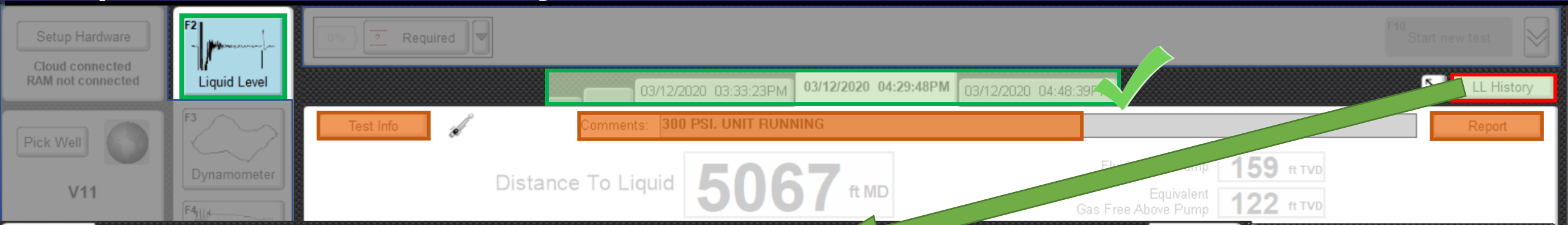
Main LL Analysis Window



Liquid Level Test Tabs



Liquid Level History



ACU Test History

☐ Thumbnails

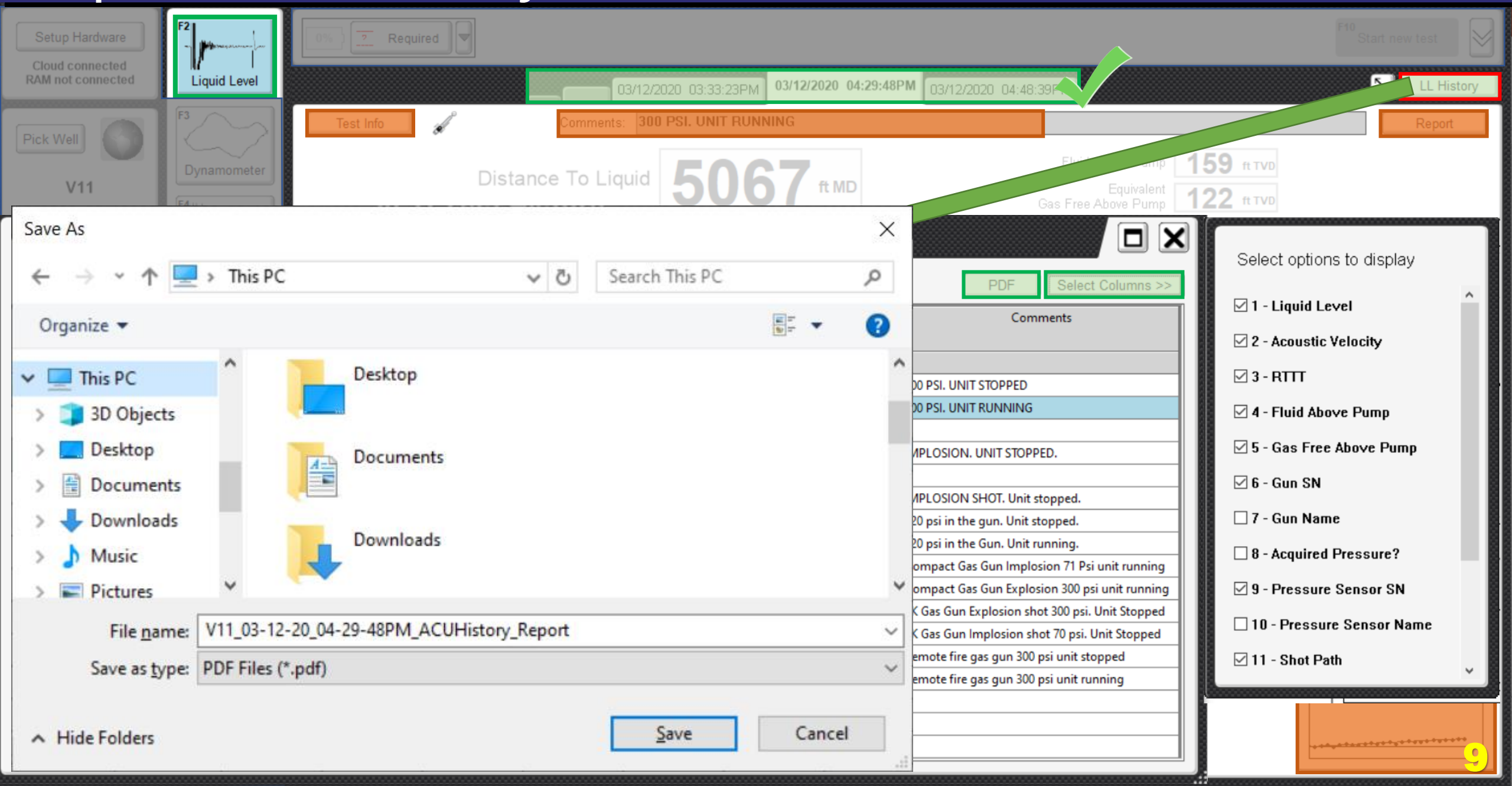
PDF | Select Columns >>

Time	LL	AV	RTTT	Fluid Above Pump	Gas Free Above Pu...	Gun SN	Pressure Sensor SN	Shot Path	Casing Pressure	Tubing Pressure	Buildup Rate	Gas Flow Rate	Comments
	ft	ft/s		ft	ft				psi (g)	psi (g)	psi/min	Mscf/D	
03/12/2020 04:48:39PM	5064	1046	9.687	162	122	WRFG MA...	WRFG MA...	Casing	59.8		0.16	3.6	300 PSI. UNIT STOPPED
03/12/2020 04:29:48PM	5067	1044	9.709	159	122	WRFG MA...	WRFG MA...	Casing	59.5		0.14	3.3	300 PSI. UNIT RUNNING
03/12/2020 03:33:23PM	5165	1050	9.842	61	37	IG 930	PT 17111	Casing	70.1		0.32	7.5	
03/12/2020 03:25:45PM	5139	1045	9.833	87	61	IG 930	PT 17111	Casing	68.4		0.22	5.2	IMPLOSION. UNIT STOPPED.
03/12/2020 03:02:13PM	5165	1048	9.858	61	52	CG 4593	PT 9498	Casing	69.6		0.07	1.7	
03/12/2020 02:55:25PM	5168	1048	9.861	58	39	CG 4593	PT 9498	Casing	68.7		0.25	5.9	IMPLOSION SHOT. Unit stopped.
03/12/2020 02:36:41PM	5159	1047	9.850	67	46	WG 3482	PT 9498	Casing	69.9		0.25	5.7	220 psi in the gun. Unit stopped.
03/12/2020 02:29:13PM	5175	1046	9.893	51	39	WG 3482	PT 9498	Casing	68.9		0.14	3.3	220 psi in the Gun. Unit running.
03/06/2020 03:30:07PM	5206	1055	9.870	20	20	CG 4593	PT 14655	Casing	71.0		-0.01	0.0	Compact Gas Gun Implosion 71 Psi unit running
03/06/2020 03:26:51PM	5199	1058	9.824	27	16	CG 4593	PT 14655	Casing	70.7		0.34	8.1	Compact Gas Gun Explosion 300 psi unit running
03/06/2020 03:10:56PM	5200	1058	9.826	26	14	IG 930	PT 17111	Casing	71.2		0.39	9.1	5K Gas Gun Explosion shot 300 psi. Unit Stopped
03/06/2020 03:06:42PM	5217	1058	9.859	9	7	IG 930	PT 17111	Casing	70.5		0.15	3.6	5K Gas Gun Implosion shot 70 psi. Unit Stopped
03/06/2020 02:53:41PM	5200	1059	9.819	26	17	WG 1317	PT 14239	Casing	70.9		0.27	6.3	Remote fire gas gun 300 psi unit stopped
03/06/2020 02:47:39PM	5161	1049	9.837	65	52	WG 1317	PT 14239	Casing	70.1		0.12	2.8	Remote fire gas gun 300 psi unit running
12/06/2017 12:37:54PM	5069	1041	9.742	157	127	WRFG 587	WRFG 587	Casing	74.3		0.11	2.4	
12/06/2017 11:43:32AM	5136	1044	9.841	90	62	CG 2221	PT 14239	Casing	89.3		0.22	5.2	
12/06/2017 11:39:28AM	5168	1046	9.884	58	40	CG 2221	PT 14239	Casing	88.3		0.23	5.3	

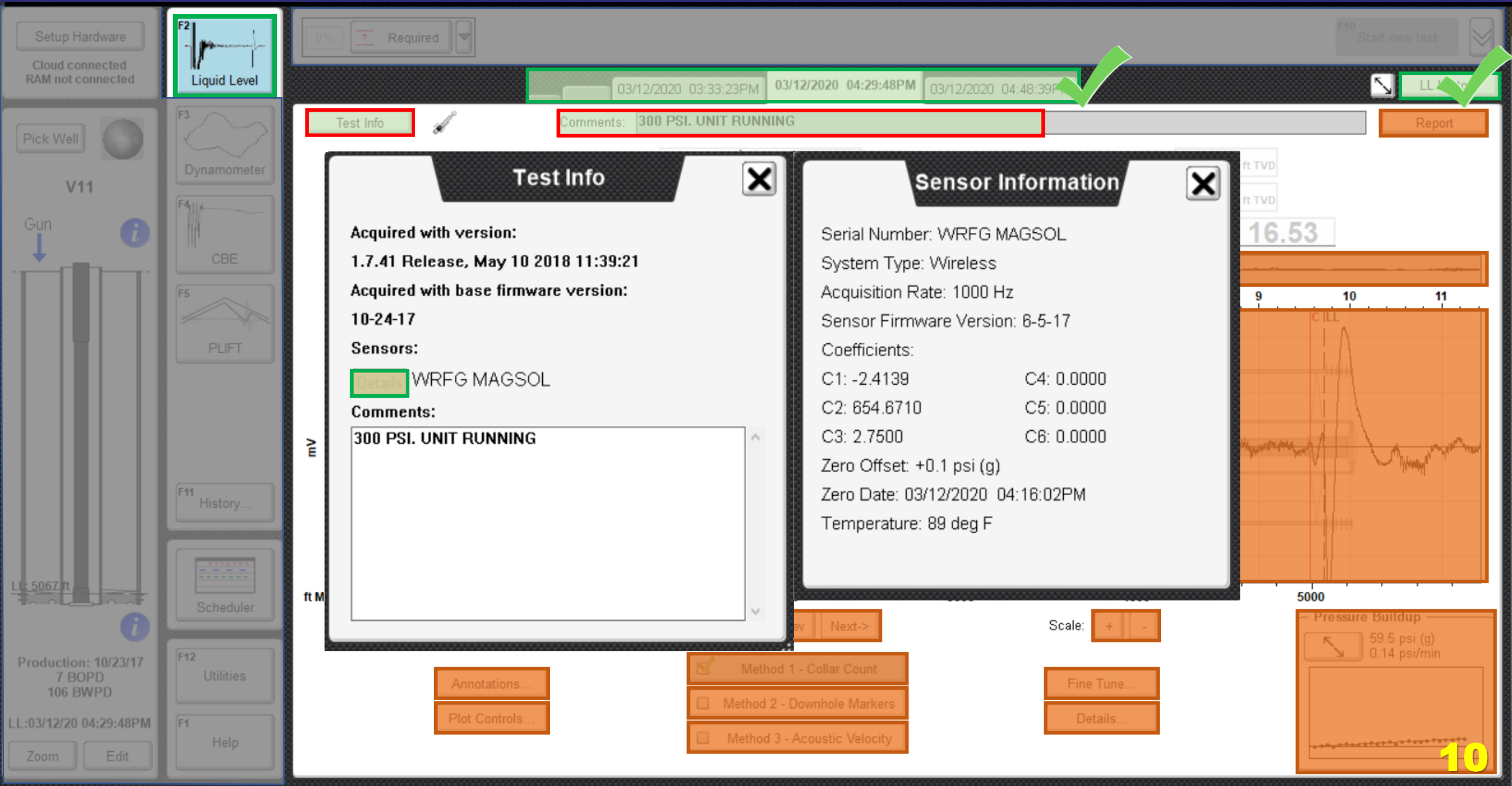
Select options to display

- ☑ 1 - Liquid Level
- ☑ 2 - Acoustic Velocity
- ☑ 3 - RTTT
- ☑ 4 - Fluid Above Pump
- ☑ 5 - Gas Free Above Pump
- ☑ 6 - Gun SN
- ☐ 7 - Gun Name
- ☐ 8 - Acquired Pressure?
- ☑ 9 - Pressure Sensor SN
- ☐ 10 - Pressure Sensor Name
- ☑ 11 - Shot Path

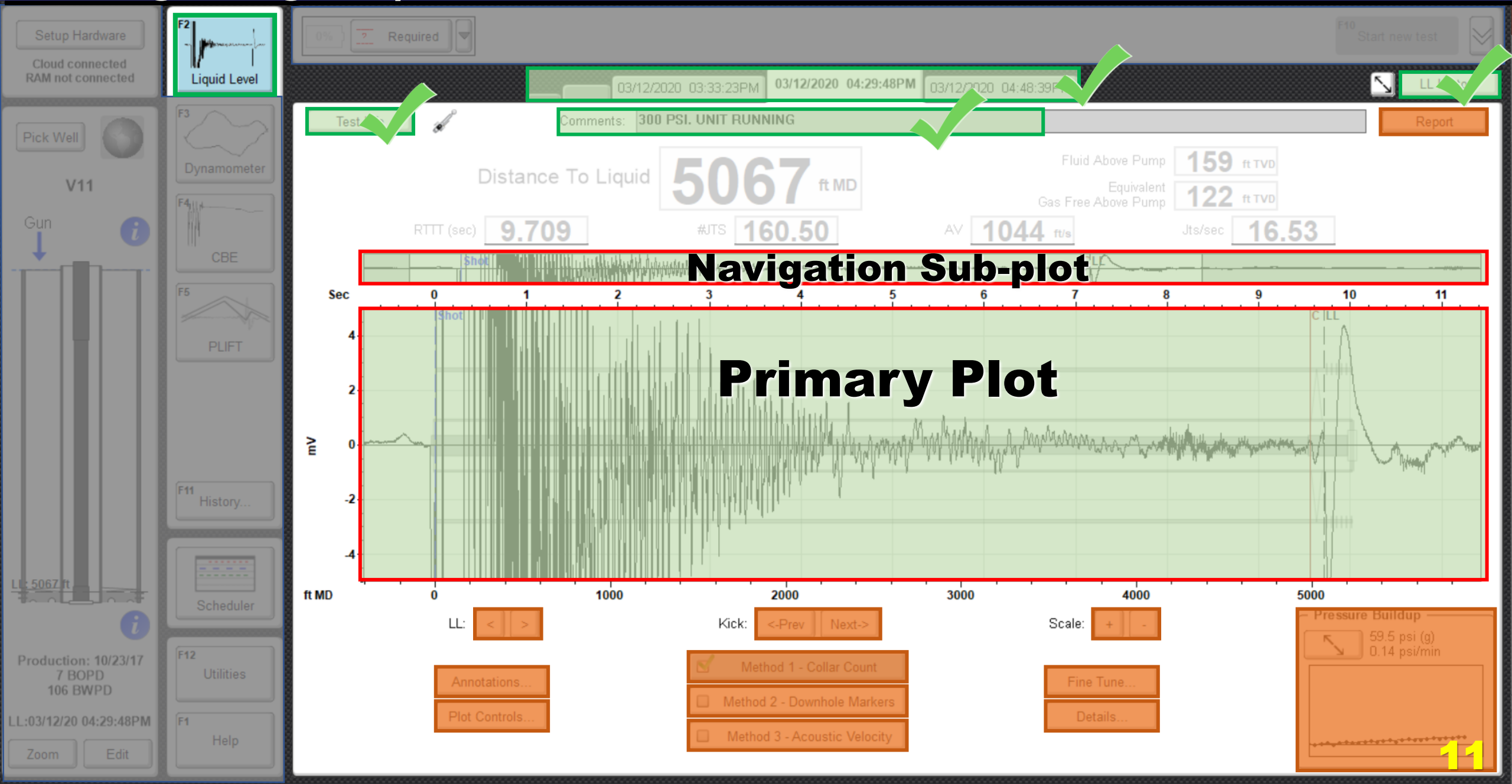
Liquid Level History



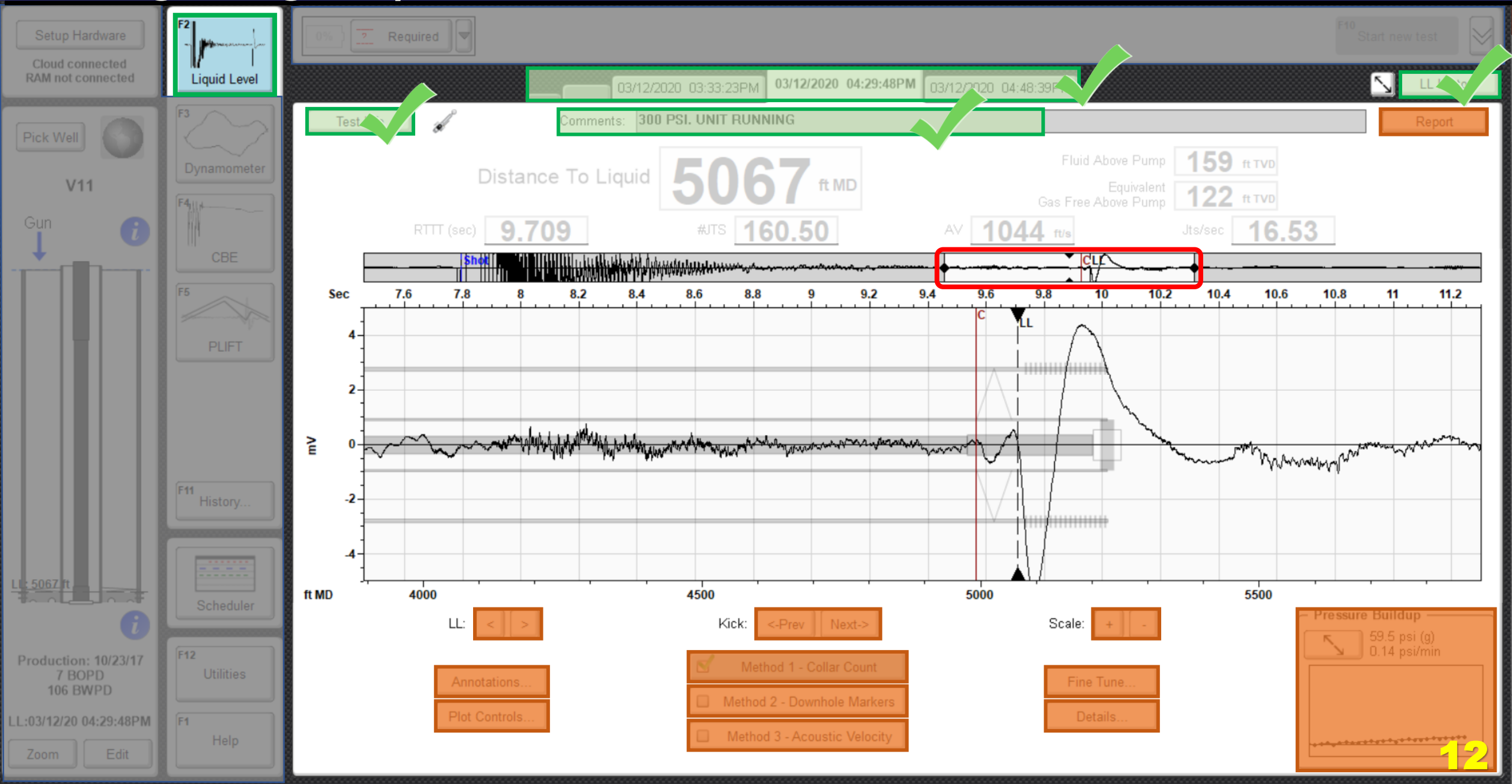
Test Info / Comments



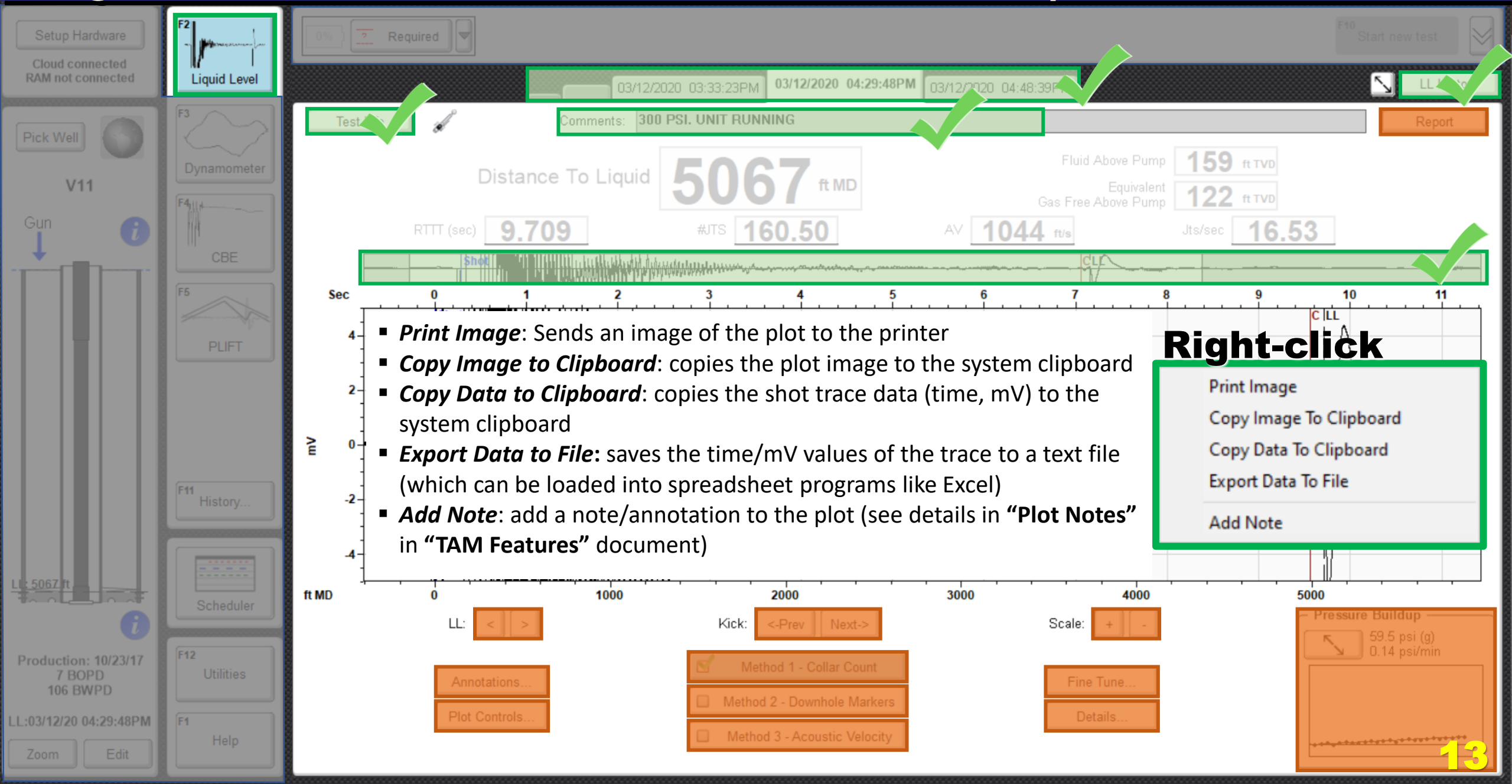
Navigating Liquid Level Plot



Navigating Liquid Level Plot

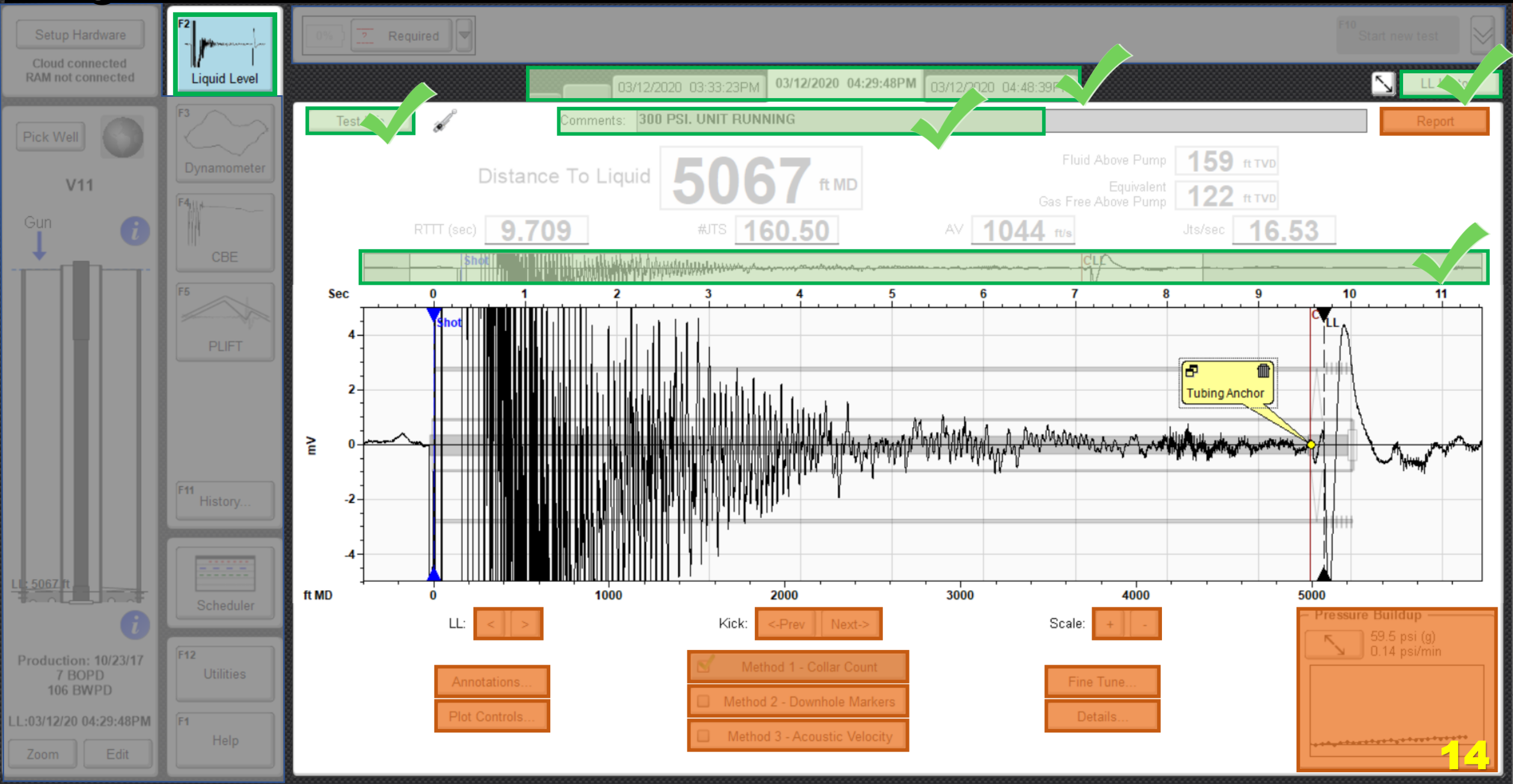


Right Click Menu - Additional LL Plot options

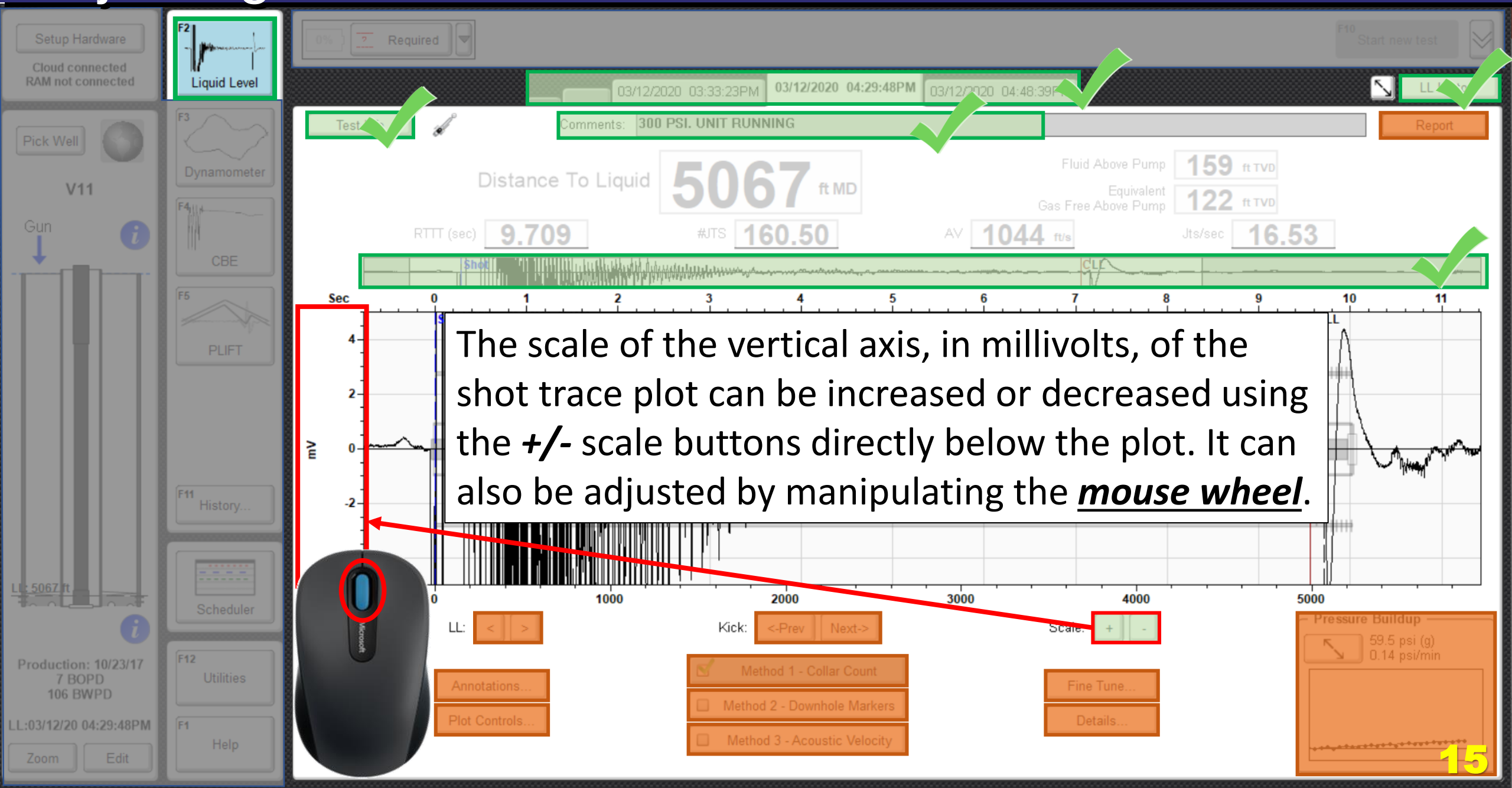


- ***Print Image***: Sends an image of the plot to the printer
- ***Copy Image to Clipboard***: copies the plot image to the system clipboard
- ***Copy Data to Clipboard***: copies the shot trace data (time, mV) to the system clipboard
- ***Export Data to File***: saves the time/mV values of the trace to a text file (which can be loaded into spreadsheet programs like Excel)
- ***Add Note***: add a note/annotation to the plot (see details in **"Plot Notes"** in **"TAM Features"** document)

Right Click Menu – Add Note

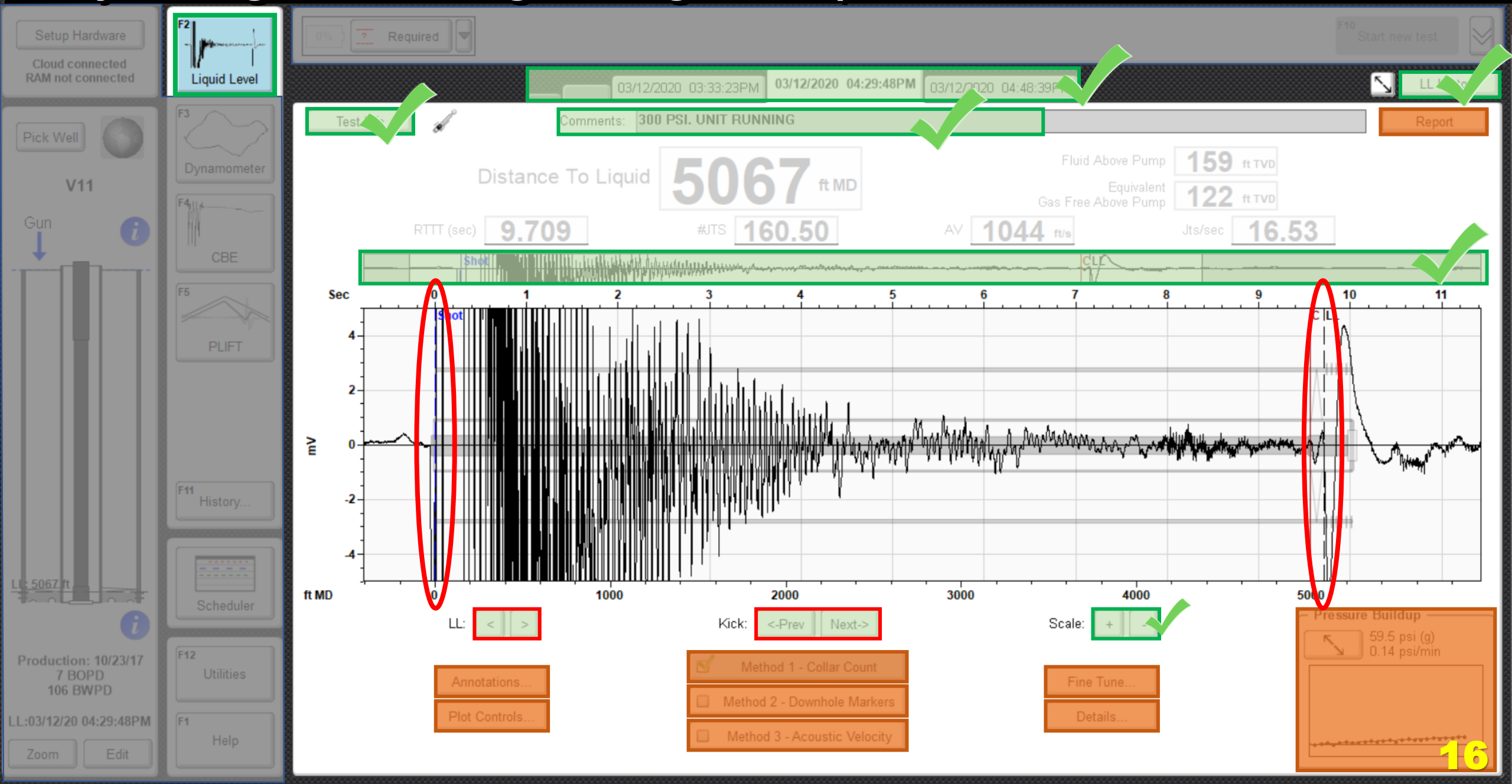


Adjusting Plot Scale



The scale of the vertical axis, in millivolts, of the shot trace plot can be increased or decreased using the ***+/-*** scale buttons directly below the plot. It can also be adjusted by manipulating the ***mouse wheel***.

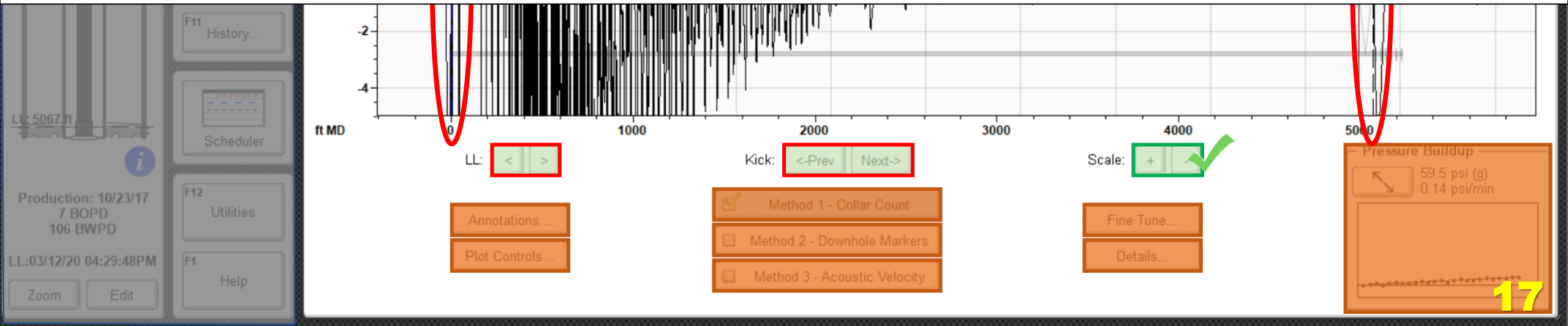
Adjusting Shot Beginning & Liquid Level



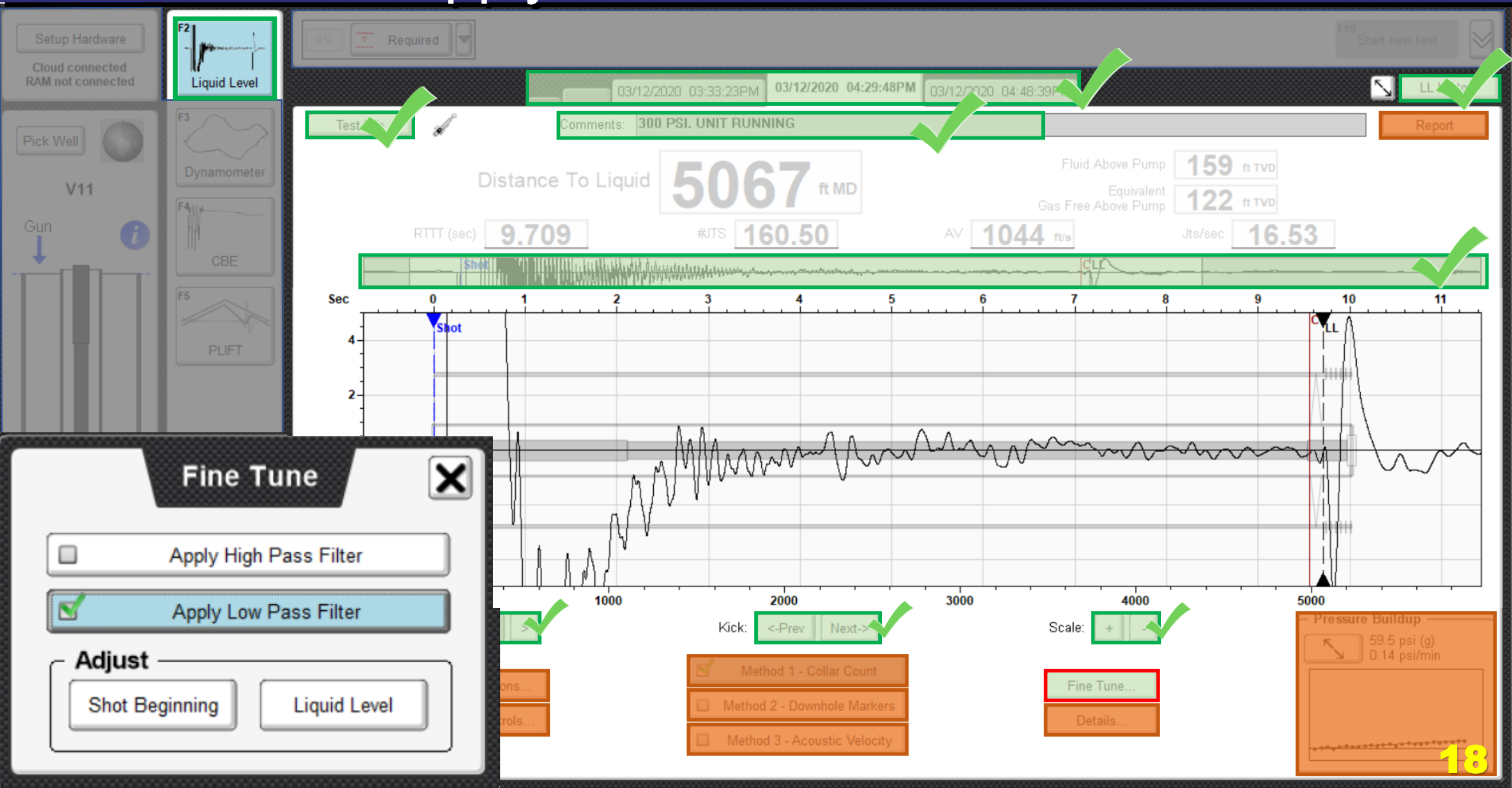
Adjusting Shot Beginning & Liquid Level

Both of these markers can be clicked and dragged to adjust their positions along the shot trace. After adjusting these markers, the liquid level distance calculation analysis is automatically re-run and new results will appear.

When multiple echoes, that satisfy the characteristics of a liquid level echo, are present, the user can investigate which echoes the software thinks that could also correspond to the liquid level by using the <- Prev and Next-> kick buttons directly below the plot. Clicking these buttons will cause the LL marker to jump to the other possible echoes. When such additional echoes are not present in the trace, the LL marker will not move. The user can refine the LL marker position by using the “<” and “>” buttons found just to the left of the kick candidate buttons

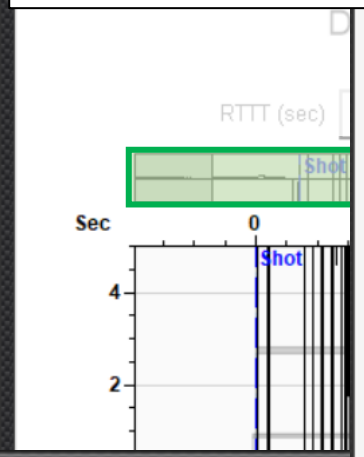


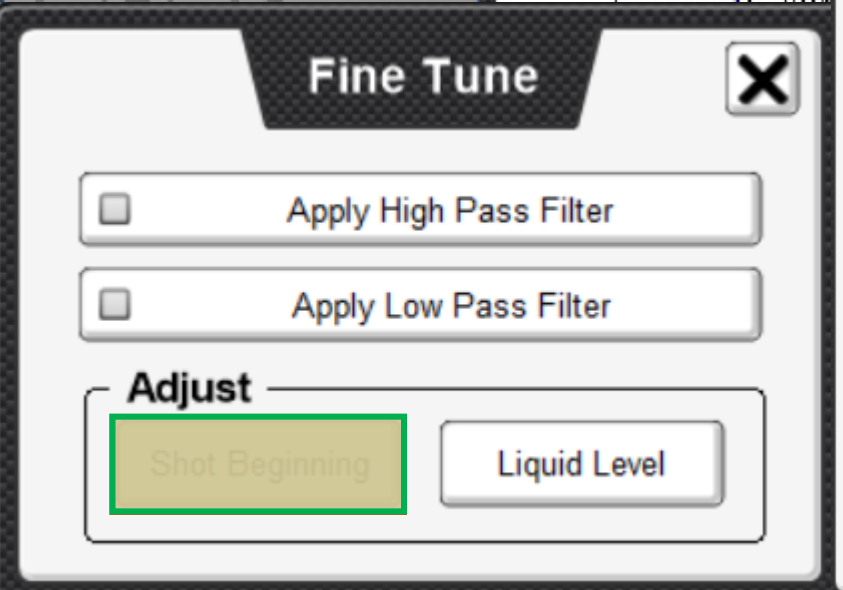
Fine Tune… / Apply Low Pass Filter

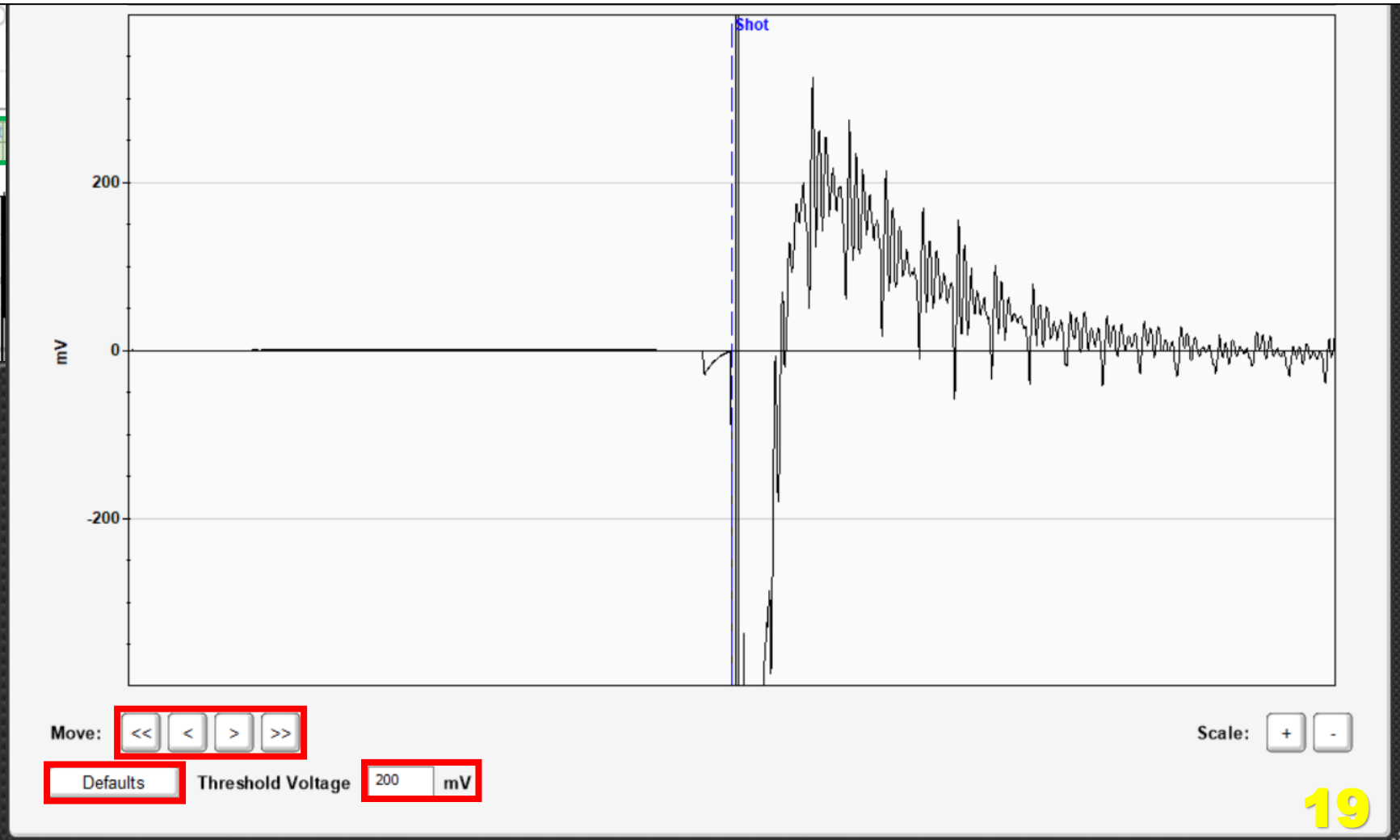


Fine Tune… / Adjust Shot Beginning

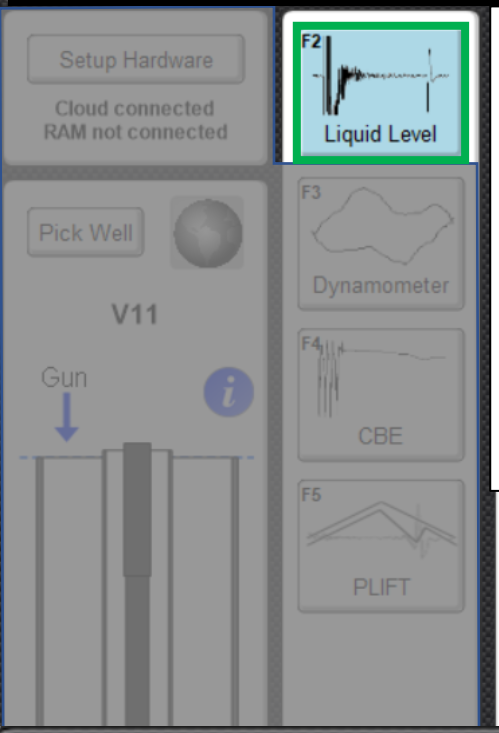
In very noisy wells, where the automatic shot detection fails to correctly locate the start of the pulse, rather than moving the shot beginning cursor manually, the user can adjust the threshold voltage used by TAM's automatic shot detection algorithm by editing the value in the ***Threshold Voltage*** box and pressing **Enter.**







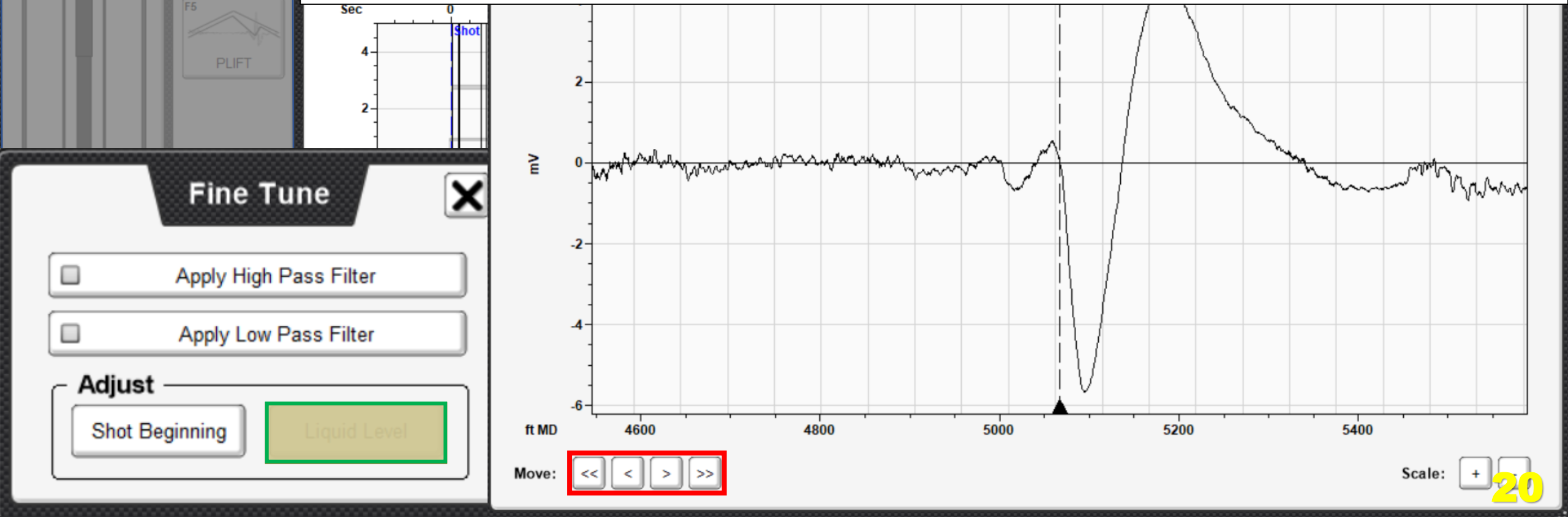
Fine Tune… / Adjust Liquid Level kick



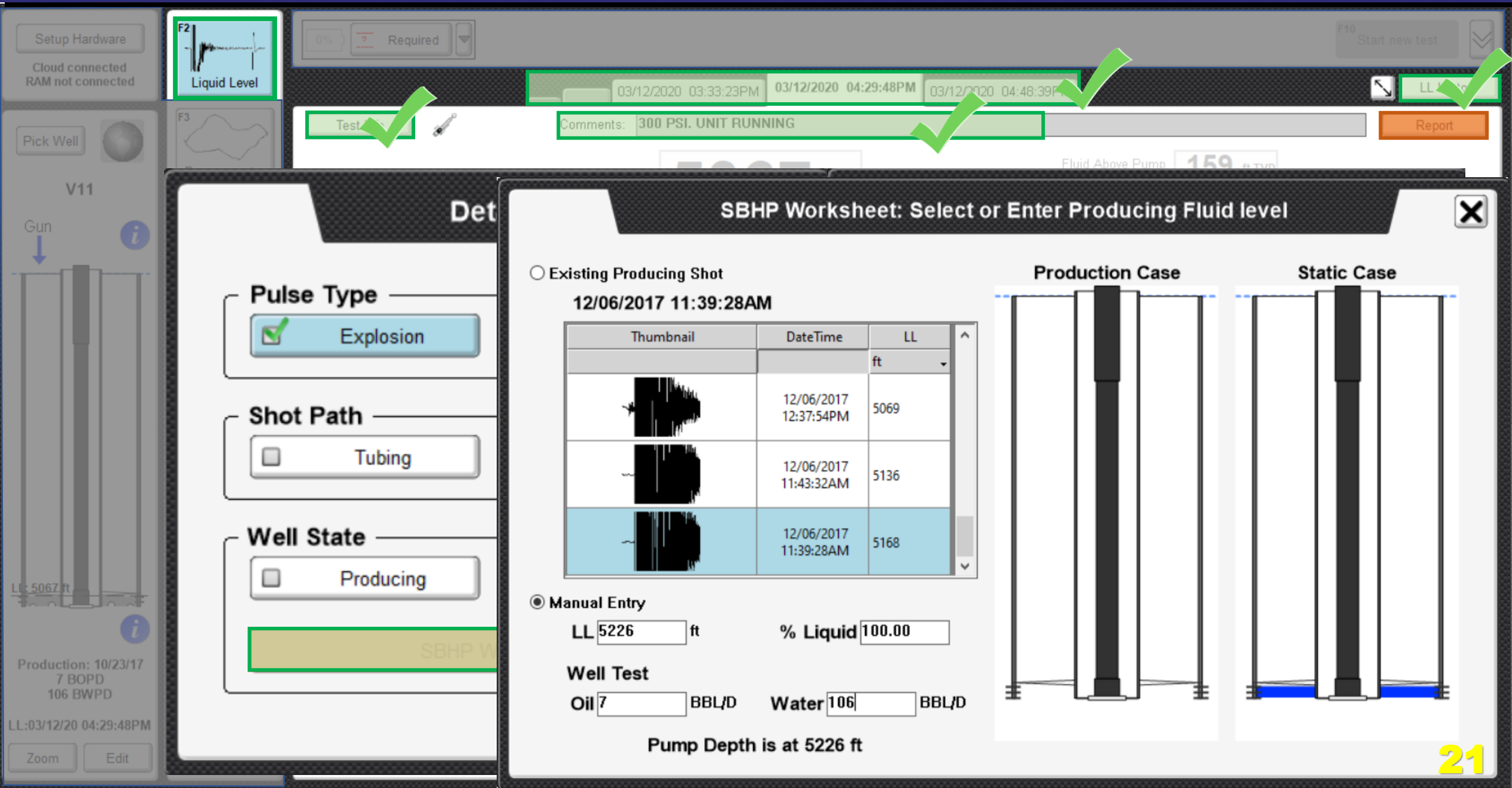
The ***Kick Selection*** panel shows a zoomed-in region around the current liquid level indicator.

The user can refine the cursor position by dragging it directly on the plot or by using the ***Move*** buttons in the bottom left-hand corner.

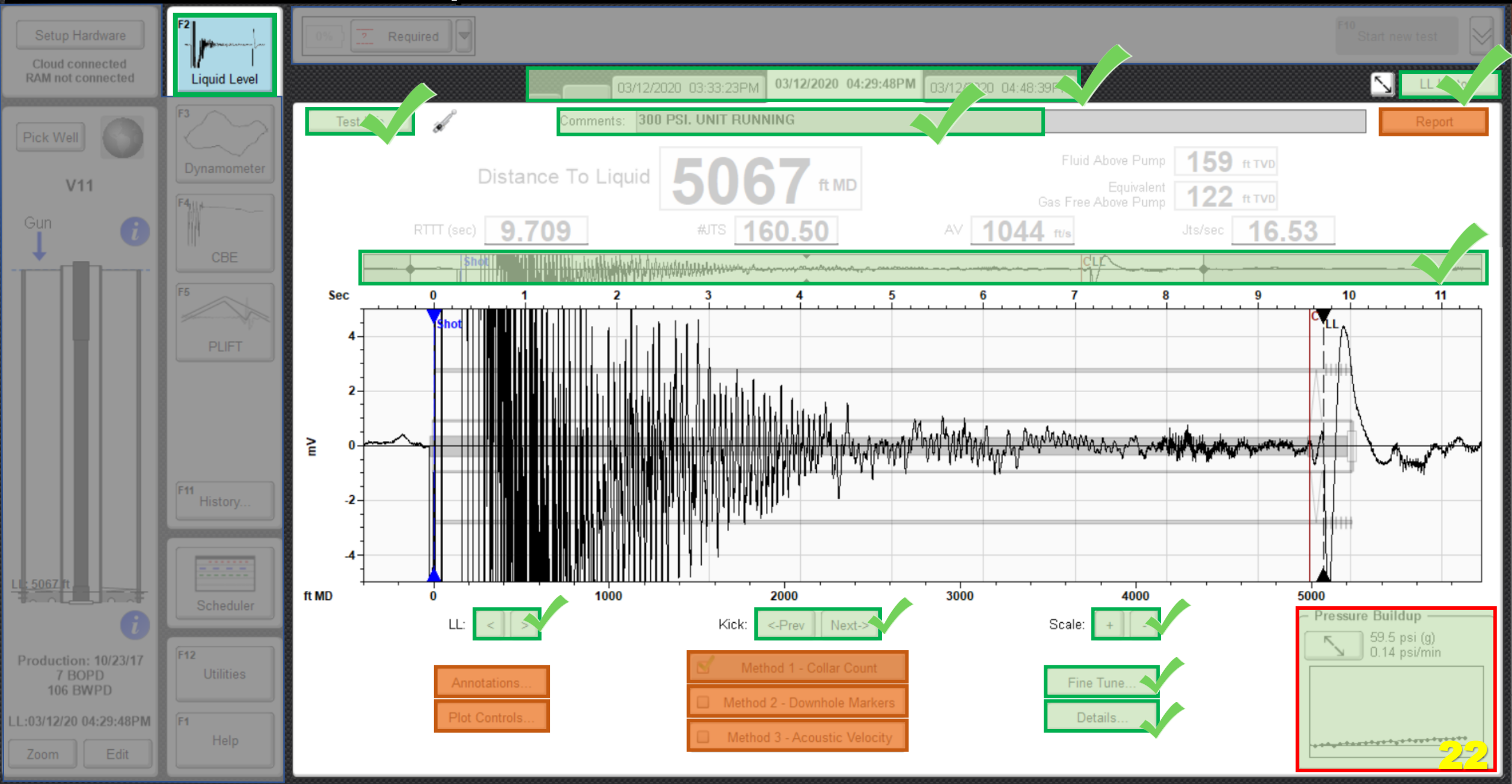
The ***Reset*** button at the top will return the ***LL*** indicator to the original time picked automatically by TAM.



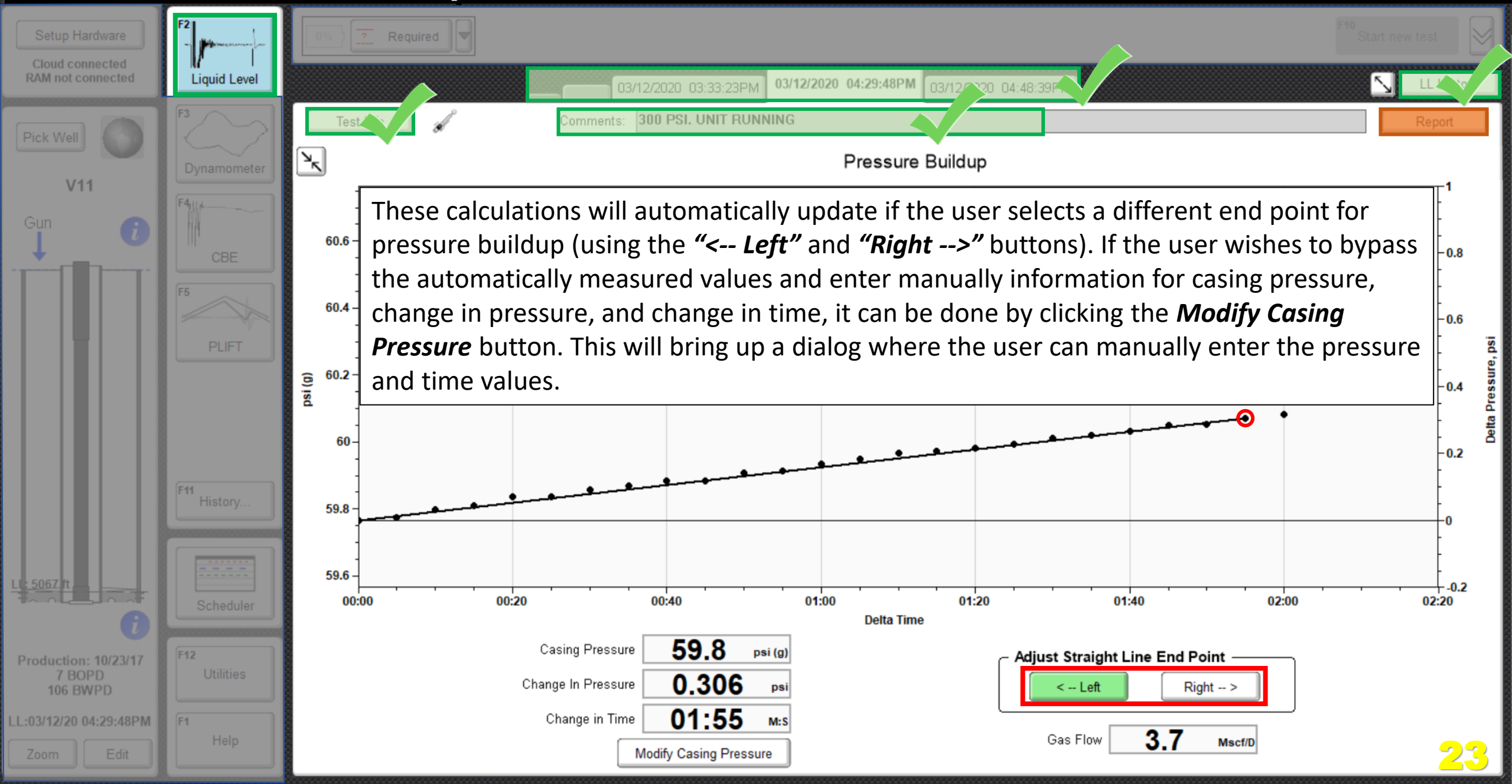
Details…


Setup Hardware
Cloud connected
RAM not connected
Liquid Level
Required
Start new test
03/12/2020 03:33:23PM
03/12/2020 04:29:48PM
Test
Comments: 300 PSI. UNIT RUNNING
Report
Fluid Above Pump
Pick Well
V11
Gun
Production: 10/23/17
7 BOPD
106 BWPD
LL:03/12/20 04:29:48PM
Zoom
Edit
Pulse Type
Explosion
Shot Path
Tubing
Well State
Producing
SBHP Worksheet: Select or Enter Producing Fluid level
Existing Producing Shot
12/06/2017 11:39:28AM
Thumbnail
DateTime
LL
ft
12/06/2017 12:37:54PM
5069
12/06/2017 11:43:32AM
5136
12/06/2017 11:39:28AM
5168
Manual Entry
LL 5226 ft
% Liquid 100.00
Well Test
Oil 7 BBL/D
Water 106 BBL/D
Pump Depth is at 5226 ft
Production Case
Static Case
21

Pressure Buildup



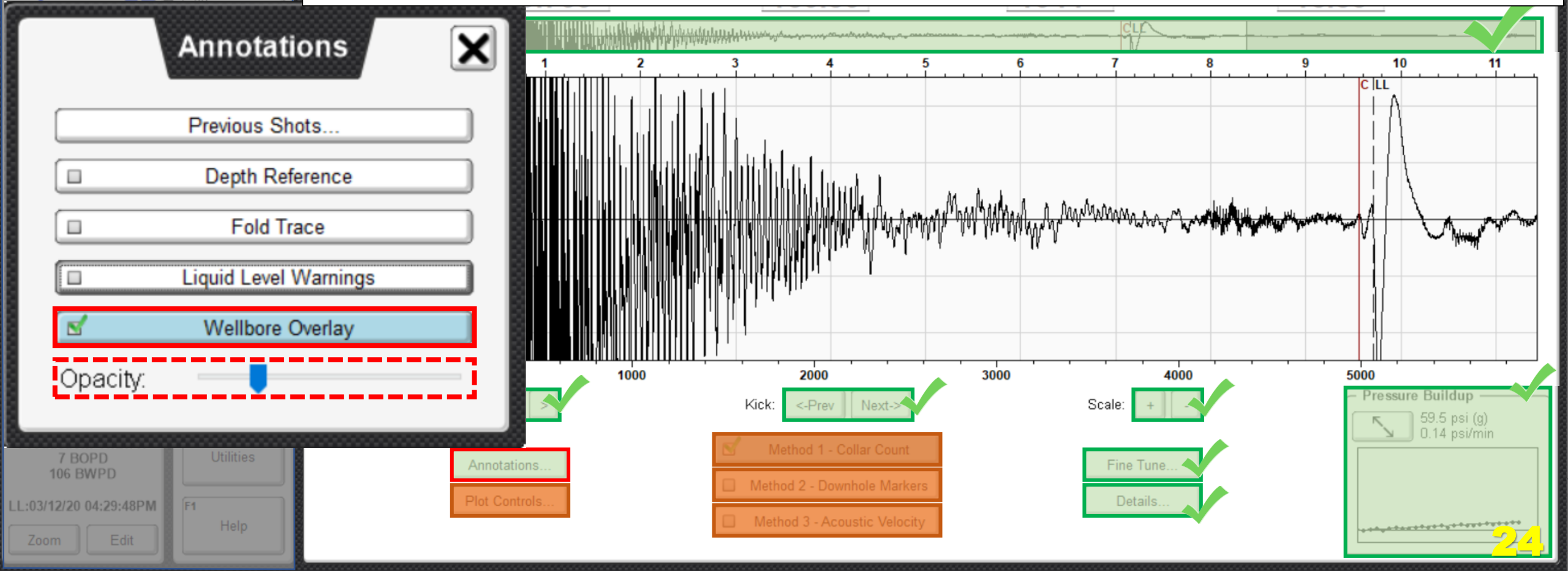
Pressure Buildup



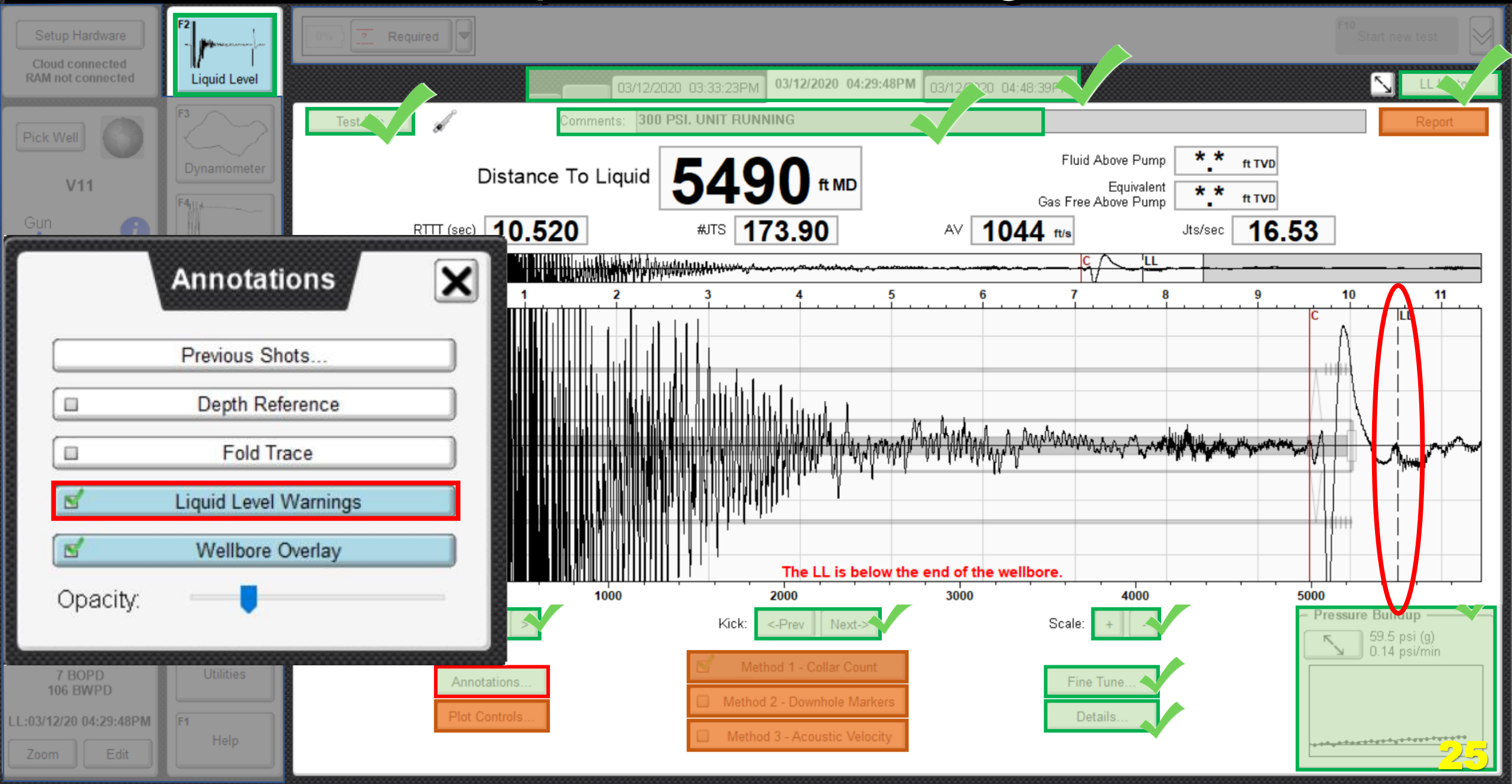
These calculations will automatically update if the user selects a different end point for pressure buildup (using the ***"<-- Left"*** and ***"Right -->"*** buttons). If the user wishes to bypass the automatically measured values and enter manually information for casing pressure, change in pressure, and change in time, it can be done by clicking the ***Modify Casing Pressure*** button. This will bring up a dialog where the user can manually enter the pressure and time values.

Annotations… / Wellbore Overlay

The wellbore details shown on the wellbore schematic at the left of the screen can be displayed on the acoustic trace.
The user will see a semi-transparent image of the well diagram on top of the acoustic trace and its opacity can be adjusted using the ***Opacity*** slider.



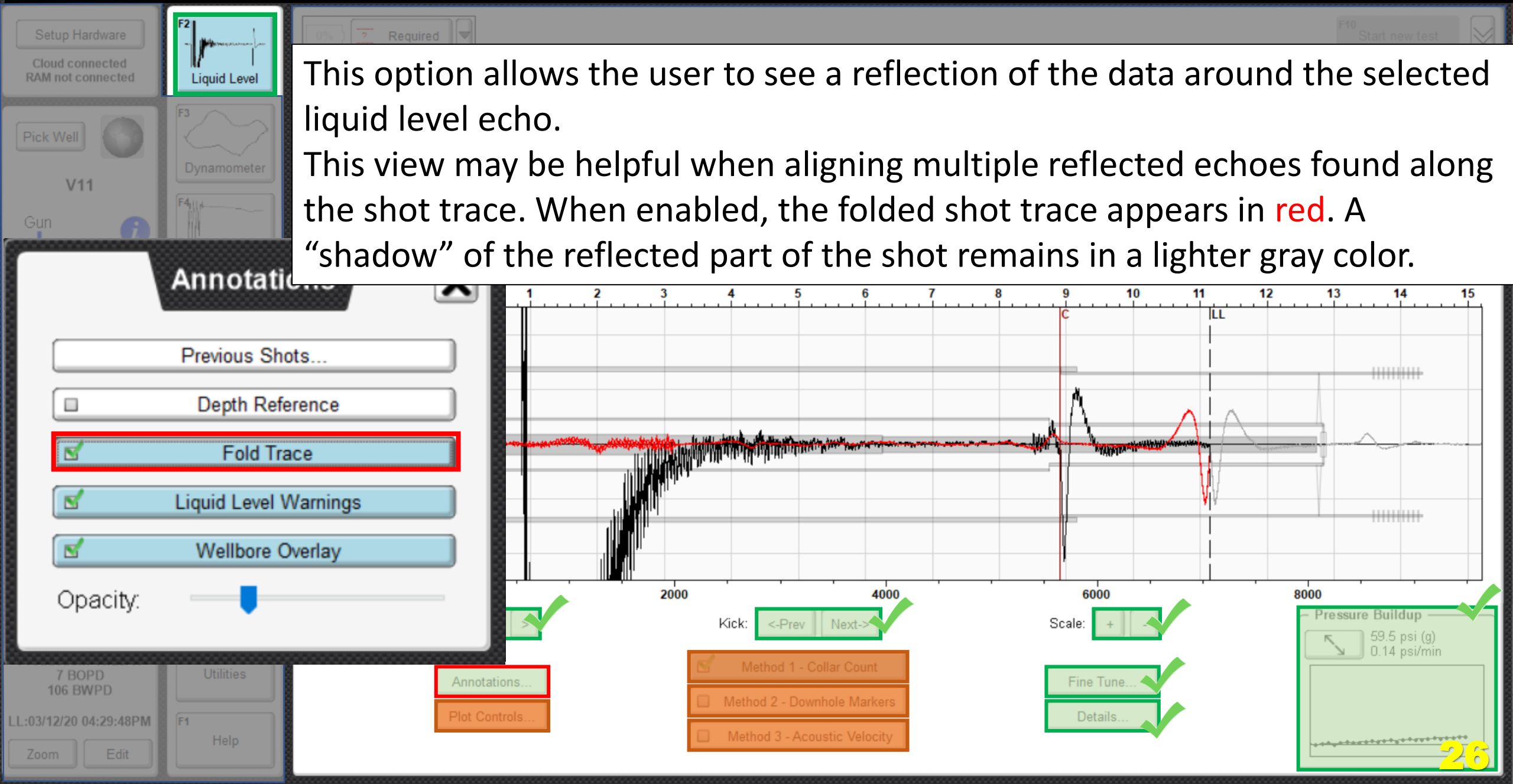
Annotations… / Liquid Level Warnings



Annotations… / Fold Trace

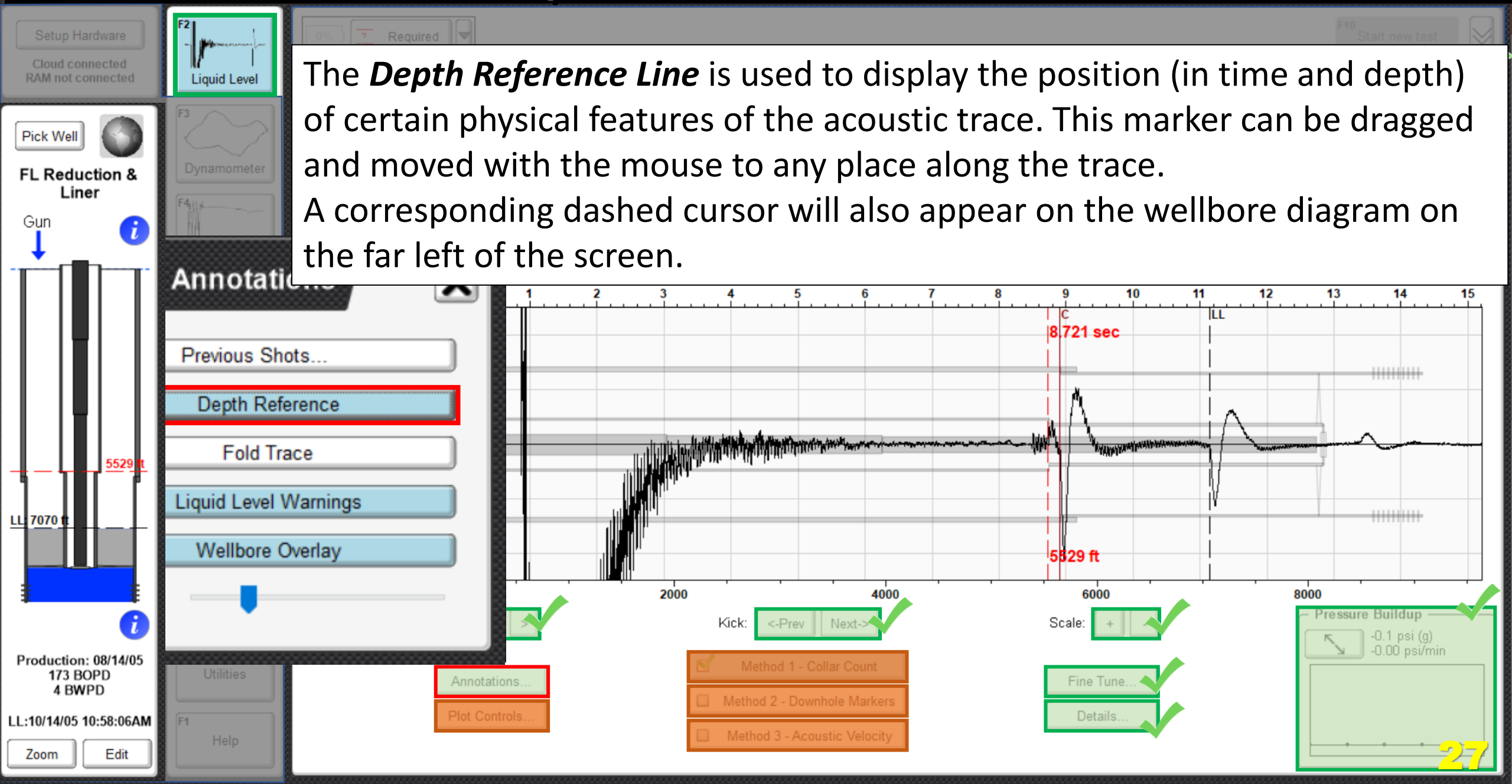
This option allows the user to see a reflection of the data around the selected liquid level echo.

This view may be helpful when aligning multiple reflected echoes found along the shot trace. When enabled, the folded shot trace appears in red. A "shadow" of the reflected part of the shot remains in a lighter gray color.

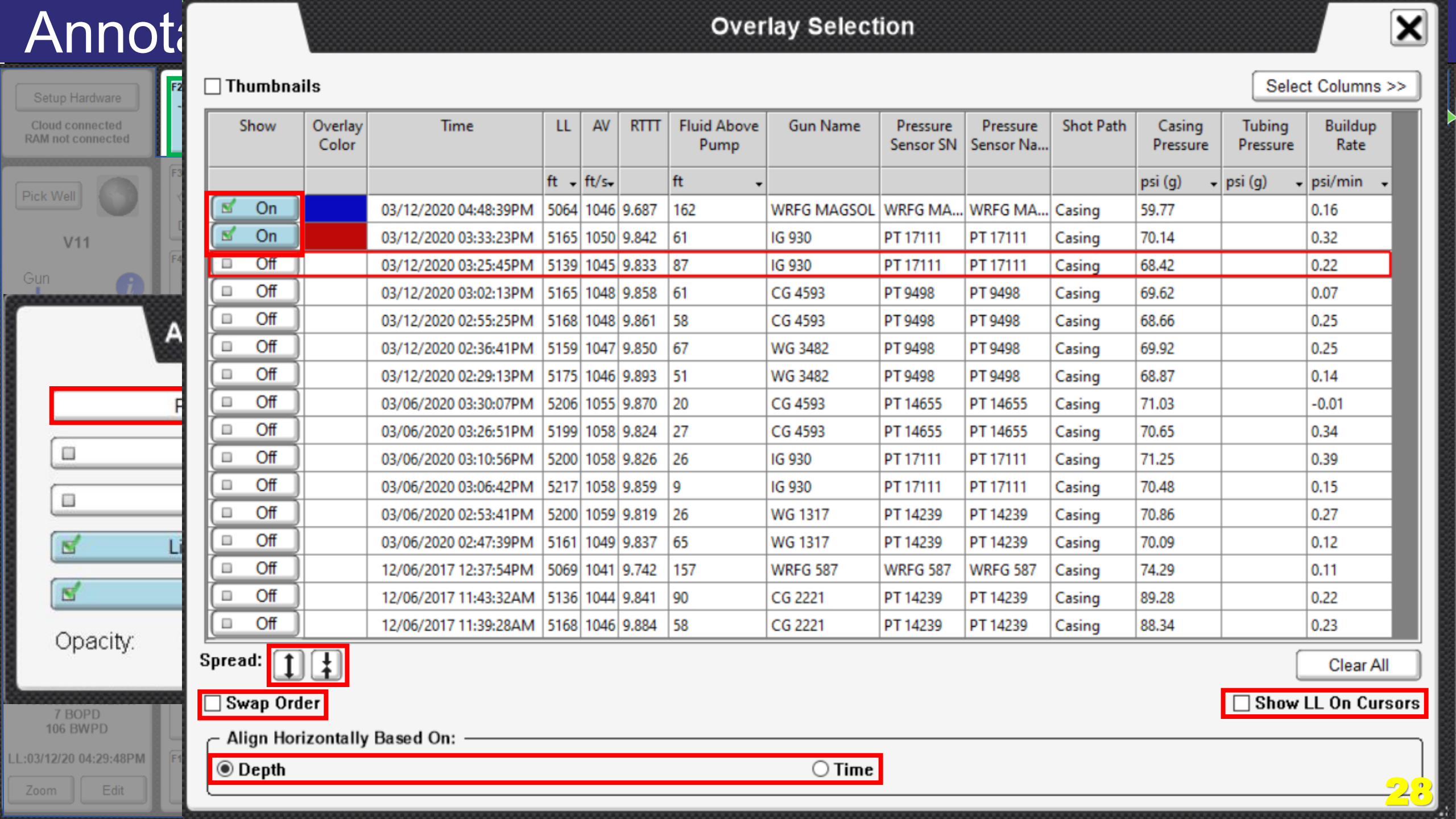


Annotations… / Depth Reference Line

The ***Depth Reference Line*** is used to display the position (in time and depth) of certain physical features of the acoustic trace. This marker can be dragged and moved with the mouse to any place along the trace.
A corresponding dashed cursor will also appear on the wellbore diagram on the far left of the screen.

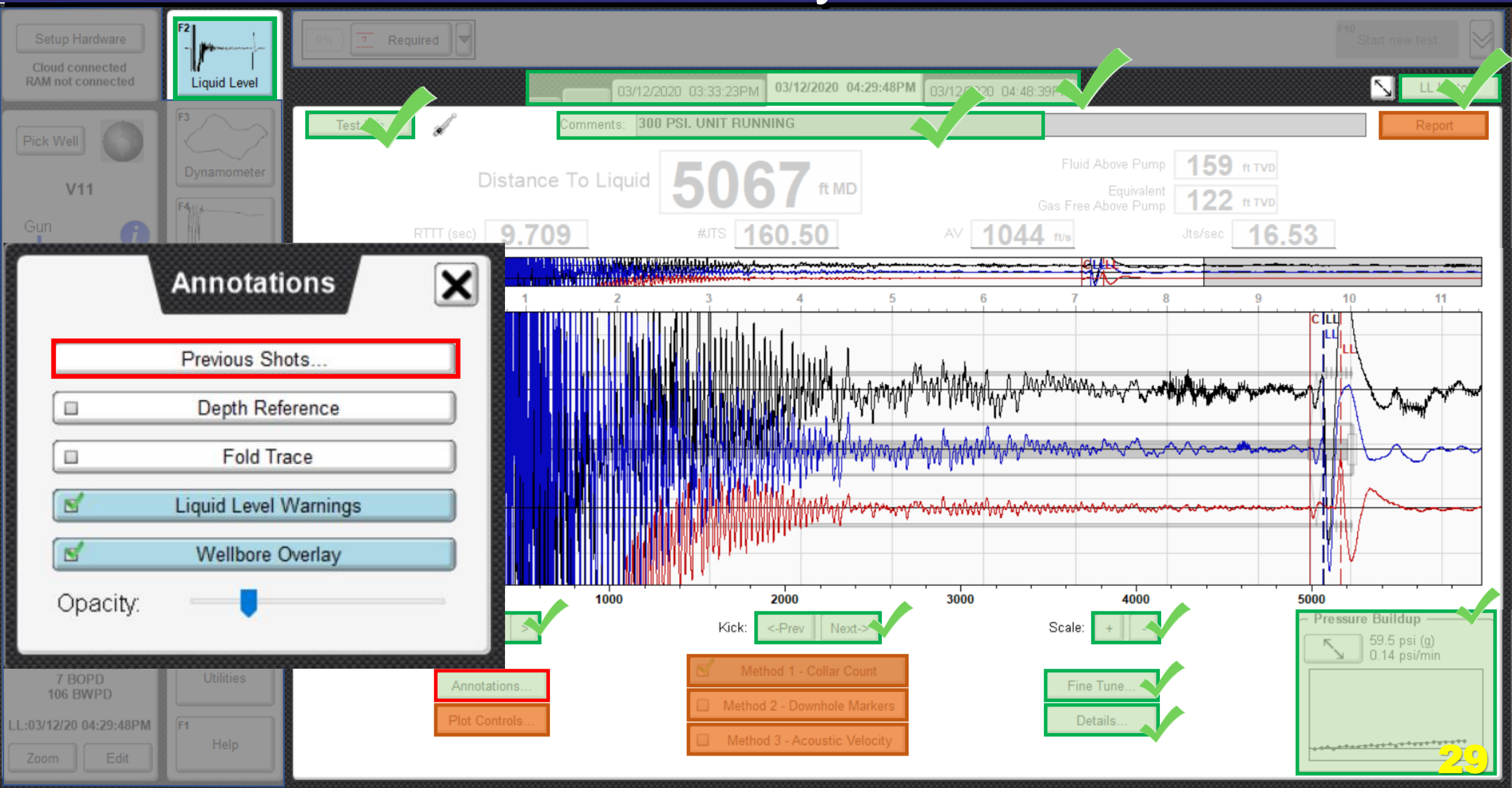


Annota



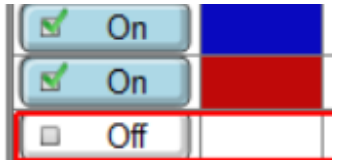
Show	Overlay Color	Time	LL	AV	RTTT	Fluid Above Pump	Gun Name	Pressure Sensor SN	Pressure Sensor Na...	Shot Path	Casing Pressure	Tubing Pressure	Buildup Rate
			ft	ft/s		ft					psi (g)	psi (g)	psi/min
On		03/12/2020 04:48:39PM	5064	1046	9.687	162	WRFG MAGSOL	WRFG MA...	WRFG MA...	Casing	59.77		0.16
On		03/12/2020 03:33:23PM	5165	1050	9.842	61	IG 930	PT 17111	PT 17111	Casing	70.14		0.32
Off		03/12/2020 03:25:45PM	5139	1045	9.833	87	IG 930	PT 17111	PT 17111	Casing	68.42		0.22
Off		03/12/2020 03:02:13PM	5165	1048	9.858	61	CG 4593	PT 9498	PT 9498	Casing	69.62		0.07
Off		03/12/2020 02:55:25PM	5168	1048	9.861	58	CG 4593	PT 9498	PT 9498	Casing	68.66		0.25
Off		03/12/2020 02:36:41PM	5159	1047	9.850	67	WG 3482	PT 9498	PT 9498	Casing	69.92		0.25
Off		03/12/2020 02:29:13PM	5175	1046	9.893	51	WG 3482	PT 9498	PT 9498	Casing	68.87		0.14
Off		03/06/2020 03:30:07PM	5206	1055	9.870	20	CG 4593	PT 14655	PT 14655	Casing	71.03		-0.01
Off		03/06/2020 03:26:51PM	5199	1058	9.824	27	CG 4593	PT 14655	PT 14655	Casing	70.65		0.34
Off		03/06/2020 03:10:56PM	5200	1058	9.826	26	IG 930	PT 17111	PT 17111	Casing	71.25		0.39
Off		03/06/2020 03:06:42PM	5217	1058	9.859	9	IG 930	PT 17111	PT 17111	Casing	70.48		0.15
Off		03/06/2020 02:53:41PM	5200	1059	9.819	26	WG 1317	PT 14239	PT 14239	Casing	70.86		0.27
Off		03/06/2020 02:47:39PM	5161	1049	9.837	65	WG 1317	PT 14239	PT 14239	Casing	70.09		0.12
Off		12/06/2017 12:37:54PM	5069	1041	9.742	157	WRFG 587	WRFG 587	WRFG 587	Casing	74.29		0.11
Off		12/06/2017 11:43:32AM	5136	1044	9.841	90	CG 2221	PT 14239	PT 14239	Casing	89.28		0.22
Off		12/06/2017 11:39:28AM	5168	1046	9.884	58	CG 2221	PT 14239	PT 14239	Casing	88.34		0.23

Annotations… / Trace Overlays



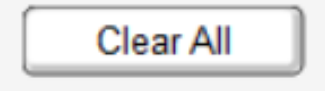
Annotations… / Trace Overlays

- ***Previous Shot*** opens an additional dialog that allows selecting up to five overlays from existing acoustic tests, for the specific well, and plotting them simultaneously with the trace being analyzed.



- Traces for overlay are enabled or disabled by clicking the corresponding ***On/Off*** buttons in the ***Overlay Selection*** table.

- Clicking on one of the two ***Spread*** buttons will increase or decrease the vertical spread between the center lines of each trace.



- The ***Clear All*** button will deselect all traces currently turned on.

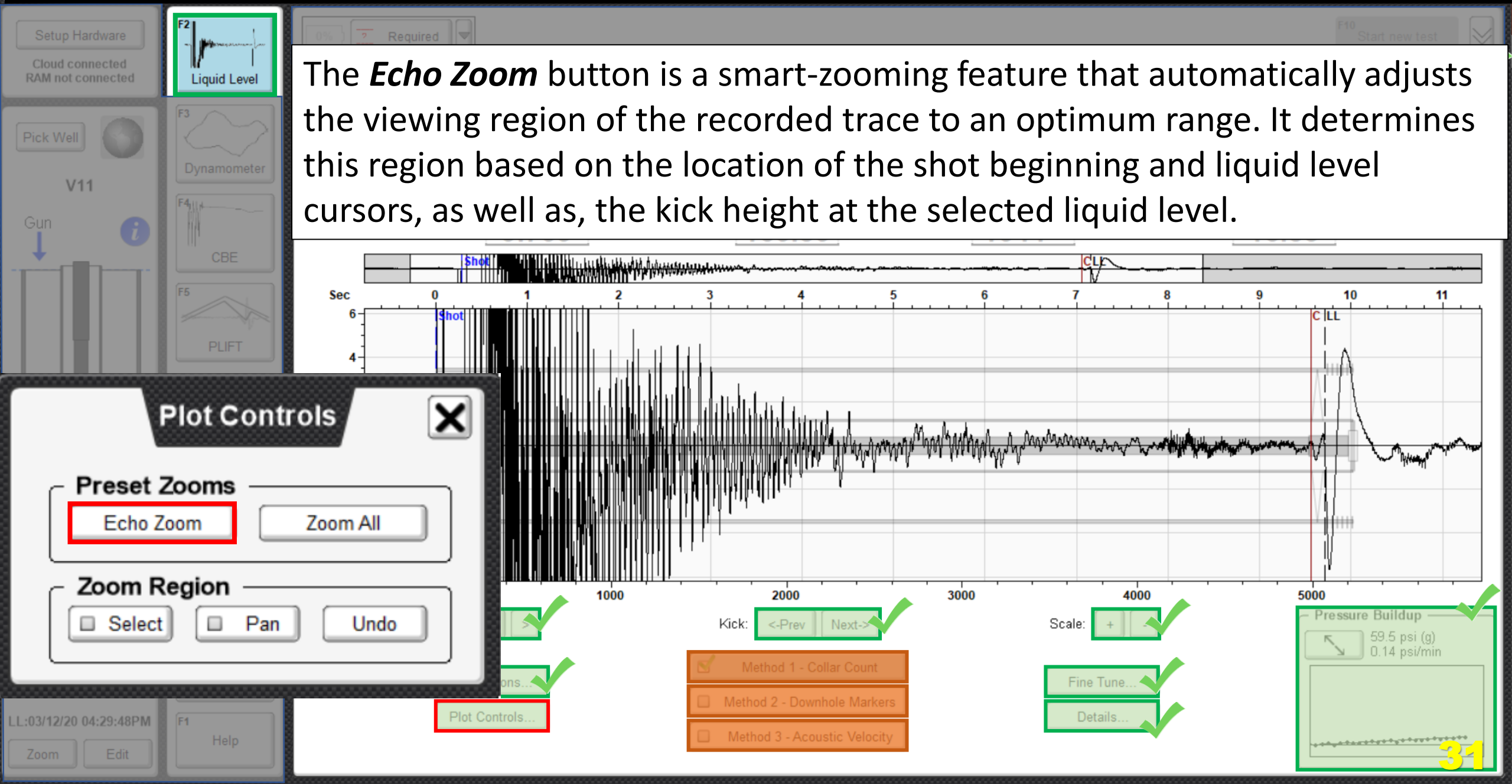
- The ***Swap Order*** button inverts the position of overlays relative to the current trace

- ***Show LL On Cursors*** displays the liquid level depth for the overlays on their ***LL*** cursors.

- The user also has the option of lining up overlays based on ***Depth*** (default) or based on ***Time***.

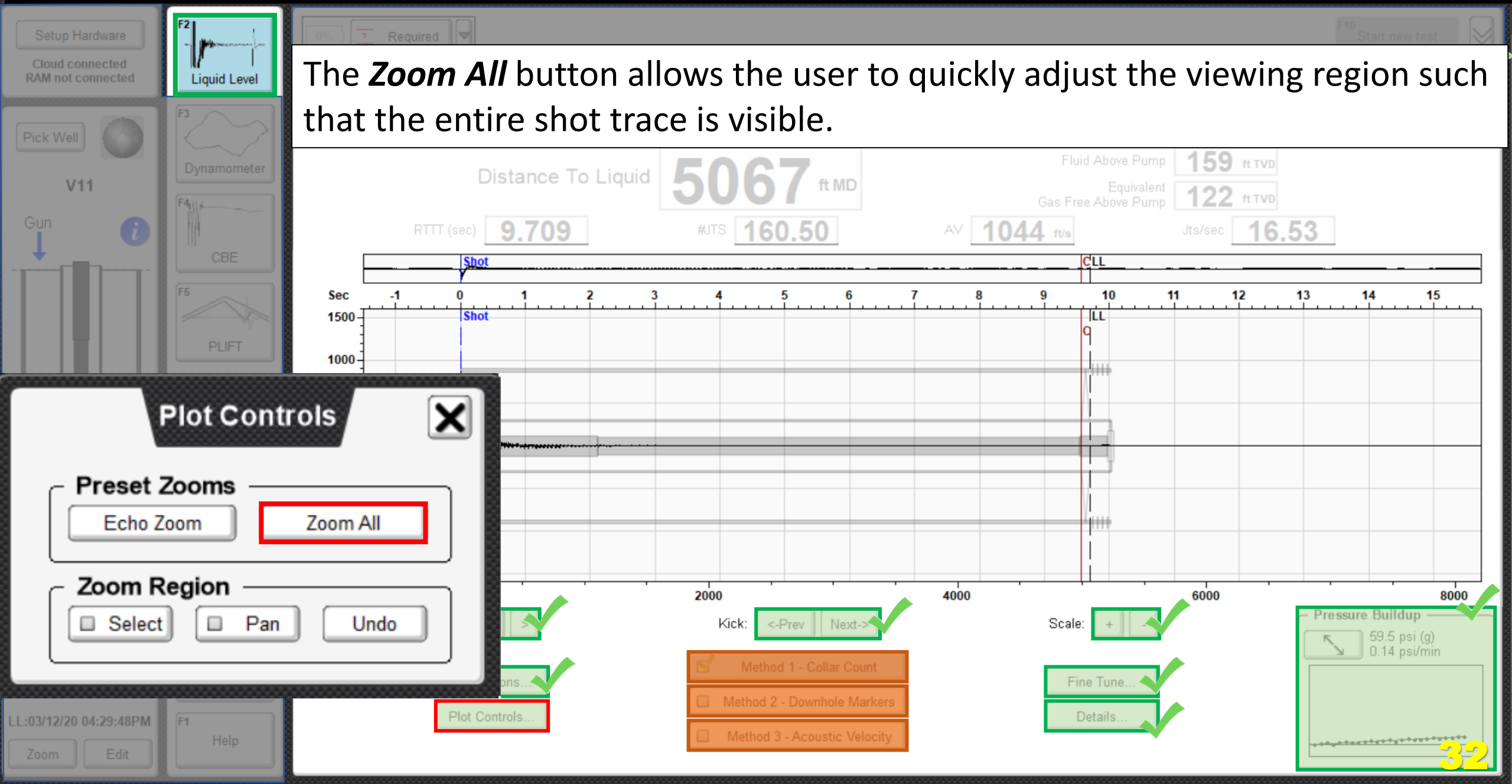
Plot Controls… / Echo Zoom

The ***Echo Zoom*** button is a smart-zooming feature that automatically adjusts the viewing region of the recorded trace to an optimum range. It determines this region based on the location of the shot beginning and liquid level cursors, as well as, the kick height at the selected liquid level.



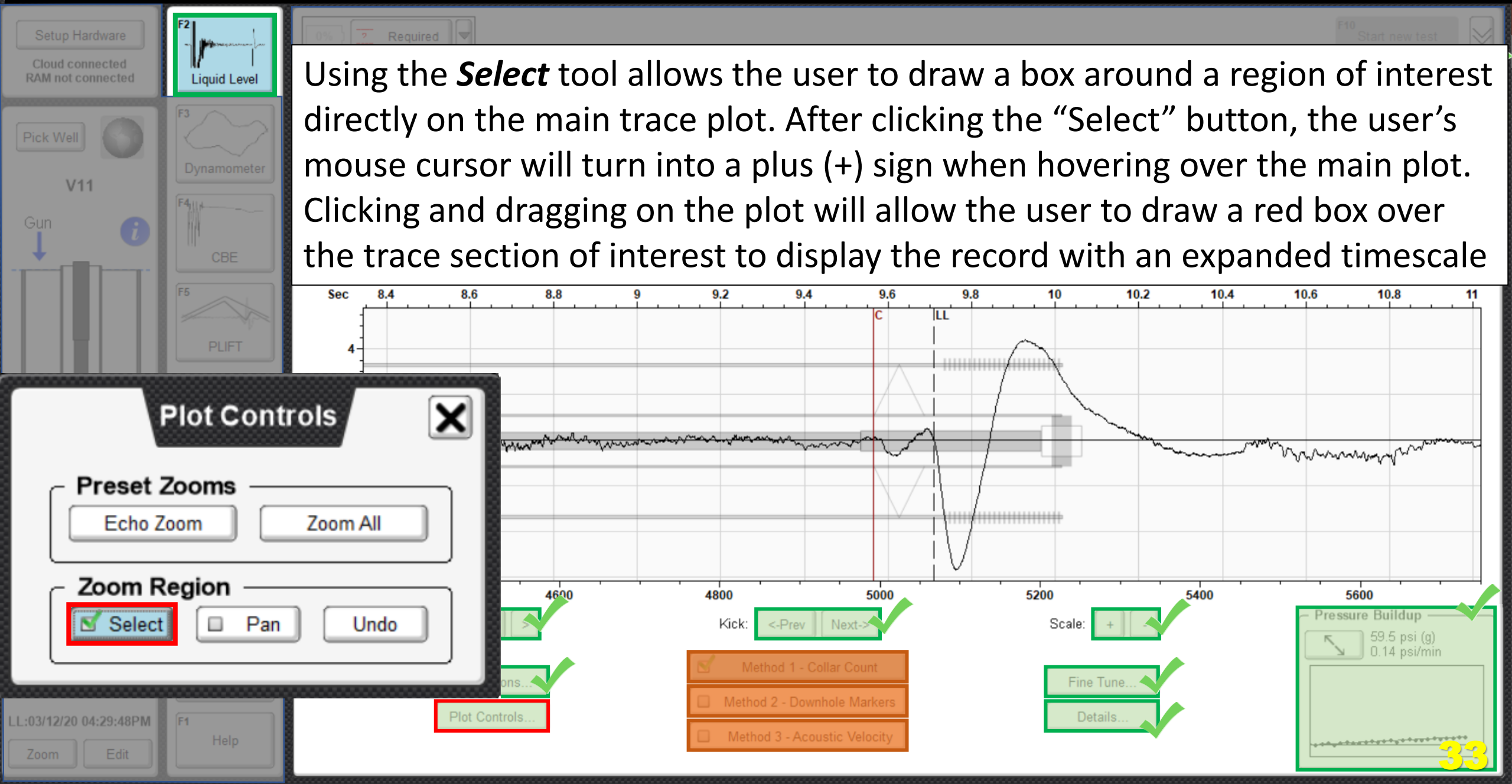
Plot Controls… / Zoom All

The ***Zoom All*** button allows the user to quickly adjust the viewing region such that the entire shot trace is visible.



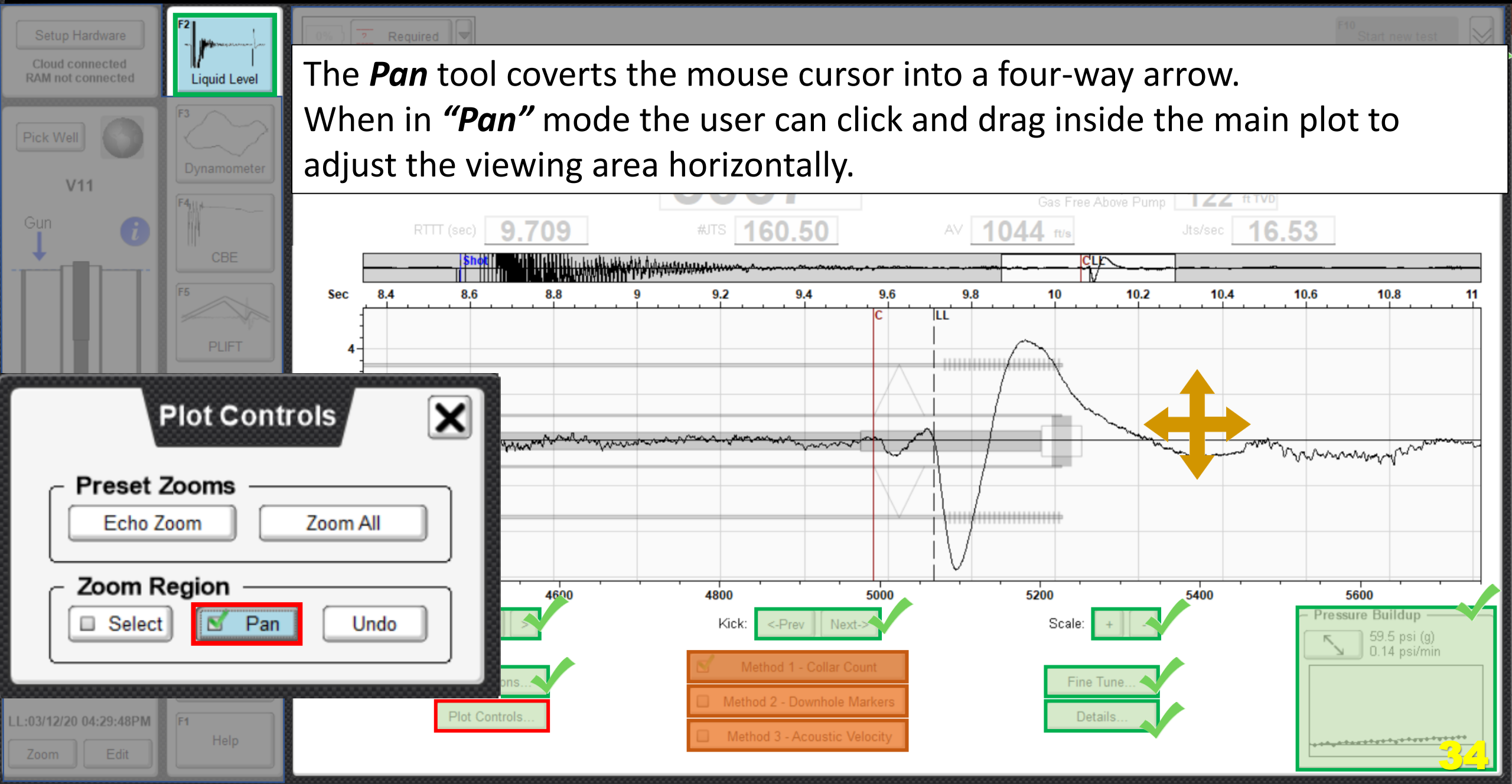
Plot Controls… / Select

Using the ***Select*** tool allows the user to draw a box around a region of interest directly on the main trace plot. After clicking the “Select” button, the user’s mouse cursor will turn into a plus (+) sign when hovering over the main plot. Clicking and dragging on the plot will allow the user to draw a red box over the trace section of interest to display the record with an expanded timescale



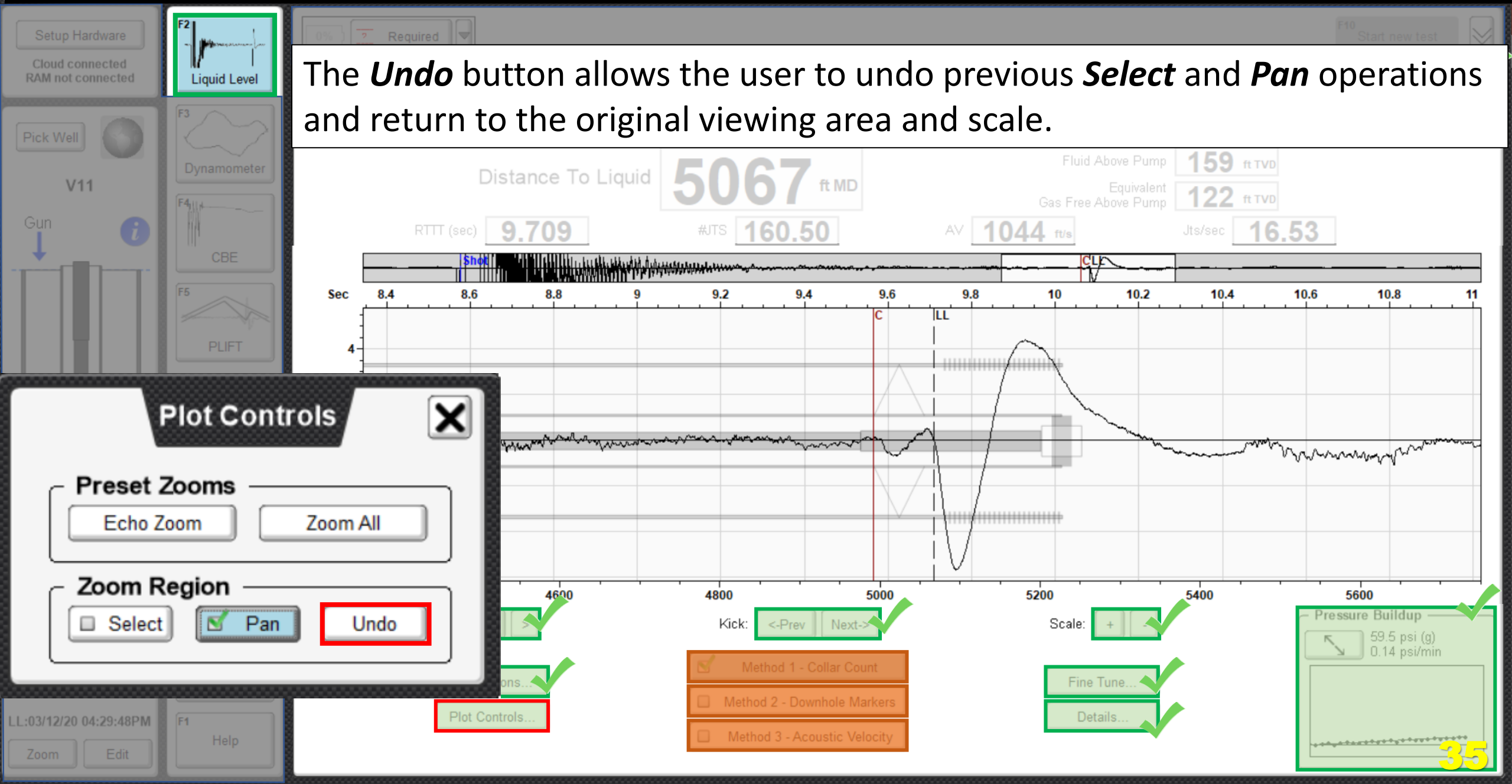
Plot Controls… / Pan

The ***Pan*** tool coverts the mouse cursor into a four-way arrow.
When in ***"Pan"*** mode the user can click and drag inside the main plot to adjust the viewing area horizontally.



Plot Controls… / Undo

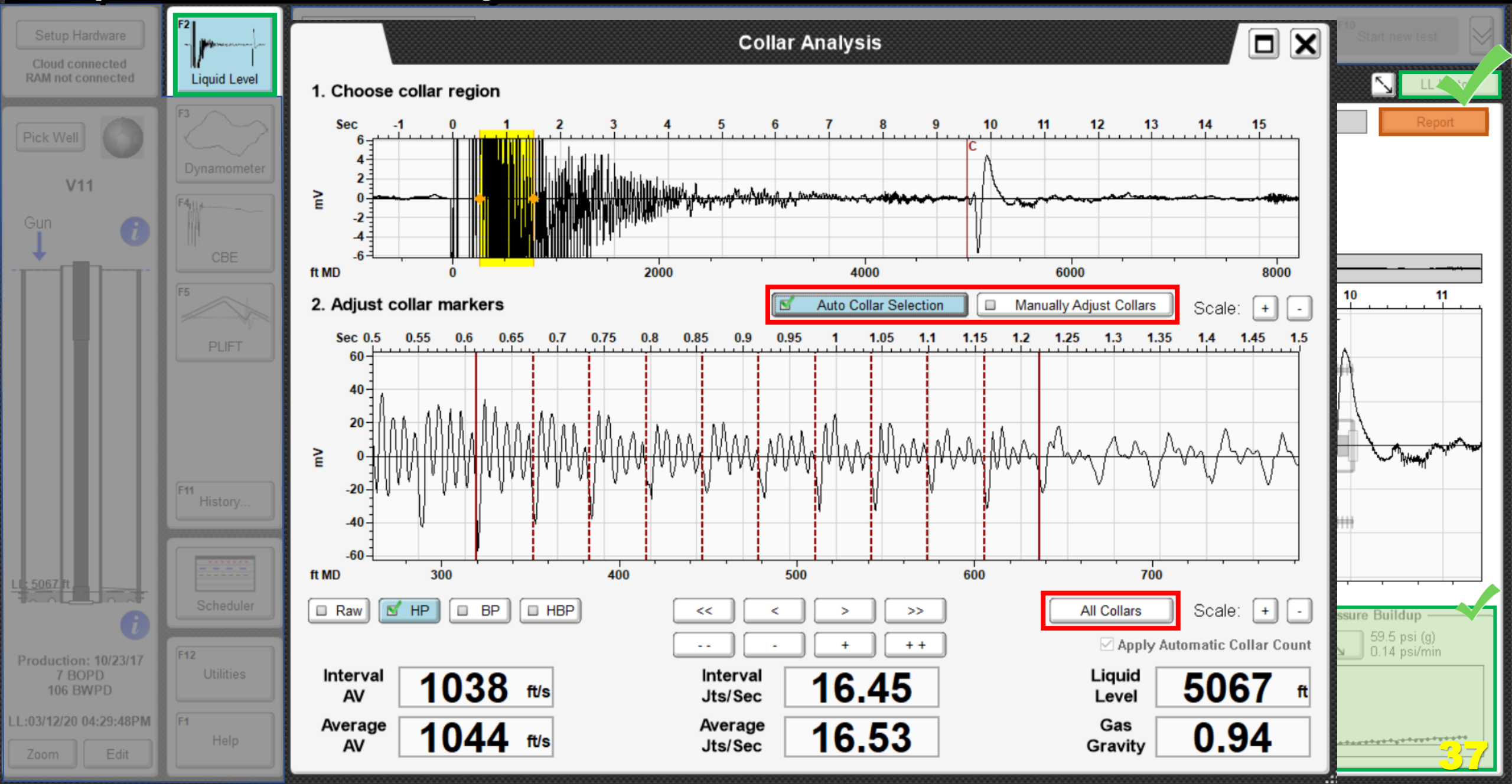
The ***Undo*** button allows the user to undo previous ***Select*** and ***Pan*** operations and return to the original viewing area and scale.



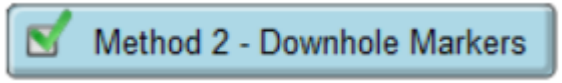
Method 1 – Collar Count

- TAM, applies the ***Collar Count Method*** by default.
- No action by the user is normally required.
- User manual adjustment may be required in those cases where the collar count marker line **"C"** is located significantly above the liquid level echo.
- The **"C"** line indicates the position of the last collar counted.
- A good *Average Joint Length* value is needed for more accuracy on LL calculation when *Collar Count Method* is used.

Liquid Level Analysis / Method 1 – Collar Count



Liquid Level Analysis / Method 1 – Collar Count



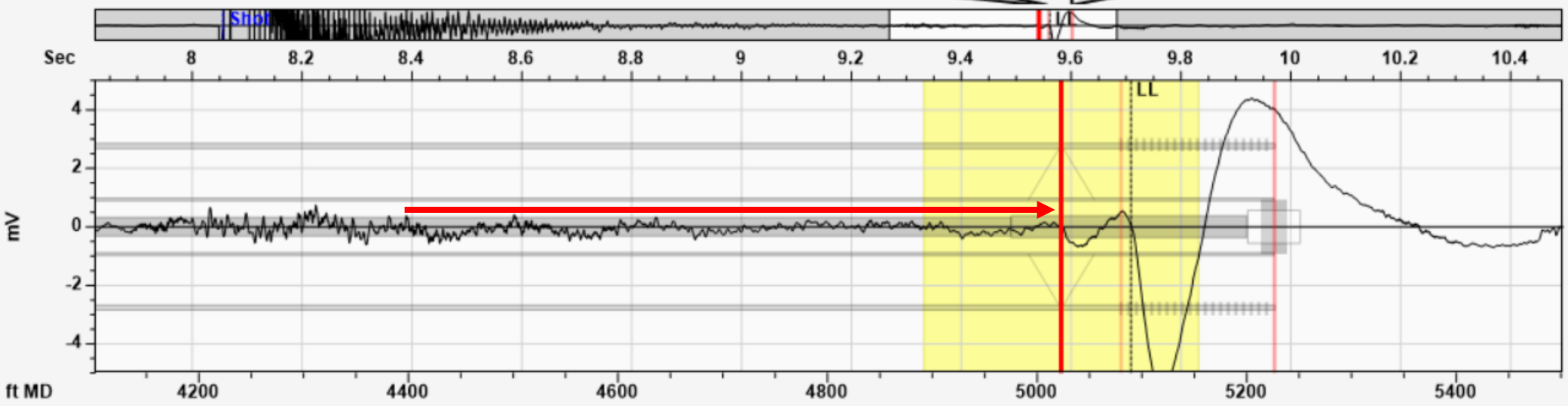
Method 2 – Downhole Marker

- This Method depends on wellbores that include downhole features that cause acoustic reflections, such as a tubing anchor.
- A Downhole Marker is a visible acoustic reflections with a known depth, above the Liquid Level kick.
- TAM shows a list of possible markers with depth, based on the information entered in the ***Detailed*** well description.
- Distance and time to the Downhole Markers is used to determine the average acoustic velocity of the gas and calculate the distance to the liquid level.

Marker Analysis

1. Select Marker to Move

Tubing Anchor	Perforation	End Of Tubing	Casing Shoe
Depth: 5023 ft	Depth: 5080 ft	Depth: 5226 ft	Depth: 5227 ft



2. Align Marker With Shot

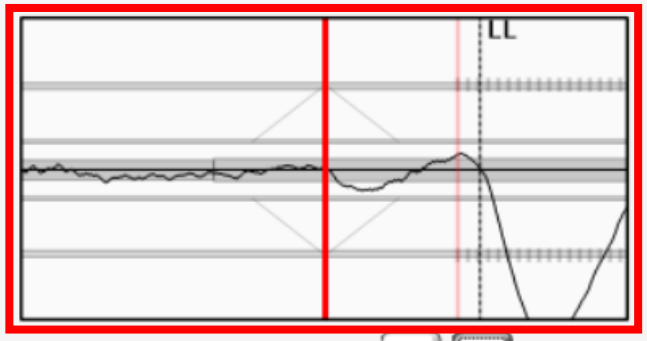
Scale: + -

Opacity:

Echo Zoom

Zoom All

3. Refine Marker Position @ 9.582 sec

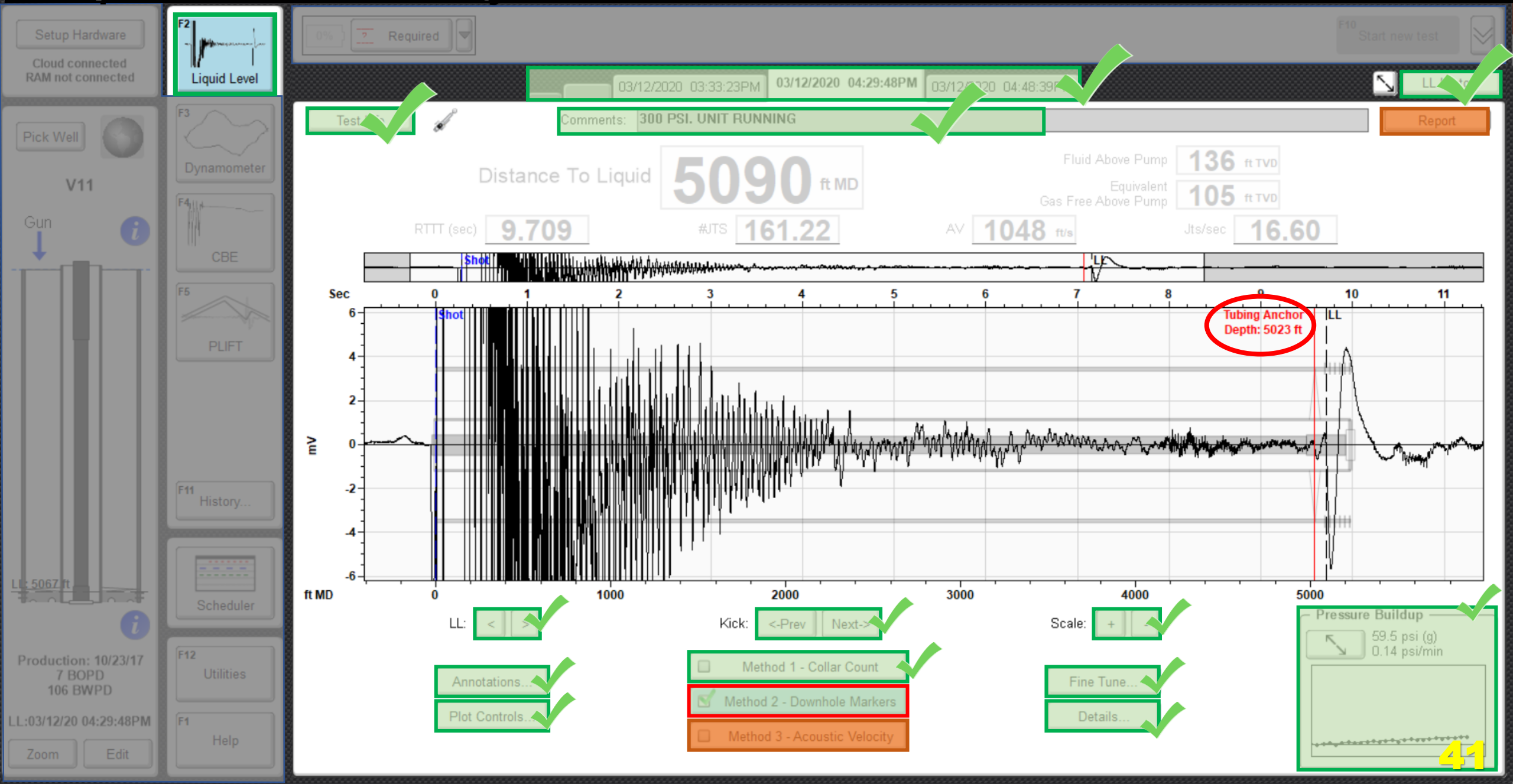


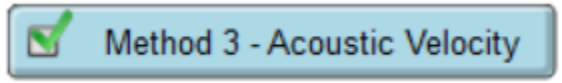
Window Size: + -

4. Verify Results

Acoustic Velocity	1048 ft/s
Liquid Level	5090 ft
Gas Gravity	0.93

Liquid Level Analysis / Method 2 – Downhole Marker

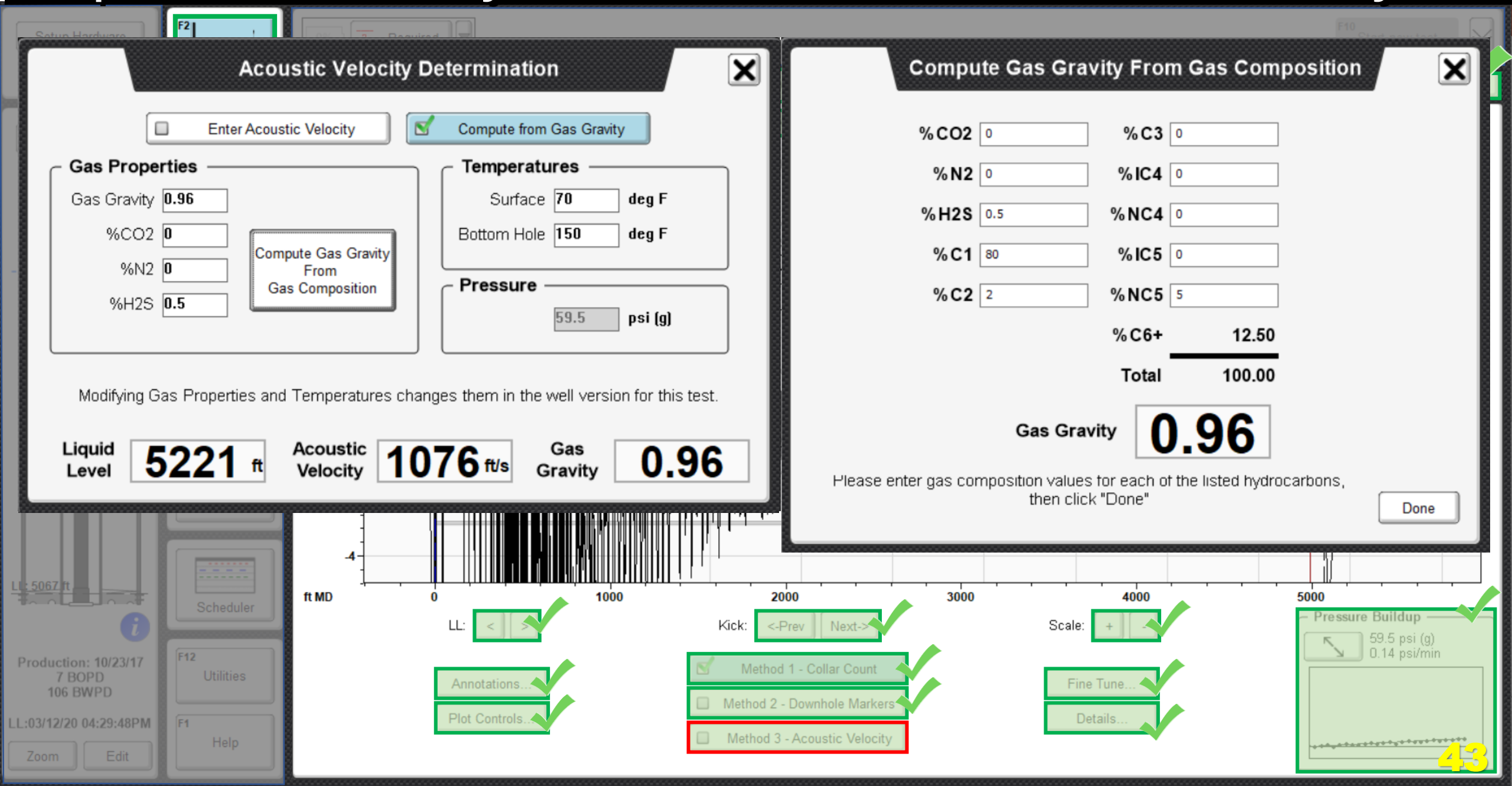




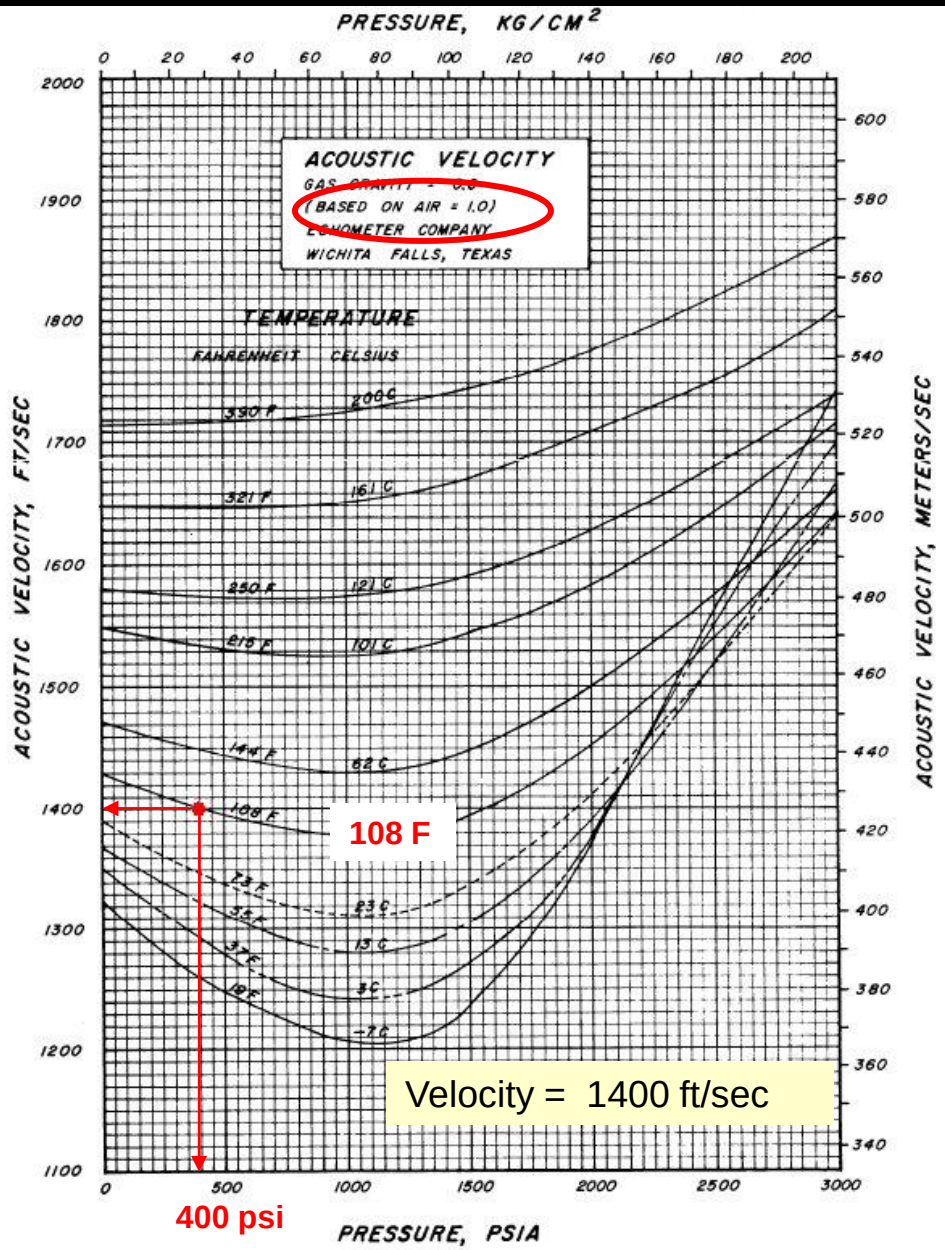
Method 3 – Acoustic Velocity

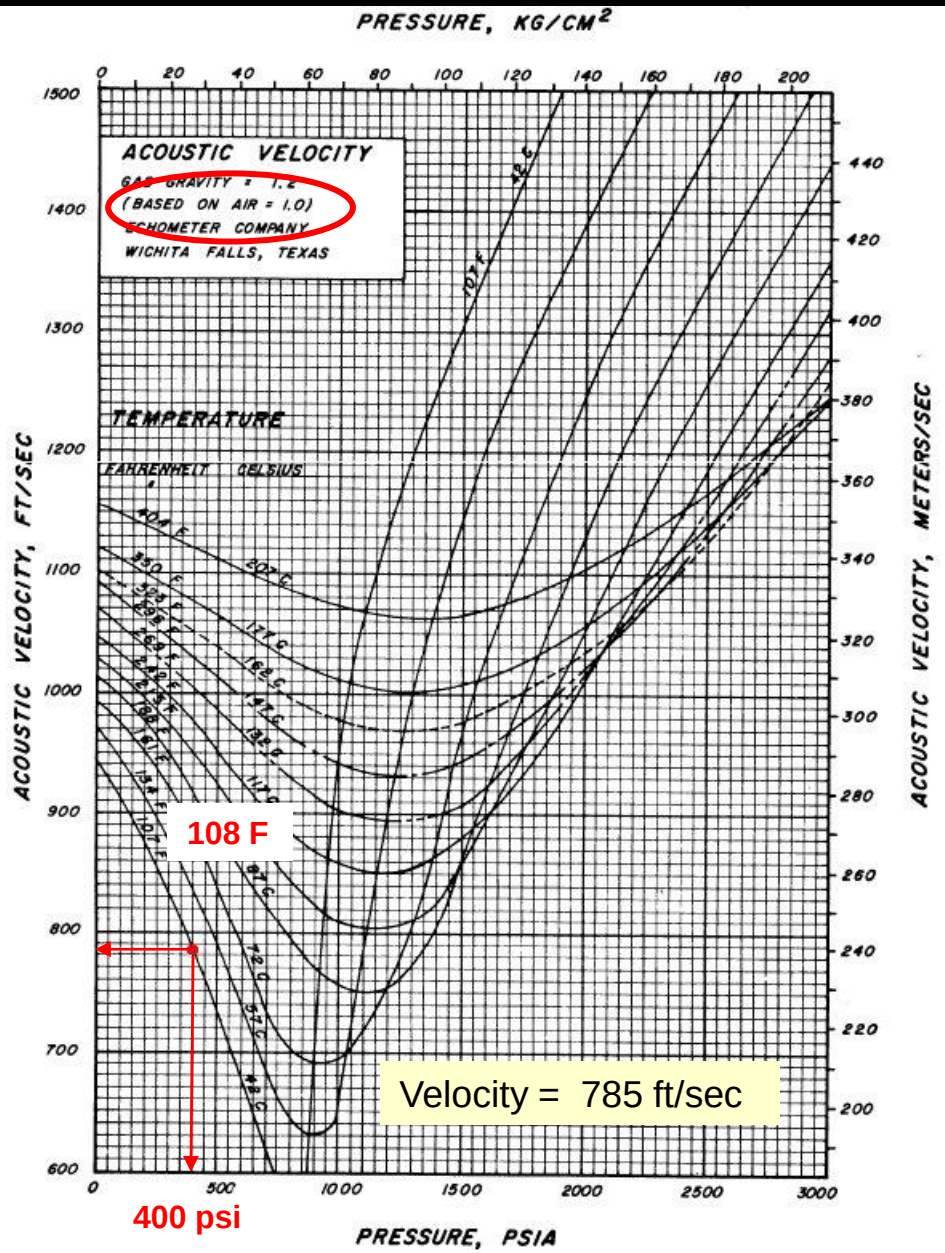
- Method used whenever the record does not show echoes from tubing collars or downhole markers.
  - Tubing shots in regular tubing or Internally flush tubing
  - Cased holes without tubing
- It allows the user to manually enter a known acoustic velocity
- TAM can calculate a velocity by:
  - Manually entering a value for gas gravity
  - Manually entering a detailed gas composition

Liquid Level Analysis / Method 3 – Acoustic Velocity

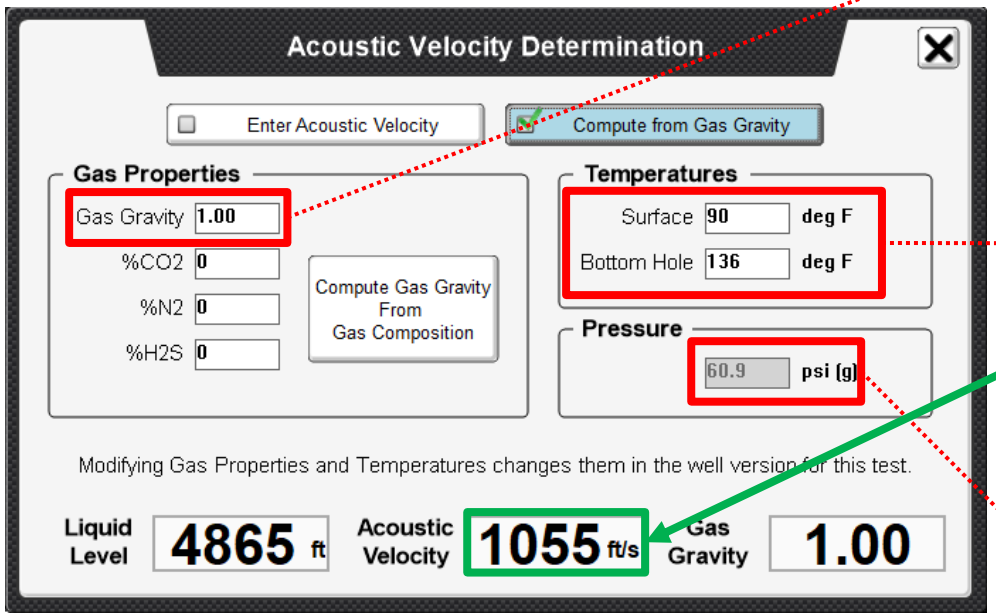


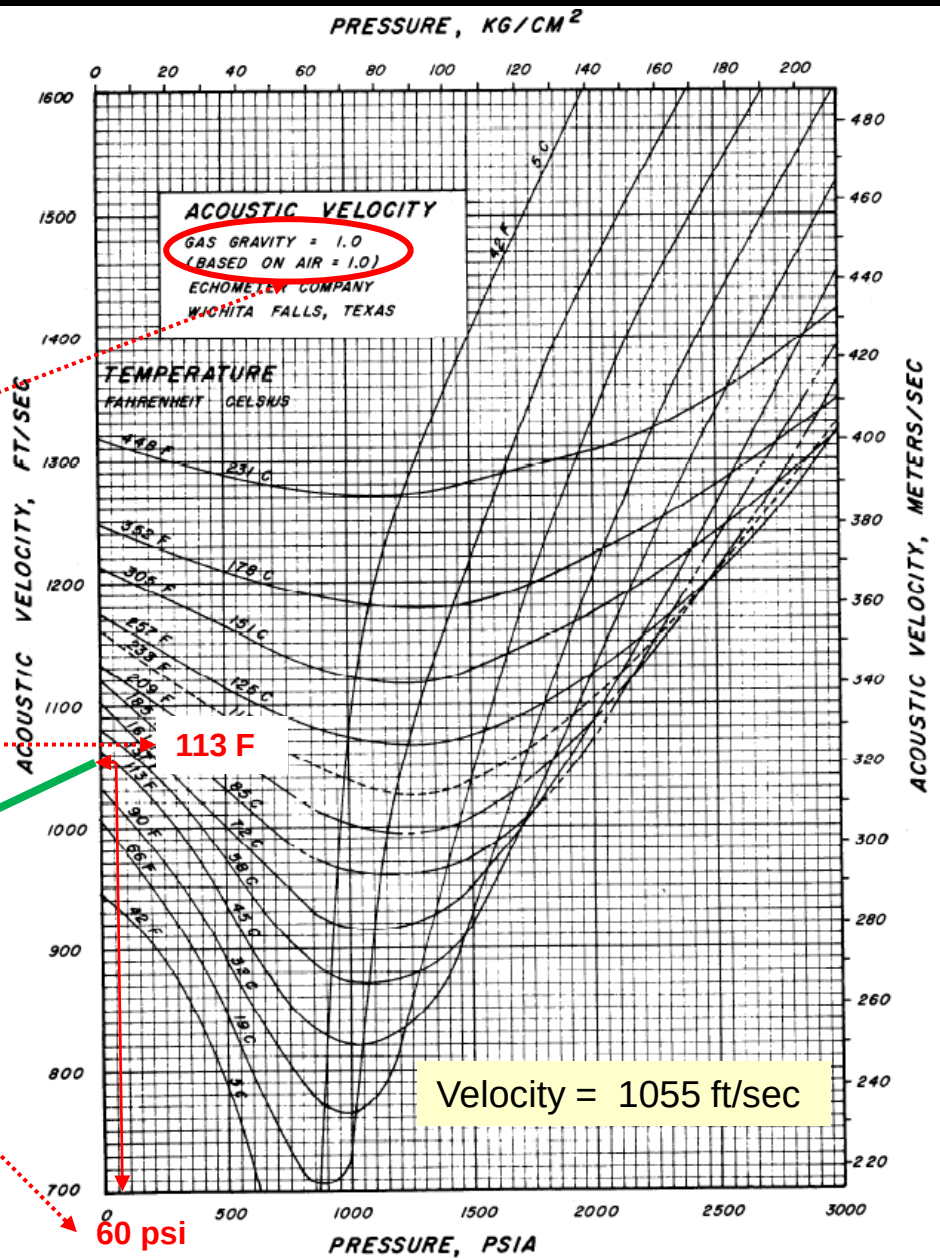
Acoustic Velocity of Gases Depends on P, T and Specific Gravity:





Acoustic Velocity of Gases Depends on P, T and Specific Gravity:





Liquid Level Report

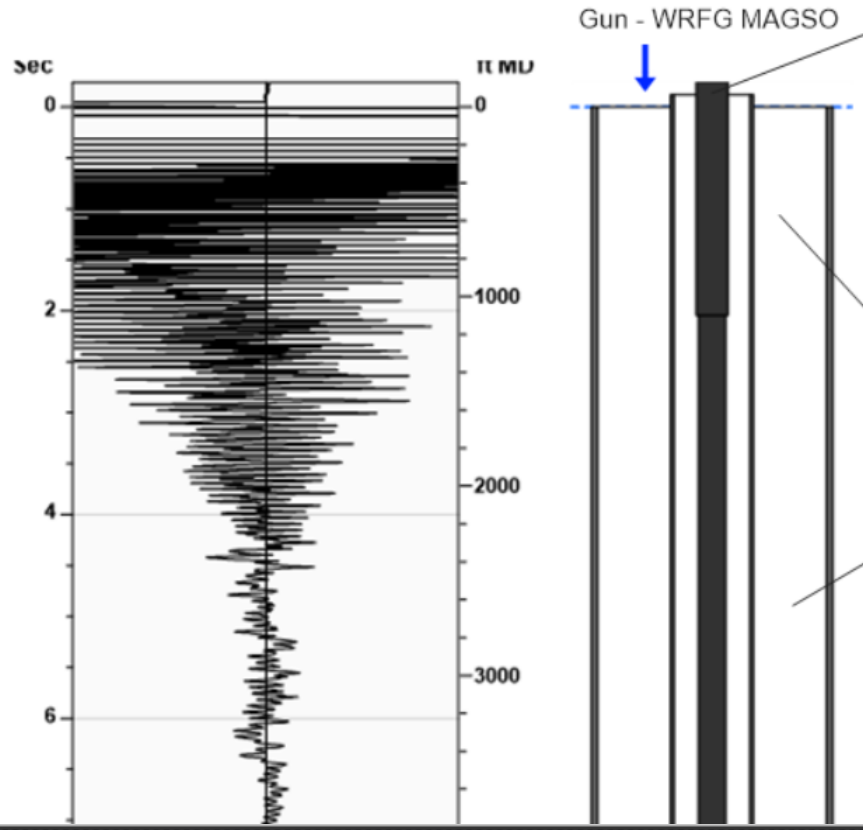
Reports

Print | PDF | Email | + | - | 110% | Producing | Settings

(((ECHOMETER))) V11 03/12/2020 04:29:48PM Click here to select image...

Liquid Level	5221 ft MD

Fluid Above Pump	5 ft TVD
Equivalent Gas Free Above Pump	4 ft TVD



Production Modify...

Date Entered			10/23/17
	Current	Potential	
Oil	7	7	BBL/D
Water	106	108	BBL/D
Gas	7.0	7.1	Mscf/D
IPR Method			Vogel
PBHP/SBHP			0.06
Producing Efficiency			98.14%

Casing Pressure

Pressure	59.5 psi (g)

Annular Gas Flow

Gas Flow	3.4 Mscf/D

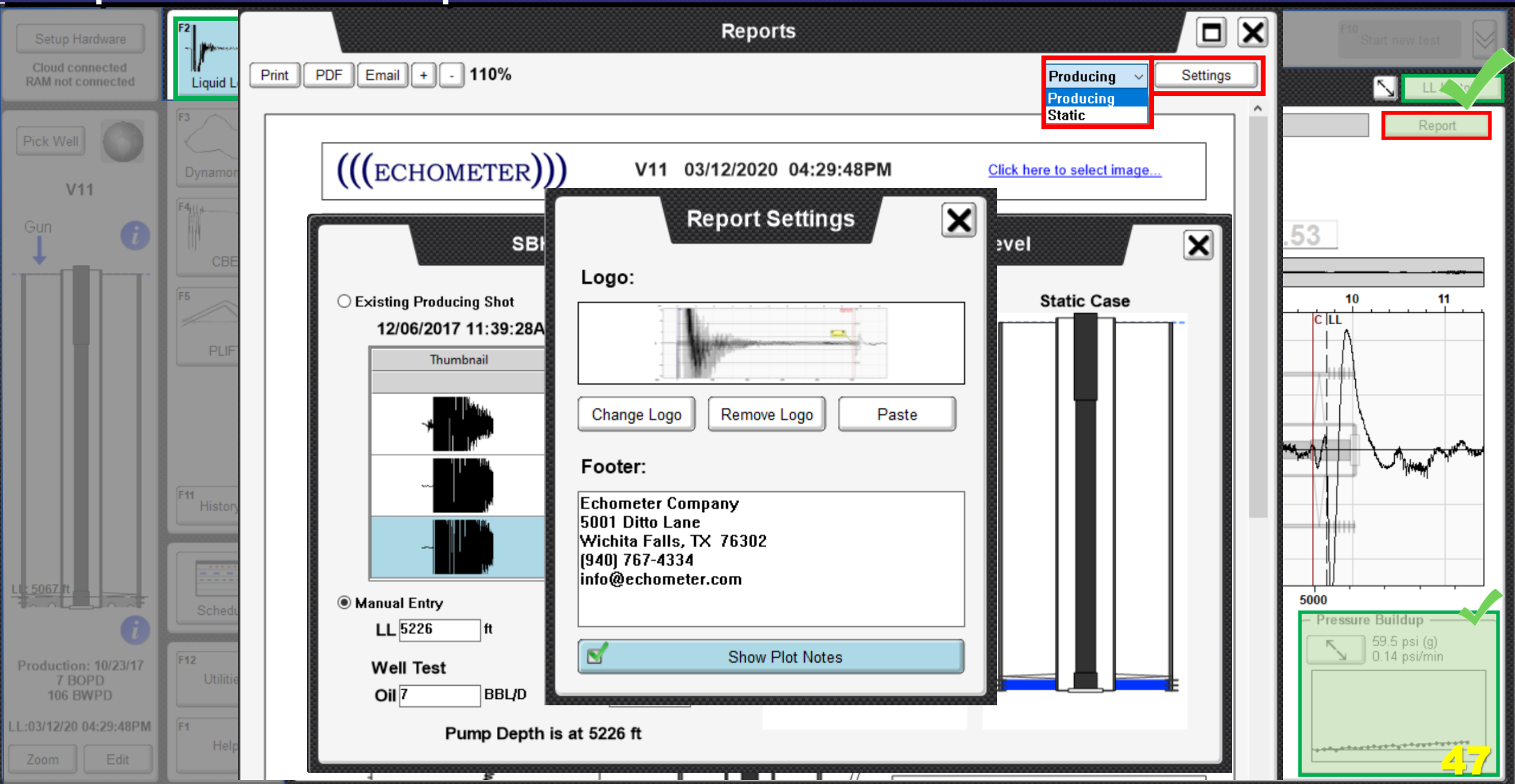
Fluid Properties Modify...

% Liquid Above Pump	76.50%
% Liquid Below Pump	85.55%

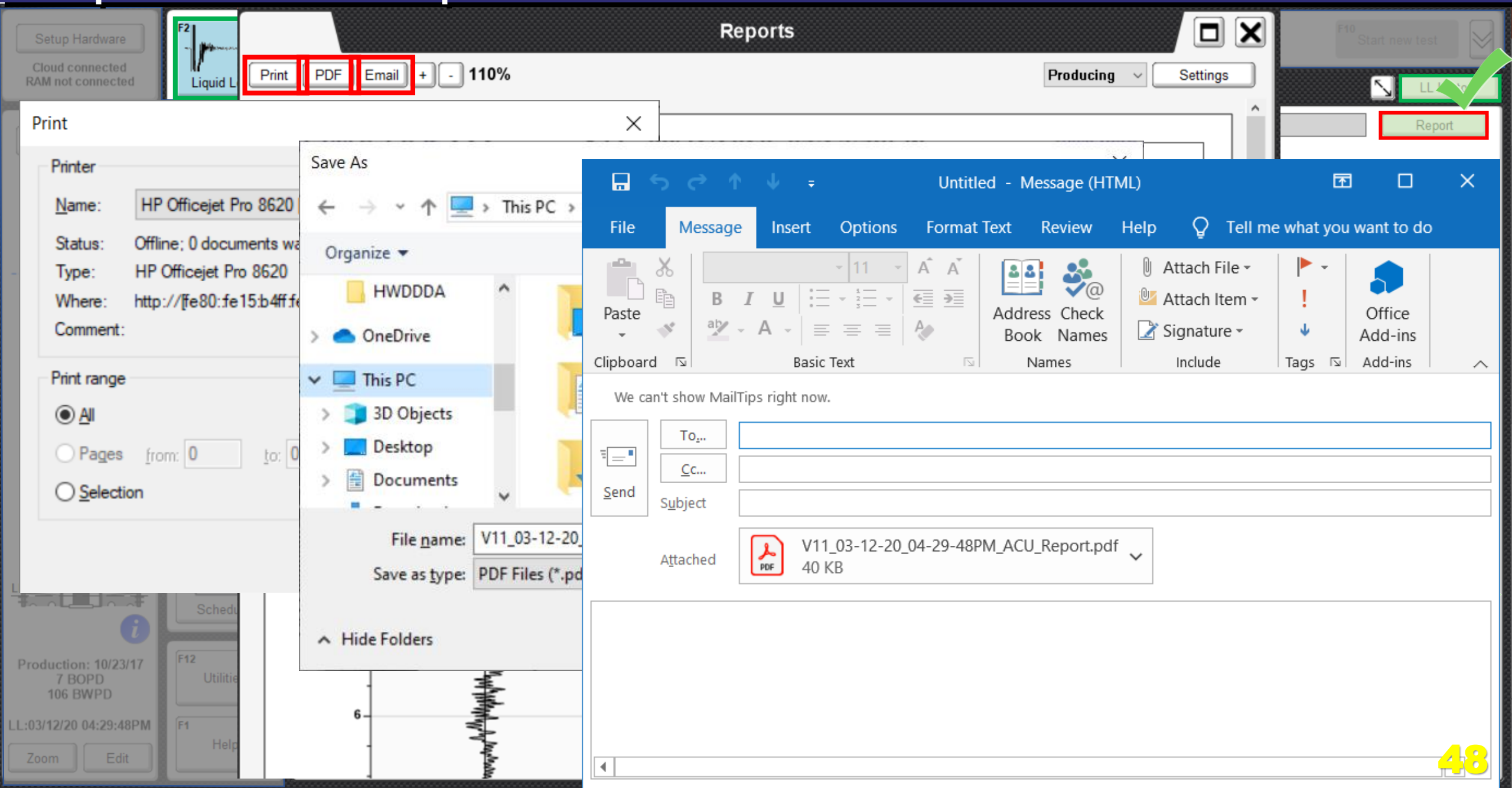
Depths

Pump Intake Depth	5226 ft
Formation Depth	5227 ft

Liquid Level Report



Liquid Level Report



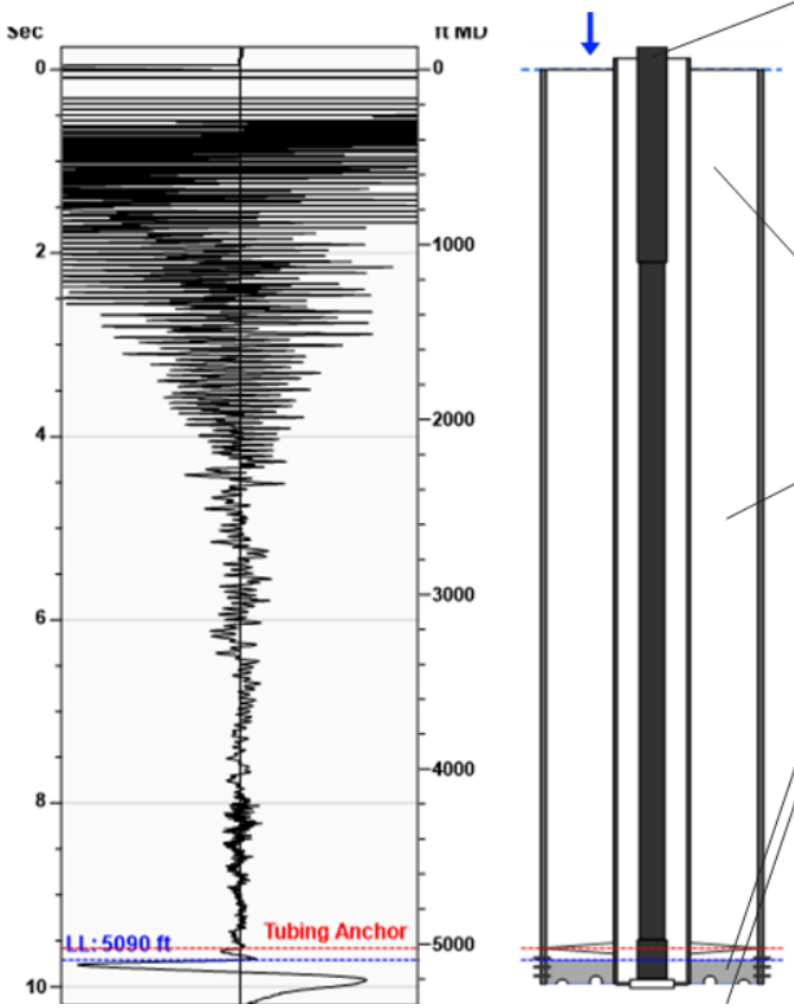
Liquid Level Report

Producing Fluid Level Report

(((ECHOMETER))) V11 03/12/2020 04:29:48PM Click here to select image...

Liquid Level	5090 ft MD

Fluid Above Pump	136 ft TVD
Equivalent Gas Free Above Pump	105 ft TVD



Production Modify...

Date Entered			10/23/17
	Current	Potential	
Oil	7	7	BBL/D
Water	106	109	BBL/D
Gas	7.0	7.2	Mscf/D
IPR Method			Vogel
PBHP/SBHP			0.09
Producing Efficiency			97.24%

Casing Pressure

Pressure	59.5 psi (g)

Annular Gas Flow

Gas Flow	3.3 Mscf/D

Fluid Properties Modify...

% Liquid Above Pump	76.82%
% Liquid Below Pump	85.75%

Depths

Pump Intake Depth	5226 ft
Formation Depth	5227 ft

Wellbore Pressures

PIP	107.5 psi (g)
PBHP	107.9 psi (g)
SBHP	1224.5 psi (g)
Gas/Liq Interface	72.3 psi (g)

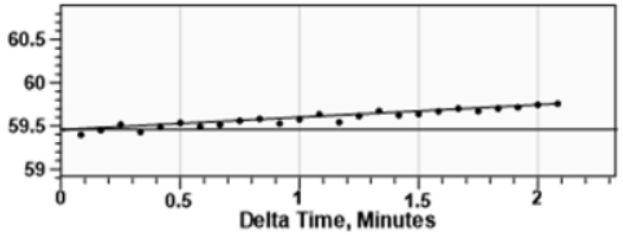
Liquid Level Report

Producing Fluid Level Report

Marker Analysis

Marker Used	Tubing Anchor
Depth	5023 ft
Acoustic Velocity	1048 ft/s
Joints Per Sec.	16.60 Jts/sec
Joints To Liquid	161.22 Jts

Casing Pressure Buildup



Casing Pressure	59.5 psi (g)
Buildup	0.3 psi (g)
Buildup Time	2 min 5 sec
Gas Gravity from Downhole Markers	0.9313 Air = 1

Comments and Recommendations

300 PSI. UNIT RUNNING

Echometer Company
5001 Ditto Lane
Wichita Falls, TX 76302
(940) 767-4334
info@echometer.com

Questions…