MEMORY PRODUCTION LOGGING TOOL (MPLT) STANDARD SERVICE PROCEDURE

Document Control

Version : 0.0
Release Date : 22-January-2020
Owner : CHS Dimension Bid Sdn. Bhd.
Author : Mohamad Firdaus Ibrahim
Reviewer : Abdul Rahman Kamal
Approver : Mohd Zahir Manan

Private

Revision History

Version	Date	Description	Prepared By
0.0	22-Jan-2020	Establishment of SSP	Mohamad Firdaus

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DESIGN

1.1 Introduction of MPLT Tool.

The objective of production logging is to provide information to the client to enable them to maximise oil recovery from their reservoirs. Initially PLT work is to profile production but later on in the life of the field PLT work is usually to diagnose problems such as:

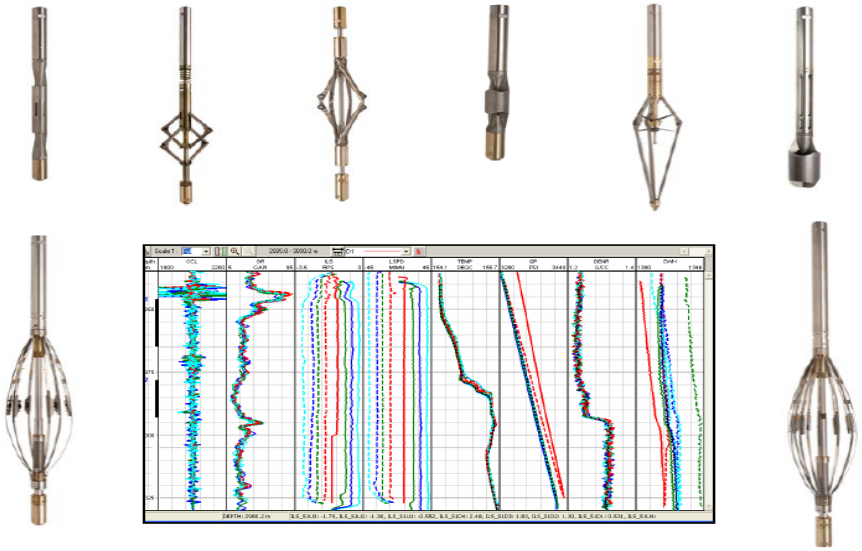
a) Not as much oil is being produced as expected
b) There is too much water being produced
c) There is too much gas being produced
d) The well has leaks or may be becoming mechanically unsound.

By diagnosing problems and quantifying multi-phase production the client can make a commercial decision of what to do next. Industry is driven by economics; PL information can make the difference between going ahead with remedial work or even the development of an entire field.

Sondex Production Logging Tool sensors consist of Pressure, CCL, Gamma Ray, Temperature, Fluid Capacitance, Density and Flowmeter. The flowmeter is the 'king' of the PL tools as it is the only one that directly gives us the flow rate, which is the key parameter, and so care should be taken to choose the right one to match the well.

Different toolstrings are required to achieve different objective, for example, in water injection wells fluid identification tools are not required.

When considering which tools to run remember it is better to have too much information than to have too little. If you have too much information then you can discard the data you do not need. If you have too little data then you have a problem.



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1.2 Tool Specification

Mechanical	
Outside Diameter	1-11/16"
Make up Length	20.77'
Housing Material	Inconel 718 / Stainless Steel 17-4
Weight	101.6 lbs
PL Tool	QPS, PRT, PGR, CCL, ILS, QPS, CWH, FDR, CFS
Deployment Tool	Knuckle Joint, Centralisers
Top Connection	15/16" Sucker Rod (Battery Housing)
End Threads (Top/Bottom)	1-3/16" UNF (Male/Female)
RIH/POOH speed	100 ft/min
Logging Speed	30/60/90 ft/min (Up & Down)
Environmental	
Pressure Ranges	Up to 15,000 psi
Pressure Accuracy	±0.02% Full Scale
Pressure Resolution	0.008 psi (depends on acquisition parameters)
Temperature Ranges	177°C (350°F)
Temperature Accuracy	±0.5°C
Temperature Resolution	0.0035°C (0.0063°F)
Density Range	0 to 1.25 g/cc
Density Resolution	0.01 g/cc
Density Accuracy	0.03 g/cc
Flowmeter Range	0 - 100 rps
Flowmeter Accuracy	± 7-10 ft/min
Flowmeter Resolution	0.1 rps
Electronic	
Power Source	Lithium Battery
Battery Pack	5C/5CC/10C (150°C/165°C/180°C)
Battery Capacity	6200/13000 mAh (19.5 V)
Battery Life	30 hours (10 sensors taking 160mA at 1 sec/sample)
Memory Size	1024 Mbytes Flash Logging Memory (UMT007)
Sample Rate	20 ms to days in 20ms in increments

**For more details on tool specification, please refer individual tool manual

1.3 Review Client Requirement

1. Operation Engineer (OE) and Field Engineer In Charge (FEIC) will get all necessary info required from client as per CHS-FORM-146 Service Program Input checklist, subject to type of logging service.
2. Gather the following information:
    a. Job proposal and objective to design toolstring configuration.
    b. Well survey data to perform simulation by WEST software.
    c. Open Hole Gamma Ray (OHGR) las file for correlation purpose
    d. Well schematic and tubing tally for completion references

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e. Well history to understand well behavior, restrictions, previous interventions history etc
f. Well test data
g. PVT Input Template to be filled by client for PLT interpretation (refer to CHS-Form-03 PVT input Template PLT)
h. Tool lift calculations to ensure tools deployed are having enough weight to reach target depth with survey condition provided.

1.4 Confirm Requirements can be met

1. Confirm the operation is within tool specifications.
2. Inform the client on the limitation of the tools, equipment, well condition and etc.

1.5 Generic Main Tool Planning

1. Please discuss with FSM on the availability of the equipment.

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PREPARE

2.1 Pre-Mobilization

1. Operation Engineers will notify upcoming jobs from certain clients. They will forward the work program to *CHS Coordinator (CHSC).*
2. CHS Coordinator will follow up with the LOI and issue an instruction to start preparing the personnel and equipment movement. Tools and equipment required for mobilization are identified based on client's work program.
3. Once the LOI is received, CHSC will appoint *FE in-charge* for the dedicated job to prepare tools and equipment.
4. FEs and Lab Technicians are responsible to perform thorough inspection on the MPLT and any other equipment. For the MPLT the *Specific Operating Procedure (SOP)* must be followed. All bench tests must be properly recorded and documented.
5. Lab technicians will produce the maintenance checklist, which then will be verified by the FE in-charge. The tools and equipment will be handed over to Material Coordinator (MC) for shipping arrangement. Lab technicians will liaise with MC regarding the shipment.
6. FE in-charge should compile all the input data related to the job.

2.2 Assembling MPLT Tools

1. Collect the components of the MPLT tools.
    a. Memory Battery Holder (ABM)
    b. Ultrawire Memory Tool (UMT007/UMT003)
    c. Quartz Pressure Sensor (QPS)
    d. Casing Collar Locator (CCL)
    e. Production Gamma Ray (PGR)
    f. Platinum Resistance Temperature (PRT)
    g. Capacitance Water Holdup (CWH)
    h. Fluid Density Radioactive (FDR)
    i. In-Line Spinner (ILS)
    j. Continuous Flowmeter Spinner (CFS)
    k. Production Roller Centralizer (PRC)
    l. Production Knuckle Joint (PKJ)
    m. Bullnose with Terminator (BUL)
    n. Ultrawire Memory Control Unit (UMU001)
    o. Depth Time Recorder (DTR)
    p. Gamma Ray Jig
    q. Lithium Battery Pack
    r. O-ring grease
    s. O-ring consumable
    t. Spare part consumable
    u. Hand tools

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2.3 Downhole tools

2.3.1 Prepare MPLT Tools

1. Ensure the MPLT tool has completed maintenance process and tagged as **READY TO GO**. If not tagged, please consult with Lab technicians.

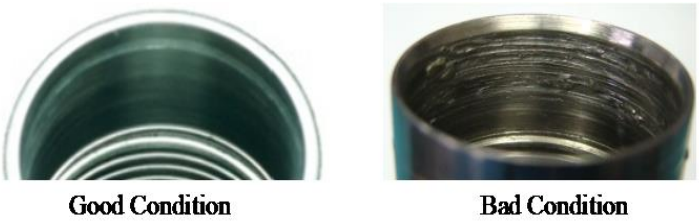

Figure 1 *Tool condition*

2. Perform visual/physical check for any damage, bending, dents, or scratches for the tools received as in 2.2.
3. Inspect the O-rings conditions. Replace if necessary.

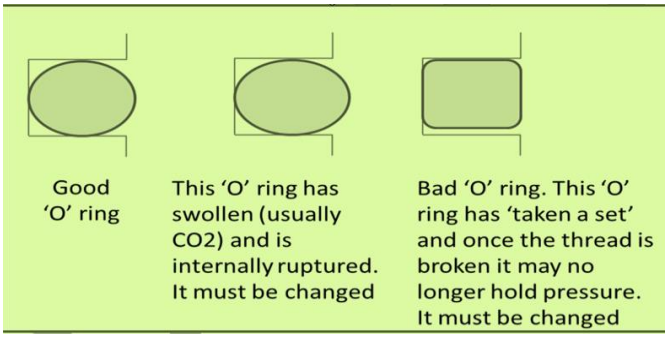

Figure 2 *O-ring condition*

4. Verify the tools and the components herein as in 2.2 are thoroughly cleaned from dirt and grease.
5. Use air gun or WD-40 and spray the sensor port to avoid any clog.

2.4 Downhole accessories

2.4.1 X-Over from MPLT tools to Wireline Tool

1. Discuss with Operation Engineer for the method of deployment of tools.
2. Identify the X-Over need to be used and perform fit test prior to mobilize to offshore.
3. Make sure the tool, figure on the right, was tested and functioning well.
4. Ensure tool inspection was done as per SLS/CTU/E-Line maintenance manual.

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2.5 MPLT Software

2.5.1 System Requirement

1. Required software:
    a. Sondex Ultrawire Memlog
    b. Warrior Acquisition
    c. SNDXUSB.EXE (if not installed automatically)
    d. SDSUSB.EXE (if not installed automatically)
    e. HASP/Hardlock drivers (if not installed automatically)
    f. RS232 to USB driver
    g. Kappa Emeraude (Optional)

2. Before installing the required software, computer system should be ready with operating systems no older than Windows 2000. In addition, for Warrior 7, requirement for computer system is 32bit and 64bit for Warrior 8.

2.5.2 Software Installation via Downloaded File

1. Go to BHGE web site (https://www.bhge.com/upstream/evaluation/wireline-products-and-equipment/downhole-equipment/wireline-software)
2. You can install from SDS website as well (http://www.scientificdata.com/downloads/Warrior-Software-Downloads.html).
3. Download the latest software needed that compatible with your computer system.
4. Download the compressed file and extract it to hard drive. Every software file has the different password. Please consult with BHGE representative for the password. From SDS website, no password required to extract the file.
5. Double click the ***SETUP.EXE*** icon to launch the software installation.
6. Follow the instructions to finish the installation process.

2.5.3 Launching Warrior Software

Warrior 7 32bit Computer Operating System

1. Insert the key dongle. Open the Warrior 7 folder and double click on *Control Panel* to launch.
2. Insert the *Key Code* at key authorization code area.
3. Double click on Warrior Acquisition shortcut at the desktop to launch.
4. The software will automatically detect key code inserted and will launch the software. If failed to launch, please check the code inserted.

Warrior 8 64bit Computer Operating System

5. Insert the key dongle. Open the Warrior 8 folder and double click on *Control Panel* to launch.
6. At the license tab, import the key license available. License key are available in the CHS server *Y:\27_Maintenance Record\5 - SOFTWARE KEY\2 - KEY LICENSE.*

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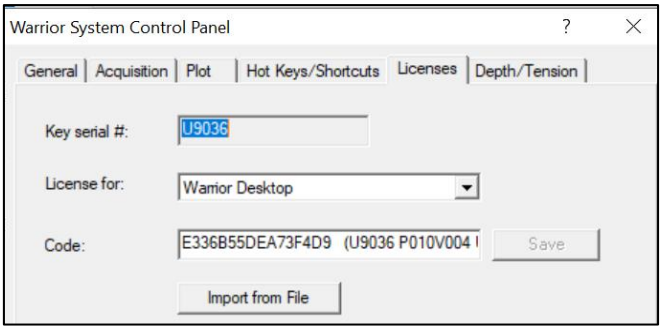


Figure 3 *Warrior System Control Panel - Licenses*

7. Select the correct **Depth** units: **feet** or **meters** on *Show depth as*.
8. Select the desired data output units on *Show data unit as* . This can be:
   English (e.g. inches, deg F, psi) or **Metric** (e.g. mm, deg C, Bars) or **User Defined**.
   You can click on **Edit** to pull down buttons to select the units to use for Englis, Metric or User Defined.

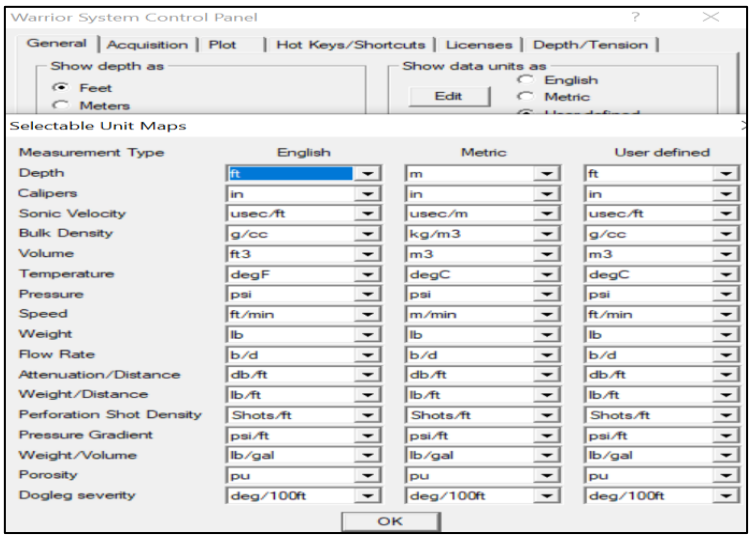
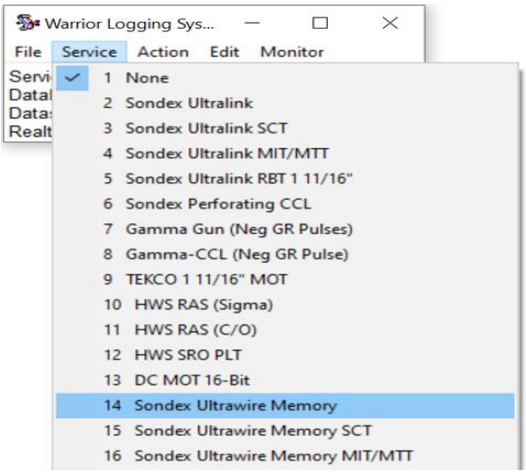


Figure 4 *Warrior System Control Panel - Unit Setting*

9. Double click on *Warrior Acqusition* shortcut at the desktop to launch. Select the Service *Sondex Ultrawire Memory*. Go to *Edit* and select *Toolstring*.



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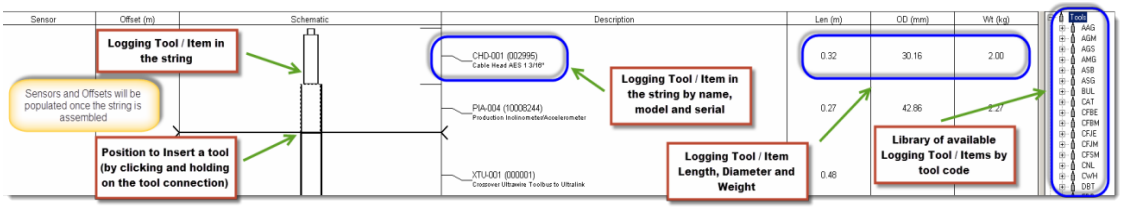
10. Select the tool type with its serial number and make sure the tool have the updated calibrated file in the **Warrior Config** folder.



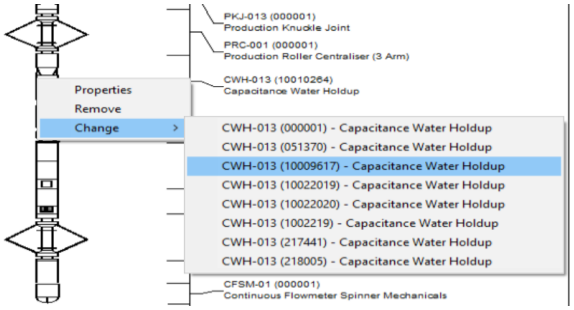
To add tool, position the mouse on the tool code in the library and click to expand and show a list of available tools. These are the tools not in the current tool string and are identified by serial number and description.

There are 2 ways to add a tool to the toolstring:

- Select the tool that you wish to add and drag to the insert point on the toolstring diagram
- Double click on the tool in the tool library. Once the tool is in the string it can be dragged and dropped to the correct position using the left hand mouse button.

To find out properties of a tool in the string, remove or exchange for a similar tools, right click to bring up the option:

- Properties – this shows the properties of the tool
- Remove – this removes the tool and returns it to the tool library
- Change – this brings up a list of tools of the same tool type within the tool library



Click *Save* after finish setup the toolstring

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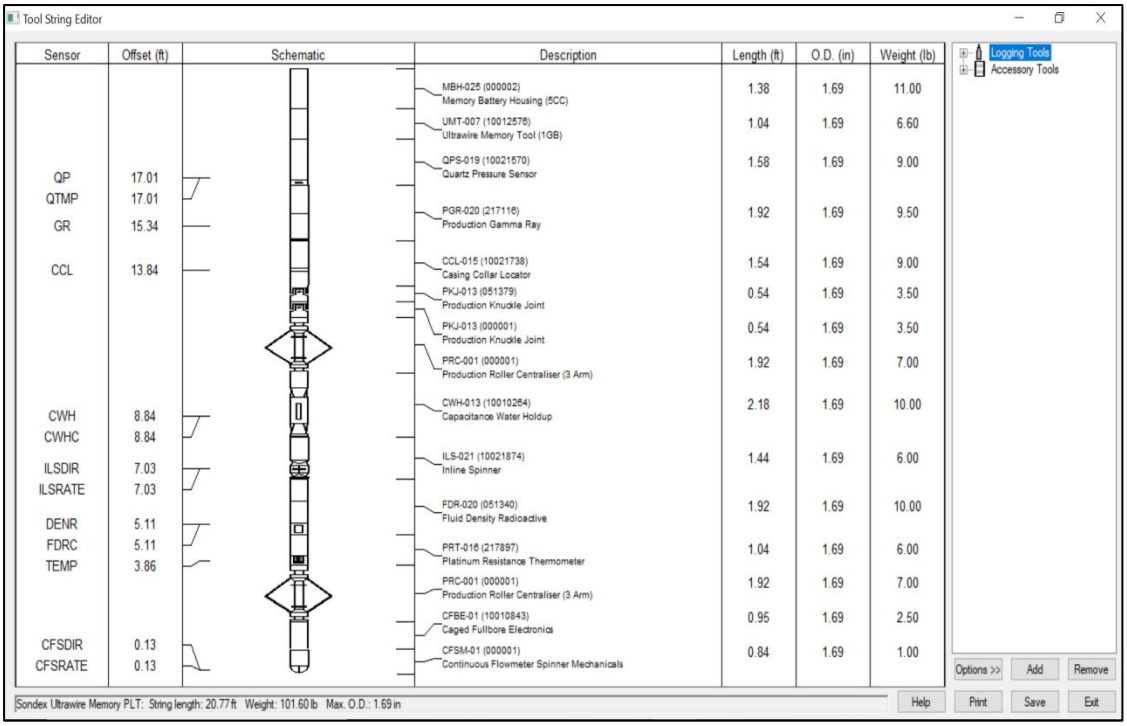


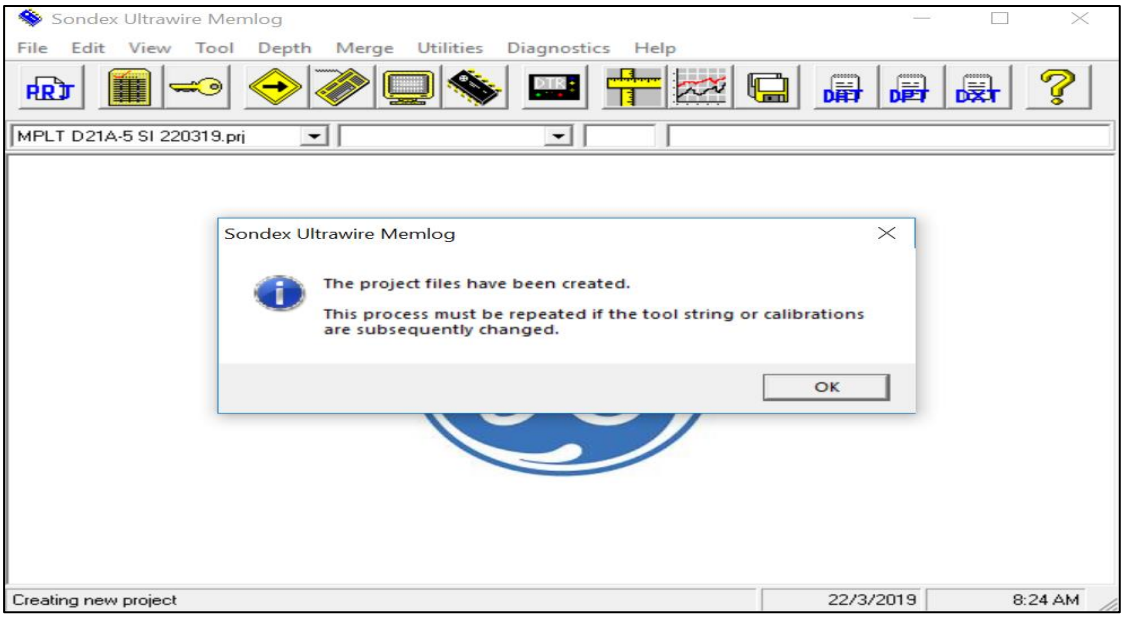
Figure 5 *Example of MPLT Toolstring in Warrior Acquisition*

For MPLT WellSun, you need to create new tool under the same tool model to avoid confusion between Sondex tool.

2.6 Operational check

2.6.1 Programming UMT007 for MPLT

11. Launch *Sondex Ultrawire Memlog*. Create *New Project* . Enter the name of the project.



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12. Open the *Edit Profile*  to write the command. *Log* to record logging data and *Sleep* to turn off the tools (do not record logging data).

    It is necessary to add in a sleep profile to re-set the memory tool after the battery has been connected and the string is made up. This is because if the memory is recording while the string is made up it is possible for an intermittent connection to lock up the tools and the data to be recorded incorrectly. An initial high current draw on the battery may also create a problem.
    You also need to use sleep profile if the toolstring is too long and need to rig up by 2 sections to accommodate into slickline PCE. For example, separate 1st section from MBH until PKJ while 2nd section from PRC until CFS. Put the 2nd section inside first into PCE and clamp by using tool clamp at PRC. Then, 1st section will connect to slickline toolstring using crossover and quick connect. Once 1st section hooked up slickline toolstring, connect the PKJ onto PRC on 2nd section. You may need at least 20 minutes in Sleep profile to complete this rig up.

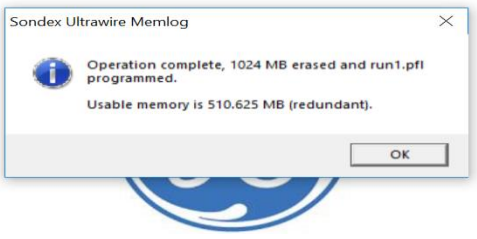
Profile

		Tool Name	UMT	PGR	FDR	ILS	QPS	PRT	CCL	CWH	CFB
		UW Address	0	2	4	7	17	18	19	20	22
		Default Rate s	1.00	0.50	0.50	0.50	0.50	0.50	0.10	0.50	0.50
Start Time (DD:HH:MM:SS)	Profile Length (minutes)	Profile Type	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate
00:00:00:00	2.00	LOG	1.00	0.50	0.50	0.50	0.50	0.50	0.10	0.50	0.50
00:00:02:00	2.00	SLEEP									
00:00:04:00	720.00	LOG	1.00	0.50	0.50	0.50	0.50	0.50	0.10	0.50	0.50

Figure 6 *Example of Profile for MPLT Logging Job*

This example is the screen after we have instructed the tool to
a) Record for 2 mins after connect battery so we can hear the tool beeping while recording
b) Sleep for 2 mins to reset any possible glitches with the tools/power
c) Record for 720 mins to record the logging data until covered all logging interval. It is possible to program for a longer job subject to battery life.

13. For the power consumption, 30 hours are estimated for 1 battery. *UMT Power Consumption Sheet* can be used to calculate the power consumption.
14. Click *Program Tool*  to program the UMT007 based on the profile setting.



15. Hook up the battery and perform the job.

    Please note the hook up time to for merge data purpose

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2.6.2 Testing The Tools in Monitor mode using the UMT

Monitor mode allows the toolstring to be logged real time to Memlog and to Warrior via the UMT. This is a good way to check that all the tools and memory are working properly and the calibrations are correct. Monitor mode is also be used for tool calibration in Warrior.

1. After program the UMT007, connect a **UMU001** to the **UMT007** as in **Figure 7.** Then, connect **MBH** to **UMU001** to power up the toolstring.

   Make sure the red dot is aligned during connecting the USB to UMT007.

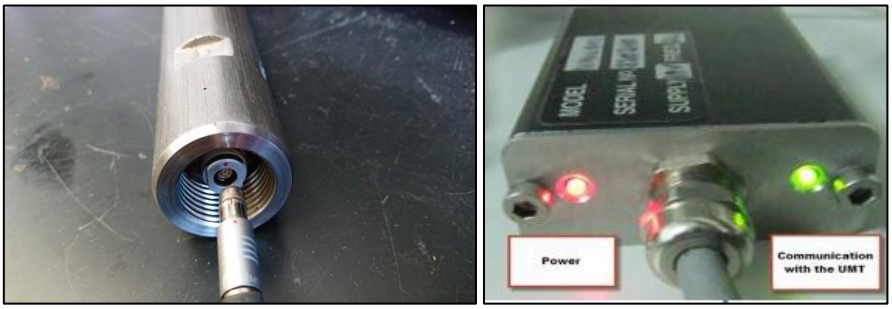
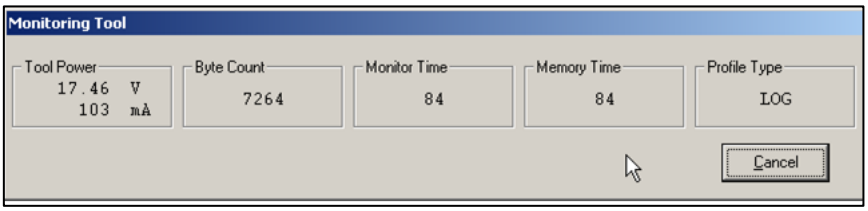


Figure 7 *UMU001 to UMT007*

2. At *Sondex Ultrawire Memlog*, click *Monitor* mode  . At the prompt to start the tool click *Yes* button.

   Note that the monitor mode also starts the tool recording into memory. After testing the memory tool should be re-programmed.

   In *Memlog* a tool status window will be displayed. This will show the total current consumption of the logging string, the data count, the memory elapsed time and the memory tool instruction at that time.



3. At the *Warrior Acquisition*, go to **Monitor → Sensor**. Then continue with **Monitor → Output.**

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Sensors

Name	Source	Channel	Value	Units
LSPD	UWD	3	0.0000	ft/min
LTEN	UWD	4	0.0000	lb
ELTIM	UWD	1	132157733...	sec
ADPTH	UWD	2	0.0000	ft
MINMK	UWD	1	132157733...	sec
CFSRATE	UWD	9	0.0000	cps
CFSDIR	UWD	10	0.0000	
TEMP	UWD	11	0.0000	cps
FDRC	UWD	12	0.0000	cps
DENR	UWD	12	0.0000	cps
ILSRATE	UWD	13	0.0000	cps
ILSDIR	UWD	14	0.0000	
CWHC	UWD	15	0.0000	cps
CWH	UWD	15	0.0000	cps
CCL	UWD	16	0.0000	cps
GR	UWD	17	0.0000	cps
QTMP	UWD	19	0.0000	cps
QP	UWD	18	0.0000	cps
QTMP	UWD	19	0.0000	cps
VBAT	UWD	20	0.0000	
IBAT	UWD	21	0.0000	
UMTTEMP	UWD	22	0.0000	
UMTCURR	UWD	23	0.0000	

Outputs

Name	Source	Value	Units
LSPD	[STD]	0.0000	ft/min
LTEN	[STD]	0.0000	lb
ELTIM	[STD]	132157736...	sec
ADPTH	[STD]	0.0000	ft
MINMK	[STD]	0.0000	
LTENRT	[STD]	0.0000	lb
DLTENRT	[STD]	0.0000	lb
LSPDRT	[STD]	0.0000	ft/min
CFS	[CFSM]	0.0000	rps
TEMP	[PRT]	-21.8959	degC
DTMP	[PRT]	0.0000	degC
FDRC	[FDR]	0.0000	cps
DENR	[FDR]	0.0000	g/cc
ILS	[ILS]	0.0000	rps
CWHC	[CWH]	0.0000	cps
CWH	[CWH]	5.7752	
CCL	[CCL]	0.0000	
CCLRT	[CCL]	0.0000	
GR	[PGR]	0.0000	GAPI
QTMP	[QPS]	299.7868	degC
QP	[QPS]	-26640.8555	psi
DQP	[QPS]	0.0000	psi/ft
QPSG	[QPS]	0.0000	
VBAT	[UMT]	0.0000	V
IBAT	[UMT]	0.0000	mA
UMTTEMP	[UMT]	-0.0000	degC
UMTCURR	[UMT]	0.0000	mA

Monitor sensors allows us to check the original counts and any data problems. Monitor outputs allows us to check that the calibrated outputs are correct.

During monitor mode the tool response to change can be tested such as rub a CCL with a spanner to see a change, touch the temperature probe etc.

4. Click *Cancel* and all tool data will be saved inside the UMT memory. You may download the tool data for reference and record.

2.6.3 Field Calibration Method

A) Calibration by using monitor mode in Sondex Ultrawire Memlog

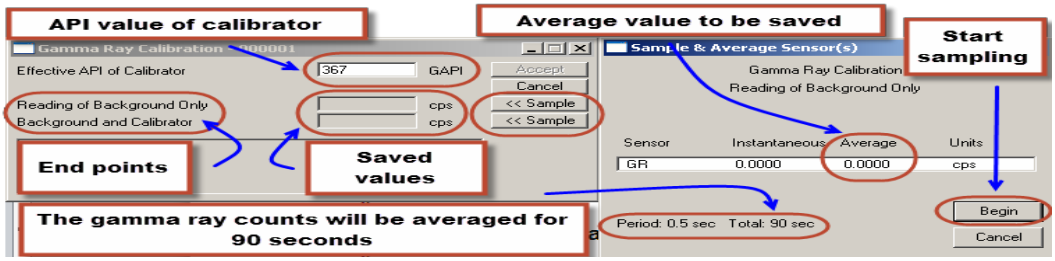
The best method is to connect the computer to the UMT tool via UMU and transfer the tool data into Warrior real time in tool in monitor mode. Use MBH and connect to UMU for power supply. The procedure is then similar to a surface readout calibration.

Gamma Ray

The standard tool outputs around 1 count per API. Therefore it may be run un-calibrated plotting raw counts on the log. The gain = 1 and the Offset = 0

If a calibration jig is available the following procedure should be followed.

a) On Warrior Acquistion,Select **Action → Calibrate → Gamma Ray**



b) Enter the value of the calibration jig (written on it)

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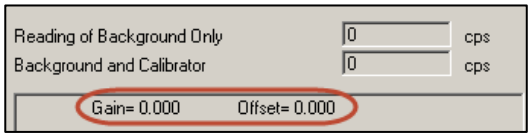
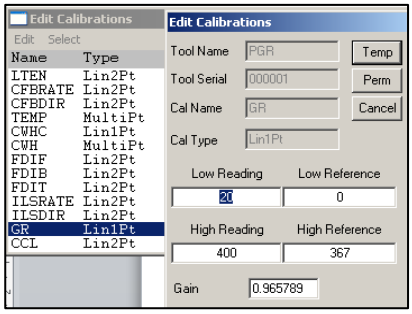
c) Sample without the calibration jig by clicking on the sample button for Reading of Background only
d) Click on Begin. The readings will be averaged for 90 seconds. When finished click on Accept to save the value.
e) Sample without the calibration jig placed on tool in the correct position by clicking on the sample button for Background and Calibrator.
f) Click on Begin. The readings will be averaged for 90 seconds. When finished click on Accept to save the value.
g) The gain (slope) and Offset of the calibration will be calculated in API/cps and cps. The gain is the value of calibrator/ (count rate with the calibrator – background)
For example: cal jig = 367 API, Background = 20 cps, with cal jig = 400 cps
The slope = 367/ (400-20) = 0.9658 API/cps
h) Make a note of the Gain. Clicking on Accept will update the calibrations for that tool.
i) Examine the calibration using Edit, Calibrations, GR. The gamma ray has a 1 point calibration.
j) The value for the slope will be displayed. Edit this value if incorrect.





Radioactive Density

The FDR density tool has calibrations in air and water real time with values for oil and salt water manually added in.

The basic calibration is in air (0 g/cc) and fresh water (1 g/cc) with intermediate calibration end points based on correlations.

a) Take a reading in air
b) Wrap the FDR sensor port with masking tape. Punch a small hole to fill up water inside the probe. Put the water inside FDR sensor port.
c) Take a reading in fresh water.
d) For an oil density of 0.846 g/cc the calibration value is 1.432 x the fresh water reading
e) For a salt water density of 1.2 g/cc the calibration value is 0.447 x the fresh water reading

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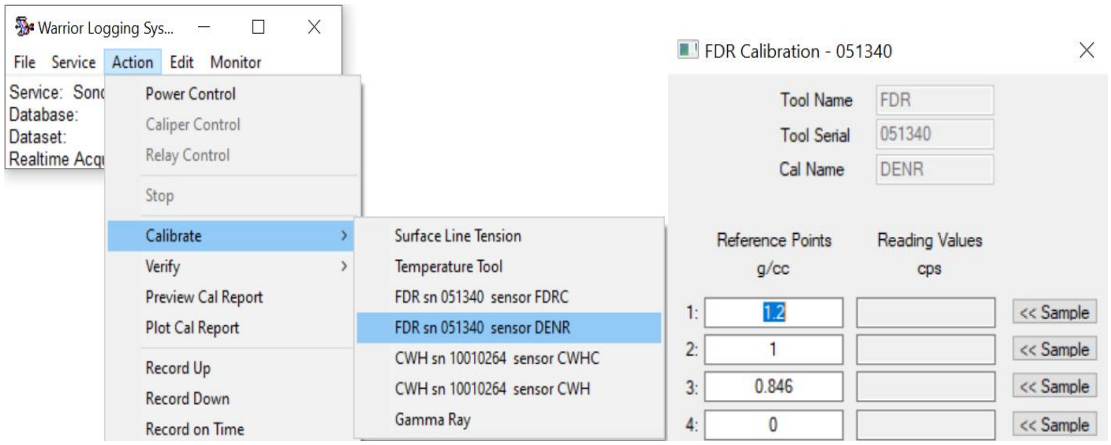
Fluid Type	Density g/cc	Value, cps	Remarks
Air	0	Air reading	Should be about 6.815 x the water reading
Oil	0.846	Calculated	The reading in fresh water x 1.432
Fresh Water	1	Water reading	The reading in fresh water
Salt Water	1.2	Calculated	The reading in fresh water x 0.447

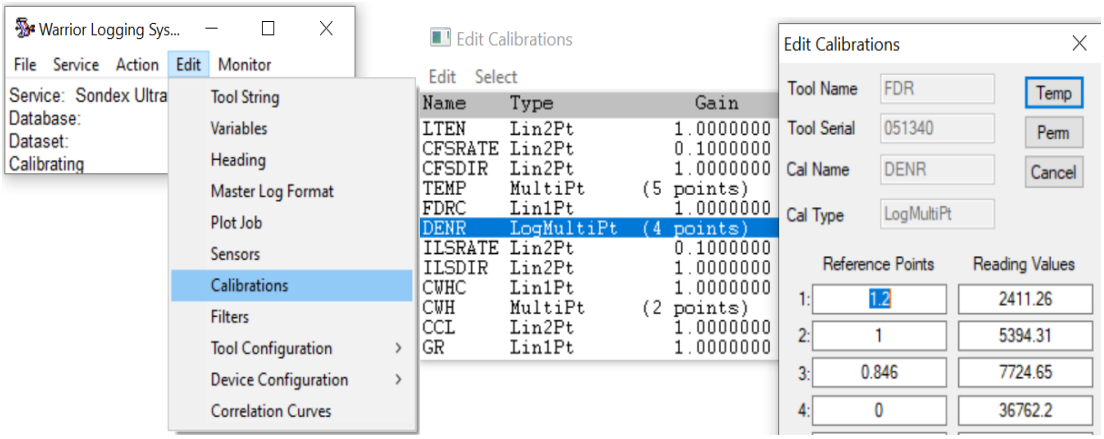
Example Calibration

Air Reading		34800	cps
Fresh Water Reading		5100	cps
Fluid Type	Density g/cc	Value, cps	Remarks
Air	0	34800	Actual reading in air
Oil	0.846	7303	The reading in fresh water x 1.432
Fresh Water	1	5100	The reading in fresh water
Salt Water	1.2	2280	The reading in fresh water x 0.447

f) Open Warrior, Select **Action → Calibrate → DENR**
g) Enter the 4 density reference points (at sea level air should be 0.0046 g/cc)
h) Sample in air (average 90 seconds) and save
i) Sample in fresh water (average 90 seconds) and save. Make sure there are no air bubbles in the sensor window.
j) Sample for oil and salt water – for editing later
k) Accept the calibration



l) On Warrior Acquisition, open **Edit → Calibrate → DENR** and manually overwrite the oil and salt water frequencies with the calculated values



m) Save permanently or temporarily as requested

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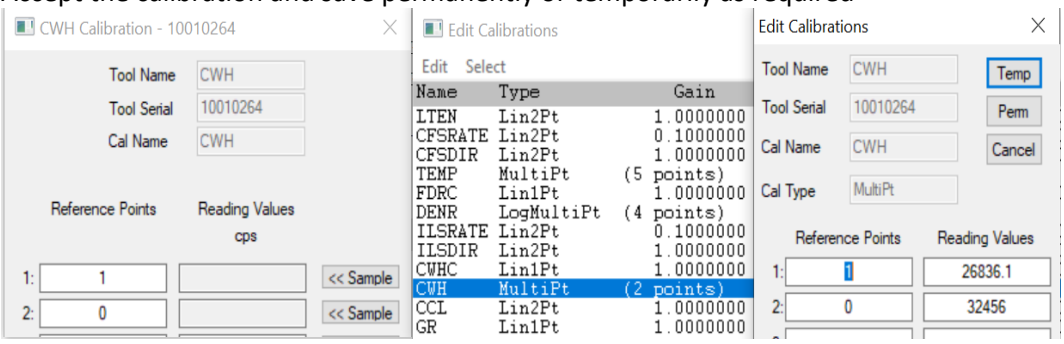
Capacitance Water Holdup

The calibration record is made in air and water. It is important that the insulator is clean and dry for the air reading.

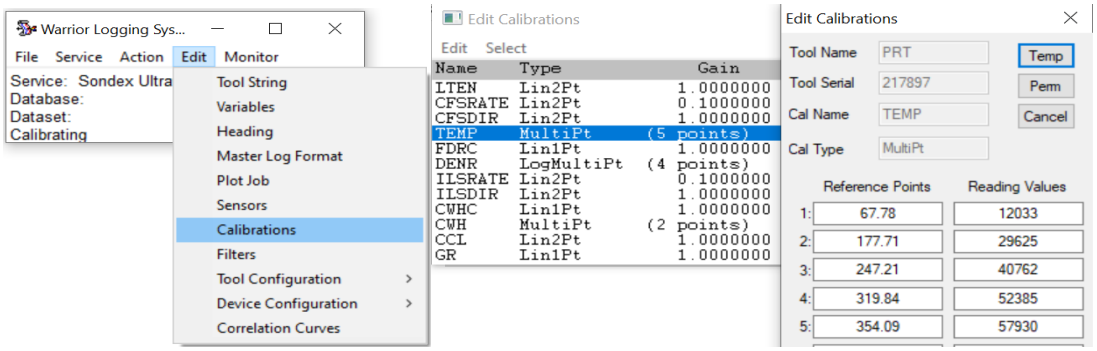
a) Open Warrior, Select **Action → Calibrate → CWH**
b) Take a reading in air and accept
c) Wrap the CWH sensor port with masking tape. Punch a small hole to fill up water inside the probe. Put the water inside CWH sensor port.
d) Take a reading in fresh water and accept
e) Accept the calibration and save permanently or temporarily as required



Temperature

The calibrations supplied by the manufacture are valid for the life of the tool. Therefore these should be edited directly into *Warrior* using *Edit Calibrations*

Cal Files are available in the CHS server *Y \\Chs-synology\chs\11_Lab\2.CALFILES\PRT*



B) Calibration by recording into the UMT memory using battery power

You can calibrate using this method for PGR, FDR and CWH.

a) Program the UMT as step 2.6.1
b) Make up the complete toolstring
c) Connect the battery to the UMT. Record the start time
d) Let all the sensors to record air/background reading for 5 minutes.
e) Place on GR jig to PGR sensor to record the reading for 5 minutes

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f) Wrap both CWH and FDR sensor port. Punch a small hole to fill up water inside the sensor port. Put the fresh water inside CWH and FDR sensor port.

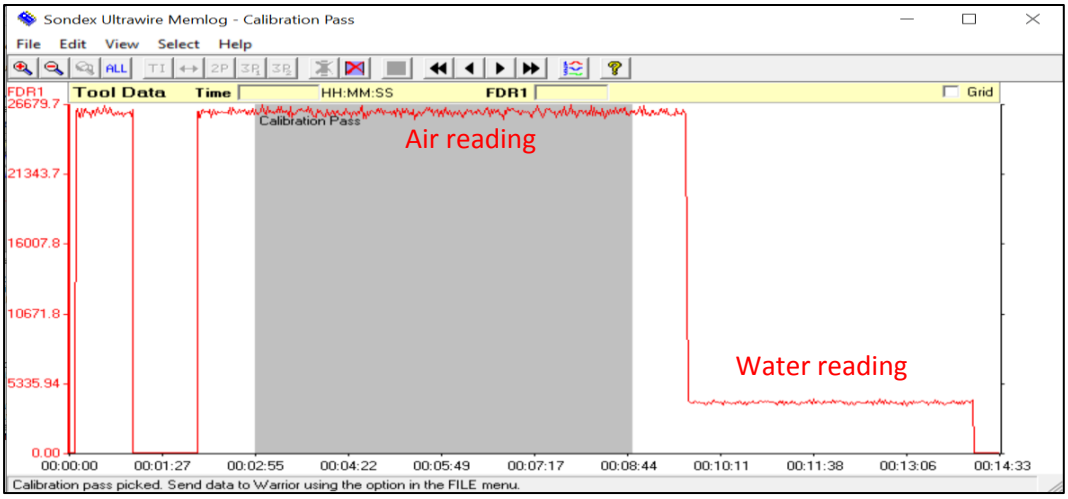
f) Let the FDR and CWH sensors to record the reading (with fresh water) for 5 minutes

g) Disconnect the battery and download the UMT data to the Ultrawire Memlog project.

h) Open the *Warrior acquisition* and select the PL service that was used to program the UMT

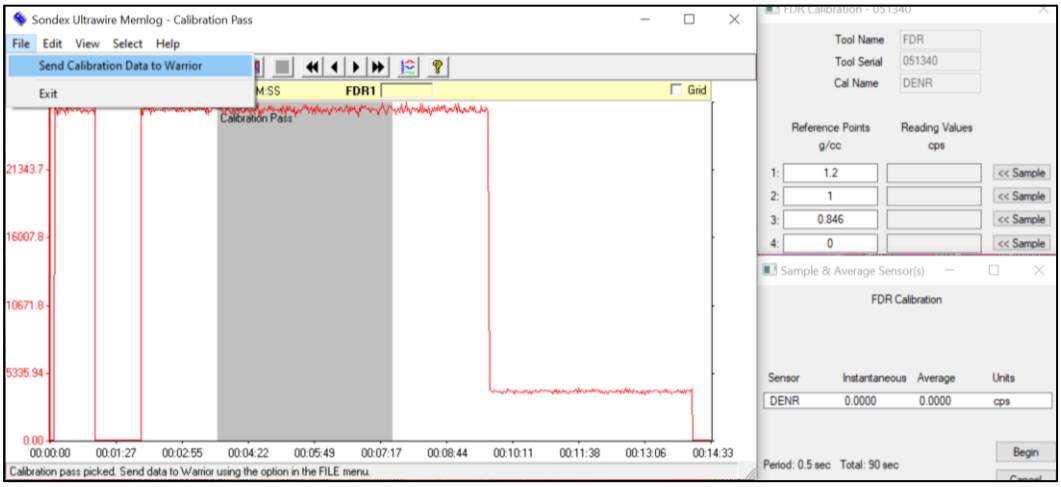
i) Click on *Output Calibration* button  in *Ultrawire Memlog*. Choose one sensor to perform calibration, for example FDR.

j) Select the beginning and end of the recorded calibration data. The data will be marked as *Calibration Pass*. This data will later be transferred 'real time' to *Warrior*. We will calibrate for air reading first.



k) On Warrior Acquisition, select **Action → Calibrate → DENR.** To calibrate air reading which is Reference Point = 0 g/cc, enter 0 on line 4 and click Sample.

l) Go back to Ultrawire Memlog. Select **File → Send Calibration Data to Warrior**



m) A cursor will be seen in the *Ultrawire Memlog* slowly moving left to right indicating the current calibration data being passed to *Warrior*.

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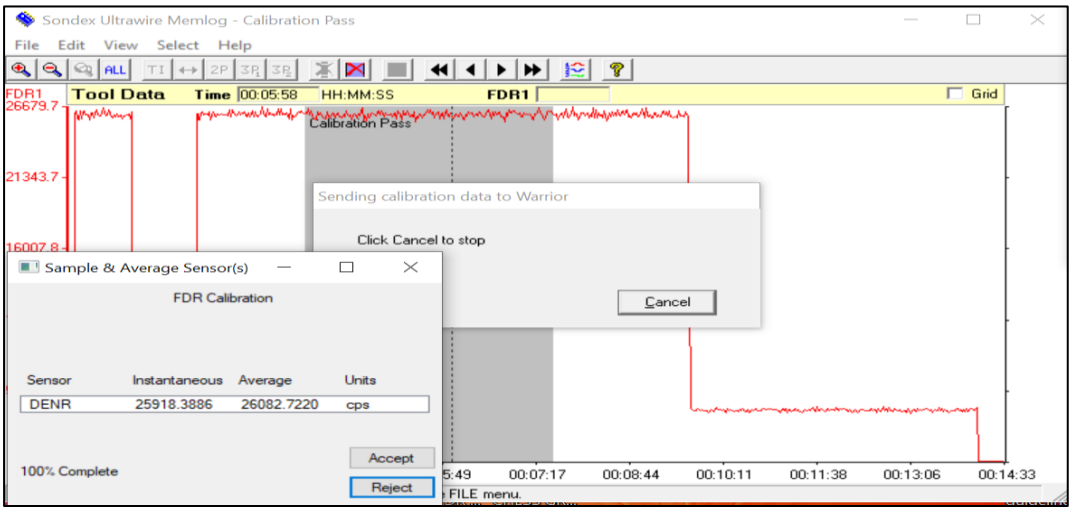
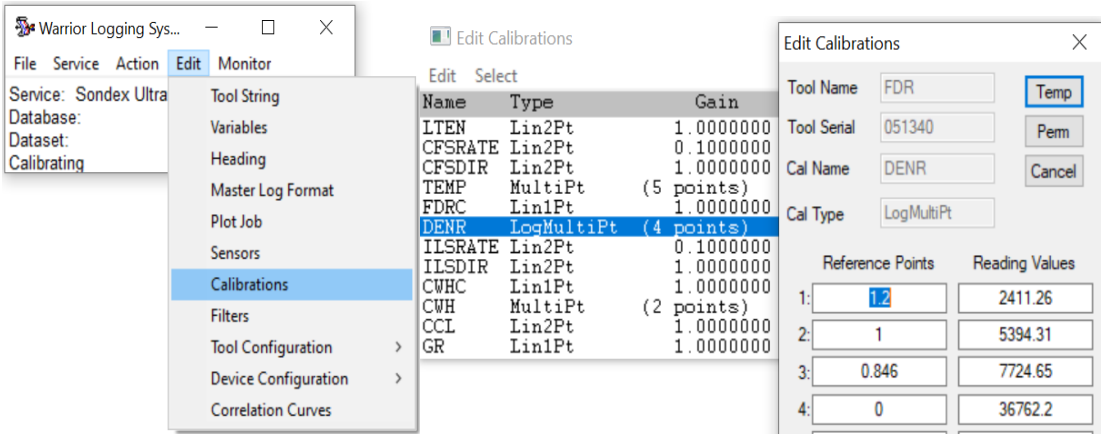
k) Click *Begin* on FDR Calibration. The readings will be averaged for 90 seconds. When finished click on *Accept* to save the value.



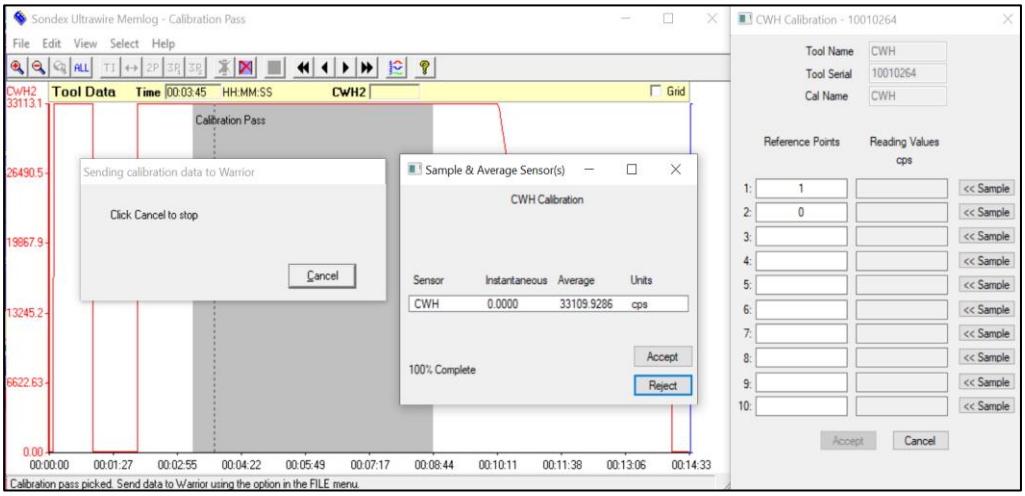
n) Repeat step (j) until (k) to calibrate for water reading.

o) On Warrior Acquisition, open **Edit → Calibrate → DENR** and manually overwrite the oil and salt water frequencies with the calculated values



p) Save permanently or temporarily as requested

q) For CWH calibration, repeat step (j) until (k) to calibrate in air and water.



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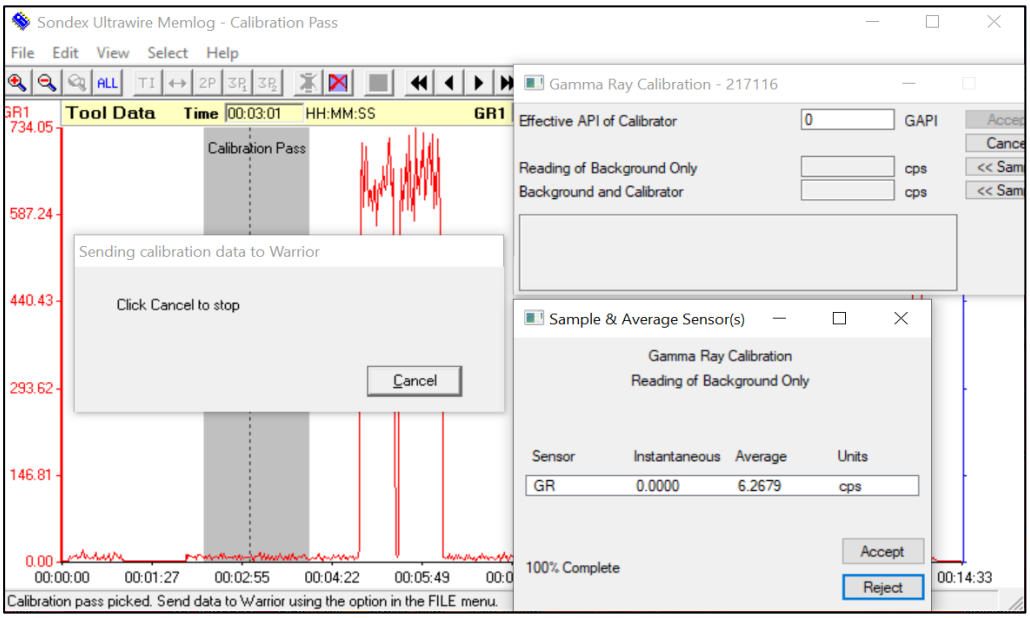
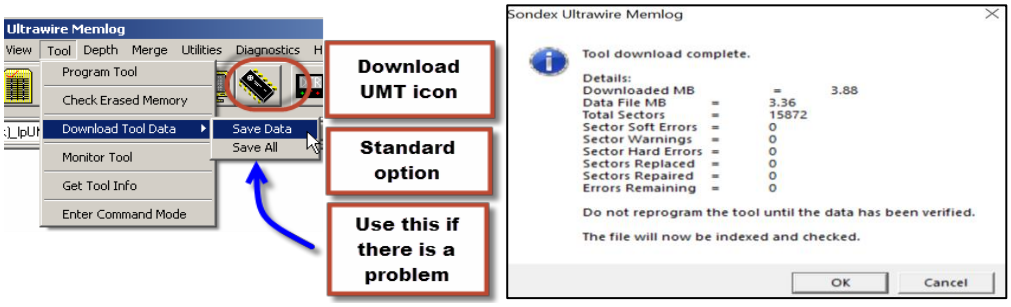
r) For PGR calibration, same step from (j) until (k) for calibrate background reading and with jig reading.

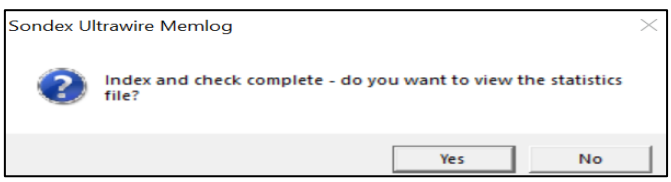


2.6.4 Downloading & Processing the Data

1. Connect UMU001 to the UMT007 as in **Figure 7** and a computer.
2. At *Sondex Ultrawire Memlog*, click *Download Tool data* to download the data from UMT007.



After the memory is downloaded the status will be shown. There will then be a prompt of to check the file. Clicking *Yes* will give you the statistic of the job.



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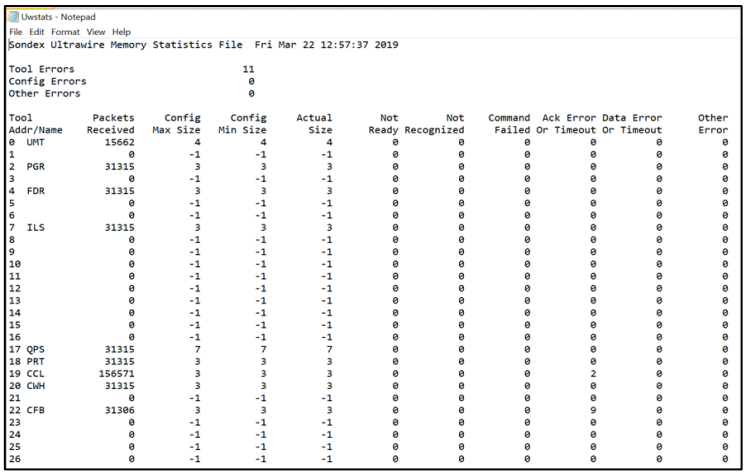
The next screen examines the file to look for errors. The screen is only available when you download the memory. To view it again you will have to go to C:\Warrior\Data and open the *Uwstats.txt* file. This file will be overwritten next time a tool is downloaded. If there has been a problem with the job keep a copy of this file for troubleshooting.


Uwstats - Notepad

File Edit Format View Help

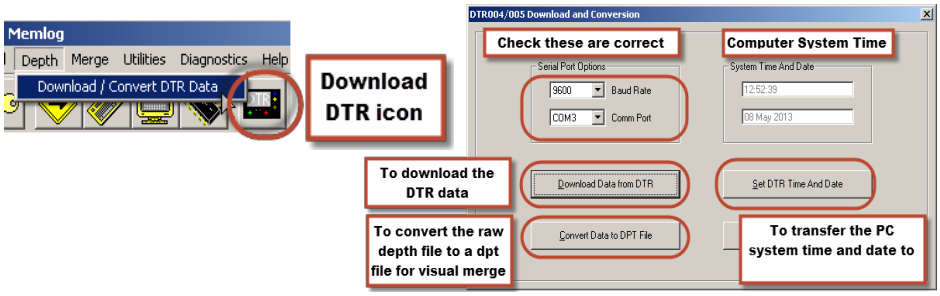
Sondex Ultrawire Memory Statistics File Fri Mar 22 12:57:37 2019

Tool Errors 11
Config Errors 0
Other Errors 0

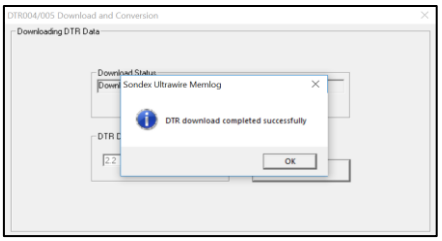
Tool Addr/Name	Packets Received	Config Max Size	Config Min Size	Actual Size	Not Ready	Not Recognized	Command Failed	Ack Error Or Timeout	Data Error Or Timeout	Other Error
0 UMT	15662	4	4	4	0	0	0	0	0	0
1	0	-1	-1	-1	0	0	0	0	0	0
2 PGR	31315	3	3	3	0	0	0	0	0	0
3	0	-1	-1	-1	0	0	0	0	0	0
4 FDR	31315	3	3	3	0	0	0	0	0	0
5	0	-1	-1	-1	0	0	0	0	0	0
6	0	-1	-1	-1	0	0	0	0	0	0
7 ILS	31315	3	3	3	0	0	0	0	0	0
8	0	-1	-1	-1	0	0	0	0	0	0
9	0	-1	-1	-1	0	0	0	0	0	0
10	0	-1	-1	-1	0	0	0	0	0	0
11	0	-1	-1	-1	0	0	0	0	0	0
12	0	-1	-1	-1	0	0	0	0	0	0
13	0	-1	-1	-1	0	0	0	0	0	0
14	0	-1	-1	-1	0	0	0	0	0	0
15	0	-1	-1	-1	0	0	0	0	0	0
16	0	-1	-1	-1	0	0	0	0	0	0
17 QPS	31315	7	7	7	0	0	0	0	0	0
18 PRT	31315	3	3	3	0	0	0	0	0	0
19 CCL	156571	3	3	3	0	0	0	2	0	0
20 CWH	31315	3	3	3	0	0	0	0	0	0
21	0	-1	-1	-1	0	0	0	0	0	0
22 CFB	31306	3	3	3	0	0	0	9	0	0
23	0	-1	-1	-1	0	0	0	0	0	0
24	0	-1	-1	-1	0	0	0	0	0	0
25	0	-1	-1	-1	0	0	0	0	0	0
26	0	-1	-1	-1	0	0	0	0	0	0

3. Connect the DTR to the computer via the download lead. Turn on DTR and make sure that the top screen **(P+F encoder)** is seen.

4. Click on download button or icon.



Click on the *Download DTR from DTR*. You will be prompted for the name for the RAW file which will be the same as the profile name. Click on OK and the progress of the download will be displayed.



Check on Pulse per Revolution and Wheel Circumference and ensure it is correct. When ready click on *Process*. This will generate a DPT file with the name as the profile.

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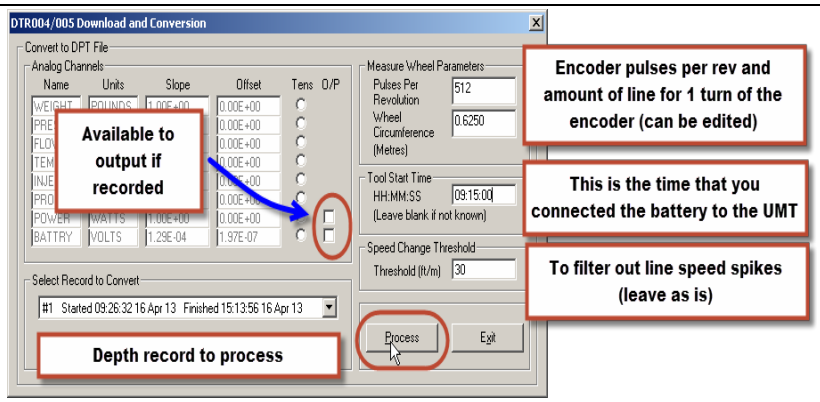

2.6.5 MPLT Data Processing

5. At Ultrawire Memlog, click on *Merge Data* . You will be prompted for which curve to use for merging. Choose 2 tools where the reading will change with changing depth and line speed. For an PLT this will be
   CCL- when tool starts moving the CCL signal will change.
   Pressure (QPS) – logging down increase pressure, logging up decrease pressure.
6. Go to *Options* and insert start time for tools. DTR time will automatically insert.
7. Next, you need to tie in (synchronize) the tool data to the depth. First of all, you will zoom in on the same part of the job in depth and tool data windows. Click on 2 points within each window that you wish to zoom in on and select zoom. If you accidently have too many cursors click on the delete cursor button.

   On the tool window below we can see the toolstring start moving as CCL change from the stationary readings to moving readings. In this example when we log up, CCL shows movement and the pressure decrease. In depth window line speed goes to negative and the depth decrease.

   Mark the exact start of the logging pass in the tool and the same moment in the depth window by left hand clicking at the exact places with the mouse. After finish, you may click *Tie In* or go **Edit → Set Tie Ins.**

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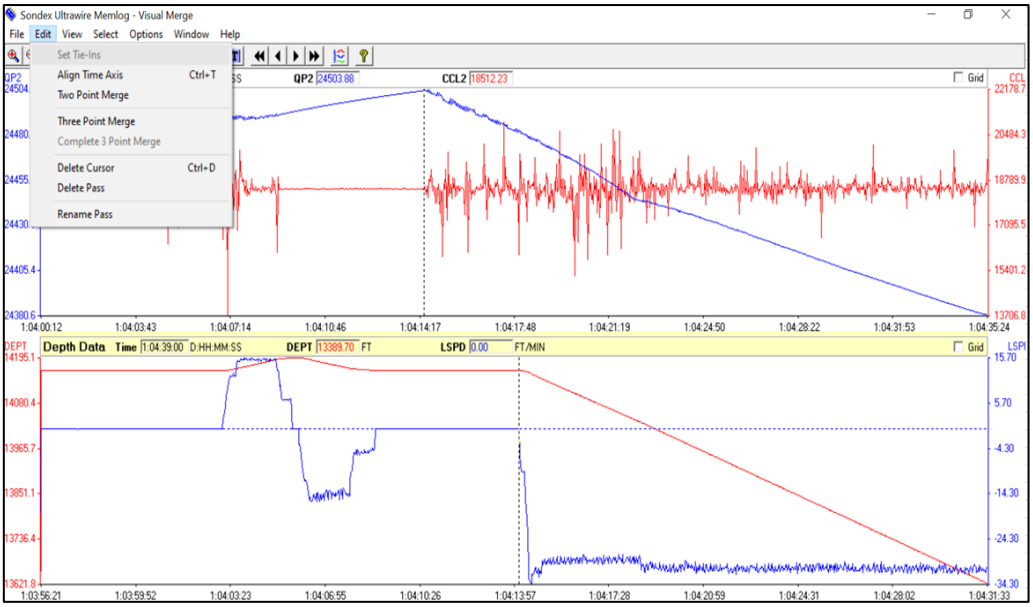
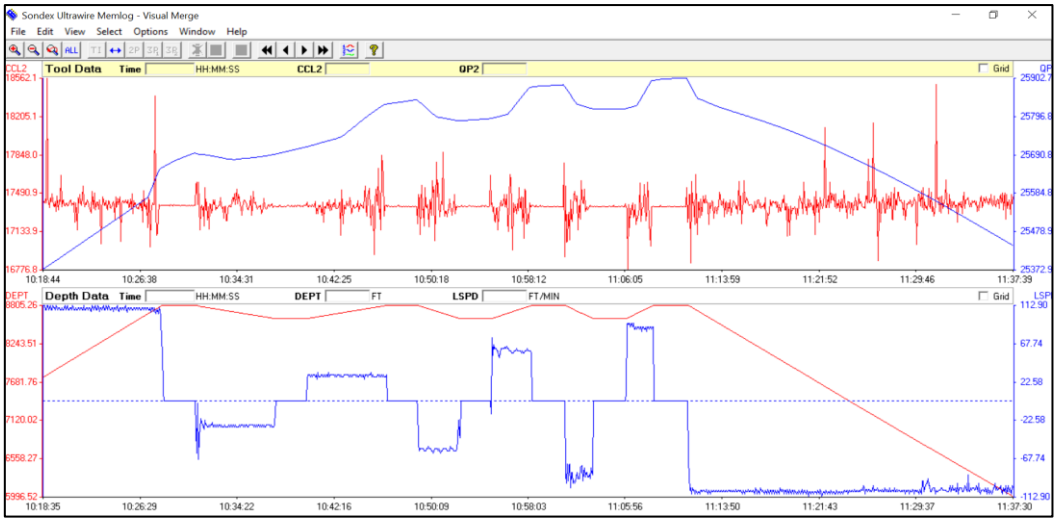


The data sets will now align. If not, click on **Edit → Allign Time Axis.** Click on *All* to view all the logging data.



8. To create passes, you may zoom either depth data or MPLT data. Using zoom and the arrow keys in the menu bar precisely mark at the start and end of the logging pass in the tool/depth data. When zooming in or moving across the screen the tool data should align automatically. If it does not, use the **Edit → Allign Time Axis**.

9. Click from start depth/data movement/spike then click at the end of depth/data movement/spike. Click *2 Point Merge* to create passes. 

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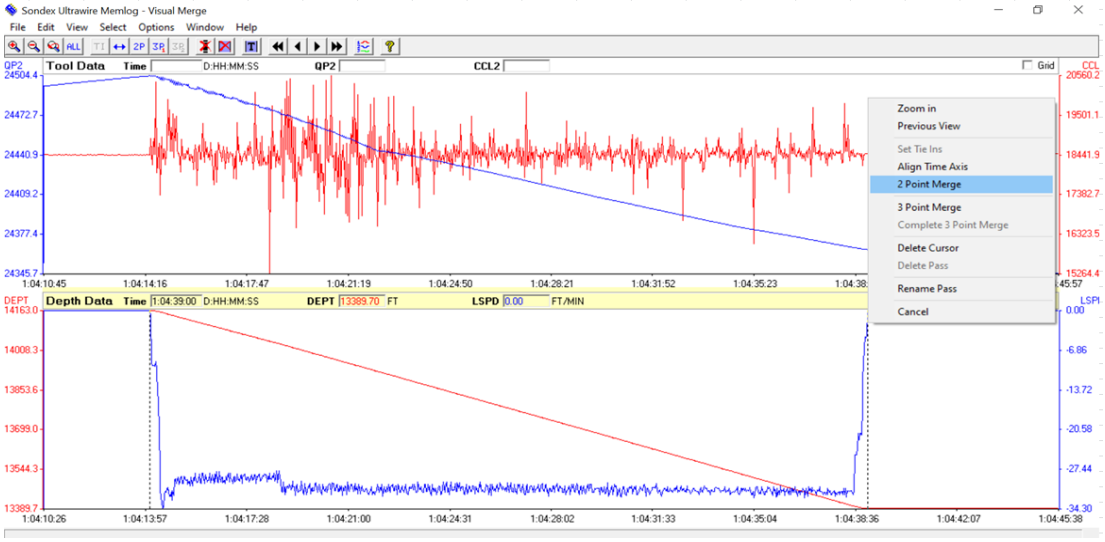

10. Proceed to create all the passes and name each logging passes correctly and with identical 'short form manner'. For example

    a. Run in hole at 120 ft/min = ***RIH_120***
    b. Logging Down at 30 ft/min in Shut In condition = ***SI_D30*** or ***SID30***
    c. Logging Up at 60 ft/min in Shut in condition = ***SI_U60***
    d. Logging Down at 90 ft/min in Flowing 50 MMscf/D rate = ***FL50_D90***
    e. Logging Up at 30 ft/min in Flowing 10 MMscf/D rate = ***FL10_U30***
    f. Station stop Shut In at 4000 ft = ***STSI_4000***
    g. Station stop Flowing at 4000 ft (50 MMscf/d rate) = ***STFL50_4000***
    h. Pull out of hole at 100 ft/min = ***POOH_100***
    Remark: **Naming the passes will be varies depend on the Client's requirements.**

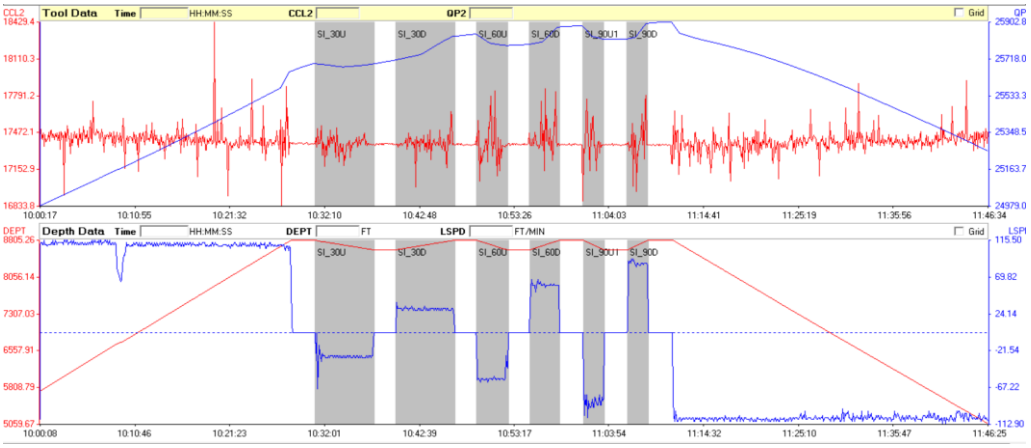

Figure 8 *Merge Passes on Sondex Ultrawire Memlog*

11. Once complete, go to **File → Save Picked Passes to MRG file**. Then, exit.

12. Go to *Merge* and click *Output Passes*  .
    Make sure logging stations are identified as time based – if depth was changing during the stations the program will assume this is a depth based logging pass.

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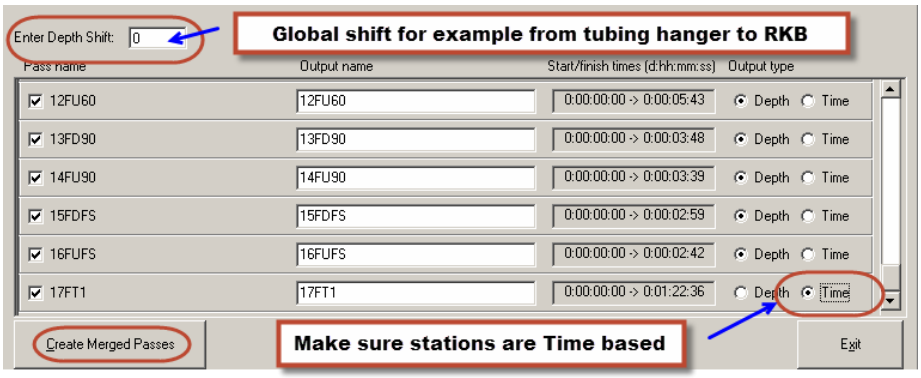
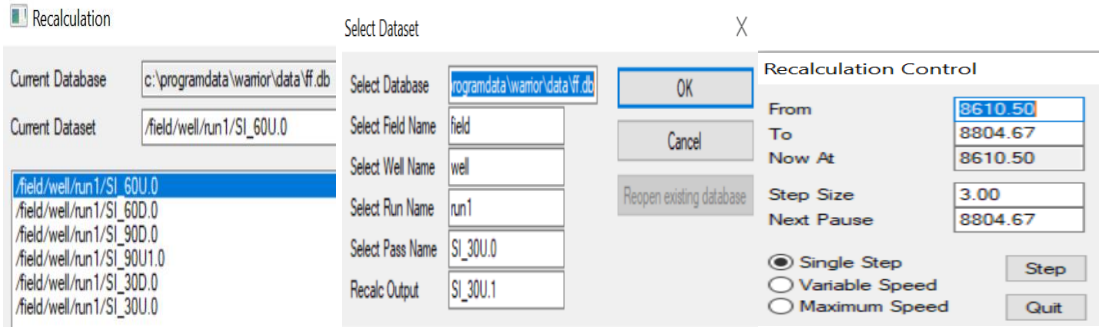
There is also the option to add a global depth shift (for example a depth offset from tubing hanger to RKB) to all the passes.



13. When ready click on *Output Passes*. Open the database (db) file that you have been working with or enter a new Warrior database Name, Field, Well and Run Number. Click on *OK*. The merged passes will be transferred to the Warrior database.
14. You will be prompted whether to open Warrior *Re-calculation*. Click *Yes*. Data will be sending to the *Warrior Acquisition* for re-calculation.
15. On Warrior *Re-calculation,* click **File → Select Dataset**. Select the database file that you already created/named with the logging pass for re-calculation.
16. The merged passes will have a suffix .0 to donate that these are original passes. Select the pass to re-calculate (you will have to re-calculate all the passes individually)



17. The new name of the re-calculated pass will be shown with a suffix .1 etc. Click on *OK*. When ready click on *Maximum Speed*. The logging pass will now be re-calculated and displayed on the screen using the presentation file that has been associated with the service.

18. Repeat to re-calculated the rest of the logging passes. The recalculated logs can be viewed using interactive plot. The presentation file attached to the service will be the default. If it is not suitable select a different one.

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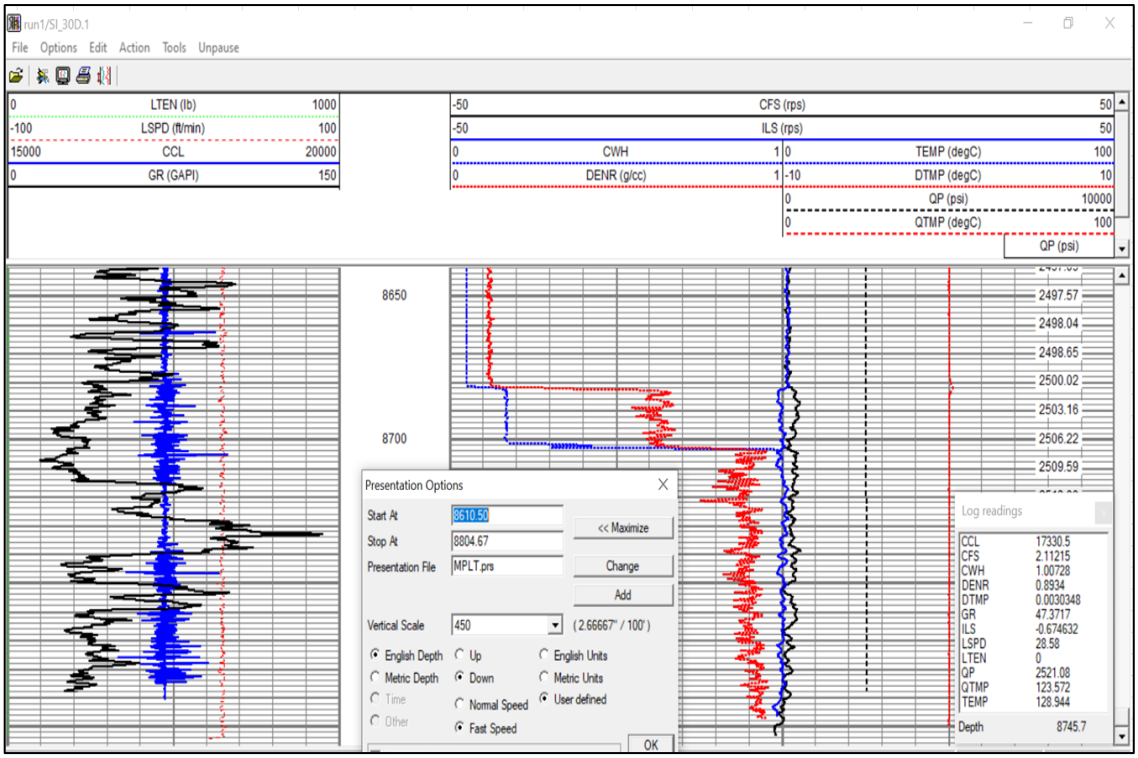
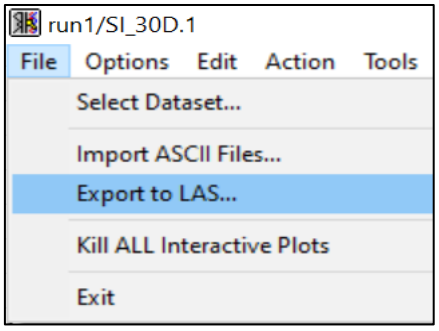
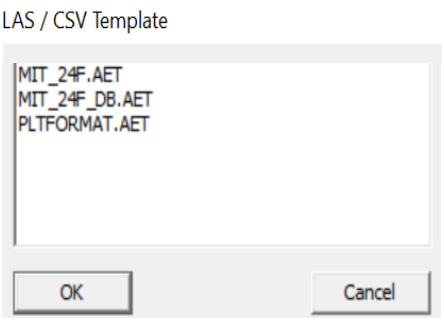


Figure 9 *Sensor Data on Warrior Interactive Plot*

19. Perform QA/QC on data. If the data is good, engineer will proceed to send the data to log analyst for further analysis and at the same time produce quick look report.
20. To export las file, on Warrior Interactive Plot, go to **File → Export to LAS**





21. You will be prompted to choose LAS/CSV Template. Select the template that you already created or you can create new template later. Click *OK*. Las file will be saved in the **Warrior Data** folder (you can be change in Data Destination). Default name for the exported las file is *export*, you need to change to appropriate name as *Step 10* in *File Base Name*.

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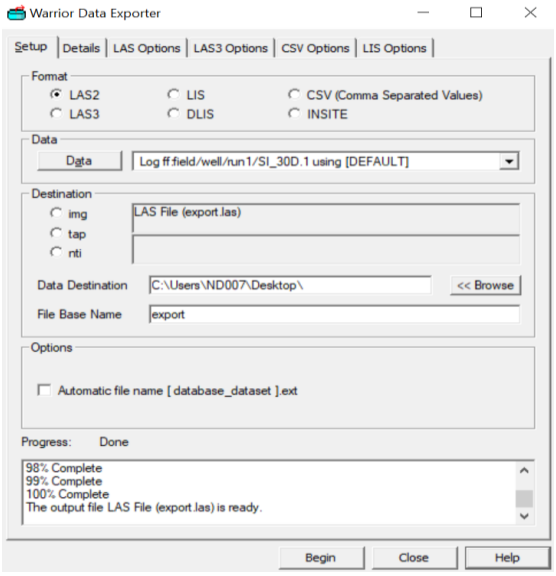

22. It is recommended checking on *Details* in *Warrior Data Explore* to make sure all the required logging data for interpretation are exported. You also can choose the unnecessary data not to be sent by right click on the list.

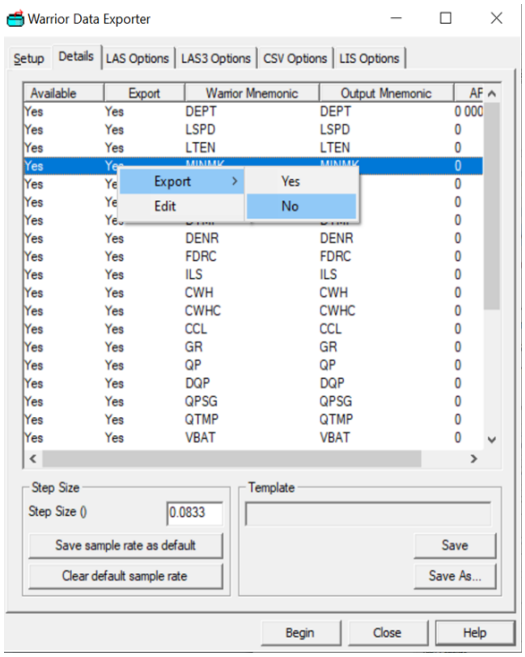

Figure 10 *Warrior Data Explore*

23. You can save the template by click on *Save* or *Save As* as you prefer. When ready, click on *Begin* to export.
24. Repeat to export the rest of the logging pass.

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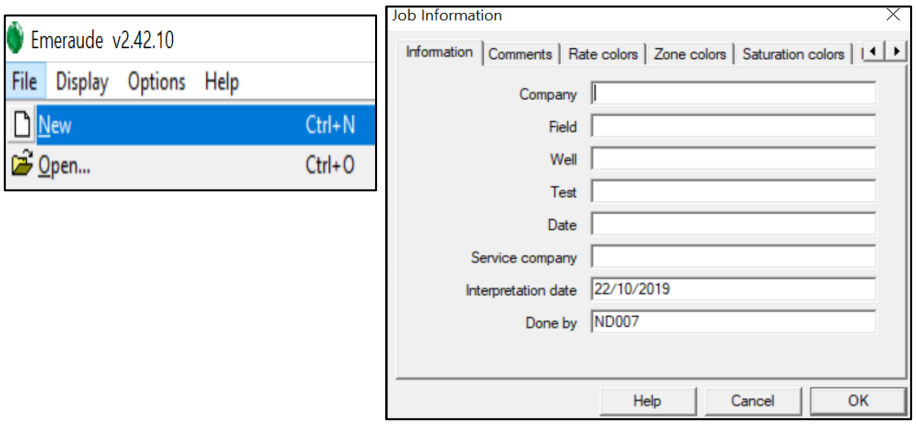
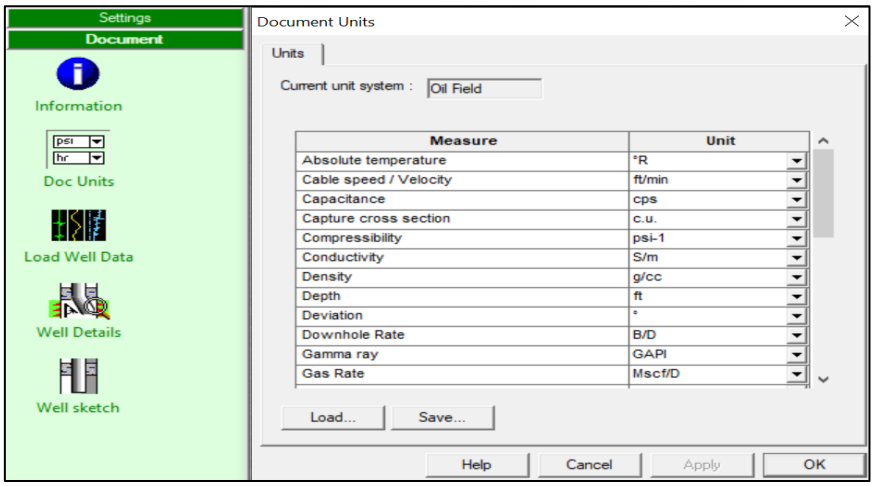
2.6.6 View MPLT Data in Emeraude

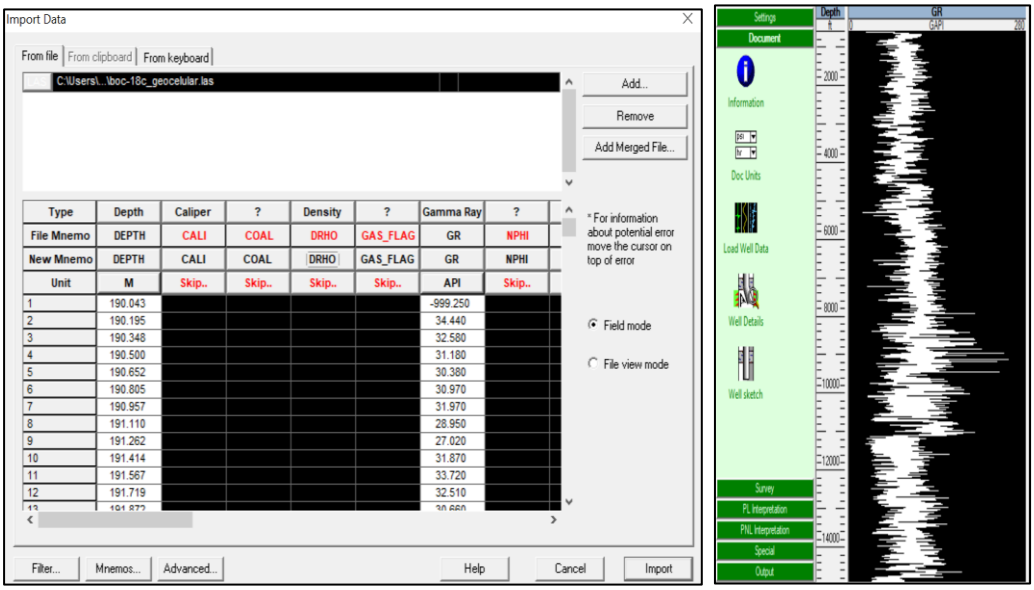
1. Open Emeraude Software. Select **File → New Document**. Fill up all related info on the *Job Information*.



2. You can change unit system at *Doc Units*



3. Click on *Load Well Data* to import OHGR las file provided from client. Click *Add* and choose the OHGR file. Skip the unnecessary data, choose only GR. When ready click *Import*. OHGR log will appear as white line on the log.



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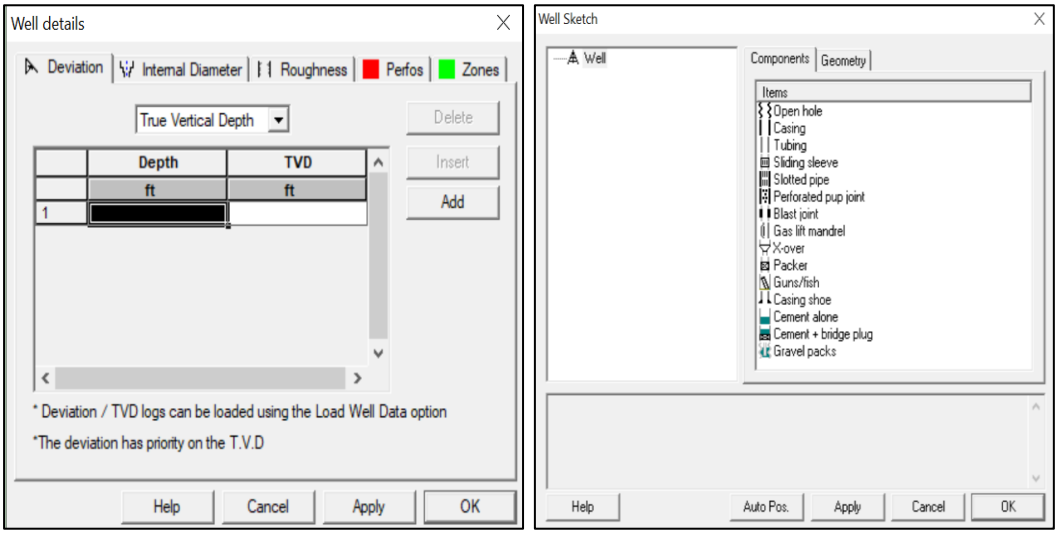
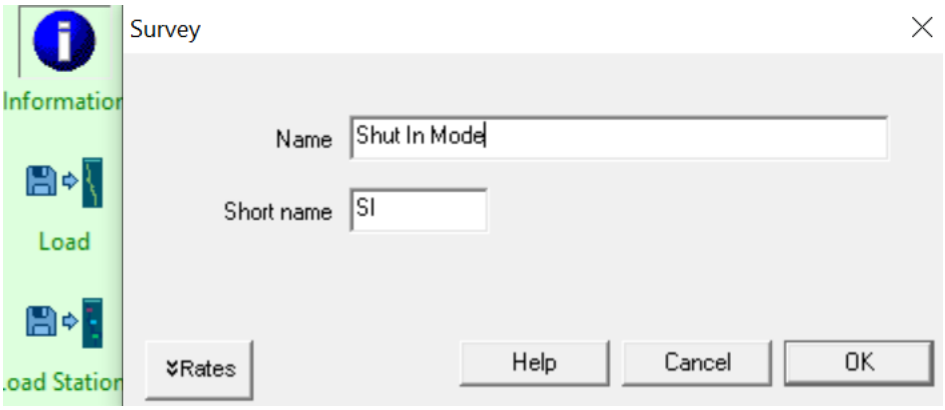
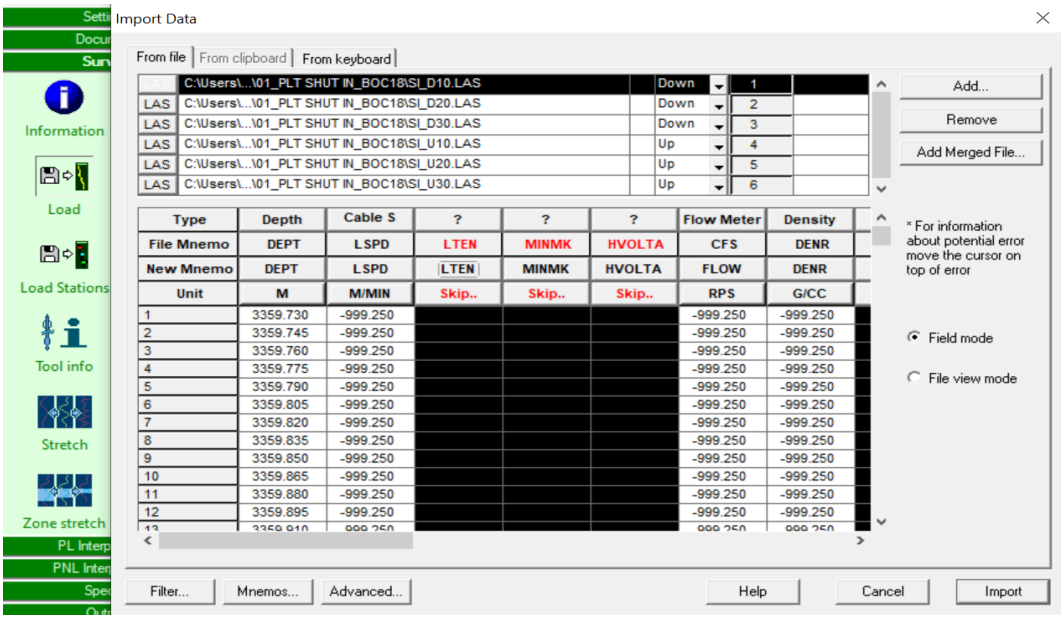
4. You can add *Well Details* and *Well Sketch* if necessary on the log by click on the button.



5. Go to *Survey* and click button *Information* to create new survey. Name the survey based on MPLT condition, example Shut In Mode. Click OK.



6. Click *Load* to import all logging passes from las files exported from Warrior. Define each pass properly for Up or Down Pass. Skip all the unnecessary data for each pass and when ready click *Import*.



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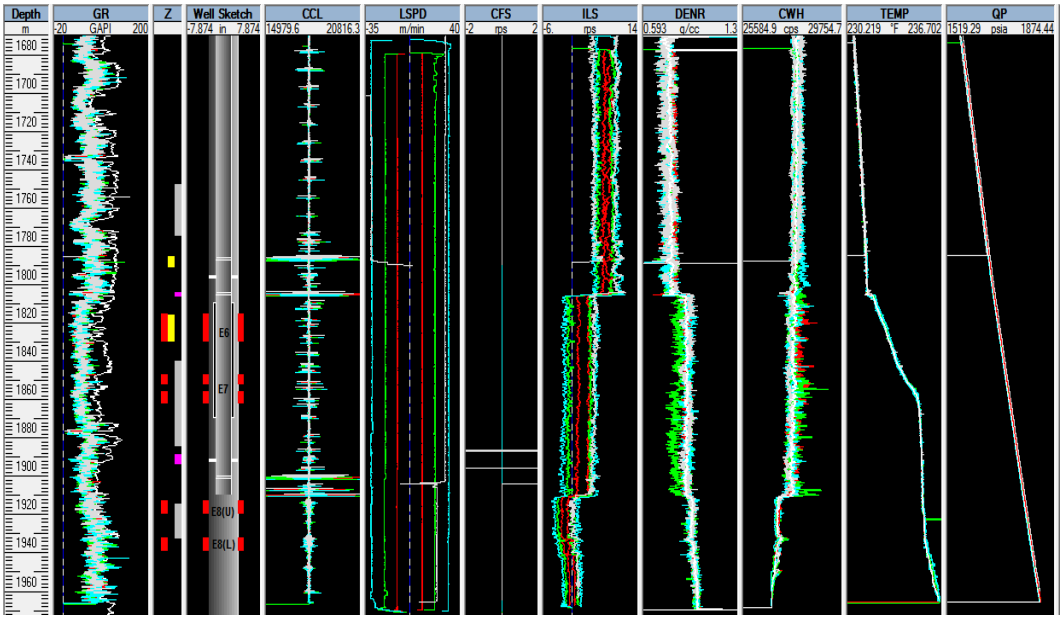
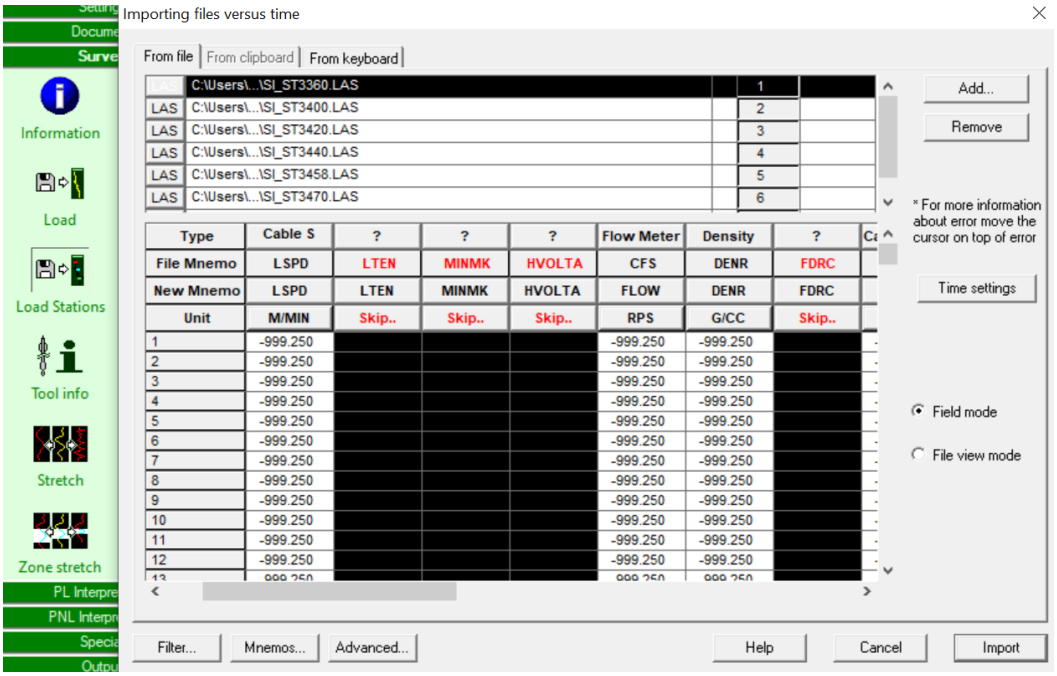


7. Go to *Load Stations* to add all station stop pass. Skip all the unnecessary data for each pass and when ready click *Import*.



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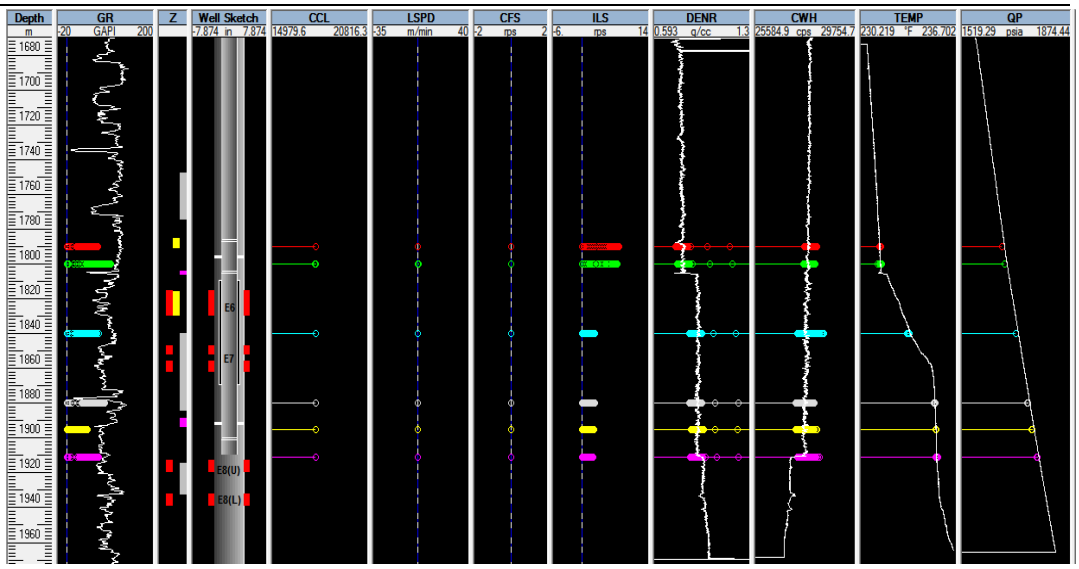
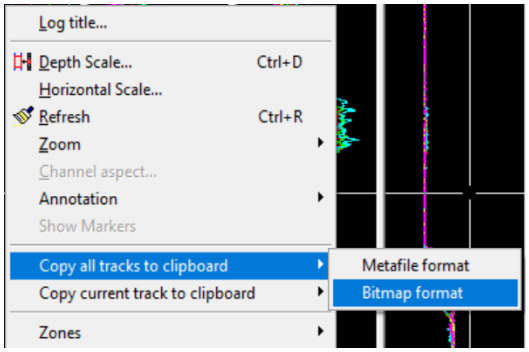


8. Repeat step from (5) until (7) to create survey for flowing pass
9. You can export or copy the image of the log by right click on the log. Select *Copy all tracks to clipboard* and choose either *Metafile* or *Bitmap format*.



You can paste the log on MPLT Field Quick Look Report on Analysis part. Refer **Form 67 – Field Quick Look Report – PLT_MAPS.**

2.6.7 Depth Time Recorder Programming

1. Switch ON the DTR and DTR will show the picture as below. Make sure it's is **P + F Encoder.** If it is not turn the box off and on again. Make a note of the baud rate in the left hand lower corner of the DTR window.

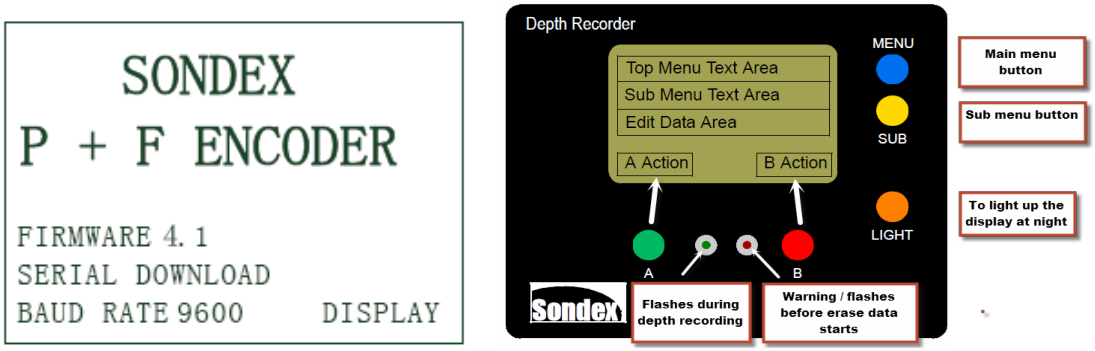


Figure 11 *DTR Interface*

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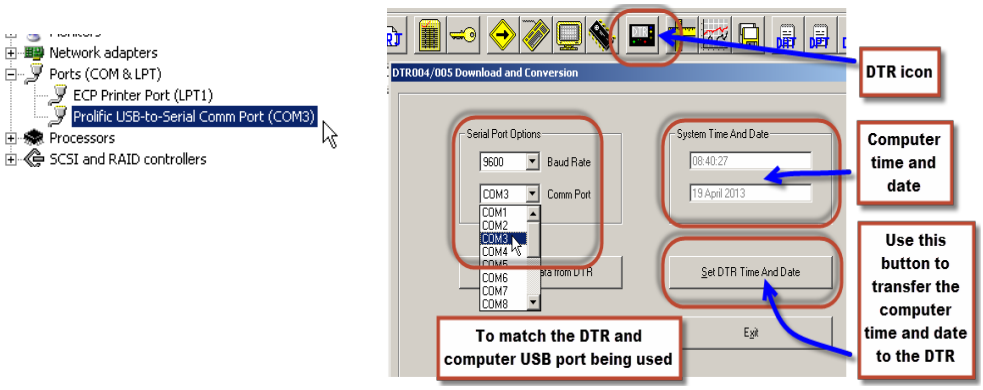
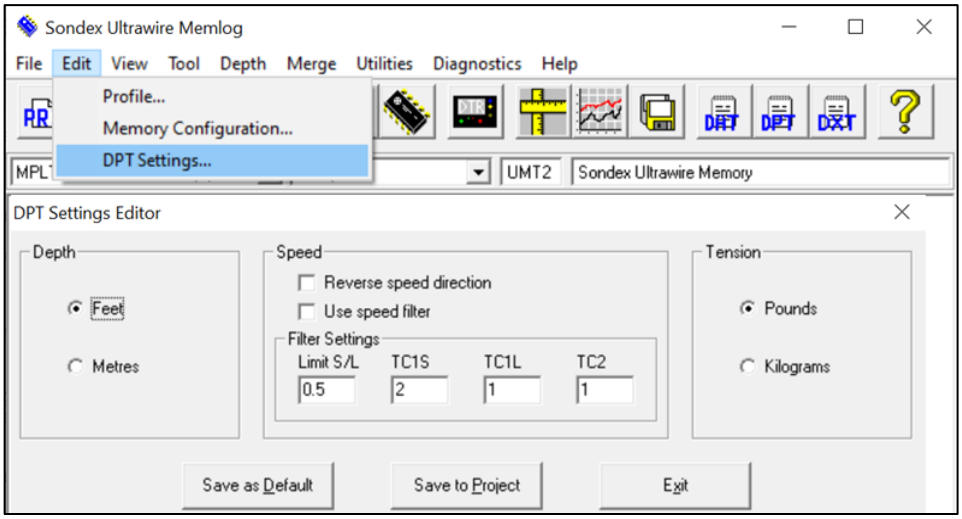
2. To synchronize the DTR time with Laptop/PC, you need to connect the DTR via RS232 cable to the Laptop/PC.

Figure 12 *Connection from DTR to Laptop via RS232 cable*

3. Open the Sondex Ultrawire Memlog and click *DTR download*  . To check Comm Port, go to **Window Start → Setting**. Search for **Device Manager** and select **Ports (COM & LPT).** The COM port being used by the interface lead/box will be shown. Make a note, for example it is COM3. Confirm the com port and baud rate prior to click *Set DTR Time and Date.*



4. Change the depth unit in Sondex Ultrawire Memlog, go to **Edit → DPT Settings**. Select the depth unit based on slickline unit either feet or meters.



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5. Hook up DTR encoder and splitter to angle drive on SSR wireline unit as picture below:

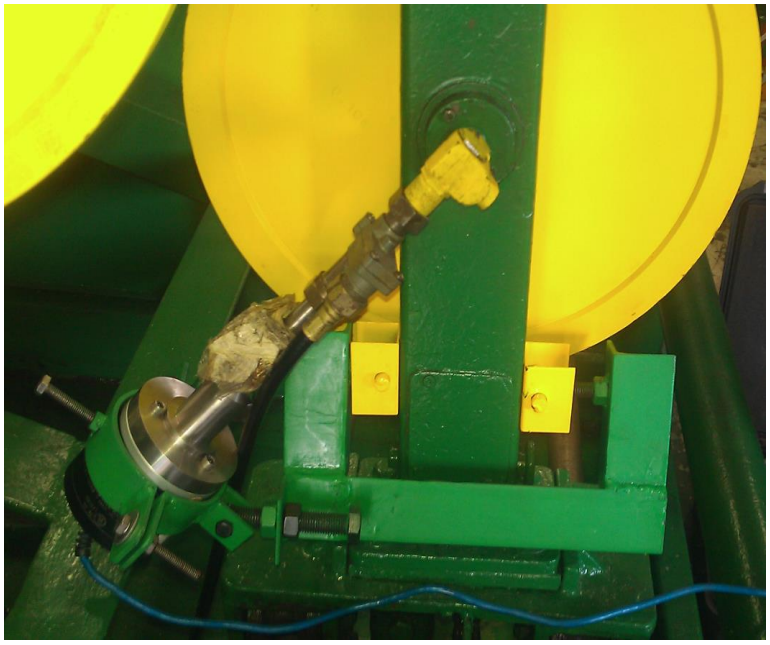

Figure 13 *Install DTR encoder to SSR wireline unit*

For ASEP wireline unit, you need to use special bracket to attach the encoder on slickline unit as picture below:

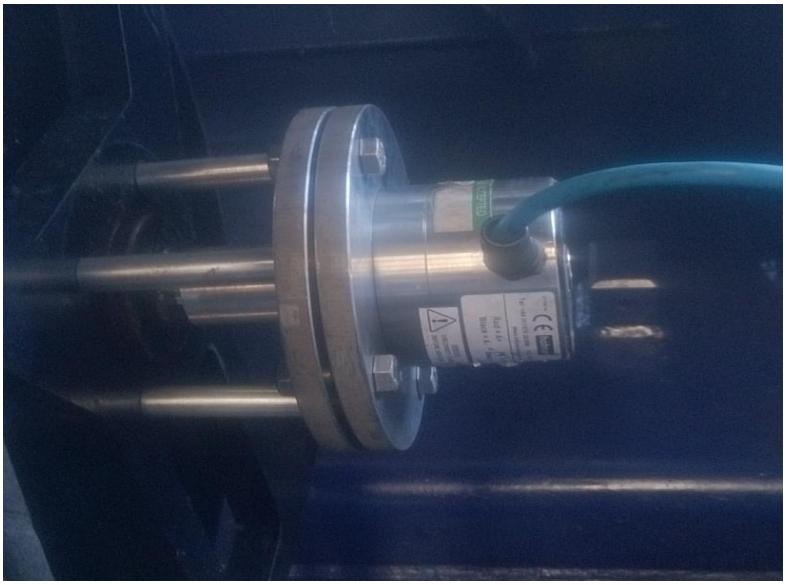

Figure 14 *Install DTR encoder to ASEP wireline unit*

6. To change the Depth Units (*ft or m*): click on Change to switch from Meters to Feet and vice versa. This sets the depth and line speed units for all the subsequent screens.

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Sub Menu Text Area	Edit Data Area	'A' Action	'B' Action	Comments
DEPTH UNITS [a]	METRES or FEET	Not used	CHANGE	Press the 'B' button to toggle depth units between 'FEET' and 'METRES'
SET DEPTH FT SET DEPTH MT	+/-nnnnn.nn [b]	NEXT	SCROLL	Sets the depth preset in the depth units displayed This will require the use of the 'A' button (annotated 'NEXT' and the 'B' button (annotated 'SCROLL') The 'FT'/'MT' is set in 'DEPTH UNIT' above
WHEEL CIRC FT WHEEL CIRC MT	nn.nnnn [a]	NEXT	SCOLL	Enter the circumference of the measure wheel in the displayed units of length This will require the use of the 'A' button (annotated 'NEXT' and the 'B' button (annotated 'SCROLL') The 'FT'/'MT' is set in 'DEPTH UNIT' above

Figure 15 *Depth Unit Editor*

7. To Set Depth (ft or m): this is where you can set the depth such as when zeroing the toolstring. The Next button allows you to scroll left to right; the Scroll button allows you to scroll through numbers 0 to 9. Note that if the encoder is turned after depth has been set that the depth will be updated.

8. Wheel Circumference (*ft or m*): Enter the amount of line for one turn of the encoder. The value is to 4 decimal places for the required resolution.
   If you do not know the wheel size and the job has a slickline drift run:
   a) Set the depth units and enter a wheel size of 1
   b) Zero the slickline depth and DTR depth together
   c) Start RIH until certain depth. Compare the slickline depth and DTR depth
   d) Calculate the wheel size from slickline depth divide by DTR depth
      For example if the slickline depth is 10000 and DTR is 5000, the new wheel size is 10000/5000 = 2.
   e) Enter the calculated wheel circumference. You can ask the slickline operator to RIH or POOH until certain depth to confirm both slickline unit and DTR are same.

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9. For **Step 8**, you can also **measure the OD of counter wheel plus with wire**. Then, use the formula circumference.

Circumference = *π* x OD Groove with wire

The value will be in inch. If you will run in feet or meter, you can convert to meter or feet. This value will be key in in Wheel Circumference.

10. To change the encoder pulse:

Sub Menu Text Area	Edit Data Area	'A' Action	'B' Action	Comments
ENCODER PULSES	nnnn [a]	NEXT	SCROLL	Set the number of pulses per revolution of the shaft encoder This will require the use of the 'A' button (annotated 'NEXT' and the 'B' button (annotated 'SCROLL')
ENCODER SENSE	REVERSE or NORMAL	Not used	CHANGE	Allows the direction of rotation of the shaft encoder to be reversed. Press the 'B' button to toggle between 'REVERSE' and 'NORMAL'

Figure 16 *Encoder Pulse Editor*

11. Encoder pulse is stated at the encoder or provided by supplier. Two types of encoder used:
    a. **Big Encoder (ENCO09) – 0512**
    b. **Small Encoder (ENCO08) – 0100**

12. To change the AUX Recording menu:

Sub Menu Text Area	Edit Data Area	'A' Action	'B' Action	Comment
1 WEIGHT POUNDS	STATUS ON STATUS OFF	Not used	CHANGE	Press the 'B' button to change the status between 'ON' and 'OFF'
2 PRESS PSI	STATUS ON STATUS OFF	Not used	CHANGE	Press the 'B' button to change the status between 'ON' and 'OFF'
3 FLOW BPD	STATUS ON STATUS OFF	Not used	CHANGE	Press the 'B' button to change the status between 'ON' and 'OFF'
4 TEMP DEGC	STATUS ON STATUS OFF	Not used	CHANGE	Press the 'B' button to change the status between 'ON' and 'OFF'
5 INJECT BPD	STATUS ON STATUS OFF	Not used	CHANGE	Press the 'B' button to change the status between 'ON' and 'OFF'
6 PROD L/HOUR	STATUS ON STATUS OFF	Not used	CHANGE	Press the 'B' button to change the status between 'ON' and 'OFF'

Figure 17 *Auxiliary Editor*

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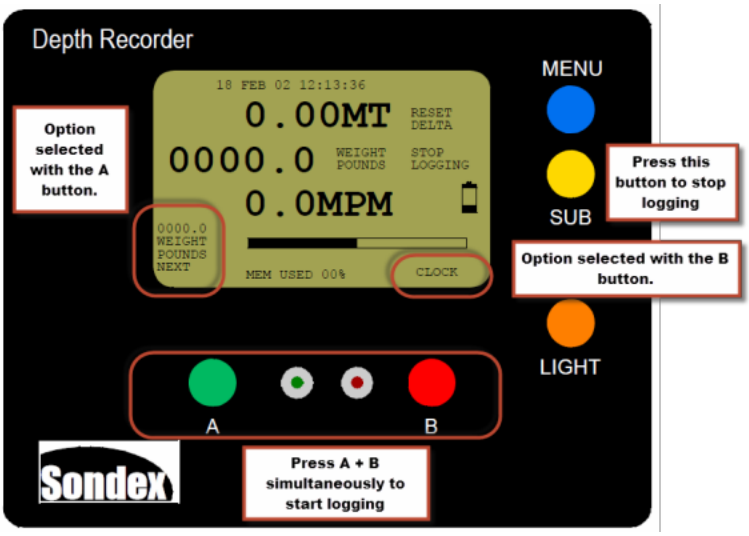
13. Once all setting been set, you may continue by pushing **blue** button until memory erase section. You need to clear the memory prior to record the new data as picture below.

14. When all the data has been erased, push the **blue** button to continue to recording section.
15. To start record, you need to push **green** and **red** button simultaneously.
16. To stop logging, you need to push **yellow** and **hold** the button until the screen show **P + F Encoder** (1st screen appear after you turn on DTR).



2.6.8 Depth Time Recorder Downloading

1. To download the data, you need to connect DTR via RS232 cable to Laptop/PC.
2. Open the DTR section in Sondex Ultrawire Memlog and click *Download DTR Data*.
3. Please check the start time prior to save. Refer 2.6.4 for DTR download step.

2.6.9 De-Passivate and Test Lithium Battery

1. Perform physical check on the battery received and inform any anomaly observed. Used battery normally has the scratch effect on the top.

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2. Test the battery using multimeter. New battery will read above **19V**. If the reading is below than **14V**, it needs to **De-passivate**.

Sensors operating at minimum voltage 13.5 V

3. For De-passivate, take an electrical meter and set it to read 20Vdc. Connect the meter across a 200Ω, 3W resistor. Connect the 200Ω resistor between the **+ve (red)** and **ground (black)** leads of the battery.
4. A passive battery will show only a small voltage reading on the meter. As the battery de-passivates and delivers more current the voltage will rise. This may take up to 20 minutes but would normally occur within 5 to 10 minutes.
5. Change the battery if the voltage reading is still below than 14V.
6. If the voltage is above 14V, battery is **READY TO GO**.

DO NOT DE-PASSIVATE *if the battery voltage is 0V. De-passivation of the battery must be done if the battery is not being used for a long time.*

2.6.10 Performing Bench Test

1. Program the memory tool.
2. Make up the complete string that you will use in the job including centralisers, knuckle joints etc.
3. Connect the battery to the toolstring.
4. Record about 5 minutes of data
    a. During this time move the string and knock lightly with mallet to simulate downhole conditions
    b. Stimulate each of the sensors – rub the CCL with a spanner, spin the spinner, apply GR jig on PGR sensor, spray CRC on temperature probe etc.
    c. For the DTR, you may rotate clockwise and anti-clockwise the encoder to check the reading at DTR.
    d. Download the memory tool and DTR, use Visual merge together and view the data from each tool.
    e. If there is any bad or incorrect data fix the problem before running in hole. Problems at surface tend to get worse downhole
5. All bench test result must be properly recorded and documented.
6. Re-program the tool for the logging job

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EXECUTE

3.1 Wellsite preparation

1. Verify all the equipment, tools, consumables, and accessories with pre-mob checklist/inventory upon arrival at wellsite.
2. Discuss with Wireline Supervisor regarding the job planning.
3. Confirm well and downhole properties with Wireline Supervisor.
4. Review well history for any restriction/HUD encountered during the last well intervention.
5. Prepare the MPLT tools, de-passivate lithium battery and DTR
6. Prepare ***Sequence of Events*** worksheet accordingly as per clients' job program.
7. Review Job Hazard Analysis (JHA) and apply Permit to Work (PTW).

3.2 Rig floor operational check

1. Make up the MPLT tools and test the X-over provided by SLS/CTU/E-Line.
2. Perform field calibration if needed and bench test.
3. Check for anomalies, reliability and consistency of the data recorded.
4. Any tool-related problem encountered during bench test; inform base/lab technician and Wireline Supervisor immediately before proceed with MPLT troubleshooting procedure.
5. Prepare problem report and request for tool or spares replacement if there is difficulty in solving the problem.
6. Otherwise, program the UMT as per client's program by following steps in 2.6.1.

Tool lift calculation is mandatory prior to intervene a flowing well in a safe manner to prevent floating tool and tool blow-out.

3.3 Wireline Preparatory Work

To prevent any hiccup while performing MPLT survey job, tubing clearance must be conducted to clear any obstruction until set depth.

1. Prepare wireline surface equipment.
2. Ensure master valve and crown valve is fully closed prior to opening tree cap.
3. Rig up PCE and pressure test up to client's requirement, i.e. 3000 psi for 15 minutes.
4. Make up wireline toolstring as per job program and zero at Tubing Head Flange.
5. Run in Hole (RIH) with Drift or Gauge Cutter to No-Go depth or top of plug (refer to well schematic). Record the No-Go depth and Pull out of Hole (POOH).

If the clearance between tool and tubing is big and there is additional tubing below the No-Go, it's recommended to run the sinker bar until 2 meter above the EOT.

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6. RIH with sinker bar to tag Total Depth (TD) or Held-Up Depth (HUD). Record TD and POOH.

*This procedure is **ONLY** valid if the MPLT need to be run out of casing*

7. For a short string well, RIH sinker bar to 2 meter below No-Go nipple.
8. Reconfirm the status of Sliding Side Door (SSD) by running shifting tool, if necessary.
9. Before perform MPLT for flowing mode, conduct dummy run with appropriate toolstring configuration in flowing condition (weight and length), ONLY after performing Tool Lift Calculation. This is to ensure the toolstring weight is adequate enough to overcome the flowing upward force during operation.
10. Retrieve the Wireline Retrievable Surface Control Subsurface Safety Valve (WR-SCSSV) / Insert valve if the well is fitted with insert valve per standard procedure.

Synchronization of DTR with SLS Odometer can be performed during slickline operation.

3.4 Toolstring Configuration

3.4.1 Standard Assembly

1. Wireline Toolstring (varies depending on TCC and dummy run)
2. Knuckle Joint
3. X-Over SLS to Logging Tools
4. Memory Battery Holder (ABM)
5. Ultrawire Memory Tools (UMT007)
6. Quartz Pressure Sensor (QPS)
7. Production Gamma Ray (PGR)
8. Casing Collar Locator (CCL)
9. Production Knuckle Joint (PKJ)
10. Production Knuckle Joint (PKJ)
11. Production Roller Centralizer (PRC)
12. Capacitance Water Holdup (CWH)
13. In-Line Spinner (ILS)
14. Fluid Density Radioactive (FDR)
15. Platinum Resistance Temperature (PRT)
16. Production Roller Centralizer (PRC)
17. Continuous Flowmeter Spinner (CFS)

Positioning the MPLT tool:

- Fullbore and continuous spinner tools go on the bottom of the string
- The spinner tools and fluid ID should be centralized
- To keep these tool centralized minimize the weight to be centralized by using knuckle joints.
- The CCL works better if run closer to the tubing – use knuckle joints to de-centralise the tools.

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- If the tool string is very long, knuckle joints should be used to reduce the rigid length and so help to get the tools down the well.
- FDR and CWH tools work better next to centralisers which tend to stir up the mixture.
- In line spinner work better when positioned away from the centralisers (which cause turbulence)

3.5 General Logging Procedures

Before the beginning of any work, ensure that all equipment comply with the client's Safety Standards. Conduct pre-job safety meeting with all personnel involved on location detailing program, pressure limitation, safety procedures, and personnel responsibilities.

3.5.1 MPLT Shut In Condition

There are two basic types of surveys - shut in and flowing conditions. Shut In passes are usually will be used as a baseline for flowing passes. FE must ensure with supervisor that the well are fully stabilize after shut in period for 12-24 hours (depending on client's requirement). Spinner data in shut in passes will be used for spinner calibration for flowing passes.

Operation Procedures:

1. Shut in well for required duration prior to MPLT Shut In Survey. Tubing clearance check must be performed prior to perform the survey.
2. Make up assembly to be run as in **3.4.1**.
3. Repeat steps in **2.6.1** and record battery hook-up time. Make sure the housing is tightened by using appropriate spanner.
4. Open the well and let the tool inside the lubricator for 5 minutes
5. RIH with average speed of 90 ft/min to set depth. The RIH speed might differ from the actual program thus read the program carefully. Also, vigilantly take several station stops to pick up pulling weight during RIH.
6. Once at set depth, wait for 5 minutes prior to perform logging passes.
7. Perform up and down logging passes with minimum 3 different speeds. Standard speeds are 30/60/90 ft/min. Different speed may be applied based on the client's requirement.
8. After completed the logging passes, perform the station stops survey during POOH. Depth and the number of station stops are based on the client's request.
9. Recover the MPLT from lubricator. Download the data from UMT and DTR data.
10. Check the data reliability before rigging down all the equipment. If the data is not satisfactory, discuss with Supervisor for the possibility of re-run the MPLT survey.
11. Produce Quick Look Analysis. Send the raw data together with Quick Look Analysis to the Log Analyst for Final Report.

3.5.2 MPLT Flowing Condition

For flowing passes, FE must ensure with supervisor that the well is already stabilized prior to perform flowing passes survey. Well test must be performed during flowing passes survey so that the data can be match with downhole survey.

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Operation Procedures:

1. Flow the well with specified choke size, as per job program, until stabilized prior to rigging up wireline and performing well test
2. Monitor FTHP and PCP. Once stabilized, proceed with 4 hours well test
3. Meanwhile, make up assembly to be run as in **3.4.1**
4. Repeat steps in **2.6.1** and record battery hook-up time. Make sure the housing is tightened by using appropriate spanner.
5. Open the well and let the tool inside the lubricator for 5 minutes
6. RIH with average speed of 90 ft/min to set depth. The RIH speed might differ from the actual program thus read the program carefully. Also, vigilantly take several station stops to pick up pulling weight during RIH.
7. Once at set depth, wait for 5 minutes prior to perform logging passes.
8. Perform up and down logging passes with minimum 3 different speeds. Standard speeds are 30/60/90 ft/min. Different speed may be applied based on the client's requirement.
9. After completed the logging passes, perform the station stops survey during POOH. Depth and the number of station stops are based on the client's request.
10. Recover the MPLT from lubricator. Download the data from UMT and DTR data.
11. Check the data reliability before rigging down all the equipment. If the data is not satisfactory, discuss with Supervisor for the possibility of re-run the MPLT survey.
12. Produce Quick Look Analysis. Send the raw data together with Quick Look Analysis to the Log Analyst for Final Report.

3.6 Field Data Processing & Delivery

Data must be sending to Client and town within 24 hours after completing the survey.

3.6.1 Data Quality Check

1. Follow the step from **2.6.5** for data processing.
2. Check downloaded data from UMT and DTR are recorded from each sensor from start to finish of logging run.
3. Make sure all sensors gave correct tool responses in known completion items and correct sensitivity without noise and spikes. Report any flat lines or spikes in the data.
4. FE must ensure to all tools have up to date calibration files. Check downhole measurements within tolerances.
5. If data is unsatisfactory, discuss with Log Analyst and Supervisor for the possibility of re-run.

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3.6.2 Field Quick Look Report Submission

1. Fill up the template of the **MPLT Quick Look Report**. Make sure the version is the latest.
2. Compile the report together with the items below:
    a. Raw data .db
    b. All passes in .las file (RIH, POOH, Passes & Station Stop)
    c. SOE/DOR
    d. Production Well Test
    e. Recorded THP & PCP Log

    E-mail these items to DCS team at *dcs@neudimension.com*

3. Send the **MPLT Field Quick Look Report** to the client and all personnel in charge.

3.7 Post Survey Maintenance Procedures

1. Ensure the MPLT Tools is clean from any debris, dirt, and grease. Use WD-40 to clean all debris, dirt, and grease.
2. Perform physical check on tool body of the whole toolstring. Record any abnormal findings (any damage or defect) in the report.
3. Physically check the flowmeters after retrieval from the well for damage/jamming. The impeller should rotate smoothly when blown upon lightly. It is recommended to change the **spinner bearing** after every run for ILS and CFS.
4. Inspect all the O-rings for any damage and replace if necessary. It is recommended that the O-rings seals be changed **every time for External O-ring** and **after 5 times for Internal O-ring**.
5. Perform post run bench test to check tool functionality. Perform calibration if necessary. Ensure tool ready for next run.
6. Please refer to the **Tool Maintenance Checklist** for the items need to be changed.
7. Record all the maintenance in the **Tool Utilization Record** and **Tool Maintenance Checklist**.

3.8 Post Job Logistics

1. After completing the maintenance, make sure all the MPLT Tools are safely packed inside the Pelican case.
2. Carry out final check utterly and specify the quantity of consumables and accessories for future reference. Request for additional items should the materials is in short supply.
3. Discuss with Wireline Supervisor concerning the next MPLT Survey job. If there is no other planned job, FE need to send back the MPLT Tools to base and prepare Material Transfer Request (MTR) documentation.

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CLOSE

4.1 Post Job

1. Post Job Reporting and Paperwork.
2. Submit any lessons learnt and improvement suggestion to FSM.
3. Follow up with the logistic team for the equipment returned from location.
4. Perform bench test prior to handover the tool to Lab Technicians. If post job servicing not performed, please perform the post job maintenance before proceeding to bench test.
5. Attend debriefing with FSM.

Private
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4.2 MPLT SSP Summary and Op-Check

MPLT SSP Summary Checklist:

MPLT SSP CHECKLIST		
At Base: Design & Prepare		
Design	Client has provided the well information, confirmed the number of run, logging interval and signed the work program.	☐
	Confirm the operation is within tool specifications.	☐
	Client already been informed on the limitation of the tools, equipment, well condition and etc.	☐
	Ensure availability of the required tool configurations.	☐
Prepare	Discussed with CHS FSM on the availability of the MPLT Tools.	☐
	For X-Over, discussed with FSM or OE on the availability and funtionality.	☐
	Prepare all the tools and accessories as per maintenance manual. Verify with the lab side on the maintenance.	☐
	Ensure all the consumables, spare parts, hand tools, and programming tools are already in the package.	☐
	Prepare Sondex Software (Refer to Op-Check Checklist).	☐
	Perform MPLT Opcheck (Refer to Op-Check Checklist).	☐
At Well Site: Execute		
Rig Up	Confirm well and hole properties with Wireline Supervisor. Review well history.	☐
	Make sure the well is stable and has been shut in for specific duration depending on the job program.	☐
	Ensure tubing clearance is conducted prior to RIH MPLT Tools.	☐
	Prepare Sequence of Events (SOE) correpsonding to the designed logging interval.	☐
	Program UMT and duration accordingly.	☐
	Make-up MPLT toolstring as per program.	☐
	Ensure FIT for X-Over from SLS/CTU/E-Line to MPLT Tools.	☐
	Hook-up battery and record MPLT initiation time.	☐
	Zero toolstring (CRP for MPLT is at bottom CFS) at Tubing Head Flange (THF).	☐
MPLT Shut In Mode	Perform MPLT shut in survey run as per SSP.	☐
	RIH with average speed of 30m/min to set depth.	☐
	Perform up and down logging passes with 3 different speeds (10/20/30 m/min) depending on job program	☐
	Perform the station stops survey during POOH based on job program	☐
	POOH to surface with average of 30m/min	☐
Dummy MPLT for Flowing Mode	Perform tool lift calculation to ensure tool weight is sufficient to overcome flowing upward force.	☐
	Ensure the tool is not floating and RIH smoothly	☐
	Monitoring the running weight, hanging weight, and pick up weight	☐
MPLT Flowing Mode	Perform MPLT flowing survey run as per SSP.	☐
	Make sure the well is stable and has been flowing for specific duration depending on the job program	☐
	Conduct 4 hours well test if needed (refer job program)	☐
	RIH with average speed of 30m/min to set depth.	☐
	Perform up and down logging passes with 3 different speeds (10/20/30 m/min) depending on job program	☐
	Perform the station stops survey during POOH based on job program	☐
	POOH to surface with average of 30m/min	☐
Post Job	Clean the tool during rig down while it hangs out from lubricator.	☐
	Rig down toolstring and retrieve MPLT Tools.	☐
	Download data and perform data QA/QC as per SSP	☐
	Perform post job maintenance on MPLT Tools	☐
	Submit the Quick Look Report and Raw Data to Client and Log Analyst	☐
Return to Base: Close		
	Arrange de-mobilization of the equipment back to base.	☐
	Complete Post Job Maintenance and Reporting	☐
	Submit any lessons learnt and improvement suggestion to FSM.	☐
	Attend debriefing with FSM.	☐
Name:	*write your name here*	
Date:	*dd/mm/yyyy* **Signature:**	*sign here*

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MPLT Op-Check Checklist:

MPLT OP-CHECK CHECKLIST		
Dedicated Software		
Software	Computer operating system no older than Windows 2000, 32bit for W7 and 64 bit for W8	☐
	Latest Warrior and Sondex Memlog Software is installed (Emeraude Software is optional).	☐
	Ensure correct Warrior Key License entered.	☐
	No error while launching and operating the software	☐
	Check all tools have up to date calibration	☐
Battery		
De-passivate	Check the battery condition received	☐
	Check the battery voltage using multimeter (reading should be >19V)	☐
	De-passivate battery (If the voltage less than 14V)	☐
	Replace the battery if the voltage reading is still below than 14V (minimum requirement is 14V)	☐
	For DTR, check the D-cell battery power and replace if it is low.	☐
MPLT Tools		
Bench Test & Field Calibration	Connect UMT Tools with laptop through USB UMU001 and launch Sondex Ultrawire Memlog and Acquisition	☐
	Check communication between laptop with UMT/DTR. Make sure no error while communicating.	☐
	Synchronize the DTR time with laptop. Recommended to synchronize with FE personal watch	☐
	Ensure correct/calibrated wheel circumference entered in DTR. Check the unit used same with wireline unit	☐
	Hook up encoder and splitter to angle drive on wireline unit. Ensure encoder in correct position to avoid pin parted	☐
	Ensure the correct serial number and layout added in toolstring configuration	☐
	Check the functionality of the MPLT Tools as per SSP and verify the output	☐
	Program the MPLT Tools for bench test and calibration as per SSP	☐
	Hook-up battery to the MPLT Tools. Ensure the sound 'Bip' at the UMT to confirm the tool is working	☐
	Perform MPLT Field Calibration as per SSP for PGR, FDR and CWH.	☐
	Apply vibration/shock test on MPLT Tools	☐
	Download data from UMT and perform calibration step as per SSP	☐
	Perform QA/QC based on the results obtained. Check all sensors reading within tolerances	☐
	Record and document the bench test results	☐
Name:	*write your name here*	
Date:	*dd/mm/yyyy*	**Signature:** *sign here*

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APPENDICES

5.1 Sequence of Events Template

DIMENSION BID
WELL INTERVENTION | PERFORATION SERVICES

MPLT SEQUENCE OF EVENTS

Client	:	SHELL	**SITHP (psig)**	:	880
Field	:	E11-DPA	**RKB Elevation (ft)**	:	55
Well No.	:	E11-107	**Deviation (deg)**	:	32.5
Tubing	:	7", 26 ppf VAM ATAC, L80 & 9Cr 4.1", 14.8 ppf VAM, 13Cr Tail			
Well Type	:	Oil Producer/Gas Producer etc			
Survey Date	:	14-Jul-15			
Survey Objective	:	To check water inflow Zone 2, Zone 3, and Layer 4			
Survey Duration	:	5 hours 45 minutes			

Time (hrs)	Event Description	Remarks
1430H	Programmed UMT Memory section.	
1430H	Hooked up battery to tool.	
1430H	Hooked up MPLT to wireline tool string.	
1430H	Open well.	880 psig
1430H	RIH with line speed of 90 ft/min to set depth at 7465 ft-WLRKB	
1430H	MPLT at set depth 7465 ft-WLRKB. Wait 5 minutes.	
1430H	Log up 30 ft/min from 7465 to 6933 ft-WLRKB.	
1430H	Stop at 6933 ft-WLRKB for 3 minutes	
1430H	Log down 30 ft/min from 6933 to 7465 ft-WLRKB.	
1430H	Stop at 7465 ft-WLRKB for 3 minutes.	
1430H	Log up 60 ft/min from 7465 to 6933 ft-WLRKB.	
1430H	Stop at 6933 ft-WLRKB for 3 minutes	
1430H	Log down 60 ft/min from 6933 to 7465 ft-WLRKB.	
1430H	Stop at 7465 ft-WLRKB for 3 minutes.	
1430H	Log up 90 ft/min from 7465 to 6933 ft-WLRKB.	
1430H	Stop at 6933 ft-WLRKB for 3 minutes	
1430H	Log down 90 ft/min from 6933 to 7465 ft-WLRKB.	
1430H	Stop at 7465 ft-WLRKB for 5 minutes.	
1430H	POOH MPLT to 7462 ft-WLRKB.	
1430H	Stop at 7462 ft-WLRKB for 5 minutes.	
1430H	POOH MPLT to 7459 ft-WLRKB.	
1430H	Stop at 7459 ft-WLRKB for 5 minutes.	
1430H	POOH MPLT into Lubricator.	
1430H	Close well. Depressurize Lubricator and recover MPLT from Lubricator.	
1430H	Disconnect MBH memory from UMT.	
1430H	Download UMT Memory and Depth Recorder (DTR).	
1430H	Verify the data and performed QA/QC analysis.	

Note: *All MPLT and Depth data were downloaded successfully with good quality data. Survey depth is based on Wireline depth.*

I, the undersigned, justified that the above services and equipment have been provided.

Field Engineer

Name:
Date:

Client Representative

Name:
Date:

EXAMPLE

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5.2 Troubleshoot

Hardware & Software Problems

Symptoms	*Possible Problems*	*Solutions*
UMU001 failing to communicate with the UMT.	Software for UMU001 not installed	Install the software for UMU001
	USB failed to communicate	Unplug and plug the USB
	UMU001 problem	Change with the backup UMU001
Unable to launch the UW Memlog software and Warrio Acquisition	Wrong Key Code inserted	Confirm the Key Code to tally with key dongle
	Compatibility problem	Check the computer operating system to tally with software installed
	Software or drivers are corrupt or damaged	Upgrade to latest software version or reinstall (ensure USB devices disconnected).
Date recorded to memory is noisy	Low voltage of the battery	Check the battery voltage or change the battery
Data is out of the tools specification	Sensor/Tools Problem	Perform physical check on tools condition for any damage or defect. Refer to the tools manual for maintenance
	The Sensor may need to be recalibrated	Perform field calibration
	Setting of software/service not correct	Please refer to the MN-UW memlog and MN-Warrior manual for setting
No data recorded	Battery blown	Change new battery
	UMT not recorded	Check the profile program or change with new UMT Perform physical check on tool for any damage or defect

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5.3 Plan Preventive Maintenance

As part of Dimension Bid – Cased Hole Services quality management requirement, all equipment and tools to be used for client must be reliable with traceable calibration record.

It is our main priority of DB-CHS to serve our clients with the best quality and reliable tools in order to acquire high quality data.

To meet this objective, the standard tools testing and calibration procedure had been established and implemented by CHS team accordingly.

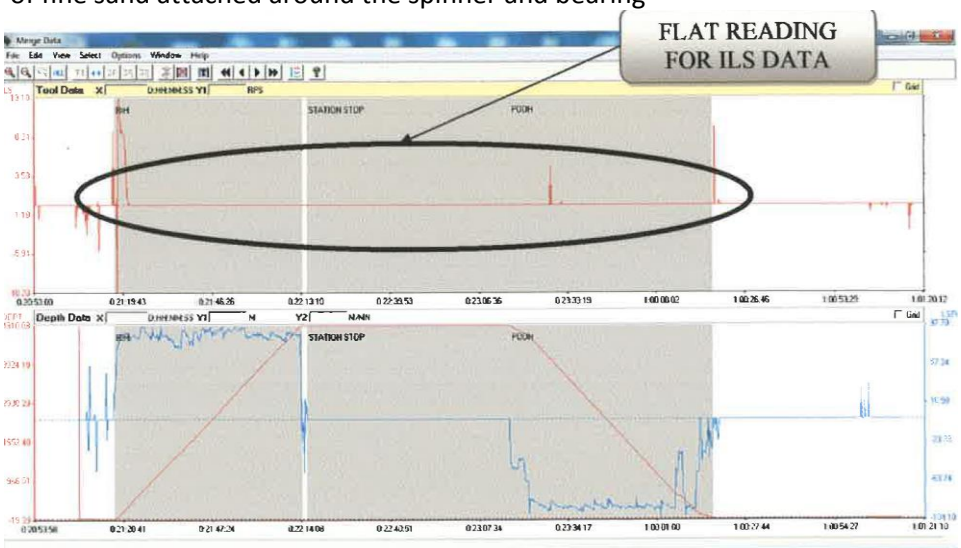
The MPLT tools are subjected to PPM **every 6-months** duration to maintain its reliability and accuracy. This involves physical inspection on internal electronic section and calibration.

5.4 Lessons Learnt

Case 1: ILS rotation stuck in hole.

Date	22 May 2017
Platform	EP-6
Well	B4
Job	MPLT Survey
BHA	Wireline toolstring + MPLT BHA

For the MPLT survey data for ILS sensor, FE found that ILS was not rotating just after the tool pass through the wing valve. From the observation on the ILS just after came out from the well, FE found that it could not rotating smoothly or almost totally stuck and found that small quantity of fine sand attached around the spinner and bearing



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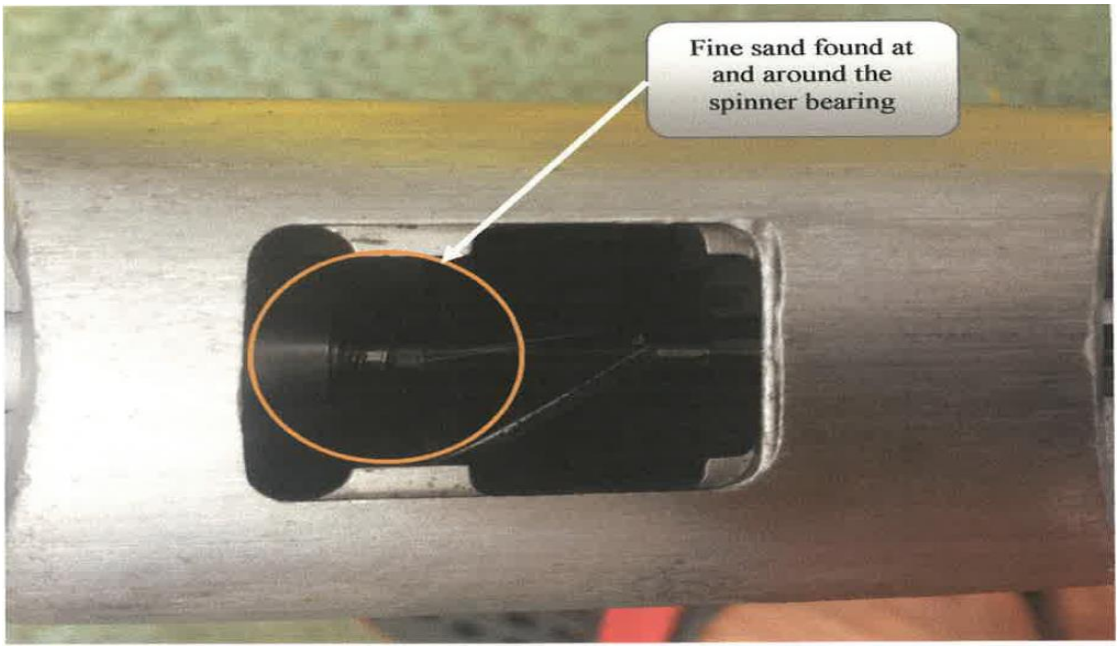
From the direct observation on the ILS just after came out of the well, FE concluded that the ILS was not rotating smoothly or almost totally stuck due to to the fine sand penetrated into the spinner bearing and attached to it.



Lesson Learnt: As this is well problem that producing sand, the only possible action to decrease the possibility of the same problem arise is might be we can use the lower choke size to decrease the flowing rate for flowing condition so that the possibility of the sand to be easily lifted up will be decreased.

5.5 Best Practices & Precautions

1. Determine the well properties and check well history to make sure the tools are within the requirement.
2. The bottom of the logging interval should be at least 10 ft/3 meter above the bottom if the bottom is sand.
3. Ensure there is sufficient battery power for MPLT and DTR to complete the job.
4. Prepare the MPLT logging plan with the assistance of Tool Lift Calculation or Well Entry Simulation (WEST) software to know the ability of the tools to be RIH or not especially during flowing.
5. Check tool positioning is correct for the tool type – centralized or not.
6. Always check all tools have up to date calibrations. Perform field calibration if needed.

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7. Perform quick bench test and calibration check prior to run.
8. Ensure the well to be stable before logging. Record WHP and flowrates of gas, oil and water to check that well is stable.
9. Make sure logging speed is constant over entire logging. Do not RIH or POOH too fast.
10. Record the battery usage to avoid waste of battery.
11. Always check O-ring conditions after every run.
12. Make sure tools are cleaning and in good condition before storage and run.

5.6 Environment Different

O-ring seals

Fluorocarbon elastomers (Viton®) exhibit very good thermal and hydrocarbon resistance but can be attacked by a number of commonly encountered oilfield media. Corrosion inhibitors will cause embrittlement, while sour wells containing Hydrogen Sulphide (H2S) and Carbon Dioxide (CO2) may cause softening with consequent reduction in the elastomer's mechanical properties.

Hydrogenated Nitrile Rubbers (HNBR) have proven invaluable in extending the boundaries of elastomeric seals in aggressive environments. These materials display superior resistance to aggressive fluids such as sour crude oil or gas, lubricating oil additives and amine corrosion inhibitors where fluorocarbon (Viton®) seals are less effective.

Hence the type of O-ring used will depend on the environment. Under normal conditions Viton® can be used, however, in harsher environments, such as in sour wells, HNBR will be more reliable.

The required O-rings sizes can be cross checked with the O-ring tables in the next section.

Conveyance in Deviated Wells

As wells become more highly deviated, or their profiles become more challenging, it is increasingly difficult to reach the targeted depths. Frictional resistance caused by the toolstring lying on the low side of the well can inhibit the operation from reaching lower depths.

Roller conveyance tools lift and support the toolstring off the low side of the well. Large rollers eliminate tool contact friction, making it easier to convey the toolstring to target depth and achieve the results expected.

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O-ring and Spare Part Cross Check Table

SPARE	124 VITON-90	124 RING BACKUP	118 VITON-90	118 RING BACKUP	211 VITON-90	211 VITON-75	023 VITON-90	120 VITON-90	BEARING BALL	SPINNER BLADE	LOCKING SPRING	PIH-KIT
PART NO.	99124	410085	99118	410084	99211	95211	99023	99120	01155	ILS 08005/ CFS 07707	01849	KITRem-PIH, SX
ABM	2/5run		2/run		2/run							
UMT007	2/5run	2/run	2/run	2/run	2/run							1/25run
CCL015	2/5run		2/run		2/run	1/5run						1/25run
PGR020	2/5run		2/run		2/run	1/5run						1/25run
QPS019	2/5run		2/run		2/run	1/5run						1/25run
PRT016	2/5run		2/run		2/run	1/5run						1/25run
CWH013	2/5run		2/run		2/run	1/5run						1/25run
FDR020	2/5run		2/run		2/run	1/5run						1/25run
ILS022	2/5run		2/run		2/run	1/5run			2/run	1/25run		1/25run
CFBE05	2/5run					1/5run	2/5run				1/25run	1/25run
CFSM02								1/5run	2/run	1/25run		
PKJ					2/run							
PRC					2/run							

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5.7 Battery Consumption Table

UltraWire UMT BATTERY LIFE ESTIMATION

Battery Information

Battery Type	BEI	
Power Rating	6.2	Ampere Hrs
Capacity Factor	80	%
Available power	4960	mAH
Self Drain per day	1.0	%

Results:

	mAhr	%
Total Available	4960.0	100.0
Total Used	4895.5	98.7
Self Drain	62.1	0.0
Total Left	2.4	0.0

TOOL:	UMT	MIT	MTT	PRT	QPC	QPS	CCL	ILS	PGR	FDR	FDD	PDC	HTU	DBT	PIA	CTF	CWH	RBT	Total
CURRENT:	15	20	25	20	20	20	16	10	20	35	50	25	30	20	25	33	17	20	Current,mA
TOOLS USED:	1	0	0	1	0	1	1	2	1	1	0	0	0	0	0	0	1	0	163

SLEEP/SETUP:	SLEEP	MOTOR	TRANS
CURRENT:	1.5	343	52

This spreadsheet is to be used as a guide only. As battery life is dependent upon so many variables.
Sondex cannot be held liable for consequences resulting from it's use.

Total Profile Length (hrs)	30.1

V100 23 Sep 2006 A Boyter

UMT Start Time	Profile Length	Command
Date/Month/Year 24hr Clock	Minutes	UMT Command
22/9/2006 23:15	2	Log
22/9/2006 23:17	2	Sleep
22/9/2006 23:19	1800	Log
23/9/2006 5:19		Sleep
23/9/2006 5:19		Sleep
23/9/2006 5:19		Sleep
23/9/2006 5:19		Sleep
23/9/2006 5:19		Sleep
23/9/2006 5:19		Sleep
23/9/2006 5:19		Sleep
23/9/2006 5:19		Sleep
23/9/2006 5:19		Sleep
23/9/2006 5:19		Sleep
23/9/2006 5:19		Sleep
23/9/2006 5:19	Profile End Time	

Capacity Factor Table, %

BEI	150 deg C	180 deg C
Capacity	5.5 Ah	4.5 Ah
Ambient	70	70
50 deg C	80	80
100 deg C	70	80
150 deg C	80	90

Instructions:

Enter Battery Information, Estimate capacity factor allowing.
for a Saftey margin.
Self drain is related to downhole temperature. For Lithium
batteries it is low.
Enter Tool Type, Tools used and Tool Current as in the final
test records
Enter Date and Tool Start time
Enter profile length minutes and Command as in UW Memlog
profile.
Computed answers are highlighted in yellow

Total	Power Used	Cumulative
Current	mAH	mAH
163	5.43	5.43
1.5	0.05	5.48
163	4890.00	4895.48
1.5	0.00	4895.48
1.5	0.00	4895.48
1.5	0.00	4895.48
1.5	0.00	4895.48
1.5	0.00	4895.48
1.5	0.00	4895.48
1.5	0.00	4895.48
1.5	0.00	4895.48
1.5	0.00	4895.48
1.5	0.00	4895.48
1.5	0.00	4895.48
Power Used:		4895.48

EXAMPLE

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