AC-RCA: SS-25A Offset Well Analysis

Rev : 2017-04-27
By : Alvares

8-5/8" Casing Logging Program - All logs from TOL (7926') to surface.

Run	Log Description	Purpose	Provider	Tool Name	Abbreviation
1	Junk Basket, Gauge Ring, Gamma Ray, Casing Collar Locator	Determine if there are ID restrictions, correlation	Baker	--	JBGR/GR/CCL
2	Mechanical Caliper	ID measurements - deformation, corrosion indications, wall thickness estimate	Baker	ICAL Multi-Finger Caliper	ICAL
3	8-5/8"" Casing condition	Metal loss detection in 8-5/8" - defect identification	Baker	High Resolution Vertilog	HRVRT
4	13-3/8" Casing condition	Metal loss detection - defect identification in the 2nd barrier (surface casing)	Versa-Line	Magnetic Defectoscope-3	MID-3
5	Formation evaluation	Porosity, Total Organic Content (TOC), presence of gas, pressure and temperature.	SLB	3D Pulsed Neutron Extreme	PNX
6	Cement bond evaluation 8-5/8" Casing condition Annulus evaluation	Cement bond quality, casing ID, casing wall thickness, condition of the annulus (fault analysis, hole enlargement), solid-liquid-gas map of annulus material, identify annular barite sag and casing centralization	SLB	Isolation Scanner, Cement Bond Log, Variable Density Log	IBC-SSCAN
7	Formation evaluation	GR, Neutron, Porosity log for quantitative mineralogy, matrix properties for petrophysical evaluation, elemental weight fractions	SLB	NEXT-LithoScanner	NEXT
	8-5/8" Casing condition	High resolution ultrasonic casing ID and OD imaging (requires mud with <5% solids, or brine)	SLB	Ultrasonic Corrosion Imager	UCI
8	Active corrosion detection	Identify anodic/cathodic cells indicating active corrosion	SLB	Corrosion and Protection Evaluation Tool	CPET
9	Downhole camera	Visual inspection of casing patch area for leaks and other anomalies noted by previous logs	EV	EV Downhole Video	

BAKER HUGHES

Operations Plan for SS25A

Imaging Caliper Service on 8.625" Casing

SoCal SS25A

CONFIDENTIAL

March 9, 2017

Table of Contents

Referenced Documents:	BHOS-OPS-048 Equipment Preparation – Wireline	OPS-GLB-En-100519 Equipment Preparation at the Wellsite – Wireline Services	OPS-GLB-En-100539 Downhole Equipment Check – Wirelines Services
	TWSO331: Work Order for Gowell #11148	TWSO372: Work Order for Gowell #11065	MFC56C-B: Gowell 56 Arm Operating Manual

1. Introduction

In support of ongoing root cause investigation on the SoCal SS25 well at the Aliso Canyon site, Baker Hughes is providing a number of services, one of which is the Imaging Caliper service (ICAL) on the 8-5/8” casing string of the SS25A well. The ICAL service is required to estimate/measure internal metal loss and other anomalous indications on the inner diameter of 8-5/8" casing. The following is a description of the ICAL service and an outline of procedures to ensure reliable data acquisition.

2. Service Description

We will utilize the GoWell MFC56C caliper tool for imaging caliper services on the 8-5/8“casing. The MFC56C (Caliper Tool) has 56 measuring fingers, each of which contacts the inner wall of downhole pipe. When measuring fingers open or close with the changing of inner diameter of pipe, the tip of each measuring finger will have radial movement against the tool itself, and the mechanical actuating mechanism of the tool converts the radial movement of measuring finger to axial displacement of the iron core in the displacement transducer. Axial displacement of the iron core is converted to an electric signal output by the displacement transducer. The electric signals go through Analog to Digital processing after amplification and filter pre-processing. The encoded data is then sent to the surface system where the data is decoded into casing inner diameter producing corresponding logging curves and 3D image to intuitively show the downhole casing condition.

3. Data Assurance Procedures

Baker Hughes personnel will follow standard company operating procedures (SOP) to deliver best in class services. In addition to standard Baker Hughes SOP, the caliper tools will be operated following manufacturer's guidelines as per MFG56C-B, Operation Manual. In preparation for this project, the assigned caliper tools with Gowell Serial:11148 (Baker Hughes equipment number: 2996LA12491422, and Gowell serial number: 10065 (Baker Hughes equipment number: 2996LA11911518) were sent to GoWell to verify instrument stability and temperature coefficients. Gowell number 10065 was maintained on 25-Jan-17 as per work order TSWO372. Gowell number 11148 was maintained on 15-Nov-2016 as per work order TSWO331. Both tools were subjected to temperature drift tests at a max temperature of 300 DEGF and showed minimal drifts not exceeding 0.05“ and 0.03“ respectively. Temperature stability tests were completed as recommended by the manufacturer.

3.1 Calibration and Verification

The Baker Hughes Engineer will calibrate the caliper tools at wellsite ambient temperature conditions utilizing nominal calibrator ring sizes of 5“, 6“, 7”, 8” and 9“ to establish calibration values closest to the ID of the 8-5/8“ casing. Prior to deploying the caliper tool downhole, ’Before-log‘ verification of the 7“ ring will be recorded and compared with a similar ’After-log‘ verification‘ at the end of the survey. Both verification readings should be within +/-0.1“ of each other and the nominal calibrator value in accordance with GoWells operations manual OPS-00005-OP-01.

3.2 Function Checks

Surface function tests on the caliper tool will be carried out to verify smooth open/close cycles, and observe tool voltage, current and duration of the open/close cycles in accordance with GoWells operations manual OPS-00005- OP-01. Tool open and close voltages are 105 VDC (+/- 5VDC), and -105 VDC (+/- 5VDC) respectively. When fully opened or closed, the current should read less than 30 mA. It should take approximately 10 to 30 seconds to fully open or close the caliper tool. In logging mode, tool power should read 90 VDC (+/-9V) and 30 mA (+/- 5 mA).

3.3 Temperature Compensation

Both Caliper tools were sent to Gowell to confirm tool sensor stability and validate temperature compensation: this was verified by Gowell as per work orders TWSO372 and TWSO331. While running in hole, the tool radii readings will be monitored for any signs of drifts or missing temperature coefficients.

4. Logging Procedure

1) Pick up Gowell 56 Arm caliper
2) Lower tool to bottom of lower centralizer on ground level and enter tool depth zero at positive depth to Kelly Bushing height (+15 feet as per well schematic)
3) Pick tool up to Rig floor
4) Establish communications by turning positive DC volts up to 90 VDC.
5) Run in hole, not to exceed 272 ft/min, install packoff
6) Preview on time in Warrior system while running in hole to monitor tool communications
7) When 100 feet above expected PBTD, slow tool descent to 50 ft/min or less.
8) Set tool down and run 10 feet of wireline slack.
9) Stop preview down
10) Open caliper, turn positive DC volts up to 110. When motor volts observed in scope window at zero tool is open all the way.
11) Turn positive DC volts to zero and re-establish tool communication by turning positive DC volts up to 90 VDC.
12) Start logging by clicking on RECORD UP. Verify depth with correlation log (collar signatures on caliper should align with CCL), adjust as necessary.
13) Record 200 feet of repeat interval at 30 ft/min. Click STOP
14) Close Caliper by turning positive DC volts to zero, switching to negative DC volts and turning power up to negative 110 VDC. When negative DC observed flat in scope window tool is closed.
15) Re-establish communication (positive DC volts to 90 VDC)
16) Observe in cross-section window that tool is fully closed.
17) If tool fully closed run back to TD at 150 ft/min, if not fully closed revert to step 14.
18) Slow tool descent to 50 ft/min when 50 foot from PBTD.
19) Set down and run 10 foot of slack on wireline.
20) Open tool by turning positive DC up to 110 VDC.
21) Re-establish communication by turning positive VDC to 0 then up to 90 VDC.
22) Click RECORD UP and pull tool uphole at 30 ft/min. Make note of any damaged zones for further repeats after main logging is completed.
23) Stop at 200 feet and disconnect packoff
24) Continue logging up to surface at 30 ft/min.
25) Stop hoist when tool is above floor, click STOP to stop the recording.
26) Close tool using method described in step 14.
27) Run in hole. If further repeats are necessary due to casing damage run in hole, not to exceed 272 ft/min to desired zones and log them using steps 10 thru 12. If no further repeats are necessary proceed to next step.
28) Run in hole to 40 to 60 feet making sure not to stop where the caliper arms will be in a collar.
29) Open caliper using same method as step 10.
30) Perform AD HOC verification with nominal Inner Diameter (I.D.) entered in system.
31) Close Caliper using method described in step 14.
32) Pull tool out of hole no faster than 50 ft/min.
33) Lay tool down and perform after log verification in 8 inch ring as describe in Section 3.1.

5. Equipment Specifications

	MFC56C-C P/N 100505339
General Specs	
Maximum Pressure	14,503 PSI (100 Mpa)
Maximum Temperature	350 °F (177 °C)
Diameter	3.5 in. (90 mm)
Length	83.7 in. (2086.5 mm)
Caliper Measure Point	27.7 in. (704.3 mm)
Weight	138.9 lbs (63.0 kg)
Steel Grade	17-4 SST, Titanium & Al-Bronze
Caliper Measurement	
Number of arms	56 arms
Minimum	3.94 in. (100 mm)
Maximum	9.65 in. (245 mm)
Finger Force	3 - 4.54 N
Accuracy	±0.02 in. (0.5 mm)
Resolution	0.0039 in. (0.1mm)
Sensor Type	Linear Displacement Sensor
Temperature Measurement	
Range	-13° F (-25° C) — 350 °F (177°C)
Accuracy	± 2° C
Resolution	0.05° C
Response Time	≤2 sec
Sensor Type	Platinum Resistor PT100
Inclination Measurement	
Minimum	0°
Maximum	180°
Accuracy	±5.0°
Resolution	0.1°
Relative Bearing Measurement	
Minimum	0°
Maximum	360°
Accuracy	±5.0° (Dev≥5.0°)
Resolution	0.1° (Dev≥5.0°)
Data Acquisition	
Typical Logging Speed	30 ft/min (9.14 m/min)
Vertical Resolution @100 samples/ft	0.12 in. (3.05 mm)
Power Requirements	
Voltage	18-36 Volts
Current	80 mA (±5 mA)
Extended Arms Option	
Tool OD	7.1 in. (180 mm)
Maximum Casing Size	13.78 in. (350 mm)

6. Tool Diagram

The MFC56C will be deployed with two bowstring centralizers placed above and below the caliper tool as shown in the tool schematic. An overpull of 3704 lbs is required to severe the 12 working wire (9 outer and 3 inner) cablehead mechanical weak point. The tool string weighs 170 lbs in air with 3.5“ outer diameter excluding the centralizers, and a total length of 13.61 ft.

Sensor	Offset (ft)	Schematic	Description	Len (ft)	OD (in)	Wt (lb)
PRATE TOTBBL PPRES BPRES	13.61 13.61 13.61 13.61		STNDRD Standard Cable Head	1.03	1.45	10.00
			3' In-Line 2. 3/4" Probe In-Line Standard GOI Centralizer	3.00	2.75	30.00
Meas Aux1	5.67 3.00		XIPEMAC-56 (10065) Hotwell 56 Arm caliper	6.58	3.50	100.00
			3' In-Line 2. 3/4" Probe In-Line Standard GOI Centralizer	3.00	2.75	30.00

Dataset: ical.db: field/well/run1/pass1
Total Length: 13.61 ft
Total Weight: 170.00 lb
O.D. 3.50 in

Operations Plan for SS25A

High Resolution Vertilog Service on 8.625” Casing
SS 25A Well

CONFIDENTIAL

March 8, 2017

Table of Contents

Referenced Documents:	BHOS-OPS-048 Equipment Preparation – Wireline	OPS-GLB-En-100519 Equipment Preparation at the Wellsite – Wireline Services	OPS-GLB-En-100539 Downhole Equipment Check – Wirelines Services
	HR VERTILOG (HRVTM) Field Manual	Aliso Canyon RCA MicroLine HRVRT Calibration Summary	

1. Introduction

In continuation of ongoing root cause investigation on the SS25 well at the Aliso Canyon field, Baker Hughes is providing the High Resolution Vertilog (HRVRT) service to determine the location, extent, and severity of corrosion and other metal loss defects in the 8-5/8” casing in the SS25A well. The following is a description of the HRVRT service and an outline of procedures to ensure reliable data acquisition.

2. Service Description

High Resolution Vertilog (HRVRT) tools employ a permanent magnet circuit designed to produce high levels of magnetic flux within the casing body wall. Defects, such as internal or external corrosion pitting, cause flux perturbations ("leakage") that are detected by a circumferential (3-axis) array of (FL) sensors. The HRVRT also employ a circumferential array of discriminator (DIS) sensors, each aligned with a corresponding FL sensor set, that respond only to flux anomalies occurring at the casing's inner surface. This combination of FL and DIS data allows the HRVRT to differentiate between internal and external features. The HRVRT system produces digital bipolar waveforms, allowing metal gain anomalies (centralizers, downhole hardware) verses metal loss (corrosion, mill defects) to be determined from the log signature. The vertical data sampling resolution is 0.100", or approximately 10 samples per inch, per sensor.

Preliminary results from the logging operation will be available 24 hours after the data has been transmitted to Geoscience for rush processing and 3-4 days for standard processing. Final results in the form of reports / prints will be available in 3-5 days for rush processing (if all necessary information from the client and correlation data has been received) and 7-10 days for standard processing.

3. Data Assurance Procedures

Baker Hughes personnel will follow standard company operating procedures (BHOS-OPS-048, OPS-GLB-En-100519, OPS-GLB-En-100539, and OPS-GLB-WS-102093) to deliver best in class services. Specific operating guidelines are described in the High Resolution Vertilog Field Manual (P/N 198625-915 Rev: 10/10/2008).
In preparation for this project, the assigned HRVRT tools with Baker Hughes equipment number: 4997PA/B:xxxxxxxx & xxxxxxxx, 4997QA/B:xxxxxxxx& xxxxxxxx were sent to our Microline Traverse City facility for calibration on {Dates-TBD}.

3.1 Calibration and Verification

The High-Resolution Vertilog series of tools requires a tool calibration process to be performed on every tool after it is manufactured and before it is shipped. This process is to verify that the magnet assemblies within the inspection shoes are performing within specifications such that they generate the proper magnetic field. Also, tool calibration ensures that all sensors within the tool will output measurements within a thin acceptability range given their exposure to a fixed ferro-magnetic stimulation.

Sensor stimulation is in the form of a calibration core called the “Calibrator”. The calibration core consists of a simulated pipe that is precision machined to have a uniform body wall as well as inner and outer diameters. The steel core also has (2) ring ‘defects’ that go 360 degrees around the circumference of the “pipe”. One is a 25% metal loss ‘defect’ and the other is a 50% metal gain ‘defect’. The nominal wall thickness provides a ‘baseline’ sensor gauss measurement (to determine sensor offset, if any), the metal loss defect provides a very positive (+) gauss measurement (close to the sensor’s maximum), and the metal gain defect provides a very negative (-) gauss measurement (close to the sensor’s minimum). With these three points, a very accurate, diagnostic tool is created by curve fitting the sensor readings with a straight line. By doing this, sensors can be compared to one another, rated for linearity (sensors showing non-linearity are replaced), sensor offset, and sensor measurement range to determine calibration factors (gain/multiplication factors) and calibration offsets (differences between a sensor’s baseline reading and the established baseline norm).

By this method, every tool that is produced can be adjusted such that the sensors will all read the same for a given stimulus (defect), no matter which tool is used. For example, if two 4995 tools were taken to the same wellbore and both logged one after the other, the two logs would produce almost identical responses within the logs. However, if the two tools did not have their correct calibration files used (the file where the corrected offsets and gains are stored for a unique tool) in the software, the two logs would be different which could produce different interpretations of the same well.

A similar calibration procedure was witnessed by Blade Energy representative – Mr. Jack Soape – and additional details of the process is outlined in the ‘Aliso Canyon SS-25 – MicroLine MVRT Calibration Summary’ report from Microline dated May 25th, 2016.

Shoe Serial No.	Calibration Reading (Kgauss)	Upper Limit (Kgauss)	Lower Limit (KGauss)	Pre Job Check (KGauss)	Pass/ Fail	Completed By

3.2 Function Checks

All surface and functional checks will be performed as per the HR Vertilog Field Manual (P/N 198625-915, Rev 10/10/2008). These will include the following:

View tool response with time selected as the pulse source and with the tool connected on surface. (Section 5.1.2, page 20)
Perform a scratch test and scratch all channels (page 21)

- Verify that all channels are present
- Verify that all channels are active
- Verify consistent polarity

All shoes are permanently mounted and are already in proper order and aligned.
Verify and input proper encoder factor (256 pulses / meter)

4. Logging Procedure

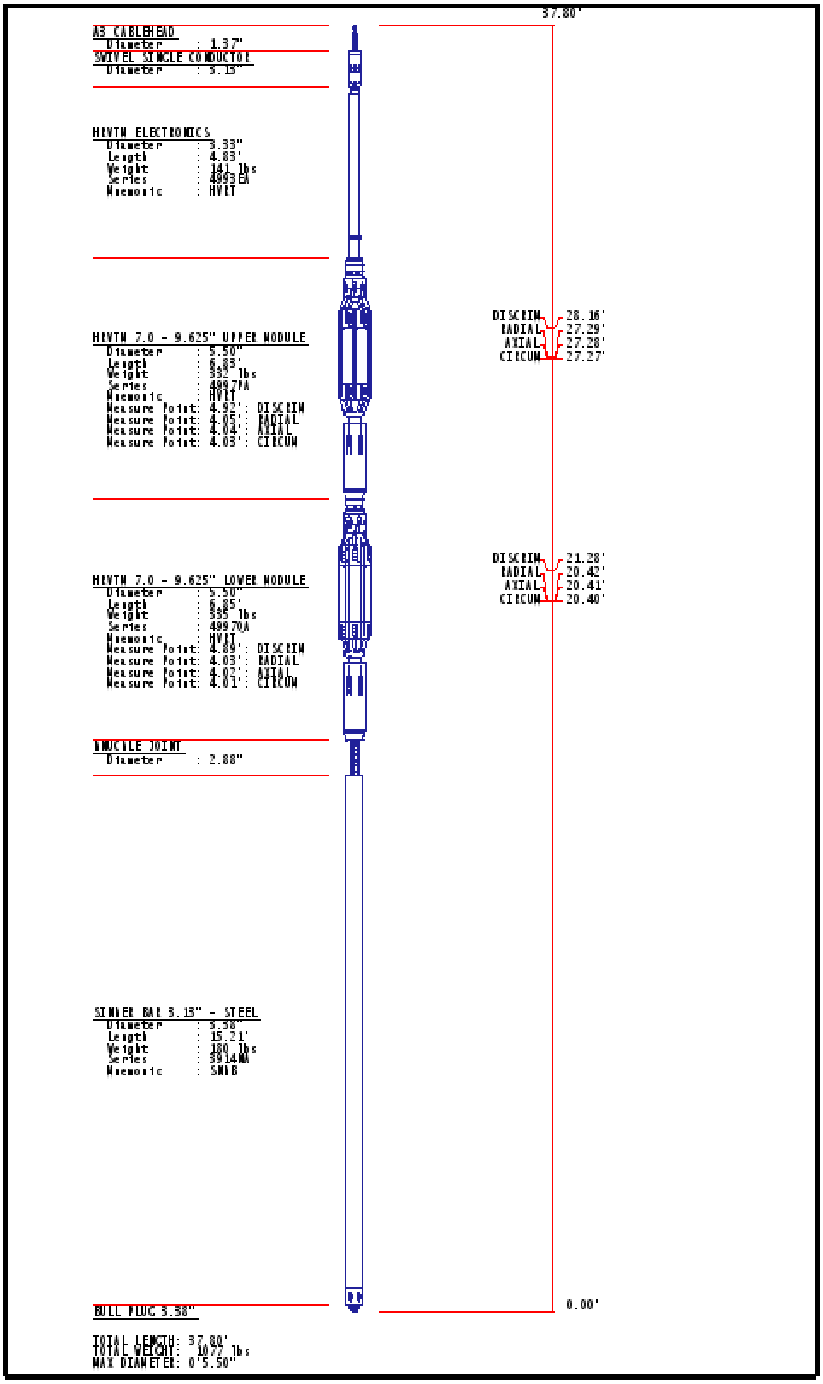
1. Pick up sinker bar(s) and run them in hole using tugger line. Using tool clamp, hang them from the rig floor.
2. Pick up lower HRVRT mandrel with tugger line and make up to sinker bars hanging in the well. Run in hole and using tool clamp hang off at the rig floor.
3. Pick up HRVRT electronics and upper HRVRT mandrel (already assembled) and make up to tools hanging in the well.
4. Zero the depth at the rig floor estimating height of floor in relation to Kelly bushing height (15 feet). Adjust hoist panel and backup odometer.
5. Start acquisition in Dual Mode as per section 5.2.1 of HR Vertilog Field Guide. Verify start depth is the same as the hoist panel.
6. Run in hole logging "Away from Truck" at no more than 160 ft/min. Review collar depths. Ensure they are the same or slightly deeper (due to slack in the line) than the collars on the caliper log.
7. Install wireline packoff at floor
8. When the toolstring is 100 feet from LINER TOP, slow the descent to 50 ft/min or less.
9. Stop 15 feet above the top of the 6-5/8" liner (as observed on caliper log) and stop recording, make note of the file name, memory block start & stop and depth interval.
10. Start new recording in "Toward Truck" and verify start depth is the same as on hoist panel.
11. Pull tool up no faster than 160 ft/min with 120 ft/min preferred.
12. When tools are at 1000 feet, remove packoff at floor and pick up with tugger line at least 25 feet.
13. When tools are 100 feet from rig floor slow upward winch speed to 30 ft/min.
14. Pull tools up above floor to bottom of lower HRVRT mandrel.
15. Stop recording, make note of file name, memory block start / stop and depth interval.
16. Run down to connection between upper / lower HRVRT mandrel and install tool clamp, set clamp down on make-up stand and break upper mandrel from lower mandrel (hanging in well).
17. Lay down HRVRT electronics and upper mandrel.
18. Break electronics from upper mandrel and bring into wireline unit for memory download.

5. Equipment Specifications

HR Vertilog Design Specifications	[redacted]
Casing Range	[redacted]
Axial Field Metal Loss Sensors (Hall Effect)	[redacted]
Radial Field Metal Loss Sensors (Hall Effect)	[redacted]
Circumferential Field Metal Loss Sensors (Hall Effect)	[redacted]
Total Field Metal Loss Sensors (Hall Effect)	[redacted]
ID/OD Discrimination Sensors	[redacted]
Number of Sensor Shoes / Pads	[redacted]
Sensor Spacing (nominal)	[redacted]
Axial Sample Resolution	[redacted]
Length	[redacted]
Weight	[redacted]
Recommended Logging Speed	[redacted]
Minimum Logging Speed	[redacted]
Maximum Logging Speed	[redacted]
Maximum Pressure	[redacted]
Operating Temperature	[redacted]
Electronics Flask Rating	[redacted]
Dynamic Range - Maximum	[redacted]
Dynamic Range - Minimum	[redacted]
Battery Power Supply	[redacted]
Wireline Power Supply	[redacted]
Survey Interval [2]	[redacted]

6. Tool Diagram

The HRVRT will be deployed as shown in the tool schematic. An overpull of 4200 lbs is required to severe the 12 king wire (9 outer and 3 inner) cablehead mechanical weak point. The tool string weighs 1077 lbs, has a hard O.D. of 5.5 inches and a total length of 37.8 feet (with sinker bar installed).



MULTI-BARRIER PIPE INSPECTION

MID-3 Logging Procedure

Well Name: Standard Sesnon #25A

Phase 3: 13-3/8" Surface casing Evaluation

Program Update: Version 1

March 28th, 2017

COMPANY	SOUTHERN CALIFORNIA GAS (SoCalGas)
CUSTOMER	RCA (CPUC/DOGGR/SCG/BLADE)
COUNTRY	USA
COUNTY	LOS ANGELES
FIELD	ALISO CANYON
PREPARED BY	MOHSEN GHANAVATI (Sr. Well Log Analyst, Global New Petro Tec.)
REVIEWED BY	HASSAN KOHZADI (CEO, Global New Petro Tec)
REVIEWED BY	STACY SCHABER (VP Business Development, Versaline- Services)

The logging procedure document is the property of contractor and needs to remain with SoCalGas, CPUC, DOGGR and Blade.

TABLE OF CONTENTS

List of Figures

List of Tables

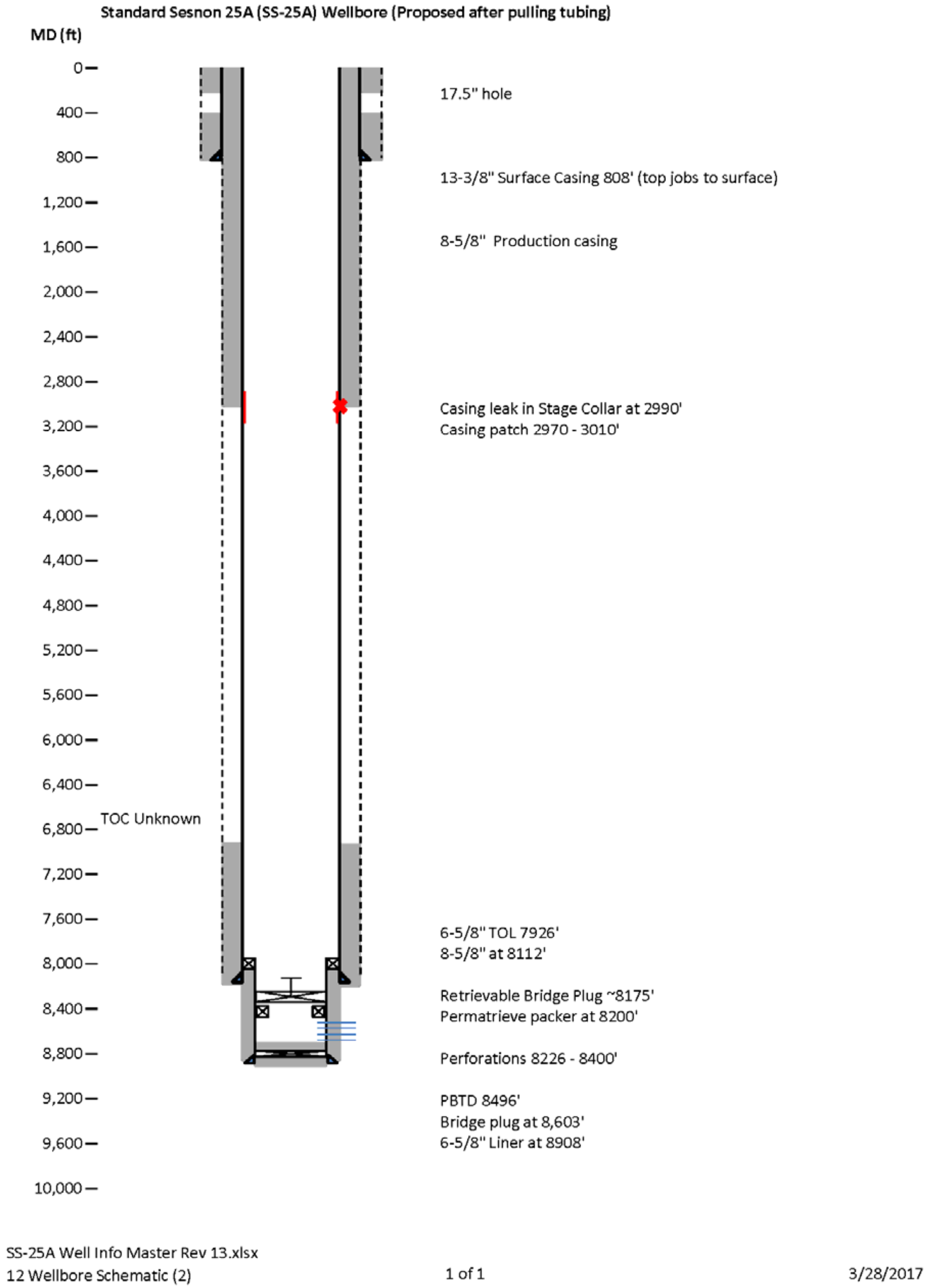
OBJECTIVES

The objective of the *Magnetic Imaging Defectoscope* (MID) Survey in this well is to identify metal loss and other significant anomalies in 13-3/8" surface casing after the retrieval of tubing.

WELL INFORMATION

Item/Parameter	Name/Value
Contractor	Versa-Line Services (VLS)
Country	USA
Company	Southern California Gas (SoCalGas)
Customer	RCA (CPUC, DOGGR, SCG, BLADE)
Field	Aliso Canyon
Well Name	Standard Sesnon #25A
Well Status	Idle
Well Profile	Slanted
Conveyance	Wire line (WL)
Surface casing	13-3/8" OD, shoe @ 808 ft/KB
Production casing	8-5/8" OD, shoe @ 8112 ft/KB
Tubing	To be retreived
PBTD	TBD
Total Depth (TD)	8908 ft/KB

WELL SCHEMATIC



JOB PREPARATION

- Tools and Crew

- As per job plan and timing (As per Figure 1 and Table 1), two professional logging personnel will be mobilized to location to perform the job.
  - All the necessary workpermits will be obtained in advance.
  - MID tools production and calibrations dates are provided in Table 3. Calibrartions are valid untill tools need repair or upgrade.
  - As per the job plan and timing (As per Figure 1 and Table 1), all required logging tools and accessories (As per Table 3) will be shipped to location in advance.
  - Logging tools will be deployed using BAKER HUGHES wireline truck/unit. The quality and adaptibility of equipments should be ensured in advance. Job plans and survey designs must be reviewed in integration meeting.
  - The job is planned as 12 hours operations per day using Wireline Truck.

- Well Preparation

- There is no pressure in the wellbore; well is dead.

- Supervision and Execution

- BLADE ENERGY PARTNERS supervises the job; actual work to be performed by Wireline Crew (BAKER HUGHES), and Versa Line logging personnel (12 hours operations per day)

DAILY LOGGING OPERATION

1. Arrive at the well site (Blade Energy Partners supervisor, VLS personnel, Wire line unit crew).
2. Attend orientation meeting organized by BLADE ENERGY PARTNERS.
3. Conduct pre-job safety meeting and discuss Job Safety Analysis (JSA).
4. Monitor casing pressure and record them in Sequence of Events (SOE).
5. Rig up Wireline unit as per the SoCalGas Safety Procedures. Ensure the wireline valve is fully functional and have a suitable pump available so that the valve can be closed in an emergency. Do not rig up tool string if lubricator length is not sufficient.
6. Program the logging tools as per instructions and requirements of logging procedures in *Table 1* and *Figure 1* and subsequently rig up logging tool string.
7. Summary of tool runs are as follows (Details are in Table 1 & Figure 1).
   - MID-3 run to investigate 13-3/8” surface casing integrity. It is up-pass at the low stable speed of 6 ft/min after a RIH at 100 ft/min down to 850 ft. A repeat pass at the same low stable speed of 6 ft/min is also designed at 650.0-850.0 ft interval (equivalent to at least 3 joints) to check meticulously the two significant events previously detected at 710.5 ft and 771.5 ft.

8. Ensure that all connections are properly tightened before Run in Hole (RIH)
9. Carry out MID logging survey as per *Table 1 and Figure 1.*

   Note:

   - **MID logging speed must be steady, the tool must be run without any jerks or stops.**
   - **VLS would use CCL-GR tool provided by Baker for depth correlation. Make sure tool offsets are recorded properly. Also, make sure generated LAS files by their tool are obtained.**
   - **Baker and Versa-Line should synchronize time on logging computers and ensure correct time zone.**
   - **During survey use caution and slow down if necessary when running through any changes in profile or diameter.**

10. After survey rig down wireline equipment
11. Download logging tools data
12. Send all data (SOE, Downloaded tools data, GR-CCL, Depth Files, Tool Sketch and tool offset info) to *well log analyst* for QC and QA and subsequent processing and analysis.
13. Tidy work site
14. Leave the wellsite safely

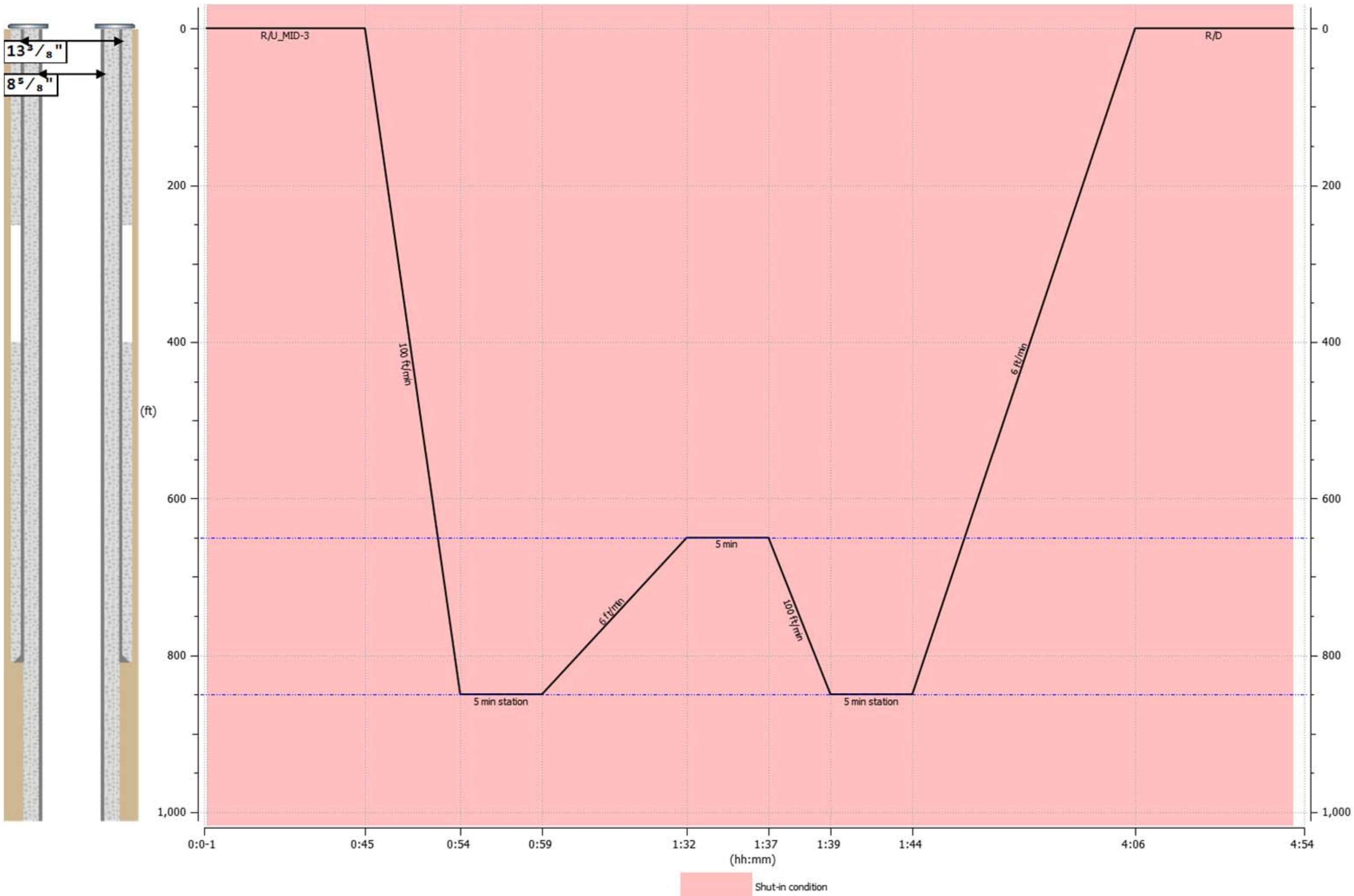


FIGURE 1: LOGGING SURVEY SCHEMATIC

TABLE 1: MID3 LOGGING PROCEDURE

MID-3 RUN (Surface-850.0 FT/KB). **OPERATING TIME IS 4:51 HR:MM.**							
NO	**Action**	**START, FT/KB**	**END, FT/KB**	**SPEED, FT/MIN**	**DURATION, H:MM**	**LAS FILE***	**GR**
1	R/U	SURFACE			0:45		OFF
2	RIH	0.0	850.0	100	0:09	Run In Hole	ON
3	STATION	850.0			0:05		ON
4	U/P	850.0	650.0	6	0:33	MID3_MAIN	ON
5	STATION	650.0			0:05		ON
6	RIH	650.0	850.0	100	0:02	Run In Hole	ON
7	STATION	850.0			0:05		ON
8	***U/P (REPEAT PASS)***	850.0	650.0	6	0:33	MID3_ REPEAT	ON
9	U/P	650	0.0	6	1:49	MID3_MAIN	ON
10	R/D	SURFACE			0:45		OFF

***** The LAS file names herein are just for internal communication. LAS files to be provided to client follow proper naming including field name, well name, and API # of the well.

DELIVERABLES

a. Preliminary report that ensures raw data quality along with the raw data las file will be provided within 24 hours.
b. Interpretation report along with the processed las file will be provided within a week.
c. Results can be presented to the client to explain and discuss the findings, one week after submission of the interpretation report.

TABLE 2: ABBREVIATIONS

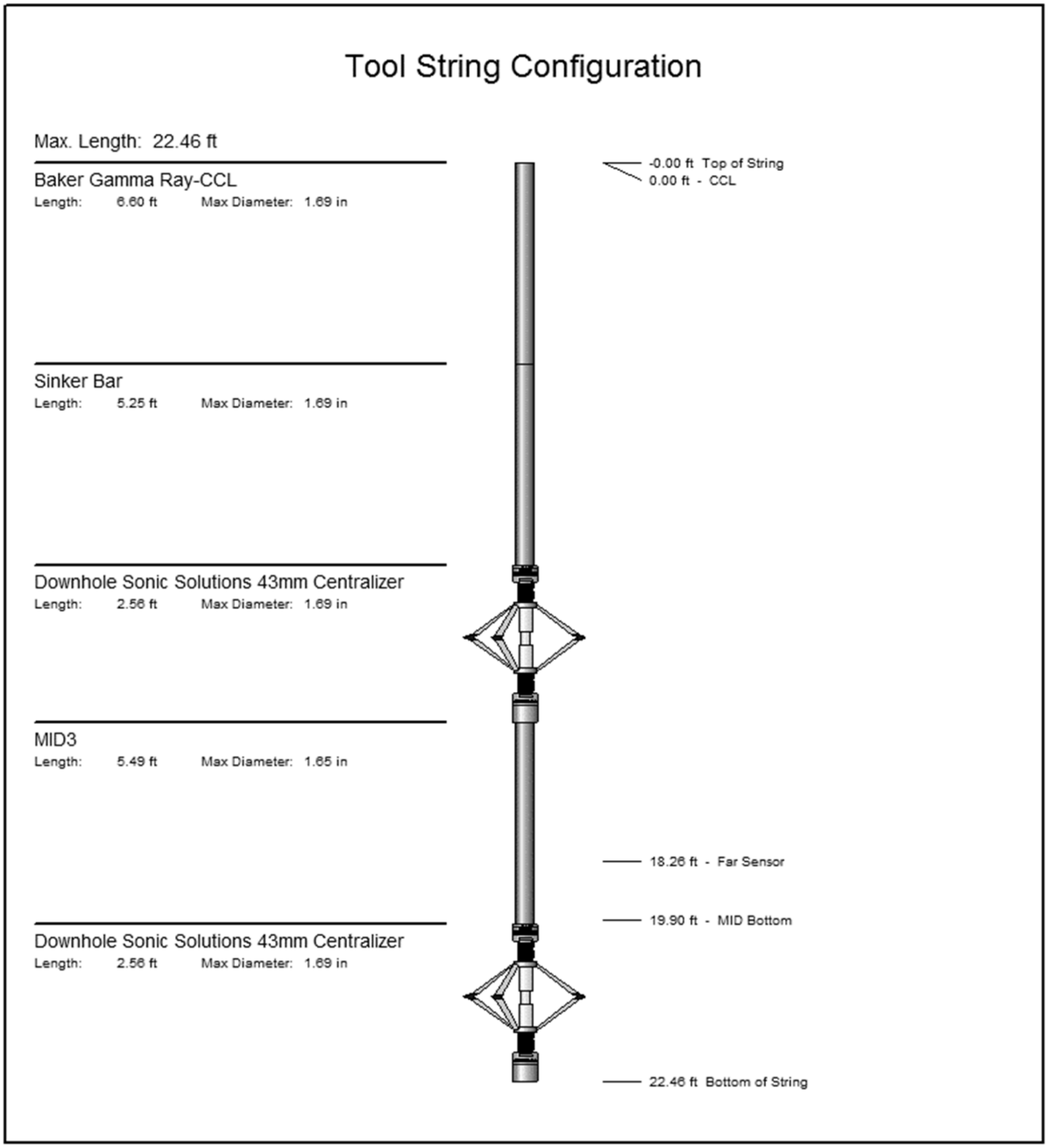
Nomenclature	Description
MID	Magnetic Imaging defectoscope
PBTD	Plug Back Total Depth
TBD	To-BE-Determined
POOH	Pull out of hole
R/D	Rig down
R/U	Rig up
RIH	Run in hole
U/P	Up Pass

TABLE 3: SERIAL NUMBERS AND FACTORY CALIBRATION DATES OF LOGGING TOOLS TO BE USED IN THIS PROJECT

Tool	Tool Set	Primary/ Back-up	Year of production	Calibration Date
MID-3	MI3, SN# 1012	Back-up	2015	Oct 23, 2016
	MI3, SN#1025	Primary	2016	Oct 23, 2016
	BAT, SN# 1018	N/A	2015	N/A
	BAT, SN# 1023	N/A	2015	N/A

TOOL SKETCHES

- MID3 run tool sketch



SCHLUMBERGER
PNX Run
Aliso Canyon

April 21, 2017

SS-25A

Logging work plan for the Pulsed Neutron eXtreme tool for SS-25A.

Version 001

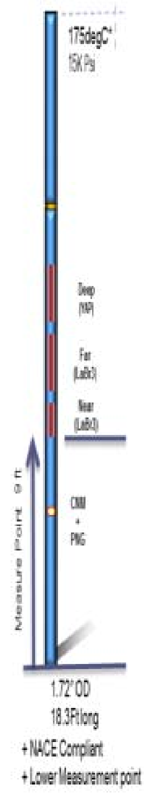
1. Service Description

Schlumberger

PNX

Description

The PNX Pulsed Neutron eXtreme tool incorporates a pulsed neutron generator and a multi-detector spectrometry system that measures elemental concentrations, including a direct carbon measurement and the carbon/oxygen ratio, and both the capture cross section and fast neutron cross section during a single trip in the well.



Oil volume can be computed using traditional carbon/oxygen (C/O) ratio processing. The C/O ratio is determined through full spectral analysis of PNX energy domain measurements for highest accuracy and also from a windows-based C/O ratio. Oil volume can also be computed from a new direct measurement of total organic carbon (TOC); this reduces the impact of environmental effects that influence the C/O ratio. Full spectral analysis also provides concentrations of rock-forming elements such as silicon, calcium, magnesium, iron, titanium, and sulphur, which can be used to evaluate matrix lithology and improve overall formation evaluation.

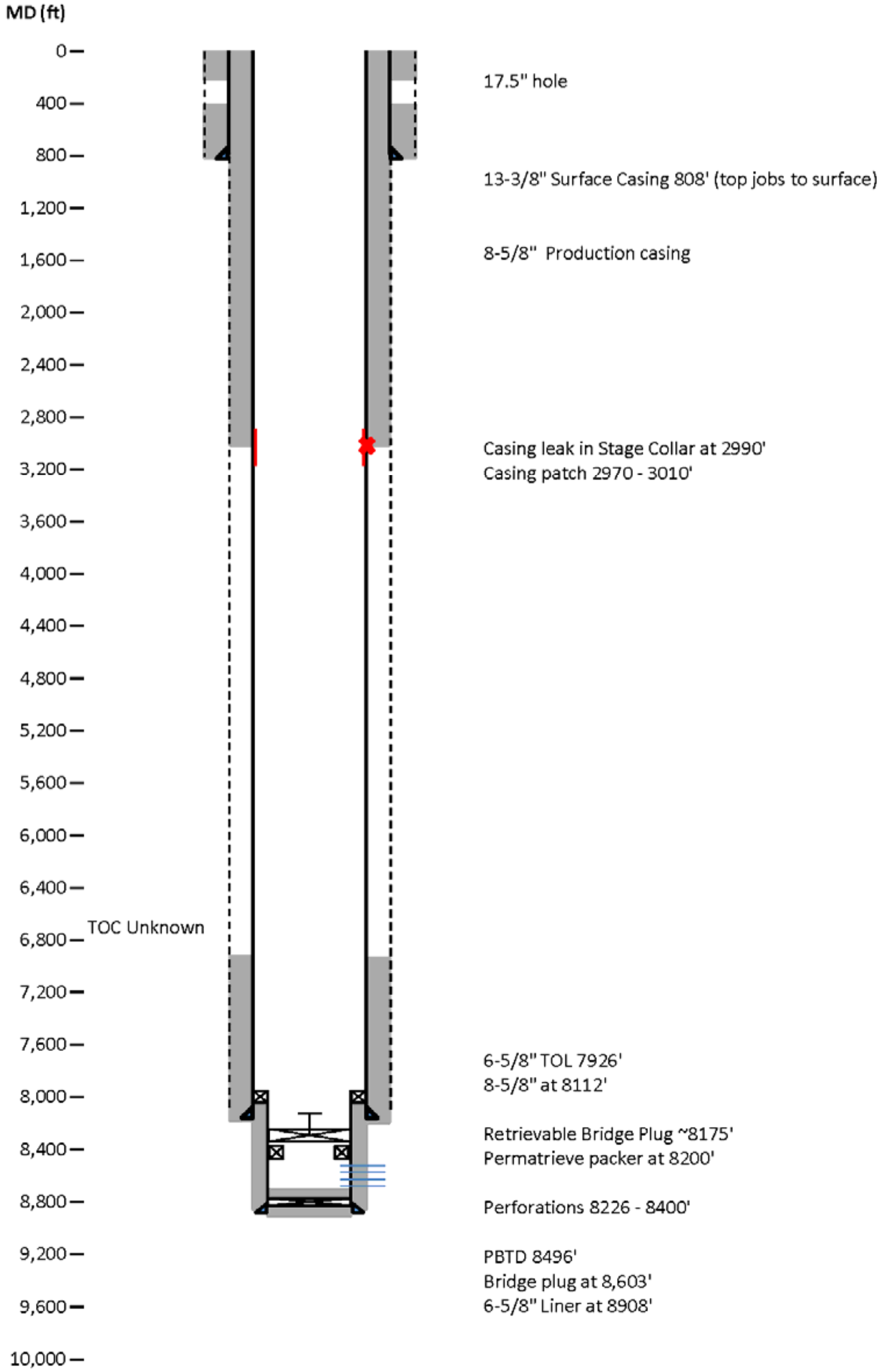
Time domain measurements are used to determine neutron porosity, capture cross section (sigma) and a unique new measurement of fast neutron cross section. The fast neutron cross section is an atom density measurement independent of capture cross section and neutron porosity. The fast neutron cross section and neutron porosity measurements can be used for stand-alone gas quantification in a similar way as open-hole density–neutron crossover methods, overcoming limitations of interpreting neutron porosity and neutron-capture cross section measurements alone. In saline waters, the capture cross section can also be used to calculate water saturation due to the large contrast between saline water and hydrocarbons. Where formation waters are fresh or of unknown salinity, saturation is determined from the direct carbon or C/O ratio measurements, which are salinity independent.

Applications

- Formation evaluation behind casing
- Formation evaluation in old wells where modern open-hole logs have not been run
- Neutron porosity, capture cross section, fast neutron cross section, C/O ratio and TOC measurements in one trip in the wellbore
- Formation oil volume from both C/O ratio and TOC measurements, independent of formation water salinity
- Differentiation of gas-filled porosity from tight formations using neutron porosity and fast neutron cross section measurements
- Capture yields (H, Cl, Si, Ca, Mg, Fe, S, Ti and Gd)
- Inelastic yields (C, O, Si, Ca, Mg, and Fe)
- SpectroLith lithology

2. Wellbore Schematic

Standard Sesnon 25A (SS-25A) Wellbore (Proposed after pulling tubing)



SS-25A Well Info Master Rev 13.xlsx
12 Wellbore Schematic (2)

1 of 1

3/28/2017

3. Data Assurance Procedures

3.1. Function Checks

Step	Description	Ref Document
	Pre-Job Maintenance	
1	Perform PNCH-A Upper Head Inspection. Change O-ring as needed and apply grease.	Pulsed Neutron eXtreme Cartridge PNXC-A Maintenance Standard Work Instructions – [redacted]
2	Perform PNCH-A Downhole End Inspection and check thread and housing wear.	Pulsed Neutron eXtreme Cartridge PNXC-A Maintenance Standard Work Instructions – [redacted]
3	Perform PNXC-A electronic checks as per PNXC-A FIT SWI	Pulsed Neutron eXtreme Cartridge PNXC-A Maintenance Standard Work Instructions – [redacted]
4	Perform PNXS-A Upper Head Inspection. Change O-ring as needed and apply grease.	Pulsed Neutron eXtreme Sonde PNXS-A Maintenance Standard Work Instructions – [redacted]
5	Perform PNXS-A Downhole End Inspection and check thread and housing wear.	Pulsed Neutron eXtreme Sonde PNXS-A Maintenance Standard Work Instructions – [redacted]
6	Perform PNXS-A electronic checks as per PNXS-A FIT SWI	Pulsed Neutron eXtreme Sonde PNXS-A Maintenance Standard Work Instructions – [redacted]

3.2. Calibration and Verification

Step	Description	Ref Document
	System Integration Test (SIT)	
1	Place PNX tool inside SFT-178 Water Tank	Pulsed Neutron Extreme (PNx) Operations Standard Work Instruction [redacted]
2	Power up the PNX by applying [redacted] voltage. Adjust shunt current between [redacted].	Pulsed Neutron Extreme (PNx) Operations Standard Work Instruction [redacted]
3	Perform "PNX Water Tank Test and Calibration" as per PNX Operations SWI [redacted].	Pulsed Neutron Extreme (PNx) Operations Standard Work Instruction [redacted]
4	Ensure calibration values are within tolerance as indicated by the software	Pulsed Neutron Extreme (PNx) Operations Standard Work Instruction [redacted]
5	Turn off PNG by setting SPNGMD from SemiManual to Idle.	Pulsed Neutron Extreme (PNx) Operations Standard Work Instruction [redacted]
6	Wait 1 minute before turning off the PNX Tool.	Pulsed Neutron Extreme (PNx) Operations Standard Work Instruction [redacted]
7	Caution: Wait for 30 minutes before removing PNX tool from SFT-178 water tank. Do not touch the	Pulsed Neutron Extreme (PNx) Operations Standard Work Instruction [redacted]

Step	Description	Ref Document
	PNXS-A in the area of the target for 24 hours or [redacted] [redacted].	

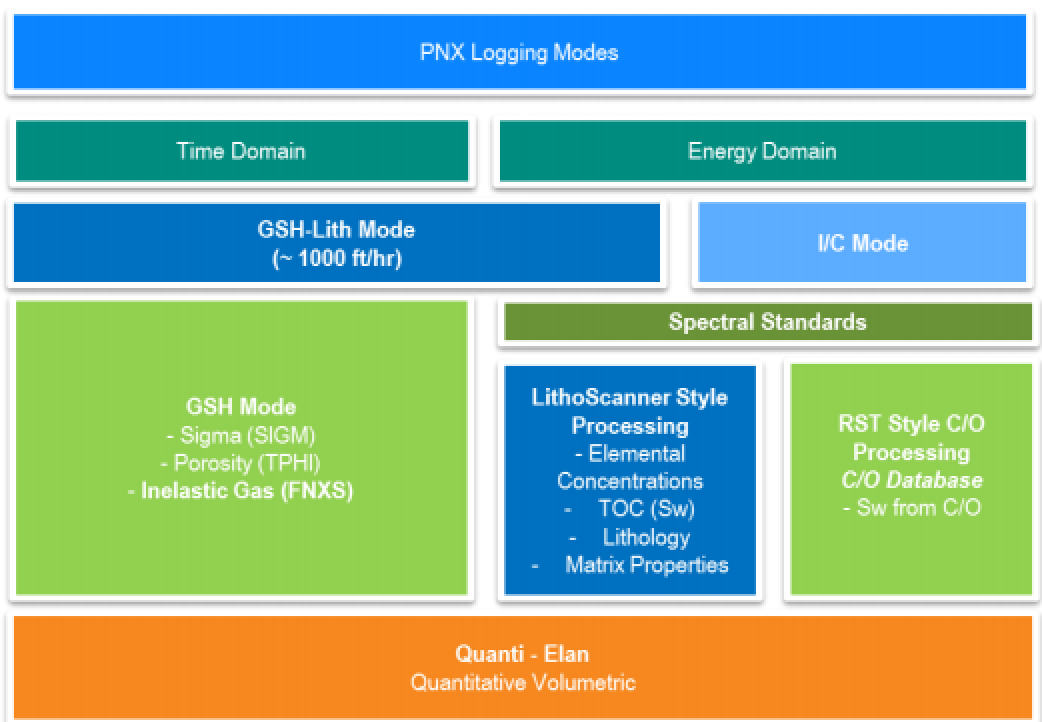
4. Logging Procedure

Step	Description	Ref Document
	Wellsite Operation	
1	Rig up the PNX-PSTP-PEH	Pulsed Neutron Extreme (PNx) Operations Standard Work Instruction [redacted]
2	Power up the PNX by applying [redacted] head voltage. Do not activate the PNG until 200 ft below ground level or deeper.	Pulsed Neutron Extreme (PNx) Operations Standard Work Instruction [redacted]
3	Zero the ToolString to KB.	
4	RIH at speed <2000 fph to 200 ft below ground level.	
5	Turn on PNG and perform PNG shallow test at 200 ft to check the functionality of PNG. Ensure [redacted] pressure [redacted] and temperature [redacted].	Pulsed Neutron Extreme (PNx) Operations Standard Work Instruction [redacted]
6	Confirm [redacted] DEST Lamps all Green	Pulsed Neutron Extreme (PNx) Operations Standard Work Instruction [redacted]
7	Monitor GSH burst sequence as per step SWI PNX [redacted]	Pulsed Neutron Extreme (PNx) Operations Standard Work Instruction [redacted]
8	Once PNG test is completed, turn off PNG to avoid activating the formation.	Pulsed Neutron Extreme (PNx) Operations Standard Work Instruction [redacted]
9	Continue RIH to 7100 ft at speed <25,000 fph with PNG turned off.	
10	Tag bottom at speed <3600 fph.	
11	Turn on PNG at TD in GSH mode. Ensure [redacted].	Pulsed Neutron Extreme (PNx) Operations Standard Work Instruction [redacted]
12	Confirm [redacted] and DEST Lamps all Green	Pulsed Neutron Extreme (PNx) Operations Standard Work Instruction [redacted]
13	Log up at speed 1800 fph to 200 ft.	Pulsed Neutron Extreme (PNx) Operations Standard Work Instruction [redacted]
14	Monitor all tool status lamps are green on Data Gauge. Perform LQC by referring to PNX Operations SWI [redacted]	Pulsed Neutron Extreme (PNx) Operations Standard Work Instruction [redacted]
15	Use Gamma Ray or Neutron to tie-in to open hole log.	
16	Power down the PNG at 200 ft.	Pulsed Neutron Extreme (PNx) Operations Standard Work Instruction [redacted]

Step	Description	Ref Document
17	Log repeat section over anomalous interval at logging speed 1800 fph with PNG turned on.	
18	Wait for 30 minutes at 200 ft after PNG is turned off before POOH. Do not touch the PNXS-A in the area of the target for 24 hours [redacted].	Pulsed Neutron Extreme (PNx) Operations Standard Work Instruction [redacted]
19	Rig down tool.	Pulsed Neutron Extreme (PNx) Operations Standard Work Instruction [redacted]
20	There is no post job calibration or test for PNX.	Pulsed Neutron Extreme (PNx) Operations Standard Work Instruction [redacted]
21	Deliver data to Schlumberger PTS for analysis.	

5. Equipment Specifications

Logging Modes



Output	Time Domain: Sigma (SIGM), Porosity (TPHI), Fast Neutron Cross Section (FNXS) Energy Domain: Inelastic and capture yields of various elements, C/O ratio, TOC
Logging speed	IC mode: Based on Tool Planner GSH mode: 3,600 ft/hr [1097 m/h] GSH-Lithology mode: 1,000 ft/hr [305 m/h] *(Simultaneous acquisition of Time & Energy Domain)*
Mud type or weight limitations	None
Combinability	Combinable with PSP and ThruBit Platform Conveyance on wireline, pump-down, or tractor

Mechanical Specifications

Temperature rating	350 DegF [177 DegC]* *ENP tools rated to 150 DegC*
Pressure rating	15, 000 psi* *upgradeable to 17, 000 psi*
Outer Diameter	1 11/16 in.
Length	18.3 ft [5.58 m]
Weight	88 lbm [40 kg]
Tension	10,000 lbf [44,480 N]
Compression	1,000 lbf [4,450 N]

6. Tool Diagram

Schlumberger						
Tool string drawing.	**RUN #1**		**Date:**	**14-Nov**	**SE:**	**CS**
Operation	**Well**	**Cable**	**Weak Point**	**Weight**	**Supl. By**	**Shear pin/Ring**
WL PNX	SS-25	7-46				
Drawing.	**Tool.**	**O.D.**	**Length.**	**lbs**		**Acc. Length**
	MH-22 - Logging head OTIS Fishing Neck	1.375	1.60	4	SLB	28.50
	AH-38 1 3/8" to 1 11/16"	1.375	0.30	2	SLB	26.90
	PBMS (Platform Basic Measurement Sonde) GR/CCL/P/T	1.688	8.30	40	SLB	26.60
	PNX - Pulse Neutron Extreme	1.720	18.30	88	SLB	18.30
Toolstring		**Feet**	**28.50**	**134.60**	**lbs**	
Max O.D. Of toolstring		**1.72**	**Inch.**			

7. Deliverables

A field print log will be available on site.   A final log will be available in 2 days. Electronic data will be provided in .PDF format. Logging domain champions will schedule a meeting for interpretation following the final log print.

April 21, 2017

SCHLUMBERGER
IBC-SSCAN
Aliso Canyon

SS-25A

Logging work plan for the Isolation Scanner tool suite for SS-25A.

Version 001

1. Service Description

Schlumberger

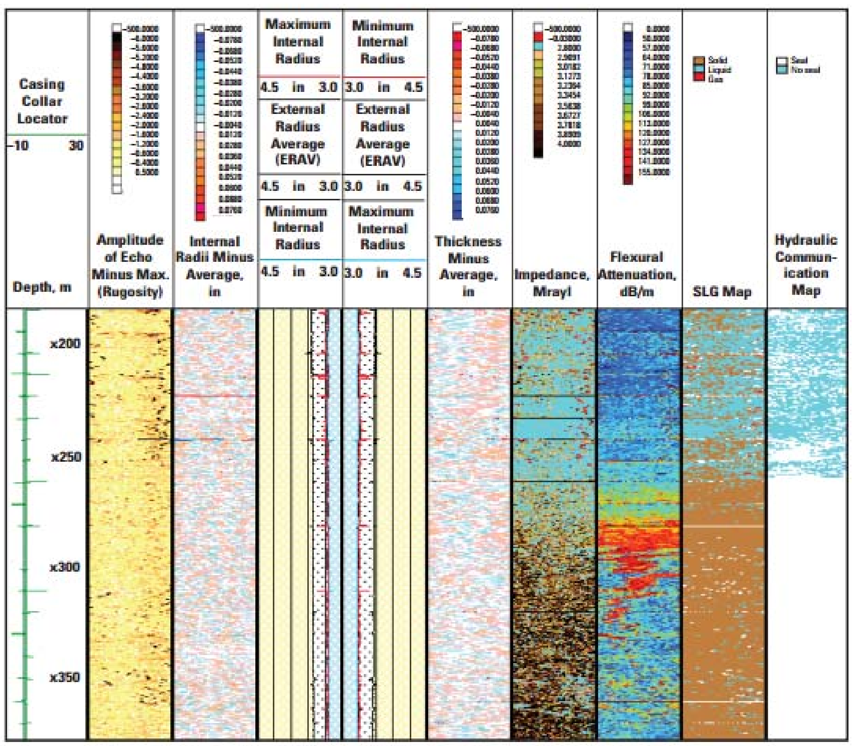
Isolation Scanner

APPLICATIONS

- Differentiate high-performance lightweight cements (foam, LiteCRETE*, and Ultra LiteCRETE* systems) from liquids
- Map annulus material as solid, liquid, or gas (SLG map)
- Confirm hydraulic isolation
- Identify channels and defects in annular isolating material
- Determine casing internal diameter and thickness

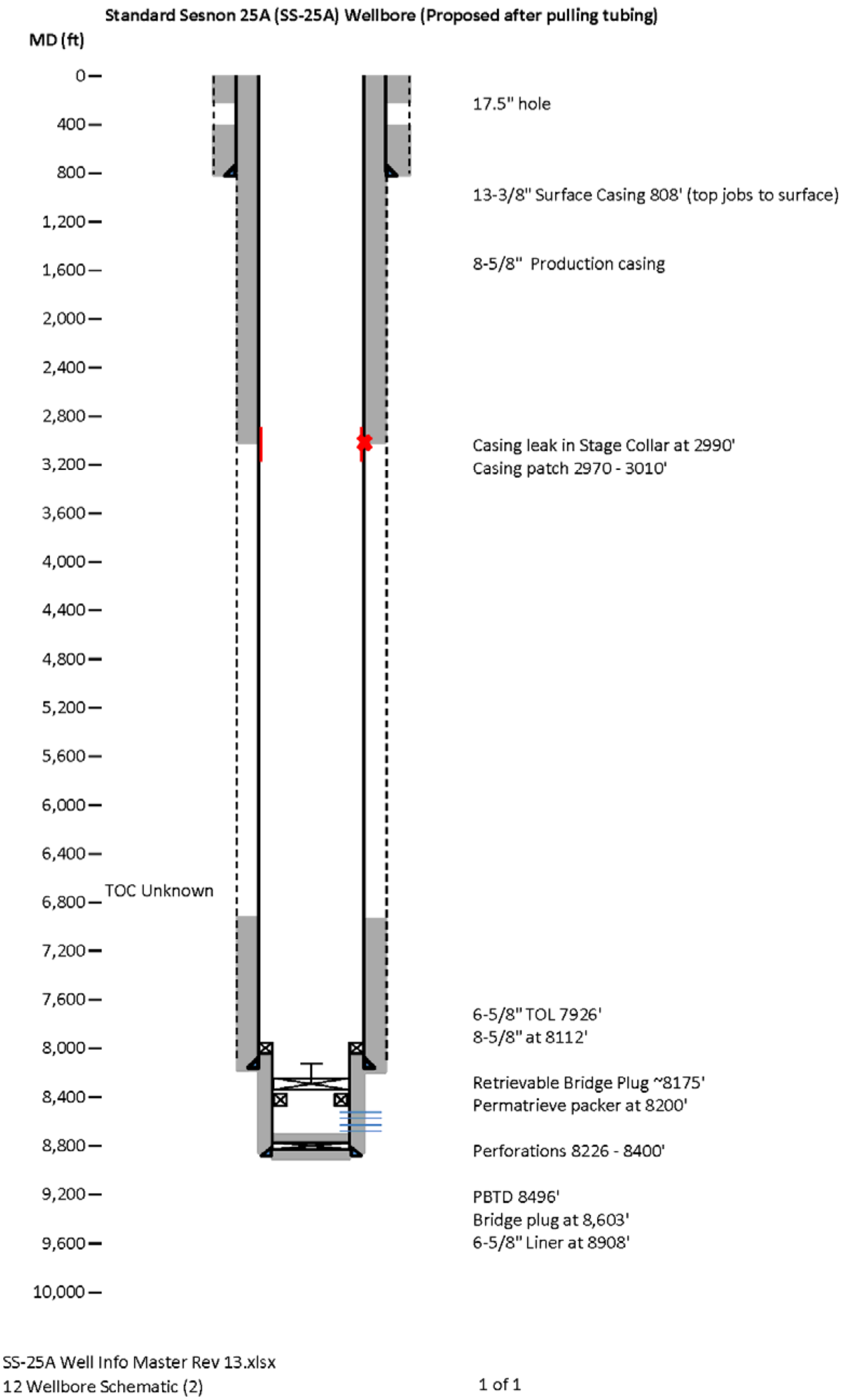
Isolation Scanner* cement evaluation service combines classic pulse-echo technology with a new ultrasonic technique—flexural wave imaging—to accurately evaluate any type of cement, from traditional slurries and heavy cements to the latest lightweight and foam cements. This innovative method provides real-time evaluation of cement jobs in a wider range of conditions than previously possible with conventional technologies.

The tool's combination of independent measurements differentiates low-density solids from liquids to distinguish lightweight, foam, and contaminated cements from liquids. Its azimuthal coverage provides an answer around the entire circumference of the casing, pinpointing any channels in the cement and confirming the effectiveness of a cement job for zonal isolation. Isolation Scanner service also identifies corrosion or drilling-induced wear through measurement of the inside diameter and thickness of the casing.



In addition to pulse-echo corrosion information on the rugosity, radius, cross section, and thickness of the 7-in casing, Isolation Scanner service combines acoustic impedance and flexural attenuation information in an SLG map. Although the cement is heavy Class G, the SLG map clearly displays low-density solid material from X320 to X270 m—revealing that the cement is contaminated. This is correctly indicated as solid on the SLG map.

2. Wellbore Schematic



3. Data Assurance Procedures

Step	Description	Ref Document
	Pre-Job Maintenance	
1	Run SLB Tool planner to determine IBCS-B sub Transducer Angle and Window Settings	UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]
2	Run Zebra to estimate Fluid Velocity and Mud Impedance	UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]
3	Perform IBCS sub preparation steps. Visually examine boots and wires, inspect frame and bellows. Perform electrical checks.	UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]
4	Verify the validity of the IBCS-Calibration. Calibration should be less than six months old, all 4 TX serial numbers match [redacted], [redacted]. If invalid, perform calibration following Appendix I of the USIT IBC Service SWI.	UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]
5	Set IBCS-C Transducer Angles correctly according to Tool planner results.	UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]
6	Inspect USIS sonde. Inspect centralizer arms, compensating piston and the rotating seals.	UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]
7	Confirm USSC-B is installed in the USIS sonde. Visually check for debris.	UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]
8	Fill USIS with oil and grease the sonde.	UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]
9	Perform visual and electronic checks of the MAMS	Multimode Array Sonic Minimum Service Sonde (MAMS-BA) Maintenance SWI [redacted]
10	Perform visual and electronic checks of the MAXS	Multimode Array Sonic Transmitter Sonde (MAXS) Maintenance SWI [redacted]
11	Perform visual and electronic checks of the MASS	Multimode Array Sonic Spacer Sonde (MASS) Maintenance SWI [redacted]
12	Perform visual and electronic checks of the MAPC	Multimode Array Sonic Power Cartridge (MAPC) Maintenance SWI [redacted]
13	Check the MAST calibration is valid (less than three months old and less than ten wireline jobs).	Sonic Scanner (MAST-B, -H) Operations, Standard Work Instructions [redacted]

Step	Description	Ref Document
14	Check oil level in MAMS, MAXS and MASS. Fill if needed with [redacted] oil.	Sonic Scanner (MAST-B, -H) Operations, Standard Work Instructions [redacted]
15	Perform operational check. Power up tool by applying [redacted]. Make sure TEL_STATUS bits are all green.	Sonic Scanner (MAST-B, -H) Operations, Standard Work Instructions [redacted]
16	Perform test and maintenance check.	Sonic Scanner (MAST-B, -H) Operations, Standard Work Instructions [redacted]
17	Select the GEMCO centralizers to use with tool. GEMCO OD should be Casing ID + 0.25 inch.	Sonic Scanner (MAST-B, -H) Operations, Standard Work Instructions [redacted]

4. Logging Procedure

Step	Description	Ref Document
	Wellsite Operation	
1	Rig up USIT-SSCAN-EDTC-LEH	Sonic Scanner (MAST-B, -H) Operations, Standard Work Instructions [redacted], UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]
2	Install IBCS-B sub on USI tool (for 8-5/8” casing)	UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]
3	Remove dipole protectors and MAMS sleeve.	Sonic Scanner (MAST-B, -H) Operations, Standard Work Instructions [redacted]
4	Install GEMCO centralizers on USIT and MAST.	UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]
5	Power up tools by applying [redacted] and perform operational checks	Sonic Scanner (MAST-B, -H) Operations, Standard Work Instructions [redacted] UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]
6	IBC: Perform motor rotation test and visually confirm IBCS is spinning at is spinning at [redacted] or if USIS [redacted].	UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]

Step	Description	Ref Document
7	SSCAN: Ensure WFQC Monitors are green. MAPC and MAXS sequence numbers increase in Data Gauge.	Sonic Scanner (MAST-B, -H) Operations, Standard Work Instructions [redacted]
8	There is no before Calibration task for IBC or Sonic Scanner.	UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]
9	Set MAST Acquisition Class to Imaging.	Sonic Scanner (MAST-B, -H) Operations, Standard Work Instructions [redacted]
10	RIH to 410 ft or deeper. Do MAST Vertical Casing Check Measurement. Ensure the part of the Sonic Scanner tool between the MF transmitter and the upper detector is not at the casing collar.	Sonic Scanner (MAST-B, -H) Operations, Standard Work Instructions [redacted]
11	When Vertical Casing Check is completed, RIH to PBTD at speed <25000 fph.	
12	While RIH, monitor MAST waveforms to identify bad detectors.	Sonic Scanner (MAST-B, -H) Operations, Standard Work Instructions [redacted]
13	Stop 30 ft above PBTD. Do not tag bottom.	
14	Make sure MAST Acquisition Class is set to Imaging.	Sonic Scanner (MAST-B, -H) Operations, Standard Work Instructions [redacted]
15	MAST: Ensure WFQC Monitors are green. MAPC and MAXS sequence numbers increase in Data Gauge.	Sonic Scanner (MAST-B, -H) Operations, Standard Work Instructions [redacted]
16	Set IBC logging mode to "Cement & Corrosion", resolution [redacted]. Turn on IBC motor and ensure RSAV [redacted]	UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]
17	Log up at speed between 400-600 fph to surface. Software will indicate the maximum logging speed.	UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]
18	Adjust USI waveform window to include the first arrival range and USI Group Delay shows a good group delay notch, and that it is centered around the correct frequency for the target casing.	UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]
19	Confirm that IBC Near and Far waveforms show the peak amplitude in the windows. Adjust windows as needed.	UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]
20	Determine if IBCS is centered. Confirm that eccentering [redacted] for Borehole Mud Attenuation [redacted]	UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]

Step	Description	Ref Document
21	SSCAN: Monitor waveforms and LQC tracks are green. Al DT curves follow high coherence path of the projection plot.	Sonic Scanner (MAST-B, -H) Operations, Standard Work Instructions [redacted]
22	Continue logging to desired top log interval.	
23	Log repeat sections over anomalous zones at 600 fph with IBC resolution [redacted].	UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]
24	Perform SSCAN Vertical Casing Check Measurement at same depth as in step 12.	UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]
25	IBC: If free pipe was available, perform Free Pipe Normalization ask. Otherwise, if there is a low-impedance material including possible free pipe, perform Inversion Normalization.	UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted]
26	POOH and rig down.	UltraSonic Imaging Tool (USIT) IBC Service SWI [redacted] Sonic Scanner (MAST-B, -H) Operations, Standard Work Instructions [redacted]
27	Deliver data to Well Integrity/Petrophysical/Reservoir Domain Champion for Qc and to SLB PTS for processing/interpretation.	

5. Equipment Specifications

Measurement Specifications

	Isolation Scanner Tool
Output†	Solid-liquid-gas map of annulus material, hydraulic communication map, acoustic impedance, flexural attenuation, rugosity image, casing thickness image, internal radius image
Max. logging speed	Standard resolution (6 in, 10° sampling): 823 m/h [2,700 ft/h] High resolution (0.6 in, 5° sampling): 172 m/h [563 ft/h]
Range of measurement	Min. casing thickness: 0.38 cm [0.15 in] Max. casing thickness: 2.01 cm [0.79 in]
Vertical resolution	High resolution: 1.52 cm [0.6 in] High speed: 15.24 cm [6 in]
Acoustic impedance‡	Range: 0 to 10 Mrayl Resolution: 0.2 Mrayl Accuracy: 0 to 3.3 Mrayl = ±0.5 Mrayl, >3.3 Mrayl = ±15%
Flexural attenuation	Range: 0 to 2 dB/cm Resolution: 0.05 dB/cm Accuracy: 0.025 dB/cm
Min. quantifiable channel width	30 mm [1.2 in]
Depth of investigation†	Casing and annulus up to 3 in
Mud type or weight limitation§	Conditions simulated before logging
Combinability	Bottom only, combinable with most wireline tools Telemetry: fast transfer bus (FTB) or enhanced FTB (EFTB)
Special applications	H_2S service

† Investigation of annulus width depends on the presence of third-interface echoes. Analysis and processing beyond cement evaluation can yield additional answers through additional outputs, including the VDL of the annulus waveform and polar movies in AVI format.

‡ Differentiation of materials by acoustic impedance alone requires a minimum gap of 0.5 MRayl between the fluid behind the casing and a solid.

§ Max. mud weight depends on the mud formulation, sub used, and casing size and weight, which are simulated before logging.

Mechanical Specifications

	Isolation Scanner Tool
Max. temperature	177 degC [350 degF]
Pressure range	1 to 138 MPa [145 to 20,000 psi]
Casing size—min.†	4½ in (min. pass-through restriction: 4 in)
Casing size—max.†	9⅝ in
Outside diameter	IBCS-A: 3.375 in IBCS-B: 4.472 in IBCS-C: 6.657 in
Length without sub	6.01 m [19.73 ft]
Weight without sub	151 kg [333 lbm]
Sub length, weight	IBCS-A: 61.22 cm [24.10 in], 7.59 kg [16.75 lbm] IBCS-B: 60.32 cm [23.75 in], 9.36 kg [20.64 lbm] IBCS-C: 60.32 cm [23.75 in], 10.73 kg [23.66 lbm]
Sub max. tension	10,000 N [2,250 lbf]
Sub max. compression	50,000 N [12,250 lbf]

† Limits for casing size depend on the sub used. Data can be acquired in casing larger than 9⅝ in with low-attenuation mud (e.g., water, brine).

6. Tool Diagram

Schlumberger						
Tool string drawing.	**RUN #2**		**Date:**	**9-Nov**	**SE:**	**CS**
Operation	**Well**	**Cable**	**Weak Point**	**Weight**	**Supl. By**	**Shear pin/Ring**
WL SSCAN-IBC	SS-25	7-46				
Drawing.	**Tool.**	**O.D.**	**Length.**	**lbs**		**Acc. Length**
	LEH-QT 2.31" fishing neck 14.95" long	3.375	2.92	32.8	SLB	47.17
	EDTCH (Telemetry cartridge) Gamma Ray	3.625	6.50	124.6	SLB	44.25
	MSIP-Sonic Scanner **(Full Mode-Compressional & Shear DT, full waveforms, CBL waveforms)** MAPC **GEMCO position is only a suggestion and will be finalized by Eng./FSM** MAMS MASS MAXS	3.625	21.04	895	SLB	37.75
	USIT-IBC (Isolation Scanner) IBCS-B: 4.472", 20.64lbs, 1.98ft **IBCS-B**	4.47	16.71	353.6	SLB	16.71
Toolstring		**Feet**	**47.17**	**1406.14**	**lbs.**	
Max O.D. Of toolstring		**6.25**	**Inch.**			

7. Deliverables

A field print log will be available on site. The corrosion and cement interpretation will be available within 2 weeks. The sonic PnS and mechanical properties will be available in 2 weeks. The Sonic Borehole Acoustic Survey (BARS) is a post-processing analysis which typically takes 2-3 weeks for preliminary results. Electronic data will be provided in .PDF formats. Logging domain champions will schedule a meeting for interpretation following the final log print.

SCHLUMBERGER

UCI-APS-NEXT

Aliso Canyon

April 21, 2017

SS-25A

Logging work plan for the Ultrasonic Corrosion Imaging Tool, Accelerator Porosity Sonde and LithoScanner for SS-25A .

Version 001

1. Service Description

UCI Ultrasonic Casing Imager

Schlumberger

The UCI* Ultrasonic Corrosion Imager is an evolution of the USI* UltraSonic Imager. The UCI tool provides all the answers required to locate, identify, and quantify casing damage or corrosion. The design is specifically engineered for high-azimuthal-resolution images and detailed examination of both the inner and outer surfaces of casing ranging from 4½ to 13⅜ in. [11.43 to 33.97 cm]. The result is improved echo detection, even in out-of-shape casing and on rough surfaces.

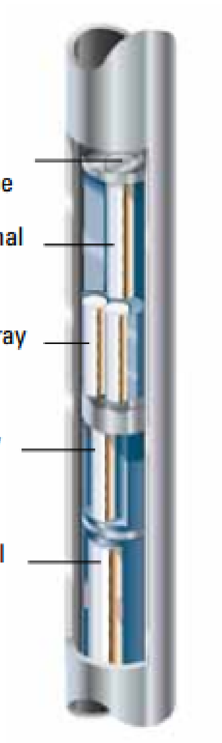
Full azimuthal coverage with a 2-MHz focused ultrasonic transducer is used to analyze the reflections. Signal arrivals are analyzed to provide the casing thickness and surface condition images, and even small defects on both internal and external casing surfaces are quantified. An improved centralization system ensures proper centralization even in horizontal wells, and eccentering effects are reduced through wellsite signal correction.

Applications

- Casing integrity evaluation
- Identification, location, and quantification of casing corrosion
- Estimated damage to casing caused by milling, fishing, or plastic deformation
- Internal and external metal loss
- Internal and external scale buildup
- Location and identification of perforated intervals
- Identification of casing holes
- Identification of casing profile and weight changes
- Identification of centralizers and other casing anomalies

APS Accelerator Porosity Sonde

Epithermal and thermal pulsed neutron solution



The APS sonde incorporates an electronic PNG and five detectors.

Obtain both epithermal and thermal neutron measurements using a high-energy electronic source for improved measurements and wellsite safety.

The APS* accelerator porosity sonde delivers both epithermal and thermal neutron measurements by using an electronic pulsed neutron generator (PNG) instead of a conventional radioactive chemical source. The combination of the large neutron yield from the PNG and detector shielding incorporated in the tool results in measurements that are relatively insensitive to the borehole environment and formation characteristics, such as lithology and salinity.

Five detectors provide accurate information for conducting porosity evaluation, gas detection, shale evaluation with greater vertical resolution, and borehole correction. APS measurements can be performed in both open and cased holes.

Litho Scanner

High-definition spectroscopy service

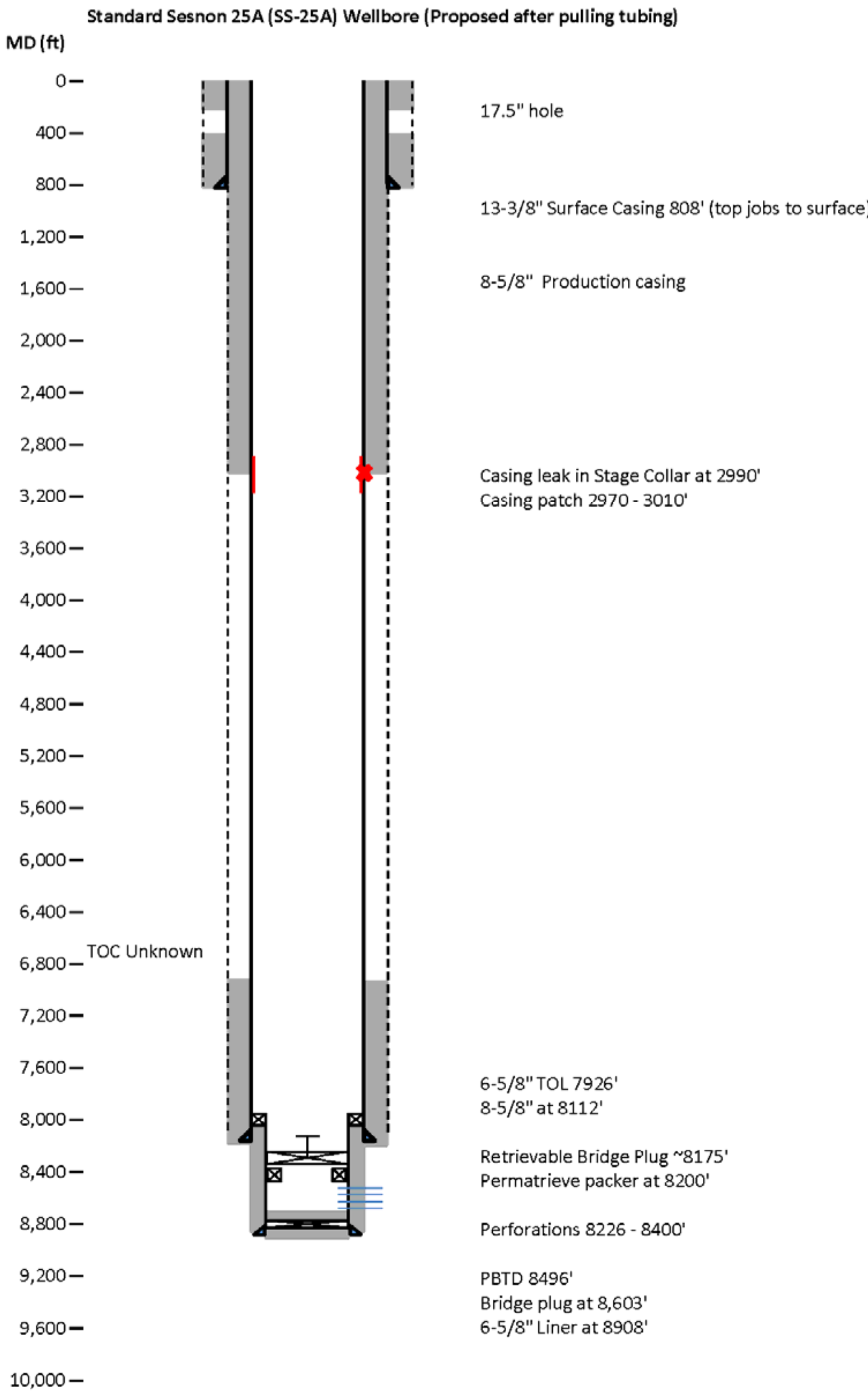
Applications

- Detailed quantitative mineralogy in complex lithologies
- Real-time element measurements and robust quantitative lithology
  - Ca, Fe, Mg, and S for carbonate lithology
  - Al, Fe, and Si for siliciclastic lithology
  - Al, Ca, Fe, K, and Si for unconventional reservoirs
- Total organic carbon (TOC) log for lithology and salinity-independent hydrocarbon saturation
  - Kerogen volume in unconventional reservoirs
  - Weight-percent oil in heavy oil reservoirs and oil sands
  - Oil volume from TOC
- Matrix properties for petrophysical evaluation
  - Accurate density porosity
  - Gas identification through matrix-corrected neutron and density
  - Accurate formation fluid sigma
- Element logs for well-to-well correlation and sequence stratigraphy
- Metals for mining exploration: Cu, Gd, Ni, and Ti
- Quick, accurate bulk mineralogy and TOC inputs to sCore* lithofacies classification to target intervals with superior reservoir and completion quality

Features and Benefits

- Enhanced suite of elements measured, including Al, Ba, C, Ca, Cl, Fe, Gd, K, Mg, Mn, Na, S, Si, Ti, and metals such as Cu and Ni
- Stand-alone TOC output
- Large cerium-doped lanthanum bromide ($LaBr_3$:Ce) gamma ray detector exclusive to Litho Scanner service for the most accurate and precise mineralogy in the industry
  - Excellent spectral resolution
  - Unmatched temperature performance
  - Industry's highest count-rate capabilities
- High-speed electronics to support high count rates
- High-performance pulsed neutron generator (PNG)
  - Elimination of AmBe source
  - High-neutron-flux output for greater precision
  - Simultaneous inelastic and capture spectra
  - 350 degF [177 degC] rating
- Combinable with most openhole services and compatible with main conveyance modes (wireline, TLC* tough logging conditions drillpipe-assisted, and tractor)
- Improved elemental precision with high-quality data at faster logging speeds
- Unlimited acquisition time at high temperatures for deep or horizontal wells

2. Wellbore Schematic



SS-25A Well Info Master Rev 13.xlsx
12 Wellbore Schematic (2)

1 of 1

3/28/2017

3. Data assurance Procedures

3.1. Calibration and Verification

Step	Description	Ref Document
	Pre-Job Maintenance	
1	Run [redacted] to determine sub selection and clearance to casing	Ultra Sonic Imager Tool (USIT): USI Service SWI [redacted]
2	Run Zebra to estimate Fluid Velocity and Mud Impedance	Ultra Sonic Imager Tool (USIT): USI Service SWI [redacted]
3	Do the [redacted] and electrical checks.	ULTRASONIC IMAGER TOOL UCI TRANSDUCER (UCI-TX) Maintenance SWI [redacted]
6	Inspect [redacted]. Inspect centralizer arms, compensating piston and the rotating seals.	Ultra Sonic Imager Tool (USIT): USI Service SWI [redacted]
8	Fill USIS with oil and grease the sonde.	Ultra Sonic Imager Tool (USIT): USI Service SWI [redacted]
7	Perform visual checks of APS o-rings, threads and housing.	Accelerator Porosity Sonde / Hostile Accelerator Porosity Sonde (APS/HAPS) Operations Standard Work Instruction [redacted]
8	Check that validity of APS Master Calibration (less than 3 months).	Accelerator Porosity Sonde / Hostile Accelerator Porosity Sonde (APS/HAPS) Operations Standard Work Instruction [redacted]
9	Inspect the bowspring or inline eccentralizer for any wear, cracks and visible damage.	Accelerator Porosity Sonde / Hostile Accelerator Porosity Sonde (APS/HAPS) Operations Standard Work Instruction [redacted]
10	Perform NEXT visual check of the tool conditions, especially of the split covers and boron sleeve	NEXT-A Operations Standard Work Instruction [redacted]
11	Inspect the bowspring [redacted] for any wear, cracks and visible damage.	NEXT-A Operations Standard Work Instruction [redacted]

3.2. Function Checks

Step	Description	Ref Document
	Operational Check at the Base	
1	Place APS tool inside [redacted]	Accelerator Porosity Sonde / Hostile Accelerator Porosity Sonde (APS/HAPS) Operations Standard Work Instruction [redacted]
2	Power up the APS by [redacted] voltage. Wait until telemetry stabilizes	Accelerator Porosity Sonde / Hostile Accelerator Porosity Sonde (APS/HAPS) Operations Standard Work Instruction [redacted]

Step	Description	Ref Document
3	Perform Electronics Check: to verify that the basic electronic components of the [redacted], such as power supplies and ADCs, are operating correctly	Accelerator Porosity Sonde / Hostile Accelerator Porosity Sonde (APS/HAPS) Operations Standard Work Instruction [redacted]
4	Perform Detector HV and Background Test: to verify that the [redacted] power supplies are reading in normal ranges.	Accelerator Porosity Sonde / Hostile Accelerator Porosity Sonde (APS/HAPS) Operations Standard Work Instruction [redacted]
5	[redacted]	Accelerator Porosity Sonde / Hostile Accelerator Porosity Sonde (APS/HAPS) Operations Standard Work Instruction [redacted]

4. Logging Procedure

Step	Description	Ref Document
	Wellsite Operation	
1	Rig up the USIT-APS-NEXT-EDTC-LEH	Accelerator Porosity Sonde / Hostile Accelerator Porosity Sonde (APS/HAPS) Operations Standard Work Instruction [redacted], NEXT-A Operations Standard Work Instruction [redacted] Ultra Sonic Imager Tool (USIT): USI Service SWI [redacted]
2	Install USRS-B sub with UCI transducer.	
3	Power up the tool by applying [redacted] voltage. Do not activate the PNG until 200 ft below ground level or deeper.	
4	Perform APS Before Calibration task.	Accelerator Porosity Sonde / Hostile Accelerator Porosity Sonde (APS/HAPS) Operations Standard Work Instruction [redacted]
5	Check NEXT waveforms with PNG Off.	NEXT-A Operations Standard Work Instruction [redacted]
6	RIH to 200 ft and perform Minitron test.	
7	Power up APS Minitron to "Neutrons ON" and complete the Plateau Check.	Accelerator Porosity Sonde / Hostile Accelerator Porosity Sonde (APS/HAPS) Operations Standard Work Instruction [redacted]
8	Turn off APS Minitron when test is completed. Do not turn on the APS Minitron while going down. This will cause formation activation and cause	Accelerator Porosity Sonde / Hostile Accelerator Porosity Sonde (APS/HAPS) Operations Standard Work Instruction [redacted]

Step	Description	Ref Document
	bad readings. Formation typically will need at least 45 minutes to deactivate.	
9	Power up NEXT Minitron. Set the PNG to “Standby” mode then set the PNG to “Neutrons On” mode.	NEXT-A Operations Standard Work Instruction [redacted]
10	Once PNG has been checked OK, click on “Off” to switch PNG off.	NEXT-A Operations Standard Work Instruction [redacted]
11	Set UCI to [redacted] to record Fluid Properties while logging down	UCI – Ultrasonic Corrosion Imager – Log Quality Control Reference Manual [redacted]
12	Continue RIH with PNG turned off to 7070 ft at speed <10000 fph. Record UCI Fluid Properties while RIH.	
13	Verify Fluid slowness is consistent with Zebra modeling.	UCI – Ultrasonic Corrosion Imager – Log Quality Control Reference Manual [redacted]
14	At 6500 ft, set APS PNG and NEXT PNG in Standby Mode.	
15	Do not tag bottom. Stop at PBTD.	
16	Turn on UCI motor and make sure the sub has flipped. Ensure RSAV [redacted]. Set UCI resolution "UCI_HighRes" to [redacted]	UCI – Ultrasonic Corrosion Imager – Log Quality Control Reference Manual [redacted]
17	Turn on APS PNG.	Accelerator Porosity Sonde / Hostile Accelerator Porosity Sonde (APS/HAPS) Operations Standard Work Instruction [redacted]
18	Power up NEXT PNG. Set logging mode to Precision Mode.	NEXT-A Operations Standard Work Instruction [redacted]
19	Log up at 300 fph.	
20	UCI: Check that average internal radius, thickness, and external casing are reasonably close to [redacted] in good pipe, if present in the well.	UCI – Ultrasonic Corrosion Imager – Log Quality Control Reference Manual [redacted]
21	APS: Check the tool response against known formation. Monitor all voltages.	Accelerator Porosity Sonde / Hostile Accelerator Porosity Sonde (APS/HAPS) Operations Standard Work Instruction [redacted]
22	NEXT: Monitor data gauges and waveform. Follow [redacted]	NEXT-A Operations Standard Work Instruction [redacted]
23	Stop at 200 ft. Turn off APS PNG and NEXT PNG. Stop the log and turn off UCI motor.	
24	Log repeat sections over anomalous zones at 300 fph with PNG turned on.	
25	Wait 30 minutes at 200 ft or below after turning off PNG.	

Step	Description	Ref Document
26	POOH.	
27	There is no After Calibration task.	
28	Rig down.	

5. Equipment specifications

5.1. UCI

Measurement Specifications

	UCI Tool
Output	Amplitude image, casing thickness image, internal radius image, fluid velocity
Logging speed	3,000 ft/hr [914 m/h] High resolution: 400 ft/hr [122 m/h]
Range of measurement	Min. casing thickness: In water = 0.15 in. [0.38 cm] In attenuated fluids, including oil-base mud = 0.2 in. [0.51 cm]
Vertical resolution	High resolution: 0.2 in. [0.51 cm] High speed (3,000 ft/hr): 1.5 in. [3.81 cm]
Accuracy	Ratio of internal radius to thickness: ±0.04 in. [±1 mm] Casing thickness: ±4%
Depth of investigation	Thickness of casing
Mud type or weight limitations	Oil-base mud: No solids Water-base mud: Solids content < 5% and mud density less than 1.9 g/cm^3 [15.9 lbm/gal]
Combinability	Bottom-only tool, combinable with most tools
Special applications	H_2S service

Mechanical Specifications

	UCI Tool
Temperature rating	350°F [177°C]
Pressure rating	20,000 psi [138 MPa]
Casing size—min.†	4½ in. [11.43 cm]
Casing size—max.†	13⅜ in. [33.97 cm]
Outer diameter	USRS-AB: 3.41 in. [8.66 cm] USRS-A: 3.56 in. [9.04 cm] USRS-B: 4.65 in. [11.81 cm] USRS-C: 6.69 in. [16.99 cm] USRS-D: 8.66 in. [22.00 cm]
Length	Without sub: 19.73 ft [6.01 m]
Weight	Without sub: 333 lbm [151 kg]
Tension	40,000 lbf [177,930 N]
Compression	4,000 lbf [17,790 N]

† Minimum and maximum casing sizes depend on the sub used.

5.2. APS

Measurement Specifications	
Output	Hydrogen index, thermal neutron porosity, formation sigma
Logging speed	Standard: 1,800 ft/h [549 m/h] High resolution: 900 ft/h [274 m/h] High speed: 3,600 ft/h [1,097 m/h]
Range of measurement	Porosity: 0 to 60 pu [0 to 60% uncorrected porosity]
Vertical resolution	14 in [35.56 cm]
Accuracy	<7 pu: ±0.5 pu 7 to 30 pu: ±7% 30 to 60 pu: ±10% Sigma: ±1 cu [±0.1/m]
Depth of investigation	7 in [17.78 cm]
Mud type or weight limitations	None
Combinability	Combinable with most services If combined with ECS* elemental capture spectroscopy sonde, the APS sonde must be run below it

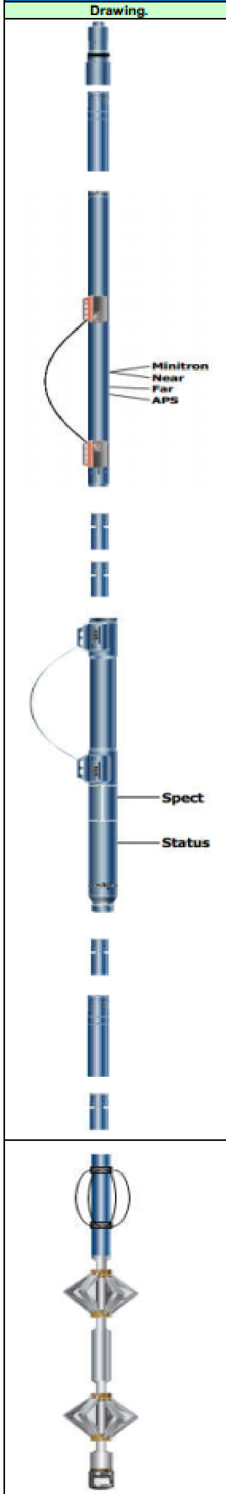
Mechanical Specifications	
Temperature rating	350 degF [177 degC]
Pressure rating	20,000 psi [138 MPa]
Borehole size—min.	4.625 in [11.75 cm]
Borehole size—max.	21 in [53.34 cm]
Outside diameter	3.625 in [9.21 cm]
Length	13 ft [3.96 m]
Weight	222 lbm [101 kg]
Tension	50,000 lbf [22,410 N]
Compression	23,000 lbf [102,310 N]

5.3. Lithoscanner

Specifications	
	Litho Scanner Tool
Measurement	
Output	Elemental yields, elemental weight fractions, TOC, dry-weight mineral concentrations, matrix properties
Logging speed†	Max.: 3,600 ft/h [1,097 m/h]
Range of measurement	1 to 10 MeV
Vertical resolution	18 in [45.72 cm]
Mud type or weight limitations	None
Mechanical	
Temperature rating	350 degF [177 degC]
Pressure rating	20,000 psi [138 MPa]
Borehole size—min.	5.5 in [13.97 cm]
Borehole size—max.††	24 in [60.96 cm]
Outside diameter	4.5 in [11.4 cm]
Length	14 ft [4.27 m]
Weight (in air)	366 lbm [166 kg]
Tension	55,000 lbf [244,652 N]
Compression	22,500 lbf [100,085 N]

† A tool planner is used to estimate the precision of the elemental concentrations and interpreted properties such as matrix density for a given environment, with the recommended logging speed depending on the required precision.
†† With bow spring

6. Tool Diagram

Schlumberger						
Tool string drawing.	RUN #3		Date:	9-Nov	SE:	CS
Operation	Well	Cable	Weak Point	Weight	Supl. By	Shear pin/Ring
WL APS NEXT UCI	SS-25	7-46				
Drawing.	Tool.	O.D.	Length.	lbs		Acc. Length
	LEH-QT 2.31" fishing neck 14.95" long	3.375	2.92	32.8	SLB	59.12
	EDTCH (Telemetry cartridge) Gamma Ray	3.625	6.50	124.6	SLB	56.20
	APS-C-EF (Array Porosity Sonde)	3.625	13.00	222.0	SLB	49.70
	AH-184 (Knuckle)	3.375	2.00	45.2	SLB	36.70
	AH-184 (Knuckle)	3.375	2.00	45.2	SLB	34.70
	NEXT (LithoScanner)	4.500	9.16	290.0	SLB	32.70
	AH-184 (Knuckle)	3.375	2.00	45.2	SLB	23.54
	Adapter Head	3.375	4.00	50.0	SLB	21.54
	AH-184 (Knuckle)	3.375	2.00	45.2	SLB	17.54
	UCI (Ultrasonic Corrosion Imager) B-Sub 4.65"	4.65	15.54	353.6	SLB	15.54
Toolstring		Feet	59.12	1253.80	lbs.	
Max O.D. Of toolstring		6.37	Inch.			

7. Deliverables

A field print log will be available on site. A final log will be available in 2 weeks. Electronic data will be provided in .PDF formats. Logging domain champions will schedule a meeting for interpretation following the final log print.

Schlumberger
CPET
Aliso Canyon

April 21, 2017

SS-25A

Logging work plan for the Corrosion Protection Evaluation Tool for SS-25A .

Version 001

1. Service Description

CPET Corrosion Protection Evaluation Tool

Schlumberger

The CPET* Corrosion Protection Evaluation Tool provides critical information for cost-effective cathodic protection programs. CPET analysis features state-of-the-art accuracy and reliability. The resulting log describes how well the cathodic protection is performing and advises whether new wells need cathodic protection.

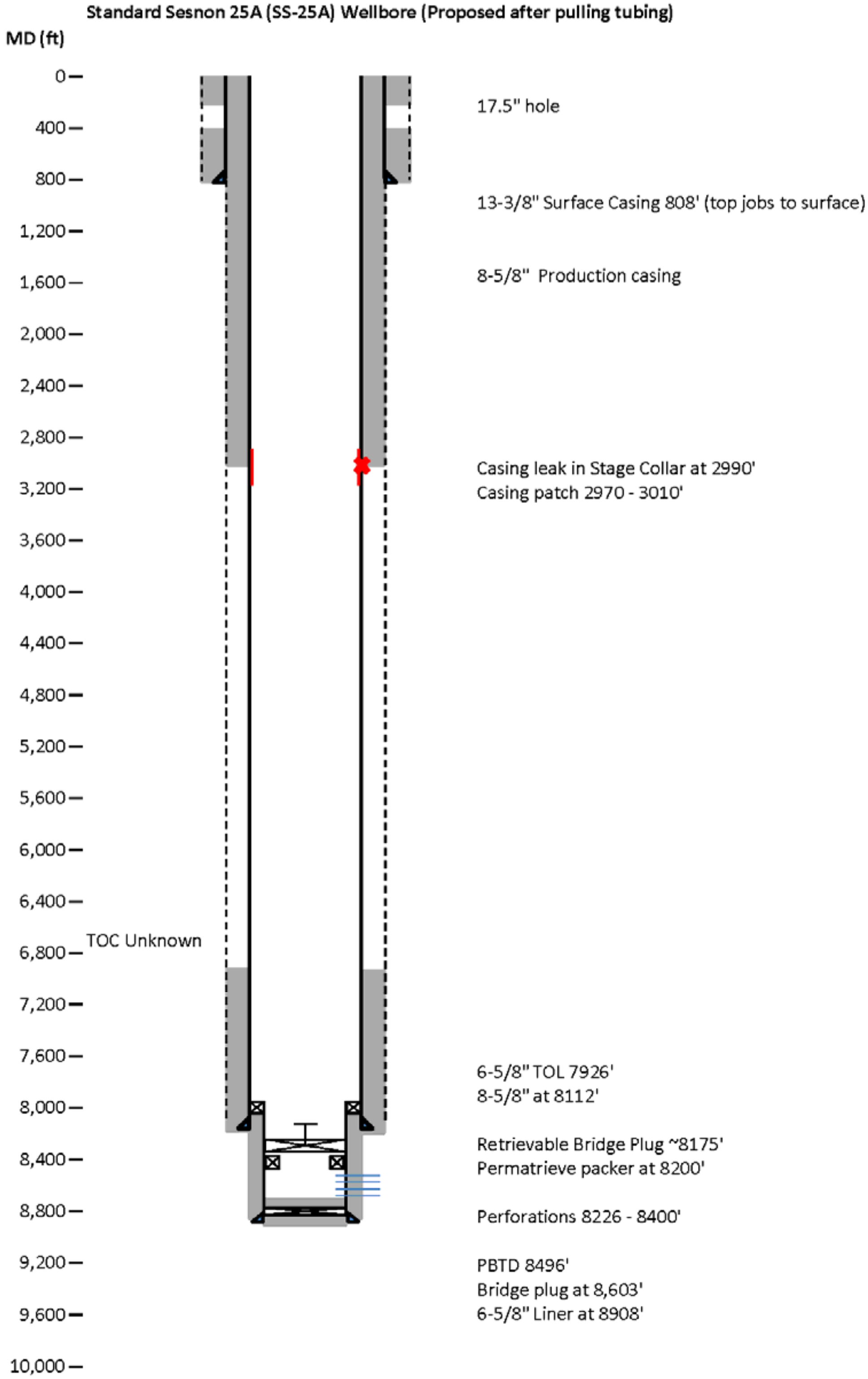
Accurate measurement of the casing potential requires good contact between the tool and the casing. To meet this requirement, the CPET tool has four sets of electrodes and performs in any wellbore fluid. This advanced design eliminates the expense of acid washing the casing and displacing the wellbore fluid with oil—steps that are usually necessary before other evaluation tools can be run, along with the rig downtime involved with these preparations. The CPET tool also saves rig time during the survey itself, with its fast thermal stabilization and hydraulic operation.

The real-time results are used to identify remedial adjustments to the cathodic protection program and to confirm the program's effectiveness while the tool is in the wellbore.

Applications

- Corrosion control
- Cathodic protection

2. Wellbore Schematic



SS-25A Well Info Master Rev 13.xlsx
12 Wellbore Schematic (2)

1 of 1

3/28/2017

3. Data assurance Procedures

3.1. Calibration and Verification

Step	Description	Ref Document
	Pre-Job Maintenance	
1	Clean and grease all thread connections. Check O-rings on the upper heads of tool.	Corrosion and Protection Evaluation Tool Maintenance Manual [redacted], [redacted]
2	Inject grease into the grease points on the four drive shaft holders of the [redacted] the half shells at the top [redacted], and the threaded rings at the top of the [redacted]	Corrosion and Protection Evaluation Tool Maintenance Manual [redacted], [redacted]
3	Check the [redacted] heads for damaged or pushed-in pins and cracked or contaminated insulators.	Corrosion and Protection Evaluation Tool Maintenance Manual [redacted], [redacted]
4	Check the [redacted] for oil leaks. Fill with oil if necessary.	Corrosion and Protection Evaluation Tool Maintenance Manual [redacted], [redacted]
5	Check the condition of the electrodes. In particular, ensure that the electrode coating is substantially intact and that electrodes do not show excessive wear	Corrosion and Protection Evaluation Tool Maintenance Manual [redacted], [redacted]
6	Check the surface of the internal fluid reference electrodes, [redacted] and, if necessary, remove any oxide or scale layer with emery paper.	Corrosion and Protection Evaluation Tool Maintenance Manual [redacted], [redacted]
7	Do insulation and continuity checks of the tool following [redacted].	Corrosion and Protection Evaluation Tool Maintenance Manual [redacted], [redacted]

3.2. Function Checks

Step	Description	Ref Document
	Operational Check at the Base	
1	Perform an operational check of the tool. Power on the cartridge and [redacted] before starting to take measurements.	Corrosion and Protection Evaluation Tool Maintenance Manual [redacted], [redacted]
2	Open the arms inside the Aluminum Tube so that the center of the arm array coincides approximately with the mid-point of the tube.	Corrosion and Protection Evaluation Tool Maintenance Manual [redacted] [redacted], [redacted]
3	In Calibrate Phase, issue the command [redacted]. The casing measurement cycle is recorded six times. Then for each channel the average and maximum difference (the difference between the highest and lowest of the six measurements [redacted]	Corrosion and Protection Evaluation Tool Maintenance Manual [redacted] [redacted], [redacted]

4. Logging Procedure

Step	Description	Ref Document
	Wellsite Operation	
1	Use grounding clamps to ground the truck to the wellhead	Corrosion and Protection Evaluation Tool Maintenance Manual [redacted], [redacted]
2	Rig up CPET-AH169-DTA-TCC-LEH.	Wellsite Reference Manual Corrosion and Protection Evaluation Tool [redacted]
	Perform an operational check of the tool. Power on the cartridge [redacted] before starting to take measurements.	Wellsite Reference Manual Corrosion and Protection Evaluation Tool [redacted]
	Open the arms inside the Aluminum Tube so that the center of the arm array coincides approximately with the mid-point of the tube.	Wellsite Reference Manual Corrosion and Protection Evaluation Tool [redacted]
	Perform shop calibration. The casing measurement cycle is recorded six times. Then for each channel the average and maximum difference (the difference between the highest and lowest of the six measurements [redacted]	Wellsite Reference Manual Corrosion and Protection Evaluation Tool [redacted]
3	Ensure the arms can be opened and closed.	Wellsite Reference Manual Corrosion

Step	Description	Ref Document
		and Protection Evaluation Tool [redacted]
4	RIH to PBTD with arms closed at speed <25000 fph.	
5	At PBTD, open arms. Allow tool to warm up to bottom hole temperature.	
6	Set [redacted]	Wellsite Reference Manual Corrosion and Protection Evaluation Tool [redacted]
7	Start Simulated Depths. [redacted] Move tool around with the sonde open until [redacted]	InTouch Content [redacted]. CPET LOGGING INSTRUCTIONS [redacted]
8	If good contacts cannot be established change parameter [redacted]	InTouch Content [redacted]. CPET LOGGING INSTRUCTIONS [redacted]
9	If good contacts can be established allow the computer to do the CPET simulation for at least [redacted] and then if [redacted] the contact resistance limits will be updated automatically. Continue the CPET simulation until the tool warms up to bottom hole temperature.	InTouch Content [redacted]. CPET LOGGING INSTRUCTIONS [redacted]
10	Start Depth Log and start CPET Normal Measurement.	Wellsite Reference Manual Corrosion and Protection Evaluation Tool [redacted]
11	Wait until measurement at the station is completed [redacted] When the bell rings and displays shows depth number with dashes or "B", the contact condition is displayed to signify that acquisition and processing has finished, move up 6 ft and stop at the next station with the sonde open. Keep running speed below 3000 fph between stations.	Wellsite Reference Manual Corrosion and Protection Evaluation Tool [redacted]
12	Repeat step 11 and continue moving up 6 ft for a minimum of 20 stations.	Wellsite Reference Manual Corrosion and Protection Evaluation Tool [redacted]
13	When the logging intervals have been completed, stop Depth Log and close the sonde.	
14	Perform additional repeat measurement over desired zones if necessary by repeating steps 7-12, minimum 20 stations.	
15	When logging is completed. POOH with sonde closed.	
16	Rig down.	
17	Deliver data to Well Integrity Domain Champion.	

5. Equipment specifications

Measurement Specifications

	CPET Tool
Output	Axial current, radial current density, potential difference, casing thickness, corrosion rate
Logging speed	1,500 ft/hr [457 m/h] (6-ft [1.8-m] stations)
Vertical resolution	10- to 25-ft [3- to 7.6-m] typical electrode spacing: Data recorded every 50 or 100 ft [15 or 30 m]
Accuracy	Potential difference: 1 mV
Depth of investigation	Casing thickness
Mud type or weight limitations	None
Combinability	Combinable with most tools
Special applications	H_2S service

Mechanical Specifications

	CPET Tool
Temperature rating	350°F [177°C]
Pressure rating	20,000 psi [138 MPa]
Casing size—min.	4½ in. [11.43 cm]
Casing size—max.	10¾ in. [27.30 cm]
Outer diameter†	3.375 in. [8.57 cm]
Length	30.58 ft [9.32 m]
Weight	533 lbm [242 kg]

† Fishing neck outer diameter = 3.375 in. [8.57 cm]

6. Tool Diagram

Schlumberger						
Tool string drawing.	**RUN #4**		**Date:**	**14-Nov**	**SE:**	**CS**
Operation	**Well**	**Cable**	**Weak Point**	**Weight**	**Supl. By**	**Shear pin/Ring**
WL CPET	SS-25	7-46				
Drawing.	**Tool.**	**O.D.**	**Length.**	**kg.**		**Acc. Length**
	LEH-QT 2.31" fishing neck 14.95" long	3.375	2.92	16.7	SLB	42.36
	DTCH (Telemetry cartridge)	3.375	3.00	21.3	SLB	39.44
	SGT-N (Scintillation Gamma Ray Tool) GR	3.375	5.51	38.0	SLB	36.44
	CPET - Corrosion Protection Evaluation Tool	3.375	30.60	135.0	SLB	30.93
	Bottom Nose	3.375	0.33	1	SLB	0.33
Toolstring		**Feet**	**42.36**	**212.00**	**Kg.**	
Max O.D. Of toolstring		**3.38**	**Inch.**	**467.38**	**lbs.**	

7. Deliverables

A field print log will be available on site. A final log will be available in 2 weeks. Electronic data will be provided in .PDF format. Logging domain champions will schedule a meeting for interpretation following the final log print.

Optis™ E-Line MK2 System

EV Optis Suite 2.12.5
Well Procedures and Operational Guidelines

Camera rig up procedures and general fluid considerations

The prerequisite for successful downhole video is to provide a clear, transparent, fluid (ex., clear water, dry gas, or air) in the wellbore at the area of interest. Successful downhole video requires proper planning and consideration of potential sources of opaque fluids and the associated countermeasures to insure a clear viewing medium. Opaque fluids prohibit viewing object(s) of interest when complications from unfavorable well conditions such as gas or sand entry occur. Clear fluid can usually be acquired with proper planning. Often, little or no well preparation is needed for a successful video log.

1. All necessary paperwork to be made available to all relevant personnel on request.
2. Hold Toolbox Talk. *Always follow all EV and Customer Safety Procedures.* Ensure that the correct working Permit has been issued and all guidelines are safely followed.
3. Spot the winch, ensuring that drum is lined up with bottom sheave to enable good spooling onto drum. *Ensure new cable head has been made prior to any run in the hole with the camera.*
4. Safety signs and barriers are put in place.
5. Connect EV down hole electronics to cable head; connect necessary amount of weight bars if applicable.
6. Follow service company rig up procedures for wireline intervention into well bore.
7. Store injection water in clean tanks, free from oil base mud, sand, and any solids left from previous use.
8. Check all hoses for debris from previous work prior to injecting clear water through...
9. Avoid using the Kelly and Kelly hoses unless flushed with tubing or casing wash such as CW-100 from Dowell Schlumberger.
10. Filtered the injection water to 3 to 5 micron. Place the filters on the draw side (LOW PRESSURE SIDE) of the pump rather than the high pressure side to ensure high volume of injection fluid.
11. Weight of filter fluid must not exceed 9.0 ppg or not greater than 10 NTU's (nephelometric turbity units) if either one of these units is exceeded good visual clarity may not be achieved.
12. Fluid clarity for downview camera 0 to 10 NTU, sideview 10 to 20 NTU if more than 20 NTU WILL NOT OBTAIN A PICTURE!!!

Typical turbidity meter values for various liquids

Liquid	**NTU**
Deionized water	0.02
Drinking water	0.02 to 0.5
Spring water	0.05 to 10
Wastewater (untreated)	70 to 2000
White water (paper industry)	60 to 800

<u>NTU readings below were taken at Geo Drilling fluids site located at SCG, Aliso Canyon location.</u>

<u>Witness by Ryan Lindsey, Geo Drilling Fluids, Recorded by, Gregg Linville EV Downhole Video.</u>

7% KCL Tested 0.00 | 22% saturated 0.56 | 3% KCL w/1.5# HEC | Produce fluid taken at well site

13. Can achieve clear video with heavier brine if PRE MIX by the plant before bringing to location. Discuss with EV prior to ordering brine.

14. If brine must be added to the injection water for well control, bring out clear, heavier weight brines and add filtered sea water to dilute and achieve brine desired brine weight or mix on location and allow the brine to settle for 24 hours after mixing to allow the impurities to settle out of suspension. Then filter the brine as described in step 11

15. Do not use inhibitors, biocides or any other additive to clean injection water prior to flushing work string or tubing.

16. <u>During inspection constant injection of clean clear fluid may be needed to keep area clean from debris.</u>

17. Very important that 200 psi pressure is left inside the lubricator after pressure testing to ensure that grease or other debris is not blown on to the camera lens.
18. Over pressure inside the lubricator will also help to blow down any wet mist that maybe near the surface.
19. In a wet gas environments it is a must that 40 to 60 barrels of clean clear fluid be pump down hole at a high rate (5 to 8 Bbls per min) to ensure a knock down. This is only done after the camera has reached the target area.
20. Wet gas environments are problematic. If fluid is not available coil tubing, using another well to knock down the wet gas will be required
21. Depth will be recorded onto the video job file using one of wireline company 5 or 12 volt measuring depth encoders.

22. Depth encoder cable to wireline contractor measuring depth encoder and x-over from wireline contractor to EV down hole tool string will be supplied by EV.

Rigging up

Some items below may not apply to all rig up procedures an or well conditions

1. Once the Wellservice engineer notifies the EV crew of the well status rigging up can now commence.

2. If tree cap fitted the tree, the cap should be carefully removed, making sure that there is no trapped pressure below the cap. The threads should be then cleaned up and oiled to aid in rigging up.

3. If a cross over is being used, it should be installed now, followed by the dual B.O.P's. (These should be fully functioned and tested prior to the well being opened).

4. Pick up hydraulic pumps place in situation as near to well site as possible. Connect them up to air and fully function test all equipment being used.

5. Make up Grease Injection Head to Lubricator.

6. Keep cable head and electronic chassis with pressure barrel at bottom of riser while assembling riser.

7. Keep grease hose and flow hose parallel to lubricator assembly and secure at approximately 10-foot intervals.

8. Put wire through bottom sheave and pick up tension on winch, ensure a clear line of sight to the logging winch is maintained.

9. Attach camera lighthead and apply lens prep surfactant to optic port.

10. Power up and verify camera and system operation. **Please refer to system setup.**

11. Zero camera by positioning camera lens at ground level to zero – use KB depth provided by customer.

12. Pull tool string into riser.

13. Lower the lubricator and tool string to just above top preventer. Take up cable slack on winch.

14. Start pressure-testing procedures.

15. Note: Depending on sight lines, noise levels and client policies, radios should be considered to ensure good communication levels throughout operation.

Running Down the Wellbore

1. Start recording video images received from camera at surface to verify proper set-up of surface laptop and components. **See pages below for system setup**

2. Start to lower the toolstring into the wellbore, taking care not to move to quickly downward. Using the camera to guide the tool through the Xmas tree and into the wellbore if clarity permits.

3. The prime objective should always be the first item viewed; therefore the programme should be adhered to. Failure to do this may result in a second camera survey due to well conditions eventually affecting the final result.

4. Actually camera-logging speeds vary, but generally they are carried out from 10ft/min to stationary.

5. Non recorded video logging speed will be 150 feet per minute

6. Narrow restrictions combined with high pump rates can cause damage and poor visibility due to change in ID's Therefore pump rates should be carefully monitored via the camera view. This includes jars, bumper subs and drill collars should not be ran on the first run with the work string.

7. Pump rates vary anywhere from 1/4bbl/min up to 8bbl/min. Need to have pump on location that will pump 8 bbls per min.

8. Allowing the camera to "sit down" is not good practice, but in some circumstances unavoidable. However damage to the optical lens port may occur as well as running the risk of contaminating the viewing area.

9. Thought should be given for the bow spring centraliser blades when lowering the tool into hostile environments, adding to the customer's problems is not the correct way forward.

10. Once the operation has been carried out, the camera should be powered down for retrieval.

11. Pulling out of hole should not be over 150ft/min.

12. All equipment should then be correctly and safely cleaned and stored.

Techniques for Achieving clear fluid for Downhole Video Operations

The prerequisite for successful downhole video is to provide a clear, transparent, fluid (ex., clear water, dry gas, or air) in the wellbore at the area of interest. Successful downhole video requires proper planning and consideration of potential sources of opaque fluids and the associated countermeasures to insure a clear viewing medium. Opaque fluids prohibit viewing object(s) of interest when complications from unfavorable well conditions such as gas or sand entry occur. Clear fluid can usually be acquired with proper planning. Often, little or no well preparation is needed for a successful video log

General fluid considerations

1. Store injection water in **clean tanks,** free from oil base mud, sand, and any solids left from previous use.
2. Check all hoses for debris from previous work prior to injecting clear water through..
3. Avoid using the Kelly and Kelly hoses unless flushed with tubing or casing wash such as **InviroChem**
4. Filtered the injection water to **5 micron**. Place the filters on the draw side of the pump rather than the high-pressure side to ensure high volume of injection fluid.
5. If brine must be added to the injection water for well control, either bring out clear, heavier weight brines and add filtered sea water to dilute and achieve brine desired brine weight or mix on location and allow the brine to settle for 24 hours after mixing to allow the impurities to settle out of suspension. Then filter the brine as described in step 4.

Fishing Operations (rig on well)

1. Check tubulars for scale, cement, or chemicals recently pumped into well bore.
2. Eliminate or minimize changes in the workstring I.D. as much as possible. **Avoid use of drill collars, jars, and fishing assemblies unless discussed prior to video operation.**
3. The only chemicals that should be used prior to a video survey are tubing or casing **washes chemicals only**. The recommend wash chemical is **InviroChem**. Other chemicals could cause poor visibility and should be avoided unless tested prior to video operations.
4. Avoid using unique tubular or special equipment unless discussed with all parties involved before video\operations begins.
5. Clean up area of interest with workstring setting on top of fish. Circulate five tubing volumes of clean filter fluid (5 micron). If possible, move tubing or workstring 5 feet past area of interest. Follow cleanup procedures as mentioned above.

Fishing Operations (rig less)

1. Reference shut-in condition.
2. Consider a fluid bailer sample using slick line if available to obtain a sample of the fluid at the area of interest to evaluate fluid clarity before running camera.

Shut-in Well Condition (Minimum 24 hours).

1. If the fluid level is below the area of interest there should be nothing else to prepare.
2. Can gas or nitrogen be injected to drop fluid level below area of interest?
3. If area of interest will be in fluid, recover fluid sample from well at time of shut in.
4. Allow particulates to settle out and gravity segregation of fluids during the 24-hour period.
5. Check water sample for clarity prior to attempting video survey.
6. If inspecting screen be aware of possible cross flow.
7. It is not recommended to run memory camera for screen inspections.

Content Redacted

Content Redacted

Content Redacted