On Site Well Log Quality Control*

Donald G. Hill1

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1The University of Southern California, Los Angeles, CA (hillpetro@gmail.com)

Abstract

Well Logs form the foundation upon which Oil and Gas reserves are based. Logging vendors are responsible for delivering data that has been acquired with instruments what were calibrated and run properly, providing documentation of this in both delivered hard and soft copy data. However, the client is responsible to see that this is done.

The wellsite is the front line of well log quality. The client representative needs to verify that well log products meet quality standards, before signing the vendor invoice, as the logging witness. Failure to do so can have severe repercussions, if “Stated Reserves” include data from miscalibrated and/or improperly run logs.

Unfortunately operators often send the most junior member of their staff to “catch the logs”, without adequate training on the responsibilities of a “Log Witness”. The complexity of modern wireline and LWD logs, with several pages of logging job parameters and calibrations do not make these duties any easier.

Simple, straight forward, wellsite techniques can allow the client representative to quickly determine if the vendor has properly done their job. These techniques can avoid later embarrassing and costly revelations, for both vendor and client.

Reference Cited

On Site Well Log Quality Control

What you don’t know CAN hurt you!

After: Theys, 1999

Why Is Log QC Important?

• Well Logs are the foundations upon which Reserves are estimated.
• Reserves are the Bank Accounts for Petroleum E&P organizations.
• E&P organizations that do not replace produced reserves are not long for this world.
• A Junior E&P firm developing a World Class Heavy Oil Resource had Billions of Bbl Oil Stated Reserves called into question because of Log Quality Problems.
Reserves

\[ STOOIP = \frac{7758 Ah\phi(1 - S_w)}{B_{oi}} \]

- **STOOIP**: Stock Tank Original Oil In Place
- **A**: Area of Structural Closure, in Acres
- **h**: Average Reservoir Net Thickness, in ft
- **\( \varnothing \)**: Average Reservoir (fractional) Porosity
- **\( S_w \)**: Average Reservoir (fractional) Water Saturation
- **\( B_{oi} \)**: Initial Oil Formation Volume Factor
Log QC Responsibilities

• Vendors are responsible for delivering data that was measured with instruments that were working correctly and properly calibrated.

• Clients and/or their representatives are responsible for seeing that this is done.

• Clients that accept the vendor products at face value, *probably get what they deserve.*
How Petrophysicists Spend Their Time

- Clients often criticize Petrophysicists for taking too long and costing too much.
- A recent LinkedIn Petrophysics discussion thread revealed that Petrophysicists spend, on average, between 50% - 75%, of their time doing data Quality Control:
  - If anything, modern logs have increased this load because there is so much more to review.
  - Digital files, without paper prints, only make the situation worse, because they often lack critical information.
Foundations of Well Log Product Quality

Data Consistency & Concise Presentation

Tool Calibration & Reliability

Contractor Performance

>>> Client Preparation <<<
Wellsite is the Front Line for QC

- While the equipment is on site and the well bore is open, Back-up sondes can be run.
- Once the well has been cased, the best the vendor can usually do is offer discounts against future work.
Don’t Keep the Vendor in the Dark

- Notify the vendor at spud-in, with the expected logging date.
- Provide the vendor with frequent up-dates.
- Request current calibrations and back-up tools.
- Have the vendor ready when the “Call-Out” is issued.
Written Protocols

• Well Location
• Services Requested
• Who will “call Out” the vendor
• Logging sequences and tool stacks
• Standard and extra calibrations expected
• Logging operations
• Displays
• Back-up and special equipment
• Specialist Engineer
• Hard and soft copy delivery
• Special conditions
Calibration Philosophy

Well Logging Tools are Calibrated by Adjusting their Response to Read some Predetermined value, in a Situation for which the Response is: Known

**Corollary-1**
The Only Time We know, for Certain, that Logging Tool is Working Properly, is During Calibration

**Corollary-2**
*Calibrate and Check Calibrations Often*
Log Calibration - 1

Linear Calibration Concept

Primary Porosity Tool calibration Test Pit

Shop Calibration

NUMAR/HES NMLR Shop Calibrator

Schlumberger LDT Shop Calibration Record
Not all Shop Calibrators are Equal
Field Calibrators

Schlumberger CNL & GR Field Calibrators

Schlumberger CNL/LDT & GR Pre-Log Calibration

Logging Job Calibration Protocol

- **Shop Calibration:**
  - Should be as recent as possible (request to have it done before the unit leaves the shop).
  - Do not accept tools with a shop calibration over **30 days old**.
- **Pre-Log Calibration Check:**
  - Check against drift from Shop Calibration.
- **Logging Trip Calibration Checks:**
  - Repeats, Casing Signal, Evaporite Beds, etc.
- **Post Log Calibration Check:**
  - Check against drift from Pre-Log Calibration Check.
- **Calibrations and calibration checks Must Be Documented on Detailed Log Prints, Including tool serial Numbers.**
Logging Jobs and Products

No Vendor wants to Deliver Bad Data

Not All Logging Jobs are Routine
However

How much sleep has your logging crew had, before they logged your well?

• Anne Schlumberger-Doll described being introduced to a logging Engineer who she thought was terribly rude – only to learn that he had not slept in 6 days.
• I once arrived at the well-site to find the logging crew draped over the fenders of the logging unit, like trophies from a dear hunt.
• I once opened the cab of a logging unit in the middle of the night to find the Engineer curled up on the floor, sound asleep.
Check The Equipment-1

1. Density Shop Calibration is expired.
2. Density Field Calibrator is not listed on header.
3. Neutron Field Calibrator is not listed on header.
4. Neutron Cartridge on header is NOT cartridge on Shop Calibration.
Check The Equipment-2

1. Density Shop Calibration is expired.
2. Density Source, Skid & Field Calibrator are not listed on header.
3. Neutron Field Calibrator is not listed on header.
4. Neutron Source is not listed on Shop Calibration.
Massive Anhydrite Density & Neutron Check
Acoustic Log Casing Check

Good Csg. Check

Bad Csg. Check
Do Your Porosity Logs Agree?

- Client Comment: “The Vendor should have caught this”.
- Vendor Comment: “The Client should have caught this”.

Do Your Logs Repeat?
Two Versions of Truth
Gamma Ray Drift
Fluid Resistivity Bridge Check

Bad Calibration

Good Calibration

Temperature Tool Calibration

Bad Calibration

Good Calibration
Log QC Summary

- It’s NOT Rocket Science.
- You *Do* need to know what should happen, *and make certain that it does*.
- It sometimes takes a little creativity.
- It can make a **BIG** difference in the quality of your reserves estimates.
Thank you for your Attention