SPWLA INDIA CHAPTER

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S. K. Singhal takes over as President, SPWLA-India Chapter

Shri S K Singhal, Executive Director and Chief Logging Services, ONGC, has taken over as President SPWLA India Chapter. Shri Singhal, a versatile Logging Engineer cum Technocrat having vast experience and expertise in all facets of Petrophysical Data Acquisition, Resource Planning & Management, Corporate administration etc., replaces Shri M K Tewari at the helm. His excellent organizational skills and attention to micro-details were demonstrated during the successful conduct of 5th SPWLA India symposium 2023. The introduction of Student engagement programs across the nation as part of the event was a testimony to his penchant for knowledge sharing and broadening vistas.

At a time when there is a clear focus on global and national energy perspective in the context of energy transition, Shri Singhal's taking over the baton assumes significance as the Oil & Gas industry in general and the community of Well Logging Professionals in specific is poised to expand the scope and scale of its ambit and activities more than ever before.

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"It is an honour that I hold close to my heart, and I am truly grateful for the opportunity to continue to serve our community. I wish to thank all my predecessors for building SPWLA's significant presence regionally as well globally. I really hope and trust in a great future for the SPWLA as we see so much energy and passion across all generations of our member community. However, I further wish more and more strengthened and mutually enriching technological and knowledge based exchanges, collaborations and ideations among the vibrant members of the society. Higher levels of participation and engagement with young professionals, local chapters, and student chapters would be highly appreciated. Let us unite in forging a technologically thriving network through SPWLA India chapter and eventually make this professional platform to transcend the regional boundary. Metaphorically as SPWLA has widened the horizon of the revered peer reviewed journal from 'Log Analyst' to 'Petrophysics', we also look forward to expand our knowledge-scape to fathom the unfathomable. I hope we all will join hands in continuing to support our various workshops, topical conferences, annual symposium, and all other SPWLA initiatives."

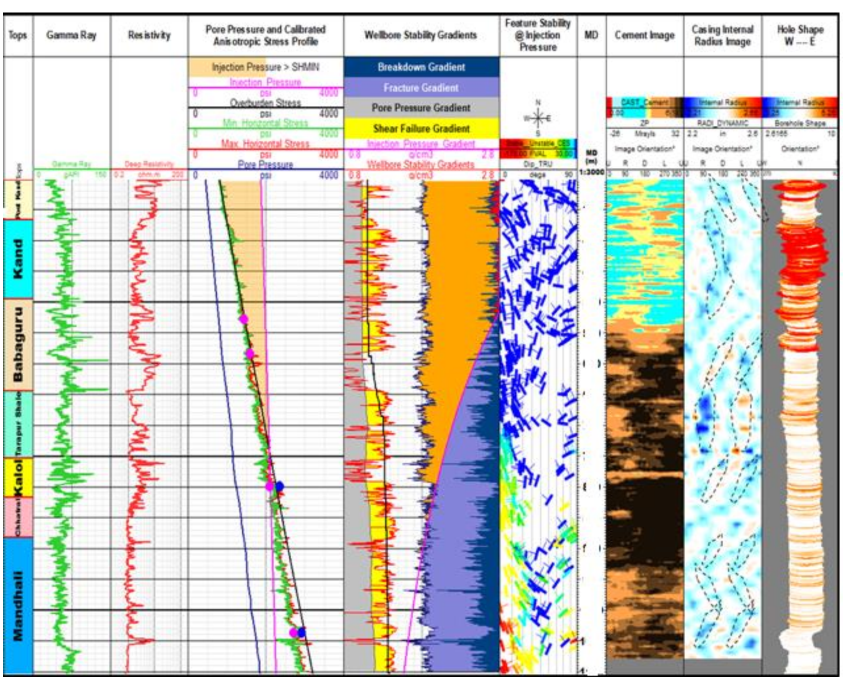
- S K Singhal, President SPWLA INDIA

Geo-mechanical Analysis: Understanding Casing Deformation in Wells of Limbodra Field

Authors: Seshadev Rana, Tanmay Chandra, Sakshi Singhal & V V Rao, ONGC

Addressing the casing deformation and wellbore instability issues encountered in the wells of Limbodra field have been a major challenge in the producing fields of Western Onland. Around 25 wells in Limbodra field have shown abnormal casing deformation at shallow depths. Casing deformations are associated with phenomena leading to alterations in the effective stresses in and around the wellbore. The possible reasons for the stress alterations include: high hydraulic pressure differential between internal and external casing surfaces, injection / hydraulic fracturing, reservoir depletion related compaction and subsidence or tectonic activation of faults, fractures and bedding due to natural or induced seismicity. This creates well integrity challenges /issues during work-over operations, ultimately leading to production losses.

In order to understand the stress regime anisotropy and identify structural features responsible for the anisotropy, the Geo Mechanical Analysis tool (Sonic Scanner) acoustic logs were recorded in one of the recently drilled wells of the field. Anisotropic geo-mechanical study of the logs showed that a strike slip stress regime is prevalent above 575m depth and therefore, the formations, casing and cement in the shallower intervals of the well are exposed to higher than normal lateral stresses. Based on modelling, it is seen that many natural features in this interval became unstable when exposed to an increase in pore pressure. The structural features have a strong tendency to open up and move due to shear slip-slide failure mechanism upon exposure to an increase in pore pressure. The same unstable structural features appear to be responsible for hole tortuosity, poor cementation and casing deformation in the well. It also indicates that, residual stresses exist in the casing prior to production or injection due to exposure to drilling fluids and cement slurry ECD surges. Stress state and slippage tendency was used to identify re-activation surfaces where casing deformation would initiate. The high-pressure injection water appears to communicate with the shallower formations through imperfections in the cement sheath as evident from the cement bond images. The injection water is anticipated to move as a fluid front through permeable sands and leak off through the unstable structural features. The high-pressure injection water is responsible for aggravating shear slip-slide failure of the unstable structural features. Consequent formation movement will transfer lateral stresses on to the casing's external surface in a non-uniform / anisotropic manner. In the absence of cement, the lateral stresses compress the casing along the SHmax in the horizon above 575m. The combined effect of the non-uniform compressive stresses, residual stresses and the pressure differential between the internal and external surfaces appears to be compressing the casing beyond its collapse ratings. Onset of collapse of 9-5/8" casing is anticipated before the 5.5" casing in such situations.



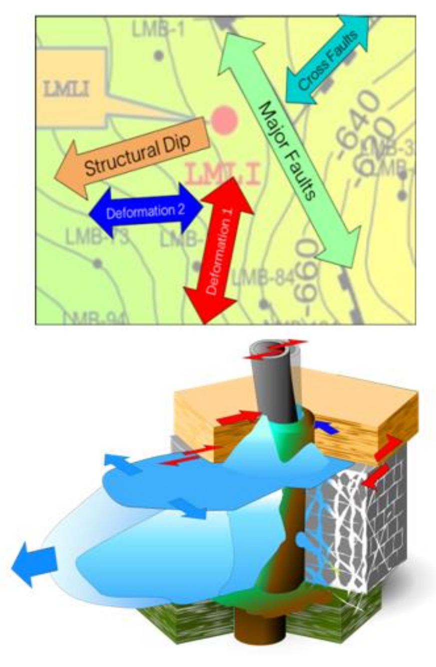


Figure 1: Log motif

Recommendations Based on Geo-mechanical Analysis:

- Redesigning of cementing and casing plan:
    - Higher strength cement & sufficient flexibility should be used, to ensure good azimuthal cement coverage & cement rise to surface.
    - Cement sheath flexibility will allow the cement to absorb non-uniform stress transfers. Use of higher strength grade casing, will help in reducing casing ovality & casing collapse strength.
    - To reduce the cost of high grade casing, mixed grade casing string can be designed based on stress profile & identified problematic zones in the well.

- Field scale comprehensive reservoir modeling study that combines geological model, reservoir simulation and geo-mechanical simulation for the reservoir, is required to model the changes in the in-situ stresses due to simultaneous production and injection.
- Continuous reservoir monitoring by time lapse PLT in injector & producer wells and Time lapse MDT pressure measurements in permeable lithologies are of prime importance.
- Advanced 3D-Sonic data can be acquired in key wells to map critically stressed structural features and calibrate MEM at the wellbore level.
- Rock mechanical core testing is also advisable for further calibration of 1D-MEMs.

Innovative approach using temperature logging helps restore casing integrity and revival of sick well. A Success Story from Lanwa heavy oil field of ONGC, Mehsana

Authors: Dinesh Kumar, Logging Services, ONGC Mehsana

The article illustrates a successful case study on how the casing leakage points were identified using temperature logs in an innovative approach thereby restoring the casing integrity of a Well, which was non-flowing due to leakage for the past 10 years. The conventional logging attempts had failed to detect casing leakage as these leaks were of very small to micro levels or through the casing collars.

Introduction and Background:

The Well LWXX was drilled to a depth of 1100m to explore the prospects of KX Pay in Lanwa field, a heavy oil field of Mehsana block. It was completed in KX pay sand (with OSC). Over the years, with the help of several work over operations to increase the productivity, the well yielded a cumulative production of 9739T oil with an average W/C < 65 %. Upon observing free water after 20 years of production, produced water samples were analyzed and found to have salinities of 2.6-3.5 gpl which were less than the formation water salinity (7-8 gpl). Based on these observations, a work over job was carried out eight years ago, to identify the water source. Multiple attempts were made in vain to set R3-Packer at depths below X80m. No significant anomaly were detected on CAST, CBL-VDL & MIT Logs that were recorded to locate the casing leakage point. The injectivity was observed as >300 lpm at 25ksc. This well was non-flowing for the past 10 years and was again taken-up for revival operation recently.

Strategy:

As the source of casing leakage could not be determined through CAST/MIT log, recording of temperature log under hot/cold water injection was adopted to detect the casing leakage in the well. A deviation from the normal temperature gradient was anticipated after injecting hot/cold water which would indicate or locate the actual leakage point.

Log Analysis:

The recorded temperature logs under both warm & normal temperature water are plotted in Fig-1. The results were quite exciting and encouraging as the log responses were as per the expectation. In Fig-1, the point of change in slopes of both temperature logs coincided at C57 m, indicating a leakage in casing at the depth. The temperature log indicated another point of casing leakage at a depth of E79m. The flattened portion of the temperature curves in both passes suggest channelling/communication behind casing between the two leakage points, developed probably due to the excessive attempts to test injectivity and setting of R3 packer.

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Based on these observations made from the Log, it was concluded that there were two suspected leakage points in the well at C55 m & E79 m. Both were present against the collar and as a result, could not be detected in CAST and MIT Logs.

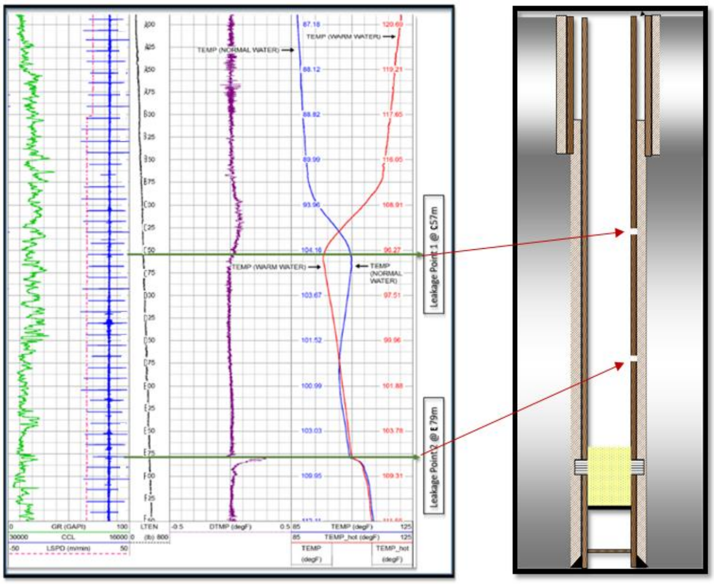

Fig-1: Left: Temperature Log recorded in both Warm Water & Normal water; Right: Well Schematic

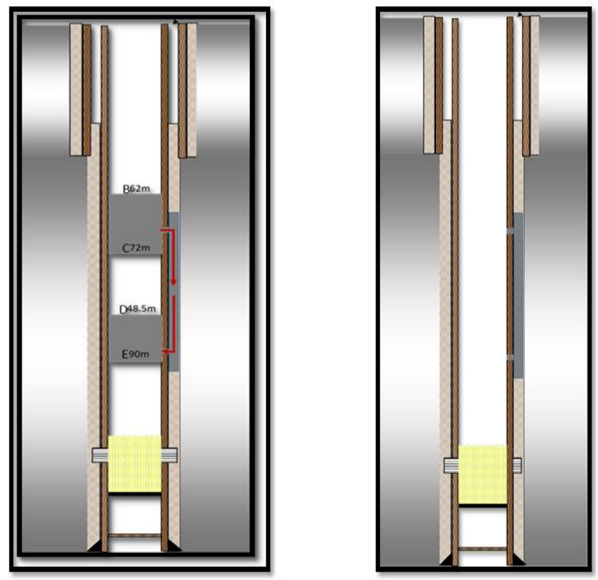

Fig-2: Well Schematic: Left: after Cement Squeeze; Right: After Cement Drilling

Temp log based CSQ salvaging operation:

Based on the observations made by the Temperature Log, Cement squeeze was planned to restore the casing integrity. Cement Squeeze was carried out keeping the tubing shoe at C65 m and squeezed around 2.8 m3 of cement. After the squeeze, while tagging the cement top, no cement was found in the wellbore indicating the Cement loss into the Formation. The injectivity was tested, which was seen as 200 LPM @ 500 PSI against the pre-CSQ injectivity of 500 Lpm @ 500psi.

A further cement squeeze was attempted keeping the tubing shoe at E65m. This time 700 Ltrs of cement was pumped @ 1200 psi. After the squeeze, while tagging, cement top was found at B62m. Cement was drilled and a Free Fall was observed at C72 m (110 m cement plug). And a Second Cement Plug was observed at a depth of D48m. The hermeticity of the casing was checked, which was found to be holding at 100 ksc.

As illustrated above, temperature log revealed a communication behind casing between two leakage points which was further verified when the second plug was encountered against E79m with cement top at D48m. The cement during Squeeze attempts must have entered from C57m (first leakage point) and travelled down behind casing till E79m (second leakage point) and then rose up inside of the well casing till D48m. Pictorial representation is provided in Fig-2. Subsequently, Cement was drilled and another Free fall was observed beyond E90 m (Total cement plug of 142m). Hermeticity was again tested after clearing the well till X00m which was found to be holding at 100ksc.

Conclusion:

Adding innovation to the available technology helps resolve problems as exemplified by the presented case. Carrying out a temperature log after injecting warm & normal temperature waters has helped in solving the well integrity problem, which ultimately helped in restoring and reviving a well that has been non-flowing for over 10 years.

For contributing Articles for Upcoming Bulletins may please contact Mail id: sajith_cs@ongc.co.in

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