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First Successful Live Well Cleanout Using Coiled Tubing Hammer Technology in the Philippine Geothermal Industry

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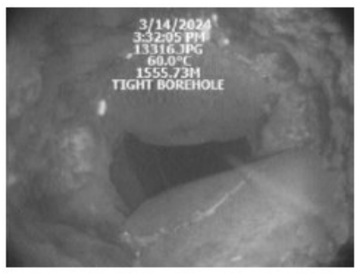
BACKGROUND

Seeking a faster, safer, and more cost-effective approach, Energy Development Corporation (EDC) successfully partnered with Western Energy Services and General Compression to execute the Philippines' first Live Well Cleanout (LWC) using Coiled Tubing Hammer (CTH) technology.

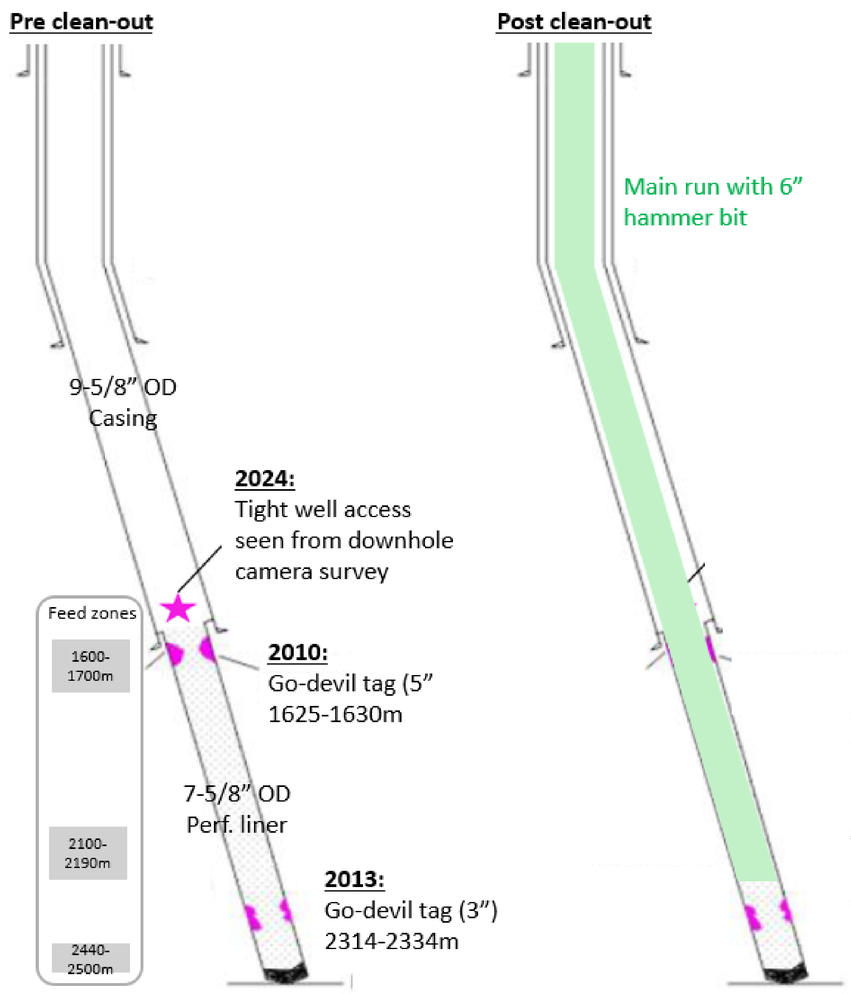
- Production well affected by scale build up needs cleaning out.
- LWC avoid risk of well quenching e.g. thermal stress, permanent well loss, and prolonged down time on production.
- CTH technology has been extensively applied in New Zealand to clean out scaled geothermal well.

SELECTION AND PLANNING CRITERIA

- The subject well was drilled in 1994, with standard construction of 9-5/8" casing and 7-5/8" production liner.
- Progressive mineral scale leading to declining output (87 Tph as of 2023).
- Tight access near top of liner.
- No casing integrity problem was observed.
- This is the first workover on the well since drilled.



EXECUTION AND CRITICAL PIVOTS



Graphical sketch of wellbore state before and after cleaning out



Site layout during well clean out work

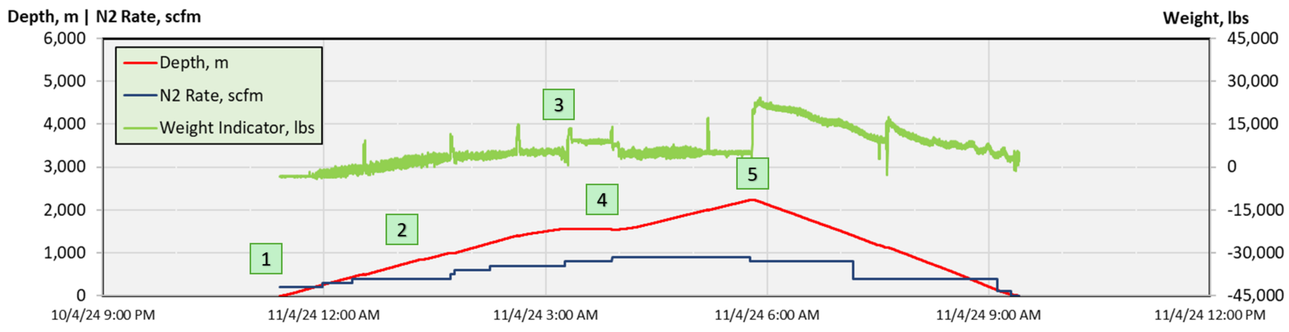


Pneumatic hammer BHA

Coiled Tubing Hammer technology uses nitrogen to drive scale removal and assist lifting of cuttings, while the hammer bit design allows debris passage and minimizes risk of casing damage.

A total of 3 downhole runs were performed during the work:

- Run 1—6" OD hammer bit cleaned out majority of scale. Well output increased 2.5x as hammer cleaned through top of liner section (1560m), seen from the continuous online monitoring station.
- Run 2—8.38" OD hammer bit run across the 9-5/8" casing section.
- Run 3—5.5" OD Polycrystalline Diamond Compact (PDC) bit in an attempt to clear/tag deepest obstruction. Despite tool being available, hammer bit was not run to address deep obstruction due to indication of liner damage problem.



Operating parameter during run

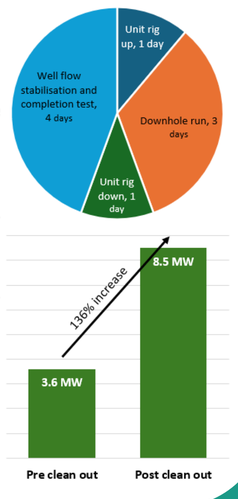
Key parameter during hammer clean out run:

1. Commence running in hole with nitrogen rate maintained at 200 scfm
2. Gradually increase nitrogen as tool run deeper
3. Obstruction is engaged and interpreted as thick scaled section. Rate of penetration (ROP) decreases before nitrogen was ramped up to initiate "hammering" action
4. Hammer through scale with slow CT speed to allow scale to disintegrate into smaller chunks.
5. Light hammering through wellbore until 2200m before pulling out of hole

RESULTS

The clean out work took **3 downhole days**, with post-clean out completion test conducted the day after. Upon put online, the well show **136% increase** from its pre-clean out performance.

The application of Coiled Tubing Hammer has also been adopted in other EDC wells (both production and injection). These has successfully demonstrated that with the precise evaluation and execution strategy, live well workovers can deliver superior cleanout results to conventional methods while significantly reducing cost, risk, and lost production.



CONCLUSION

Live Well Cleanout enables maintaining well under live (flowing) condition to minimize down time and preserve casing integrity from thermal cycling risk.

On planning and running a live well clean out, the **best practices** below are maintained:

- Availability of data through pre-clean out downhole survey to understand well accessibility and flowing properties.
- Thorough assessment of well condition and nature of obstruction. Different case requires different solution.
- Controlled ROP while the hammer BHA engage scale or obstruction. This allow scale to break into smaller pieces, less lifting force required.

Acknowledgements

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REFERENCES

Wilson, D., and Anderson, J.: Coiled Tubing Live Well Cleanout, *Proceedings,* World Geothermal Congress, Iceland (2020).