Review of ACR's Orphan Well Methodology and How Rebellion has addressed the Methodology's shortcomings

The ACR Orphan Oil and Gas Well methodology (OOG v1.0) was originally published in May of 2023. This methodology provided the foundation for taking urgent and necessary action of plugging orphan wells, which are actively emitting methane and other toxic gases, and creating a measurable and quantifiable practice with a financing option. Prior to the voluntary market, this practice was, at best and with the most generous view, severely limited. Outside of carbon market financing, plugging orphan oil and gas wells exists as federal- and state-funded plugging operations, but falls dramatically short of the true scope of the challenge[1].

OOG v1.0 was developed with what the market and academia understood at the time to be how an orphan well behaved. This is based on limited research and assumed small volumes, low pressures and short-lived timespan, and was reflected in an arbitrary crediting period. This understanding is exemplified in OOG v1.0's exponential extrapolation of the original measurement over the 20-year crediting period. This previous assumption/understanding may be appropriate for a large subset of orphan wells that are very close to the end of their economically recoverable reserves and their potential to emit was minor and fairly constant but we have learned in the past 3 years that there is another, more impactful (for immediate climate benefits) category of orphan wells to be considered. The original methodology laid the foundation for how we begin to quantify methane emissions during baseline testing and how to confirm emissions are abated after plugging.

Recently, oil and gas industry experts have joined the VCM and begun contributing to academic research on orphan wells, which were previously constricted by the lack of technical prowess and oil and gas know-how, it became clear there were shortcomings in the methodology's addressal of the full population of orphan wells, and therefore places where improvement is critical.

We have identified areas in which the OOG v1.0 methodology lacks industry expertise and knowledge of how a well behaves:

1. Lacks stabilized pressure monitoring
2. Lacks verifiable evidence the well is emitting when first discovered
3. Unclear evaluation of stability in data
4. Lacks methane analyzer specifications

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[1] In Oklahoma, there are more than 15,000 documented orphan wells and many more undocumented. Across the country, the Interstate Oil and Gas Compact Commission identifies over 141,000 documented orphan wells and hundreds of thousands more that remain unverified. The scale is unprecedented and Oklahoma stands at the center of the nation's most consequential methane abatement opportunity.

Merrill, M.D., Grove, C.A., Gianoutsos, N.J., and Freeman, P.A., 2023, *Analysis of the United States documented unplugged orphaned oil and gas well dataset* (ver. 1.1, April 2023): U.S. Geological Survey Data Report 1167
IOGCC Idle and Orphan Oil and Gas Wells Report (September 2024)

5. Lacks clarification on direct connect method of quantification
6. Lacks proper forecasting over crediting period
7. Lacks understanding of when the leak started or where it was in its lifecycle
8. Lacks detailed plugging policy for permanence
9. Lacks buffer pool to reduce risk if a reversal occurs
10. Lacks post plugging MRV plan
11. Lacks HSE policy

The updates through Errata and Clarifications (OOG v1.0 E&C) made the combination of ACR OOG v1.0 and E&C system much tighter and addressed 1 - 5 of these 11 shortfalls, including:

- The E&C edits provided parameters to ensure measurements are conducted consistently, inclusive of pressures, and proper methane measurement equipment requirements. The result is that the data is more reliable as a predictive tool and project data collection and quantification are more consistent across project developers.
- Allowing direct connection to the well-head provided developers with the only safe and regulatory-permissible operation option, while measuring high pressure wells and/or wells with multiple leak points (Risks near the well include well integrity failure resulting in injury or fatality from pressure, projectiles, toxic gas exposure, etc.).
    - Connecting rated rig technology directly to the well and measuring through properly pressure-rated oilfield equipment enables workers to maintain a safe distance from unpredictable orphan wells and follows the requirements provided in the OSHA General Duty Clause for workplace safety.

Addressing all these shortfalls was important because the market continues to need confidence, reduction of harm potential, and standardization.

Even with these improvements, the ACR methodology + E&C's rely on premise that measures how much methane is coming out of a well today and then assumes that level continues (extrapolated). This may be appropriate for those micro-emitting wells typically studied by academia and known to have a very shallow decline at the end of their lives. However, after many project developers have tested thousands of wells, it is well-understand that not all orphans fall into this category and an extrapolated issuance is a blind spot.

Many orphan wells do not behave this way in real life; they change over time as internal and external corrosion of unmaintained wellheads progress. Pressure drops, flow paths shift, and emissions will spike and then tend to decline as the well ages. So, while ACR's methodology + E&C's has provided a very solid and reliable foundation for measuring what is happening right now, it does not fully capture what will happen over the next 20 years.

Rebellion addresses this by keeping the strong and safe measurement foundation and adding a key component: our **Certainty in Forecasting Policy**. This policy considers real well behavior over time

instead of relying on the assumption that emissions stay flat. Our policy uses accepted and well-understood industry standards to model how emissions decline, which aligns the forecast of avoided emissions with reality and overlays a conservative approach rooted in a reservoir engineering understanding of drive mechanisms. The policy is based on empirical research developed on regional type wells constructed from using ~1.8 million vertical onshore gas production profiles to determine the rate of decline at which a wells emission profile will decrease in its terminal, boundary dominated flow regime. The Certainty in Forecasting policy ensures reservoir depletion is accounted for, what the orphan well will do as it continues to corrode and reach the height of its emissions requires those emissions to be established along the leak path.

Rebellion's use of the De-Ward Milliam's corrosion model anchors the measured leak in time. Rebellion uses the day-of leak identification as day zero, a largely conservative variable assumption. We do this even if the well has been orphaned and the well head, if it is even present, has not been maintained by the operator for years or decades. From there, gas analysis is used alongside measured and observed input variables for the corrosion model calculations. This analyzes internal corrosion only, excluding external corrosion factors, which may be serious, as an added layer of conservativism.
Rebellion applies an appropriate model to the individual wells in each project, providing heightened certainty that the overall project emissions are accurately erring on the side of conservative versus what would have happened should the well never have been plugged. In contrast, ACR mostly relies on what is measured at a point in unknown time. Rebellion's method also looks at the bigger picture, comparing measurements to historical production and to analogous wells which adds another layer of engineering context that helps confirm the calculations.

ACR focuses on making sure measurements are done correctly, and Rebellion's method builds conservativeness into the structure, reducing risk from the start. Once credits are issued, the number of credits outside of our model are never brought to market.

Another important difference is how Rebellion approaches permanence in it plugging activities. Orphaned wells are systems with missing data, damaged infrastructure, corrosion, unknown well conditions, and multiple potential gas pathways, all of which make permanent plugging a challenge. Because gas pressure is often present and behaves differently in each well, successful abandonment depends on understanding where the gas is coming from, how it is moving, and how pressure builds over time. **Rebellion's Cementing Policy** (The Rebellion Method of Plugging) focuses on directly evaluating these real-world conditions rather than relying on assumptions, ensuring that each well is properly diagnosed and sealed for long-term integrity using Rebellion's 5 tenets of plugging:

- **Complete Barriers**: formation to formation barriers are beyond industry standard but critical to a permanent seal
- **Precise Placement**: cement plugs should be placed on a verified physical base to ensure formation coverage.
- **Engineered Plugs**: a certified Professional Engineer considers well conditions and designs for superior bond and seal

- **Oversight and Validation**: onsite adherence to procedures as closely as possible and post job validation is required
- **Reporting**: records are strictly kept in-line with company policy for review and verification at any point in time as well as clear issuance monitoring procedures.

While our plugging policy reduces the risk of permanence reversal, we also apply a **Buffer Pool Policy** which holds back 5% of credits from each project. Another step that is above and beyond the methodology is our long-term strategy detailed in the **Rebellion MRV Plan and post-plugging monitoring requirements**. This plan details a 20-year post plugging monitoring phase to confirm zero emissions over the crediting period. To date, with initial project well's plugged ~3 years ago, Rebellion has confirmed zero emissions.

These policies build confidence in the marketplace that our credits are real and unimpeachable; however, none of this means anything if we don't bring home every employee safely. The inherent danger of dealing with high pressure explosive gases merits robust safety protocols. Rebellion Energy Solutions is committed to ensuring the safety of our employees, contractors, and those who live and work in the communities in which we operate. We hold the safety and protection of our workers, our neighbors, and our shared environment as the top priority, and we conduct ourselves in a manner that demonstrates our commitment to this goal in our **HSE Safety Policy**:

To that end we:

- Comply with all applicable local, state, and federal laws and regulations.
- Prioritize health, safety, and environmental stewardship by employing HSE personnel and providing all resources needed for development of HSE standards, for equipment and training, and for safety performance incentives.
- Develop HSE standards, train on those standards, and conduct field visits to monitor progress on HSE initiatives and compliance.
- Define HSE-related Key Performance Indicators (KPI) and goals and report regularly to Board on status of KPIs and goals.
- Maintain a Contractor Management standard to help identify and evaluate HSE performance among contractors. Contractors also attend relevant RES HSE training.
- Develop and maintain field emergency response plan for each geographical area of operations. Training and tabletop drills are provided to employees and contractors to improve effectiveness and efficiency during a response.
- Conduct monthly safety meetings for RES staff and relevant contractors. Safety meetings include HSE training, incident and metrics review, ongoing operations discussion, monthly safety incentive award.
- Encourage, track, and reward positive leading HSE indicators including, but not limited to, Good Catches, HSE coaching, pre-job safety meetings and Stop Work Authority

ACR created a system for measuring and verifying methane reductions. The E&C updates made it more consistent and credible. However, Rebellion's post-methodology practices build on that and turn the methodology into a scientific-and-industry aligned practice by addressing the remaining six elements that are currently missing from the ACR +E&C practices. Rebellion's method addresses these shortfalls through internal policy that pertain to certainty in emissions, corrosion model, permanence, insurance for a reversal, post plugging validation over the crediting period, and most importantly safety to ensure the work being done for people and the planet through the VCM is durable and measurable with conservative practices