Electrolab DLS Level Sensor

vs. Guided Wave Radar in High-Volume Oil Production Tanks

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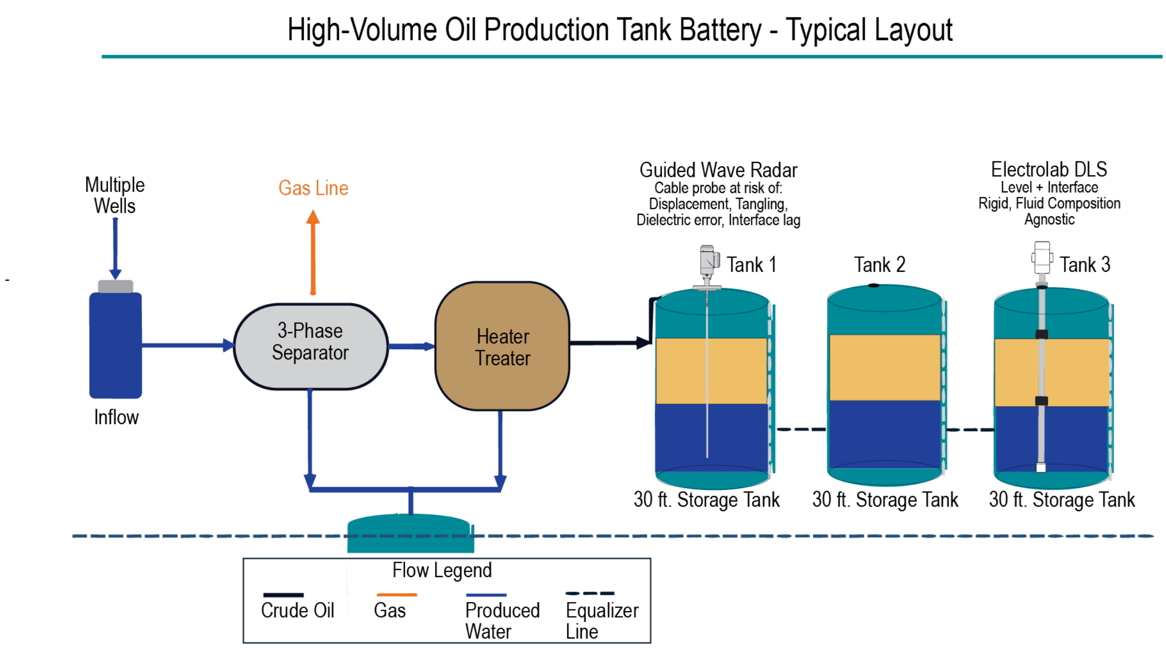

Figure 1. Typical high-volume production tank battery with three 30 ft. crude oil storage tanks, separator, heater-treater, and water disposal system.

Executive Summary

High-volume crude oil production tanks present a uniquely demanding measurement environment: constant fluid turnover from multiple source wells, variable fluid compositions, active interface layers, and physically congested interiors containing ladders, agitators, and cathodic protection systems. Selecting the right level sensor for this environment requires careful consideration of long-term reliability and measurement consistency under these conditions.

This paper evaluates two technologies—the Electrolab DLS (Digital Level Sensor) and guided wave radar (GWR)—against the specific demands of high-volume oil production tank environments. Both technologies are capable instruments with established track records. However, across three key performance dimensions—mechanical durability, fluid composition adaptability, and interface detection reliability—the Electrolab DLS is better suited to the challenges of this particular application.

1. Mechanical Durability in Congested Tank Environments

The Challenge

High-volume production tanks are operationally dense. Ladders, agitators, cathodic protection systems, and internal piping share space within the tank. Fluid movement is frequent and sometimes turbulent as product is drawn from or delivered by multiple well sources throughout the day. In this environment, sensor installation geometry and long-term physical integrity deserve careful evaluation.

Guided Wave Radar: Installation Considerations

Guided wave radar sensors use a probe—either a rigid rod or a flexible cable—extending from the top of the tank toward the tank floor. In deep tanks, flexible cable probes are a common choice. This design works well in many applications, but in high-volume tanks with active fluid movement, a few considerations are worth noting:

- Fluid turbulence from active fill and draw cycles can exert lateral force on cables, often displacing them from their intended path.
- In tanks with ladders, agitators, heaters, or cathodic protection equipment, displaced cables may contact internal structures over time, even getting tangled in the tank hardware (as shown in the graphic at right).
- Periodic inspection of probe alignment is advisable in these environments to confirm measurement integrity.

GWR tangled in tank

Electrolab DLS: Rigid Construction

The Electrolab DLS uses a rigid sensor design with no suspended probe (see graphic at right). This eliminates the possibility of turbulence-induced displacement and removes the need to account for internal tank obstructions in sensor positioning. The result is a sensor that maintains consistent measurement geometry over long operating periods with minimal mechanical maintenance requirements, well suited to the physical demands of a busy production tank.

DLS in tank

2. Performance with Variable Fluid Composition

The Challenge

High-volume production tanks typically receive fluid from multiple wells simultaneously. Each well contributes crude with its own blend of hydrocarbons, water content, suspended solids, and dissolved gases. As the well contributions shift throughout the day, the aggregate cmposition of the tank content changes accordingly.

Guided Wave Radar: Dielectric Constant Dependency

Guided wave radar sensors measure level by analyzing the reflection of electromagnetic pulses off the fluid surface. This method relies on the dielectric constant (εr) of the fluid—a value that must be known and configured within the instrument. In single-source tanks with stable, well-characterized fluid, this presents no issue.

In a multi-well aggregation tank, however, the effective dielectric constant of the blended fluid changes as the well contributions vary. This can introduce measurement drift that may require periodic recalibration or manual adjustment to correct. Some GWR instruments offer automated dielectric compensation features, though their effectiveness varies depending on the rate and range of composition change.

Electrolab DLS: Composition-Independent Measurement

The Electrolab DLS operates on a simple, direct measurement principle that is not dependent on the dielectric constant of the fluid. Rather than relying on electromagnetic reflectivity, the float rises and falls based purely on the buoyancy of the fluid column, it responds directly to the fluid's physical displacement force — not its chemical or electromagnetic properties. This makes measurement consistent even when fluid composition varies. Foam, sludge, condensate, and conductivity, are not an issue and do not affect the measurement. In multi-well tank environments where fluid composition changes frequently, this characteristic reduces the need for ongoing reconfiguration and supports stable measurement continuity.

In applications where fluid composition is variable or difficult to characterize in advance, a measurement approach that does not depend on dielectric calibration offers a practical advantage in maintaining consistent accuracy over time.

3. Interface Layer Detection in Active Tanks

The Challenge

Crude oil production tanks contain multiple fluid phases: free oil, emulsion layers, produced water, and settled sediment (BS&W). Accurate measurement of the interface between these phases is important for custody transfer, separation efficiency monitoring, and process control. In a high-volume tank, the interface layer can shift frequently as new fluid is introduced from multiple sources.

Guided Wave Radar: Interface Detection Conditions

Guided wave radar sensors can detect interface layers by identifying a secondary electromagnetic reflection at the fluid phase boundary. This capability works well when the interface is relatively stable and the dielectric contrast between phases is sufficient to produce a clear secondary reflection. In high-volume tanks, two factors can make this more challenging:

- Emulsion layers—common where fluid from multiple wells is blended—present a gradual transition between phases rather than a sharp boundary, which can reduce the clarity of the secondary reflection.
- Rapid interface movement may result in readings that lag behind actual conditions, depending on the instrument’s update rate and signal processing settings.

Electrolab DLS: Buoyancy-Based Interface Measurement

The Electrolab DLS measures interface position through direct sensing of the buoyancy of the fluid across the fluid column. This approach responds to the actual physical stratification of tank content and is not dependent on dielectric contrast or a sharp phase boundary. In tanks where the interface layer is active or where emulsion is present, this provides a more consistent measurement foundation, supporting reliable data for production and custody transfer decisions.

Where interface accuracy is important to production decisions or regulatory reporting, a measurement method that is independent of phase boundary clarity and fluid composition offers greater consistency in demanding tank environments.

4. Technology Comparison Summary

Performance Dimension	Electrolab DLS	Guided Wave Radar
Mechanical durability in crowded tanks	Rigid design; sensor body does not move; immune to displacement	Cable probe may move, requiring periodic inspection in turbulent, congested tanks
Variable fluid composition	Measurement independent of dielectric constant; no reconfiguration required	Accuracy depends on stable dielectric constant; may require recalibration as fluid composition varies
Interface layer detection	Continuous real-time measurement sensing based on buoyancy; unaffected by turbulence or emulsion	Performance may be reduced with emulsion layers or rapidly shifting interfaces in multi-well tanks
Ease of initial installation	Standard mounting; no probe length configuration	Simpler to install initially, but probe length and dielectric must be configured correctly
Long-term maintenance burden	Low; no probe replacement, no periodic reconfiguration	May require additional inspection and dielectric recalibration in high-volume, multi-well environments

5. Conclusion

Guided wave radar is a proven and widely used level measurement technology. In many oil and gas applications—particularly single-source tanks with stable fluid properties and unobstructed interiors—it performs reliably and offers a straightforward installation path.

High-volume crude oil production tanks, however, present a different set of conditions. The combination of physical congestion, continuous multi-well inflow, variable fluid composition, and active interface layers creates an environment where the DLS's design characteristics are better aligned with the application's demands. Its rigid construction avoids the probe management considerations that arise in crowded tanks. Its composition-independent measurement removes dielectric calibration from the ongoing maintenance picture. And its direct interface sensing provides consistent results regardless of emulsion character or interface activity.

For operators evaluating level instrumentation for high-volume production tanks, the Electrolab DLS warrants consideration not only for its ease of installation, but for the long-term measurement consistency it offers in conditions where fluid composition and interface behavior are rarely predictable.

For more information about Electrolab DLS sensor specifications, installation requirements, or application engineering support, contact your Electrolab representative.