

# CASE HISTORY

*A deeper look into how Gradiant Energy Services' Free Radical Disinfection (FRD™) Technology provided a safe and cost effective solution for bacteria and H2S treatment*

## SUCCESS SNAPSHOT

### BENEFITS OF FRD™

- Designed to handle varying water quality
- On-the-fly bacterial treatment eliminates the need for storage and associated delays in fracturing operations
- On-site biocide generation provides 24/7 treatment for a continuous frac operation
- Achieves treatment rates of up to 120 bpm
- Eliminates bacteria and H2S
- Increases ORP of water
- Minimal footprint and manpower
- Eliminates exposure of hazardous chemicals on location

### BACKGROUND & CHALLENGES

- Was able to meet a wide range of influent water
- Ensured effluent water quality matched the desired quality standards
- Quality control on each stage
- Treated on the fly at 85 bpm

### GES SOLUTION & RESULTS

- FRD™ combines our unique chemistry application with salt to remove bacteria
- Eliminated the use, cost & transportation of hazardous biocides, such as chlorine dioxide
- Treated 1.6MM bbls of water on the fly using FRD™ solution
- ORP of water increased by 175%
- 97% of bacteria eliminated
- Continued joint partnership and expansion of program

**IN 2017 AN OPERATOR IN THE PERMIAN BASIN WANTED TO FIND A COST EFFECTIVE METHOD TO RE-USE PRODUCED WATER IN THEIR FRACTURING SERVICES.** The client was facing challenges in cleaning the produced water, storing the produced water, and controlling bacteria in the water. Gradiant Energy Services (GES) was able to provide a unique out-of-the-box solution that lowered the client's costs, eliminated the use for long term storage, and effectively disinfected the water all while using an environmentally safe process.



### THE CHALLENGE

Water sourcing has become a greater challenge in the Permian Basin as water volumes have increased for the growing frac sizes and longer laterals. Fresh water sources can be costly and are not always in close proximity to well sites. Trucking fresh water to locations is often uneconomical. As a result, operators have turned to recycling and reuse of excess produced water as a new source for supplying fracturing operations. The large volumes now required for fracturing caused the water to often be stored in pits ranging from 500,000 BBL to 1MM BBL ponds. While the water sits in these large ponds, excess bacteria can begin to accumulate, particularly in the warm southwest climate. The waste product of the bacteria can be in the form of H2S gas which is soluble in water, and poisonous to humans and animals. H2S is highly corrosive, and if introduced to a well has the potential to "sour" the well, leading to additional incurred costs to combat health risks and well integrity. The client needed to use their produced water in fracturing treatments without introducing large concentrations of bacteria into the system. Treatment also needed to be compatible and maintain fracturing fluid stability. Concentrations of bacteria in the produced water were as high as 22,000 cATP. This high level of bacteria had strong likelihood of potentially souring the well system or effecting the fracturing fluid system.

TREATMENT OVERVIEW	
VOLUME TREATED (BBLs)	1,622,874
MIXED OXIDANT GENERATED (GALS)	215,112
AVERAGE ORP (mV)	672
AVERAGE FAC (ppm)	6

### THE SOLUTION

The hydraulic fracturing job consisted of three wells with a total of 194 stages requiring more than 1.6MM BBLs of produced water. GES was able to offer a unique solution to the client. With GES' FRD™ technology the client was able to treat the produced water "on the fly" and eliminate the risks associated with high bacteria counts. GES' FRD™ technology is a safe, environmentally friendly bacteria treatment solution that focuses on quality control. FRD™ uses electrolysis to generate a mixed oxidant solution including multiple free radicals, which is injected into the water stream. The ions bind to, and remove the bacteria, resulting in bacteria-free water that maintains the integrity of the reservoir for an extended period of time. With this continuous job, GES was able to treat all of the produced water over a 26-day period. The Free Available Chlorine (FAC) content was raised to an average level of 6.0ppm, the Oxidation Reduction Potential (ORP) was increased 175%, and 97% of the harmful bacteria was reduced. This successful treatment resulted in cost savings to the client from trucking, pit management, and maintenance, and an overall clean and healthy reservoir system.