SOUTHERN UNION GAS SERVICES
now Regency Gas Services, LP
Lea County, New Mexico

JAL #3 Acid Gas Injection Well #001

Southern Union Gas Services (SUGS), now Regency Gas Services, LP (Regency), contacted Geolex, Inc.® (Geolex) when their Sulfur Recovery Unit (SRU) at the Jal #3 gas plant had reached its processing limit and SUGS had to curtail gas production and processing at the plant, thereby impacting New Mexico gas producers. Hundreds of different wells supply natural gas to the plant where it is treated in an amine sweetening unit to remove the acid gas; consisting of approximately 78% carbon dioxide (CO_2), 20% hydrogen sulfide (H_2S), and 2 % C_1-C_7. The acid gas removed from the natural gas stream was directed to the SRU where the bulk of the H_2S was converted to elemental sulfur, which was then sold or disposed of. The remaining H_2S and CO_2 was routed to a thermal oxidizer, where the residual H_2S was combusted to form sulfur dioxide (SO_2) and released to the atmosphere along with all the CO_2. Geolex's feasibility study showed that this was a viable site for an AGI well and SUGS further retained Geolex to design and oversee drilling and completion of the Jal #3 acid gas injection (AGI) well. In addition to resolving the original SRU problems the new AGI well has had a number of benefits. Instead of venting the CO_2 to the atmosphere, the CO_2 and H_2S is sequestered underground thereby reducing the atmospheric greenhouse gas effects. By expanding the treatment capabilities the efficiency and capacity of the gas plant has increased, allowing New Mexico gas producers and the plant to increase their production, obtain higher cash flows and enhance tax revenues for the State of New Mexico. Since completion, the Jal #3 AGI #001 well has been used for mixed wastewater and dissolved treated acid gas (TAG) disposal, safely injecting approximately 2,300 to 7,930 barrels per day over a lifespan of 30 years.

Phase I - AGI Feasibility Study:
Geolex collected, analyzed and evaluated the available geological information relevant to the area, and developed a feasibility study. This study included an evaluation of the regional and local geology and hydrogeology, and reservoir characterization and modeling through the analysis of well logs and geophysical data. It was critical to the success of the AGI well project to identify and characterize a suitable injection reservoir. This reservoir is required to have sufficient injectivity to hold 30 years' worth of wastewater and TAG, as well as confining barriers to vertical migration of fluid from the injection zone. The feasibility study also included evaluating land uses in the surrounding properties, and identifying/locating/mapping existing and potential oil and gas production in the area. Due to the isolated nature and structure controls on the injection zone and reservoir, the Jal #3 AGI #001 should not impact the local freshwater aquifers or oil production in adjacent formation intervals or wells. Geolex also conducted a review of the New Mexico Oil Conservation Division (NMOCD) regulatory and permitting requirements for a successful application and approval of an AGI well.

Phase II – Permitting:
New Mexico requires a C-108 application be submitted to the NMOCD for authorization to drill and inject. The permit process for the C-108 includes work produced from the feasibility study and notifications to all operators, oil, gas and mineral lessees, and surface owners within the area. Following public notice, a

Major Project Elements:

Phase I:
AGI Feasibility Study

Phase II:
Permitting and Expert Witness Testimony

Phase III:
Well Design, Drilling and Completion Supervision

Commissioning, Training, and Start-up Oversight

Phase IV:
Ongoing Maintenance, Support, and Compliance for existing AGI wells

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hearing on the Jal #3 AGI C-108 application was held before the New Mexico Oil Conservation Commission (NMOCC) where Alberto A. Gutiérrez, president of Geolex, provided testimony as an expert petroleum geologist and hydrogeologist. No operators or landowners from the area surrounding the Jal #3 plant appeared in opposition to the application. Information regarding the proposed AGI well was presented by Geolex and the application was approved.

Phase III - Well Design, Drilling and Completion Supervision:
Geolex was contracted by SUGS to design, oversee drilling of and complete a Class II injection well for acid gas and wastewater at the SUGS Jal #3 plant. Preliminary designs and an Authorization for Expenditure (AFE) were submitted by Geolex and approved by SUGS. Geolex then coordinated drilling services and provided oversight for all drilling operations. Due to the corrosive environment the well would be required to operate in; special considerations had to be given to the metals used in its construction. The mixing of H_2S and CO_2 with water from hydrochloric and carbonic acids will rapidly corrode typical carbon steel components used in wellheads, valves, packers, casing and tubing. Corrosion resistant alloys (CRAs) were evaluated thoroughly prior to their selection for inclusion in the well design. An additional challenge was the presence of nearly 5,000 parts per billion (ppb) of oxygen in the blow-down water. Oxygen in excess of 10 ppb can cause pitting within carbon steel and can also lead to small amounts of sulfur precipitation within the reservoir itself. The options were to either treat the oxygen at the surface with expensive de-aerator towers and oxygen scavengers, or upgrade the metallurgy within the design. After evaluation of the alternatives, it was decided to upgrade the metallurgy for critical components.

The lithology in the area made drilling the upper section of the hole prone to deviation problems. Therefore, it was decided to "directionally drill" a vertical hole and avoid any chance the hole would have to be sidetracked later. It was important to have as much geological information as possible in order to fully characterize and model the reservoir for injection performance. In addition to cutting samples and cores collected, electric logs were run and analyzed to measure additional geological parameters (i.e. gamma rays, porosity, resistivity, borehole diameter, and dip and fracture information). A cement bond log was run to verify adequate hydraulic isolation of the injection interval and then the well was perforated.

Upon startup injection of salt water, it was discovered that the formation had a slight skin buildup which manifested itself in higher surface injection pressures than anticipated. A 3-barrel per minute (bpm) at 1,200 psi rate was not acceptable, so it was decided to inject 3,000 gallons of 15% solution hydrochloric acid down-hole to eliminate the skin. A maximum injection rate was achieved, and ultimately the acid broke the formation skin and the injection rate was maintained at much lower surface injection pressures. After the acid job was complete, a normal operating pressure of 0 psi (a slight vacuum) was achieved and the fully operational well was then turned over to SUGS.

Phase IV - Ongoing Maintenance, Support, and Compliance:
Geolex's ongoing activities include annual mechanical integrity tests, notifying Regency of any upcoming deadlines, and currently overseeing monitoring and maintenance of Jal #3 AGI #001.

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