WGR RESOURCES ASSET HOLDING COMPANY, LLC
an Anadarko Petroleum Company
San Juan County, New Mexico

Pathfinder Acid Gas Injection Well #1

Western Gas Resources Asset Holding Company, LLC (WGR), a subsidiary of Anadarko Petroleum Company (Anadarko), contacted Geolex, Inc.® (Geolex) when their San Juan River Gas Plant was experiencing reduced efficiency due to their Sulfur Recovery Unit (SRU). The San Juan River Gas Plant receives natural gas from hundreds of different wells operated by multiple operators, primarily from the Aneth and Barker fields in the San Juan basin. The natural gas stream is treated in an amine sweetening unit to remove the acid gas; generating a treated acid gas (TAG) stream of approximately 90% carbon dioxide (CO_2), 10 % hydrogen sulfide (H_2S), and traces of C_1-C_7. Prior to the retention of Geolex, the TAG stream was directed to an SRU, where the H_2S was converted to elemental sulfur and water, using the Claus process, which was then disposed of or sold. The associated CO_2 was not treated in this process, and was vented to the atmosphere along with the water vapor generated. Because the first step of the Claus process involves oxidization of the H_2S to sulfur dioxide (SO_2), significant amounts of natural gas were included in the combustion process to counteract the extinguishing effect of the abundant CO_2. This fuel requirement greatly reduced the efficiency of the SRU, and limited the overall throughput of the plant. In addition, prices of elemental sulfur were below hauling costs, making the sulfur disposal an overhead cost. Geolex's feasibility study concluded that this was a viable site for an AGI well and WGR further retained Geolex to design and oversee drilling and completion of the Pathfinder AGI well #1. By replacing the SRU with the AGI well, WGR effectively sequesters 75-190 tons of carbon and from 6.5-16 tons of sulfur per day from the environment. Furthermore, the efficiency and capacity of the gas plant has increased since the installment of the AGI well, allowing San Juan Basin producers and the plant to increase their production, obtain higher cash flows and enhance tax revenues for the State of New Mexico.

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. 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. 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 WGR's C-108 application included work produced from the feasibility study and notifications to all operators, oil, gas and mineral lessees, and surface owners within the area. Geolex prepared the C-108 application, and prior to drilling the well, a comprehensive H_2S Contingency Plan (NMOCD Rule 11) was submitted and approved. The Contingency Plan addresses the plant operations, H_2S monitoring and control, and emergency response

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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activities that encompass both the plant and all other facilities and residents within one mile of the well.

Phase III - Well Design, Drilling and Completion Supervision:
Geolex was contracted by Anadarko to design, permit, and oversee drilling and completion of the Pathfinder AGI #1. Preliminary designs and an Authorization for Expenditure (AFE) were prepared by Anadarko. Upon approval of the AFE, a drilling company was retained to drill and complete the well. Due to the corrosive environment in which the well would be required to operate, special consideration had to be given to the metals used in its construction. The acid gas can impact wellheads, valves, packers, casing and tubing. Therefore, metallurgy requirements had to be incorporated into the wellhead design; including the tubing hanger. Corrosion resistant alloys (CRAs) were evaluated thoroughly prior to their selection for inclusion in the well design. The AGI system was designed to be safe and robust, and extensive reservoir testing was performed to characterize the injectivity of the formation at the Pathfinder AGI #1. Variable rate injection tests were performed, including two step-rate injection tests (SRTs) at the wellhead and injectivity tests on nearby saltwater disposable (SWD) wells of the desired formation. These tests concluded that the Pathfinder target was an acceptable formation and the SRTs confirmed these conclusions.

Phase IV - Ongoing Maintenance, Support, and Compliance:
Geolex's ongoing activities include annual mechanical integrity tests, notifying DCP of any upcoming deadlines, and currently overseeing monitoring and maintenance of Pathfinder AGI #1. Due to seasonal fluctuations, the annular pressure is constantly monitored by Gas Control Operations at the plant so that any pressure anomalies can be addressed immediately if the need arises. Tubing injection pressure and volume are monitored and archived for input into reservoir modeling software. Any changes in injection pressure are analyzed with regard to anticipated reservoir performance. The hydraulic pressures at the subsurface safety valve (SSSV) control panel are constantly monitored, and regular function tests for the SSSV are scheduled every 6 months to verify proper functioning of the sliding sleeve within the SSSV. Current State guidelines mandate a Mechanical Integrity Tests (MIT) of the annular space every two years. By having the annular pressures monitored constantly by Gas Control, regular MIT tests can be conducted in a routine manner.

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