Breaking Energy

COAL, GAS, TECHNOLOGY

Underground Coal Gasification Gets New Start in USA

By EDWARD DODGE
on November 06, 2014 at 12:03 PM

Linc Energy recently received a research & development license for Underground Coal Gasification (UCG), the first issued in the USA in twenty years. Linc Energy is moving ahead with a demonstration phase project in Wyoming's Powder River Basin, one of the country's most active coal mining regions.

In addition to the R&D license, the EPA and Wyoming Department of Environmental Quality (WDEQ) approved the final Aquifer Exemption permit on Sept. 8, 2014, that allows Linc to move forward in Wyoming. Multiple public comment periods were held where stakeholders and residents were able to address their concerns. The aquifer exemption permit is required anytime a process injects anything into an aquifer. Regulators will strictly monitor Linc's activities to ensure they remain in compliance.

Underground coal gasification has been tried by industry for decades without much success. The idea is simple enough, identify deep coal reserves that are not suitable for mining and then drill a pair of wells, one of which is used to inject air or oxygen and create a partial fire underground. The combustion is carefully controlled to enable gasification of the coal resources which creates synthesis gas that passes up the second well. Synthesis gas or syngas is a blend of carbon monoxide and hydrogen and is valuable as a fuel or feedstock. Though coal has long been known to burn underground, usually in problematic ways, the idea of harnessing the process for beneficial uses has been an industrial dream that has proven difficult to master.

Linc Energy has developed proprietary new technology that they believe will allow them to succeed where others have failed. Linc Energy is an Australian company formed in 1996 that has been primarily focused on UCG but also has holdings in unconventional oil and gas. They have successfully tested a series of small UCG projects in Australia, and have produced synthetic jet fuel from their UCG syngas. The current project in Wyoming is known as G6, because it is the company's sixth project.

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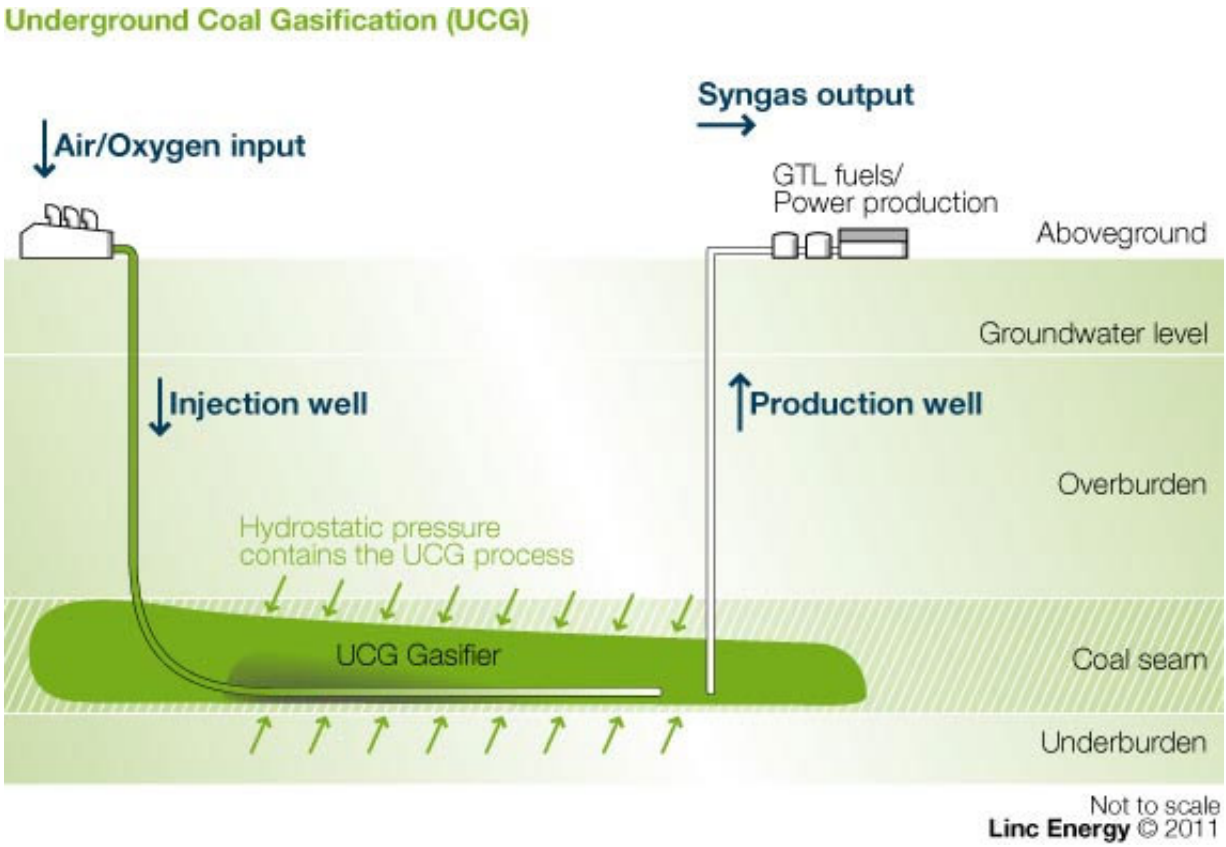

The key breakthrough in Linc Energy's UCG technology has been the use of horizontal directional drilling, similar to what is used to hydrofrack shale. Traditional UCG used simple vertical wells and it was always a steep challenge to both control the combustion and to maintain communication between the two wells for the effective flow of gas. By using directional horizontal drilling Linc can establish clear flow through between the two wells. Linc has also developed proprietary ignition,

injection and burner technology that enables them to carefully calibrate and tune the gasification process. This method also allows Linc to go after much deeper coal seems, making the process safer and opening up a wider variety of potential sites.

There are many potential benefits to underground coal gasification if it can be made to work effectively. UCG has a very small footprint on the ground, there is very little equipment required, and there is very little impact on the surface. Since there is no coal mine, there are no coal miners or dangerous underground work. Coal resources that were previously not economic can be utilized. No coal is stockpiled, there is no leaching, no dust, and no coal ash. The syngas product comes out of the ground cleaner than coal with low SOx, NOx, heavy metals and particulates and is easily scrubbed pure to natural gas standards. CO_2 is also readily captured from these gasification processes and Linc is actively seeking buyers for its CO_2 for use in enhanced oil recovery.

> One of Linc Energy's biggest breakthroughs also represents its greatest challenge, which is the use of water and potential aquifer impacts. One of the historical challenges of UCG has been that the fire could get out of control and burn unimpeded underground. Linc Energy has addressed this issue by using water both in the process and as a safety feature.

Linc Energy's gasification chamber operates at a lower pressure than the surrounding coal seam and non-potable water. The lower pressure in the gasification chamber induces water to come in which is then used in the process to create a water-shift reaction in the syngas production. Secondly, the water is a safety feature that prevents an underground fire from getting out of control. When operations are complete after months or years, an underground chamber has been created and water is allowed to fill the chamber up, the water is then extracted, filtered, and reinjected repeatedly until the process runs clean. The process of cleaning up the ground water inside the chamber is central to Linc Energy's decommissioning process for the site.

Linc Energy's G6 well site in Wyoming is the company's first in the USA and the culmination of many years of ongoing R&D work. The first five wells were all pilot projects in Australia that featured incremental growth in technology and complexity. G6 is located in the Powder River Basin and is designed to gasify the Wyodak coal seam at a depth of 1100' for 90-100 days while proving that there will be no subsidence at the surface, robust decommissioning procedures, and appropriate operations and monitoring. This well is still considered a demonstration project meant to prove the technology so they can move forward with full commercial operations.

Another critical goal of the G6 project has been public outreach and stakeholder management. UCG is a new technology and there were many concerns raised by landowners about potential effects on the groundwater. Groundwater will be monitored throughout the process using a series of water monitoring wells. WDEQ's responses to public comments when the permits were issued can be found here in which they discuss ground water monitoring and site decommissioning in detail.

Linc Energy has operations in many countries and plans to expand beyond the USA and Australia. They hold leases in Poland and are actively exploring areas for UCG. The company believes that Europe offers tremendous opportunity for UCG as there are extensive coal resources and far less natural gas making the market dynamics favorable. Linc Energy signed agreements in Ukraine in 2012, but in areas that are now a conflict zone so work has been put on hold, though the country offers excellent potential. Exploratory work is also going on in Tanzania, South Africa, Russia and Alaska.

Topics: Aqufier Exemption Permit, Coal Mining Regions, EPA, G6, Linc Energy, R&D License, Stakeholders, syngas, UCG Technology, WDEQ, Wyoming Powder River Basin