Partnership Results In Advanced Energy Solutions

Los Alamos National Laboratory

It's been the dream of researchers for years — to revolutionize the development of energy resources. Consider that in the last 125 years, according to Cambridge Energy Research Associates, the world has used one trillion barrels of oil and the demand keeps growing. In the next 30 years, another trillion barrels of oil are expected to be needed.

Availability of fuel is taken for granted by some, but not those who work in the energy industry. Los Alamos Industrial Fellow assigned to Chevron, Kevin Jakubenas says, "It takes an increasingly sophisticated technology to keep the lights on and our cars running."

The Alliance for Advanced Energy Solutions, a partnership between Chevron and Los Alamos National Laboratory, is working on innovative solutions.

"They are drawing on every area of expertise, from fundamental physics, chemistry and materials science to satellite engineering and earth and environmental sciences," says Jakubenas.

It takes an enormous amount of effort and money to fill up a car with gas. If you're filling up in the United States, approximately one in 10 gallons comes from the Gulf of Mexico, and it doesn't come easy.

"Reaching oil in the Gulf of Mexico requires a platform the size of a city block located more than 100 miles offshore," Jakubenas explains. "Up to two miles below that platform on the sea floor is a completely automated village in which the only business is moving oil to the surface. The oil itself starts as many as five miles below the village, locked away in an environment with such high pressure that rock can flow like taffy."

Cutting-Edge Science

Technology plays a significant part when the oil reaches the surface and is then sent through miles of pipeline to a refinery or a molecular factory where atoms are pulled apart and reassembled into products such as gasoline. In discussing the cost Jakubenas says, "These processes involve billions of dollars of cutting edge technology and thousands of highly trained engineers, technicians and scientists."

What happens when oil that is easy to access now becomes difficult to attain? Finding, recovering and processing the next trillion barrels in an efficient and environmentally responsible way is a formidable challenge.

> *Scientists unrelated to the oil industry are beginning to solve some of the oldest problems in the industry, including how to reduce the United States' reliance on foreign oil.*

The collaborative partnership has given Chevron the opportunity to work with Los Alamos scientists of widely different backgrounds. For example, a polymer chemist is using laser technology to prevent collapse of wells in the Gulf of Mexico while a space scientist is enabling breakthroughs in sensors miles underground, and a materials scientist's expertise is measuring complex flows in oil pipelines.

In 1987, the relationship began with Manuel Gonzalez, a senior drilling engineer in the oil and gas industry who is now co-manager of the Alliance. Gonzalez first encountered Los Alamos technology during his time in the U.S. Army.

"The Los Alamos technology I worked with in the military was impressively advanced, but more importantly it always worked when needed," recalls Gonzalez.

When he left the Army for the oil business, Gonzalez remembered is previous encounters with the innovative equipment from the scientists "on the hill" and how he had come to trust their ability to make advanced technology reliable. Subsequently, Gonzalez worked with Los Alamos technology both in an innovative oil well logging tool and in a company he started to track fraud in retail gasoline distribution.

Building Partnerships

In 2003, while working at Chevron, Gonzalez initiated conversations with Los Alamos' Technology Transfer Division on yet another technology, wireless communication. The technology, called Inficomm, implies "infinite communication."

It was the initial Alliance project and grew out of technology originally developed for military communications. Gonzales and Don Coates, a technical staff member in Los Alamos' Physics Division and an Intellectual Property Coordinator for Los Alamos' Technology Transfer Division, proposed to adapt Inficomm to allow down-hole wireless communication in oil and gas wells. Inficomm is expected to allow data rates up to a million times faster than conventional techniques without the need for any power source located in the well. This would enable the collection of real-time, broadband production data and revolutionize the way in which oil fields are managed, potentially allowing much more oil to be recovered from existing fields.

Los Alamos and Chevron realized the project was just one in which Los Alamos' technology could help Chevron face its growing challenges in extracting oil from increasingly difficult environments. They also recognized an opportunity to build a lasting relationship to meet long-term goals that would continually benefit the United States and possibly the world.

The Alliance for Advanced Energy Solutions was established in 2004 in order to coordinate efforts across multiple project areas. This formalized partnership is guided by an Alliance Agreement that states that the parties will collaborate to advance energy security and help Chevron and the entire oil industry deliver reliable, affordable, and environmentally sound energy. This is also a strategic goal of the Department of Energy.

Los Alamos has designated John Russell as its Alliance Coordinator to coordinate technical projects, agreements, and strategic planning. "The Alliance allows Los Alamos to apply world-class science to Chevron's greatest challenges that in turn helps Los Alamos advance these sciences further benefiting the Laboratory's mission in energy security," Russell says. Twice each year, the Los Alamos-Chevron Alliance Decision Review Board meets to discuss new and ongoing projects. The Board consists of Chevron and Los Alamos senior managers who set the strategic direction for the Alliance.

The structure of the Alliance provided the framework and eventually the contractual mechanism — an umbrella Cooperative Research and Development Agreement, or CRADA — to build effective relationships, select and manage projects, and to ensure early success.

The umbrella CRADA sets the overall contractual terms of interaction including protection of proprietary information and expectations for licensing of intellectual property. A separate Alliance Agreement has also helped build a bridge of trust and clear communication that is making the Alliance increasingly successful.

A second early project developed through the Alliance is trapped annular pressure mitigation, or TAP, used in deep water drilling. Trapped annular pressure is a problem in deep water drilling when hot oil from miles under the seafloor first flows in wells located in cold deep ocean water. The temperature differential can cause extremely high pressure that can collapse wells like a cheap soda straw. The elegant solution developed under the Alliance uses a new compound as an ingredient in the drilling mud. This compound is a monomer (small, simple molecules that chemically bond to other monomers to form polymers) liquid that combines to form a solid polymer upon exposure to heat. The monomer solution was first brainstormed in early 2005, and then was tested in the laboratory and scaled up and demonstrated in a test well within a year. When these monomers are present in the drilling fluid, they cause a reduction in volume that eliminates the pressure buildup.

Robert Hermes, lead scientist on the TAP project, says, "I've had this solution sitting on my desk for 25 years, but I didn't know it. I had never heard of the problem until Chevron came to Los Alamos."

Through a partnership with Baker-Hughes, a leader in oilfield services, Chevron and Los Alamos have been able to field test TAP. Chevron believes that the use of the Los Alamos TAP technology has the potential to prevent catastrophic failure in every one of their deep-sea wells — an insurance policy for billions of dollars in investment, much of it in the U.S. Gulf of Mexico where a single well may cost well over $100 million to drill. TAP is one of the technologies that may be commercially available to the oil and gas industry within the next two years. The Alliance has agreed that once tested and successful in working wells it will partner with outside companies to manufacture and market TAP for the rest of the industry.

Developing New Technologies

Los Alamos and Chevron also have a strong commitment to the environment and are studying methods for oil shale recovery that can be done with as little environmental impact as possible. The Alliance is also drawing on expertise at other national laboratories and universities. Through the Alliance, Los Alamos provides opportunities for Chevron to work with some of the most knowledgeable scientists in the world along with other research collaboration.

The Alliance is constantly trying to develop new technologies to solve the industries' toughest problems. One example is the development of oil shale in the western United States. The work includes reservoir simulation and modeling, as well as experimental validation of new recovery techniques. The project demonstrates Los Alamos' and Chevron's interests in basic research for unconventional fuels, in addition to applied problems facing the industry like trapped annular pressure.

The Los Alamos-Chevron Alliance is successful because it is built on the common goals of applying first-class science to problems of compelling need. The Alliance has established a strong structure to guide and organize the efforts while also allowing sufficient flexibility for the unexpected confluence of ideas that leads to true innovation.

The broad breadth of projects is an indication of the value of the Alliance to both parties. "We have 15 projects in place — Inficomm and TAP are current projects that address every aspect of the oil industry. Our projects are in advanced well performance, oil shale, deep water exploration and high efficiency separation processes," says Russell.

Chevron and Los Alamos continue to work together to identify new areas of potential collaboration in refining, equipment reliability and advanced geologic imaging. The Alliance expects to see these technologies advance into field trials and deployment within the next two years. Through commercialization, these projects not only help Chevron better provide energy but they are also consistent with the Department of Energy's mission of energy security.

There's no doubt about it. Future opportunities exist to develop technologies to enhance oil exploration, which improve efficiency, save money and reduce environmental impact. Together, Chevron and Los Alamos are championing the future.

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