

# Drilling Technology for National Security

Sandia National Laboratories

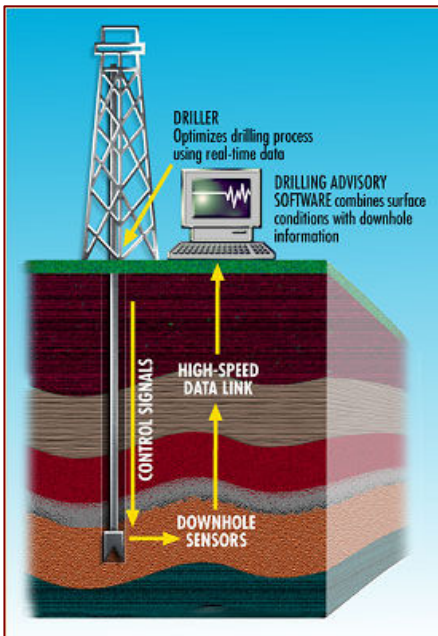


*Help our nation secure a peaceful and free world through technology.*

Sandia's work in drilling technology is aimed at reducing the cost and risk associated with drilling in harsh, subterranean environments. The historical focus of the drilling research has been directed at significantly expanding the nation's utilization of geothermal energy. This focus in geothermal related drilling research is the search for practical solutions to challenges associated with tapping the most intense sources of heat, typically found well below the earth's surface in very severe environments. Because a large portion of the cost and risk of generating electricity from geothermal sources is associated with drilling and completing exploration, production, and injection wells, **Sandia's primary focus has been on the development of improved drilling and completion technologies such as diagnostics while drilling, high-temperature electronics, advanced drill bit technologies, and wellbore integrity technologies** to reduce and mitigate problems associated with loss of circulation. We also actively work on advanced drilling concepts to provide economical access to deeper and hotter resources in the future. Most of these research projects are conducted in cooperation with geothermal operators and companies within the well service industry. On a cost-per-foot basis, geothermal drilling is among the most expensive type of drilling performed; and Sandia's work this area has created natural synergies that benefit other industries and agencies (e.g., Oil & Gas and DOD) requiring drilled access to the underground.

## Drilling Technology

Sandia's drilling program has traditionally focused on geothermal drilling, which is challenging because the formations are hot, hard, abrasive, corrosive and often fractured. Most of Sandia's geothermal technology also has application to oil and gas drilling. As a national laboratory, Sandia's drilling research plays a vital role in support of various defense programs vital to our national security. The major goals for this program are to reduce the cost of drilling and well construction by improving conventional drilling technology, and developing new and advanced drilling methods.



Diagnostics While Drilling Concept

## Technical challenges include:

- Develop drilling equipment designs and materials that can withstand temperatures greater than 600 degrees F, as well as drill through hard, abrasive rock.
- Build and commercialize high temperature / high pressure electronic instruments that can withstand extreme downhole environments. These instruments are directly applicable to drilling, logging and monitoring of geothermal and deep oil and gas wells with cross-cutting applications to other industries (e.g., aerospace and automotive).
- Develop drill bits that cut faster and last longer, thus reducing drilling time and saving money.
- Develop new drilling systems that reduce costs, improve safety, and avoid mishaps by showing the driller a real-time picture of what's happening downhole.
- Develop advanced, innovative, laboratory simulation capabilities that allow the drilling environment to be reproduced in the laboratory to support development, demonstration, and qualification of new downhole tools and drilling systems.
- Develop methods that sense, describe, and correct the problem of lost circulation, a situation in which the fluid necessary for the drilling process escapes into the surrounding rock.
- Develop technology that allows diagnosis of sub-surface environmental conditions.
- Develop drilling technology that allows rapid subterranean access in support of national security objectives.

Sandia's technology developments have been transferred to industry and various US agencies through intellectual property licensing, cooperative research and development agreements, and collaborative work arrangements.

Some examples of recent technology developments include:

- Advanced bit and cutter development
- High temperature component development
- Advanced telemetry systems
- Bit vibration mitigation technologies
- Drilling advisory software
- Computational modeling of reservoirs and geologic processes

### **Geothermal, Oil & Gas and Other Applications**

Reliable drilling technology is needed to ensure continued access to our natural resources resident in geothermal formations, oil and gas reservoirs, and mineral deposits.

Geothermal energy is an abundant energy resource that comes from tapping the natural heat of molten rock deep beneath the Earth's surface. Geothermal energy is a vast energy resource thousands of times greater than the world's oil reserves. This energy resource would last millennia at the current rate of consumption. It is an energy resource with relative low environmental impact that could be used to generate electricity, heat buildings, and drive industrial processes while emitting virtually no environmentally harmful gases.

Although these vast reservoirs of untapped energy offer enormous opportunity for clean, abundant power, the expense of actually drilling to them limits the market for such energy. The current geothermal electricity generation in the United States is limited to about 2800 megawatts, with 8000 megawatts worldwide. This is only the tiniest fraction of the energy that could be generated by tapping geothermal sources.



**The Geysers produce about 1500 megawatts of electricity, most of the power for San Francisco.**

Sandia investigates new drilling processes and tools that could make geothermal energy a practical and affordable energy source. More than 50% of a geothermal power plant's capital cost can come from drilling and completing the well.

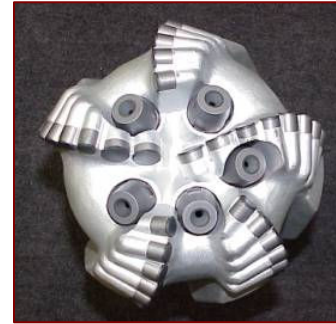
Reliable drilling technology is also vital to ensure access to our diminishing oil & gas reserves. These remaining hydrocarbons are often found in deep reservoirs with ever increasing downhole temperatures and pressures.

Many of the challenges in oil and gas drilling are similar to those encountered in geothermal well construction.



**Acoustic Telemetry Tool**

Sandia also supports a variety of non-energy related governmental programs requiring drilling research in support of other national security objectives. Through a strong application-oriented R&D approach, Sandia is uniquely qualified to apply drilling technology to these applications and develop new technologies to address the challenging problems necessary to ensure our national security.



**PDC Bit with Cavitating Nozzles**

### **The Bottom Line**

Drilling is expensive. The United States spends more than \$10 billion a year on oil and gas drilling. Technology development is vital to allow economic access to the subterranean environment to ensure the safety, security, and reliability of our national energy supply. Development of these technologies is vital to ensure our continued national security.

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