

Diamond-Cutter Drill Bits

Diamond-cutter drill bits cut through tough rock quicker, reducing the cost of drilling for energy resources

The U.S. Department of Energy (DOE) contributed markedly to the geothermal, oil, and gas industries through the development of the advanced polycrystalline diamond compact (PDC) drill bit. Introduced in the 1970s by General Electric Company (GE), the PDC bit uses thin, diamond layers bonded to tungsten carbide-cobalt studs or blades. The extreme resistance of diamond to abrasive wear makes it possible to use the shearing action of cutters for drilling. PDC bits are inherently more efficient than the crushing action of the roller-core bits.

In the 1980s, DOE's Geothermal Energy Program, working with the U.S. geothermal industry and Sandia National Laboratories, recognized the potential of PDC bits for the extremely hot, hard-rock environment usually associated with drilling for geothermal fluids. Sandia worked with GE, bit manufacturers, and geothermal operators to design and test PDC bits in hard-rock formations.

After several modifications, laboratory and field-testing demonstrated that PDC bits

Highlights

- **Advanced diamond bits are now used widely in other extractive industries although they were developed for geothermal energy.**
- **This DOE technology holds the drilling record for a single bit: 20,000 feet (6096 m).**
- **Geothermal R&D has spawned what is now a \$400 million industry in PDC products.**



NREL/PIX #00450

This geothermal drilling rig in Imperial Valley, California, uses the polycrystalline diamond compact (PDC) drill bit for hard-rock drilling.

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could effectively drill harder rock than had ever been drilled before. They cut faster and lasted longer than other bits, and a number of



NREL/PIX 05933

A diamond-cutter drill bit

companies sprang up to serve the rapidly growing demand for the new technology.

Further research by Sandia led to a better understanding of basic rock-cutting actions, allowing researchers to model the performance and wear of PDC bit designs. A computer code based on this model was released in 1986 and is still being used by bit companies.

Today, PDC bits account for more than one-third of the total footage drilled worldwide, with annual sales by U.S. manufacturers exceeding \$260 million. Over the useful lifetime of a bit, a single PDC bit will save more than \$100,000 compared to drilling with roller-core bits.

DOE and Sandia are again active in synthetic-diamond drill bit research and development, with a new goal of extending the technology into even harder and more abrasive rock formations. Seven companies have teamed with the lab on five projects, ranging from new PDC cutter and bit designs to thermally stable polycrystalline diamond and impregnated-diamond bit development.

Project Partners

U.S. Department of Energy

Sandia National Laboratories

General Electric Company

Dennis Tool Co.

Maurer Engineering, Inc.

Slimhole International, Inc.

Security DBS, Inc.

Hughes Christensen Company

For More Information:

Visit the Energy Efficiency and Renewable Energy Network (EREC)
Web site at: <http://www.eren.doe.gov>

DOE's Geothermal energy program
Web site at: www.eren.doe.gov/geothermal

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www.eren.doe.gov/consumerinfo/
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