

Millimeter Wave Drilling System

A combined approach

A hybrid drilling rig is at the heart of this ultra-deep drilling operation. It combines state-of-the-art rotary drilling with ground-breaking millimeter waves optimized for basement rock.

Powered by a gyrotron

A gyrotron produces high power millimeter waves, which are transmitted to the downhole environment with high efficiency via a single waveguide. No complex equipment below the ground.

Gyrotrons are well-established in fusion research and industrial heating applications. They represent the most compelling way to generate electromagnetic waves for rock destruction. They are many times more powerful than lasers in continuous wave operation, can transfer high power over long distances and into the rock with great efficiency, and possess a wavelength that allows the energy to penetrate through the downhole particulate clouds generated during the drilling process with minimal scattering.

And real-time remote diagnostics

Radiometry and spectroscopy enable a full suite of real-time measurements: well depth, rate of penetration, downhole temperature and particulate composition, all superimposed on the high energy millimeter beam and transferred through the same waveguide.

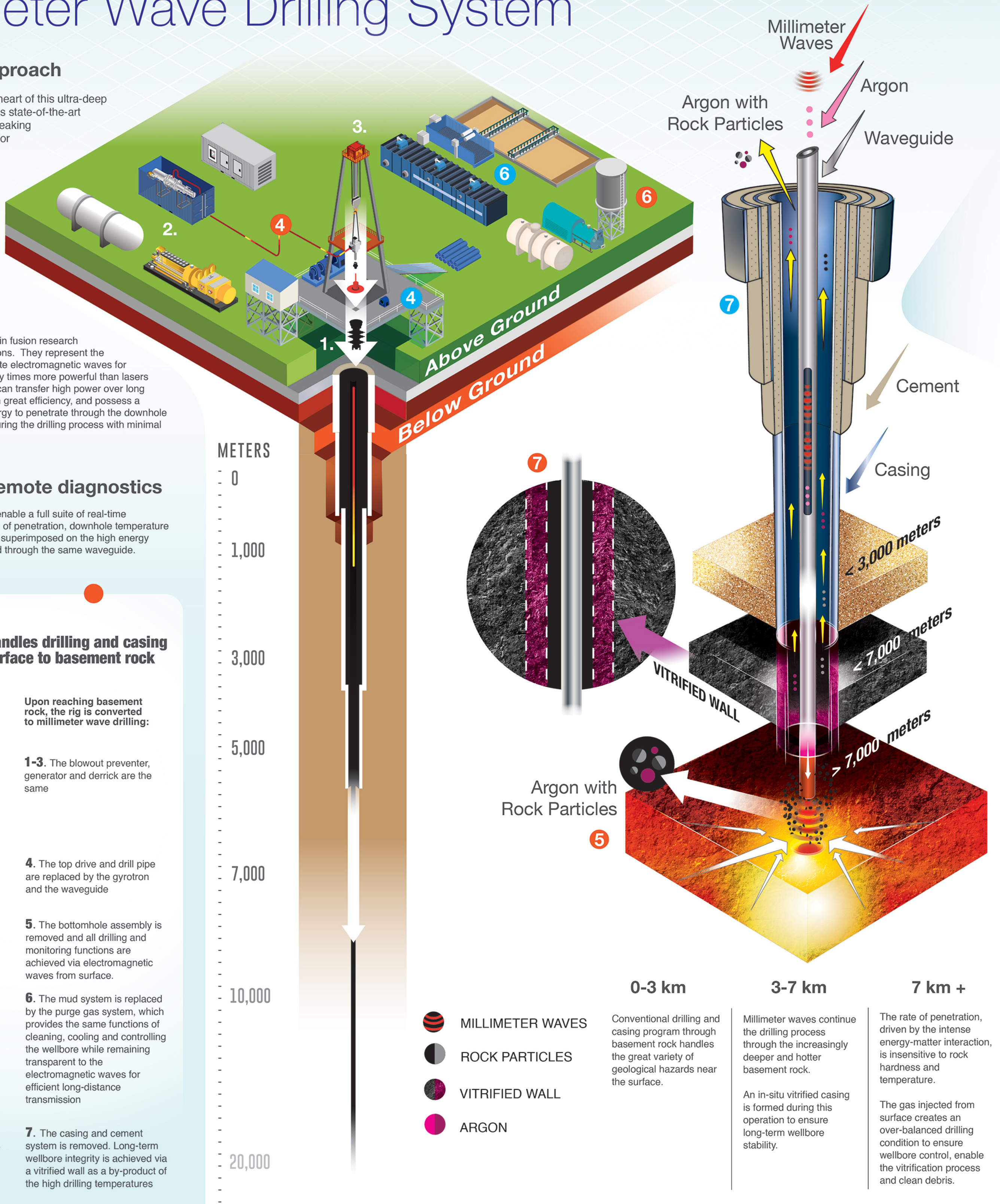
A conventional rig handles drilling and casing operations from surface to basement rock

Its main components include:

- 1. A blowout preventer to ensure safety
- 2. A generator to power all equipment
- 3. A derrick to handle all pipe movement
- 4. The top drive to rotate the drill pipe
- 5. The bottomhole assembly to drill the rock and monitor the process
- 6. The mud system to clean, cool and control the wellbore

Upon reaching basement rock, the rig is converted to millimeter wave drilling:

- 1-3. The blowout preventer, generator and derrick are the same
- 4. The top drive and drill pipe are replaced by the gyrotron and the waveguide
- 5. The bottomhole assembly is removed and all drilling and monitoring functions are achieved via electromagnetic waves from surface.
- 6. The mud system is replaced by the purge gas system, which provides the same functions of cleaning, cooling and controlling the wellbore while remaining transparent to the electromagnetic waves for efficient long-distance transmission
- 7. The casing and cement system is removed. Long-term wellbore integrity is achieved via a vitrified wall as a by-product of the high drilling temperatures



SUPERCritical GEOTHERMAL

Water is a supercritical fluid at pressures above 22 MPa and temperatures higher than 374 C. A power plant that uses supercritical water as the working fluid can extract up to **10 times more useful energy from each drop** when compared to non-supercritical plants. Aiming for supercritical conditions is key to attain power densities consistent with fossil fuels. A game changer for geothermal energy.

10-20 KILOMETERS To supercritical conditions everywhere

100 DAYS To depth

1 MEGAWATT Gyrotron

1,000 TONS Rig capacity

30,000

We all share a common ground

