



## THE DRIVING FORCE IN DEEP DRILLING.

Herrenknecht Vertical GmbH, a subsidiary of Herrenknecht AG, designs and manufactures deep drilling rigs and equipment for wells down to 6,000 meters. The innovative "Terra Invader" rigs are specifically adapted to customer and project requirements offering high technical standards based on offshore technology and a number of new developments. Central features comprise an optimized safety concept (hands-off technology) and flexible energy management, comprehensive automation of working processes to increase time savings as well as integrated noise protection devices to benefit our environment.



## EXPLORATION OF GEOTHERMAL ENERGY RESERVOIRS WITH DEEP DRILLING RIG TERRA INVADER 350 BOX-ON-BOX.

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The Terra Invader 350 prototype allowed to gain important project experience required for further optimizations.



Rig operator H. Anger's Söhne successfully drilled the two wells in Dürrenhaar.



## GEOTHERMAL ENERGY IN GERMANY.

The Bavarian molasse basin between the Alps and the Danube was location for operation of three deep drilling rigs from type Terra Invader 350 made by Herrenknecht Vertical. Overall, five deviated wells were drilled successfully up to depths of approx. 4,500m in this area. Herrenknecht Vertical delivered also one of the rigs for the Genesys project in Hanover. This German city was chosen because it has sediment formations that are typical for the North German Plain.

Close to urban areas near Munich and Hanover, the rigs distinguished themselves by calm and quiet operations with high availability rates under highest safety standards without any accidents.

### TECHNICAL DATA

#### TERRA INVADER 350

Max. hook load:	410mt (450sh) <sup>1</sup>
Hoist power:	1,600kW (2,200hp)
Top drive power:	800kW (1,000hp)
Max. tripping speed:	600m/h (1,970ft/h)
Max. drilling depth:	6,000m (19,700ft) <sup>2</sup>
Mud pumps:	3 units per 1,000kW (1,300hp)
Generators:	3 units per 1,540kVA

<sup>1</sup> hook load upgrade upon customer's request  
<sup>2</sup> depending on well sketch and casing scheme

## PROJECTS DÜRRNHAAR AND HANOVER.



Two wells have been drilled to depths of 4,393m and 4,530m in Dürrenhaar. Since cluster drilling is often required during geothermal projects, the deep drilling rig contains a skidding system which allows the operator to skid the core rig by up to ten meters. The same Terra Invader also finished a project in Hanover which will show that drilling just one bore hole is sufficient to gain enough geothermal heat to keep the BGR (Germany's Federal Institute for Geosciences and Resources) office building warm. The final depth of the well was 3,902m.

### PROJECT DATA

Location:	Dürrenhaar, Munich
Measured depth well 1:	4,393m
Measured depth well 2:	4,530m
Well diameter:	23" to 8 1/2"
Geology:	tertiary, malm
Employment:	geothermal power

Location:	Hanover
Measured depth:	3,902m
Well diameter:	23" to 8 1/2"
Geology:	chalkstone, jurassic, tertiary
Employment:	geothermal power

## PROJECT MAUERSTETTEN.



In Mauerstetten near Kaufbeuren, the prototype B-001 of the Herrenknecht Vertical Terra Invader 350 successfully drilled its first deviated well with a measured depth of 4,545m. The rig accomplished its mission and provided important project experiences which led into the high availability of the rig. During the drilling progress, the high-sensitive cylinder hoist system proved itself during fishing jobs which could be performed with maximum accuracy. Shock compensation during jarring operations is an additional advantage of the cylinder hoist system over traditional drawworks.

### PROJECT DATA

Location:	Mauerstetten, Kaufbeuren
Measured depth:	4,545m
Well diameter:	23" to 8 1/2"
Geology:	tertiary, malm
Employment:	geothermal power

## PROJECT KIRCHSTOCKACH.



The third-built Terra Invader 350, B-004, was used in a geothermal project in Kirchstockach. Herrenknecht Vertical engineers benefited from the project experience gained with the first two rigs, which helped improve several design features of the third TI-350. Close to urban areas, the rig safely drilled both wells to their final depth with high availability rates. The second well was finished in 4,452m after only 81 days.

### PROJECT DATA

Location:	Kirchstockach, Munich
Measured depth well 1:	4,214m
Measured depth well 2:	4,452m
Well diameter:	23" to 8 1/2"
Geology:	tertiary, malm
Employment:	geothermal power

