Cutting-Edge Pumping Solutions for the Geothermal Power Generation
The Sulzer Advantage

Taking on new challenges

Around the world, the power industry is taking on the challenge to produce clean, dependable energy from renewable resources. Combining its expertise in geothermal power and other renewable technologies with its experience in industrial power, Sulzer develops and tailors pumps and auxiliaries that meet the unique demands of geothermal power generation.

Understanding your process

• With years of experiences in the geothermal pumping solutions, Sulzer is a single-supplier with a comprehensive portfolio which fulfills all the needs of all major processes in a geothermal plant
• From a single pump to a total system solution, Sulzer works closely with customers to develop the most optimized solution
• Sulzer focuses on delivering efficient, total life cycle performance to enable customer to produce competitive geothermal power

Focused on efficiency

• Selecting the right pump is one key factor for boosting operational efficiency; Sulzer is the specialist to provide efficient pumping solutions
• Thanks to leading-edge products, Sulzer contributes to improve customers’ equipment efficiency

Improvement of environmental footprint

• Sulzer’s high-efficiency pumps and services contribute to reduce overall emissions
• Sulzer aims at maintaining the balance between economic success, social responsibility and environmentally friendly solutions in short- and long-term decision making
Dry steam geothermal plant

A dry steam plant has production wells that are drilled down to the geothermal reservoir. The superheated pressurized steam (180°C < T < 280°C) is brought to the surface at high speeds and passed through a steam turbine to generate electricity. The steam passes through a condenser and is converted into water. The condensate is then re-injected into the ground through wells. Sulzer supports these processes with Condensate Re-Injection pumps (CRIP), Cooling Water pumps (CWP) and auxiliary pumps.

\[
\text{G} = \text{Generator} \\
\text{ST} = \text{Steam Turbine} \\
\text{CWP} = \text{Cooling Water Pump}
\]
Flash steam geothermal plant

In a flash steam plant, hot and high-pressure water ($185^\circ C < T < 220^\circ C$) is converted into steam by flashing the extracted liquid through reduced pressure. The liquid is separated into steam and brine. This brine is pumped back down into the reservoir and the steam is sent to the turbine, which drives a generator. After passing through the turbine, the steam enters a condenser, is cooled to a liquid state and pumped back down into the reservoir. Sulzer supports these processes with Production pumps (PP), Brine Re-Injection pumps (BRIP), Condensate Re-Injection pumps (CRIP), Cooling Water pumps (CWP) and auxiliary pumps.
Binary cycle geothermal plant, organic Rankine or Kalina cycle

A binary cycle plant transfers heat from the hot geothermal fluid (105°C < T < 185°C) that is sent through a heat exchanger to vaporize a secondary working fluid such as pentane, iso-butane in the organic Rankine cycle, or ammonia in the Kalina cycle. The working fluid is then expanded in a turbine, condensed and reheated in a closed loop cycle. The brine is disposed of by re-injection into the ground. Sulzer supports these processes with Production pumps (PP), Brine Re-Injection pumps (BRIP), Hydrocarbon Feed pumps (HFP), Cooling Water pumps (CWP) and auxiliary pumps.

G = Generator  
CWP = Cooling Water Pump  
OT = Organic Turbine
Flash/binary cycle geothermal plant

A flash/binary cycle plant uses a combination of flash and binary technology. The portion of the geothermal fluid (185°C < T < 220°C) which “flashes” to steam under reduced pressure is first converted to electricity with a back-pressure steam turbine. The low-pressure steam exiting the back-pressure turbine is condensed in a binary system. Sulzer supports these processes with Production pumps (PP), Brine Re-Injection pumps (BRIP), Hydrocarbon Feed Pumps (HFP), Cooling Water pumps (CWP) and auxiliary pumps.
Enhanced geothermal system (EGS)

Enhanced Geothermal Systems (EGS) have an injection well (deeper than the ground water tables) drilled into hot bedrock that has limited permeability and fluid content. Water is injected at very high pressure usually by reciprocating pumps, to ensure fracturing and re-opening of existing fractures some distance from the injection wellbore. The production well, which intersects the stimulated fracture network, has water circulated to extract the heat from the hot rock. The temperature of the water extraction can be higher than in the natural geothermal fields, resulting in higher vaporization pressures and thermodynamic efficiencies. Depending on the production hot water temperature (T < 280°C), the EGS fields can be typically combined with binary cycle or flash steam power plants. Sulzer supports these processes with high pressure Brine Re-Injection pumps (BRIP), Condensate Re-Injection pumps (CRIP), Hydrocarbon Feed Pumps (HFP), Cooling Water pumps (CWP) and auxiliary pumps.
## Our Comprehensive Product Portfolio

<table>
<thead>
<tr>
<th>Power plant type</th>
<th>Application</th>
<th>Geothermal island</th>
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<tr>
<td></td>
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<td>Condensate Re-</td>
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<td>Injection Pump</td>
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<td>SJD (CEP)</td>
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<td>SJM</td>
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<td>MSD MSD HPcp</td>
<td>ZPP</td>
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<td>AHLSTAR</td>
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- **Dry steam geothermal plant**: ✓ ✓ ✓ ✓ ✓ ✓
- **Flash steam geothermal plant**: ✓ ✓ ✓ ✓ ✓ ✓
- **Binary cycle geothermal plant**: ✓ ✓ ✓ ✓ ✓ ✓
- **Flash/binary geothermal plant**: ✓ ✓ ✓ ✓ ✓ ✓
- **Enhanced geothermal system (EGS)**: ✓ ✓ ✓ ✓ ✓ ✓
Product Overview

Geothermal island

Production pump

SJT GEO PRODUCTION HOT WATER PUMP

FEATURES AND BENEFITS

• Increased flow for higher geothermal hot water production capacity of 13 3/8” wells
• Increased power transmission capability
• Increased temperature for high enthalpy geothermal resources
• Water lubricated bearings or oil recovery system to protect environment
• Up to 5.5” end-play axial float for shaft adaptation to shallow geothermal wells

KEY CHARACTERISTICS

| Capacities | Up to 680 m³/h / 3,000 USgpm |
| Heads      | Up to 700 m / 2,300 ft       |
| Pressures  | Up to 100 bar / 1,450 psi    |
| Temperatures | Up to 220°C / 428°F         |

APPLICATIONS

• Production hot water for geothermal power plants

Condensate re-injection pumps

SJD (CEP) VERTICAL CAN MOUNTED TURBINE TYPE PUMP

KEY CUSTOMER BENEFITS

• Ideal for applications when Net Positive Suction Head Available (NPSHA) is limited

KEY CHARACTERISTICS

| Capacities | Up to 4,900 m³/h / 21,560 USgpm |
| Heads      | Up to 400 m / 1,300 ft          |
| Pressures  | Up to 94 bar / 1,360 psi        |
| Temperatures | Up to 100°C / 212°F            |

APPLICATIONS

• High pressure condensate extraction

ZE END SUCTION PUMP

FEATURES AND BENEFITS

• Designed for hot or cold water medium design pressure applications with relatively low Net Positive Suction Head (NPSH) available
• Modular construction to provide maximum interchangeability of spares

KEY CHARACTERISTICS

| Capacities | Up to 2,600 m³/h / 11,440 USgpm |
| Heads      | Up to 300 m / 1,000 ft          |
| Pressures  | Up to 100 bar / 1,450 psi       |
| Temperatures | Up to 100°C / 212°F            |

APPLICATIONS

• Condensate extraction for industrial, biomass and concentrated solar power
• Feedwater booster for combined-cycle and thermal power plants
• Heat transfer fluid oil for concentrated solar power
• Auxiliary services
Brine re-injection pumps

**OHH OVERHUNG SINGLE STAGE PUMP ISO 13709 / API 610 OH2**

**FEATURES AND BENEFITS**
- Finned bearing housing and fan cooling for long bearing life
- Broadest range map in the industry for ISO 13709 (API 610) type OH2 pumps
- Heavy duty baseplates with 2x ISO 13709 (API 610) nozzle load option
- ISO 21049 (API 682) cartridge type mechanical seals for reduced emissions
- Electric motor, Variable Frequency Drive (VFD), engine and steam turbine drivers

**KEY CHARACTERISTICS**
- Capacities: Up to 2,250 m³/h / 10,000 USgpm
- Heads: Up to 400 m / 1,300 ft
- Pressures: Up to 75 bar / 1,110 psi
- Temperatures: Up to 425°C / 800°F

**APPLICATIONS**
- Heat transfer fluid oil circulation for concentrated solar power

**MBN MEDIUM PRESSURE STAGE CASING PUMP**

**FEATURES AND BENEFITS**
- Centerline support for reduced thermally induced misalignment
- Double suction impeller for low low Net Positive Suction Head Required (NPSHR)
- First critical speed is well above operating speed range for smooth operation
- Casing designed for 2x API 610 nozzle loads for freedom from piping distortions
- Grouted or ungrouted, 1x or 2x nozzle load baseplates for reduced installation cost

**KEY CHARACTERISTICS**
- Capacities: Up to 5,000 m³/h / 22,000 USgpm
- Heads: Up to 450 m / 1,500 ft
- Pressures: Up to 50 bar / 740 psi
- Temperatures: Up to 425°C / 800°F

**APPLICATIONS**
- Crude oil shipping
- Various refinery and petrochemical services
- Heat transfer fluid oil circulation

**BBS BETWEEN BEARINGS SINGLE STAGE PUMP ISO 13709 / API 610 BB2**

**FEATURES AND BENEFITS**
- Simple construction to minimize dimensions and reduce investment and maintenance costs
- High quality investment cast impellers and diffusers for better efficiency
- Fast and easy impeller mounting
- Bearing unit can be serviced without disassembling the pump
- Wide range of materials including duplex stainless steel grades

**KEY CHARACTERISTICS**
- Capacities: Up to 700 m³/h / 3,080 USgpm
- Heads: Up to 900 m / 2,950 ft
- Pressures: Up to 100 bar / 1,450 psi
- Temperatures: Up to 180°C / 355°F

**APPLICATIONS**
- Feedwater for industrial and biomass power plants
- Condensate extraction for industrial and biomass power plants
- Auxiliary services
MC HIGH PRESSURE STAGE CASING PUMP

FEATURES AND BENEFITS

- Modular hydraulics for high efficiency in a wide range of operating conditions
- Large branch sizes for optimized inlet flow, low noise level and higher allowable forces and moments
- Unaffected by rapid temperature variations
- Easy access for cleaning to the seal cooling chambers
- Stiff shaft design for critical speeds above the maximum operating speed

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<td>Up to 1,750 m / 5,500 ft</td>
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<td>Pressures</td>
<td>Up to 180 bar / 2,610 psi</td>
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<td>Temperatures</td>
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</tbody>
</table>

APPLICATIONS

- Feedwater for industrial, biomass, concentrated solar power and combined-cycle power plants
- Fuel injection and NOx abatement in open- and combined-cycle power plants

MSD AND MSD2 AXIALLY SPLIT MULTISTAGE PUMPS BB3

FEATURES AND BENEFITS

- Broadest hydraulic coverage of any BB3 type multistage pump in the market
- Axially split casing means rotor balance is not disturbed when rotor is installed
- Opposed impellers balance axial thrust, saving lube system costs on most applications
- Double suction, first-stage available on most sizes for reduced Net Positive Suction Head (NPSH)

KEY CHARACTERISTICS

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<th>Capacities</th>
<th>Up to 3,200 m³/h / 14,000 USgpm</th>
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<tbody>
<tr>
<td>Heads</td>
<td>Up to 2,900 m / 9,500 ft</td>
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<tr>
<td>Pressures</td>
<td>Up to 300 bar / 4,400 psi</td>
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<td>Temperatures</td>
<td>Up to 200°C / 400°F</td>
</tr>
</tbody>
</table>

APPLICATIONS

- Feedwater for industrial, biomass, concentrated solar power and combined-cycle power plants
- Safety related services for nuclear power plants

HPcp DIFFUSER STYLE HIGH ENERGY PUMP ISO 13709 / API 610 BB5

KEY CUSTOMER BENEFITS

- Inline or back-to-back rotor stack designs for rotodynamic stability
- Forged Carbon steel, Duplex SS, HIP’s and overlaid barrel construction
- Twistlock or bolted barrel closure with Superbolts™
- Sleeve, pocketed, or tilt pad bearings
- Grouted, ungrouted and offshore 3- or 4-point support baseplates

KEY CHARACTERISTICS

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<tr>
<th>Capacities</th>
<th>Up to 4,000 m³/h / 20,000 USgpm</th>
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<tbody>
<tr>
<td>Heads</td>
<td>Up to 8,000 m / 26,300 ft</td>
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<tr>
<td>Pressures</td>
<td>Up to 1,100 bar / 16,000 psi</td>
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<td>Temperatures</td>
<td>Up to 200°C / 400°F</td>
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</tbody>
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APPLICATIONS

- Water injection
- Offshore crude oil shipping
- Remote pipeline services
FEATURES AND BENEFITS

- Can be built as VS 1 construction
- Reduced number of stages results in shorter, more reliable pumps
- Double suction on larger sizes can reduce pump length
- High efficiency with reduced power consumption
- Modular construction to fit project nozzle location requirements
- High head per stage means process conditions can be reached with slower speeds

KEY CHARACTERISTICS

| Capacities | Up to 3,800 m³/h / 20,000 USgpm |
| Heads      | Up to 700 m / 3,000 ft          |
| Pressures  | Up to 75 bar / 1,100 psi        |
| Temperatures | Up to 205°C / 400°F          |

APPLICATIONS

- Shipping of liquefied petroleum gas (LPG)
- Crude oil pipeline booster
- Debutanizer/depropanizer services in cryogenic gas plants

Power island

Cooling water pumps

SJT VERTICAL PUMP

FEATURES AND BENEFITS

- Optimized hydraulics for high efficiency
- Packed stuffing box for reliable sealing and simple maintenance; mechanical seal is optional
- Rubber-lined product-lubricated bearing in bowls and columns for long maintenance-free periods; other bearing materials are also available

KEY CHARACTERISTICS

| Capacities | up to 62,000 m³/h / 270,000 USgpm |
| Heads      | up to 110 m per stage / 350 ft per stage |
| Pressures  | up to 64 bar / 930 psi |
| Temperatures | up to 50°C / 120°F |

APPLICATIONS

- Cooling water
- Nuclear safety services
- Auxiliary services
- Water intake and irrigation

Hydrocarbon feed pump

SJD-API VERTICAL CAN MOUNTED TURBINE TYPE PUMP

FEATURES AND BENEFITS

- Can be built as VS 1 construction
- Reduced number of stages results in shorter, more reliable pumps
- Double suction on larger sizes can reduce pump length
- High efficiency with reduced power consumption
- Modular construction to fit project nozzle location requirements
- High head per stage means process conditions can be reached with slower speeds

KEY CHARACTERISTICS

| Capacities | Up to 58,000 m³/h / 250,000 USgpm |
| Heads      | up to 30 m per stage / 100 ft per stage |
| Pressures  | up to 18 bar / 260 psi |
| Temperatures | up to 50°C / 120°F |

APPLICATIONS

- Cooling water
- Nuclear safety services
- Auxiliary services
- Water intake and irrigation

SJM VERTICAL PUMP

FEATURES AND BENEFITS

- Optimized hydraulics for high efficiency
- Packed stuffing box for reliable sealing and simple maintenance; mechanical seal is optional
- Rubber-lined product-lubricated bearing in bowls and columns for long maintenance-free periods; other bearing materials are also available

KEY CHARACTERISTICS

| Capacities | up to 58,000 m³/h / 250,000 USgpm |
| Heads      | up to 30 m per stage / 100 ft per stage |
| Pressures  | up to 18 bar / 260 psi |
| Temperatures | up to 50°C / 120°F |

APPLICATIONS

- Cooling water
- Nuclear safety services
- Auxiliary services
- Water intake and irrigation
APPLICATIONS

• Cooling water pumps
• Auxiliary services

KEY CUSTOMER BENEFITS

• Exceeds requirements of international ISO 5199 standard
• Unique, patented and superior design features minimize life cycle costs
• Quick and easy installation, reliable operation, easy maintenance and service

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<td>Up to 16 bar / 230 psi</td>
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<td>Temperatures</td>
<td>Up to 120 °C / 250 °F</td>
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APPLICATIONS

• Cooling water pumps
• Auxiliary services

ZPP DOUBLE SUCTION AXIALLY SPLIT SINGLE STAGE PUMP

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<td>Heads</td>
<td>Up to 260 m / 850 ft</td>
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<tr>
<td>Pressures</td>
<td>Up to 34 bar / 490 psi</td>
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<td>Up to 140°C / 280°F</td>
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</tbody>
</table>

APPLICATIONS

• Water intake, transport and supply
• Desalination
• Water treatment
• District heating and cooling
• Industrial water applications

SMD AXIALLY SPLIT CASING DOUBLE SUCTION PUMP

FEATURES AND BENEFITS

• Optimum hydraulic fit with high efficiency maintained over a wider flow range
• Exceptionally low Net Positive Suction Head Required (NPSHR) value not only at the best efficiency point but also on overload
• Maintenance-friendly features; excellent interchangeability of parts
• Horizontal and vertical constructions

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<th>Capacities</th>
<th>Up to 10,000 m³/h / 44,000 USgpm</th>
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• Water intake, transport and supply
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SMN AXIALLY SPLIT CASING DOUBLE SUCTION PUMP BB1

FEATURES AND BENEFITS

• Broad hydraulic coverage through over 50 different sizes
• High efficiency
• Robust design for long service life
• Easy maintenance
• Flexible layout enabled by clockwise and counterclockwise rotation / vertical and horizontal arrangements

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APPLICATIONS

• Water intake, transport and supply
• Desalination
• Water treatment
• District heating and cooling
• Industrial water applications

SMD AXIALLY SPLIT CASING DOUBLE SUCTION PUMP

FEATURES AND BENEFITS

• Optimum hydraulic fit with high efficiency maintained over a wider flow range
• Exceptionally low Net Positive Suction Head Required (NPSHR) value not only at the best efficiency point but also on overload
• Maintenance-friendly features; excellent interchangeability of parts
• Horizontal and vertical constructions

KEY CHARACTERISTICS

<table>
<thead>
<tr>
<th>Capacities</th>
<th>Up to 10,000 m³/h / 44,000 USgpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heads</td>
<td>Up to 200 m / 650 ft</td>
</tr>
<tr>
<td>Pressures</td>
<td>Up to 30 bar / 435 psi</td>
</tr>
<tr>
<td>Temperatures</td>
<td>Up to 50°C / 120°F</td>
</tr>
</tbody>
</table>

APPLICATIONS

• Water intake, transport and supply
• Desalination
• Water treatment
• District heating and cooling
• Industrial water applications

ZPP DOUBLE SUCTION AXIALLY SPLIT SINGLE STAGE PUMP

FEATURES AND BENEFITS

• Exceeds requirements of international ISO 5199 standard
• Unique, patented and superior design features minimize life cycle costs
• Quick and easy installation, reliable operation, easy maintenance and service

KEY CHARACTERISTICS

<table>
<thead>
<tr>
<th>Capacities</th>
<th>Up to 25,000 m³/h / 130,000 USgpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heads</td>
<td>Up to 160 m / 525 ft</td>
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<tr>
<td>Pressures</td>
<td>Up to 16 bar / 230 psi</td>
</tr>
<tr>
<td>Temperatures</td>
<td>Up to 120 °C / 250 °F</td>
</tr>
</tbody>
</table>

APPLICATIONS

• Cooling water pumps
• Auxiliary services
Auxiliary pump

AHLSTAR END SUCTION SINGLE STAGE LONG COUPLED CENTRIFUGAL PUMP

KEY CUSTOMER BENEFITS

- Exceeds standard requirements of international ISO 5199 and ISO 2858 standards
- Suitable for the most demanding industrial applications
- Unique, patented and superior design features minimize life cycle costs
- Quick and easy installation, reliable operation, easy maintenance and service

KEY CHARACTERISTICS

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
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</thead>
<tbody>
<tr>
<td>Capacities</td>
<td>Up to 11,000 m³/h / 48,400 USgpm</td>
</tr>
<tr>
<td>Heads</td>
<td>Up to 160 m / 525 ft</td>
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<tr>
<td>Pressures</td>
<td>Up to 16-25 bar / 230-360 psi</td>
</tr>
<tr>
<td>Temperatures</td>
<td>Up to 180°C / 355°F</td>
</tr>
</tbody>
</table>

APPLICATIONS

- Cooling water pumps
- Auxiliary services
For more information, please contact power@sulzer.com

www.sulzer.com