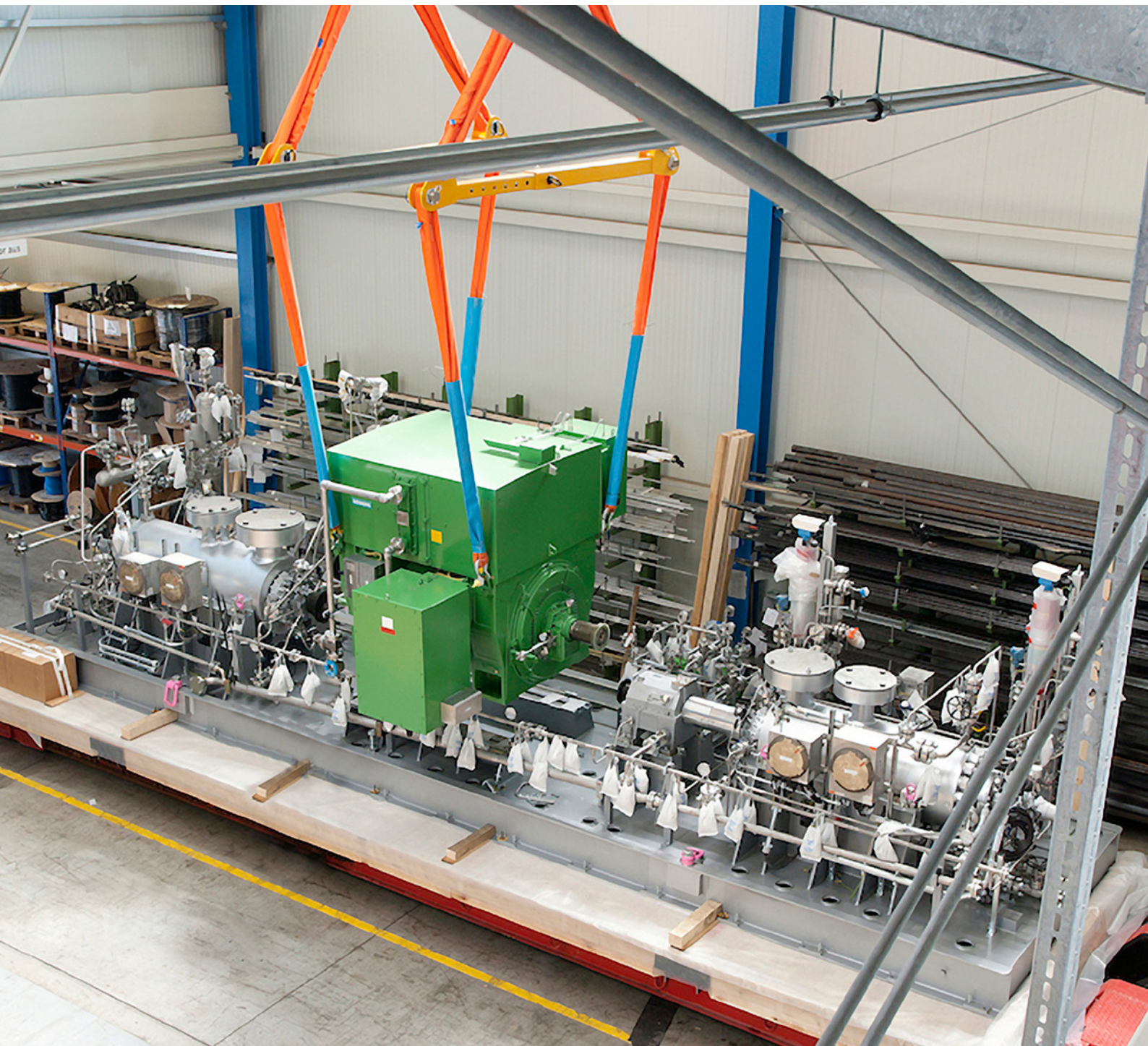


Your Partner for Hydraulic Power Recovery



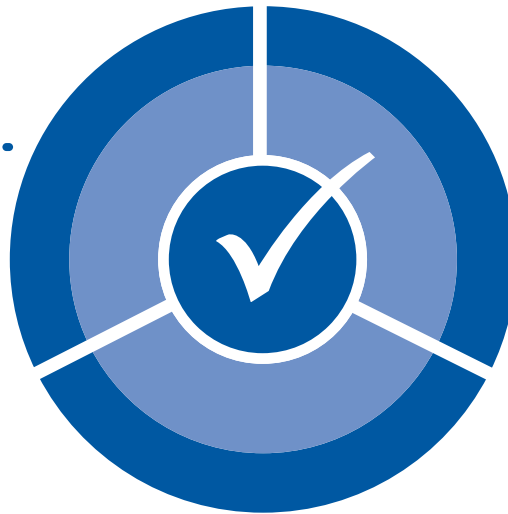
The Sulzer Advantage

Taking on Your Challenges

Sulzer has years of experience applying reverse running pumps as power recovery turbines. Hundreds of Sulzer Hydraulic Power Recovery Turbines (HPRTs) are installed in refining hydrotreaters, gas processing and nitrogenous fertilizer plants - around the world.

Expertise

- In several industrial processes, a fluid under high pressure must be throttled to suit subsequent process steps. Typically, conventional pressure reducing valves are used to dissipate, and consequently waste this hydraulic energy.
- Hydraulic Power Recovery Turbines (HPRTs) can convert the excess pressure into mechanical shaft energy and increase the overall process efficiency. However, saving energy is not only an economic aspect; a careful use of resources is also an important contribution to environmental protection.



Applications

HPRTs can be found in the following applications:

- Capture 800 kW to 1.6 MW of energy in fertilizer plants
- Capture 800 kW in power recovery in refining hydrotreaters
- Capture 600 kW in gas processing plants

The Right Product

- Hydraulic turbines come in various shapes and sizes. For higher flows common in process streams, centrifugal pumps in reverse rotation are efficiently used as HPRTs. For high flows and lower pressure differential, mixed flow, or axial flow (propeller) type vertical pumps may be used as HPRTs
- Sulzer has the right products to support your pumping and HPRT needs

Whatever the Process, We Have the Pumping Solutions

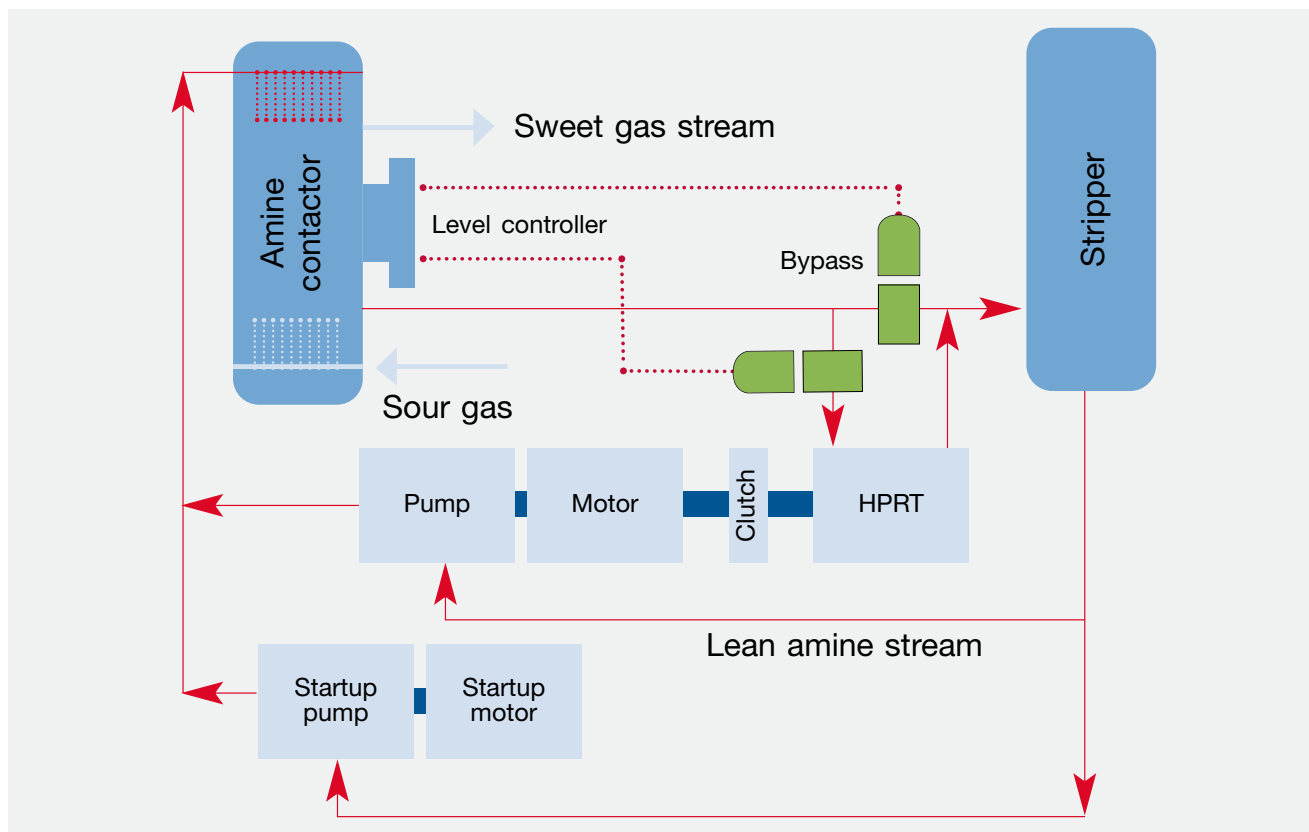
You set out the challenge, we present the solutions.

The HPRT may be used to drive a pump, generator, compressor or other rotating machinery. Speed is governed by the inlet control valve, motor or generator and the electrical grid frequency. If required, a one-way clutch between a motor and the HPRT prevents the HPRT from robbing power from the train under low flow startup conditions. Due to high gas volume fraction carryover, experience strongly indicates that conservative speeds are prudent on Pump-Motor-HPRT trains in fertilizer plants.

Typical Hydraulic Turbine Installations

Split range liquid level controllers are typically used to regulate turbines. The controller adjusts the HPRT inlet valve or further open the bypass valve when the turbine is overpowered.

Overspeed trip devices are often furnished with hydraulic turbines. This device shuts the HPRT inlet valve and activates overspeed alarms when required.



A gas-scrubbing HPRT application can recover more than 2 MW

Pump and HPRT Products

BB1

HSB HORIZONTAL AXIALLY SPLIT SINGLE STAGE BETWEEN BEARING PUMP ISO 13709 / API 610 BB1

KEY CUSTOMER BENEFITS

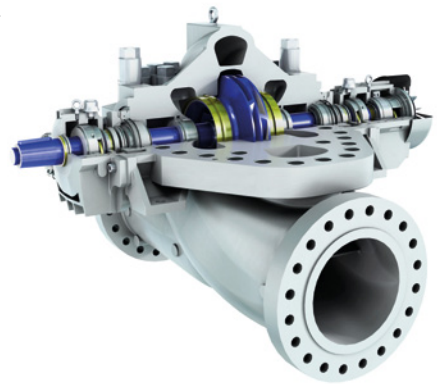
When run backwards and reconfigured as an HPRT, the HT-HSB or HST is a economical solution to a pressure reducing application. They are one of the world's most popular nitrogenous fertilizer plant HPRTs.

KEY CHARACTERISTICS

Capacities	Up to 10,00 m ³ /h / 45,000 USgpm
Heads	Up to 550 m / 1,800 ft
Pressures	Up to 150 bar / 2,200 psi
Temperatures	Up to 205°C / 400°F

APPLICATIONS

- Crude oil pipelines
- Heavy duty auxiliary applications
- Fertilizer HPRTs



BB2

BBS, CD AND HZB RADIALLY SPLIT SINGLE STAGE PUMPS ISO 13709 / API 610 BB2

KEY CUSTOMER BENEFITS

BBS radially split, 1 and 2 stage pumps are primarily used in process applications in refineries and petrochemical plants. The BBS double suction impeller is particularly suited to low Net Positive Suction Head Available (NPSHA) applications. Like the HSB above, they can be utilized to capture energy as an HPRT.

KEY CHARACTERISTICS

Capacities	Up to 4,200 m ³ /h / 22,000 USgpm
Heads	Up to 350 m / 1,500 ft
Pressures	Up to 51 bar / 740 psi
Temperatures	Up to 425°C / 800°F

APPLICATIONS

- Booster as well as high speed crude shipping services
- Sulfate removal
- Process HPRT



BBT/BBT-D AND CD 2-STAGE RADially SPLIT PUMPS ISO 13709 / API 610 BB2

KEY CUSTOMER BENEFITS

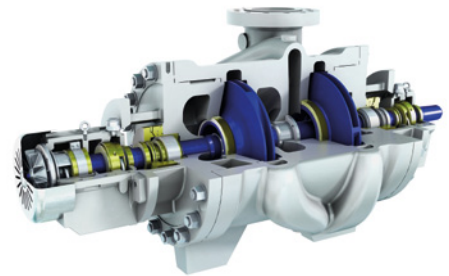
BBT/BBT-D 1 and 2 stage pumps are primarily used in process applications in refineries and petrochemical plants. The BBT-D double suction impeller is particularly suited to low NPSHA applications. Both the BBT and BBT-D may be utilized as HPRTs.

KEY CHARACTERISTICS

Capacities	Up to 2,300 m ³ /h / 10,000 USgpm
Heads	Up to 760 m / 2,500 ft
Pressures	Up to 100 bar / 1,440 psi
Temperatures	Up to 425°C / 800°F

APPLICATIONS

- Seawater and crude oil boosting applications
- Process HPRT



BB3

MSD, MSD2 AND MSD-RO AXIALLY SPLIT MULTISTAGE PUMPS ISO 13709 / API 610 BB3

KEY CUSTOMER BENEFITS

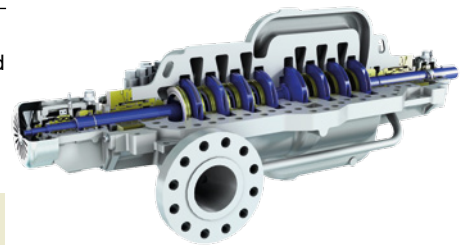
MSD/MSD2/MSD-RO are double volute opposed impeller pumps used in refinery charge, high pressure Reverse Osmosis (RO), Liquefied Petroleum Gas (LPG) and refined product pipelines. Over 10,000 are installed. Some are used as HPRTs in amine units and hydrotreaters.

KEY CHARACTERISTICS

Capacities	Up to 3,200 m ³ /h / 14,000 USgpm
Heads	Up to 2,900 m / 9,500 ft
Pressures	Up to 300 bar / 4,400 psi
Temperatures	Up to 200°C / 400°F

APPLICATIONS

- Pipelines
- Water injection
- CO₂ pipeline and injection
- HPRTs



BB5

CP HORIZONTAL RADIALLY SPLIT MULTISTAGE BARREL PUMP ISO 13709 / API 610 BB5

KEY CUSTOMER BENEFITS

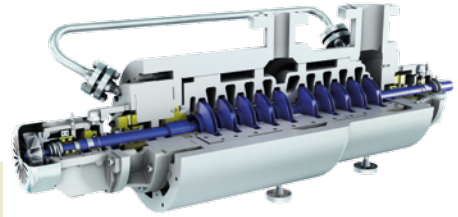
CP volute style pumps are used in both oil production and high temperature refinery applications. They are particularly suited to low specific gravity applications where the back-to-back design and center bush provide natural axial balance and additional shaft support. They also make excellent HPRTs for high pressure letdown services.

KEY CHARACTERISTICS

Capacities	Up to 1,000 m ³ /h / 4,400 USgpm
Heads	Up to 7,000 m / 23,000 ft
Pressures	Up to 425 bar / 6,250 psi
Temperatures	Up to 425°C / 800°F

APPLICATIONS

- High pressure oil transport
- Onshore water injection
- Offshore crude oil shipping
- Process HPRTs



GSG DIFFUSER STYLE BARREL PUMP ISO 13709 / API 610 BB5

KEY CUSTOMER BENEFITS

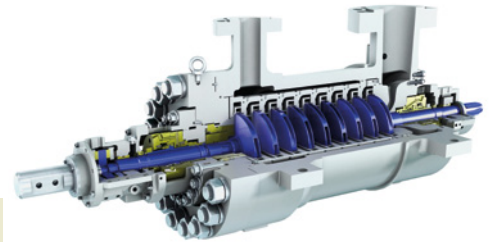
GSG radially split pumps are used in oil production, refining and boiler feed applications. They are available in both inline and back-to-back rotor configurations. The GSG back-to-back pumps make excellent HPRTs for high pressure letdown process applications.

KEY CHARACTERISTICS

Capacities	Up to 900 m ³ /h / 4,600 USgpm
Heads	Up to 2,600 m / 10,000 ft
Pressures	Up to 300 bar / 4,500 psi
Temperatures	Up to 425°C / 800°F

APPLICATIONS

- Onshore or offshore water injection
- Offshore crude oil shipping
- Process HPRTs



VS

SJD VERTICALLY SUSPENDED PROCESS PUMP ISO 13709 / API 610 VS6

KEY CUSTOMER BENEFITS

SJD (API) process pumps are specified wherever limited NPSH is available, either due to system constraints or liquids operating near their vapor pressure. Typical applications include liquefied petroleum gas booster and cryogenics. They can be used as HPRTs as well.

KEY CHARACTERISTICS

Capacities	Up to 3,800 m ³ /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



References

Hydrotreater Charge Pump with the HPRT (China)

CHALLENGES

A separate booster pump is installed on the pump skid to increase the pressure of the available quench oil for Plan 32 from 12 bar to 40 bar. Due to safety concerns, mechanical seals and seal system static pressure designed to pump and HPRT Maximum Allowable Working Pressure (MAWP) and Maximum Allowable Working Temperature (MAWT).

SOLUTION

HPRT train: pump with API 682 plans 23 & 52, double extended shaft motor, over-running clutch, and HPRT with plans 32 and 53C. API 614 lube system supplies entire train.

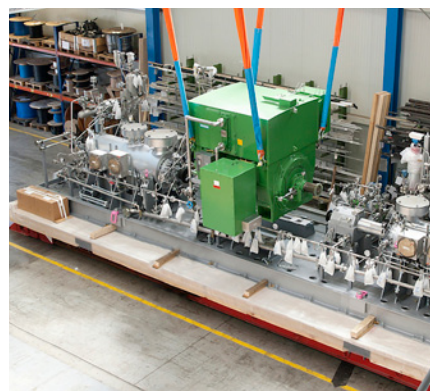
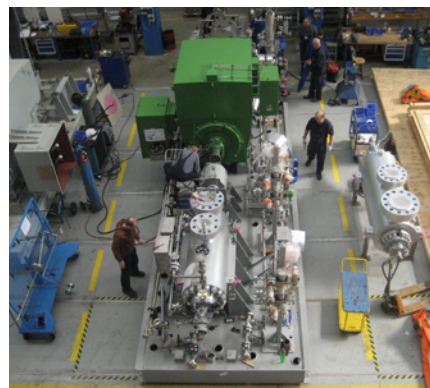
PRODUCTS

Pump GSG 150-360/6+6, MAWP 260 bar
MAWT 318°C
HPRT GSG 100-300/6+6, MAWP 176 bar
MAWT 400°C

CUSTOMER BENEFITS

- HPRT converts pressure into 631 KW shaft power and increases the overall process efficiency

Pump/motor/HPRT skid is nearly 12 m long x 3 m wide and weighs nearly 40 tonnes



MSD-D 3 Stage Double Suction Pump with a HT-HSB Single Stage HPRT (USA)

CHALLENGES

CO₂ flashes out of solution as pressure is reduced through HPRT, and when excited through pump. Resulting shock loads can increase maintenance costs.

SOLUTION

Select seal system to isolate seal faces from CO₂. Use heavy duty shaft for rotor rigidity. Select larger pump and HPRT at reduced speed.

PRODUCTS

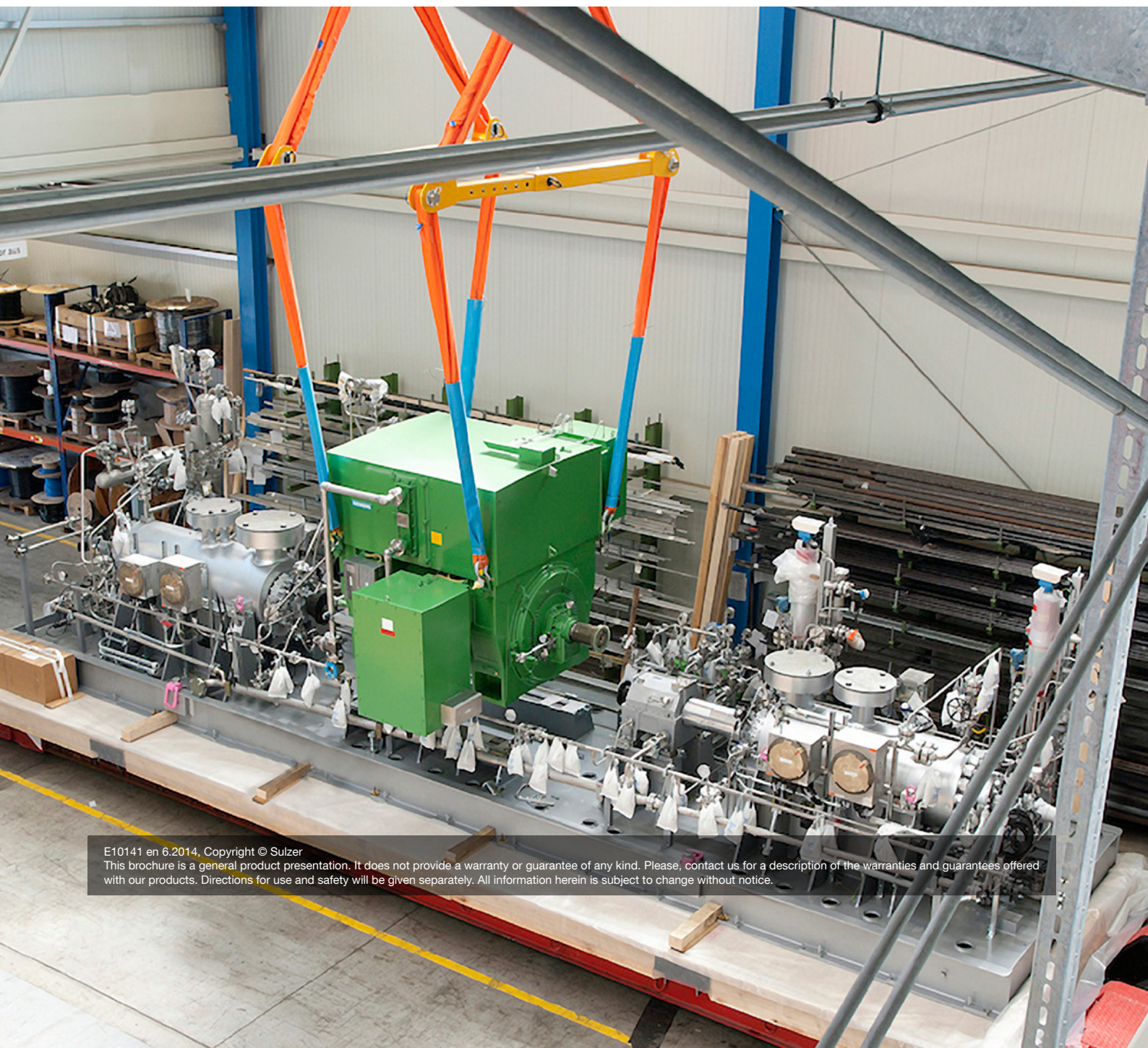
Pump 16x18x26 MSD-D 3 stage
HPRT 16x18x27 HT-HSB

CUSTOMER BENEFITS

- HPRT converts pressure drop into 1,600 KW of shaft power and increases the overall process efficiency



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