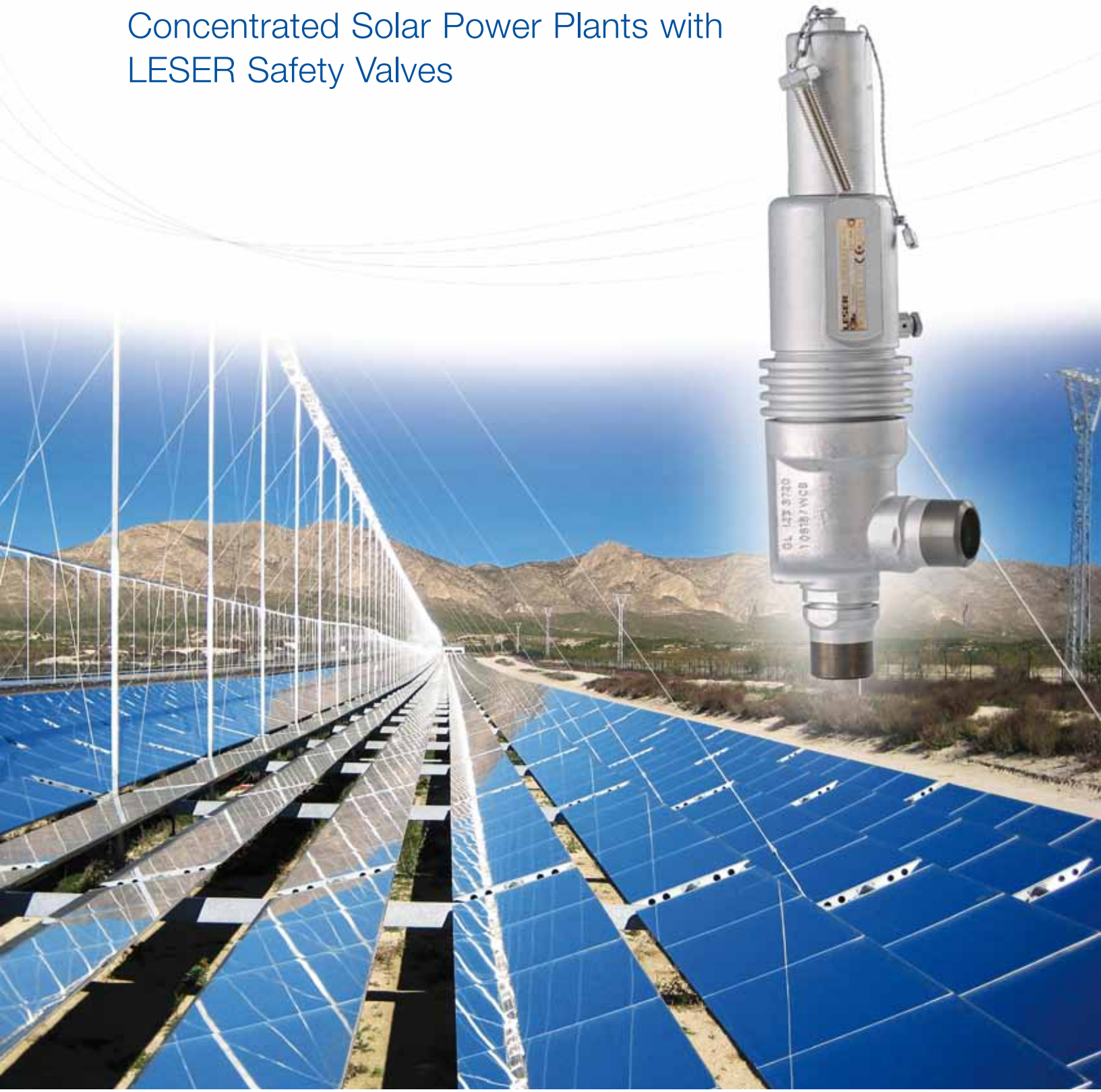
Approaching the Sun

Concentrated Solar Power Plants with LESER Safety Valves



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The-Safety-Valve.com

Application

We Protect Your Plants

The worldwide supply of energy is currently characterized by fossil fuels such as coal and gas, as well as by nuclear power. These resources are limited and, with regard to the climate change, alternatives are needed. Additionally, global energy demand will rise drastically in the next years: according to International Energy Agency (IEA) calculations it will increase approximately 50 percent by 2035.

This means that massive expansion in renewable energies will take place in the next years. Part of that will be solar energy because the sun sends over one billion terawatt hours of energy to the earth each year. This is over 60,000 times the total global energy demand per year. Hence we have a clean, CO_2-free, renewable energy in practically unlimited quantities available to us.

Solar energy can be collected and converted to usable energy through different types of plants. For example:

Photovoltaic Plants:

These plants use solar cells to convert solar energy directly into electricity.

Concentrated Solar Power Plants (CSP)

These plants collect the sun's heat and use a heat transfer medium to transport it to a power plant where electricity is then produced. Market-mature types of Concentrated solar power plants are Parabolic Trough- and Fresnel- power plants. Solar tower power plants are another possible CSP variation.

Safety valves are used in Concentrated solar power plants. They are necessary for protecting the plant and must meet the special demands placed on them by the high temperatures, pressures and medias used.

With over 2,500 valves delivered since 2009, we at LESER have a lot of experience in this area and offer the proper safety valve for each type of plant and heat transfer medium.

LESER Advantages for Concentrating Solar Power Plants (CSP):

- **Valves operationally proven for the special demands of this application**
- **Short delivery times and simple ordering through standardization**
- **References in leading plants**

Parabolic Trough Power Plant, Photo: Schott AG

Fresnel Power Plants, Photo: Novatec Solar GmbH

Application

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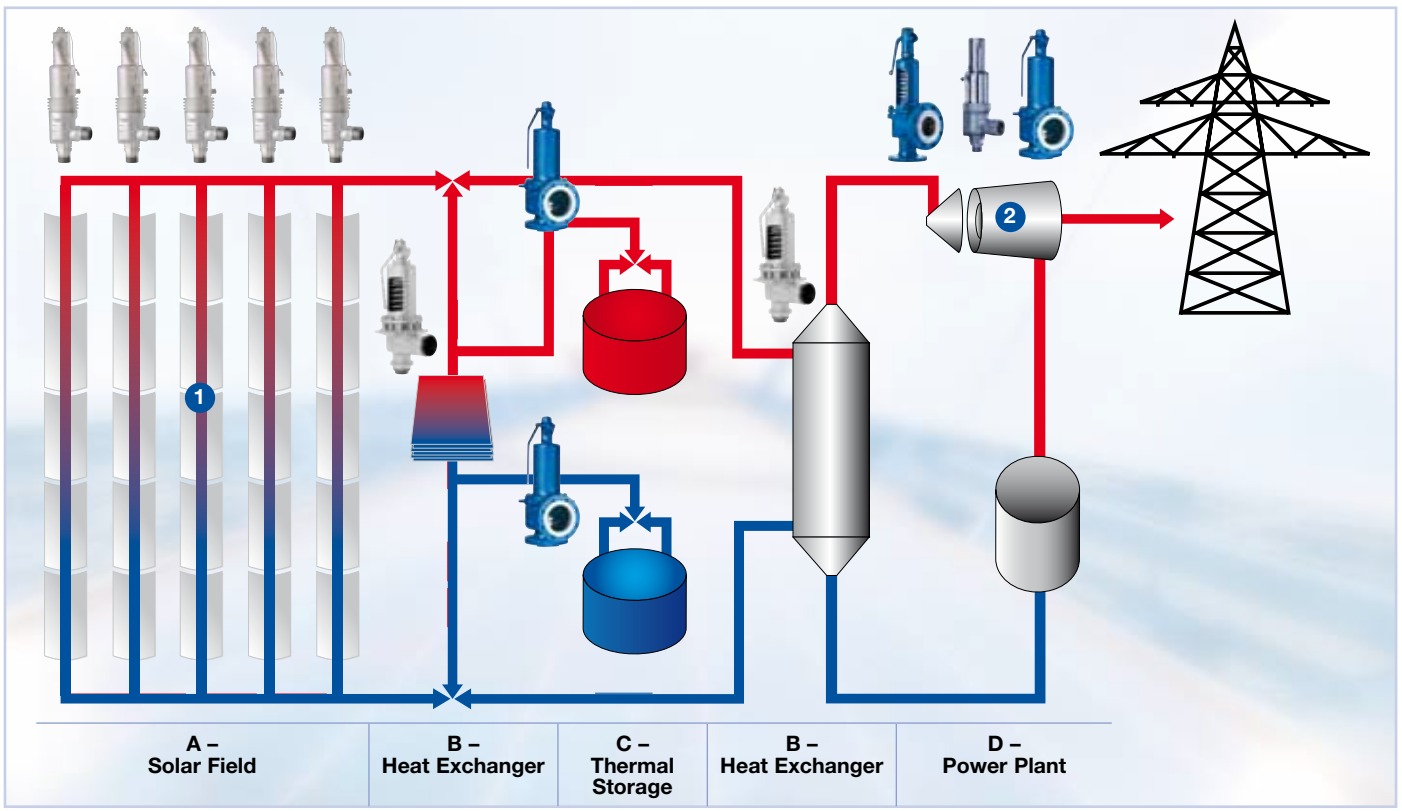
Construction of Concentrated Solar Power Plants

Large reflecting mirrors in the solar field (A) concentrate the sun's rays on one of the absorber tubes (1) along the collector's focal point. In the case of parabolic trough power plants the reflectors are trough-shaped. In contrast to this, Fresnel power plants have many shallow-curvature (or flat) rows of reflectors parallel to the earth. In the absorbing tube the concentrated sunrays are converted to heat which is passed to a circulating heat transfer medium. The medium runs into a heat exchanger (B) were the heat is converted to steam. In the power plant (D) the steam drives a steam turbine with a generator (3) that produces electricity. Some plants also have integrated thermal storage units (C) that allow continued operation at night or when cloudy.



A – Solar Field

A heat transfer medium in the absorbing tubes located along the collector's focal point is heated by the sun's rays being reflected off of the reflecting mirrors. There are two types of medium that can be used:

Thermal Oil (Parabolic Trough Power Plants)
The thermal oil is heated to up to 400 °C / 752 °F and is then transported through the piping at 25 – 40 bar / 363 – 580 psig.

Water / Saturated Steam (Fresnel Power Plants)
The water is heated to up to 300° C / 572 °F in the absorbing tube and is then, as saturated steam, transported through the piping at high pressure.

Safety valves in the solar field serve as protection from thermal expansion and they protect the sensitive absorbing tubes. At the end of the solar field the heat transfer medium from the different tubes is combined and transported to the power plant to produce energy or to a thermal storage unit for later use.

B – Heat Exchanger

The heat exchanger takes the heat from the heat transfer medium and either converts it to steam for the power plant or places it in a storage medium in the thermal storage unit. The heat exchanger is protected by safety valves.

C – Thermal Storage

To increase a power plant's utilization, a portion of the collected heat can be stored in an integrated thermal storage unit. These storage units primarily consist of tanks filled with molten salt which has a high thermal capacity. Safety valves are used to protect the thermal storage unit from overpressure.

D – Power Plant

As with conventional power plants, electricity is produced using turbines and generators. The various power plant components are also protected by safety valves.

Product Solutions

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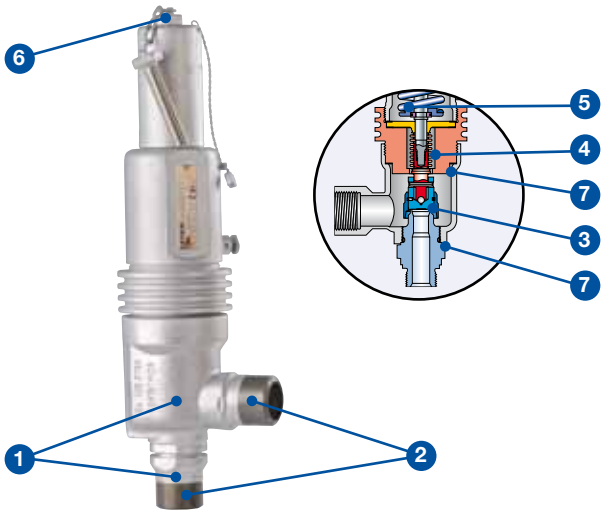
A – Solar Field

Demands on safety valves when using thermal oil as a heat transfer medium:

- Good heat resistance
- Capability to transport small capacities
- No external loss of creeping medium
- Compensation for high backpressure

LESER Product Solution for the Solar Field

This safety valve that was specially developed for use in solar fields using thermal oil has special product characteristics that guarantee safe operation. Product standardization guarantees quick delivery times and cost effectiveness.



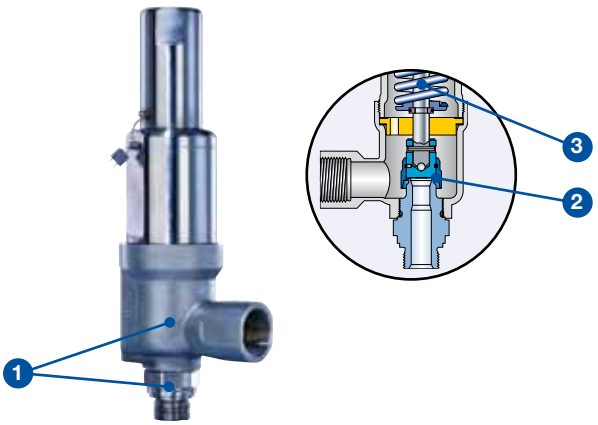
No.	Product Feature	Benefit to Customer
	Valve Size of 1" Actual Orifice Diameter (d_0) of 13 mm	Small construction allows protection of small and midsized capacities
	Set Pressure of 25 – 40 bar / 363 – 580 psig	Protection for all pressures that arise
	Temperatures to +400 °C / +752 °F	High heat resistance

1	Body materials made for high temperatures	Ensured resistance to heat
2	Weld-on inlet and outlet ends	No possible loss of thermal oil at plant connection points
3	Durable, wear-resistant sealing surfaces	Improved seat tightness to prevent leakage of thermal oil. Long-lasting (durable) sealing surfaces
4	High-quality, temperature-resistant bellows material	Resistance to high temperatures. Reliable sealing of the spring area. Compensation for backpressure
5	High-temperature spring material	Ensures heat resistance
6	Test gag	Allows hydrostatic pressure testing of plant
7	High pressure sealing and sealing weld	Absolute external tightness

Product Solutions

A – Solar Field

Demands on the safety valve when using water as a heat transfer medium:
- Good heat resistance
- Capability to transport small to midsized capacities
- Protection for varying aggregate states (water to saturated steam)



LESER Product Solution for the Solar Field

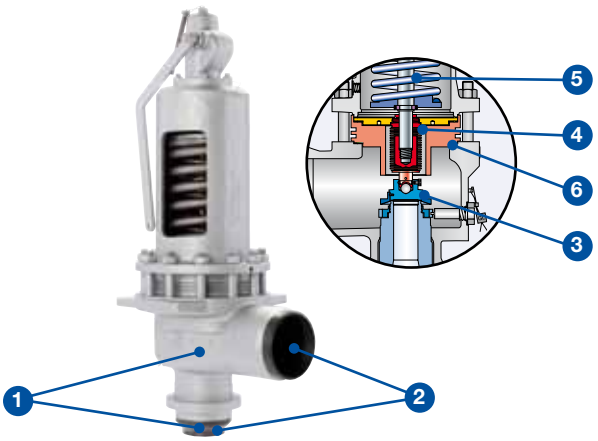
The Compact Performance safety valve series 459 can transport small and midsized capacities and is suitable for the varying aggregate states:

No.	Product Feature	Benefit to Customer
	Valve Size of $^1/_2$" to 1" Actual Orifice Diameter (d_0) of 13 mm	Small construction allows protection of small to midsized capacities
	Set Pressure of 0.2 to 200 bar / 1.9 – 2900 psig	Covers a wide range of pressures
	Temperatures to +400 °C / +752 °F	High heat resistance

1	Body materials made for high temperatures	Ensured resistance to heat
2	Durable, wear-resistant sealing surfaces	Improved seat tightness
3	Single trim for steam, gases, and fluids	Useable with all aggregate states

B – Heat Exchanger

Demands on the safety valve when using thermal oil:
- Good heat resistance
- Capability to transport mid to large sized capacities
- No external loss of creeping medium
- Compensation for high backpressure



LESER Product Solution for Heat Exchangers used on Power Plants.

The API safety valve is modified so that large volumes can be quickly discharged upon popping without allowing the medium to escape to the outside.

No.	Product Feature	Benefit to Customer
	Valve size: Orifice K to T	Protection for midsized to large capacities
	Set pressure of 0.1 to 40 bar / 1.5 – 580 psig	Protection for all pressures that arise
	Temperatures to +550 °C / +1022 °F	High heat resistance

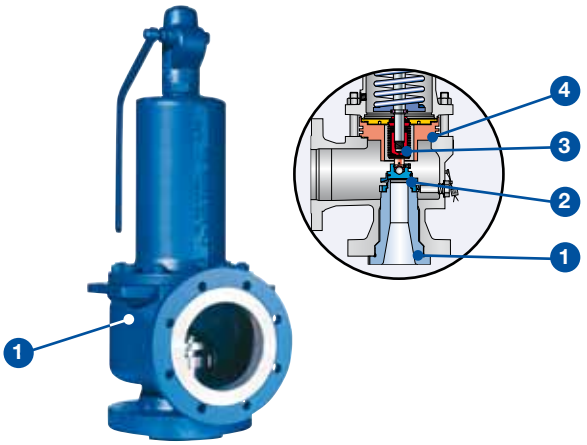
1	Body materials made for high temperatures	Ensured resistance to heat
2	Weld-on inlet and outlet ends	No possible loss of thermal oil at plant connection points
3	Durable, wear-resistant sealing surfaces	Improved seat tightness to prevent leakage of thermal oil. Long-lasting (durable) sealing surfaces
4	High-quality, temperature-resistant bellows material	Resistance to high temperatures. Reliable sealing of the spring area. Compensation for backpressure
5	High-temperature spring material	Ensures heat resistance
6	High pressure sealing	Absolute external tightness

C – Thermal Storage

Demands on the safety valve:
- Good heat resistance
- Capability to transport midsized capacities
- Resistance to salt corrosion

LESER Product Solution for the Thermal Storage Unit

For this application we offer an API Safety Valve with an application-appropriate configuration so that it is suitable for predominate conditions. Alternatively, when the API standard is not required, a High Performance safety valve with the same configuration as the API valve can be utilized. The High Performance valve allows the use of a smaller nominal diameter for the same performance.



No.	Product Feature	Benefit to Customer
	API Series 526: Orifice D to K High Performance: DN 20 to DN 50	Protection for midsized capacities
	Set pressure of 0.1 to 40 bar / 1.5 – 580 psig	Protection for all pressures that arise
	Temperatures to +550 °C / +1022 °F	High heat resistance
1	Body materials made for high temperatures	Ensured resistance to heat. Media-contacting inlet out of stainless steel ensures resistance to medium
2	Durable, wear-resistant sealing surfaces	Improved seat tightness to prevent leakage of molten salt
3	High-quality, temperature-resistant bellows material	Resistance to high temperatures. High durability/resistance to medium. Compensation for backpressure
4	High-quality seal materials	Salt corrosion resistant seals

D – Power Plant

The demands put on the safety valve by the power plant are the same as by conventional power plants. These demands are covered by our standard products.

Product group API

Type 459

Type 437

Product group Compact Performance

Product group High Performance

References

References

We are the experts at equipping consolidating solar power plants with safety valves. Even though this is a relatively new field of application, we can already provide a large number of references to prove our expertise. Combined with the know-how of our partner in Spain, Bvalve Flow, Systems & Controls, we have introduced more than 4,000 safety valves since 2009.
For example:

Plant	Type of Plant	Plant Power	Country	Plant Operator	Year/Order
Agua Prieta II	Parabolic trough	14 MW	Mexico	Comisión Federal de Electricidad	2012
Andasol 3	Parabolic trough	50 MW	Spain	Marquesado Solar SL	2011
Andasol I and II	Parabolic trough	50 MW each	Spain	Cobra O&M	2013
Arenales	Parabolic trough	50 MW	Spain	OHL	2012
Borges Termosolar	Parabolic trough	25 MW	Spain	Abantia & Comsa Emte	2012
Crescent Dunes (Tonopah)	Solar Tower	110 MW	USA	SolarReserve's Tonopah Solar Energy, LLC	2013
Dead Sea (Israel)	Solar Pond	150 kW	Israel	Dead Sea Works	2014
Genesis Solar Project Lot 1 and 2	Parabolic trough	250 MW	USA	Genesis Solar	2012
Hassi r'mel project	Parabolic trough	25 MW	Algeria	Abener	2011
Helioenergy 1 and 2	Parabolic trough	50 MW each	Spain	Abengoa Solar/E.ON	2011/13
KAXU Plant	Parabolic trough	100 MW	South Africa	Abengoa Solar	2013
KHI Solar One Plant	Solar Tower	50 MW	South Africa	Abengoa Solar	2013
Lebrija	Parabolic trough	50 MW	Spain	Iberese	2011
Logrosan/Extremadura Solar Complex	Parabolic trough	50 MW	Spain	Abengoa Solar	2014
Manchasol	Parabolic trough	50 MW	Spain	Cobra O&M	2013
Manchasol 2	Parabolic trough	50 MW	Spain	ACS/Cobra Group	2011
Mojave Solar Project	Parabolic trough	280 MW	USA	Mojave Solar	2012/13
Moron	Parabolic trough	50 MW	Spain	Ibereólica Solar	2011
Olivenza	Parabolic trough	50 MW	Spain	Ibereólica Solar	2011
Shams 1	Parabolic trough	100 MW	UAE	Foster Wheeler Energía	2011
Solaben 2, 3 and 4	Parabolic trough	50 MW each	Spain	Solaben Electricidad	2013
Solana Plant	Parabolic trough with Molten Salt storage	280 MW	USA	Foster Wheeler Energía	2012
Solar Field Helios I and II	Parabolic trough	50 MW each	Spain	Hyperion Energy	2011
Solarcor 1 and 2	Parabolic trough	50 MW each	Spain	Abengoa	2011
Termosolar La Africana	Parabolic trough	50 MW	Spain	Africana Energía, S.L.	2011
Termosolar Soluz Guzmán	Parabolic trough	50 MW	Spain	Bidarte	2011

LESER has delivered safety valves to a number of solar plants around the world. Our customers are plant owners and operators, engineering/procurement/construction companies and original equipment manufacturers. The table indicates the plant owner, which may not necessarily be the customer.

Approvals

Country	Approval
Europe	PED / ISO 4126-1
Germany	PED / AD 2000-Merkblatt A2
USA	ASME Sec. VIII Div. 1
China	AQSIQ
Canada	CRN
Russia	RTN / TR
Kazakhstan	GOST-K
Belarus	GOSPROMNAZADOR

Power Plant, Photo: Bvalve Flow, Systems & Controls

LESER worldwide

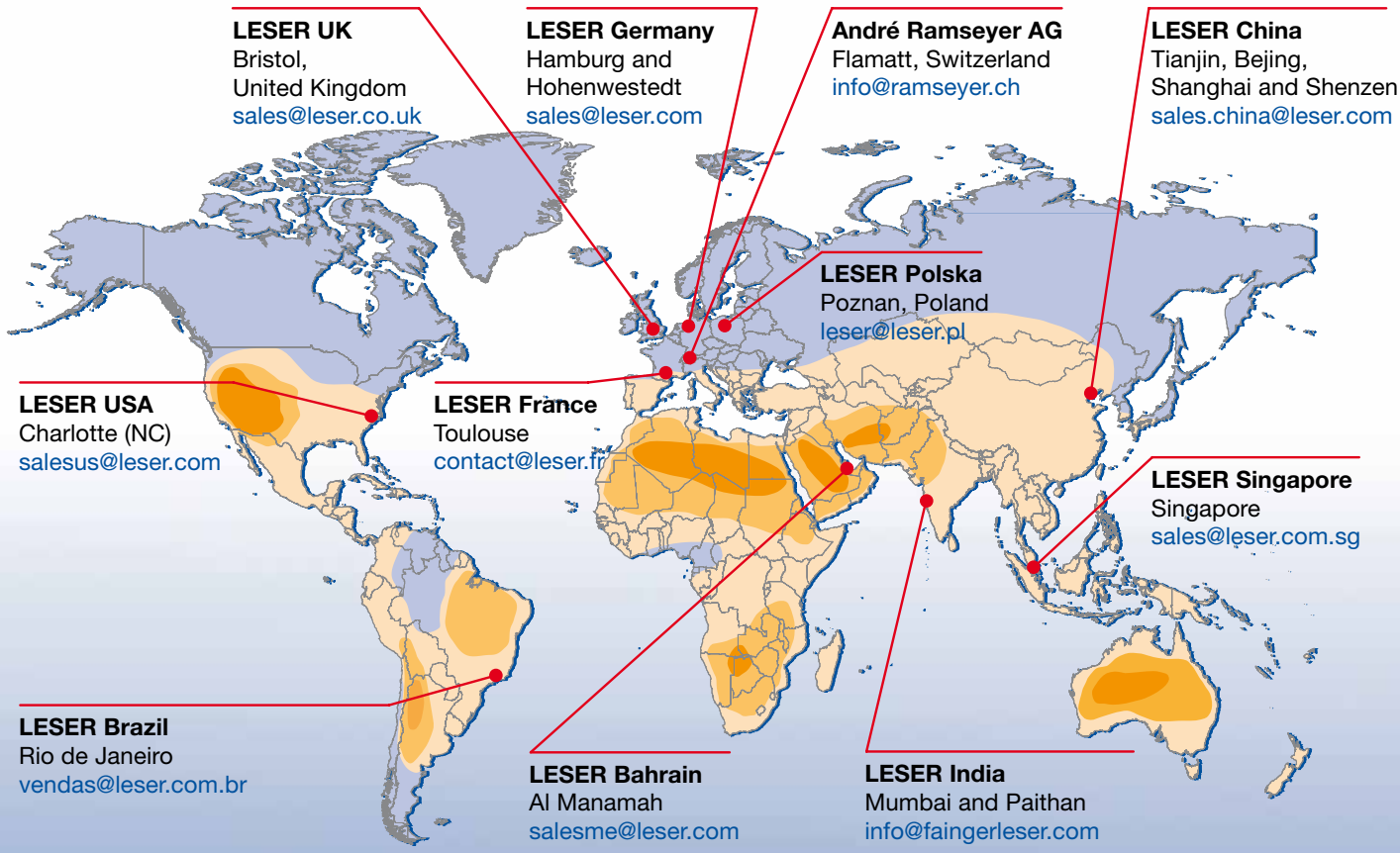


Illustration: Global Distribution of Annual Solar Radiation

Average annual solar radiation in kWh/m²

- > 2.000
- 1.500 – 2.000
- 1.000 – 1.500
- < 1.000

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