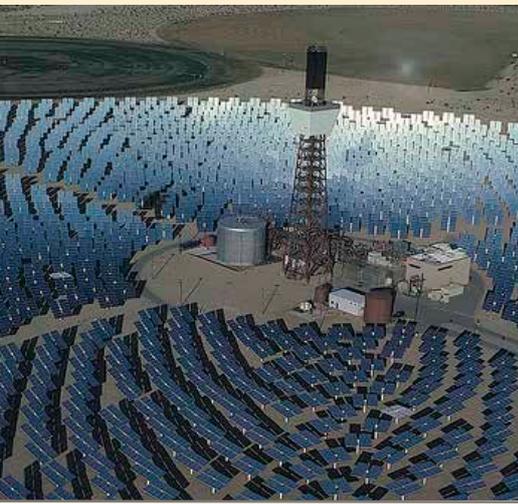


AUTOMATIC FIREFIGHTING
SYSTEMS IN
**SOLAR THERMAL
PLANTS**





REASONS FOR ITS EXTENSIVE IMPLEMENTATION

IT IS MANAGEABLE

OFFERS PLENTY OF
STORAGE

CLEAN

SAFE

RENEWABLE

REDUCES ENERGY
DEPENDENCE

OFFERS NEW
ALTERNATIVES IN
MANY REGIONS OF THE
WORLD

Solar Thermal Plants

A thermal power plant is an industrial facility in which a fluid is heated by solar radiation and used in a conventional thermodynamic cycle to produce the power required to move an alternator to generate electricity, as in a conventional power plant. It involves the thermal harnessing of solar energy to transfer and store it in a heat transfer medium, usually water. Thermal storage is one of the advantages of CSP technology.

The most commonly technology to store this energy is molten salt storage (nitrates). The composition of these salts is variable. The most commonly used mixture is potassium nitrate, sodium, and lately calcium nitrate has also been added.

Solar radiation is converted to electricity by converting solar radiation into heat energy that is then converted into electricity, using one of these eight procedures:

- Parabolic trough concentrator plants equipped with thermal storage using inorganic salts.
- Fresnel lens plants.
- Central tower direct steam generation plants.
- Central tower plants using inorganic salts as the heat transfer fluid.
- Parabolic mirror plants equipped with Stirling engine.
- Cylindrical-parabolic concentrator plants hybridized with biomass.
- Cylindrical-parabolic concentrator plants hybridized with combined cycle plants.
- Tower plants hybridized with gas turbine.



WHAT ARE THE ADVANTAGES OF SOLAR THERMAL ENERGY?

IT IS MANAGEABLE AND CAN BE STORED.

Solar thermal energy, unlike other “flowing” technologies whose energy has to be used at the time of his generation, is a renewable technology which can be stored, capable of feeding into the grid whenever required, even in hours without sunlight. This is a great advantage as it ensures a high level of safety for the electrical system in general together with the stability that comes from the considerable inertia of the generating equipment - the turbine and alternator - as well as supporting the grid in case of incidents.

CLEAN, SAFE AND RENEWABLE.

It is very important to note that this is a clean, safe and renewable energy source, which is absolutely vital in the fight against climate change and the development of a sustainable economic and social model. And the fact is that the sun is the most abundant renewable resource on Earth.

IT REDUCE ENERGY DEPENDENCE.

Solar thermal power, and any type of renewable technology in general, prevents the import of oil and other fossil fuels from abroad, allowing countries to reduce their high energy dependence on other states.

IT PROVIDES OPPORTUNITIES FOR MANY REGIONS OF THE PLANET.

Countries with lower energy and economic development usually have great solar resources. Solar thermal technology is a great opportunity for remote areas and developing countries to access electricity. Implementation uses local components heavily.

PROTECTED PLANTS

SIEX products are installed in many solar thermal plants, including:

- *Villena Solar Thermal Plant (Alicante)*
- *Andasol Solar Thermal Plant (Granada)*
- *Orellana la Vieja Solar Thermal Plant (Badajoz)*
- *Olivenza Solar Thermal Plant*
- *etc.*

Fire hazard

The main areas to be protected with automatic extinguishing in a solar thermal plant are:

- Diesel generators
- Technical rooms
- Control Rooms
- IT rooms
- Electrical cabinets
- Cable tunnels
- False floors and ceilings
- Diesel storage tanks
- LNG tanks
- Turbines
- Electrical panel rooms
- Electrical transformers
- Battery rooms
- Refrigeration rooms
- Steam generators
- Low/high voltage rooms

Of all the hazards mentioned, we need to choose the most convenient extinguishing method, since all these places are an serious source of possible fires that can cause severe damages.

HTF BOILERS, however, require further attention and must be adequately protected. They contain three dangerous elements that can cause explosive atmospheres. These are natural gas, hydrogen and, above all, HTF thermal fluid.

The existence of any of these three fuels in a solar thermal plant is enough for the area to qualify as an ATEX area.

Hydrogen

Hydrogen is extremely flammable. If found in flammable or explosive concentrations in an enclosure, it poses a risk of explosion in the presence of any source of ignition. Hydrogen and oxygen are released during the water electrolysis reaction during the final phase in the final phase of battery charging, and especially if there are overloads.

Natural gas

Used in the auxiliary boiler, it has a flash point of $-180\text{ }^{\circ}\text{C}$ and a lower explosive threshold of 5%. A possible natural gas leak would have disastrous consequences, if all other conditions occur (ignition point, presence of oxygen and proper concentration).

HTF SYSTEM BOILERS

In solar thermal power plants, the fire protection of this type of boilers needs to be stressed. They are usually protected with SIEX equipment. Most recent fires in solar thermal plants have occurred in this type of boilers, so it's worth analyzing these hazards further:

The HTF System is undoubtedly the most complex component of a solar thermal plant. This oil has a high flash point and excellent resistance to oxidation, which provides a high service life, even in severe operating conditions.

HTF boilers in a solar thermal field has two functions:

- It keeps the system running if the sunlight is insufficient under the conditions established by Royal Decree 661/2007
- It keeps the fluid hot in the event of prolonged downtime or unfavourable environmental conditions

FEATURES

- Three-pass coil boilers
- Vertical mounting to ensure optimal emptying
- Gas/oil heat recovery for increased efficiency
- Gas/air economizer for preheating combustion
- Oil outlet temperatures 380 °C to 395 °C
- Skin temperatures up to 405 °C
- Yield 90%

BENEFITS

- Good conductivity and high thermal stability in service
- High oxidation stability and low vapour pressure
- Strong economic performance, low cost and low maintenance of installations
- Wide margins of operating temperatures (-30 °C to 280 °C)

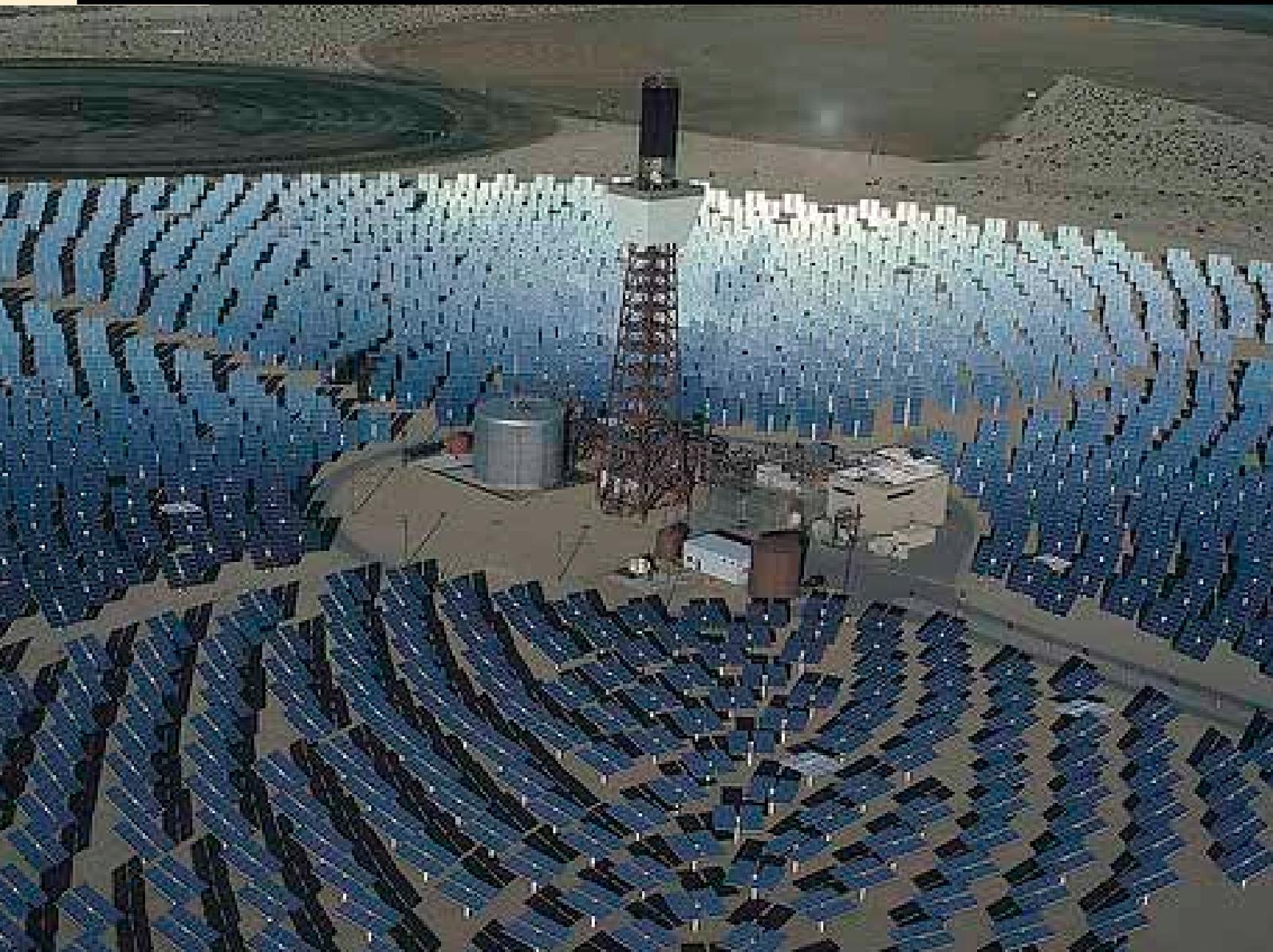
Heat transfer fluid (HTF)

It is the main fuel in these facilities. There are anywhere from 1,300 to 2,200 tons of thermal fluid circulating in a solar thermal plant. Since its flash point is only 110-124 °C and the fluid is used at average temperatures of 350 °C, any leakage of the hot fluid will cause an explosive atmosphere. The auto-ignition point is about 600 °C, but that temperature can be reached inside the tubes if fluid is flowing or if the flow rate is sufficiently low.

However, numerous fires that have occurred in recent times are due to this fluid igniting spontaneously given a sharp inlet of air, at a much lower temperature than what is reflected in the safety data sheet of the product.

When a leak occurs in one of the main solar field pipelines, the fluid permeates the lagging, which is usually made of rockwool covered with a protective sheet of aluminium. When removing the aluminium sheet, on occasion a spontaneous and sudden flame occurs, threatening workers in the area.





SIEX Solutions

The HFC-227ea agent is used to protect cable rooms, technical rooms, electrical rooms and cabinets, control rooms, battery rooms



The transformers and turbines can be protected by CO₂, water mist or dry chemical.



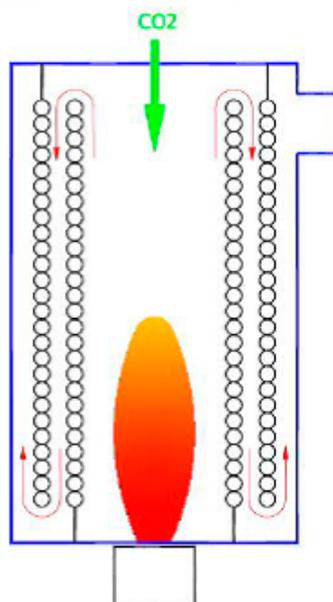


For the protection of HTF BOILERS

Given the risk of a small leak of fluid, the best option is the installation of a fixed Carbon Dioxide extinguishing system. The aim is to provide a CO₂ extinguishing system inside the boiler.

These boilers are made of concentric rings of small tubes which are filled with the hot oil.

Usually, leakage in rolled, coil-shaped tubes under pressure is very rare; they are normally microcracks. Fluid can leak out of these **MICRO-CRACKS** in the shape of spray cloud which, upon contact with the burner flame, catches fire and contributes additional energy to the boiler. In most cases, this leak will not have consequences for the boiler and the extinguishing procedure is simple, but if the crack is larger, leakage involving more energy may occur, which may pose a risk to the boiler.



If the leak is so large that the flame cannot be blown out, the procedure to follow is to extinguish it by applying an external extinguishing agent such as CO₂. In this case, the operator will act as follows:

- shut off the burner, close the general gas valve and close the oil inlet and outlet valve.
- Notify security personnel to isolate the area.
- Press CO₂ discharge button.
- Wait a few minutes and check again if the flame has been successfully and fully extinguished.

The amount of CO₂ required to extinguish the fire inside the boiler will be determined using the NFPA 12 guidelines.

Benefits of SIEX CO₂

HIGH COOLING POWER

Quickly cools the HTF surface. This, combined with the high power of oxygen displacement that “chokes” the fire, makes it an effective and cost-effective method. .

PROVIDES ITS OWN PRESSURE

This pressure, coupled with its gaseous state, allows it to easily reach and extend to all parts of the boiler.

EXTRA PROTECTION

CO₂ is used as an extinguishing method if the boiler’s principal extinguishing system is not working. In these cases CO₂ is rapidly discharged inside the boiler.

But it is also often used in this type of installation with a second function, for slow or prolonged discharge:

For example, for the concentration to be maintained for 20 minutes after the fire is extinguished, and thus avoid re-ignitions due to microcracks through which HTF liquid could continue to leak.

OTHER SPECIAL HAZARDS PROTECTING BY SIEX:

SERVICE STATIONS

ARCHIVES AND LIBRARIES

DPCs

PAINT SPRAY BOOTHS

ELECTRICAL PANELS

INDUSTRIAL KITCHEN

TURBINES AND GENERATORS

ROAD TUNNELS

NATURAL GAS PLANTS

CLEAN ROOMS

CABLE TUNNELS

TELECOMMUNICATION CENTRES

HOTELS

HOSPITALS

EDUCATIONAL ESTABLISHMENTS

TRAIN AND UNDERGROUND STATIONS

TRAINS

TRANSFORMERS

OFFSHORE PLATFORMS

SOLAR THERMAL PLANTS

MACHINE TOOLS

PRINTING INDUSTRY

HISTORIC BUILDINGS

ROBOTIC PARKINGS

WIND TURBINES

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BANKS

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TIMBER INDUSTRY



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