S.E.P.P.

SOLAR ENERGY POWER PLANT

LARGE PARABOLIC DISH SYSTEMS - L.P.D.S.

FEATURES

ICRA, Switzerland

SOLAR ENERGY POWER PLANT REQUIREMENTS

Solar thermal power plants have to fulfill the following requirements:

1. **24-hour system use,**
2. **autonomous system,**
3. **high plant availability,**
4. **high thermal and electric conversion efficiency,**
5. **operation and service with little man power,**
6. **high temperature process heat production,**
7. **electricity production and use of waste heat energy,**
8. **clean and ecological system.**

Line concentrators and heliostat-tower systems can only partially fulfill these requirements: it is important to keep the operation and the system as simple as possible. A Large Parabolic Dish System employs standard components available in industrial applications: the dish technology is taken from radio astronomy and communication, the turbine and heat exchanger are proven, standard industrial products, receiver technology is applied from the experience

gained in running more than a cumulated total of 800.000 hours in radiation heaters of gas turbine plants in Germany.

Continuous production of energy is a user requirement that has been given far too little attention in the design and operation of present day solar power plants: only systems that can provide the user with a constant and guaranteed supply of the energy (thermal or electric) will increase cost-effectiveness of solar thermal power plants.

In the case of solar energy this means thermal storage for night and cloud periods or hybrid operation, i.e. fossil fuel operation as an addition to solar radiation or in the absence of solar insolation.

BASIC FEATURES OF LARGE PARABOLIC DISH SYSTEMS - L.P.D.S.

Solar thermal power systems utilize concentrated solar energy from direct radiation (as part of the entire solar insolation, i.e. diffuse and direct radiation) onto a surface normal in order to drive - via a heat exchanging system - a heat conversion engine which produces either electric power or industrial process heat using steam, sodium, or gas (air - open cycle, helium - closed cycle) as a working medium.

Large Parabolic Dish Systems show:

- *high conversion efficiency due to high process temperatures,*
- *low service and maintenance requirements,*
- *simple and reliable cycle using air as working medium,*
- *low thermal inertia for a short system start-up time,*
- *development potential for extremely high process temperatures through the use of ceramics in receiver and turbine for future generations of LPDS (1200° Celsius and higher),*
- *compact, stand-alone system with 24 h system use due to hybrid firing mode.*

Comparison with other types of solar thermal power plants show, that the Large Parabolic Dish System has considerable advantages over the heliostat-tower and farm concept:

1. higher output in annual kWh (electric or thermal) due to constant two axis solar tracking without a cosine loss factor;

2. higher efficiency in electric power conversion due to constant heat flux distribution in receiver;

3. high availability through the use of proven components;

4. process heat availability in a wide spectrum of temperatures (650° down to 200° Celsius and lower as exhaust heat)

5. exhaust heat utilization at temperature levels of 200° Celsius together with electricity production can bring plant efficiency up to 85 %;

6. spin-offs for use of collector as radio telescope for radio astronomy during non-sunshine hours.

USER PROFILE

Since conventional sources of energy have different costs depending on their size, type, and availability and accessibility to the conventional fuels, three principal user types can be identified for the penetration of solar energy in short term, medium term and long term time frames. These users are:

1. ***isolated load user*** - including small communities with isolated site characteristics for electricity production and process heat applications;

2. ***industrial process heat*** user with the demands for both process heat and electricity in a "total energy systems" market. This market includes producers of chemical or fuels, apart from the smaller industrial process heat consumer in developing countries;

3. ***grid-connected electric utility*** user, primarily small communities, the repowering market - with the bulk electric market as the ultimate goal.

The user profile of the first type can be described as the isolated load market where the user is generally isolated from a national grid. The local utility plant, if there is one at all, consists of a few diesel generators with possibly a small transmission and distribution network. This application is typical of small communities on islands, isolated industrial sites, and villages in remote areas with no infrastructure.

It is certainly these markets that will allow the economic penetration of solar energy in the very near future. Small power plants in the order of a few hundred kilowatts are needed for pumping water for irrigation, to drive machines in small industries, to supply simple lighting installations, medical instruments, television etc.

Reliable, simple and compact aggregates with low maintenance have good possibilities for application in these fields with the added use of the reject heat from the cycle for small industrial processes, such as desalination, food drying, chemicals, fertilizer production, etc.

Production cost of electric energy in the isolated load market is considerably higher than in large, grid-connected national networks. In these markets solar energy can provide competitively priced thermal and electric energy in utilities, industrial, and related applications for rural communities and farms, as well as municipal and industrial users through modular, individual stand-alone systems of the Large Parabolic Dish System (LPDS) type.

The application of the LPDS type of solar power plant can be seen in either stand-alone or mini-grid configurations in those markets. Grid-connection of solar power plants of the LPDS type can be achieved to feed electricity to a national grid; Large Parabolic Dish System modules can be installed either in single station modules or connected to form an array for electric power production.

The electricity interconnection shows advantages in arrays: servicing one LPDS does not affect the overall performance of the grid as it is designed with a basic load factor and peaks are assumed by other units.

The primary uses of energy in the above-defined market are:

- desalination
- foods with drying, canneries, etc.
- chemicals
- fuel production
- textiles
- paper
- fertilizers
- housing (heating and cooling)
- services (laundries, cleaners, etc.).