STEM® (Solar Thermo Electric Magaldi): The first industrial module in operation in Sicily

On June 30, 2016, the first STEM® (Solar Thermo Electric Magaldi) industrial model plant started operations in San Filippo del Mela (Sicily). This Concentrating Solar Power system with Thermal Energy Storage represents a "disruptive" technology because it's able to collect solar energy – through a solar field made of heliostats – and convert it into thermal energy to be stored and extracted when desired. Installed in the Integrated Energy Pole of the A2A Group – the largest Italian multi-utility in the energy sector – this plant is the first one worldwide using sand as Thermal Energy Storage

DOI 10.12910/EAI2017-033

by **Letizia Magaldi**, *Magaldi Group*

On June 30, 2016, the first STEM® (Solar Thermo Electric Magaldi) market size, first of a kind, model plant was in operation in San Filippo del Mela (Sicily).
Installed in the Integrated Energy Pole of the A2A Group – the largest Italian multi-utility in the energy sector – this disruptive CSP (Concentrating Solar Power) technology is one of a kind worldwide using fluidized bed sand as Thermal Energy Storage.
Nowadays various tests are being performed with very positive results.
STEM® technology has been developed and patented by Magaldi Group in cooperation with Prof. Piero Salatino of Federico II University of Naples and a prestigious institute of the National Research Council headed by Riccardo Chirone.
Founded in 1895, Magaldi Group is a world's leading specialist in dependable and environmentally-friendly high temperature material handling systems, pioneering solutions for demanding problems in solid-fuel Power Plants, Metallurgical & Mining companies, Waste to Energy plants.
Over the years, Magaldi has developed a broad range of patented technologies capable of ensuring such benefits as high dependability, longer service life, negligible maintenance, water and energy savings, like in the case of STEM® technology.
This new CSP system with TES (Thermal Energy Storage) is able to collect solar energy – through a heliostat solar field – and convert it into thermal energy to be stored and extracted whenever needed.

STEM® is based on modular steam generator units (SGU) for power production and thermal energy storage. Several modules can be combined together to produce the superheated steam flow rate (at around 500 °C), to be used to generate electricity or as process heat.
Solar radiation captured by heliostats field is concentrated on a secondary reflector (beam down) and subsequently focused into a receiver, positioned at ground level. The receiver is based on a fluidized bed technology: 270 tons of fluidized sand, at an operating temperature of 550-650 °C, are used to effectively transfer and store the solar thermal energy. Up to 8.2 MWh thermal energy can be stored per module, thus allowing the release of the required energy at night, or in the absence of sun radiation. Different configurations of STEM® can be applied, according to the Customer's need.
STEM® is an ideal system to be combined with existing or dedicated PV plants to grant continuity of green power production during night time. During the day, electric power could also be directly produced from sunlight with the PV plant, which also feeds the STEM® auxiliaries, allowing solar energy to be effectively stored in the fluidized bed receiver.
The fluidized bed receiver, in this way, works as TES of solar power, that can be used during the night for steam or power generation.
STEM® uses and applications may be many and different, making it an ideal solution for tomorrow's distributed energy needs, Distributed Energy Resources (DER) and Distributed Energy Storage Systems (DESS), being able to provide the user with thermal energy and steam when needed, for civil (energy, heat generation and storage), agricultural (steam, clean water through desalinization) and industrial uses such as: EOR (Enhanced Oil Recovery) – Refining for Hydrocarbon industry, Mining etc.
STEM® can be used to immediately provide thermal power generated energy to fringe and off the grid communities, to satisfy their needs, without depending on costly and large distribution lines and networks. It can therefore represent a quick solution to foster local development in rural communities or areas not reached by the grid like most

of Africa, thus providing relief to local people suffering lack of access to clean water and energy, helping to prevent them from forcedly leaving their homes..
Finally, whatever STEM® is applied to, it is an efficient way to reduce carbon footprint and a sure path to a cleaner world.
Moreover, the absolute lack of poisonous emissions into the environment (both in case of normal operation and failures) as well as the non-use of cooling water and any chemicals, makes STEM® technology the best way to produce and store green energy in remote zones.
Even from the standpoint of the landscape, STEM® confirms its commitment to the environment. In fact, compared to traditional Power Tower systems, STEM® does not have a huge visual impact since its highest structure does not exceed 22 m height whereas other CSP tower systems reach over 100 m.
STEM® key strengths:

- *Dependability*: The simple operational process and the modular configuration give STEM® a competitive advantage over other CSP technologies. Even if one module is under maintenance, the other modules guarantee continuity to the production of steam.
- *Flexibility*: Fluidized bed technology using sand as storage medium and the possibility to connect the modules in parallel or in series enable the system to generate electricity according to the load demand.
- *Modularity*: The base modules can be combined together to meet

the required power demand. It is possible to add modules at a later stage, in case demand increases.

- *Hybridization*: STEM® technology can be integrated with both renewable and fossil fuel plants, to guarantee a continuous operation, day and night, year-round. The receiver is designed to also allow the combustion of low heating value fuels, such as biogas.
- *Cogeneration*: High temperature steam generated can be used for district heating and cooling, water desalinization, greenhouses.
- *Environmental friendliness:* STEM® technology only uses absolute eco-friendly materials, such as glass for heliostats, steel for structures and sand for thermal storage so that, even in case of decommissioning or at the end of its working life, all materials are completely recyclable.
- *Long service life*: STEM® system is almost static and it is designed to be operational for decades. Batteries, on the other hand, need to be replaced after a certain number of cycles.
- *Ideal solution for remote areas*: STEM® operates locally on demand without the need to build large power plants nor expensive distribution grids.

For further information, please contact: www.magaldi.com/en/contact-us/