

SMA Uses PLECS to Develop Next Generation of Flagship Inverter „Sunny Boy“

SMA is the worldwide market leader in the field of innovative system technology for grid-connected and off-grid photovoltaics. Located in Kassel in the center of Germany, SMA develops standard-setting power electronic devices and communication and control systems for such diverse fields as photovoltaics, fuel cells, wind energy and railway technology.



Climate change and shrinking fossil resources require innovative concepts for future energy supplies. SMA considers decentralized and modular energy technology as fundamental for an environmentally friendly and sustainable energy supply – all over the world.

As a pioneer in photovoltaics, SMA aims at providing private, commercial and institutional owners of solar power plants with optimal solar yields and smooth supply to the public grid with maximized profitability. At the *Intersolar 2007*, SMA presented the next generation of its flagship inverter *Sunny Boy* which will be released in January 2008.

„To provide our customers with the highest standard products, we need to apply the highest standard tools in our development“, says Dr. Ralf Juchem, head of SMA’s department of simulation technology. „PLECS enabled us to optimize the reliability and efficiency of our bestseller *Sunny Boy* for the new generation inverters“, Juchem remarks. „And as a very intuitive and high-speed tool, it helped us to reduce development time and cost.“

■ The challenge

The sun is practically a never-ending natural source of energy for the earth. SMA aims at making this source accessible for

the benefit of human beings all over the world. The company provides its customers with innovative and sophisticated device technology for optimized yield and reliable operation of solar plants, irrespective of size.

A key component for feeding the solar power generated by the photovoltaic (PV) system into the public grid is the inverter. This sophisticated equipment transforms the generated dc-power into grid-compatible ac-power, according to severe standards and safety regulations.

One of the key challenges for the SMA engineers is to assure that the solar cell’s output is transferred with highest possible efficiency. Even improvements in the range of tenths of a percent lead to appreciable increases in the customers’ gains.

„Since solar plants are an investment for at least 20 years, we have to guarantee long-term trouble-free operation – one of the basic requirements for our technology“, says Ralf Juchem.

SMA’s customers run their PV systems in all parts of the world. Due to the fluctuating nature of solar energy in most regions, the inverter has to be optimized for partial load conditions. In addition, it must be universally compatible with the diverse grid standards.

■ The solution

With its bestseller *Sunny Boy*, SMA has already brought to market devices of extraordinary performance. Nevertheless, to continue providing their customers with cutting-edge technology and with optimal levels of convenience and usability, SMA’s engineers developed a totally new inverter generation.

The inverter is a complex system consisting of several tiers of power electronic circuits combined with elaborate hardware and software for control. In a first step,



Ralf Juchem:

„We rely on PLECS in many aspects of our development and design, since it quickly provides us with accurate and convincing results that reduce development time and cost and help us to continuously improve our products.“



Photos: SMA Technologie AG

the PV generated dc-voltage is raised by a boost-converter and then transformed into ac using inverter bridges. The optimal interplay of these different stages is essential for maximizing system efficiency.

„The new generation of *Sunny Boy* has evolved from many small but crucial improvements“, summarizes Ralf Juchem. To meet all the requirements of a complex system, SMA engineers apply ultramodern model-based development techniques. „To reduce development time and cost it is essential for us to implement sophisticated simulations before building a prototype“, explains Juchem.

On the one hand, engineers rely on virtual prototyping to get a good overview of the general system. On the other hand, it is also important to evaluate details of a circuit and to decide whether, for instance, a diode might better be replaced by a transistor or where it might be preferable to measure a current.

SMA decided to use PLECS for the simulation of the power electronics part of the inverter. „PLECS has proven to be a high-speed tool that leads to very reliable results“, says Juchem. In the end, the engineers could even build the prototype in 1:1-correlation to the model.

To achieve this, they first rely on excellent

models of their system. „PLECS enables us to build our models quickly and in a straight forward way – just as electrical engineers like it“, says Juchem. Within PLECS' schematic editor, power electronic circuits can be built up simply by drag-and-drop of circuit components and connections from a rich library.

„For successful simulations, you don't have to worry about step-widths and fault-tolerance“, remarks Juchem and adds: „All is very intuitive and even newcomers to the field of simulation will get excellent results.“

The interplay of the inverter's hardware model and the control software turned out to be very smooth. „It is a great advantage that PLECS has its roots in MATLAB/Simulink“, notes Juchem, because MATLAB/Simulink is a well-established tool for control simulation at SMA. „Thus, we can easily integrate PLECS into our design flow.“

SMA engineers are not only convinced of the outstanding performance of PLECS. „We have enjoyed very competent support from Plexim experts, within 24 hours of any e-mail request“, says Ralf Juchem. „And we feel that Plexim's development engineers are open to new ideas.“

■ The results

The *Sunny Boy* next generation

„With the help of PLECS we were able to achieve a break-through in inverter performance, combining convenience and usability with leading-edge technologies“, says Ralf Juchem.

Faster development, lower cost

„Development times of the new *Sunny Boy* generation were significantly reduced“, says Ralf Juchem. „Using PLECS for simulation very much corresponds to the way electrical engineers think: model building is straight forward and the calculations run both, reliably and quickly.“

