**SE-23.1 Combining small and large-scale technologies for the development of the MicroRankine bottoming steam cycle. (A)**

P. Chatzitakis[1], F. Opferkuch[1]
[1]Technische Hochschule Nürnberg

Distributed power generation is a key factor in Germany's energy transition because it involves renewable fuel utilization (e.g. biofuels) and at the same time a flexible energy-portfolio, satisfying power, heating and cooling demands simultaneously (CHP, CCHP). In contrast to large-scale power generation plants, located far from load centers, distributed power generation can provide energy more efficiently and onsite, minimizing dependence on the distribution and transmission grid. In fact, such systems are starting now to contribute positively towards power network stability.

Waste heat utilization is one of the most promising methods of increasing distributed power generation efficiency and flexibility without any major environmental impact. The MicroRankine project is the development of a bottoming cycle, suited for the waste heat potential of medium range cogeneration applications, like biogas combustion CHP systems in sewage treatment and landfill plants. The goal of this project is to demonstrate the advantages of a hybrid construction utilizing technologies of large-scale applications, such as steam turbines, and those of small-scale systems, like magnetic bearings and asymmetric plate heat exchangers.

Steam was chosen as the working fluid due to its inherent safety and stability, since most motor exhaust temperatures were above 300°C, a physical barrier for almost all organic working fluids. The expander is an axial two-stage velocity compounded turbine (Curtis) designed to provide power ratings between 30 and 130kW and is supplied with supersonic steam flow from a configuration of converging-diverging (de Laval) nozzles. The turbine is connected to a synchronous generator, rotating at 600 Hz and supported by magnetic bearings in an oil-free hermetic design.

The waste heat recovery steam generator was originally designed with a typical economizer-evaporator-superheater concept. The rationale behind it was to provide a base reference to the system's efficiency, agility and economy, directly comparable with the project's next phase optimization candidates, including once through and falling film evaporators. The design of the overall system offers the possibility to adjust live steam conditions through the use of feed water injection. Additionally, the design includes the option for a recuperator, to facilitate performance comparison with ORC systems.