Invited Lecture

Uncommon Turbine Architectures for Distributed Power Generation – Development of a Small Velocity-compounded Radial Re-entry Turbine

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The energy industry is undergoing a major upheaval. In Germany, for example, the large nuclear and coal-fired power plants in the gigawatt scale are planned to be shut down in the forthcoming years. Electricity is to be generated in many small units in a decentralized, renewable and environmentally friendly manner. The large 1000 MW multi-stage axial steam turbines used to this date are no longer suitable for these tasks. For this reason, the authors examine turbine architectures that are known per se but have fallen into oblivion due to their inferior efficiency and upcoming electric drives about 100 year ago. However, these uncommon turbine concepts could be suitable for small to micro scale distributed in power plants using thermodynamic cycles, which use for example geothermal wells or waste heat from industry to generate electricity close to the consumers.

Thus, the paper describes and discusses the concept of a velocity-compounded single wheel reentry cantilever turbine in comparison with other turbine concepts, especially other velocity-compounded turbines like the CURTIS-type. Furthermore, the authors describe the design considerations, which led to a specific design of a 5 kW air turbine demonstrator, which was later manufactured and investigated. Finally, first numerical as well as experimental results are presented, compared and critically discussed with regards to the originally defined design approach.