

Efficiency optimized Hydrogenerators

W. Ladstätter, W. Harb, G. Kastner, G. Maier, M. Lang, F. Ramsauer

Abstract

In the last years alternative renewable energy production like wind energy or photovoltaic has significantly increased and contributes notable to world-wide energy production. Nevertheless hydro energy still represents by far the largest share of so called “green” energy production. Thus efforts have been made and will be made in the future to make this energy even more reliable and more efficient.

This paper deals with design and material modifications as well as calculation methods to increase the already high efficiency of hydro generators. Various methods are known to increase the efficiency of high voltage hydro-generators. Today’s standard reaches up to 99%. Common to all methods is the goal to reduce losses without harming the machine or exceeding internal and international limits and standards.

The reduction of losses within the electromagnetic design is based on three factors:

- Enhanced calculation methods like Finite Element Analysis (FEA) increases the accuracy of the loss calculation and allows reduced safety margins
- Optimized design (e.g. Roebel bars with 540° transposition)
- System programs, which couple ventilation and temperature calculation are used to identify the lowest loss variant, taking into account temperatures and electromagnetic reactances for example Computational Fluid Dynamics (CFD) is used to optimize high end hydrogenerator ventilation designs to calculate air flows through the generator. By doing so, several ventilation issues can be addressed, e.g. the fan design can be judged, different possible ambiguities in the air flow circuit can be investigated or the behaviour of certain devices, e.g. interpolar space body or rotor winding overhang, can be reviewed. A stator winding concept with improved heat transfer capability will reduce copper temperatures and consequently also improves the total generator efficiency. Last but not least bearing efficiency has to be optimized, keeping a reliable and robust design, also towards unforeseen exceptional operation conditions.