

Keynote Presentation 22nd Blade Mechanics Seminar

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Dr. Norbert Sürken, Siemens AG, Power and Gas, Germany

Lifing Challenges of Steam Turbine Blades under Changing Operation Conditions due to Renewable Energy Power Fluctuation

Lifing may be defined as the engineering art of improving the fatigue life of specific technical components and the fatigue properties of materials. For conventional base-load power plants, the turbomachinery component life largely depends on the number of starts and the operation hours. However, in an energy market dominated by renewable energy sources, “flexibility” becomes a key requirement for turbomachinery.

Frequent and continuing part-load operation, rapid load and temperature changes (load-cycling) as well as a largely increased need for start-stop cycles (speed-cycling) are getting common. In other words, the life-cycle assessment of turbine components needs to include additional lifing parameters to reflect more speed cycles at higher peak loads (static & dynamic) and broader load variations. Additionally, the required operation regime may lead towards elevated flow excitation of the blading and degraded steam chemistry, which may necessitate on-site monitoring in the field. A good example for such conditions is windage operation at deep part load (low volumetric flow), which increases the blading temperatures and generates unsteady excitation forces acting upon the last stage blades of low-pressure steam turbines.

In the keynote, an OEM's view is given on how these changed requirements can practically be met by turbine blade design. Important aspects such as material data acquisition, LCF and HCF analysis as well as operational influences on the component lifing will be treated starting with historical and theoretical deliberations, progressing via experimental component fatigue testing and concluding with real size application validation. Special attention is given to recent design and assessment methods for large blades being necessarily exposed to High and Low Cycle Fatigue. The determination of “moving life leading locations” under varying loading, operating and aging conditions will be handled as well as accompanying condition monitoring of blades shall be put up for discussion.