## 3. Thermo-Mechanical Analysis of Power Plant Components

The operation of solar thermal power plants is very different from that of traditional base-load power plants: as a result of the variable nature of the solar supply and the daily operating cycle of solar power plants, the number of power plants starts per year is an order of magnitude higher. This requires component optimisation to avoid excessive thermal stresses and low cycle fatigue during start-up, shut down and load variations. Due to the uncontrollable nature of the solar supply, it is also desirable that the power plant be able to start as quickly as possible, in order to be able to harvest as much as possible of the Sun's energy once it becomes available.

Start-up of the power plant is limited by transient thermal stresses within critical power plant components such as the turbines and steam generators. Accurate prediction of the thermo-mechanical behaviour of these component allows optimisation of both the start-up procedure and the components themselves, increasing the flexibility of the power plant flexibility whilst maintaining component life.

Coupled thermo-mechanical and thermodynamic models of the power plant components (developed using COMSOL® and MATLAB®) allow promising component modifications to be studied and their effects on the thermal stresses to be determined. Typical examples include the steam turbine units, where thermo-mechanical analysis (see Figure 1) has allowed optimisation of start-up curves and operating strategies to increase flexibility.

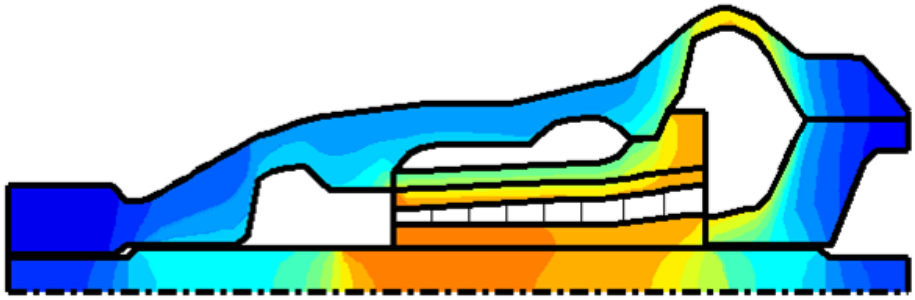

Figure 1: Temperature profiles of a modelled high pressure turbine.

The thermo-mechanical analysis tool can be applied for both the optimisation and redesign of existing components as well as the design of new units. Proactive engineering analysis of the upgrading potential of existing solar power plants can create business through repowering of solar steam turbine plants.