

Popular scientific summary

The aim of the project is to develop two methods of stress control in pressure elements of the power unit. Both methods will be used to monitor the startup and shutdown of a power unit with a view to shorten the time of unit integration into the power network. Thanks to the application of thermal stress monitoring methods developed in the project, the life of a power unit will not be affected significantly despite faster startup and shutdown.

Two methods will be developed in the project. The first one concerns the measurement of thermal stresses in elements where the temperature field is one-dimensional, at least in the selected area of the component with a complex shape. The second method allows the determination of thermal stresses in pressure elements where the temperature field is three-dimensional.

Both methods will be validated by calculation and experimentation. The proposed technique for measuring thermal stresses in complex shapes based on six points temperature measurement will be patented.

Based on the determined time variations of thermal stress at the place of its concentration, it is possible to assess the degree of life-time usage of the element caused by low-cyclical fatigue. If the component wears out too quickly, the startup and shutdown technologies can be modified.

The methods proposed in the project to determine transient thermal stresses in boiler pressure parts are new and more accurate than those currently used. They allow for the determination of stresses on the inner surface of the component with high accuracy, even with very rapid changes in fluid temperature. Furthermore, the stresses can be determined at the edge of the opening, i.e. where they are concentrated.

The proposed techniques for determining thermal and pressure stresses are innovative and can be used in power units by both manufacturers and users of power plants. Due to the requirements for greater flexibility of fossil fuel fired thermal units and combined cycle gas-steam (CCGS) systems, high demand for the solutions proposed in the project should be expected. The advantage of the proposed theoretical methods and measurement techniques (software and hardware) is the high speed of the developed calculation algorithms and ease of installation of instruments on the real object. The costs of the system for monitoring several or several dozen or so pressure elements of the block are small. Thanks to the installation of the proposed stress monitoring system, the unit startup time can be significantly shortened and thus it can be connected to the power network faster. Through the control of thermal stresses and possible online calculation of the remnant life of the pressure elements of the unit, the process of accelerated startup of the block can be carried out correctly without significant shortening of its lifetime.

By installing the system proposed in the project, power plants and CHPs can ensure stable operation of the power system with a large share of renewable energy sources such as wind and solar power plants.