Thermomechanical low cycle fatigue involving the elastic-plastic deformation is the basic failure mechanism of many machine components operating at elevated temperatures. Such elements may include, among other: power boilers, boiler pipes, heaters, engine parts, forging dies, etc. Operating temperatures for steel these elements are made of come to 600^0 C.

The basis for fatigue life predictions of this type of components is knowledge of the basic low cycle fatigue characteristics obtained at elevated temperatures. These characteristics are most often determined for the so called stabilization period. If this period does not occur, these characteristics are determined from the period corresponding to half of the fatigue life. Therefore, they do not include interactions between fatigue load and temperature, and their influence on the evolution of low cycle fatigue characteristics. For this reason, there is a significant dispersion between the results of calculations and experimental testing when the fatigue life of structural components subjected to variable load at elevated temperatures is predicted. Necessary for the structural elements reliability is in such case achieved by selecting high safety factors.

The predictions of the fatigue life are associated with the issue of fatigue damage evolution and the need to adopt an appropriate hypothesis of fatigue damage cumulation. Due to the phenomenon of material cyclic softening or hardening taking place during low-cycle fatigue of metals, and frequent lack of a clear stabilization period, the problem of damage accumulation becomes difficult to describe even for structural elements subjected to variable loads at room temperatures. It becomes even more complicated when the process of low cycle fatigue no longer depends only on the material properties and on the load program, but also on the variable ambient temperature. In such conditions the change of the material properties is the result of interaction between mechanical and thermal fatigue mechanisms. In practice, for both mechanical and thermal types of fatigue the same calculation models are often used. It is however not possible to apply them to all metals. Changes in temperature may in fact cause the changes in the mechanical properties as well as changes in the microstructure of the material. Furthermore, the rate of deformation due to thermal pulse is most often significantly lower than the rate of the mechanical deformation.

One of the reasons for the unsatisfactory effectiveness of current methods for assessing the structural components durability in variable loading conditions at elevated temperatures is certainly disregarding in the simulations of cyclic properties evolution. Basing on low cycle fatigue tests conducted at room temperature, it was found that taking this evolution into account when calculating the fatigue life can significantly reduce the existing disparity in results of calculations and experiment. Considering that at elevated temperatures the scope of changes in cyclic properties can often be much larger, it seems that proper modeling of cyclic properties evolution will significantly contribute to improving the compatibility of the calculation results and experiment.

The **research problem** of the project is a quantitative and qualitative description (constitutive and numerical) of cyclic changes in the structural steel properties at variable load at elevated temperatures, and its **essence** is to answer the question whether the course of these changes can be predicted on the basis of the results of normative (constant amplitude) testing? Preliminary studies and literature reports allow to presume that such a possibility exists. However, formulating general conclusions requires benchmarking analysis of different load cases at different temperatures.

The **scientific goa**l of the project is developing constitutive modeling of materials subjected to cyclic loading under conditions of elevated and variable temperature.

The **final** result of the project will be a new constitutive model of material subjected to low cycle fatigue in nonisothermal temperature field, in which the process of fatigue damage accumulation in a natural way is associated with the course of the cyclic material properties evolution affected by changing temperatures.