Objectives

The aim of the project is to investigate material behaviour of improved materials for the application in highly efficient and highly flexible future power plants with steam temperatures up to 725 °C. These materials promise a reduction in manufacturing costs as well as an increase in flexibility by providing enhanced creep strength and therefore the possibility for wall thickness reduction.

The material transition area (ferritic/bainitic and martensitic materials to Ni-based alloys) in the boiler membrane wall of a 725 °C power station is a critical area therefore the connection of Ni-based alloys to conventional ferritic/bainitic and martensitic materials (HR6W – T24 / HR6W – T91/T92 / Alloy 617B – T24 / Alloy 617B – T91/T92) will be investigated in the proposed project. In accordance with the future expected design point, this connection will be investigated by means of membrane test panels. This connection is extremely challenging and of essential importance for future projects. Not only because of the different physical properties of the two welded materials, but also because of the huge dimension of this connection weld, completely around the combustion chamber (boiler wall). In addition a further key investigation in the proposed project is the exit header in the live steam system, the component with the highest load situation and highest thermal stresses. This component should therefore be manufactured using material with ultra-high creep strength; a promising material is the Ni-based Alloy 740H. By choosing a material of higher quality for this header, the connection to the steam pipe downstream can be made with an equal geometry which limits the stresses in this connection. The subsequent steam pipe will be also made from a Ni-based Alloy with a less expensive chemical composition.

The concept of an exit header with different material requires the investigation of the transition within the thin walled area from A617B resp. HR6W to A740H and in the thick walled area (after the header) between Alloy 740H and Alloy 617B resp. Alloy 263 as pipe materials.

Material data will be collected in laboratory tests in order to describe the behaviour of base materials and welds under operational conditions. The data will be implemented into numerical models to evaluate the stress strain behaviour of components out of these materials, along with their welds. The completion of the material investigation will be a field test to observe the component behaviour made of these materials under real operating conditions. The field test will be the integration of components into the test rig "725 HWT GKM", phase III. This project is currently in the application phase and will - start at the beginning of next year. This test rig provides the unique possibility of a cost-efficient implementation of high-temperature components into the steam cycle of a real currently operating power plant.