

TOPFLOW - a new multipurpose test facility for the study of transient two-phase phenomena

Abstract

TOPFLOW is an acronym standing for Transient Two Phase FLOW Test Facility. It is designed for generic and applied studies of transient two phase flow phenomena in power and process industries. The fluid is either steam-water or air-water mixture. TOPFLOW stands in the tradition of single-effect tests in large-scale models of safety relevant components of nuclear plants performed at the NOKO test facility, which was successfully operated at the Forschungszentrum Jülich for many years. The new test facility in Rossendorf was constructed using parts of NOKO, which was dismantled in 2001. The electrical heater and the condenser tank were transferred to the new site in Rossendorf and completed by a number of new components.

Meanwhile, in the end of 2002 the facility was commissioned and reached its working parameters of 7 MPa and the corresponding saturation temperature of 286 °C. The maximum steam mass flow is about 2 kg/s, produced with an electrical heater of 4 MW. The maximum water mass flow is 50 kg/s. A simplified scheme of the TOPFLOW facility is given in fig. 1. Between the heat source and the heat sink different test sections can be operated. Presently, TOPFLOW is equipped with three main experimental components. These are:

- Two vertical pipes, nominal diameter DN50 and DN200, both 9 m tall, the corresponding maximums of the L/D-ratios are 45 for DN200 and 180 for DN50.
- The condenser, which can be used to study the behaviour of passive safety systems for nuclear reactors. This vessel is 6 m long, the diameter is about 2 m, it has a volume of 18 m³, the condenser tube bundle can transfer the full heater power.
- The steam drum (L = 5 m, D = 1.5 m, V = 8 m³, p ≤ 7 MPa).

In the vertical pipe with DN200 the following superficial phase velocities can be reached: $J_{\text{steam}} < 2.2$ m/s at 7 MPa and $J_{\text{steam}} < 15$ m/s at 1 MPa, $J_{\text{water}} < 1.9$ m/s. The water flow is generated by test section pump, which is circulating the water through the test sections and the steam drum. The steam is supplied by the steam generating system consisting of the electrical heater, the circulation pump and the cyclone separator. The two-phase flow is generated by injecting the steam at the bottom of the test sections. After leaving the vertical test sections, the two-phase mixture is separated in the steam drum. The steam is condensed, i.e. the condenser test facility is used as a component of the heat sink.

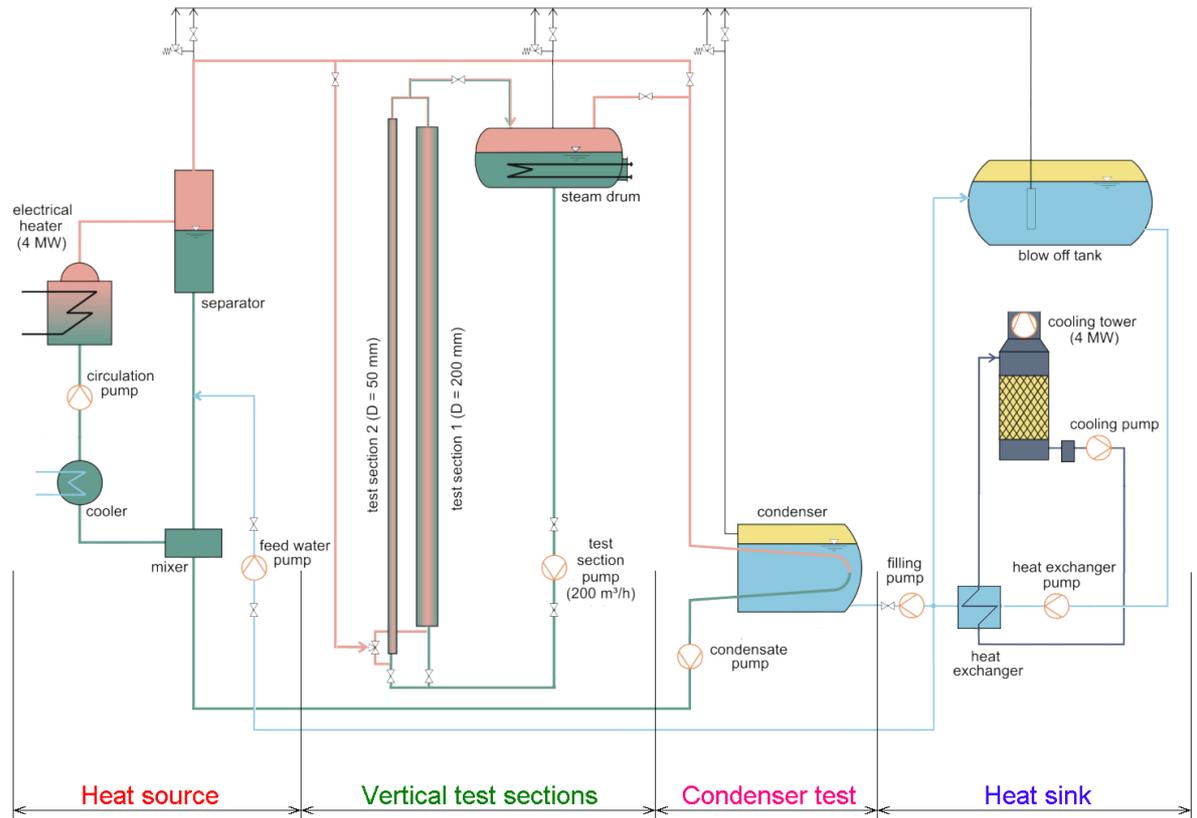


Fig. 1 Scheme of the thermal-hydraulic test facility TOPFLOW (without pressurized air supply)