framatome

BENSON

Thermal-Hydraulic Separate Effects Tests

A unique loop for single-phase and two-phase flow applications investigated up to supercritical pressure conditions

Challenge

Investigating a wide variety of separate thermal-hydraulic effects, while achieving maximum operational flexibility for single- and two-phase operations at high-temperature and high-pressure conditions up to supercritical pressure conditions, is required for process optimization, components qualification, analysis of single effects and code validation. It requires a powerful and flexible test facility and measurements method.

Solution

We operate a high-pressure test facility with a unique in the world flexibility and range of applications in order to fulfill efficiently all your testing requirements. All kinds of test objects can be installed in the facility and can be heated using a powerful direct current power supply. A wide variety of separate thermal-hydraulic effects can be investigated, such as:

- Heat transfer
- Critical heat flux
- Water / steam distribution
- Guaranteed thermal performance data
- Pressure drop
- Natural circulation limits
- Leakage rates
- Fouling
- Magnetite layer formation and behavior.

With the test facility, we can investigate any issue of power generation with fossil, nuclear and renewable energy sources, as well as other applications.

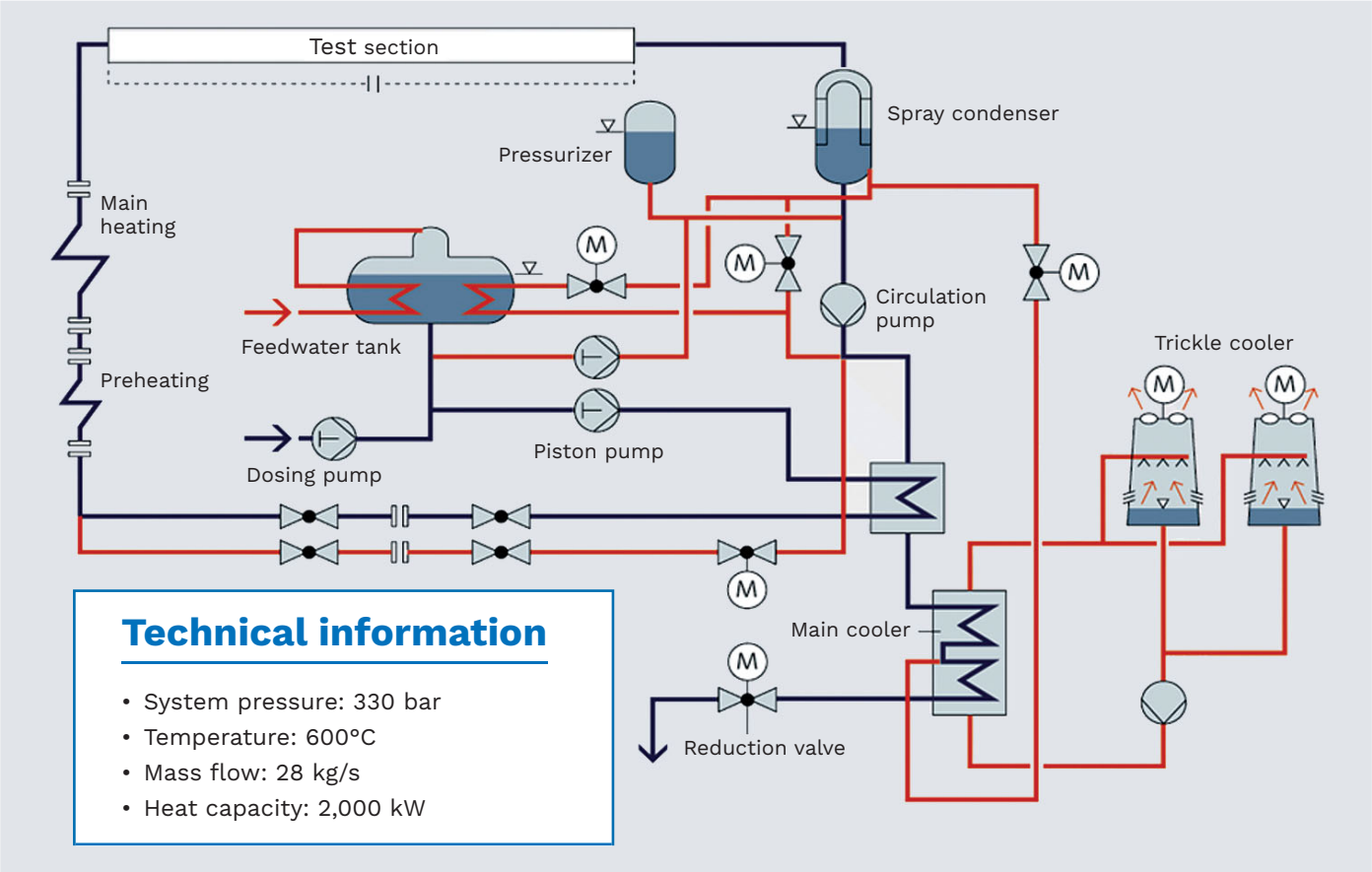
Benefit from our broad-based knowledge of all facets of water, water / steam and steam flows to ensure that all tests are performed in a proficient manner. Over 40 years of experience in this field enable us to process the test results so that they are suitable for use either in direct clarifying separate effects issues or as boundary conditions for numerical simulations.

Typical test set-up

Customer benefits

- Test facility with maximum flexibility – unique in the world and applicable for nuclear, fossil and renewable projects in order to meet all your needs
- Extended possibilities with access to the Framatome thermal-hydraulic worldwide platform
- Reliable test results through accreditation as test and inspection body in accordance with ISO 17025 and 17020, accepted by ILAC

Your performance
is **our** everyday **commitment**



Flow diagram of high-pressure test facility

References

Reactor system thermal-hydraulics

- Separate effect tests for condensers of next-generation reactors
- Heat transfer tests on a steam generator tube for fouling aspects
- Investigations of fuel assembly cladding tube temperatures and pressure drop using a 5x5 rod bundle from a pressurized water reactor)
- Studies of the Three Miles Island 2 accident
- Verification of the cooling function in the EPR reactor core melt spreading area
- KERENA Boiling Water Reactor exterior vessel cooling concept safety margins

Power, process and renewable energy applications

- Investigation of heat transfer and flow behavior for direct solar steam generation by absorber/evaporator tubes in concentrated solar power (CSP) plants
- Heat exchanger performance tests
- Validation of multi-phase flow steam quality and mass flow sensors
- Code validations for the hydraulic systems of the power and process industries
- Development of advanced local multi-phase flow measurement techniques

BENSON steam generators

- Performance of experimental investigations of heat transfer and pressure drop in vertical, inclined and horizontal smooth and rifled tubes heated either uniformly or on one side for BENSON licenses
- Experimental results used to develop and validate the computer codes ATHUN and DRUBEN; these codes run as subroutines in boiler design programs in the fossil-fired power generation field
- Largest database in the world for critical heat flux, heat transfer and pressure drop

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