Profile SFR-29

DRESDYN

GERMANY

GENERAL INFORMATION

NAME OF THE FACILITY	Dresden sodium facility for dynamo and thermohydraulic studies
ACRONYM	DRESDYN
COOLANT(S) OF THE FACILITY	Liquid sodium
LOCATION (address):	Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Institute of Fluid Dynamics, MHD Department, Dresden, Germany
OPERATOR	HZDR
CONTACT PERSON (name, address, institute, function, telephone, email):	Gunter Gerbeth, HZDR, Bautzner Landstr. 400, 01328 Dresden, Germany, Head of Institute of Fluid Dynamics, Tel. + 49 351 2603480, g.gerbeth@hzdr.de

STATUS OF THE FACILITY Under Construction
Start of operation (date): 2020

MAIN RESEARCH FIELD(S)

- ☐ Zero power facility for V&V and licensing purposes
- ☐ Design Basis Accidents (DBA) and Design Extended Conditions (DEC)
- ☒ Thermal-hydraulics
- ☐ Coolant chemistry
- ☐ Materials
- ☐ Systems and components
- ☒ Instrumentation & ISI&R

TECHNICAL DESCRIPTION

Description of the facility

In the first instance, DRESDYN is a platform for experimental studies related to the hydromagnetic dynamo effect and the magnetorotational instability (MRI), which both are of fundamental relevance to geo- and astrophysics [1,2]. For these experiments, a total sodium inventory of 12 tons will be available.

Besides of these basic research experiments, DRESDYN will also comprise experiments for the development and safety evaluation of sodium cooled fast reactors, in particular for the measurement and visualisation of single and two-phase sodium flows. The main focus lays on the following three issues:

1. Development and test of various measurement techniques for the in-service inspection (ISI) of constructional components and of flow parameters such as flow rates and gas fractions (ultrasonics, electromagnetic flow tomography).

2. Experiments on gas entrainment effects and of the subsequent transport of gas in the liquid sodium using appropriate visualization techniques (electromagnetic induction tomography, X-ray visualization, ultrasound).

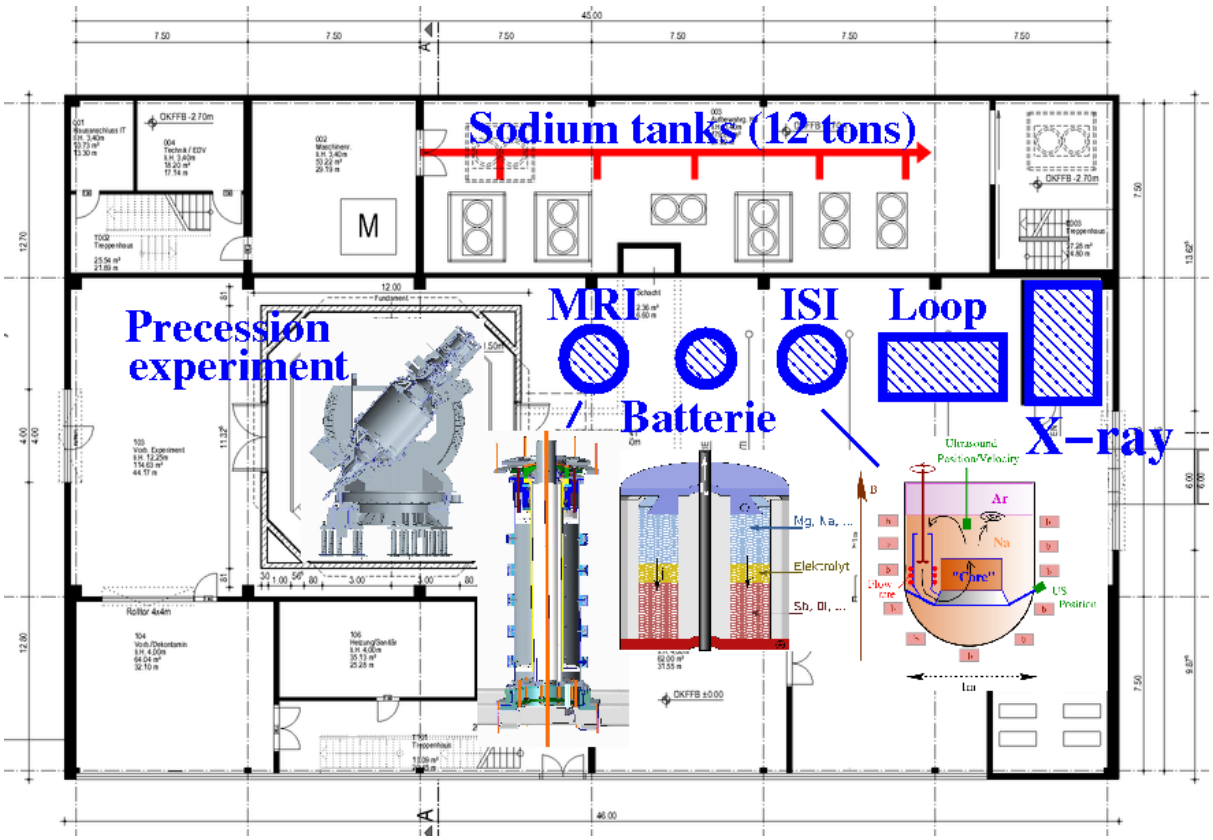
3. Experimental studies of magnetic instabilities and self-excitation, in particular in connection with the presence of magnetic materials in the reactor core.

The details of the experimental set-ups for the corresponding investigations are in the design phase and partly still under discussion.

Acceptance of radioactive material

No

Scheme/diagram



3D drawing/photo

Status of the construction of the DRESDYN building as of September 2018

Parameters table

Coolant inventory	Max Na inventory: 12000 kg
Power	1 MW
Experiments	The following experiments are planned in frame of DRESDYN: - A large-scale precession driven dynamo experiment. - The MRI/TI experiment for the investigation of various magnetic field driven instabilities. - A sodium loop with an inventory of 100-200 Litre. - An ISI (In-Service Inspection) experiment for the investigation of special flow phenomena and the test and development of various measurement techniques. - An X-ray lab for the visualization of sodium gas two-phase flows and the solidification of liquid metals. - An experiment for test and development of liquid metal batteries. Further details cannot be specified as all experiments are still in preparation. The first two experiments are already in the technical design phase [2], whereas the others are in the phase of scientific definition and design. The construction phase of the DRESDYN building is finished.

COMPLETED EXPERIMENTAL CAMPAIGNS: MAIN RESULTS AND ACHIEVEMENTS

The facility is presently under construction

PLANNED EXPERIMENTS (including time schedule)

The basic set-up with relevance to Sodium Fast Reactors will be a mock-up of a reactor vessel with a number of constructional elements, in particular a primary sodium pump and a core-like structure. At this mock-up, various measurement techniques for telemetry, flow rate and gas fractions will be tested. For this purpose, the expertise in Ultrasonic Doppler Velocimetry (UDV) for single [3] and two-phase flows [4], on the Contactless Inductive Flow Tomography (CIFT) [5], and on contactless flow-rate sensors [6, 7] will be exploited.

There will be the possibility to inject argon bubbles into this pool and to study the motion of these bubbles under a variety of flow conditions. Of particular interest will be the possibility of gas entrainment at the free sodium surface [8] due to high flow velocities at the suction side of the pump. Such gas entrainment likely occurs only in case of a very strong vortical melt motion. Some conditions for such a kind of “liquid metal tornado” were recently studied at HZDR [9].

For the two-phase flow case a sensor system for magnetic inductance tomography (MIT) will be developed and tested in close collaboration with the group of A. Peyton in Manchester [10].

TRAINING ACTIVITIES

Possible, but not yet planned.

REFERENCES (*specification of availability and language*)

[1] F. Stefani, S. Eckert, G. Gerbeth, A. Giesecke, Th. Gundrum, C. Steglich, T. Weier, B. Wustmann, “DRESDYN – a new facility for MHD experiments with liquid sodium”, Magnetohydrodynamics 48, 103-13 (2012). (En)

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[3] S. Eckert, G. Gerbeth, "Velocity measurements in liquid sodium by means of Ultrasound Doppler Velocimetry", Exp. Fluids 32, 542-546 (2002). (En)
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[5] F. Stefani, T. Gundrum, G. Gerbeth, "Contactless inductive flow tomography", Phys. Rev. E 70, 056306 (2004). (En)
[6] J. Priede, D. Buchenau, G. Gerbeth, "Contactless electromagnetic phase-shift flowmeter for liquid metals", Meas. Sci. Technol. 22, 055402 (2011). (En)
[7] N. Krauter, F. Stefani, "Immersed transient eddy current flow metering: a calibration-free velocity measurement technique for liquid metals", Meas. Sci. Technol. 28, 105301 (2017). (En)
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