

Profile SFR-2

ESPRESSO

CHINA

GENERAL INFORMATION

NAME OF THE FACILITY ESPRESSO
ACRONYM ESPRESSO
COOLANT(S) OF THE FACILITY SODIUM
LOCATION (address): China Institute of Atomic Energy(CIAE),FangshanDistrict,Beijing,China
OPERATOR CIAE
CONTACT PERSON (name, address, institute, function, telephone, email): XU Yijun, China Institute of Atomic Energy, Department of Fast Reactor Research and Design, Tel:+86-10-69358195,Mail:juntaxu2008@163.com

STATUS OF THE FACILITY Standby
Start of operation (date): 1976

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

As one of the few large-scale high temperature sodium test loop in the world, the ESPRESSO loop has two functions for the rod tests: One is the high temperature lasting test for fuel subassembly or other subassembly simulators and the other is the thermal shock experiment for the fuel rods. For example, some new design and fabricated fast reactor subassembly simulators should be operated in the test loop for a long time to simulate the practical operation condition of the real reactor. The thermal shock test can also be used to check the mechanical characteristics of the fuel subassembly when the reactor is in accident

conditions or non-typical operation condition. The biggest temperature difference can reach 200°C in the test sections.

The ESPRESSO test loop consists of a main loop and some auxiliary loops, including the sodium filling loop, sodium purification loop, argon gas covering loop and emergency power supply system and so on.

The main loop consists of a perpendicular pump (P. M), two parallel arranged test sections for plugging fuel assembly models, an electrical heater R3 and a tube-type air cooler RF. Mechanical pump supplies the coolant sodium to the test sections by means of a pipe with a diameter of 4 inch. The sodium that drains out of the two test sections flows through heater R3 and a tube type air cooler into the expansion vessel at the same time.

The 2-inch diameter bypass pipe of test sections are equipped with electric control valve, while the entrance of test sections is loaded with two electrical pneumatic shut-off valves, so the thermal shock test can be taken place in the two test sections for fuel rod simulators.

In order to measure the pressure drop along the entire loop and the pressure loss from the lower end to the upper one of test section, pressure meters are equipped between the sodium entrance and exit of two test sections and the expansion vessel .

For realizing thermal shock in a required manner, each entrance of test sections is equipped with an electromagnetic flow meter, while another permanent magnet type flow meter is installed in the test section and bypass pipes.

The sodium filling and discharging loop consists of a storage tank (SD), an electromagnetic pump (PEM1), a sodium filter (FNaI) and a 50mm diameter pipe and a 20mm diameter pipe. It is connected with the main loop in a manner so the sodium can be filled to loop from the lower part. Thus, the risk of large amounts of gas stagnated in the loop can be avoided.

Purification loop is connected to entrance and exit of the main loop in the expansion vessel, it is composed of following facilities: one single electromagnetic pump (PEM2), two alternative cold traps (PF1, PF2), one blocking meter (IB) and one permanent magnetic flow meter (DPI). The diameter of pipes in purification loop is 20 mm.

In the loop, the free surfaces of following facilities are filling with argon which is used to cover the facilities:

- two test sections
- main heater
- expansion vessel
- sodium filling-discharging tank

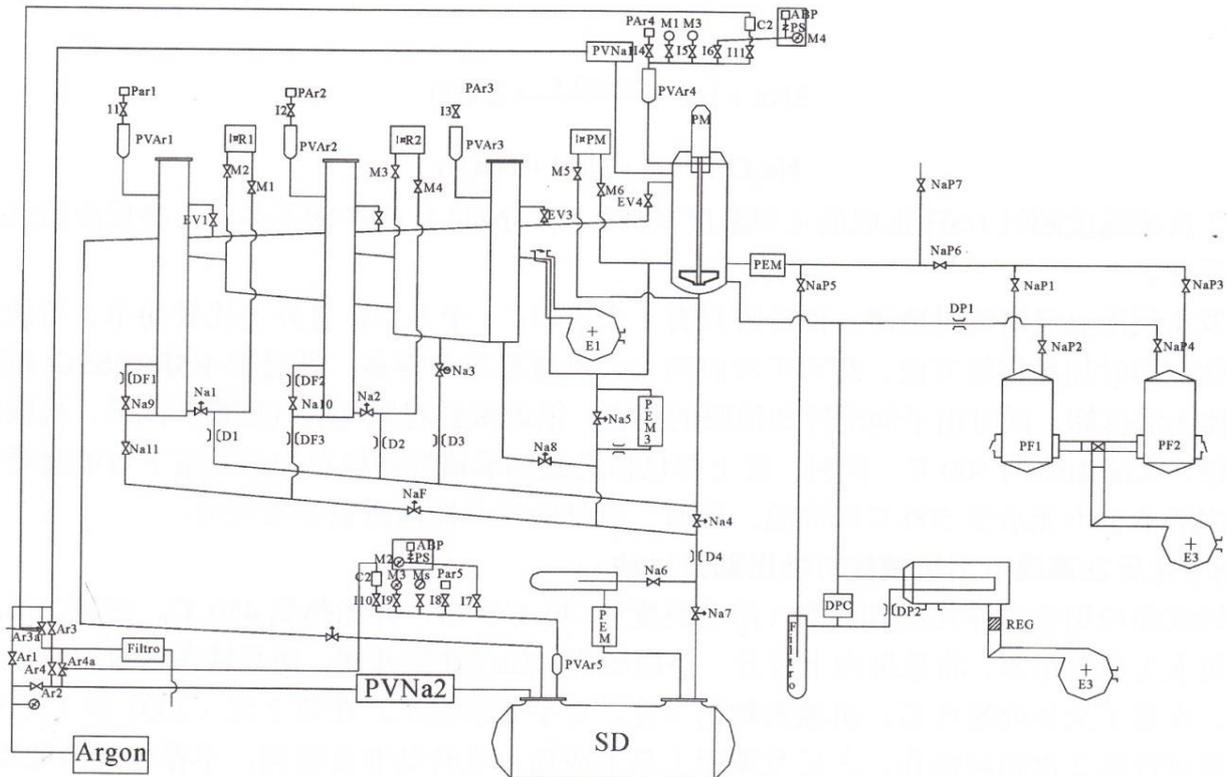
The free surfaces of the above-mentioned facilities are covered by the same pressure through a balance pipe with 50mm diameter, which is also used as the overflowing pipe. when sodium flows into the loop and the loop isn't in operation, the free surfaces of every facility has the same height. To measure the pressure of covering gas, every equipment is equipped with pressure meter.

To prevent sodium from solidification and blocking, all of pipes that the sodium flow through in the loop is equipped with electric heater. The outside surface of the heater is covered with asbestos to keep warm and the temperature of the insulating layer is about 40°C-70°C. At the same time there is a 0.8mm thick protective case made of Galvanized Steel Sheet outside the insulating layer.

Acceptance of radioactive material

No

Scheme/diagram



P. M -perpendicular pump D1/D2 -electromagnetic flow meter
 SD -storage tank PEM1-- electromagnetic pump FNaI -- sodium filter
 PF1/PF2--cold traps DPI--permanent magnetic flow meter R1/R2--test sections

FIG. 1. The flow chart of the ESPROSSO loop

3D drawing/photo

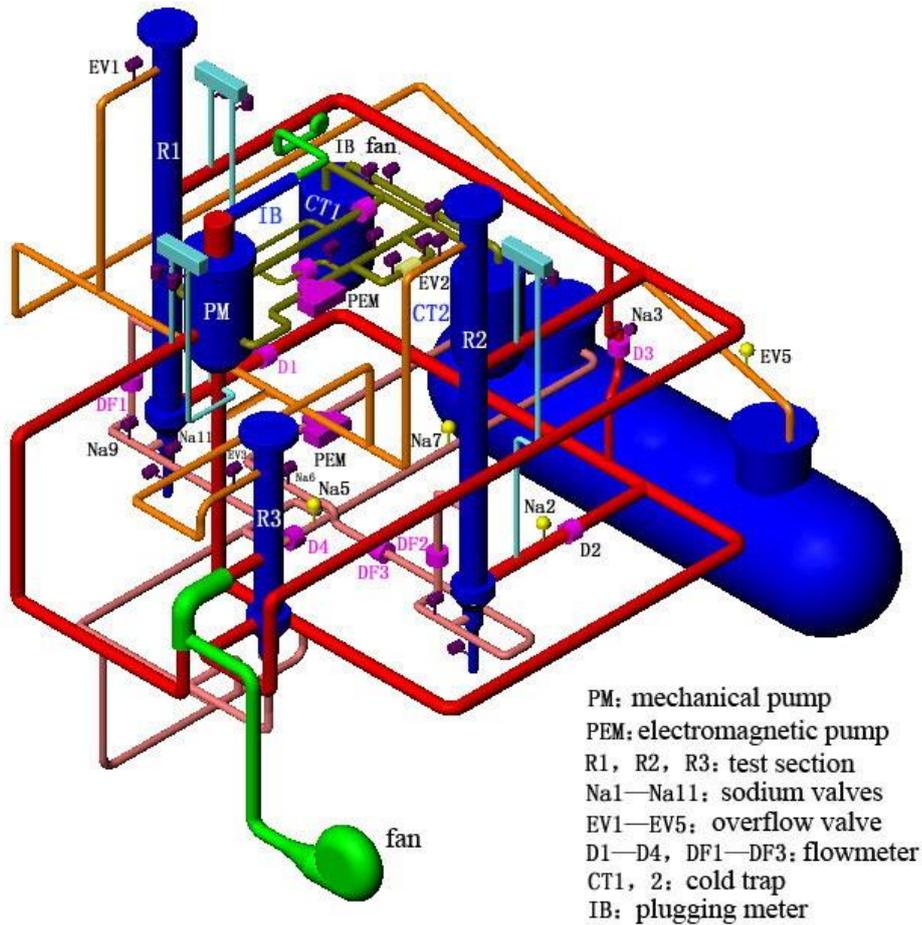


FIG. 2. The ESPROSSO loop

Parameters table

Coolant inventory	3180kg
Power	Max 450 kW
Test sections	
TS #1	<u>Characteristic dimensions</u> Outside diameter 202 mm Overall height →4500 mm
	<u>Static/dynamic experiment</u> Dynamic
	<u>Temperature range in the test section (Delta T)</u> 400 °C-600 °C
	<u>Operating pressure and design pressure</u> Operating Pressure →0.7MPa Design pressure →1.0MPa
	<u>Flow range (mass, velocity, etc.)</u> The rated sodium flowrate is 112m ³ /h The maximum sodium flowrate is 140m ³ /h
Coolant chemistry measurement and control (active or not,	There are two cold traps in the circuit to guarantee the sodium purification process on line.The plugging temperature in the meter is lower than 130 °C when the circuit is on operation. The off-line measurement of the oxygen content dissolved in the

measured parameters)	melt can be used and the limits for this is lower than 12ppm.
Instrumentation	Thermocouples, pressure transducer, Gas injection system, flow meters,

COMPLETED EXPERIMENTAL CAMPAIGNS: MAIN RESULTS AND ACHIEVEMENTS

ESPRESSO test loop rebuilt in CIAE from 1995 to 2000. After that it was in commissioning with sodium in 2005. Then the loop was on standby until the CEFR steel shielding rod and reflecting rod thermal shock tests began since 2007 year.

For CEFR steel shielding rod and reflecting rod, it was made in China. It is very necessary to have the high temperature lasting test to investigate the structure integration of the rods before these rods were put into the reactor. The results shown that the distortion of rods are very small compared with that of the one before the tests.

PLANNED EXPERIMENTS (including time schedule)

Neither the new fuel rods subassemblies nor the other steel shielding rods, they should have the high temperature lasting tests before they are put into the reactor. So in the future, homemade rods will be tested in this facility and a series of tests including thermal shock tests will be done.

TRAINING ACTIVITIES

Training activities can be available for the ESPRESSO facility, especially for the new staff of reactor operators and sodium loop designer and researcher.

REFERENCES (*specification of availability and language*)

- [1] BASILI R., VEL-ISBRA-ELNOC , Operation Manual of ESPRESSO loop , 1987.3, VI-WGB00006, ENEA - Brasimone Research Centre (Italy).
- [2] BASILI R., STORAI S., Maintenance Manual of ESPRESSO loop , 1987.10, VT-WGB00029, ENEA - Brasimone Research Centre (Italy).