

Profile SFR-7

SIPHON

CHINA

GENERAL INFORMATION

NAME OF THE FACILITY Siphon broken device test rig
ACRONYM SIPHON
COOLANT(S) OF THE FACILITY WATER
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](tel:+86-10-69358195),Mail:juntaxu2008@163.com

STATUS OF THE FACILITY Standby
Start of operation (date): 2003

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 a specific safety facility of primary sodium purify system of CEFR (China Experiment Fast Reactor), the Siphon broken device will be put into operation when the double-end rupture (large break) accident of the pipes takes place in the primary sodium purify system which is located outside of reactor. The purpose of the Siphon broken device is to stop or relieve the accident as soon as possible when it happens and cuts the leakage of sodium lowest by passively discharging the gas of air cavity out of the reactor quickly, reduces the pressure in the reactor and breaks the Siphon.

As the Siphon broken device has not been used in reactor ever before, the experience of actual use and necessary experiment data is limited. So it is necessary to design such a verification experiment to define its effect of Siphon broken.

The test facility basically consists of Siphon broken device model, hot sodium pool simulation vessel, cold pool simulation vessel and two connecting perpendicular pipes between them, water loop, gas loop, test instruments and data collection system.

Siphon broken device model mainly consists of the internal components of the pipelines of purification system which provide sodium, such as sodium accessing pipe, protective thimble and sodium inlet orifice plate, and sodium return system including sodium returning pipe and protective thimble and so on. In order to observe the siphon phenomena, all the components are made of plexiglass, the external diameter of the sodium accessing pipe and sodium returning pipe is 90 mm, the thickness is 5 mm, the external diameter of the protective thimble is 135 mm, the thickness is same as the sodium accessing pipe and sodium returning pipe, and the aperture of the sodium inlet orifice plate is 50 millimetre. In addition, two level plexiglass pipes and one perpendicular plexiglass pipe in the exterior part of pipeline are used, which external diameter and thickness are 90 millimetre and 5 millimetre, respectively. At the same time, a same scale plexiglass pipe in sodium returning pipeline near the cold pool is used.

Acceptance of radioactive material

No

Scheme/diagram

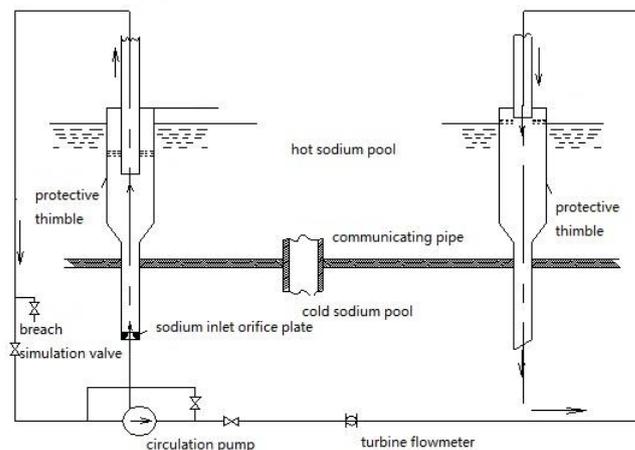


FIG.1. Schematic diagram of the Siphon test

3D drawing/photo



FIG. 2. The SIPHON test rig

Parameters table

The main parameters of test facility as follow:

Coolant inventory	Water ,about 6 tons
Power	Max 50 kW
Test sections	
TS #1	<u>Characteristic dimensions</u> Outside diameter 125 mm Overall height →6500 mm
	<u>Static/dynamic experiment</u> Dynamic
	<u>Temperature range in the test section (Delta T)</u> The maximum operation temperature is 65°C
	<u>Operating pressure and design pressure</u> Operating Pressure →0.25MPa (gauge) Design pressure →0.4MPa (gauge)
	<u>Flow range (mass, velocity, etc.)</u> The water flow rate can be got from 0 ~20m ³ /h
Coolant chemistry measurement and control (active or not, measured parameters)	The coolant in the loop is desalination water. The off-line measurement of the various hydronium concentration in the water can be used. Among them, the Cl ⁻ is lower than 2.5μg/L and Na ⁺ is lower than 5μg/L and the conductance of the water is lower 2.

COMPLETED EXPERIMENTAL CAMPAIGNS: MAIN RESULTS AND ACHIEVEMENTS

The design verification experiment of Siphon broken device in CEFR was carried on the facility using water and air as working medium.

First, the steady experiments were performed when the outlet sodium pipes were the same as the original of CEFR. Using the different initial conditions, 37 cases of Siphon broken simulation experiments were carried out. The experiments results can show us the time-varying characteristics of pressure inside the reactor, the level of hot pool and leakage flow type of the liquid.

It was indicated that original design did not reach the limited discharging flow of sodium but also existed some issues that may affect the normal operation and safety of the reactor. So, some design were modified and a various tests were carried out again to verify the design.

The last results of the tests indicated that the modification is successful. The modification improved the origin design problems, eliminated the emphasis hidden danger of reactor, confirmed the reasonable and perfect geometry constructor and dimension of Siphon broken device's interior components, and provided the test evidence for the construction design of the device.

PLANNED EXPERIMENTS (including time schedule)

In the future, about the siphon broken device of the CFR600, a serial of experiments can be carried out to verify the design.

TRAINING ACTIVITIES

Training activities can be agreed with CIAE for operation and experimental researches under the supervision of CIAE qualified staff.

REFERENCES (*specification of availability and language*)

- [1] CEFR siphon test reports , 2003,CIAE technical reports for CEFR, Chinese language .
- [2] Design and layout of the SIPHON test rig, CIAE technical reports for CEFR, 2002, Chinese language .