Profile SFR- 40

SADHANA

INDIA

NAME OF THE FACILITY	SAFETY DECAY HEAT ANALYSIS IN NATRIUM LOOP
ACRONYM	SADHANA
COOLANT(S) OF THE FACILITY	Sodium
LOCATION (address)	Fast Reactor Technology Group (FRTG), Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam, India
OPERATOR	FRTG, IGCAR
CONTACT PERSON	Dr. P. Selvaraj, Director, Fast Reactor Technology Group, Indira Gandhi Centre for Atomic Research, Kalpakkam – 603102, India, +91 44 27480083, pselva@igcar.gov.in
STATUS OF THE FACILITY	In operation
Start of operation (Date):	2009

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

Loop is constructed to demonstrate the passive decay heat removal system of PFBR. This is a 1:22 scaled model of Safety Grade Decay Heat Removal system of PFBR by adopting Richardson number similitude. The test vessel-4 with immersion heaters of 450 kW capacity simulates the main vessel of PFBR with decay heat from reactor core. The decay heat exchanger is located inside the test vessel. Air heat exchanger is located at 19 m elevation. A chimney induces natural draft. Maximum operating temperature of loop is 550°C and so far loop has operated for 4,000 h. Material of construction is SS 316L.

ACCEPTANCE OF RADIOACTIVE MATERIALS - No

Scheme/Diagram

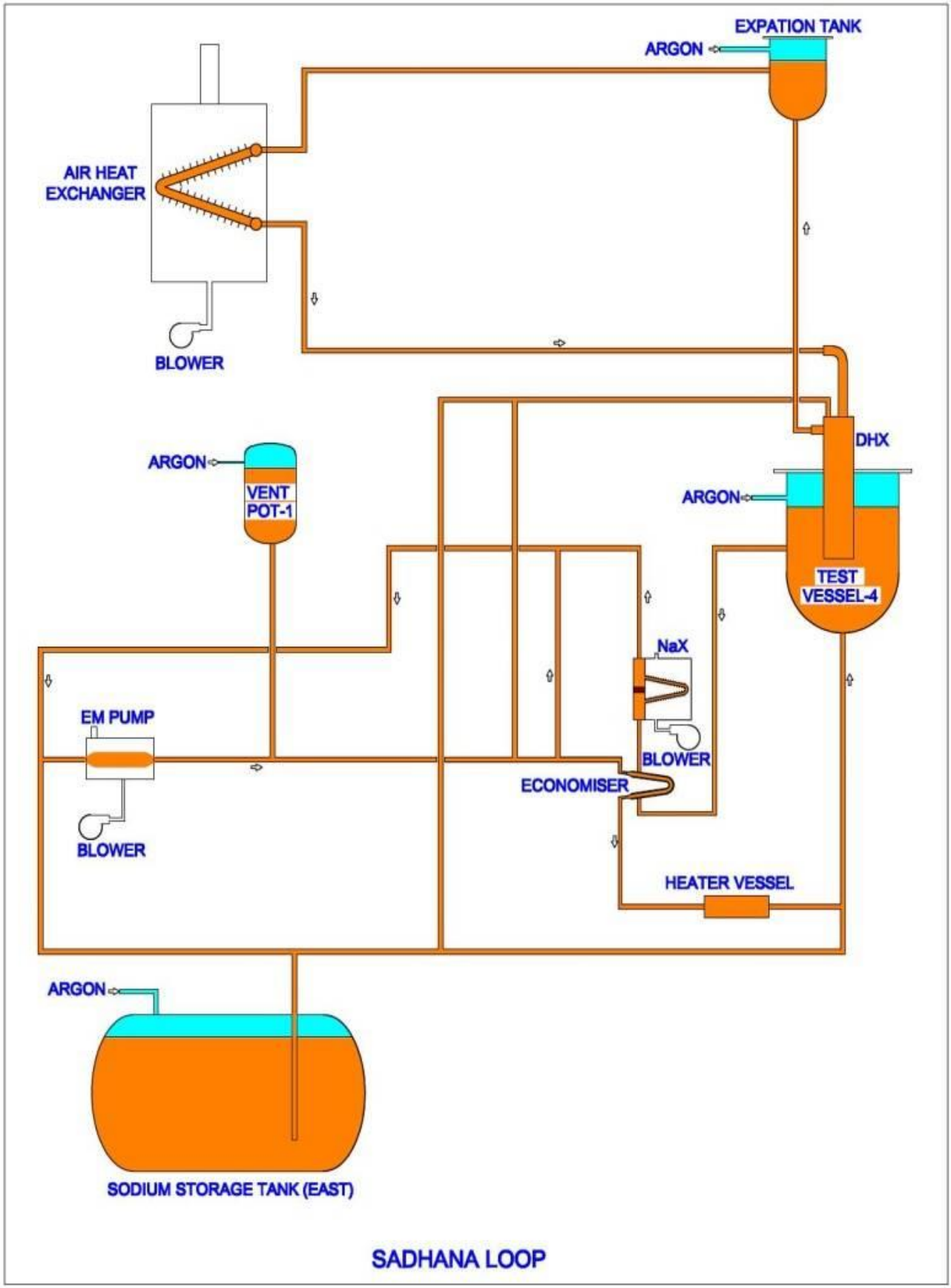

FIG. 1. Scheme of SADHANA loop

3D Drawing/Photo

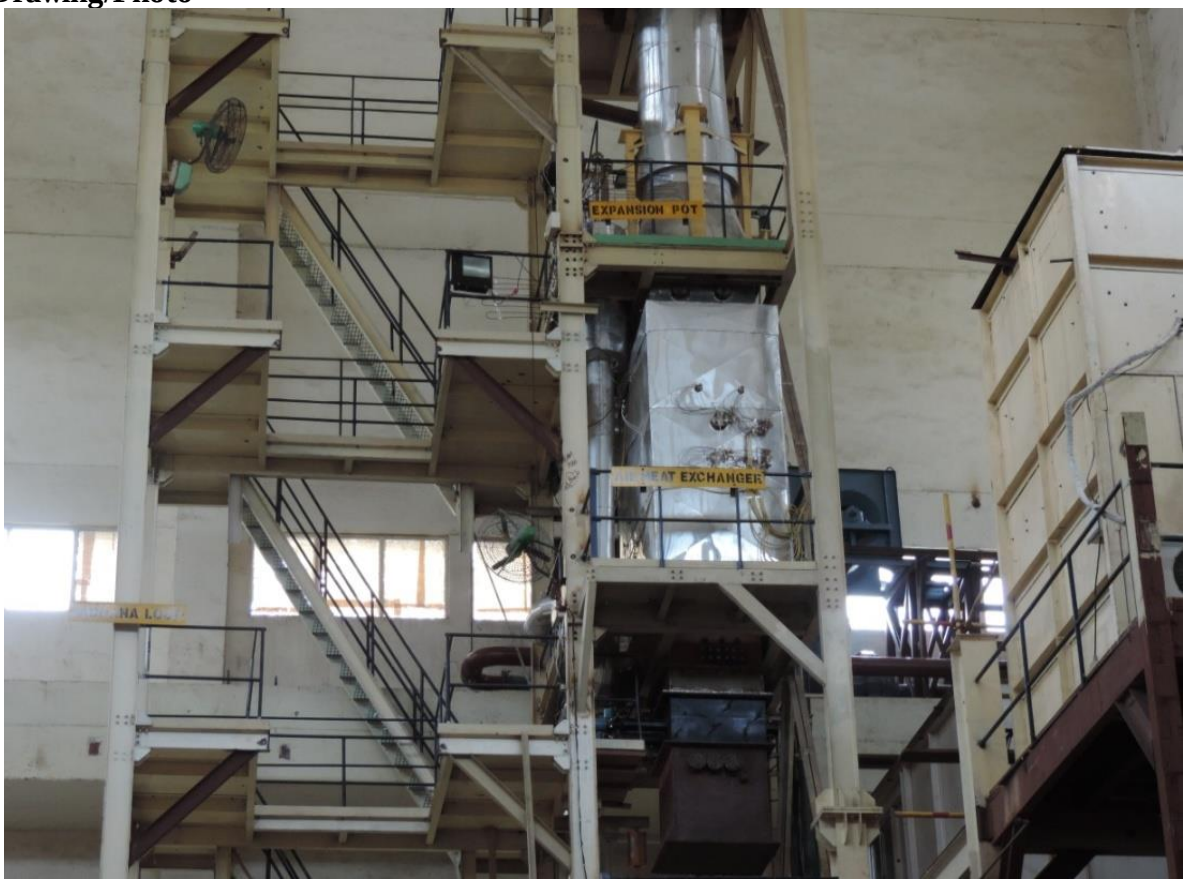

FIG. 2. SADHANA Structure with AHX and Expansion Pot

FIG. 3. Test Vessel-4 with Decay Heat Exchanger

Parameters table

Coolant inventory	5 tonnes of sodium
Power	Heater vessels with a total power of 440 kW
No of test sections	One
Test sections	
	Characteristic dimensions Test Vessel of 3m tall and 1 m outer diameter.
	Static/Dynamic experiment Dynamic
	Temperature in the test section 300 to 550°C
	Operating pressure and design pressure Operating pressure : 0.2 bar (g) Design pressure : 4 bar (g)
	Flow range (mass velocity etc) Sodium flow ≈ 7 m^3/h
Coolant chemistry measurement and control (active or not, measured parameters	Coolant is not active Coolant purity is maintained by cold trapping and monitored using online plugging indicator, and periodical sampling and analysis
Instrumentation	Thermocouples for temperature measurement Wire type and spark plug type leak detectors, and sodium aerosol detectors for sodium leak detection Resistance type discontinuous and mutual inductance type continuous level probes for monitoring sodium level

COMPLETED EXPERIMENTAL CAMPAIGNS: MAIN RESULTS AND ACHIEVEMENTS

Steady state experiment for evaluating the heat transfer capacity was completed. Heat removal capacity of Type A DHX and Type-A AHX was assessed. Transient condition of sudden full opening of the AHX side damper was simulated and the heat transfer capacity at these transient was evaluated. Similarly, heat removal capacity of AHX during partial opening of damper was also evaluated. In addition air flow distribution in the AHX shell side was studied. Behaviour of SGDHR system during SCRAM conditions and during station black out conditions were completed.

PLANNED EXPERIMENTS (including time schedule)

Performance testing with Type A AHX and Type B DHX [different type] is planned [July 2019 – Mar 2020]

TRAINING ACTIVITIES

Training activities can be agreed with IGCAR Kalpakkam for the operation of experimental campaign under the supervision of IGCAR qualified staff.

REFERENCES (*specification of availability*):

1. Calibration of an averaging pitot tube by numerical simulations; Flow Measurement and Instrumentation; Vol – 24, pp. 26-28 (2012).
2. SADHANA facility for simulation of natural convection in the SGDHR system of PFBR, Progress in Nuclear Energy, 66 (2013).
3. Experimental evaluation of safety grade decay heat removal in prototype fast breeder reactor, Nuclear Engineering and design, 265, 1057– 1065 (2013).
4. Experimental study on the transient response of passive decay heat removal system, Nuclear Engineering and Design, 280, 564-569, 2014
5. Performance evaluation of decay heat removal system of PFBR with partial availability of air side dampers, Nuclear Engineering and Design, 318, 174-181, 2017