

Profile SFR- 34

BI-METALLIC SODIUM LOOP

INDIA

NAME OF THE FACILITY	BI-METALLIC SODIUM LOOP
ACRONYM	BIM
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)	2003

MAIN RESEARCH FIELD(S)	<input type="checkbox"/> Zero power facility for V&V and licensing purposes
	<input type="checkbox"/> Design Basis Accidents (DBA) and Design Extended Conditions (DEC)
	<input type="checkbox"/> Thermal-hydraulics
	<input type="checkbox"/> Coolant chemistry
	<input checked="" type="checkbox"/> Materials
	<input checked="" type="checkbox"/> Systems and components
	<input checked="" type="checkbox"/> Instrumentation & ISI & R

TECHNICAL DESCRIPTION

Description of the facility

This loop is mainly to study the behavior (in particular about the carbon transfer) of materials under the flowing sodium environment. The loop is constructed using SS316LN and Mod 9Cr-1Mo which are, the materials used in the secondary system of PFBR and hence BIM loop simulates the secondary sodium circuit of PFBR. There are standard specimens made up of SS316LN and Mod 9Cr-1Mo materials placed in the sample holders. Surface area ratio, sodium velocity and sodium purity are maintained as same as in PFBR. There is a heater vessel with 180kW capacity immersion heaters for achieving required sodium temperature in the system. Maximum sodium temperature in the system is 530°C and the maximum sodium flow rate in the loop is 5 m³/h. 50000 h of cumulative operation is completed.

ACCEPTANCE OF RADIOACTIVE MATERIALS - No

Scheme/Diagram

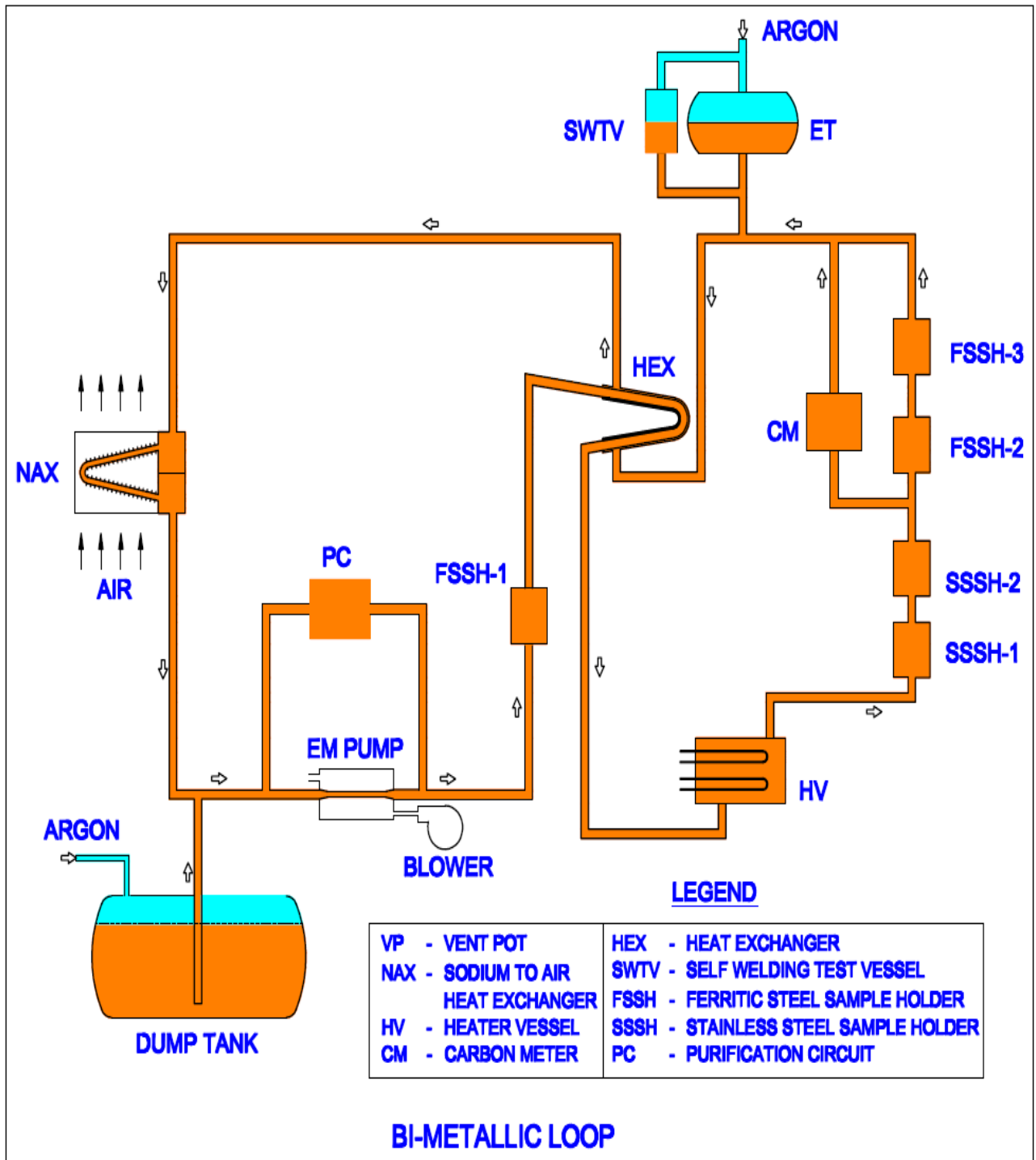


FIG. 1. Scheme of BIM loop

3D Drawing/Photo



FIG. 2. BIM Loop Pipe Lines and Components



FIG. 3. Plasma Nitrided samples in the loop

Parameters table

Coolant inventory	0.5 tonnes of sodium	
Power	Heater power of 180 kW	
No of test sections	Five	
No of test vessel	One	
Test sections		
	<u>Characteristic dimensions</u> ¾" Schedule.40 piping figure of eight loop, Sample holders for material testing.	
	<u>Static/Dynamic experiment</u> Dynamic	
	<u>Temperature in the test section</u>	<u>Temperature in the test vessel</u>
	350 to 525°C	550°C
	<u>Operating pressure and design pressure</u> Operating pressure : 0.5 bar (g) Design pressure : 4.0 bar (g)	
	<u>Flow range (mass velocity etc)</u> Sodium flow : 5m 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

50,000 h of operation of the loop was completed and the samples were removed and send for analysis. Sodium Pressure Measurement Device was developed and tested successfully. Performance testing of Electromagnetic pumps like 1.5 m³/h ALIP, 2 m³/h AC conduction pump were completed.

PLANNED EXPERIMENTS (including time schedule)

Exposure of plasma nitride material specimens to dynamic sodium [Mar-2019- July 2019]

TRAINING ACTIVITIES

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

REFERENCES

1. Evaluation of Micro structural, Mechanical Properties and Corrosion Behavior of AISI Type 316LN Stainless Steel and Modified 9Cr-1Mo Steel Exposed in a Dynamic Bimetallic Sodium Loop at 798 K (525 °C) for 16,000 Hours, Metallurgical and Material Transactions, Vol.43A, Feb 2012.
2. Effect of flowing sodium on corrosion and tensile properties of AISI 316 LN stainless steel at 823 K. Journal of nuclear materials.377 (2008) 378 -384.
3. Self-welding susceptibility of 316LN and alloy D9 stainless steels in high-temperature flowing sodium, Int. J. Nuclear Energy Science and Technology, Vol. 5, No. 3, 2010 195.

4. Self welding susceptibility of cold-worked alloy D9 and 316LN austenitic steel in flowing sodium, *Journal of Materials Science and Technology*, pp. 1484-1491, Vol. 28, No12, Dec 2012.
5. Changes in Microstructural and mechanical properties of AISI type 316LN stainless steel and Mod 9 Cr 1 Mo on long term exposure of flowing sodium in Bi-Metallic loop, *Metallurgical and Materials transactions*, Vol.46 A, 6065-6080, Dec 2015