

## Profile SFR- 36

### INSOT Fatigue Loop

#### INDIA

NAME OF THE FACILITY	IN SODIUM TEST FACILITY – FATIGUE LOOP
ACRONYM	INSOT
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, <a href="mailto:pselva@igcar.gov.in">pselva@igcar.gov.in</a>

<b>STATUS OF THE FACILITY</b>	In operation
Start of operation (Date)	2002

<b>MAIN RESEARCH FIELDS</b>	<input type="checkbox"/> Zero power facility for V&V and licensing purpose
	<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 type="checkbox"/> Systems and components
	<input type="checkbox"/> Instrumentation & ISI & R

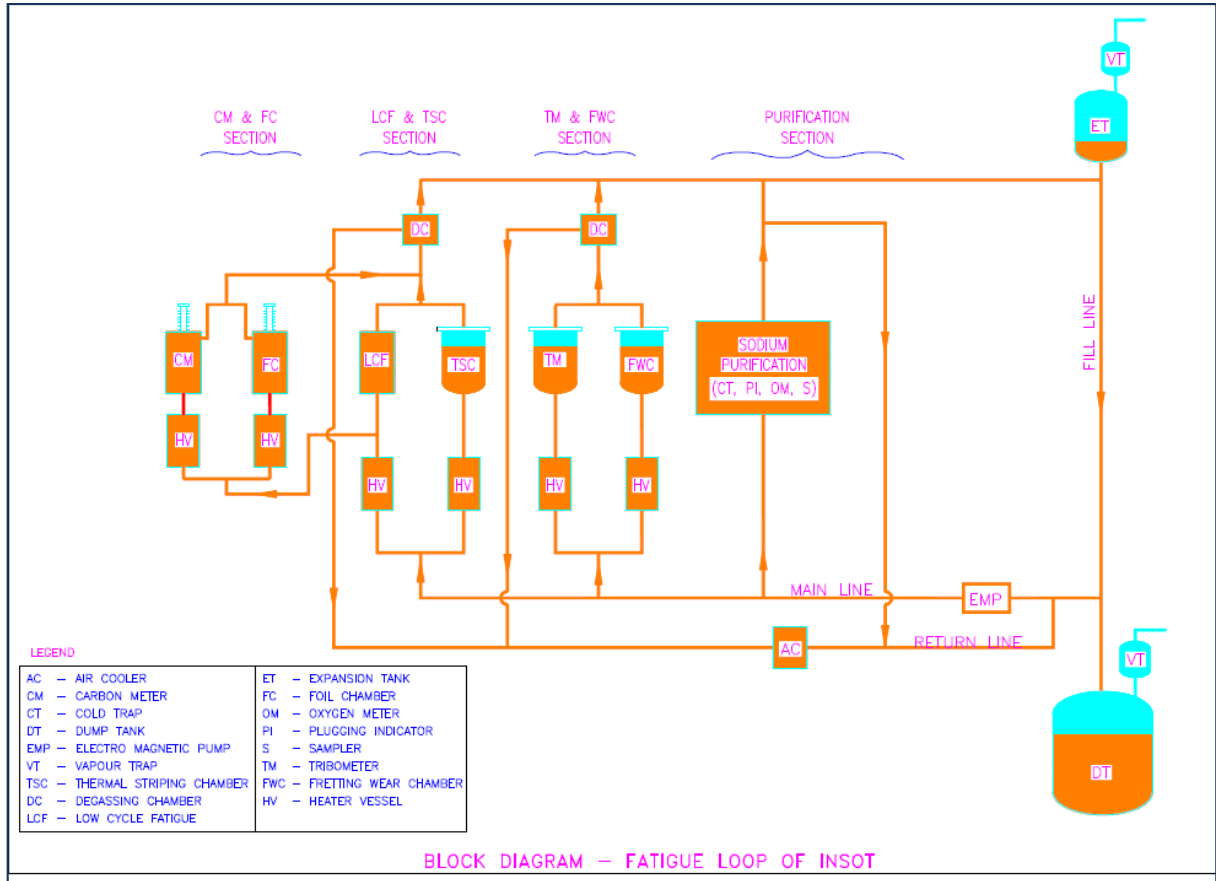
#### TECHNICAL DESCRIPTION

##### Description of the facility

INSOT fatigue loop is designed to study the mechanical properties such as fatigue and creep-fatigue interaction of PFBR component materials under the influence of flowing sodium. Low cycle fatigue, creep-fatigue interaction studies, pin-on-disc tribology studies and thermal stripping experiments are planned in this loop. Loop sodium hold up is 500 kg. This loop has two test vessels; one each in pin on disc tribometer section for friction wear studies and in thermal stripping section for thermal stripping studies. It has an air cooler, two heater vessels with 60 kW capacity immersion heaters. Test sections in hot leg can attain a maximum operating temperature of 625°C. Electrochemical carbon meters and foil equilibration chambers are also available to monitor the carbon activity in sodium. Maximum sodium flow in the loop is 3 m<sup>3</sup>/h and so far loop has completed 22,200 hours of cumulative operation. Material of construction of the loop is SS316L[N]/ SS316L.

Acceptance of radioactive materials – No

**Sche me /Diag ram**



*FIG. 1 Scheme of the INSOT fatigue loop facility*

**3D Drawing/Photo**



*FIG. 2:View of the INSOT fatigue loop facility*

### Parameters table

Coolant inventory	0.5 tonne
Power	60 kW
No of test sections	Two
No. of test vessels	Two
Test sections	
	<u>Characteristic dimensions</u> Each test section occupies space of 2.5 m High x 1m Long x
Test Vessels	<u>Characteristic dimensions</u> Each test vessel occupies space of 2.5 m High x 1m Long x
	<u>Static/Dynamic experiment:</u> Dynamic
	<u>Temperature in the test section/ test vessel</u> 300-600°C
	<u>Operating pressure and design pressure</u> Operating pressure : 3.0 bar (g) Design pressure : 10 bar (g)
	<u>Flow range (mass velocity etc)</u> Sodium flow 2.5 m/s in Test chamber 1 m <sup>3</sup> /h in Test sections/ test vessels
Coolant chemistry measurement and control (active or not, measured parameters)	Coolant is not Radioactive. Coolant purity is maintained by continuous cold trapping and monitored periodically using online plugging indicator, over flow type sodium sampling and chemical analysis of
Instrumentation	Programmable Logic Control based Supervisory control and data acquisition system. Thermocouples for temperature measurement. Permanent magnet type flow meters for sodium flow 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

36 numbers of low cycle fatigue experiments and 13 numbers of creep fatigue interaction experiments have been completed on base, weld metal specimens of SS 316LN and Mod 9

Cr-1 Mo steels. 12 numbers of tribology experiments at 300°C, 400°C, 450°C and 550°C on different material combinations have been completed using pin-on-disc tribometer. 156 numbers of thermal stripping experiments at 400°C (Cold) and 550°C (hot) in seven test campaigns have been completed to study thermal hydraulic phenomena of hot & cold sodium jets impinging on a thermocouple embedded instrumented plate under different process conditions.

## **PLANNED EXPERIMENTS (including time schedule)**

Tribological studies on hard faced material specimens, thermal stripping studies, low cycle fatigue, fatigue crack growth and fretting wear experiments on FBR material specimens.

## **TRAINING ACTIVITIES**

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

## **REFERENCES**

1. Operating Experience of High Temperature Sodium Loops for Material Testing, M. Shanmugavel, S.Vijayaraghavan, P.Rajasundaram, T.Chandran, M.Shanmugasundaram, K.K.Rajan, P.Kalyanasundaram, Energy Procedia, Volume 7, 2011, Pages 609-615, <https://doi.org/10.1016/j.egypro.2011.06.081>
2. Experimental Facility for Thermal Stripping Studies in Dynamic Sodium Environment, S. Vijayaraghavan, P. Rajasundaram, T. Chandran, M.Shanmugavel, B. Babu, P. Selvaraj, Proceedings of Fatigue, Durability and Fracture Mechanics, Springer Link Series, Lecture Notes in Mechanical Engineering, 2018, Pages 41-52, [https://doi.org/10.1007/978-981-10-6002-1\\_4](https://doi.org/10.1007/978-981-10-6002-1_4), ISSN: 2195-4356.