

## Profile SFR-44

### SOWART

### INDIA

|                            |  |
|----------------------------|--|
| NAME OF THE FACILITY       | SODIUM WATER REACTION TEST RIG   |
| ACRONYM                    | SOWART   |
| 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)     | 2001         |

|                               |  |
|-------------------------------|--|
| <b>MAIN RESEARCH FIELD(S)</b> | <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 checked="" type="checkbox"/> Thermal-hydraulics                                     |
|                               | <input checked="" 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

SOWART test rig is used to study the behavior of self wastage and impingement wastage of steam generator tube material (Mod 9 Cr-1 Mo) during sodium – water reaction and to develop the methods for detection of tube leak. Sodium hold up of the loop is 10 ton. Sodium loop has an online purification system with air cooled cold trap, 150kW rated immersion heater in hot leg and cold leg. There is a flat linear induction pump used to circulate sodium in the loop at 10m<sup>3</sup>/h. Loop also has a sodium-air heat exchanger of 150 kW capacity and main heat exchanger of 380 kW. Maximum sodium temperature in the loop is 525°C. There is a high pressure steam circuit, to inject steam into sodium a rated condition. Material of construction of loop is SS316. Loop was operated nearly 45,000 h so far.

**ACCEPTANCE OF RADIOACTIVE MATERIALS - No**

Scheme/Diagram

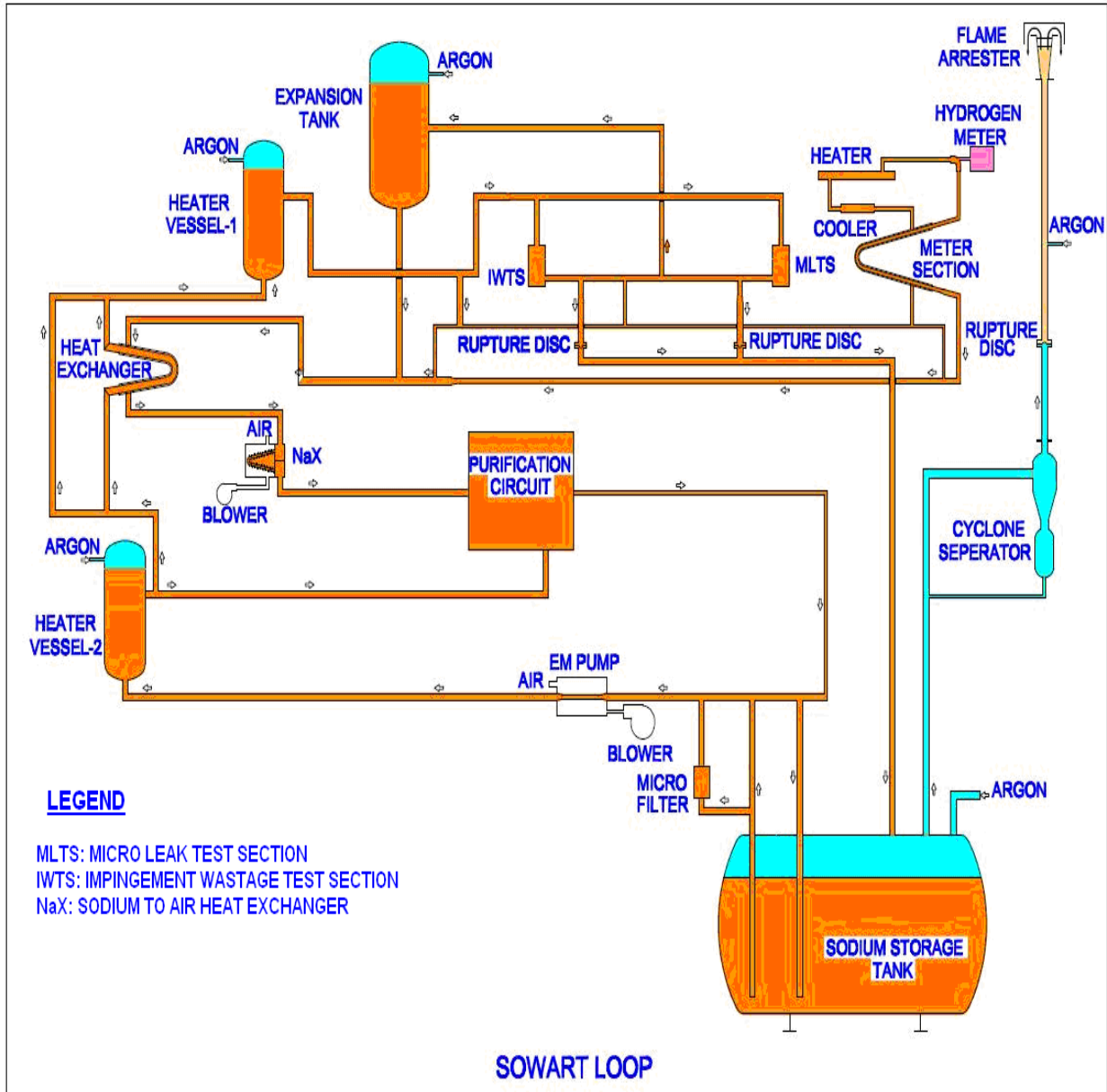


FIG. 1. Scheme of SOWART loop

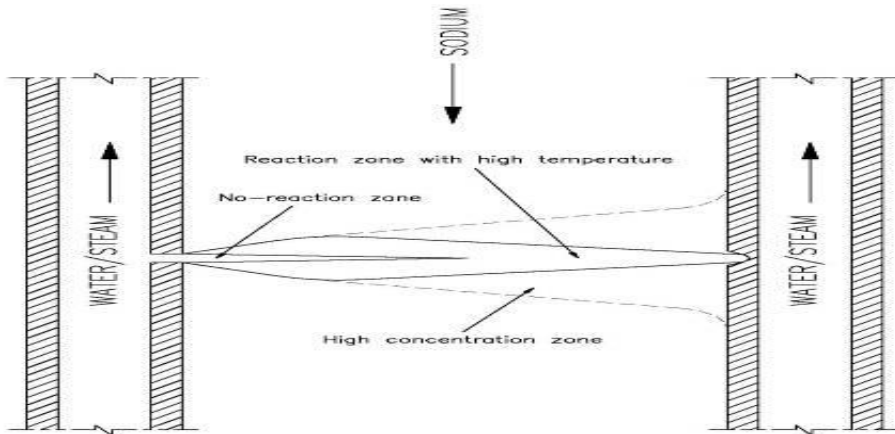


FIG. 2. Impingement wastage of SG tubes

3D Drawing/photo



*FIG. 3. SOWART Structure with loop pipelines*



*FIG.4. Test section*

### Parameters table

|  |  |
|--|--|
| Coolant inventory  | 10 tonne   |
| Power  | Two heater vessels with a total power of 330 kW  |
| No of test sections  | Two  |
| Test sections  |  |
|  | <b><u>Characteristic dimensions</u></b><br><u>IWTS Test Section:</u> Outer Pipe: 3” Schedule. 160, Simulator Tube: 17.2 mm OD, 2.3 to 3 mm WT; Target Tube: 17.2 mm OD, 2.3 to 3 mm WT, Distance between tubes: 15 mm<br><u>HIS Test Section:</u> Outer Pipe: 70 mm OD, 15 mm WT; Simulator Tube: 17.2 mm OD, 2.3 to 3 mm WT |
|  | <u>Static/Dynamic experiment</u><br>Dynamic  |
|  | <u>Temperature in the test section</u><br>200 to 500°C (sodium)   493 °C at 170 bar (steam)  |
|  | <u>Operating pressure and design pressure</u><br><u>Shell side</u><br>Operating pressure : 0.3 bar (g)<br>Design pressure : 8 bar (g)  |
|  | <u>Flow range (mass velocity etc)</u><br>Sodium flow : 10 m <sup>3</sup> /h  |
| Coolant chemistry measurement and control (active or not, measured parameters) | Coolant is not active<br>Coolant purity is maintained by cold trapping and monitored using online plugging indicator, and periodical sampling and analysis   |
| Instrumentation  | Thermocouples for temperature measurement<br>Wire type and spark plug type leak detectors, and sodium aerosol detectors for sodium leak detection<br>Resistance type discontinuous and mutual inductance type continuous level probes for monitoring sodium level  |

### COMPLETED EXPERIMENTAL CAMPAIGNS: MAIN RESULTS AND ACHIEVEMENTS

Calibration of Electro Chemical Hydrogen Meter, TCD Sensor, SnO<sub>2</sub> Sensor

Testing and calibration of FBTR ECHM

Adjacent tube Wastage Experiments with high steam leak rates > 1 g/s and < 5 g/s –Five experiments

### PLANNED EXPERIMENTS (including time schedule)

Impingement wastage experiments on Mod 9 Cr 1 Mo specimens to be continued: Jan. 2018 – 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. Performance of semiconducting oxide based hydrogen sensor for argon cover gas in engineering scale sodium facility, Nuclear Engineering and Design; Vol. 273, pp. 555-559, 2014.
2. Experimental studies on acoustic leak detection in steam generators of Fast Breeder Reactor, Journal of Maintenance Engineering Vol.1, pp. 254-266, 2016
3. Impingement wastage experiments with 9 Cr 1 Mo steel, Nuclear Engineering and Design; Vol. 297, 104-110, 2016.