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
FIG. 1. Scheme of SADHANA loop
FIG. 2. SADHANA Structure with AHX and Expansion Pot

FIG. 3. Test Vessel-4 with Decay Heat Exchanger
### Parameters table

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coolant inventory</td>
<td>5 tonnes of sodium</td>
</tr>
<tr>
<td>Power</td>
<td>Heater vessels with a total power of 440 kW</td>
</tr>
<tr>
<td>No of test sections</td>
<td>One</td>
</tr>
<tr>
<td>Test sections</td>
<td>Test Vessel of 3m tall and 1 m outer diameter.</td>
</tr>
<tr>
<td>Characteristic dimensions</td>
<td>Static/Dynamic experiment</td>
</tr>
<tr>
<td>Temperature in the test section</td>
<td>300 to 550°C</td>
</tr>
<tr>
<td>Operating pressure and design pressure</td>
<td>Operating pressure : 0.2 bar (g) Design pressure : 4 bar (g)</td>
</tr>
<tr>
<td>Flow range (mass velocity etc)</td>
<td>Sodium flow ≈ 7 m³/h</td>
</tr>
<tr>
<td>Coolant chemistry measurement and control (active or not, measured parameters)</td>
<td>Coolant is not active Coolant purity is maintained by cold trapping and monitored using online plugging indicator, and periodical sampling and analysis</td>
</tr>
<tr>
<td>Instrumentation</td>
<td>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</td>
</tr>
</tbody>
</table>

### 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):