Profile SFR-22

PEMDYN

FRANCE

GENERAL INFORMATION

NAME OF THE FACILITY
PEMDYN (Electromagnetic Pump in Dynamic Conditions)

ACRONYM
PEMDYN

COOLANT(S) OF THE FACILITY
Sodium

LOCATION (address):
CEA Cadarache,
13108 Saint Paul Lez Durance
FRANCE

OPERATOR
CEA

CONTACT PERSON
O. GASTALDI
CEA Cadarache
Building 208,
13108 Saint Paul Lez Durance, FRANCE
Sodium Technology and Components Project Manager
+33 4 42 25 46 40
Olivier.gastaldi@cea.fr

STATUS OF THE FACILITY
In operation
Start of operation (date):
2015

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
This facility called PEMDYN consists in a simple closed loop connecting in a serial arrangement an ALIP EMP (Annular Linear Induction Pump, Electro Magnetic Pumps), heat exchangers and a regulating valve. A test section is placed for reservation for implementing additional instrumentations. The facility is instrumented in order to acquire data on mass flow measurement, pressure drop and to measure the magnetohydrodynamic instabilities. The objective of this facility is
to reach a sufficient sodium velocity in order to obtain instabilities to better understand and model them. It implies to reach a sodium velocity of about 8 to 10 m.s⁻¹.

The ALIP EMP pump used on this facility has an active length of 2 m, gap thickness: 0.02 to 0.05 m, electrical input frequency : 5-25 Hz, typical value of the magnetic field : from 0.05 to 0.1 T, sodium average velocity: up to 10 m.s⁻¹ (with 200 mm pipe diameter, flowrate is about 1200 m³.h⁻¹), magnetic Reynolds number : higher than 10, operating temperature of sodium : 115°C to 220°C.

All classical components of a sodium loop are present: storage vessel, cold trap, plugging indicator... The atmosphere above sodium surface is composed of Argon.

Acceptance of radioactive material
No

Scheme/diagram
### Parameters table

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coolant inventory</td>
<td>1 m³</td>
</tr>
<tr>
<td>Power</td>
<td>400 kW</td>
</tr>
</tbody>
</table>

### Test sections

**TS #1**

**Characteristic dimensions**
- Active length of 2 m,
- Gap thickness: 0.02 to 0.05 m,
- Electrical input frequency: 5-25 Hz,
- Typical value of the magnetic field: from 0.05 to 0.1 T,
- Sodium average velocity: up to 10 m.s⁻¹

**Static/dynamic experiment**
- Dynamic

**Temperature range in the test section (ΔT)**
- 115 to 220°C

**Operating pressure and design pressure**
- Maximum operating pressure: 10 bars abs

**Flow range (mass, velocity, etc.)**
- Maximum sodium flowrate: 1450 m³.h⁻¹

**Coolant chemistry measurement and control (active or not, measured parameters)**
- Active coolant quality measurement and control (purification on a by passed flow: 1 m³/h and impurities level < few ppm)

**Instrumentation**
- Thermocouples
- Sodium pressure measurement
- Argon pressure measurement
- Inductive level probes
- Electromagnetic flowmeters
- Ultrasound Doppler Velocimetry (UDV)

### COMPLETED EXPERIMENTAL CAMPAIGNS: MAIN RESULTS AND ACHIEVEMENTS

By the end of 2015 PEMDYN facility was put in operation. EMP performance map experiments had been started in 2016 and achieved at the beginning of 2017. The second kind of experiment devoted to the study of magneto hydrodynamic instabilities at high has started in 2017 and magnetic Reynolds number has been performed until 2018.

### PLANNED EXPERIMENTS (including time schedule)

In 2019, a new hydro-dynamic instabilities test campaign is planned.

### TRAINING ACTIVITIES

No
REFERENCES (specification of availability and language)
E. Martin Lopez, Etude des instabilités Magnétohydrodynamiques dans les Pompes Electromagnétiques à induction annulaire à fort débit, Thèse de doctorat, Université Grenoble Alpes, 2018

S. Vitry, E. Martin Lopez, F. Benoit, L. Cachon and L. Goldsteins, Performance maps of a high flowrate EM pump, Experimental and numerical analysis, EPM2018

Y. Delannoy, E. Martin-Lopez, F Benoit, Convective end effects in annular linear induction pumps, EPM2018

E. Martin Lopez, Y Delannoy, F Benoit, A Munoz Medina, R Martinie, ANALYTICAL AND NUMERICAL STUDY OF THE STALLING PHENOMENON IN AN ELECTROMAGNETIC PUMP FOR A SODIUM FAST REACTOR, ICAPP 2018

Y Delannoy, E Martin Lopez, F Benoit, The velocity profile in annular linear electromagnetic pumps, ISEM 2017

E. Martin Lopez, Y. Delannoy, F. Benoit, R. Martinie, S. Vitry, Numerical and experimental validation of the performance of an electromagnetic pump for a sodium fast reactor, ICAPP 2017

S. Vitry, L. Goldsteins, C. Biscarrat, F. Benoit, S. Madeleine, F. Dechelette, O. Gastaldi, Experimental and numerical analysis of magnetic field spatial measurements inside an electromagnetic pump channel duct, 10th PAMIR International Conference Fundamental and Applied MHD, 2016


L. Goldsteins, Analyse expérimentale et numérique du comportement électromagnétique de pompe à induction linéaire annulaire, Thèse de doctorat, Université Grenoble Alpes, Université de Lettonie, 2015


