

Profile SFR-17

FUTUNA2

FRANCE

GENERAL INFORMATION

NAME OF THE FACILITY	FUTUNA2
ACRONYM	FUTUNA2
COOLANT(S) OF THE FACILITY	Sodium
LOCATION (address):	CEA Cadarache, 13108 Saint Paul Lez Durance FRANCE
OPERATOR	CEA
CONTACT PERSON (name, address, institute, function, telephone, email):	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):	1997

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 checked="" type="checkbox"/> Coolant chemistry
	<input checked="" type="checkbox"/> Materials
	<input type="checkbox"/> Systems and components
	<input checked="" type="checkbox"/> Instrumentation & ISI&R

TECHNICAL DESCRIPTION

Description of the facility

This experimental facility is devoted to tests and qualification of detection systems for sodium leak in different configurations (offset or plated insulating material), it can also be used for pipes corrosion tests under insulation (potential sodium corrosion enhanced by local conditions depending on the oxygen content and species contained in insulating materials).

This facility is composed of a storage vessel, a loading vessel, different high precision pumps (jack and bellow pumps), purification unit, sodium flowmeters and sodium valves. The gas in contact with liquid sodium in the different vessels is argon.

The sodium leakage flow can be controlled within the range: 0.05 cm³/min to 30 cm³/min. The precise value of the leaking flowrate is guaranteed by the use of different feeding pumps and the freezing of the sodium branch lines which are not used during the experiment (in order to avoid perturbations due to upstream to downstream potential leak on closed valves).

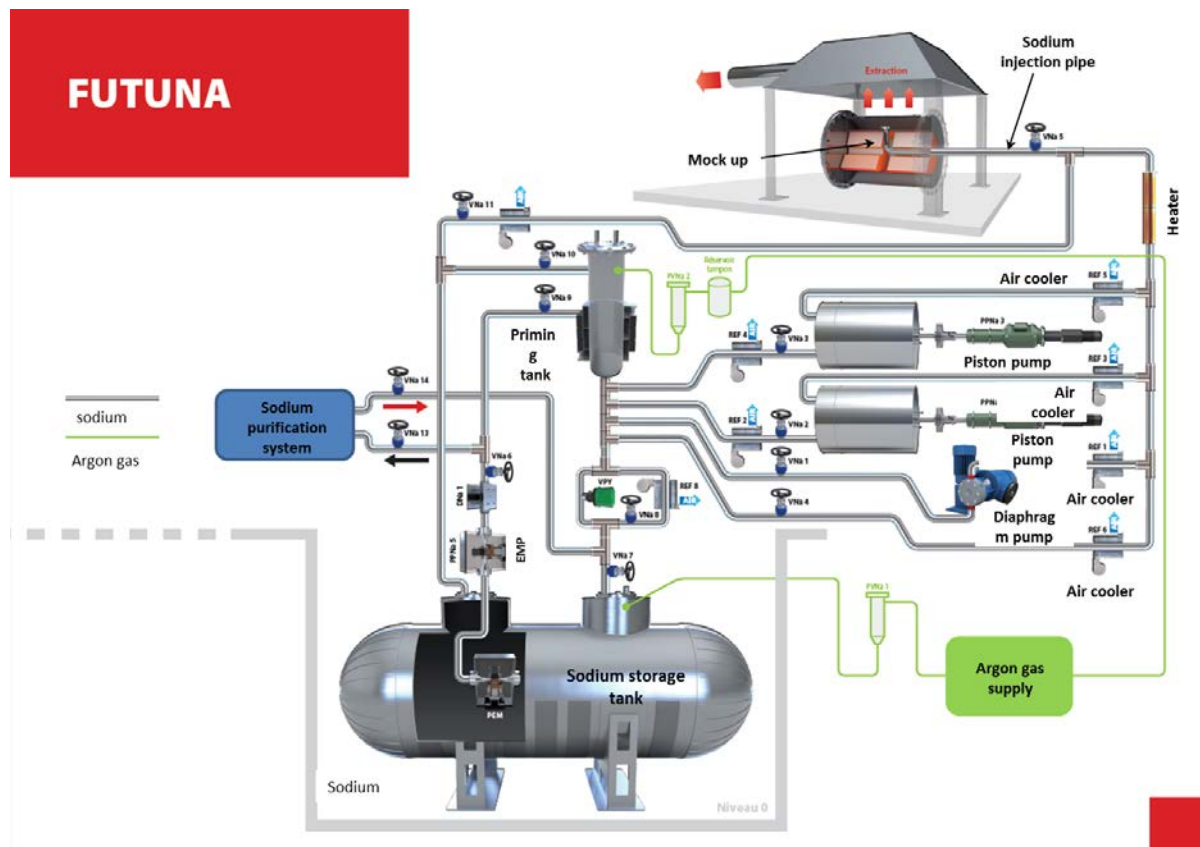
This facility can deal with large pipe mock-up. The maximum diameter which has been experimented is 800 mm outer diameter, but there is enough room to image the use of a larger mock-up. The length is about 2 m.

The mock-up is installed in a devoted area where a specific venting system operates to avoid sodium aerosols dissemination in the building. In order to simulate the presence of liquid sodium inside the pipe a heating core is adapted to the mock-up and then a constant temperature can be maintained in the inner surface of the pipe.

Acceptance of radioactive material

No

Scheme/diagram



3D drawing/photo



Parameters table

Coolant inventory	150 L of sodium
Power	Around 30 kW
Test sections	
TS #1	<u>Characteristic dimensions</u> The room available in the test section is about 2x2x2 m. The order of magnitude of the maximum diameter of pipe mock-up already tested is around 800 mm
	<u>Static/dynamic experiment</u> Dynamic experiment: small and controlled leak rate
	<u>Temperature range in the test section (Delta T)</u> The temperature of leaking sodium can be controlled between 250°C to 550°C
	<u>Operating pressure and design pressure</u> Maximum operating pressure: 4 bars rel.
	<u>Flow range (mass, velocity, etc.)</u> The sodium flowrate at the hole simulating the leak point is defined between 0.05 cm ³ /min to 30 cm ³ /min. The conical leak hole diameter is 6 mm.
Coolant chemistry measurement and control (active or not, measured parameters)	Active coolant quality measurement and control (purification on a by passed flow: 1 m ³ /h and impurities level < few ppm)
Instrumentation	Thermocouples

	Argon pressure measurement Inductive level probes Electromagnetic flowmeters
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COMPLETED EXPERIMENTAL CAMPAIGNS: MAIN RESULTS AND ACHIEVEMENTS

Different experimental campaigns have been realized on FUTUNA and FUTUNA2 (name after large refurbishment). They concern mainly:

- The under insulating materials corrosion behaviour in case of sodium leak. Many different experimental conditions were studied to establish the kinetic of corrosion phenomena with long duration tests (several hundred hours),
- The tests of different sodium leak detection systems in different configurations (diameter of the pipes, leak location compared to detectors positions, type of insulating material, leak rate, temperature...). The different leak detection systems are mainly based on techniques using electrical conducting properties of sodium. The most common ones are based on an electrical wire separated from the pipe by ceramic beads. But several other types have been tested using a metallic grid or a kind of mesh for example.

PLANNED EXPERIMENTS (including time schedule)

New detection techniques are planned to be tested with the year 2015 and 2016, mainly with 2 configurations of insulating materials: plated or with an offset between the pipe and the inner part of the insulating material.

TRAINING ACTIVITIES

No specific training activities.

REFERENCES (*specification of availability and language*)

T. FURUKAWA, D. PIAT, S. ROSANVALLON and C. LATGE

A study on corrosion mechanism of FBR structural material in small sodium leak under insulator, Icone conference, 2000.

E. Boldyreva, R. Cotillard, G. Laffont, P. Ferdinand, D. Cambet, J.-P. Jeannot, P. Charvet, S. Albadéjo, and G. Rodriguez

Distributed temperature monitoring for liquid sodium leakage detection using OFDR-based Rayleigh backscattering, International Conference on Optical fibre Sensors - 2 - 6 juin 2014 , Santander, Spain

S. Armiroli, G. Laffont, R. Cotillard : CEA Saclay, France

M. Girard, D. Cambet, JPh. Jeannot, P. Charvet, S. Albaladejo, S. Lusso : CEA Cadarache, France
Sodium leakage detection on a lagged pipe mock-up using OFDR-based Rayleigh backscattering
ANIMMA 2017_ International Conference on Advancements in Nuclear Instrumentation
Measurement Methods and their Applications, June 19 - 23, 2017, Liège, Belgique

M. Girard, S. Albaladejo, D. Cambet, S. Armiroli, R. Cotillard, G. Laffont: CEA Cadarache - Saclay,
France O. Carra : FRAMATOME, G. Prêle : EDF, France
Development of innovating Na leak detector on pipes
Fr 17_ International Conference on Fast Reactors and Related Fuel Cycles (AIEA), June 26-29, 2017,
Yekaterinburg, Russian Federation

M. Girard, S. Albaladejo, P. Charvet, S. Lusso : CEA Cadarache, France

S. Armiroli, G. Laffont, R. Cotillard : CEA Saclay, France

Innovating leak detection on conducting fluid pipelines

I2MTC 2018_ International Instrumentation & Measurement Technology Conference (IEEE), 14-17
May, 2018, Houston, USA