

Profile SFR-27

VKS2

FRANCE

GENERAL INFORMATION

NAME OF THE FACILITY	Von Karman Sodium 2
ACRONYM	VKS2
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):	2005

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

TECHNICAL DESCRIPTION

Description of the facility

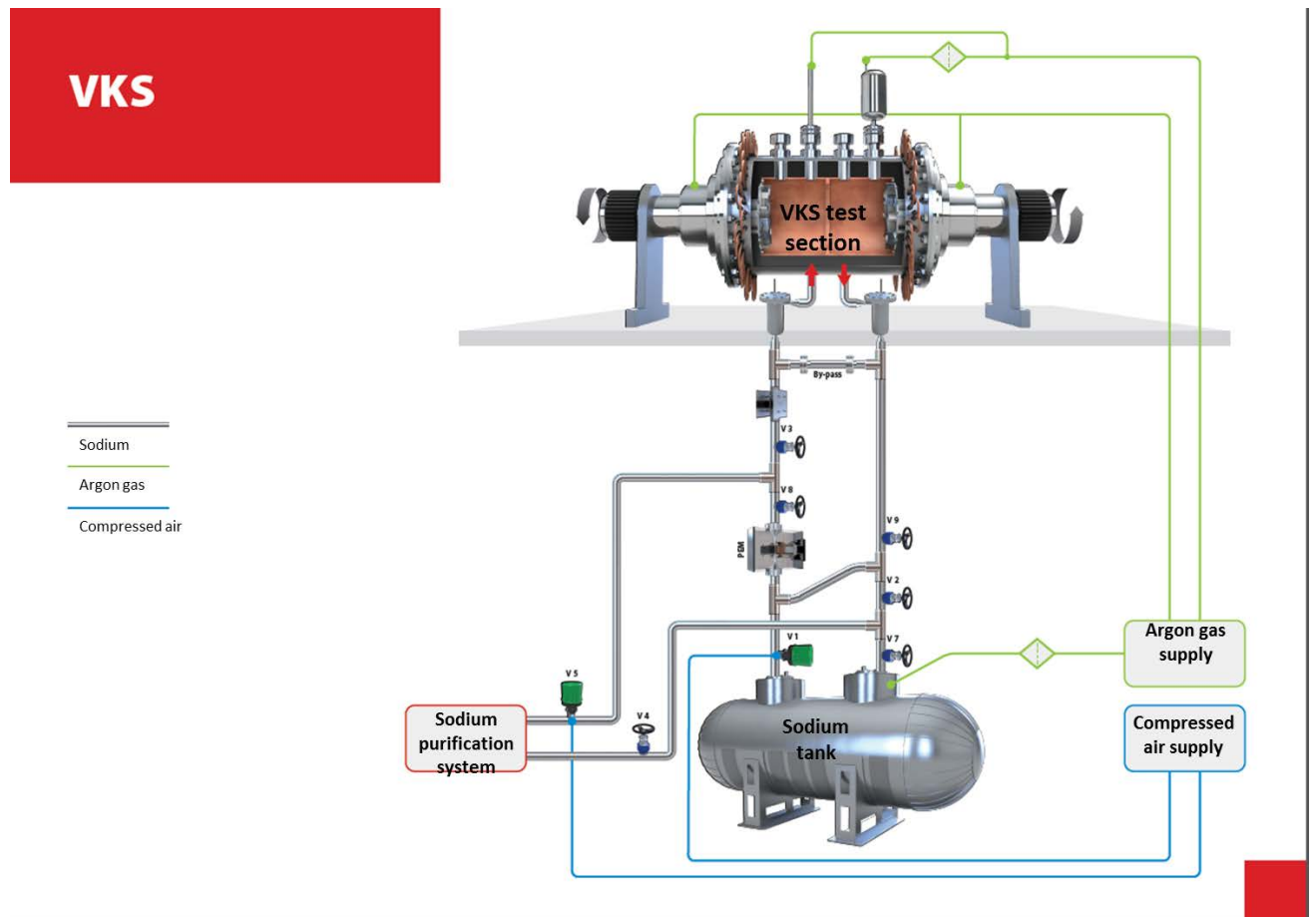
The VKS facility is a mid-size sodium loop (210 L of sodium in the storage vessel). It was originally devoted to the study of magnetic field induced by dynamo effect. Thus it is possible to reach turbulent regime in its test section. This turbulent regime is obtained through the movement of 2 impellers in the test section (27 Hz and 300 kW). In order to extract the heat a specific jacket is used around the test section. In this jacket, specific oil insures the heat exchange. Due to the characteristics of this oil the operating temperature is limited to 200°C.

This facility handles sodium with a high chemical quality obtained through an active purification system. The classical subsystems of such sodium facility are present: storage vessel, cold trap, plugging indicator... The atmosphere above sodium surface is composed of Argon. A specificity of this loop is the presence of dynamic tightness system in contact with liquid sodium in order to transmit the rotation movement to the immersed impellers.

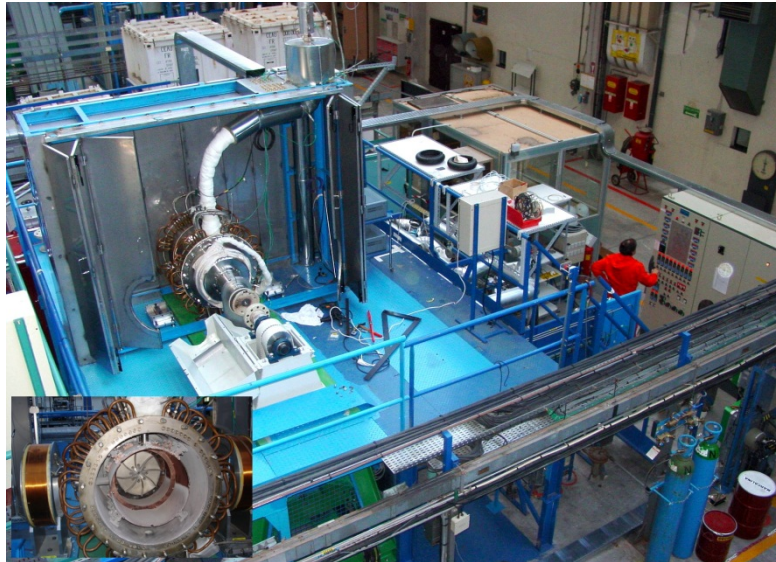
Acceptance of radioactive material

No

Scheme/diagram



3D drawing/photo



Parameters table

Coolant inventory	210 L of sodium
Power	About 400 kW
Test sections	
TS #1	<u>Characteristic dimensions</u> Vessel sodium capacity: 165 L (cylinder shape) Vessel material: copper Active cooling system Vessel equipped with 2 impellers allowing to reach turbulent liquid sodium state
	<u>Static/dynamic experiment</u> Sodium is not fed continuously into the test section, but a strong movement is imposed in this vessel allowing to reach high sodium velocity ($>10 \text{ m}\cdot\text{s}^{-1}$)
	<u>Temperature range in the test section (ΔT)</u> 120°C to 180°C
	<u>Operating pressure and design pressure</u> Maximum operating pressure: 3.5 rel. bar
	<u>Flow range (mass, velocity, etc.)</u> Sodium velocity in the closed test vessel can locally reach $10 \text{ m}\cdot\text{s}^{-1}$
Coolant chemistry measurement and control (active or not, measured parameters)	Active coolant quality measurement and control (purification with a cold trap on a bypassed flow: $2 \text{ m}^3/\text{h}$ and impurities level $< \text{few ppm}$, and impurities content evaluation by a plugging indicator)
Instrumentation	Thermocouples Argon pressure measurement Inductive level probes Electromagnetic flowmeters Magnetic field probes (if needed) Sodium velocimetry measurement (if needed)

COMPLETED EXPERIMENTAL CAMPAIGNS: MAIN RESULTS AND ACHIEVEMENTS

The main experimental campaigns realized on VKS2 facility were dedicated between 2005 and 2013 to the study of magnetic field induced by dynamo effect. The VKS experiment (Von Karman Sodium) has been designed to achieve magnetic field self-generation in a conducting liquid. It is a joint experiment run at CEA Cadarache as a collaboration between physicists based at CEA Saclay - SPEC, ENS Paris - LPS and ENS Lyon - LP. The obtained flow is a von-Karman type flow, where liquid sodium is stirred by the counter-rotation of two bladed disk in a cylinder. Self-generation of magnetic field in a turbulent flow was first achieved in September 2006.

PLANNED EXPERIMENTS (including time schedule)

This facility will be used from now within the framework of Sodium Fast Reactor studies. In particular, some experiments on different techniques of velocimetry measurement are foreseen.

TRAINING ACTIVITIES

Possible, but no specific program is planned

REFERENCES (*specification of availability and language*)

Sophie Miralles, Nicolas Bonnefoy, Mickael Bourgoïn, Philippe Odier, Jean-François Pinton, Nicolas Plihon, and Gautier Verhille

Dynamo threshold detection in the von Karman sodium experiment

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J. Boisson, S. Aumaitre, N. Bonnefoy, M. Bourgoïn, F. Daviaud, B. Dubrulle, Ph. Odier, J.-F. Pinton, N. Plihon and G. Verhille

Symmetry and couplings in stationary Von Kármán sodium dynamos

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G. Verhille, J. Boisson, C. Gissinger, S. Fauve, N. Mordant, F. Pétrélis, M. Bourgoïn, P. Odier, J.-F. Pinton, N. Plihon, S. Aumaître, A. Chiffaudel, F. Daviaud, B. Dubrulle, and C. Pirat

Dynamo regimes and transitions in the VKS experiment

THE EUROPEAN PHYSICAL JOURNAL B, 77, 459–468 (2010)

M. Berhanu, B. Gallet, R. Monchaux, M. Bourgoïn, P. Odier, J.-F. Pinton, N. Plihon, R. Volk, S. Fauve, N. Mordant, F. Pétrélis, S. Aumaître, A. Chiffaudel, F. Daviaud, B. Dubrulle and F. Ravelet

Bistability between a stationary and an oscillatory dynamo in a turbulent flow of liquid sodium

JOURNAL OF FLUID MECHANICS, 641, 217 (2009).

R. Monchaux, M. Berhanu, S. Aumaître, A. Chiffaudel, F. Daviaud, B. Dubrulle, F. Ravelet, S. Fauve, N. Mordant, F. Pétrélis, M. Bourgoïn, Ph. Odier, J.-F. Pinton, N. Plihon, and R. Volk

The VKS experiment: turbulent dynamical dynamos

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