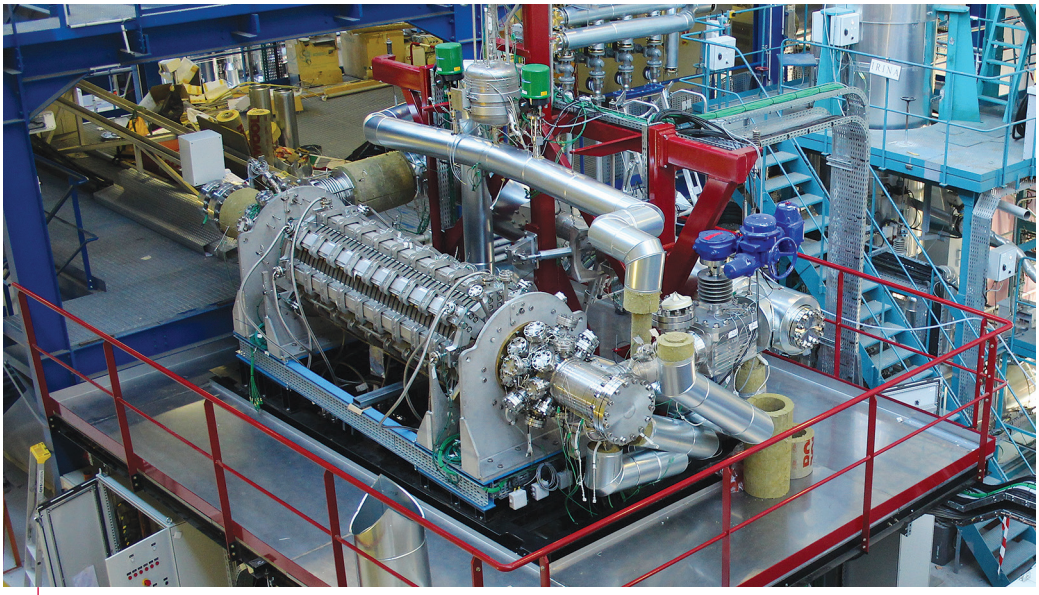
CEA

Vibratory expertise turns multiphysical

The electromagnetic pump of CEA Cadarache must move 400 kg of sodium at the speed of 10 m/s. Cetim's expertise in the field of multiphysics proved to be essential to validate the vibratory behaviour of the structure.



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OUR CUSTOMER

Corporate name
Commissariat à l'Énergie Atomique et aux Énergies Alternatives (French alternative energies and atomic energy commission).

Business activity
CEA Cadarache is one of 10 research centres of the CEA.
It is located in Saint-Paul-Lez-Durance (13).
Its annual purchase volume amounts to 300 million euros and it holds some 200 active patents.

Workforce
Almost 2,400 employees on the site, including 130 doctoral and post-doctoral employees.

In order to study the operation of electromagnetic pumps with high sodium flowrates, the prospective technology for the cooling of 4th generation reactors, the R&D teams from CEA Cadarache set up a large test loop that must move no less than 400 kg of sodium at a pressure of 5 bar and a temperature of 150°C. It is an electromagnetic pump with outstanding dimensions that must move the liquid metal by using the Laplace force via coils located around stainless steel pipes. The test loop (Pemdyn - dynamic electromagnetic pump) weighs 10 tons and is installed on a metallic framework more than three meters above the ground.

Several phenomena in play

Cadarache experts commissioned Cetim to check that its vibratory behaviour will not cause any problems. "*We carried out an audit of the design by working on a digital model of the installation provided by CEA. In parallel, we instrumented the test loop before it was filled up with sodium so as to determine very precisely its proper modes of vibration and check the results of the calculations*", explained Arnaud Caracciolo from Cetim, who led the project.
In order to take into account the physical phenomena in play, a "multiphysics" simulation proved essential. This required the collaboration of specialists in calculation, vibrations, pressurised equipment, materials as well as heat physicists. "*With the work of everyone, it was thus possible to check that the entire physics had been duly taken into account in the model*", explained Arnaud Caracciolo, who added: "*the CEA model had been correctly built and it gave account of the vibratory behaviour of the system. However, we had to suggest some modifications and give an opinion on the risks related to vibrations*". Today, the test campaign has begun and, so far, no excessive vibration has disturbed the Pemdyn.

Cetim's asset

The presence of specialists in multiple areas, essential to carrying out a multiphysics simulation and recognised expertise in pairing tests-calculations by means of "hybrid" methods.

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