The DRACCAR calculation software is developed by IRSN to support safety analyses for pressurised water reactors (PWR). It is used to simulate a loss-of-coolant accident (LOCA) following, for instance, the loss of coolant from the reactor core or the dewatering of a fuel storage pool. During such accidents, the coolant water vapourises and this causes the fuel rods to dry out, thus increasing their temperature and resulting in swelling and failure of the cladding around the fuel. Such swelling can lead to significant blockage of part of the core and jeopardise the cooling capacity provided by back-up cooling systems.

Objectives
The 3D multi-rod software package is designed to model a fuel rod assembly to determine the blockage rate due to deformed rods and the impact on cooling, while taking into account mechanical and thermal interactions between rods. It must be able to:

- Provide a consistent interpretation of the entire experimental database, whether this be for «single-rod» or «rod bundle» geometries with real or simulant fuel.
- Transpose the phenomena and their behaviour to reactor scale by means of models which have been validated on the basis of test results in order to support nuclear safety studies.

Models
With the objective of accurately simulating the behaviour of a fuel rod assembly during a LOCA, the following physical phenomena are modelled:

- Thermal conduction in the fuel and cladding in 3D conditions.
- Heat exchanges between the fuel rods and the coolant.
- Cladding deformation due to creep and failure of the fuel rods.
- Relocation of fuel in the deformed areas of the rods.
- Oxidation and hydriding of the fuel rod cladding due to steam.
- Mechanical interactions between the deformed fuel rods.
- Feedback due to fuel rod deformation on the coolant flow areas.

Validation
The first version of the DRACCAR V2.2 software was delivered in 2014. Its validation required checking that the implementation of the software did indeed reflect the physical reality. This was not only done by comparing the results with other calculation software, but also through comparison with a large experimental database. Numerous comparisons with experiments were performed, i.e. PHEBUS LOCA, HALDEN IFA 650, CORA, PERICLES, REBEKA, etc.

Scientific community and collaboration
The DRACCAR software is co-funded by EDF and has been coupled with the European platform called NURESAFE under the 7th FPRD since 2009. It benefits from the support of a high-level scientific community thanks to collaborations with French research organisations, in particular the CNRS in Nancy (Laboratory for materials, energetics and theoretical & applied mechanics) and the CNRS in Perpignan (the PROMES laboratory).

The DRACCAR software also benefits from the scientific contribution of experimental programmes such as ELFE, COCAGNE and COAL within the scope of the PERFROI project («investment for the future» programme).