

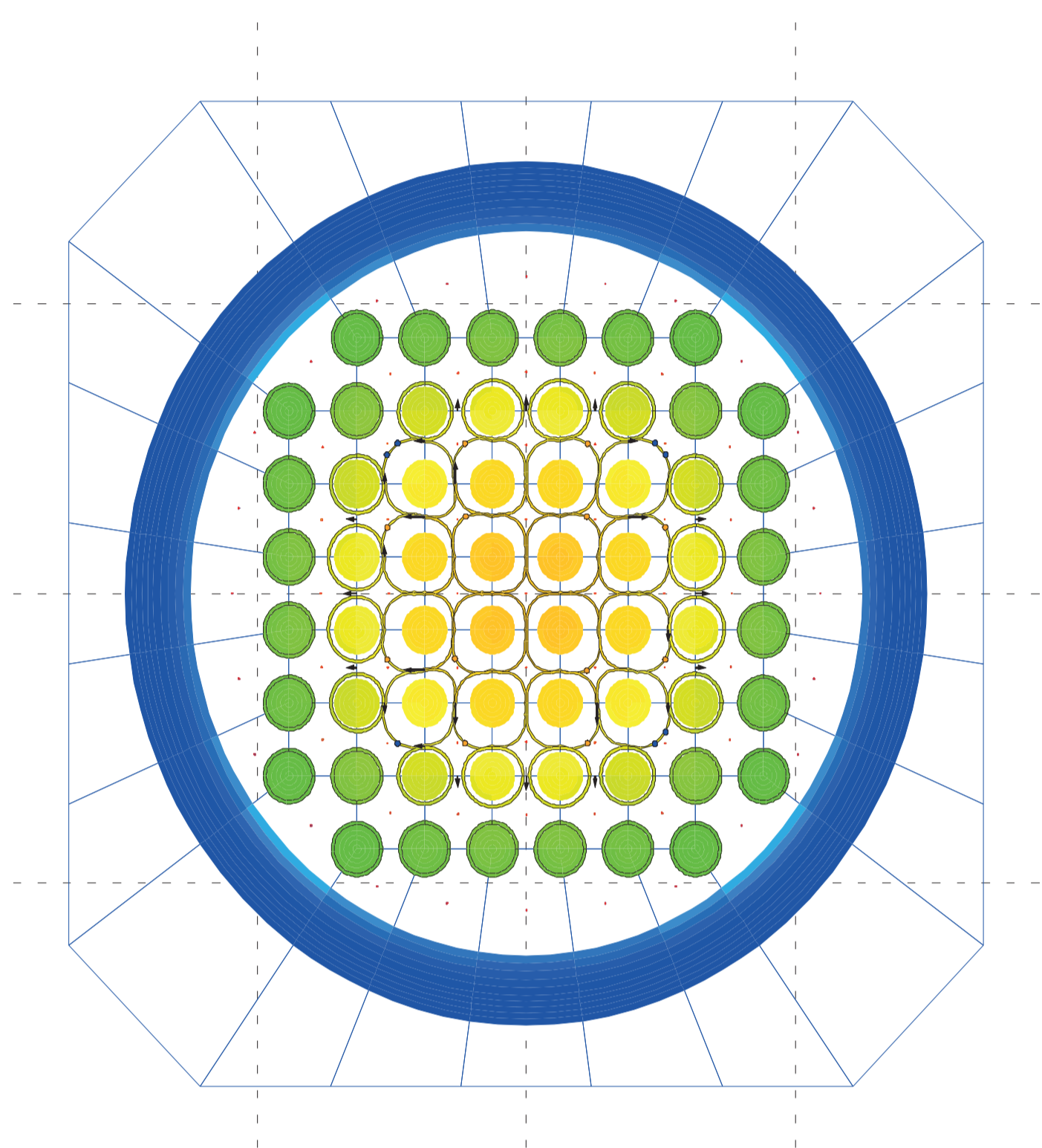
Assessing the LOCA transient: The DRACCAR code and the CYCLADES experimental program

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The French Institut de Radioprotection et de Sûreté Nucléaire (IRSN) is developing the multi-rod 3-D LOCA transient DRACCAR code. Meantime IRSN performs a set of experiments called CYCLADES to validate the DRACCAR code. DRACCAR and CYCLADES particularly cover four topics of interest affecting the short and long term coolability of the reactor core in case of a LOCA:

1. Cladding mechanical behaviour and failure conditions,
2. Flow restriction due to cladding ballooning,
3. Axial relocation of fuel in the ballooning parts of the rods,
4. Fuel ejection in the primary circuit.

IRSN DRACCAR COMPUTER CODE



DRACCAR simulation

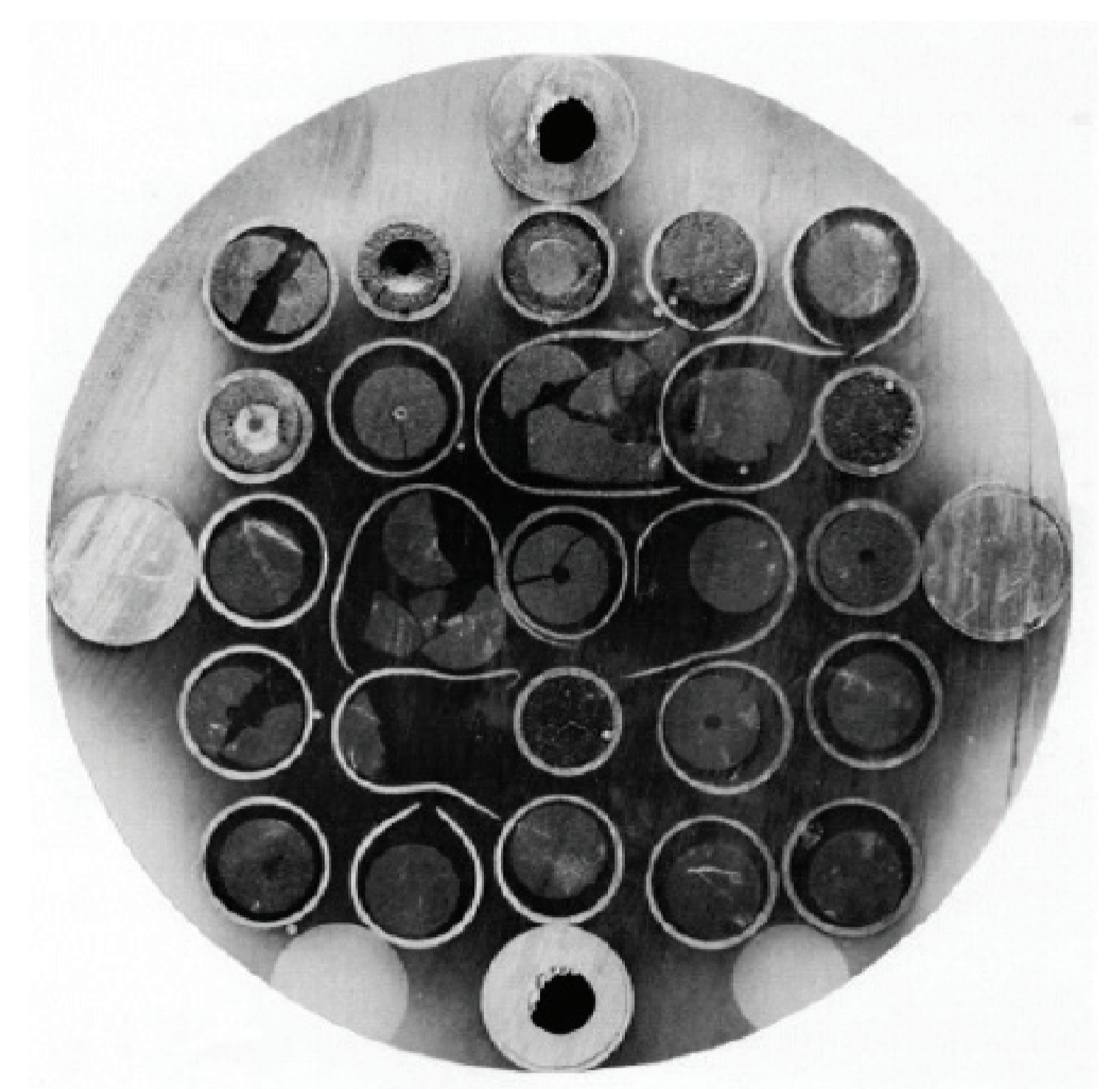
Simulation of the 3D thermo-mechanical deformation and reflooding of a fuel rod assembly during a LOCA transient:

- Cladding embrittlement before and after reflooding,
- Coolability of a fuel rod assembly during a LOCA.

Coupling with the thermohydraulic code CATHARE3 under progress.

Large validation matrix (Halden, PHEBUS LOCA,...).

Evolution towards multiple assemblies for full core and spent fuel pool modelling.



PHEBUS LOCA test

IRSN CYCLADES EXPERIMENTAL PROGRAM

1. Cladding mechanical behaviour and failure conditions

MARGO-R (2009-2012):

effect of a corrosion layer on high temperature cladding oxidation.

2. Effect of flow restriction and fuel relocation on core coolability

COAL (2014-2016)

- Out of pile full length 49 rods assembly, electrical heating,
- 16 ballooned rods with fuel relocation simulation,
- Large and intermediate break thermal hydraulics conditions.

3. and 4. Integral in pile LOCA test with fuel relocation and ejection

DOPAMINE (starting 2016-2018)

- Scheduled in the CABRI reactor with high burn up - 1m rodlet,
- Temperature measurement in the ballooned area,
- Online fuel relocation measurements thanks to the hodoscope,
- Fuel ejection measurement,
- Online spectrometry measurement.

ELFE-COCAGNE (2013-2015):

effect of rod contact on cladding deformation and rupture.



	1	2	3	4	5	6	7	
A	6	5	4	4	1	5	6	
B	5	6	4	4	1	1	5	
C	4	4	4	4	1	1	1	
D	5	5	3	3	2	2	2	
E	1	1	3	3	2	2	2	
F	6	3	6	3	2	5	6	
G	3	5	6	3	2	6	5	

