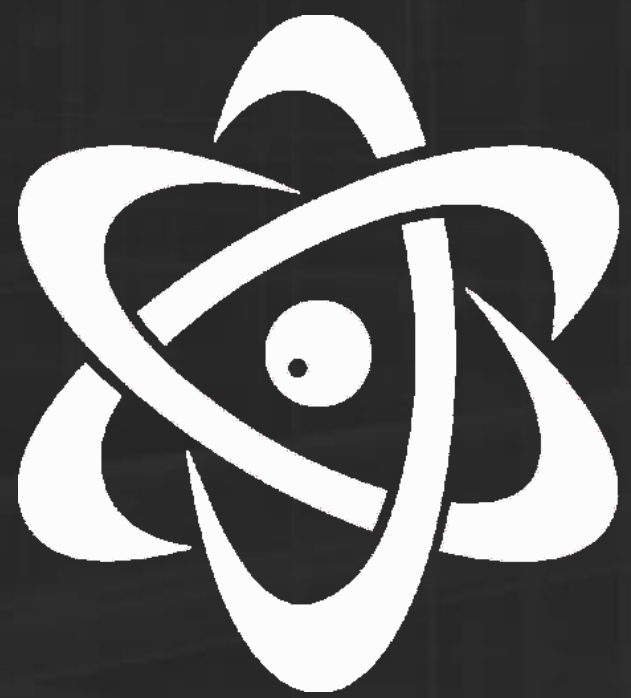


Licensing process of a new fuel type element
in Poland on an example of the experimental
fuel element for samples irradiation
in the fast neutron spectrum

Maciej Lipka, Rafał Prokopowicz, Anna Talarowska, Michał Dorosz,
Zuzanna Marcinkowska, Tomasz Machtyl



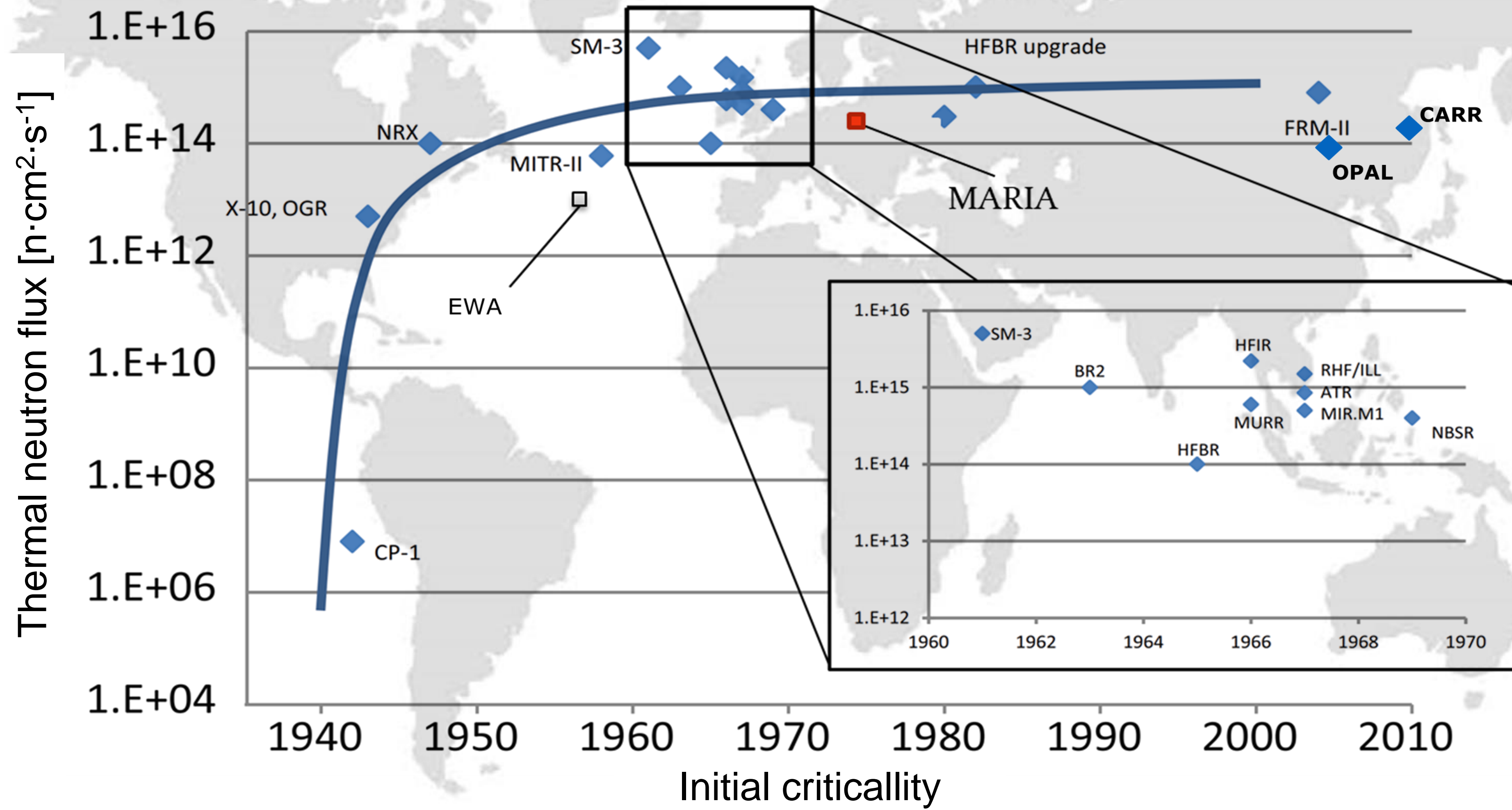
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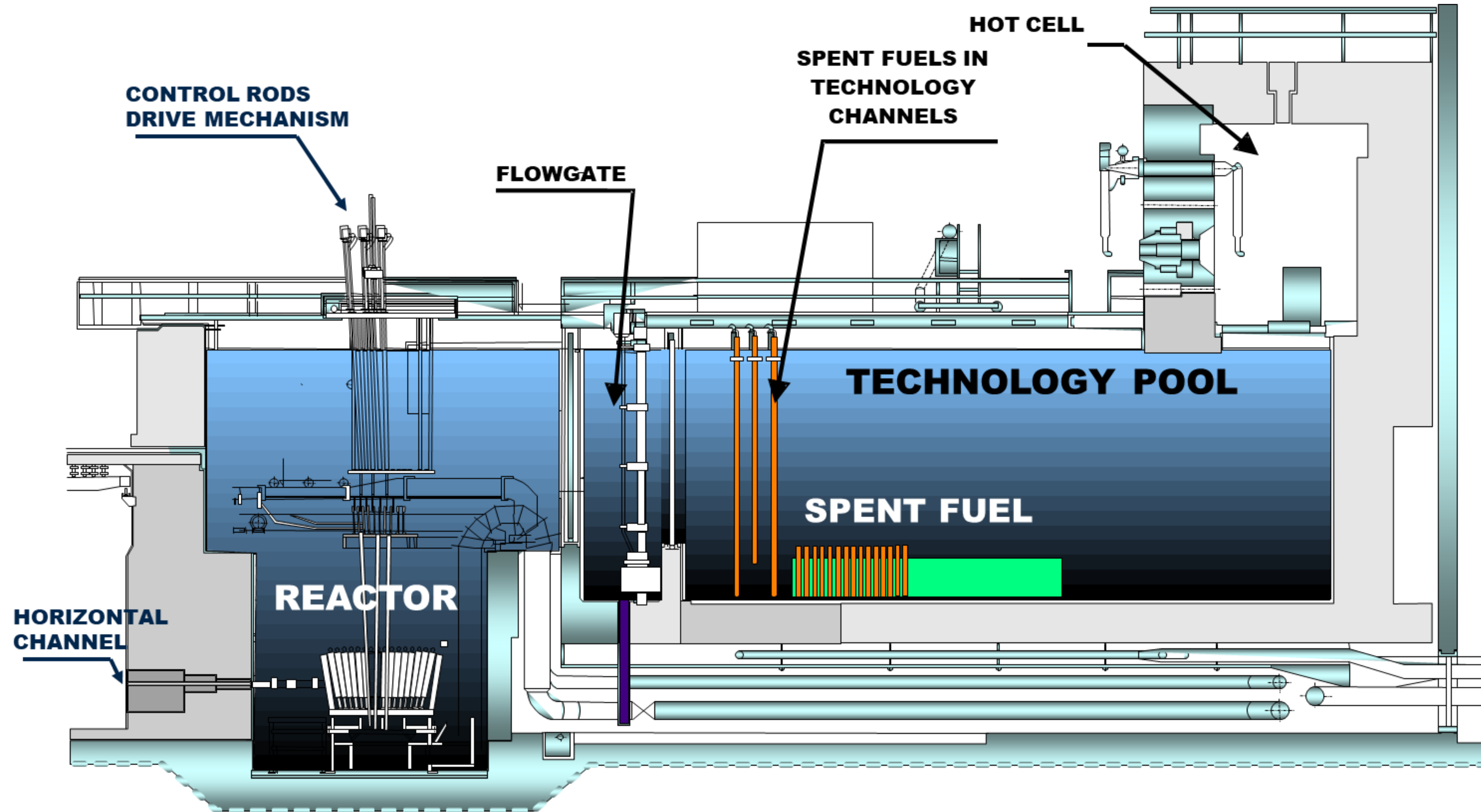
- Criticality **1974**
- Nominal power **30** MW_{th}
- Channels-in-pool type
- Thermal neutron flux: **$2,5 \cdot 10^{14}$** n/cm²/s
- Fast neutron flux: **$1 \cdot 10^{14}$** n/cm²/s
- Modernizations: 1985–1991, 2003, 2013, 2015, 2018, 2019, 2021+
- Operation horizon: **2053**

Unique MARIA



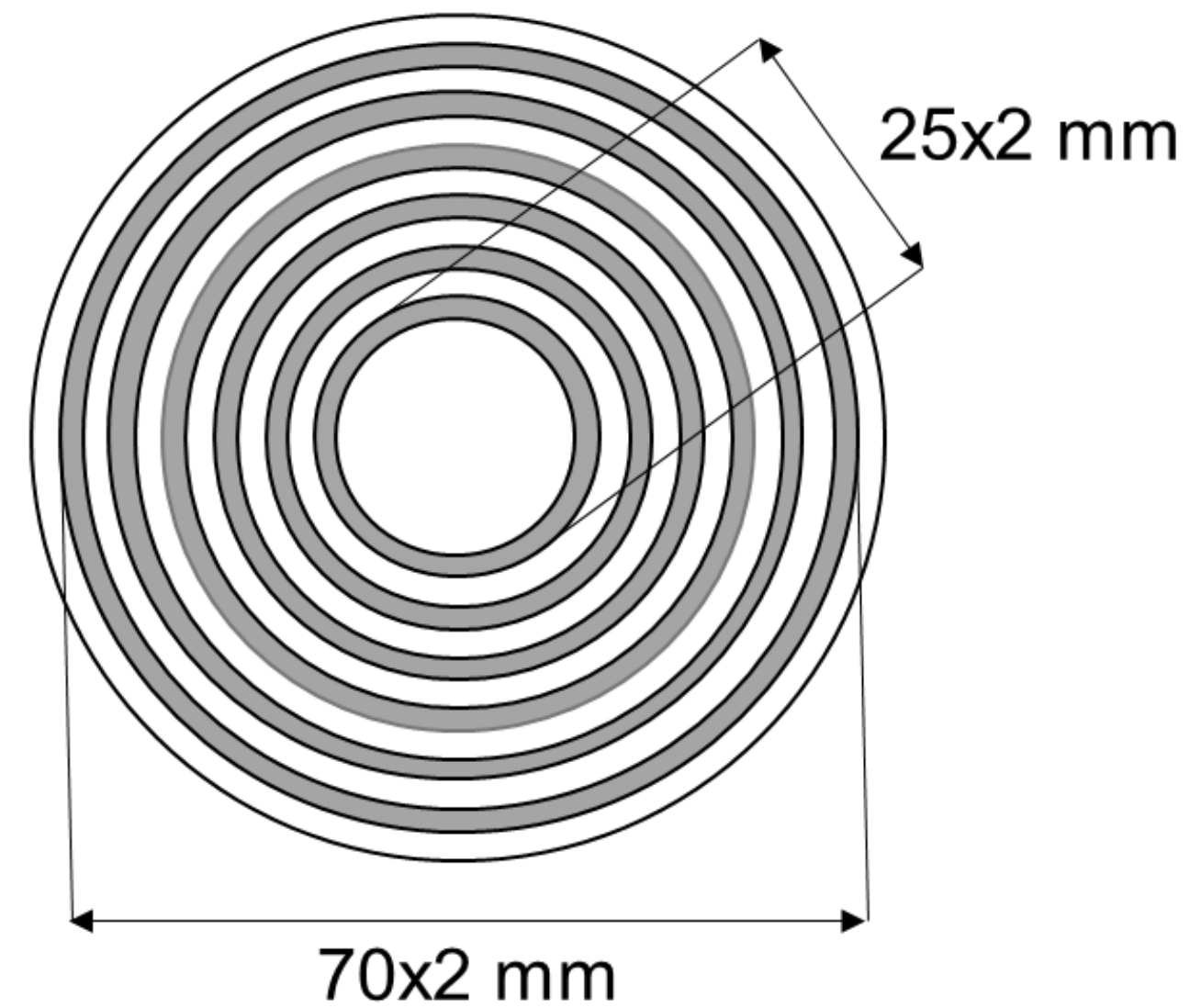
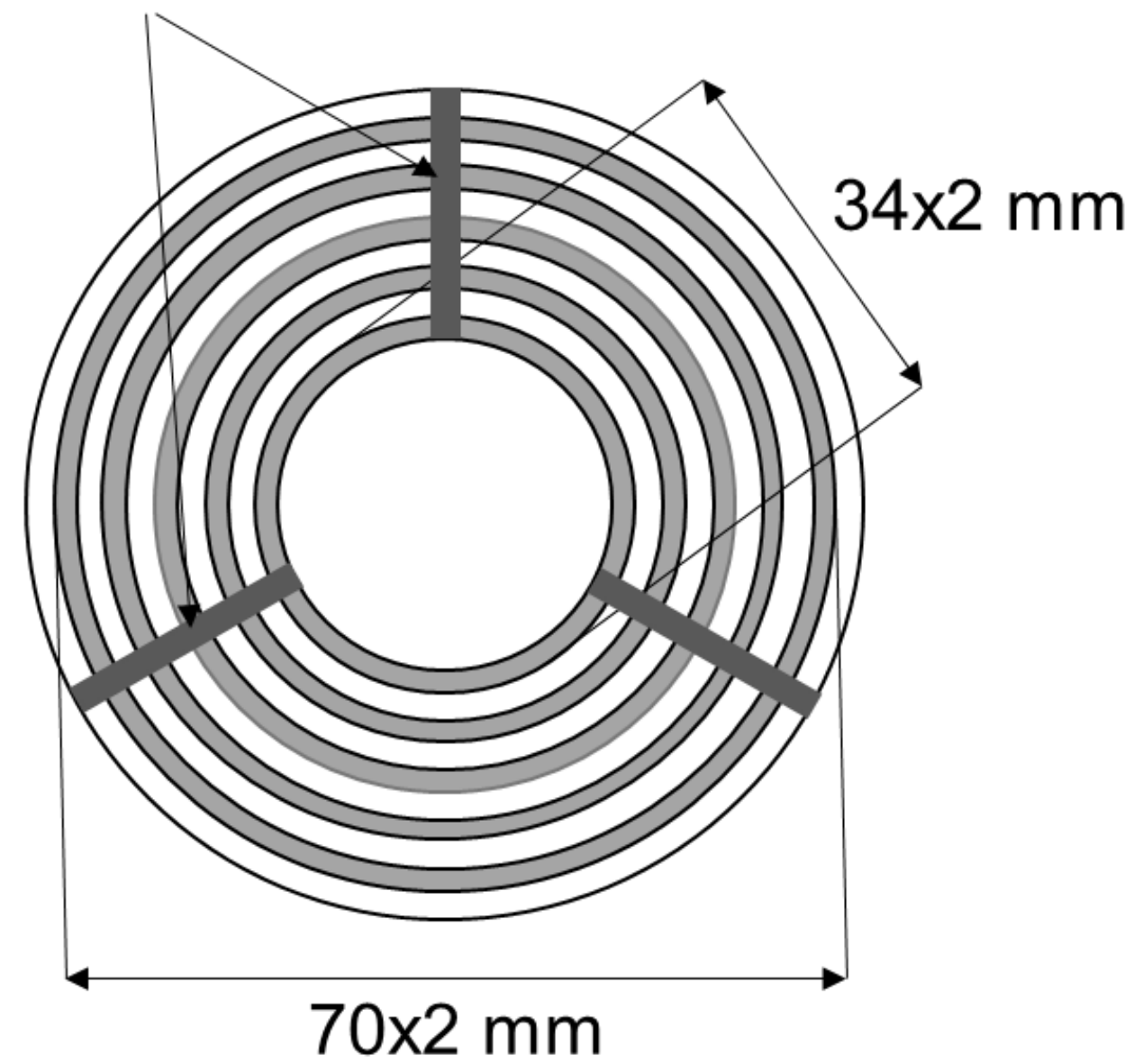
MARIA among the other reactors





MARIA reactor fuel elements

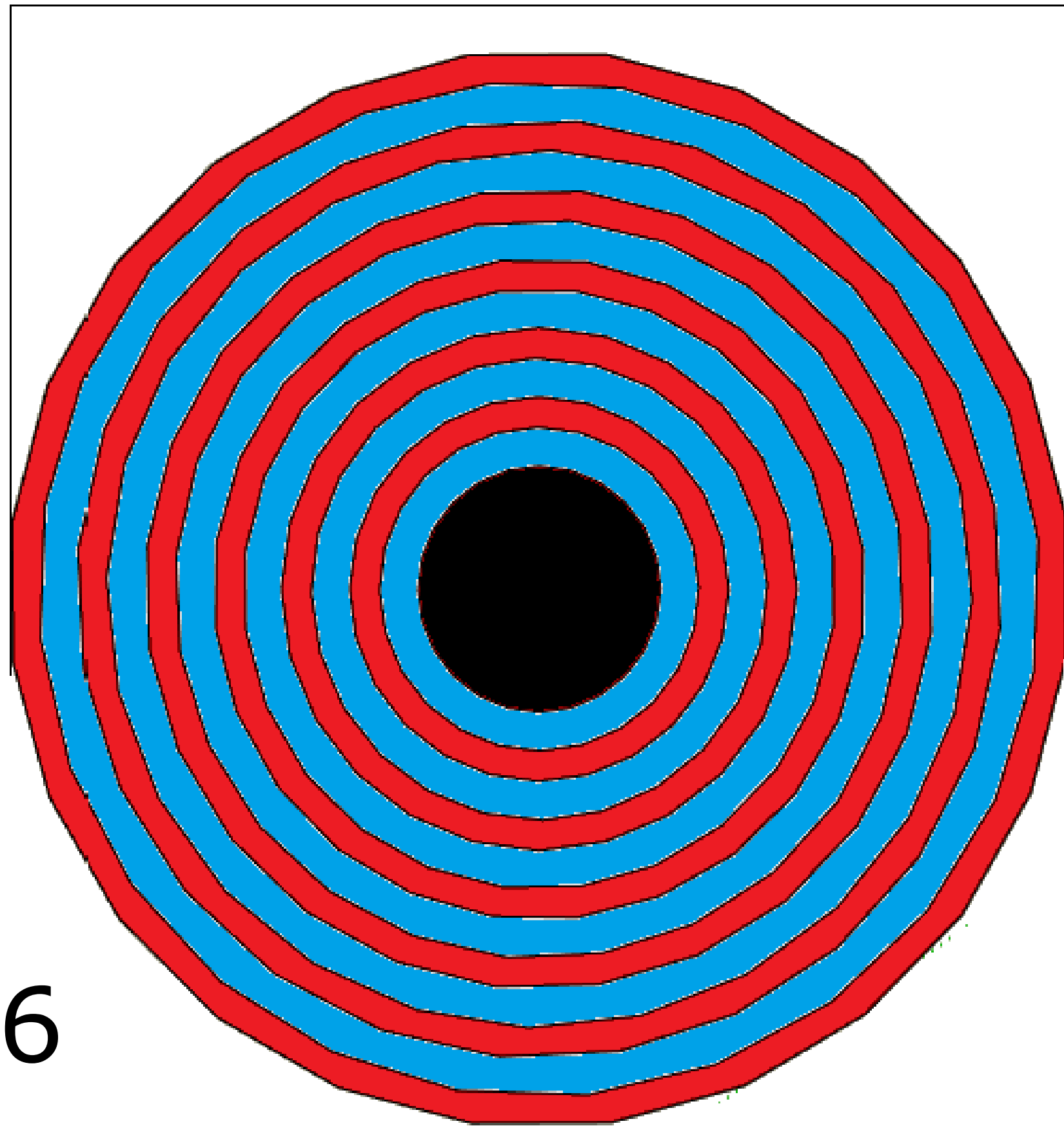
stiffeners



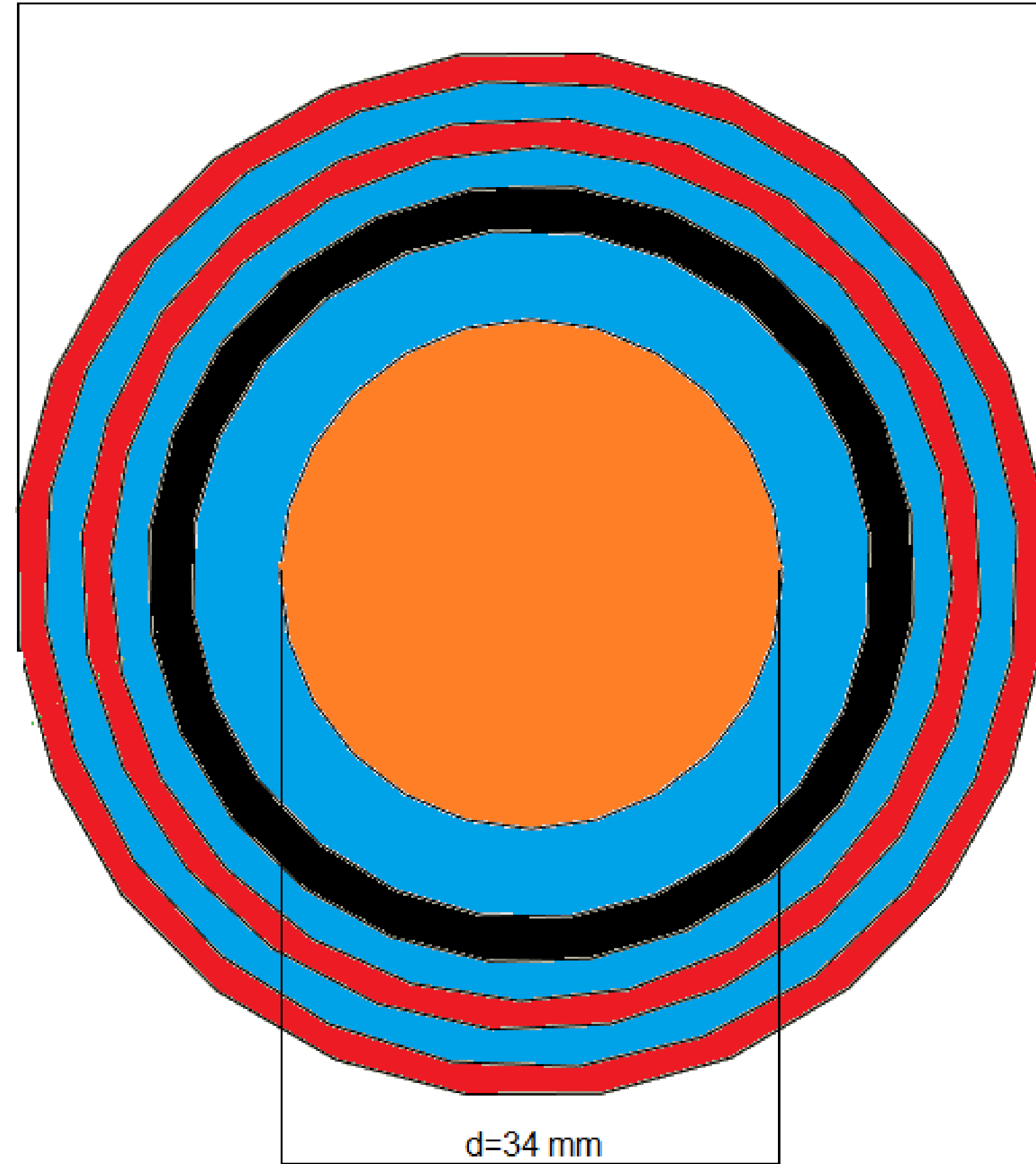
Parameter	Value	
	MC-5	MR-6
Number of fuel tubes	5	6
Total length [mm]	1315	1380
Fuel meat length [mm]	1000	1000
Fuel meat material	U ₃ Si ₂ dispersed in Al	UO ₂ dispersed in Al
Tube thickness [mm]	2	2
Mass of ²³⁵ U [g]	485 ± 5	485 ± 5
Uranium density [g/cm ³]	4.79	3.59
Total heat transfer area [m ²]	1.29	1.79
Enrichment	<20%	<20%


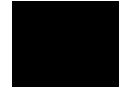


MR-2 fuel element

d=70 mm



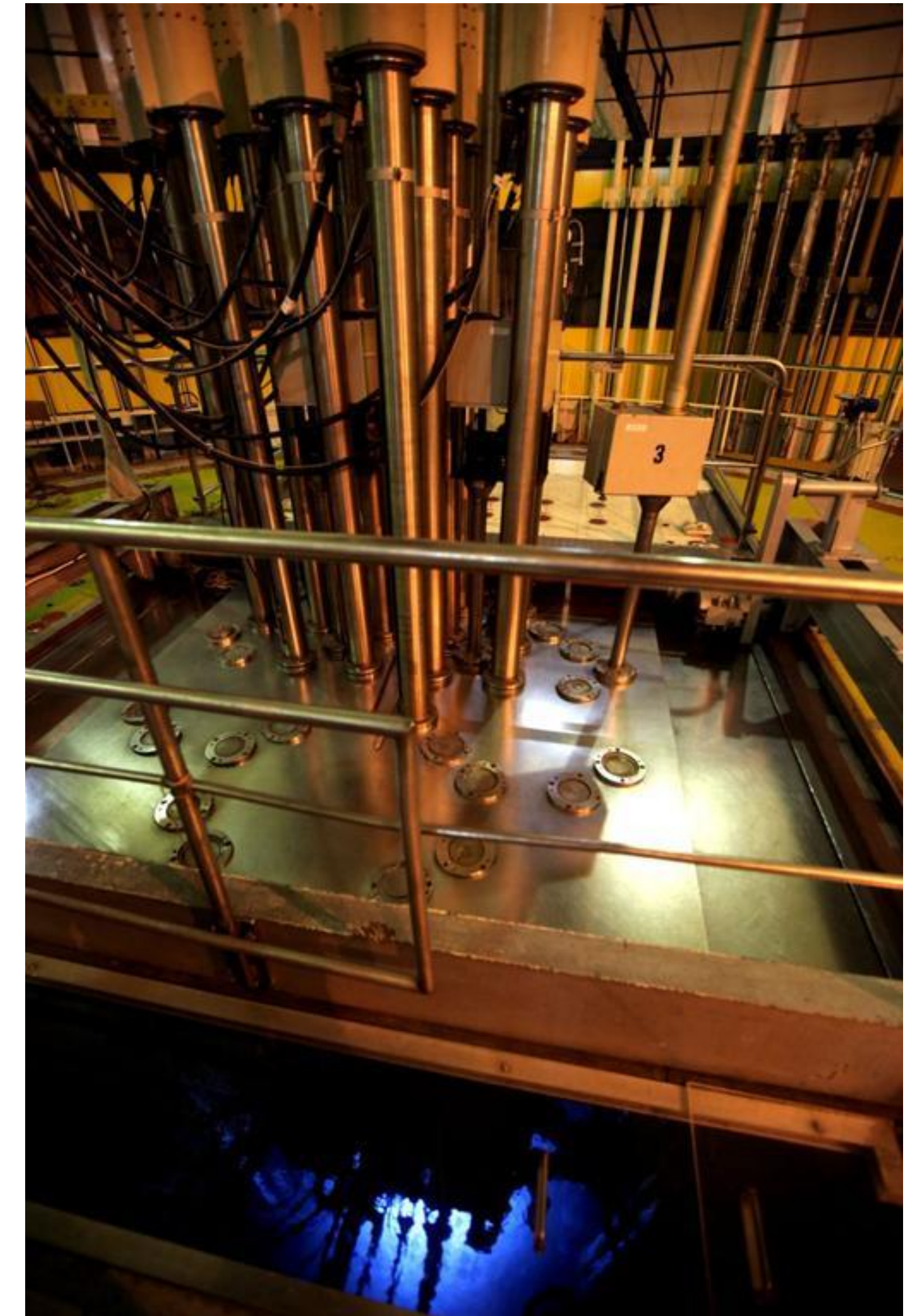
d=70 mm



- | | | | |
|---|-----------|---|-----------------------|
|  | Fuel tube |  | Aluminum |
|  | Water |  | Irradiation container |

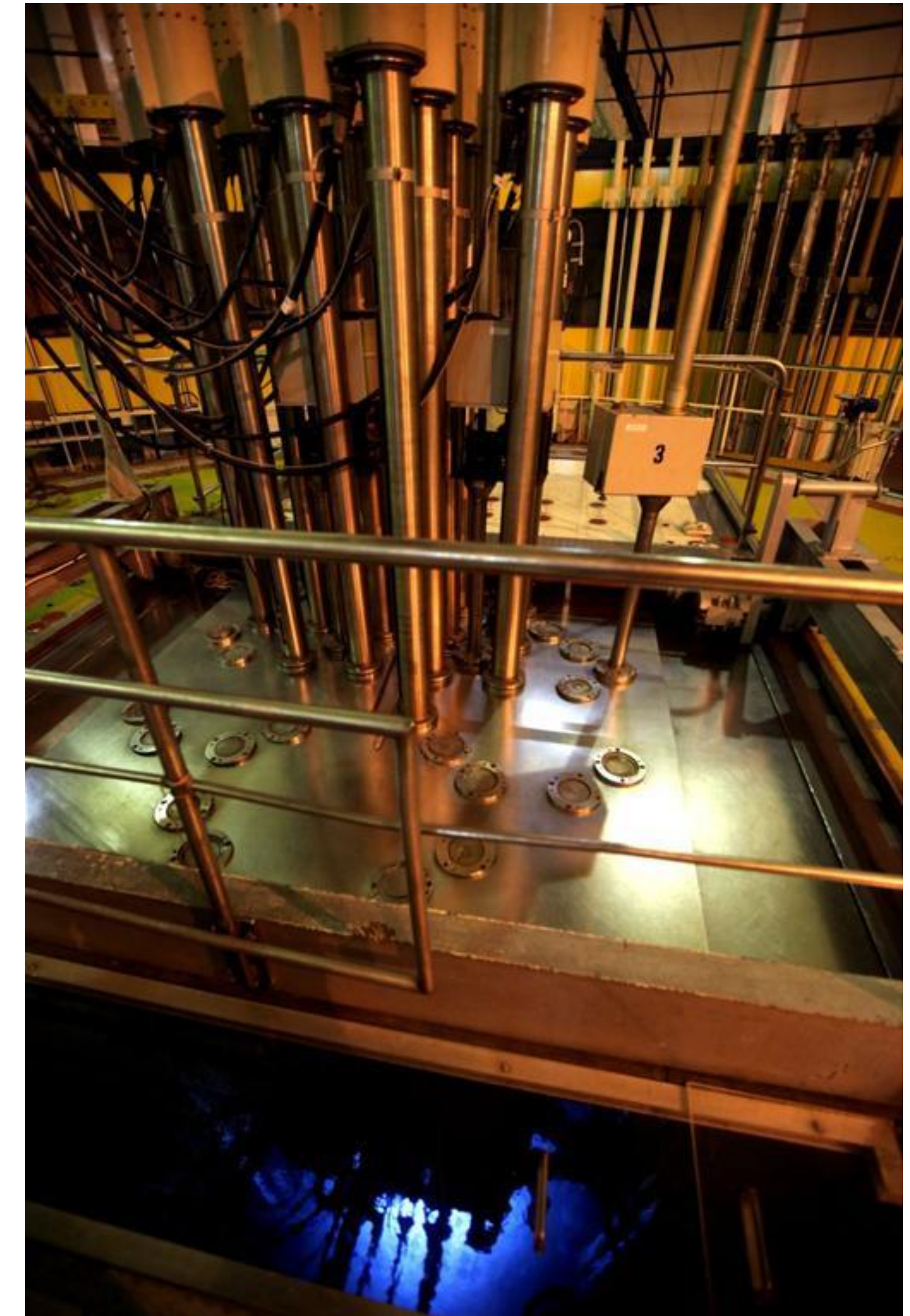
Licensing process (MR-2)

- Initial contact with the regulatory body
- License change required to incorporate new fuel type
- Safety analyses:
 - Thermalhydraulic
 - Neutronic
 - Reactivity
 - Mechanical analysis was not needed as FA was constructed by our past fuel supplier
 - Source term during potential accident

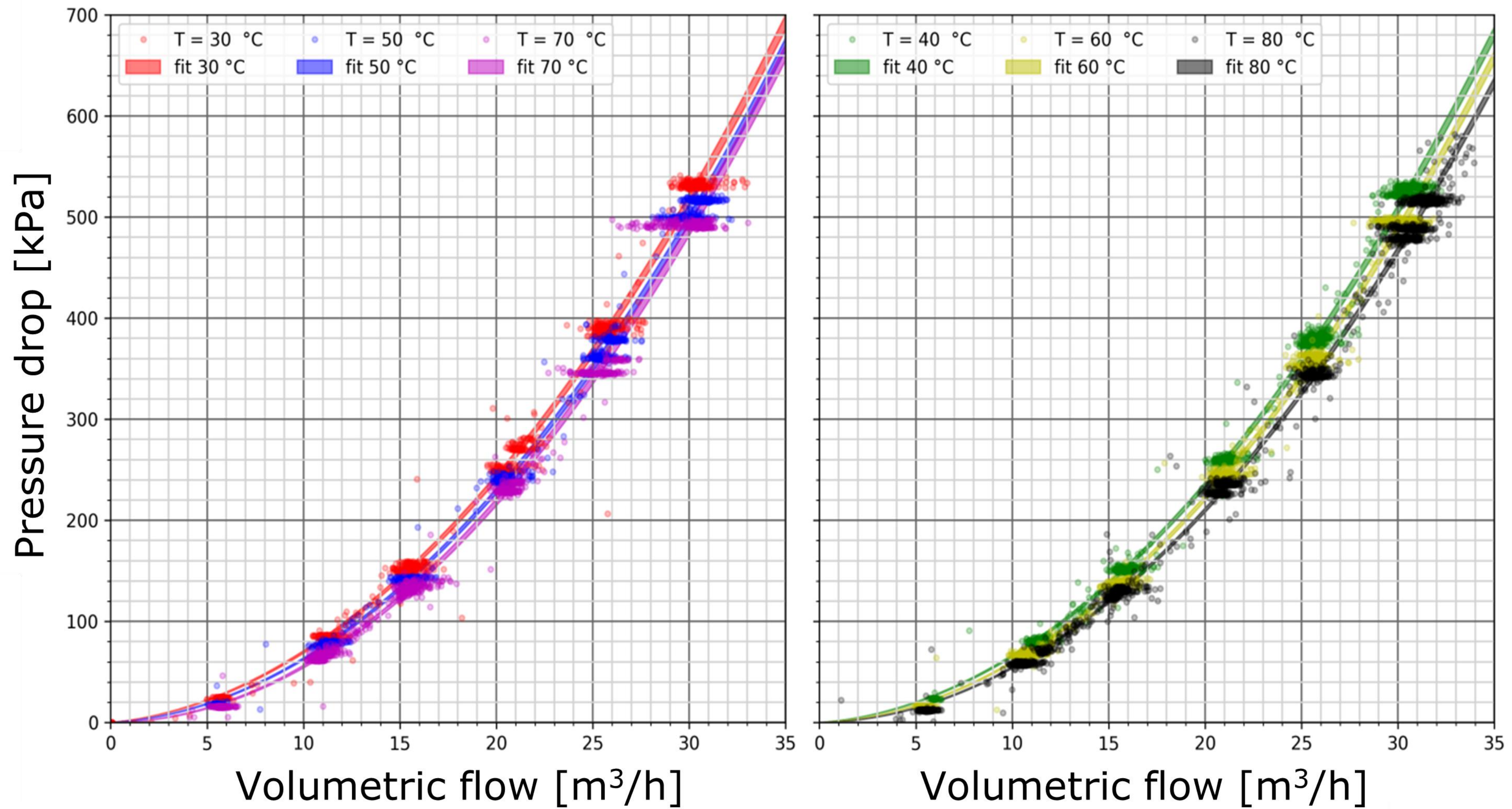


Licensing proces additional requirements (past experiences)

- Two lead test assemblies needed
- Hydraulic measurements (off-core)
- Vibrations measurements (off-core)
- In-core irradiation with constant releases monitoring
(up to 60% burn-up)
- Sipping-tests (off-core leakage detection)
- Mechanical analysis needed

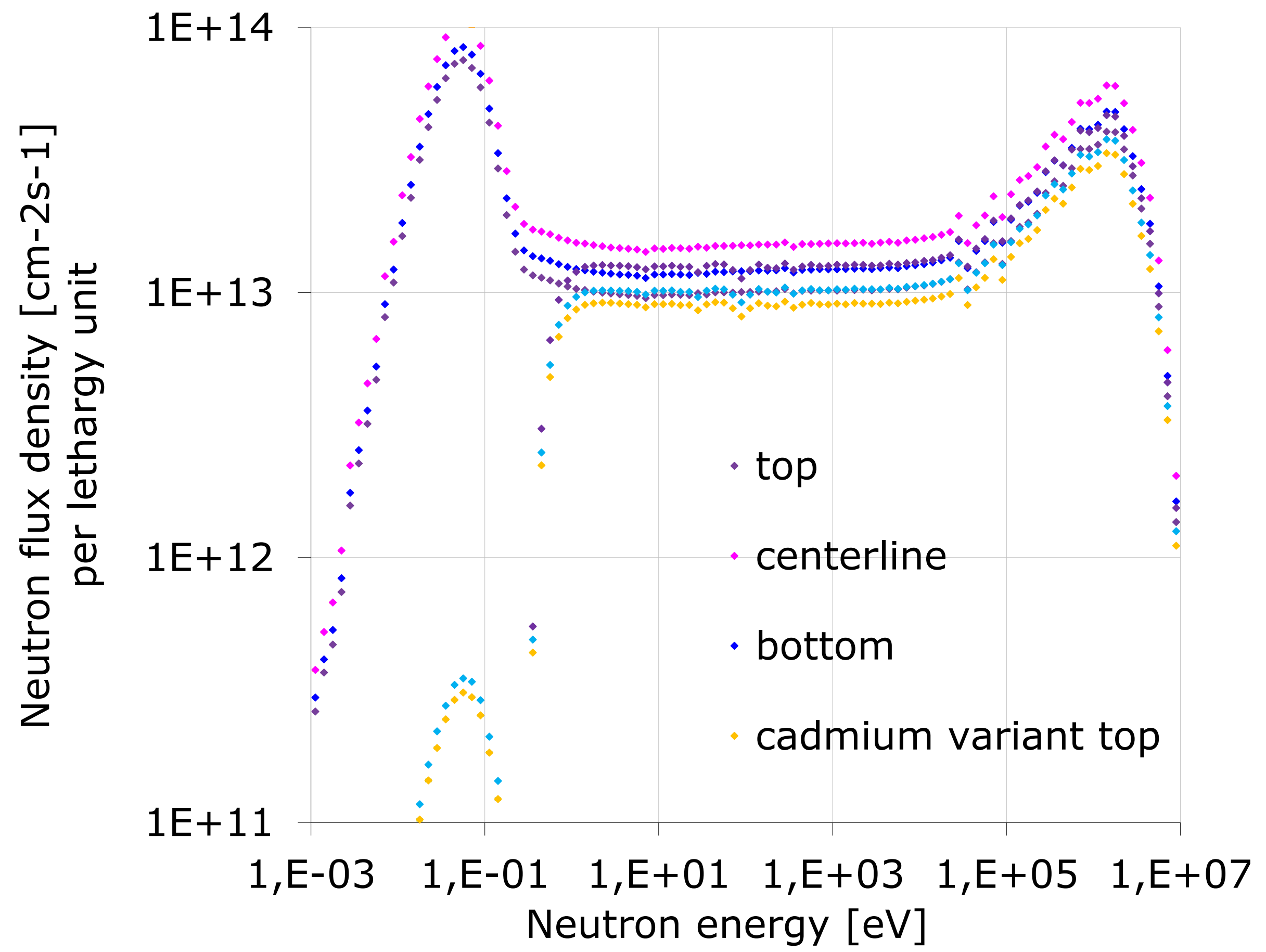


MR-2 measurements – pressure drop





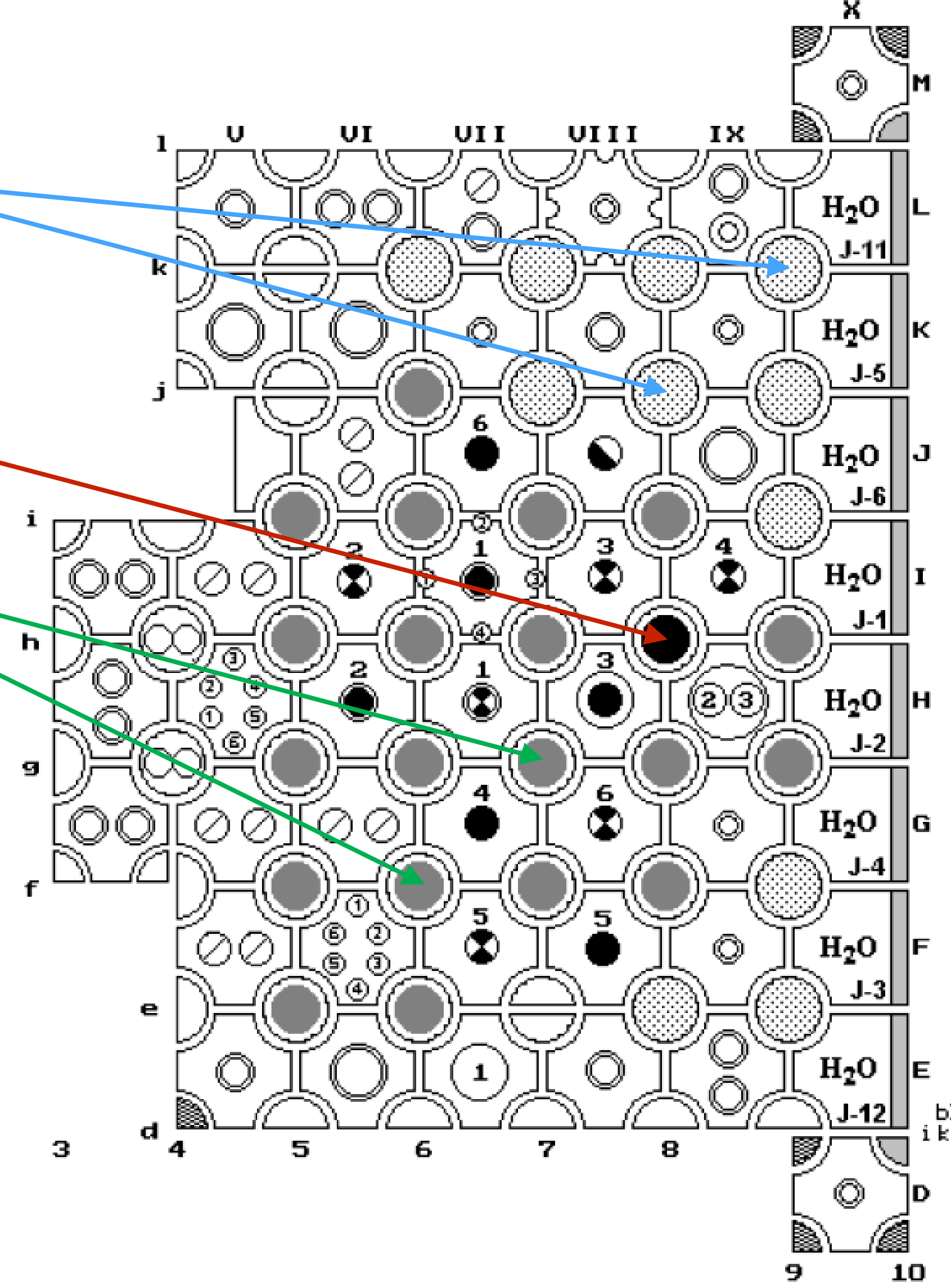
MR-2 measurements – in-core irradiation



graphite plugs

MR-2

MR-6



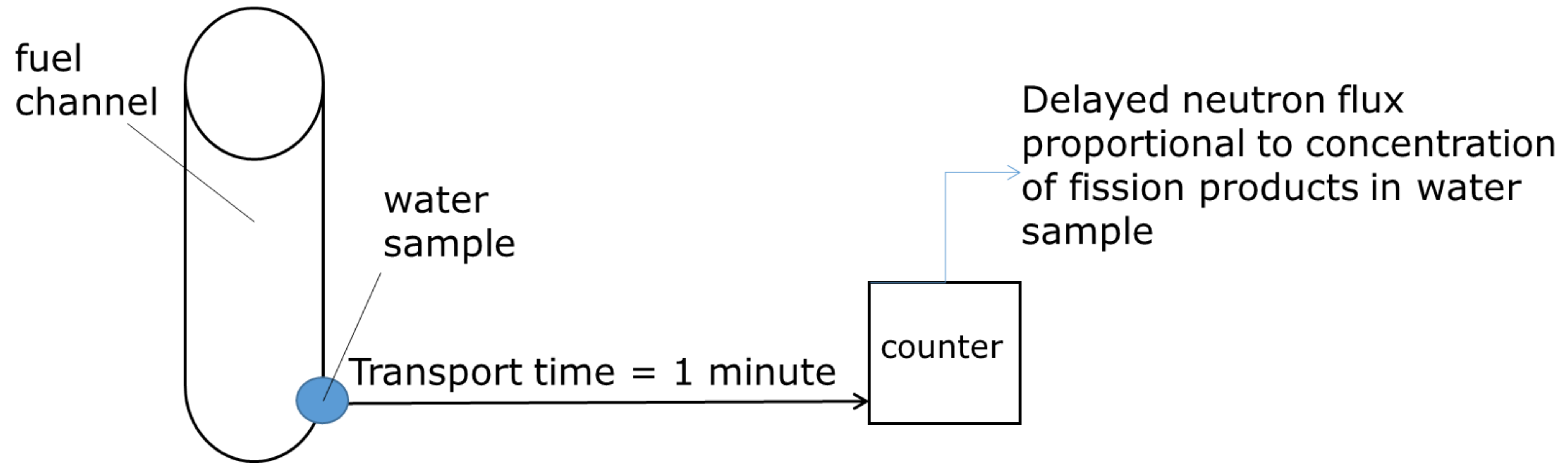
cXXIV/202225 25.08.2022–26.08.2022

cXXIVa/202226 29.08.2022–04.09.2022

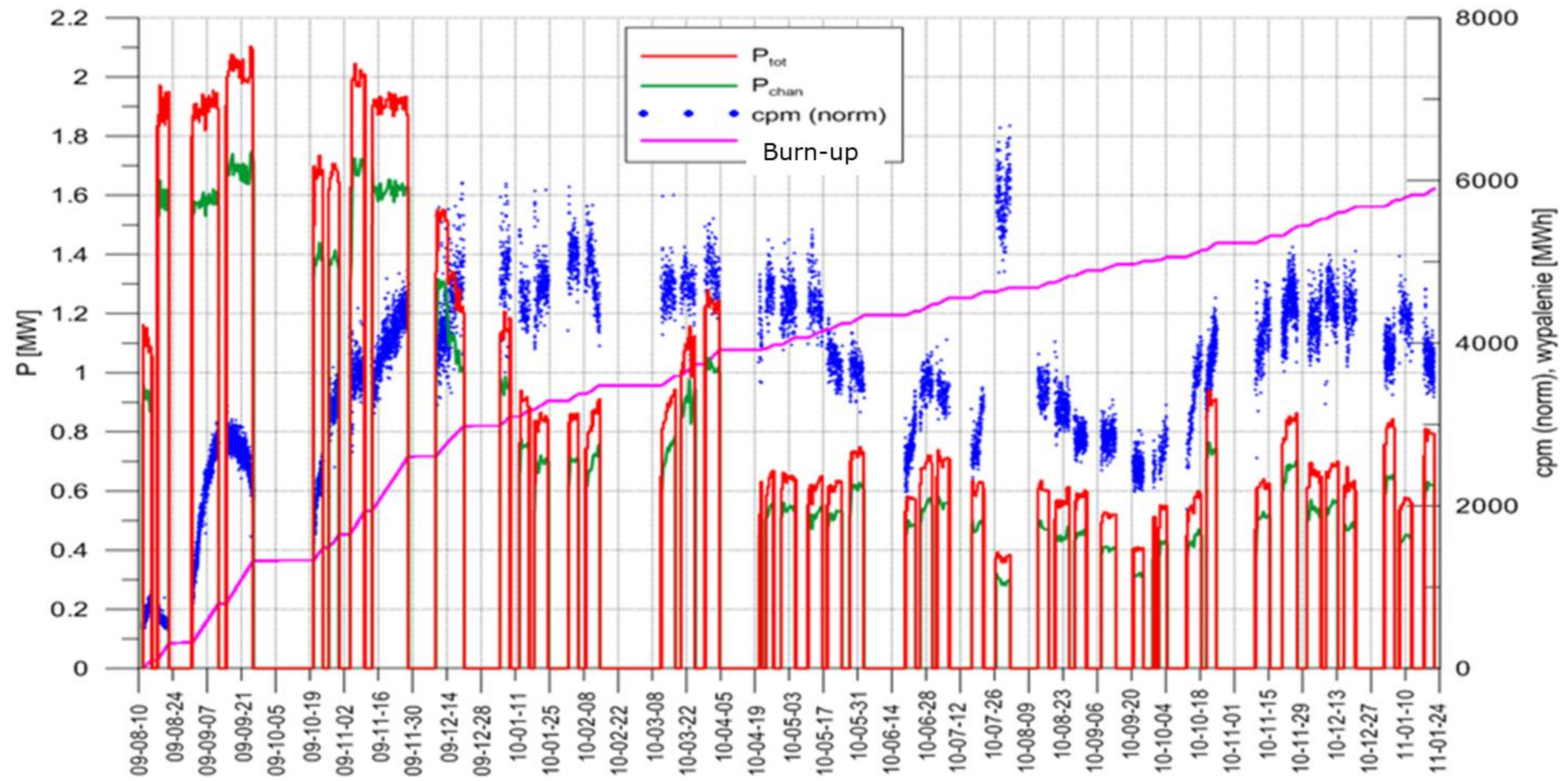


MR-2 measurements – Fuel Elements Integrity Measurements System

- Online
- In-core
- Individual for each fuel channel



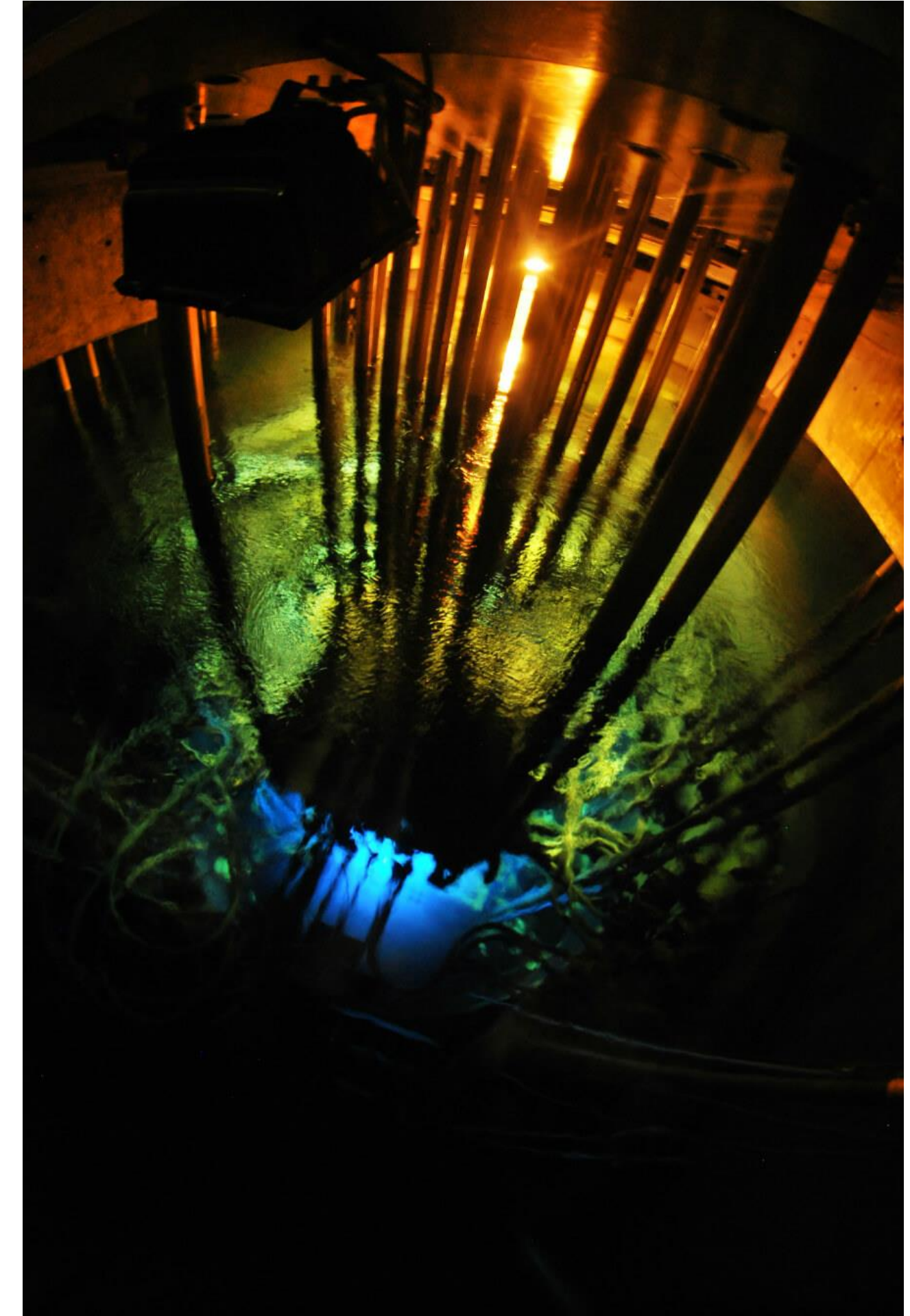
MR-2 measurements – Fuel Elements Integrity Measurements System



Summary



- MARIA reactor team is up-to-date with the licensing process
- Three new fuel element types have been licensed in the years 2009–2022
- Additionally four types of uranium targets for Mo-99 production
- New computational tools
- We are ready for the new developments



MARIA perspective: 2025–2053

2050
OLA¹

2025–2053
New License

250 mln USD

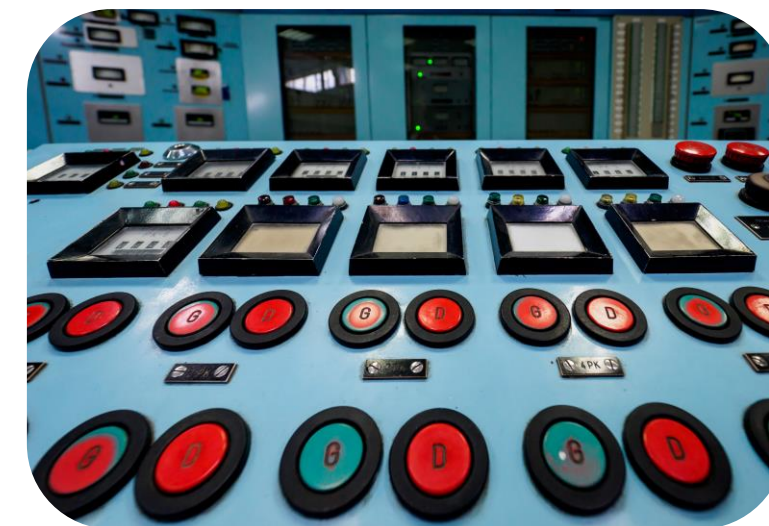
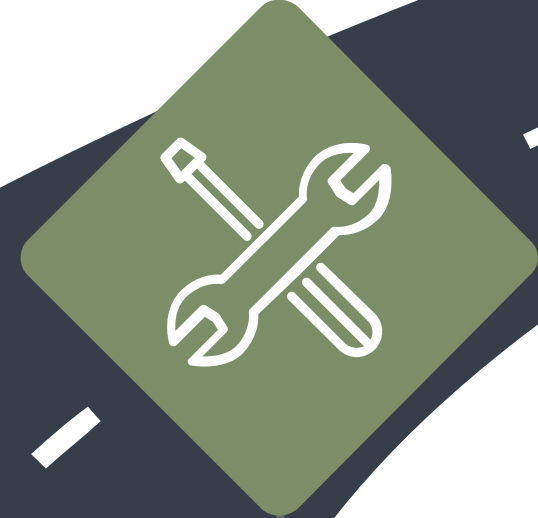
the cost of the OPAL reactor construction in Australia (2007) amounted to 400 mln USD. Meanwhile, the planned PALLAS is to cost at least 600–800 mln €.

2018–2019
Periodic assessment

2021–2025
Modernization

20+ mln EUR

¹ OLA – Open-pool Light-water Atomic



Control system

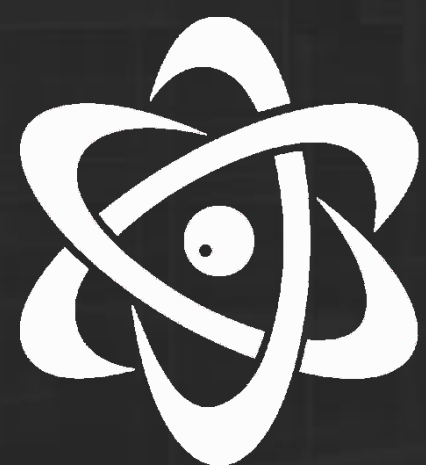


Power supply



Safety system

Thank you for attention



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