

Gamma and neutron dose rate measurements around the KATANA water activation loop at JSI TRIGA reactor



ANIMMA
JUNE 9-13 2025
VALENCIA - SPAIN




MOTIVATION

- Lack of **water activation** experiments in **fusion relevant conditions**
- Lack of experimental facilities featuring **high-energy γ sources**
- Lack of **experimentally validated** fluid activation codes/methodologies


KATANA FACILITY

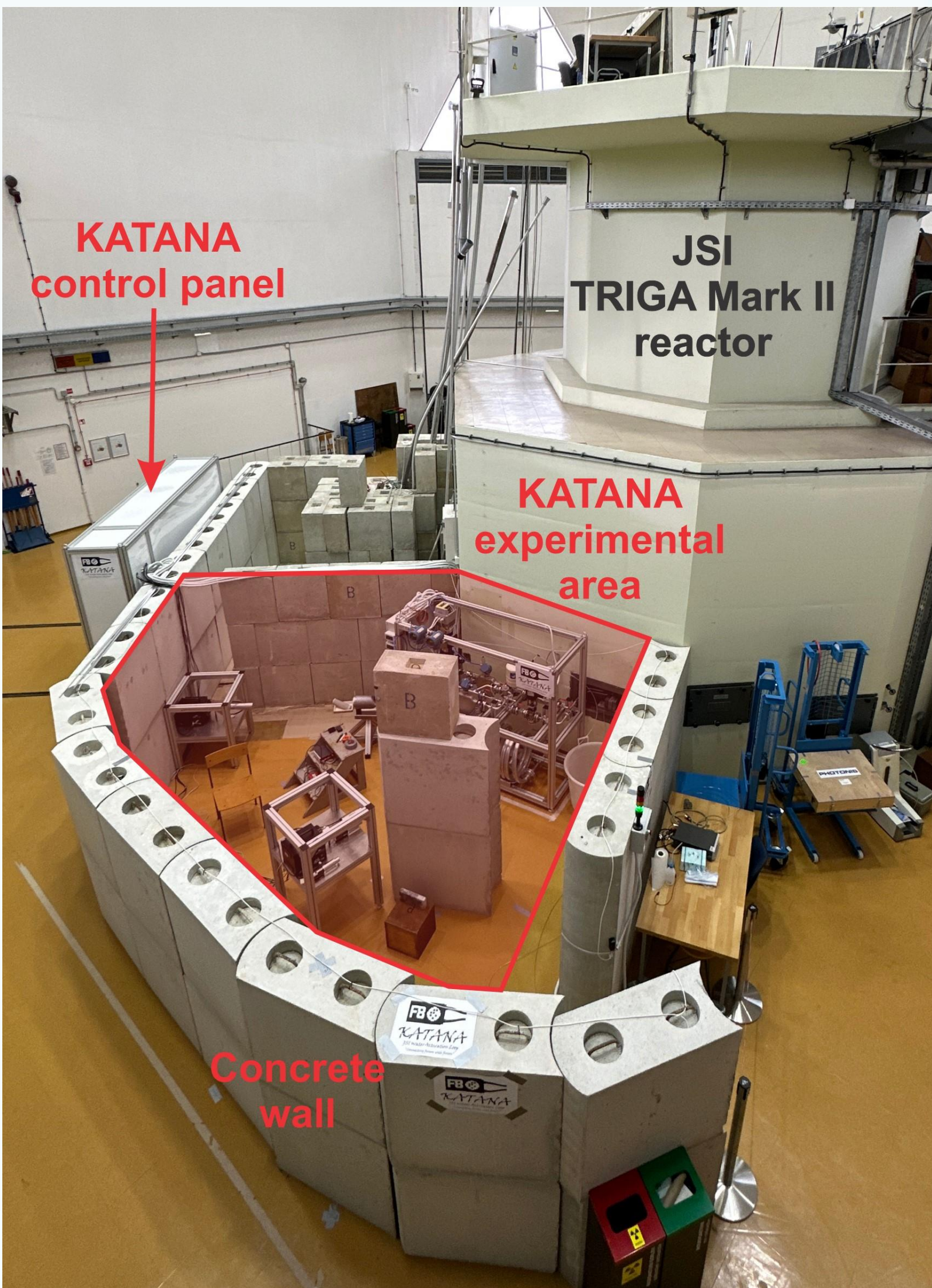
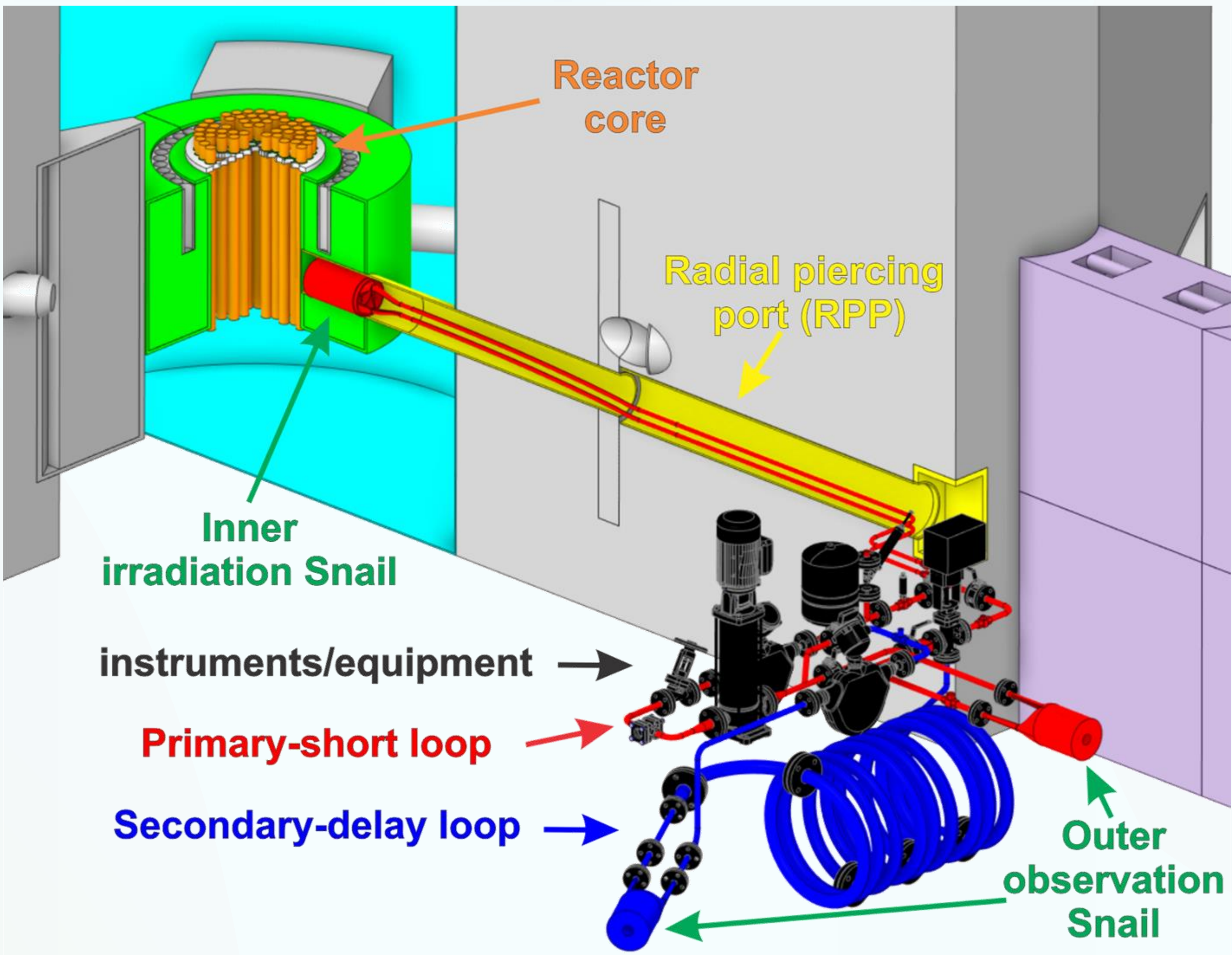
- Closed-water activation loop
- Successfully commissioned in Dec. 2023
- Execution of several experiments
 - γ & n dose rate measurements: $H^*(10)$
 - Safety aspect + C/E comparison

CONCLUSIONS

- C/E values are within 1 order of magnitude (**reasonable**)
- **Improvements:**
 - **Absolute calibration** of n and γ detectors → flux measurements
 - Use of **CFD-based fluid activation codes** → accurate modelling of source (activated water)
- **Experimental campaigns:** 2024, 2025, 2026+  EUROfusion

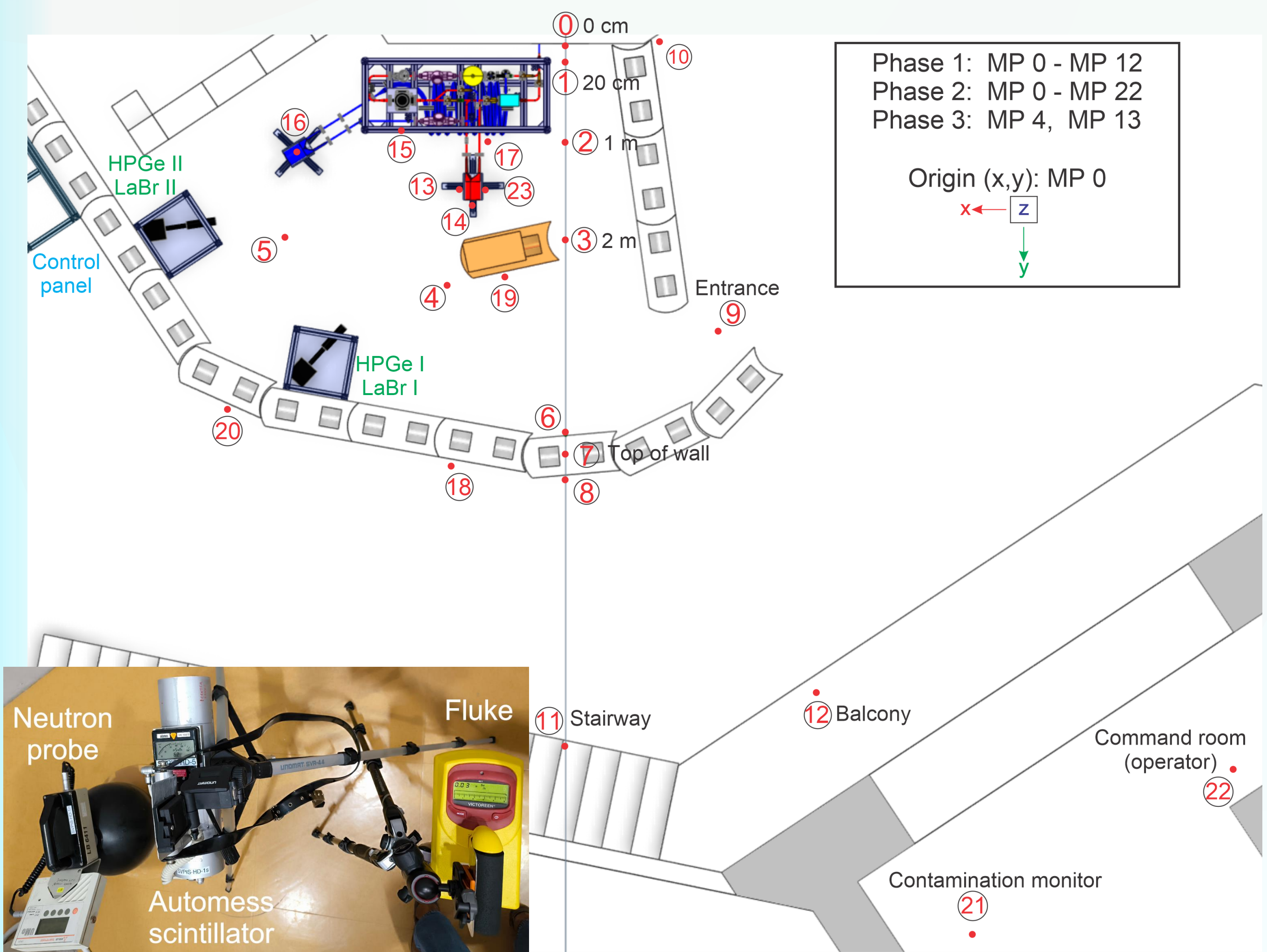
KATANA: closed water activation loop

- **Well-defined and stable high energy irradiation source:**
 - Gamma: 6 MeV – 7 MeV
 - Neutron: ~1 MeV
- **Water activation based experiments** (^{16}N , ^{17}N , ^{19}O)
- Experimental validation of **fluid activation codes**
 - **FLUNED, RSTM, ActiFlow & GammaFlow**
- **Calibration** of γ detectors and dosimeters
- **Shielding experiments** using ITER-relevant materials
- **Integral cross-section** measurements
- Dose rates and γ spectrum measurement
-  **relevant conditions**

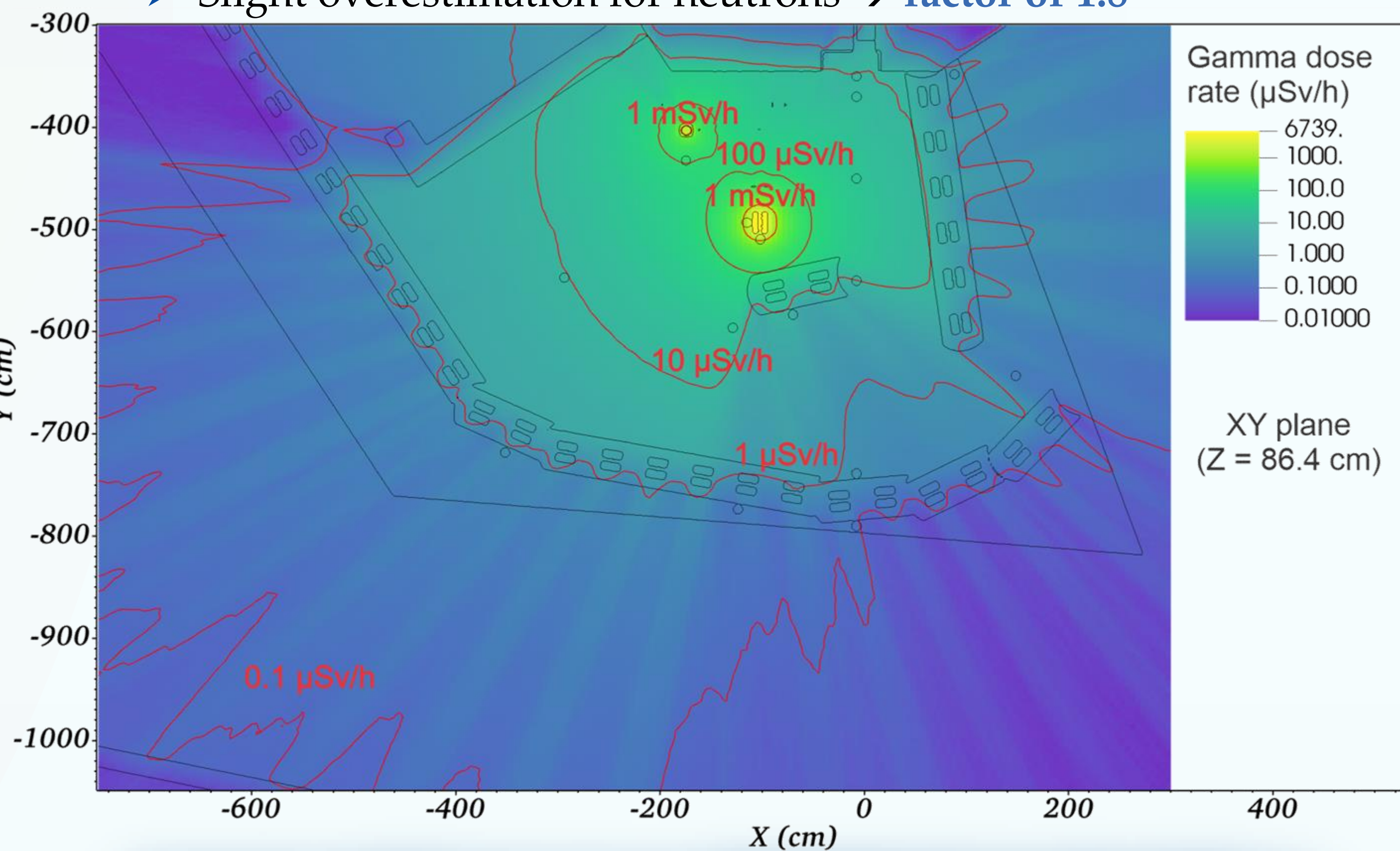


Gamma & neutron dose rate measurements

- Obtain dose field map + safety aspect
 - **Green zone** limit: 10 $\mu\text{Sv/h}$ (reactor hall)
- Dose rate equivalent ($H^*(10)/\text{time}$)
 - **Max: 5 mSv/h** (MP 13; flow = 0.4 l/s)



- **Calculation:** simplified convectional model without CFD
 - MCNP + analytical approach
- Underestimation for gammas → **factor of 2-5 times**
- Slight overestimation for neutrons → **factor of 1.8**



MP	Snail No. 1 + Pump			
	Calculation		C/E	
	γ [$\mu\text{Sv/h}$]	neutron [$\mu\text{Sv/h}$]	γ []	neutron []
0	10.6	4.31E-02	0.08	0.004
1	13.5	5.68E-02	0.45	0.006
2	26.2	1.00E-01	0.22	0.13
3	9.8	2.89E-02	0.20	0.06
4	22.9	5.71E-02	0.19	0.14
5	9.6	3.71E-02	0.18	0.37
6	0.8	5.34E-03	0.26	0.03
7	0.2	1.61E-03	0.12	N/A
8	0.1	4.29E-04	0.33	N/A
9	0.3	1.63E-03	0.22	N/A
10	1.1	1.24E-03	0.41	N/A
11	0.3	1.37E-03	0.17	N/A
12	0.0	7.20E-04	0.03	N/A
13	1397.7	3.68	0.28	1.23
14	1236.8	3.54	0.36	1.77
15	109.1	2.34E-01	0.18	0.21
16	14.8	5.04E-02	0.16	0.17
17	56.0	1.74E-01	0.17	0.16
18	0.2	6.01E-04	0.37	N/A
19	6.3	1.05E-02	0.70	N/A
20	0.7	1.03E-03	0.42	N/A



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