

Application of the FW-CADIS Variance Reduction Method to Calculate a Precise N-Flux Distribution for the FRJ-2 Research Reactor

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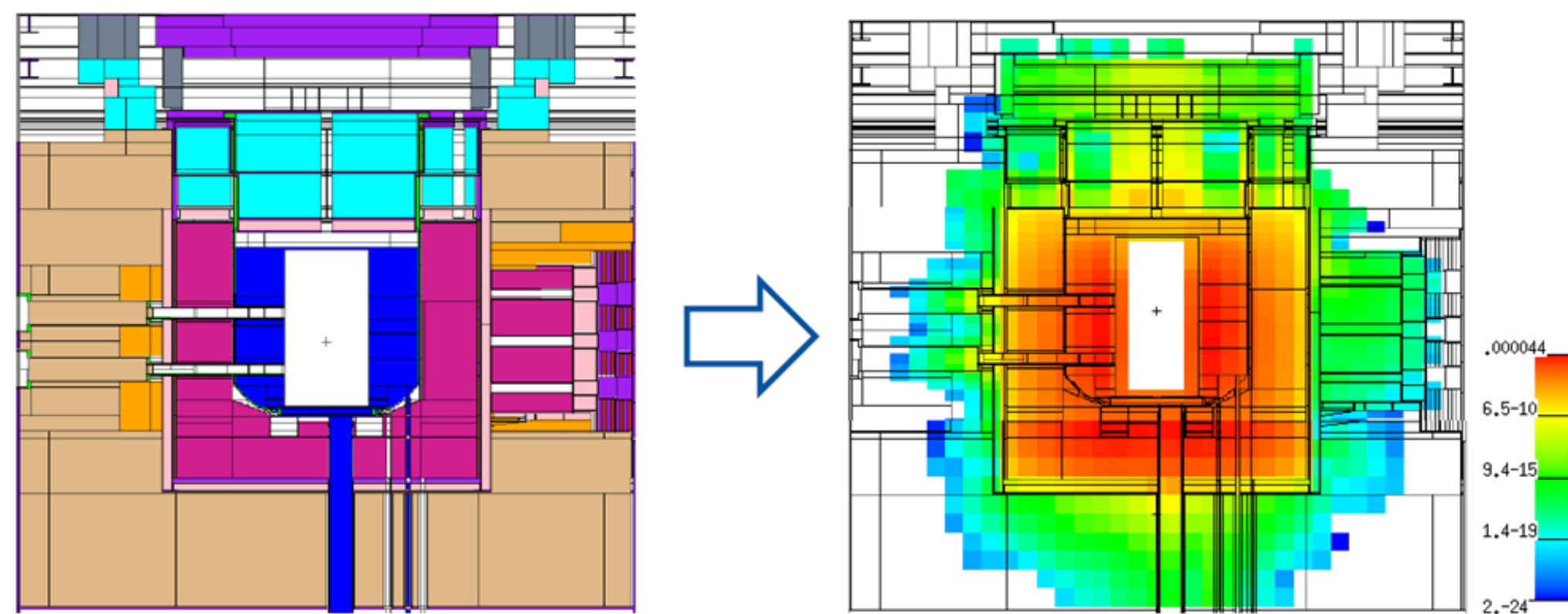
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Background and Motivation:

- Detailed activity and dose rate atlases (ADAs) in the decommissioning process of research reactor FRJ-2 to:
 - Speed up of decommissioning/approval process
 - Determine radiation field for optimal radiation protection
 - Quantify and characterize nuclear waste for disposal
- Monte Carlo N-Particle code is widely used for N-transport calculations

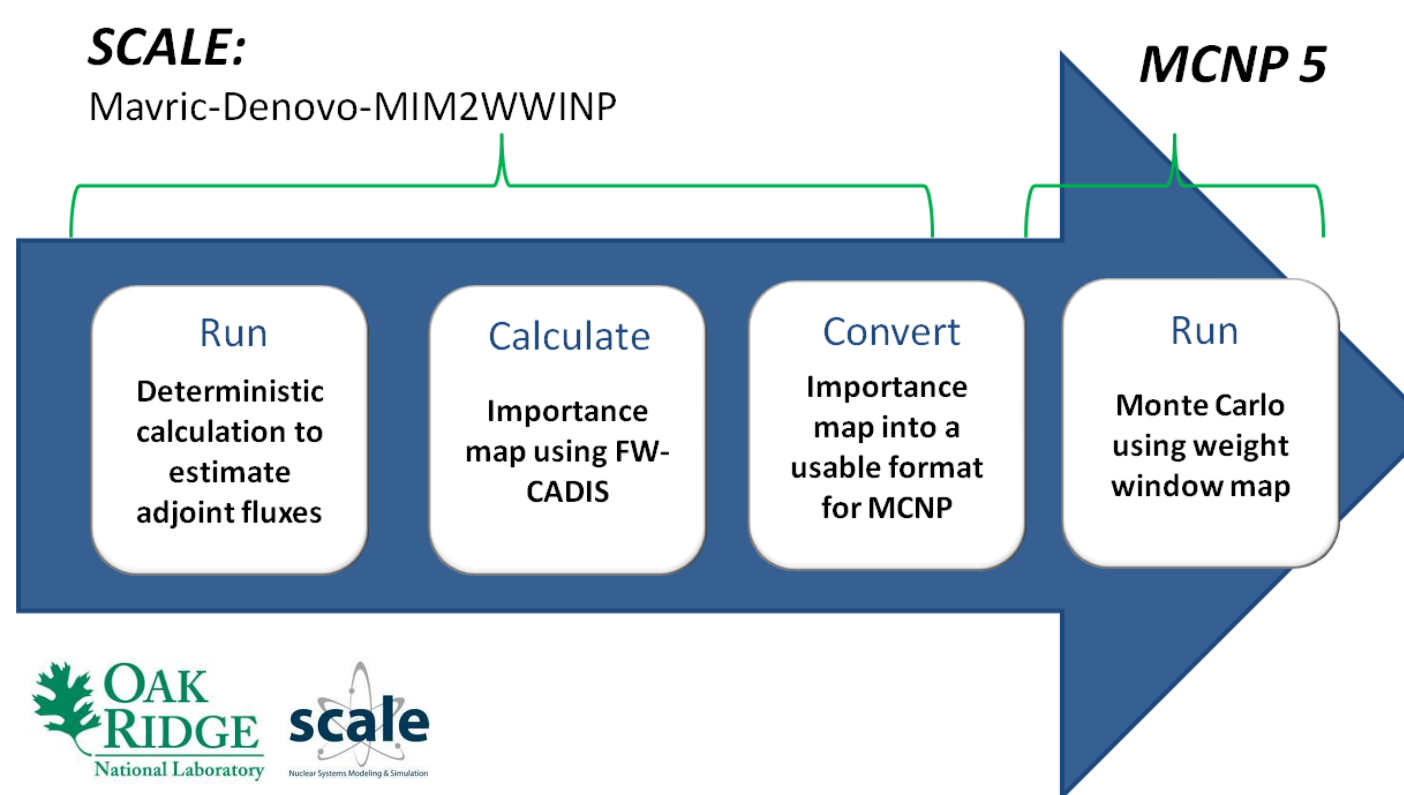
Numerical and statistical limitation of MCNP:

- Limited application of MCNP variance reduction methods for complex geometry

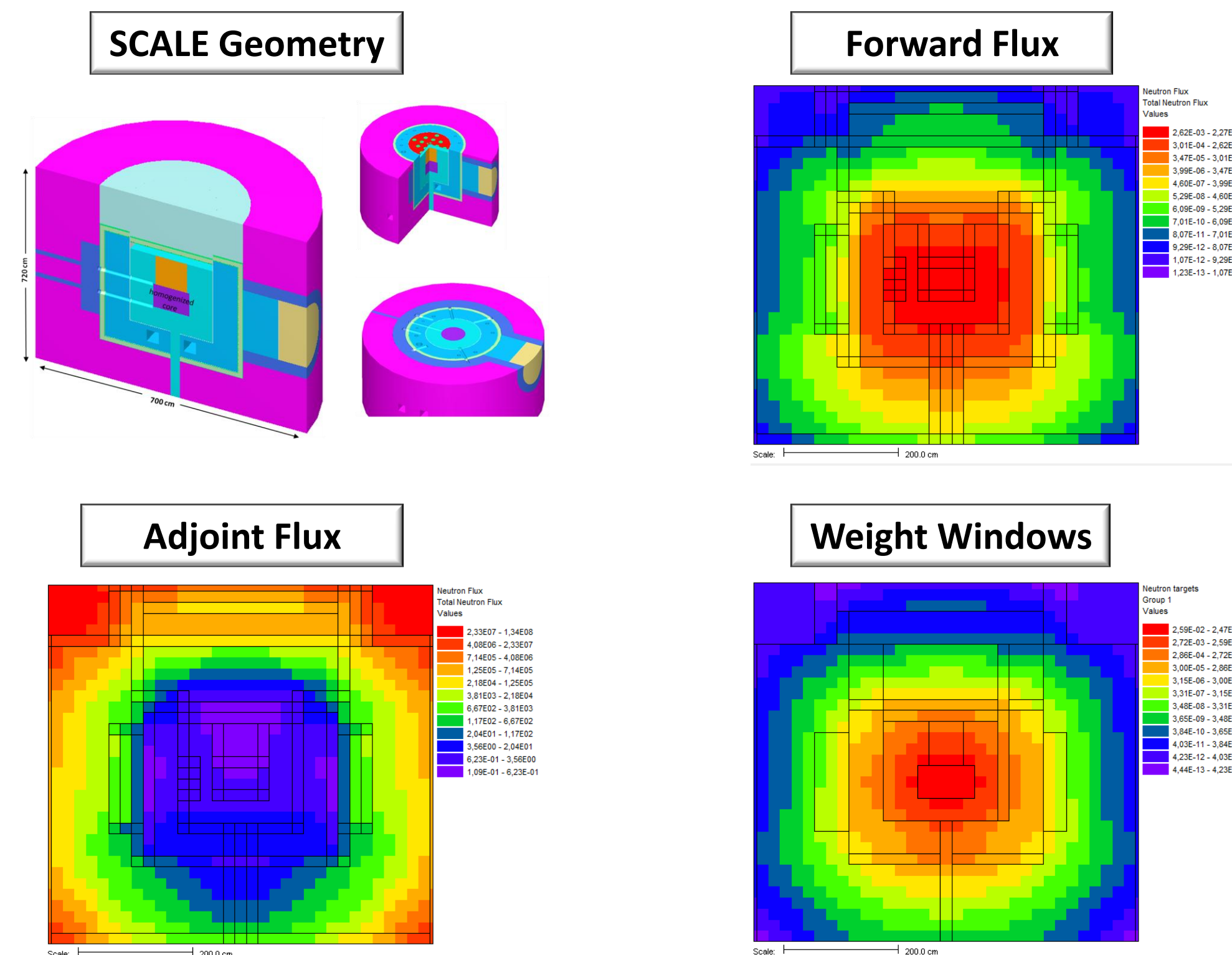


Application of FW-CADIS Method:

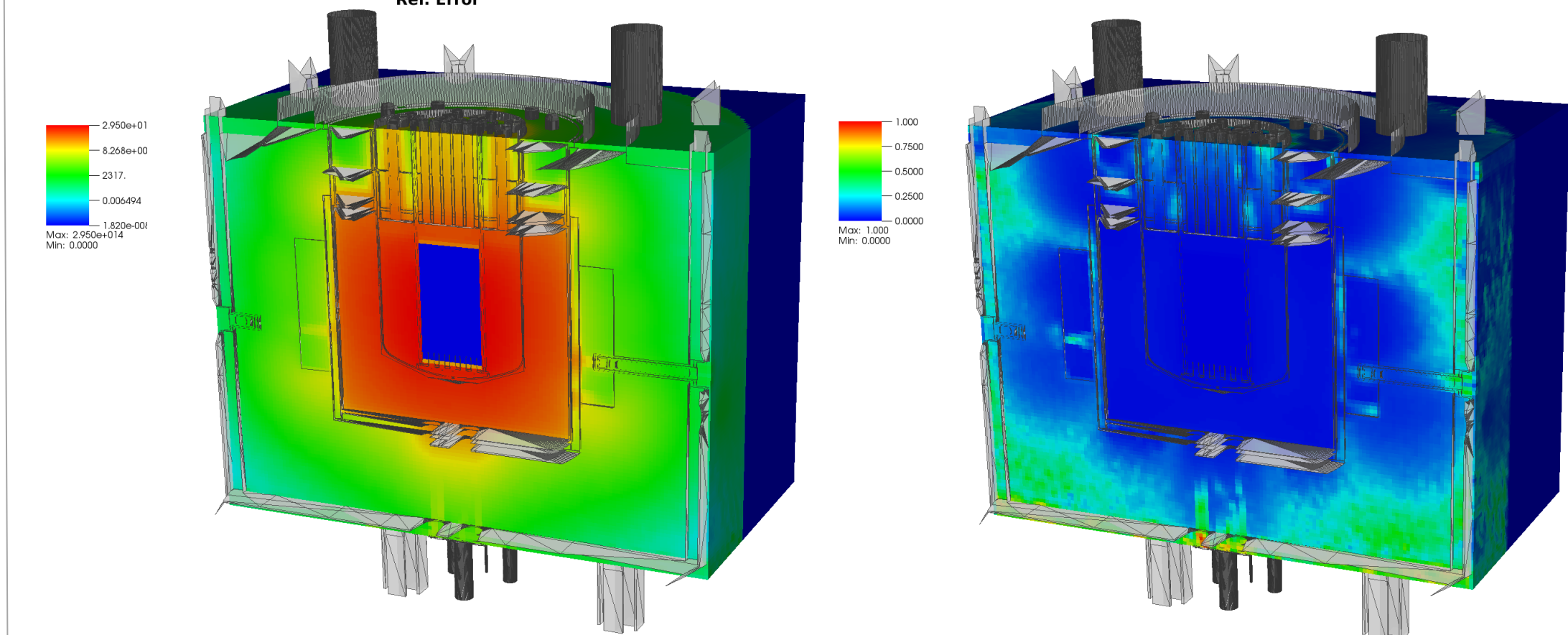
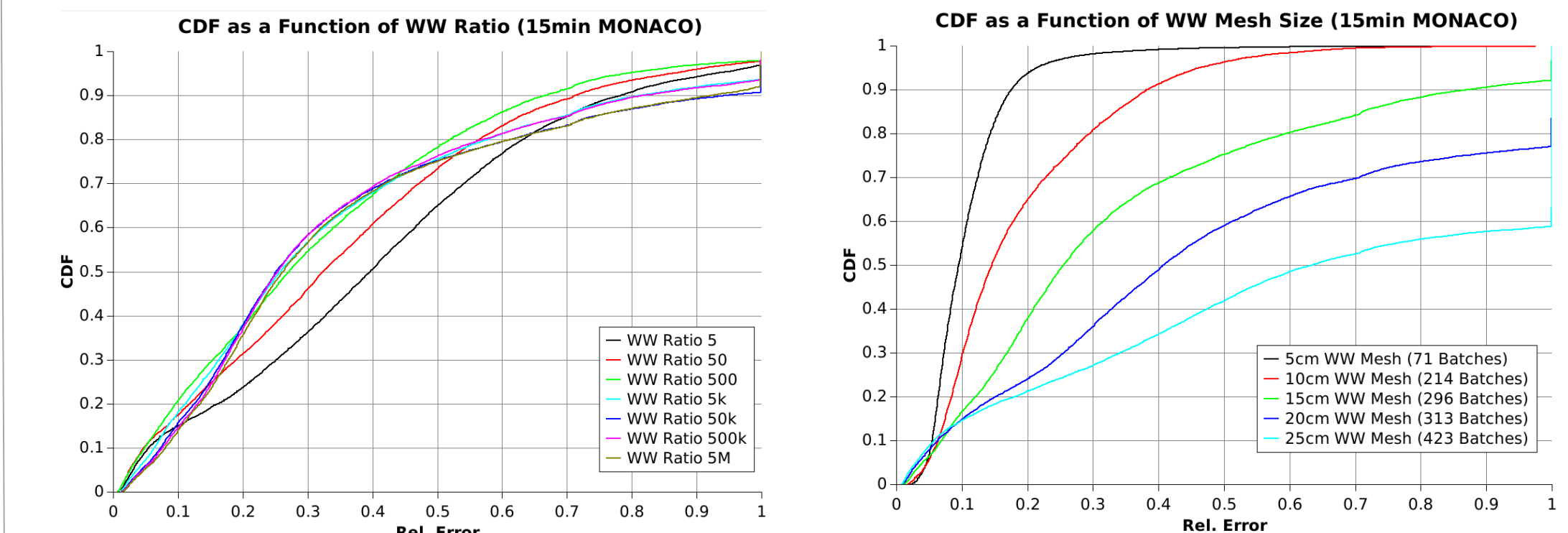
- To improve the particle sampling by generation of properly distributed particle weight
- Is based on forward and adjoint flux calculation using deterministic method embedded in MARVIC
- Allows automatic variance reduction through consistent source and transport biasing



- Generation of weight windows based on a simplified reactor model
- Performing a forward and an adjoint flux calculation
- Applying the FW-CADIS method to generate an importance map
- Converting the importance map into a weight window map for MCNP



Efficiency of the FW-CADIS Method:



Parameters	MCNP	MCNP + VR	FW-CADIS
CPU Time (h)	1192	1425	864
Rel. error	85,50%	55%	17%
Avg. FOM	1,6E-03	2,3E-03	5E-02

Conclusion:

- The limited capability of analog MC method for deep penetration
- MCNP simulation with FW-CADIS based importance map resulted in:
 - Low variance for the entire MCNP model
 - Significant enhancement of the simulation performance