WP6 “Core Safety”. Status as of March 2015.

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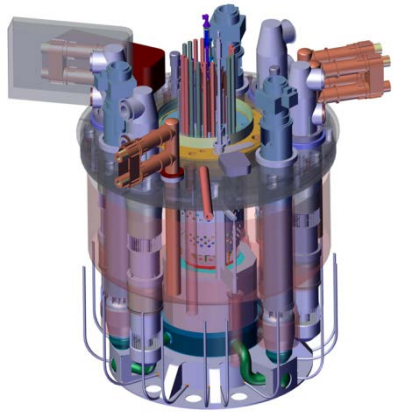
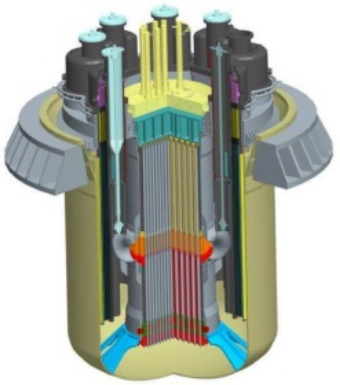
Paul Scherrer Institut, Switzerland

ESNII biennial conference, Brussels, March 18, 2015

Goal of WP6 “Core safety”





Support ASTRID, ALLEGRO, and ALFRED in:

- development of ESNII roadmap
- implementation of ESNII Deployment Strategy
- licensing of ESNII systems

By identifying the experimental and theoretical R&D needs to improve

- present designs from viewpoint of safety enhancement
- existing methods, tools and databases for static and transient analysis

By organizing a series of precise benchmark calculations

- to comparatively evaluate state-of-the-art codes and databases
- to estimate and rank uncertainties of different natures

WP6 tasks and subtasks

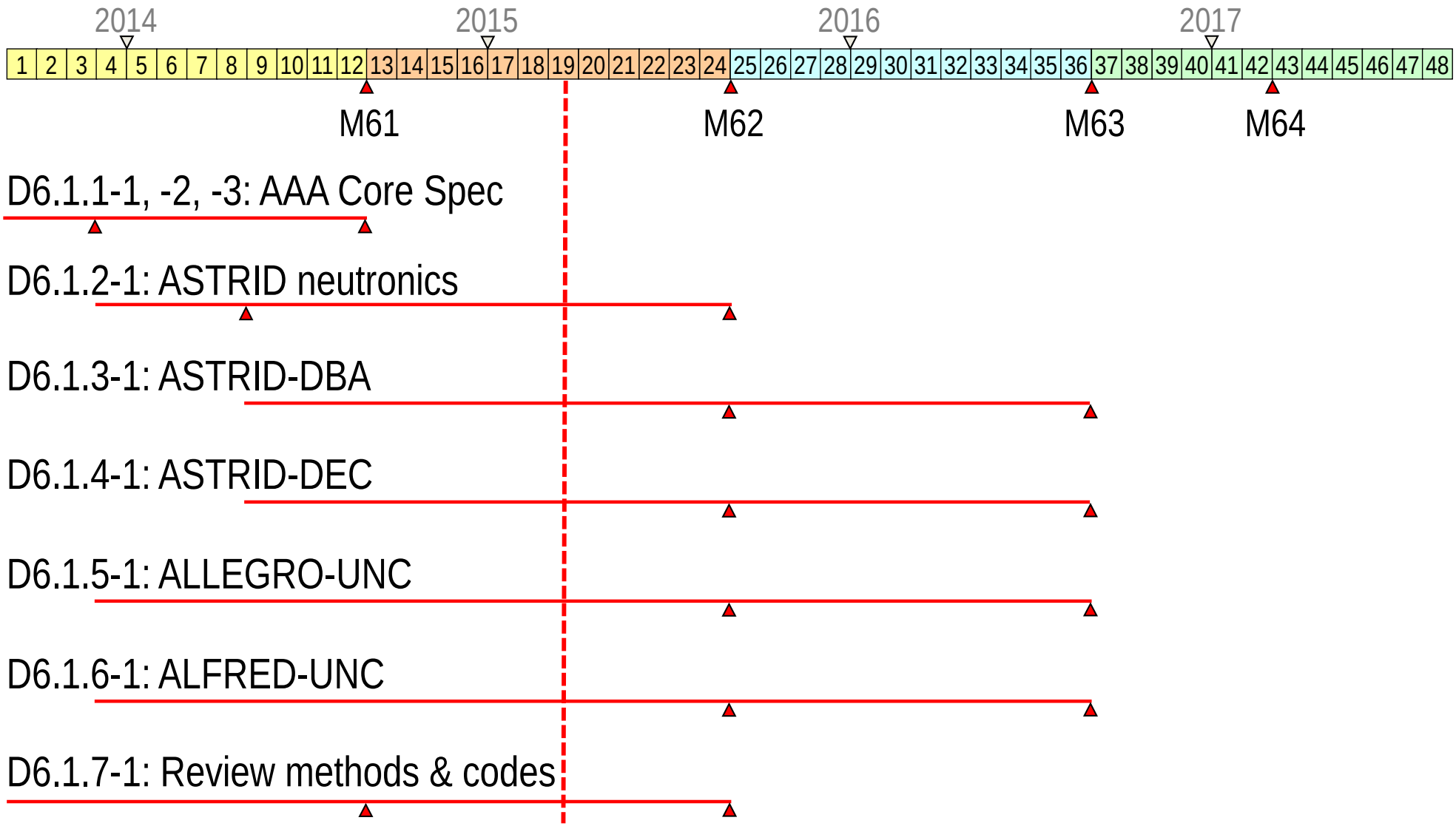
Task 6.1. Core safety calculations for ESNII reactors

- Specifications of the ASTRID, ALLEGRO and ALFRED cores (CEA, MTA EK, ANSALDO)
- ASTRID core safety coefficients (PSI)
- ASTRID core behaviour under design-basis accident conditions (KIT)
- ASTRID core behaviour under design-extension conditions (KIT)
- ALLEGRO core safety parameters and influence of model uncert's on transients (MTA EK)
- ALFRED core safety parameters and influence of model uncertainties on transients (ENEA)
- Review of methods, tools and databases used for core safety analysis (PSI)

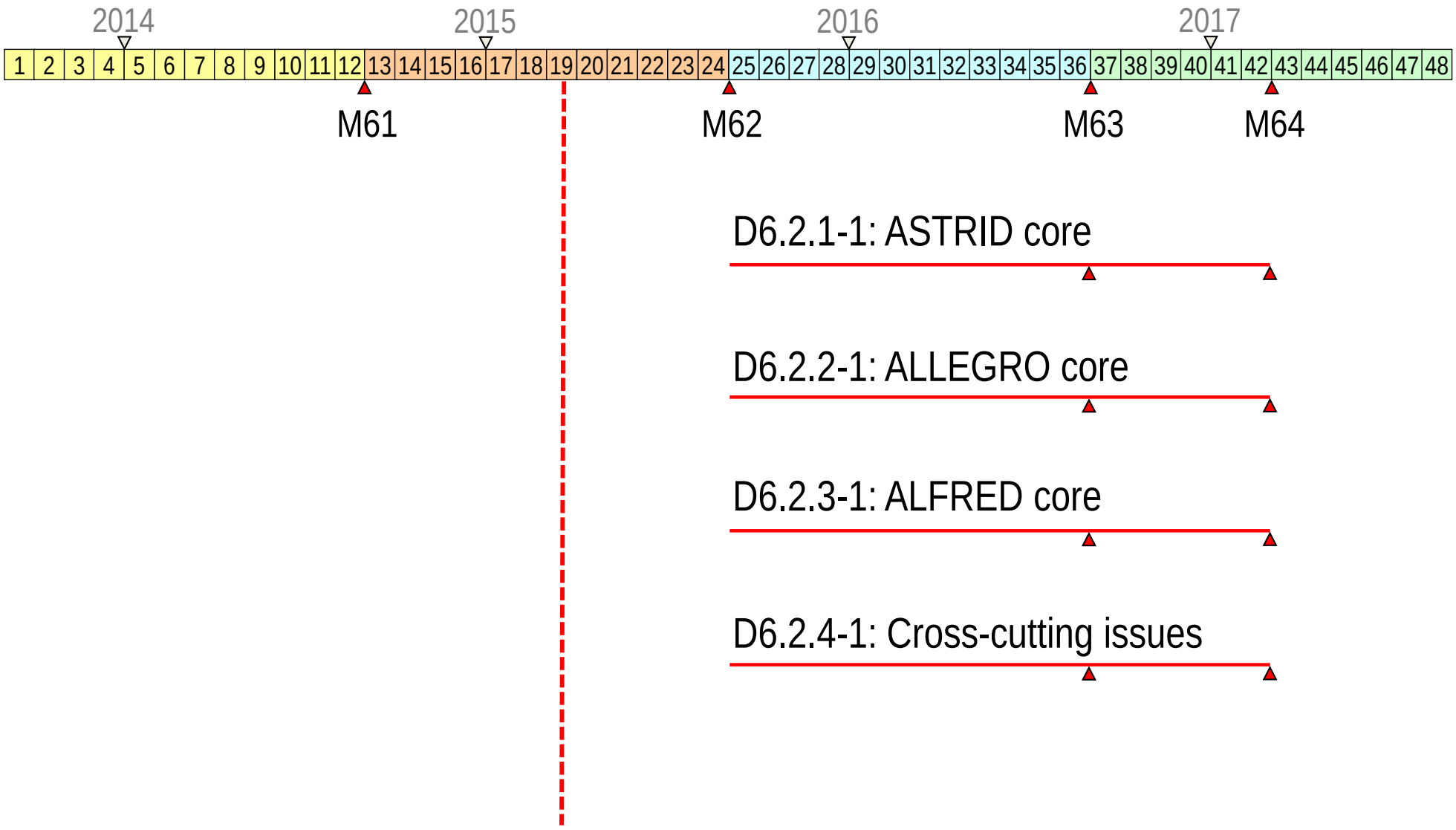
Task 6.2. Identification of R&D needs for improving core safety of ESNII reactors

- ASTRID core (PSI)
- ALLEGRO core (MTA EK)
- ALFRED core (ENEA)
- Cross-cutting R&D and experimental needs for core safety of ESNII reactors (ENEA)

Task 6.1. Core safety calculations for ESNII reactors



Task 6.2. Identification of R&D needs for improving core safety of ESNII reactors



24 organisations, 178 MM

WHO	CORE SPEC (3)			ASTRID (78)			UNC (52)		AAA (9)	R&D NEEDS (36)			
	AST	ALF	ALL	NEUT	DBA	DEC	ALL	ALF	REVIEW	AST	ALL	ALF	AAA
PSI													
CEA													
AMEC													
ANSALDO													
CIEMAT													
EDF													
ENEA													
GRS													
HZDR													
INR													
JRC													
KIT													
KTH													
MTA-EK													
NNL													
NRG													
RSE													
SCK-CEN													
TU DELFT													
UJV													
UPM													
UPVLC													
VUJE													
UNI ROME													

1st WP6 progress meeting

- September 9 and 10, 2014 at Paul Scherrer Institute, Switzerland
- 28 participants from 16 European organizations joined to discuss the status and coordination of work on neutronics and transient analysis of ESNII reactors
- Near-term actions defined in particular to issue the pending deliverables. Main discussion was about ASTRID neutronic results

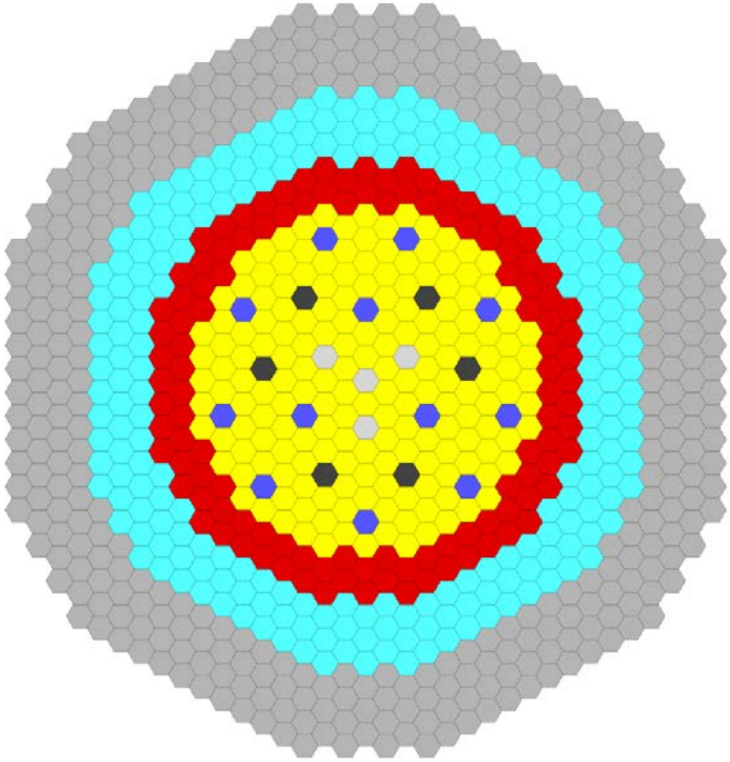
D6.1.1-1. ASTRID core specification (CEA)

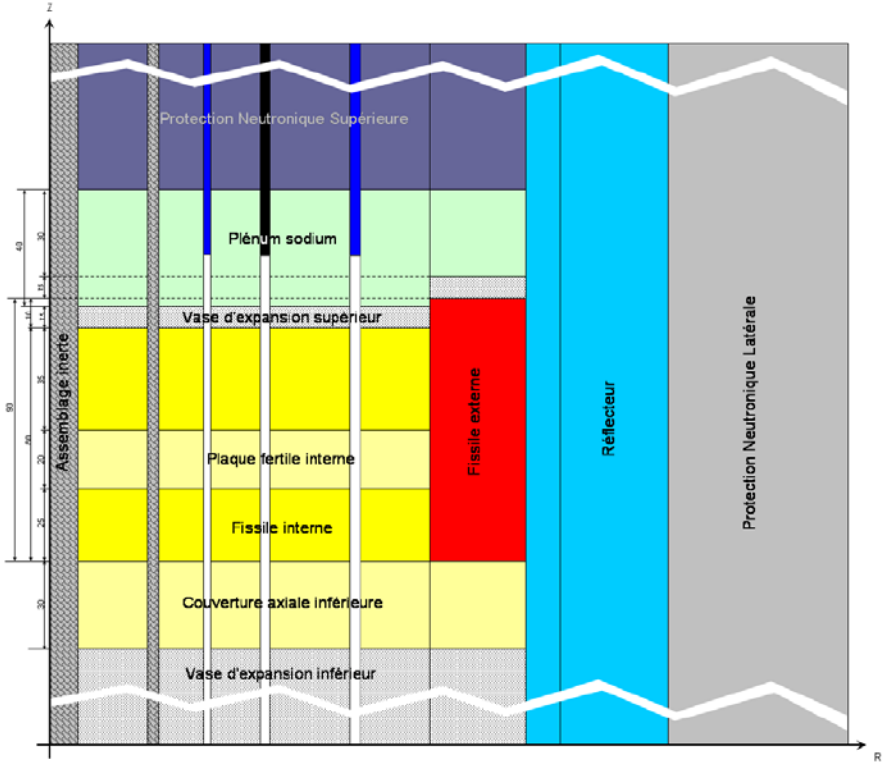
Detailed 3D core specifications at EOC

Heterogeneous except radial reflector and shielding

Thermally expanded geometry

COMMON TEMPLATE





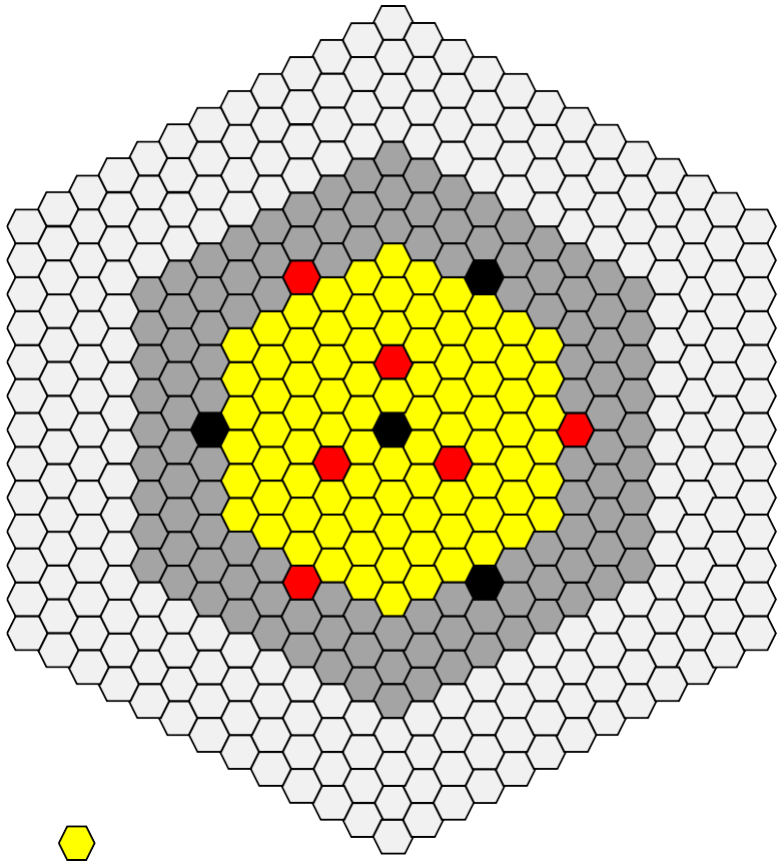
D6.1.1-2. ALLEGRO core specification (MTA EK)

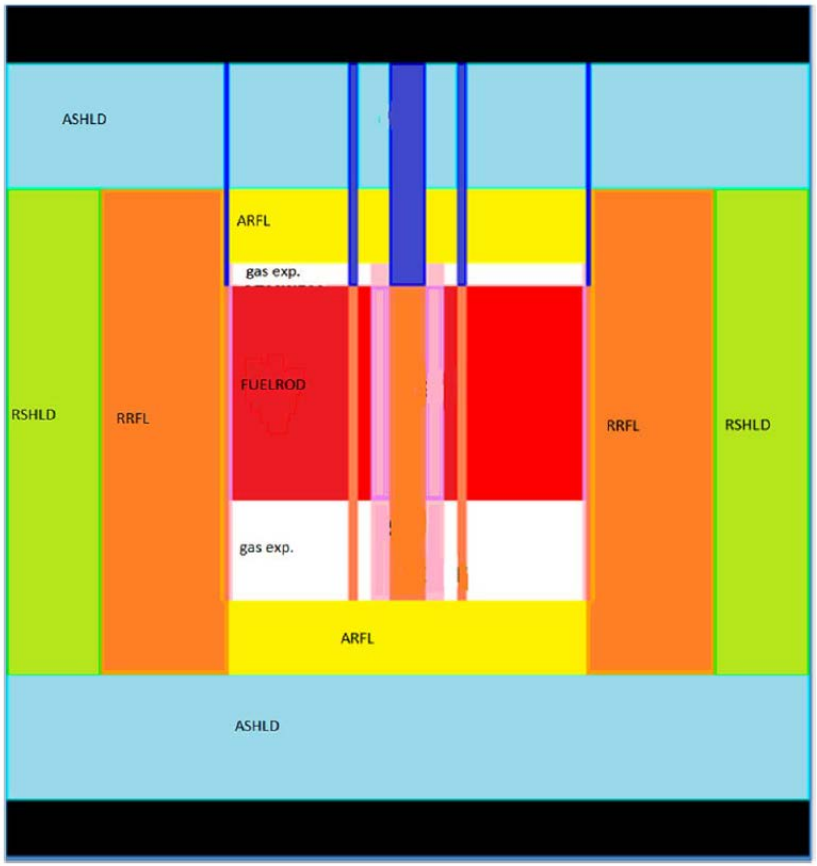
Detailed 3D core specifications at BOL

Heterogeneous except radial reflector and shielding

Thermally expanded geometry

COMMON TEMPLATE





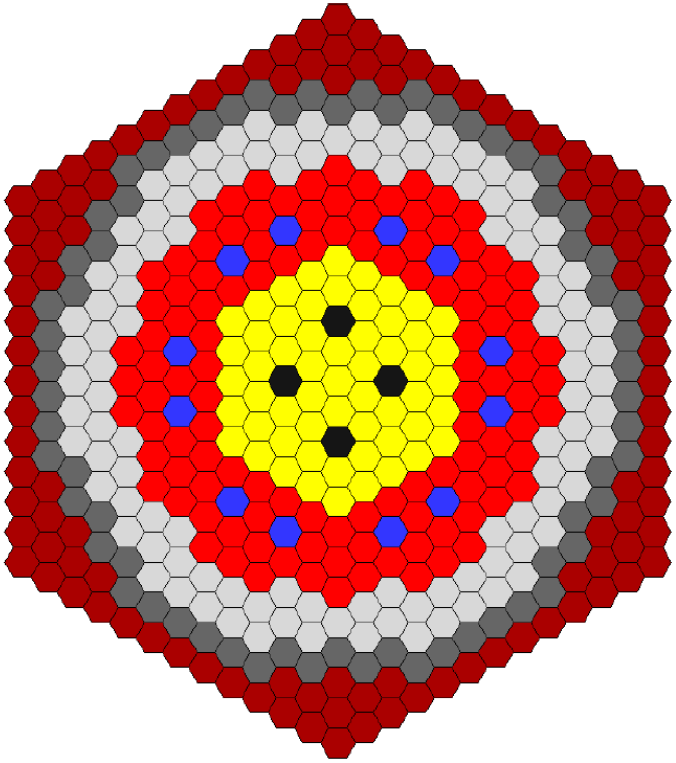
D6.1.1-3. ALFRED core specification (ENEA)

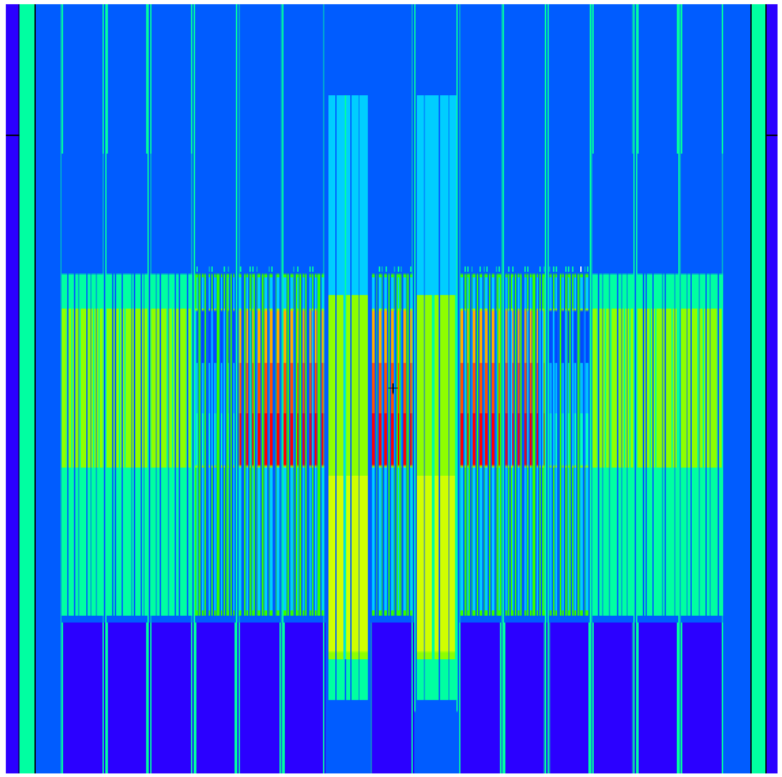
Detailed 3D core specifications at BOL

Fully heterogeneous

Thermally expanded geometry

COMMON TEMPLATE





D6.1.2-1. ASTRID core safety coefficients: Codes & libraries.

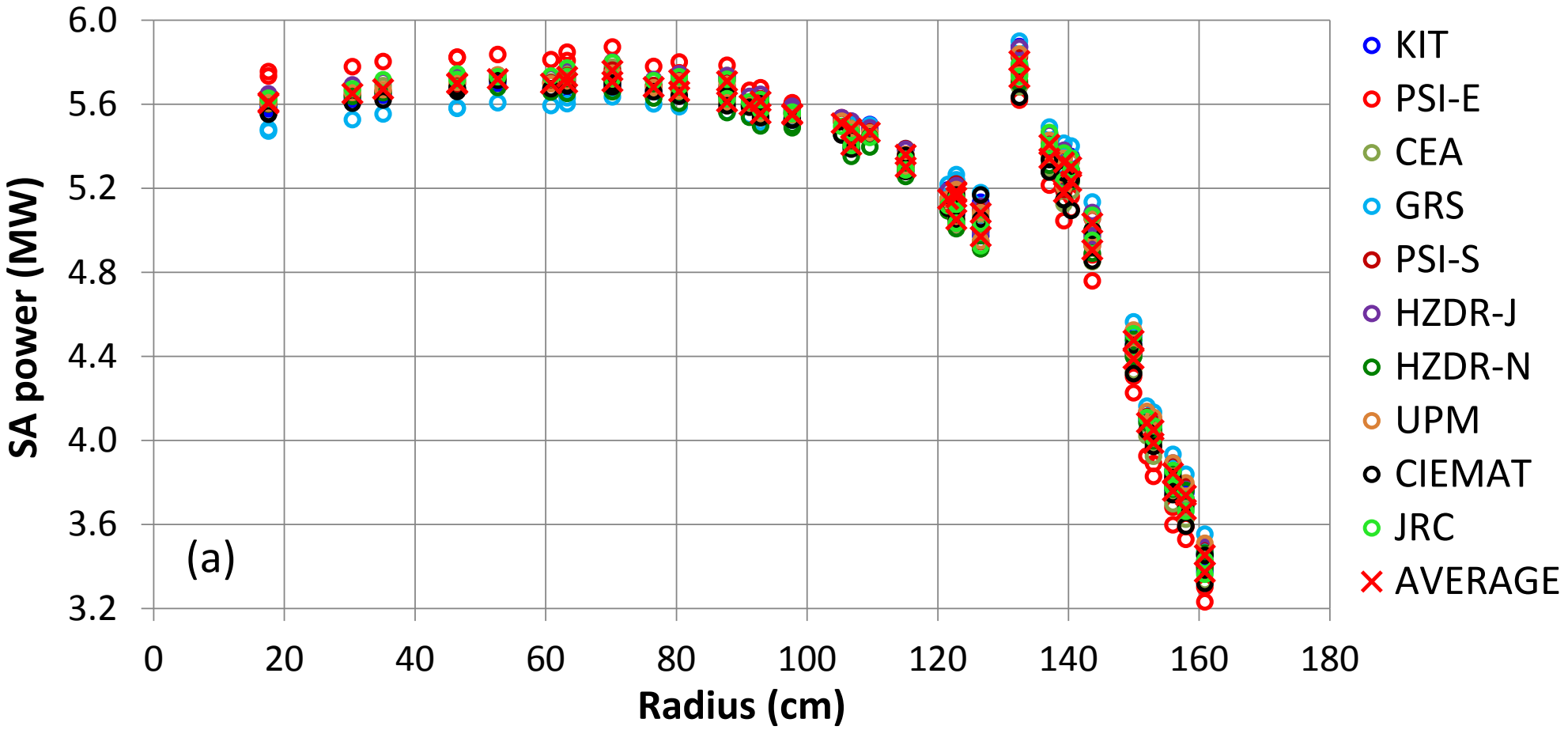
10 solutions (4 deterministic+ 6 stochastic); 8 organizations; 6 codes; 3 nuclear data libraries

PSI-E	ERANOS	JEFF3.1
CEA	ERANOS	JEFF3.1
GRS	HELIOS-1.12&FEM-DIFF-3D	HELIOS
KIT	KANEXT	JEFF3.1.1

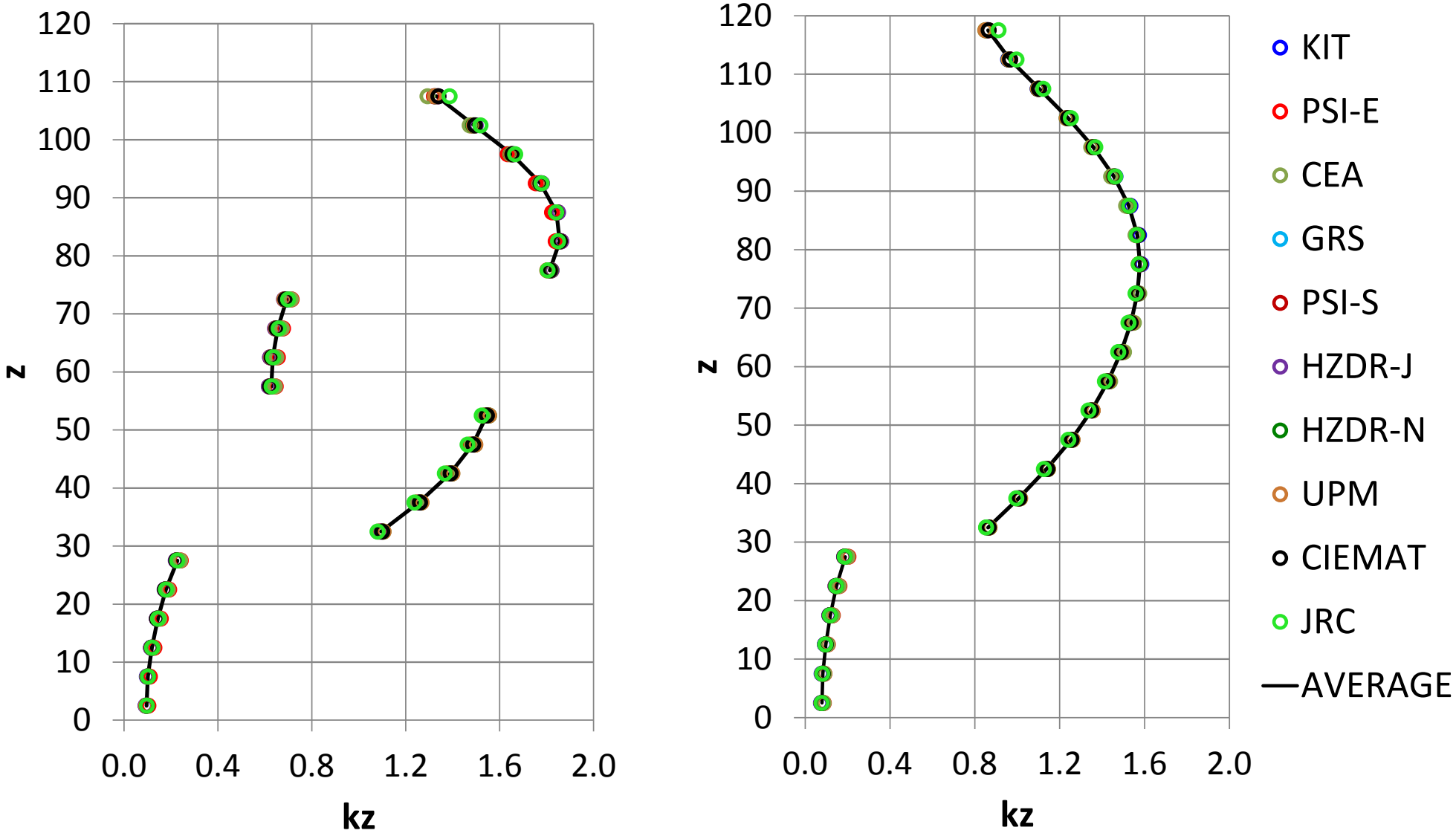
PSI-S	Serpent 2	JEFF3.1
HZDR-J	Serpent 2	JEFF3.1
HZDR-N	Serpent 2	ENDF/B-VII
CIEMAT	MCNP6	JEFF3.1.1
JRC	MXNPX/MCNP6	JEFF3.1
UPM	KENO-VI (SCALE6.2 beta)	ENDF/B-VII.0

D6.1.2-1. ASTRID core safety coefficients

Idea: evaluate uncertainties based on the spread of the solutions and try to propagate them into transient calculations (ULOF)

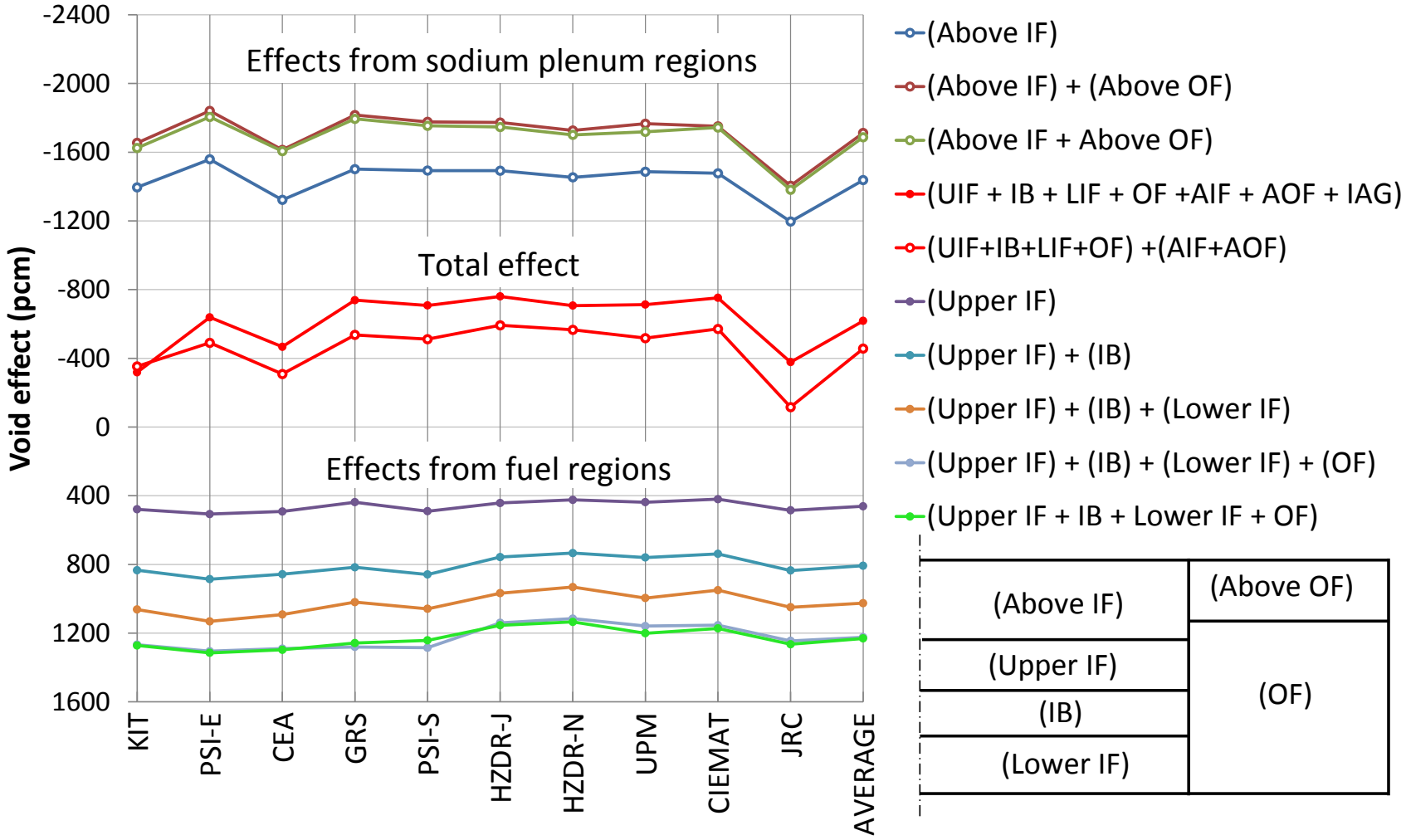


D6.1.2-1. ASTRID core safety coefficients: axial power profiles



D6.1.2-1. ASTRID core safety coefficients: Void effect.

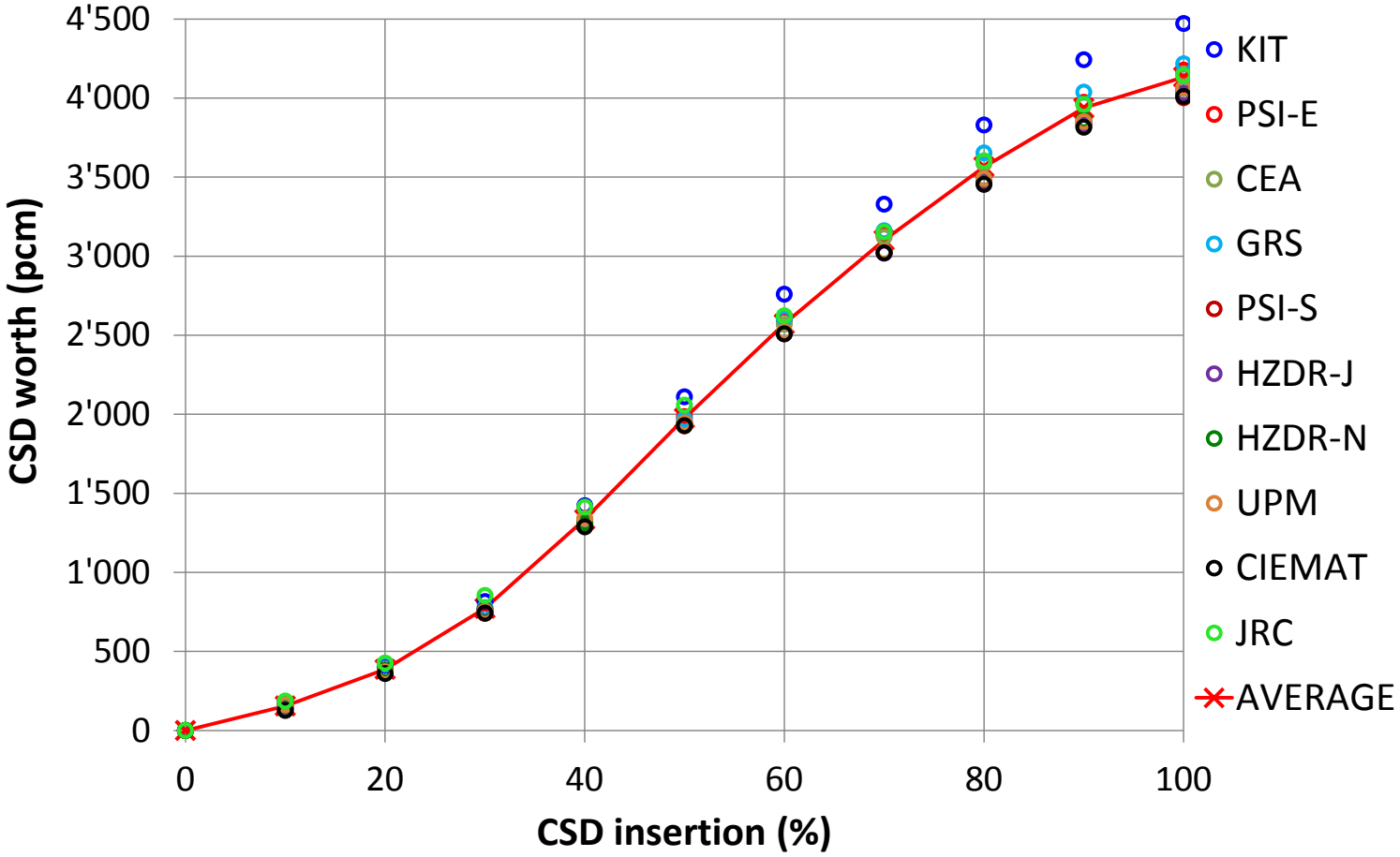
All codes predicted *negative* total effect. Still issues to resolve before final deliverable.



D6.1.2-1. ASTRID core safety coefficients: S-curve.

Consistent predictions of heterogeneous models

Important for absorber/fuel differential expansion



D6.1.2-1. ASTRID core safety coefficients: ICAPP.

The first results of the ASTRID neutronic benchmark will be presented at ICAPP in Nice on May 6 afternoon:

S. Bortot (PSI), F. Alvarez-Velarde (CIEMAT), E. Fridman (HZDR), I. Garcia Cruzado (UPM), N. Garcia Herranz (UPM), F. Martin-Fuertes (CIEMAT), K. Mikityuk (PSI), A.-L. Panadero (PSI), S. Pelloni (PSI), A. Ponomarev (KIT), P. Sciora (CEA), A. Seubert (GRS), H. Tsige-Tamirat (JRC), A. Vasile (CEA)

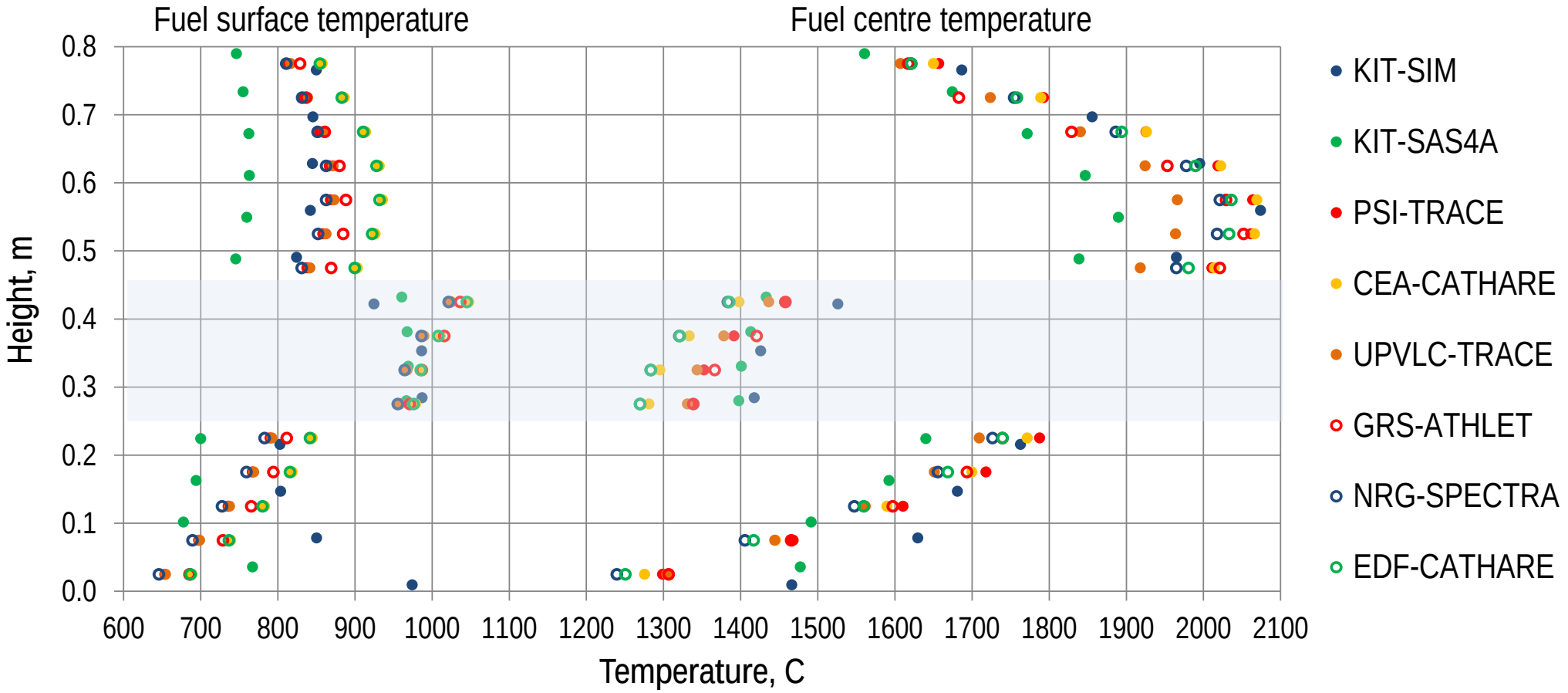
"European Benchmark on the ASTRID-like Low-void-effect Core Characterization: Neutronic Parameters and Safety Coefficients"

Paper 15361

D6.1.3-1. ASTRID DBA analysis: very first results.

We started DBA analysis with steady-state fuel temperature exercise

Technical meeting on March 27 at KIT to discuss next steps



Summary

During the first one and a half year of the ESNII plus project, work package 6 “Core safety” mainly focused on

- Detailed specifications of the AAA cores
- Learning and analyzing ASTRID core neutronic aspects (new for community)
- Using refined models for ALFRED and ALLEGRO created, few studies on uncertainty quantifications for these systems have started based on the previous experience from the LEADER and GoFastR FP7 projects.

No significant deviations from the work program.

The 2nd WP6 progress meeting planned in Autumn 2015 to discuss the status of work on all deliverables of Task 6.1.