

Best SCALE Model Contest 2023: Contestants – 1/3

SOUTH-WEST EXPERIMENTAL FAST OXIDE REACTOR (SEFOR)

- SEFOR is a MOX-fueled sodium cooled fast reactor.
- No control rods, the reactivity is controlled by adjusting the position of the reflector surrounding the active core.
- The American General Electric Company and the West German Karlsruhe Laboratory conducted a series of experimental programs from 1969 to 1972 (mainly focused on Doppler)
- Proposed by L. Buiron (CEA) in OECD/NEA SFR-UAM benchmark for validation of multi-physics simulation tools and used at UPM for assessment of JEFF nuclear data libraries in the frame of EU SANDA project.
- Model for KENO-VI/SCALE6.2.4.

Labels: Radial shield, Nickel reflector, Radial reflector (multicolor), Nickel reflector, Beryllium, UO₂ insulator, PuO₂-UO₂ fuel, Stainless steel.

CORE I-E Model developed by M. Redondo, N. García-Herranz and A. Jiménez-Carrascosa (UPM) under the sponsor of CSN (Spain)

Mario Redondo Morales (UPM)

mHTGR Similar to the Xe-100

- High-temperature gas-cooled pebble-bed reactor based on Xe-100 specifications
- Full model with 40 equal volume zones used for power profile and slice model used for depletion
- SCALE 6.3.0 used for the modeling

Fuel	15.5 wt% UCO
Burnup	165 MWth
# passes	6

Annie Berens (UTK)

OECD-NEA FHR Benchmark – Controlled Assembly Model

Labels: FLiBe, Control blade, Plank spacer, TRISO fuel, TRISO embedded fuel planks, 3D Assembly, Control Rod Insertion Depth, Controlled Thermal Neutron Flux (75% Insertion).

- AHTR style FHR developed for OECD-NEA benchmark calculations
- 3D Static (KENOV1) and depletion (OE-TRITON6) benchmark calculations performed
- keff, flux shape, spectrum, isotopic evolution, ...
- "Triple" heterogeneity: TRISO – fuel plank – assembly – full core
- Presented calculation: 55 hours | 24 cores | 97.7% parallel efficiency | 100M particles | $\sigma = 9$ pcm
- 179,504,640 TRISO particles for a single 3D assembly
- Other interesting aspects: epithermal, graphite content, periodic BC mandated, relatively decoupled core
- Purpose: Complex geometry and heterogeneity introduces interesting/non-trivial challenges when performing benchmark quality calculations. Our goal is to evaluate challenges and benchmarking differences between state-of-the-art MC and deterministic codes

Model by Jonathan F. Faulkner

Jonathan Faulkner (Georgia Tech)

ATHENA: A Thermal Neutron Spectrum Sodium-Cooled Microreactor

- Power: 10 MW_e
- Fuel: UCO TRISO particles.
- Moderation: YH_{1.84} moderation particles.
- Particles embedded in graphite matrix.
- Coolant: sodium channels (0.5 cm diameter) with ZrC cladding (0.04 cm thick).
- Control Mechanism: B₂C control drums
- Python-SCALE Interface for Writing Input Files

Core Parameter	Value
Power Level (MWth)	31.04
Inlet/Outlet Temp. (K)	773/873
Core Volume (m ³)	0.909
Enrichment (% U-235)	18.0
Fuel Plates	546

Labels: Hexagonal array with six element rows and 36 control drums, Total Scalar Flux Distribution. Units: neutrons per cm² per second per initial source neutron.

Ethan Krammer, Shane Evans, Ashley Machado, Asha Jayakumar, Thomas Smith Undergraduate Senior Design Project

OAK RIDGE National Laboratory Ethan Krammer (UNM)

Xe-100 Full Core and Slice Models

- 165 MWth
- The "slice" model is a 10 cm selection from the center of the active core region
- 5 of 9 control rods fully inserted
- Helium coolant shown at reduced opacity

Zoe Richter (UIUC)

Generic SFR

- SCALE model based on public information of the Terrapower's Sodium design
- Absent parameters assumed from historically operated HALEU SFRs
- Non-fuel elements are adapted from Rike Bostelmann's MET-1000 model

Labels: Plane view, Fuel Assembly, 3D Model.

Green: Inner driver fuel assemblies
 Red: Outer driver fuel assemblies
 Grey: Control rod assemblies
 Blue: Reflector assemblies
 Dark Green: Shield Assemblies

Jonathan Wing (UTK)

Best SCALE Model Contest 2023: Contestants – 2/3

IER-554: Insertion of a Boralcan plate into a light water critical assembly at Sandia National Laboratories

SPRF/CX critical assembly model

B&C plate

B&C plate model Without Aluminum

20 x 20 x 0.75 cm plate

B&C plate model zoomed 4000 times

3.41 billion B&C spheres

- Contributor: Mathieu Dupont, ORNL, NEFCO, Criticality Safety Group.
- Source: IER-554 CED-1 preliminary design report (NCSF funded).

Mathieu Dupont (ORNL)

Versa-Pac package model

- 3D model of the VP-55 package proposed to transport fresh HTGR pebbles
- The Pebbles are placed randomly inside the container.
- 364 pebbles are placed at 55% packing fraction.
- The model is based on information provided in the safety analysis report*

HTGR pebble

VP-55 package

Model created by Rabab Elzohery

*Versa-Pac Safety Analysis Report, <https://www.nrc.gov/docs/ML1833/ML18330A093.pdf>

Rabab Elzohery (ORNL)

Integral Molten Salt Reactor
Developed by Donny Hartanto, Matthew Jessee, and Daniel Carleton (TEUSA)

HX

Pump

Top view

Flux distribution

OAK RIDGE National Laboratory

Donny Hartanto (ORNL)

Polaris Wars

- Polaris version 6.3.2 or 7.0beta05
- 200x200 pinmap of 13 pin types
- <https://manytools.org/hacker-tools/convert-images-to-ascii-art/go/>

```

=polaris
system PWR
lib broad_wvr
geom first_plane : ASSM 200 2.0 modularsys
comp c_uox25 : UOX 2.5
mat FUEL1 : C_uox25 10.5
mat FUEL4 : C_uox25 10.5

pin W : 1.0 : STRUCT : SQR
pin X : 1.0 : FUEL4 : SQR
pin R : 1.0 : FUEL1 : SQR
pin B : 1.0 : FUEL1 : SQR
pin Z : 1.0 : MOD1 : SQR
pin G : 1.0 : CLAD : SQR
pin V : 1.0 : COOL1 : SQR

pin C : 1.0 : COOL2 : SQR
pin D : 1.0 : COOL2 : SQR
pin E : 1.0 : COOL2 : SQR
pin F : 1.0 : COOL2 : SQR
pin H : 1.0 : COOL2 : SQR
pin O : 1.0 : COOL2 : SQR
    
```

Model created by M.A. Jessee

Matt Jessee (ORNL)

Polaris Benchmark for Critical Experiments

- Polaris version 6.3.2 or 7.0beta05
- Critical experiments
 - CE critical experiment: 60x60 (Quarter symmetry)
 - KRITZ critical experiment: 70x70 (Full symmetry)
 - B&W critical experiment: 119x119 (Full symmetry)
- Polaris validation
 - Pin peaking factor uncertainty

Model created by K.S. Kim

Kang Seog Kim (ORNL)

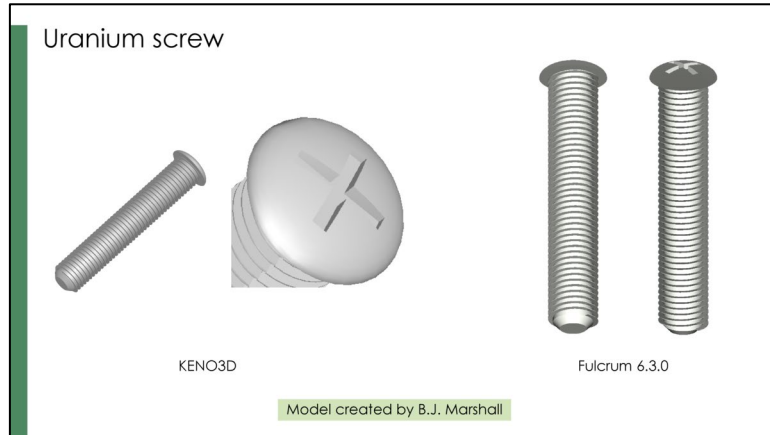
Open Pool Australian Light Water (OPAL) Reactor

- 20 MW_{th} open pool type light water research reactor
- Australian Nuclear Science and Technology Organisation (ANSTO) in Sydney, AU
- Officially opened April 2007 replacing High Flux Australian Reactor (HIFAR)
- Multi-purpose facility: neutron beams, radiopharmaceuticals, irradiation of materials
- Heavy water (D₂O) neutron reflector
- LEU (19.8% ²³⁵U) U₃Si₂ fuel on Al plates
- Maximum neutron irradiation flux: $\phi_{th} \lesssim 3 \times 10^{14}$ n/cm²/s
- 30-35 day cycles with 5-day shutdown for refueling or reshuffling

OAK RIDGE National Laboratory

Matthew Krupcale (ORNL)

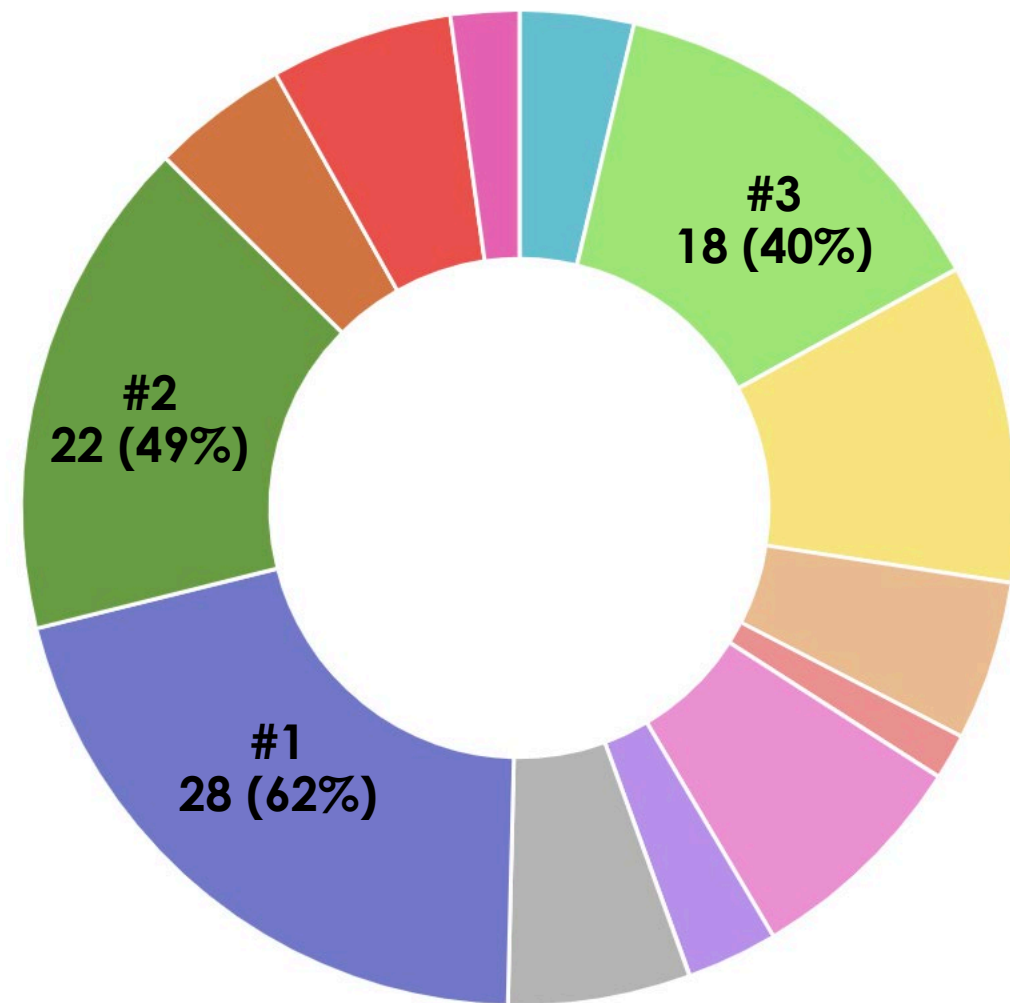
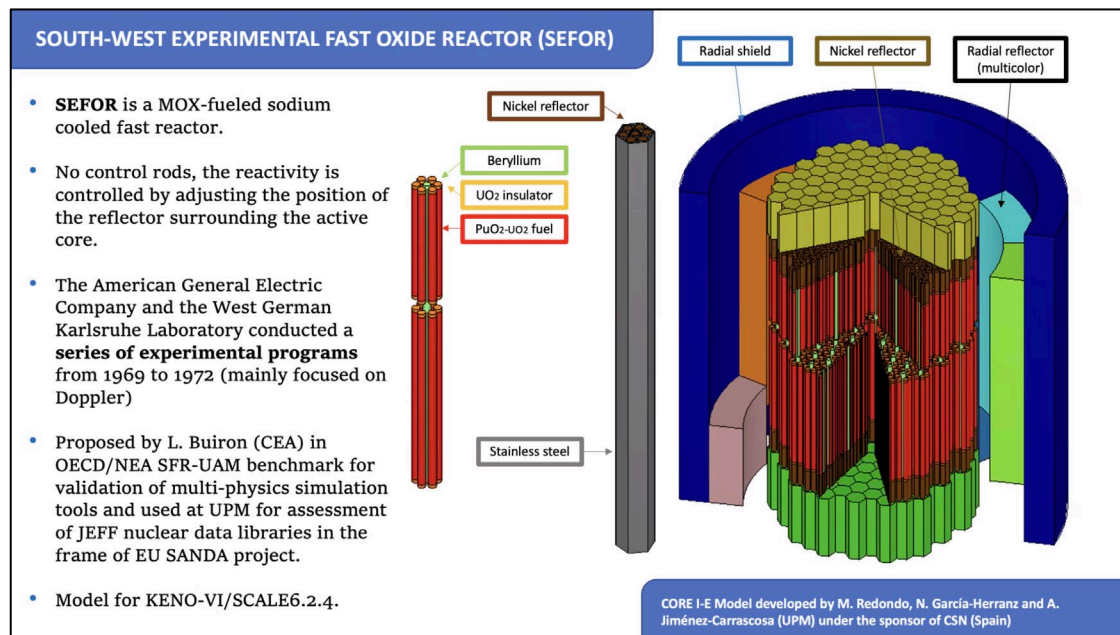
Best SCALE Model Contest 2023: Contestants – 3/3



B. J. Marshall (ORNL)

Best SCALE Model Contest 2023

Winner: Best SCALE model



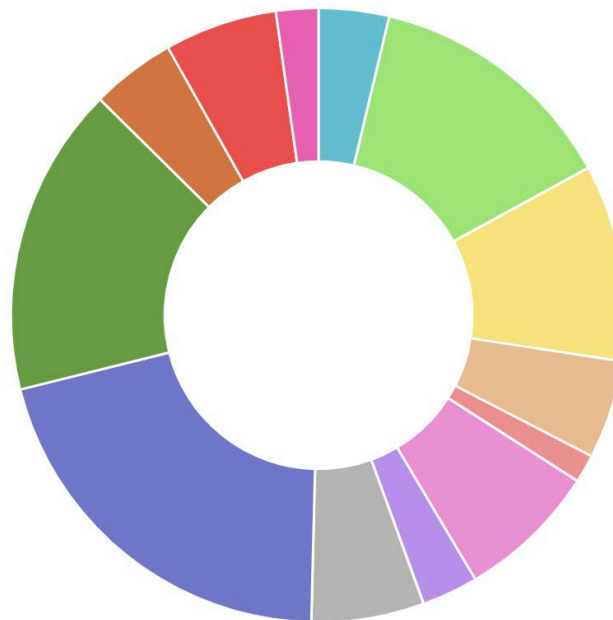
Mario Redondo Morales
UPM

28 from 45 votes survey participants (62%)

Congratulations!

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Which is the best model? Select your favorite 3 models.



11% (5)

Mathieu Dupont (ORNL)

4% (2)

Kang Seog Kim (ORNL)

62% (28)

Mario Redondo Morales (UPM)

7% (3)

Jonathan Wing (UTK)

(135)

Responses

40% (18)

Rabab Elzohery (ORNL)

22% (10)

B. J. Marshall (ORNL)

49% (22)

Jonathon Faulkner (Georgia Tech)

31% (14)

Donny Hartanto (ORNL)

9% (4)

Matthew Krupcale (ORNL)

13% (6)

Ethan Krammer (UNM)

16% (7)

Matt Jessee (ORNL)

18% (8)

Annie Berens (UTK)

18% (8)

Zoe Richter (UIUC)