ARPA-E WORKSHOP

Nuclear Heat and Power for Industrial Process Applications

May 31 – June 1, 2023

Anchal Jatale

Manager Application Engineering : Energy|Process

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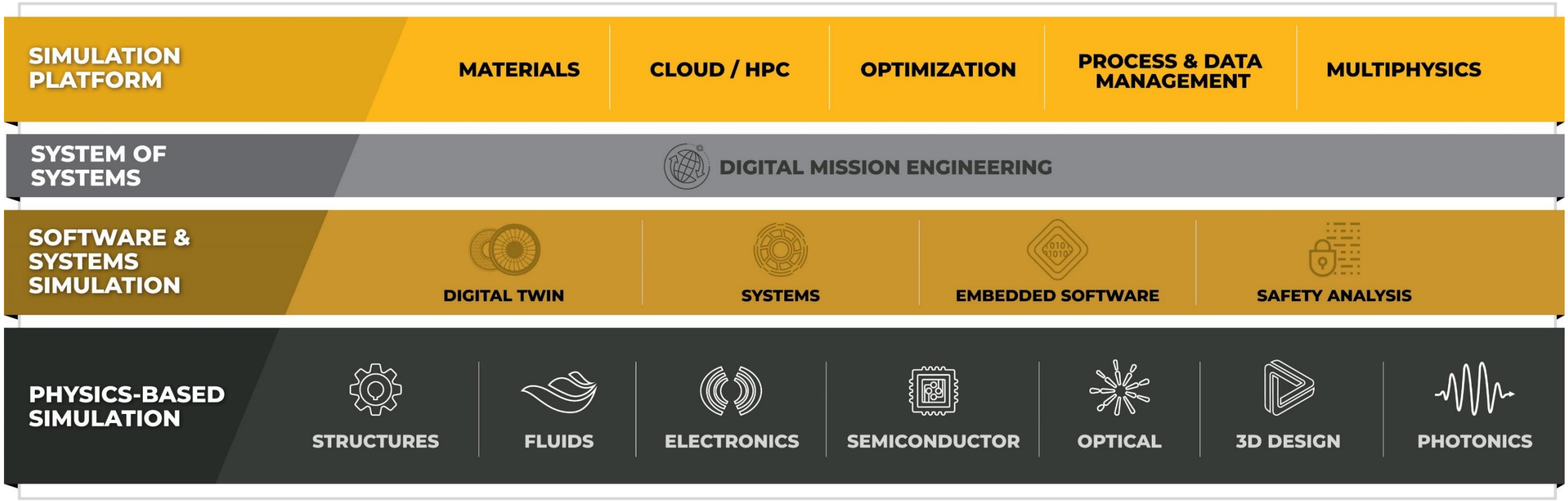
Ansys Delivers Complete System Optimization

Driving efficiency, optimization, collaboration and consolidation



Simulation is All We Do

- 85 Ansys products
- Development team focused on simulation
- A managed, customer-specific learning program to sustain and accelerate the value of engineering simulation

Open Ecosystem

- Integration with partner & competitor products
- Connect on-premises and in the cloud
- Optimized with artificial intelligence and machine learning

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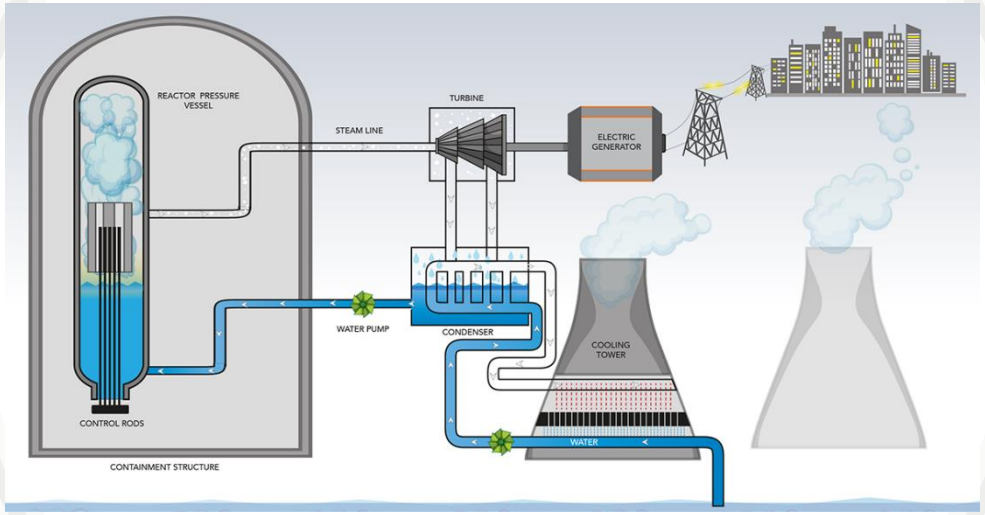
Simulation Solutions for Nuclear Systems

- Nuclear Fission Reactor Design (PWR, SMR)
- Nuclear Fusion Reactor Design
- Fuel Assembly
- Waste storage, treatment & transport
- Equipment design & tooling



- Safety: Building design and modifications
- Safety: Extreme events
- Safety: I&C systems and software controls
- Reactor Digital Twins
- Electronic systems design

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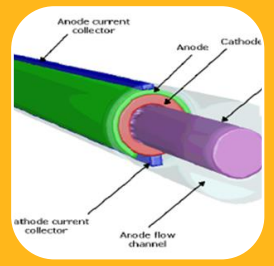
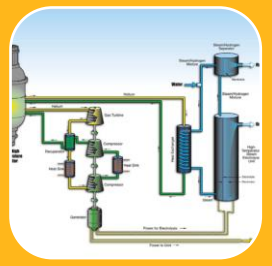
Use case: Nuclear Heat for Hydrogen Production

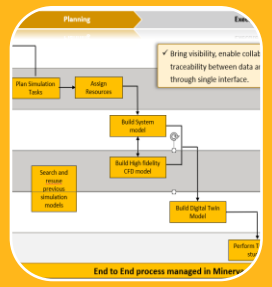


Component Modeling



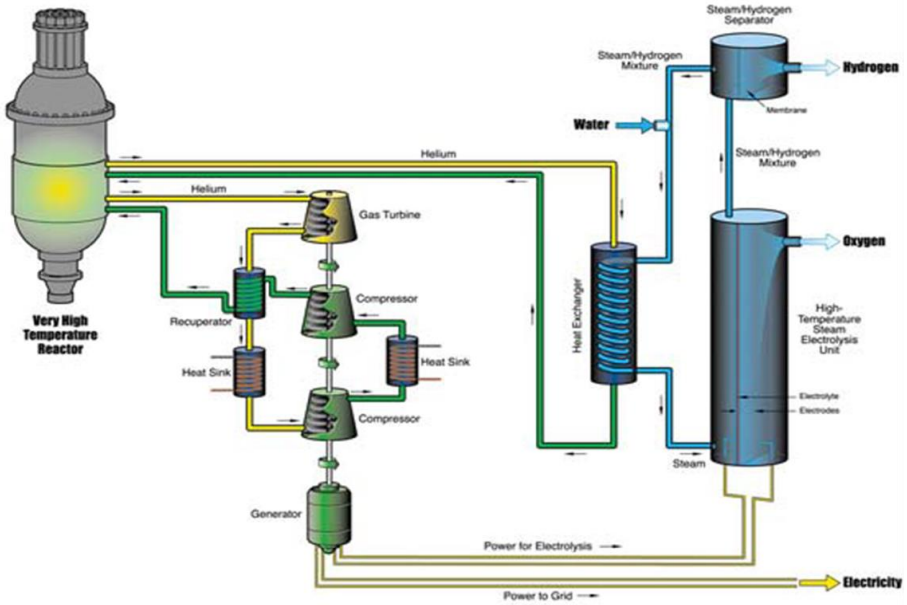
System Modeling

Requirements



Project/Process management

Multifidelity Modeling; Open architecture; Automated; Easy adoption and deployment



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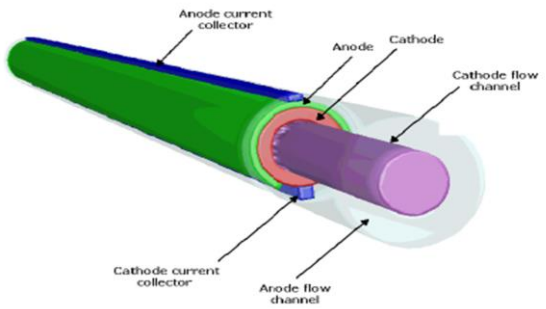
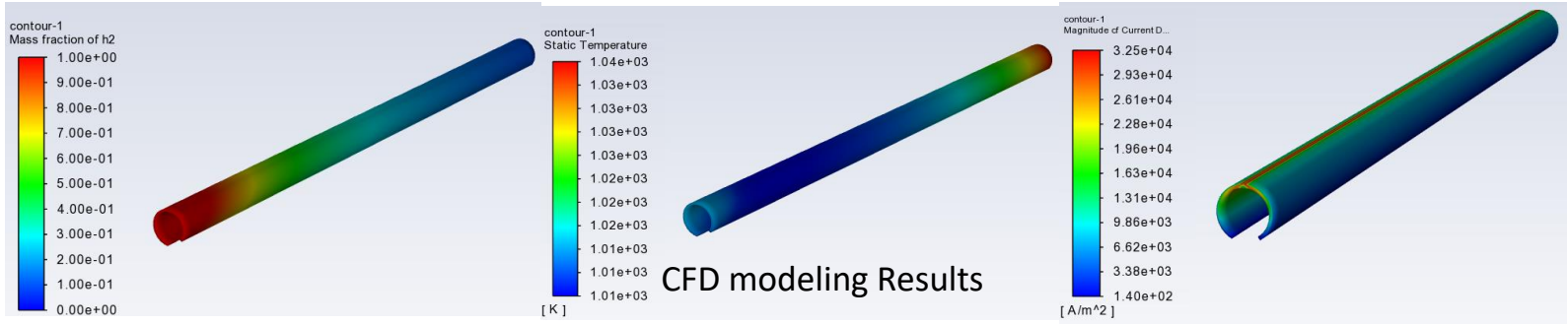
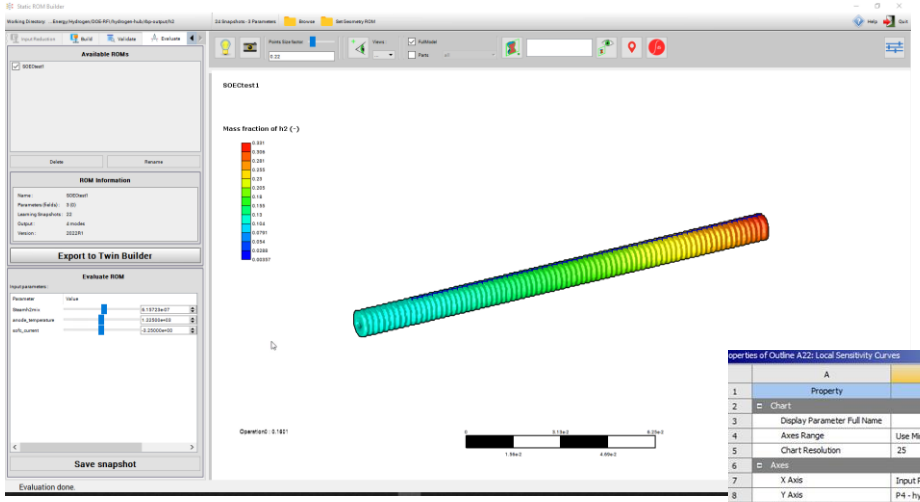
High Fidelity models: Electrolysis Unit





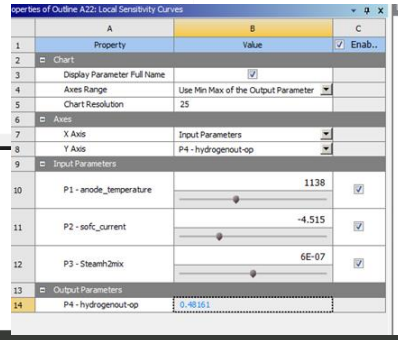
Also available:
Electric Potential, current density, Nernst Potential, Activation potential etc

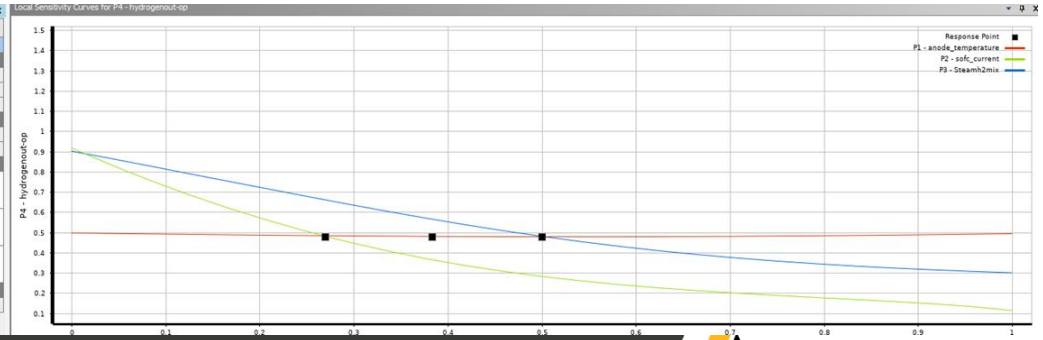
Reduced Order Modeling (ROM)



3 Input Variables
- Anode Temperature : (850K-1900K)
- Current : (-6 to -0.5 Amp)
- Steam Flow (4e-7 to 8e-7 Kg/s)

Total : 24 training points in DOE
DOE algorithms: Optimal Space Filling Design





Response Surface ROM : hydrogen conversion efficiency
3D ROM : hydrogen Mass fraction in the domain

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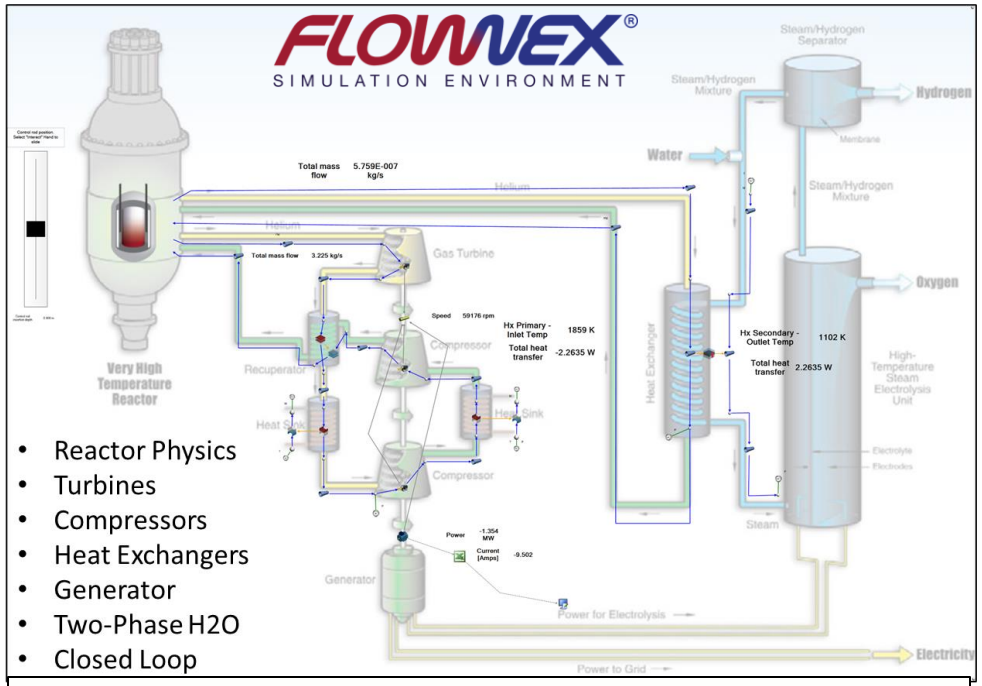
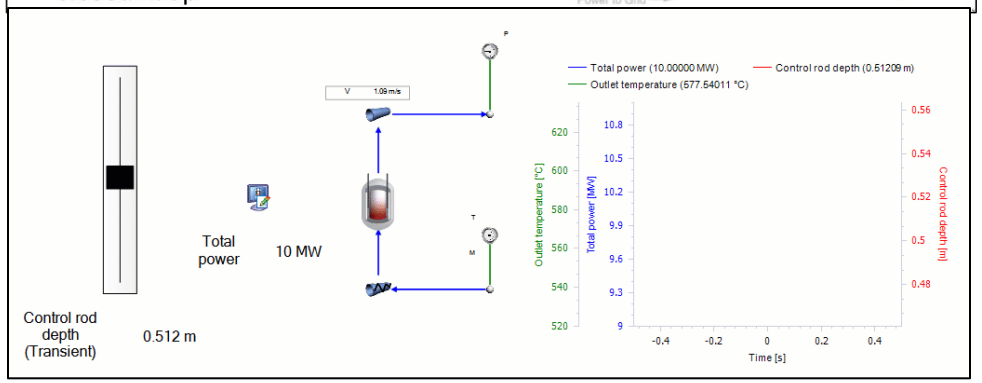
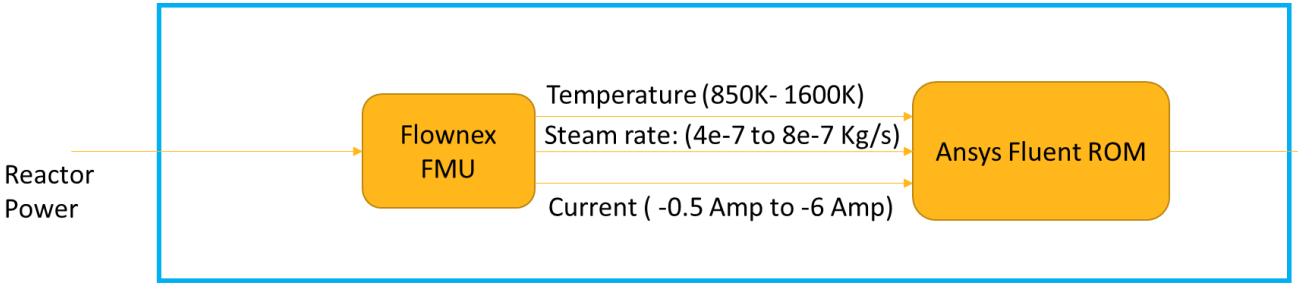
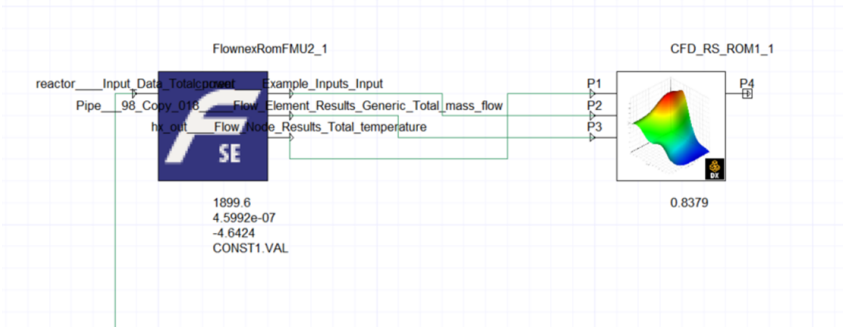
Expedite design and analysis of Nuclear system with Coupling



- Reactor Physics
- Turbines
- Compressors
- Heat Exchangers
- Generator
- Two-Phase H2O
- Closed Loop







1D-3D system coupling

- NQA1 Compliant
- 1D CFD
- 2D Thermal Transport
- Complex Fluid Models
- Robust Component Libraries
- Customize and Connect

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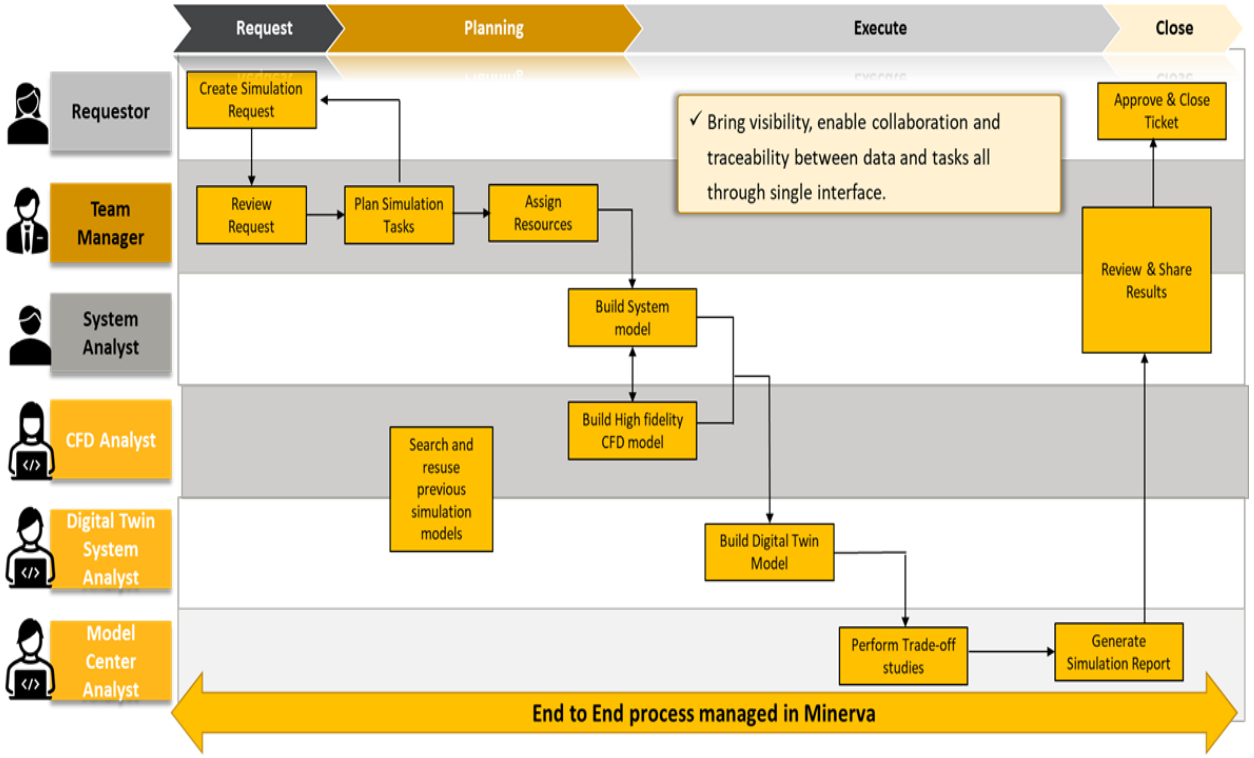
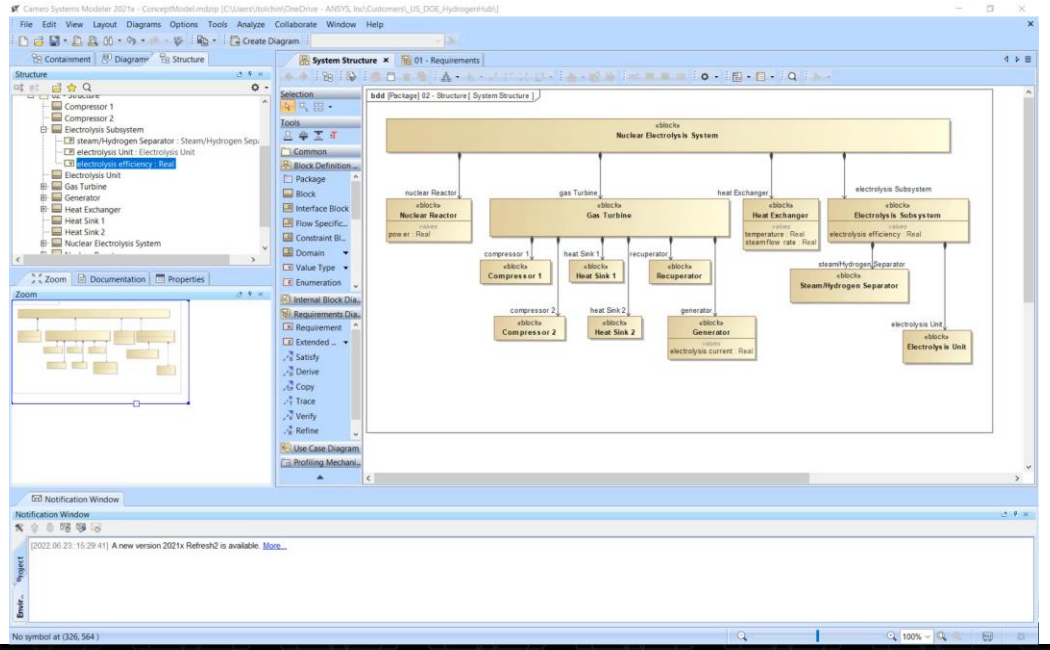
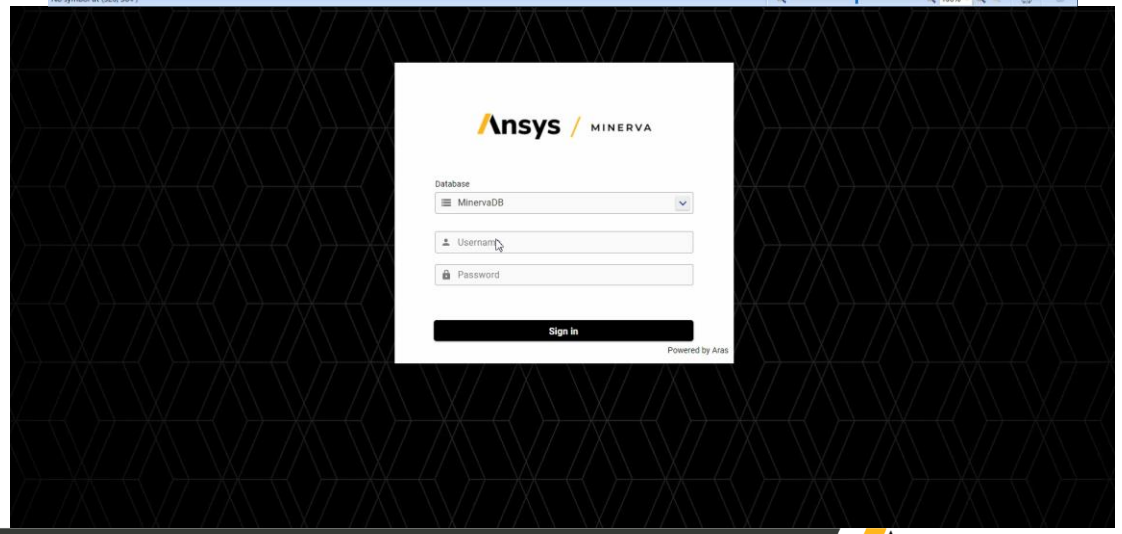
Efficient Simulation Project Management







Connect People and Process
a) Requirements (MBSE)
b) Data management

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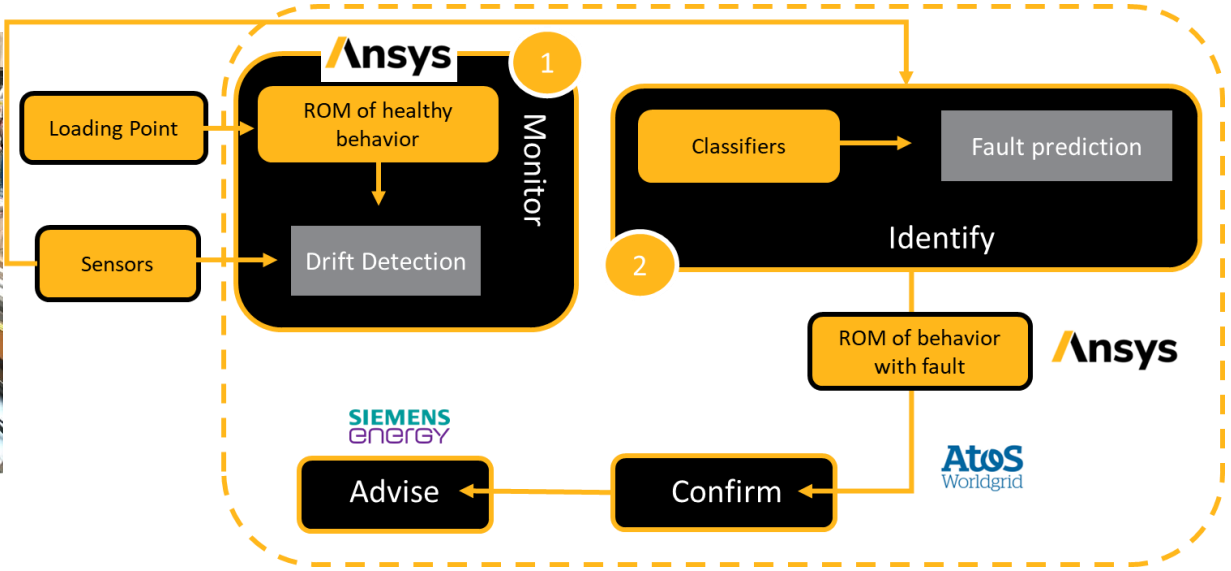
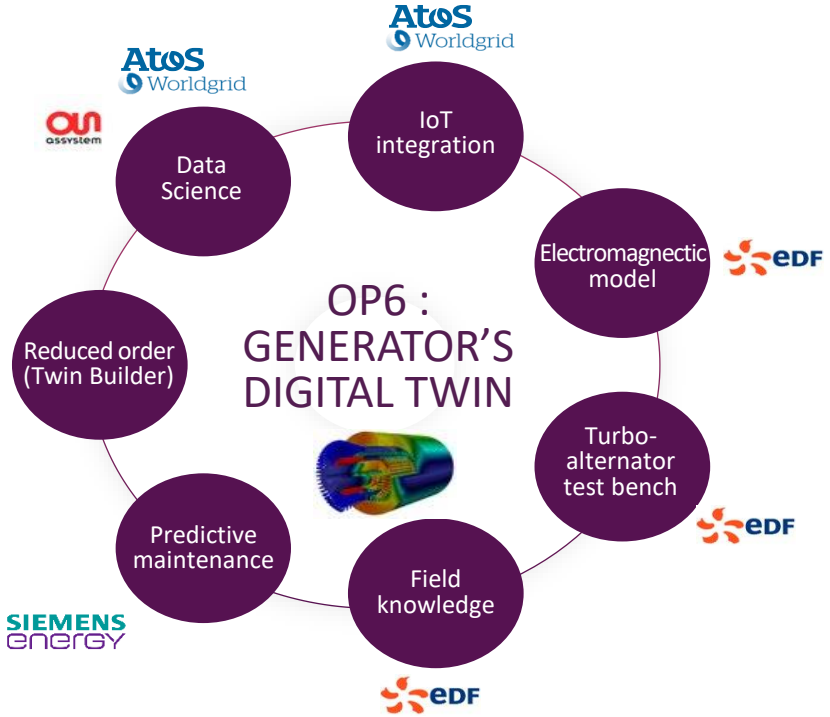
Digital Twins at Saclay Nuclear Research Centre (CEA)

KEY OBJECTIVES

- ✓ Centralize data acquisition and analytics
- ✓ Access to monitoring data and automated insights
- ✓ Provide predictive maintenance capabilities





Digital Twins at CEA: Operation Stage

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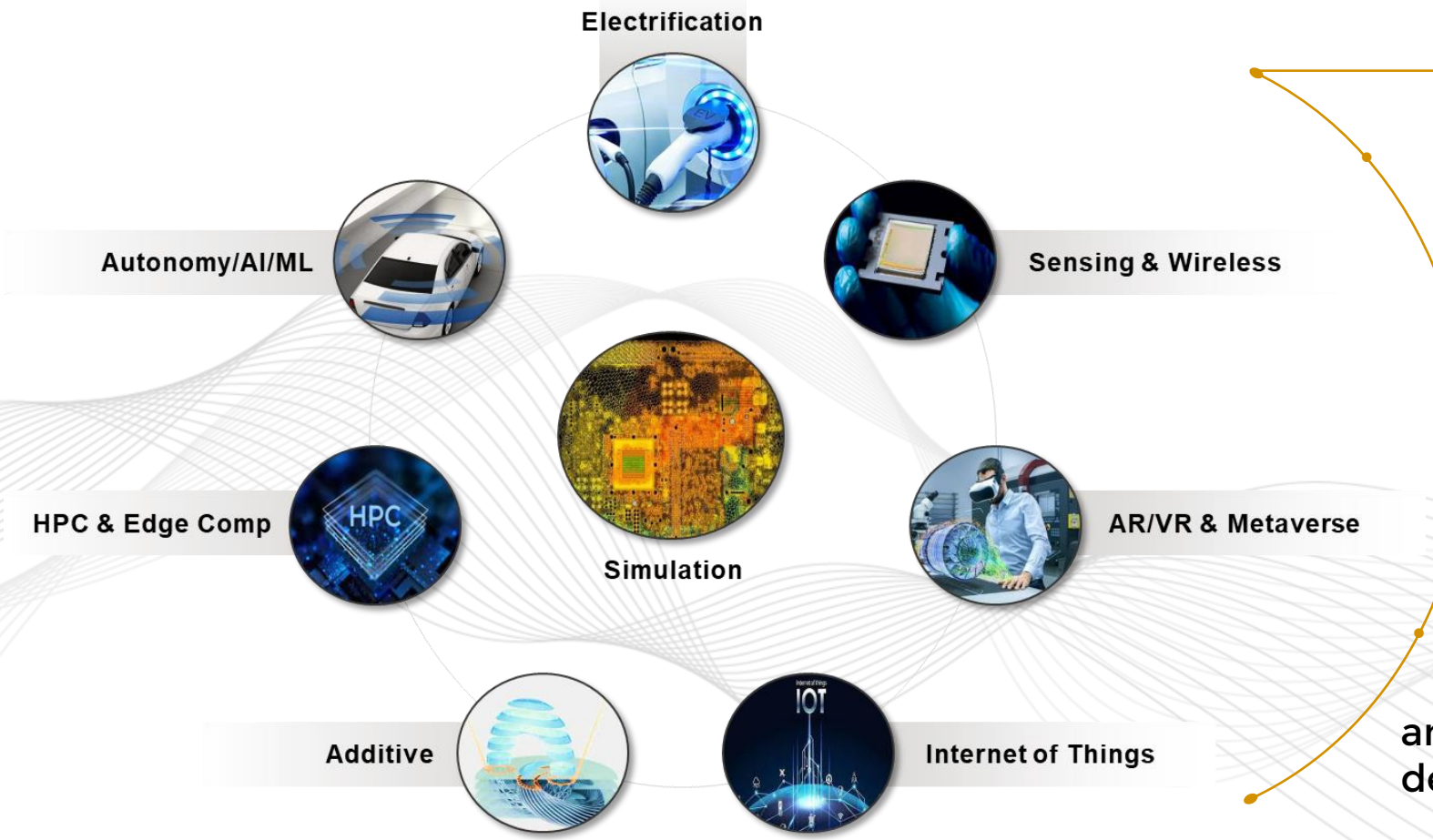
Digital Technology Convergence | Accelerated Through Simulation



3 Truths | "1 x 1 can be >10"

All of these technologies are, or will help accelerate & deliver the digital transition

These technologies are ***anything but linear***, their combined applications can drive order(s) of magnitude change … ***Hyper-Scalers!***

Simulation enables it all to go faster, reducing- risk, improving performance, and delivering more certainty earlier in the development process

Proliferating digital assets, democratizing solution methods, and maturing new technologies …

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