# LEVERAGING AI FOR ENHANCED EFFICIENCY AND SAFETY IN NUCLEAR PLANTS: FOCUS ON OPERATIONAL PERFORMANCE, FLEXIBILITY, AND DECOMMISSIONING

BERLAND Julien[1], CORRIERI Eric[1], GROSSETETE Alain[1], DUPRE Guillaume[1], SEGOND Mathieu[1], HAOUANEB Hayder[1], ALLORY Mathieu[1], SOUBEYRAND Lucas[1], QUERFURTH Frank[1], PAGE Ian[1,2]

1Framatome, Tour Areva, 92400 Courbevoie, FRANCE
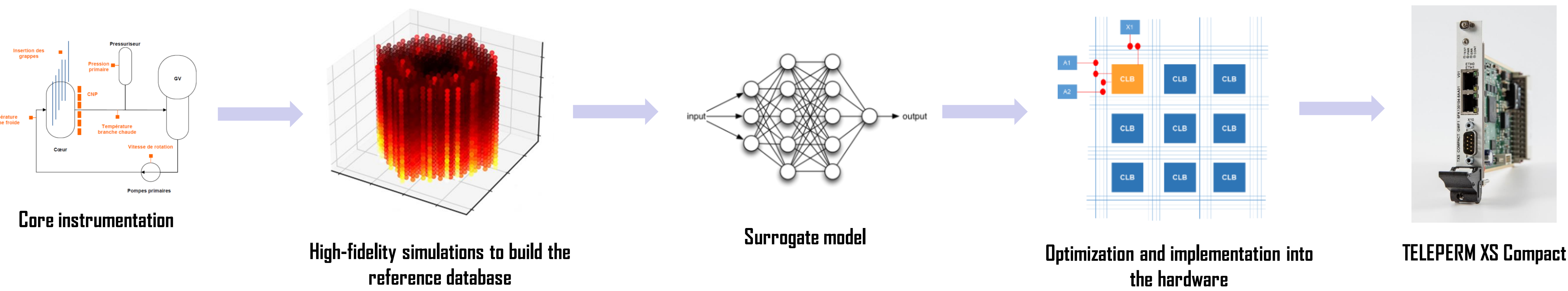2GIPSA Lab, 38400 Saint-Martin-d'Hères, FRANCE

The transformative role of Artificial Intelligence (AI) for nuclear plant operations
The incorporation of AI in nuclear power plants represents a transformative opportunity for enhancing operational efficiency and addressing critical challenges in the industry. This poster explores three key areas where surrogate models and AI can significantly impact nuclear plant performance: capacity optimization, flexibility, and decommissioning practices.
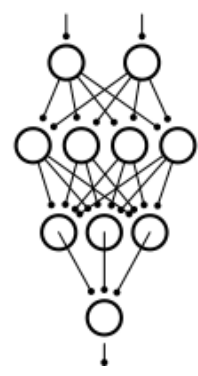
Improved representation of physical models in automated systems through surrogate models

The Integrable High-Speed Data Processor is designed to leverage a metamodel, specifically a neural network algorithm, which is derived from reference simulations. This approach is intended to be seamlessly integrated into Instrumentation and Control (I&C) hardware, namely the TXS Compact, which is built upon FPGA (Field-Programmable Gate Array) chipset technology.
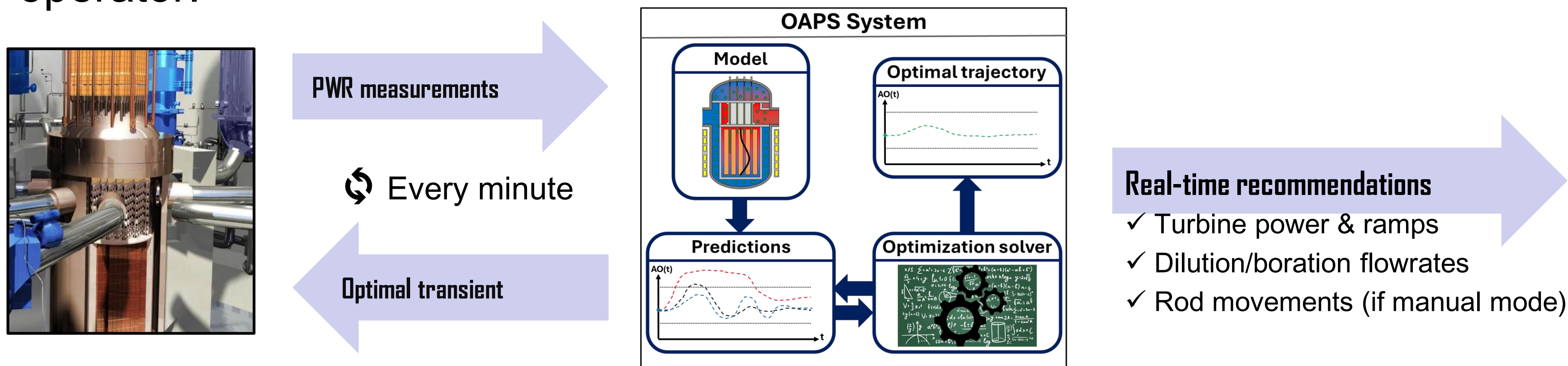

Core instrumentation → High-fidelity simulations to build the reference database → Surrogate model → Optimization and implementation into the hardware → TELEPERM XS Compact

The product is engineered to maintain the precision and accuracy characteristic of the original reference code.
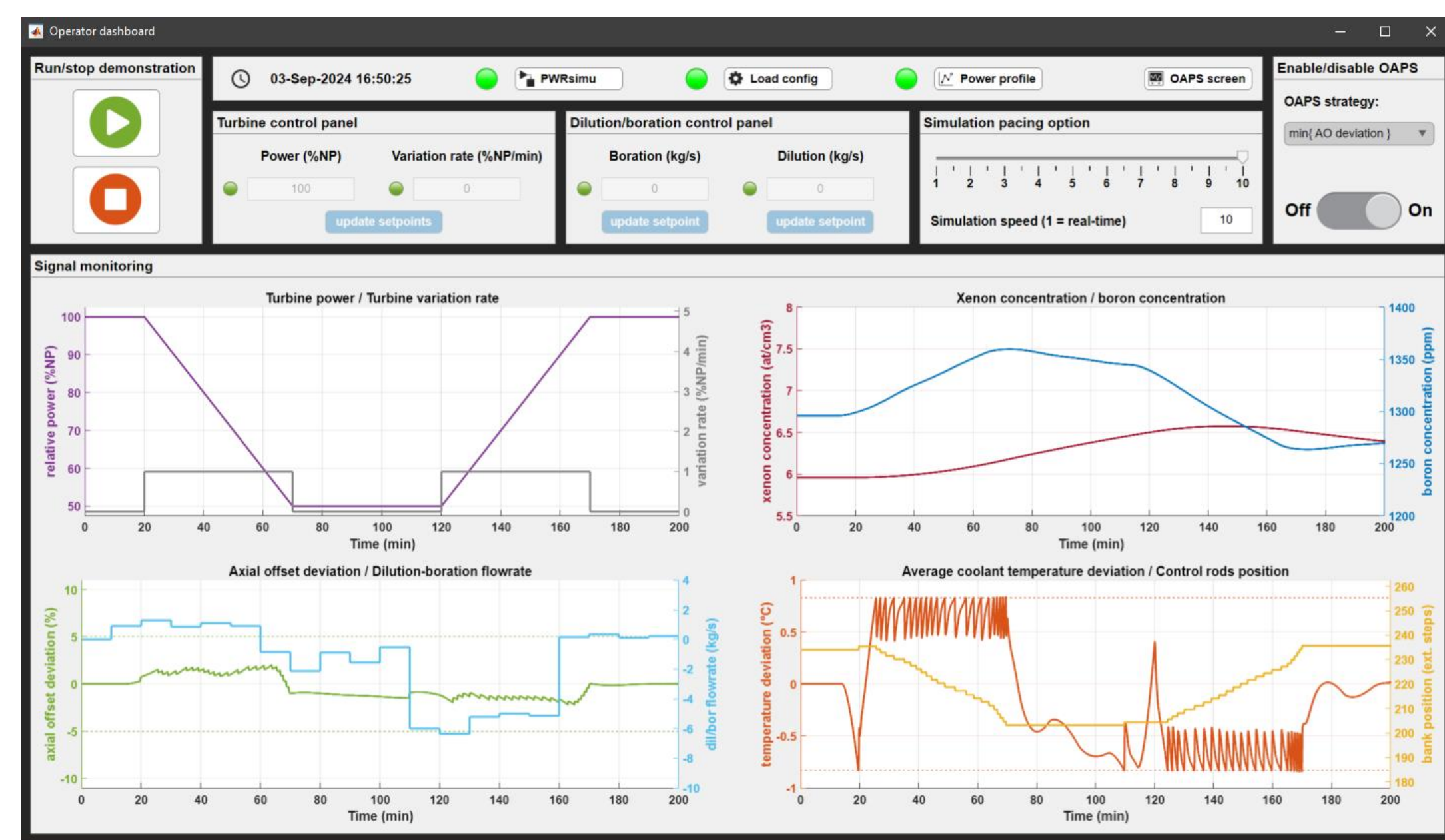
OAPS System – Realtime predictive system for flexible operation

The OAPS System has been developed to utilize real-time plant measurements. OAPS System employs an accurate and rapid model of the system to be controlled to accurately predict and optimize its future behavior on a minute-by-minute basis by given recommendations to the operator.

PWR measurements → **OAPS System** (Model, Optimal trajectory, Predictions, Optimization solver)
↻ Every minute
Optimal transient

Real-time recommendations
✓ Turbine power & ramps
✓ Dilution/boration flowrates
✓ Rod movements (if manual mode)

Load-follow with OAPS System
☑ Accurate AO control → better flexibility

AMORAC – Assistance to radioprotection and incident handling with a legged robot

Both in operation and decommissioning of nuclear sites, many hazardous tasks still require manual execution by on-site personnel. For instance, clearance measurement involves individuals closely assessing surfaces for radiation. AMORAC is a quadrupedal robot that autonomously navigates, measures, documents and potentially act in irradiated areas, thereby reducing the workload and radiation exposure of specialized staff.

Autonomous MObile Robot for Automated Clearance

Completely automated measurements
✓ Spatial exploration (LiDAR sensor) and processing (3D Room-mapping, segmentation)
✓ Automated gridding of segmented wall elements
✓ Radiological measurement and hotspot search

Realtime environment reconstruction for visual teleoperation
✓ Display to the teleoperator a real time simulation containing a digital twin of AMORAC and its surrounding environment

Unknown environment

RGB-D Camera on manipulator.
SPOT.

Figure 10: Real environment with SPOT.

• Dense VI-SLAM with the RGB-D camera to reconstruct the environment and localize the robot
• Animate digital twin based on the user's inputs

Simulation

Real-time 3D reconstructed environment.
SPOT's digital twin.

Figure 11: One chosen point of view in the simulation.