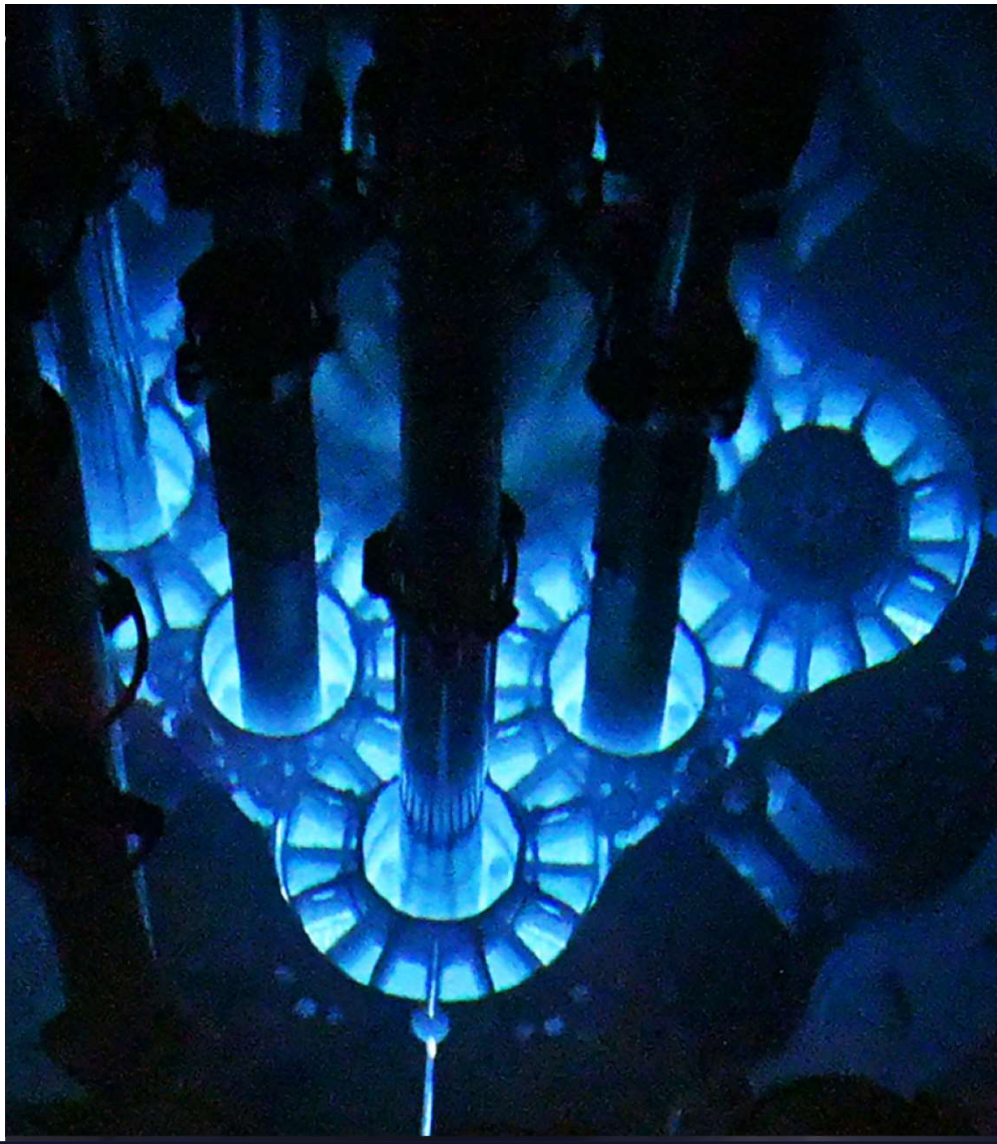
Genesis Mission

AI for Nuclear Energy

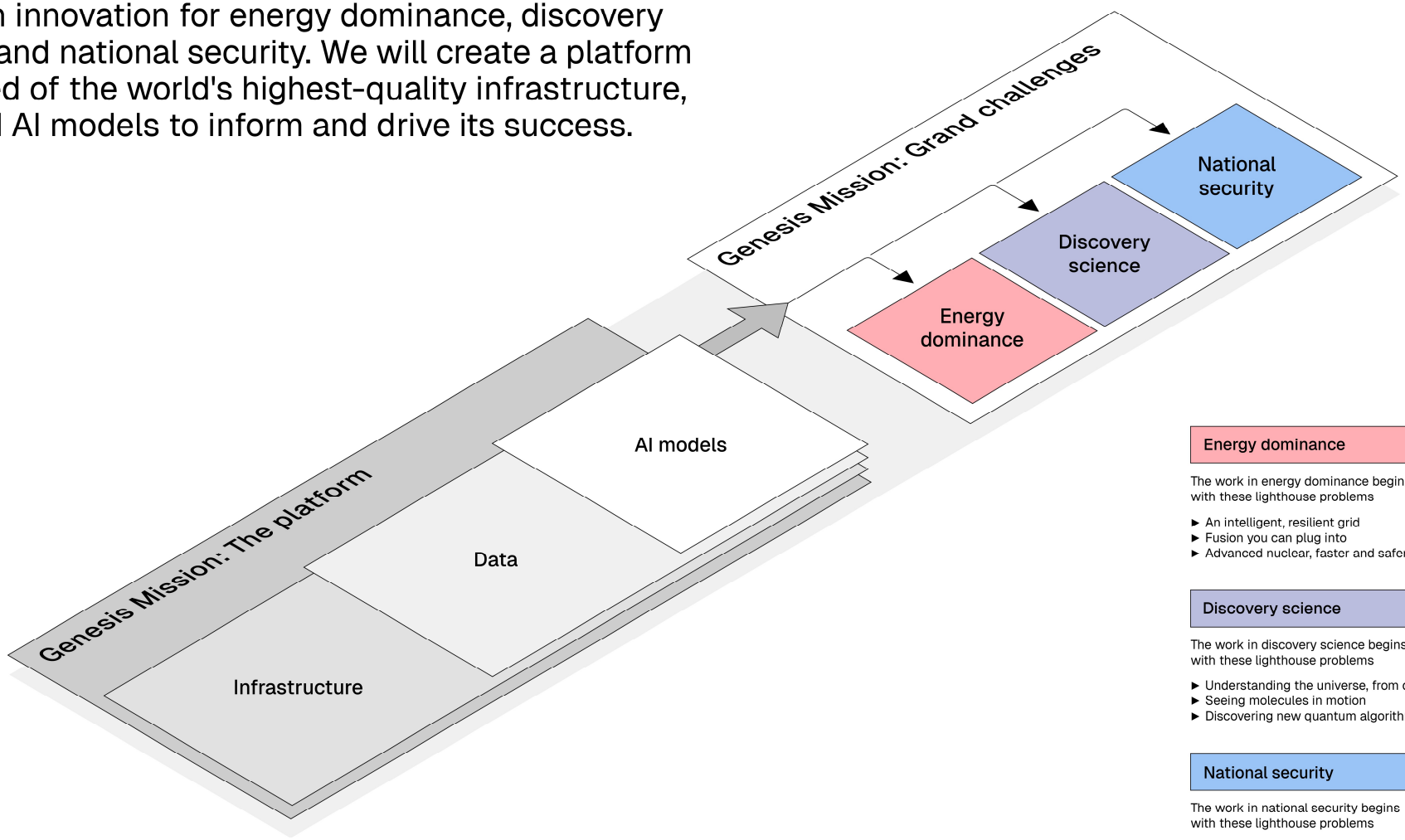
Genesis Mission Advanced Nuclear



U.S. DEPARTMENT of ENERGY

Genesis Mission

The Genesis Mission is a call to action to accelerate American innovation for energy dominance, discovery science, and national security. We will create a platform composed of the world's highest-quality infrastructure, data, and AI models to inform and drive its success.



Energy dominance

The work in energy dominance begins with these lighthouse problems

- An intelligent, resilient grid
- Fusion you can plug into
- Advanced nuclear, faster and safer

Discovery science

The work in discovery science begins with these lighthouse problems

- Understanding the universe, from quarks to cosmos
- Seeing molecules in motion
- Discovering new quantum algorithms

National security

The work in national security begins with these lighthouse problems

- Discovering mission-ready materials
- Securing critical materials
- Accelerating advanced manufacturing

V1.1 Updated 10.29.2025

Genesis Mission

AI to Accelerate Nuclear Energy Deployment Initiative at Office of Nuclear Energy

- Accelerate **Design**, **Manufacturing**, & **Licensing**
- Realize Autonomous **Operations**
- Dominate Nuclear Energy R&D *(e.g., **autonomous labs**)*
- Capstone: Autonomous Reactor Demonstration

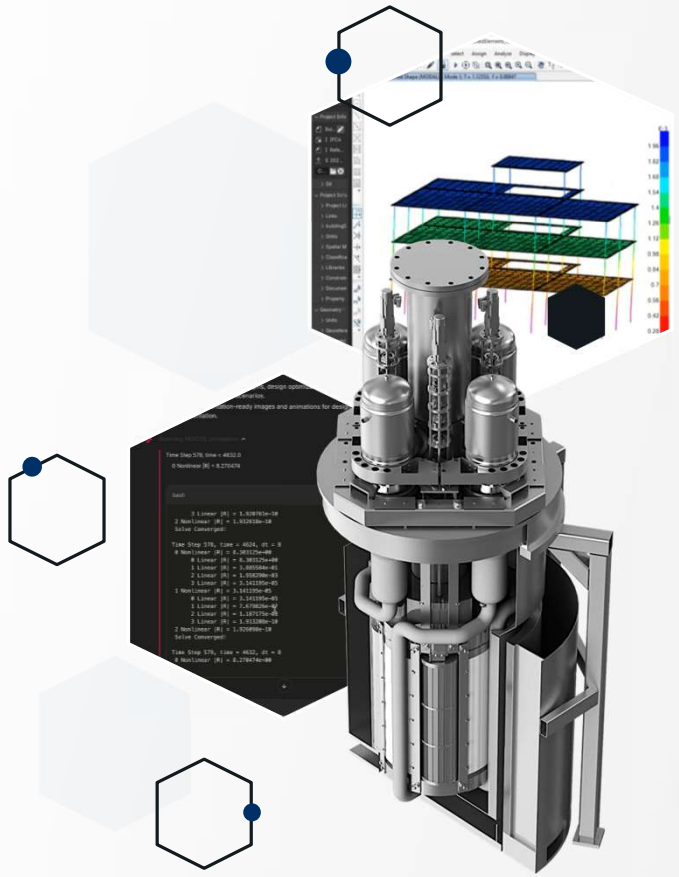
Genesis Mission

Prometheus Challenge

AI-First Nuclear Paradigm

First-of-its-kind autonomous nuclear reactor designed, safety analyzed, built, and operated with <5% human intervention

- **Strategic Impact**: Supports U.S. goal to reach 400 GW nuclear capacity by 2050; enables **2–5x schedule acceleration** and **up to 70% OPEX** reduction.
- **Born-Certified Manufacturing**: Digitally certified, AI-augmented fabrication with in-situ quality control.
- **Public-Private Partnership**: Uniting national labs, AI developers, and industry for shared innovation and leadership.
- **Technical Milestones**: From AI design platform (2026), limited autonomy demo (2027) to full reactor (2031).



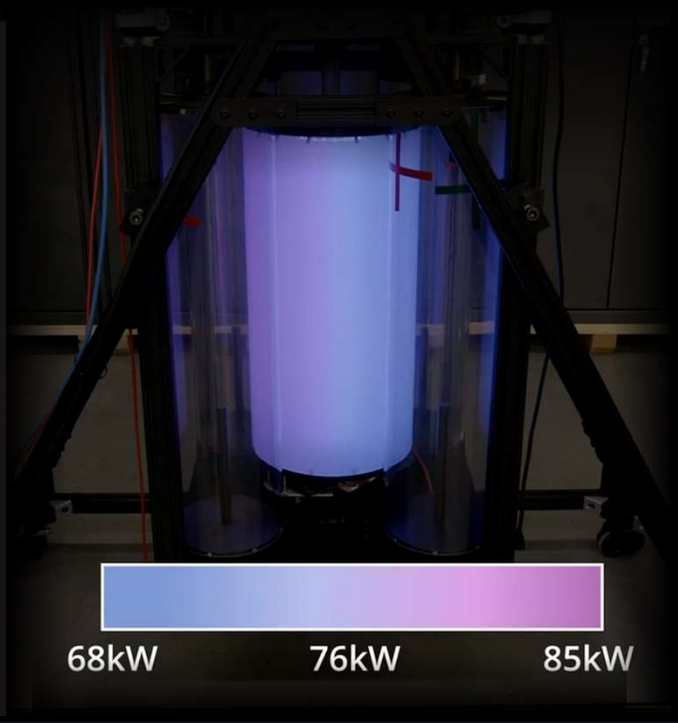

Readme
Chainlit
Type your message here...

Genesis Mission

Autonomous Operations and Maintenance

First Autonomously Controlled Non-Nuclear Microreactor

First Real-time, Real-world **Digital Twin** of a Nuclear Reactor




Beholder Digital Twin
Anomaly Detected – Statistical
Anomaly Detected – Machine Learning
INL

Genesis Mission

VULCAN Challenge

AI-Driven Nuclear Materials Revolution

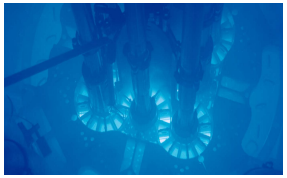
Autonomous pipeline for nuclear materials discovery, qualification, and deployment—compressing decades into years

- **Historic Data Foundation**: Digitizes 25,000+ irradiation experiments; LLMs guide optimal testing using legacy data from EBR-II, HFIR, ATR.
- **AI-Driven Materials Design**: Predicts qualified materials using multi-modal models aligned with ASME/NRC standards; auto-generates compliance docs.
- **High-Throughput Autonomous Experimentation**: Fabricates 100+ samples per campaign; robotics and AI vision automate irradiation and monitoring.
- **Automated Characterization** & Analysis: Robotic hot cells and AI analytics deliver real-time PIE and predictive models into ASME-compliant databases.

Genesis Mission

Nuclear Infrastructure and Data are Key for AI

Key Nuclear Infrastructure


Advanced Test Reactor

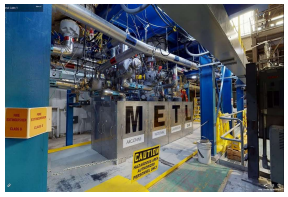

Fuel Conditioning Facility

NRIC DOME


Hot Fuel Examination Facility


Sample Preparation Lab


High Flux Isotope Reactor



Argonne's METL

C3 Computing


TREAT

Rich Data Assets at National Labs

- **Legacy data** from decades of reactor, fuels, and materials tests
- ATR, HFIR, and TREAT experimental campaigns provide **foundational fuel performance** and transient behavior data
- DOME, test bed, and pilot projects can capture **industry-relevant reactor experiment** data
- Fuels and Fuel Cycle Facilities (e.g. at ANL and INL) contributes critical **material property characterization**
- Alexandria supports **non-proliferation** and **safeguards** applications (petabyte-scale)
- Near-term **microreactor** deployments (e.g., MARVEL, Pele) will generate **autonomous control**, digital twin validation, and **mobile reactor** datasets