


Innovating and Scaling Up Artificial Intelligence

For Nuclear Power Today And Tomorrow

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Nuclear Technology and Applications
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AI adoption is scaling up in
the electric power industry
Including Nuclear

The technology is ready. We're building an AI-Electric Power community to bring state-of-the-art solutions and deployment processes to utilities.

AI will enhance:

- Real-time insights from historical reports
- Prognostics for future actions
- Automation to increase reliability

- Automated diagnosis and benchmarking performance
- Inspections of plant structures, systems, and components
- Work orders and Correction Action Report Process

EPRI's Nuclear AI and Data PROJECTS



Insights

- ISI UT Examination Results Comparison Tool
- Event Management Response Tool (EMRT)
- Low Cycle Fatigue (LCF) Transient Monitoring
- Nuclear NLP Dictionary

Optimization

- RaDUCE: Radiation Field Source Term Optimization
- Optimizing Inventory Management Practices
- Scenario Evaluation for Decommissioning Planning
- Surrogate Machine Learning Model for Pellet-Cladding

Prognostics

- Data Mining to Support Integrated Monitoring and Diagnostics
- Machine Learning to Inform Flow Accelerated Corrosion (FAC) Programs

Automation

- Automation of Non-Destructive Evaluation Results
- Concrete Defect Detection Tool
- Adaptive Feedback Welding
- Automating Corrective Action Programs
- Automatic Monitoring of Dry Cask Vent Temperature



Our Nuclear **DATA SETS** | Power Plant Operational Data, Generation Asset Maintenance Information, & Nondestructive Evaluation data

EPRI's
AI WORK spans ...



T&D Overhead Line Imagery

Power Plant Operational Data



Transformer Demographic, Oil Analysis Data

Generation Asset Maintenance Information



AMI Data

Control Center Operational & Protection Data



Power Quality



Nondestructive Evaluation Data



Satellite Data

5G and Advanced Network Data



Nuclear Power Dictionary



for Natural Language Processing (NLP)

- Uses nuclear plant operational database
- Demonstrated AI solution for groundwater contamination
- Will be capable of recommending future courses of action based on Corrective Action Reports, among other utility reports
- Long-term goal: Expand dictionary to the broader entire electric power industry

PROJECT STATUS

- Six industry experts with 30+ years were interviewed to identify the corpus for the dictionary
- Interviews are currently being analyzed
- Technical Report to be published in mid-2022

Automated diagnostics and processing



of Corrective Action Program (CAP) data

- EPRI's AI solution will automatically process CAP data
- Could reduce 6 people's work of 2 hours a day, 5 days a week to 1 person, 1 hour a day, 5 days a week → 90% reduction
- Early detection, improved resolution time, reduced personnel time



PROJECT STATUS

- Analyzing CAP data from 2 U.S. fleets (13 reactors total) over a 3-year period
- Formed Industry Working Group, 2nd webinar on 22 September
- Technical Report expected December 2021

to Predict Flow-Accelerated Corrosion (FAC) Wear Rates

- Machine learning model improves wear rate prediction accuracy within EPRI's CHECWORKS™ software
 - Especially good for thinner components
- Optimizes number of inspections to allocate resources to the right locations



PROJECT STATUS

- Over 27,000 inspection datasets have been analyzed from 48 units
- Improved algorithm is now being evaluated using industry-proven FAC metrics
- Machine learning methodology will be applied to unmodeled, risk-ranked components

Machine Vision Models



to automatically detect damage in concrete structures

- EPRI is training AI models to perform visual inspections of concrete structures. Initial results show approach is feasible and can provide value to the industry.
- Model is trained to localize corrosion, cracking, efflorescence, grease stain, and spall.
- Damage localization models show high detection rates and acceptable false call rates across all damage types considered.



PROJECT STATUS

- Real-time implementation available for field testing
- Online tool for post-inspection implementation to be released by year-end
- Coming soon in 2022: Anonymized and labeled common database for the industry

These projects will benefit the nuclear industry



But there are other challenges to overcome:

Workforce development |

Accelerated reskilling of existing staff, and developing a new workforce are fundamental to progress. Training enhanced with artificial intelligence can support the workforce evolution.

Explainability |

The industry has adopted more AI applications as models have included details of why an algorithm arrived at the decision or recommendation it made, supporting staff to improve benchmarking, issue identification and training data.

Trust in the AI models |

The nuclear industry employs a “trust but verify” approach in all it does. AI models can be compared against ground truth data.

Our



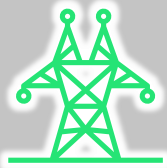
AI GRAND CHALLENGES



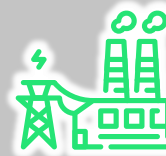
Grid-Interactive
Smart Communities



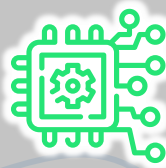
Environmental
Impacts



Energy System
Resiliency

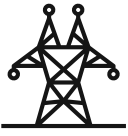


Intelligent and
Autonomous Power Plants



AI-Enhanced
Cybersecurity

Applies to nuclear



Grand Challenge: Energy System Resiliency



Catastrophic events such as the 2021 Texas winter storm severely disrupt the normal functioning of critical electrical grid infrastructure for significant durations. This grand challenge seeks to identify, develop, demonstrate, benchmark, and scale adoption of AI that can help to predict both weather and grid

conditions and intelligently control energy flow to minimize or eliminate the impact of such events in the future and reduce unplanned outage durations by performing critical-path tasks more efficiently.



Grand Challenge: Intelligent & Autonomous Power Plants



Automating tasks enables plant operational and grid integration efficiency improvements. It also preserves energy system assets and equipment while enabling energy system operators to focus on the most valuable maintenance, asset management and integration tasks. AI applications such as digital twins,

machine learning/reinforcement learning, machine vision, and automatic diagnostics optimize inspection, monitoring, and utilization. This grand challenge seeks to identify, develop, demonstrate, benchmark, and scale AI applications for automation.



Grand Challenge: AI-Enhanced Cybersecurity



Cybersecurity protects important utility data, such as personally identifiable information, critical operational data, and data for AI models. Conversely, AI can be used to augment cybersecurity by helping to monitor network connections and traffic more effectively, identify suspect or anomalous activity,

and automatically detect underlying vulnerabilities in software codes. This grand challenge seeks to advance the state-of-the-art in cybersecurity practices through effective implementation of AI, benchmark identified solutions, and scale them up across the electric power industry.



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Building an AI-Electric Power Community

Collecting, Curating and Sharing Data,
and Developing Solutions

Deepening AI Expertise in the Electric Power Industry

A blue-tinted photograph of four people (two women and two men) in professional attire, some wearing hard hats, looking towards the right. The image is overlaid with a semi-transparent blue filter.

Together...Shaping the Future of Energy™

And stay tuned for more details on our 2022 AI and Electric Power Summit!

Sign up for updates [here about AI.EPRI.com](https://www.a1.epri.com)