Data Science in the Nuclear Industry

John Lindberg, PE
Technical Executive
Electric Power Research Institute

Big Data for Nuclear Power Plants
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Agenda

▪ What is needed?
▪ Where can it make relevant impact?
  – Insights
  – Prognostics
  – Automation
  – Optimization
What is needed?

Engagement & Collaboration

Data
- Leverage the collected experience of the whole industry

Expertise
- **AI**
  - Engage the AI community
  - Leverage AI.EPRI

- **Business**
  - Focus on relevant issues to develop relevant solutions

- **Domain**
  - SMEs in the field

EPRI is well placed to facilitate this
Where can it make relevant impact?

Application
Decades of experience recorded in databases can be leveraged to unlock new best practices and better inform future decisions.

Value
New trends and observations lead to improved operating and maintenance efficiencies that utilities can implement today.

Example Targets
Operational experience (OE), corrective action program, work order history
Where can it make relevant impact?

**Applications**

**Insights**

Extracting new lessons from the past

**Example Projects**

**Event Management Response Tool**
Establish OE database and subsequent analysis of the OE to support emerging issue, early career engineers, and rapid response.

**Exploring Cable Aging Databases**
Explore data mining techniques to gain new insights from databases on aging assessment of low-voltage and medium-voltage cables.

**Explore Fuel Databases**
Develop tools to mine various databases (e.g., Fuel Fragmentation Experiments, BWR Channel Distortion, PWR Fuel Assembly Distortion, general Fuel Reliability databases) that consist of complex, multi-variable issues or phenomena to improve the identification and trending of issues.
Where can it make relevant impact?

**Application**

Leverage data science to predict events and assess current asset conditions, supporting better informed decisions to improve and optimize maintenance and outage strategies.

**Value**

Reduced unexpected down times and optimizing frequency of required/periodic inspections in the future.

**Example Targets**

Component and asset integrity and health condition
Where can it make relevant impact?

Applications

Insights

Prognostics

Better preparing for the future

Example Projects

Material Characterization
Integrate the results of different techniques to nondestructively assess the microstructural condition and mechanical properties of irradiated austenitic stainless steel.

Remaining Useful Life for pumps/motors
Assess condition of pumps/motors based on monitoring data to determine incipient faults or issues

Fuel Crud Prediction
Develop tool for crud prediction to investigate correlations between past core operational histories and reactor crud behavior under flexible power operation.
Where can it make relevant impact?

Applications

Insights

Prognostics

Automation

Increasing reliability

Application

Automate tasks such as the analysis and evaluation of periodic examination results.

Value

Utilities increase operational reliability by reducing human factors, i.e. fatigue, and decreasing analysis activity time.

Example Targets

Ultrasonic, eddy current and visual nondestructive examinations.
Where can it make relevant impact?

Applications

- Insights
- Prognostics
- Automation

Increasing reliability

Example Projects

Automating Visual examinations
Develop algorithms for automated defect detection from remote visual examination of reactor internals and fuels.

Eddy Current (EC) examinations
Develop algorithms for defect detection in EC measurements in fuel rods and to improve sizing accuracy in Balance of Plant (BOP) heat exchanger examinations.

Auto-Analysis of CRDM UT Data
Develop algorithms for automated analysis of ultrasonic examinations of reactor vessel head penetrations.

Dry Storage Canister Vent Temperature Monitoring
Autonomously monitor vent temperature in DSC from thermal images to assure canister operational integrity.

Adaptive Feedback Welding
Real time evaluation and monitoring of in-process welding.
Where can it make relevant impact?

Applications

Insights

Prognostics

Automation

Optimization

Being smarter

Application

Optimize current operational processes and tasks.

Value

Utilities improve operations, plans and decision-drivers.

Example Targets

Inventory, fuel cycles, schedules.
Where can it make relevant impact?

**Applications**

- **Insights**
- **Prognostics**
- **Automation**
- **Optimization**

**Example Projects**

- **Decision Logic for Source Term Reduction**
  Develop decision logic to enable NPPs to assess the impacts of proposed system or operational changes (flexible operations) on the plant's source term and radiation fields.

- **Outage/Work Scheduling**
  Optimize outage logic and scheduling based on historical performance.

- **Inventory Management**
  Develop tools to optimize inventory availability and purchasing based on work order history, part usage, shelf life, lead times, etc.

- **Fuel Usage Optimization**
  Develop tools to optimize fuel loading patterns and fuel cycle parameters.
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Applications

Insights
- Extracting new lessons from the past

Prognostics
- Better preparing for the future

Automation
- Increasing reliability

Optimization
- Being smarter
Upcoming Workshop – Energy Industry & AI Community

- The goal of this meeting is to connect energy technical leads with the AI community.
- Industry technical leads will introduce current or upcoming needs that require integrated solutions from the AI community.
- The workshop will include an “inverse exhibit”, where leads from the energy industry will have exhibits allowing vendors to obtain direct information on each project needs.
- It is expected that during this vendor workshop issues from the Nuclear, Fossil, Environment, and Power Delivery sectors will be discussed.

April 28-29, 2020 - EPRI Charlotte office

For more information contact: Thiago Seuaciuc Osorio
tseuaciuc-osorio@epri.com
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