



Applications of Artificial Intelligence in Automating Nuclear Operations and Work Processes

December 2020

Changing the World's Energy Future

Ahmad Y Al Rashdan



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**Idaho National Laboratory
Idaho Falls, Idaho 83415**

<http://www.inl.gov>

**Prepared for the
U.S. Department of Energy
Under DOE Idaho Operations Office
Contract DE-AC07-05ID14517**

December 7, 2020

Ahmad Al Rashdan, Ph.D.

Senior R&D Scientist

Nuclear Science and Technology

ahmad.alrashdan@inl.gov

Applications of Artificial Intelligence in Automating Nuclear Operations and Work Processes

Motivation



Artificial Intelligence in a Nuclear Power Plant

Collect Information



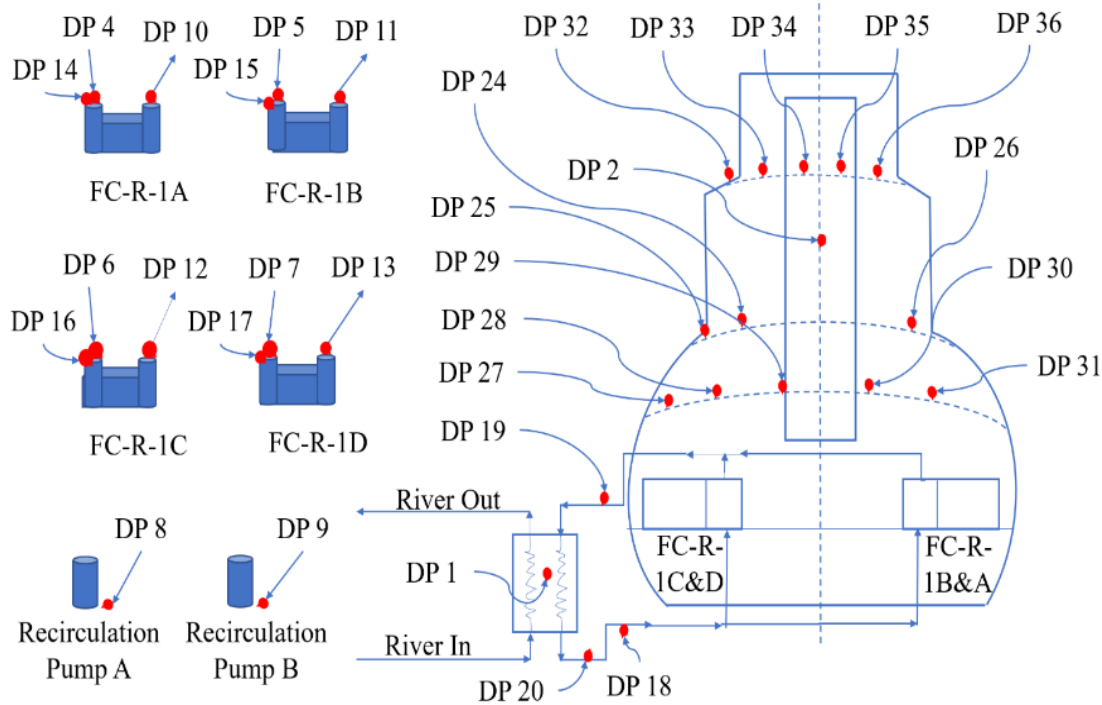
Analyze Information to Make Decisions



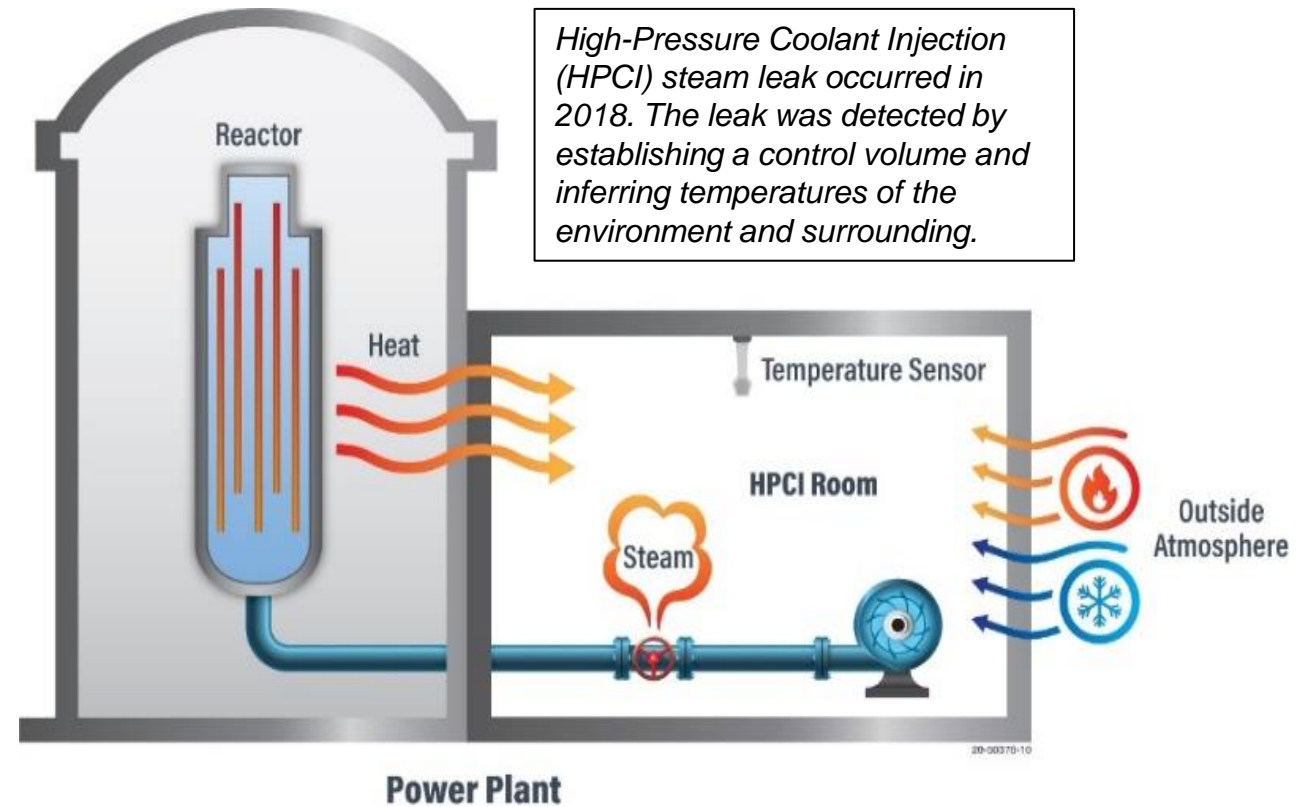
How? perform work autonomously, faster, more frequently, more accurately, or perform tasks that a human can't perform.



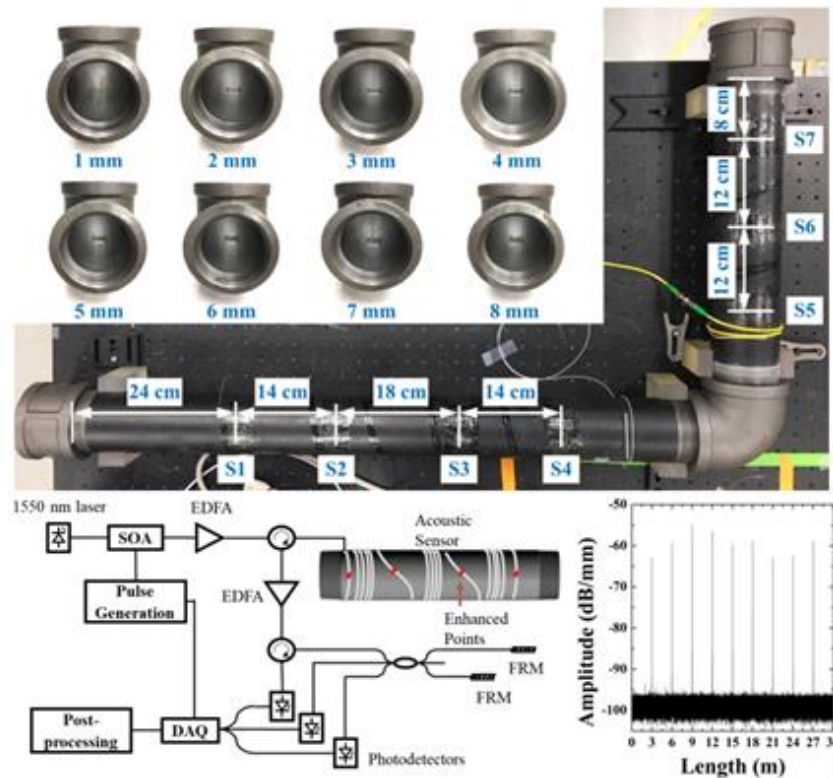
Artificial Intelligence for Nuclear Plant Monitoring and Predictive Analysis



Two dry well cooling fans failed within weeks in Cooper nuclear station in 2018 and caused outage for 6 days. Condition inference relied on surrounding sensors to determine the condition of the fan.

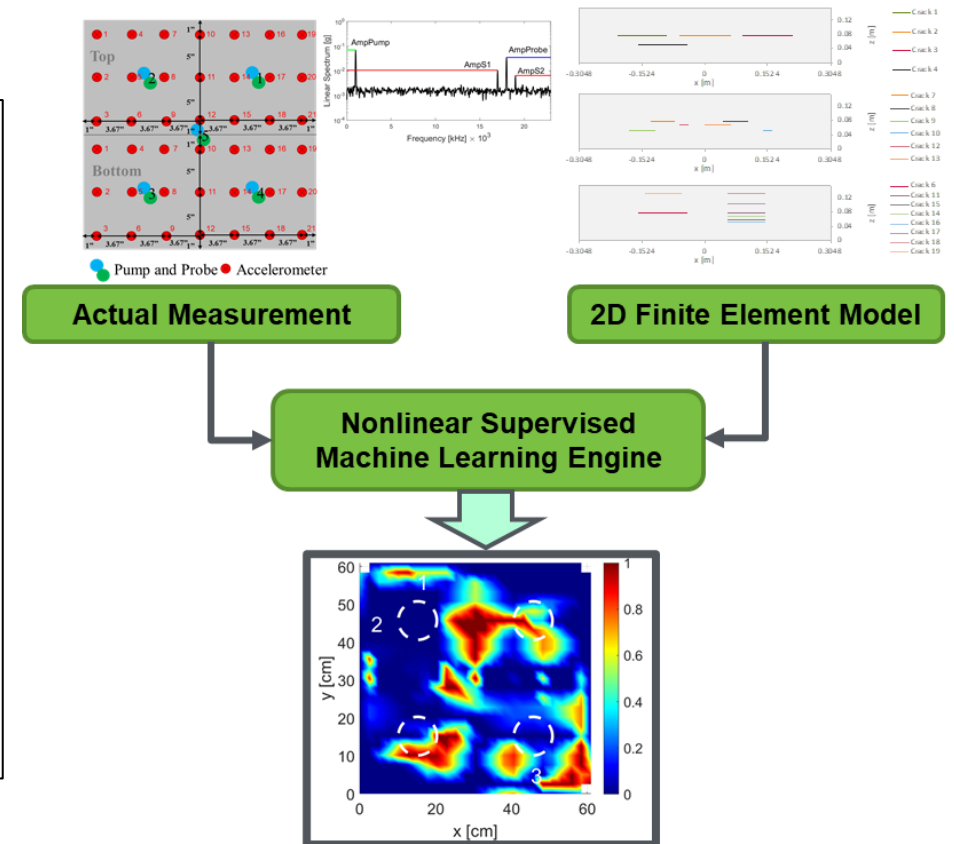


Artificial Intelligence for Nuclear Plant Monitoring and Predictive Analysis



Given the dynamic nature of alkali-silica reaction (ASR) degradation due to different concrete aggregates, large volume of experimental data would be required to develop a highly accurate diagnostic and prognostic models. physics-informed machine learning approach was used to develop a technology to locate and estimate damage.

High-resolution fiber optics sensors can cover very long stretches of piping of different geometries and monitor miles of piping from a single location. Coupled with ML-based pattern recognition algorithm, its possible to detect piping degradation.



Physics-informed machine learning damage map due to ASR

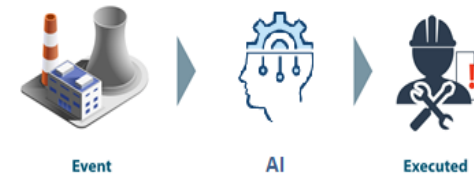
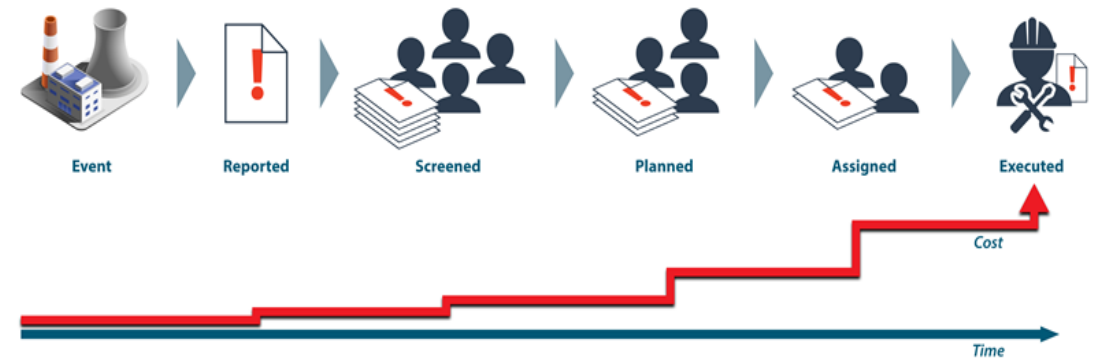


Artificial Intelligence for Business Automation



Optimizing/reducing the stocking requirements in a plant releases 10s of millions of USD that can be leveraged in modernizing the plant. Inventory management is being optimized by coupling work demand information with parts inventory to reduce the minimum stocking requirements in plants.

Condition reports screening is a process that involves several staff on daily or bi-daily basis for several hours a week. Condition reports screening process (specifically, the classification of condition reports according to their impact to safety) is being automated by means of natural language processing and deep learning.



Inspections support is being explored as another costly process that could be improved by means of automation using advances in AI/ML.



AI/ML for Support Functions



Drones can automate several activities in a plant including operator and security rounds, and inspections of hazardous locations. Drones navigation is being enabled by introducing AI/ML methods to enable drones to recognize and navigate their environment.

Automated gauge reading impacts a wide spectrum of activities in a plant including operator rounds, gauges calibration, and peer verification, and improves data fidelity for online monitoring. Manual logging of analog gauges is being automated by creating AI/ML to recognize gauges in oblique angles and read their values.



Fire watch cost can exceed \$1M per month in a nuclear power plant. Computer vision AI/ML is used to identify a fire in a video stream to eliminate the need for a fire watch.





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