# A Holistic Artificial Intelligence Tool to Mitigate Human Factor Uncertainty in Operation and Maintenance

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**Program**: RC-7.3: Reducing Human Factor Uncertainty Using Artificial Intelligence in Operation and Maintenance of Nuclear Power Plants

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**ABSTRACT:**

The goal of the proposed work is to develop a holistic artificial intelligence (AI) tool to help the detection and mitigation of human factors errors in nuclear power plants (NPPs). Specifically, this project aims to

(1) Develop a holistic AI-powered data fusion tool that is robust to the uncertainty in manually collected data, which are prone to human factors errors, across various activities/individuals;

(2) Develop a 'warning system' that relies on the explainable capabilities of the AI tool to alert individuals of potential errors and prompt opportunities for appropriate mitigation; and

(3) Enable uncertainty quantification with respect to human factors errors, across activities/individuals in order to provide opportunities to close the loop.

In summary, the proposed tool will increase the efficiency of various activities such as testing, inspection, data collection, and interpretation, improve operation and maintenance (O&M) decision-making, and reduce costs in NPPs by minimizing the impact of human factors errors and providing warnings to mitigate them when possible.

To address the problem at hand, we propose to develop a holistic explainable physics-enhanced AI tool to detect human factors errors and fuse the non-anomalous data in a robust manner to minimize the impact of potential human errors on O&M of NPPs. Specifically, we will develop a physics-informed anomaly detection algorithm to detect manually collected/inputted data affected by human factors errors. That is, we combine the capabilities of anomaly detection algorithms, which are able to detect unusual patterns in data that do not conform to expected behavior, with physics-based learning, which incorporates dynamics of the system into the algorithm, to develop a tool with improved performance, while reducing the training time and the need for large volumes of data.

The proposed research will be completed through a series of tasks as follows:

– Task 1. Understanding the different types of data and human factors errors, and their contributing factors and their variability, at various levels, in NPPs.

– Task 2. Developing an AI tool to detect and mitigate human factors errors at Level I: Field worker using real-world data and testbed data.

– Task 3. Extending the AI tool to mitigate the human factors errors at Level II: Systems engineers/analysts.

– Task 4. Uncertainty quantification and closing the loop.

The major deliverables include a trained, validated, and tested AI tool that is generalizable and capable of uncertainty quantification with respect to human factors errors, periodic technical progress reports, and a comprehensive final report, to be prepared at the conclusion of the project.