Pacific Northwest
NATIONAL LABORATORY

Applying machine learning capabilities, Pacific Northwest National Laboratory (PNNL) researchers developed the Transformative Remedial Action Scheme Tool (TRAST) to automate the process of identifying and evaluating remedial action schemes (RAS) used by electric utilities to plan for specific contingencies and emergencies.

TRAST

Preventive measures for real-world reliability

DATA-DRIVEN ANALYTICS

Remedial action schemes (RAS), also known as special protection schemes, are used throughout the electric utility transmission systems as a non-wire method of responding to abnormal or predetermined system conditions to maintain overall system reliability. TRAST enhances and automates the process of identifying and evaluating RAS scenarios and settings to plan for contingencies and emergencies. The tool uses parallel and cloud computing to consider an unprecedented number of operating scenarios and contingencies to better configure RAS settings for more realistic environments.

A LIMITED VIEW, LITTLE VALIDATION

Due to a lack of automated tools and computation power, RAS settings are traditionally determined by time-consuming offline studies that don't allow for adaptive learning. These limitations result in overly conservative RAS settings, causing unnecessary flow curtailment, generation tripping, or misoperation of RAS. These actions can affect the revenue of generator owners and the economic operation of the entire network.

TECHNOLOGY FEATURES

- Advanced statistical data analysis
- Automated power flow case generation using optimization algorithms
- Customized dynamic simulations in a high-performance computing cloud platform
- Machine-learning-based RAS coefficient prediction
- Reliable RAS validation strategy in multiple commercial platforms
- In partnership with PacifiCorp and Idaho Power, PNNL researchers identified technology gaps in current RAS modeling practices to build TRAST

U.S. DEPARTMENT OF ENERGY

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TRAST uses machine learning to enhance the design, study, and evaluation of RAS for the power system, thereby improving grid reliability.

SIGNIFICANTLY SIMPLYIFYING THE RAS DESIGN AND STUDY PROCESS

TRAST, a prototype research tool, originated from data analysis by utilities and evolved with domain knowledge from PNNL power engineers. The technology uses advanced statistical data analysis tools to automatically generate RAS use cases. Machine learning algorithms then analyze, validate, and aid in the creation of RAS plans with preventive emergency controls.

Automatic and semi-automatic functionalities integrated in TRAST significantly simplify and shorten the RAS design and study process. In addition, the TRAST evaluation methodology enables continuous improvement and validation.

With the development of faster computational techniques at PNNL, including parallel dynamic simulation and massive contingency analysis powered by high-performance computing techniques, it becomes feasible to validate the preventive controls and adjust parameter settings in near real-time to improve security and efficiency. With adaptive RAS settings, the power grid can be operated less conservatively and more reliably.

WHAT MAKES TRAST UNIQUE

Today's commercial tools are not fast enough to perform a full-scale study to calculate RAS parameters and validate the control performance in a preventive way. Even so, the primary barrier is not computing tools but convincing utilities and regulators to embrace the advantage that high-performance computing techniques allow; in this case, the convergence of data and models. TRAST bridges this gap.

INDUSTRY APPLICATIONS

RAS represent one of the core resilience components of the electric power system and are critical in maintaining overall system reliability. More importantly, regulators require utility companies to report the commission, update, and revision of RAS as a valid strategy for rapid response to system emergencies in advance of field implementation.

In partnership with PacifiCorp and Idaho Power, PNNL researchers have identified the technology gaps in current RAS modeling practices for planning and operation and are using machine learning to better understand grid operation patterns and improve RAS designs. Building from real-world system data, TRAST algorithms will determine the arming levels of RAS to develop use cases that demonstrate the benefits of adaptive RAS parameter settings.

The team is working closely with the power industry, including PacifiCorp, Peak Reliability, Idaho Power, and the Western Electricity Coordinating Council.

Both grid operators and utility planning engineers will benefit from the technology, and a better RAS modeling process will increase interconnection-level system reliability and resilience.

AVAILABLE FOR LICENSING

TRAST is protected with pending patents and copyrights, which are available for licensing. You can view all of PNNL's intellectual property designed to help power grid operators and utility planning engineers at *availabletechnologies.pnnl.gov*.

LET'S CONNECT

If you have questions, regarding this technology, please send inquiries to commercialization@pnnl.gov. You can view all PNNL technologies available for licensing at www.pnnl.gov/available-technologies.

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