

HUMAN FACTORS RESEARCH FOR A SAFER, MORE RELIABLE GRID

Empowering utility operators with better tools, better training, and better decisions

Ensuring a reliable and secure electric grid increasingly depends on how effectively humans and advanced technologies work together. Today's grid is a cognitively complex, high-consequence environment, requiring operators to rapidly interpret large volumes of information, monitor constantly changing conditions, and make decisions where mistakes can lead to service disruptions and significant financial costs. Because of this, the design of technology and training must be intentionally developed to support how operators perceive, think, and act.

Pacific Northwest National Laboratory (PNNL) not only operates the Electricity Infrastructure Operations Center (EIOC), a realistic control room environment for studying operator behavior, but also houses a multidisciplinary team with expertise in human factors research. By understanding how operators build situation awareness, make decisions, and perform tasks, we can design tools and training that builds on existing expertise to improve operator performance. Early consideration of human factors into research and development has several benefits, including:



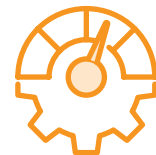
Technologies reflect operator needs from the start, which leads to better adoption



AI systems are deployed with known limitations and appropriate safeguards



Operators maintain appropriate trust, minimizing misuse or disuse



Training, procedures, and interfaces support safe and efficient adoption

Key Human Factors Capabilities

PNNL's Human Factors Team is a multidisciplinary group specializing in the study of how people interact with technology. Team members have backgrounds in psychology and human computer interaction with expertise in cognition, perception, decision-making, human subjects research, data science, and AI/machine learning experience. This combination allows PNNL to support a variety of grid-focused training and technology development activities, such as the following:

Requirements gathering and workflow analysis

Using interviews, task analysis, observations, and facilitated sessions, human factors researchers at PNNL document how operators actually work— independent of existing tools—to uncover gaps and challenges. The EIOC provides a simulated, real-world control room environment to support this activity. In the EIOC, researchers can observe operator behavior, replay scenarios, and collect detailed insights.

Human-centered design for tools and interfaces

Insights from operators inform the design of new technologies, ensuring display layouts, interactive elements, information timing, and automation features support cognitive processes and operational demands.

AI/automation integration and evaluation

Human factors researchers at PNNL help shape appropriate automation levels and inform trust calibration and explainability requirements for emerging tools such as agentic AI.

Training design and enhancement

PNNL human factors researchers work with professional trainers to refine and evaluate training that strengthens operators' skills in critical thinking, decision-making, bias awareness, and resilience.

Standards development

Human factors researchers at PNNL can develop standards for technology design, information display, cognitive workload management, and AI-enabled system behavior.



Contact Us

For information about PNNL's Human Factors capabilities for grid operations and training, contact us at:

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