



U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

**Office Of Nuclear Energy
Sensors and Instrumentation
Annual Review Meeting**

**Advanced Operational Concepts and Human-
Automation Collaboration
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ART**

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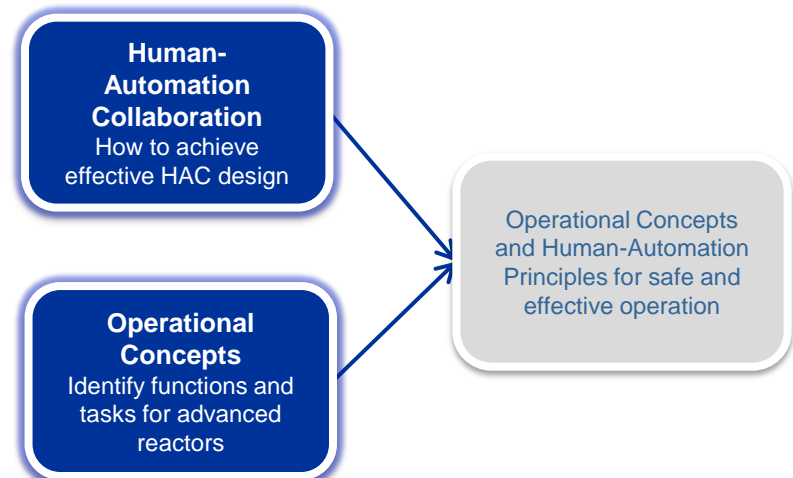
Project Objectives

■ Operational Concepts for Advanced Reactors, PI - Jacques Hugo

- Identify unique operating characteristics of advanced reactors
- Develop methodology for development of Ops Concepts
 - Inform system, functional & operational design and licensing basis of advanced reactors
 - Improve ability to plan for the challenges of operating advanced reactors
 - Ensure traceability of design decisions, help assure effective, efficient, safe operations

■ Human-Automation Collaboration (HAC), PI - Johanna Oxstrand

- Analyze impact of automation on human and system performance in advanced nuclear power plants
- Define criteria for human-automation interaction design to optimize overall plant performance and reliability





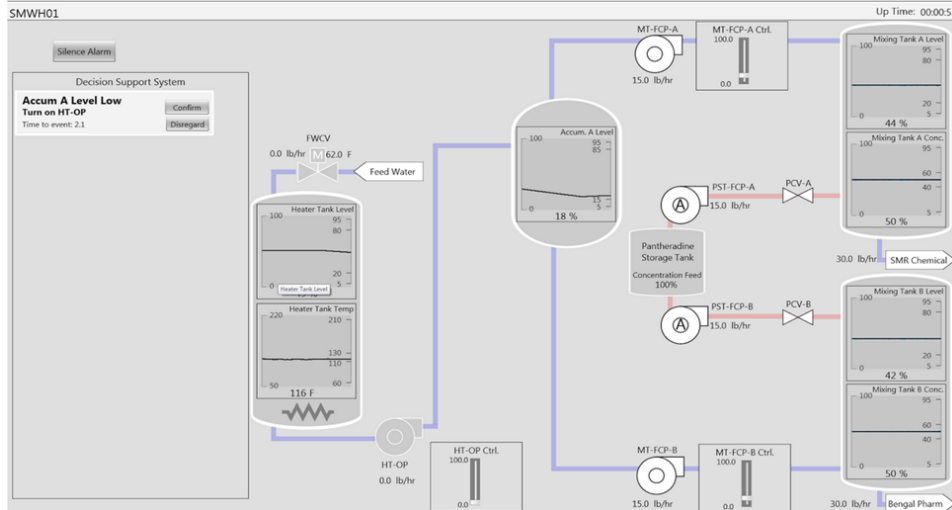
Accomplishments

■ Operational Concepts for Advanced Reactors

- Developed methodology for identifying and documenting operational concepts in advanced reactors
- Developed a reference operational concepts document for the sodium fast reactor

■ Human-Automation Collaboration

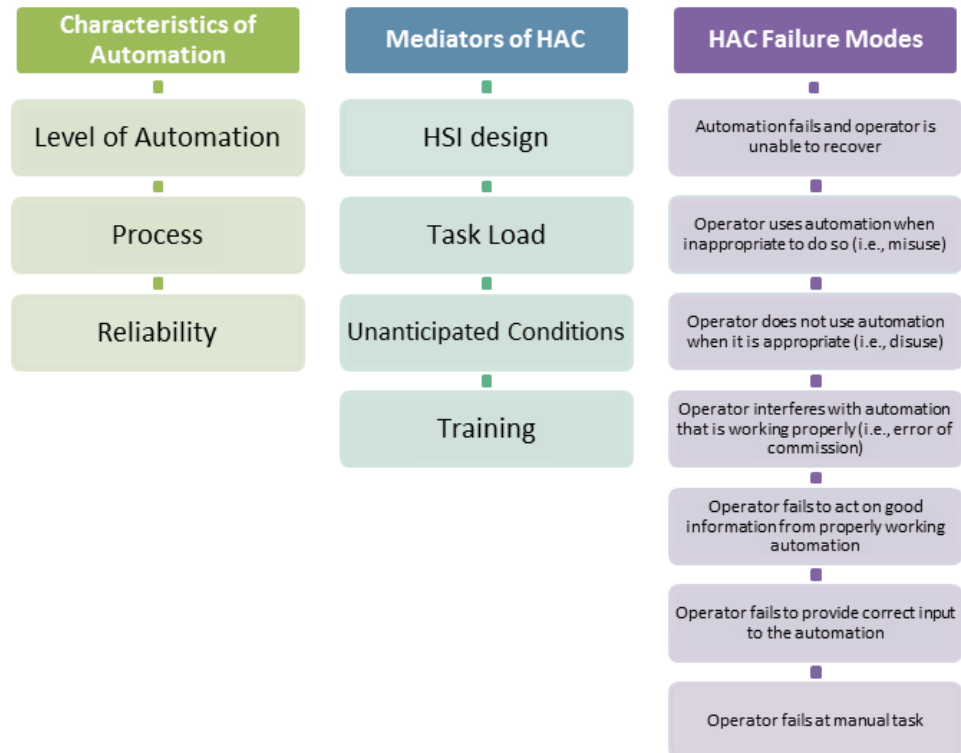
- Developed a framework for human automation based on the state of the art
- Completed a series of analytical and experimental studies to address critical research gaps
- Developed a modified framework of human-automation collaboration that:
 - Developed a simplified characterization of automation
 - Identified the human performance consequences of HAC design





Impact

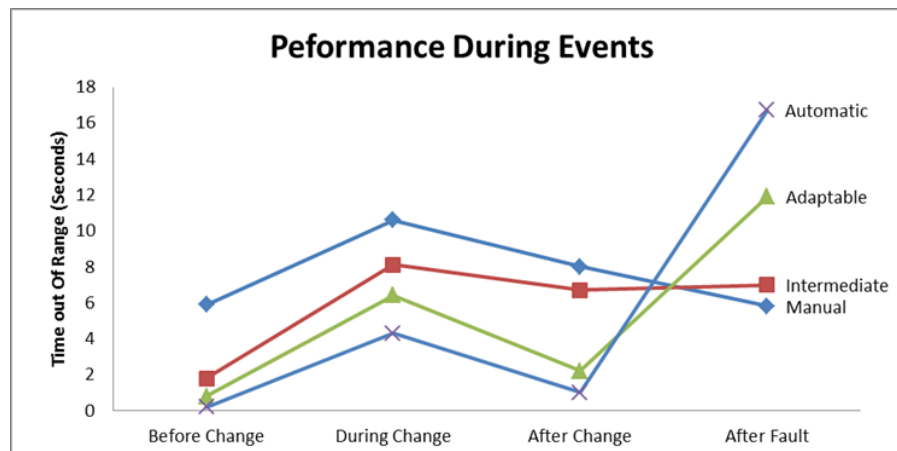
- Advanced Operational Concepts developed a systematic methodology for developing operational concepts in advanced reactors
- HAC developed a framework for human automation collaboration that defines how automation design decisions impact human performance, and provides preliminary guidance on designing effective HAC
 - Provided input to EPRI revision of standard on automation design





Future Work

- Investigate the impact of new concepts of operation
- Identify human automation collaboration design that fully supports operator decision making in highly automated systems
 - Existing research reveals a fundamental trade-off between system performance and human performance, and proposed designs are not sufficient to overcome this tradeoff. Future work should identify ways to enhance system performance through the use of automation without sacrificing human performance.



Conclusion

- Advanced operational concepts are a part of new reactors and may be part of modernization of existing plants, understanding the impact to operations and human performance is critical to enable the future of nuclear energy
- Effective HAC design will ensure humans are appropriately integrated into the overall concept of automation and system design and will facilitate safe and efficient operation of nuclear energy technologies