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December 3 - 5, 2024

Human and Technology Integration (HTI):

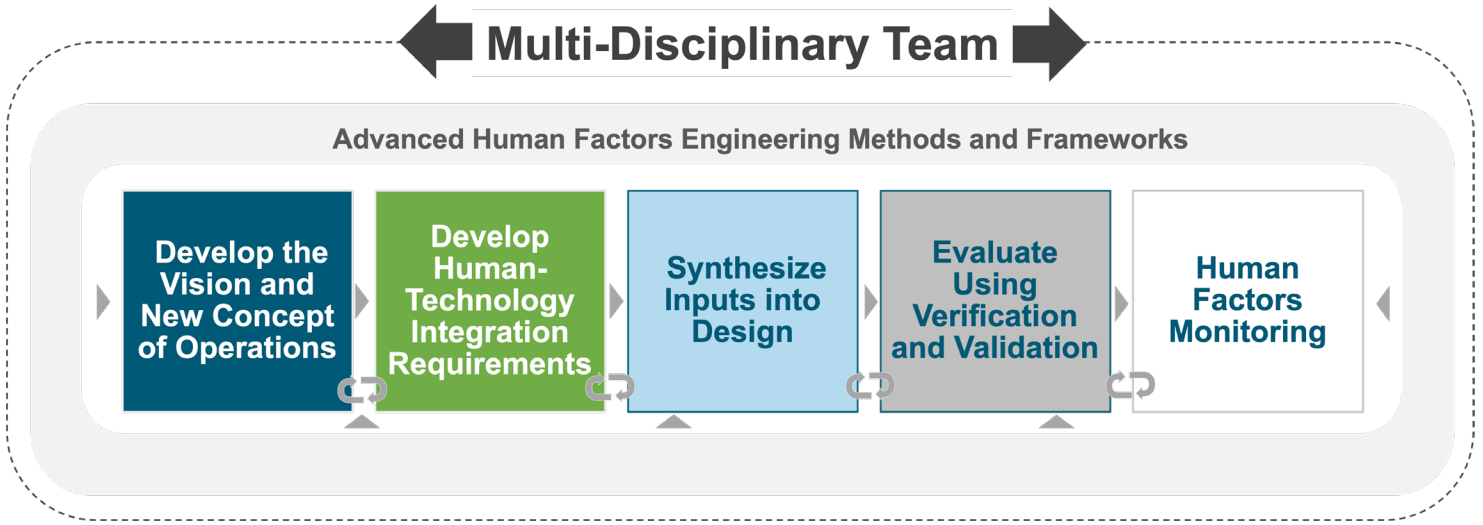
Ensuring Safe, Reliable, and Effective Use for Digital Technologies in Nuclear Power Plants

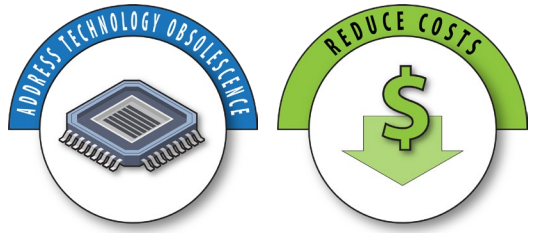
Plant Modernization Pathway Stakeholder Engagement Meeting

HTI provides effective integration of people and innovative technologies to ensure safe, reliable, and effective use.

Greater Technology Adoption | Transparency in Automation | Improved Performance and Usability | Improved Situation Awareness | Reduced Workload | Reduced Human Error | Minimized Training Demands

- HTI applies advanced human factors engineering (HFE) methods such as human-in-the-loop simulation to evaluate key interactions between personnel and new digital technologies.
- HTI is applied early during conceptualization of the new vision to ensure that human factors considerations can be addressed effectively. It also is applied throughout the project lifecycle (**right**).
- HTI champions cross-functional, multidisciplinary design and testing activities to ensure integrated solutions.

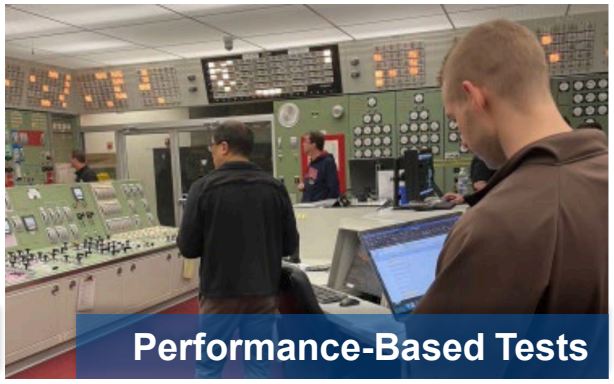


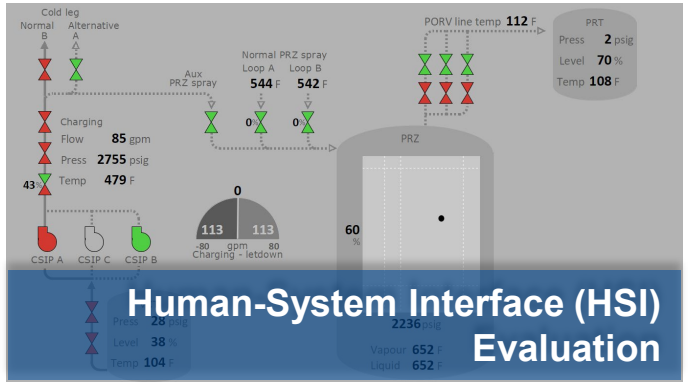


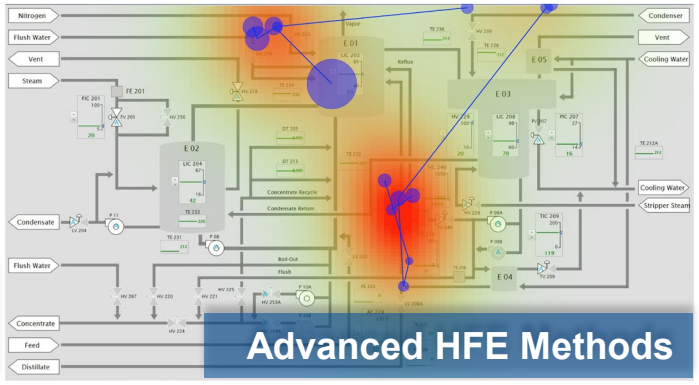
The LWRS Program is an industry leader in digital main control room and plant modernization.

- With over a decade of experience, HTI researchers have collaborated with several U.S. utilities and partnering research organizations in enabling both safety-related and non-safety digital instrumentation and control system modifications.

- HTI researchers have demonstrated core HFE methods and tools (**right**) across these projects to improve the human readiness of these digital systems.







LWRS Program researchers have collaborated with utility partners in support of their large-scale digital control system upgrades.

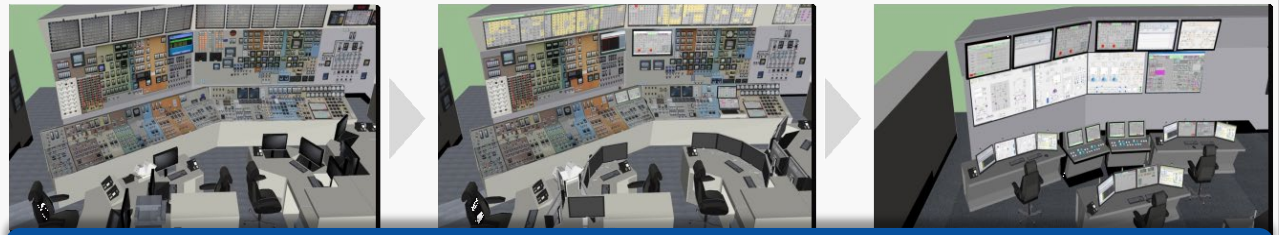
Constellation Energy Limerick Safety-Related Systems Upgrade

LWRS researchers collaborated with Constellation Energy to develop a first-of-a-kind method to accomplish HFE related verification and validation (V&V) efforts to enable use of the Alternative Review Process for safety-related I&C upgrades.

Southern Nuclear Fleet-Wide Strategic Modernization

LWRS researchers collaborated with Sargent and Lundy and Southern Nuclear to support Southern in addressing human factors considerations for their Digital Modernization Strategy.

Dominion Energy's Surry and North Anna Plant Modernization Activities



LWRS researchers collaborated with Dominion Energy to support their digital modernization activities for Surry and North Anna.

Evaluating the human element within current processes to determine the potential for digitization.

Challenge

- One reason digital innovations fail, usability aspects of work are not considered, which lead to incorrect candidate selection

Our Approach

- LWRS Program researchers created a plant-wide crowdsourcing tool that captures digital health and HTI of current work processes

	N	Frequency	Total	Duration	Digital	Workload	Reliability	Effective
Plant Database Management	4	6.00		2.75	4.50	2.75	2.75	2.50
Security Rounds	3	6.00		1.67	2.33	3.33	3.00	2.67
Operator Rounds, Log Keeping	2	6.00		3.50	4.50	3.50	2.50	2.50
Security Equipment and Zone	2	6.00		5.00	4.00	3.00	3.00	2.50
Dose Recording and Reporting	1	6.00		3.00	5.00	1.00	2.00	1.00
Testing Process	1	6.00		4.00	5.00	2.00	1.00	2.00
Plant and Department Meetings	21	5.95		3.62	3.67	2.86	2.75	2.52
Action Items Tracking	134	5.37		2.47	4.42	3.04	2.86	2.62
Lesson Plan Creation	6	5.33		4.33	4.00	3.00	2.83	3.00
Plant Radiological Surveys	3	5.33		3.33	4.00	3.33	3.00	3.00
Sampling and Monitoring	3	5.33		4.00	3.67	3.00	3.00	2.67
Plant Access Processing	4	5.25		3.50	3.50	3.25	3.00	3.00
Regulatory Interface/Commitment	4	5.25		2.50	4.00	3.00	2.75	2.50
CAP Program Administration	16	5.19		2.75	4.63	3.13	3.00	2.69
Job Briefings	13	5.08		2.31	2.54	3.31	2.92	2.69
Rad Shipping	4	5.00		4.00	4.25	3.25	3.00	3.00
Simulation	4	5.00		4.00	3.75	2.33	2.33	2.67
Employee Observation and Coach	46	4.78		2.67	4.28	3.09	2.82	2.36
Plant Drawings and References	21	4.76		2.76	4.14	2.95	2.75	2.60
Work Schedule Use and Update	47	4.55		2.92	4.40	3.04	2.83	2.60
Remote Monitoring and Sampling	4	4.50		3.50	2.75	3.00	2.50	2.50
Investigation and Evaluation	2	4.50		3.50	4.50	2.00	2.50	2.50

Color chart showing health indicator status for select work processes allowing rapid identification of digital health

Addressing AI Technology Adoption Barriers through a Human-Centered Approach.

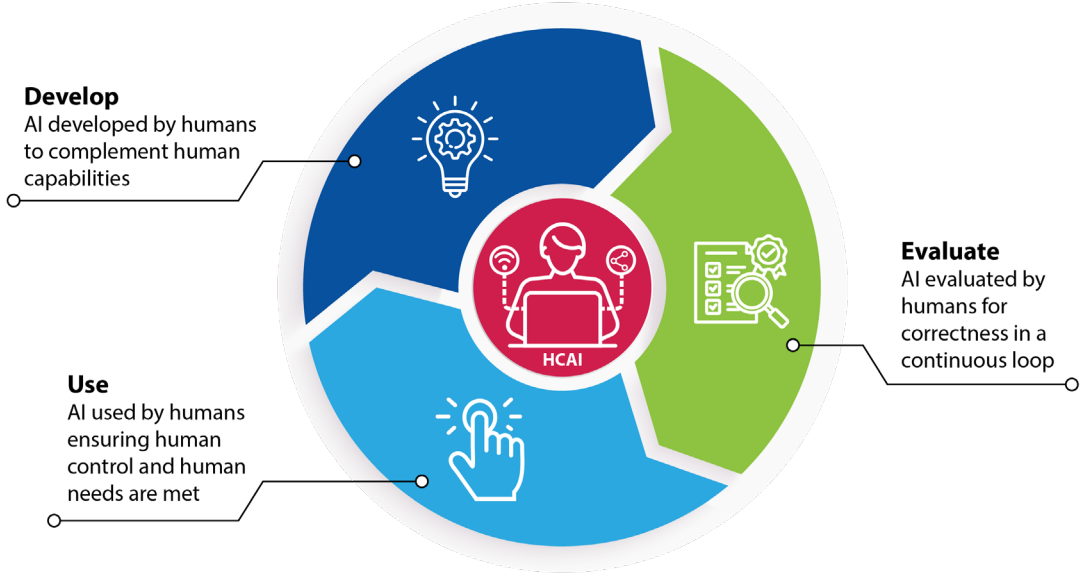
Challenge

- There have been recent advancements in the development of generative AI tools such as large language models (LLMs) for improving operational efficiency and reducing operation and maintenance costs.
- The deployment of LLMs across the nuclear industry remains a challenge due to concerns of reliability of LLMs (leading to lack of confidence and trust in their adoption) and credible business case.

Our Approach

- This research is evaluating ways to enhance the reliability, confidence, and deployment of AI tools to improve operational efficiency and reduce costs of nuclear power plants operation and maintenance.
- This research considers different technological, regulatory, and human factors aspects of enhancing LLM reliability, as well as stakeholder confidence and trust.
- The outcome of this research will accelerate the adoption, deployment, and safe use of LLMs.

Human-Centered AI Approach



Benefits

Improved Reliability	Improved Explainability	Improved Trustworthiness
Improved Stakeholder Confidence	Improved Trust	Greater Adoption

Day 3 - Session 5 – Human and Technology Integration

Thursday, December 5, 2024
10:00am – 1:00pm (EST)

Time (EST)	Topic	Speaker - Organization
10:00 - 10:05	Introduction	Casey Kovesdi, INL
10:05 - 10:30	Updates on the Limerick Safety Related Systems Upgrade Activities: Lessons Learned on Integrating Human Factors into the Engineering Upgrade Process	Scott Schumacher, Constellation
10:30 - 10:55	Human Factors Engineering Perspectives in Southern Nuclear Company's Plant Modernization Activities	Ray Herb, Southern Nuclear
10:55 - 11:20	Dominion's Plant Modernization Activities: Human Factors Multi-Stage Validation Lessons Learned	Stephen Kenney, Dominion Energy
11:20 - 11:45	Assessing Digital Opportunities: Finding Current Human Technology Integration Pain Points	Carl Golightly, Energy Northwest
11:45 - 12:10	Real-time Poll	Anna Hall, INL
12:10 - 12:30	General Q&A and Session Wrap Up	Jeffrey Joe, INL
12:30 - 01:00	Plant Modernization Stakeholder Meeting Wrap-Up	Ahmad Al Rashdan, INL
01:00	Meeting Adjourned	

Sustaining National Nuclear Assets

Add your name and email here

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