## Rancor Hybrid Energy System Microworld

## (How to design and evaluate HMIs for Nuclear Power)

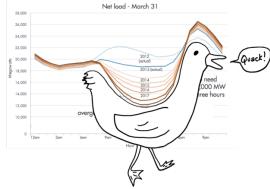
NPP Nuclear Power Plant
ConOps Concept of Operations
Ht/11 Human Machine Interface
Uof1 University of Idaho
INL Idaho National Laboratory
H55L Human Systems Simulation Laboratory
HFE Human Factors Engineer

Thomas A. Ulrich Idaho National Laboratory
Ronald L. Boring Idaho National Laboratory

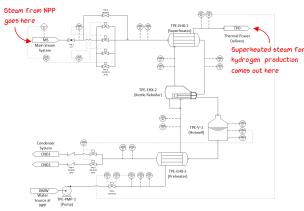
## 1. Understand the Problem

Roger Lew University of Idaho

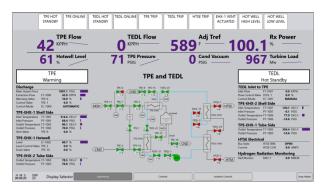
Proliferation of renewables results in too much electricity being generated during the day. Nuclear Power Plants (NPPs) can't load follow and need alternative revenue streams to remain competitive.



2. Design Hybrid Energy System for NPP. Easy, just hire some nuclear engineers.



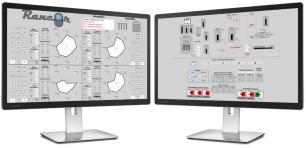
- 3. Specify ConOps and HMI requirements.
- 4. Survive Pandemic.
- 5. Design Quasi-Dynamic Prototype HMI and Procedures



2020 Supervisory HMI

- 6. Remote User Evaluation w/ Operators

  Operators walked through scenarios with a quasi-dynamic HMI over teleconferencing. We validated the basic ConOps and received lots of feedback regarding the interface and engineering design.
- 7. Utilize Rancor Microworld for Iterative Interface
  Design and Evaluation with Student Operators
  The Rancor Microworld is a dynamic simplified nuclear reactor
  simulator developed by the Uofl and INL. We implemented a
  simplified model of the hybrid energy system allowing us to
  iterate the design with students.

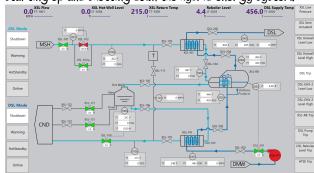


8. Implement Refined HMI in INL's HSSL's Full-scope, Full-scale, Reconfigurable Simulator.



HFE5 (yours truly) pretending to discuss something important during a photoshoot in the HSSL circa 2013.

Conduct Dynamic Scenario Testing w/ Operators
 Operators were able to complete normal and abnormal
 operating procedures but desired increased automation for
 starting up and shutting down the hybrid energy system.



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