# *Empirical Performance Data and Human Reliability Analysis*

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Idaho National Laboratory

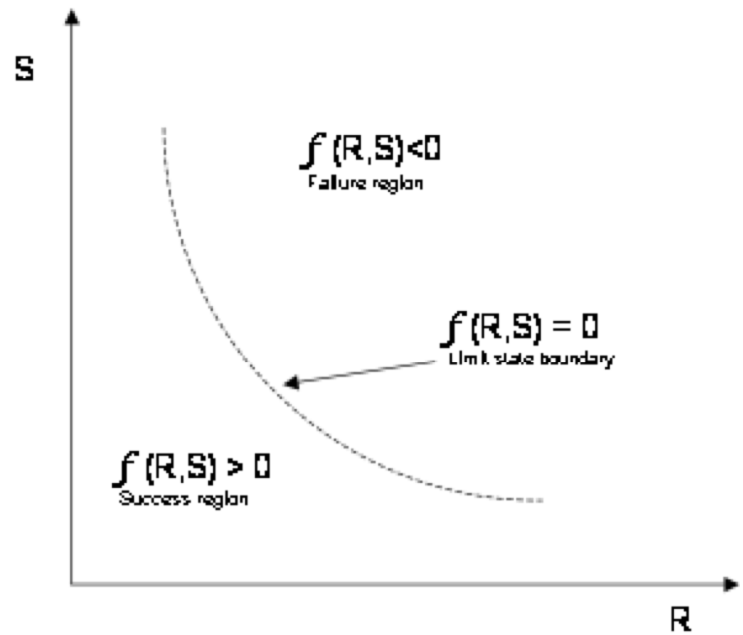
# Empirical Human Performance Data

- Refers to human performance data obtained from high fidelity simulated work performance environments.
- Includes, potentially
  - Objective performance measures (control actions)
  - Plant Parameters
  - Judgments and descriptions about performance
  - Subjective performance measures
- Need: consider the relationship between human performance and human reliability and identify how the context of simulator-based data can be used to inform and improve methods and assessments of human reliability.
- Goals:
  - Identify objectives and standards for data collection that can be used to readily obtain a sufficient volume of human performance data to strengthen the technical bases of HRA.
  - Establish a simulator data and information collection and exchange program.

# Human Performance and Human Reliability

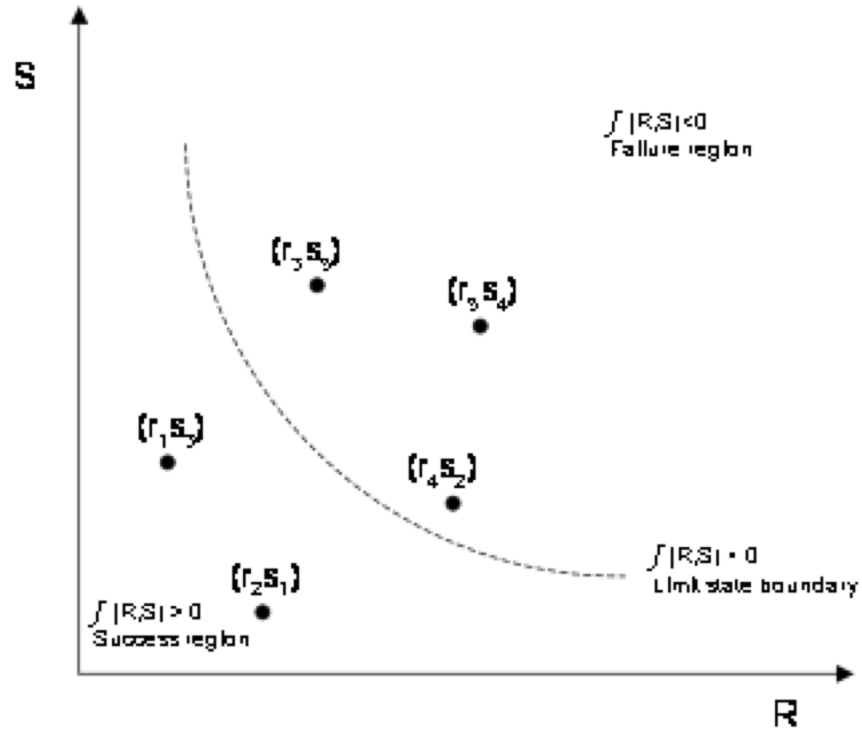
- Data on human performance are readily available in the records of training and qualification routinely conducted in simulators.
- Training is conducted to ensure or verify that crew and individual performance is within accepted standards for the position and that for foreseeable situations, it remains within the limit state.
- How can these data be used to support HRA?
- Human Reliability aims to predict:
  - Conditions
  - Feasibility
  - Probability

  …that lead to occurrences of the limit state



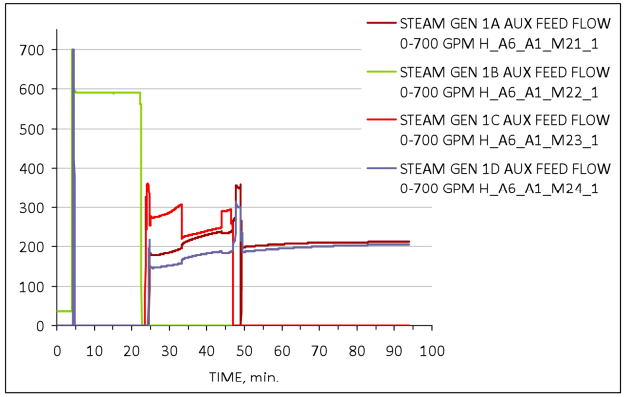
# *Data are needed*

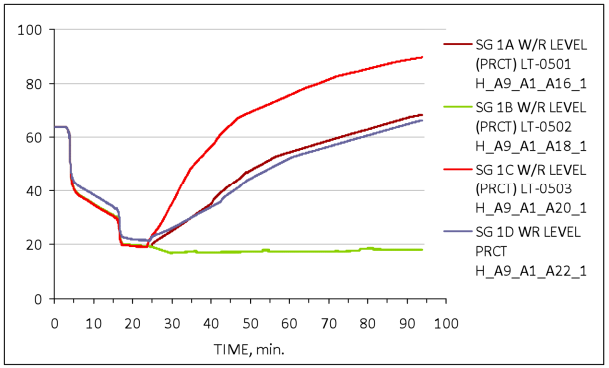
- From PRA-relevant contexts that include limit state conditions.
- These data should…
- …sample performance conditions that drive performance reliability (e.g., PSFs, PIFs, CPCs, etc.)
- …include one or more HFEs of interest
- …describe objective performance (what/when)
- …provide insights into subjective behaviors (why/how)
- …show sensitivity of plant response to human performance
- Can be used to empirically derive limit state curves for different contexts.



# *Empirical study at a U.S. Plant*

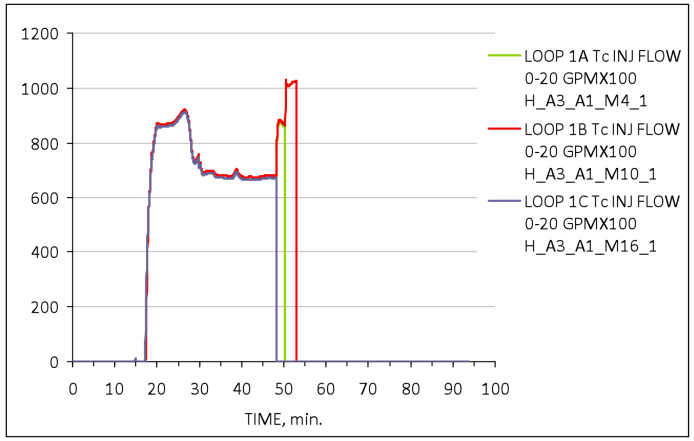
- Plant Parameters:
  - Sensitive to actions that are themselves or in part constitute the HFE
  - Illustrate the base or nominal case expected actions – “What is normal for this plant?”
  - Sensitivity runs:
    - Effects on plant parameters from the human failure event
    - Timing
    - Additional contexts and cues provided by the HFE
    - Degraded PSFs of relevance



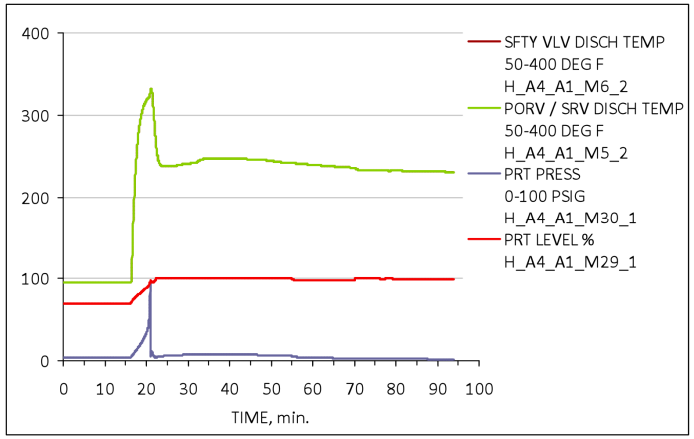



# Empirical Study at a U.S. Plant

- Objective Measures
  - Control actions that were performed
  - Acknowledgements
  - Procedures entered and in effect
  - Decision points and solution path

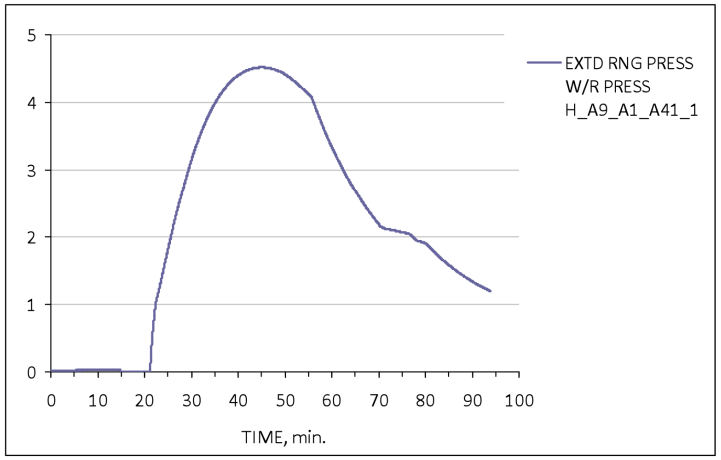


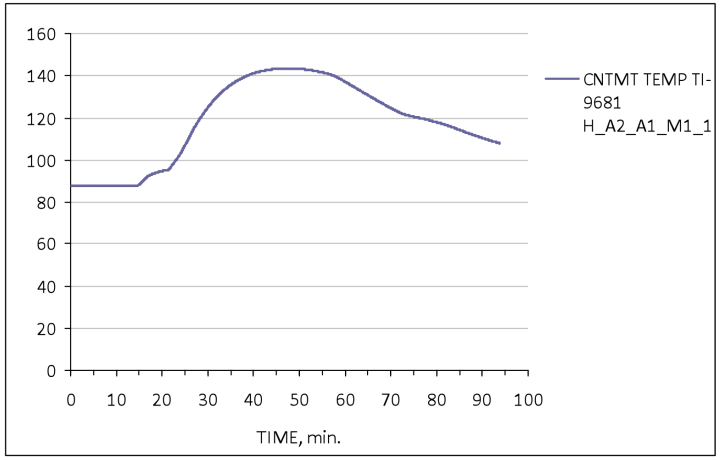

- Corroborated by event log data
- Correspond to groups of plant parameters
- Require modest interpretation



# Empirical Study at a U.S. Plant

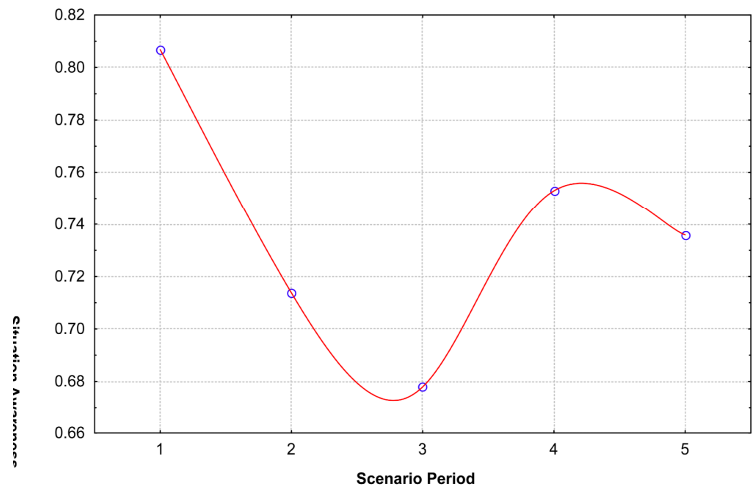
- Descriptions and Judgments of performance
  - Could be based on performance criteria reflected in the boundary conditions of the given scenario.
  - Should be related to the HFE of interest
  - Constitution of 'failures' critical
    - Not deviations
    - Not artifact of experiment
    - Differentiates recovered from unrecovered
  - Resulting analysis should relate back to the 'limit state'



# Empirical Study at a U.S. Plant

- Subjective Measures
  - Explain performance in terms of the cognition, dynamics, demonstrated abilities, and limitations of crew members.
  - Can be validated via other performance measures and self report.
  - Demonstrate psychometric properties such as reliability and validity.



# Application

- Testing qualitative and quantitative aspects of HRA methods
  - Do HRA methods demonstrate reliability
    - Comparisons of different HRA teams applying the same method to an HFE to demonstrate convergence in their estimates of likelihood.
    - Depict the same kinds of failures and driving mechanisms.
  - Do HRA methods demonstrate sensitivity
    - Do they scale to the expected complexity and difficulty of the postulated HFEs?
    - Do some methods demonstrate better sensitivity to some plant conditions and human performance than others?
- Includes intra- and inter-method comparisons.
- Data will be obtained from several PRA-relevant scenarios involving manipulation of PSFs over a range of conditions (including anticipated limit state conditions).

# *Longer term perspective*

- Interest in establishing an international working group focusing on methods and activities to support data exchange.
- Emphasis on data from relevant performance contexts that are collected according to open standards.
- Support collaborative R&D and longer-term resolution of HRA issues related to
  - Validity of underlying human performance models used in HRA
  - Improving guidance and training for HRA practitioners
  - Developing consensus regarding performance measures
  - Sustainability and advancement of PRA technologies.