

## Human Reliability

- In 1958 Williams suggested that human element reliability must be included in overall system reliability.
- In 1960 proved that human error is the cause for 20-50% of all equipment failure.
- In 1962, a database known as DATA STORE containing time and human performance reliability estimates for human engineering design features was established.
- In 1973, IEEE Transaction on reliability published a special issue on human reliability.
- In 1980, a selective bibliography on human reliability was published covering the period from 1958 to 1978.
- The first book on human reliability entitled human reliability with human factors appeared in 1986.



# Maximizing Human Reliability

- Increasingly, human reliability needs to go beyond being a diagnostic tool to become a prescriptive tool
- Nuclear industry are looking at new designs for control rooms and want plants designed with human reliability in mind, not simply verified after the design is completed
- NASA has issued strict Human-Rating Requirements (NPR 8705.2) that all space systems designed to come in contact with humans must demonstrate that they impose minimal risk, they are safe for humans, and they maximize human reliability in the operation of that system
- How do we make reliable human systems?
  - Design } "classic" human factors
  - Test
  - Model } human reliability analysis



## What are the links?

- HRA is a set of methods to describe incorrect human actions
- HRA functions in the constraint defined by PRA/PSA
- The accident sequence analyzed by PRA/PSA is typically represented as a tree
  - The action that the operator does is a node
- Each node carries probability of safety risk, goal failure etc
  Historically, HRA provides the basis for calculating this
- probability
- HEP is traditionally the sought after probability value
- HEP contains the element of human limitations, but also other environmental factors
- These other factors are called PSF







- More of an art than a science.
- OATS introduced notion of cognitive error.
- Cognitive errors typically occur after an accident/ incident has occurred.
  - Failure to detect accident event.
  - Failure to diagnose event & devise remedy.
  - Failure to implement remedy correctly.
- But shortcomings:
  - Relies on "best guesses" to fill in values for quantification curve equation.
  - Uses a single time-reliability for all cognitive activities

## Human Reliability Design Triptych



- Screen interactions that are significant to the operation and safety
- 3. Define the key influence factors necessary to complete the modeling. The model consists of a representation (e.g., qualitative model), impact assessments and quantification.
- 4. Assess the impact of significant human actions identified in the preceding steps
- Apply appropriate data or other quantification methods to assign probabilities for the various interactions examined, determine sensitivities and establish uncertainty ranges
- Report all information for getting a traceable, understandable, and reproducible assessment

#### Desian

- Compliance with applicable standards and best practices documents
  - Where applicable, ANSI, ASME, IEEE, ISO, or other discipline-specific standards should be followed
- Consideration of system usability and human factors System should be designed according to usability and human factors standards such as NASA-STD-3000, MIL-STD-1472, or ISO
- Tractability of design decisions
  - Where decisions have been made that could affect the functions of the system, these decisions should be clearly documented
- Verified reliability of design solutions
  - It is especially important to project system reliability throughout the system lifecycle, including considerations for maintenance once the system has been deployed
  - It is also important to incorporate the estimated mean time before failure into the estimated life of the system

