CRA risk analysis

IFE

Human Reliability Data for Central Control of Modern Power Stations

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Overview

Human Reliability Data for Central Control of Modern Power Stations, a review of HRA data needs and HRA data collections. Presentation of a survey done by CRA Risk Analysis and IFE for EDF Energy in the UK.

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- Background
- Key Questions Posed
- Methods Used
- Authors of the Study
- Participants
- Key Findings
- Implications for NARA
- Further Work

Background

- AGRs – Largely designed and built between 1970-1980 beginning with Dungeness B.
- Traditional hardwired alarms and panels in the Central Control Room with paper-based procedures.
- Refurbishments and plant upgrades began to incorporate greater levels of computer based interfaces and alarms.

- The introduction of modern control rooms in new station designs (e.g. HPC) are likely to introduce a significant step-change in the level of automation and digitisation.

Key Questions

The data used at EDF Energy (ENGL) for Human Reliability Assessment (HRA) using NARA are based upon data from earlier systems and may no longer be applicable.

Questions

1. What data are currently being collected from modern systems? Which exercises are planned?
2. Can this data be adapted to UK context? What are the benefits and limitations?
3. What new approaches in HRA are being used for modern systems?
4. What challenges have been encountered when undertaking HRA for modern systems?
5. What are the data needs for modern systems and are these being addressed in the international community?
6. What are the best practices for data collection?

7. **What are the implications for NARA?**

Methods

- Structured Literature Review
  - 265 literature papers collected from academic databases.
  - Additional papers collected from CRA/IFE sources.
  - 50+ literature items referenced.

- Semi-Structured Interviews
  - Conducted over 3-month period
  - 23 leading experts in HRA from industry and academia, spanning Europe, Americas and Asia.
  - Targeting primarily international community but includes UK experts.
  - Majority of experts operate in the nuclear power sector.

Participant Backgrounds

Examples:

Lloyd's Register

Idaho National Laboratory

EUROCONTROL

ELECTRIC POWER RESEARCH INSTITUTE

Korea Atomic Energy Research Institute

NUCLEAR RESEARCH INSTITUTE

PAUL SCHERRER INSTITUT

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Key Findings

1. Global Activities in HRA Data Collection (Modern Systems)
2. Publically available datasets
3. Benefits/Limitations of studies and adapting for UK context
4. Lessons learned and best practice guidance
5. Current data needs and unknowns
6. Future data collection exercises
7. Approaches used for HRQ on modern systems
8. Current challenges/considerations when undertaking HRQ.

1 - Global Activities in HRA Data Collection

- NRC – SACADA project. Joint effort with training departments to collect data in terms of cognitive functions and EPCs at task level.
- KAERI – HuREX Framework, includes conventional and modern control rooms.
- HRP – HAMMLAB, Human Performance Data Repository
- INL – HSSL laboratory and plants as part of a modernisation project. Also exploring micro-worlds to obtain larger datasets for lower-level task performance.
- China – several HRA data collection programs, largely proprietary
- EPRI – HRA User Group and HRA calculator. Modernisation projects being planned in 2019.
- UJV Rez (Czech Republic) – data collection at Temelin NPP.
- NEA – HRA data collection workshops and research.

2 - Publically Available Data

- Most data are not immediately accessible by the ‘public’, e.g. SACADA, KAERI, INL, Chinese data collection.
- HAMMLAB data are available to all Halden Project members – this includes the portion of data used in SACADA.
- Availability of data presents a significant challenge for developing and updating HRA tool. The HRAS has continued to push for greater transparency where possible.

3 - Benefits and Limitations of HRA Studies and Adaption of Data for UK Context

- SACADA is an example whereby HRA data goals can be combined with station goals (training) in order to collect meaningful amounts of data.
- Where possible, full scale simulator studies should be performed, however the scarcity of data means that other techniques should be considered for specific purposes (e.g. microworlds).

- Adaption for UK context was the most contentious issue. No majority agreement was reached as to whether data can or cannot be adapted for UK context.
- Issues such as cultural differences, contextual issues and methods to adapt data (Bayesian analyses) were discussed, with varying opinions.

4 - Lessons Learned/ Best Practices

- No combined set of international best practices were identified.
- Individual organisations have developed their own best practice guidance (e.g. HRP, KAERI) that could be used to inform an international standard.
- The HRAS may provide the best platform for such an exercise.
- Standardisation has been a key topic in the HRA community this year in order to help effectively understand if data can be used in other applications than the context it was collected for.

5 - Data Needs and Unknowns

- Understanding the new human failure mechanisms and error modes that may be introduced/ made negligible by the introduction of modern systems.
- New failure mechanisms may not necessarily be due to the technology itself, but how it is implemented.
- How will current mechanisms change numerically? Which should be prioritised for data collection?
- Examples:
  - Computerised & looping procedures.
  - New HMI and navigation differences.
  - Role of automation in fault diagnosis and other tasks.

6 - Future Data Collection Exercises

- NRC – SACADA
- EPRI
- INL
- KAERI
- HRP
- UJV Rez

- Other diverse sources of information could be considered, e.g. cyber security, rail. Petrochemical, and also UX and usability data.

7 – Approaches used for HRQ on Modern Systems

- Methods such as HuRECA, MERMOS, SPAR-H and Petro-HRA were mentioned as techniques that could be applied to modern systems.

- HuRECA/MERMOS have applicable task descriptions and data – however HuRECA data is proprietary, and MERMOS is resource intensive and may not see widespread usage.

- SPAR-H and Petro-HRA are suitable due to their broad task and EPC descriptors – but do not provide granularity that NARA utilises.

8 – Challenges when undertaking HRQ

- Obtaining a thorough understanding of the nature of tasks using modern systems and potential failure modes/EPCs.
- Task to re-define generic tasks and EPCs, particularly with the introduction of automation – therefore allocation of function will need to be reconsidered.
- Looping procedures may also lead to the need to redefine task boundaries.
- Diversity of modern systems and their configurations will be challenging, particularly as configurability will be simple and quick.
- Finding suitable data from different contexts, and the means to extrapolate/ process data from different contexts correctly.

Conclusions

- In conclusion, the pilot study was successful in eliciting information from a wide variety of HRA experts and literature and the goals of the study were met.

- Many of the conclusions provided were supported by a clear majority of participants, however debate remains as to how/if HRA techniques should be updated.

- NARA has some advantages when it comes to assessing modern systems, and therefore a targeted update appears to be the most suitable option rather than a fundamental overhaul of the method.

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