

Human and Organizational Factors during Emergency Situations: Design of EOCs and Communications during Emergencies

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Background: Emergency response in the nuclear industry is a critical function at an operating nuclear site. The lessons learned of the mitigation and response efforts at the Fukushima Daiichi accident in 2011 were largely defined by the ability of responders to act under pressure to unforeseen circumstances [1]. Human factors (HF) in emergency operations centers (EOCs) should be considered a priority when developing an emergency response program.

Objective: the objective of this research is to inform best practices for the design of an EOC. Research results will be applicable in a regulatory and design setting. The end goal of this project is to apply knowledge pertaining to leveraging human factors principles to optimize emergency response efforts from an EOC.

Emergency Operation Centre (EOC): An EOC is the centre for site decision making and communications in the instance of an emergency at a nuclear site. The goals of the EOC are to manage and recover from emergency events while ensuring nuclear safety and the safety of employed personnel, the public, and the environment.

Human Factors (HF): concerns the interactions among humans and other elements of a system and the profession that applies theory, principles, data and methods to design systems that optimize human input to system performance [2].

Year 1 (2018/2019) Conclusions:

Positions in the EOC at CNL were analyzed at a task and equipment level. Responsibilities of each position were defined.

HF considerations for members of the EOC and their applications at CNL were discussed. Considerations included:

- The importance of non-technical skills for EOC members
- Suggestions for improving information transfer and management
- Recommendations for information displays in the EOC, and role of software for events logging, shift turnover, task assignments and etc.

Year 2 (April 2019 – September 2019)

A **Human Factors Analysis** was performed on new software implemented in CNL's and the CNSC's EOC, and will serve as a benchmarking study for the research project. Concepts such as user capabilities and responsibilities, and user training programs were considered.

Benchmarking Concepts to be analyzed in Year 2

EOC Layout

- Floorplan
- Workstation Design
- Is the space reconfigurable?

Staffing Models

- Number of On-Duty Personnel
- Recruitment Strategies

Information Displays

- Number of displays
- Display capabilities
- Display design

Alert Systems

- Alarm annunciation
- Management of alerts from external groups

Software

- Capabilities
- Security
- IT involvement
- Communications

Anticipated Results

The end result of this research will be a structured set of benchmarking observations from EOCs in and outside of the nuclear industry. The observations may inform regulatory activities and the design of EOCs in the future.

Collaborations

Our research team is currently in contact with a variety of different organizations to perform benchmarking activities including: Idaho National Labs, the Calgary Emergency Management Agency, and the Emergency Preparedness group at CNL.

References:

- [1] Canadian Nuclear Safety Commission. (2016). *DIS-16-05, Human Performance*. Ottawa, ON. Retrieved from <https://nuclearsafety.gc.ca/eng/acts-and-regulations/consultation/comment/d-16-05/index.cfm>
- [2] Dul, J., Bruder, R., Buckle, P., Carayon, P., Falzon, P., Marras, W., ... van der Doelen, B. (2012). *A strategy for human factors/ergonomics: Developing the discipline and profession*. <https://doi.org/10.1080/00140139.2012.661087>

Stakeholder: CNSC (primary)



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