Human-system interfaces evaluation applied to the operation safety of control room

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A control room provides operators interaction with the nuclear plant through analog and digital interfaces. Operators observe, manipulate and interact with complex systems. In this respect, a well-designed control room and the performance of the control crew are crucial for safe and efficient operation of the plant. A control room is defined as a functional entity with an associated physical structure, where operators carry out centralized control, monitoring and administrative responsibilities [1]. Most industrial installations have one or several control rooms that function as safety critical barriers against major hazards. It is thus of vital importance that the control room and human-system interfaces (HSI) should be designed according to human factors principles. The design must be based on human-centered approach, in order to exploit the technical innovations for the optimum human–system interactions. Usability is defined as the effectiveness, efficiency and satisfaction with which specified users can achieve specified goals in particular environments [2]. Effectiveness refers to the extent to which a goal or a task is achieved. Efficiency refers to the amount of effort required to reach a goal. Satisfaction refers to the level of comfort that the users experience when using a product and how the product is acceptable to the users as a means of achieving their goals. The human-centered approach emphasizes the development of the equipment and systems with a deep understanding of the users activities, current work practices, needs and abilities of the users. An important concept of human-centered design is that the ease-of-use of the system can be ensured only if users are actively incorporated in all phases of the life cycle of design process. Representative groups of users are exposed to the system at various stages in development, in a variety of testing, evaluation and interviewing situations. The users feedback obtained is then used to refine the design with the result serving as input to the next interaction of design process. The limits of the approach are that users cannot address any particular future needs without prior experience or knowledge about the system operation. The goal is to encourage and to support work force participation in the analysis, the redesign and the evaluation of their own tasks, of the workplaces and of the work practices by applying different methods and techniques. The aim of this paper is to present a methodological framework that contributes to the design of the nuclear system and human-system interfaces, through an approach related to the operators and their activities. The framework phases are:

- Step 1: The identification of the system mission
- Step 2: The analysis of the reference system: visiting nuclear control rooms; the operational experience review
- Step 3: The analysis of the context of the new system: the characterization of the work environment; the characterization of the users population; the identification of the users needs
- Step 4: The identification and analysis of the interfaces features: the functions analysis; the function allocation; the hierarchical task analysis; the prototyping and the simulation
- Step 5: The integrated evaluation: Usability tests (Heuristic evaluations, checklists and users satisfaction questionnaire); the operators activity analysis (ethnographic study)

The methodological framework was applied to the evaluation of the human-system interfaces of two control rooms.

References

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