ALLOCATION OF FUNCTION

The expectations of the Office for Nuclear Regulation (*ONR*) with respect to the Allocation of Function, also known as the Allocation of Safety Actions, Between Human and Engineered Systems, are set out in the Safety Assessment Principles (*SAPs*). In particular EHF.2 must be considered as follows:

- **EHF.2**: When designing systems, dependence on human action to maintain and recover a stable, safe state should be minimised. The allocation of safety actions between humans and engineered structures, systems or components should be substantiated.

The allocation of safety actions is the consideration of the deployment of safety functions to personnel. The rule of thumb is to avoid placing system safety functions on humans because people are not as reliable as machines. Nevertheless, there will always be some element of a systems operation where a human has to provide an action that has potential safety consequences. It is for this reason that those actions must be fully understood and documented through systematic analysis. This is what is meant by the term 'substantiation'. The decision to allocate any safety function to human action should be thoroughly substantiated so the ONR can understand the lines of thought and mitigations considered before allocating safety actions to humans. Paragraph 445 of the SAPs provides reference to elements that require consideration when allocating safety actions and states:

"*This allocation should consider the monitoring of automatic functions and the potential need to assume manual control in the event of the failure of an automatic system*."

Additional elements to consider are provided in Paragraph 446 of the SAPs which states:

"*Where administrative safety measures are identified to deliver safety functions (see SAPs EKP.5) the guidance in Paragraphs 155 and 156 should be followed. SAPs ESS.8 and ESS.9 on safety system initiation are also relevant here*."

Note, SAP EHF.2 should be reconsidered when modifications to an existing plant are planned.

IAEA Guideline SSG-39 states:

"*…….human factor processes should be integrated into the overall design process"*

"Applicable human factor techniques include functional analysis, task analysis and workload analysis. These are used in the allocation of functions among humans and machines, and in the design of the human–machine interface. Guidance on human factor engineering is available, in particular on anthropometrics, human error, design of user interfaces and various other related subjects. To take advantage of this knowledge, systematic attention should be paid to human factors."

"*Applicable design principles or requirements for human factors should be observed to ensure compatibility with the users, comprehensibility and effectiveness of the human-machine interface. The system design process should incorporate user group feedback and appropriate measures for verification and validation of the human–machine interface. The engineering programme for human factors should be included in the overall project plan. Analyses and findings in relation to human factors should be systematically documented in the course of the engineering design, following applicable engineering guides and references to human factors*."

Further information relating to human factors and the Allocation of Function can be found in:

Pulliam et al, 'A Methodology for Allocating Nuclear Power Plant Control Functions to Human or Automatic Control' and BS EN 61839:2014 Nuclear power plants. Design of control rooms. Functional analysis and assignment, both of which provide an overview.

Jeffrey et al, 'Function Allocation for Humans and Automation in the Context of Team Dynamics' which provides a detailed look at cognitive elements that influence allocation of function between humans and automated systems in the context of team dynamics.

Additional Information & Guidance

- ONR, Safety Assessment Principles for Nuclear Facilities, 2014 Edition Revision 1 (January 2020).
- IAEA, Design of Instrumentation and Control Systems for Nuclear Power Plants (SSG-39), IAEA: Vienna, 2016.
- Pulliam R. et al. A Methodology for Allocating Nuclear Power Plant Control Functions to Human or Automatic Control. (1983) NUREG CR-3331.
- BS EN 61839:2014 Nuclear power plants. Design of control rooms. Functional analysis and assignment, November 2000.
- Jeffrey C.J., O'Hara J., Hugo J.V., Oxstrand J.H. (2015) Function Allocation for Humans and Automation in the Context of Team Dynamics. 6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the Affiliated Conferences, AHFE 2015.