

18.4 Functional Requirements Analysis and Allocation

Functional requirements and function allocation analyses are performed to establish and document design decisions with respect to level of plant automation.

Functional requirements analysis is defined as the "identification of those functions that must be performed to satisfy plant safety objectives, that is, to prevent or mitigate the consequences of postulated accidents that could cause undue risk to the health and safety of the public" (Reference 1).

Function allocation is defined as the "analysis of the requirements for plant control and the assignment of control functions to (1) personnel (e.g., manual control), (2) system elements (e.g., automatic control and passive, self-controlling phenomena), and (3) combinations of personnel and system elements (e.g., shared control and automatic systems with manual backup)" (Reference 1).

Reference 2 documents the methods and results of the functional requirements analysis and function allocation conducted for AP600.

The report provides a description of the AP600 approach to functional requirements analysis and presents the results for AP600 safety functions. The results include a description of AP600 processes, systems, and components involved in maintaining AP600 safety functions. The report also includes a similar analysis for current Westinghouse pressurized water reactor designs to serve as a reference in identifying areas where the AP600 plant differs from previous designs for which operating experience exists. An explicit comparison of the AP600 design with the reference plant design is provided that identifies plant functions, processes, and systems that are new or modified relative to the reference plant design. This includes changes in level of automation.

The report also describes the AP600 approach to initial function allocation and presents the results for AP600 safety functions. A methodology adapted from Reference 3 is used to document the rationale for initial allocation decisions and verify the acceptability of the initial allocation from a human factors perspective. The results include a specification of level of automation and personnel responsibility for AP600 safety functions, processes, and systems. The rationale for the function allocation decisions for AP600 safety functions is documented.

Since AP1000 is like AP600 in its operation and approach to safety functions, Reference 2 is directly applicable to AP1000. It is used as is for functional requirements and function allocation analyses for AP1000.

The report includes a description of human factors activities that are conducted as part of the AP600 HSI design process to verify the adequacy of function allocation decisions and establish the capability of operators to perform the role assigned to them. This is applied to AP1000 and includes:

- How human factors input is provided early in the design process
- How the integrated role of the operator across the systems is confirmed for acceptability

- Mechanisms available for reconsidering, and if necessary, changing AP1000 function allocations in response to operating experience, and the outcomes of ongoing analyses and trade studies

18.4.1 Combined License Information

This section has no requirement for additional information to be provided in support of the Combined License application.

18.4.2 References

1. NUREG-0711, "Human Factors Engineering Program Review Model," U.S. NRC, July 1994.
2. WCAP-14644, "AP600/AP1000 Functional Requirements Analysis and Function Allocation," Revision 1.
3. NUREG/CR-3331, "A Methodology for Allocation of Nuclear Power Plant Control Functions to Human and Automated Control," 1983.