

18.4 Task Analysis

The functions allocated to plant personnel define their roles and responsibilities; human actions (HA) accomplish these functions. HAs can be further divided into tasks or groups of related activities which have common objectives or goals. Task analysis (TA) identifies requirements for accomplishing these tasks; specifically, for the displays, data processing, controls, and job support aids needed to accomplish tasks. The results of the TA are identified as inputs in several activities in accordance with NUREG-0711 (Reference 1), as listed:

- Job design, and training.
- Human system interface (HSI), procedure, and training program design.
- Defining task support verification and validation criteria.

The scope and methodology for TA for the U.S. EPR are summarized in the U.S. EPR Task Analysis Implementation Plan (Reference 2).

18.4.1 Task Analysis Objectives and Scope

The objective of the U.S. EPR TA is to identify the specific tasks needed to accomplish the safety significant functions that are allocated to personnel. The TA also identifies the information, control, and support requirements for those tasks. TA is used to develop the inventory of alarms, displays, and controls necessary for operators to perform tasks, and to evaluate the number and qualifications of personnel. The scope of personnel is defined in Section 18.1.1.5.

The TA considers a full range of plant operating modes (i.e., startup, normal power, abnormal and emergency operations, as well as transient, low-power, and shutdown conditions) including selected representative and important tasks from the areas of operations, maintenance, test, inspection, and surveillance that directly support critical safety function. The TA also considers HAs that involve monitoring and backup of automatic functions. Risk important HAs are identified via the probabilistic risk assessment (PRA) Level I and II analyses (see Sections 18.6 and Chapter 19). Also included in the scope of the TA are the analyses of tasks with automated critical functions, including monitoring the automated system and executing backup actions if the system fails.

18.4.2 Task Analysis Methodology

TA is performed on functions identified during the FRA/FA process which includes the automatic actions and operator backup to the automation. A graded approach to TA coupled with a screening process is used to select functions to be subject to TA as described in the TA Implementation Plan. The requirements for accomplishing each task are identified as follows: the activity sequence, task prerequisites, operational

limitations on other trains/systems during task performance, as well as information and controls required to initiate, monitor, terminate, and verify task completion, communication requirements, operator skills, operator qualifications, and job support aids needed.

OER, FRA/FA, HRA, and system data provide input into the TA process. The TA Implementation Plan (Reference 2) provides additional detail on the identification and analysis process for tasks.

The output from TA covers system level and plant level functions for normal, abnormal (including emergency and severe accident events), and surveillance and testing activities performed by licensed and non-licensed operators. The system level TA identifies the tasks required to operate systems during each mode of operation.

The plant level TA identifies the strategy required to accomplish the plant safety and power generation goals. System-level tasks are sequenced based on plant-level strategy and functional requirements.

TA includes workload analysis to evaluate the number of crew members and the skills and qualification in the staffing and qualification assumptions against the sets of concurrent tasks required to implement plant-level operating strategies. Workload values are assigned to tasks allocated to each crew member to determine if changes are required to the initial function allocation among:

- Manual, automatic, group control.
- Shift manager, control room supervisor, licensed operator, non-licensed operator and non-operator plant personnel.
- Control room and local control.

If changes are made to the FA, the TA and workload are reassessed to confirm that the staffing and qualification assumptions remain valid.

The TA process is iterative and progressively more detailed. The results are maintained in the functional branch tree data structure which maps the plant safety objectives to individual operator tasks and plant equipment used to accomplish safety-related functions. This data structure facilitates requirement traceability as well as clearly defined outputs for other activities as follows: the design of the HSI, the plant operating procedures, and plant personnel training program.

18.4.3 Results Summary

A summary report is generated describing the scope of TA and implementation details (e.g., qualification of individuals performing analysis, out of process issues, process outputs). These outputs include:

- Identified specific tasks that are needed to accomplish the analyzed functions that are allocated to personnel covering the modes of operation.
- Information, control, and support requirements defined for each task.
- An inventory of alarms, displays, and controls necessary for operators to perform the tasks.
- Identification of risk-significant HAs and their incorporation into the design.
- Determination of necessary number and skill levels of crew members.
- Documentation of necessary changes to the crew compliment as specified in the initial staffing assumption for the U.S. EPR design.
- Allocation of monitoring and control tasks for crew members.

18.4.4

References

1. NUREG-0711, "Human Factors Engineering Program Review Model," Revision 2, U.S. Nuclear Regulatory Commission, February 2004.
2. [*U.S. EPR Task Analysis Implementation Plan, AREVA NP Inc., 2011.*]*