Staffing and Qualifications Implementation Plan

Technical Report

Non-proprietary

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1. Overview

1.1. Purpose

This document provides the implementation plan for the systematic analysis of the required staffing and qualifications (S&Q) of the operation personnel in the APR1400.

This document also describes the assumed initial S&Q of the APR1400 plant for human factors engineering (HFE) development.

1.2. Scope

The scope of S&Q analysis is defined in three aspects: positions, facilities, and operating conditions.

The positions is focused on the operation personnel who work in the main control room (MCR) or the remote shutdown room (RSR), assumed as Table 1, which satisfying the minimum requirements defined in 10 CFR 50.54m (Reference 2.1).

The facilities considered by S&Q analysis are the MCR and the RSR.

The ranges of operating conditions considered for S&Q analysis cover normal, abnormal, and emergency operating conditions as required by 10 CFR 50.54.

1.3. Acronyms

EO	electrical operator
FRA/FA	function requirements analysis and function allocation
HFE	human factors engineering
HFEPP	human factors engineering program plan
HSI	human-system interface
HVAC	heating, ventilation, and air conditioning
ITS	issue tracking system
MCR	main control room
RO	reactor operator
S&Q	staffing and qualifications
SS	shift supervisor
SRO	senior reactor operator
STA	shift technical advisor
TA	task analysis
TO	turbine operator
V&V	verification and validation

2. APPLICABLE REFERENCES

2.1 10 CFR 50.54, US Code of Federal Regulations, Part 50, Conditions of Licenses
2.2 NUREG-0711, Human Factors Engineering Program Review Model, Rev. 3
2.3 KHNP APR1400-E-J-NR-12002-P, Human Factors Engineering Program Plan
2.4 ANSI/ANS 58.8, Time Response Design Criteria for Safety-Related Operator Actions
2.5 NUREG-0800, Standard Review Plan, Rev. 6

3. METHOD

The goal of S&Q analysis is to determine the number of qualified staffs to ensure safe operation under the full range of plant conditions.

The S&Q analysis consists of three activities: 1) initial S&Q assumption, 2) S&Q analysis, 3) handling of issues related to S&Q.

3.1. Initial Staffing and Qualifications Assumption

The initial staffing level assumptions are established based on the operating experience with the reference plants and the operating experience review (OER), the function requirements analysis and function allocation (FRA/FA), utility's staffing policy, or government regulation.

The initial staffing assumption for the MCR operation personnel is five operators (i.e., shift supervisor (SS), shift technical advisor (STA), reactor operator (RO), turbine operator (TO), and electrical operator (EO)).

Four of the operators (i.e., SS, STA, RO and TO) are licensed operators, while the other operator (i.e., EO) does not require the license as a minimum requirement. This initial qualification assumption meets the minimum requirements required by 10 CFR 50.54m and Section 13.1 of NUREG-0800 (Reference 2.2).

3.2. Staffing and Qualifications Analysis

These initial assumptions are then assessed and confirmed through the analysis of the FRA/FA, task analysis (TA), treatment of important human actions (IHAs), and later validated in the integrated system validation (ISV) of the human factors verification and validation (V&V).

From TA results, assigned tasks and required qualifications for each operation staff are evaluated. The evaluations are conducted by operation experts of the APR1400.

3.3. Staffing and Qualifications Related Issues Resolution

During these evaluations, all S&Q related issues registered in the HFE issue tracking system (ITS) are reviewed and resolved following Section 4.2 of the Human Factors Engineering Program Plan (HFEPP) (Reference 2.3).

4. IMPLEMENTATION

The overall process for the S&Q analysis is represented in Figure 1.

4.1. The Initial Staffing and Qualifications Assumption

4.1.1. Assumption

The initial S&Q assumption, listed in Table 1, is used as an input to the first-time TA, human-reliability analysis (HRA), and subsequent HFE elements in the iterative process.

If no issue is raised during the design phase, this initial S&Q assumption is finalized as the final S&Q. The initial S&Q assumption will be modified if any change is determined to be required by the analysis and testing performed through the HFEPP.

4.1.2. Input

The inputs to the initial S&Q assumption include:

- NUREG-0800 Section 13.1 (Reference 2.5)
- 10 CFR 50.54m
- S&Q from the System 80+ design and the SKN 3&4 plants operating in Korea,
- Results of OER
- Staffing goals on the onset of the design process
- Utility policies
- Government regulations
- Results of FRA/FA
- Results of TA

4.1.3. Process

Bases on 4.1.2, the initial S&Q assumption, APR1400 is designed to be operated by five MCR operators.

Initial staff qualification and responsibility assumptions are:

Shift Supervisor is a licensed senior reactor operator (SRO) and plays a supervisory role for the plant operation for the duration of shift.

Safety Technical Advisor is also a licensed SRO and advises the Shift Supervisor, mainly, regarding the safety in the operation. Shift Technical Advisor may act as Shift Supervisor for the tasks that are delegated by the Shift Supervisor.

Reactor Operator is a licensed reactor operator (RO) as a minimum qualification and is responsible for the operation of the primary side of nuclear power plant, including the reactor and safety features.

Turbine Operator is a licensed RO as a minimum qualification and is responsible for the operation of the secondary side of nuclear power plant, including Feedwater System, Steam System, Turbine, Condenser System, and Instrument Air Systems.

Electric Operator, which does not require any license as a minimum qualification, is responsible for the operation of electrical systems, i.e., generator and electric distribution systems inside the plant, radiation monitoring system, and HVAC system.

The initial S&Q assumption may be modified due to the resolution from the activity in Section 4.3 or the COL applicant's staffing policy difference from the assumption. In this case, the inputs that are considered

in the initial S&Q assumptions, i.e., those listed in Section 4.1.2 should be taken into account.

Table 1. S&Q for APR1400 MCR

Position	Number of Operator	Minimum Qualification Required
Shift Supervisor	1	Senior Reactor Operator
Shift Technical Advisor	1	Senior Reactor Operator
Reactor Operator	1	Reactor Operator
Turbine Operator	1	Reactor Operator
Electric Operator	1	No License Required

4.2. Staffing and Qualifications Analysis

4.2.1. Assumption

Same as 4.1.1.

4.2.2. Input

Same as 4.1.2.

4.2.3. Process

This activity assigns the results of the initial S&Q assumptions to each position in the TA and the treatment of IHAs.

This job assignment considers the qualifications and responsibilities of operators described above and task characteristics such as the knowledge and abilities required, relationship among tasks, time required to perform the tasks, and estimated workload.

The job assignment also considers the person's ability to maintain situation awareness of the plant as well as teamwork. In the APR1400 design phase, this activity is included as a part of TA.

4.3. Handling of Issues Related to the Staffing and Qualifications

4.3.1. Assumption

The staffing analysis is performed in an iterative way. As shown in Figure 1, the initial staffing assumption may need to be modified according to the results of other HFE element's evaluation.

When staffing-related issues are raised throughout the other HFE element's activity, the issues are registered in the Issue Tracking System (ITS).

4.3.2. Inputs

The inputs to this activity are the staffing-related issues that may be raised in other HFE elements as follows:

- Functional Requirements Analysis and Function Allocation
  - Potential mismatch between functions allocated to personnel and their qualifications
- Task Analysis
  - Potential mismatch between the time needed to a task and the estimated task completion time based on the assumed staffing level
  - Too high workload to the number and qualification of crew
  - Potential mismatch between the time needed to a tasks and the estimated task

completion time from ANSI/ANS 58.8 (Reference 2.4)

- Treatment of Important Human Actions
  - Modification requested for improving the plant safety by reducing human error probability of IHAs
- Procedure Development
  - Mismatch in staffing demands resulting from requirements to concurrently use multiple procedures
  - Mismatch in personnel knowledge, abilities, and authorities identified in the procedure
- Training Program Development
  - Mismatch in the coordination of personnel that are identified during the development
- HSI Design
  - Design constraints or issues that needs to be solved by the modification of staffing level
- Procedures Development and Training Program Development
  - Staffing demands due to use of multiple concurrent procedures
  - Coordination of personnel identified during the development of the training program
- Human Factors Engineering Verification and Validation
  - Human engineering discrepancies or issues that needs to be solved by the modification of staffing level

4.3.3. Process

The identified issues found in the initial assumptions will be tracked and resolved by the process of the ITS described in Reference 2.3.

If the resolution includes modification of S&Q, the new staffing level is fed back into the initial S&Q assumption iteratively.

The modification of staffing level does not necessarily require all the HFE elements to be performed to the same extent as in the initial analyses and design activities. The scope of additional analyses and design change could be limited to the potential influence of modification

4.3.4. Output

The final S&Q of the APR1400 and job assignment to the personnel will be concluded and documented through this analysis.

Figure 1. Procedure of S&Q Analysis in the Design Phase

5. RESULTS

The results of the S&Q implementation are summarized in the S&Q Results Summary Report.