

## 17 QUALITY ASSURANCE AND RELIABILITY ASSURANCE

This chapter describes the U.S. Nuclear Regulatory Commission (NRC or Commission) staff's review of the Advanced Power Reactor 1400 (APR1400) Design Control Document (DCD), Tier 2, Chapter 17, "Quality Assurance and Reliability Assurance," Revision 2. DCD Tier 2, Chapter 17 discusses the quality assurance (QA) during the design phase, QA during the construction and operation phases, the QA program (QAP), the reliability assurance program (RAP) and the QAP description (QAPD) for the design certification (DC). It also discusses the position of Korea Hydro & Nuclear Power Company, Ltd. (KHNP), the DC applicant, regarding a combined license (COL) applicant's responsibility for developing a QAP for the construction and operations phase and a program for implementation of Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants," in Section 17.6. The QAP described in Sections 17.1, "Quality Assurance during the Design Certification Phase;" 17.2, "Quality Assurance during the Operations Phase;" 17.3, "Quality Assurance Program Description;" and 17.5, "Quality Assurance Program Description – Design Certification" of Chapter 17 of DCD Tier 2 is applicable for QA during the APR1400 standard plant design activities. The RAP described in Section 17.4 of DCD Tier 2 applies to those structures, systems, and components (SSCs) that are identified as being risk-significant or significant contributors to plant safety.

### 17.0 Quality Assurance and Reliability Assurance

no underscore

The KHNP QAP used for the APR1400 DC is described in KHNP Topical Report APR1400-K-Q-TR-11005-NP, Revision 5, "Quality Assurance Program Description (QAPD) for the APR1400 Design Certification," dated May 2, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16123A404), which was approved by the staff on October 6, 2016 (ML16265A505). Accordingly, KHNP published the accepted version of the document as Topical Report APR1400-K-Q-TR-11005-NP-A, Revision 2, for the APR1400 Design Certification (ML18085B044). The accepted version of the topical report added an "-A" (designated accepted) following the report identification number. Topical Report APR1400-K-Q-TR-11005-NP-A, Revision 2, included the changes that the NRC staff reviewed and accepted in APR1400-K-Q-TR-11005-NP, Revision 5. The KHNP QAP topical report covers the activities associated with the certification of the APR1400 design. The QAP is based on the applicable portions of both Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," and the American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA) Standard NQA-1-2008 and NQA-1a 2009 Addenda, "Quality Assurance Requirements for Nuclear Applications," relevant to the APR1400 DCD Tier 2.

### 17.1 Quality Assurance during the Design Certification Phase

#### 17.1.1 Introduction

NQA-1a-2009

The KHNP QAP for the APR1400 during the DC phase is described in APR1400 DCD Tier 2, Section 17.1. The staff reviewed Section 17.1 in accordance with Section 17.5, "Quality Assurance Program Description – Design Certification, Early Site Permit and New License Applicants," of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition" (SRP), and that evaluation is in Section 17.5 of this safety evaluation report (SER).

## Expert Panel

The staff verified that the applicant adequately described the roles, responsibilities, and qualification requirements of the expert panel and its members. The staff finds the described minimum expertise of the expert panel with knowledge of the plant design to be consistent with SRP Section 17.4, Revision 1. The staff verified, during review of the expert panel meeting minutes, that the applicant adequately implemented the RAP program requirements in the make-up of the expert panel. Based on its review as described above, the staff finds the description and implementation of the expert panel to be acceptable.

## SSC within the Scope of the Reliability Assurance Program

Overall, the staff verified that the application contained a comprehensive list of RAP SSCs based on the methodology for identifying and characterizing SSCs within the scope of the RAP. The staff audited the RAP notebook, which included the expert panel meeting minutes. Consistent with the proposed RAP program, the expert panel reviewed a combination of information, including results of probabilistic and deterministic analyses, and relied on the expert panel members' experience with the APR1400 design to account for the limitations of the PRA or SSCs not modeled in the PRA. During the audit, the staff observed that the PRA results described in APR1400 DCD, Chapter 19, identified the failure of the in-containment refueling water storage tank (IRWST) sump due to plugging to be very risk significant and, based on the applicant's methodology, should have been provided to the expert panel to be considered for inclusion in the RAP list. The applicant subsequently conducted a second expert panel to review the issue, which resulted in the IRWST sump being added to the RAP list. The staff observed that the applicant's methodology does not automatically include PRA risk important SSCs in the RAP list; rather, the expert panel reviews the RAP list and excludes SSCs from the list after documenting its rationale. The staff evaluated the replicability of this process and finds it to be reasonable because the SSCs excluded from the RAP list are very close to the risk important threshold established. In addition, these excluded SSCs are safety-related, which ensures that they will be adequately designed, procured, and constructed. This is acceptable, because the applicant applied the approach consistently and documented its basis for excluding the SSCs. The RAP list sufficiently identified the RAP SSCs and the basis for including each SSC. Consistent with SRP Section 17.4, Revision 1, the staff finds that the applicant appropriately cited the section of the DCD that describes SSC boundaries. Based on its review, as described above, the staff finds the RAP SSCs list to be acceptable.

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## Process for Determining Dominant Failure Modes

The staff verified that the application describes a proposed process for determining dominant failure modes of RAP SSCs. Consistent with guidance in SRP Section 17.4, Revision 1, the applicant's proposed process for determining dominant failure modes incorporates consideration of insights from the PRA model, analytical methods, and IOE. The process described by the applicant is consistent with the guidance for an acceptable process described in SRP Section 17.4, Revision 1, and therefore is acceptable.

## Quality Assurance Associated with Design Activities

The staff verified that the applicant specified where the QA controls for DC design activities are described. The applicant cited the specific section of the DCD that describes QA controls applied to non-safety-related RAP SSCs. The QA controls are evaluated in the staff's SER of DCD Section 17.5. These controls are consistent with staff's expectations for QA controls described in SRP Section 17.4, Revision 1, and are therefore acceptable.