

KHNPDCDRAIsPEm Resource

From: Ciocco, Jeff
Sent: Tuesday, April 19, 2016 6:53 AM
To: apr1400rai@khnp.co.kr; KHNPDCDRAIsPEm Resource; Junggho Kim (jhokim082@gmail.com); Andy Jiyong Oh; Erin Wisler
Cc: Zhang, Deanna; Zhao, Jack; Ward, William; Williams, Donna
Subject: APR1400 Design Certification Application RAI 460-8554 (07.01 - Instrumentation and Controls - Introduction)
Attachments: APR1400 DC RAI 460 ICE 8554.pdf

KHNP,

The attachment contains the subject request for additional information (RAI). This RAI was sent to you in draft form. Your licensing review schedule assumes technically correct and complete responses within 30 days of receipt of RAIs. However, KHNP requests, and we grant, 45 days to respond to this RAI. We may adjust the schedule accordingly.

Please submit your RAI response to the NRC Document Control Desk.

Thank you,

Jeff Ciocco
New Nuclear Reactor Licensing
301.415.6391
jeff.ciocco@nrc.gov



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From: Ciocco, Jeff
Created By: Jeff.Ciocco@nrc.gov

Recipients:

"Zhang, Deanna" <Deanna.Zhang@nrc.gov>
Tracking Status: None
"Zhao, Jack" <Jack.Zhao@nrc.gov>
Tracking Status: None
"Ward, William" <William.Ward@nrc.gov>
Tracking Status: None
"Williams, Donna" <Donna.Williams@nrc.gov>
Tracking Status: None
"apr1400rai@khnp.co.kr" <apr1400rai@khnp.co.kr>
Tracking Status: None
"KHNPDCDRAIsPEM Resource" <KHNPDCDRAIsPEM.Resource@nrc.gov>
Tracking Status: None
"Junggho Kim (jhokim082@gmail.com)" <jhokim082@gmail.com>
Tracking Status: None
"Andy Jiyong Oh" <jiyong.oh5@gmail.com>
Tracking Status: None
"Erin Wisler " <erin.wisler@aecom.com>
Tracking Status: None

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REQUEST FOR ADDITIONAL INFORMATION 460-8554

Issue Date: 04/19/2016
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 07.01 - Instrumentation and Controls - Introduction
Application Section: 7.1

QUESTIONS

07.01-53

Demonstrate how functional diversity is achieved in the APR1400 design to meet the requirements of 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 22.

GDC 22, "Protection system independence" states, "The protection system shall be designed to assure that the effects of natural phenomena, and of normal operating, maintenance, testing, and postulated accident conditions on redundant channels do not result in loss of the protection function, or shall be demonstrated to be acceptable on some other defined basis. Design techniques, such as functional diversity or diversity in component design and principles of operation, shall be used to the extent practical to prevent loss of the protection function." NUREG/CR-6303, "Method for Performing Diversity and Defense-in-Depth Analyses of Reactor Protection Systems" provides guidance for meeting the requirements of GDC 22 for computer-based nuclear reactor protection systems. This NUREG, section 2.6.4, "Functional Diversity," states two systems are functionally diverse if they perform different **physical** functions though they may have overlapping safety effects.

In **RAI 43-7887, Question 07.01-15**, the staff requested the applicant to describe how the requirements of GDC 22 is met for APR1400 Plant Protection System (PPS) and Core Protection Calculator System (CPCS). In the September 24, 2015 response to this RAI (ADAMS Accession No. ML15267A764), the applicant stated that, "The conformance to the requirements of IEEE Std. 603 and GDC 22 regarding independence and functional diversity is described and provided in Sections 7.2.2.3 and 7.3.2.3 as well as in Section 4.1 of Safety I&C System Technical report." The applicant proposed to revise APR1400 FSAR, Tier 2, Section 7.1.2.24 to state: "The applicable I&C systems listed in Table 7.1-1 are designed to meet the requirement of GDC 22 as described in Subsections 7.2.2.3 and 7.3.2.3 as well as in Section 4.1 of the Safety I&C System Technical Report."

The staff finds this response unacceptable. Specifically, APR1000 FSAR, Tier 2, Sections 7.2.2.3 and 7.3.2.3 address independence and Section 4.1 of the Safety I&C System Technical Report does not discuss functional diversity. Section 4.2.2.1 of Technical Report APR1400-Z-J-NR-14001, "Safety I&C System" does state that "Each BP [(bi-stable)] processes the bistable logic in the reverse order to that of the other BP for software functional diversity." However, there was no definition provided for what is meant by "software functional diversity." In accordance with NUREG/CR-6303, designing each BP such that it processes the bistable logic in reverse order does not constitute functional diversity as the BPs do not have different purposes, functions, or actuation means. Also, reversing the processing order does not count as different control logic as mentioned in section 3.2.3. Further, Technical Report APR1400-Z-J-NR-14002, "Diversity and Defense-in-Depth" only discusses functional diversity between safety I&C systems and the diverse protection system and not within the PPS or CPCS. As such, the staff requests the applicant to demonstrate how functional diversity is achieved in the design.



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