KHNPDCDRAIsPEm Resource

From:	Ciocco, Jeff
Sent:	Tuesday, February 21, 2017 6:50 AM
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Cc:	Ray, Sheila; Zimmerman, Jacob; Wunder, George; McCoppin, Michael
Subject:	APR1400 Design Certification Application RAI 540-8729 (08.02 - Offsite Power System)
Attachments:	APR1400 DC RAI 540 EEB 8729.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, 60 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,

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REQUEST FOR ADDITIONAL INFORMATION 540-8729

Issue Date: 02/21/2017
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 08.02 - Offsite Power System
Application Section:

QUESTIONS

08.02-12

In Request for Additional Information (RAI) response dated November 14, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16319A389), the applicant discussed its response to RAI 08.02-11 an open phase detection (OPD) system on the primary side of the main transformer and standby auxiliary transformers (SATs). The applicant stated that the OPD system will provide an alarm in the main control room (MCR) and send trip signals to the Class 1E switchgear buses. The applicant revised COL item 8.2(7) to state that the COL applicant is to determine the specific type of OPD system and in addition added COL item 8.2(10) for the COL applicant to provide a high-impedance ground fault detection feature that provides an alarm in the MCR. The applicant stated that the OPD system combined with the conventional protective relays in the current design ensures protection for all OPCs. However, in the analysis results of simulation for open phase conditions, the applicant states that for certain scenarios, the Class 1E undervoltage relays will not operate and there is a possibility of actuation of Class 1E degraded voltage relays.

Based on the above, the staff finds that the applicant did not provide sufficient design information concerning the automatic protective features that would be provided to transfer the offsite power circuits to Class 1E buses if they are functionally degraded due to open-phase conditions. Furthermore, the staff's review of operating reactor licensees' NRC Bulletin 2012-01, "Design Vulnerability in Electric Power System," responses and interactions with the industry representatives in various public meetings revealed that undervoltage and degraded voltage detection and protection schemes cannot detect all OPCs and mitigate the consequences of OPCs under all operating electrical system configurations and plant loading conditions.

In BTP 8-9, Position B.2.c , the NRC staff position for new reactors with active design safety features, reviewed under 10 CFR Part 50 and 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," the following criteria should be satisfied when evaluating OPCs:

"The design of protection features for OPCs should address the following:

(i) Power quality issues caused by OPCs such as unbalanced voltages and currents, sequence voltages and currents, phase angle shifts, and harmonic distortion that could affect redundant ESF buses. The ESF loads should not be subjected to power quality conditions specified in industry standards such as Institute of Electrical and Electronic Engineers (IEEE) Standard (Std) 308-2001, "Criteria for Class 1E Power Systems for Nuclear Power Generating Stations," Section 4.5, "Power Quality," with respect to the design and operation of electrical systems as indicated in Regulatory Guide (RG) 1.32 "Criteria for Power Systems for Nuclear Plants."

(ii) Protection scheme should comply with applicable requirements including single failure criteria for ESF systems as specified in 10 CFR Part 50, Appendix A, GDC17, and 10 CFR 50.55a(h)(2) or 10 CFR 50.55a(h)(3), which require compliance with IEEE Std 279-1971 "Criteria for Protection Systems for Nuclear Power Generating Stations" or IEEE Std 603-1991, "Standard Criteria for Safety Systems for Nuclear Power Generating Stations." RG 1.153, "Criteria for Power, Instrumentation, and Control Portions of Safety Systems," provides additional guidance on this topic.

If protective features are provided in a non-Class 1E system only, a failure of the non-Class 1E scheme should not preclude the onsite electrical power system from performing its safety function given a single failure in the onsite power system.

(iii) Protection scheme design should minimize misoperation, maloperation, and spurious actuation of an operable off-site power source. Additionally, the protective scheme should not separate the operable off-site power source in the range of voltage perturbations such as switching surges, load or generation variations etc., normally expected in the transmission system.

(iv) The unbalanced voltage/current conditions for ESF components expected during various operating and loading conditions should not exceed motor manufacturer's recommendations. The International Electrotechnical Commission (IEC) Standard IEC 60034-26, National Electrical Manufacturers Association (NEMA) Standard (MG 1) Parts 14.36 and 20.24, and IEEE Std. C37.96- 2012 (Guide for AC Motor Protection), Section 5.7.2.6, "Unbalanced Protection and Phase Failures," may be used for general guidance.

Technical Specification Surveillance Requirements and Limiting Conditions of Operation for equipment used for mitigation of OPCs should be identified and implemented consistent with the operability requirements specified in the plant TSs and in accordance with 10 CFR 50.36(c)(2) and 10 CFR 50.36(c)(3). RG 1.93 "Availability of Electric Power Sources," provides additional guidance on this topic."

QUESTION 1:

Describe the design features that would be provided in the event that offsite power circuit(s) is (are) functionally degraded due to open-phase conditions, and safe shutdown capability is not assured, then the safety related buses should be designed to be transferred automatically to the alternate reliable offsite power source or onsite standby power system within the time assumed in the accident analysis and without actuating any protective devices, given a concurrent design basis event. Describe how the protection features meet the criteria in BTP 8-9, B.2.c. Specifically, explain how the failure of the non-Class 1E scheme (i.e. failure of the OPD system, which is the failure of the redundant detection subsystems) does not preclude the onsite electrical power system from performing its safety function given a single failure in the Class 1E onsite system.

QUESTION 2:

IEEE Std. 603-1991 defines protective action as the initiation of a signal within the sense and command features or the operation of equipment within the execute features for the purpose of accomplishing a safety function. Furthermore, in IEEE Std. 603-1991 safety function is defined as

> "one of the processes or conditions (for example, emergency negative reactivity insertion, post-accident heat removal, emergency core cooling, post-accident radioactivity removal, and containment isolation) essential to maintain plant parameters within acceptable limits established for a design basis event. NOTE: A safety function is achieved by the completion of all required protective actions by the reactor trip system or the engineered safety features concurrent with the completion of all required protective actions by the auxiliary supporting features, or both."

In light of the above definitions, please explain how the protective actions to automatically protect the Class 1E system against OPC are in accordance with IEEE Std. 603-1991 and 10 CFR 50.55a(h)(3).


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