KHNPDCDRAIsPEm Resource

From: Ciocco, Jeff
Sent: Thursday, August 13, 2015 10:44 AM
To: KHNPDCDRAIsPEm Resource
Subject: FW: APR1400 Design Certification Application RAI 121-8050 (10.02 - Turbine Generator)
Attachments: APR1400 DC RAI 121 SPSB 8050.pdf; image001.jpg

From: Ciocco, Jeff
Sent: Monday, July 27, 2015 10:39 AM
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Subject: APR1400 Design Certification Application RAI 121-8050 (10.02 - Turbine Generator)

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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U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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REQUEST FOR ADDITIONAL INFORMATION 121-8050

Issue Date: 07/27/2015
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 10.02 - Turbine Generator
Application Section:

QUESTIONS

10.02-1

GDC 4 requires, in part, that SSCs important to safety be "designed to accommodate the effects of and to be compatible with normal operation, maintenance, testing, and postulated accidents …" According to SRP 10.2, the requirements of GDC 4 are met, as it relates to T/G speed-load control, when for normal speed-load control, the speed governor action of the electrohydraulic control system fully cuts off steam at 103 percent of rated turbine speed by closing the control and intercept valves (CVs and IVs).

DCD Tier 2, Subsection 10.2.2.3.1.1 indicates that the active speed governor closes all CVs and IVs fully at 105 percent of the turbine normal operating speed. An acceleration limiter built into the microprocessor-based controller is activated during a high load rejection. The valves are fully closed below 105 percent.

The staff finds this as a deviation from SRP subsection 10.2.III, Item 2.B to meet the GDC 4 criteria, as related to T/G speed-load control.

The applicant is requested to provide an explanation and/or justification for this non-conformance with and deviation from the above SRP guidance.

10.02-2

GDC 4 requires, in part, that SSCs important to safety be "appropriately protected against dynamic effects, including the effects of missiles …" According to SRP 10.2, the requirements of GDC 4 are met by the provision of an emergency turbine over-speed protection system (with suitable redundancy and diversity) to minimize the probability of generation of the turbine missiles. SRP, 10.2 further specifies that a mechanical overspeed trip device will actuate the control, stop, and intercept valves to close at approximately 111 percent of rated speed. The SRP also specifies that an independent and redundant backup electric overspeed trip device should actuate to close the control, stop, and intercept valves at approximately 112 percent of the turbine rated speed.

DCD Tier 2, Section 10.2.2.3 indicates there are the two electrical overspeed control systems: TCS (for normal conditions) and EOST (for emergency conditions). Both systems have dedicated triple-redundant speed sensors and are independent of each other, with separate processors and input/output modules. For each system, control signals are processed in redundant microprocessors, and these trip controllers are separate from each other.

While reviewing DCD Tier 2, Section 10.2, and the staff could not find any information on how these overspeed trips are performed and what components and subsystems are used in implementing these overspeed trip systems. Also missing is a description on how the turbine steam inlet valves and associated hydraulic fluid systems and solenoid valves function in tripping the turbine. Furthermore, there is no description on whether there are any fail-safe conditions.

In order to conform to the GDC 4 criteria, as it relates to minimizing the probability of generation of turbine missiles, the staff finds that the following additional information is needed to establish the redundancy, independency, and diversity, and single failure considerations of the TG overspeed protection systems EOST and the MOST.

The applicant is requested to:

1) Identify the turbine-generator control and overspeed protection systems

2) Provide electrical schematics and logic diagrams for the T/G control and overspeed protection systems, from the speed sensors to the Terminal Block, which is an interface between overspeed speed control and hydraulic/pneumatic fluid systems. Also, provide a detailed description of the overspeed Terminal Block and how it meets the single failure criteria described in SRP Section 10.2.III, Item 2A.

3) Provide a detailed functional performance description of the control and fluid systems in conjunction with the schematics in preventing the turbine overspeed. Further, describe how these overspeed systems conform to the above SRP guidance and meet the redundancy and independency considerations.

4) Address adequately with full justification how the APR1400 T/G subsystems and components meet the single failure considerations as described in SRP acceptance criteria Subsection10.2.II, Item 1.A.

5) Address the locations of the power sources for TGCS and EOST and whether they are isolated from and independent of each other.

10.02-3

GDC 4 requires, in part, that SSCs important to safety be "appropriately protected against dynamic effects, including the effects of missiles …" According to SRP 10.2, the requirements of GDC 4 are met by the provision of an emergency turbine over-speed protection system (with suitable redundancy and diversity) to minimize the probability of generation of the turbine missiles. The SRP also indicates that the applicant should include in-depth defense and diverse protection means to preclude unsafe turbine overspeed conditions.

DCD Tier 2, Section 10.2.2.3 describes various control systems for the APR1400 TG system for normal and abnormal operating conditions, including normal control and emergency protection systems to protect the turbine from overspeed. The DCD further describes the automatic turbine startup and shutdown (ATS) in that it receives commands from the operator using the operator interface or from a plant computer through a data link.

While reviewing DCD Tier 2, Section 10.2, the staff could not find any reference to or description of the manual turbine trip feature for the APR1400 turbine. The staff considers the manual turbine trip system as one of the diverse turbine protection systems under all modes of plant operations.

The applicant is requested to provide detailed information regarding a manual control and/or manual turbine trip system for the APR1400 TG system. Also requested is the inclusion of any hard wiring from the main control room (MCR) to the T/G unit, including a push button at the turbine pedestal.

10.02-4

In consideration to meet the GDC 4 requirements, as related to single failure criteria for the turbine control and the turbine hydraulic fluid systems, SRP Section 10.2 and NUREG-1275, "Operating experience feedback report," provides guidance to avoid the single failure impacts on the T/G operation. The turbine trip-block provides an interface between the turbine speed control systems and the turbine valve control fluid systems.

While reviewing the DCD Tier 2, Section 10.2, the staff could not find any description of the turbine trip-block, which is an interface between the turbine control systems and the turbine steam inlet valves (i.e., (MSVs, CVs, ISVs, and IVs) and associated fluid systems .

The applicant is requested to provide adequate details of this turbine trip-block and its configuration, considering the full "end-to-end," from the T/G input speed sensors to the device that eventually drains the hydraulic/air fluid from turbine steam inlet valves. In case the APR1400 uses a single trip-block for turbine overspeed control, the applicant is requested to provide:

1) The single failure criteria for the turbine overspeed protection system

2) Justification on how this satisfies the requirement for redundancy and diversity

3) Justification on how this meets the SRP guidance in SRP Subsection 10.2.III.A and the NUREG-1275 recommendation to avoid single failures in the controls and hydraulic fluid systems

Further, the staff requests that the applicant to provide detailed schematics depicting the turbine-trip block, logic diagrams between the turbine speed sensors to the turbine trip-block and fluid flow paths between the turbine steam admission valves and the fluid tank.

10.02-5

In consideration of GDC 4 requirements as to prevent vulnerabilities to avoid common mode and common cause failures (CCF) of the turbine overspeed systems to function properly, SRP and NUREG-1275 provide guidance to meet the industry experience.

While reviewing DCD Tier 2, Section 10.2, the staff could not find any details regarding the design and testing requirements to minimize or eliminate the common cause failures (CCF) in the hydraulic and air systems associated with the T/G control and protection systems, including the TG steam admission and extraction non-return valves.

The applicant is requested to address the details of the following air/hydraulic systems as they relate to turbine overspeed:

1) The electrical and fluid flow paths, shared components, failure modes, and CCF vulnerabilities.

2) A description on reliable operation of the hydraulic/air systems as associated with preventing turbine overspeed conditions.

The description of the turbine overspeed protection and fluid systems should clearly indicate what parts are shared. For example, shared air and hydraulic dump lines and components such as trip blocks, dump valves and fluid reservoirs should be described in the DCD. For clarity, the response should include schematic diagrams that show the control fluid flow paths, piping and valves being actuated (i.e., turbine stop, control, reheat stop, intercept, and extraction non-return valves).


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