RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**319-8360**
SRP Section:	**03.09.03 – ASME Code Class 1,2, and 3 Components**
Application Section:	**Section 3.9.3**
Date of RAI Issue:	**11/24/2015**

Question No. 03.09.03-5

10 CFR Part 50, Appendix A, GDC 2 and Appendix S, require that structures and components important to safety be designed to withstand the effects of earthquakes without loss of capability to perform their safety functions. One aspect of compliance with these requirements, as described in SRP Section 3.9.3, is the inclusion of energy-absorbing snubbers in the design. As stated in the acceptance criteria in SRP Section 3.9.3, Subsection II, the snubber end fitting clearance, mismatch of end fitting clearances, mismatch of activation and release rates, and lost motion should be minimized and should be considered when calculating snubber reaction loads and stress which are based on a linear analysis of the system or component. This is especially important in multiple snubber applications where mismatch of end fitting clearance has a greater effect on the load sharing of these snubbers than does the mismatch of activation level or release rate. Equal load sharing of multiple snubber supports should not be assumed if mismatch in end fitting clearance exists.

In DCD Tier 2, Section 3.9.3.4 “Component Supports” the applicant states that “where required, snubber supports are used as shock arrestors for safety-related systems and components. Snubbers are used as structural supports during a dynamic event such as an earthquake or a pipe break but during normal operation act as passive devices that accommodate normal expansions and contractions of the systems without resistance. For the APR1400, snubbers are minimized to the extent practical through the use of design optimization.”

To the extent that snubbers may be used in the detailed design of the APR1400 plant, their general design should be described in DCD Tier 2, Section 3.9.3.4. The applicant is requested to provide additional information, with a summary in the DCD, of the following snubber-related information (as well as other general information as appropriate on the snubber design):

- The snubber end fitting clearance, mismatch of end fitting clearances, mismatch of activation and release rates
- The snubber lost motion when calculating snubber reaction loads

- The load sharing, release rate when multiple snubber application are used

Response

For large bore hydraulic snubbers used for Steam Generators and Reactor Coolant Pumps, the snubber end fitting clearances between clevis pins and holes are designed and manufactured to be minimized. When a pair of snubbers is installed on a component, a mismatch of end fitting clearances may occur, but the maximum magnitude remains a tight fit that will not affect the snubber's function.

The snubber is modeled as a linear spring element whose spring rate is determined using test results (e.g., displacements and test loads). The displacements include the effects of end fitting clearances, lost motion and compression of fluid as well. Snubber reaction loads are determined from the system analysis with the spring elements.

The mismatch of the snubber action initiation velocities is required to be within 0.01 in/sec (0.25 mm/sec) of each other. This means that if one snubber in the pair locks, the other snubber will lock almost immediately and share its load evenly. The mismatch of release rates is insignificant compared to the activation level mismatch, since the loading mismatch at the end of a loading cycle is only a fraction of the maximum loads acting on the components.

The snubbers are certified by the manufacturer to meet the functional requirements of the snubber Design Specification. The snubbers are included in the inservice testing (IST) program to confirm their operability and correct installation.

This additional information on the snubbers will be summarized and added to the DCD.

Impact on DCD

DCD Tier 2 Section 3.9.3.4 will be revised as indicated in the attached markup.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environment Report.

the APR1400, snubbers are minimized to the extent practical through the use of design optimization. Insert "A" from next page.

Reasonable assurance of snubber operability is provided by incorporating analytical, design, installation, in-service, and verification criteria. The elements used to provide reasonable assurance of snubber operability for the APR1400 include:

a. Consideration of load cycles and travel that each snubber undergoes during normal plant operating conditions

b. Verification that the thermal growth rates of the system do not exceed the required lock-up velocity of the snubber

c. Accurate characterization of snubber mechanical properties in the structural analysis of the snubber-supported system

d. For engineered, large-bore snubbers, issuance of a design specification to the snubber supplier describing the required structural and mechanical performance of the snubber and verification that the specified design and fabrication requirements are met

e. Verification that snubbers are properly installed and operable prior to plant operation through visual inspection and measurement of thermal movements of snubber-supported systems during startup tests

f. A snubber in-service inspection and testing program, which includes periodic maintenance and visual inspection, inspection following a faulted event, a functional testing program, and repair or replacement of snubbers failing inspection or test acceptance criteria. The inservice testing program for snubbers is described in Subsection 3.9.6.4.

Site-specific information includes a list of all safety-related components that use snubbers in accordance with SRP 3.9.3.

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The snubber is modeled as a linear spring element whose spring rate is determined using test results between the displacements and the test loads. The displacements include the effects of end fitting clearances, lost motion and compression of the fluid as well. Snubber reaction loads are determined from the system analysis with the spring elements. The snubber end fitting clearance, mismatch of end fitting clearances and mismatch of activation are minimized especially in multiple snubber application at the same support to share loads evenly.