

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.: 287-8272
SRP Section: 09.01.02 – New and Spent Fuel Storage
Application Section: 9.1.2
Date of RAI Issue: 11/02/2015

Question No. 09.01.02-12

1. The 10 CFR Part 50, Appendix A, General Design Criteria (GDC) 1, 2, 4, 5, 63, and 10CFR 52.80 (a) provide the regulatory requirements for the design of the new and spent fuel storage facilities. Standard Review Plan (SRP) Sections 9.1.2 and 3.8.4, Appendix D describes specific SRP acceptance criteria for the review of the fuel racks that are acceptable to meet the relevant requirements of the Commission's regulations identified above. The SRP 3.8.4 Appendix D I.3 'Seismic and Impact loads' requires that "For freestanding spent fuel pool racks, which are potentially subject to sliding, uplift, and Impact between racks and with the pool walls, time-varying seismic excitation along three orthogonal directions (2 horizontal and vertical) should be imposed simultaneously". The staff did not find sufficient information regarding the input seismic time histories considered for the nonlinear seismic evaluation of the new and the spent fuel racks.

In accordance with SRP 3.8.4 Appendix D I.3, the applicant is requested to provide the following information so that the staff can perform its safety evaluation of the seismic and impact loads.

- a. Design target response spectra at the locations of new and spent fuel storage that were used to generate the synthetic time histories. Please describe the basis for selecting the target response spectra.
- b. Seeds of earthquake ground motions used to generate the synthetic time histories.
- c. The record length and the time increment of the synthetic time histories.
- d. Coefficient of correlation to verify the statistical independence of the generated artificial time histories from given target response spectra.
- e. Provide a comparison of PSD (Power Spectral Density) of original (target) with PSD developed from synthetic time histories.
- f. Clarify and confirm that the seismic excitation time histories along three orthogonal directions (2 horizontal and vertical) in the nonlinear seismic analysis are applied simultaneously.

g. Discuss the validation and verification procedure used for the computer codes ATIGEN and STCOR referenced in Table 3-5 of the report APR1400-H-N-NR-14012, Rev.0. The applicant is also requested to provide reference to operating or new nuclear power plants that have been licensed using ATIGEN and STCOR computer codes.

Response

a. Design target response spectra at the locations of new and spent fuel storage that were used to generate the synthetic time histories are as shown below. The design target response spectra are specified on the technical specification of the new and spent fuel storage racks. The damped 3% response spectra under SSE loading are used as target response spectra for the APR1400 fuel storage racks.

TS

ISRS for AB New Fuel Storage Area at 137.5',
Multiple Damping, Envelop of All 20 Cases

TS



ISRS for AB Spent Fuel Pool Bottom Slab at Elev. 114',
Multiple Damping, Envelope of All 20 Cases

- b. Generated from 10 ground motions as listed in the report APR1400-E-S-NR-14001-P. The three spatial components of artificial time histories are generated from the design target response spectra for the purpose of carrying out a time history analysis.
- c. The record length and the time increment of the synthetic time histories are 25 and 0.01 seconds, respectively.
- d. Each pair of time histories are considered to be statistically independent if the absolute value of their correlation coefficient does not exceed 0.16 in accordance with SPR 3.7.1 II. The cross correlation coefficients for acceleration-time histories are less than 0.16 indicating the desired statistical independence in three directions for time histories are met. The cross correlation coefficients for each direction are as follows:
 - New Fuel Pool : East-West to North-South = 0.0001
 East-West to Vertical = 0.0116
 North-South to Vertical = 0.0399
 - Spent Fuel Pool : East-West to North-South = -0.0092
 East-West to Vertical = -0.0211
 North-South to Vertical = -0.0263
- e. Average Power Spectral Density (PSD) function by time history data that was generated from rule of Appendix A of SRP 3.7.1 should exceed the 80% of calculated target PSD, and be applied to range 0.3Hz - 24Hz. Also, when calculating average PSD, width of ± 20% from central frequency should be included. Below figures show comparison of the average PSD with target PSD.



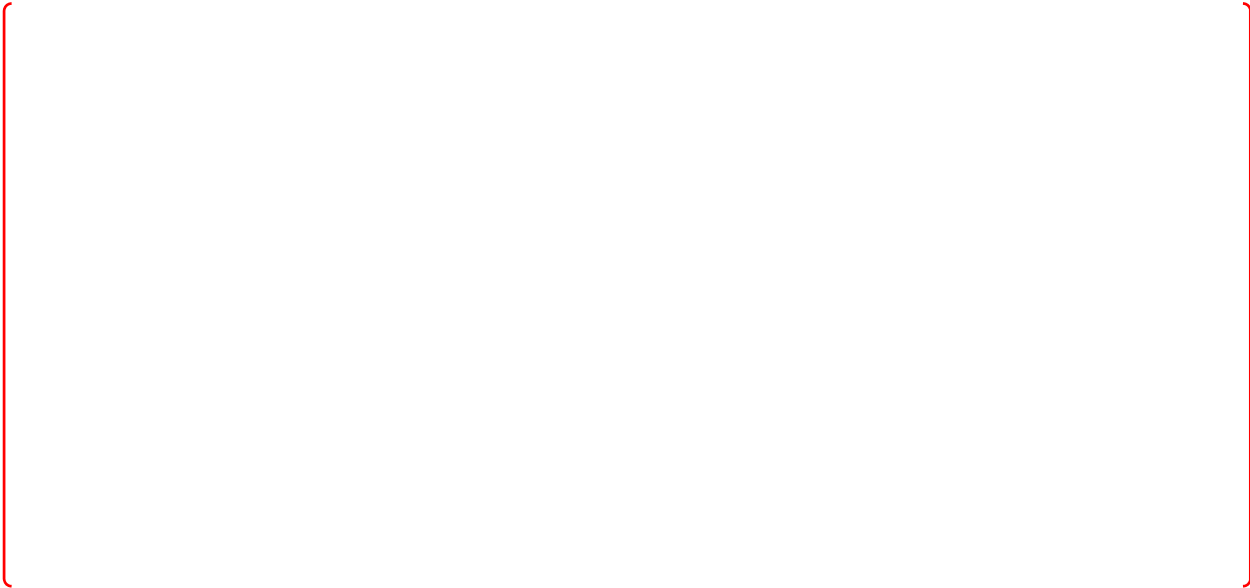
137'-6" PSD Graph (SSE, 3% Damping, E-W Direction)

TS



137'-6" PSD Graph (SSE, 3% Damping, N-S Direction)

TS



137'-6" PSD Graph (SSE, 3% Damping, Vertical Direction)

TS



114'-0" PSD Graph (SSE, 3% Damping, E-W Direction)

TS



114'-0" PSD Graph (SSE, 3% Damping, N-S Direction)

114'-0" PSD Graph (SSE, 3% Damping, Vertical Direction)

- f. Time history seismic loadings for three orthogonal directions (2 horizontal and vertical) in the nonlinear seismic analysis are applied simultaneously.
- g. Computer codes used to perform the seismic/structural analysis of the new and the spent fuel racks, namely ATIGEN and STCOR are controlled in accordance with Doosan's Quality Control Procedure, NQCP-0303. The nuclear power plants that have been licensed using ATIGEN and STCOR computer codes are Shin-Kori Units 1 and 2.

Impact on DCD

There is no impact on the DCD.

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.

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Question No. 09.01.02-44

The 10 CFR Part 50, Appendix A, General Design Criteria (GDC) 1, 2, 4, 5, 63, and 10CFR 52.80 (a) provide the regulatory requirements for the design of the new and spent fuel storage facilities. Standard Review Plan (SRP) Sections 9.1.2 and 3.8.4, Appendix D describes specific SRP acceptance criteria for the review of the fuel racks that are acceptable to meet the relevant requirements of the Commission's regulations identified above. SRP Section 3.8.4, "Other Seismic Category I Structures," Appendix D (7) in parts requires that the applicant should describe materials, quality control procedures, and any special construction techniques. In DCD Tier 2, Section 9.1.2, the staff did not find the governing quality control requirements and procedure for design and construction for the spent fuel storage racks. The staff also did not find the manufacturing process; special fabrication techniques; and the sequences used for constructing the fuel storage racks to reduce fabrication distortions and to provide accessibility for inspection. In accordance with SRP 3.8.4 Appendix D, and Appendix A to 10 CFR Part 50, General Design Criteria 1, 2, 4, 5, 61, 63, the applicant is requested to provide governing quality control requirements and procedure and any special fabrication and construction techniques used for constructing the fuel storage racks.

Response

The requirements and procedure for the design and construction of the spent fuel storage racks are as follows:

1. Quality control requirements

The quality control requirements for the fuel storage racks are in accordance with 10 CFR 50, Appendix B.

2. Quality control procedure

The quality control procedures for the spent fuel storage racks are prepared in accordance with the requirements of the codes and standards below:

- 1) ASME Boiler and Pressure Vessel Code, Section III, Div. 1, NF
- 2) ASME NQA-1
- 3) US Code of Federal Regulations, 10 CFR 50
- 4) US NRC Regulatory Guide No. 1.28

3. Special fabrication and construction techniques

Fabrication of the spent fuel racks is in accordance with the requirements of Subsection NF of Section III of the ASME B&PV Code for component supports.

Impact on DCD

There is no impact on the DCD.

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.