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Your ref: Docket No. 52-006
Our ref: DCP_NRC_002717

December 15, 2009

Subject: AP1000 Response to Request for Additional Information (SRP 12)

Westinghouse is submitting a response to the NRC request for additional information (RAI) on SRP Section 12. This RAI response is submitted in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The information included in this response is generic and is expected to apply to all COL applications referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application.

Enclosure 1 provides the response for the following RAI(s):

RAI-SRP12.3-CHPB-04

Questions or requests for additional information related to the content and preparation of this response should be directed to Westinghouse. Please send copies of such questions or requests to the prospective applicants for combined licenses referencing the AP1000 Design Certification. A representative for each applicant is included on the cc: list of this letter.

Very truly yours,

JJ DeBlasio

for/ Robert Sisk, Manager
Licensing and Customer Interface
Regulatory Affairs and Standardization

/Enclosure

1. Response to Request for Additional Information on SRP Section 12

D063
NRO

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ENCLOSURE 1

Response to Request for Additional Information on SRP Section 12

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: RAI-SRP12.3-CHPB-04
Revision: 0

Question from RAI-SRP12.3-CHPB-04:

RAI-SRP12.3-CHPB-04

AP1000 DCD Tier 2, Section 12.3.2.3, "Shielding Calculational Methods," describes specific computer codes used to determine the design and operational dose rates (and the associated radiation zones indicated on the various plant layout maps in Section 12.3) for the AP1000 nuclear island. The staff has the following request for information related to the shielding codes used and referenced in this section.

1) The point kernel code, MicroShield 4 (DCD reference 22), is described in the AP1000DCD as being a PC version with a menu-guided user interface of the mainframe calculation code QAD. Identify and/or provide a copy the document that supports the validity of this statement. Additionally, since MicroShield 4, is not available from the Radiation Safety Information Computational Center (RSICC), describe or provide the information to support verification and validation of this computer code as it is used in the AP1000 DCD dose rate calculations.

2) Describe the AP1000 Nuclear Island locations from the DCD, where the MicroShield 4 code was used to analyze dose rates and provide a description of the basis for use of the code at these locations.

3) MicroShield 4 code is an early version of commercially available program. Later versions of the MicroShield code have been developed but are not used or described in the AP1000 DCD FSAR. Please justify not using an updated version of the code when submitting Revision 17 of the AP1000 DCD.

Revise the AP1000 DCD to include the information and provide a markup in the response.

Westinghouse Response:

Following receipt of this RAI, Westinghouse has reviewed AP1000 shielding calculations and updated the DCD to reflect the software used in the most recent shielding analyses of the plant. The DCD now cites Version 6.20 of the Microshield code in Reference 22 of Section 12.3.6. A DCD revision reflecting this change is provided with this submittal, and questions 1 through 3 are answered based upon Microshield version 6.20.

1) The means through which the MicroShield code analyzes gamma radiation is described in the Microshield User's Manual (reference 1). The User's Manual describes some of the mathematical means used for point-kernel numerical

integration (Gaussian quadrature), and also displays screen shots of the program's Graphical User Interface.

MicroShield Version 6.20, although not available from RSICC, is widely used in the nuclear industry and well-suited for analyzing simple gamma radiation shielding problems within the AP1000. The software is based upon data from the ANSI standard for gamma radiation attenuation and buildup (reference 2), which are referenced by many of the codes available from RSICC.

To support the use of this code within the AP1000, Westinghouse has verified the software through a comparison between the software results and results for reference problems provided in the 1979 ANS standard (reference 3). The results and a description of the comparison are documented within the Westinghouse Validation report on MicroShield 6.20 for Windows XP Service Pack 2 (reference 4).

2) MicroShield was used extensively throughout the shielding analysis of the AP1000 Auxiliary building under normal operations. This code was selected as a suitable way to analyze non-complex radiation fields during design basis normal operating conditions based upon the utility of the code and the expected radiation fields in most areas of the plant.

   The main sources of radiation in the Auxiliary Building during normal operations are fission products associated with small cladding defects and activated corrosion product (crud) sources. In the Auxiliary Building these sources, such as spent resin, are contained within pipes or tanks, or are generally shielded within equipment or underneath water. These arrangements result in a radiation field consisting of mostly (if not solely) gamma radiation in many places. Thus, for personnel access, gamma radiation is the most significant component of the deep dose equivalent in many rooms of the Auxiliary Building.

   MicroShield was not used for radiation analysis in all rooms and in all cases. For example, in areas of the plant where either (a) a mixed radiation field existed (such as neutron or beta radiation in conjunction with gamma radiation), (b) material thicknesses and compositions preclude the use of effective buildup factors, (c) significant scattering is expected, or (d) complex geometries existed; Monte Carlo or discrete ordinate techniques were used to determine radiation zones. However, in portions of the plant where these situations did not exist, MicroShield was selected as the analysis tool of choice for determining expected radiation zones.

   In short, the use of MicroShield is consistent with its intention and technical capability for estimating dose rates from gamma radiation in non-complex geometries based upon user-defined sources.

2) The version of MicroShield used by Westinghouse in the AP1000 analysis, Version 6.20, was released in 2005. The current version of MicroShield available on the Grove Software website is version 8.02. Version 6.20 has received a thorough verification and validation by Westinghouse, and there are no known differences between version 8.02 and version 6.20 with respect to gamma radiation analysis.

References:

1. MicroShield, Version 6.20, User's Manual. Grove Engineering Inc. 2005

2. American Nuclear Society (1991). *Gamma-Ray Attenuation Coefficients and Buildup Factors for Engineering Materials* (ANSI/ANS-6.4.3-1991).

3. American Nuclear Society (1979), *American National Standard for Calculation and Measurement of Direct and Scattered Gamma Radiation from LWR Nuclear Power Plants*, (ANSI/ANS-6.6.1-1979).

4. Westinghouse Electric Company (2008), Validation of MicroShield Version 6.20 on Windows XP Service Pack 2 Platforms, (CN-REA-08-55, Revision 0).

Design Control Document (DCD) Revision:

Changes to Section 12.3.2.3, paragraph three are shown below.

> Computer codes based on point kernel and Monte Carlo methods are used to calculate gamma dose rates. Most dose rates for non-complex geometries are calculated with a point kernel code MicroShield 6.20 (Reference 22), which is a PC shielding code with a menu-guided user-interface. For complex geometries, Monte Carlo or discrete ordinate methods were used for radiation analysis. Some simplifications are made in the modeling, concerning non-active components connected to the sources, and shielding. As a rule, these simplifications result in conservative dose rate estimates, but do not significantly affect the overall evaluation of the radiological conditions in the containment. Non-homogenous sources, such as fuel assemblies, ion exchange resin beds are homogenized, where this does not underestimate the dose rates.

Changes to Section 12.3.6, Reference 22 are shown below.

22. MicroShield, Version 6.20, User's Manual. Grove Engineering Inc. 2005.

PRA Revision:
None

Technical Report (TR) Revision:
None