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Your ref: Docket No. 52-006
Our ref: DCP_NRC_002746

January 21, 2010

Subject: AP1000 Response to Proposed Open Item (Chapter 12)

Westinghouse is submitting the following responses to the NRC open item (OI) on Chapter 12. These proposed open item response are submitted in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The information included in these responses 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 proposed Open Item(s):

OI-SRP12.3-CHPB-01

Enclosure 1 contains sensitive unclassified non-safeguards information relative to the physical protection of an AP1000 Nuclear Power Plant that should be withheld from public disclosure pursuant to 10 CFR 2.390(d). Enclosure 2 provides the redacted version (public version).

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,

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

/Enclosure

D063
NRO

1. OI-SRP12.3-CHPB-01 Security Related Information – Withhold Under 10 CFR 2.390
2. OI-SRP12.3-CHPB-01 Redacted Version – Withheld Under 10 CFR 2.390

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ENCLOSURE 2

OI-SRP12.3-CHPB-01 Redacted Version – Withheld Under 10 CFR 2.390

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

RAI Response Number: OI-SRP12.3-CHPB-01
Revision: 0

Question:

In its review of DCD Section 12.3, the staff identified areas in which additional information was necessary to complete its evaluation of the applicant's change. In Tier 2 DCD Subsection 12.3.1.1.1, the staff noted that the applicants' description now includes an integrated head package which combines the head lifting rig, control and gray rod drive mechanisms, lift columns, control rod drive mechanism cooling system and power and instrumentation cabling. Also the conventional top mounted instrumentation ports/conoseal thermocouple arrangement has been replaced with a combination thermocouple /incore detector system. The description of the change to include the integrated head package does not provide sufficient information to determine if the Containment area radiation zones are affected or the implementation results in an increase or decrease in the refueling dose estimates.

In Revision 17, Tier 2, Figure 12.3-1 (Sheet 8 of 16), Radiation Zones, Normal Operation / Shutdown Nuclear Island, EL 135'-3" indicates that the RV Head stand area may be a Plant Radiation Zone V (less than or equal to 1 Rem/hr) when the RV head is in the stand, which is defined by Figure 12.3-1 (Sheet 1 of 16). In Revision 16, the same drawing indicated that the area for the RV stand would be a Plant Radiation Zone II, (less than or equal to 2.5 mrem/hr) There are no supporting calculations to show that the Integrated Head Package will result in a dose rate of less than or equal to the original RV head configuration, or how this change is ALARA.

Table 12.4-12, Dose Estimate for Refueling Activities, has not changed as a result of the addition of the design change implementing the integrated head package.

AP1000 DCA, Revision 17, incorporated the Westinghouse Topical Report APP-GW-GLE-016, Revision 0, "Impact of In-core Instrumentation Grid, Quicklocs and Changes to Integrated Head Package" This report did not describe any changes to Section 12.4 and the dose assessment.

a) Provide a complete description of the how the placement of integrated head package and the revised and associated equipment in the Containment building meets the acceptance criteria of SRP 12.3-4.

b) Describe the effect on occupational exposures in and adjacent to the Containment building. Include this information in the DCD and provide a markup of the text and appropriate revised radiation zone maps and dose estimate tables in your response.

Westinghouse Response:

AP1000 TECHNICAL REPORT REVIEW

Response to Request For Additional Information (RAI)

This response is based upon portions of the AP1000 still undergoing design finalization. Significant changes to the information in this response are not expected as a result of these efforts, however. DCD markups in response to the above are provided following this text.

The previous AP1000 integrated head package (IHP) design, described in DCD Revision 16, included in-core instrument thimbles as part of the IHP. During normal operations, these thimbles are expected to become activated, and will then be withdrawn into the IHP during refueling. The activated in-core instrument thimbles were the dominant gamma radiation source for the IHP, and had a significant impact on dose rates and personnel doses.

The current IHP design, reflected in Revision 17 of the DCD, is based upon technology in existing Combustion Engineering plants. This design does not allow in-core instrument thimbles to remain with the IHP during removal, eliminating the dominant gamma source from the IHP during refueling.

This IHP design allows the in-core instrument thimbles to stay with the reactor internals. During refueling, these components will remain underwater in the refueling cavity at all times. The water in the refueling cavity serves as a significant shield, reducing dose rates from activated in-core instrument thimbles.

As part of refueling operations, the IHP itself (without the in-core instrument thimbles) will be placed on a conventional stand inside of the containment vessel. The design of the stand includes shielding intended to minimize area radiation fields.

Responding to the NRC's questions:

a) The changes to the IHP design can be shown to meet the SRP in three specific ways. The ability of the AP 1000 design to satisfy the SRP has not been otherwise affected by this change in the IHP design.

   As stated in APP-GW-GLE-016, Revision 0, "the goal of this change is to enhance safety, facilitate reactor vessel head inspection and reduce ORE [occupational radiation exposure] during refueling outages." Thus, a primary concern addressed in the IHP design change was personnel dose during refueling. Specifically, the IHP design change to separate the in-core instrument thimbles from the IHP assembly during removal eliminates a major exposure source term on the operating floor during refueling operations. This design change meets SRP 12.3-4, Acceptance Criteria, Section 1. Facility Design Features, paragraph one by considering major exposure accumulating functions and incorporating radiation protection into the design to help maintain ORE ALARA.

Secondly, by separating the in-core instrument thimbles from the IHP, and allowing these components to be kept underwater during refueling, additional shielding of a source term is provided. This also meets SRP 12.3-4, Acceptance Criteria, Section 1. Facility Design Features, paragraph one, item (2) by providing the ability to shield the intensity of a source term.

Thirdly, as stated in APP-GW-GLE-016, Revision 0, the current IHP design "reduces both the radiation dose and number of personnel needed to service the IHP." By reducing the number of personnel servicing the IHP, SRP 12.3-4, Acceptance Criteria, Section 1. Facility Design Features, paragraph one, item (4) is satisfied.

The ability of other equipment associated with the IHP not mentioned above to meet the SRP has not been impacted by the change in the IHP design. For example, although specifics of the IHP stand have been changed to accommodate the current IHP, the stand design includes shielding to reduce exposure rates on the operating floor during refueling.

The placement of the IHP and the associated equipment within the containment vessel was designed using an ALARA approach to radiation exposure. The IHP Head Storage Stand, for example, is placed to allow individuals to perform work (inspections and maintenance) on and around the IHP during refuelings without being near other significant radioactive sources, such as RCS components. Additionally, significant sources within the IHP are shielded to reduce general area exposure rates on the operating deck.

b) The changes to the IHP design are significant with respect to occupational exposures within the shield building, and result in an overall decrease in exposure. With this decrease, the exposure values shown in the current DCD can be revised, as indicated in this response. The majority of exposures affected by the IHP design change relate to refueling operations. As described above, with the dominant gamma source term placed underwater and ALARA considerations included in the design of the IHP, refueling exposures will decrease. This was confirmed by examining a detailed job exposure model of refueling and In-Service Inspection.

Exposures outside of the shield building remain negligible, due to (a) the thickness of the shield building walls, (b) the location of the reactor vessel, and (c) the shielding on the IHP storage stand.

Details of the refueling exposure decrease are provided in this Open Item response. Detailed changes are based upon dose rates determined using Monte Carlo Neutral Particle (MCNP) Version 5 calculations of expected radiation from activated corrosion and wear products on the IHP, both as a separate component and also while in place on the Head Storage Stand. The resulting dose rates were then considered in conjunction with typical radiation levels for portions of existing Westinghouse PWRs. The analyses then considered expected tasks (including the number of workers, expected task durations, and expected locations) using Job Exposure Models. These methods were used to estimate doses for refueling and In-Service Inspection, and are consistent with the description of methods shown in the DCD, Section 12.4.1 (paragraph five).

In addition, the area under the IHP has the potential to exceed radiation zone V levels. As such, this space will be controlled as a locked High Radiation Area with the potential for dose rates to exceed 1 rem/hour, as noted in DCD Chapter 16.

The finalized DCD markups include decreases to refueling dose estimates and reactor head in-service inspection dose estimates. In addition, based on the April 7 phone call between Westinghouse and the NRC, a revised version of DCD Chapter 12, Figure 12.3-3 (Sheets 3, 7, 8, and 9 of 16) with revised notes are included in this response to ensure consistency between all sheets of Figure 12.3-3.

Reference(s):

1) APP-GW-GLE-016, Revision 0
2) NUREG-800, Revision 3, March 2007

Design Control Document (DCD) Revisions:
See the following pages for revisions to Chapter 12.

PRA Revision:
None.

Technical Report (TR) Revision:
None.

12.3.1.1.1 Common Equipment and Component Designs for ALARA

This subsection describes the design features utilized for several general classes of equipment or components. These classes of equipment are common to many of the plant systems; thus, the features employed for each system to maintain minimum exposures are similar and are presented by equipment class in the following paragraphs.

Reactor Vessel

The reactor vessel design includes an integrated head package which combines the head lifting rig, control and gray rod drive mechanism (CRDM/GRDM), lift columns, control rod drive mechanism cooling system and power and instrumentation cabling into an effective, one-package reactor vessel head design. Mounted directly on the reactor vessel head assembly, the system helps to minimize the time, manpower and radiation exposure associated with head removal and replacement during refueling. Integral in the design is permanent shielding for reducing work area dose rates from the control rod drive mechanism drive shafts~~ and thermocouple/incore detector system~~.

The ~~conventional top mounted instrumentation ports/conoseal thermocouple arrangement is replaced with a ~~combination thermocouple/incore detector system is not kept with head assembly during refueling, but instead remains with the upper internals. This allows the thermocouple/incore detector system to be shielded underwater in the refueling cavity during a majority of refueling operations, reducing dose rates around the head assembly.~~. This eliminates the need to disassemble and reassemble the instrument port conoseals at each refueling, which has historically been a relatively high radiation exposure task.~~

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Figure 12.3-3 (Sheet 3 of 16)

Radiological Access Controls, Normal Operations/Shutdown Nuclear Island, Elevation 66′-6″

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Figure 12.3-3 (Sheet 7 of 16)

Radiological Access Controls, Normal Operations/Shutdown Nuclear Island, Elevation 117′-6″

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Figure 12.3-3 (Sheet 8 of 16)

Radiological Access Controls, Normal Operations/Shutdown Nuclear Island, Elevation 135′-3″

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Figure 12.3-3 (Sheet 9 of 16)
Radiological Access Controls, Normal Operations/Shutdown Nuclear Island, Elevation 153′-0″ & 160′-6″

12.4.1.7 Overall Plant Doses

The estimated annual personnel doses associated with the six activity categories discussed above are summarized below:

Category	Percent of Total	Estimated Annual (man-rem)
Reactor operations and surveillance	~~20.6~~21.8	13.8
Routine inspection and maintenance	1~~8~~9.2~~0~~	12.1
Inservice inspection	2~~4.7~~2.7	14~~6~~.3~~6~~
Special maintenance	2~~2.4~~3.7	15.0
Waste processing	8~~7~~.2~~7~~	5.2
Refueling	4.4~~6.6~~	~~4.4~~2.8
Total	100.0	63.2~~7.1~~

These dose estimates are based on operation with an 18-month fuel cycle and are bounding for operation with a 24-month fuel cycle.

Table 12.4-6 **DOSE ESTIMATE FOR INSERVICE INSPECTION**	
Component	**Annual Dose (man-rem)**
Valve Bodies and Boltings	6.10
SG Primary Side Inspections	1.25
Reactor Vessel and Head	~~2~~0.31~~56~~
Reactor Coolant Loop Piping and Supports	1.45
SG Shell	0.12
Other Piping	2.83
Heat Exchanger Shells	0.73
Pressurizer Shell	1.20
Pumps	0.11
Tank Shells and Supports	0.15
Filter Housings and Supports	0.06
Total Dose:	1~~6~~4.3~~6~~

Table 12.4-12 **DOSE ESTIMATE FOR REFUELING ACTIVITIES**	
Refueling Operations Work Description	**Dose (man-rem)**
Preparation	0.1~~2~~
Reactor Disassembly	1.~~6~~4
Fuel Shuffle	0.~~6~~5
Reactor Reassembly	~~4.1~~2.2
Clean-Up	<0.1
Total Refueling Dose:	~~6.6~~4.2
Average Annual Dose:	(a)42.8~~.4~~

Note:
a. Based on an 18-month fuel cycle. The stated dose bounds operation with a 24-month fuel cycle.