May 2, 2007

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SUBJECT: WESTINGHOUSE AP1000 COMBINED LICENSE (COL) PRE-APPLICATION TECHNICAL REPORT 34 - REQUEST FOR ADDITIONAL INFORMATION (TAC NO. MD3648)

Dear Ms. Sterdis:

By letter dated November 17, 2006 (DCP/NRC1802), you submitted AP1000 Technical Report 34, “AP1000 Licensing Design Change Document for Generic Reactor Coolant Pump”. The Nuclear Regulatory Commission staff has reviewed the application and has determined that additional information is required. Our questions are provided in the Enclosure. We discussed these issues with your staff on March 23, 2007. Your staff indicated that you would attempt to provide your response within 30 days from the date of this letter.

Please contact me at (301) 415-2304, if you have any questions on these issues.

Sincerely,

/RA/

Michael J. Miernicki, Project Manager
AP1000 Projects Branch
Division of New Reactor Licensing
Office of New Reactors

Project No. 740

Enclosure:
Request for Additional Information

cc w/encl: See next page

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REQUEST FOR ADDITIONAL INFORMATION

APP-GW-GLN-016, TECHNICAL REPORT 34,

"AP1000 LICENSING DESIGN DOCUMENT FOR GENERIC

REACTOR COOLANT PUMP"

TR34-1 The revised Design Control Document (DCD) Section 5.4.1.2.1, "Design Description," states that the reactor coolant pump is a single stage, high-inertia, centrifugal sealless pump of either canned motor or wet winding design.... In a canned motor pump the stator and rotor are encased in corrosion-resistant cans that prevent contact of the rotor bars and statorwindings by the reactor coolant. In a wet winding motor pump the rotor is isolated from the reactor coolant while the windings are individually encased in protective insulation. Because the shaft for the impeller and rotor is contained within the pressure boundary, seals are not required to restrict leakage out of the pump into containment.... Sealless reactor coolant pumps have a long history of safe, reliable performance in military and commercial nuclear plant service."

A. In addition to the differences described above, are there other differences between a canned-motor sealless pump and a wet winding motor sealless pump? Could these differences result in the wet winding sealless pump not meeting the design bases and the reactor coolant pressure boundary safety function of the reactor coolant pumps?

B. Describe physical arrangements to show how the rotor in the wet winding motor pump is isolated from the reactor coolant, and how the stator insulation protects the stator (windings and insulation) from the reactor coolant circulating inside the motor and bearing cavity.

C. Please provide a list of examples of both the canned motor and the wet winding sealless Reactor Coolant Pump (RCP) operations in military and commercial plant service that demonstrate the long history of safe and reliable performance.

TR34-2 One of the design changes in the AP1000 reactor coolant pumps is that the thermal barrier cooling coil and wraparound heat exchanger configuration has been replaced with an externally mounted, conventional shell and tube heat exchanger and a stator cooling jacket. The revised DCD Sections 5.4.1.2.1 and 5.4.1.2.2 describe the revised motor cooling arrangement. An auxiliary impeller at the lower part of the rotor shaft circulates a controlled volume of the reactor coolant through the motor cavity, where the rotor, bearing and stator are cooled, and through an external heat exchanger where the reactor coolant is cooled to about 150°F by the component cooling water (CCW) circulating on the shell side. The CCW also circulates through a cooling jacket on the outside of the motor housing to cool the stator.

A. Provide a summary the RCP cooling design, such as the overall heat generation rate of the pump operation, heat removal capacity of the stator cooling jacket located outside of the stator, heat removal capacity of the external heat exchanger, including design flow rates and velocities on the tube and shell sides, and overall heat transfer coefficient of the heat exchanger, as well as the CCW water temperature.

B. Describe how the auxiliary impeller controls the primary coolant flow rate through the motor cavity and the external heat exchanger.

TR34-3 It is stated that the RCP flywheel design is changed because of the need to increase the minimum pump assembly rotating inertia from the current value of 16,500 lb-ft^2 to meet the pump coastdown used in the safety analyses shown in Fig. 15.3.2-1. The revised Table 5.4-1 does not specify the new minimum rotating inertia.

What is the new required minimum rotating inertia that would meet the pump coastdown rate of Figure 15.3.2-1 used in the safety analyses?

TR34-4 The revised DCD Section 5.4.1.2.1 states that "If required, the lower [flywheel] assembly is located below the motor." The revised Figure 5.4-1 includes a lower flywheel assembly. The report AP1000 RCP-06-009, "Structural Analysis Summary for the AP1000 Reactor Coolant Pump High Inertia Flywheel," dated October 19, 2006, is based on a canned motor reactor coolant pump with an upper flywheel assembly and a lower flywheel assembly of tungsten heavy alloy.

A. Clarify why it is necessary to include the qualifier "if required" and whether the AP1000 sealless pump design has a lower flywheel assembly that is incorporated into the thrust bearing assembly.

B. Clarify whether the report AP1000 RCP-06-009 is applicable to wet winding motor sealless pump designs or RCP designs without a lower flywheel. If applicable, describe the bases of this conclusion. If not applicable, describe what requirements should be specified for combined operating license applicants using a wet winding motor sealless pump design or a RCP design without a lower flywheel.

TR34-5 In Section II.1.0, "Introduction," of APP-GW-GLN-016, Revision 0, the applicant stated that, to provide primary coolant flow, the Westinghouse AP1000 nuclear plant design employs four single stage, high-inertia, centrifugal sealless pumps. The RCPs are mounted in pairs in the channel head at the bottom of the steam generators and are an integral part of the primary pressure boundary. The integration of the pump suction into the bottom of the SG channel head eliminates the cross-over leg of coolant loop piping; reduces the loop pressure drop; simplifies the foundation and support system for the SG, pumps, and piping; and reduces the potential for uncovering the core by eliminating the need to clear the loop seal during a small loss-of-coolant accident (LOCA).

The applicant is requested to provide the results of the design calculations for the simplified foundation and support system for the steam generator, pumps, and reactor coolant loop piping to demonstrate the adequacy of system and components under the seismic and dynamic (RCP-induced vibrations, etc.) loads as a result of licensing design changes for the RCP.

TR34-6 In Section 6.0, “Pump Casing Discharge Nozzle Changes,” of APP-GW-GLN-016, Revision 0, the applicant stated that stress analysis results of the current casing discharge nozzle showed that the allowable stresses were exceeded. To reduce the stresses in the casing, the wall thickness near the discharge nozzle was increased, which results in an increase (2.25 inches) in the length of the discharge nozzle.

The applicant is requested to provide the detailed summary of the stress analysis by describing the loads considered, the analysis model constructed, and the Codes and Standards used for the allowable stresses, etc., including the demonstration that the pump casing discharge nozzle design changes are acceptable for 60 years operation from the metal fatigue standpoint.

TR34-7 In Section 4.0, “Heat Exchanger Configuration,” of APP-GW-GLN-016, Revision 0, the applicant stated that a conventional shell and tube heat exchanger mounted on the pump flange has been implemented to replace the current wraparound heat exchangers; and Class 1 piping is installed to connect the heat exchanger to the inlet and outlet of the pump internal flow path.

A. The applicant is requested to demonstrate the mounting adequacy of the external heat exchangers under the seismic and dynamic (RCP-induced vibrations, etc.) loads.

B. In Section 7.0, “Reactor Coolant Pump Parameter Changes,” of APP-GW-GLN-016, Revision 0, the applicant stated that to remove the additional heat resulting from the increase in motor load, the component cooling water which circulates through the external heat exchanger and stator cooling jacket has been increased from 360 gpm to 600 gpm. The applicant is requested to demonstrate, by calculations, the adequacy of heat exchanger tubes under the flow-induced vibration loads for 60 years design life, including potential fluid-elastic instability vibration of the heat exchanger tubes.

C. The applicant is requested to demonstrate, by calculations, the adequacy of the Class 1 primary water piping from the external heat exchanger to the RCP under the design basis loads for 60 years design life including the seismic and dynamic (RCP-induced vibrations, etc.) loads.

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