ENCLOSURE 3

APP-GW-GLN-016, Revision 0

"AP1000 Licensing Design Change Document for Generic Reactor Coolant Pump"

Technical Report 34

AP1000 DOCUMENT COVER SHEET

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Document Number: APP-GW-GLN-016 **Revision Number:** 0

Title: AP1000 Licensing Design Change Document for Generic Reactor Coolant Pump

Brief Description of the change (what is being changed and why):

This report summarizes changes to the AP1000 reactor coolant pump design which have resulted from detailed design work. The major changes include:

1) The reactor coolant pump flywheel design has changed from depleted uranium to a design of bi-metallic construction. The change to a bi-metallic flywheel was necessary because the depleted uranium flywheel could not provide the inertia needed for the required pump coastdown without increasing the flywheel diameter to a size that resulted in stresses in the uranium which exceeded the design limits.

2) 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. Utilizing an external heat exchanger mounted above the pump removable assembly allows for natural circulation cooling flow through the motor when it is not running. The natural circulation capability of the external heat exchanger configuration enables the elimination of the thermal barrier cooling coils.

3) A keyphasor and additional vibration monitors have been added to the design to allow for more robust monitoring and diagnostic capability of the reactor coolant pump.

4) The pump casing configuration has been changed to relieve an overstressed condition at the casing discharge nozzle, provide sufficient access for discharge nozzle to loop piping weld inspection, and to provide additional material for flexibility in installation of the steam generators.

Reactor coolant pump descriptions in Tier 1 and Tier 2 of the AP1000 DCD have also been modified to reflect a generic sealless reactor coolant pump design, rather than a canned motor design. This will provide flexibility in selecting a specific pump design and thus increase the number of possible pump vendors.

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I. APPLICABILITY DETERMINATION

This evaluation is prepared to document that the change described above is a departure from Tier 2 information of the AP1000 Design Control Document (DCD) that may be included in plant specific FSARs without prior NRC approval.

A.	Does the proposed change include a change to:		
	1. Tier 1 of the AP1000 Design Control Document APP-GW-GL-700	☐NO ☒ YES	(If YES prepare a report for NRC review of the changes)
	2. Tier 2* of the AP1000 Design Control Document, APP-GW-GL-700	☒NO ☐ YES	(If YES prepare a report for NRC review of the changes)
	3. Technical Specification in Chapter 16 of the AP1000 Design Control Document, APP-GW-GL-700	☒ NO ☐ YES	(If YES prepare a report for NRC review of the changes)
B.	Does the proposed change involve:		
	1. Closure of a Combined License Information Item identified in the AP1000 Design Control Document, APP-GW-GL-700	☒ NO ☐ YES	(If YES prepare a COL item closure report for NRC review.)
	2. Completion of an ITAAC item identified in Tier 1 of the AP1000 Design Control Document, APP-GW-GL-700	☒ NO ☐ YES	(If YES prepare an ITAAC completion report for NRC review.)

☐ The questions above are answered no, therefore the departure from the DCD in a COL application does not require prior NRC review unless review is required by the criteria of 10 CFR Part 52 Appendix D Section VIII B.5.b or B.5.c.

II. TECHNICAL DESCRIPTION AND JUSTIFICATION

1.0 Introduction

To provide primary coolant flow, the Westinghouse AP1000 nuclear plant design employs four single stage, high-inertia, centrifugal sealless pumps. The reactor coolant pumps 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 AP1000 design requires a sealless pump design to support the passive safety approach of the AP1000. The use of sealless pumps eliminates the need for a seal injection system which requires active power systems to prevent loss-of-coolant events.

This report summarizes design changes resulting from detailed pump design and analysis work. Also, DCD text revisions have been made to change the pump description from a specific design - "canned motor pump" - to the more generic "sealless pump" description to provide flexibility in specific pump design and vendor selection.

2.0 Bi-Metallic Flywheel Design

The preliminary flywheel design employed an upper and lower flywheel assembly constructed of forged depleted uranium (DU) disks fitted to an inner stainless steel hub which was fit to the motor shaft. Structural integrity of the flywheel assemblies relied upon the strength of the depleted uranium forged disks.

The depleted uranium flywheel was designed to meet the minimum rotating inertia value, 16,500 lb-ft^2, given in the DCD, Tier 2, Table 5.4-1. As the design progressed, it was determined that this inertia value must be increased to meet the pump coastdown used in the safety analyses as given in DCD Figure 15.3.2-1.

To achieve the required inertia, the depleted uranium flywheel design required increases in length and/or diameter. However, increases in diameter resulted in stress levels beyond the design criteria limits and increases in length resulted in violation of the RCP space envelope as well as unacceptable rotordynamics.

Therefore, a revised flywheel assembly design of bi-metallic construction was developed. The design features heavy alloy annular or cylindrical segments which are machined and fitted around a central Type 403 stainless steel hub. The segments are held in place by an interference fit of an 18Ni maraging steel retainer cylinder placed over the outside of the assembly. The assembly is hermetically sealed from primary coolant by Alloy 690 endplates and an outer thin shell. Structural integrity of the flywheel assembly relies upon the stainless steel hub and the retainer cylinder. Both the upper and lower flywheels are of the same design.

The revised design has the following advantages over the uranium flywheel design:

- Provides a higher inertia per given volume (considering the depleted uranium diameter limitations required to meet stress limits) which in turn reduces the fluid frictional losses in the pump
- Inertia in the flywheel can be easily adjusted and balanced
- Structural integrity of the flywheel is dependent upon steel materials whose properties are known and better understood than the depleted uranium alloy properties

The structural analysis of the revised flywheel design, which includes a missile containment evaluation of a fractured flywheel, has been completed for the canned motor design. The calculated stresses during both normal operating conditions and design conditions are less than the applicable stress limits. Missile penetration calculations show that in the unlikely event of a flywheel facture, the flywheel assembly components will not have sufficient energy to penetrate the pump pressure boundary structures. These analyses are contained in Curtiss-Wright Electro-Mechanical Corporation Report AP1000RCP-06-009, "Structural Analysis Summary for the AP1000 Reactor Coolant Pump High Inertia Flywheel", October 2006 (Reference 3). This report supersedes the analyses of the uranium flywheel documented in WCAP-15994 Revision 1 (Reference 4).

The flywheel assembly design change has resulted in updates to the following subsections of the DCD:

- Tier 2: Appendix 1A, 5.1.3.3, 5.4.1.1, 5.4.1.2.1, 5.4.1.3.6.2, 5.4.1.6.3.3, Figure 5.4-1, Table 5.4-1

3.0 Thrust Bearing Assembly design

By increasing the inertia of the rotating assembly to maintain the pump coastdown required to support the safety analyses, the rotordynamics of the rotating assembly have been changed. To meet the rotordynamic requirements, the thrust bearing assembly has been modified from the previous configuration depicted in Tier 2, Figure 5.4-1.

The updated design incorporates the lower flywheel into the thrust bearing assembly. Two separate thrust runners are mounted with minimal clearance from the top and bottom of the lower flywheel. Upper and lower mounted thrust bearings borrow structural stiffness from the flywheel. In addition to providing acceptable and improved rotordynamics, the updated design provides the required inertia within the RCP space envelope while minimizing fluid frictional forces on the end faces of the lower flywheel.

The thrust bearing assembly design change requires updates to the following sections of the DCD:

- Tier 2: Figure 5.4-1

4.0 Heat Exchanger Configuration

The preliminary design of the reactor coolant pump dissipated heat from the motor cavity by means of internal cooling coils near the thermal barrier (thermal barrier heat exchanger) and an external heat exchanger which wrapped around the outside of the motor stator (wraparound heat exchanger). Heat removal components of the reactor coolant pump described in Tier 2 of the DCD reflect this preliminary heat removal configuration.

As the detailed design of the pump has progressed, the heat transfer requirements on the heat exchanger have increased due to increased motor power requirements and the detailed analysis of the effects of design transients on motor operation. The current heat removal requirements have resulted in significant manufacturing challenges associated with the wraparound heat exchanger design. A conventional shell and tube heat exchanger mounted on the pump flange has been implemented to replace the current wraparound heat exchanger.

The thermal barrier heat exchanger was able to be eliminated as detailed design work progressed. The thermal barrier heat exchanger was necessary to provide cooling to the upper flywheel assembly during hot standby conditions if the pump is not operating. The change to an external heat exchanger mounted above the pump promotes natural circulation when the pump is not operating. The external heat exchanger, along with the change to a flywheel design which can sustain higher operating temperatures, has eliminated the need for the thermal barrier heat exchanger. Removing the thermal barrier heat exchanger simplifies the pump design and improves the manufacturability of the component. Class 1 piping connects the heat exchanger to the inlet and outlet of the pump internal circulation flow path.

With the wraparound heat exchanger design, heat from the casing side of the stator could be removed by the heat exchanger. In the updated design this small amount of heat is removed by component cooling water circulated through a stator cooling jacket located on the outside of the stator.

The change in heat exchanger configuration will require updates to the following sections of the DCD:

- Tier 2: 5.4.1.2.1, 5.4.1.3.3, Figure 5.4-1

5.0 Instrumentation

Instrumentation of the reactor coolant pump has been modified from the preliminary design described in Tier 2 of the DCD. The following instrumentation changes have been made to provide a more robust monitoring and diagnostic capability of the reactor coolant pump:

- Addition of Keyphasor
  - The keyphasor is an electric pulse, or trigger, which is derived from a point on a rotating shaft. It serves as a zero phase reference for determining the location of imbalance on a rotor. This will aid in diagnostics in the event of high vibration indications.

- Addition of Vibration Monitors
  - Additional monitors are provided to supply measurements in two planes at two different axial locations for diagnostic purposes.

- Change in Function of Speed Sensor
  - In Tier 2, Section 5.4.1.2.1 the speed sensor is described as allowing the determination of both load and direction of rotation. In order to determine the direction of rotation multiple speed sensors would be required, however the current pump is equipped with a single speed sensor. Methods of determining both load and direction of rotation are being investigated. Motor current input and flow in the reactor coolant cold leg piping are possible indicators of these parameters. The speed sensors function will be updated to provide only the rotational speed of the pump.

The instrumentation modifications require updates to the following sections of the DCD:
- Tier 2: 5.4.1.2.1, Figures 5.4-1, 5.1-5

6.0 Casing Discharge Nozzle Changes

As a result of detailed stress analyses and evaluations of installation and in-service inspection requirements, the pump casing nominal dimension from the centerline of the suction nozzle to the end of the discharge nozzle was increased from 48.25 inches to 53.5 inches (an increase of 5.25 inches). The nominal length of the cold leg pipes decreases a corresponding 5.25 inches, such that the actual positions of the steam generator/reactor coolant pump and reactor vessel do not change.

Stress analyses 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.

Evaluation of the in-service inspection requirements of the casing discharge nozzle to cold leg piping weld showed that, to meet the current practices for the ultrasonic inspection of the weld, a straight nozzle length of at least 4.6 inches from the centerline of the weld will be required to provide an adequate mounting surface for the inspection probe.

The casing discharge nozzle design changes require updates to the following sections of the DCD:

- Tier 2: Figure 5.4-1

7.0 Reactor Coolant Pump Parameter Changes

Subsection 5.4.1.3.6.1 has been updated to provide a minimum damped natural frequency for the pump rotating assembly which is a more relevant parameter than the undamped natural frequency. The previous undamped natural frequency was defined to be at least 125% of normal operating speed, while the updated damped natural frequency design parameter is at least 120% of normal operating speed.

With more detailed design work completed for the reactor coolant pump design, Table 5.4-1 has been updated to reflect the current pump design parameters. The parameter updates are:

- 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 maximum continuous supply temperature of this component cooling water has been clarified as 95°F; however, the cooling water temperature can increase to a maximum of 110°F for a period of approximately 6 hours during plant cooldown or transients in the cooling water system.
- The reactor coolant pump voltage of 6600 V given in Table 5.4-1 was a preliminary value based on a standard NEMA motor design operating on a 6900 V bus. Since the reactor coolant pump motor is a specially designed motor with a limited space envelope, it was designed for a nominal 6900 V at the motor terminals. The motor is also designed for operation over a voltage range of +7%/- 5% from nominal for an indefinite period of time.

The reactor coolant pump parameter changes require updates to the following sections of the DCD:

- Tier 2: 5.4.1.3.6.1, Table 5.4-1

8.0 Generic Sealless Pump

The AP1000 DCD currently describes the reactor coolant pump as a "canned motor" design. This description can be found in Tier 2, Section 5.4.1.2.1:

A canned motor pump contains the motor and all rotating components inside a pressure vessel. The pressure vessel consists of the pump casing, stator closure, stator main flange,, stator shell, stator lower flange, and stator cap, which are designed for full reactor coolant system pressure. The stator and rotor are encased in corrosion-resistant cans that prevent contact of the rotor bars and stator windings by the reactor coolant. 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.

The passive safety design of the AP1000 does not require a "canned motor" pump but rather a "sealless" pump. Both wet winding and canned motor pump designs are sealless; each design encases rotating components within a pressure vessel and therefore each design restricts leakage out of the pump under operating and accident conditions.
The primary difference between the canned motor and wet winding design is that:

- In the canned motor, the rotor and stator assemblies are encased in corrosion-resistant cans that prevent contact of the rotor bars and stator windings by the reactor coolant
- In the wet winding motor, the rotor is isolated from the reactor coolant while the stator windings are individually encased in protective insulation.

The DCD reactor coolant pump descriptions have been revised to describe a more generic sealless reactor coolant pump. This enables flexibility in the selection of the specific pump design and increases the supplier base.

The following sections of the DCD have been updated to incorporate the sealless reactor coolant pump description:

- Tier 1: 2.1.2
- Tier 2: Appendix 1B, 1.2.1.2.3, 1.2.4.1, 1.9.3, 1.9.4.2.3 Issue 23, 1.9.5.1., 3.5.1.2.1.4, 3.9.2.3, 4.4.4.6, 5.1.2, 5.1.3.3, 5.4.1.1, 5.4.1.2.1, 5.4.1.2.2, 5.4.1.3.3, 5.4.1.3.4, 5.4.1.3.6.1, 5.4.1.3.6.2, 5.4.1.3.6.3, 5.4.1.3.6.4, 5.4.2.2, 5.4.2.3.3, 5.4.5.2.3, 5.4.16, 9.5.1.2.1.1, 12.3.1.1.1, 12.4.1.2, 12.4.1.4, 19.1.5, 19.59.1, 19.59.9.1, 19.59.9.2.2, Appendix 19E.2.1.2.6, Tables 1.3-1, 5.4-1, 5.4-2, 5.4-3, 9.5.1-1, Table 5.1-2

III. REFERENCES

1. APP-GW-GL-700, AP1000 Design Control Document, Revision 15
2. Design Change Proposal (DCP) APP-GW-GEE-110, Design Change Proposal for Reactor Coolant Pump Design, Revision 1
3. Curtiss-Wright Electro-Mechanical Corporation Report AP1000RCP-06-009-P (Proprietary) and AP1000RCP-06-009-NP (Non-Proprietary), "Structural Analysis Summary for the AP1000 Reactor Coolant Pump High Inertia Flywheel," October 2006.
4. WCAP-15994 Revision 1, "Structural Analysis Summary for the AP1000 Reactor Coolant Pump High Inertia Flywheel," March 2003.

IV. DCD MARK-UP

The following changes to the AP1000 DCD Revision 15 are necessary to incorporate the changes in reactor coolant pump design.

Impacted DCD Sections

Tier 1

Subsections 2.1.2

Tier 2

Tables 1.3-1, 5.1-2, 5.4-1, 5.4-2, and 5.4-3; and 9.5.1-1

Figure 5.1-5, 5.4-1
Appendix 1A Conformance with Regulatory Guides
Appendix 1B Severe Accident Mitigation Design Alternatives

Appendix 19E.2.1.2.6
Subsections 1.2.1.2.3, 1.2.4.1, 1.9.3, 1.9.4.2.3 Issue 23, 1.9.5.1.6, 3.5.1.2.1.4, 3.9.2.3, 4.4.4.6, 5.1.2, 5.1.3.3, 5.4.1.1, 5.4.1.2.1, 5.4.1.2.2, 5.4.1.3.3, 5.4.1.3.4, 5.4.1.3.6.1, 5.4.1.3.6.2, 5.4.1.3.6.3, 5.4.1.3.6.4, 5.4.2.2, 5.4.2.3.3, 5.4.5.2.3, 5.4.16, 9.5.1.2.1.1, 12.3.1.1.1, 12.4.1.2, 12.4.1.4, 19.1.5, 19.59.1, 19.59.9.1, 19.59.9.2.2

Tier 1

Revise Subsection 2.1.2 as follows:

2.1.2 Reactor Coolant System
Design Description

The reactor coolant system (RCS) removes heat from the reactor core and transfers it to the secondary side of the steam generators for power generation. The RCS contains two vertical U-tube steam generators, four ~~canned motor~~ sealless reactor coolant pumps (RCPs), and one pressurizer.

Tier 2

Revise Bullet in Subsection 1.2.1.2.3 as follows:

1.2.1.2.3 Reactor Coolant Pump Design

- ~~Hermetically sealed~~Sealless ~~canned~~ pumps of proven design are employed.

Revise paragraph in Subsection 1.2.4.1 as follows:

1.2.4.1 Containment Building
Equipment Arrangement

The principal system located within the containment building is the reactor coolant system that consists of two main coolant loops, a reactor vessel, two steam generators, four ~~canned motor~~sealless reactor coolant pumps, and a pressurizer. Figures 1.2-9, 1.2-14 and 1.2-16 depict the reactor coolant system component locations in the containment.

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Revise Table 1.3-1 as follows:

Table 1.3-1 (Sheet 2 of 6)

AP1000 PLANT COMPARISON WITH SIMILAR FACILITIES

Systems – Components	DCD	AP1000	AP600	Reference 2 Loop
Reactor Vessel	5.3			
Vessel ID		159 in	157 in	172 in
Construction		forged rings	forged rings	welded plate
Number hot leg nozzles		2	2	2
– ID		31.0 in	31.0 in	42 in
Number cold leg nozzles		4	4	4
– ID		22.0 in	22.0 in	30 in
Number safety injection nozzles		2	2	0
Steam Generators	5.4.2			
Type		Vertical U-tube Recirc. design	Vertical U-tube Recirc. design	Vertical U-tube Recirc. design
Model		Delta-125	Delta-75	–
Number		2	2	2
Heat transfer area/SG		125,000 ft^2	75,180 ft^2	103,574 ft^2
Number tubes/SG		10,000	6,307	9,300
Tube material		I 690 TT	I 690 TT	I 600 TT
Separate startup feedwater nozzle		Yes	Yes	No
Reactor Coolant Pumps	5.4.1			
Type		~~Canned~~sealless	canned	shaft seal
Number		4	4	4
Rated HP		~~6,000~~7,300 hp/pump	≤3,500 hp/pump	9,700 hp/pump
Estimated flow/loop		150,000 gpm	102,000 gpm	198,000 gpm

Revise paragraph in subsection 1.9.3 as follows:

1.9.3 Three Mile Island Issues

(1)(iii) Reactor Coolant Pump Seals (NUREG-0737 Items II.K.2.16 and II.K.3.25)

"Perform an evaluation of the potential for and impact of reactor coolant pump seal damage following small-break loss of coolant accident with loss of offsite power. If damage cannot be precluded, provide an analysis of the limiting small-break loss of coolant accident with subsequent reactor coolant pump seal damage."

AP1000 Response:

The AP1000 design uses ~~canned~~ sealless ~~motor~~ pumps for circulating primary reactor coolant through the reactor core, piping, and steam generators. In the sealless design all rotating components are enclosed inside a pressure vessel, therefore no seal~~The canned motor pump design does not have a seal that~~ can fail and initiate reactor coolant system leakage.

1.9.4.2.3 Issue 23 Reactor Coolant Pump Seal Failures

Discussion:

Generic Safety Issue 23 addresses reactor coolant pump seal failures that challenge the makeup capacity in PWRs. Such seal failures represent small-break loss-of-coolant accidents.

AP1000 Response:

The AP1000 reactor coolant pumps are ~~canned~~ sealless ~~motor~~ pumps. A ~~canned~~ sealless ~~motor~~ pump contains the motor and all rotating components inside a pressure vessel designed for full reactor coolant system pressure. The shaft for the impeller and rotor is contained within the pressure boundary; therefore, seals are not required in order to restrict leakage out of the pump into containment. Subsection 5.4.1 provides additional information on the ~~canned~~ sealless ~~motor~~ pump design for the AP1000 reactor coolant pumps. Since the reactor coolant pumps do not rely on seals as a reactor coolant pressure boundary, this issue is not applicable to the AP1000.

1.9.5.1.6 Fire Protection

AP1000 Response:

- The in-containment fire area contains reduced combustible material due to the use of ~~canned~~ sealless reactor coolant pump motors that do not use oil lubrication and due to strict combustible material limitations.

Revise the Appendix 1.A, Reg. Guide 1.14, Rev. 1, 8/75 – Reactor Coolant Pump Flywheel Integrity

Section	Criteria	Referenced Criteria	Position	AP1000 Clarification/Summary Description of Exceptions
Reg. Guide 1.14, Rev. 1, 8/75 – Reactor Coolant Pump Flywheel Integrity				
1.a	ASTM A.20		Exception	The flywheel is made of a of bi-metallic design. Heavy alloy segments are fitted to a stainless steel hub and if necessary held in place by a retaining ring~~depleted uranium casting of high quality~~. Therefore, the specific guidelines in this section are not directly applicable to the AP1000.
1.b			Exception	~~The test methods used to verify the fracture toughness of the uranium casting are not the same as those required in material specifications for steel such as Charpy V-notch and upper shelf energy determinations~~Fracture toughness and tensile properties are checked for components which are required for structural integrity of the bi-metallic flywheel.
1.c			N/A	This guideline is not applicable to ~~uranium castings~~the flywheel assembly. Therefore, the guideline is not applicable to the AP1000 ~~canned-motor pump~~reactor coolant pump.
1.d			Conforms	The ~~uranium casting~~ components of the flywheel which are relied upon for structural integrity requires no welding. ~~The enclosure is welded using specifications meeting ASME Code requirements. The enclosure, including the welds, are considered in the analysis of potential missiles.~~
2.a-b			Conforms	
2.c-e	ASME Code, Section III		Exception	The limits and methods of ASME Code, Section III, Paragraph F-1331.1(b), (replacement for Paragraph F-1323.1) are not directly applicable to ~~a uranium casting~~the flywheel assembly. The calculated stress levels in the flywheel are evaluated against the ASME Code, Section III, Subsection NG stress limits used as guidelines and

			the recommended stress limits in Positions 4.a and 4.c of the Standard Review Plan 5.4.1.1.
2.f		Exception	The calculated stress levels in the flywheel satisfy the ASME Code, Section III, Subsection NG stress limits used as guidelines and the recommended stress limits in Position 4.a of the Standard Review Plan 5.4.1.1.
2.g		Conforms	
3		Conforms	
4.a	ASME Code, Section III, NB-2545 or NB-2546, NB-2540, NB-2530	Exception	The inspections and guidelines referenced in the regulatory guide were developed for steel flywheels in shaft seal pumps. The paragraphs of Subsection NB referenced in the regulatory guide only apply to forged and plate steel components. The bi-metallic flywheel design will be manufactured using multiple processes and materials. In accordance with the regulatory guide each structural component of the bi-metallic flywheel will be inspected prior to final assembly according to its fabrication and the procedures outlined in Section III, NB-2500 of the ASME Code. Inspection of the flywheel assembly inside the ~~flywheel assembly~~sealed enclosure following a spin test is not practical. ~~The ultrasonic inspection of the flywheel prior to final assembly is in conformance with the requirements of the ASME Code, Section III, paragraph NB-2574, for ferritic steel castings, including the use of the procedures outlined in SA-609 (ASTM-A-609). Machined surfaces of the uranium flywheel undergo liquid penetrant inspection prior to final assembly. The liquid penetrant inspection conforms with the requirements of the ASME Code, Section III, paragraph NB-2576, including the use of the procedures outlined in SA-165 (ASTM-A-165).~~
4.b	ASME Code, Section XI	Exception	Inservice inspection of the flywheel assembly is not required to support safe operation of the ~~canned motor~~ reactor coolant pump. Planned, routine inspections of the flywheel assembly requires considerable occupational radiation exposure and are not recommended. Inservice inspection of the ~~uranium casting~~ flywheel assemblies requires extensive disassembly. Postulated missiles from the failure of the flywheel are contained within the stator shell and the pressure boundary is not breached. Vibration of the shaft due to a small flywheel fracture

or leak in the enclosure does not result in stresses in the pressure boundary of sufficient magnitude to result in a break in the primary pressure boundary.

Revise Bullet in Appendix 1B as follows:

1B.1.9 Results

Due to the existing low risk of the AP1000 plant, none of the design alternatives described in Section 1B.1.3 meet an acceptable benefit to cost ratio of 1 or greater.
Several of the design alternatives evaluated in other SAMDA analyses are included in the current AP1000 design. These design features include the following:

- Reactor coolant system depressurization system
- Passive residual heat removal system located inside containment
- Cavity flooding system
- Passive containment cooling system
- Hydrogen igniters in a large-dry containment
- Diverse actuation system
- ~~Canned~~ Sealless motor reactor coolant pumps
- Interfacing system with high design pressure

Revise paragraph in Subsection 3.5.1.2.1.4 as follows:

3.5.1.2.1.4 Evaluation of Internally Generated Missiles (Inside Containment)

The consideration of credible missile sources inside containment that can adversely affect safety-related structures, systems, or components is limited to a few rotating components. The safety-related systems and components needed to bring the plant to a safe shutdown are inside the containment shield building and auxiliary building both of which have thick structural concrete exterior walls that provide protection from missiles generated in other portions of the plant. Rotating components inside containment that are either safety-related or are constructed as ~~canned~~ sealless ~~motor~~ pumps would contain fragments from a postulated fracture of the rotating elements and are excluded from evaluation as missile sources. Rotating components in use less than 2 percent of the time are also excluded from evaluation as missile sources. This exclusion of equipment that is used for a limited time is similar to the approach used for the definition of high-energy systems. This includes the reactor coolant drain pumps, the containment sump pumps and motors for valve operators, and mechanical handling equipment. Non-safety-related rotating equipment in compartments surrounded by structural concrete walls with no safety-related systems or components inside the compartment is not considered a missile source. Rotating equipment with a housing or an enclosure that contains the fragments of a postulated impeller failure is not considered a credible source of missiles. For one or more of these reasons the non-safety-related rotating equipment inside containment is considered not to be a credible missile source. Non-safety-related rotating equipment in compartments with safety-related systems or components that do not provide other separation features has design requirements for a housing or an enclosure to retain fragments from postulated failures of rotating elements.

Revise bullet and paragraph in Subsection 3.9.2.3 as follows:

3.9.2.3 Dynamic Response Analysis of Reactor Internals under Operational Flow Transients and Steady-State Conditions

AP1000 includes design features that differ from the design in plants in which the reactor internals have been tested as outlined previously. These design differences include the following:

- The reactor coolant is moved using a ~~canned~~ sealless ~~motor~~ pump instead of a shaft seal pump.

The sealless reactor coolant ~~canned motor~~ pumps of the AP1000, have a higher rotational speed and the same number of impeller blades as in previous plants. An evaluation of pump-induced loads will be included in the vibration assessment. For calculation of pump induced pulsations acting on the AP1000 reactor internals, the pulsation level at the pumps is taken to be the same as the level of previous shaft seal pumps. Since the horsepower of an AP1000 pump is lower than that of a 3XL shaft seal pump, the shaft seal pump pulsation is expected to be a conservative analysis basis for the AP1000.

Revise paragraph in Subsection 4.4.4.6 as Follows:

4.4.4.6 Hydrodynamic and Flow Power Coupled Instability

The ~~canned motor~~reactor coolant pump head curve has a negative slope ($\partial\Delta P/\partial G$ external less than zero), whereas the reactor coolant system pressure drop-flow curve has a positive slope ($\partial\Delta P/\partial G$ internal greater than zero) over the Condition I and Condition II operational ranges. Thus, the Ledinegg instability does not occur.

Revise bullet in Subsection 5.1.2 as Follows:

5.1.2 Design Description

- The reactor coolant pumps, consisting of four ~~canned~~ sealless ~~motor~~ pumps that pump fluid through the entire reactor coolant and reactor systems. ~~and t~~Two pumps ~~that~~ are coupled with each steam generator.

Revise Subsection 5.1.3.3 as Follows:

5.1.3.3 Reactor Coolant Pumps

The AP1000 reactor coolant pumps are high-inertia, high-reliability, low-maintenance, ~~hermetically sealed~~sealless ~~canned motor~~ pumps of either canned motor or wet winding motor design that circulate the reactor coolant through the reactor vessel, loop piping, and steam generators. The pumps are integrated into the steam generator channel head.

The integration of the pump suction into the bottom of the steam generator channel head eliminates the cross-over leg of coolant loop piping; reduces the loop pressure drop; simplifies the foundation and support system for the steam generator, pumps, and piping; and reduces the potential for uncovering of the core by eliminating the need to clear the loop seal during a small loss of coolant accident.

The AP1000 design uses four pumps. Two pumps are coupled with each steam generator. Each AP1000 reactor coolant pump is a vertical, single-stage centrifugal pump designed to pump large volumes of main coolant at high pressures and temperatures. Because of its ~~canned~~ sealless design, it is more tolerant of off-design conditions that could adversely affect shaft seal designs. The main impeller attaches to the rotor shaft of the driving motor, which is an electric induction motor. ~~The stator and rotor of the motor are both encased in corrosion-resistant cans constructed and supported to withstand full system pressure.~~

Primary coolant circulates between the stator and rotor which obviates the need for a seal around the motor shaft. Additionally, the motor bearings are lubricated by primary coolant. The motor is thus an integral part of the pump. The basic pump design has been proven by many years of service in other applications.

The pump motor size is minimized through the use of a variable frequency drive to provide speed control in order to reduce motor power requirements during pump startup from cold conditions. The variable frequency drive is used only during heatup and cooldown when the reactor trip breakers are open. During power operations, the drive is isolated and the pump is run at constant speed.

To provide the rotating inertia needed for flow coast-down, ~~a uranium alloy~~bi-metallic flywheel assemblies ~~is~~are attached to the pump shaft.

Revise Table 5.1-2 as Follows:

Table 5.1-2

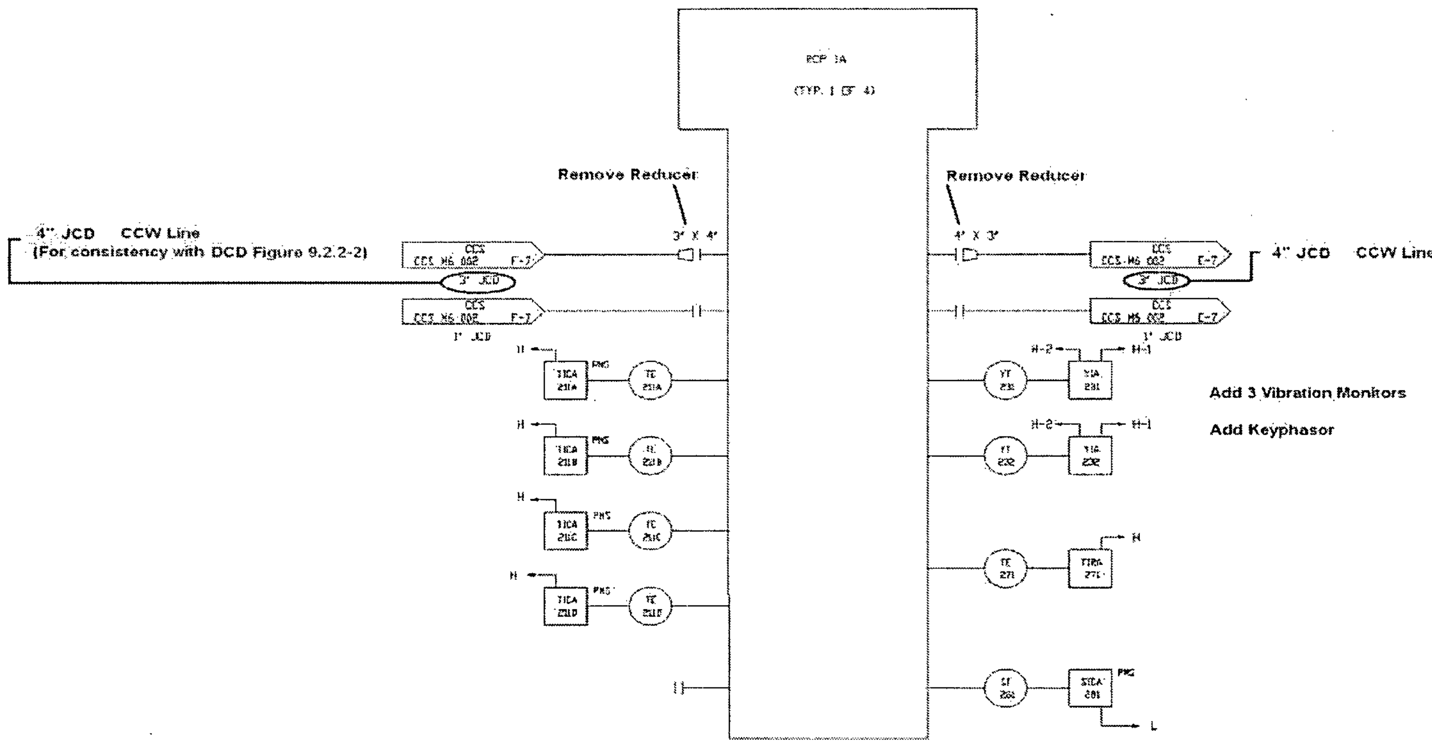
NOMINAL SYSTEM DESIGN AND OPERATING PARAMETERS

General	
Plant design objective, years	60
NSSS power, MWt	3415
Reactor coolant pressure, psia	2250
Reactor coolant liquid volume at power conditions (including 1000 ft^3 pressurizer liquid), ft^3	9600
Loops	
Number of cold legs	4
Number of hot legs	2
Hot leg ID, in.	31
Cold leg ID, in.	22
Reactor Coolant Pumps	
Type of reactor coolant pumps	~~Canned~~Sealless~~-motor~~
Number of reactor coolant pumps	4
~~Nameplate~~ Estimated motor rating, hp	~~7000~~7300
Effective pump power to coolant, MWt	15
Pressurizer	
Number of units	1
Total volume, ft^3	2100
Water volume, ft^3	1000
Spray capacity, gpm	500
Inside diameter, in.	90
Height, in.	607
Steam Generator	
Steam generator power, MWt/unit	1707.5
Type	Vertical U-tube Feedring-type
Number of units	2
Surface area, ft^2/unit	123,540
Shell design pressure, psia	1200
Zero load temperature, °F	557
Feedwater temperature, °F	440
Exit steam pressure, psia	836

Steam flow, lb/hr per steam generator	$7.49x10^6$
Total steam flow, lb/hr	$14.97x10^6$

Revise Figure 5.1-5 Sheet 3 according to markup on next page:

Revised Figure 5.1-5 Sheet 3



Update Table to Reflect New Instrumentation Labeling

Add 3 Vibration Monitors per Pump

	RCP	1A	1B	2A	2B
Existing		231A	232A	233A	234A
		231B	232B	233B	234B
Additional		231C	232C	233C	234C
		231D	232D	233D	234D
		231E	232E	233E	234E

Add 1 Keyphasor per Pump

RCP	1A	1B	2A	2B
	261	262	263	264

REACTOR COOLANT PUMP INSTRUMENTATION					
	RCP 1A	RCP 1B	RCP 2A	RCP 2B	SENSOR SUPPLIED WITH PUMP
BEARING WATER TEMPERATURE (TE -)	211A 211B 211C 211D	212A 212B 212C 212D	213A 213B 213C 213D	214A 214B 214C 214D	YES YES YES YES
VIBRATION (YT -)	UPDATED	UPDATED	UPDATED	UPDATED	YES YES
STATOR TEMPERATURE (TE -)	271	272	273	274	YES
PUMP SPEED (ST -)	281	282	283	284	YES

Inside Reactor Containment
Figure 5.1-5 (Sheet 3 of 3)

Reactor Coolant System
Piping and Instrumentation Diagram

Revise the last paragraph of Subsection 5.4.1.1 as Follows:

5.4.1.1 Design Bases

The reactor coolant pump pressure boundary shields the balance of the reactor coolant pressure boundary from theoretical worst-case flywheel failures. The reactor coolant pump pressure boundary is analyzed to demonstrate that a fractured flywheel cannot breach the reactor coolant system boundary (impacted pressure boundary components are, stator closure, stator main flange, lower stator flange~~stator shell, flange, and casing~~) and impair the operation of safety-related systems or components. This meets the requirements of General Design Criteria 4. The reactor coolant pump flywheel is designed, manufactured, and inspected to minimize the potential for the generation of high-energy fragments (missiles) under any anticipated operating or accident condition consistent with the intent of the guidelines set forth in Standard Review Plan Section 5.4.1.1 and Regulatory Guide 1.14. Each flywheel is tested at an overspeed condition to verify the flywheel design and construction.

Revise Subsection 5.4.1.2.1 as follows:

5.4.1.2.1 Design Description

The reactor coolant pump is a single stage, ~~hermetically sealed~~, high-inertia, centrifugal ~~canned~~ sealless ~~motor~~ pump of either canned motor or wet winding design. It pumps large volumes of reactor coolant at high pressures and temperature. Figure 5.4-1 shows ~~the~~ a reactor coolant pump. Table 5.4-1 gives the design parameters.

A reactor coolant pump is directly connected to each of two outlet nozzles on the steam generator channel head. The two pumps on a steam generator turn in the same direction.

A ~~canned motor~~sealless pump contains the motor and all rotating components inside a pressure vessel. The pressure vessel consists of the pump casing, ~~thermal barrier,~~ stator closure, stator main flange, stator shell, stator lower flange and stator cap, which are designed for full reactor coolant system pressure. In a canned motor pump ~~The~~ the stator and rotor are encased in corrosion-resistant cans that prevent contact of the rotor bars and stator windings 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. ~~A gasket and canopy seal type~~ The connection between the pump casing, and the stator ~~flange~~closure ~~, and the thermal barrier is provided. This design~~may be provided with a welded canopy type seal assembly, which provides definitive leak protection for the pump closure. If the canopy seal is used, ~~To~~ access to the internals of the pump and motor~~,~~ is by severing the canopy seal weld. ~~is severed.~~ When the pump is reassembled, a canopy seal is rewelded. ~~Canned motor~~Sealless reactor coolant pumps have a long history of safe, reliable performance in military and commercial nuclear plant service.

The reactor coolant pump driving motor is a vertical, water-cooled, squirrel-cage induction motor. ~~with a canned rotor and a canned stator.~~ It is designed for removal from the casing for inspection, maintenance and replacement, if required. The stator can or insulation protects the stator (windings and insulation) from the controlled portion of the reactor coolant circulating inside the motor and bearing cavity. ~~The can on the rotor isolates~~ T~~t~~he copper rotor bars are isolated from the system ~~and~~ to minimizes the potential for the copper to plate out in other areas.

The motor is cooled by primary reactor coolant system coolant circulating through the motor cavity and by component cooling water circulating through a cooling jacket on the outside of the motor housing. ~~and through a thermal barrier between the pump casing and the rest of the motor internals. Inside the cooling jacket are coils filled with circulating rotor cavity coolant. This rotor cavity coolant is a controlled volume of reactor coolant that circulates inside the rotor cavity. After the rotor cavity coolant is cooled in the cooling jacket, it~~ Primary coolant used to cool the motor enters the lower end of the rotor and passes axially ~~between the rotor and stator~~through the motor cavity ~~cans~~ to remove heat from the rotor and stator. An auxiliary impeller provides the motive force for circulating the coolant. Heat from the primary coolant is transferred to component coolant water in an external heat exchanger.

Each pump motor is driven by a variable speed drive, which is used for pump startup and operation when the reactor trip breakers are open. When the reactor trip breakers are closed, the variable frequency drives are bypassed and the pumps run at constant speed.

~~A f~~Flywheel~~, consisting of two separate~~ assemblies~~,~~ provide~~s~~ rotating inertia that increases the coastdown time for the pump. Each flywheel assembly is ~~a composite of a uranium alloy flywheel casting or forging contained within a welded nickel-chromium-iron alloy enclosure.~~ of bi-metallic design consisting of a heavy metal alloy and stainless steel. The upper flywheel assembly is located between the motor and pump impeller. If required, t~~T~~he lower assembly is located ~~within~~ below the ~~canned~~ motor ~~below the thrust bearing~~. Surrounding the flywheel assemblies are the heavy walls of the ~~motor end closure~~stator closure, casing, thermal barrier ~~flange, stator shell~~, or ~~main flange~~stator lower flange.

The materials in contact with the reactor coolant and cooling water (with the exception of the bearing material) are austenitic stainless steel, nickel-chromium-iron alloy, or equivalent corrosion-resistant material.

~~There are two pump journal~~ Journal bearings are provided as necessary based on rotor dynamics analyses.~~, one at the bottom of the rotor shaft and the other between the upper flywheel assembly and the motor.~~ The bearings are a hydrodynamic film-riding design. During rotor rotation, a thin film of water forms between the journal and pads, providing lubrication.

The thrust bearing assembly is at the bottom of the rotor shaft. The pivoted pad hydrodynamic bearing provides positive axial location of the rotating assembly regardless of operating conditions.

The reactor coolant pump is equipped with a vibration monitoring system that continuously monitors pump structure (frame) vibrations. Five vibration monitors~~Three-axis monitoring~~ provide~~s~~ pump vibration information. The readout equipment includes warning alarms and high-vibration level alarms, as well as output for analytical instruments.

Four resistance temperature detectors (RTDs) monitor motor cooling circuit water temperature. These detectors provide indication of anomalous bearing or motor operation. They also provide a system for automatic shutdown in the event of a prolonged loss of component cooling water.

A speed sensor monitors rotor rpm's.~~, which determines the load and direction of rotation.~~ Additionally, voltage and current sensors provide information on motor load and electrical input.

Revise Subsection 5.4.1.2.2 as follows:

5.4.1.2.2 Description of Operation

Reactor coolant is pumped by the main impeller. It is drawn through the eye of the impeller and discharged via the diffuser out through the radial discharge nozzle in the side of the casing. Once the motor housing is filled with coolant, the labyrinth seals around the shaft between the impeller and the thermal barrier minimize the flow of coolant into the motor during operation.

An auxiliary impeller at the lower part of the rotor shaft circulates a controlled volume of the primary coolant through the motor ~~cooling coils~~cavity and external heat exchanger. The coolant is cooled to about 150°F by component cooling water circulating on the shell side of the external heat exchanger. ~~circulating around the cooling coils in the cooling jacket outside the stator shell~~. The cooled reactor coolant then passes through the ~~annulus between the rotor and stator~~motor cavity ~~cans~~, where it remove~~s~~ heat from the rotor and stator and lubricate~~s~~ the motor's hydrodynamic bearings.

The variable frequency drives enable the startup of the reactor coolant pumps at slow speeds to decrease the power required from the pump motor during operation at cold conditions. The variable frequency drive provides operational flexibility during pump startup and reactor coolant system heatup. During a plant startup, the general startup procedure for the pumps is for the operator to start the pumps at a low speed. During reactor coolant system heatup, the pumps are run at the highest speed that is within the allowable motor current limits. As the reactor coolant temperature increases, the allowable pump speed also increases. Before the reactor trip breakers are closed, the variable frequency controllers are bypassed and the pumps run at constant speed.

During all power operations (Modes 1 and 2), the variable frequency drives are bypassed and the pumps run at constant speed.

Revise subsection 5.4.1.3.3 as follows:

5.4.1.3.3 Pressure Boundary Integrity

The pressure boundary integrity is verified for normal, anticipated transients, and postulated accident conditions. The pressure boundary components (pump casing, stator closure, stator main flange, stator shell, stator lower flange, stator cap, ~~thermal barrier,~~ and ~~motor cooling coils~~external piping and tube side of the external heat exchanger) meet the requirements of the ASME Boiler and Pressure Vessel Code, Section III. These components are designed, analyzed, and tested according to the requirements in Paragraph NB-3400 of the ASME Code, Section III. Wells provided for resistance temperature detectors and speed sensor penetrations also satisfy the requirements of the ASME Code, Section III.

For the canned motor design, t~~T~~he motor terminals form part of the pressure boundary in the event of a stator-can failure. The ASME Code does not include criteria or methods for completely designing or analyzing such terminals. Motor terminals are designed, analyzed, and tested using criteria established and validated based on many years of service. Where applicable, ASME Code requirements and criteria are used. Individual terminals are hydrostatically tested and a high-pressure nitrogen test is performed on the finished stator assembly with the terminals installed.

For the wet winding design, the cable penetrations are designed as part of the pressure boundary. These penetrations are designed to be self-sealing and include redundant sealing features.

Revise the last paragraph of subsection 5.4.1.3.4 as follows:

5.4.1.3.4 Coastdown Capability

If the stator can or winding insulation should leak during operation, the reactor coolant may cause a short in the stator windings. In such a case, the result would be the same as a loss of power to that pump. With either a rotor or a stator can or stator insulation failure, no fluid would be lost to the containment.

Revise paragraphs of subsection 5.4.1.3.6.1 as follows:

5.4.1.3.6.1 Natural Frequency and Critical Speeds

The ~~fundamental, un~~damped natural frequency of the reactor coolant pump rotating assembly is greater ~~calculated for simple supports at the bearing locations and the rotor vibrating in air. This frequency, defined as the "classical lateral critical speed" (Reference 1) is greater~~ than ~~125~~ 120 percent of the normal operating speed.

Determination of the damped natural frequency of the reactor coolant pump rotor bearing system model includes the effects of the bearing films, can or winding annular fluid interaction, motor magnetic phenomena, and pump structure. The damped natural frequencies for the AP1000 ~~canned motor~~reactor coolant pump exhibit sufficient energy dissipation to be stable. The high degree of damping provides smooth pump operation.

Revise paragraphs of subsection 5.4.1.3.6.2 as follows:

5.4.1.3.6.2 Rotor Seizure

The design of the pump is such as to preclude the instantaneous stopping of any rotating component of the pump or motor. ~~for a canned motor of this type.~~ The rotating inertia and power supplied to the motor would overcome interference between the impeller, bearings, flywheel assemblies, motor rotor, or rotor can and the surrounding components for a period of time. A change in the condition of any of the components sufficient to cause an interference would be indicated by the instrumentation monitoring speed, vibration, temperature, or current.

The reactor coolant system and ~~canned motor~~ reactor coolant pump are analyzed for a locked rotor event. To analyze the mechanical and structural effects of a rapid slow down of the rotating assembly, a failure of the rotating assembly is postulated that results in deformation that causes an interference with the surrounding reactor coolant pump components. For such an interference, the pump and motor are postulated to come to a complete stop in a very short time period. This assumption bounds other postulated mechanisms for a rapid slowdown of the rotor, including impeller rub and rotor or stator can failure. The connection of the pump with the steam generator and discharge piping is analyzed for the vibration of the pump, hydraulic effects, and the torque due to the rapid slow down of the rotating assembly. The stresses in the pump casing, motor housing, steam generator channel head, and piping are analyzed using ASME Code, Section III, Service Level D limits for this condition.

Revise subsection 5.4.1.3.6.3 as follows:

5.4.1.3.6.3 Flywheel Integrity

The ~~canned motor~~ reactor coolant pump in the AP1000 complies with the requirement of General Design Criterion (GDC) Number 4. That Criterion states that components important to safety be protected against the effects of missiles.

The flywheel assemblies are located within and surrounded by the heavy walls of the ~~motor end~~stator closure, stator main flange, casing, thermal barrier ~~flange, stator shell~~, or ~~main~~ lower stator flange. In the event of a postulated worst-case flywheel assembly failure, the surrounding structure can, by a large margin, contain the energy of the fragments without causing a rupture of the pressure boundary. The analysis in Reference 10 of the capacity of the housing to contain the fragments of the flywheel is done using the energy absorption equations of Hagg and Sankey (Reference 2).

Compliance with the requirement of GDC 4 related to missiles can be demonstrated without reference to flywheel integrity, nevertheless, the intent of the guidelines of Regulatory Guide 1.14 is followed in the design and fabrication of the flywheel. The guidelines in Regulatory Guide 1.14 apply to steel flywheels. Since the ~~uranium alloy~~bi-metallic design of the AP1000 reactor coolant pump flywheel does not respond in the same manner as homogeneous steel, many of the guidelines in the Regulatory Guide are not directly applicable.

The reactor coolant pump flywheel assemblies are fabricated from a heavy metal alloy and stainless steel. Heavy alloy segments are fitted to a stainless steel hub; these segments are not relied upon structurally. The segments may be held into place by an interference fit retainer cylinder placed over the outside of the assembly. The assembly is hermetically sealed from primary coolant by Alloy 690 endplates and an outer thin shell.

~~high-quality, depleted uranium alloy castings or forgings. Castings are poured using a process to minimize the formation of voids, cracks, or other flaws. The forging process is also controlled to minimize the formation of flaws. Subsequent to casting or forging, the flywheel is heat treated by solution annealing in a vacuum furnace and slowly cooled. This heat treatment minimizes the potential for residual stresses. The heat treatment process also removes hydrogen from the material to reduce the potential for hydrogen embrittlement.~~

~~The key parameters for the uranium alloy specification are defined in Table 5.4-2. These parameters include the minimum ultimate and yield tensile strength. Nil ductility transition and upper shelf energy are not specified in the requirements for the uranium alloy. These are characteristics of steel not duplicated in the uranium alloys. The material specification has appropriate testing to confirm that the fracture toughness used in the flywheel evaluation is satisfied. A Charpy V-notch test is required. A portion of the uranium is machined off to obtain specimens for tensile and impact tests and to inspect the microstructure.~~

~~The uranium is ultrasonically inspected following final machining. The acceptance criteria for the ultrasonic inspection are based on criteria in the ASME Code, Section III, and are done in conformance with the procedures outlined in ASTM A-609 (Reference 3) with modifications as required for use with uranium alloy. Thermal methods are not used for finishing operations on the uranium.~~

The bi-metallic flywheel design will be manufactured using multiple processes and materials. In accordance with Regulatory Guide 1.14 each structural component of the bi-metallic flywheel will be inspected prior to final assembly according to its fabrication and the procedures outlined in Section III, NB-2500 of the ASME Code. Following finishing operations on the ~~casting~~ flywheel assembly the outside surface and the inside bore are subject to liquid penetrant inspections in conformance with the requirements of ASTM-E-165 (Reference 4). In-process controls used during the construction of the flywheel assemblies also provide for the quality of the completed assemblies.

The design speed of the flywheel is defined as 125 percent of the normal speed of the motor. The design speed envelopes all expected overspeed conditions. At the normal speed the calculated maximum primary stress in the ~~uranium~~ flywheel assemblies is less than one third of minimum yield strength. At the design speed the calculated maximum primary stress in the ~~uranium~~ flywheel assemblies is less than two thirds of minimum yield strength.

An analysis of the flywheel failure modes of ductile failure, nonductile failure and excessive deformation of the flywheel is performed to evaluate the flywheel design. The analysis is performed to determine that the critical flywheel failure speeds, based on these failure modes, are greater than the design speed. The critical flywheel failure speeds are not the same as the critical speed identified for the rotor. The critical flywheel failure speeds are greater than the design speed. The overspeed condition for a postulated pipe rupture accident is less than the critical flywheel failure speeds.

The ~~uranium is~~flywheel assemblies are sealed within a welded nickel-chromium-iron alloy enclosure to prevent contact with the reactor coolant or any other fluid. The enclosure minimizes the potential for corrosion of the flywheel and contamination of the reactor coolant~~ with depleted uranium~~. The enclosure material specifications are ASTM-B-168 and ASTM-B-564. Even though the welds of the flywheel enclosure are not external pressure boundary welds, these welds are made using procedures and specifications that follow the rules of the ASME Code. A dye penetrant and ultrasonic test of the enclosure welds is performed in conformance with these requirements.

No credit is taken in the analysis of the flywheel missile generation for the retention of the fragments by the enclosure. A leak in the enclosure during operation could result in an out-of-balance flywheel assembly. ~~A postulated small fracture of the flywheel casting inside the enclosure that does not penetrate or significantly deform the enclosure would also be expected to result in an out-of-balance condition.~~ An out-of-balance flywheel exhibits an increase in vibration, which is monitored by vibration instrumentation.

The flywheel enclosure contributes only a small portion of the energy in a rotating flywheel assembly.

~~The outside ring, inside ring, and ends of the flywheel enclosure are connected together with flexible, full penetration welds. The flexible welds and the local area adjacent to the welds may have stresses greater than the guidelines in the Standard Review Plan for normal and design speeds.~~ The stress in the ~~flexible~~ welds ~~and~~ of the flywheel enclosure components for normal and design speeds are within the criteria in subsection NG of the ASME Code, which is used as a guideline.

Pipe rupture overspeed is based on a break of the largest branch line pipe connected to the reactor coolant system piping that is not qualified for leak-before-break criteria. The exclusion of the reactor coolant loop piping and branch line piping of 6 inches or larger size from the basis of the pump loss of coolant accident overspeed condition is based on the provision in GDC 4 to exclude dynamic effects of pipe rupture when a leak-before-break analysis demonstrates that appropriate criteria are satisfied. See subsection 3.6.3 for a discussion of leak-before-break analyses. The criteria of subsection 3.6.2 are used to determine pipe break size and location for those piping systems that do not satisfy the requirements for mechanistic pipe break criteria.

In addition to material specification and non destructive testing requirement, each flywheel is subject to a spin test at 125 percent overspeed during manufacture. This demonstrates quality of the flywheel. Since the basis for the safety of the flywheel is retention of the fragments within the reactor coolant pump pressure boundary, periodic inservice inspections of the flywheel assemblies are not required to ensure that the basis for safe operation is maintained.

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Because of the configuration of the flywheel assemblies, inservice inspection of the flywheel assemblies may not result in significant inspection results. Inspection of the ~~uranium alloy casting~~flywheel assemblies would require removal of the assembliesy from the shaft, removal of the ~~uranium from the~~ enclosures, rewelding of the enclosure, reassembly, and balancing of the pump shaft. Opening of the pump assembly for a periodic inspection of the enclosure would result in an increased occupational radiation exposure and would not be consistent with goals relative to maintaining exposure as low as reasonably achievable. Also, opening the pump may increase the potential for entry of foreign objects into the ~~canned~~ motor area. For these reasons, routine, periodic inspection of the flywheel assemblies in the AP1000 ~~canned motor~~ reactor coolant pump is not recommended.

Revise subsection 5.4.1.3.6.4 as follows:

5.4.1.3.6.4 Other Rotating Components

The rotating components (other than the flywheel), including the impeller, auxiliary impeller, rotor, and rotor can, are evaluated for potential missile generation. In the event of fracture, the fragments from these components are contained by the surrounding pressure housing. The impeller is contained by the pump casing. The rotor and rotor can are contained by the stator, ~~stator can, and~~ motor housing and/or stator can. The auxiliary impeller is contained by the motor housing. In each case, the energy of the postulated fragments is less than that required to penetrate through the pressure boundary.

Revise paragraph in subsection 5.4.2.2 as follows:

5.4.2.2 Design Description

The reactor coolant flow enters the inverted U-tubes, transferring heat to the secondary side during its traverse, and returns to the cold leg side of the primary chamber. The flow exits the steam generator via two cold leg nozzles to which the ~~canned motor~~ reactor coolant pumps are directly attached. A high-integrity, nickel-chromium-iron (Alloy 690) weld is made to the nickel-chromium-iron alloy buttered ends of these nozzles.

Revise paragraph in subsection 5.4.2.3.3 as follows:

5.4.2.3.3 Mechanical and Flow-Induced Vibration under Normal Operating Conditions

Potential sources of tube excitation are considered, including primary fluid flow within the U-tubes, mechanically induced vibration, and secondary fluid flow on the outside of the U-tubes. The effects of primary fluid flow and mechanically induced vibration, including those developed by the ~~canned motor~~reactor coolant pump, are acceptable during normal operation. The primary source of potential tube degradation due to vibration is the hydrodynamic excitation of the tubes by the secondary fluid. This area has been emphasized in both analyses and tests, including evaluation of steam generator operating experience.

Revise paragraph in subsection 5.4.2.3.3 as follows:

5.4.5.2.3 Operation

During heatup and cooldown of the plant, when the potential for thermal stratification in the pressurizer is the greatest, the pressurizer may be operated with a continuous outsurge of water from the pressurizer. This is achieved by continuous maximum spray flow and energizing of all of the backup pressurizer heater groups. The temperature difference between the pressurizer and hot leg is minimized by maintaining the lowest reactor coolant system pressure possible consistent with operation of a ~~canned motor~~ reactor coolant pump. This mode of operation minimizes the frequency and magnitude of thermal shock to the surge line nozzle and lower pressurizer head, and the potential for stratification in the pressurizer and surge line. The design analyses of the pressurizer include consideration of transients on the lower head and shell regions to account for these possible insurge/outsurge events.

Revise subsection 5.4.16 as follows:

5.4.16 References

1. ~~Eshleman, R. L., "Flexible Rotor-Bearing System Dynamics, Part I. Critical Speeds and Response of Flexible Rotor Systems," Flexible Rotor System Subcommittee, Design Engineering Division, American Society of Mechanical Engineers, 1972.~~ Deleted

2. Hagg, A. C. and Sankey, G. O., "The Containment of Disk Burst Fragments by Cylindrical Shells," ASME Journal of Engineering for Power, April 1974, pp. 114-123.

3. ~~ASTM-A-609-91, Standard Specification for Longitudinal Beam Ultrasonic Inspection of Carbon and Low-alloy Steel Castings.~~ Deleted

4. ASTM-E-165-95, Practice for Liquid Penetrant Inspection Method.

5. ANSI/ANS-5.1-1994, "Decay Heat Power in Light Water Reactors."

6. ANSI/ANS-51.1-1983, "Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants."

7. ANSI N278.1-1975, Self-Operated and Power-Operated Safety-Relief Valves Functional Specification Standard.

8. QME-1, Qualification of Active Mechanical Equipment Used in Nuclear Power Plants.

9. ANSI B16.34-1996, Valves - Flanged and Buttwelding End.

10. ~~WCAP-15994-P (Proprietary) Revision 1, and WCAP-15994-NP (Non-Proprietary) Revision 1, "Structural Analysis Summary for the AP1000 Reactor Coolant Pump High Inertia Flywheel," March 2003.~~ Curtiss-Wright Electro-Mechanical Corporation Report AP1000RCP-06-009-P (Proprietary), and AP1000RCP-06-009-NP (Non-Proprietary), "Structural Analysis Summary for the AP1000 Reactor Coolant Pump High Inertia Flywheel", October 2006.

Revise Table 5.4-1 as follows:

Table 5.4-1

REACTOR COOLANT PUMP DESIGN PARAMETERS

Unit design pressure (psiag)	2500
Unit design temperature (°F)	650
Estimated Unit overall height (ft~~-in~~)	22~~21-11.5~~
Component cooling water flow (gpm)	600~~360~~
Maximum continuous component cooling water inlet temperature (°F)$^{(1)}$	95~~110~~
Total estimated weight motor and casing, dry (lb) ~~nominal~~	~~184,500~~ ~200,000
Pump	
Design flow (gpm)	78,750
Developed head (feet)	365
Pump discharge nozzle, inside diameter (inches)	22
Pump suction nozzle, inside diameter (inches)	26
Speed (synchronous)(rpm)	1800
Motor	
Type	Squirrel Cage Induction
Voltage (V)	6900~~6600~~
Phase	3
Frequency (Hz)	60
Insulation class	Class H or N
Current (amp)	
Starting	Variable
Nominal input, cold reactor coolant	Variable
Motor/pump rotor minimum required moment of inertia ~~(lb-ft^2)~~	~~16,500~~ Sufficient to provide flow coastdown as given in Figure 15.3.2-1

Note 1: An elevated component cooling water supply temperature of up to 110 °F~~degrees F~~ may occur for a 6 hour period. ~~during plant cooldown.~~

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Table 5.4-3 Delete Table 5.4-2:

~~Table 5.4-2~~ **~~FLYWHEEL MATERIAL SPECIFICATION~~**	
~~Chemistry Requirements~~	
~~Element~~	**~~Amount (ppm)~~**
~~Molybdenum~~	~~2.0% ± 0.2%~~
~~Carbon~~	~~150 Max.~~
~~Iron~~	~~75 Max.~~
~~Silicon~~	~~75 Max.~~
~~Copper~~	~~20 Max.~~
~~Aluminum~~	~~20 Max.~~
~~Uranium~~	~~Balance~~
~~Mechanical Requirements~~	
~~Ultimate Tensile Stress~~	~~110 ksi Min.~~
~~Yield Stress~~	~~55 ksi Min.~~
~~Elongation~~	~~10% Min.~~
~~Reduction of Area~~	~~25% Min.~~
~~Charpy V-notch~~	~~10 ft-lb Min.~~
~~Heat Treatment~~	
~~Hold at 1000°C for 24 hours~~	
~~Furnace cool to room temperature at less than 100°C per hour~~	
~~Furnace vacuum atmosphere less than 10^{-4} torr~~	

Table 5.4-3 Revise Note (b) for Table 5.4-3 as follows:

(b) ~~The motor terminals are helium leak tested prior to installation.~~See subsection 5.4.1.3.3.

Figure 5.4-1 Current Outline as shown in Rev. 15 DCD:

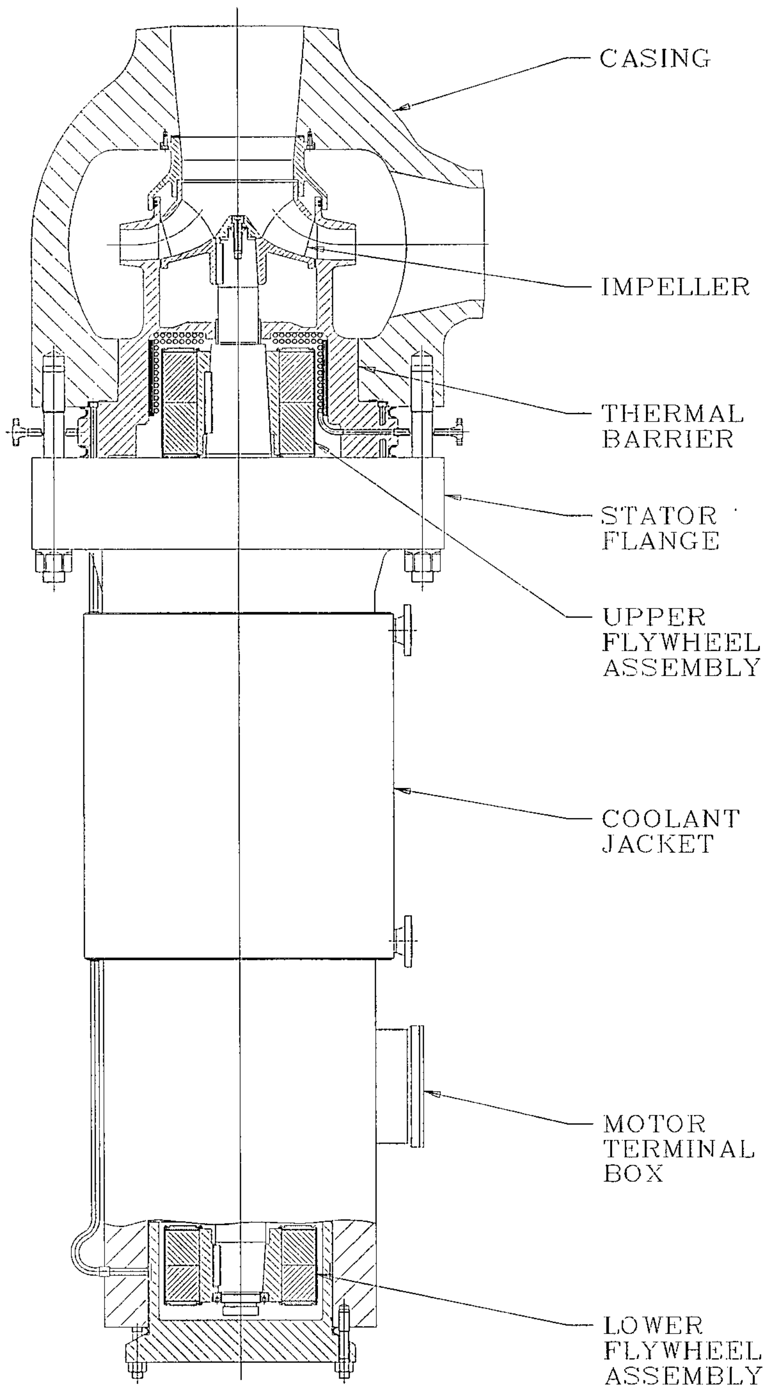

Figure 5.4-1

Reactor Coolant Pump

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Revised Figure to Replace Figure 5.4-1:

5. Reactor Coolant System and Connected Systems AP1000 Design Control Document

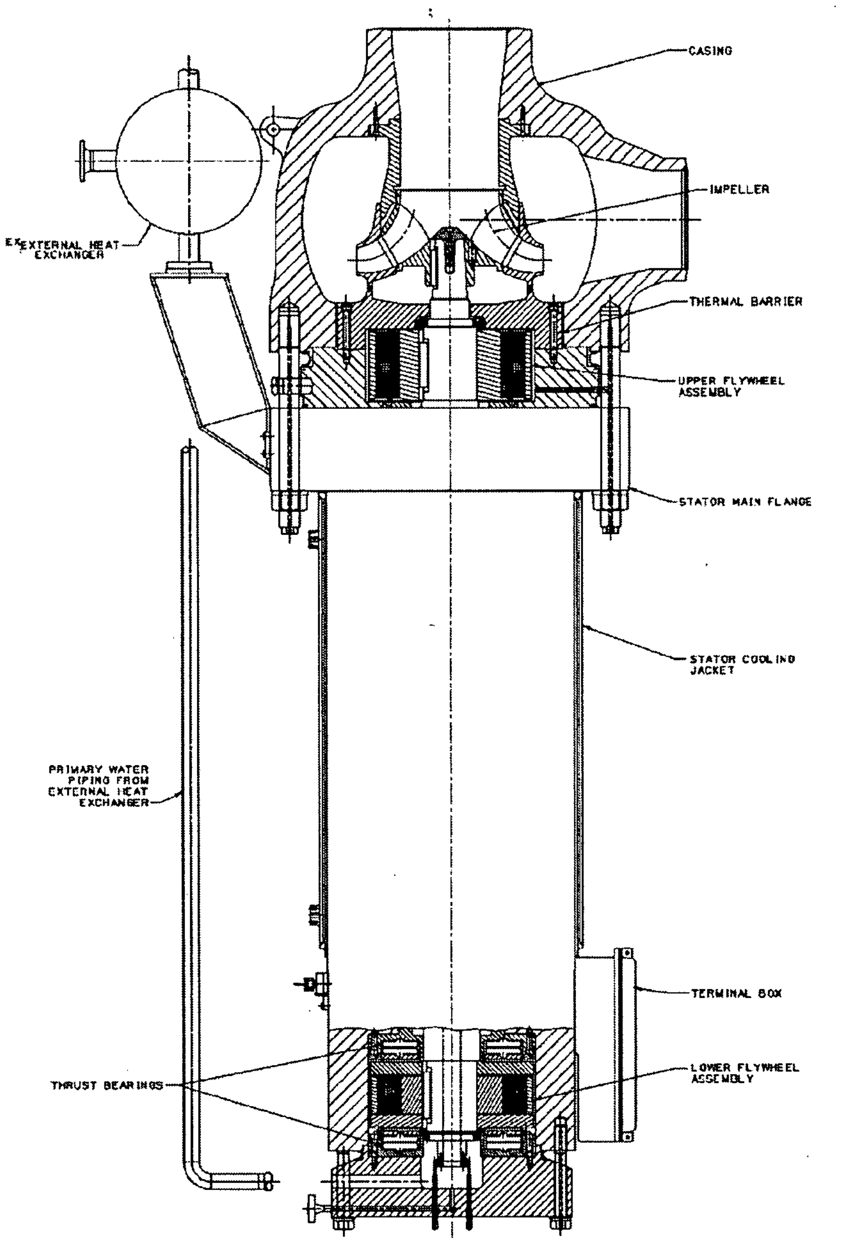

Figure 5.4-1

Reactor Coolant Pump

Tier 2 Material 5.4-2 Revision 15

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Revise bullet in Subsection 9.5.1.2.1.1 as follows:

9.5.1.2.1.1 Plant Fire Prevention and Control Features
Plant Arrangement

- Complete fire barrier separation necessary to define a fire area is not provided throughout the primary containment fire area (including the middle and upper annulus zones of the shield building) because of the need to satisfy other design requirements, such as allowing for pressure equalization within the containment following a high-energy line break. Fire protection features and equipment arrangement which define fire zones within the containment fire area provide confidence that at least one train of safe shutdown equipment will remain undamaged following a fire in any fire zone. The quantity of combustible materials is minimized. The use of ~~canned~~ sealless reactor coolant pump motors has eliminated the need for an oil lubrication system. Redundant trains of safe shutdown components are separated whenever possible by existing structural walls, or by distance. Selected cables of a safety-related division which pass through a fire zone of an unrelated division are protected by fire barriers. The fire protection system provides appropriate fire detection and suppression capabilities.

Revise Tables 9.5.1-1 as follows:

Table 9.5.1-1 (Sheet 24 of 33)

AP1000 FIRE PROTECTION PROGRAM COMPLIANCE WITH BTP CMEB 9.5-1

BTP CMEB 9.5-1 Guideline	Paragraph	Comp[1]	Remarks
Carbon Dioxide Suppression Systems			
160. Carbon dioxide suppression systems should comply with the requirements of NFPA 12.	C.6.e	NA	Fixed carbon dioxide suppression systems are not used on AP1000.
161. Automatic carbon dioxide systems should be equipped with a predischarge alarm system and a discharge delay to permit personnel egress.	C.6.e	NA	Fixed carbon dioxide suppression systems are not used on AP1000.
162. Provisions for locally disarming automatic carbon dioxide systems should be key locked and under administrative control. Disarming of systems should be controlled as described in Position C.2.	C.6.e	NA	Fixed carbon dioxide suppression systems are not used on AP1000.
163. Considerations for design of carbon dioxide suppression systems.	C.6.e	NA	Fixed carbon dioxide suppression systems are not used on AP1000.
Portable Extinguishers			
164. Fire extinguishers should be provided in areas that contain, or could present a fire exposure hazard to, safety-related equipment in accordance with NFPA 10.	C.6.f	C	See Note 3
165. Dry chemical extinguishers should be installed with due consideration given to possible adverse effects on safety-related equipment.	C.6.f	C	
Primary and Secondary Containment			
166. Fire protection for the primary and secondary containment areas should be provided for hazards identified by the fire protection analysis.	C.7.a (1)	C	Fires are identified and fire suppression systems are provided accordingly.
167. Because of the general inaccessibility of primary containment during normal plant operation, protection should be provided by automatic fixed systems.	C.7.a (1)	AC	No automatic suppression systems are needed due to the ~~canned~~ sealless ~~motor~~ reactor coolant pumps (RCPs) having no external lube oil system. Automatic

			suppression is provided in one fire zone as described in Appendix 9A.

Table 9.5.1-1 (Sheet 25 of 33)

AP1000 FIRE PROTECTION PROGRAM COMPLIANCE WITH BTP CMEB 9.5-1

BTP CMEB 9.5-1 Guideline	Paragraph	Comp(1)	Remarks
168. Operation of the fire protection systems should not compromise the integrity of the containment or other safety-related systems.	C.7.a(1)(a)	C	
169. Recommendations for protection of safety-related cables and equipment inside non-inerted containments.	C.7.a(1)(b)	AC	See Appendix 9A for a description of protection inside containment.
170. Recommendations concerning fire detection inside the primary containment.	C.7.a(1)©	C	
171. Standpipe and hose stations inside containment may be connected to a high quality water supply of sufficient quantity and pressure other than the fire main loop if plant-specific features prevent extending the fire main supply inside containment.	C.7.a(1)(d)	C	
172. Recommendations for reactor coolant pump oil collection systems in non-inerted containments.	C.7.a(1)(e)	NA	The reactor coolant pumps are ~~canned~~ sealless ~~motor~~ pumps and do not require an oil collection system.
173. For secondary containment areas, cable fire hazards that could affect safety should be protected as described in Position C.5.e.(2).	C.7.a (1)(f)	NA	
174. Self-contained breathing apparatus should be provided near the containment entrances for firefighting and damage control personnel. These units should be independent of any breathing apparatus provided for general plant activities.	C.7.a (2)	WA	See Note 2
Main Control Room Complex			
175. The main control room complex should be separated from other areas of the plant by 3-hour rated fire barriers.	C.7.b	C	
176. Recommendations concerning peripheral	C.7.b	NC	The MCR/tagging room wall is not fire-rated based on

rooms in the main control room complex.			other design criteria. Manual fire suppression is provided for peripheral rooms. See Appendix 9A.

Revise paragraph in Subsection 12.3.1.1.1 as Follows:

12.3.1.1.1 Common Equipment and Component Designs for ALARA Reactor Coolant Pumps

The ~~canned~~ sealless high-inertia reactor coolant pumps are designed to require infrequent maintenance and inspection. When maintenance or replacement is required, the pump can be removed and moved to a low radiation background work area using a specially provided pump removal cart.

Revise paragraph in Subsection 12.4.1.2 as follows:

12.4.1.2 Routine Inspection and Maintenance

Routine inspection and maintenance are required for mechanical and electrical components. Table 12.4-2 provides a breakdown of the collective doses for routine inspection and maintenance. These estimates are based on having good access to equipment (a characteristic of the AP1000 layout).

Table 12.4-3 lists the doses associated with inspection of the ~~canned motor~~ reactor coolant pumps (RCPs). Table 12.4-4 itemizes the doses estimated to be incurred from steam generator sludge lancing operations and Table 12.4-5 lists the doses resulting from the visual examination of the secondary side of the steam generators.

Revise last sentence in Subsection 12.4.1.2 as follows:

12.4.1.4 Special Maintenance

No special maintenance activities are forecast for the ~~canned motor~~ reactor coolant pumps.

Revise bullet in Subsection 19.1.5 as follows:

19.1.5 Results

- Reactor coolant pump seal loss-of-coolant accidents are eliminated because of the use of ~~canned~~ sealless ~~motor~~ reactor coolant pumps.

Revise bullet in Subsection 19.59.1 as follows:

19.59.1 Introduction

- Typical current PRA dominant initiating events are significantly less important for the AP1000. For example, the reactor coolant pump (RCP) seal loss-of-coolant accident (LOCA) event has been eliminated as a core damage initiator since AP1000 uses ~~canned motor~~sealless reactor coolant pumps.~~, which do not have seals.~~ Another example is the loss of offsite power (LOOP) event. The station blackout and loss of offsite power event is a minor contributor to AP1000 since the passive safety-related systems do not require the support of ac power.

Revise last paragraph in Subsection 19.59.1 as follows:

19.59.9.1 Reactor Design

The AP1000 has ~~canned~~ sealless reactor coolant pumps, thus avoiding ~~seal~~ loss-of-coolant accident issues related to shaft seals and simplifying the chemical and volume control system. The reactor coolant system has fewer welds, which reduces the potential for loss-of-coolant accident events. The probability of a loss-of-coolant accident is also reduced by the application of "leak-before-break" to reactor coolant system piping.

Revise paragraph in Subsection 19.59.9.2.2 as follows:

19.59.9.2.2 Nonsafety-Related Systems

Component cooling water and service water systems have a limited role in the plant risk profile because the passive safety-related systems do not require cooling, and the ~~canned motor~~ reactor coolant pumps do not require seal cooling from the component cooling water.

Revise paragraph in Appendix 19E.2.1.2.6 as follows:

19E.2.1.2.6 Steam Generator Channel Head

The reactor coolant enters the inverted U-tubes, transferring heat to the secondary side during its traverse, and returns to the cold leg side of the primary chamber. The flow exits the steam generator via two cold leg nozzles to which the ~~canned motor RCPs~~reactor coolant pumps are directly attached.

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V. REGULATORY IMPACT

A. FSER IMPACT

The reactor coolant pump design is described as a canned motor pump in the NRC Final Safety Evaluation Report (FSER). To be consistent with the changes to DCD Tier 2 regarding the description of the reactor coolant pump as being "sealless" rather than a "canned motor" the following sections will need to be revised:

- Abstract, 1.2.2.4, 3.12.5.10, 5.1.2, 5.1.3.3, 5.4.1 5.4.2, 9.5.1.7.a, 12.4.1, 12.5, 16.2.8, 19.1.2.1.9, 19.1.3.1.2.1, 19.4.3.1, Chapter 20 Issue 23, Chapter 20 Issue II.K.2(16), Chapter 20 Issue II.K.2(25), 21.3, 21.6.1.1, 21.A.3, 21.A.8.2

The description of the cooling of the pump motor in subsection 5.4.1 will also need to be revised to reflect the design change to the use of an external heat exchanger. Subsection 5.4.1.2 will need to be revised to remove the specific pump inertia value, since the required value depends upon the magnitude of the pump resistance during coastdown. The ultimate requirement which must be met is to provide a pump coastdown that meets the coastdown curve of DCD Tier 1 Figure 2.1.2-2 which was used in the safety analyses. The conclusions that reactor coolant pump will meet all performance requirements and provide the pump coastdown required to protect the core during a loss of all four pumps are not impacted by the design changes made to the pump.

Subsections 5.1.3.3 and 5.4.1.4.2, state that the reactor coolant pump flywheel assembly is constructed from a depleted uranium casting. The description of the flywheel construction would change to a flywheel of bi-metallic construction. Subsection 5.4.1.4.2 discusses Revision 1 of WCAP-15994 which address flywheel integrity and the associated missile analysis. The subsection will need to be revised to refer to Curtiss-Wright EMD report AP1000RCP-06-009. Also, the response to AP1000 RAI 251.021, as discussed in subsection 5.4.1.4.2, would change as the result of the pump design changes. These changes will not impact the conclusion that the integrity of the reactor coolant pump pressure boundary will be maintained in the event of a postulated reactor coolant pump flywheel missile and that the measures taken to ensure the integrity of the RCP flywheels are acceptable and meet the safety requirements of GDC 1 and 4 and 10 CFR 50.55a(a)(1).

B. SCREENING QUESTIONS (Check correct response and provide justification for that determination under each response)

1. Does the proposed change involve a change to an SSC that adversely affects a DCD described design function? ☐ YES ☒ NO

   The performance, flow coastdown, and pressure boundary integrity design functions of the reactor coolant pump are not altered by the pump design changes described in APP-GW-GLN-016.

2. Does the proposed change involve a change to a procedure that adversely affects how DCD described SSC design functions are performed or controlled? ☐ YES ☒ NO

   The reactor coolant pump design changes described in APP-GW-GLN-016 will not affect how the reactor coolant pump flow coastdown and pressure boundary integrity functions are performed or how the pump and reactor coolant system operates.

3. Does the proposed activity involve revising or replacing a DCD described evaluation methodology that is used in establishing the design bases or used in the safety analyses? ☐ YES ☒ NO

   The reactor coolant pump design changes described in APP-GW-GLN-016 will not change the analysis methodology used to ensure the required flow coastdown, the integrity of the flywheel, or the pressure boundary integrity.

4. Does the proposed activity involve a test or experiment not described in the DCD, where an SSC is utilized or controlled in a manner that is outside the reference bounds of the design for that SSC or is inconsistent with analyses or descriptions in the DCD? ☐ YES ☒ NO

   The reactor coolant pump design changes described in APP-GW-GLN-016 does not require an additional test or experiment where an SSC is utilized or controlled in a manner that is outside the reference bounds of the design for that SSC or is inconsistent with analyses or descriptions in the DCD.

C. EVALUATION OF DEPARTURE FROM TIER 2 INFORMATION (Check correct response and provide justification for that determination under each response)

10 CFR Part 52, Appendix D, Section VIII. B.5.a. provides that an applicant for a combined licensee who references the AP1000 design certification may depart from Tier 2 information, without prior NRC approval, if it does not require a license amendment under paragraph B.5.b. The questions below address the criteria of B.5.b.

1. Does the proposed departure result in more than a minimal increase in the frequency of occurrence of an accident previously evaluated in the plant-specific DCD? ☐ YES ☒ NO

The reactor coolant pump design changes described in APP-GW-GLN-016 will not increase the frequency of occurrence of an accident because there is no significant increase in the probability of failure of the pump safety functions due to the design changes.

2. Does the proposed departure result in more than a minimal increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) important to safety and previously evaluated in the plant-specific DCD? ☐ YES ☒ NO

The reactor coolant pump design changes described in APP-GW-GLN-016 do not affect the pump coastdown or pressure boundary integrity, therefore there is no increase in the probability of malfunctions of these pump safety functions.

3. Does the proposed departure result in more than a minimal increase in the consequences of an accident previously evaluated in the plant-specific DCD? ☐ YES ☒ NO

Reactor coolant pump design changes described in APP-GW-GLN-016 have no effect on the operation, coastdown, or pressure boundry integrity. Therefore, there is no impact on the consequences of an accident.

4. Does the proposed departure result in more than a minimal increase in the consequences of a malfunction of an SSC important to safety previously evaluated in the plant-specific DCD? ☐ YES ☒ NO

The reactor coolant pump design changes described in APP-GW-GLN-016 will not impact the integrity of the reactor coolant system pressure boundary and therefore, will not increase the consequences of a malfunction of an SSC important to safety.

5. Does the proposed departure create a possibility for an accident of a different type than any evaluated previously in the plant-specific DCD? ☐ YES ☒ NO

The reactor coolant pump design changes described in APP-GW-GLN-016 will not impact the response of the reactor coolant pump or reactor coolant system to postulated accident conditions. The changes also do not introduce any additional failure modes. Therefore, these changes will not result in an accident of a type different than what has already been evaluated in the DCD.

6. Does the proposed departure create a possibility for a malfunction of an SSC important to ☐ YES ☒ NO

safety with a different result than any evaluated previously in the plant-specific DCD?

The reactor coolant pump design changes described in APP-GW-GLN-016 will not result in any impact to the safety functions of the reactor coolant pump, flywheel integrity, or reactor coolant system pressure boundary integrity, and therefore there it will not impact a malfunction of an SSC to cause a different result than what has been evaluated previously.

7. Does the proposed departure result in a design basis limit for a fission product barrier as described in the plant-specific DCD being exceeded or altered? ☐ YES ☒ NO

   The reactor coolant pump design changes described in APP-GW-GLN-016 will not result in any impact to reactor coolant pump or reactor coolant system pressure boundary integrity and thus will not result in a design basis limit for a fission product barrier being exceeded.

8. Does the proposed departure result in a departure from a method of evaluation described in the plant-specific DCD used in establishing the design bases or in the safety analyses? ☐ YES ☒ NO

   The reactor coolant pump design changes described in APP-GW-GLN-016 will not alter the methodology used in verifying pump pressure boundary integrity or coastdown capability, or in performing the safety analyses.

☒ The answers to the evaluation questions above are "NO" and the proposed departure from Tier 2 does not require prior NRC review to be included in plant specific FSARs as provided in 10 CFR Part 52, Appendix D, Section VIII. B.5.b

☐ One or more of the the answers to the evaluation questions above are "YES" and the proposed change requires NRC review.

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D. IMPACT ON RESOLUTION OF A SEVERE ACCIDENT ISSUE

10 CFR Part 52, Appendix D, Section VIII. B.5.a. provides that an applicant for a combined licensee who references the AP1000 design certification may depart from Tier 2 information, without prior NRC approval, if it does not require a license amendment under paragraph B.5.c. The questions below address the criteria of B.5.c.

1. Does the proposed activity result in an impact on features that mitigate severe accidents. If the answer is Yes answer Questions 2 and 3 below. ☐ YES ☒ NO

   The reactor coolant pump design changes described in APP-GW-GLN-016 will not have an impact on the pump pressure boundary integrity or any features that mitigate severe accidents.

2. Is there is a substantial increase in the probability of a severe accident such that a particular severe accident previously reviewed and determined to be not credible could become credible? ☐ YES ☐ NO ☒ N/A

3. Is there is a substantial increase in the consequences to the public of a particular severe accident previously reviewed? ☐ YES ☐ NO ☒ N/A

☒ The answers to the evaluation questions above are "NO" or are not applicable and the proposed departure from Tier 2 does not require prior NRC review to be included in plant specific FSARs as provided in 10 CFR Part 52, Appendix D, Section VIII. B.5.c

☐ One or more of the answers to the evaluation questions above are "YES" and the proposed change requires NRC review.

E. SECURITY ASSESSMENT

1. Does the proposed change have an adverse impact on the security assessment of the AP1000. ☐ YES ☒ NO

   The reactor coolant pump design changes described in APP-GW-GLN-016 will not alter barriers or alarms that control access to protected areas of the plant. The changes to the reactor coolant pump design will not alter requirements for security personnel.