

Risk Information Matrix for
AP1000 Designs – Risk Importance
(Date: 08/11/2016)

AP1000 Systems that are <i>Risk Important</i> and Reasons for Importance Not Prioritized within this Portion of the Table				
Important Systems	Reasons for Importance ¹	Cornerstones ²		
		Initiating Events ³	Mitigating Systems ⁴	Barrier Integrity ⁵
The risk importance information in IMC 2519 was agreed upon by industry and NRC staff during the development of the construction ROP.				
Protection and Safety Monitoring System (PMS)	[Importance: High]: PMS is a 4-Division safety-related system that uses Digital I&C consisting of functions with software, hardware and display panels which is likely to involve novel concepts. PMS is used to detect off-nominal conditions and actuation of appropriate safety-related functions necessary. In addition, it provides the equipment necessary to monitor the plant safety-related functions during and following an accident.	X	X	
Automatic Depressurization System (ADS)	[Importance: High]: ADS is a 4-stage (Stages 1 to 3 each have 2 lines with 2 MOVs in series per line; MOVs have electrical DC motor operators; Stage 4 has 4 lines with 1 Normally-Open MOV and 1 squib valve in series; Valves (DC Motors) are powered by Class 1E IDS; 10-year Full System Tech Specs Test safety-related system) safety-related system. ADS valves open when actuated and remain open for the duration of an	X	X	X

Commented [CS1]: Verify IE?

¹ Risk importance or significance of each system. The risk importance information in IMC 2519 was agreed upon by industry and NRC staff during the development of the construction ROP. It categorizes plant systems into High (>1E-4), Intermediate (1E-4 to 1E-5), Low (1E-5 to 1E-6), and Very Low (<1E-6) Risk based on the mean core damage frequency (CDF) if the SSC is assumed to be completely unavailable. The SSCs were compared with the DCD risk importance results and they were very similar. Source: IMC 2519 - cROP program document, Appendix A-10.

² To monitor and measure performance, the oversight process focuses on seven “cornerstones” that support the safety of plant operations in the three strategic performance areas. The three cornerstones applicable to this RIM are Initiating Events, Mitigating Systems, and Barrier Integrity.

³ **Initiating Events:** Any potential occurrence that could disrupt plant operations and challenge safety functions is an initiating event. This cornerstone focuses on limiting the occurrence of these type of events. These events could include equipment failures leading to a plant shutdown, shutdowns with unexpected complications, or large changes in the plant’s power output.

⁴ **Mitigating Systems:** These are safety systems designed into each plant that alleviate the effects of initiating events. Mitigating systems can prevent an accident or reduce the consequences of a possible accident. This cornerstone monitors the function of these safety systems through periodic testing and actual performance.

⁵ **Barrier Integrity:** There are three important barriers between the highly radioactive fuel inside the reactor and the public and the environment outside the plant. These barriers are: (1) the fuel rods, (2) the reactor vessel/reactor coolant system, and (3) the steel containment vessel. The licensees continuously monitor the integrity of these barriers to ensure their integrity is maintained.

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	automatic depressurization event.			
Core Makeup Tanks (PXS)	[Importance: Intermediate]: The Core Makeup Tank is a safety related system of two unheated tanks with 2 Normally-Open MOVs, 2 AOVs in parallel per line and in-line check valves; a 10-year Full System Tech Specs Test is required. Two CMTs maintained at RCS pressure Provide core decay heat removal during transients, accidents or whenever the normal heat removal paths are lost	X	X	X
Accumulators (PXS)	[Importance: Low]: The accumulators are a safety-related system of two uninsulated, unheated tanks with a nitrogen blanket and 2 normally-open MOVs and check valves in series. Safety injection is from 2 accumulators into RCS via direct injection lines to provide adequate core cooling for all LOCA sizes.		X	X
In-Containment RWST (PXS) – PRHR Heat Sink Injection Mode	[Importance: High]: The In-Containment RWST (PXS) – PRHR Heat Sink Injection Mode is a Safety Related system that transfers heat from RCS into IRWST via PRHR HX for long term decay heat removal during a non-LOCA event and is redundant to non-safety-related normal RHR (RNS)		X	X
Passive RHR (PXS)	[Importance: Intermediate]: The Passive RHR (PXS) is a safety-related system consisting of 1 Normally-Open MOV and 4 AOVs – 2 in parallel. The system is actuated by redundant parallel AOVs that fail open on loss of air, PMS signal or 1E power and requires a 10-year Full System Tech Specs Test. During non-LOCA events, passive RHR transfers heat from RCS into IRWST via PRHR HX for long term decay heat removal. The Passive RHR system is redundant to the non-safety-related normal RHR (RNS).	X	X	X
Passive Containment Cooling System (PCS)	[Importance: Low]: The Passive Containment Cooling System (PCS) is a safety-related system consisting of a passive containment cooling water storage tank built into containment structure and three discharge lines from the tank. Two lines each have an AOV and one line has an MOV for diversity. The PCS provides at least 72 hours of containment wetting to reduce containment temperature and pressure following a loss of coolant accident (LOCA) or main steam line break (MSLB) inside the containment. This is accomplished by a water distribution bucket and weir system evenly deliver water to the containment outer shell. Air flow paths are provided with screens to move air through the containment side and out through the containment chimney for cooling the containment shell. Containment must be vented after 24 hours. The PCS annulus drains inspected every 2 years.		X	X

Commented [CS2]: Not IE include in BI

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	Key portions of the system are accessible during power operations or shutdown. PCS Water Makeup is Included in the Short-Term Availability Controls Program with allowed outage times and surveillance requirements. A 10-year Full System Tech Specs Test is required. Additionally, the PCS transfers heat to the safety-related ultimate heat sink for other events resulting in a significant increase in containment pressure and temperature.			
DC-1E (IDS)	[Importance: High]: The DC-1E is a safety-related system consisting of four independent divisions of Class 1E 250VDC battery (two 24-hour and two 72-hour battery banks) systems each with a 120VAC UPS and battery charger, and. A spare Class 1E battery system and charger is provided. DC-1E powers I&C and various valves needed for safe shutdown (both DC and AC, via inverters)	X	X	X
Main AC Power (ECS)	[Importance: Low]: The main power system is a non-safety-related, non-class 1E system. ECS provides normal power source for reactor, turbine, and balance of plant auxiliary electrical loads. On loss of normal and preferred sources, ancillary diesel generators supply selected loads. ECS charges the Class 1E DC battery. Safety-related reactor coolant pump breakers open to allow CMT operation.		X	
Offsite Power ***RTNSS***	[Importance: Very Low]: AC Power is a non-safety-related system and is the preferred power source when the normal power source (Main AC Power) is not available. Offsite Power provides power from the high-voltage switchyard via a back feed using the main and auxiliary transformers during plant startup, shutdown, and maintenance. AC power source is not required and is included in the Short-Term Availability Controls Program with allowed outage times and surveillance requirements.		X	

Commented [CS3]: Verify if valves are used for containment cooling

Commented [CS4]: Possibly IE due to Rx trip??

Commented [CS6]: Keep because charges Class 1E DC Batteries

Commented [CS5]: Ayo to verify why this is included.

Commented [CS7]: Rx trip, offsite power or diesels, these do apply. No cornerstones. Any cornerstones impacted?, does not cause IE

Commented [CS8]: Valves open, do not need AC power

⁶ Regulatory Treatment of Non-Safety Systems is required for passive plants. RTNSS SSCs are active and non-safety related systems relied on for defense-in-depth and necessary to meet passive-ALWR-plant safety goals and investment protection goals. The RTNSS SSCs were identified in the AP1000 DCD 16.3, Investment Protection Short-Term Availability Controls Program.

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Diesel Generators (DG) ***RTNSS*** (includes both standby and ancillary diesels)	<p>[Importance: Very Low]: The AP1000 design supports island mode if the main generator is still available during LOOP:</p> <p><u>Ancillary DGs:</u> Provides long term Class-1E power supplies for Post-Accident Monitoring (PAM), MCR lighting, MCR and I&C room ventilation, and power to refill the PCS water storage tank and spent fuel pool if no other sources of AC power are available.</p> <p><u>Standby DGs:</u> Provide backup power source when the main generator, feedback from offsite power and maintenance power are not available.</p> <p>The DG is a non-safety system consisting of two Ancillary DGs and two Standby DGs. The Ancillary DGs support post-72 hour actions such as lighting, cooling, tank refilling and battery recharging. DG is included in the Short-Term Availability Controls Program with allowed outage times and surveillance requirements.</p>			X
DC POWER (EDS) ***RTNSS***	<p>[Importance: Intermediate]: The EDS is a non-safety-related system that consists of two separate power supply trains - each train will last 2 hours after loss of all AC. EDS is included in the Short-Term Availability Controls Program with allowed outage times and surveillance requirements. The non-Class 1E 125VDC and UPS system (EDS) provides dc and uninterruptible ac power to non-safety-related loads including Diverse Actuation System (DAS) to support ATWS mitigation and the Hydrogen igniters;</p>			X
Normal RHR (RNS) ***RTNSS***	<p>[Importance: Low]: Normal RHR is a non-safety system and not part of containment & RCS isolation functions. RNS provides long term post-accident containment inventory makeup and is typically powered by onsite standby DGs. Normal RHR is included in the Short-Term Availability Controls Program with allowed outage times and surveillance requirements. Normal RHR is a back-up for passive RHR system.</p>		X	
Service Water System (SWS) ***RTNSS***	<p>[Importance: Low]: SWS is a non-safety-related system consisting of 2 trains - with one normally running and the other in standby and backed up by the onsite standby DGs. SWS is included in the Short-Term Availability Controls Program with allowed outage times and surveillance requirements. SWS supplies cooling water to remove heat from the non-safety related component cooling water system heat exchangers in the turbine building, transferring it to the non-safety-related ultimate heat sink.</p>			

Commented [CS9]: PCS water storage tank and spent fuel pool if no other sources of AC power are available

Commented [CS10]: Normal RHR is a back-up for passive RHR system

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Component Cooling Water System (CCS) ***RTNSS***	[Importance: Low]: Component cooling water is a closed-loop non-safety-related system consisting of 2 trains with one pump each and backed up by the onsite standby DGs. Component Cooling Water is included in the Short-Term Availability Controls Program with allowed outage times and surveillance requirements. Component cooling water transfers heat from various components needed for plant operation and removes core decay heat and sensible heat for normal reactor shutdown and cooldown.			
Diverse Actuation System (DAS) ***RTNSS***	[Importance: Low]: DAS is a non-safety-related system that utilizes is used as a backup to PMS. DAS Instrumentation is Included in the Short-Term Availability Controls Program with allowed outage times and surveillance requirements. DAS is also included in Tech Specs with testing every 24 months. DAS provides an alternate means of initiating reactor trip and actuating selected engineered safety features, and providing plant information to the operator.	X	X	X
Containment Hydrogen Control System (VLS)	[Importance: Low]: Containment hydrogen control system is a non-safety-related system consisting of two non-safety related passive autocatalytic recombiners (PARs) for defense-in-depth protection against the buildup of hydrogen following a loss of coolant accident. The hydrogen Igniters are Included in the Short-Term Availability Controls Program with allowed outage times and surveillance requirements. The containment hydrogen control system allows monitoring and limiting of hydrogen concentration levels inside containment.			X

Commented [CS11]: BU to PMS and diverse way to S/D Reactor

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Main control room and I&C rooms B/C ancillary fans Nuclear Island Nonradioactive Ventilation System (VBS - FANS)	<p>[Importance: Low]: VBS-FANS is a safety-related system consisting of VBS MCR and I&C rooms B/C ancillary fans (VBS-MA-10A/B, -11, -12) that are available to provide cooling of the MCR and the two I&C rooms (B/C) that provide post-accident monitoring. VBS-FANS is included in the Short-Term Availability Controls Program with allowed outage times and surveillance requirements.</p> <p>VBS-FANS isolates the HVAC penetrations in the main control room boundary on high-high particulate or iodine concentrations in the main control room supply air or on extended loss of ac power and deliver the required air flow to the main control room to meet the ventilation and pressurization requirements for 72 hours.</p> <p>VBS-FANS provide passive heat sinks capable of limiting the temperature rise for the main control room, instrumentation and control rooms, and dc equipment rooms and serves the main control room, technical control support center area, Class 1E dc equipment rooms, Class 1E instrumentation and control (I&C) rooms, Class 1E electrical penetration rooms, Class 1E battery rooms, remote shutdown room and the passive containment cooling system (PCS) valve room.</p>	X	X	
Plant Control System (PLS)	<p>[Importance: Intermediate]: The Plant Control System is a non-safety related system that allows automatic and manual control of non-safety related equipment. PLS provides the functions necessary for normal operation of the plant from cold shutdown through full power and establishes and maintains plant operating conditions within prescribed limits. PLS also minimizes challenges to the protection systems.</p>	X		
Reactor Coolant System (RCS)	<p>[Importance: High]: The reactor coolant system is a safety-related system that transfers heat to the steam and power conversion system (during power operation as well as the initial phase of plant cooldown). RCS transfers heat produced during the subsequent phase of plant cooldown and cold shutdown to the normal residual heat removal system.</p>			X

Commented [CS12]: Can cause Rx Trip.

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Chemical and Volume Control System (CVS)	[Importance: Very Low]: CVS is a non-safety-related system consisting of 2 trains with one pump and one letdown AOV isolation valve each. The chemical and volume control system provides a safety-related means to terminate inadvertent RCS boron dilution and to preserve containment integrity by isolation of the CVS lines penetrating the containment. CVS maintains the required coolant inventory in the RCS including maintaining RCS purity and activity level within acceptable limits. CVS provides pressurizer auxiliary spray water for depressurization and is used to fill and pressure tests the RCS (with connections for hydrostatic testing).	X		X
Steam Generator System (SGS)	[Importance: Very Low]: RCS Pressure Boundary portion of the Steam Generator System is Safety Related. The heat transfer function and associated secondary water and steam system are not safety related. The Steam Generator System removes heat from the reactor coolant system during power operation and anticipated transients as well as under natural circulation conditions	X		X
Startup Feedwater System (FWS)	[Importance: Very Low]: The startup feedwater system is a non-safety-related that is capable of providing an alternate core cooling mechanism to the PRHR heat exchangers for non-LOCA or steam generator tube ruptures. The startup feedwater system supplies feedwater to the steam generators during plant startup, hot standby and shutdown conditions, and during transients in the event of main feedwater system unavailability.	X	X	
Main Control Room Emergency Habitability System (VES)	[Importance: Very Low]: The Main Control Room Emergency Habitability System is a safety-related that functions 10 mins after loss of AC and is included in Tech Specs 3.7.6. The Main Control Room Emergency Habitability System Provides emergency ventilation and pressurization for the main control room after a loss of AC power and provides emergency passive heat sinks for the main control room, instrumentation and control rooms, and dc equipment rooms.		X	

Commented [CS13]: Boration/Dilution Pzr Press Control Low Pzr Press

Commented [CS14]: Containment Integrity

Commented [CS15]: Loss of system causes transient

Commented [CS16]: Transients in the event of main feedwater system unavailability.