REVISED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**No. 434-8352**
SRP Section:	**SRP 19**
Application Section:	**19.1**
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Question No. 19-87

10 CFR 52.47(b)(1) and 10 CFR 52.80(a) require, in part, that applications for a design certification (DC) include the inspections, tests, analyses and acceptance criteria (ITAAC) necessary to demonstrate that the facility has been constructed and will be operated in conformity with the NRC regulations. In addition, Section 14.3, “Inspections, Tests, Analyses, and Acceptance Criteria,” indicates that “the important insights and assumptions from the PRA provided in DCD Chapter 19 should be used to determine the appropriate top-level design features for inclusion in Tier 1. A discussion of how the important insights or assumptions from the PRA should be addressed in the selection of the Tier 1 material. The important integrated plant safety analyses from Tier 2 should be considered, such as analyses of internal events, fires, floods, severe accidents, and shutdown risk.”

Accordingly, in order for the staff to reach a reasonable finding that the application includes the appropriate ITAAC associated with the PRA as noted above, please describe in detail how the APR1400 PRA was used in determining the scope of ITAAC and include the discussion in the DCD. In addition, the staff reviewed APR1400 DCD and could not find any ITAAC that were derived from the important PRA assumptions and insights, therefore, please revise the DCD to identify these ITAAC.

Response – (Rev. 2)

The APR1400 design uses successful, proven technology throughout the plant, including the design of systems and components, maintainability and operability features, and construction techniques. General design descriptions are provided in DCD Tier 2 Section 1.2. APR1400 has utilized the PRA throughout the design phase and the PRA models and results were used to influence the selection of design alternatives. As an integral part of the design process, PRA is used to optimize the plant design with respect to safety during the design phase. To provide reasonable assurance that this information is incorporated into the design process, the PRA insights and assumptions are categorized by design requirement, operational programs and PRA Model insight.

During the design phase, PRA provided insights leading to improvements. Major design features adopted in the APR1400 to reduce or eliminate weaknesses included a design change relating to emergency power, by increasing the number of EDGs from two to four, extending the 125 Vdc battery life from 8 hours to 16 hours. A more complete discussion on the APR1400 design features are described in Subsection 19.1.3. In addition, Table 19.1-3 also includes the effects of new design features found in the APR1400 on plant risk, as well as features and requirements introduced to reduce or eliminate the known weaknesses and vulnerabilities in current reactor designs, and Table 19.1-4 is a list of significant PRA insights and assumptions regarding how the design and operational features affect the plant risk, and how uncertainties affect the PRA models in representing the plant risk.

As required by the SRP, the type of information and level of detail in Tier 1 are based on a graded approach commensurate with the safety significance of the structures, systems and components (SSC) for the design. For the identification and development of APR1400 ITAAC, top-level information was selected, including principal performance characteristics and safety functions of the SSCs, for verification after consideration of appropriate treatments of important insights and assumptions from the PRA. Design commitments were identified for portions of the design description that were to be verified by ITAAC. For those design commitments, Acceptance Criteria were specifically developed to ensure the performance, physical condition, or analysis for SSC are satisfactorily demonstrated. The important insights and assumptions from the PRA provided in DCD Chapter 19 were used to assess the appropriate top-level design features for inclusion in Tier 1.

Table 14.3.4-2 summarizes the design information particularly significant to selection of design features for Tier 1 from the PRA (Attachment 1, 2). Design features and performance characteristic information presented as ITAAC were also cross referenced to appropriate Tier 2 Sections. DCD Table 14.3.4-2 was reviewed again to ensure that the ITAAC derived from the important PRA assumptions and insights from the final PRA update are appropriately included. As a result of the PRA update, Table 14.3.4-2 and Table 19.1-4 were revised as shown in Attachments 4 and 5 which included some DCD cross reference corrections and conforming changes to reflect the updated information and impacts. In addition, updated risk insights affecting design features, key assumption and ITAAC resulting from the PRA update were summarized as shown in Attachment 6. While no impacts were identified, information was updated for nine items relative to key design features, assumptions and insights, including adding one item associated with 2.4.1 ITAAC #8.b involving design controls required to start/stop the reactor coolant pumps and open/close certain MOVs/AOVs as shown in the revised Table 14.3.4-2 in Attachment 4.

A revised DCD Section 19.1 with updated results is being submitted with KHNP’s response to RAI 434-8352 for Question 19-92.

Impact on DCD

DCD Tier 2, Subsection 19.1.1.1 will be revised as indicated on the Attachment 1. DCD Tier 2 Markups related to Subsection 14.3.4 will be revised as indicated on the Attachments 2 and 3.

DCD Tier 2, Table 14.3.4-2 will be revised as indicated on Attachment 4. DCD Tier 2, Table 19.1-4 will be revised as indicated on Attachment 5.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

The PRA is documented in an extensive set of PRA notebooks, which are cross-referenced in the PRA Summary Report (Reference 7).

19.1.1 Uses and Applications of the PRA

19.1.1.1 Design Phase

The PRA is an integral part of the design process and is used to optimize the plant design with respect to safety. The PRA models and results influence the selection of design alternatives.

The APR1400 is designed to perform better than currently operating plants in the area of severe accident performance, since prevention and mitigation of severe accidents are evaluated during the design phase, taking advantage of PRA results and severe accident evaluations. The PRA results indicate that the APR1400 design results in a low level of risk and meets the core damage frequency (CDF), LRF, and containment performance goals for new-generation pressurized water reactors (PWRs).

At the design phase, the PRA results are used as information providing input to Inspection, Test, Analysis, and Acceptance Criteria (Section 14.3), Technical Specifications (Chapter 16), reliability assurance program (RAP) (Section 17.4), human factors engineering (Section 18.6), severe accident evaluation (Section 19.2), and other design areas. For the identification and development of APR1400 ITAAC, top-level information was selected, including principal performance characteristics and safety functions of the SSCs, for verification after consideration of appropriate treatments of important insights and assumptions from the PRA. Design commitments were identified for portions of the design description that were to be verified by ITAAC. For those design commitments, Acceptance Criteria were specifically developed to ensure the performance, physical condition, or analysis for SSC are satisfactorily demonstrated. The important insights and assumptions from the PRA were used to assess the appropriate top-level design features for inclusion in Tier 1.

19.1.1.2 Combined License Application Phase

Uses of the PRA related to a specific combined license (COL) application are not addressed at this stage. A COL applicant that references the APR1400 design certification needs to describe the uses of PRA in support of licensee programs and identify and describe risk-informed applications being implemented during the combined license application (COLA) phase (COL 19.1(1)).

19.1.1.3 Construction Phase

Uses of the PRA related to a specific COL application and associated construction activities are not addressed at this stage. A COLA that references the APR1400 design certification needs to describe the uses of PRA in support of licensee programs and identify and describe risk-informed applications being implemented during the construction phase (COL 19.1(2)).

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Tables 14.3.4-1 through 14.3.4-6 summarize the design information particularly significant to selection of design material for Tier 1, as follows:

a. Table 14.3.4-1: Design Bases Accident Analysis Key Design Features

b. Table 14.3.4-2: PRA ~~and Severe Accident Analysis~~ Key Design Features

c. Table 14.3.4-3: Flooding Analysis Key Design Features

d. Table 14.3.4-4: Fire Protection Analysis Key Design Features

e. Table 14.3.4-5: ATWS Analysis Key Design Features

f. Table 14.3.4-6: Radiological Analysis Key Design Features

The referenced Tier 2 sections in these tables, however, may contain more information than is encompassed by the subject areas. Each table may also include design information (certified or noncertified) that is not directly related to the particular subject area. Further, the tables are not intended to include all system-specific information that is provided in the Tier 2 system descriptions. The risk insights from the PRA are used to identify and support ITAAC as summarized in Table 14.3.4-2.

14.3.5 Design ITAAC Closure Process

APR1400 standard design uses "design ITAAC" to specify the limits, parameters, procedures, and attributes associated with HFE(V&V). These design ITAAC are identified in DCD Tier 1 and provided with an as-built ITAAC to verify their completion prior to initial fuel load.

Design ITAAC will be closed using the process described in this subsection. Following closure of the design ITAAC, ITAAC for related as-built SSCs will be closed to verify that their respective principal performance characteristics and safety functions conform to the certified design. RG 1.206 (Reference 1), "Combined License Applications for Nuclear Power Plants (LWR Edition)," Section C.III.5 provides design ITAAC closure guidance.

14.3.5.1 Design ITAAC Closure Options

There are three options available to close a design ITAAC. Design information used to close design ITAAC represents a level of detail similar to that which would have been

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Table 14.3.4-2 (1 of 7)

PRA ~~and Severe Accident Analysis~~ Key Design Features

Item #	Tier 1 Reference	Design Features	Tier 2 Reference
2-1	2.2.1 ITAAC #2.c	The containment and its penetrations retain their pressure boundary integrity associated with the design pressure. The containment pressure boundary is evaluated to provide reasonable assurance the maintenance of its role as a reliable leak-tight barrier under severe accident conditions.	3.8.1 3.8.2 19.1.3 19.2.4
~~2-2~~ 2-3	2.4.~~2~~ 1 ITAAC #9.a	The pressurizer POSRVs provide overpressure protection for reactor coolant pressure boundary components in the RCS.	5.2.2 19.1.3 19.2.3
~~2-3~~ 2-4	2.4.~~3~~ 2 ITAAC #1~~,~~ ~~#9d~~	The IRWST provides borated water for the safety injection system (SIS) and the containment spray system (CSS). It is the primary heat sink for discharges from the safety depressurization and vent system. It is the source of water for the CFS, and for filling the refueling pool via the shutdown cooling system (SCS).	6.8.1 19.1.3 19.2.3
~~2-4~~ 2-5	2.4.~~3~~ 2 ITAAC #9.~~d~~ c	The IRWST sump for each SIS/CSS division has a strainer.	6.8.2.2 19.1.3
~~2-5~~ 2-6	2.4.~~4~~ 3 ITAAC #1, #9a a	The safety injection system (SIS) injects borated water into the reactor vessel to provide core cooling and reactivity control in response to design basis accidents. The SIS also provides core cooling during feed and bleed operation, in conjunction with the pilot operated safety relief valves (POSRVs). The major components of the SIS are four identical safety injection pumps (SIPs), an in-containment refueling water storage tank (IRWST), four identical safety injection tanks (SITs), and associated valves.	6.3.1 19.1.3
~~2-6~~ 2-7	2.4.~~4~~ 3 ITAAC #9.~~e~~ f	The SIS can be manually realigned for simultaneous hot leg injection and direct vessel injection (DVI).	6.3.1 19.1.3
~~2-7~~ 2-8	2.4.~~5~~ 4 ITAAC #1, #9.a, #9d	The SCS is designed such that the shutdown cooling pumps (SCPs) are identical and functionally interchangeable with containment spray pumps (CSPs) for containment spray system (CSS). Provisions are made to control the valves used in the SCS/CSS interconnection. The SCS contains two heat exchangers and two pumps. One SCS pump is capable of meeting the safety-grade cooldown criteria and two SCS pumps are required to meet the normal cooldown	5.4.7 19.1.3
2-2	2.4.1 ITAAC #8.b	All controls required by the design exist in the RSR to start and stop the reactor coolant pumps and to open and close MOVs and AOVs listed in Table 2.4.1-2.	5.4.1 19.1.4.1

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Table 14.3.4-2 (2 of 7)

Item #	Tier 1 Reference	Design Features	Tier 2 Reference
2-9 ~~2-8~~	2.4.~~5~~ 4 ITAAC #9.a	The SCS cools the reactor by removing decay heat, and other residual heat from the reactor core and the RCS during the normal plant shutdown and cool down conditions.	5.4.7 19.1.3
2-10 ~~2-9~~	2.4.~~7~~ 6 ITAAC #9.c	The CVCS provides backup spray water to the pressurizer, provides cooling water to the RCP seals, and provides water to the spent fuel pool and in-containment refueling water storage tank (IRWST).	9.3.4 19.1.3
2-11 ~~2-10~~	2.4.~~7~~ 6 ITAAC #9.b	The CVCS supplies seal water to the RCP seals.	9.3.4.2.4 19.1.3
2-12 ~~2-11~~	2.5.1 Design Description	The plant protection system (PPS) consists of four channels of PPS cabinets and core protection calculator system (CPCS) cabinets.	7.2.1 19.1.3
2-13 ~~2-12~~	2.5.1 ITAAC #4.c	Manual initiation switches are provided for reactor trip in the MCR and the RSR.	7.2.1.53 19.1.3
2-14 ~~2-13~~	2.5.1 ITAAC #8	Each PPS channel is controlled from either the MCR or the RSR as selected from master transfer switches.	7.7.1.2 19.1.3
2-15 ~~2-14~~	2.5.1 ITAAC #~~14~~ 13	The RT logic of the PPS is designed to fail to a safe state such that loss of electrical power to a channel of PPS results in a trip but does not result in ESF actuation.	7.2.1.3 19.1.3
2-16 ~~2-15~~	2.5.2 ITAAC #1, #2, #3	The diverse protection system (DPS) is non-safety system which provides a diverse mechanism to decrease risk from the anticipated transient without scram (ATWS) events, and assist the mitigation of the effects of a postulated common cause failure (CCF) of the digital computer logic within the plant protection system (PPS) and the engineered safety features-component control system (ESF-CCS).	7.8.1.1 7.8.1.2 7.8.1.3 Table 7.8-1 Table 7.8-2 19.1.3
2-17 ~~2-16~~	2.5.2 ITAAC #~~1~~ 2, #4	The DPS is physically separate, electrically independent, and diverse from the PPS and ESF-CCS including a diverse method for the interruption of power to the control element drive mechanism (CEDM), the turbine trip, the auxiliary feedwater actuation and safety injection actuation.	7.8.1.1 19.1.3
2-18 ~~2-17~~	2.5.4 ITAAC #8	Each ESF-CCS channel is controlled from either the MCR or RSR, as selected from master transfer switches.	7.3.1 19.1.5

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Table 14.3.4-2 (3 of 7)

Item #	Tier 1 Reference	Design Features	Tier 2 Reference
~~2-18~~ 2-19	2.5.4 ITAAC #7	Upon detecting loss of power to Class 1E division the ESF-CCS initiates startup of the diesel generators, shedding of electrical load, transfer of Class 1E bus connections to the diesel generators, and sequencing to the reloading of safety-related loads to the Class 1E bus.	7.3.1.8 19.1.3
~~2-19~~ 2-20	2.5.2 ITAAC #7 2.5.4 ITAAC #1	Diverse manual ESF actuation (DMA) switches are provided in the MCR as an alternate means for manual actuation of ESF components in four channels of the ESF-CCS.	7.3.2.4 19.1.3
~~2-20~~ 2-21	2.6.1 ITAAC #1	The ac electric power distribution system consists of the transmission system, the plant switchyard, main transformer (MT), two unit auxiliary transformers (UATs), two standby auxiliary transformers (SATs), a main generator (MG), a generator circuit breaker (GCB), isolated phase buses, switchgears, load centers (LCs), and motor control centers (MCCs). The electric power distribution system also includes the power, control, instrumentation cables and raceways, and electrical protection devices, such as circuit breakers and fuses.	8.1.1, 8.1.2 19.1.3
~~2-21~~ 2-22	2.6.1 ITAAC #8	If normal offsite power supply is not available, 4.16 kV Class 1E medium voltage buses are automatically transferred to alternate offsite power supply.	8.3.1.1 19.1.3 19.2.2
~~2-22~~ 2-23	2.6.1 ITAAC #10.a	Independence is provided between each of the four trains of Class 1E distribution equipment and circuits.	8.3.1.1.2.3 19.1.3
~~2-23~~ 2-24	2.6.1 ITAAC #21	The post-fire safe-shutdown circuit analysis provides reasonable assurance that one success path of shutdown SSCs remains free of fire damage.	Table 9.5.1-1 19.1.5
~~2-24~~ 2-25	2.6.2 ITAAC #1	Four EDGs provide Class 1E power to the four independent Class 1E trains, respectively, during a LOOP or a LOOP concurrent with DBA. EDGs are normally in standby mode.	8.3.1.1 19.1.3

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Table 14.3.4-2 (4 of 7)

Item #	Tier 1 Reference	Design Features	Tier 2 Reference
~~2-25~~ 2-26	2.6.2 ITAAC #15	A loss of power to a Class 1E medium voltage safety bus automatically starts its respective EDG and load sheds the Class 1E bus within the affected train. Following attainment of required voltage and frequency, the EDG automatically connects to its respective train bus. After the EDG connects to its respective bus, the non-accident loads are automatically sequenced onto the bus.	8.3.1.1.3.6 19.1.3
~~2-26~~ 2-27	2.6.2 ITAAC #16	The Class 1E auxiliary power for EDG support systems is supplied power from the same train respectively.	8.3.1.1.3 19.1.3
~~2-27~~ 2-28	2.6.2 ITAAC #17	For a loss of power to a Class 1E medium voltage safety bus concurrent with a design basis event condition (SIAS/CSAS/ AFAS), each EDG automatically starts and load shedding of the Class 1E bus within the affected train occurs. Following attainment of required voltage and frequency, the EDG automatically connects to its respective bus and the accident loads are sequenced onto the bus.	8.3.1.1.3 19.1.3
~~2-28~~ 2-29	2.6.2 ITAAC #9	Each EDG has fuel storage capacity to provide fuel to its EDG for a period of seven days with the EDG supplying the power requirements for the most limiting design basis event.	9.5.4 19.1.3
~~2-29~~ 2-30	2.6.2 ITAAC #11	One transfer pump in each train automatically supply diesel fuel oil from the storage tank to the day tank prior to actuation of low level alarm and stops automatically on a fuel oil day tank high-level signal.	9.5.4 19.1.3
~~2-30~~ 2-31	2.6.3 ITAAC #1	The Class 1E 125 Vdc system consists of four independent subsystems, train A, B, C, and D, each corresponding to one of the four reactor protection instrumentation channels A, B, C, and D. The non-Class 1E dc power system is also comprised of two separate subsystems, divisions I and II. Each Class 1E and non-Class 1E dc power system is provided with its own battery, two battery chargers (normal and standby), a dc control center, and dc distribution panels. The Class 1E dc power system supplies reliable continuous power to the plant safety system dc loads and the Class 1E I&C system.	8.3.2.1.2.1 19.1.3
~~2-31~~ 2-32	2.6.3 ITAAC #4	The Class 1E dc power system cables are routed in raceway systems within their respective trains.	8.3.2.1.2 19.1.5

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Table 14.3.4-2 (5 of 7)

Item #	Tier 1 Reference	Design Features	Tier 2 Reference
~~2-32~~ 2-33	2.6.4 ITAAC #1	The Class 1E 120 Vac I&C power system is separated into four subsystems, trains A, B, C, and D that supply power to the plant protection system channels A, B, C, and D. The Class 1E I&C power system includes four separate and independent 120 Vac power distribution panel, and each system is powered from a 125 Vdc control center via a 125 Vdc/120 Vac static inverter.	8.3.2.1.2.2 19.1.3
~~2-33~~ 2-34	2.6.4 ITAAC #4	When dc input power to the Class 1E inverter power supply unit is lost, input to the Class 1E inverter power supply unit is provided by the regulating transformer without interruption of power supply to the loads.	8.3.2 19.1.3
~~2-34~~ 2-35	2.6.6 ITAAC #1	The alternate ac (AAC) power source supplies power to safety-related loads to maintain the plant in a safe shutdown condition during station blackout (SBO). The AAC power source also provides power to the permanent non-safety (PNS) buses during a loss of offsite power (LOOP) condition. The AAC power source is a gas turbine generator (GTG) that is independent from the EDGs and the offsite power sources.	8.4.1.2 8.4.1.3 19.1.3
~~2-35~~ 2-36	2.6.6 ITAAC #3	The AAC source is connected to the Class 1E train A or train B bus through two in series (one Class 1E circuit breaker at the Class 1E bus and the other non-Class 1E circuit breaker at the non-Class 1E AAC bus) circuit breakers during SBO condition.	8.3.1.1.1 19.1.3
~~2-36~~ 2-37	2.6.6 ITAAC #4	The AAC source can be started, brought up to the required voltage and frequency, and connected manually to the Class 1E train A or train B bus within 10 minutes in the event of SBO.	8.4.1.3 19.1.3
~~2-37~~ 2-38	2.6.6 ITAAC #6	The GTG has fuel oil storage capacity enough to supply power to the required loads for 24 hours.	9.5.9 19.1.3
~~2-38~~ 2-39	2.7.1.5 ITAAC #1, #11.a	The AFWS is designed to be either manually actuated or automatically actuated by an auxiliary feedwater actuation signal (AFAS) from the engineered safety feature actuation system (ESFAS) or diverse protection system (DPS).	10.4.9 19.1.3
~~2-39~~ 2-40	2.7.1.5 ITAAC #10.b	Each AFWST has sufficient capacity for 8 hours of operation at hot standby condition and subsequent cooldown of the reactor coolant system within 6 hours to condition that permit operation of the shutdown cooling system.	10.4.9 19.1.3

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Table 14.3.4-2 (6 of 7)

Item #	Tier 1 Reference	Design Features	Tier 2 Reference
~~2-40~~ 2-41	2.7.1.5 ITAAC #11.b	The ESF-CCS includes logic to close the AFW isolation valves when SG water level has risen above a high-level setpoint, and to reopen AFW isolation valves when SG water level drops below a low-level setpoint.	10.4.9 19.1.3
~~2-41~~ 2-42	2.7.2.1 ITAAC #1	The ESWS consists of two independent, redundant, once-through, safety-related divisions. Each division cools one of two divisions of the CCWS, which cools 100 percent of the safety-related loads. Each division of the ESWS consists of two pumps, three CCW heat exchangers, three debris filters, and associated piping, valves, controls, and instrumentation.	9.2.1 19.1.3
~~2-42~~ 2-43	2.7.2.1 ITAAC #9	The two mechanical divisions of the ESWS are physically separated.	9.2.1 19.1.3
~~2-43~~ 2-44	2.7.2.2 ITAAC #1	The CCWS consists of two separate, independent, redundant, closed loop, and safety-related divisions. Either division of the CCWS is capable of supporting 100 percent of the cooling functions required for a safe reactor shutdown. Each division of the CCWS includes three heat exchangers, a surge tank, two CCW pumps, a chemical addition tank, a CCW radiation monitor, piping, valves, controls, and instrumentation.	9.2.2 19.1.3
~~2-44~~ 2-45	2.7.2.2 ITAAC #9	The two mechanical divisions of the CCWS are physically separated.	9.2.2 19.1.3
~~2-45~~ 2-46	2.7.2.3 ITAAC #1, #9	The ECWS consists of two divisions. Each division includes two chillers, two chilled water pumps, a compression tank, an essential chilled water makeup pump, an air separator, piping, valves, controls, and instrumentation. The ECWS is located in the auxiliary building.	9.2.7.1.1 19.1.3
~~2-46~~ 2-47	2.11.2 Design Description	The containment spray system (CSS) is a safety-related system. It removes heat and reduces the concentration of radionuclides released from the containment atmosphere and transfers the heat to the component cooling water system following events that increase the containment temperature and pressure. The CSS can also remove heat from the in-containment refueling water storage tank (IRWST).	6.2.2 19.1.3 19.2.2

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Table 14.3.4-2 (7 of 7)

Item #	Tier 1 Reference	Design Features	Tier 2 Reference
~~2-47~~ 2-48	2.11.4 ~~Design Description~~ ITAAC #~~3~~ 1	The containment hydrogen control system (CHCS) is non-safety-related system. The CHCS is used to maintain hydrogen gas concentration in containment at a level that precludes an uncontrolled hydrogen and oxygen recombination within containment following beyond-design-basis accidents. The CHCS consists of the passive autocatalytic recombiners (PARs) and hydrogen igniters (HIs). The PARs and HIs are designed to control and allow adiabatic controlled burning of hydrogen at fairly low concentration in containment and in-containment refueling water storage tank (IRWST) from exceeding 10 volume percent during a degraded core accident with 100 percent fuel clad metal-water reaction.	6.2.5 19.1.3 19.2.3
~~2-48~~ 2-49	2.11.4 ITAAC #3	The CHCS provides PARs complemented by HIs to control the containment hydrogen concentration for beyond-design-basis accidents.	6.2.5 19.1.3 19.2.3
~~2-49~~ 2-50	2.11.4 ITAAC #3~~.a~~	At least 30 PARs and 8 hydrogen igniters are provided inside containment.	6.2.5 19.2.3
~~2-50~~ 2-51	3.2 a.	The UHS provides the capability to reject the heat under normal and accident conditions (safe shutdown or post-accident) assuming a single active failure concurrent with a loss of offsite power.	9.2.5 19.1.3

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Table 19.1-4 (5 of 26)

No.	Insight	Disposition
Risk Insights from Key Design Features		
12	The in-containment refueling water storage tank (IRWST) is an important design feature that helps reduce the risk with respect to currently operating reactor designs. Important characteristics are: Located inside containment CSS and/or SCS can be aligned to cool the IRWST contents using the CSS or SCS heat exchangers, respectively No valve changeover is required for the recirculation mode of emergency core cooling; IRWST inventory can be made up from the BAST. In conjunction with remote manual valve operation, IRWST provides source of water for flooding the reactor cavity in severe accidents.	Subsection 6.8.2.2
13	The following are some important aspects of the SIS as represented in the PRA:	
	Four redundant trains are arranged and are completely physically and electrically separated from each other. Each SIP has an independent suction line connection from the IRWST.	Subsection 6.3.2.1
	A passive flow regulating device, the fluidic device (FD), is installed in safety injection tank (SIT) to regulate the discharge flow rate from SIT during large break LOCA. By the adoption of the FD, the need for large-capacity low pressure SIPs was eliminated.	Subsection 6.3.2.1
	Safety injection for "feed and bleed" is an important backup decay heat removal method during an accident condition or shutdown operation.	Subsection 6.3.1.4 COL 13.5(4), COL 13.5(5)
	The SIS can be manually realigned for simultaneous hot leg injection and direct vessel injection (DVI).	Subsection 6.3.1 Subsection 19.1.3

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Table 19.1-4 (8 of 26)

No.	Insight	Disposition
Risk Insights from Key Design Features		
17	A diverse RCP seal injection capability is provided using a positive displacement pump that is diverse from the CVCS and can be powered from either the EDG or the AAC.	Subsection 9.3.4.3
18	The following are important aspects of the auxiliary feedwater system (AFWS) as represented in the PRA:	
	The AFWS is a dedicated safety system that has two separate and redundant divisions. Each division has two diverse 100% capacity AFW pumps, one motor operated and one turbine driven. Redundancy, diversity, and separation between divisions are important features improving the reliability of the secondary side heat removal.	Subsection 10.4.9.2
	The turbine-driven AFW pump in each division is supplied steam from the SG in its division via a pipe connection located upstream of the MSIV. For SBO sequences that do not credit the alternate ac source, the turbine-driven AFW pumps are the only safety system available for removing decay heat. Their operation, however, requires dc power supplied by batteries.	Subsection 10.4.9.2 Subsection 10.4.9.3
	Each auxiliary feedwater storage tank (AFWST) can be supplied by gravity flow from either the condensate water storage tank (CST) or the raw water storage tank, thereby providing long-term cooling.	Subsection 10.4.9.2
	The AFWS is designed to be either manually actuated or automatically actuated by an auxiliary feedwater actuation signal (AFAS) from the engineered safety feature actuation system (ESFAS) or diverse protection system (DPS).	Subsection 10.4.9 Subsection 19.1.3

The Updated Risk Insights and Key Assumptions vs ITTAC

No.	Insight	Tier 1
PRA Key Assumptions		
1	The RCP seal LOCA model is based on Reference 64. Seal LOCA is assumed to occur if the RCPs are not tripped within 20 minutes of loss of all seal cooling from both RCP thermal barrier cooling from the CCWS and RCP seal injection from the CVCS. If the RCPs are successfully tripped, the model still assumes a conditional seal failure probability (CSFP). The CSFP is dependent upon RCS subcooling, isolation time of the controlled bleed off (CBO) lines and duration. The PRA conservatively assumes RCS subcooling is > 50oF for all scenarios as this results in the largest CSFP, and uses the 24 hour PRA mission time for the duration of the event. The isolation of the CBO is modeled directly in the event trees.	In the DCD Rev.1, RCP seal probability is assumed, but the updated PRA model is evaluated by using WCAP RCP Report. The RCP seal probability for APR1400 is prepared in the report. *Impact on ITTAC* *(add in table 14.3.4-2)* 2.4.1 #8b

The Updated Risk Insights and Key Assumptions vs ITTAC

No.	Insight	Tier 1
PRA Key Assumptions		
5	Room cooling is assumed not to be needed for the following rooms. Room heat-up calculations performed in individual rooms demonstrated that given loss of failure of all HVAC and the cubicle cooler in the room, the temperature would not exceed the NUREG/CR-6850 Appendix H solid-state control components thermal damage failure criteria of 150oF for up to 72 hours with the exception of the train C IP& DC equipment and battery rooms which reaches 150oF at about 16 hours. 16 hours is assumed to be adequate time for operators to take compensatory measures such as opening doors (calculations assumed doors were closed), and setting up portable fans. Analyses were performed on the following rooms, and it is assumed (due to symmetry in the Auxiliary Building) that the calculation is applicable to redundant rooms (e.g., analysis of 1E 4KV SWGR Room 01A is applicable to the same rooms for 01B, 01C and 01D): TURBINE DRIVEN AFW PUMP RM (078-A15C) CLASS 1E SWITCHGEAR 01A RM (078-A25A) 480V CLASS 1E MCC 01A RM (100-A12A) 480V CLASS 1E MCC 03A RM (137-A23A) CLASS 1E LOAD CENTER 01C RM (078-A03C) DG CONTROL PANEL RM (100-A02C) SWING LOAD CENTER RM (078-A58B) TRAIN-A/C DC&IP EQUIPMENT RM (078-A56A, 078-A05C) TRAIN-C BATTERY RM (078-A07C) PENETRATION MUX A RM (137-A17A) I&C EQUIPMENT RM (157-A19C, 157-A01D) 480V CLASS 1E MCC 03B RM (120-A15B)	In the DCD Rev.1, the room cooling is assumed. The room heatup calculation for APR1400 is prepared. *(No impact on ITTAC)*

The Updated Risk Insights and Key Assumptions vs ITTAC

No.	Insight	Tier 1
PRA Key Assumptions		
7	The digital I&C system model retains the current hardware model from the reference plant, except for the addition of software common cause failure events. The digital I&C model is retained as-is with several events representing the operating system and application software common cause failures as black-box events. The software common cause failure event probabilities in the fault tree model are based on Reference 65. System reliability analyses were performed which demonstrated that these software CCF probabilities result in an overall system reliability of > 10^{-4} which is consistent with the 10^{-4} limit stated in IEC 61226 (Reference 66).	In the DCD Rev.1, digital I&C software CCF is assumed, but the updated PRA model is updated based on Westinghouse response (LTR-RAM-17-81). *(No impact on ITTAC)*
9	ATWS Unfavorable Exposure Time (UET) is based on the equilibrium core. The UET value is dependent upon the success or failure of turbine trip, and the number of POSRVs available to relieve RCS pressure. The UET value is 0.27, which is based on the reference in Subsection 15.8.2.	In the updated PRA model is used to APR1400's value for UET. *(No impact on ITTAC)*

The Updated Risk Insights and Key Assumptions vs ITTAC

No.	Insight	Tier 1
Risk Insights from Key Design Features		
11	The following are important aspects of pilot-operated safety relief valves (POSRVs) as represented in the PRA:	POSRVs be included in the current Tier 1.(Rev.1) *(No impact on ITTAC)*
	The POSRVs, located on the top of the pressurizer, have two functions: overpressure protection and rapid depressurization (RD). When long-term decay heat removal is not available through the steam generators, the rapid depressurization (or bleed) function provides a means of rapidly depressurizing the RCS manually from the control room so that the SIS can inject to the RCS, enabling a "feed and bleed" cooling capability.	
	Spurious opening of pressurizer POSRVs due to a fire is not considered, because the power to the POSRVs is removed during normal operation and can only be provided by local manual operator action. Conversely this means that operators must locally re-energize the POSRVs for use in feed and bleed. The operator action HEPs account for this local manual action, and the internal fire and flood models directly address the ability of the operators to access the rooms where the local manual actions take place.	2.4.1, #9a (already included in Tablel 14.3.4-2)
	Another function of the RD is to provide the capability to depressurize the RCS during a severe accident to minimize the potential for high pressure melt ejection (HPME).	
	The POSRV discharge line is immersed into the IRWST water through the sparger, the discharging load dissipation device. When POSRVs actuate, the discharged RCS fluid is scrubbed in the IRWST, reducing the fission product releases.	
	The 3-way valves located in the POSRV discharge path are manually operated to redirect the steam release to the containment atmosphere via the SG compartment to rapidly depressurize the RCS.	
	The COL applicant is to provide a program for developing and implementing emergency operating procedures, including the procedures for use of the RD for "feed and bleed" cooling.	

The Updated Risk Insights and Key Assumptions vs ITTAC

No.	Insight	Tier 1
Risk Insights from Key Design Features		
14	The following are some important aspects of the shutdown cooling system (SCS) as represented in the PRA: The SCS has two separate and redundant trains, each with the heat removal capacity to cool the RCS to cold shutdown conditions. The SC and CS pumps are designed to be independent, but identical and functionally interchangeable. Either pump in a division can provide flow to either the CSS header or the SCS heat exchanger. The SC pumps can be aligned to take suction from the IRWST, and can also be aligned to discharge to the IRWST via the SCS heat exchangers. The SCS can be aligned to provide IRWST cooling. This backs up the CSS capability for providing IRWST cooling. With the SC pumps aligned to the IRWST, the pump's NPSH is adequate to prevent pump cavitation and failure even if the IRWST inventory is saturated. During plant shutdown operations, the SCS can be aligned to the IRWST to provide RCS inventory makeup. The SC pump trains are powered from the A and B trains; hence, during an SBO, power from the AAC can be supplied to either SC pump.	SC Pump be included in the current Tier 1.(Rev.1) *(No impact on ITTAC)* 2.6.2 (already included in Table 14.3.4-2)

The Updated Risk Insights and Key Assumptions vs ITTAC

No.	Insight	Tier 1
Risk Insights from Key Design Features		
15	The following are important aspects of the containment spray system (CSS) as represented in the PRA: Containment heat removal: The CSS is designed so that the CS pumps and the SC pumps are functionally interchangeable during power or shutdown operation, when not required to perform their requisite design basis function, assuming a loss of offsite power and single failure. Conservatively, this backup capability is not credited in the PRA. The SC pumps are designed to be aligned from the MCR to provide the containment spray. Containment pressure control: Following a LOCA or MSLB, the containment pressure is reduced to near the atmospheric pressure with the CSS operation. Fission product scrubbing: The CSS is a safety-grade system designed to remove fission products from the containment atmosphere following a DBA. Backup for SC pump: The CSS is designed to provide a backup to the SCS for residual heat removal and for cooling of the IRWST during post-accident feed and bleed operations using the SIS and pressurizer POSRVs. In addition to its design basis capabilities, the CSS provides the capability to cool the IRWST during accidents requiring "feed and bleed" operation. The CS pump's NPSH is adequate to prevent pump cavitation and failure if the IRWST inventory is saturated. The CS pump trains are powered from the C and D trains; hence, during an SBO, power from the AAC cannot be supplied to any CS pump.	SC Pump be included in the current Tier 1.(Rev.1) *(No impact on ITTAC)* 2.6.2 (already included in Table 14.3.4-2)

The Updated Risk Insights and Key Assumptions vs ITTAC

No.	Insight	Disposition
Risk Insights from Key Design Features		
21	The following are important aspects of the component cooling water system (CCWS) as represented in the PRA: The CCWS has two redundant and separate safety-related divisions, each with capacity to achieve and maintain safe shutdown. Each division has two pumps. The two CCW heat exchanger structures (one per division) are seismic Category I. The CCWS has a crosstie between two divisions, which can be used if one division is not available, to prevent a potential initiating event or to mitigate the accident consequences. When the division crosstie is used, both pumps on the operating division need to run. However, the CCWS crosstie is not credited in the PRA; and the CCWS Division 1 (Train A and C) both provides RCP seal thermal barrier cooling, and CVCS charging pump cooling. Therefore, upon loss of CCWS Division 1, all RCP seal cooling assumed to be lost, and the potential for RCP seal LOCA exists. Modeling of the CCWS crosstie would decrease the likelihood of these events. During normal operation, one CCW pump in each division is running with the second pump in standby mode. The standby pump will automatically start if the running pump in that division trips. This configuration improves availability of the CCWS. The nonessential headers are isolated automatically on a safety injection actuation signal (SIAS) or a low-low surge tank level signal. The COL applicant is to provide a program for developing and implementing emergency operating procedures, including the procedures for use of the divisional crosstie when needed. Due to physical separation, there are no single or multiple compartment fire scenarios resulting in a total loss of CCW.	CCWS be included in the current Tier 1.(Rev.1) *(No impact on ITTAC)* 2.7.2.2 #1, #9 (already included in Table 14.3.4-2)

The Updated Risk Insights and Key Assumptions vs ITTAC

No.	Insight	Disposition
Risk Insights from PRA Models		
66	The COL applicant is to demonstrate that HCLPF capacity is equal to or exceed 1.67 times the GMRS for site-specific structures (ESWIS and CCW Hx Building) and HCLPF capacity is equal to or exceeds 1.67 times the CSDRS for BOP components, and is to complete the SEL. At the design certification phase, specific design data for the BOP components such as material properties, analysis results, qualification test information, etc. are not available. Appendix E of EPRI-NP-1002988 (Reference 58) presents example calculations showing that the equipment designed for 0.25g SSE can have 0.5g or higher HCLPF considering the conservatism in the design process. The EPRI-NP-6041 (Reference 39) indicates that Seismic Category I concrete structure and BOP equipment can have 0.5g HCLPF as long as the structure and the equipment are designed in accordance with the current code and standard and the anchorage is rugged. The generic fragility data provided by the Electric Power Research Institute (EPRI) Utility Requirements Document (Reference 37) show the BOP components have HCLPF capacities higher than 0.5g. The COL applicant is to demonstrate that failure of buildings that are not seismic Category I (e.g., turbine building and compound building) does not impact SSCs designed to be seismic Category I.	Containment System be included in the current Tier 1.(Rev.1) *(No impact on ITTAC)*
	The containment structure is assumed to have the same median capacity in shutdown configurations as it does for the full power fragility calculation. That is, collapse of the structure is not affected by whether or not the equipment hatch is removed or installed with four bolts. Additionally, failure of the containment to provide an effective fission product boundary during LPSD conditions when the equipment hatch installed using four bolts has the same fragility as for at-power conditions when the equipment hatch is installed with all bolts.	2.2.1 (already included in Table 14.3.4-2)