KHNP Response to Issues - DCD Section 3.9.4

Issue #1

Are the functional requirements of the APR1400 CEDM identical to those of the first production tests, i.e. 76.2 cm/min for maximum stepping speed and 159kg for design drive line load, as described in FSAR Section 3.9.4.4? If not, what are they? Also, in DCD Section 3.9.4.1, it states that the design duty requirement for the CEDM is a total cumulative CEA travel of 30,480 m (100,000 ft) operation without loss of function. The staff requests the applicant to clarify the basis of the design duty requirement of 100,000 ft of travel. This information is necessary to complete the area of review described in SRP 3.9.4, Item I.1, which states that "[t]he descriptive information, including design criteria, testing programs, drawings, and a summary of the method of operation of the control rod drives, is reviewed to permit an evaluation of the adequacy of the system to perform its mechanical function properly."

Response

1) The functional requirements of the CEDM are very similar to those of the first production tests. The maximum stepping speed requirement, 76.2 cm/min (30 in/min), is the same, but the drive line load requirement, 156 kg (345 lbs), is slightly less than the tested weight of 159 kg (350 lbs).
2) The design duty requirement of 100,000 ft of travel was determined by operational experience.[

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Impact on DCD

There is no impact on the DCD.

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 Reports.

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KHNP Response to Issues - DCD Section 3.9.4

Issue #2

The staff requests the applicant to update the Figure 3.9-7, “Control Element Drive Mechanism” to clearly indicate the components that form the pressure boundary, including the motor housing assembly. This information is necessary to complete the area of review described in SRP 3.9.4, Item I.1, which states that “[t]he descriptive information, including design criteria, testing programs, drawings, and a summary of the method of operation of the control rod drives, is reviewed to permit an evaluation of the adequacy of the system to perform its mechanical function properly.”

Response

Figure 3.9-7 for the Control Element Drive Mechanism will be updated to clearly indicate the pressure boundary components.

Impact on DCD

Figure 3.9-7 will be revised as indicated on the attached markup.

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 Reports.

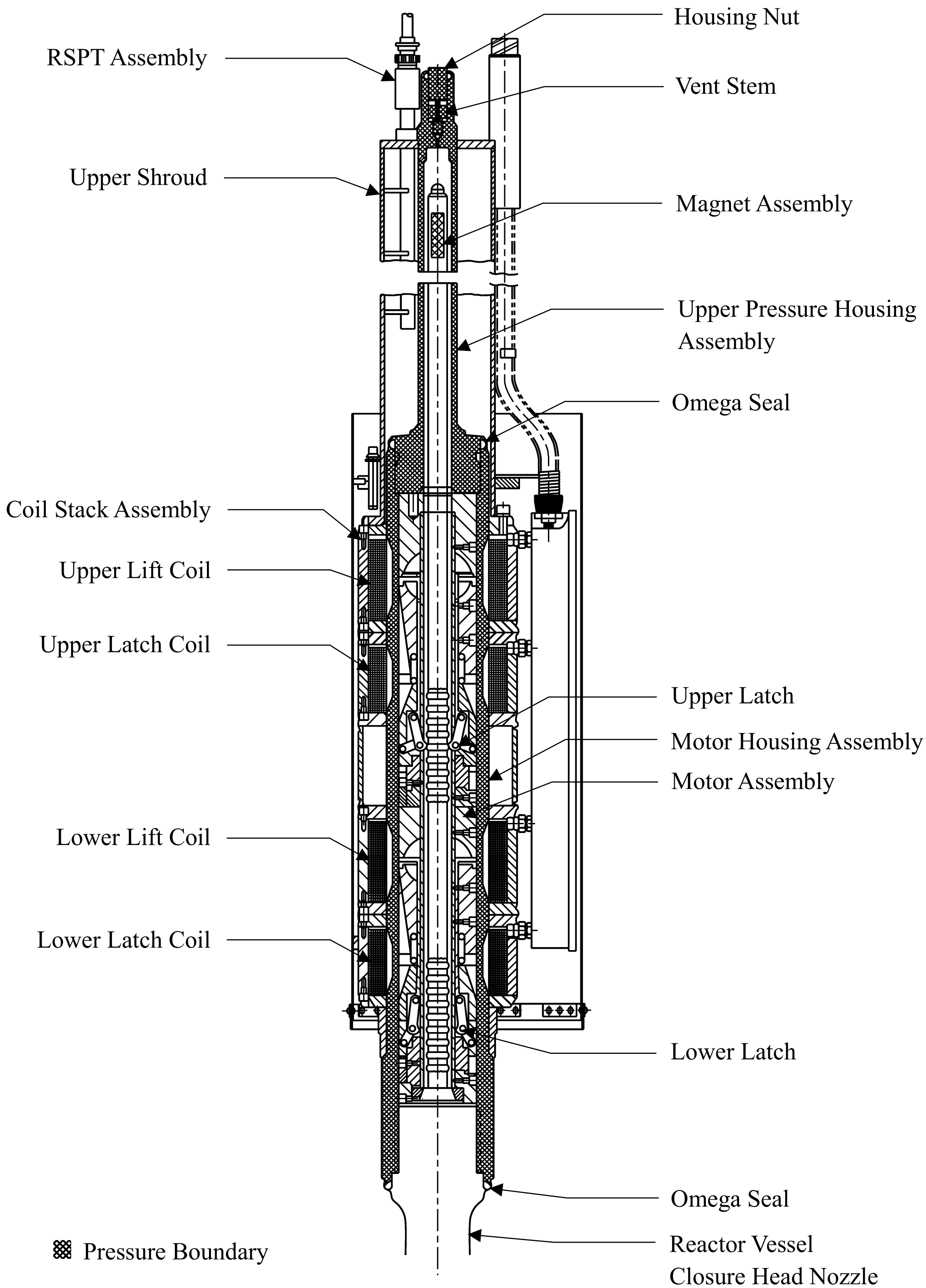

Figure 3.9-7 Control Element Drive Mechanism

Non-Proprietary

KHNP Response to Issues - DCD Section 3.9.4

Issue #3

The staff requests that the applicant reference in the DCD the codes and standards used for the motor assembly and extension shaft assembly as described in Table 3.2-1, Item 11a(2) and (3). This information is necessary to complete the area of review described in SRP Section 3.9.4, Item I.2, which states that "[t]hose portions that are not part of the RCPB are reviewed for compliance with other specified parts of Section III, or other sections of the ASME Code ".

Response

Codes and standards for the motor assembly and extension shaft assembly were not described because the safety function of those components is limited to scramability which was verified by testing as described in the DCD section 3.9.4.4. Table 3.2-1 will be revised to add a footnote providing the safety function.

Impact on DCD

Table 3.2-1 will be revised as indicated on the attached markup.

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 Reports.

Table 3.2-1 (9 of 86)

Item No. / Principal SSCs	Location(2)	Safety Class	Quality Group	Codes and Standards	10 CFR 50, App. B(3)	Seismic Category	Remarks
9) Non-essential supply and return piping in the compound building of the division II	RCB	NNS	D	ASME B31.1-2010	N/A	III	
10. CD – Condensate							
a. Piping in auxiliary bldg.	AB	NNS	D	ASME B31.1-2010	A	II	(3)(d)
b. Condenser, condensate pumps, tanks, valves, strainers, and feed water heaters	TGB	NNS	D	ASME B31.1-2010	N/A	III	
c. Other piping	TGB	NNS	D	ASME B31.1-2010	N/A	III	
11. CE – Control Element Assembly Drive							
a. Control element drive mechanism	RCB	SC-1	A	ASME Sec. III NB -2007 with 2008 addenda	Yes	I	
1) Pressure housing assembly	RCB	SC-1	A	ASME Sec. III NB -2007 with 2008 addenda	Yes	I	
2) Motor assembly	RCB	SC-2	B	N/A	Yes	I	(N−10)
3) Extension shaft assembly	RCB	SC-2	B	N/A	Yes	I	(N−10)
b. Reactor trip switchgear	RCB	SC-3	N/A	IEEE-603-1991	Yes	I	
c. Rod drive motor generator set	RCB	NNS	N/A	N/A	N/A	III	

Table 3.2-1 (86 of 86)

NSSS Notes:

(N-1) Two safety classes are used for heat exchangers to distinguish primary and secondary sides where they are different.

(N-2) Only those core support structures necessary to support and restrain the core and to maintain safe shutdown capability are classified as seismic Category I.

(N-3) Loss of cooling water and/or seal water service to the reactor coolant pumps (RCPs) may require stopping the pumps. However, the continuous operation of the pumps is not required during or following an SSE. The auxiliaries are therefore not necessarily seismic Category I. The provision for cooling water to the pump bearing oil cooler and pump motor air cooler does not conform with the requirements of NRC RG 1.29.

(N-4) Only those structural portions of the RCPs that are necessary to provide reasonable assurance of the integrity of the RCPB are Safety Class 1.

(N-5) Safety classes of piping within the RCPB (as defined in 10 CFR 50) are selected in accordance with the ANSI/ANS 51.1 criteria. Safety Classes 1, 2, 3 and Non-Nuclear Safety of ANSI/ANS 51.1 are equivalent to Quality Groups A, B, C, and D of NRC RG 1.26, respectively.

(N-6) Flow-restricting orifices are provided in the nozzles for the RCS sampling lines, the pressurizer (PZR) level and pressure instruments, the RCP differential pressure instrument lines, the common SI header pressure instrument lines, the RCP seal pressure instrument lines, the charging line differential pressure instrument line, and the SI hot leg injection pressure instrument lines to limit flow in the event of a downstream break of a nozzle. The orifice size, 5.55 mm (7/32 in) diameter × 25.4 mm (1 in) long, precludes exceeding fuel design limits while using minimum makeup rates. This permits orderly shutdown in the event of a downstream break in accordance with 10 CFR 50, Appendix A, GDC 33. A reduction may therefore be made in the classification of downstream lines of the orifice.

(N-7) All containment isolation valves (and their operators) within NSSS scope of supply including manual valves, check valves, and relief valves, which also serve as isolation valves, are subject to the pertinent requirements of the Quality Assurance Program.

(N-8) The POSRVs are used for overpressure protection and rapid depressurization function.

(N-9) The "Associated Circuits" are defined, in accordance with IEEE Standard 384, as equipment, components, or systems the functions of which are Non-Nuclear Safety (NNS) and electrically Non-Class 1E, though their failures or abnormal states can affect the Class 1E equipment, components, or systems due to the effects of less than the minimum separation or the absence of electrical isolation from the Class 1E equipment, components, or systems. Consequently, the equipment, components, or systems, which are defined as "Associated Circuits" although they are functionally Non-Nuclear Safety, are subject to the qualification requirements placed on Class 1E equipment, components, or systems.

(N-10) Safety function of the motor assembly and extension shaft assembly is limited to scramability.

KHNP Response to Issues - DCD Section 3.9.4

Issue #4
The applicant should include in the DCD the design margins for non-pressure boundary components. This information is necessary for the staff to make a finding under SRP acceptance criterion 2.C in SRP Section 3.9.4: “For nonpressurized equipment (Non-ASME BPV Code): Design margins presented for allowable stress, deformation, and fatigue should be equal to or greater than margins for other plants of similar design with successful operating experience. A justification of any decreases in design margins should be provided.”

Response
In DCD section 3.9.4.4, the second paragraph describes the design margin for non-pressure boundary components as follows: “The CEDM was operated for a total travel length of 47,854 m (157,000 ft) with no abnormality, which is about 1.5 times the design duty requirement.”

Impact on DCD
There is no impact on the DCD.

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 Reports.

KHNP Response to Issues - DCD Section 3.9.4

Issue #5

DCD Section 3.9.4.4 discusses changes to the material of the motor housing lower end fitting and thickness of the upper shroud tube, but does not discuss how these changes affect the 60-year life of the CEDM, as the changes are stated to improve structural integrity (from material change) and mechanical strength (thickness change). The changing of materials and thickness may result in changes to loads such as deadweight and changes to the pressure housing could affect its safety function as a pressure boundary. Also, 3.9.4.4 discusses operating experience as providing design verification of the APR1400 CEDM. The applicant should provide additional detail on how the referenced operating plants have provided verify design verification of the changes as mentioned above to the motor housing lower end fitting and upper tube shroud?

Response

1) The structural integrity of the pressure housing is evaluated by fatigue analysis for its 60-years life. The design changes are considered in the evaluation. The evaluation result is described in the CEDM Summary Stress Report (APR1400-H-N-NR-14006-P) which was recently completed at the end of June.

2) DCD section 3.9.4.4 pertains to operational assurance, which focuses on performance of the active components such as the motor assembly and the ESA. The 'operating experience as providing design verification of the APR1400 CEDM' in the DCD section 3.9.4.4 was stated with regard to the active components. The motor housing lower end fitting and upper tube shroud are not active components; therefore, the operating experience statement does not apply to the design changes made to the motor housing lower end fitting and upper tube shroud.

Impact on DCD

There is no impact on the DCD.

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 Reports.

KHNP Response to Issues - DCD Section 3.9.4

Issue #6

SRP acceptance criterion 4 in SRP Section 3.9.4 states that "[t]he operability assurance program will be acceptable provided the observed performance as to wear, functioning times, latching, and ability to overcome a stuck rod meet system design requirements." DCD Section 3.9.4.1.1.2 states that clearances in the motor assembly enable the CEDM to avoid stuck rod condition, which is verified by the tests described in Subsection 3.9.4.4. However, DCD Section 3.9.4.4 does not explicitly state where the ability to overcome a stuck rod is verified. Additional information in the DCD on the ability to overcome a stuck rod is necessary for the staff to make a finding under this SRP acceptance criterion.

Response

DCD Section 3.9.4.4 does not explicitly deal with the ability to overcome a stuck rod; however, the acceleration life time test and drop test were described. Those tests are regarded as verification of the ability to overcome a stuck rod since those tests show that the CEDM operates properly without a stuck rod during such severe tests. DCD Section 3.9.4.4 will be revised to include a statement referring to the tests.

Impact on DCD

DCD 3.9.4.4 will be revised as indicated in the attached markup.

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 Reports.

The life cycle test and scram test provide verification of the ability to overcome a stuck rod because the CEDM operated properly without a stuck rod during such severe tests.

motor housing lower end fitting was changed to Alloy 690TT from Alloy 600 to improve structural integrity against PWSCC, and thickness of the upper shroud was increased to improve mechanical strength. These changes enhance the structural integrity of the CEDM and do not affect the safety-related functions of the APR1400 CEDM. The following describes the tests performed during development of System 80 CEDM, which provides design verification for the APR1400 CEDM.

For the life cycle test, the CEDM was installed on a test facility that was operated at a nominal temperature of 315.6 °C (600 °F) and a gauge pressure of 15.5 MPa (2,250 psig). The CEDM was operated for a total travel length of 47,854 m (157,000 ft) with no abnormality, which is about 1.5 times the design duty requirement.

During the CEA scram test, 300 full-height drops were completed. All release times were less than 0.3 second, and CEA drop times to 90 percent of full insertion were less than 4.0 seconds, which meets the design criterion.

Operating experience also provides design verification of the APR1400 CEDM. The APR1400 CEDM is essentially identical to the CEDM of Palo Verde, HBN 3&4, HBN 5&6, HUN 3&4, HUN 5&6, SKN 1&2, and SWN 1, which are all in operation. The experience has demonstrated that the CEDM operates without malfunction.

First production test programs were completed on the CEDM to verify operability. During the course of this program, more than 1,219 m (4,000 ft) of travel was accumulated and 30 full-height gravity drops were made without mechanism malfunction or measurable wear on operating parts. The program included the following:

a. Operation at 76.2 cm/min (30 in/min) traveling 159 kg (350 lb) of weight at ambient temperature and a gauge pressure of 0.7 MPa (100 psig) for 15.2 m (50 ft)

b. Fifteen full-height drops at simulated reactor operating conditions with 159 kg (350 lb) of weight during the first 61 m (200 ft) travel at 76.2 cm/min (30 in/min)

c. Fifteen full-height drops at simulated reactor operating conditions with 159 kg (350 lb) of weight after traveling 1,162 m (3,812 ft)