Response to

Request for Additional Information No. 95 (1088), Revision 0

10/28/2008

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.09.04 - Control Rod Drive Systems

Application Section: FSAR Ch. 3

QUESTIONS for EMB1 Branch

Question 03.09.04-1:

a. The control rod drive mechanism (CRDM) equipment is designed and qualified to operate in reactor vessel environment. Please provide reference(s) that document CRDM qualification to operate in RPV environment for 60 years plant life.

b. Section 3.9.4.4 of the FSAR: Confirm that for mechanical adequacy of CRDS, a prototype testing program comprised of performance, stability and endurance tests was created. Provide status and results of the prototype testing program and the range of environmental conditions that supports it.

c. Section 4.6.4 states that mechanical failure or overheating of the CRDM causes failure of only one RCCA from inserting into the core by gravity, while other CRDMs remain functional. Please provide the technical basis that supports this DCD statement.

d. Define "Hydrostatic Test Methods" for the CRDM housing. Is "Hydrostatic Test" for the connection of rod travel housing to the latch assembly housing done as part of the system hydrostatic test?"

e. The ability of the pressure housing components to perform throughout their design life, using the criteria of an operating life of 60 years, is confirmed by the primary stress analysis report required by the ASME Code, Section III. Please provide a reference(s) to primary stress analysis report for pressure housing components ability to perform their intended functions throughout the 60 years plant life.

f. The CRDMs are designed to withstand loading combinations and loading values, and meet the primary stresses stress limits of ASME Code, Section III, Division I, Subsection NB. The analyses for the loading combinations, in conjunction with the initial testing, verify that the actual design conforms to the design criteria and that design limits have been met. In addition to the loading requirements, the CRDMs are designed with the ability to overcome a stuck rod condition. Please provide a reference(s) to loading combination analysis, in conjunction with testing, and confirm that CRDM design conforms to its design criteria and limits.

g. The FSAR states that in addition to the prototype testing program, tests are performed on the CRDMs to verify their function. These tests verify that the insertion and withdrawal times in the stepping mode, and the drop times, meet the design requirements. Please clarify, if all CRDMs do go through the function verification test, and at what stage.

Response to Question 03.09.04-1:

a. The control rod drive mechanism (CRDM) pressure housing components are designed for a 60 year operating plant life. ASME Section II materials comprise the pressure boundary components of the CRDM. The CRDM pressure housing design is confirmed by the primary stress analysis of the pressure boundary components per the requirements of ASME Boiler and Pressure Vessel Code, Section III for Class 1 Components. The ASME code requirements do not apply to the non-pressure boundary components of the CRDM. The design of the CRDM is based on a proven AREVA design that has 30 years of operating experience. The equipment specification for the CRDMs requires a 60 year design life and specifies the plant operating conditions. The equipment specification also requires the CRDMs be designed as required by ASME Boiler and Pressure Vessel Code, Section III for Class 1 Components. The seismic and

dynamic qualification of the CRDMs is described in U.S. EPR FSAR Tier 2, Section 3.10 and the environmental qualification of the CRDMs is described in U.S. EPR FSAR Tier 2, Section 3.11.

b. Prototype testing for the U.S. EPR design is comprised of performance, stability and endurance tests. The performance tests verify the adequate performance of the equipment in a range of temperature, pressure and flow rate conditions. Stability tests ensure proper functioning is achieved over an amount of time in normal conditions. Both of these tests have been completed for the U.S. EPR design. The endurance tests quantify the amount of time and/or number of steps during which no appreciable mechanical damage possibly altering the correct mechanical behavior is to be expected. Testing is currently being conducted in Germany at the KOPRA test facility for the U.S. EPR design.

c. Mechanical failure of any individual CRDM does not cause failure of the other CRDMs. If a mechanical failure occurred (i.e., latch assembly failure, broken latch), the other CRDMs would remain operational. The mechanical operation of each CRDM is independent of the mechanical operation of the other CRDMs.

   Overheating of the operating coil on an individual CRDM assembly does not prevent the other CRDMs from operating. If overheating of the operating coil occurred and electrical power was lost to the CRDM, the CRDM would fail in a safe condition. Once power is removed from the operating coils, the latches retract from the drive rod, and the RCCA inserts into the core by gravity. Failure to supply power to the operating coils of the CRDMs does not result in a condition that would prevent the rods from inserting into the core.

d. The pressure housing of the CRDM consists of two main sections, the latch unit section and the position indicator section. The CRDMs may not be part of the system hydrostatic test at site. The pressure housing of the CRDMs, however, will be hydrostatically tested prior to shipping and installation at site. Hydrostatic testing will be done in accordance with ASME Section III requirements for Class 1 Components.

e. The primary stress analysis reports are internal AREVA documents and are available for NRC review or audit.

f. The CRDMs are required by the equipment specification to be designed with the capability to overcome a stuck rod condition. The capability of the CRDM to overcome a stuck rod condition is demonstrated by analytical means or through testing. Loading combinations are discussed in U.S. EPR FSAR Tier 2, Section 3.9. Supporting documentation for the loading combinations is available for NRC review or audit.

g. Functional tests are performed on all CRDMs at the manufacturing facility prior to shipping. As noted in U.S. EPR FSAR Tier 2, Section 3.9.4.4, drop times are performed after installation at site. Drop times are not recorded at the manufacturing facility. Drop tests are performed at the manufacturing facility to ensure the latch assembly operates and releases as required, but these tests are not timed. Function verification tests are conducted at the manufacturing facility prior to shipping all CRDMs.

   U.S. EPR FSAR Tier 2, Section 3.9.4.4 will be revised to clarify that drop time testing is not conducted as part of the functional tests at the manufacturing facility, but drop tests are performed to verify the mechanical functioning of the CRDMs.

FSAR Impact:

U.S. EPR FSAR, Tier 2, Section 3.9.4.4 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

the correct mechanical functioning of a prototype of the complete control rod line with the CRDM. Operation of the CRDS and rod drops under various conditions are tested and measured. The prototype assembly is tested under simulated conditions of reactor temperature, pressure, and flow.

The first phase of the function tests are the performance tests, which verify the performance of the equipment under a broad range of conditions. Temperature, pressure, and flow rate conditions are tested for a complete assessment of the system behavior. The performance tests provide information for recording, adjusting, and optimizing the coil activation sequence to achieve reliable stepping operation. The performance tests also provide dynamic behavior assessment, including displacement and snapback tests with natural frequency measurements, and drop time measurements in perturbed geometries. These measurements help demonstrate that the entire system will operate as designed under seismic conditions. The performance tests also evaluate stepping operation dynamic characterization, including acceleration and stepping force measurements, and coupling forces.

After the performance tests, stability tests are conducted to demonstrate correct functioning over an appreciable amount of time. These tests consist of repeated stepping motions under nominal conditions, periodically interrupted with full height drops. An objective of these medium-term stability tests, which involve up to three million steps, is to verify the relative insensitivity of drop times to repeated stepping and drop operations.

The final set of prototype tests are endurance tests, with up to six million additional steps, to quantify the amount of time and the number of steps during which no appreciable mechanical damage is expected (i.e., fatigue and wear) that could alter the correct mechanical behavior. In addition to the performance, stability, and endurance testing performed on the prototypes, each CRDM has a series of production tests performed to verify the integrity of the pressure housing and the function of the CRDM. These tests include a hydrostatic test of each assembled CRDM in accordance with the ASME Code, Section III, Division I, Subsection NB to verify the pressure housing, and a functionality test.

In addition to the prototype testing program, tests are performed on the CRDMs to verify their function. These tests verify that the insertion and withdrawal times in the stepping mode~~, and the drop times,~~ meet the design requirements. Drop tests are performed to verify the mechanical functioning of the CRDMs.

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Following installation of the CRDMs, preoperational tests are performed. These tests verify the correct sequencing of the operating coils and verify the design requirements are met for insertion, withdrawal, and drop times. A description of the initial startup test program is provided in Section 14.2.