



STPNOC Planned License Amendment Request: Technical Specification 5.3.2, Control Rod Assemblies

STP Participants:

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STPNOC/NRC Pre-Submittal Meeting

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Objectives

- Provide a description of the Unit 1 D-6 Control Rod Drive Mechanism (CRDM) issue
- Provide overview of planned implementation actions
- Provide overview of expected License Amendment Request (LAR) content
- Discuss planned submittal date and need date
- Answer NRC questions



Presentation Outline

- Overview of Proposed Change
- Background
- Plant Changes Required
- Impact on Safety Analyses
- Regulatory Evaluation
- Summary Conclusions
- Proposed Schedule
- Additional Questions and Recap



Problem Statement

- Control Rod D-6 could not be reliably withdrawn during startup testing



Overview of Proposed Change

- Requesting proposed amendment to allow Unit 1 to resume operation with 56 full-length control rod assemblies
- Proposed change to TS 5.3.2 (change bar on right):

CONTROL ROD ASSEMBLIES

5.3.2 The core shall contain 57* full-length control rod assemblies. The full-length control rod assemblies shall contain a nominal 158.9 inches of absorber material. The absorber material within each assembly shall be silver-indium-cadmium or hafnium. Mixtures of hafnium and silver-indium-cadmium are not permitted within a bank. All control rods shall be clad with stainless steel tubing.

* The Unit 1 Cycle 20 core shall contain 56 full-length control rod assemblies with no full-length control rod assembly installed in core location D-6.

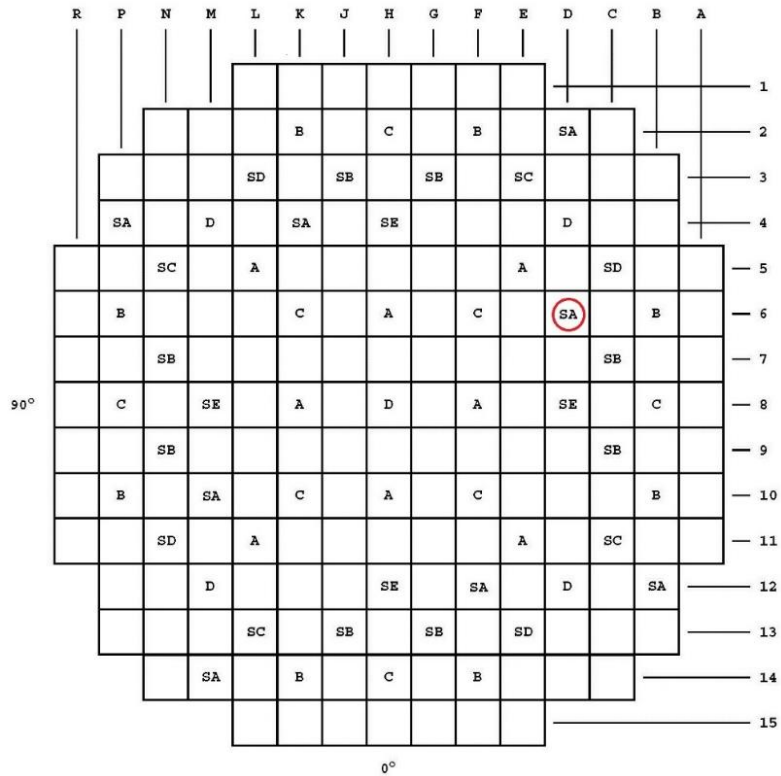


Overview of Proposed Change

- There is no methodology change involved with this change to the TS
- The proposed change would last through the end of Unit 1 Cycle 20
 - One cycle of operation
- TS requirement to contain 57 control rods will remain unchanged for Unit 2

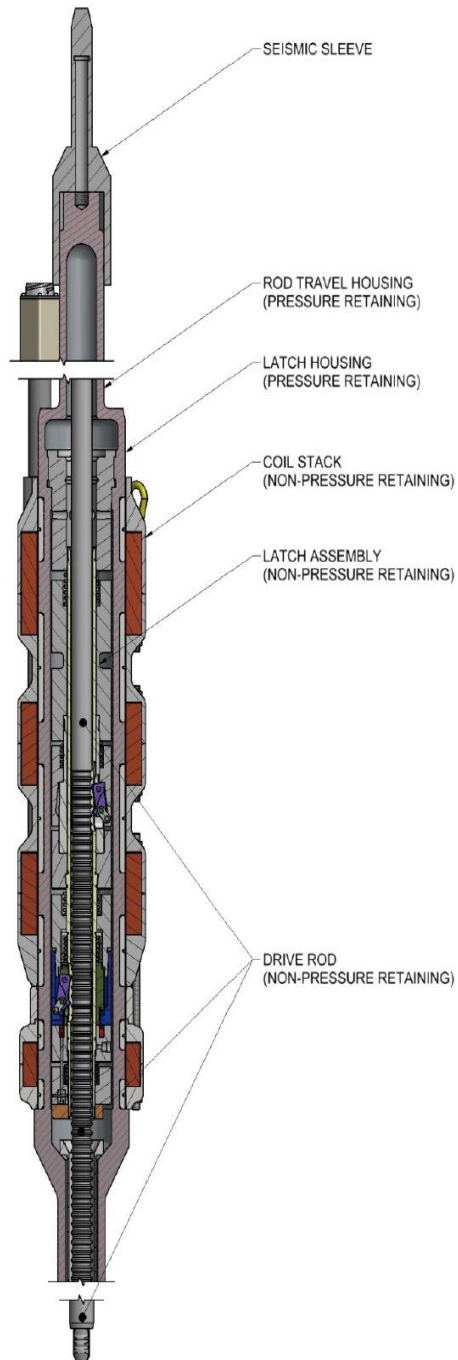


Control Rod Configuration

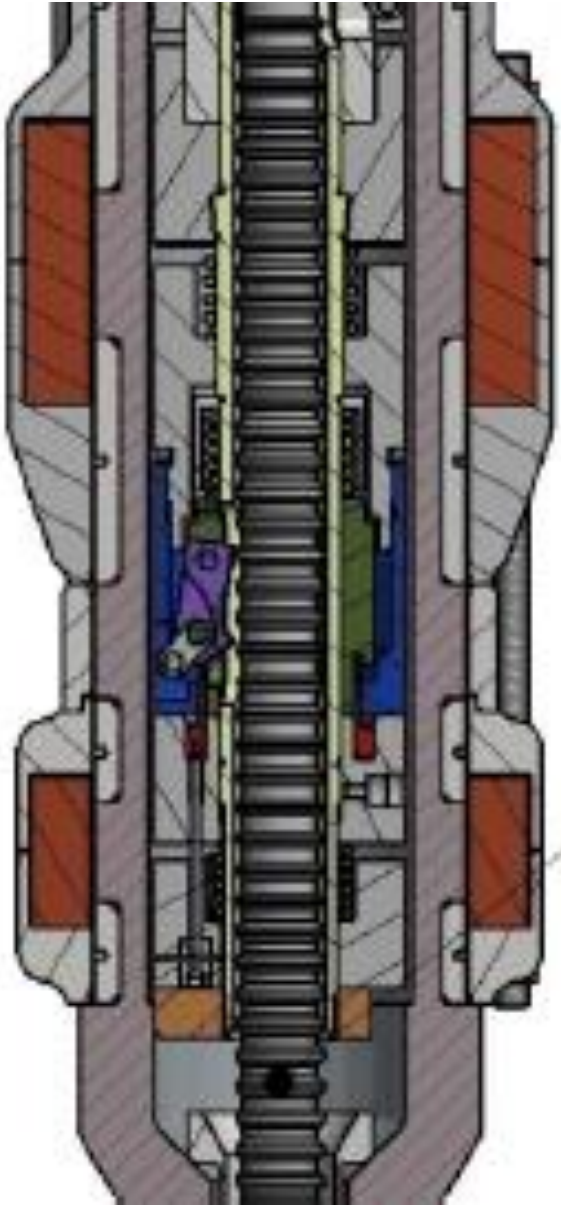


Bank Identifier	Number of Locations	Bank Identifier	Number of Locations
A	8	SA	8
B	8	SB	8
C	8	SC	4
D	5	SD	4
		SE	4

- Rod D-6 is a Shutdown Bank rod normally positioned fully withdrawn at power
- 57 Total Control Rods
 - 29 Control Bank Rods
 - 28 Shutdown Bank Rods



Background – CRDM Description



Background – Rod Holdout Lock Ring

- Deformation in D-6 Rod Holdout lock ring
- Initiated in 2012 during rod control sequencing while unlocking control rods
- Source of sequencing issue has been addressed with a design change



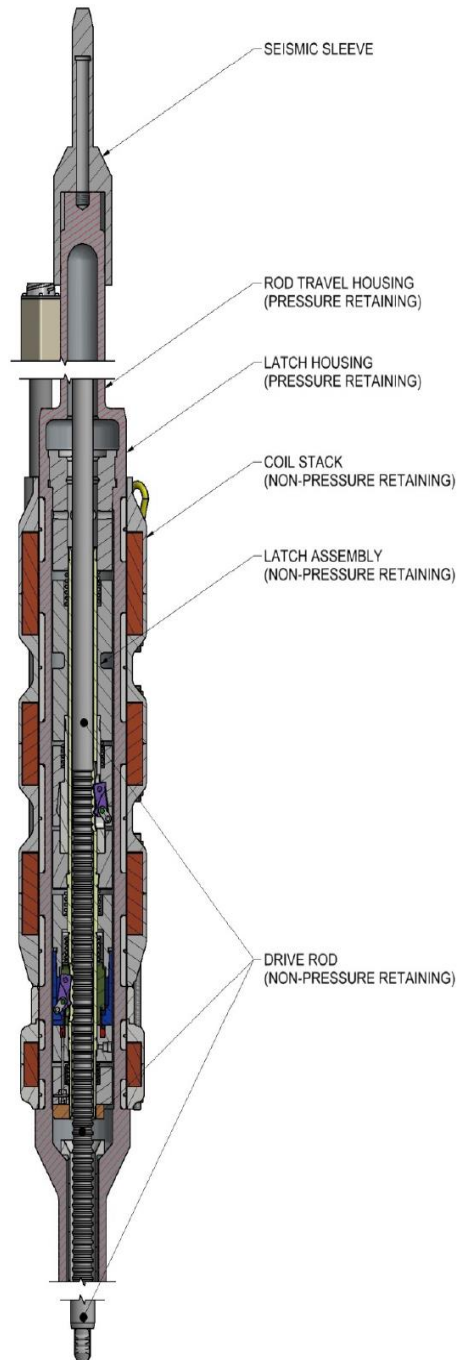
Background – Condition of Control Rod D-6

- Control Rod D-6 is not functioning as expected
- D-6 unable to be moved using normal methods during troubleshooting
- CRDM for Rod D-6 has been visually inspected and compared to another CRDM
- Confirming that this issue is confined to the CRDM for Rod D-6



Extent of Condition

- Deformation on lockout ring is only seen on Unit 1 Rod D-6 CRDM
- Extent of condition – other 56 rods unaffected
 - Visual inspection has been performed on other 56 CRDMs
 - CRDM monitoring (coil traces) indicate other 56 CRDMs are operating reliably
- Plans for future monitoring
 - On startup: CRDM testing, rod drop timing testing
 - Periodic control rod exercise at power
 - Continue to evaluate coil traces
- Unit 2 CRDMs have been monitored and indicate reliable operation



Background – Pressure Boundary

- Components being removed are internal to the RCS pressure boundary
- Pressure boundary: butt weld between CRDM latch housing and rod travel housing



D-6 CRDM Replacement

- In-situ CRDM replacement would be a first-of-a-kind activity in United States
 - Butt weld instead of canopy seal weld
- Requires special tooling that does not currently exist
- Lengthy preparation required for building mockup, testing, developing/obtaining tools



Plant Changes Required

- Remove Rod Cluster Control Assembly (RCCA) and associated drive shaft at core location D-6
- Some plant changes to Digital Rod Position Indication (DRPI) and Rod Control systems are required
- Install guide tube flow restrictor and fuel assembly thimble plug to maintain core and vessel thermal hydraulic characteristics
- Revise Reload Safety Evaluation to include impact of control rod removal on nuclear design and safety analyses
- Revise affected procedures and design documents



Thermal Hydraulic, Seismic and Structural Impacts

- Insertion of guide tube flow restrictor and thimble plug device maintain flow characteristics equivalent to previous configuration
- Dynamic analysis (seismic and loss of coolant accident forces) of the CRDM that was performed using the reactor equipment system model remains valid after removal of the D-6 control rod drive shaft and RCCA
 - Drive shaft does not provide stiffening function – free motion



Impact on Safety Analyses

- Rod D-6 is a Shutdown Bank RCCA
 - Accidents where at-power core power distribution is a key factor are not affected
- Evaluated Rod D-6 removal impacts
 - Available shutdown margin including highest reactive stuck rod
 - Boron worth when all RCCAs are inserted
 - Rod worth of adjacent RCCAs when all RCCAs are inserted
 - Trip reactivity as a function of time
 - Most positive Moderator Density Coefficient (MDC)



Impact on Safety Analyses – Available Shutdown Margin

- TS 3.1.1.1 requires shutdown margin to be within the limits of the COLR
 - TS shutdown margin limits are not affected
- UFSAR Chapter 15 safety analyses remain bounding
- Actual shutdown margin reduced from $2.43\% \Delta\rho$ to $2.18\% \Delta\rho$ for Modes 1 and 2 at End of Life (EOL)
 - $1.3\% \Delta\rho$ limit for Modes 1 and 2 currently specified in COLR Section 2.3.1 is met



Impact on Shutdown Margin (EOL Values Below)

	<u>Cycle 19</u> RCCA in D-6	<u>Cycle 20</u> RCCA in D-6	<u>Cycle 20</u> No RCCA in D6
Control Rod Worth (% $\Delta\rho$)			
All Rods Inserted minus Worst Stuck Rod (N-1)	6.94	7.10	6.82
Less 10%	6.25	6.39	6.13
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Control Rod Requirements (% $\Delta\rho$)			
Reactivity Defects	3.60	3.60	3.59
Rod Insertion Allowance	0.39	0.37	0.37
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Total Requirements	3.99	3.97	3.96
Shutdown Margin	2.26	2.42	2.17
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Required Shutdown Margin	1.30	1.30	1.30



Impact on Safety Analyses – Boron Worth

- Potential impact to the chemical and volume control system (CVCS) malfunction resulting in a Reactor Coolant System (RCS) boron dilution in Modes 3, 4, and 5
- Rod removal impacts boron worth for the all-rods inserted condition
- Analysis conservatively determines a boron worth with all rods out, therefore there is no impact with D-6 removed from the core



Impact on Safety Analyses – Rod Worth of Adjacent Rods

- Removal of Rod D-6 slightly increases the rod worth of the adjacent control rods with all RCCAs inserted
 - Potential impact to results of uncontrolled RCCA bank withdrawal from a subcritical or low power startup conditions and spectrum of rod ejection accidents
 - Change in rod worth is considered and is bounded by the current analysis



Impact on Safety Analyses – Trip Reactivity

- Removal of Rod D-6 reduces the trip reactivity as a function of rod insertion position
- The revised trip reactivity insertion vs. position remains greater than values required by the UFSAR Chapter 15 analysis
- There is no adverse impact to analyses for events where a reactor trip occurs



Impact on Safety Analyses – Moderator Density Coefficient (MDC)

- The most positive MDC is conservatively calculated assuming all rods in the core
- Updated MDC without rod D-6 remains bounded by the limiting value assumed in the Chapter 15 safety analysis



Impact to UFSAR Chapter 15 Accident Analyses

- Postulated accidents dependent on core power distributions while at power are not impacted
- Effects on available shutdown margin, rod worth of the adjacent control rods, boron worth, trip reactivity as a function of time, and most positive MDC are bounded
- Therefore, the removal of RCCA D-6 does not adversely impact the results presented in Chapter 15



Regulatory Evaluation

- Requesting proposed amendment to allow Unit 1 to resume operation with 56 fuel assemblies for Unit 1 Cycle 20
- No other changes to STP TS required
- Applicable General Design Criteria have been reviewed and are satisfied
- These items will be discussed in the proposed LAR



Overview of Proposed Change

- Proposed change to TS 5.3.2 (change bar on right):

CONTROL ROD ASSEMBLIES

5.3.2 The core shall contain 57* full-length control rod assemblies. The full-length control rod assemblies shall contain a nominal 158.9 inches of absorber material. The absorber material within each assembly shall be silver-indium-cadmium or hafnium. Mixtures of hafnium and silver-indium-cadmium are not permitted within a bank. All control rods shall be clad with stainless steel tubing.

* The Unit 1 Cycle 20 core shall contain 56 full-length control rod assemblies with no full-length control rod assembly installed in core location D-6.



Summary Conclusions

- Appropriate safety margins maintained with 56 rods
- One fuel cycle change (Unit 1 Cycle 20)
- Why is this TS change needed?
 - As previously discussed, first of a kind change in the United States for CRDM replacement requiring a pressure boundary weld
 - Significant planning and remote tooling development is required to ensure no unforeseen impact to RCS pressure boundary and associated components



Summary Conclusions

- TS change does not involve a methodology change
- Instrumentation setpoints and trip settings will not be affected
- No new operator actions are proposed
- Installation of flow restrictor and thimble plug – negligible impact on thermal hydraulics
- Input will be provided for No Significant Hazards Consideration determination



Proposed Schedule

- Submit LAR to NRC December 4, 2015
- Approval of the proposed amendment is requested by December 11, 2015 to support Unit 1 entry into Mode 5 and resume operation
- Planned implementation of LAR actions within 24 hours
- Change will remain in effect for the duration of Unit 1 Cycle 20



Additional Questions and Action Recap