ENCLOSURE 2

MFN 10-245 R4

Description of the Evaluation and Surveillance Recommendations for BWR/2-5 Plants

Non-Proprietary Version

IMPORTANT NOTICE

This is a non-proprietary version of Enclosure 1 to MFN 10-245 R4, from which the proprietary information removed. Portions of the enclosure that have been removed are indicated by open and closed double square brackets as shown here [[ ]].

Description of Evaluation and Surveillance Recommendations for BWR/2-5 Plants

Background

In 2010, GE Hitachi Nuclear Energy (GEH) identified that the engineering evaluations supporting the guidance provided in MFN 08-420, did not address the potential impact of a seismic event on the ability of control rods to fully insert during a scram under conditions with substantial channel – control blade interference. GEH issued three 60-Day Interim Reports in accordance with the requirements set forth in 10CFR 21.21(a)(2) to allow additional time for the evaluation to be completed.

In September 2010, GEH issued MFN 10-245 (and MFN 10-245 R1) to communicate the following results from the evaluation completed as of that date:

1. The required scram performance for the BWR/6 plant is not adversely impacted by the seismic events (Operating Basis Earthquake, OBE, or Safe Shutdown Earthquake, SSE). The guidance specified in MFN 08-420 continues to ensure that the BWR/6 control rods will fully insert during a seismic event (OBE or SSE) at all normal and abnormal operating conditions.
2. For BWR/2-5 plants, at reactor system pressures of 1000 psig and above, the required scram capability is not adversely impacted by the inclusion of seismic events (OBE or SSE). The guidance specified in MFN 08-420 continues to ensure that the BWR/2-5 control rods will fully insert during a seismic event (OBE or SSE).
3. For the BWR/2-5 plants, the potential existed that, during a seismic event (OBE or SSE), control rods with scram friction near the limits specified in MFN 08-420 may not fully insert at the Main Steam Isolation Valve (MSIV) isolation set point pressure condition, or at lower reactor system pressures (with maximum adverse effects occurring at roughly 550 to 600 psig reactor system pressure).

On December 15, 2010, GEH issued MFN 10-245 R2 to communicate the status of the on-going evaluation. Additional time was needed to modify and verify the model used for establishing the maximum allowable control rod friction limits in MFN 08-420 in order to incorporate the effects of these seismic loads. The scope of the modification, upon verification, also included other changes needed to account for the depletion of the Hydraulic Control Unit (HCU) scram accumulator and pressurization of the Scram Discharge Volume (SDV).

On August 11, 2011, GEH issued MFN 10-245 R3 to communicate that further time was needed to complete and verify the predictions of scram performance using the modified model that accounted for the seismic condition. Interim guidance was also issued at that time and in the weeks that followed, in support of reactor engineers and operators assessing the implications for reactor plants.

The evaluation has been completed and the implications for reactor operations have been assessed. For the purposes of this communication, the scram capability of the control rod drive mechanism in BWR/2-5 plants will be discussed in context of operation above and below the MSIV isolation set point pressure.[1] For this evaluation it is understood that a plant's normal operating condition is at reactor system pressure considerably above the MSIV isolation set point pressure, and operation below the MSIV isolation set point pressure typically occurs during plant startup and shutdown.

In addition to the evaluation of the condition and assessment of implications, GEH and Global Nuclear Fuel (GNF) have also prepared a probabilistic risk assessment (PRA) of the condition, to help plant staffs appropriately assess conditions at their respective plants. The PRA treatment of this condition is described near the end of this document.

Evaluation Method

For the purposes of this communication, the scram capability of the control rod drive mechanism in BWR/2-5 plants will be discussed in context of Reactor operation above and below the Main Steam Isolation Valve (MSIV) isolation set point pressure. A typical plant spends the most time operating at full reactor system pressure. The plants do occasionally perform reactor down-powers for various reasons that result in slightly reduced reactor system pressures but remain above the MSIV isolation set point pressure. There is also the potential for reductions in reactor system pressure by Anticipated Operational Occurrences (AOOs) and transients that can take reactor system pressure down to as low as the MSIV isolation set point pressure. Operation below the MSIV isolation set point pressure is typically limited to reactor startup and shutdown conditions[2]. One important reason for this distinction is to associate different values of control rod friction limits with the reactor system pressure condition to which they apply and indicate the recommended control rod monitoring frequency for these different reactor system pressure conditions. Monitoring for

[1] It is left to the users of this guidance to determine whether the MSIV nominal isolation set point or the lower MSIV analytical limit isolation set point as found in Technical Specifications is appropriate here.
[2] It is recognized that the transition from Mode 2 to Mode 1 during startup or the transition from Mode 1 to Mode 2 during shutdown does not necessarily occur at the MSIV isolation set point pressure. However, the MSIV isolation set point pressure is useful for distinguishing differences in control rod monitoring guidance for normal operating conditions compared to startups and shutdowns.

control rod friction applicable above the MSIV isolation set point pressure must occur periodically to maintain control rod operability (similar to the recommended monitoring in MFN 08-420). Monitoring for control rod friction applicable below the MSIV isolation set point pressure is necessary only prior to initiating a startup sequence or prior to reaching the MSIV isolation set point in a controlled shutdown sequence.

To ensure that plant operations meet the NRC General Design Criteria (GDC) requirements, GEH assessed the requirements for control rod performance during a scram, concurrent with an OBE or SSE. That assessment determined that the control rods must fully insert during a scram, concurrent with an OBE or SSE for the reactor to be considered shutdown under all conditions, and to assure that the assumptions of scram reactivity in the design basis and transient analyses are not violated. Although partial insertion of some control rods does not necessarily preclude reactor shutdown, this evaluation seeks conditions providing high confidence that all rods will fully insert. Partial insertion of some rods is considered in the probabilistic analysis summarized at the end of this document, which is provided for informational purposes.

Because the SSE loads are larger than the OBE loads, the SSE is bounding and the subsequent scram performance predictions in this evaluation characterize only the SSE attributes. For operations in plants with a Mark II containment, the load combination analyzed includes interference from an SSE plus design basis Loss of Coolant Accident (LOCA) and Safety Relief Valve (SRV) events to ensure control rod insertion is achieved to satisfy the acceptance criteria specified in NUREG-0800, Section 4.2. Because the licensing requirements for the Mark I containment do not require consideration of combined SSE plus LOCA dynamic loads, and the SSE loads bound the LOCA loads, the dynamic loads considered herein for Mark I containment result from the SSE only.

To predict scram performance during an SSE event, GEH modified the model previously used in the development of the maximum allowable friction limits in MFN 08-420. This modification was required [[
]] not previously included in the model. In addition, due to the longer scram times expected during a seismic event at low reactor system pressure, the model was modified to account for the depletion of the HCU accumulator, which assists in rod insertion, and the pressurization of the SDV that opposes control rod insertion. Other assumptions incorporated into the model or used as inputs were selected to conservatively bound conditions in the BWR/2-5 fleet and include the following:

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]] The response spectrum for that plant was selected because it was considered to conservatively bound those for other plants after being scaled to represent the respective seismic load magnitudes. [[

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Because the model uses [[
]] the results can be applied to any fuel bundle design for which the natural frequency is similar to, or bounded by, the GNF GE14 or GNF2 designs. GEH/GNF believes the characteristics of all BWR fuel bundles will be sufficiently similar to allow generic application of the model for time-dependent dynamic loading, but does not have sufficient information for non-GNF fuel designs to confirm that assertion. However, given this assumption, the calculated friction limits for a given lateral bundle deflection (see Tables 2 and 3) can be applied to non-GNF fuel by confirming that the bundle deflections for the fuel design under a plant's specific dynamic loading are bounded by the indicated deflections (e.g., for a plant with dynamic fuel bundle deflections of 18 mm, the closest bounding friction limits would be those in the column for 20-mm deflections).

<u>GNF-pecific Determination of Dynamic Loads and Deflections</u>: [[

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Evaluation Results

The results of the evaluation are compiled in Tables 2 – 5, which provide limiting values of friction above which control rods may not insert during an SSE,[3] for ranges of reactor system pressure and control rod drive scram accumulator pressure. Table 2 contains the control rod friction limits with 20-mm dynamic deflection impact considered at all reactor system pressures, and Table 3 contains those limits applicable to 30-mm dynamic deflection. Tables 4 and 5 contain, for 20-mm and 30-mm deflection, respectively, the control rod friction limits with the dynamic impact incorporated only for reactor system pressure ranging from full pressure down to and including 900 psig. For pressures below 900 psig down to MSIV isolation set point pressure, Tables 4 & 5 list the lesser of either the 900 psig value or the corresponding value from MFN 08-420.[4] Therefore, Tables 4 and 5 provide GEH/GNF-recommended limits if considering the impact of SSEs during normal and anticipated down-power operation, while Tables 2 and 3 friction limits apply when considering impact of SSEs below 900 psig to the MSIV isolation set point pressure (e.g., if considering an SSE in conjunction with a transient that takes the plant to MSIV isolation set point pressure). Tables

[3] Or SSE with concurrent LOCA and SRV for plants with Mark II containment.

[4] An Anticipated Operational Occurrence (AOO) may cause the reactor system pressure to decrease below 900 psig. However because licensing requirements do not consider the simultaneous occurrence of an AOO and SSE, it is acceptable to define the limiting friction levels for an SSE (or, SSE + LOCA, for Mark II containment plants) at 900 psig.

2 and 3 also provide the control rod friction limits applied to low-reactor system pressure operation, such as during plant startup and shutdown. [[

]]

Close inspection of Tables 2 – 5 will reveal that [[

]] The total wet weight of these components is termed the "control rod weight" for the present purpose, and a list of these weights for most GEH C-lattice and D-lattice control blade designs is provided in Table 6. [[

]] Guidance for identifying those two populations is provided in the Recommendations section.

Recommendations

The guidance presented here is conservative, intended for generic application to all BWR/2-5s. The generic nature of the guidance necessitates conservatism to address behavior and potential issues for all plants, with differentiation only as the calculated values of control rod friction for different conditions allow. However, experience and observations at plants in the international GE-design BWR fleet indicates that channel distortion and its effects do not manifest to the same degree in all plants; this is true under conditions or parameters that appear to be similar. Therefore, utility or plant operating experience can be considered to develop more appropriate plant-specific approaches as an alternative to these recommendations.

Because this guidance is generic, and because the postulated conditions addressed herein are not specific to a fuel design or a particular vendor's product line, guidance is presented in a manner to enable application to any fuel design. However, GNF has additional guidance that can be applied to GNF fuel bundles and/or GNF-designed cores, which is also provided and so-labeled. In particular, GNF's Cell Friction Methodology (CFM values) can be used to help define the population of control cells that might develop friction due to channel-control blade interference and the population of control cells with potential to develop no-settle-levels of friction. Other means to define these populations might be applied, making use of information available from fuel vendors or plant-specific observations.

As described above, the guidance defines two test populations of control cells, [[ ]] (the Settle Test Population) [[ ]] (the Full-Stroke Insertion Test Population), which are named for the tests recommended to address them and are described in the following sections. [[ ]] so the monitoring population must be expanded beyond the recommendations in MFN 08-420 to include control cells with potential to develop [[ ]] Although it was previously deemed acceptable to risk an undetected no-settle condition in unmonitored cells because the probability that the control rod friction exceeded the friction limits was low enough to ignore, the objective of monitoring for the presently postulated conditions must now be to identify all no-settle conditions for the Settle Test Population and control rod friction approaching friction limits for the Full-Stroke Insertion Test Population.

Because some plant conditions might otherwise lead to large numbers of control rods to be tested in accordance with this guidance, and because testing of large numbers of control rods might introduce risk (e.g., due to degradation of equipment, or additional opportunity for operator error) that is commensurate with or greater than the risk associated with the postulated condition (see the probabilistic analysis summary near the end of this document), GEH/GNF encourages implementation of a statistically-based sampling plan for either or both test populations. Development of such a sampling plan should consider accepted principles or standards for statistically based sampling, but sampling should emphasize testing of the more friction-susceptible cells. This approach might be particularly helpful for plants for which cell friction predictions based on fleet-wide characteristics are overly conservative.

<u>Application to Ranges of Reactor Operating Pressure</u>

Control rod friction limits for operation above MSIV isolation set point pressures are [[ ]] the Settle Test Population. However, some control rod friction limits for MSIV isolation set point pressures, as found in Tables 2 and 3, [[ ]] (specifically, if SSE-impacted limits are to be applied for main steam isolation transients). Otherwise, [[

]] After a control cell is placed into a population, frequency of testing for that cell is determined [[

]] as indicated in the testing recommendations below.

Control rod friction limits applicable to [[

]] Therefore, testing from either the Settle Test Population or the Full-Stroke Insertion Population may be necessary to ensure control rod function for these operating pressures. [[

]] Testing for this operating range need be performed only prior to entering that pressure range – e.g., prior to a planned startup or shutdown. However, GEH/GNF recommends that operability for this pressure range be determined from testing [[ ]]

The following procedural steps are provided for information only to assist the development of a monitoring plan. Plant operating staff will determine the most appropriate procedures.
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The following provides the specifics for the GNF recommendations regarding settle testing or full-stroke insertion testing.

Settle Test Population

This test population is determined to be those cells with potential for [[ ]] as determined by predictions or experience, and as correlated with bundle and control cell characteristics. [[ ]] So, GEH/GNF recommends that this population be determined as those cells with potential for slow-to-settle or no-settle behavior, beginning at the point of time in the operating cycle when such control rod friction might be expected. Note that although a settle test is recommended for identifying elevated control rod friction in the population, [[ ]] as necessary to determine the operability of a control rod with friction identified in a settle test. GEH/GNF-specific guidance (i.e., guidance specific to GNF fuel and core designs) for determining this population is given below, but the indicated principles can be applied to non-GNF fuel by determining thresholds or exposures above which slow-to-settle and no-settle behavior is observed.

GEH/GNF-specific guidance for selecting the Settle Test population:

[[

]]

Full-Stroke Insertion Test Population

As mentioned above, some control rod friction limits [[

]] (Anecdotally, some reactor engineers report plant staff familiar with plant characteristics are often able to discern unusual control rod behavior leading up to slow-to-settle behavior; perhaps this discernment can be helpful in preparation of plant-specific monitoring plans.) As indicated in Tables 2 – 5, [[

]] so this test population is only required to be addressed prior to startup and before reaching the MSIV isolation set point pressure during shutdown.

[[

]] The control rod friction being addressed in this plan is that arising from channel-control blade interference, and the onset of channel-control blade interference (or contact) is the point at which control rod friction begins accumulating from zero, increasing with increasing channel deformation due to increased exposure. Typically, at the beginning of an operating cycle, control cells will have little or no control rod friction. This is particularly true for most cores designed currently with intention to minimize channel-control blade interference. There would likely be no control cells in this population at the beginning of a cycle, but the population could grow as the cycle progresses. A threshold for defining this test population can be any figure of merit that indicates the onset of channel-control blade interference, such as bundle exposure or resident time as correlated with channel dimension measurements. GEH/GNF-specific guidance for determining this population is given below, but the indicated principles can be applied to non-GNF fuel by determining thresholds or exposures below which channel dimensions remain below the point of channel-control blade contact.

GEH/GNF-specific guidance for selecting the Full-Stroke Insertion Test Population:

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Testing Recommendations for the Settle Test Population

To ensure control rods in the Settle Test Population fully insert under all postulated conditions, control rod friction from interference (as implied in a settle test or as measured in a full-stroke insertion test) should remain below the applicable values indicated in Tables 2 and 3 for the reactor system pressure of interest, if the impact of an SSE is to be considered in conjunction with transients that place the plant at MSIV isolation set point pressure. If the impact of an SSE need not be considered for main steam isolation transients, then the values in Tables 4 and 5 are recommended.

Because slow-to-settle (>7 seconds) and no-settle (>30 seconds) conditions indicate [[

]] settle testing may continue to be used to identify the presence of channel-control blade interference during operation above the MSIV isolation set point pressure. However, [[

]]

The monitoring guidance recommended herein conservatively covers all GE BWR/2-5 plants, and is given below for control cells placed into the Settle Test Population.

Population(s): The Settle Test Population – control cells with control rod friction limits equal to or greater than [[

]]. In lieu of sampling all rods in this population, a statistical sampling plan can be implemented, consistent with accepted statistical sampling principles.

First Test: Prior to reaching the time in the cycle at which a slow-to-settle or no-settle might occur.

Test Result: Notch-to-notch settle time(s) in seconds[5]

Anticipated Results & Actions:

1) [[
2)

]] comparison against the appropriate limit selected from Tables 2 – 5. If below the limit then place into increasing friction sub-population and determine time of next test per the recommendations for that population.

3) [[

5 [[

]] Then place into increasing-friction sub-population.

4) If the measured friction is greater than the appropriate limit selected from Tables 2 - 5, insert the control rod, declare it inoperable and place it out of service in accordance with Technical Specifications.

Control cells that exhibit signs of channel-control blade interference as indicated in settle tests are considered to be in the increasing-friction sub-population. The recommended guidance for this Increasing-Friction population is given below.

Population(s): Increasing-friction sub-population of the Settle Test Population – [[ ]]

First test: [[ ]]

Test Result: From [[ ]] or from an equivalent approach.

Subsequent tests: Test frequency, indicated by maximum number of days, is specific to each rod and is determined by: [6]

[[

[6] [[ ]]

]] = appropriate value from Tables 2 – 5

Anticipated Results & Actions:

i.

Test Friction < Friction Limit$_{above\text{-}MSIV}$;

Rod remains in Increasing-Friction Population; determine maximum time to next test.

ii.

Test Friction ≥ Friction Limit$_{above\text{-}MSIV}$;

Declare inoperable and place out of service in accordance with Technical Specifications.

Testing Recommendations for the Full-Stroke Insertion Test Population

To ensure control rods in the Full-Stroke Insertion Test Population fully insert all postulated SSE conditions, friction from interference as measured in a full-stroke insertion test should remain below the applicable minimum values indicated in Tables 2 and 3. As described above in the section “Full-Stroke Insertion Test Population”, this population is to include all control cells with potential friction, [[

]]

[[

]]

The monitoring guidance recommended herein conservatively covers all GE BWR/2-5 plants, and is given below for control cells placed into the Full-Stroke Insertion Test Population.

Population(s): Full-Stroke Insertion Test Population – control cells with control rod

[[

]] as determined by fuel vendor data, models, or plant experience. In lieu of sampling all rods in this population, a statistical sampling plan can be implemented, consistent with accepted statistical sampling principles.

First Test: Prior to initiating startup or shutdown operations, test all cells in the monitoring population (or the population sample).

Test Result: [[ ]] control rod friction is determined using the control rod drive model incorporated into the Level-2 code FORCE01P[7], or from an equivalent approach.

Subsequent tests: Test results are valid for [[ ]]

Anticipated Results & Actions:

i.

Test Friction ≥ Friction $\text{Limit}_{\text{sub-MSIV}}$

All control rods with slow friction greater than the applicable limit from Table 2 or 3 must be inserted prior to reactor operation at the associated reactor system pressure. Control rods inserted for low-pressure may be withdrawn once the pressure is greater than the MSIV isolation set point pressure. If the measured slow friction is greater than the applicable limit for operation above MSIV isolation set point pressure insert the control rod, declare it inoperable and place it out of service in accordance with Technical Specifications.

ii.

Test Friction < Friction $\text{Limit}_{\text{sub-MSIV}}$;
Rod remains in the Full-Stroke Insertion Test Population

Additional Anticipated Results & Actions:

1) For a planned soft shutdown, the testing should be performed within [[ ]] If testing is not desired, then prior to decreasing the reactor system pressure

[7] FORCE01P (GNF User Manual ECP ID: 0000-0081-4479)

below [[ ]] either insert all rods in cells in the monitoring population or scram the plant.

2) For an unplanned shutdown, prior to decreasing the reactor system pressure below [[ ]] either insert all rods in cells in the monitoring population or scram the plant.

ABWR and ESBWR Design Certification Documentation Applicability

The issues described above have been reviewed for applicability to documentation associated with 10CFR 52 and it has been determined that there is no effect on the technical information contained in either the ABWR certified design or the ESBWR design in certification.

Probabilistic Analysis of the Condition

A probabilistic analysis was performed to estimate the frequency of earthquakes pertinent to this issue, defined as earthquakes higher in magnitude than the Safe Shutdown Earthquake (SSE), occurring while the plant is shutting down or starting up, and while all or some control rods are withdrawn. The analysis considered 17 US BWRs, covering a comprehensive range of SSEs and geographical locations. The frequency of exceedance for the different plant SSEs was extracted from the 2008 U.S. Geological Survey (USGS) National Seismic Hazard Maps. Based on the results of this analysis, the frequency of larger-than-SSE earthquakes occurring while the plant is shutting down or starting up, and while not all control rods are in, is expected to be less than [[ ]] per year for most U.S. BWRs. This frequency can be considered low in comparison to most initiating event frequencies used in a Probabilistic Risk Assessment (PRA).

In order to compare with the Core Damage Frequencies (CDFs) resulting from operating BWR PRAs, the probability of common cause failure of control rods to fully insert is estimated based on the postulated earthquake conditions and the channel bow concerns, which result in a failure of shutdown. The resulting consequence is a failure to achieve hot shutdown, which is comparable to the CDF contribution from the ATWS (Anticipated Transient Without Scram) sequences although additional systems/functions (e.g., the actuation of Standby Liquid Coolant, or SLC, system) can be credited. The frequency for failure to achieve hot shutdown is estimated to be [[ ]] per year.

Additionally, the failure to achieve cold shutdown is also estimated based on the minimum number of control rods that cannot be fully inserted resulting in a loss of shutdown margin. The frequency for failure to achieve cold shutdown is estimated to be [[ ]] per year.

Table 1

Maximum Fuel Bundle Horizontal Acceleration and Associated Bundle Deflection for GNF Fuel Bundles for Various Plants*

Plant	Plant Type	Containment Type	Maximum Acceleration (g)	Deflection (mm)
Garona (Nuclenor)	BWR/3	Mark I	[[	
NMP 2	BWR/5	Mark II		
Hope Creek	BWR/4	Mark I		
Quad Cities 1&2	BWR/3	Mark I		
Pilgrim	BWR/3	Mark I		
Monticello	BWR/3	Mark I		
Dresden 2 & 3	BWR/3	Mark I		
Browns Ferry 1	BWR/4	Mark I		
Limerick	BWR/4	Mark II		
La Salle 1	BWR/5	Mark II		
Fermi 2	BWR/4	Mark I		
Laguna Verde 1 & 2	BWR/5	Mark II		
Hatch 1	BWR/4	Mark I		
Hatch 2	BWR/4	Mark I		
Fitzpatrick	BWR/4	Mark I		
Duane Arnold	BWR/4	Mark I		
Brunswick 1 & 2	BWR/4	Mark I		
Peach Bottom 2 & 3	BWR/4	Mark I		
KKM	BWR/4	Mark I		
NMP 1	BWR/2	Mark I		
Cooper	BWR/4	Mark I		
Oyster Creek	BWR/2	Mark I		
Columbia	BWR/5	Mark II		]]

* The values listed apply only to GNF fuel bundles in the indicated plants.

Table 2 Maximum Allowed Control Rod Friction to Protect Against Incomplete Rod Insertion for 20-mm Bundle Dynamic Deflections (at all indicated Pressures) and Various Control Rod Weights

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* [[

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Table 2 (cont.) Maximum Allowed Control Rod Friction to Protect Against Incomplete Rod Insertion for 20-mm Bundle Dynamic Deflections (at all indicated Pressures) and Various Control Rod Weights

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* [[

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Table 2 (cont.) Maximum Allowed Control Rod Friction to Protect Against Incomplete Rod Insertion for 20-mm Bundle Dynamic Deflections (at all indicated Pressures) and Various Control Rod Weights

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* [[

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Table 2 (cont.) Maximum Allowed Control Rod Friction to Protect Against Incomplete Rod Insertion for 20-mm Bundle Dynamic Deflections (at all indicated Pressures) and Various Control Rod Weights

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* [[

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Table 2 (cont.) Maximum Allowed Control Rod Friction to Protect Against Incomplete Rod Insertion for 20-mm Bundle Dynamic Deflections (at all indicated Pressures) and Various Control Rod Weights

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* [[

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Table 2 (cont.) Maximum Allowed Control Rod Friction to Protect Against Incomplete Rod Insertion for 20-mm Bundle Dynamic Deflections (at all indicated Pressures) and Various Control Rod Weights

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* [[

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Table 3 Maximum Allowed Control Rod Friction to Protect Against Incomplete Rod Insertion for 30-mm Bundle Dynamic Deflections (at all indicated Pressures) and Various Control Rod Weights

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* [[

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Table 3 (cont.) Maximum Allowed Control Rod Friction to Protect Against Incomplete Rod Insertion for 30-mm Bundle Dynamic Deflections (at all indicated Pressures) and Various Control Rod Weights

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* [[

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Table 3 (cont.) Maximum Allowed Control Rod Friction to Protect Against Incomplete Rod Insertion for 30-mm Bundle Dynamic Deflections (at all indicated Pressures) and Various Control Rod Weights

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* [[

]]

Table 3 (cont.) Maximum Allowed Control Rod Friction to Protect Against Incomplete Rod Insertion for 30-mm Bundle Dynamic Deflections (at all indicated Pressures) and Various Control Rod Weights

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	[[			
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Table 3 (cont.) Maximum Allowed Control Rod Friction to Protect Against Incomplete Rod Insertion for 30-mm Bundle Dynamic Deflections (at all indicated Pressures) and Various Control Rod Weights

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				]]

[[

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Table 3 (cont.) Maximum Allowed Control Rod Friction to Protect Against Incomplete Rod Insertion for 30-mm Bundle Dynamic Deflections (at all indicated Pressures) and Various Control Rod Weights

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Table 4 Recommended Control Rod Friction Limits to Protect Against Incomplete Rod Insertion for 20-mm Bundle Dynamic Deflections at > 900 psig Reactor Operating Pressure and Combined with MFN 08-420 Friction Limits for MSIV isolation set point pressure

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Table 5 Recommended Control Rod Friction Limits to Protect Against Incomplete Rod Insertion for 30-mm Bundle Dynamic Deflections at > 900 psig Reactor Operating Pressure and Combined with MFN 08-420 Friction Limits for MSIV isolation set point pressure

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[[

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Table 6

Maximum Hot Wet Weights of GEH Control Rod Types For BWR/2-5

Control Rod Type	Control Rod Hot Wet Weight, lbs	
	C-Lattice	**D-Lattice**
OEM	[[	
DuraLife 100		
DuraLife 120		
DuraLife 140		
DuraLife 140A		
DuraLife 160		
DuraLife 190		
DuraLife 215		
DuraLife 230		
Marathon C		
Marathon C+		
Marathon D		
Marathon -5S C (Ultra MD)		
Marathon -5S D (Ultra MD)		]]