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LTR-NRC-11-9

March 9, 2011

**Subject: Submittal of WCAP-13360-NP, Supplement 1, Revision 0, "Clarification on Use of Dynamic Rod Worth Measurement (DRWM) in Initial Plant Start-up Applications" (Non-Proprietary) for Review and Approval**

Enclosed is a non-proprietary copy of WCAP-13360-NP, Supplement 1, Revision 0 "Clarification on Use of Dynamic Rod Worth Measurement (DRWM) in Initial Start-up Applications," dated February 2011 submitted to the Nuclear Regulatory Commission for review and approval. This licensing topical report supplement provides information on the use of DRWM in new plant start-up applications. Approval of this supplement is requested by June 30, 2011.

In support of NRR's prioritization efforts, the following prioritization scheme matrix was completed and justification for the points assigned is provided on the following page.

Correspondence with respect to this topical should be addressed to J. A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company LLC, Suite 428, 1000 Westinghouse Drive, Cranberry Township, Pennsylvania 16066.

Very truly yours,

A handwritten signature in black ink that reads "J. A. Gresham / FOR".

J. A. Gresham, Manager  
Regulatory Compliance

Enclosures

cc: E. Lenning  
A. Mendiola

TOD  
NRR

<b>TR Prioritization Scheme Matrix</b>			
*Industry input on shaded areas was not requested.			
<b>Factors</b>	<b>Select the Criteria That the TR satisfies</b>	<b>Points Assigned For Each Criteria</b>	<b>Total Points (if points are cumulative, total them for each factor in this column)</b>
<b>TR Classification</b> (Points are cumulative)	Generic Safety Issue	6	1
	Emergent Technical Issue	3	
	Standard TR	1	
<b>Applicability</b> (Points are not cumulative)	Industry-wide Implementation	3	1
	Applicable to entire groups of licensees (BWROG, PWROG, BWRVIP, etc.)	2	
	Applicable only to partial groups of licensees	1	
<b>Specialized Resource Availability</b> (Points are cumulative)	NRC staff expertise is readily available (The NRC staff will evaluate this criteria)	1.5	0.5
	Technical data is available/readily accessible (The NRC staff will evaluate this criteria)	1	
	A SE is requested by a certain date (less than two years) to support a licensing activity. Provide justification.	0.5	
Total Points (Add the total points from each factor and total here):			2.5

**TR Classification:** The use of DRWM has already been reviewed and approved by the NRC and is used at a number of currently operating plants. The NRC's review and approval of extending the application of DRWM to initial start up will provide an update to the application of an already approved method.

**Applicability:** Supplement 1 of this Topical Report (TR) is applicable to plants licensed under 10CFR Part 50 and Part 52.

**Specialized Resource Availability:** The SER for the attached Supplement is requested by June 30, 2011 in order to maintain the start-up schedule for TVA's Watts Bar Unit 2, which is currently scheduled to start up in 2012.

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WCAP-13360-NP,  
Supplement 1,  
Revision 0

February 2011

# **Clarification on Use of Dynamic Rod Worth Measurement (DRWM) in Initial Plant Start-up Applications**



**Westinghouse**

**WCAP-13360-NP  
Supplement 1,  
Revision 0**

**Clarification on Use of  
Dynamic Rod Worth Measurement (DRWM)  
in Initial Plant Start-up Applications**

**February 2011**

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## 1 INTRODUCTION

Dynamic Rod Worth Measurement (DRWM™) has proven to be an accurate and safe physics testing method with over 200 applications around the world. With the advent of the nuclear renaissance, it is desired to use this accurate and proven methodology for initial plant start-ups. This application would be limited to Westinghouse-designed Nuclear Steam Supply System (NSSS) with Westinghouse licensed fuel products and would include the additional requirements noted here-in. This clarification request is to request U.S. Nuclear Regulatory Commission (NRC) approval to use DRWM on initial plant start-ups.

By letter dated January 5, 1996, the NRC approved the use of the Dynamic Rod Worth Measurement (DRWM) technique at Westinghouse Pressurized Water Reactors. The NRC made the following conclusions about the DRWM technique:

*“Based on our review as outlined in the evaluation in Section 2.0 above, we conclude that the dynamic rod worth measurement technique is acceptable for measurement of rod worth at the beginning of reload cycles for two, three, and four loop Westinghouse cores. This acceptance is based on using the technique as outlined in Attachment B of Reference 4 and applying the evaluation criteria and remedial actions also outlined in this attachment. It is also limited to use with the rod patterns and rod worths bounded by those used in the sensitivity studies.”*

The aforementioned Attachment B describes the actions to be taken upon failure of the individual bank worth review criteria. Failure of these criteria indicates a possible inconsistency in the core power distribution caused by differences between the design and the as built core, or a core anomaly (dropped rod, misloading, etc.). For this reason, a power distribution measurement (full core flux map) is required prior to exceeding 5% power when the measurement difference is confirmed. This is consistent with the misload analysis in place for Westinghouse plants at the time of the approval.

Westinghouse plans to meet the intent of WCAP-13360-P-A, Revision 1 (henceforth referred to as WCAP-13360-P-A) for initial plant start-ups in the following manner. An outline of the approach that will be taken by Westinghouse is provided at the end of this document.

It should be noted that throughout WCAP-13360-P-A, Westinghouse did not stipulate that this methodology was limited to reload applications only. The NRC stipulated this requirement in their approval, which Westinghouse accepted at that time, since initial plant start-ups were not envisioned when the topical report was initially approved. The one item in WCAP-13360-P-A where Westinghouse referred to previous cycles is in Section 3.3, page 3-4. Since Westinghouse calculates the dynamic spatial factors for the banks each cycle, for each plant, there is no reliance on previous cycle data to determine sensitivity correlations.

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## **2 CHANGE TO REVIEW CRITERIA**

Because of the lack of fuel burnup and fission product distribution changes, the measurements performed on a clean core are expected to be much more accurate than those of a reload core. For that reason, Westinghouse has historically tightened the review criteria on individual bank worths to 10% or 75 pcm. The review criteria specified in the topical report is 15% or 100 pcm. This change to the review and criteria is specific to the initial plant start-up applications only and is based on prior initial plant start-up experience.

## **3 REPLACEMENT OF 5% FLUX MAP**

In the event of a review criterion failure, WCAP-13360-P-A states that a power distribution measurement (full core flux map) is required prior to exceeding 5% power in order to determine the cause of the failure. When WCAP-13360-P-A was written, it was applicable only for plants equipped with a moveable incore detector system; however, many of the Westinghouse NSSS plants that will be going through initial start-ups will have a fixed incore detector system. Fixed incore detector systems lack the ability to perform a power distribution measurement below ~20% power.

For the initial plant start-up, any bank that is confirmed to fail the individual bank worth review criteria will be re-measured by either Boron Dilution or the Rod Swap methodology. Both of these methods are approved for first cores and within the licensing basis for these new units coming on-line. In the unlikely case that the results from the subsequent measurement using either of these other two methods fails the bank worth criteria, then the data will be reviewed considering other measurement information to determine a possible cause (e.g., unlatched Rod Control Cluster Assembly, misloaded assembly). The core design analyst will evaluate the magnitude of the failure and provide a safety assessment to allow power ascension to ~25% Rated Thermal Power (RTP) to perform a fixed incore detector based power distribution measurement. Note that Regulatory Guide 1.68 Revision 2 specifically recognizes that initial flux maps can be taken above 5% power, depending on the sensitivity of the incore instrumentation.

**Table 1: Reload vs. Initial Core Criteria and Resolution**

<b><u>Reload Core Review Criteria and Resolution</u></b>	<b><u>Initial Core Review Criteria and Resolution</u></b>
Individual Bank Worth Review Criteria	Individual Bank Worth Review Criteria
<ul style="list-style-type: none"> <li>• Within 15% or 100 pcm</li> </ul>	<ul style="list-style-type: none"> <li>• Within 10% or 75 pcm</li> </ul>
If the individual bank worth fails	If the individual bank worth fails
<ul style="list-style-type: none"> <li>• Investigate the failure by re-measurement with DRWM</li> </ul>	<ul style="list-style-type: none"> <li>• Investigate the failure by re-measurement with DRWM</li> </ul>
If the individual bank worth fails the investigation/re-measurement	If the individual bank worth fails the investigation/re-measurement
<ul style="list-style-type: none"> <li>• Measure the bank by dilution or swap</li> </ul>	<ul style="list-style-type: none"> <li>• Measure the bank by dilution or swap</li> </ul>
If any of the failures cannot be resolved by re-measurement	If any of the failures cannot be resolved by re-measurement
<ul style="list-style-type: none"> <li>• Review data in detail to see if there is a probable cause (e.g., unlatched RCCA, misloaded assembly).</li> </ul>	<ul style="list-style-type: none"> <li>• Review data in detail to see if there is a probable cause (e.g., unlatched RCCA, misloaded assembly).</li> </ul>
<ul style="list-style-type: none"> <li>• Perform a full core flux map prior to exceeding 5% power</li> </ul>	<ul style="list-style-type: none"> <li>• The core design analyst will evaluate the magnitude of the failure and provide a safety assessment to allow power ascension to ~25% RTP to perform a fixed incore detector based power distribution measurement.</li> </ul>