

# American Nuclear Society

**reload startup physics tests  
for pressurized water reactors**

**an American National Standard**

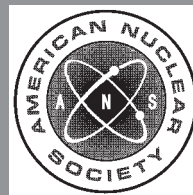
**REAFFIRMED**

**August 5, 2016**

**ANSI/ANS-19.6.1-2011; R2016**

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**American National Standard  
Reload Startup Physics Tests  
for Pressurized Water Reactors**

Secretariat  
**American Nuclear Society**

Prepared by the  
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## **American National Standard**

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This standard was developed under procedures of the Standards Committee of the American Nuclear Society; these procedures are accredited by the American National Standards Institute, Inc., as meeting the criteria for American National Standards. The consensus committee that approved the standard was balanced to ensure that competent, concerned, and varied interests have had an opportunity to participate.

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Comments on this standard are encouraged and should be sent to Society Headquarters.

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**Foreword** (This Foreword is not a part of American National Standard “Reload Startup Physics Tests for Pressurized Water Reactors,” ANSI/ANS-19.6.1-2011.)

It is the intent of this American National Standard to provide guidance for verifying the nuclear characteristics of a commercial pressurized water reactor core. This standard is intended to cover the physics tests that are performed following a refueling or other alteration of the reactor core for which nuclear design calculations are required. This standard provides the minimum acceptable startup physics test program; however, the standard recognizes that additional tests may be required by special design features for a particular core. This standard does not reflect all test programs that have been approved by the U.S. Nuclear Regulatory Commission. This standard specifies the minimum testing required to confirm that the reconstructed core is the same as the designed core.

Compliance with the intent of this standard can be demonstrated by meeting the following requirements:

- (1) Perform the physics tests described herein using an acceptable test method;
- (2) Determine if the test results agree with the predicted results within the previously established test criteria;
- (3) Document the above in accordance with the requirements of Sec. 7 of this standard.

Suggestions for the improvement of this standard are welcome. They should be sent to the American Nuclear Society, 555 North Kensington Avenue, La Grange Park, Illinois 60526.

Following is a summary of changes that were made to the 2005 version:

- (1) The list of acceptable methods for each physics test has been moved to the Appendix;
- (2) The overall bases for performing a startup test program has been added;
- (3) The bases for performing each physics test has been added in the Appendix;
- (4) Several clarifications and editing changes were made.

This standard was developed by Working Group ANS-19.6.1 of the American Nuclear Society, which had the active participation of the following members in preparing the current version:

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This is a preview of "ANSI/ANS-19.6.1-2011...". [Click here to purchase the full version from the ANSI store.](#)

# Reload Startup Physics Tests for Pressurized Water Reactors

## 1 Introduction

In conjunction with each refueling shutdown or other significant reactor core alteration, nuclear design calculations are performed to ensure that the reactor physics characteristics of the new core will be consistent with the safety limits. Prior to return to normal operation, successful execution of a physics test program is required to determine if the operating characteristics of the core are consistent with the design predictions and to ensure that the core can be operated as designed.

This standard specifies the content of the minimum acceptable startup physics test program for commercial pressurized water reactors (PWRs) and provides the bases for each test. Acceptable methods for performing the individual tests are provided in the Appendix.<sup>1)</sup> Alternate methods may be used as long as they are shown to meet the requirements of Sec. 6.

Successful completion of the physics test program is demonstrated when the test results agree with the predicted results within predetermined test criteria. Successful completion of the physics test program and successful completion of other tests that are performed after each refueling or significant reactor core alteration provide assurance that the plant can be operated as designed.

## 2 Scope

This standard applies to the reactor physics tests that are performed following a refueling or other core alteration of a PWR for which nuclear design calculations are required. This

standard does not address the physics test program for the initial core of a commercial PWR.<sup>2)</sup>

This standard specifies the minimum acceptable startup reactor physics test program to determine if the operating characteristics of the core are consistent with the design predictions, which provides assurance that the core can be operated as designed. This standard does not address surveillance of reactor physics parameters during operation or other required tests such as mechanical tests of system components (for example, the rod drop time test), visual verification requirements for fuel assembly loading, or the calibration of instrumentation or control systems (even though these tests are an integral part of an overall program to ensure that the core behaves as designed).

This standard assumes that the same previously accepted analytical methods are used for both the design of the reactor core and the startup test predictions. It also assumes that the expected operation of the core will fall within the historical database established for the plant and/or sister plants.

When major changes are made in the core design, the test program should be reviewed to determine if more extensive testing is needed. Typical changes that might fall into this category include the initial use of novel fuel cycle designs, significant changes in fuel enrichments, fuel assembly design changes, burnable absorber design changes, and cores resulting from unplanned short cycles. Changes such as these may lead to operation in regions outside of the plant's experience database and therefore may necessitate expanding the test program.

<sup>1)</sup> The Appendix to this standard is the User's Guide, which provides acceptable methods, guidelines, precautions, suggestions, and typical test criteria for each required test.

<sup>2)</sup> The good practices discussed in this standard should be considered for use in the physics test program for the initial core of a commercial PWR. One test that provides useful information (without additional test time) is the hot-zero-power to hot-full-power reactivity measurement.