



U.S. NUCLEAR REGULATORY COMMISSION  
**STANDARD REVIEW PLAN**  
OFFICE OF NUCLEAR REACTOR REGULATION

15.4.7 INADVERTENT LOADING AND OPERATION OF A FUEL ASSEMBLY IN AN IMPROPER POSITION  
REVIEW RESPONSIBILITIES.

Primary - Core Performance Branch (CPB)

Secondary - None

I. AREAS OF REVIEW

The review of fuel loading errors considers:

1. The spectrum of misloading events analyzed. A sufficient number of fuel loading errors must be studied by the applicant and presented to show that the worst situation undetectable by incore instrumentation has been identified. The kinds of errors considered should include loading of one or more fuel assemblies into improper locations and, where physically possible, with incorrect orientation. For those reactors in which burnable poison or fuel rods are added to or removed from fuel assemblies at the plant, errors in these processes must be considered.
2. Changes in the power distribution and increased local power density.
3. The provisions made to search for loading errors at the beginning of each fuel cycle.

CPB also reviews the effect of misloaded fuel on nuclear design parameters, the detection of fuel loading errors, and any operational restrictions that would assist in staying within fuel rod failure limits.

On request, the appropriate technical review branch reviews the radiological implications of misloaded fuel or the measures provided to minimize the probability of a fuel misloading.

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**USNRC STANDARD REVIEW PLAN**

Standard review plans are prepared for the guidance of the Office of Nuclear Reactor Regulation staff responsible for the review of applications to construct and operate nuclear power plants. These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Standard review plans are not substitutes for regulatory guides or the Commission's regulations and compliance with them is not required. The standard review plan sections are keyed to the Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants. Not all sections of the Standard Format have a corresponding review plan.

Published standard review plans will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience.

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555.

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## II. ACCEPTANCE CRITERIA

The acceptance criteria for this SRP section are as follows:

1. General Design Criterion 13 (Ref. 1) as it relates to instrumentation and controls provided to monitor variables over anticipated ranges for normal operations, anticipated operational occurrences, and for accident conditions.
2. 10 CFR Part 100 (Ref. 2) as it relates to offsite consequences resulting from reactor operations with an undetected misloaded fuel assembly.

The primary safeguards against fuel loading errors are procedures and design features to minimize the likelihood of the event. Additional safeguards include incore instrumentation systems which would detect errors. However, should an error be made and go undetected, it is possible in some reactor designs for fuel rod failure limits to be exceeded. Therefore, the following acceptance criteria are necessary to cover the event of operation with misloaded fuel caused by loading errors:

- a. To meet the requirements of GDC 13, plant operating procedures should include a provision requiring that reactor instrumentation be used to search for potential fuel loading errors after fueling operations.
- b. In the event the error is not detectable by the instrumentation system and fuel rod failure limits could be exceeded during normal operation, the offsite consequences should be a small fraction of the 10 CFR Part 100 guidelines.

## III. REVIEW PROCEDURES

The review procedures for fuel loading errors are as follows:

1. The reviewer verifies that the various cases of misloaded fuel assemblies outlined in subsection I above have been analyzed by the applicant and the worst case determined. For each case the effect on the reactor power distribution should be given.
2. The reviewer determines that the effect each postulated error has on reactor instrumentation has been ascertained. For limiting events (where fuel rod failure limits are exceeded), the reviewer verifies that acceptable techniques (see SRP Section 4.4) have been used to calculate the fuel temperature conditions.
3. The reviewer assures compliance with acceptance criterion a of subsection II above by reviewing the plant operating procedures to verify that they contain provisions requiring that incore instrumentation be used to search for misloaded fuel after each fueling operation. Since low-power mapping is typically done, searching for misloading can be accomplished by the usual low-power maps.
4. When it is determined that fuel rod failure limits can be exceeded, the appropriate technical review branch is requested to perform dose calculations to assure that acceptable criterion b of subsection II above is met.

#### IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided and his review supports the following kind of statement, to be included in the staff's safety evaluation report:

The staff has evaluated the consequences of a spectrum of postulated fuel loading errors. We conclude that the analyses provided by the applicant have shown for each case considered that either the error is detectable by the available instrumentation (and hence remediable) or the error is undetectable but the offsite consequences of any fuel rod failures are a small fraction of 10 CFR Part 100 guidelines. The applicant affirms that the available incore instrumentation will be used before the start of a fuel cycle to search for fuel loading errors.

The staff concludes that the requirements of General Design Criterion 13 and 10 CFR Part 100 have been met. This conclusion is based on the following:

The applicant has met the requirements of GDC 13 with respect to providing adequate provisions to minimize the potential of a misloaded fuel assembly going undetected and meets Part 100 with respect to mitigating the consequences of reactor operations with a misloaded fuel assembly. These requirements have been met by providing acceptable procedures and design features that will minimize the likelihood of loading fuel in a location other than its designated place.

#### V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this SRP section.

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of conformance with Commission regulations.

#### VI. REFERENCES

1. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."
2. 10 CFR Part 100, "Reactor Site Criteria."