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10 CFR 50.46 Reporting Guidelines

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ABSTRACT

This guideline describes an acceptable approach to satisfy the reporting requirements of 10 CFR 50.46(a)(3). These requirements involve the identification, evaluation, and reporting of changes to or errors in an acceptable ECCS evaluation model for loss-of-coolant-accidents (LOCAs).

This guideline is intended for voluntary use by operating reactor licensees subject to 10 CFR 50.46(a)(3) and by vendors that develop, own, and maintain ECCS evaluation models on behalf of reactor licensees.

The guideline describes the reporting requirements and definitions associated with 10 CFR 50.46(a)(3), outlines a practical evaluation and reporting process, and recommends a reporting format and schedule. It has not been submitted to NRC for endorsement.

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1.0 INTRODUCTION

This guideline describes an acceptable approach for satisfying the reporting requirements of 10 CFR 50.46(a)(3). These requirements involve the identification, evaluation, and reporting of changes to (or errors in) an acceptable Emergency Core Cooling System (ECCS) evaluation model for loss-of-coolant-accidents (LOCAs).

This guideline is intended for use by operating reactor licensees subject to 10 CFR 50.46(a)(3) and by vendors that develop, own, and maintain ECCS evaluation models on behalf of reactor licensees.

2.0 REPORTING REQUIREMENTS AND DEFINITIONS

The pertinent parts of the regulation are quoted in Section 2.1. The terms and concepts used by the commercial nuclear industry to comply with the regulation are defined in Section 2.2. The definitions are based on the "statements of consideration" that accompanied the publication of 10 CFR 50.46(a)(3) in the Federal Register, related Nuclear Regulatory Commission (NRC) Information Notices, and industry reporting practices reflected in industry 30-day reports and annual reports submitted pursuant to the regulation.

It is important to note that only the reactor licensees, not the fuel vendors, are subject to the regulation. Typically, a fuel vendor develops an evaluation model, secures generic NRC approval for its use (typically via a topical report), maintains the model, and conducts LOCA analyses using the model. Thus, pertinent information (such as the identification of changes, identification of errors, estimated impact of changes and errors on calculated peak cladding temperature, and the results of reanalysis if warranted) must be provided by the fuel vendor to the licensee to assist the licensee in complying with the regulation. The transfer of such information is a contractual matter between the licensee and the vendor, and is not addressed in this guideline. Also, some licensees maintain their own ECCS models, in which case analytical support from the fuel vendor is not necessary.

2.1 10 CFR 50.46(a)(3) Reporting Requirements

The requirements of 10 CFR 50.46(a)(3) are:

- (i) "Each applicant for or holder of an operating license or construction permit shall estimate the effect of any change to or error in an acceptable evaluation model or in the application of such a model to determine if the change or error is significant. For this purpose, a significant change or error is one which results in a calculated peak fuel cladding temperature different by more than 50 degrees F from the temperature calculated for the limiting transient using the last acceptable model, or is an accumulation of changes and errors such that the sum of the absolute magnitudes of the respective temperature changes is greater than 50 degrees F."
- (ii) "For each change to or error discovered in an acceptable evaluation model or in the application of such a model that affects the temperature calculation, the applicant or licensee shall report the nature of the change or error and its estimated effect on the limiting ECCS analysis to the Commission at least annually as specified in § 50.4. If the change or error is significant, the applicant or licensee shall provide this report within 30 days and include with the report a proposed schedule for providing a reanalysis or taking other action as may be needed to show compliance with § 50.46 requirements. This schedule may be developed using an integrated scheduling system previously approved for the facility by the

NRC. For those facilities not using an NRC approved scheduling system, a schedule will be established by the NRC staff within 60 days of receipt of the proposed schedule. Any change or error correction that results in a calculated ECCS performance that does not conform to the criteria set forth in paragraph (b) of this section is a reportable event as described in §§ 50.55(e), 50.72 and 50.73. The affected applicant or licensee shall propose immediate steps to demonstrate compliance or bring plant design or operation into compliance with § 50.46 requirements.”

2.2 Definitions¹

2.2.1 *Analysis*

The term “analysis” refers to the use of an acceptable evaluation model to demonstrate compliance with 10 CFR 50.46 for a specific plant.

2.2.2 *Application*

The term “application” denotes the range of applicability of an evaluation model, i.e., the conditions under which it is appropriate to apply the evaluation model. This definition is consistent with the explanation of application provided in item 6 of the “Summary of Public Comments” section in the statements of consideration that accompanied the final rule language published in the Federal Register in 1988.

2.2.3 *Change*

The term “change” denotes any alteration of the acceptable evaluation model or its application that affects the transient temperature calculation even if the impact on peak cladding temperature (PCT) is zero degrees F. The transient temperature calculation consists of the time-dependent temperature for the limiting fuel rod in both the limiting and non-limiting cases. Alterations of the acceptable evaluation model that do not affect the temperature calculation are not considered changes for the purposes of compliance with 10 CFR 50.46(a)(3). An extension of the range of model applicability is considered to be a change. The use of a different acceptable evaluation model (such as from a different fuel supplier, or a new evaluation model from the same fuel supplier) is also considered to be a change.

Since the regulation discusses errors separately from changes, errors are not considered a subset of changes.

2.2.4 *Evaluation Model*

10 CFR 50.46(c)(2) defines “evaluation model” as follows:

“An evaluation model is the calculation framework for evaluating the behavior of the reactor coolant system during a postulated loss-of-coolant accident (LOCA). It includes one or more computer programs and all other information necessary for application of the calculational framework to a specific LOCA, such as mathematical models used, assumptions included in the programs, procedure for treating the program input and output information, specification

¹ It is important to note that many of the terms in this section do not have a counterpart in 10 CFR 50.46, hence, the need for their definition within this guideline.

of those portions of analysis not included in computer programs, values of parameters, and all other information necessary to specify the calculational procedure.”

A key concept in the definition of the evaluation model is that it consists of more than just the details specified in the model documentation that the NRC reviewed and approved. Supporting details for implementing the model that is described in licensing documentation (typically a topical report submitted to NRC by the fuel supply vendor, or in some cases by the licensee) are also considered part of the evaluation model. This means that error corrections and changes made to details not specifically described in the evaluation model documentation are also subject to the reporting requirements of 10 CFR 50.46(a)(3). The evaluation model does not include the input information that describes a plant, although it does include the process to develop the input information.

2.2.5 Acceptable Evaluation Model

An “acceptable evaluation model” is defined as the baseline evaluation model approved by the NRC as documented in a Safety Evaluation, plus implementation details (those details below the level of information reviewed by the NRC), error corrections, and changes to the baseline evaluation model that have been reported to the NRC in accordance with 10 CFR 50.46(a)(3). The term baseline evaluation model denotes the one reviewed and approved by the NRC.

2.2.6 Limiting Transient

For the purpose of complying with reportability requirements, the “limiting transient” is the LOCA simulation (i.e., break size, location, etc.) that results in the highest peak cladding temperature (PCT).

2.2.7 Error

An “error” is any feature of the evaluation model or its use that does not perform its intended function.

- a) Errors in evaluation models include:
 - i. new information which indicates the model is in error,
 - ii. deviations of the evaluation model from its current description (including those details below the level described in the licensing documentation),
 - iii. coding errors, and
 - iv. application of a model outside its intended range of applicability.
- b) Errors in analysis include:
 - i. use of incorrect plant descriptive input information (excluding inputs which were intentionally chosen to be conservative), and
 - ii. unintended changes in plant conditions that cause the input information to be incorrect.

2.2.8 Estimated Effect

A combination of information, either derived from evaluation model sensitivity studies, calculated from first principles, extracted from existing calculations, or based upon engineering experience, along with known sensitivities from appropriate applications of evaluation models is used to determine the "estimated effect" of a change on calculated PCT. It is distinguished from an analysis in that it may or may not involve the direct application of the computer codes or calculations that comprise an evaluation model to determine the effect of the change.

2.2.9 Reanalysis

A "reanalysis" is an analysis that effectively supplements or replaces all or some portion of the LOCA analysis performed using a previous acceptable evaluation model. A reanalysis is the formal means used to demonstrate continuing compliance with 10 CFR 50.46.

2.2.10 Other Action

In the context of 10 CFR 50.46(a)(3)(ii), "other action" generally means:

a) A change to an allowed operating condition (e.g., peaking factor) that results in compliance with 10 CFR 50.46(b) limits, as demonstrated by reanalysis or engineering evaluation. An engineering evaluation is one in which an analysis is not performed, but available information is reviewed to make a judgment.

or

b) An engineering evaluation to provide assurance that 10 CFR 50.46(b) criteria would be met if a reanalysis were performed.

2.2.11 Input Information

There are two categories of evaluation model "input information."

The first category of input information is the basic engineering information that describes a specific plant, (for example, component lengths and volumes, initial temperatures and pressures, safety injection flows, set points, cycle specific physics parameters, fuel design parameters, and other quantities that may be modified and evaluated under 10 CFR 50.59). A change to input information of this type is not considered a change to the evaluation model. Changes and error corrections in this category are not reportable under 10 CFR 50.46.

The second category of input information describes model options or values for specific models or correlations in order to apply the evaluation model consistent with licensing documentation. A change to input information of this type is considered a change to the evaluation model. Changes and error corrections in this category contribute to the cumulative impact on PCT and are reportable under 10 CFR 50.46

3.0 RELATIONSHIP BETWEEN 10 CFR 50.46 & 10 CFR 50.59

10 CFR 50.46 and 10 CFR 50.59 are, in part, "change management" regulations that involve interaction with the NRC. The following guidance differentiates these two regulations.

10 CFR 50.46 does not apply to a change in plant configuration or operating conditions, even if such change results in a change in the PCT for the limiting transient. A change of this type represents a change in input information that is not part of the acceptable evaluation model. Such changes are evaluated in accordance with 10 CFR 50.59, which includes an assessment of its affect on LOCA analysis consequences. This is consistent with the statements of consideration published with the 1988 rule change notice in the Federal Register, which contains the following comment in item 6 of the "Summary of Public Comments."

"One commenter interpreted the use of the words 'or in the application of such a model' as requiring reporting when facility changes (already reportable under 50.59), resulting in model changes occur.

The regulatory language referred to is intended to assure that applications of models to areas not contemplated during the initial review of the model do not result in errors by extending the model beyond the range that it was intended. The Commission does not believe that further clarification of this requirement is necessary and has not done so in the final rule."

Although the procedure that is used to develop an input to an evaluation model is part of the model, the plant specific input itself is not. It is important to recognize this distinction. For example, the nodalization procedure that is used to represent the length of a fuel rod is part of the evaluation model, but the length of the fuel rod is not part of the model.

Other important distinctions between 10 CFR 50.46 and 10 CFR 50.59 are (1) the scope of the licensee's review, and (2) the timing of interactions with NRC. 10 CFR 50.46 applies only to changes to (or errors in) an ECCS evaluation model. It does not limit the type of change that can be made without prior NRC approval, but manages change by means of reporting and scheduling requirements. 10 CFR 50.59 applies to plant changes, tests, and experiments. It may limit the type of change that can be made without prior NRC approval, based on a set of regulatory acceptance criteria and reporting requirements.

4.0 EVALUATION & REPORTING PROCESS

This section describes a standardized process for identifying, evaluating, and reporting changes to an ECCS evaluation model, errors in the model, and changes and errors in the application of the model. The changes in PCT that may result from changes in plant configuration or operating conditions are not within the scope of 10 CFR 50.46(a)(3) and are not addressed in this guideline.

The steps in the identification, evaluation, and reporting of changes to (and errors in) the evaluation model are as follows:

- a. The vendor (or model owner) identifies a model change or error.
- b. The vendor (or model owner) estimates the impact of the change or error on PCT.
- c. The vendor notifies the licensee of the change or error (not applicable if the licensee is the model owner).
- d. The licensee (1) evaluates the impact of the change or error in conjunction with previous changes, (2) determines a reporting schedule (either a 30-day report or an annual report), and (3) decides to either reanalyze, take other action, or take no further action

if none is needed. Tables 1 and 2 are templates for a 30-day report and an annual report, respectively.

- e. The licensee reports the change(s) or error(s) to the NRC in accordance with the appropriate reporting schedule.
- f. The NRC reviews the licensee report to determine if additional interaction with licensee is warranted.

Plant configuration or operating condition changes are evaluated in accordance with 10 CFR 50.59 to determine whether the change requires NRC approval. NEI 96-07, "Guidelines for 10 CFR 50.59 Implementation," contains industry guidance for evaluating plant changes in accordance with 10 CFR 50.59.

The requirement to identify, evaluate, and report evaluation model changes and errors applies equally to both small and large break sizes in the spectrum of postulated loss of coolant accidents. Boiling water reactors (BWRs) typically have a single evaluation model that applies to the entire break spectrum. Pressurized water reactors (PWRs) typically have separate evaluation models for large breaks and small breaks.

In addition, if the reactor contains more than one fuel type supplied by one or more fuel vendors, the reporting requirements apply to the fuel type with the limiting PCT. Model changes or error corrections in a non-limiting fuel type may be reported at the discretion of the licensee.

5.0 REPORTING SCHEDULE & FORMAT

10 CFR 50.46(a)(3) requires licensees to estimate the effect of any change to (or error in) an acceptable evaluation model or in the application of such a model, to determine if the change or error is significant. A significant change or error is one that results in a calculated peak fuel cladding temperature (PCT) different by more than 50 degrees F from the temperature calculated by an analysis for the limiting transient using an acceptable model, or results in an accumulation of changes and errors such that the sum of the absolute magnitudes of the respective temperature changes is greater than 50 degrees F. If the change or error is significant, the report must be submitted to the NRC within 30 days and must include a proposed schedule for providing a reanalysis or other action as may be needed to show compliance with 10 CFR 50.46. The most recent 30-day report or annual report may be used to determine the base PCT from which the PCT impact of changes or errors are estimated.

The phrase "within 30 days" refers to the time period (thirty calendar days) within which a licensee must report the impact on the PCT for the limiting transient of a significant change or error in an acceptable evaluation model. The regulation requires that a report be submitted to NRC within 30 days if the absolute value of the impact of a single change or error, or if the cumulative sum of the absolute values of a series of changes and errors, exceeds 50 degrees F. The 30-day time period begins when the licensee estimates the effect of a change. In general, this will be after the licensee has reviewed and accepted information provided by the fuel vendor on the estimated effect of a change or error. The regulation does not place any specific limit on the time that a vendor has to identify a change or error, estimate its impact, and provide information to affected licensees. Fuel supply vendors balance the need for prompt notification of customers with the need for accuracy in verifying changes and errors.

It is important to note that 10 CFR 50.46(a)(3) does not require a reanalysis, but permits "other action as may be needed" to show compliance with the criteria of 10 CFR 50.46(b). Licensees that operate nuclear plants satisfy this part of the regulation by reviewing the remaining margin to the limiting PCT to ensure there is sufficient margin to provide confidence that the limit will not be exceeded. Typically, a reanalysis is scheduled to coincide with the next planned change for which a LOCA reanalysis would be required. Furthermore, the regulation does not require NRC review and approval of the reanalysis, although the NRC may request that the reanalysis be submitted for information and possible follow-up action.

There are three options for establishing a baseline PCT for reporting purposes: (1) using the ECCS model to perform a full or partial reanalysis (the preferred option), (2) submitting a 30-day report, or (3) submitting an annual report.

Annual reports are independent of 30-day reports. Annual reports should be made even if a 30-day report has been recently issued.

6.0 REFERENCES

1. 10 CFR 50.46, Acceptance criteria for emergency core cooling systems for light-water nuclear power plants, subsection (a)(3).
2. Federal Register, 53 FR 35996 – 36003, Final Rule, "Emergency Core Cooling Systems; Revisions to Acceptance Criteria," September 16, 1988.
3. Information Notice 97-15, "Reporting of Errors and Changes in Large Break Loss-of-Coolant Accident Evaluation Models of Fuel Vendors and Compliance with 10 CFR 50.46(a)(3)", April 4, 1997
4. Information Notice 97-15 Supplement 1, "Reporting of Errors and Changes in Large Break Loss-of-Coolant Accident Evaluation Models of Fuel Vendors and Compliance with 10 CFR 50.46(a)(3)", April 23, 1999
5. 10 CFR 50.4, Written communications.
6. 10 CFR 50.55, Conditions of construction permits, subsection (e).
7. 10 CFR 50.59, Changes, tests, and experiments.
8. 10 CFR 50.72, Immediate notification requirements for operating nuclear power reactors.
9. 10 CFR 50.73, Licensee event report system.
10. 10 CFR 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants.
11. Nuclear Energy Institute, NEI 96-07, revision 1, "Guidelines for 10 CFR 50.59 Implementation," November 2000.

Table 1

LOCA Margin Summary Sheet – 30 Day Report

Plant Name: _____
 Utility Name: _____

Evaluation Model: (Description or Name)		<u>Net PCT Effect</u>	<u>Absolute PCT Effect</u>
A.	Prior 10 CFR 50.46 Changes or Error Corrections – Previous Years	$\Delta PCT = + 10 \text{ }^\circ\text{F}$	$+ 20 \text{ }^\circ\text{F}$
B.	Prior 10 CFR 50.46 Changes or Error Corrections – This year	$\Delta PCT = - 5 \text{ }^\circ\text{F}$	$+ 10 \text{ }^\circ\text{F}$
C.	Current 10 CFR 50.46 Changes: - This Report		
1.	Description	$\Delta PCT = - 17 \text{ }^\circ\text{F}$	$+ 17 \text{ }^\circ\text{F}$
2.	Description	$\Delta PCT = + 20 \text{ }^\circ\text{F}$	$+ 20 \text{ }^\circ\text{F}$
	Absolute Sum of 10 CFR 50.46 Changes	$\Delta PCT =$	$+ 67 \text{ F}$

The sum of the PCT from the most recent analysis using an acceptable evaluation model and the estimates of PCT impact for changes and errors identified since this analysis is less than 2200 degrees F.

Table 2

LOCA Margin Summary Sheet – Annual Report

Plant Name: _____
 Utility Name: _____

Evaluation Model:	(Description or Name)	<u>Net PCT Effect</u>	<u>Absolute PCT Effect</u>
A.	Prior 10 CFR 50.46 Changes or Error Corrections – Previous Years	$\Delta PCT = + \underline{8}^{\circ}F$	$+ \underline{12}^{\circ}F$
B.	Prior 10 CFR 50.46 Changes or Error Corrections – This year	$\Delta PCT = - \underline{4}^{\circ}F$	$+ \underline{21}^{\circ}F$
	Absolute Sum of 10 CFR 50.46 Changes	$\Delta PCT =$	$+ \underline{33}^{\circ}F$

The sum of the PCT from the most recent analysis using an acceptable evaluation model and the estimates of PCT impact for changes and errors identified since this analysis is less than 2200 degrees F.