Public availability of this draft document is intended to inform stakeholders of the current status of the NRC staff's preliminary draft final rule package and associated documents for § 50.46c of Title 10 of the Code of Federal Regulations (10 CFR). This preliminary draft document is in support of a November 23, 2015, Category 3 public meeting, and a December 3, 2015, Advisory Committee on Reactor Safeguards (ACRS) full committee meeting. The red-line strike out markings show the differences from the language found in the October 7, 2015, preliminary draft final rule statements of consideration and rule language found in ADAMS at ML15281A196.

This draft document has not been subject to all levels of NRC management review. Accordingly, it is incomplete and may be in error in one or more respects. The document may be subject to further revision before the staff provides the final draft rule language package to the Commission (currently scheduled to be provided to the Commission in February 2016).

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E. Corrective Actions and Reporting Requirements.

1. Deterministic ECCS Performance.

The reporting requirements currently provided in 10 CFR 50.46(a)(3) were added during the 1988 revision to § 50.46. At the time, the Commission stated, "these reporting requirements are indeed a clarification and relaxation over the current interpretation for the existing requirements" (53 Fed. Reg. 35996 at 35998, September 16, 1988). A number of public comments were provided in response to the 1988 rulemaking, some of which suggested that the reporting requirements be relaxed further, or even eliminated.

In response to these comments, the NRC identified several reasons for requiring reporting of changes to, or errors in, ECCS EMs, or in the applications thereof. First, the Commission believed that significant changes or errors raise potential questions about the adequacy of an evaluation model as a whole. Second, the Commission noted that even minor or inconsequential errors and changes constituted a deviation from what previously had been reviewed and accepted. Finally, the Commission also noted that applications of models to areas not contemplated during initial review of the model could result in errors by extending a model beyond its intended range.

In its present rulemaking efforts, the NRC again received numerous public comments, some of which suggested that the reporting requirements should be relaxed or eliminated. In

response to the public comments, the NRC has made several relaxations to, and clarifications of, the reporting requirements, compared to what currently appears in § 50.46(a)(3). However, the NRC has left the deterministic reporting requirements under the 1988 revision to the ECCS Rule largely intact, with the addition of reporting requirements for changes and error corrections affecting the % ECR calculation.

The NRC believes that reporting remains necessary for changes to, or errors in, ECCS EMs, and applications thereof, for several reasons. First, considering all safety analysis for design basis events, LOCA analysis requires substantially more complex thermal-hydraulic calculations. The reporting requirements allow minor changes to, and error corrections, for these calculations. Second, the reporting requirements provide a regulatory framework for communicating, and addressing the effects of, these changes and errors. And finally, reporting requirements are less burdensome than an alternative that would include topical report revisions and license amendments in order to address changes and errors. The NRC considered these benefits, in addition to the original, safety-related justification for the reporting requirements set forth in the 1988 rulemaking, when deciding to retain reporting requirements in 10 CFR 50.46c.

The final rule clarifies existing reporting and corrective action requirements in order to resolve recurring issues involving the interpretation of the current regulations' requirements. The draft final rule distinguishes three possible combinations of reporting criteria based upon predicted response, level of significance (i.e., significant or not significant, as defined by the proposed rule), and whether the error, change or operation would result in any exceeded acceptance criteria. For each scenario, the proposed rule provides the required actions, reports, and a time frame for providing the necessary reports.

Presently, the reporting requirements in ~~10 CFR 50~~10 CFR 50.46(a)(3) require that licensees report changes to or errors in an ECCS evaluation model, or in the application of the evaluation model, and the estimated effect of the changes or errors on predicted peak cladding temperature. The final rule expands the definition of a significant change or error to include

integral time at temperature. The NRC made this change to improve the content and communications of reports submitted to the NRC. The NRC also made this change to inform the staff's response to future changes to or errors discovered in ECCS evaluation models, or in the applications thereof.

Many comments were received on Paragraph (m) corrective actions and reporting requirements. Based on these comments, the rule was modified to improve clarity and allow 60 days for reporting significant errors or changes that do not cause acceptance criteria to be exceeded.

The rule adds a reporting requirement and definition of significant change or error based on predicted changes in integral time-at-temperature (i.e., ECR) and reformats the reporting section to clarify existing requirements. Any changes or errors that prolong the temperature transient may further challenge the ~~the~~ post-quench ductility analytical limits; however, they may not significantly change the predicted PCT. As such, this change or error would not be captured in the existing reporting requirements. To improve the reporting and evaluation of changes or errors of this type, the NRC is expanding the definition of significant change or error to include integral time-at-temperature. The threshold for a significant change or error, 0.4 percent ECR, is equivalent to a change in calculated ECR for a 50 °F change in cladding temperature.

The definition of a significant change or error (i.e., 50 °F PCT, 0.4 percent ECR) is specific to zirconium-alloy cladding. A new definition of significant change or error may be necessary for other cladding materials. In addition, the rule requires the use of maximum local oxidation (i.e., percent ECR) to evaluate the impact of a change or error on the predicted integral time-at-temperature.

Existing reporting requirements ~~§~~ § 50.46(a)(3) with respect to any "change to or error discovered in an acceptable evaluation model or in the application of such a model" have been a source of confusion. Two areas of common misconceptions are related to: 1) the baseline PCT and integral time-at-~~temperatrue~~ temperature values when estimating a significant change

or error (i.e., greater than 50 °F), and 2) the 30-day reporting requirement including "a proposed schedule for providing a reanalysis or taking other action as may be needed to show compliance with ~~§~~ § 50.46 requirements." In the final rule, the NRC has revised the reporting requirements to: 1) identify more clearly the baseline values to be used in reporting pursuant to the requirements of this section, 2) insert provisions in § 50.46c, paragraphs (m)(1)(ii) and (m)(1)(iii) to include, in a report describing a significant change, a proposed scope and schedule for providing a reanalysis, and ~~2~~3) distinguish between the requirements for proposing a reanalysis scope and schedule, and for ~~taking other action~~proposing to implement corrective action as may be needed to show compliance with ~~§~~ § 50.46c requirements.

As is the case with 10 CFR 50.46(a)(3), flexibility exists in terms of both the scope of reanalysis required to comply with paragraphs (m)(1)(ii) and (m)(1)(iii), and with the schedule that the reporting entity may propose. Since the promulgation of the 1988 revision to § 50.46, the NRC has accepted multiple evaluations, which have been performed within a scope that has been significantly limited when compared to full-scale implementation of an ECCS EM. In these cases, the NRC staff has still concluded that such evaluations satisfied the requirements of 10 CFR 50.46(a)(3)(ii). The Commission does not intend to change its philosophy in this regard. In addition, a proposed schedule for reanalysis may also incorporate appropriate flexibility. The NRC staff has accepted proposed schedules that extend as far as four years into the future, and that are managed using regulatory commitments that can be changed or updated as operating conditions require and nuclear safety considerations permit. The revised language contained in 10 CFR 50.46c, paragraphs (m)(1)(ii) and (m)(1)(iii) continue to retain this flexibility, also.

When estimating the effect of a significant change or error, the rule provides threshold values for both PCT and integral time-at-temperature. The baseline predictions used to assess a significant change or error should be the PCT and integral time-at-temperature values documented in a plant's updated final safety analysis report (UFSAR). These values should

represent the latest LOCA analyses that were submitted and reviewed by the NRC staff as part of a license amendment request (e.g., power uprate, fuel transition), or as incorporated into the facility licensing basis in accordance with NRC-approved reload licensing methods, as amended by prior annual reports. The following example illustrates the NRC's position:

> In 2007, a licensee submits new LOCA analyses as part of an extended power uprate license amendment request with a predicted PCT of 1900 °F and maximum local oxidation (MLO) of 2.4 percent ECR. The 2008 and 2009 annual reports identify no changes or errors. In 2010, two errors in the ECCS evaluation model are discovered and documented in the annual report with an estimated impact on PCT of +25 °F and -20 °F and estimated impact on MLO of +0.08 percent ECR and -0.01 percent ECR. A 30-day notification was not required since the estimated impact was below the threshold for a significant change or error. At this point, the licensee was required update the UFSAR, document the error notification, and identify the baseline for judging future changes or errors as 1905 °F PCT and 2.5 percent ECR.

In the existing rule language, there is a requirement to include a "proposed schedule for providing a re-analysis or taking other action as may be needed to show compliance with ~~§~~ § 50.46 requirements" in a report describing the nature of a significant error or change, and its estimated effect on the predicted PCT. This language has led to a misconception that, when a significant error is reported that does not cause the predicted PCT to exceed its 2200 °F acceptance criterion, a proposed schedule for providing a reanalysis is not required and taking other action is not needed to show compliance with the requirements. It has long been the NRC's determination that facility operation in excess of the ~~§~~ § 50.46 acceptance criteria is an immediate safety concern that requires prompt corrective action, and the "other action" language in the rule was intended to address that concern. This concept is further underscored by the final sentence of the existing paragraph at ~~§~~ § 50.46(a)(3)(iii): "The affected applicant or holder shall propose immediate steps to demonstrate compliance or bring plant design into

compliance with ~~§~~ § 50.46 requirements." Therefore, the reporting and reanalysis requirements have been further separated to distinguish the requirements applicable when a significant change or error is identified that results in facility operation in excess of the ~~§~~ § 50.46 acceptance criteria, from those that apply when a significant change or error is identified that does not result in facility operation in excess of the ~~§~~ § 50.46 acceptance criteria.

When a change to or error in an ECCS evaluation model, or in the application of such a model, is discovered, the licensee would be responsible for estimating the magnitude of changes in predicted results to: 1) determine if immediate steps are necessary to demonstrate compliance or bring plant design or operation into compliance with ~~§~~ § 50.46c requirements, and 2) identify reporting requirements. Under the final rule, a licensee's obligation to report and take corrective action varies depending upon whether the licensee's situation falls into one of three possible scenarios, as described below:

1. *Change or error that does not result in any predicted response that exceeds any acceptance criteria and is itself not significant*.

The licensee must:

a. Submit an annual report documenting the change(s) and/or, error(s), along with the estimated magnitudes of changes in predicted results.
b. Revise the UFSAR in accordance with ~~§~~ § 50.71(e).
c. Use the revised UFSAR PCT/ECR predictions as a baseline for future evaluations.

2. *Change or error that does not result in any predicted response that exceeds any acceptance criteria but is significant*.

The licensee must:

a. Submit a 60-day report documenting the change(s) and/or error(s), estimated magnitudes of changes in predicted results, ~~and~~ the proposed scope and schedule for providing a ~~new analysis of record (AOR)~~reanalysis, and a

description of and schedule for implementing corrective actions. The reanalysis shall be performed within a scope of detail appropriate to address the reported, significant change to, or error in, the ECCS evaluation model, or in its application. The proposed reanalysis schedule should reflect consideration for both the magnitude of the change or error and the available margin to NRC acceptance criteria, once the estimated effect of the change or error is applied to the existing results.

b. In accordance with the schedule proposed in a), provide the re-analysis to the NRC. This may be accomplished by submitting a subsequent report, pursuant to ~~§~~ § 50.46(m)(1), describing the re-analysis and providing the updated results. The re-analysis may be limited in scope, but shall otherwise be performed using an acceptable evaluation model.

c. Revise the UFSAR to include new evaluation model results in accordance with ~~§~~ § 50.71(e).

d. Use the revised UFSAR evaluation model results as a baseline for the future evaluations.

3. *Change or error that results in any predicted response that exceeds any of the five acceptance criteria established at ~~§~~ § 50.46c(g)(1)(i-v).*

The licensee must:

a. Take immediate actions to bring the plant into compliance with the acceptance criteria.

b. Report the change(s) and/or error(s) under §~~§~~ § 50.55(e), 50.72, and 50.73, as applicable.

c. Submit a 30-day report documenting the change(s) and/or error(s), estimated magnitudes of changes in predicted results, description of corrective actions and/or compensatory measures, and the proposed scope and schedule for

providing a ~~new AOR~~reanalysis, and a description of and schedule for implementing corrective actions. The reanalysis shall be performed within a scope of detail appropriate to address the reported, significant change to, or error in, the ECCS evaluation model, or in its application. The proposed reanalysis schedule should reflect consideration for both the magnitude of the change or error and the fact that the change or error has caused the NRC's acceptance criteria to be exceeded.

d. In accordance with the schedule proposed in (c), provide the re-analysis to the NRC. This may be accomplished by submitting a subsequent report, pursuant to ~~§~~ § 50.46(m)(1), describing the re-analysis and providing the updated results. The re-analysis shall be performed using an acceptable evaluation model. Revise the UFSAR to include new evaluation model results in accordance with ~~§~~ § 50.71(e).

e. Use the revised UFSAR evaluation model results as the baseline for future evaluations.

The reporting requirements in ~~§~~ § 50.46c(m) reflect reformatting of the existing reporting provisions in order to separately identify these three scenarios and clarify their respective requirements.

Explicit reporting requirements have not been established for breakaway oxidation, maximum hydrogen generation, or long-term cooling. However, the language in ~~§~~ § 50.46c(m)(1)(iii) and ~~§~~ § 50.46c(m)(2)(i) are intended to apply to changes to, or errors in, ECCS evaluation models, or the applications thereof, that affect the predicted performance relative to all of the acceptance criteria contained in ~~§~~ § 50.46c. For example, an error or change in a PWR boron precipitation calculation that invalidates the timing for emergency operating procedures is considered a condition in which a plant's conformance to ~~§~~

§ 50.46c(g)(1)(v) is uncertain. In this circumstance, the NRC would consider this a potentially serious safety issue in need of immediate attention and potential correction.

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(m) *Reporting, corrective actions and updates.* Each entity subject to the requirements of this section shall comply with paragraphs (m)(1) and (m)(2) of this section. Each entity demonstrating acceptable long--term core cooling under the provisions of paragraph (e) of this section shall also comply with the requirements of paragraph (m)(6) through (8) of this section.

(1) *ECCS evaluation model: reporting*.

(i) If an entity identifies any change to, or error in, an ECCS evaluation model or the application of such a model that does not result in any predicted response that exceeds any of the acceptance criteria specified in this section and is itself not significant as defined in paragraph (n) of this section, then the entity must prepare a report describing each such change or error, ~~and~~ its estimated effect on predicted response, and the basis for the entity's determination that the error change is not significant. ~~and a demonstration that the error or change is not significant~~ The entity must ~~be~~ submit the report to the NRC at least annually~~no later than 12 months after the change or discovery of the error~~.

(ii) If an entity identifies any change to, or error in, an ECCS evaluation model, or the application of such a model, that does not result in any predicted response that exceeds any of the acceptance criteria but is significant as defined in paragraph (n) of this section, then the entity must prepare a report describing each such change or error, its estimated effect on predicted response, ~~-~~proposed corrective actions, ~~and~~ a proposed scope and schedule for providing a reanalysis~~,~~ and ~~implementation~~implementat~~ion~~g ~~of~~ the corrective actions. The entity

must ~~be submitted~~submit the report to the NRC within 60 days of the change or discovery of the error.

(iii) If a licensee of a facility licensed to operate identifies any change to, or error in, an ECCS evaluation model or the application of such a model, that results in any of the acceptance criteria specified in this section to be exceeded at the facility, then the licensee shall ~~report the change or error under §§ 50.55(e), 50.72, and 50.73, as applicable, and~~ submit a report describing each such change or error, its estimated effect on predicted response, ~~and~~proposed corrective actions, and ~~-~~a proposed scope and schedule for providing a reanalysis~~,~~ and ~~implementation~~ implementatioing the ~~of~~ corrective actions. The entity must submit the report to the NRC within 30 days of the change or discovery of the error. This report may also contain the information required to be reported under §§ 50.55(e) and 50.73, as applicable; alternatively, the information required by this paragraph may be included in the report filed in accordance with §§ 50.55(e) and 50.73, as applicable. The report required by this paragraph is in addition to any reporting required by 10 CFR 50.72.

(n) *Significant change or error in the ECCS evaluation model.*

(1) *Uranium and mixed urainium-plutionium oxide fuel.* For uranium oxide and mixed uranium-plutonium oxide pellets within cylindrical zirconium-alloy cladding, a significant change or error is one that results in a calculated–

(i) Peak fuel cladding temperature different by more than 50 °F from the temperature calculated for the limiting transient using the last acceptable evaluation model, or is a cumulation of changes and errors such that the sum of the absolute magnitudes of the respective temperature changes is greater than 50 °F; or

(ii) Integral time at temperature different by more than 0.4 percent ECR from the oxidation calculated for the limiting transient using the last acceptable evaluation model, or is a cumulation of changes and errors such that the sum of the absolute magnitudes of the respective oxidation changes is greater than 0.4 percent ECR.