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Preparing Probabilistic Fracture Mechanics Submittals

Comment On: NRC-2021-0087-0001
Preparing Probabilistic Fracture Mechanics Submittals

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Comment on FR Doc # 2021-20566

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General Comment

See attached file(s)

Attachments

EPRI Comments DG-1382 and NUREG-7278

2021-082_____BWR Vessel & Internals Project (BWRVIP)

October 25, 2021

Office of Administration
ATTN: Program Management, Announcements and Editing Staff
Mail Stop: TWFN-7A-06M
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Attention: Program Management, Announcements and Editing Staff

Subject: EPRI Submittal of Comments on DG-1382 (Draft Regulatory Guide 1.245) and Draft NUREG/CR-7875, NRC Docket Number NRC-2021-0087

References:
1. "Preparing Probabilistic Fracture Mechanics Submittals," 86 Federal Register 52927, September 23, 2021.
2. Draft Regulatory Guide DG-1382, Proposed new Regulatory Guide 1.245, "Preparing Probabilistic Fracture Mechanics Submittals," issued September 2021.
3. Draft NUREG/CR-7278, "Technical Basis for the use of Probabilistic Fracture Mechanics in Regulatory Applications," issued September 2021.

In a Federal Register Notice dated September 23, 2021 (Reference 1), the U.S. Nuclear Regulatory Commission (NRC) issued for public comment documents DG-1382 (Reference 2) and Draft NUREG/CR-7875 (Reference 3), requesting public comment no later than October 25, 2021.

The attachment to this letter provides comments of the Electric Power Research Institute (EPRI) and Dominion Engineering, Inc. on these two documents.

If you have any questions regarding this subject, please contact Matt Walter at EPRI by telephone at 303-229-7251 or by e-mail at mwalter@epri.com.

Sincerely,

Matthew Walter

Matthew Walter, EPRI, BWRVIP Senior Technical Leader

Reviewers: **Electric Power Research Institute (EPRI), Dominion Engineering, Inc. (DEI)**

Documents: **Draft Regulatory Guide DG-1382, Preparing Probabilistic Fracture Mechanics Submittals (Proposed New Regulatory Guide 1.245) [ML21034A328]**
Technical Basis for the use of Probabilistic Fracture Mechanics in Regulatory Applications (Draft Report for Comment, NUREG/CR-7278) [ML21257A237]

Review Comments on DG-1382 (Draft Regulatory Guide 1.245)

Note: Minor editorial comments are identified with a light grey background

#	Location	Text in Question	Comment
1		General Comment	We believe that the overall plan for a graded approach, as identified in Regulatory Position C.1, as well as the set of items to be included in the PFM analysis and submittal as identified in Regulatory Position C.2 define a reasonable framework that meets the objective of having standardized content and a graded approach for PFM submittals to NRC. We also agree that key content from the EPRI white paper has been incorporated in DG-1382. Furthermore, we agree that presubmittal discussions will be key to ensure NRC and industry alignment regarding the choice of categorization within several of the tables shown in DG-1382.
2	Page 1	10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities,” applies to applicants for, and holders of, , licenses for production and utilization facilities.	Delete extra comma after “and holders of”
3	Page 6	Further, the EPRI document does not precisely define its guidance in some areas, leading to ambiguity, inefficient reviews, and uncertainty in regulatory outcomes. Some of these issues may result from the lack of precise guidelines when the minimum requirements specified in the EPRI guidance are not sufficient.	The second of the two referenced sentences seem somewhat redundant with the first and generally provides little additional clarity. Consider deleting or revising the second sentence.
4	Page 6	In 2018, the NRC published the technical letter report, “Important Aspects of Probabilistic Fracture Mechanics Analyses” (Ref. 17), to outline the important concepts for using PFM in support of regulatory applications.	The October 23, 2018 public meeting followed publication of NRC’s 2018 technical letter report, which is dated September 13, 2018. To clarify the chronology in this background section, it is suggested to discuss first NRC’s technical letter report, followed by the October 23, 2018 public meeting and BWRVIP Letter 2019-016, and finally this Draft RG-1382 and Draft NUREG/CR-7278.

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5	Page 6	The NRC has an approved methodology for risk-informed decision making for design-basis changes, and PFM may be used as a tool within that framework.	Add reference for approved methodology
6	Page 8	To enhance the efficiency of the NRC's review of PFM submittals, the staff recommends that applicants using the framework presented in this guidance document identify any deviations in their application and provide explanations for each deviation.	We agree that identification of deviations from this RG would help streamline NRC's review, as well as correspondence between NRC and industry as part of the review process.
7	Page 9	Figure C-1	Sections 2.2, 2.4 and 2.5 should be included somewhere in this Figure. Sections 2.2. and 2.4 seem to fit under Step 1 and Section 2.5 seems to fit under Step 2.
8	Page 9	"Plan" Step 1, Action	Selection of appropriate models (Sec. 2.5) should be included in the 'Plan' step.
9	Page 9	"Plan" Step 1, Action	Since NRC is encouraging applicants to have pre-submittal discussions/meetings with NRC (Sec. 2.2), this should be part of the 'Plan' step.
10	Page 9	"Plan" Step 1, Action	Suggest referencing Sec. 2.2 and Sec. 2.4 for 3rd bullet in 'Plan' step.
11	Page 9	Draw conclusions From analysis results	Use lower case for 'from'
12	Page 11	Provide NRC reviewers with direct access to the PFM software	Please specify that "direct access" entails access to the software executable not the source code.

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13	Page 11	The use of previously approved acceptance criteria (if already in existence for the specific application at hand) is encouraged but should be appropriately justified and explained. Specifically, the applicant should ensure that inherent assumptions and requirements of the source activity are respected, and that any apparent differences are reconciled. If there is no precedent for an acceptance criterion, the applicant should derive probabilistic acceptance criteria based on risk-informed decision making principles in accordance with RG 1.200 and RG 1.174, if applicable, and describe the bases for the chosen acceptance criteria.	We concur with this discussion of acceptance criteria, but we suggest that the discussion of acceptance criteria be extended to cover some specifics. We believe inclusion of some specific information would be productive and valuable for applicants who apply PFM. We suggest that the Reg Guide list acceptance criteria that were previously approved by NRC and remain acceptable to NRC, including the acceptable range of use for each set of approved acceptance criteria. The discussion should include the rationale that NRC applied to find that each set of acceptance criteria was acceptable. This information would be valuable to applicants who are considering whether derivation of new acceptance criteria is needed. Ideally, NRC would publish acceptance criteria for the most common types of expected PFM applications. For example, for xLPR applications related to leak-before-break, the acceptance criteria presented in ML21217A088 could be referenced. PFM is often used to investigate both structural integrity and leak tightness of pressure boundary components. Structural integrity is assessed in terms of the calculated frequency of unstable rupture, while leak tightness is considered through the calculated frequency of through-wall crack penetration and leakage. Risk-informed decision making principles in accordance with RG 1.200 and RG 1.174 do not appear suited for development of acceptance criteria for leak tightness and the calculated frequency of small pressure boundary leaks that do not have direct safety consequences. Could the Reg Guide discuss NRC's position on acceptance criteria for the calculated frequency of small pressure boundary leaks that do not have direct safety consequences?

#	Location	Text in Question	Comment
14	Page 12 and Page 13, Note a	The NRC has approved the following codes as of the publication of this RG: • the latest version of FAVOR, • the latest version of xLPR, and • the version of the SRRA code approved in Ref. 21. Note a: As of publication of this RG, NRC-approved PFM codes include xLPR, FAVOR, and SRRA	What are the limits of the approval for these three codes? Can references be added documenting NRC's approval of FAVOR and xLPR, along with the use case(s) and ranges of inputs for which these codes are considered approved? Considering that NRC has approved these codes, what additional actions would be required of a user to accept them to be exercised under their Appendix B QA program to perform analyses in support of a licensing submittal? Does the NRC approval process sufficiently assess the effectiveness of the developmental and maintenance SQA program such that the user may then cite NRC approval as the basis for code acceptance under their Appendix B program? The only NRC-approved codes mentioned are xLPR, FAVOR and SRRA. A question was asked during the August 10, 2021 ACRS meeting (ML21223A043): What constitutes an NRC-approved code? The response by the NRC was that the above-mentioned codes were included, but also codes where a safety evaluation report would have been written for a code for a specific application. There have been other PFM codes that have been used in reports where a NRC safety evaluation was written. These include: • The VIPER code was used for RPV shell weld evaluations in BWRVIP-05 which has an NRC Safety Evaluation • The VIPER-NOZ code was used for RPV nozzle evaluations in BWRVIP-108-A and BWRVIP-241 A which both have an NRC Safety Evaluations
15	Page 13	Table C-2 and subsequent similar tables	The intent of these tables when the comment column is subdivided into multiple entries for a given Category is potentially ambiguous. To ensure they are viewed as complimentary to each other rather than alternative selections, clarify the intent that the applicability of all listed comments should be considered when planning a PFM application.
16	Page 13	Exercised within validated range	Can references be added documenting the validated range of use for the NRC-approved codes?
17	Page 14	Category M-1, Description or QV-1B within the same validated range	QV-1B is by definition outside a validated range; therefore, how can this be "within the same validated range". The Submittal Guideline implies the model is within a validated range.

#	Location	Text in Question	Comment
18	Page 14	See the submittal guidelines for M-1, except demonstrate validity of the model for the new applicability range (document a comparison of model predictions for the entire new range to applicable supporting data, including quantitative goodness-of-fit analyses).	Quantitative goodness-of-fit-analyses were not performed for all xLPR modules and should not be required for models in category M-2. For xLPR, module validation was performed to assess the predictive capability of modules relative to a combination of plant operating experience, laboratory data, alternative software/models, and/or engineering judgment. Although quantitative metrics were encouraged for xLPR module validation, visual assessment (e.g., plotting module predictions along with data being applied for validation) was also considered an appropriate technique. Thus, we believe similar flexibility should be included in the submittal guidelines for models in category M-2. Suggest updating guideline to: "document a comparison of model predictions for the entire new range to applicable supporting data, predictions made using alternative models, and/or using engineering judgment, optionally supported using quantitative methods such as goodness-of-fit analyses"
19	Page 14	Category M-4 Well-established model not previously part of an NRC-approved code	What are the criteria of a well-established model?
20	Page 15	The applicant should also consider the use of sensitivity studies to show the impact (or lack thereof) of some of the key assumptions…	Should this be 'sensitivity analyses' or both?
21	Page 15	Table C-4	Although the term "important variable" is defined in the glossary as a variable whose uncertainty contributes substantially to the uncertainty in the response, additional guidance on identification of "important variables" is needed. Such additional guidance may consist of either more objective criteria defining "important variables" or input regarding the NRC expectation for the number/fraction of included variables that are "important." For example, if all inputs are considered to be important, one could also make the argument that none of the inputs are important.
22	Page 16	Table Title Submittal Guidelines for Inputs	Remove first line in the table caption. Also, update List of Tables in page 30.
23	Page 16	Table C-5: "List input distribution type and parameters"	In addition to listing distribution type and parameters, if applicable, sampling frequency (e.g., component-to-component, within-component, flaw-to-flaw) should also be listed.

#	Location	Text in Question	Comment
24	Page 16	For each deterministic input, give the rationale (method and data) for the selection of its numerical value, along with any known conservatisms in that numerical value and the rationale for such conservatisms. For each uncertain input, describe both its distribution parameter values and its distributional form. Give the rationale (method and data) for selecting each distribution, including any known conservatisms in the specified input distributions and the rationale for the conservatism. Detail the distributional fitting method, including interpolation, extrapolation, distribution truncation, and curve fitting.	Depending on the application, some input values may be conservative for some QoIs while being nonconservative for other QoIs. For example, a larger bending moment tends to be conservative in that it results in a smaller critical circumferential crack size, but it also has nonconservative effects in that it results in larger leak rates that are more easily detectable for a given through-wall circumferential crack size. We suggest that the RG acknowledge this possibility. It is suggested to update the text to: "along with any known conservatisms or nonconservatisms in that numerical value and the rationale for such conservatisms or nonconservatisms." and "including any known conservatisms or nonconservatisms in the specified input distributions and the rationale for the conservatism or nonconservatism."
25	Page 16	If applicable, list uncertainty classification (aleatory or epistemic). If relevant, classify uncertain inputs as aleatory or epistemic and give the corresponding rationale.	These two guidelines seem quite parallel and should be consolidated into one guideline. Suggested wording: "If applicable, list uncertainty classification (aleatory or epistemic) and provide the corresponding rationale."
26	Page 18	For PFM codes in categories QV-1A and QV-1B, the applicant need not document discretization convergence, but analysts should nonetheless verify that discretization convergence is achieved.	It is possible that in exercising an NRC-approved code outside of the validated range, discretization may also be impacted. Suggest adding the following sentence to this bullet: "This verification should also be documented in cases where the use of a QV-1 code exercised outside of the validated range (i.e., QV-1B) may directly impact discretization convergence."
27	Page 18	Table C-7	These descriptions were initially difficult to follow. A decision tree/flowchart may be a more effective method for defining each of these categories (e.g., first split being acceptance criteria met with at least one order of magnitude of margin vs. less than one order of magnitude of margin).
28	Page 18	[Acceptance criteria met with at least one order of magnitude margin] AND [use of importance sampling OR surrogate models OR both]] AND [separation of aleatory and epistemic uncertainties is implemented in the PFM code]	Correct imbalanced square brackets.

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29	Page 20	If the submittal presents several PFM analyses, the applicant should determine the category for each PFM analysis sensitivity analysis and document sensitivity analyses for each PFM analysis according to the guidelines in Table C-8.	Revise sentence to "…the applicant should determine the sensitivity analysis category for each PFM analysis and document…"
30	Page 21	Previously approved code (QV-1, QV-1A) with same QoI and same inputs	As QV-1 is a header, suggest only listing QV-1A.
31	Page 21	Previously approved code (QV-1, QV-1A) with same QoI and same inputs	To ensure that the "same" inputs are applied, it is suggested to include a reference to the previously approved inputs for QV-1A codes. Please define what is intended by "same inputs". As used, the context leaves it subject to interpretation. On one extreme, "numerically identical" inputs would make it impractical to evaluate a new problem. Alternatively, the intent may be that new inputs must not have been introduced to the input set of the NRC approved code version. Additional guidance to clarify the intent regarding the definition of "same" is needed.
	Page 24	Inputs must remain the same because sensitivity is dependent on the input distributions.	
32	Page 21	Descriptions	Where would QV-1B fall? QV-1C should be identified as part of SA-3 and SA-4. QV-2 and QV-3 should be identified as part of SA-5 and SA-6.
33	Page 21	Describe the analyses, important input, and measure of input importance and include additional documentation.	What additional documentation should be included?
34	Page 22	Category O-3, Submittal Guidelines Box	'Or' for guideline directly above or the entire row above? It seems like submittal guidelines for O-1 should be included for O-3 regardless of the selection.
35	Page 24	Category SS-4 List changes to the code and the QA procedure used.	This guideline is already included in Table C-2 and does not seem relevant for this table.

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36	Page 14	Table 3-3, Category M-1: Reference existing documentation for that model in the NRC-approved code, demonstrate that the current range of the model is within the previously approved and validated range, and demonstrate that the model functions as intended in the new software.	When the idea for what became xLPR was being refined, a modular approach that placed the relevant phenomenological models into generally self-contained modules was selected to facilitate code modification should analytical needs or knowledge in these individual areas evolve. However, Category M-1 highlights an unexpected benefit realized from this early modularity decision. Each xLPR module was independently verified and validated establishing confidence in the underlying models and investing them with a degree of portability beyond xLPR. Already several other PFM applications supported by EPRI have relied on the V&V pedigree of xLPR modules and repurposed them to address problems outside that for which xLPR is applicable. While clearly not relevant for every software development project, in a regulated environment where confidence in analytical models must be rigorously established, such a modular design approach can also have significant secondary benefits.

Review Comments on Draft NUREG/CR-7278

Note: Minor editorial comments are identified with a light grey background

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37		General Comment	There is no mention in this document about presubmittal meetings with the NRC. Presubmittal meetings are encouraged in Draft Guide 1382, Section 2.2. Guidance should be given in NUREG/CR-7278 as to the timeliness of these meetings. For example: Should they be done early in the project lifecycle or not until the submittal is ready to be sent to the NRC?
38	Page xiii	The report discusses concepts and methods to verify and validate a probabilistic framework.	This sentence on lines 47-48 appears to address a slightly different topic than the rest of this bullet. Should it be a separate bullet?
39	Page xv	BIC Bayesian Information Criterion CDF cumulative distribution function	Insert missing carriage return between defined acronyms for BIC and CDF.
40	Page 3	Examples include the primary water stress-corrosion cracking aging issue in Alloy 600 and 182/82 welds in pressurized-water reactors (which led in part to the development of the xLPR code), cold head cracking, and control rod drive mechanism thermal sleeve wear.	Of the listed examples, “cold head cracking” appears to be a vaguely described subset of primary water stress corrosion cracking that is more fully described as the first example. Additional information should be included if cold head cracking is intended to describe something other than PWSCC. Otherwise consider deleting this example from the list.

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41	Page 3	For example, the Electric Power Research Institute's (EPRI's) Materials Reliability Program (MRP) has submitted to the NRC several reports containing PFM analyses, both for informational purposes and for seeking review and approval. Such efforts include the following:	Consider also referencing the BWRVIP as well since several of their reports are also listed.
42	Page 3	"Materials Reliability Program: Topical Report for Primary Water Stress Corrosion Cracking Mitigation by Surface Stress Improvement (MRP-335 Revision 3)," Report 3002007392, issued 2016 (Reference 1-11)	The latest revision of this report is MRP-335 R3-A (EPRI 3002009241). Suggest updating this reference to reflect the latest revision of this report.
	Page 5	Electric Power Research Institute, "Materials Reliability Program: Topical Report for Primary Water Stress Corrosion Cracking Mitigation by Surface Stress Improvement (MRP-335 Rev. 3)," Report 3002007392, 2016 (ML16055A215).	
43	Page 7	This section provides background information on developing a graded approach for PFM analyses, and, where applicable, provides explanations and supporting information for portions of new proposed RG-1.245 (Reference 2-1)..	Delete extra period at the end of the sentence.
44	Page 7	In one such effort, the NRC developed guidance on a risk-informed decisionmaking process that is acceptable to use for design-basis changes. This guidance is contained in new proposed regulatory guide, RG-1.245.	This statement appears to be a bit broader than either the Purpose of the draft RG presented on page 1 or what this document actually contains. Preparing a thoughtful, competently documented PFM analysis is only one element in risk-informed decisionmaking. It is not by itself guidance on the overall RI decisionmaking process. Consider revising this statement.
45	Page 7	Table 2-1 gives the complete mapping between the guidance in new proposed RG-1.245, the NRC's analytical steps in Section 3, and the item number of the suggested minimum content and considerations of additional content given in Tables 1 and 2 from EPRI's white paper (Reference 2-2).	Table 2-1 was very useful in facilitating our review of DG-1382 and NUREG/CR-7278.
46	Page 8	Table 2-1	To be consistent with Table C-1 of Draft Guide 1382, add NUREG/CR-7278 Section 2.2.1 to RG Section 2.3, Section 2.2.2 to RG Section 2.4 and Section 2.2.3 to RG Section 2.5.

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47	Page 8	Table 2-1	For RG Section 2.1, EPRI White Paper Table 1 Item 9 and Table 2 Items 7 and 8 are relevant. For Section 2.9, EPRI White Paper Table 1 Item 5 is relevant. For Section 2.10, EPRI White Paper Table 1 Item 7 is relevant.
48	Page 9	With this in mind, the set of different analysis codes can be divided into several categories that may warrant different levels of QA and V&V...	Delete extra periods at the end of the sentence.
49	Page 13	Step 4: Modeling assumption uncertainties. PFM analyses may rely on assumptions and approximations that introduce additional uncertainty into the analysis. The impact of uncertain assumptions can be addressed using sensitivity studies.	"Uncertain assumptions" sounds somewhat redundant. Consider whether this is the best wording to use here.
50	Page 14	As an example, consider an analysis intended to show that the likelihood of a single pipe leaking is small over the life of a plant. The QoI is the probability of pipe leakage, the acceptance criterion is the acceptable upper limit on the probability of leakage, the time period is the plant life duration, and the units are the single pipe of interest. All quantities are dependent on the modeling assumptions. For example, no mitigation, 10-year inspection intervals, and the leak detection system all impact the assessments.	Leak detection does not impact the probability of leakage. Suggest changing the last sentence of this paragraph to: “For example, no mitigation and 10-year inspection intervals both impact the assessments.”
51	Page 15	The SQA process should follow the graded approach suggested in Section 2.2.2. It is intended to provide assurance that the software was developed in a deliberate and controlled manner, such that every aspect of the software is known and understood. Furthermore, the SQA process ensures source and version control, so as to prevent inadvertent changes to the software that could have unintended consequences on the software predictions. For nuclear regulatory applications, Title 10 of the Code of Regulations, Part 50, “Domestic licensing of production and utilization facilities,” (Reference 3-1) Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants,” requires that the applicants have an approved QA process in place.	10 CFR 50 Appendix B, which requires NQA-1, represents the highest level of QA for software development. The xLPR and FAVOR codes have not been developed to this standard. As noted in the Draft NUREG text, the SQA process should follow a graded approach. Thus, for some uses of PFM models, it may not be necessary to meet the most stringent requirements for all aspects of the software development. An explanation should be provided indicating that it is not the expectation that all SQA requirements per the currently NRC-approved versions of NQA-1 apply in all cases to PFM software that falls under the purview of this NUREG and Reg Guide.

	Location	Text in Question	Comment
52	Page 15	An alternative validation approach in the absence of experimental data includes benchmarking the software with comparable software that has been verified and validated previously.	If there is no experimental data for validation of the current code, then there presumably wasn't any such data for that same problem aspect when other software reached the validation step.
53	Page 15	Section 2.2.2 provides information on SQA and V&V documentation for all PFM analysis codes used in analysis.	The words “used in analysis” appear to add very little to this sentence. Consider deleting them.
54	Page 16	Does the range of inputs for which the code has been calibrated and validated include the range of inputs that are required for the specific application? Have the physics models been changed for the specific application? Are the numerical approximations sufficient for the application?	This bullet appears focused on the base code while the next bullet addresses problem-specific changes to that code. Therefore, it appears inconsistent to include the following sentence here: “*Have the physics models been changed for the specific application?”*
55	Page 18	This uncertainty in model inputs is what distinguishes a purely deterministic analysis from a PFM analysis.	This sentence mixes a general description "purely deterministic analysis" with a specific one - "PFM analysis". Not all probabilistic analyses are fracture mechanics so it would be more consistent to replace “PFM” with "probabilistic."
56	Page 18	These sensitivity studies are especially important when specifying a best estimate or conservative value is difficult due to limited information.	Consider deleting "These" from the sentence. It seems to imply a specific set or class of sensitivity studies that appears both unnecessary and potentially confusing.
57	Page 19	Linear elastic fracture toughness (K_{IC})	K_{IC} should be defined as the plane strain fracture toughness, consistent with ASME Code Section XI and other industry documents.
58	Page 35	The interpretation of the results of a PFM analysis changes depending on whether the separation of uncertainty types is maintained (Reference 0). Section 4.1.1.4 contains more information.	The broken cross-reference (Reference 0) should be re-linked with the intended reference.
59	Page 38	When separating, the conclusion is that roughly 17 percent of epistemic values result in rupture probabilities above 0.05. When not separating, the conclusion is the estimated probability of pipe rupture is 0.046. These are two very different conclusions.	Although such different conclusions can be drawn when separating or when not separating epistemic and aleatory uncertainties, it is important to also point out that the mean results obtained using either approach should be the same (e.g., see the results and conclusions drawn from Case 1.1.23 documented in ML21217A088).
60	Page 43	Statistical goodness-of-fit hypothesis test can also be used to detect evidence of a poor model fit	Please provide examples of goodness-of-fit hypothesis test, such as Student t-test
61	Page 71	Row numbers 7-10	Row numbers 7 through 10 are not left justified.

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62	Page 99	Section 2 is intended for applicants of all experience levels. Each subsection introduces an element of content that would be expected in a PFM submittal. It identifies representative circumstances for a submittal and describes a graded approach for the specific information to provide to the NRC.	Suggest rewording this summary paragraph to indicate that the subsections of Section 2.2 only cover a handful of topics from DG-1382. The topics included are quantities of interest and acceptance criteria, software quality assurance and verification and validation, as well as models. Also indicate that the remaining topics (regulatory context, information made available to NRC staff, PFM software, supporting documents, inputs, uncertainty propagation, convergence, sensitivity analyses, output uncertainty characterization, and sensitivity studies) are discussed directly in DG-1382.
63	Page 18	Calibration The process of adjusting physical modeling parameters in the computational model to improve agreement with experimental data (Reference 0-2).	Limiting this definition to only experimental data seems overly restrictive. Presumably experimental data will be better controlled and characterized but there are times where calibrating a model to well-characterized field data is appropriate as well.
64	Page 106	A systematic method for assessing the likelihood of accidents and their potential consequences (Reference 0-1).	Suggest replacing the “L SEP” symbols shown with regular spaces between the words “systematic method” and “for assessing.”