

Improving the Processes Associated with Establishing the Technical Adequacy of Probabilistic Risk Assessments - Status and Path Forward

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ABSTRACT

Working groups representing the NRC and industry are engaged, via public meeting interactions, in an initiative to improve various processes associated with establishing the technical adequacy of plant-specific Probabilistic Risk Assessments (PRAs). Specifically, the working groups are striving to achieve a number of objectives, including: improve the process for gaining acceptance of new PRA methods/approaches and improve the process for documentation and closure of PRA peer review findings and suggestions. As directed by their respective risk-informed steering committees, the working groups may ultimately clarify and/or develop enhancements to existing guidance to enable these improved processes. This paper discusses this initiative and these two specific objectives.

INTRODUCTION

Since the advent of the Probabilistic Risk Assessment (PRA) Policy Statement¹ in 1995, the U.S. Nuclear Regulatory Commission (NRC) has steadily shifted from having purely deterministic regulatory processes to those that are risk-informed. Over the years, several risk-informed initiatives have been successfully undertaken. Examples include risk-informed in-service inspection, risk-informed technical specification completion times, and risk-informed surveillance intervals. Despite the advancement of risk-informed initiatives, more work needs to be done to continue to advance risk-informed decision-making within the NRC and industry.

In 2014, the NRC formed the Risk-Informed Steering Committee (RISC), which is comprised of NRC senior managers, to provide strategic direction to the NRC staff in advancing the use of risk-informed decision-making in licensing, oversight, rulemaking, and other regulatory areas. The industry also has a RISC that is a counterpart to the NRC RISC with membership comprised of licensee chief nuclear officers and other senior level executives, as well as representation from the Nuclear Energy Institute (NEI). The NRC and industry steering committees agreed to initially form two working groups to focus on improving current risk-informed processes. One of these working groups is focused on the technical adequacy of a PRA relied upon in a licensing action.

The NRC's regulatory position on PRA technical adequacy for risk-informed license applications is

documented in Regulatory Guide (RG) 1.200.² However, recent experiences have raised concerns regarding the sufficiency and efficiency of the current process in addressing the use of new PRA methods/approaches and the level of NRC involvement in the determination of the acceptability of these new methods prior to their use in risk-informed applications. There are also concerns with aspects of the implementation of the peer review process currently endorsed in RG 1.200; specifically is the concern related to how licensees close findings and suggestions (also previously referred to as Facts and Observations) from these peer reviews.

The NRC and industry working groups addressing these PRA technical adequacy concerns developed a problem statement and action plan with three major objectives:

1. Improve the process for new methods/approaches to be used in risk-informed regulatory applications.
2. Improve the process for the documentation and closure of peer review findings and suggestions.
3. Evaluate any additional gaps in the current peer review process.

Through numerous public meetings, the NRC and industry working groups are engaged in detailed discussions on this initiative, while reporting to their respective steering committees. It is expected that this initiative will identify specific enhancements to the current process for determining the acceptability of new methods/approaches and enabling them to be used in risk-informed applications, as well as identify improvements in the process for closing peer review findings and suggestions.

As directed by their respective steering committees, the working groups may ultimately clarify and/or develop enhancements to existing guidance. For example, the industry may enhance or develop new peer review guidance to be reviewed and endorsed by the NRC and the NRC staff may develop interim staff guidance for the implementation of these new processes.

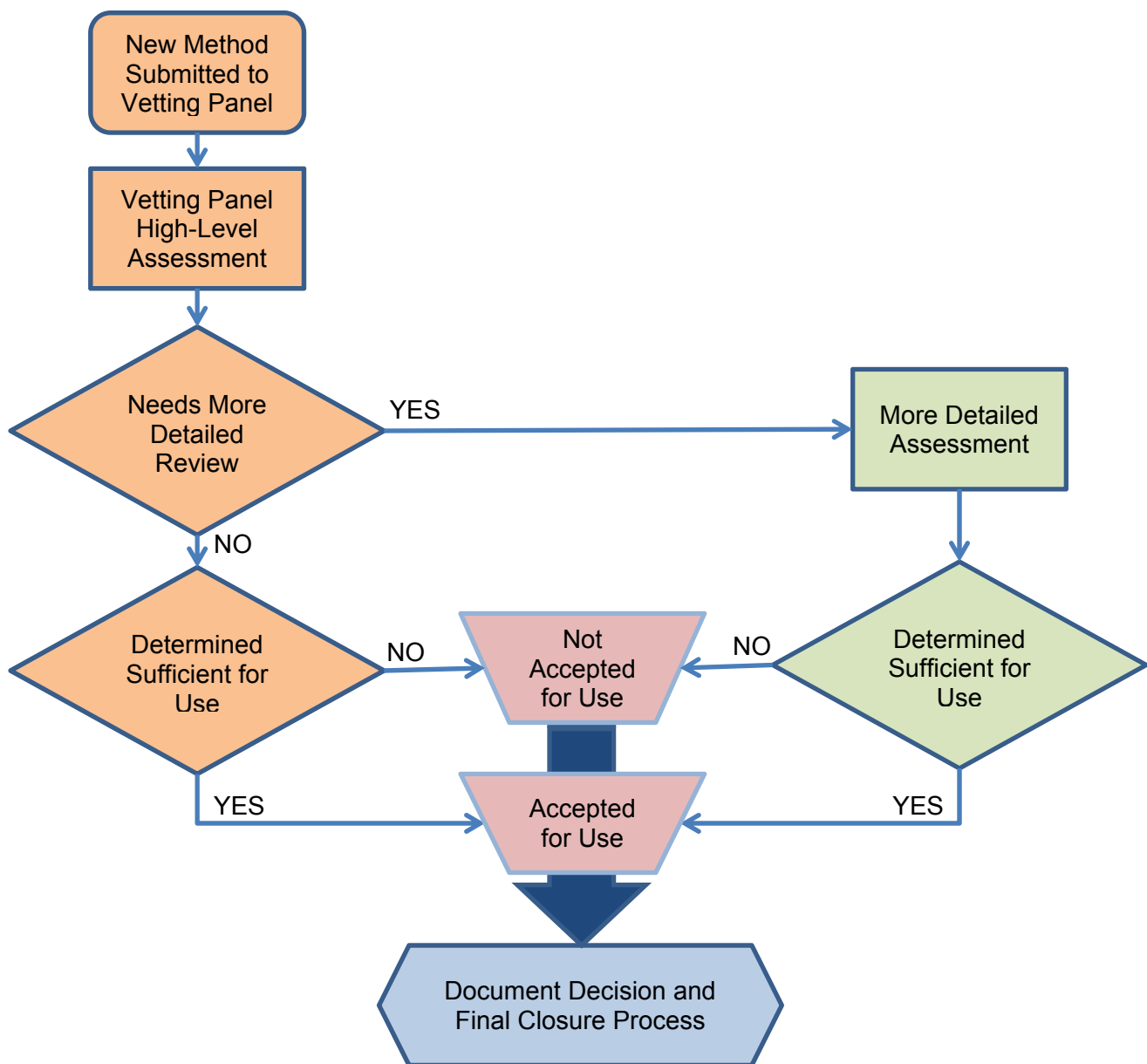
This paper discusses the first two objectives: improving the process for new methods and improving the process for the close-out of peer review findings.

IMPROVED PROCESS FOR NEW METHODS

In addressing the use of new methods in risk-informed applications, the first step is to define “new method.” Within the working groups, a new method is basically defined as being new in usage in nuclear power plant PRAs in the U.S. and/or sufficiently different from methods currently in use such that it would be considered an “upgrade” in accordance with the definition (and examples) of upgrade in the American Society for Mechanical Engineers (ASME)/American Nuclear Society (ANS) PRA Standard³ endorsed by RG 1.200.

When a new method is developed and proposed for use, there also needs to be an established and consistent process for reviewing the method to determine its acceptability for use. The following diagram presents a simplistic concept of such a process.

The process starts with the submittal of the proposed new method for use to a “Vetting Panel.” The Industry/NRC Vetting Panel would consist of a handful of senior technical experts representing industry and NRC that would perform an initial high-level assessment of the proposed method.



The first aspect of this assessment would be to determine if the new method is simple enough (and there is sufficient knowledge and expertise within the vetting panel) to allow a quick and direct determination regarding the method's acceptability by the vetting panel. The vetting panel may also seek input from subject matter experts to augment their consideration of a relatively straightforward and simple method.

If the vetting panel determines that it has sufficient expertise and the method is simple enough to support their review, then the panel decisions will be based on a holistic assessment of the method. The panel's review would consider the technical bases for the method and make a decision on if the method is acceptable for use. If technical concerns or sufficient technical justification and information is determined to be lacking, then the vetting panel may determine that the new method is not acceptable for use. The decision and rationale for the decision would be provided to the submitter of the method. This would allow the submitter to consider pursuing modifications and further justification of the method outside this process and potentially enable the submitter to re-submit the enhanced method anew at a later date. If the vetting panel determines that the method is acceptable for use, then the panel will document that decision, the rationale, and any identified limitations or technical considerations to the submitter.

If the vetting panel determines that the proposed new method is too complex or needs a more thorough review, then the panel will refer the method to an expert panel review. This expert panel review may be similar to a PRA peer review team, augmented with an NRC representation, or a full-blown expert review panel similar to the NRC/EPRI methods panel used for a few fire PRA methods. These panels would conduct a relatively detailed technical review of the method and its technical bases to determine if the proposed method is acceptable for use. Similar to the vetting panel review, if technical concerns or sufficient technical justification and information is determined to be lacking, then the expert review panel may determine that the new method is not acceptable for use. The decision and rationale for the decision would be provided to the submitter of the method. This would allow the submitter to consider pursuing modifications and further justification of the method outside this process and potentially enable the submitter to re-submit the enhanced method to the process anew at a later date. If the expert review panel determines that the method is acceptable for use, then the panel will document that decision, the rationale, and any identified limitations or technical considerations to the submitter.

Regardless of acceptance or non-acceptance of the method, a final closure process would need to be pursued

to ensure the status of the proposed method is thoroughly documented within the regulatory structure to support risk-informed applications and NRC reviews.

IMPROVED PROCESS FOR CLOSURE OF PEER REVIEW FINDINGS

There is no explicit guidance on the process for licensees to close-out PRA peer review findings. NRC and industry guidance is geared towards how peer reviews (and their findings) are used to support an application; not in achieving close-out of the findings.

After a peer review, the licensee typically addresses or "dispositions" each finding per their PRA update processes and procedures. The licensee then identifies their implementation of their proposed resolutions, or "dispositions," of the peer review findings within each risk-informed application; including justification and application-specific actions (e.g., sensitivity analyses) for those findings not fully resolved for the application.

Without a formal close-out process, risk-informed license applications are required to address all findings from the latest peer review, as augmented by findings from a gap assessment if there is not a peer review against the latest endorsed PRA Standard. However, because there is implicit guidance that peer reviews can be performed to close-out earlier peer reviews and because there have been issues with how the disposition of findings are documented (e.g., the finding is not fully characterized, the disposition only notes disagreement with the peer review, the disposition may not address all issues or extent of condition, etc.), the NRC has previously accepted the performance of a new peer review to close earlier findings. The industry has stated that the requirement to retain and report all past peer review findings until re-evaluated by another peer review is an administrative burden that provides minimal benefit to the licensee with additional expenses and often results in additional new findings while closing out previous findings.

It is recognized that there needs to be a cost effective, robust process that would allow licensees to close findings. The following sections present the NRC perspective regarding the proposed different approaches for the close-out of peer review findings, including pros and cons.

Original Peer Review Team Close-out

In this process, the licensee would identify the implementation of their resolutions to the peer review findings to the original peer review team. This peer review team would then determine if the proposed

resolution appropriately resolves the original findings. In this approach, the licensee may identify their proposed resolutions during the actual performance of the peer review, but the peer review team would still need to review implementation of the resolution to close-out the finding.

PROs

- Ensures continuity with the reviewers most knowledgeable about the findings (and their intentions) in evaluating the licensee's resolutions.
- Provides an independent process for establishing closure of previous peer review findings that do not need to be addressed in new applications.
- The acceptability of the actions by the licensee in closing the finding can be more quickly assessed, as the focus of the team is solely on the prior findings and not against the latest endorsed PRA Standard.
- The costs of this approach should be less than those associated with a new peer review team as the reviewers would already be familiar with the PRA and findings and are focused only on the close-out of the findings; not on a completely new peer review
- No need for other peer reviews (unless there is a PRA upgrade or additional hazards/modes modeled that would require a focused-scope peer review); only gap assessments to latest PRA Standard would need to be addressed.

CONs

- Original reviewers may no longer be available.
- Close-out of the findings may require considerable time, and repeatedly re-assembling even part of the original team, especially with the team leader, may quickly become prohibitive.
- The review would not be against the latest endorsed PRA Standard, but only focused on what was implemented to close the finding.
- Limited resources for conducting peer reviews results in potential scheduling issues. These impacts are more significant as licensee PRAs are upgraded to address other hazards (e.g., seismic), and thus need peer reviews in these areas too.
- May not completely eliminate the potential for NRC performing an audit or asking questions on the close-out of the findings.

New Peer Review Used for Close-out

This process involves a focused-scope peer review of one element and the close-out of findings within that element (with findings on remaining elements still having to be addressed) or a completely new peer review that re-addresses how the PRA comports with the Standard. In this approach, the licensee has a new peer review

performed (total or focused-scope) that includes consideration of previous peer review findings and the licensee's implementation of their proposed resolutions of those findings. Original findings of the newly peer reviewed elements are eliminated and replaced by any new findings of the new peer review. New peer reviews often result in new findings that have to be addressed in future applications.

This process could also be implemented on a periodic basis (e.g., every 10 or 15 years or after a significant number of PRA updates) to ensure all PRAs across the industry are maintained up-to-date to the latest endorsed PRA Standard and resolution of findings is part of a regular, formal process. This process may become more important as the use and scope of PRAs expand.

PROs

- A new peer review allows an independent consideration and review of how prior findings were addressed by the licensee.
- It provides an independent process for establishing closure of previous peer review findings that do not need to be addressed in new applications
- It updates peer reviewed elements to the latest endorsed PRA Standard and encourages PRAs to be kept relatively contemporary as methods, plant configurations, etc., evolve.
- Need not secure availability from original peer review team members

CONs

- Some of the important knowledge of the issues that generated the findings may be lost without participation by the original reviewers.
- Limited resources for conducting peer reviews results in potential scheduling issues. These impacts are more significant as licensee PRAs are upgraded to address other hazards (e.g., seismic), and thus need peer reviews in these areas too.
- May not completely eliminate the potential for NRC performing an audit or asking questions on the close-out of the findings.
- Non-trivial burden associated with assembling and conducting a full peer review team on a regular, periodic basis.

NRC Review Used for Close-out

In this process, the licensee would submit information to the NRC that identifies the implementation of their resolution of findings separate and independent of any risk-informed applications. The NRC would perform a review to determine if the licensee's resolutions

appropriately address the original findings or if additional information/action is needed to close-out the findings.

PROs

- Provides a regulatory process for establishing closure of previous peer review findings that do not need to be addressed in new applications.
- No need for other peer reviews (unless there is a PRA upgrade or additional hazards/modes modeled that would require a focused-scope peer review); only gap assessments to latest PRA Standard would need to be addressed.
- The potential for a future audit or questions on the resolution of the finding would be greatly reduced. Common risk-informed applications would no longer need detailed PRA Technical Adequacy reviews as this topic would be addressed by the separate NRC finding close-out review, though the need for gap assessments to the latest endorsed PRA Standard may still be needed.

CONs

- Significant up-front resource and time investment for both the licensee and the NRC as this is essentially an application review, though only focused on resolution of findings, and involves schedule, resources, and associated costs typical of a regulatory review. Similarly, this process will likely require RAIs in order to come to agreement on the closure of some findings, which will extend such reviews well beyond the length of other approaches. This process will primarily benefit licensees that plan on submitting multiple risk-informed applications.
- It would not necessarily be against the latest endorsed PRA Standard if the peer review was conducted using an earlier version of the standard. The review would only be focused on what was implemented to close out the finding, unless a gap assessment is required.

Licensee Close-out

In this process the licensee would document the implementation of their resolution of findings to formally close-out the peer review findings, using internal resources that are independent of the PRA developers or with contracted independent resources. This process has minimal additional costs or impacts beyond the already established need to document closure of findings and should be part of the existing licensee processes for updating the PRA. The documentation of closure would be retained for NRC audit, which would be conducted in the context of risk-informed application reviews.

PROs

- Provides a process, though not fully organizationally independent, for establishing closure of previous peer review findings.
- No need for other peer reviews (unless there is a PRA upgrade or additional hazards/modes modeled that would require a focused-scope peer review); only gap assessments to latest PRA Standard would need to be addressed.

CONs

- It would not necessarily be against the latest endorsed PRA Standard if the peer review was conducted using an earlier version of the standard. The review would be only focused on what was implemented to close out the finding, unless a gap assessment is required.
- It is not a fully independent process. Many multi-site licensees have PRA-related procedures that require consistency in approaches across their fleet. As such, licensee close-out using the parent company PRA staff would have an inherent bias regarding the acceptance of specific approaches and close-outs across their fleet. In addition, though there may be some independence using the parent company PRA staff for the close-out review, there are still organizational and ownership expectations that could potentially influence the internal reviewers.
- The NRC would not necessarily be provided the findings as part of this process and will likely seek RAIs or need to audit the close-out documentation to assure there is agreement with the closure of the findings.

Hybrid Approach (Industry Proposed Approach)

This process is a merger of multiple aspects of the above approaches within some hierarchical framework. This will involve the identification of attributes of findings for grouping into types of findings and then the determination of which of the above approaches are appropriate for close-out of specific types of findings. The NRC would also need to provide a clear expectation of what is required for risk-informed applications and would need to revise NRC guidance accordingly.

PROs

- Allows a graded approach to the closure process for peer review findings.
- Provides a process with varying levels of independence for establishing closure of previous peer review findings that do not need to be addressed in new applications.
- In resolving most findings, there will be no need for other peer reviews (unless there is a PRA upgrade or

additional hazards/modes modeled that would require a focused-scope peer review); only gap assessments to latest PRA Standard would need to be addressed.

CONs

- Requires establishing a hierarchical framework for how to close out findings; including identifying the attributes of findings that can be addressed by various approaches.
- This approach might become overly burdensome and complicated and create a new inspection element regarding the close-out process that does not currently exist.
- It would not necessarily be against the latest endorsed PRA Standard if the peer review was conducted using an earlier version of the standard. The review would be only focused on what was implemented to close out the finding, unless a gap assessment is required.
- May not eliminate the potential for NRC performing an audit or questions on the close-out of the findings, especially those findings allowed to be closed by the licensee since this aspect would not be an independent review.
- A monitoring program may be required for finding close-out, particularly if some findings are closed out via NRC reviews of risk-informed applications or if the licensee closes out findings without an independent review.

CONCLUSIONS

As discussed above, through numerous public meetings, the NRC and industry working groups are engaged in an effort to improve the processes for accepting new PRA methods and approaches and for the closure of findings and suggestions from industry peer reviews. The industry working group submitted a white paper to the NRC addressing these objectives in December 2014. The NRC is currently reviewing the paper and is expecting to provide comments to the industry in early February 2015. The white paper and NRC comments will be discussed at a future public working group meeting and then at a joint RISC public meeting. Ultimately, it is expected that this initiative will identify specific process enhancements that, if accepted by their respective steering committees, will result in future revisions to industry and/or regulatory guidance documents, such as RG 1.200.

REFERENCES

1. Federal Register Notice, Volume 60, Number 158, Pages 42622-42629, "Use of Probabilistic Risk Assessment Methods in Nuclear Regulatory Activities; Final Policy Statement," August 16, 1995.

2. Regulatory Guide 1.200, "An Approach For Determining the Technical Adequacy of Probabilistic Risk Assessment Results For Risk-Informed Activities," U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, Revision 2, March 2009.
3. ASME/ANS RA-Sa-2009, "Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," Addendum A to RA-S-2008, ASME, New York, NY, ANS, La Grange Park, Illinois, February 2009.

ACRONYMS

ANS	American Nuclear Society
ASME	American Society for Mechanical Engineers
EPRI	Electric Power Research Institute
LAR	License Amendment Request
NEI	Nuclear Energy Institute
NRC	Nuclear Regulatory Commission
PRA	Probabilistic Risk Assessment
RAI	Request for Additional Information
RG	Regulatory Guide
RISC	Risk-Informed Steering Committee
US	United States