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NUCLEAR ENERGY INSTITUTE

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The Honorable Allison M. Macfarlane
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Industry Support and Use of PRA and Risk-Informed Regulation

Project Number: 689

Dear Chairman Macfarlane:

Risk-informed approaches have proven valuable in providing an integrated perspective on safety to inform regulatory and industry activities. We believe these approaches have even more importance today in light of the large number of post-Fukushima (as well as pre-existing) regulatory and industry activities. There is a clear need for a better safety-focused measure of efficacy and priority of these activities, as well as that of proposed future safety initiatives. Industry and NRC have made large investments in probabilistic risk assessments (PRA), but progress in applying risk-informed insights is discouragingly slow. To address this, industry has developed a vision and plan to achieve a better understanding of risk and PRA model development as a strategic objective. The first step is to address the issue of realism in PRA models. In this regard, both NRC and industry have formed "Risk-Informed Steering Committees" at a senior management level. We intend to constructively engage beginning in early 2014.

To facilitate Commission awareness and understanding of the industry's development status, current problems, potential solutions and vision relative to PRA and risk-informed regulation, the following attachments are provided:

- Attachment 1 is the draft industry paper on "Reclaiming the Promise of Risk-Informed Decision-Making." This is the proposed long term strategic plan for consideration by advisory chief nuclear officers.

- Attachment 2 is the draft industry paper on "Restoring Risk-Informed Regulation." This articulates industry's view of the current impediments to achieving the plan, and our proposed solution path.
- Attachment 3 is a matrix that provides a comprehensive industry status on PRA model development, meeting of NRC endorsed PRA Standards, and peer review.

Regarding the status of PRA model development, NEI has gathered information on the scope of PRAs supporting current operating plants. This report reflects the considerable investment that licensees have made to date. Information regarding Level 1 (core damage frequency) internal events, internal flooding, internal fires, external events, low power/shutdown (LPSD) operations, and Level 2 (containment performance) models is included in this attachment. This matrix also provides the status of peer reviews of these models against the NRC-endorsed portions of the joint American Society of Mechanical Engineers (ASME)/American Nuclear Society (ANS) PRA Standard.

The aggregate information demonstrates the industry's commitment to risk-informed decision-making and dedication to achieving PRA technical adequacy via the industry peer review process. Every operating power reactor in the U.S. reported that they maintain a quantitative internal events PRA model. Further, over three quarters have also pursued fire PRA models, which have allowed plants to apply high-level insights and make safety improvements, even as the methods supporting these models continue to advance and undergo research.

In reviewing this information, it is important to note several clarifications:

- Many plants have Individual Plant Examination of External Events (IPEEE) models, however, these are not modern, nor are they full PRAs. Plants with IPEEE models only are therefore reported as not having a model for a given initiator category.
- For Level 2 models, only those including release frequency and source term evaluations beyond those of the Large Early Release Frequency (LERF) scope are reported as Level 2 models. LERF is addressed as part of the Level 1 model and peer review.
- As there is no NRC-endorsed ASME/ANS PRA Standard for full Level 2 or LPSD, no peer reviews have been conducted.

We hope the information provided will be useful to inform the Commission and staff relative to the level of PRA development, the current impediments and potential solutions for applications, and a vision for PRA use from an industry perspective. Significant additional model development is underway, to the extent that the expert resources are essentially saturated for the foreseeable future, primarily with respect to fire and seismic PRA development. It is imperative that fundamental issues are understood, clarified, and resolved as that work progresses. We look forward to further interactions with the NRC in making substantive progress on risk-informed regulation. Please contact me if you have any questions.

Sincerely,

Anthony R. Pietrangelo

Anthony R. Pietrangelo

Attachments

c: The Honorable Kristine L. Svinicki, Commissioner, NRC
The Honorable George Apostolakis, Commissioner, NRC
The Honorable William D. Magwood, IV, Commissioner, NRC
The Honorable William C. Ostendorff, Commissioner, NRC
Mr. Mark A. Satorius, Executive Director for Operations, NRC
Mr. Eric J. Leeds, Director, Office of Nuclear Reactor Regulation, NRC
Mr. Joseph G. Giitter, Director, Division of Risk Assessment, NRR, NRC

Reclaiming the Promise of Risk-Informed Decision-Making

Preface

Recent meetings with individual U.S. Nuclear Regulatory Commission (NRC) commissioners raised the awareness of the problems that are inhibiting expansion of risk-informed regulation (RIR). The commissioners believe that probabilistic risk assessments (PRA) offer a set of tools that would improve the management of the regulatory workload as well as assuring that resources are correctly focused on those matters that have the highest safety significance. Yet, the commissioners recognize that there are impediments to further expansion of risk-informed activities, and that these problems must be resolved before additional progress in RIR is possible.

This paper provides a critical assessment of the current status of RIR, identifies impediments and opportunities in furthering risk-informed decision-making, and recommends a path forward.

In the late 1990s, the NRC and the industry initiated a large number of risk-informed regulatory activities. The promise of RIR stems from the objective balance it can provide through an integrated consideration of both risks and deterministic elements of safety. The NRC sought risk-informed applications in order to provide additional assurance of safety for risk-significant issues. The industry supported risk-informed applications as a means to balance areas and issues of high and low risk significance and support more objective decision-making on potential safety issues.

Over the past five years, progress in RIR has been stunted. A variety of factors have contributed to this, but the result has been a growing distrust of risk-informed processes. Ironically in the post-Fukushima era, where nuclear power faces many decisions that could be better informed by a risk perspective, the reluctance to use PRA in new regulatory activities has removed a valuable tool from the process.

Background

The industry initiated the move to using PRA to inform safety decision-making in the landmark EPRI document: "The PSA Applications Guide," published in 1995. The Applications Guide outlined a process for using plant-specific PRAs to assess the significance of plant changes. Later that same year, the NRC issued a policy statement on the use of PRA methods in nuclear regulatory activities. The PRA policy statement includes four main elements paraphrased below:

1) Increase use of PRA to the extent supported by the state-of-the-art and in a way that complements traditional engineering approaches.
2) Use PRA both to reduce unnecessary conservatism in current requirements and to support proposals for additional regulatory requirements.
3) Be as realistic as practicable.
4) Consider uncertainties appropriately when using the Commission's safety goals and subsidiary numerical objectives.

In 1998, the NRC approved an overarching plan for risk-informing the regulations and issued the foundational regulatory guide for risk-informed decision-making, Reg. Guide 1.174. In 1999, the Reactor Oversight Process (ROP) was improved through the use of risk as a primary input to the objective assessment of licensee performance.

RIR initially served both the NRC and the industry well, focusing resources on the most safety-significant issues. Some notable successes of the risk-informed approach include:

- equipment reliability and plant performance improved under the Maintenance Rule

- outage durations were reduced by safely planning and managing equipment maintenance during power operations
- greater focus on the risk-significant in-service inspections, improved safety and reduced worker doses
- increased objectivity was introduced into the ROP using risk-informed methods.

Current Status

Over the past five years, risk-informed regulatory activities have stagnated. Licensees are not pursuing as many risk-informed changes. There are several reasons for this condition:

- The low-hanging RIR fruit has largely been picked. Many of the early applications of risk-informed decision-making obtained immediate benefit by reducing outage durations and increasing capacity factors through improved plant reliability. Further applications often involve more ambitious uses of risk-informed decision-making and broader scope PRA models.
- The risk-informed ROP is working reasonably well, but there have been numerous instances where the NRC and industry staffs have attempted to adjust the inputs to a significance determination process (SDP) evaluation to attain an outcome that supports the industry or NRC supposition.
- Cultural issues with regard to deterministic thinking have not been overcome. Elements of the NRC staff have reinterpreted or objected to certain risk-informed activities and the industry has indirectly agreed through accommodating NRC staff positions. The discussions that surround these actions and interpretations often result in prolonged regulatory interactions and reviews, increasing the costs and uncertainties in the decision-making process. This has the result of reducing or sometimes eliminating benefit (safety, reliability and productivity).
- The PRA standards, the NRC's unpredictable application of Reg. Guide 1.200 regarding NRC expectations for PRA quality, and the role of peer reviews have created an overhead structure that does not return commensurate value.

While there are some pockets of progress, e.g., Southern Company's adoption of 50.69 and Risk-Informed Technical Specification (RITS) Initiative 4B, the overall level of industry support for risk-informed initiatives is at a relative low point. Unfortunately, this comes at a time when risk-informed processes could be valuable to the industry and the NRC in making decisions about the priority for and need for new regulatory requirements.

Current Impediments

The following summarize the major impediments to advancing risk-informed decision-making:

- **NFPA-805's Chilling Effect** – An example of a failed risk-informed process is NFPA-805. The long and problematic history surrounding fire protection has been carried forward in the use of risk methods in this area. Political pressure drove the use of untested PRA fire methods laced with conservatisms in the required fire-risk analyses. As a result, fire PRAs are not consistent with operating experience and obscure the insights that could be gleaned from these PRA studies. The consequence is that the expected benefits of NFPA-805 programs have been elusive. The process is protracted, costly and unstable. These fire PRA problems have severely diminished industry confidence in risk-informed approaches and programs.
- **Approach to PRA Quality** – the Consensus Standards have not achieved their intended value. The goal of providing consensus standards for PRA that were supplemented by peer reviews has led to unanticipated and adverse consequences. PRA standards requirements have been supplemented by additional NRC review requirements resulting in cumbersome, complex, inefficient and nonintegrated set of reviews that are duplicative and consume unnecessary industry and NRC resources. These multiple layers of review have become subjective audits of conformance with the standards rather than actual peer reviews.

- **The Fukushima Fallacy** – Since the 2011 accident at Fukushima Dai-ichi, PRA has been criticized as being invalid because the computed results do not appear to comport with the accidents at Fukushima and Three Mile Island. This is not correct. An objective assessment of risks would have indicated that there was an unacceptable likelihood at the Japanese Pacific coastal sites like Fukushima for a tsunami to cause an accident. If the Japanese had more completely embraced PRA as a technology, the significance of the tsunami risk would have been apparent. In the U.S., we could have the similar issues, especially considering flooding. One value of a PRA is identifying latent and sometimes unknown risk outliers and confirming the importance of such outliers.

Opportunities

While recent risk-informed activities, notably fire protection, have resulted in a negative outlook for PRA, there are strong reasons to continue to look to risk-informed processes to support the industry's needs in the near future, providing the problems described above can be resolved. The commissioners' initiative, Improving Nuclear Safety and Regulatory Efficiency, demonstrates a renewed commission interest in reviving PRA and using it to improve the regulatory process. Potential activities include:

- **Prioritizing Implementation of Regulatory Requirements** – Much as the ROP has provided objectivity to the severity of inspection findings, risk-informed approaches can provide an objective basis for prioritizing the implementation of regulatory requirements. As importantly, risk-informed prioritization does not require the detailed Reg. Guide 1.200 PRA that has encumbered other applications, since the goal is simply to understand the relative importance of an activity from the perspective of reactor safety.
- **Providing a Yardstick for Assessing Future Regulatory Requirements** – The resources required to respond to the Tier 1 post-Fukushima requirements have grown well beyond expectations. As the NRC staff pursues the remainder of the Fukushima Near-Term Task Force recommendations, it would be valuable to have a robust, risk-informed basis for assessing their relative importance and prudence of the remaining activities. A risk-informed decision-making process would provide an objective basis for assessing the true safety benefit of any future proposed requirements. Today, without a consistent basis for such decision-making, the NRC has demonstrated a more ad hoc process that is increasingly relying on "qualitative factors" or other subjective judgments to support regulatory decisions.
- **Future Success with More Ambitious RIR Applications** – As the industry pilots for risk-managed tech specs (RITS 4b) and risk-informed special treatment requirements (50.69) progress to implementation, a more complete understanding of plant risk profiles will better inform utilities on the hurdles and benefits associated with adoption of these potentially valuable regulatory applications.

Action vs. Inaction

Inaction: Recent experience confirms that the NRC will continue to pursue additional regulatory actions. The industry can continue to assess and where appropriate propose, on a case-by-case basis, deferral, reduction or elimination of these new requirements. Recent experience demonstrates the apparent drive to justify additional requirements without proper consideration of the appropriate backfit protocols and safety significance. For example, the current 50.54(f) letter on seismic and external flooding is a request for information, but on the current path, the vast majority of sites will spend millions of dollars in doing studies to supply that information, but that could otherwise be better allocated on matters of higher safety significance or more efficiently on matters of equal significance without overly conservative conclusions.

The NRC may continue to pursue risk-informed approaches using PRA to gain additional insights that could result in a further layering effect of regulation.

The cost of inaction could well be many millions more spent on unjustified studies and follow-up actions, including associated plant modifications that result in minimal or no improvement in safety.

Action: The industry could proactively move to correct the problems with fire PRAs and NFPA 805, making it more efficient and consistent with operating experience. Once positive steps to resolve the fire PRA problems are demonstrated, the next steps can be taken to establish an appropriate site-specific yardstick by which new requirements and regulatory expectations could be assessed, in order to focus resources on only the most safety-significant issues. The challenge in such an action is in defining a plan that will support the opportunities, while addressing the impediments, as identified above.

Recommendation: Take action to develop and implement a four-phase approach with elements designed to obtain the maximum near-term benefit, while mitigating the challenges.

Stage	Timeframe	Objectives
Stage 1 – Resolve problems with fire PRAs and NFPA 805	2014	1. Provide for use of more realistic fire PRA methods and a more efficient and predicable regulatory process.
Stage 2 – Characterization of Site Risk Drivers	2014-2015	1. Provide foundation for reactor safety prioritization 2. Identify fleet-wide risk drivers to support generic prioritization and decision-making 3. Document (best understanding of) important risk contributors for each reactor site
Stage 3 – Identification of Site-specific Risk Insights	2014-2016	1. Identify site-specific risk insights for consideration in prioritization 2. Provide a consistent basis for decision-making on the need for more detailed quantification of dominant risk contributors
Stage 4 – Characterization of Dominant Risk Contributors	2015-2019	1. Obtain detailed, site-specific understanding of dominant risk contributors

Restoring Risk Informed Regulation

Currently, enthusiasm for risk informed approaches has been seriously diminished, as very large resource impacts, extended review cycles and unpredictable (and potentially incorrect) outcomes have been experienced. Both industry and NRC need to evaluate our contributions to this problem, and take measures to improve the situation. This paper addresses the underlying causes of the observed problems and proposes solutions to restore the value and premise of risk-informed regulation. This is important today, as risk provides the best available tool to evaluate the safety nexus for beyond design basis events and anticipated new requirements.

NFPA 805 is a significant existing application that illustrates the issues at hand. While many of the examples discussed are in the context of NFPA 805, the intent of this effort is broader, and also aimed at ensuring future uses of PRA, such as seismic risk characterization, are carried out in a manner consistent with NRC policy and guidance.

NRC PRA Policy Statement

In August 1995, the NRC adopted the PRA policy statement (emphasis added).

- The use of PRA technology should be increased in <u>all regulatory matters</u> to the extent <u>supported by the state of the art in PRA methods and data</u> and in a manner that <u>complements</u> the NRC's deterministic approach and <u>supports</u> the NRC's traditional defense-in-depth philosophy.

- PRA and associated analyses (e.g., sensitivity studies, uncertainty analyses, and importance measures) should be used in regulatory matters, where practical within the bounds of the state of the art, to <u>reduce unnecessary conservatism</u> associated with current regulatory requirements, regulatory guides, license commitments, and staff practices. Where appropriate, PRA should be used to <u>support the proposal of additional regulatory requirements</u> in accordance with 10 CFR 50.109 (Backfit Rule). Appropriate procedures for including PRA in the process for changing regulatory requirements should be developed and followed. It is, of course, understood that the intent of this policy is that existing rules and regulations shall be complied with unless these rules and regulations are revised.

- PRA evaluations in support of regulatory decisions should be <u>as realistic as practicable</u> and appropriate <u>supporting data should be publicly available</u> for review.

- The <u>Commission's safety goals</u> for nuclear power plants and subsidiary numerical objectives are <u>to be used with appropriate consideration of uncertainties</u> in making regulatory judgments on need for <u>proposing and backfitting new generic requirements</u> on nuclear power plant licensees.

The NRC Policy Statement has provided the foundation for meaningful regulatory improvement, such as the risk-informed reactor oversight process. However, it is not clear that the policy statement is being followed at this point. We believe this is at the root of the current difficulties, which have been evidenced primarily in NFPA 805 review, approval and implementation.

Observations: We believe the following are the key issues that underlie the current problems:

- Design basis concepts are being applied to the use of risk approaches, in that:
    - Excessive emphasis is placed on quantification, modeling details, and numerical thresholds (risk-based versus risk-informed)
    - NRC technical staff is prescribing PRA methods on an ad hoc basis as a condition of acceptance of applications
    - The NRC prescribed methods are deterministic (bounding) rather than realistic, and skew insights and risk perceptions – confounding the central premise of the NRC PRA policy statement
    - These could lead to modifications of little or no risk significance, masking of true contributors, and dissuade the installation of true safety improvements (e.g. incipient detection) due to "no credit"
    - These methods result in models that do not comport with operating experience (e.g. number of large fires, number of spurious actuations) and are problematic for overall plant risk characterization, as well as comparison to other risk contributors that are more realistically modeled
    - The established regulatory process for demonstrating PRA technical adequacy has been followed by industry, but in practice the formal (and burdensome) process is not sufficient for the purposes of regulatory acceptance. The process does not achieve the intent (e.g., efficiency of reviews, consideration and allowance of multiple methods within the Standard requirements) that was represented by NRC during its development.
    - Industry has, been driven to accommodate the NRC "accepted methods" into the peer review process, and the value of a true peer review has been diminished, in some cases becoming more of a compliance audit to NRC "accepted methods"
- The above reflect a preference for "conservative cookbook" decisionmaking versus use of informed judgment and a true integrated decision
- A separate and distinct problem is that defense in depth (DID) is sometimes invoked without clear basis to disapprove risk informed approaches

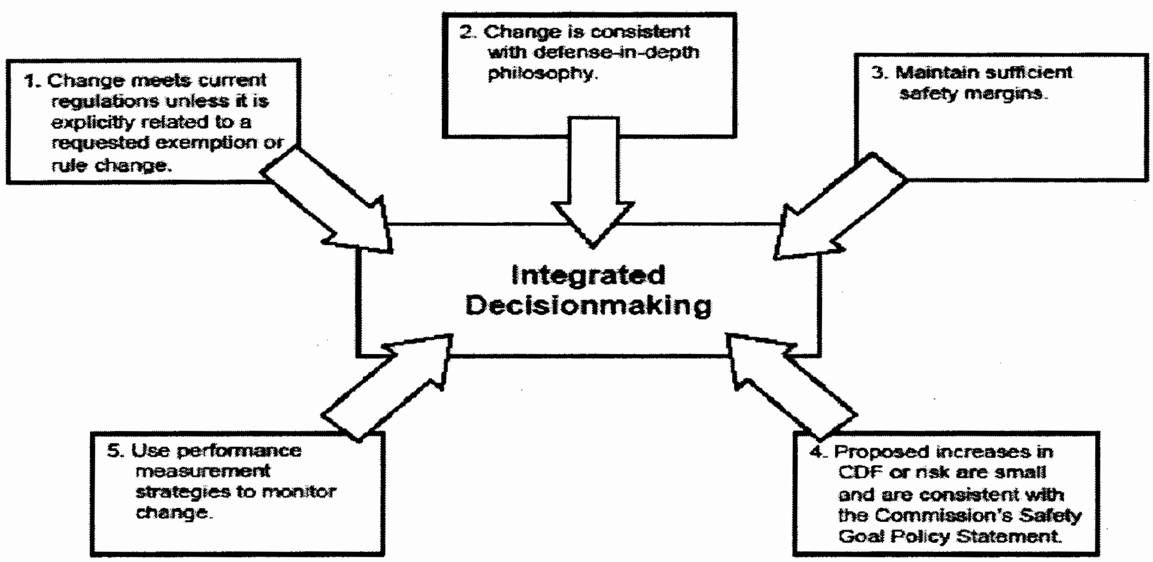
Solution Path: Restore the original approach of NRC Regulatory Guide 1.174

This Regulatory Guide builds from the principles of the PRA policy statement to define a "risk-informed" process for licensing basis changes. RG 1.174 was derived from the Safety Goal Policy Statement, and the numerical decision guidelines already provide margin to the quantitative health objectives, in part to accommodate uncertainties as discussed in the RG. Overall, RG 1.174 provides a very well thought out approach (which has stood the test of time), and much could be accomplished through returning to the original premise. Proper application of risk-informed approaches requires some judgment, and this cannot be avoided. One root of the problem is the general tendency in industry and NRC to avoid "engineering judgment" and move towards "cookbook" methods. The issuance of RG 1.200 on PRA technical adequacy, with its endorsement of PRA standards and voluminous workload, has diverted emphasis away from the philosophies embodied in RG 1.174 and the integrated decisionmaking process. True integrated decisionmaking has been the hallmark of successful applications, such as the Maintenance Rule and risk-informed Technical Specifications Surveillance Intervals.

The emphasis needs to be on decisionmaking. The NRC's own Glossary defines "risk-informed decisionmaking" as "An approach to regulatory decisionmaking, in which insights from probabilistic risk assessment are considered with other engineering insights."

Note that the decisionmaking basis is "insights", not numbers or criteria.

Integrated decisionmaking: The key principle of RG 1.174 is the integrated decisionmaking process. The elements need to be considered in combination, both by industry in developing applications, and by NRC in reviewing:



Key Risk-Informed principles (that need renewed attention):

The use of an integrated decision process, as described in Reg Guide 1.174 has not been consistently followed, and continues to erode: In reality, decisions are generally either risk based or defense in depth based rather than risk informed, leading to a number of problems.

1. In some applications, the quantitative PRA portion of this process has taken on a disproportionate role in decisionmaking with respect to defense in depth and safety margins. The latter aspects are often given minimal or token treatment, while large and burdensome emphasis is placed on modeling issues, technical adequacy, and NRC required methods. License Amendment Request volume and NRC review hours have become very large, and are dominated by PRA tchnical details to the extent of discouraging applications.

2. In cases where the numerically-driven approach is used, there is a regulatory tendency to introduce conservatism in modeling ("deterministic" PRA). This is fundamentally contradictory to the principles of the PRA Policy Statement that calls for realism and it undermines the predictability of the decision-making process. There should be an expectation that PRA results reasonably comport with operating experience. The treatment of uncertainties should not be accomplished through conservative assumptions in the base model. This masks the very insights that are needed for decision making, undermines safety, and distorts our perceptions of risk diverting attention away from more risk significant contributors. Appendix A provides a more detailed discussion of how this has been manifested in Fire PRA and NFPA 805.

3. In cases where defense in depth is used without consideration of risk insights, the risk-informed process is effectively abandoned. Once again, such approaches are in contradiction to the principles of the PRA Policy Statement.

4. The combination of high resource load, potential for mischaracterization of risk, and overriding of the risk-informed process by deterministic positions creates unpredictability in outcome of risk-informed activities that is very damaging to the future of PRA applications and contrary to NRC policy.

The PRA technical adequacy process has lost much of its value, and timely improvements are needed to provide a less burdensome, more predictable process that returns to the true intent of peer review.

1. For some applications (notably NFPA 805) PRA peer review has evolved from the original industry peer review process to become what is generally a compliance audit against each sub-element of the PRA Standard or "NRC approved methods". This burdensome process, which addresses hundreds of requirements, has essentially displaced the ability to perform a true peer review within the context of reasonable time and resources. This has undermined the true intent and value of a real peer review, an assessment of the degree to which the models realistically reflect the key plant-specific contributors to risk and the appropriateness

of assumptions related to key areas of uncertainty. The checklist approach is not an effective use of resources and misses the point of a peer review. It is a contributor to cumulative effects, and, like other CER issues, is in need of a better value proposition.

2. Due to the push by NRC for a "compliance" approach, the peer review process outcomes can be unpredictable and subject to reviewer's interpretation of what NRC might accept. Often peer reviewers approach the review from the context of methods they have used, when there are multiple appropriate methods that meet the standard. NRC also may perform PRA audits that appear duplicative of the peer review process and diminish its value.

3. Even with the above PRA technical adequacy process completed with an acceptable result, NRC staff invokes additional "requirements" for PRA methods and assumptions, generally through use of the RAI process after the licensee has made a large investment and is compelled to comply to a staff position to achieve approval of the application. The RAI process, with the implication that the application will not be approved absent the "correct" response (e.g. acceptance of an informal NRC position) provides an override of the entire regulatory process for PRA adequacy and is a key contributor to uncertainty and avoidance of risk-informed approaches. This concern is not limited to PRA and is another contributor to CER.

A better approach to integrated decision making is needed.

1. NRC's "integrated decision making" can often involve independent decisions made by disparate NRC review staff (e.g. risk analysis and engineering branches). The NRC's process separates the review into distinct parts, with no apparent attempt to integrate. This puts more emphasis on each element separately, such that, as good regulators, each reviewer feels the need to be conservative from his/her perspective, and the final decision imposes the most conservative position. This was not the intent of RG 1.174, and was, in fact, raised by the ACRS as a concern prior to the issuance of the RG. Significant deterministic margin, either defense in depth or safety margins, already exists in plant design and operation, and additional proposed layers should be technically justified in the context of the corresponding risk insights. Industry could also do a better job in tailoring applications in this regard and providing more integrated arguments.

2. Where DID is invoked, it can be imposed independent of risk insights, and there is little structure or predictability. This introduces uncertainty into the outcome, further discouraging the large investments necessary for risk-informed applications. BTP 8.8 (alternate AC sources) is a prime example of a DID position whose basis is unclear and apparently independent of risk insights or integrated decisionmaking.

3. A better process for treatment of "new information" needs to be established, as the current approach can lead to unpredictable or unjustified outcomes. Research undertaken in support of plant safety needs to reflect actual operating environments and experience. This is primarily reflected in NFPA 805. See Appendix A for more detail.

Cultural issues and apparent misunderstanding of the intent and approach of PRA are the root of much of the above problems. These continue to exist many years after the PRA policy statement, both in industry and NRC:

1. The generally deterministic mindset of some industry and NRC technical staff can undermine attempts to produce and use a realistic PRA. Some NRC branches, for instance Technical Specifications, have accepted and promoted the use of risk, but this is not consistent, and the appearance of resistance remains within certain technical branches. This could be improved by an internal NRC process that could better infuse risk-informed thinking at the technical staff level.

2. NRC fire testing in particular is biased towards producing very large fires which skew the outcomes and introduce unrealistic and possibly detrimental results with respect to PRA. Use of accelerants, burners and other measures to cause "burnout" create physically different effects than observed in actual plant fire events

3. There are some who believe PRA is just a way to reduce requirements, despite the use of PRA insights to justify new regulations such as ATWS and SBO.

4. Some in the industry believe that compliance is equal to safety. The fact is that there are conditions that involve elevated risk and PRA should not be expected to always show low risk/Green SDP findings. As the PRA Policy statement implies PRA is a double-edged sword. It can show deterministic requirements to be unduly conservative, but it can also identify safety issues, even today.

5. In some cases, lack of understanding of (or the perception of over reliance on) probabilities and uncertainties can lead to a mistrust of the PRA result or the treatment of PRA as an inscrutable black box. This can lead to dismissal of risk insights and non-informed DID expectations.

6. A true, explicit, and predictable consensus process for modeling issues is sorely needed. The current process, despite many attempts at definition, still tends towards deferral to conservative dissenting opinions rather than consensus realistic methods. Both industry and NRC are culpable and need to jointly improve this process.

Top specific issues of concern:

NFPA 805 - Fire PRA realism and failure of consensus process, burden without commensurate benefit, timeliness, resource drain beyond expectations and uncertainty (by far the most obvious example and largest contributor to the current problems). See Appendix A for detail. This issue has three important dimensions: (1) skewing of the FPRA results leading to unnecessary plant changes that may have less safety benefit than indicated, and leading to masking of other fire risk scenarios, (2) potential for mischaracterization with respect to other contributors that have been realistically modeled (e.g. internal events); and, 3) The total plant risk profile (typically, if incorrectly represented as the sum of initiator-specific risk) is overstated. With the impending expectation for seismic PRAs and their incorporation into the total risk profile, the introduction of conservatism (both existing and future) will present an improper perspective of the plant's total risk and its relation to the NRC safety goals and subsidiary objectives. This could be easily misrepresented, especially given NRC's Policy that PRAs are intended to be realistic estimates of risk.

BTP 8.8: (Additional AC sources as condition of DG completion time extensions.) Use of non risk-informed DID measures to overcome risk insights leading to decisions without clear or documented safety basis. This position has dissuaded many risk-informed applications and is in direct contradiction of the NRC's own policies and guidance.

Seismic PRA: Without due care, SPRA could undergo similar issues to fire PRA. Due to the large uncertainties in the seismic initiator frequency, it is not clear that the significant investment of resources and time in PRA is the best use of resources to address new seismic hazards. Attempts to streamline the PRA process, in recognition of the above (the SPID process) have not led to meaningful changes. There is evidence (operating experience) that currently available SPRA methods already contain a degree of conservative bias. Based on the NFPA-805 experience, using uncertainties as the basis to introduce additional conservatisms into the seismic PRA process will compound the problem.

ROP Process: The reactor SDP (elements of which are essentially risk based rather than risk informed) leads to large resource impacts to address insignificant events, particularly to avoid two white findings that lead to a degraded cornerstone with significant ramifications for the licensee. These resources could be better allocated, including to improving PRA models and freeing PRA staff.

In particular, the manner in which human reliability is treated has become increasingly problematic as a lever for biasing SDP colors. A particular issue involves the recent NRC documentation of the use of conditional core damage probability (CCDP) in lieu of delta CDF, to color findings involving initiating events. The ROP (and NRC risk informed processes in general) are based on the safety goal subsidiary objectives of CDF and large early release frequency. These metrics are not comparable to CCDP, and should not be equated. Further, limiting human error probability assumptions generally lead to an automatic greater than green finding based on CCDP, without clear safety basis.

Proposed actions to address the situation:

Commission level/NRC Senior Leadership: There is a need to reinforce PRA policy statement. 1995 was a long time ago. There are tangencies between this activity, Fukushima NTTF Recommendation 1, NUREG 2150 (risk managed regulatory framework), as well as risk-informed prioritization and cumulative effects. There is a Commission briefing planned in January with an opportunity to make this case. Consider opportunities relative to Recommendation 1 and PRA vision.

NRC/Industry Management:

- Establish a Risk Informed Steering Committee (RISC) and NRC counterpart. Achieve constructive process to air out the issues and to communicate positions to respective stakeholders.

- Promote a return to approach of RG 1.174 and integrated decisionmaking, and take measures to educate the management and technical staff (both NRC and industry) on risk-informed principles. RG 1.174 generally contains the necessary subsidiary guidance for the PRA policy statement. One area that could benefit from further guidance is the integration of risk insights and DID.
- Provide a proper and defensible process and forum for establishing consensus
- Articulate and reinforce the expectation that PRA results should reasonably conform with observed operating experience
- Integrate the participation in NRC reviews of risk applications so that the technical branches and risk analysts can achieve an integrated decision rather than separate siloed decisions.
- Implement Cumulative Effects process enhancements and assure formal processes are used to promulgate NRC "positions". RAI process with threat to not approve is a significant root of the problems.
- Provide a vision for the development of appropriately comprehensive plant-specific risk insights to support industry and NRC decision making
- Pilots of 10 CFR 50.69 and Tech Specs completion times are significant to the industry, and their approval and implementation could alleviate some of the current concerns.

Industry/Technical

- Provide clear and consistent industry position on PRA. We speak with many voices, for instance there are supporters of pure quantitative approaches within industry
- Care should be taken not to acquiesce to out of process demands (either NRC or industry peer review) for modeling changes that deviate from realism – elevate attention instead
- Enhance coordination of NEI, EPRI and OG such that we are all on the same page. EPRI involvement with NRC research might benefit from further discussion; owner's groups are in a good position to improve the PRA peer review process and pilot new methods and applications.
- Evaluate the standards and PRA peer review process in the context of lessons learned, with the intent of returning to original premise and value proposition. Propose improved process (or our original process).
- Utility support of industry research, with both funding and personnel, to pursue revision of Fire PRA methods to reflect the latest OE available

Appendix A – NFPA 805 PRA issues

The fundamental issue is the application of deterministic thinking to PRA, that is, the bias towards purposefully incorporating bounding methods and data to address state of knowledge uncertainties rather than addressing such uncertainties appropriately. As is understood in the PRA community, everything in our current state of knowledge can be reflected in a probability distribution with appropriate uncertainties. The less complete our state of knowledge, the greater the uncertainty. However, in NFPA 805 models, until there is complete proof through extensive testing (similar to what would be done for development of a design standard), minimal credit is given in the FPRA even though sufficient information to support development of probabilities and distributions that would fully meet the requirements of RG 1.200 and the ASME/ANS PRA standard is available. Further, much of the testing relied upon to offer such evidence and enhance data is designed to skew the results in the conservative direction, and industry-sponsored operating experience and testing is not accepted by the NRC staff.

Table of specific FPRA issues and how they relate to the problems discussed in the paper:

	Hot Short	DC Hot Short	Incipient Detection	Heat Release Rate	Fire Testing
Deterministic/ Bounding	x	x		x	x
Improper Consensus Approach	x	x	x	x	
Numerically driven decision	x	x	x	x	
Operating Experience Mismatch	x	x	x	x	x
Unpredicted Resource Expenditure	x	x			

Hot Short Probabilities: Initial hot short probabilities were provided in NUREG/CR-6850, and they were thought to be conservative. There were two sets of tables provided, one for circuits without control power transformers (CPTs) and one for circuits with CPTs. The latter was a factor of two lower than the former. A significant amount of testing was performed, and turned over to an expert panel (PIRT) to convert into new probabilities. The tests indicated that the failure rate reduction credit for circuits with CPTs was not valid; however, the tests and PIRT panel processes also indicated that certain types of spurious operations were less likely than initially documented in NUREG/CR-6850. Rather than holistically consider the revised data and approach incorporation of the new information through the normal PRA maintenance and upgrade process, NRC immediately directed licensees, based on draft results, to remove the factor of two credit for CPTs, but did not allow application of lower probabilities of hot shorts until the final results were published.

DC Circuit Hot Short Duration*:* Because of some inconclusive testing, NRC mandated that no credit could be taken for the probability that a DC hot short would clear as a function of time. Therefore, all DC hot shorts have to be assumed to exist indefinitely despite sufficient information from the tests to have developed a probability versus time distribution. NRC rejected all proposals for DC hot short duration probability distributions, insisting that definitive testing was the only thing they would accept. As previously noted, testing results allowing for more realistic treatment are available, but not yet published for use in regulatory applications.

Incipient detection: This fire protection feature is used extensively in the telecommunications industry with great success. NRC has rejected the data from other industries in this matter, and insists that only nuclear power plant experience can be used. Duke has installed incipient detection and recently had an alert and was able to successfully mitigate a fire precursor (resistors and plastic wiring in close proximity were found discolored). They had a second OE, in which an incipient detector went off to detect a pre-fire condition that was many cabinets away. RES has been performing multiple phases of incipient testing, and the results seem mixed/inconclusive. Therefore, NRC's position, which is based on tests that are not representative of the use of incipient detection in the industry, is that no additional credit, beyond the minimal applicability allowed in NFPA 805 FAQ 46, is permitted.

Heat Release Rates*:* A significant body of evidence exists that the heat release rate (HRR) of fires in cabinets is limited by the size and location of vents or gaps that allow air flow. Using data from both US and international tests and research performed by others, EPRI prepared a document that proposed HRR distributions based on the data and research. This document went through multiple peer reviews, the last one of which included US NRC (who provided over 50 comments, all of which were addressed). The peer reviewers approved it, but NRC still rejected it because, in their opinion, there were not sufficient tests to anchor the lower tail of the distribution. So, no credit is allowed for ventilation limited cabinet fire until substantial testing is performed. In addition, the electrical cabinet testing that the RES is planning to do is "more of the same". They are planning to create aggressive fires in control cabinets (which we already believe we understand at the upper bound). They have one power cabinet which they plan to use to determine HRR. EPRI/Industry provided fifty technical comments that do not appear to be addressed in the test plan. The testing is scheduled to start very soon. It will burn the cabinet to 98th percentile which will not provide data to further anchor the lower tail of the distribution.

Mismatch of Fire Data and Fire Scenarios: The available information about fire frequency and fire severity are not the same population, so when defining a fire scenario we are currently forced to use: fire frequencies from operating experience, heat release rates from bounding tests, and non-suppression probabilities from operating experience which are applied to fast growing "experimental" fires. The process essentially combines factors that may not be directly related. Therefore, whereas operating experience is able to quickly detect fires and put them out, the FPRAs are not able to credit suppression as the fire is ramping up too quickly and damage ensures. Bottom line, the experimental 98th percentile HRR and fast fire growth rate (8 min to peak, 12 min peak HRR) are very aggressive, meant to be bounding and are unlike the fires occurring in electrical cabinets at NPPs. NRC has rejected all attempts to adjust the frequencies to match the HRR distributions until a multi-year effort to update the fire events data base is completed even though a proposed method for this went through extensive peer review, which included NRC representatives during the entire process, and extensive changes were made to the approach based on the peer reviewer comments. The peer review team approved the final product, but the NRC rejected its use. RES interprets realism as defining worst case heat release rates such that they can adequately model the fire dynamics. PRA practitioners define realism as what has/can occur in realistic NPP fire scenarios. The fire events database has hundreds of electrical cabinet fires with very little, if any actually causing damage beyond the component of origin.

Conclusion

Presented above are a number of examples where conservative deterministic assumptions and conditions are imposed on the NFPA 805 FPRAs. Practitioners are not permitted to utilize the state of knowledge probabilistically in order to achieve a realistic mean value of risk, even though such utilization would fully meet the requirements of RG 1.200 and the ASME/ANS PRA Standard. Piling these conservatisms on top of each other results in FPRA "mean values" that are not means at all. The available evidence on these examples, as well as others, indicates that, ultimately, all of these assumptions will be found to be conservative. Attempts by industry to develop a coherent framework that would allow the integration of fire frequency, fire severity, and suppression response to better reflect with actual industry fire experience are rejected in favor of analytical approaches based solely bounding input parameters.

	Internal Events		Internal Flooding		Fire		External Events		LPSD	Level 2
	Have model?	Peer review against ASME/ANS PRA Standard?	Have model?	Peer review against ASME/ANS PRA Standard?	Have model?	Peer review against ASME/ANS PRA Standard?	Model scope (e.g. seismic, high winds)	Peer review against ASME/ANS PRA Standard?	Model scope (e.g. internal events, fire initiators)	Model scope (e.g. initiators, modes)
ANO 1	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes
ANO 2	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes
Beaver Valley 1	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes
Beaver Valley 2	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes
Braidwood 1	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Internal Events, Flooding
Braidwood 2	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Internal Events, Flooding
Browns Ferry 1	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Browns Ferry 2	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Browns Ferry 3	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Brunswick 1	Yes	Yes	Yes	Yes	Yes	Yes	Floods, High Winds	Yes	No	No
Brunswick 2	Yes	Yes	Yes	Yes	Yes	Yes	Floods, High Winds	Yes	No	No
Byron 1	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Internal Events, Flooding
Byron 2	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Internal Events, Flooding
Callaway	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Calvert Cliffs 1	Yes	Yes	Yes	Yes	Yes	Yes	Seismic, High winds	No	No	No
Calvert Cliffs 2	Yes	Yes	Yes	Yes	Yes	Yes	Seismic, High winds	No	No	No
Catawba 1	Yes	No	Yes	Yes	Yes	Yes	No	No	No	No
Catawba 2	Yes	No	Yes	Yes	Yes	Yes	No	No	No	No
Clinton	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Internal Events, Flooding

	Internal Events		Internal Flooding		Fire		External Events		LPSD	Level 2
	Have model?	Peer review against ASME/ANS PRA Standard?	Have model?	Peer review against ASME/ANS PRA Standard?	Have model?	Peer review against ASME/ANS PRA Standard?	Model scope (e.g. seismic, high winds)	Peer review against ASME/ANS PRA Standard?	Model scope (e.g. internal events, fire initiators)	Model scope (e.g. initiators, modes)
Columbia	Yes	Yes	Yes	Yes	Yes	No	Seismic	No	No	Mode 1
Comanche Peak 1	Yes	Yes	Yes	Yes	No	No	No	No	No	Full Power
Comanche Peak 2	Yes	Yes	Yes	Yes	No	No	No	No	No	Full Power
Cooper	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes
DC Cook 1	Yes	No	Yes	No	Yes	Yes	No	No	No	Internal Events, Flooding, & Fire, MODE 1
DC Cook 2	Yes	No	Yes	No	Yes	Yes	No	No	No	Internal Events, Flooding, & Fire, MODE 1
Davis-Besse	Yes	Yes	Yes	Yes	Yes	Yes	High Winds	No	No	Yes
Diablo Canyon 1	Yes	Yes	Yes	Yes	Yes	Yes	Seismic	Yes	No	Yes
Diablo Canyon 2	Yes	Yes	Yes	Yes	Yes	Yes	Seismic	Yes	No	Yes
Dresden 2	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Internal Events, Flooding
Dresden 3	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Internal Events, Flooding
Duane Arnold	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes
Hatch 1	Yes	Yes	Yes	Yes	Yes	Yes	Seismic	No	No	No
Hatch 2	Yes	Yes	Yes	Yes	Yes	Yes	Seismic	No	No	No
Fermi 2	Yes	Yes	Yes	Yes	No	No	No	No	No	Yes
Fort Calhoun	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Ginna	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Internal Events	Yes
Grand Gulf 1	Yes	No	Yes	No	No	No	No	No	No	Yes
H.B. Robinson 2	Yes	Yes	No	No	Yes	Yes	No	No	No	No
Hope Creek 1	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No

	Internal Events		Internal Flooding		Fire		External Events		LPSD	Level 2
	Have model?	Peer review against ASME/ANS PRA Standard?	Have model?	Peer review against ASME/ANS PRA Standard?	Have model?	Peer review against ASME/ANS PRA Standard?	Model scope (e.g. seismic, high winds)	Peer review against ASME/ANS PRA Standard?	Model scope (e.g. internal events, fire initiators)	Model scope (e.g. initiators, modes)
Indian Point 2	Yes	Yes	Yes	Yes	No	No	No	No	No	Yes
Indian Point 3	Yes	Yes	Yes	Yes	No	No	No	No	No	Yes
FitzPatrick	Yes	Yes	Yes	Yes	No	No	No	No	No	Yes
Farley 1	Yes	Yes	Yes	Yes	Yes	Yes	Seismic	No	No	No
Farley 2	Yes	Yes	Yes	Yes	Yes	Yes	Seismic	No	No	No
LaSalle 1	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Internal Events, Flooding
LaSalle 2	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Internal Events, Flooding
Limerick 1	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Internal Events, Flooding
Limerick 2	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Internal Events, Flooding
McGuire 1	Yes	No	Yes	Yes	Yes	Yes	No	No	No	No
McGuire 2	Yes	No	Yes	Yes	Yes	Yes	No	No	No	No
Millstone 2	Yes	Yes	Yes	Yes	No	No	No	No	No	Internal Events and Flood
Millstone 3	Yes	Yes	Yes	Yes	No	No	No	No	No	Internal Events and Flood
Monticello	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes
Nine Mile Point 1	Yes	Yes	Yes	Yes	Yes	Yes	Seismic	No	Internal Events	No
Nine Mile Point 2	Yes	Yes	Yes	Yes	Yes	Yes	Seismic	No	Internal Events	No
North Anna 1	Yes	Yes	Yes	Yes	No	No	No	No	No	Internal Events and Flood
North Anna 2	Yes	Yes	Yes	Yes	No	No	No	No	No	Internal Events and Flood
Oconee 1	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Oconee 2	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Oconee 3	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No

	Internal Events		Internal Flooding		Fire		External Events		LPSD	Level 2
	Have model?	Peer review against ASME/ANS PRA Standard?	Have model?	Peer review against ASME/ANS PRA Standard?	Have model?	Peer review against ASME/ANS PRA Standard?	Model scope (e.g. seismic, high winds)	Peer review against ASME/ANS PRA Standard?	Model scope (e.g. internal events, fire initiators)	Model scope (e.g. initiators, modes)
Oyster Creek	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Internal Events, Flooding
Palisades	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes
Palo Verde 1	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No (Pilot)	Yes
Palo Verde 2	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No (Pilot)	Yes
Palo Verde 3	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No (Pilot)	Yes
Peach Bottom 2	Yes	Yes	Yes	Yes	Yes	Yes	No	No	All Modes, Internal and External Events	No
Peach Bottom 3	Yes	Yes	Yes	Yes	Yes	Yes	No	No	All Modes, Internal and External Events	No
Perry 1	Yes	Yes	Yes	Yes	No	No	No	No	No	Yes
Pilgrim 1	Yes	Yes	Yes	Yes	No	No	No	No	No	Yes
Point Beach 1	Yes	Yes	yes	Yes	Yes	Yes	High Winds	Yes	No	Yes
Point Beach 2	Yes	Yes	yes	yes	Yes	Yes	High Winds	Yes	No	Yes
Prairie Island 1	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Prairie Island 2	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Quad Cities 1	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Quad Cities 2	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
River Bend 1	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Salem 1	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No
Salem 2	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No
Seabrook	Yes	Yes	Yes	Yes	Yes	Yes	All	No	Yes	Yes
Sequoyah 1	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Sequoyah 2	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Harris	Yes	Yes	Yes	No	Yes	Yes	No	No	No	No
South Texas 1	Yes	Yes	Yes	Yes	Yes	Yes	All	Yes	Yes	Yes
South Texas 2	Yes	Yes	Yes	Yes	Yes	Yes	All	Yes	Yes	Yes
St. Lucie 1	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Full Power
St. Lucie 2	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Full Power

	Internal Events		Internal Flooding		Fire		External Events		LPSD	Level 2
	Have model?	Peer review against ASME/ANS PRA Standard?	Have model?	Peer review against ASME/ANS PRA Standard?	Have model?	Peer review against ASME/ANS PRA Standard?	Model scope (e.g. seismic, high winds)	Peer review against ASME/ANS PRA Standard?	Model scope (e.g. internal events, fire initiators)	Model scope (e.g. initiators, modes)
Summer	Yes	Yes	No	No	Yes	Yes	No	No	No	No
Surry 1	Yes	Yes	Yes	Yes	No	No	No	No	No	Internal Events and Flood
Surry 2	Yes	Yes	Yes	Yes	No	No	No	No	No	Internal Events and Flood
Susquehanna 1	Yes	Yes	Yes	Yes	No	No	No	No	No	Internal Events, Full Power
Susquehanna 2	Yes	Yes	Yes	Yes	No	No	No	No	No	Internal Events, Full Power
Three Mile Island 1	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Internal Events, Flooding
Turkey Point 3	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Full Power
Turkey Point 4	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Full Power
Vermont Yankee	Yes	Yes	Yes	Yes	No	No	No	No	No	Yes
Vogtle 1	Yes	Yes	Yes	Yes	Yes	Yes	Seismic	No	No	Yes
Vogtle 2	Yes	Yes	Yes	Yes	Yes	Yes	Seismic	No	No	Yes
Waterford 3	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Watts Barr 1	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Wolf Creek	Yes	Yes	No	No	No	No	No	No	No	Yes

Joosten, Sandy

From:	PIETRANGELO, Tony <arp@nei.org>
Sent:	Thursday, December 19, 2013 3:25 PM
To:	CHAIRMAN Resource
Cc:	Svinicki, Kristine; Apostolakis, George; CMRMAGWOOD Resource; CMROSTENDORFF Resource; Satorius, Mark; Leeds, Eric; Giitter, Joseph; Lepre, Janet; Blake, Kathleen; Pace, Patti; Taylor, Renee; Herr, Linda; GRP. Nuclear Generation Senior Staff (Tony Pietrangelo); GRP. President's Staff (Systems Administrator); ANDERSON, Victoria
Subject:	Industry Support and Use of PRA and Risk-Informed Regulation
Attachments:	12-19-13_NRC_Industry Support and Use of PRA and Risk-Informed Regulation.pdf; 12-19-13_NRC_Industry Support and Use of PRA and Risk-Informed Regulation_Attachment 1.pdf; 12-19-13_NRC_Industry Support and Use of PRA and Risk-Informed Regulation_Attachment 2.pdf; 12-19-13_NRC_Industry Support and Use of PRA and Risk-Informed Regulation_Attachment 3.pdf

December 19, 2013

The Honorable Allison M. Macfarlane
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Industry Support and Use of PRA and Risk-Informed Regulation

Project Number: 689

Dear Chairman Macfarlane:

Risk-informed approaches have proven valuable in providing an integrated perspective on safety to inform regulatory and industry activities. We believe these approaches have even more importance today in light of the large number of post-Fukushima (as well as pre-existing) regulatory and industry activities. There is a clear need for a better safety-focused measure of efficacy and priority of these activities, as well as that of proposed future safety initiatives. Industry and NRC have made large investments in probabilistic risk assessments (PRA), but progress in applying risk-informed insights is discouragingly slow. To address this, industry has developed a vision and plan to achieve a better understanding of risk and PRA model development as a strategic objective. The first step is to address the issue of realism in PRA models. In this regard, both NRC and industry have formed "Risk-Informed Steering Committees" at a senior management level. We intend to constructively engage beginning in early 2014.

To facilitate Commission awareness and understanding of the industry's development status, current problems, potential solutions and vision relative to PRA and risk-informed regulation, the following attachments are provided:

- Attachment 1 is the draft industry paper on "Reclaiming the Promise of Risk-Informed Decision-Making." This is the proposed long term strategic plan for consideration by advisory chief nuclear officers.

- Attachment 2 is the draft industry paper on "Restoring Risk-Informed Regulation." This articulates industry's view of the current impediments to achieving the plan, and our proposed solution path.
- Attachment 3 is a matrix that provides a comprehensive industry status on PRA model development, meeting of NRC endorsed PRA Standards, and peer review.

Regarding the status of PRA model development, NEI has gathered information on the scope of PRAs supporting current operating plants. This report reflects the considerable investment that licensees have made to date. Information regarding Level 1 (core damage frequency) internal events, internal flooding, internal fires, external events, low power/shutdown (LPSD) operations, and Level 2 (containment performance) models is included in this attachment. This matrix also provides the status of peer reviews of these models against the NRC-endorsed portions of the joint American Society of Mechanical Engineers (ASME)/American Nuclear Society (ANS) PRA Standard.

The aggregate information demonstrates the industry's commitment to risk-informed decision-making, and dedication to achieving PRA technical adequacy via the industry peer review process. Every operating power reactor in the U.S. reported that they maintain a quantitative internal events PRA model. Further, over three quarters have also pursued fire PRA models, which have allowed plants to apply high-level insights and make safety improvements, even as the methods supporting these models continue to advance and undergo research.

In reviewing this information, it is important to note several clarifications:

- Many plants have Individual Plant Examination of External Events (IPEEE) models, however, these are not modern, nor are they full PRAs. Plants with IPEEE models only are therefore reported as not having a model for a given initiator category.
- For Level 2 models, only those including release frequency and source term evaluations beyond those of the Large Early Release Frequency (LERF) scope are reported as Level 2 models. LERF is addressed as part of the Level 1 model and peer review.
- As there is no NRC-endorsed ASME/ANS PRA Standard for full Level 2 or LPSD, no peer reviews have been conducted.

We hope the information provided will be useful to inform the Commission and staff relative to the level of PRA development, the current impediments and potential solutions for applications, and a vision for PRA use from an industry perspective. Significant additional model development is underway, to the extent that the expert resources are essentially saturated for the foreseeable future, primarily with respect to fire and seismic PRA development. It is imperative that fundamental issues are understood, clarified, and resolved as that work progresses. We look forward to further interactions with the NRC in making substantive progress on risk-informed regulation. Please contact me if you have any questions.

Sincerely,

Anthony R. Pietrangelo
Senior Vice President and Chief Nuclear Officer

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